Weston & Sampson

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STORMWATER REPORT

February 2022

Devens
MASSACHUSETTS

Bulge Rd & Patton Rd Intersection Improvements

PREPERED FOR

MassDevelopment
33 Andrews Parkway, Devens, MA

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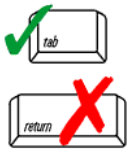
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Laurence F Keegan Date: 2022.02.07 16:44:05-05'00'

Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

☐ Limited Project

☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.

☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area

☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff

☐ Bike Path and/or Foot Path

☒ Redevelopment Project

☐ Redevelopment portion of mix of new and redevelopment.

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

Applicant/Project Name:	MassDevelopment – Bulge Rd and Patton Rd Intersection Improvements
Project Address:	Bulge Road, Devens, MA
Application Prepared by:	
Firm:	Weston & Sampson, Inc.
Registered PE:	Laurence F. Keegan, PE

NARRATIVE

Project Description

The project consists of roadway and drainage improvements along an approximately 1,500-foot stretch of Bulge Road, terminating at the intersection with Patton Road, in Devens, MA. The purpose of this project is to re-align existing intersection of Bulge Rd and Patton Road, resurface approximately 1,000 feet of Bulge Road, construct curbing and continuous sidewalk, and implement drainage improvements in compliance with MA Stormwater Management Standards and MS4 Permit for Devens. A locus map of the project area, as well as other site mapping, is included in Appendix A.

The existing intersection of Bulge Road and Patton Road was constructed as "Y" intersection and does not meet current local and state design guidelines. Currently, Bulge Road is operating as a low volume roadway, providing access to the existing golf course and golf course maintenance facility located at road terminus. However, a significant increase in traffic is anticipated due to a construction of a new major commercial/industrial development along Bulge Road, necessitating an improvement of the Bulge Road and intersection with Patton Road to adequately service the development. The proposed project will replace an existing "Y" intersection with a standard "T" intersection to address safety issues and improve sight distances. The existing legs of Bulge Road will be reclaimed to full depth and restored to a pervious condition, and approximately 350 feet new roadway will be constructed to connect bulge Road with proposed "T" intersection at Patton Road. The remaining portion of Bulge Road will be resurfaced. Additional site work includes construction of bituminous curb and sidewalk along Bulge Road frontage, and existing stormwater drainage system will be replaced with a new system that complies with the current local and state stormwater regulations. The drainage improvements will include removal and replacement of existing drainage network along Bulge Road, replacing old catch basins with deep sump catch basins, equipped with gas and oil trap hoods. Two new infiltration basins will be constructed at the terminus of the proposed drainage network, which will provide peak rate and volume attenuation, groundwater recharge, and water quality treatment, prior to discharging of stormwater runoff into Cold Spring Brook via existing outfall.

Debris from the site preparation will be transported in covered container vehicles for off-site disposal or recycling. Erosion control measures, including the use of compost filter tubes will be used to mitigate sediment migration outside the limits of work. Catch basin protection will be implemented for all catch basins affected by the work area to minimize sediment loading into each catch basin.

Environmental protection measures will also include dust control to ensure that generation of on-site dust during work activities will be minimized. Dust control activities will not add to any additional

stormwater runoff at the site, as dust control will not be used during storm events. Wet suppression shall be used to provide temporary control of dust. At a minimum, wet suppression shall be applied to demolition debris, excavated material, aggregate piles, and exposed soils and dirt. Dust suppression wetting agents shall be water soluble, non-toxic, non-reactive, non-volatile, and non-foaming and will not result in ponding of water.

As detailed herein, this Stormwater Management Report

- Demonstrates compliance with the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards;
- Demonstrates compliance with the Devens Enterprise Commission (DEC) Rules and Regulations;
- Details construction-phase erosion and sedimentation controls, inspection requirements and maintenance requirements to protect downstream receiving waters; and,
- Presents a details long-term operation and maintenance plan for the stormwater management and the site.

Stormwater Management:

The proposed project will update an existing drainage system that does not provide any treatment of attenuation of stormwater. The proposed stormwater design will incorporate Stormwater Best Management Practices (BMPs) compliant with current MA DEP Stormwater Management Standards, DEC Stormwater Management Regulations and MS4 permit for Devens.

In the existing condition surface runoff from the western portion of Bulge Road is managed through an outdated subsurface drainage network, which discharges stormwater directly into the Cold Spring Brook without providing any water quality treatment. The drainage network consists of a series of interconnected shallow catch which also convey stormwater runoff from the existing golf course maintenance facility located upstream of the project limits which discharges directly into the adjacent Spring Brook. The runoff from the eastern portion of Bulge Road, encompassing the “Y” legs of the intersection, sheet flows across Patton Road and discharges into the Cold Spring Brook via surface flow.

In the proposed condition, the existing drainage network will be removed and replaced with a new drainage network, consisting of deep sump catch basins equipped with “gas and oil” hood traps, manholes, and RCP pipe. The runoff collected by drainage network will convey stormwater into one of the two proposed infiltration basins which will provide required recharge, attenuation of peak flows, and water quality treatment. During the large storms the overflow from the infiltration basins will discharge into the Cold Spring Brook via an existing outfall structure.

Stormwater Design:

Weston & Sampson utilized HydroCAD computer software to model the stormwater runoff for 2-year, 10-year, 25-year, and 100-year 24-hour storm events. Based on NOAA Atlas 14, Volume 10, the rainfall depths were 3.15 inches, 4.83 inches, 5.88 inches, and 7.49 inches, for 2, 10, 25, and 100-year storms respectively. To properly simulate the existing and proposed stormwater conditions at the project site, specific data was obtained and/or considered, including topography, site layout, soil composition, and groundwater.

Soil information was obtained from the Natural Resources Conservation Service (NRCS) Worcester County Web Soil Survey. The soil survey indicates a mixture of Hinckley loamy sand and Quonset loamy sand withing the limits of the project. As a result, Hydrologic Group A was assigned to the soils within project area for the purposes of hydrologic calculations. The soil map and descriptions are included in Appendix A.

In addition to information gathered from Web Soil Survey, borings from a previously completed construction project were reviewed to confirm soil information obtained from Web Soil Survey. A boring was performed approximately 150 feet from the proposed infiltration basins during the construction of the golf cart tunnel crossing below Patton Road. The boring indicated sand for the full length of the boring exploration. The boring was progressed to a depth of 26 feet and no groundwater was observed. A copy of the boring log is included in Appendix A. Because of the boring log data and Web Soil Survey mapping, a Rawl's rate of 8.27 inches per hour was used for design of infiltration basins.

Devens is also located within the Nashua River Watershed, which has an impairment for phosphorus. MS4 Permit requires that all stormwater BMPs discharging to water bodies impaired for phosphorus be optimized for phosphorus removal. Generally, an infiltration or filtration type of BMP is best suited for phosphorus removal. Therefore, the retrofit of the existing drainage system will implement two infiltration basins to remove phosphorus from the stormwater runoff generated from the project area.

REGULATORY COMPLIANCE

This project was designed in compliance with Massachusetts Department of Environmental Protection (MassDEP) – Stormwater Management standards and MS4 permit for Devens. Below is an explanation of MS4 Permit requirements and MassDEP Stormwater Standards 1-10 as they apply to the Hospital Road Improvements project in Devens, MA:

MS4 PERMIT

Per Stormwater Management Plan developed for Devens to demonstrate compliance with MS4 permit, all redevelopment projects that disturb greater than one acre of land are required to achieve 80% TSS removal and 50% phosphorus removal. The project has been designed to fully meet the MS4 permit requirements. The project provides 86% TSS removal and 96% phosphorus removal. The compliance with TSS removal requirement is calculated in accordance with MA Stormwater Management Handbook and is demonstrated in Appendix C. Phosphorus removal rate has been calculated using the framework established by EPA as part of MS4 permit and can be also found in Appendix C.

MassDEP STANDARD 1 – NO NEW UNTREATED DISCHARGES

The proposed project will create no new untreated discharges. The proposed project was designed to mimic existing conditions as much as possible and improve the condition to the maximum extent practicable.

As part of the proposed project, surface runoff from the paved areas will be collected by a combination of deep sump catch basins and a vegetated swale and directed to a proposed infiltration basins for treatment. The overflow from the infiltration basin will discharge into an existing drainage pipe that will covey the runoff to an existing outfall discharging into Cold Spring Brook.

MassDEP STANDARD 2 – PEAK RATE ATTENUATION

Post construction peak runoff rates and total volume of runoff will not increase for the 2-, 10-, 25-, and 100-year storms. Supporting documentation is included with this report. A summary table is provided in Appendix B to illustrate that post-construction peak discharge rates will significantly reduce pre-construction rates and volumes. Furthermore, since Devens Stormwater Regulations require that all stormwater management systems be designed with the pre-development areas modeled as "green field", the actual reduction in stormwater runoff is significantly greater than illustrated by the summary table. The "green field" requirement has been only applied to the impervious areas within project limits, and not to the upstream drainage area.

MassDEP STANDARD 3 – RECHARGE

The impervious area within the proposed project limits will decrease by approximately 23,300 SF, therefore no recharge is required per MA Stormwater Management Standards. However, in accordance with Devens Stormwater Regulations, all existing areas were modeled as grassed areas, therefore requiring this project to pretreat and infiltrate significantly more runoff than would have been required for a redevelopment project under the Massachusetts Stormwater Management Standards. After completion of the project, the recharge will be provided via a proposed infiltration basins located near Patton Road intersection. The recharge requirement calculation is included in Appendix C and illustrates compliance with the current DEP Stormwater policy as well as Devens Stormwater Regulations.

MassDEP STANDARD 4 – WATER QUALITY

The project has been designed to comply with Standard 4. The proposed stormwater management system implements a treatment train of BMP's that has been designed to provide 80% TSS removal of stormwater runoff from the proposed impervious surface as well as 44% pretreatment prior to infiltration BMPs because the project is located within soils with a rapid infiltration rate (greater than 2.4 inches per hour). The pretreatment rate of 47% was achieved for Infiltration Basin - 1 by using deep sump catch basins and sediment forebay. The pretreatment rate of 64% was achieved for Infiltration Basin - 2 by using deep sump catch basins and a proprietary stormwater treatment device. Computations and supporting information are included in Appendix C.

MassDEP STANDARD 5 – LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS (LUHPPLs)

Not Applicable. This project does not have the potential for higher potential pollutant loads.

MassDEP STANDARD 6 – CRITICAL AREAS

Not applicable. The project site is not located within a Critical Area as described under Standard6 of the Massachusetts Stormwater Handbook.

MassDEP STANDARD 7 – REDEVELOPMENTS AND OTHER PROJECTS SUBJECT TO THE STANDARDS ONLY TO THE MAXIMUM EXTENT PRACTICABLE

The project site is considered a redevelopment, as the roadway improvements occur within existing roadway right of way and does not result in increase in impervious area. While the project is only required to meet the MA Stormwater Management Standards to the maximum extent practicable, the proposed drainage improvements will fully meet and exceed all applicable Stormwater Management Standards as described above and below.

MassDEP STANDARD 8 – CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENT CONTROL

A detailed Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan is included in Appendix D of this report. To ensure that the work incorporates the performance standards recommended in the DEP's Stormwater Management Policy, necessary erosion and sedimentation control measures will be utilized during construction. These measures include compost filter tubes and catch basin protection as depicted on the site plans. In addition, the contractor will be required to produce the SWPPP prior to any land disturbance.

MassDEP STANDARD 9 – OPERATION AND MAINTENANCE PLAN

An Operations and Maintenance Plan is provided in Appendix D of this report.

MassDEP STANDARD 10 – PROHIBITION OF ILLICIT DISCHARGES

Illicit discharges will be prevented on the site through the use of spill/discharge prevention measures, along with good housekeeping and BMPs, and in accordance with the Long-Term Pollution Prevention Plan and O&M plan. An Illicit Discharge Compliance Statement has been developed for this site and is included in Appendix D.

REGISTERED PROFESSIONAL ENGINEER'S CERTIFICATION

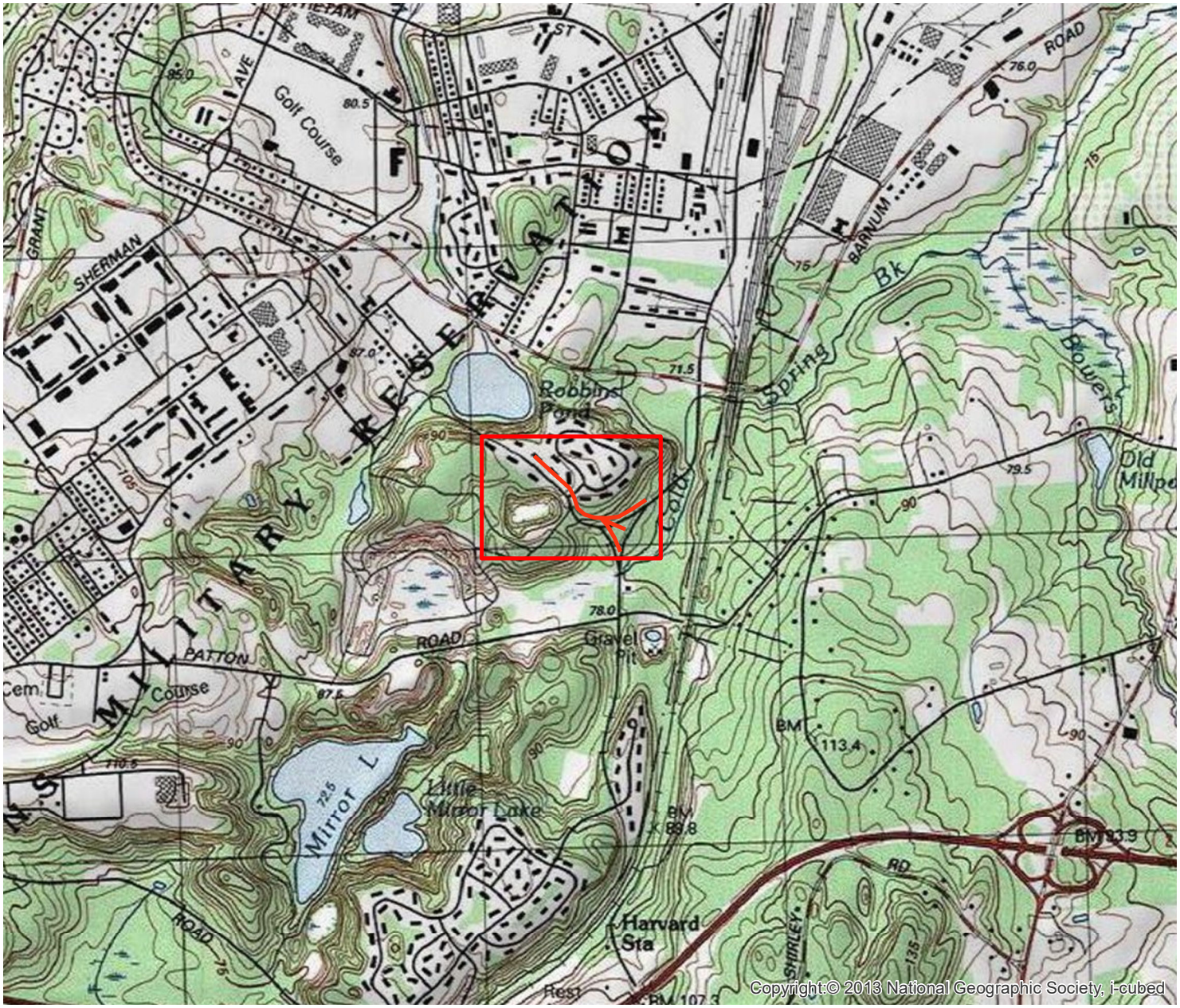
I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-Term Pollution Prevention Plan, Construction Period Erosion and Sedimentation Control Plan, Post-Construction Operation and Maintenance Plan, Illicit Discharge Compliance Statement, and the plans showing the stormwater 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

Laurence F Keegan Jr. Date: 2022.02.07 16:48:52-05'00'

Signature and Date

Appendix A



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Data Source: Office of Geographic and Environmental Information (MassGIS), Commonwealth of Massachusetts Executive Office of Environmental Affairs

Legend

Work Area

FIGURE 1

DO #7 Bulge at
Patton Intersection
Devens, MA

USGS Topographic Map

Weston & Sampson

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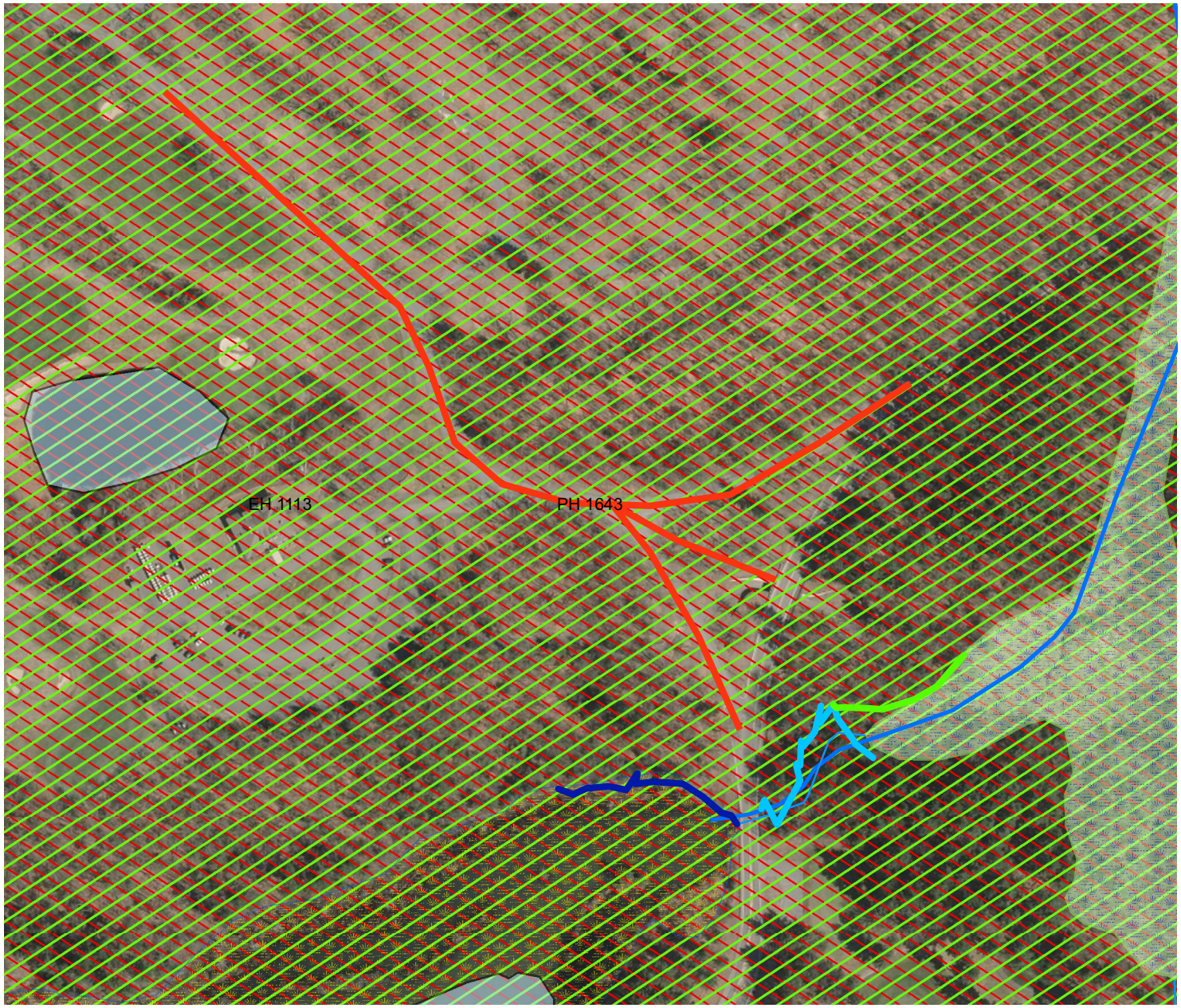

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- BVW
- Bank-Pond
- Bank-Perennial
- Work Area
- WsPABufferZones
- Hydrologic Connection
- Perennial Stream
- Intermittent Stream
- Marsh/Bog
- Wooded marsh
- Cranberry Bog
- Salt Marsh
- Open Water
- Reservoir (with PWSID)
- Tidal Flats
- Beach/Dune

Ch 91 Jurisdiction

- Public Way
- Marsh Boundary - landward
- Landlocked Tidelands
- Jurisdiction
- Historic High Water
- Marsh Boundary - seaward
- Contemporary High Water
- Inferred Contemporary High Water
- Inferred Historic High Water

ACECs

- ACECs

NHESP Habitats

- NHESP Estimated Habitats of Rare Wildlife
- NHESP Priority Habitats of Rare Species
- NHESP Certified Vernal Pools
- NHESP Potential Vernal Pools
- Cold Water Fisheries

Outstanding Resource Waters

- Public Water Supply Contributor
- ORW for ACEC
- ORW for both Water Supply and Other
- Coastal Zone

FIGURE 2

DO #7 Bulge at Patton Intersection
Devens, MA

Environmental Resource Map

Weston & Sampson

National Flood Hazard Layer FIRMette

FEMA

71°36'27"W 42°32'13"N

71°35'49"W 42°31'47"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

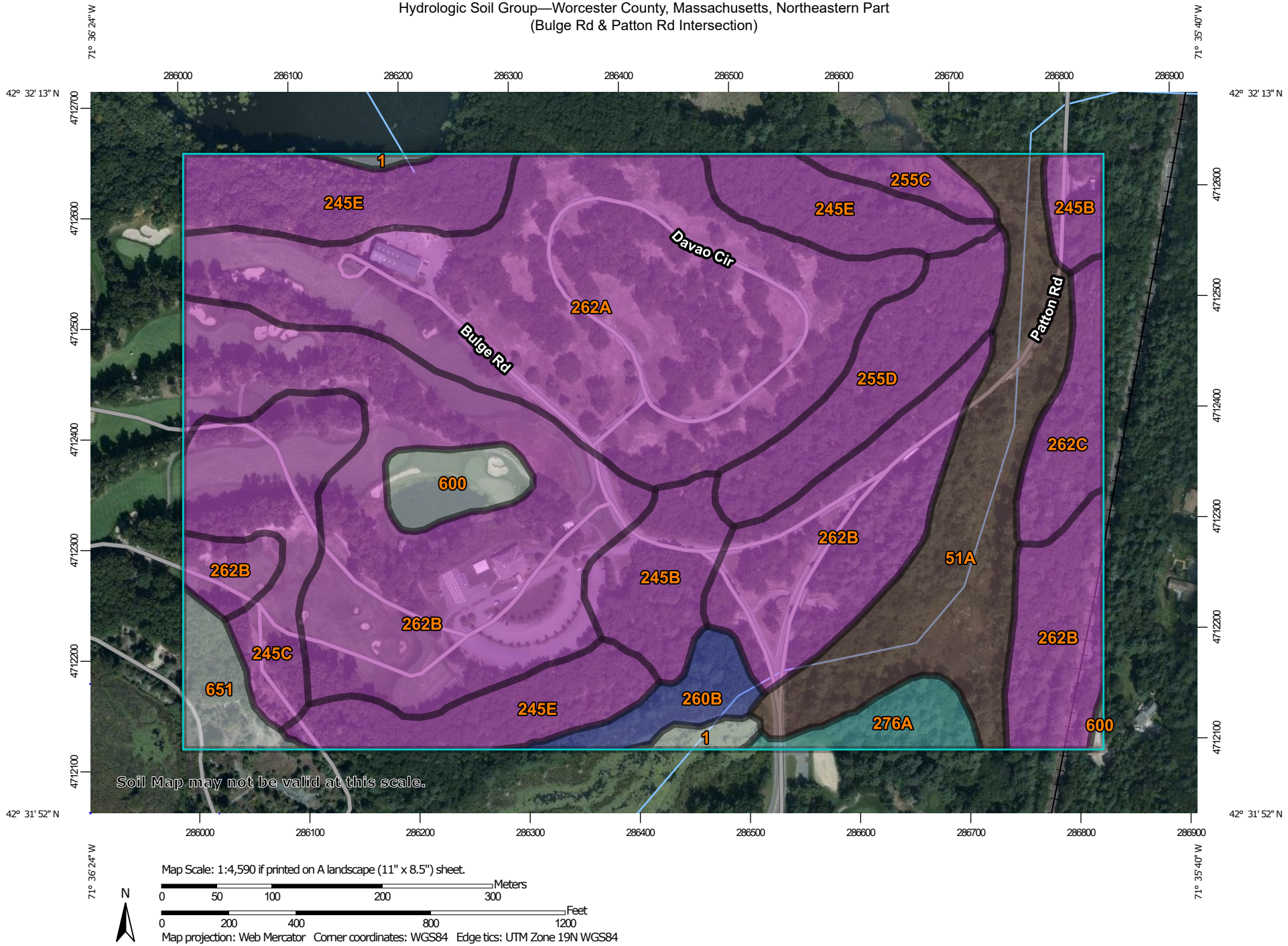
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/3/2021 at 1:49 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Hydrologic Soil Group—Worcester County, Massachusetts, Northeastern Part
(Bulge Rd & Patton Rd Intersection)



Map Scale: 1:4,590 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 16, Sep 3, 2021

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

Date(s) aerial images were photographed: Aug 12, 2019—Sep 29, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		0.8	0.7%
51A	Swansea muck, 0 to 1 percent slopes	B/D	11.6	10.4%
245B	Hinckley loamy sand, 3 to 8 percent slopes	A	5.0	4.5%
245C	Hinckley loamy sand, 8 to 15 percent slopes	A	6.1	5.5%
245E	Hinckley loamy sand, 25 to 35 percent slopes	A	12.6	11.3%
255C	Windsor loamy sand, 8 to 15 percent slopes	A	1.3	1.2%
255D	Windsor loamy sand, 15 to 25 percent slopes	A	5.5	5.0%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	B	2.1	1.9%
262A	Quonset loamy sand, 0 to 3 percent slopes	A	25.8	23.1%
262B	Quonset loamy sand, 3 to 8 percent slopes	A	31.9	28.6%
262C	Quonset loamy sand, 8 to 15 percent slopes	A	2.9	2.6%
276A	Ninigret fine sandy loam, 0 to 3 percent slopes	C	1.9	1.7%
600	Pits, gravel		2.0	1.8%
651	Udorthents, smoothed		2.0	1.8%
Totals for Area of Interest			**111.7**	**100.0%**

Description

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

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

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

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

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

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

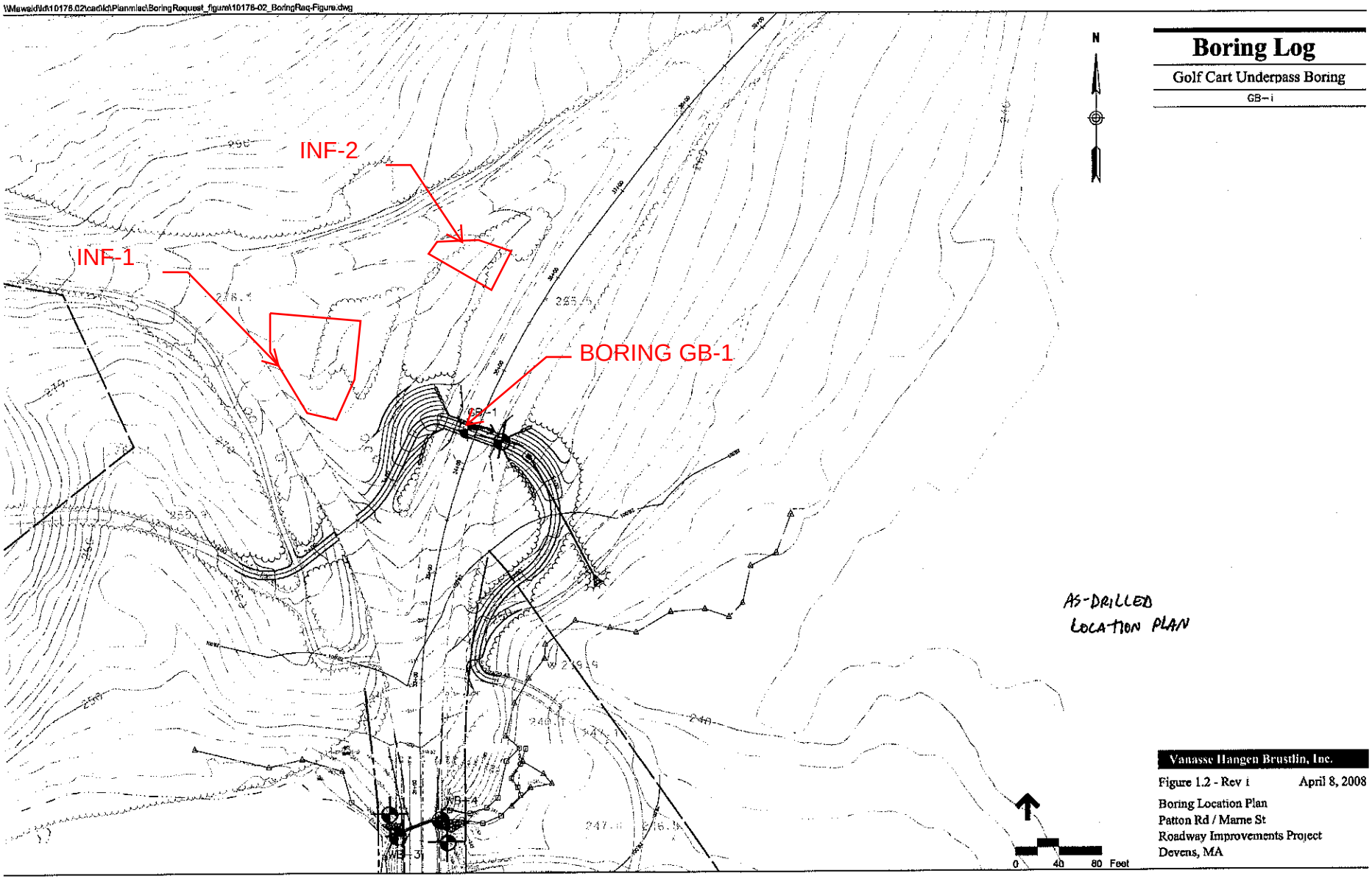
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



Boring Log

Golf Cart Underpass Boring

GB-1

Vanasse Hangen Brustlin, Inc.

Figure 1.2 - Rev 1 April 8, 2008

Boring Location Plan
Patton Rd / Marne St
Roadway Improvements Project
Devens, MA

HALEY & ALDRICH

TEST BORING REPORT

Boring No. GB-1

Project PATTON RD/ MARNE ST ROADWAY IMPROVEMENTS, DEVENS, MA
Client VHB
Contractor GEOLOGIC-EARTH EXPLORATION, INC.

File No 10884-082
Sheet No. 1 of 2
Start April 25, 2008
Finish April 25, 2008
Driller T. Tucker
H&A Rep. M. Dodson
Elevation 264.0 (est.)
Datum
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	-	Rig Make & Model: CME LC-60 Rubber Track
Inside Diameter (in.)	3.25	1 3/8	-	Bit Type: Roller Bit
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: HSA Spun to 24.0 ft
				Hoist/Hammer: Cat-Head Safety Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS* Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, natural grain size and artificial component percentage estimates, manual test properties, structure odors, moisture, other descriptions and observations GEOLOGIC INTERPRETATION)
0	3 4 5 4	S1 18	0.0 2.0	263.8 0.2	SP-SM	2.0 in. Gray coarse to fine SAND, little coarse to fine gravel (Road Shoulder) -FILL- Loose yellow brown fine SAND (trace silt top 6.0 in.), weakly stratified, no odor, moist to dry
	4 4 4 4	S2 17	2.0 4.0		SP	Similar to bottom half of above, occasional layers are near well graded coarse to fine SAND, more gray brown near 3.0 to 4.0 ft
5	2 3 4 4	S3 15	4.0 6.0		SP/SW	Similar to above except gray brown tan
						-GLACIOFLUVIAL DEPOSITS-
10	2 6 6 8	S4 14	9.0 11.0		SP	Medium dense tan light gray brown fine SAND, little to trace medium sand, weakly stratified, no odor, moist
15	3 3 4 4	S5 14	14.0 16.0		SP	Similar to above except loose occasional trace silt in weakly defined layers
20	6 8	S6 21	19.0 21.0		SP/SW	Medium dense light gray medium to fine SAND, little coarse sand, stratified/weakly bedded, no odor, moist to near wet in bottom 6.0 in.

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
4/25/08	1235	0.75	24.0	26.0	21.5

Component Percentage Estimates

Term	Range
adjective modifier	20% - 50%
and	20% - 50%
some	20% - 33%
little	10% - 20%
trace	5% - 10%
with	present

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	26.0
Rock Cored (ft)	-
Samples	S7

Boring No. GB-1

Sampler Type: S - Split Spoon Sampler U - Undisturbed Tube Sampler T - Thin Wall Tube Sampler

*NOTE: USCS Group Symbols based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

NOTE: Visual-Manual Identification and Description based upon Haley & Aldrich OP2001A - Field Practice for Soil Identification and Description.

H&A-TEST BORING-08 HA-UB08-BETA.GLB HA-TB+CORE+WELL-08-BETA.GDT G:\10884\082\FIELDDATA\10884-082_TB.GPJ May 13, 08

HALEY& ALDRICH

TEST BORING REPORT

Boring No. GB-1
File No. 10884-082
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS* Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, natural grain size and artificial component percentage estimates, manual test properties, structure odors moisture, other descriptions and observations GEOLOGIC INTERPRETATION)
20	8 11					
						-GLACIOFLUVIAL DEPOSITS-
	3 2 3 5	S7 22	24 0 26 0		SP	Loose light brown yellow fine SAND stratified, no odor wet
25				238 0 26 0		BOTTOM OF EXPLORATION 26 0 FT

*NOTE: USCS Group Symbols based on visual-manual methods of the USCS system as practiced by Haley & Aldrich, Inc.

Boring No. GB-1

NOTE: Visual-Manual Identification and Description based upon Haley & Aldrich OP2001A - Field Practice for Soil Identification and Description.

H&A-TEST BORING-08 HA-LIB08-BETA.GLB HA-TB+CORE+WELL-08-BETA.GDT G:\10884\082\FIELDDATA\10884-092_TB.GPJ May 13, 08

APPENDIX B

Bulge Road and Patton Road Intersection Improvements
Devens, MA

Pre-Development Conditions vs. Post-Development Conditions

TABLE 1.0 – PRE-AND POST- DEVELOPMENT FLOWS COMPARISON					
Existing Condition w/ Green Field Standard (Road Only)	2-Year Storm (cfs)	10-Year Storm (cfs)	25-Year Storm (cfs)	50-Year Storm (cfs)	50-Year Storm (cfs)
POA-1 - Exist Outfall	2.40	3.71	4.54	5.32	6.35
POA-2 - Overland to Cold Spring Brook	0.00	0.06	0.37	0.73	1.35
Total	2.4	3.77	4.91	6.05	7.7
Proposed Condition	2-Year Storm (cfs)	10-Year Storm (cfs)	25-Year Storm (cfs)	50-Year Storm (cfs)	50-Year Storm (cfs)
POA-1 - Exist Outfall	1.74	3.52	4.29	5.40	5.73
POA-2 - Overland to Cold Spring Brook	0.00	0.05	0.26	0.50	0.91
Total	1.74	3.57	4.55	5.9	6.64

Bulge Road and Patton Road Intersection Improvements
Devens, MA

Pre-Development Conditions vs. Post-Development Conditions

TABLE 2.0 – PRE-AND POST- DEVELOPMENT VOLUME COMPARISON					
Existing Condition w/ Green Field Standard (Road Only)	2-Year Storm (cf)	10-Year Storm (cf)	25-Year Storm (cf)	50-Year Storm (cf)	100-Year Storm (cf)
POA-1 - Exist Outfall	8,104	13,255	16,985	19,925	23,306
POA-2 - Overland to Cold Spring Brook	0	1,147	3,039	4,902	7,333
Total	8,104	14,402	20,024	24,827	30,639
Proposed Condition	2-Year Storm (cf)	10-Year Storm (cf)	25-Year Storm (cf)	50-Year Storm (cf)	100-Year Storm (cf)
POA-1 - Exist Outfall	3,000	9,796	14,903	18,982	23,920
POA-2 - Overland to Cold Spring Brook	7	1,013	2,365	3,643	5,278
Total	3,007	10,809	17,268	22,625	29,198

GOLF COURSE
MAINTENANCE FACILITY
IMPERVIOUS=±35,000 SF

CB
RIM=321.09'

CB
RIM=321.08'

CB
RIM=319.24'

CB
RIM=319.52'

CB
RIM=319.39'

CB
RIM=310.60'

CB
RIM=310.29'

N

BULGE RD DRAINAGE
A=46,635 SF
PAVEMENT=30,284 SF
(MODELED AS GRASS FOR
DRAINAGE ANALYSIS)
PERVIOUS=16,351 SF

CULVERT
INV DROP INLET
ELEV: 276.18'

CB
RIM=289.30'

OVERLAND FLOW TO
COLD SPRING BROOK
A=106,729 SF
PAVEMENT=29,9937 SF
(MODELED AS GRASS
FOR DRAINAGE ANALYSIS)
PERVIOUS=76,792 SF

CULVERT
INV 36 RCP
ELEV: 240.55'

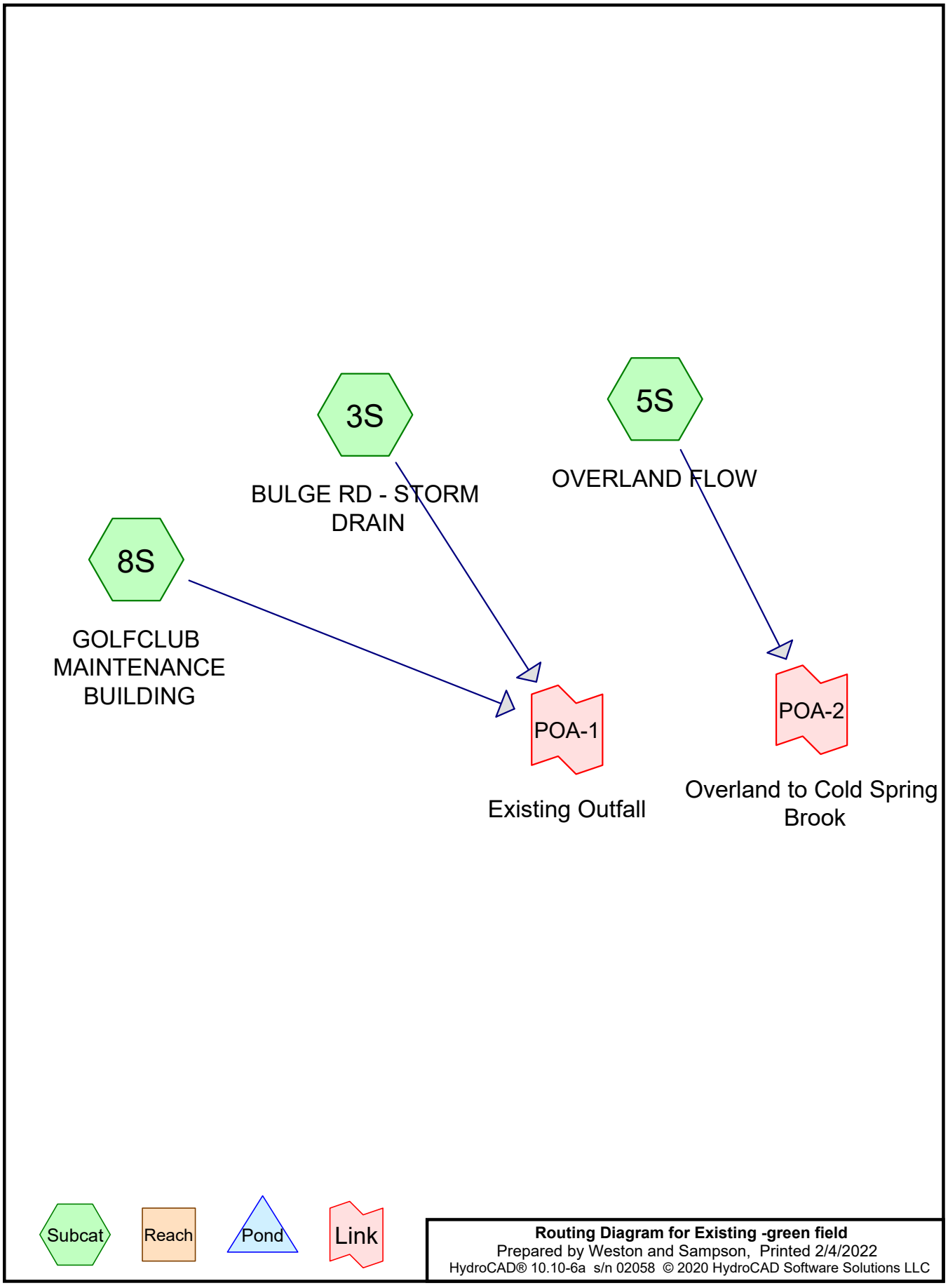
CULVERT
INV 12 RCP
ELEV: 244.04'

CULVERT
INV 12 RCP
ELEV: 243.59'

CULVERT
INV 24 RCP
ELEV: 240.66'

CULVERT
INV 24 RCP
ELEV: 242.20'

EXISTING DRAINAGE AREA MAP DEVENS, MA BULGE RD & PATTON RD INTERSECTION IMPROVEMENTS	
DATE:	DECEMBER, 2021
SCALE:	1"=120'
CHECKED BY:	LFK
DESIGNED BY:	EC
DRAWNED BY	EC



Routing Diagram for Existing -green field
Prepared by Weston and Sampson, Printed 2/4/2022
HydroCAD® 10.10-6a s/n 02058 © 2020 HydroCAD Software Solutions LLC

Existing -green field

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.15	2
2	10-Year	Type III 24-hr		Default	24.00	1	4.83	2
3	25-Year	Type III 24-hr		Default	24.00	1	5.88	2
4	50-Year	Type III 24-hr		Default	24.00	1	6.65	2
5	100-Year	Type III 24-hr		Default	24.00	1	7.49	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
153,364	39	>75% Grass cover, Good, HSG A (3S, 5S)
35,000	98	Paved parking, HSG A (8S)
188,364	**50**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
188,364	HSG A	3S, 5S, 8S
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
188,364		**TOTAL AREA**

Existing -green field

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
153,364	0	0	0	0	153,364	>75% Grass cover, Good	
35,000	0	0	0	0	35,000	Paved parking	
188,364	**0**	**0**	**0**	**0**	**188,364**	**TOTAL AREA**	

Time span=2.00-20.00 hrs, dt=0.05 hrs, 361 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: BULGE RD - STORM Runoff Area=46,635 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment5S: OVERLAND FLOW Runoff Area=106,729 sf 0.00% Impervious Runoff Depth=0.00"
Tc=10.0 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment8S: GOLFCLUB Runoff Area=35,000 sf 100.00% Impervious Runoff Depth>2.78"
Tc=6.0 min CN=98 Runoff=2.40 cfs 8,104 cf

Link POA-1: Existing Outfall Inflow=2.40 cfs 8,104 cf
Primary=2.40 cfs 8,104 cf

Link POA-2: Overland to Cold Spring Brook Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Total Runoff Area = 188,364 sf Runoff Volume = 8,104 cf Average Runoff Depth = 0.52"
81.42% Pervious = 153,364 sf 18.58% Impervious = 35,000 sf

Summary for Subcatchment 3S: BULGE RD - STORM DRAIN

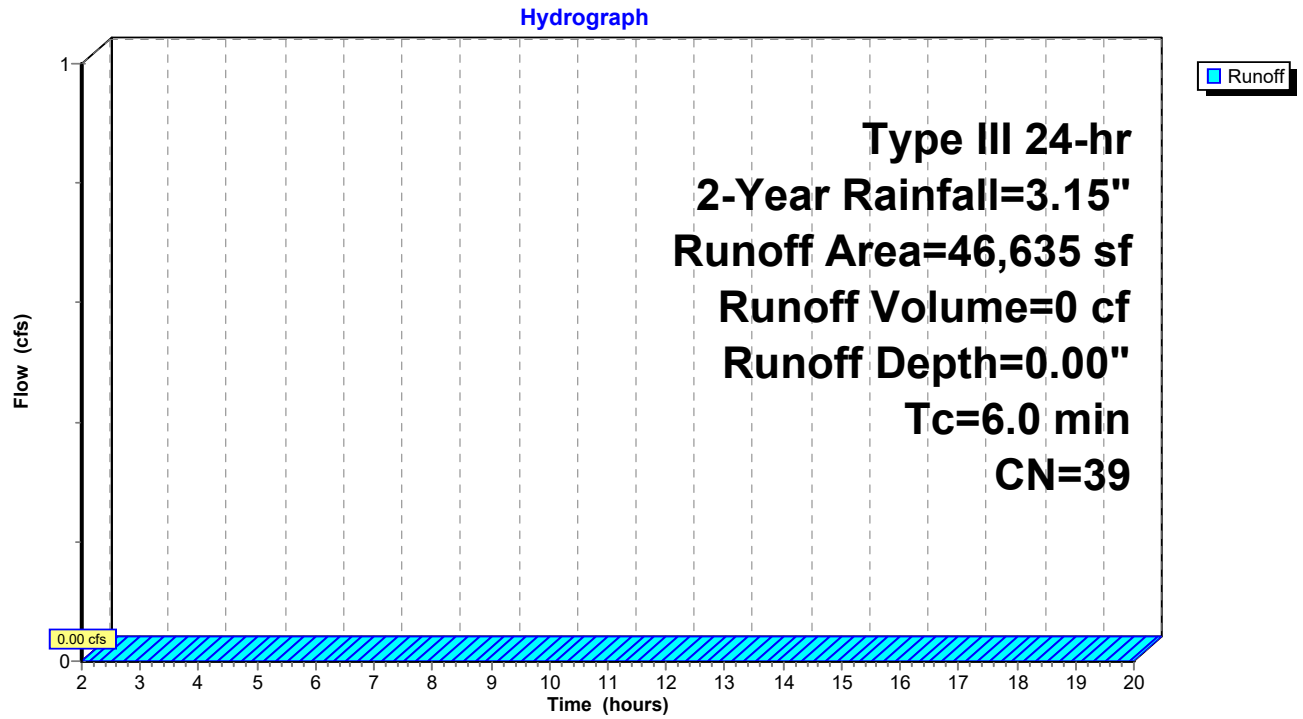
Runoff = 0.00 cfs @ 2.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link POA-1 : Existing Outfall

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
46,635	39	>75% Grass cover, Good, HSG A
46,635		100.00% Pervious Area

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

Subcatchment 3S: BULGE RD - STORM DRAIN



Summary for Subcatchment 5S: OVERLAND FLOW

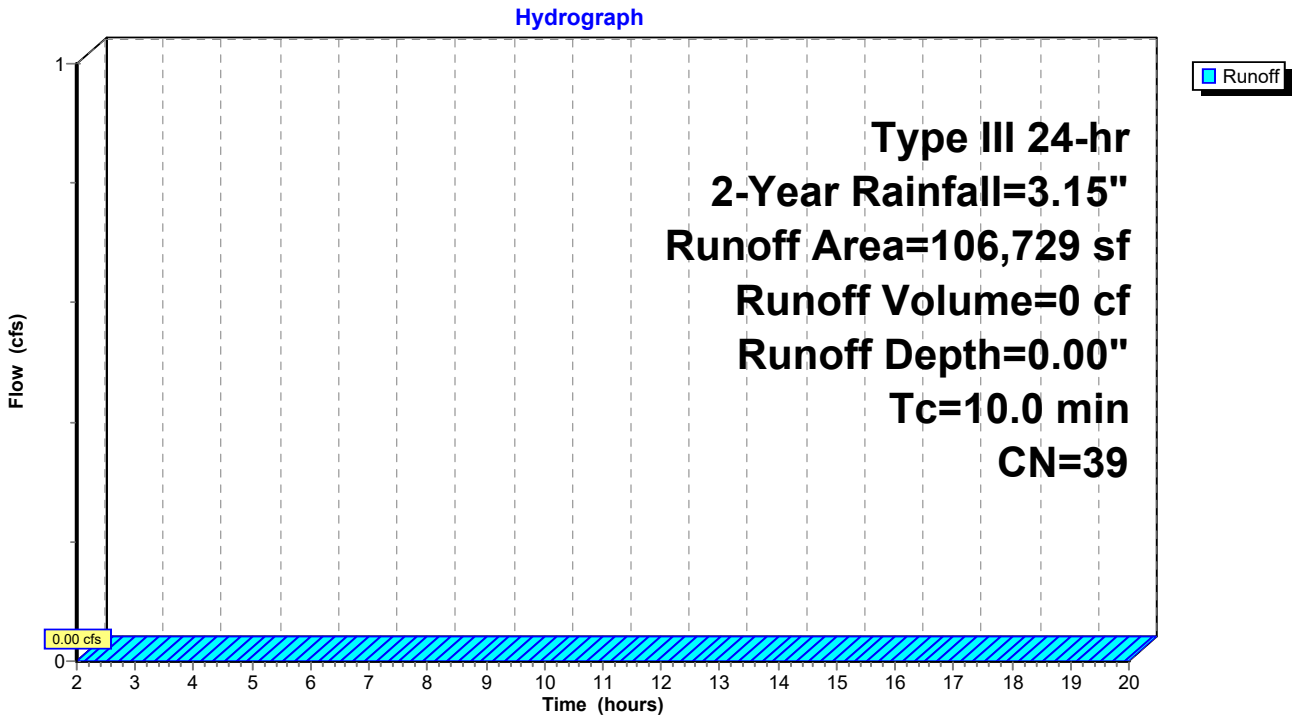
Runoff = 0.00 cfs @ 2.00 hrs, Volume= 0 cf, Depth= 0.00"
Routed to Link POA-2 : Overland to Cold Spring Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
106,729	39	>75% Grass cover, Good, HSG A
106,729		100.00% Pervious Area

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

Subcatchment 5S: OVERLAND FLOW



Summary for Subcatchment 8S: GOLFCLUB MAINTENANCE BUILDING

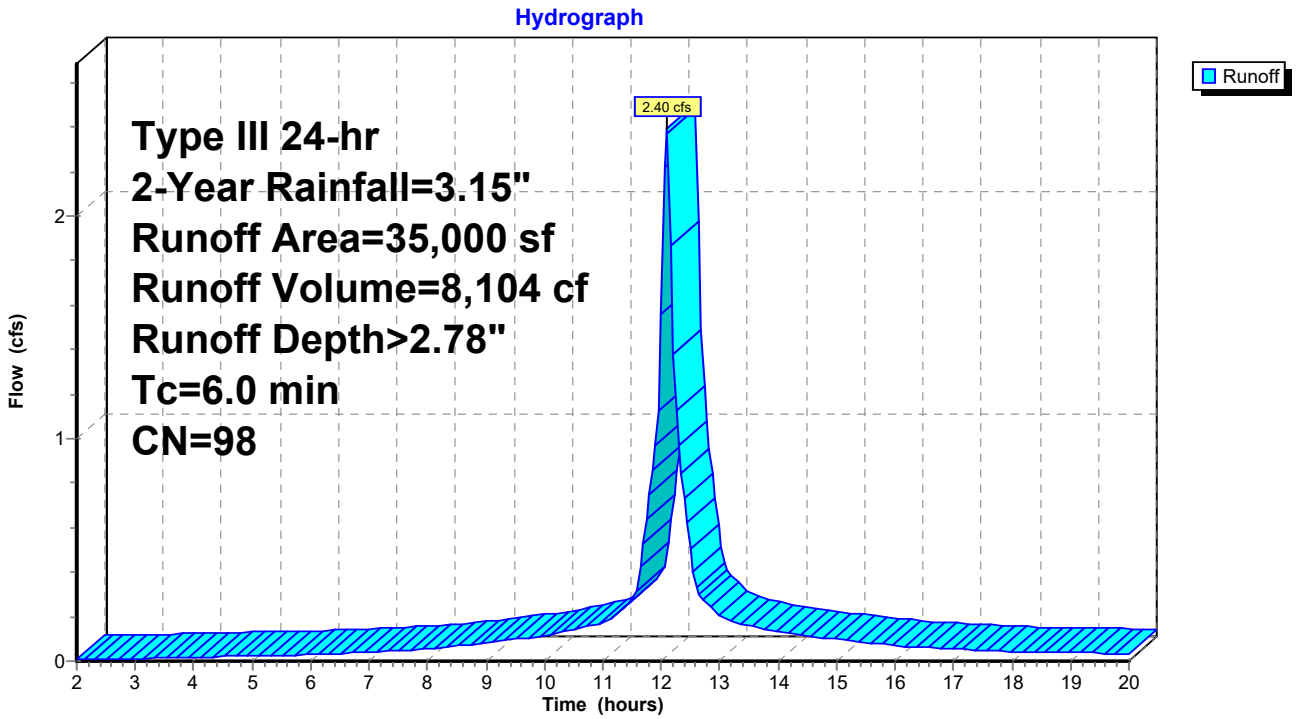
Runoff = 2.40 cfs @ 12.09 hrs, Volume= 8,104 cf, Depth> 2.78"
Routed to Link POA-1 : Existing Outfall

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
35,000	98	Paved parking, HSG A
35,000		100.00% Impervious Area

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

Subcatchment 8S: GOLFCLUB MAINTENANCE BUILDING

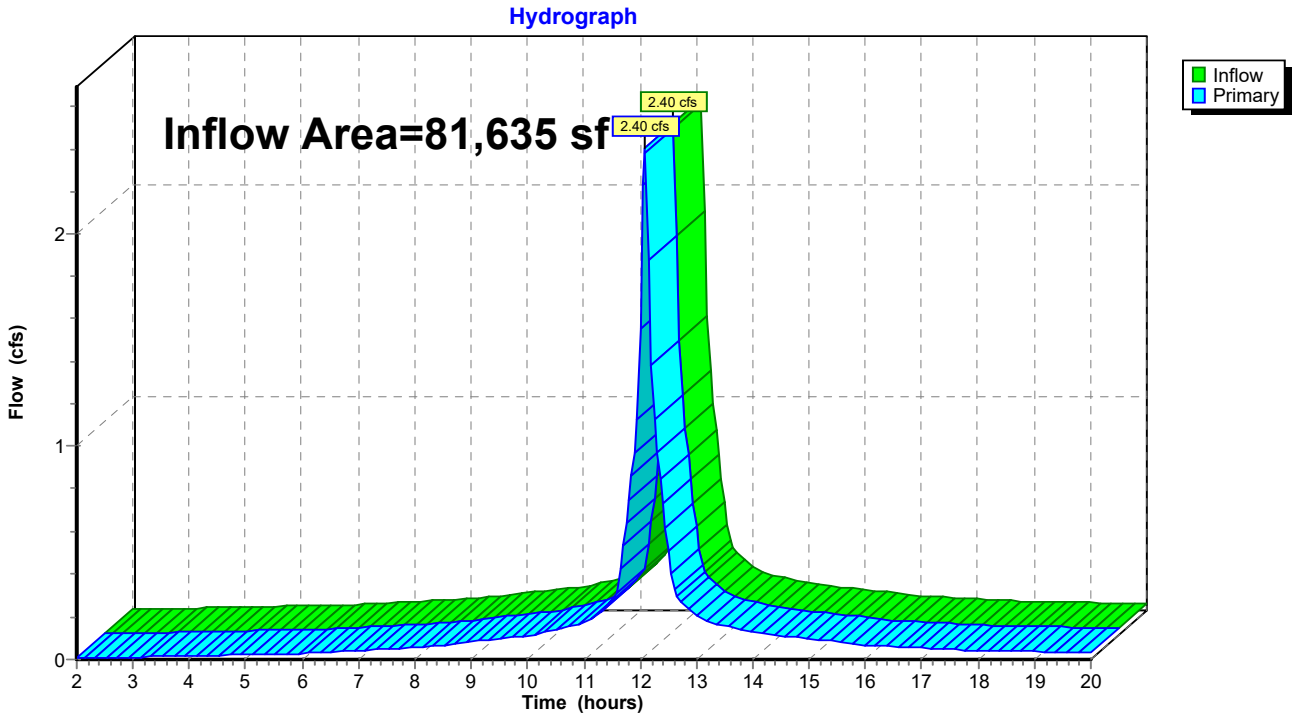


Summary for Link POA-1: Existing Outfall

Inflow Area = 81,635 sf, 42.87% Impervious, Inflow Depth > 1.19" for 2-Year event
Inflow = 2.40 cfs @ 12.09 hrs, Volume= 8,104 cf
Primary = 2.40 cfs @ 12.09 hrs, Volume= 8,104 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs

Link POA-1: Existing Outfall

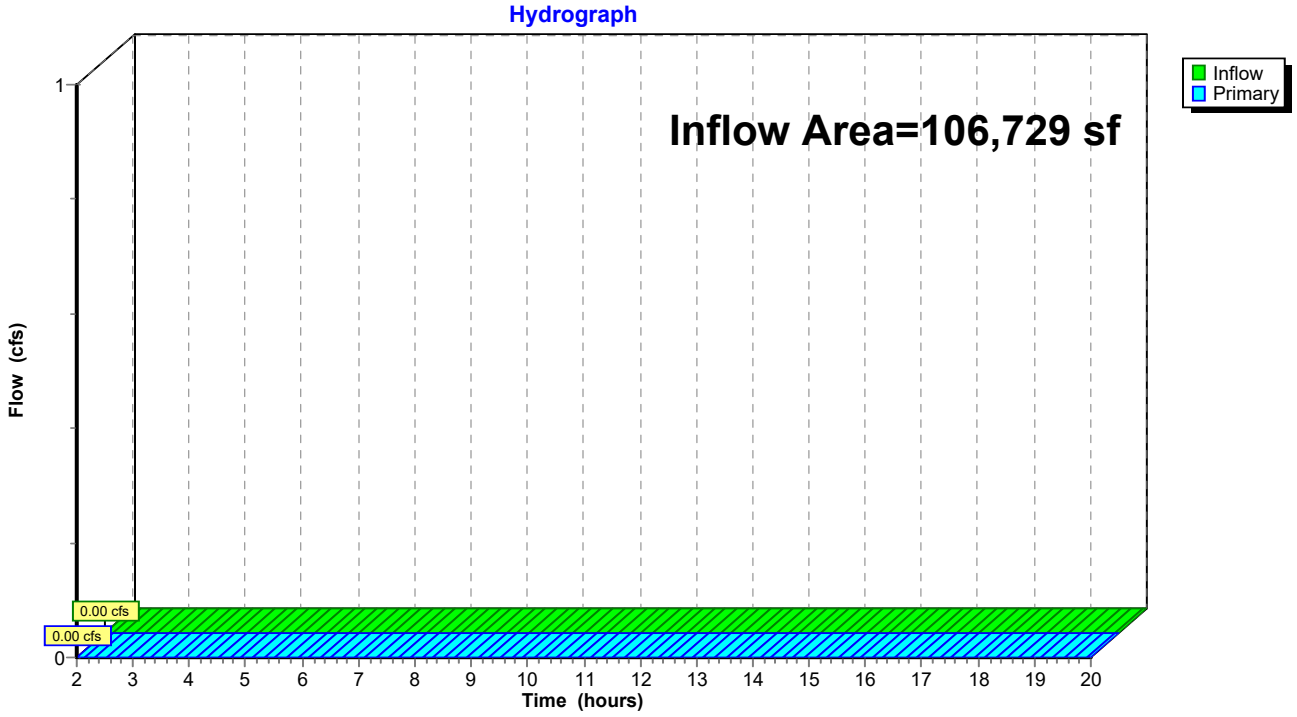


Summary for Link POA-2: Overland to Cold Spring Brook

Inflow Area = 106,729 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 2.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 2.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs

Link POA-2: Overland to Cold Spring Brook



Time span=2.00-20.00 hrs, dt=0.05 hrs, 361 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: BULGE RD - STORM Runoff Area=46,635 sf 0.00% Impervious Runoff Depth>0.13"
Tc=6.0 min CN=39 Runoff=0.03 cfs 504 cf

Subcatchment5S: OVERLAND FLOW Runoff Area=106,729 sf 0.00% Impervious Runoff Depth>0.13"
Tc=10.0 min CN=39 Runoff=0.06 cfs 1,147 cf

Subcatchment8S: GOLFCLUB Runoff Area=35,000 sf 100.00% Impervious Runoff Depth>4.37"
Tc=6.0 min CN=98 Runoff=3.71 cfs 12,752 cf

Link POA-1: Existing Outfall Inflow=3.71 cfs 13,255 cf
Primary=3.71 cfs 13,255 cf

Link POA-2: Overland to Cold Spring Brook Inflow=0.06 cfs 1,147 cf
Primary=0.06 cfs 1,147 cf

Total Runoff Area = 188,364 sf Runoff Volume = 14,402 cf Average Runoff Depth = 0.92"
81.42% Pervious = 153,364 sf 18.58% Impervious = 35,000 sf

Summary for Subcatchment 3S: BULGE RD - STORM DRAIN

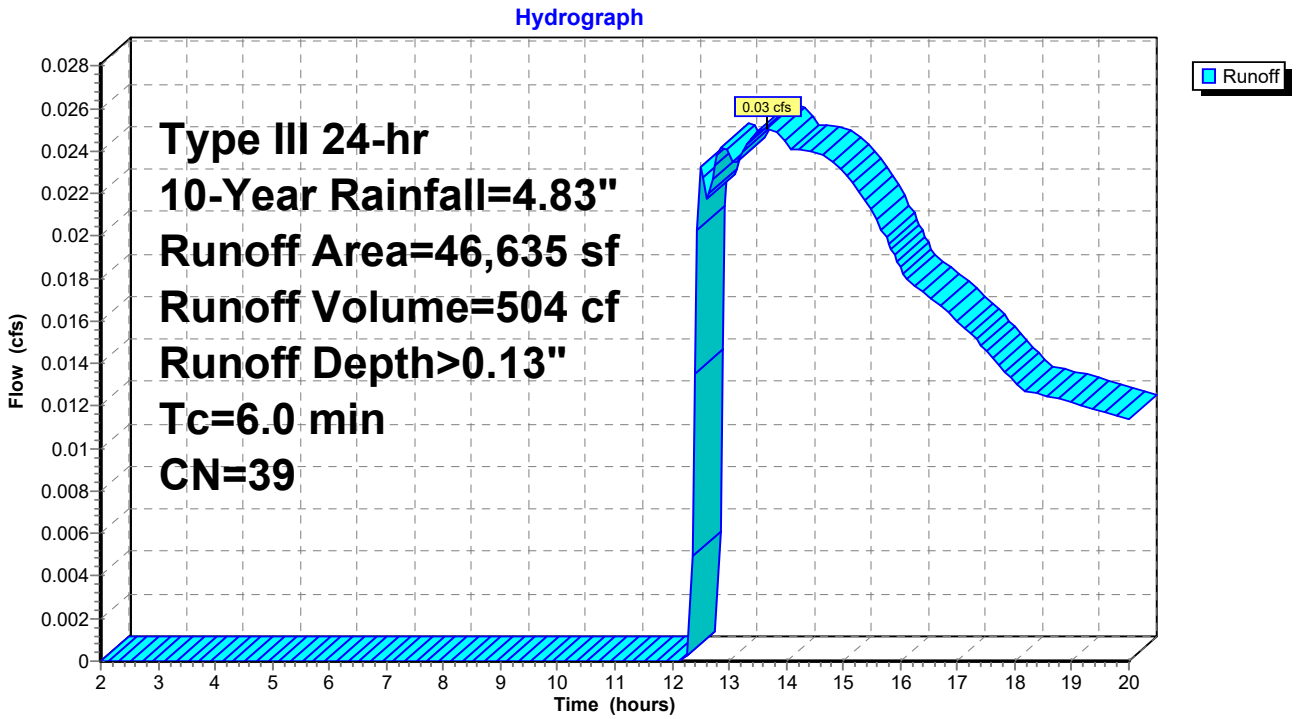
Runoff = 0.03 cfs @ 13.65 hrs, Volume= 504 cf, Depth> 0.13"
Routed to Link POA-1 : Existing Outfall

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
46,635	39	>75% Grass cover, Good, HSG A
46,635		100.00% Pervious Area

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

Subcatchment 3S: BULGE RD - STORM DRAIN



Summary for Subcatchment 5S: OVERLAND FLOW

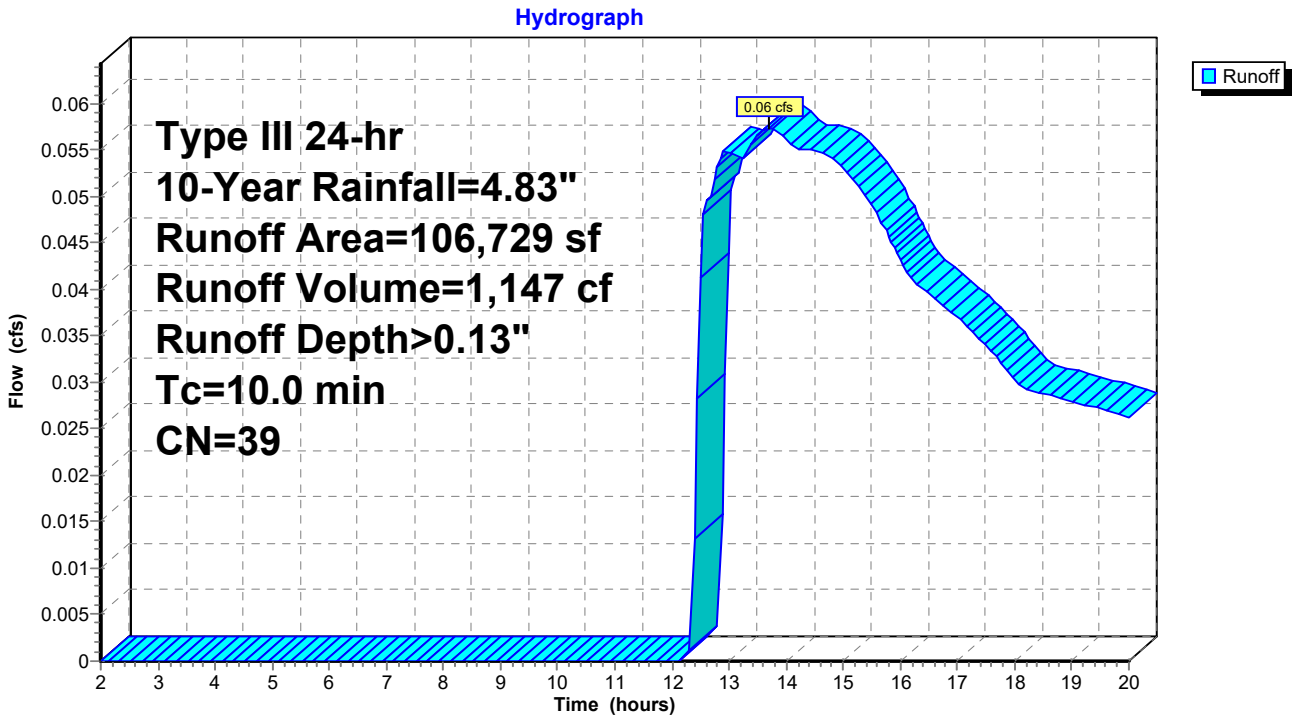
Runoff = 0.06 cfs @ 13.71 hrs, Volume= 1,147 cf, Depth> 0.13"
Routed to Link POA-2 : Overland to Cold Spring Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
106,729	39	>75% Grass cover, Good, HSG A
106,729		100.00% Pervious Area

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

Subcatchment 5S: OVERLAND FLOW



Summary for Subcatchment 8S: GOLFCLUB MAINTENANCE BUILDING

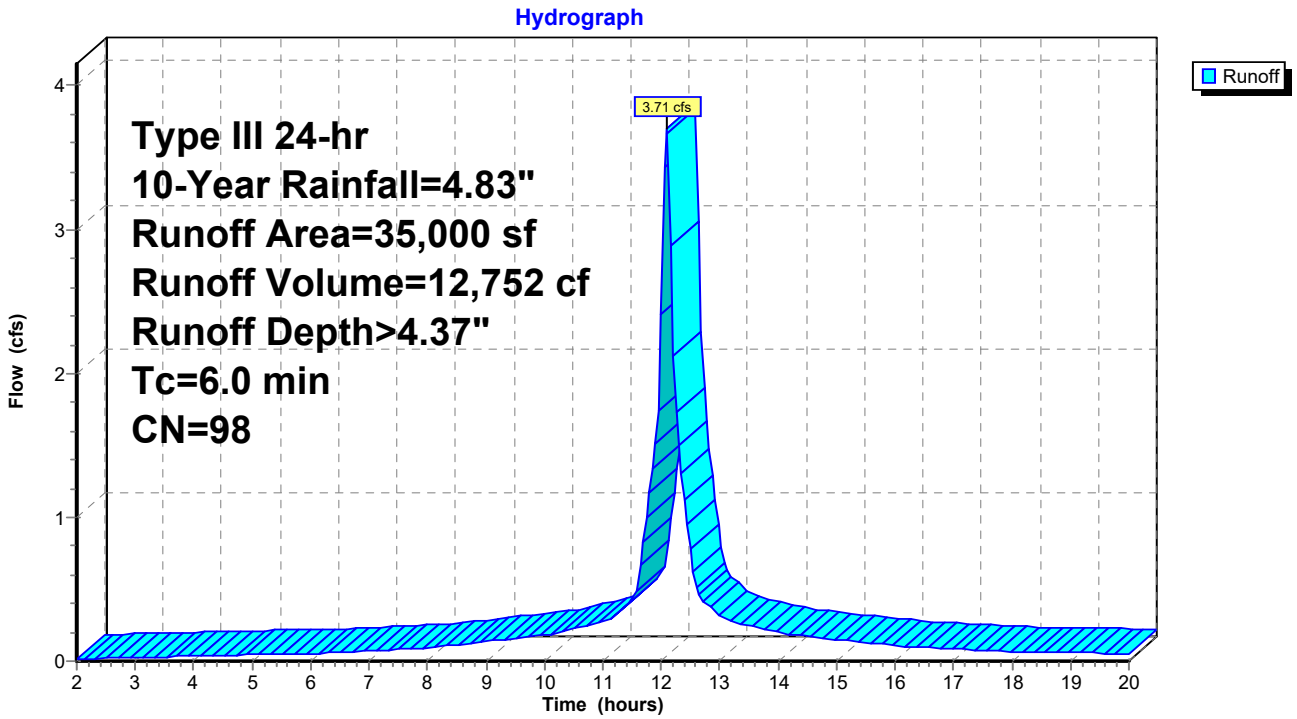
Runoff = 3.71 cfs @ 12.09 hrs, Volume= 12,752 cf, Depth> 4.37"
Routed to Link POA-1 : Existing Outfall

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
35,000	98	Paved parking, HSG A
35,000		100.00% Impervious Area

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

Subcatchment 8S: GOLFCLUB MAINTENANCE BUILDING

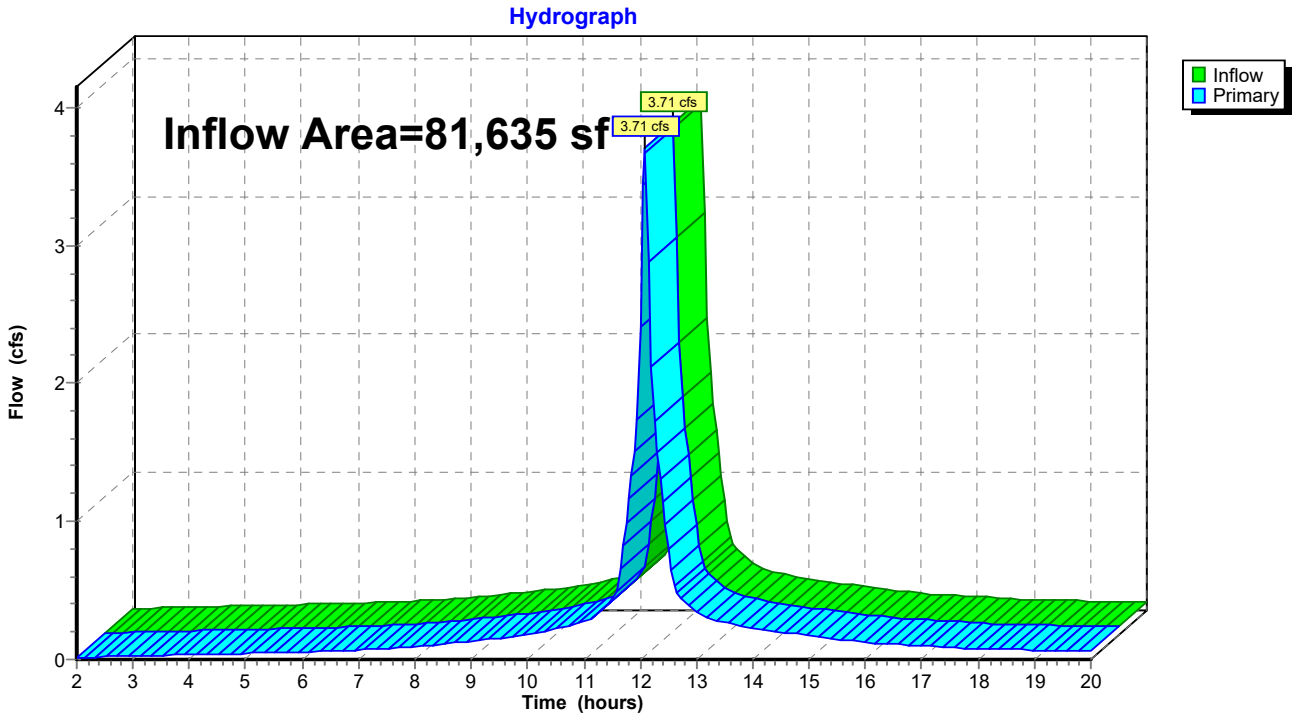


Summary for Link POA-1: Existing Outfall

Inflow Area = 81,635 sf, 42.87% Impervious, Inflow Depth > 1.95" for 10-Year event
Inflow = 3.71 cfs @ 12.09 hrs, Volume= 13,255 cf
Primary = 3.71 cfs @ 12.09 hrs, Volume= 13,255 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs

Link POA-1: Existing Outfall

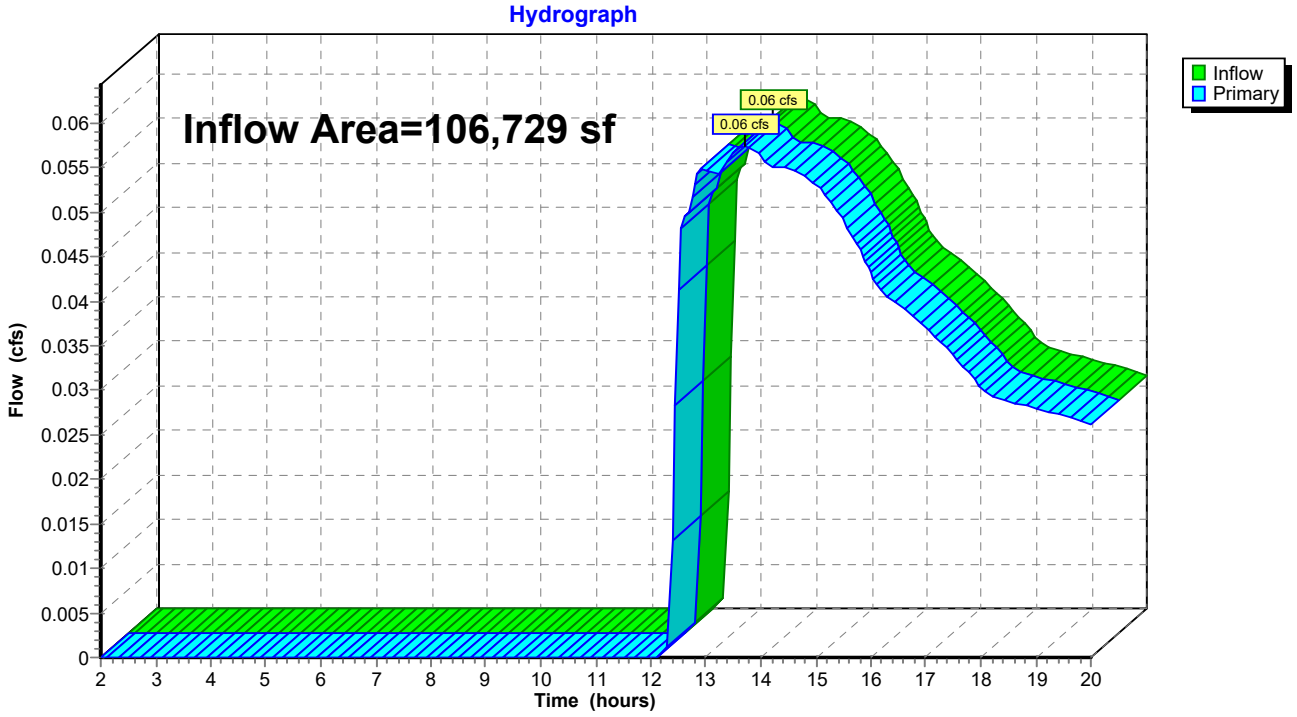


Summary for Link POA-2: Overland to Cold Spring Brook

Inflow Area = 106,729 sf, 0.00% Impervious, Inflow Depth > 0.13" for 10-Year event
Inflow = 0.06 cfs @ 13.71 hrs, Volume= 1,147 cf
Primary = 0.06 cfs @ 13.71 hrs, Volume= 1,147 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs

Link POA-2: Overland to Cold Spring Brook



Time span=2.00-20.00 hrs, dt=0.05 hrs, 361 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: BULGE RD - STORM Runoff Area=46,635 sf 0.00% Impervious Runoff Depth>0.34"
Tc=6.0 min CN=39 Runoff=0.17 cfs 1,333 cf

Subcatchment5S: OVERLAND FLOW Runoff Area=106,729 sf 0.00% Impervious Runoff Depth>0.34"
Tc=10.0 min CN=39 Runoff=0.37 cfs 3,039 cf

Subcatchment8S: GOLFCLUB Runoff Area=35,000 sf 100.00% Impervious Runoff Depth>5.37"
Tc=6.0 min CN=98 Runoff=4.52 cfs 15,652 cf

Link POA-1: Existing Outfall Inflow=4.54 cfs 16,985 cf
Primary=4.54 cfs 16,985 cf

Link POA-2: Overland to Cold Spring Brook Inflow=0.37 cfs 3,039 cf
Primary=0.37 cfs 3,039 cf

Total Runoff Area = 188,364 sf Runoff Volume = 20,024 cf Average Runoff Depth = 1.28"
81.42% Pervious = 153,364 sf 18.58% Impervious = 35,000 sf

Summary for Subcatchment 3S: BULGE RD - STORM DRAIN

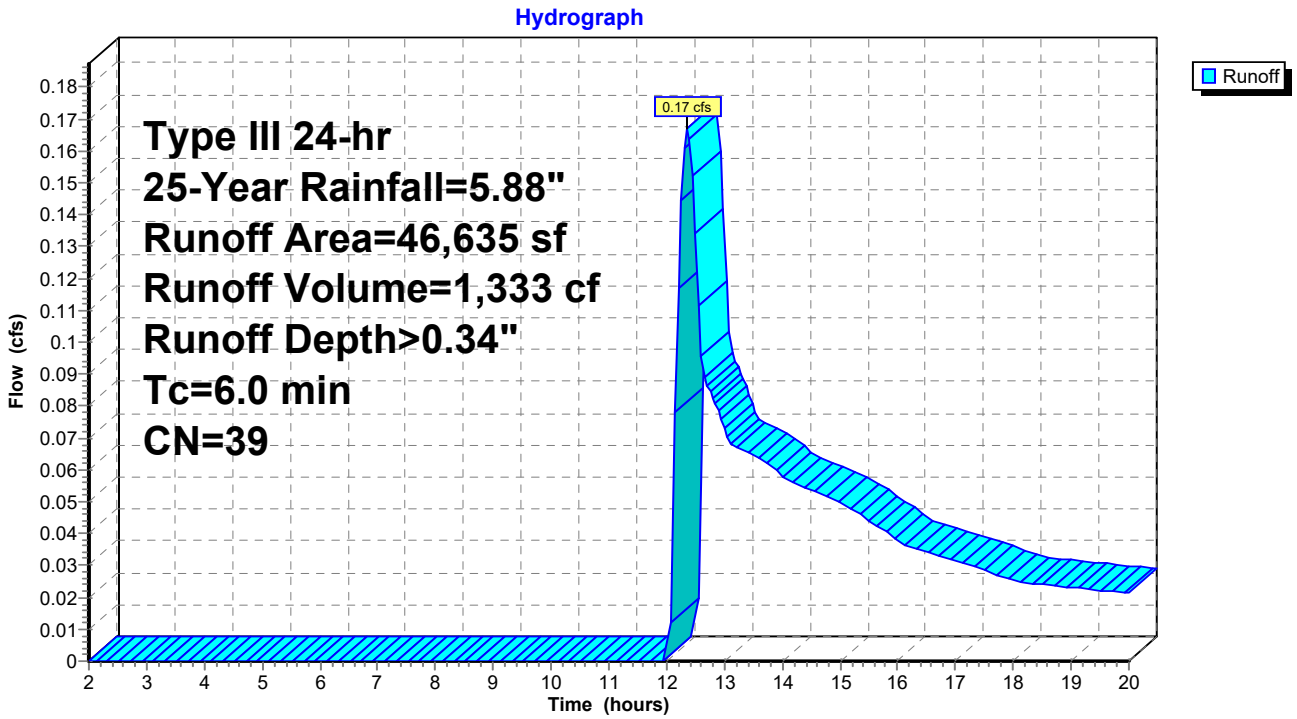
Runoff = 0.17 cfs @ 12.36 hrs, Volume= 1,333 cf, Depth> 0.34"
Routed to Link POA-1 : Existing Outfall

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.88"

Area (sf)	CN	Description
46,635	39	>75% Grass cover, Good, HSG A
46,635		100.00% Pervious Area

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

Subcatchment 3S: BULGE RD - STORM DRAIN



Summary for Subcatchment 5S: OVERLAND FLOW

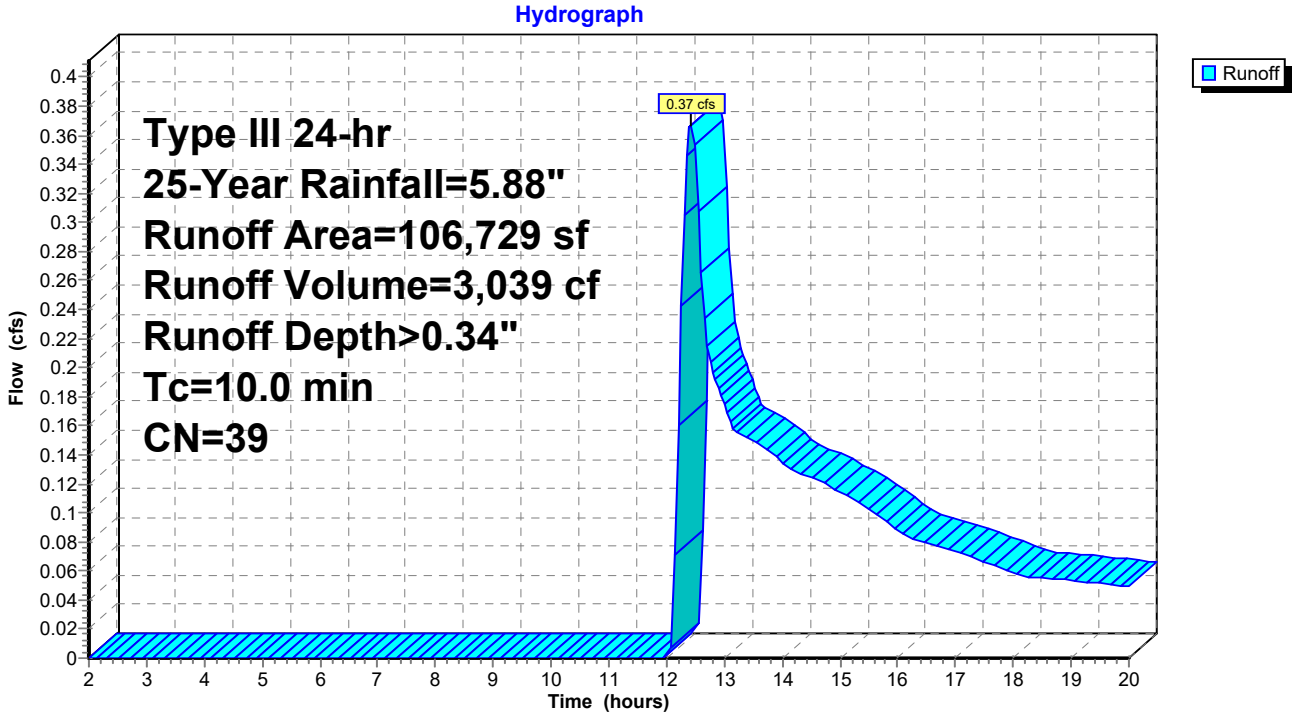
Runoff = 0.37 cfs @ 12.42 hrs, Volume= 3,039 cf, Depth> 0.34"
Routed to Link POA-2 : Overland to Cold Spring Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.88"

Area (sf)	CN	Description
106,729	39	>75% Grass cover, Good, HSG A
106,729		100.00% Pervious Area

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

Subcatchment 5S: OVERLAND FLOW



Summary for Subcatchment 8S: GOLFCLUB MAINTENANCE BUILDING

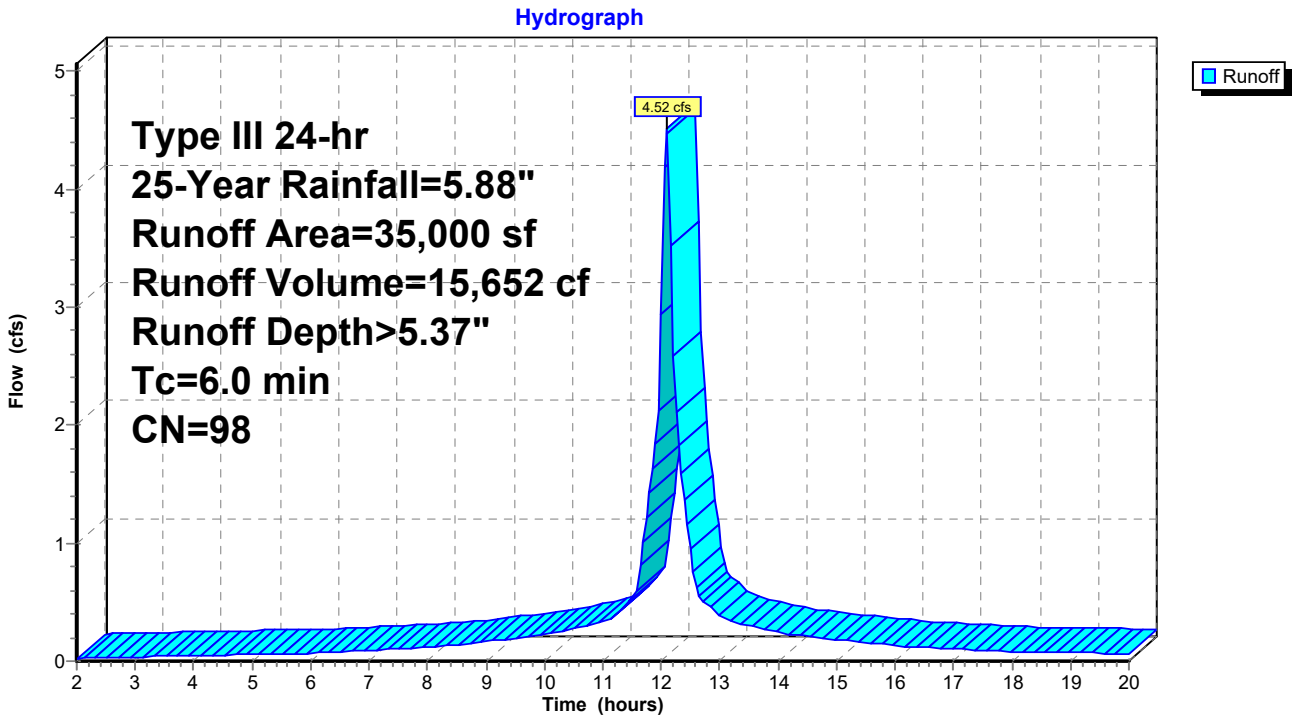
Runoff = 4.52 cfs @ 12.09 hrs, Volume= 15,652 cf, Depth> 5.37"
Routed to Link POA-1 : Existing Outfall

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.88"

Area (sf)	CN	Description
35,000	98	Paved parking, HSG A
35,000		100.00% Impervious Area

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

Subcatchment 8S: GOLFCLUB MAINTENANCE BUILDING

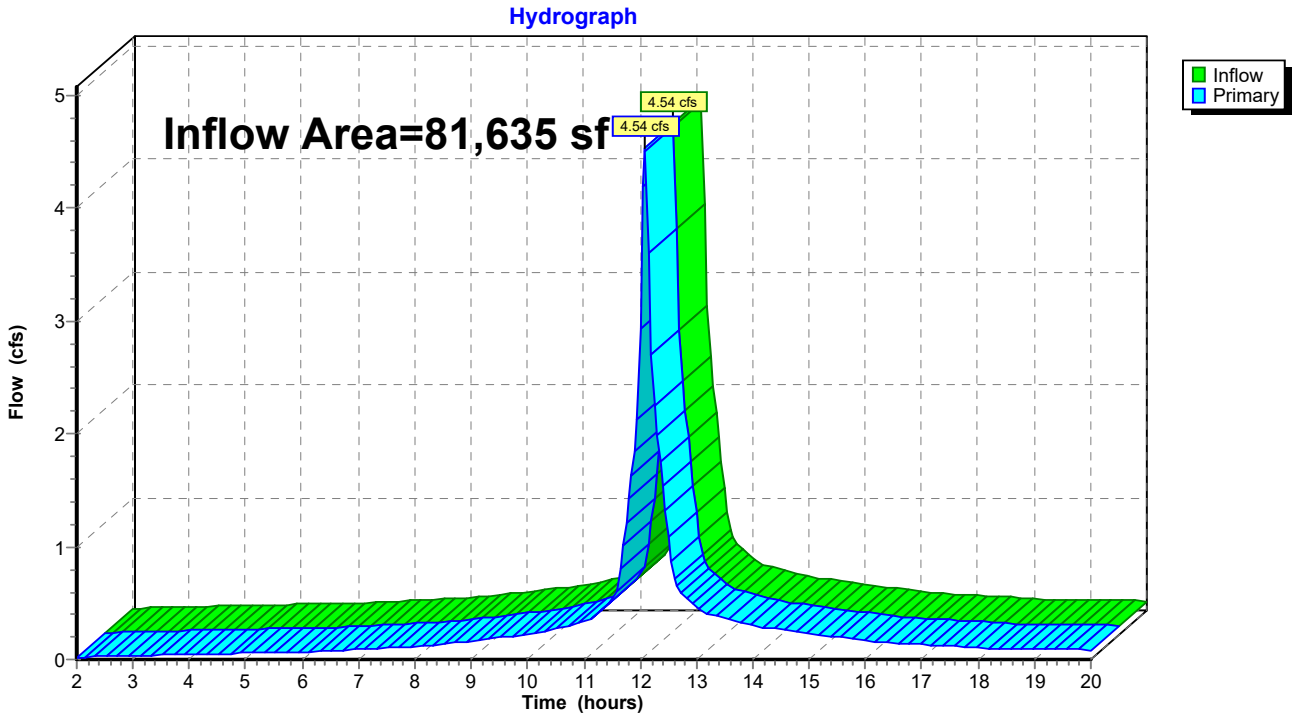


Summary for Link POA-1: Existing Outfall

Inflow Area = 81,635 sf, 42.87% Impervious, Inflow Depth > 2.50" for 25-Year event
Inflow = 4.54 cfs @ 12.09 hrs, Volume= 16,985 cf
Primary = 4.54 cfs @ 12.09 hrs, Volume= 16,985 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs

Link POA-1: Existing Outfall

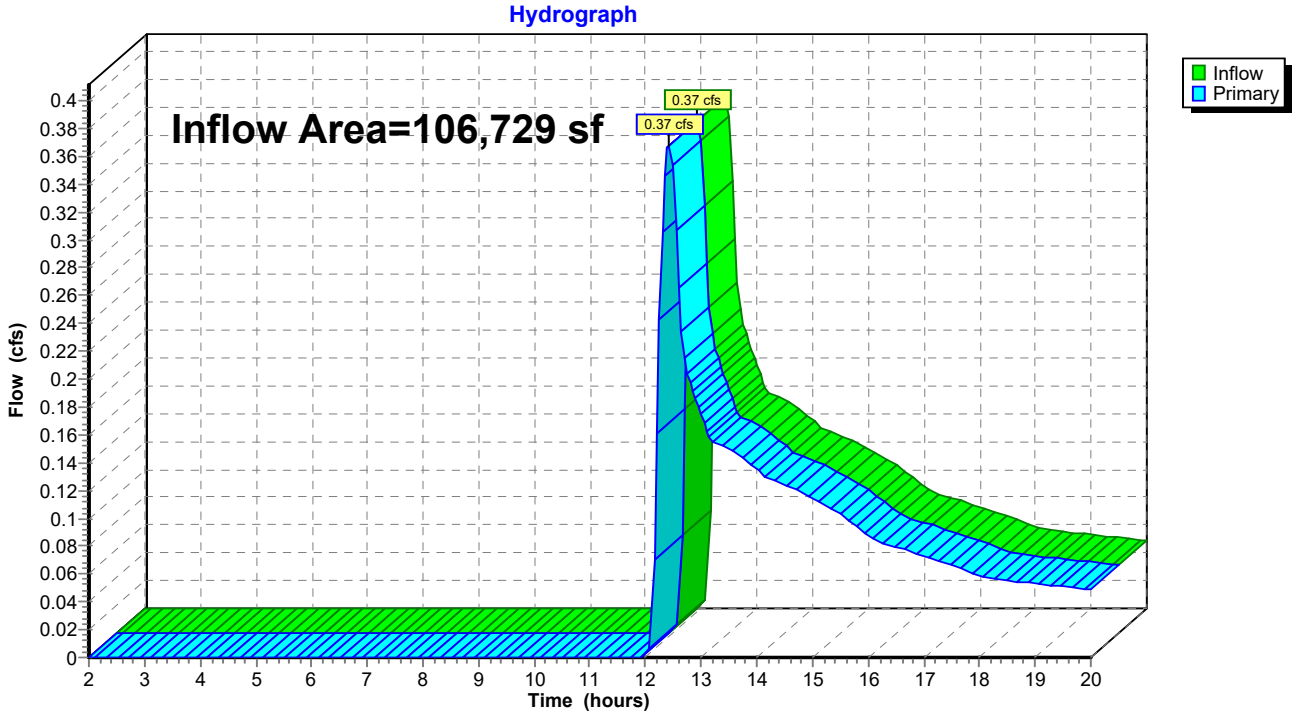


Summary for Link POA-2: Overland to Cold Spring Brook

Inflow Area = 106,729 sf, 0.00% Impervious, Inflow Depth > 0.34" for 25-Year event
Inflow = 0.37 cfs @ 12.42 hrs, Volume= 3,039 cf
Primary = 0.37 cfs @ 12.42 hrs, Volume= 3,039 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs

Link POA-2: Overland to Cold Spring Brook



Time span=2.00-20.00 hrs, dt=0.05 hrs, 361 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: BULGE RD - STORM Runoff Area=46,635 sf 0.00% Impervious Runoff Depth>0.55"
Tc=6.0 min CN=39 Runoff=0.33 cfs 2,148 cf

Subcatchment5S: OVERLAND FLOW Runoff Area=106,729 sf 0.00% Impervious Runoff Depth>0.55"
Tc=10.0 min CN=39 Runoff=0.73 cfs 4,902 cf

Subcatchment8S: GOLFCLUB Runoff Area=35,000 sf 100.00% Impervious Runoff Depth>6.09"
Tc=6.0 min CN=98 Runoff=5.12 cfs 17,777 cf

Link POA-1: Existing Outfall Inflow=5.32 cfs 19,925 cf
Primary=5.32 cfs 19,925 cf

Link POA-2: Overland to Cold Spring Brook Inflow=0.73 cfs 4,902 cf
Primary=0.73 cfs 4,902 cf

Total Runoff Area = 188,364 sf Runoff Volume = 24,827 cf Average Runoff Depth = 1.58"
81.42% Pervious = 153,364 sf 18.58% Impervious = 35,000 sf

Summary for Subcatchment 3S: BULGE RD - STORM DRAIN

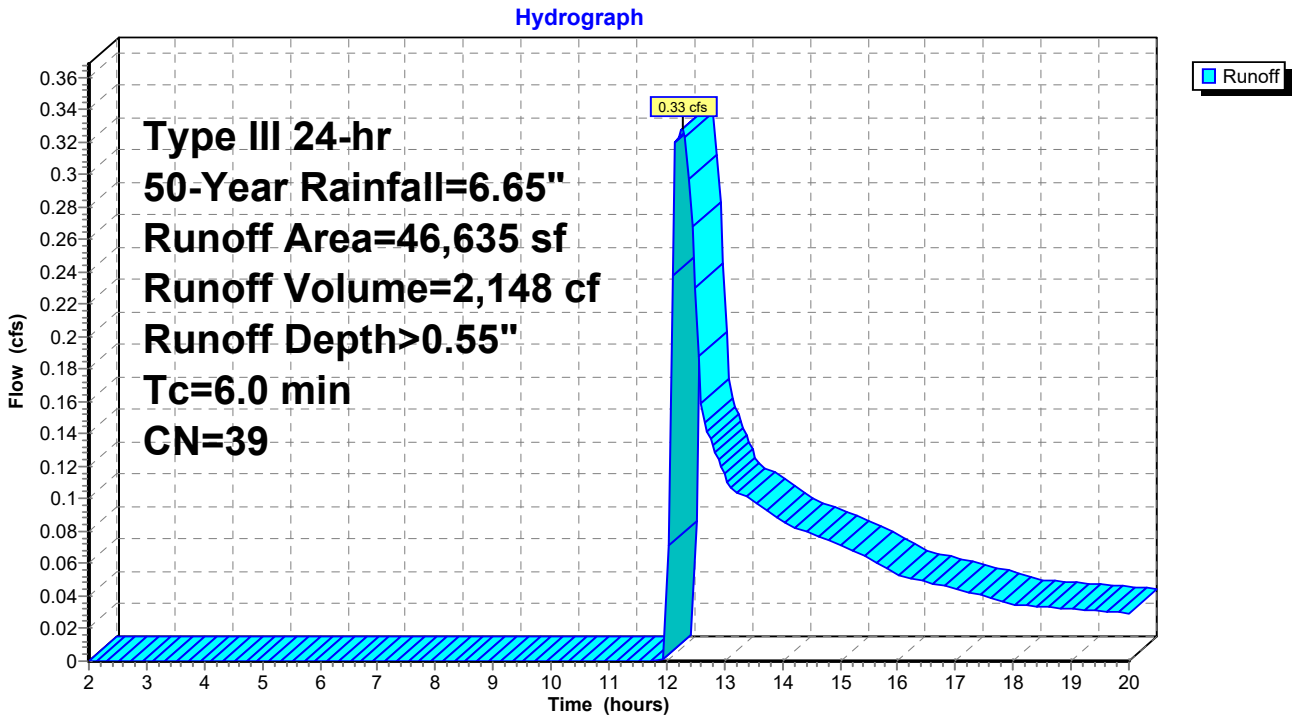
Runoff = 0.33 cfs @ 12.28 hrs, Volume= 2,148 cf, Depth> 0.55"
Routed to Link POA-1 : Existing Outfall

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.65"

Area (sf)	CN	Description
46,635	39	>75% Grass cover, Good, HSG A
46,635		100.00% Pervious Area

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

Subcatchment 3S: BULGE RD - STORM DRAIN



Summary for Subcatchment 5S: OVERLAND FLOW

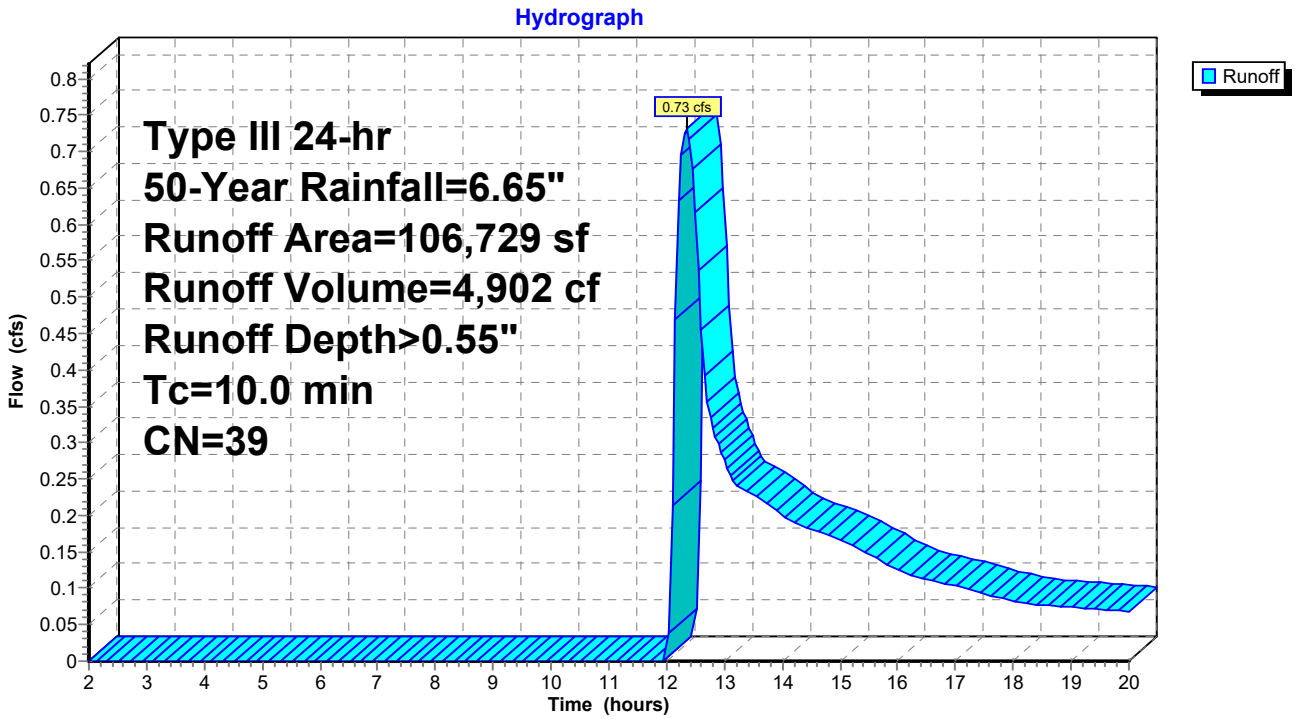
Runoff = 0.73 cfs @ 12.34 hrs, Volume= 4,902 cf, Depth> 0.55"
Routed to Link POA-2 : Overland to Cold Spring Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.65"

Area (sf)	CN	Description
106,729	39	>75% Grass cover, Good, HSG A
106,729		100.00% Pervious Area

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

Subcatchment 5S: OVERLAND FLOW



Summary for Subcatchment 8S: GOLFCLUB MAINTENANCE BUILDING

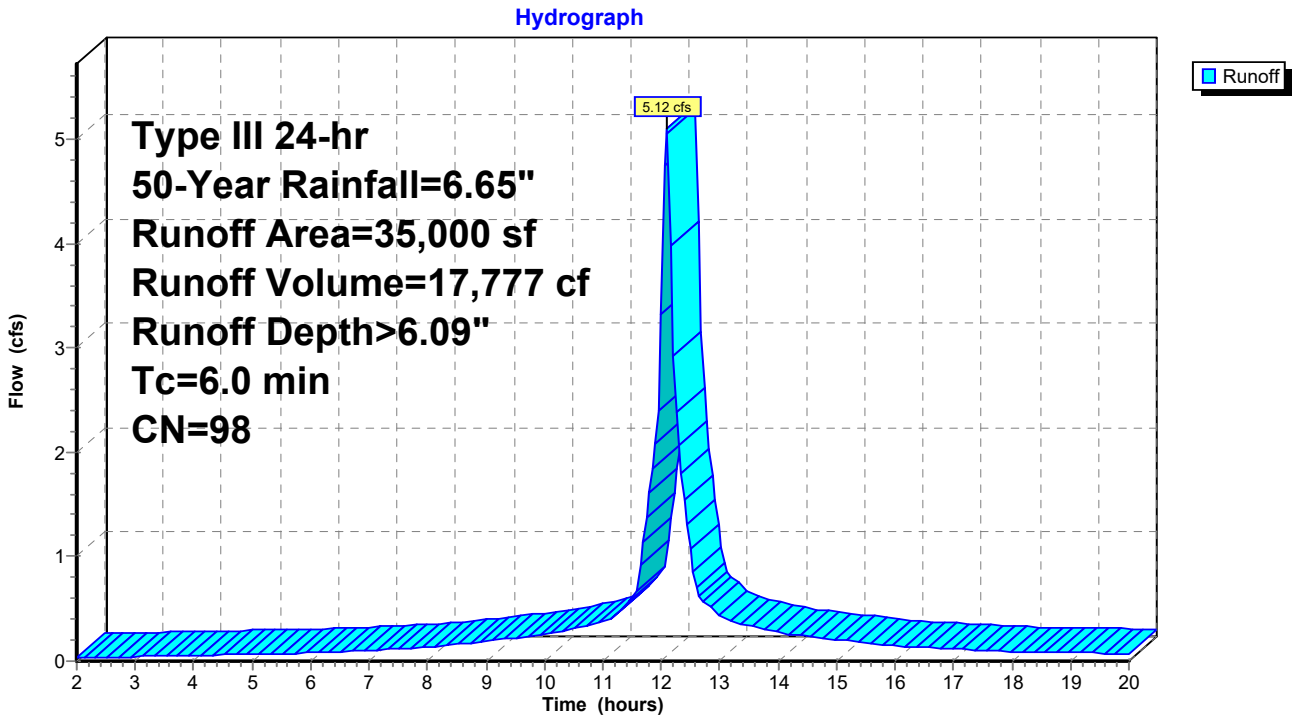
Runoff = 5.12 cfs @ 12.09 hrs, Volume= 17,777 cf, Depth> 6.09"
Routed to Link POA-1 : Existing Outfall

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.65"

Area (sf)	CN	Description
35,000	98	Paved parking, HSG A
35,000		100.00% Impervious Area

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

Subcatchment 8S: GOLFCLUB MAINTENANCE BUILDING

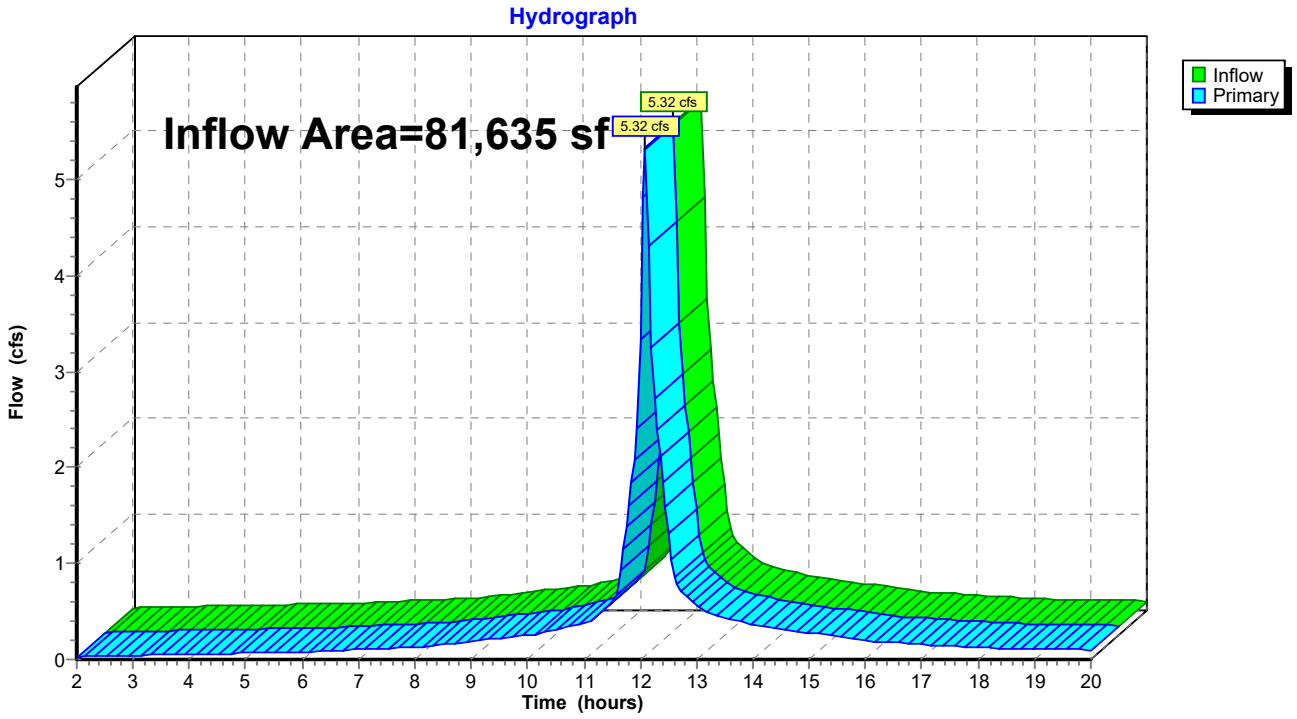


Summary for Link POA-1: Existing Outfall

Inflow Area = 81,635 sf, 42.87% Impervious, Inflow Depth > 2.93" for 50-Year event
Inflow = 5.32 cfs @ 12.09 hrs, Volume= 19,925 cf
Primary = 5.32 cfs @ 12.09 hrs, Volume= 19,925 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs

Link POA-1: Existing Outfall

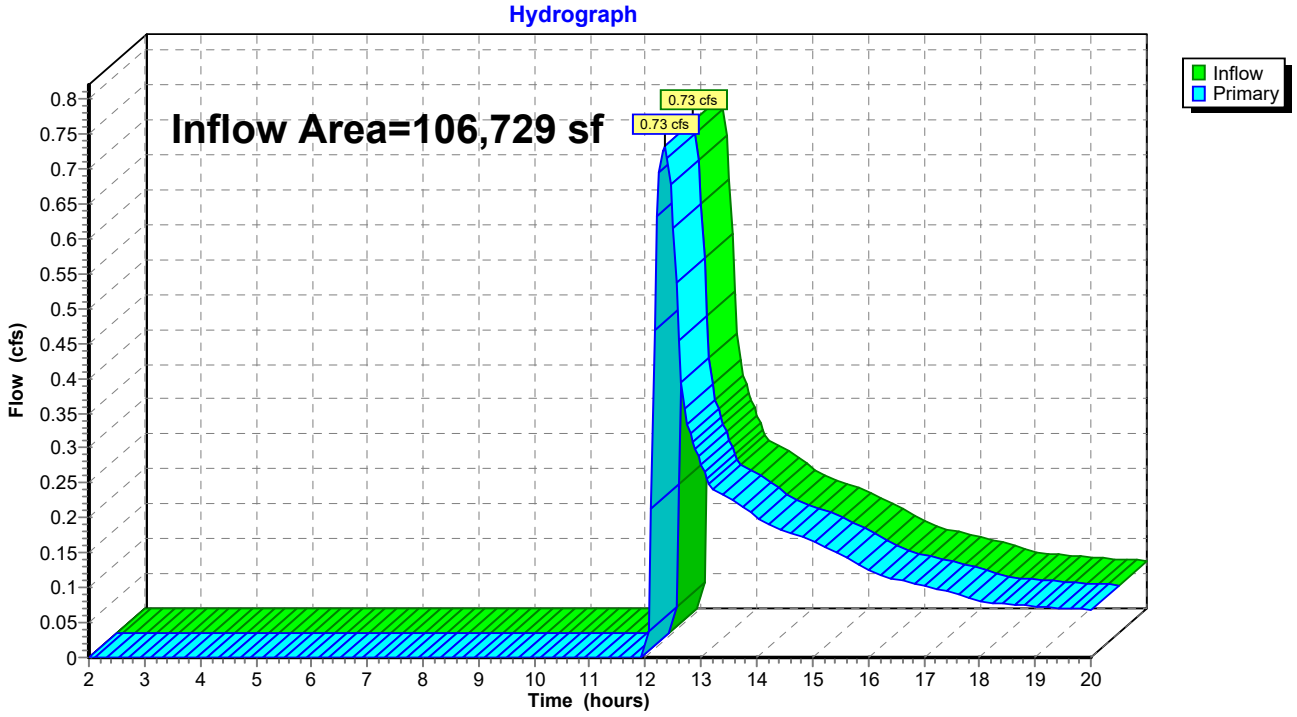


Summary for Link POA-2: Overland to Cold Spring Brook

Inflow Area = 106,729 sf, 0.00% Impervious, Inflow Depth > 0.55" for 50-Year event
Inflow = 0.73 cfs @ 12.34 hrs, Volume= 4,902 cf
Primary = 0.73 cfs @ 12.34 hrs, Volume= 4,902 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs

Link POA-2: Overland to Cold Spring Brook



Time span=2.00-20.00 hrs, dt=0.05 hrs, 361 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: BULGE RD - STORM Runoff Area=46,635 sf 0.00% Impervious Runoff Depth>0.83"
Tc=6.0 min CN=39 Runoff=0.66 cfs 3,213 cf

Subcatchment5S: OVERLAND FLOW Runoff Area=106,729 sf 0.00% Impervious Runoff Depth>0.82"
Tc=10.0 min CN=39 Runoff=1.35 cfs 7,333 cf

Subcatchment8S: GOLFCLUB Runoff Area=35,000 sf 100.00% Impervious Runoff Depth>6.89"
Tc=6.0 min CN=98 Runoff=5.77 cfs 20,093 cf

Link POA-1: Existing Outfall Inflow=6.35 cfs 23,306 cf
Primary=6.35 cfs 23,306 cf

Link POA-2: Overland to Cold Spring Brook Inflow=1.35 cfs 7,333 cf
Primary=1.35 cfs 7,333 cf

Total Runoff Area = 188,364 sf Runoff Volume = 30,640 cf Average Runoff Depth = 1.95"
81.42% Pervious = 153,364 sf 18.58% Impervious = 35,000 sf

Summary for Subcatchment 3S: BULGE RD - STORM DRAIN

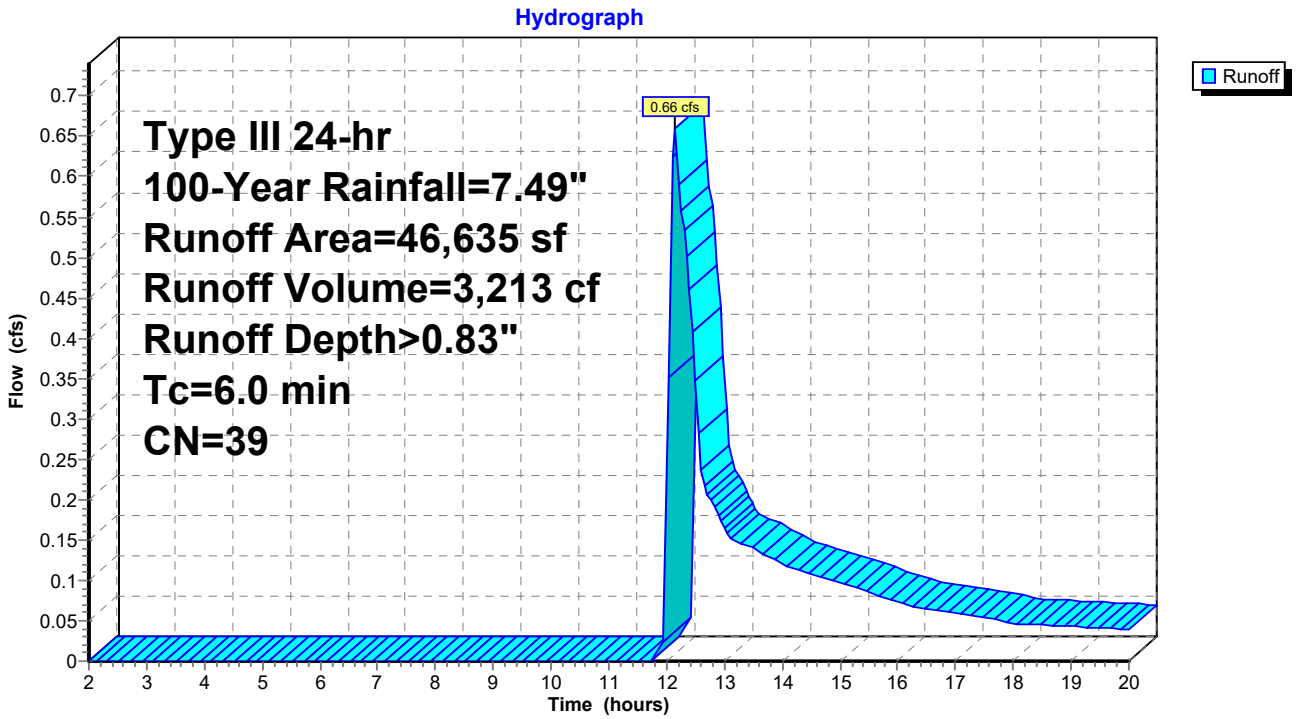
Runoff = 0.66 cfs @ 12.14 hrs, Volume= 3,213 cf, Depth> 0.83"
Routed to Link POA-1 : Existing Outfall

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.49"

Area (sf)	CN	Description
46,635	39	>75% Grass cover, Good, HSG A
46,635		100.00% Pervious Area

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

Subcatchment 3S: BULGE RD - STORM DRAIN



Summary for Subcatchment 5S: OVERLAND FLOW

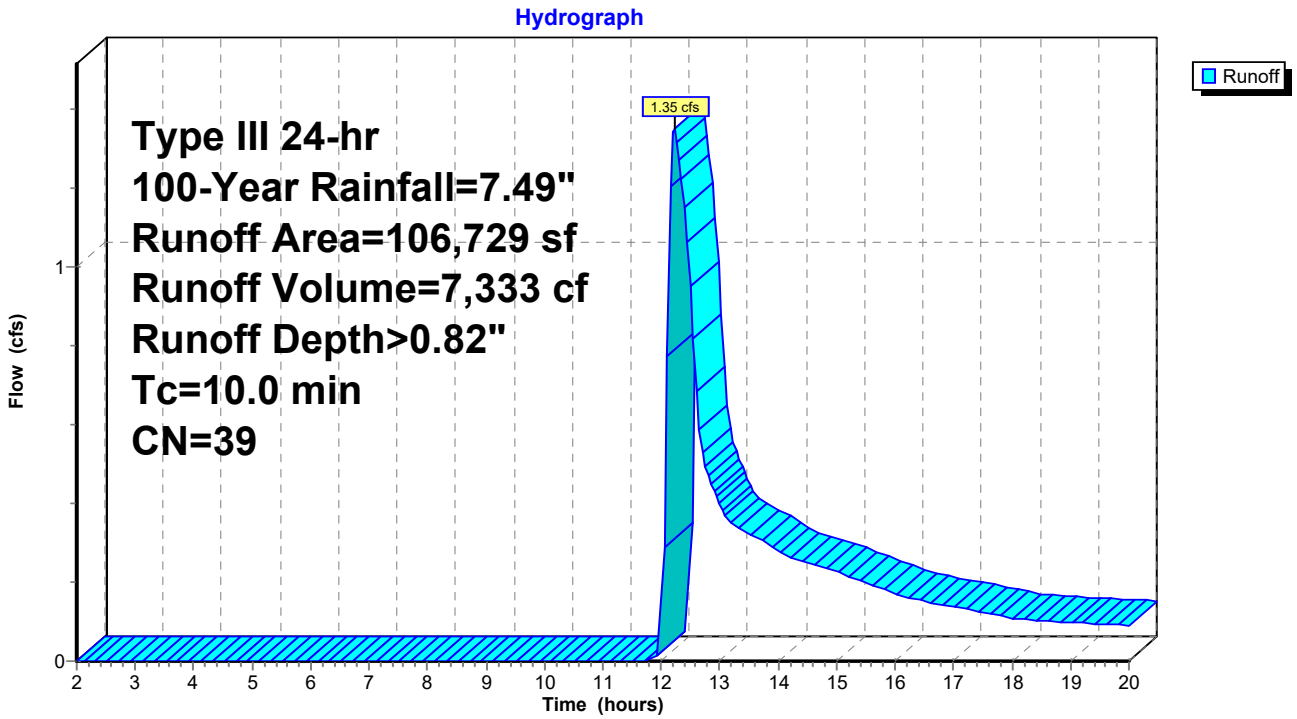
Runoff = 1.35 cfs @ 12.22 hrs, Volume= 7,333 cf, Depth> 0.82"
Routed to Link POA-2 : Overland to Cold Spring Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.49"

Area (sf)	CN	Description
106,729	39	>75% Grass cover, Good, HSG A
106,729		100.00% Pervious Area

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

Subcatchment 5S: OVERLAND FLOW



Summary for Subcatchment 8S: GOLFCLUB MAINTENANCE BUILDING

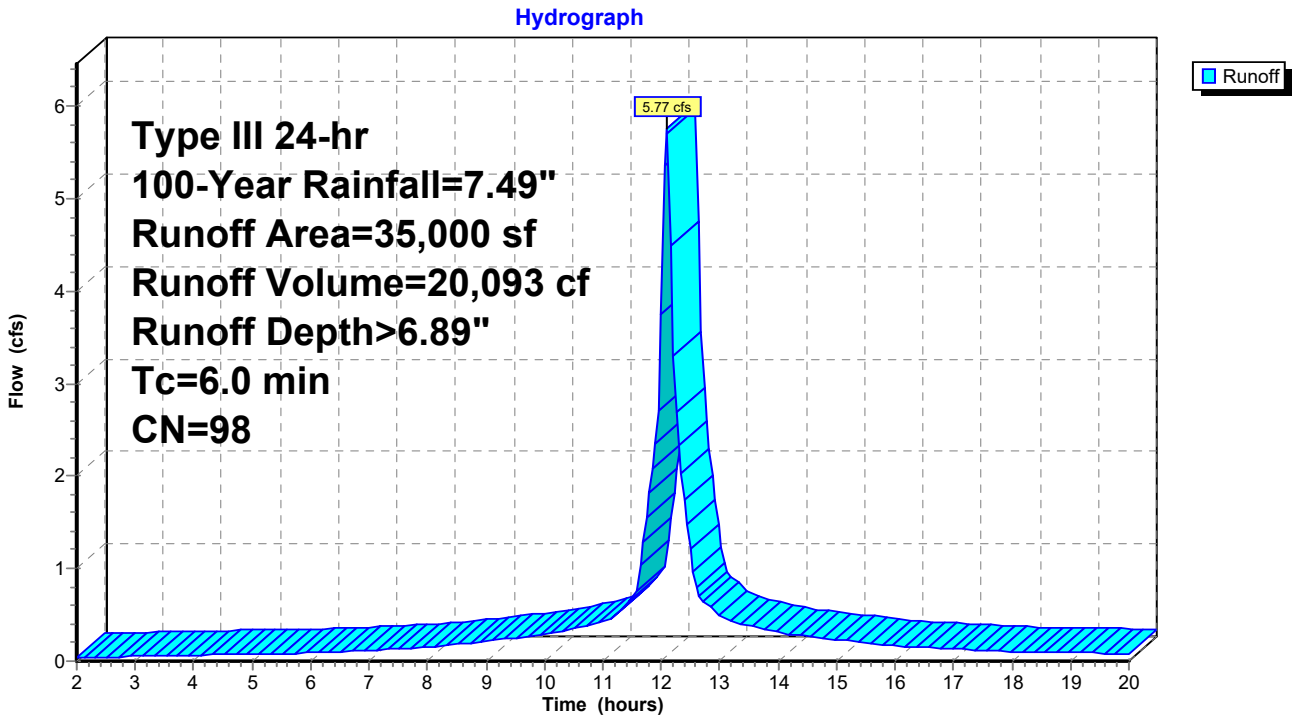
Runoff = 5.77 cfs @ 12.09 hrs, Volume= 20,093 cf, Depth> 6.89"
Routed to Link POA-1 : Existing Outfall

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.49"

Area (sf)	CN	Description
35,000	98	Paved parking, HSG A
35,000		100.00% Impervious Area

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

Subcatchment 8S: GOLFCLUB MAINTENANCE BUILDING

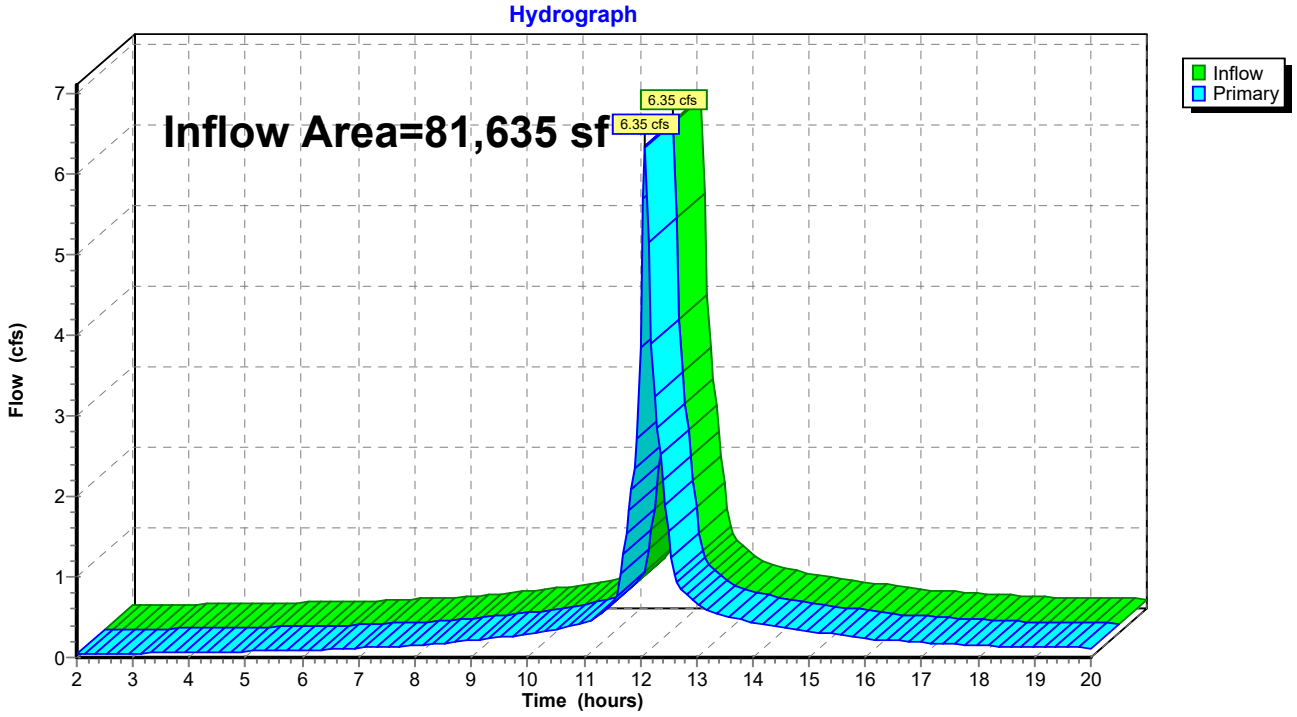


Summary for Link POA-1: Existing Outfall

Inflow Area = 81,635 sf, 42.87% Impervious, Inflow Depth > 3.43" for 100-Year event
Inflow = 6.35 cfs @ 12.09 hrs, Volume= 23,306 cf
Primary = 6.35 cfs @ 12.09 hrs, Volume= 23,306 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs

Link POA-1: Existing Outfall

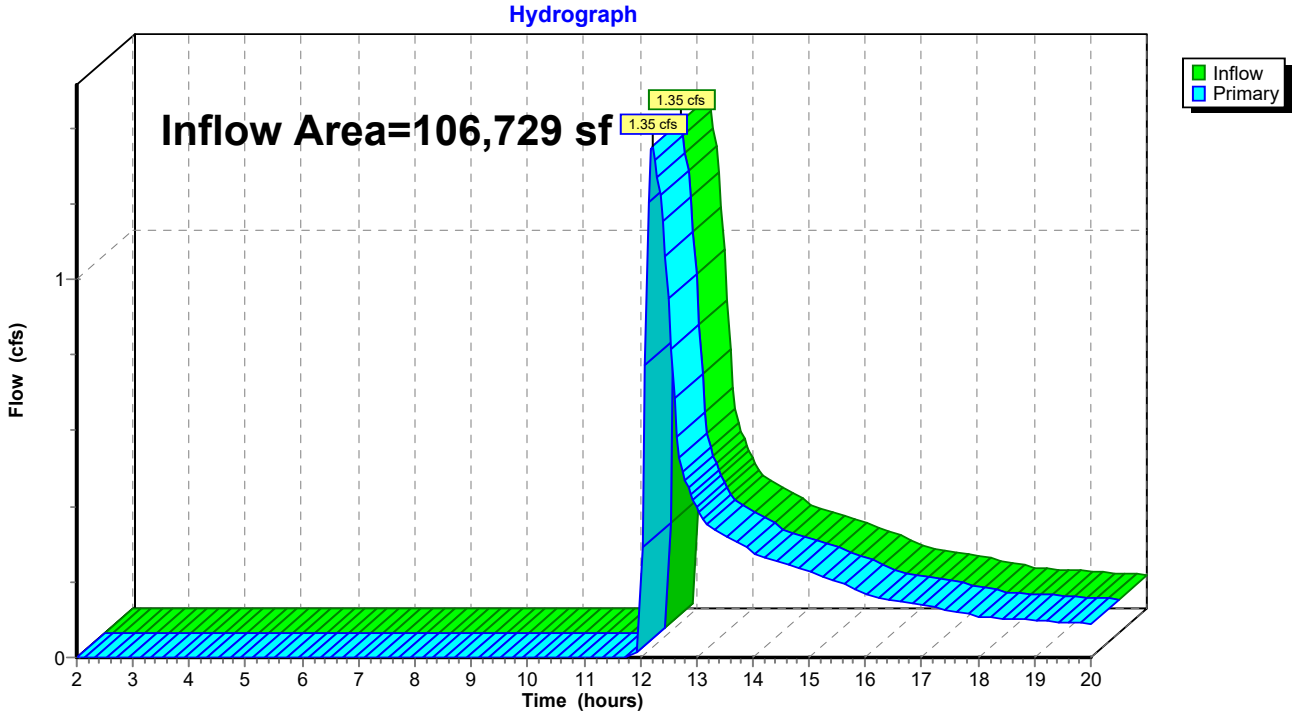


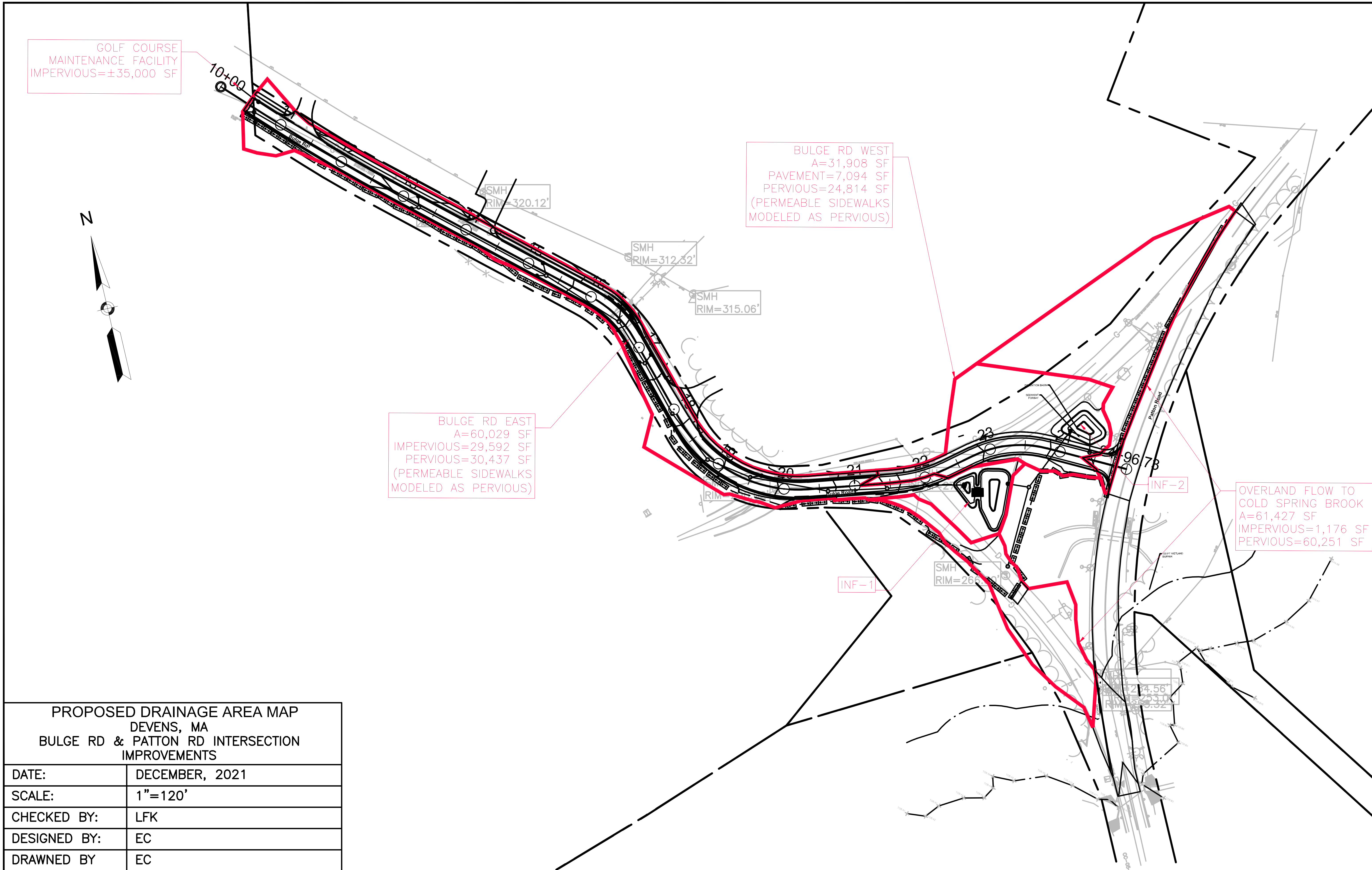
Summary for Link POA-2: Overland to Cold Spring Brook

Inflow Area = 106,729 sf, 0.00% Impervious, Inflow Depth > 0.82" for 100-Year event
Inflow = 1.35 cfs @ 12.22 hrs, Volume= 7,333 cf
Primary = 1.35 cfs @ 12.22 hrs, Volume= 7,333 cf, Atten= 0%, Lag= 0.0 min

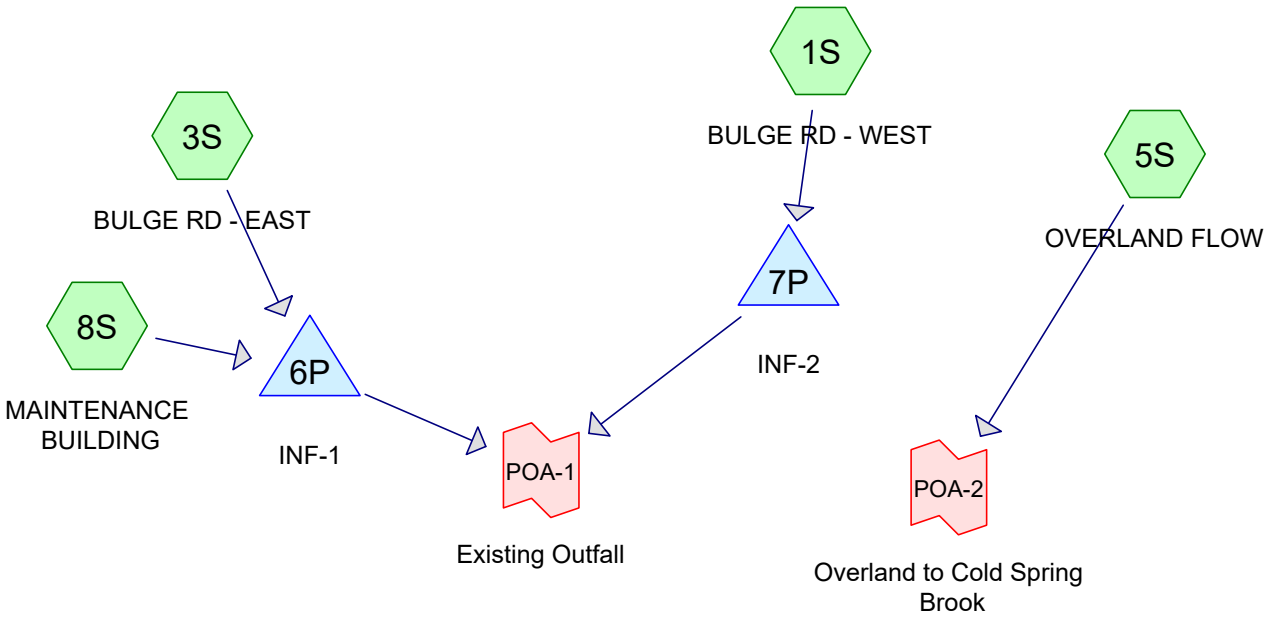
Primary outflow = Inflow, Time Span= 2.00-20.00 hrs, dt= 0.05 hrs

Link POA-2: Overland to Cold Spring Brook




GOLF COURSE
MAINTENANCE FACILITY
IMPERVIOUS=±35,000 SF
10+00
N
SMH
RIM=320.12'
SMH
RIM=312.32'
SMH
RIM=315.06'
BULGE RD WEST
A=31,908 SF
PAVEMENT=7,094 SF
PERVIOUS=24,814 SF
(PERMEABLE SIDEWALKS
MODELED AS PERVIOUS)
BULGE RD EAST
A=60,029 SF
IMPERVIOUS=29,592 SF
PERVIOUS=30,437 SF
(PERMEABLE SIDEWALKS
MODELED AS PERVIOUS)
20
21
22
23
Bulge Rd
Bulge Road
Patton Road
INF-1
INF-2
SMH
OVERLAND FLOW TO
COLD SPRING BROOK
A=61,427 SF
IMPERVIOUS=1,176 SF
PERVIOUS=60,251 SF

PROPOSED DRAINAGE AREA MAP DEVENS, MA BULGE RD & PATTON RD INTERSECTION IMPROVEMENTS	
DATE:	DECEMBER, 2021
SCALE:	1"=120'
CHECKED BY:	LFK
DESIGNED BY:	EC
DRAWNED BY	EC



Subcat Reach Pond Link

Routing Diagram for Proposed-v3
Prepared by Weston and Sampson, Printed 2/4/2022
HydroCAD® 10.10-6a s/n 02058 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.15	2
2	10-Year	Type III 24-hr		Default	24.00	1	4.83	2
3	25-Year	Type III 24-hr		Default	24.00	1	5.88	2
4	50-Year	Type III 24-hr		Default	24.00	1	6.65	2
5	100-Year	Type III 24-hr		Default	24.00	1	7.49	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
115,502	39	>75% Grass cover, Good, HSG A (1S, 3S, 5S)
35,000	98	Paved parking, HSG A (8S)
8,270	98	Paved roads w/curbs & sewers, HSG A (1S, 5S)
27,908	98	Paved roads, HSG A (3S)
1,684	98	Sidewalks by Developer, HSG A (3S)
188,364	**62**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
188,364	HSG A	1S, 3S, 5S, 8S
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
188,364		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
115,502	0	0	0	0	115,502	>75% Grass cover, Good
35,000	0	0	0	0	35,000	Paved parking
27,908	0	0	0	0	27,908	Paved roads
8,270	0	0	0	0	8,270	Paved roads w/curbs & sewers
1,684	0	0	0	0	1,684	Sidewalks by Developer
188,364	**0**	**0**	**0**	**0**	**188,364**	**TOTAL AREA**

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	6P	271.50	271.20	30.0	0.0100	0.013	0.0	12.0	0.0
2	7P	263.83	263.34	98.0	0.0050	0.013	0.0	12.0	0.0

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

Subcatchment1S: BULGE RD - WEST Runoff Area=31,908 sf 22.23% Impervious Runoff Depth>0.16"
Tc=6.0 min CN=52 Runoff=0.03 cfs 428 cf

Subcatchment3S: BULGE RD - EAST Runoff Area=60,029 sf 49.30% Impervious Runoff Depth>0.70"
Tc=6.0 min CN=68 Runoff=0.96 cfs 3,525 cf

Subcatchment5S: OVERLAND FLOW Runoff Area=61,427 sf 1.91% Impervious Runoff Depth>0.00"
Tc=10.0 min CN=40 Runoff=0.00 cfs 7 cf

Subcatchment8S: MAINTENANCE Runoff Area=35,000 sf 100.00% Impervious Runoff Depth>2.92"
Tc=6.0 min CN=98 Runoff=2.40 cfs 8,505 cf

Pond 6P: INF-1 Peak Elev=273.60' Storage=2,628 cf Inflow=3.34 cfs 12,029 cf
Discarded=0.31 cfs 9,018 cf Primary=1.74 cfs 3,000 cf Outflow=2.05 cfs 12,018 cf

Pond 7P: INF-2 Peak Elev=262.07' Storage=9 cf Inflow=0.03 cfs 428 cf
Discarded=0.03 cfs 427 cf Primary=0.00 cfs 0 cf Outflow=0.03 cfs 427 cf

Link POA-1: Existing Outfall Inflow=1.74 cfs 3,000 cf
Primary=1.74 cfs 3,000 cf

Link POA-2: Overland to Cold Spring Brook Inflow=0.00 cfs 7 cf
Primary=0.00 cfs 7 cf

Total Runoff Area = 188,364 sf Runoff Volume = 12,465 cf Average Runoff Depth = 0.79"
61.32% Pervious = 115,502 sf 38.68% Impervious = 72,862 sf

Summary for Subcatchment 1S: BULGE RD - WEST

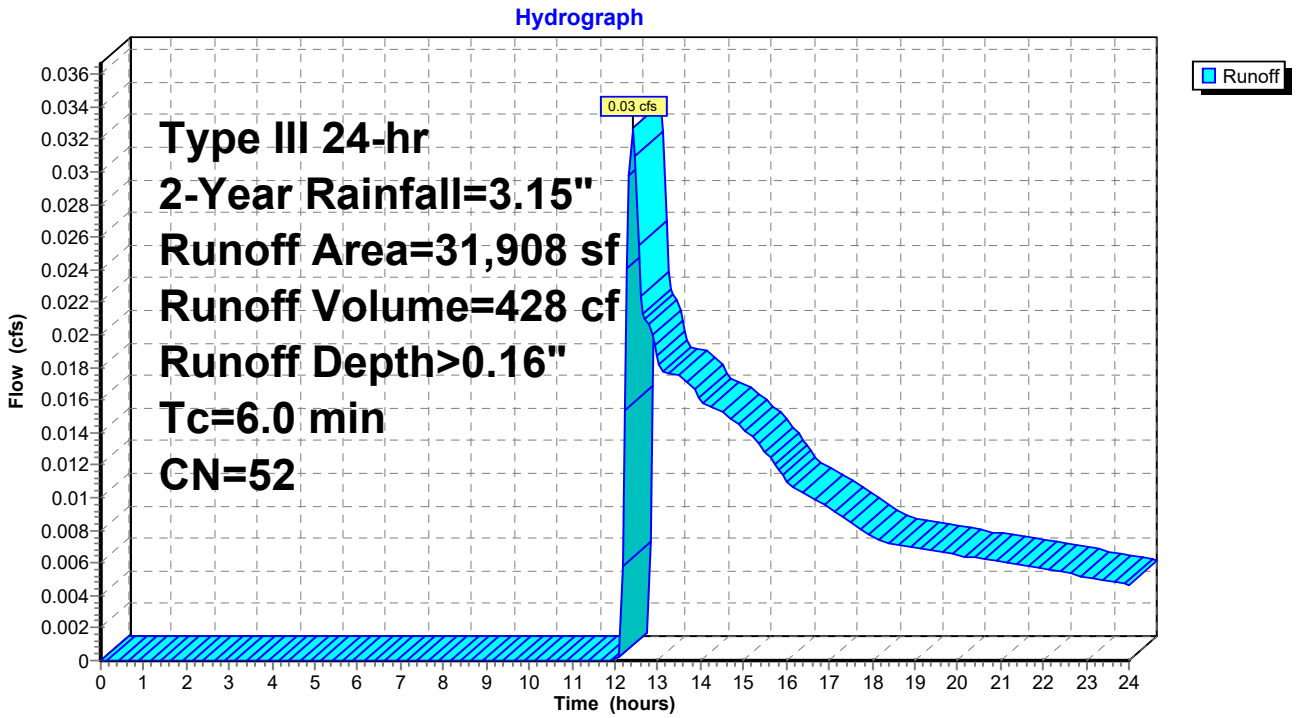
Runoff = 0.03 cfs @ 12.42 hrs, Volume= 428 cf, Depth> 0.16"
Routed to Pond 7P : INF-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
7,094	98	Paved roads w/curbs & sewers, HSG A
24,814	39	>75% Grass cover, Good, HSG A
31,908	52	Weighted Average
24,814		77.77% Pervious Area
7,094		22.23% Impervious Area

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

Subcatchment 1S: BULGE RD - WEST



Summary for Subcatchment 3S: BULGE RD - EAST

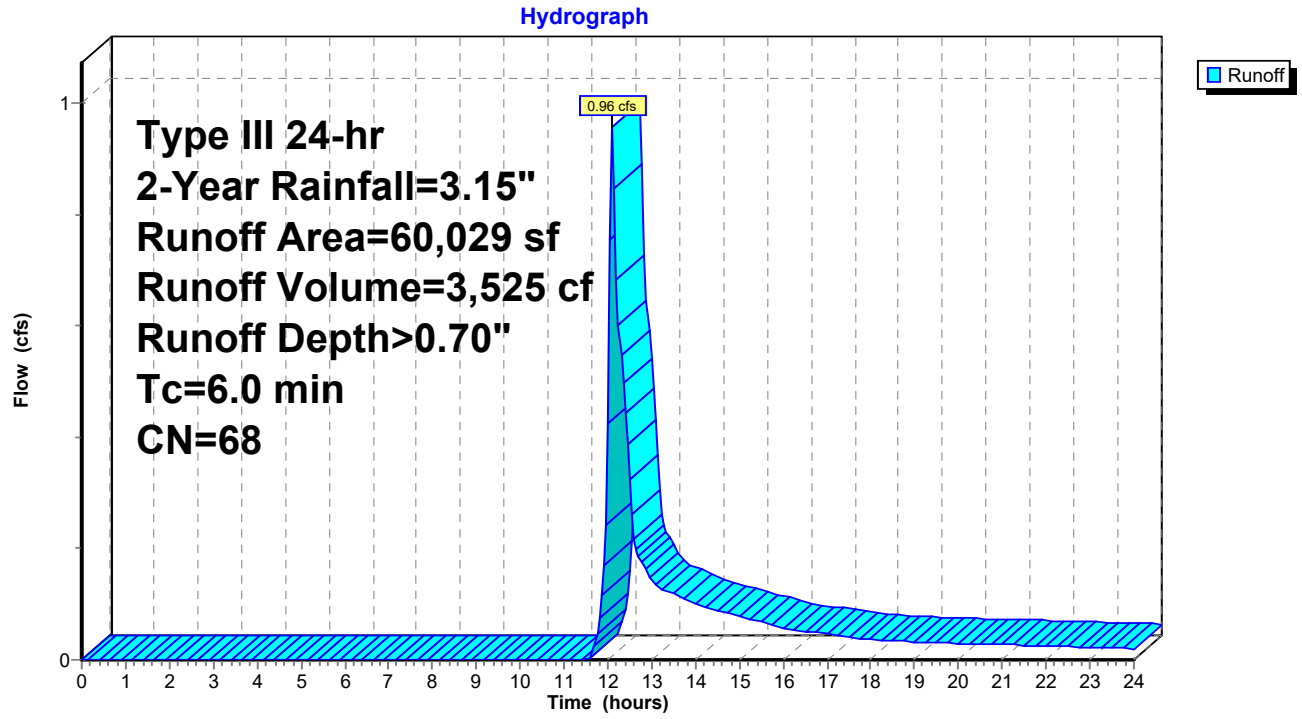
Runoff = 0.96 cfs @ 12.11 hrs, Volume= 3,525 cf, Depth> 0.70"
Routed to Pond 6P : INF-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

	Area (sf)	CN	Description
*	27,908	98	Paved roads, HSG A
	30,437	39	>75% Grass cover, Good, HSG A
*	1,684	98	Sidewalks by Developer, HSG A
	60,029	68	Weighted Average
	30,437		50.70% Pervious Area
	29,592		49.30% Impervious Area

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

Subcatchment 3S: BULGE RD - EAST



Summary for Subcatchment 5S: OVERLAND FLOW

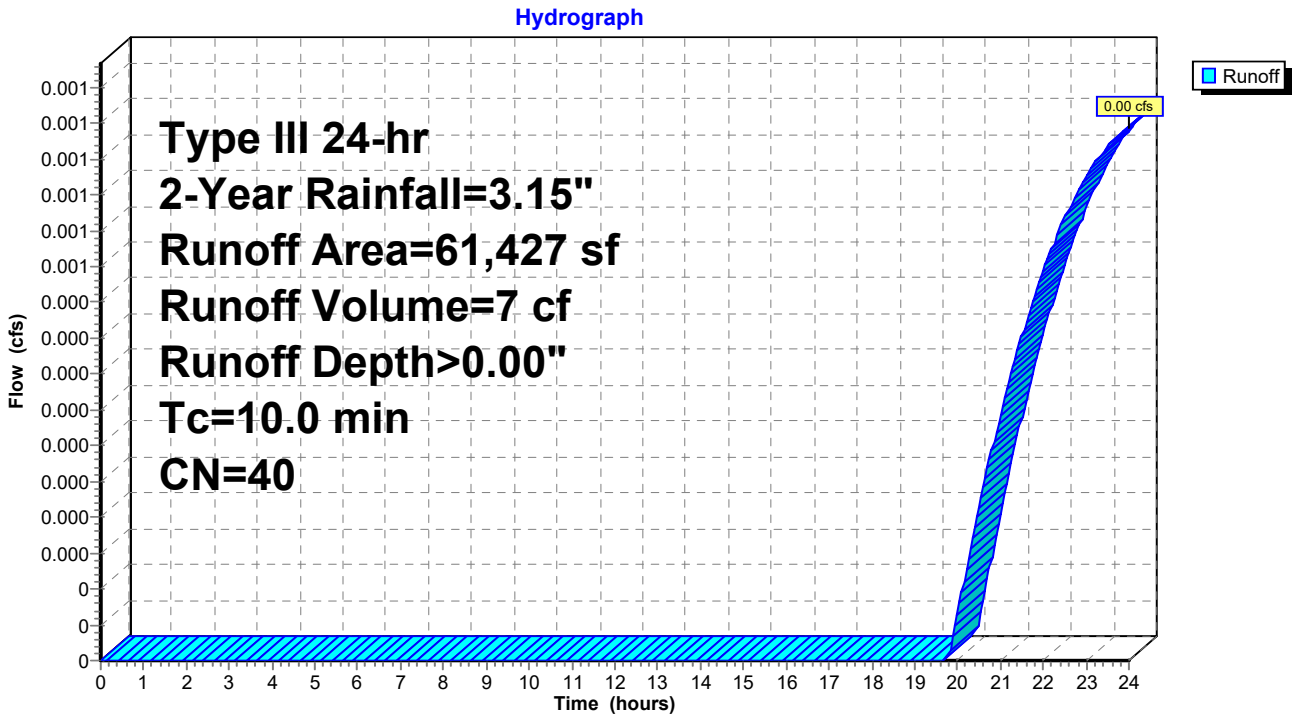
Runoff = 0.00 cfs @ 24.00 hrs, Volume= 7 cf, Depth> 0.00"
Routed to Link POA-2 : Overland to Cold Spring Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
1,176	98	Paved roads w/curbs & sewers, HSG A
60,251	39	>75% Grass cover, Good, HSG A
61,427	40	Weighted Average
60,251		98.09% Pervious Area
1,176		1.91% Impervious Area

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

Subcatchment 5S: OVERLAND FLOW



Summary for Subcatchment 8S: MAINTENANCE BUILDING

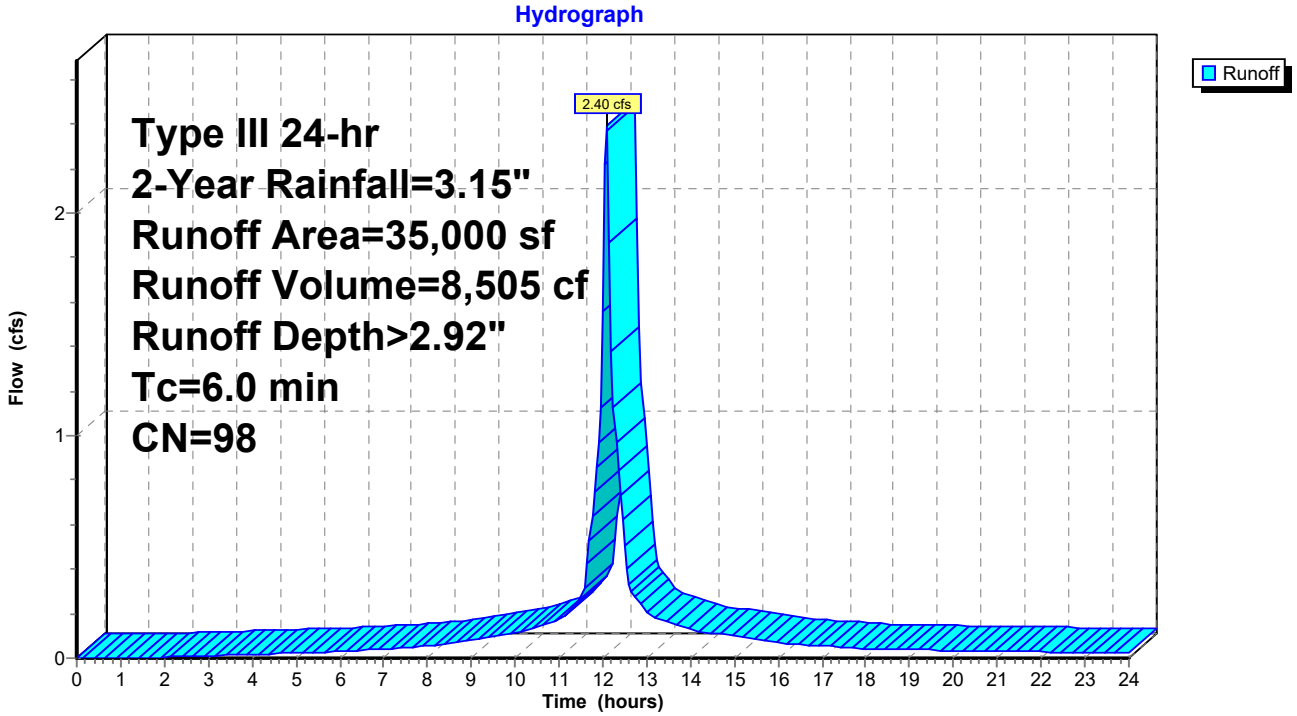
Runoff = 2.40 cfs @ 12.09 hrs, Volume= 8,505 cf, Depth> 2.92"
Routed to Pond 6P : INF-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
35,000	98	Paved parking, HSG A
35,000		100.00% Impervious Area

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

Subcatchment 8S: MAINTENANCE BUILDING



Summary for Pond 6P: INF-1

Inflow Area = 95,029 sf, 67.97% Impervious, Inflow Depth > 1.52" for 2-Year event
Inflow = 3.34 cfs @ 12.09 hrs, Volume= 12,029 cf
Outflow = 2.05 cfs @ 12.21 hrs, Volume= 12,018 cf, Atten= 39%, Lag= 7.3 min
Discarded = 0.31 cfs @ 12.21 hrs, Volume= 9,018 cf
Primary = 1.74 cfs @ 12.21 hrs, Volume= 3,000 cf
Routed to Link POA-1 : Existing Outfall

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 273.60' @ 12.21 hrs Surf.Area= 1,612 sf Storage= 2,628 cf

Plug-Flow detention time= 54.6 min calculated for 11,993 cf (100% of inflow)
Center-of-Mass det. time= 53.9 min (847.6 - 793.6)

Volume	Invert	Avail.Storage	Storage Description
#1	271.00'	8,023 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

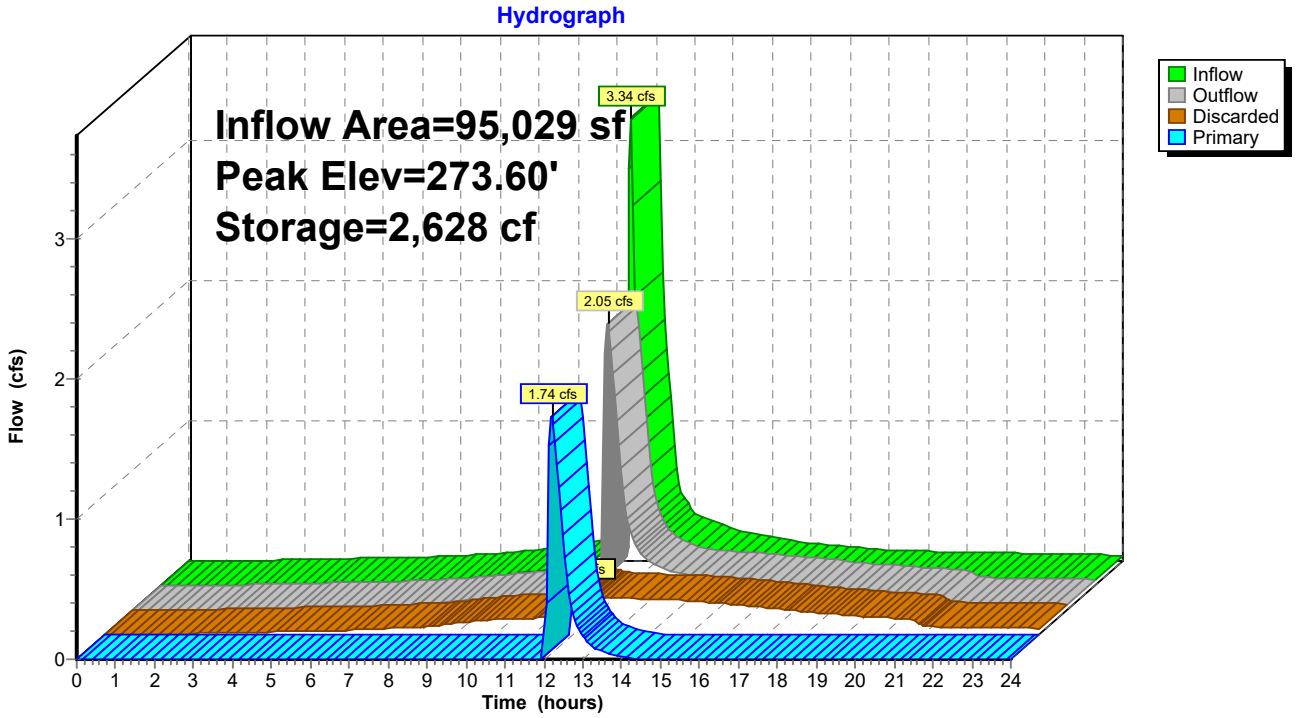
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
271.00	543	0	0	543
272.00	846	689	689	860
273.00	1,307	1,068	1,757	1,335
274.00	1,836	1,564	3,321	1,882
275.00	2,423	2,123	5,444	2,492
276.00	2,738	2,579	8,023	2,854

Device	Routing	Invert	Outlet Devices
#1	Primary	271.50'	**12.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 271.50' / 271.20' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Discarded	271.00'	**8.270 in/hr Exfiltration over Surface area**
#3	Device 1	273.00'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	275.00'	**30.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	275.85'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.31 cfs @ 12.21 hrs HW=273.59' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.31 cfs)

Primary OutFlow Max=1.71 cfs @ 12.21 hrs HW=273.59' (Free Discharge)
└**1=Culvert** (Passes 1.71 cfs of 3.77 cfs potential flow)
  └**3=Orifice/Grate** (Orifice Controls 1.71 cfs @ 2.62 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)
└**5=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 6P: INF-1



Summary for Pond 7P: INF-2

Inflow Area = 31,908 sf, 22.23% Impervious, Inflow Depth > 0.16" for 2-Year event
Inflow = 0.03 cfs @ 12.42 hrs, Volume= 428 cf
Outflow = 0.03 cfs @ 12.54 hrs, Volume= 427 cf, Atten= 20%, Lag= 7.3 min
Discarded = 0.03 cfs @ 12.54 hrs, Volume= 427 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link POA-1 : Existing Outfall

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 262.07' @ 12.54 hrs Surf.Area= 136 sf Storage= 9 cf

Plug-Flow detention time= 4.3 min calculated for 426 cf (100% of inflow)
Center-of-Mass det. time= 3.1 min (991.2 - 988.1)

Volume	Invert	Avail.Storage	Storage Description
#1	262.00'	4,289 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

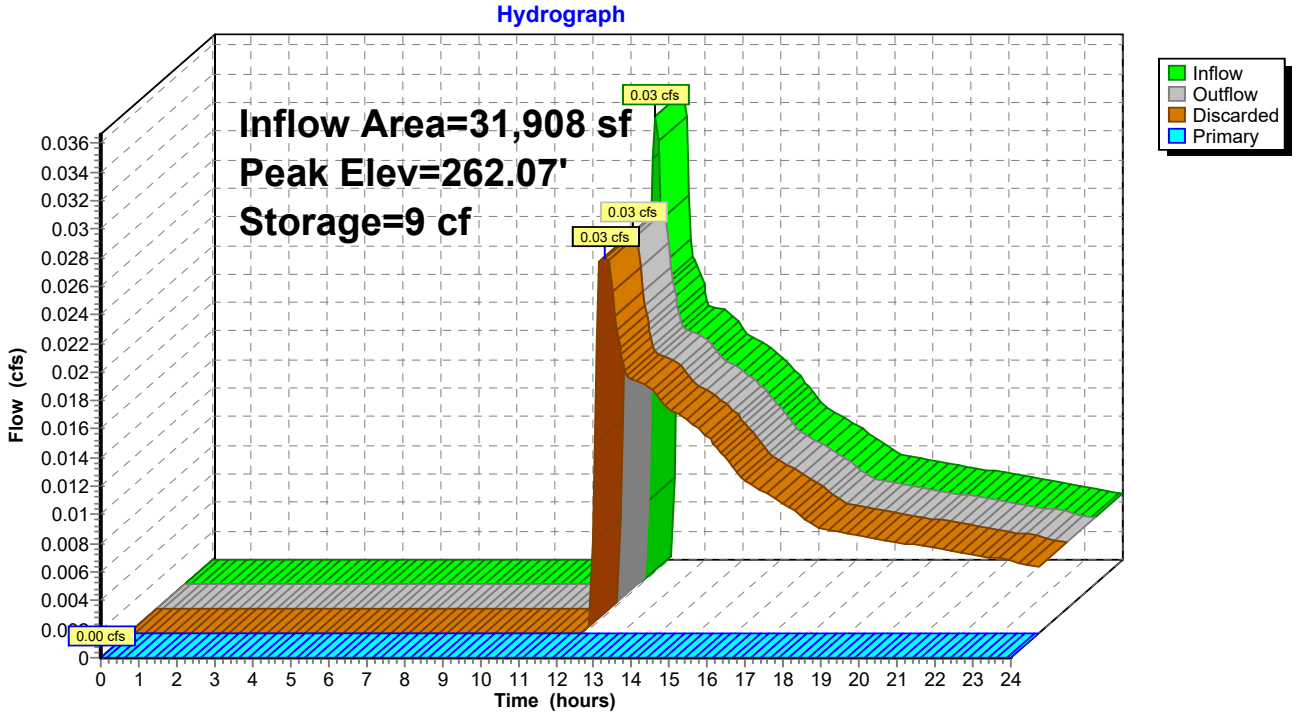
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
262.00	131	0	0	131
262.50	174	76	76	179
263.00	565	175	251	572
264.00	588	576	828	660
265.00	935	755	1,583	1,020
266.00	1,345	1,134	2,717	1,447
267.00	1,812	1,573	4,289	1,935

Device	Routing	Invert	Outlet Devices
#1	Discarded	262.00'	**8.270 in/hr Exfiltration over Wetted area**
#2	Device 3	265.20'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	263.83'	**12.0" Round Culvert** L= 98.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 263.83' / 263.34' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 12.54 hrs HW=262.07' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=262.00' (Free Discharge)
└**3=Culvert** (Controls 0.00 cfs)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 7P: INF-2

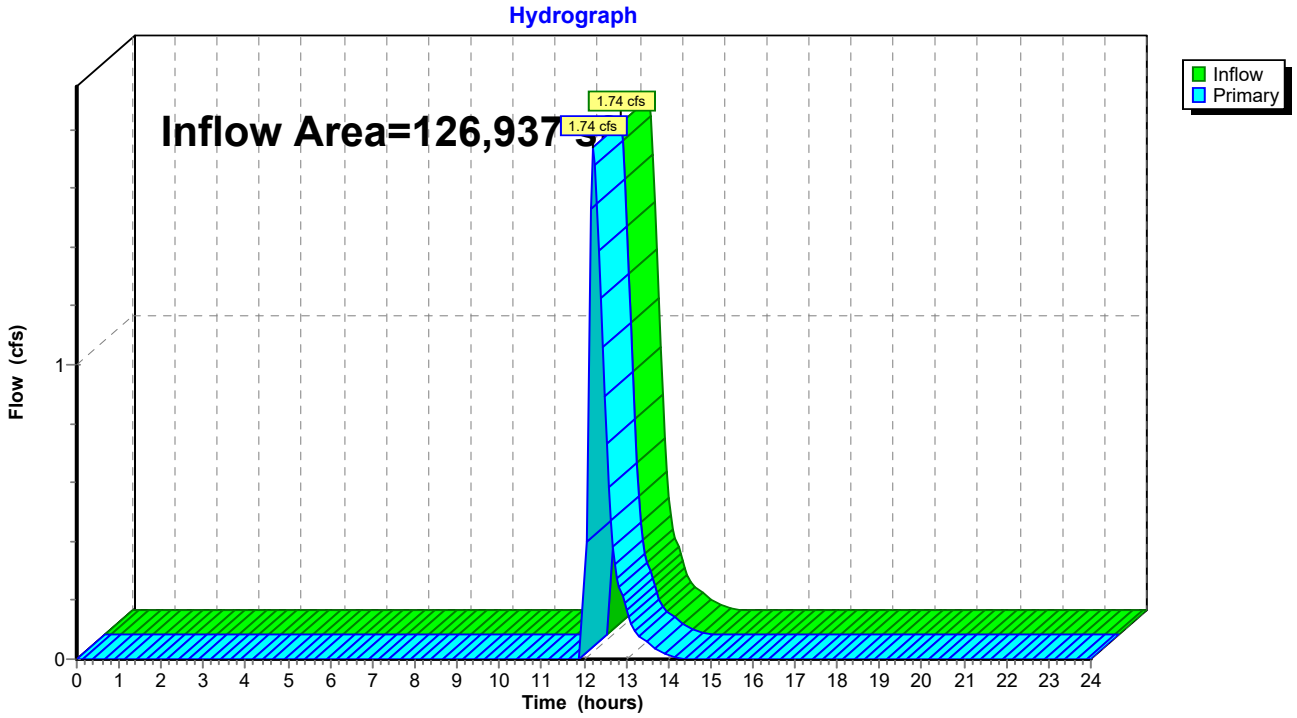

Hydrograph
Inflow Area=31,908 sf
Peak Elev=262.07'
Storage=9 cf
0.03 cfs
0.03 cfs
0.03 cfs
0.00 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0.036
0.034
0.032
0.03
0.028
0.026
0.024
0.022
0.02
0.018
0.016
0.014
0.012
0.01
0.008
0.006
0.004
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time (hours)

Summary for Link POA-1: Existing Outfall

Inflow Area = 126,937 sf, 56.47% Impervious, Inflow Depth = 0.28" for 2-Year event
Inflow = 1.74 cfs @ 12.21 hrs, Volume= 3,000 cf
Primary = 1.74 cfs @ 12.21 hrs, Volume= 3,000 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node Total

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-1: Existing Outfall

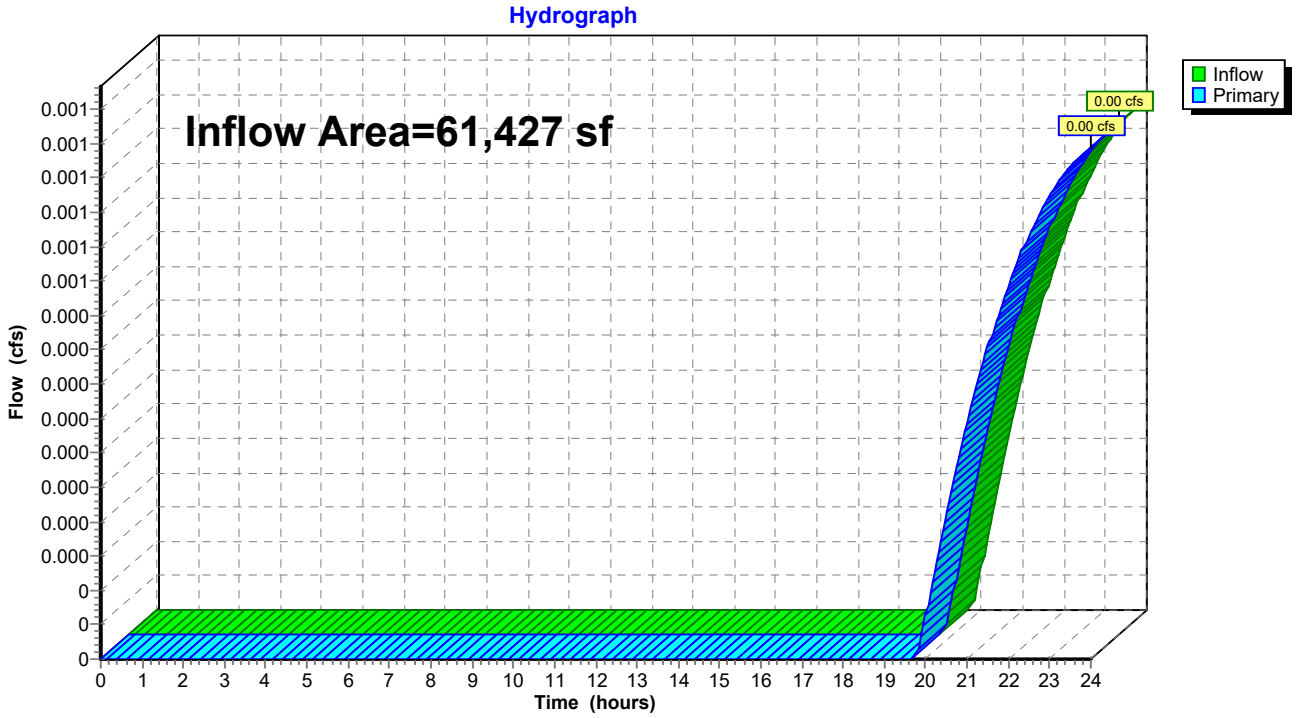


Summary for Link POA-2: Overland to Cold Spring Brook

Inflow Area = 61,427 sf, 1.91% Impervious, Inflow Depth > 0.00" for 2-Year event
Inflow = 0.00 cfs @ 24.00 hrs, Volume= 7 cf
Primary = 0.00 cfs @ 24.00 hrs, Volume= 7 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node Total

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-2: Overland to Cold Spring Brook



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

Subcatchment1S: BULGE RD - WEST Runoff Area=31,908 sf 22.23% Impervious Runoff Depth>0.73"
Tc=6.0 min CN=52 Runoff=0.42 cfs 1,935 cf

Subcatchment3S: BULGE RD - EAST Runoff Area=60,029 sf 49.30% Impervious Runoff Depth>1.76"
Tc=6.0 min CN=68 Runoff=2.70 cfs 8,792 cf

Subcatchment5S: OVERLAND FLOW Runoff Area=61,427 sf 1.91% Impervious Runoff Depth>0.20"
Tc=10.0 min CN=40 Runoff=0.05 cfs 1,013 cf

Subcatchment8S: MAINTENANCE Runoff Area=35,000 sf 100.00% Impervious Runoff Depth>4.59"
Tc=6.0 min CN=98 Runoff=3.71 cfs 13,389 cf

Pond 6P: INF-1 Peak Elev=274.43' Storage=4,160 cf Inflow=6.40 cfs 22,182 cf
Discarded=0.40 cfs 12,273 cf Primary=3.52 cfs 9,796 cf Outflow=3.92 cfs 22,069 cf

Pond 7P: INF-2 Peak Elev=263.24' Storage=389 cf Inflow=0.42 cfs 1,935 cf
Discarded=0.11 cfs 1,932 cf Primary=0.00 cfs 0 cf Outflow=0.11 cfs 1,932 cf

Link POA-1: Existing Outfall Inflow=3.52 cfs 9,796 cf
Primary=3.52 cfs 9,796 cf

Link POA-2: Overland to Cold Spring Brook Inflow=0.05 cfs 1,013 cf
Primary=0.05 cfs 1,013 cf

Total Runoff Area = 188,364 sf Runoff Volume = 25,130 cf Average Runoff Depth = 1.60"
61.32% Pervious = 115,502 sf 38.68% Impervious = 72,862 sf

Summary for Subcatchment 1S: BULGE RD - WEST

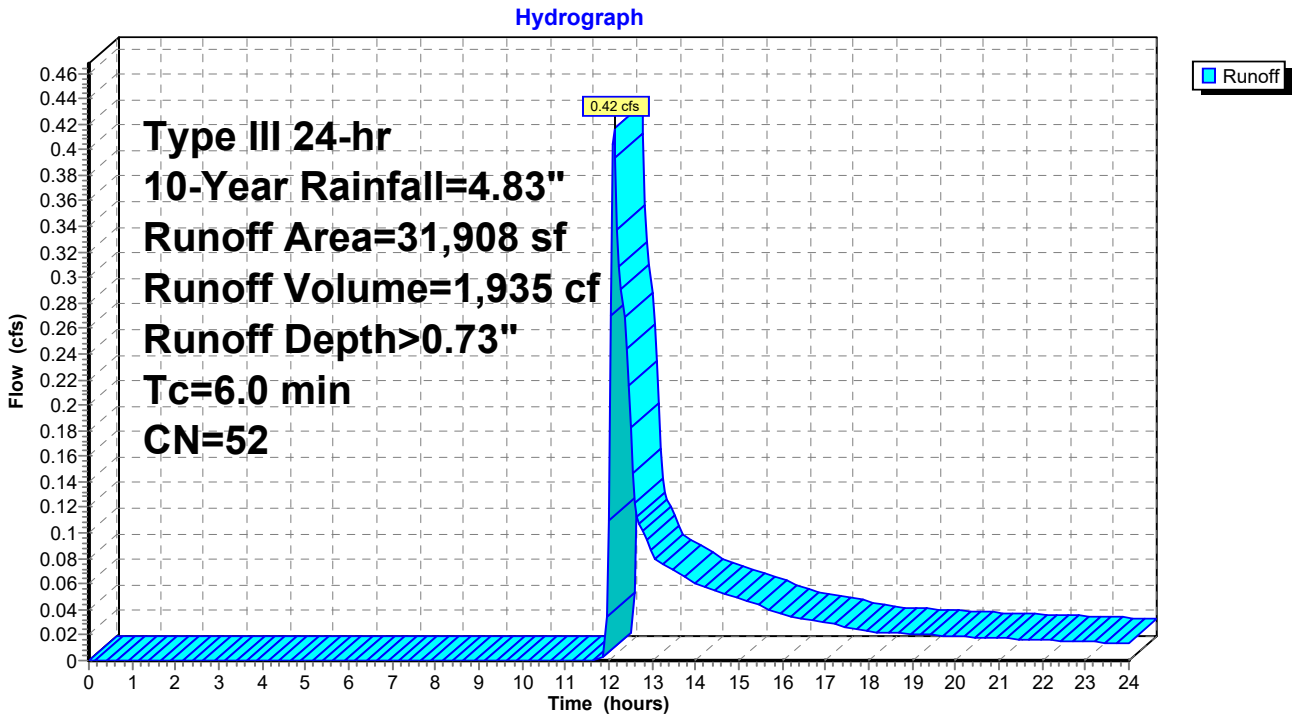
Runoff = 0.42 cfs @ 12.12 hrs, Volume= 1,935 cf, Depth> 0.73"
Routed to Pond 7P : INF-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
7,094	98	Paved roads w/curbs & sewers, HSG A
24,814	39	>75% Grass cover, Good, HSG A
31,908	52	Weighted Average
24,814		77.77% Pervious Area
7,094		22.23% Impervious Area

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

Subcatchment 1S: BULGE RD - WEST



Summary for Subcatchment 3S: BULGE RD - EAST

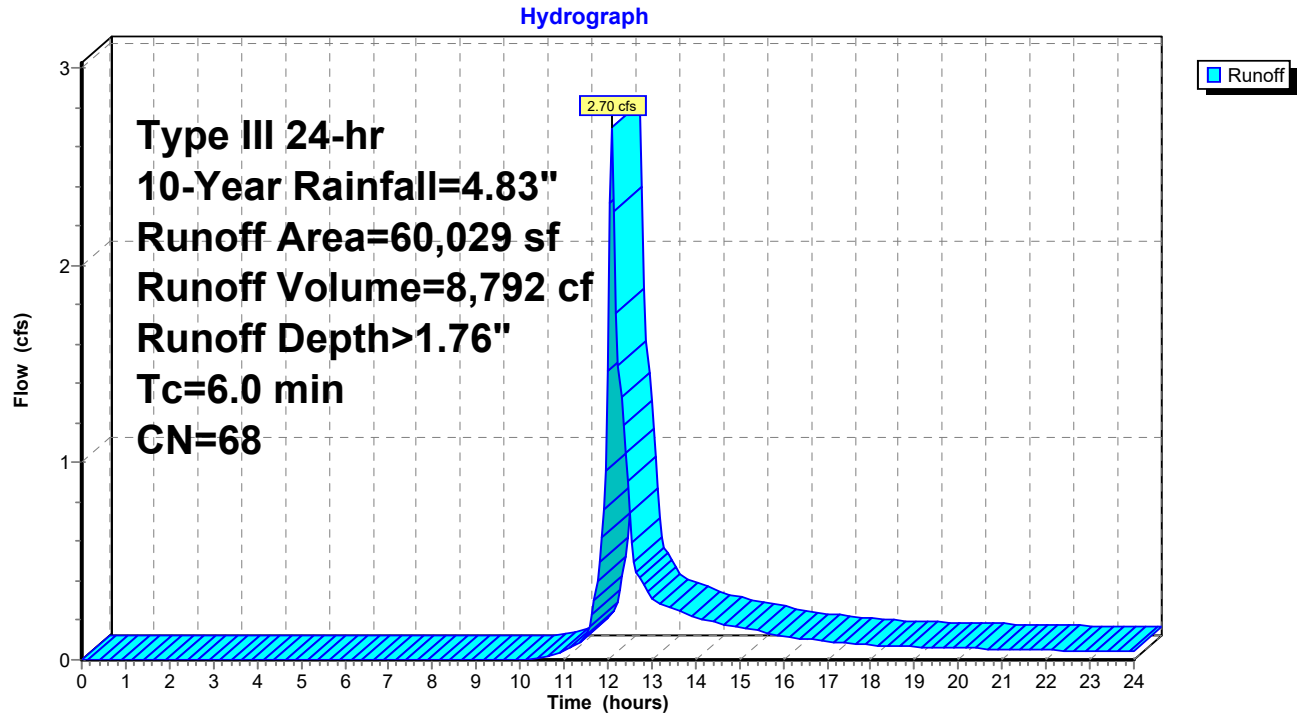
Runoff = 2.70 cfs @ 12.10 hrs, Volume= 8,792 cf, Depth> 1.76"
Routed to Pond 6P : INF-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.83"

	Area (sf)	CN	Description
*	27,908	98	Paved roads, HSG A
	30,437	39	>75% Grass cover, Good, HSG A
*	1,684	98	Sidewalks by Developer, HSG A
	60,029	68	Weighted Average
	30,437		50.70% Pervious Area
	29,592		49.30% Impervious Area

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

Subcatchment 3S: BULGE RD - EAST



Summary for Subcatchment 5S: OVERLAND FLOW

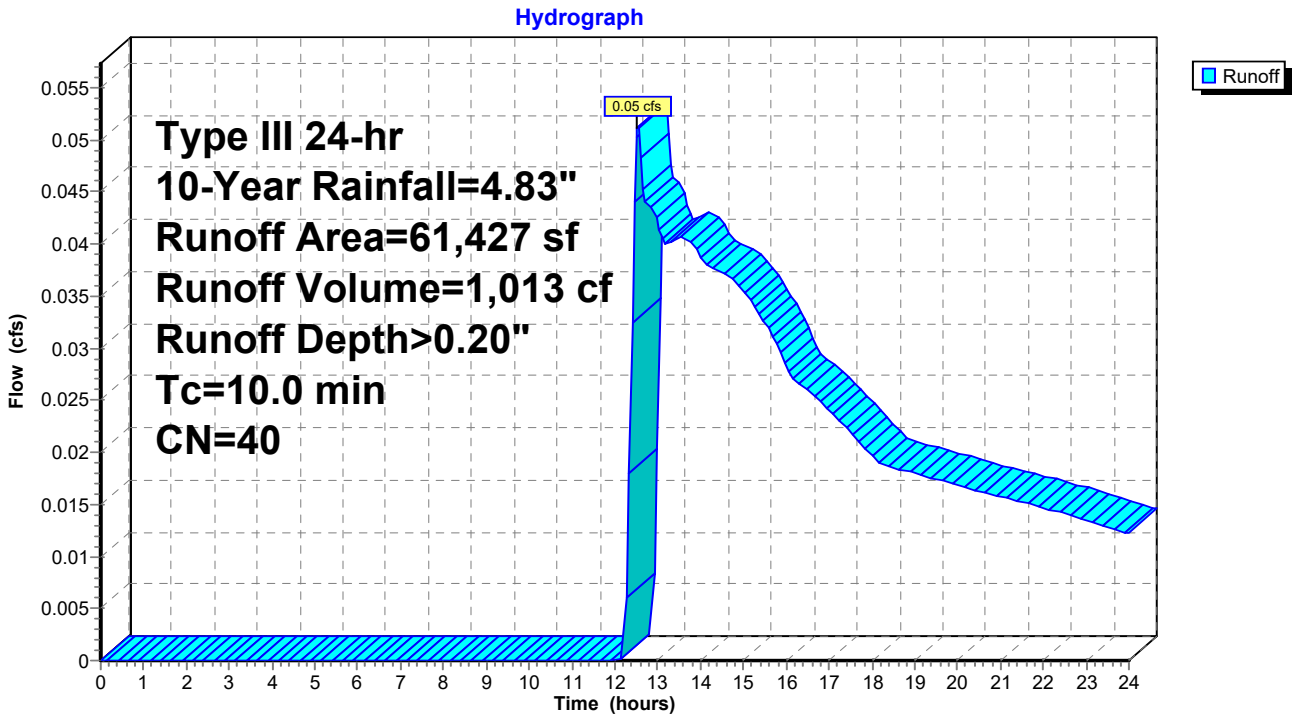
Runoff = 0.05 cfs @ 12.54 hrs, Volume= 1,013 cf, Depth> 0.20"
Routed to Link POA-2 : Overland to Cold Spring Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
1,176	98	Paved roads w/curbs & sewers, HSG A
60,251	39	>75% Grass cover, Good, HSG A
61,427	40	Weighted Average
60,251		98.09% Pervious Area
1,176		1.91% Impervious Area

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

Subcatchment 5S: OVERLAND FLOW



Summary for Subcatchment 8S: MAINTENANCE BUILDING

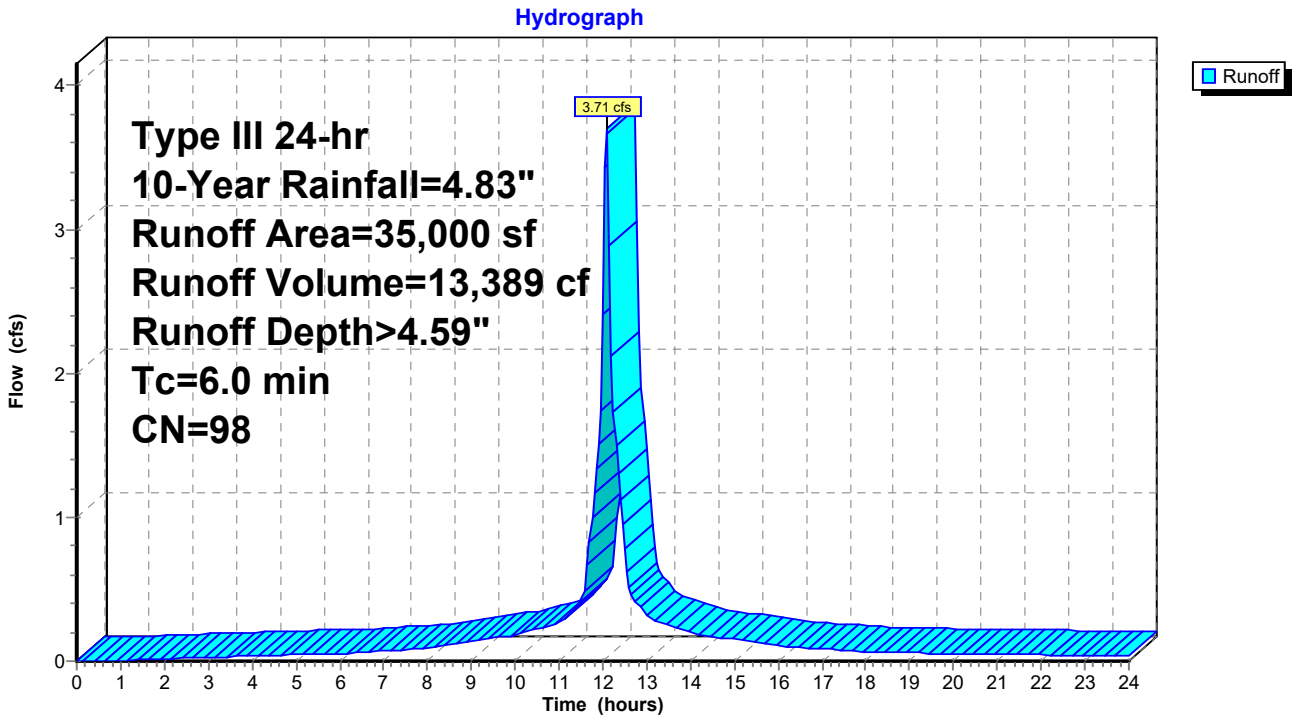
Runoff = 3.71 cfs @ 12.09 hrs, Volume= 13,389 cf, Depth> 4.59"
Routed to Pond 6P : INF-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.83"

Area (sf)	CN	Description
35,000	98	Paved parking, HSG A
35,000		100.00% Impervious Area

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

Subcatchment 8S: MAINTENANCE BUILDING



Summary for Pond 6P: INF-1

Inflow Area = 95,029 sf, 67.97% Impervious, Inflow Depth > 2.80" for 10-Year event
Inflow = 6.40 cfs @ 12.09 hrs, Volume= 22,182 cf
Outflow = 3.92 cfs @ 12.21 hrs, Volume= 22,069 cf, Atten= 39%, Lag= 7.0 min
Discarded = 0.40 cfs @ 12.21 hrs, Volume= 12,273 cf
Primary = 3.52 cfs @ 12.21 hrs, Volume= 9,796 cf
Routed to Link POA-1 : Existing Outfall

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 274.43' @ 12.21 hrs Surf.Area= 2,078 sf Storage= 4,160 cf

Plug-Flow detention time= 48.6 min calculated for 22,069 cf (99% of inflow)
Center-of-Mass det. time= 45.3 min (835.5 - 790.2)

Volume	Invert	Avail.Storage	Storage Description
#1	271.00'	8,023 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

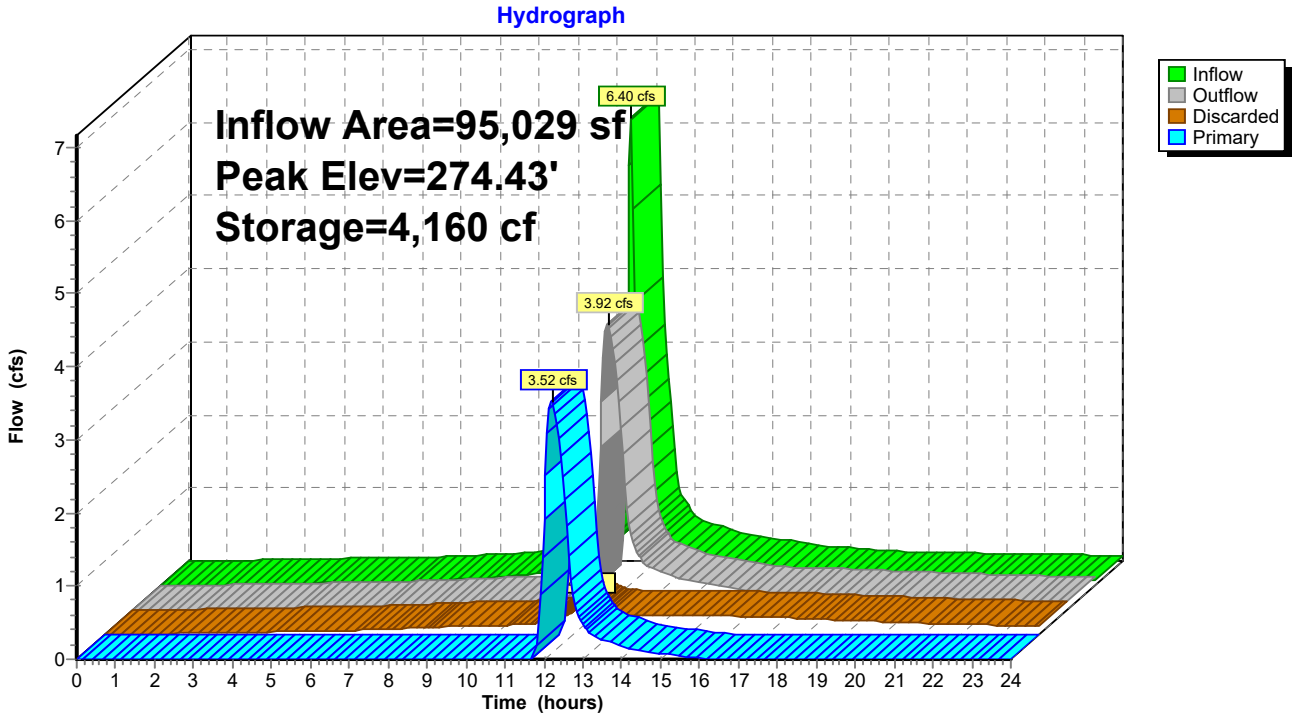
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
271.00	543	0	0	543
272.00	846	689	689	860
273.00	1,307	1,068	1,757	1,335
274.00	1,836	1,564	3,321	1,882
275.00	2,423	2,123	5,444	2,492
276.00	2,738	2,579	8,023	2,854

Device	Routing	Invert	Outlet Devices
#1	Primary	271.50'	**12.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 271.50' / 271.20' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Discarded	271.00'	**8.270 in/hr Exfiltration over Surface area**
#3	Device 1	273.00'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	275.00'	**30.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	275.85'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.40 cfs @ 12.21 hrs HW=274.42' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.40 cfs)

Primary OutFlow Max=3.51 cfs @ 12.21 hrs HW=274.42' (Free Discharge)
└**1=Culvert** (Passes 3.51 cfs of 4.65 cfs potential flow)
  └**3=Orifice/Grate** (Orifice Controls 3.51 cfs @ 5.03 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)
└**5=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 6P: INF-1



Summary for Pond 7P: INF-2

Inflow Area = 31,908 sf, 22.23% Impervious, Inflow Depth > 0.73" for 10-Year event
Inflow = 0.42 cfs @ 12.12 hrs, Volume= 1,935 cf
Outflow = 0.11 cfs @ 12.65 hrs, Volume= 1,932 cf, Atten= 73%, Lag= 31.9 min
Discarded = 0.11 cfs @ 12.65 hrs, Volume= 1,932 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link POA-1 : Existing Outfall

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 263.24' @ 12.65 hrs Surf.Area= 571 sf Storage= 389 cf

Plug-Flow detention time= 34.2 min calculated for 1,928 cf (100% of inflow)
Center-of-Mass det. time= 33.2 min (941.6 - 908.4)

Volume	Invert	Avail.Storage	Storage Description
#1	262.00'	4,289 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

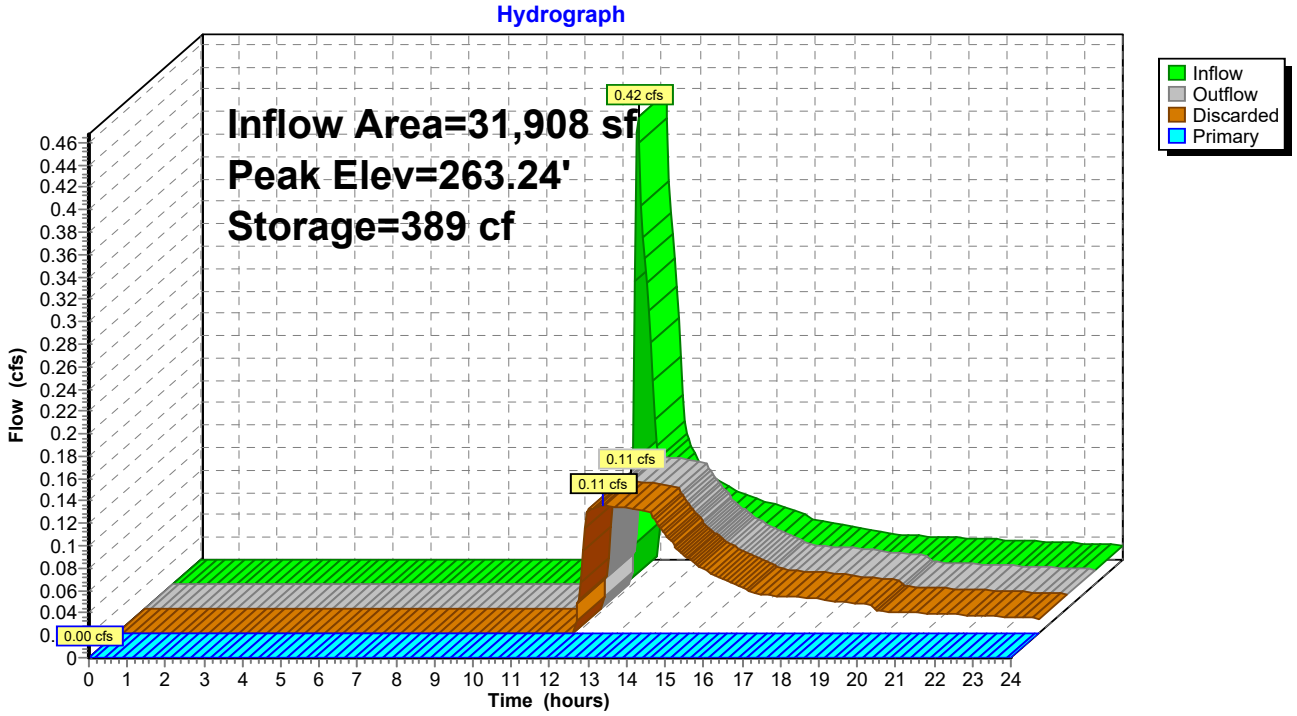
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
262.00	131	0	0	131
262.50	174	76	76	179
263.00	565	175	251	572
264.00	588	576	828	660
265.00	935	755	1,583	1,020
266.00	1,345	1,134	2,717	1,447
267.00	1,812	1,573	4,289	1,935

Device	Routing	Invert	Outlet Devices
#1	Discarded	262.00'	**8.270 in/hr Exfiltration over Wetted area**
#2	Device 3	265.20'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	263.83'	**12.0" Round Culvert** L= 98.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 263.83' / 263.34' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Discarded OutFlow Max=0.11 cfs @ 12.65 hrs HW=263.24' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=262.00' (Free Discharge)
└**3=Culvert** (Controls 0.00 cfs)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 7P: INF-2

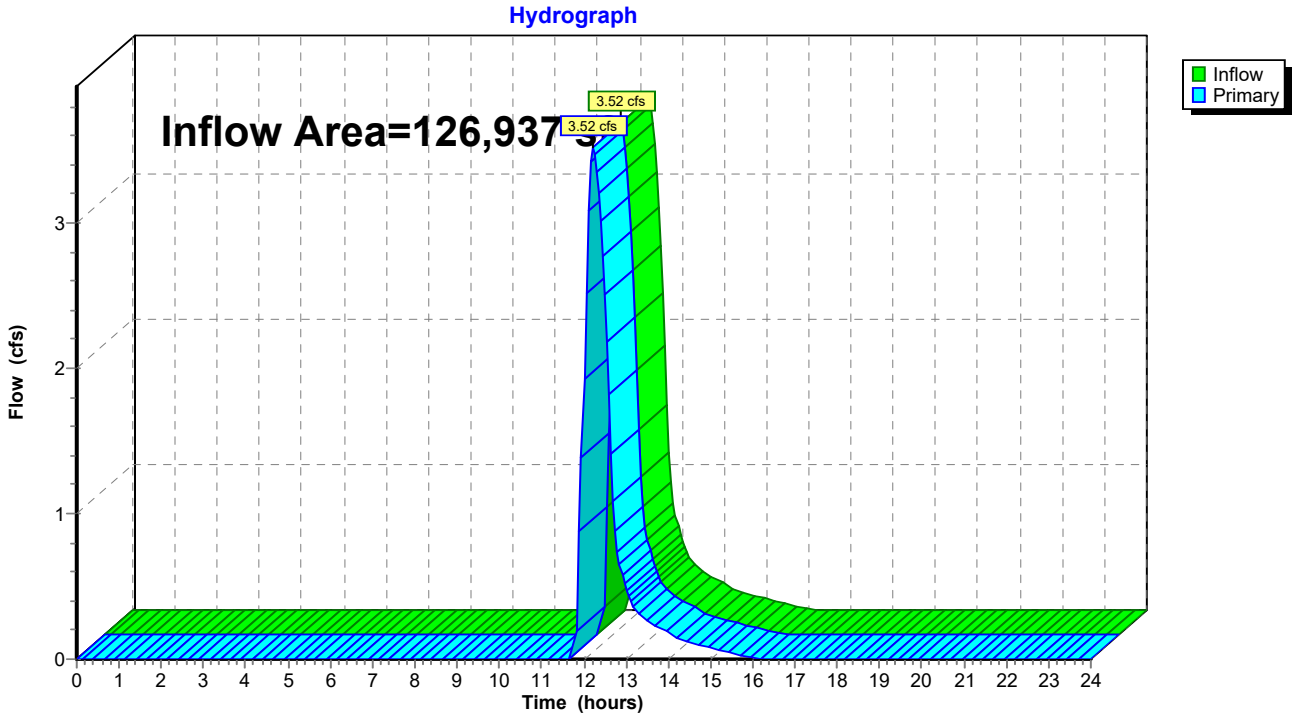

Hydrograph
Inflow Area=31,908 sf
Peak Elev=263.24'
Storage=389 cf
0.42 cfs
0.11 cfs
0.11 cfs
0.00 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)

Summary for Link POA-1: Existing Outfall

Inflow Area = 126,937 sf, 56.47% Impervious, Inflow Depth = 0.93" for 10-Year event
Inflow = 3.52 cfs @ 12.21 hrs, Volume= 9,796 cf
Primary = 3.52 cfs @ 12.21 hrs, Volume= 9,796 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node Total

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-1: Existing Outfall

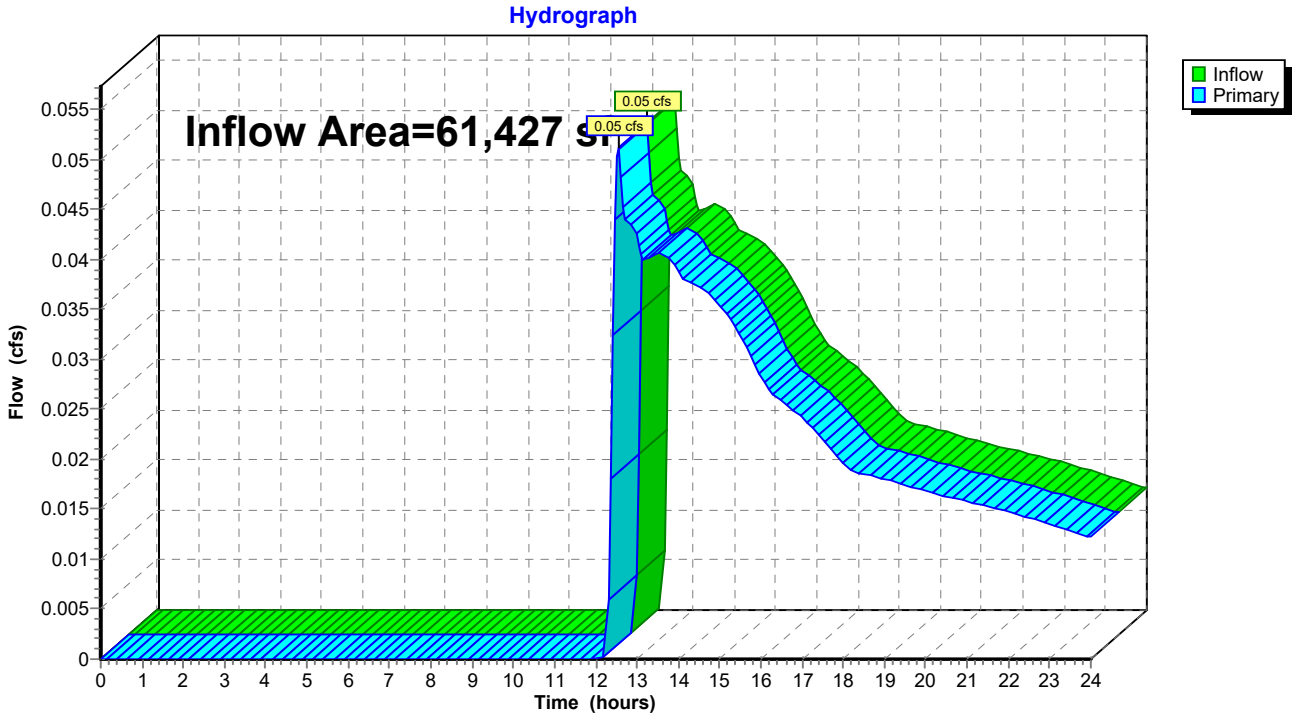


Summary for Link POA-2: Overland to Cold Spring Brook

Inflow Area = 61,427 sf, 1.91% Impervious, Inflow Depth > 0.20" for 10-Year event
Inflow = 0.05 cfs @ 12.54 hrs, Volume= 1,013 cf
Primary = 0.05 cfs @ 12.54 hrs, Volume= 1,013 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node Total

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-2: Overland to Cold Spring Brook



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

Subcatchment1S: BULGE RD - WEST Runoff Area=31,908 sf 22.23% Impervious Runoff Depth>1.22"
Tc=6.0 min CN=52 Runoff=0.86 cfs 3,257 cf

Subcatchment3S: BULGE RD - EAST Runoff Area=60,029 sf 49.30% Impervious Runoff Depth>2.53"
Tc=6.0 min CN=68 Runoff=3.96 cfs 12,638 cf

Subcatchment5S: OVERLAND FLOW Runoff Area=61,427 sf 1.91% Impervious Runoff Depth>0.46"
Tc=10.0 min CN=40 Runoff=0.26 cfs 2,365 cf

Subcatchment8S: MAINTENANCE Runoff Area=35,000 sf 100.00% Impervious Runoff Depth>5.64"
Tc=6.0 min CN=98 Runoff=4.52 cfs 16,446 cf

Pond 6P: INF-1 Peak Elev=274.96' Storage=5,349 cf Inflow=8.47 cfs 29,084 cf
Discarded=0.46 cfs 13,763 cf Primary=4.29 cfs 14,903 cf Outflow=4.75 cfs 28,666 cf

Pond 7P: INF-2 Peak Elev=264.21' Storage=960 cf Inflow=0.86 cfs 3,257 cf
Discarded=0.14 cfs 3,252 cf Primary=0.00 cfs 0 cf Outflow=0.14 cfs 3,252 cf

Link POA-1: Existing Outfall Inflow=4.29 cfs 14,903 cf
Primary=4.29 cfs 14,903 cf

Link POA-2: Overland to Cold Spring Brook Inflow=0.26 cfs 2,365 cf
Primary=0.26 cfs 2,365 cf

Total Runoff Area = 188,364 sf Runoff Volume = 34,706 cf Average Runoff Depth = 2.21"
61.32% Pervious = 115,502 sf 38.68% Impervious = 72,862 sf

Summary for Subcatchment 1S: BULGE RD - WEST

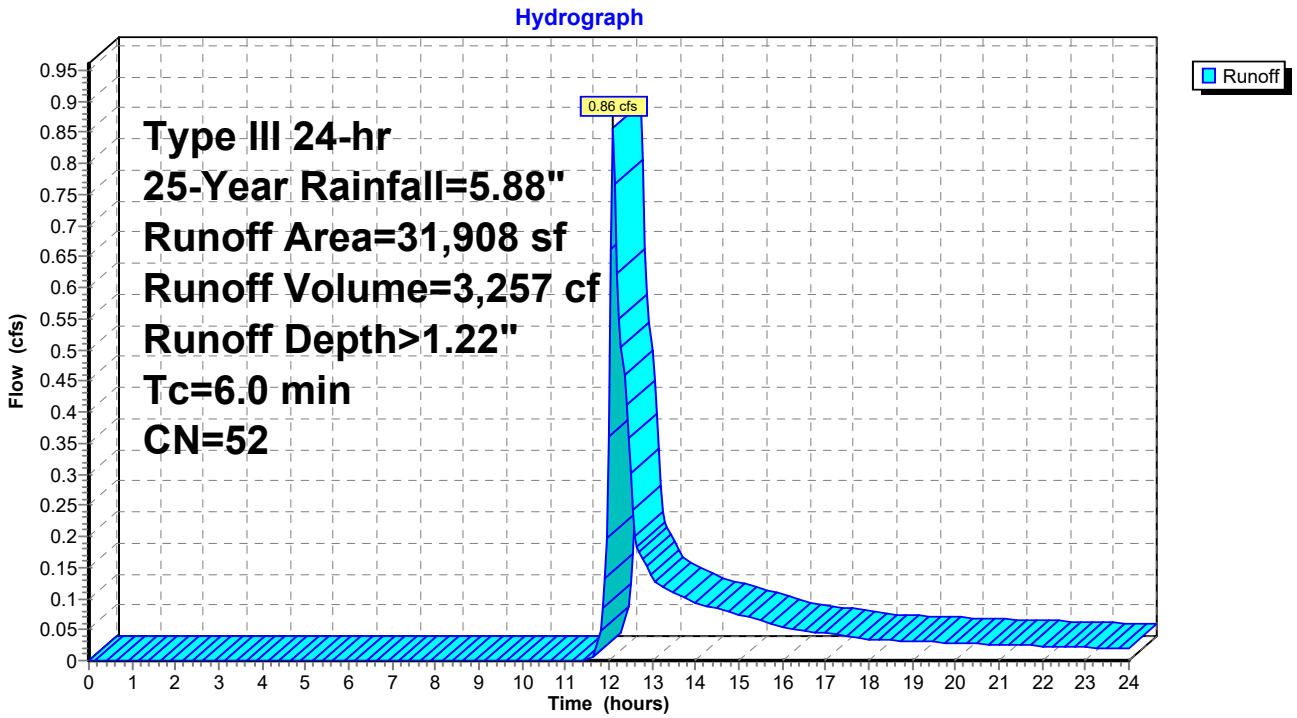
Runoff = 0.86 cfs @ 12.11 hrs, Volume= 3,257 cf, Depth> 1.22"
Routed to Pond 7P : INF-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.88"

Area (sf)	CN	Description
7,094	98	Paved roads w/curbs & sewers, HSG A
24,814	39	>75% Grass cover, Good, HSG A
31,908	52	Weighted Average
24,814		77.77% Pervious Area
7,094		22.23% Impervious Area

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

Subcatchment 1S: BULGE RD - WEST



Summary for Subcatchment 3S: BULGE RD - EAST

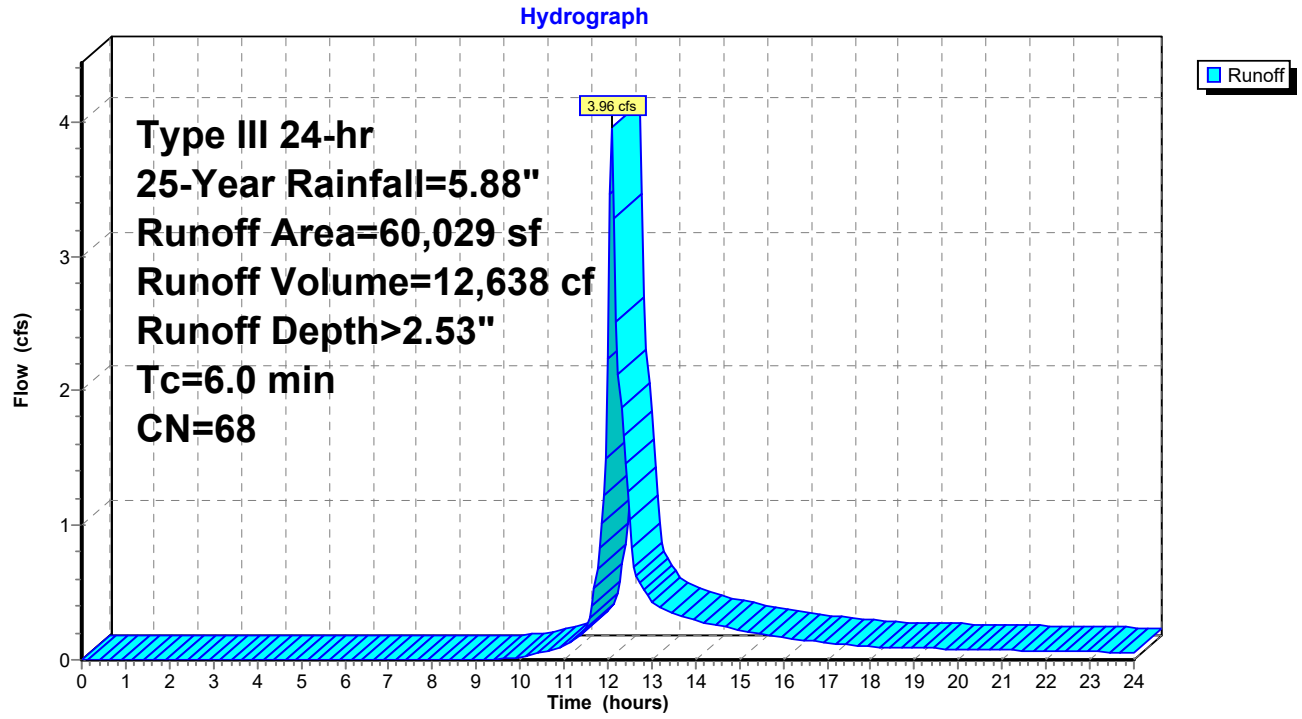
Runoff = 3.96 cfs @ 12.10 hrs, Volume= 12,638 cf, Depth> 2.53"
Routed to Pond 6P : INF-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.88"

	Area (sf)	CN	Description
*	27,908	98	Paved roads, HSG A
	30,437	39	>75% Grass cover, Good, HSG A
*	1,684	98	Sidewalks by Developer, HSG A
	60,029	68	Weighted Average
	30,437		50.70% Pervious Area
	29,592		49.30% Impervious Area

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

Subcatchment 3S: BULGE RD - EAST



Summary for Subcatchment 5S: OVERLAND FLOW

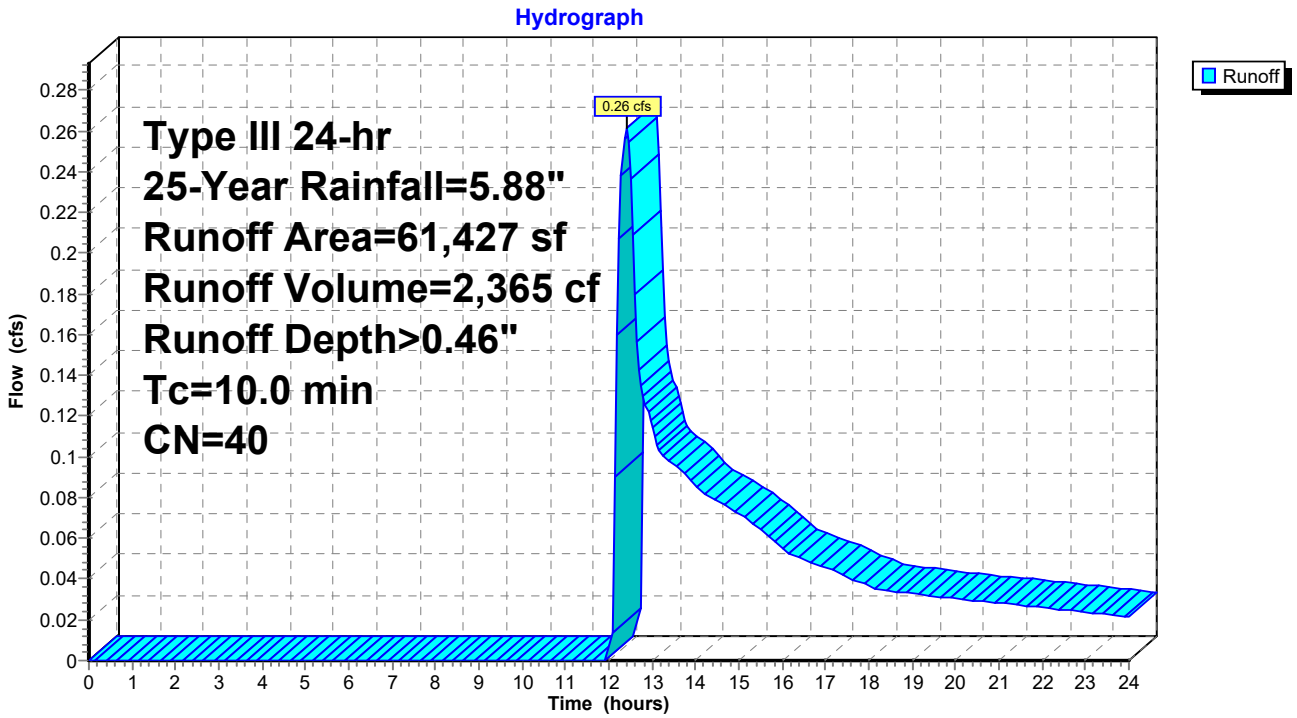
Runoff = 0.26 cfs @ 12.40 hrs, Volume= 2,365 cf, Depth> 0.46"
Routed to Link POA-2 : Overland to Cold Spring Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.88"

Area (sf)	CN	Description
1,176	98	Paved roads w/curbs & sewers, HSG A
60,251	39	>75% Grass cover, Good, HSG A
61,427	40	Weighted Average
60,251		98.09% Pervious Area
1,176		1.91% Impervious Area

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

Subcatchment 5S: OVERLAND FLOW



Summary for Subcatchment 8S: MAINTENANCE BUILDING

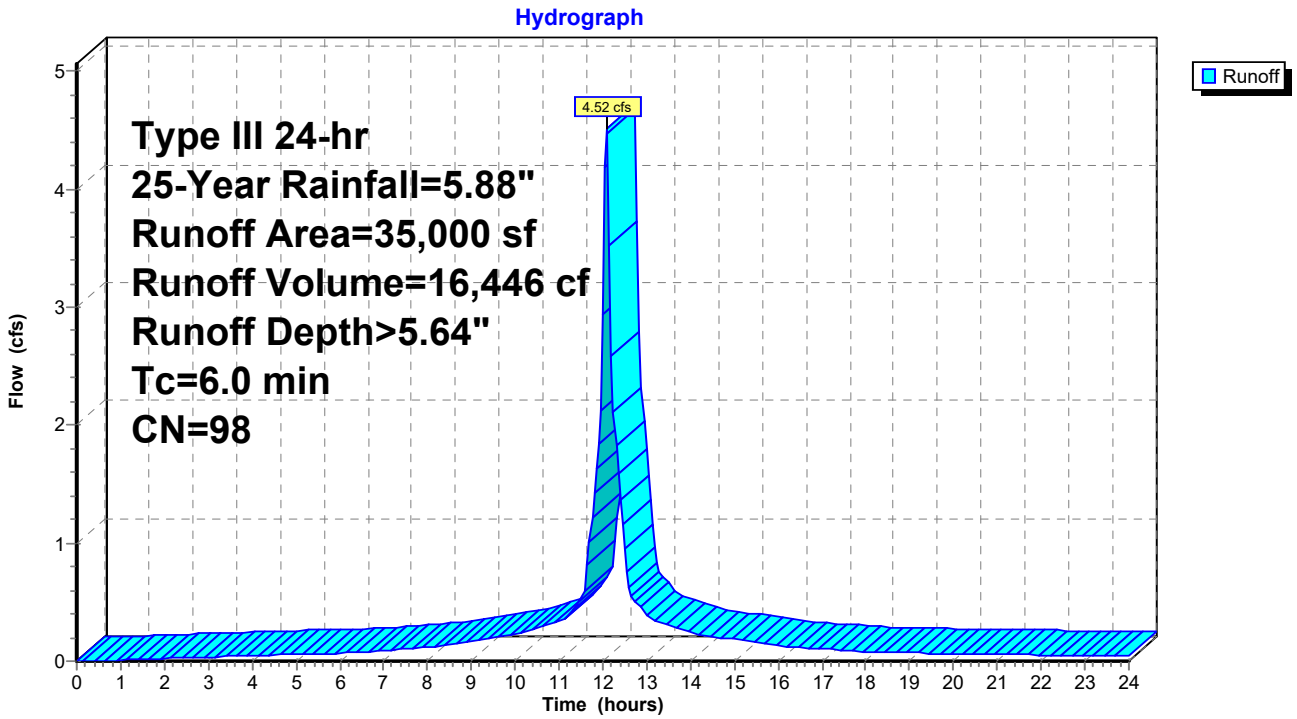
Runoff = 4.52 cfs @ 12.09 hrs, Volume= 16,446 cf, Depth> 5.64"
Routed to Pond 6P : INF-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.88"

Area (sf)	CN	Description
35,000	98	Paved parking, HSG A
35,000		100.00% Impervious Area

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

Subcatchment 8S: MAINTENANCE BUILDING



Summary for Pond 6P: INF-1

Inflow Area = 95,029 sf, 67.97% Impervious, Inflow Depth > 3.67" for 25-Year event
Inflow = 8.47 cfs @ 12.09 hrs, Volume= 29,084 cf
Outflow = 4.75 cfs @ 12.22 hrs, Volume= 28,666 cf, Atten= 44%, Lag= 7.9 min
Discarded = 0.46 cfs @ 12.22 hrs, Volume= 13,763 cf
Primary = 4.29 cfs @ 12.22 hrs, Volume= 14,903 cf
Routed to Link POA-1 : Existing Outfall

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 274.96' @ 12.22 hrs Surf.Area= 2,398 sf Storage= 5,349 cf

Plug-Flow detention time= 45.8 min calculated for 28,606 cf (98% of inflow)
Center-of-Mass det. time= 36.8 min (824.6 - 787.8)

Volume	Invert	Avail.Storage	Storage Description
#1	271.00'	8,023 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

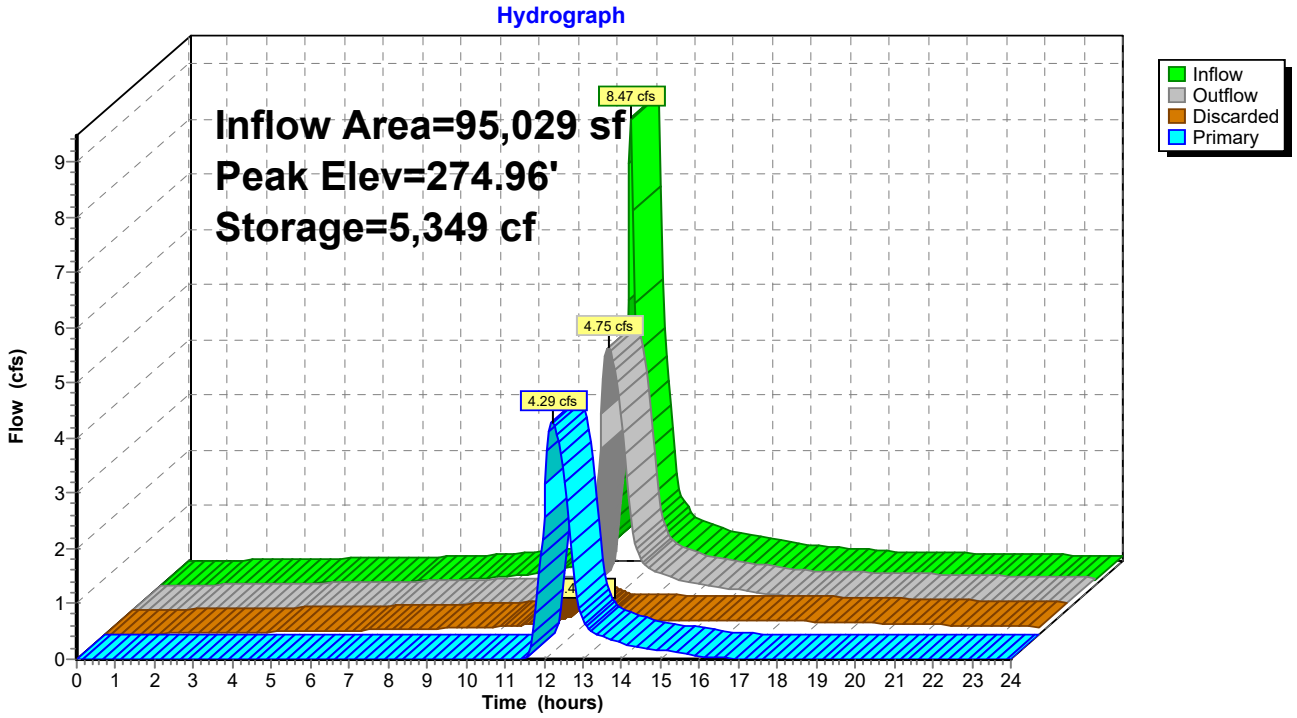
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
271.00	543	0	0	543
272.00	846	689	689	860
273.00	1,307	1,068	1,757	1,335
274.00	1,836	1,564	3,321	1,882
275.00	2,423	2,123	5,444	2,492
276.00	2,738	2,579	8,023	2,854

Device	Routing	Invert	Outlet Devices
#1	Primary	271.50'	**12.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 271.50' / 271.20' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Discarded	271.00'	**8.270 in/hr Exfiltration over Surface area**
#3	Device 1	273.00'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	275.00'	**30.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	275.85'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.46 cfs @ 12.22 hrs HW=274.95' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.46 cfs)

Primary OutFlow Max=4.27 cfs @ 12.22 hrs HW=274.95' (Free Discharge)
└**1=Culvert** (Passes 4.27 cfs of 5.13 cfs potential flow)
  └**3=Orifice/Grate** (Orifice Controls 4.27 cfs @ 6.12 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)
└**5=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 6P: INF-1



Summary for Pond 7P: INF-2

Inflow Area = 31,908 sf, 22.23% Impervious, Inflow Depth > 1.22" for 25-Year event
Inflow = 0.86 cfs @ 12.11 hrs, Volume= 3,257 cf
Outflow = 0.14 cfs @ 12.97 hrs, Volume= 3,252 cf, Atten= 84%, Lag= 51.6 min
Discarded = 0.14 cfs @ 12.97 hrs, Volume= 3,252 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link POA-1 : Existing Outfall

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 264.21' @ 12.97 hrs Surf.Area= 655 sf Storage= 960 cf

Plug-Flow detention time= 73.4 min calculated for 3,245 cf (100% of inflow)
Center-of-Mass det. time= 72.4 min (960.4 - 888.0)

Volume	Invert	Avail.Storage	Storage Description
#1	262.00'	4,289 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

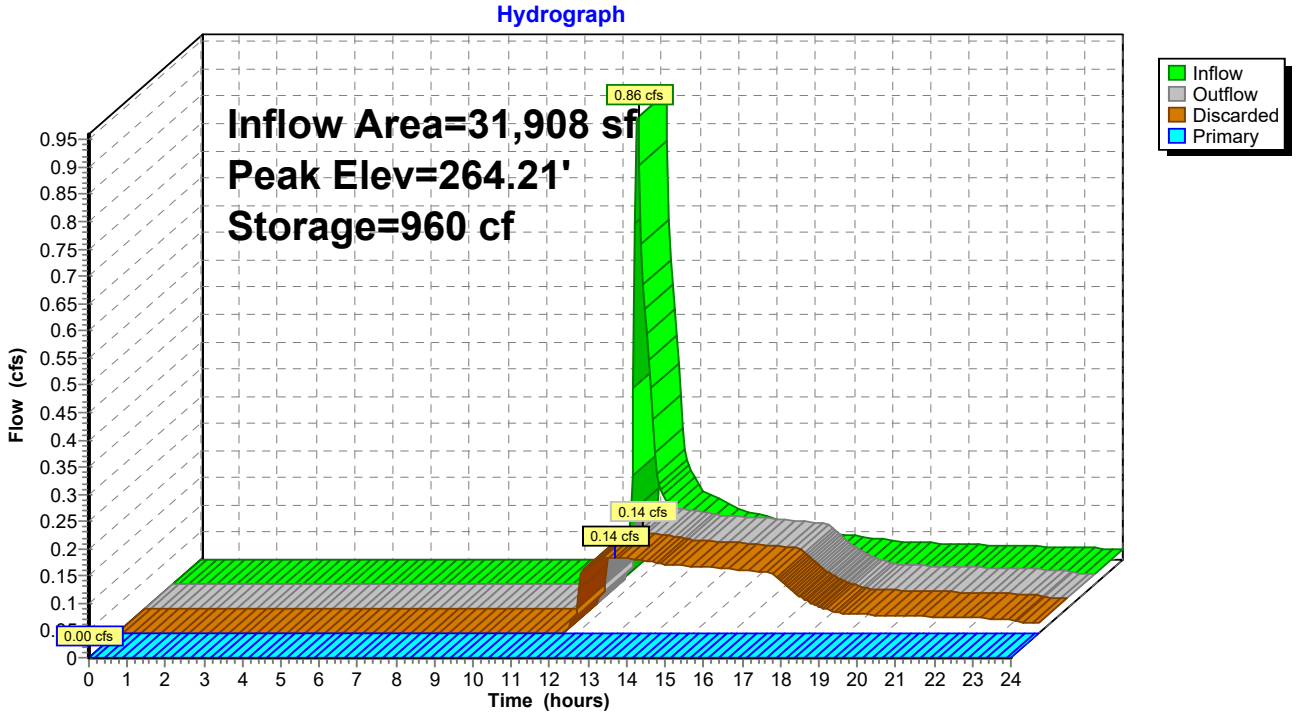
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
262.00	131	0	0	131
262.50	174	76	76	179
263.00	565	175	251	572
264.00	588	576	828	660
265.00	935	755	1,583	1,020
266.00	1,345	1,134	2,717	1,447
267.00	1,812	1,573	4,289	1,935

Device	Routing	Invert	Outlet Devices
#1	Discarded	262.00'	**8.270 in/hr Exfiltration over Wetted area**
#2	Device 3	265.20'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	263.83'	**12.0" Round Culvert** L= 98.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 263.83' / 263.34' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Discarded OutFlow Max=0.14 cfs @ 12.97 hrs HW=264.21' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=262.00' (Free Discharge)
└**3=Culvert** (Controls 0.00 cfs)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 7P: INF-2

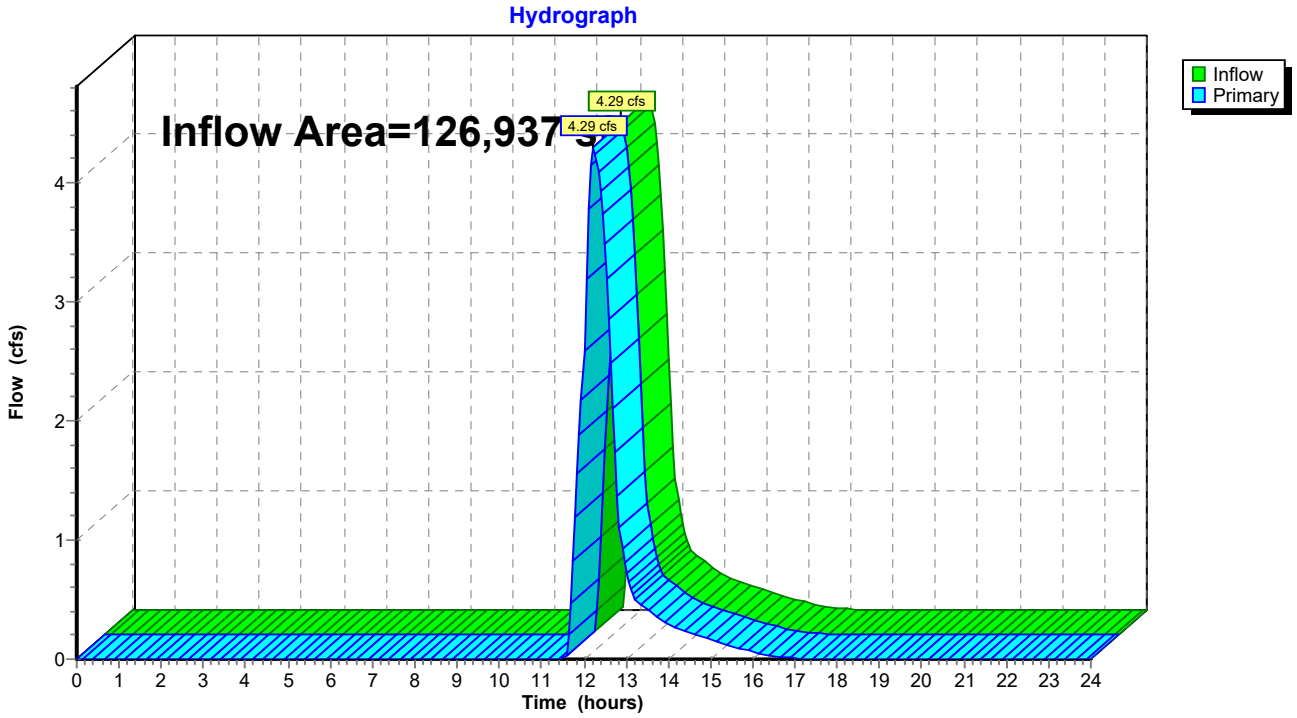

Hydrograph
Inflow Area=31,908 sf
Peak Elev=264.21'
Storage=960 cf
0.86 cfs
0.14 cfs
0.14 cfs
0.00 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)

Summary for Link POA-1: Existing Outfall

Inflow Area = 126,937 sf, 56.47% Impervious, Inflow Depth = 1.41" for 25-Year event
Inflow = 4.29 cfs @ 12.22 hrs, Volume= 14,903 cf
Primary = 4.29 cfs @ 12.22 hrs, Volume= 14,903 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node Total

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-1: Existing Outfall

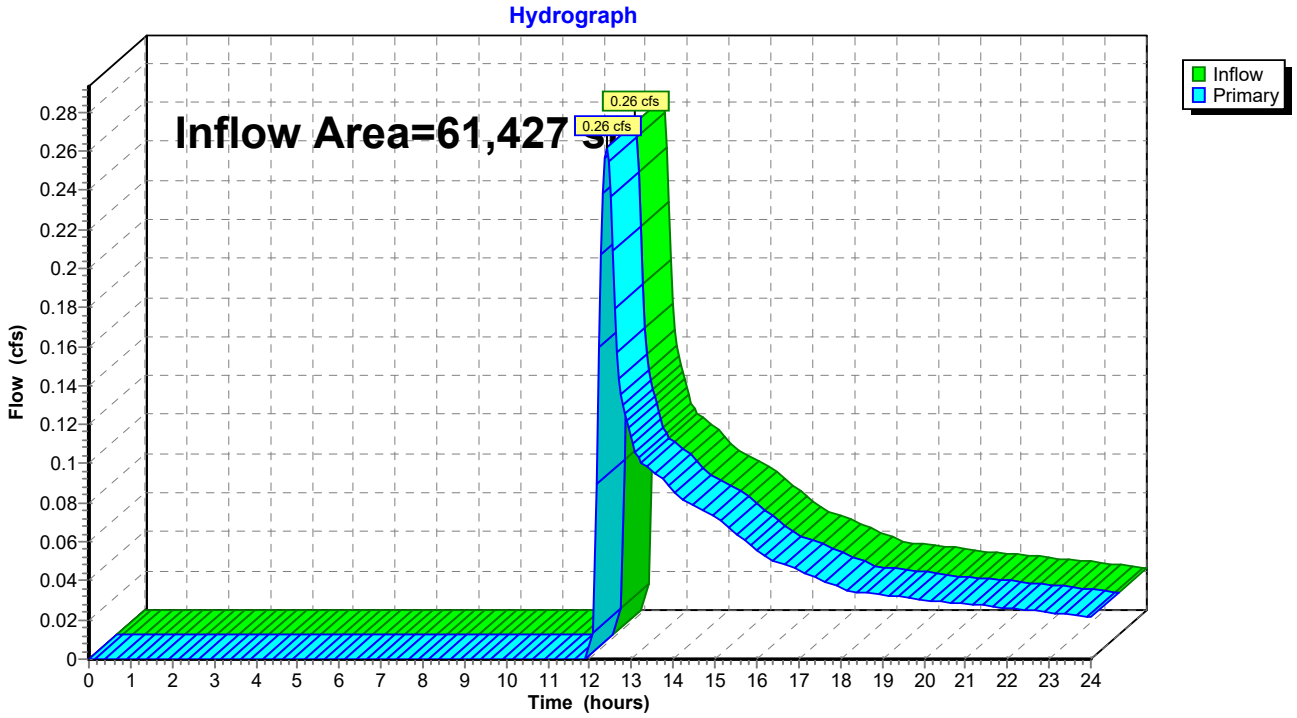


Summary for Link POA-2: Overland to Cold Spring Brook

Inflow Area = 61,427 sf, 1.91% Impervious, Inflow Depth > 0.46" for 25-Year event
Inflow = 0.26 cfs @ 12.40 hrs, Volume= 2,365 cf
Primary = 0.26 cfs @ 12.40 hrs, Volume= 2,365 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node Total

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-2: Overland to Cold Spring Brook



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

Subcatchment1S: BULGE RD - WEST Runoff Area=31,908 sf 22.23% Impervious Runoff Depth>1.64"
Tc=6.0 min CN=52 Runoff=1.23 cfs 4,366 cf

Subcatchment3S: BULGE RD - EAST Runoff Area=60,029 sf 49.30% Impervious Runoff Depth>3.13"
Tc=6.0 min CN=68 Runoff=4.94 cfs 15,639 cf

Subcatchment5S: OVERLAND FLOW Runoff Area=61,427 sf 1.91% Impervious Runoff Depth>0.71"
Tc=10.0 min CN=40 Runoff=0.50 cfs 3,643 cf

Subcatchment8S: MAINTENANCE Runoff Area=35,000 sf 100.00% Impervious Runoff Depth>6.41"
Tc=6.0 min CN=98 Runoff=5.12 cfs 18,688 cf

Pond 6P: INF-1 Peak Elev=275.27' Storage=6,101 cf Inflow=10.04 cfs 34,327 cf
Discarded=0.48 cfs 14,715 cf Primary=5.40 cfs 18,982 cf Outflow=5.88 cfs 33,696 cf

Pond 7P: INF-2 Peak Elev=264.83' Storage=1,432 cf Inflow=1.23 cfs 4,366 cf
Discarded=0.18 cfs 4,333 cf Primary=0.00 cfs 0 cf Outflow=0.18 cfs 4,333 cf

Link POA-1: Existing Outfall Inflow=5.40 cfs 18,982 cf
Primary=5.40 cfs 18,982 cf

Link POA-2: Overland to Cold Spring Brook Inflow=0.50 cfs 3,643 cf
Primary=0.50 cfs 3,643 cf

Total Runoff Area = 188,364 sf Runoff Volume = 42,336 cf Average Runoff Depth = 2.70"
61.32% Pervious = 115,502 sf 38.68% Impervious = 72,862 sf

Summary for Subcatchment 1S: BULGE RD - WEST

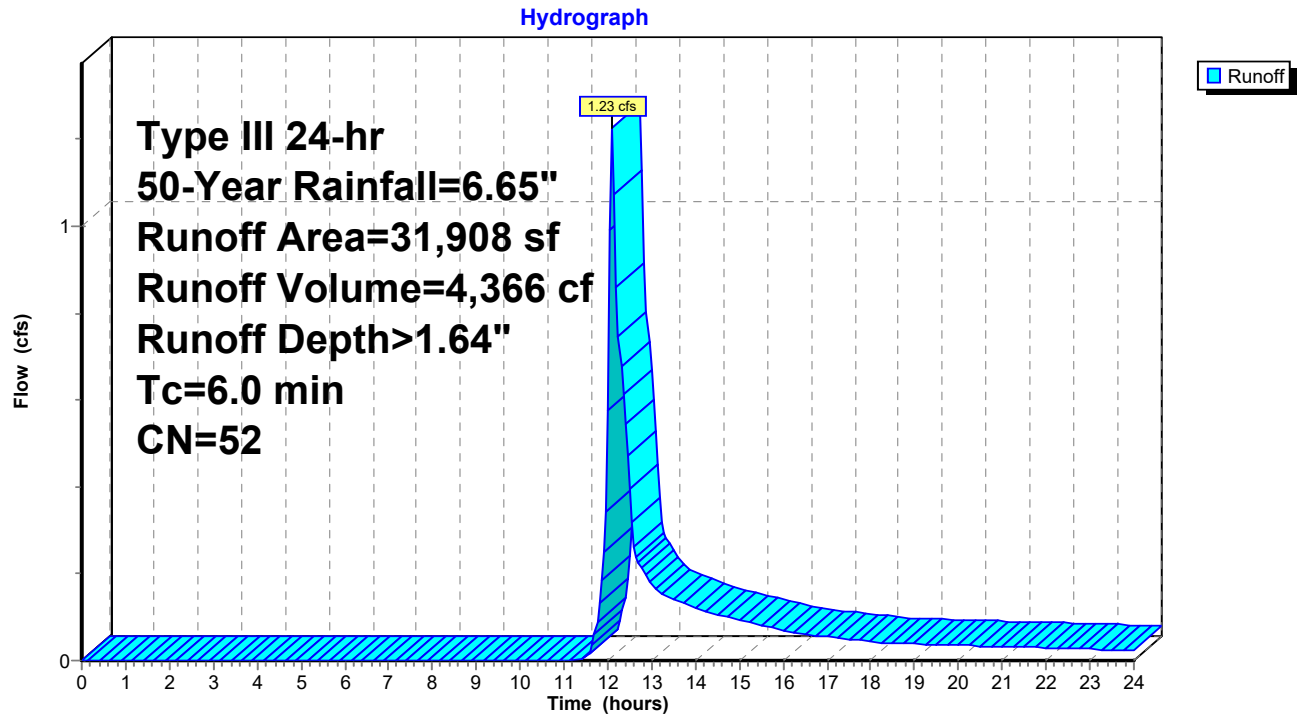
Runoff = 1.23 cfs @ 12.11 hrs, Volume= 4,366 cf, Depth> 1.64"
Routed to Pond 7P : INF-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.65"

Area (sf)	CN	Description
7,094	98	Paved roads w/curbs & sewers, HSG A
24,814	39	>75% Grass cover, Good, HSG A
31,908	52	Weighted Average
24,814		77.77% Pervious Area
7,094		22.23% Impervious Area

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

Subcatchment 1S: BULGE RD - WEST



Summary for Subcatchment 3S: BULGE RD - EAST

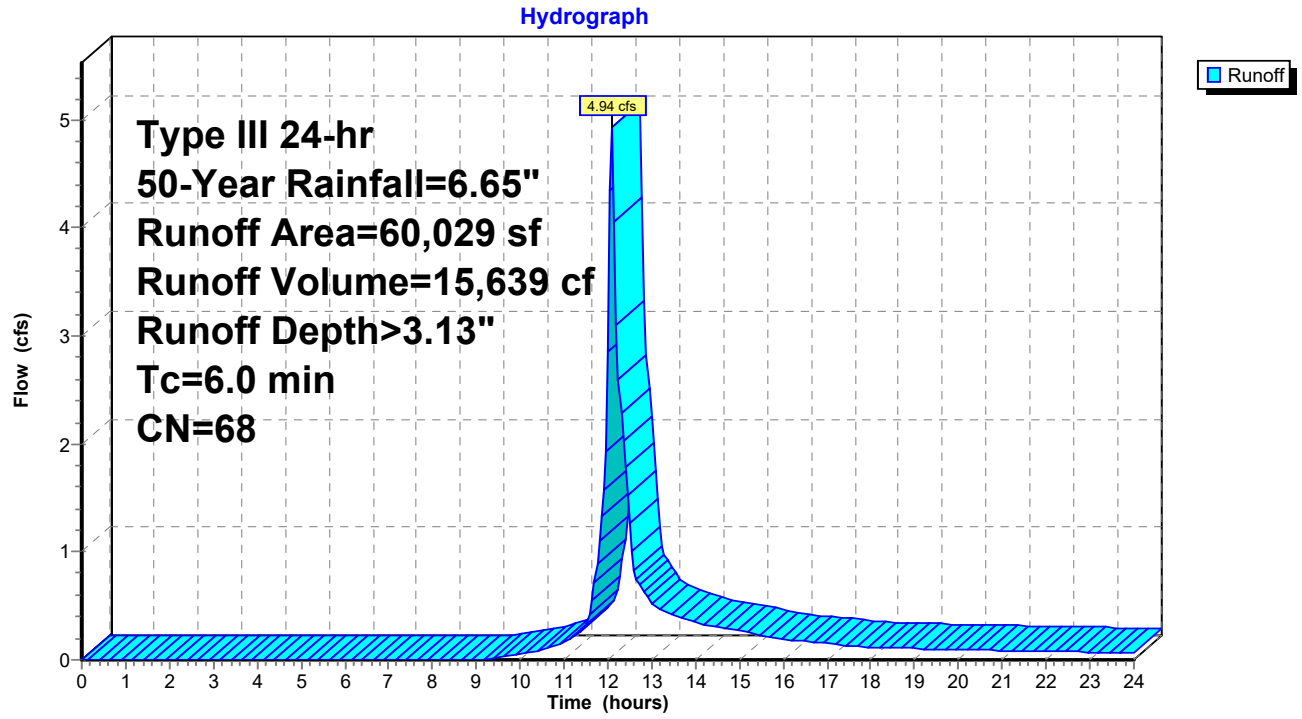
Runoff = 4.94 cfs @ 12.09 hrs, Volume= 15,639 cf, Depth> 3.13"
Routed to Pond 6P : INF-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.65"

	Area (sf)	CN	Description
*	27,908	98	Paved roads, HSG A
	30,437	39	>75% Grass cover, Good, HSG A
*	1,684	98	Sidewalks by Developer, HSG A
	60,029	68	Weighted Average
	30,437		50.70% Pervious Area
	29,592		49.30% Impervious Area

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

Subcatchment 3S: BULGE RD - EAST



Summary for Subcatchment 5S: OVERLAND FLOW

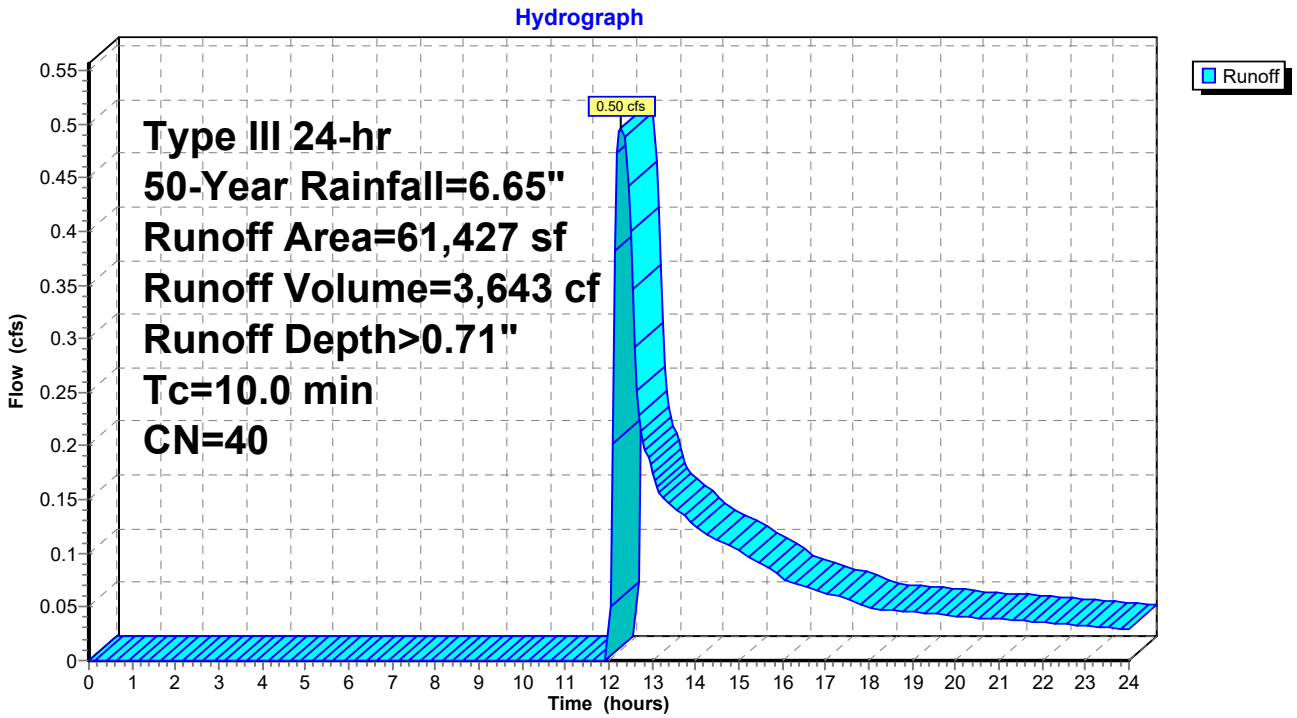
Runoff = 0.50 cfs @ 12.30 hrs, Volume= 3,643 cf, Depth> 0.71"
Routed to Link POA-2 : Overland to Cold Spring Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.65"

Area (sf)	CN	Description
1,176	98	Paved roads w/curbs & sewers, HSG A
60,251	39	>75% Grass cover, Good, HSG A
61,427	40	Weighted Average
60,251		98.09% Pervious Area
1,176		1.91% Impervious Area

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

Subcatchment 5S: OVERLAND FLOW



Summary for Subcatchment 8S: MAINTENANCE BUILDING

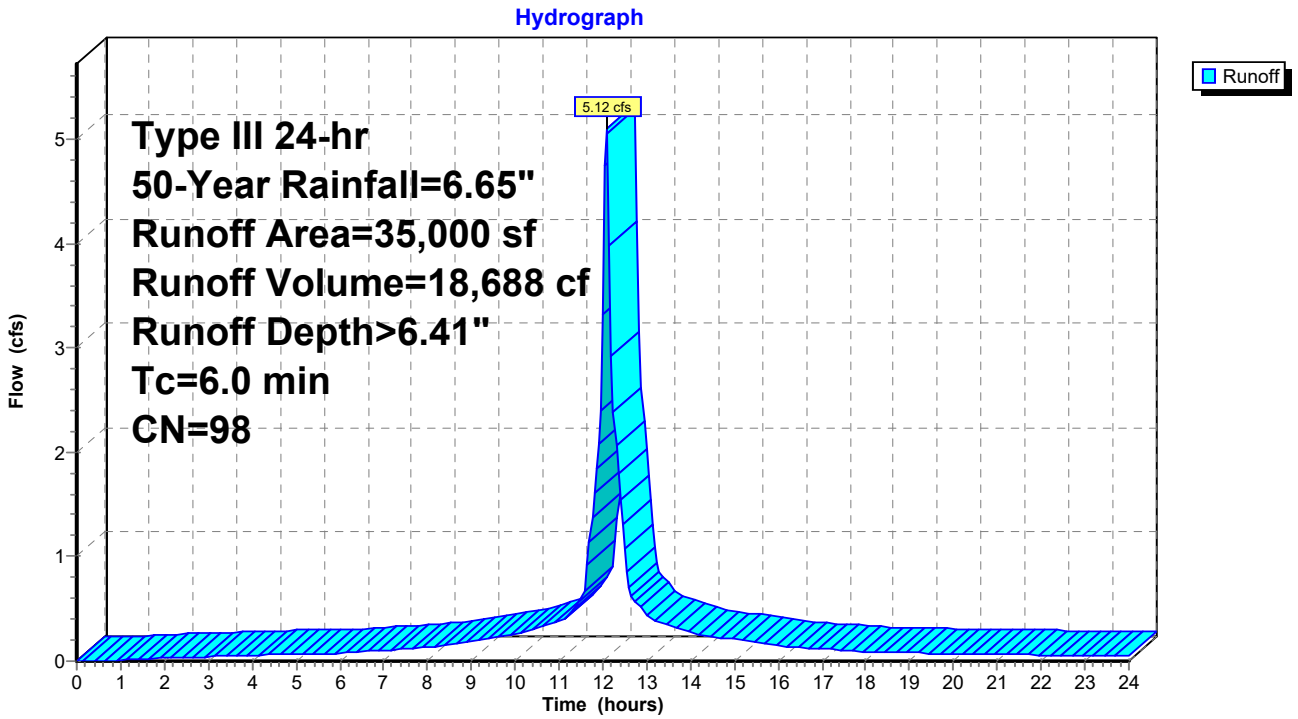
Runoff = 5.12 cfs @ 12.09 hrs, Volume= 18,688 cf, Depth> 6.41"
Routed to Pond 6P : INF-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.65"

Area (sf)	CN	Description
35,000	98	Paved parking, HSG A
35,000		100.00% Impervious Area

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

Subcatchment 8S: MAINTENANCE BUILDING



Summary for Pond 6P: INF-1

Inflow Area = 95,029 sf, 67.97% Impervious, Inflow Depth > 4.33" for 50-Year event
Inflow = 10.04 cfs @ 12.09 hrs, Volume= 34,327 cf
Outflow = 5.88 cfs @ 12.21 hrs, Volume= 33,696 cf, Atten= 42%, Lag= 7.4 min
Discarded = 0.48 cfs @ 12.21 hrs, Volume= 14,715 cf
Primary = 5.40 cfs @ 12.21 hrs, Volume= 18,982 cf
Routed to Link POA-1 : Existing Outfall

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 275.27' @ 12.21 hrs Surf.Area= 2,505 sf Storage= 6,101 cf

Plug-Flow detention time= 43.5 min calculated for 33,696 cf (98% of inflow)
Center-of-Mass det. time= 32.1 min (818.2 - 786.0)

Volume	Invert	Avail.Storage	Storage Description
#1	271.00'	8,023 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

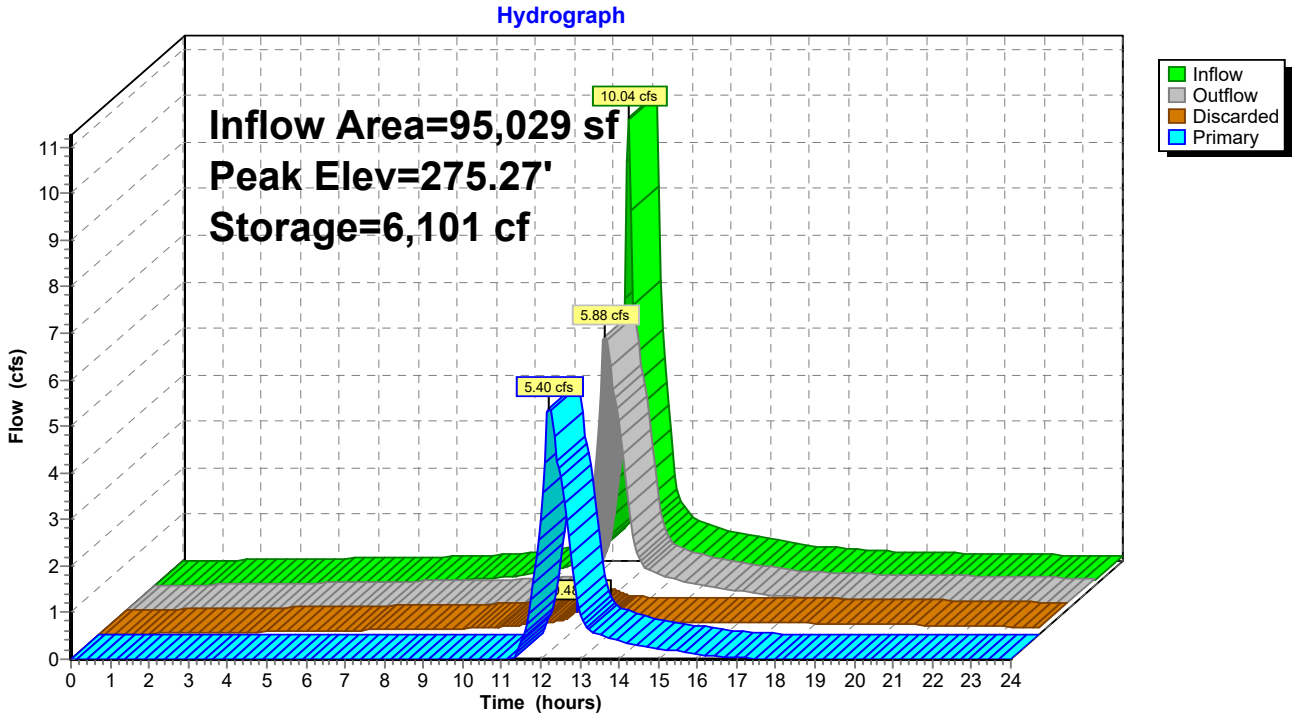
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
271.00	543	0	0	543
272.00	846	689	689	860
273.00	1,307	1,068	1,757	1,335
274.00	1,836	1,564	3,321	1,882
275.00	2,423	2,123	5,444	2,492
276.00	2,738	2,579	8,023	2,854

Device	Routing	Invert	Outlet Devices
#1	Primary	271.50'	**12.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 271.50' / 271.20' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Discarded	271.00'	**8.270 in/hr Exfiltration over Surface area**
#3	Device 1	273.00'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	275.00'	**30.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	275.85'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.48 cfs @ 12.21 hrs HW=275.26' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.48 cfs)

Primary OutFlow Max=5.39 cfs @ 12.21 hrs HW=275.26' (Free Discharge)
└**1=Culvert** (Inlet Controls 5.39 cfs @ 6.86 fps)
  └**3=Orifice/Grate** (Passes < 4.66 cfs potential flow)
  └**4=Orifice/Grate** (Passes < 4.23 cfs potential flow)
└**5=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 6P: INF-1



Summary for Pond 7P: INF-2

Inflow Area = 31,908 sf, 22.23% Impervious, Inflow Depth > 1.64" for 50-Year event
Inflow = 1.23 cfs @ 12.11 hrs, Volume= 4,366 cf
Outflow = 0.18 cfs @ 12.96 hrs, Volume= 4,333 cf, Atten= 85%, Lag= 51.3 min
Discarded = 0.18 cfs @ 12.96 hrs, Volume= 4,333 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Routed to Link POA-1 : Existing Outfall

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 264.83' @ 12.96 hrs Surf.Area= 872 sf Storage= 1,432 cf

Plug-Flow detention time= 93.1 min calculated for 4,324 cf (99% of inflow)
Center-of-Mass det. time= 88.6 min (966.4 - 877.7)

Volume	Invert	Avail.Storage	Storage Description
#1	262.00'	4,289 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

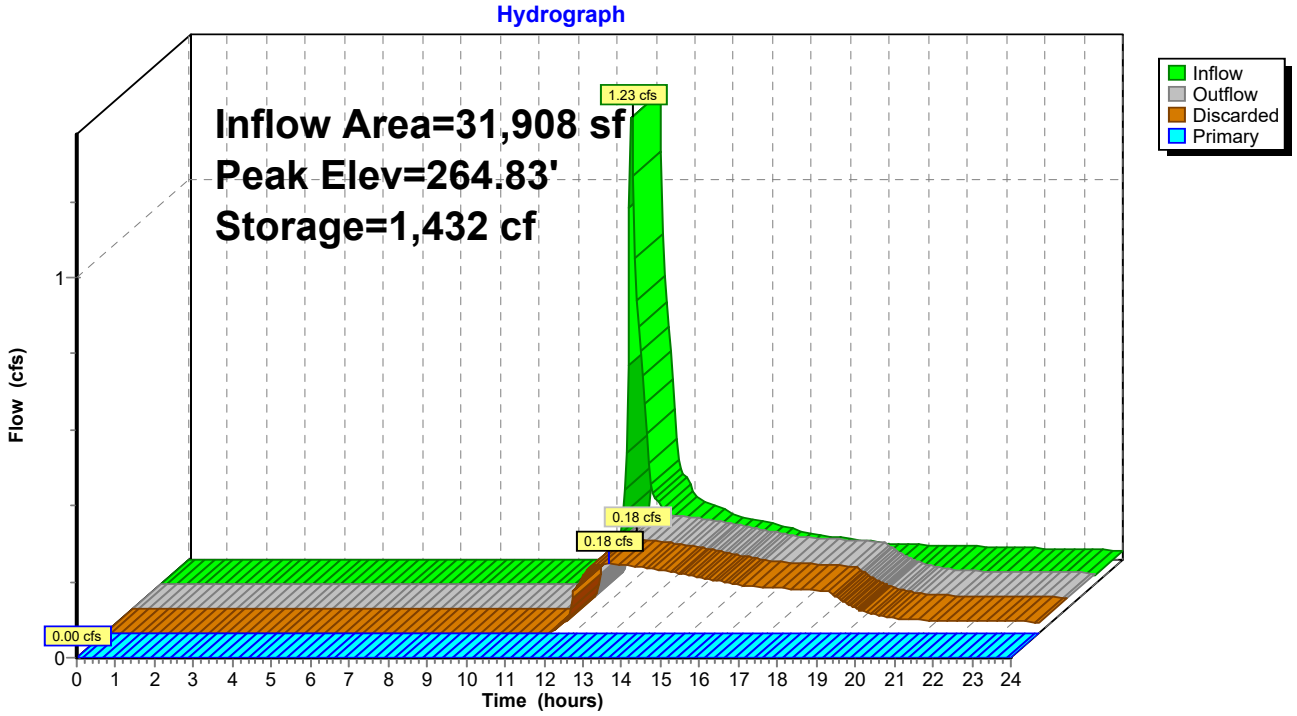
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
262.00	131	0	0	131
262.50	174	76	76	179
263.00	565	175	251	572
264.00	588	576	828	660
265.00	935	755	1,583	1,020
266.00	1,345	1,134	2,717	1,447
267.00	1,812	1,573	4,289	1,935

Device	Routing	Invert	Outlet Devices
#1	Discarded	262.00'	**8.270 in/hr Exfiltration over Wetted area**
#2	Device 3	265.20'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	263.83'	**12.0" Round Culvert** L= 98.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 263.83' / 263.34' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Discarded OutFlow Max=0.18 cfs @ 12.96 hrs HW=264.83' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.18 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=262.00' (Free Discharge)
└**3=Culvert** (Controls 0.00 cfs)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond 7P: INF-2

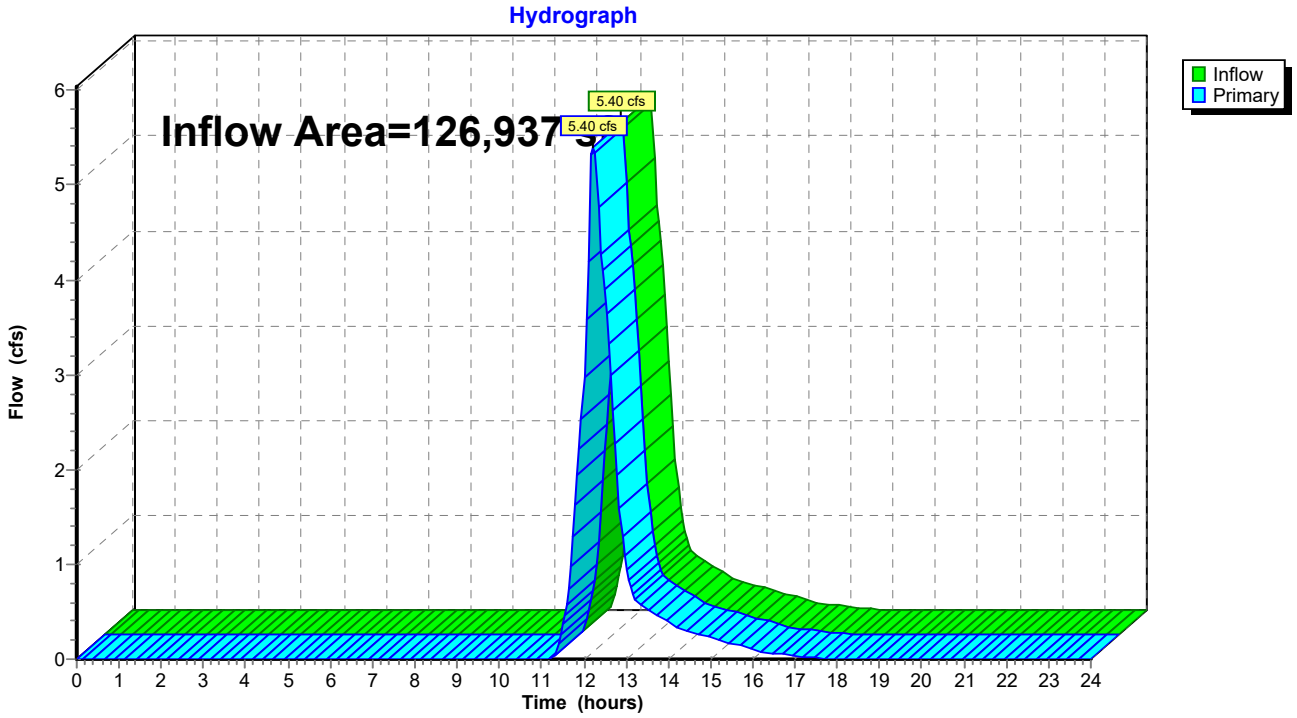

Hydrograph
Inflow Area=31,908 sf
Peak Elev=264.83'
Storage=1,432 cf
1.23 cfs
0.18 cfs
0.18 cfs
0.00 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Summary for Link POA-1: Existing Outfall

Inflow Area = 126,937 sf, 56.47% Impervious, Inflow Depth = 1.79" for 50-Year event
Inflow = 5.40 cfs @ 12.21 hrs, Volume= 18,982 cf
Primary = 5.40 cfs @ 12.21 hrs, Volume= 18,982 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node Total

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-1: Existing Outfall

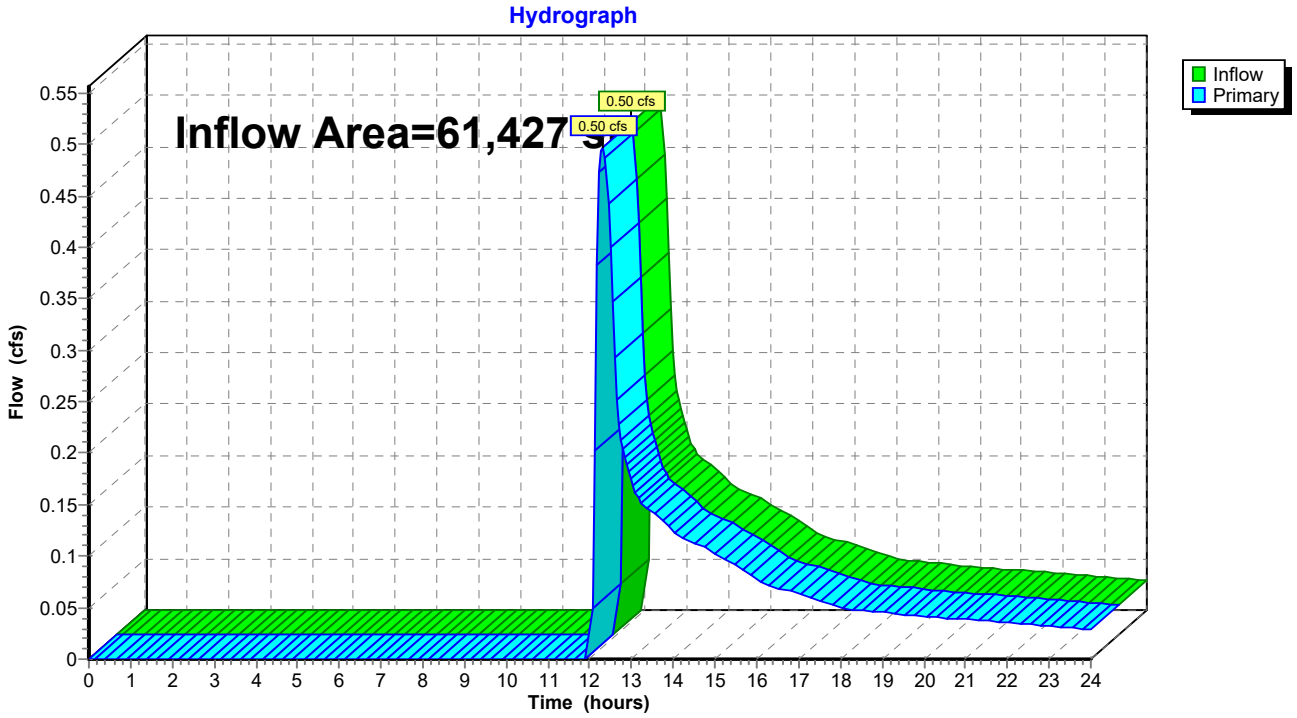


Summary for Link POA-2: Overland to Cold Spring Brook

Inflow Area = 61,427 sf, 1.91% Impervious, Inflow Depth > 0.71" for 50-Year event
Inflow = 0.50 cfs @ 12.30 hrs, Volume= 3,643 cf
Primary = 0.50 cfs @ 12.30 hrs, Volume= 3,643 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node Total

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-2: Overland to Cold Spring Brook



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

Subcatchment1S: BULGE RD - WEST Runoff Area=31,908 sf 22.23% Impervious Runoff Depth>2.14"
Tc=6.0 min CN=52 Runoff=1.67 cfs 5,687 cf

Subcatchment3S: BULGE RD - EAST Runoff Area=60,029 sf 49.30% Impervious Runoff Depth>3.81"
Tc=6.0 min CN=68 Runoff=6.03 cfs 19,044 cf

Subcatchment5S: OVERLAND FLOW Runoff Area=61,427 sf 1.91% Impervious Runoff Depth>1.03"
Tc=10.0 min CN=40 Runoff=0.91 cfs 5,278 cf

Subcatchment8S: MAINTENANCE Runoff Area=35,000 sf 100.00% Impervious Runoff Depth>7.25"
Tc=6.0 min CN=98 Runoff=5.77 cfs 21,135 cf

Pond 6P: INF-1 Peak Elev=275.69' Storage=7,180 cf Inflow=11.79 cfs 40,179 cf
Discarded=0.50 cfs 15,670 cf Primary=5.73 cfs 23,659 cf Outflow=6.24 cfs 39,329 cf

Pond 7P: INF-2 Peak Elev=265.25' Storage=1,829 cf Inflow=1.67 cfs 5,687 cf
Discarded=0.21 cfs 5,360 cf Primary=0.29 cfs 261 cf Outflow=0.51 cfs 5,621 cf

Link POA-1: Existing Outfall Inflow=5.73 cfs 23,920 cf
Primary=5.73 cfs 23,920 cf

Link POA-2: Overland to Cold Spring Brook Inflow=0.91 cfs 5,278 cf
Primary=0.91 cfs 5,278 cf

Total Runoff Area = 188,364 sf Runoff Volume = 51,143 cf Average Runoff Depth = 3.26"
61.32% Pervious = 115,502 sf 38.68% Impervious = 72,862 sf

Summary for Subcatchment 1S: BULGE RD - WEST

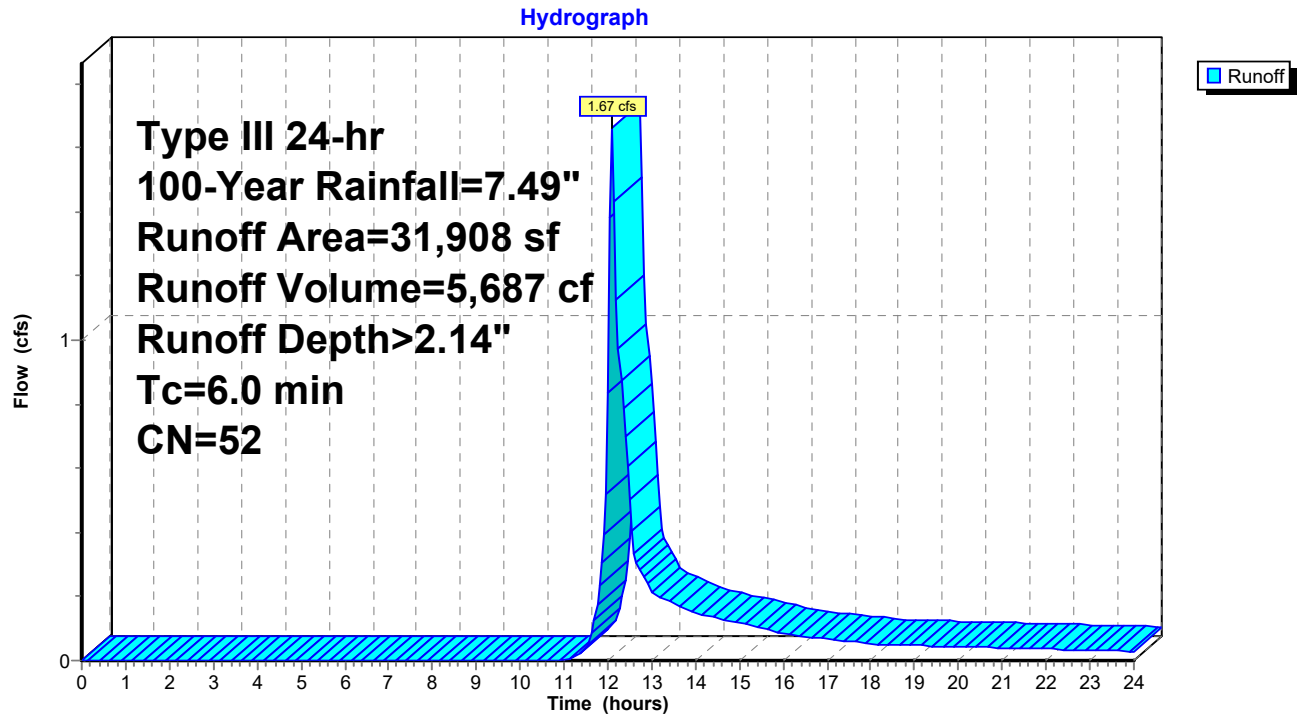
Runoff = 1.67 cfs @ 12.10 hrs, Volume= 5,687 cf, Depth> 2.14"
Routed to Pond 7P : INF-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.49"

Area (sf)	CN	Description
7,094	98	Paved roads w/curbs & sewers, HSG A
24,814	39	>75% Grass cover, Good, HSG A
31,908	52	Weighted Average
24,814		77.77% Pervious Area
7,094		22.23% Impervious Area

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

Subcatchment 1S: BULGE RD - WEST



Summary for Subcatchment 3S: BULGE RD - EAST

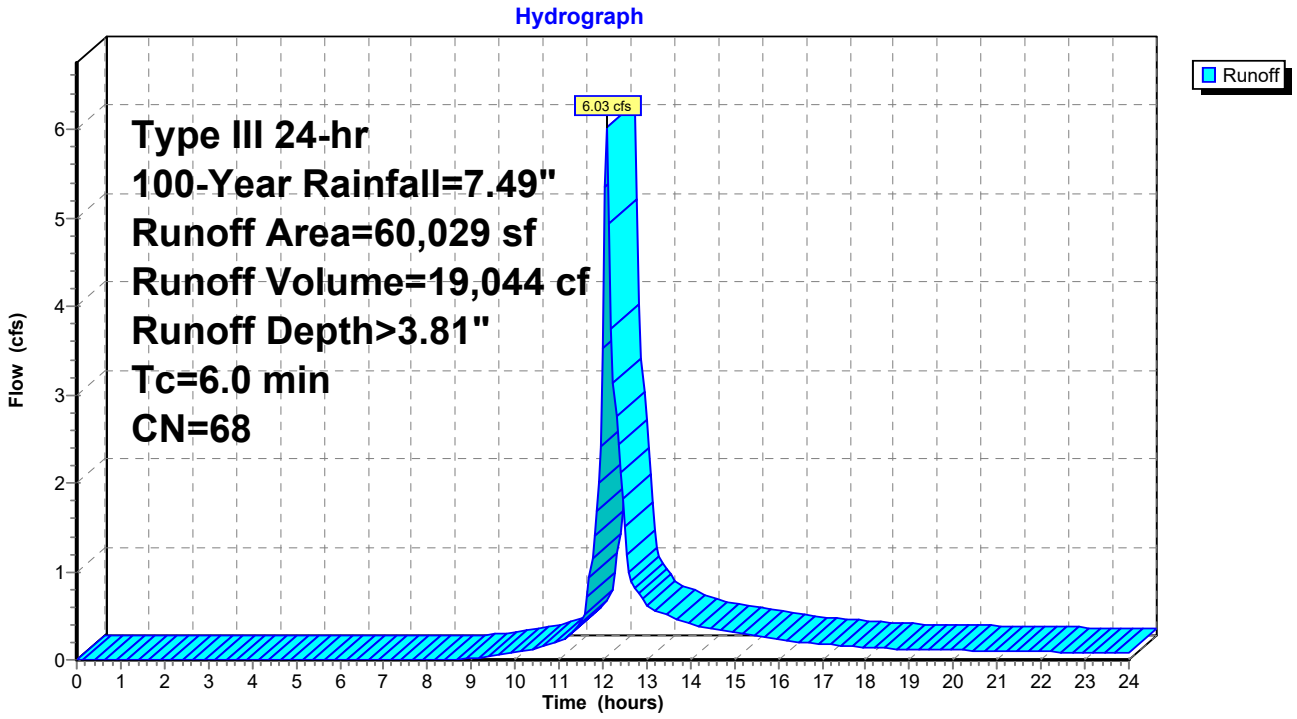
Runoff = 6.03 cfs @ 12.09 hrs, Volume= 19,044 cf, Depth> 3.81"
Routed to Pond 6P : INF-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.49"

	Area (sf)	CN	Description
*	27,908	98	Paved roads, HSG A
	30,437	39	>75% Grass cover, Good, HSG A
*	1,684	98	Sidewalks by Developer, HSG A
	60,029	68	Weighted Average
	30,437		50.70% Pervious Area
	29,592		49.30% Impervious Area

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

Subcatchment 3S: BULGE RD - EAST



Summary for Subcatchment 5S: OVERLAND FLOW

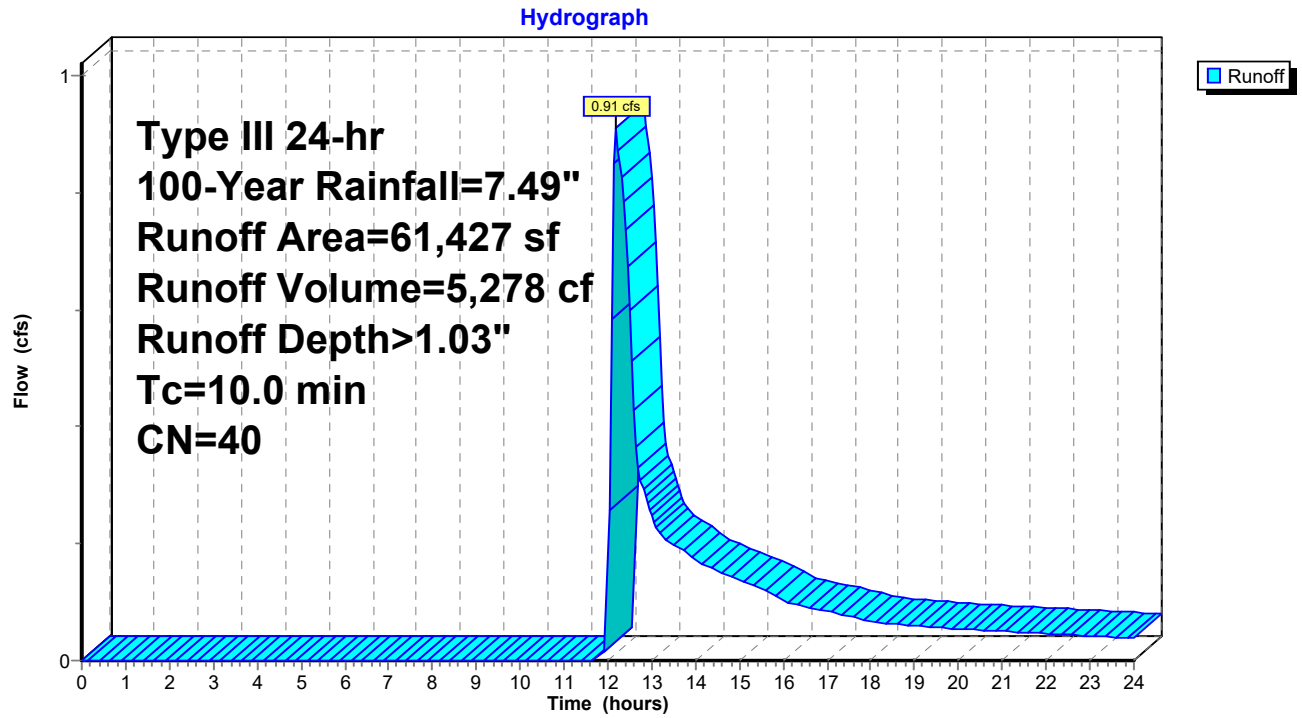
Runoff = 0.91 cfs @ 12.21 hrs, Volume= 5,278 cf, Depth> 1.03"
Routed to Link POA-2 : Overland to Cold Spring Brook

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.49"

Area (sf)	CN	Description
1,176	98	Paved roads w/curbs & sewers, HSG A
60,251	39	>75% Grass cover, Good, HSG A
61,427	40	Weighted Average
60,251		98.09% Pervious Area
1,176		1.91% Impervious Area

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

Subcatchment 5S: OVERLAND FLOW



Summary for Subcatchment 8S: MAINTENANCE BUILDING

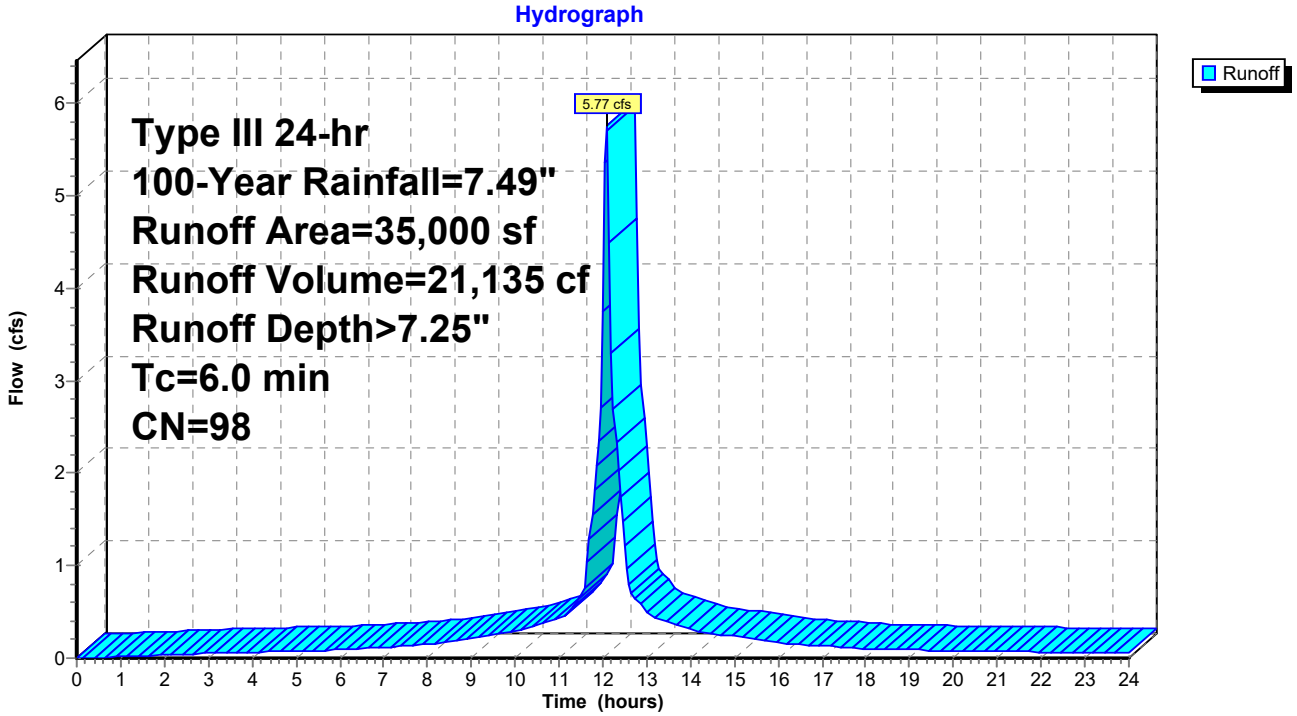
Runoff = 5.77 cfs @ 12.09 hrs, Volume= 21,135 cf, Depth> 7.25"
Routed to Pond 6P : INF-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.49"

Area (sf)	CN	Description
35,000	98	Paved parking, HSG A
35,000		100.00% Impervious Area

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

Subcatchment 8S: MAINTENANCE BUILDING



Summary for Pond 6P: INF-1

Inflow Area = 95,029 sf, 67.97% Impervious, Inflow Depth > 5.07" for 100-Year event
Inflow = 11.79 cfs @ 12.09 hrs, Volume= 40,179 cf
Outflow = 6.24 cfs @ 12.24 hrs, Volume= 39,329 cf, Atten= 47%, Lag= 8.7 min
Discarded = 0.50 cfs @ 12.24 hrs, Volume= 15,670 cf
Primary = 5.73 cfs @ 12.24 hrs, Volume= 23,659 cf
Routed to Link POA-1 : Existing Outfall

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 275.69' @ 12.24 hrs Surf.Area= 2,637 sf Storage= 7,180 cf

Plug-Flow detention time= 41.4 min calculated for 39,248 cf (98% of inflow)
Center-of-Mass det. time= 28.5 min (812.7 - 784.2)

Volume	Invert	Avail.Storage	Storage Description
#1	271.00'	8,023 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

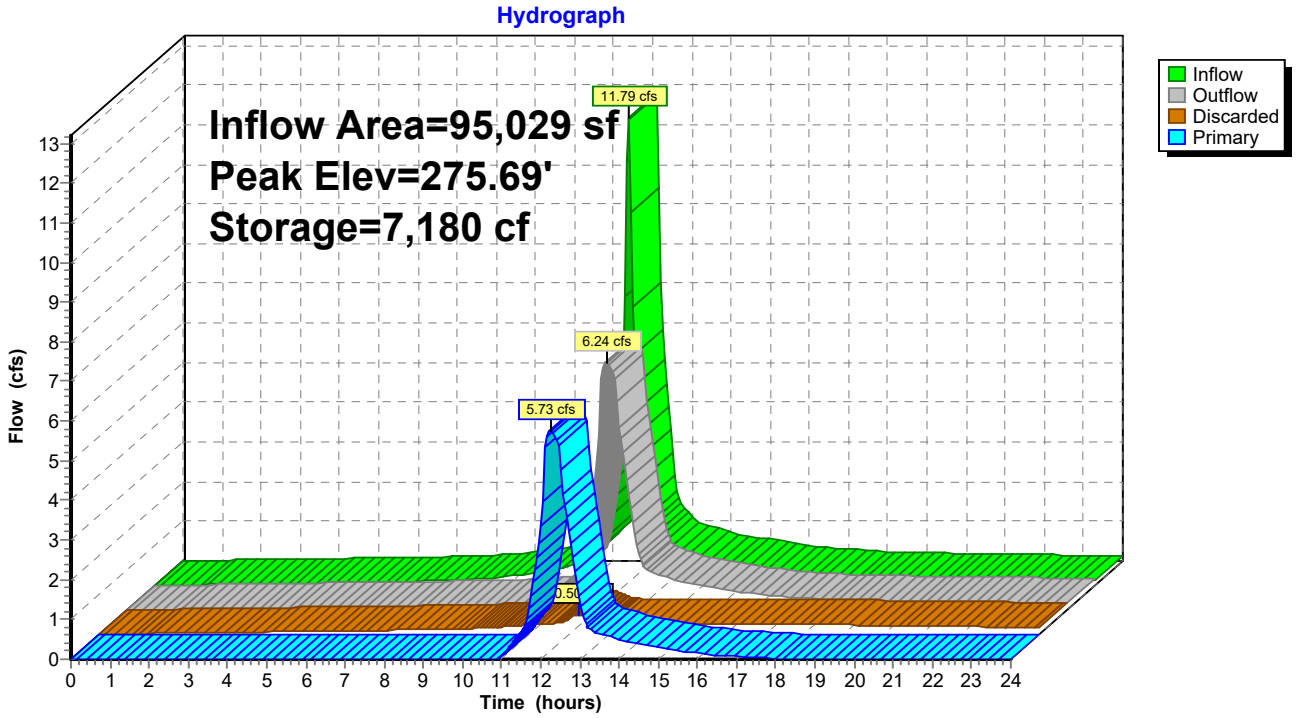
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
271.00	543	0	0	543
272.00	846	689	689	860
273.00	1,307	1,068	1,757	1,335
274.00	1,836	1,564	3,321	1,882
275.00	2,423	2,123	5,444	2,492
276.00	2,738	2,579	8,023	2,854

Device	Routing	Invert	Outlet Devices
#1	Primary	271.50'	**12.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 271.50' / 271.20' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Discarded	271.00'	**8.270 in/hr Exfiltration over Surface area**
#3	Device 1	273.00'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	275.00'	**30.0" x 30.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	275.85'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.50 cfs @ 12.24 hrs HW=275.68' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.50 cfs)

Primary OutFlow Max=5.73 cfs @ 12.24 hrs HW=275.68' (Free Discharge)
└**1=Culvert** (Inlet Controls 5.73 cfs @ 7.29 fps)
  └**3=Orifice/Grate** (Passes < 5.15 cfs potential flow)
  └**4=Orifice/Grate** (Passes < 18.32 cfs potential flow)
└**5=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 6P: INF-1



Summary for Pond 7P: INF-2

Inflow Area = 31,908 sf, 22.23% Impervious, Inflow Depth > 2.14" for 100-Year event
Inflow = 1.67 cfs @ 12.10 hrs, Volume= 5,687 cf
Outflow = 0.51 cfs @ 12.51 hrs, Volume= 5,621 cf, Atten= 70%, Lag= 24.7 min
Discarded = 0.21 cfs @ 12.51 hrs, Volume= 5,360 cf
Primary = 0.29 cfs @ 12.51 hrs, Volume= 261 cf
Routed to Link POA-1 : Existing Outfall

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 265.25' @ 12.51 hrs Surf.Area= 1,031 sf Storage= 1,829 cf

Plug-Flow detention time= 99.9 min calculated for 5,621 cf (99% of inflow)
Center-of-Mass det. time= 93.4 min (962.4 - 869.0)

Volume	Invert	Avail.Storage	Storage Description
#1	262.00'	4,289 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

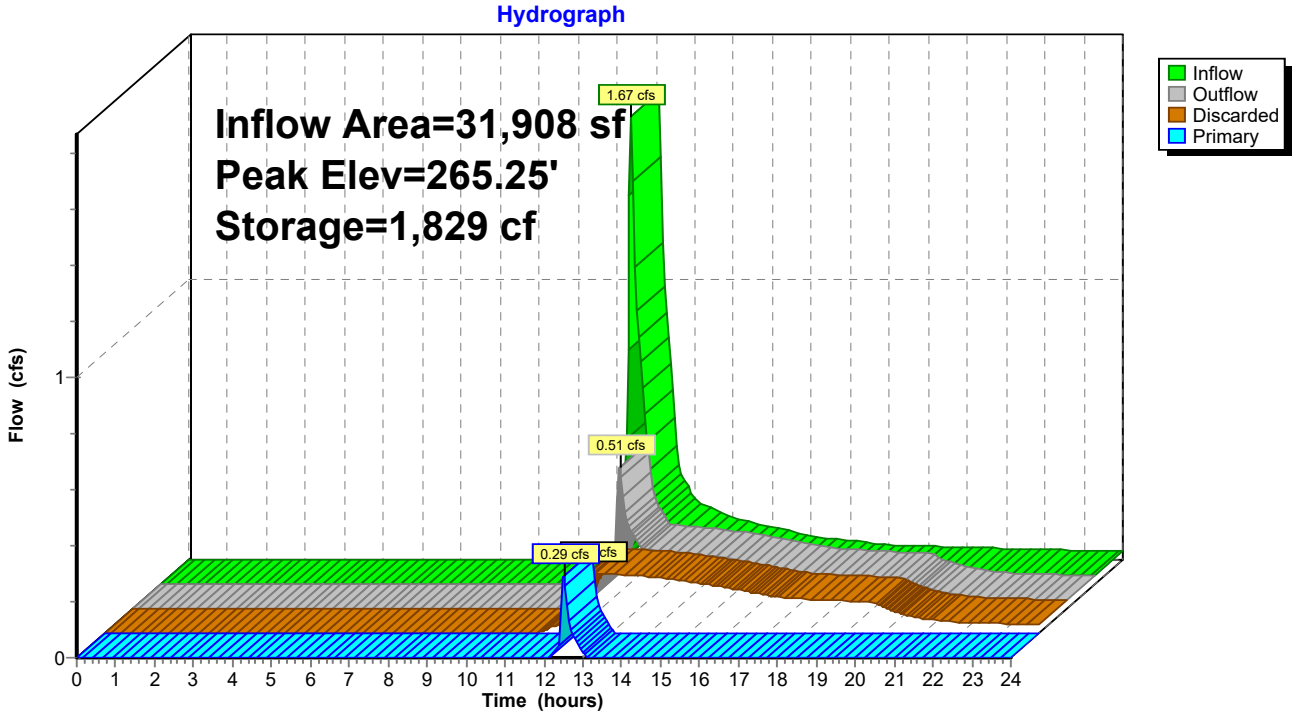
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
262.00	131	0	0	131
262.50	174	76	76	179
263.00	565	175	251	572
264.00	588	576	828	660
265.00	935	755	1,583	1,020
266.00	1,345	1,134	2,717	1,447
267.00	1,812	1,573	4,289	1,935

Device	Routing	Invert	Outlet Devices
#1	Discarded	262.00'	**8.270 in/hr Exfiltration over Wetted area**
#2	Device 3	265.20'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	263.83'	**12.0" Round Culvert** L= 98.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 263.83' / 263.34' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Discarded OutFlow Max=0.21 cfs @ 12.51 hrs HW=265.25' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=0.27 cfs @ 12.51 hrs HW=265.25' (Free Discharge)
↑**3=Culvert** (Passes 0.27 cfs of 2.81 cfs potential flow)
↑**2=Orifice/Grate** (Weir Controls 0.27 cfs @ 0.71 fps)

Pond 7P: INF-2

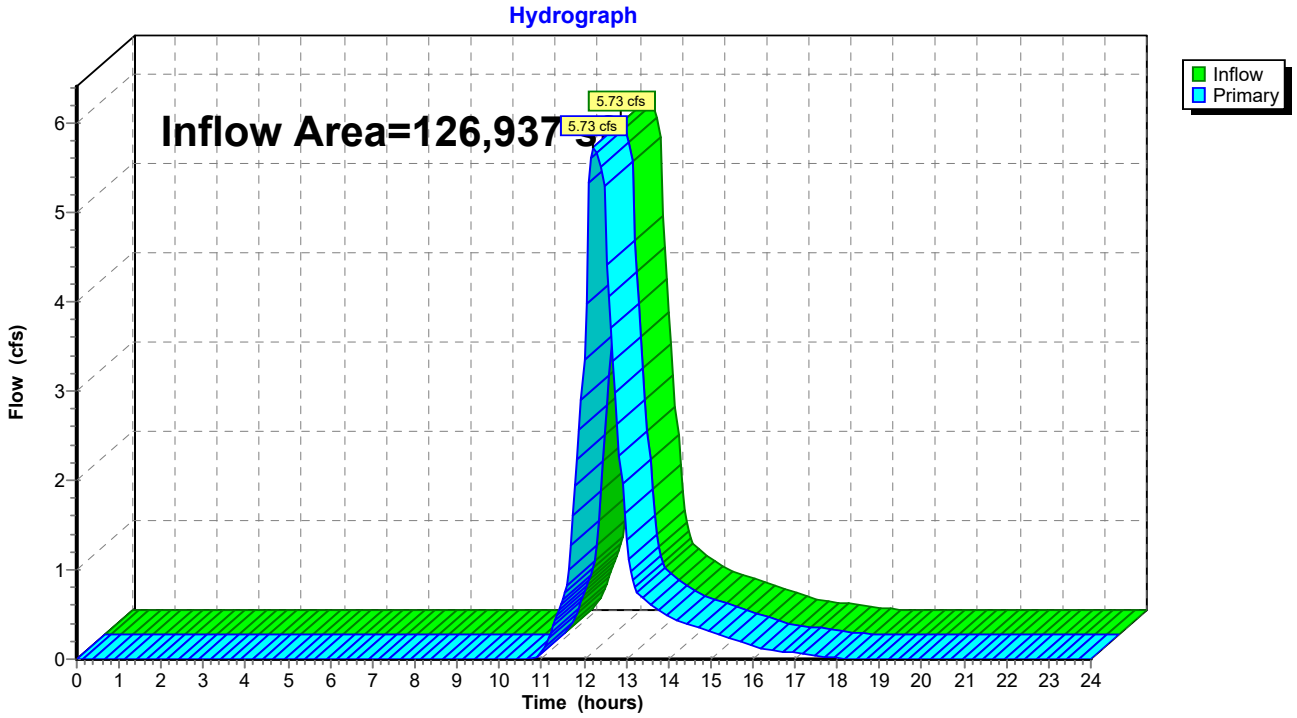

Hydrograph
Inflow Area=31,908 sf
Peak Elev=265.25'
Storage=1,829 cf
1.67 cfs
0.51 cfs
0.29 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
0
1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time (hours)

Summary for Link POA-1: Existing Outfall

Inflow Area = 126,937 sf, 56.47% Impervious, Inflow Depth = 2.26" for 100-Year event
Inflow = 5.73 cfs @ 12.24 hrs, Volume= 23,920 cf
Primary = 5.73 cfs @ 12.24 hrs, Volume= 23,920 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node Total

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-1: Existing Outfall

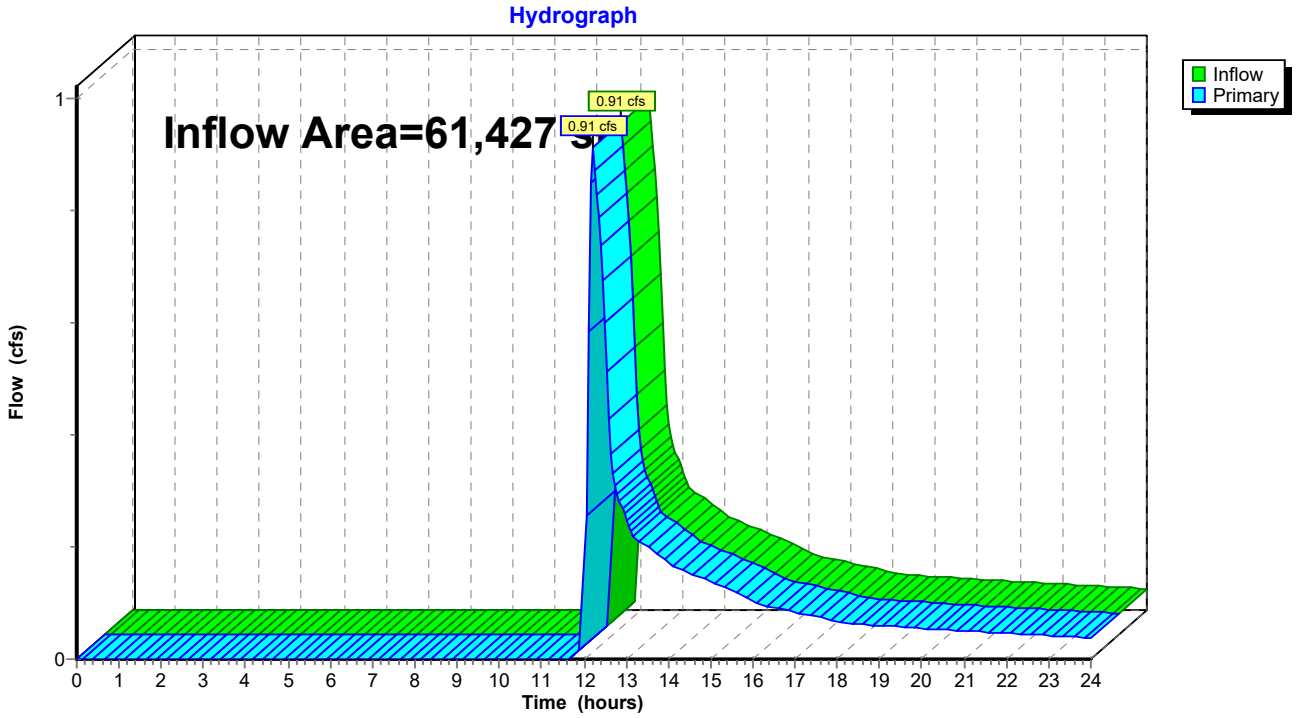


Summary for Link POA-2: Overland to Cold Spring Brook

Inflow Area = 61,427 sf, 1.91% Impervious, Inflow Depth > 1.03" for 100-Year event
Inflow = 0.91 cfs @ 12.21 hrs, Volume= 5,278 cf
Primary = 0.91 cfs @ 12.21 hrs, Volume= 5,278 cf, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node Total

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link POA-2: Overland to Cold Spring Brook



APPENDIX C

Bulge Road and Patton Road Intersection Improvements
Recharge Calculation

Required Recharge

Area Summary	
	Area (SF)*
Existing Impervious	35,000
Proposed Impervious	72,862
Required Recharge Area *(Proposed - Existing)*	37,862

* See Note

Note (1) Actual existing impervious is 96,238, however for recharge calculation all areas withing limit of work in existing condition is assumed as pervious per DEC Recuirements. Only area upstream of the project limits (golf course maintenance facility) is considered impervious

Note (2) Site consists of HSG A soils; therefore 0.6 Target Depth Factor will be used for calculation.

Hydrologic Soil Group Summary		
Group	Target Depth Factor (in)	Area (SF)
A	0.6	37,862
B	0.35	0
C	0.25	0
D	0.1	0

Required Recharge (*Rv*) Calculation:

Rv = Target Depth Factor x Δ Impervious Area
Rv = 0.6 x (1/12) x 37,862
Rv = 1,893 CF

Proposed Recharge Summary
Detailed calculations included on following pages

Location	Volume (CF)
Proposed Infiltration Basin-1	1,654
Proposed Infiltration Basin-1	1,706
Total	3,360

Rv = 1,893 CF
Provided recharge = 3,360 CF

Recharge Requirement is met.

Proposed Recharge

Proposed Infiltration Basin 1 (INF-1)

Bottom of Basin Elevation	271.00	FT
Orifice Elevation	273.00	FT
Storage Height	2.00	FT
Area @ Bottom of Basin	543	SF
Area @ Orifice	1,111	SF
Storage Area = (543 SF + 1307 SF)/2 =	827	SF
Total Recharge Volume	1,654	CF

Proposed Infiltration Basin 2 (INF-2)

Bottom of Basin Elevation	262.00	FT
Orifice Elevation	265.20	FT
Storage Height	3.20	FT
Area @ Bottom of Basin	131	SF
Area @ Orifice	935	SF
Storage Area = (131 SF + 935 SF)/2 =	533	SF
Total Recharge Volume	1,706	CF

Bulge Road and Patton Road Intersection Improvements
Drawdown Calculation

-- Maximum drawdown time is 72 hours --

Time to drawdown calculation

$$\text{Time} = \frac{Rv}{k * \text{bottom area}}$$

where,

Rv = storage volume

k = saturated hydraulic conductivity rate

bottom area = average surface storage area of recharge structure

Proposed Storage Drawdown Calcuations

Proposed Infiltration Basin 1 (INF-1)			
Net storage volume	1,654	CF	
Bottom area	543	SF	
k	8.27	in/hr *	* Rawl's Rate for sand
Time =	4.42	hours	

Proposed drawdown time is acceptable.

Proposed Infiltration Basin 2 (INF-2)			
Net storage volume	1,706	CF	
Bottom area	131	SF	
k	8.27	in/hr *	* Rawl's Rate for sand
Time =	18.89	hours	

Proposed drawdown time is acceptable.

Bulge Road and Patton Road Intersection Improvements
Water Quality Volume

Standard 4 Water Quality

As stated in the Stormwater Handbook, the required water quality volume equals 1 inches of runoff times the total impervious area of the post-development site for sites with a rapid infiltration rate.

Proposed Impervious Area	37,862	SF

Req'd Water Quality Volume

37,862	sf	x	1"	x	1'/12"=	3,155	CF

Provided Recharge Volume =	3,360	CF

WQV Requirement is met.

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 - Catch basin to to Infiltration Basin 1

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)
Street Sweeping - 5%	0.05	1.00	0.05	0.95
Deep Sump and Hooded Catch Basin	0.25	0.95	0.24	0.71
Sediment Forebay	0.25	0.71	0.18	0.53
	0.00	0.53	0.00	0.53
	0.00	0.53	0.00	0.53

Total TSS Removal = 47%

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

Project: Bulge Road Improvements
Prepared By: Elena Compter
Date: 1/6/2022

*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.

Location: Pre-Treatment - Catch basin to to Infiltration Basin 2

TSS Removal Calculation

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 5%	0.05	1.00	0.05	0.95
Deep Sump and Hooded Catch Basin	0.25	0.95	0.24	0.71
Proprietary Treatment Practice	0.50	0.71	0.36	0.36
	0.00	0.36	0.00	0.36
	0.00	0.36	0.00	0.36

Total TSS Removal (Pre-treatment) = 64%

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

Project: Bulge Road Improvements

Prepared By: Elena Compter

Date: 1/6/2022

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

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

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

Location: TSS Removal - Full Treatment Train

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)
Street Sweeping - 5%	**0.05**	**1.00**	**0.05**	**0.95**
Deep Sump and Hooded Catch Basin	**0.25**	**0.95**	**0.24**	**0.71**
Infiltration Basin	**0.80**	**0.71**	**0.57**	**0.14**
	0.00	**0.14**	**0.00**	**0.14**
	0.00	**0.14**	**0.00**	**0.14**

Total TSS Removal = **86%**

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

Project: **Bulge Road Improvements**

Prepared By: **Elena Compter**

Date: **1/6/2022**

*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

Bulge Road Improvements

Phosphorus Reduction Calculation

Description of BMP

A surface stromwater infiltration basin is proposed to treat runoff from approximatly 2.826 acre watershed, which included 1.18 acres of open space and 1.64 acres of roadways in order to meet 50% Phosphorus reduction as required by MS4 report for Devens.

Calculation of phosphorus load reduction for BMP with known storage volume when both pervious and impervious drainage areas are present as outlined in Method 4 in the MA MS4 General Permit, Appendix F, Attachment 3

Step 1: **Identify contributing drainage area**

Impervious Area (IA) = 1.64 ac
Pervious Area (PA) = 1.18 ac (HSG A)

Step 2: **Determine Storage Volume of the structural BMP**

Storage Volume of infiltration basins below the lowest outfall is 9,534 cf from HydroCAD
BMP Volume =2856 cf

Step 3: **Determine BMP design storage volume in terms of runoff depth (in)**

To Determine what the BMP design storage volume is in terms of runoff depth (in) from IA, an iterative process is undertaken:

Solution Iteration 1:
For the first iteration (1), the BMP-Volume is converted into inches of runoff from the contributing impervious area

BMP Volume $_{(IA\text{-}in)1}$ =(2,856 ft^3 /1.64 acre) x (12 in/ft/43,560 ft^2/acre)
=0.48 in

Step 4-1 The total volume of Runoff (ft^3) from the contributing Pervious Area (BMP Volume $_{PA\text{-}ft^3}$) for a rainfall size equal to the sum of BMP Volume $_{(IA\text{-}in)}$1 determined in step 3 is determined for pervious area identified in step 1 using the information from Table 3-3 (attached). Interpolation was used to determine runoff depth corresponding to 0.48 in of runoff

BMP Volume $_{(PA\text{-}ft3)1}$ =(1.64 acre x 0.00 in) X 3,630 ft3/acre-in
=0 ft^3

Since runoff volume contributed by pervious area is negligible, entire infiltration volume is available to treat impervious runoff, therefore no further iterations are necessary

Step 5 The % of Phosphorus load reduction for the infiltration basin (BMP Reduction $_{\%P}$) is determined by using the infiltration basin performance curve for an infiltration rate of 8.27 in/hr (see attached Figure 3-12: BMP Performance Curve: Infiltration Basin (rate = 8.27in/hr)) and the treatment volume (BMP -Volume $_{Net\ IA\text{-}in}$ = 0.48 in) calculated in step 3. **BMP Reduction %P = 96%** which significantly exceeds the 50% Phosphorus Reduction as required by MS4 Permit

Step 6 The cumulative phosphorus load reduction in pounds of phosphorus (BMP - Reduction $_{lbs\text{-}P}$) for the proposed infiltration basin is calculated based on BMP Load and the P $_{target}$ of 96%

BMP Subarea ID	Land Use Category	Cover Type	Area (acres)	P export rate (lb/acre/yr)*
1	Open Space (	pervious	1.18	0.03
2	Highway	impervious	1.64	1.34

* From MA MS4 General Permit Table 3-1, Appendix F, Attachment 3

BMP Load $=(A_{open\ space} * PLER_{open\ space}) + (A_{highway} * PLER_{highway})$
=(1.18*0.03)+(1.64*1.34)
=2.23 lbs P/year

BMP-Reduction $_{lbs\text{-}P}$ = BMP Load x (P target/100)
= 2.23 lbs/year * 96/100
=2.14 lbs/year

APPENDIX D

Illicit Discharge Compliance Statement

Section I – Purpose/Intent

The purpose of this document is to provide for the health, safety, and general welfare of the citizens of Devens, Massachusetts through the regulation of non-stormwater discharges into existing outstanding resource areas near the proposed project site to the maximum extent practicable, as required by federal and state law. This document establishes methods for controlling the introduction of pollutants into existing outstanding resource areas to comply with requirements of the National Pollutant Discharge Elimination System (NPDES) permit process.

Section II - Definitions

For the purposes of this statement, the following shall mean:

Best Management Practices (BMPs): Schedules of activities, prohibitions of practices, general good housekeeping practices, pollution prevention and educational practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants directly or indirectly to stormwater, receiving waters, or stormwater conveyance systems. BMPs also include treatment practices, operating procedures, and practices to control site runoff, spillage or leaks, sludge or water disposal, or drainage from raw materials storage.

Clean Water Act: The federal Water Pollution Control Act (33 U.S.C § 1251 et seq.), and any subsequent amendments thereto.

Construction Activity: Activities subject to the Massachusetts Erosion and Sedimentation Control Act or NPDES Construction Permits. Such activities include but are not limited to clearing and grubbing, grading, excavating, and demolition.

Hazardous Materials: Any material, including any substance, waste, or combination thereof, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, a substantial present or potential hazard to human health, safety, property, or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Illegal Connection: An illegal connection is defined as either of the following:

a. Any pipe, open channel, drain or conveyance, whether on the surface or subsurface, which allows an illicit discharge to enter the outstanding resource area including but not limited to any conveyances which allow any non-stormwater discharge including sewage, process wastewater, and wash water, regardless of whether said drain or connection has been previously allowed, permitted, or approved by an authorized enforcement agency; or
b. Any pipe, open channel, drain or conveyance connected to Devens storm water treatment system which has not been documented in plans, maps, or equivalent records and approved by an authorized enforcement agency.

Illicit Discharge: Any direct or indirect non-stormwater discharge to Devens stormwater treatment system, except as exempted in Section II of this ordinance.

Industrial Activity: Activities subject to NPDES Industrial Permits as defined in 40CFR, Section 122.26 (b) (14).

National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit: A permit issued by MassDEP under authority delegated pursuant to 33 USC § 1342 (b) that authorizes the discharge of pollutants to waters of the United States, whether the permit is applicable on an individual, group, or general area-wide basis.

Devens Stormwater Treatment System: Any facility, owned or maintained by Devens, designed or used for collecting and/or conveying stormwater, including but not limited to roads with drainage systems, Devens streets, curbs, gutters, inlets, catch basins, piped storm drains, pumping facilities, infiltration, retention and detention basins, natural and man-made or altered drainage channels, reservoirs, and other drainage structures.

Non-Stormwater Discharge: Any discharge to the storm drain system that is not composed entirely of stormwater.

Person: Any individual, association, organization, partnership, firm, joint venture, public or private corporation, trust, estate, commission, board, public or private institution, utility, cooperative, city, county or other political subdivision of the State, interstate body, or any other legal entity.

Pollutant: Anything which causes or contributes to pollution. Pollutants may include, but are not limited to: paints, varnishes, and solvents; petroleum hydrocarbons; automotive fluids; cooking grease; detergents (biodegradable or otherwise); degreasers; cleaning chemicals; non-hazardous liquid and solid wastes; refuse, rubbish, garbage, litter, or other discarded or abandoned objects and accumulations, so that same may cause or contribute to pollution; floatables; pesticides, herbicides, and fertilizers; liquid and solid wastes; sewage, fecal coliform and pathogens; dissolved and particulate metals; animal wastes; wastes and residues that result from constructing a building or structure; concrete and cement; and noxious or offensive matter of any kind.

Pollution: Contamination or other alteration of any water's physical, chemical, or biological properties by addition of any constituent including but not limited to a change in temperature, taste, color, turbidity, or odor of such waters, or the discharge of any liquid, gaseous, solid, radioactive, or other substance into any such waters as will or is likely to create a nuisance or render such waters harmful, detrimental, or injurious to the public health, safety, welfare, or environment, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

Premises: Any building, lot, parcel of land, or portion of land whether improved or unimproved including adjacent sidewalks and parking strips.

Stormwater: Any surface flow, runoff, and drainage consisting entirely of water from any form of natural precipitation, and resulting from such precipitation.

Wastewater: Any water or other liquid discharged from a facility, that has been used, as for washing, flushing, or in a manufacturing process, and so contains waste products.

Section III - Prohibitions

Prohibition of Illicit Discharges:

No person shall throw, drain, or otherwise discharge, cause or allow others under its control to throw, drain, or otherwise discharge into Devens stormwater treatment system or watercourses any materials, including but not limited to, any pollutants or waters containing any pollutants, other than stormwater. The commencement, conduct or continuance of any illicit discharge to the storm drain system is prohibited except as described as follows:

1. Water line flushing performed by a government agency, other potable water sources, landscape irrigation or lawn watering, diverted stream flows, rising ground water, ground water infiltration to storm drains, uncontaminated pumped ground water, foundation or footing drains (not including active groundwater dewatering systems), crawl space pumps, air conditioning condensation, springs, natural riparian habitat or wetland flows, and any other water source not containing pollutants;

2. Discharges or flows from fire fighting, and other discharges specified in writing by Devens as being necessary to protect public health and safety;

3. Dye testing is an allowable discharge, but requires a verbal notification to Devens prior to the time of the test;

4. Any non-stormwater discharge permitted under an NPDES permit, waiver, or waste discharge order issued to the discharger and administered under the authority of the Federal Environmental Protection Agency, provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations, and provided that written approval has been granted for a discharge to Devens stormwater treatment system.

Section IV - Industrial or Construction Activity Discharges

Any person subject to an industrial or construction activity NPDES stormwater discharge permit shall comply with all provisions of such permit. Proof of compliance with said permit may be required in a form acceptable to the Devens Public Works Department prior to allowing discharges to the Devens stormwater treatment system.

Section V - Notification of Spills and Accidental Discharges

Notwithstanding other requirements of law, as soon as any person responsible for a facility, activity or operation, or responsible for emergency response for a facility, activity or operation has information of any known or suspected release of pollutants or non-stormwater discharges from that facility, activity, or operation which are resulting or may result in illicit discharges or pollutants discharging into stormwater, Devens stormwater treatment system, State Waters, or Waters of the U.S., said person shall take all necessary steps to ensure the discovery, containment, and cleanup of such release so as to minimize the effects of the discharge. In the event of such a release of hazardous materials, said person shall immediately notify emergency response agencies of the occurrence via emergency dispatch services. In the event of a release of non-hazardous materials, said person shall notify Devens Public Works Department in person or by phone no later than the next business day, including the nature, quantity and time of occurrence of the discharge. Notifications in person or by phone shall be confirmed by written notice, via certified mail return receipt requested addressed to Devens Public Works Department within three (3) business days of the initial notice. If the discharge of prohibited materials emanates from a commercial or industrial establishment, the owner or operator of such establishment shall also retain an on-site written record of the discharge and the actions taken to prevent its recurrence. Such records shall be retained for at least three years.

IN WITNESS WHEREOF the parties hereto have executed copies of this Agreement on the _____ day of _____, _____.

_____

Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan

SECTION 1: Introduction

The project consists of reconfiguring and reconstruction of the Patton Road and Bulge Road intersection and resurfacing and drainage improvements to 1,500 feet of Bulge Road. The improvements will take place within right-of-way of the above referenced streets. The work will include roadway resurfacing, curb and sidewalk construction, and drainage improvements that will consist of the removal and replacement of the old drainage system and construction of a new infiltration basin which will be compliant with current stormwater regulations and the municipal separate storm sewer system (MS4) permit for Devens.

As part of this project, this "Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan" has been created to ensure that no disturbance to the resource area occurs during the construction of these repairs.

SECTION 2: Construction Period Pollution Prevention Measures

Best Management Practices (BMPs) will be utilized as Construction Period Pollution Prevention Measures to reduce potential pollutants and prevent any off-site discharge. The objectives of the BMPs for construction activity are to minimize the disturbed areas, stabilize any disturbed areas, control the site perimeter and retain sediment. Both erosion and sedimentation controls and non-stormwater best management measures will be used to minimize site disturbance and ensure compliance with the performance standards of the Wetlands Protection Act (WPA) and MassDEP Stormwater Standards. Measures will be taken to minimize the area disturbed by construction activities to reduce the potential for soil erosion and stormwater pollution problems. In addition, good housekeeping measures will be followed for the day-to-day operation of the construction site under the control of the contractor to minimize the impact of construction. This section describes the control practices that will be in place during construction activities. All recommended control practices will comply with the standards set in the MassDEP Stormwater Handbook.

2.1 Minimize Disturbed Area and Protect Natural Features and Soil

To minimize disturbed areas, all work will be completed within well-defined work limits. These work limits are shown on the site plans included with this submission. The Contractor shall not disturb native vegetation in the undisturbed bank area without prior approval from the Engineer. The Contractor will be responsible to make sure that all workers know the proper work limits and do not extend their work into the undisturbed areas. The protective measures are described in more detail in the following sections.

2.2 Control Stormwater Flowing onto and through the project

The Contractor will be required to install straw wattles between the work area and the resource area.

2.3 Stabilize Soils

The Contractor shall limit the area of land which is exposed and free from vegetation during the project. The soils will be exposed for no longer that one week.

2.4 Proper storage and cover of any stockpiles

The location of the Contractor's storage areas for equipment and/or materials shall be upon cleared portions of the job site and shall require written approval of the Engineer.

Adequate measures for erosion and sediment control, such as the placement of straw wattles around the downstream perimeter of stockpiles, shall be employed to protect any downstream areas from siltation.

There shall be no storage of equipment or materials in the resource area.

The Engineer may designate an area or areas where the Contractor may store materials used in his operations.

2.5 Perimeter Controls and Sediment Barriers

Erosion control lines as described in Section 5 will be utilized to ensure that no sedimentation occurs outside the perimeter of the work area.

2.6 Storm Drain Inlet Protection

Catch basin protection will be implemented for all catch basins affected by the work area. Filter fabric will be placed over the catch basin to minimize sediment loading into the catch basin.

2.7 Retain Sediment On-Site

The Contractor will be responsible to monitor all erosion control measures. Whenever necessary, the Contractor will clear all sediment from the straw wattles. Daily monitoring should be conducted using the attached Inspection Form.

2.8 Material Handling and Waste Management

All materials stored on-site will be stored in a neat, orderly manner in appropriate containers. All materials will be kept in their original containers with the original manufacturer’s label. Substances will not be mixed with one another unless recommended by the manufacturer.

All waste materials will be collected and stored in a securely lidded metal container from a

licensed management company. The waste and any construction debris from the site will be hauled off-site daily and disposed of properly. The Contractor will be responsible for all waste removal. Manufacturer's recommendations for proper use and disposal will be followed for all materials.

2.9 Designated Washout Areas

The Contractor shall use washout facilities at their own plants, unless otherwise directed by the Engineer.

2.10 Proper Equipment/Vehicle Fueling and Maintenance Practices

On-site vehicles will be monitored for leaks and receive regular preventative maintenance to reduce the risk of leakage. To ensure that leaks on stored equipment do not contaminate the site, oil-absorbing mats will be placed under all equipment during storage. Regular fueling and service of the equipment may be performed using approved methods and with care taken to minimize chance of spills. Repair of equipment or machinery within the 100' of water resources area shall not be allowed without the prior approval of the Engineer. Any petroleum products will be stored in tightly sealed containers that are clearly labeled.

2.11 Equipment/Vehicle Washing

The Contractor will be responsible to ensure that no equipment is washed on site except to remove sediments prior to transport from the site.

SECTION 3: Spill Prevention and Control Plan

The Contractor will be responsible for preventing spills in accordance with the project specifications and applicable federal, state and local regulations. The Contractor will identify a properly trained site employee, involved with the day-to-day site operations to be the spill prevention and cleanup coordinator. The name(s) of the responsible spill personnel will be posted on-site. Each employee will be instructed that all spills are to be reported to the spill prevention and cleanup coordinator.

3.1 Spill Control Equipment

Spill control/containment equipment will be kept in the Work Area. Materials and equipment necessary for spill cleanup will be kept either in the Work Area or in an otherwise accessible on-site location. Equipment and materials will include, but not be limited to, absorbent booms/mats, brooms, dust pans, mops, rags, gloves, goggles, sand, plastic and metal containers specifically for this purpose. It is the responsibility of the Contractor to ensure the inventory will be readily accessible and maintained.

3.2 Notification

All workers will be directed to inform the on-site supervisor of a spill event. The supervisor will assess the incident and initiate proper containment and response procedures immediately upon

notification. Workers should avoid direct contact with spilled materials during the containment procedures. Primary notification of a spill should be made to the local Fire Department and Police Departments. Secondary Notification will be to the certified cleanup contractor if deemed necessary by Fire and/or Police personnel. The third level of notification is to the DEP. The specific cleanup contractor to be used will be identified by the Contractor prior to commencement of construction activities.

3.3 Spill Containment and Clean-Up Measures

Spills will be contained with granular sorbent material, sand, sorbent pads, booms or all the above to prevent spreading. Certified cleanup contractors should complete spill cleanup. The material manufacturer's recommended methods for spill cleanup will be clearly posted and on-site personnel will be made aware of the procedures and the location of the information and cleanup supplies.

3.4 Hazardous Materials Spill Report

The Contractor will report and record any spill. The spill report will present a description of the release, including the quantity and type of material, date of the spill, circumstances leading to the release, location of spill, response actions and personnel, documentation of notifications and corrective measures implemented to prevent reoccurrence.

This document does not relieve the Contractor of the Federal reporting requirements of 40 CFR Part 110, 40 CFR Part 117, 40 CFR Part 302 and the State requirements specified under the Massachusetts Contingency Plan (M.C.P) relating to spills or other releases of oils or hazardous substances. Where a release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity established under either 40 CFR Part 110, 40 CFR Part 117 or 40 CFR Part 302, occurs during a twenty-four (24) hour period, the Contractor is required to comply with the response requirements of the above-mentioned regulations. Spills of oil or hazardous material in excess of the reportable quantity will be reported to the National Response Center (NRC).

SECTION 4: Contact Information/Responsible Parties

Owner/Operator:
Mass Development
33 Andrews Parkway
Devens, MA 01434
(978) 784-2900

Engineer:
Laurence F. Keegan, Jr, PE
Weston & Sampson, Inc.
100 Foxborough Blvd, Suite 250
Foxborough, MA 02035
(508) 698-3034

Site Inspector:
TBD

Contractor:
TBD

SECTION 5: Erosion and Sedimentation Control

Erosion and Sedimentation Control details and layout can be found in the attached plan set. In addition, a technical specification (Section 01570, Environmental Protection) has been included with this report, which details all Erosion and Sedimentation controls.

SECTION 6: Site Development Plan

The Site Development Plan is included in the plan set submitted with the Request for Determination (RDA).

SECTION 7: Operation and Maintenance of Erosion Control

The erosion control measures will be installed as detailed in the technical specification Section 01570, Environmental Protection. If there is a failure to the controls, the Contractor will be required to stop work until the failure is repaired.

Periodically throughout the work, whenever the Engineer deems it necessary, the sediment that has been deposited against the controls will be removed to ensure that the controls are working properly.

SECTION 8: Inspection Schedule

During construction, the erosion and sedimentation controls will be inspected daily. Once the contractor is selected, an on-site inspector will be selected to work closely with the Engineer to ensure that all erosion and sedimentation controls are in place and working properly. An Inspection Form is included.

Inspection Form

Inspected By: _____ Date: _____Time:_____

YES	NO	DOES NOT APPLY	ITEM
			Do any erosion/siltation control measures require repair or clean out to maintain adequate function?
			Is there any evidence that sediment is leaving the site and entering the wetlands?
			Are any temporary soil stockpiles or construction materials located in non-approved areas?
			Are on-site construction traffic routes, parking, and storage of equipment and supplies located in areas not specifically designed for them?

Specific location, current weather conditions, and action to be taken:

_____

_____

_____

_____

_____

Other Comments:

_____

_____

Pending the actions noted above I certify that the site is in compliance with the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan.

Signature: _____ Date: _____

Illicit Discharge Compliance Statement

Section I – Purpose/Intent

The purpose of this document is to provide for the health, safety, and general welfare of the citizens of Devens, Massachusetts through the regulation of non-stormwater discharges into existing outstanding resource areas near the proposed project site to the maximum extent practicable, as required by federal and state law. This document establishes methods for controlling the introduction of pollutants into existing outstanding resource areas to comply with requirements of the National Pollutant Discharge Elimination System (NPDES) permit process.

Section II - Definitions

For the purposes of this statement, the following shall mean:

Best Management Practices (BMPs): Schedules of activities, prohibitions of practices, general good housekeeping practices, pollution prevention and educational practices, maintenance procedures, and other management practices to prevent or reduce the discharge of pollutants directly or indirectly to stormwater, receiving waters, or stormwater conveyance systems. BMPs also include treatment practices, operating procedures, and practices to control site runoff, spillage or leaks, sludge or water disposal, or drainage from raw materials storage.

Clean Water Act: The federal Water Pollution Control Act (33 U.S.C § 1251 et seq.), and any subsequent amendments thereto.

Construction Activity: Activities subject to the Massachusetts Erosion and Sedimentation Control Act or NPDES Construction Permits. Such activities include but are not limited to clearing and grubbing, grading, excavating, and demolition.

Hazardous Materials: Any material, including any substance, waste, or combination thereof, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, a substantial present or potential hazard to human health, safety, property, or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

Illegal Connection: An illegal connection is defined as either of the following:

a. Any pipe, open channel, drain or conveyance, whether on the surface or subsurface, which allows an illicit discharge to enter the outstanding resource area including but not limited to any conveyances which allow any non-stormwater discharge including sewage, process wastewater, and wash water, regardless of whether said drain or connection has been previously allowed, permitted, or approved by an authorized enforcement agency; or
b. Any pipe, open channel, drain or conveyance connected to Devens storm water treatment system which has not been documented in plans, maps, or equivalent records and approved by an authorized enforcement agency.

Illicit Discharge: Any direct or indirect non-stormwater discharge to Devens stormwater treatment system, except as exempted in Section II of this ordinance.

Industrial Activity: Activities subject to NPDES Industrial Permits as defined in 40CFR, Section 122.26 (b) (14).

National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit: A permit issued by MassDEP under authority delegated pursuant to 33 USC § 1342 (b) that authorizes the discharge of pollutants to waters of the United States, whether the permit is applicable on an individual, group, or general area-wide basis.

Devens Stormwater Treatment System: Any facility, owned or maintained by Devens, designed or used for collecting and/or conveying stormwater, including but not limited to roads with drainage systems, Devens streets, curbs, gutters, inlets, catch basins, piped storm drains, pumping facilities, infiltration, retention and detention basins, natural and man-made or altered drainage channels, reservoirs, and other drainage structures.

Non-Stormwater Discharge: Any discharge to the storm drain system that is not composed entirely of stormwater.

Person: Any individual, association, organization, partnership, firm, joint venture, public or private corporation, trust, estate, commission, board, public or private institution, utility, cooperative, city, county or other political subdivision of the State, interstate body, or any other legal entity.

Pollutant: Anything which causes or contributes to pollution. Pollutants may include, but are not limited to: paints, varnishes, and solvents; petroleum hydrocarbons; automotive fluids; cooking grease; detergents (biodegradable or otherwise); degreasers; cleaning chemicals; non-hazardous liquid and solid wastes; refuse, rubbish, garbage, litter, or other discarded or abandoned objects and accumulations, so that same may cause or contribute to pollution; floatables; pesticides, herbicides, and fertilizers; liquid and solid wastes; sewage, fecal coliform and pathogens; dissolved and particulate metals; animal wastes; wastes and residues that result from constructing a building or structure; concrete and cement; and noxious or offensive matter of any kind.

Pollution: Contamination or other alteration of any water's physical, chemical, or biological properties by addition of any constituent including but not limited to a change in temperature, taste, color, turbidity, or odor of such waters, or the discharge of any liquid, gaseous, solid, radioactive, or other substance into any such waters as will or is likely to create a nuisance or render such waters harmful, detrimental, or injurious to the public health, safety, welfare, or environment, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

Premises: Any building, lot, parcel of land, or portion of land whether improved or unimproved including adjacent sidewalks and parking strips.

Stormwater: Any surface flow, runoff, and drainage consisting entirely of water from any form of natural precipitation, and resulting from such precipitation.

Wastewater: Any water or other liquid discharged from a facility, that has been used, as for washing, flushing, or in a manufacturing process, and so contains waste products.

Section III - Prohibitions

Prohibition of Illicit Discharges:

No person shall throw, drain, or otherwise discharge, cause or allow others under its control to throw, drain, or otherwise discharge into Devens stormwater treatment system or watercourses any materials, including but not limited to, any pollutants or waters containing any pollutants, other than stormwater. The commencement, conduct or continuance of any illicit discharge to the storm drain system is prohibited except as described as follows:

1. Water line flushing performed by a government agency, other potable water sources, landscape irrigation or lawn watering, diverted stream flows, rising ground water, ground water infiltration to storm drains, uncontaminated pumped ground water, foundation or footing drains (not including active groundwater dewatering systems), crawl space pumps, air conditioning condensation, springs, natural riparian habitat or wetland flows, and any other water source not containing pollutants;

2. Discharges or flows from fire fighting, and other discharges specified in writing by Devens as being necessary to protect public health and safety;

3. Dye testing is an allowable discharge, but requires a verbal notification to Devens prior to the time of the test;

4. Any non-stormwater discharge permitted under an NPDES permit, waiver, or waste discharge order issued to the discharger and administered under the authority of the Federal Environmental Protection Agency, provided that the discharger is in full compliance with all requirements of the permit, waiver, or order and other applicable laws and regulations, and provided that written approval has been granted for a discharge to Devens stormwater treatment system.

Section IV - Industrial or Construction Activity Discharges

Any person subject to an industrial or construction activity NPDES stormwater discharge permit shall comply with all provisions of such permit. Proof of compliance with said permit may be required in a form acceptable to the Devens Public Works Department prior to allowing discharges to the Devens stormwater treatment system.

Section V - Notification of Spills and Accidental Discharges

Notwithstanding other requirements of law, as soon as any person responsible for a facility, activity or operation, or responsible for emergency response for a facility, activity or operation has information of any known or suspected release of pollutants or non-stormwater discharges from that facility, activity, or operation which are resulting or may result in illicit discharges or pollutants discharging into stormwater, Devens stormwater treatment system, State Waters, or Waters of the U.S., said person shall take all necessary steps to ensure the discovery, containment, and cleanup of such release so as to minimize the effects of the discharge. In the event of such a release of hazardous materials, said person shall immediately notify emergency response agencies of the occurrence via emergency dispatch services. In the event of a release of non-hazardous materials, said person shall notify Devens Public Works Department in person or by phone no later than the next business day, including the nature, quantity and time of occurrence of the discharge. Notifications in person or by phone shall be confirmed by written notice, via certified mail return receipt requested addressed to Devens Public Works Department within three (3) business days of the initial notice. If the discharge of prohibited materials emanates from a commercial or industrial establishment, the owner or operator of such establishment shall also retain an on-site written record of the discharge and the actions taken to prevent its recurrence. Such records shall be retained for at least three years.

IN WITNESS WHEREOF the parties hereto have executed copies of this Agreement on the _____ day of _____, _____.

_____

Operations and Maintenance Plan

Bulge Road and Patton Road Intersection Improvements

Devens, Massachusetts

February 2022

Weston & Sampson
100 Foxborough Boulevard
Suite 250
Foxboro, MA 02035

www.westonandsapmson.com
Tel: 508-698-3034

Table of Contents

1.0 Introduction

The following document has been written to comply with the stormwater guidelines set forth by the Massachusetts Department of Environmental Protection (MassDEP). The intent of these guidelines is to encourage Low Impact Development techniques to improve the quality of the stormwater runoff. These techniques, also known as Best Management Practices (BMPs) collect, store, and treat the runoff before discharging to adjacent environmental resources.

2.0 Responsible parties

MassDevelopment
ATTN: John Marc-Aurele
33 Andrews Parkway
Devens, MA 01434
(978)784-2900

3.0 Purpose

This Operation and Maintenance Plan (O&M Plan) is intended to provide a mechanism for the consistent inspection and maintenance of each BMP installed on the project site. Included in this O&M Plan is a description of each BMP type and an inspection form for each BMP. Devens is the owner and operator of the system and is responsible for its upkeep and maintenance. This work will be funded on an annual basis through Devens operating budget. The estimated budget to maintain these BMPs utilizing is approximately $5,000 per year.

In the event the Owner sells the property, it is the Owner's responsibility to transfer this plan, as well as the past three years of operation and maintenance records, to the new property owner.

4.0 BMP Description and Locations

Proposed BMP's are described below and identified on the BMP Location Map included in Appendix A of O&M Plan.

4.1 Deep Sump Catch Basins

There are several deep sump catch basins that collect stormwater runoff in the project area. Deep sump catch basins are part are collection systems that are designed to remove trash, debris, and coarse sediment from the stormwater runoff. Catch basins will be equipped with "Eliminator" hoods, which is designed to trap oil and debris within a catch basin preventing pollutants from traveling downstream.

4.2 Street Sweeping

Street Sweeping involves the use of mechanical street sweeping equipment which utilizes brooms or rotary brushes to scour the pavement to improve TSS removal from strormwater. Street sweeping is part of good housekeeping measures that help to keep the pavement clear of sediment buildup.

4.3 Infiltration Basin

There are two infiltration basins within project area that will receive stormwater. The infiltration basin stores and/or attenuates runoff from the storm events until the runoff exfiltrates through the basin floor or discharges over the spillways.

4.4 Stormwater Treatment Structures

There are four stormwater treatment structures on site. These structures are hydrodynamic separators, designed to slow stormwater down and allow oil and debris to rise and sediment to settle out.

5.0 Inspection, Maintenance Checklist and Schedule

5.1 Deep Sump Catch Basins

Inspect and/or clean catch basins at least four times per year and at the end of foliage and snow removal seasons. Sediments must be removed whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. Each catch basin should be cleaned a minimum of four times per year regardless of the amount of sediment in the basin. They shall be cleaned using clamshell buckets or vacuum trucks.

In the event of contamination by a spill or other means, all cleanings must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000 and handled as hazardous waste.

In the absence of evidence of contamination, catch basin cleanings may be taken to a landfill or other facility permitted by MassDEP to accept Solid Waste without any prior approval by MassDEP. Please note that current MassDEP regulations prevent landfills from accepting materials that contain free-draining liquids.

5.2 Infiltration Basin

Infiltration basin should be inspected at least twice per year and after any storm event in which the drainage discharges through the highest outlet. Once a basin is in use, it should be inspected after every major storm for the first few months to ensure it is stabilized and is functioning properly. Take corrective actions if the system is not functioning properly.

Upon establishing that the system is functioning properly, the basin shall be inspected at least twice per year. The following items should be checked:

- Signs of differential settlement
- Cracking
- Erosion
- Leakage in embankments
- Tree growth on the embankments
- Condition of riprap
- Sedimentation accumulation
- Health of the turf
- Draining completely within 72 hours of rain events
- Outlet control structure orifices

At least twice per year, mow the basin area, side slopes, and basin bottom. Remove all grass clippings and accumulated organic matter to prevent an impervious organic mat from forming. In addition, remove all trash, debris, and sediment from the basin bottom. Sediment shall only be removed when the bottom of the basin is thoroughly dry and shall be accomplished with eh use of light equipment. All accumulated sediment and debris in the infiltration basins should be removed and disposed of according to local, state and federal regulations. During the growing season, vegetation should not exceed six inches in height in the infiltration basin and should be mowed as necessary. Any grassed areas near areas that use salt in deicing applications should be re-seeded in the spring. Bare spots should be re-seeded as needed.

5.3 Stormwater Treatment Structure

Stormwater treatment structures shall be inspected every six months for the first year. Following the first year, the structures can be inspected a minimum of once per year or as first year data indicates. After a hazardous spill, structures shall be inspected immediately. The structures shall be cleaned a minimum of once per year or when the sediment depth is 15% of its capacity. Polluted water, sediments, and debris should be disposed of in accordance with local, state, and federal regulations.

5.4 Flared Ends/Headwalls

All inlet and outlet channels and structures including flared ends and headwall, and roof drains shall be inspected and cleaned twice a year and after heavy rainstorms. Sediment and debris should be removed by hand and disposed of in accordance with local, state and federal regulations.

6.0 Documentation and Record Keeping

- An inspection form should be filled out every time maintenance work is performed.

- A binder should be kept at the Devens DPW that contains all the completed inspection forms and any other related materials. All operation and maintenance log forms for the last three years, at a minimum, shall be kept at Devens DPW.

- A review of all Operation & Maintenance actions should take place annually to ensure that these Stormwater BMPs are being taken care of in the manner illustrated in this Operation & Maintenance Plan.

- The inspection and maintenance schedule may be refined in the future based on the findings and results of this operation and maintenance program or policy.

- The owner of the property shall maintain a log of disposal activities which shall include the types of material disposed and disposal locations.

- The owner shall submit annual stormwater monitoring and maintenance report to the DEC addressing inspection and maintenance of the BMPs. The report shall include:

    - Descriptions of the conditions of the BMPs
    - Descriptions of maintenance performed and
    - Receipts for maintenance performed.

Bulge Road and Patton Road Intersection Improvements
Devens, MA
Permanent BMP Inspection Checklist

Street Sweeping

Frequency: Street sweeping shall be done quarterly.

Inspected By: _____ Date: _____
Observations: _____
_____
_____

Actions Taken: _____
_____
_____

Instructions: Sweep all paved areas of sediment and debris. Dispose of sediment and debris in accordance with local, state, and federal laws.

Deep Sump Catch Basins

Frequency:	Inspect and clean deep sump catch basins and leaching galleys in March, June, September and December.
Structure Number:	_____
Inspected By:	_____ Date: _____
Observations:	_____ _____ _____
Actions Taken:	_____ _____ _____
Instructions:	Clean unit four times per year or whenever the depth of the deposits is greater than or equal to one half the depth from the bottom of the invert to lowest pipe in the basin/galley.

Stormwater Treatment Structure

Frequency:	Inspect every six months for the first year and minimum once per year following the first year. After a hazardous spill, structures shall be inspected immediately.
Structure Number:	_____
Inspected By:	_____ Date: _____
Observations:	_____ _____ _____
Actions Taken:	_____ _____ _____
Instructions:	Clean unit when the sediment depth is 15% of its capacity. Dispose of sediment and debris in accordance with local, state, and federal laws.

Infiltration Basin

Frequency: The basin shall be inspected at least twice per year (preferably in May and November) and after major storm events. At least twice a year, mow the basin area, side slopes, and basin bottom. At least twice a year, the outlet control structure should be inspected, and any accumulated sediment shall be removed.

Inspected By: _____ Date: _____

Observations: _____
_____
_____

Actions Taken: _____
_____
_____

Instructions: The following items should be checked:

1. Signs of differential settlement
2. Cracking
3. Erosion
4. Leakage in embankments
5. Tree growth on the embankments
6. Condition of riprap
7. Sedimentation accumulation
8. Health of the turf
9. Draining completely w/in 72 hrs. of rain events
10. Outlet control structure orifices

When mowing is conducted, remove all grass clippings and accumulated organic matter to prevent an impervious organic mat from forming. In addition, remove all trash, debris, and sediment from the basin bottom. Sediment shall only be removed when the bottom of the basin is thoroughly dry and shall be accomplished with the use of light equipment. Removal activities shall remove the top layer without compacting the underlying soil. Repair damage to vegetated areas by deep tilling and re-vegetating accordingly. All sediment and debris should be disposed of in accordance with local, state, and federal regulations.