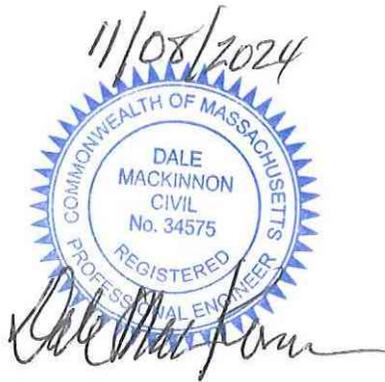


Stormwater Report
for
Site Plan Modification
124-126 Grove Street
Franklin, MA

Date: November 5, 2024

Prepared By:
Guerriere & Halnon, Inc.
55 West Central Street
Franklin, MA. 02038



Prepared for:
Key Boston, Inc.
126 Grove Street
Franklin, MA 02038



**Guerriere &
Halnon, Inc.**
ENGINEERING & LAND SURVEYING

F-4593



Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.¹ This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8²
- Operation and Maintenance Plan required by Standard 9

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

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

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

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

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



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

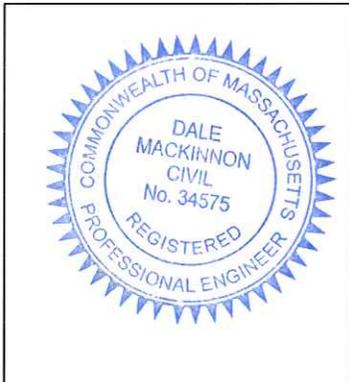
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Dale Mackinnon 11/08/2024
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 Field¹
- Runoff from all impervious areas at the site discharging to the infiltration BMP.
- Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - Site is comprised solely of C and D soils and/or bedrock at the land surface
 - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - Solid Waste Landfill pursuant to 310 CMR 19.000
 - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

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

- Good housekeeping practices;
 - Provisions for storing materials and waste products inside or under cover;
 - Vehicle washing controls;
 - Requirements for routine inspections and maintenance of stormwater BMPs;
 - Spill prevention and response plans;
 - Provisions for maintenance of lawns, gardens, and other landscaped areas;
 - Requirements for storage and use of fertilizers, herbicides, and pesticides;
 - Pet waste management provisions;
 - Provisions for operation and management of septic systems;
 - Provisions for solid waste management;
 - Snow disposal and plowing plans relative to Wetland Resource Areas;
 - Winter Road Salt and/or Sand Use and Storage restrictions;
 - Street sweeping schedules;
 - Provisions for prevention of illicit discharges to the stormwater management system;
 - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
 - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
 - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
 - Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - is within the Zone II or Interim Wellhead Protection Area
 - is near or to other critical areas
 - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - involves runoff from land uses with higher potential pollutant loads.
 - The Required Water Quality Volume is reduced through use of the LID site Design Credits.
 - Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
 - The ½" or 1" Water Quality Volume or
 - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does **not** cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
 - Limited Project
 - Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - Bike Path and/or Foot Path
 - Redevelopment Project
 - Redevelopment portion of mix of new and redevelopment.
- Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

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

- Narrative;
 - Construction Period Operation and Maintenance Plan;
 - Names of Persons or Entity Responsible for Plan Compliance;
 - Construction Period Pollution Prevention Measures;
 - Erosion and Sedimentation Control Plan Drawings;
 - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
 - Vegetation Planning;
 - Site Development Plan;
 - Construction Sequencing Plan;
 - Sequencing of Erosion and Sedimentation Controls;
 - Operation and Maintenance of Erosion and Sedimentation Controls;
 - Inspection Schedule;
 - Maintenance Schedule;
 - Inspection and Maintenance Log Form.
- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- The project is **not** covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - Name of the stormwater management system owners;
 - Party responsible for operation and maintenance;
 - Schedule for implementation of routine and non-routine maintenance tasks;
 - Plan showing the location of all stormwater BMPs maintenance access areas;
 - Description and delineation of public safety features;
 - Estimated operation and maintenance budget; and
 - Operation and Maintenance Log Form.
- The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- An Illicit Discharge Compliance Statement is attached;
- NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

Table of Contents

- Narrative
- Stormwater Design Parameters
- Massachusetts Stormwater Management Standards 1-10
- **Attachments**
 - Pre and Post Watershed Development Condition
- Hydro CAD Calculations
(Pre-Post Development Conditions 2, 10, 25, 100-Year Storm Events)
- Street Drain Calculations – Rational Method and Catchment Area Calculation
- NCRS Soil Survey
- Basin Drawdown Tabulation for (100-Yr)
- TSS Removal Calculations
- Contech worksheet

NARRATIVE

This report was prepared on behalf of the applicant, Key Boston, Inc. The project site encompasses an area of 1,086,116 +/- sf. (24.93 +/-Ac.) owned by NEAG Real Estate, LLC and to be developed by the applicant. The property is bordered by commercial properties to the north and east, wetlands and a industrial building to the south, and a single family home with associated agricultural land use to the west. The site is located within the Industrial zoning district and has primary site access from Grove Street from two existing driveways. Portions of the site contain bordering vegetated wetlands and their associated jurisdictional buffers, and portions of the site are located within the Franklin water resource district. The site is not located within a FEMA flood zone. The existing site is presently developed with a 269,105 +/-sf (6.18+/- AC) Warehouse building, with associated parking, utilities, drainage, and landscaping.

PROJECT DESCRIPTION

The Applicant is proposing to construct a 85,150sf +/- addition on the north side of the existing building. The existing northern site entrance will service new loading docks on the west face of the proposed addition, and a new site entrance from Prime Park east of the proposed addition (a private shared driveway located on 124 Grove Street, in common ownership with the project property) is proposed east of the existing building expand the southeast truck, loading, parking and maneuvering area, and expand passenger vehicle parking areas near the main entrance. To support the proposed development, the applicant also proposed to construct associated utilities, drainage, grading, and landscaping, as well as modifications to existing site features and infrastructure. The topography consists of natural and constructed slopes ranging from 0% to 50% grade. Portions of existing basins #2 and #3 contain isolated vegetated wetlands as delineated by the ORAD issued 2/13/2024, MassDEP file# 159-1274.

DESCRIPTION OF EXISTING DRAINAGE

The existing developed site drains principally from north to south via a conventional catch basin and manhole system, with captured runoff routed to three existing stormwater basins for treatment, detention, and infiltration, prior to excess flows being discharged to the existing wetlands located on the southern portion of the site. The pre-development drainage area is modeled as eight hydrologic areas. These hydrologic areas are shown on the Pre-Development Watershed Plan attached to this report and are denoted as EX-1 through EX-8.

EX-1, located north of the existing building, contains approximately 123,165 square feet of contributing area, and includes all land which drains directly to the existing basin #3, excluding roof runoff from the existing building. Pavement and other impervious areas are captured by a conventional catch basin and manhole system. Excess runoff from this basin is conveyed by pipe to basin #2 for additional detention and infiltration prior to discharge to the southern bordering vegetated wetlands, AP-1.

EX-2, located west of the existing building, contains approximately 49,694 square feet of contributing area, and includes land which drains overland to existing basin #1 from the western parking area via existing paved & unpaved swales. Excess runoff from this basin is conveyed by pipe to basin #2 for additional detention, treatment and infiltration prior to discharge to the southern bordering vegetated wetlands, AP-1.

EX-3, located south of the existing building, contains approximately 92,774 square feet of contributing area, and includes all land which drains directly to the western forebay of existing basin #2. Pavement and other impervious areas are captured by a conventional catch basin and manhole system, merging with excess runoff from basin #1.

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Basin #2 provides detention, treatment, and infiltration prior to discharge to the southern bordering vegetated wetlands, AP-1.

EX-4, located east and southeast of the existing building, contains approximately 38,175 square feet of contributing area, and includes all land which drains directly to the eastern forebay of existing basin #2. Pavement and other impervious areas are captured by a conventional catch basin and manhole system, merging with excess runoff from basin #3. Basin #2 provides detention, treatment, and infiltration prior to discharge to the southern bordering vegetated wetlands, AP-1.

EX-5, located at the southern edge of the developed site, contains approximately 121,653 square feet of contributing area, consists primarily of wooded slopes, and contains all land within the project area not captured by existing drainage infrastructure. Runoff from this hydrologic area flows overland to the bordering vegetated wetlands, AP-1.

EX-6, located south of watershed EX-4, contains approximately 68,451 square feet of contributing area, and includes all land which drains overland directly to existing basin #2. Basin #2 provides detention, treatment, and infiltration prior to discharge to the southern bordering vegetated wetlands, AP-1.

EX-7 contains approximately 269,289 square feet of contributing area and consists of the existing building's roof area. Runoff from the existing roof is conveyed by pipe to existing basin #3. Excess runoff from this basin is conveyed by pipe to basin #2 for additional detention and infiltration prior to discharge to the southern bordering vegetated wetlands, AP-1.

EX-8, located south of basin #1, contains approximately 23,544 square feet of contributing area, and includes land captured by existing catch basins within the southwest parking area and conveyed by pipe to existing basin #1. Pavement and other impervious areas are captured by a conventional catch basin and manhole system. Excess runoff from this basin is conveyed by pipe to basin #2 for additional detention and infiltration prior to discharge to the southern bordering vegetated wetlands, AP-1.

DESCRIPTION OF PROPOSED DRAINAGE FACILITIES

The proposed drainage system to manage stormwater from the propose development consists of Deep Sump Hooded Catch Basins, Contech CS-6 and CS-8 Cascade Hydrodynamic Separators, Infiltration Basins, and a subsurface pipe detention system. Stormwater from sidewalks, driveways, and parking areas are collected and conveyed by a conventional catch basin and drain manhole system to the infiltration basins and subsurface detention system for treatment, detention, and infiltration. Stormwater from the roof of the proposed building is directed to the proposed detention basin or chambers prior to being conveyed to the forebays/infiltration basins for infiltration. Existing basin #3 and part of existing basin #2 are to be filled during construction.

In the Post-Development condition, nine hydrologic areas were considered. These watershed areas consider the pavement, lawns, sidewalks, roofs, and drainage facilities proposed to be constructed. These hydrologic areas are shown on the Post-Development Watershed Plan attached to this report and are denoted as PR-1 through PR-9.

PR-1 contains approximately 5,245 square feet of contributing area and includes the narrow strip of land north of the proposed addition which is captured by existing catch basins located in Prime Park. Runoff is conveyed by pipe to the East and then discharged to the existing drainage system at 124 Grove Street, which discharges to the bordering vegetated wetland, AP-1.

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PR-2, located west of the existing building, contains approximately 49,958 square feet of contributing area, and includes land which drains overland to existing basin #1 from the existing and proposed western parking areas via paved & unpaved swales. Excess runoff from this basin is conveyed by pipe to the subsurface detention system and basin #2 for additional detention, treatment and infiltration prior to discharge to the southern bordering vegetated wetlands, AP-1.

PR-3, located south of the existing building, contains approximately 113,186 square feet of contributing area, and includes all land which drains directly to the western Contech CS-6 Separator. Pavement and other impervious areas are captured by a conventional catch basin and manhole system, merge with excess runoff from basin #1 and discharges to the proposed subsurface detention system and basin #2 for detention, treatment, and infiltration prior to discharge to the bordering vegetated wetlands, AP-1.

PR-4, located southeast of the existing building, contains approximately 56,112 square feet of contributing area, and includes all land which drains directly to the eastern Contech CS-8 Separator. Pavement and other impervious areas are captured by a conventional catch basin and manhole system, merge with runoff from PR-7 and PR-9, and discharges to the proposed subsurface detention system and basin #2 for detention, treatment, and infiltration prior to discharge to the bordering vegetated wetlands, AP-1.

PR-5, located at the southern edge of the developed site, contains approximately 89,348 square feet of contributing area, consists primarily of wooded slopes, and contains all land within the project area not captured by existing drainage infrastructure. Runoff from this hydrologic area flows overland to the bordering vegetated wetlands, AP-1.

PR-6, located south of watershed PR-4, contains approximately 44,275 square feet of contributing area, and includes all land which drains overland directly to existing basin #2. Basin #2 provides detention, treatment, and infiltration prior to discharge to the southern bordering vegetated wetlands, AP-1.

PR-7 contains approximately 354,459 square feet of contributing area consist of the existing and proposed roof area. Runoff is conveyed by pipe, merges with runoff from PR-4 and PR-9, and discharges to the proposed subsurface detention system and basin #2 for detention, treatment, and infiltration prior to discharge to the bordering vegetated wetlands, AP-1.

PR-8, located south of basin #1, contains approximately 26,155 square feet of contributing area, and includes land captured by existing catch basins within the southwest parking area and conveyed by pipe to existing basin #1. Pavement and other impervious areas are captured by a conventional catch basin and manhole system. Excess runoff from this basin is conveyed by pipe to the proposed subsurface detention system and basin #2 for additional detention and infiltration prior to discharge to the southern bordering vegetated wetlands, AP-1.

PR-9, located west of the proposed addition, contains approximately 33,755 square feet of contributing area, and includes all land which drains to the proposed catch basins in the proposed loading dock area. Pavement and other impervious areas are captured by a conventional catch basin and manhole system, merge with runoff from PR-4 and PR-7, and discharges to the proposed subsurface detention system and basin #2 for detention, treatment, and infiltration prior to discharge to the bordering vegetated wetlands, AP-1.

PR-10, located south of PR-8, contains approximately 14,533 square feet of contributing area and includes all land which drains to proposed catch basin CB 24-1. runoff is conveyed by pipe to the east and merges with flows from PR-3 and basin #1, discharging to the proposed subsurface detention system and basin #2 for detention, treatment, and infiltration prior to discharge to the bordering vegetated wetlands, AP-1.

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This report documents design compliance with the applicable sections of the Massachusetts Stormwater Management Standards 1-10.

Stormwater Design Parameters:

The stormwater management system was designed to control the post-development rate of peak rainfall runoff from the site by keeping it below the post-development peak rate of rainfall runoff as stated as the objective in the Massachusetts Stormwater Handbook. The calculations were performed using the HydroCAD hydraulic program, developed by applied Microcomputer System. The HydroCAD software is based upon the Soil Conservation Service, “Technical Release 55 – Urban Hydrology for Small Watersheds” and is generally accepted industry methodology.

The analysis was performed for the 2-year, 10-year, 25-year, and 100-year 24-hour storm events.

The following data was required for input:

- Watershed Area: Areas of each watershed were calculated and expressed in square feet for these calculations.
- SCS Curve Number (Cn): Based on the cover type and hydrologic soil group, a weighted curve number (CN) was determined for each of the existing watersheds utilizing Table 2-2a- *Runoff Curve Numbers For Urban Areas* and *Worksheet 2, Runoff Curve Number and Runoff* from the Soil Conservation Service Technical Release 55 – Urban Hydrology for Small Watersheds.
- Time of Concentration, Tc (Minutes): The time of concentration for each watershed was determined by finding the time necessary for runoff to travel from the hydraulically most distant point in the watershed to the point of analysis. This was calculated by using a minimum time of 6 minutes for runoff to reach the most distant catch basin.
- SCS 24-Hour Storm Type: For the greater New England region, a Type III storm rainfall distribution is recommended for drainage calculations and was used for this project.
- Rainfall Precipitation: Rainfall precipitations used the Atlas-14 Volume 10, Version 3 rainfall estimates for the site, obtained from the NOAA Precipitation Frequency Data Server (PFDS) for the 2, 10, 25, and 100 year storm events and are as follows:

2-year storm event:	3.36 inches
10-year storm event:	5.22 inches
25-year storm event:	6.39 inches
100-year storm event:	8.18 inches

An on-site conventional storm drainage collection system is designed based on the “Rational Method” using Manning’s equation to carry a minimum 25-year storm event and underground culverts to carry a minimum 50-year storm event through the site (See Pipe Sizing Attachments). The proposed drainage pipes will be Reinforced Concrete Pipe (RCP), unless otherwise noted on the plans.

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

All runoff from impervious areas will sheet flow across the pavement areas, accumulate into hooded catch basins, connect with drain pipe to a chamber system with separator row or sediment forebay, and discharge to the infiltration basins. No new untreated stormwater discharges are proposed.

Standard 2: Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates.

To meet Standard 2, the post-development peak discharge rate must be equal to or less than pre-development rates to prevent storm damage and downstream and offsite flooding from the 2-year, 10-year, and 100 year 24-hour storm events.

Peak discharge rates volumes were calculated and evaluated at one analysis point. The point of evaluation is shown on the accompanying watershed plans. The projects discharges to Grove Street or abutting properties are de minimis in both the existing and proposed conditions and were not included as separate analysis points in the stormwater analysis.

In summary of the attached drainage analysis (HydroCAD), the peak discharge rates at the point of evaluation in cubic feet per second (cfs) are as follows;

Storm Events	Run off			
	Pre-dev. (cfs)[af]	Proposed (cfs)[af]	Change (cfs)[af]	
Analysis Point 1 (AP-1)	2-year	(0.07)[0.131]	(0.02)[0.011]	(-0.05)[-0.120]
	10-year	(1.69)[2.067]	(1.56)[1.127]	(-0.13)[-0.940]
	25-year	(2.94)[3.409]	(2.93)[2.677]	(-0.01)[-0.732]
	100-year	(5.28)[5.581]	(4.82)[5.113]	(-0.46)[-0.468]

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

Soil Evaluation

Soil evaluation is broken down into two stages. Stage 1 identifies the underlying soils just beneath the surface that contribute to how much runoff is generated as stormwater falls and moves across the surface. Stage 2 evaluates the soils in direct contact with the proposed infiltration BMPs. The attachments section includes the NRCS Soil Survey used for Stage 1 while the site plan set includes the on-site soil textural analysis in the specific locations that infiltration is proposed. The information from the NRCS Soil Survey is included on the Pre and Post Development Watershed Plans.

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Recharge Volume

Soils underlying the site are defined as map unit 10 Scarboro and Birdsall soils, 0 to 3 percent slopes, 71B Ridgebury fine sandy loam, 3 to 8 percent slopes – extremely stony, 103B Charlton-Hollis-Rock Outcrop complex, 3 to 8 percent slopes, 245B Hinckley Loamy Sand, 3 to 8 percent slopes, 253D Hinckley Loamy Sand, 15 to 35 percent slopes, 254B Merrimac Fine Sandy Loam, 3 to 8 percent slopes, 255C Windsor Loamy Sand, 8 to 15 percent slopes, and map unit 653 Udorthents, sandy. Map unit 1 – Water is also present on the USGS soil map, however it is located largely within the footprint of the existing building and no surface water was observed in this location. Soil borings in this location identify an approximately 10’ thick layer of sandy fill over a 13’ layer of natural sand. We have estimated the soil as a mix of hydrologic group “A” for the majority of the upland portion of the site and “D” for the remaining portion of the site underlain by map unit 10 Scarboro and Birdsall soils, based on Web Soil Survey USDA/NRCS Soil Map. A geotechnical report, prepared by Northeast Geotechnical, Inc, has been included, and provides boring and test pit data within the proposed work areas for the project. The infiltration design is based on a Type A Soil “1982 Rawls Rates” of 2.41 in/hr for the existing and proposed Infiltration Basins, and 1.02 in/hr for the proposed 40B Infiltration Basins. See attached Geotechnical Engineering Report.

Table 2: Basin #1 Required Recharge Volume Calculation

Hydrologic Group	Recharge (in/sqft)	Impervious (sqft)	Volume (cf)
A - sand	0.60	559,049.0	27,952.5
B - loam	0.35	40,554.4	0
C - silty loam	0.25	75,968.6	0
D - clay	0.10	5,009.4	41.74
Required Recharge Volume Total			27,994.2 cf

Stormwater Basin Sizing

There are three ways of determining the recharge volume provided by a storm water basin (Static, Simple Dynamic, and Dynamic Field). The Static Method, used here, includes the volume of water that can be stored beneath the lowest outlet of the basin. This, the most conservative method of determining the recharge volume, doesn’t account for any infiltration that takes place while the basin is filling with water and is less dependent on maintenance of the basin since the only way for the water below the lowest invert can leave the basin is through infiltration. The following table summarizes the recharge volume provided by the infiltration chambers. Detailed volume calculations for the basin are included in the attachments.

Table 3: Basin Recharge Volumes

	Recharge Volume
Basin 1 @ 275.0	9,136 cf
Basin 2 @ 256.2	122,035 cf
Total	131,171 cf

72-hour Drawdown

When using the conservative Static Method to determine infiltration volume provided, the Rawls Rate is used to represent the infiltration rate in place of a hydraulic conductivity rate. The specific rate chosen is based on the textural analysis of the in-site soil performed by a competent soil professional.

A Massachusetts Certified Soil Evaluator performed an evaluation of the soil at the proposed infiltration BMP. Soil testing and borings within the footprint of existing stormwater basin #2 determined the underlying parent material soil to include layers of Sand and Loamy Sand. The soil textural analysis for the infiltration BMP is listed below with the associated Rawls Rate used in the HydroCAD calculations. Where textural analysis varied within any single BMP, the most restrictive textural evaluation and Rawls Rate were used. Soil logs of the in situ soil evaluation are included within the Site Plan set.

Table 4: Rawls Rate

	Most Restrictive Soil Texture	Rawls Rate (in/hour)
Infiltration Basin 1	Sandy Loam	1.02 in/hr
Infiltration Basin 2	Loamy Sand	2.41 in/hr

Drawdown time for the infiltration chamber systems is modeled by HydroCAD and included in the attachments. The following table summarizes the drawdown time for the basin to show it will drawdown within the 72-hour maximum.

Table 5: Basin Drawdown

	Time for Drawdown
Infiltration Basin 1	44 hours
Infiltration Basin 2	52 hours
Subsurface Detention System	58 hours

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

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

The Water Quality Volume requiring 80% TSS removal, is calculated as follows:

The required water quality volume is based on 1.0” as the soil recharge rate is 2.41 in/hr, meeting the threshold rate of 2.4 in/hr or greater. The water quality volume equals 1.0 inches of runoff times the increased impervious area of the post-development site.

Basin #1 Required Water Quality Volume:

Proposed Site Impervious Area = 32,931.4 sf

Impervious area to be treated = **32,931.4 sf**

Total volume to be treated:

1.0” x 1’/12” x 32,931 sf = 2,744 **cf Water Quality Volume Required**

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Basin #1 Provided Water Quality Volume:

Infiltration Basin 1 Treatment volume:

(Storage below lowest invert @ 275.00) = 9,136 cf

Basin #2 Required Water Quality Volume:

Proposed Site Impervious Area = 564,058.4 sf

Impervious area to be treated = **564,058.4 sf**

Total volume to be treated:

1.0' x 1'1/12' x 564,058.4 sf = 47,005 **cf Water Quality Volume Required**

Basin #2 Provided Water Quality Volume:

Infiltration Basin 2 Treatment volume:

(Storage below lowest invert @ 356.20) = 122,035 cf

Water Quality Unit Sizing

All the stormwater from impervious areas is collected and discharged to one of two Contech Cascade Hydrodynamic Separators. Water Quality Flow Rates were calculated in accordance with the procedures outlined within the Massachusetts Stormwater Management Handbook. Detailed calculations from the manufacturer for the two Contech units are included in Appendix 5.

Water Quality Flow Rate = (qu)(A)(WQV)

DMH 24-5:

qu = 774 csm/in

A = 3.322 acres = 0.005191 sq.mi.

WQV = 1"

DMH 24-5 required WQFR = 4.02cfs

Cascade CS-6 maximum rated treatment capacity = 5.6cfs

DMH 24-18:

qu = 774 csm/in

A = 8.137 acres = 0.012714 sq.mi.

WQV = 1"

DMH 24-5 required WQFR = 9.84cfs

Cascade CS-8 maximum rated treatment capacity = 12.0cfs (off-line configuration)

See TSS Removal Calculations in Attachment Section.

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MS4 Bylaw Compliance:

Based on the Town of Franklin MS4 stormwater bylaw as specified in § 153-16 (B)(1)(a), new developments require the on-site stormwater management systems to be designed to retain the volume of runoff equivalent to, or greater than, one (1.0) inch multiplied by the total post-construction impervious surface area, and/or remove 90% of the average annual load of Total Suspended Solids (TSS) generated from the total post construction impervious area on site and 60% of the average annual load of Total Phosphorous (TP) generated from the post construction impervious surface area on site..

The total impervious area, including roofs, is 564,058 square feet. The equivalent 1" of runoff from these surfaces is 47,005 cubic feet. The total storage provided below the lowest inverts out are as follows. See Appendix 5 – Stage -Area-Storage calculations.

Basin 1 @ Elev. 275.00 = 9,136 cf
Basin 2 @ Elev. 256.20 = 122,035 cf

Total Storage Volume Required = 47,005 cf
Total Storage Volume Provided = 131,171 cf

Standard 4: requires the development and implementation of suitable practices for source control and pollution prevention. These measures must be identified in a long-term pollution prevention plan.

The long-term pollution prevention plan is incorporated into the Operation and Maintenance Plan required by Standard 9.

Standard 5: For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

The proposed project is not a use with higher potential pollutant loads.

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

The subject property discharges stormwater within the Franklin Water Resource District. In addition, soils with rapid recharge rates in the area of the infiltration basin are present on site. Accordingly the Water Quality Volume is calculated using the required 1.0" rule, and 44% TSS removal is achieved prior to discharge to the infiltration basin. See Standard 4 for computations. The design utilizes stormwater BMPs designated as suitable for critical areas within the Massachusetts Stormwater Handbook. No metal roof is proposed.

Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable:

This project is not a redevelopment project and meets all applicable stormwater standards.

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

During land disturbance and construction activities, project proponents must implement controls that prevent erosion, control sediment movement, and stabilize exposed soils to prevent pollutants from moving offsite or entering wetlands or waters. Land disturbance activities include demolition, construction, clearing, excavation, grading, filling, and reconstruction.

Construction Period Pollution Prevention Plan and Erosion and Sedimentation Control.
EPA NPDES – Storm Water Pollution Prevention Plan (SWPPP)

A. Names of Persons or Entities Responsible for Plan Compliance

Key Boston, Inc.
126 Grove Street
Franklin, MA 02038
Tel: 508-298-7402

B. Construction Period Pollution Prevention Measures

1. Inventory materials to be present on-site during construction.
2. Train employees and subcontractors in prevention and clean up procedures.
3. All materials stored on site will be stored in their appropriate containers and if possible, under a roof or covered.
4. Follow manufacturer's recommendation for disposal of used containers.
5. Store only enough product on site to do the job.
6. On site equipment, fueling and maintenance measures:
 - a. Inspect on-site vehicles and equipment daily for leaks.
 - b. Conduct all vehicle and equipment maintenance and refueling in front of building, away from storm drains.
 - c. Perform major repairs and maintenance off site.
 - d. Use drip pans, drip cloths or absorbent pads when replacing spent fuels.
 - e. Collect spent fuels and remove from site, per Local and State regulations.
 - f. Maintain a clean construction entrance where truck traffic is frequent to reduce soil compaction constant sweeping is required and limit tracking of sediment into streets, sweeping street when silt is observed on street.
7. Stockpile materials and maintain Erosion Control around the materials where it can easily be accessed. Maintain easy access to clean up materials to include brooms, mops, rags gloves, goggles, sand, sawdust, plastic and metal trash containers.
8. Clean up spills.
 - a. Never hose down "dirty" pavement or impermeable surfaces where fluids have spilled. Use dry clean up methods (sawdust, cat litter and/or rags and absorbent pads).
 - b. Sweep up dry materials immediately. Never wash them away or bury them.
 - c. Clean up spills on dirt areas by digging up and properly disposing of contaminated soil in a certified container and notify a certified hauler for removal.
 - d. Report significant spills to the Fire Department.
9. It is the responsibility of the site superintendent or employees designated by the Applicant to inspect erosion control and repair as needed, also to inspect all on site vehicles for leaks and check all containers on site that may contain hazardous materials daily.

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C. Construction Erosion and Sedimentation Control Plan.

See "Site Plan Modification, 124/126 Grove Street, Franklin, Massachusetts" prepared by Guerriere & Halnon, Inc. Dated 11/05/24

D. Site Development Plans.

See "Site Plan Modification, 124/126 Grove Street, Franklin, Massachusetts" prepared by Guerriere & Halnon, Inc. Dated 11/05/24

E. Construction Sequencing Plan

- a. A NPDES NOI shall be filed with the EPA.
- b. Record Order of Conditions - The site superintendent shall be aware of all the Conditions contained within the Order including inspection schedules
- c. Install DEP File # Sign prior to commencement of work.
- d. Prior to any work on the site including tree/brush clearing, the approved limit of clearing as well as the location of the proposed erosion control devices (such as mulch socks) must be staked on the ground under the direction of a Massachusetts registered Professional Land Surveyor.
- e. Install erosion control barriers and temporary construction entrances at locations depicted on the plans.
- f. Erosion control to be inspected by either the design engineer (or agent) or an erosion control monitor appointed by the Town of Franklin.
- g. Perform tree/brush removal.
- h. Strip off top and subsoil. Stockpile material to be reused away from the wetland, remove excess material from the site. Install and maintain erosion control barrier around stockpile.
- i. Rough grade site, maintaining temporary low areas/sediment traps for sediment accumulation and away from the wetlands and prevent sedimentation from migrating from the site.
- j. Construct retaining wall, drainage outfalls, underdrains, modifications to stormwater basins #1 & #2, and Subsurface Detention System. Protect all stormwater inlets, basins, and chambers with additional erosion control as necessary to prevent siltation during construction. Stabilize side slopes with loam, seed and mulch.
- k. Install underground utilities, including manholes and catch basins; protect all open drainage structures with erosion/siltation control devices.
- l. Begin construction of building foundation.
- m. Install binder course of bituminous asphalt.
- n. Complete construction of building.
- o. Install wearing course of asphalt, and striping (where required).
- p. Maintain all erosion control devices until site is stabilized and a Certificate of Compliance is issued by the Conservation Commission.
- q. The Contractor shall be responsible to schedule any required inspections of his/her work.

F. Construction Waste Management Plan

- a. Dumpster for trash and bulk waste collection shall be provided separately for construction.
- b. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material are recommended.
- c. Segregate and provide containers for disposal options for waste.
- d. Do not bury waste and debris on site.

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- e. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.
- f. The sewer system is only for disposal of human waste, and substances permitted for disposal in the site sewer permit with the Town B.O.H.

G. Operation and Maintenance of Erosion and Sedimentation Controls

The operation and maintenance of sedimentation control shall be the responsibility of the contractor. The inspection and maintenance of the stormwater component shall be performed as noted below. The contractor shall have erosion control in place at all times. The contractor, based on future weather reports, shall prepare and inspect all erosion control devices; cleaning, repairing and upgrading is a priority so that the devices perform as per design. Inspect the site during rain events. Do not stay away from the site. At a minimum there should be inspection to assure the devices are not clogged or plugged, or that devices have not been destroyed or damaged during the rain event. After a storm event inspection is required to clean and repair any damage components. Immediate repair is required.

H. Inspection and Maintenance Schedules

1. Inspection must be conducted at least once every 7 days and within 24 hours of the end of a storm event 0.5 inches or greater.
2. Inspection frequency can be reduced to once a month if:
 - a. The site is temporarily stabilized.
 - b. Runoff is unlikely due to winter conditions when site is covered with snow or ice.
3. Inspections must be conducted by qualified personnel, “qualified personnel” means a person knowledgeable in the principles and practice of erosion and sediment controls and who possess the skills to assess the conditions and take measures to maintain and ensure proper operation, also to conclude if the erosion control methods selected are effective.
4. For each inspection, the inspection report must include: (See attached inspection and maintenance log)
 - a. The inspection date.
 - b. Names, titles of personnel making the inspection.
 - c. Weather information for the period since the last inspection.
 - d. Weather information at the time of the inspection.
 - e. Locations of discharges of sediment from the site, if any.
 - f. Locations of BMP’s that need to be maintained.
 - g. Locations where additional BMP’s may be required.
 - h. Corrective action required or any changes to the SWPPP that may be necessary.
5. The owner, or their representative, such as the contractor, shall inspect the following in-place work:

Inspection Schedule:

Erosion Control	Weekly
Catch Basins	Weekly
Temporary Sedimentation Traps/Basins	Weekly
Street Sweeping	Weekly

Maintenance Schedule

Erosion Control Devices Failure	Immediately
Catch Basins	Sump 1/4 full of sediment
Temporary Sedimentation Trap/Basin	As needed
Street Sweeping	14 days minimum and prior to any significant rain event.

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Please Note: Special inspections and maintenance shall also be made after a significant rainfall event. The individual responsible for plan compliance shall keep a log of the inspections and maintenance, and the report shall be submitted to the conservation office on a weekly basis detailing the state of the erosion control and any steps taken to address any issues with failure of the barriers.

I. Inspection and Maintenance Log Form. (Log Form Follows)

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

The following shall serve as the (O&M) Plan required by Standard 9, as well as the Long-Term Pollution Prevention Plan required by Standard 4.

A. Names of Persons or Entities Responsible for Plan Compliance;

Key Boston, Inc.
126 Grove Street
Franklin, MA 02038
Tel: 508-298-7402

B. Stormwater Management System Owner

Key Boston, Inc.
126 Grove Street
Franklin, MA 02038
Tel: 508-298-7402

C. Good housekeeping practices

1. Maintain site, landscaping and vegetation.
2. Sweep and pick up litter on pavements and grounds.
3. Deliveries shall be monitored by owners or representative to ensure that if any spillage occurs, it shall be contained and cleaned up immediately.
4. Maintain pavement and curbing in good repair.

D. Requirements for routine inspections and maintenance of stormwater BMPs

1. Plans: The stormwater Operation and Maintenance Plan shall consist of all Plans, documents and all local state and federal approvals as required for the subject property.
2. Record Keeping:
 - a. Maintain a log of all operation and maintenance activities for at least three years following construction, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and the disposal location).
 - b. Make this log available to MassDEP and the Conservation Commission upon request; and
 - c. Allow MassDEP and the Conservation Commission to inspect each BMP to determine whether the responsible party is implementing the Operation and Maintenance Plan.
3. Descriptions and Designs: The Best Management Practices (BMP) incorporated into the design include the following.
 - a. Street Sweeping – Stipulated within the Construction Period Pollution Prevention Plan, the Long-Term Pollution Prevention Plan, and the Operation and Maintenance Plan. As the amount of TSS removal is discretionary, no credit was taken within the calculations for this BMP.

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- b. Deep Sump Catch Basins with Hoods - Installed to promote TSS Removal of solids and control floatable pollutants. This BMP has a design rate of 25% TSS Removal.
 - c. Contech Cascade Hydrodynamic Separators - installed to promote TSS Removal of solids. These proprietary BMPs have a variable rate of TSS removal, see manufacturer calculations in attachment section of this report. For purposes of documentation of meeting required removal rates, these BMPs have an assigned removal rate of 50%.
 - d. Subsurface Detention System – the subsurface detention BMP provides additional storage and detention for the purpose of mitigating offsite stormwater impacts. No TSS removal credit is claimed. Refer to TSS Removal Worksheet included in the Attachments.
 - e. Infiltration Basin - provided to promote groundwater recharge, detention, and the required 80% TSS Removal. Refer to TSS Removal Worksheet in Standard 4 for treatment train.
 - f. Safety Fencing - Provide 6-FT high chain link fence with lockable gates around detention basin for public safety.
 - g. Spill Containment Kit to contain and clean-up spills that could occur on site.
4. BMP Maintenance: After construction it is the responsibility of the owner to perform maintenance. The cleaning of the components of the stormwater management system shall generally be as follows:
- a. Roadway: The owner shall keep the roadway swept with a mechanical sweeper or hand swept semi-annually at a minimum.
 - b. Catch Basins: Shall be cleaned by excavating, pumping or vacuuming four times per year and at the end of foliage and snow removal seasons. The sediment shall be disposed of off-site by the Owner. Inspect quarterly, remove silt when ¼ full.
 - c. Water Quality Manholes: Inspect twice a year. Clean structure when sediment accumulation reaches a depth of 2.0ft. Cleaning is generally done with the combination of a high pressure spray jet and vacuum truck and is the most effective and convenient method. A maintenance log shall be kept for all maintenance activities
 - d. Subsurface Detention System: Inspect after 1 years of commission using the inspection port or manhole via a CCTV and inspect every year thereafter or as needed depending on rainfall and site conditions. Cleaning with high pressure water through culvert cleaning nozzle when sediment accumulation reaches a depth of 3 inches or more. A maintenance log shall be kept for all maintenance activities.
 - e. Infiltration Basins: Preventative maintenance shall be performed at least twice per year. Inspection shall be performed after every major storm for the first three months and twice a year thereafter and when there are discharges through the high outlet orifice. Mowing of the buffer area, and bottom of basin; removal of trash and debris; removal of grass clippings and organic matter to be performed at least twice per year. Pretreatment devices shall be inspected every other month and a least twice a year and after every major storm event.
5. Access Provisions: All of the components of the storm water system shall be accessible by the Owner

E. Spill prevention and response plans

1. Inventory materials to be present on-site during construction.
2. Train employees and subcontractors in prevention and clean up procedures.
3. All materials stored on site will be stored in their appropriate containers under a roof.
4. Follow manufacturers recommendation for disposal of used containers.
5. Store only enough product on site to do the job.
6. On site equipment, fueling and maintenance measures:
 - a. Inspect on-site vehicles and equipment daily for leaks.

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- b. Conduct all vehicle and equipment maintenance and refueling in one location, away from storm drains.
 - c. Perform major repairs and maintenance off site.
 - d. Use drip pans, drip cloths or absorbent pads when replacing spent fuels.
 - e. Collect spent fuels and remove from site.
7. Clean up spills.
- a. Spill Containment Kit to contain and clean-up spills that could occur on site
 - b. Never hose down “dirty” pavement or impermeable surfaces where fluids have spilled. Use dry clean up methods (sawdust, cat litter and/or rags and absorbent pads).
 - c. Sweep up dry materials immediately. Never wash them away or bury them.
 - d. Clean up spills on dirt areas by digging up and properly disposing of contaminated soil.
 - e. Report significant spills to the Fire Department, Conservation Commission and Board of Health.

F. Provisions for maintenance of lawns, gardens, and other landscaped areas

Use only organic fertilizer. Dispose of clippings outside of the 100-foot buffer zone to the adjacent wetland.

G. Requirements for storage and use of herbicides, and pesticides

The application of herbicides or pesticides will be done by professional certified contractor.

H. Provisions for operation and management of septic system

Site to be serviced by private on-site sewer.

I. Requirements for handling of pet waste

Pet waste should never be dumped or washed into the local storm drain system. Waste shall be picked up immediately and placed in bags and properly disposed of in the garbage to be collected and taken to a landfill.

J. Provisions for washing of vehicles

Washing of vehicles shall be done in an area away from sensitive areas and drainage inlets, so as to eliminate wash water from being directly discharged to the local storm drain system. Vehicles should be washed in areas where wash water can be held prior to discharging to the sanitary sewer system or in areas where infiltration precludes runoff to storm drains. Avoid using detergents whenever possible.

K. Provisions for solid waste management

1. Waste Management Plan

- a. Recycle materials whenever possible (paper, plaster cardboard, metal cans). Separate containers for material are recommended.
- b. Do not bury waste and debris on site.
- c. Certified haulers will be hired to remove the dumpster container waste as needed. Recycling products will also be removed off site weekly.

L. Snow disposal and plowing plans relative to Wetland Resource Areas

Snow storage is adequate around the site for large storm events. Storage of snow shall not be placed directly near areas adjacent to the proposed infiltration basin.

M. Winter Road Salt and/or Sand Use and Storage restrictions

No sand, salt, or chemicals for de-icing will be stored outside.

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N. Street sweeping schedules

Sweeping, the act of cleaning pavement can be done by mechanical sweepers, vacuum sweeper or hand sweeper. The quantity of sand is a direct correlation with the treatment of ice and snow and the types of chemicals and spreaders that are being used on site to manage snow. If a liquid de-icer such as calcium chloride is used as a pretreatment to new events the amount of sand is minimized. Sweeping for this site should be done semi-annually at a minimum. Collecting the particulate before it enters the catch basins is cheaper and more environmentally friendly than in a catch basin mixing with oils and greases in the surface water runoff in catch basins.

O. Provisions for prevention of illicit discharges to the stormwater management system

The discharge into the stormwater system is not being violated, see attachment for illicit discharges compliance.

P. Training the staff or personnel involved with implementing Long-Term Pollution Prevention Plan

The owner shall develop policies and procedures for containing the illicit spilling of oils, soda, beer, paper and litter. These wastes provide a degrading of the water quality. The placement of signs and trash barrels with lids around the site would contribute to a clean water quality site condition.

Q. List of Emergency contacts for implementing Long-Term Pollution Prevention Plan:

Key Boston, Inc.
126 Grove Street
Franklin, MA 02038
Tel: 508-298-7402

This shall be the contact until such time as the project is sold.

R. Estimated BMP Maintenance Costs

The following prices are estimates of the costs associated with maintenance of the proposed site BMPs. Costs provided are only estimates and may not reflect actual costs to perform the work. Actual costs may vary depending on company/personnel performing the work. Actual costs may increase over time.

<u>BMP</u>	<u>Estimated Maintenance Cost</u>
Pavement sweeping	\$ 400 per year
Catch basink & WQMH cleaning	\$ 200 per catch basin per cleaning
Subsurface Detention System	\$ 1,000 per cleaning
Infiltration Basin	\$ 200 per cleaning
Spill Containment Kit	\$ 750 purchase price

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

Standard 10 prohibits illicit discharges to stormwater management systems. The stormwater management system is the system for conveying, treating, and infiltrating stormwater on site, including stormwater best management practices and any pipes intended to transport stormwater to the ground water, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

Illicit Discharge Compliance Statement

It is the intent of the Applicant, Key Boston, Inc., 126 Grove Street, Franklin, MA 02038 to prevent illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease. There will be no connection to the storm water system to inadvertently direct other types of liquids, chemicals or solids into the storm drainage system. The Owner will also promote a clean Green Environment by mitigating spills onto pavements; oils, soda, chemicals, pet waste, debris and litter.

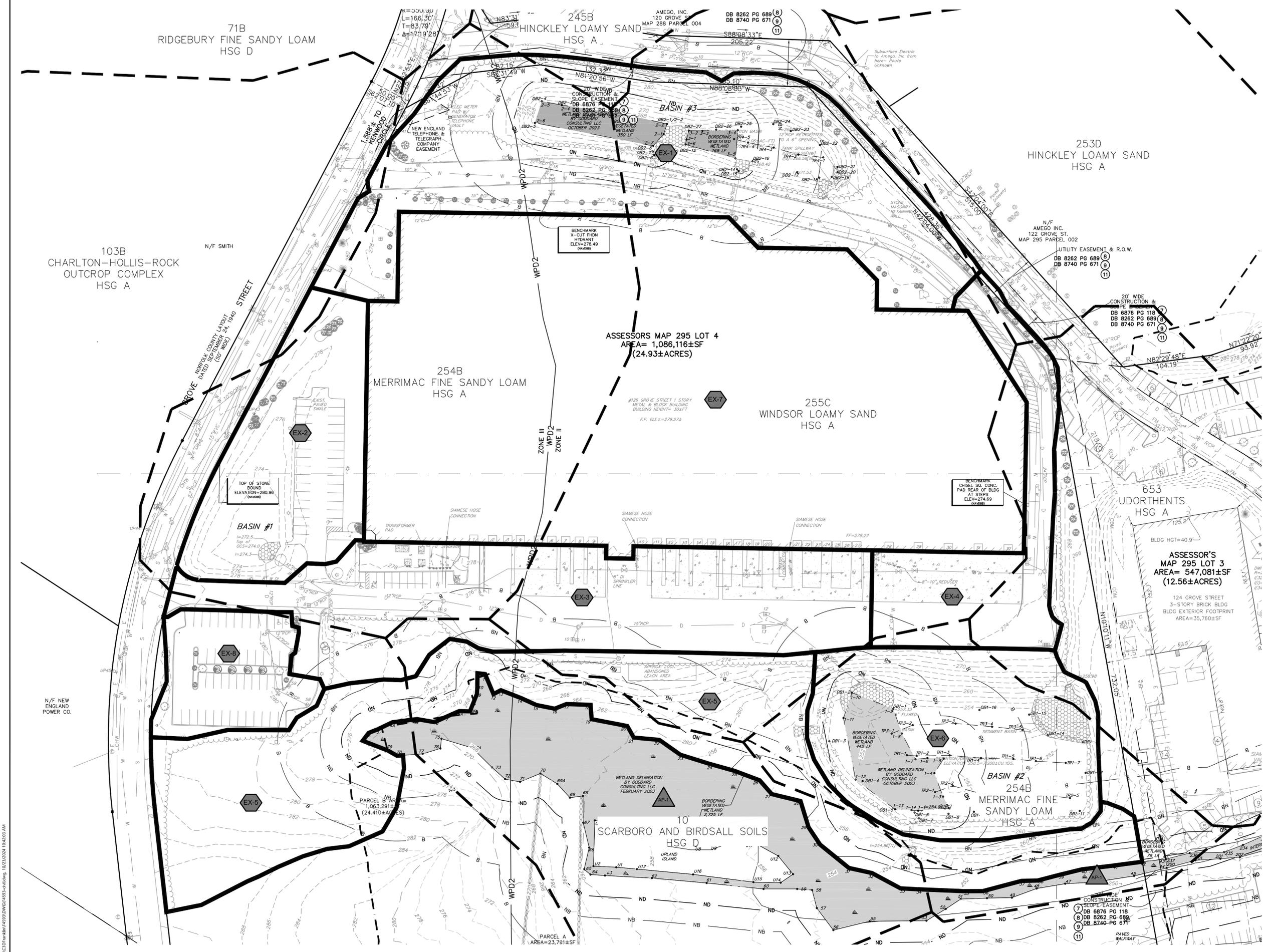
Respectfully Acknowledged,



A handwritten signature in black ink, appearing to be 'J. L. O.', is written over a horizontal line.

ATTACHMENTS

Pre- Post Drainage Plans



F4593

APPROVED DATE: _____
 FRANKLIN PLANNING BOARD

 BEING A MAJORITY

LEGAL NOTES

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OWNER
 A.M. 295 LOT 003
 NEAG REAL ESTATE LLC
 126 GROVE ST
 FRANKLIN, MA
 DEED BOOK 41715 PAGE 121
 PLAN No. 253 OF 1989 PLAN Bk. 379

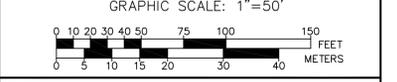
APPLICANT
 A.M. 295 LOT 4
 KEY BOSTON, INC.
 126 GROVE STREET
 FRANKLIN, MA 02038
 DEED BOOK 6353 PAGE 200
 DEED BOOK 6876 PAGE 112
 PLAN No. 238 OF 1984 PLAN Bk. 309
 PLAN No. 1655 OF 1985 PLAN Bk. 330

SITE PLAN
BUILDING EXPANSION
 124 / 126 GROVE ST.
 FRANKLIN MASSACHUSETTS

EXISTING CONDITIONS

OCTOBER 29, 2024

DATE	REVISION DESCRIPTION



Guerriere & Halon, Inc.
 ENGINEERING & LAND SURVEYING
 55 WEST CENTRAL ST. PH. (508) 528-3221
 FRANKLIN, MA 02038 FX. (508) 528-7921
 www.gandhengineering.com

APPROVED DATE: _____

FRANKLIN PLANNING BOARD

BEING A MAJORITY

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 126 GROVE ST
 FRANKLIN, MA
 DEED BOOK 41715 PAGE 121
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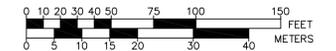
SITE PLAN
BUILDING EXPANSION
 124 / 126 GROVE ST.
 FRANKLIN MASSACHUSETTS

POST-DEVELOPMENT
WATERSHED PLAN

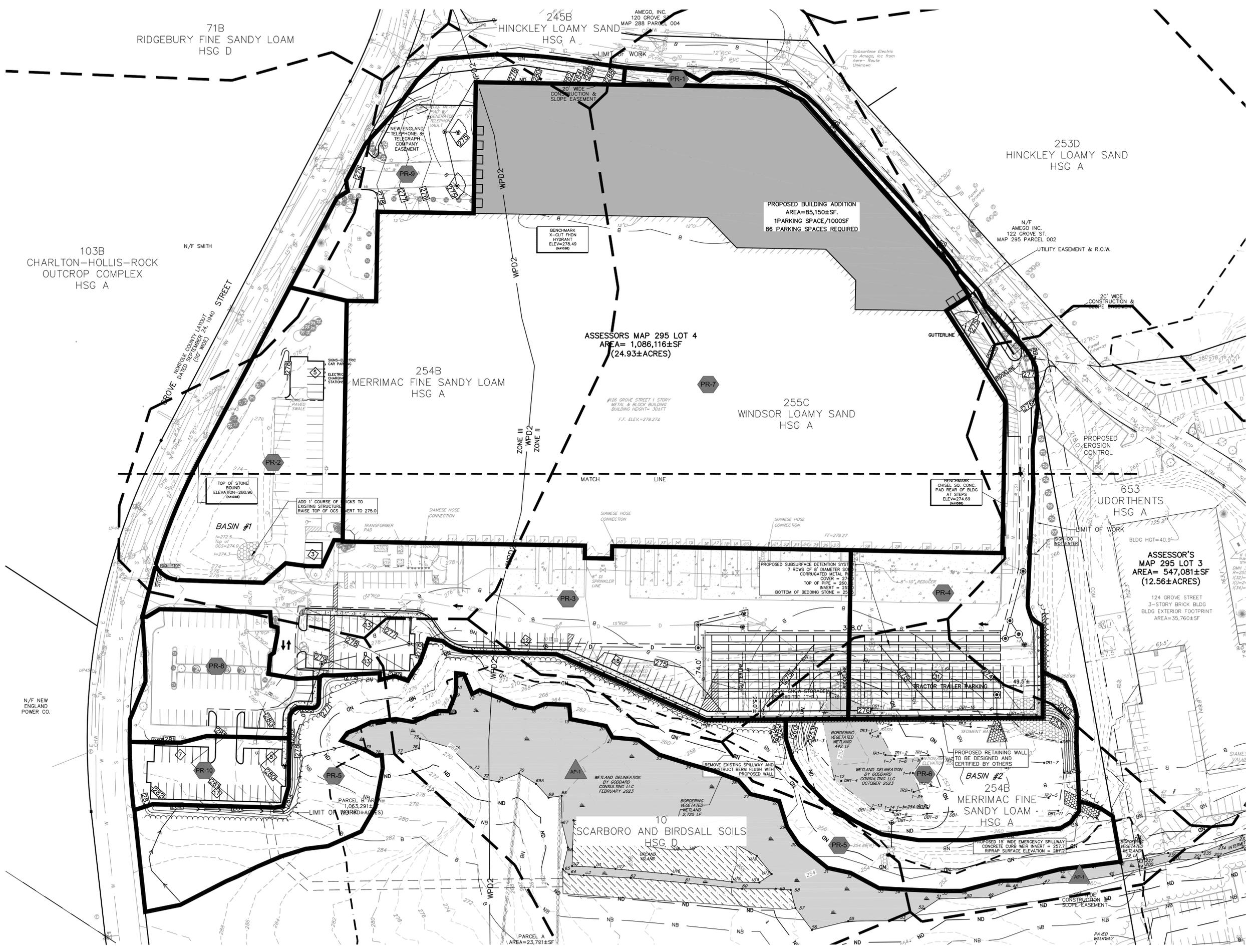
OCTOBER 29, 2024

DATE	REVISION DESCRIPTION

GRAPHIC SCALE: 1"=50'



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Hydro CAD Calculations

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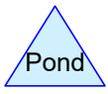
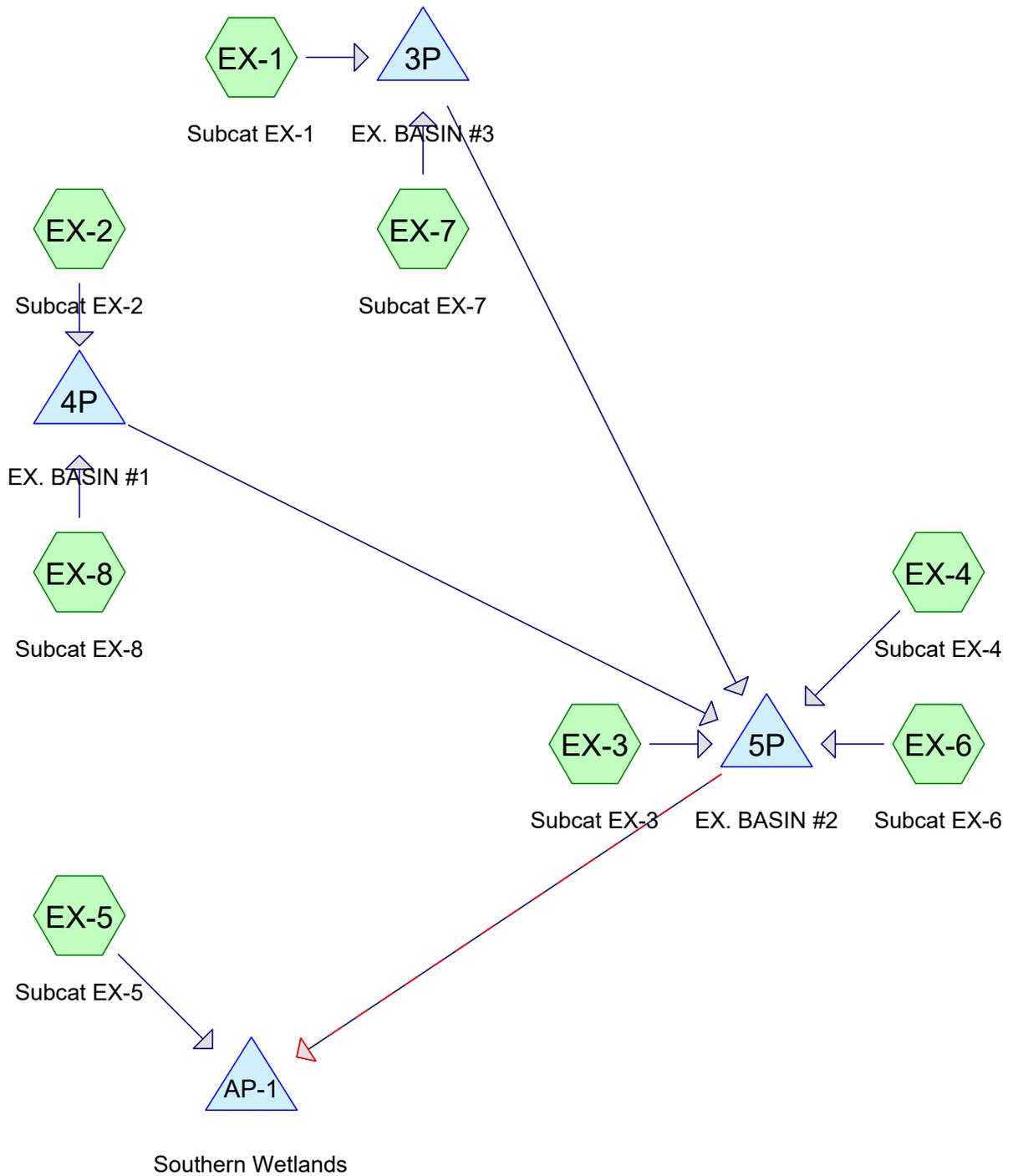
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Routing Diagram for F4593 PRE-Development
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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	NOAA10 24-hr	D	Default	24.00	1	3.36	2
2	10-yr	NOAA10 24-hr	D	Default	24.00	1	5.22	2
3	25-yr	NOAA10 24-hr	D	Default	24.00	1	6.39	2
4	100-yr	NOAA10 24-hr	D	Default	24.00	1	8.18	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.884	39	>75% Grass cover, Good, HSG A (EX-1, EX-2, EX-3, EX-4, EX-5, EX-6, EX-7, EX-8)
0.031	80	>75% Grass cover, Good, HSG D (EX-3, EX-5)
3.561	98	Paved parking, HSG A (EX-1, EX-2, EX-3, EX-4, EX-8)
0.039	98	Paved parking, HSG D (EX-3)
6.182	98	Roofs, HSG A (EX-7)
0.018	98	Unconnected pavement, HSG A (EX-1, EX-2, EX-3, EX-7)
1.252	98	Water Surface, HSG A (EX-1, EX-2, EX-6)
3.417	30	Woods, Good, HSG A (EX-1, EX-3, EX-5, EX-6)
0.677	77	Woods, Good, HSG D (EX-3, EX-5)
18.062	75	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
17.314	HSG A	EX-1, EX-2, EX-3, EX-4, EX-5, EX-6, EX-7, EX-8
0.000	HSG B	
0.000	HSG C	
0.748	HSG D	EX-3, EX-5
0.000	Other	
18.062		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
2.884	0.000	0.000	0.031	0.000	2.915	>75% Grass cover, Good	EX-1, EX-2, EX-3, EX-4, EX-5, EX-6, EX-7, EX-8
3.561	0.000	0.000	0.039	0.000	3.601	Paved parking	EX-1, EX-2, EX-3, EX-4, EX-8
6.182	0.000	0.000	0.000	0.000	6.182	Roofs	EX-7
0.018	0.000	0.000	0.000	0.000	0.018	Unconnected pavement	EX-1, EX-2, EX-3, EX-7
1.252	0.000	0.000	0.000	0.000	1.252	Water Surface	EX-1, EX-2, EX-6
3.417	0.000	0.000	0.677	0.000	4.094	Woods, Good	EX-1, EX-3, EX-5, EX-6
17.314	0.000	0.000	0.748	0.000	18.062	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	EX-1	0.00	0.00	100.0	0.0080	0.013	0.0	12.0	0.0	
2	EX-3	0.00	0.00	679.0	0.0220	0.013	0.0	15.0	0.0	
3	3P	265.60	264.50	223.3	0.0049	0.013	0.0	24.0	0.0	
4	3P	266.06	265.90	8.4	0.0190	0.013	0.0	12.0	0.0	
5	3P	266.58	265.80	12.3	0.0634	0.013	0.0	12.0	0.0	
6	4P	272.50	271.90	75.9	0.0079	0.013	0.0	12.0	0.0	
7	5P	254.94	254.86	12.0	0.0067	0.013	0.0	12.0	0.0	

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NOAA10 24-hr D 2-yr Rainfall=3.36"

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Page 7

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1: Subcat EX-1	Runoff Area=2.827 ac 27.56% Impervious Runoff Depth=0.21" Flow Length=424' Tc=8.1 min CN=52 Runoff=0.10 cfs 0.050 af
SubcatchmentEX-2: Subcat EX-2	Runoff Area=1.141 ac 44.71% Impervious Runoff Depth=0.68" Flow Length=231' Tc=11.0 min CN=65 Runoff=0.65 cfs 0.065 af
SubcatchmentEX-3: Subcat EX-3	Runoff Area=2.130 ac 78.35% Impervious Runoff Depth=1.97" Flow Length=813' Tc=11.4 min CN=86 Runoff=4.15 cfs 0.351 af
SubcatchmentEX-4: Subcat EX-4	Runoff Area=0.877 ac 88.00% Impervious Runoff Depth=2.41" Tc=6.0 min CN=91 Runoff=2.55 cfs 0.176 af
SubcatchmentEX-5: Subcat EX-5	Runoff Area=2.793 ac 0.00% Impervious Runoff Depth=0.02" Flow Length=349' Tc=16.9 min CN=41 Runoff=0.01 cfs 0.004 af
SubcatchmentEX-6: Subcat EX-6	Runoff Area=1.571 ac 45.77% Impervious Runoff Depth=0.64" Tc=6.0 min CN=64 Runoff=1.05 cfs 0.083 af
SubcatchmentEX-7: Subcat EX-7	Runoff Area=6.182 ac 99.99% Impervious Runoff Depth=3.13" Tc=6.0 min CN=98 Runoff=20.97 cfs 1.611 af
SubcatchmentEX-8: Subcat EX-8	Runoff Area=0.540 ac 77.97% Impervious Runoff Depth=1.89" Tc=6.0 min CN=85 Runoff=1.28 cfs 0.085 af
Pond 3P: EX. BASIN #3	Peak Elev=268.36' Storage=33,180 cf Inflow=20.98 cfs 1.661 af Outflow=4.25 cfs 1.485 af
Pond 4P: EX. BASIN #1	Peak Elev=274.05' Storage=2,386 cf Inflow=1.79 cfs 0.150 af Outflow=0.35 cfs 0.101 af
Pond 5P: EX. BASIN #2	Peak Elev=255.09' Storage=93,623 cf Inflow=8.52 cfs 2.196 af Primary=0.07 cfs 0.127 af Secondary=0.00 cfs 0.000 af Outflow=0.07 cfs 0.127 af
Pond AP-1: Southern Wetlands	Inflow=0.07 cfs 0.131 af Primary=0.07 cfs 0.131 af

Total Runoff Area = 18.062 ac Runoff Volume = 2.425 af Average Runoff Depth = 1.61"
38.81% Pervious = 7.010 ac 61.19% Impervious = 11.052 ac

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NOAA10 24-hr D 2-yr Rainfall=3.36"

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Summary for Subcatchment EX-1: Subcat EX-1

Runoff = 0.10 cfs @ 12.34 hrs, Volume= 0.050 af, Depth= 0.21"
 Routed to Pond 3P : EX. BASIN #3

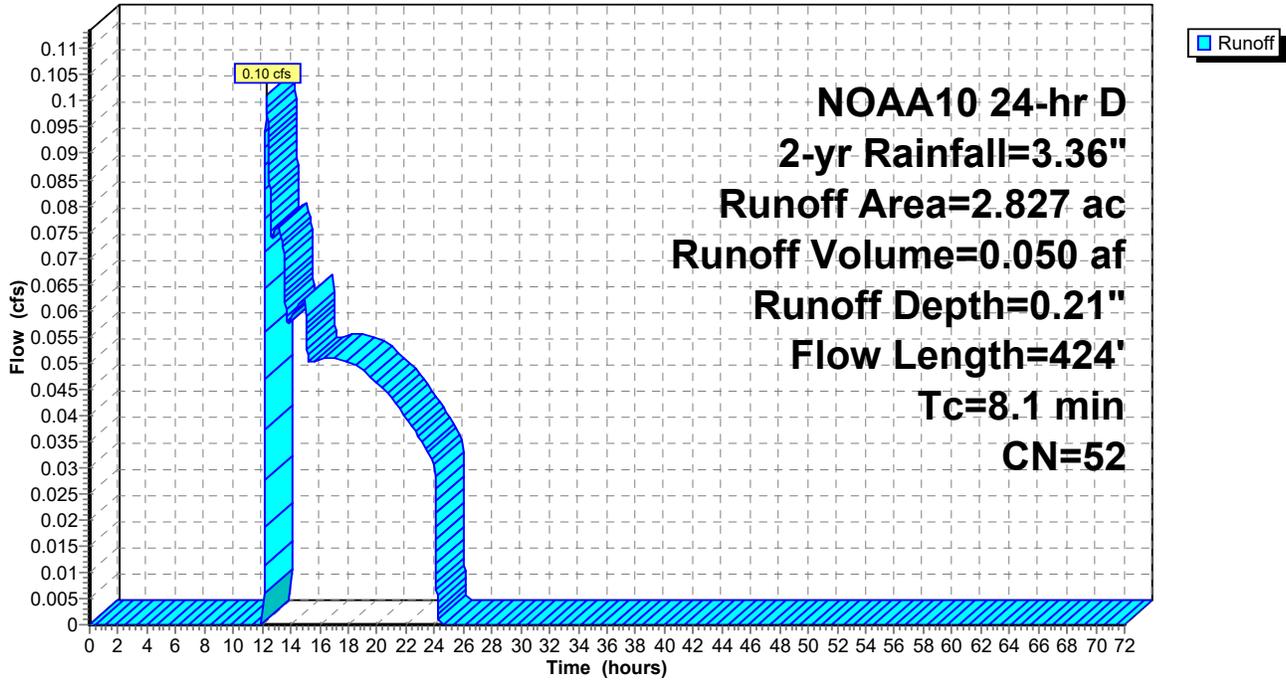
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
1.115	39	>75% Grass cover, Good, HSG A
0.505	98	Paved parking, HSG A
0.003	98	Unconnected pavement, HSG A
0.271	98	Water Surface, HSG A
0.933	30	Woods, Good, HSG A
2.827	52	Weighted Average
2.048		72.44% Pervious Area
0.779		27.56% Impervious Area
0.003		0.37% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	50	0.0250	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.36"
0.4	19	0.0110	0.73		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.3	255	0.0080	1.82		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	100	0.0080	4.06	3.19	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
8.1	424	Total			

Subcatchment EX-1: Subcat EX-1

Hydrograph



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Summary for Subcatchment EX-2: Subcat EX-2

Runoff = 0.65 cfs @ 12.20 hrs, Volume= 0.065 af, Depth= 0.68"
 Routed to Pond 4P : EX. BASIN #1

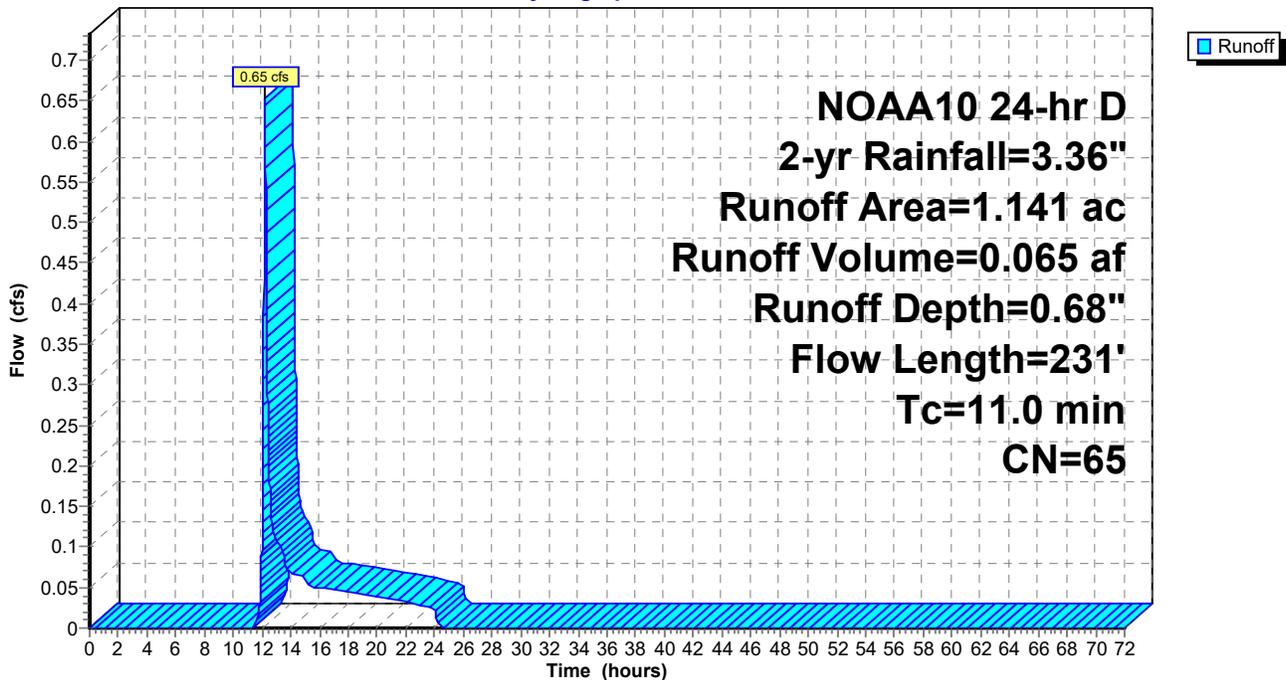
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.631	39	>75% Grass cover, Good, HSG A
0.239	98	Paved parking, HSG A
0.009	98	Unconnected pavement, HSG A
0.261	98	Water Surface, HSG A
1.141	65	Weighted Average
0.631		55.29% Pervious Area
0.510		44.71% Impervious Area
0.009		1.84% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		Sheet Flow, Grass: Short n= 0.150 P2= 3.36"
1.4	181	0.0220	2.22		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
11.0	231	Total			

Subcatchment EX-2: Subcat EX-2

Hydrograph



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Summary for Subcatchment EX-3: Subcat EX-3

Runoff = 4.15 cfs @ 12.19 hrs, Volume= 0.351 af, Depth= 1.97"
 Routed to Pond 5P : EX. BASIN #2

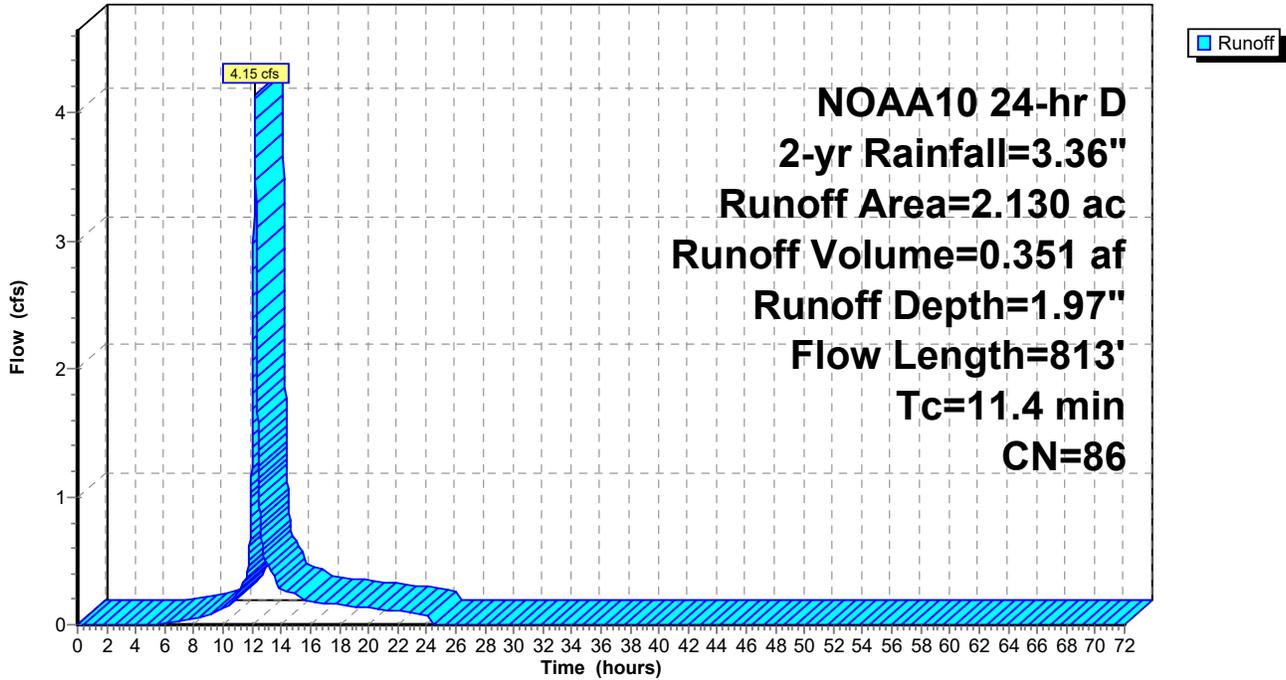
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.238	39	>75% Grass cover, Good, HSG A
0.015	80	>75% Grass cover, Good, HSG D
1.623	98	Paved parking, HSG A
0.039	98	Paved parking, HSG D
0.006	98	Unconnected pavement, HSG A
0.137	30	Woods, Good, HSG A
0.071	77	Woods, Good, HSG D
2.130	86	Weighted Average
0.461		21.65% Pervious Area
1.669		78.35% Impervious Area
0.006		0.35% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	50	0.0440	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
1.2	84	0.0520	1.14		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
1.4	679	0.0220	7.81	9.58	Pipe Channel, 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Concrete pipe, bends & connections
11.4	813	Total			

Subcatchment EX-3: Subcat EX-3

Hydrograph



Summary for Subcatchment EX-4: Subcat EX-4

Runoff = 2.55 cfs @ 12.13 hrs, Volume= 0.176 af, Depth= 2.41"
 Routed to Pond 5P : EX. BASIN #2

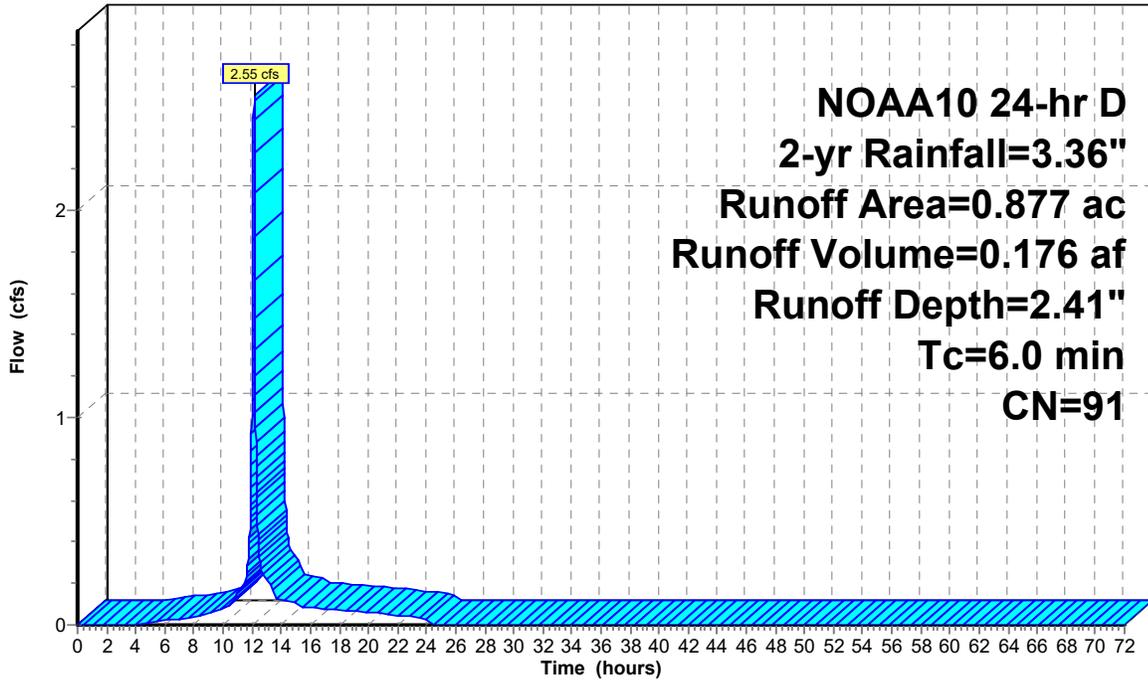
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.105	39	>75% Grass cover, Good, HSG A
0.772	98	Paved parking, HSG A
0.877	91	Weighted Average
0.105		12.00% Pervious Area
0.772		88.00% Impervious Area

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

Subcatchment EX-4: Subcat EX-4

Hydrograph



Runoff

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Summary for Subcatchment EX-5: Subcat EX-5

Runoff = 0.01 cfs @ 22.44 hrs, Volume= 0.004 af, Depth= 0.02"
 Routed to Pond AP-1 : Southern Wetlands

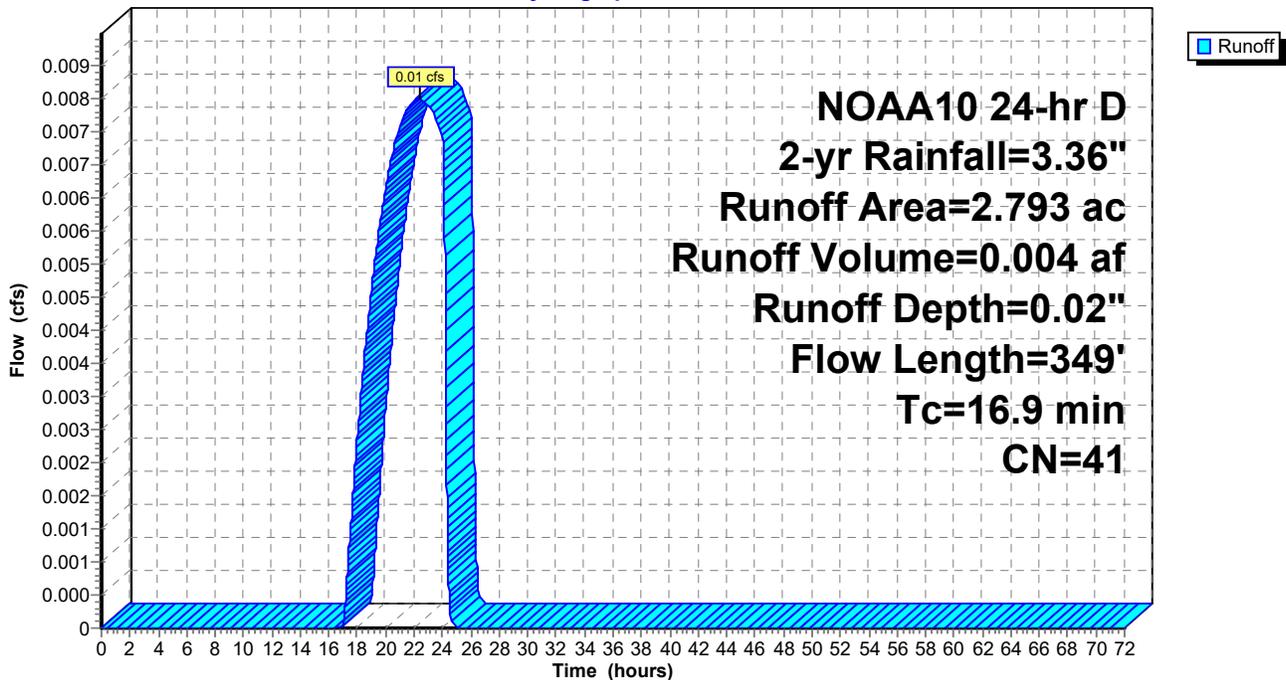
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.176	39	>75% Grass cover, Good, HSG A
0.016	80	>75% Grass cover, Good, HSG D
1.994	30	Woods, Good, HSG A
0.606	77	Woods, Good, HSG D
2.793	41	Weighted Average
2.793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0190	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
0.7	58	0.0780	1.40		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.9	241	0.0420	1.02		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
16.9	349	Total			

Subcatchment EX-5: Subcat EX-5

Hydrograph



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Summary for Subcatchment EX-6: Subcat EX-6

Runoff = 1.05 cfs @ 12.14 hrs, Volume= 0.083 af, Depth= 0.64"
Routed to Pond 5P : EX. BASIN #2

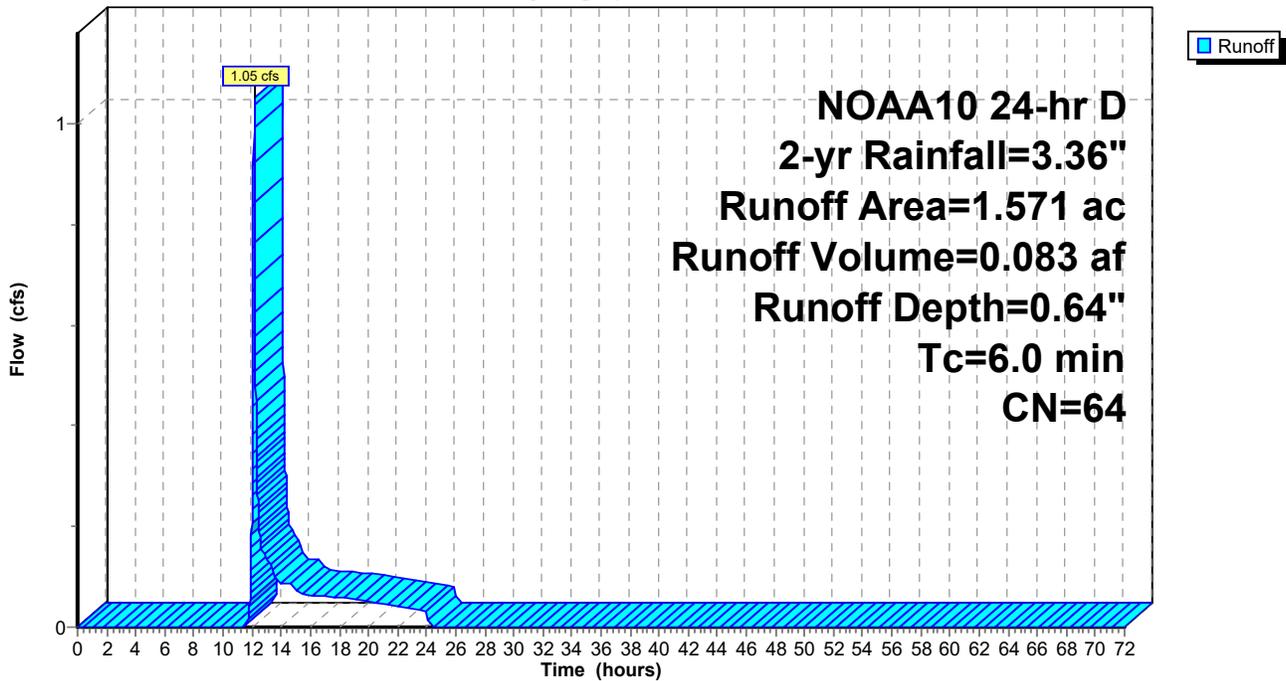
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.500	39	>75% Grass cover, Good, HSG A
0.719	98	Water Surface, HSG A
0.352	30	Woods, Good, HSG A
1.571	64	Weighted Average
0.852		54.23% Pervious Area
0.719		45.77% Impervious Area

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

Subcatchment EX-6: Subcat EX-6

Hydrograph



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NOAA10 24-hr D 2-yr Rainfall=3.36"

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Summary for Subcatchment EX-7: Subcat EX-7

Runoff = 20.97 cfs @ 12.13 hrs, Volume= 1.611 af, Depth= 3.13"
 Routed to Pond 3P : EX. BASIN #3

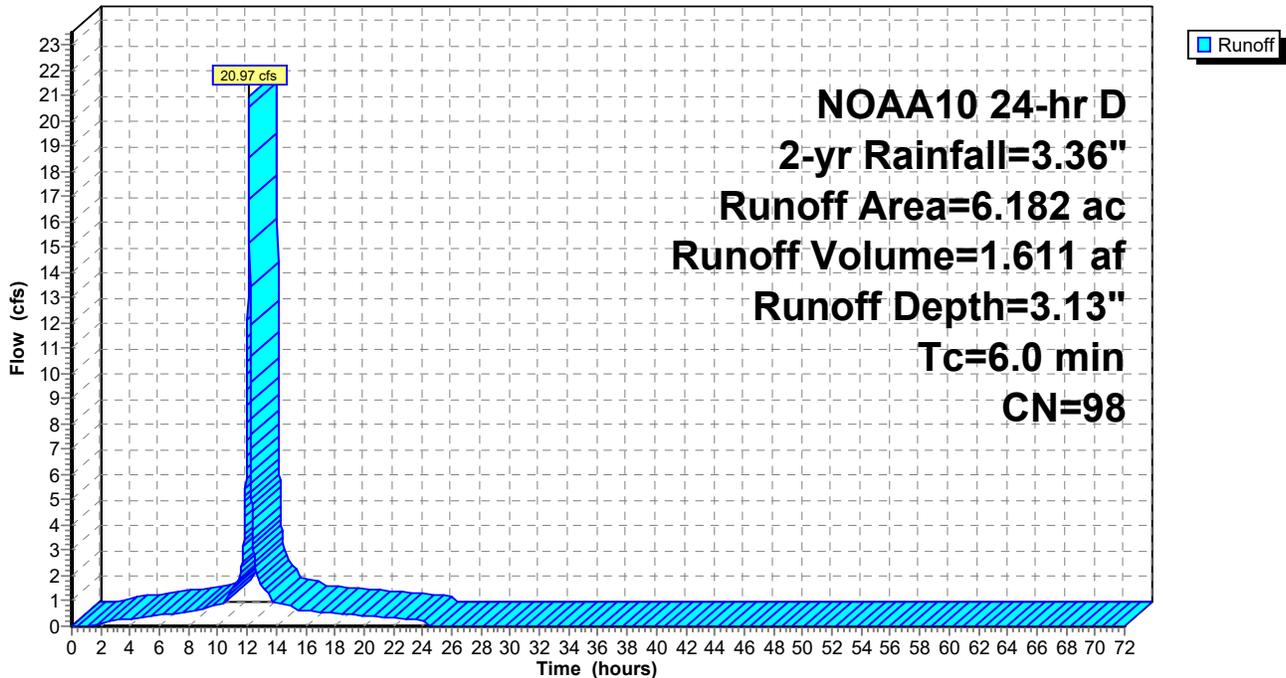
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.000	39	>75% Grass cover, Good, HSG A
6.182	98	Roofs, HSG A
0.000	98	Unconnected pavement, HSG A
6.182	98	Weighted Average
0.000		0.01% Pervious Area
6.182		99.99% Impervious Area
0.000		0.00% Unconnected

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

Subcatchment EX-7: Subcat EX-7

Hydrograph



Summary for Subcatchment EX-8: Subcat EX-8

Runoff = 1.28 cfs @ 12.13 hrs, Volume= 0.085 af, Depth= 1.89"
 Routed to Pond 4P : EX. BASIN #1

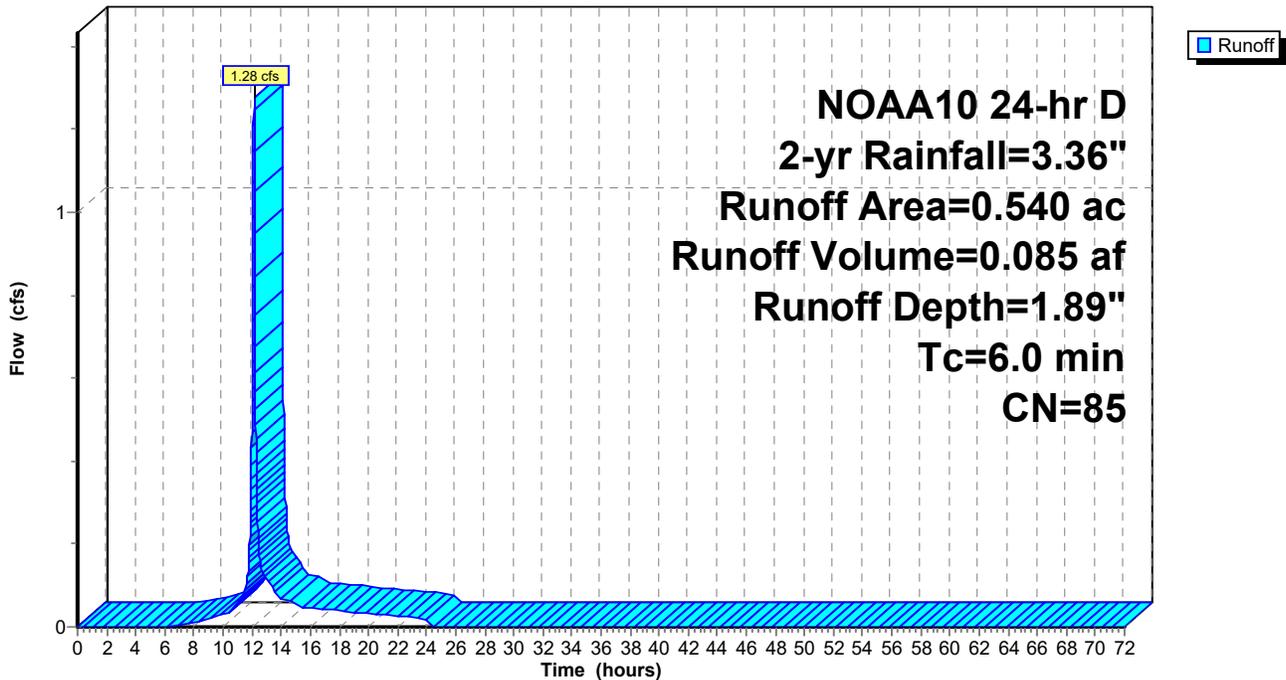
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.119	39	>75% Grass cover, Good, HSG A
0.421	98	Paved parking, HSG A
0.540	85	Weighted Average
0.119		22.03% Pervious Area
0.421		77.97% Impervious Area

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

Subcatchment EX-8: Subcat EX-8

Hydrograph



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NOAA10 24-hr D 2-yr Rainfall=3.36"

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Summary for Pond 3P: EX. BASIN #3

Inflow Area = 9.009 ac, 77.26% Impervious, Inflow Depth = 2.21" for 2-yr event
 Inflow = 20.98 cfs @ 12.13 hrs, Volume= 1.661 af
 Outflow = 4.25 cfs @ 12.36 hrs, Volume= 1.485 af, Atten= 80%, Lag= 13.7 min
 Primary = 4.25 cfs @ 12.36 hrs, Volume= 1.485 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 268.36' @ 12.36 hrs Surf.Area= 16,160 sf Storage= 33,180 cf

Plug-Flow detention time= 326.0 min calculated for 1.485 af (89% of inflow)
 Center-of-Mass det. time= 266.3 min (1,034.3 - 768.0)

Volume	Invert	Avail.Storage	Storage Description
#1	265.00'	188,837 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
265.00	6,581	0	0
266.00	7,637	7,109	7,109
267.00	8,818	8,228	15,337
268.00	15,371	12,095	27,431
269.00	17,536	16,454	43,885
270.00	19,637	18,587	62,471
271.00	21,748	20,693	83,164
272.00	23,983	22,866	106,029
273.00	26,245	25,114	131,143
274.00	28,727	27,486	158,629
275.00	31,688	30,208	188,837

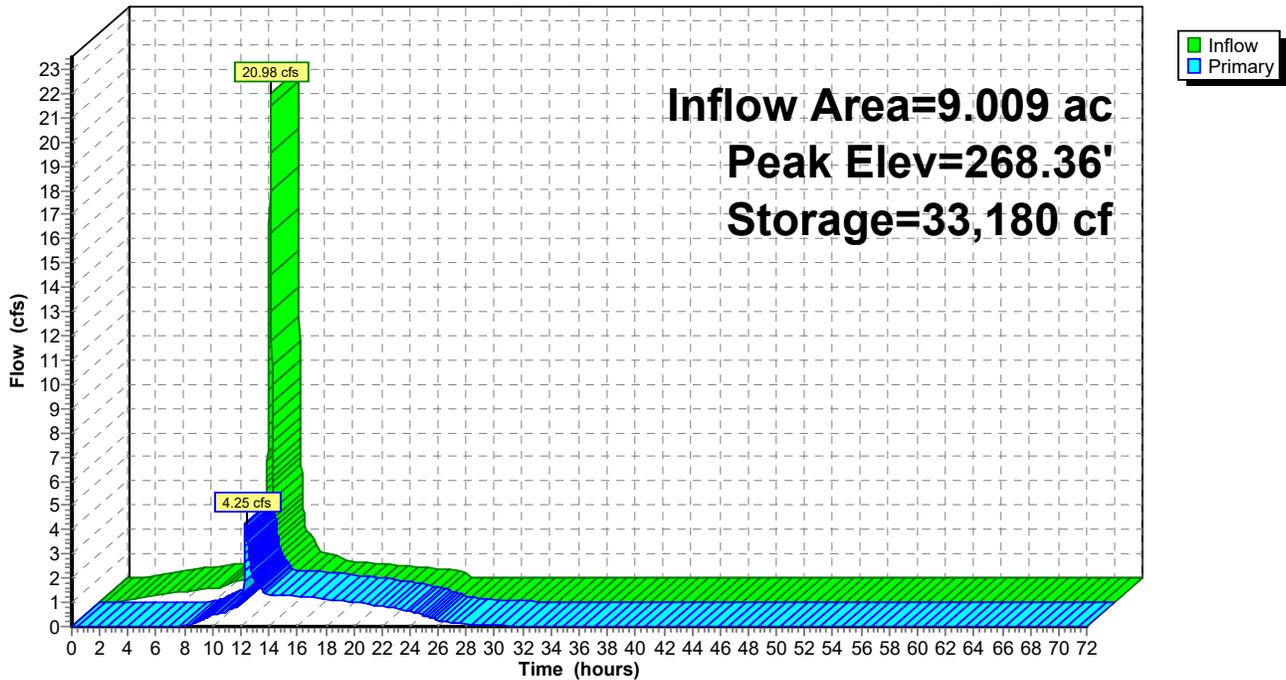
Device	Routing	Invert	Outlet Devices
#1	Primary	265.60'	24.0" Round Culvert L= 223.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 265.60' / 264.50' S= 0.0049 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	266.06'	12.0" Round Culvert L= 8.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 266.06' / 265.90' S= 0.0190 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#3	Device 2	266.06'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 1	266.58'	12.0" Round Culvert L= 12.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 266.58' / 265.80' S= 0.0634 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#5	Device 4	268.26'	57.0" x 100.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.25 cfs @ 12.36 hrs HW=268.36' TW=252.92' (Dynamic Tailwater)

- 1=Culvert (Passes 4.25 cfs of 16.63 cfs potential flow)
- 2=Culvert (Passes 1.36 cfs of 5.08 cfs potential flow)
- 3=Orifice/Grate (Orifice Controls 1.36 cfs @ 6.90 fps)
- 4=Culvert (Passes 2.90 cfs of 4.29 cfs potential flow)
- 5=Orifice/Grate (Weir Controls 2.90 cfs @ 1.06 fps)

Pond 3P: EX. BASIN #3

Hydrograph



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NOAA10 24-hr D 2-yr Rainfall=3.36"

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Summary for Pond 4P: EX. BASIN #1

Inflow Area = 1.681 ac, 55.40% Impervious, Inflow Depth = 1.07" for 2-yr event
 Inflow = 1.79 cfs @ 12.14 hrs, Volume= 0.150 af
 Outflow = 0.35 cfs @ 12.53 hrs, Volume= 0.101 af, Atten= 81%, Lag= 23.1 min
 Primary = 0.35 cfs @ 12.53 hrs, Volume= 0.101 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 274.05' @ 12.53 hrs Surf.Area= 5,512 sf Storage= 2,386 cf

Plug-Flow detention time= 244.1 min calculated for 0.101 af (67% of inflow)
 Center-of-Mass det. time= 111.2 min (1,002.3 - 891.1)

Volume	Invert	Avail.Storage	Storage Description
#1	273.40'	31,754 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
273.40	1,731	0	0
274.00	5,352	2,125	2,125
275.00	8,670	7,011	9,136
276.00	11,387	10,029	19,164
277.00	13,793	12,590	31,754

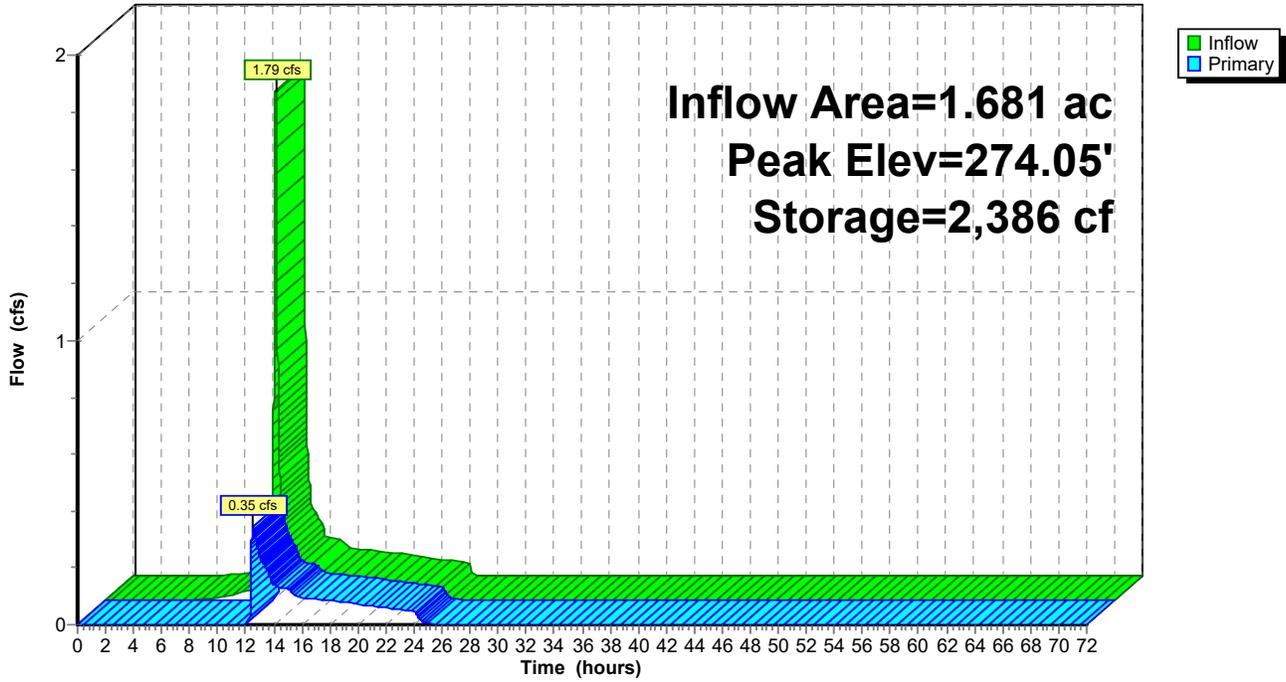
Device	Routing	Invert	Outlet Devices
#1	Primary	272.50'	12.0" Round Culvert L= 75.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 272.50' / 271.90' S= 0.0079 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	274.00'	24.0" x 36.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.35 cfs @ 12.53 hrs HW=274.05' TW=253.04' (Dynamic Tailwater)

- ↑1=Culvert (Passes 0.35 cfs of 3.43 cfs potential flow)
- ↑2=Orifice/Grate (Weir Controls 0.35 cfs @ 0.72 fps)

Pond 4P: EX. BASIN #1

Hydrograph



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NOAA10 24-hr D 2-yr Rainfall=3.36"

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Summary for Pond 5P: EX. BASIN #2

Inflow Area = 15.269 ac, 72.38% Impervious, Inflow Depth = 1.73" for 2-yr event
 Inflow = 8.52 cfs @ 12.15 hrs, Volume= 2.196 af
 Outflow = 0.07 cfs @ 28.61 hrs, Volume= 0.127 af, Atten= 99%, Lag= 987.7 min
 Primary = 0.07 cfs @ 28.61 hrs, Volume= 0.127 af
 Routed to Pond AP-1 : Southern Wetlands
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond AP-1 : Southern Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 255.09' @ 28.61 hrs Surf.Area= 36,421 sf Storage= 93,623 cf

Plug-Flow detention time= 1,840.2 min calculated for 0.127 af (6% of inflow)
 Center-of-Mass det. time= 1,431.6 min (2,414.5 - 982.9)

Volume	Invert	Avail.Storage	Storage Description
#1	252.00'	261,437 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
252.00	2,679	0	0
252.50	29,599	8,070	8,070
253.00	31,025	15,156	23,226
254.00	33,475	32,250	55,476
255.00	36,062	34,769	90,244
256.00	39,913	37,988	128,232
257.00	43,021	41,467	169,699
258.00	46,190	44,606	214,304
259.00	48,075	47,133	261,437

Device	Routing	Invert	Outlet Devices
#1	Secondary	257.70'	9.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	254.94'	12.0" Round Culvert L= 12.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 254.94' / 254.86' S= 0.0067 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=0.07 cfs @ 28.61 hrs HW=255.09' TW=0.00' (Dynamic Tailwater)

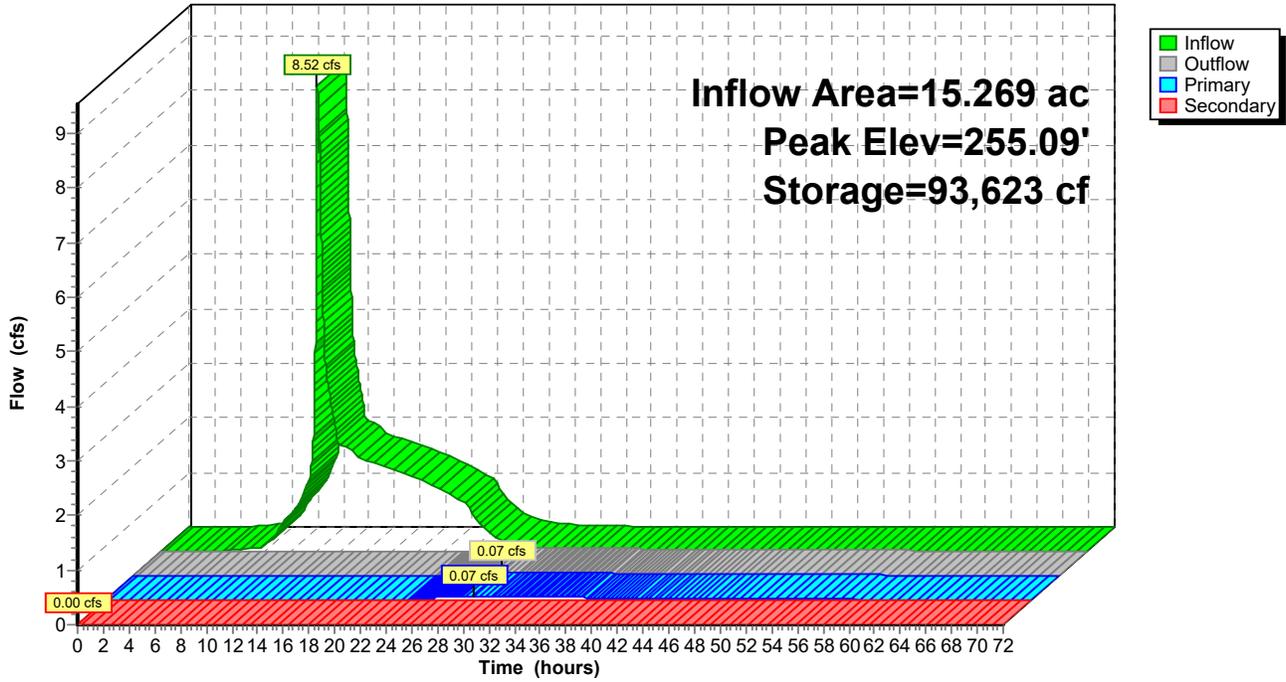
↑**2=Culvert** (Barrel Controls 0.07 cfs @ 1.48 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=252.00' TW=0.00' (Dynamic Tailwater)

↑**1=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 5P: EX. BASIN #2

Hydrograph



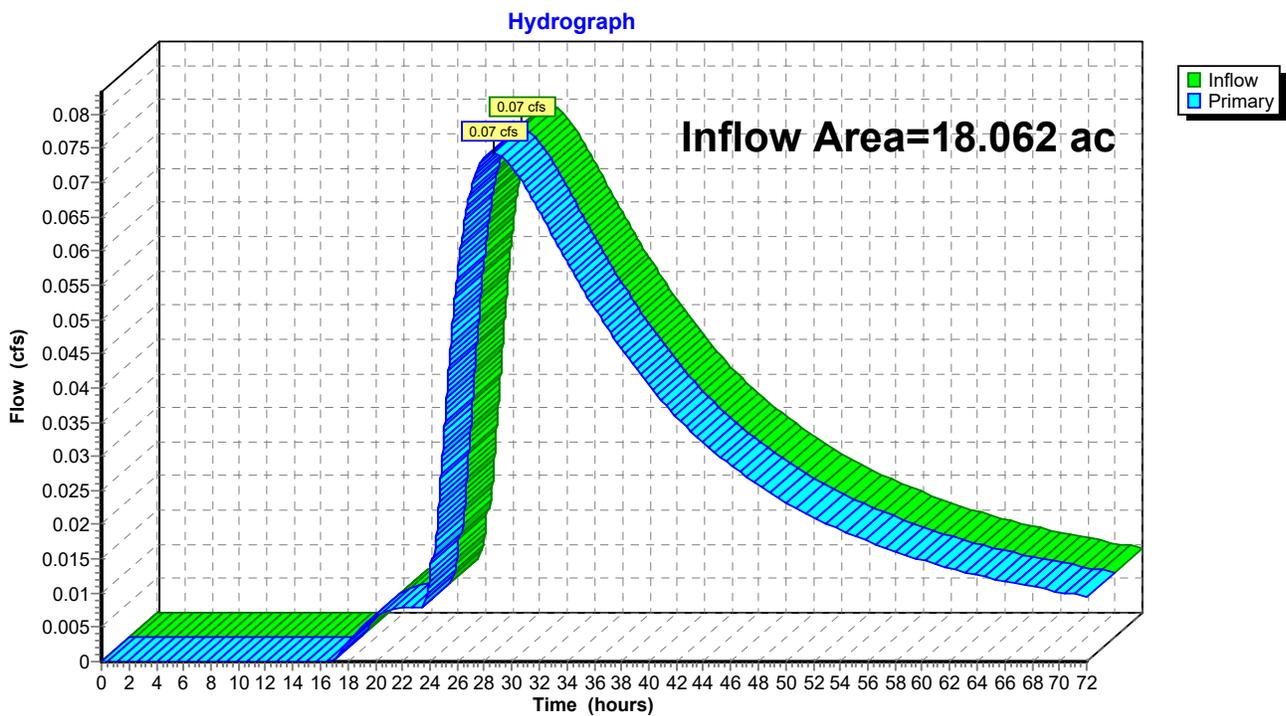
Summary for Pond AP-1: Southern Wetlands

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

Inflow Area = 18.062 ac, 61.19% Impervious, Inflow Depth > 0.09" for 2-yr event
Inflow = 0.07 cfs @ 28.61 hrs, Volume= 0.131 af
Primary = 0.07 cfs @ 28.61 hrs, Volume= 0.131 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: Southern Wetlands



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NOAA10 24-hr D 10-yr Rainfall=5.22"

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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1: Subcat EX-1	Runoff Area=2.827 ac 27.56% Impervious Runoff Depth=0.90" Flow Length=424' Tc=8.1 min CN=52 Runoff=2.28 cfs 0.213 af
SubcatchmentEX-2: Subcat EX-2	Runoff Area=1.141 ac 44.71% Impervious Runoff Depth=1.80" Flow Length=231' Tc=11.0 min CN=65 Runoff=2.02 cfs 0.171 af
SubcatchmentEX-3: Subcat EX-3	Runoff Area=2.130 ac 78.35% Impervious Runoff Depth=3.67" Flow Length=813' Tc=11.4 min CN=86 Runoff=7.56 cfs 0.652 af
SubcatchmentEX-4: Subcat EX-4	Runoff Area=0.877 ac 88.00% Impervious Runoff Depth=4.20" Tc=6.0 min CN=91 Runoff=4.30 cfs 0.307 af
SubcatchmentEX-5: Subcat EX-5	Runoff Area=2.793 ac 0.00% Impervious Runoff Depth=0.33" Flow Length=349' Tc=16.9 min CN=41 Runoff=0.13 cfs 0.076 af
SubcatchmentEX-6: Subcat EX-6	Runoff Area=1.571 ac 45.77% Impervious Runoff Depth=1.73" Tc=6.0 min CN=64 Runoff=3.32 cfs 0.226 af
SubcatchmentEX-7: Subcat EX-7	Runoff Area=6.182 ac 99.99% Impervious Runoff Depth=4.98" Tc=6.0 min CN=98 Runoff=32.80 cfs 2.567 af
SubcatchmentEX-8: Subcat EX-8	Runoff Area=0.540 ac 77.97% Impervious Runoff Depth=3.57" Tc=6.0 min CN=85 Runoff=2.36 cfs 0.161 af
Pond 3P: EX. BASIN #3	Peak Elev=269.24' Storage=48,237 cf Inflow=34.77 cfs 2.780 af Outflow=7.18 cfs 2.603 af
Pond 4P: EX. BASIN #1	Peak Elev=274.21' Storage=3,343 cf Inflow=4.06 cfs 0.332 af Outflow=3.22 cfs 0.283 af
Pond 5P: EX. BASIN #2	Peak Elev=255.77' Storage=119,044 cf Inflow=23.66 cfs 4.071 af Primary=1.63 cfs 1.991 af Secondary=0.00 cfs 0.000 af Outflow=1.63 cfs 1.991 af
Pond AP-1: Southern Wetlands	Inflow=1.69 cfs 2.067 af Primary=1.69 cfs 2.067 af

Total Runoff Area = 18.062 ac Runoff Volume = 4.373 af Average Runoff Depth = 2.91"
38.81% Pervious = 7.010 ac 61.19% Impervious = 11.052 ac

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NOAA10 24-hr D 10-yr Rainfall=5.22"

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Summary for Subcatchment EX-1: Subcat EX-1

Runoff = 2.28 cfs @ 12.16 hrs, Volume= 0.213 af, Depth= 0.90"
 Routed to Pond 3P : EX. BASIN #3

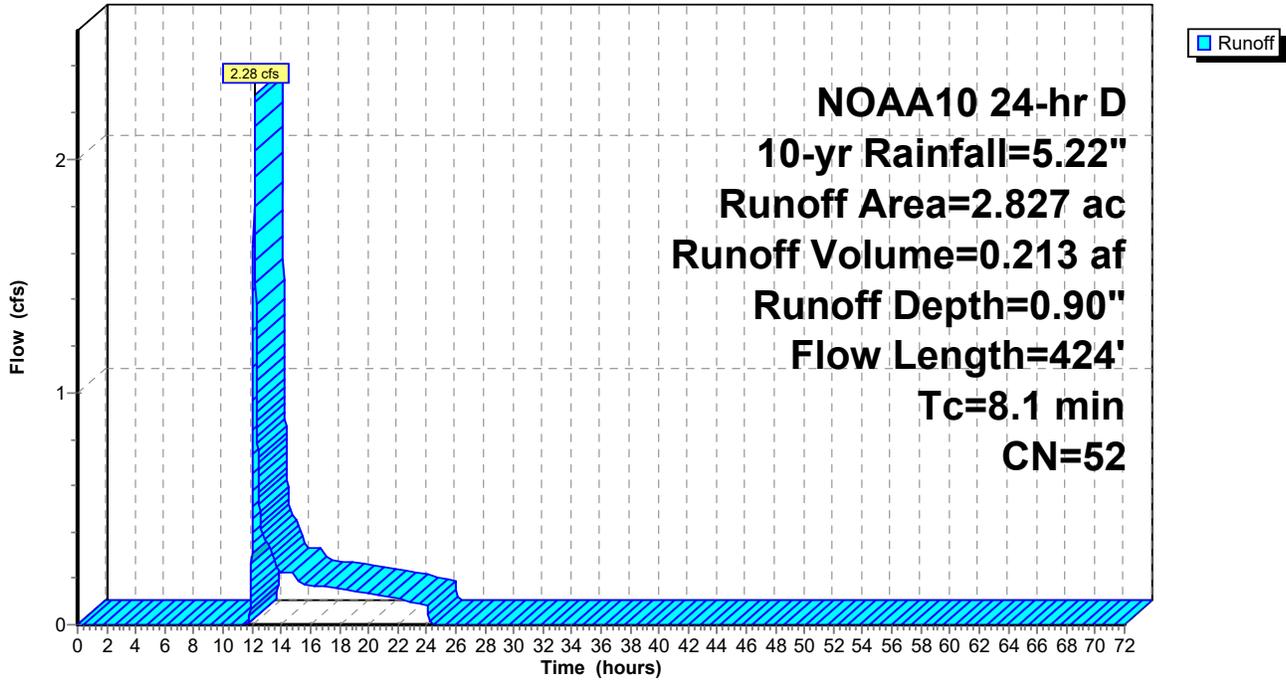
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
1.115	39	>75% Grass cover, Good, HSG A
0.505	98	Paved parking, HSG A
0.003	98	Unconnected pavement, HSG A
0.271	98	Water Surface, HSG A
0.933	30	Woods, Good, HSG A
2.827	52	Weighted Average
2.048		72.44% Pervious Area
0.779		27.56% Impervious Area
0.003		0.37% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	50	0.0250	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.36"
0.4	19	0.0110	0.73		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.3	255	0.0080	1.82		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	100	0.0080	4.06	3.19	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
8.1	424	Total			

Subcatchment EX-1: Subcat EX-1

Hydrograph



Summary for Subcatchment EX-2: Subcat EX-2

Runoff = 2.02 cfs @ 12.19 hrs, Volume= 0.171 af, Depth= 1.80"
 Routed to Pond 4P : EX. BASIN #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

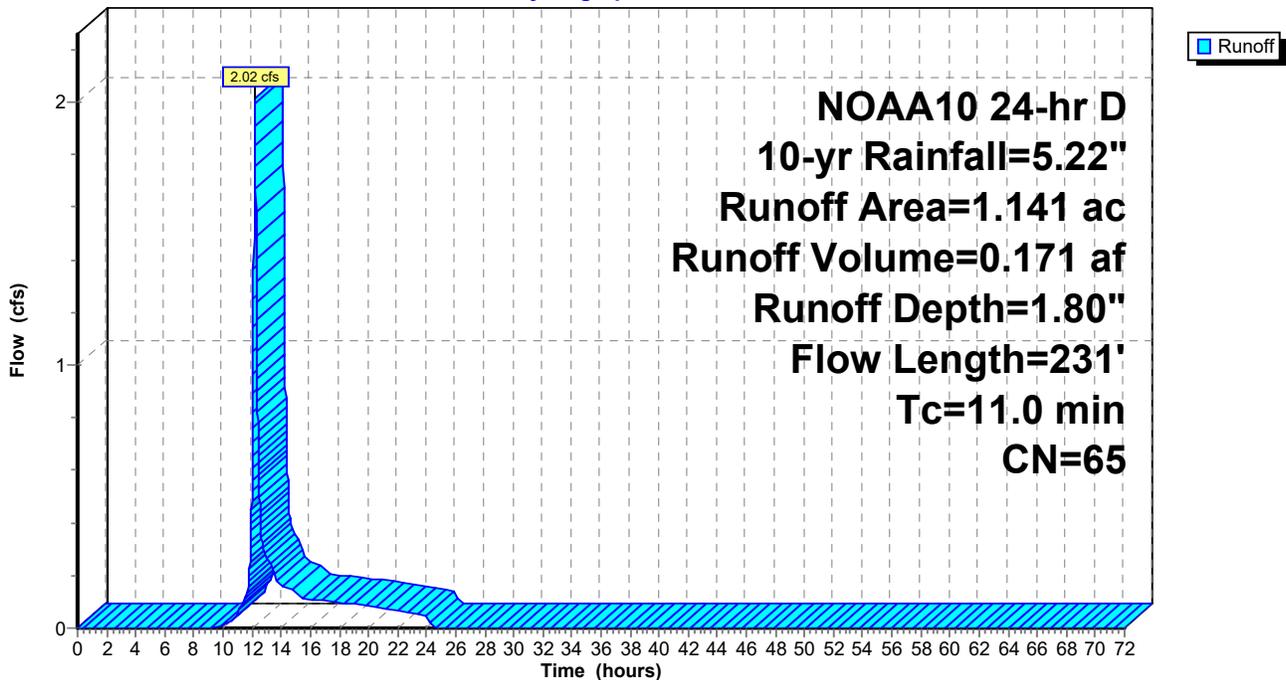
Area (ac)	CN	Description
0.631	39	>75% Grass cover, Good, HSG A
0.239	98	Paved parking, HSG A
0.009	98	Unconnected pavement, HSG A
0.261	98	Water Surface, HSG A

1.141	65	Weighted Average
0.631		55.29% Pervious Area
0.510		44.71% Impervious Area
0.009		1.84% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		Sheet Flow, Grass: Short n= 0.150 P2= 3.36"
1.4	181	0.0220	2.22		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
11.0	231	Total			

Subcatchment EX-2: Subcat EX-2

Hydrograph



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NOAA10 24-hr D 10-yr Rainfall=5.22"

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Summary for Subcatchment EX-3: Subcat EX-3

Runoff = 7.56 cfs @ 12.19 hrs, Volume= 0.652 af, Depth= 3.67"
 Routed to Pond 5P : EX. BASIN #2

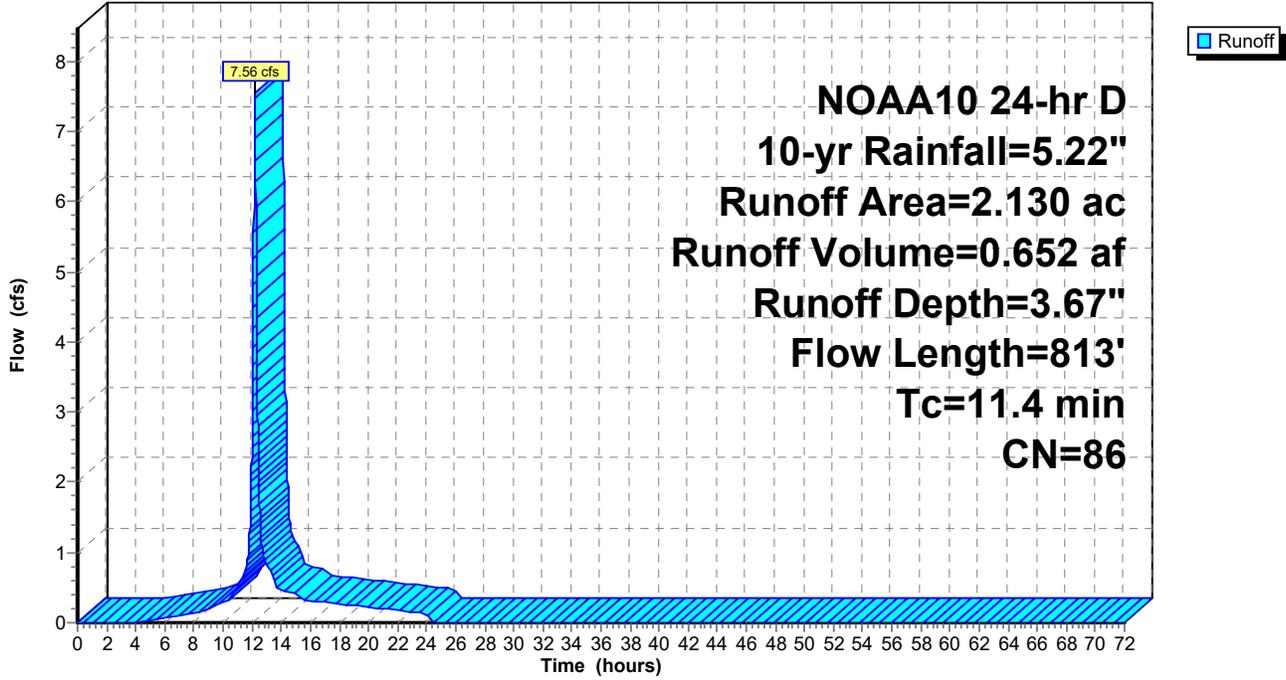
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.238	39	>75% Grass cover, Good, HSG A
0.015	80	>75% Grass cover, Good, HSG D
1.623	98	Paved parking, HSG A
0.039	98	Paved parking, HSG D
0.006	98	Unconnected pavement, HSG A
0.137	30	Woods, Good, HSG A
0.071	77	Woods, Good, HSG D
2.130	86	Weighted Average
0.461		21.65% Pervious Area
1.669		78.35% Impervious Area
0.006		0.35% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	50	0.0440	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
1.2	84	0.0520	1.14		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
1.4	679	0.0220	7.81	9.58	Pipe Channel, 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Concrete pipe, bends & connections
11.4	813	Total			

Subcatchment EX-3: Subcat EX-3

Hydrograph



Summary for Subcatchment EX-4: Subcat EX-4

Runoff = 4.30 cfs @ 12.13 hrs, Volume= 0.307 af, Depth= 4.20"
 Routed to Pond 5P : EX. BASIN #2

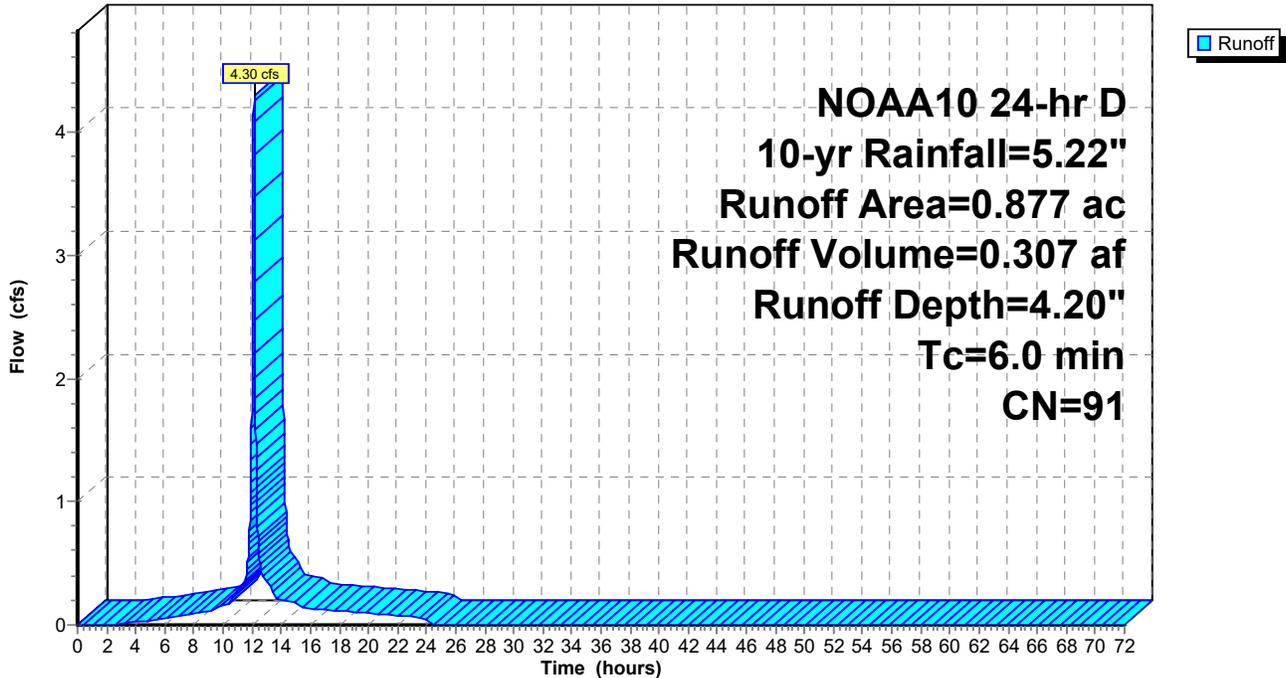
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.105	39	>75% Grass cover, Good, HSG A
0.772	98	Paved parking, HSG A
0.877	91	Weighted Average
0.105		12.00% Pervious Area
0.772		88.00% Impervious Area

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

Subcatchment EX-4: Subcat EX-4

Hydrograph



Summary for Subcatchment EX-5: Subcat EX-5

Runoff = 0.13 cfs @ 12.49 hrs, Volume= 0.076 af, Depth= 0.33"
 Routed to Pond AP-1 : Southern Wetlands

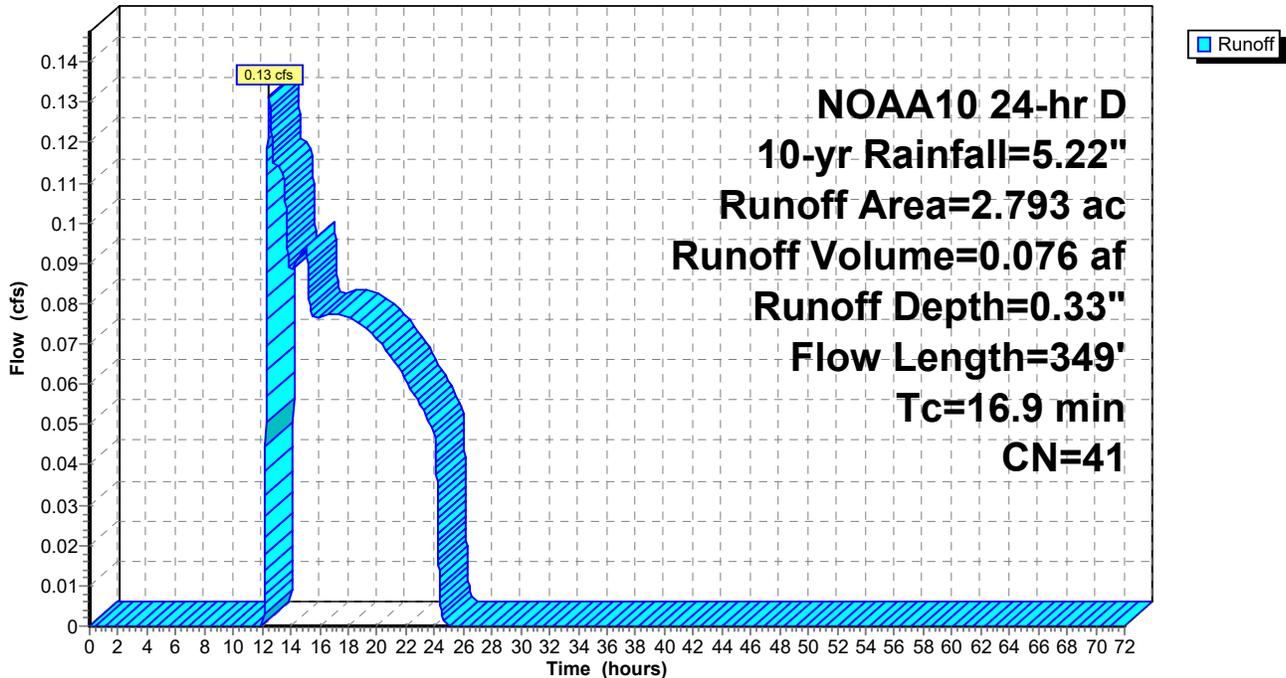
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.176	39	>75% Grass cover, Good, HSG A
0.016	80	>75% Grass cover, Good, HSG D
1.994	30	Woods, Good, HSG A
0.606	77	Woods, Good, HSG D
2.793	41	Weighted Average
2.793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0190	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
0.7	58	0.0780	1.40		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.9	241	0.0420	1.02		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
16.9	349	Total			

Subcatchment EX-5: Subcat EX-5

Hydrograph



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NOAA10 24-hr D 10-yr Rainfall=5.22"

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Summary for Subcatchment EX-6: Subcat EX-6

Runoff = 3.32 cfs @ 12.14 hrs, Volume= 0.226 af, Depth= 1.73"
 Routed to Pond 5P : EX. BASIN #2

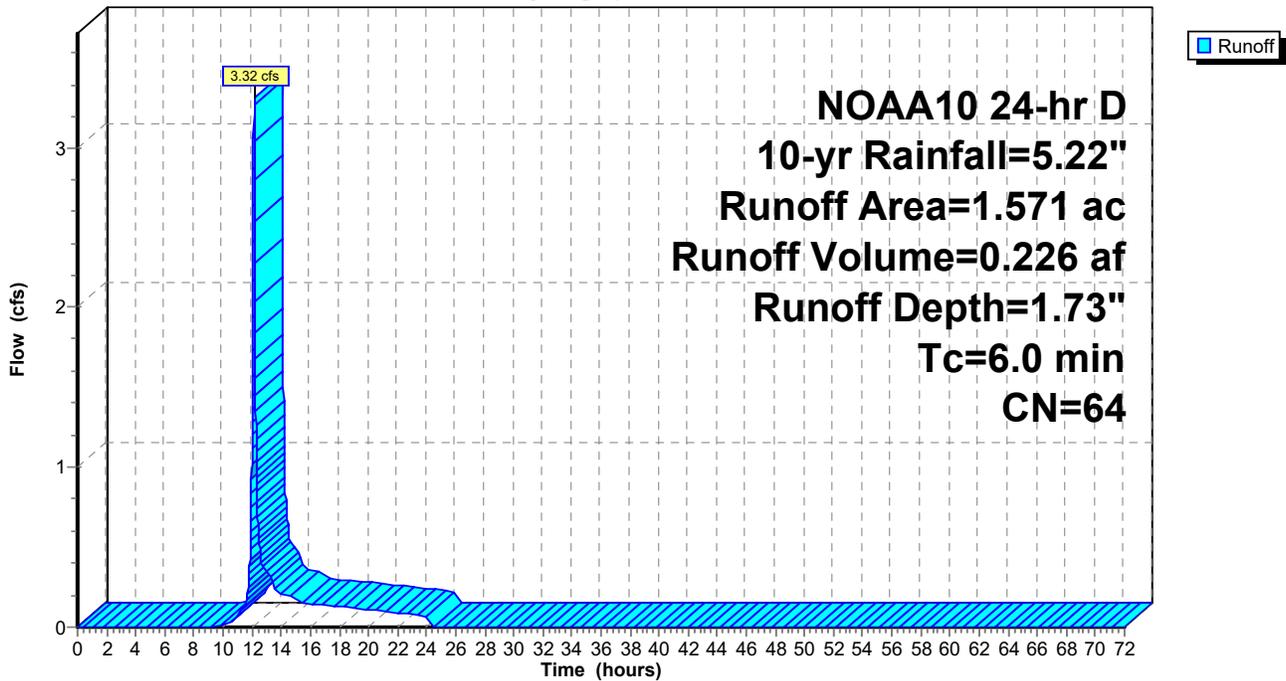
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.500	39	>75% Grass cover, Good, HSG A
0.719	98	Water Surface, HSG A
0.352	30	Woods, Good, HSG A
1.571	64	Weighted Average
0.852		54.23% Pervious Area
0.719		45.77% Impervious Area

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

Subcatchment EX-6: Subcat EX-6

Hydrograph



Summary for Subcatchment EX-7: Subcat EX-7

Runoff = 32.80 cfs @ 12.13 hrs, Volume= 2.567 af, Depth= 4.98"
 Routed to Pond 3P : EX. BASIN #3

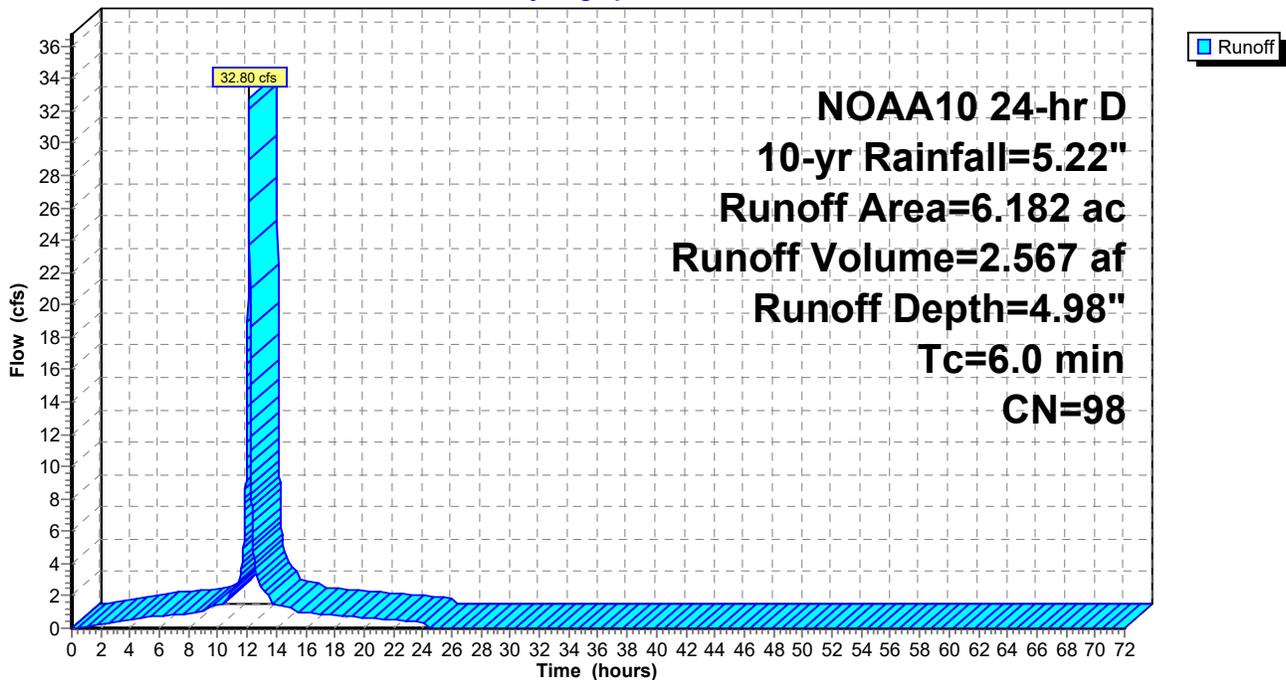
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.000	39	>75% Grass cover, Good, HSG A
6.182	98	Roofs, HSG A
0.000	98	Unconnected pavement, HSG A
6.182	98	Weighted Average
0.000		0.01% Pervious Area
6.182		99.99% Impervious Area
0.000		0.00% Unconnected

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

Subcatchment EX-7: Subcat EX-7

Hydrograph



Summary for Subcatchment EX-8: Subcat EX-8

Runoff = 2.36 cfs @ 12.13 hrs, Volume= 0.161 af, Depth= 3.57"
 Routed to Pond 4P : EX. BASIN #1

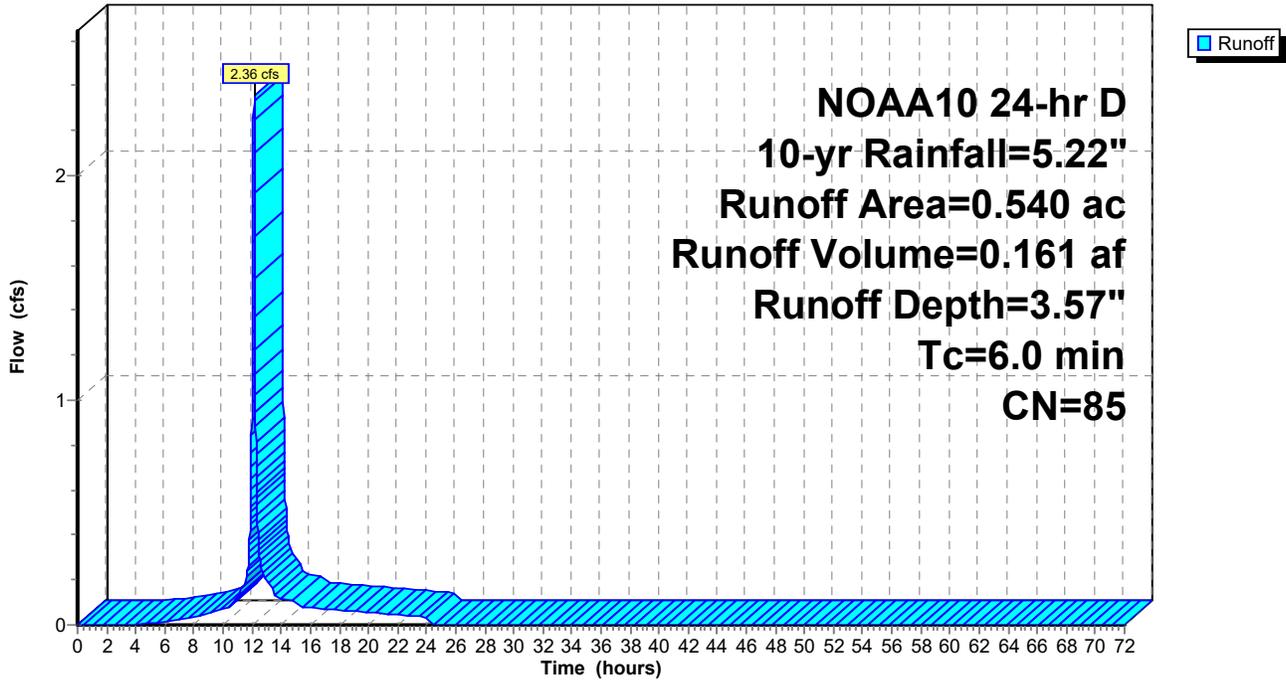
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.119	39	>75% Grass cover, Good, HSG A
0.421	98	Paved parking, HSG A
0.540	85	Weighted Average
0.119		22.03% Pervious Area
0.421		77.97% Impervious Area

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

Subcatchment EX-8: Subcat EX-8

Hydrograph



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NOAA10 24-hr D 10-yr Rainfall=5.22"

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Summary for Pond 3P: EX. BASIN #3

Inflow Area = 9.009 ac, 77.26% Impervious, Inflow Depth = 3.70" for 10-yr event
 Inflow = 34.77 cfs @ 12.13 hrs, Volume= 2.780 af
 Outflow = 7.18 cfs @ 12.36 hrs, Volume= 2.603 af, Atten= 79%, Lag= 13.8 min
 Primary = 7.18 cfs @ 12.36 hrs, Volume= 2.603 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 269.24' @ 12.36 hrs Surf.Area= 18,050 sf Storage= 48,237 cf

Plug-Flow detention time= 256.8 min calculated for 2.603 af (94% of inflow)
 Center-of-Mass det. time= 218.6 min (984.0 - 765.4)

Volume	Invert	Avail.Storage	Storage Description
#1	265.00'	188,837 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
265.00	6,581	0	0
266.00	7,637	7,109	7,109
267.00	8,818	8,228	15,337
268.00	15,371	12,095	27,431
269.00	17,536	16,454	43,885
270.00	19,637	18,587	62,471
271.00	21,748	20,693	83,164
272.00	23,983	22,866	106,029
273.00	26,245	25,114	131,143
274.00	28,727	27,486	158,629
275.00	31,688	30,208	188,837

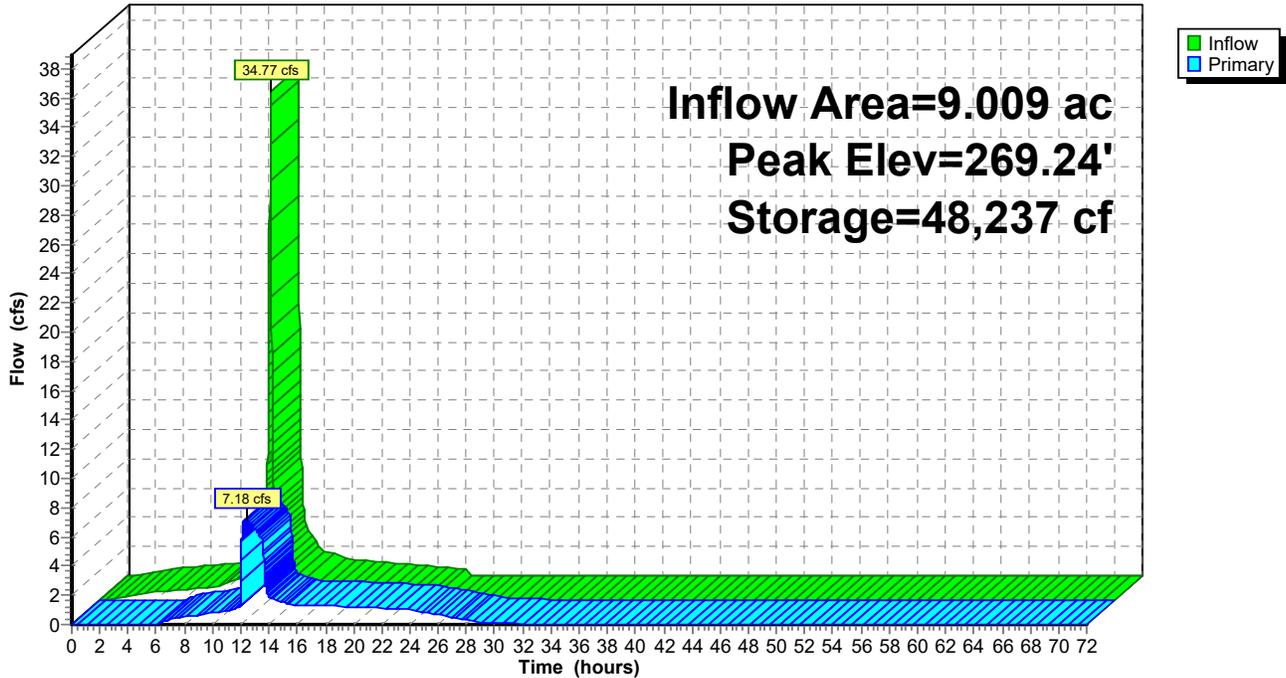
Device	Routing	Invert	Outlet Devices
#1	Primary	265.60'	24.0" Round Culvert L= 223.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 265.60' / 264.50' S= 0.0049 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	266.06'	12.0" Round Culvert L= 8.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 266.06' / 265.90' S= 0.0190 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#3	Device 2	266.06'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 1	266.58'	12.0" Round Culvert L= 12.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 266.58' / 265.80' S= 0.0634 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#5	Device 4	268.26'	57.0" x 100.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=7.18 cfs @ 12.36 hrs HW=269.24' TW=253.83' (Dynamic Tailwater)

- 1=Culvert (Passes 7.18 cfs of 20.18 cfs potential flow)
- 2=Culvert (Passes 1.62 cfs of 6.20 cfs potential flow)
- 3=Orifice/Grate (Orifice Controls 1.62 cfs @ 8.25 fps)
- 4=Culvert (Inlet Controls 5.56 cfs @ 7.08 fps)
- 5=Orifice/Grate (Passes 5.56 cfs of 83.59 cfs potential flow)

Pond 3P: EX. BASIN #3

Hydrograph



Summary for Pond 4P: EX. BASIN #1

Inflow Area = 1.681 ac, 55.40% Impervious, Inflow Depth = 2.37" for 10-yr event
 Inflow = 4.06 cfs @ 12.15 hrs, Volume= 0.332 af
 Outflow = 3.22 cfs @ 12.21 hrs, Volume= 0.283 af, Atten= 21%, Lag= 3.7 min
 Primary = 3.22 cfs @ 12.21 hrs, Volume= 0.283 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 274.21' @ 12.21 hrs Surf.Area= 6,060 sf Storage= 3,343 cf

Plug-Flow detention time= 124.8 min calculated for 0.283 af (85% of inflow)
 Center-of-Mass det. time= 53.4 min (918.7 - 865.3)

Volume	Invert	Avail.Storage	Storage Description
#1	273.40'	31,754 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
273.40	1,731	0	0
274.00	5,352	2,125	2,125
275.00	8,670	7,011	9,136
276.00	11,387	10,029	19,164
277.00	13,793	12,590	31,754

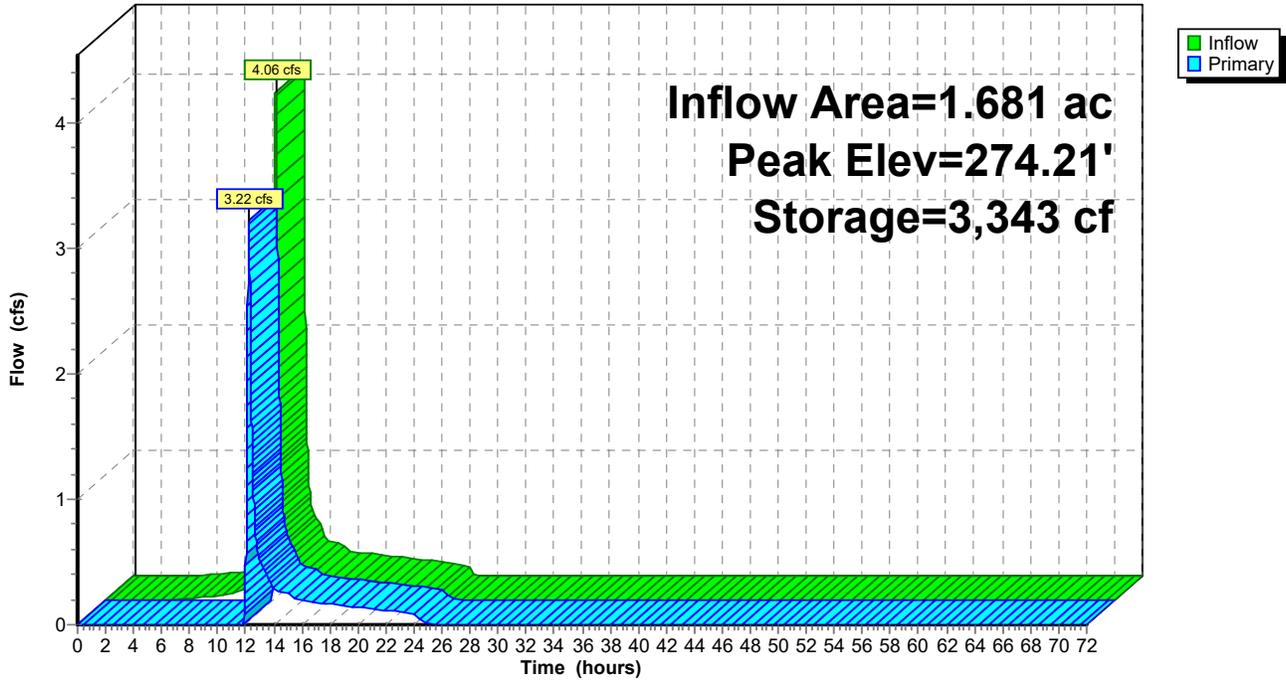
Device	Routing	Invert	Outlet Devices
#1	Primary	272.50'	12.0" Round Culvert L= 75.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 272.50' / 271.90' S= 0.0079 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	274.00'	24.0" x 36.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.22 cfs @ 12.21 hrs HW=274.21' TW=253.53' (Dynamic Tailwater)

- ↑1=Culvert (Passes 3.22 cfs of 3.67 cfs potential flow)
- ↑2=Orifice/Grate (Weir Controls 3.22 cfs @ 1.51 fps)

Pond 4P: EX. BASIN #1

Hydrograph



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NOAA10 24-hr D 10-yr Rainfall=5.22"

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Summary for Pond 5P: EX. BASIN #2

Inflow Area = 15.269 ac, 72.38% Impervious, Inflow Depth = 3.20" for 10-yr event
 Inflow = 23.66 cfs @ 12.16 hrs, Volume= 4.071 af
 Outflow = 1.63 cfs @ 21.59 hrs, Volume= 1.991 af, Atten= 93%, Lag= 566.2 min
 Primary = 1.63 cfs @ 21.59 hrs, Volume= 1.991 af
 Routed to Pond AP-1 : Southern Wetlands
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond AP-1 : Southern Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 255.77' @ 21.59 hrs Surf.Area= 39,016 sf Storage= 119,044 cf

Plug-Flow detention time= 812.9 min calculated for 1.991 af (49% of inflow)
 Center-of-Mass det. time= 585.9 min (1,521.6 - 935.7)

Volume	Invert	Avail.Storage	Storage Description
#1	252.00'	261,437 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
252.00	2,679	0	0
252.50	29,599	8,070	8,070
253.00	31,025	15,156	23,226
254.00	33,475	32,250	55,476
255.00	36,062	34,769	90,244
256.00	39,913	37,988	128,232
257.00	43,021	41,467	169,699
258.00	46,190	44,606	214,304
259.00	48,075	47,133	261,437

Device	Routing	Invert	Outlet Devices
#1	Secondary	257.70'	9.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	254.94'	12.0" Round Culvert L= 12.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 254.94' / 254.86' S= 0.0067 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=1.63 cfs @ 21.59 hrs HW=255.77' TW=0.00' (Dynamic Tailwater)

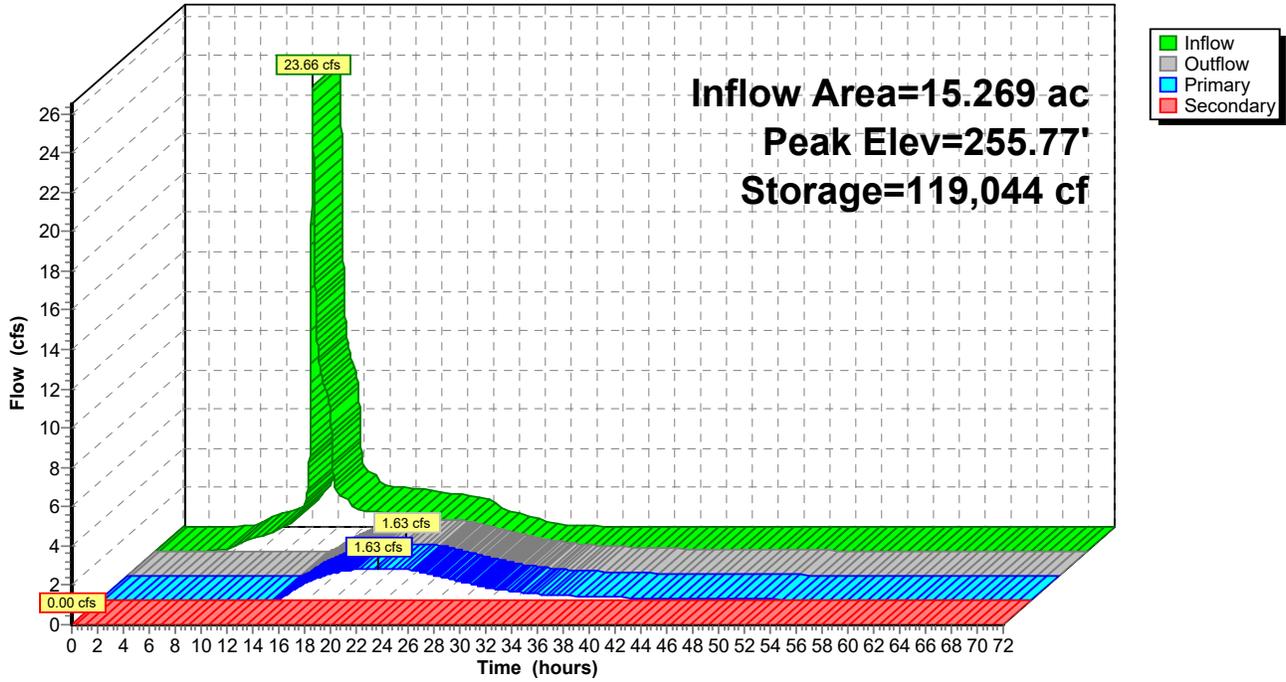
↑**2=Culvert** (Barrel Controls 1.63 cfs @ 3.19 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=252.00' TW=0.00' (Dynamic Tailwater)

↑**1=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 5P: EX. BASIN #2

Hydrograph



Summary for Pond AP-1: Southern Wetlands

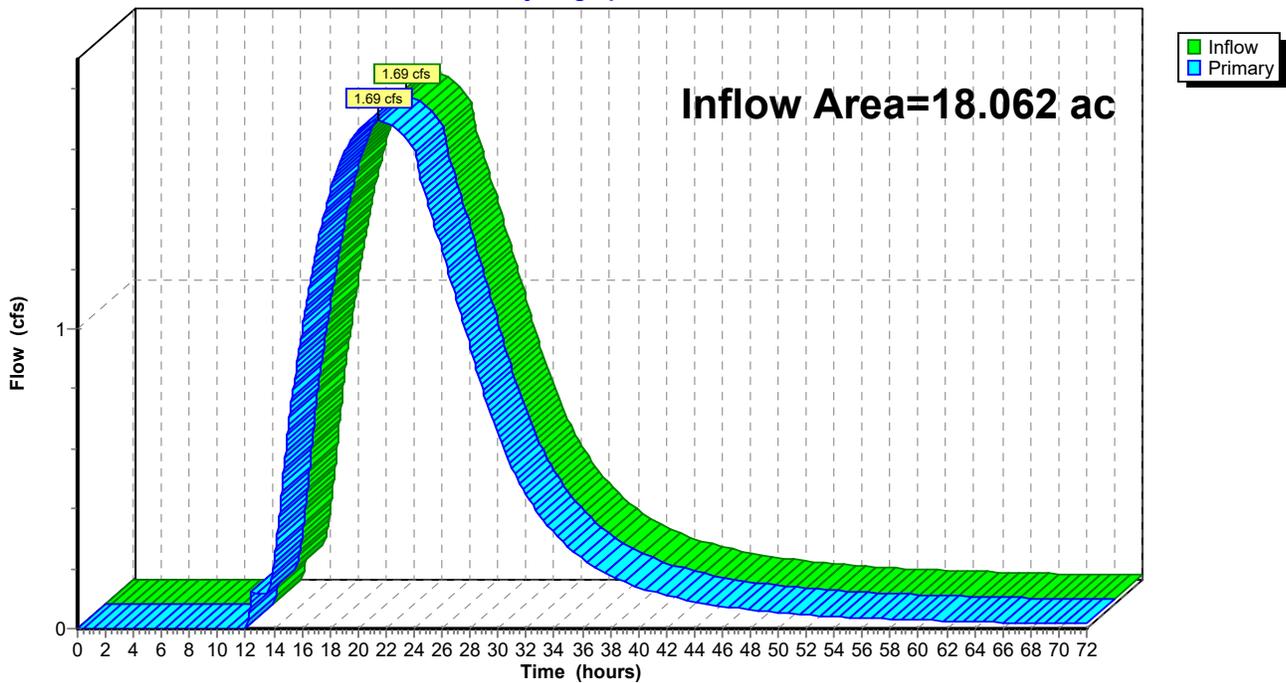
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 18.062 ac, 61.19% Impervious, Inflow Depth > 1.37" for 10-yr event
Inflow = 1.69 cfs @ 21.43 hrs, Volume= 2.067 af
Primary = 1.69 cfs @ 21.43 hrs, Volume= 2.067 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: Southern Wetlands

Hydrograph



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NOAA10 24-hr D 25-yr Rainfall=6.39"

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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1: Subcat EX-1	Runoff Area=2.827 ac 27.56% Impervious Runoff Depth=1.50" Flow Length=424' Tc=8.1 min CN=52 Runoff=4.33 cfs 0.353 af
SubcatchmentEX-2: Subcat EX-2	Runoff Area=1.141 ac 44.71% Impervious Runoff Depth=2.64" Flow Length=231' Tc=11.0 min CN=65 Runoff=3.02 cfs 0.251 af
SubcatchmentEX-3: Subcat EX-3	Runoff Area=2.130 ac 78.35% Impervious Runoff Depth=4.78" Flow Length=813' Tc=11.4 min CN=86 Runoff=9.71 cfs 0.849 af
SubcatchmentEX-4: Subcat EX-4	Runoff Area=0.877 ac 88.00% Impervious Runoff Depth=5.34" Tc=6.0 min CN=91 Runoff=5.39 cfs 0.390 af
SubcatchmentEX-5: Subcat EX-5	Runoff Area=2.793 ac 0.00% Impervious Runoff Depth=0.69" Flow Length=349' Tc=16.9 min CN=41 Runoff=0.73 cfs 0.160 af
SubcatchmentEX-6: Subcat EX-6	Runoff Area=1.571 ac 45.77% Impervious Runoff Depth=2.55" Tc=6.0 min CN=64 Runoff=4.98 cfs 0.333 af
SubcatchmentEX-7: Subcat EX-7	Runoff Area=6.182 ac 99.99% Impervious Runoff Depth=6.15" Tc=6.0 min CN=98 Runoff=40.21 cfs 3.169 af
SubcatchmentEX-8: Subcat EX-8	Runoff Area=0.540 ac 77.97% Impervious Runoff Depth=4.67" Tc=6.0 min CN=85 Runoff=3.04 cfs 0.210 af
Pond 3P: EX. BASIN #3	Peak Elev=269.85' Storage=59,473 cf Inflow=44.12 cfs 3.522 af Outflow=8.07 cfs 3.346 af
Pond 4P: EX. BASIN #1	Peak Elev=274.31' Storage=3,935 cf Inflow=5.63 cfs 0.461 af Outflow=3.80 cfs 0.412 af
Pond 5P: EX. BASIN #2	Peak Elev=256.15' Storage=134,226 cf Inflow=30.01 cfs 5.330 af Primary=2.77 cfs 3.248 af Secondary=0.00 cfs 0.000 af Outflow=2.77 cfs 3.248 af
Pond AP-1: Southern Wetlands	Inflow=2.94 cfs 3.409 af Primary=2.94 cfs 3.409 af

Total Runoff Area = 18.062 ac Runoff Volume = 5.716 af Average Runoff Depth = 3.80"
38.81% Pervious = 7.010 ac 61.19% Impervious = 11.052 ac

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NOAA10 24-hr D 25-yr Rainfall=6.39"

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Summary for Subcatchment EX-1: Subcat EX-1

[47] Hint: Peak is 136% of capacity of segment #4

Runoff = 4.33 cfs @ 12.16 hrs, Volume= 0.353 af, Depth= 1.50"
 Routed to Pond 3P : EX. BASIN #3

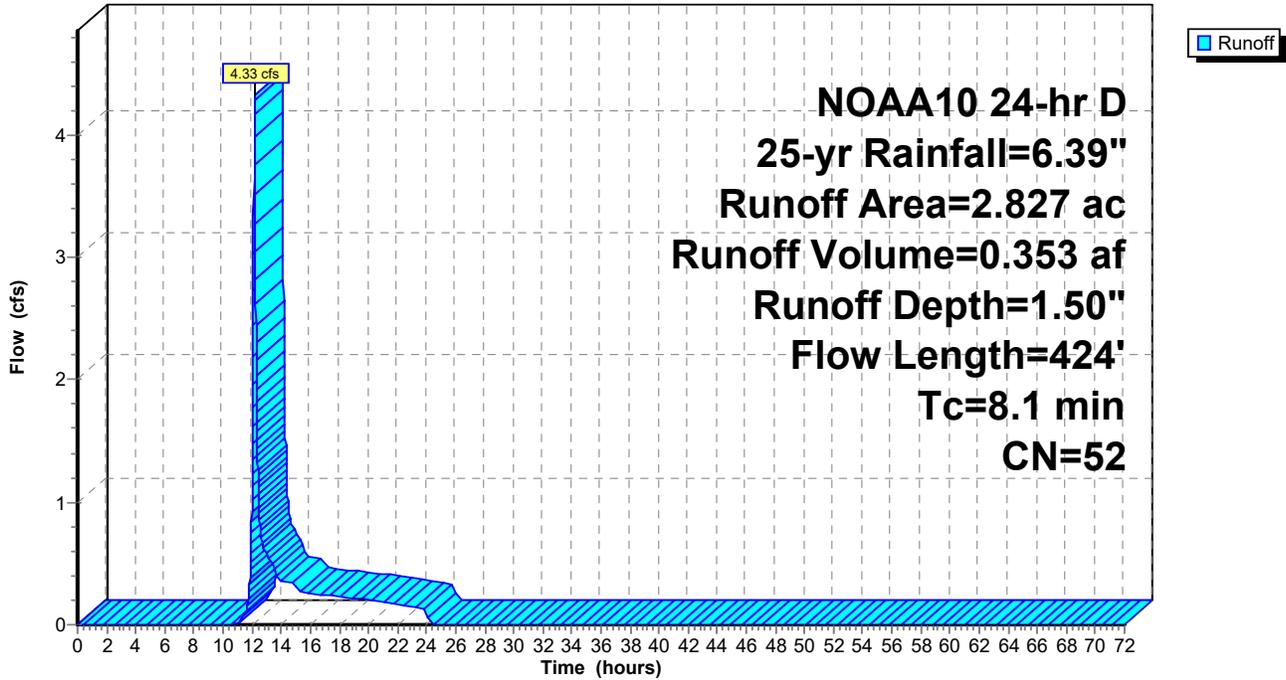
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
1.115	39	>75% Grass cover, Good, HSG A
0.505	98	Paved parking, HSG A
0.003	98	Unconnected pavement, HSG A
0.271	98	Water Surface, HSG A
0.933	30	Woods, Good, HSG A
2.827	52	Weighted Average
2.048		72.44% Pervious Area
0.779		27.56% Impervious Area
0.003		0.37% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	50	0.0250	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.36"
0.4	19	0.0110	0.73		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.3	255	0.0080	1.82		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	100	0.0080	4.06	3.19	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
8.1	424	Total			

Subcatchment EX-1: Subcat EX-1

Hydrograph



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NOAA10 24-hr D 25-yr Rainfall=6.39"

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Summary for Subcatchment EX-2: Subcat EX-2

Runoff = 3.02 cfs @ 12.19 hrs, Volume= 0.251 af, Depth= 2.64"
 Routed to Pond 4P : EX. BASIN #1

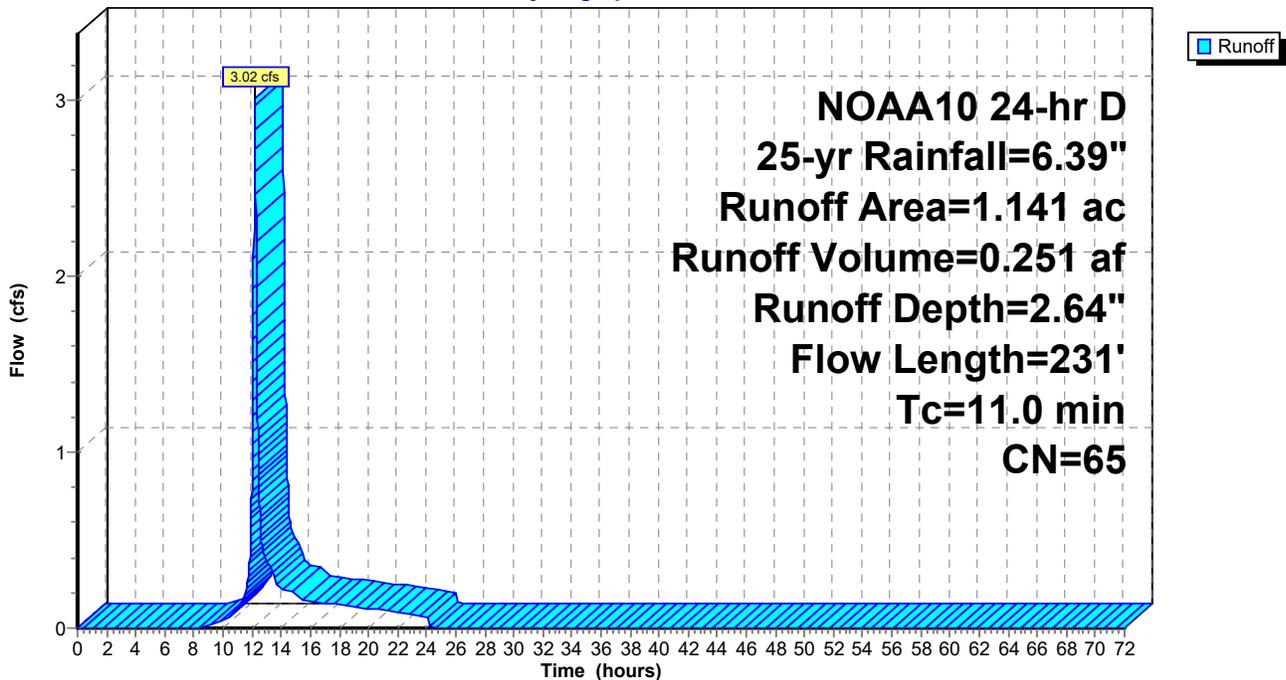
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.631	39	>75% Grass cover, Good, HSG A
0.239	98	Paved parking, HSG A
0.009	98	Unconnected pavement, HSG A
0.261	98	Water Surface, HSG A
1.141	65	Weighted Average
0.631		55.29% Pervious Area
0.510		44.71% Impervious Area
0.009		1.84% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		Sheet Flow, Grass: Short n= 0.150 P2= 3.36"
1.4	181	0.0220	2.22		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
11.0	231	Total			

Subcatchment EX-2: Subcat EX-2

Hydrograph



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NOAA10 24-hr D 25-yr Rainfall=6.39"

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Summary for Subcatchment EX-3: Subcat EX-3

[47] Hint: Peak is 101% of capacity of segment #3

Runoff = 9.71 cfs @ 12.19 hrs, Volume= 0.849 af, Depth= 4.78"
 Routed to Pond 5P : EX. BASIN #2

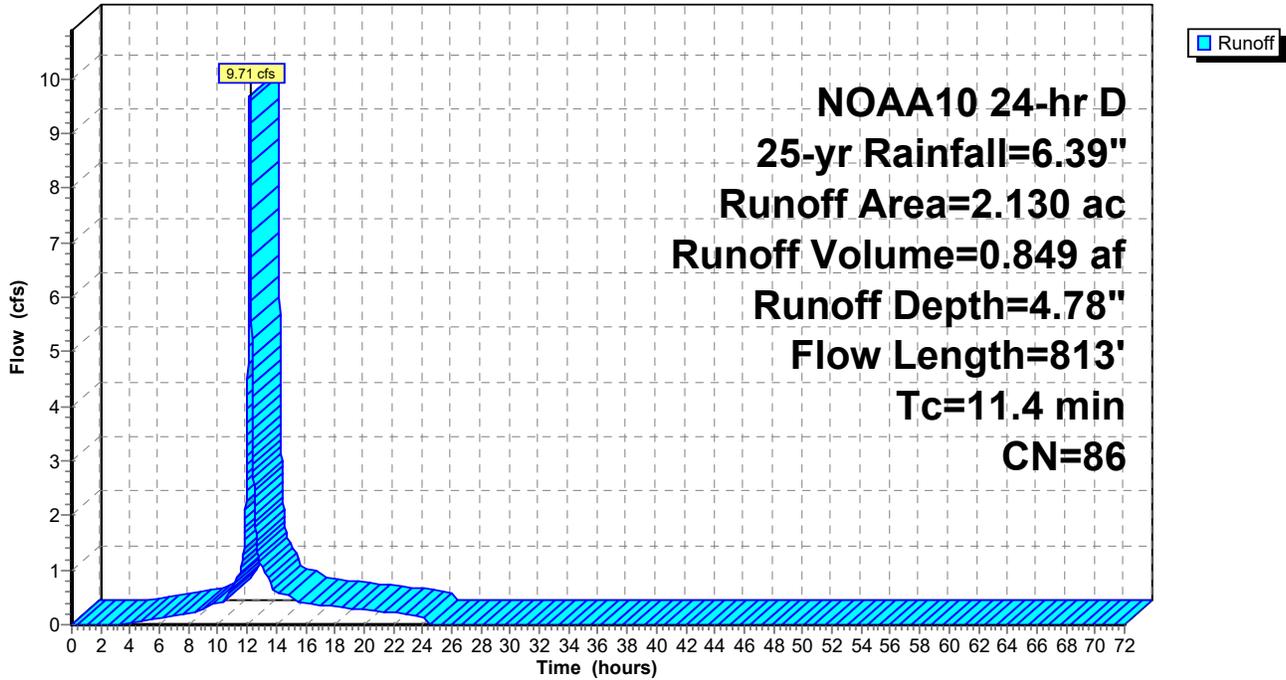
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.238	39	>75% Grass cover, Good, HSG A
0.015	80	>75% Grass cover, Good, HSG D
1.623	98	Paved parking, HSG A
0.039	98	Paved parking, HSG D
0.006	98	Unconnected pavement, HSG A
0.137	30	Woods, Good, HSG A
0.071	77	Woods, Good, HSG D
2.130	86	Weighted Average
0.461		21.65% Pervious Area
1.669		78.35% Impervious Area
0.006		0.35% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	50	0.0440	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
1.2	84	0.0520	1.14		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
1.4	679	0.0220	7.81	9.58	Pipe Channel, 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Concrete pipe, bends & connections
11.4	813	Total			

Subcatchment EX-3: Subcat EX-3

Hydrograph



Summary for Subcatchment EX-4: Subcat EX-4

Runoff = 5.39 cfs @ 12.13 hrs, Volume= 0.390 af, Depth= 5.34"
 Routed to Pond 5P : EX. BASIN #2

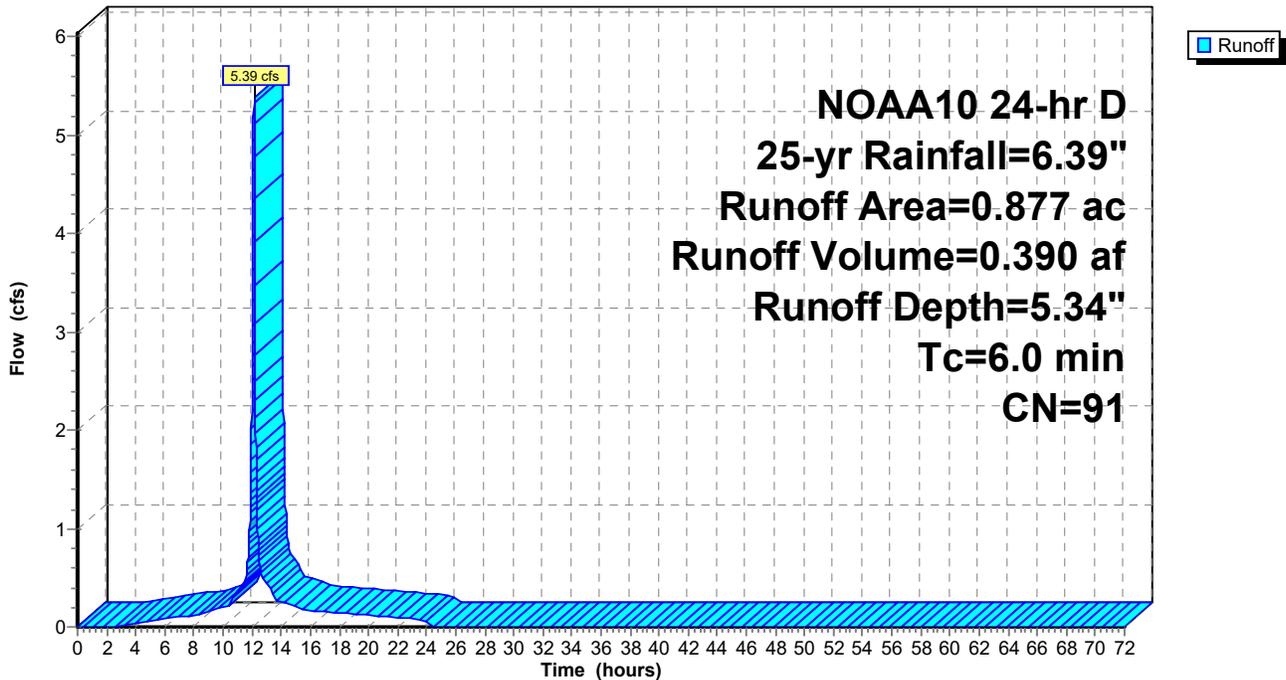
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.105	39	>75% Grass cover, Good, HSG A
0.772	98	Paved parking, HSG A
0.877	91	Weighted Average
0.105		12.00% Pervious Area
0.772		88.00% Impervious Area

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

Subcatchment EX-4: Subcat EX-4

Hydrograph



Summary for Subcatchment EX-5: Subcat EX-5

Runoff = 0.73 cfs @ 12.33 hrs, Volume= 0.160 af, Depth= 0.69"
 Routed to Pond AP-1 : Southern Wetlands

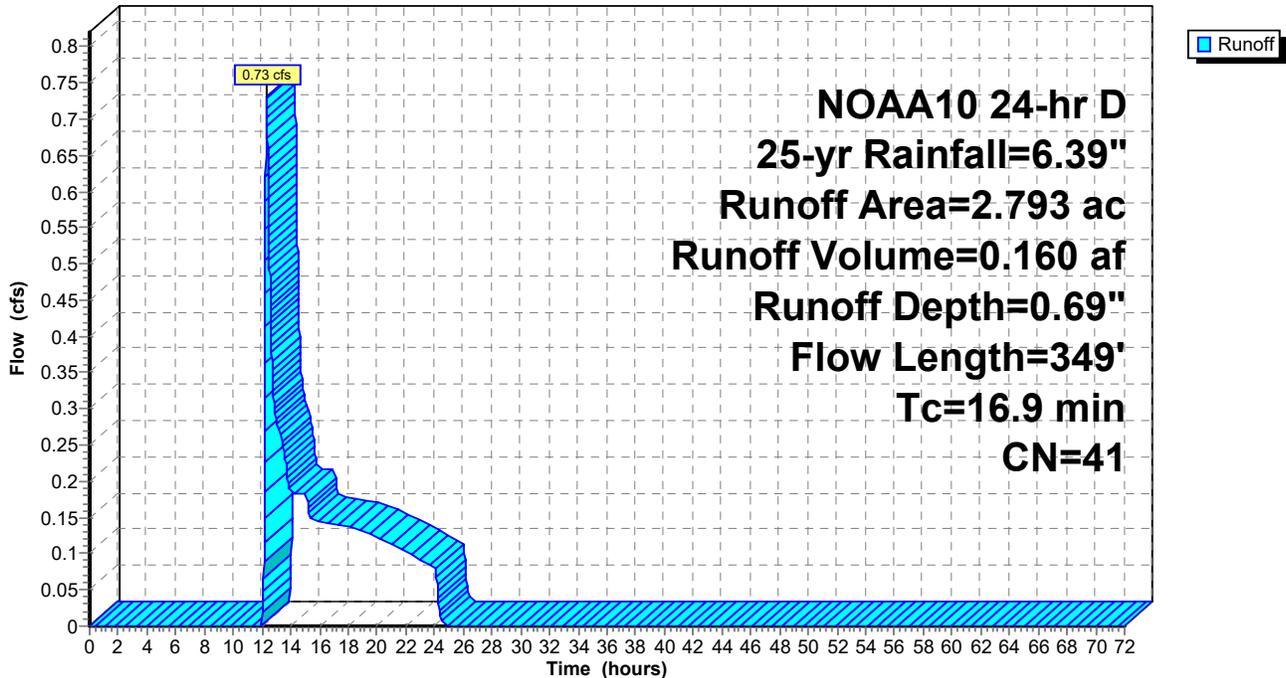
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.176	39	>75% Grass cover, Good, HSG A
0.016	80	>75% Grass cover, Good, HSG D
1.994	30	Woods, Good, HSG A
0.606	77	Woods, Good, HSG D
2.793	41	Weighted Average
2.793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0190	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
0.7	58	0.0780	1.40		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.9	241	0.0420	1.02		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
16.9	349	Total			

Subcatchment EX-5: Subcat EX-5

Hydrograph



Summary for Subcatchment EX-6: Subcat EX-6

Runoff = 4.98 cfs @ 12.13 hrs, Volume= 0.333 af, Depth= 2.55"
 Routed to Pond 5P : EX. BASIN #2

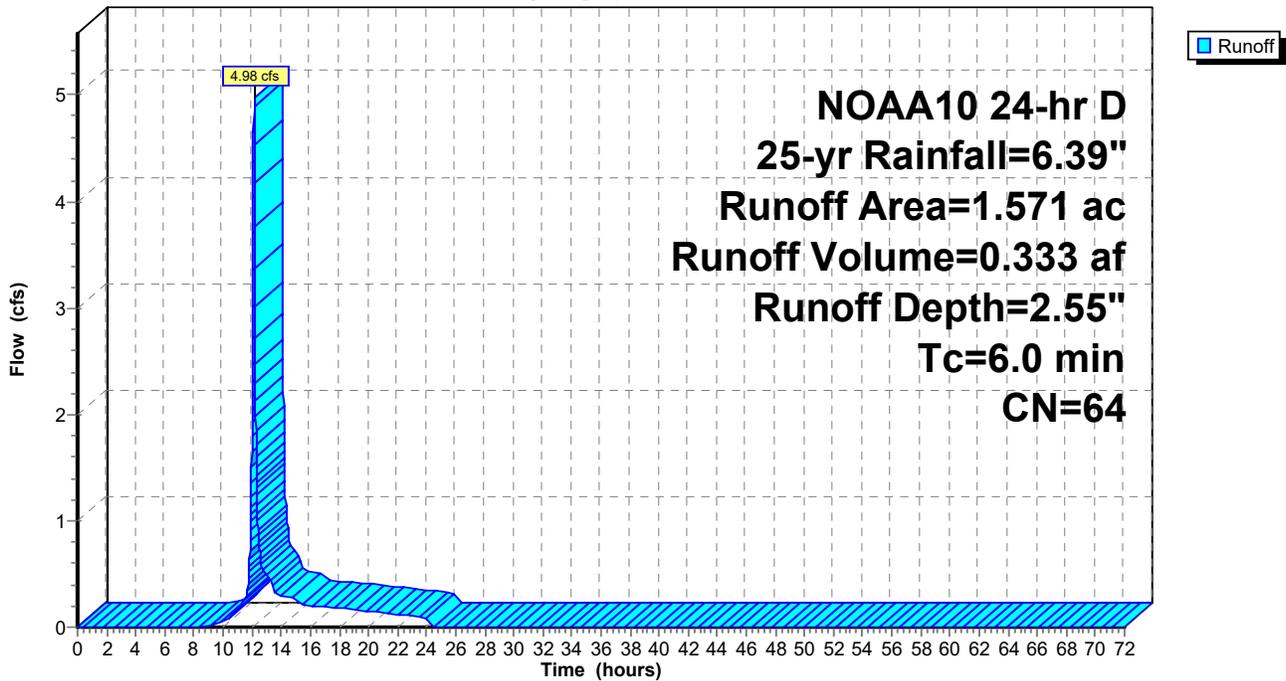
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.500	39	>75% Grass cover, Good, HSG A
0.719	98	Water Surface, HSG A
0.352	30	Woods, Good, HSG A
1.571	64	Weighted Average
0.852		54.23% Pervious Area
0.719		45.77% Impervious Area

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

Subcatchment EX-6: Subcat EX-6

Hydrograph



Summary for Subcatchment EX-7: Subcat EX-7

Runoff = 40.21 cfs @ 12.13 hrs, Volume= 3.169 af, Depth= 6.15"
 Routed to Pond 3P : EX. BASIN #3

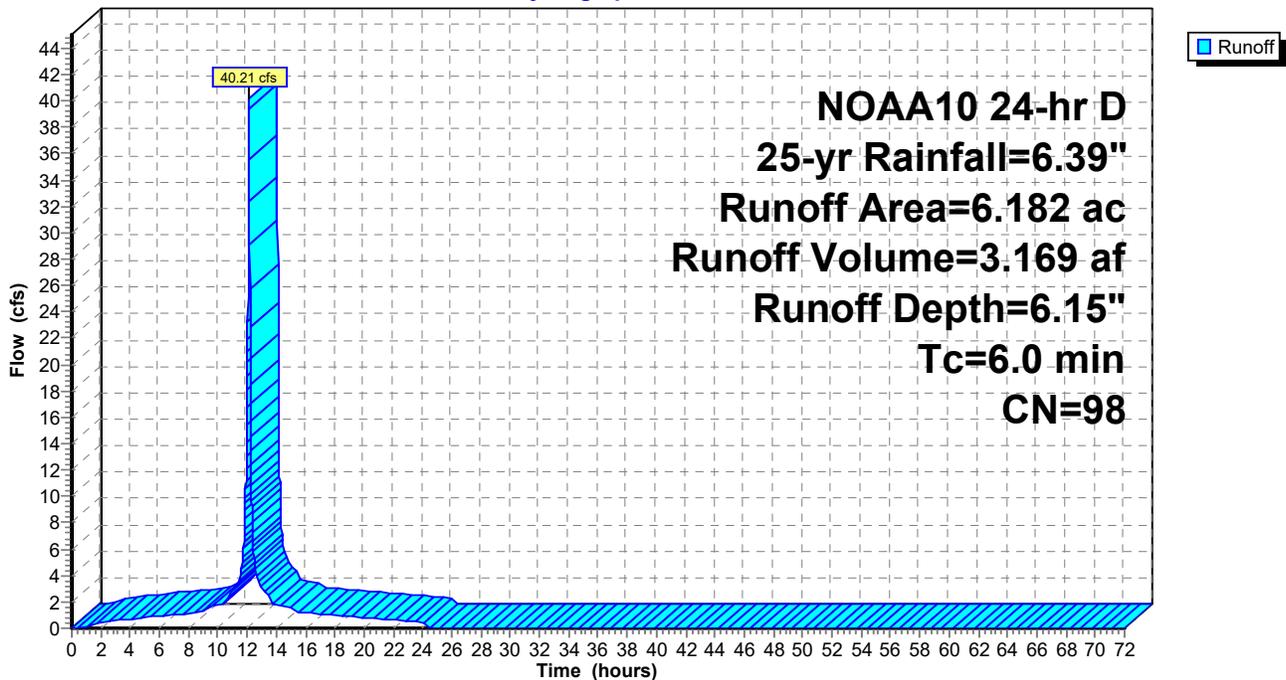
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.000	39	>75% Grass cover, Good, HSG A
6.182	98	Roofs, HSG A
0.000	98	Unconnected pavement, HSG A
6.182	98	Weighted Average
0.000		0.01% Pervious Area
6.182		99.99% Impervious Area
0.000		0.00% Unconnected

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

Subcatchment EX-7: Subcat EX-7

Hydrograph



Summary for Subcatchment EX-8: Subcat EX-8

Runoff = 3.04 cfs @ 12.13 hrs, Volume= 0.210 af, Depth= 4.67"
 Routed to Pond 4P : EX. BASIN #1

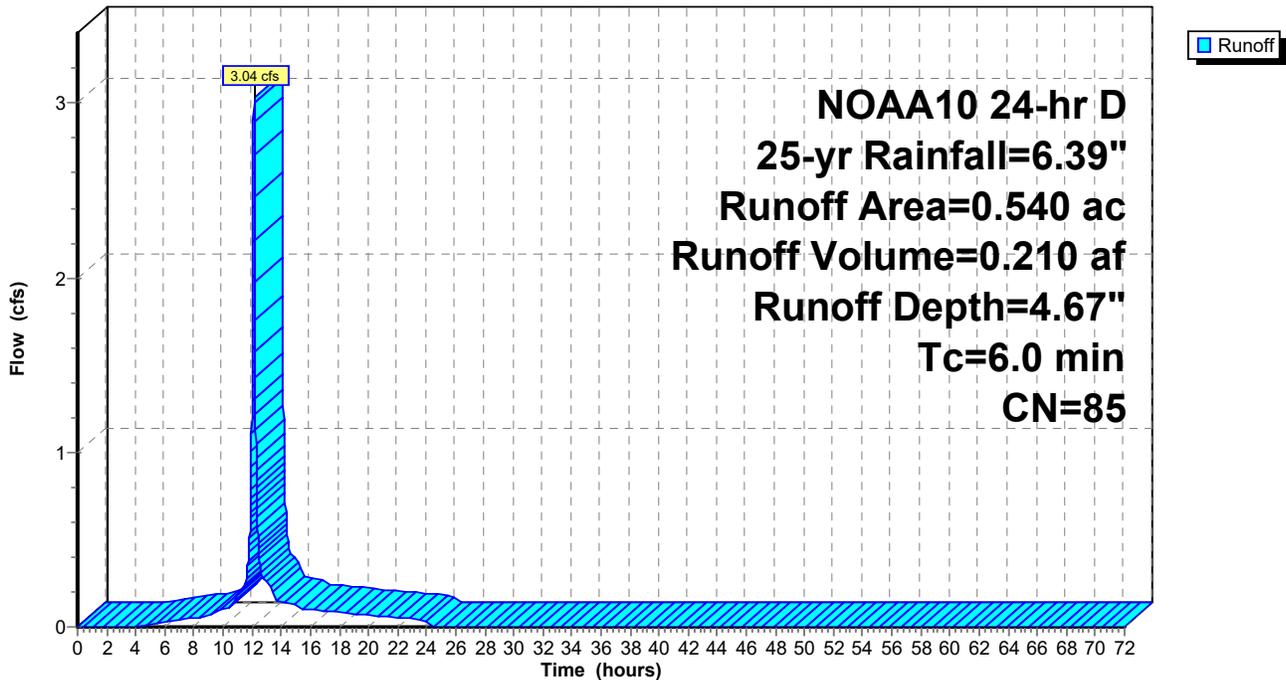
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.119	39	>75% Grass cover, Good, HSG A
0.421	98	Paved parking, HSG A
0.540	85	Weighted Average
0.119		22.03% Pervious Area
0.421		77.97% Impervious Area

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

Subcatchment EX-8: Subcat EX-8

Hydrograph



Summary for Pond 3P: EX. BASIN #3

Inflow Area = 9.009 ac, 77.26% Impervious, Inflow Depth = 4.69" for 25-yr event
 Inflow = 44.12 cfs @ 12.13 hrs, Volume= 3.522 af
 Outflow = 8.07 cfs @ 12.39 hrs, Volume= 3.346 af, Atten= 82%, Lag= 15.5 min
 Primary = 8.07 cfs @ 12.39 hrs, Volume= 3.346 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 269.85' @ 12.39 hrs Surf.Area= 19,314 sf Storage= 59,473 cf

Plug-Flow detention time= 235.3 min calculated for 3.345 af (95% of inflow)
 Center-of-Mass det. time= 204.6 min (969.2 - 764.6)

Volume	Invert	Avail.Storage	Storage Description
#1	265.00'	188,837 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
265.00	6,581	0	0
266.00	7,637	7,109	7,109
267.00	8,818	8,228	15,337
268.00	15,371	12,095	27,431
269.00	17,536	16,454	43,885
270.00	19,637	18,587	62,471
271.00	21,748	20,693	83,164
272.00	23,983	22,866	106,029
273.00	26,245	25,114	131,143
274.00	28,727	27,486	158,629
275.00	31,688	30,208	188,837

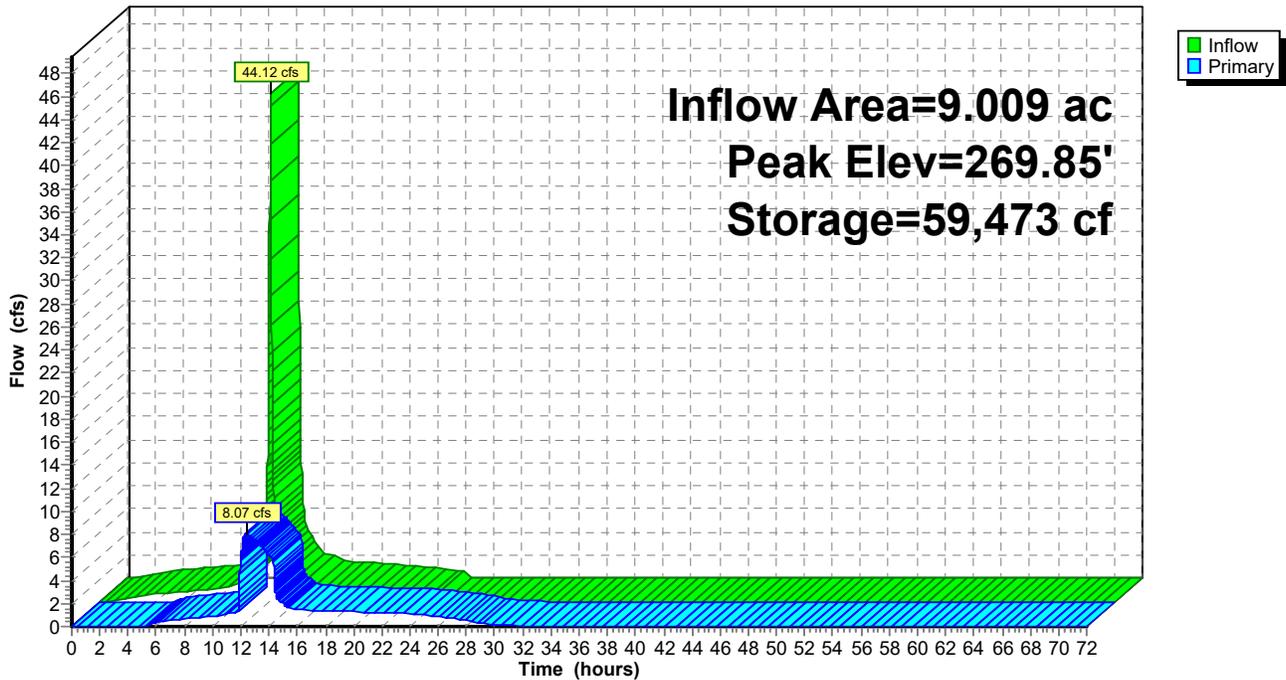
Device	Routing	Invert	Outlet Devices
#1	Primary	265.60'	24.0" Round Culvert L= 223.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 265.60' / 264.50' S= 0.0049 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	266.06'	12.0" Round Culvert L= 8.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 266.06' / 265.90' S= 0.0190 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#3	Device 2	266.06'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 1	266.58'	12.0" Round Culvert L= 12.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 266.58' / 265.80' S= 0.0634 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#5	Device 4	268.26'	57.0" x 100.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=8.07 cfs @ 12.39 hrs HW=269.85' TW=254.44' (Dynamic Tailwater)

- 1=Culvert (Passes 8.07 cfs of 22.28 cfs potential flow)
- 2=Culvert (Passes 1.78 cfs of 6.86 cfs potential flow)
- 3=Orifice/Grate (Orifice Controls 1.78 cfs @ 9.05 fps)
- 4=Culvert (Inlet Controls 6.29 cfs @ 8.01 fps)
- 5=Orifice/Grate (Passes 6.29 cfs of 170.91 cfs potential flow)

Pond 3P: EX. BASIN #3

Hydrograph



Summary for Pond 4P: EX. BASIN #1

Inflow Area = 1.681 ac, 55.40% Impervious, Inflow Depth = 3.29" for 25-yr event
 Inflow = 5.63 cfs @ 12.15 hrs, Volume= 0.461 af
 Outflow = 3.80 cfs @ 12.24 hrs, Volume= 0.412 af, Atten= 33%, Lag= 5.6 min
 Primary = 3.80 cfs @ 12.24 hrs, Volume= 0.412 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 274.31' @ 12.24 hrs Surf.Area= 6,376 sf Storage= 3,935 cf

Plug-Flow detention time= 99.0 min calculated for 0.412 af (89% of inflow)
 Center-of-Mass det. time= 44.5 min (898.9 - 854.4)

Volume	Invert	Avail.Storage	Storage Description
#1	273.40'	31,754 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
273.40	1,731	0	0
274.00	5,352	2,125	2,125
275.00	8,670	7,011	9,136
276.00	11,387	10,029	19,164
277.00	13,793	12,590	31,754

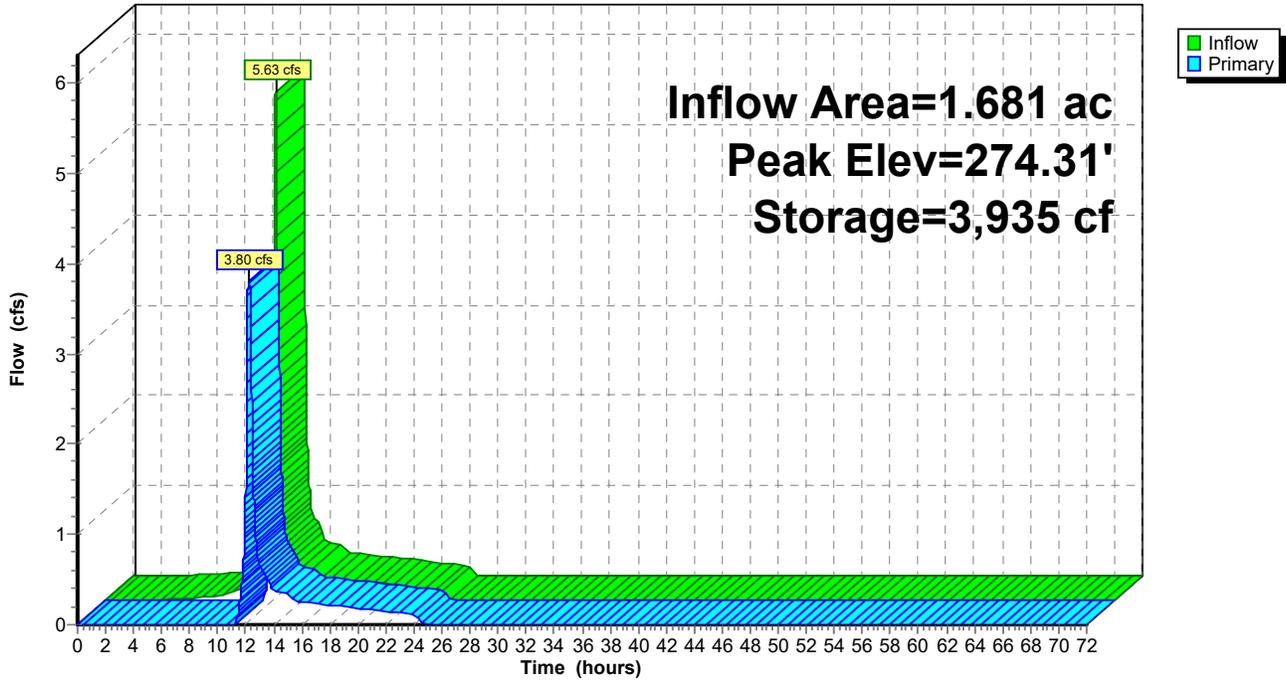
Device	Routing	Invert	Outlet Devices
#1	Primary	272.50'	12.0" Round Culvert L= 75.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 272.50' / 271.90' S= 0.0079 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	274.00'	24.0" x 36.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.80 cfs @ 12.24 hrs HW=274.31' TW=254.13' (Dynamic Tailwater)

- ↑1=Culvert (Barrel Controls 3.80 cfs @ 4.83 fps)
- ↑2=Orifice/Grate (Passes 3.80 cfs of 5.61 cfs potential flow)

Pond 4P: EX. BASIN #1

Hydrograph



Summary for Pond 5P: EX. BASIN #2

Inflow Area = 15.269 ac, 72.38% Impervious, Inflow Depth = 4.19" for 25-yr event
 Inflow = 30.01 cfs @ 12.15 hrs, Volume= 5.330 af
 Outflow = 2.77 cfs @ 15.30 hrs, Volume= 3.248 af, Atten= 91%, Lag= 189.3 min
 Primary = 2.77 cfs @ 15.30 hrs, Volume= 3.248 af
 Routed to Pond AP-1 : Southern Wetlands
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond AP-1 : Southern Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 256.15' @ 15.30 hrs Surf.Area= 40,377 sf Storage= 134,226 cf

Plug-Flow detention time= 654.4 min calculated for 3.248 af (61% of inflow)
 Center-of-Mass det. time= 461.4 min (1,382.5 - 921.1)

Volume	Invert	Avail.Storage	Storage Description
#1	252.00'	261,437 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
252.00	2,679	0	0
252.50	29,599	8,070	8,070
253.00	31,025	15,156	23,226
254.00	33,475	32,250	55,476
255.00	36,062	34,769	90,244
256.00	39,913	37,988	128,232
257.00	43,021	41,467	169,699
258.00	46,190	44,606	214,304
259.00	48,075	47,133	261,437

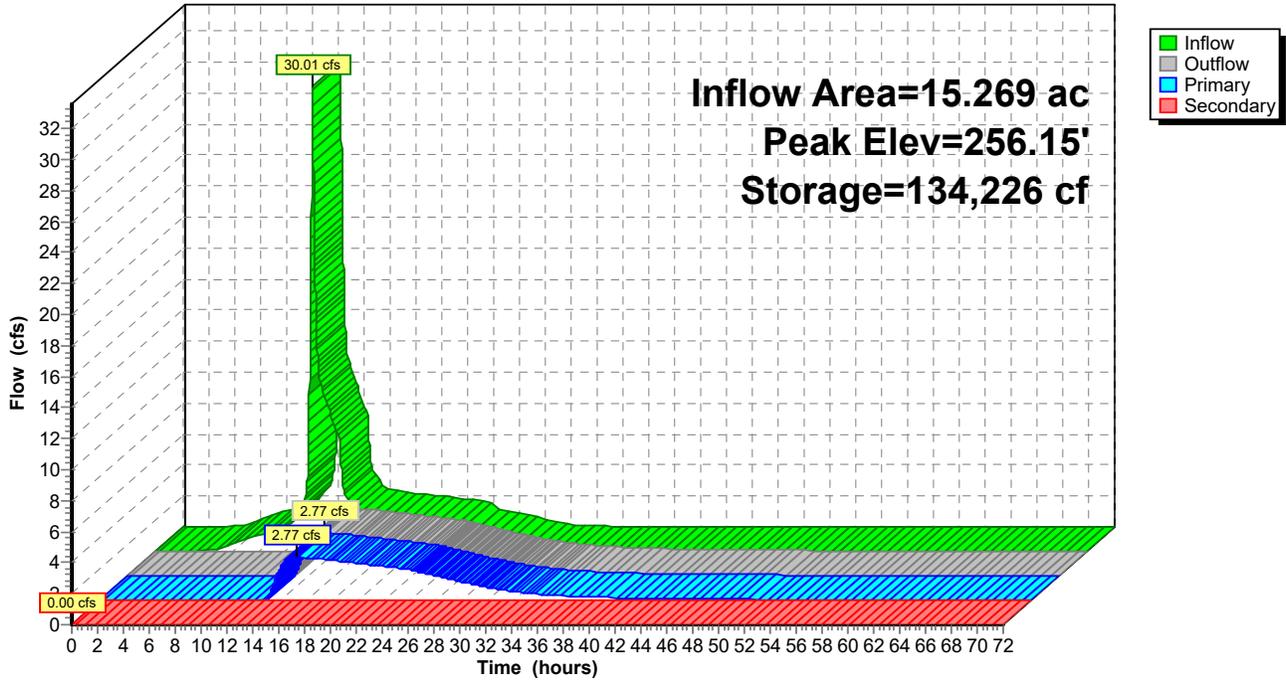
Device	Routing	Invert	Outlet Devices
#1	Secondary	257.70'	9.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	254.94'	12.0" Round Culvert L= 12.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 254.94' / 254.86' S= 0.0067 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=2.77 cfs @ 15.30 hrs HW=256.15' TW=0.00' (Dynamic Tailwater)
 ↑**2=Culvert** (Barrel Controls 2.77 cfs @ 3.70 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=252.00' TW=0.00' (Dynamic Tailwater)
 ↑**1=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 5P: EX. BASIN #2

Hydrograph



Summary for Pond AP-1: Southern Wetlands

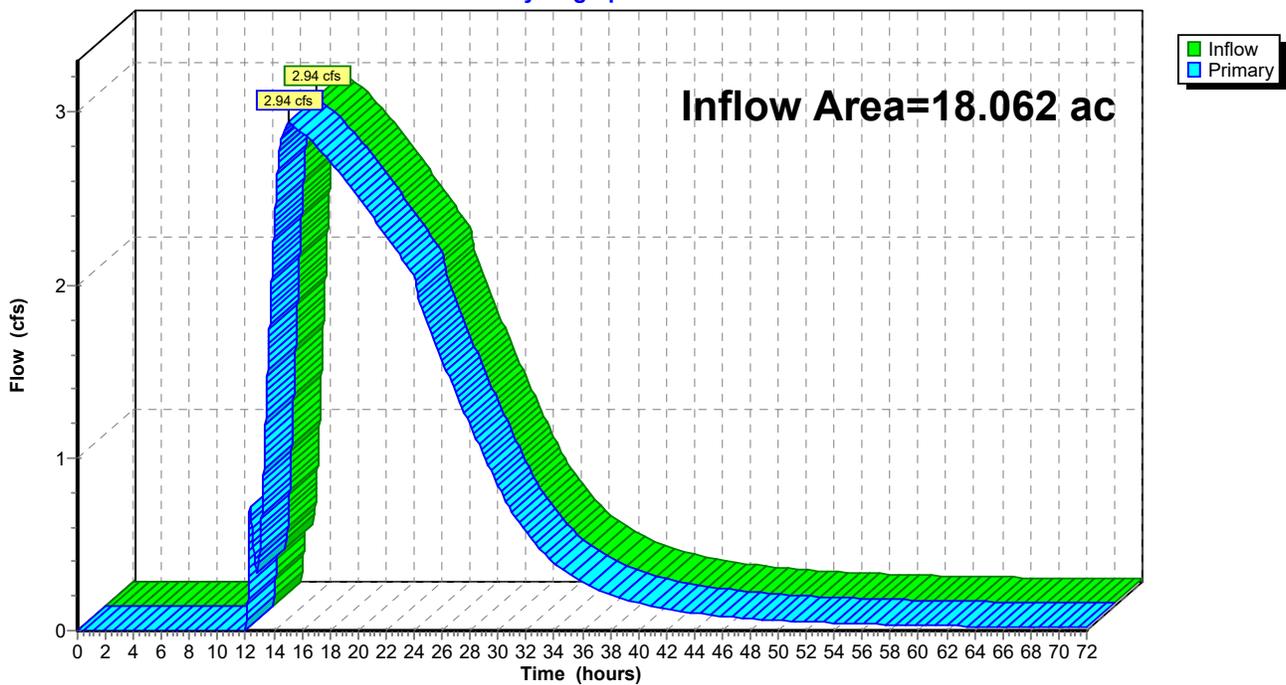
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 18.062 ac, 61.19% Impervious, Inflow Depth > 2.26" for 25-yr event
Inflow = 2.94 cfs @ 15.12 hrs, Volume= 3.409 af
Primary = 2.94 cfs @ 15.12 hrs, Volume= 3.409 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: Southern Wetlands

Hydrograph



F4593 PRE-Development

NOAA10 24-hr D 100-yr Rainfall=8.18"

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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentEX-1: Subcat EX-1	Runoff Area=2.827 ac 27.56% Impervious Runoff Depth=2.58" Flow Length=424' Tc=8.1 min CN=52 Runoff=8.00 cfs 0.607 af
SubcatchmentEX-2: Subcat EX-2	Runoff Area=1.141 ac 44.71% Impervious Runoff Depth=4.04" Flow Length=231' Tc=11.0 min CN=65 Runoff=4.67 cfs 0.384 af
SubcatchmentEX-3: Subcat EX-3	Runoff Area=2.130 ac 78.35% Impervious Runoff Depth=6.51" Flow Length=813' Tc=11.4 min CN=86 Runoff=12.99 cfs 1.155 af
SubcatchmentEX-4: Subcat EX-4	Runoff Area=0.877 ac 88.00% Impervious Runoff Depth=7.10" Tc=6.0 min CN=91 Runoff=7.05 cfs 0.519 af
SubcatchmentEX-5: Subcat EX-5	Runoff Area=2.793 ac 0.00% Impervious Runoff Depth=1.43" Flow Length=349' Tc=16.9 min CN=41 Runoff=2.45 cfs 0.332 af
SubcatchmentEX-6: Subcat EX-6	Runoff Area=1.571 ac 45.77% Impervious Runoff Depth=3.93" Tc=6.0 min CN=64 Runoff=7.73 cfs 0.514 af
SubcatchmentEX-7: Subcat EX-7	Runoff Area=6.182 ac 99.99% Impervious Runoff Depth=7.94" Tc=6.0 min CN=98 Runoff=51.54 cfs 4.090 af
SubcatchmentEX-8: Subcat EX-8	Runoff Area=0.540 ac 77.97% Impervious Runoff Depth=6.39" Tc=6.0 min CN=85 Runoff=4.08 cfs 0.288 af
Pond 3P: EX. BASIN #3	Peak Elev=270.64' Storage=75,398 cf Inflow=58.94 cfs 4.698 af Outflow=9.10 cfs 4.521 af
Pond 4P: EX. BASIN #1	Peak Elev=274.54' Storage=5,497 cf Inflow=8.15 cfs 0.672 af Outflow=4.10 cfs 0.623 af
Pond 5P: EX. BASIN #2	Peak Elev=257.19' Storage=178,028 cf Inflow=38.27 cfs 7.332 af Primary=5.01 cfs 5.249 af Secondary=0.00 cfs 0.000 af Outflow=5.01 cfs 5.249 af
Pond AP-1: Southern Wetlands	Inflow=5.28 cfs 5.581 af Primary=5.28 cfs 5.581 af

Total Runoff Area = 18.062 ac Runoff Volume = 7.890 af Average Runoff Depth = 5.24"
38.81% Pervious = 7.010 ac 61.19% Impervious = 11.052 ac

Summary for Subcatchment EX-1: Subcat EX-1

[47] Hint: Peak is 251% of capacity of segment #4

Runoff = 8.00 cfs @ 12.16 hrs, Volume= 0.607 af, Depth= 2.58"
 Routed to Pond 3P : EX. BASIN #3

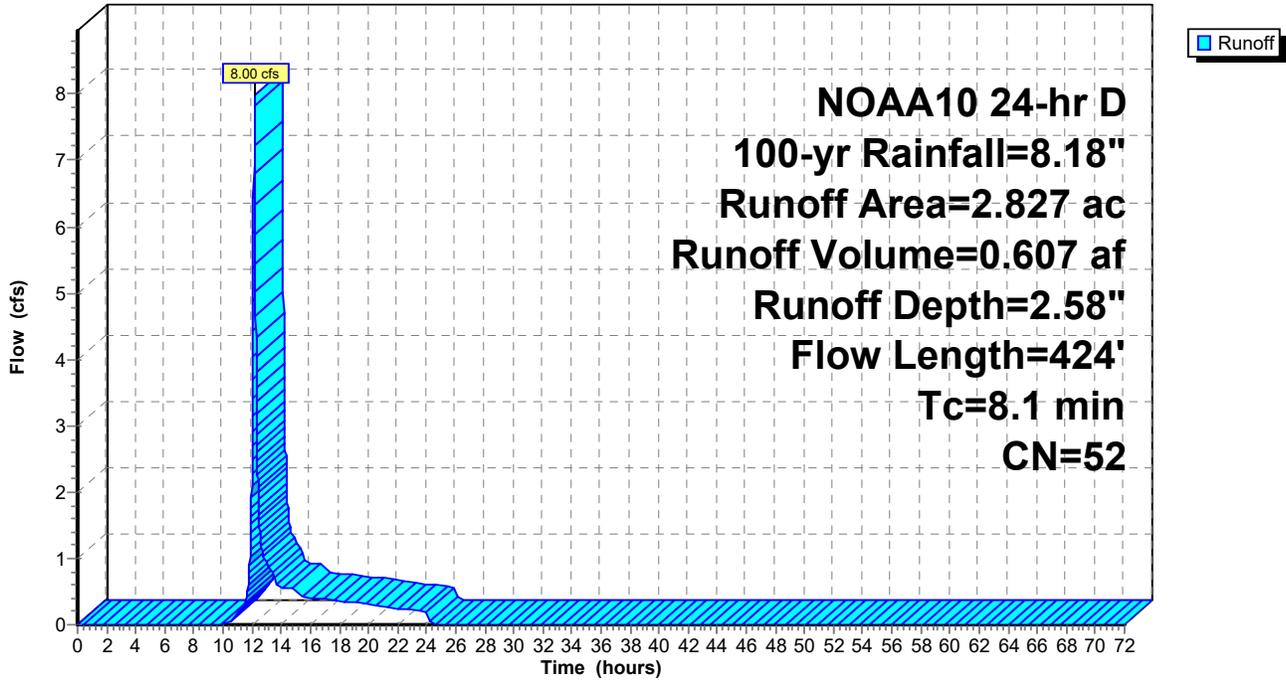
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
1.115	39	>75% Grass cover, Good, HSG A
0.505	98	Paved parking, HSG A
0.003	98	Unconnected pavement, HSG A
0.271	98	Water Surface, HSG A
0.933	30	Woods, Good, HSG A
2.827	52	Weighted Average
2.048		72.44% Pervious Area
0.779		27.56% Impervious Area
0.003		0.37% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	50	0.0250	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.36"
0.4	19	0.0110	0.73		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
2.3	255	0.0080	1.82		Shallow Concentrated Flow, Paved Kv= 20.3 fps
0.4	100	0.0080	4.06	3.19	Pipe Channel, 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Concrete pipe, bends & connections
8.1	424	Total			

Subcatchment EX-1: Subcat EX-1

Hydrograph



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NOAA10 24-hr D 100-yr Rainfall=8.18"

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Summary for Subcatchment EX-2: Subcat EX-2

Runoff = 4.67 cfs @ 12.19 hrs, Volume= 0.384 af, Depth= 4.04"
 Routed to Pond 4P : EX. BASIN #1

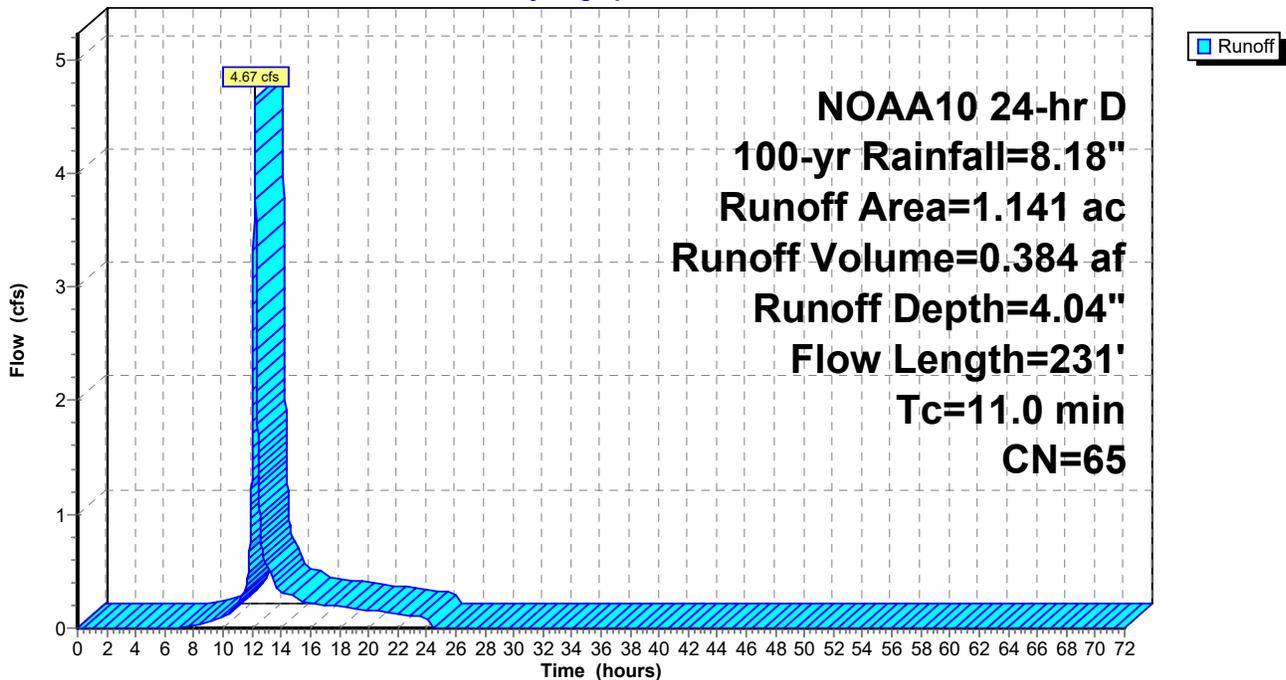
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.631	39	>75% Grass cover, Good, HSG A
0.239	98	Paved parking, HSG A
0.009	98	Unconnected pavement, HSG A
0.261	98	Water Surface, HSG A
1.141	65	Weighted Average
0.631		55.29% Pervious Area
0.510		44.71% Impervious Area
0.009		1.84% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		Sheet Flow, Grass: Short n= 0.150 P2= 3.36"
1.4	181	0.0220	2.22		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
11.0	231	Total			

Subcatchment EX-2: Subcat EX-2

Hydrograph



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Summary for Subcatchment EX-3: Subcat EX-3

[47] Hint: Peak is 136% of capacity of segment #3

Runoff = 12.99 cfs @ 12.19 hrs, Volume= 1.155 af, Depth= 6.51"
 Routed to Pond 5P : EX. BASIN #2

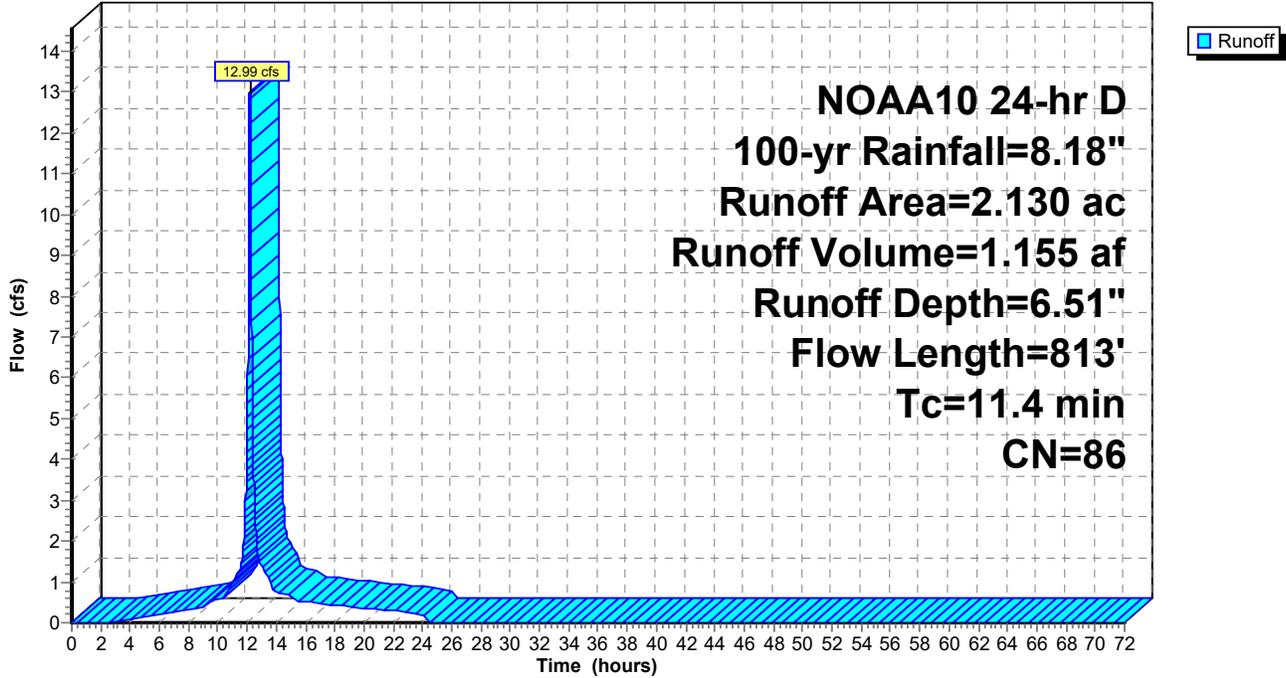
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.238	39	>75% Grass cover, Good, HSG A
0.015	80	>75% Grass cover, Good, HSG D
1.623	98	Paved parking, HSG A
0.039	98	Paved parking, HSG D
0.006	98	Unconnected pavement, HSG A
0.137	30	Woods, Good, HSG A
0.071	77	Woods, Good, HSG D
2.130	86	Weighted Average
0.461		21.65% Pervious Area
1.669		78.35% Impervious Area
0.006		0.35% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	50	0.0440	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
1.2	84	0.0520	1.14		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
1.4	679	0.0220	7.81	9.58	Pipe Channel, 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Concrete pipe, bends & connections
11.4	813	Total			

Subcatchment EX-3: Subcat EX-3

Hydrograph



Summary for Subcatchment EX-4: Subcat EX-4

Runoff = 7.05 cfs @ 12.13 hrs, Volume= 0.519 af, Depth= 7.10"
 Routed to Pond 5P : EX. BASIN #2

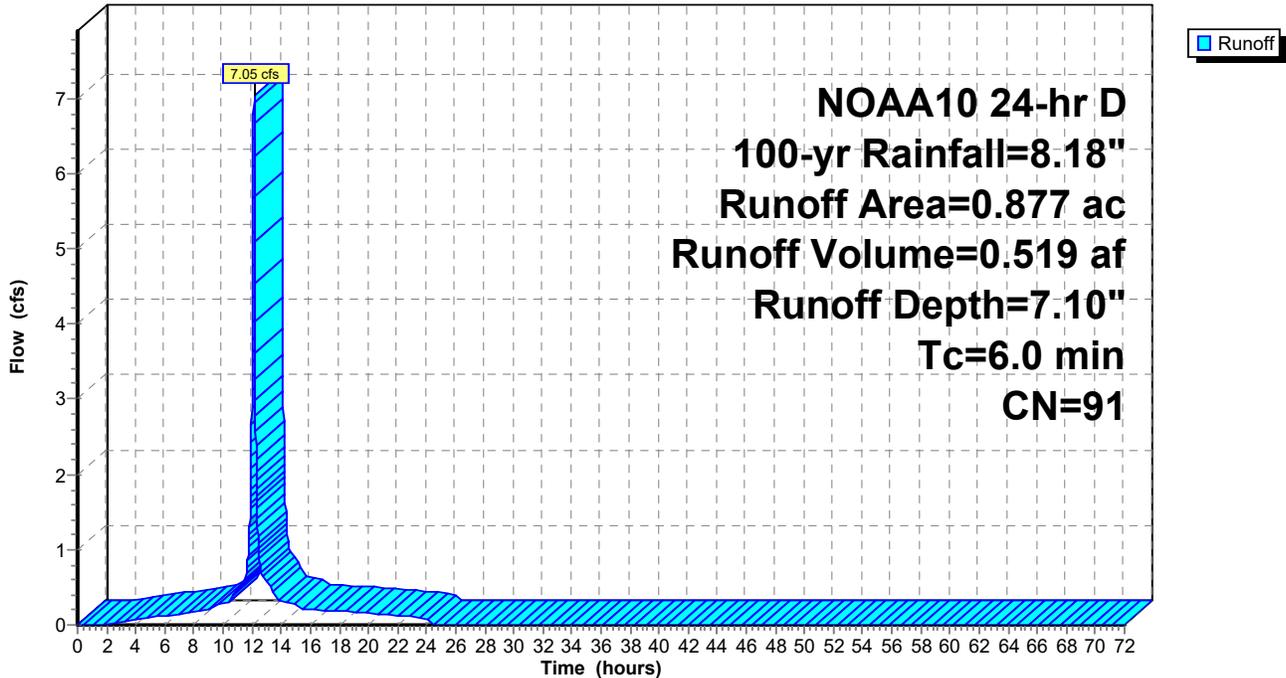
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.105	39	>75% Grass cover, Good, HSG A
0.772	98	Paved parking, HSG A
0.877	91	Weighted Average
0.105		12.00% Pervious Area
0.772		88.00% Impervious Area

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

Subcatchment EX-4: Subcat EX-4

Hydrograph



Summary for Subcatchment EX-5: Subcat EX-5

Runoff = 2.45 cfs @ 12.28 hrs, Volume= 0.332 af, Depth= 1.43"
 Routed to Pond AP-1 : Southern Wetlands

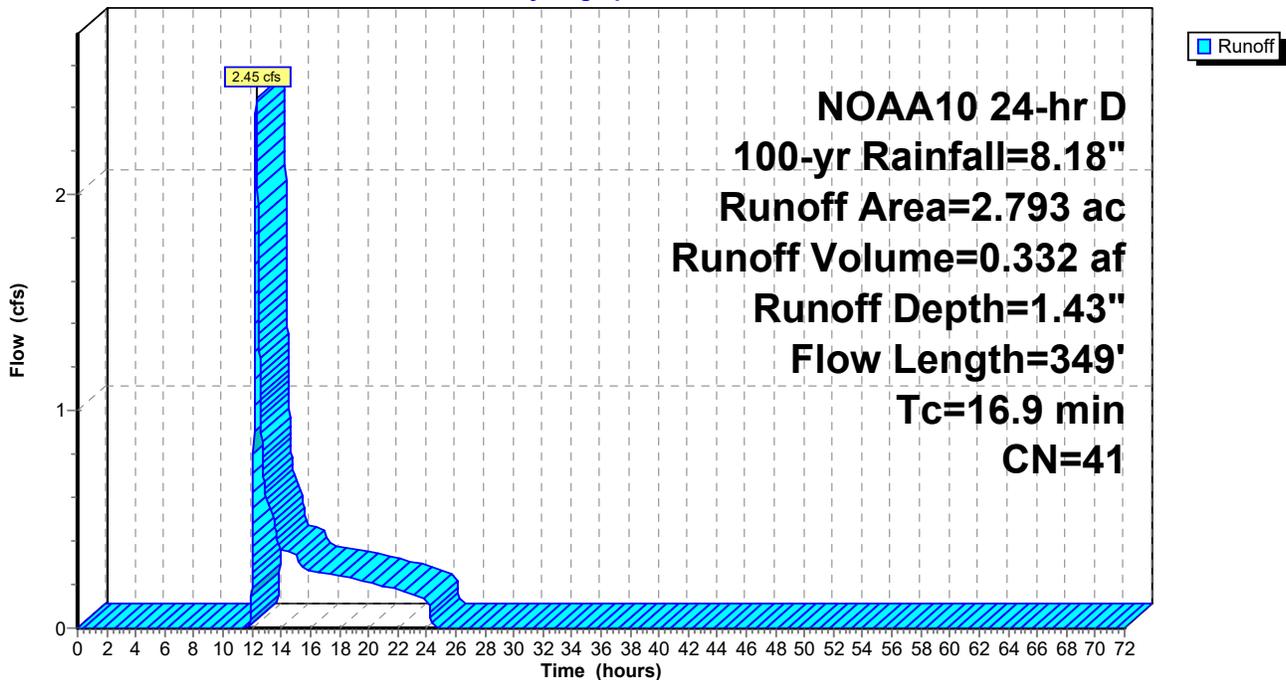
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.176	39	>75% Grass cover, Good, HSG A
0.016	80	>75% Grass cover, Good, HSG D
1.994	30	Woods, Good, HSG A
0.606	77	Woods, Good, HSG D
2.793	41	Weighted Average
2.793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0190	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
0.7	58	0.0780	1.40		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
3.9	241	0.0420	1.02		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
16.9	349	Total			

Subcatchment EX-5: Subcat EX-5

Hydrograph



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NOAA10 24-hr D 100-yr Rainfall=8.18"

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Summary for Subcatchment EX-6: Subcat EX-6

Runoff = 7.73 cfs @ 12.13 hrs, Volume= 0.514 af, Depth= 3.93"
 Routed to Pond 5P : EX. BASIN #2

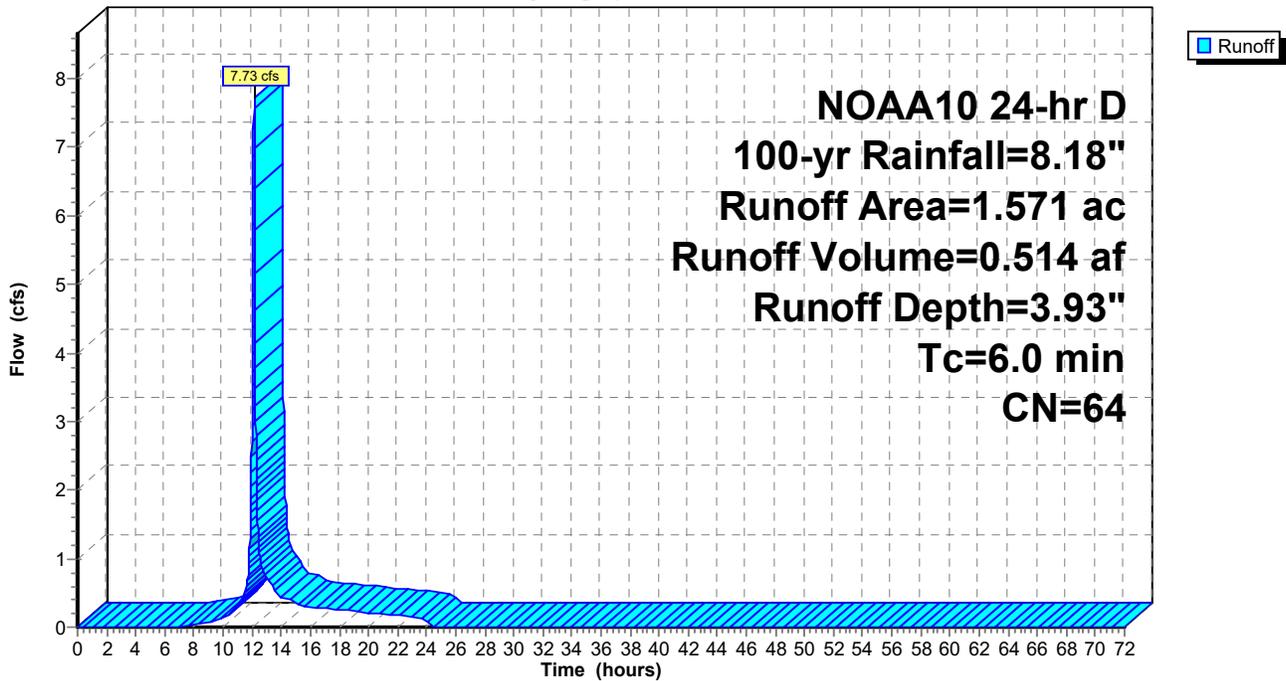
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.500	39	>75% Grass cover, Good, HSG A
0.719	98	Water Surface, HSG A
0.352	30	Woods, Good, HSG A
1.571	64	Weighted Average
0.852		54.23% Pervious Area
0.719		45.77% Impervious Area

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

Subcatchment EX-6: Subcat EX-6

Hydrograph



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NOAA10 24-hr D 100-yr Rainfall=8.18"

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Summary for Subcatchment EX-7: Subcat EX-7

Runoff = 51.54 cfs @ 12.13 hrs, Volume= 4.090 af, Depth= 7.94"
 Routed to Pond 3P : EX. BASIN #3

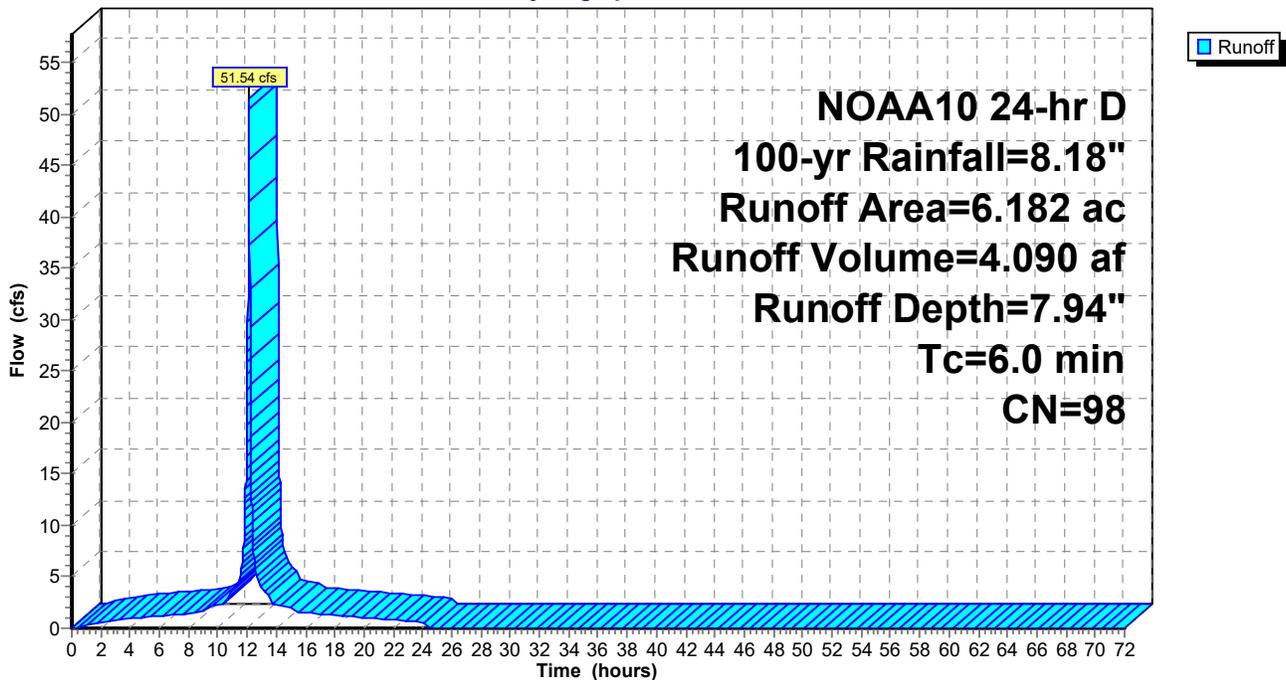
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.000	39	>75% Grass cover, Good, HSG A
6.182	98	Roofs, HSG A
0.000	98	Unconnected pavement, HSG A
6.182	98	Weighted Average
0.000		0.01% Pervious Area
6.182		99.99% Impervious Area
0.000		0.00% Unconnected

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

Subcatchment EX-7: Subcat EX-7

Hydrograph



Summary for Subcatchment EX-8: Subcat EX-8

Runoff = 4.08 cfs @ 12.13 hrs, Volume= 0.288 af, Depth= 6.39"
 Routed to Pond 4P : EX. BASIN #1

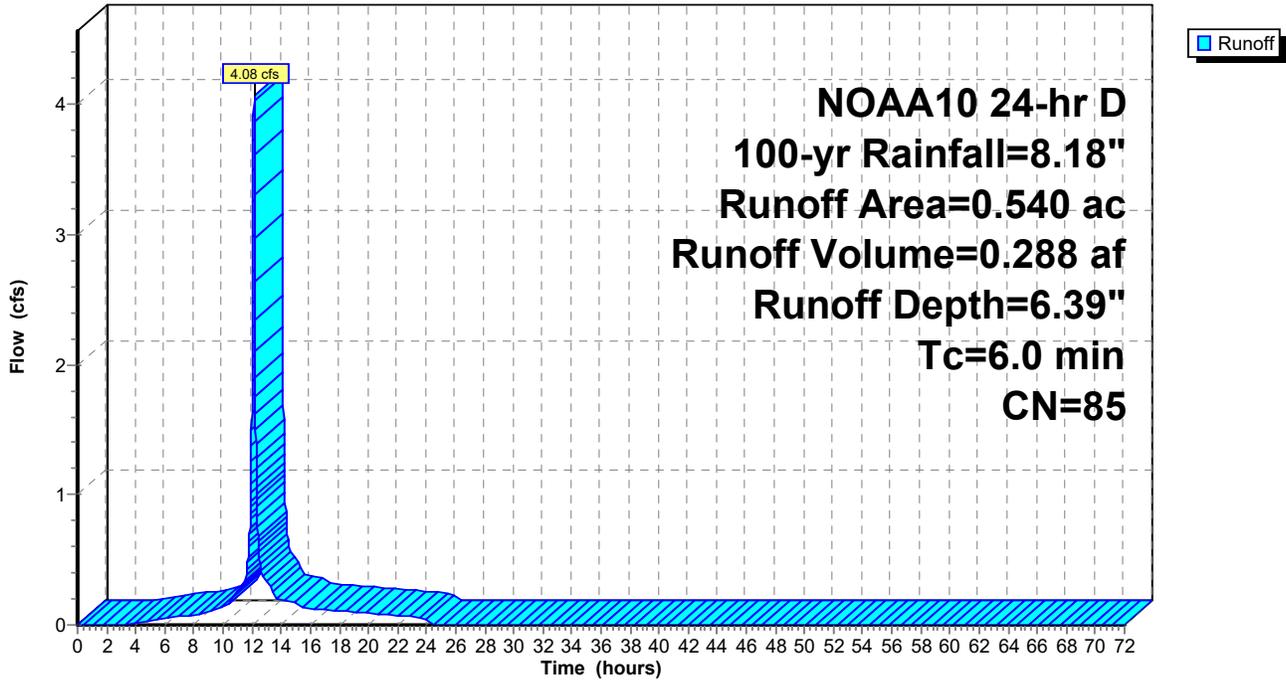
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.119	39	>75% Grass cover, Good, HSG A
0.421	98	Paved parking, HSG A
0.540	85	Weighted Average
0.119		22.03% Pervious Area
0.421		77.97% Impervious Area

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

Subcatchment EX-8: Subcat EX-8

Hydrograph



Summary for Pond 3P: EX. BASIN #3

Inflow Area = 9.009 ac, 77.26% Impervious, Inflow Depth = 6.26" for 100-yr event
 Inflow = 58.94 cfs @ 12.13 hrs, Volume= 4.698 af
 Outflow = 9.10 cfs @ 12.44 hrs, Volume= 4.521 af, Atten= 85%, Lag= 18.7 min
 Primary = 9.10 cfs @ 12.44 hrs, Volume= 4.521 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 270.64' @ 12.44 hrs Surf.Area= 20,981 sf Storage= 75,398 cf

Plug-Flow detention time= 208.9 min calculated for 4.521 af (96% of inflow)
 Center-of-Mass det. time= 185.3 min (949.0 - 763.7)

Volume	Invert	Avail.Storage	Storage Description
#1	265.00'	188,837 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
265.00	6,581	0	0
266.00	7,637	7,109	7,109
267.00	8,818	8,228	15,337
268.00	15,371	12,095	27,431
269.00	17,536	16,454	43,885
270.00	19,637	18,587	62,471
271.00	21,748	20,693	83,164
272.00	23,983	22,866	106,029
273.00	26,245	25,114	131,143
274.00	28,727	27,486	158,629
275.00	31,688	30,208	188,837

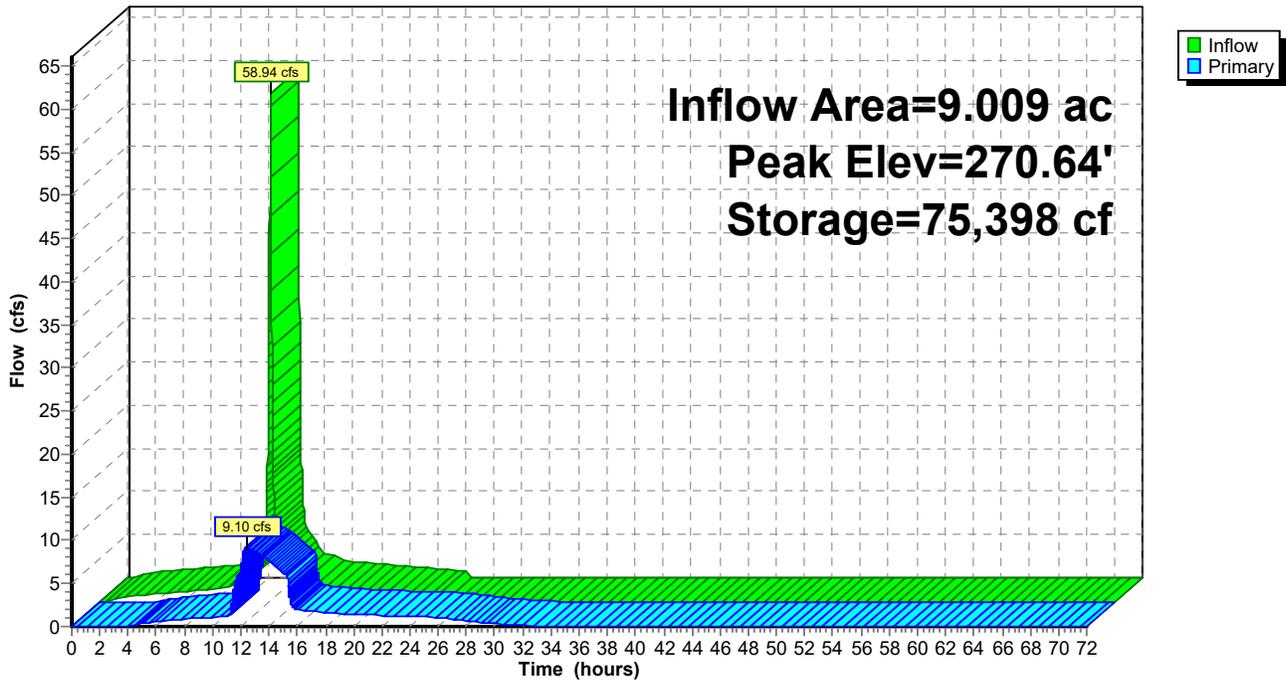
Device	Routing	Invert	Outlet Devices
#1	Primary	265.60'	24.0" Round Culvert L= 223.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 265.60' / 264.50' S= 0.0049 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf
#2	Device 1	266.06'	12.0" Round Culvert L= 8.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 266.06' / 265.90' S= 0.0190 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#3	Device 2	266.06'	6.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 1	266.58'	12.0" Round Culvert L= 12.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 266.58' / 265.80' S= 0.0634 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#5	Device 4	268.26'	57.0" x 100.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=9.10 cfs @ 12.44 hrs HW=270.64' TW=255.45' (Dynamic Tailwater)

- 1=Culvert (Passes 9.10 cfs of 24.78 cfs potential flow)
- 2=Culvert (Passes 1.97 cfs of 7.64 cfs potential flow)
- 3=Orifice/Grate (Orifice Controls 1.97 cfs @ 10.02 fps)
- 4=Culvert (Inlet Controls 7.13 cfs @ 9.08 fps)
- 5=Orifice/Grate (Passes 7.13 cfs of 293.81 cfs potential flow)

Pond 3P: EX. BASIN #3

Hydrograph



Summary for Pond 4P: EX. BASIN #1

Inflow Area = 1.681 ac, 55.40% Impervious, Inflow Depth = 4.79" for 100-yr event
 Inflow = 8.15 cfs @ 12.15 hrs, Volume= 0.672 af
 Outflow = 4.10 cfs @ 12.29 hrs, Volume= 0.623 af, Atten= 50%, Lag= 8.4 min
 Primary = 4.10 cfs @ 12.29 hrs, Volume= 0.623 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 274.54' @ 12.29 hrs Surf.Area= 7,143 sf Storage= 5,497 cf

Plug-Flow detention time= 77.8 min calculated for 0.623 af (93% of inflow)
 Center-of-Mass det. time= 38.2 min (879.9 - 841.7)

Volume	Invert	Avail.Storage	Storage Description
#1	273.40'	31,754 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
273.40	1,731	0	0
274.00	5,352	2,125	2,125
275.00	8,670	7,011	9,136
276.00	11,387	10,029	19,164
277.00	13,793	12,590	31,754

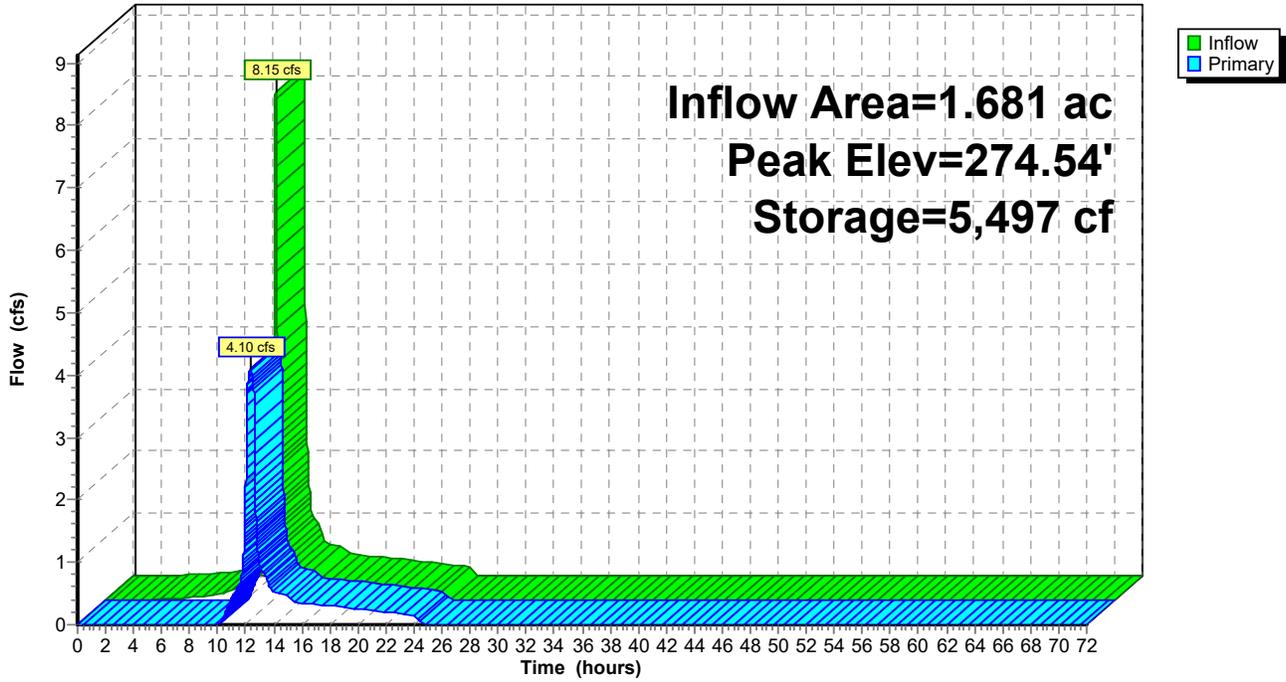
Device	Routing	Invert	Outlet Devices
#1	Primary	272.50'	12.0" Round Culvert L= 75.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 272.50' / 271.90' S= 0.0079 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	274.00'	24.0" x 36.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.10 cfs @ 12.29 hrs HW=274.54' TW=255.13' (Dynamic Tailwater)

- ↑1=Culvert (Barrel Controls 4.10 cfs @ 5.21 fps)
- ↑2=Orifice/Grate (Passes 4.10 cfs of 12.97 cfs potential flow)

Pond 4P: EX. BASIN #1

Hydrograph



Summary for Pond 5P: EX. BASIN #2

Inflow Area = 15.269 ac, 72.38% Impervious, Inflow Depth = 5.76" for 100-yr event
 Inflow = 38.27 cfs @ 12.15 hrs, Volume= 7.332 af
 Outflow = 5.01 cfs @ 15.44 hrs, Volume= 5.249 af, Atten= 87%, Lag= 197.5 min
 Primary = 5.01 cfs @ 15.44 hrs, Volume= 5.249 af
 Routed to Pond AP-1 : Southern Wetlands
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond AP-1 : Southern Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 257.19' @ 15.44 hrs Surf.Area= 43,630 sf Storage= 178,028 cf

Plug-Flow detention time= 552.3 min calculated for 5.248 af (72% of inflow)
 Center-of-Mass det. time= 398.2 min (1,301.1 - 902.9)

Volume	Invert	Avail.Storage	Storage Description
#1	252.00'	261,437 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
252.00	2,679	0	0
252.50	29,599	8,070	8,070
253.00	31,025	15,156	23,226
254.00	33,475	32,250	55,476
255.00	36,062	34,769	90,244
256.00	39,913	37,988	128,232
257.00	43,021	41,467	169,699
258.00	46,190	44,606	214,304
259.00	48,075	47,133	261,437

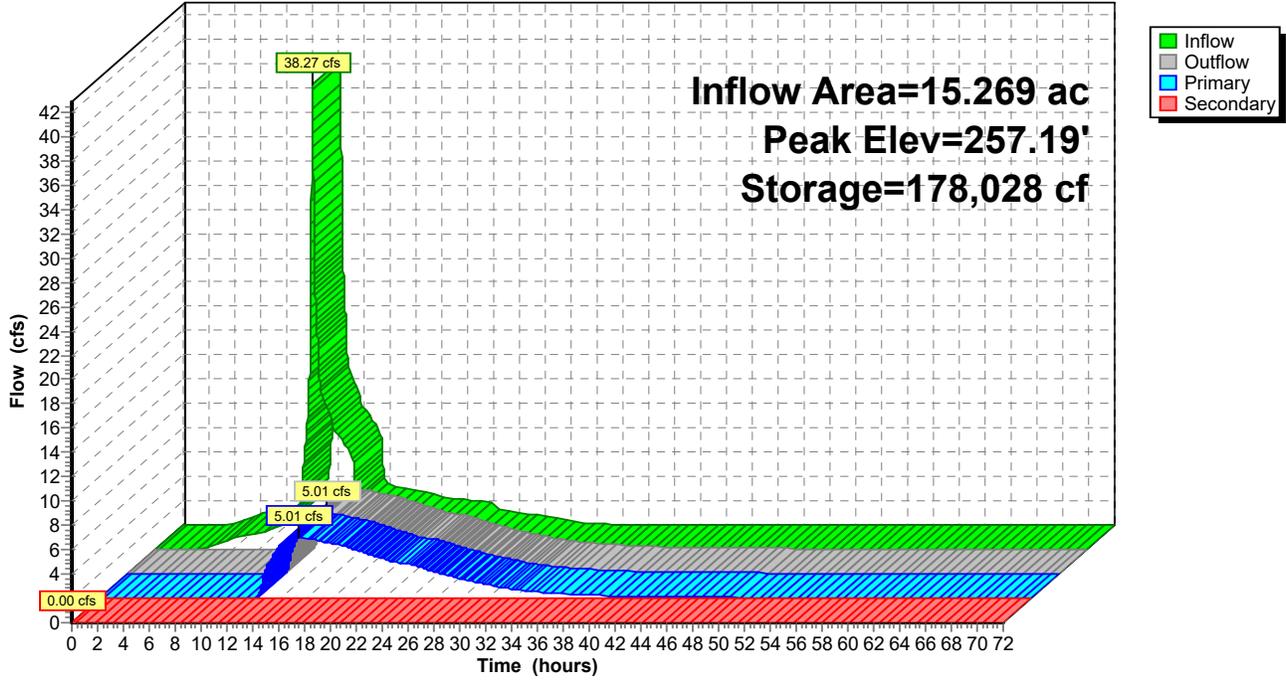
Device	Routing	Invert	Outlet Devices
#1	Secondary	257.70'	9.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	254.94'	12.0" Round Culvert L= 12.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 254.94' / 254.86' S= 0.0067 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=5.01 cfs @ 15.44 hrs HW=257.19' TW=0.00' (Dynamic Tailwater)
 ↑**2=Culvert** (Inlet Controls 5.01 cfs @ 6.37 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=252.00' TW=0.00' (Dynamic Tailwater)
 ↑**1=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 5P: EX. BASIN #2

Hydrograph



Summary for Pond AP-1: Southern Wetlands

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

Inflow Area = 18.062 ac, 61.19% Impervious, Inflow Depth > 3.71" for 100-yr event
Inflow = 5.28 cfs @ 15.41 hrs, Volume= 5.581 af
Primary = 5.28 cfs @ 15.41 hrs, Volume= 5.581 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: Southern Wetlands

Hydrograph

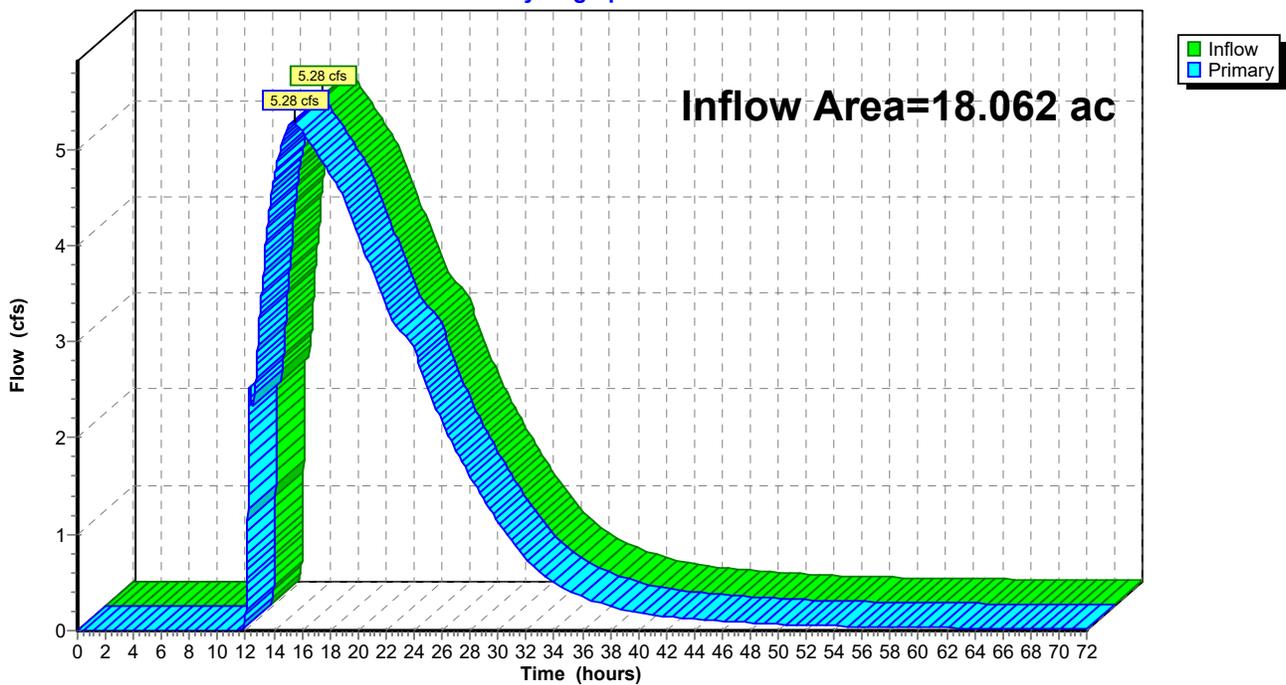


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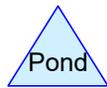
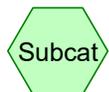
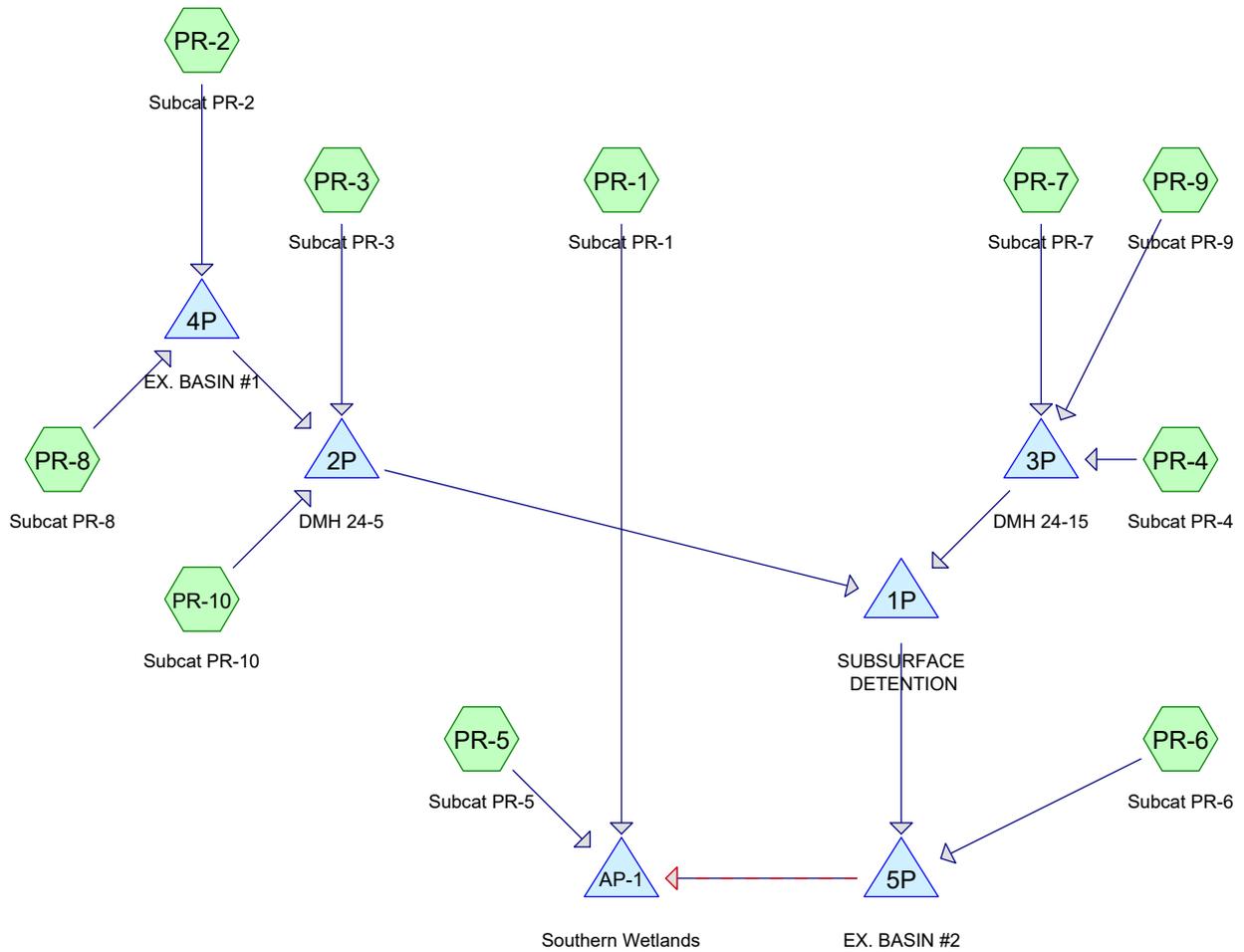
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Routing Diagram for F4593 Post-Development 10-22
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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	NOAA10 24-hr	D	Default	24.00	1	3.36	2
2	10-yr	NOAA10 24-hr	D	Default	24.00	1	5.22	2
3	25-yr	NOAA10 24-hr	D	Default	24.00	1	6.39	2
4	100-yr	NOAA10 24-hr	D	Default	24.00	1	8.18	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.106	39	>75% Grass cover, Good, HSG A (PR-1, PR-10, PR-2, PR-3, PR-4, PR-5, PR-6, PR-8, PR-9)
0.051	80	>75% Grass cover, Good, HSG D (PR-3, PR-5)
4.611	98	Paved parking, HSG A (PR-10, PR-2, PR-3, PR-4, PR-8, PR-9)
0.102	98	Paved parking, HSG D (PR-3)
8.137	98	Roofs, HSG A (PR-7)
0.086	98	Unconnected pavement, HSG A (PR-10, PR-2, PR-3, PR-8, PR-9)
0.013	98	Unconnected pavement, HSG D (PR-3)
0.918	98	Water Surface, HSG A (PR-2, PR-6)
1.461	30	Woods, Good, HSG A (PR-5, PR-6)
0.582	77	Woods, Good, HSG D (PR-5)
18.068	85	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
17.320	HSG A	PR-1, PR-10, PR-2, PR-3, PR-4, PR-5, PR-6, PR-7, PR-8, PR-9
0.000	HSG B	
0.000	HSG C	
0.748	HSG D	PR-3, PR-5
0.000	Other	
18.068		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
2.106	0.000	0.000	0.051	0.000	2.158	>75% Grass cover, Good	PR-1, PR-10, PR-2, PR-3, PR-4, PR-5, PR-6, PR-8, PR-9
4.611	0.000	0.000	0.102	0.000	4.713	Paved parking	PR-10, PR-2, PR-3, PR-4, PR-8, PR-9
8.137	0.000	0.000	0.000	0.000	8.137	Roofs	PR-7
0.086	0.000	0.000	0.013	0.000	0.099	Unconnected pavement	PR-10, PR-2, PR-3, PR-8, PR-9
0.918	0.000	0.000	0.000	0.000	0.918	Water Surface	PR-2, PR-6
1.461	0.000	0.000	0.582	0.000	2.043	Woods, Good	PR-5, PR-6
17.320	0.000	0.000	0.748	0.000	18.068	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	1P	251.90	251.50	28.6	0.0140	0.013	0.0	36.0	0.0	
2	4P	272.50	271.90	75.9	0.0079	0.013	0.0	12.0	0.0	
3	5P	254.96	254.86	28.9	0.0035	0.013	0.0	12.0	0.0	

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NOAA10 24-hr D 2-yr Rainfall=3.36"

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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-1: Subcat PR-1	Runoff Area=0.120 ac 0.00% Impervious Runoff Depth=0.00" Tc=6.0 min CN=39 Runoff=0.00 cfs 0.000 af
SubcatchmentPR-10: Subcat PR-10	Runoff Area=0.334 ac 69.45% Impervious Runoff Depth=1.53" Tc=6.0 min CN=80 Runoff=0.64 cfs 0.042 af
SubcatchmentPR-2: Subcat PR-2	Runoff Area=1.147 ac 48.82% Impervious Runoff Depth=0.82" Tc=6.0 min CN=68 Runoff=1.09 cfs 0.078 af
SubcatchmentPR-3: Subcat PR-3	Runoff Area=2.598 ac 89.87% Impervious Runoff Depth=2.50" Tc=6.0 min CN=92 Runoff=7.79 cfs 0.542 af
SubcatchmentPR-4: Subcat PR-4	Runoff Area=1.288 ac 88.94% Impervious Runoff Depth=2.41" Tc=6.0 min CN=91 Runoff=3.75 cfs 0.259 af
SubcatchmentPR-5: Subcat PR-5	Runoff Area=2.051 ac 0.00% Impervious Runoff Depth=0.06" Flow Length=378' Tc=15.5 min CN=45 Runoff=0.02 cfs 0.011 af
SubcatchmentPR-6: Subcat PR-6	Runoff Area=1.016 ac 64.57% Impervious Runoff Depth=1.20" Tc=6.0 min CN=75 Runoff=1.51 cfs 0.102 af
SubcatchmentPR-7: Subcat PR-7	Runoff Area=8.137 ac 100.00% Impervious Runoff Depth=3.13" Tc=6.0 min CN=98 Runoff=27.61 cfs 2.120 af
SubcatchmentPR-8: Subcat PR-8	Runoff Area=26,155 sf 76.06% Impervious Runoff Depth=1.82" Tc=6.0 min CN=84 Runoff=1.36 cfs 0.091 af
SubcatchmentPR-9: Subcat PR-9	Runoff Area=0.775 ac 44.36% Impervious Runoff Depth=0.68" Tc=0.0 min CN=65 Runoff=0.78 cfs 0.044 af
Pond 1P: SUBSURFACE DETENTION	Peak Elev=255.21' Storage=1.059 af Inflow=39.99 cfs 3.007 af Outflow=6.19 cfs 1.949 af
Pond 2P: DMH 24-5	Inflow=8.43 cfs 0.584 af Primary=8.43 cfs 0.584 af
Pond 3P: DMH 24-15	Inflow=31.57 cfs 2.423 af Primary=31.57 cfs 2.423 af
Pond 4P: EX. BASIN #1	Peak Elev=274.79' Storage=7,379 cf Inflow=2.45 cfs 0.169 af Outflow=0.00 cfs 0.000 af
Pond 5P: EX. BASIN #2	Peak Elev=255.21' Storage=89,349 cf Inflow=6.54 cfs 2.051 af Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af
Pond AP-1: Southern Wetlands	Inflow=0.02 cfs 0.011 af Primary=0.02 cfs 0.011 af

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Total Runoff Area = 18.068 ac Runoff Volume = 3.290 af Average Runoff Depth = 2.18"
23.25% Pervious = 4.201 ac 76.75% Impervious = 13.866 ac

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Summary for Subcatchment PR-1: Subcat PR-1

Runoff = 0.00 cfs @ 23.84 hrs, Volume= 0.000 af, Depth= 0.00"

Routed to Pond AP-1 : Southern Wetlands

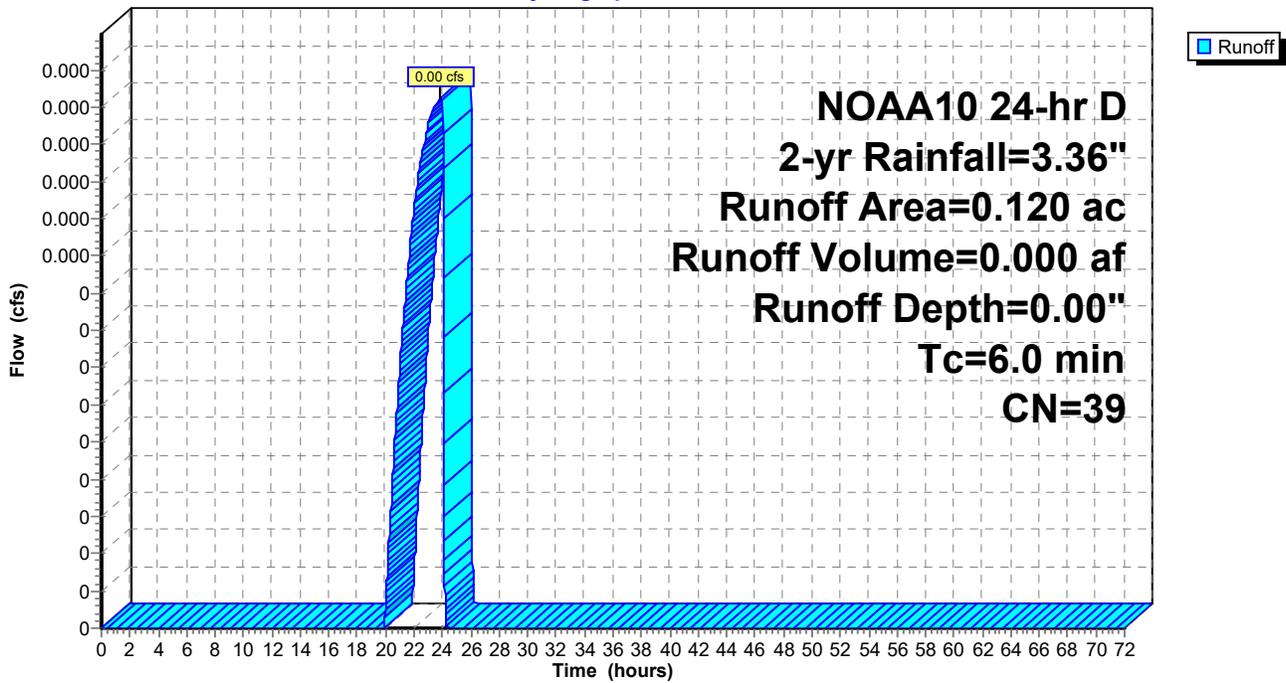
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.120	39	>75% Grass cover, Good, HSG A
0.120		100.00% Pervious Area

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

Subcatchment PR-1: Subcat PR-1

Hydrograph



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Summary for Subcatchment PR-10: Subcat PR-10

Runoff = 0.64 cfs @ 12.13 hrs, Volume= 0.042 af, Depth= 1.53"
 Routed to Pond 2P : DMH 24-5

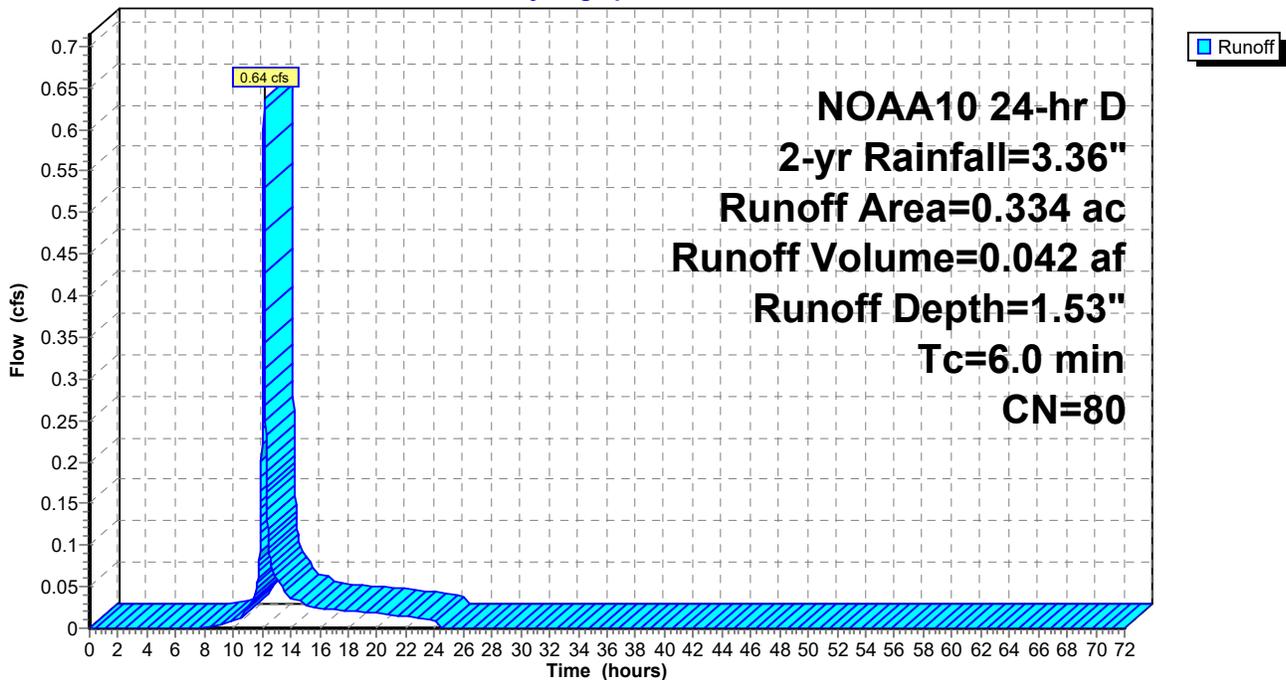
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.102	39	>75% Grass cover, Good, HSG A
0.228	98	Paved parking, HSG A
0.004	98	Unconnected pavement, HSG A
0.334	80	Weighted Average
0.102		30.55% Pervious Area
0.232		69.45% Impervious Area
0.004		1.57% Unconnected

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

Subcatchment PR-10: Subcat PR-10

Hydrograph



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NOAA10 24-hr D 2-yr Rainfall=3.36"

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Summary for Subcatchment PR-2: Subcat PR-2

Runoff = 1.09 cfs @ 12.14 hrs, Volume= 0.078 af, Depth= 0.82"
 Routed to Pond 4P : EX. BASIN #1

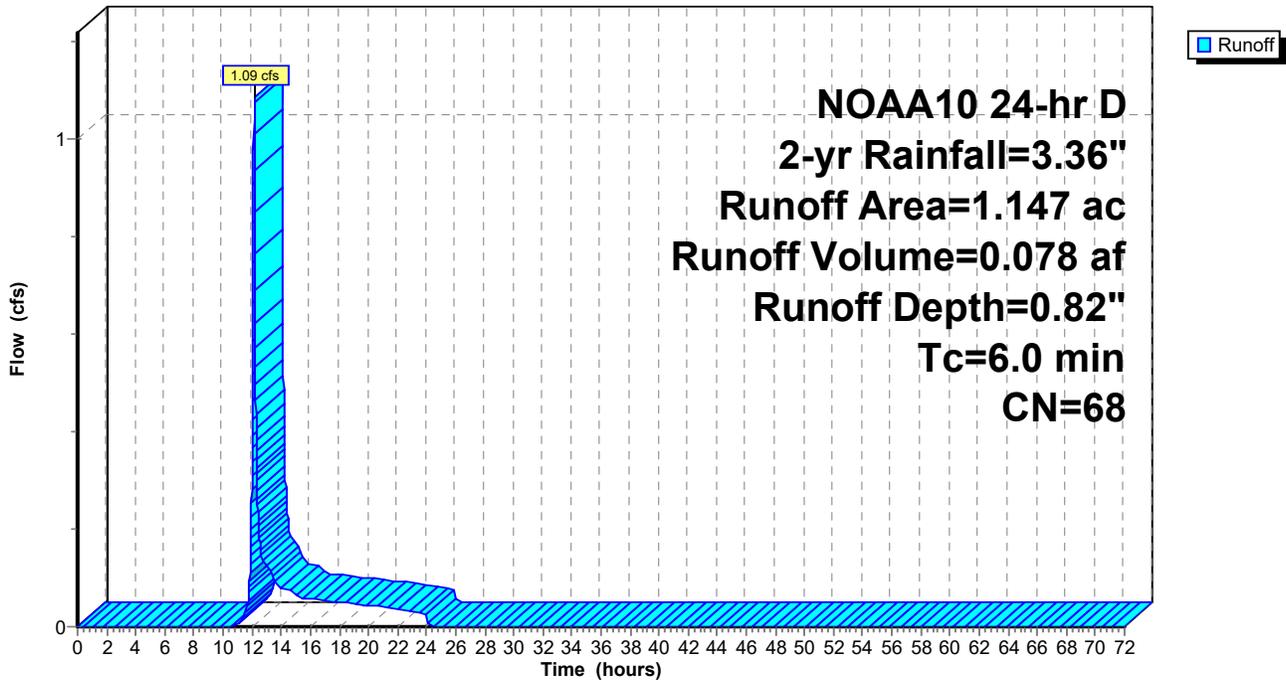
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.587	39	>75% Grass cover, Good, HSG A
0.289	98	Paved parking, HSG A
0.009	98	Unconnected pavement, HSG A
0.261	98	Water Surface, HSG A
1.147	68	Weighted Average
0.587		51.18% Pervious Area
0.560		48.82% Impervious Area
0.009		1.68% Unconnected

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

Subcatchment PR-2: Subcat PR-2

Hydrograph



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Summary for Subcatchment PR-3: Subcat PR-3

Runoff = 7.79 cfs @ 12.13 hrs, Volume= 0.542 af, Depth= 2.50"
 Routed to Pond 2P : DMH 24-5

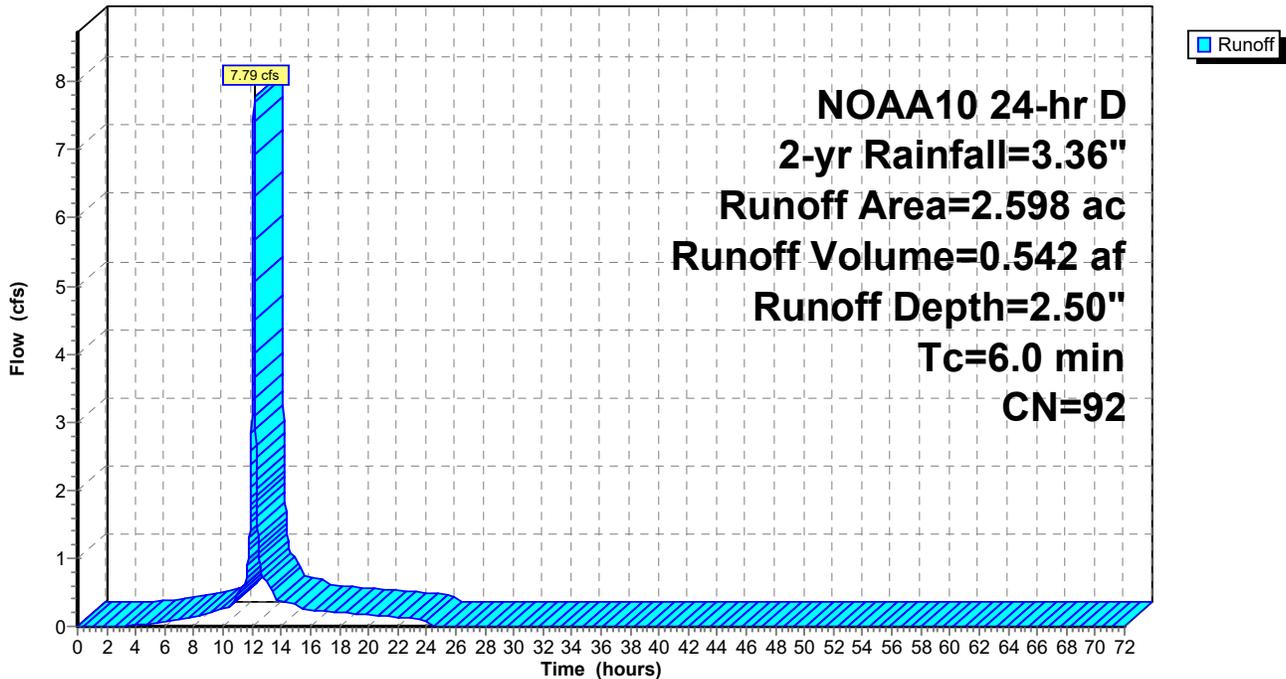
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.234	39	>75% Grass cover, Good, HSG A
0.030	80	>75% Grass cover, Good, HSG D
2.159	98	Paved parking, HSG A
0.102	98	Paved parking, HSG D
0.061	98	Unconnected pavement, HSG A
0.013	98	Unconnected pavement, HSG D
2.598	92	Weighted Average
0.263		10.13% Pervious Area
2.335		89.87% Impervious Area
0.074		3.16% Unconnected

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

Subcatchment PR-3: Subcat PR-3

Hydrograph



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NOAA10 24-hr D 2-yr Rainfall=3.36"

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Summary for Subcatchment PR-4: Subcat PR-4

Runoff = 3.75 cfs @ 12.13 hrs, Volume= 0.259 af, Depth= 2.41"
 Routed to Pond 3P : DMH 24-15

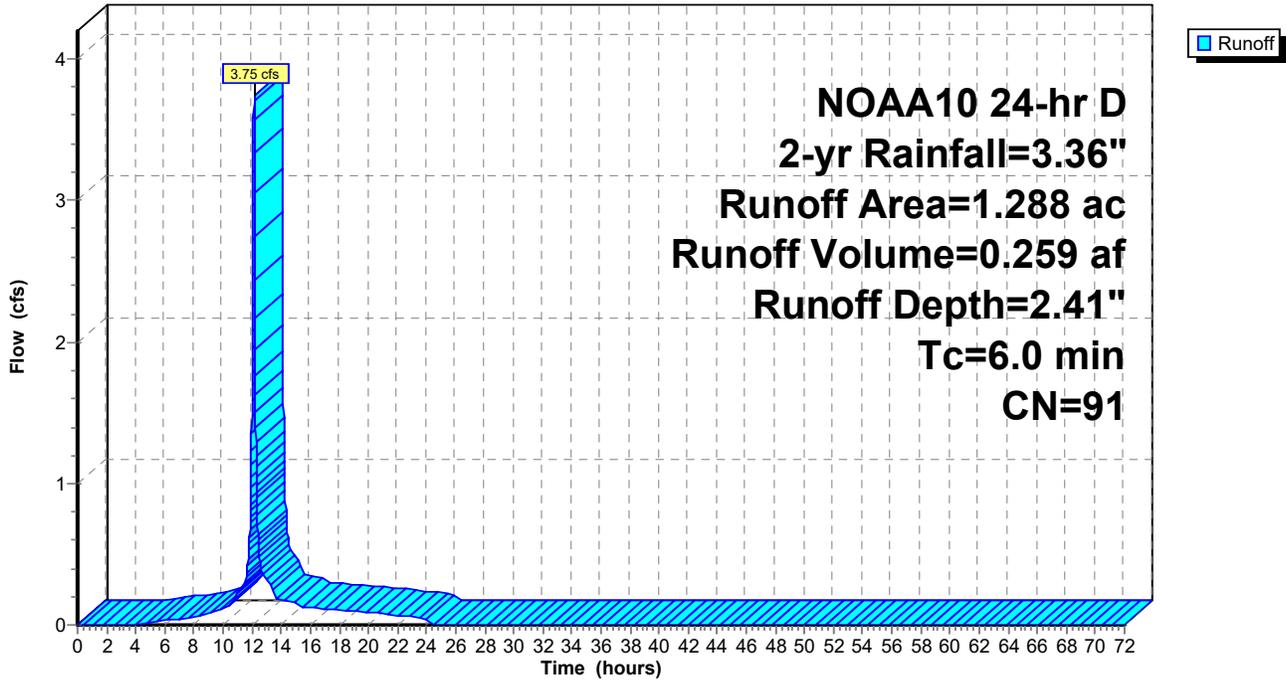
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.142	39	>75% Grass cover, Good, HSG A
1.146	98	Paved parking, HSG A
1.288	91	Weighted Average
0.142		11.06% Pervious Area
1.146		88.94% Impervious Area

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

Subcatchment PR-4: Subcat PR-4

Hydrograph



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Summary for Subcatchment PR-5: Subcat PR-5

Runoff = 0.02 cfs @ 19.72 hrs, Volume= 0.011 af, Depth= 0.06"
 Routed to Pond AP-1 : Southern Wetlands

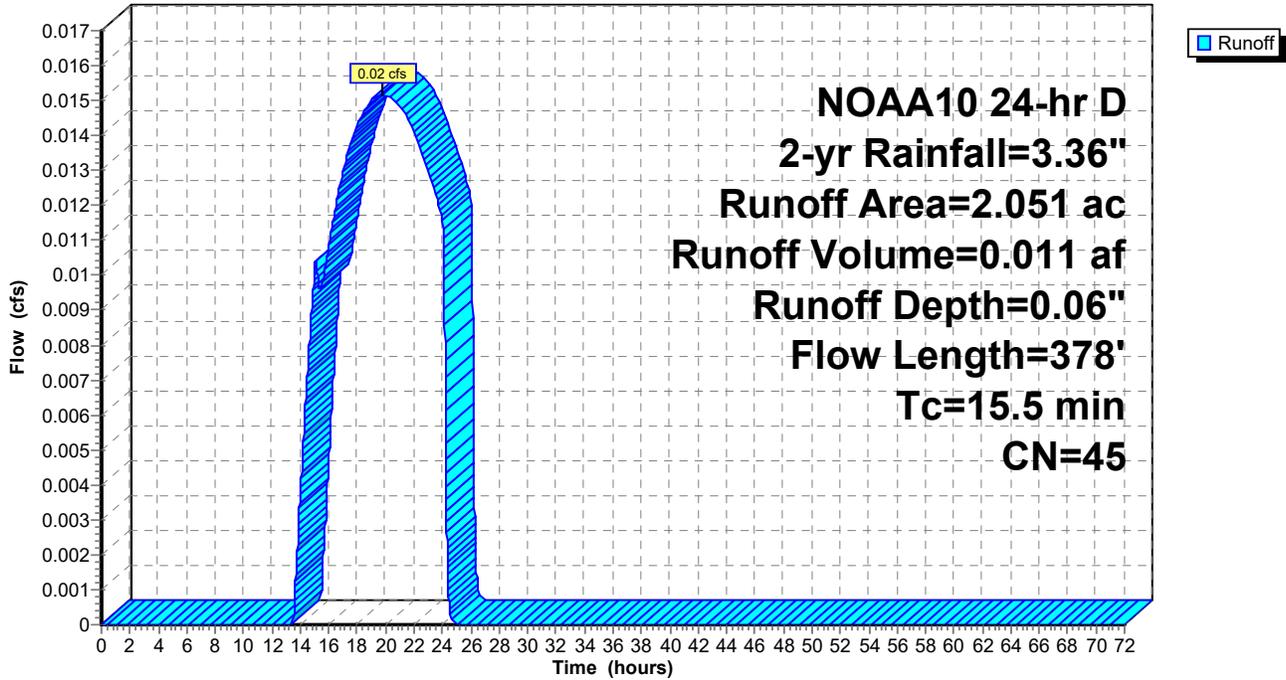
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.221	39	>75% Grass cover, Good, HSG A
0.022	80	>75% Grass cover, Good, HSG D
1.227	30	Woods, Good, HSG A
0.582	77	Woods, Good, HSG D
2.051	45	Weighted Average
2.051		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0190	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
0.8	67	0.0780	1.40		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.0	14	0.3300	8.62		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.5	148	0.0125	1.68		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
0.2	46	0.0550	3.52		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
0.7	53	0.0700	1.32		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
15.5	378	Total			

Subcatchment PR-5: Subcat PR-5

Hydrograph



Summary for Subcatchment PR-6: Subcat PR-6

Runoff = 1.51 cfs @ 12.14 hrs, Volume= 0.102 af, Depth= 1.20"
 Routed to Pond 5P : EX. BASIN #2

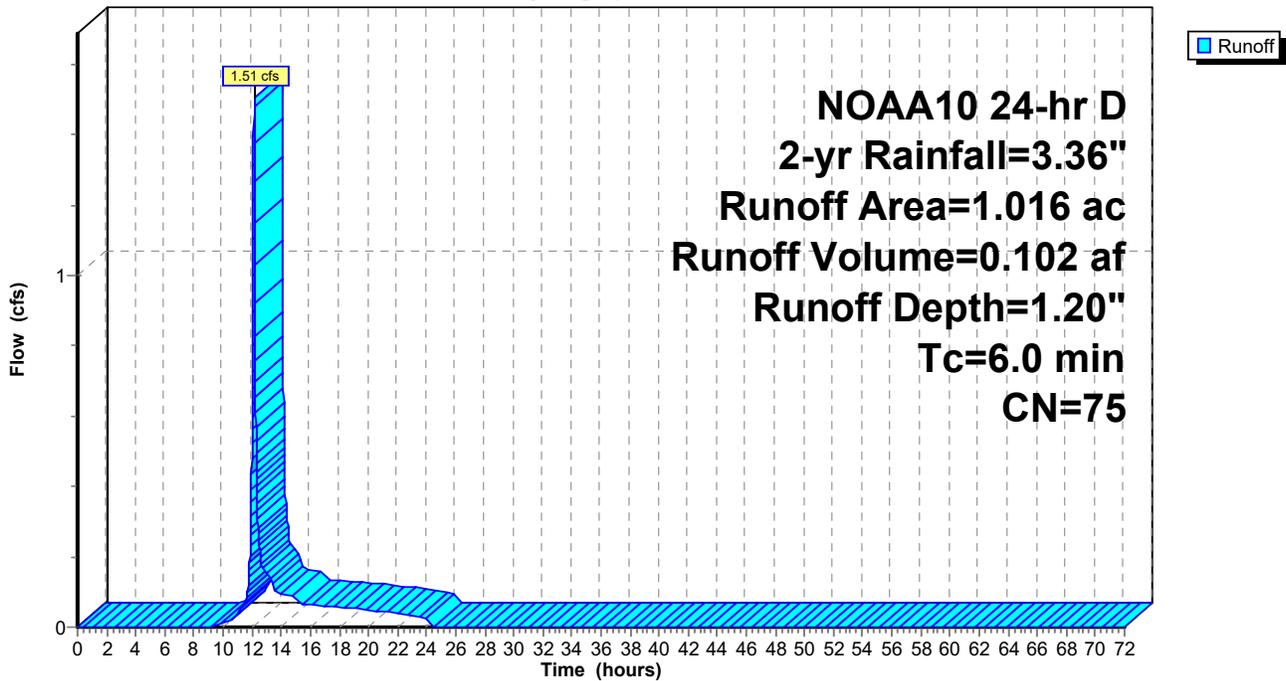
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.125	39	>75% Grass cover, Good, HSG A
0.656	98	Water Surface, HSG A
0.235	30	Woods, Good, HSG A
1.016	75	Weighted Average
0.360		35.43% Pervious Area
0.656		64.57% Impervious Area

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

Subcatchment PR-6: Subcat PR-6

Hydrograph



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Summary for Subcatchment PR-7: Subcat PR-7

Runoff = 27.61 cfs @ 12.13 hrs, Volume= 2.120 af, Depth= 3.13"

Routed to Pond 3P : DMH 24-15

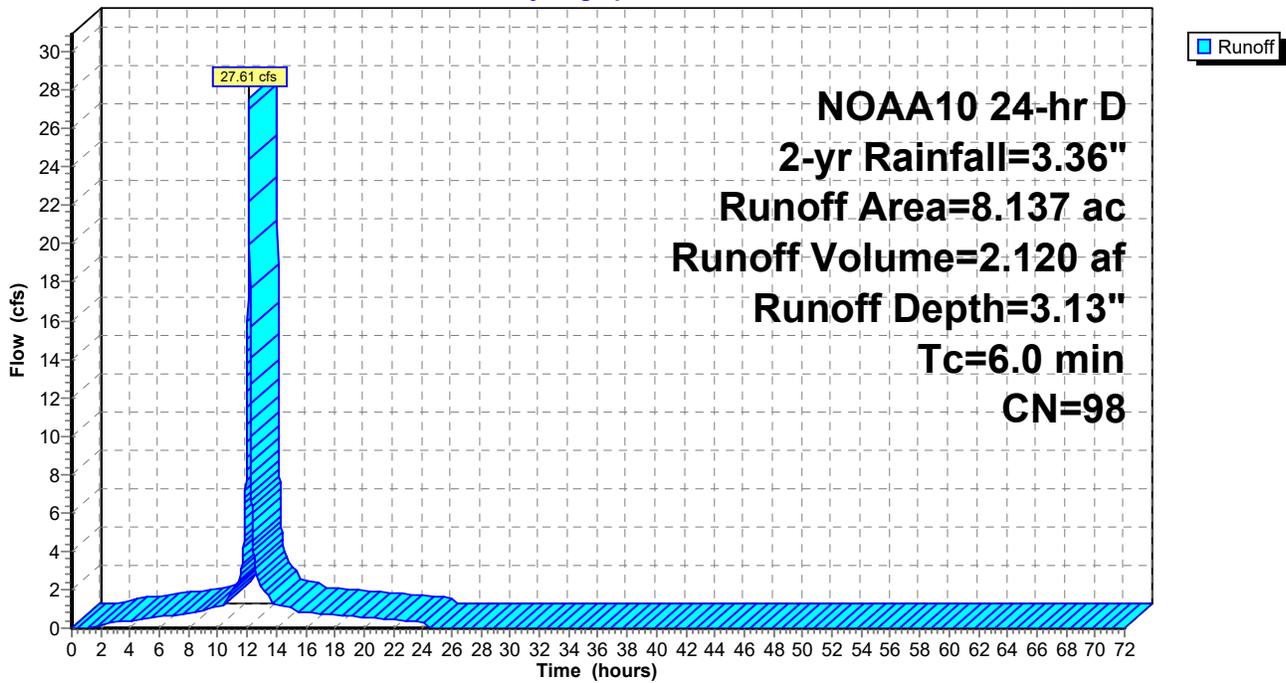
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
8.137	98	Roofs, HSG A
8.137		100.00% Impervious Area

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

Subcatchment PR-7: Subcat PR-7

Hydrograph



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Summary for Subcatchment PR-8: Subcat PR-8

Runoff = 1.36 cfs @ 12.13 hrs, Volume= 0.091 af, Depth= 1.82"
 Routed to Pond 4P : EX. BASIN #1

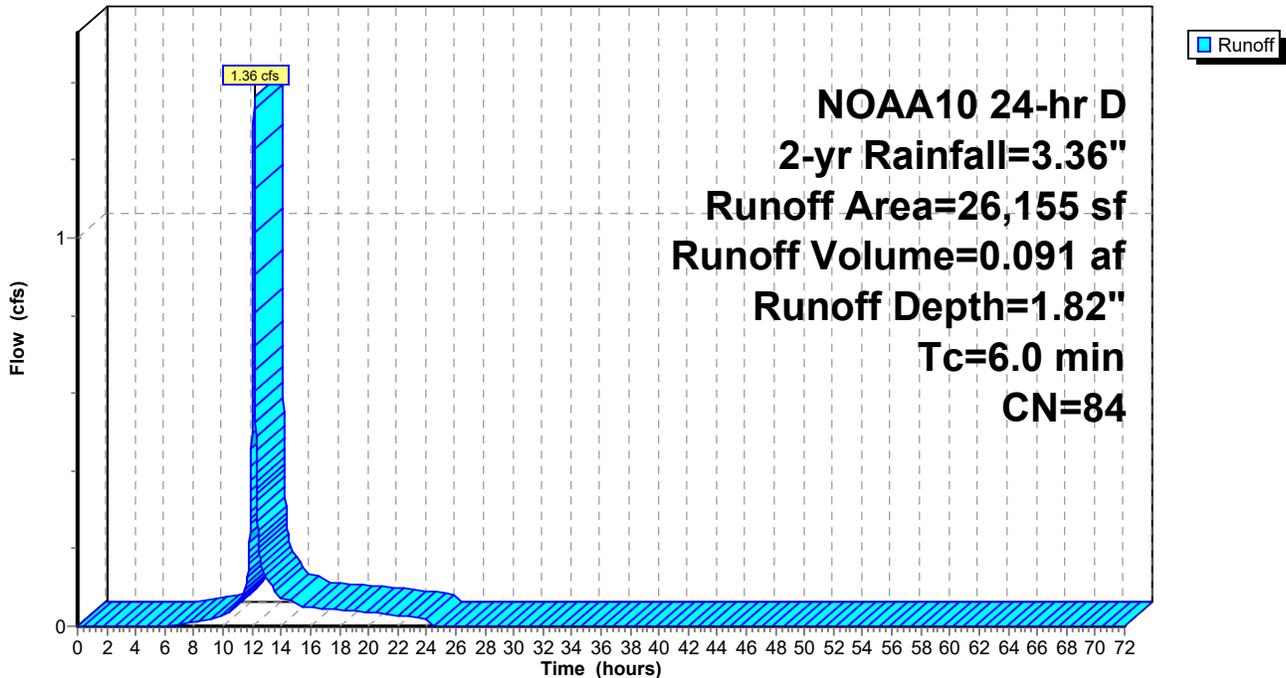
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (sf)	CN	Description
6,261	39	>75% Grass cover, Good, HSG A
19,408	98	Paved parking, HSG A
486	98	Unconnected pavement, HSG A
26,155	84	Weighted Average
6,261		23.94% Pervious Area
19,894		76.06% Impervious Area
486		2.44% Unconnected

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

Subcatchment PR-8: Subcat PR-8

Hydrograph



Summary for Subcatchment PR-9: Subcat PR-9

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

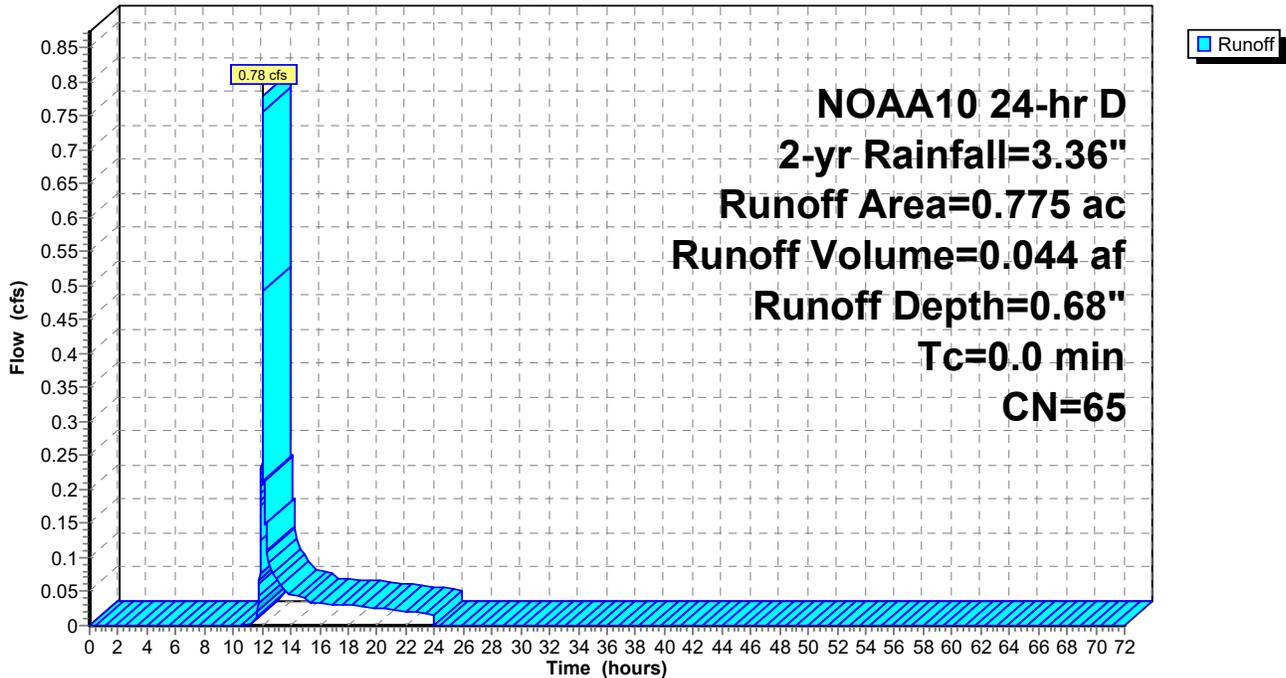
Runoff = 0.78 cfs @ 12.09 hrs, Volume= 0.044 af, Depth= 0.68"
 Routed to Pond 3P : DMH 24-15

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 2-yr Rainfall=3.36"

Area (ac)	CN	Description
0.431	39	>75% Grass cover, Good, HSG A
0.343	98	Paved parking, HSG A
0.001	98	Unconnected pavement, HSG A
0.775	65	Weighted Average
0.431		55.64% Pervious Area
0.344		44.36% Impervious Area
0.001		0.15% Unconnected

Subcatchment PR-9: Subcat PR-9

Hydrograph



Summary for Pond 1P: SUBSURFACE DETENTION

NOTE: A -0.6' ROW LENGTH ADJUSTMENT HAS BEEN APPLIED TO ACCOUNT FOR A 4' LONG INTERNAL MANHOLE IN THE FINAL ROW, WHICH SERVES AS AN OUTLET CONTROL STRUCTURE. THIS ROW ADJUSTMENT SPREADS THE LOSS IN STORAGE ACROSS ALL 7 ROWS TO MAINTAIN AN ACCURATE TOTAL STORAGE VOLUME FOR THE SYSTEM.

Inflow Area = 14.880 ac, 88.78% Impervious, Inflow Depth = 2.43" for 2-yr event
 Inflow = 39.99 cfs @ 12.13 hrs, Volume= 3.007 af
 Outflow = 6.19 cfs @ 12.38 hrs, Volume= 1.949 af, Atten= 85%, Lag= 14.8 min
 Primary = 6.19 cfs @ 12.38 hrs, Volume= 1.949 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 255.21' @ 24.31 hrs Surf.Area= 0.590 ac Storage= 1.059 af

Plug-Flow detention time= 151.4 min calculated for 1.949 af (65% of inflow)
 Center-of-Mass det. time= 15.8 min (794.1 - 778.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	252.00'	0.000 af	74.00'W x 347.40'L x 8.50'H Field A 5.016 af Overall - 2.827 af Embedded = 2.189 af x 0.0% Voids
#2A	252.00'	2.827 af	CMP Round 96 x 119 Inside #1 Effective Size= 96.0"W x 96.0"H => 50.27 sf x 20.00'L = 1,005.3 cf Overall Size= 96.0"W x 96.0"H x 20.00'L Row Length Adjustment= -0.60' x 50.27 sf x 7 rows 74.00' Header x 50.27 sf x 1 = 3,719.6 cf Inside
		2.827 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 4	252.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Device 4	254.50'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Device 4	258.50'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Head (feet) 6.50 6.56 6.64 6.72 6.80 6.88 6.96 7.04 7.12 7.20 7.28 7.36 7.44 7.52 7.60 7.68 7.76 7.84 7.92 8.00 Width (feet) 6.25 6.15 6.01 5.87 5.71 5.55 5.38 5.20 5.01 4.80 4.58 4.34 4.08 3.80 3.49 3.14 2.73 2.24 1.59 0.00
#4	Primary	251.90'	36.0" Round Culvert L= 28.6' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 251.90' / 251.50' S= 0.0140 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 7.07 sf

Primary OutFlow Max=6.17 cfs @ 12.38 hrs HW=255.09' TW=253.41' (Dynamic Tailwater)

- ↳ **4=Culvert** (Passes 6.17 cfs of 41.23 cfs potential flow)
 - ↳ **1=Orifice/Grate** (Orifice Controls 4.90 cfs @ 6.25 fps)
 - ↳ **2=Orifice/Grate** (Orifice Controls 1.27 cfs @ 2.62 fps)
 - ↳ **3=Custom Weir/Orifice** (Controls 0.00 cfs)

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Pond 1P: SUBSURFACE DETENTION - Chamber Wizard Field A

Chamber Model = CMP Round 96 (Round Corrugated Metal Pipe)

Effective Size= 96.0"W x 96.0"H => 50.27 sf x 20.00'L = 1,005.3 cf

Overall Size= 96.0"W x 96.0"H x 20.00'L

Row Length Adjustment= -0.60' x 50.27 sf x 7 rows

96.0" Wide + 36.0" Spacing = 132.0" C-C Row Spacing

17 Chambers/Row x 20.00' Long -0.60' Row Adjustment +8.00' Header x 1 = 347.40' Row Length

7 Rows x 96.0" Wide + 36.0" Spacing x 6 = 74.00' Base Width

96.0" Chamber Height + 6.0" Stone Cover = 8.50' Field Height

119 Chambers x 1,005.3 cf -0.60' Row Adjustment x 50.27 sf x 7 Rows + 74.00' Header x 50.27 sf =
123,140.4 cf Chamber Storage

218,514.6 cf Field - 123,140.4 cf Chambers = 95,374.2 cf Stone x 0.0% Voids = 0.0 cf Stone Storage

Chamber Storage = 123,140.4 cf = 2.827 af

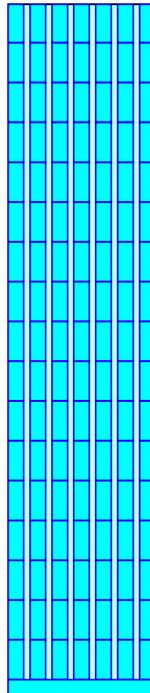
Overall Storage Efficiency = 56.4%

Overall System Size = 347.40' x 74.00' x 8.50'

119 Chambers

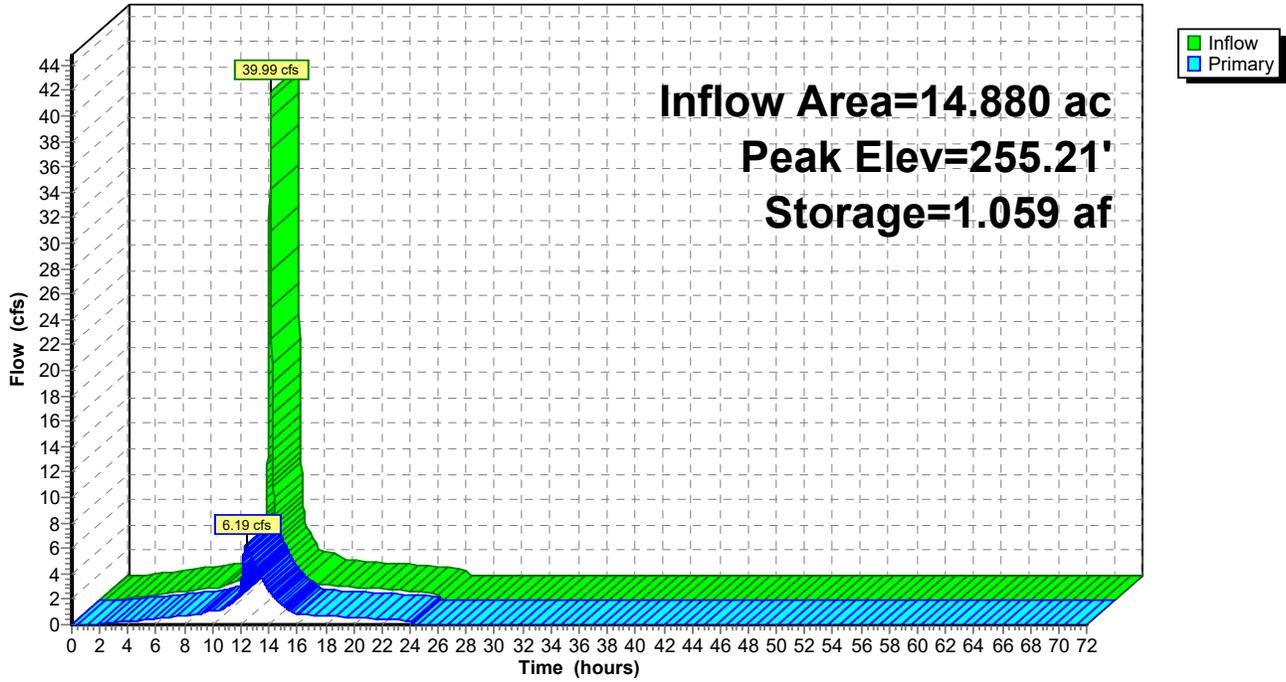
8,093.1 cy Field

3,532.4 cy Stone



Pond 1P: SUBSURFACE DETENTION

Hydrograph



Summary for Pond 2P: DMH 24-5

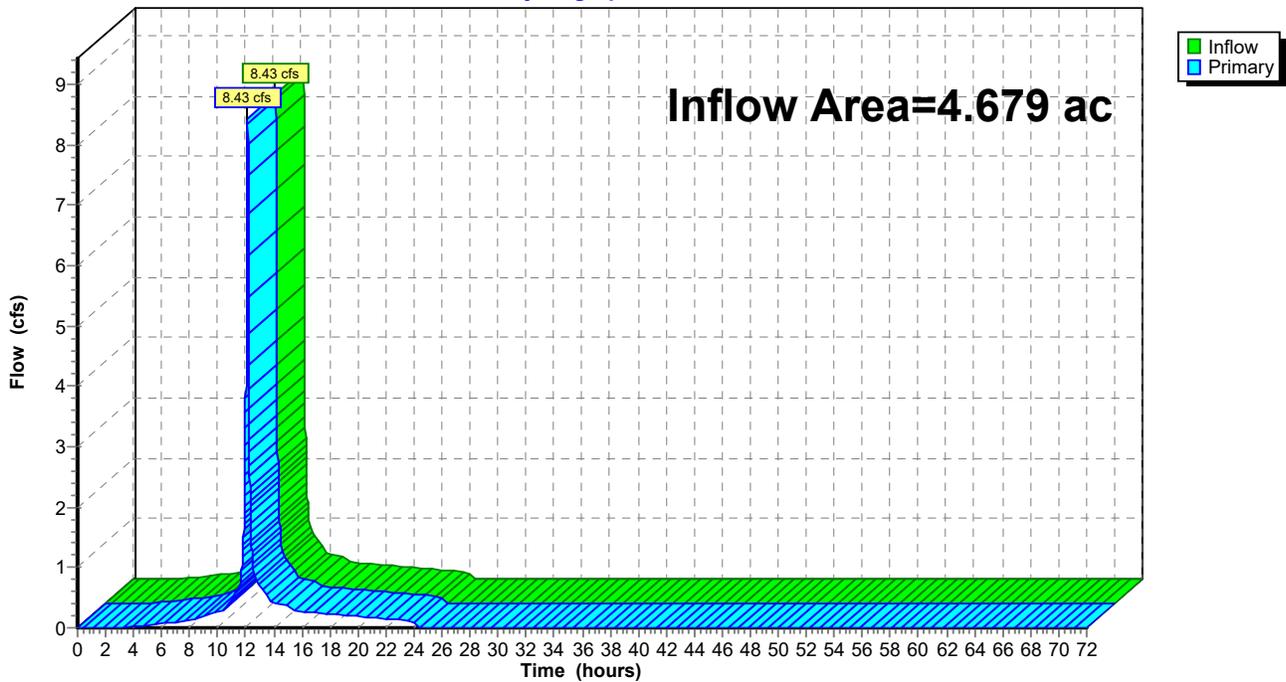
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.679 ac, 76.58% Impervious, Inflow Depth = 1.50" for 2-yr event
Inflow = 8.43 cfs @ 12.13 hrs, Volume= 0.584 af
Primary = 8.43 cfs @ 12.13 hrs, Volume= 0.584 af, Atten= 0%, Lag= 0.0 min
Routed to Pond 1P : SUBSURFACE DETENTION

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 2P: DMH 24-5

Hydrograph



Summary for Pond 3P: DMH 24-15

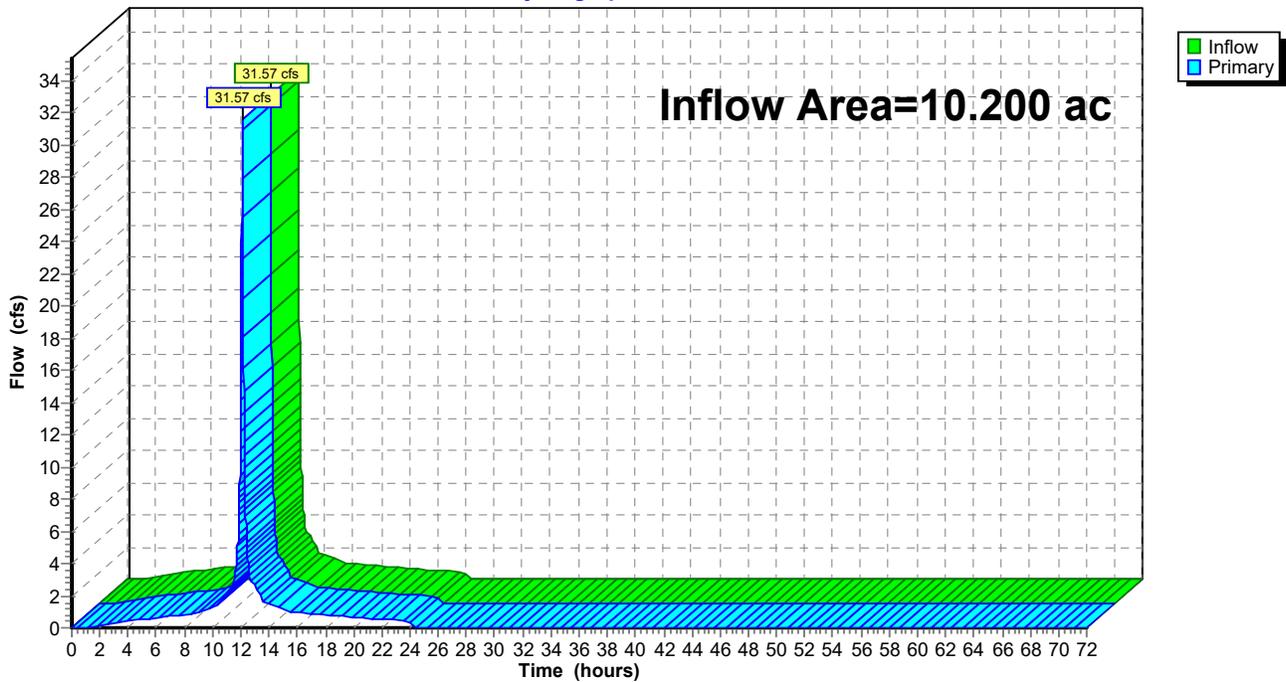
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 10.200 ac, 94.38% Impervious, Inflow Depth = 2.85" for 2-yr event
Inflow = 31.57 cfs @ 12.13 hrs, Volume= 2.423 af
Primary = 31.57 cfs @ 12.13 hrs, Volume= 2.423 af, Atten= 0%, Lag= 0.0 min
Routed to Pond 1P : SUBSURFACE DETENTION

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 3P: DMH 24-15

Hydrograph



Summary for Pond 4P: EX. BASIN #1

Inflow Area = 1.747 ac, 58.18% Impervious, Inflow Depth = 1.16" for 2-yr event
 Inflow = 2.45 cfs @ 12.14 hrs, Volume= 0.169 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond 2P : DMH 24-5

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 274.79' @ 24.34 hrs Surf.Area= 7,969 sf Storage= 7,379 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	273.40'	31,754 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
273.40	1,731	0	0
274.00	5,352	2,125	2,125
275.00	8,670	7,011	9,136
276.00	11,387	10,029	19,164
277.00	13,793	12,590	31,754

Device	Routing	Invert	Outlet Devices
#1	Primary	272.50'	12.0" Round Culvert L= 75.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 272.50' / 271.90' S= 0.0079 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	275.00'	34.0" x 50.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

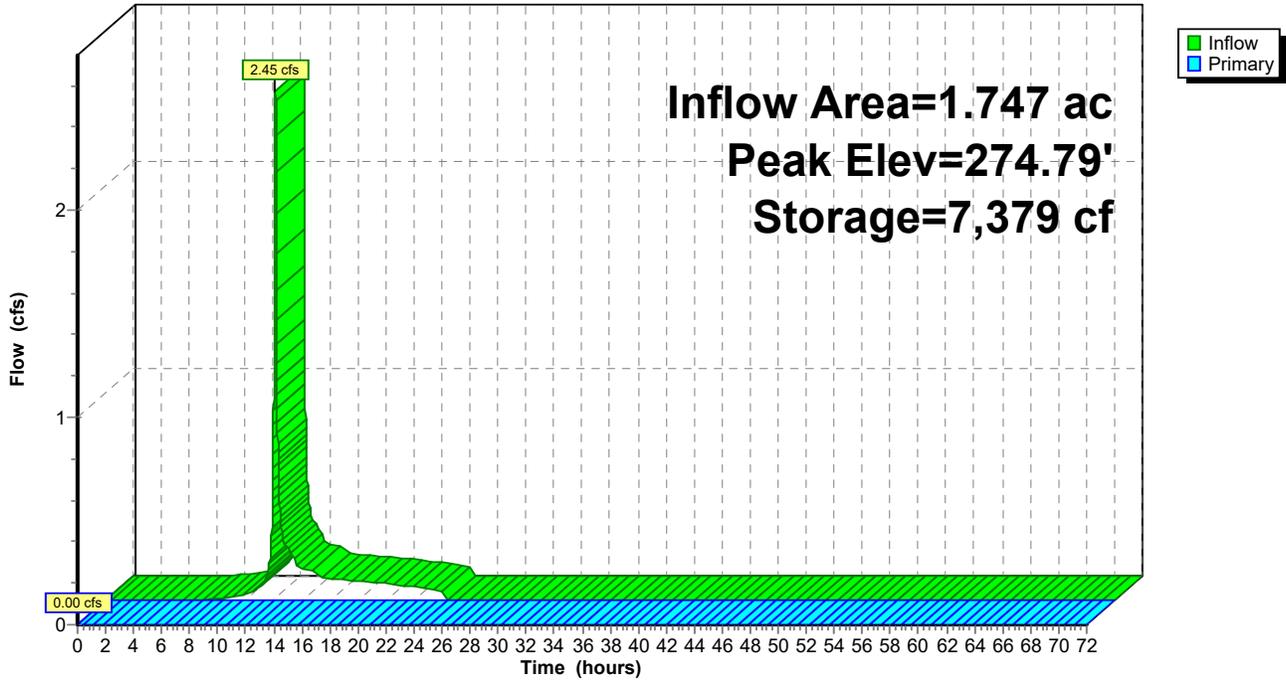
Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=273.40' TW=0.00' (Dynamic Tailwater)

↑ **1=Culvert** (Passes 0.00 cfs of 2.22 cfs potential flow)

↑ **2=Orifice/Grate** (Controls 0.00 cfs)

Pond 4P: EX. BASIN #1

Hydrograph



Summary for Pond 5P: EX. BASIN #2

Inflow Area = 15.896 ac, 87.23% Impervious, Inflow Depth = 1.55" for 2-yr event
 Inflow = 6.54 cfs @ 12.34 hrs, Volume= 2.051 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond AP-1 : Southern Wetlands
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond AP-1 : Southern Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 255.21' @ 72.00 hrs Surf.Area= 32,264 sf Storage= 89,349 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
 Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	252.00'	222,384 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
252.00	2,679	0	0
252.50	27,225	7,476	7,476
253.00	29,112	14,084	21,560
254.00	30,548	29,830	51,390
255.00	31,966	31,257	82,647
256.00	33,393	32,680	115,327
257.00	34,883	34,138	149,465
258.00	36,434	35,659	185,123
259.00	38,088	37,261	222,384

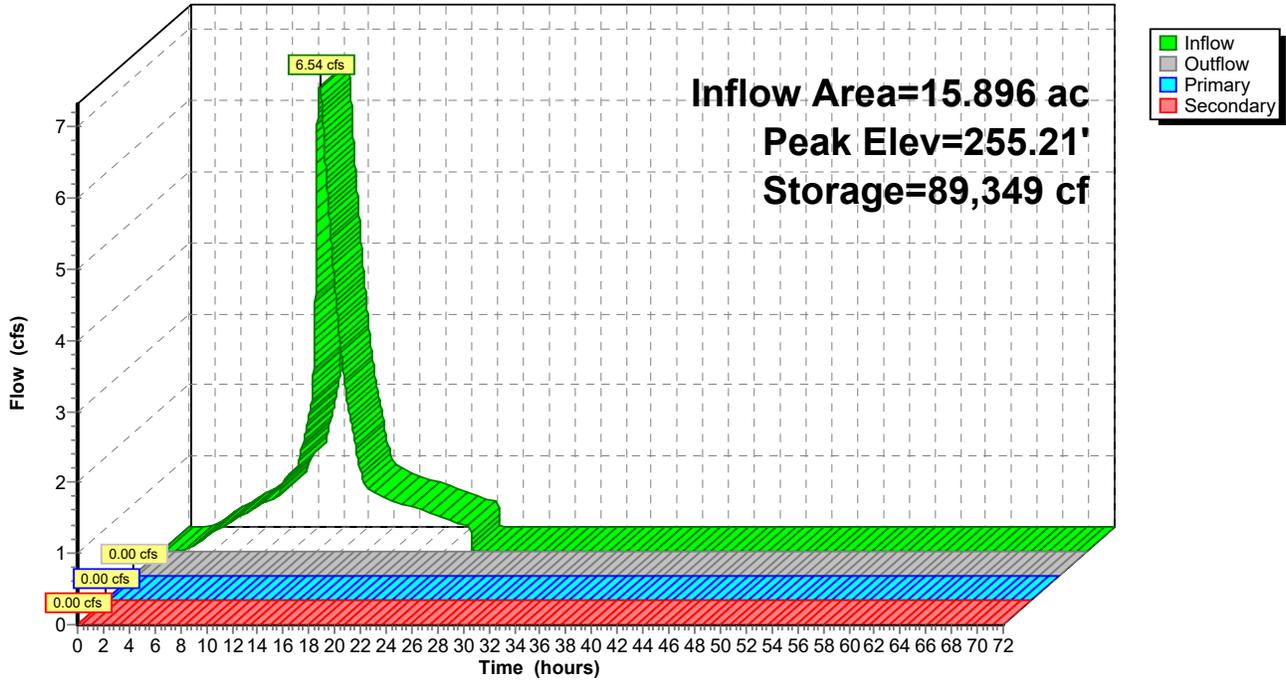
Device	Routing	Invert	Outlet Devices
#1	Secondary	257.70'	9.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	254.96'	12.0" Round Culvert L= 28.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 254.96' / 254.86' S= 0.0035 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#3	Device 2	256.20'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=252.00' TW=0.00' (Dynamic Tailwater)
 ↑**2=Culvert** (Controls 0.00 cfs)
 ↑**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=252.00' TW=0.00' (Dynamic Tailwater)
 ↑**1=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 5P: EX. BASIN #2

Hydrograph



Summary for Pond AP-1: Southern Wetlands

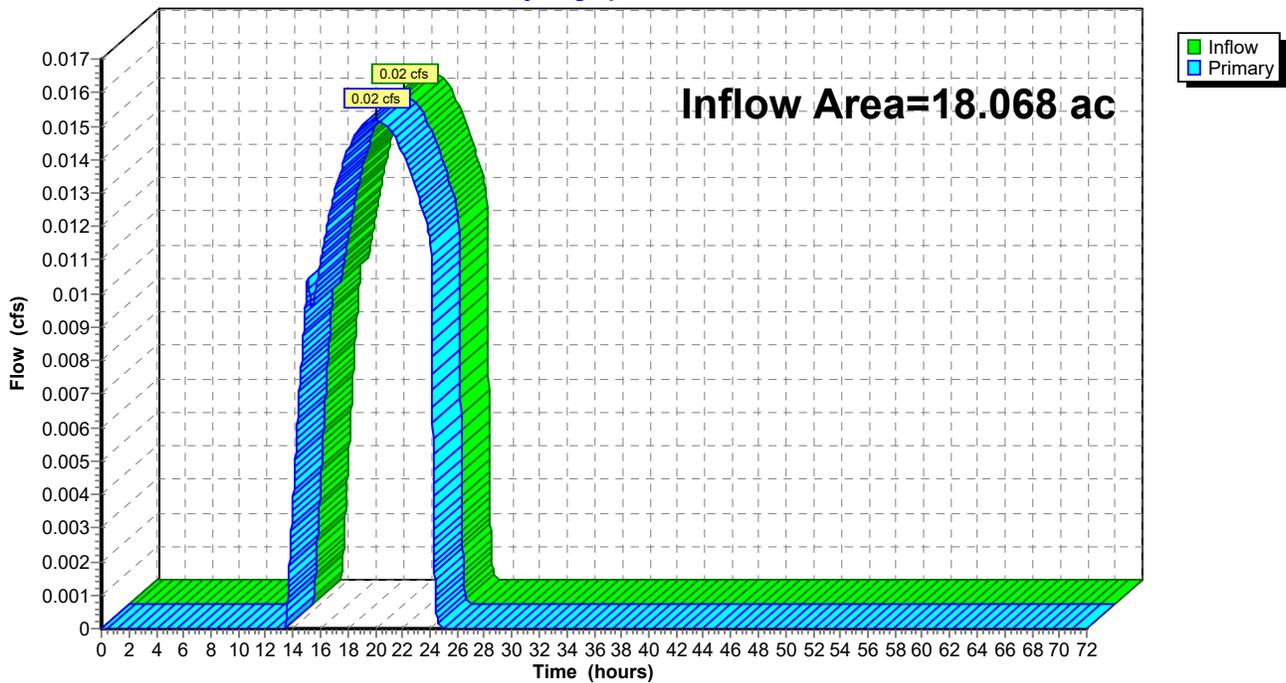
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 18.068 ac, 76.75% Impervious, Inflow Depth = 0.01" for 2-yr event
Inflow = 0.02 cfs @ 20.03 hrs, Volume= 0.011 af
Primary = 0.02 cfs @ 20.03 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: Southern Wetlands

Hydrograph



F4593 Post-Development 10-22

NOAA10 24-hr D 10-yr Rainfall=5.22"

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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-1: Subcat PR-1	Runoff Area=0.120 ac 0.00% Impervious Runoff Depth=0.25" Tc=6.0 min CN=39 Runoff=0.00 cfs 0.002 af
SubcatchmentPR-10: Subcat PR-10	Runoff Area=0.334 ac 69.45% Impervious Runoff Depth=3.09" Tc=6.0 min CN=80 Runoff=1.28 cfs 0.086 af
SubcatchmentPR-2: Subcat PR-2	Runoff Area=1.147 ac 48.82% Impervious Runoff Depth=2.04" Tc=6.0 min CN=68 Runoff=2.91 cfs 0.195 af
SubcatchmentPR-3: Subcat PR-3	Runoff Area=2.598 ac 89.87% Impervious Runoff Depth=4.30" Tc=6.0 min CN=92 Runoff=12.95 cfs 0.932 af
SubcatchmentPR-4: Subcat PR-4	Runoff Area=1.288 ac 88.94% Impervious Runoff Depth=4.20" Tc=6.0 min CN=91 Runoff=6.32 cfs 0.450 af
SubcatchmentPR-5: Subcat PR-5	Runoff Area=2.051 ac 0.00% Impervious Runoff Depth=0.51" Flow Length=378' Tc=15.5 min CN=45 Runoff=0.37 cfs 0.088 af
SubcatchmentPR-6: Subcat PR-6	Runoff Area=1.016 ac 64.57% Impervious Runoff Depth=2.63" Tc=6.0 min CN=75 Runoff=3.35 cfs 0.223 af
SubcatchmentPR-7: Subcat PR-7	Runoff Area=8.137 ac 100.00% Impervious Runoff Depth=4.98" Tc=6.0 min CN=98 Runoff=43.17 cfs 3.379 af
SubcatchmentPR-8: Subcat PR-8	Runoff Area=26,155 sf 76.06% Impervious Runoff Depth=3.47" Tc=6.0 min CN=84 Runoff=2.56 cfs 0.174 af
SubcatchmentPR-9: Subcat PR-9	Runoff Area=0.775 ac 44.36% Impervious Runoff Depth=1.80" Tc=0.0 min CN=65 Runoff=2.19 cfs 0.116 af
Pond 1P: SUBSURFACE DETENTION	Peak Elev=256.69' Storage=1.722 af Inflow=64.30 cfs 5.122 af Outflow=10.92 cfs 3.618 af
Pond 2P: DMH 24-5	Inflow=14.23 cfs 1.177 af Primary=14.23 cfs 1.177 af
Pond 3P: DMH 24-15	Inflow=50.06 cfs 3.946 af Primary=50.06 cfs 3.946 af
Pond 4P: EX. BASIN #1	Peak Elev=275.03' Storage=9,437 cf Inflow=5.46 cfs 0.368 af Outflow=0.29 cfs 0.159 af
Pond 5P: EX. BASIN #2	Peak Elev=256.48' Storage=131,403 cf Inflow=12.68 cfs 3.840 af Primary=1.49 cfs 1.036 af Secondary=0.00 cfs 0.000 af Outflow=1.49 cfs 1.036 af
Pond AP-1: Southern Wetlands	Inflow=1.56 cfs 1.127 af Primary=1.56 cfs 1.127 af

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NOAA10 24-hr D 10-yr Rainfall=5.22"

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Total Runoff Area = 18.068 ac Runoff Volume = 5.645 af Average Runoff Depth = 3.75"
23.25% Pervious = 4.201 ac 76.75% Impervious = 13.866 ac

Summary for Subcatchment PR-1: Subcat PR-1

Runoff = 0.00 cfs @ 13.25 hrs, Volume= 0.002 af, Depth= 0.25"
 Routed to Pond AP-1 : Southern Wetlands

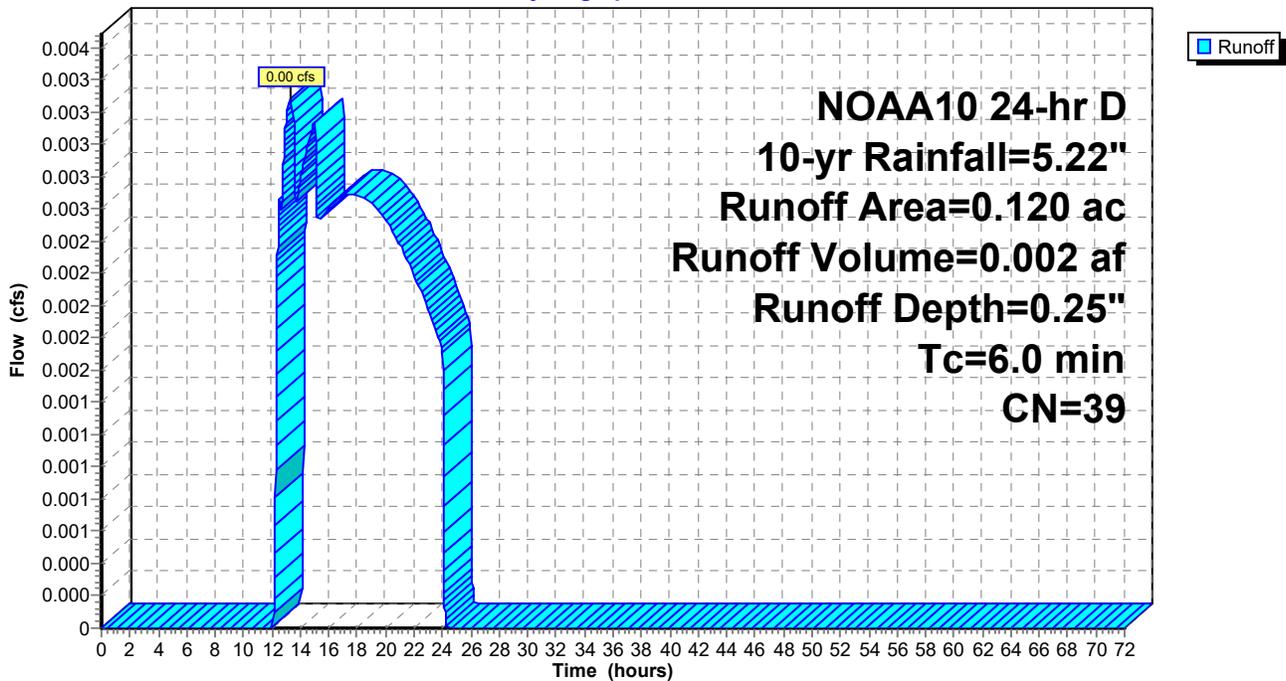
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.120	39	>75% Grass cover, Good, HSG A
0.120		100.00% Pervious Area

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

Subcatchment PR-1: Subcat PR-1

Hydrograph



Summary for Subcatchment PR-10: Subcat PR-10

Runoff = 1.28 cfs @ 12.13 hrs, Volume= 0.086 af, Depth= 3.09"
 Routed to Pond 2P : DMH 24-5

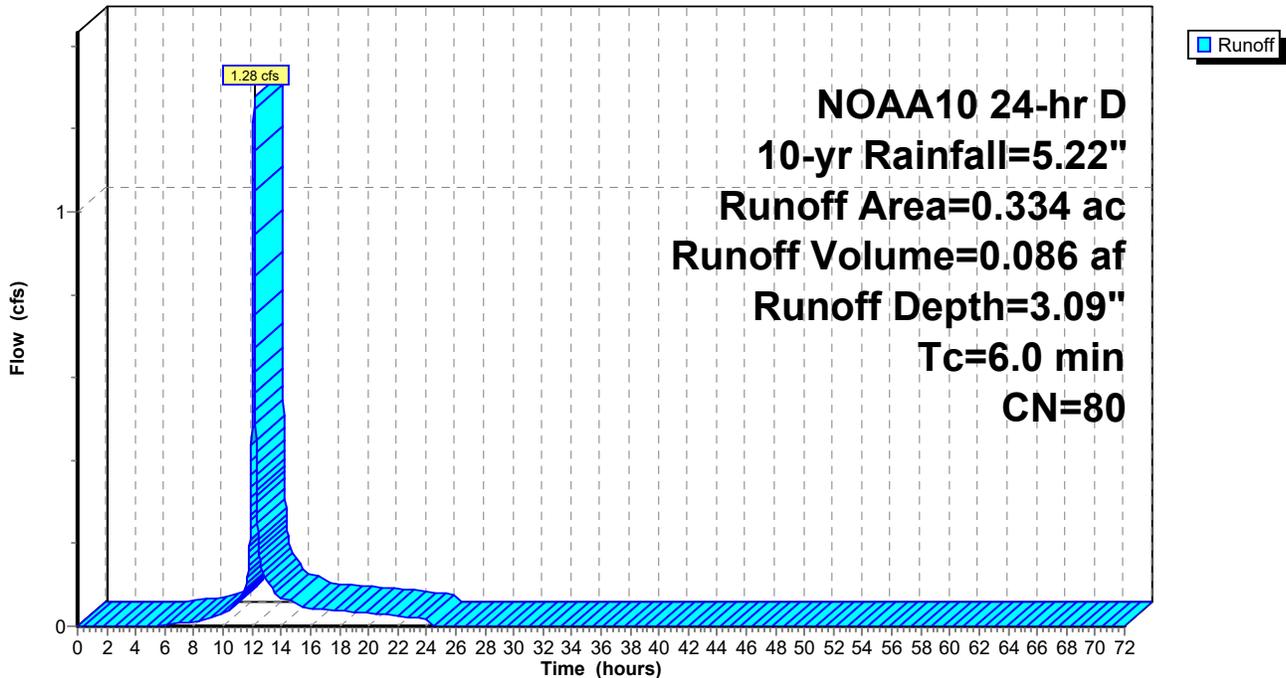
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.102	39	>75% Grass cover, Good, HSG A
0.228	98	Paved parking, HSG A
0.004	98	Unconnected pavement, HSG A
0.334	80	Weighted Average
0.102		30.55% Pervious Area
0.232		69.45% Impervious Area
0.004		1.57% Unconnected

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

Subcatchment PR-10: Subcat PR-10

Hydrograph



Summary for Subcatchment PR-2: Subcat PR-2

Runoff = 2.91 cfs @ 12.13 hrs, Volume= 0.195 af, Depth= 2.04"
 Routed to Pond 4P : EX. BASIN #1

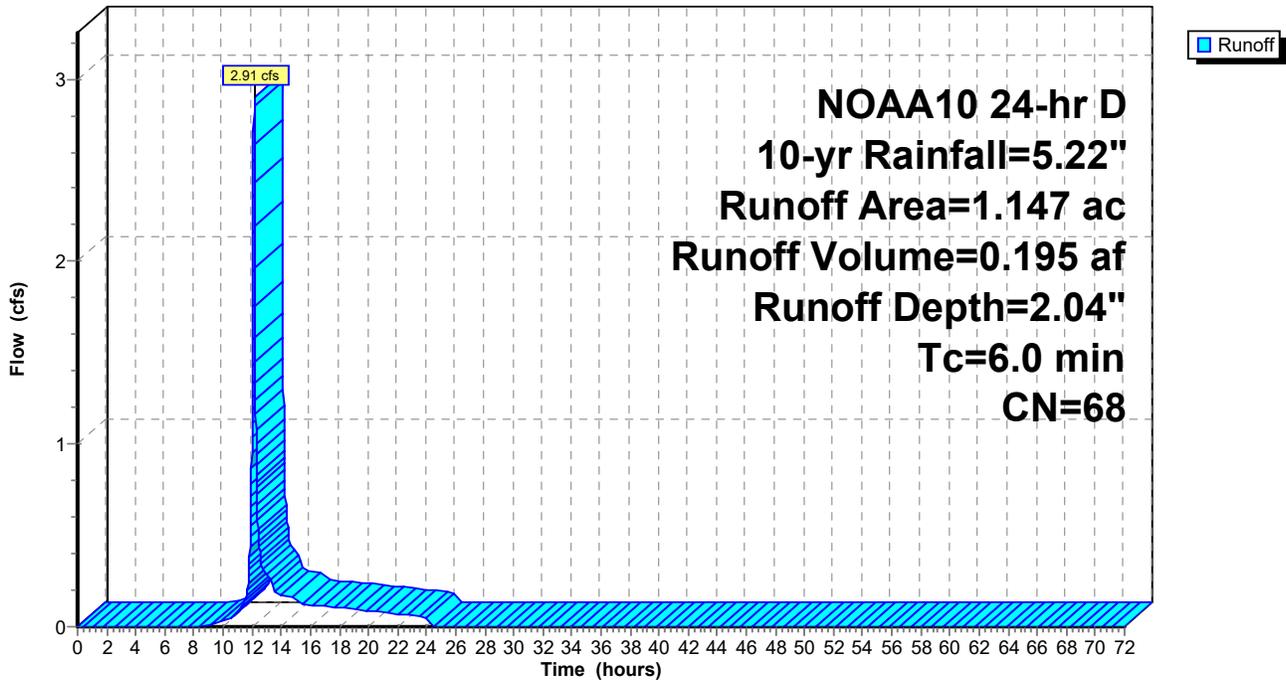
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.587	39	>75% Grass cover, Good, HSG A
0.289	98	Paved parking, HSG A
0.009	98	Unconnected pavement, HSG A
0.261	98	Water Surface, HSG A
1.147	68	Weighted Average
0.587		51.18% Pervious Area
0.560		48.82% Impervious Area
0.009		1.68% Unconnected

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

Subcatchment PR-2: Subcat PR-2

Hydrograph



Summary for Subcatchment PR-3: Subcat PR-3

Runoff = 12.95 cfs @ 12.13 hrs, Volume= 0.932 af, Depth= 4.30"
 Routed to Pond 2P : DMH 24-5

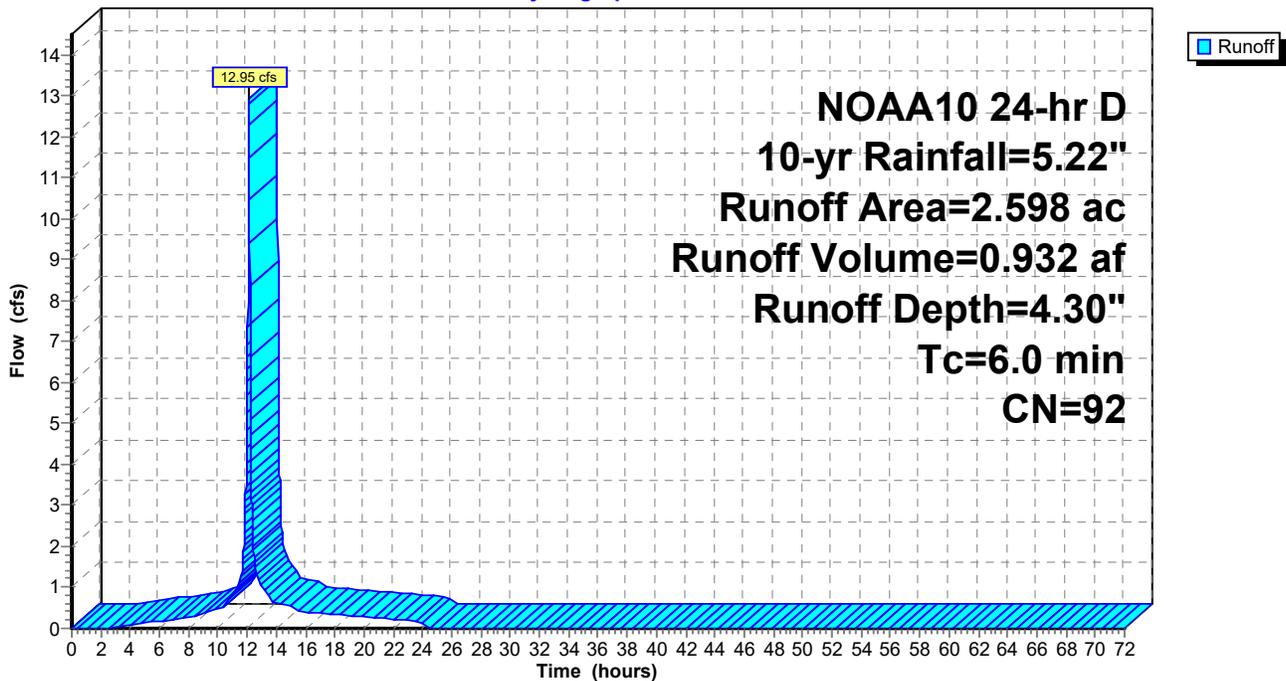
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.234	39	>75% Grass cover, Good, HSG A
0.030	80	>75% Grass cover, Good, HSG D
2.159	98	Paved parking, HSG A
0.102	98	Paved parking, HSG D
0.061	98	Unconnected pavement, HSG A
0.013	98	Unconnected pavement, HSG D
2.598	92	Weighted Average
0.263		10.13% Pervious Area
2.335		89.87% Impervious Area
0.074		3.16% Unconnected

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

Subcatchment PR-3: Subcat PR-3

Hydrograph



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Summary for Subcatchment PR-4: Subcat PR-4

Runoff = 6.32 cfs @ 12.13 hrs, Volume= 0.450 af, Depth= 4.20"
 Routed to Pond 3P : DMH 24-15

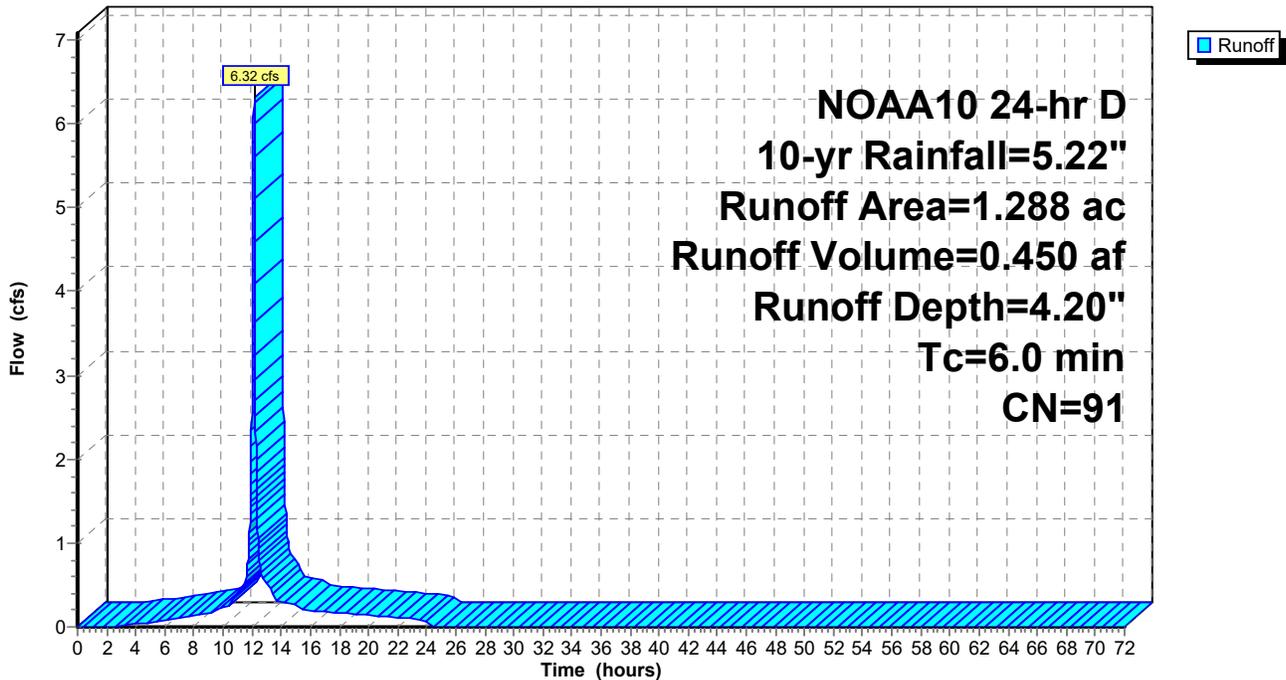
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.142	39	>75% Grass cover, Good, HSG A
1.146	98	Paved parking, HSG A
1.288	91	Weighted Average
0.142		11.06% Pervious Area
1.146		88.94% Impervious Area

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

Subcatchment PR-4: Subcat PR-4

Hydrograph



Summary for Subcatchment PR-5: Subcat PR-5

Runoff = 0.37 cfs @ 12.31 hrs, Volume= 0.088 af, Depth= 0.51"
 Routed to Pond AP-1 : Southern Wetlands

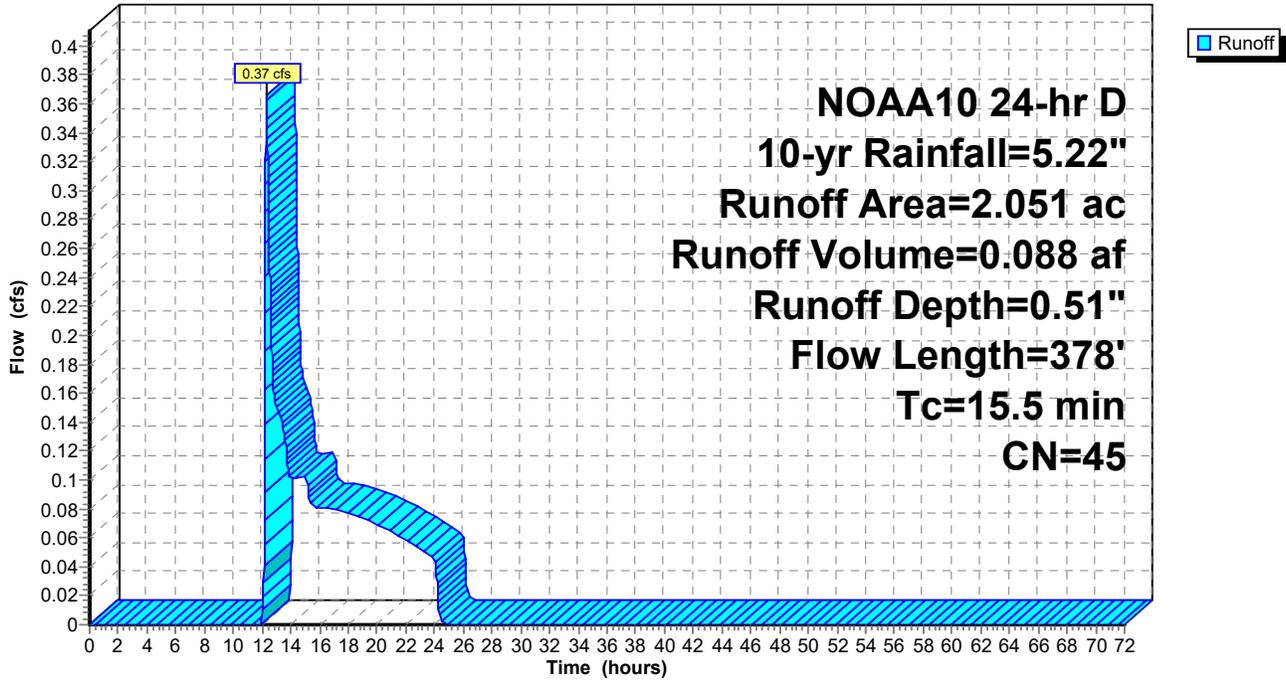
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.221	39	>75% Grass cover, Good, HSG A
0.022	80	>75% Grass cover, Good, HSG D
1.227	30	Woods, Good, HSG A
0.582	77	Woods, Good, HSG D
2.051	45	Weighted Average
2.051		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0190	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
0.8	67	0.0780	1.40		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.0	14	0.3300	8.62		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.5	148	0.0125	1.68		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
0.2	46	0.0550	3.52		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
0.7	53	0.0700	1.32		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
15.5	378	Total			

Subcatchment PR-5: Subcat PR-5

Hydrograph



Summary for Subcatchment PR-6: Subcat PR-6

Runoff = 3.35 cfs @ 12.13 hrs, Volume= 0.223 af, Depth= 2.63"
 Routed to Pond 5P : EX. BASIN #2

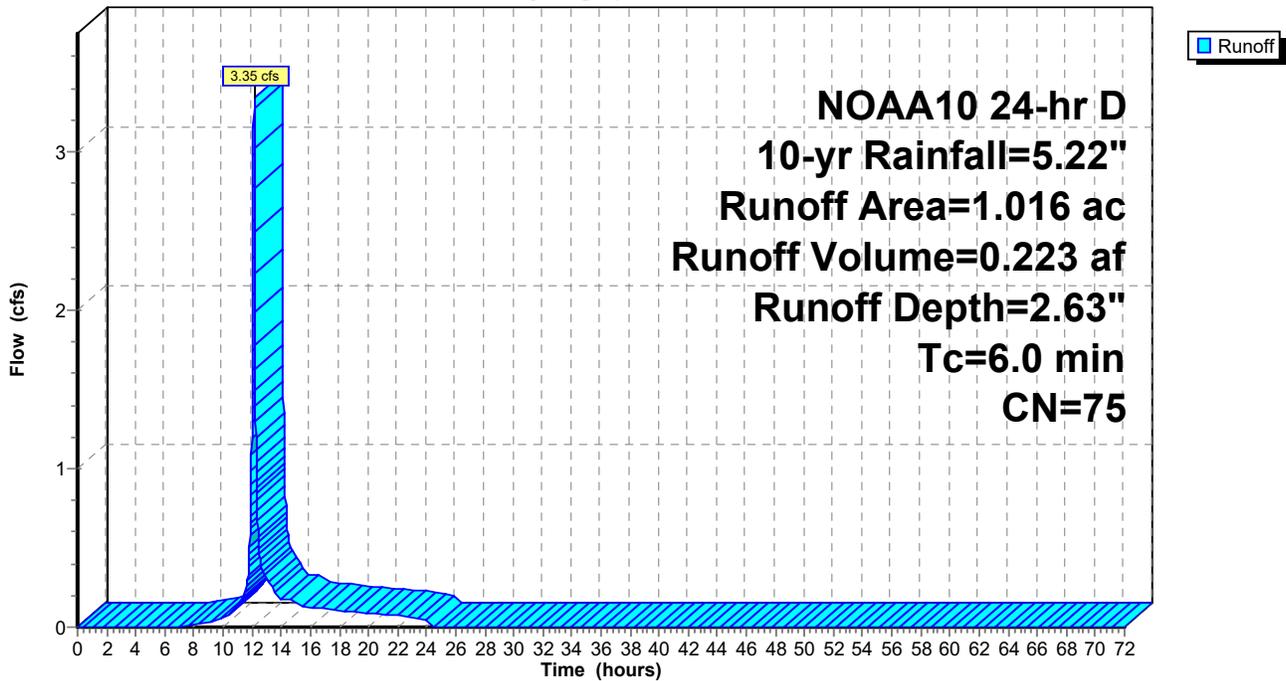
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.125	39	>75% Grass cover, Good, HSG A
0.656	98	Water Surface, HSG A
0.235	30	Woods, Good, HSG A
1.016	75	Weighted Average
0.360		35.43% Pervious Area
0.656		64.57% Impervious Area

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

Subcatchment PR-6: Subcat PR-6

Hydrograph



Summary for Subcatchment PR-7: Subcat PR-7

Runoff = 43.17 cfs @ 12.13 hrs, Volume= 3.379 af, Depth= 4.98"
 Routed to Pond 3P : DMH 24-15

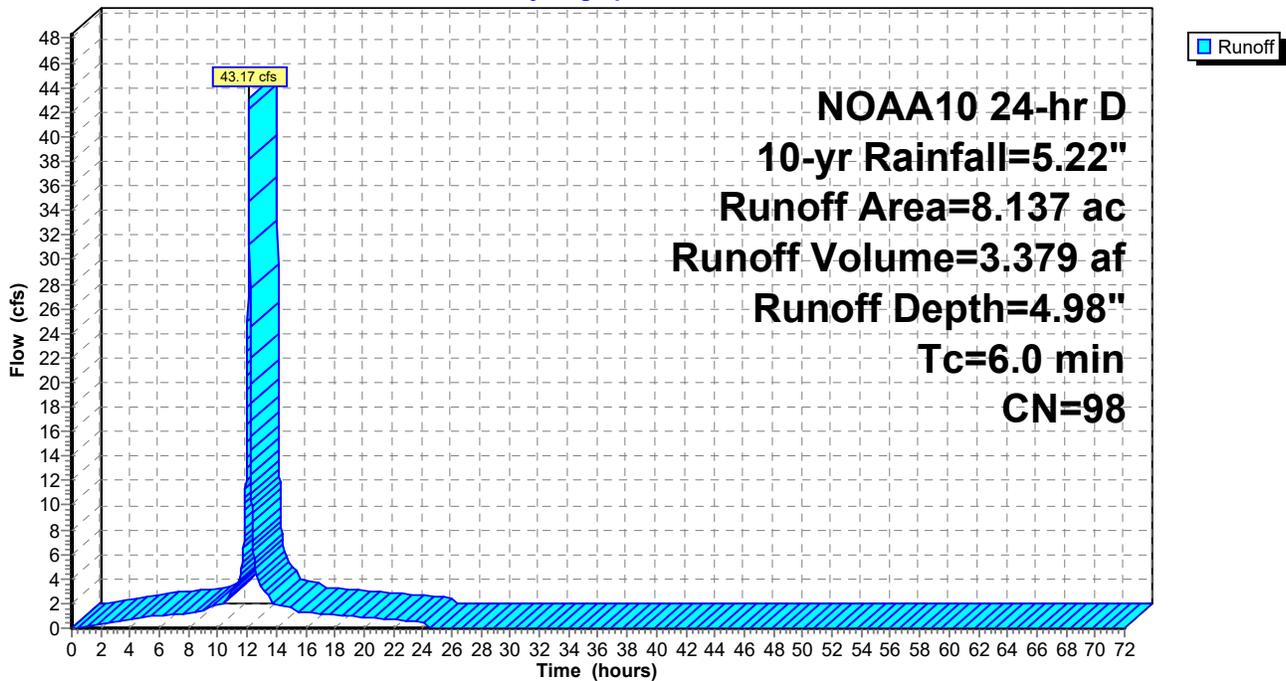
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
8.137	98	Roofs, HSG A
8.137		100.00% Impervious Area

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

Subcatchment PR-7: Subcat PR-7

Hydrograph



Summary for Subcatchment PR-8: Subcat PR-8

Runoff = 2.56 cfs @ 12.13 hrs, Volume= 0.174 af, Depth= 3.47"
 Routed to Pond 4P : EX. BASIN #1

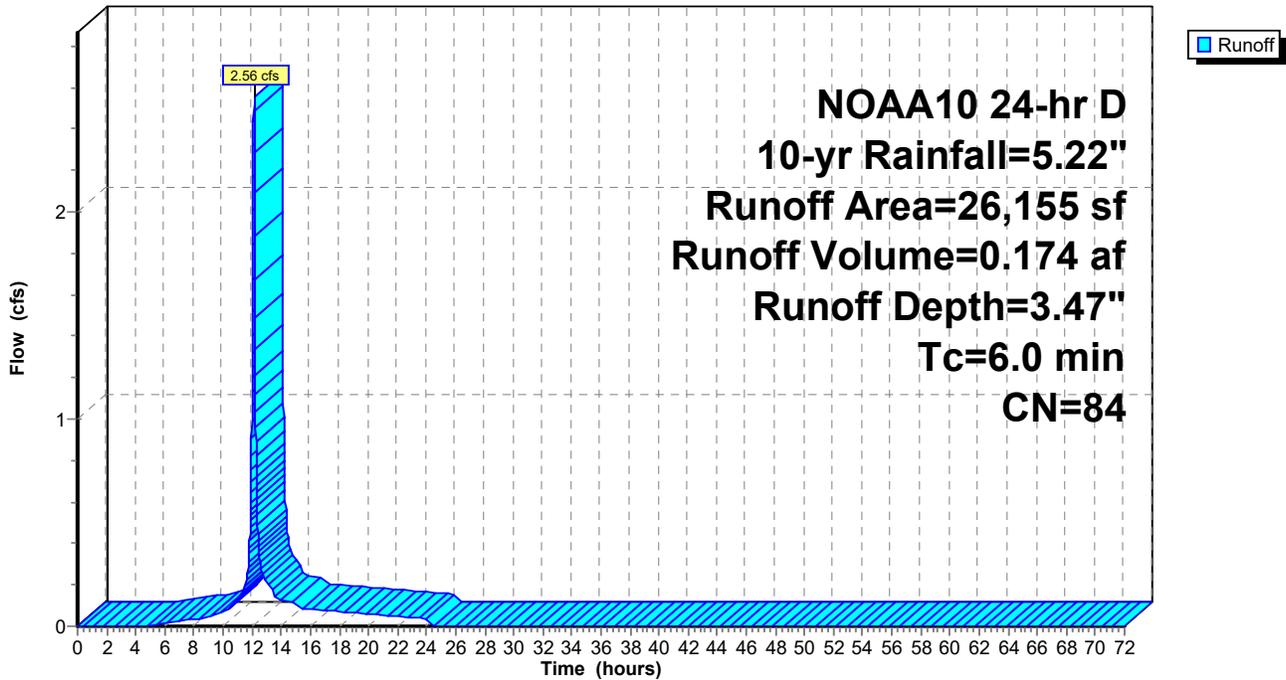
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (sf)	CN	Description
6,261	39	>75% Grass cover, Good, HSG A
19,408	98	Paved parking, HSG A
486	98	Unconnected pavement, HSG A
26,155	84	Weighted Average
6,261		23.94% Pervious Area
19,894		76.06% Impervious Area
486		2.44% Unconnected

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

Subcatchment PR-8: Subcat PR-8

Hydrograph



Summary for Subcatchment PR-9: Subcat PR-9

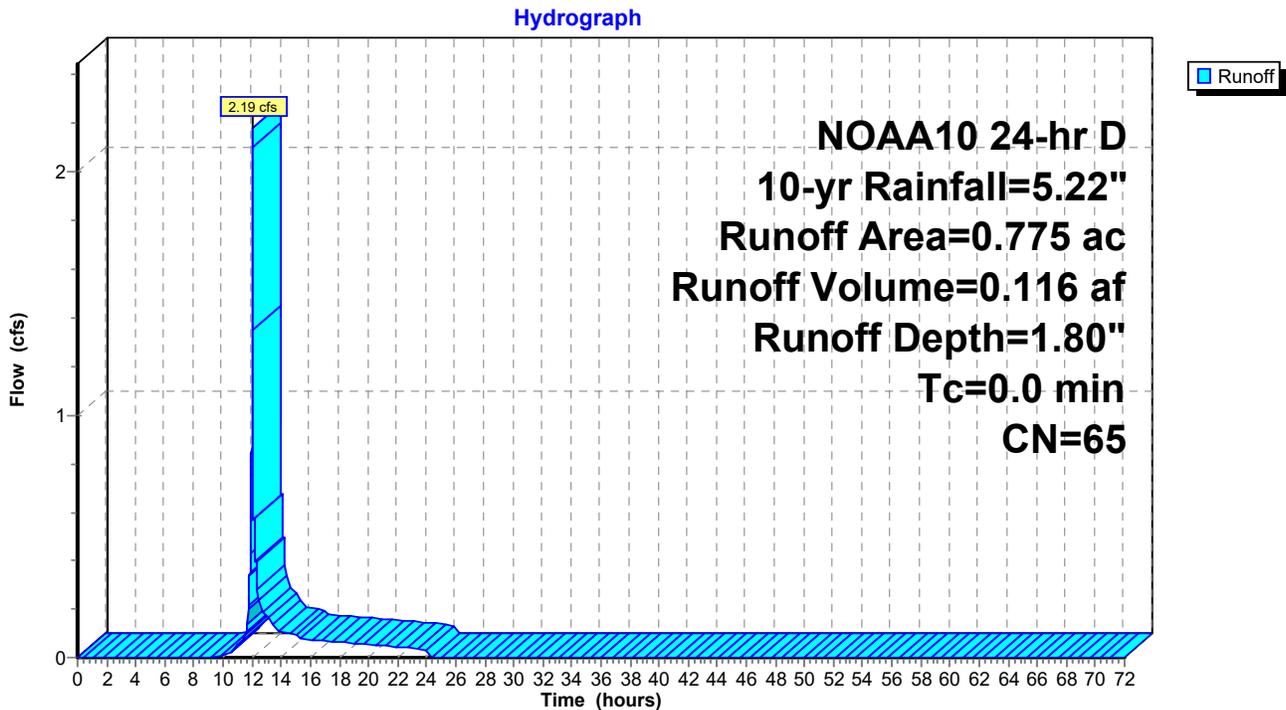
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 2.19 cfs @ 12.09 hrs, Volume= 0.116 af, Depth= 1.80"
 Routed to Pond 3P : DMH 24-15

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 10-yr Rainfall=5.22"

Area (ac)	CN	Description
0.431	39	>75% Grass cover, Good, HSG A
0.343	98	Paved parking, HSG A
0.001	98	Unconnected pavement, HSG A
0.775	65	Weighted Average
0.431		55.64% Pervious Area
0.344		44.36% Impervious Area
0.001		0.15% Unconnected

Subcatchment PR-9: Subcat PR-9



Summary for Pond 1P: SUBSURFACE DETENTION

NOTE: A -0.6' ROW LENGTH ADJUSTMENT HAS BEEN APPLIED TO ACCOUNT FOR A 4' LONG INTERNAL MANHOLE IN THE FINAL ROW, WHICH SERVES AS AN OUTLET CONTROL STRUCTURE. THIS ROW ADJUSTMENT SPREADS THE LOSS IN STORAGE ACROSS ALL 7 ROWS TO MAINTAIN AN ACCURATE TOTAL STORAGE VOLUME FOR THE SYSTEM.

Inflow Area = 14.880 ac, 88.78% Impervious, Inflow Depth = 4.13" for 10-yr event
 Inflow = 64.30 cfs @ 12.13 hrs, Volume= 5.122 af
 Outflow = 10.92 cfs @ 12.33 hrs, Volume= 3.618 af, Atten= 83%, Lag= 12.3 min
 Primary = 10.92 cfs @ 12.33 hrs, Volume= 3.618 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 256.69' @ 12.39 hrs Surf.Area= 0.590 ac Storage= 1.722 af

Plug-Flow detention time= 203.1 min calculated for 3.617 af (71% of inflow)
 Center-of-Mass det. time= 75.8 min (852.7 - 776.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	252.00'	0.000 af	74.00'W x 347.40'L x 8.50'H Field A 5.016 af Overall - 2.827 af Embedded = 2.189 af x 0.0% Voids
#2A	252.00'	2.827 af	CMP Round 96 x 119 Inside #1 Effective Size= 96.0"W x 96.0"H => 50.27 sf x 20.00'L = 1,005.3 cf Overall Size= 96.0"W x 96.0"H x 20.00'L Row Length Adjustment= -0.60' x 50.27 sf x 7 rows 74.00' Header x 50.27 sf x 1 = 3,719.6 cf Inside
		2.827 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 4	252.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Device 4	254.50'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Device 4	258.50'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Head (feet) 6.50 6.56 6.64 6.72 6.80 6.88 6.96 7.04 7.12 7.20 7.28 7.36 7.44 7.52 7.60 7.68 7.76 7.84 7.92 8.00 Width (feet) 6.25 6.15 6.01 5.87 5.71 5.55 5.38 5.20 5.01 4.80 4.58 4.34 4.08 3.80 3.49 3.14 2.73 2.24 1.59 0.00
#4	Primary	251.90'	36.0" Round Culvert L= 28.6' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 251.90' / 251.50' S= 0.0140 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 7.07 sf

Primary OutFlow Max=10.90 cfs @ 12.33 hrs HW=256.67' TW=254.14' (Dynamic Tailwater)

- ↳ **4=Culvert** (Passes 10.90 cfs of 54.11 cfs potential flow)
- ↳ **1=Orifice/Grate** (Orifice Controls 6.01 cfs @ 7.66 fps)
- ↳ **2=Orifice/Grate** (Orifice Controls 4.89 cfs @ 6.23 fps)
- ↳ **3=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 1P: SUBSURFACE DETENTION - Chamber Wizard Field A

Chamber Model = CMP Round 96 (Round Corrugated Metal Pipe)

Effective Size= 96.0"W x 96.0"H => 50.27 sf x 20.00'L = 1,005.3 cf

Overall Size= 96.0"W x 96.0"H x 20.00'L

Row Length Adjustment= -0.60' x 50.27 sf x 7 rows

96.0" Wide + 36.0" Spacing = 132.0" C-C Row Spacing

17 Chambers/Row x 20.00' Long -0.60' Row Adjustment +8.00' Header x 1 = 347.40' Row Length

7 Rows x 96.0" Wide + 36.0" Spacing x 6 = 74.00' Base Width

96.0" Chamber Height + 6.0" Stone Cover = 8.50' Field Height

119 Chambers x 1,005.3 cf -0.60' Row Adjustment x 50.27 sf x 7 Rows + 74.00' Header x 50.27 sf =
123,140.4 cf Chamber Storage

218,514.6 cf Field - 123,140.4 cf Chambers = 95,374.2 cf Stone x 0.0% Voids = 0.0 cf Stone Storage

Chamber Storage = 123,140.4 cf = 2.827 af

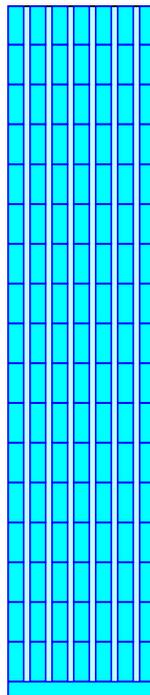
Overall Storage Efficiency = 56.4%

Overall System Size = 347.40' x 74.00' x 8.50'

119 Chambers

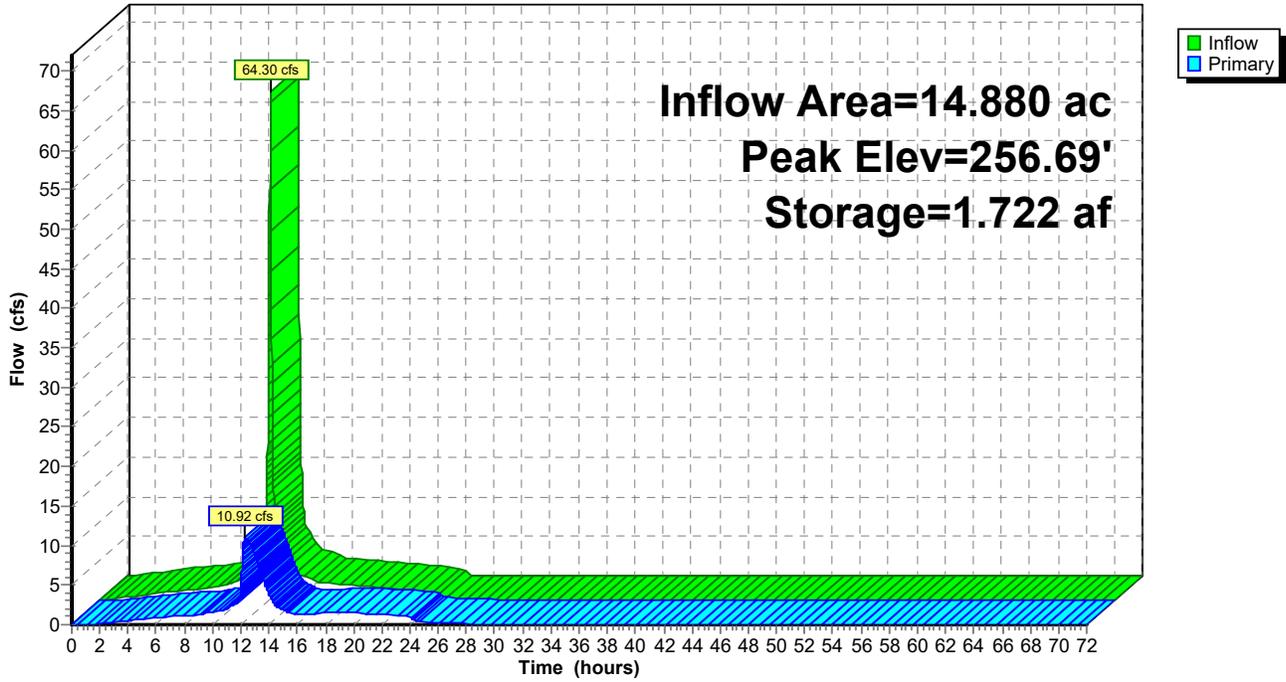
8,093.1 cy Field

3,532.4 cy Stone



Pond 1P: SUBSURFACE DETENTION

Hydrograph



Summary for Pond 2P: DMH 24-5

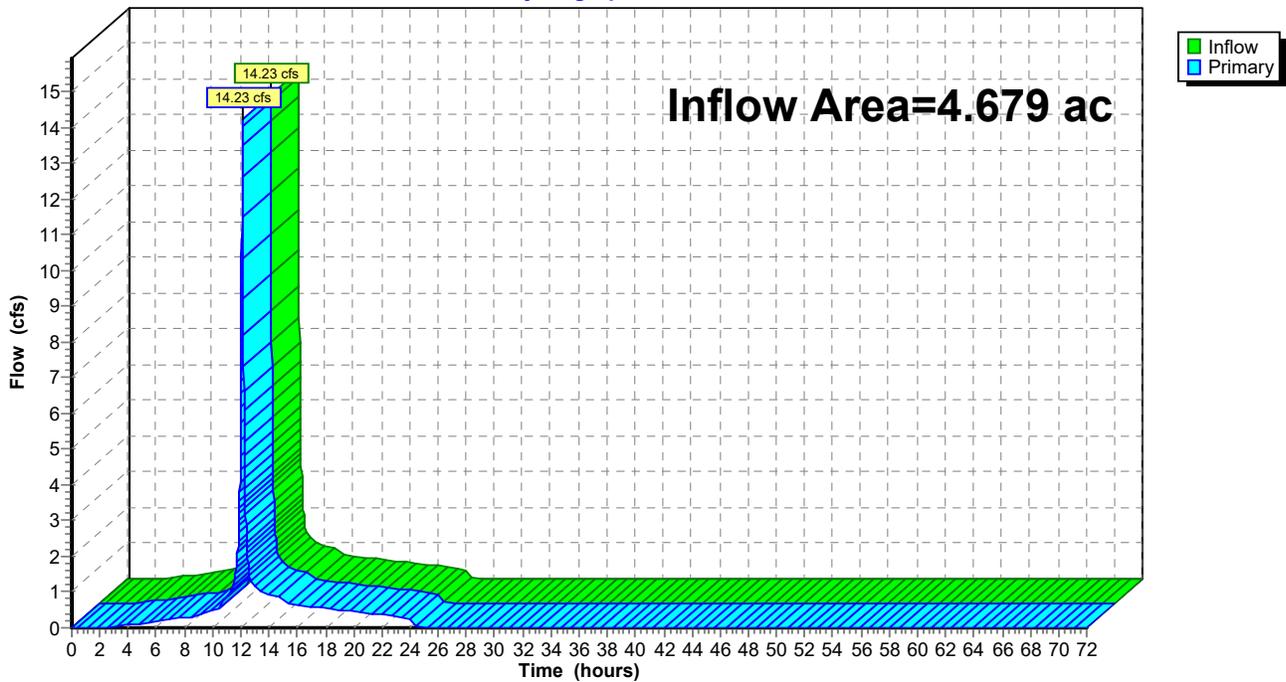
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.679 ac, 76.58% Impervious, Inflow Depth = 3.02" for 10-yr event
Inflow = 14.23 cfs @ 12.13 hrs, Volume= 1.177 af
Primary = 14.23 cfs @ 12.13 hrs, Volume= 1.177 af, Atten= 0%, Lag= 0.0 min
Routed to Pond 1P : SUBSURFACE DETENTION

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 2P: DMH 24-5

Hydrograph



Summary for Pond 3P: DMH 24-15

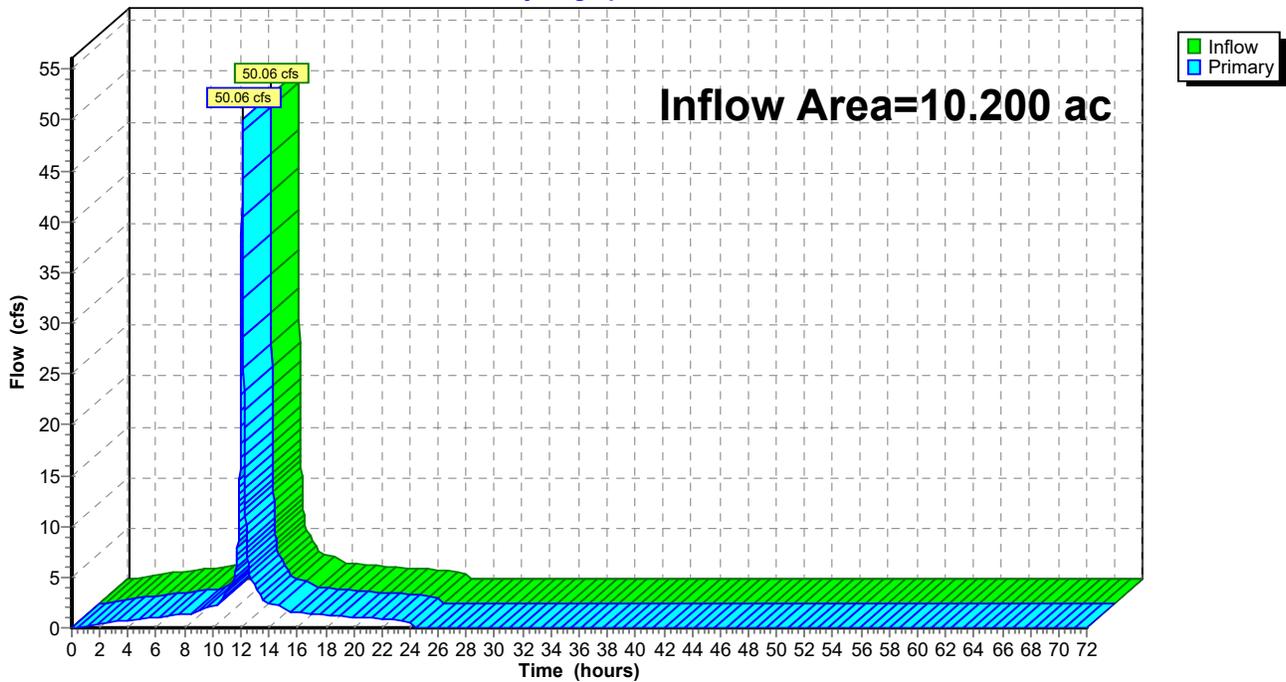
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 10.200 ac, 94.38% Impervious, Inflow Depth = 4.64" for 10-yr event
Inflow = 50.06 cfs @ 12.13 hrs, Volume= 3.946 af
Primary = 50.06 cfs @ 12.13 hrs, Volume= 3.946 af, Atten= 0%, Lag= 0.0 min
Routed to Pond 1P : SUBSURFACE DETENTION

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 3P: DMH 24-15

Hydrograph



Summary for Pond 4P: EX. BASIN #1

Inflow Area = 1.747 ac, 58.18% Impervious, Inflow Depth = 2.53" for 10-yr event
 Inflow = 5.46 cfs @ 12.13 hrs, Volume= 0.368 af
 Outflow = 0.29 cfs @ 14.16 hrs, Volume= 0.159 af, Atten= 95%, Lag= 121.7 min
 Primary = 0.29 cfs @ 14.16 hrs, Volume= 0.159 af
 Routed to Pond 2P : DMH 24-5

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 275.03' @ 14.16 hrs Surf.Area= 8,764 sf Storage= 9,437 cf

Plug-Flow detention time= 384.7 min calculated for 0.159 af (43% of inflow)
 Center-of-Mass det. time= 218.0 min (1,078.3 - 860.3)

Volume	Invert	Avail.Storage	Storage Description
#1	273.40'	31,754 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
273.40	1,731	0	0
274.00	5,352	2,125	2,125
275.00	8,670	7,011	9,136
276.00	11,387	10,029	19,164
277.00	13,793	12,590	31,754

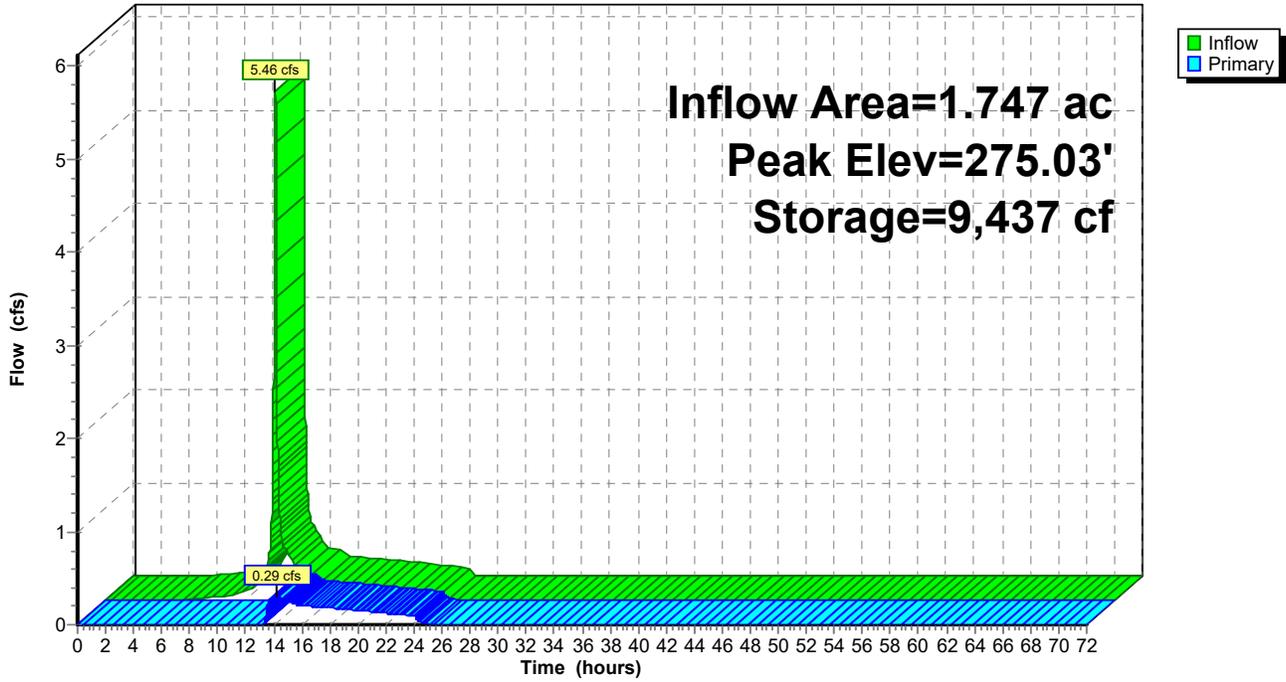
Device	Routing	Invert	Outlet Devices
#1	Primary	272.50'	12.0" Round Culvert L= 75.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 272.50' / 271.90' S= 0.0079 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	275.00'	34.0" x 50.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.29 cfs @ 14.16 hrs HW=275.03' TW=0.00' (Dynamic Tailwater)

- ↑1=Culvert (Passes 0.29 cfs of 4.67 cfs potential flow)
- ↑2=Orifice/Grate (Weir Controls 0.29 cfs @ 0.61 fps)

Pond 4P: EX. BASIN #1

Hydrograph



Summary for Pond 5P: EX. BASIN #2

Inflow Area = 15.896 ac, 87.23% Impervious, Inflow Depth = 2.90" for 10-yr event
 Inflow = 12.68 cfs @ 12.16 hrs, Volume= 3.840 af
 Outflow = 1.49 cfs @ 21.05 hrs, Volume= 1.036 af, Atten= 88%, Lag= 533.5 min
 Primary = 1.49 cfs @ 21.05 hrs, Volume= 1.036 af
 Routed to Pond AP-1 : Southern Wetlands
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond AP-1 : Southern Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 256.48' @ 21.05 hrs Surf.Area= 34,103 sf Storage= 131,403 cf

Plug-Flow detention time= 861.6 min calculated for 1.036 af (27% of inflow)
 Center-of-Mass det. time= 539.1 min (1,392.4 - 853.3)

Volume	Invert	Avail.Storage	Storage Description
#1	252.00'	222,384 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
252.00	2,679	0	0
252.50	27,225	7,476	7,476
253.00	29,112	14,084	21,560
254.00	30,548	29,830	51,390
255.00	31,966	31,257	82,647
256.00	33,393	32,680	115,327
257.00	34,883	34,138	149,465
258.00	36,434	35,659	185,123
259.00	38,088	37,261	222,384

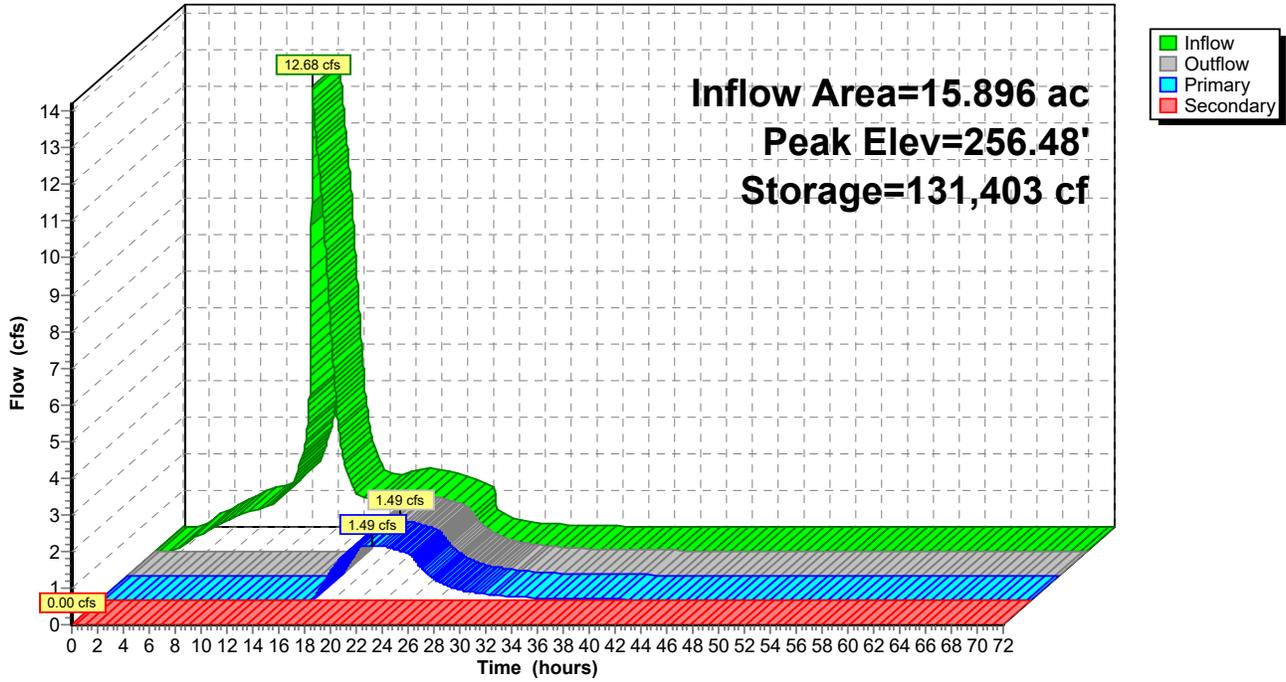
Device	Routing	Invert	Outlet Devices
#1	Secondary	257.70'	9.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	254.96'	12.0" Round Culvert L= 28.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 254.96' / 254.86' S= 0.0035 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#3	Device 2	256.20'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.49 cfs @ 21.05 hrs HW=256.48' TW=0.00' (Dynamic Tailwater)
 ↑ **2=Culvert** (Passes 1.49 cfs of 3.19 cfs potential flow)
 ↑ **3=Orifice/Grate** (Weir Controls 1.49 cfs @ 1.72 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=252.00' TW=0.00' (Dynamic Tailwater)
 ↑ **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: EX. BASIN #2

Hydrograph



Summary for Pond AP-1: Southern Wetlands

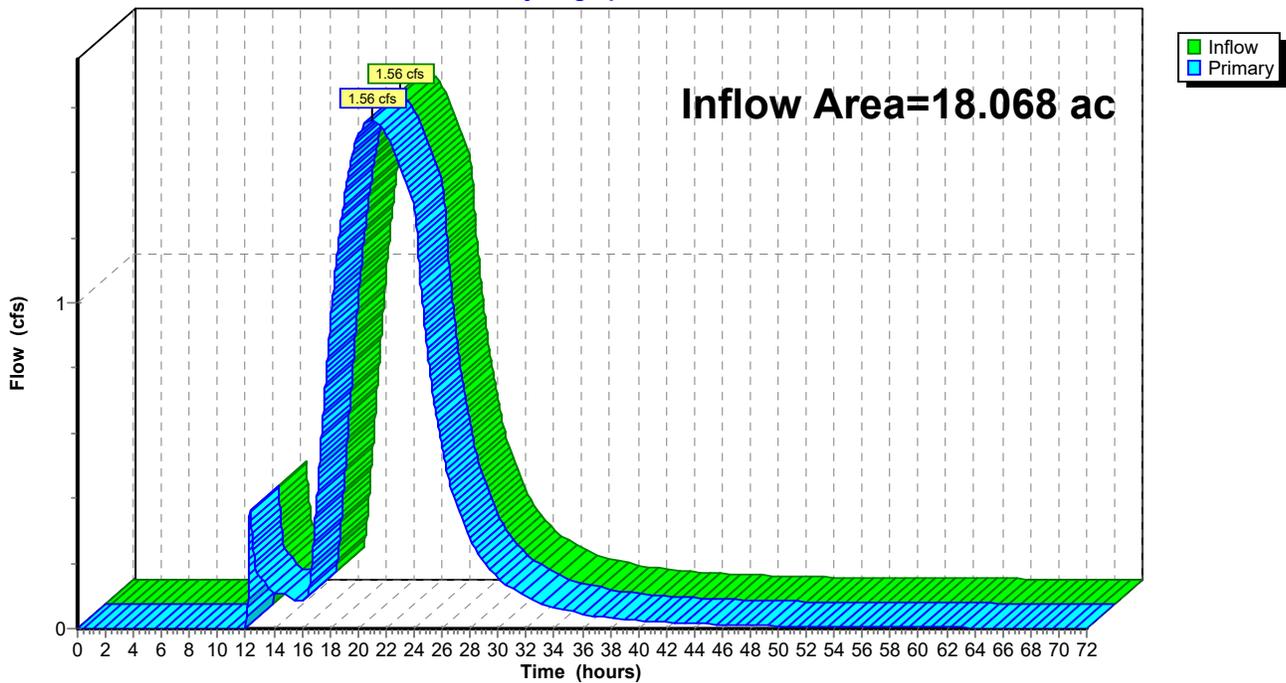
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 18.068 ac, 76.75% Impervious, Inflow Depth > 0.75" for 10-yr event
Inflow = 1.56 cfs @ 20.99 hrs, Volume= 1.127 af
Primary = 1.56 cfs @ 20.99 hrs, Volume= 1.127 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: Southern Wetlands

Hydrograph



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-1: Subcat PR-1	Runoff Area=0.120 ac 0.00% Impervious Runoff Depth=0.56" Tc=6.0 min CN=39 Runoff=0.03 cfs 0.006 af
SubcatchmentPR-10: Subcat PR-10	Runoff Area=0.334 ac 69.45% Impervious Runoff Depth=4.13" Tc=6.0 min CN=80 Runoff=1.70 cfs 0.115 af
SubcatchmentPR-2: Subcat PR-2	Runoff Area=1.147 ac 48.82% Impervious Runoff Depth=2.92" Tc=6.0 min CN=68 Runoff=4.20 cfs 0.279 af
SubcatchmentPR-3: Subcat PR-3	Runoff Area=2.598 ac 89.87% Impervious Runoff Depth=5.45" Tc=6.0 min CN=92 Runoff=16.16 cfs 1.181 af
SubcatchmentPR-4: Subcat PR-4	Runoff Area=1.288 ac 88.94% Impervious Runoff Depth=5.34" Tc=6.0 min CN=91 Runoff=7.92 cfs 0.573 af
SubcatchmentPR-5: Subcat PR-5	Runoff Area=2.051 ac 0.00% Impervious Runoff Depth=0.96" Flow Length=378' Tc=15.5 min CN=45 Runoff=1.14 cfs 0.165 af
SubcatchmentPR-6: Subcat PR-6	Runoff Area=1.016 ac 64.57% Impervious Runoff Depth=3.62" Tc=6.0 min CN=75 Runoff=4.59 cfs 0.306 af
SubcatchmentPR-7: Subcat PR-7	Runoff Area=8.137 ac 100.00% Impervious Runoff Depth=6.15" Tc=6.0 min CN=98 Runoff=52.93 cfs 4.171 af
SubcatchmentPR-8: Subcat PR-8	Runoff Area=26,155 sf 76.06% Impervious Runoff Depth=4.56" Tc=6.0 min CN=84 Runoff=3.31 cfs 0.228 af
SubcatchmentPR-9: Subcat PR-9	Runoff Area=0.775 ac 44.36% Impervious Runoff Depth=2.64" Tc=0.0 min CN=65 Runoff=3.07 cfs 0.170 af
Pond 1P: SUBSURFACE DETENTION	Peak Elev=257.83' Storage=2.209 af Inflow=79.55 cfs 6.509 af Outflow=13.07 cfs 5.004 af
Pond 2P: DMH 24-5	Inflow=17.86 cfs 1.594 af Primary=17.86 cfs 1.594 af
Pond 3P: DMH 24-15	Inflow=61.68 cfs 4.915 af Primary=61.68 cfs 4.915 af
Pond 4P: EX. BASIN #1	Peak Elev=275.09' Storage=9,944 cf Inflow=7.51 cfs 0.508 af Outflow=1.28 cfs 0.298 af
Pond 5P: EX. BASIN #2	Peak Elev=256.74' Storage=140,556 cf Inflow=15.76 cfs 5.310 af Primary=2.79 cfs 2.506 af Secondary=0.00 cfs 0.000 af Outflow=2.79 cfs 2.506 af
Pond AP-1: Southern Wetlands	Inflow=2.93 cfs 2.677 af Primary=2.93 cfs 2.677 af

F4593 Post-Development 10-22

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NOAA10 24-hr D 25-yr Rainfall=6.39"

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Total Runoff Area = 18.068 ac Runoff Volume = 7.195 af Average Runoff Depth = 4.78"
23.25% Pervious = 4.201 ac 76.75% Impervious = 13.866 ac

Summary for Subcatchment PR-1: Subcat PR-1

Runoff = 0.03 cfs @ 12.16 hrs, Volume= 0.006 af, Depth= 0.56"
 Routed to Pond AP-1 : Southern Wetlands

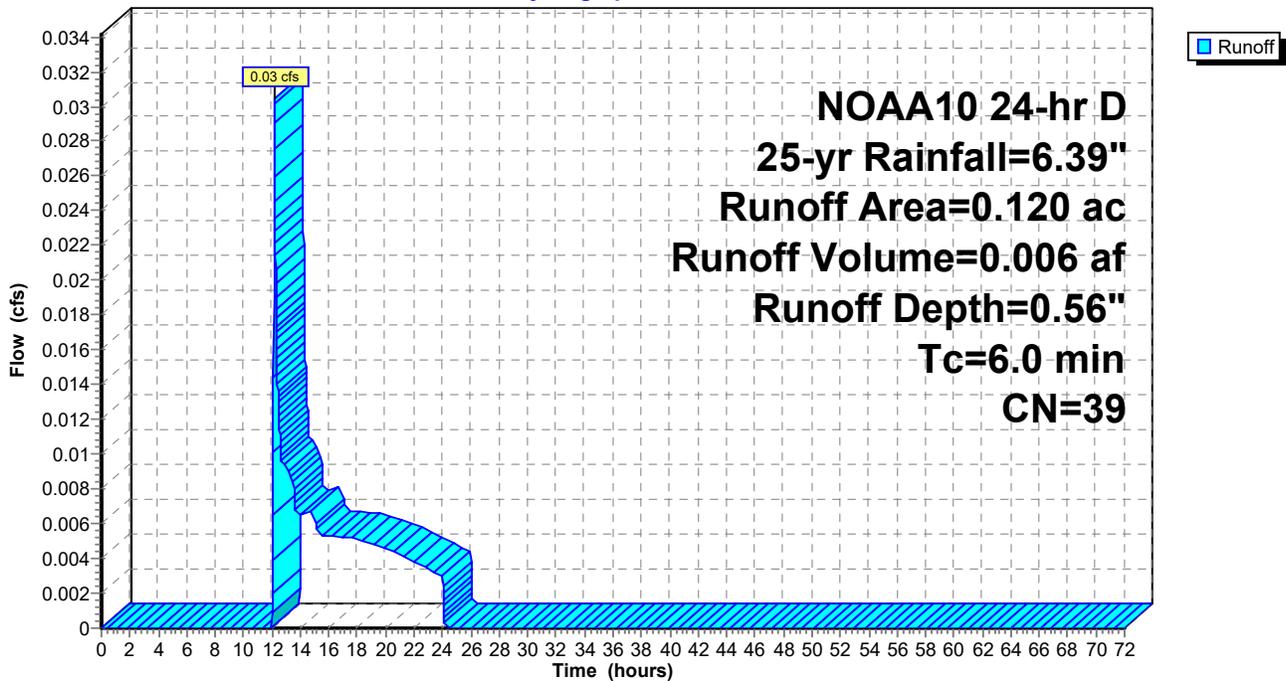
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.120	39	>75% Grass cover, Good, HSG A
0.120		100.00% Pervious Area

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

Subcatchment PR-1: Subcat PR-1

Hydrograph



Summary for Subcatchment PR-10: Subcat PR-10

Runoff = 1.70 cfs @ 12.13 hrs, Volume= 0.115 af, Depth= 4.13"
 Routed to Pond 2P : DMH 24-5

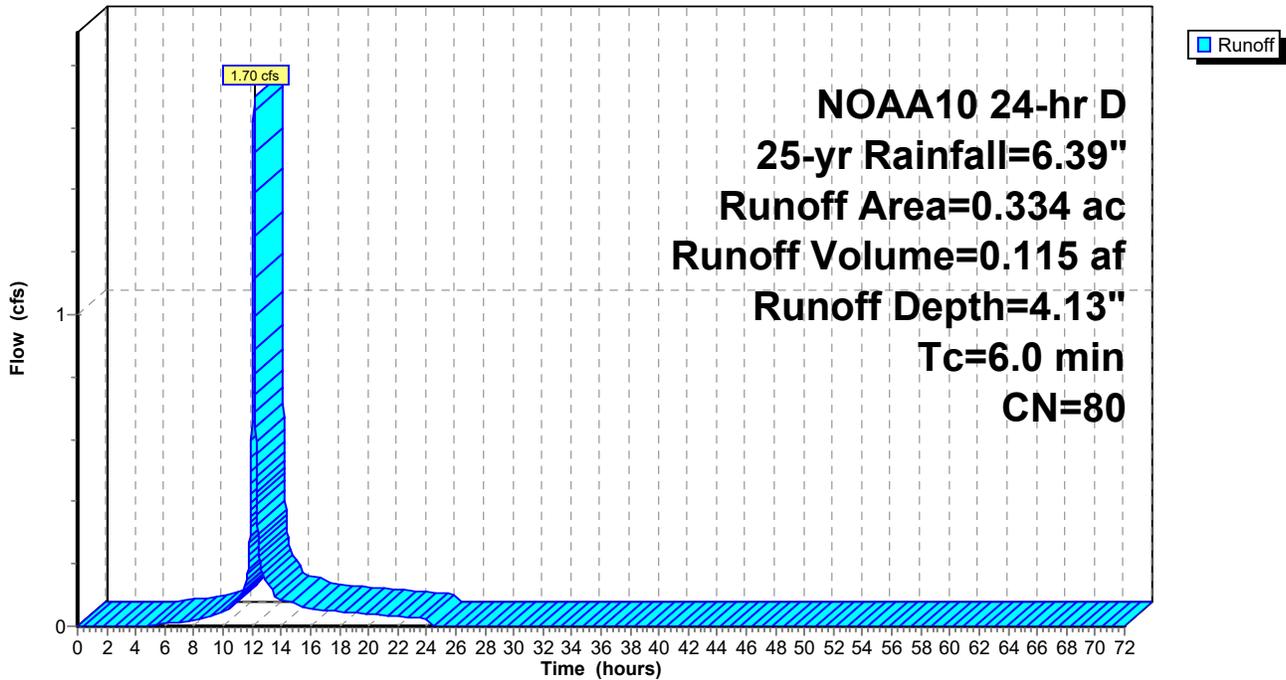
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.102	39	>75% Grass cover, Good, HSG A
0.228	98	Paved parking, HSG A
0.004	98	Unconnected pavement, HSG A
0.334	80	Weighted Average
0.102		30.55% Pervious Area
0.232		69.45% Impervious Area
0.004		1.57% Unconnected

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

Subcatchment PR-10: Subcat PR-10

Hydrograph



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Summary for Subcatchment PR-2: Subcat PR-2

Runoff = 4.20 cfs @ 12.13 hrs, Volume= 0.279 af, Depth= 2.92"
 Routed to Pond 4P : EX. BASIN #1

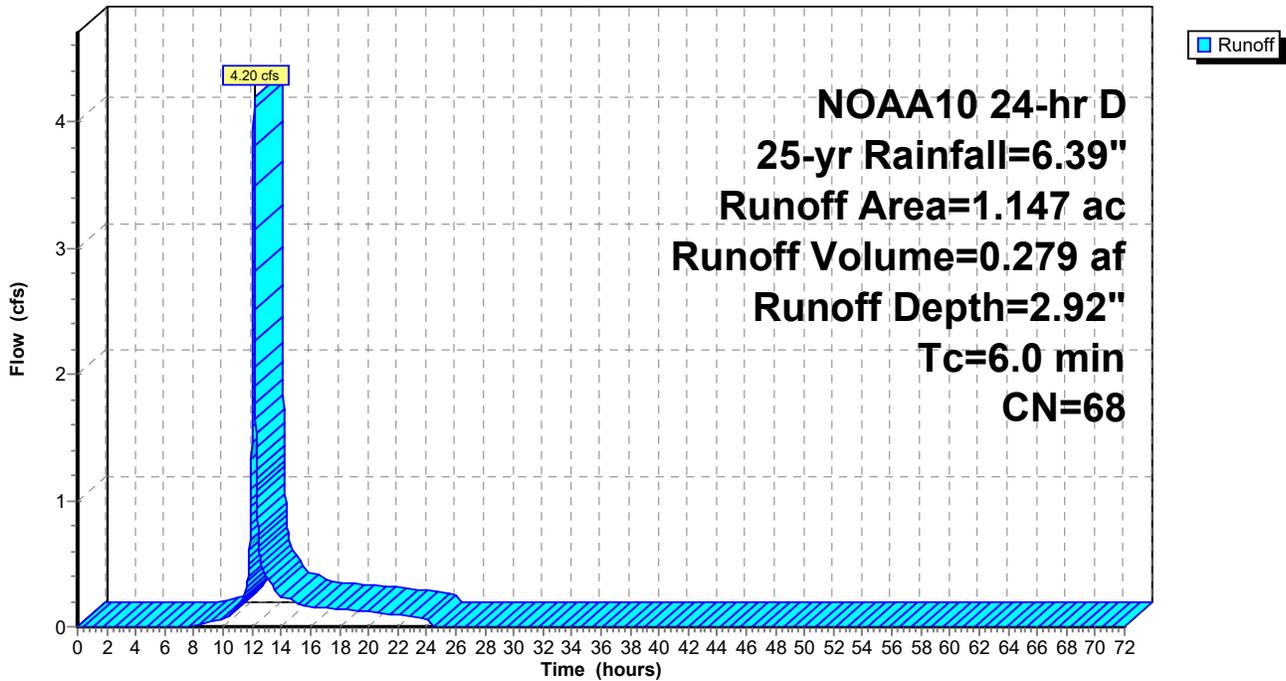
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.587	39	>75% Grass cover, Good, HSG A
0.289	98	Paved parking, HSG A
0.009	98	Unconnected pavement, HSG A
0.261	98	Water Surface, HSG A
1.147	68	Weighted Average
0.587		51.18% Pervious Area
0.560		48.82% Impervious Area
0.009		1.68% Unconnected

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

Subcatchment PR-2: Subcat PR-2

Hydrograph



Summary for Subcatchment PR-3: Subcat PR-3

Runoff = 16.16 cfs @ 12.13 hrs, Volume= 1.181 af, Depth= 5.45"
 Routed to Pond 2P : DMH 24-5

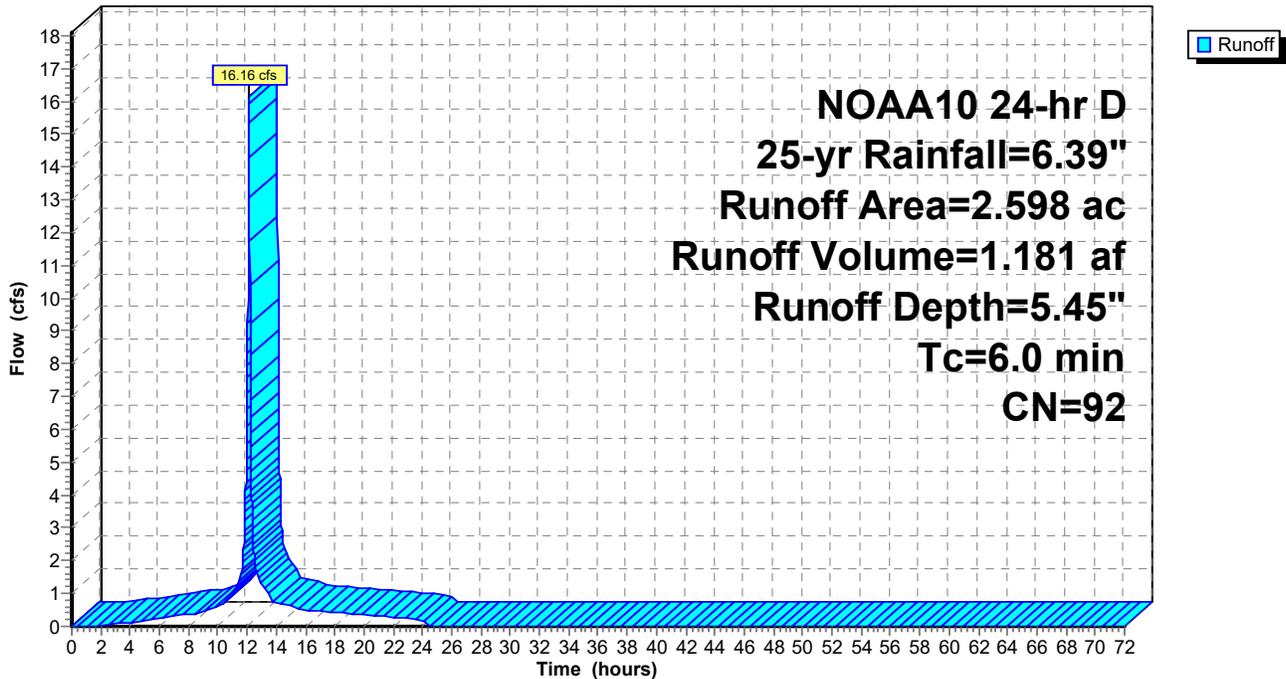
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.234	39	>75% Grass cover, Good, HSG A
0.030	80	>75% Grass cover, Good, HSG D
2.159	98	Paved parking, HSG A
0.102	98	Paved parking, HSG D
0.061	98	Unconnected pavement, HSG A
0.013	98	Unconnected pavement, HSG D
2.598	92	Weighted Average
0.263		10.13% Pervious Area
2.335		89.87% Impervious Area
0.074		3.16% Unconnected

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

Subcatchment PR-3: Subcat PR-3

Hydrograph



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Summary for Subcatchment PR-4: Subcat PR-4

Runoff = 7.92 cfs @ 12.13 hrs, Volume= 0.573 af, Depth= 5.34"
 Routed to Pond 3P : DMH 24-15

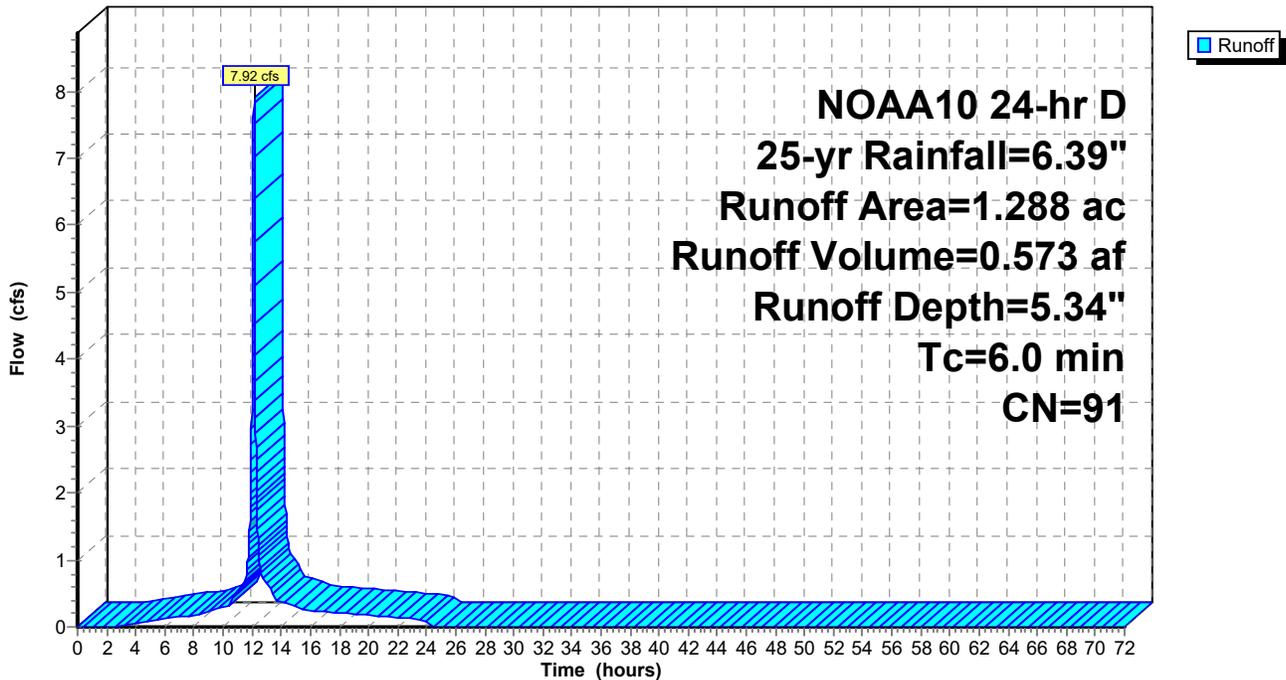
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.142	39	>75% Grass cover, Good, HSG A
1.146	98	Paved parking, HSG A
1.288	91	Weighted Average
0.142		11.06% Pervious Area
1.146		88.94% Impervious Area

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

Subcatchment PR-4: Subcat PR-4

Hydrograph



Summary for Subcatchment PR-5: Subcat PR-5

Runoff = 1.14 cfs @ 12.28 hrs, Volume= 0.165 af, Depth= 0.96"
 Routed to Pond AP-1 : Southern Wetlands

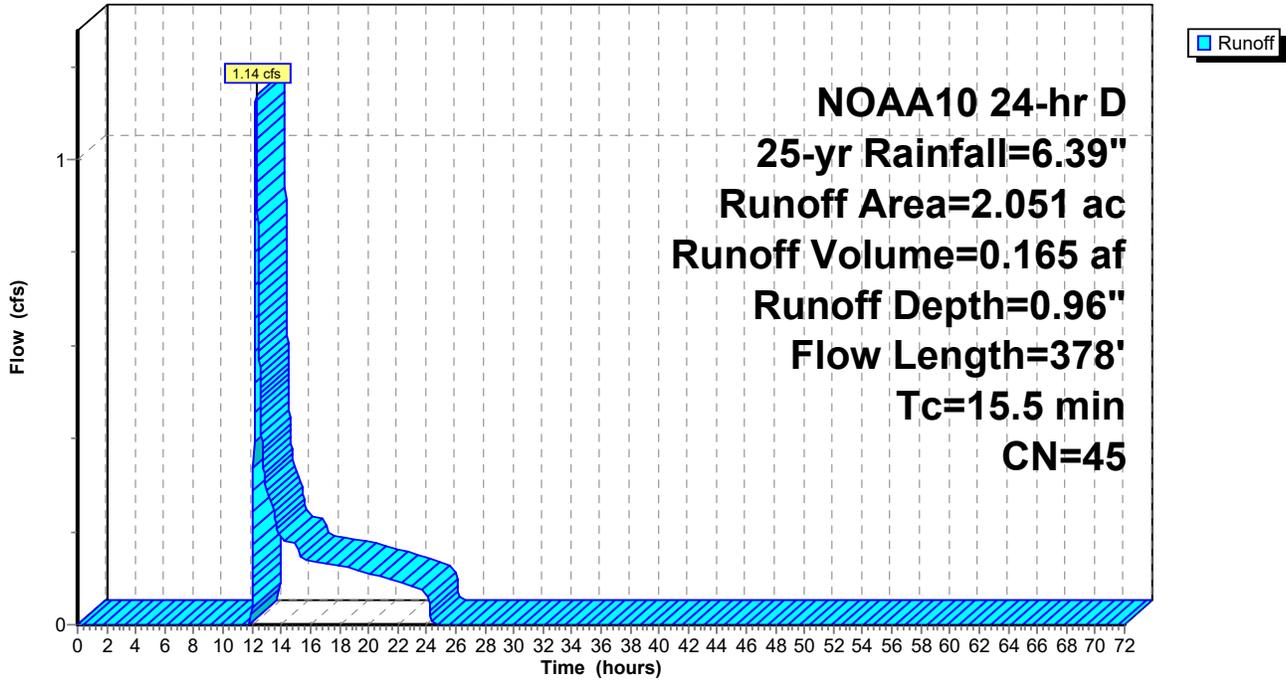
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.221	39	>75% Grass cover, Good, HSG A
0.022	80	>75% Grass cover, Good, HSG D
1.227	30	Woods, Good, HSG A
0.582	77	Woods, Good, HSG D
2.051	45	Weighted Average
2.051		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0190	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
0.8	67	0.0780	1.40		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.0	14	0.3300	8.62		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.5	148	0.0125	1.68		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
0.2	46	0.0550	3.52		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
0.7	53	0.0700	1.32		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
15.5	378	Total			

Subcatchment PR-5: Subcat PR-5

Hydrograph



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NOAA10 24-hr D 25-yr Rainfall=6.39"

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Summary for Subcatchment PR-6: Subcat PR-6

Runoff = 4.59 cfs @ 12.13 hrs, Volume= 0.306 af, Depth= 3.62"
 Routed to Pond 5P : EX. BASIN #2

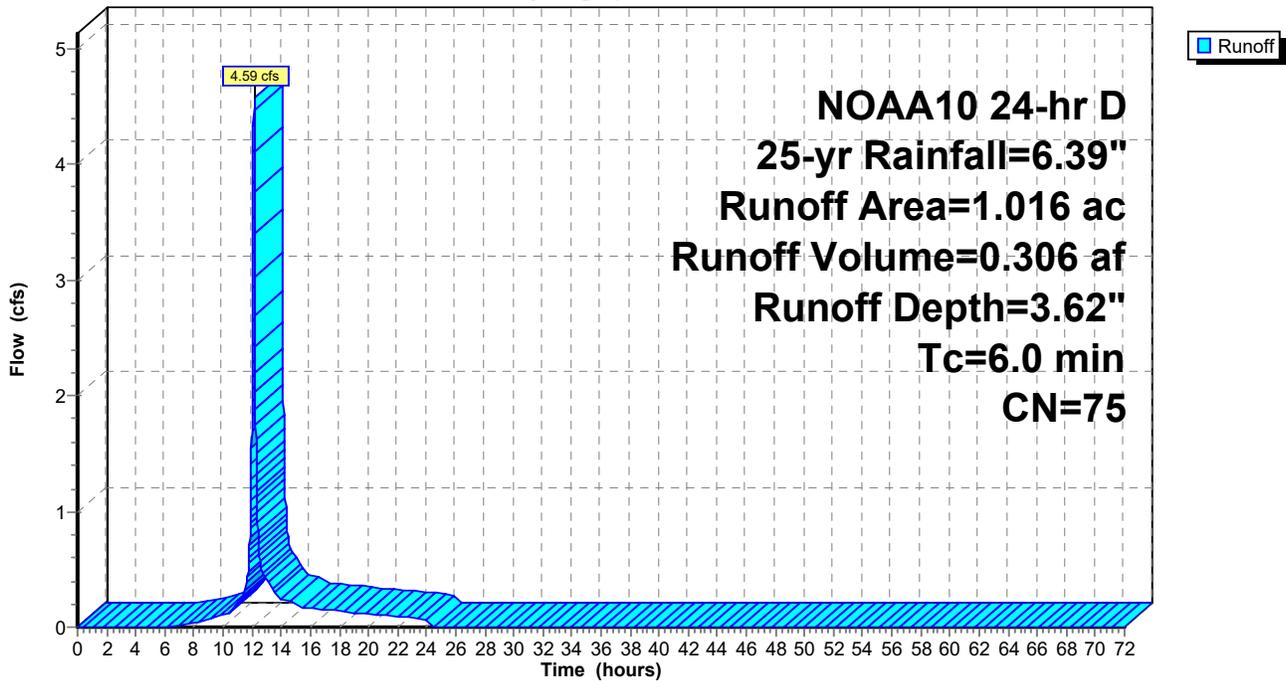
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.125	39	>75% Grass cover, Good, HSG A
0.656	98	Water Surface, HSG A
0.235	30	Woods, Good, HSG A
1.016	75	Weighted Average
0.360		35.43% Pervious Area
0.656		64.57% Impervious Area

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

Subcatchment PR-6: Subcat PR-6

Hydrograph



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NOAA10 24-hr D 25-yr Rainfall=6.39"

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Summary for Subcatchment PR-7: Subcat PR-7

Runoff = 52.93 cfs @ 12.13 hrs, Volume= 4.171 af, Depth= 6.15"
Routed to Pond 3P : DMH 24-15

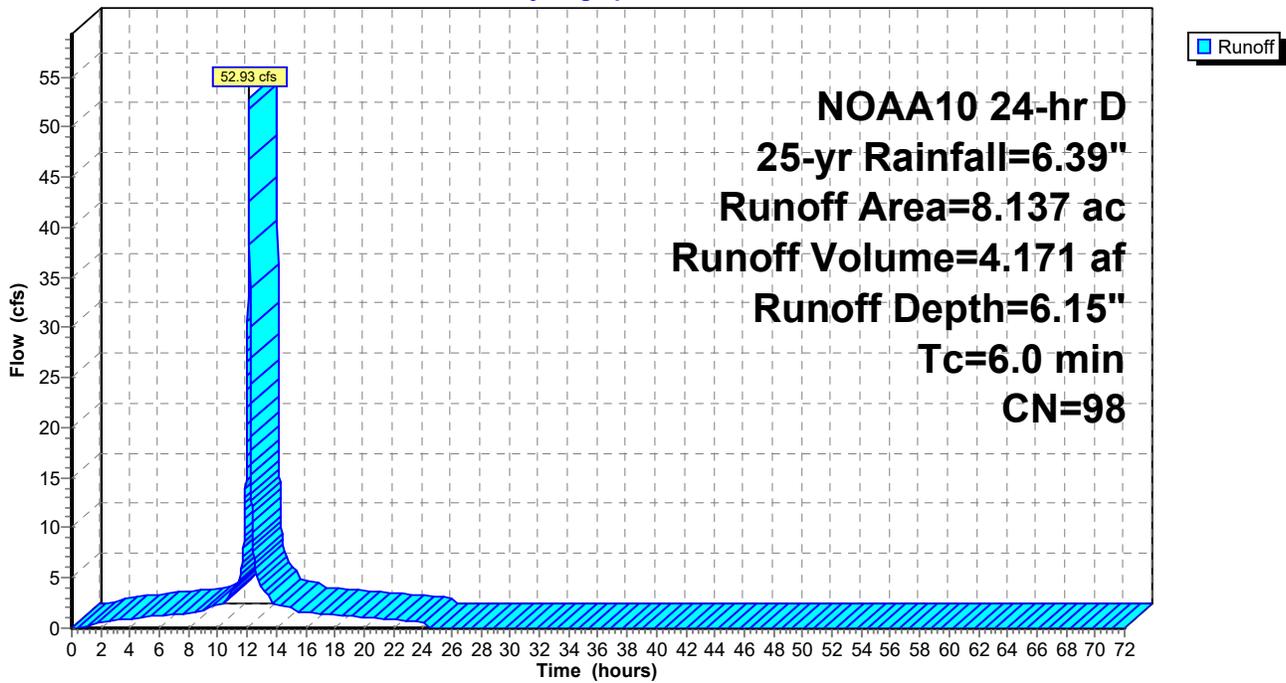
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
8.137	98	Roofs, HSG A
8.137		100.00% Impervious Area

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

Subcatchment PR-7: Subcat PR-7

Hydrograph



Summary for Subcatchment PR-8: Subcat PR-8

Runoff = 3.31 cfs @ 12.13 hrs, Volume= 0.228 af, Depth= 4.56"
 Routed to Pond 4P : EX. BASIN #1

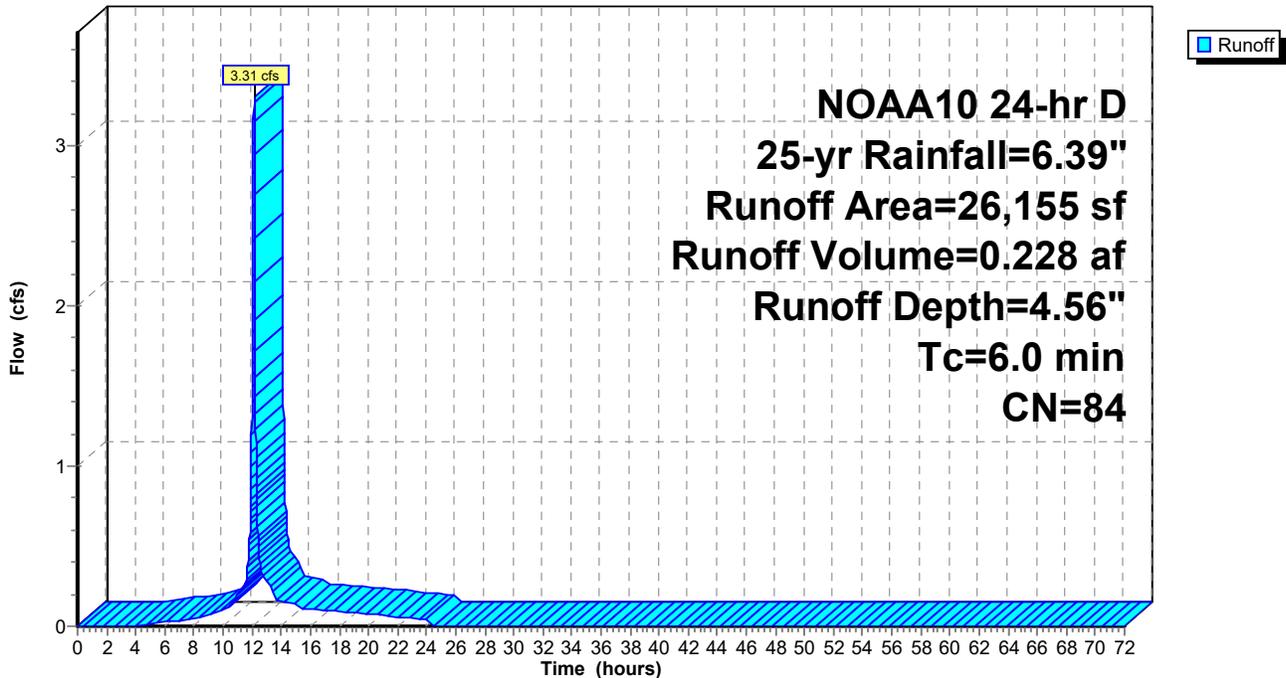
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (sf)	CN	Description
6,261	39	>75% Grass cover, Good, HSG A
19,408	98	Paved parking, HSG A
486	98	Unconnected pavement, HSG A
26,155	84	Weighted Average
6,261		23.94% Pervious Area
19,894		76.06% Impervious Area
486		2.44% Unconnected

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

Subcatchment PR-8: Subcat PR-8

Hydrograph



Summary for Subcatchment PR-9: Subcat PR-9

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

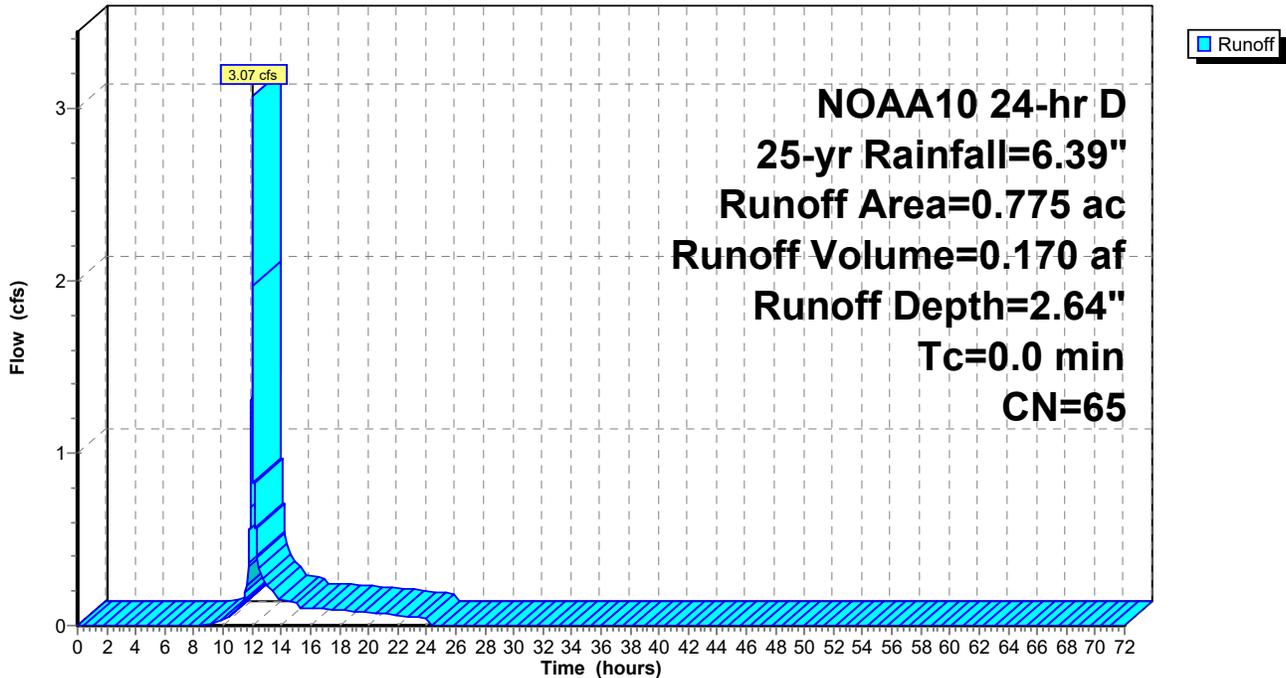
Runoff = 3.07 cfs @ 12.09 hrs, Volume= 0.170 af, Depth= 2.64"
 Routed to Pond 3P : DMH 24-15

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 25-yr Rainfall=6.39"

Area (ac)	CN	Description
0.431	39	>75% Grass cover, Good, HSG A
0.343	98	Paved parking, HSG A
0.001	98	Unconnected pavement, HSG A
0.775	65	Weighted Average
0.431		55.64% Pervious Area
0.344		44.36% Impervious Area
0.001		0.15% Unconnected

Subcatchment PR-9: Subcat PR-9

Hydrograph



Summary for Pond 1P: SUBSURFACE DETENTION

NOTE: A -0.6' ROW LENGTH ADJUSTMENT HAS BEEN APPLIED TO ACCOUNT FOR A 4' LONG INTERNAL MANHOLE IN THE FINAL ROW, WHICH SERVES AS AN OUTLET CONTROL STRUCTURE. THIS ROW ADJUSTMENT SPREADS THE LOSS IN STORAGE ACROSS ALL 7 ROWS TO MAINTAIN AN ACCURATE TOTAL STORAGE VOLUME FOR THE SYSTEM.

Inflow Area = 14.880 ac, 88.78% Impervious, Inflow Depth = 5.25" for 25-yr event
 Inflow = 79.55 cfs @ 12.13 hrs, Volume= 6.509 af
 Outflow = 13.07 cfs @ 12.36 hrs, Volume= 5.004 af, Atten= 84%, Lag= 14.0 min
 Primary = 13.07 cfs @ 12.36 hrs, Volume= 5.004 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 257.83' @ 12.44 hrs Surf.Area= 0.590 ac Storage= 2.209 af

Plug-Flow detention time= 204.8 min calculated for 5.003 af (77% of inflow)
 Center-of-Mass det. time= 96.2 min (869.1 - 772.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	252.00'	0.000 af	74.00'W x 347.40'L x 8.50'H Field A 5.016 af Overall - 2.827 af Embedded = 2.189 af x 0.0% Voids
#2A	252.00'	2.827 af	CMP Round 96 x 119 Inside #1 Effective Size= 96.0"W x 96.0"H => 50.27 sf x 20.00'L = 1,005.3 cf Overall Size= 96.0"W x 96.0"H x 20.00'L Row Length Adjustment= -0.60' x 50.27 sf x 7 rows 74.00' Header x 50.27 sf x 1 = 3,719.6 cf Inside
		2.827 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 4	252.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Device 4	254.50'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Device 4	258.50'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Head (feet) 6.50 6.56 6.64 6.72 6.80 6.88 6.96 7.04 7.12 7.20 7.28 7.36 7.44 7.52 7.60 7.68 7.76 7.84 7.92 8.00 Width (feet) 6.25 6.15 6.01 5.87 5.71 5.55 5.38 5.20 5.01 4.80 4.58 4.34 4.08 3.80 3.49 3.14 2.73 2.24 1.59 0.00
#4	Primary	251.90'	36.0" Round Culvert L= 28.6' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 251.90' / 251.50' S= 0.0140 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 7.07 sf

Primary OutFlow Max=13.05 cfs @ 12.36 hrs HW=257.81' TW=254.66' (Dynamic Tailwater)

- ↑ 4=Culvert (Passes 13.05 cfs of 60.39 cfs potential flow)
- ↑ 1=Orifice/Grate (Orifice Controls 6.71 cfs @ 8.54 fps)
- ↑ 2=Orifice/Grate (Orifice Controls 6.34 cfs @ 8.07 fps)
- ↑ 3=Custom Weir/Orifice (Controls 0.00 cfs)

Pond 1P: SUBSURFACE DETENTION - Chamber Wizard Field A

Chamber Model = CMP Round 96 (Round Corrugated Metal Pipe)

Effective Size= 96.0"W x 96.0"H => 50.27 sf x 20.00'L = 1,005.3 cf

Overall Size= 96.0"W x 96.0"H x 20.00'L

Row Length Adjustment= -0.60' x 50.27 sf x 7 rows

96.0" Wide + 36.0" Spacing = 132.0" C-C Row Spacing

17 Chambers/Row x 20.00' Long -0.60' Row Adjustment +8.00' Header x 1 = 347.40' Row Length

7 Rows x 96.0" Wide + 36.0" Spacing x 6 = 74.00' Base Width

96.0" Chamber Height + 6.0" Stone Cover = 8.50' Field Height

119 Chambers x 1,005.3 cf -0.60' Row Adjustment x 50.27 sf x 7 Rows + 74.00' Header x 50.27 sf =
123,140.4 cf Chamber Storage

218,514.6 cf Field - 123,140.4 cf Chambers = 95,374.2 cf Stone x 0.0% Voids = 0.0 cf Stone Storage

Chamber Storage = 123,140.4 cf = 2.827 af

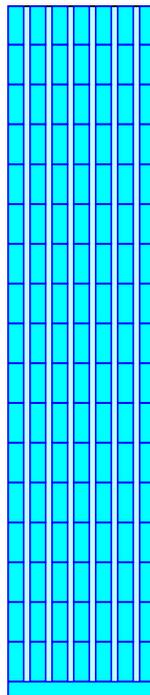
Overall Storage Efficiency = 56.4%

Overall System Size = 347.40' x 74.00' x 8.50'

119 Chambers

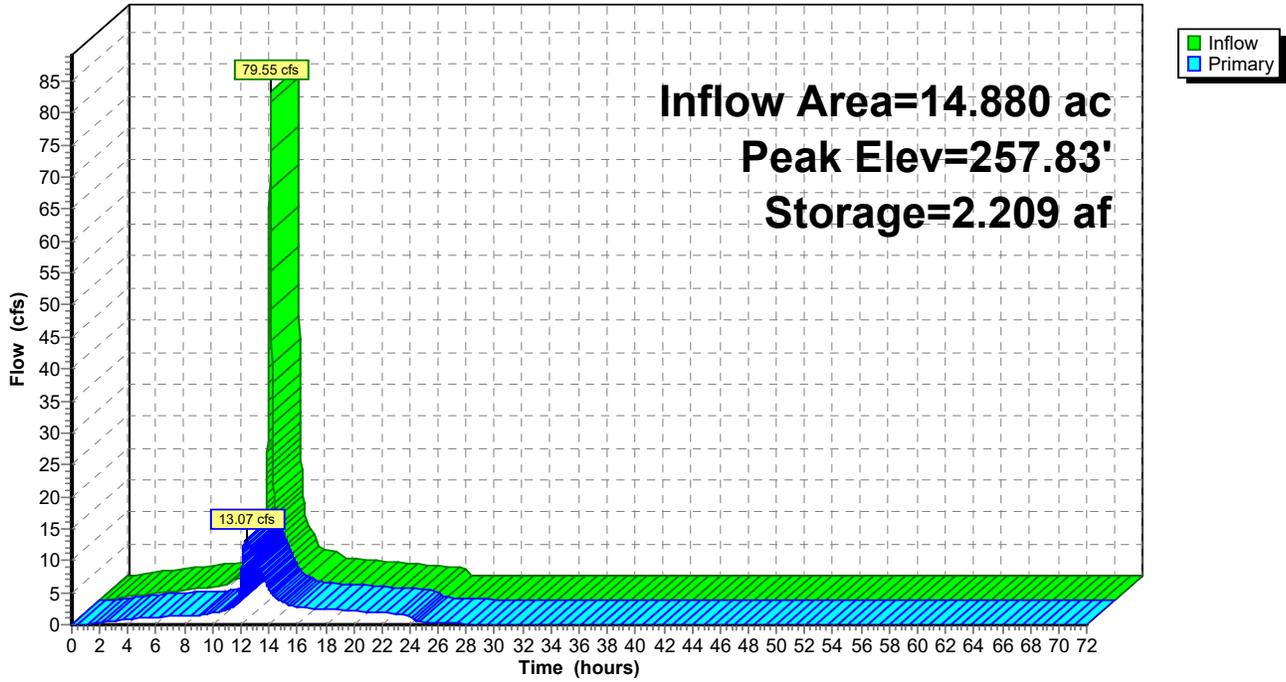
8,093.1 cy Field

3,532.4 cy Stone



Pond 1P: SUBSURFACE DETENTION

Hydrograph



Summary for Pond 2P: DMH 24-5

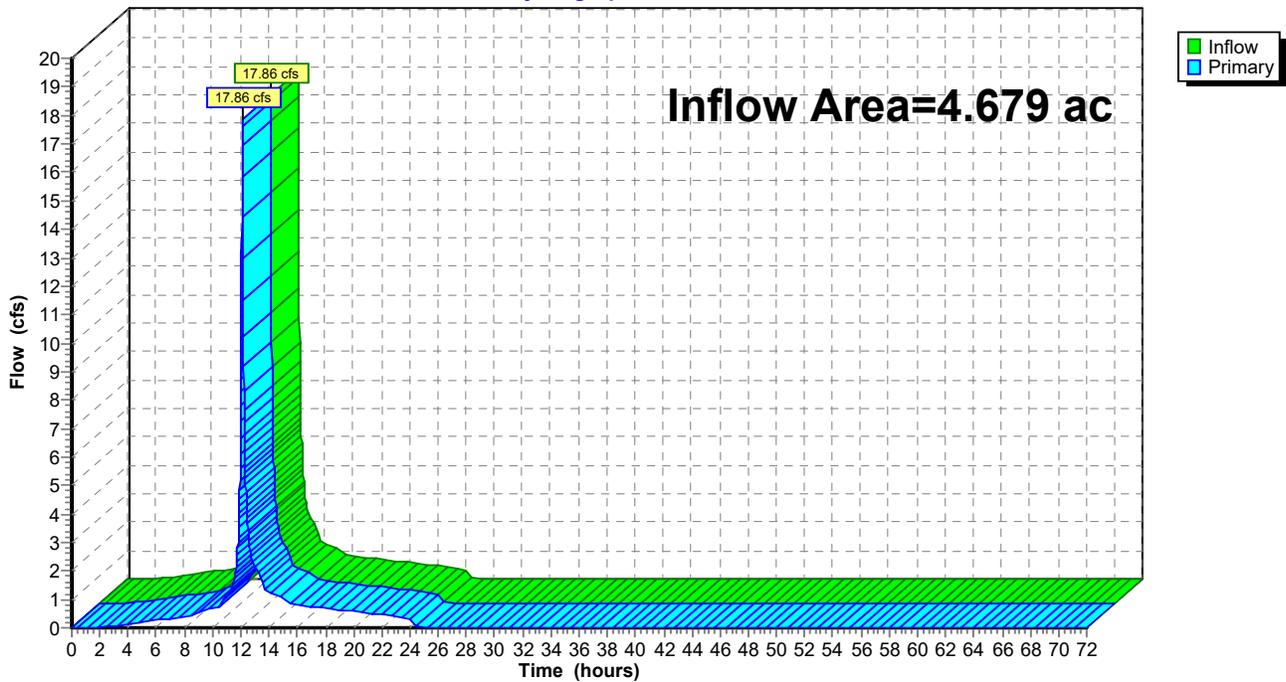
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.679 ac, 76.58% Impervious, Inflow Depth = 4.09" for 25-yr event
Inflow = 17.86 cfs @ 12.13 hrs, Volume= 1.594 af
Primary = 17.86 cfs @ 12.13 hrs, Volume= 1.594 af, Atten= 0%, Lag= 0.0 min
Routed to Pond 1P : SUBSURFACE DETENTION

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 2P: DMH 24-5

Hydrograph



Summary for Pond 3P: DMH 24-15

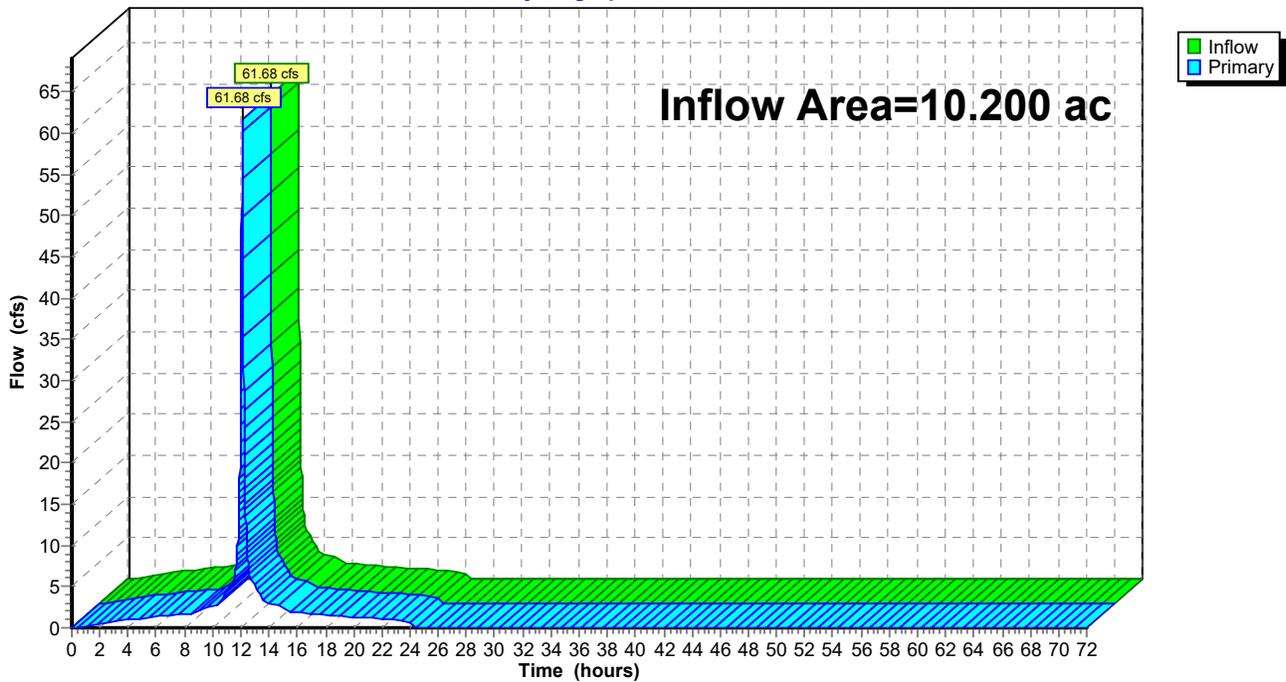
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 10.200 ac, 94.38% Impervious, Inflow Depth = 5.78" for 25-yr event
Inflow = 61.68 cfs @ 12.13 hrs, Volume= 4.915 af
Primary = 61.68 cfs @ 12.13 hrs, Volume= 4.915 af, Atten= 0%, Lag= 0.0 min
Routed to Pond 1P : SUBSURFACE DETENTION

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 3P: DMH 24-15

Hydrograph



Summary for Pond 4P: EX. BASIN #1

Inflow Area = 1.747 ac, 58.18% Impervious, Inflow Depth = 3.49" for 25-yr event
 Inflow = 7.51 cfs @ 12.13 hrs, Volume= 0.508 af
 Outflow = 1.28 cfs @ 12.41 hrs, Volume= 0.298 af, Atten= 83%, Lag= 16.7 min
 Primary = 1.28 cfs @ 12.41 hrs, Volume= 0.298 af
 Routed to Pond 2P : DMH 24-5

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 275.09' @ 12.41 hrs Surf.Area= 8,920 sf Storage= 9,944 cf

Plug-Flow detention time= 278.8 min calculated for 0.298 af (59% of inflow)
 Center-of-Mass det. time= 134.3 min (983.1 - 848.8)

Volume	Invert	Avail.Storage	Storage Description
#1	273.40'	31,754 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
273.40	1,731	0	0
274.00	5,352	2,125	2,125
275.00	8,670	7,011	9,136
276.00	11,387	10,029	19,164
277.00	13,793	12,590	31,754

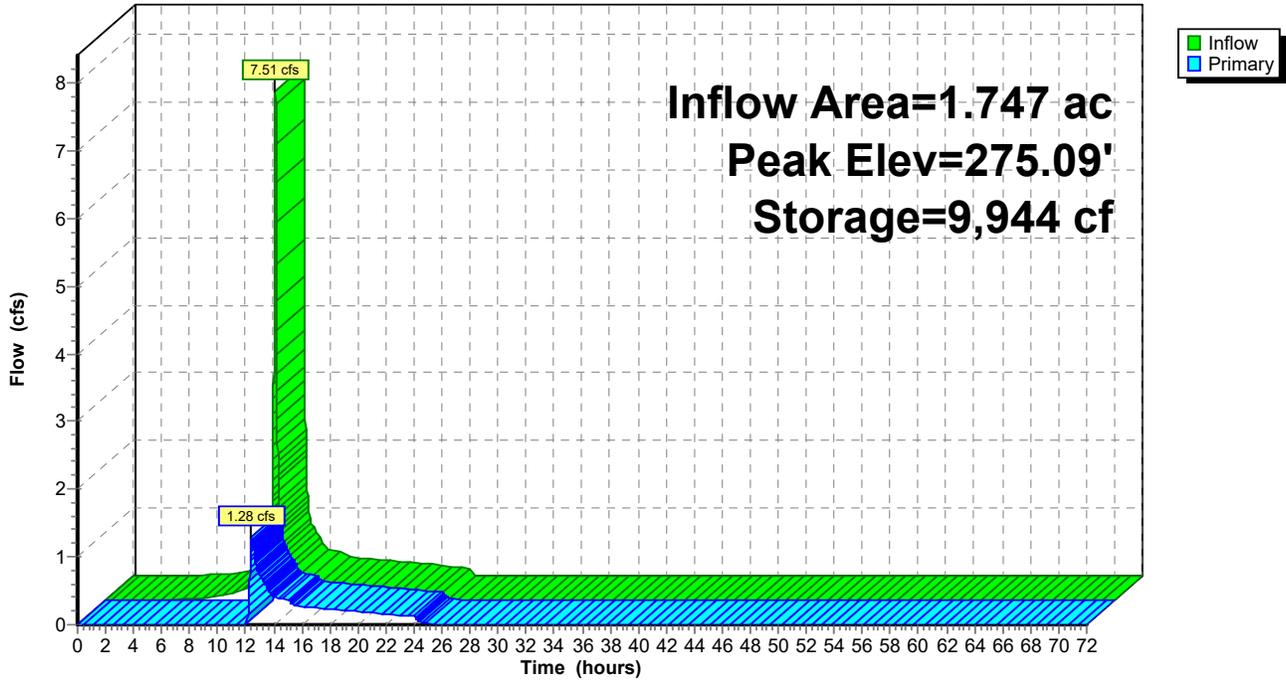
Device	Routing	Invert	Outlet Devices
#1	Primary	272.50'	12.0" Round Culvert L= 75.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 272.50' / 271.90' S= 0.0079 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	275.00'	34.0" x 50.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.28 cfs @ 12.41 hrs HW=275.09' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 1.28 cfs of 4.74 cfs potential flow)
- ↑ **2=Orifice/Grate** (Weir Controls 1.28 cfs @ 0.99 fps)

Pond 4P: EX. BASIN #1

Hydrograph



Summary for Pond 5P: EX. BASIN #2

Inflow Area = 15.896 ac, 87.23% Impervious, Inflow Depth = 4.01" for 25-yr event
 Inflow = 15.76 cfs @ 12.15 hrs, Volume= 5.310 af
 Outflow = 2.79 cfs @ 16.76 hrs, Volume= 2.506 af, Atten= 82%, Lag= 276.3 min
 Primary = 2.79 cfs @ 16.76 hrs, Volume= 2.506 af
 Routed to Pond AP-1 : Southern Wetlands
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond AP-1 : Southern Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 256.74' @ 16.76 hrs Surf.Area= 34,500 sf Storage= 140,556 cf

Plug-Flow detention time= 583.5 min calculated for 2.506 af (47% of inflow)
 Center-of-Mass det. time= 351.7 min (1,219.7 - 868.0)

Volume	Invert	Avail.Storage	Storage Description
#1	252.00'	222,384 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
252.00	2,679	0	0
252.50	27,225	7,476	7,476
253.00	29,112	14,084	21,560
254.00	30,548	29,830	51,390
255.00	31,966	31,257	82,647
256.00	33,393	32,680	115,327
257.00	34,883	34,138	149,465
258.00	36,434	35,659	185,123
259.00	38,088	37,261	222,384

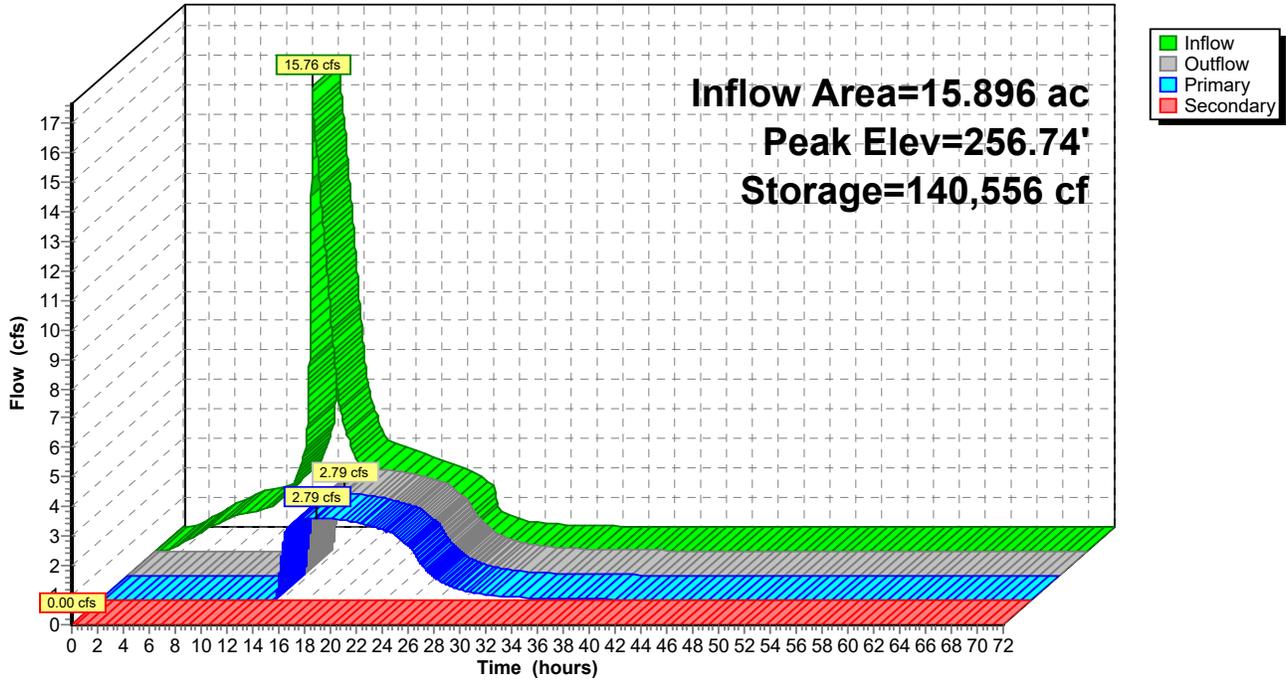
Device	Routing	Invert	Outlet Devices
#1	Secondary	257.70'	9.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	254.96'	12.0" Round Culvert L= 28.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 254.96' / 254.86' S= 0.0035 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#3	Device 2	256.20'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.79 cfs @ 16.76 hrs HW=256.74' TW=0.00' (Dynamic Tailwater)
 ↑ **2=Culvert** (Passes 2.79 cfs of 3.82 cfs potential flow)
 ↑ **3=Orifice/Grate** (Orifice Controls 2.79 cfs @ 3.55 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=252.00' TW=0.00' (Dynamic Tailwater)
 ↑ **1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: EX. BASIN #2

Hydrograph



Summary for Pond AP-1: Southern Wetlands

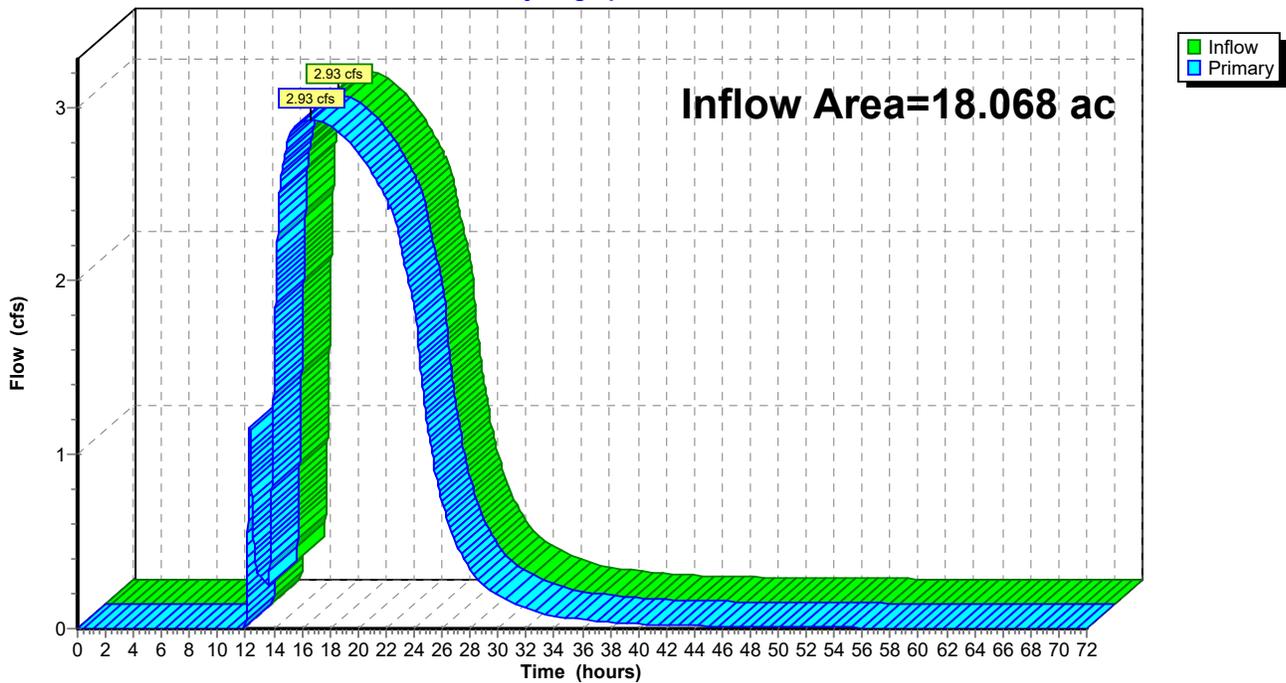
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 18.068 ac, 76.75% Impervious, Inflow Depth > 1.78" for 25-yr event
Inflow = 2.93 cfs @ 16.62 hrs, Volume= 2.677 af
Primary = 2.93 cfs @ 16.62 hrs, Volume= 2.677 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: Southern Wetlands

Hydrograph



F4593 Post-Development 10-22

NOAA10 24-hr D 100-yr Rainfall=8.18"

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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPR-1: Subcat PR-1	Runoff Area=0.120 ac 0.00% Impervious Runoff Depth=1.23" Tc=6.0 min CN=39 Runoff=0.14 cfs 0.012 af
SubcatchmentPR-10: Subcat PR-10	Runoff Area=0.334 ac 69.45% Impervious Runoff Depth=5.79" Tc=6.0 min CN=80 Runoff=2.34 cfs 0.161 af
SubcatchmentPR-2: Subcat PR-2	Runoff Area=1.147 ac 48.82% Impervious Runoff Depth=4.39" Tc=6.0 min CN=68 Runoff=6.30 cfs 0.419 af
SubcatchmentPR-3: Subcat PR-3	Runoff Area=2.598 ac 89.87% Impervious Runoff Depth=7.22" Tc=6.0 min CN=92 Runoff=21.04 cfs 1.564 af
SubcatchmentPR-4: Subcat PR-4	Runoff Area=1.288 ac 88.94% Impervious Runoff Depth=7.10" Tc=6.0 min CN=91 Runoff=10.35 cfs 0.762 af
SubcatchmentPR-5: Subcat PR-5	Runoff Area=2.051 ac 0.00% Impervious Runoff Depth=1.83" Flow Length=378' Tc=15.5 min CN=45 Runoff=2.75 cfs 0.313 af
SubcatchmentPR-6: Subcat PR-6	Runoff Area=1.016 ac 64.57% Impervious Runoff Depth=5.20" Tc=6.0 min CN=75 Runoff=6.53 cfs 0.441 af
SubcatchmentPR-7: Subcat PR-7	Runoff Area=8.137 ac 100.00% Impervious Runoff Depth=7.94" Tc=6.0 min CN=98 Runoff=67.84 cfs 5.384 af
SubcatchmentPR-8: Subcat PR-8	Runoff Area=26,155 sf 76.06% Impervious Runoff Depth=6.27" Tc=6.0 min CN=84 Runoff=4.47 cfs 0.314 af
SubcatchmentPR-9: Subcat PR-9	Runoff Area=0.775 ac 44.36% Impervious Runoff Depth=4.04" Tc=0.0 min CN=65 Runoff=4.64 cfs 0.261 af
Pond 1P: SUBSURFACE DETENTION	Peak Elev=259.60' Storage=2.774 af Inflow=106.99 cfs 8.656 af Outflow=35.80 cfs 7.151 af
Pond 2P: DMH 24-5	Inflow=27.97 cfs 2.248 af Primary=27.97 cfs 2.248 af
Pond 3P: DMH 24-15	Inflow=79.44 cfs 6.408 af Primary=79.44 cfs 6.408 af
Pond 4P: EX. BASIN #1	Peak Elev=275.32' Storage=12,020 cf Inflow=10.77 cfs 0.733 af Outflow=4.97 cfs 0.523 af
Pond 5P: EX. BASIN #2	Peak Elev=257.64' Storage=172,201 cf Inflow=37.90 cfs 7.591 af Primary=4.54 cfs 4.787 af Secondary=0.00 cfs 0.000 af Outflow=4.54 cfs 4.787 af
Pond AP-1: Southern Wetlands	Inflow=4.82 cfs 5.113 af Primary=4.82 cfs 5.113 af

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NOAA10 24-hr D 100-yr Rainfall=8.18"

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Total Runoff Area = 18.068 ac Runoff Volume = 9.632 af Average Runoff Depth = 6.40"
23.25% Pervious = 4.201 ac 76.75% Impervious = 13.866 ac

Summary for Subcatchment PR-1: Subcat PR-1

Runoff = 0.14 cfs @ 12.14 hrs, Volume= 0.012 af, Depth= 1.23"
 Routed to Pond AP-1 : Southern Wetlands

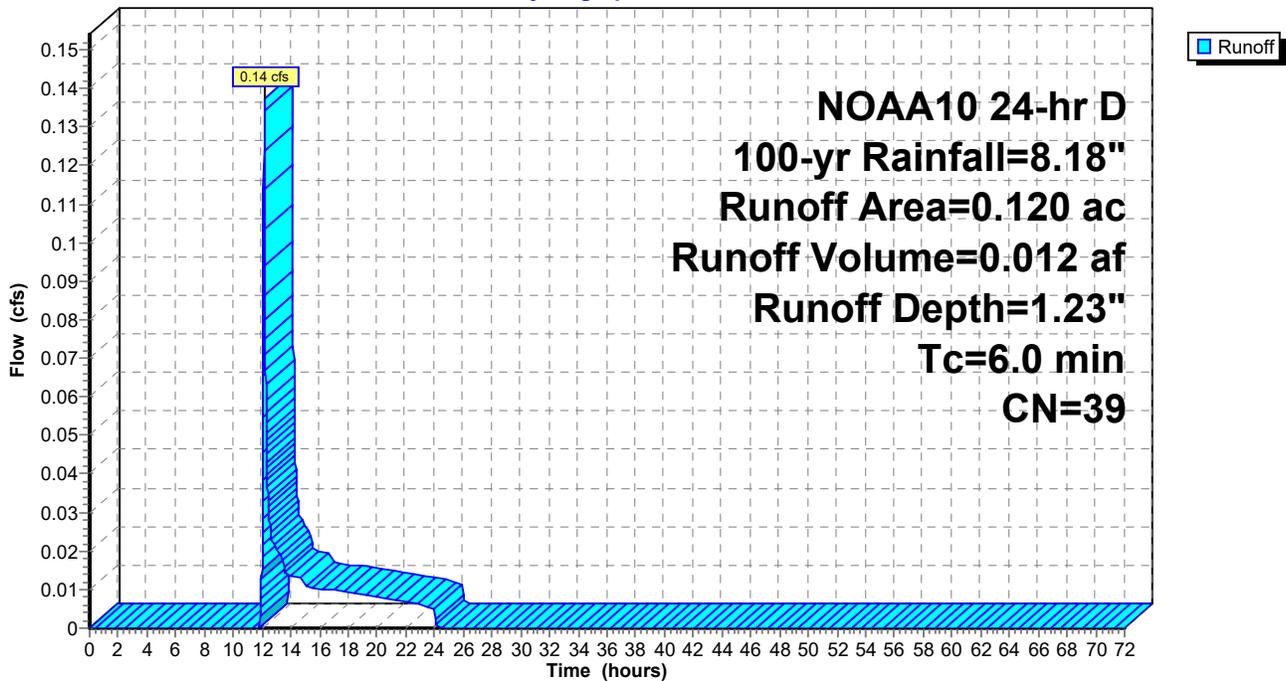
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.120	39	>75% Grass cover, Good, HSG A
0.120		100.00% Pervious Area

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

Subcatchment PR-1: Subcat PR-1

Hydrograph



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Summary for Subcatchment PR-10: Subcat PR-10

Runoff = 2.34 cfs @ 12.13 hrs, Volume= 0.161 af, Depth= 5.79"
 Routed to Pond 2P : DMH 24-5

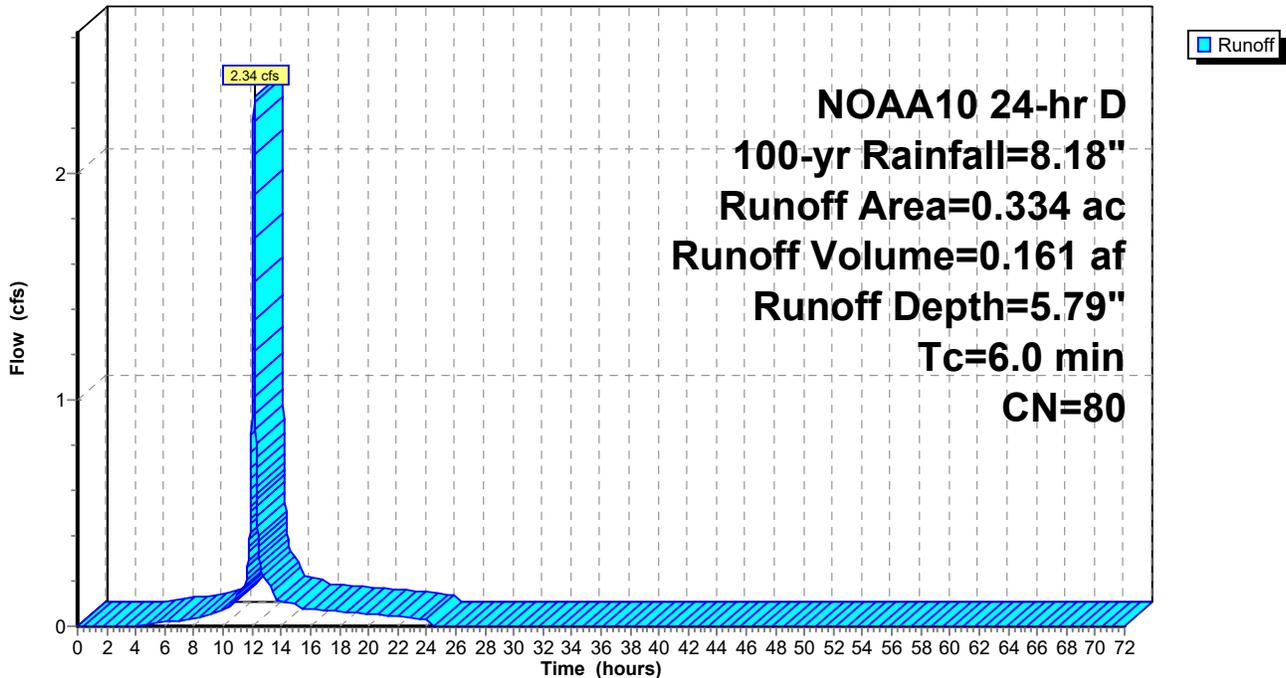
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.102	39	>75% Grass cover, Good, HSG A
0.228	98	Paved parking, HSG A
0.004	98	Unconnected pavement, HSG A
0.334	80	Weighted Average
0.102		30.55% Pervious Area
0.232		69.45% Impervious Area
0.004		1.57% Unconnected

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

Subcatchment PR-10: Subcat PR-10

Hydrograph



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Summary for Subcatchment PR-2: Subcat PR-2

Runoff = 6.30 cfs @ 12.13 hrs, Volume= 0.419 af, Depth= 4.39"
 Routed to Pond 4P : EX. BASIN #1

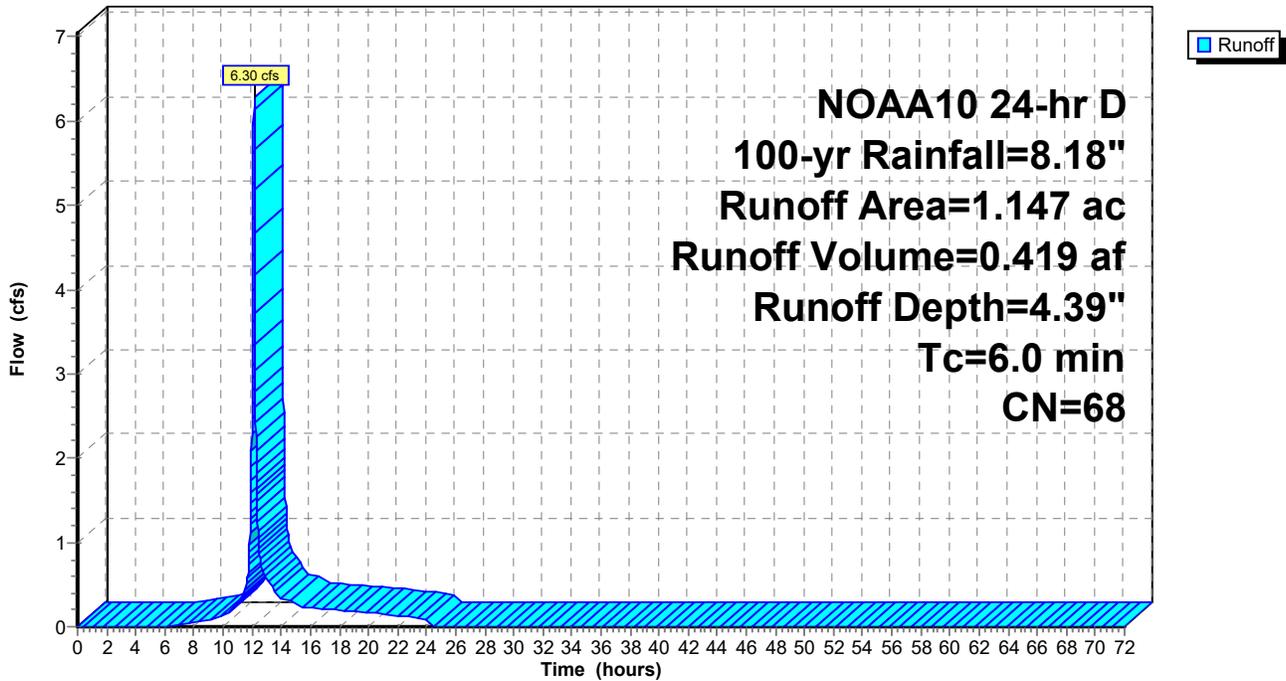
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.587	39	>75% Grass cover, Good, HSG A
0.289	98	Paved parking, HSG A
0.009	98	Unconnected pavement, HSG A
0.261	98	Water Surface, HSG A
1.147	68	Weighted Average
0.587		51.18% Pervious Area
0.560		48.82% Impervious Area
0.009		1.68% Unconnected

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

Subcatchment PR-2: Subcat PR-2

Hydrograph



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Summary for Subcatchment PR-3: Subcat PR-3

Runoff = 21.04 cfs @ 12.13 hrs, Volume= 1.564 af, Depth= 7.22"
 Routed to Pond 2P : DMH 24-5

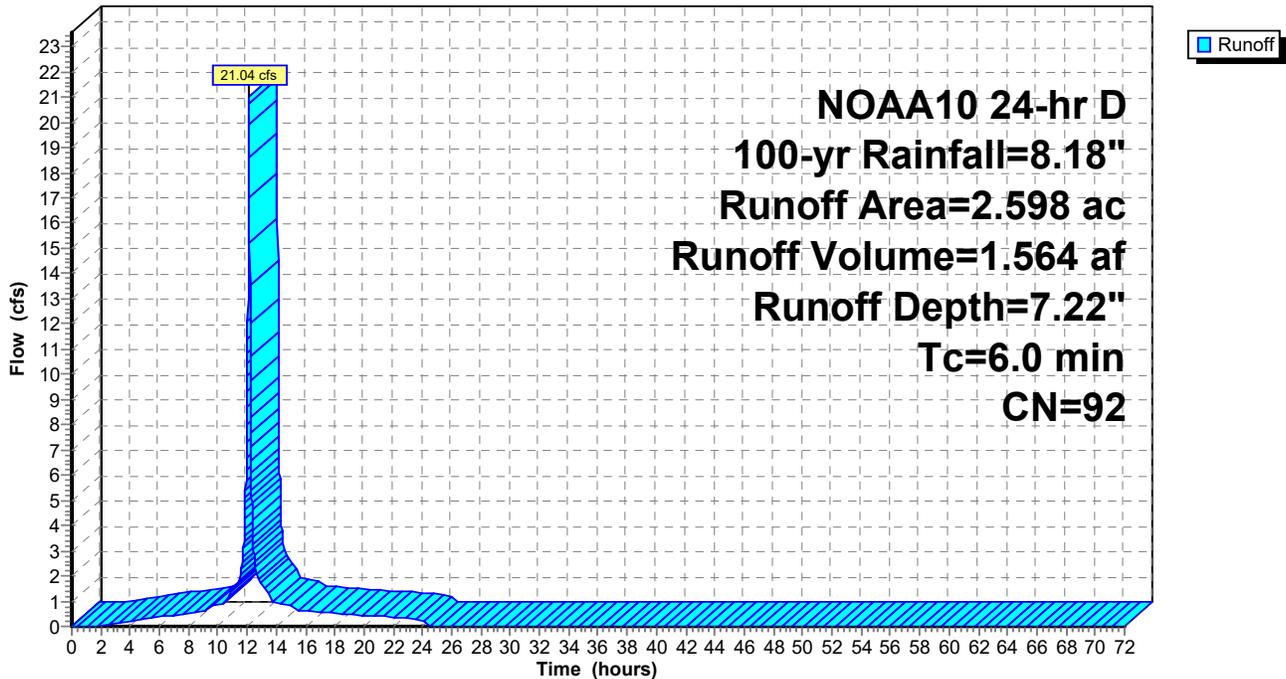
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.234	39	>75% Grass cover, Good, HSG A
0.030	80	>75% Grass cover, Good, HSG D
2.159	98	Paved parking, HSG A
0.102	98	Paved parking, HSG D
0.061	98	Unconnected pavement, HSG A
0.013	98	Unconnected pavement, HSG D
2.598	92	Weighted Average
0.263		10.13% Pervious Area
2.335		89.87% Impervious Area
0.074		3.16% Unconnected

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

Subcatchment PR-3: Subcat PR-3

Hydrograph



Summary for Subcatchment PR-4: Subcat PR-4

Runoff = 10.35 cfs @ 12.13 hrs, Volume= 0.762 af, Depth= 7.10"
 Routed to Pond 3P : DMH 24-15

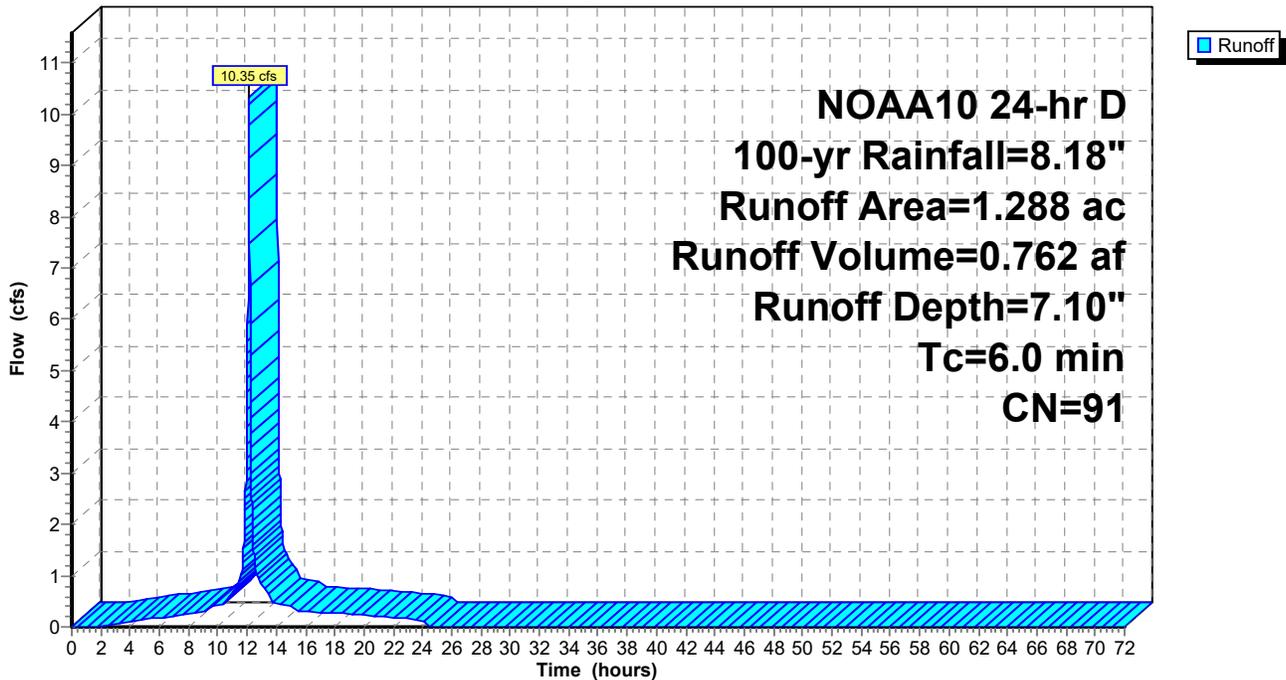
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.142	39	>75% Grass cover, Good, HSG A
1.146	98	Paved parking, HSG A
1.288	91	Weighted Average
0.142		11.06% Pervious Area
1.146		88.94% Impervious Area

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

Subcatchment PR-4: Subcat PR-4

Hydrograph



Summary for Subcatchment PR-5: Subcat PR-5

Runoff = 2.75 cfs @ 12.25 hrs, Volume= 0.313 af, Depth= 1.83"
 Routed to Pond AP-1 : Southern Wetlands

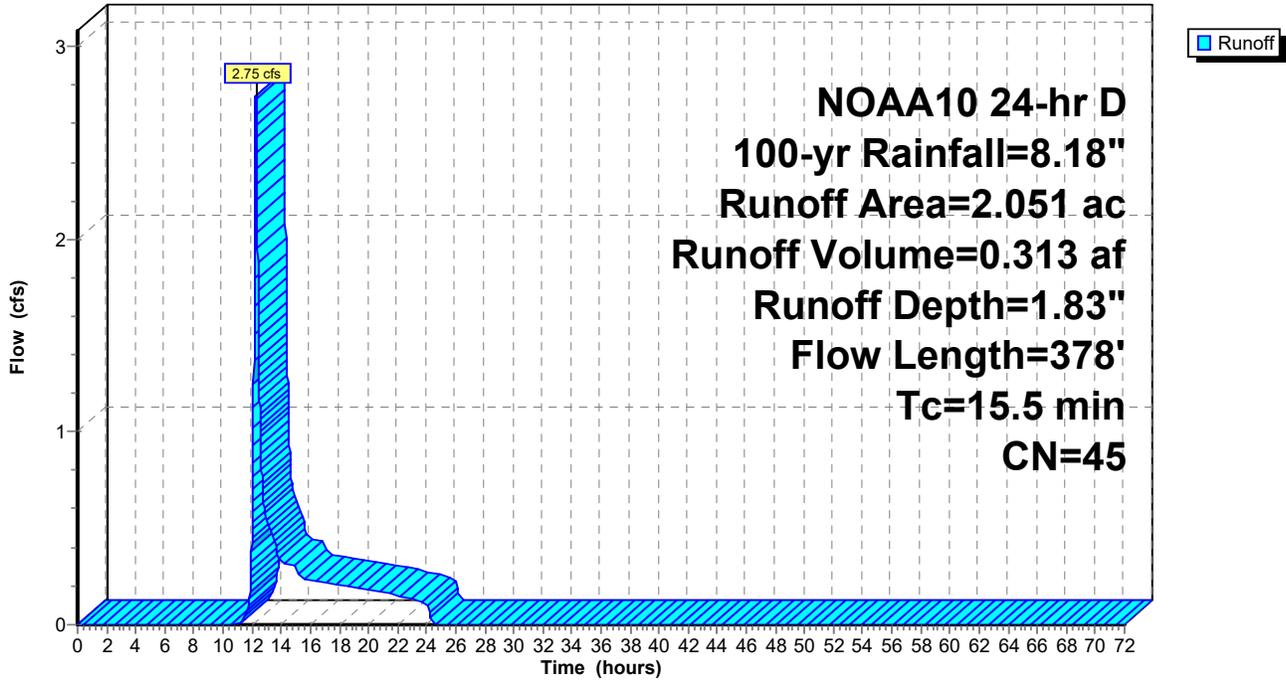
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.221	39	>75% Grass cover, Good, HSG A
0.022	80	>75% Grass cover, Good, HSG D
1.227	30	Woods, Good, HSG A
0.582	77	Woods, Good, HSG D
2.051	45	Weighted Average
2.051		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0190	0.07		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.36"
0.8	67	0.0780	1.40		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
0.0	14	0.3300	8.62		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.5	148	0.0125	1.68		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
0.2	46	0.0550	3.52		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
0.7	53	0.0700	1.32		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
15.5	378	Total			

Subcatchment PR-5: Subcat PR-5

Hydrograph



Summary for Subcatchment PR-6: Subcat PR-6

Runoff = 6.53 cfs @ 12.13 hrs, Volume= 0.441 af, Depth= 5.20"
 Routed to Pond 5P : EX. BASIN #2

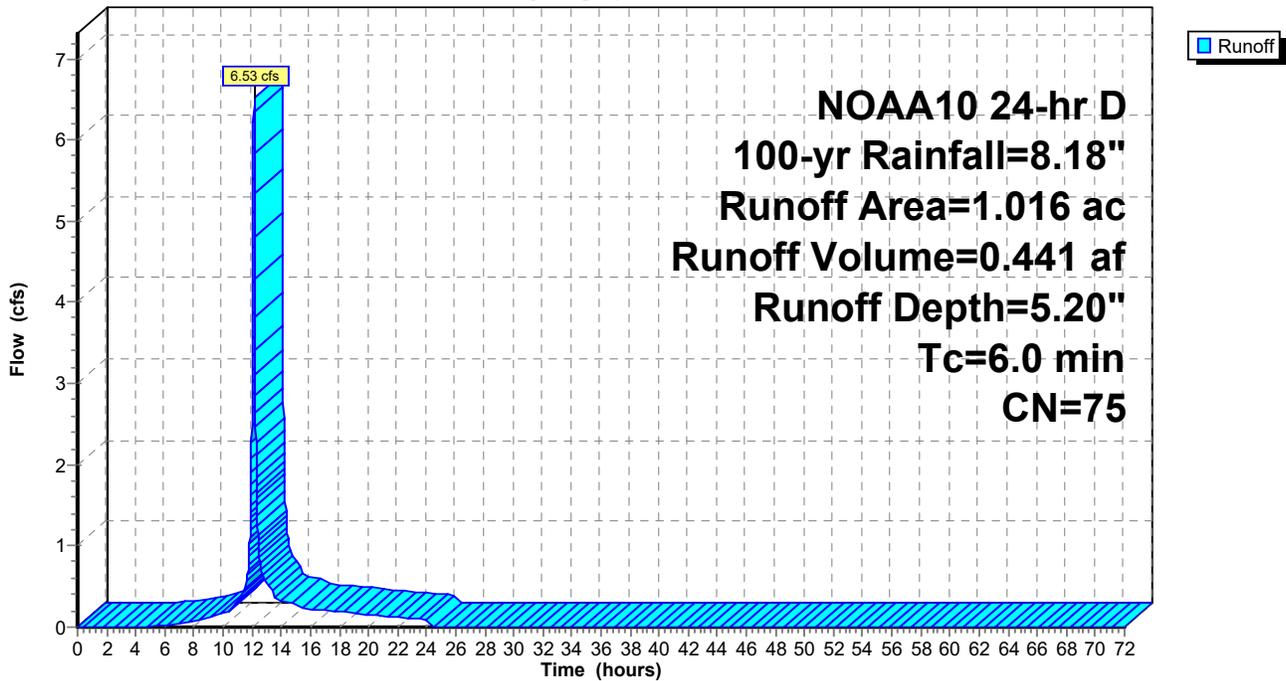
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.125	39	>75% Grass cover, Good, HSG A
0.656	98	Water Surface, HSG A
0.235	30	Woods, Good, HSG A
1.016	75	Weighted Average
0.360		35.43% Pervious Area
0.656		64.57% Impervious Area

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

Subcatchment PR-6: Subcat PR-6

Hydrograph



Summary for Subcatchment PR-7: Subcat PR-7

Runoff = 67.84 cfs @ 12.13 hrs, Volume= 5.384 af, Depth= 7.94"
 Routed to Pond 3P : DMH 24-15

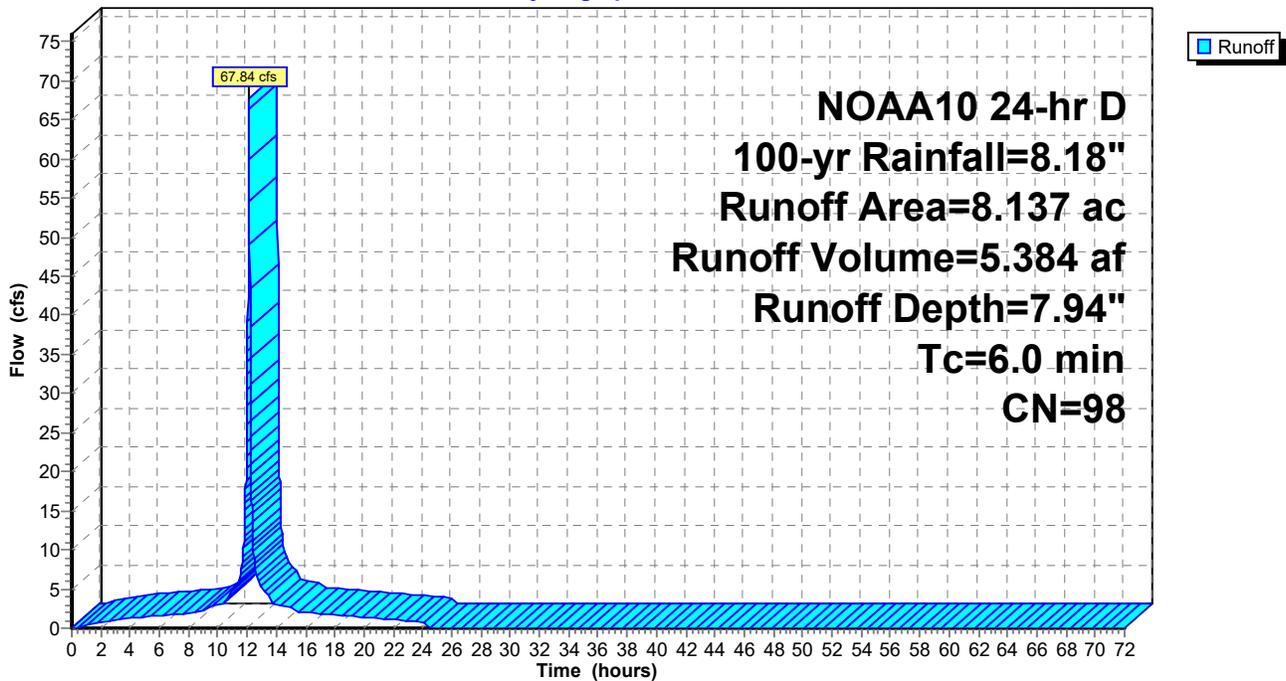
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
8.137	98	Roofs, HSG A
8.137		100.00% Impervious Area

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

Subcatchment PR-7: Subcat PR-7

Hydrograph



Summary for Subcatchment PR-8: Subcat PR-8

Runoff = 4.47 cfs @ 12.13 hrs, Volume= 0.314 af, Depth= 6.27"
 Routed to Pond 4P : EX. BASIN #1

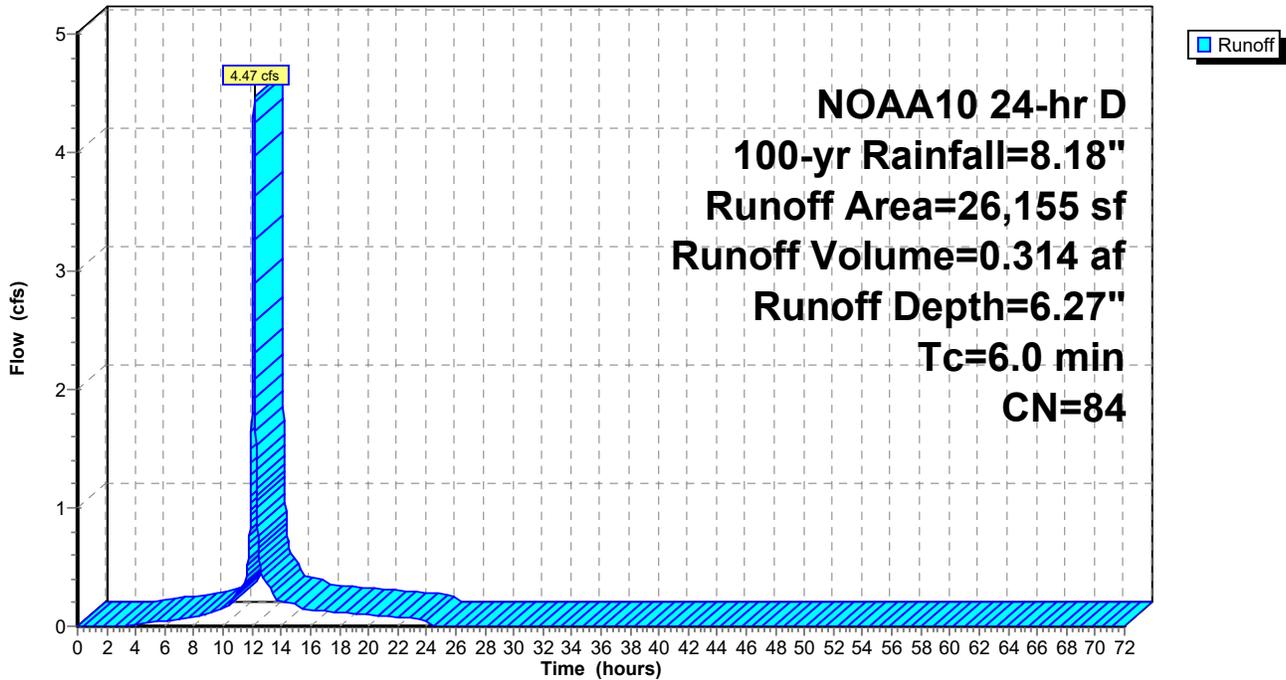
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (sf)	CN	Description
6,261	39	>75% Grass cover, Good, HSG A
19,408	98	Paved parking, HSG A
486	98	Unconnected pavement, HSG A
26,155	84	Weighted Average
6,261		23.94% Pervious Area
19,894		76.06% Impervious Area
486		2.44% Unconnected

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

Subcatchment PR-8: Subcat PR-8

Hydrograph



Summary for Subcatchment PR-9: Subcat PR-9

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

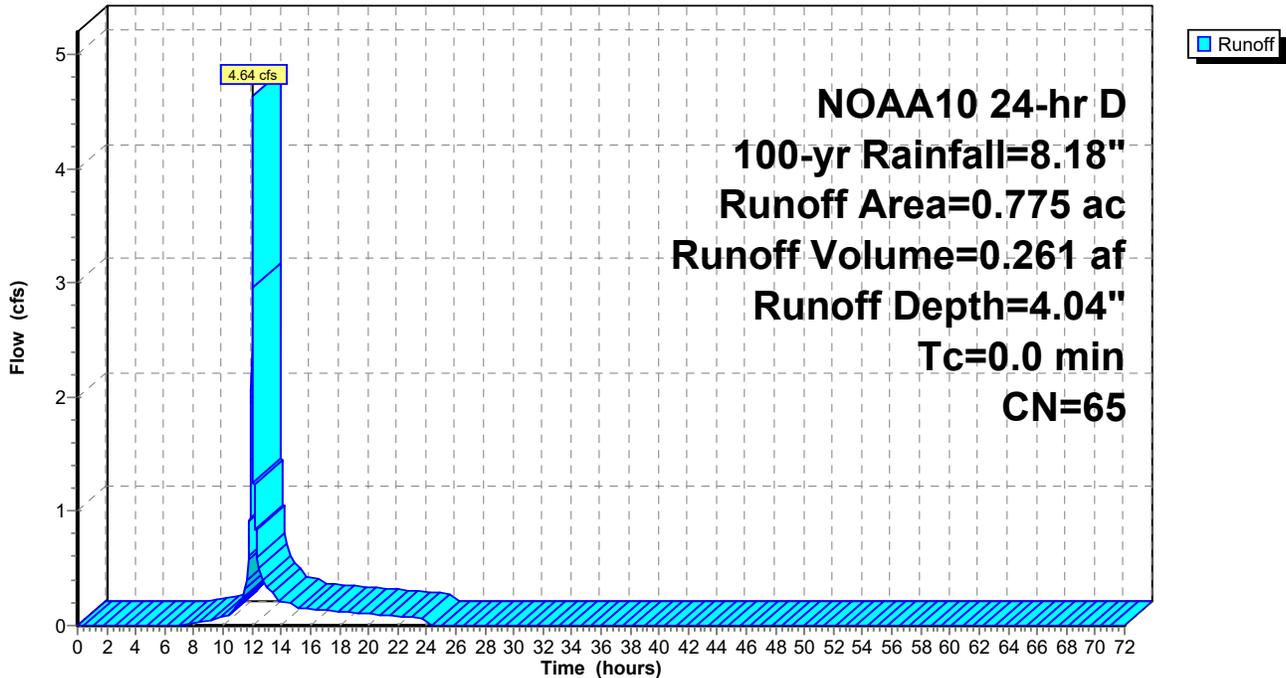
Runoff = 4.64 cfs @ 12.09 hrs, Volume= 0.261 af, Depth= 4.04"
 Routed to Pond 3P : DMH 24-15

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 NOAA10 24-hr D 100-yr Rainfall=8.18"

Area (ac)	CN	Description
0.431	39	>75% Grass cover, Good, HSG A
0.343	98	Paved parking, HSG A
0.001	98	Unconnected pavement, HSG A
0.775	65	Weighted Average
0.431		55.64% Pervious Area
0.344		44.36% Impervious Area
0.001		0.15% Unconnected

Subcatchment PR-9: Subcat PR-9

Hydrograph



Summary for Pond 1P: SUBSURFACE DETENTION

NOTE: A -0.6' ROW LENGTH ADJUSTMENT HAS BEEN APPLIED TO ACCOUNT FOR A 4' LONG INTERNAL MANHOLE IN THE FINAL ROW, WHICH SERVES AS AN OUTLET CONTROL STRUCTURE. THIS ROW ADJUSTMENT SPREADS THE LOSS IN STORAGE ACROSS ALL 7 ROWS TO MAINTAIN AN ACCURATE TOTAL STORAGE VOLUME FOR THE SYSTEM.

Inflow Area = 14.880 ac, 88.78% Impervious, Inflow Depth = 6.98" for 100-yr event
 Inflow = 106.99 cfs @ 12.13 hrs, Volume= 8.656 af
 Outflow = 35.80 cfs @ 12.27 hrs, Volume= 7.151 af, Atten= 67%, Lag= 8.5 min
 Primary = 35.80 cfs @ 12.27 hrs, Volume= 7.151 af
 Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 259.60' @ 12.28 hrs Surf.Area= 0.590 ac Storage= 2.774 af

Plug-Flow detention time= 207.8 min calculated for 7.150 af (83% of inflow)
 Center-of-Mass det. time= 119.3 min (887.2 - 767.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	252.00'	0.000 af	74.00'W x 347.40'L x 8.50'H Field A 5.016 af Overall - 2.827 af Embedded = 2.189 af x 0.0% Voids
#2A	252.00'	2.827 af	CMP Round 96 x 119 Inside #1 Effective Size= 96.0"W x 96.0"H => 50.27 sf x 20.00'L = 1,005.3 cf Overall Size= 96.0"W x 96.0"H x 20.00'L Row Length Adjustment= -0.60' x 50.27 sf x 7 rows 74.00' Header x 50.27 sf x 1 = 3,719.6 cf Inside
		2.827 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 4	252.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Device 4	254.50'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Device 4	258.50'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Head (feet) 6.50 6.56 6.64 6.72 6.80 6.88 6.96 7.04 7.12 7.20 7.28 7.36 7.44 7.52 7.60 7.68 7.76 7.84 7.92 8.00 Width (feet) 6.25 6.15 6.01 5.87 5.71 5.55 5.38 5.20 5.01 4.80 4.58 4.34 4.08 3.80 3.49 3.14 2.73 2.24 1.59 0.00
#4	Primary	251.90'	36.0" Round Culvert L= 28.6' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 251.90' / 251.50' S= 0.0140 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 7.07 sf

Primary OutFlow Max=35.69 cfs @ 12.27 hrs HW=259.60' TW=255.42' (Dynamic Tailwater)

- ↑ 4=Culvert (Passes 35.69 cfs of 69.59 cfs potential flow)
- ↑ 1=Orifice/Grate (Orifice Controls 7.73 cfs @ 9.85 fps)
- ↑ 2=Orifice/Grate (Orifice Controls 7.73 cfs @ 9.85 fps)
- ↑ 3=Custom Weir/Orifice (Weir Controls 20.22 cfs @ 3.62 fps)

Pond 1P: SUBSURFACE DETENTION - Chamber Wizard Field A

Chamber Model = CMP Round 96 (Round Corrugated Metal Pipe)

Effective Size= 96.0"W x 96.0"H => 50.27 sf x 20.00'L = 1,005.3 cf

Overall Size= 96.0"W x 96.0"H x 20.00'L

Row Length Adjustment= -0.60' x 50.27 sf x 7 rows

96.0" Wide + 36.0" Spacing = 132.0" C-C Row Spacing

17 Chambers/Row x 20.00' Long -0.60' Row Adjustment +8.00' Header x 1 = 347.40' Row Length

7 Rows x 96.0" Wide + 36.0" Spacing x 6 = 74.00' Base Width

96.0" Chamber Height + 6.0" Stone Cover = 8.50' Field Height

119 Chambers x 1,005.3 cf -0.60' Row Adjustment x 50.27 sf x 7 Rows + 74.00' Header x 50.27 sf =
123,140.4 cf Chamber Storage

218,514.6 cf Field - 123,140.4 cf Chambers = 95,374.2 cf Stone x 0.0% Voids = 0.0 cf Stone Storage

Chamber Storage = 123,140.4 cf = 2.827 af

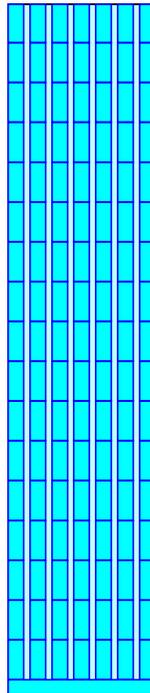
Overall Storage Efficiency = 56.4%

Overall System Size = 347.40' x 74.00' x 8.50'

119 Chambers

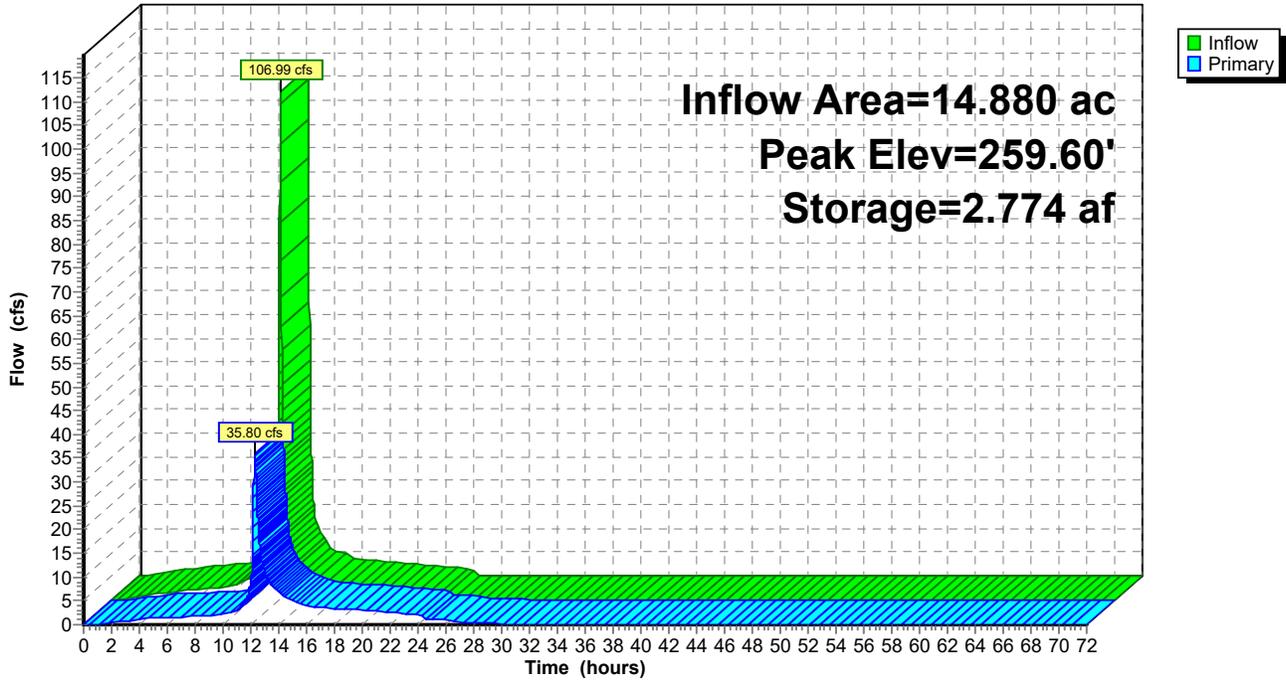
8,093.1 cy Field

3,532.4 cy Stone



Pond 1P: SUBSURFACE DETENTION

Hydrograph



Summary for Pond 2P: DMH 24-5

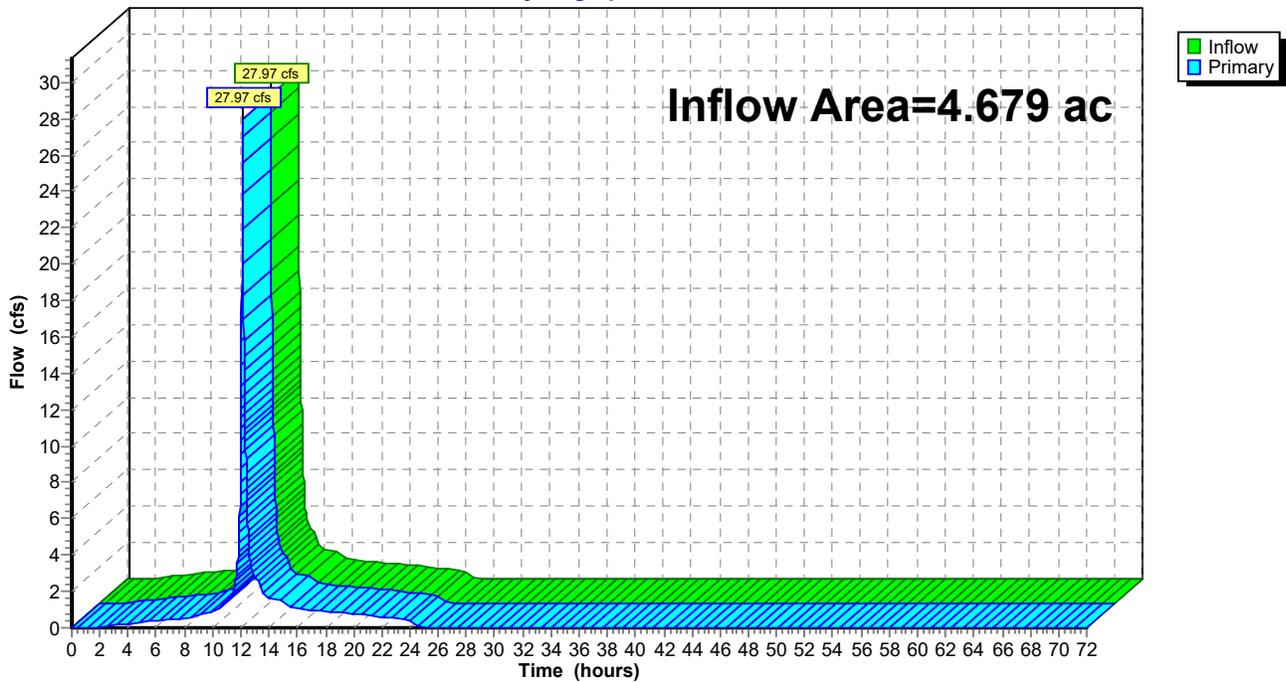
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.679 ac, 76.58% Impervious, Inflow Depth = 5.76" for 100-yr event
Inflow = 27.97 cfs @ 12.14 hrs, Volume= 2.248 af
Primary = 27.97 cfs @ 12.14 hrs, Volume= 2.248 af, Atten= 0%, Lag= 0.0 min
Routed to Pond 1P : SUBSURFACE DETENTION

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 2P: DMH 24-5

Hydrograph



Summary for Pond 3P: DMH 24-15

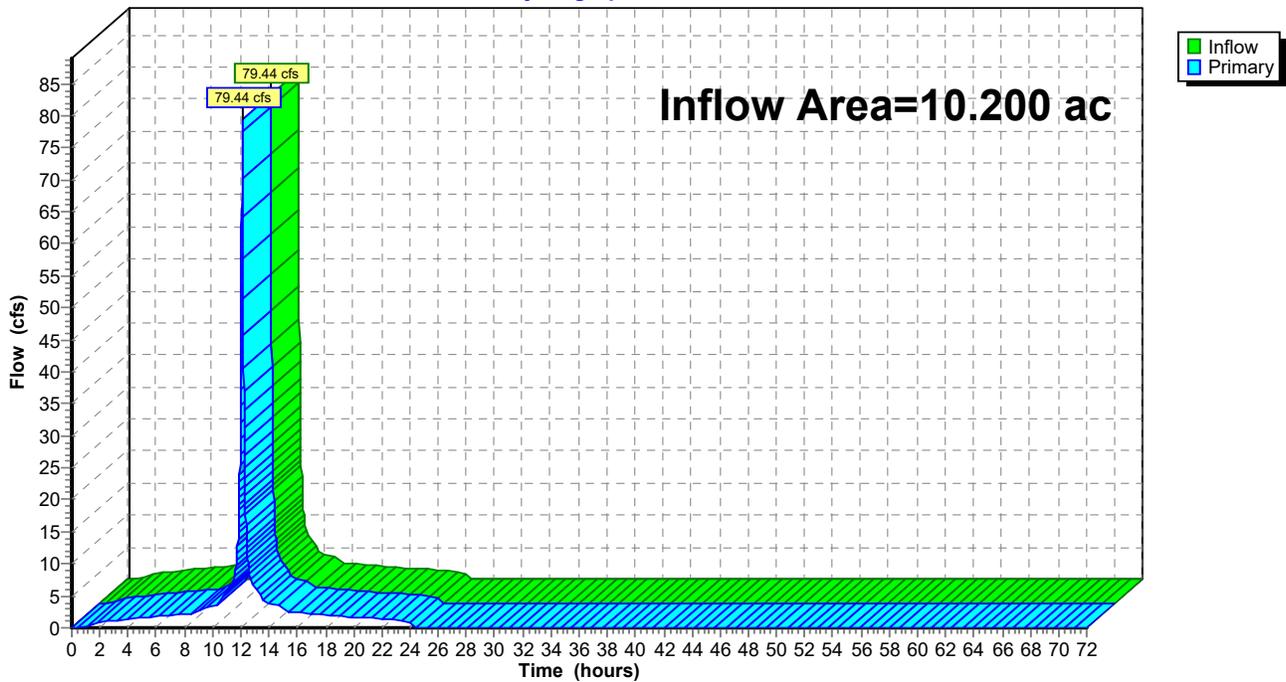
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 10.200 ac, 94.38% Impervious, Inflow Depth = 7.54" for 100-yr event
Inflow = 79.44 cfs @ 12.13 hrs, Volume= 6.408 af
Primary = 79.44 cfs @ 12.13 hrs, Volume= 6.408 af, Atten= 0%, Lag= 0.0 min
Routed to Pond 1P : SUBSURFACE DETENTION

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond 3P: DMH 24-15

Hydrograph



Summary for Pond 4P: EX. BASIN #1

Inflow Area = 1.747 ac, 58.18% Impervious, Inflow Depth = 5.03" for 100-yr event
 Inflow = 10.77 cfs @ 12.13 hrs, Volume= 0.733 af
 Outflow = 4.97 cfs @ 12.22 hrs, Volume= 0.523 af, Atten= 54%, Lag= 5.6 min
 Primary = 4.97 cfs @ 12.22 hrs, Volume= 0.523 af
 Routed to Pond 2P : DMH 24-5

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 275.32' @ 12.22 hrs Surf.Area= 9,531 sf Storage= 12,020 cf

Plug-Flow detention time= 208.6 min calculated for 0.523 af (71% of inflow)
 Center-of-Mass det. time= 90.7 min (926.4 - 835.6)

Volume	Invert	Avail.Storage	Storage Description
#1	273.40'	31,754 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
273.40	1,731	0	0
274.00	5,352	2,125	2,125
275.00	8,670	7,011	9,136
276.00	11,387	10,029	19,164
277.00	13,793	12,590	31,754

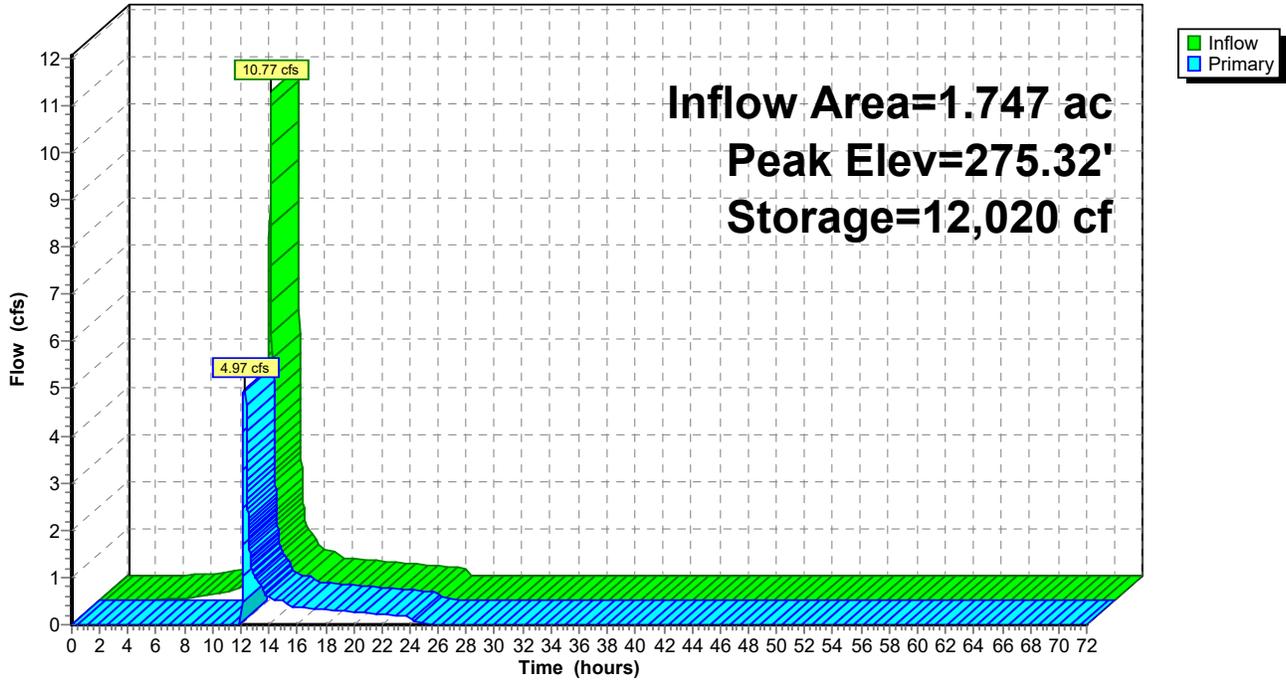
Device	Routing	Invert	Outlet Devices
#1	Primary	272.50'	12.0" Round Culvert L= 75.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 272.50' / 271.90' S= 0.0079 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	275.00'	34.0" x 50.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.97 cfs @ 12.22 hrs HW=275.32' TW=0.00' (Dynamic Tailwater)

- ↑1=Culvert (Barrel Controls 4.97 cfs @ 6.33 fps)
- ↑2=Orifice/Grate (Passes 4.97 cfs of 8.16 cfs potential flow)

Pond 4P: EX. BASIN #1

Hydrograph



Summary for Pond 5P: EX. BASIN #2

Inflow Area = 15.896 ac, 87.23% Impervious, Inflow Depth = 5.73" for 100-yr event
 Inflow = 37.90 cfs @ 12.27 hrs, Volume= 7.591 af
 Outflow = 4.54 cfs @ 15.63 hrs, Volume= 4.787 af, Atten= 88%, Lag= 201.8 min
 Primary = 4.54 cfs @ 15.63 hrs, Volume= 4.787 af
 Routed to Pond AP-1 : Southern Wetlands
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond AP-1 : Southern Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 257.64' @ 15.63 hrs Surf.Area= 35,880 sf Storage= 172,201 cf

Plug-Flow detention time= 515.8 min calculated for 4.787 af (63% of inflow)
 Center-of-Mass det. time= 322.2 min (1,206.4 - 884.2)

Volume	Invert	Avail.Storage	Storage Description
#1	252.00'	222,384 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
252.00	2,679	0	0
252.50	27,225	7,476	7,476
253.00	29,112	14,084	21,560
254.00	30,548	29,830	51,390
255.00	31,966	31,257	82,647
256.00	33,393	32,680	115,327
257.00	34,883	34,138	149,465
258.00	36,434	35,659	185,123
259.00	38,088	37,261	222,384

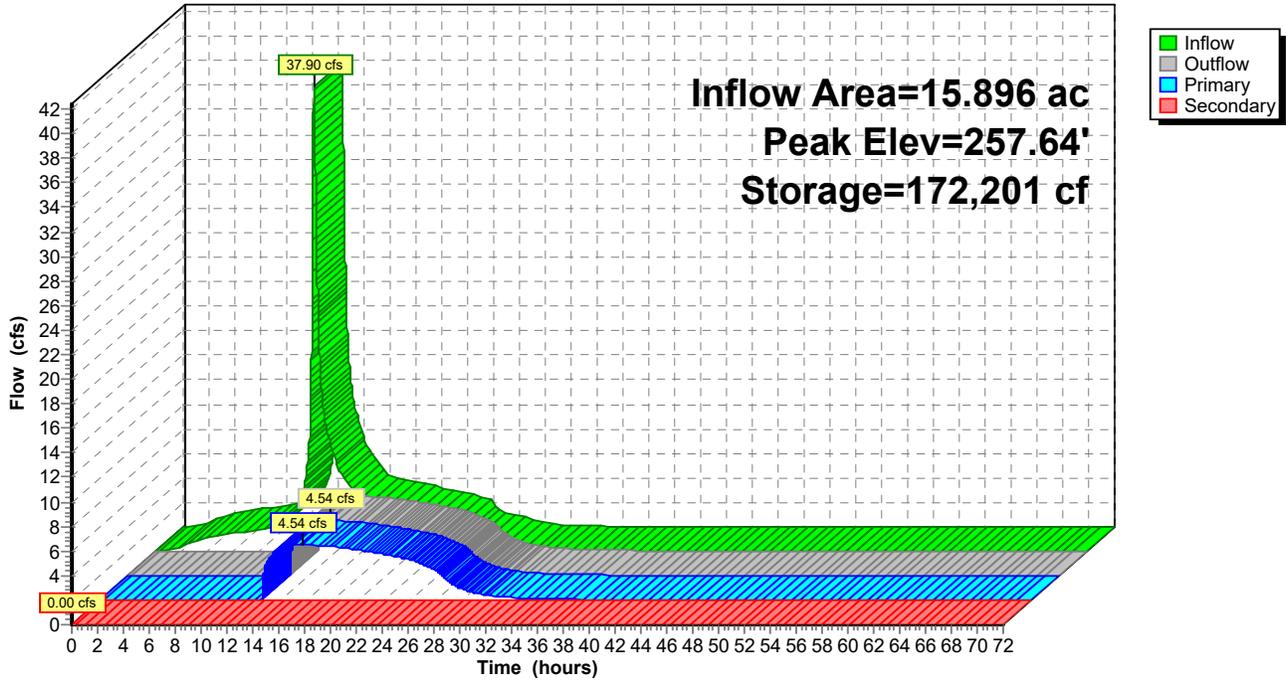
Device	Routing	Invert	Outlet Devices
#1	Secondary	257.70'	9.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	254.96'	12.0" Round Culvert L= 28.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 254.96' / 254.86' S= 0.0035 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#3	Device 2	256.20'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.54 cfs @ 15.63 hrs HW=257.64' TW=0.00' (Dynamic Tailwater)
 ↑**2=Culvert** (Passes 4.54 cfs of 5.42 cfs potential flow)
 ↑**3=Orifice/Grate** (Orifice Controls 4.54 cfs @ 5.78 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=252.00' TW=0.00' (Dynamic Tailwater)
 ↑**1=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

Pond 5P: EX. BASIN #2

Hydrograph



Summary for Pond AP-1: Southern Wetlands

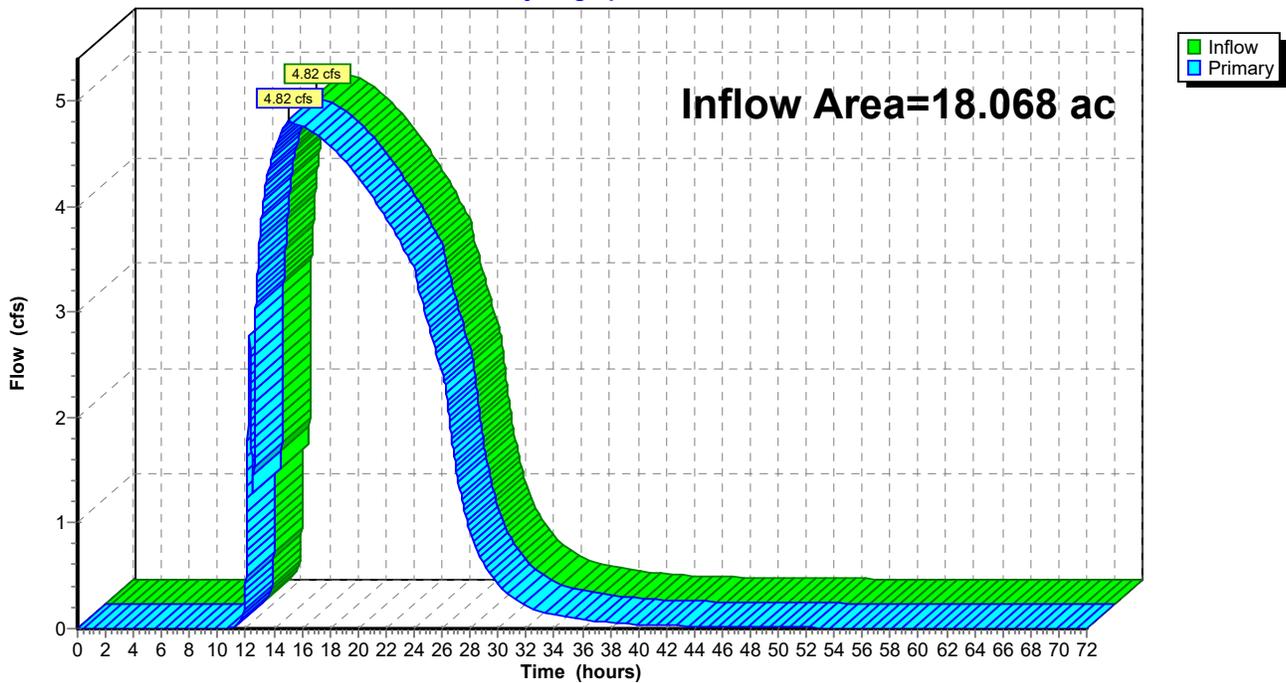
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 18.068 ac, 76.75% Impervious, Inflow Depth > 3.40" for 100-yr event
Inflow = 4.82 cfs @ 15.07 hrs, Volume= 5.113 af
Primary = 4.82 cfs @ 15.07 hrs, Volume= 5.113 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Pond AP-1: Southern Wetlands

Hydrograph



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Multi-Event Tables

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Events for Subcatchment PR-1: Subcat PR-1

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-yr	3.36	0.00	0.000	0.00
10-yr	5.22	0.00	0.002	0.25
25-yr	6.39	0.03	0.006	0.56
100-yr	8.18	0.14	0.012	1.23

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Events for Subcatchment PR-10: Subcat PR-10

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-yr	3.36	0.64	0.042	1.53
10-yr	5.22	1.28	0.086	3.09
25-yr	6.39	1.70	0.115	4.13
100-yr	8.18	2.34	0.161	5.79

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Events for Subcatchment PR-2: Subcat PR-2

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-yr	3.36	1.09	0.078	0.82
10-yr	5.22	2.91	0.195	2.04
25-yr	6.39	4.20	0.279	2.92
100-yr	8.18	6.30	0.419	4.39

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Events for Subcatchment PR-3: Subcat PR-3

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-yr	3.36	7.79	0.542	2.50
10-yr	5.22	12.95	0.932	4.30
25-yr	6.39	16.16	1.181	5.45
100-yr	8.18	21.04	1.564	7.22

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Events for Subcatchment PR-4: Subcat PR-4

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-yr	3.36	3.75	0.259	2.41
10-yr	5.22	6.32	0.450	4.20
25-yr	6.39	7.92	0.573	5.34
100-yr	8.18	10.35	0.762	7.10

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Events for Subcatchment PR-5: Subcat PR-5

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-yr	3.36	0.02	0.011	0.06
10-yr	5.22	0.37	0.088	0.51
25-yr	6.39	1.14	0.165	0.96
100-yr	8.18	2.75	0.313	1.83

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Events for Subcatchment PR-6: Subcat PR-6

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-yr	3.36	1.51	0.102	1.20
10-yr	5.22	3.35	0.223	2.63
25-yr	6.39	4.59	0.306	3.62
100-yr	8.18	6.53	0.441	5.20

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Events for Subcatchment PR-7: Subcat PR-7

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-yr	3.36	27.61	2.120	3.13
10-yr	5.22	43.17	3.379	4.98
25-yr	6.39	52.93	4.171	6.15
100-yr	8.18	67.84	5.384	7.94

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Events for Subcatchment PR-8: Subcat PR-8

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-yr	3.36	1.36	0.091	1.82
10-yr	5.22	2.56	0.174	3.47
25-yr	6.39	3.31	0.228	4.56
100-yr	8.18	4.47	0.314	6.27

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Events for Subcatchment PR-9: Subcat PR-9

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
2-yr	3.36	0.78	0.044	0.68
10-yr	5.22	2.19	0.116	1.80
25-yr	6.39	3.07	0.170	2.64
100-yr	8.18	4.64	0.261	4.04

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Events for Pond 1P: SUBSURFACE DETENTION

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
2-yr	39.99	6.19	255.21	1.059
10-yr	64.30	10.92	256.69	1.722
25-yr	79.55	13.07	257.83	2.209
100-yr	106.99	35.80	259.60	2.774

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Events for Pond 2P: DMH 24-5

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
2-yr	8.43	8.43	0.00	0.000
10-yr	14.23	14.23	0.00	0.000
25-yr	17.86	17.86	0.00	0.000
100-yr	27.97	27.97	0.00	0.000

F4593 Post-Development 10-22

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Multi-Event Tables

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Events for Pond 3P: DMH 24-15

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
2-yr	31.57	31.57	0.00	0.000
10-yr	50.06	50.06	0.00	0.000
25-yr	61.68	61.68	0.00	0.000
100-yr	79.44	79.44	0.00	0.000

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Multi-Event Tables

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Events for Pond 4P: EX. BASIN #1

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (cubic-feet)
2-yr	2.45	0.00	274.79	7,379
10-yr	5.46	0.29	275.03	9,437
25-yr	7.51	1.28	275.09	9,944
100-yr	10.77	4.97	275.32	12,020

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Events for Pond 5P: EX. BASIN #2

Event	Inflow (cfs)	Outflow (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Storage (cubic-feet)
2-yr	6.54	0.00	0.00	0.00	255.21	89,349
10-yr	12.68	1.49	1.49	0.00	256.48	131,403
25-yr	15.76	2.79	2.79	0.00	256.74	140,556
100-yr	37.90	4.54	4.54	0.00	257.64	172,201

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Events for Pond AP-1: Southern Wetlands

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
2-yr	0.02	0.02	0.00	0.000
10-yr	1.56	1.56	0.00	0.000
25-yr	2.93	2.93	0.00	0.000
100-yr	4.82	4.82	0.00	0.000

Pipe Sizing Calculations

Land Use Coefficients "C"

Pave	0.90
Gravel	0.80
Wetland	0.72
Grass	0.30
Woods	0.25
Roof	0.90

Area	Land Use Area						Total (acres)	Weighted "C"
	Impervious (acres)	Gravel (acres)	Wetland (acres)	Pervious (acres)	Woods (acres)	Roof (acres)		
CB 24-1	0.231			0.101		0.000	0.332	0.72
CB 24-2	0.185			0.034		0.000	0.219	0.81
CB 24-3, 4, &5	0.113			0.051		0.000	0.164	0.71
CB 24-6&7	0.343			0.313		0.000	0.656	0.61
CB 7&8	0.112			0.024		0.000	0.136	0.79
CB 9	0.244			0.111		0.000	0.355	0.71
CB 10&11	0.807			0.047		0.000	0.854	0.87
CB 12&13	0.985			0.047		0.000	1.032	0.87
CB 14	0.914			0.073		0.000	0.987	0.86
CB 15&16	0.118			0.018		0.000	0.136	0.82
CB 58&59	0.258			0.105		0.000	0.363	0.73
CB 60&61	0.200			0.040		0.000	0.240	0.80
ROOF	0.000			0.000		8.137	8.137	0.90
SUBTOTAL	4.510	0.000	0.000	0.964	0.000	8.137	13.611	
OVERALL TOTALS	4.510			0.964	0.000	8.137	13.611	

Drainage Area	Upper Structure	Lower Structure	Sum of CA's (sf)	Time of Concentration (Tc) (min)	Rainfall Intensity (I) (in/hr)	Actual Peak Flow Rate (Q) (cfs)	Pipe Diameter (in)	Slope (ft/ft)	Roughness Coefficient (n)	Design Flow Full (Q) (cfs)	Velocity Flow Full (V) (fps)	Actual Velocity (V) (fps)	Length of Pipe (L)* (ft)	Time in pipe (min)	Total Fall (ft)	Invert Elevation		Rim Elev		Destination								
																Elev.	Elev.	Elev.	Elev.									
																Upper End	Lower End	Upper End	Lower End									
	CB 24-1	DMH 24-1	0.24	6.00	8.02	1.91	12	0.030	0.011	7.35	9.36	2.43	127.9	0.23	3.90	273.00	269.10	279.60	277.70	SUBSURFACE DETENTION SYSTEM #1								
	CB 24-2	DMH 24-2	0.18	6.00	8.02	1.42	12	0.010	0.011	4.25	5.42	1.80	29.4	0.09	0.30	267.30	267.00				SUBSURFACE DETENTION SYSTEM #1							
	CB 24-3, 4, &5	DMH 24-13	0.12	6.00	8.02	0.94	12	0.013	0.011	4.73	6.02	1.19	19.9	0.05	0.25	267.75	267.50		275.70			SUBSURFACE DETENTION SYSTEM #1						
	CB 24-6&7	DMH 24-6	0.40	6.00	8.02	3.23	15	0.005	0.011	5.36	4.37	2.63	73.1	0.28	0.36	271.26	270.90	274.80	276.50				SUBSURFACE DETENTION SYSTEM #1					
	CB 7&8	DMH 6	0.11	6.00	8.02	0.87	12	0.065	0.011	10.76	13.70	1.10	30.6	0.04	2.00	273.90	271.90	277.60	277.60					SUBSURFACE DETENTION SYSTEM #1				
	CB 9	DMH 7	0.25	6.00	8.02	2.03	12	0.175	0.011	17.61	22.43	2.58	8.0	0.01	1.40	270.60	269.20	275.32	275.45						SUBSURFACE DETENTION SYSTEM #1			
	CB 10&11	DMH-8	0.74	6.00	8.02	5.94	12	0.106	0.011	13.71	17.46	7.56	13.2	0.01	1.40	269.50	268.10	274.20	274.35							SUBSURFACE DETENTION SYSTEM #1		
	CB 12&13	DMH-24-4	0.90	6.00	8.02	7.22	12	0.047	0.011	9.15	11.65	9.20	55.1	0.08	2.60	269.10	266.50	273.75	274.60								SUBSURFACE DETENTION SYSTEM #1	
	CB 14	DMH 24-19	0.84	6.00	8.02	6.77	15	0.021	0.011	11.10	9.04	5.52	14.2	0.03	0.30	258.30	258.00	272.98										SUBSURFACE DETENTION SYSTEM #1
	CB 15&16	DMH 24-14	0.11	6.00	8.02	0.90	12	0.017	0.011	5.44	6.92	1.14	18.0	0.04	0.30	270.40	270.10	274.50	274.30									
	CB 58&59	DMH 46	0.26	6.00	8.02	2.11	12	0.003	0.011	2.21	2.81	2.69	36.3	0.22	0.10	276.50	276.40	279.60		SUBSURFACE DETENTION SYSTEM #1								
	CB 60&61	DMH 45	0.19	6.00	8.02	1.54	12	0.034	0.011	7.76	9.89	1.96	23.5	0.04	0.80	275.90	275.10	278.92			SUBSURFACE DETENTION SYSTEM #1							
	ROOF	DMH 24-12	7.32	6.00	8.02	58.73	30	0.023	0.011	73.99	15.07	11.96	75.6	0.08	1.76	267.12	265.36					SUBSURFACE DETENTION SYSTEM #1						
																							SUBSURFACE DETENTION SYSTEM #1					
	DMH 46	DMH 45	0.26	6.22	8.02	2.11	12	0.017	0.011	5.52	7.02	2.69	69.9	0.17	1.20	276.30	275.10	279.85	279.87					SUBSURFACE DETENTION SYSTEM #1				
	DMH 45	BASIN 1	0.46	6.38	8.02	3.65	12	0.009	0.011	3.95	5.03	4.65	79.6	0.26	0.70	275.00	274.30	279.87							SUBSURFACE DETENTION SYSTEM #1			
*	BASIN 1	DMH 24-4	0.16	6.64	8.02	1.28	12	0.020	0.011	5.99	7.62	1.63	540.4	1.18	10.92	272.50	261.58		274.60							SUBSURFACE DETENTION SYSTEM #1 WEST INLET		
	DMH 24-1	DMH 24-2	0.24	6.23	8.02	1.91	12	0.020	0.011	5.94	7.56	2.43	100.6	0.22	2.00	269.00	267.00	279.20	277.00								SUBSURFACE DETENTION SYSTEM #1 WEST INLET	
	DMH 24-2	DMH 24-3	0.41	6.45	8.02	3.33	15	0.019	0.011	10.42	8.49	2.71	155.8	0.31	2.90	266.50	263.60	277.00	274.60									SUBSURFACE DETENTION SYSTEM #1 WEST INLET
	DMH 24-3	DMH 24-5	0.41	6.76	8.02	3.33	15	0.017	0.011	10.04	8.18	2.71	173.6	0.35	3.00	263.50	260.50	274.60	274.60									
	DMH 24-4	DMH 24-5	1.06	7.83	7.44	7.89	18	0.048	0.011	27.22	15.40	4.47	20.8	0.02	1.00	261.00	260.00	274.60	274.60	SUBSURFACE DETENTION SYSTEM #1 WEST INLET								
	DMH 24-5	WEST INLET	1.48	7.85	7.44	10.98	18	0.056	0.011	29.26	16.56	6.21	4.5	0.00	0.25	258.75	258.50	274.60			SUBSURFACE DETENTION SYSTEM #1 WEST INLET							
																						SUBSURFACE DETENTION SYSTEM #1 WEST INLET						
	DMH 24-6	DMH 24-11	0.40	6.28	8.02	3.23	18	0.005	0.011	9.05	5.12	1.83	663.6	2.16	3.53	270.65	267.12	276.50	285.70				SUBSURFACE DETENTION SYSTEM #1 EAST INLET					
	DMH 24-11	DMH 24-12	7.73	6.08	8.02	61.96	30	0.023	0.011	73.99	15.07	12.62	75.5	0.08	1.76	266.92	265.16	285.70	277.00					SUBSURFACE DETENTION SYSTEM #1 EAST INLET				
	DMH 24-12	DMH 24-13	7.73	6.17	8.02	61.96	36	0.012	0.011	86.68	12.26	8.77	104.2	0.14	1.26	264.66	263.40	277.00	275.70						SUBSURFACE DETENTION SYSTEM #1 EAST INLET			
	DMH 24-13	DMH 24-14	7.84	6.31	8.02	62.90	36	0.013	0.011	91.28	12.91	8.90	185.7	0.24	2.49	263.30	260.81	275.70	274.30							SUBSURFACE DETENTION SYSTEM #1 EAST INLET		
	DMH 24-14	DMH 24-15	7.95	6.55	8.02	63.80	36	0.010	0.011	79.43	11.24	9.03	49.2	0.07	0.50	260.71	260.21	274.30	273.80								SUBSURFACE DETENTION SYSTEM #1 EAST INLET	
	DMH 24-15	DMH 24-16	8.22	6.62	8.02	65.91	36	0.065	0.011	201.05	28.44	9.32	32.3	0.02	2.10	260.10	258.00	273.80	273.50									SUBSURFACE DETENTION SYSTEM #1 EAST INLET
	DMH 24-16	UGND BASIN	8.80	6.64	8.02	70.57	36	0.010	0.011	80.52	11.39	9.98	5.8	0.01	0.06	257.06	257.00	273.50										
**	DMH 24-15	DMH 24-19	0.00	6.00	8.02	9.80	18	0.010	0.011	12.57	7.11	5.55	27.3	0.06	0.28	258.00	257.72	273.80	273.40	SUBSURFACE DETENTION SYSTEM #1 EAST INLET								
**	DMH 24-19	UGND BASIN	0.84	6.00	8.02	9.80	24	0.010	0.011	26.74	8.51	3.12	14.2	0.03	0.60	262.00	261.40	273.40			SUBSURFACE DETENTION SYSTEM #1 EAST INLET							

Pipe lengths were taken from center of structures

* 25 Year basin outflow from HydroCAD used to approximate design flow

** Required water quality volume

Basin Drawdown Tabulation

DRAWDOWN CONFIGURATION:

F4593 Post-Development 10-22

NOAA10 24-hr D 100-yr Rainfall=8.18"

Prepared by Guerriere & Halnon Inc

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Summary for Pond 4P: EX. BASIN #1

Inflow Area = 1.747 ac, 58.18% Impervious, Inflow Depth = 5.03" for 100-yr event
 Inflow = 10.77 cfs @ 12.13 hrs, Volume= 0.733 af
 Outflow = 4.57 cfs @ 12.23 hrs, Volume= 0.733 af, Atten= 58%, Lag= 6.2 min
 Discarded = 0.22 cfs @ 12.23 hrs, Volume= 0.458 af
 Primary = 4.35 cfs @ 12.23 hrs, Volume= 0.275 af
 Routed to Pond 2P : DMH 24-5

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 275.21' @ 12.23 hrs Surf.Area= 9,236 sf Storage= 11,001 cf

Plug-Flow detention time= 350.5 min calculated for 0.733 af (100% of inflow)
 Center-of-Mass det. time= 350.4 min (1,186.1 - 835.6)

Volume	Invert	Avail.Storage	Storage Description
#1	273.40'	31,754 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
273.40	1,731	0	0
274.00	5,352	2,125	2,125
275.00	8,670	7,011	9,136
276.00	11,387	10,029	19,164
277.00	13,793	12,590	31,754

Device	Routing	Invert	Outlet Devices
#1	Primary	272.50'	12.0" Round Culvert L= 75.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 272.50' / 271.90' S= 0.0079 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	275.00'	34.0" x 50.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Discarded	273.40'	1.020 in/hr Exfiltration over Surface area Phase-In= 0.01'

Discarded OutFlow Max=0.22 cfs @ 12.23 hrs HW=275.21' (Free Discharge)
 ↑**3=Exfiltration** (Exfiltration Controls 0.22 cfs)

Primary OutFlow Max=4.35 cfs @ 12.23 hrs HW=275.21' TW=0.00' (Dynamic Tailwater)
 ↑**1=Culvert** (Passes 4.35 cfs of 4.86 cfs potential flow)
 ↑**2=Orifice/Grate** (Weir Controls 4.35 cfs @ 1.49 fps)

F4593 Post-Development 10-22

NOAA10 24-hr D 100-yr Rainfall=8.18"

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Hydrograph for Pond 4P: EX. BASIN #1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	273.40	0.00	0.00	0.00
2.00	0.00	0	273.40	0.00	0.00	0.00
4.00	0.01	5	273.40	0.01	0.01	0.00
6.00	0.05	19	273.41	0.04	0.04	0.00
8.00	0.12	260	273.52	0.06	0.06	0.00
10.00	0.29	1,114	273.79	0.10	0.10	0.00
12.00	4.71	5,788	274.58	0.17	0.17	0.00
14.00	0.54	9,480	275.04	0.57	0.21	0.36
16.00	0.37	9,341	275.02	0.37	0.21	0.17
18.00	0.32	9,298	275.02	0.32	0.21	0.12
20.00	0.26	9,247	275.01	0.27	0.21	0.07
22.00	0.21	9,180	275.01	0.22	0.21	0.02
24.00	0.16	9,003	274.98	0.20	0.20	0.00
26.00	0.00	7,634	274.82	0.19	0.19	0.00
28.00	0.00	6,309	274.65	0.18	0.18	0.00
30.00	0.00	5,080	274.48	0.16	0.16	0.00
32.00	0.00	3,947	274.31	0.15	0.15	0.00
34.00	0.00	2,910	274.14	0.14	0.14	0.00
36.00	0.00	1,970	273.97	0.12	0.12	0.00
38.00	0.00	1,178	273.80	0.10	0.10	0.00
40.00	0.00	560	273.63	0.07	0.07	0.00
42.00	0.00	116	273.46	0.05	0.05	0.00
44.00	0.00	0	273.40	0.00	0.00	0.00
46.00	0.00	0	273.40	0.00	0.00	0.00
48.00	0.00	0	273.40	0.00	0.00	0.00
50.00	0.00	0	273.40	0.00	0.00	0.00
52.00	0.00	0	273.40	0.00	0.00	0.00
54.00	0.00	0	273.40	0.00	0.00	0.00
56.00	0.00	0	273.40	0.00	0.00	0.00
58.00	0.00	0	273.40	0.00	0.00	0.00
60.00	0.00	0	273.40	0.00	0.00	0.00
62.00	0.00	0	273.40	0.00	0.00	0.00
64.00	0.00	0	273.40	0.00	0.00	0.00
66.00	0.00	0	273.40	0.00	0.00	0.00
68.00	0.00	0	273.40	0.00	0.00	0.00
70.00	0.00	0	273.40	0.00	0.00	0.00
72.00	0.00	0	273.40	0.00	0.00	0.00

DRAWDOWN CONFIGURATION:

F4593 Post-Development 10-22

NOAA10 24-hr D 100-yr Rainfall=8.18"

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Summary for Pond 5P: EX. BASIN #2

Inflow Area = 15.896 ac, 87.23% Impervious, Inflow Depth = 6.68" for 100-yr event
 Inflow = 25.69 cfs @ 12.34 hrs, Volume= 8.848 af
 Outflow = 4.72 cfs @ 15.58 hrs, Volume= 8.848 af, Atten= 82%, Lag= 194.5 min
 Discarded = 1.93 cfs @ 15.58 hrs, Volume= 7.381 af
 Primary = 2.80 cfs @ 15.58 hrs, Volume= 1.467 af
 Routed to Pond AP-1 : Southern Wetlands
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond AP-1 : Southern Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 256.75' @ 15.58 hrs Surf.Area= 34,507 sf Storage= 140,721 cf

Plug-Flow detention time= 553.5 min calculated for 8.847 af (100% of inflow)
 Center-of-Mass det. time= 553.4 min (1,637.7 - 1,084.3)

Volume	Invert	Avail.Storage	Storage Description
#1	252.00'	222,384 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
252.00	2,679	0	0
252.50	27,225	7,476	7,476
253.00	29,112	14,084	21,560
254.00	30,548	29,830	51,390
255.00	31,966	31,257	82,647
256.00	33,393	32,680	115,327
257.00	34,883	34,138	149,465
258.00	36,434	35,659	185,123
259.00	38,088	37,261	222,384

Device	Routing	Invert	Outlet Devices
#1	Secondary	257.70'	9.0' long x 15.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	254.96'	12.0" Round Culvert L= 28.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 254.96' / 254.86' S= 0.0035 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#3	Device 2	256.20'	12.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Discarded	252.00'	2.410 in/hr Exfiltration over Surface area Phase-In= 0.01'

F4593 Post-Development 10-22

NOAA10 24-hr D 100-yr Rainfall=8.18"

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Discarded OutFlow Max=1.93 cfs @ 15.58 hrs HW=256.75' (Free Discharge)

↑**4=Exfiltration** (Exfiltration Controls 1.93 cfs)

Primary OutFlow Max=2.80 cfs @ 15.58 hrs HW=256.75' TW=0.00' (Dynamic Tailwater)

↑**2=Culvert** (Passes 2.80 cfs of 3.83 cfs potential flow)

↑**3=Orifice/Grate** (Orifice Controls 2.80 cfs @ 3.56 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=252.00' TW=0.00' (Dynamic Tailwater)

↑**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

F4593 Post-Development 10-22

NOAA10 24-hr D 100-yr Rainfall=8.18"

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Hydrograph for Pond 5P: EX. BASIN #2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	0	252.00	0.00	0.00	0.00	0.00
2.00	0.42	194	252.05	0.29	0.29	0.00	0.00
4.00	1.28	2,338	252.26	0.86	0.86	0.00	0.00
6.00	1.89	5,873	252.44	1.35	1.35	0.00	0.00
8.00	2.38	10,683	252.62	1.54	1.54	0.00	0.00
10.00	3.08	18,290	252.89	1.60	1.60	0.00	0.00
12.00	11.71	37,789	253.55	1.67	1.67	0.00	0.00
14.00	8.47	129,883	256.43	3.04	1.90	1.15	0.00
16.00	4.30	140,389	256.74	4.70	1.92	2.77	0.00
18.00	3.57	135,709	256.60	4.31	1.91	2.40	0.00
20.00	2.90	131,337	256.47	3.38	1.90	1.48	0.00
22.00	2.26	128,162	256.38	2.69	1.89	0.79	0.00
24.00	1.72	125,071	256.29	2.16	1.89	0.28	0.00
26.00	0.69	117,021	256.05	1.87	1.87	0.00	0.00
28.00	0.69	108,606	255.80	1.85	1.85	0.00	0.00
30.00	0.68	100,307	255.55	1.83	1.83	0.00	0.00
32.00	0.67	92,097	255.29	1.81	1.81	0.00	0.00
34.00	0.66	83,951	255.04	1.79	1.79	0.00	0.00
36.00	0.64	75,851	254.79	1.77	1.77	0.00	0.00
38.00	0.63	67,788	254.53	1.75	1.75	0.00	0.00
40.00	0.63	59,859	254.28	1.73	1.73	0.00	0.00
42.00	0.61	51,991	254.02	1.71	1.71	0.00	0.00
44.00	0.60	44,135	253.76	1.69	1.69	0.00	0.00
46.00	0.57	36,270	253.50	1.66	1.66	0.00	0.00
48.00	0.54	28,360	253.23	1.64	1.64	0.00	0.00
50.00	0.50	20,362	252.96	1.62	1.62	0.00	0.00
52.00	0.43	12,285	252.67	1.56	1.56	0.00	0.00
54.00	0.32	4,518	252.38	1.18	1.18	0.00	0.00
56.00	0.16	514	252.10	0.42	0.42	0.00	0.00
58.00	0.03	6	252.00	0.03	0.03	0.00	0.00
60.00	0.01	2	252.00	0.01	0.01	0.00	0.00
62.00	0.00	1	252.00	0.00	0.00	0.00	0.00
64.00	0.00	0	252.00	0.00	0.00	0.00	0.00
66.00	0.00	0	252.00	0.00	0.00	0.00	0.00
68.00	0.00	0	252.00	0.00	0.00	0.00	0.00
70.00	0.00	0	252.00	0.00	0.00	0.00	0.00
72.00	0.00	0	252.00	0.00	0.00	0.00	0.00

DRAWDOWN CONFIGURATION:

F4593 Post-Development 10-22

NOAA10 24-hr D 100-yr Rainfall=8.18"

Prepared by Guerriere & Halnon Inc

Printed 11/5/2024

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Summary for Pond 1P: SUBSURFACE DETENTION

NOTE: A -0.6' ROW LENGTH ADJUSTMENT HAS BEEN APPLIED TO ACCOUNT FOR A 4' LONG INTERNAL MANHOLE IN THE FINAL ROW, WHICH SERVES AS AN OUTLET CONTROL STRUCTURE. THIS ROW ADJUSTMENT SPREADS THE LOSS IN STORAGE ACROSS ALL 7 ROWS TO MAINTAIN AN ACCURATE TOTAL STORAGE VOLUME FOR THE SYSTEM.

Inflow Area = 14.880 ac, 88.78% Impervious, Inflow Depth = 6.78" for 100-yr event
Inflow = 102.87 cfs @ 12.13 hrs, Volume= 8.407 af
Outflow = 24.24 cfs @ 12.35 hrs, Volume= 8.407 af, Atten= 76%, Lag= 13.1 min
Primary = 24.24 cfs @ 12.35 hrs, Volume= 8.407 af
Routed to Pond 5P : EX. BASIN #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 259.07' @ 12.35 hrs Surf.Area= 0.590 ac Storage= 2.645 af

Plug-Flow detention time= 336.6 min calculated for 8.406 af (100% of inflow)
Center-of-Mass det. time= 336.9 min (1,097.3 - 760.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	252.00'	0.000 af	74.00'W x 347.40'L x 8.50'H Field A 5.016 af Overall - 2.827 af Embedded = 2.189 af x 0.0% Voids
#2A	252.00'	2.827 af	CMP Round 96 x 119 Inside #1 Effective Size= 96.0"W x 96.0"H => 50.27 sf x 20.00'L = 1,005.3 cf Overall Size= 96.0"W x 96.0"H x 20.00'L Row Length Adjustment= -0.60' x 50.27 sf x 7 rows 74.00' Header x 50.27 sf x 1 = 3,719.6 cf Inside
		2.827 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Device 4	252.00'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Device 4	254.50'	12.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Device 4	258.50'	Custom Weir/Orifice, Cv= 2.62 (C= 3.28) Head (feet) 6.50 6.56 6.64 6.72 6.80 6.88 6.96 7.04 7.12 7.20 7.28 7.36 7.44 7.52 7.60 7.68 7.76 7.84 7.92 8.00 Width (feet) 6.25 6.15 6.01 5.87 5.71 5.55 5.38 5.20 5.01 4.80 4.58 4.34 4.08 3.80 3.49 3.14 2.73 2.24 1.59 0.00
#4	Primary	251.90'	36.0" Round Culvert L= 28.6' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 251.90' / 251.50' S= 0.0140 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 7.07 sf

Primary OutFlow Max=24.22 cfs @ 12.35 hrs HW=259.07' TW=254.29' (Dynamic Tailwater)

- ↑ **4=Culvert** (Passes 24.22 cfs of 74.48 cfs potential flow)
- ↑ **1=Orifice/Grate** (Orifice Controls 8.28 cfs @ 10.54 fps)
- ↑ **2=Orifice/Grate** (Orifice Controls 7.63 cfs @ 9.72 fps)
- ↑ **3=Custom Weir/Orifice** (Weir Controls 8.31 cfs @ 2.53 fps)

F4593 Post-Development 10-22

Prepared by Guerriere & Halnon Inc

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NOAA10 24-hr D 100-yr Rainfall=8.18"

Printed 11/5/2024

Hydrograph for Pond 1P: SUBSURFACE DETENTION

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.000	252.00	0.00
2.00	0.82	0.038	252.32	0.42
4.00	1.57	0.095	252.60	1.28
6.00	2.18	0.143	252.78	1.87
8.00	2.75	0.201	252.99	2.31
10.00	4.35	0.358	253.47	2.90
12.00	51.41	1.293	255.73	8.84
14.00	5.12	2.108	257.59	8.15
16.00	3.32	1.872	257.03	4.09
18.00	2.81	1.772	256.80	3.38
20.00	2.29	1.685	256.61	2.74
22.00	1.78	1.621	256.46	2.14
24.00	1.27	1.565	256.34	1.63
26.00	0.00	1.441	256.06	0.69
28.00	0.00	1.327	255.81	0.69
30.00	0.00	1.214	255.56	0.68
32.00	0.00	1.102	255.30	0.67
34.00	0.00	0.992	255.05	0.66
36.00	0.00	0.884	254.81	0.64
38.00	0.00	0.779	254.56	0.63
40.00	0.00	0.674	254.30	0.63
42.00	0.00	0.571	254.05	0.61
44.00	0.00	0.471	253.79	0.60
46.00	0.00	0.375	253.52	0.57
48.00	0.00	0.283	253.25	0.54
50.00	0.00	0.197	252.98	0.50
52.00	0.00	0.121	252.70	0.43
54.00	0.00	0.058	252.42	0.32
56.00	0.00	0.018	252.19	0.16
58.00	0.00	0.005	252.09	0.03
60.00	0.00	0.002	252.05	0.01
62.00	0.00	0.000	252.03	0.00
64.00	0.00	0.000	252.01	0.00
66.00	0.00	0.000	252.01	0.00
68.00	0.00	0.000	252.01	0.00
70.00	0.00	0.000	252.01	0.00
72.00	0.00	0.000	252.01	0.00

NRCS Soils Report



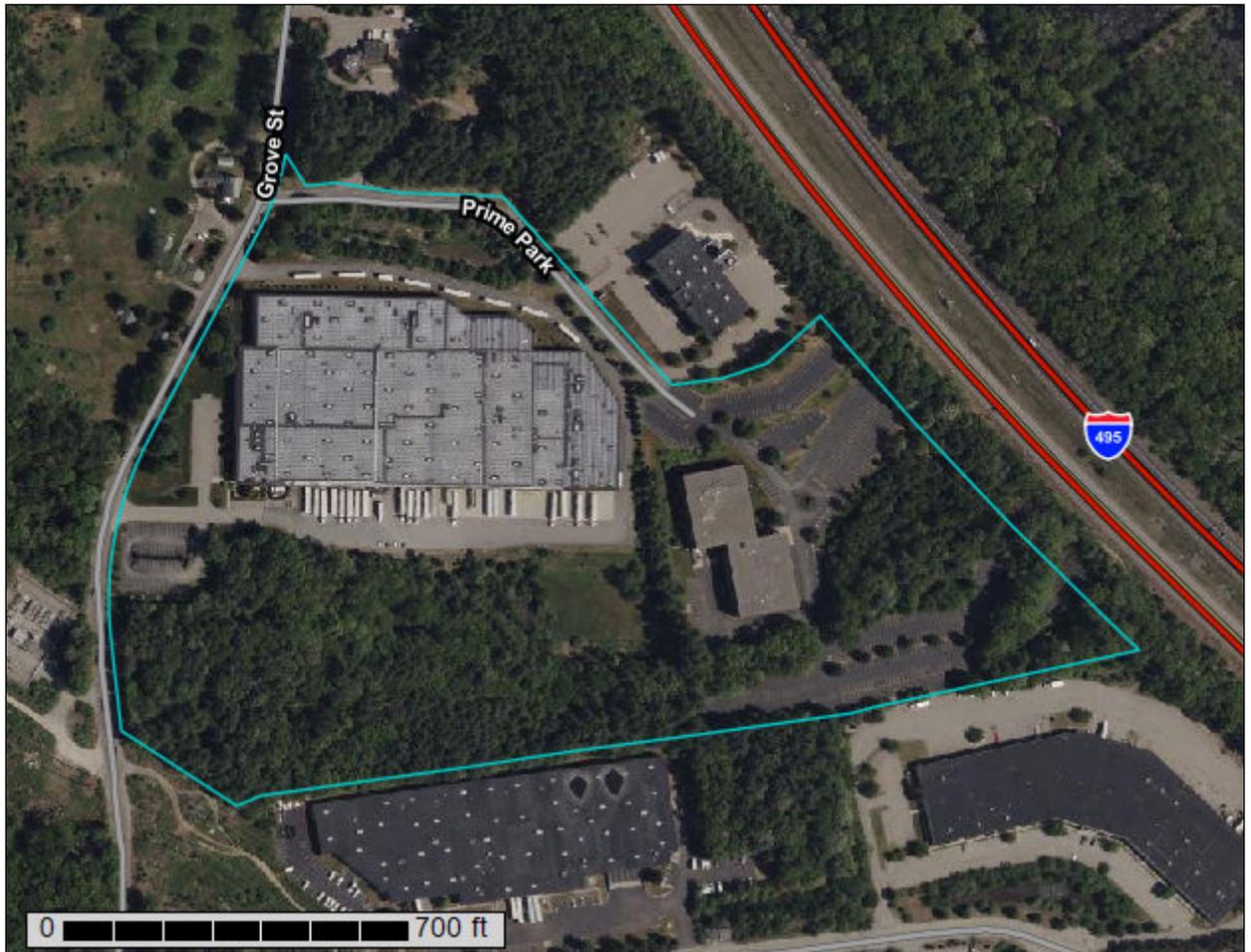
United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

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

Custom Soil Resource Report for Norfolk and Suffolk Counties, Massachusetts



Preface

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

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

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

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

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

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

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How Soil Surveys Are Made

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

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

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

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

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

Custom Soil Resource Report

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

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

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

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

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

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

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

Custom Soil Resource Report

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

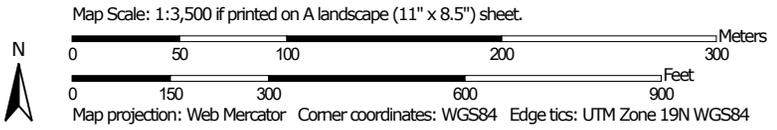
Soil Map

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

Custom Soil Resource Report Soil Map



Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features

Water Features

 Streams and Canals

Transportation

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

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
 Survey Area Data: Version 20, Aug 27, 2024

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	0.9	2.4%
10	Scarboro and Birdsall soils, 0 to 3 percent slopes	3.3	8.7%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	0.0	0.1%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	4.8	12.8%
245B	Hinckley loamy sand, 3 to 8 percent slopes	5.2	14.0%
253D	Hinckley loamy sand, 15 to 35 percent slopes	4.1	11.0%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	6.9	18.4%
255C	Windsor loamy sand, 8 to 15 percent slopes	7.6	20.3%
653	Udorthents, sandy	4.6	12.2%
Totals for Area of Interest		37.5	100.0%

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They

Custom Soil Resource Report

generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

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

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

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

Norfolk and Suffolk Counties, Massachusetts

1—Water

Map Unit Setting

National map unit symbol: vkyp
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 120 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

10—Scarboro and Birdsall soils, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: vkxw
Elevation: 0 to 2,100 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Scarboro and similar soils: 65 percent
Birdsall and similar soils: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scarboro

Setting

Landform: Terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 9 inches: mucky fine sandy loam
H2 - 9 to 60 inches: stratified loamy fine sand to gravelly coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)

Custom Soil Resource Report

Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F144AY031MA - Very Wet Outwash
Hydric soil rating: Yes

Description of Birdsall

Setting

Landform: Terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Soft coarse-silty glaciolacustrine deposits

Typical profile

H1 - 0 to 8 inches: very fine sandy loam
H2 - 8 to 16 inches: very fine sandy loam
H3 - 16 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Very high (about 12.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Ecological site: F144AY031MA - Very Wet Outwash
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Bogs
Hydric soil rating: Yes

Raynham

Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: Yes

Walpole

Percent of map unit: 2 percent
Landform: Terraces
Hydric soil rating: Yes

71B—Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69c
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Ridgebury, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ridgebury, Extremely Stony

Setting

Landform: Drumlins, depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None

Custom Soil Resource Report

Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY009CT - Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Woodbridge, extremely stony

Percent of map unit: 10 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony

Percent of map unit: 8 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

103B—Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vktd
Elevation: 0 to 480 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton and similar soils: 40 percent
Hollis and similar soils: 25 percent
Rock outcrop: 20 percent

Custom Soil Resource Report

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

Description of Charlton

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable coarse-loamy ablation till derived from granite

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 36 inches: fine sandy loam
H3 - 36 to 60 inches: fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Shallow, friable loamy ablation till derived from igneous rock

Typical profile

H1 - 0 to 3 inches: fine sandy loam
H2 - 3 to 14 inches: gravelly fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained

Custom Soil Resource Report

Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: D

Ecological site: F144AY033MA - Shallow Dry Till Uplands

Hydric soil rating: No

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8s

Hydric soil rating: Unranked

Minor Components

Canton

Percent of map unit: 7 percent

Hydric soil rating: No

Chatfield

Percent of map unit: 5 percent

Hydric soil rating: No

Scituate

Percent of map unit: 2 percent

Hydric soil rating: No

Whitman

Percent of map unit: 1 percent

Landform: Depressions

Hydric soil rating: Yes

245B—Hinckley loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2svm8

Elevation: 0 to 1,430 feet

Mean annual precipitation: 36 to 53 inches

Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 140 to 250 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash deltas, outwash terraces, kames, kame terraces, moraines, eskers, outwash plains

Landform position (two-dimensional): Summit, shoulder, backslope, footslope

Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread

Down-slope shape: Concave, convex, linear

Across-slope shape: Convex, linear, concave

Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material

A - 1 to 8 inches: loamy sand

Bw1 - 8 to 11 inches: gravelly loamy sand

Bw2 - 11 to 16 inches: gravelly loamy sand

BC - 16 to 19 inches: very gravelly loamy sand

C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Excessively drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)

Custom Soil Resource Report

Available water supply, 0 to 60 inches: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3s

Hydrologic Soil Group: A

Ecological site: F144AY022MA - Dry Outwash

Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 8 percent

Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces

Landform position (two-dimensional): Summit, shoulder, backslope, footslope

Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread

Down-slope shape: Concave, convex, linear

Across-slope shape: Convex, linear, concave

Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent

Landform: Outwash deltas, outwash terraces, moraines, outwash plains, kame terraces

Landform position (two-dimensional): Backslope, footslope

Landform position (three-dimensional): Head slope, side slope, base slope, tread

Down-slope shape: Concave, linear

Across-slope shape: Concave, linear

Hydric soil rating: No

Agawam

Percent of map unit: 2 percent

Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces

Landform position (two-dimensional): Summit, shoulder, backslope, footslope

Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread

Down-slope shape: Concave, convex, linear

Across-slope shape: Convex, linear, concave

Hydric soil rating: No

253D—Hinckley loamy sand, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2svmd

Elevation: 0 to 860 feet

Mean annual precipitation: 36 to 71 inches

Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 140 to 240 days

Custom Soil Resource Report

Farmland classification: Not prime farmland

Map Unit Composition

Hinckley and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser

Down-slope shape: Concave, convex, linear

Across-slope shape: Convex, linear, concave

Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material

A - 1 to 8 inches: loamy sand

Bw1 - 8 to 11 inches: gravelly loamy sand

Bw2 - 11 to 16 inches: gravelly loamy sand

BC - 16 to 19 inches: very gravelly loamy sand

C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 15 to 35 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Excessively drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)

Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: A

Ecological site: F144AY022MA - Dry Outwash

Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 10 percent

Landform: Moraines, eskers, kames, outwash deltas, outwash terraces, outwash plains, kame terraces

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser

Custom Soil Resource Report

Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Merrimac

Percent of map unit: 3 percent
Landform: Kame terraces, outwash plains, outwash terraces, moraines, eskers, kames
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 2 percent
Landform: Outwash deltas, outwash plains, kame terraces, outwash terraces, moraines
Landform position (two-dimensional): Backslope, footslope, toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: No

254B—Merrimac fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyqs
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Merrimac and similar soils: 86 percent
Minor components: 14 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Outwash plains, outwash terraces, moraines, eskers, kames
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex

Custom Soil Resource Report

Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F145XY008MA - Dry Outwash
Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 5 percent
Landform: Deltas, kames, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash plains, deltas, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Windsor

Percent of map unit: 3 percent
Landform: Dunes, deltas, outwash terraces, outwash plains
Landform position (two-dimensional): Summit

Custom Soil Resource Report

Landform position (three-dimensional): Tread, riser
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Walpole

Percent of map unit: 1 percent
Landform: Depressions
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: F144AY028MA - Wet Outwash
Hydric soil rating: Yes

255C—Windsor loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svkq
Elevation: 0 to 1,260 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Windsor

Setting

Landform: — error in exists on —
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, riser
Down-slope shape: Convex
Across-slope shape: Convex, linear
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
Ap - 1 to 11 inches: loamy sand
Bw - 11 to 31 inches: loamy sand
C - 31 to 65 inches: sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained

Custom Soil Resource Report

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)

Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: A

Ecological site: F144AY022MA - Dry Outwash

Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 10 percent

Landform: Deltas, kames, eskers, outwash plains

Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Head slope, nose slope, side slope, crest, rise

Down-slope shape: Convex

Across-slope shape: Convex, linear

Hydric soil rating: No

Deerfield

Percent of map unit: 5 percent

Landform: Deltas, terraces, outwash plains

Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Tread, tal

Down-slope shape: Linear

Across-slope shape: Linear

Hydric soil rating: No

653—Udorthents, sandy

Map Unit Setting

National map unit symbol: vky8

Elevation: 0 to 3,000 feet

Mean annual precipitation: 45 to 54 inches

Mean annual air temperature: 43 to 54 degrees F

Frost-free period: 145 to 240 days

Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 85 percent

Minor components: 15 percent

Custom Soil Resource Report

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Landform position (two-dimensional): Shoulder, summit

Landform position (three-dimensional): Riser, tread

Down-slope shape: Convex, linear

Across-slope shape: Convex, linear

Parent material: Excavated and filled sandy glaciofluvial deposits

Typical profile

H1 - 0 to 6 inches: variable

H2 - 6 to 60 inches: variable

Properties and qualities

Slope: 0 to 25 percent

Depth to restrictive feature: More than 80 inches

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 20.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: A

Hydric soil rating: Unranked

Minor Components

Udorthents

Percent of map unit: 8 percent

Hydric soil rating: Unranked

Urban land

Percent of map unit: 5 percent

Hydric soil rating: Unranked

Swansea

Percent of map unit: 2 percent

Landform: Bogs

Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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.

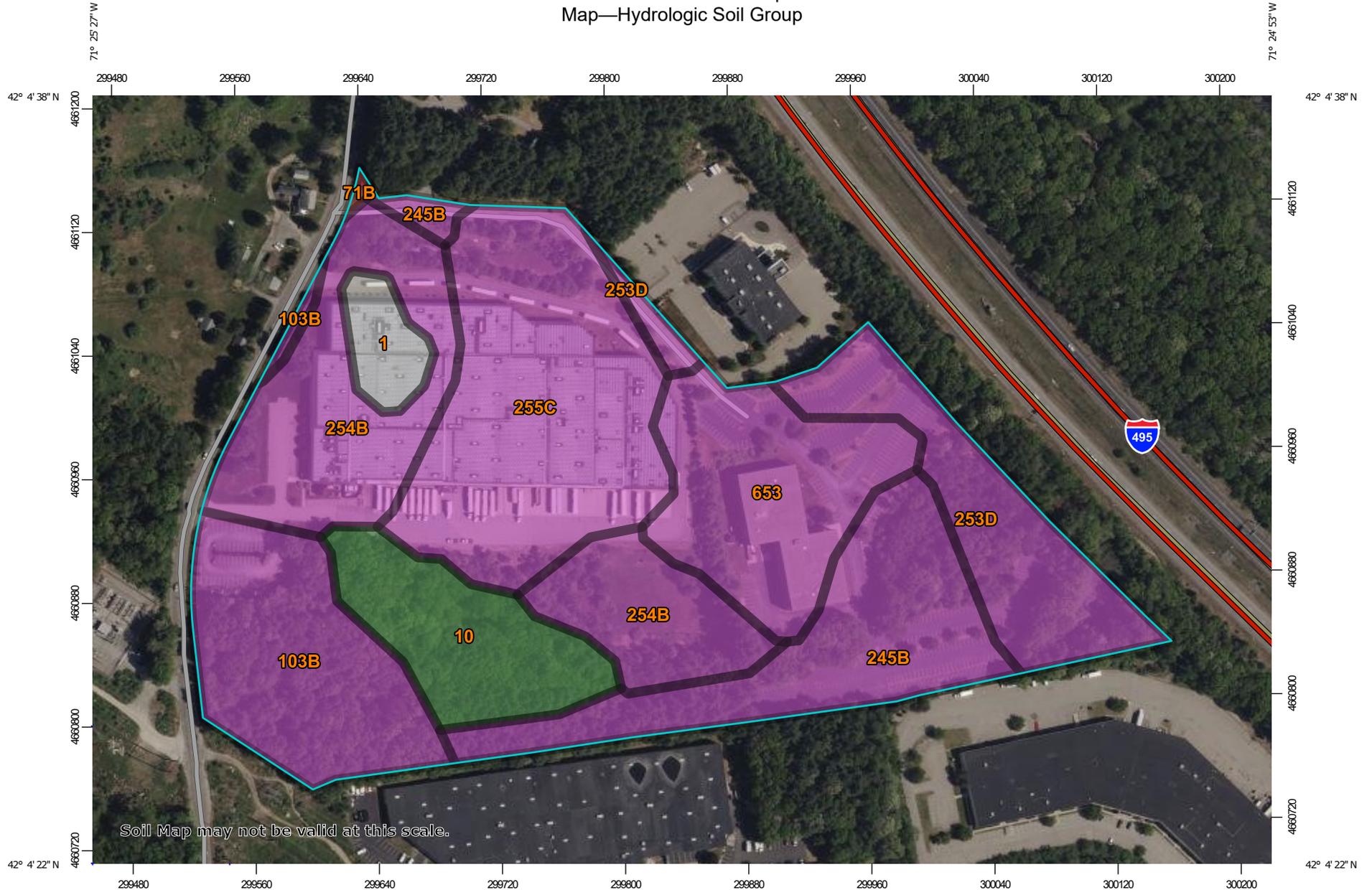
Custom Soil Resource Report

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.

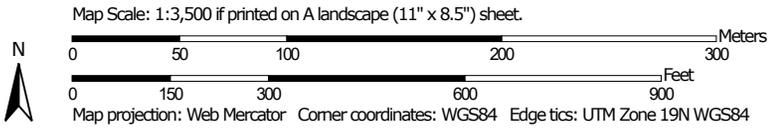
Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over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

Custom Soil Resource Report Map—Hydrologic Soil Group



Soil Map may not be valid at this scale.



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

Water Features

-  Streams and Canals

Transportation

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

Background

-  Aerial Photography

Soils

-  C
-  C/D
-  D
-  Not rated or not available

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
 Survey Area Data: Version 20, Aug 27, 2024

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

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

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		0.9	2.4%
10	Scarboro and Birdsall soils, 0 to 3 percent slopes	A/D	3.3	8.7%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	0.0	0.1%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	A	4.8	12.8%
245B	Hinckley loamy sand, 3 to 8 percent slopes	A	5.2	14.0%
253D	Hinckley loamy sand, 15 to 35 percent slopes	A	4.1	11.0%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	6.9	18.4%
255C	Windsor loamy sand, 8 to 15 percent slopes	A	7.6	20.3%
653	Udorthents, sandy	A	4.6	12.2%
Totals for Area of Interest			37.5	100.0%

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

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- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>

Custom Soil Resource Report

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

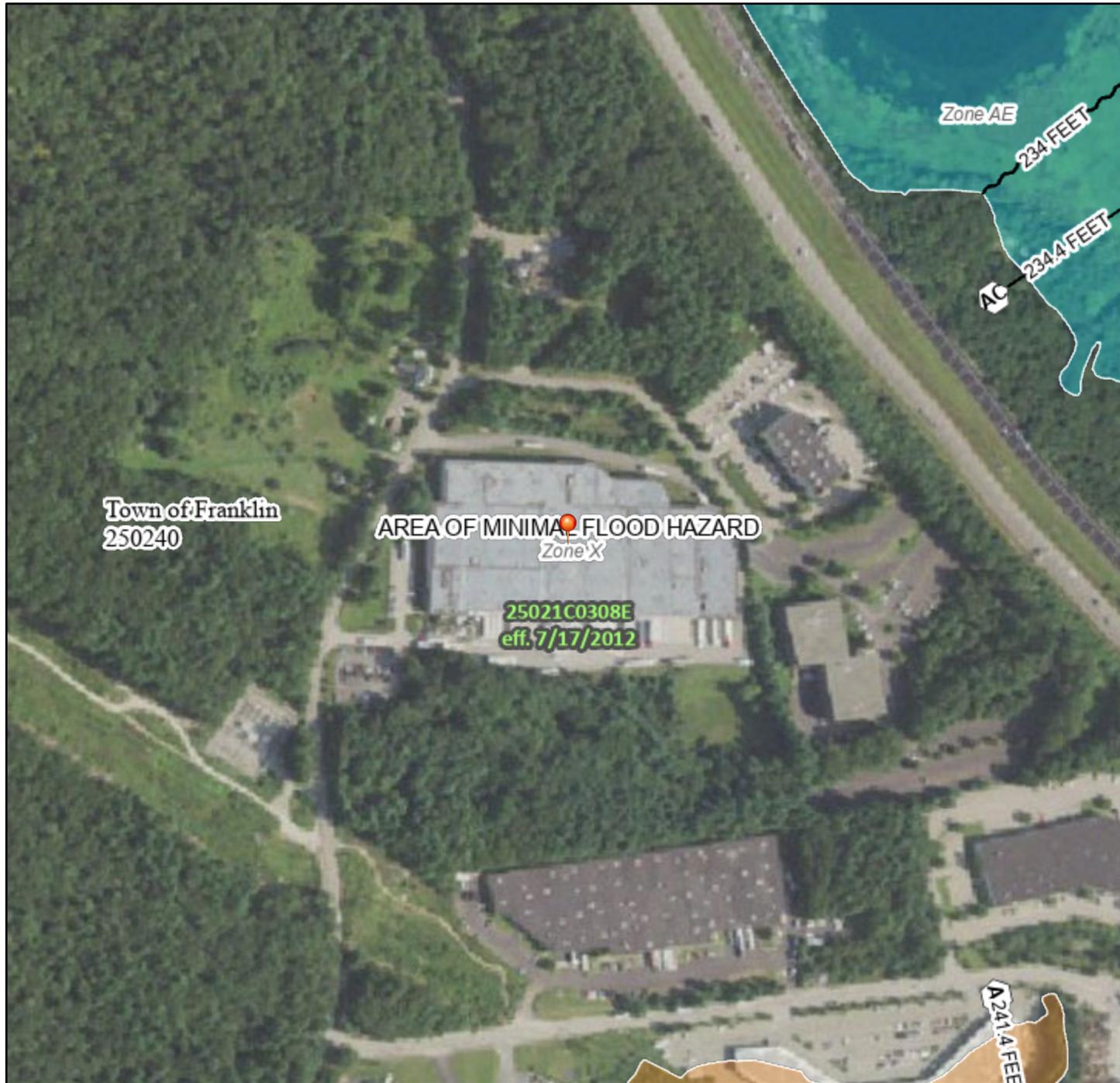
United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

National Flood Hazard Layer FIRMMette



71°25'35"W 42°4'45"N



Legend

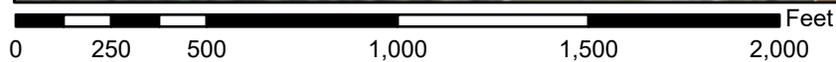
SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

- | | |
|---|--|
| <p>SPECIAL FLOOD HAZARD AREAS</p> | <p>Without Base Flood Elevation (BFE)
<i>Zone A, V, A99</i></p> <p>With BFE or Depth <i>Zone AE, AO, AH, VE, AR</i></p> <p>Regulatory Floodway</p> |
| <p>OTHER AREAS OF FLOOD HAZARD</p> | <p>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 <i>Zone X</i></p> <p>Future Conditions 1% Annual Chance Flood Hazard <i>Zone X</i></p> <p>Area with Reduced Flood Risk due to Levee. See Notes. <i>Zone X</i></p> <p>Area with Flood Risk due to Levee <i>Zone D</i></p> |
| <p>OTHER AREAS</p> | <p>NO SCREEN Area of Minimal Flood Hazard <i>Zone X</i></p> <p>Effective LOMRs</p> <p>Area of Undetermined Flood Hazard <i>Zone D</i></p> |
| <p>GENERAL STRUCTURES</p> | <p>Channel, Culvert, or Storm Sewer</p> <p>Levee, Dike, or Floodwall</p> |
| <p>OTHER FEATURES</p> | <p>Cross Sections with 1% Annual Chance Water Surface Elevation</p> <p>Coastal Transect</p> <p>Base Flood Elevation Line (BFE)</p> <p>Limit of Study</p> <p>Jurisdiction Boundary</p> <p>Coastal Transect Baseline</p> <p>Profile Baseline</p> <p>Hydrographic Feature</p> |
| <p>MAP PANELS</p> | <p>Digital Data Available</p> <p>No Digital Data Available</p> <p>Unmapped</p> |
- 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 **10/18/2024 at 3:35 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.



1:6,000

71°24'58"W 42°4'19"N

Basemap Imagery Source: USGS National Map 2023

TSS Removal Worksheet

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: 126 Grove Street - Infiltration Basin #2

TSS Removal Calculation Worksheet

A BMP ¹	B TSS Removal Rate ¹	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Hooded Catch Basin	0.25	1.00	0.25	0.75
Contech CS-6 / CS-8 Hydrodynamic Separator	0.50	0.75	0.375	0.375

Pretreatment

Total TSS Removal =

62.5%

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

Project: F-4593
 Prepared By: Michael Hassett
 Date: 10/23/2024

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location:

TSS Removal Calculation Worksheet

A BMP ¹	B TSS Removal Rate ¹	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Hooded Catch Basin	0.25	1.00	0.25	0.75
Contech CS-6 / CS-8 Hydrodynamic Separator	0.50	0.75	0.375	0.375
Subsurface Pipe Detention System	0.00	0.00	0.00	0.00
Infiltration Basin #2	0.80	0.375	0.30	0.075

Total TSS Removal =

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

Project:
 Prepared By:
 Date:

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location:

TSS Removal Calculation Worksheet

A BMP ¹	B TSS Removal Rate ¹	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Vegetated Filter Strip	0.25	1.00	0.25	0.75
Stormwater Basin #1	0.50	0.75	0.375	0.375

Pretreatment

Total TSS Removal =

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

Project:
 Prepared By:
 Date:

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location:

TSS Removal Calculation Worksheet

A BMP ¹	B TSS Removal Rate ¹	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Vegetated Filter Strip	0.25	1.00	0.25	0.75
Stormwater Basin #1	0.50	0.75	0.375	0.375
Contech CS-6 / CS-8 Hydrodynamic Separator	0.50	0.375	0.188	0.188
Subsurface Pipe Detention System	0.00	0.00	0.00	0.00
Infiltration Basin #2	0.80	0.188	0.15	0.04

Total TSS Removal =

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

Project:
 Prepared By:
 Date:

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

Contech worksheet

Estimated Net Annual Solids Load Reduction
Based on the Rational Rainfall Method



126 Grove Street
Franklin, MA
DMH 24-5



AREA	3.32	acres	CASCADE MODEL	CS-6	
WEIGHTED C	0.90		PARTICLE SIZE	110	microns
TC	6.00	minutes	RAINFALL STATION	68	

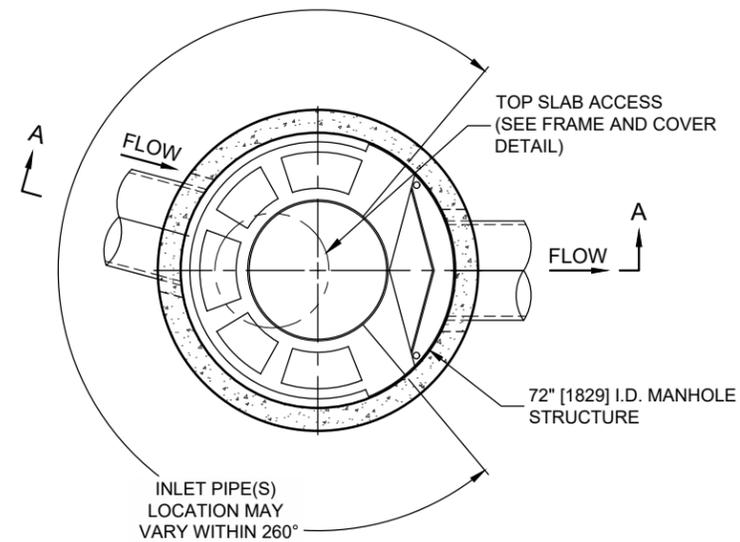
Rainfall Intensity ¹ (in/hr)	Percent Rainfall Volume ¹	Hydraulic Loading Rate (gpm/ft ²)	Removal Efficiency (%)	Incremental Removal (%)
0.02	9.3%	0.95	100.0	9.3
0.04	9.5%	1.90	100.0	9.5
0.06	8.7%	2.85	100.0	8.7
0.08	10.1%	3.80	100.0	10.1
0.10	7.2%	4.75	100.0	7.2
0.12	6.0%	5.70	100.0	6.0
0.14	6.3%	6.64	100.0	6.3
0.16	5.6%	7.59	100.0	5.6
0.18	4.7%	8.54	100.0	4.7
0.20	3.6%	9.49	100.0	3.6
0.25	8.2%	11.87	100.0	8.2
0.50	14.9%	23.73	89.6	13.4
0.75	3.2%	35.60	78.4	2.5
1.00	1.2%	47.46	67.3	0.8
1.50	0.7%	71.19	45.0	0.3
2.00	0.8%	94.92	22.7	0.2
				96.4

Removal Efficiency Adjustment ² =	6.5%
Predicted % Annual Rainfall Treated =	93.5%
Predicted Net Annual Load Removal Efficiency =	89.9%

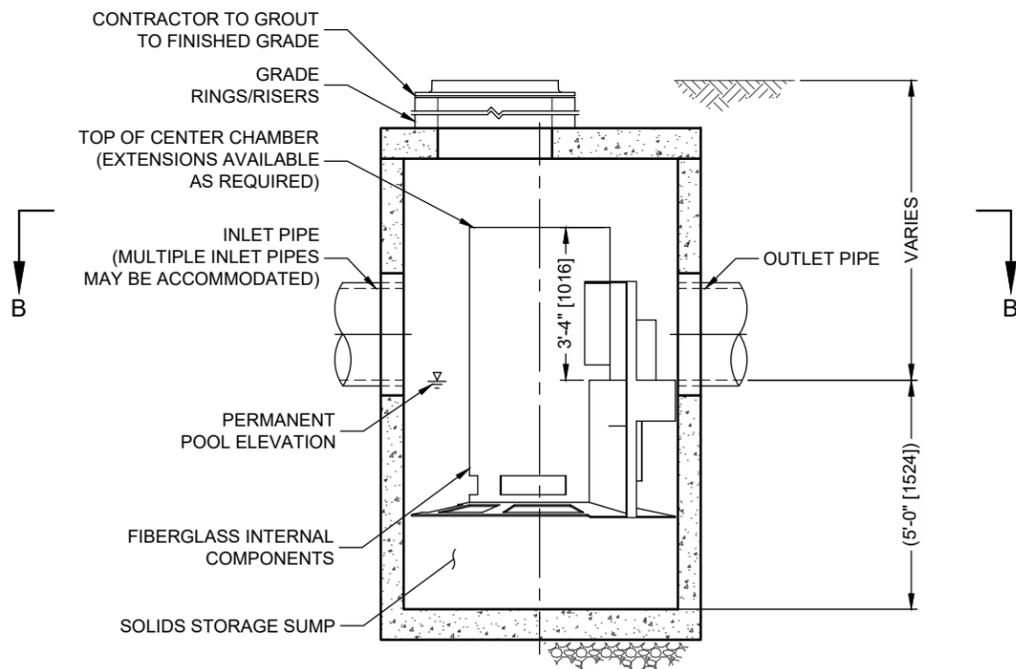
1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

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PLAN VIEW B-B
NOT TO SCALE



ELEVATION A-A
NOT TO SCALE

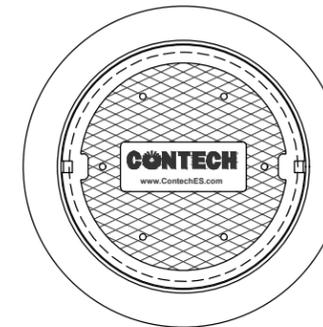
CASCADE
separator™

CASCADE SEPARATOR DESIGN NOTES

CS-6 RATED TREATMENT CAPACITY IS 5.6 CFS, OR PER LOCAL REGULATIONS. THE STANDARD CS-6 CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

CONFIGURATION DESCRIPTION

- GRATED INLET ONLY (NO INLET PIPE)
- GRATED INLET WITH INLET PIPE OR PIPES
- CURB INLET ONLY (NO INLET PIPE)
- CURB INLET WITH INLET PIPE OR PIPES



FRAME AND COVER
(DIAMETER VARIES)
NOT TO SCALE

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (cfs [L/s])			
PEAK FLOW RATE (cfs [L/s])			
RETURN PERIOD OF PEAK FLOW (yrs)			
RIM ELEVATION			
PIPE DATA:	INVERT	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			

NOTES / SPECIAL REQUIREMENTS:

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CASCADE SEPARATOR WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. CASCADE SEPARATOR STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2' [610], AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
5. CASCADE SEPARATOR STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C478 AND AASHTO LOAD FACTOR DESIGN METHOD.
6. ALTERNATE UNITS ARE SHOWN IN MILLIMETERS [mm].

INSTALLATION NOTES

- A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
- B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CASCADE SEPARATOR MANHOLE STRUCTURE.
- C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
- D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
- E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH
ENGINEERED SOLUTIONS LLC

www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CS-6
CASCADE SEPARATOR
STANDARD DETAIL

Estimated Net Annual Solids Load Reduction
Based on the Rational Rainfall Method



126 Grove Street
Franklin, MA
DMH 24-15



AREA	8.14	acres	CASCADE MODEL	CS-8	
WEIGHTED C	0.90		PARTICLE SIZE	110	microns
TC	6.00	minutes	RAINFALL STATION	68	

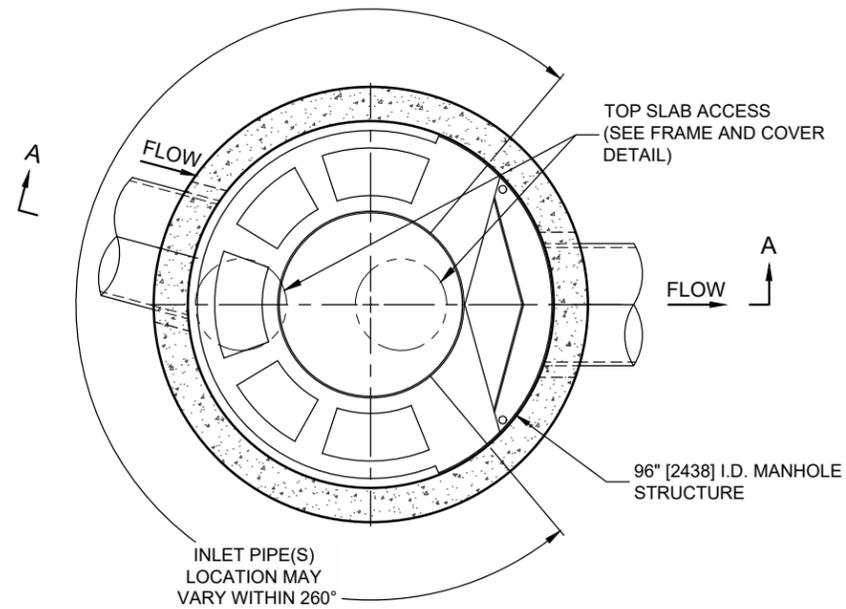
Rainfall Intensity ¹ (in/hr)	Percent Rainfall Volume ¹	Hydraulic Loading Rate (gpm/ft ²)	Removal Efficiency (%)	Incremental Removal (%)
0.02	9.3%	1.31	100.0	9.3
0.04	9.5%	2.62	100.0	9.5
0.06	8.7%	3.92	100.0	8.7
0.08	10.1%	5.23	100.0	10.1
0.10	7.2%	6.54	100.0	7.2
0.12	6.0%	7.85	100.0	6.0
0.14	6.3%	9.15	100.0	6.3
0.16	5.6%	10.46	100.0	5.6
0.18	4.7%	11.77	100.0	4.7
0.20	3.6%	13.08	99.6	3.6
0.25	8.2%	16.35	96.5	7.9
0.50	14.9%	32.70	81.2	12.1
0.75	3.2%	49.04	65.8	2.1
1.00	1.2%	65.39	50.4	0.6
1.50	0.7%	98.09	19.7	0.1
2.00	0.8%	130.78	0.0	0.0
				93.8

Removal Efficiency Adjustment ² =	6.5%
Predicted % Annual Rainfall Treated =	93.5%
Predicted Net Annual Load Removal Efficiency =	87.4%

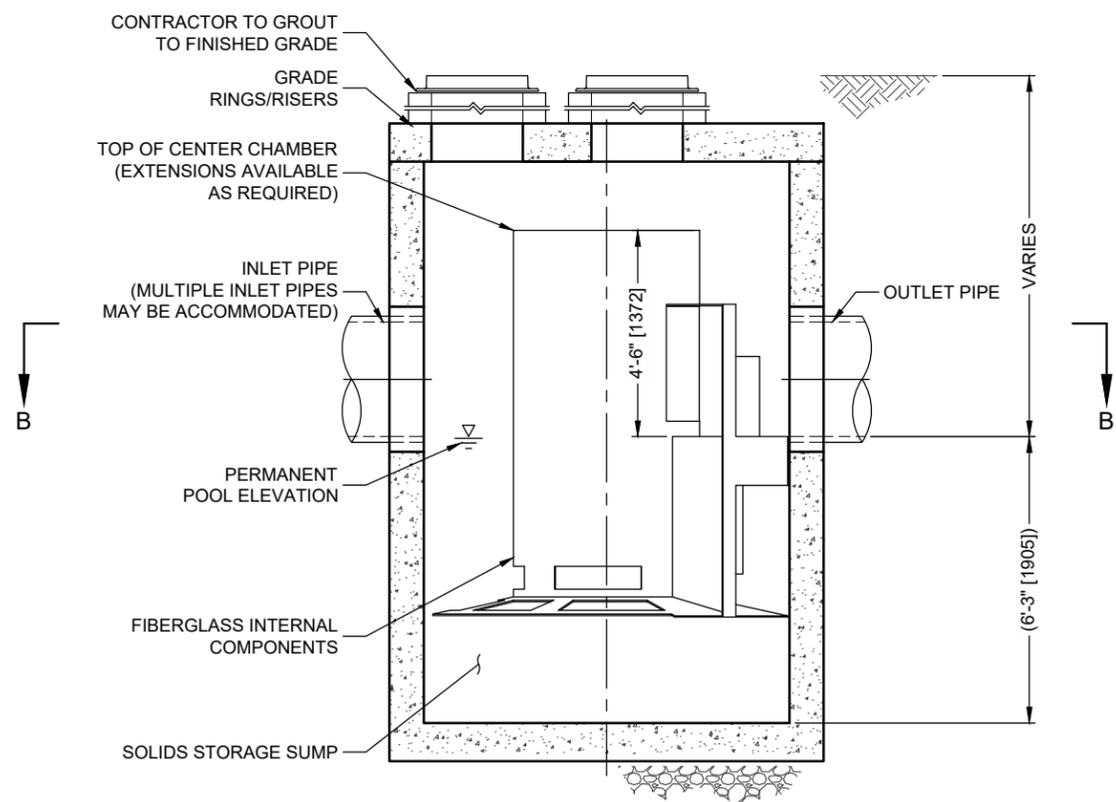
1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

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PLAN VIEW B-B
NOT TO SCALE



ELEVATION A-A
NOT TO SCALE

CASCADE
separator™

CASCADE SEPARATOR DESIGN NOTES

CS-8 RATED TREATMENT CAPACITY IS 12.00 CFS, OR PER LOCAL REGULATIONS. THE STANDARD CS-8 CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

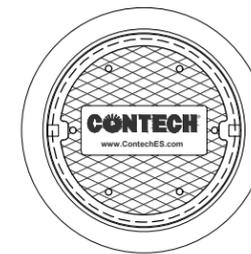
CONFIGURATION DESCRIPTION

- GRATED INLET ONLY (NO INLET PIPE)
- GRATED INLET WITH INLET PIPE OR PIPES
- CURB INLET ONLY (NO INLET PIPE)
- CURB INLET WITH INLET PIPE OR PIPES

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (cfs [L/s])			
PEAK FLOW RATE (cfs [L/s])			
RETURN PERIOD OF PEAK FLOW (yrs)			
RIM ELEVATION			
PIPE DATA:	INVERT	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			

NOTES / SPECIAL REQUIREMENTS:



FRAME AND COVER
(DIAMETER VARIES)
NOT TO SCALE

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.contechES.com
3. CASCADE SEPARATOR WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. CASCADE SEPARATOR STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2' [610], AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO.
5. CASCADE SEPARATOR STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C478 AND AASHTO LOAD FACTOR DESIGN METHOD.
6. ALTERNATE UNITS ARE SHOWN IN MILLIMETERS [mm].

INSTALLATION NOTES

- A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
- B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CASCADE SEPARATOR MANHOLE STRUCTURE.
- C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
- D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
- E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

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www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CS-8
CASCADE SEPARATOR
STANDARD DETAIL

SECTION (____)
STORM WATER TREATMENT DEVICE

1.0 GENERAL

- 1.1 This item shall govern the furnishing and installation of the Cascade Separator® by Contech Engineered Solutions LLC, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.
- 1.2 The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.
- 1.3 The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a Cascade Separator™ device manufactured by:

Contech Engineered Solutions LLC
9100 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

1.4 Related Sections

- 1.4.1 Section 02240: Dewatering
 - 1.4.2 Section 02260: Excavation Support and Protection
 - 1.4.3 Section 02315: Excavation and Fill
 - 1.4.4 Section 02340: Soil Stabilization
- 1.5 All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.
 - 1.6 The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.
 - 1.7 The SWTD manufacturer shall submit to the Engineer of Record a “Manufacturer’s Performance Certification” certifying that each SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research

- 1.8 No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

2.0 MATERIALS

- 2.1 Housing unit of stormwater treatment device shall be constructed of pre-cast or cast-in-place concrete, no exceptions. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:
 - 2.1.1 Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
 - 2.1.2 Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
 - 2.1.3 Cement shall be Type III Portland Cement conforming to ASTM C 150;
 - 2.1.4 Aggregates shall conform to ASTM C 33;
 - 2.1.5 Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
 - 2.1.6 Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
 - 2.1.7 Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.
- 2.2 Internal Components and appurtenances shall conform to the following:
 - 2.2.1 Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
 - 2.2.2 Support brackets shall be manufactured of 5052 aluminum
 - 2.2.3 Fiberglass components shall conform to applicable sections of ASTM D-4097
 - 2.2.4 Polypropylene copolymer components shall conform to a tensile strength of 3,600 psi (ASTM D-638), and Izod impact value of "no break" (ASTM D-256).
 - 2.2.5 Access system(s) conform to the following:
Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

3.0 PERFORMANCE

- 3.1 The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using the OK-110 particle distribution having particles ranging from 53 microns to 212 microns with a d50 of around 110 microns.
- 3.2 The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage

capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.

- 3.3 The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.
- 3.4 The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

4.0 EXECUTION

- 4.1 The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.
- 4.2 The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.
- 4.3 The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.
- 4.4 The contractor shall removal all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Owner.

TABLE 1: Storm Water Treatment Device Storage Capacities

Cascade Model	Minimum Sump Storage Capacity (yd ³)	Minimum Oil Storage Capacity (gal)
CS-3	0.41	59.0
CS-4	0.70	141.0
CS-5	1.09	269.3
CS-6	1.57	475.9
CS-8	2.79	1128.0
CS-10	4.36	2203.2
CS-12	6.28	3807.1

END OF SECTION



Center for Environmental Systems

Stevens Institute of Technology

One Castle Point

Hoboken, NJ 07030-0000

November 6, 2018

Gabriel Mahon, Chief
NJDEP
Bureau of Non-Point Pollution Control
Bureau of Water Quality
401 E. State Street
Mail Code 401-02B, PO Box 420
Trenton, NJ 08625-0420

Dear Mr. Mahon,

Based on my review, evaluation and assessment of the testing conducted on a full-scale, commercially available Contech Cascade Separator (CS-4) at Contech's Portland, Oregon laboratory facility with Scott Wells, Ph.D., from Portland State University, and associates providing independent third-part oversight, the test protocol requirements contained in the "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" (NJDEP Filter Protocol, January 2013) were met consistent with the NJDEP Approval Process. Specifically:

Test Sediment Feed

The sediment used for removal efficiency tests was a ground and whole-grain silica blend with a specific gravity of 2.65. Twelve subsamples, taken from varying locations within the test sediment batch were composited. Three samples taken from the composite were pulled and analyzed for PSD and moisture content according to ASTM D422-63 (2007). The sampling and analysis were conducted in-house, under third party observation prior to testing. The sediment met the NJDEP Protocol specifications and the d_{50} of the sediment was 64 μm , significantly less than the NJDEP specification of <75 μm .

Scour Test Sediment

The test sediment used for the scour testing was a blend of whole-grain silica with a specific gravity of 2.65. Prior to testing, twelve subsamples were taken from three randomly chosen bags of the sediment batch and composited. Three samples taken from the composite were then analyzed for PSD according to ASTM D422-63 (2007). The sampling and analysis were conducted in-house, under third party observation prior to testing. The sediment met the NJDEP Protocol specifications.

Removal Efficiency Testing

Removal efficiency testing followed the effluent grab sampling test method outlined in Section 5 of the NJDEP Protocol. The weighted sediment removal efficiency of the Cascade Separator (CS-4) (MTFR 808 gpm, 1.80 cfs) was 50.0%.

Scour Testing

Scour testing of the Cascade Separator (CS-4) was conducted in accordance with Section 4 of the NJDEP Protocol at a target flow rate greater than 200% of the Cascade Separator MTFR to qualify the MTD for online installation. The average test flow rate was 3.99 cfs or 222% of the 1.80 cfs MTFR. The average adjusted effluent SSC for this test was 1.68 mg/L, well below the maximum allowable SSC of 20 mg/L, qualifying the Contech Cascade separator for online installation.

Sincerely,



Richard S. Magee, Sc.D., P.E., BCEE

Cascade Separator[®] Inspection and Maintenance Guide



Maintenance

The Cascade Separator® system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects sediment and debris will depend upon on-site activities and site pollutant characteristics. For example, unstable soils or heavy winter sanding will cause the sediment storage sump to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall). However, more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment wash-down areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

A visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet chamber, flumes or outlet channel. The inspection should also quantify the accumulation of hydrocarbons, trash and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided in this Inspection and Maintenance Guide.

Access to the Cascade Separator unit is typically achieved through one manhole access cover. The opening allows for inspection and cleanout of the center chamber (cylinder) and sediment storage sump, as well as inspection of the inlet chamber and slanted skirt. For large units, multiple manhole covers allow access to the chambers and sump.

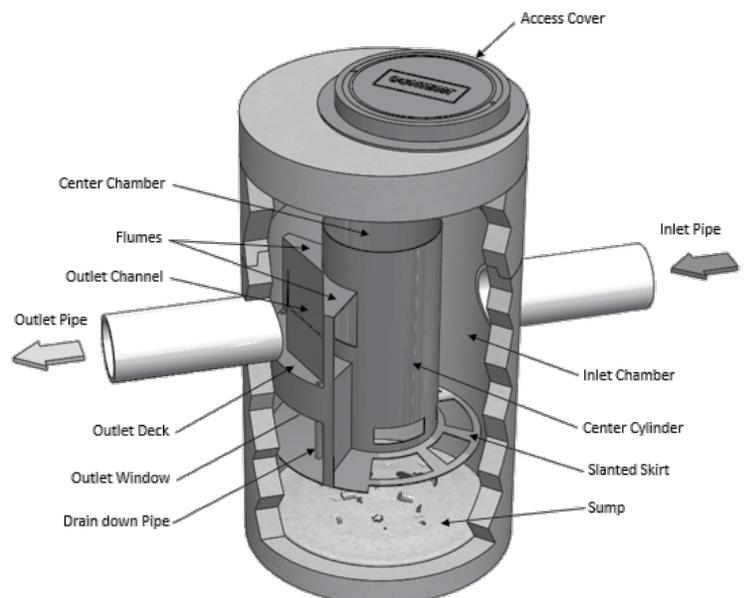
The Cascade Separator system should be cleaned before the level of sediment in the sump reaches the maximum sediment depth and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it must be replaced when significant discoloration has occurred. Performance may be impacted when maximum sediment storage capacity is exceeded. Contech recommends maintaining the system when sediment level reaches 50% of maximum storage volume. The level of sediment is easily determined by measuring the distance from the system outlet invert (standing water level) to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the chart in this document to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage.

Cleaning

Cleaning of a Cascade Separator system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole cover and insert the vacuum tube down through the center chamber and into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The areas outside the center chamber and the slanted skirt should also be washed off if pollutant build-up exists in these areas.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. Then the system should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and to ensure proper safety precautions. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the Cascade Separator system must be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal. If any components are damaged, replacement parts can be ordered from the manufacturer.



Cascade Separator® Maintenance Indicators and Sediment Storage Capacities

Model Number	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y ³	m ³
CS-3	3	0.9	1.5	0.5	0.4	0.3
CS-4	4	1.2	2.5	0.8	0.7	0.5
CS-5	5	1.3	3	0.9	1.1	0.8
CS-6	6	1.8	3.5	1	1.6	1.2
CS-8	8	2.4	4.8	1.4	2.8	2.1
CS-10	10	3.0	6.2	1.9	4.4	3.3
CS-12	12	3.6	7.5	2.3	6.3	4.8

Note: The information in the chart is for standard units. Units may have been designed with non-standard sediment storage depth.



A Cascade Separator unit can be easily cleaned in less than 30 minutes.



A vacuum truck excavates pollutants from the systems.

Inspection Forms

**Post Construction Inspection Report
126 Grove Street
Franklin, Massachusetts**

INSPECTION DATE:						
Person Inspecting		Weather			Other Personnel Present	
		Clear				
Item	N/A*	sat.**	NMR***	CAM**	MCA*	Comments:
Pavement Swept						
Catch Basins						
CB #24-1						
CB #24-2						
CB #24-3						
CB #24-4						
CB #24-5						
CB #24-6						
CB #24-7						
CB #7						
CB #8						
CB #9						
CB #10						
CB #11						
CB #12						
CB #13						
CB #14						
CB #15						
CB #16						
CB #59						
CB #60						
CB #61						
Water Quality Manholes						
DMH #24-5						
DMH #24-19						
Subsurface Detention System #1						
Outlet Control Structure						
Infiltration Basin #1						
Basin Inlet Swales						
Basin Inlet Pipe						
Outlet Control Structure						
Infiltration Basin #2						
Basin Inlet						
Outlet Control Structure						
NMR* normal maintenance requested						
N/A* not applicable at the time of inspection						
CAM* corrective action - minor						
SAT* satisfactory conditions as compliant						
MCA* Major corrective action						