STORMWATER REPORT

for the

PEMBROKE 5 MA

85 WASHINGTON STREET

PEMBROKE, MASSACHUSETTS

MAY 2021

PREPARED FOR:

NEXIUS

PREPARED BY:

McMAHON
TRANSPORTATION ENGINEERS & PLANNERS

TABLE OF CONTENTS

FIGURES (within Stormwater Report)

TABLES (within Stormwater Report)

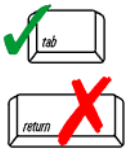
APPENDICES (end of Stormwater Report)

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

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:

- [X] No disturbance to any Wetland Resource Areas
- [ ] Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- [ ] Reduced Impervious Area (Redevelopment Only)
- [X] Minimizing disturbance to existing trees and shrubs
- [ ] LID Site Design Credit Requested:
  - [ ] Credit 1
  - [ ] Credit 2
  - [ ] Credit 3
- [X] 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
- [X] Other (describe): 50'x50' Pervious crushed stone compound to alleviate flows, infiltrate if possible, and provide some treatment.

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☐ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

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

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

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

☒ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

A. INTRODUCTION

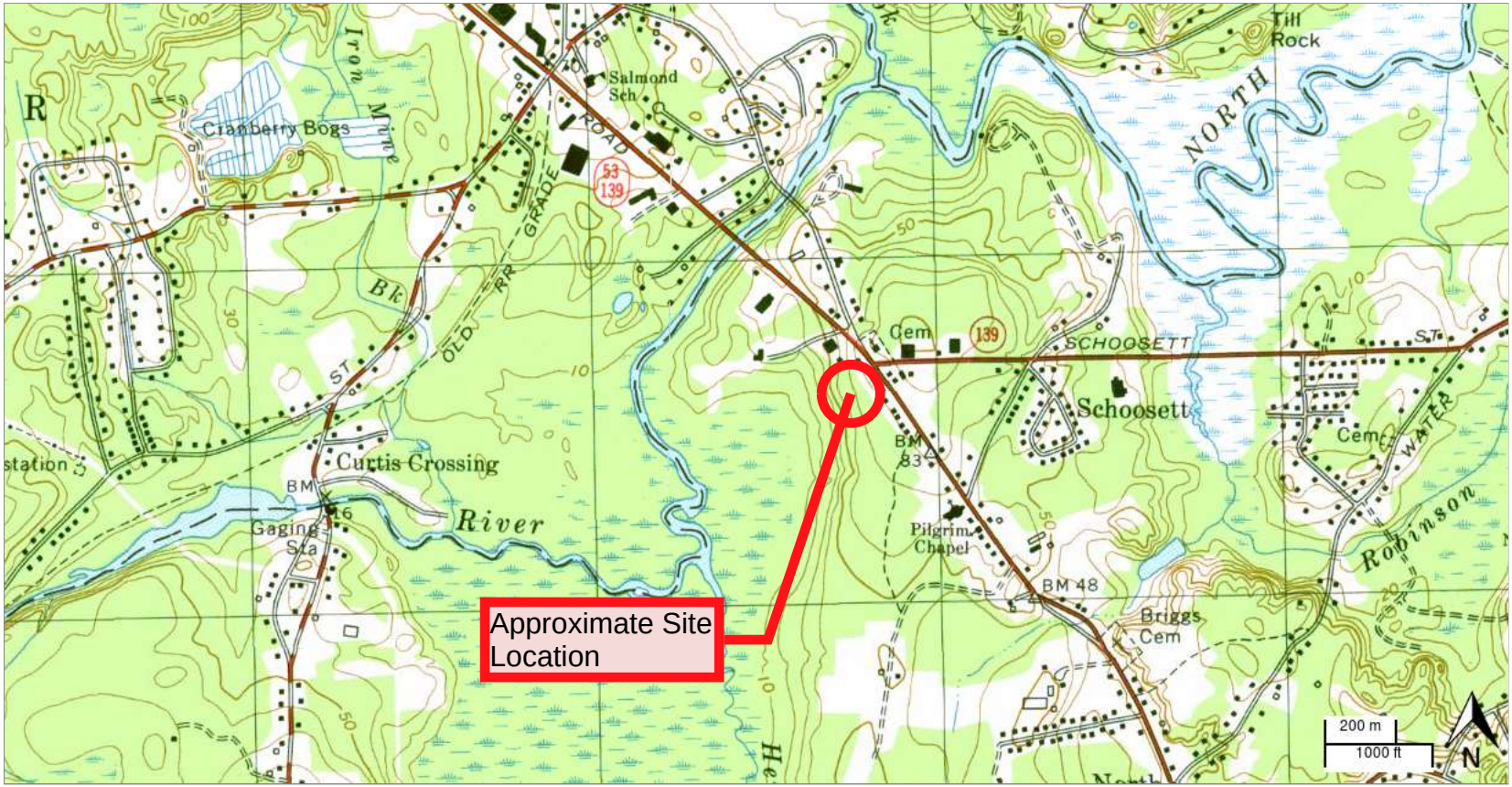
On behalf of NEXIUS and Verizon Wireless, McMahon Associates (McMahon) prepared this stormwater report in accordance with the Massachusetts Wetlands Protection Act, M.G.L. Chapter 131, Section 40 and the Pembroke Stormwater Management By-Law Article XXXV to evaluate the potential construction and post-development impacts created by the construction of a proposed wireless communication facility in Pembroke, Massachusetts.

The purpose of the overall project is to construct a wireless communications tower for Verizon Wireless to benefit its users and reduce or eliminate communication gaps and dropped calls. The project is generally bounded by Washington Street to the east, commercial properties to the north and south and forest to the west. The overall site is approximately 1.9 acres. The project proposes approximately 10,500 square feet (sf) (0.24 acre) of disturbance which includes selective tree removal, installation of a gravel access drive, gravel parking area, crushed stone compound with concrete slab, chain link fence, 120 foot (ft) tall monopole, antenna tower and underground electrical conduit. A locus map showing the project area is shown in Figure 1 - Site Location Map.

The objective of this report is to determine the existing condition and post construction condition runoff or peak flows and design appropriate stormwater mitigation measures to ensure that post construction peak flows match or are less than existing condition runoff peak flows.

FIGURE 1 – SITE LOCATION MAP

LOCUS_PEMBROKE_5_MA



USGS Topographic Maps

MassGIS Topographic Basemaps

B. EXISTING CONDITIONS

The site includes a wooded area to the west and retail developments to the north, east and south. A 7,890 sf building with associated 26 stall parking lot, paved driveway and sidewalks are located on the northeastern half of the lot, closest to Washington Street. The existing developed area within the lot is landscaped and the parking lot contains one catch basin. Information regarding the storm system within the parking lot is not known at this time, but will not affect the analysis. The existing site has a total of approximately 20,100 sf of impervious (pavement, sidewalk, roof) area within the 82,914 sf lot. The project area is located within the Business B and Historic Overlay zoning district.

Project Area

The project area/ area of future development is an undeveloped, partially wooded area located to the west of the existing parking lot of the site. Based on review of Natural Resources Conservation Service (NRCS) soil survey, the site is comprised of type C/D soils and has an infiltration rate of 0.2 in/hr.

Wetland Resource Areas

Based on review of the wetland resource areas on Oliver, MassGIS's Online Mapping Tool, the project area is not located within the vicinity of a wetland resource area or wetland resource area boundary.

Existing Drainage System

The existing storm system within the developed portion of the parcel consists of one storm sewer catch basin with an unknow invert and discharge point. This catch basin appears to collect stormwater from the paved parking area and driveway. For this report, the catch basin is assumed to discharge southwesterly on the site following the natural topography and not northeasterly to the State-owned road, Washington Street (Route 53).

As can be seen in the previously submitted site plans, the proposed wireless communication facility will be located in an undeveloped portion of the lot and will not connect to or affect the current on-site storm sewer system. The site drains to the western edge of the

Soil Classification

According to the soil survey in Plymouth County, Massachusetts prepared by the NRCS, soils at this site consist of mostly Scituate gravelly sandy loam (316B) with Urban land (640B) closest to Washington Street and a small amount of Birchwood sand (321C) at the western corner. Scituate soils generally consist of gravely sandy loam, this site is classified with 3 to 8 percent slopes and are very stony. According to the soil survey Scituate soils are classified as Hydrologic Soils Group C/D soils and have a low infiltration rate of 0.2 in/hour. Based on the sloped nature of the topography, type C soil was used for hydrologic calculations. Refer to the Appendix for a Hydrologic Soil Group Map.

Flood Zone Classification

According to the most recent Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) on Community-Panel Number 25023C0206J, effective date 8/15/2012, the project area, is not within the 100-year floodplain. Refer to Figure 2 – FEMA Flood Map.

Natural Heritage and Endangered Species Program

The Massachusetts Wetlands Protection Act requires that no project may be permitted that will have any adverse effect on specified habitat site of rare vertebrate or invertebrate species, as identified by procedures set forth in 310 CMR 10.59.

Based upon review of the Massachusetts Natural Heritage and Endangered Species Program (NHESP) within Oliver, MassGIS's Online Mapping Tool, the project area is not located within Estimated or Priority Habitat and there are no Certified Vernal Pools in, or nearby the inspected area. Refer to Figure 3 – Natural Heritage & Endangered Species (NHESP) Map.

Area of Critical Environmental Concern (ACEC)

There are no areas of environmental concern or outstanding resource waters within the project area. Refer to Figure 4 – Outstanding Water Resources & Figure 5 – Areas of Critical Environmental Concern (ACEC) Map.

National Flood Hazard Layer FIRMette

FEMA

70°48'32"W 42°6'26"N

70°47'54"W 42°6'N

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

1:6,000

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

FIGURE 2 – FEMA FLOOD MAP

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 4/30/2021 at 1:11 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.

FIGURE 3 – NATURAL HERITAGE & ENDANGERED SPECIES (NHESP) MAP

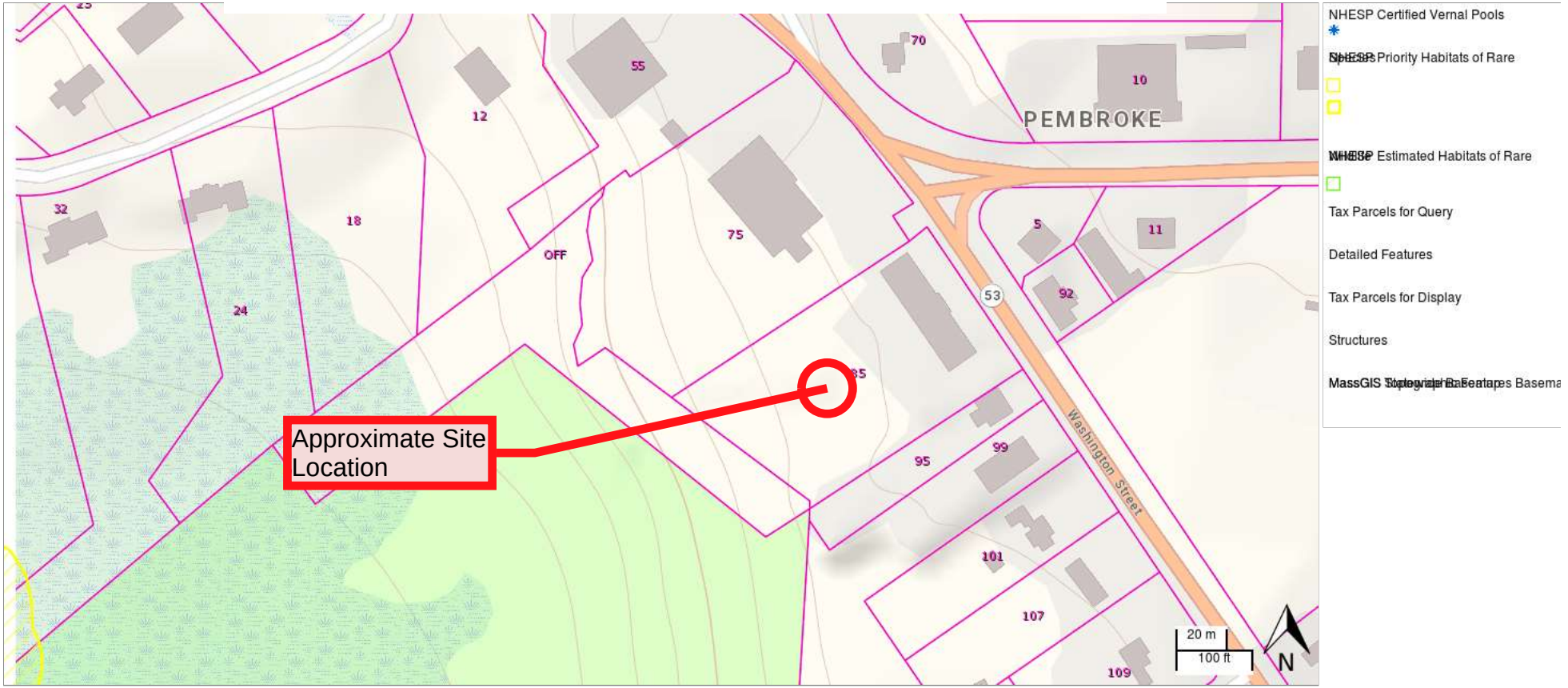


FIGURE 4 – OUTSTANDING WATER RESOURCES

ORW_PEMBROKE_5_MA

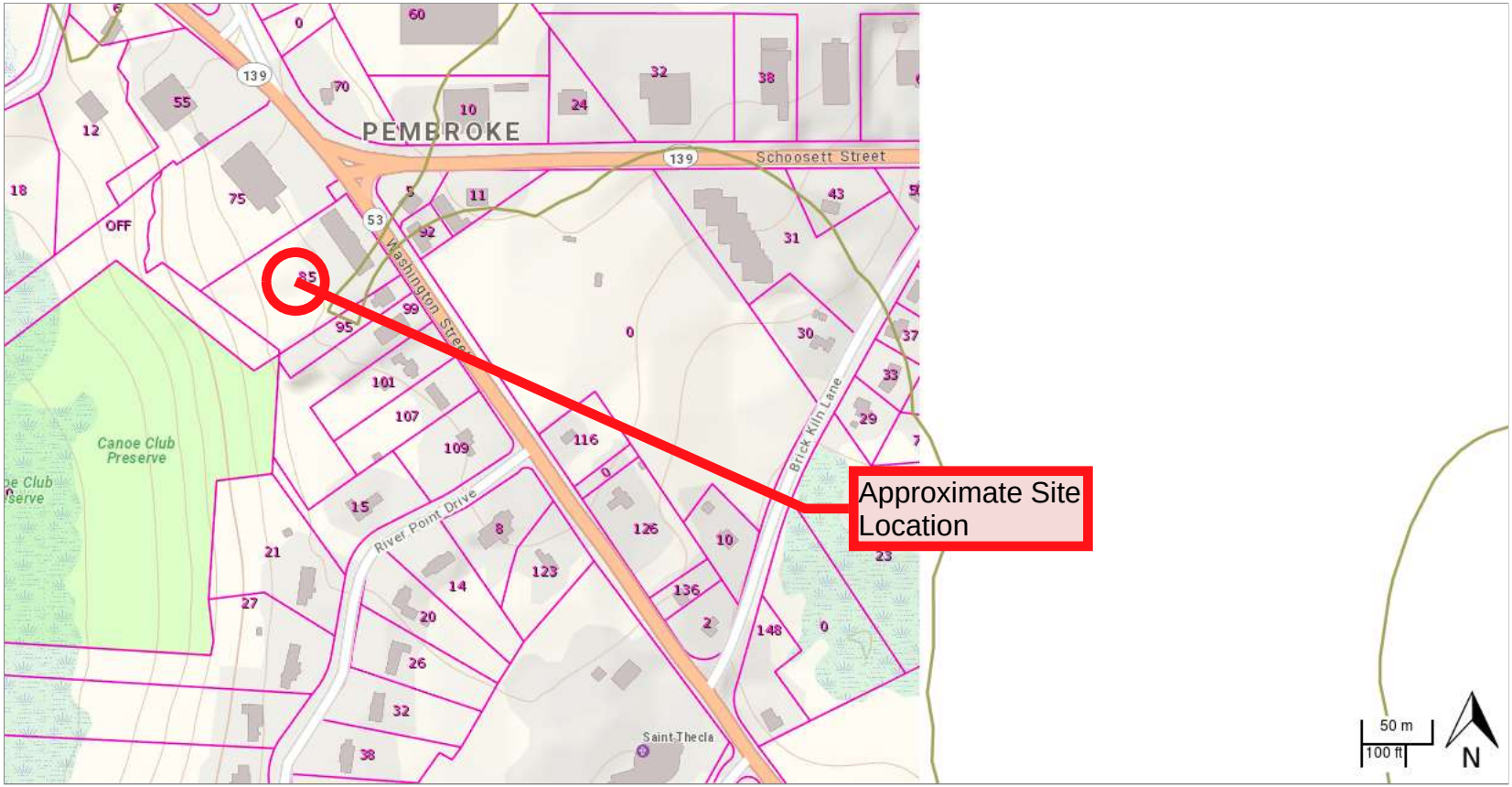
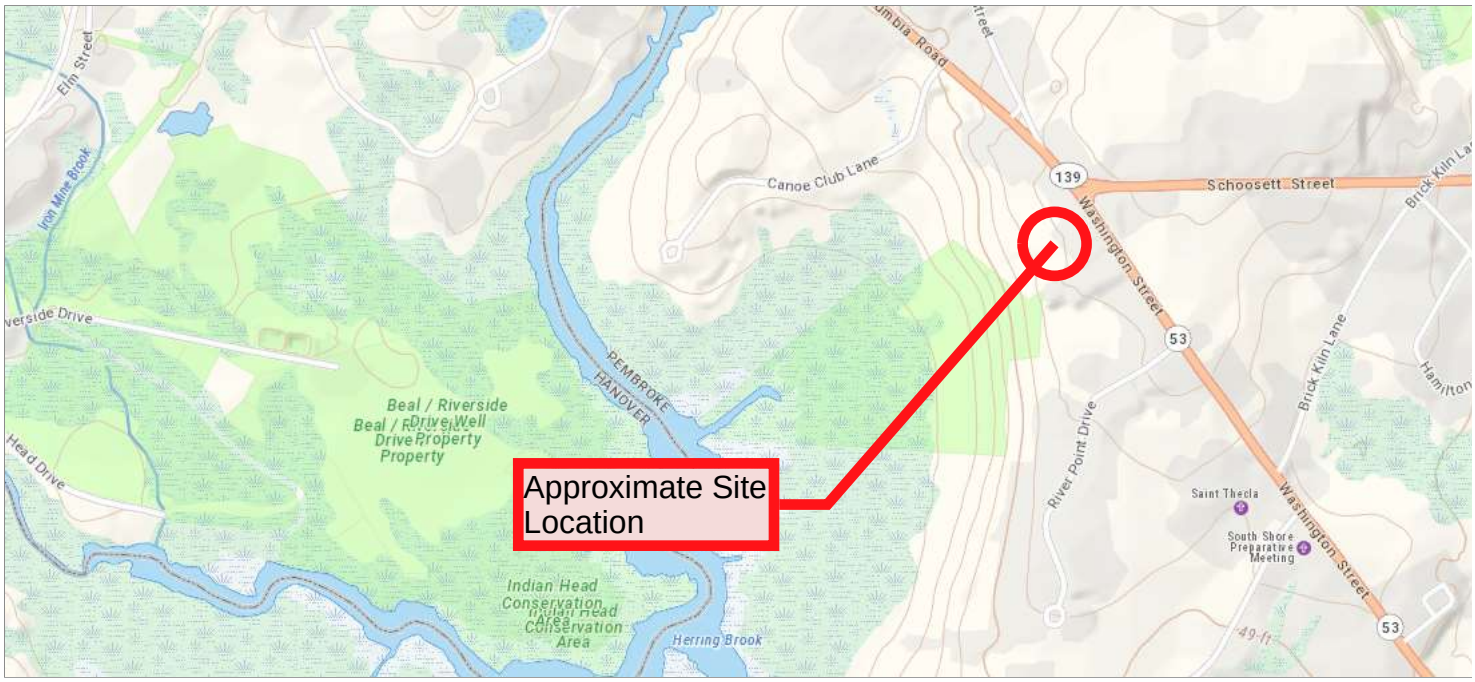


FIGURE 5 –AREAS OF CRITICAL ENVIRONMENTAL CONCERN (ACEC) MAP

PEMBROKE_5_MA



Legend

Areas of Critical Environmental Concern ACECs Boundaries

- ROAD/RAIL BASED
- RIVER BASED
- WETLAND BASED
- FLOODPLAIN BASED
- TIDAL BASED
- CONTOUR BASED
- POLITICAL BOUNDARY
- PROPERTY LINE BASED
- OTHER
- NOT DEFINED

Areas of Critical Environmental Concern ACECs

Existing Conditions Drainage Analysis

The following is a description and analysis of the existing conditions as they relate to stormwater runoff from the site.

Methodology

Hydrologic analyses were performed using site-specific precipitation frequency data based on Soil Conservation Service, Technical Release 20 (TR-20) from the NRCS to compare the existing and proposed conditions stormwater runoff. The 1-, 2-, 10-, 25-, 50- and 100-year statistical rain events were modeled for a Type III 24-hour storm utilizing HydroCAD version 10.0.

The following Massachusetts rainfall amounts were utilized for each design storm event. The rainfall distributions are based on conservative data provided by the Northeast Regional Climate Center (NRCC):

- 1-Year Storm Event = 2.78 inches/24 hours
- 2-Year Storm Event = 3.35 inches/24 hours
- 10-Year Storm Event = 4.95 inches/24 hours
- 25-Year Storm Event = 6.19 inches/24 hours
- 50-Year Storm Event = 7.33 inches/24 hours
- 100-Year Storm Event = 8.68 inches/24 hours

They hydrologic and hydraulic models using HydroCAD (pre and post construction) are included in the Appendix of this report.

Existing Conditions Watershed Summary

Under existing conditions stormwater runoff from the site (area 1S) appears to flow to the southwest corner of the lot. Stormwater within the parking lot discharges to the catch basin and is estimated to discharge towards the southeast corner (design point 2L). Gutters within the building roof discharge to ground level and the general topography for the site is towards the south west. It appears, stormwater ultimately discharges to the North River via overland flow.

A drainage area map and calculations for drainage areas and peak discharges during the 1-, 2-, 10-, 25-, 50- and 100-year storms can be found in the attached appendix. Table 1 provides a summary of the peak flows for each modeled rain event.

C. PROJECT DESCRIPTION

The proposed project of concern consists of a 50'x50' crushed stone compound with four lease areas for potential wireless providers. Verizon Wireless will locate at this site.

Approximately 1,560 sf of gravel access drive, 1,680 sf of very porous crushed stone surface to a depth of 12 inches and approximately 820sf of impervious surface (communication equipment or pad) will be installed.

Proposed Drainage Analysis

The following is an analysis of proposed conditions as they relate to stormwater runoff from the parcel and proposed improvements

Methodology

The same methodology and rainfall distributions were used as those for existing conditions. Hydrologic analyses were performed using site-specific precipitation frequency data based on Soil Conservation Service, Technical Release 20 (TR-20) from the NRCS to compare the existing and proposed conditions stormwater runoff. The 1-, 2-, 10-, 25-, 50- and 100-year statistical rain events were modeled for a Type III 24-hour storm utilizing HydroCAD version 10.0. The rainfall distributions are based on conservative data provided by the Northeast Regional Climate Center (NRCC).

Proposed Conditions Analysis

Under the proposed conditions/ post construction condition scenario, existing drainage patterns will be maintained. A drainage area map and calculations for drainage areas and peak

discharges during the 1-, 2-, 10-, 25-, 50- and 100-year storms can be found in attached appendix. As can be seen, the post construction peak flows are provided in Table 1.

Watersheds Summary

As can be seen in the site plan and the proposed grading, the small development will maintain current lot drainage patterns. Although land alterations will occur for the construction of the communication facility, the crushed stone compound will act as a means of storage volume for runoff generated from the gravel driveway and communication pad or equipment. Peak discharge rates decrease for the 1-, 2-, 10-, 25- and 50- year analyzed rain events when existing conditions are compared to proposed conditions (design point 2L). The addition of gravel for the access drive and crushed stone containment area where previously pervious/wooded area existed contributes to the very small increase in peak discharge rate for the 100- year storm. As stated above, based on the undeveloped nature of the proposed project location and poor draining soils on site limits areas to provide stormwater quality so as not to disturb a greater area. The proposed crushed stone compound/containment area will act as an infiltration and detention system. Given the NRCS soil classification of C/D, stormwater will to infiltrate into the subsoil.

Table 1 displays the difference in peak discharge under existing and proposed conditions. Based on the results of the analysis, as proposed, peak flows decrease when compared to pre-development peak discharge rates for Design Point 2L for the 1-, 2-, 10-, 25- and 50- year storm events. A negligible 0.07 cfs increase occurs in the 100- year storm event which is not anticipated to increase flooding offsite.

Table 1: Summary of Peak Discharge (cfs)

	Storm Year					
	1	**2**	**10**	**25**	**50**	**100**
Design Point 2L						
Existing	1.65	2.38	4.65	6.51	8.24	10.34
Proposed	1.57	2.27	4.42	6.19	7.84	10.41
Change	-0.08	-0.11	-0.23	-0.32	-0.40	0.07

As can be seen in Table 1 and the HydroCAD reports included as part of this report, the post construction flows for the proposed installation of a crushed stone compound with gravel access drive, gravel parking area in an exsting undeveloped, partially wooded area will be attenuated for the 1-, 2-, 10-, 25- and 50- year rain events. The negligible increase of 0.07 cfs for the 100-year rain event will not negatively impact stormwater runoff or peak flows.

D. MITIGATION METHODS

Soil Erosion and Sedimentation Controls

Soil erosion and sedimentation control issues have been considered in the design and construction planning process for this project. Control measures for soil erosion and sedimentation will be installed before construction activities begin and will be maintained throughout construction. Straw wattles and silt fence have been proposed at the limits of disturbance perimeter and a silt sack is proposed within catch basin in parking area. A stabilized construction entrance is proposed to limit potential sediment from tracking off the project site. Once established, these measures will be monitored weekly until construction is complete. The location of perimeter erosion controls will serve as the strict limits of disturbance for the project. Areas beyond these limits as shown on the plans will be left undisturbed and in their completely natural condition. In the event of a significant rainstorm (i.e. greater than 1") the sedimentation control measures will be inspected and replaced if needed.

Operation and Maintenance Plan

Under lease agreement with Verizon Wireless, after project approval and construction the operation and maintenance of the crushed stone compound will be the responsibility of Verizon Wireless. Refer to the attached appendix for the stormwater operation and maintenance actions.

Construction Sequence

The anticipated sequence of construction proceeds as follows:

1. Complete a "DIGSAFE" prior to any onsite activity.

2. Install erosion and sediment control (E&S) measures as indicated on the Soil Erosion & Sedimentation Control Plan and Notes sheet ES-1 and Soil Erosion & Sedimentation Control Details & Notes sheet ES-2. E&S measures include catch basin inlet protection, stabilized construction entrance, silt fence and straw waddles. Additional E&S measures shall be added, as necessary, to protect adjacent downgradient areas.
3. Tree clearing and grubbing in area of proposed construction.
4. Excavate top soils from proposed gravel drive limits and within compound and for utility trench.
5. Install underground utility conduit.
6. Excavate for and construct antennal tower foundation, grade compound.
7. Place subgrade for gravel compound area, gravel drive and parking.
8. Install gravel and concrete pads
9. Install antenna tower, communication equipment and fence.
10. Plant, seed, and stabilize disturbed soil surfaces.
11. Clean catch basins of any collected sediment or debris, dispose of properly.
12. Remove sedimentation controls once all disturbed areas have been finally stabilized and healthy vegetation has been established.

E. STORMWATER MANAGEMENT STANDARDS

The project has been designed to meet the Stormwater Management Standards outlined in 310 CMR 10.05(6)(k) to the maximum extent possible. This project qualifies as a limited project under 310 CMR 10.53(3)(d). Due to the low infiltrating soil, classified as type C/D the project aimed to meet the following Stormwater Management Standards only to the maximum extent practicable. The projects conformance with these standards is described below.

Standard 1: No New Untreated Discharges

The project meets this standard. This standard has two parts where all new stormwater discharges must be treated and stormwater discharges must not cause erosion. The proposed

crushed stone compound acts as a detention and infiltration area to slow down the flows prior to discharging to the design point. Due to the nature of the project, located within woodlands with no daily vehicle trips and crushed stone proposed base, the runoff is assumed to be clean and would therefore meet the standard of no new untreated outlets as part of this project. Existing low points will remain and the flows within the project site will remain the same.

Standard 2: Peak Rate Attenuation

This standard has been met for the 1-, 2-, 10-, 25- and 50-year storms for Design Point 2L, the southwest corner of the siter. The peak discharge during each of the storm years analyzed decreases under post-development scenario. Refer to Table 1 for this data. A small increase in peak discharge occurs in 100 – year storm due to volume of runoff created for this rain event. The crushed stone compound provides peak rate flow attenuation for the compound area. The small increase in impervious areas of concrete pads and electrical equipment offset by the one foot thick crushed stone compound.

Standard 3: Recharge

This project has met this standard to the maximum extent practicable. As stated previously, the project soils are poorly draining type C/D. Infiltration has been modeled however, given the low infiltration rate, only 0.01 cfs is being infiltrated during the storm events.

Due to the natural poorly draining soil types, groundwater recharge may be increased in order to attenuate flows without increasing the clearing limits, the crushed stone compound was designed to detain and infiltrate as best as possible.

The project incorporates low impact development techniques in the design where practicable including protection of existing trees and minimizing the limit of clearing.

Standard 4: Water Quality

This standard has been met to the maximum extent practicable. The project site will be unmanned and therefore no regular vehicular traffic is expected and therefore the area will be essentially free from potential contaminants. The following is a list of communication and utility related appurtenances in which Verizon Wireless will monitor during their routine quarterly inspections.

- DC batteries are required as part of electrical backup but are typically fully encased in plastic battery containers (similar to sealed car batteries) and within locked communications cabinets;
- Each carrier may install a diesel or propane powered emergency electrical generator. In each case, the carrier shall comply with Federal, State, and local fuel storage container and containment requirements;
- There are no provisions for potable water faucets, mains, or service connections and therefore vehicle washing will not be possible;
- Fertilizers, herbicides, pesticides will not be utilized or stored at this site;
- No oils are stored within the communications pads or shelters or within the compound;
- No pets will exist at the facilities, therefore no pet waste;
- No on-site sanitary sewage or septic systems are proposed for this project;
- Snow clearing will be limited to the existing access road and gravel parking or travel ways. Snow on shelters and within the compound is normally or typically left in place (not cleared);
- No road salt or de-icers will be used or necessary for the operation of this facility;
- Street sweeping is not proposed or viable for this proposed project;
- The commercial carrier technicians and staff are trained of need for immediate response and containment in the event of an unforeseeable event or spill and will contact the individual carriers emergency response department, as well as contacting local Fire Departments and Landlord;

- The facility and use is not a Land Use with Higher Potential Pollutant Load

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

This standard is not applicable because there are no land uses within the project area that have higher potential pollutant loads.

Standard 6: Critical Areas

This standard is not applicable because there are no critical areas within the project area.

Standard 7: Redevelopment Projects

The proposed project is not considered a redevelopment project. The project qualifies as a limited project under 310 CMR 10.53(3)(d). The project meets standards 1, 2, 3 and 4 to the maximum extent practicable.

Standard 8: Erosion and Sediment Control

This standard has been met. Soil and erosion control shall be provided during construction by means of silt fence, straw waddles, stabilized construction entrance and silt sacks as described earlier in the report. The chosen contractor will be responsible to adhere to the Soil Erosion & Sedimentation Control Plan and Notes sheet ES-1 and Soil Erosion & Sedimentation Control Details & Notes sheet ES-2. Verizon Wireless shall use their long-term pollution prevention procedures once the project is constructed.

Standard 9: Operation and Maintenance Plan

This standard has been met. The operation and maintenance plan for the post-construction BMP's on this project has been included. Please refer to the attached appendix for the Operation and Maintenance Plan and Long-Term Pollution Prevention Plan.

Standard 10: Illicit Discharges

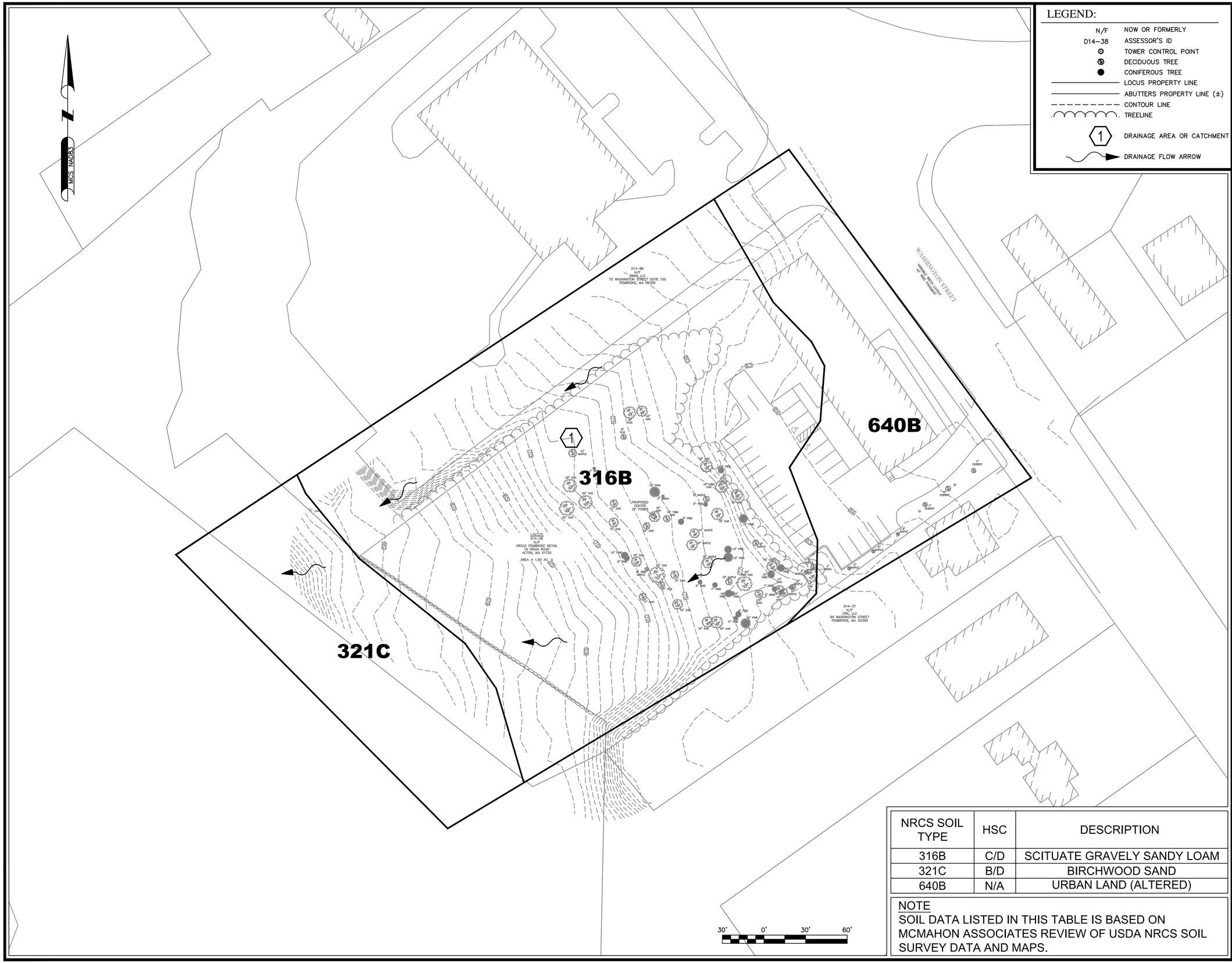
There are no known or suspected illicit discharges to the Washington Street stormwater management (existing or proposed) system at the site, based on review of existing survey.

F. CONCLUSION

This report summarizes the potential project impacts and the stormwater analysis results for the existing and proposed conditions as a result of the communication facility installation improvements project. The proposed installation of a gravel access drive, gravel parking area, crushed stone compound with concrete slab, chain link fence, 120 ft tall monopole and underground electrical conduit will attenuate flows to be less or match existing peak flows for the 1-, 2-, 10-, 25- and 50- year storms. The negligible 0.07 cfs higher flow for the 100- year storm will not negatively impact stormwater runoff or peak flows.

Erosion and sediment control measures will be implemented to minimize impacts from construction. The project has been designed to the stormwater standards to the maximum extent practicable.

APPENDIX A –
EXISTING & PROPOSED WATERSHED ANALYSIS WITH MAP



LEGEND:

N/F	NOW OR FORMERLY
D14–38	ASSESSOR'S ID
	TOWER CONTROL POINT
	DECIDUOUS TREE
	CONIFEROUS TREE
	LOCUS PROPERTY LINE
	ABUTTERS PROPERTY LINE (±)
	CONTOUR LINE
	TREELINE
1	DRAINAGE AREA OR CATCHMENT
	DRAINAGE FLOW ARROW

NRCS SOIL TYPE	HSC	DESCRIPTION
316B	C/D	SCITUATE GRAVELY SANDY LOAM
321C	B/D	BIRCHWOOD SAND
640B	N/A	URBAN LAND (ALTERED)

NOTE
SOIL DATA LISTED IN THIS TABLE IS BASED ON MCMAHON ASSOCIATES REVIEW OF USDA NRCS SOIL SURVEY DATA AND MAPS.

PREPARED BY:
nexius
TRANFORM YOUR BUSINESS...THROUGH WIRELESS
A&E OFFICE:
300 APOLLO DRIVE, SUITE 7
CHELMSFORD, MA 01824
1 (978) 923–7965

APPLICANT:
verizon

CELLCO PARTNERSHIP d/b/a
VERIZON WIRELESS
118 FLANDERS ROAD, 3RD FLOOR
WESTBOROUGH, MA 01581

I HEREBY CERTIFY TO THE BEST OF MY PROFESSIONAL KNOWLEDGE, INFORMATION AND BELIEF THAT:

THIS SURVEY HAS BEEN PERFORMED IN THE FIELD UNDER MY SUPERVISION, AND TO MY KNOWLEDGE, BELIEF AND INFORMATION, THIS SURVEY HAS BEEN PERFORMED IN ACCORDANCE WITH CURRENTLY ACCEPTED ACCURACY STANDARDS;

DANIEL F. STASZ PLS #47160

MCMAHON

SUBMITTALS

REV	DATE	DESCRIPTION	BY
1	02/24/2020	SUBMITTED FOR REVIEW	JDG
2	10/5/2020	SITE PLAN REQ'S	JDG
3	1/8/2021	SITE PLAN REQ'S	JDG
4	2/2/2021	TREE SURVEY	JDG

SITE INFO:

SITE NAME:
PEMBROKE_5_MA
LOCATION CODE:

SITE ADDRESS:
85 WASHINGTON STREET
PEMBROKE, MA 02359

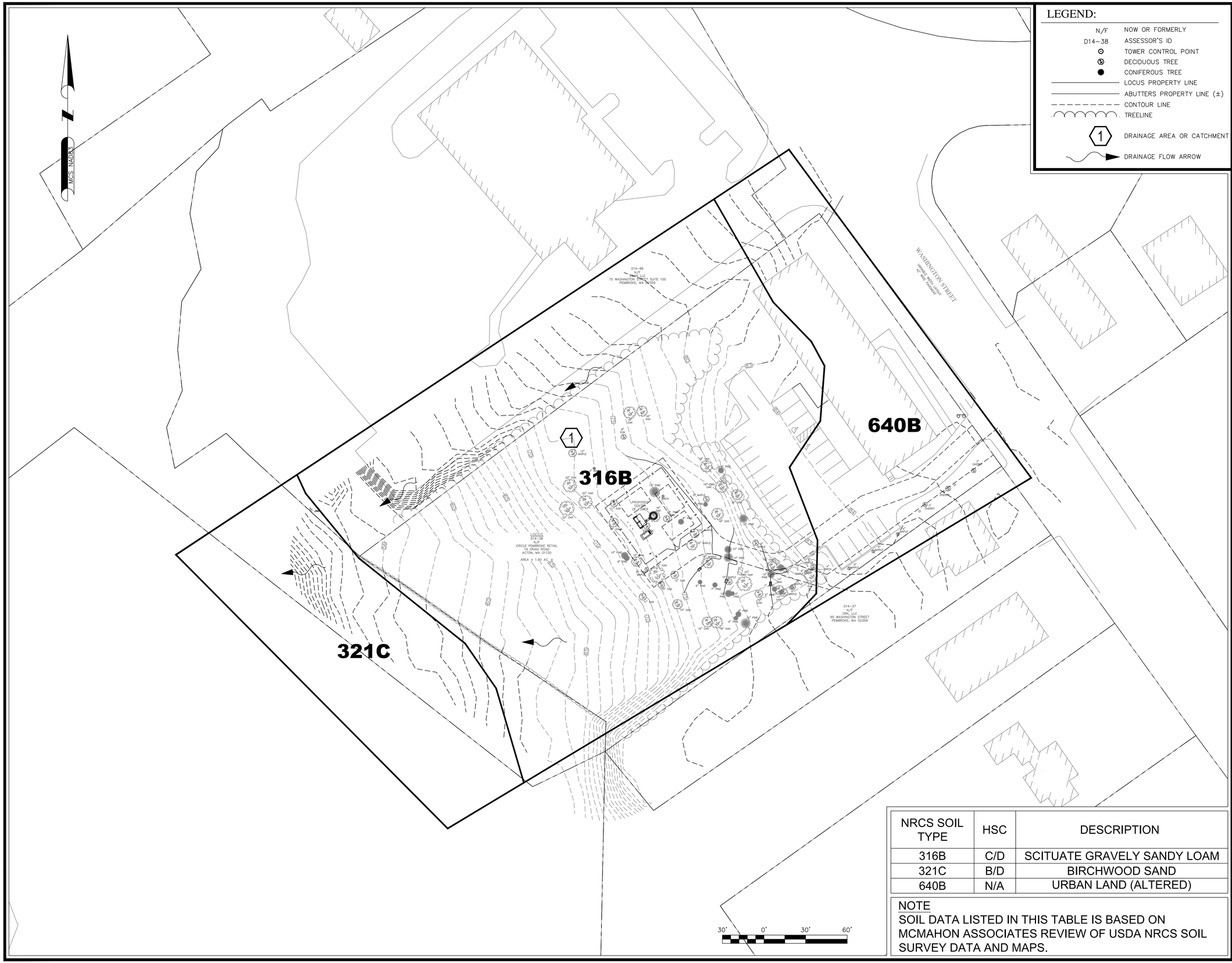
SHEET TITLE:
EXISTING DRAINAGE AND SOIL SURVEY

NEXIUS PROJ. NO:
20161495803

CHECKED BY:
BCF

CHECKED BY DATE:
2/2/2021

SHEET NUMBER:
D-1



LEGEND:

N/F	NOW OR FORMERLY
D14–38	ASSESSOR'S ID
	TOWER CONTROL POINT
	DECIDUOUS TREE
	CONIFEROUS TREE
	LOCUS PROPERTY LINE
	ABUTTERS PROPERTY LINE (±)
	CONTOUR LINE
	TREELINE
1	DRAINAGE AREA OR CATCHMENT
	DRAINAGE FLOW ARROW

NRCS SOIL TYPE	HSC	DESCRIPTION
316B	C/D	SCITUATE GRAVELY SANDY LOAM
321C	B/D	BIRCHWOOD SAND
640B	N/A	URBAN LAND (ALTERED)

NOTE
SOIL DATA LISTED IN THIS TABLE IS BASED ON MCMAHON ASSOCIATES REVIEW OF USDA NRCS SOIL SURVEY DATA AND MAPS.

PREPARED BY:

nexius
TRANFORM YOUR BUSINESS...THROUGH WIRELESS

A&E OFFICE:
300 APOLLO DRIVE, SUITE 7
CHELMSFORD, MA 01824
1 (978) 923–7965

APPLICANT:

verizon

CELLCO PARTNERSHIP d/b/a
VERIZON WIRELESS
118 FLANDERS ROAD, 3RD FLOOR
WESTBOROUGH, MA 01581

I HEREBY CERTIFY TO THE BEST OF MY PROFESSIONAL KNOWLEDGE, INFORMATION AND BELIEF THAT:

THIS SURVEY HAS BEEN PERFORMED IN THE FIELD UNDER MY SUPERVISION, AND TO MY KNOWLEDGE, BELIEF AND INFORMATION, THIS SURVEY HAS BEEN PERFORMED IN ACCORDANCE WITH CURRENTLY ACCEPTED ACCURACY STANDARDS;

DANIEL F. STASZ PLS #47160

McMAHON

SUBMITTALS

REV	DATE	DESCRIPTION	BY
1	02/24/2020	SUBMITTED FOR REVIEW	JDG
2	10/5/2020	SITE PLAN REQ'S	JDG
3	1/8/2021	SITE PLAN REQ'S	JDG
4	2/2/2021	TREE SURVEY	JDG

SITE INFO:

SITE NAME:
PEMBROKE_5_MA
LOCATION CODE:

SITE ADDRESS:
85 WASHINGTON STREET
PEMBROKE, MA 02359

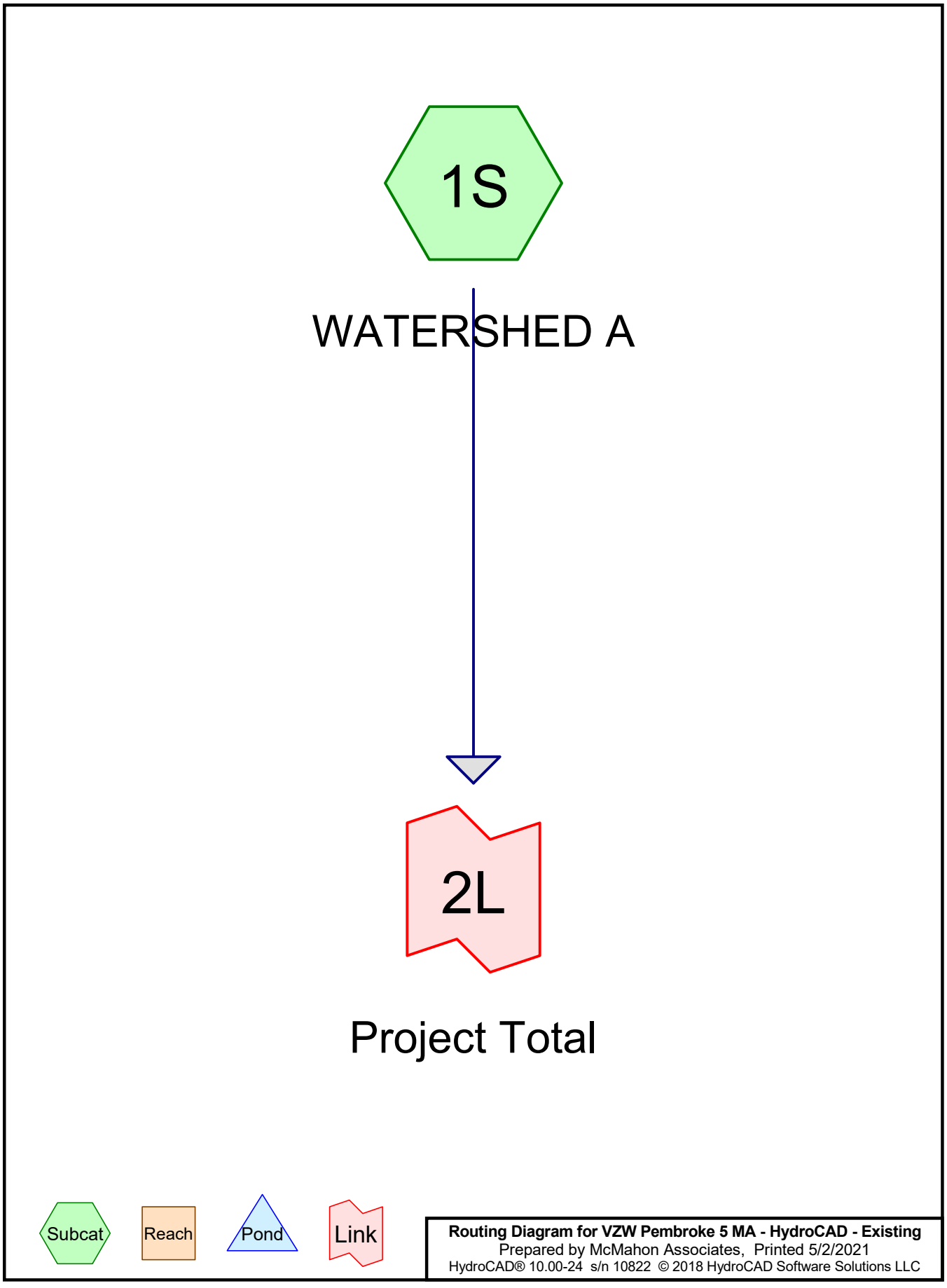
SHEET TITLE:
PROPOSED DRAINAGE AND SOIL SURVEY

NEXIUS PROJ. NO:
20161495803

CHECKED BY:
BCF

CHECKED BY DATE:
2/2/2021

SHEET NUMBER:
D-2



Routing Diagram for VZW Pembroke 5 MA - HydroCAD - Existing
Prepared by McMahon Associates, Printed 5/2/2021

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 4230 MA Pembroke Plymouth County

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.320	74	>75% Grass cover, Good, HSG C (1S)
0.069	87	Mulch/Dirt roads, HSG C (1S)
0.461	98	Paved parking, HSG C (1S)
1.054	70	Woods, Good, HSG C (1S)
1.903	**78**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
1.903	HSG C	1S
0.000	HSG D	
0.000	Other	
1.903		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.320	0.000	0.000	0.320	>75% Grass cover, Good	1S
0.000	0.000	0.069	0.000	0.000	0.069	Mulch/Dirt roads	1S
0.000	0.000	0.461	0.000	0.000	0.461	Paved parking	1S
0.000	0.000	1.054	0.000	0.000	1.054	Woods, Good	1S
0.000	**0.000**	**1.903**	**0.000**	**0.000**	**1.903**	**TOTAL AREA**	

Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=82,914 sf 24.19% Impervious Runoff Depth>0.87"
Flow Length=359' Tc=14.5 min CN=78 Runoff=1.65 cfs 0.138 af

Link 2L: Project Total Inflow=1.65 cfs 0.138 af
Primary=1.65 cfs 0.138 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.138 af Average Runoff Depth = 0.87"
75.81% Pervious = 1.443 ac 24.19% Impervious = 0.461 ac

Summary for Subcatchment 1S: WATERSHED A

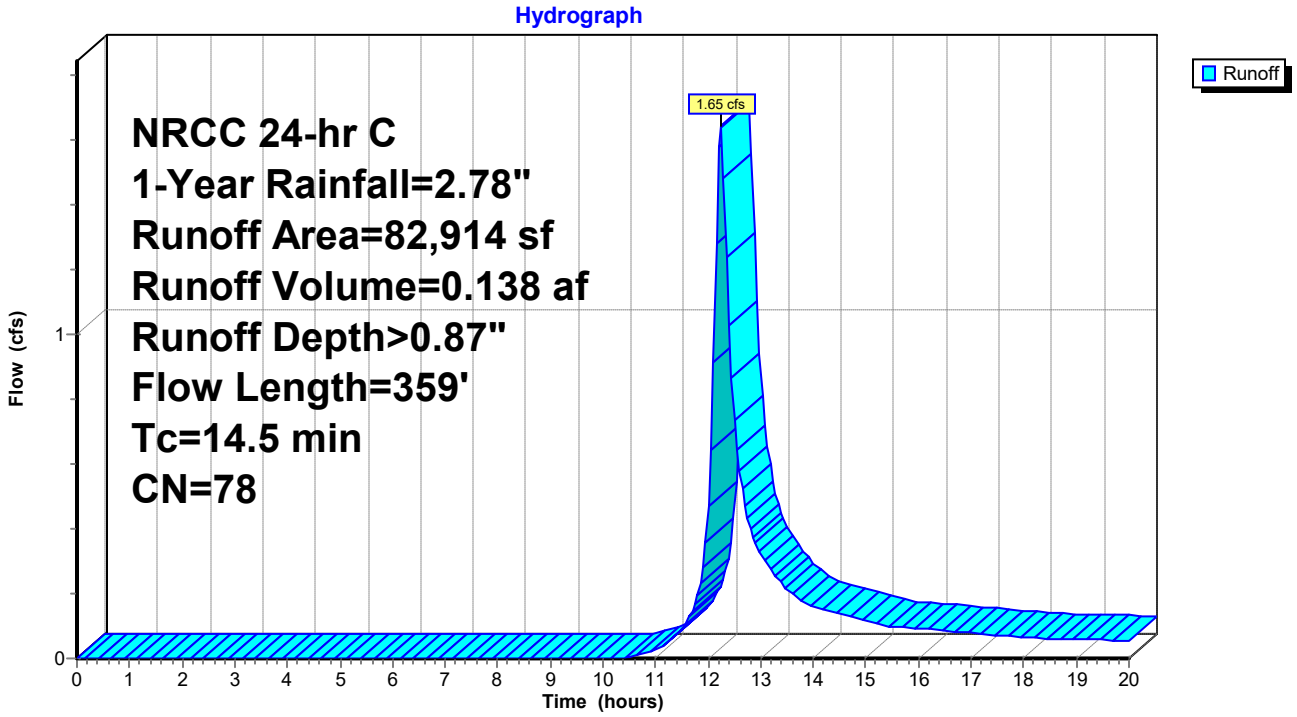
Runoff = 1.65 cfs @ 12.24 hrs, Volume= 0.138 af, Depth> 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 1-Year Rainfall=2.78"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	45,892	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	82,914	78	Weighted Average
	62,853		75.81% Pervious Area
	20,061		24.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A

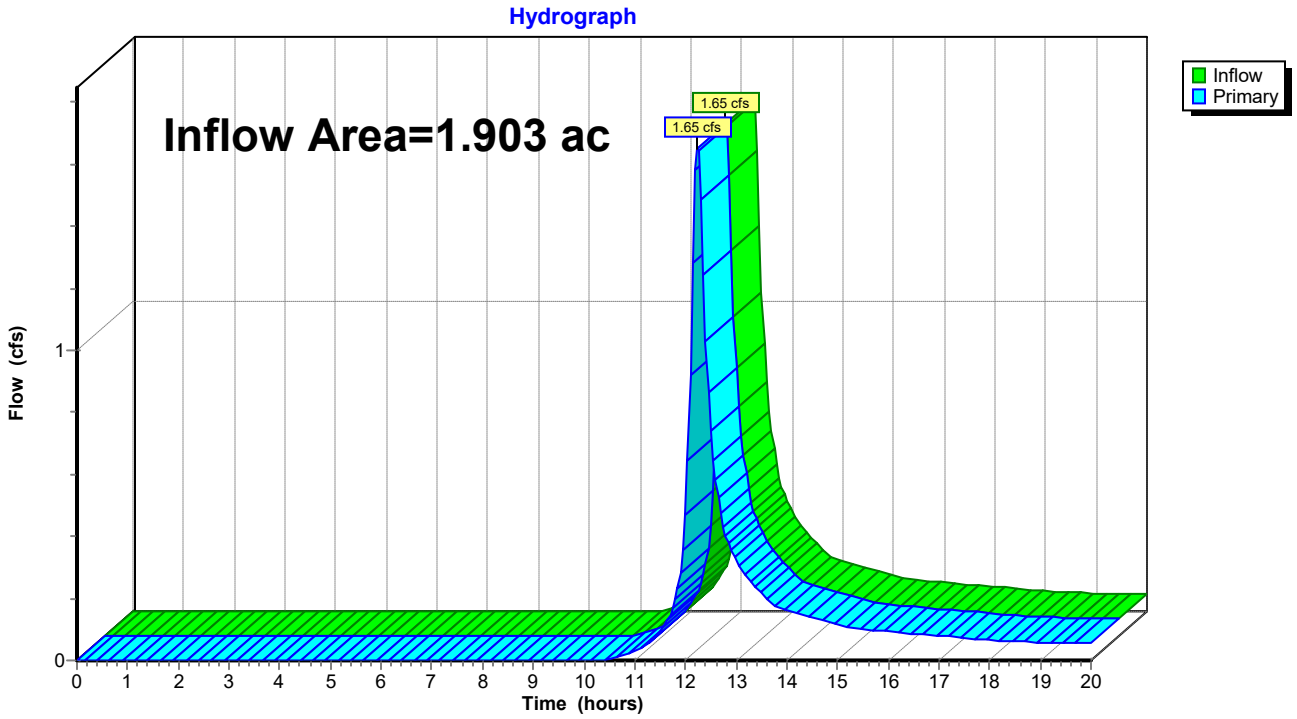


Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 24.19% Impervious, Inflow Depth > 0.87" for 1-Year event
Inflow = 1.65 cfs @ 12.24 hrs, Volume= 0.138 af
Primary = 1.65 cfs @ 12.24 hrs, Volume= 0.138 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total



Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=82,914 sf 24.19% Impervious Runoff Depth>1.25"
Flow Length=359' Tc=14.5 min CN=78 Runoff=2.38 cfs 0.198 af

Link 2L: Project Total Inflow=2.38 cfs 0.198 af
Primary=2.38 cfs 0.198 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.198 af Average Runoff Depth = 1.25"
75.81% Pervious = 1.443 ac 24.19% Impervious = 0.461 ac

Summary for Subcatchment 1S: WATERSHED A

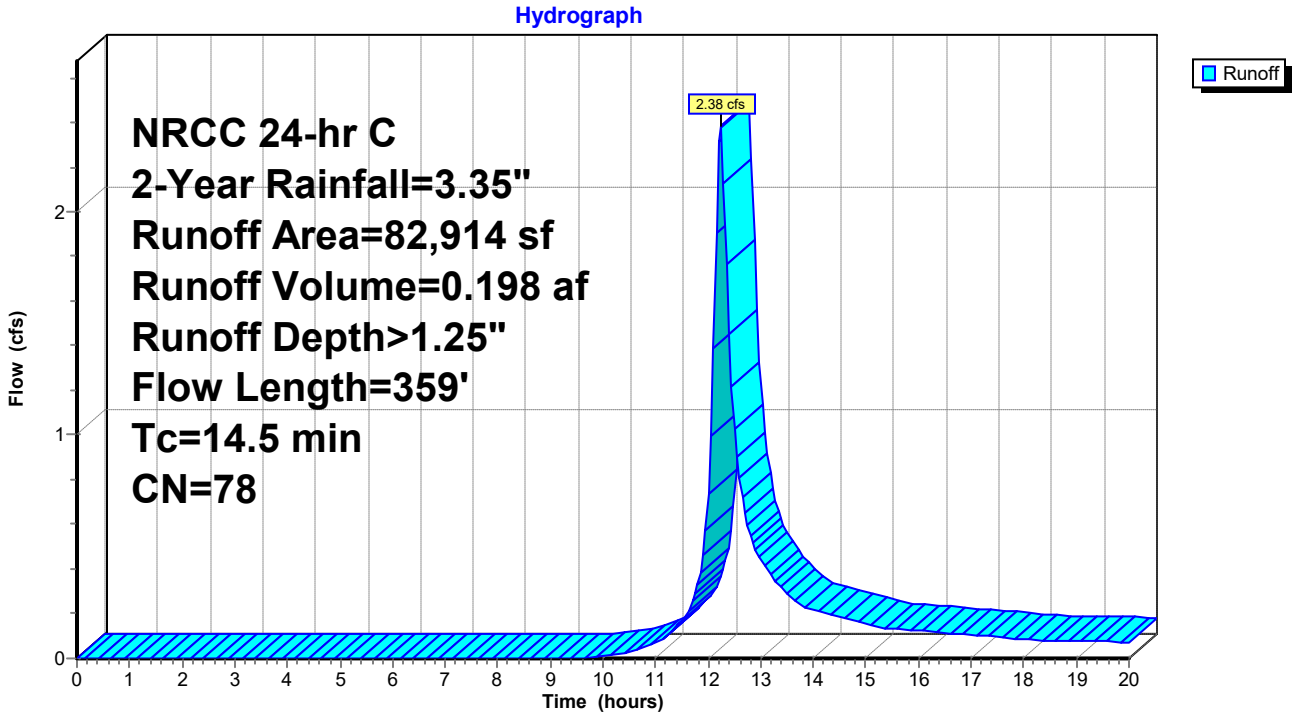
Runoff = 2.38 cfs @ 12.23 hrs, Volume= 0.198 af, Depth> 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	45,892	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	82,914	78	Weighted Average
	62,853		75.81% Pervious Area
	20,061		24.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A

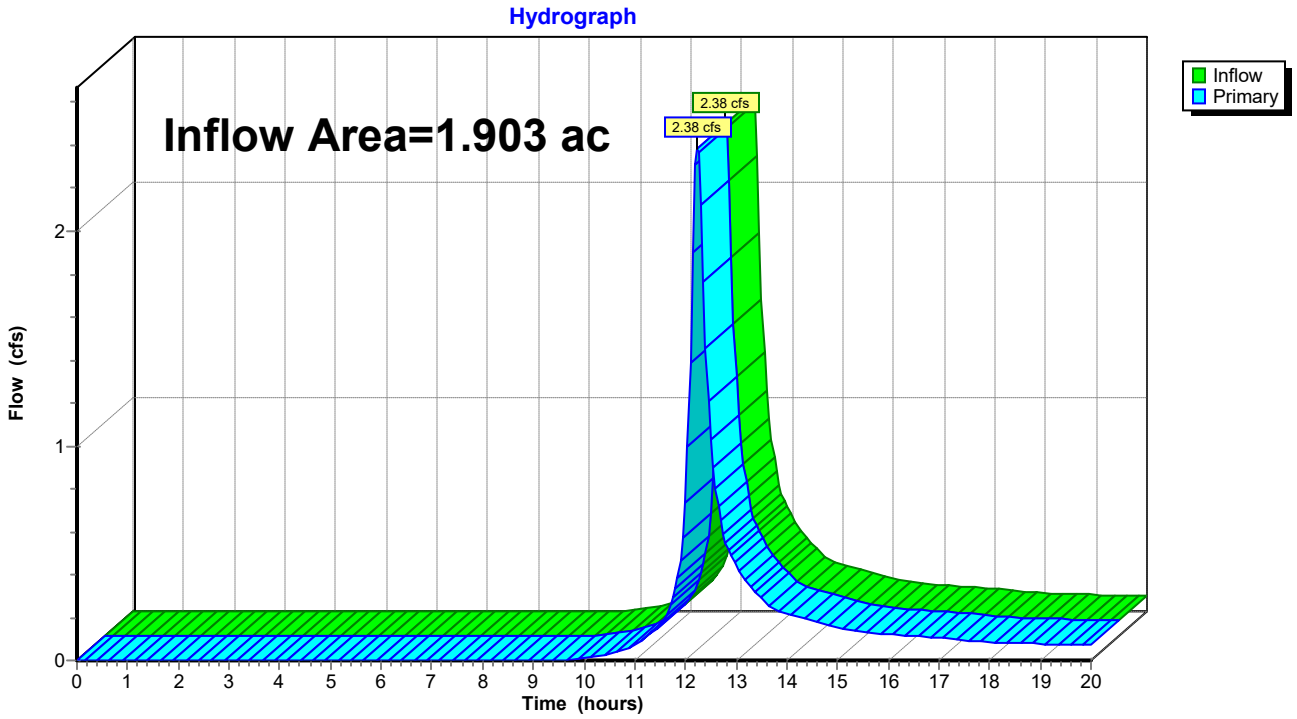


Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 24.19% Impervious, Inflow Depth > 1.25" for 2-Year event
Inflow = 2.38 cfs @ 12.23 hrs, Volume= 0.198 af
Primary = 2.38 cfs @ 12.23 hrs, Volume= 0.198 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total



Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=82,914 sf 24.19% Impervious Runoff Depth>2.44"
Flow Length=359' Tc=14.5 min CN=78 Runoff=4.65 cfs 0.386 af

Link 2L: Project Total Inflow=4.65 cfs 0.386 af
Primary=4.65 cfs 0.386 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.386 af Average Runoff Depth = 2.44"
75.81% Pervious = 1.443 ac 24.19% Impervious = 0.461 ac

Summary for Subcatchment 1S: WATERSHED A

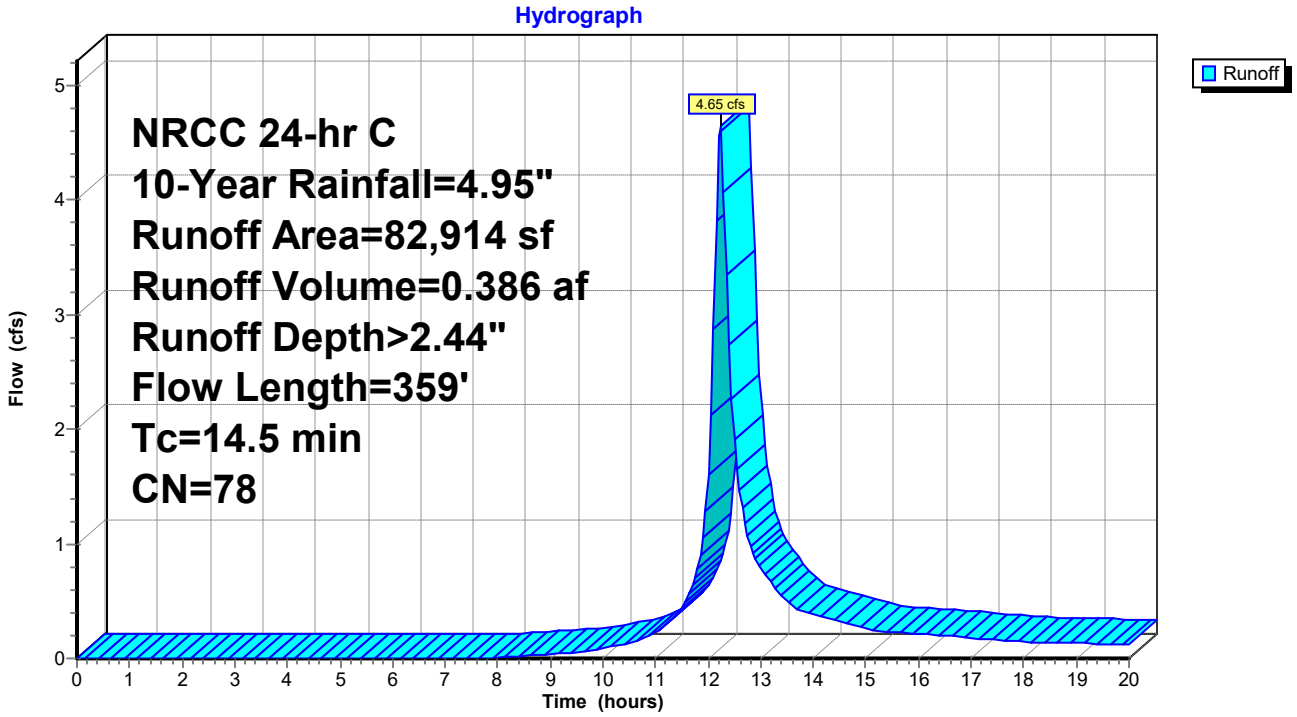
Runoff = 4.65 cfs @ 12.23 hrs, Volume= 0.386 af, Depth> 2.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.95"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	45,892	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	82,914	78	Weighted Average
	62,853		75.81% Pervious Area
	20,061		24.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A

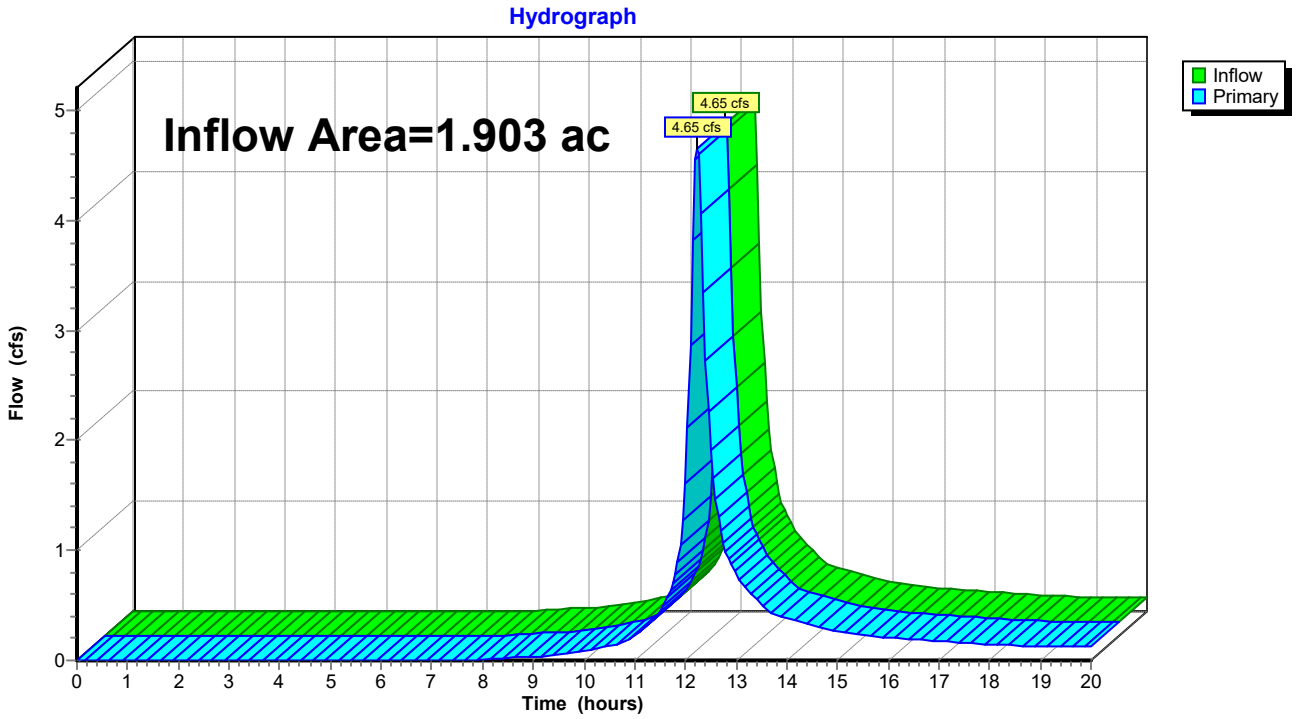


Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 24.19% Impervious, Inflow Depth > 2.44" for 10-Year event
Inflow = 4.65 cfs @ 12.23 hrs, Volume= 0.386 af
Primary = 4.65 cfs @ 12.23 hrs, Volume= 0.386 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total



Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=82,914 sf 24.19% Impervious Runoff Depth>3.44"
Flow Length=359' Tc=14.5 min CN=78 Runoff=6.51 cfs 0.546 af

Link 2L: Project Total Inflow=6.51 cfs 0.546 af
Primary=6.51 cfs 0.546 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.546 af Average Runoff Depth = 3.44"
75.81% Pervious = 1.443 ac 24.19% Impervious = 0.461 ac

Summary for Subcatchment 1S: WATERSHED A

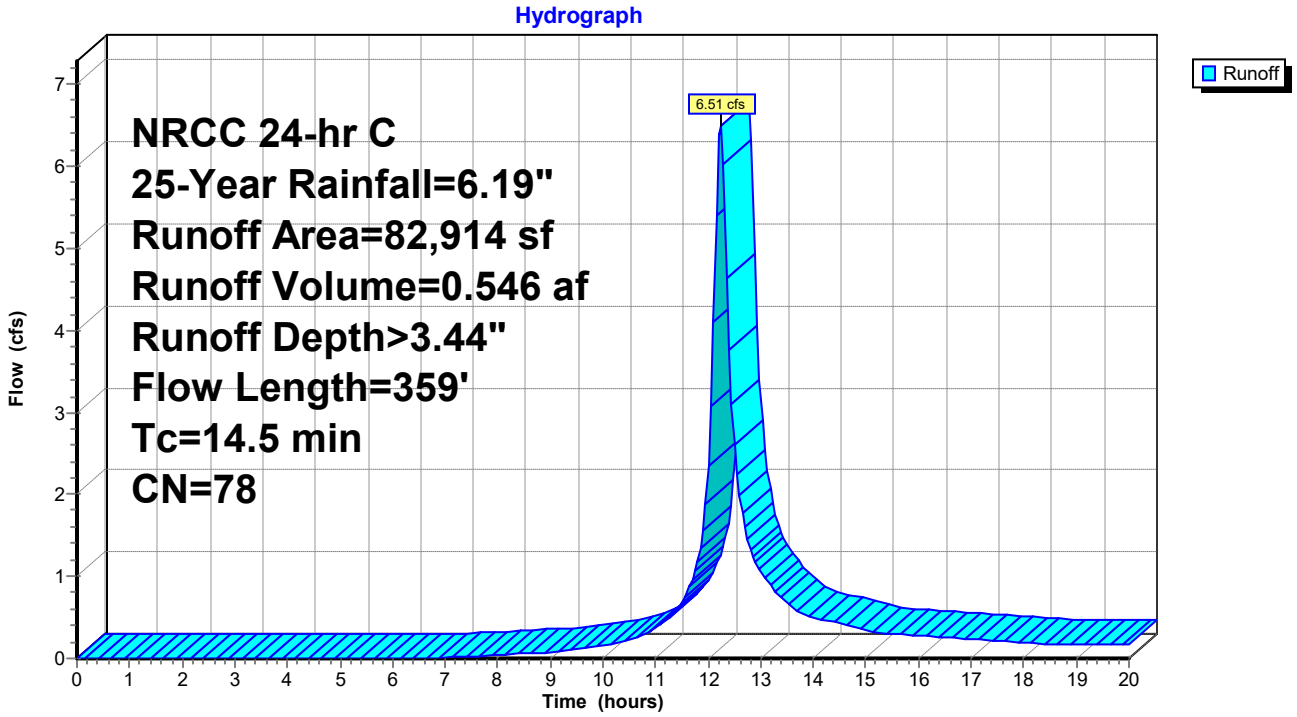
Runoff = 6.51 cfs @ 12.23 hrs, Volume= 0.546 af, Depth> 3.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	45,892	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	82,914	78	Weighted Average
	62,853		75.81% Pervious Area
	20,061		24.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A

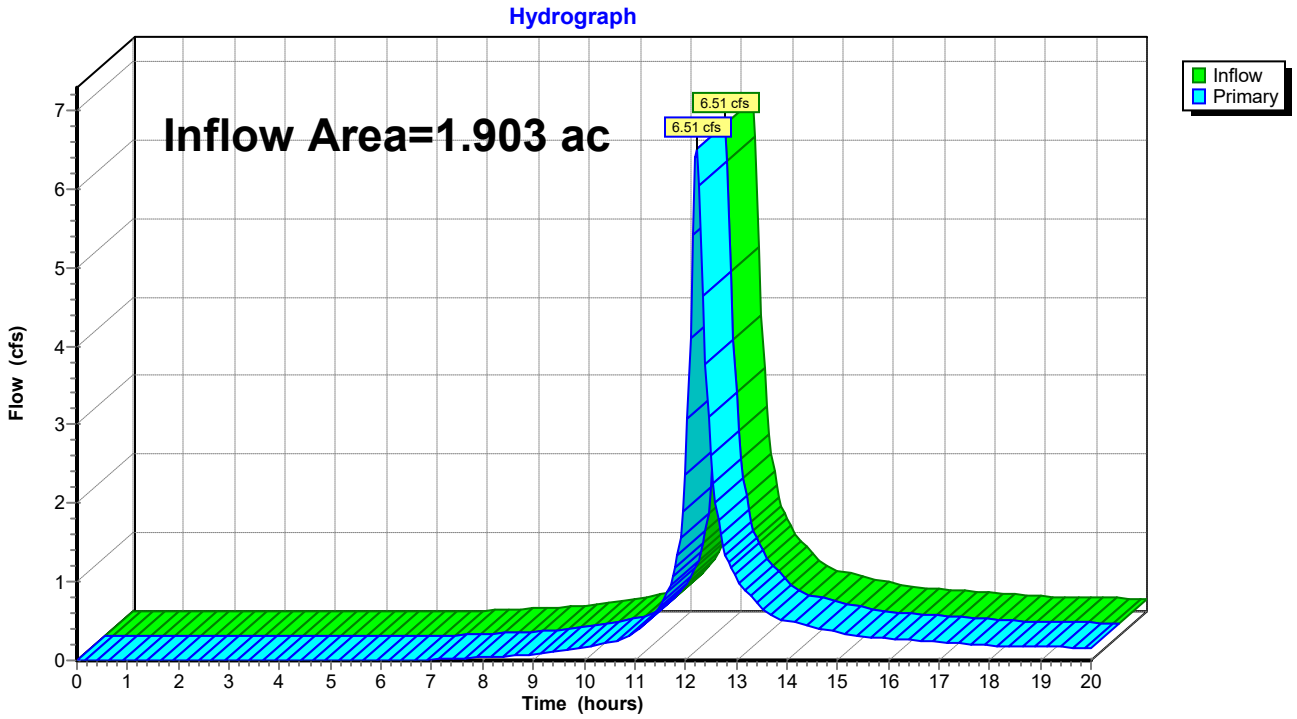


Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 24.19% Impervious, Inflow Depth > 3.44" for 25-Year event
Inflow = 6.51 cfs @ 12.23 hrs, Volume= 0.546 af
Primary = 6.51 cfs @ 12.23 hrs, Volume= 0.546 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total



Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=82,914 sf 24.19% Impervious Runoff Depth>4.40"
Flow Length=359' Tc=14.5 min CN=78 Runoff=8.24 cfs 0.698 af

Link 2L: Project Total Inflow=8.24 cfs 0.698 af
Primary=8.24 cfs 0.698 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.698 af Average Runoff Depth = 4.40"
75.81% Pervious = 1.443 ac 24.19% Impervious = 0.461 ac

Summary for Subcatchment 1S: WATERSHED A

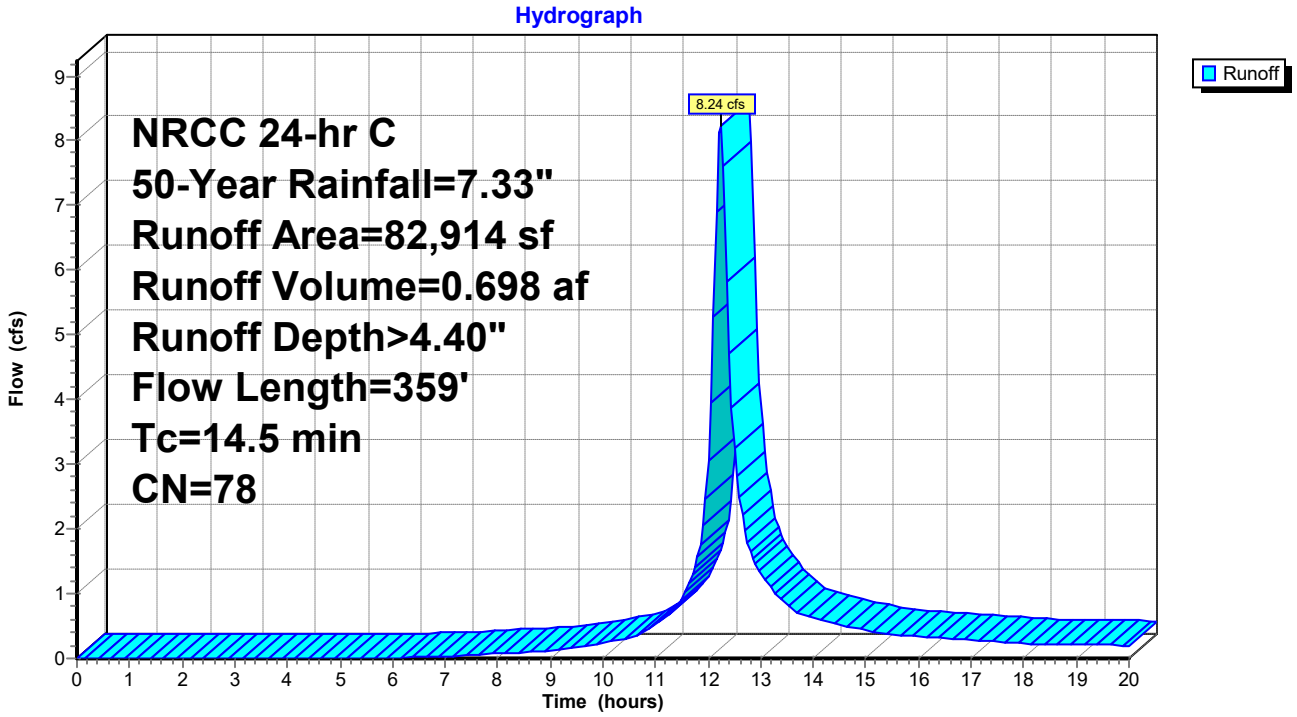
Runoff = 8.24 cfs @ 12.23 hrs, Volume= 0.698 af, Depth> 4.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 50-Year Rainfall=7.33"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	45,892	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	82,914	78	Weighted Average
	62,853		75.81% Pervious Area
	20,061		24.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A

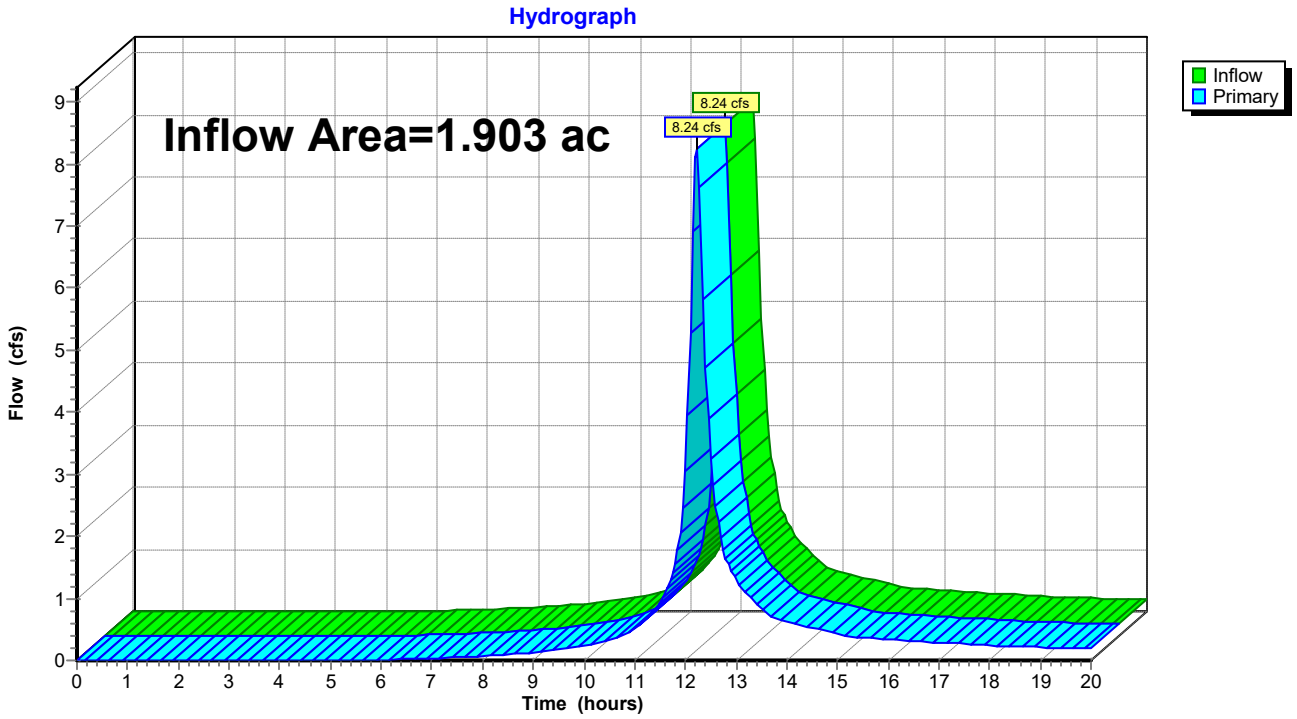


Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 24.19% Impervious, Inflow Depth > 4.40" for 50-Year event
Inflow = 8.24 cfs @ 12.23 hrs, Volume= 0.698 af
Primary = 8.24 cfs @ 12.23 hrs, Volume= 0.698 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total



Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=82,914 sf 24.19% Impervious Runoff Depth>5.57"
Flow Length=359' Tc=14.5 min CN=78 Runoff=10.34 cfs 0.884 af

Link 2L: Project Total Inflow=10.34 cfs 0.884 af
Primary=10.34 cfs 0.884 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.884 af Average Runoff Depth = 5.57"
75.81% Pervious = 1.443 ac 24.19% Impervious = 0.461 ac

Summary for Subcatchment 1S: WATERSHED A

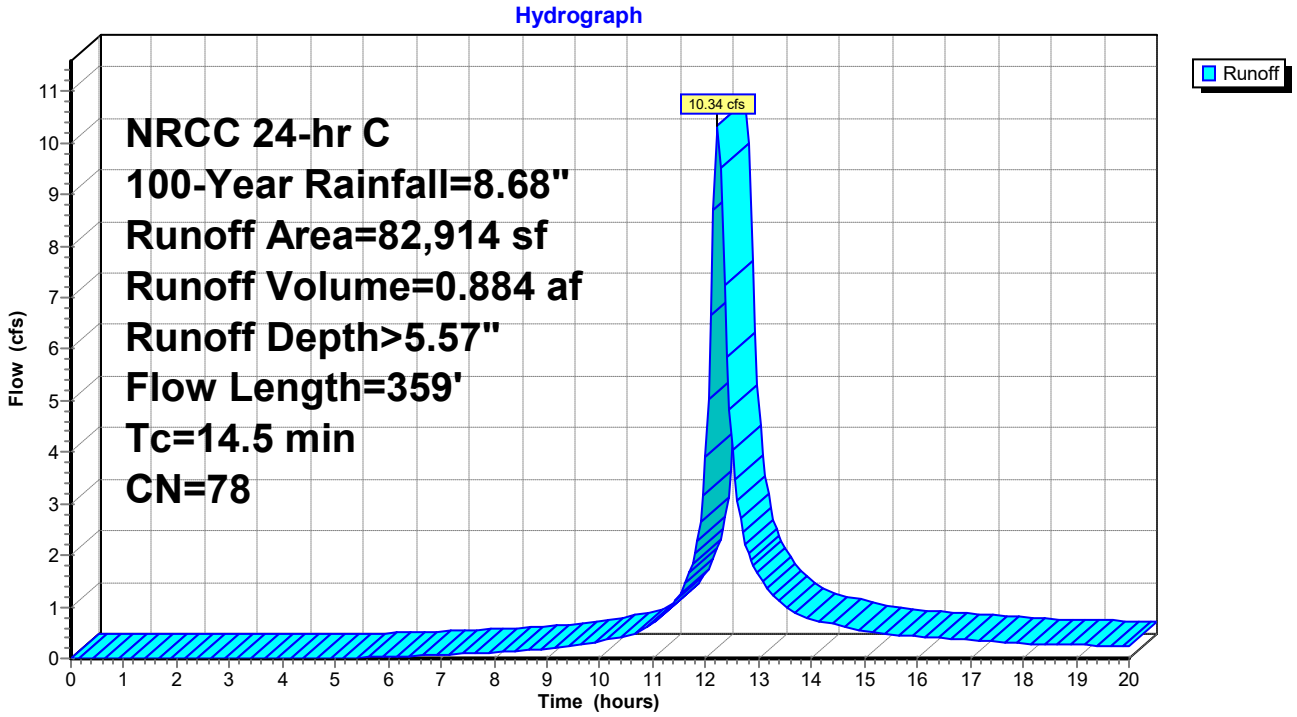
Runoff = 10.34 cfs @ 12.22 hrs, Volume= 0.884 af, Depth> 5.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.68"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	45,892	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	82,914	78	Weighted Average
	62,853		75.81% Pervious Area
	20,061		24.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A

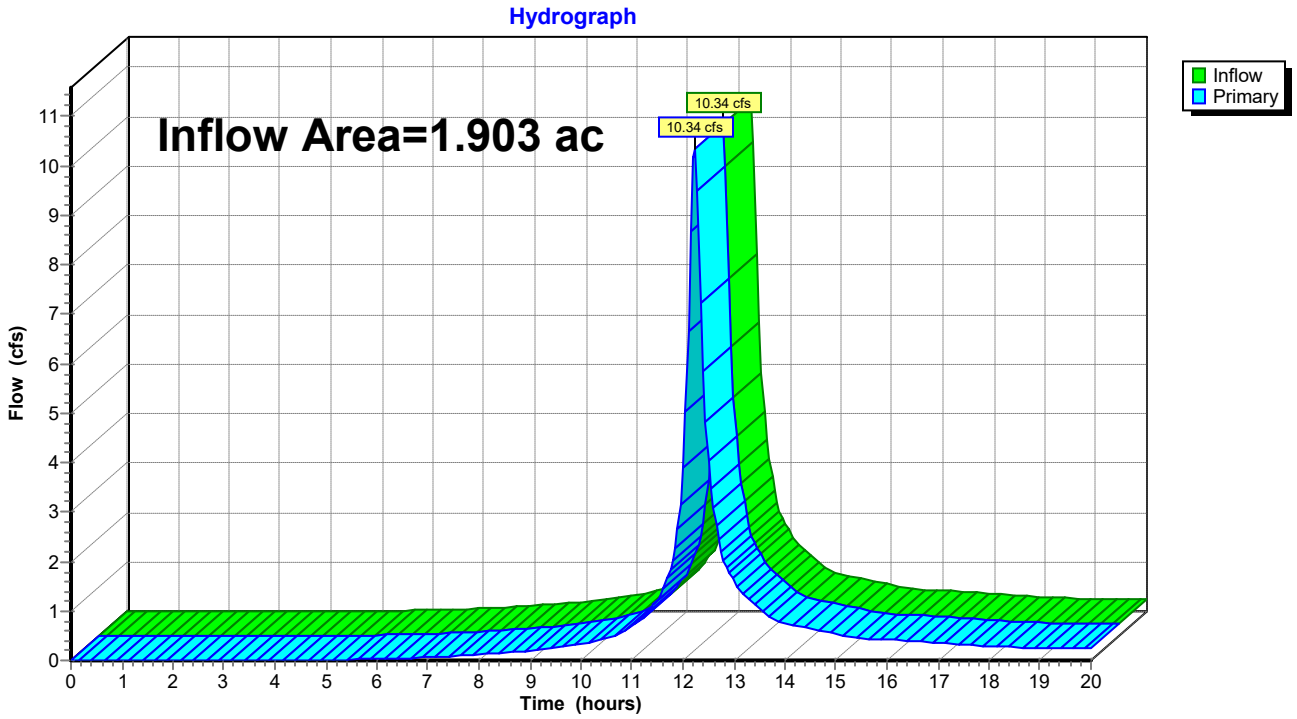


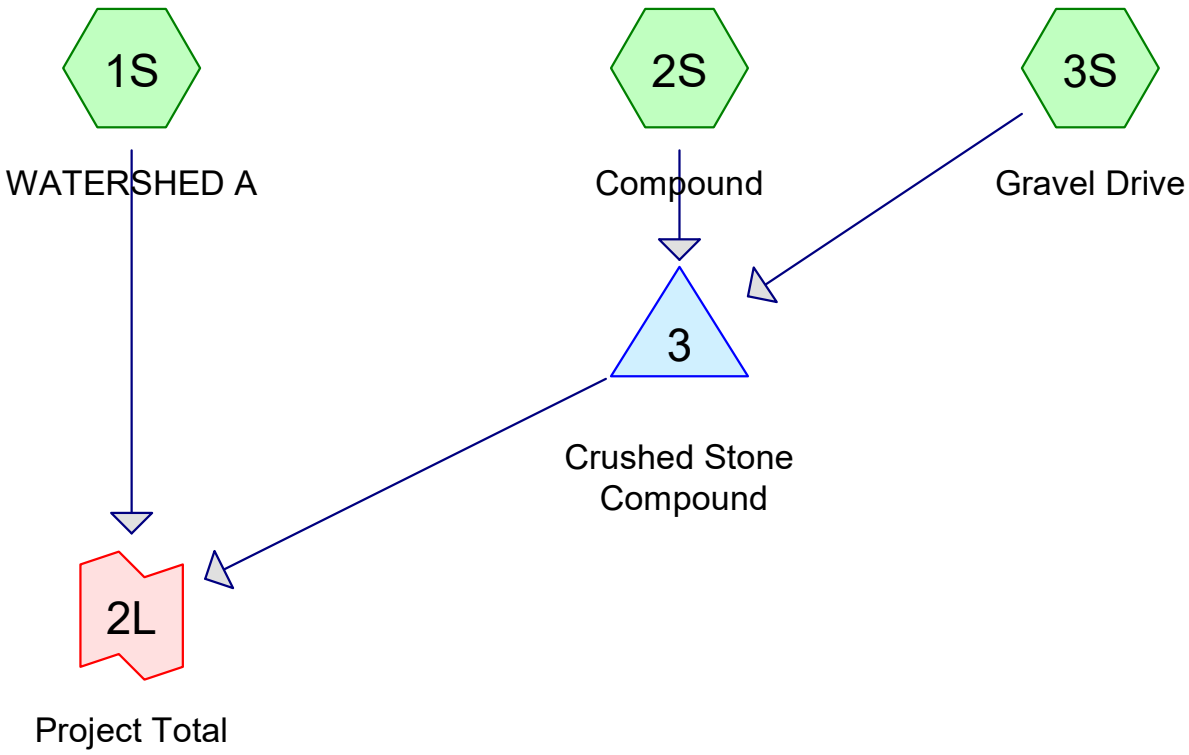
Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 24.19% Impervious, Inflow Depth > 5.57" for 100-Year event
Inflow = 10.34 cfs @ 12.22 hrs, Volume= 0.884 af
Primary = 10.34 cfs @ 12.22 hrs, Volume= 0.884 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total





Subcat Reach Pond Link

Routing Diagram for VZW Pembroke 5 MA - HydroCAD - Proposed
Prepared by McMahon Associates, Printed 5/2/2021

Project Notes

Rainfall events imported from "NRCS-Rain.txt" for 4230 MA Pembroke Plymouth County

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.017	99	3 Future Carrier Pads (12'x20' ea) (2S)
0.320	74	>75% Grass cover, Good, HSG C (1S)
0.039	89	Crushed Stone Compound (exposed) (2S)
0.069	87	Mulch/Dirt roads, HSG C (1S)
0.461	98	Paved parking, HSG C (1S)
0.036	85	Proposed Gravel Drive (3S)
0.002	99	VZW Comm Equip & Pads (2S)
0.960	70	Woods, Good, HSG C (1S)
1.903	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
1.810	HSG C	1S
0.000	HSG D	
0.093	Other	2S, 3S
1.903		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatch Numbers
0.000	0.000	0.000	0.000	0.017	0.017	3 Future Carrier Pads (12'x20' ea)	
0.000	0.000	0.320	0.000	0.000	0.320	>75% Grass cover, Good	
0.000	0.000	0.000	0.000	0.039	0.039	Crushed Stone Compound (exposed)	
0.000	0.000	0.069	0.000	0.000	0.069	Mulch/Dirt roads	
0.000	0.000	0.461	0.000	0.000	0.461	Paved parking	
0.000	0.000	0.000	0.000	0.036	0.036	Proposed Gravel Drive	
0.000	0.000	0.000	0.000	0.002	0.002	VZW Comm Equip & Pads	
0.000	0.000	0.960	0.000	0.000	0.960	Woods, Good	
0.000	**0.000**	**1.810**	**0.000**	**0.093**	**1.903**	**TOTAL AREA**	

Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=78,854 sf 25.44% Impervious Runoff Depth>0.87"
Flow Length=359' Tc=14.5 min CN=78 Runoff=1.57 cfs 0.131 af

Subcatchment 2S: Compound Runoff Area=2,500 sf 32.80% Impervious Runoff Depth>1.81"
Flow Length=70' Slope=0.0050 '/' Tc=6.0 min CN=92 Runoff=0.13 cfs 0.009 af

Subcatchment 3S: Gravel Drive Runoff Area=1,560 sf 0.00% Impervious Runoff Depth>1.29"
Tc=0.0 min CN=85 Runoff=0.07 cfs 0.004 af

Pond 3: Crushed Stone Compound Peak Elev=72.76' Storage=0.006 af Inflow=0.18 cfs 0.013 af
Discarded=0.01 cfs 0.010 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.010 af

Link 2L: Project Total Inflow=1.57 cfs 0.131 af
Primary=1.57 cfs 0.131 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.144 af Average Runoff Depth = 0.91"
74.82% Pervious = 1.424 ac 25.18% Impervious = 0.479 ac

Summary for Subcatchment 1S: WATERSHED A

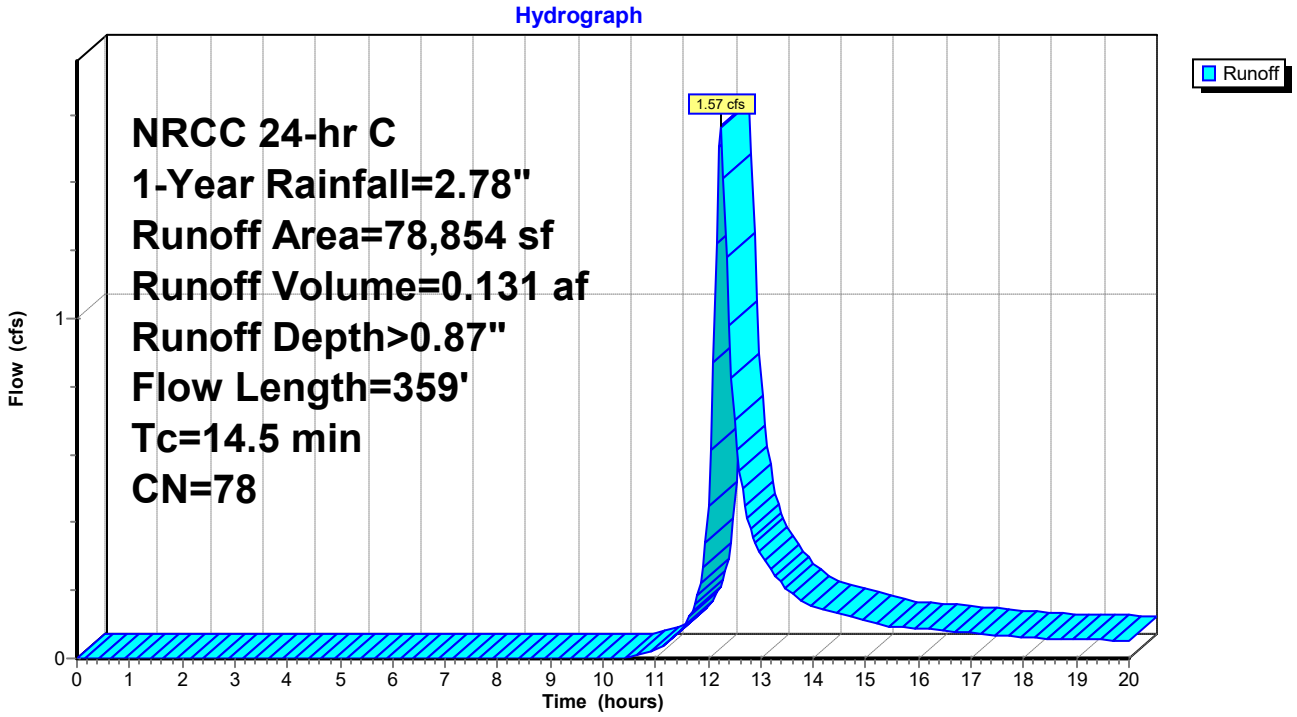
Runoff = 1.57 cfs @ 12.24 hrs, Volume= 0.131 af, Depth> 0.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 1-Year Rainfall=2.78"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	41,832	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	78,854	78	Weighted Average
	58,793		74.56% Pervious Area
	20,061		25.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A



Summary for Subcatchment 2S: Compound

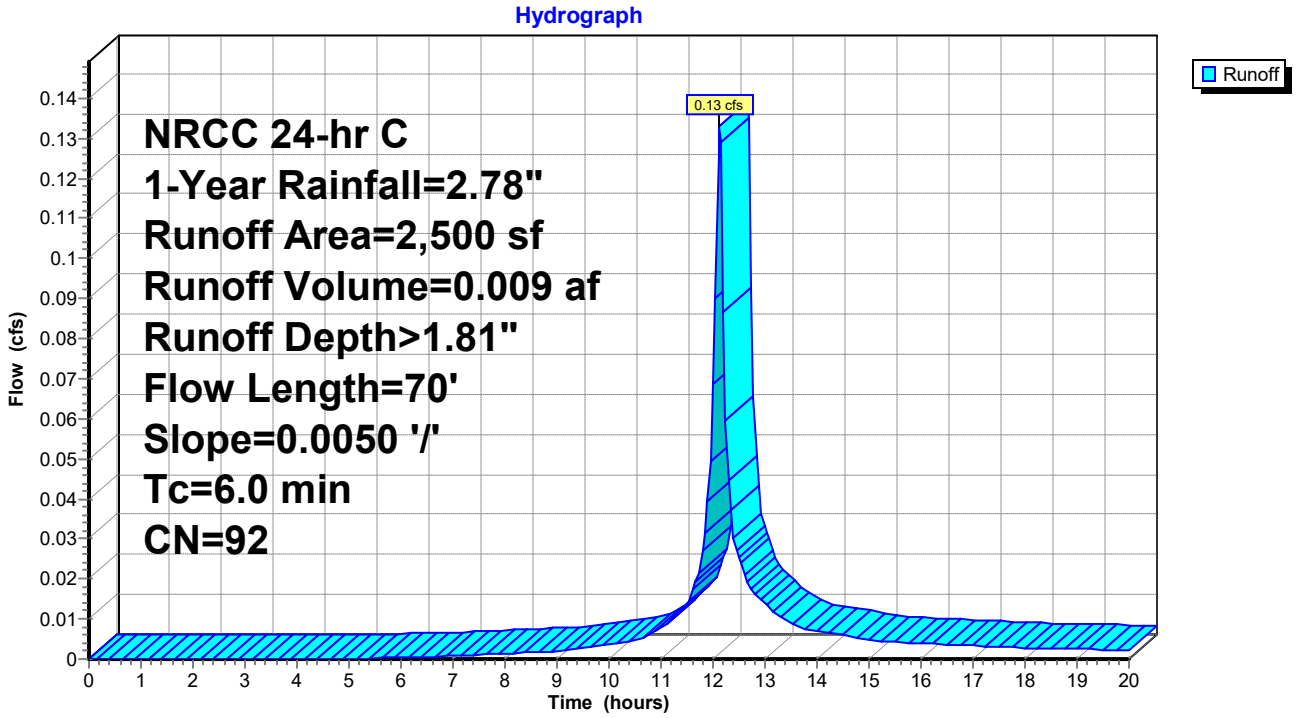
Runoff = 0.13 cfs @ 12.13 hrs, Volume= 0.009 af, Depth> 1.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 1-Year Rainfall=2.78"

	Area (sf)	CN	Description
*	1,680	89	Crushed Stone Compound (exposed)
*	100	99	VZW Comm Equip & Pads
*	720	99	3 Future Carrier Pads (12'x20' ea)
	2,500	92	Weighted Average
	1,680		67.20% Pervious Area
	820		32.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	70	0.0050	0.34		**Lag/CN Method,**
3.5	70	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Compound



Summary for Subcatchment 3S: Gravel Drive

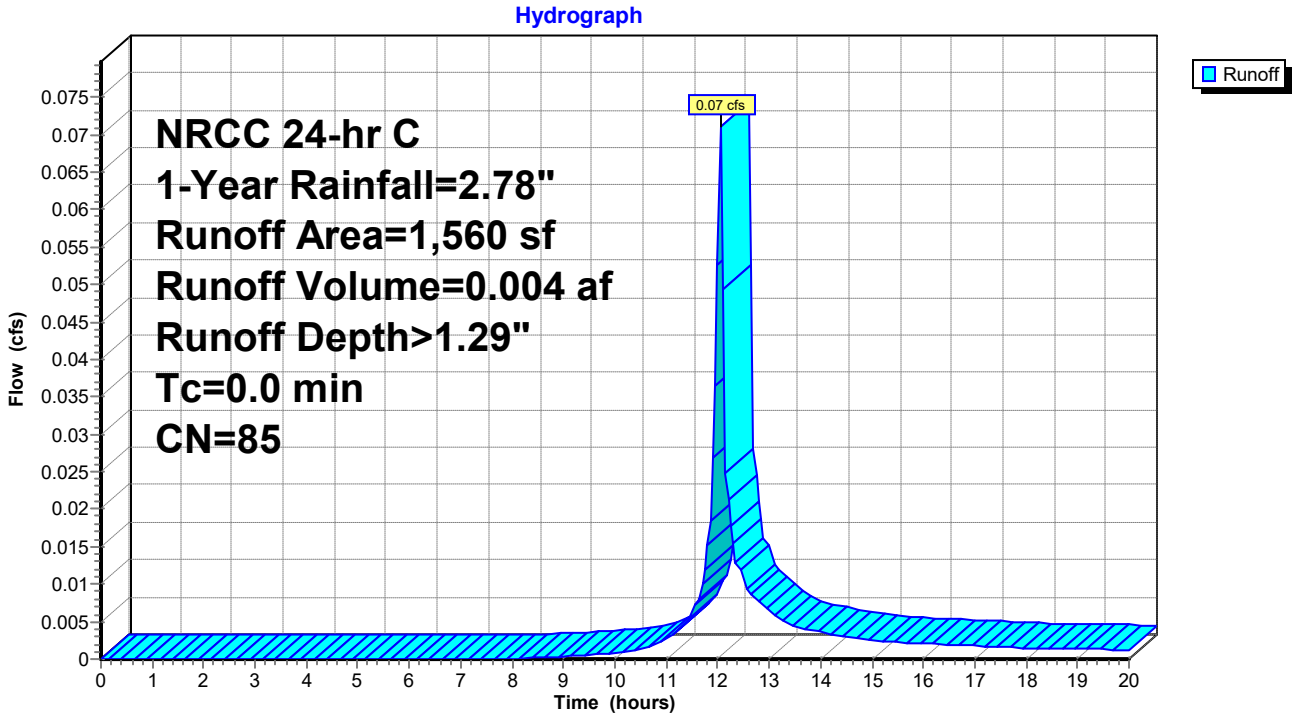
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.07 cfs @ 12.05 hrs, Volume= 0.004 af, Depth> 1.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 1-Year Rainfall=2.78"

	Area (sf)	CN	Description
*	1,560	85	Proposed Gravel Drive
	1,560		100.00% Pervious Area

Subcatchment 3S: Gravel Drive



Summary for Pond 3: Crushed Stone Compound

Inflow Area = 0.093 ac, 20.20% Impervious, Inflow Depth > 1.61" for 1-Year event
Inflow = 0.18 cfs @ 12.09 hrs, Volume= 0.013 af
Outflow = 0.01 cfs @ 11.30 hrs, Volume= 0.010 af, Atten= 93%, Lag= 0.0 min
Discarded = 0.01 cfs @ 11.30 hrs, Volume= 0.010 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 72.76' @ 13.71 hrs Surf.Area= 0.057 ac Storage= 0.006 af

Plug-Flow detention time= 180.6 min calculated for 0.010 af (76% of inflow)
Center-of-Mass det. time= 118.6 min (896.2 - 777.6)

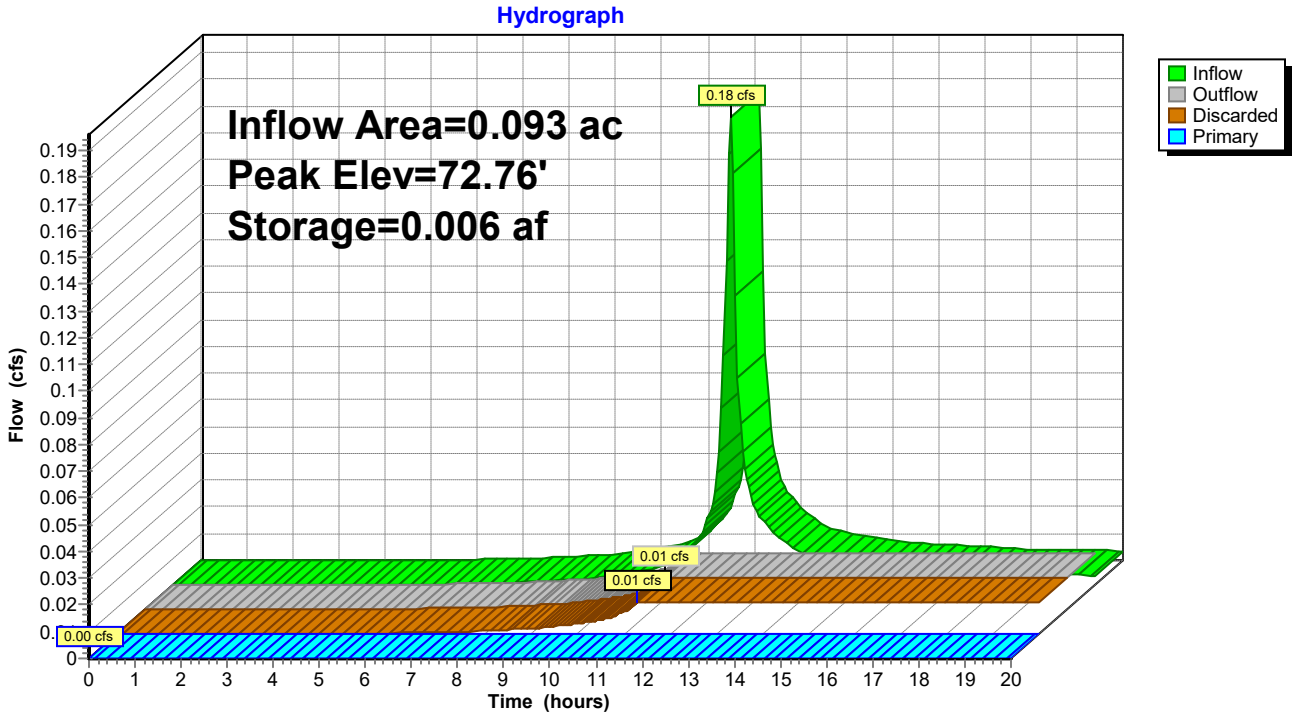
Volume	Invert	Avail.Storage	Storage Description
#1	72.50'	0.023 af	**50.00'W x 50.00'L x 1.00'H Prismatoid** 0.057 af Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	73.45'	**50.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	72.50'	**0.200 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 11.30 hrs HW=72.51' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=72.50' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3: Crushed Stone Compound

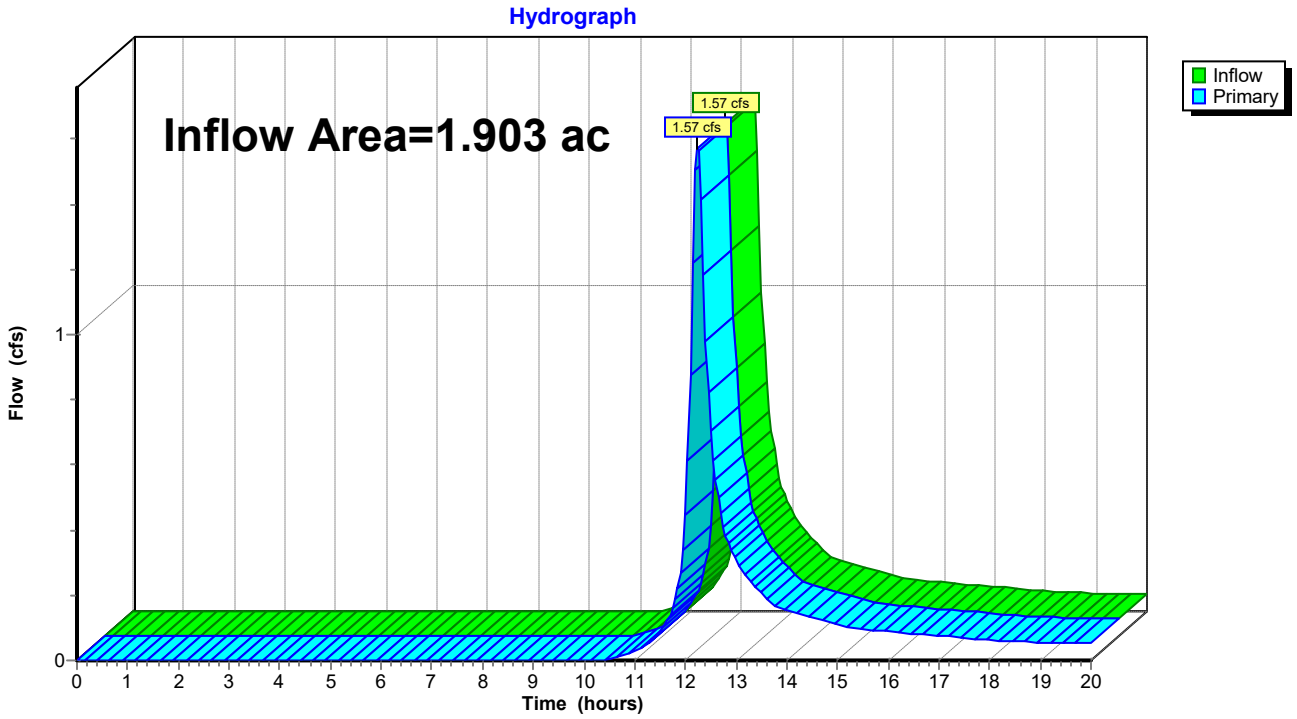


Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 25.18% Impervious, Inflow Depth > 0.83" for 1-Year event
Inflow = 1.57 cfs @ 12.24 hrs, Volume= 0.131 af
Primary = 1.57 cfs @ 12.24 hrs, Volume= 0.131 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total



Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=78,854 sf 25.44% Impervious Runoff Depth>1.25"
Flow Length=359' Tc=14.5 min CN=78 Runoff=2.27 cfs 0.188 af

Subcatchment 2S: Compound Runoff Area=2,500 sf 32.80% Impervious Runoff Depth>2.32"
Flow Length=70' Slope=0.0050 '/' Tc=6.0 min CN=92 Runoff=0.17 cfs 0.011 af

Subcatchment 3S: Gravel Drive Runoff Area=1,560 sf 0.00% Impervious Runoff Depth>1.74"
Tc=0.0 min CN=85 Runoff=0.10 cfs 0.005 af

Pond 3: Crushed Stone Compound Peak Elev=72.87' Storage=0.009 af Inflow=0.22 cfs 0.016 af
Discarded=0.01 cfs 0.010 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.010 af

Link 2L: Project Total Inflow=2.27 cfs 0.188 af
Primary=2.27 cfs 0.188 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.204 af Average Runoff Depth = 1.29"
74.82% Pervious = 1.424 ac 25.18% Impervious = 0.479 ac

Summary for Subcatchment 1S: WATERSHED A

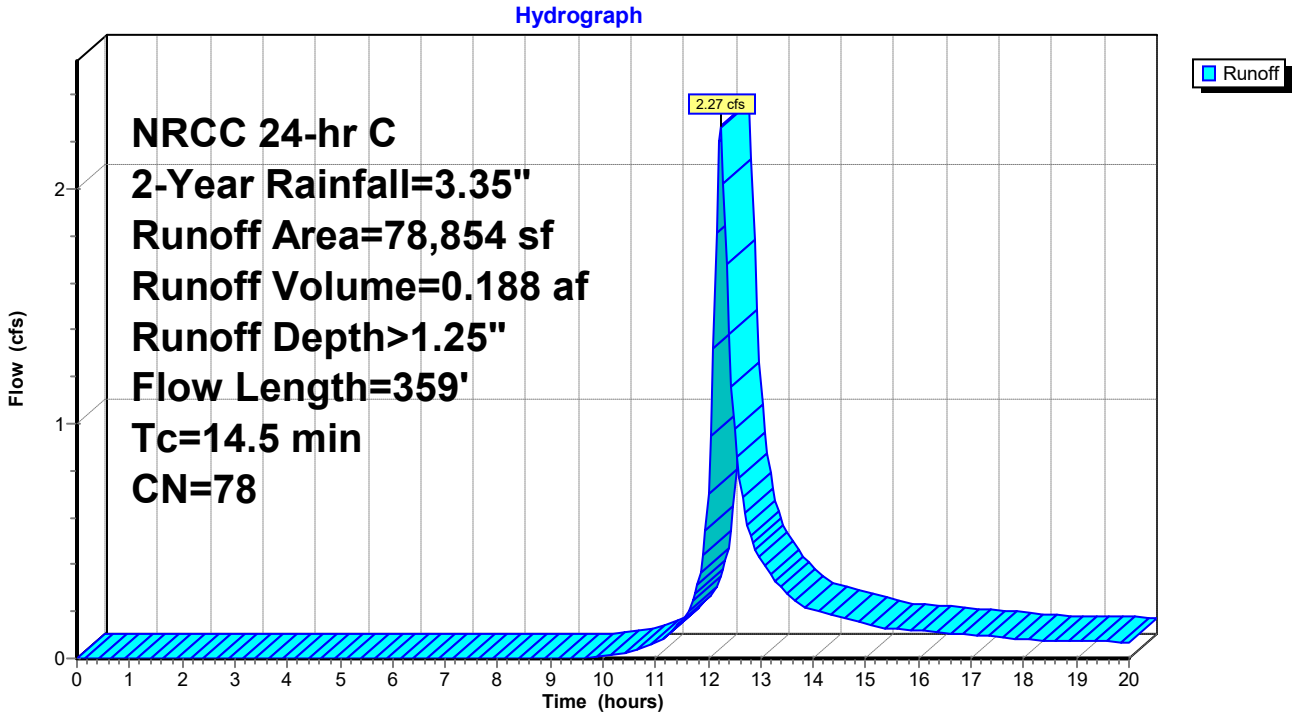
Runoff = 2.27 cfs @ 12.23 hrs, Volume= 0.188 af, Depth> 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	41,832	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	78,854	78	Weighted Average
	58,793		74.56% Pervious Area
	20,061		25.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A



Summary for Subcatchment 2S: Compound

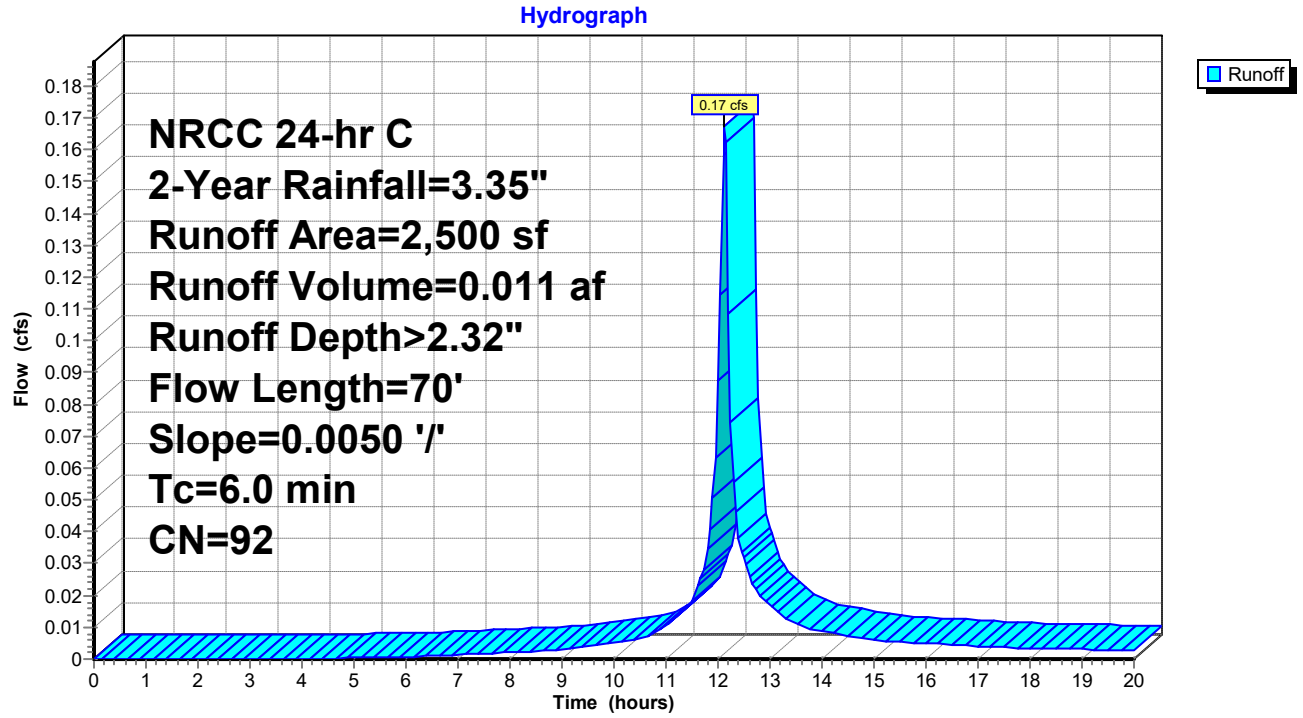
Runoff = 0.17 cfs @ 12.13 hrs, Volume= 0.011 af, Depth> 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	1,680	89	Crushed Stone Compound (exposed)
*	100	99	VZW Comm Equip & Pads
*	720	99	3 Future Carrier Pads (12'x20' ea)
	2,500	92	Weighted Average
	1,680		67.20% Pervious Area
	820		32.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	70	0.0050	0.34		**Lag/CN Method,**
3.5	70	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Compound



Summary for Subcatchment 3S: Gravel Drive

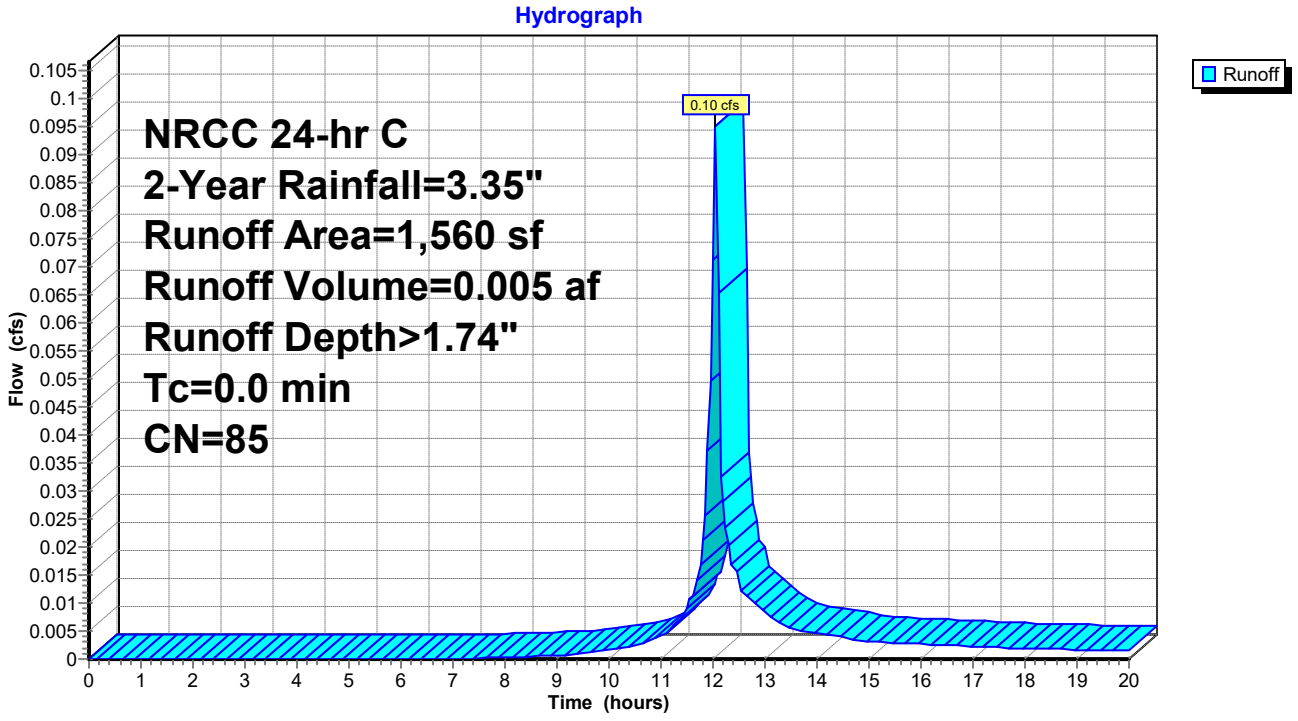
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.10 cfs @ 12.05 hrs, Volume= 0.005 af, Depth> 1.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 2-Year Rainfall=3.35"

	Area (sf)	CN	Description
*	1,560	85	Proposed Gravel Drive
	1,560		100.00% Pervious Area

Subcatchment 3S: Gravel Drive



Summary for Pond 3: Crushed Stone Compound

Inflow Area = 0.093 ac, 20.20% Impervious, Inflow Depth > 2.10" for 2-Year event
Inflow = 0.22 cfs @ 12.09 hrs, Volume= 0.016 af
Outflow = 0.01 cfs @ 11.00 hrs, Volume= 0.010 af, Atten= 95%, Lag= 0.0 min
Discarded = 0.01 cfs @ 11.00 hrs, Volume= 0.010 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 72.87' @ 14.41 hrs Surf.Area= 0.057 ac Storage= 0.009 af

Plug-Flow detention time= 183.2 min calculated for 0.010 af (62% of inflow)
Center-of-Mass det. time= 105.9 min (877.0 - 771.1)

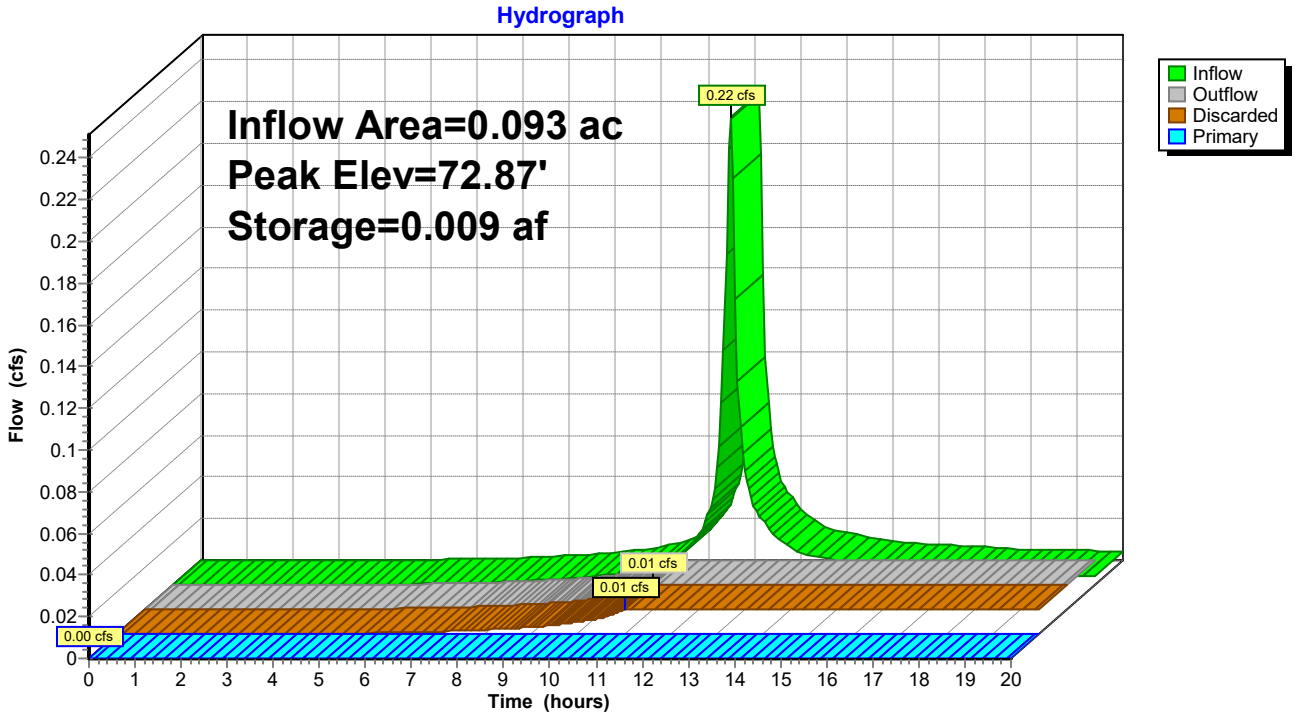
Volume	Invert	Avail.Storage	Storage Description
#1	72.50'	0.023 af	**50.00'W x 50.00'L x 1.00'H Prismatoid** 0.057 af Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	73.45'	**50.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	72.50'	**0.200 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 11.00 hrs HW=72.51' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=72.50' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3: Crushed Stone Compound

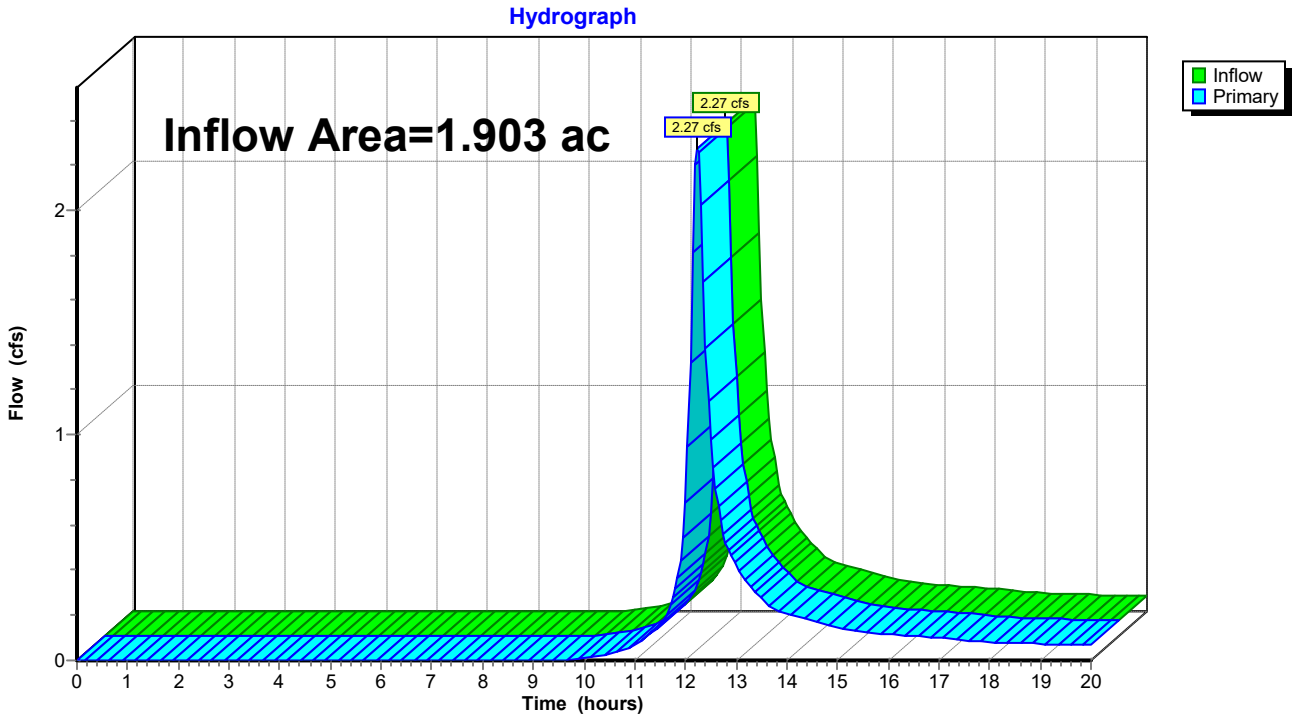


Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 25.18% Impervious, Inflow Depth > 1.19" for 2-Year event
Inflow = 2.27 cfs @ 12.23 hrs, Volume= 0.188 af
Primary = 2.27 cfs @ 12.23 hrs, Volume= 0.188 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total



Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=78,854 sf 25.44% Impervious Runoff Depth>2.44"
Flow Length=359' Tc=14.5 min CN=78 Runoff=4.42 cfs 0.368 af

Subcatchment 2S: Compound Runoff Area=2,500 sf 32.80% Impervious Runoff Depth>3.78"
Flow Length=70' Slope=0.0050 '/' Tc=6.0 min CN=92 Runoff=0.26 cfs 0.018 af

Subcatchment 3S: Gravel Drive Runoff Area=1,560 sf 0.00% Impervious Runoff Depth>3.08"
Tc=0.0 min CN=85 Runoff=0.16 cfs 0.009 af

Pond 3: Crushed Stone Compound Peak Elev=73.23' Storage=0.017 af Inflow=0.36 cfs 0.027 af
Discarded=0.01 cfs 0.012 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.012 af

Link 2L: Project Total Inflow=4.42 cfs 0.368 af
Primary=4.42 cfs 0.368 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.395 af Average Runoff Depth = 2.49"
74.82% Pervious = 1.424 ac 25.18% Impervious = 0.479 ac

Summary for Subcatchment 1S: WATERSHED A

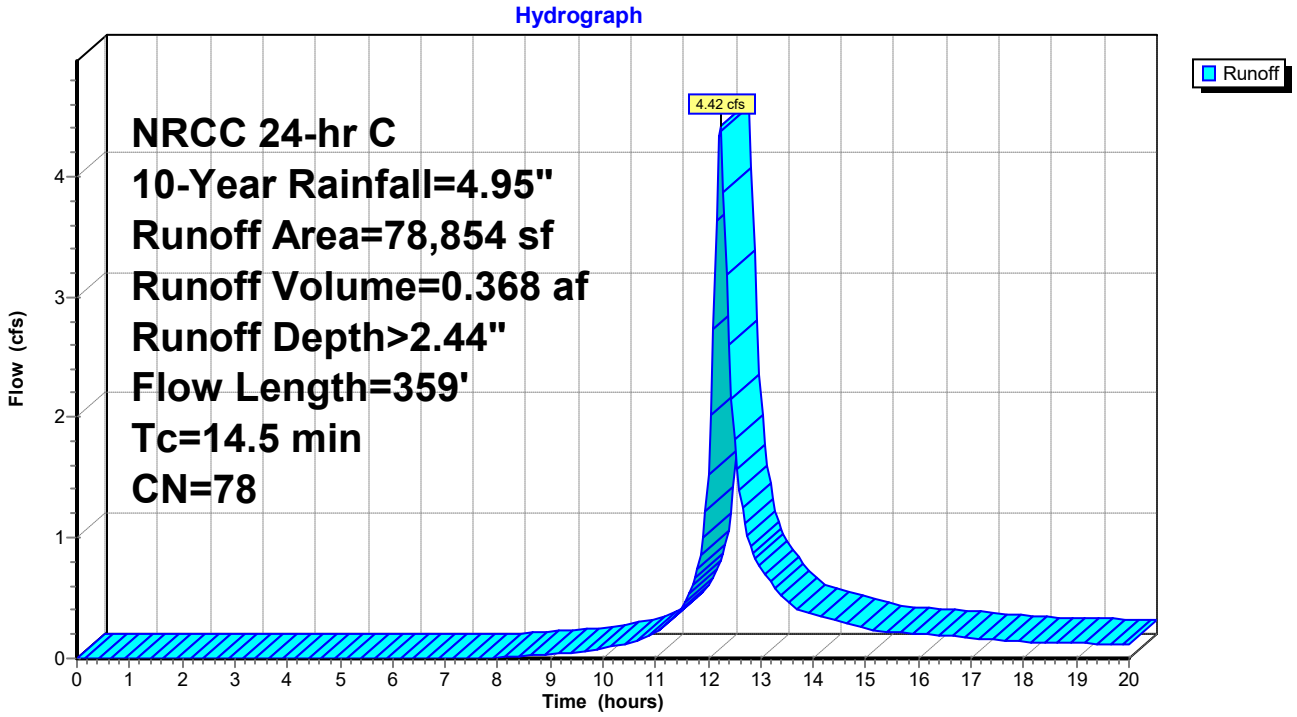
Runoff = 4.42 cfs @ 12.23 hrs, Volume= 0.368 af, Depth> 2.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.95"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	41,832	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	78,854	78	Weighted Average
	58,793		74.56% Pervious Area
	20,061		25.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A



Summary for Subcatchment 2S: Compound

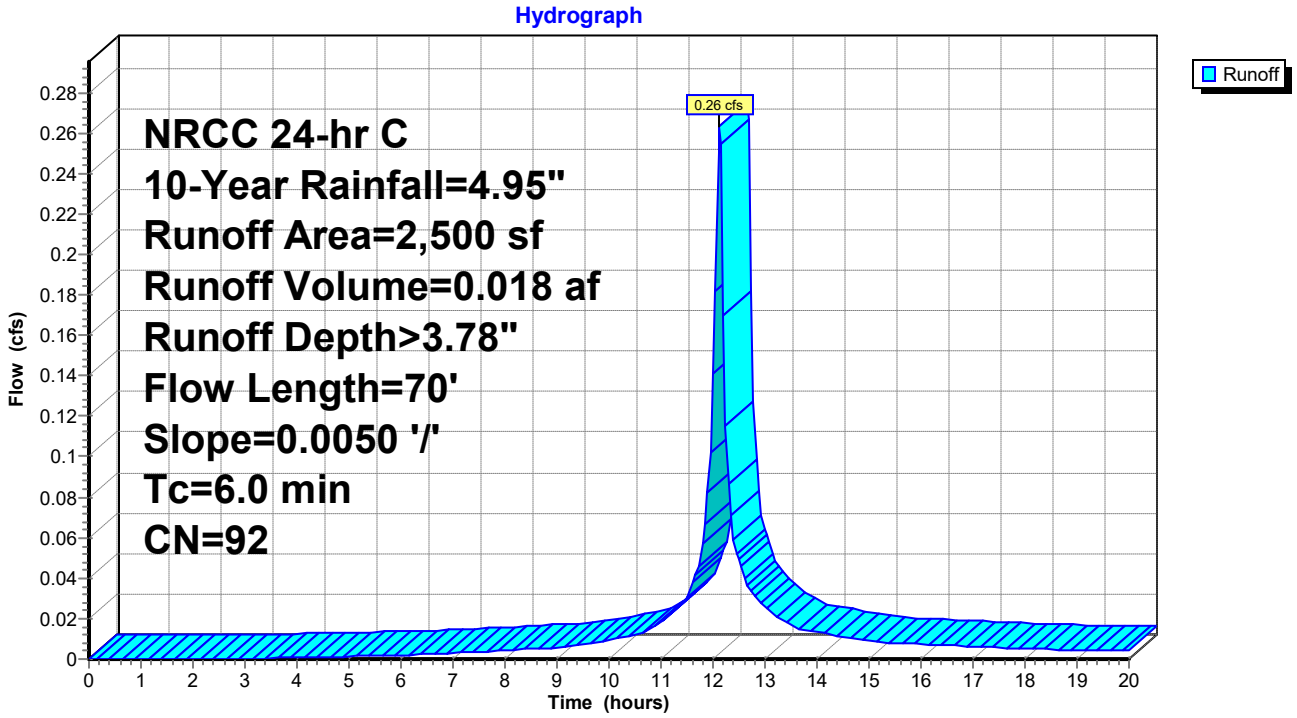
Runoff = 0.26 cfs @ 12.13 hrs, Volume= 0.018 af, Depth> 3.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.95"

	Area (sf)	CN	Description
*	1,680	89	Crushed Stone Compound (exposed)
*	100	99	VZW Comm Equip & Pads
*	720	99	3 Future Carrier Pads (12'x20' ea)
	2,500	92	Weighted Average
	1,680		67.20% Pervious Area
	820		32.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	70	0.0050	0.34		**Lag/CN Method,**
3.5	70	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Compound



Summary for Subcatchment 3S: Gravel Drive

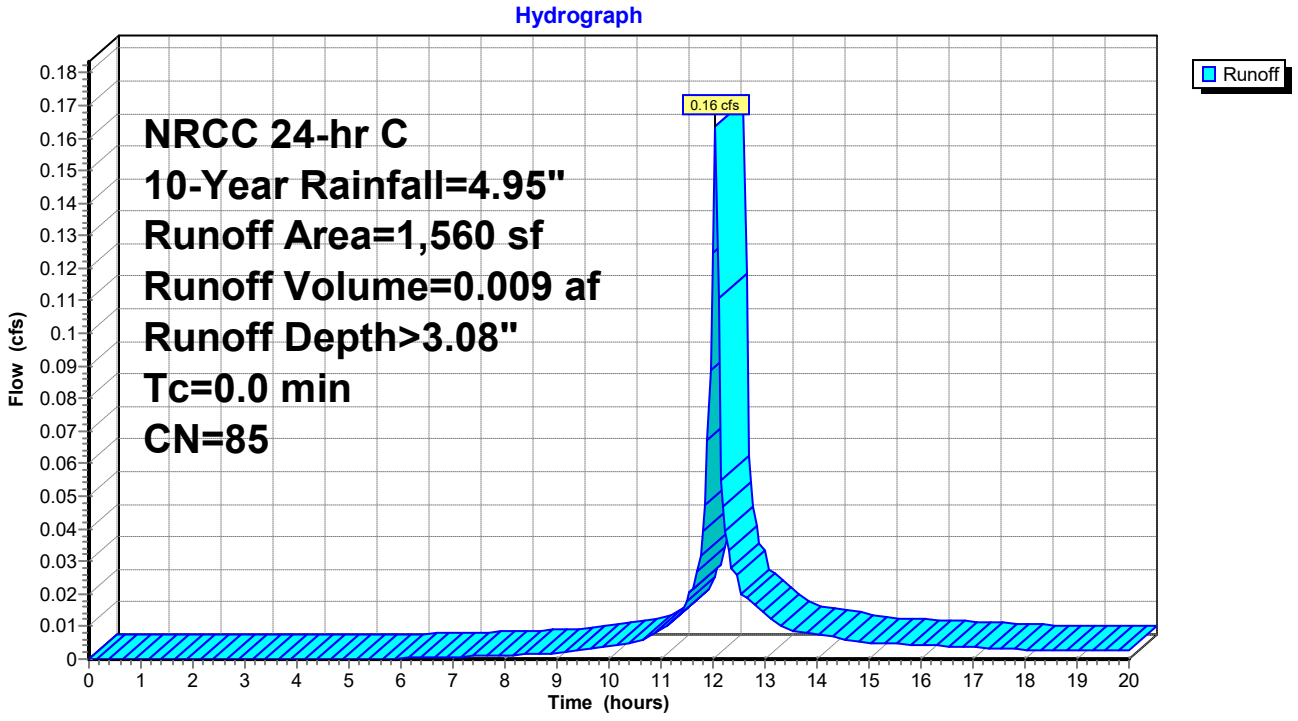
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.16 cfs @ 12.05 hrs, Volume= 0.009 af, Depth> 3.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 10-Year Rainfall=4.95"

	Area (sf)	CN	Description
*	1,560	85	Proposed Gravel Drive
	1,560		100.00% Pervious Area

Subcatchment 3S: Gravel Drive



Summary for Pond 3: Crushed Stone Compound

Inflow Area = 0.093 ac, 20.20% Impervious, Inflow Depth > 3.51" for 10-Year event
Inflow = 0.36 cfs @ 12.09 hrs, Volume= 0.027 af
Outflow = 0.01 cfs @ 10.00 hrs, Volume= 0.012 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.01 cfs @ 10.00 hrs, Volume= 0.012 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 73.23' @ 16.08 hrs Surf.Area= 0.057 ac Storage= 0.017 af

Plug-Flow detention time= 174.3 min calculated for 0.012 af (43% of inflow)
Center-of-Mass det. time= 70.9 min (828.8 - 757.9)

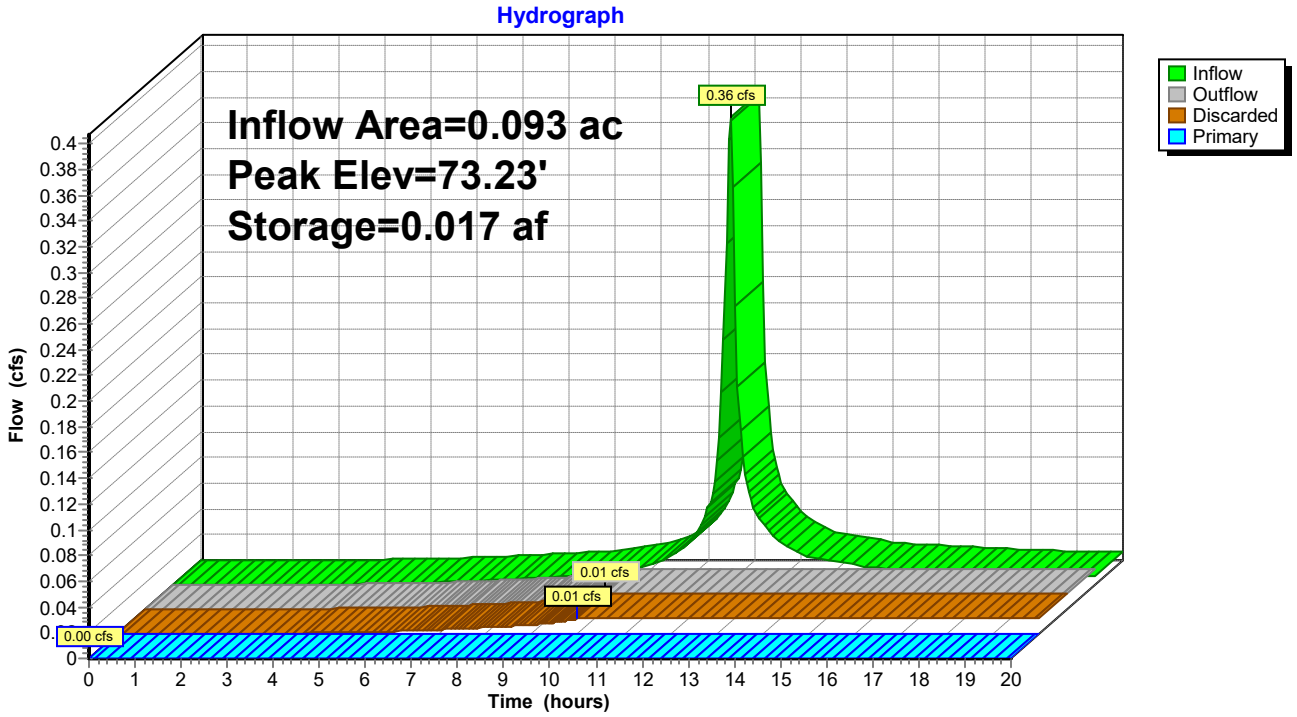
Volume	Invert	Avail.Storage	Storage Description
#1	72.50'	0.023 af	**50.00'W x 50.00'L x 1.00'H Prismatoid** 0.057 af Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	73.45'	**50.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	72.50'	**0.200 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 10.00 hrs HW=72.51' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=72.50' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3: Crushed Stone Compound

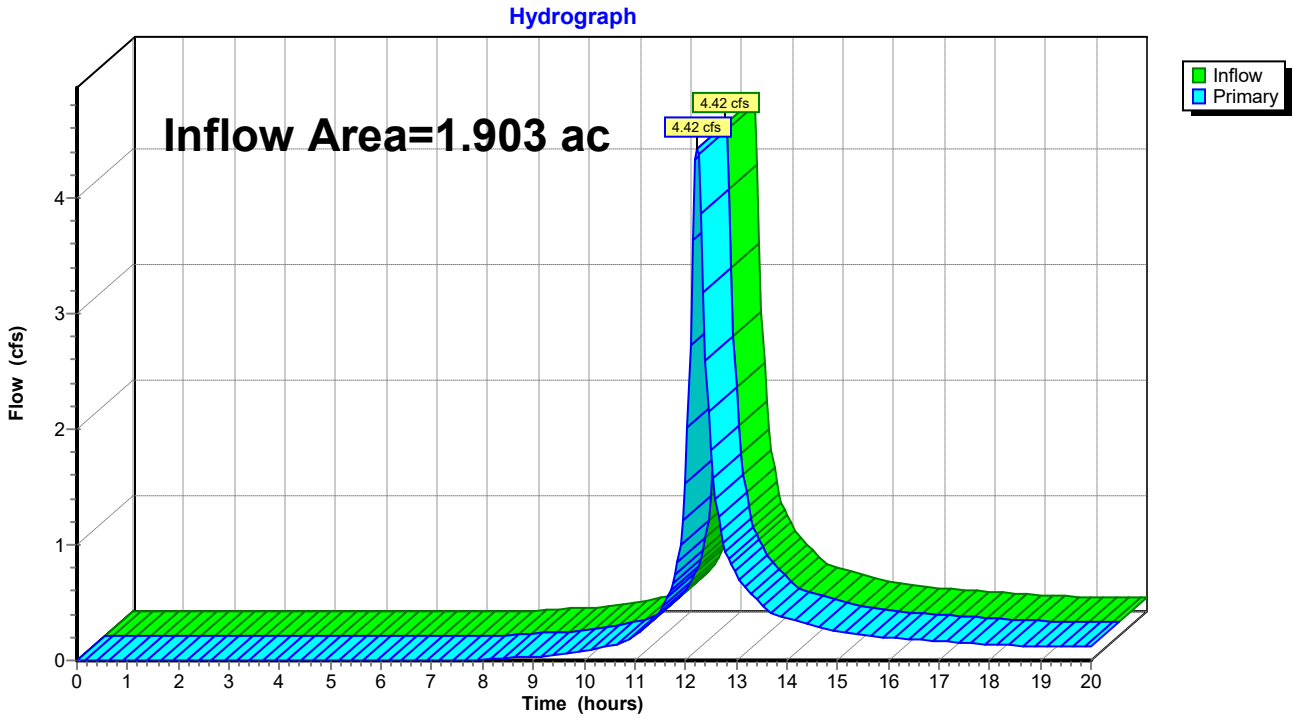


Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 25.18% Impervious, Inflow Depth > 2.32" for 10-Year event
Inflow = 4.42 cfs @ 12.23 hrs, Volume= 0.368 af
Primary = 4.42 cfs @ 12.23 hrs, Volume= 0.368 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total



Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=78,854 sf 25.44% Impervious Runoff Depth>3.44"
Flow Length=359' Tc=14.5 min CN=78 Runoff=6.19 cfs 0.519 af

Subcatchment 2S: Compound Runoff Area=2,500 sf 32.80% Impervious Runoff Depth>4.93"
Flow Length=70' Slope=0.0050 '/' Tc=6.0 min CN=92 Runoff=0.34 cfs 0.024 af

Subcatchment 3S: Gravel Drive Runoff Area=1,560 sf 0.00% Impervious Runoff Depth>4.18"
Tc=0.0 min CN=85 Runoff=0.22 cfs 0.012 af

Pond 3: Crushed Stone Compound Peak Elev=73.45' Storage=0.022 af Inflow=0.47 cfs 0.036 af
Discarded=0.01 cfs 0.013 af Primary=0.02 cfs 0.002 af Outflow=0.03 cfs 0.015 af

Link 2L: Project Total Inflow=6.19 cfs 0.521 af
Primary=6.19 cfs 0.521 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.555 af Average Runoff Depth = 3.50"
74.82% Pervious = 1.424 ac 25.18% Impervious = 0.479 ac

Summary for Subcatchment 1S: WATERSHED A

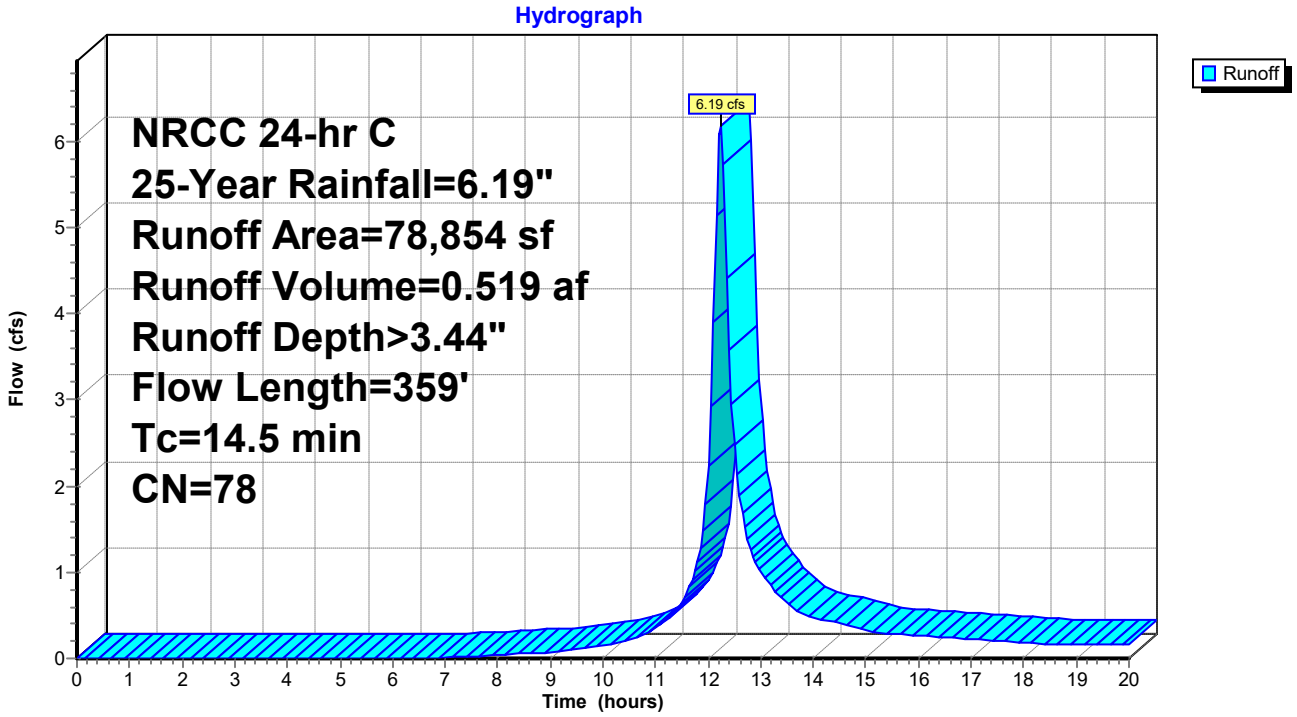
Runoff = 6.19 cfs @ 12.23 hrs, Volume= 0.519 af, Depth> 3.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	41,832	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	78,854	78	Weighted Average
	58,793		74.56% Pervious Area
	20,061		25.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A



Summary for Subcatchment 2S: Compound

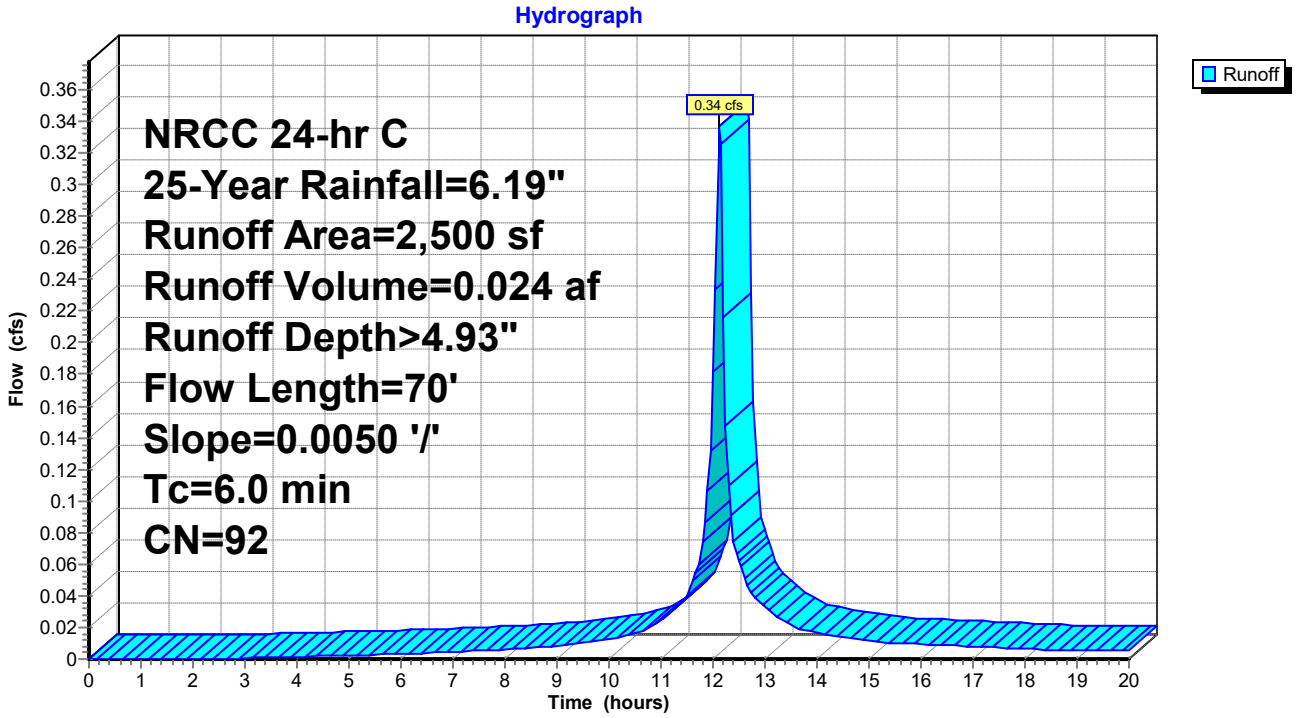
Runoff = 0.34 cfs @ 12.13 hrs, Volume= 0.024 af, Depth> 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	1,680	89	Crushed Stone Compound (exposed)
*	100	99	VZW Comm Equip & Pads
*	720	99	3 Future Carrier Pads (12'x20' ea)
	2,500	92	Weighted Average
	1,680		67.20% Pervious Area
	820		32.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	70	0.0050	0.34		**Lag/CN Method,**
3.5	70	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Compound



Summary for Subcatchment 3S: Gravel Drive

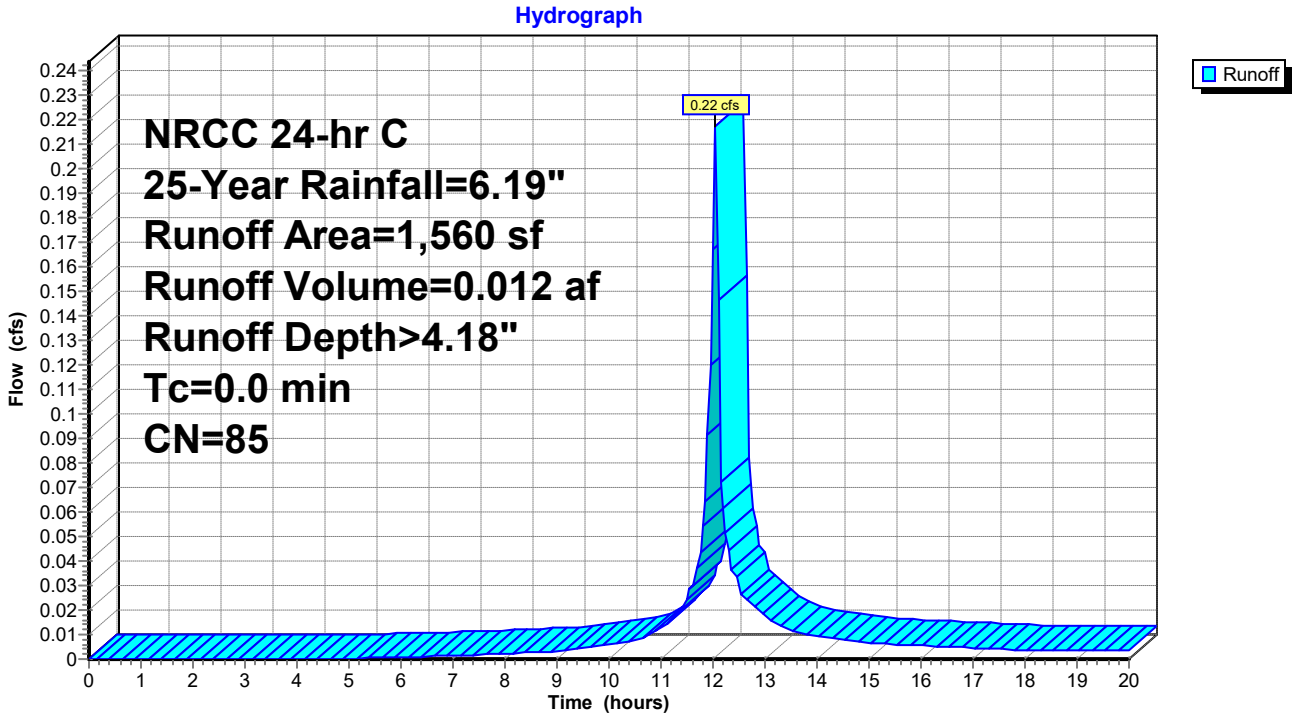
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.22 cfs @ 12.05 hrs, Volume= 0.012 af, Depth> 4.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 25-Year Rainfall=6.19"

	Area (sf)	CN	Description
*	1,560	85	Proposed Gravel Drive
	1,560		100.00% Pervious Area

Subcatchment 3S: Gravel Drive



Summary for Pond 3: Crushed Stone Compound

Inflow Area = 0.093 ac, 20.20% Impervious, Inflow Depth > 4.64" for 25-Year event
Inflow = 0.47 cfs @ 12.08 hrs, Volume= 0.036 af
Outflow = 0.03 cfs @ 13.67 hrs, Volume= 0.015 af, Atten= 93%, Lag= 95.0 min
Discarded = 0.01 cfs @ 9.30 hrs, Volume= 0.013 af
Primary = 0.02 cfs @ 13.67 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 73.45' @ 13.65 hrs Surf.Area= 0.057 ac Storage= 0.022 af

Plug-Flow detention time= 169.8 min calculated for 0.015 af (41% of inflow)
Center-of-Mass det. time= 58.4 min (809.3 - 750.9)

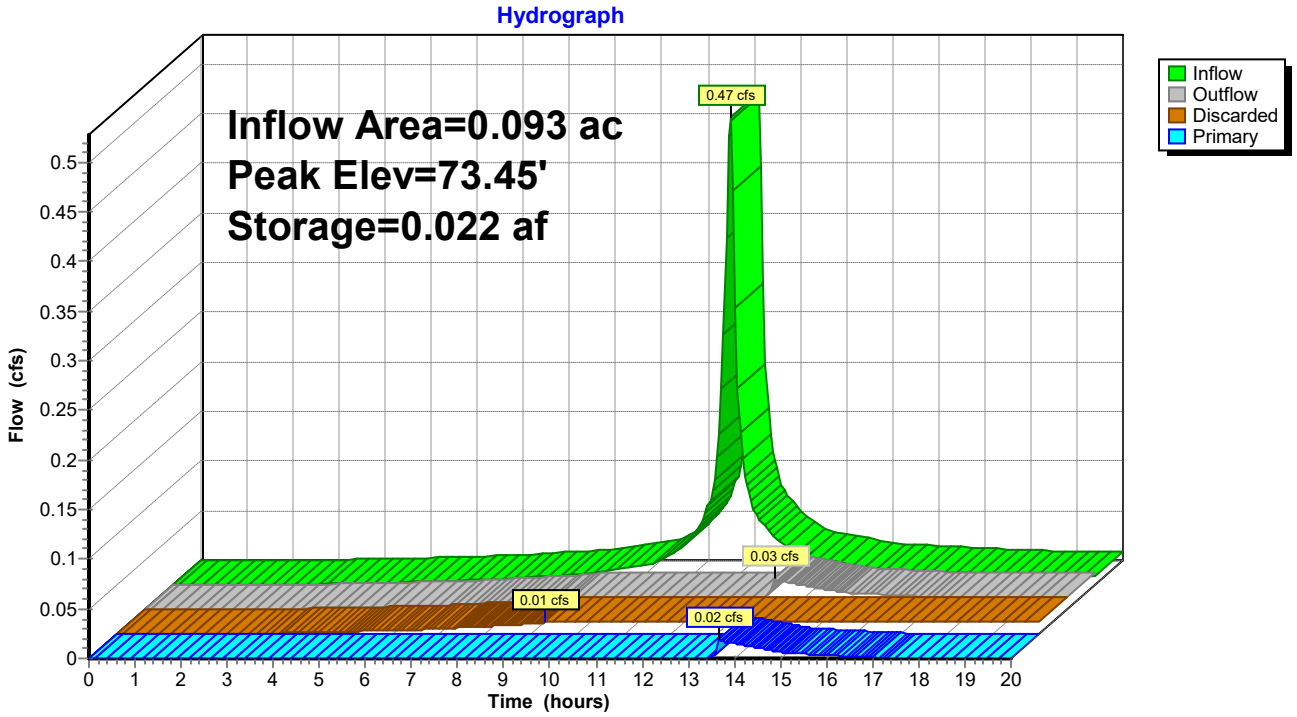
Volume	Invert	Avail.Storage	Storage Description
#1	72.50'	0.023 af	**50.00'W x 50.00'L x 1.00'H Prismatoid** 0.057 af Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	73.45'	**50.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	72.50'	**0.200 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 9.30 hrs HW=72.51' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.01 cfs @ 13.67 hrs HW=73.45' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.10 fps)

Pond 3: Crushed Stone Compound

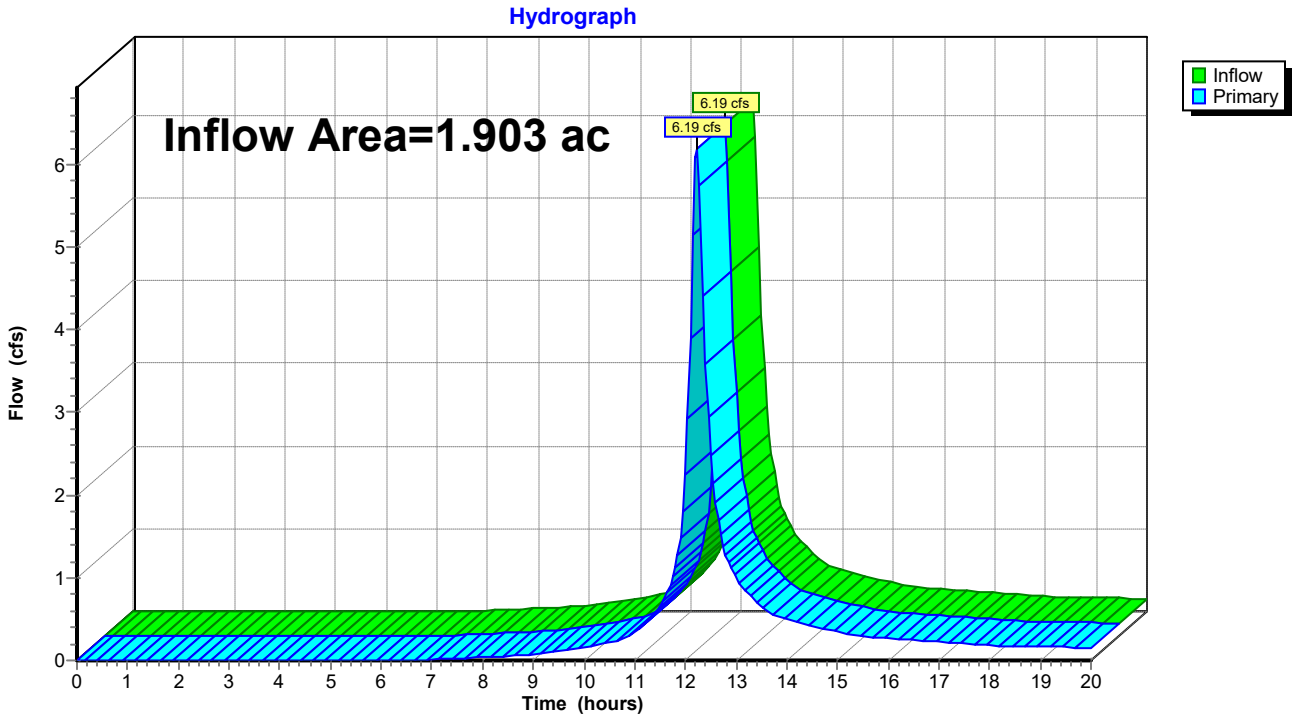


Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 25.18% Impervious, Inflow Depth > 3.29" for 25-Year event
Inflow = 6.19 cfs @ 12.23 hrs, Volume= 0.521 af
Primary = 6.19 cfs @ 12.23 hrs, Volume= 0.521 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total



Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=78,854 sf 25.44% Impervious Runoff Depth>4.40"
Flow Length=359' Tc=14.5 min CN=78 Runoff=7.84 cfs 0.664 af

Subcatchment 2S: Compound Runoff Area=2,500 sf 32.80% Impervious Runoff Depth>5.99"
Flow Length=70' Slope=0.0050 '/' Tc=6.0 min CN=92 Runoff=0.40 cfs 0.029 af

Subcatchment 3S: Gravel Drive Runoff Area=1,560 sf 0.00% Impervious Runoff Depth>5.20"
Tc=0.0 min CN=85 Runoff=0.27 cfs 0.016 af

Pond 3: Crushed Stone Compound Peak Elev=73.46' Storage=0.022 af Inflow=0.57 cfs 0.044 af
Discarded=0.01 cfs 0.013 af Primary=0.12 cfs 0.009 af Outflow=0.13 cfs 0.022 af

Link 2L: Project Total Inflow=7.84 cfs 0.673 af
Primary=7.84 cfs 0.673 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.708 af Average Runoff Depth = 4.47"
74.82% Pervious = 1.424 ac 25.18% Impervious = 0.479 ac

Summary for Subcatchment 1S: WATERSHED A

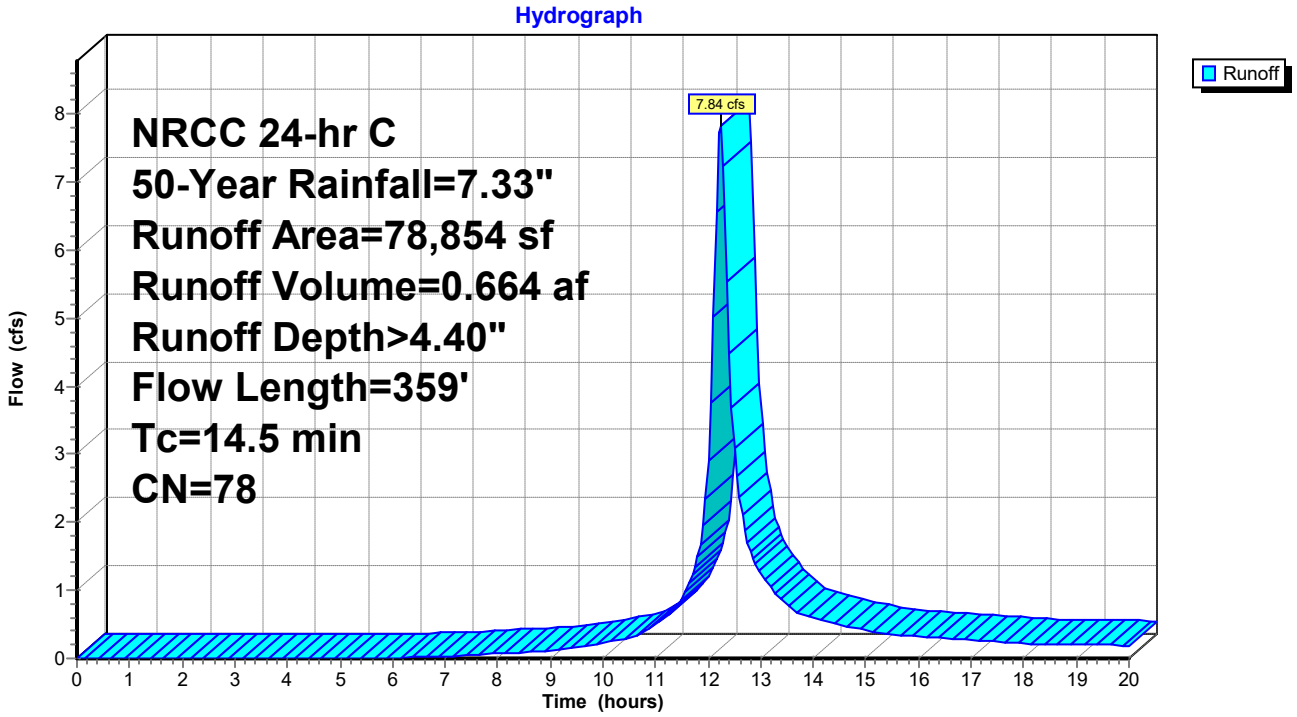
Runoff = 7.84 cfs @ 12.23 hrs, Volume= 0.664 af, Depth> 4.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 50-Year Rainfall=7.33"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	41,832	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	78,854	78	Weighted Average
	58,793		74.56% Pervious Area
	20,061		25.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A



Summary for Subcatchment 2S: Compound

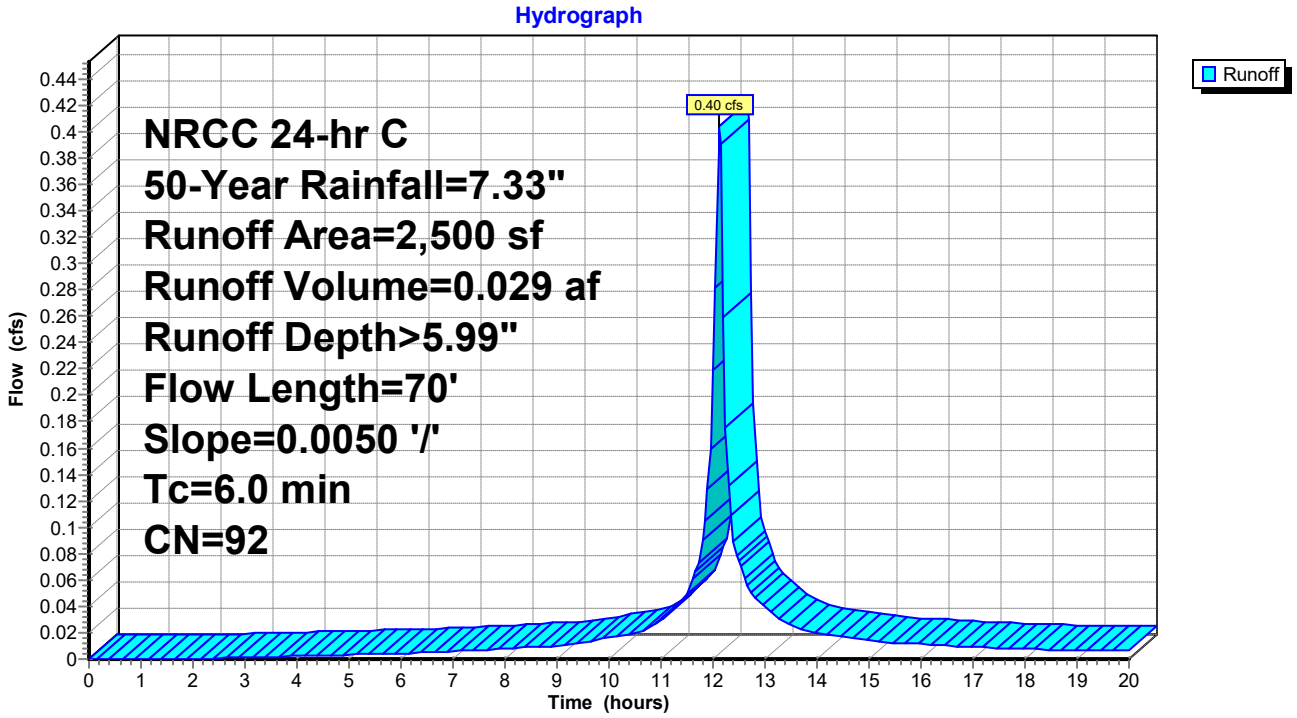
Runoff = 0.40 cfs @ 12.13 hrs, Volume= 0.029 af, Depth> 5.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 50-Year Rainfall=7.33"

	Area (sf)	CN	Description
*	1,680	89	Crushed Stone Compound (exposed)
*	100	99	VZW Comm Equip & Pads
*	720	99	3 Future Carrier Pads (12'x20' ea)
	2,500	92	Weighted Average
	1,680		67.20% Pervious Area
	820		32.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	70	0.0050	0.34		**Lag/CN Method,**
3.5	70	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Compound



Summary for Subcatchment 3S: Gravel Drive

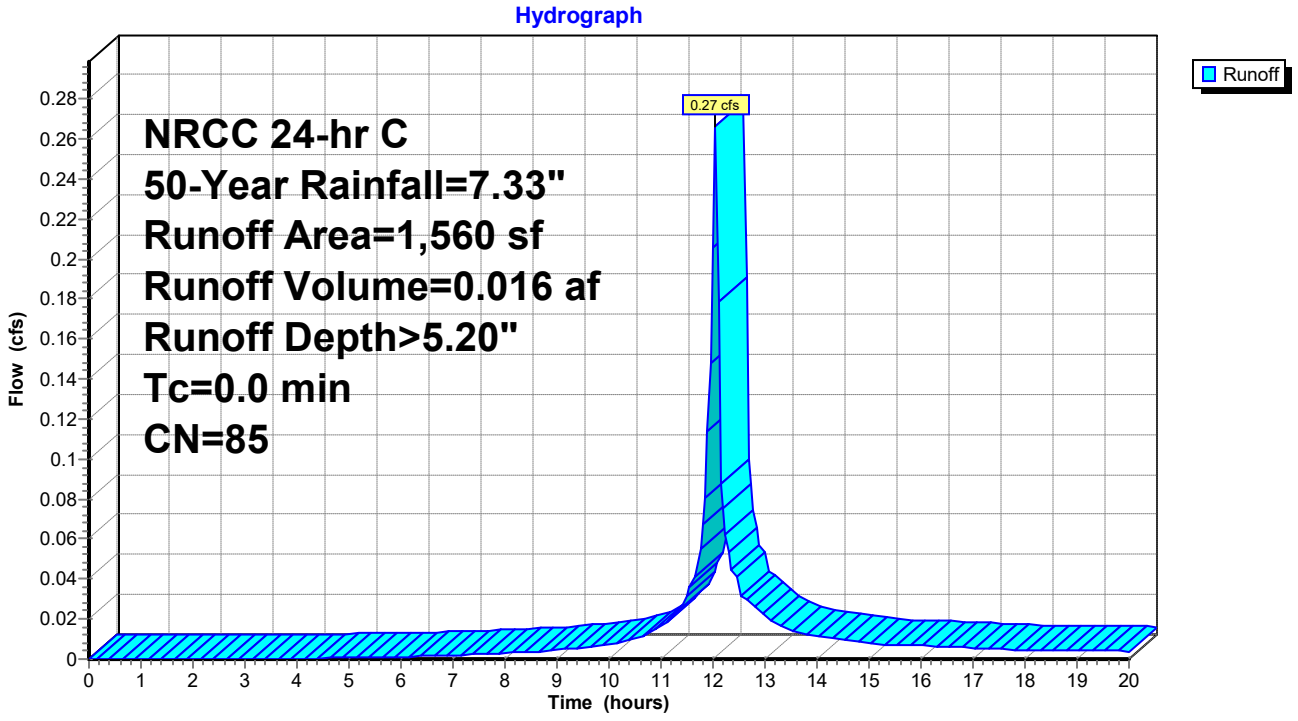
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.27 cfs @ 12.05 hrs, Volume= 0.016 af, Depth> 5.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 50-Year Rainfall=7.33"

	Area (sf)	CN	Description
*	1,560	85	Proposed Gravel Drive
	1,560		100.00% Pervious Area

Subcatchment 3S: Gravel Drive



Summary for Pond 3: Crushed Stone Compound

Inflow Area = 0.093 ac, 20.20% Impervious, Inflow Depth > 5.69" for 50-Year event
Inflow = 0.57 cfs @ 12.08 hrs, Volume= 0.044 af
Outflow = 0.13 cfs @ 12.46 hrs, Volume= 0.022 af, Atten= 77%, Lag= 22.4 min
Discarded = 0.01 cfs @ 8.45 hrs, Volume= 0.013 af
Primary = 0.12 cfs @ 12.46 hrs, Volume= 0.009 af

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 73.46' @ 12.46 hrs Surf.Area= 0.057 ac Storage= 0.022 af

Plug-Flow detention time= 139.9 min calculated for 0.022 af (51% of inflow)
Center-of-Mass det. time= 44.5 min (790.2 - 745.7)

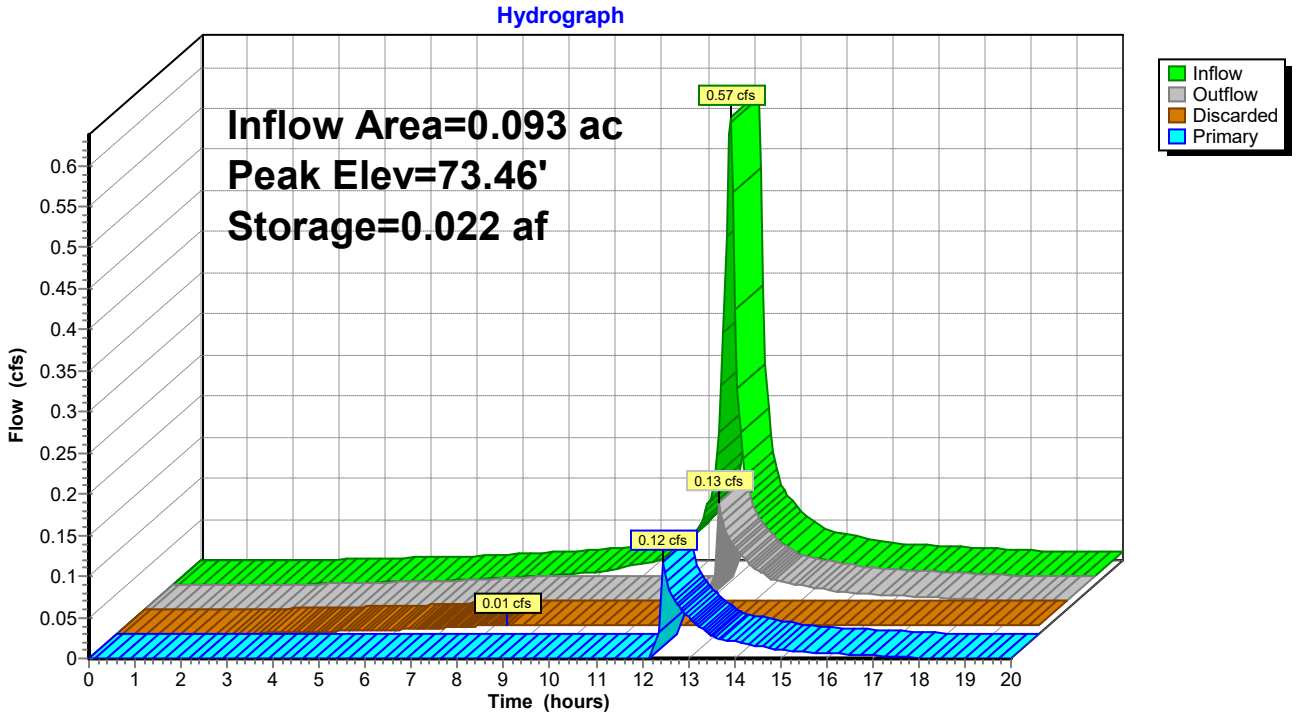
Volume	Invert	Avail.Storage	Storage Description
#1	72.50'	0.023 af	**50.00'W x 50.00'L x 1.00'H Prismatoid** 0.057 af Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	73.45'	**50.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	72.50'	**0.200 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 8.45 hrs HW=72.51' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.11 cfs @ 12.46 hrs HW=73.46' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.11 cfs @ 0.25 fps)

Pond 3: Crushed Stone Compound

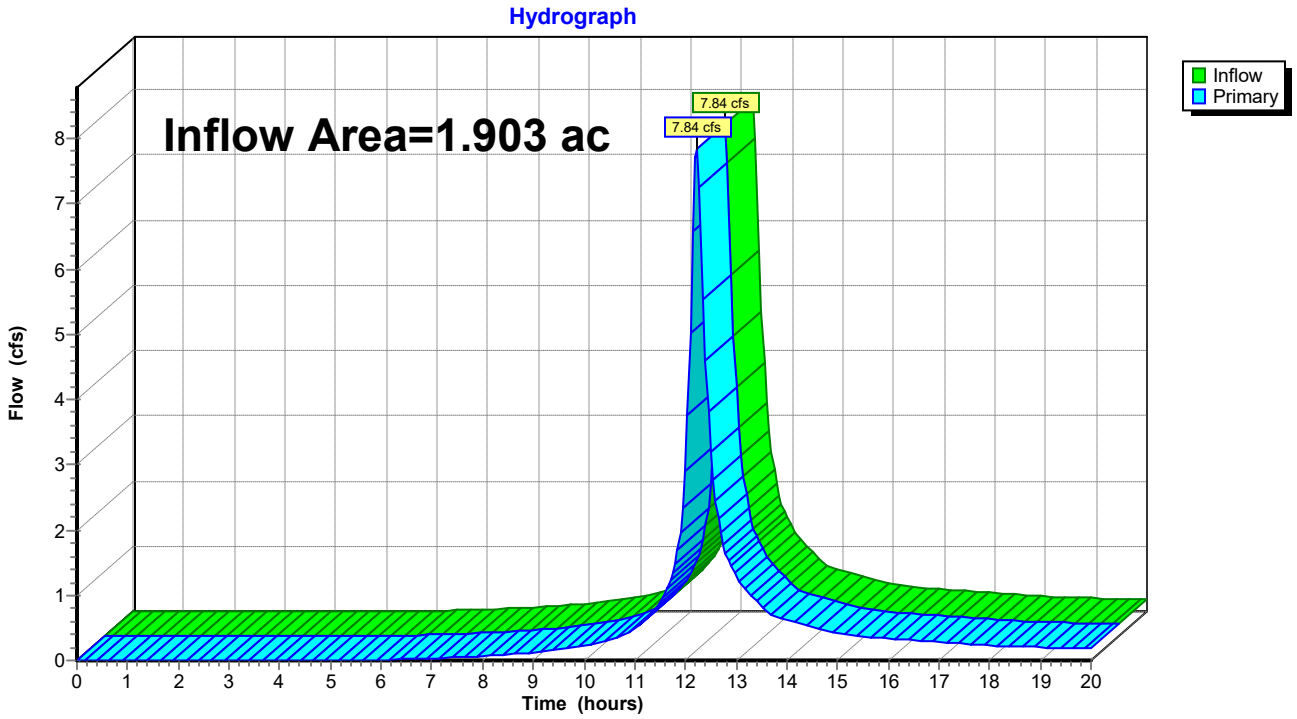


Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 25.18% Impervious, Inflow Depth > 4.24" for 50-Year event
Inflow = 7.84 cfs @ 12.23 hrs, Volume= 0.673 af
Primary = 7.84 cfs @ 12.23 hrs, Volume= 0.673 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total



Time span=0.00-20.00 hrs, dt=0.05 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: WATERSHED A Runoff Area=78,854 sf 25.44% Impervious Runoff Depth>5.57"
Flow Length=359' Tc=14.5 min CN=78 Runoff=9.84 cfs 0.840 af

Subcatchment 2S: Compound Runoff Area=2,500 sf 32.80% Impervious Runoff Depth>7.25"
Flow Length=70' Slope=0.0050 '/' Tc=6.0 min CN=92 Runoff=0.48 cfs 0.035 af

Subcatchment 3S: Gravel Drive Runoff Area=1,560 sf 0.00% Impervious Runoff Depth>6.43"
Tc=0.0 min CN=85 Runoff=0.32 cfs 0.019 af

Pond 3: Crushed Stone Compound Peak Elev=73.48' Storage=0.022 af Inflow=0.69 cfs 0.054 af
Discarded=0.01 cfs 0.014 af Primary=0.62 cfs 0.018 af Outflow=0.64 cfs 0.032 af

Link 2L: Project Total Inflow=10.41 cfs 0.858 af
Primary=10.41 cfs 0.858 af

Total Runoff Area = 1.903 ac Runoff Volume = 0.894 af Average Runoff Depth = 5.64"
74.82% Pervious = 1.424 ac 25.18% Impervious = 0.479 ac

Summary for Subcatchment 1S: WATERSHED A

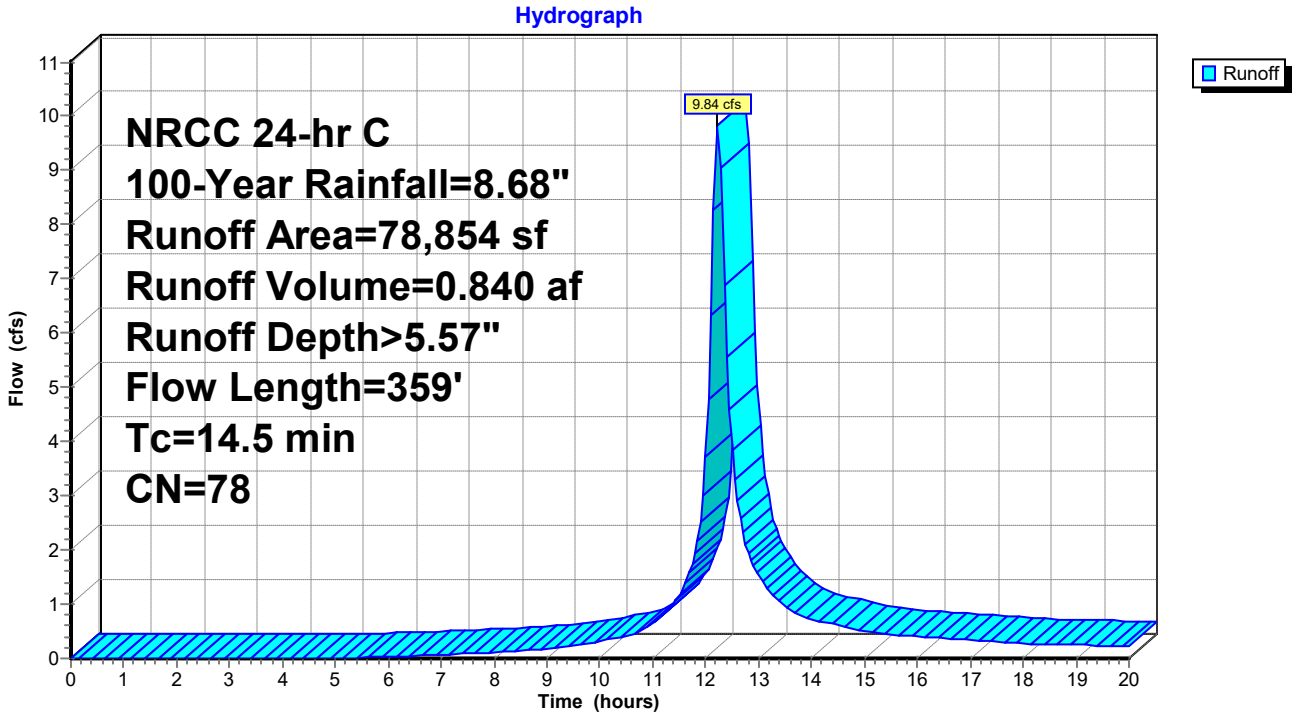
Runoff = 9.84 cfs @ 12.22 hrs, Volume= 0.840 af, Depth> 5.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.68"

	Area (sf)	CN	Description
	13,955	74	>75% Grass cover, Good, HSG C
	20,061	98	Paved parking, HSG C
	41,832	70	Woods, Good, HSG C
*	3,006	87	Mulch/Dirt roads, HSG C
	78,854	78	Weighted Average
	58,793		74.56% Pervious Area
	20,061		25.44% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	15	0.1110	0.22		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.00"
9.8	85	0.1110	0.14		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.00"
2.0	147	0.0630	1.25		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
1.6	112	0.0520	1.14		**Shallow Concentrated Flow, Shallow Concentrated** Woodland Kv= 5.0 fps
14.5	359	Total			

Subcatchment 1S: WATERSHED A



Summary for Subcatchment 2S: Compound

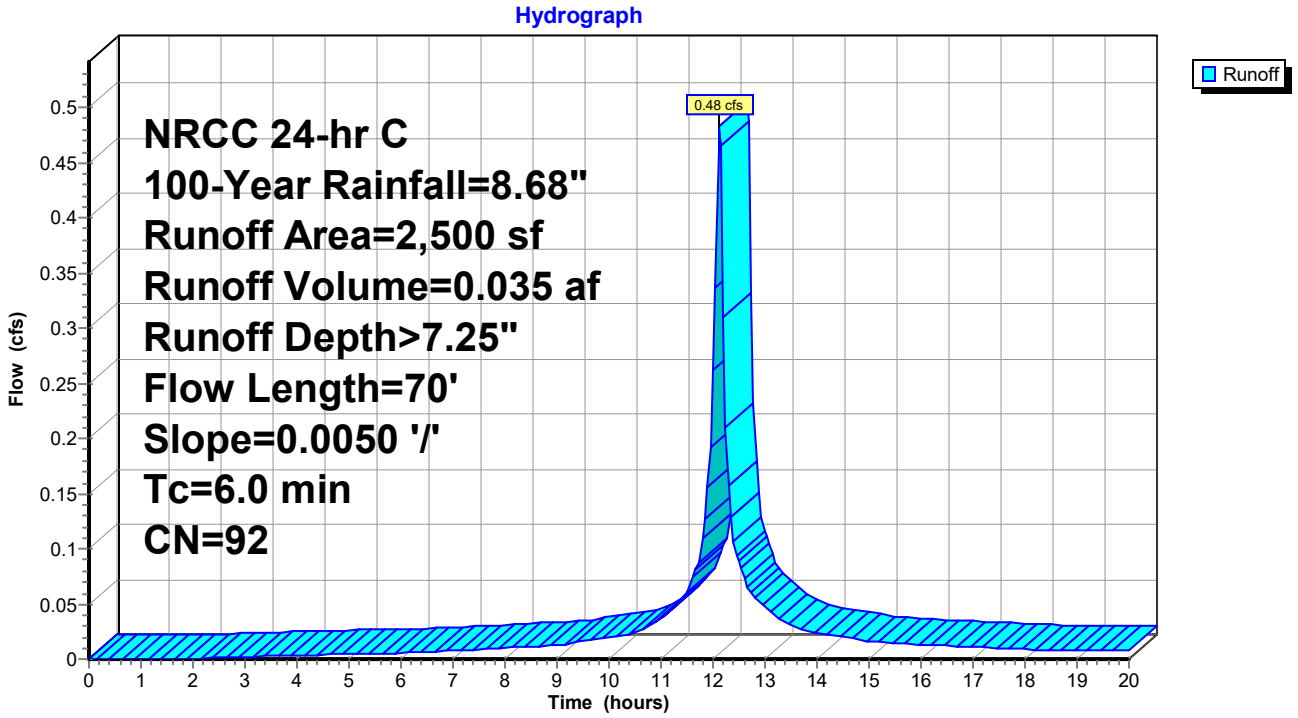
Runoff = 0.48 cfs @ 12.13 hrs, Volume= 0.035 af, Depth> 7.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.68"

	Area (sf)	CN	Description
*	1,680	89	Crushed Stone Compound (exposed)
*	100	99	VZW Comm Equip & Pads
*	720	99	3 Future Carrier Pads (12'x20' ea)
	2,500	92	Weighted Average
	1,680		67.20% Pervious Area
	820		32.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	70	0.0050	0.34		**Lag/CN Method,**
3.5	70	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Compound



Summary for Subcatchment 3S: Gravel Drive

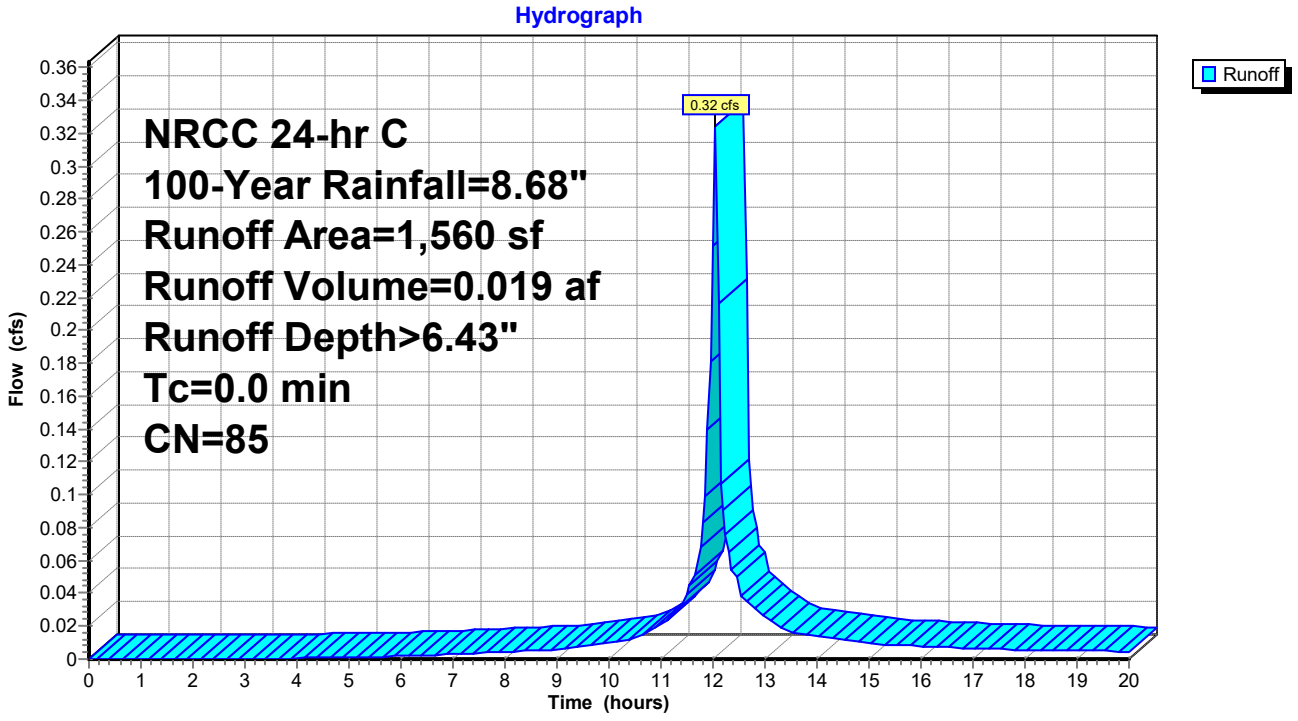
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.32 cfs @ 12.05 hrs, Volume= 0.019 af, Depth> 6.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
NRCC 24-hr C 100-Year Rainfall=8.68"

	Area (sf)	CN	Description
*	1,560	85	Proposed Gravel Drive
	1,560		100.00% Pervious Area

Subcatchment 3S: Gravel Drive



Summary for Pond 3: Crushed Stone Compound

Inflow Area = 0.093 ac, 20.20% Impervious, Inflow Depth > 6.94" for 100-Year event
Inflow = 0.69 cfs @ 12.08 hrs, Volume= 0.054 af
Outflow = 0.64 cfs @ 12.20 hrs, Volume= 0.032 af, Atten= 7%, Lag= 7.3 min
Discarded = 0.01 cfs @ 7.55 hrs, Volume= 0.014 af
Primary = 0.62 cfs @ 12.20 hrs, Volume= 0.018 af

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 73.48' @ 12.20 hrs Surf.Area= 0.057 ac Storage= 0.022 af

Plug-Flow detention time= 122.3 min calculated for 0.032 af (60% of inflow)
Center-of-Mass det. time= 36.7 min (777.5 - 740.8)

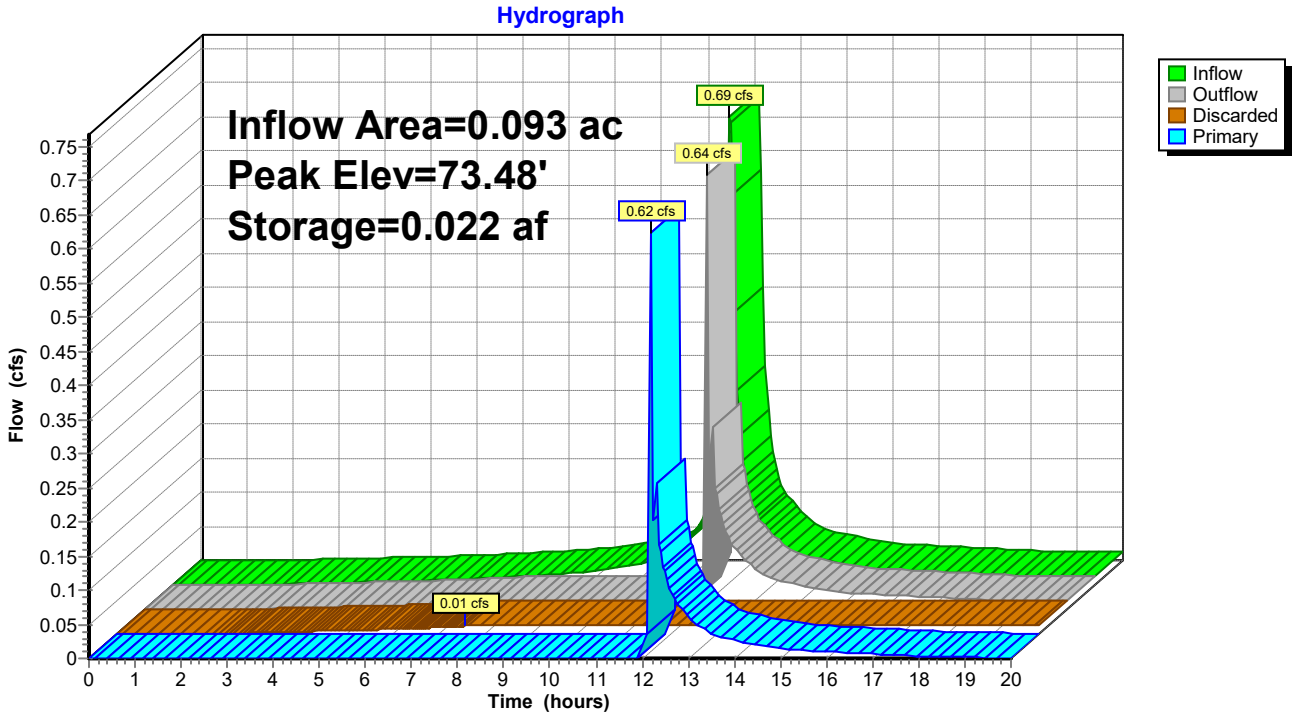
Volume	Invert	Avail.Storage	Storage Description
#1	72.50'	0.023 af	**50.00'W x 50.00'L x 1.00'H Prismatoid** 0.057 af Overall x 40.0% Voids

Device	Routing	Invert	Outlet Devices
#1	Primary	73.45'	**50.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32
#2	Discarded	72.50'	**0.200 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 7.55 hrs HW=72.51' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.59 cfs @ 12.20 hrs HW=73.48' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.59 cfs @ 0.44 fps)

Pond 3: Crushed Stone Compound

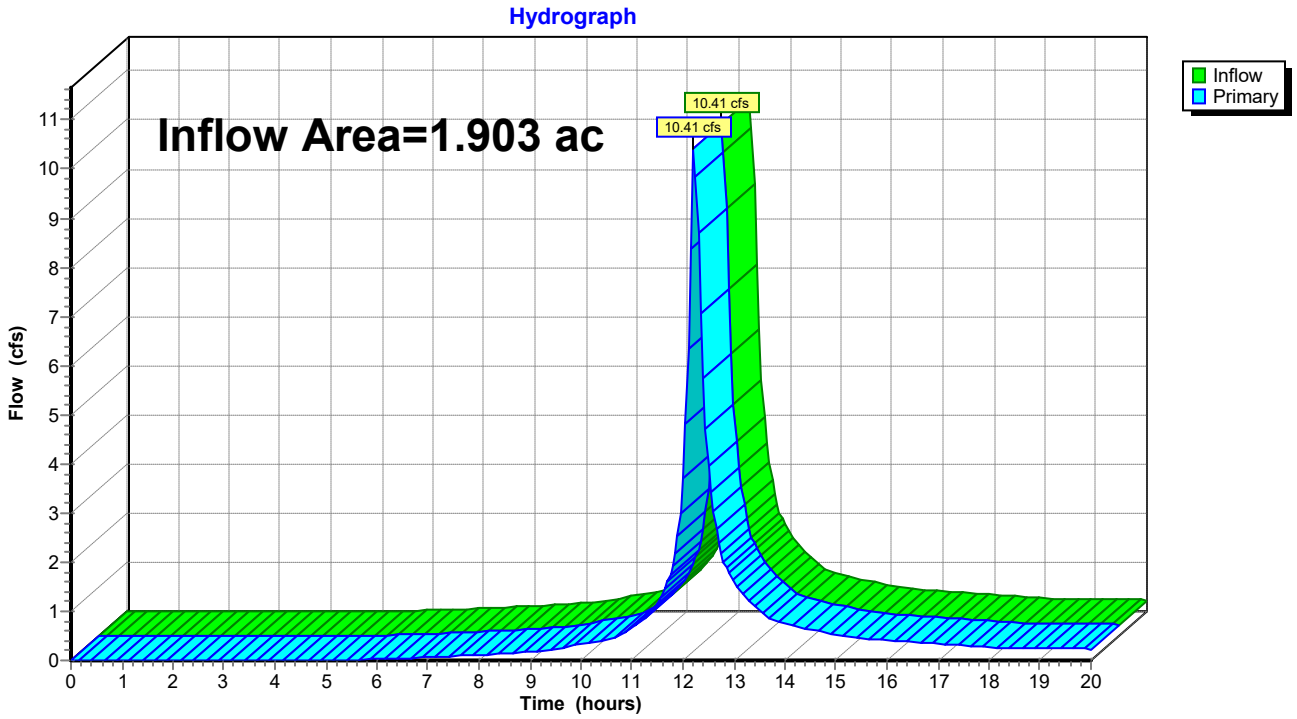


Summary for Link 2L: Project Total

Inflow Area = 1.903 ac, 25.18% Impervious, Inflow Depth > 5.41" for 100-Year event
Inflow = 10.41 cfs @ 12.22 hrs, Volume= 0.858 af
Primary = 10.41 cfs @ 12.22 hrs, Volume= 0.858 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Link 2L: Project Total



APPENDIX B –
HYDROLOGIC SOIL GROUP MAP

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 (VZW Pembroke 5 MA)

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

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

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

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

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group (VZW Pembroke 5 MA)

Map Scale: 1:1,260 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

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: Plymouth County, Massachusetts
Survey Area Data: Version 13, Jun 9, 2020

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

Date(s) aerial images were photographed: Jul 31, 2019—Sep 1, 2019

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

Table—Hydrologic Soil Group (VZW Pembroke 5 MA)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
316B	Scituate gravelly sandy loam, 3 to 8 percent slopes, very stony	C/D	2.0	61.2%
321C	Birchwood sand, 8 to 15 percent slopes, very stony	B/D	0.6	18.0%
640B	Urban land, till substratum, 0 to 8 percent slopes		0.7	20.8%
Totals for Area of Interest			**3.3**	**100.0%**

Rating Options—Hydrologic Soil Group (VZW Pembroke 5 MA)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX C –
OPERATIONI AND MAINTENACE PLAN & LONG TERM POLLUTION PREVENTION PLAN

Verizon Wireless
Pembroke 5 MA
Stormwater Management System
Operation and Maintenance Plan (O&M)
and
Long Term Pollution Prevention Plan (LTPPP)

April 2021

This Stormwater Management System Operation and Maintenance Plan provides for the inspection and maintenance of structural Best Management Practices (BMPs) and for measures to prevent pollution associated with the construction of cellular communication antenna tower in the Town of Pembroke, MA.

This document has been prepared in accordance with the requirements of the Stormwater Regulations included in the Massachusetts Wetlands Protection Act Regulations (310 CMR 10).

Responsible Party

Verizon Wireless is the lease owner of the facility area and will be responsible for the maintenance of the roadway facilities and associated stormwater management features, in accordance with Town standards.

Questions or concerns regarding maintenance activities may be addressed to Lease/Maintenance Owner:

Verizon Wireless
118 Flanders Road
Westborough, MA 01581

Maintenance Measures

The stormwater management system covered by this Operation and Maintenance Plan consists of the following components:

- Communications Compound

The communications compound shall be inspected and cleaned at a minimum of once per year before May 1st of each year. The site shall be inspected for general refuse including cups, drink containers, food wrappers, telecom project related debris such as coaxial cable, electronics communications equipment, adhesive and cementing compound containers, wire spools, etc. and be properly removed of and disposed of at an approved facility or waste transfer station. As the proposed compound surface shall be porous crushed stone to provide rain water infiltration

and groundwater recharge, the facility and surface shall be kept clean and free of any liquids or liquid-filled containers than may contaminate the rainwater or runoff for infiltration.

If inspection indicates the need for major repairs of structural surfaces, the inspector should contact Verizon Wireless to initiate procedures to effect repairs in accordance with Town standard construction practices.

Practices for Long Term Pollution Prevention

In general, long term pollution prevention and related maintenance activities will be conducted consistent with Town of Pembroke's Bylaws.

For the facilities covered by this Operation and Maintenance Plan, long term pollution prevention includes the following measures:

Routine Inspection and Maintenance of Stormwater BMPs
Verizon will conduct inspection and maintenance of the stormwater management practices in accordance with the guidelines discussed above.

Spill Prevention and Response
Verizon Wireless will implement response procedures for releases of significant materials such as fuels, oils, or chemical materials onto the ground or other areas that could reasonably be expected to discharge to surface or groundwater.

- Reportable quantities will immediately be reported to the applicable Federal, State, and local agencies as required by law. The Town should also be notified. Reportable quantities of chemical, fuels, or oils are established under the Clean Water Act and enforced through MassDEP. The MassDEP Emergency Response Program shall be immediately notified in accordance with required procedures for the report of a release (telephone 888-304-1133).
- Applicable containment and cleanup procedures will be performed immediately. Impacted material collected during the response must be removed promptly and disposed of in accordance with Federal, State, and local requirements. A licensed emergency response contractor may be required to assist in cleanup of releases depending on the amount of the release and the ability of the responsible party to perform the required response.
- Reportable quantities of chemical, fuels, or oils are established under the Clean Water Act and enforced through DEP.

Maintenance of Landscaped Areas
Routine mowing should be conducted during spring and summer months as needed given the tower is unmanned.

Snow and Ice Management
Snow and Ice Management shall be conducted as needed given the tower is unmanned.

Prohibition of Illicit Discharges

The MassDEP Stormwater Management Standards prohibit illicit discharges to the storm water management system. Illicit discharges are discharges that do not entirely consist of stormwater, except for certain specified non-stormwater discharges.

Examples of discharges from the following sources are not considered illicit discharges:

Firefighting activities*	Riparian habitats/wetlands
Foundation drain lines	Potable water sources
Line flushing	Dechlorinated swimming pool water
Footing drains	Street sweeping
Irrigation systems	Wash water from buildings (without detergents)
Residential car washing	Condensation from air conditioning units
Uncontaminated groundwater	Run-on from private driveways caused by precipitation
Rising groundwater	Lawn watering

*Water from firefighting activities is allowed under this permit and need only be addressed where they are identified as significant sources of pollutants to waters of the United States.

There are no known or proposed illicit connections associated with this project. If a potential illicit discharge to the facilities covered by this plan is detected (e.g., dry weather flows at any pipe outlet, evidence of contamination of surface water discharge by non-stormwater sources), Verizon Wireless shall be notified for assistance in determining the nature and source of the discharge, and for resolution through the Town's IDDE program.

_____

Owners Signature

APPENDIX D –
WATER QUALITY VOLUME/GROUNDWATER RECHARGE CALCS

MA STORMWATER HANDBOOK
REQUIRED WATER QUALITY VOLUME

STORMWATER TREATMENT REQUIREMENTS

Stormwater Treatment Impervious Area Tabulation

	SF	*ACRES*
Total Existing Impervious Area to Remain (I_X):	20,081	0.461
Total New Impervious Area (I_P):	4,095	0.094
Total Impervious Area to be Treated (I_{TR})*:	4,095	0.555

* For New Development or Redevelopment ($I_{TR} = I_P$)

Standard 4: Water Quality (WQv)

Water Quality Factor "D_{WQ}"

D_{WQ} = 0.5 (inch)

Total Required Water Quality Volume "V_{WQ}"

F =	0.5	(unitless)				
I_{TR} =	0.555	AC				
Water Quality Volume = $V_{WQ} = (D_{WQ})(I_{TR})/12$ =			0.023	AC-FT	=	1,007 CF

Crushed Stone Compound

Contributing I_{TR} =	0.093	AC				
Required Water Quality Volume = WQ_V =			0.004	AC-FT	=	169 CF
Provided Water Quality Volume =			0.023	AC-FT	=	1002 CF

MA STORMWATER HANDBOOK
REQUIRED RECHARGE VOLUME

STORMWATER TREATMENT REQUIREMENTS

Stormwater Treatment Impervious Area Tabulation

	SF	*ACRES*
Total Existing Impervious Area to Remain (I_X):	20,081	0.461
Total New Impervious Area (I_P):	4,095	0.094
Total Impervious Area to be Treated (I_{TR})*:	4,095	0.094

* For New Development or Redevelopment ($I_{TR} = I_P$)

Standard 3: Groundwater Recharge (Re_v)

Soils

Predominant Underlying Soil Type:	Scituate
Hydrologic Soil Group:	C

Recharge Factor "F"

F = 0.25 (unitless)

Recharge Volume

F =	0.25	(unitless)				
I_{TR} =	0.094	AC				
Total Recharge Volume = $Re_v = (1")(F)(I_{TR})/12$ =	0.002	AC-FT	=	85	CF	

New Impervious Area contributing to (3L)

Crushed Stone Compound

Area I_{TR} =	0.019	AC				
Recharge Volume = $Re_v = (1")(F)(I_{TR})/12$ =	0.000	AC-FT	=	17	CF	

Provided Storage Volume = 1002 *CF

Total Re_v= 17 CF

Total Provided Storage Volume= 1,002 CF

72 HOUR DRAWDOWN

Infiltration Rate "K"

K = 0.2 inch/hour Rawls Rate for NRCS HSG C Silt Loam/Sandy Clay Loam

MA STORMWATER HANDBOOK
REQUIRED RECHARGE VOLUME

STORMWATER TREATMENT REQUIREMENTS

Time Drawdown "T"

$T = Re_v / (K * \text{Area Bottom})$ (hours)

Pervious Pavement

Bottom Area of System=	2500	sf		
System $Re_{v=}$	1002	cf		
T=	24	hours	<	72 Hours

APPENDIX E –
PROPOSED PROJECT PLANS (UNDER SEPARATE COVER)