STORMWATER MANAGEMENT REPORT

Goodridge Brook Estates

Sterling Road
Lancaster, Massachusetts

July 5, 2018
Revised: 9/18/18

Prepared for:

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Project Introduction:

The applicant, Cresent Builders, Inc., is proposing to develop the existing property located off Sterling Road in Lancaster, Massachusetts. The property is identified as Assessor Map 41, Lot 34B containing approximately 45.4 +/- acres and is serviced by municipal water and sewer. The proposed development is submitted for review by the Lancaster Zoning Board of Appeals under Massachusetts Comprehensiver Permit M.G.L. c. 40B.

The proposed project is designed as a multi-unit apartment style complex and single family homeownership on two separate distinct parcels, shown as Lot B1 and B2. Access to both properties is proposed via separate entrances off Sterling Road. On Lot B1, A development of 136 apartment units in three buildings on Lot B1 is proposed, with access drives, parking areas, passive recreation areas and associated appurtenances. A development of sixty-four (64) single family dwellings on individual lots within the Lot B2 parcel is proposed with access roadways and utilities. The Project will utilize public water, sewer, gas, electric, telephone and cable if available.

The purpose of these calculations is to demonstrate design compliance of the Project's stormwater management system for water quantity and quality objectives of the DEP's Stormwater Management Policy, the Town of Lancaster's Stormwater Management and Erosion Control Bylaws. As designed, the system will mitigate peak rates and volumes of runoff for storms up to and including the 100-year event under post-construction conditions.

Methodology/Sources of Data:

The overall storm water management plan for the project is designed to maintain the peak rate of storm water runoff and runoff volumes from the site after development. The Soil Conservation Service Modified Soil Cover Complex Method, the computer program "HydroCAD" by Applied Microcomputer Systems, and the procedures specified in Urban Hydrology for storm Small Watersheds were used to determine pre-and post-developed peak flow rates of runoff from the site. The storm events have been compiled from the Soil Conservation Services Technical Report No. 55 and the U.S. Department of Commerce Technical Paper (TP 40). The 2-year, 10-year, 25-year and 100-year storm events have been utilized for hydrology calculations. The rainfall data for the Type III, 24-hour storm events follow:

24-Hour Storm	Rainfall (inches)
2	3.20
10	4.80
25	5.50
100	7.0

The storm water runoff will be controlled through the use of "Best Management Practices" and in conformance with the MADEP Stormwater Management Policy. The proposed Project will result in an improvement over the existing conditions, by constructing a storm water management system that will provide treatment, groundwater recharge and reduce the peak rates of runoff and offsite runoff volumes.

The piped drainage system has been designed utilizing the Rational Method for the 25 year storm event to size street drains.

Soils:

The Natural Resources Conservation Service (NRCS), Hydrologic Soils Group Map for Worcester county, Massachusetts indicates that the on-site soils consist of Woodbridge Fine Sandy Loam-311B, Ridgebury Fine Sandy Loam-71A, Merrimac Fine Sandy Loam 254B and Chatfield Hollis Rock, 102C. NRCS assigned hydrologic soil rating for these soils ranges from A to D soil classification. The majority of the site consists of C/D hydrologic soil rating. The soils along the southerly property boundary consists of Merrimac with an A rating. On-site soil testing was performed to determine groundwater elevations and confirm soil classifications. Based on site area limitations and economic factors the ”Simple Dynamic” method was used in the design analysis for the stormwater drainage basins.

Existing Conditions Overview:

The Project is located off Sterling Road and identified as Assessor Map 41, Lot 34B containing approximately 45.4 +/- acres. The site is currently undeveloped woodlands with a bordering vegetated wetland area centrally located on the property. The site gently slopes from Sterling Road (North) to the rear property boundary (South) with a change in elevation of approximately thirty-firve (35) feet.

The existing site is divided into four (4) existing watershed subcatchment areas. See the attached Pre-Development Subcatchment Area Plan for delineations with associated Design Points (DP).

Description	Design Point	Comments
1S	DP-1	Overland flow to the Northeast
2S	DP-2	Overland flow central portion of the site
3S	DP-3	Overland flow to the Southwest
4S	DP-4	Overland flow to the Southeast Corner

Proposed Conditions Overview:

The proposed project is designed as a multi-unit apartment style complex and single family homeownership on two separate distinct parcels, shown as Lot B1 and B2. Access to both properties is proposed via separate entrances off Sterling Road. On Lot B1, A development of 136 apartment units in three buildings on Lot B1 is proposed, with access drives, parking areas, passive recreation areas and associated appurtenances. A development of sixty-four (64) single family dwellings on individual lots within the Lot B2 parcel is proposed with access roadways and utilities. The Runoff generated from the Project will be collected via deep sump catch basins where it will be conveyed to a drainage basins systems for mitigation. These systems will mitigate the peak rate and volume of runoff through the 100-year storm event. The proposed systems will reduce or match all post-development peak flows for design storms up to and including the 100-year storm event.

The proposed runoff areas have been divided into several subcatchments. The subcatchment areas are directed to the various drainage basin and outflows are combined at the design points (Links DP-1 thru DP-4).

The proposed systems will reduce all post-development flow rates and volumes of runoff up to and including the 100-year event to existing levels at all abutting areas. Existing uncaptured off-site runoff not associated with the Project will continue to flow overland without change.

Design Point	**Comments**
DP-1	Uncaptured overland flow to the Northern BVW
DP-1	Piped flow to the Subsurface Chamber Array #1
DP-2	Piped flow to the Subsurface Chamber Array #3
DP-2	Uncaptured flow to the Eastern BVW

The following is summary comparison of Pre- and Post-Developed Rates and Volumes of Runoff:

Summary of Peak Stormwater Runoff Rates:								
Design Point	**2-Yr Peak Flow (cfs)**		**10-Yr Peak Flow (cfs)**		**25-Yr Peak Flow (cfs)**		**100-Yr Peak Flow (cfs)**	
	Existing	***Proposed***	***Existing***	***Proposed***	***Existing***	***Proposed***	***Existing***	***Proposed***
***(1S)* DP-1**	3.20	2.05	6.67	4.20	8.29	5.25	11.86	10.51
***(2S)* DP-2**	20.32	17.82	47.66	44.65	60.88	58.75	90.74	88.43
***(3S)* DP-3**	1.80	1.74	5.74	3.99	7.80	5.02	12.60	7.24
***(4S)* DP-4**	0.68	0.57	2.80	1.95	3.98	2.68	6.82	4.40

Summary of Peak Stormwater Runoff Volumes:								
Design Point	**2-Yr Volume (cu.ft.)**		**10-Yr Volume (cu.ft.)**		**25-Yr Volume (cu.ft.)**		**100-Yr Volume (cu.ft.)**	
	Existing	***Proposed***	***Existing***	***Proposed***	***Existing***	***Proposed***	***Existing***	***Proposed***
***(1S)* DP-1**	0.38	0.20	0.77	0.56	0.95	.75	1.37	1.20
***(2S)* DP-2**	2.78	2.50	6.11	5.93	7.73	7.59	11.44	11.37
***(3S)* *D*P-3**	0.26	0.25	0.68	0.69	0.89	0.91	1.40	1.40
***(4S)* *D*P-4**	0.11	0.07	0.33	0.19	0.44	0.25	0.72	0.39

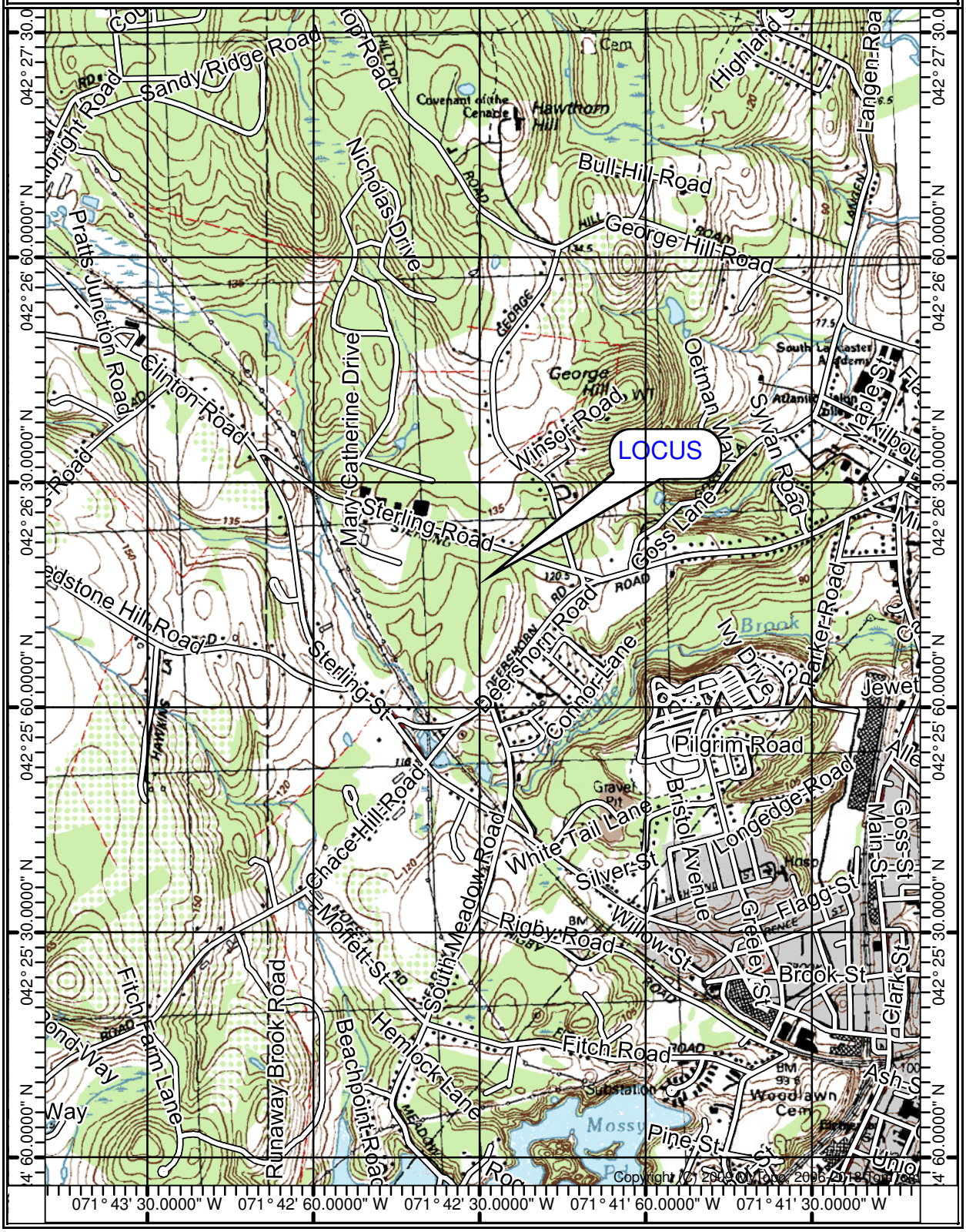
Summary:

The calculations performed for all design storm events indicate that the total peak rates and volumes of runoff for the Project as proposed will not exceed those of existing conditions with the implementation of the stormwater management system. With the implementation of the stormwater management system as designed, along with the Operation and Maintenance plan contained herein, all of the objectives of the DEP's Stormwater Management Regulations are satisfied.

Map Name: HUDSON
Print Date: 05/19/18

Scale: 1 inch = 2,000 ft.
Map Center: 042° 26' 16.8229" N,

Horizontal Datum: NAD27

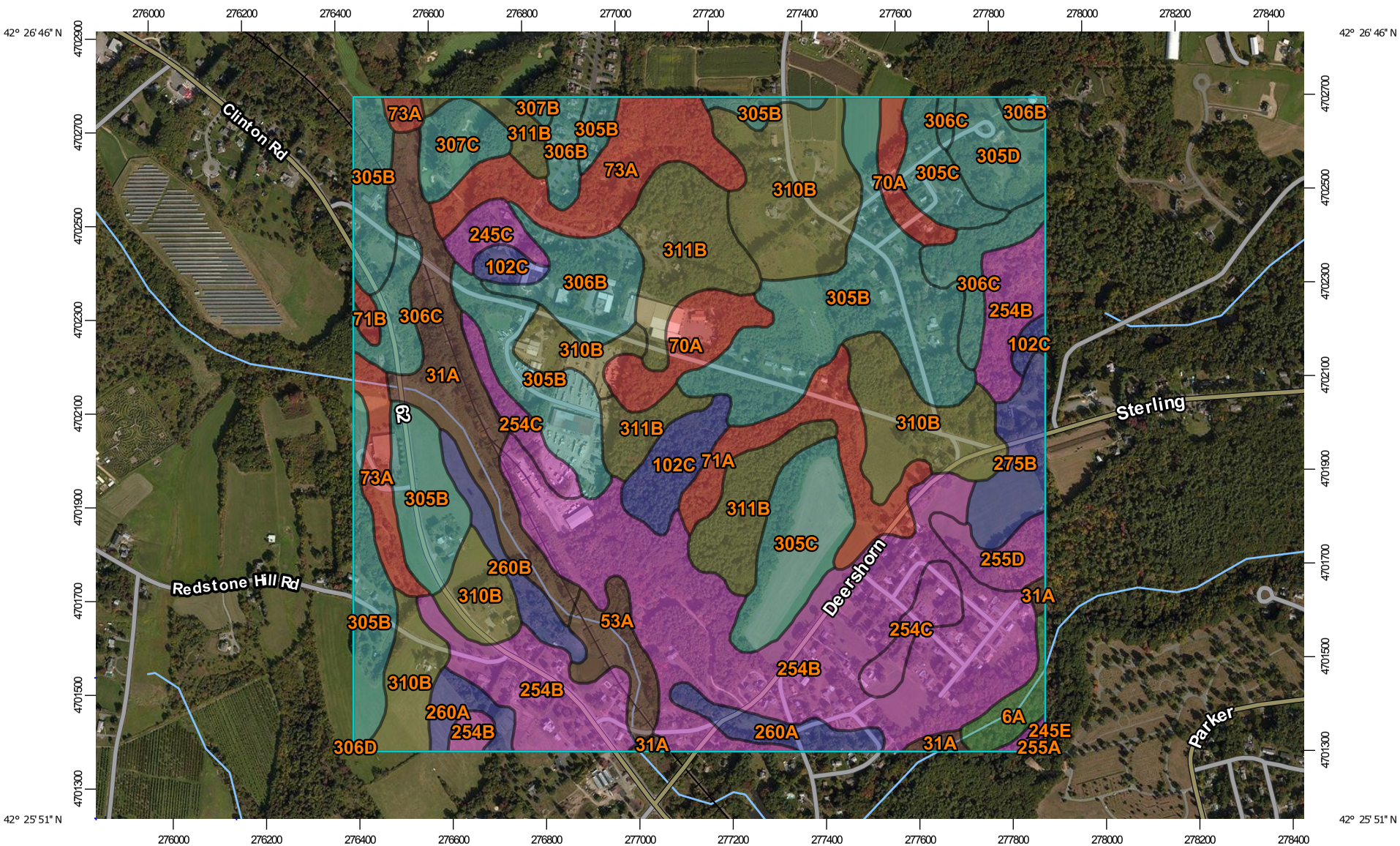


SCALE 1:24000

0 1000 2000 3000 4000 5000 6000

FEET

Hydrologic Soil Group—Worcester County, Massachusetts, Northeastern Part
(Lancaster MA)



Map Scale: 1:11,800 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

Streams and Canals

Transportation

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

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 12, Oct 6, 2017

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

Date(s) aerial images were photographed: Sep 12, 2014—Sep 28, 2014

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	4.5	0.9%
31A	Walpole sandy loam, 0 to 3 percent slopes	B/D	25.3	4.9%
53A	Freetown muck, ponded, 0 to 1 percent slopes	B/D	8.0	1.6%
70A	Ridgebury fine sandy loam, 0 to 3 percent slopes	D	14.3	2.8%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	D	14.7	2.9%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	1.2	0.2%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	D	28.9	5.6%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	B	11.7	2.3%
245C	Hinckley loamy sand, 8 to 15 percent slopes	A	4.3	0.8%
245E	Hinckley loamy sand, 25 to 35 percent slopes	A	0.8	0.2%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	105.4	20.5%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	A	10.5	2.0%
255A	Windsor loamy sand, 0 to 3 percent slopes	A	0.2	0.0%
255D	Windsor loamy sand, 15 to 25 percent slopes	A	5.8	1.1%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	B	10.5	2.0%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	B	6.2	1.2%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
275B	Agawam fine sandy loam, 3 to 8 percent slopes	B	10.0	1.9%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	83.7	16.3%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	C	23.3	4.5%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	C	9.2	1.8%
306B	Paxton fine sandy loam, 0 to 8 percent slopes, very stony	C	17.6	3.4%
306C	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	C	14.3	2.8%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	C	0.0	0.0%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	C	1.0	0.2%
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	C	7.0	1.4%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	59.4	11.6%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	C/D	36.1	7.0%
Totals for Area of Interest			**513.8**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

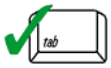
Tie-break Rule: Higher

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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:

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

[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;

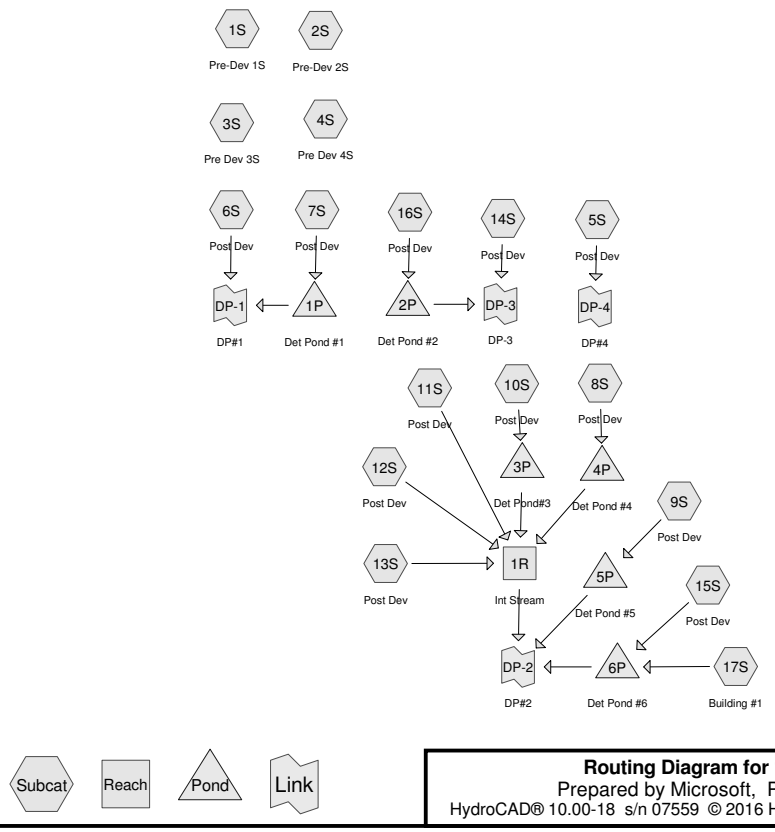
☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX – A

Hydrogeological Calculations for Pre & Post Development

Standard 2



Routing Diagram for 12274-081518
Prepared by Microsoft, Printed 9/20/2018
HydroCAD® 10.00-18 s/n 07559 © 2016 HydroCAD Software Solutions LLC

Summary for Subcatchment 1S: Pre-Dev 1S

Runoff = 3.20 cfs @ 12.36 hrs, Volume= 16,501 cf, Depth= 1.21"

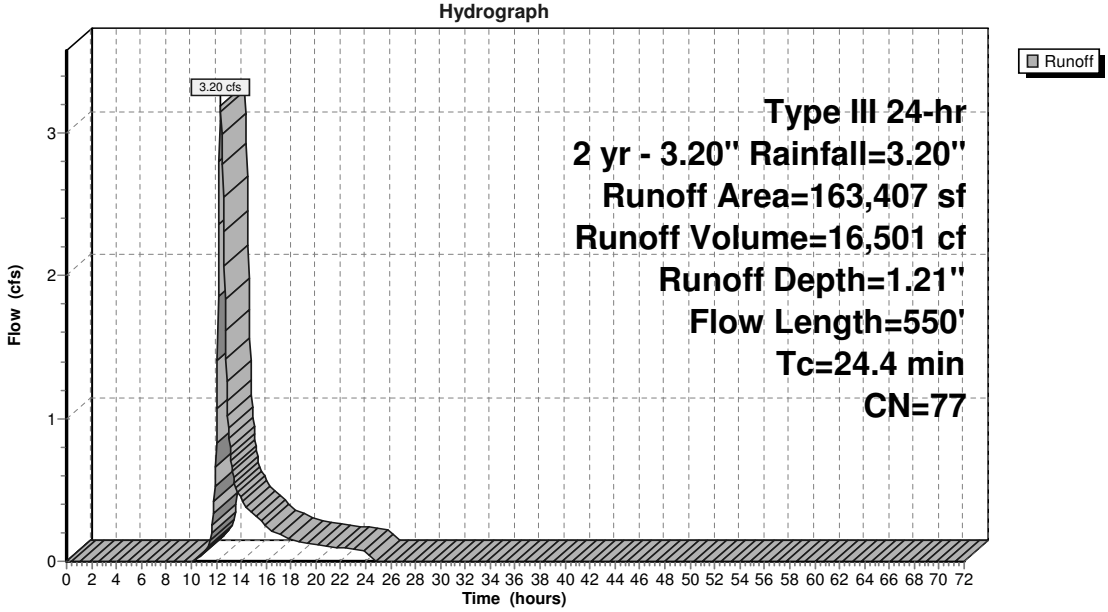
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
	6,616	98	Paved parking, HSG C
	59,968	73	Woods, Fair, HSG C
	48,086	79	Woods, Fair, HSG D
*	48,737	78	Wetlands
	163,407	77	Weighted Average
	156,791		95.95% Pervious Area
	6,616		4.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	50	0.0120	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
9.3	500	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
24.4	550	Total			

Subcatchment 1S: Pre-Dev 1S

Hydrograph



Summary for Subcatchment 2S: Pre-Dev 2S

Runoff = 20.32 cfs @ 12.47 hrs, Volume= 120,937 cf, Depth= 0.93"

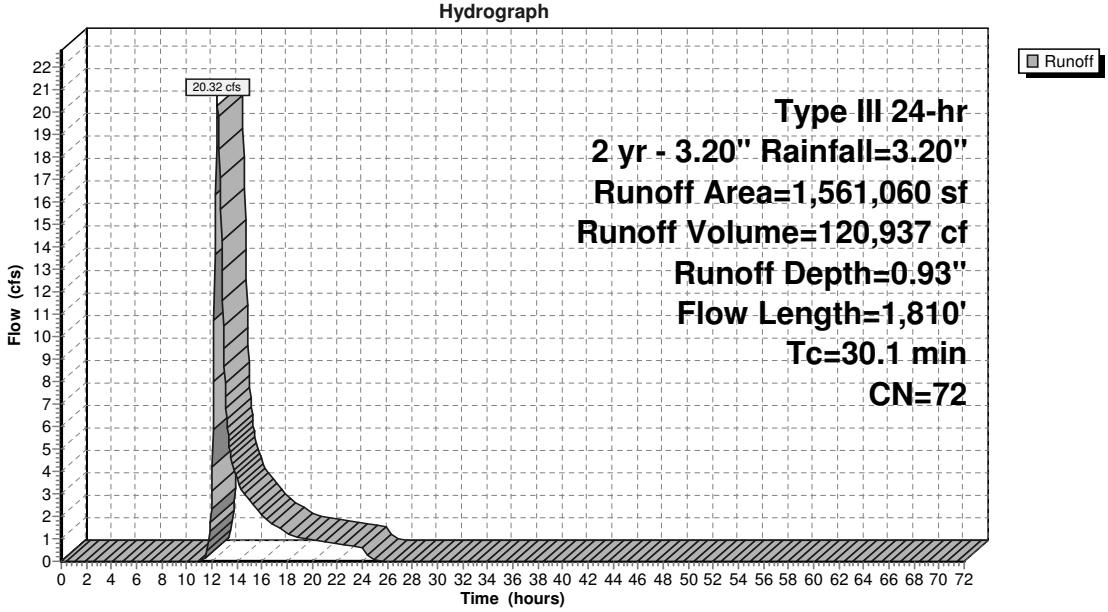
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
	12,734	98	Paved parking, HSG C
	103,393	36	Woods, Fair, HSG A
	175,914	79	Woods, Fair, HSG D
	93,562	60	Woods, Fair, HSG B
	720,766	73	Woods, Fair, HSG C
*	454,691	78	Wetlands
	1,561,060	72	Weighted Average
	1,548,326		99.18% Pervious Area
	12,734		0.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0370	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
16.9	950	0.0350	0.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.6	810	0.0100	3.74	7.49	**Channel Flow,** Area= 2.0 sf Perim= 4.0' r= 0.50' n= 0.025 Earth, clean & winding
30.1	1,810	Total			

Subcatchment 2S: Pre-Dev 2S

Hydrograph



Summary for Subcatchment 3S: Pre Dev 3S

Runoff = 1.80 cfs @ 12.39 hrs, Volume= 11,337 cf, Depth= 0.56"

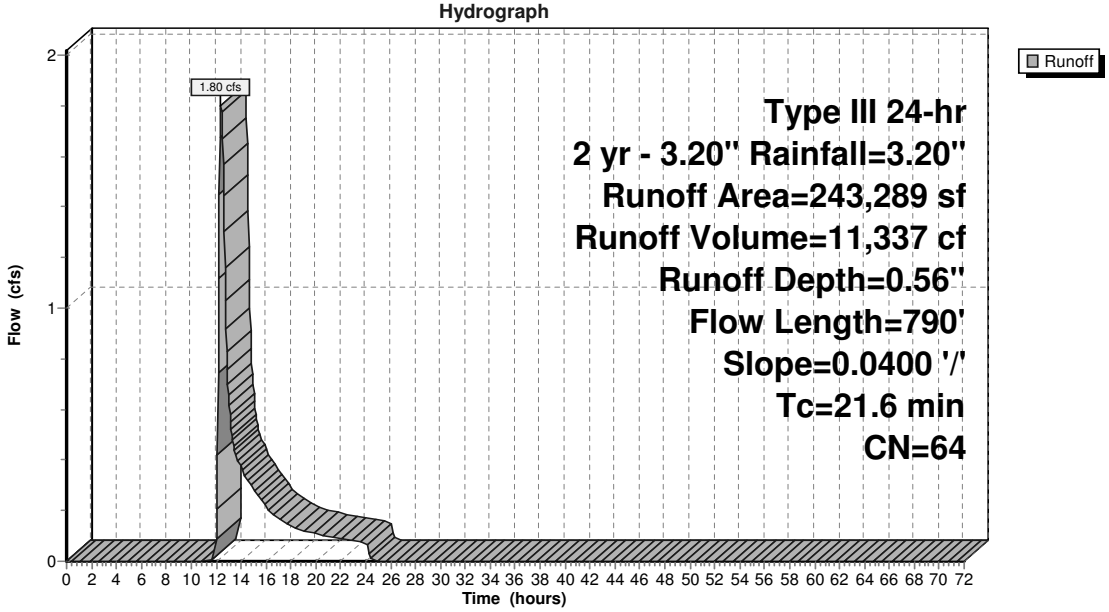
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
	37,431	36	Woods, Fair, HSG A
	74,966	60	Woods, Fair, HSG B
	98,598	73	Woods, Fair, HSG C
*	32,294	78	Wetlands
	243,289	64	Weighted Average
	243,289		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
12.3	740	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
21.6	790	Total			

Subcatchment 3S: Pre Dev 3S

Hydrograph



Summary for Subcatchment 4S: Pre Dev 4S

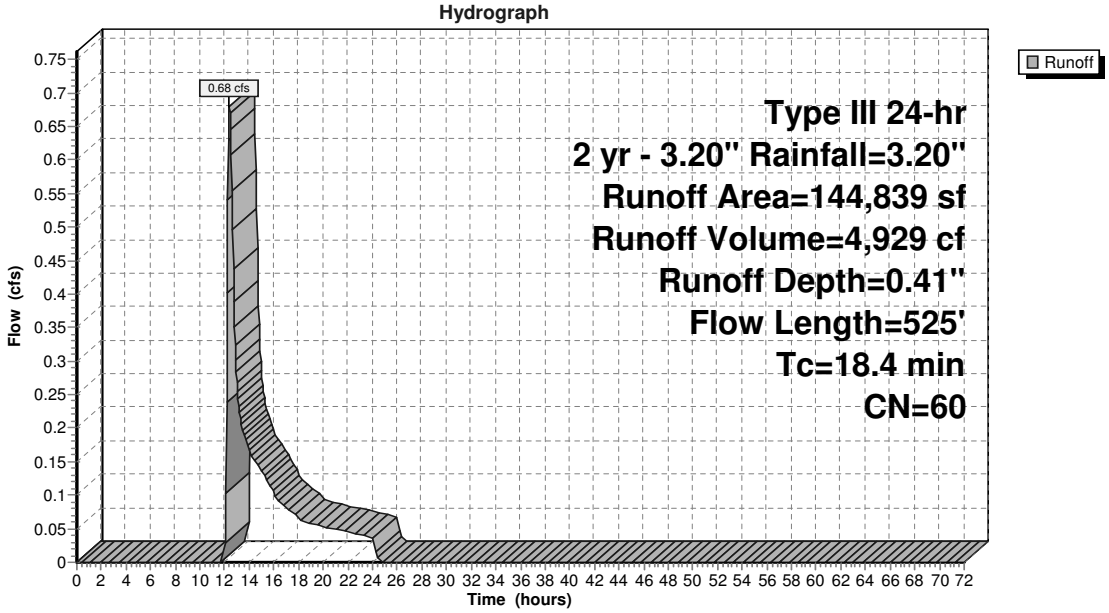
Runoff = 0.68 cfs @ 12.40 hrs, Volume= 4,929 cf, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

Area (sf)	CN	Description
51,728	36	Woods, Fair, HSG A
93,111	73	Woods, Fair, HSG C
144,839	60	Weighted Average
144,839		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow, 4-1** Woods: Light underbrush n= 0.400 P2= 3.20"
7.9	475	0.0400	1.00		**Shallow Concentrated Flow, 4-2** Woodland Kv= 5.0 fps
18.4	525	Total			

Subcatchment 4S: Pre Dev 4S



Summary for Subcatchment 5S: Post Dev

Runoff = 0.57 cfs @ 12.22 hrs, Volume= 3,048 cf, Depth= 0.52"

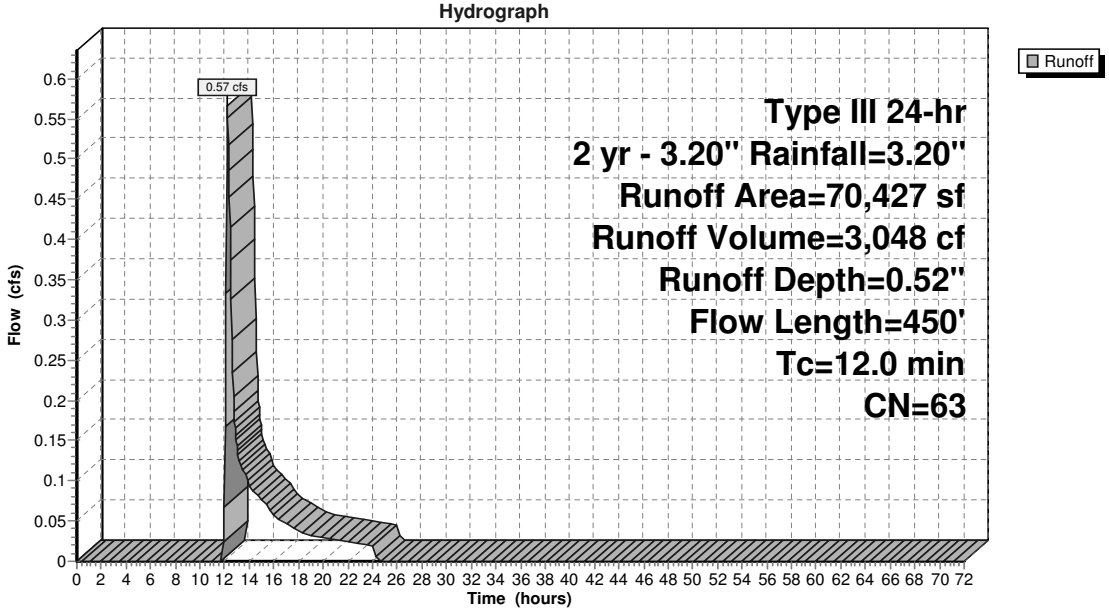
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
*	2,760	98	Roofs,
	11,100	36	Woods, Fair, HSG A
	11,852	39	>75% Grass cover, Good, HSG A
	13,834	74	>75% Grass cover, Good, HSG C
	30,881	73	Woods, Fair, HSG C
	70,427	63	Weighted Average
	67,667		96.08% Pervious Area
	2,760		3.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	50	0.0350	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.1	400	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	450	Total			

Subcatchment 5S: Post Dev

Hydrograph



Summary for Subcatchment 6S: Post Dev

Runoff = 2.05 cfs @ 12.21 hrs, Volume= 8,562 cf, Depth= 1.27"

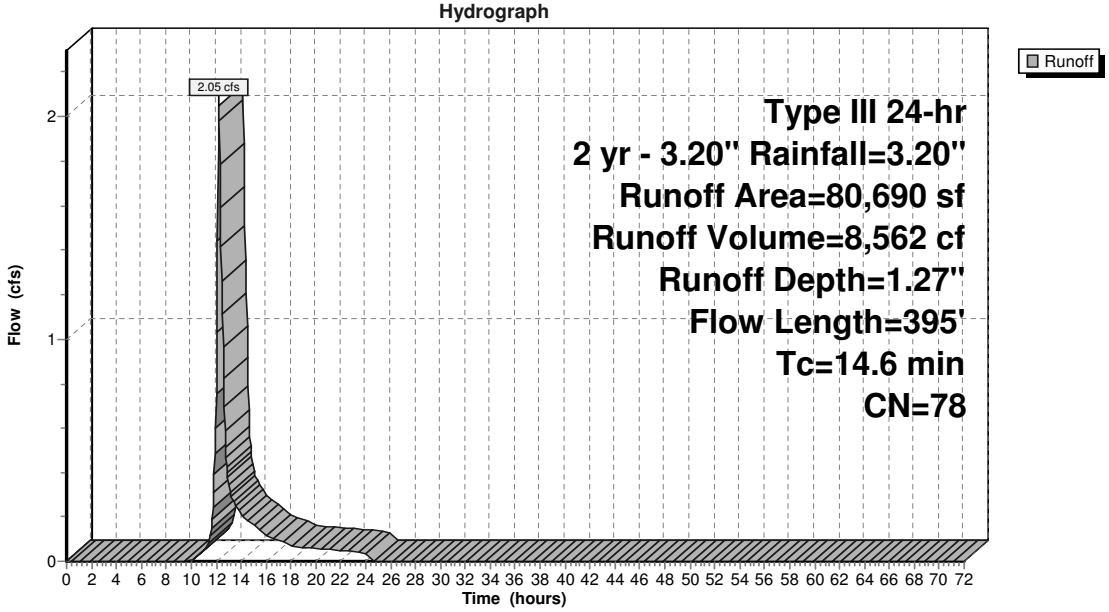
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
	4,155	98	Paved roads w/curbs & sewers, HSG C
	1,530	98	Roofs, HSG C
	21,839	74	>75% Grass cover, Good, HSG C
	4,429	73	Woods, Fair, HSG C
*	48,737	78	Wetlands
	80,690	78	Weighted Average
	75,005		92.95% Pervious Area
	5,685		7.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
6.4	345	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.6	395	Total			

Subcatchment 6S: Post Dev

Hydrograph



Summary for Subcatchment 7S: Post Dev

Runoff = 3.39 cfs @ 12.15 hrs, Volume= 12,225 cf, Depth= 1.54"

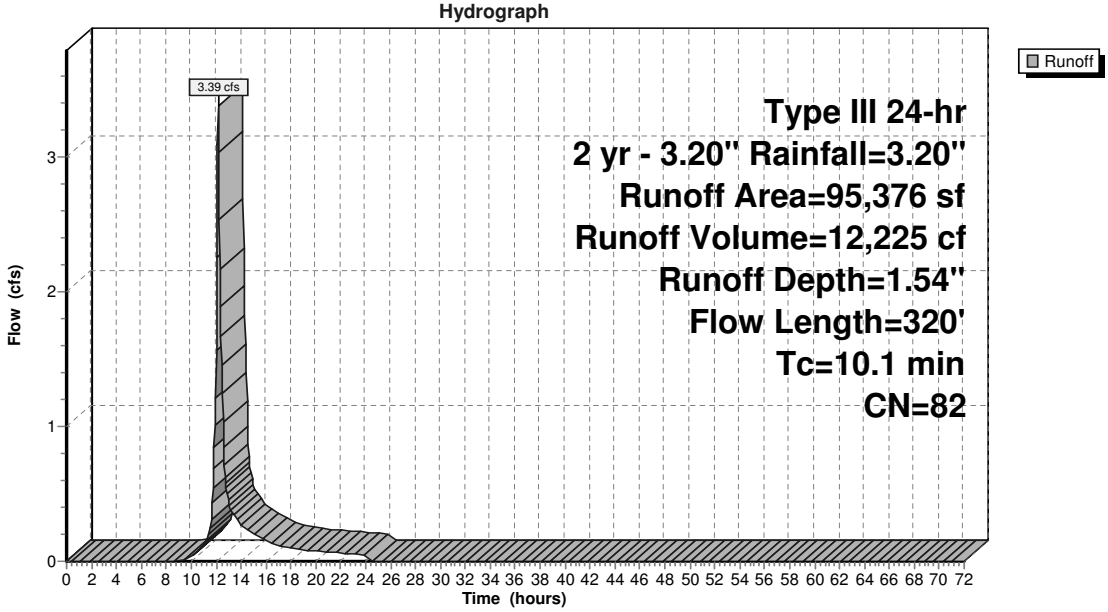
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
*	9,688	98	Roofs
*	6,758	98	Drives
*	11,562	98	Road
	4,360	73	Woods, Fair, HSG C
	18,385	80	>75% Grass cover, Good, HSG D
	44,623	74	>75% Grass cover, Good, HSG C
	95,376	82	Weighted Average
	67,368		70.63% Pervious Area
	28,008		29.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	110	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.3	160	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.1	320	Total			

Subcatchment 7S: Post Dev

Hydrograph



Summary for Subcatchment 8S: Post Dev

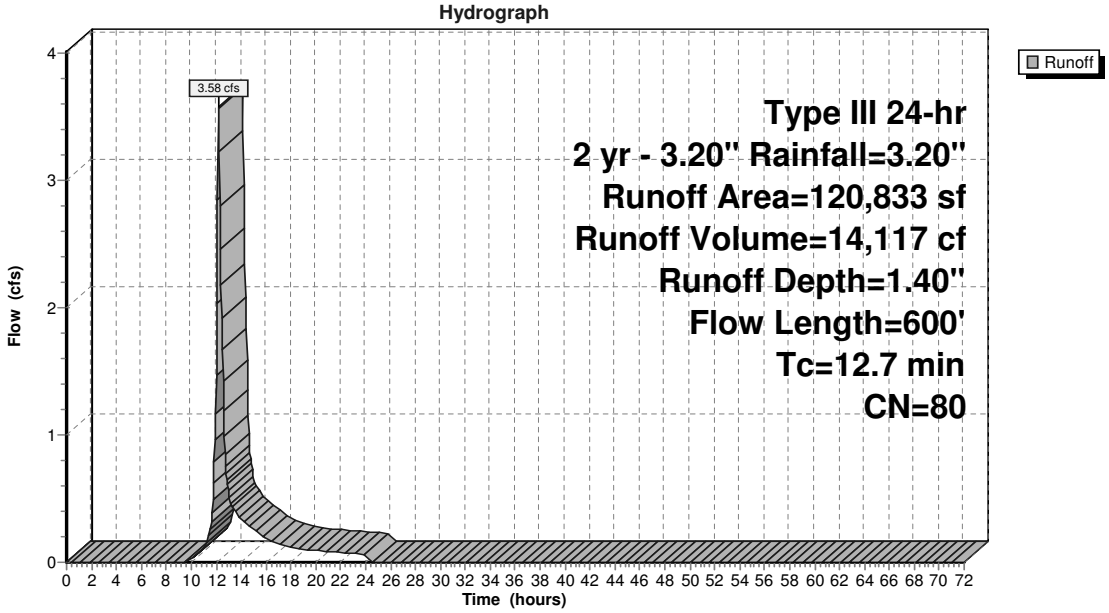
Runoff = 3.58 cfs @ 12.18 hrs, Volume= 14,117 cf, Depth= 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
*	12,140	98	Road
*	6,595	98	Drives
*	11,166	98	Roofs
	19,454	73	Woods, Fair, HSG C
	54,858	74	>75% Grass cover, Good, HSG C
	16,620	74	>75% Grass cover, Good, HSG C
	120,833	80	Weighted Average
	90,932		75.25% Pervious Area
	29,901		24.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.6	200	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.9	350	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
12.7	600	Total			

Subcatchment 8S: Post Dev



Summary for Subcatchment 9S: Post Dev

Runoff = 8.87 cfs @ 12.17 hrs, Volume= 35,043 cf, Depth= 1.09"

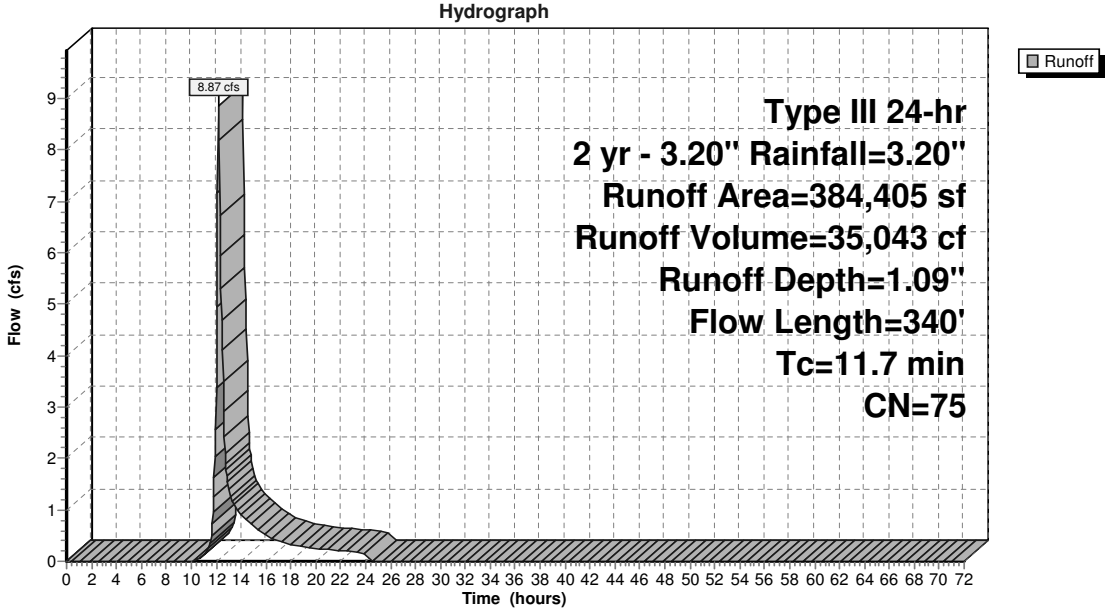
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
*	39,480	98	Road
*	21,444	98	Drives
*	38,845	98	Roofs
	57,414	39	>75% Grass cover, Good, HSG A
	194,109	74	>75% Grass cover, Good, HSG C
	33,113	73	Woods, Fair, HSG C
	384,405	75	Weighted Average
	284,636		74.05% Pervious Area
	99,769		25.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.4	150	0.0150	1.84		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.1	140	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.7	340	Total			

Subcatchment 9S: Post Dev

Hydrograph



Summary for Subcatchment 10S: Post Dev

Runoff = 2.38 cfs @ 12.14 hrs, Volume= 8,433 cf, Depth= 1.68"

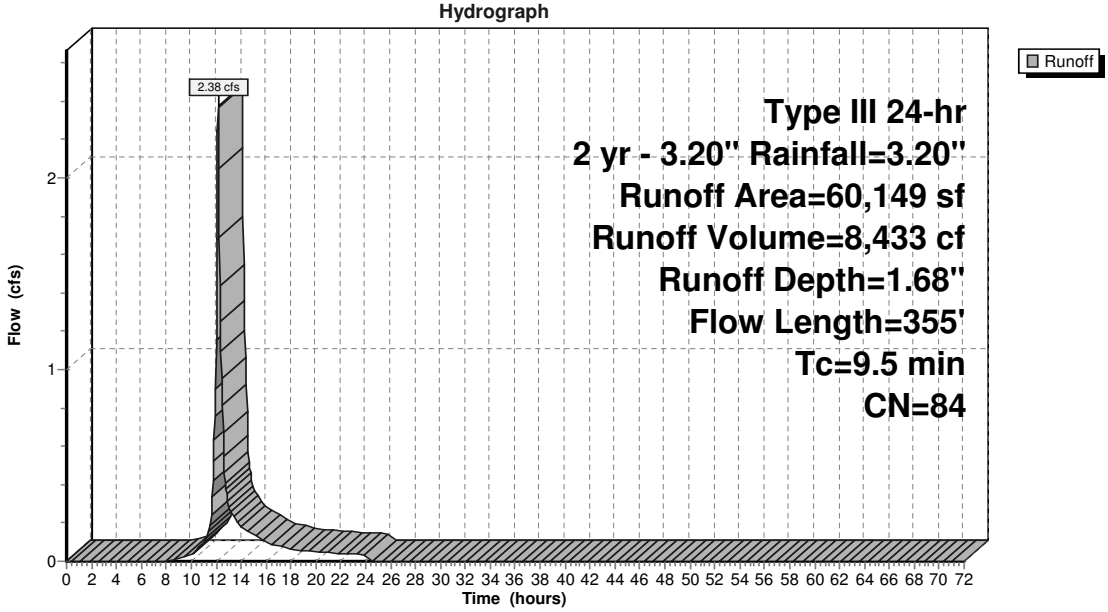
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
*	12,584	98	Road
*	4,570	98	Drives
*	4,665	98	Roofs
	12,147	80	>75% Grass cover, Good, HSG D
	26,183	74	>75% Grass cover, Good, HSG C
	60,149	84	Weighted Average
	38,330		63.73% Pervious Area
	21,819		36.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.2	25	0.0200	2.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.1	280	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.5	355	Total			

Subcatchment 10S: Post Dev

Hydrograph



Summary for Subcatchment 11S: Post Dev

Runoff = 3.99 cfs @ 12.37 hrs, Volume= 20,788 cf, Depth= 1.27"

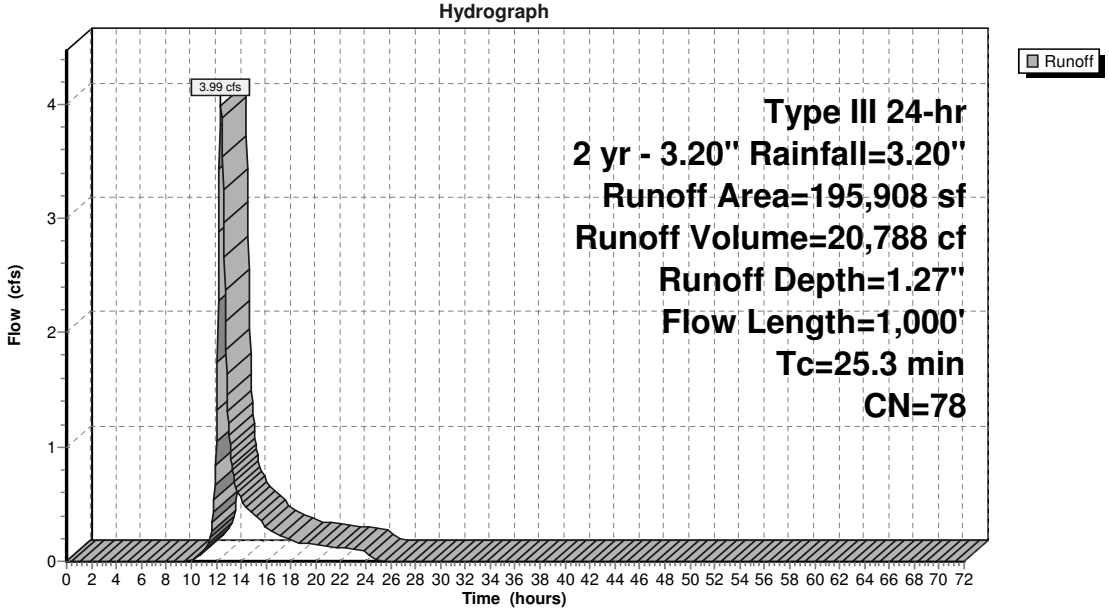
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
*	3,584	98	Road
*	9,873	98	Roofs
	20,413	73	Woods, Fair, HSG C
	19,040	79	Woods, Fair, HSG D
	70,498	74	>75% Grass cover, Good, HSG C
	8,004	80	>75% Grass cover, Good, HSG D
*	64,496	78	Wetlands
	195,908	78	Weighted Average
	182,451		93.13% Pervious Area
	13,457		6.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.8	100	0.0200	2.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
15.3	650	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.0	200	0.0150	3.19	12.78	**Channel Flow,** Area= 4.0 sf Perim= 6.8' r= 0.59' n= 0.040 Mountain streams
25.3	1,000	Total			

Subcatchment 11S: Post Dev

Hydrograph



Summary for Subcatchment 12S: Post Dev

Runoff = 9.87 cfs @ 12.43 hrs, Volume= 54,924 cf, Depth= 1.21"

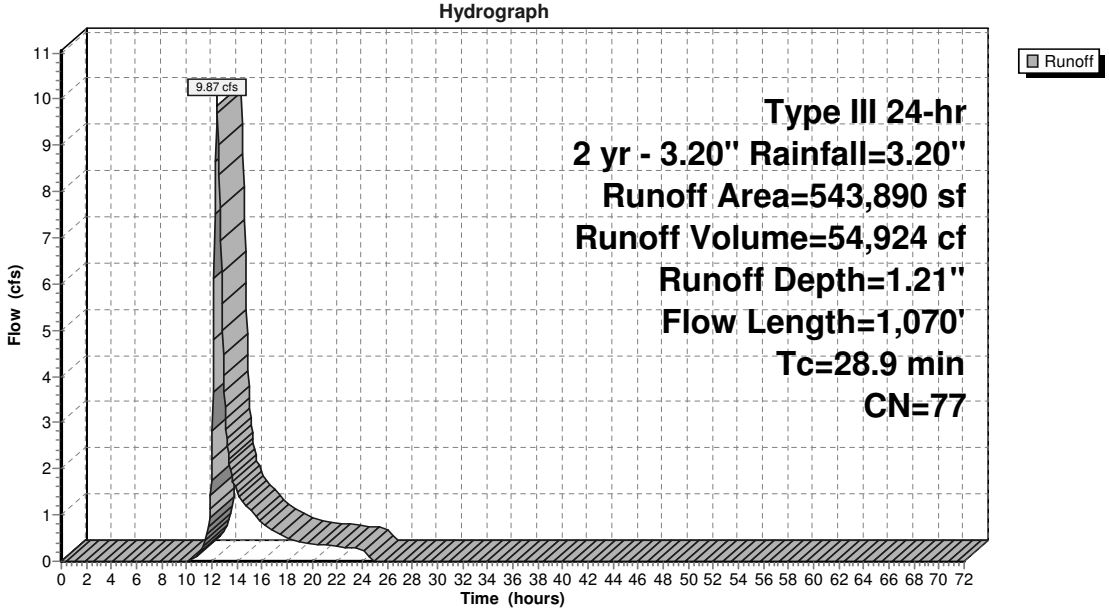
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
*	10,801	98	Paved
*	6,530	98	Roof
	35,887	60	Woods, Fair, HSG B
	9,984	61	>75% Grass cover, Good, HSG B
	52,770	74	>75% Grass cover, Good, HSG C
	15,275	80	>75% Grass cover, Good, HSG D
	51,310	79	Woods, Fair, HSG D
	40,779	73	Woods, Fair, HSG C
*	320,554	78	Wetlands
	543,890	77	Weighted Average
	526,559		96.81% Pervious Area
	17,331		3.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	50	0.0350	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
19.0	1,020	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
28.9	1,070	Total			

Subcatchment 12S: Post Dev

Hydrograph



Summary for Subcatchment 13S: Post Dev

Runoff = 3.16 cfs @ 12.18 hrs, Volume= 13,718 cf, Depth= 0.78"

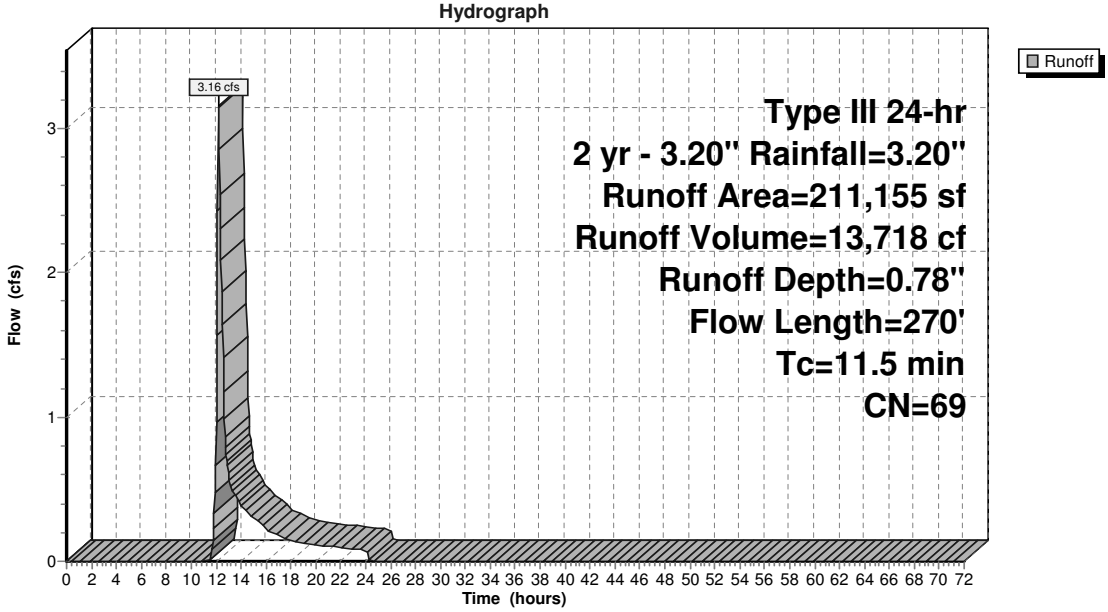
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
*	3,805	98	Roofs
	17,106	36	Woods, Fair, HSG A
	7,569	60	Woods, Fair, HSG B
	11,993	73	Woods, Fair, HSG C
	34,942	79	Woods, Fair, HSG D
	14,634	39	>75% Grass cover, Good, HSG A
	20,863	61	>75% Grass cover, Good, HSG B
	25,669	74	>75% Grass cover, Good, HSG C
	4,934	80	>75% Grass cover, Good, HSG D
*	69,640	78	Wetlands
	211,155	69	Weighted Average
	207,350		98.20% Pervious Area
	3,805		1.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
3.3	220	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.5	270	Total			

Subcatchment 13S: Post Dev

Hydrograph



Summary for Subcatchment 14S: Post Dev

Runoff = 0.63 cfs @ 12.35 hrs, Volume= 3,930 cf, Depth= 0.52"

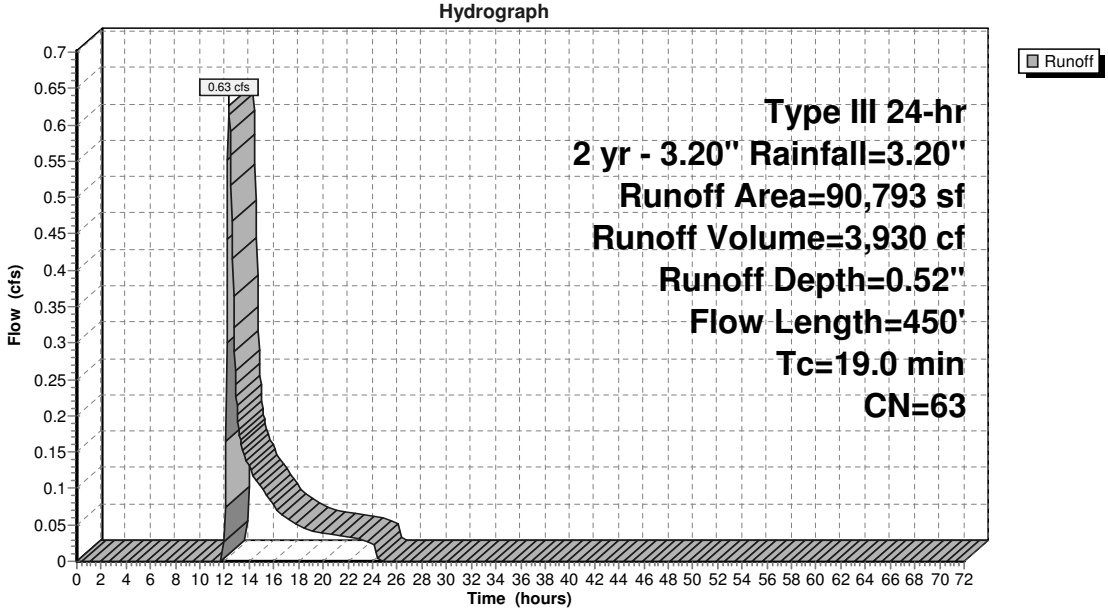
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
	12,475	39	>75% Grass cover, Good, HSG A
	15,110	61	>75% Grass cover, Good, HSG B
	6,750	74	>75% Grass cover, Good, HSG C
	8,310	36	Woods, Fair, HSG A
	12,274	60	Woods, Fair, HSG B
	3,580	73	Woods, Fair, HSG C
*	32,294	78	Wetlands
	90,793	63	Weighted Average
	90,793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
6.7	400	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
19.0	450	Total			

Subcatchment 14S: Post Dev

Hydrograph



Summary for Subcatchment 15S: Post Dev

Runoff = 1.98 cfs @ 12.16 hrs, Volume= 7,319 cf, Depth= 1.40"

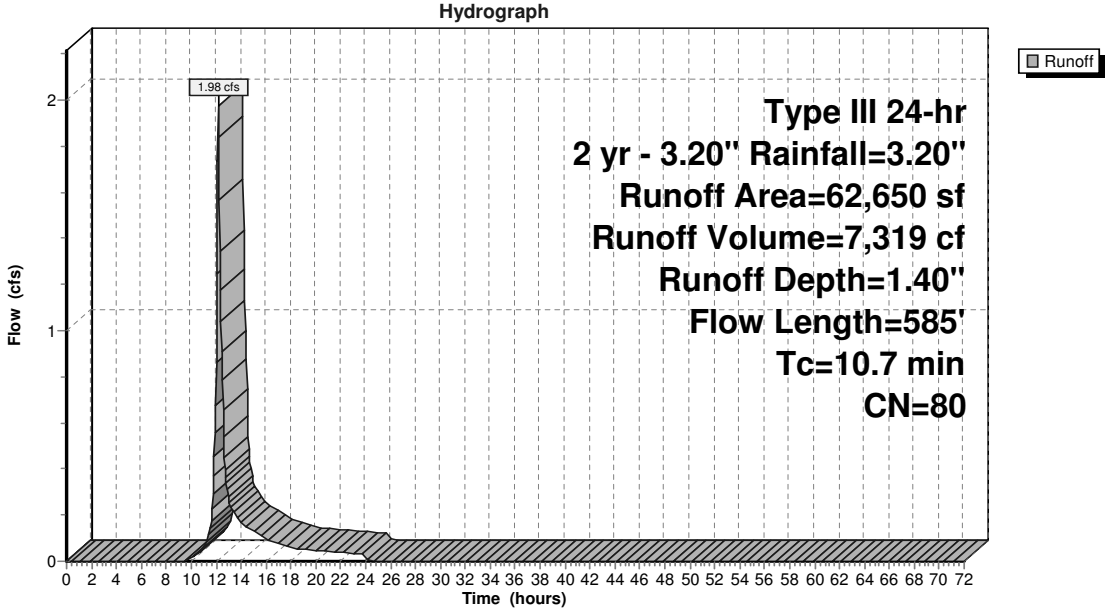
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
*	34,455	98	Pavement
*	4,599	98	Walks
	12,433	39	>75% Grass cover, Good, HSG A
	11,163	61	>75% Grass cover, Good, HSG B
	62,650	80	Weighted Average
	23,596		37.66% Pervious Area
	39,054		62.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	35	0.0200	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.7	450	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.7	585	Total			

Subcatchment 15S: Post Dev

Hydrograph



Summary for Subcatchment 16S: Post Dev

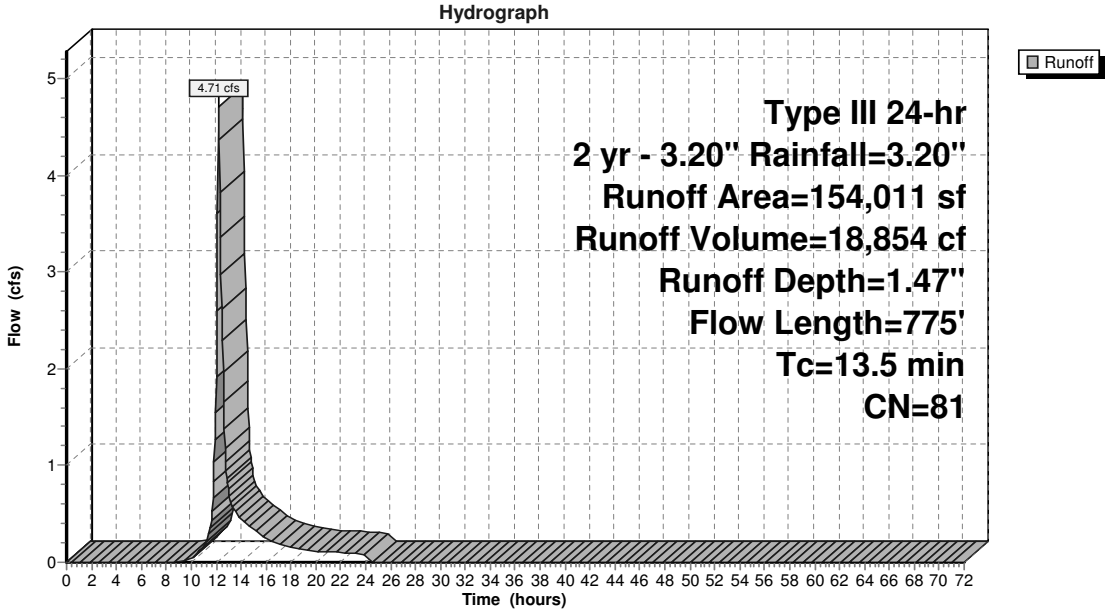
Runoff = 4.71 cfs @ 12.19 hrs, Volume= 18,854 cf, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

	Area (sf)	CN	Description
*	48,668	98	Pavement
*	16,480	98	Roof
	17,110	39	>75% Grass cover, Good, HSG A
	39,096	74	>75% Grass cover, Good, HSG C
	27,277	80	>75% Grass cover, Good, HSG D
	5,380	73	Woods, Fair, HSG C
	154,011	81	Weighted Average
	88,863		57.70% Pervious Area
	65,148		42.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.4	250	0.0220	3.01		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.9	475	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.5	775	Total			

Subcatchment 16S: Post Dev



Summary for Subcatchment 17S: Building #1

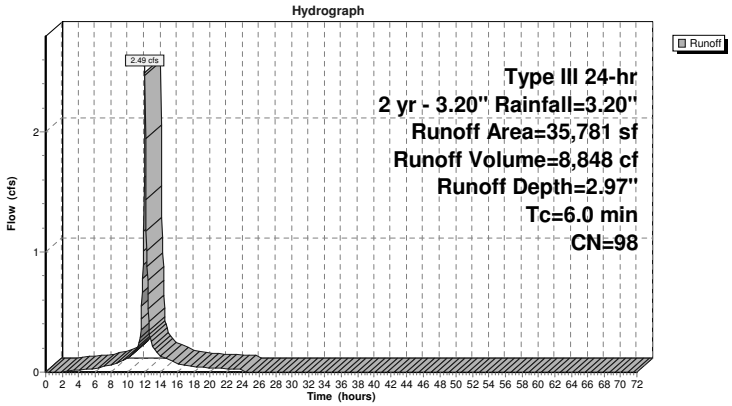
Runoff = 2.49 cfs @ 12.09 hrs, Volume= 8,848 cf, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr - 3.20" Rainfall=3.20"

Area (sf)	CN	Description
35,781	98	Roofs, HSG C
35,781		100.00% Impervious Area

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

Subcatchment 17S: Building #1



Summary for Reach 1R: Int Stream

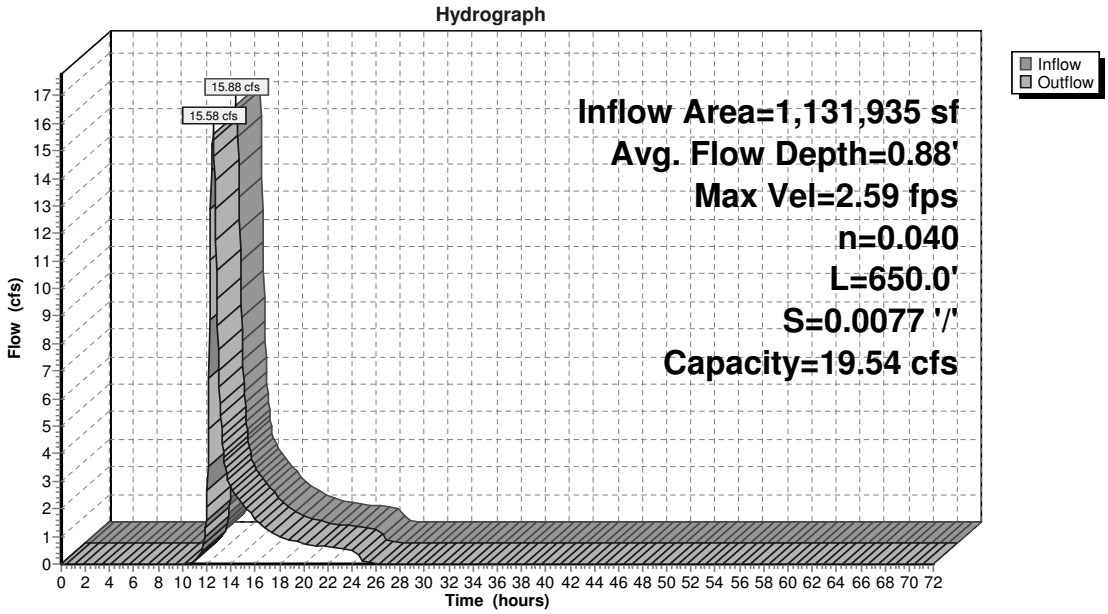
Inflow Area = 1,131,935 sf, 7.63% Impervious, Inflow Depth = 1.00" for 2 yr - 3.20" event
Inflow = 15.88 cfs @ 12.39 hrs, Volume= 94,622 cf
Outflow = 15.58 cfs @ 12.51 hrs, Volume= 94,622 cf, Atten= 2%, Lag= 7.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.59 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 15.9 min

Peak Storage= 3,917 cf @ 12.44 hrs
Average Depth at Peak Storage= 0.88'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 19.54 cfs

6.00' x 1.00' deep channel, n= 0.040 Mountain streams
Side Slope Z-value= 1.0 '/' Top Width= 8.00'
Length= 650.0' Slope= 0.0077 '/'
Inlet Invert= 394.00', Outlet Invert= 389.00'

Reach 1R: Int Stream



Summary for Pond 1P: Det Pond #1

Inflow Area = 95,376 sf, 29.37% Impervious, Inflow Depth = 1.54" for 2 yr - 3.20" event
Inflow = 3.39 cfs @ 12.15 hrs, Volume= 12,225 cf
Outflow = 0.13 cfs @ 16.65 hrs, Volume= 12,225 cf, Atten= 96%, Lag= 270.2 min
Discarded = 0.13 cfs @ 16.65 hrs, Volume= 12,225 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 401.69' @ 16.65 hrs Surf.Area= 5,335 sf Storage= 8,014 cf

Plug-Flow detention time= 809.9 min calculated for 12,216 cf (100% of inflow)
Center-of-Mass det. time= 811.0 min (1,651.1 - 840.1)

Volume	Invert	Avail.Storage	Storage Description
#1	399.00'	23,858 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

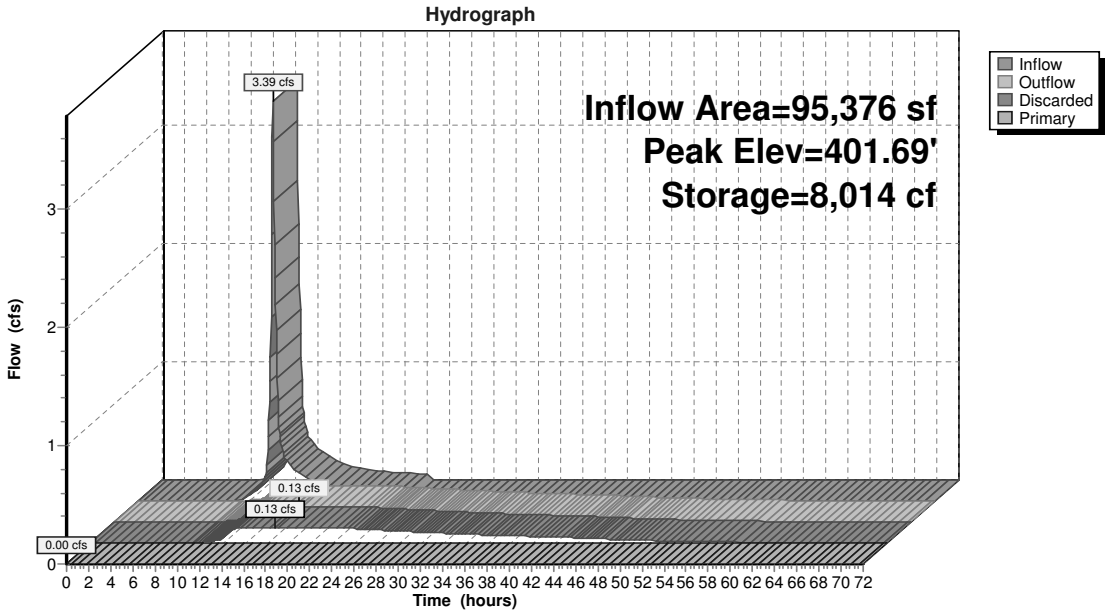
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
399.00	364	96.0	0	0	364
400.00	2,650	302.0	1,332	1,332	6,891
401.50	5,070	454.0	5,693	7,025	16,053
402.00	5,780	456.0	2,711	9,735	16,323
404.00	8,426	454.0	14,123	23,858	17,245

Device	Routing	Invert	Outlet Devices
#1	Discarded	399.00'	**0.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 394.80'
#2	Primary	402.00'	**18.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 402.00' / 398.50' S= 0.1400 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Discarded OutFlow Max=0.13 cfs @ 16.65 hrs HW=401.69' (Free Discharge)
└**1=Exfiltration** (Controls 0.13 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=399.00' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)

Pond 1P: Det Pond #1



Summary for Pond 2P: Det Pond #2

Inflow Area = 154,011 sf, 42.30% Impervious, Inflow Depth = 1.47" for 2 yr - 3.20" event
Inflow = 4.71 cfs @ 12.19 hrs, Volume= 18,854 cf
Outflow = 1.58 cfs @ 12.61 hrs, Volume= 18,854 cf, Atten= 67%, Lag= 25.2 min
Discarded = 0.36 cfs @ 12.61 hrs, Volume= 11,718 cf
Primary = 1.21 cfs @ 12.61 hrs, Volume= 7,136 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 400.86' @ 12.61 hrs Surf.Area= 5,177 sf Storage= 6,718 cf

Plug-Flow detention time= 135.9 min calculated for 18,841 cf (100% of inflow)
Center-of-Mass det. time= 136.0 min (982.5 - 846.5)

Volume	Invert	Avail.Storage	Storage Description
#1	398.00'	35,756 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

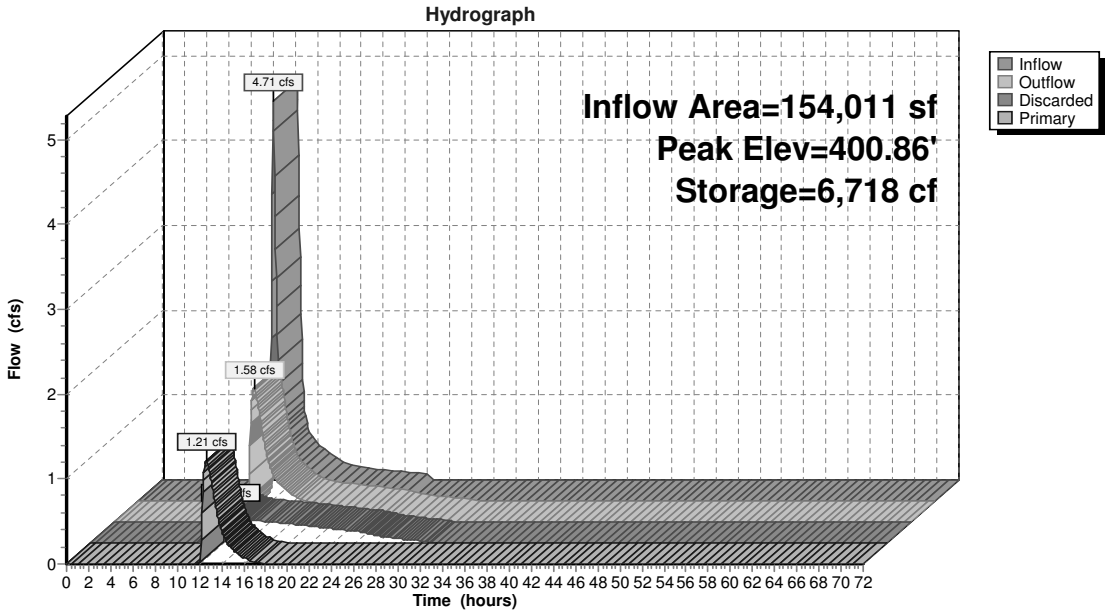
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
398.00	283	84.0	0	0	283
399.00	1,340	176.0	746	746	2,191
400.00	3,441	271.0	2,309	3,056	5,578
402.00	8,049	401.0	11,169	14,224	12,562
404.00	13,735	491.0	21,532	35,756	19,012

Device	Routing	Invert	Outlet Devices
#1	Discarded	398.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 394.00'
#2	Primary	400.00'	**8.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 400.00' / 394.00' S= 0.1500 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf

Discarded OutFlow Max=0.36 cfs @ 12.61 hrs HW=400.85' (Free Discharge)
└**1=Exfiltration** (Controls 0.36 cfs)

Primary OutFlow Max=1.21 cfs @ 12.61 hrs HW=400.85' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.21 cfs @ 3.48 fps)

Pond 2P: Det Pond #2



Summary for Pond 3P: Det Pond#3

Inflow Area = 60,149 sf, 36.27% Impervious, Inflow Depth = 1.68" for 2 yr - 3.20" event
Inflow = 2.38 cfs @ 12.14 hrs, Volume= 8,433 cf
Outflow = 0.06 cfs @ 18.17 hrs, Volume= 5,935 cf, Atten= 98%, Lag= 361.7 min
Discarded = 0.03 cfs @ 18.17 hrs, Volume= 5,280 cf
Primary = 0.03 cfs @ 18.17 hrs, Volume= 655 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 406.08' @ 18.17 hrs Surf.Area= 4,907 sf Storage= 6,640 cf

Plug-Flow detention time= 1,490.2 min calculated for 5,935 cf (70% of inflow)
Center-of-Mass det. time= 1,393.6 min (2,226.4 - 832.8)

Volume	Invert	Avail.Storage	Storage Description
#1	404.00'	19,828 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

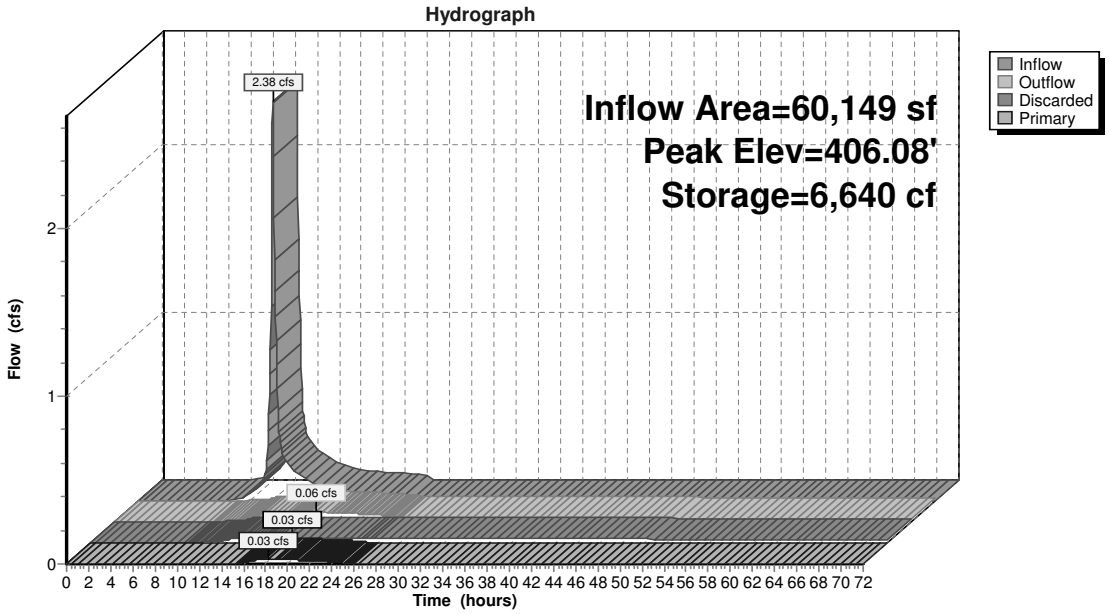
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
404.00	815	180.0	0	0	815
405.00	3,663	255.0	2,069	2,069	3,420
406.00	4,741	281.0	4,190	6,259	4,561
407.00	7,050	450.0	5,857	12,116	14,399
408.00	8,392	470.0	7,711	19,828	15,934

Device	Routing	Invert	Outlet Devices
#1	Discarded	404.00'	**0.170 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 402.00'
#2	Primary	406.00'	**12.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 406.00' / 402.50' S= 0.1400 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 18.17 hrs HW=406.08' (Free Discharge)
└**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=0.03 cfs @ 18.17 hrs HW=406.08' (Free Discharge)
└**2=Culvert** (Inlet Controls 0.03 cfs @ 0.96 fps)

Pond 3P: Det Pond#3



Summary for Pond 4P: Det Pond #4

Inflow Area = 120,833 sf, 24.75% Impervious, Inflow Depth = 1.40" for 2 yr - 3.20" event
Inflow = 3.58 cfs @ 12.18 hrs, Volume= 14,117 cf
Outflow = 0.27 cfs @ 14.84 hrs, Volume= 11,284 cf, Atten= 93%, Lag= 159.4 min
Discarded = 0.04 cfs @ 14.84 hrs, Volume= 6,747 cf
Primary = 0.23 cfs @ 14.84 hrs, Volume= 4,537 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 401.72' @ 14.84 hrs Surf.Area= 6,127 sf Storage= 8,816 cf

Plug-Flow detention time= 1,057.0 min calculated for 11,276 cf (80% of inflow)
Center-of-Mass det. time= 978.8 min (1,827.8 - 849.0)

Volume	Invert	Avail.Storage	Storage Description
#1	400.00'	28,626 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

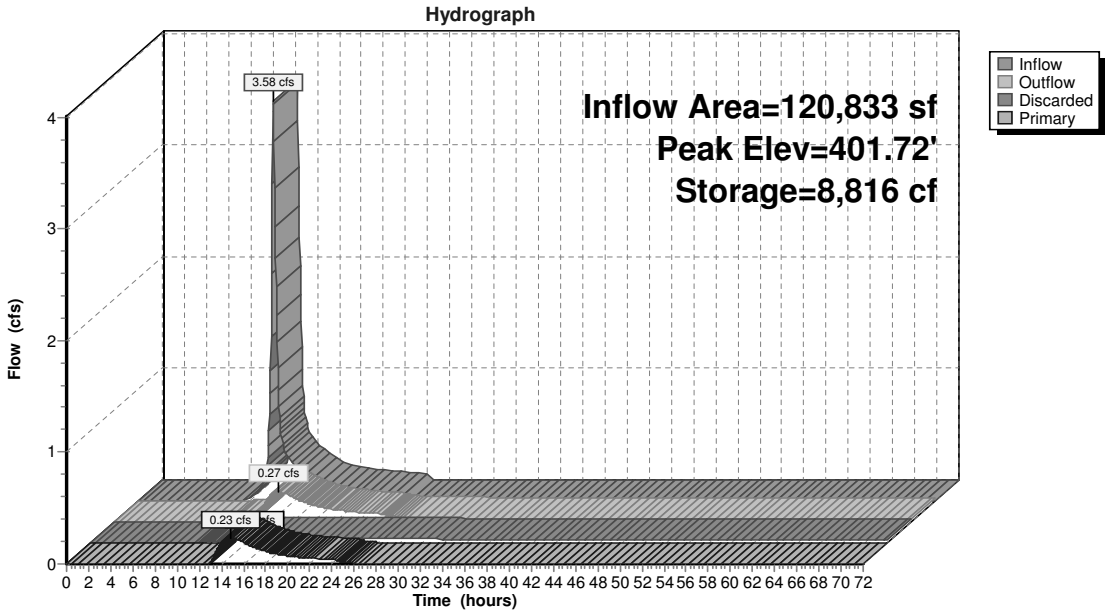
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
400.00	4,196	306.0	0	0	4,196
402.00	6,479	349.0	10,593	10,593	6,531
403.00	9,236	539.0	7,817	18,410	19,965
404.00	11,230	578.0	10,217	28,626	23,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	400.00'	**0.170 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 397.50'
#2	Primary	401.50'	**15.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 401.50' / 397.50' S= 0.1600 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Discarded OutFlow Max=0.04 cfs @ 14.84 hrs HW=401.72' (Free Discharge)
└**1=Exfiltration** (Controls 0.04 cfs)

Primary OutFlow Max=0.23 cfs @ 14.84 hrs HW=401.72' (Free Discharge)
└**2=Culvert** (Inlet Controls 0.23 cfs @ 1.59 fps)

Pond 4P: Det Pond #4



Summary for Pond 5P: Det Pond #5

Inflow Area = 384,405 sf, 25.95% Impervious, Inflow Depth = 1.09" for 2 yr - 3.20" event
Inflow = 8.87 cfs @ 12.17 hrs, Volume= 35,043 cf
Outflow = 2.10 cfs @ 12.71 hrs, Volume= 35,043 cf, Atten= 76%, Lag= 32.0 min
Discarded = 0.67 cfs @ 12.71 hrs, Volume= 23,474 cf
Primary = 1.43 cfs @ 12.71 hrs, Volume= 11,569 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 395.82' @ 12.71 hrs Surf.Area= 8,735 sf Storage= 12,282 cf

Plug-Flow detention time= 128.2 min calculated for 35,019 cf (100% of inflow)
Center-of-Mass det. time= 128.2 min (992.3 - 864.1)

Volume	Invert	Avail.Storage	Storage Description
#1	394.00'	51,928 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

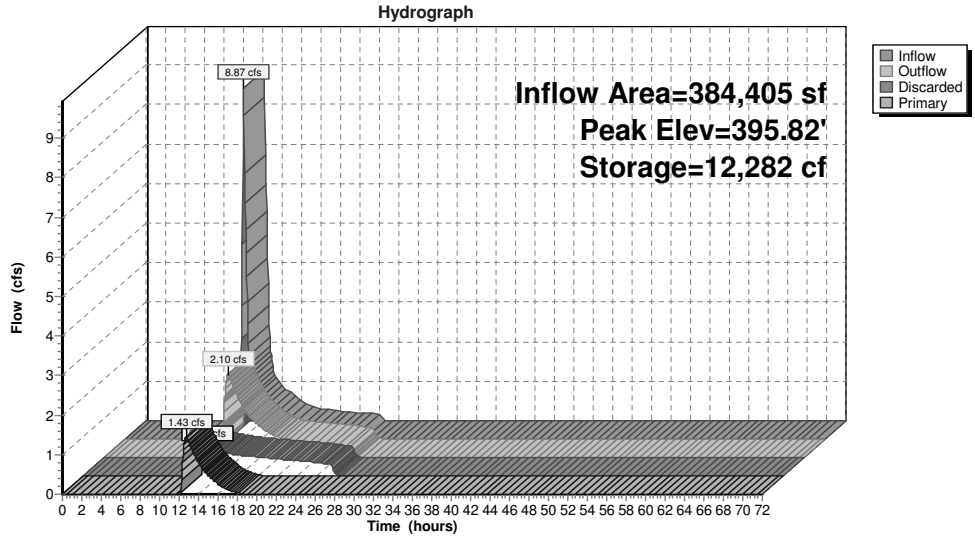
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
394.00	4,910	333.0	0	0	4,910
396.00	9,160	429.0	13,851	13,851	10,781
398.00	14,180	514.0	23,158	37,009	17,229
399.00	15,670	533.0	14,919	51,928	18,896

Device	Routing	Invert	Outlet Devices
#1	Discarded	394.00'	**2.410 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 390.50'
#2	Primary	393.50'	**24.0" Round Culvert** L= 30.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 393.50' / 392.50' S= 0.0333 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#3	Device 2	394.90'	**6.0" W x 36.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 2	396.00'	**12.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.67 cfs @ 12.71 hrs HW=395.82' (Free Discharge)
└─**1=Exfiltration** (Controls 0.67 cfs)

Primary OutFlow Max=1.43 cfs @ 12.71 hrs HW=395.82' (Free Discharge)
└─**2=Culvert** (Passes 1.43 cfs of 17.41 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 1.43 cfs @ 3.09 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Pond 5P: Det Pond #5



Summary for Pond 6P: Det Pond #6

Inflow Area = 98,431 sf, 76.03% Impervious, Inflow Depth = 1.97" for 2 yr - 3.20" event
Inflow = 4.22 cfs @ 12.11 hrs, Volume= 16,168 cf
Outflow = 2.35 cfs @ 12.31 hrs, Volume= 16,168 cf, Atten= 44%, Lag= 11.7 min
Discarded = 1.05 cfs @ 12.31 hrs, Volume= 13,760 cf
Primary = 1.30 cfs @ 12.31 hrs, Volume= 2,408 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 396.17' @ 12.31 hrs Surf.Area= 2,825 sf Storage= 3,474 cf

Plug-Flow detention time= 25.7 min calculated for 16,156 cf (100% of inflow)
Center-of-Mass det. time= 25.7 min (823.2 - 797.5)

Volume	Invert	Avail.Storage	Storage Description
#1	394.00'	16,799 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

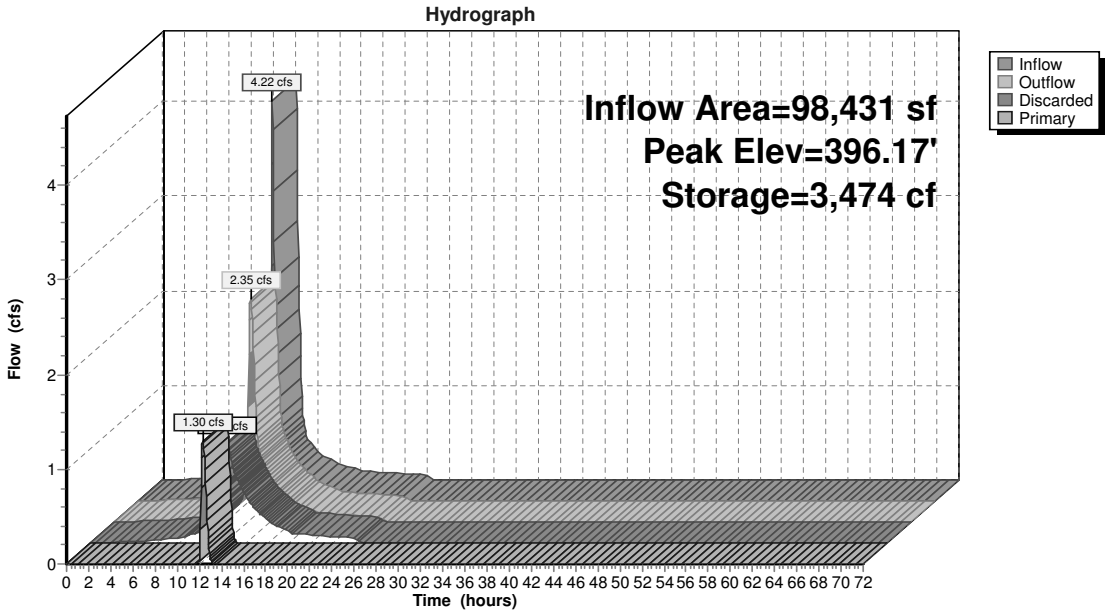
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
394.00	598	106.0	0	0	598
396.00	2,661	225.0	3,014	3,014	3,750
398.00	4,932	299.0	7,477	10,491	6,880
399.00	7,793	364.0	6,308	16,799	10,325

Device	Routing	Invert	Outlet Devices
#1	Discarded	394.00'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 391.50'
#2	Primary	395.50'	**10.0" Round Culvert** L= 30.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 395.50' / 393.00' S= 0.0833 '/' Cc= 0.900 n= 0.013, Flow Area= 0.55 sf

Discarded OutFlow Max=1.05 cfs @ 12.31 hrs HW=396.17' (Free Discharge)
└**1=Exfiltration** (Controls 1.05 cfs)

Primary OutFlow Max=1.30 cfs @ 12.31 hrs HW=396.17' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.30 cfs @ 2.78 fps)

Pond 6P: Det Pond #6

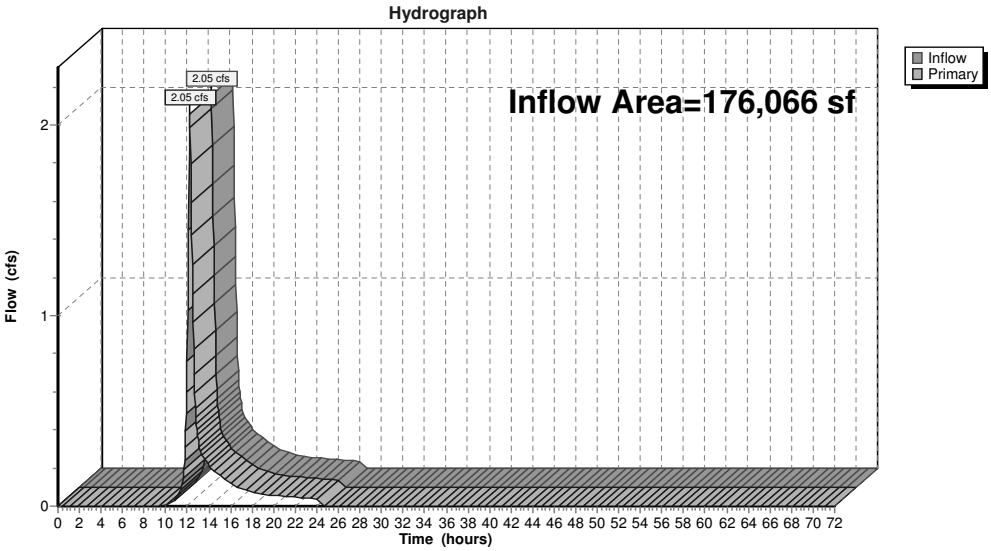


Summary for Link DP-1: DP#1

Inflow Area = 176,066 sf, 19.14% Impervious, Inflow Depth = 0.58" for 2 yr - 3.20" event
Inflow = 2.05 cfs @ 12.21 hrs, Volume= 8,562 cf
Primary = 2.05 cfs @ 12.21 hrs, Volume= 8,562 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-1: DP#1

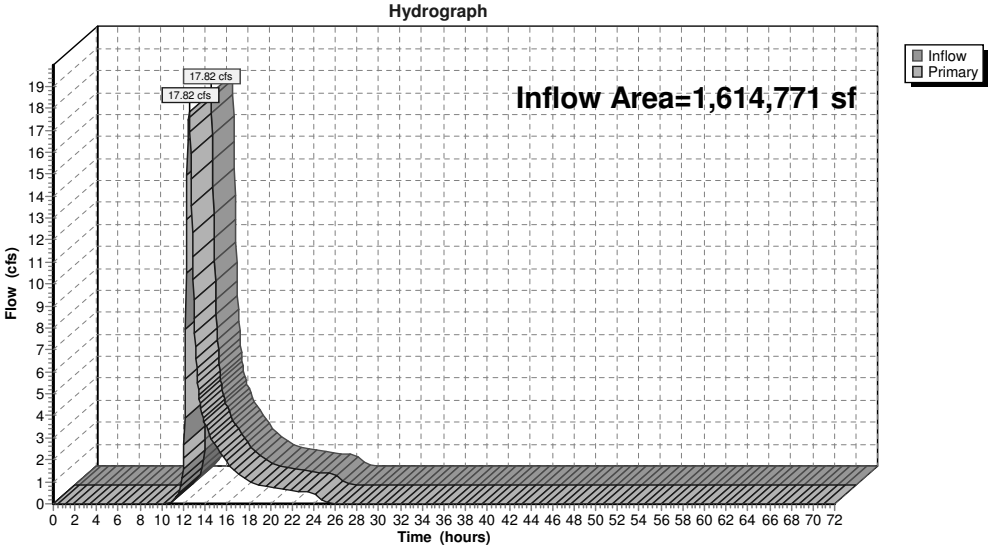


Summary for Link DP-2: DP#2

Inflow Area = 1,614,771 sf, 16.16% Impervious, Inflow Depth = 0.81" for 2 yr - 3.20" event
Inflow = 17.82 cfs @ 12.51 hrs, Volume= 108,599 cf
Primary = 17.82 cfs @ 12.51 hrs, Volume= 108,599 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-2: DP#2

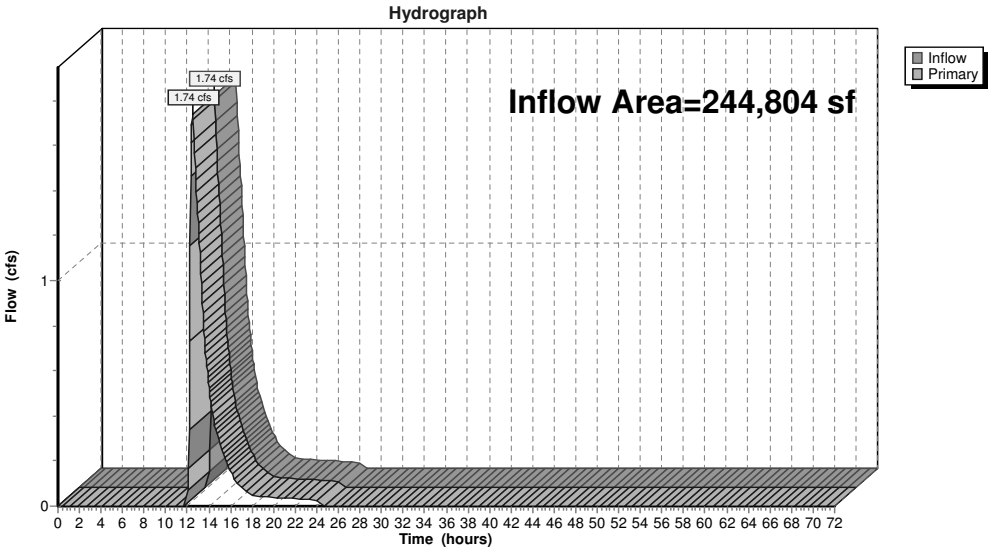


Summary for Link DP-3: DP-3

Inflow Area = 244,804 sf, 26.61% Impervious, Inflow Depth = 0.54" for 2 yr - 3.20" event
Inflow = 1.74 cfs @ 12.49 hrs, Volume= 11,066 cf
Primary = 1.74 cfs @ 12.49 hrs, Volume= 11,066 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-3: DP-3

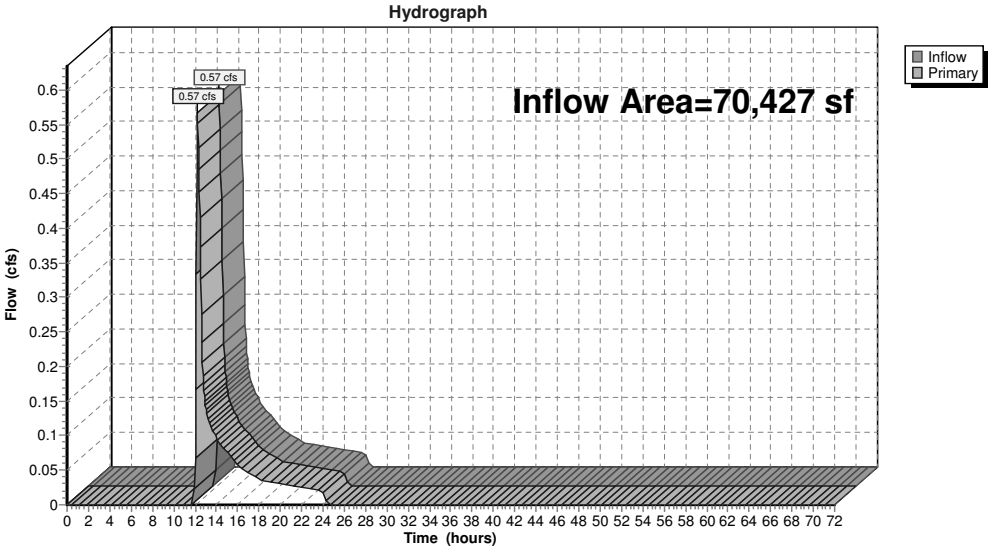


Summary for Link DP-4: DP#4

Inflow Area = 70,427 sf, 3.92% Impervious, Inflow Depth = 0.52" for 2 yr - 3.20" event
Inflow = 0.57 cfs @ 12.22 hrs, Volume= 3,048 cf
Primary = 0.57 cfs @ 12.22 hrs, Volume= 3,048 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-4: DP#4



Summary for Subcatchment 1S: Pre-Dev 1S

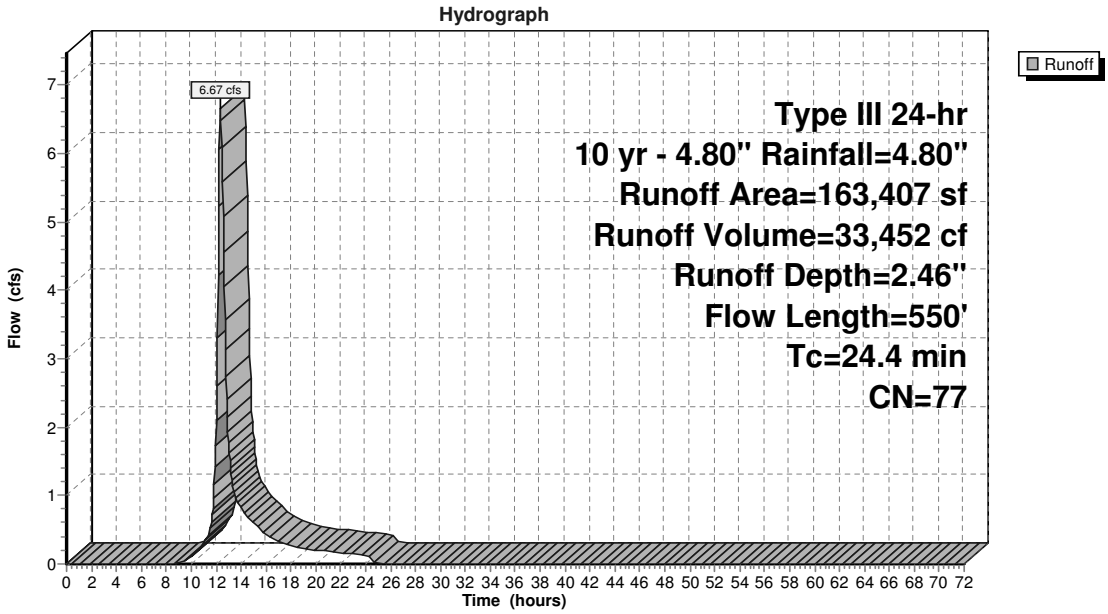
Runoff = 6.67 cfs @ 12.35 hrs, Volume= 33,452 cf, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
	6,616	98	Paved parking, HSG C
	59,968	73	Woods, Fair, HSG C
	48,086	79	Woods, Fair, HSG D
*	48,737	78	Wetlands
	163,407	77	Weighted Average
	156,791		95.95% Pervious Area
	6,616		4.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	50	0.0120	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
9.3	500	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
24.4	550	Total			

Subcatchment 1S: Pre-Dev 1S



Summary for Subcatchment 2S: Pre-Dev 2S

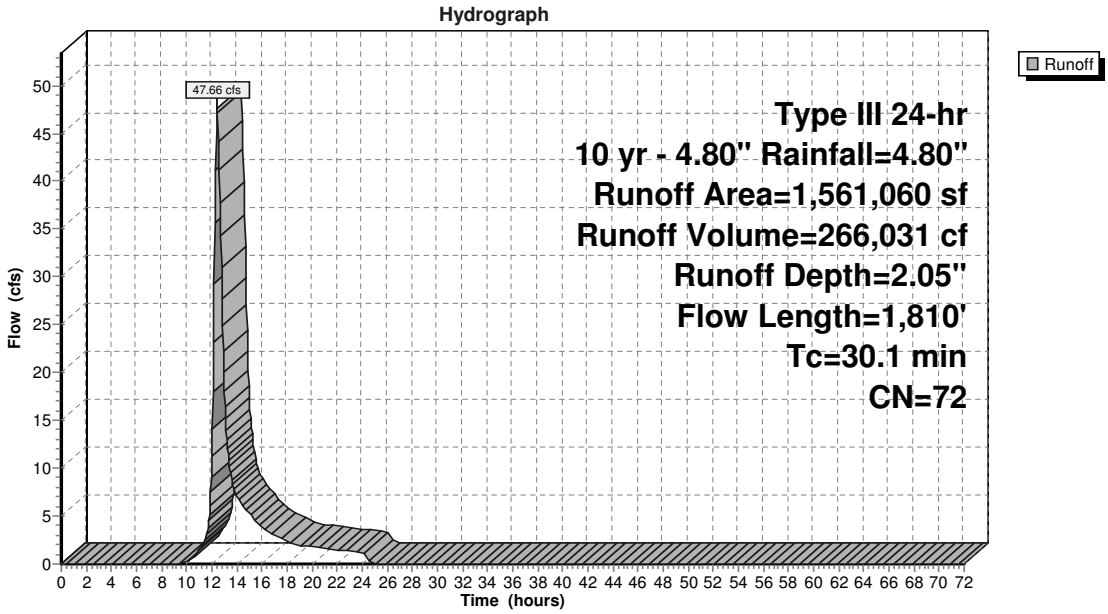
Runoff = 47.66 cfs @ 12.44 hrs, Volume= 266,031 cf, Depth= 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
	12,734	98	Paved parking, HSG C
	103,393	36	Woods, Fair, HSG A
	175,914	79	Woods, Fair, HSG D
	93,562	60	Woods, Fair, HSG B
	720,766	73	Woods, Fair, HSG C
*	454,691	78	Wetlands
	1,561,060	72	Weighted Average
	1,548,326		99.18% Pervious Area
	12,734		0.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0370	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
16.9	950	0.0350	0.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.6	810	0.0100	3.74	7.49	**Channel Flow,** Area= 2.0 sf Perim= 4.0' r= 0.50' n= 0.025 Earth, clean & winding
30.1	1,810	Total			

Subcatchment 2S: Pre-Dev 2S



Summary for Subcatchment 3S: Pre Dev 3S

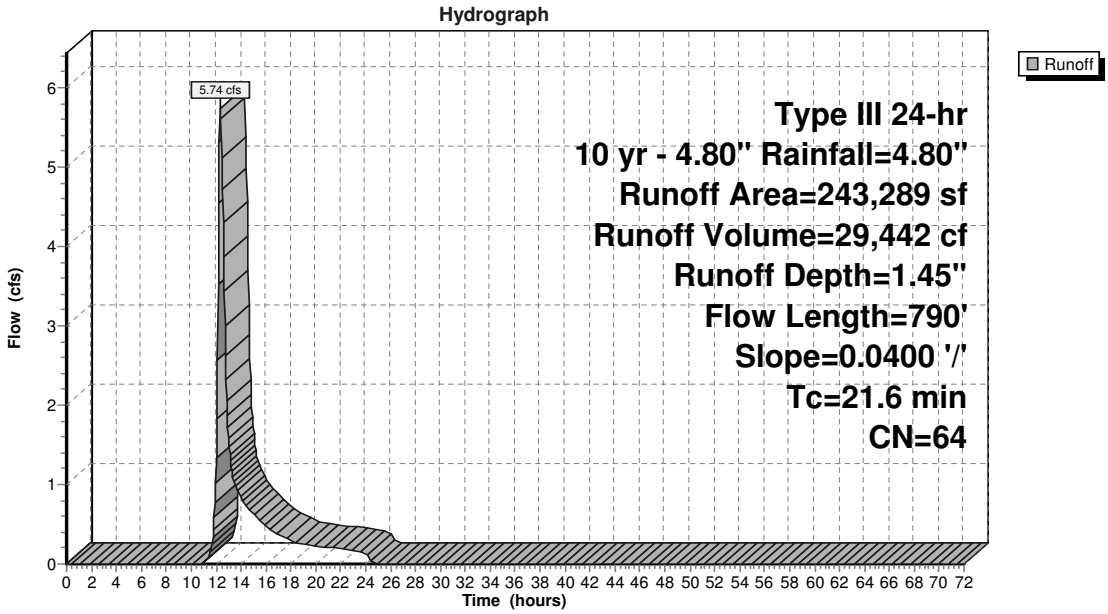
Runoff = 5.74 cfs @ 12.33 hrs, Volume= 29,442 cf, Depth= 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
	37,431	36	Woods, Fair, HSG A
	74,966	60	Woods, Fair, HSG B
	98,598	73	Woods, Fair, HSG C
*	32,294	78	Wetlands
	243,289	64	Weighted Average
	243,289		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
12.3	740	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
21.6	790	Total			

Subcatchment 3S: Pre Dev 3S



Summary for Subcatchment 4S: Pre Dev 4S

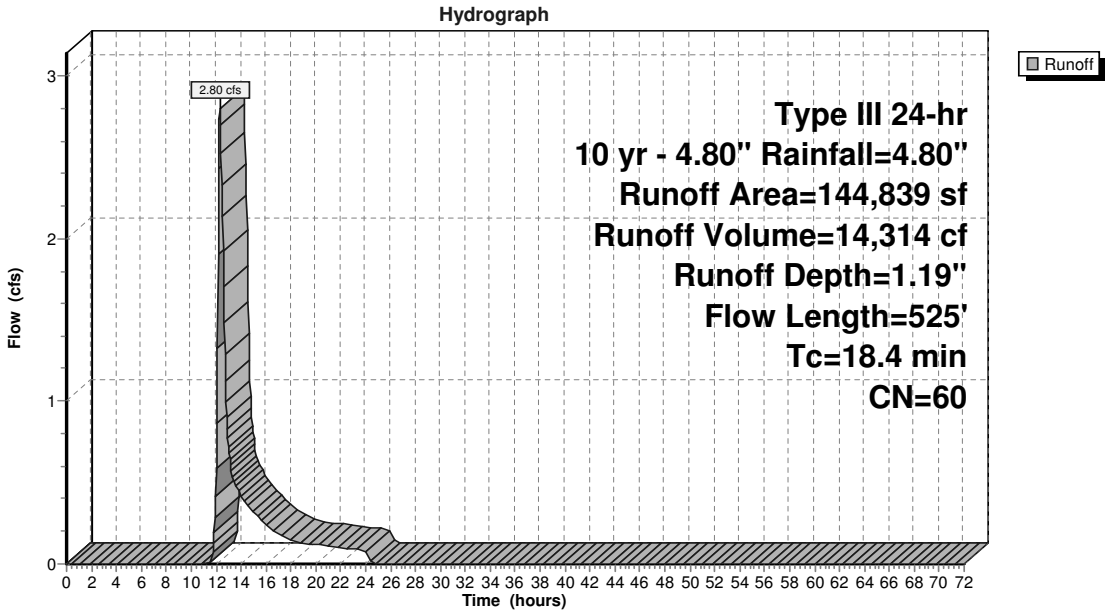
Runoff = 2.80 cfs @ 12.29 hrs, Volume= 14,314 cf, Depth= 1.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

Area (sf)	CN	Description
51,728	36	Woods, Fair, HSG A
93,111	73	Woods, Fair, HSG C
144,839	60	Weighted Average
144,839		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow, 4-1** Woods: Light underbrush n= 0.400 P2= 3.20"
7.9	475	0.0400	1.00		**Shallow Concentrated Flow, 4-2** Woodland Kv= 5.0 fps
18.4	525	Total			

Subcatchment 4S: Pre Dev 4S



Summary for Subcatchment 5S: Post Dev

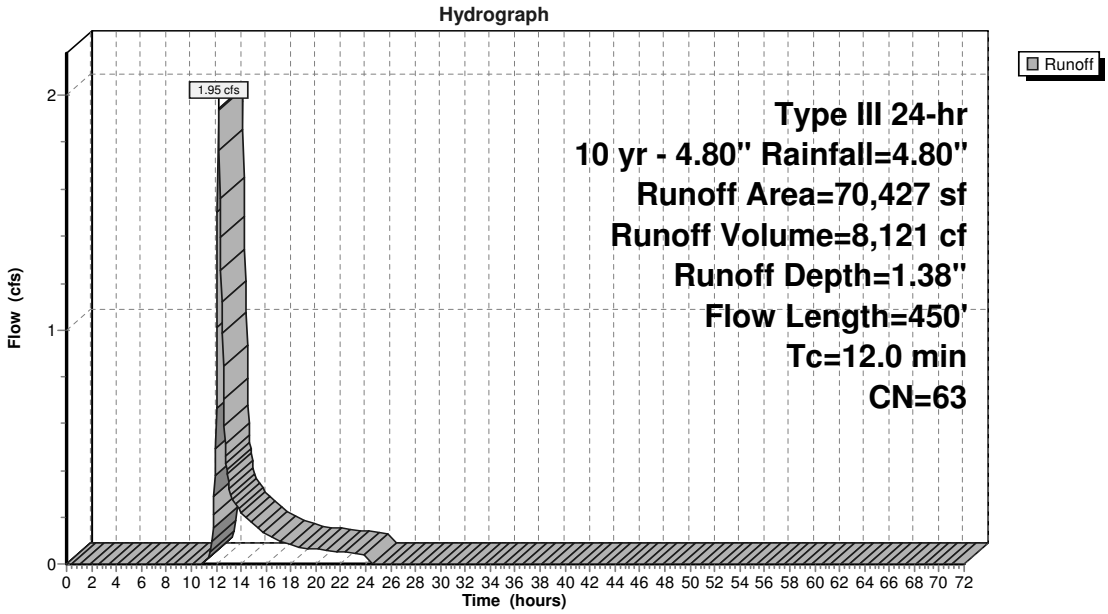
Runoff = 1.95 cfs @ 12.19 hrs, Volume= 8,121 cf, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
*	2,760	98	Roofs,
	11,100	36	Woods, Fair, HSG A
	11,852	39	>75% Grass cover, Good, HSG A
	13,834	74	>75% Grass cover, Good, HSG C
	30,881	73	Woods, Fair, HSG C
	70,427	63	Weighted Average
	67,667		96.08% Pervious Area
	2,760		3.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	50	0.0350	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.1	400	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	450	Total			

Subcatchment 5S: Post Dev



Summary for Subcatchment 6S: Post Dev

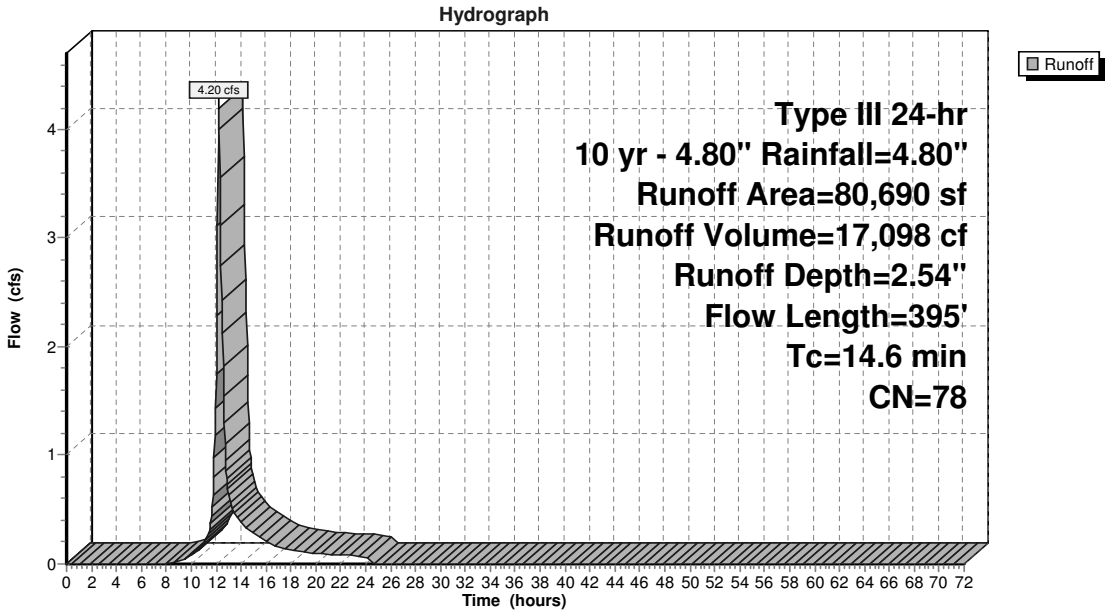
Runoff = 4.20 cfs @ 12.21 hrs, Volume= 17,098 cf, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
	4,155	98	Paved roads w/curbs & sewers, HSG C
	1,530	98	Roofs, HSG C
	21,839	74	>75% Grass cover, Good, HSG C
	4,429	73	Woods, Fair, HSG C
*	48,737	78	Wetlands
	80,690	78	Weighted Average
	75,005		92.95% Pervious Area
	5,685		7.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
6.4	345	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.6	395	Total			

Subcatchment 6S: Post Dev



Summary for Subcatchment 7S: Post Dev

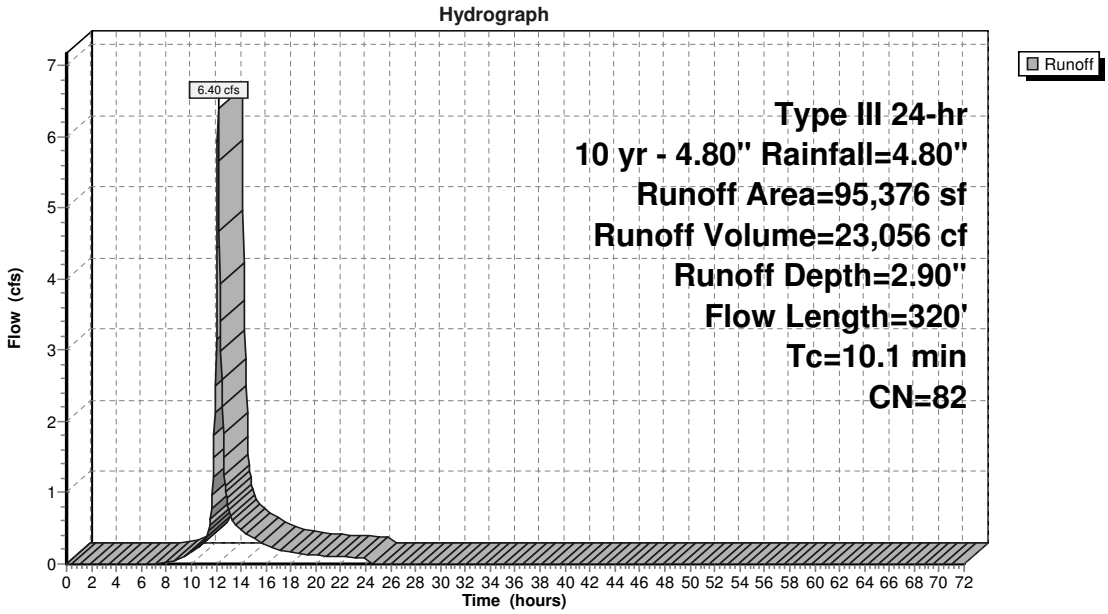
Runoff = 6.40 cfs @ 12.14 hrs, Volume= 23,056 cf, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
*	9,688	98	Roofs
*	6,758	98	Drives
*	11,562	98	Road
	4,360	73	Woods, Fair, HSG C
	18,385	80	>75% Grass cover, Good, HSG D
	44,623	74	>75% Grass cover, Good, HSG C
	95,376	82	Weighted Average
	67,368		70.63% Pervious Area
	28,008		29.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	110	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.3	160	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.1	320	Total			

Subcatchment 7S: Post Dev



Summary for Subcatchment 8S: Post Dev

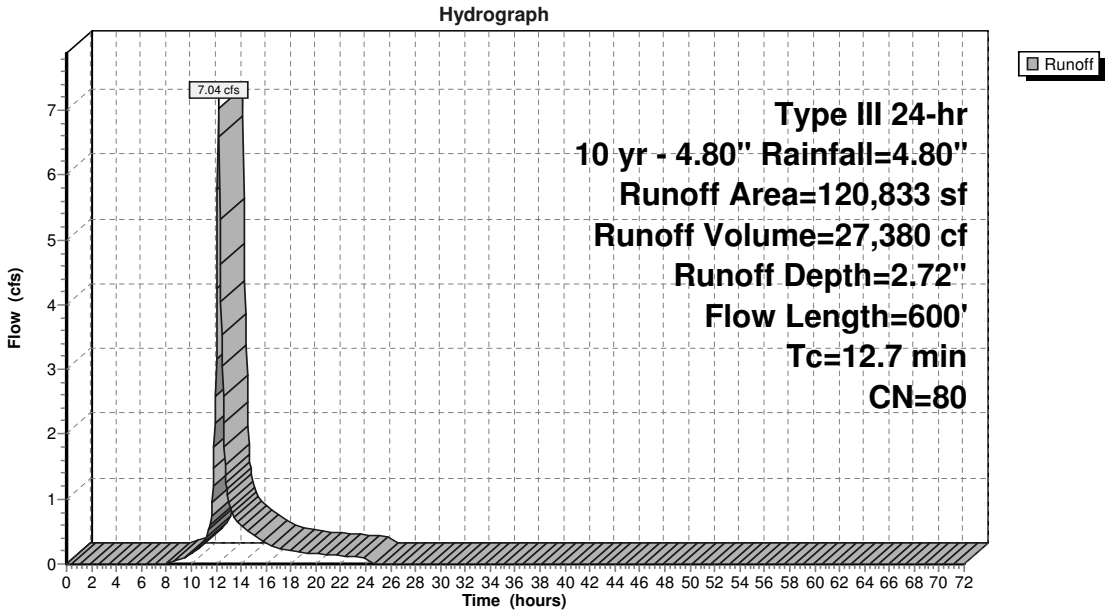
Runoff = 7.04 cfs @ 12.18 hrs, Volume= 27,380 cf, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
*	12,140	98	Road
*	6,595	98	Drives
*	11,166	98	Roofs
	19,454	73	Woods, Fair, HSG C
	54,858	74	>75% Grass cover, Good, HSG C
	16,620	74	>75% Grass cover, Good, HSG C
	120,833	80	Weighted Average
	90,932		75.25% Pervious Area
	29,901		24.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.6	200	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.9	350	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
12.7	600	Total			

Subcatchment 8S: Post Dev



Summary for Subcatchment 9S: Post Dev

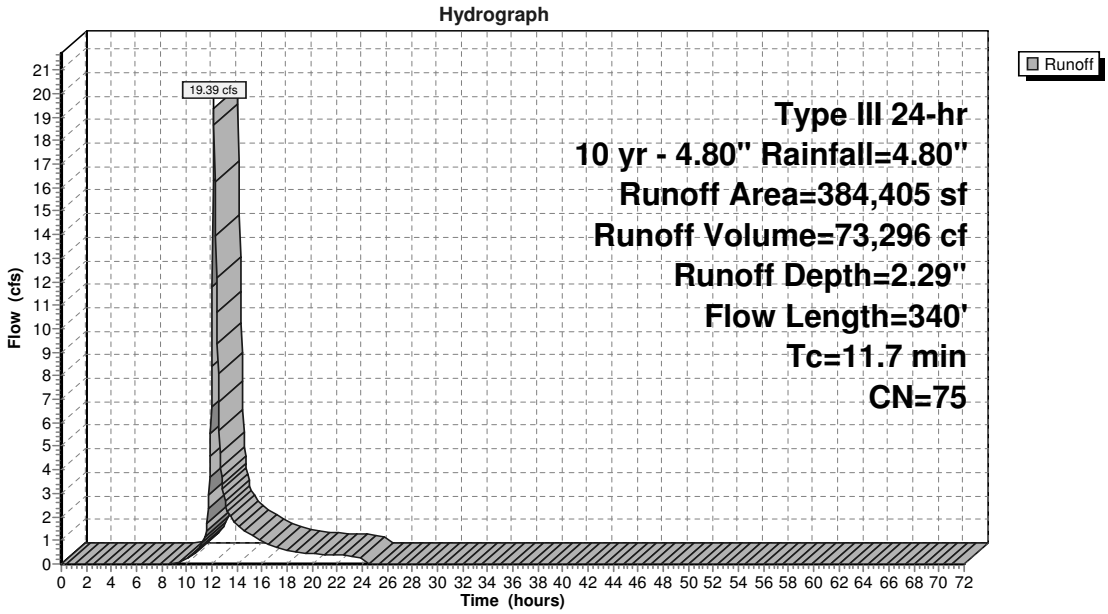
Runoff = 19.39 cfs @ 12.17 hrs, Volume= 73,296 cf, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
*	39,480	98	Road
*	21,444	98	Drives
*	38,845	98	Roofs
	57,414	39	>75% Grass cover, Good, HSG A
	194,109	74	>75% Grass cover, Good, HSG C
	33,113	73	Woods, Fair, HSG C
	384,405	75	Weighted Average
	284,636		74.05% Pervious Area
	99,769		25.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.4	150	0.0150	1.84		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.1	140	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.7	340	Total			

Subcatchment 9S: Post Dev



Summary for Subcatchment 10S: Post Dev

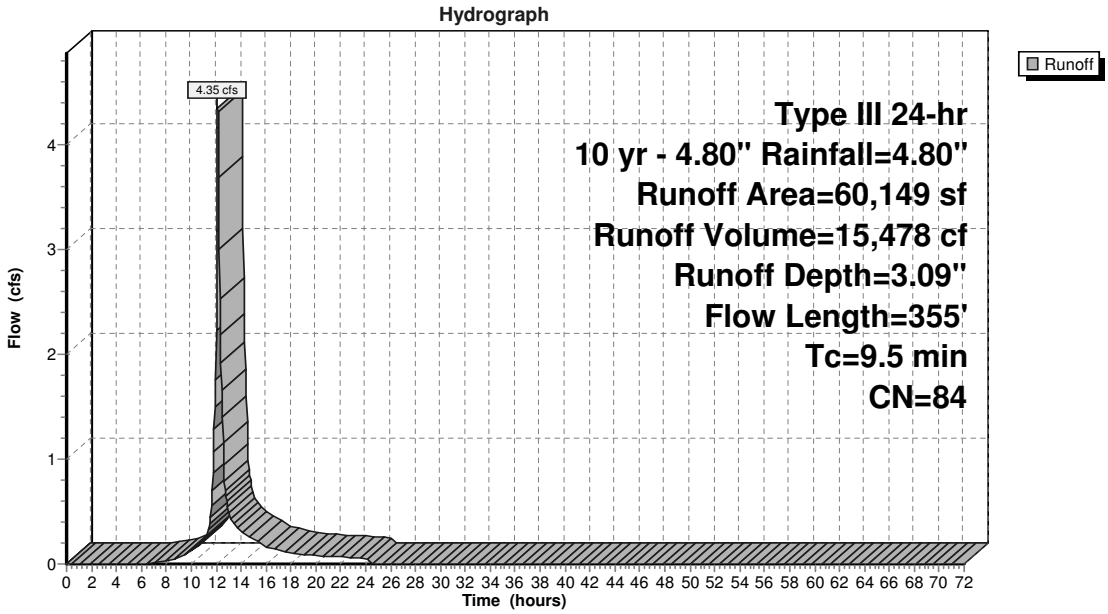
Runoff = 4.35 cfs @ 12.14 hrs, Volume= 15,478 cf, Depth= 3.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
*	12,584	98	Road
*	4,570	98	Drives
*	4,665	98	Roofs
	12,147	80	>75% Grass cover, Good, HSG D
	26,183	74	>75% Grass cover, Good, HSG C
	60,149	84	Weighted Average
	38,330		63.73% Pervious Area
	21,819		36.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.2	25	0.0200	2.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.1	280	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.5	355	Total			

Subcatchment 10S: Post Dev



Summary for Subcatchment 11S: Post Dev

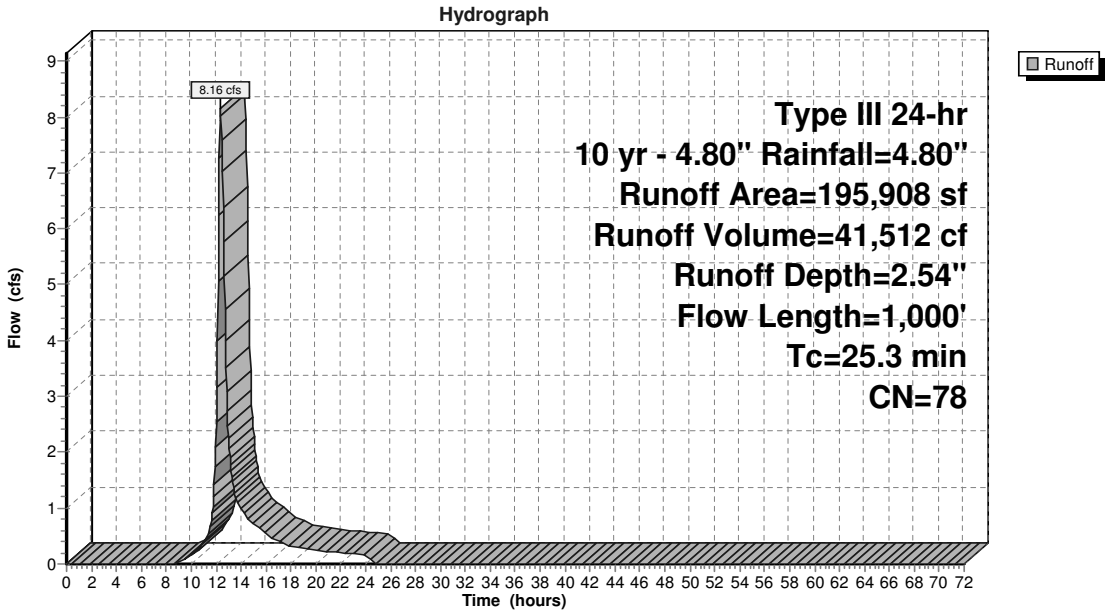
Runoff = 8.16 cfs @ 12.36 hrs, Volume= 41,512 cf, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
*	3,584	98	Road
*	9,873	98	Roofs
	20,413	73	Woods, Fair, HSG C
	19,040	79	Woods, Fair, HSG D
	70,498	74	>75% Grass cover, Good, HSG C
	8,004	80	>75% Grass cover, Good, HSG D
*	64,496	78	Wetlands
	195,908	78	Weighted Average
	182,451		93.13% Pervious Area
	13,457		6.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.8	100	0.0200	2.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
15.3	650	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.0	200	0.0150	3.19	12.78	**Channel Flow,** Area= 4.0 sf Perim= 6.8' r= 0.59' n= 0.040 Mountain streams
25.3	1,000	Total			

Subcatchment 11S: Post Dev



Summary for Subcatchment 12S: Post Dev

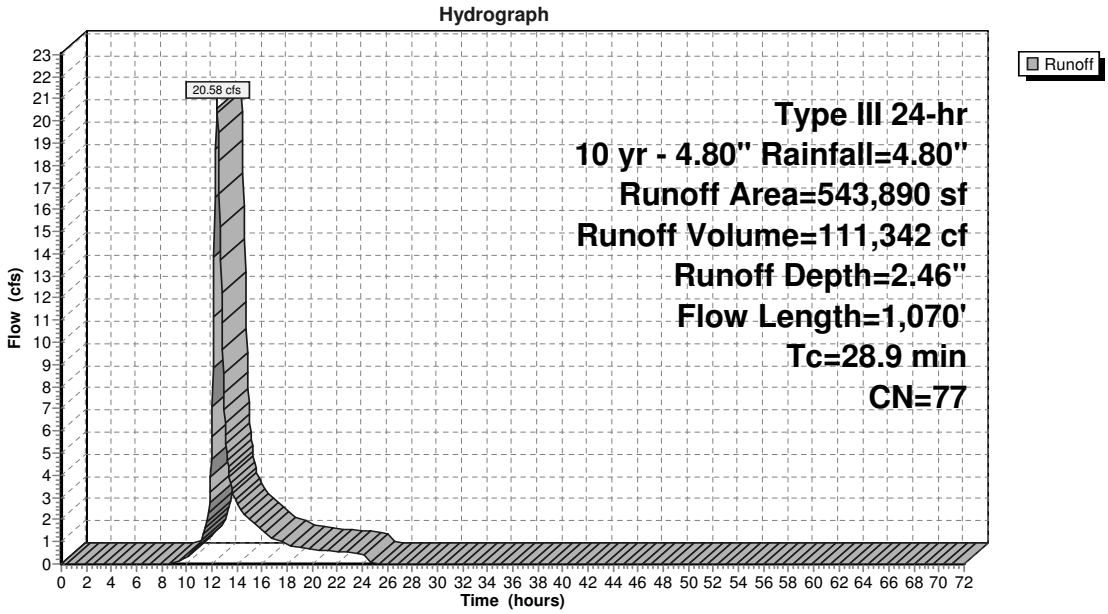
Runoff = 20.58 cfs @ 12.41 hrs, Volume= 111,342 cf, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
*	10,801	98	Paved
*	6,530	98	Roof
	35,887	60	Woods, Fair, HSG B
	9,984	61	>75% Grass cover, Good, HSG B
	52,770	74	>75% Grass cover, Good, HSG C
	15,275	80	>75% Grass cover, Good, HSG D
	51,310	79	Woods, Fair, HSG D
	40,779	73	Woods, Fair, HSG C
*	320,554	78	Wetlands
	543,890	77	Weighted Average
	526,559		96.81% Pervious Area
	17,331		3.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	50	0.0350	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
19.0	1,020	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
28.9	1,070	Total			

Subcatchment 12S: Post Dev



Summary for Subcatchment 13S: Post Dev

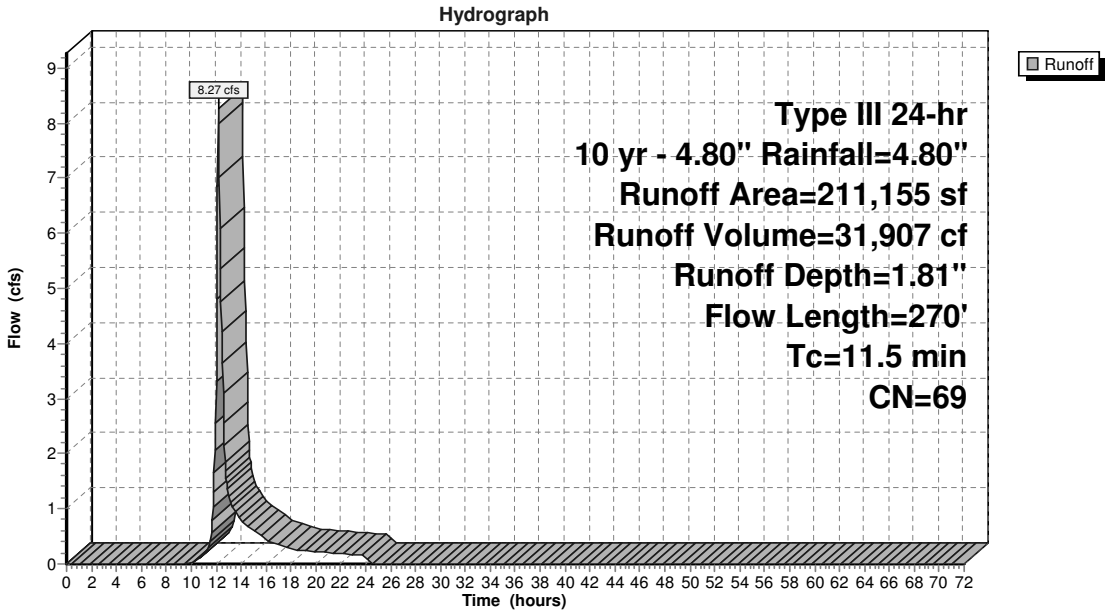
Runoff = 8.27 cfs @ 12.17 hrs, Volume= 31,907 cf, Depth= 1.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
*	3,805	98	Roofs
	17,106	36	Woods, Fair, HSG A
	7,569	60	Woods, Fair, HSG B
	11,993	73	Woods, Fair, HSG C
	34,942	79	Woods, Fair, HSG D
	14,634	39	>75% Grass cover, Good, HSG A
	20,863	61	>75% Grass cover, Good, HSG B
	25,669	74	>75% Grass cover, Good, HSG C
	4,934	80	>75% Grass cover, Good, HSG D
*	69,640	78	Wetlands
	211,155	69	Weighted Average
	207,350		98.20% Pervious Area
	3,805		1.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
3.3	220	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.5	270	Total			

Subcatchment 13S: Post Dev



Summary for Subcatchment 14S: Post Dev

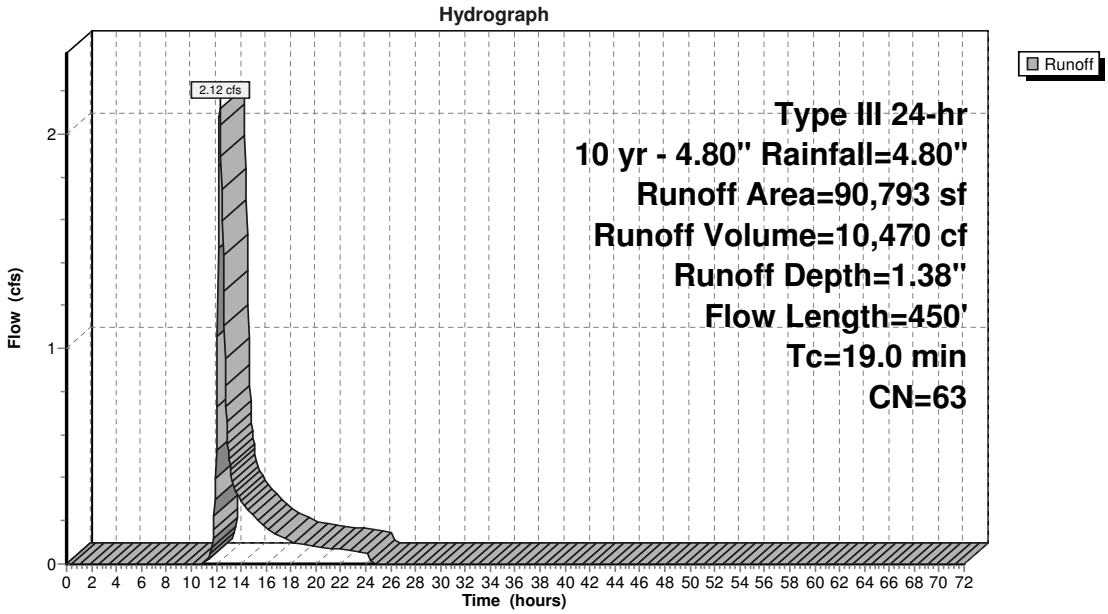
Runoff = 2.12 cfs @ 12.29 hrs, Volume= 10,470 cf, Depth= 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
	12,475	39	>75% Grass cover, Good, HSG A
	15,110	61	>75% Grass cover, Good, HSG B
	6,750	74	>75% Grass cover, Good, HSG C
	8,310	36	Woods, Fair, HSG A
	12,274	60	Woods, Fair, HSG B
	3,580	73	Woods, Fair, HSG C
*	32,294	78	Wetlands
	90,793	63	Weighted Average
	90,793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
6.7	400	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
19.0	450	Total			

Subcatchment 14S: Post Dev



Summary for Subcatchment 15S: Post Dev

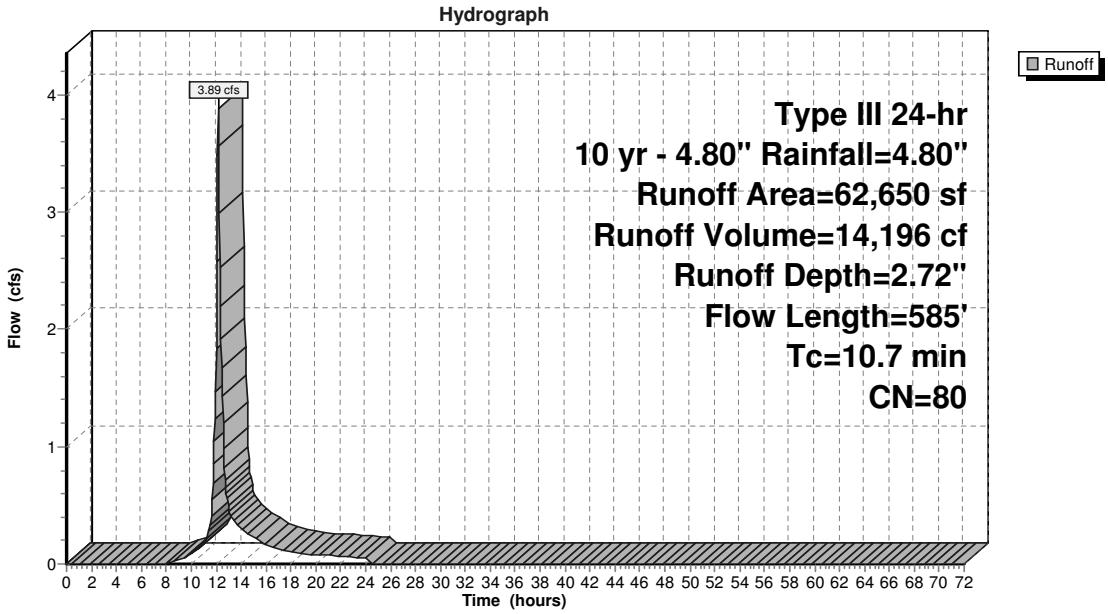
Runoff = 3.89 cfs @ 12.15 hrs, Volume= 14,196 cf, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
*	34,455	98	Pavement
*	4,599	98	Walks
	12,433	39	>75% Grass cover, Good, HSG A
	11,163	61	>75% Grass cover, Good, HSG B
	62,650	80	Weighted Average
	23,596		37.66% Pervious Area
	39,054		62.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	35	0.0200	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.7	450	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.7	585	Total			

Subcatchment 15S: Post Dev



Summary for Subcatchment 16S: Post Dev

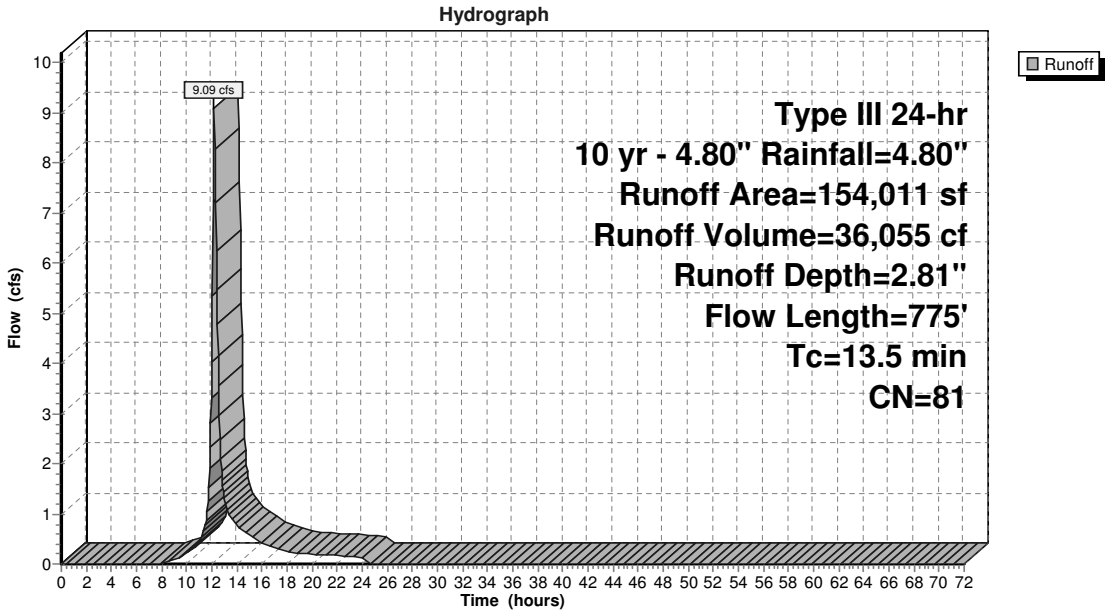
Runoff = 9.09 cfs @ 12.19 hrs, Volume= 36,055 cf, Depth= 2.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

	Area (sf)	CN	Description
*	48,668	98	Pavement
*	16,480	98	Roof
	17,110	39	>75% Grass cover, Good, HSG A
	39,096	74	>75% Grass cover, Good, HSG C
	27,277	80	>75% Grass cover, Good, HSG D
	5,380	73	Woods, Fair, HSG C
	154,011	81	Weighted Average
	88,863		57.70% Pervious Area
	65,148		42.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.4	250	0.0220	3.01		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.9	475	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.5	775	Total			

Subcatchment 16S: Post Dev



Summary for Subcatchment 17S: Building #1

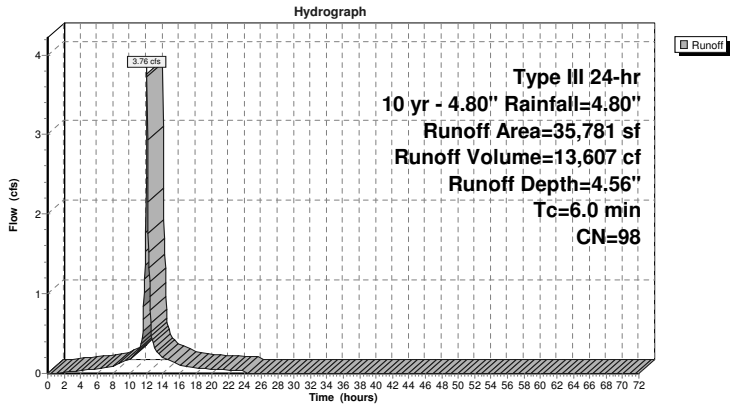
Runoff = 3.76 cfs @ 12.09 hrs, Volume= 13,607 cf, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr - 4.80" Rainfall=4.80"

Area (sf)	CN	Description
35,781	98	Roofs, HSG C
35,781		100.00% Impervious Area

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

Subcatchment 17S: Building #1



Summary for Reach 1R: Int Stream

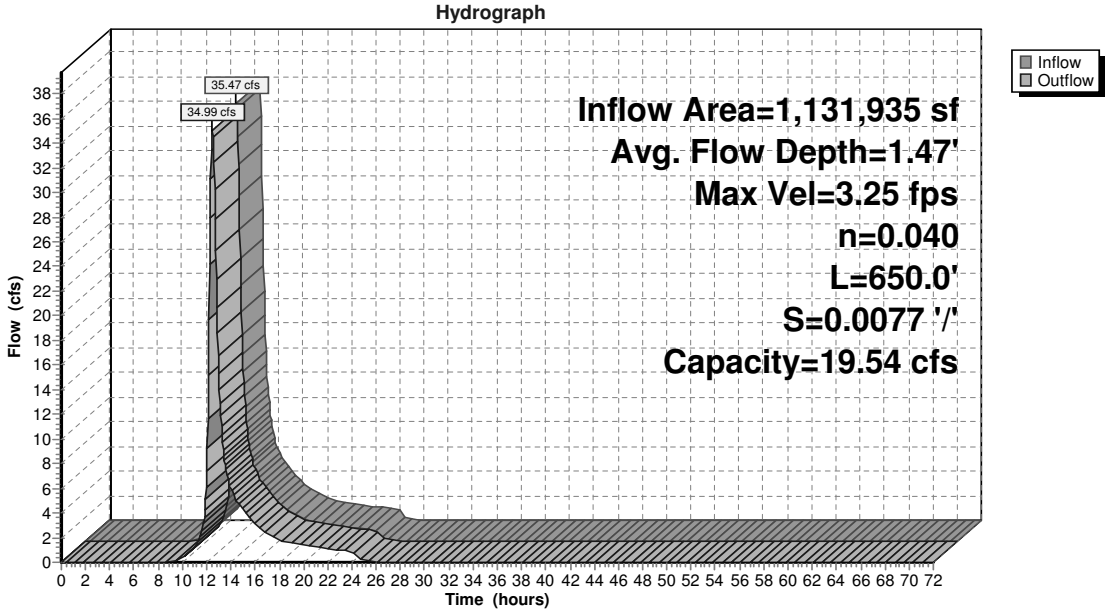
Inflow Area = 1,131,935 sf, 7.63% Impervious, Inflow Depth = 2.22" for 10 yr - 4.80" event
Inflow = 35.47 cfs @ 12.38 hrs, Volume= 209,504 cf
Outflow = 34.99 cfs @ 12.49 hrs, Volume= 209,504 cf, Atten= 1%, Lag= 6.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.25 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 0.85 fps, Avg. Travel Time= 12.8 min

Peak Storage= 6,995 cf @ 12.43 hrs
Average Depth at Peak Storage= 1.47'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 19.54 cfs

6.00' x 1.00' deep channel, n= 0.040 Mountain streams
Side Slope Z-value= 1.0 '/' Top Width= 8.00'
Length= 650.0' Slope= 0.0077 '/'
Inlet Invert= 394.00', Outlet Invert= 389.00'

Reach 1R: Int Stream



Summary for Pond 1P: Det Pond #1

Inflow Area =	95,376 sf, 29.37% Impervious, Inflow Depth = 2.90" for 10 yr - 4.80" event				
Inflow =	6.40 cfs @	12.14 hrs, Volume=	23,056 cf		
Outflow =	0.94 cfs @	12.81 hrs, Volume=	23,054 cf, Atten= 85%, Lag= 39.7 min		
Discarded =	0.14 cfs @	12.81 hrs, Volume=	15,924 cf		
Primary =	0.80 cfs @	12.81 hrs, Volume=	7,130 cf		

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 402.40' @ 12.81 hrs Surf.Area= 6,263 sf Storage= 12,113 cf

Plug-Flow detention time= 661.3 min calculated for 23,038 cf (100% of inflow)
Center-of-Mass det. time= 662.7 min (1,484.5 - 821.8)

Volume	Invert	Avail.Storage	Storage Description
#1	399.00'	23,858 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
399.00	364	96.0	0	0	364
400.00	2,650	302.0	1,332	1,332	6,891
401.50	5,070	454.0	5,693	7,025	16,053
402.00	5,780	456.0	2,711	9,735	16,323
404.00	8,426	454.0	14,123	23,858	17,245

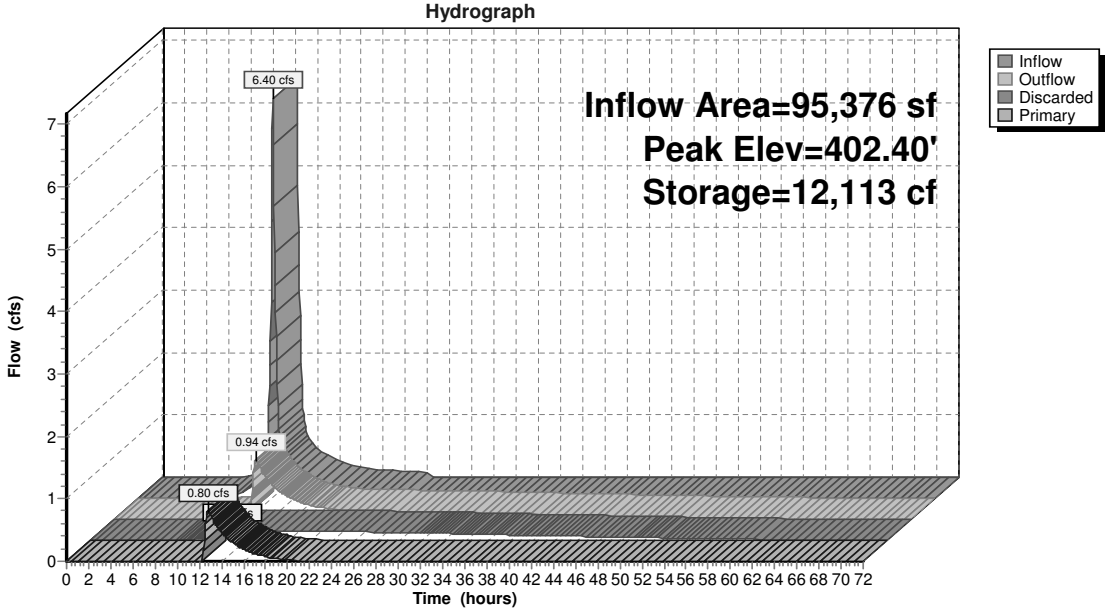
Device	Routing	Invert	Outlet Devices
#1	Discarded	399.00'	**0.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 394.80'
#2	Primary	402.00'	**18.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 402.00' / 398.50' S= 0.1400 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Discarded OutFlow Max=0.14 cfs @ 12.81 hrs HW=402.39' (Free Discharge)
└**1=Exfiltration** (Controls 0.14 cfs)

Primary OutFlow Max=0.80 cfs @ 12.81 hrs HW=402.39' (Free Discharge)
└**2=Culvert** (Inlet Controls 0.80 cfs @ 2.14 fps)

Pond 1P: Det Pond #1

Hydrograph



Summary for Pond 2P: Det Pond #2

Inflow Area = 154,011 sf, 42.30% Impervious, Inflow Depth = 2.81" for 10 yr - 4.80" event
Inflow = 9.09 cfs @ 12.19 hrs, Volume= 36,055 cf
Outflow = 2.68 cfs @ 12.63 hrs, Volume= 36,055 cf, Atten= 71%, Lag= 26.4 min
Discarded = 0.57 cfs @ 12.63 hrs, Volume= 16,240 cf
Primary = 2.11 cfs @ 12.63 hrs, Volume= 19,815 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 401.90' @ 12.63 hrs Surf.Area= 7,780 sf Storage= 13,452 cf

Plug-Flow detention time= 113.0 min calculated for 36,030 cf (100% of inflow)
Center-of-Mass det. time= 113.2 min (941.0 - 827.8)

Volume	Invert	Avail.Storage	Storage Description
#1	398.00'	35,756 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

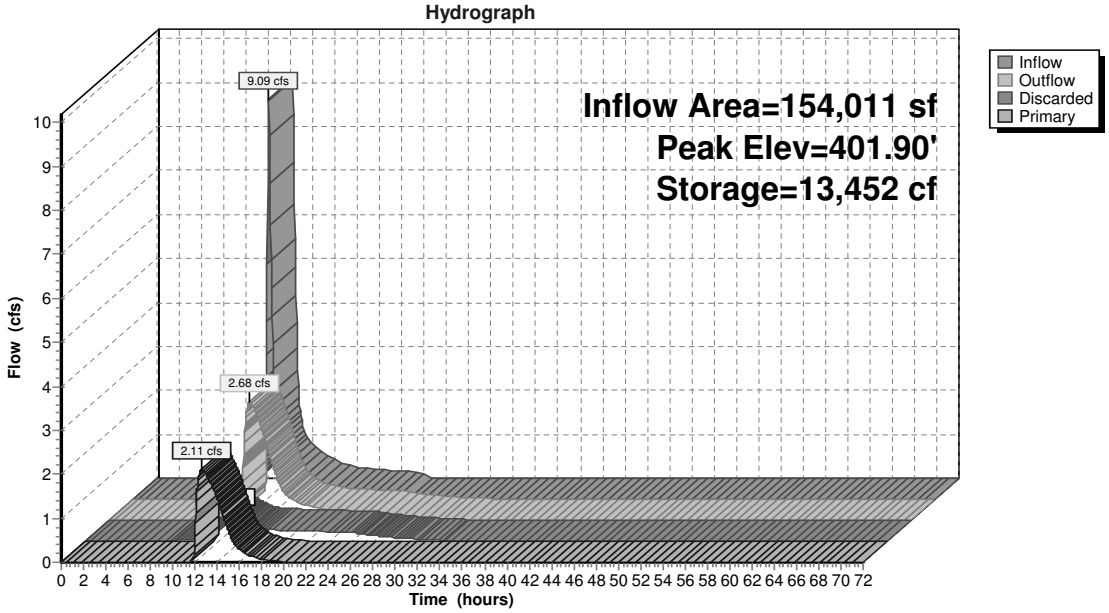
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
398.00	283	84.0	0	0	283
399.00	1,340	176.0	746	746	2,191
400.00	3,441	271.0	2,309	3,056	5,578
402.00	8,049	401.0	11,169	14,224	12,562
404.00	13,735	491.0	21,532	35,756	19,012

Device	Routing	Invert	Outlet Devices
#1	Discarded	398.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 394.00'
#2	Primary	400.00'	**8.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 400.00' / 394.00' S= 0.1500 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf

Discarded OutFlow Max=0.57 cfs @ 12.63 hrs HW=401.90' (Free Discharge)
└**1=Exfiltration** (Controls 0.57 cfs)

Primary OutFlow Max=2.10 cfs @ 12.63 hrs HW=401.90' (Free Discharge)
└**2=Culvert** (Inlet Controls 2.10 cfs @ 6.03 fps)

Pond 2P: Det Pond #2



Summary for Pond 3P: Det Pond#3

Inflow Area = 60,149 sf, 36.27% Impervious, Inflow Depth = 3.09" for 10 yr - 4.80" event
Inflow = 4.35 cfs @ 12.14 hrs, Volume= 15,478 cf
Outflow = 0.69 cfs @ 12.71 hrs, Volume= 12,919 cf, Atten= 84%, Lag= 34.7 min
Discarded = 0.04 cfs @ 12.71 hrs, Volume= 5,653 cf
Primary = 0.65 cfs @ 12.71 hrs, Volume= 7,266 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 406.40' @ 12.71 hrs Surf.Area= 5,621 sf Storage= 8,354 cf

Plug-Flow detention time= 766.8 min calculated for 12,910 cf (83% of inflow)
Center-of-Mass det. time= 700.2 min (1,515.6 - 815.4)

Volume	Invert	Avail.Storage	Storage Description
#1	404.00'	19,828 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
404.00	815	180.0	0	0	815
405.00	3,663	255.0	2,069	2,069	3,420
406.00	4,741	281.0	4,190	6,259	4,561
407.00	7,050	450.0	5,857	12,116	14,399
408.00	8,392	470.0	7,711	19,828	15,934

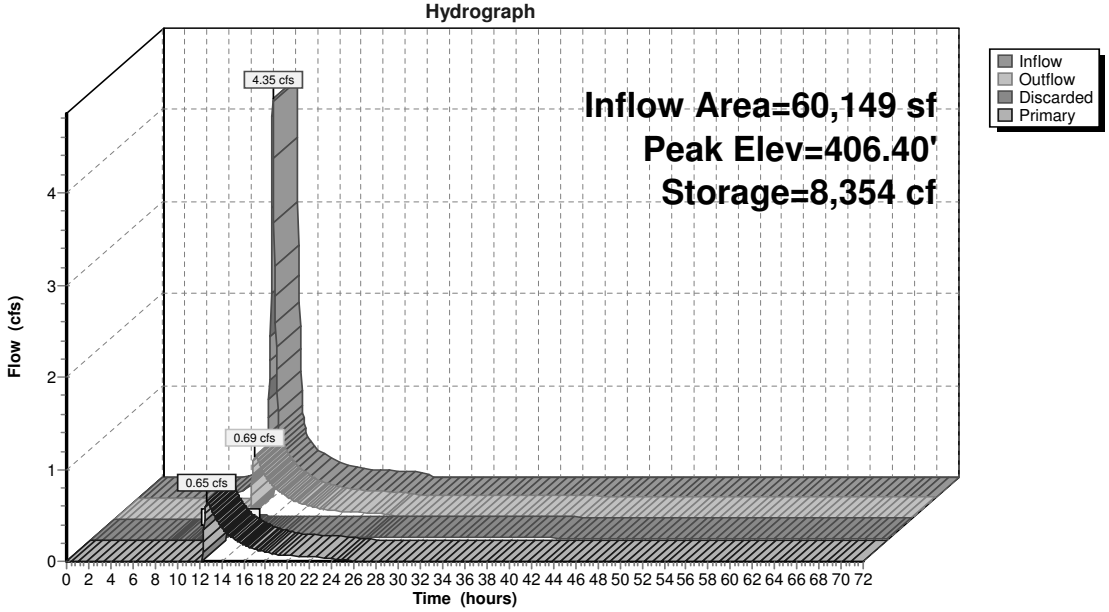
Device	Routing	Invert	Outlet Devices
#1	Discarded	404.00'	**0.170 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 402.00'
#2	Primary	406.00'	**12.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 406.00' / 402.50' S= 0.1400 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Discarded OutFlow Max=0.04 cfs @ 12.71 hrs HW=406.40' (Free Discharge)
└**1=Exfiltration** (Controls 0.04 cfs)

Primary OutFlow Max=0.65 cfs @ 12.71 hrs HW=406.40' (Free Discharge)
└**2=Culvert** (Inlet Controls 0.65 cfs @ 2.17 fps)

Pond 3P: Det Pond#3

Hydrograph



Summary for Pond 4P: Det Pond #4

Inflow Area =	120,833 sf,	24.75% Impervious,	Inflow Depth =	2.72"	for 10 yr - 4.80" event
Inflow =	7.04 cfs @	12.18 hrs, Volume=	27,380 cf		
Outflow =	2.27 cfs @	12.59 hrs, Volume=	24,482 cf,	Atten= 68%,	Lag= 24.8 min
Discarded =	0.05 cfs @	12.59 hrs, Volume=	7,006 cf		
Primary =	2.22 cfs @	12.59 hrs, Volume=	17,476 cf		

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 402.24' @ 12.59 hrs Surf.Area= 7,097 sf Storage= 12,223 cf

Plug-Flow detention time= 531.5 min calculated for 24,465 cf (89% of inflow)
Center-of-Mass det. time= 482.6 min (1,312.4 - 829.8)

Volume	Invert	Avail.Storage	Storage Description
#1	400.00'	28,626 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

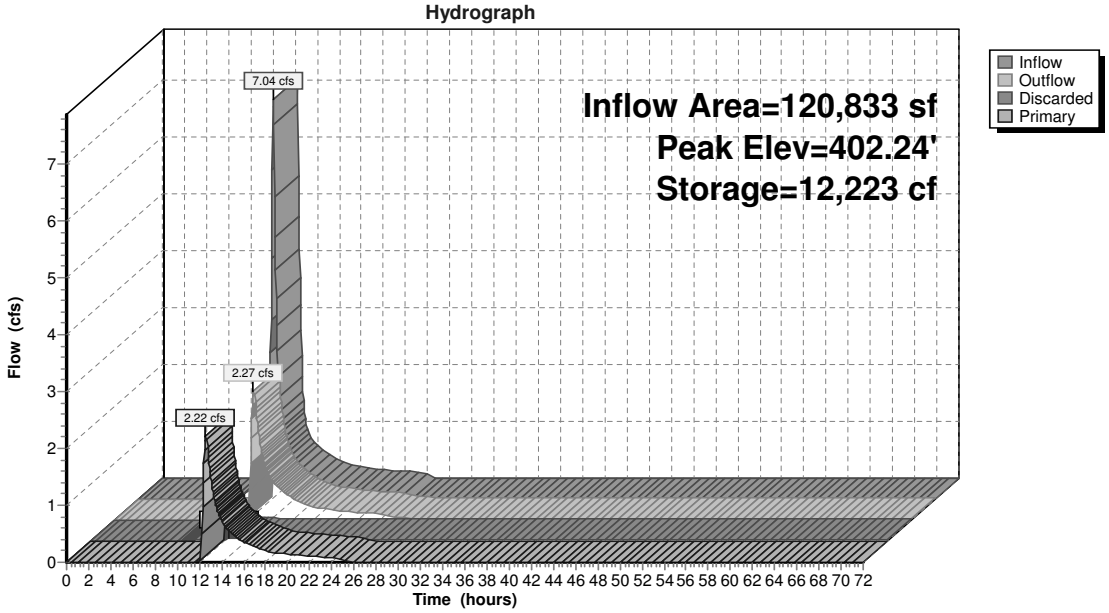
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
400.00	4,196	306.0	0	0	4,196
402.00	6,479	349.0	10,593	10,593	6,531
403.00	9,236	539.0	7,817	18,410	19,965
404.00	11,230	578.0	10,217	28,626	23,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	400.00'	**0.170 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 397.50'
#2	Primary	401.50'	**15.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 401.50' / 397.50' S= 0.1600 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Discarded OutFlow Max=0.05 cfs @ 12.59 hrs HW=402.24' (Free Discharge)
└─**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=2.21 cfs @ 12.59 hrs HW=402.24' (Free Discharge)
└─**2=Culvert** (Inlet Controls 2.21 cfs @ 2.93 fps)

Pond 4P: Det Pond #4



Summary for Pond 5P: Det Pond #5

Inflow Area = 384,405 sf, 25.95% Impervious, Inflow Depth = 2.29" for 10 yr - 4.80" event
Inflow = 19.39 cfs @ 12.17 hrs, Volume= 73,296 cf
Outflow = 8.26 cfs @ 12.50 hrs, Volume= 73,296 cf, Atten= 57%, Lag= 19.7 min
Discarded = 0.97 cfs @ 12.50 hrs, Volume= 31,946 cf
Primary = 7.30 cfs @ 12.50 hrs, Volume= 41,350 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 396.90' @ 12.50 hrs Surf.Area= 11,289 sf Storage= 23,055 cf

Plug-Flow detention time= 98.4 min calculated for 73,245 cf (100% of inflow)
Center-of-Mass det. time= 98.5 min (940.6 - 842.1)

Volume	Invert	Avail.Storage	Storage Description
#1	394.00'	51,928 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

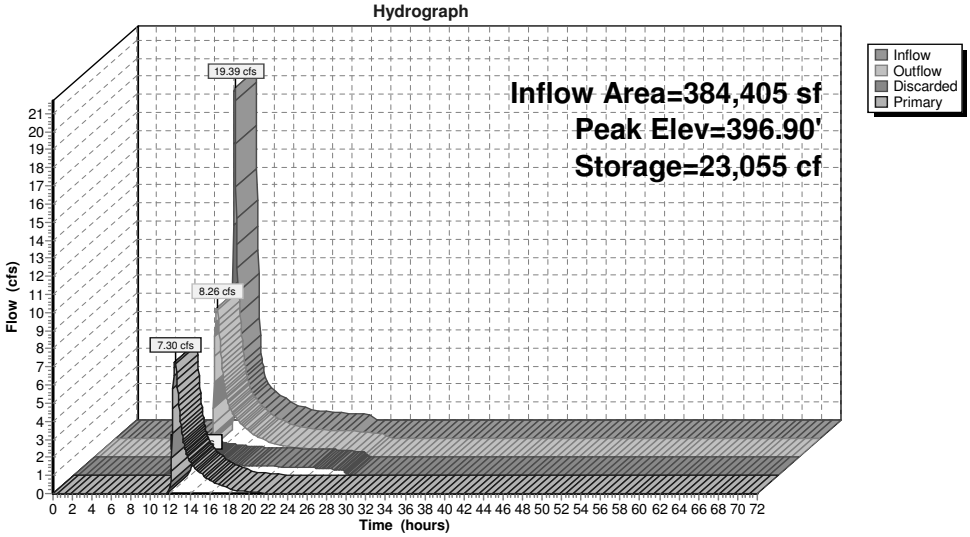
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
394.00	4,910	333.0	0	0	4,910
396.00	9,160	429.0	13,851	13,851	10,781
398.00	14,180	514.0	23,158	37,009	17,229
399.00	15,670	533.0	14,919	51,928	18,896

Device	Routing	Invert	Outlet Devices
#1	Discarded	394.00'	**2.410 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 390.50'
#2	Primary	393.50'	**24.0" Round Culvert** L= 30.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 393.50' / 392.50' S= 0.0333 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#3	Device 2	394.90'	**6.0" W x 36.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 2	396.00'	**12.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.97 cfs @ 12.50 hrs HW=396.90' (Free Discharge)
└**1=Exfiltration** (Controls 0.97 cfs)

Primary OutFlow Max=7.29 cfs @ 12.50 hrs HW=396.90' (Free Discharge)
└**2=Culvert** (Passes 7.29 cfs of 23.44 cfs potential flow)
├**3=Orifice/Grate** (Orifice Controls 4.54 cfs @ 4.54 fps)
└**4=Orifice/Grate** (Orifice Controls 2.75 cfs @ 3.05 fps)

Pond 5P: Det Pond #5



Summary for Pond 6P: Det Pond #6

Inflow Area = 98,431 sf, 76.03% Impervious, Inflow Depth = 3.39" for 10 yr - 4.80" event
Inflow = 7.26 cfs @ 12.11 hrs, Volume= 27,803 cf
Outflow = 3.99 cfs @ 12.31 hrs, Volume= 27,803 cf, Atten= 45%, Lag= 11.8 min
Discarded = 1.42 cfs @ 12.31 hrs, Volume= 20,572 cf
Primary = 2.57 cfs @ 12.31 hrs, Volume= 7,232 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 396.87' @ 12.31 hrs Surf.Area= 3,569 sf Storage= 5,729 cf

Plug-Flow detention time= 26.6 min calculated for 27,784 cf (100% of inflow)
Center-of-Mass det. time= 26.6 min (815.7 - 789.2)

Volume	Invert	Avail.Storage	Storage Description
#1	394.00'	16,799 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

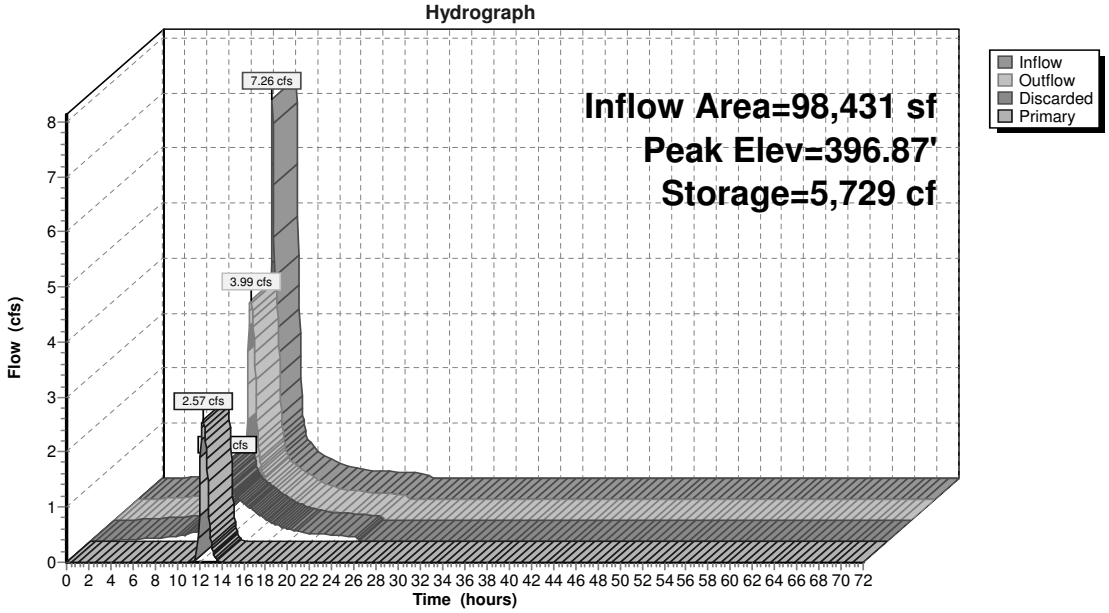
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
394.00	598	106.0	0	0	598
396.00	2,661	225.0	3,014	3,014	3,750
398.00	4,932	299.0	7,477	10,491	6,880
399.00	7,793	364.0	6,308	16,799	10,325

Device	Routing	Invert	Outlet Devices
#1	Discarded	394.00'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 391.50'
#2	Primary	395.50'	**10.0" Round Culvert** L= 30.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 395.50' / 393.00' S= 0.0833 '/' Cc= 0.900 n= 0.013, Flow Area= 0.55 sf

Discarded OutFlow Max=1.42 cfs @ 12.31 hrs HW=396.87' (Free Discharge)
└**1=Exfiltration** (Controls 1.42 cfs)

Primary OutFlow Max=2.57 cfs @ 12.31 hrs HW=396.87' (Free Discharge)
└**2=Culvert** (Inlet Controls 2.57 cfs @ 4.71 fps)

Pond 6P: Det Pond #6

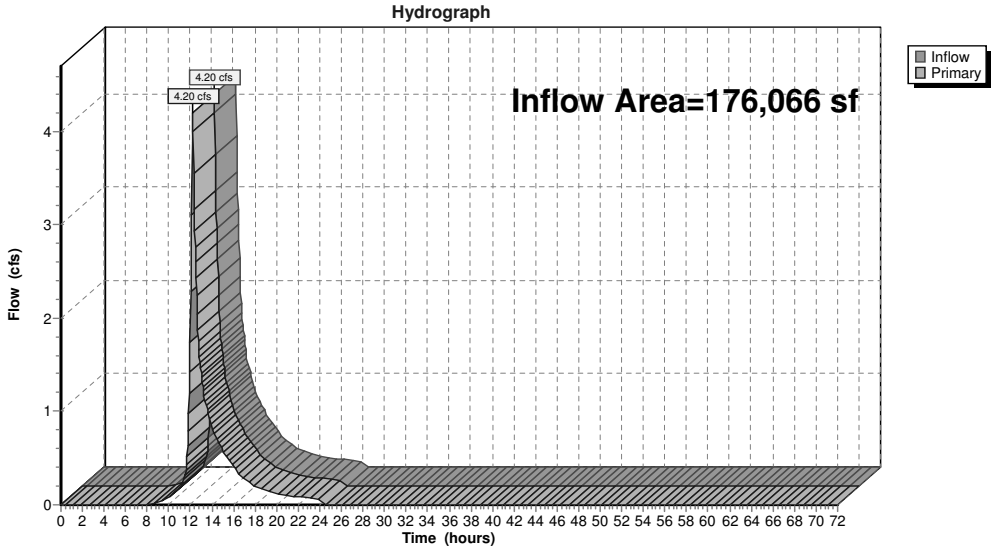


Summary for Link DP-1: DP#1

Inflow Area = 176,066 sf, 19.14% Impervious, Inflow Depth = 1.65" for 10 yr - 4.80" event
Inflow = 4.20 cfs @ 12.21 hrs, Volume= 24,228 cf
Primary = 4.20 cfs @ 12.21 hrs, Volume= 24,228 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-1: DP#1

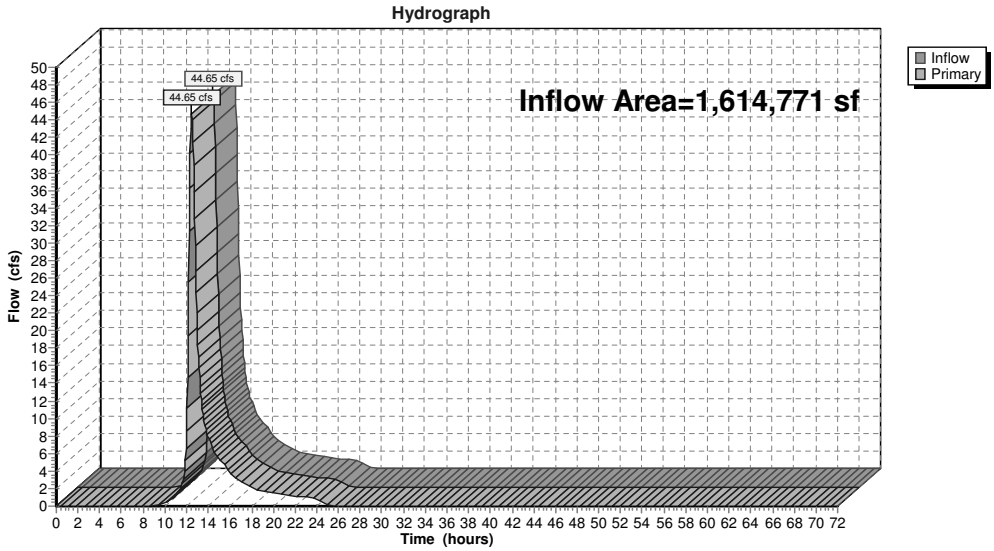


Summary for Link DP-2: DP#2

Inflow Area = 1,614,771 sf, 16.16% Impervious, Inflow Depth = 1.92" for 10 yr - 4.80" event
Inflow = 44.65 cfs @ 12.48 hrs, Volume= 258,086 cf
Primary = 44.65 cfs @ 12.48 hrs, Volume= 258,086 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-2: DP#2

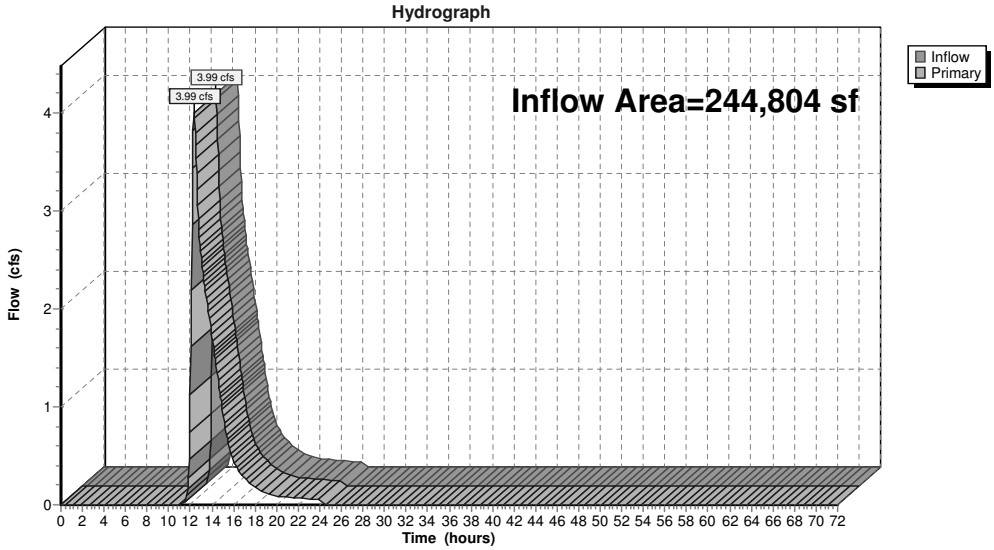


Summary for Link DP-3: DP-3

Inflow Area = 244,804 sf, 26.61% Impervious, Inflow Depth = 1.48" for 10 yr - 4.80" event
Inflow = 3.99 cfs @ 12.33 hrs, Volume= 30,285 cf
Primary = 3.99 cfs @ 12.33 hrs, Volume= 30,285 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-3: DP-3

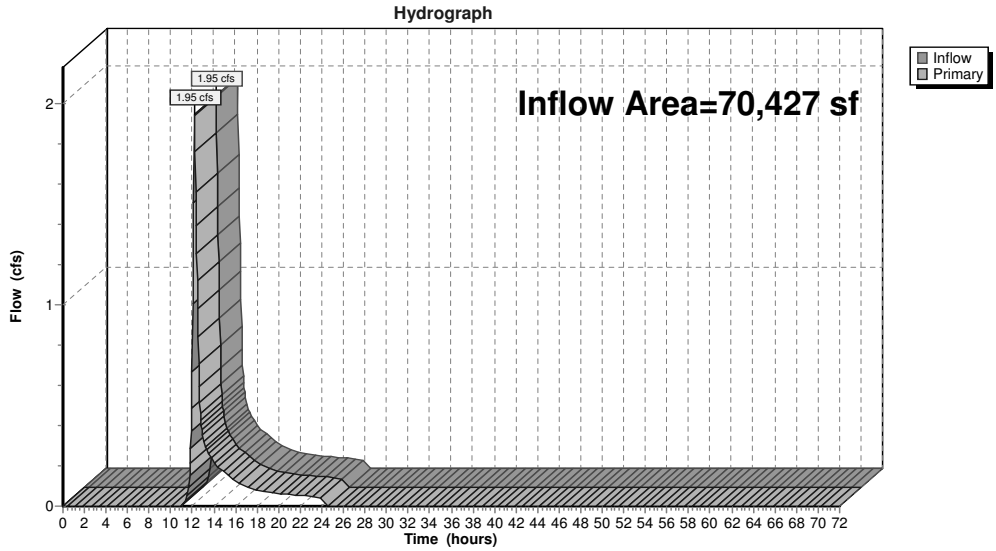


Summary for Link DP-4: DP#4

Inflow Area = 70,427 sf, 3.92% Impervious, Inflow Depth = 1.38" for 10 yr - 4.80" event
Inflow = 1.95 cfs @ 12.19 hrs, Volume= 8,121 cf
Primary = 1.95 cfs @ 12.19 hrs, Volume= 8,121 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-4: DP#4



Summary for Subcatchment 1S: Pre-Dev 1S

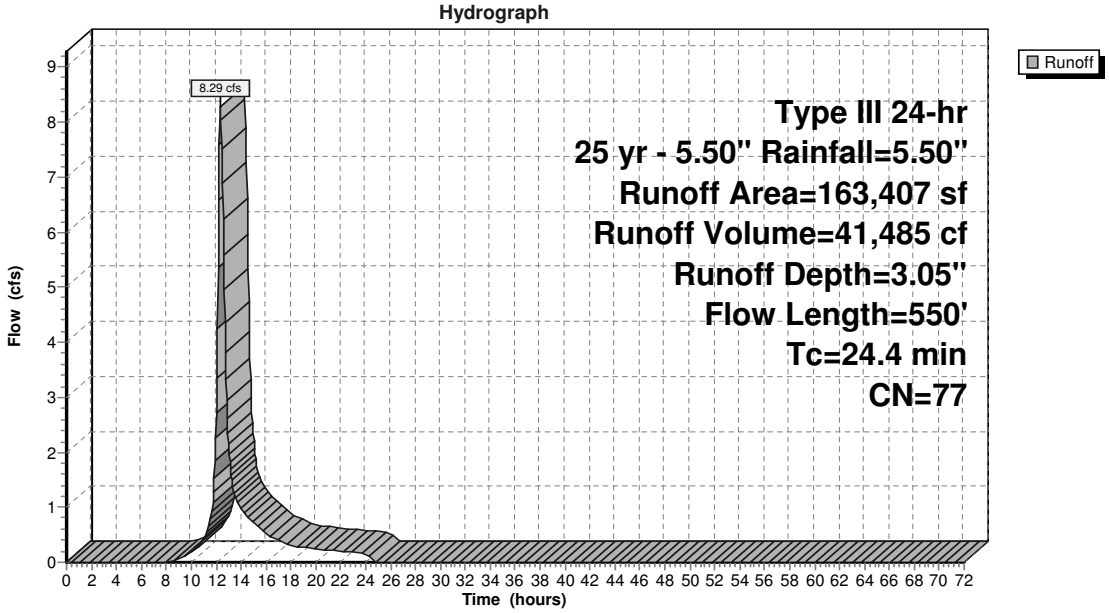
Runoff = 8.29 cfs @ 12.34 hrs, Volume= 41,485 cf, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
	6,616	98	Paved parking, HSG C
	59,968	73	Woods, Fair, HSG C
	48,086	79	Woods, Fair, HSG D
*	48,737	78	Wetlands
	163,407	77	Weighted Average
	156,791		95.95% Pervious Area
	6,616		4.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	50	0.0120	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
9.3	500	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
24.4	550	Total			

Subcatchment 1S: Pre-Dev 1S



Summary for Subcatchment 2S: Pre-Dev 2S

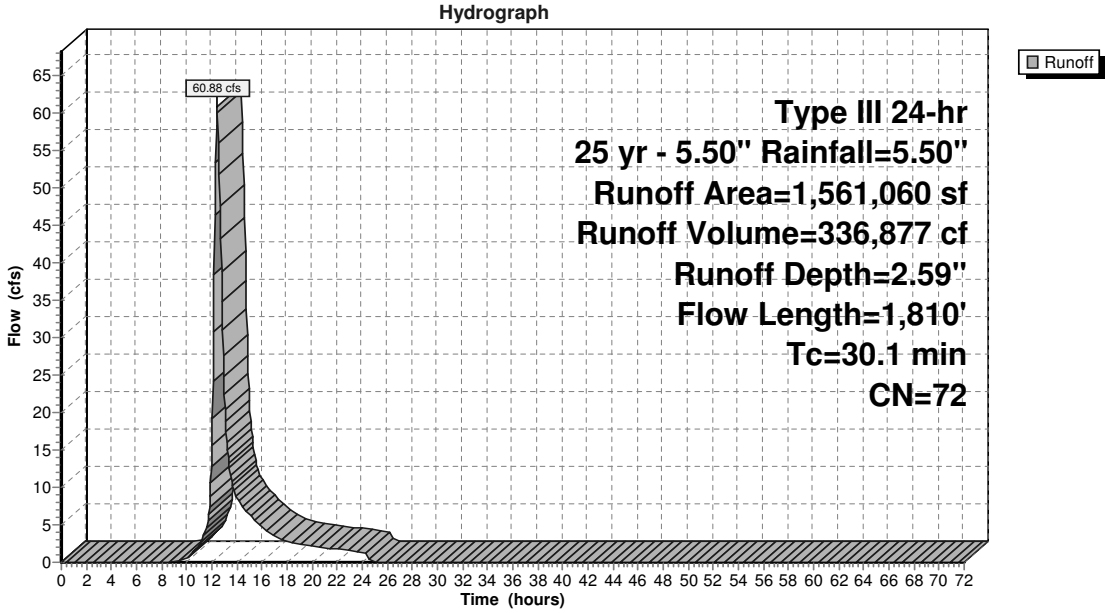
Runoff = 60.88 cfs @ 12.43 hrs, Volume= 336,877 cf, Depth= 2.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
	12,734	98	Paved parking, HSG C
	103,393	36	Woods, Fair, HSG A
	175,914	79	Woods, Fair, HSG D
	93,562	60	Woods, Fair, HSG B
	720,766	73	Woods, Fair, HSG C
*	454,691	78	Wetlands
	1,561,060	72	Weighted Average
	1,548,326		99.18% Pervious Area
	12,734		0.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0370	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
16.9	950	0.0350	0.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.6	810	0.0100	3.74	7.49	**Channel Flow,** Area= 2.0 sf Perim= 4.0' r= 0.50' n= 0.025 Earth, clean & winding
30.1	1,810	Total			

Subcatchment 2S: Pre-Dev 2S



Summary for Subcatchment 3S: Pre Dev 3S

Runoff = 7.80 cfs @ 12.32 hrs, Volume= 38,806 cf, Depth= 1.91"

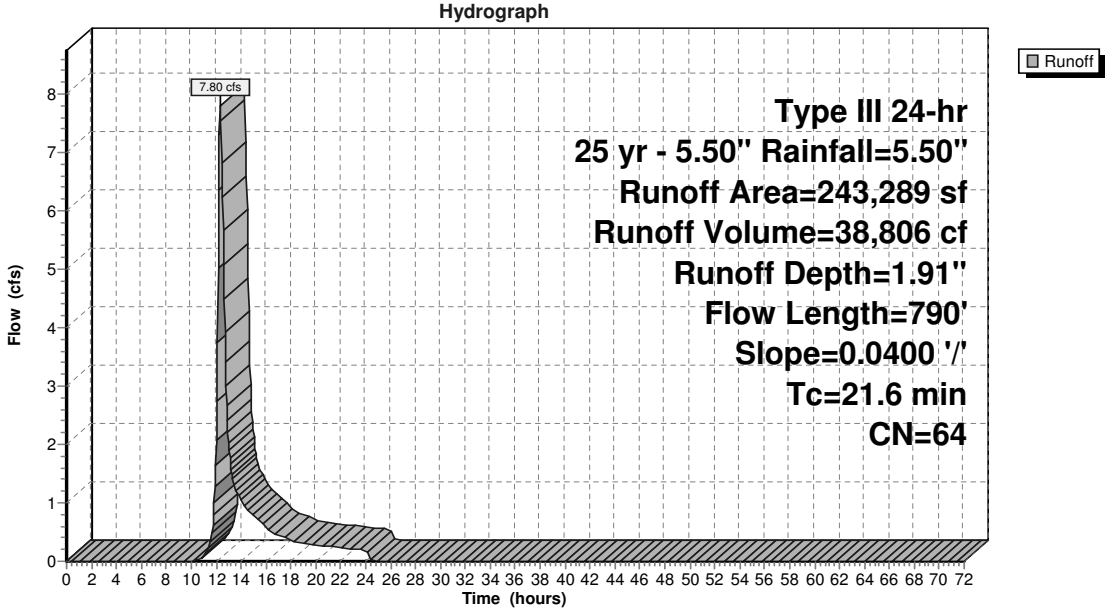
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
	37,431	36	Woods, Fair, HSG A
	74,966	60	Woods, Fair, HSG B
	98,598	73	Woods, Fair, HSG C
*	32,294	78	Wetlands
	243,289	64	Weighted Average
	243,289		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
12.3	740	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
21.6	790	Total			

Subcatchment 3S: Pre Dev 3S

Hydrograph



Summary for Subcatchment 4S: Pre Dev 4S

Runoff = 3.98 cfs @ 12.28 hrs, Volume= 19,343 cf, Depth= 1.60"

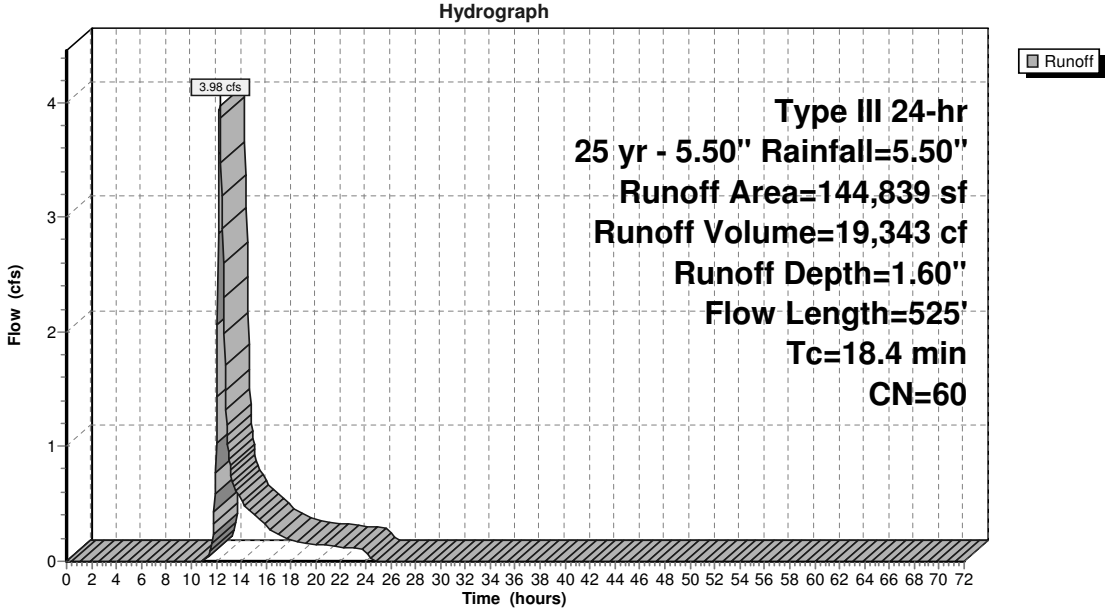
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

Area (sf)	CN	Description
51,728	36	Woods, Fair, HSG A
93,111	73	Woods, Fair, HSG C
144,839	60	Weighted Average
144,839		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow, 4-1** Woods: Light underbrush n= 0.400 P2= 3.20"
7.9	475	0.0400	1.00		**Shallow Concentrated Flow, 4-2** Woodland Kv= 5.0 fps
18.4	525	Total			

Subcatchment 4S: Pre Dev 4S

Hydrograph



Summary for Subcatchment 5S: Post Dev

Runoff = 2.67 cfs @ 12.18 hrs, Volume= 10,767 cf, Depth= 1.83"

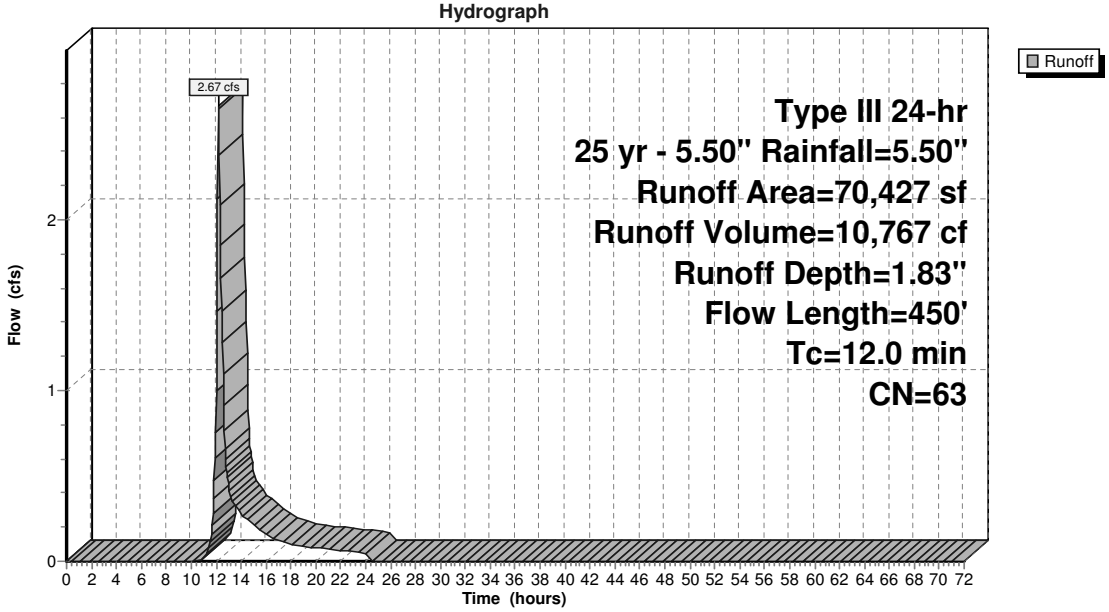
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
*	2,760	98	Roofs,
	11,100	36	Woods, Fair, HSG A
	11,852	39	>75% Grass cover, Good, HSG A
	13,834	74	>75% Grass cover, Good, HSG C
	30,881	73	Woods, Fair, HSG C
	70,427	63	Weighted Average
	67,667		96.08% Pervious Area
	2,760		3.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	50	0.0350	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.1	400	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	450	Total			

Subcatchment 5S: Post Dev

Hydrograph



Summary for Subcatchment 6S: Post Dev

Runoff = 5.19 cfs @ 12.20 hrs, Volume= 21,121 cf, Depth= 3.14"

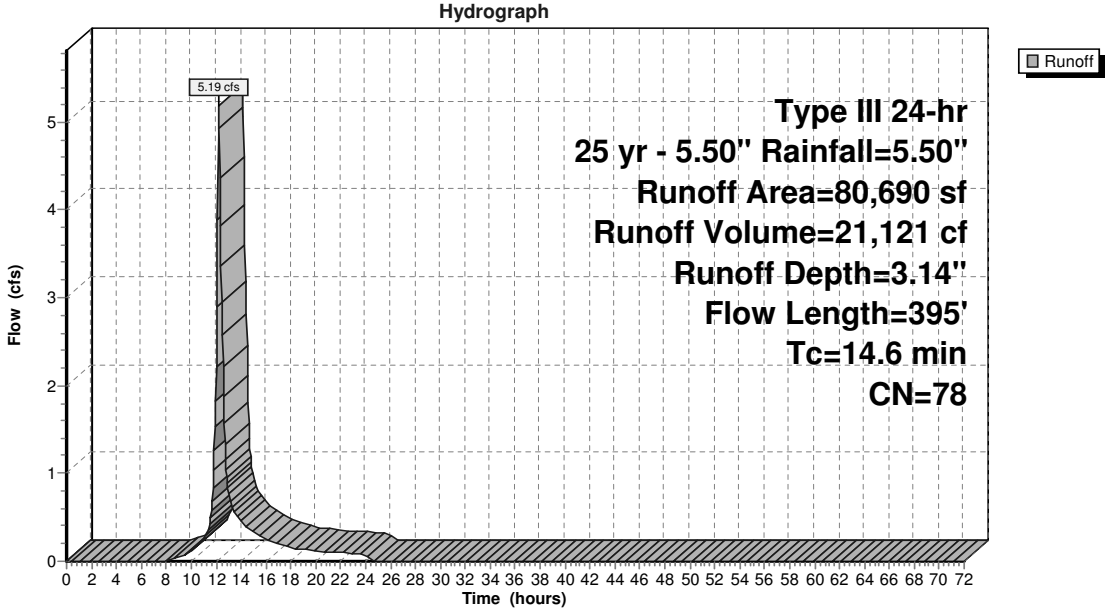
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
	4,155	98	Paved roads w/curbs & sewers, HSG C
	1,530	98	Roofs, HSG C
	21,839	74	>75% Grass cover, Good, HSG C
	4,429	73	Woods, Fair, HSG C
*	48,737	78	Wetlands
	80,690	78	Weighted Average
	75,005		92.95% Pervious Area
	5,685		7.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
6.4	345	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.6	395	Total			

Subcatchment 6S: Post Dev

Hydrograph



Summary for Subcatchment 7S: Post Dev

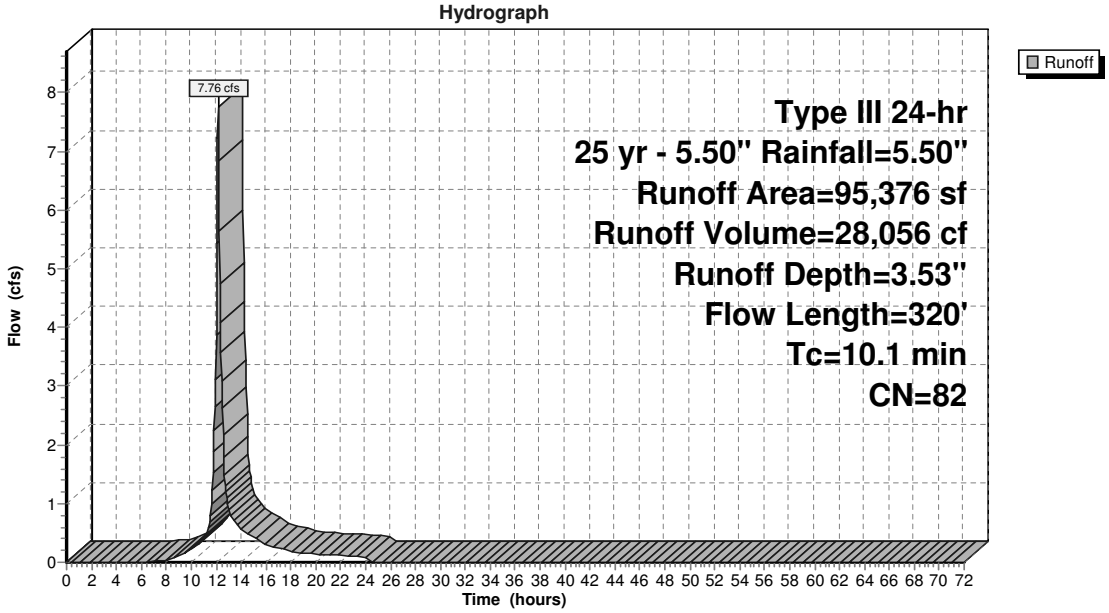
Runoff = 7.76 cfs @ 12.14 hrs, Volume= 28,056 cf, Depth= 3.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
*	9,688	98	Roofs
*	6,758	98	Drives
*	11,562	98	Road
	4,360	73	Woods, Fair, HSG C
	18,385	80	>75% Grass cover, Good, HSG D
	44,623	74	>75% Grass cover, Good, HSG C
	95,376	82	Weighted Average
	67,368		70.63% Pervious Area
	28,008		29.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	110	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.3	160	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.1	320	Total			

Subcatchment 7S: Post Dev



Summary for Subcatchment 8S: Post Dev

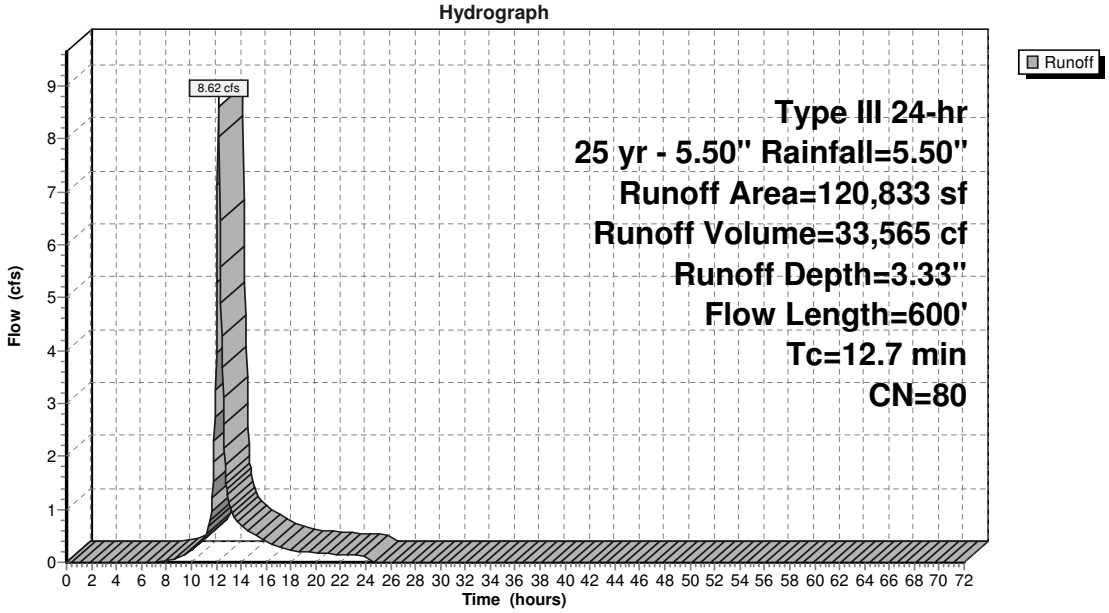
Runoff = 8.62 cfs @ 12.18 hrs, Volume= 33,565 cf, Depth= 3.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
*	12,140	98	Road
*	6,595	98	Drives
*	11,166	98	Roofs
	19,454	73	Woods, Fair, HSG C
	54,858	74	>75% Grass cover, Good, HSG C
	16,620	74	>75% Grass cover, Good, HSG C
	120,833	80	Weighted Average
	90,932		75.25% Pervious Area
	29,901		24.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.6	200	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.9	350	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
12.7	600	Total			

Subcatchment 8S: Post Dev



Summary for Subcatchment 9S: Post Dev

Runoff = 24.35 cfs @ 12.17 hrs, Volume= 91,634 cf, Depth= 2.86"

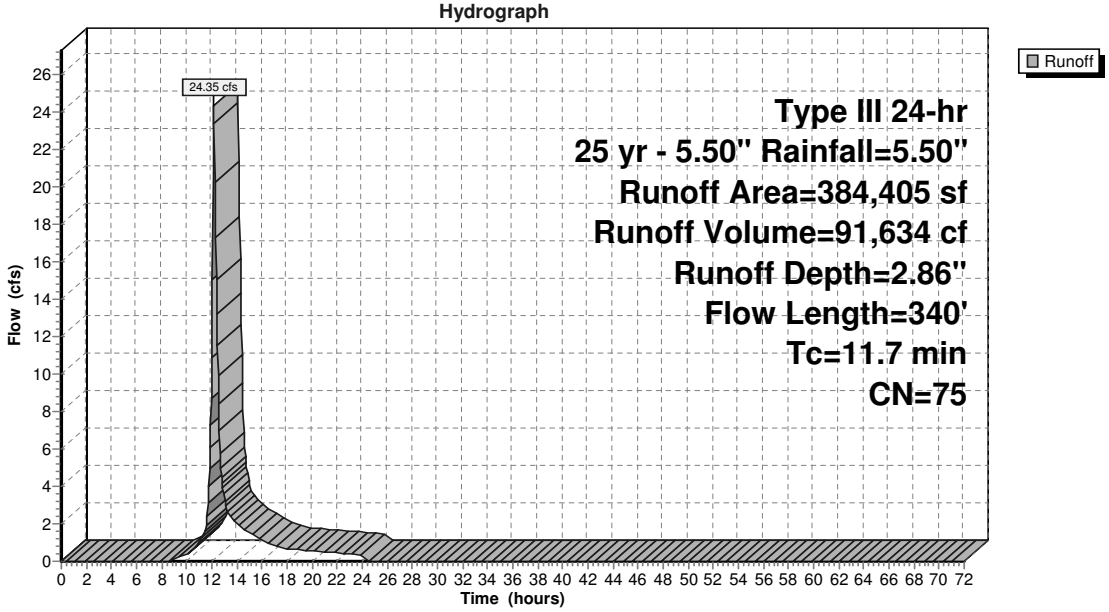
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
*	39,480	98	Road
*	21,444	98	Drives
*	38,845	98	Roofs
	57,414	39	>75% Grass cover, Good, HSG A
	194,109	74	>75% Grass cover, Good, HSG C
	33,113	73	Woods, Fair, HSG C
	384,405	75	Weighted Average
	284,636		74.05% Pervious Area
	99,769		25.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.4	150	0.0150	1.84		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.1	140	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.7	340	Total			

Subcatchment 9S: Post Dev

Hydrograph



Summary for Subcatchment 10S: Post Dev

Runoff = 5.22 cfs @ 12.13 hrs, Volume= 18,700 cf, Depth= 3.73"

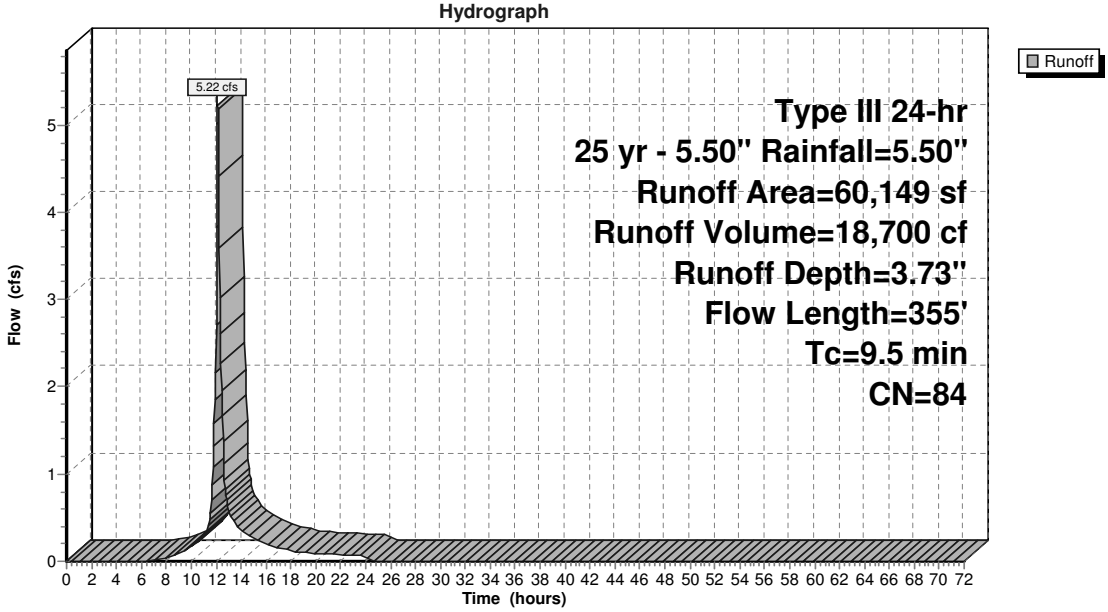
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
*	12,584	98	Road
*	4,570	98	Drives
*	4,665	98	Roofs
	12,147	80	>75% Grass cover, Good, HSG D
	26,183	74	>75% Grass cover, Good, HSG C
	60,149	84	Weighted Average
	38,330		63.73% Pervious Area
	21,819		36.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.2	25	0.0200	2.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.1	280	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.5	355	Total			

Subcatchment 10S: Post Dev

Hydrograph



Summary for Subcatchment 11S: Post Dev

Runoff = 10.09 cfs @ 12.35 hrs, Volume= 51,279 cf, Depth= 3.14"

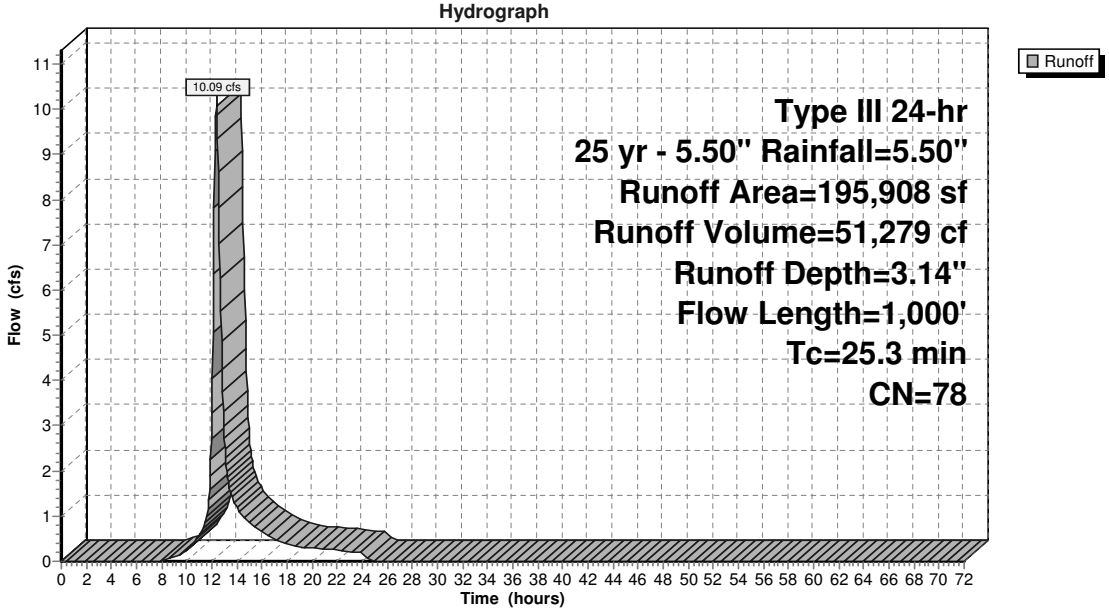
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
*	3,584	98	Road
*	9,873	98	Roofs
	20,413	73	Woods, Fair, HSG C
	19,040	79	Woods, Fair, HSG D
	70,498	74	>75% Grass cover, Good, HSG C
	8,004	80	>75% Grass cover, Good, HSG D
*	64,496	78	Wetlands
	195,908	78	Weighted Average
	182,451		93.13% Pervious Area
	13,457		6.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.8	100	0.0200	2.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
15.3	650	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.0	200	0.0150	3.19	12.78	**Channel Flow,** Area= 4.0 sf Perim= 6.8' r= 0.59' n= 0.040 Mountain streams
25.3	1,000	Total			

Subcatchment 11S: Post Dev

Hydrograph



Summary for Subcatchment 12S: Post Dev

Runoff = 25.58 cfs @ 12.40 hrs, Volume= 138,079 cf, Depth= 3.05"

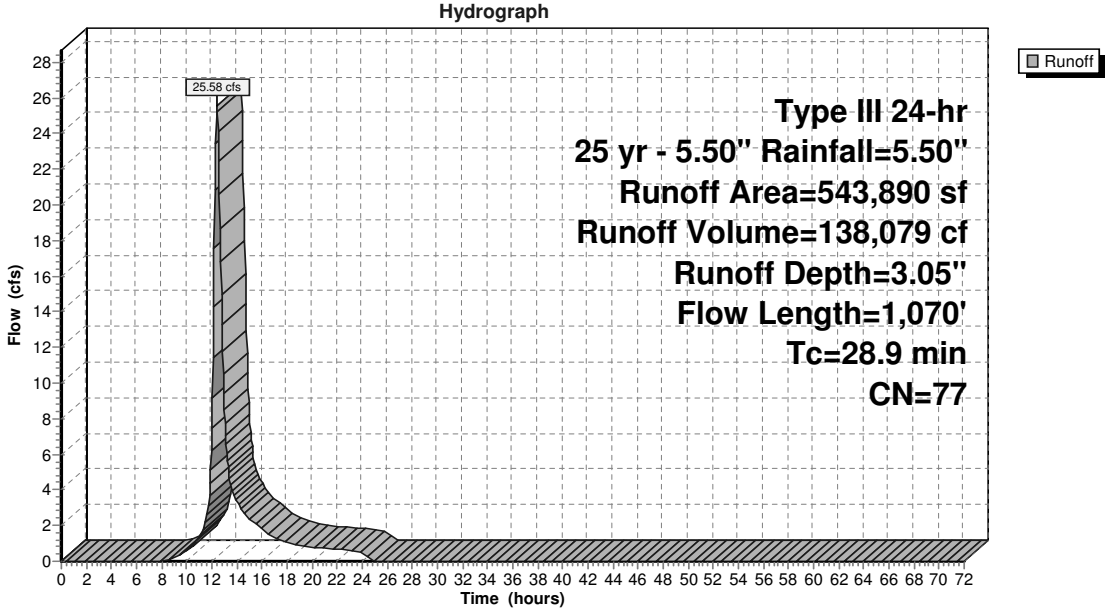
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
*	10,801	98	Paved
*	6,530	98	Roof
	35,887	60	Woods, Fair, HSG B
	9,984	61	>75% Grass cover, Good, HSG B
	52,770	74	>75% Grass cover, Good, HSG C
	15,275	80	>75% Grass cover, Good, HSG D
	51,310	79	Woods, Fair, HSG D
	40,779	73	Woods, Fair, HSG C
*	320,554	78	Wetlands
	543,890	77	Weighted Average
	526,559		96.81% Pervious Area
	17,331		3.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	50	0.0350	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
19.0	1,020	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
28.9	1,070	Total			

Subcatchment 12S: Post Dev

Hydrograph



Summary for Subcatchment 13S: Post Dev

Runoff = 10.78 cfs @ 12.17 hrs, Volume= 40,968 cf, Depth= 2.33"

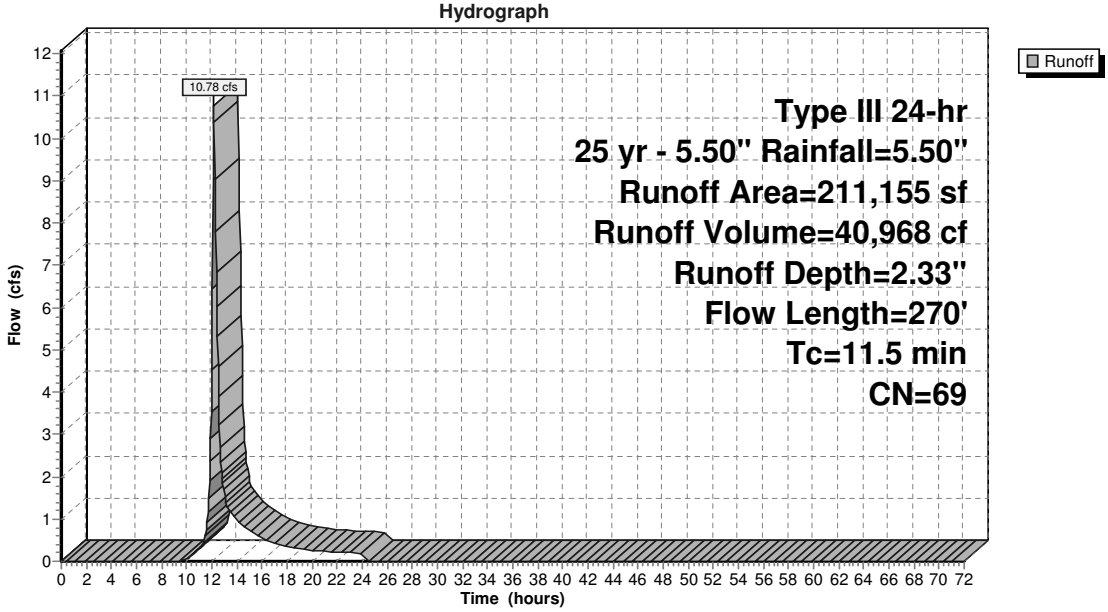
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
*	3,805	98	Roofs
	17,106	36	Woods, Fair, HSG A
	7,569	60	Woods, Fair, HSG B
	11,993	73	Woods, Fair, HSG C
	34,942	79	Woods, Fair, HSG D
	14,634	39	>75% Grass cover, Good, HSG A
	20,863	61	>75% Grass cover, Good, HSG B
	25,669	74	>75% Grass cover, Good, HSG C
	4,934	80	>75% Grass cover, Good, HSG D
*	69,640	78	Wetlands
	211,155	69	Weighted Average
	207,350		98.20% Pervious Area
	3,805		1.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
3.3	220	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.5	270	Total			

Subcatchment 13S: Post Dev

Hydrograph



Summary for Subcatchment 14S: Post Dev

Runoff = 2.91 cfs @ 12.28 hrs, Volume= 13,880 cf, Depth= 1.83"

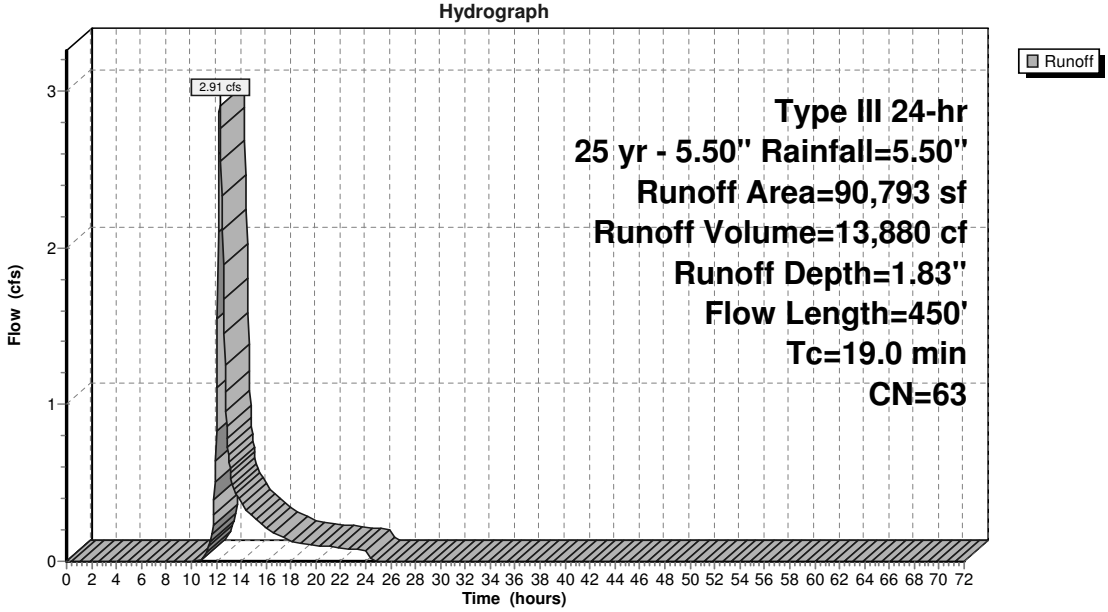
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
	12,475	39	>75% Grass cover, Good, HSG A
	15,110	61	>75% Grass cover, Good, HSG B
	6,750	74	>75% Grass cover, Good, HSG C
	8,310	36	Woods, Fair, HSG A
	12,274	60	Woods, Fair, HSG B
	3,580	73	Woods, Fair, HSG C
*	32,294	78	Wetlands
	90,793	63	Weighted Average
	90,793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
6.7	400	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
19.0	450	Total			

Subcatchment 14S: Post Dev

Hydrograph



Summary for Subcatchment 15S: Post Dev

Runoff = 4.76 cfs @ 12.15 hrs, Volume= 17,403 cf, Depth= 3.33"

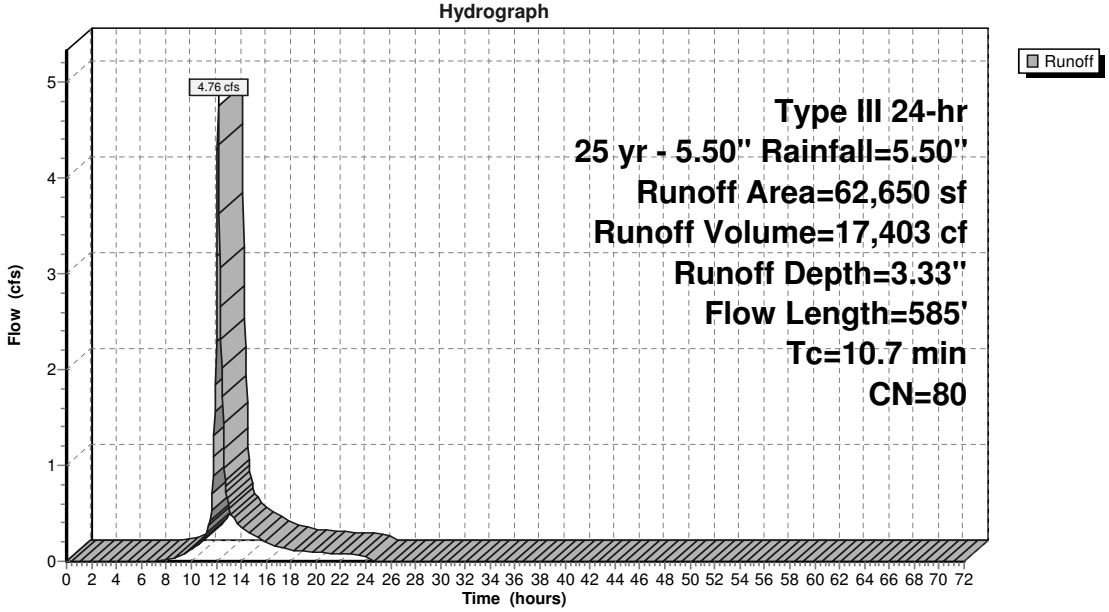
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
*	34,455	98	Pavement
*	4,599	98	Walks
	12,433	39	>75% Grass cover, Good, HSG A
	11,163	61	>75% Grass cover, Good, HSG B
	62,650	80	Weighted Average
	23,596		37.66% Pervious Area
	39,054		62.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	35	0.0200	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.7	450	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.7	585	Total			

Subcatchment 15S: Post Dev

Hydrograph



Summary for Subcatchment 16S: Post Dev

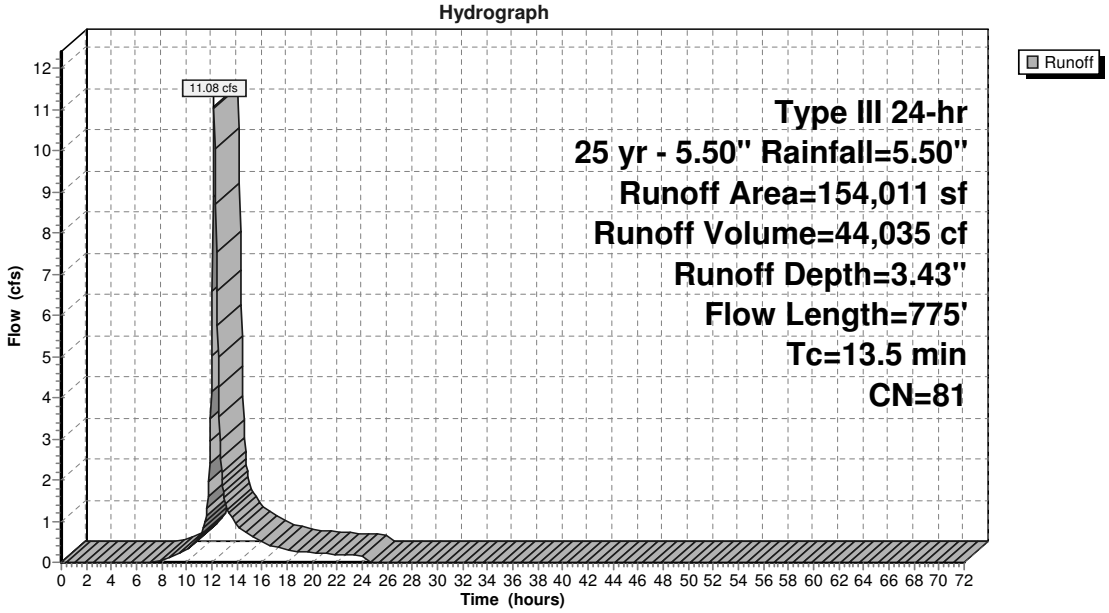
Runoff = 11.08 cfs @ 12.19 hrs, Volume= 44,035 cf, Depth= 3.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

	Area (sf)	CN	Description
*	48,668	98	Pavement
*	16,480	98	Roof
	17,110	39	>75% Grass cover, Good, HSG A
	39,096	74	>75% Grass cover, Good, HSG C
	27,277	80	>75% Grass cover, Good, HSG D
	5,380	73	Woods, Fair, HSG C
	154,011	81	Weighted Average
	88,863		57.70% Pervious Area
	65,148		42.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.4	250	0.0220	3.01		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.9	475	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.5	775	Total			

Subcatchment 16S: Post Dev



Summary for Subcatchment 17S: Building #1

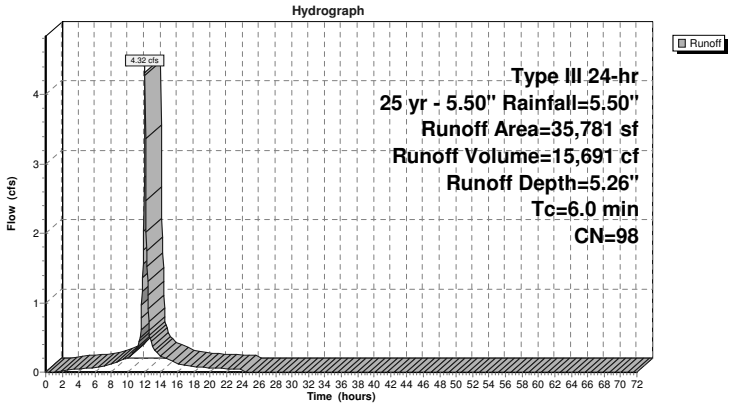
Runoff = 4.32 cfs @ 12.09 hrs, Volume= 15,691 cf, Depth= 5.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr - 5.50" Rainfall=5.50"

Area (sf)	CN	Description
35,781	98	Roofs, HSG C
35,781		100.00% Impervious Area

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

Subcatchment 17S: Building #1



Summary for Reach 1R: Int Stream

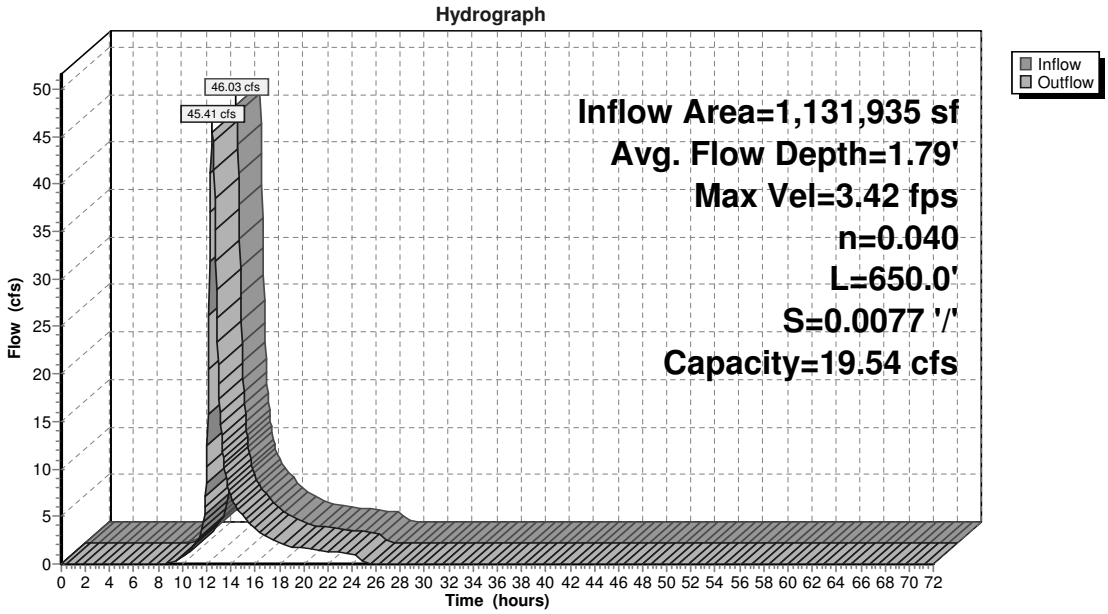
Inflow Area = 1,131,935 sf, 7.63% Impervious, Inflow Depth = 2.80" for 25 yr - 5.50" event
Inflow = 46.03 cfs @ 12.37 hrs, Volume= 264,220 cf
Outflow = 45.41 cfs @ 12.47 hrs, Volume= 264,220 cf, Atten= 1%, Lag= 5.9 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.42 fps, Min. Travel Time= 3.2 min
Avg. Velocity = 0.90 fps, Avg. Travel Time= 12.0 min

Peak Storage= 8,638 cf @ 12.42 hrs
Average Depth at Peak Storage= 1.79'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 19.54 cfs

6.00' x 1.00' deep channel, n= 0.040 Mountain streams
Side Slope Z-value= 1.0 '/' Top Width= 8.00'
Length= 650.0' Slope= 0.0077 '/'
Inlet Invert= 394.00', Outlet Invert= 389.00'

Reach 1R: Int Stream



Summary for Pond 1P: Det Pond #1

Inflow Area = 95,376 sf, 29.37% Impervious, Inflow Depth = 3.53" for 25 yr - 5.50" event
Inflow = 7.76 cfs @ 12.14 hrs, Volume= 28,056 cf
Outflow = 2.02 cfs @ 12.57 hrs, Volume= 28,053 cf, Atten= 74%, Lag= 25.7 min
Discarded = 0.15 cfs @ 12.57 hrs, Volume= 16,350 cf
Primary = 1.87 cfs @ 12.57 hrs, Volume= 11,703 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 402.62' @ 12.57 hrs Surf.Area= 6,552 sf Storage= 13,582 cf

Plug-Flow detention time= 565.9 min calculated for 28,053 cf (100% of inflow)
Center-of-Mass det. time= 565.8 min (1,382.0 - 816.2)

Volume	Invert	Avail.Storage	Storage Description
#1	399.00'	23,858 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

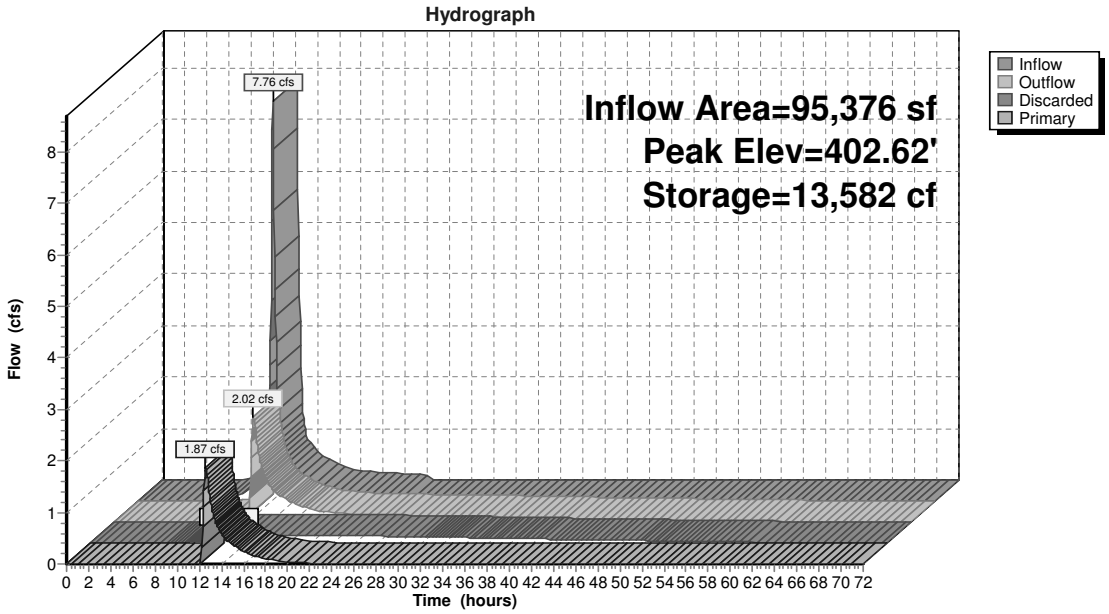
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
399.00	364	96.0	0	0	364
400.00	2,650	302.0	1,332	1,332	6,891
401.50	5,070	454.0	5,693	7,025	16,053
402.00	5,780	456.0	2,711	9,735	16,323
404.00	8,426	454.0	14,123	23,858	17,245

Device	Routing	Invert	Outlet Devices
#1	Discarded	399.00'	**0.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 394.80'
#2	Primary	402.00'	**18.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 402.00' / 398.50' S= 0.1400 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Discarded OutFlow Max=0.15 cfs @ 12.57 hrs HW=402.62' (Free Discharge)
└**1=Exfiltration** (Controls 0.15 cfs)

Primary OutFlow Max=1.86 cfs @ 12.57 hrs HW=402.62' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.86 cfs @ 2.69 fps)

Pond 1P: Det Pond #1



Summary for Pond 2P: Det Pond #2

Inflow Area = 154,011 sf, 42.30% Impervious, Inflow Depth = 3.43" for 25 yr - 5.50" event
Inflow = 11.08 cfs @ 12.19 hrs, Volume= 44,035 cf
Outflow = 3.02 cfs @ 12.65 hrs, Volume= 44,035 cf, Atten= 73%, Lag= 27.6 min
Discarded = 0.66 cfs @ 12.65 hrs, Volume= 18,222 cf
Primary = 2.36 cfs @ 12.65 hrs, Volume= 25,813 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 402.31' @ 12.65 hrs Surf.Area= 8,822 sf Storage= 16,806 cf

Plug-Flow detention time= 110.3 min calculated for 44,005 cf (100% of inflow)
Center-of-Mass det. time= 110.5 min (932.6 - 822.0)

Volume	Invert	Avail.Storage	Storage Description
#1	398.00'	35,756 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

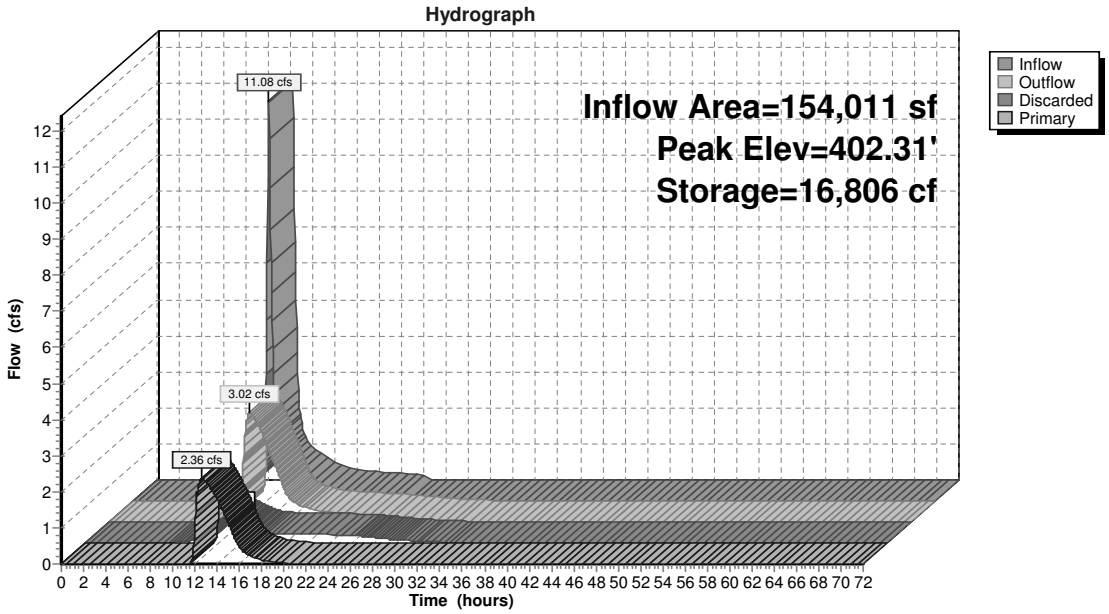
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
398.00	283	84.0	0	0	283
399.00	1,340	176.0	746	746	2,191
400.00	3,441	271.0	2,309	3,056	5,578
402.00	8,049	401.0	11,169	14,224	12,562
404.00	13,735	491.0	21,532	35,756	19,012

Device	Routing	Invert	Outlet Devices
#1	Discarded	398.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 394.00'
#2	Primary	400.00'	**8.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 400.00' / 394.00' S= 0.1500 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf

Discarded OutFlow Max=0.66 cfs @ 12.65 hrs HW=402.31' (Free Discharge)
└**1=Exfiltration** (Controls 0.66 cfs)

Primary OutFlow Max=2.36 cfs @ 12.65 hrs HW=402.31' (Free Discharge)
└**2=Culvert** (Inlet Controls 2.36 cfs @ 6.76 fps)

Pond 2P: Det Pond #2



Summary for Pond 3P: Det Pond#3

Inflow Area = 60,149 sf, 36.27% Impervious, Inflow Depth = 3.73" for 25 yr - 5.50" event
Inflow = 5.22 cfs @ 12.13 hrs, Volume= 18,700 cf
Outflow = 1.31 cfs @ 12.56 hrs, Volume= 16,126 cf, Atten= 75%, Lag= 25.7 min
Discarded = 0.05 cfs @ 12.56 hrs, Volume= 5,760 cf
Primary = 1.26 cfs @ 12.56 hrs, Volume= 10,366 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 406.59' @ 12.56 hrs Surf.Area= 6,044 sf Storage= 9,424 cf

Plug-Flow detention time= 634.1 min calculated for 16,126 cf (86% of inflow)
Center-of-Mass det. time= 573.4 min (1,383.4 - 810.0)

Volume	Invert	Avail.Storage	Storage Description
#1	404.00'	19,828 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

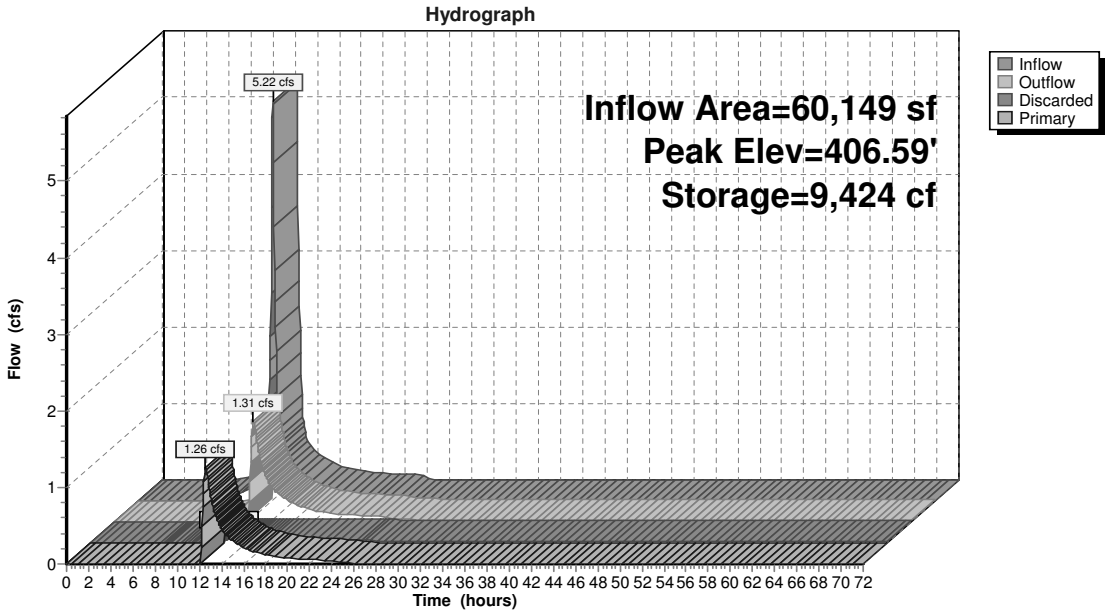
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
404.00	815	180.0	0	0	815
405.00	3,663	255.0	2,069	2,069	3,420
406.00	4,741	281.0	4,190	6,259	4,561
407.00	7,050	450.0	5,857	12,116	14,399
408.00	8,392	470.0	7,711	19,828	15,934

Device	Routing	Invert	Outlet Devices
#1	Discarded	404.00'	**0.170 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 402.00'
#2	Primary	406.00'	**12.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 406.00' / 402.50' S= 0.1400 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Discarded OutFlow Max=0.05 cfs @ 12.56 hrs HW=406.59' (Free Discharge)
└**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=1.25 cfs @ 12.56 hrs HW=406.59' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.25 cfs @ 2.61 fps)

Pond 3P: Det Pond#3



Summary for Pond 4P: Det Pond #4

Inflow Area = 120,833 sf, 24.75% Impervious, Inflow Depth = 3.33" for 25 yr - 5.50" event
Inflow = 8.62 cfs @ 12.18 hrs, Volume= 33,565 cf
Outflow = 3.50 cfs @ 12.52 hrs, Volume= 30,650 cf, Atten= 59%, Lag= 20.5 min
Discarded = 0.07 cfs @ 12.52 hrs, Volume= 7,121 cf
Primary = 3.43 cfs @ 12.52 hrs, Volume= 23,529 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 402.47' @ 12.52 hrs Surf.Area= 7,718 sf Storage= 13,935 cf

Plug-Flow detention time= 436.7 min calculated for 30,628 cf (91% of inflow)
Center-of-Mass det. time= 394.9 min (1,218.9 - 823.9)

Volume	Invert	Avail.Storage	Storage Description
#1	400.00'	28,626 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

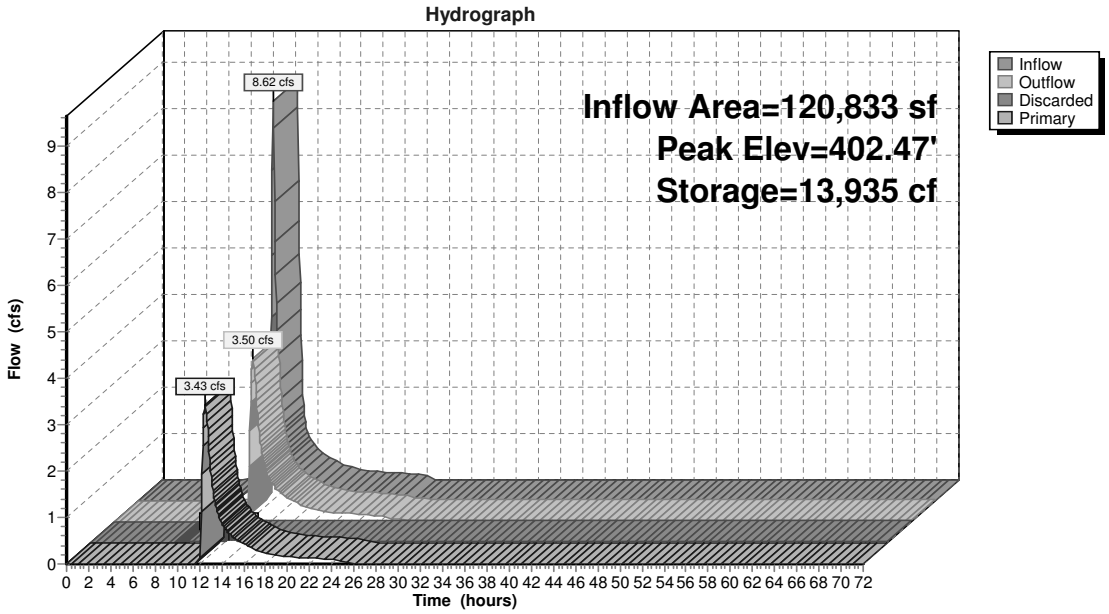
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
400.00	4,196	306.0	0	0	4,196
402.00	6,479	349.0	10,593	10,593	6,531
403.00	9,236	539.0	7,817	18,410	19,965
404.00	11,230	578.0	10,217	28,626	23,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	400.00'	**0.170 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 397.50'
#2	Primary	401.50'	**15.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 401.50' / 397.50' S= 0.1600 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Discarded OutFlow Max=0.07 cfs @ 12.52 hrs HW=402.47' (Free Discharge)
└**1=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=3.43 cfs @ 12.52 hrs HW=402.47' (Free Discharge)
└**2=Culvert** (Inlet Controls 3.43 cfs @ 3.35 fps)

Pond 4P: Det Pond #4



Summary for Pond 5P: Det Pond #5

Inflow Area = 384,405 sf, 25.95% Impervious, Inflow Depth = 2.86" for 25 yr - 5.50" event
Inflow = 24.35 cfs @ 12.17 hrs, Volume= 91,634 cf
Outflow = 11.61 cfs @ 12.45 hrs, Volume= 91,634 cf, Atten= 52%, Lag= 17.1 min
Discarded = 1.08 cfs @ 12.45 hrs, Volume= 34,662 cf
Primary = 10.53 cfs @ 12.45 hrs, Volume= 56,972 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 397.28' @ 12.45 hrs Surf.Area= 12,243 sf Storage= 27,485 cf

Plug-Flow detention time= 89.2 min calculated for 91,570 cf (100% of inflow)
Center-of-Mass det. time= 89.3 min (924.9 - 835.7)

Volume	Invert	Avail.Storage	Storage Description
#1	394.00'	51,928 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

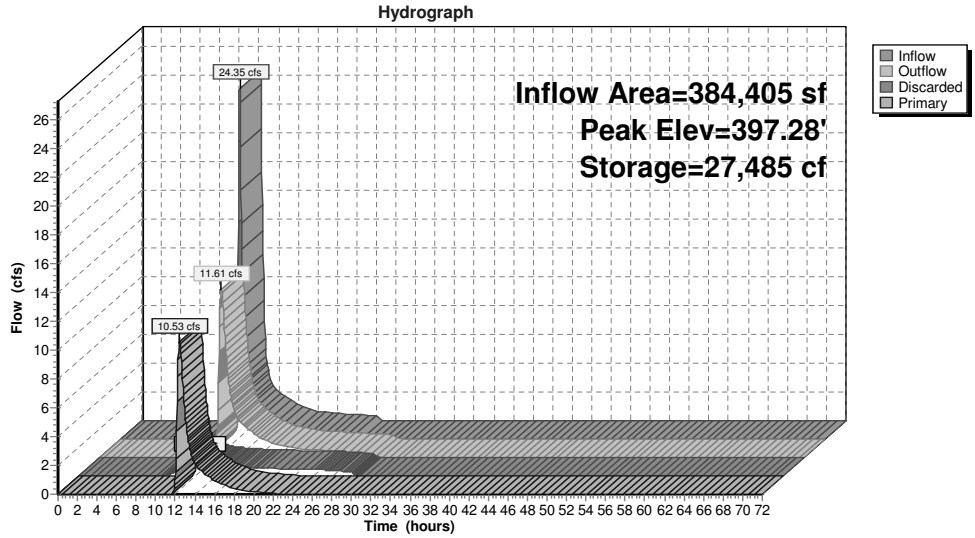
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
394.00	4,910	333.0	0	0	4,910
396.00	9,160	429.0	13,851	13,851	10,781
398.00	14,180	514.0	23,158	37,009	17,229
399.00	15,670	533.0	14,919	51,928	18,896

Device	Routing	Invert	Outlet Devices
#1	Discarded	394.00'	**2.410 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 390.50'
#2	Primary	393.50'	**24.0" Round Culvert** L= 30.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 393.50' / 392.50' S= 0.0333 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#3	Device 2	394.90'	**6.0" W x 36.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 2	396.00'	**12.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=1.08 cfs @ 12.45 hrs HW=397.28' (Free Discharge)
└─**1=Exfiltration** (Controls 1.08 cfs)

Primary OutFlow Max=10.53 cfs @ 12.45 hrs HW=397.28' (Free Discharge)
└─**2=Culvert** (Passes 10.53 cfs of 25.21 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 5.89 cfs @ 4.95 fps)
  └─**4=Orifice/Grate** (Orifice Controls 4.64 cfs @ 3.63 fps)

Pond 5P: Det Pond #5



Summary for Pond 6P: Det Pond #6

Inflow Area = 98,431 sf, 76.03% Impervious, Inflow Depth = 4.03" for 25 yr - 5.50" event
Inflow = 8.63 cfs @ 12.11 hrs, Volume= 33,094 cf
Outflow = 4.55 cfs @ 12.32 hrs, Volume= 33,094 cf, Atten= 47%, Lag= 12.5 min
Discarded = 1.60 cfs @ 12.32 hrs, Volume= 23,540 cf
Primary = 2.95 cfs @ 12.32 hrs, Volume= 9,554 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 397.18' @ 12.32 hrs Surf.Area= 3,917 sf Storage= 6,872 cf

Plug-Flow detention time= 27.3 min calculated for 33,094 cf (100% of inflow)
Center-of-Mass det. time= 27.3 min (813.5 - 786.2)

Volume	Invert	Avail.Storage	Storage Description
#1	394.00'	16,799 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

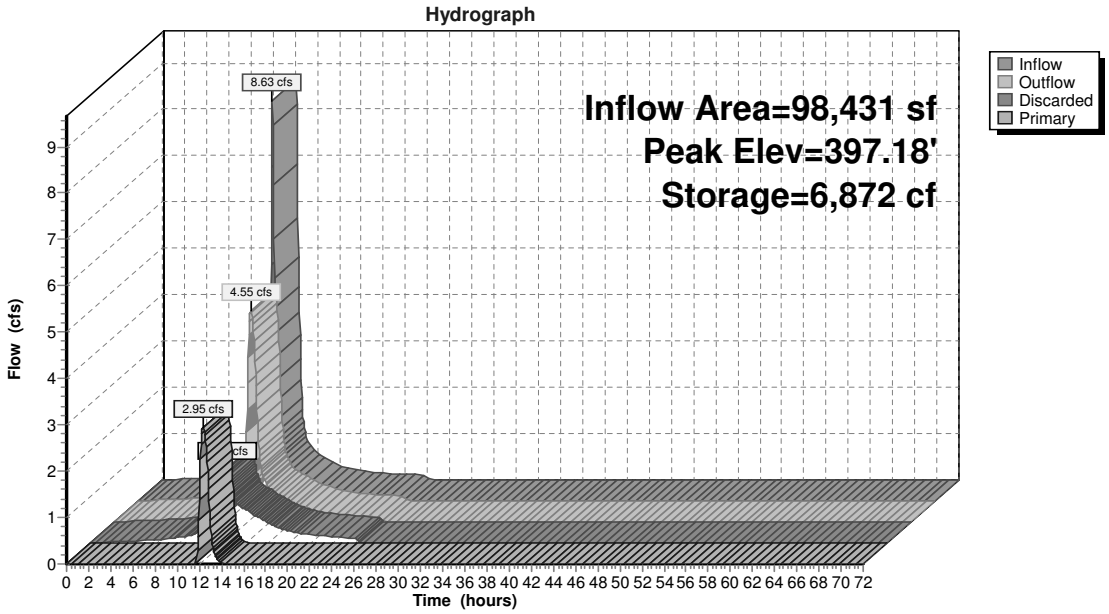
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
394.00	598	106.0	0	0	598
396.00	2,661	225.0	3,014	3,014	3,750
398.00	4,932	299.0	7,477	10,491	6,880
399.00	7,793	364.0	6,308	16,799	10,325

Device	Routing	Invert	Outlet Devices
#1	Discarded	394.00'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 391.50'
#2	Primary	395.50'	**10.0" Round Culvert** L= 30.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 395.50' / 393.00' S= 0.0833 '/' Cc= 0.900 n= 0.013, Flow Area= 0.55 sf

Discarded OutFlow Max=1.59 cfs @ 12.32 hrs HW=397.18' (Free Discharge)
└**1=Exfiltration** (Controls 1.59 cfs)

Primary OutFlow Max=2.95 cfs @ 12.32 hrs HW=397.18' (Free Discharge)
└**2=Culvert** (Inlet Controls 2.95 cfs @ 5.40 fps)

Pond 6P: Det Pond #6

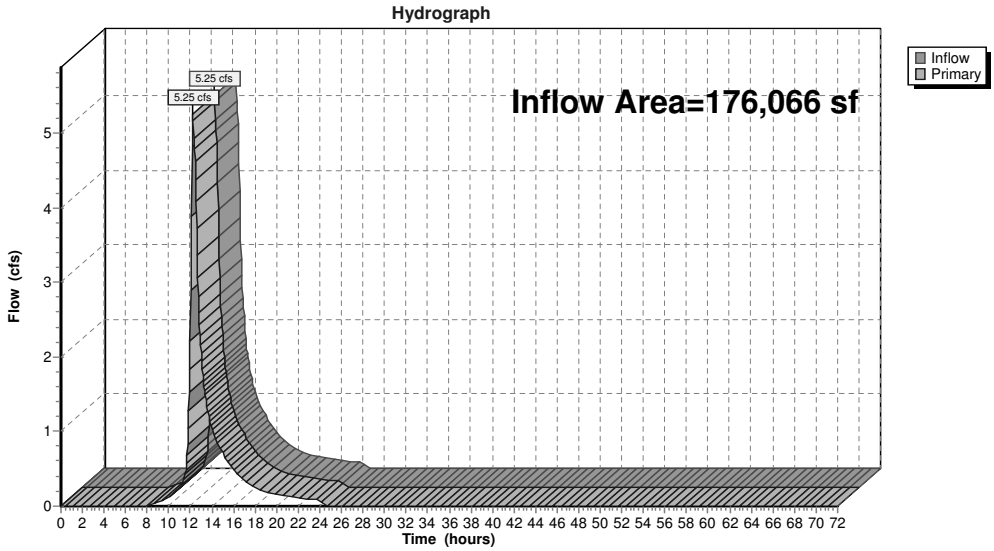


Summary for Link DP-1: DP#1

Inflow Area = 176,066 sf, 19.14% Impervious, Inflow Depth = 2.24" for 25 yr - 5.50" event
Inflow = 5.25 cfs @ 12.23 hrs, Volume= 32,824 cf
Primary = 5.25 cfs @ 12.23 hrs, Volume= 32,824 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-1: DP#1

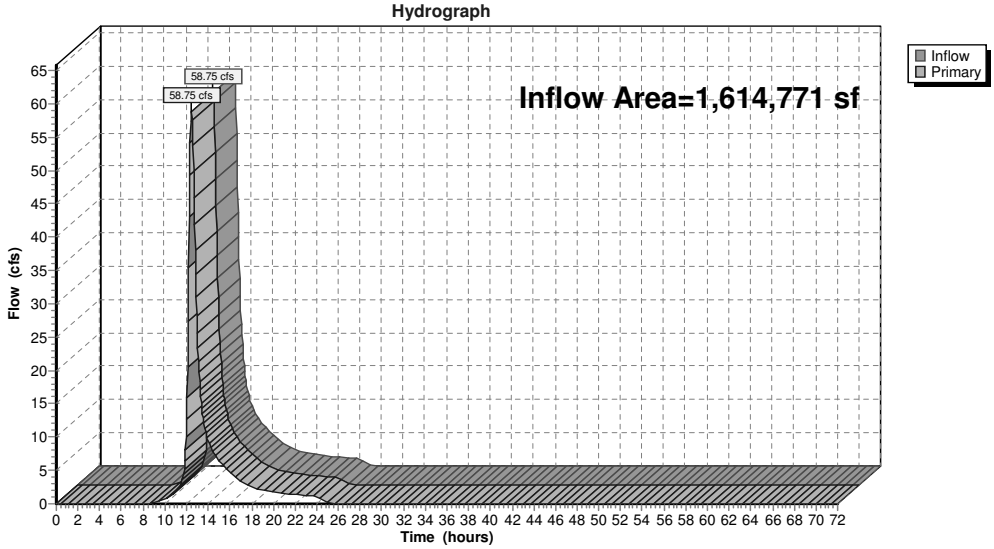


Summary for Link DP-2: DP#2

Inflow Area = 1,614,771 sf, 16.16% Impervious, Inflow Depth = 2.46" for 25 yr - 5.50" event
Inflow = 58.75 cfs @ 12.47 hrs, Volume= 330,747 cf
Primary = 58.75 cfs @ 12.47 hrs, Volume= 330,747 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-2: DP#2

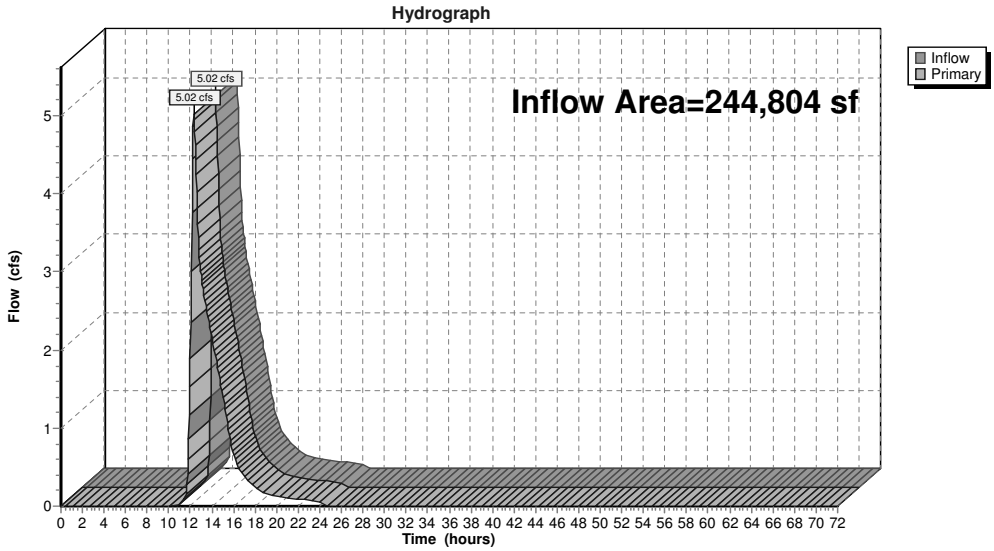


Summary for Link DP-3: DP-3

Inflow Area = 244,804 sf, 26.61% Impervious, Inflow Depth = 1.95" for 25 yr - 5.50" event
Inflow = 5.02 cfs @ 12.31 hrs, Volume= 39,693 cf
Primary = 5.02 cfs @ 12.31 hrs, Volume= 39,693 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-3: DP-3

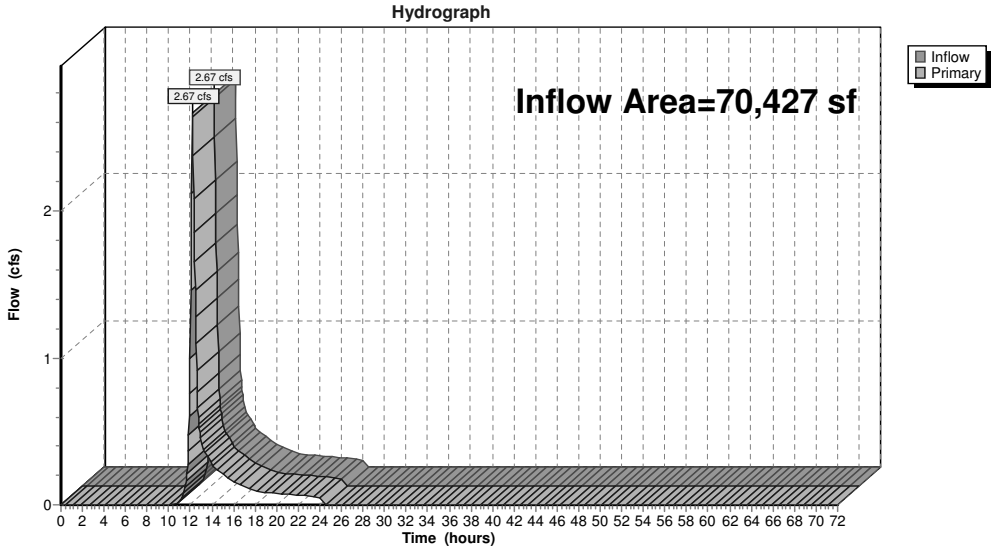


Summary for Link DP-4: DP#4

Inflow Area = 70,427 sf, 3.92% Impervious, Inflow Depth = 1.83" for 25 yr - 5.50" event
Inflow = 2.67 cfs @ 12.18 hrs, Volume= 10,767 cf
Primary = 2.67 cfs @ 12.18 hrs, Volume= 10,767 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-4: DP#4



Summary for Subcatchment 1S: Pre-Dev 1S

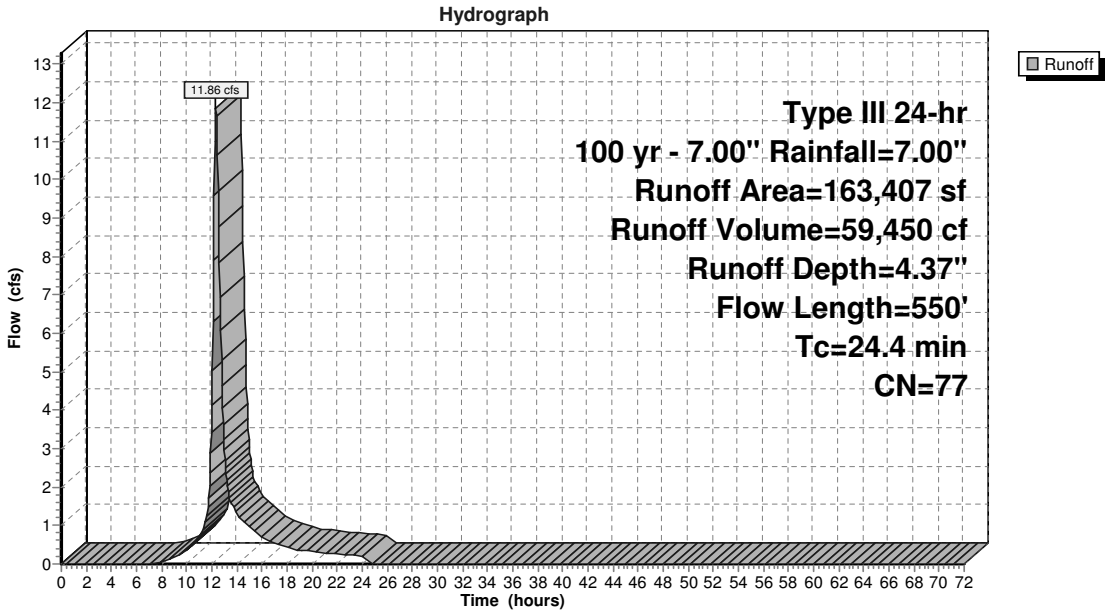
Runoff = 11.86 cfs @ 12.34 hrs, Volume= 59,450 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
	6,616	98	Paved parking, HSG C
	59,968	73	Woods, Fair, HSG C
	48,086	79	Woods, Fair, HSG D
*	48,737	78	Wetlands
	163,407	77	Weighted Average
	156,791		95.95% Pervious Area
	6,616		4.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	50	0.0120	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
9.3	500	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
24.4	550	Total			

Subcatchment 1S: Pre-Dev 1S



Summary for Subcatchment 2S: Pre-Dev 2S

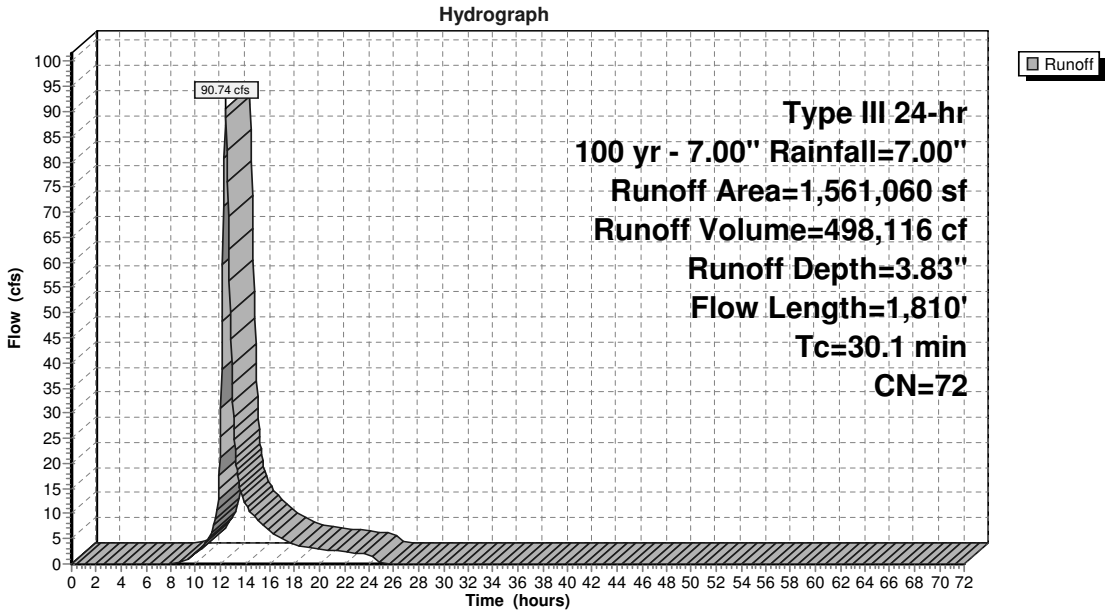
Runoff = 90.74 cfs @ 12.42 hrs, Volume= 498,116 cf, Depth= 3.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
	12,734	98	Paved parking, HSG C
	103,393	36	Woods, Fair, HSG A
	175,914	79	Woods, Fair, HSG D
	93,562	60	Woods, Fair, HSG B
	720,766	73	Woods, Fair, HSG C
*	454,691	78	Wetlands
	1,561,060	72	Weighted Average
	1,548,326		99.18% Pervious Area
	12,734		0.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0370	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
16.9	950	0.0350	0.94		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.6	810	0.0100	3.74	7.49	**Channel Flow,** Area= 2.0 sf Perim= 4.0' r= 0.50' n= 0.025 Earth, clean & winding
30.1	1,810	Total			

Subcatchment 2S: Pre-Dev 2S



Summary for Subcatchment 3S: Pre Dev 3S

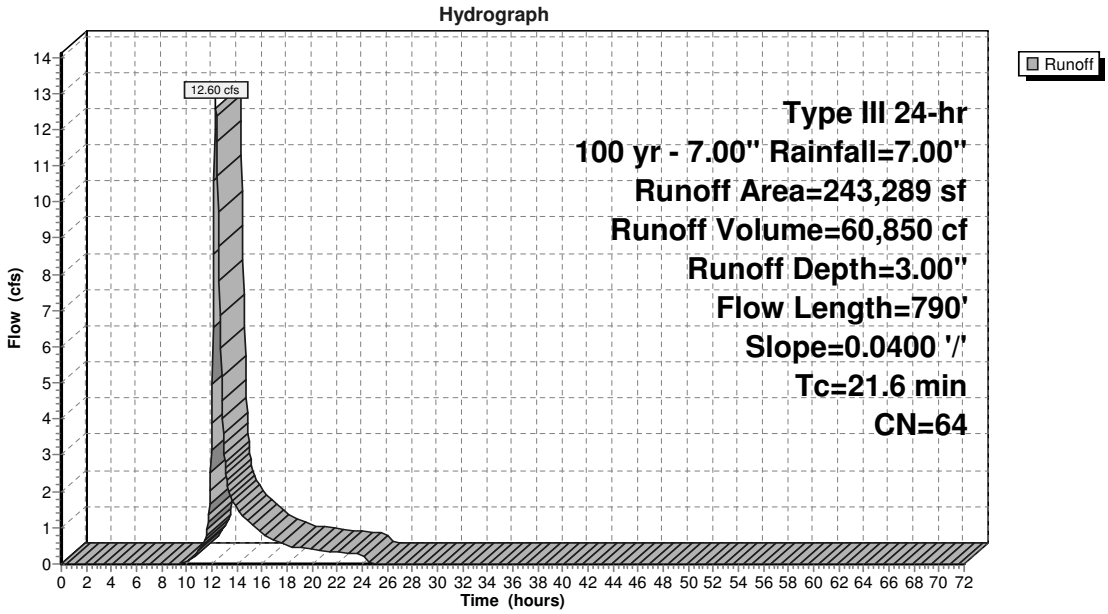
Runoff = 12.60 cfs @ 12.31 hrs, Volume= 60,850 cf, Depth= 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
	37,431	36	Woods, Fair, HSG A
	74,966	60	Woods, Fair, HSG B
	98,598	73	Woods, Fair, HSG C
*	32,294	78	Wetlands
	243,289	64	Weighted Average
	243,289		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
12.3	740	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
21.6	790	Total			

Subcatchment 3S: Pre Dev 3S



Summary for Subcatchment 4S: Pre Dev 4S

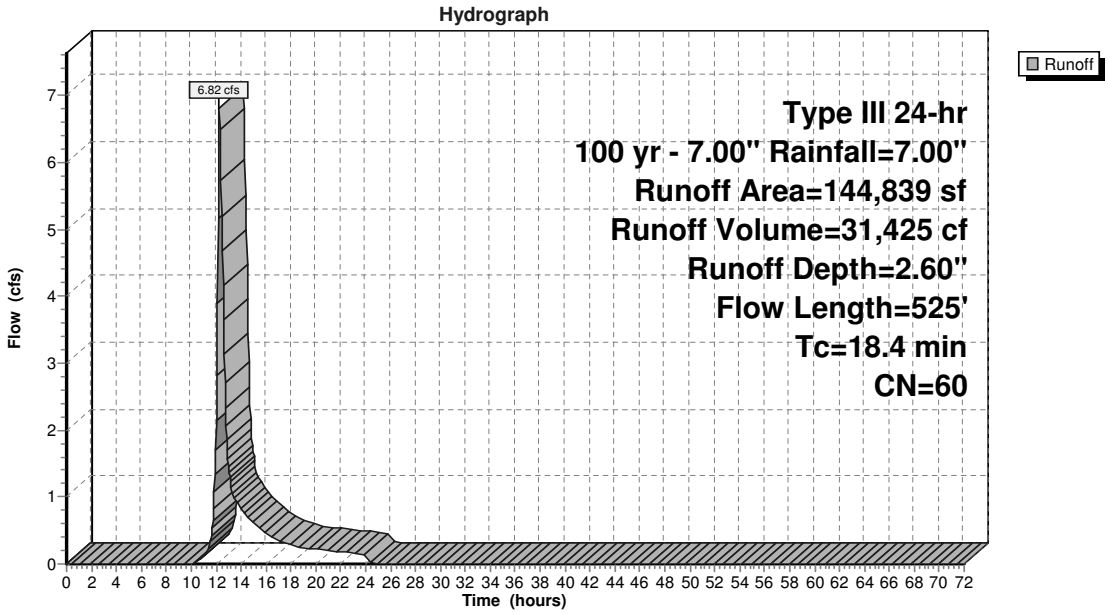
Runoff = 6.82 cfs @ 12.27 hrs, Volume= 31,425 cf, Depth= 2.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

Area (sf)	CN	Description
51,728	36	Woods, Fair, HSG A
93,111	73	Woods, Fair, HSG C
144,839	60	Weighted Average
144,839		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow, 4-1** Woods: Light underbrush n= 0.400 P2= 3.20"
7.9	475	0.0400	1.00		**Shallow Concentrated Flow, 4-2** Woodland Kv= 5.0 fps
18.4	525	Total			

Subcatchment 4S: Pre Dev 4S



Summary for Subcatchment 5S: Post Dev

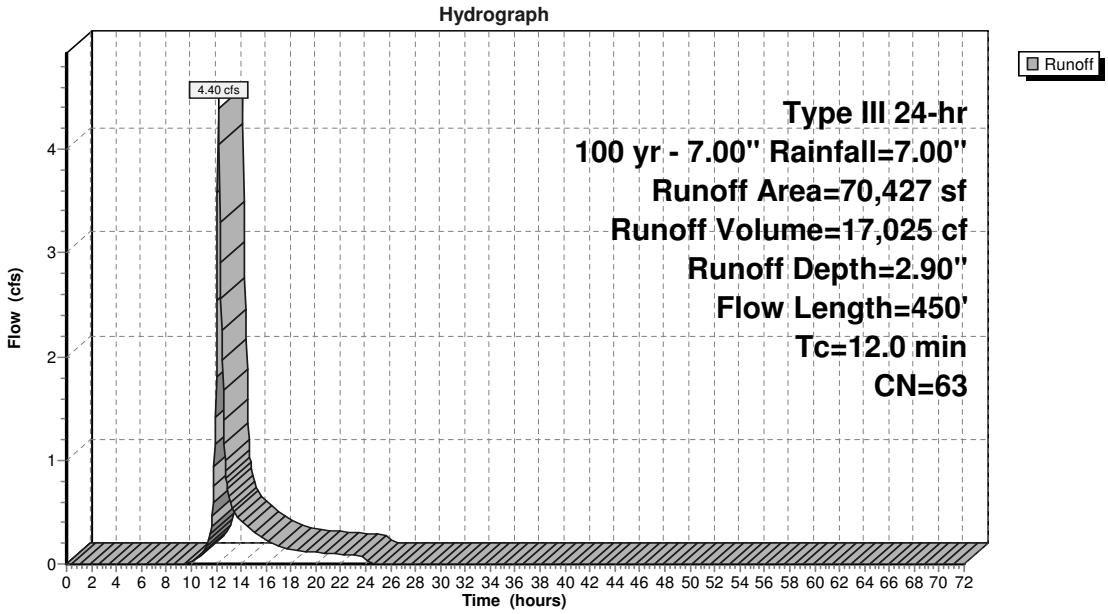
Runoff = 4.40 cfs @ 12.17 hrs, Volume= 17,025 cf, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
*	2,760	98	Roofs,
	11,100	36	Woods, Fair, HSG A
	11,852	39	>75% Grass cover, Good, HSG A
	13,834	74	>75% Grass cover, Good, HSG C
	30,881	73	Woods, Fair, HSG C
	70,427	63	Weighted Average
	67,667		96.08% Pervious Area
	2,760		3.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	50	0.0350	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
2.1	400	0.0400	3.22		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.0	450	Total			

Subcatchment 5S: Post Dev



Summary for Subcatchment 6S: Post Dev

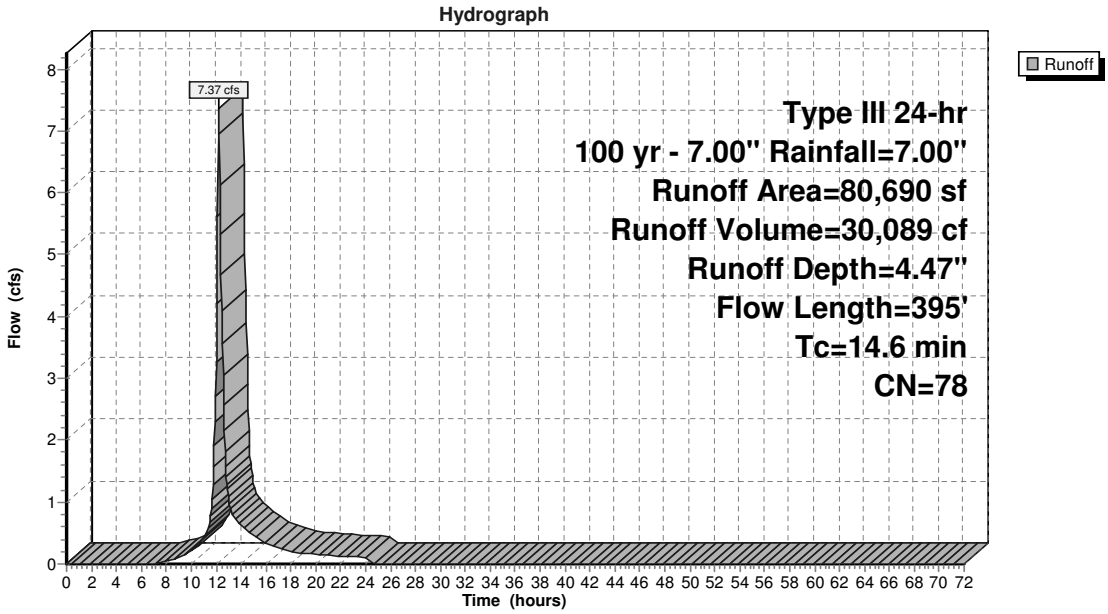
Runoff = 7.37 cfs @ 12.20 hrs, Volume= 30,089 cf, Depth= 4.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
	4,155	98	Paved roads w/curbs & sewers, HSG C
	1,530	98	Roofs, HSG C
	21,839	74	>75% Grass cover, Good, HSG C
	4,429	73	Woods, Fair, HSG C
*	48,737	78	Wetlands
	80,690	78	Weighted Average
	75,005		92.95% Pervious Area
	5,685		7.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
6.4	345	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.6	395	Total			

Subcatchment 6S: Post Dev



Summary for Subcatchment 7S: Post Dev

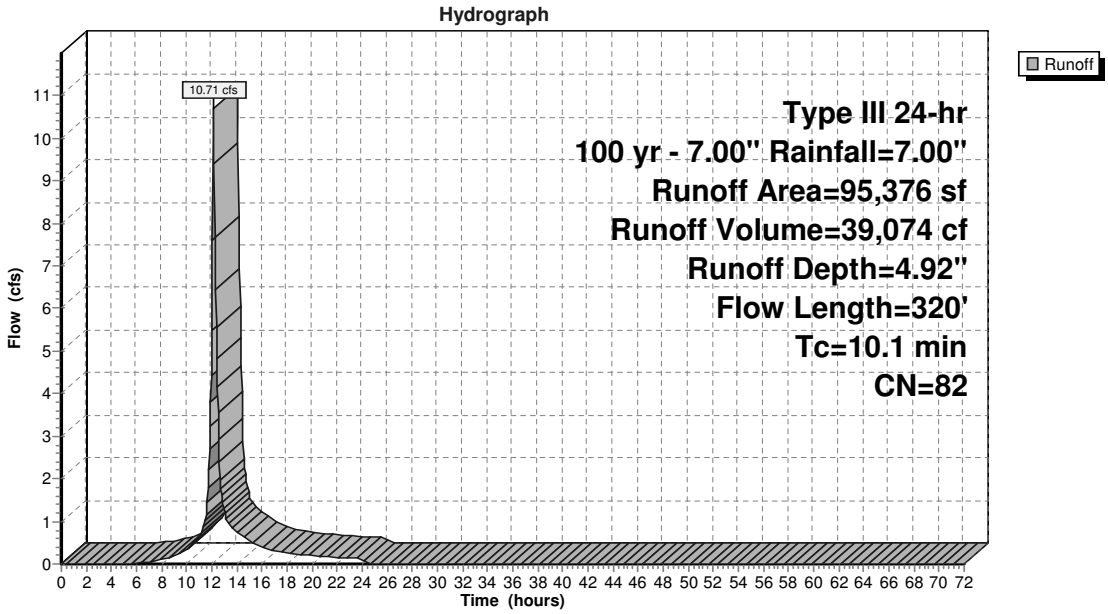
Runoff = 10.71 cfs @ 12.14 hrs, Volume= 39,074 cf, Depth= 4.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
*	9,688	98	Roofs
*	6,758	98	Drives
*	11,562	98	Road
	4,360	73	Woods, Fair, HSG C
	18,385	80	>75% Grass cover, Good, HSG D
	44,623	74	>75% Grass cover, Good, HSG C
	95,376	82	Weighted Average
	67,368		70.63% Pervious Area
	28,008		29.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.6	110	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.3	160	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.1	320	Total			

Subcatchment 7S: Post Dev



Summary for Subcatchment 8S: Post Dev

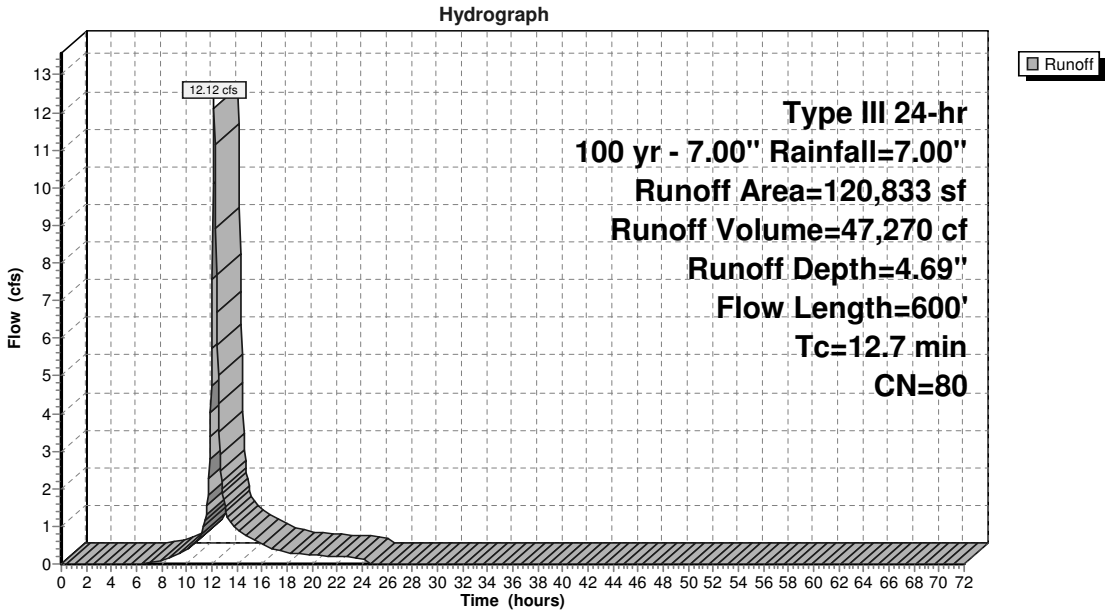
Runoff = 12.12 cfs @ 12.17 hrs, Volume= 47,270 cf, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
*	12,140	98	Road
*	6,595	98	Drives
*	11,166	98	Roofs
	19,454	73	Woods, Fair, HSG C
	54,858	74	>75% Grass cover, Good, HSG C
	16,620	74	>75% Grass cover, Good, HSG C
	120,833	80	Weighted Average
	90,932		75.25% Pervious Area
	29,901		24.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.6	200	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.9	350	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
12.7	600	Total			

Subcatchment 8S: Post Dev



Summary for Subcatchment 9S: Post Dev

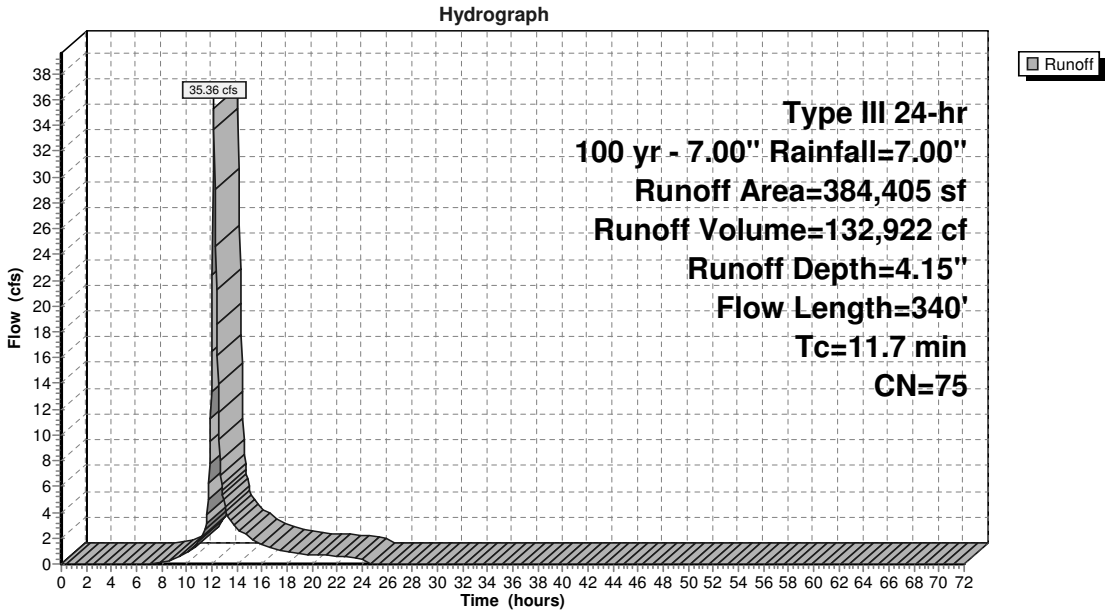
Runoff = 35.36 cfs @ 12.16 hrs, Volume= 132,922 cf, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
*	39,480	98	Road
*	21,444	98	Drives
*	38,845	98	Roofs
	57,414	39	>75% Grass cover, Good, HSG A
	194,109	74	>75% Grass cover, Good, HSG C
	33,113	73	Woods, Fair, HSG C
	384,405	75	Weighted Average
	284,636		74.05% Pervious Area
	99,769		25.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0150	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.4	150	0.0150	1.84		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.1	140	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
11.7	340	Total			

Subcatchment 9S: Post Dev



Summary for Subcatchment 10S: Post Dev

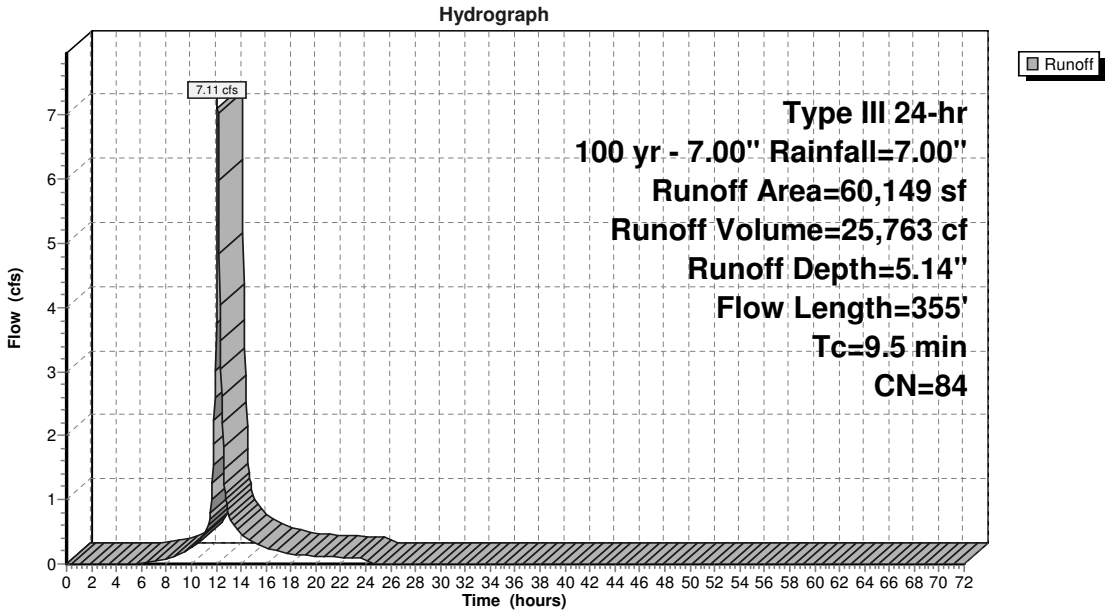
Runoff = 7.11 cfs @ 12.13 hrs, Volume= 25,763 cf, Depth= 5.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
*	12,584	98	Road
*	4,570	98	Drives
*	4,665	98	Roofs
	12,147	80	>75% Grass cover, Good, HSG D
	26,183	74	>75% Grass cover, Good, HSG C
	60,149	84	Weighted Average
	38,330		63.73% Pervious Area
	21,819		36.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.2	25	0.0200	2.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
1.1	280	0.0400	4.06		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.5	355	Total			

Subcatchment 10S: Post Dev



Summary for Subcatchment 11S: Post Dev

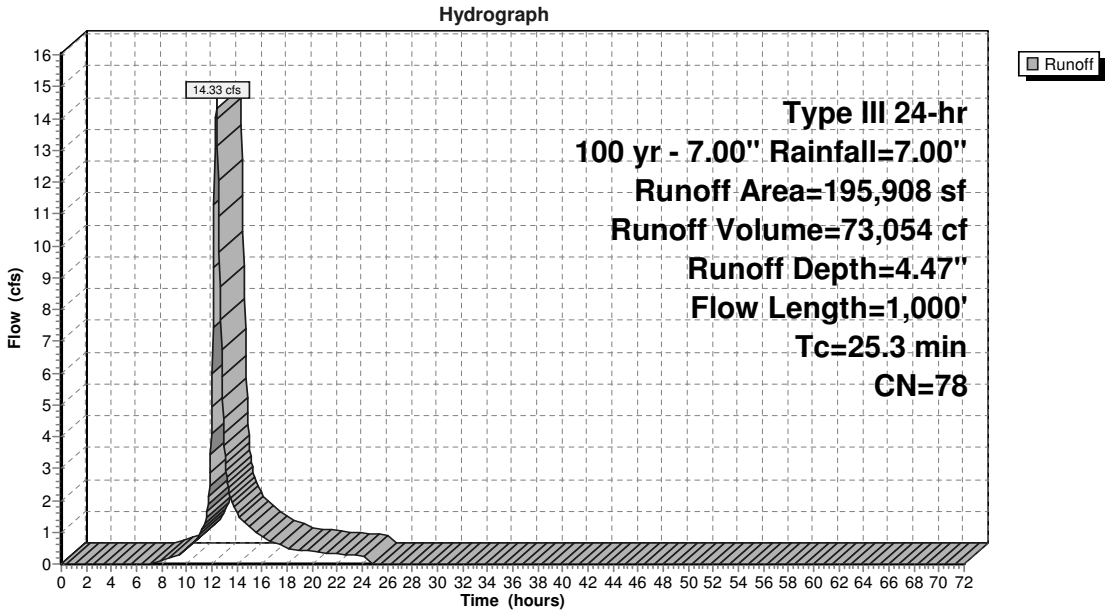
Runoff = 14.33 cfs @ 12.35 hrs, Volume= 73,054 cf, Depth= 4.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
*	3,584	98	Road
*	9,873	98	Roofs
	20,413	73	Woods, Fair, HSG C
	19,040	79	Woods, Fair, HSG D
	70,498	74	>75% Grass cover, Good, HSG C
	8,004	80	>75% Grass cover, Good, HSG D
*	64,496	78	Wetlands
	195,908	78	Weighted Average
	182,451		93.13% Pervious Area
	13,457		6.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.8	100	0.0200	2.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
15.3	650	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.0	200	0.0150	3.19	12.78	**Channel Flow,** Area= 4.0 sf Perim= 6.8' r= 0.59' n= 0.040 Mountain streams
25.3	1,000	Total			

Subcatchment 11S: Post Dev



Summary for Subcatchment 12S: Post Dev

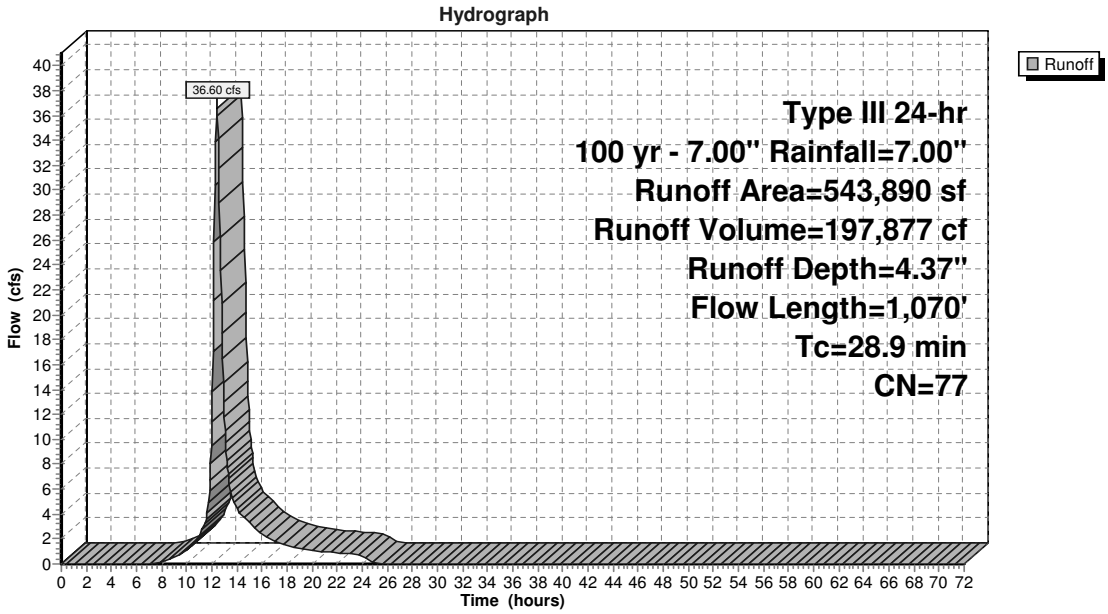
Runoff = 36.60 cfs @ 12.40 hrs, Volume= 197,877 cf, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
*	10,801	98	Paved
*	6,530	98	Roof
	35,887	60	Woods, Fair, HSG B
	9,984	61	>75% Grass cover, Good, HSG B
	52,770	74	>75% Grass cover, Good, HSG C
	15,275	80	>75% Grass cover, Good, HSG D
	51,310	79	Woods, Fair, HSG D
	40,779	73	Woods, Fair, HSG C
*	320,554	78	Wetlands
	543,890	77	Weighted Average
	526,559		96.81% Pervious Area
	17,331		3.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	50	0.0350	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
19.0	1,020	0.0320	0.89		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
28.9	1,070	Total			

Subcatchment 12S: Post Dev



Summary for Subcatchment 13S: Post Dev

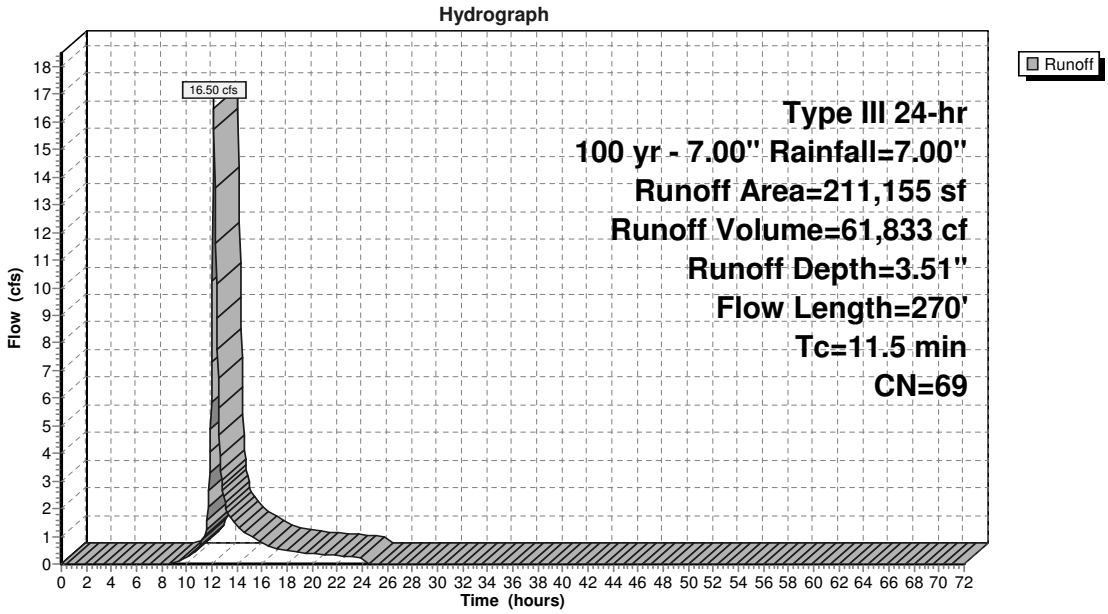
Runoff = 16.50 cfs @ 12.16 hrs, Volume= 61,833 cf, Depth= 3.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
*	3,805	98	Roofs
	17,106	36	Woods, Fair, HSG A
	7,569	60	Woods, Fair, HSG B
	11,993	73	Woods, Fair, HSG C
	34,942	79	Woods, Fair, HSG D
	14,634	39	>75% Grass cover, Good, HSG A
	20,863	61	>75% Grass cover, Good, HSG B
	25,669	74	>75% Grass cover, Good, HSG C
	4,934	80	>75% Grass cover, Good, HSG D
*	69,640	78	Wetlands
	211,155	69	Weighted Average
	207,350		98.20% Pervious Area
	3,805		1.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
3.3	220	0.0500	1.12		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
11.5	270	Total			

Subcatchment 13S: Post Dev



Summary for Subcatchment 14S: Post Dev

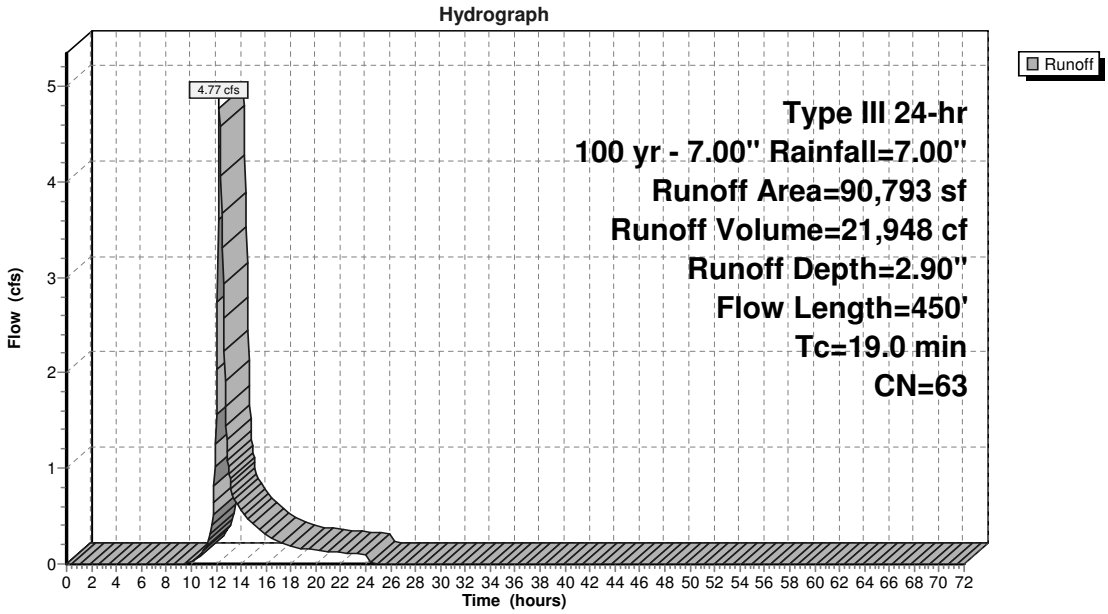
Runoff = 4.77 cfs @ 12.27 hrs, Volume= 21,948 cf, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
	12,475	39	>75% Grass cover, Good, HSG A
	15,110	61	>75% Grass cover, Good, HSG B
	6,750	74	>75% Grass cover, Good, HSG C
	8,310	36	Woods, Fair, HSG A
	12,274	60	Woods, Fair, HSG B
	3,580	73	Woods, Fair, HSG C
*	32,294	78	Wetlands
	90,793	63	Weighted Average
	90,793		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.20"
6.7	400	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
19.0	450	Total			

Subcatchment 14S: Post Dev



Summary for Subcatchment 15S: Post Dev

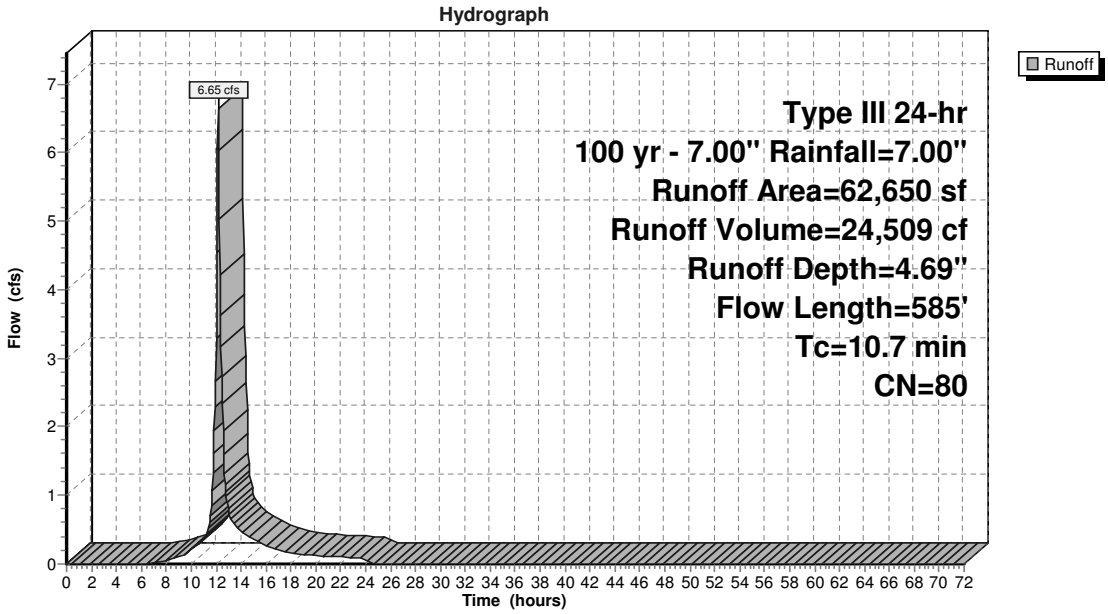
Runoff = 6.65 cfs @ 12.15 hrs, Volume= 24,509 cf, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
*	34,455	98	Pavement
*	4,599	98	Walks
	12,433	39	>75% Grass cover, Good, HSG A
	11,163	61	>75% Grass cover, Good, HSG B
	62,650	80	Weighted Average
	23,596		37.66% Pervious Area
	39,054		62.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	35	0.0200	0.09		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
0.8	100	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.7	450	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.7	585	Total			

Subcatchment 15S: Post Dev



Summary for Subcatchment 16S: Post Dev

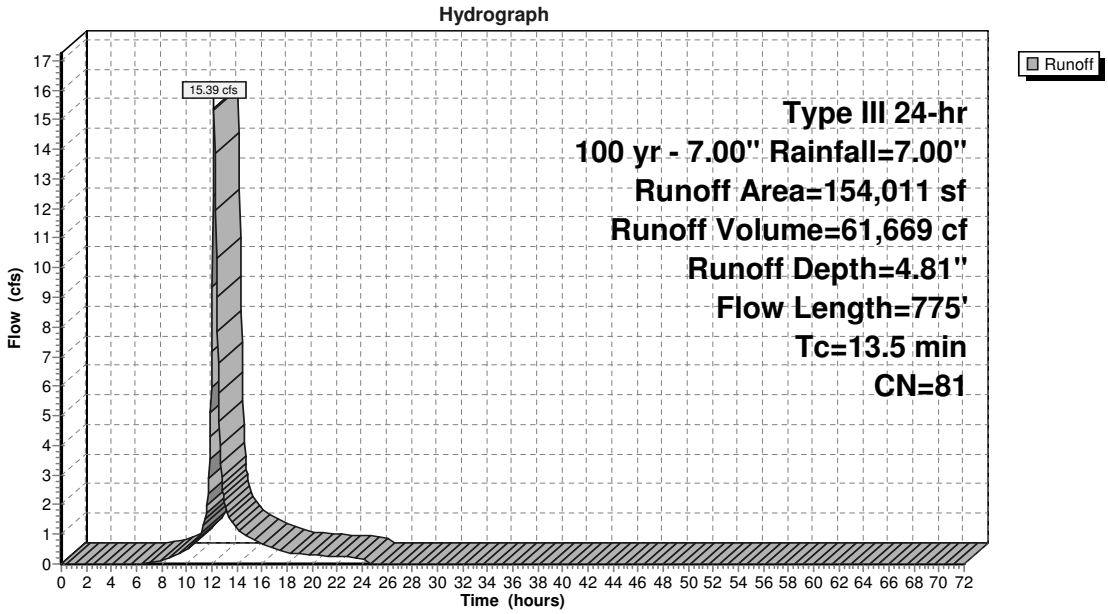
Runoff = 15.39 cfs @ 12.19 hrs, Volume= 61,669 cf, Depth= 4.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

	Area (sf)	CN	Description
*	48,668	98	Pavement
*	16,480	98	Roof
	17,110	39	>75% Grass cover, Good, HSG A
	39,096	74	>75% Grass cover, Good, HSG C
	27,277	80	>75% Grass cover, Good, HSG D
	5,380	73	Woods, Fair, HSG C
	154,011	81	Weighted Average
	88,863		57.70% Pervious Area
	65,148		42.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0200	0.10		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20"
1.4	250	0.0220	3.01		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.9	475	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
13.5	775	Total			

Subcatchment 16S: Post Dev



Summary for Subcatchment 17S: Building #1

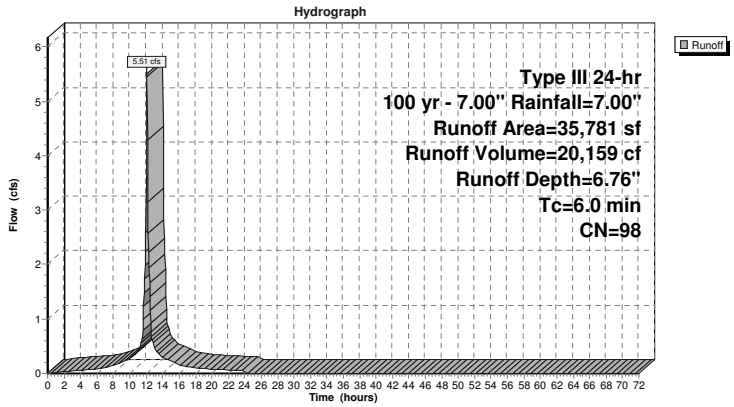
Runoff = 5.51 cfs @ 12.09 hrs, Volume= 20,159 cf, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr - 7.00" Rainfall=7.00"

Area (sf)	CN	Description
35,781	98	Roofs, HSG C
35,781		100.00% Impervious Area

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

Subcatchment 17S: Building #1



Summary for Reach 1R: Int Stream

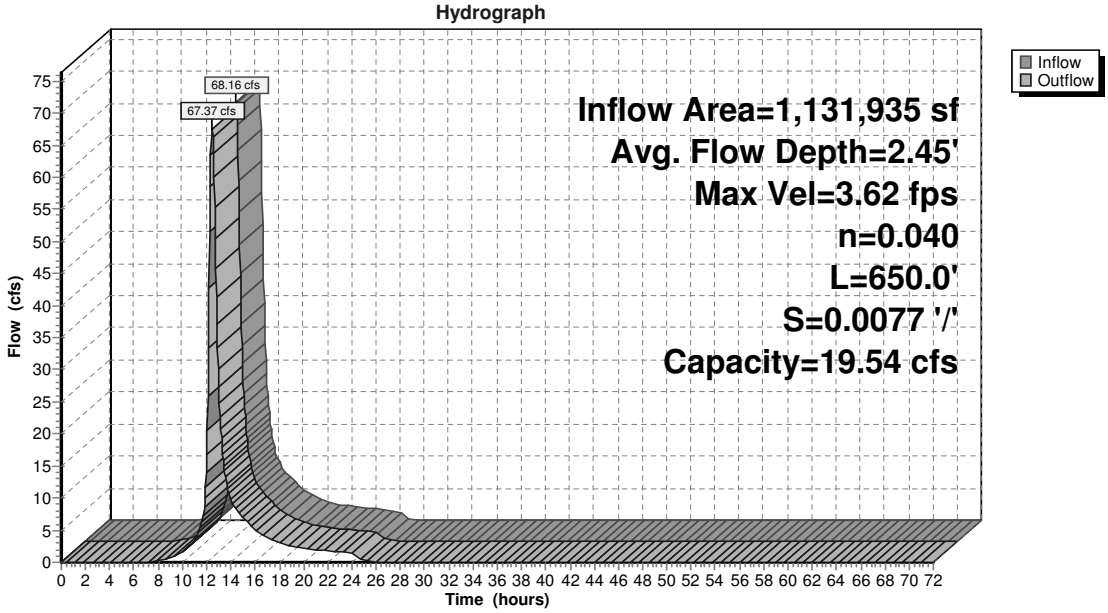
Inflow Area = 1,131,935 sf, 7.63% Impervious, Inflow Depth = 4.10" for 100 yr - 7.00" event
Inflow = 68.16 cfs @ 12.35 hrs, Volume= 386,896 cf
Outflow = 67.37 cfs @ 12.45 hrs, Volume= 386,896 cf, Atten= 1%, Lag= 5.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.62 fps, Min. Travel Time= 3.0 min
Avg. Velocity = 0.99 fps, Avg. Travel Time= 10.9 min

Peak Storage= 12,096 cf @ 12.40 hrs
Average Depth at Peak Storage= 2.45'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 19.54 cfs

6.00' x 1.00' deep channel, n= 0.040 Mountain streams
Side Slope Z-value= 1.0 '/' Top Width= 8.00'
Length= 650.0' Slope= 0.0077 '/'
Inlet Invert= 394.00', Outlet Invert= 389.00'

Reach 1R: Int Stream



Summary for Pond 1P: Det Pond #1

Inflow Area =	95,376 sf, 29.37% Impervious, Inflow Depth = 4.92" for 100 yr - 7.00" event				
Inflow =	10.71 cfs @	12.14 hrs,	Volume=	39,074 cf	
Outflow =	4.64 cfs @	12.42 hrs,	Volume=	39,070 cf,	Atten= 57%, Lag= 16.4 min
Discarded =	0.16 cfs @	12.42 hrs,	Volume=	17,023 cf	
Primary =	4.49 cfs @	12.42 hrs,	Volume=	22,047 cf	

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 403.03' @ 12.42 hrs Surf.Area= 7,084 sf Storage= 16,364 cf

Plug-Flow detention time= 430.6 min calculated for 39,070 cf (100% of inflow)
Center-of-Mass det. time= 430.5 min (1,237.4 - 806.8)

Volume	Invert	Avail.Storage	Storage Description
#1	399.00'	23,858 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

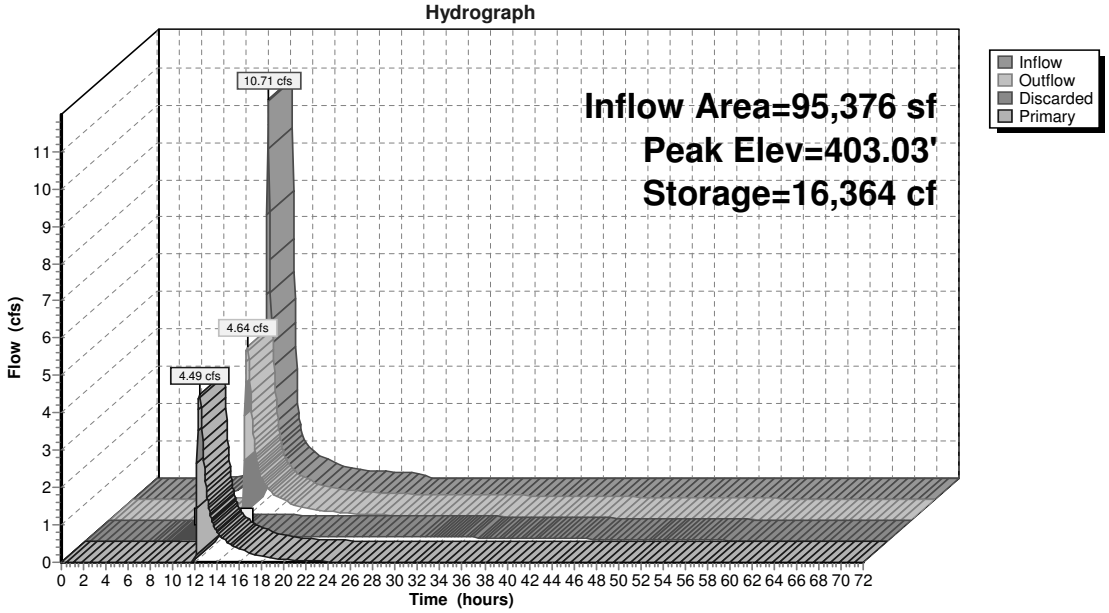
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
399.00	364	96.0	0	0	364
400.00	2,650	302.0	1,332	1,332	6,891
401.50	5,070	454.0	5,693	7,025	16,053
402.00	5,780	456.0	2,711	9,735	16,323
404.00	8,426	454.0	14,123	23,858	17,245

Device	Routing	Invert	Outlet Devices
#1	Discarded	399.00'	**0.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 394.80'
#2	Primary	402.00'	**18.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 402.00' / 398.50' S= 0.1400 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf

Discarded OutFlow Max=0.16 cfs @ 12.42 hrs HW=403.03' (Free Discharge)
└**1=Exfiltration** (Controls 0.16 cfs)

Primary OutFlow Max=4.47 cfs @ 12.42 hrs HW=403.03' (Free Discharge)
└**2=Culvert** (Inlet Controls 4.47 cfs @ 3.46 fps)

Pond 1P: Det Pond #1



Summary for Pond 2P: Det Pond #2

Inflow Area =	154,011 sf, 42.30% Impervious, Inflow Depth = 4.81" for 100 yr - 7.00" event				
Inflow =	15.39 cfs @	12.19 hrs,	Volume=	61,669 cf	
Outflow =	3.62 cfs @	12.68 hrs,	Volume=	61,669 cf,	Atten= 76%, Lag= 29.7 min
Discarded =	0.84 cfs @	12.68 hrs,	Volume=	22,341 cf	
Primary =	2.78 cfs @	12.68 hrs,	Volume=	39,328 cf	

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 403.07' @ 12.68 hrs Surf.Area= 10,891 sf Storage= 24,277 cf

Plug-Flow detention time= 109.2 min calculated for 61,626 cf (100% of inflow)
Center-of-Mass det. time= 109.5 min (922.0 - 812.5)

Volume	Invert	Avail.Storage	Storage Description
#1	398.00'	35,756 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

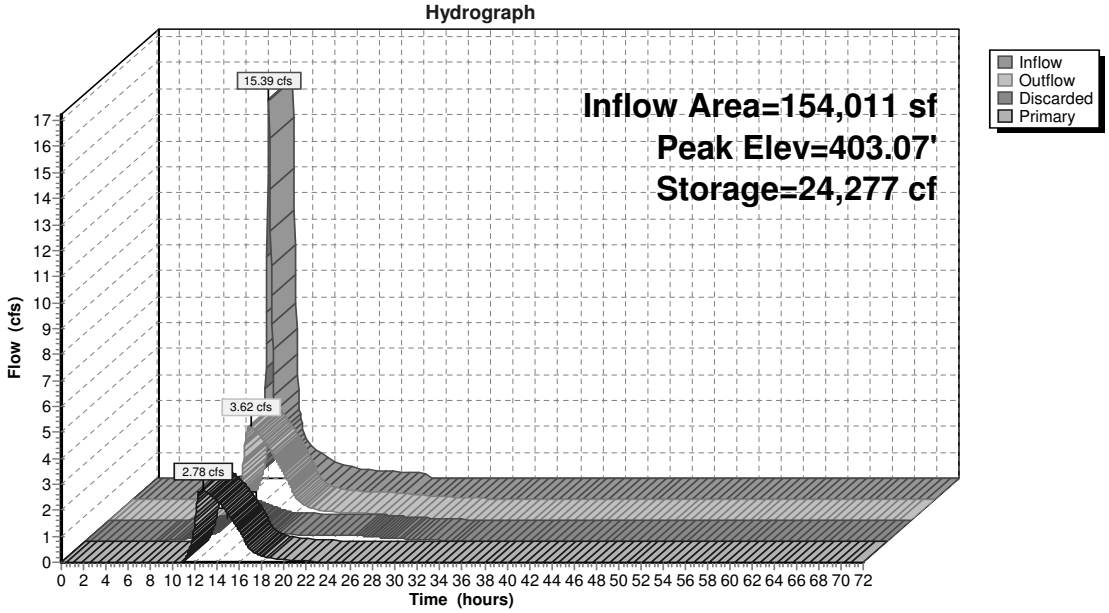
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
398.00	283	84.0	0	0	283
399.00	1,340	176.0	746	746	2,191
400.00	3,441	271.0	2,309	3,056	5,578
402.00	8,049	401.0	11,169	14,224	12,562
404.00	13,735	491.0	21,532	35,756	19,012

Device	Routing	Invert	Outlet Devices
#1	Discarded	398.00'	**2.410 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 394.00'
#2	Primary	400.00'	**8.0" Round Culvert** L= 40.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 400.00' / 394.00' S= 0.1500 '/' Cc= 0.900 n= 0.013, Flow Area= 0.35 sf

Discarded OutFlow Max=0.84 cfs @ 12.68 hrs HW=403.06' (Free Discharge)
└**1=Exfiltration** (Controls 0.84 cfs)

Primary OutFlow Max=2.78 cfs @ 12.68 hrs HW=403.06' (Free Discharge)
└**2=Culvert** (Inlet Controls 2.78 cfs @ 7.96 fps)

Pond 2P: Det Pond #2



Summary for Pond 3P: Det Pond#3

Inflow Area =	60,149 sf, 36.27% Impervious, Inflow Depth = 5.14" for 100 yr - 7.00" event				
Inflow =	7.11 cfs @	12.13 hrs, Volume=	25,763 cf		
Outflow =	2.59 cfs @	12.45 hrs, Volume=	23,165 cf, Atten= 64%, Lag= 19.2 min		
Discarded =	0.07 cfs @	12.45 hrs, Volume=	5,973 cf		
Primary =	2.52 cfs @	12.45 hrs, Volume=	17,191 cf		

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 406.94' @ 12.45 hrs Surf.Area= 6,893 sf Storage= 11,682 cf

Plug-Flow detention time= 464.7 min calculated for 23,148 cf (90% of inflow)
Center-of-Mass det. time= 417.7 min (1,218.7 - 801.0)

Volume	Invert	Avail.Storage	Storage Description
#1	404.00'	19,828 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
404.00	815	180.0	0	0	815
405.00	3,663	255.0	2,069	2,069	3,420
406.00	4,741	281.0	4,190	6,259	4,561
407.00	7,050	450.0	5,857	12,116	14,399
408.00	8,392	470.0	7,711	19,828	15,934

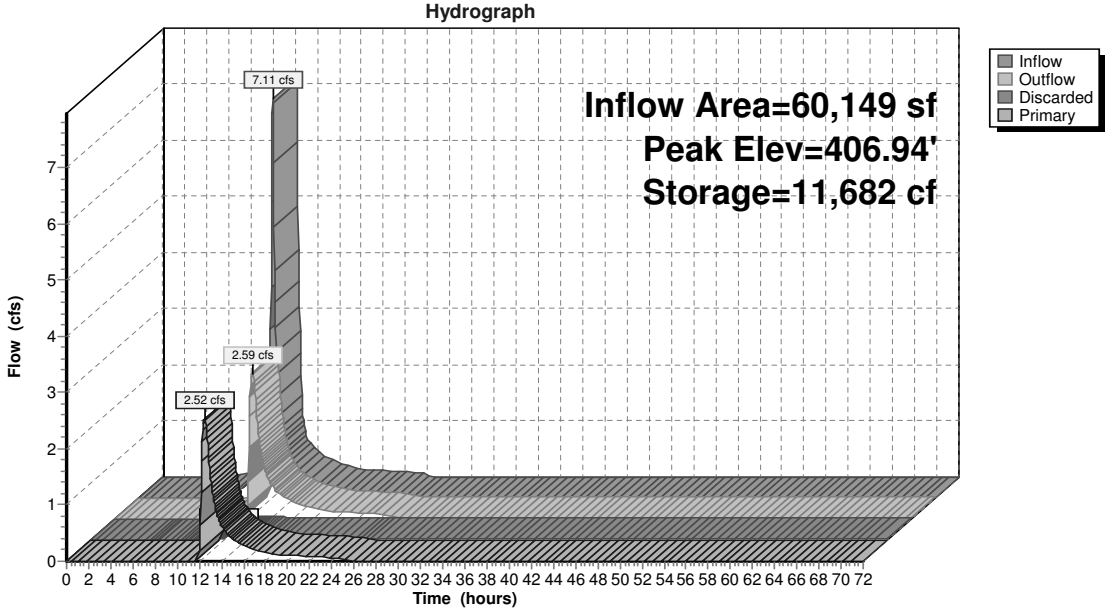
Device	Routing	Invert	Outlet Devices
#1	Discarded	404.00'	**0.170 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 402.00'
#2	Primary	406.00'	**12.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 406.00' / 402.50' S= 0.1400 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Discarded OutFlow Max=0.07 cfs @ 12.45 hrs HW=406.94' (Free Discharge)
└**1=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=2.52 cfs @ 12.45 hrs HW=406.94' (Free Discharge)
└**2=Culvert** (Inlet Controls 2.52 cfs @ 3.30 fps)

Pond 3P: Det Pond#3

Hydrograph



Summary for Pond 4P: Det Pond #4

Inflow Area = 120,833 sf, 24.75% Impervious, Inflow Depth = 4.69" for 100 yr - 7.00" event
Inflow = 12.12 cfs @ 12.17 hrs, Volume= 47,270 cf
Outflow = 5.51 cfs @ 12.47 hrs, Volume= 44,330 cf, Atten= 55%, Lag= 17.8 min
Discarded = 0.11 cfs @ 12.47 hrs, Volume= 7,388 cf
Primary = 5.40 cfs @ 12.47 hrs, Volume= 36,941 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 402.96' @ 12.47 hrs Surf.Area= 9,117 sf Storage= 18,044 cf

Plug-Flow detention time= 321.9 min calculated for 44,330 cf (94% of inflow)
Center-of-Mass det. time= 288.5 min (1,102.8 - 814.2)

Volume	Invert	Avail.Storage	Storage Description
#1	400.00'	28,626 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

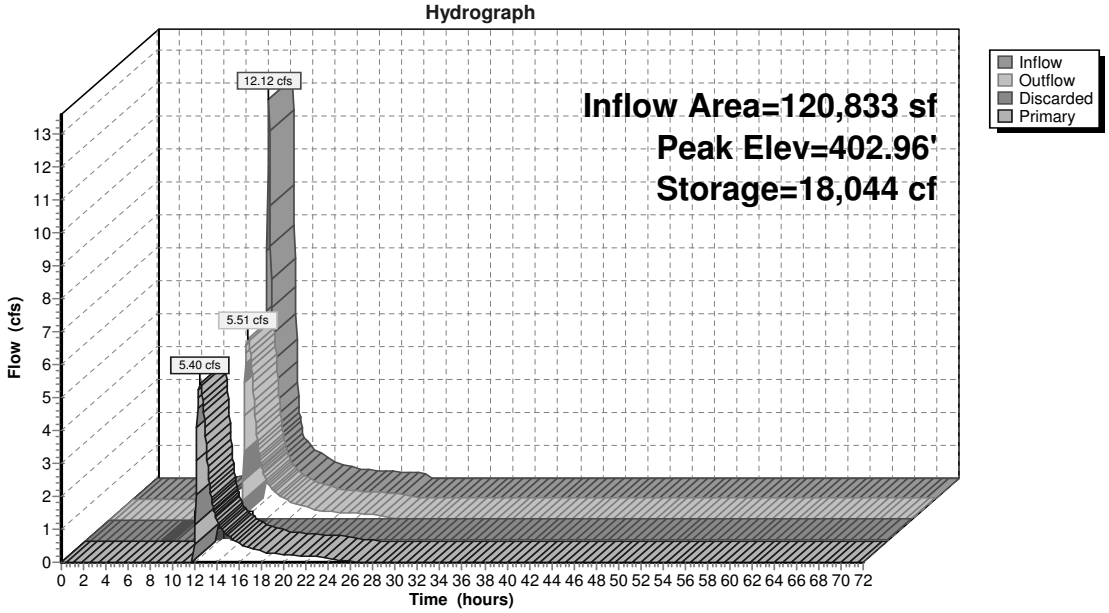
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
400.00	4,196	306.0	0	0	4,196
402.00	6,479	349.0	10,593	10,593	6,531
403.00	9,236	539.0	7,817	18,410	19,965
404.00	11,230	578.0	10,217	28,626	23,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	400.00'	**0.170 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 397.50'
#2	Primary	401.50'	**15.0" Round Culvert** L= 25.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 401.50' / 397.50' S= 0.1600 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Discarded OutFlow Max=0.11 cfs @ 12.47 hrs HW=402.96' (Free Discharge)
└─**1=Exfiltration** (Controls 0.11 cfs)

Primary OutFlow Max=5.39 cfs @ 12.47 hrs HW=402.96' (Free Discharge)
└─**2=Culvert** (Inlet Controls 5.39 cfs @ 4.39 fps)

Pond 4P: Det Pond #4



Summary for Pond 5P: Det Pond #5

Inflow Area = 384,405 sf, 25.95% Impervious, Inflow Depth = 4.15" for 100 yr - 7.00" event
Inflow = 35.36 cfs @ 12.16 hrs, Volume= 132,922 cf
Outflow = 18.97 cfs @ 12.40 hrs, Volume= 132,922 cf, Atten= 46%, Lag= 14.0 min
Discarded = 1.30 cfs @ 12.40 hrs, Volume= 39,506 cf
Primary = 17.67 cfs @ 12.40 hrs, Volume= 93,415 cf

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 397.99' @ 12.40 hrs Surf.Area= 14,147 sf Storage= 36,841 cf

Plug-Flow detention time= 75.7 min calculated for 132,829 cf (100% of inflow)
Center-of-Mass det. time= 75.8 min (900.8 - 825.0)

Volume	Invert	Avail.Storage	Storage Description
#1	394.00'	51,928 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

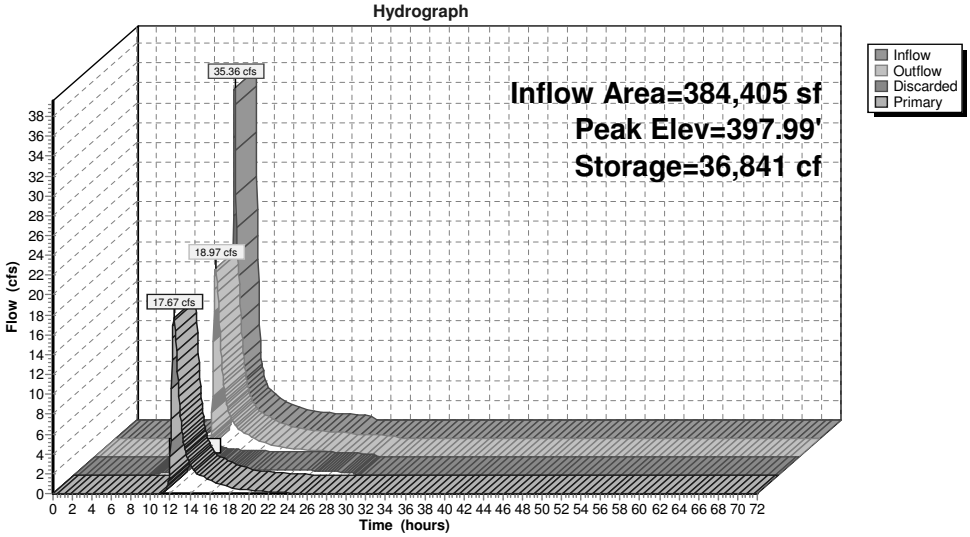
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
394.00	4,910	333.0	0	0	4,910
396.00	9,160	429.0	13,851	13,851	10,781
398.00	14,180	514.0	23,158	37,009	17,229
399.00	15,670	533.0	14,919	51,928	18,896

Device	Routing	Invert	Outlet Devices
#1	Discarded	394.00'	**2.410 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 390.50'
#2	Primary	393.50'	**24.0" Round Culvert** L= 30.0' RCP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 393.50' / 392.50' S= 0.0333 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#3	Device 2	394.90'	**6.0" W x 36.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 2	396.00'	**12.0" W x 24.0" H Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=1.30 cfs @ 12.40 hrs HW=397.99' (Free Discharge)
└─**1=Exfiltration** (Controls 1.30 cfs)

Primary OutFlow Max=17.65 cfs @ 12.40 hrs HW=397.99' (Free Discharge)
└─**2=Culvert** (Passes 17.65 cfs of 28.25 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 8.66 cfs @ 5.78 fps)
  └─**4=Orifice/Grate** (Orifice Controls 8.99 cfs @ 4.52 fps)

Pond 5P: Det Pond #5



Summary for Pond 6P: Det Pond #6

Inflow Area =	98,431 sf, 76.03% Impervious, Inflow Depth = 5.45" for 100 yr - 7.00" event				
Inflow =	11.59 cfs @	12.11 hrs, Volume=	44,668 cf		
Outflow =	5.59 cfs @	12.35 hrs, Volume=	44,668 cf, Atten= 52%, Lag= 14.3 min		
Discarded =	1.98 cfs @	12.35 hrs, Volume=	29,832 cf		
Primary =	3.61 cfs @	12.35 hrs, Volume=	14,836 cf		

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 397.80' @ 12.35 hrs Surf.Area= 4,678 sf Storage= 9,545 cf

Plug-Flow detention time= 28.9 min calculated for 44,668 cf (100% of inflow)
Center-of-Mass det. time= 28.9 min (809.9 - 781.0)

Volume	Invert	Avail.Storage	Storage Description
#1	394.00'	16,799 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

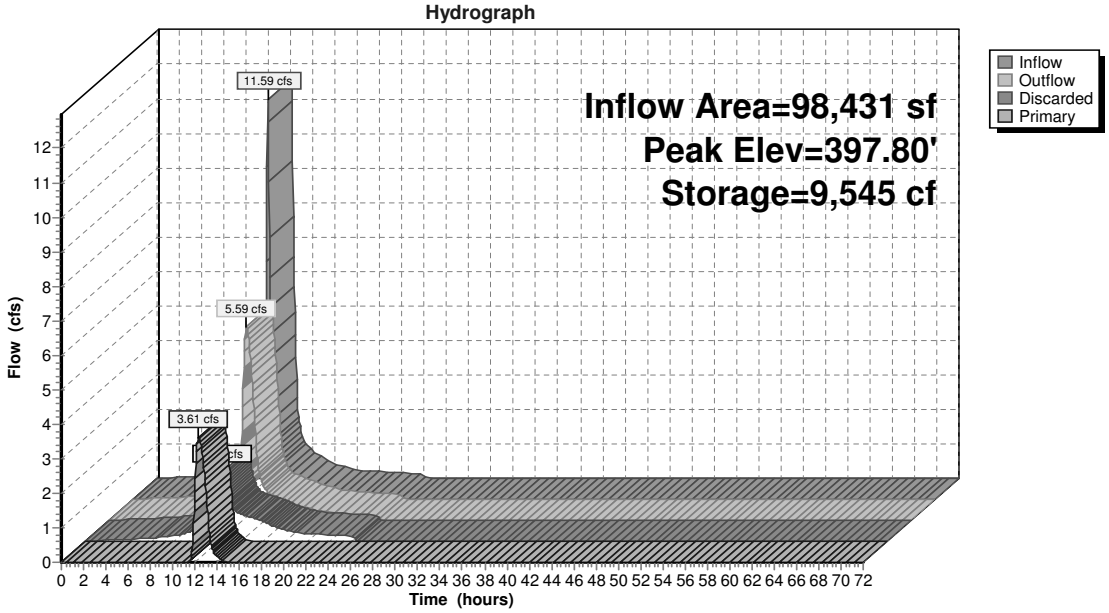
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
394.00	598	106.0	0	0	598
396.00	2,661	225.0	3,014	3,014	3,750
398.00	4,932	299.0	7,477	10,491	6,880
399.00	7,793	364.0	6,308	16,799	10,325

Device	Routing	Invert	Outlet Devices
#1	Discarded	394.00'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 391.50'
#2	Primary	395.50'	**10.0" Round Culvert** L= 30.0' CMP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 395.50' / 393.00' S= 0.0833 '/' Cc= 0.900 n= 0.013, Flow Area= 0.55 sf

Discarded OutFlow Max=1.98 cfs @ 12.35 hrs HW=397.80' (Free Discharge)
└─**1=Exfiltration** (Controls 1.98 cfs)

Primary OutFlow Max=3.61 cfs @ 12.35 hrs HW=397.80' (Free Discharge)
└─**2=Culvert** (Inlet Controls 3.61 cfs @ 6.61 fps)

Pond 6P: Det Pond #6

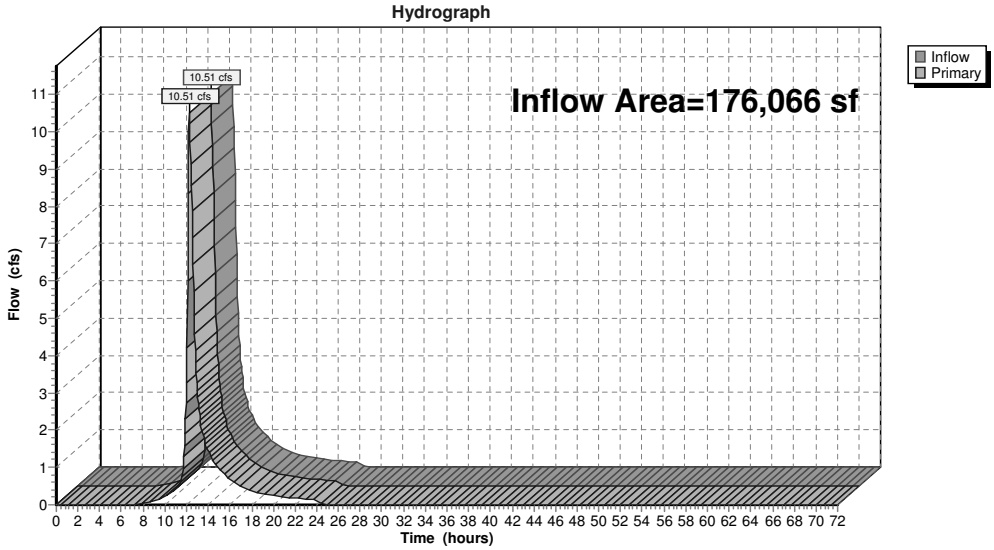


Summary for Link DP-1: DP#1

Inflow Area = 176,066 sf, 19.14% Impervious, Inflow Depth = 3.55" for 100 yr - 7.00" event
Inflow = 10.51 cfs @ 12.26 hrs, Volume= 52,136 cf
Primary = 10.51 cfs @ 12.26 hrs, Volume= 52,136 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-1: DP#1

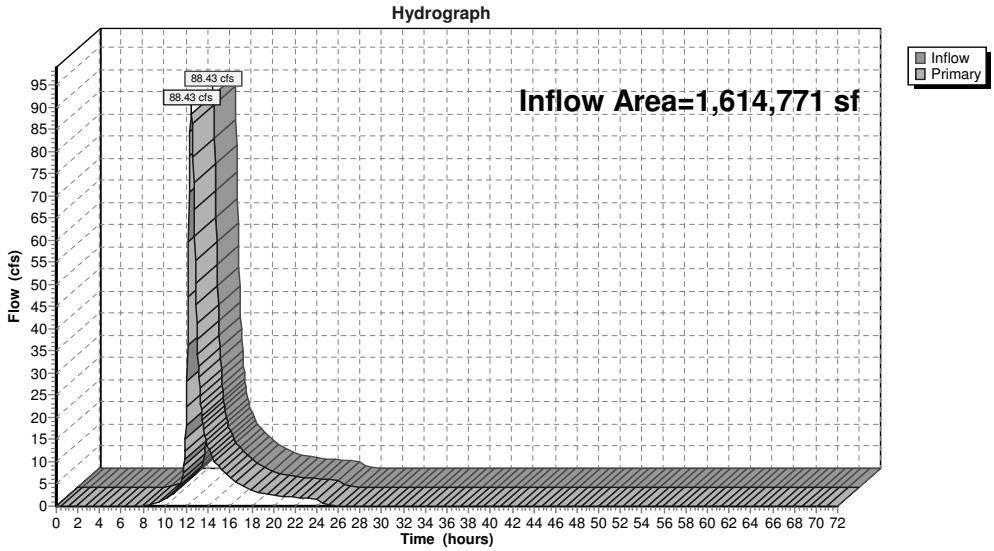


Summary for Link DP-2: DP#2

Inflow Area = 1,614,771 sf, 16.16% Impervious, Inflow Depth = 3.68" for 100 yr - 7.00" event
Inflow = 88.43 cfs @ 12.44 hrs, Volume= 495,148 cf
Primary = 88.43 cfs @ 12.44 hrs, Volume= 495,148 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-2: DP#2

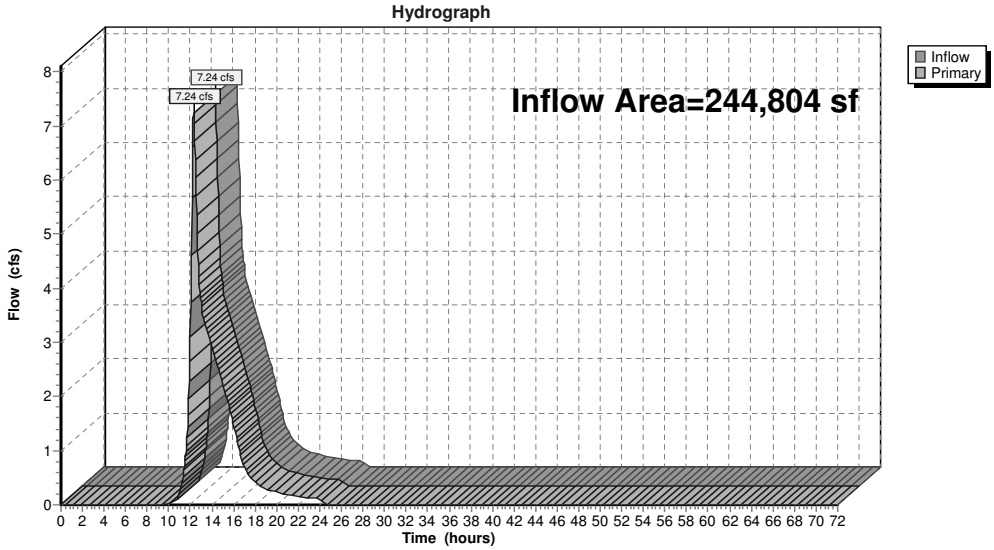


Summary for Link DP-3: DP-3

Inflow Area = 244,804 sf, 26.61% Impervious, Inflow Depth = 3.00" for 100 yr - 7.00" event
Inflow = 7.24 cfs @ 12.29 hrs, Volume= 61,276 cf
Primary = 7.24 cfs @ 12.29 hrs, Volume= 61,276 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-3: DP-3

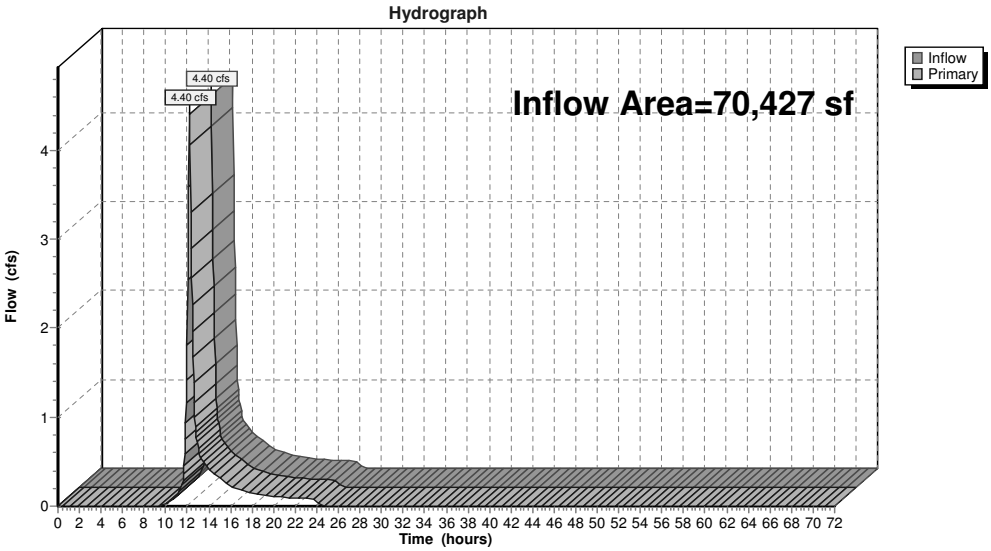


Summary for Link DP-4: DP#4

Inflow Area = 70,427 sf, 3.92% Impervious, Inflow Depth = 2.90" for 100 yr - 7.00" event
Inflow = 4.40 cfs @ 12.17 hrs, Volume= 17,025 cf
Primary = 4.40 cfs @ 12.17 hrs, Volume= 17,025 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link DP-4: DP#4



APPENDIX – A-1

Hydraulic Design (Manning's Equation)
Time of Flow, Average CN values

Standard 2

OVERLAND FLOW TRAVEL TIME

STORM RUNOFF DATA

Date: **6/27/18**
Revised: **9/18/2018**

Project: **Goodridge Brook Estates**
Town: **Lancaster, MA**

Job No: **12,274**
Calc. by: **rst**

Structure	Impervious			Lawn			Wooded			Total
	Length (ft)	Slope ('/')	Time (min.)	Length (ft)	Slope ('/')	Time (min.)	Length (ft)	Slope ('/')	Time (min.)	Travel Time (min.)
1	125	0.045	1.06	75	0.020	14.05				15.11
2	125	0.045	1.06	50	0.020	11.63				12.69
4	170	0.045	1.34	50	0.020	11.63				12.97
6	200	0.010	2.72	75	0.020	14.05				16.77
7	200	0.010	2.72	50	0.020	11.63				14.34
11	110	0.010	1.71	40	0.010	12.33				14.04
12	195	0.010	2.66	80 0	0.040 0.000	12.30 0.00				14.97
15	125	0.010	1.89	50	0.010	13.68				15.57
16	125	0.010	1.89	100	0.040	13.65				15.55
20	225	0.010	2.97	50	0.010	13.68				16.66
21	225	0.010	2.97	50	0.010	13.68				16.66
23	290	0.010	3.62	40	0.010	12.33				15.94
24	220	0.010	2.92	170	0.025	19.54				22.46
26	150	0.010	2.18	70	0.010	16.01				18.19
27	150	0.010	2.18	50	0.010	13.68				15.86
30	100	0.010	1.59	50	0.020	11.63				13.22
31	100	0.010	1.59	100	0.040	13.65				15.25
33	100	0.010	1.59	50	0.020	11.63				13.22
34	100	0.010	1.59	100	0.040	13.65				15.25
36	260	0.010	3.32	100	0.040	13.65				16.98
45	120	0.018	1.46	60	0.030	11.51				12.97
46	120	0.018	1.46	10	0.010	6.45				7.91
50	360	0.018	3.41	10	0.100	3.76				7.16
51	360	0.018	3.41	45	0.030	10.06				13.47
53	60	0.010	1.07	86	0.015	16.03				17.10
55	40	0.010	0.79	25	0.010	9.90				10.69
59	220	0.022	2.16	0	0.000	0.00				2.16
60	190	0.022	1.93	0	0.000	0.00				1.93
61	190	0.022	1.93	0	0.000	0.00				1.93
63	220	0.022	2.16	0	0.000	0.00				2.16
68	120	0.011	1.77	35	0.030	8.95				10.71
70	71	0.010	1.22	10	0.010	6.45				7.68
72	40	0.010	0.79	35	0.010	11.58				12.37
75	185	0.050	1.38	10	0.010	6.45				7.83

AVERAGE 'c' VALUE FOR STRUCTURES

STORM RUNOFF DATA

Date: **9/27/07**
Revised: **3/24/2008**

Project: **Fieldcrest Estates**
Town: **Lancaster, MA**

Job No: **12,274**
Calc. by: **WML**

#	CB	Total Area (SF)	Ground Cover	Area (SF)	c	Σ(Area*c)	Average c	Total Area (Ac)
1		13,086	imp	6,141	0.95	5,833.95	0.61	0.300
			lawn	6,945	0.30	2,083.50		
			wooded	0	0.20	0.00		
2		8,735	imp	4,324	0.95	4,107.80	0.62	0.201
			lawn	4,411	0.30	1,323.30		
			wooded	0	0.20	0.00		
4		22,294	imp	12,411	0.95	11,790.45	0.66	0.512
			lawn	9,883	0.30	2,964.90		
			wooded	0	0.20	0.00		
6		30,794	imp	12,878	0.95	12,234.10	0.57	0.707
			lawn	17,916	0.30	5,374.80		
			wooded	0	0.20	0.00		
7		29,799	imp	12,519	0.95	11,893.05	0.57	0.684
			lawn	17,280	0.30	5,184.00		
			wooded	0	0.20	0.00		
12		53,561	imp	12,614	0.95	11,983.30	0.42	1.230
			lawn	23,020	0.30	6,906.00		
			wooded	17,927	0.20	3,585.40		
11		18,567	imp	8,699	0.95	8,264.05	0.60	0.426
			lawn	9,868	0.30	2,960.40		
			wooded	0	0.20	0.00		
15		8,980	imp	2,952	0.95	2,804.40	0.51	0.206
			lawn	6,028	0.30	1,808.40		
			wooded	0	0.20	0.00		
16		23,023	imp	5,380	0.95	5,111.00	0.42	0.529
			lawn	11,231	0.30	3,369.30		
			wooded	6,412	0.20	1,282.40		
20		13,969	imp	4,817	0.95	4,576.15	0.52	0.321
			lawn	9,152	0.30	2,745.60		
			wooded	0	0.20	0.00		
21		12,477	imp	4,111	0.95	3,905.45	0.51	0.286
			lawn	8,366	0.30	2,509.80		
			wooded	0	0.20	0.00		
23		31,133	imp	13,193	0.95	12,533.35	0.58	0.715
			lawn	17,940	0.30	5,382.00		
			wooded	0	0.20	0.00		
24		85,975	imp	22,742	0.95	21,604.90	0.47	1.974
			lawn	63,233	0.30	18,969.90		
			wooded	0	0.20	0.00		
26		11,668	imp	3,831	0.95	3,639.45	0.51	0.268
			lawn	7,837	0.30	2,351.10		
			wooded	0	0.20	0.00		
27		12,694	imp	4,371	0.95	4,152.45	0.52	0.291
			lawn	8,323	0.30	2,496.90		
			wooded	0	0.20	0.00		
30		11,770	imp	5,241	0.95	4,978.95	0.59	0.270
			lawn	6,529	0.30	1,958.70		
			wooded	0	0.20	0.00		
31		31,594	imp	6,092	0.95	5,787.40	0.40	0.725
			lawn	16,035	0.30	4,810.50		
			wooded	9,467	0.20	1,893.40		
33		11,061	imp	4,808	0.95	4,567.60	0.58	0.254
			lawn	6,253	0.30	1,875.90		
			wooded	0	0.20	0.00		

Project: **Fieldcrest Estates** Job No: **12,274**

Town: **Lancaster, MA** Calc. by: **WML**

#	CB	Total Area	Ground Cover	Area	c	Σ(Area*c)	Average c	Total Area
34		32,243	imp	6,327	0.95	6,010.65	0.41	0.740
			lawn	21,276	0.30	6,382.80		
			wooded	4,640	0.20	928.00		
36		64,826	imp	21,663	0.95	20,579.85	0.52	1.488
			lawn	43,163	0.30	12,948.90		
			wooded	0	0.20	0.00		
		(SF)		**(SF)**				**(Ac)**
45		21,522	imp	4,156	0.95	3,948.20	0.43	0.494
			lawn	17,366	0.30	5,209.80		
			wooded	0	0.20	0.00		
46		4,863	imp	3,340	0.95	3,173.00	0.75	0.112
			lawn	1,523	0.30	456.90		
			wooded	0	0.20	0.00		
50		6,400	imp	4,304	0.95	4,088.80	0.74	0.147
			lawn	2,096	0.30	628.80		
			wooded	0	0.20	0.00		
51		20,454	imp	4,456	0.95	4,233.20	0.44	0.470
			lawn	15,998	0.30	4,799.40		
			wooded	0	0.20	0.00		
53		21,000	imp	10,694	0.95	10,159.30	0.63	0.482
			lawn	10,306	0.30	3,091.80		
			wooded	0	0.20	0.00		
55		4,211	imp	2,827	0.95	2,685.65	0.74	0.097
			lawn	1,384	0.30	415.20		
			wooded	0	0.20	0.00		
59		5,247	imp	5,247	0.95	4,984.65	0.95	0.120
			lawn	0	0.30	0.00		
			wooded	0	0.20	0.00		
60		3,541	imp	2,250	0.95	2,137.50	0.71	0.081
			lawn	1,291	0.30	387.30		
			wooded	0	0.20	0.00		
61		5,701	imp	5,701	0.95	5,415.95	0.95	0.131
			lawn	0	0.30	0.00		
			wooded	0	0.20	0.00		
63		8,149	imp	7,373	0.95	7,004.35	0.89	0.187
			lawn	776	0.30	232.80		
			wooded	0	0.20	0.00		
68		16,975	imp	14,925	0.95	14,178.75	0.87	0.390
			lawn	2,050	0.30	615.00		
			wooded	0	0.20	0.00		
70		4,612	imp	4,079	0.95	3,875.05	0.87	0.106
			lawn	533	0.30	159.90		
			wooded	0	0.20	0.00		
72		12,050	imp	8,244	0.95	7,831.80	0.74	0.277
			lawn	3,806	0.30	1,141.80		
			wooded	0	0.20	0.00		
75		13,252	imp	11,922	0.95	11,325.90	0.88	0.304
			lawn	1,330	0.30	399.00		
			wooded	0	0.20	0.00		

STORM DRAINAGE CALCULATIONS

Pipe Flow Calculations - Manning's Equation

i = Rainfall Intensity at 25 Year Storm

Date: 6/27/18
Revised: 9/18/18
Job No: 12,274
Calc. by: rst

Project: **Goodridge Brook Estates**
Town: **Lancaster, Mass**

Line		Length	Drain Area	Total Area	Runoff	Time of Concentration (min.)			Rainfall i	Required Capacity Q(cfs)		Pipe Diameter	Slope	Design Conditions		Invert Elevation		Rim Elev.	
From	To	(Feet)	(Ac)	(Ac)	"C"	Upper End	In Pipe	Total	(in./hr.)	Inlet	Pipe	(in.)	(ft./ft.)	Depth (in.)	Velocity (f.p.s.)	Upper	Lower	Upper	n
CB 1	DMH 3	7	0.30		0.61	15.11	0.02	15.13	4.44	0.81		12	0.043	2.68	6.19	415.00	414.70	418.64	0.013
CB 2	DMH 3	13	0.20		0.62	12.69	0.05	12.74	4.76	0.59		12	0.023	2.68	4.81	415.00	414.70	418.64	0.013
DMH 3	DMH 5	130		0.50	0.61	15.13	0.30	15.43	4.44	1.36	1.36	12	0.045	3.95	7.29	414.50	408.65	413.00	0.013
CB 4	DMH 5	5	0.51		0.66	12.97	0.01	12.98	4.72	1.59		12	0.070	3.33	8.92	409.00	408.65	412.52	0.013
DMH 5	OUTLET 6	20		1.01	0.64	15.43	0.04	15.46	4.41	2.84	2.84	12	0.047	5.05	9.08	408.45	407.50	408.50	0.013
CB 6	DMH 8	10	0.71		0.57	16.77	0.02	16.79	4.26	1.72		12	0.040	4.01	7.47	404.60	404.20	407.85	0.013
CB 7	DMH 8	17	0.68		0.57	14.34	0.05	14.39	4.54	1.76		12	0.024	4.65	6.24	404.60	404.20	407.85	0.013
DMH 8	DMH 9	42		1.39	0.57	16.79	0.12	16.91	4.26	3.37	3.37	12	0.014	3.11	5.96	404.10	403.50	407.96	0.013
DMH 9	OUTLET 10	100		1.39	0.57	16.91	0.28	17.19	4.24	3.36	3.36	12	0.014	8.11	5.90	403.40	402.00	408.26	0.013
CB 11	DMH 13	20	0.43		0.60	14.04	0.07	14.11	4.58	1.18		12	0.015	4.26	4.72	404.80	404.50	407.95	0.013
CB 12	DMH 13	25	1.23		0.42	14.97	0.08	15.05	4.46	2.30		12	0.012	6.62	5.17	404.80	404.50	407.95	0.013
DMH 13	DMH 17	60		1.66	0.47	14.11	0.19	14.30	4.57	3.54	3.54	12	0.010	9.76	5.16	404.40	403.80	408.12	0.013
CB 15	DMH 14	7	0.21		0.51	15.57	0.02	15.59	4.39	0.47		12	0.086	1.77	6.80	405.50	404.90	409.37	0.013
CB 16	DMH 14	13	0.53		0.42	15.55	0.03	15.58	4.39	0.98		12	0.046	2.96	6.77	405.50	404.90	409.37	0.013
DMH 14	DMH 17	50		0.74	0.45	14.30	0.15	14.45	4.54	1.50	1.50	12	0.020	4.55	5.63	404.80	403.80	408.77	0.013
DMH 17	DMH 18	130		2.40	0.46	15.59	0.48	16.07	4.39	4.85	4.85	18	0.005	10.89	4.52	403.70	403.10	407.28	0.013
DMH 18	OUTLET 19	100		2.40	0.46	16.07	0.37	16.44	4.34	4.79	4.79	18	0.005	10.81	4.51	403.00	402.50	407.28	0.013
CB 30	DMH 32	7	0.27		0.59	13.22	0.02	13.24	4.68	0.75		12	0.043	2.58	6.04	405.80	405.50	409.05	0.013
CB 31	DMH 32	15	0.73		0.40	15.25	0.05	15.30	4.43	1.29		12	0.020	4.14	5.36	405.80	405.50	409.05	0.013
DMH 32	DMH 35	180		1.00	0.45	15.30	0.64	15.94	4.42	2.00	2.00	12	0.010	6.43	4.66	405.40	403.60	409.02	0.013
CB 33	DMH 35	7	0.25		0.58	13.22	0.02	13.24	4.68	0.68		12	0.057	2.19	6.31	404.00	403.60	407.20	0.013
CB 34	DMH 35	15	0.74		0.41	15.25	0.04	15.29	4.43	1.34		12	0.027	3.80	5.95	404.00	403.60	407.20	0.013
DMH 35	DMH 37	155		1.99	0.45	15.29	0.44	15.73	4.42	3.98	3.98	12	0.013	9.66	5.89	403.50	401.50	407.17	0.013
CB 36	DMH 37	65	1.49		0.52	16.98	0.23	17.21	4.24	3.28		12	0.008	10.18	4.61	402.00	401.50	405.02	0.013
DMH 37	DMH 38	185		3.48	0.48	17.21	0.47	17.68	4.21	7.05	7.05	18	0.011	10.46	6.61	401.00	398.90	406.05	0.013
DMH 38	OUTLET 39	100		3.48	0.48	17.68	0.27	17.96	4.16	6.97	6.97	18	0.009	11.86	6.09	398.90	398.00	404.00	0.013

CB 45	DMH 47	7	0.49		0.43	12.97	0.02	12.99	4.72	0.99		12	0.043	2.97	6.54	422.80	422.50	426.05	0.013
CB 46	DMH 47	15	0.11		0.75	7.91	0.06	7.97	5.60	0.46		12	0.020	2.45	3.99	422.80	422.50	426.05	0.013
DMH 47	DMH 48	235		0.60	0.49	12.99	0.72	13.71	4.71	1.38	1.38	12	0.020	4.29	5.46	422.50	417.70	425.94	0.013
DMH 48	DMH 49	46		0.60	0.49	13.71	0.14	13.85	4.62	1.35	1.35	12	0.020	4.22	5.42	417.60	416.70	421.35	0.013
DMH 49	DMH 52	54		0.60	0.49	13.71	0.15	13.85	4.62	1.35	1.35	12	0.028	3.86	6.12	416.60	415.10	420.32	0.013
CB 50	DMH 52	15	0.15		0.74	7.16	0.07	7.23	5.78	0.64		12	0.020	3.29	3.64	415.40	415.10	418.71	0.013
CB 51	DMH 52	7	0.47		0.44	13.47	0.02	13.49	4.65	0.96		12	0.043	3.63	4.77	415.40	415.10	418.71	0.013
DMH 52	DMH 54	108		1.22	0.50	13.49	0.36	13.85	4.65	2.84	2.84	12	0.010	8.09	5.03	415.00	413.90	419.11	0.013
CB 53	DMH 54	5	0.48		0.63	17.10	0.03	17.13	4.22	1.28		12	0.120	6.03	3.23	414.50	413.90	418.00	0.013
DMH 54	DMH 56	135		1.70	0.54	17.13	0.40	17.52	4.22	3.86	3.86	12	0.012	9.71	5.66	413.80	412.45	418.45	0.013
CB 55	DMH 56	5	0.10		0.74	13.50	0.01	13.51	4.65	0.33		12	0.110	1.41	6.37	413.00	412.45	418.35	0.013
DMH 56	DMH 57	64		1.80	0.74	13.85	0.12	13.97	4.60	6.12	6.12	12	0.030	9.72	8.95	412.35	411.05	418.50	0.013
DMH 57	OUTLET 58	120		1.80	0.74	13.97	0.17	14.14	4.58	6.10	6.10	12	0.056	7.55	11.69	410.95	404.00	419.00	0.013
CB 59	DMH 62	45	0.12		0.95	2.16	0.19	2.35	7.91	0.90		12	0.011	4.01	3.91	410.00	409.50	413.40	0.013
CB 60	DMH 62	10	0.08		0.71	1.93	0.03	1.96	8.11	0.46		12	0.050	1.95	5.51	410.00	409.50	413.80	0.013
CB 61	DMH 62	6	0.13		0.95	1.93	0.01	1.94	8.11	1.00		12	0.083	2.53	8.29	410.00	409.50	413.30	0.013
DMH 62	DMH 64	54		0.33	0.89	2.35	0.19	2.54	7.76	2.28	2.28	12	0.010	7.01	4.82	409.40	408.85	413.65	0.013
CB 63	DMH 64	40	0.19		0.89	2.16	0.13	2.29	7.91	1.34		12	0.016	4.48	5.00	409.50	408.85	412.70	0.013
DMH 64	DMH 65	78		0.52	0.89	2.29	0.17	2.46	7.81	3.62	3.62	12	0.025	6.97	7.60	408.75	406.80	414.15	0.013
DMH 65	DMH 66	170		0.52	0.89	2.54	0.55	3.09	7.63	3.53	3.53	12	0.010	9.79	5.17	406.70	405.00	410.10	0.013
DMH 66	OUTLET 67	30		0.52	0.89	3.09	0.06	3.15	7.28	3.37	3.37	12	0.030	6.38	8.05	404.90	404.00	410.10	0.013
CB 68	DMH 69	6	0.39		0.87	10.71	0.01	10.72	5.06	1.72		12	0.033	4.22	6.94	407.70	407.50	411.00	0.013
DMH 69	DMH 71	80		0.39	0.87	10.72	0.30	11.02	5.06	1.72	1.72	12	0.010	5.87	4.50	407.40	406.60	411.20	0.013
CB 70	DMH 71	5	0.11		0.87	7.68	0.01	7.69	5.65	0.54		12	0.080	1.88	6.82	407.00	406.60	411.00	0.013
DMH 71	DMH 73	55		0.50	0.87	7.69	0.19	7.88	5.65	2.46	2.46	12	0.010	7.33	4.89	406.50	405.95	411.50	0.013
CB 72	DMH 73	8	0.28		0.74	12.37	0.02	12.39	4.80	0.99		12	0.069	2.63	7.74	406.50	405.95	410.00	0.013
DMH 73	DMH 74	55		0.78	0.74	12.39	0.18	12.57	4.80	2.77	2.77	12	0.010	8.20	5.05	405.85	405.30	410.25	0.013
DMH 74	DMH 76	158		0.78	0.74	12.57	0.52	13.09	4.77	2.76	2.76	12	0.010	8.16	5.04	405.20	403.60	411.50	0.013
CB 75	DMH 76	5	0.30		0.88	7.83	0.01	7.84	5.62	1.48		12	0.080	3.10	9.20	404.00	403.60	407.25	0.013
DMH 76	DMH 77	5		0.78	0.74	13.09	0.01	13.10	4.70	2.71	2.71	12	0.020	6.30	6.50	403.50	403.40	408.00	0.013
DMH 77	DMH 78	35		0.78	0.74	13.10	0.09	13.19	4.70	2.71	2.71	12	0.020	6.30	6.50	403.00	402.30	408.20	0.013
DMH 77	OUTLET 79	90		0.78	0.74	13.19	0.19	13.38	4.69	2.71	2.71	12	0.036	5.30	8.10	402.20	399.00	410.20	0.013
CB 20	DMH 22	8	0.32		0.52	16.66	0.03	16.69	4.27	0.71		12	0.025	2.90	4.90	402.50	402.30	405.66	0.013
CB 21	DMH 22	15	0.29		0.51	16.66	0.07	16.73	4.27	0.62		12	0.013	3.20	3.70	402.50	402.30	405.66	0.013
DMH 22	DMH 25	298		0.61	0.52	16.73	1.18	17.91	4.26		1.35	12	0.010	5.00	4.20	402.20	399.30	405.63	0.013
CB 23	DMH 25	8	0.72		0.58	15.94	0.02	15.96	4.35	1.80		12	0.025	4.60	6.40	399.50	399.30	402.57	0.013
CB 24	DMH 25	15	1.97		0.47	22.46	0.04	22.50	3.74	3.46		12	0.013	8.50	5.80	399.50	399.30	402.57	0.013
DMH 25	DMH 29	172		3.29	0.48	22.50	0.61	23.11	3.73	5.89	5.89	18	0.005	12.10	4.70	399.10	398.25	402.66	0.013
CB 26	DMH 28	17	0.27		0.51	18.19	0.08	18.27	4.11	0.56		12	0.012	3.07	3.52	401.00	400.80	404.39	0.013
CB 27	DMH 28	13	0.29		0.52	15.86	0.05	15.91	4.36	0.66		12	0.015	3.20	4.00	401.00	400.80	404.39	0.013
DMH 28	DMH 29	25		0.56	0.52	23.11	0.06	23.18	3.69	1.06	1.06	12	0.040	3.10	6.50	400.70	399.70	404.31	0.013
DMH 29	OUTLET 30	30		3.85	0.48	23.18	0.10	23.28	3.68	6.87	6.87	18	0.005	13.70	4.80	398.15	398.00	405.00	0.013

APPENDIX – B

Stormwater Recharge Calculations, Water Quality Volumes, TSS Removal & Infiltration BMP Drain Time
Groundwater Mounding Calculations

Standards 3 & 4:

APPENDIX – B
Stormwater Recharge & Water Quality Volume and Forebay Calulations
Standard 3:

Project:
Goodridge Brook Estates
Lancaster, Massachusetts
Date: July 6, 2018; Revised: 9/18/18

Water Quality Volume (WQV): Based on 0.5 inch rainfall
Recharge Volume(Rv): Based on Soil Classification

Rv = F * Impervious Area
Rv = Required Recharge Volume
F = Depth Factor
Soil Type A – 0.60 inch
Soil Type B – 0.35 inch
Soil Type C – 0.25 inch
Soil Type D – 0.00 inch

Drainage Basin #1 (See Subcatchment 7S):
Imp. Area Pavement: 18,320 s.f.
WQV = (18,320 sf * 0.5 in)/12 = 763 c.f.

Recharge Volume Required: (Soil Type C – 0.25 inch)
Tot. Imp Area: 28,008 s.f.
Rv = (28,008 sf * 0.25 in)/12 = 583 c.f.

Forebay Sizing:

Elev.	Area	Avg.	Depth	Vol.
400.0	597			
401.5	1074	836	1.5	1,253 c.f. > 763 c.f.

Recharge Volume Provided:
Forebay storage volume = 1,253 c.f. > 583 c.f.

Time to drain(Static Method):
Drawdown time = Volume/(K*Bottom Area)
Volume = 1,253 cf
K = 0.27 in/hr = 0.023 ft/hr (Soil Type C)
Bottom Area = 1074 sf

Drawdown time = 1253 c.f./(0.023 ft/hr x 1074 sf)
Drawdown time = 50 hr < 72 hr ***ok***

Drainage Basin #2(See Subcatchment 16S):
Imp. Area Pavement: 48,668 s.f.
WQV = (48,668 sf * 0.5 in)/12 = 2,027 c.f.

Recharge Volume Required: (Soil Type B & C – Use 0.35 inch)
Tot. Imp Area: 64,148 s.f.
Rv = (57,652 sf * 0.35 in)/12 = 1,900 c.f.

Pretreatment provided with Proprietary Unit (Stormceptor or equal)

Recharge Volume Provided:
Storage volume below basin outlet = 5,709 c.f. > 1,900 c.f.

Time to drain(Static Method):
Drawdown time = Volume/(K*Bottom Area)
Volume = 5,709 cf
K = 2.41 in/hr = 0.20 ft/hr (Soil Type A)
Bottom Area = 1360 sf

Drawdown time = 5709 c.f./(0.20 ft/hr x 1360 sf)
Drawdown time = 21.0 hr < 72 hr ***ok***

Drainage Basin #3 (See Subcatchment 10S):
Imp. Area Pavement: 17,154 s.f.
WQV = (17,154 sf * 0.5 in)/12 = 715 c.f.

Recharge Volume Required: (Soil Type C – 0.25 inch)
Tot. Imp Area: 21,819 s.f.
Rv = (21,819 sf * 0.25 in)/12 = 455 c.f.

Forebay Sizing:

Elev.	Area	Avg.	Depth	Vol.
406.2	1202			
407.0	1611	1190	0.8	1,125 c.f. > 715 c.f.

Recharge Volume Provided:
Forebay storage volume = 1,125 c.f. > 455 c.f.

Time to drain(Static Method):
Drawdown time = Volume/(K*Bottom Area)
Volume = 1,125 cf
K = 0.17 in/hr = 0.014 ft/hr (Soil Type C)
Bottom Area = 1202 sf

Drawdown time = 1125 c.f./(0.014 ft/hr x 1202 sf)
Drawdown time = 67.0 hr < 72 hr ***ok***

Drainage Basin #4 (See Subcatchment 8S):
Imp. Area Pavement: 18,735 s.f.
WQV = (18,735 sf * 0.5 in)/12 = 780 c.f.

Recharge Volume Required: (Soil Type C – 0.25 inch)
Tot. Imp Area: 29,901 s.f.
Rv = (29,901 sf * 0.25 in)/12 = 623 c.f.

Forebay Sizing:

Elev.	Area	Avg.	Depth	Vol.
402.15	824			
403.00	1105	964	.085	819 c.f. > 780 c.f.

Recharge Volume Provided:
Forebay storage volume = 819 c.f. > 623 c.f.

Time to drain(Static Method):
Drawdown time = Volume/(K*Bottom Area)
Volume = 819 cf
K = 0.17 in/hr = 0.014 ft/hr (Soil Type C)
Bottom Area = 824 sf

Drawdown time = 819 c.f./(0.014 ft/hr x 824 sf)
Drawdown time = 71 hr < 72 hr ***ok***

Drainage Basin #5 (See Subcatchment 9S):
Imp. Area Pavement: 60,924 s.f.
WQV = (60,924 sf * 0.5 in)/12 = 2,538 c.f.

Recharge Volume Required: (Soil Type C – 0.25 inch)
Tot. Imp Area: 99,769 s.f.
Rv = (99,769 sf * 0.25 in)/12 = 2,078 c.f.

Forebay Sizing:

Elev.	Area	Avg.	Depth	Vol.
397	1567			
398	5460	3513	1.0	3,513 c.f. > 2,538 c.f.

Recharge Volume Provided:
Forebay storage volume = 3,513 c.f. > 2,078 c.f.

Time to drain(Static Method):
Drawdown time = Volume/(K*Bottom Area)
Volume = 3,513 cf
K = 2.41 in/hr = 0.20 ft/hr (Soil Type A)
Bottom Area = 1567 sf

Drawdown time = 3513 c.f./(0.20 ft/hr x 1567 sf)
Drawdown time = 11.2 hr < 72 hr ***ok***

Drainage Basin #6 (See Subcatchment 15S):
Imp. Area Pavement: 39,054 s.f.
WQV = (39,054 sf * 0.5 in)/12 = 1,627 c.f.

Recharge Volume Required: (Soil Type B & C – use 0.35 inch)
Tot. Imp Area: 74,835 s.f.
Rv = (74,835 sf * 0.35 in)/12 = 2,182 c.f.

Pretreatment provided with Proprietary Unit (Stormceptor or equal)

Recharge Volume Provided:
Storage volume below basin outlet = 2,444 c.f. > 2,182 c.f.

Time to drain(Static Method):
Drawdown time = Volume/(K*Bottom Area)
Volume = 2,444 cf
K = 8.27 in/hr = 0.69 ft/hr (Soil Type A)
Bottom Area = 598 sf

Drawdown time = 2,444 c.f./(0.69 ft/hr x 598 sf)
Drawdown time = 5.9 hr < 72 hr ***ok***

Mounding Calculation Basin #2
Goodridge Brook Estates
Lancaster, MA 9/18/18

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values

2.0500	*R*	**Recharge (infiltration) rate (feet/day)**
0.320	Sy	**Specific yield, Sy (dimensionless, between 0 and 1)**
48.20	K	**Horizontal hydraulic conductivity, Kh (feet/day)***
65.000	x	**1/2 length of basin (x direction, in feet)**
16.000	y	**1/2 width of basin (y direction, in feet)**
1.000	t	**duration of infiltration period (days)**
75.000	hi(0)	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	**feet/day**
0.67	1.33
2.00	4.00

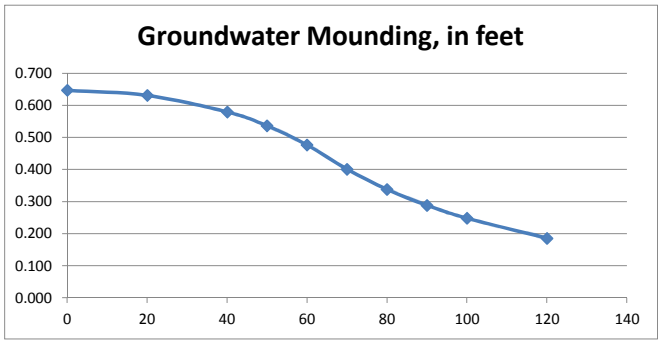
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

75.647	h(max)	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.647	Δh(max)	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.647	**0**
0.631	**20**
0.580	**40**
0.537	**50**
0.477	**60**
0.401	**70**
0.338	**80**
0.289	**90**
0.249	**100**
0.186	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Mounding Calculation Basin #3
Goodridge Brook Estates
Lancaster, MA 9/18/18

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
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use consistent units (e.g. feet & days **or** inches & hours)

Input Values

0.8600	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
3.40	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
50.000	**x**	**1/2 length of basin (x direction, in feet)**
20.000	**y**	**1/2 width of basin (y direction, in feet)**
1.000	**t**	**duration of infiltration period (days)**
75.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	**feet/day**
0.67	1.33
2.00	4.00

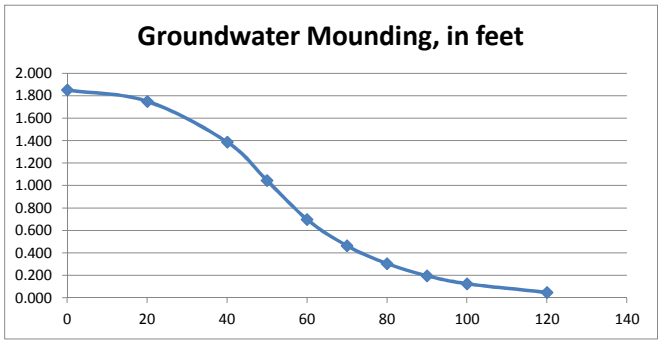
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

76.852	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
1.852	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
1.852	**0**
1.751	**20**
1.388	**40**
1.046	**50**
0.699	**60**
0.464	**70**
0.305	**80**
0.198	**90**
0.126	**100**
0.049	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Mounding Calculation Basin #4
Goodridge Brook Estates
Lancaster, MA 9/18/18

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
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use consistent units (e.g. feet & days **or** inches & hours)

Input Values

0.8100	*R*	**Recharge (infiltration) rate (feet/day)**
0.200	Sy	**Specific yield, Sy (dimensionless, between 0 and 1)**
3.40	K	**Horizontal hydraulic conductivity, Kh (feet/day)***
70.000	x	**1/2 length of basin (x direction, in feet)**
25.000	y	**1/2 width of basin (y direction, in feet)**
1.000	t	**duration of infiltration period (days)**
75.000	hi(0)	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	**feet/day**
0.67	1.33
2.00	4.00

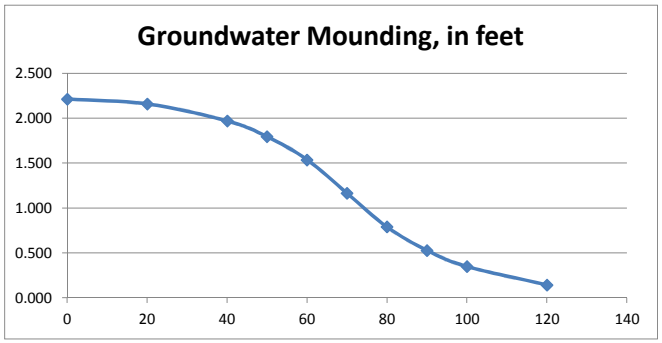
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

77.214	h(max)	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
2.214	Δh(max)	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
2.214	**0**
2.160	**20**
1.971	**40**
1.796	**50**
1.538	**60**
1.165	**70**
0.790	**80**
0.529	**90**
0.350	**100**
0.145	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Mound Calculation Basin #5
Goodridge Brook Estates
Lancaster, MA 9/18/18

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
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Input Values

use consistent units (e.g. feet & days **or** inches & hours)

2.7900	***R***	**Recharge (infiltration) rate (feet/day)**
0.330	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
48.20	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
80.000	**x**	**1/2 length of basin (x direction, in feet)**
42.000	**y**	**1/2 width of basin (y direction, in feet)**
1.000	**t**	**duration of infiltration period (days)**
75.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	**feet/day**
0.67	1.33
2.00	4.00

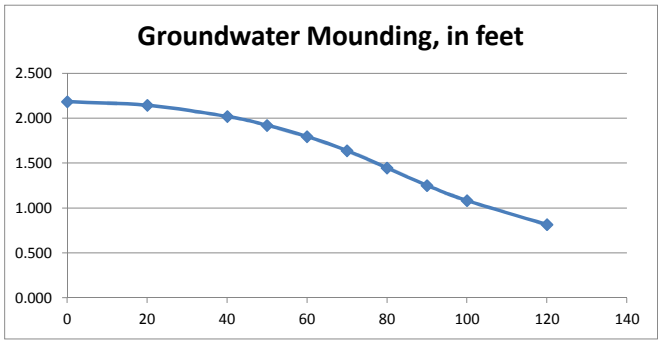
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

77.185	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
2.185	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
2.185	**0**
2.145	**20**
2.021	**40**
1.923	**50**
1.797	**60**
1.640	**70**
1.448	**80**
1.253	**90**
1.084	**100**
0.816	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: DRAINAGE OUTLET #79 (TO BASIN #6)

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
DEEP SUMP HOODED CATCH BASIN	0.25	1.00	0.25	0.75
PROPRIETARY UNIT STORMCEPTOR PRE-TREATMENT	-	-	-	-
INFILTRATION BASIN	0.80	0.75	0.60	0.15

Total TSS Removal = 85%

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

Project: GOODRIDGE BROOK ESTATE
Prepared By: GLM
Date: 7/6/18

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: DRAINAGE OUTLET #67 (TO BASIN #2)

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
DEEP SUMP HOODED CATCH BASIN	0.25	1.00	0.25	0.75
PROPRIETARY UNIT STORMCEPTOR PRE-TREATMENT	-	-	-	-
INFILTRATION BASIN	0.80	0.75	0.60	0.15

Total TSS Removal = 85%

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

Project: GOODRIDGE BROOK ESTATE
Prepared By: GLM
Date: 7/6/18

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: DRAINAGE OUTLET #58 (TO BASIN #2)

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
DEEP SUMP HOODED CATCH BASIN	0.25	1.00	0.25	0.75
PROPRIETARY UNIT STORMCEPTOR PRE-TREATMENT	-	-	-	-
INFILTRATION BASIN	0.80	0.75	0.60	0.15

Total TSS Removal = 85%

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

Project: GOODRIDGE BROOK ESTATE
Prepared By: GLM
Date: 7/6/18

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

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

Version 1, Automated: Mar. 4, 2008

Location: Drainage Outlet #39 (To Basin#5)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
W/Forebay **Infiltration Basin**	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

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

Project: **Goodridge Brook Estate**
Prepared By: **GLM**
Date: **7/6/2018**

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

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

Version 1, Automated: Mar. 4, 2008

Location: Drainage Outlet #30 (To Basin#5)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
W/Forebay **Infiltration Basin**	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

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

Project: **Goodridge Brook Estate**
Prepared By: **GLM**
Date: **7/6/2018**

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

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

Version 1, Automated: Mar. 4, 2008

Location: Drainage Outlet #19 (To Basin#4)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
W/Forebay **Infiltration Basin**	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

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

Project: **Goodridge Brook Estate**
Prepared By: **GLM**
Date: **7/6/2018**

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

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

Version 1, Automated: Mar. 4, 2008

Location: Drainage Outlet #10 (To Basin#1)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
W/Forebay **Infiltration Basin**	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

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

Project: Goodridge Brook Estate
Prepared By: GLM
Date: 7/6/2018

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

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

Version 1, Automated: Mar. 4, 2008

Location: Drainage Outlet #6 (To Basin#3)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
W/Forebay **Infiltration Basin**	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

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

Project: **Goodridge Brook Estate**
Prepared By: **GLM**
Date: **7/6/2018**

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

Project: Goodridge Brook Estates
Location: Lancaster, MA
Prepared For: GLM Engineering Consultants

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
DMH #57	0.68	0.0010625	10.0	0.167	1.00	700.00	0.74
DMH #66	0.47	0.0007344	10.0	0.167	1.00	700.00	0.51
DMH #77	0.90	0.0014063	10.0	0.167	1.00	700.00	0.98

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

GOODRIDGE BROOK ESTATES
LANCASTER, MA

Area	**0.90 ac**	Unit Site Designation	**DMH #77**
Weighted C	**0.9**	Rainfall Station #	**69**
t_c	**10 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.02	0.02	10.1
0.04	9.6%	19.8%	0.03	0.03	9.5
0.06	9.4%	29.3%	0.05	0.05	9.2
0.08	7.7%	37.0%	0.06	0.06	7.4
0.10	8.6%	45.6%	0.08	0.08	8.2
0.12	6.3%	51.9%	0.10	0.10	5.9
0.14	4.7%	56.5%	0.11	0.11	4.3
0.16	4.6%	61.2%	0.13	0.13	4.3
0.18	3.5%	64.7%	0.15	0.15	3.2
0.20	4.3%	69.1%	0.16	0.16	3.9
0.25	8.0%	77.1%	0.20	0.20	7.0
0.30	5.6%	82.7%	0.24	0.24	4.7
0.35	4.4%	87.0%	0.28	0.28	3.6
0.40	2.5%	89.5%	0.32	0.32	2.0
0.45	2.5%	92.1%	0.36	0.36	1.9
0.50	1.4%	93.5%	0.41	0.41	1.0
0.75	5.0%	98.5%	0.61	0.61	3.0
1.00	1.0%	99.5%	0.81	0.81	0.5
1.50	0.0%	99.5%	1.22	1.00	0.0
2.00	0.0%	99.5%	1.62	1.00	0.0
3.00	0.5%	100.0%	2.43	1.00	0.1
					89.7
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**83.3%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

GOODRIDGE BROOK ESTATES
LANCASTER, MA

Area	**0.47 ac**	Unit Site Designation	**DMH #66**
Weighted C	**0.9**	Rainfall Station #	**69**
t_c	**10 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	10.2
0.04	9.6%	19.8%	0.02	0.02	9.6
0.06	9.4%	29.3%	0.03	0.03	9.3
0.08	7.7%	37.0%	0.03	0.03	7.6
0.10	8.6%	45.6%	0.04	0.04	8.4
0.12	6.3%	51.9%	0.05	0.05	6.1
0.14	4.7%	56.5%	0.06	0.06	4.5
0.16	4.6%	61.2%	0.07	0.07	4.5
0.18	3.5%	64.7%	0.08	0.08	3.4
0.20	4.3%	69.1%	0.08	0.08	4.1
0.25	8.0%	77.1%	0.11	0.11	7.5
0.30	5.6%	82.7%	0.13	0.13	5.1
0.35	4.4%	87.0%	0.15	0.15	4.0
0.40	2.5%	89.5%	0.17	0.17	2.3
0.45	2.5%	92.1%	0.19	0.19	2.2
0.50	1.4%	93.5%	0.21	0.21	1.2
0.75	5.0%	98.5%	0.32	0.32	4.0
1.00	1.0%	99.5%	0.42	0.42	0.7
1.50	0.0%	99.5%	0.63	0.63	0.0
2.00	0.0%	99.5%	0.85	0.85	0.0
3.00	0.5%	100.0%	1.27	1.00	0.1
					94.8
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.4%
				Predicted Net Annual Load Removal Efficiency =	**88.3%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

GOODRIDGE BROOK ESTATES
LANCASTER, MA

Area	**0.68 ac**	Unit Site Designation	**DMH #57**
Weighted C	**0.9**	Rainfall Station #	**69**
t_c	**10 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	10.1
0.04	9.6%	19.8%	0.02	0.02	9.5
0.06	9.4%	29.3%	0.04	0.04	9.3
0.08	7.7%	37.0%	0.05	0.05	7.5
0.10	8.6%	45.6%	0.06	0.06	8.3
0.12	6.3%	51.9%	0.07	0.07	6.0
0.14	4.7%	56.5%	0.09	0.09	4.4
0.16	4.6%	61.2%	0.10	0.10	4.4
0.18	3.5%	64.7%	0.11	0.11	3.3
0.20	4.3%	69.1%	0.12	0.12	4.0
0.25	8.0%	77.1%	0.15	0.15	7.2
0.30	5.6%	82.7%	0.18	0.18	4.9
0.35	4.4%	87.0%	0.21	0.21	3.8
0.40	2.5%	89.5%	0.24	0.24	2.1
0.45	2.5%	92.1%	0.28	0.28	2.1
0.50	1.4%	93.5%	0.31	0.31	1.1
0.75	5.0%	98.5%	0.46	0.46	3.5
1.00	1.0%	99.5%	0.61	0.61	0.6
1.50	0.0%	99.5%	0.92	0.92	0.0
2.00	0.0%	99.5%	1.22	1.00	0.0
3.00	0.5%	100.0%	1.84	1.00	0.1
					92.3
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**85.9%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

APPENDIX – C

Stormwater Operation and Maintenance Plan

Standard 9

Stormwater Management Operation and Maintenance Plan

Maintenance Agreement
Goodridge Brook Estates
Lancaster, Massachusetts
July 6, 2018
Revised: September 19, 2018

In accordance with Standard 9 of the Massachusetts Department of Environmental Protection Stormwater Handbook (February 2008), the attached on-site maintenance program for the proposed stormwater management system has been developed to ensure the Best Management Practices (BMP's) in place will remain functioning as designed. The landowner/operator, or its successors, of the Project Site, shall be responsible for financing maintenance and emergency repairs of the entire stormwater management system on the property. The Plan contains both construction period operations and maintenance as well as post construction responsibilities that shall "run" with the property if ownership is transferred.

Responsible Operator:

Cresent Builders Inc.
92 North Main Street
Building C, Unit 100
West Boylston, MA 01583

_____ _____
Signature Date

Construction Period Operation and Maintenance:

- It should be noted that the US EPA mandated NPDES stormwater program requires construction site operators engaged in clearing, grading, and excavating activities that disturb 1 acre or more, including smaller sites in a larger common plan of development or sale, to obtain coverage under an NPDES permit for their stormwater discharges. The Project is subject to this permit and therefore, a Stormwater Pollution Prevention Plan (SWPPP) will be prepared prior to commencement of construction. The SWPPP will contain additional construction period and post construction erosion control requirements.

Erosion Control Barriers:
Filtermitts in combination with silt fencing shall be installed where indicated on the plans and in other appropriate locations where warranted. These barriers shall be installed prior to the commencement of any work on-site and in accordance with the construction plans. A supply of filtermitts and silt fencing shall be kept on-site to replace and/or repair barriers that are damaged or degraded. The barriers shall be observed and maintained on a weekly basis during construction.

Construction Entrances:
The purpose of stabilizing entrances to a construction site is to minimize the amount of sediment leaving the area as mud and sediment attached to vehicles. The entrances shall be sized according to the Massachusetts DEP and US EPA guidelines and will be maintained on a weekly basis during construction. A Detail is included in the Site Plans prepared for the Project.

Sediment Traps/Basins:
Sediment basins and rock dams can be used to capture sediment from stormwater runoff before it leaves a construction site. Both structures allow a pool to form in an excavated or natural depression, where sediment can settle. The pool is dewatered through a single riser and drainage hole leading to a suitable outlet on the downstream side of the embankment or through the gravel of the rock dam. Design a sediment trap to maximize the surface area for infiltration and sediment settling. This increases the effectiveness of the trap and decreases the likelihood of backup during and after periods of high runoff intensity. Site conditions dictate specific design criteria, but the minimum storage capacity should be 1,800 ft^3 per acre of total drainage area (Smolen et al., 1988). The volume of a natural sediment trap can be approximated using the following equation (Smolen et al., 1988): *Volume (ft^3) = 0.4 x surface area (ft^2) x maximum pool depth (ft).* Sediment traps have a useful life of about 18 to 24 months (USEPA, 1993), but their effectiveness depends on the amount and intensity of rainfall and erosion, and proper maintenance.

Dust Control:
Soils information for the site indicates that it is comprised of sandy soils. Therefore, Dust control BMPs to reduce surface activities and air movement that causes dust to be generated from disturbed soil surfaces will be required. The preferred measure for dust control is sprinkling/irrigation. This is an on-going/as-needed requirement until surfaces have been stabilized. There shall be a water truck on-site available as needed.

Diversions:
Temporary diversion swales and mounds will be constructed to divert stormwater away from areas under construction to limit sediment transport. These diversions will be relocated as construction progresses. Stone check dams will be installed in swales as necessary to limit scour and sediment transport.

Catch Basin Protection:
Temporary inlet protection barriers consisting of Silt Sacks® will be placed within all constructed inlets to prevent inflow of sediments into the constructed drainage system. The barriers shall remain in place until a permanent cover is established or diversions away from the inlets are constructed. The barriers shall be observed and maintained as necessary on a weekly basis and after every rainfall of 0.5 inches or more.

Detention Basins/Infiltration Basins:
During Construction, the basins shall be observed during and after all storm events to ensure there is no sediment accumulation or degradation of infiltrative surfaces. The basin bottoms shall be maintained at an elevation at least 1-foot above the proposed finished bottom elevation to protect final infiltrative surfaces. The basins will be excavated to final grades after all surfaces contributing runoff to the basins have been stabilized. Ensure all stumps are fully removed from the area of the system to ensure proper function. Care should be taken by the contractor to prevent compaction of the final basin bottom. Use deep tilling to break up compacted surfaces, should it occur.

Spill Control:
A contingency plan to address the spillage/release of petroleum products and any hazardous materials will be implemented for the site during construction. The plan will include the following measures:

- Equipment necessary to quickly attend to inadvertent spills or leaks shall be on-site in a secure but accessible location. Such equipment will include, but not be limited to, the following: urethane drain cover seals (mats), a spill containment kit which includes sand and shovels, suitable absorbent materials, storage containers, safety goggles, chemically resistant gloves and overshoe boots, water and chemical fire extinguishers, and first aid equipment.
- Spills or leaks will be treated properly according to material type, volume of spillage and location of spill. Mitigation will include preventing further spillage, containing the spilled material to the smallest practical area, removing spilled material in a safe and environmentally friendly manner, and remediating any damage to the environment.
- The contractor shall be familiar with the reporting requirements of the Massachusetts Contingency Plan (310 CMR 40.00) as issued by the Massachusetts Department of Environmental Protection (DEP); specifically Subpart C Notification of Releases and Threats of Release of Oil and Hazardous Materials and Subpart D Preliminary Response Activities and Risk Reduction Measures.
- For any large spills. The Massachusetts DEP Hazardous Waste Incident Response Group shall be notified immediately at 1-617-792-7653 and an emergency response contractor will be called in.

Post-Construction Period Operation and Maintenance:

Pavement Sweeping:
Sweeping has been shown to be an effective initial treatment for reducing contaminants in stormwater runoff. Sweeping is not required to meet TSS removal goals in this case but should be performed in the spring to remove winter accumulations or at other when warranted.

Deep Sump Catch Basins:
Deep sump catch basins remain effective at removing pollutants only if they are cleaned out frequently. Inspect and clean sumps when sediments whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert to the lowest pipe in the basin, at least once (1) time per year, at the end of the foliage and snow removal seasons. Clamshell buckets or vacuum trucks shall be utilized.

Detention Basins/Infiltration Basins:
Vehicle access if necessary will be via the 10 foot wide access way from the project to the retention basin. The drainage easement shall be mowed twice a year and kept clear of any trees.

Inspect it after every major storm for the first few months to ensure it is stabilized and functioning properly and if necessary to take corrective action. Also inspect the basin every time there is a discharge through the high outlet weir. A major storm is defined as a storm that is equal to or greater than the 2.5 inches in a 24-hour storm. Note how long the water remains standing after a storm. If longer than 72 hours, there may be clogging of the infiltrative surfaces. Inspect the basin and mow it at least twice per year. Remove grass clippings, organic matter and trash. Use deep tilling to break up compacted or clogged surfaces.

Roof Runoff System (Infiltration Chambers) :
The inlet pipe and observation access port shall be inspected 4 times per year. Inspect recharge facilities following a rainfall event greater than 2.5 inches in a 24 hour period. Any accumulated debris shall be removed.

If standing water is observed for more than 72 hours following a storm event, immediately retain a qualified professional to assess whether infiltration function has been lost and develop recommended correction actions.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the chambers, clean-out should be performed. Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles.
See Cultec Operations and Maintenance Guidelines for additional information.

Sediment Forebays:

Inspect sediment forebays monthly. Stabilize the floor and sidewalls of the sediment forebay before making it operational, otherwise the practice will discharge excess amounts of suspended sediments. When mowing grasses, keep the grass height no greater than 6 inches. Set mower blades no lower than 3 to 4 inches. Check for signs of rilling and gullying and repair as needed. After removing the sediment, replace any vegetation damaged during the clean-out by either reseeding or resodding. When reseeding, incorporate practices such as hydroseeding with tackifier, blanket, or similar practice to ensure that no scour occurs in the forebay, while seeds germinate and develop roots.

Snow Removal and De-icing:
The use of Sodium Chloride ("rock salt") for de-icing of paved surfaces will be limited; except when found to be necessary for safety of the workers. Sand will be the primary icing control agent. Alternative de-icing products such as calcium chloride may be used as temperatures or other conditions warrant.

Fertilizer:
Slow release organic fertilizers will be used in landscape areas to limit nutrient transport to groundwater and wetland areas. Application will be limited to 3 lbs. per 1000 sf of lawn area.

Spill Control:
See Construction Period Spill control requirements.

General Information			
Project Name	Goodridge Brook Estates		
MA DEP File No.		**Location**	Sterling Road, Lancaster, MA
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Inspector's Qualifications			
Describe present phase of construction			
Type of Inspection: ❑ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event			
Weather Information			
Has there been a storm event since the last inspection? ❑Yes ❑No **If yes, provide:** Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in):			
Weather at time of this inspection? ❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds ❑ Other: Temperature:			
Have any discharges occurred since the last inspection? ❑Yes ❑No **If yes, describe:**			
Are there any discharges at the time of inspection? ❑Yes ❑No **If yes, describe:**			

Site-specific BMPs

- *Number the structural and non-structural BMPs identified in your SWPPP on your site map and list them below (add as many BMPs as necessary). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required BMPs at your site.*
- *Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.*

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
1		❑Yes ❑No	❑Yes ❑No	
2		❑Yes ❑No	❑Yes ❑No	
3		❑Yes ❑No	❑Yes ❑No	
4		❑Yes ❑No	❑Yes ❑No	
5		❑Yes ❑No	❑Yes ❑No	
6		❑Yes ❑No	❑Yes ❑No	
7		❑Yes ❑No	❑Yes ❑No	
8		❑Yes ❑No	❑Yes ❑No	
9		❑Yes ❑No	❑Yes ❑No	
10		❑Yes ❑No	❑Yes ❑No	
11		❑Yes ❑No	❑Yes ❑No	
12		❑Yes ❑No	❑Yes ❑No	
13		❑Yes ❑No	❑Yes ❑No	
14		❑Yes ❑No	❑Yes ❑No	

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
15		❑Yes ❑No	❑Yes ❑No	
16		❑Yes ❑No	❑Yes ❑No	
17		❑Yes ❑No	❑Yes ❑No	
18		❑Yes ❑No	❑Yes ❑No	
19		❑Yes ❑No	❑Yes ❑No	
20		❑Yes ❑No	❑Yes ❑No	

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
1	Are all slopes and disturbed areas not actively being worked properly stabilized?	❑Yes ❑No	❑Yes ❑No	
2	Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	❑Yes ❑No	❑Yes ❑No	
3	Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained?	❑Yes ❑No	❑Yes ❑No	
4	Are discharge points and receiving waters free of any sediment deposits?	❑Yes ❑No	❑Yes ❑No	
5	Are storm drain inlets properly protected?	❑Yes ❑No	❑Yes ❑No	
6	Is the construction exit preventing sediment from being tracked into the street?	❑Yes ❑No	❑Yes ❑No	
7	Is trash/litter from work areas collected and placed in covered dumpsters?	❑Yes ❑No	❑Yes ❑No	
8	Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	❑Yes ❑No	❑Yes ❑No	
9	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	❑Yes ❑No	❑Yes ❑No	
10	Are materials that are	❑Yes ❑No	❑Yes ❑No	

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
	potential stormwater contaminants stored inside or under cover?			
11	Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	❑Yes ❑No	❑Yes ❑No	
12	(Other)	❑Yes ❑No	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance not described above:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: _____

Signature:_____ **Date:**_____

APPENDIX – D

Illicit Discharge Statement

Standard 10

Illicit Discharge Compliance Statement

Goodridge Brook Estates
Lancaster, Massachusetts

July 6, 2018

This statement is provided in accordance with the provisions of the Massachusetts Stormwater Management Standard #10.

To the best of the applicant's/owners knowledge there are no illicit discharges to the site's stormwater manangement system.

All proposed uses on the site will not generate, store or discharge any pollutants to the groundwater and/or wetland resource areas.

Any illicit discharges identified during or after construction will be terminated immediately.

Applicant/Owner:

Cresent Builders Inc.
92 North Main Street
Building C, Unit 100
West Boylston, MA 01583

_____ _____
Signature Date

APPENDIX – E

Supplemental Information

Lancaster, Mass.

PRECIPITATION CHART

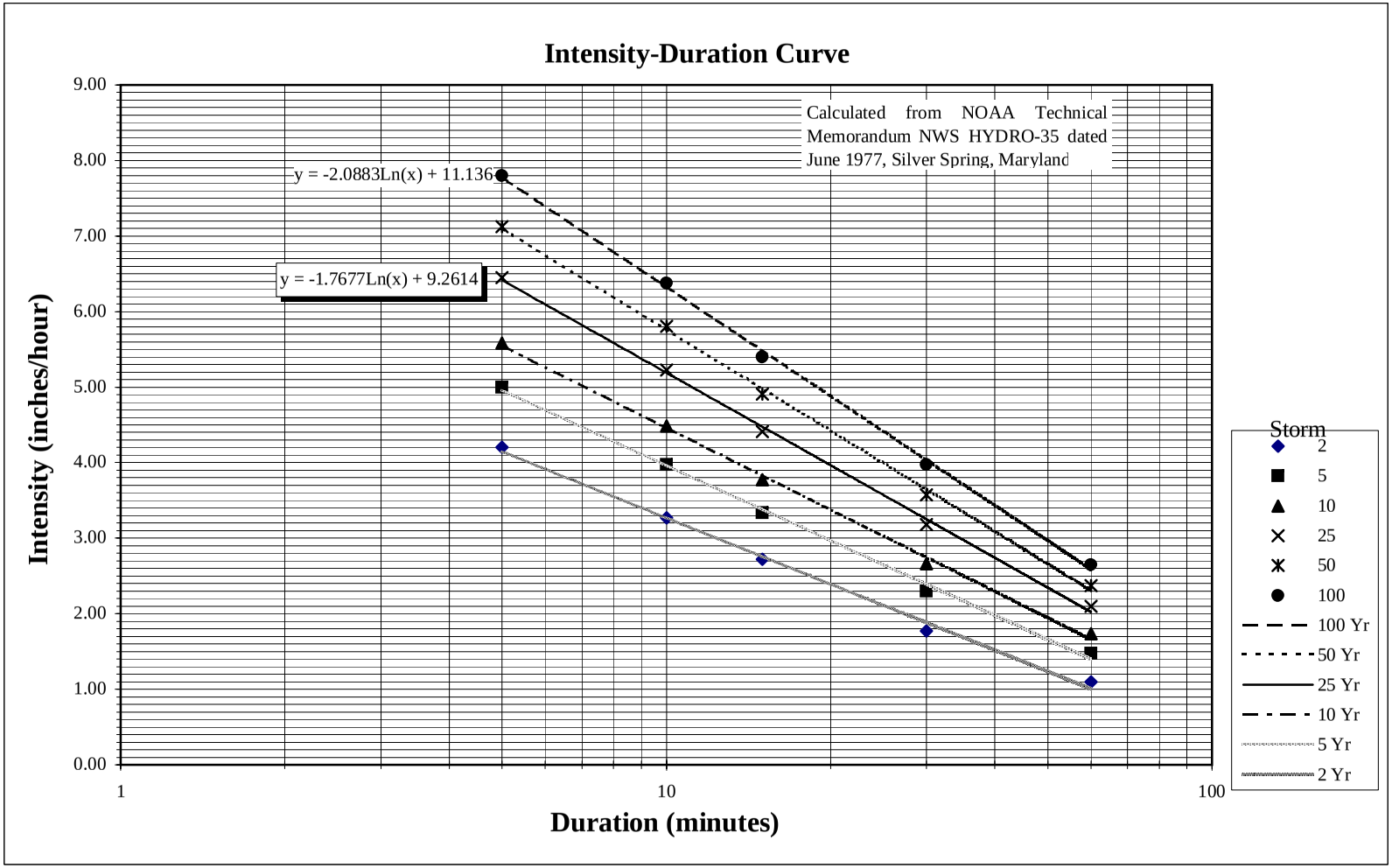
INTENSITY (INCHES)

Frequency (YEARS)	Duration (minutes) 5	10	15	30	60
2	0.35	0.54	0.68	0.89	1.10
5	0.42	0.66	0.83	1.15	1.48
10	0.47	0.75	0.94	1.33	1.74
25	0.54	0.87	1.10	1.59	2.10
50	0.59	0.97	1.23	1.79	2.37
100	0.65	1.06	1.35	1.99	2.65

INTENSITY (INCHES/HOUR)

Frequency (YEARS)	Duration (minutes) 5	10	15	30	60
2	4.20	3.27	2.72	1.77	1.10
5	5.00	3.98	3.33	2.30	1.48
10	5.59	4.48	3.77	2.66	1.74
25	6.45	5.22	4.41	3.18	2.10
50	7.13	5.80	4.91	3.58	2.37
100	7.80	6.38	5.40	3.97	2.65

Calculated from NOAA Technical Memorandum NWS HYDRO-35 dated June 1977, Silver Spring, Maryland


Intensity-Duration Curve
Calculated from NOAA Technical Memorandum NWS HYDRO-35 dated June 1977, Silver Spring, Maryland
y = -2.0883Ln(x) + 11.136
y = -1.7677Ln(x) + 9.2614
Intensity (inches/hour)
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1
10
100
Duration (minutes)
Storm
2
5
10
25
50
100
100 Yr
50 Yr
25 Yr
10 Yr
5 Yr
2 Yr

APPENDIX – F

Supplemental Stormwater Plans

Pre-Development Subcatchment Areas
Post-Development Subcatchment Areas
Hydraulic Subcatchment Areas

SITE DEVELOPMENT PLAN
"GOODRIDGE BROOK ESTATES"
Multi Unit & Single Family Subdivision Layout
LANCASTER, MASSACHUSETTS

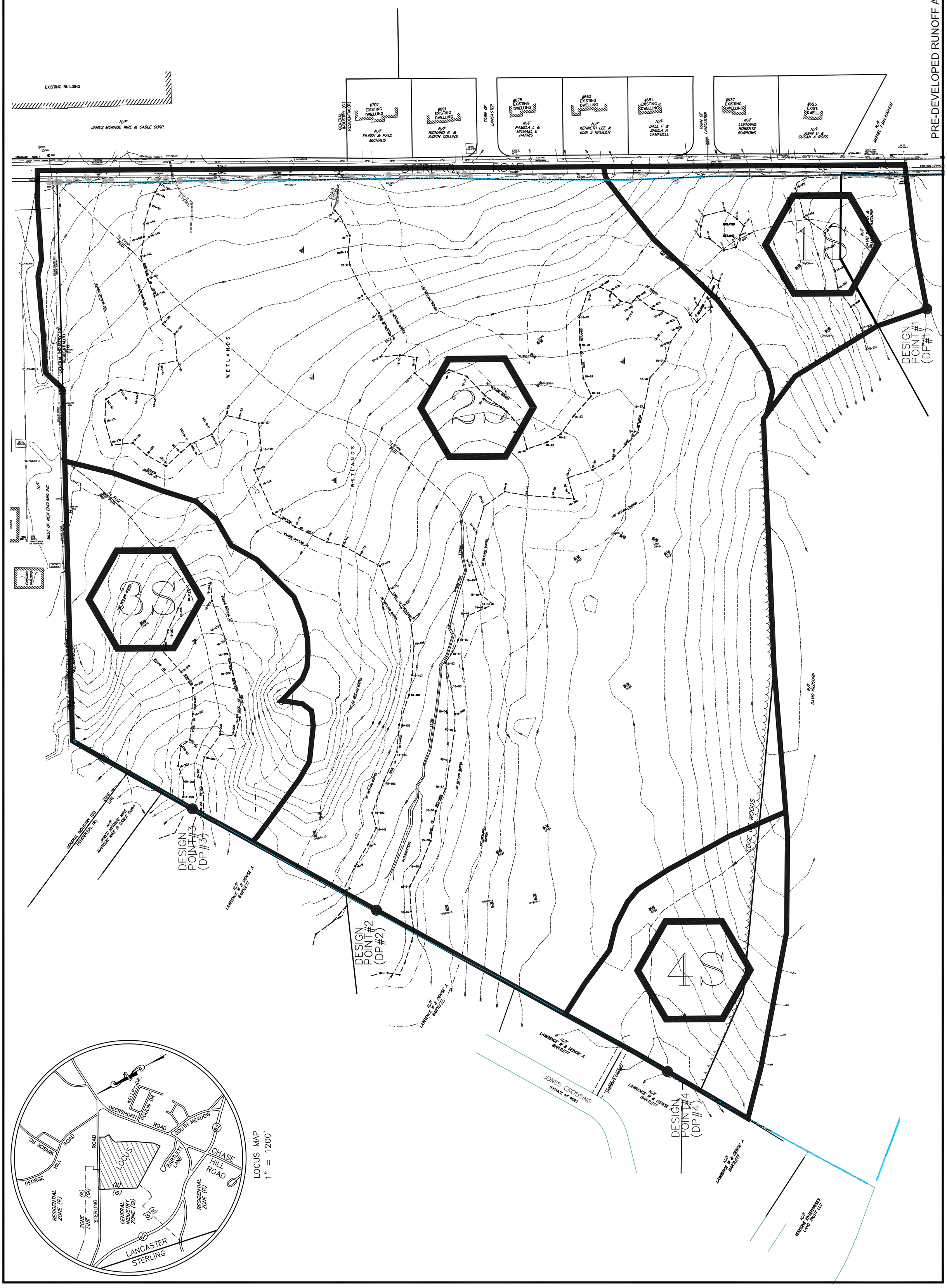
PREPARED FOR:
CRESCENT BUILDERS, INC.
94 NORTH MAIN STREET
BOYLSTON MA 01583

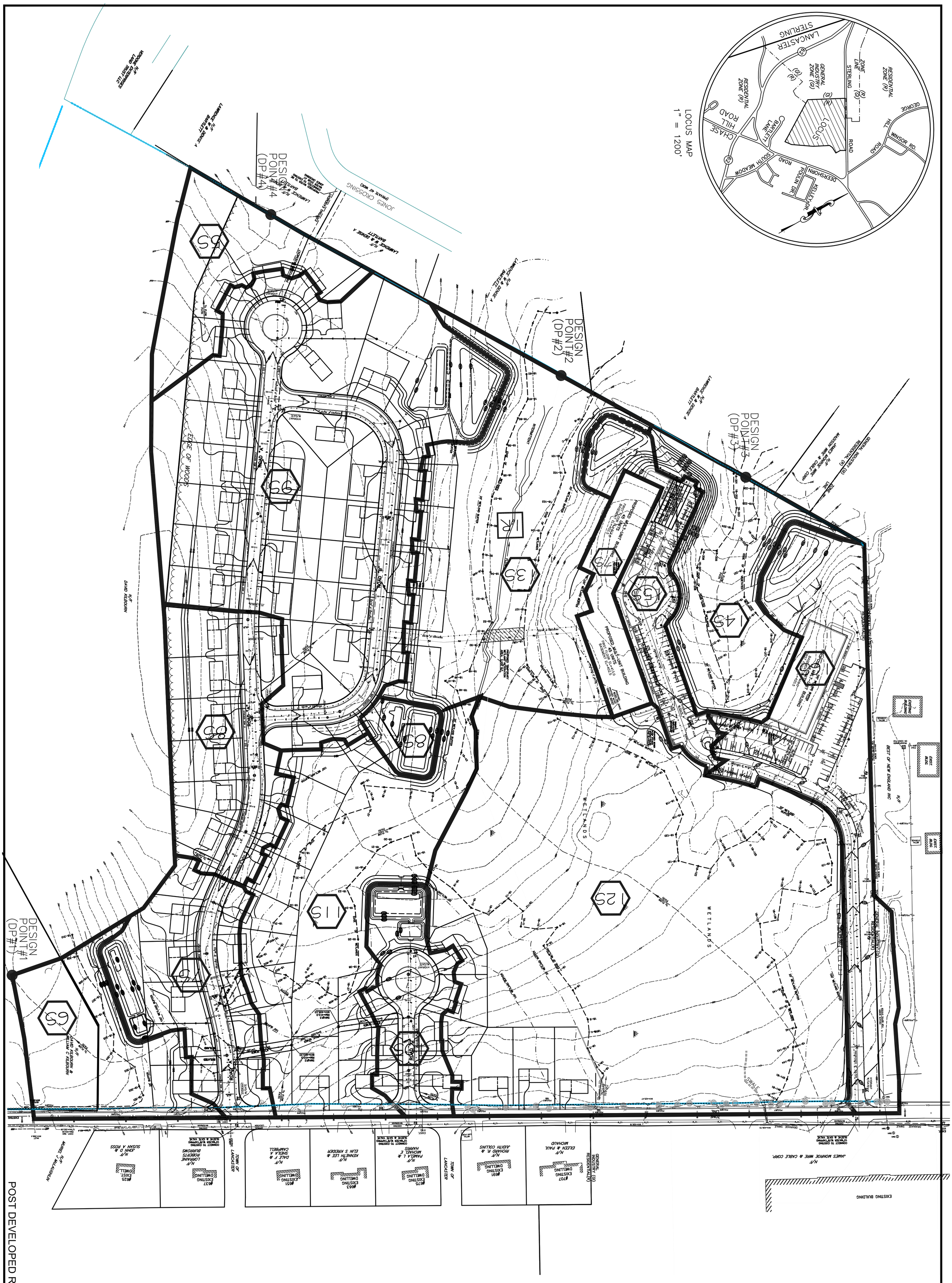
GLM Engineering Consultants, Inc.
19 EXCHANGE STREET
HOLLISTON, MA 01746
P: 508-429-1100
F: 508-429-7160
www.GLMengineering.com

DRW.: RST
JOB No. 12,274-DUPLEX
DATE: OCTOBER 4, 2017
SCALE: 1"= 80'
SHEET: 1 of 3
PLAN #: 27,147

REVISIONS

No.	DATE	DESCRIPTION
1	04/10/18	APARTMENTS 136 UNITS
2	07/06/18	PLAN LAYOUT & DRAINAGE





SITE DEVELOPMENT PLAN
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SCALE: 1"= 80'

SHEET: 2 of 3

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SHEET:	3 of 3
PLAN #:	27,147

REVISIONS

No.	DATE	DESCRIPTION
1	04/10/18	APARTMENTS 136 UNITS

DEEP HOLE – #08-1

HORIZ DEPTH	DATE: 01/28/08 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	404.0
6"		403.5
16"	B – SILT LOAM	402.2
84"	C – FINE SILT LOAM, 5 % GRAVEL	397.0
28"	GROUNDWATER OBSERVED (STANDING / WEEPING)	401.7
24"	SOIL MOTTLING	402.0
24"	ESTIMATED SEASONAL HIGH GROUNDWATER	**402.0**

DEEP HOLE – #08-2

HORIZ DEPTH	DATE: 01/28/08 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	406.0
4"		405.7
12"	B – SANDY LOAM	405.0
80"	C – SILT LOAM	399.3
38"	GROUNDWATER OBSERVED (STANDING / WEEPING)	402.8
30"	SOIL MOTTLING – FAINT	403.5
30"	ESTIMATED SEASONAL HIGH GROUNDWATER	**403.5**

DEEP HOLE – #08-3

HORIZ DEPTH	DATE: 01/28/08 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	402.0
2"		401.8
10"	B – SILT LOAM	401.2
115"	C – SILT LOAM	392.4
NA	GROUNDWATER OBSERVED (STANDING / WEEPING)	
86"	SOIL MOTTLING – FAINT	394.8
30"	ESTIMATED SEASONAL HIGH GROUNDWATER	**394.8**

DEEP HOLE – #08-4

HORIZ DEPTH	DATE: 01/28/08 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	402.2
4"		401.9
14"	B – SILT LOAM	401.0
76"	C – SILT LOAM	395.9
NA	GROUNDWATER OBSERVED (STANDING / WEEPING)	
NA	SOIL MOTTLING – FAINT	
	ESTIMATED SEASONAL HIGH GROUNDWATER	

DEEP HOLE – #08-5

HORIZ DEPTH	DATE: 01/28/08 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	404.5
8"		403.8
26"	B – SILT LOAM	402.3
108"	C – SILT LOAM	395.5
48"	GROUNDWATER OBSERVED (STANDING / WEEPING)	400.5
34"	SOIL MOTTLING – FAINT	401.7
34"	ESTIMATED SEASONAL HIGH GROUNDWATER	**401.7**

DEEP HOLE – #08-6

HORIZ DEPTH	DATE: 01/28/08 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	406.3
3"		406.0
26"	B – SILT LOAM	404.1
72"	C – SILT LOAM	400.3
48"	GROUNDWATER OBSERVED (STANDING / WEEPING)	402.3
38"	SOIL MOTTLING – FAINT	403.1
34"	ESTIMATED SEASONAL HIGH GROUNDWATER	**403.1**

DEEP HOLE – #08-7

HORIZ DEPTH	DATE: 01/28/08 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	401.2
2"		401.0
10"	B – SANDY LOAM	400.4
92"	C – SANDY LOAM	393.5
NA	GROUNDWATER OBSERVED (STANDING / WEEPING)	
NA	SOIL MOTTLING – FAINT	
NA	ESTIMATED SEASONAL HIGH GROUNDWATER	

DEEP HOLE – #08-8

HORIZ DEPTH	DATE: 01/28/08 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	394.0
2"		393.8
20"	B – SILT LOAM	392.3
48"	C1– COURSE SAND	390.0
108"	C1– FINE SAND	385.0
52"	GROUNDWATER OBSERVED (STANDING / WEEPING)	389.7
42"	SOIL MOTTLING – FAINT	390.5
42"	ESTIMATED SEASONAL HIGH GROUNDWATER	**390.5**

DEEP HOLE – #08-9

HORIZ DEPTH	DATE: 01/28/08 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	398.5
3"		398.3
10"	B – SANDY LOAM	397.7
102"	C – SANDY LOAM	390.0
80"	GROUNDWATER OBSERVED (STANDING / WEEPING)	391.8
74"	SOIL MOTTLING – FAINT	392.3
74"	ESTIMATED SEASONAL HIGH GROUNDWATER	**392.3**

DEEP HOLE – #08-10

HORIZ DEPTH	DATE: 01/28/08 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	398.0
3"		397.8
8"	B – SANDY LOAM	397.3
48"	C1 – SANDY LOAM	394.0
76"	C2 – SILTY LOAM	391.7
108"	C3 – SILTY LOAM WITH SHALE	389.0
88"	GROUNDWATER OBSERVED (STANDING / WEEPING)	390.7
78"	SOIL MOTTLING – FAINT	391.5
78"	ESTIMATED SEASONAL HIGH GROUNDWATER	**391.5**

DEEP HOLE – #1

HORIZ DEPTH	DATE: 03/28/06 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	401.8
4"		401.5
19"	B–FINE SANDY LOAM	401.6
108"	C – FINE SILT LOAM, 20% GRAVEL	392.8
48"	GROUNDWATER OBSERVED (STANDING / WEEPING)	397.8
24"	SOIL MOTTLING – FAINT	399.8
24"	ESTIMATED SEASONAL HIGH GROUNDWATER	**399.8**

DEEP HOLE – #2

HORIZ DEPTH	DATE: 03/28/06 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	404.3
8"		403.6
18"	B–FINE SANDY LOAM	402.8
108"	C – SILT LOAM	395.3
18"	GROUNDWATER OBSERVED (STANDING / WEEPING)	402.8
18"	SOIL MOTTLING – FAINT	402.8
18"	ESTIMATED SEASONAL HIGH GROUNDWATER	**402.8**

DEEP HOLE – #3

HORIZ DEPTH	DATE: 03/28/06 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	398.6
8"		397.9
12"	B–FINE SANDY LOAM	397.6
108"	C – SILT LOAM	389.6
72"	GROUNDWATER OBSERVED (STANDING / WEEPING)	392.6
NA	SOIL MOTTLING – FAINT	
72"	ESTIMATED SEASONAL HIGH GROUNDWATER	**392.6**

DEEP HOLE – #4

HORIZ DEPTH	DATE: 03/28/06 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	402.2
6"		401.7
19"	B–FINE SANDY LOAM	400.6
120"	C – SILT LOAM	392.2
92"	GROUNDWATER OBSERVED (STANDING / WEEPING)	394.5
NA	SOIL MOTTLING – FAINT	
92"	ESTIMATED SEASONAL HIGH GROUNDWATER	**394.5**

DEEP HOLE – #5

HORIZ DEPTH	DATE: 03/28/06 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	406.6
6"		406.1
18"	B – SANDY LOAM	405.1
37"	C1 – SANDY LOAM	403.5
113"	C2 – SILT LOAM	397.2
28"	GROUNDWATER OBSERVED (STANDING / WEEPING)	404.3
28"	SOIL MOTTLING – FAINT	404.3
28"	ESTIMATED SEASONAL HIGH GROUNDWATER	**404.3**

DEEP HOLE – #6

HORIZ DEPTH	DATE: 03/28/06 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	407.5
6"		407.0
20"	B – SANDY LOAM	405.8
36"	C1 – SANDY LOAM	404.5
113"	C2 – SILT LOAM	398.1
51"	GROUNDWATER OBSERVED (STANDING / WEEPING)	403.3
24"	SOIL MOTTLING	406.5
24"	ESTIMATED SEASONAL HIGH GROUNDWATER	**406.5**

DEEP HOLE – #7

HORIZ DEPTH	DATE: 03/28/06 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	401.8
8"		401.1
28"	B – SILT LOAM	399.5
38"	C1 – SANDY LOAM	398.6
108"	C2 – SILT LOAM	392.8
36"	GROUNDWATER OBSERVED (STANDING / WEEPING)	398.8
NA	SOIL MOTTLING	
36"	ESTIMATED SEASONAL HIGH GROUNDWATER	**398.8**

DEEP HOLE – #8

HORIZ DEPTH	DATE: 03/28/06 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	407.0
6"		406.5
16"	B – SILT LOAM	405.2
108"	C – SILT LOAM	397.5
48"	GROUNDWATER OBSERVED (STANDING / WEEPING)	403.0
NA	SOIL MOTTLING	
48"	ESTIMATED SEASONAL HIGH GROUNDWATER	**403.0**

DEEP HOLE – #9

HORIZ DEPTH	DATE: 03/28/06 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	418.1
8"		417.4
28"	B – SILT LOAM	415.8
40"	C1 – SANDY LOAM	414.8
108"	C2 – SILT LOAM	409.1
44"	GROUNDWATER OBSERVED (STANDING / WEEPING)	414.4
NA	SOIL MOTTLING	
44"	ESTIMATED SEASONAL HIGH GROUNDWATER	**414.4**

DEEP HOLE – #10

HORIZ DEPTH	DATE: 03/28/06 SOIL DESCRIPTION	ELEV.
0"	A – TOPSOIL	410.1
8"		409.4
18"	B–FINE SANDY LOAM	408.6
28"	C1 – SANDY LOAM	407.8
108"	C2 – SILT LOAM	401.1
60"	GROUNDWATER OBSERVED (STANDING / WEEPING)	405.1
NA	SOIL MOTTLING	
60"	ESTIMATED SEASONAL HIGH GROUNDWATER	**405.1**

SOIL TEST LOGS

REVISIONS

No.	DATE	DESCRIPTION
1	04/10/18	APARTMENTS 136 UNITS
2	07/06/18	PLAN LAYOUT & DRAINAGE

SITE DEVELOPMENT PLAN
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DRW.: RST
JOB No. 12,274
DATE: FEBRUARY 8, 2018
SCALE:
SHEET: 22 of 22
PLAN #: 27,147