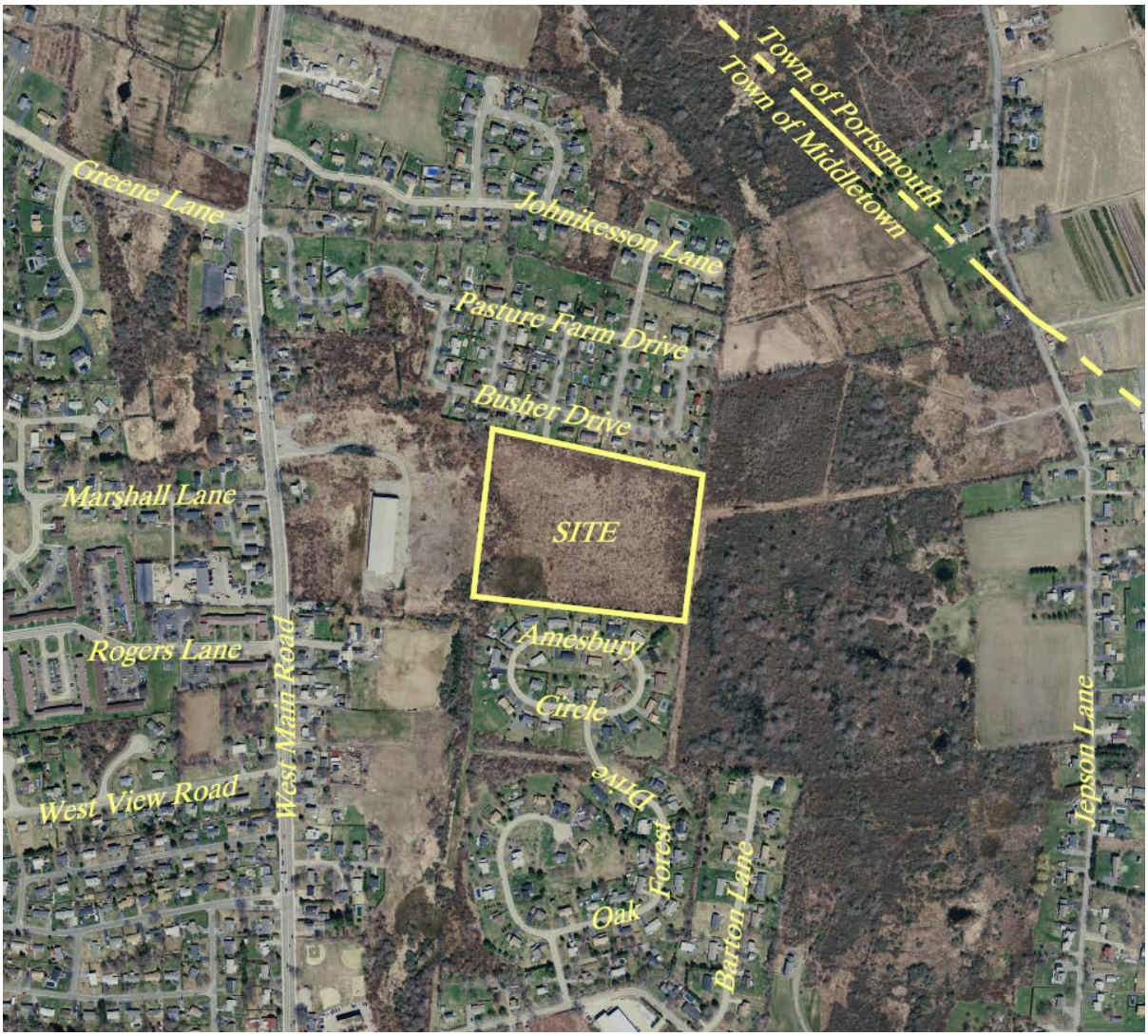
Stormwater Management Report

Revised March 2022



Project Name: GD Middletown West Main

Project Location: 1747 West Main Road, Middletown, RI 02842
Applicant: GD Middletown West Main, LLC, 2000 Chapel View Blvd, Suite 500, Cranston, RI 02920
Owner: Cenz Corp, 4 Fox Place, Providence, RI 02903

Table of Contents

Executive Summary

The purpose of this report is to document drainage calculations and compliance with the Rhode Island Stormwater Design and Installation Standards Manual for the proposed project located in Middletown, Rhode Island. The project is located at 1747 West Main Road in Middletown, Rhode Island on Assessor's Plat 11 Lot 9A (Site). The Site is currently an unoccupied open field.

The project proposes to utilize the open field area on site and convert it to a solar facility by seeding and installing the solar array as shown on the plans associated with this report. No woodland areas or wetlands will be altered by this project. The limit of disturbance is proposed along the existing cleared area to maintain a buffer to abutting property owners, so no clearing is required for the project.

The field will be re-seeded with a wildflower pollinator mix. The primary focus for Best Management Practices incorporated into the site design will be to provide treatment of the water quality volume and provide stormwater quantity detention. A permanent Water Quality Basin is proposed in order to provide both stormwater quantity and quality control. A grass swale is proposed to be installed on the southern side of the site to capture runoff and transport stormwater to the water quality basin. Furthermore, five (5) stone infiltration trenches are proposed to be installed in order to promote sheet flow on the site by acting as level spreaders. The stone infiltration trenches will also promote treatment of the water quality volume. During the construction phase, temporary sediment traps are proposed to capture sediments and to limit the disturbance required for the installation of the solar field.

The nature of the solar field requires no regrading on the majority of the site. Some grading is required to construct a water quality basin and associated swale in the south of the site. The existing grades and slopes are conducive for the installation of the proposed solar array. The project is designed to utilize the existing materials on site to minimize the fill required to be imported. There is no FEMA floodplain on site.

This report details how the Site will show no net increase in stormwater runoff from pre-development to post development conditions, and how the proposed BMP's will provide water quality treatment during construction.

Below is a summary of pre-development and post-development conditions for the watershed:

	Storm Event				
Conditions	**1-Year**	**2-Year**	**10-Year**	**25-Year**	**100-Year**
Pre Development					
Flow (cfs)	4.90 cfs	7.78 cfs	18.75 cfs	28.03 cfs	48.76 cfs
Volume (af)	0.502 af	0.735 af	1.627 af	2.392 af	4.132 af
Post Development					
Flow (cfs)	1.84 cfs	2.66 cfs	14.86 cfs	27.13 cfs	48.72 cfs
Volume (af)	0.157 af	0.360 af	1.226 af	1.998 af	3.768 af
Net Change					
Flow (cfs)	3.06 cfs	5.12 cfs	3.89 cfs	0.90 cfs	0.04 cfs
Volume (af)	0.305 af	0.375 af	0.401 af	0.394 af	0.364 af

Note: cfs = cubic feet per second | af = acre feet

1.0 Project Description and Site Conditions

1.1 Project Description

The project is located at 1747 West Main Road in Middletown, Rhode Island and is located on Assessor's Plat 11 Lot 9A. The subject property is 12.67 acres. The Site is currently zoned L1, Industrial District with a 40,000 square-foot (0.92 acre) lot minimum. The Site is currently an unoccupied open field.

The project proposes to utilize the open field area on site and convert it to a solar facility by seeding and installing the solar array shown on the plans associated with this report. No woodland areas or wetlands will be altered by this project. The limit of disturbance is proposed along the existing cleared area to maintain a buffer to abutting property owners, so no clearing is required for the project.

The field will be re-seeded with a wildflower pollinator mix. The primary focus for Best Management Practices incorporated into the site design will be to provide treatment of the water quality volume and provide stormwater quantity detention. A permanent Water Quality Basin is proposed in order to provide both stormwater quantity and quality control. A grass swale is proposed to be installed on the southern side of the site to capture runoff and transport stormwater to the water quality basin. Furthermore, five (5) stone infiltration trenches are proposed to be installed in order to promote sheet flow on the site by acting as level spreaders. The stone infiltration trenches will also promote treatment of the water quality volume. During the construction phase, temporary sediment traps are proposed to capture sediments and to limit the disturbance required for the installation of the solar field.

The nature of the solar field requires no regrading on the majority of the site. Some grading is required to construct a water quality basin and associated swale in the south of the site. The existing grades and slopes are conducive for the installation of the proposed solar array. The project is designed to utilize the existing materials on site to minimize the fill required to be imported. There is no FEMA floodplain on site.

1.2 Existing Site Conditions

The Site is currently an unoccupied open field. There is no drainage system in or around the area of the Site. Stormwater flows predominantly from east to west and north to south across the Site via sheet flow towards the onsite wetland. The existing field has been modeled as a 50/50 blend of brush/grass as it has been observed from aerial imagery contain both brush/grass that is periodically mowed. The field area of the site has historically been maintained. Limited maintenance mowing of the field in the last few years has allowed a grass/brush mix to establish. The existing field will have wildflower pollinator seed mix applied in and around the entire solar array field to improve the runoff conditions from pre-development to post-development.

The Site is surrounded by residential zones and uses on three sides. The Site abuts a R-10 Residential zone to the north, a R-30 Residential zone to the east and a R-20 Residential zone to the south. There is an existing natural 25-foot vegetative buffer along the northern, eastern and southern property lines. Existing single-family residential dwellings are located to the north

and south of the property. National Grid owns one of the abutting properties to the east, Assessor's Plat 111, Lot 49. A secondary Site access point is located along the northeastern property line to National Grid's property. There is an existing National Grid easement that runs parallel with the eastern property line on Assessor's Plat 11, Lot 46. The projects point of interconnection is proposed within this easement as shown on the plans provided. The property to the west of the Site, Assessor's Plat 111 Lot 8, is zoned L1 and owned by the same company, separate LLC, who owns the subject property. Existing industrial/commercial use is located on the westerly abutting lot and the primary Site access is proposed from this lot.

The nature of the solar field requires no regrading on the majority of the site. Some grading is required to construct a water quality basin and associated swale in the south of the site. The existing grades and slopes are conducive for the installation of the proposed solar array. The project is designed to utilize the existing materials on site to minimize the fill required to be imported. There is no FEMA floodplain on site.

1.3 Proposed Site Conditions

The installation of a 2.25 MW (AC) solar array field is proposed within the open field area. The project proposes that wildflower pollinator seed mix be applied in and around the entire solar array field to improve the runoff conditions from pre-development to post-development. The nature of the solar field requires no regrading on the majority of the site. Some grading is required to construct a water quality basin and associated swale in the south of the site. The existing grades and slopes are conducive for the installation of the proposed solar array. The project is designed to utilize the existing materials on site to minimize the fill required to be imported. There is no FEMA floodplain on site.

The project has minimal frontage on Laura Road to the north. To avoid maintenance and emergency vehicles from accessing the property through a residential neighborhood, the primary proposed vehicular access to the solar array is from the property to the west of the Site, Assessor's Plat 111 Lot 8. This abutting site is owned by the same ownership under a separate LLC, who owns the subject property. A secondary Site access point is located along the northeastern property line to the National Grid owned property, Assessor's Plat 111 Lot 49. The projects point of interconnection is proposed on existing utility pole #17 within an existing National Grid easement that runs parallel with the eastern property line on Assessor's Plat 11, Lot 46 as shown on the plans provided. There is an existing natural 25-foot vegetative buffer along the northern, eastern and southern property lines that will remain and be supplemented by the projects landscape architect where applicable.

The primary focus for Best Management Practices incorporated into the site design will be to provide treatment of the water quality volume and provide stormwater quantity detention. A permanent Water Quality Basin is proposed in order to provide both stormwater quantity and quality control. A grass swale is proposed to be installed on the southern side of the site to capture runoff and transport stormwater to the water quality basin. Furthermore, five (5) stone infiltration trenches are proposed to be installed in order to promote sheet flow on the site by acting as level spreaders. The stone infiltration trenches will also promote treatment of the water quality volume. During the construction phase, temporary sediment traps are proposed to capture sediments and to limit the disturbance required for the installation of the solar field.

1.4 Soils

The following section summarizes the soil types and hydrologic group for this property. The soils are shown on the site plans and are taken from the Soil Survey of RI (USDA NRCS) and available RIGIS mapping.

Soil Symbol	Hydrologic Soil Group	Description
NeB*	C	Newport Silt Loam, 3 to 8 percent slopes
PmA*	C	Pittstown Silt Loam, 0 to 3 percent slopes
PmB*	C	Pittstown Silt Loam, 3 to 8 percent slopes
Se*	D	Stissing Silt Loam

* Prime Agricultural Soils

2.0 RI Stormwater Design and Installation Standards Manual Compliance

The following sections outline how the proposed design complies with the minimum standards of the Rhode Island Stormwater Design and Installation Standards Manual (RISDISM) as amended.

2.1 Standard 1: Low Impact Development Assessment

The Site is currently an unoccupied open field. There is no drainage system in or around the area of the Site. The solar modules are not considered impervious due to the vegetation beneath them. The solar array is located entirely in grass areas to avoid any clearing. Selective clearing will be necessary to install overhead wiring to the utility easement abutting the Site to the east to service the solar array. The site will remain in a vegetated state and be supplemented by a wildflower pollinator seed mix which will be applied in and around the entire solar array field to improve the ground cover and runoff conditions.

The Site is conservatively modeled during pre-development as a field with a 50/50 mix of brush and grass to reflect the current ground cover conditions. The site has a clear history of farming and fields dating from the 1930's to the 1990's with maintenance and mowing continuing through 2020. The original analysis presented to RIDEM assumed the field was grass for pre-development conditions (versus a mix of grass and brush as in the current model). This application was approved under Application No. 18-0326 and RIPDES No. RIR101838. Modelling as a brush/grass mix for pre-development conditions results in a more conservative analysis than originally approved by RIDEM. During post-development, the site has been modeled as being a grass field, showing an increase in curve number. Additionally, the time of concentration has been conservatively modeled and reduced for the sub-catchment areas from pre-development to post development conditions. Since the existing Site currently has no

impervious areas on it, the proposed project will show a negligible net increase of impervious area (0.007 acres) due to the concrete equipment pads. Since the concrete equipment pad area is so minimal and that stormwater from these minor impervious improvements may infiltrate into adjacent vegetated areas, the proposed impervious area was not modeled in post-development conditions, rather it was modeled as grass area. The access driveway is a stone surface consisting of an 8" layer of clean, washed crushed stone in lieu of bituminous concrete pavement to retain pervious surface conditions and reduce runoff rates and volumes. This area has been modeled as grass in post-development conditions as well.

Additionally, five lateral stone infiltration trenches running parallel to the natural contours are proposed on the Site (see Plan Sheet 1.7 for detail). These tranches will provide for additional infiltration and the interception of stormwater. The temporary sediment traps are proposed to be converted to permanent water quality infiltration basins to allow for additional groundwater recharge/water quality treatment. One of the two temporary swales is proposed to be converted to a permanent swale (GS-1) to further facilitate groundwater recharge and to direct stormwater runoff to the water quality basin.

The groundwater recharge and water quality volumes are provided from the proposed water quality basin. Additional groundwater recharge and water quality treatment is provided by the proposed stone infiltration trenches, however these volumes are not counted in the calculations.

The nature of the solar field requires limited regrading. The existing grades and slopes will be maintained and are conducive for a solar array. The existing terrain and positive drainage paths will be preserved. The project is designed to utilize the existing materials on site to minimize the fill required to be imported. There is no FEMA floodplain on site.

Ultimately, the onsite wetlands will be protected during construction and remain unaltered. See Appendix A: Stormwater Management Checklist and LID Planning Report.

2.2 Standard 2: Groundwater Recharge

The requirement for recharge is based on the impervious coverage of the Site and associated recharge factors based on Hydrologic Soil Group's per RISDISM Table 3-4 as outlined below:

Hydrologic Soil Group A – Recharge Factor (F) = 0.60
Hydrologic Soil Group B – Recharge Factor (F) = 0.35
Hydrologic Soil Group C – Recharge Factor (F) = 0.25
Hydrologic Soil Group D – Recharge Factor (F) = 0.10

The recharge requirements are calculated as follows:

Re_v= (1")(F)(I)/12 | Where Re_v= groundwater recharge volume (ac-ft)

F= Recharge Factor (per Table 3-4 of the RISDISM)

I = impervious area (acres) → 0.007 acres (concrete equipment pads)

Re_v= (1")(0.25)(0.007)/12 = 0.0001 ac-ft

The recharge volume is negligible. No impervious areas are proposed that will hinder infiltration. The impervious coverage of the Site (area proposed for solar) is negligible. The rainfall hitting

the panels will flow off and infiltrate into the underlying soils in a similar fashion to rainfall hitting the site under pre-development conditions. Stormwater from minor impervious areas (concrete equipment pads) may infiltrate into adjacent vegetated areas. Therefore, no groundwater recharge is required. However, the proposed water quality basin will provide additionally groundwater recharge as stormwater is directed to it.

2.3 Standard 3: Water Quality

The post-development conditions on the Site result in a slight increase of impervious surface from pre-development conditions. The introduction of the concrete equipment pads results in a negligible increase in runoff from pre-development to post-development conditions.

The Water Quality Volume (WQv) **required** is:

WQv= (0.4")(P)/12 | For pervious areas
P = pervious area (acres) □ 7.729 acres (area within fence)
WQv= (0.4")(7.729)/12 = 0.256 ac-ft required
WQv= (1")(I)/12 | For impervious areas
WQv= (1")(0.007)/12 = 0.0001 ac-ft required
Total WQv required = 0.256 ac-ft + 0.0001 ac-ft = **0.2561 ac-ft required**

The Water Quality Volume (WQv) provided is:
WQv Basin – 11,174 cu-ft / 43,560 sqft = 0.2565 ac-ft
Total WQv provided = **0.2565 ac-ft provided > 0.2561 ac-ft req.**

The water quality volume provided by the proposed water quality basin is taken as the available storage volume (in cubic feet) below the weir invert elevation. It can be seen from the HydroCAD model that for the 1.2" WQv and 1-year storm events, the water quality basin infiltrates all stormwater into the underlying soils. For the purposes of the WQv calculation, the stone infiltration trenches and stone areas around the concrete equipment pads are ignored. The access driveway is a stone surface consisting of an 8" layer of clean, washed crushed stone in lieu of bituminous concrete pavement to retain pervious surface conditions and reduce runoff rates and volumes. The access driveway will only be utilized for periodic maintenance and emergency access and will not receive any pollutant loads. Sanding and salting of the access driveway is prohibited.

2.4 Standard 4: Conveyance and Natural Channel Protection

The site design does not propose any pipe networks associated with this project. Because the site is defined as a small facility with impervious cover less than or equal to an acre (0.007 acres) the channel protection volume requirement is waived in accordance with RISDISM 3.3.4.

2.5 Standard 5: Overbank Flood Protection

The overbank flood protection (Qp) is addressed in this section based on an analysis of the pre-development and post-development watershed based on 1-year, 2-year, 10-year, 25-year, and 100-year storms in accordance with the RIDEM Stormwater Manual and Middletown, RI Stormwater Ordinance (Chapter 153)

TR-20 (Technical Release Number 20) from the USDA Soil Conservation Service Method was used to determine the stormwater runoff rate and volume. Type III rainfall distribution is utilized.

TR-55 (Technical Release Number 55) methodology was used to determine time of concentration. HydroCAD ver. 10.00-21 by Applied Microcomputer Systems was used to model pre-development and post-development conditions.

2.5.1 Design Storm

Analysis of the pre-development and post-development watershed based on 1-year, 2-year, 10-year, 25-year, and 100-year storms are included below. The Rhode Island Stormwater Design and Installation Standards Manual states that for a 24-hour rainfall intensity found in Table 3-1 for Newport County is as follows:

1 year	=	2.8 inches
2 year	=	3.3 inches
10 year	=	4.9 inches
25 year	=	6.1 inches
100 year	=	8.6 inches

2.5.2 Subcatchment Breakdown

The site has been analyzed as one watershed area with one sub-catchment for pre-development and two sub-catchments for post-development. The project proposes to convert the existing unoccupied open field to a solar field. The nature of the solar field requires no significant regrading. The existing grades and slopes will be maintained across the eastern portion of the site and are conducive for a solar array. The western portion of the site is proposed to be regraded in order to create a water quality basin. The existing terrain and positive drainage paths will be preserved. The project is designed to utilize the existing materials on site to minimize the fill required to be imported.

This project aims to minimize the alteration of runoff conditions from pre-development to post-development. Peak runoff rates and volumes from the site for all modeled storm events have been effectively maintained or reduced from pre-development to post-development. A description of each watershed is provided below.

Design Line:

The watershed encompasses the entire site which sheet flows to the Design Line.

Pre (100) encompasses the entire site. There is an existing natural 25-foot vegetative buffer along the northern, eastern and southern property lines that will remain. The Site is currently an unoccupied open field. The field area has historically been mowed but in previous years has had less frequent maintenance, allowing a mix of brush and grass to establish. The field has been conservatively modeled as a 50/50 blend of the brush value (65 for HSG C and 73 for HSG D) and grass (74 for HSG C and 80 for HSG D). There is no drainage system in or around the area of the Site. Stormwater flows predominantly from east to west and north to south across the site via sheet flow towards the onsite wetland.

Post-1 (201) encompasses the majority of the site, excluding the northwestern portion. Elements from Pre (100) will remain and the solar array, access driveway and concrete

equipment pads will be installed. The CN has been increased for the grass field as compared to pre-development conditions. The existing terrain and positive drainage paths will be preserved. This watershed consists of four (4) stone infiltration trenches running along various contour lines that are designed to promote sheet flow and water quality infiltration. Stormwater flows predominantly from east to west and north to south across the site via sheet flow the proposed Water Quality Basin (WQB-201P). Stormwater on the south side of the watershed is captured by a proposed swale to be directed towards WQB-201P. The time of concentration has been reduced as compared to pre-development conditions.

Post-2 (202) encompasses the northwestern portion of the site. Elements from Pre (100) will remain, and the solar array and access driveway will be installed. The CN has been increased for the grass field as compared to pre-development conditions. The existing terrain and positive drainage paths will be preserved. This watershed consists of one (1) stone infiltration trenches running along a contour line that is designed to promote sheet flow and water quality infiltration. Stormwater flows predominantly from east to west and north to south across the site via sheet flow towards the onsite wetland. The time of concentration has been reduced as compared to pre-development conditions.

Ultimately, the onsite wetlands will be protected during construction and remain unaltered. The table below summarizes the hydrologic parameters for the pre-development and post development areas for Design Line-1.

	Area (acres)	**CN**	**Tc (min)**
Pre (100)	9.949 acres	69	11.3 mins

	Area (acres)	**CN**	**Tc (min)**
Post-1 (201)	7.692 acres	74	9.5 mins
Post-2 (202)	2.257 acres	75	9.0 mins

2.5.3 Downstream Analysis

Under the following conditions a downstream analysis is required:

Area of Disturbance (Acres)	**Impervious Cover (%)**
>5 to 10	>75
>10 to 25	>50
>25 to 50	>25
>50	All Projects

The proposed project disturbs 8.46+/- acres and is 0.007 acres of impervious. A downstream analysis is not required.

2.5.4 Overbank Flood Protection Conclusion

Below is a summary of pre-development and post-development conditions for the watershed:

	Storm Event				
Conditions	**1-Year**	**2-Year**	**10-Year**	**25-Year**	**100-Year**
Pre Development Flow (cfs) Volume (af)	 4.90 cfs 0.502 af	 7.78 cfs 0.735 af	 18.75 cfs 1.627 af	 28.03 cfs 2.392 af	 48.76 cfs 4.132 af
Post Development Flow (cfs) Volume (af)	 1.84 cfs 0.157 af	 2.66 cfs 0.360 af	 14.86 cfs 1.226 af	 27.13 cfs 1.998 af	 48.72 cfs 3.768 af
Net Change Flow (cfs) Volume (af)	 3.06 cfs 0.305 af	 5.12 cfs 0.375 af	 3.89 cfs 0.401 af	 0.90 cfs 0.394 af	 0.04 cfs 0.364 af

Note: cfs = cubic feet per second | af = acre feet

2.6 Standard 6: Redevelopment and Infill Projects

The Site is not considered a redevelopment or infill project.

2.7 Standard 7: Pollution Prevention

A separate report entitled “Soil Erosion and Sediment Control Plan for GD Middletown West Main” provides compliance with this Standard. See the Soil Erosion and Sediment Control Plan for the development prepared by Green Development. The SESC contains information for construction pollution prevention. For post construction pollution prevention see the report entitled “Stormwater Operation and Maintenance Plan for GD Middletown West Main” prepared for this development by Green Development.

2.8 Standard 8: Land Uses with Higher Potential Pollutant Loads (LUHPPL)

The site area proposed for solar development is not considered a land use with high potential pollutant load (LUHPPL).

2.9 Standard 9: Illicit Discharges

No illicit discharges as outlined in the RISDIEM 3.2.9 are proposed as part of this project.

2.10 Standard 10: Soil Erosion and Sediment Control

A separate report entitled “Soil Erosion and Sediment Control Plan for GD Middletown West Main” provides compliance with this Standard.

2.11 Standard 11: Stormwater Management System Operation and Maintenance

A separate report entitled “Stormwater Operation and Maintenance Plan for GD Middletown West Main” provides detail for the short and long-term operation and maintenance for this site.

Appendix A: RIDEM Appendix A Checklist

APPENDIX A: STORMWATER MANAGEMENT CHECKLIST AND LID PLANNING REPORT

PROJECT NAME: GD Middletown West Main	(RIDEM USE ONLY)
CONTACT FOR STORMWATER DESIGN QUESTIONS: Kevin Morin, P.E.	
PHONE NUMBER: (401) 295-4998	
EMAIL ADDRESS: km@green-ri.com	
BRIEF PROJECT DESCRIPTION: 2.50 MW AC Solar Energy Project	DATE RECEIVED

STORMWATER MANAGEMENT PLAN ELEMENTS

APPENDIX A: STORMWATER MANAGEMENT CHECKLIST	STORMWATER ANALYSIS AND DRAINAGE REPORT	SOIL EROSION AND SEDIMENT CONTROL PLAN	OPERATIONS AND MAINTENANCE PLAN
PART 1: PROJECT AND SITE INFORMATION **MINIMUM STANDARDS:** 6. REDEVELOPMENT 8. LUHHPL IDENTIFICATION **PART 2.** **MINIMUM STANDARD:** 1. LID SITE PLANNING **PART 3.** SUMMARY OF REMAINING STANDARDS **PART 4.** SUBWATERSHED MAPPING SITE PLAN DETAILS	ADDRESSES MINIMUM STANDARDS: 2. GROUNDWATER RECHARGE 3. WATER QUALITY VOLUME 4. CONVEYANCE & NATURAL CHANNEL PROTECTION 5. OVERBANK AND FLOOD PROTECTION 9. ILLICIT DISCHARGE DETECTION AND ELIM.	ADDRESSES MINIMUM STANDARDS: 7. POLLUTION PREVENTION DURING CONSTRUCTION 10. CONSTRUCTION EROSION AND SEDIMENTATION CONTROL	ADDRESSES MINIMUM STANDARDS: 7. POLLUTION PREVENTION AFTER CONSTRUCTION 11. OPERATIONS AND MAINTENANCE

Note: **All** stormwater construction projects **must submit** a Stormwater Management Plan (SMP). However, not every element listed below (see the Stormwater Management Plan Table) is required per the RISDISM and the RIPDES Construction General Permit (CGP). This checklist will help you identify the elements of the stormwater plan you are required to submit with your permit application.

PART 1. PROJECT AND SITE INFORMATION

PROJECT TYPE (Check all that apply)

☐ RESIDENTIAL	☐ COMMERCIAL	☐ FEDERAL	☐ RETROFIT	☐ RESTORATION
☐ ROAD	X UTILITY	☐ FILL	☐ DREDGE	☐ MINE

☐ OTHER: (please explain)
SITE INFORMATION
X VICINITY MAP: See Plan Set X EXISTING ZONING: L-1 (Industrial, 40,000 SF minimum)
DISCHARGE LOCATION: The WQv discharges to: (you may choose more than one answer if there are several discharge points on the project) (Guidance to identify receiving waters)

☐ GROUNDWATER	GROUNDWATER X GAA ☐ GA ☐ GB
☐ SURFACE WATER	☐ ISOLATED WETLAND X NAMED WATERBODY: ☐ UNNAMED WATERBODY CONNECTED TO NAMED WATERBDY
☐ MS4	☐ RIDOT ☐ RIDOT ALTERATION PERMIT IS APPROVED ☐ TOWN ☐ OTHER:_____

RECEIVING WATER INFORMATION: (check all that apply and *repeat* this row for each waterbody)	
THE WATER QUALITY VOLUME DISCHARGES TO: ☐ N/A (discharges to: CSO, Disconnected wetland or Groundwater) WATERBODY NAME: Narragansett Basin/ Aquidneck Subbasin/Bailey's Brook WATERBODY ID: RI0007035R-01 IMPAIRMENTS: Lead, Enterococcus, Total Phosphorous X TMDL FOR: Enterococcus ☐ CONTRIBUTES TO A PRIORITY OUTFALL LISTED IN THE TMDL	☐ IMPAIRED (303(d) LIST) ☐ SRPW ☐ COLDWATER X WARMWATER ☐ UNASSESSED ☐ 4TH ORDER STREAM ☐ POND OF 50 ACRES OR MORE ☐ KNOWN HISTORY OF REPETITIVE FLOODING (i.e. Pocasset River) ☐ CONTRIBUTES STORMWATER TO A PUBLIC BEACH ☐ CONTRIBUTES TO SHELLFISHING GROUNDS

PROJECT HISTORY:	
☐ PRE-APPLICATION MEETING DATE: N/A	☐ MINUTES ARE ATTACHED
☐ RIDEM GRANT FUNDING INVOLVED: N/A	GRANT SOURCE:_____
☐ TOWN MASTER PLAN APPROVAL N/A (Project cannot start the process until a RIDEM permit is received)	☐ MINUTES ARE ATTACHED
☐ SUBDIVISION SUITABILITY REQUIRED: N/A	APPROVAL #: _____

☐ PREVIOUS ENFORCEMENT ACTION HAS BEEN TAKEN ON THIS PROPERTY: N/A	ENFORCEMENT # _____
FRESHWATER WETLANDS JURISDICTION: X **FEMA FLOODPLAIN FIRMETTE HAS BEEN REVIEWED** ☐ CALCULATIONS ARE PROVIDED FOR CUT/FILL PROPOSED ANYWHERE WITHIN THE 100-YR FLOODPLAIN: N/A ☐ RESTRICTIONS OR MODIFICATINS ARE PROPOSED TO THE FLOWPATH OR VELOCITIES IN A FLOODWAY: N/A ☐ FLOODPLAIN STORAGE CAPACITY IS IMPACTED: N/A	AMOUNT OF FILL: _____(CY) AMOUNT OF CUT: _____(CY) N/A
CRMC JURISDICTION ☐ THIS PROJECT REQUIRES A CRMC PERMIT: N/A ☐ THE PROPERTY IS SUBJECT TO A SPECIAL AREA MANAGEMENT PLAN : N/A ☐ SEA LEVEL RISE MITIGATION WAS DESIGNED INTO THIS PROJECT: N/A	
MINUMUM STANDARD 8: LUHHPL IDENTIFICATION	
OFFICE OF WASTE MANAGEMENT (OWM) ☐ THERE ARE KNOWN OR SUSPECTED RELEASES OF HAZARDOUS MATERIAL AT THE SITE: N/A ☐ THIS SITE IS ON THE LIST OF CERCLA and STATE SITES in RI : N/A	OWM CONTACT: _____ ☐ SITE ID#:_____
STORMWATER INDUSTRIAL PERMITTING ☐ THERE ARE EXISTING OR PROPOSED ACTIVITIES THAT ARE CONSIDERED LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS (LUHPPLS) (see Table 3-2) : N/A ☐ CONSTRUCTION IS PROPOSED ON A SITE THAT IS SUBJECT TO THE MULTI-SECTOR GENERAL PERMIT (MSGP) UNDER RULE 31(B)15 OF THE RIPDES REGULATIONS. : N/A ☐ ADDITIONAL STORMWATER TREATMENT IS REQUIRED BY THE MSGP	ACTIVITIES: _____ SECTOR: _____ MSGP PERMIT #: _____ EXPLAIN ADDITIONAL TREATMENT: ____ _____
MINIMUM STANDARD 6. REDEVELOPMENT (*Required calculation for all construction projects)	
X PRE-CONSTRUCTION IMPERVIOUS AREA	TOTAL IMPERVIOUS AREA **(TIA)** = 0.007 acres
☐ CALCULATE THE SITE SIZE SITE SIZE **(SS)** = **(TSA)** – **(JW)** – **(CL)** = 9.19 acres	TOTAL SITE AREA **(TSA)** = 12.67 acres JURISDICTIONAL WETLANDS **(JW)**: 3.48 acres CONSERVATION LAND **(CL)** = N/A

(TIA)/(SS) = 0.0007 acres	**(TIA)/(SS)** IS **>** 0.4) ☐ YES (REDEVELOPMENT) (address minimum standards 3 and 7-11)	**(TIA)/(SS)** IS **<** 0.4) X NO (NEW DEVELOPMENT) (all standards must be addressed)

PART 2: MINIMUM STANDARD 1

LOW IMPACT DEVELOPMENT ASSESSMENT

(**NOT REQUIRED FOR REDEVELOPMENT OR RETROFITS**) – You may delete this section if it is not required

State Law requires the use of low impact-design techniques as the primary method of stormwater control to the maximum extent practicable. LID is intended to maintain or replicate predevelopment hydrology through the use of site planning, source control, and small-scale practices integrated throughout the site to prevent, infiltrate, and manage runoff as close to its source as possible. Non-structural LID techniques to Avoid and Reduce the stormwater impacts of development shall be explored as a first priority before LID structural practices are planned to Manage stormwater as part of a comprehensive LID approach.

The applicant must document specific LID Site Planning and Design Strategies applied for the project (see Manual Chapter Four and the *RI Low Impact Development (LID) Site Planning and Design Guidance Manual* for more details regarding each strategy). This checklist is designed to guide the required documentation of the site planning process, and to ensure that the proposed project is consistent with and taking advantage of LID strategies required or allowed in the municipality where the project is proposed. Included within this checklist are specific LID techniques (and practices) taken from the *RI Low Impact Development (LID) Site Planning and Design Guidance Manual* that a municipality may require or allow.

If a particular strategy is not used or not applicable, a written description of why a certain method is not used or applicable at the site must be provided. Appropriate answers may include such statements as:

- Town requires XXX (state the specific local requirement)
- Meets Town's dimensional requirement of XXXXX.
- Not practical for site because XXXXXX.
- Applying for waiver/variance to achieve this (pending; was approved; was denied)
- Applying for wavier/variance to seek relief from this (pending; approved; denied)

A) PRESERVATION OF UNDISTURBED AREAS, BUFFERS AND FLOODPLAINS X Sensitive resource areas and site constraints are identified (required) X Local development regulations have been reviewed (required) X All vegetated buffers and coastal and freshwater wetlands have been designed to be protected during and after construction ☐ Conservation Development or other site design technique to protect open space and pre-development hydrology; [NOTE: If this technique has been used, check box and skip to **c**.] N/A X Maintain as much natural vegetation and pre-development hydrology as possible	***IF NOT IMPLEMENTED - EXPLAIN HERE***
B) LOCATE DEVELOPMENT IN LESS SENSITIVE AREAS AND WORK WITH THE NATURAL LANDSCAPE CONDITIONS, HYDROLOGY, AND SOILS X Building envelopes/ development sites directed away from wetlands/waterbodies X Development and stormwater systems are located in areas with greatest infiltration capacity (e.g., soil groups A and B.) Water Quality Basin located in soils with 1.02 in/hr infiltration rate. ☐ Plans show measures to prevent soil compaction in areas designated as Qualified Pervious Areas (QPA's): N/A X Building envelopes/ development sites are directed away from floodplains X Site designed to locate buildings, roadways and parking to avoid impacts to surface water features. X Building envelopes/ development sites directed away from steep slopes (≥15%) ☐ Other:	***IF NOT IMPLEMENTED - EXPLAIN HERE***
C) MINIMIZE CLEARING AND GRADING X Site clearing restricted to <u>minimum area needed</u> for building footprints, development activities, construction access and safety. Site already cleared. Project envelope is within the limits of the existing clearing. X Site designed to locate buildings, roadways and parking to minimize grading (cut and fill quantities): Existing grades on site are already conducive to the solar array project and are to remain as is for the majority of the site. Minimal regrading is required to create a water quality basin. X Protection for stands of trees and individual trees and their root zones to be preserved is specified and such protection extends at least to the drip line. Existing vegetated buffers along residential area are proposed to be preserved. X Notes on plan specify that public trees that are removed or damaged during construction shall be replaced with equivalent. Site is primarily located within existing cleared areas.	***IF NOT IMPLEMENTED - EXPLAIN HERE***

D) REDUCE IMPERVIOUS COVER	***IF NOT IMPLEMENTED - EXPLAIN HERE***
X Reduce roadway widths (≤22 feet for ADT ≤ 400; ≤ 26 feet for ADT 400-2,000) Access driveway is a stone surface consisting of an 8" layer of clean, washed crushed stone between 15'-20' wide to provide for emergency and maintenance access. X Reduce driveway areas (length minimized via reduced ROW width (≤ 45 ft.) and/or reduced (or absolute minimum) front yard setback; width minimized to ≤ 9 ft. wide one lane; ≤ 18 ft. wide two lanes; shared driveways; pervious surface) Access driveway at minimum length for emergency and maintenance services only. X Reduced building footprint: Explain approach No foundations proposed for solar racking units. Units will be anchored with driven posts. ☐ Reduce sidewalk area (≤ 4 ft. wide; one side of the street; unpaved path; pervious surface) N/A ☐ Reduce cul-de-sacs (radius < 45 ft; vegetated island; alternative turn-around) N/A ☐ Reduced parking lot area: Explain approach N/A X Pervious surfaces (driveways, sidewalks, parking areas/overflow parking area) Access driveway **is a stone surface consisting of an 8" layer of clean, washed crushed stone**. The solar arrays are not anchored with full foundations. X Maximum Impervious Surface (project meets or is less than the maximum specified by the Zoning Ordinance **N/A** ☐ Other (describe):	
E) DISCONNECT IMPERVIOUS AREA	***IF NOT IMPLEMENTED - EXPLAIN HERE*** The proposed project will show a negligible net increase in impervious area due to the concrete equipment pads. The access driveway is a stone surface consisting of an 8" layer of clean, washed crushed stone and has been modeled as grass. Cover type for the grass field has been shown to have a higher CN value for post-development (grass) versus pre-development (brush/grass mix). A stormwater BMP is proposed to mitigate this and provide water quality treatment. Stone infiltration trenches are proposed on the site to promote sheet flow and water quality treatment.
☐ Impervious surfaces have been disconnected and runoff has been diverted to QPAs to the maximum extent possible N/A ☐ Residential street edges allow side-of-the-road drainage into vegetated open swales N/A ☐ Parking lot landscaping breaks up impervious expanse AND accepts runoff N/A ☐ Other:	

F) MITIGATE RUNOFF AT THE POINT OF GENERATION X Small-scale BMPs have been designated to treat runoff as close as possible to the source	***IF NOT IMPLEMENTED - EXPLAIN HERE*** The proposed project will show a negligible net increase in impervious area due to the concrete equipment pads. The access driveway is a stone surface consisting of an 8" layer of clean, washed crushed stone and has been modeled as grass. Cover type for the grass field has been shown to have a higher CN value for post-development (grass) versus pre-development (brush/grass mix). A stormwater BMP is proposed to mitigate this and provide water quality treatment. Stone infiltration trenches are proposed on the site to promote sheet flow and water quality treatment.
G) PROVIDE LOW-MAINTENANCE NATIVE VEGETATION X Low-maintenance landscaping is proposed using native species and cultivars ☐ Plantings of native trees and shrubs in areas previously cleared of native vegetation are shown on the site plan N/A: only low vegetation can be planted due to the proposed primary use of the development. X Lawn areas have been limited and/or minimized and yards have been kept undisturbed to the maximum extent on residential lots Cleared area will not be actively maintained with use of fertilizers; the existing field will be replanted with a wildflower pollinator seed mix.	***IF NOT IMPLEMENTED - EXPLAIN HERE***
H) RESTORE STREAMS/WETLANDS ☐ Historic drainage patterns have been restored by removing closed drainage systems, daylighting buried streams, and/or restoring degraded stream channels and/or wetlands. ☐ Removal of invasive species ☐ Other	***IF NOT IMPLEMENTED - EXPLAIN HERE*** No restoration required. Existing onsite wetland will not be removed, blocked or altered during this project.

PART 3: SUMMARY OF REMAINING STANDARDS

Minimum Standard 2: Groundwater Recharge

X YES ☐ NO The project has been designed to meet the groundwater recharge standard.

If No, please explain the justification for groundwater recharge criterion waiver (i.e. threat of groundwater contamination, or physical limitation), if applicable (see Section 3.3.2);

Please describe your waiver request

The proposed project will show a negligible net increase in impervious area due to the concrete equipment pads. The access driveway is a stone surface consisting of an 8" layer of clean, washed crushed stone and has been

modeled as grass. Cover type for the grass field has been shown to have a higher CN value for post-development (grass) versus pre-development (brush/grass mix). A stormwater BMP is proposed to mitigate this and provide water quality treatment. Stone infiltration trenches are proposed on the site to promote sheet flow and water quality treatment.

A waiver is being requested for not providing recharge volume due to no increase in impervious from pre to post-development.

☐ YES X NO Is this site listed as a CERCLA or contaminated site?, if yes?

☐ YES ☐ NO Has any part of the site been approved for infiltration by the Office of Waste Management? (see Subsurface Contamination Guidance)

X YES ☐ NO Is there an ELUR on the property?

TABLE 2-1: Summary of Recharge (see Manual section 3.3.2)

Subwatershed	Total Re_v Required (Acre-ft)	LID Stormwater Credits (Manual see Section 4.6.1)		Recharge Required by Remaining BMPs (acre-ft)	Recharge Provided by BMPs (acre-ft)
		Impervious volume directed to a QPA (acre-ft)	Recharge Credit Applied (acre-ft)		
DP-1:	0.0000	0.0000	0.0000	0	0.000 ac-ft
Totals:	0.0000	0.0000	0.0000	0	0.000 ac-ft

**Note: Only BMPs listed in Manual Table 3-5, List of BMPs Acceptable for Recharge may be used to meet the recharge requirement.*

X Indicate below where the pertinent calculations and/or information for the above items are provided (i.e. name of report/document, page numbers); N/A – The CN Storm is not included in this report due to no increase in impervious area.

Minimum Standard 3: Water Quality

X YES ☐ NO Does this project meet or exceed the required water quality volume WQv (see section 3.3.3)?

☐ YES X NO Is the proposed final impervious cover is greater than 20% of the disturbed area (see section 3.3.3)?

☐ If yes, the Spit Pervious/Impervious method in Hydro-Cad was used to calculate WQv, or

☐ If yes, TR-55 or TR-20 was used to calculate WQv, and

X If no, the project meets the minimum WQv of 0.2 watershed inches over the entire disturbed area.

X YES ☐ NO Does this project meet or exceed the ability to treat required water quality flow WQf(see section 3.3.3.2)?

☐ YES X NO Is there an increase of impervious cover to a receiving water body with impairments?

If yes, please indicate below the method that was used to address the water quality requirements of no further degradation to a low quality water.

☐ RISDISM section H.3 Pollutant Loading Analysis

☐ The Water Quality Guidance Document (Water Quality Goals and Pollutant Loading Analysis Guidance for Discharges to Impaired Waters)

☐ YES X NO BMPs are proposed that are on the approved technology list if yes, please provide all of the required worksheets from the manufacturer. No BMP's proposed.

☐ YES X NO Additional pollutant-specific requirements and/or pollutant removal efficiencies are applicable to the site as the result of a TMDL, SAMP or other watershed-specific requirements; If yes, please describe: N/A

TABLE 3-1: Summary of Water Quality (see Manual section 3.3.3)

Subwatershed	Total WQ_v Required (Acre-ft)	LID Stormwater Credits (Manual see Section 4.6.1)		Water Quality Treatment Remaining (acre-ft)	Water Quality Provided by BMPs (acre-ft)
		Impervious volume directed to a QPA (acre-ft)	Water Quality Credit Applied (acre-ft)		
DP-1:	0.2561	0.0000	0.0000	0.00	0.2565
Totals:	0.2561	0.0000	0.0000	0.00	0.2565

**Note: Only BMPs listed in Chapter 5 of the Manual or the Approved Technologies List of BMPs is Acceptable for Water Quality treatment.*

X YES ☐ NO This project has met the setback requirements for each BMP. If no, please explain *_ The proposed project will show a negligible net increase in impervious area due to the concrete equipment pads. The access driveway is a stone surface consisting of an 8" layer of clean, washed crushed stone and has been modeled as grass. Cover type for the grass field has been shown to have a higher CN value for post-development (grass) versus pre-development (brush/grass mix). A stormwater BMP is proposed to mitigate this and provide water quality treatment. Stone infiltration trenches are proposed on the site to promote sheet flow and water quality treatment.

☐ Indicate below where the pertinent calculations and/or information for the above items are provided (i.e. name of report/document, page numbers);

Minimum Standard 4: Conveyance and Natural Channel Protection (3.3.4)

X YES ☐ NO Is this standard waived? If yes, please check indicate one or more of the reasons below:

☐ The project directs discharge to a large river (i.e., 4th-order stream or larger. See Appendix I for State-wide list and map of stream order), bodies of water >50.0 acres in surface area (i.e., lakes, ponds, reservoirs), or tidal waters.

☒ The project directs is a small facility with impervious cover of less than or equal to 1 acre.

☐ The project has a post-development peak discharge rate from the facility that is less than 2 cfs for the 1-year, 24-hour Type III design storm event (prior to any attenuation). (**NOTE:** *LID design strategies can greatly reduce the peak discharge rate)*

☐ YES ☐ NO Conveyance and natural channel protection for the site have been met.

If no, explain why _N/A_____

_____

TABLE 4-1: Summary of Channel Protection Volumes (see Manual section 3.3.4)

Drainage Point	Receiving Water Body Name	Coldwater Fishery? Y/N	Total CPv Required (acre-ft)	Total CPv Provided (acre-ft)	Release Rate Modeled in the 2-yr storm (cfs)
DP-1:	Bailey's Brook	N	0	0	0
Totals:			0	0	0

N/A

☐ YES ☐ NO The CPv is released at roughly a uniform rate over a 24-hour duration (see example sizing calculations in Appendix D of the RISDISM). N/A

☐ YES X NO Do additional design restrictions apply resulting from any discharge to cold water fisheries; N/A

If yes, please indicate restrictions and solutions

_____

_____

☐ Indicate below where the pertinent calculations and/or information for the above items are provided (i.e. name of report/document, page numbers);

__N/A_____

_____

Minimum Standard 5: Overbank Flood Protection (3.3.5) (and other potential high flows)

☐ YES X NO Is this standard waived? If yes, please check indicate one or more of the reasons below:

☐ The project directs discharge to a large river (i.e., 4th-order stream or larger. See Appendix I for State-wide list and map of stream order), bodies of water >50.0 acres in surface area (i.e., lakes, ponds, reservoirs), or tidal waters.

☐ A Downstream Analysis (see section 3.3.6), indicates that peak discharge control would not be beneficial or would exacerbate peak flows in a downstream tributary of a particular site (i.e. through coincident peaks)

☐ YES X NO Does the project flow to an MS4 system? If yes, indicate below:

☐ RIDOT ☐ Other _____

(**NOTE**: *your project could be approved by RIDEM but not meet RIDOT or Town standards. RIDOT's*

*regulations indicate that post-volumes must be **less** than pre-volumes for the 10-yr storm at the design point entering the RIDOT system)*. If you have not already received approval for the discharge to an MS4, please explain your strategy to comply with RIDEM and the MS4.

_____
_____
_____

X YES ☐ NO Did you use a model for your analysis, if yes, indicate below

☐ TR-55 ☐ TR-20 X Hydrocad ☐ Other _____

X YES ☐ NO Does the hydrologic model demonstrate that flows from the 100-year event will be safely conveyed to a control practice designed to manage the 100-year event? If no, please explain

_____
_____

☐ YES X NO Do off-site areas contribute to the subwatersheds and design points? If yes,

☐ YES ☐ NO Are the areas modeled as "present condition" for both pre- and post-development analysis N/A

☐ YES ☐ NO Are the off-site areas are shown on the subwatershed maps N/A

☐ YES ☐ NO Does the hydrologic model confirm safe passage of the 100-year flow through the site for off-site runoff; N/A

☐ YES X NO Is a Downstream Analysis required? (see Manual Section 3.3.6):

Please calculate the following:

Area of disturbance within the sub-watershed (areas) 8.46 acres

Impervious cover (%) 0%

☐ YES X NO Is a dam breach analysis required (earthen embankments over six (6) feet in height, or a capacity of 15 acre-feet or more, and contributes to a significant or high hazard dam?

X YES ☐ NO Does this project meet the overbank flood protection standard?

Table 5-1 Hydraulic Analysis Summary

Subwatershed (design point)	1.2" Peak Flow Pre (cfs)	1.2" Peak Flow Post (cfs)	1-yr Peak Flow Pre (cfs)	1-yr Peak Flow Post (cfs)	10-yr Peak Flow Pre (cfs)	10-yr Peak Flow Post (cfs)	100-yr Peak Flow Pre (cfs)	100-yr Peak Flow Post (cfs)
Design Line (1 & 2)	0.03	0.05	4.90	1.84	18.75	14.86	48.76	48.72
Totals:	0.03	0.05	4.90	1.84	18.75	14.86	48.76	48.72

X Indicate below where the pertinent calculations and/or information for the above items are provided (i.e. name of report/document, page numbers);

✓ Existing condition analysis for each subwatershed, including (curve numbers, times of concentration, runoff rates, volumes, and water surface elevations showing methodologies used and supporting calculations);

Section 2.5.2, Section 2.5.4 and Appendix E of the Stormwater Management Report.

✓ Proposed condition analysis for each subwatershed, including (curve numbers, times of concentration, runoff rates, volumes, water surface elevations, and routing showing the methodologies used and supporting calculations);

Section 2.5.2, Section 2.5.4 and Appendix E of the Stormwater Management Report.

Final sizing calculations for structural stormwater BMPs including, contributing drainage area, storage, and outlet configuration; Section 2.5.2, Section 2.5.4 and Appendix E of the Stormwater Management Report.

Stage-storage, inflow and outflow hydrographs for storage facilities (e.g., detention, retention, or infiltration facilities); Section 2.5.2, Section 2.5.4 and Appendix E of the Stormwater Management Report.

Table 5-2 Summary of Best Management Practices

DP No.	BMP ID.	BMP Type (i.e. bioretention or tree filter)	BMP Functions (acre-ft)				Overbank Flood Reduction	Internal Bypass	Horizontal Setback Criteria Met	
			Pre-treatment (volume)	Re_v	WQ_v	CP_v	Y/N	Y/N	Distance (ft)	From constraint (i.e. private well or foundation)
1	WQB-1	Infiltration Basin	Grass Filter Strip	0.2565	0.2565	N/A	Y	N	N/A	N/A
		TOTAL:		0.2565	0.2565					

Table 5-3 Summary of Soils to evaluate each BMP

DP No.	BMP ID.	BMP Type (i.e. bioretention or tree filter)	Soils Analysis for Each BMP						
			Primary Test Pit ID #	Secondary Test Pit ID #	Top of Filter Elevation (ft)	SHWT Elevation (ft)	Separation Distance (ft)	Hydrologic Soil Group A,B,C or D	Exfiltration Rate Applied (in/hr)
1	WQB-1	Infiltration Basin	TH1	TH5	148.5	146.5	2’	C	1.02
		TOTAL:							

Minimum Standard 7: (questions are now asked in Minimum Standard 10 and 11)

Minimum Standard 8: Land Uses with Higher Potential Pollutant Loads (LUHPPLs)

☐ YES X NO Are there any existing activities or land uses proposed that would be considered LUHPPLs (see Manual Table 3-2)? If yes, please describe. If no, you may continue on to Minimum Standard 9:

_____

_____

☐ YES ☐ NO Are these activities already covered under an MSGP? If, no please explain if you have applied for an MSGP, or intend to do so?

_N/A_____

_____

☐ YES ☐ NO ☐ List the specific BMPs that are proposed for this project that receive stormwater from LUHPPL drainage areas. These BMP types must be listed in Manual Table 3-3, "Acceptable BMPs for Use at LUHPPLs";

Please list BMPs __N/A_____

☐ Additional BMPs, or additional pretreatment BMP's if any, that meet RIPDES MSGP requirements;

Please list BMPs __N/A_____

☐ Indicate below where the pertinent calculations and/or information for the above items are provided (i.e. name of report/document, page numbers);_____

_____

Minimum Standard 9: Illicit Discharges

X YES ☐ NO Have you checked for illicit discharges?

☐ YES X NO Have any been found and/or corrected? If yes, please identify

_____

X YES ☐ NO Does your report explain preventative measures that keep non-stormwater discharges out of the Waters of the State (during and after construction)?

Minimum Standard 10 Soil Erosion and Sediment Control

X YES ☐ NO Have you included a Soil Erosion and Sediment Control Plan Set and/or Complete Construction Plan Set?

X YES ☐ NO Did you provide a separately bound document based upon the SESC Template? If yes, proceed to Minimum Standard 11 (the following items can be assumed to be addressed). If no, include a document with your submittal that addresses the following:

Elements of a SESC Plan:

☐ Soil Erosion and Sediment Control Plan project narrative including a description of how the fifteen (15) Performance Criteria have been met:

☐ Provide Natural Buffers and Maintain Existing Vegetation;

☐ Minimize Area of Disturbance;

☐ Minimize the Disturbance of Steep Slopes;
☐ Preserve Topsoil;
☐ Stabilize Soils;
☐ Protect Storm Drain Inlets;
☐ Protect Storm Drain Outlets;
☐ Establish Temporary Controls for the Protection of Post-Construction Stormwater Control Measures;
☐ Establish Perimeter Controls and Sediment Barriers;
☐ Divert or Manage Run-On from Up-Gradient Areas;
☐ Properly Design Constructed Stormwater Conveyance Channels;
☐ Retain Sediment On-Site;
☐ Control Temporary Increases in Stormwater Velocity, Volume, and Peak Flows;
☐ Apply construction Activity Pollution Prevention Control Measures;
☐ Install, Inspect, and Maintain Control Measures and Take Corrective Actions.

☐ Qualified SESC plan preparer's information and certification;
☐ Operator's information and certification; if not known at the time of application the operator must certify the SESC Plan upon selection and prior to initiating site activities;
☐ Description of control measures such as temporary sediment trapping and conveyance practices, including design calculations and supporting documentation, as required.

Minimum Standard 7&11: Stormwater Management System Operation, Maintenance and Pollution Prevention Plan (See section 3.2.11 and Appendices G and E for guidance)

X YES ☐ NO Have you minimized all sources of pollutant contact with stormwater runoff, to the maximum extent practicable?

X YES ☐ NO Have you provided a separately bound **Operations, Maintenance and Pollution Prevention Manual** for the site and for all of the BMPs?

The (O&M and PP Plan Contains):

X YES ☐ NO Contact name, address, and phone number of the responsible party for maintenance;

X YES ☐ NO 8.5" x 11" map indicating the location of all of the proposed stormwater BMPs that will require maintenance;

X YES ☐ NO Description of routine and non-routine maintenance tasks and their frequency for required elements for each BMP;

X YES ☐ NO A description and delineation of public safety features;

X YES ☐ NO An estimated operations and maintenance budget;

X YES ☐ NO Minimum vegetative cover requirements;

X YES ☐ NO Access and safety for maintenance?

X YES ☐ NO Lawn, Garden and Landscape Management meet the requirements of section G.7? If not, why not?

_____

_____

X YES ☐ NO Is the property owner or homeowners association is responsible for the stormwater maintenance of all BMP's? The lease between property owner and operator of the solar project requires the lease to be responsible for all aspect of the project associated with the solar array including construction and post-

construction over the life of the lease as well as decommissioning. The O&M report discusses this as well.

If no, you must provide a legally binding and enforceable maintenance agreement (see Appendix E-page 26) that identifies the entity that will be responsible for maintenance of the stormwater. Please indicate where this agreement can be found in your report:_____

☐ YES X NO Do you anticipate that you will need legal agreements related to the stormwater structures? (e.g. off-site easements, deed restrictions, and covenants).
If yes, have you obtained them? Or please explain your plan to obtain them:
_____
_____

☐ YES X NO Is stormwater being directed from public areas to private property? If yes, *(***NOTE***: this is not allowed unless there is a funding mechanism in place to provide the finances for the long-term maintenance of the BMP and drainage unless there is a funding mechanism is demonstrated that can guarantee the long-term maintenance of a stormwater BMP by an individual homeowner*)
_____
_____

Pollution Prevention Section Contains:

☐ YES ☒ NO Designated snow stockpile locations? In the event the access driveway needs to be plowed it will be plowed to either side along its length and not to a central location.

☐ YES ☐NO Trash racks to prevent floatables, trash and debris from discharging to waters of the state? N/A, none proposed

☐ YES ☐ NO Asphalt only based sealants? N/A

☐ YES ☐ NO Pet waste stations? (**NOTE:** *if a receiving water has a bacterial impairment and the project involves housing units, this could be an important part your pollution prevention plan*) N/A

☐ YES ☐ NO Regular sweeping? Please describe _N/A

☐ YES ☐ NO Deicing specifications in accordance with Appendix G of the Manual. (**NOTE***: if the groundwater is GAA or this area contributes to a drinking water supply, this could be an important part of your pollution prevention plan (see Appendix G):* N/A- no sanding or salting is required or permitted
_____

☒ YES ☐ NO A prohibition of phosphate based fertilizers? (**NOTE**: *if the site discharges to a phosphorus impaired waterbody, this could be an important part of your pollution prevention plan*)?

PART 3: SUBWATERSHED MAPPING AND SITE PLAN DETAILS

Existing and Proposed Subwatershed Mapping (REQUIRED)

☒ Existing and proposed drainage area delineations

✓ Locations, cross sections, and profiles of all streams and drainage swales and their method of stabilization;

☒ Drainage flow paths, mapped according to the DEM *Guidance for Preparation of Drainage Area Maps* (included in Appendix K).

☒ Complete drainage area boundaries; include off-site areas in both mapping and analyses, as applicable;

☒ Logs of borings and/or test pit investigations along with supporting soils/geotechnical report.

☒ Mapped seasonal high water table,

☒ Mapped locations of the site-specific borings and/or test pits and soils information from the test pits at the locations of the BMPs

☒ Mapped locations of the BMPs with the BMPs consistently identified on the Site Construction Plans temporary sediment traps outlined on plans

☐ Mapping bedrock within 3' of any BMP

X YES ☐ NO Soils were logged by a:

x DEM-licensed Class IV soil evaluator Name: Christian Sutter

☐ RI-registered PE. Name; _____

Subwatershed Summary *(add or subtract rows as necessary)*				
Subwatershed (acres to each design point)	**First Receiving Water ID or MS4**	**Area Disturbed (acres)**	**Existing Impervious (acres)**	**Proposed Impervious (acres)**
DP-1: 9.949 ac	Onsite wetland	8.46 ac	0.0 ac	0.007 ac
DP-2:				
DP-3:				
DP-4:				
Totals:				

Site Construction Plans (the following applicable specifications are provided)

☒ Existing and proposed plans (scale not greater than 1" = 40') with North arrow

☒ Existing and proposed site topography (with 1 or 2-foot contours). 10-foot contours accepted for off-site areas

☒ Boundaries of existing predominant vegetation and proposed limits of clearing;

☒ Site Location clarification

☒ Location and field-verified boundaries of resource protection areas such as:

- freshwater and coastal wetlands, lakes, ponds,
- coastal shoreline features
- Perennial and intermittent streams, in addition to areas subject to storm flowage (ASSFs);

☒ All required setbacks (e.g., buffers, water supply wells, septic systems);

☒ Representative cross-section and profile drawings, notes and details of structural stormwater management practices and conveyances (i.e., storm drains, open channels, swales, etc.), which include:

- Location and size of the stormwater treatment practices (type of practice, depth, area). Stormwater treatment practices (BMPs) must have labels that correspond to table 5-2;
- Design water surface elevations (applicable storms);

- Structural details of outlet structures, embankments, spillways, stilling basins, grade control structures, conveyance channels, etc.;
- Existing and proposed structural elevations (e.g., invert of pipes, manholes, etc.);
- Location of floodplain and, if applicable, floodway limits and relationship of site to upstream and downstream properties or drainage that could be affected by work in the floodplain;
- Planting plans for structural stormwater BMPs, including species, size, planting methods, and maintenance requirements of proposed planting;
- Logs of borings and/or test pit investigations along with supporting soils/geotechnical report and corresponding water tables.

✓ Mapping of any OWM approved activities related to current/former site use areas for any known contamination and/or remedial clean-up efforts.

☒ Location of existing and proposed roads, buildings, and other structures including limits of disturbance;

- Existing and proposed utilities (e.g., water, sewer, gas, electric) and easements;
- Location of existing and proposed conveyance systems such as grass channels, swales, and storm drains, as well as location(s) of final discharge point (wetland, waterbody);
- Cross sections of roadways, with edge details such as curbs and sidewalks;
- Location and dimensions of channel modifications, such as bridge or culvert crossings;
- Locations, cross sections, and profiles of all stream or wetland crossings and their method of stabilization

< **(As applicable)**

Appendix B: RIDEM Solar Stormwater Guidance Considerations

GD Middletown West Main

RIDEM Solar Stormwater Guidance Considerations

Stormwater Site Planning, Analysis, and Design

1) Maximum existing slopes on the site are approximately 5-6%. Solar panel drip edges are approximately perpendicular to existing contour lines on a majority of the site. Adequate row-row panel spacing is provided approximately equal to the panel width. No fertilizer, pesticide, or herbicide use is proposed. Stone infiltration trenches are proposed to intercept stormwater and promote sheet flow and water quality infiltration. A water quality basin is also proposed that is designed to fully treat the WQv (0.4" over the disturbed area, in accordance with the Middletown, RI Chapter 153 Stormwater Ordinance).

2) Stone infiltration trenches are proposed to intercept stormwater and promote sheet flow and water quality infiltration. A Water Quality Basin is proposed designed to fully treat the WQv (0.4" over the disturbed area, in accordance with the Middletown, RI Chapter 153 Stormwater Ordinance). The concrete equipment pads are proposed to have stone infiltration trenches surrounding them in order to promote water quality treatment in these areas. The access driveway is proposed to be clean, washed, crushed stone 8" in depth. Construction operations shall be carried out in such a manner as to minimize potential erosion and water quality degradation.

3) Stone infiltration trenches are proposed to intercept stormwater and promote sheet flow and water quality infiltration. A water quality basin is also proposed designed to fully treat the WQv (0.4" over the disturbed area, in accordance with the Middletown, RI Chapter 153 Stormwater Ordinance).

4) Stone infiltration trenches are proposed to intercept stormwater and promote sheet flow and water quality infiltration. A water quality basin is also proposed designed to fully treat the WQv (0.4" over the disturbed area, in accordance with the Middletown, RI Chapter 153 Stormwater Ordinance).

5) A minimum of 6" of loam cover is proposed across the site. The existing A-horizon (topsoil) will remain on-site, and care will be taken not to compact it. No soil export is proposed.

6) Construction methods are proposed that minimize soil compaction, such as the minimization of the use of heavy equipment. The majority of the site does not require re-grading and will largely remain as pre-development conditions.

7) Adequate row-row panel spacing is provided approximately equal to the panel width. Stone infiltration trenches are proposed to intercept stormwater and promote sheet flow. These measures will provide adequate conditions in order to establish good vegetative cover.

8) The 1.2", 1-year, 10-year, and 100-year storm events (as well as the 2-year and 25-year storm events) have been modeled in HydroCAD and included in this report. Peak flows are shown to have been reduced from pre-development to post-development conditions. Concrete ballasts are not proposed as part of this project. The proposed concrete level spreader weir outlet structure has been analyzed with HydroCAD and the analysis is included in this report.

9) No outlet pipes or culverts are proposed as part of this project.

10) The peak runoff discharge rates for the 10-year and 100-year storm events have been modeled in HydroCAD and included in this report. Peak flows are shown to have been reduced from pre-development to post-development conditions.

11) The amount of proposed disturbance does not exceed 50 acres; therefore, a downstream analysis is not required.

12) No outlet pipes or culverts are proposed as part of this project. The proposed concrete level spreader weir outlet structure does not discharge directly onto a down-gradient property. The discharge is to a wetland complex that continues offsite.

13) No part of the solar array or associated equipment is located within a 100-year floodplain. A limited number of solar panels (as seen on the plans) are proposed to be located with the water quality basin. The maximum ponding depth beneath these modules is modeled as being one foot. This depth of ponding will have no impact on the panels, as the lower panel edge is located three feet off of the ground. All wires and electrical infrastructure associated with these panels are located above three feet from the ground.

14) A sand/loam mix is proposed to be provided at the bottom of the water quality basin.

15) This site is not located within the watershed of the Pocasset River.

Appendix C: Soil Evaluations

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources
Onsite Wastewater Treatment System Program

Site Evaluation Form
Part A – Soil Profile Description

Application Number: NA

Property Owner: Cenz Corp
Property Location: West Main Road Middletown, RI
Date of Test Hole: August 9, 2018
Soil Evaluator: Christian Sutter
License Number: D-4077
Weather: Clear, 80's
Shaded: Yes ☐ No ☑
Time: 10:00 am

TH 1 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox			Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab.	S.	Contr.				
A	0-8"	C	S	10YR 3/2					fsl	1-sbk	fri	4
Bw	8-18"	C	S	10YR 5/6	7.5YR 5/6	C	3	P	fsl	1-sbk	fri	4
BC	18-50"	C	S	2.5Y 5/3	7.5YR 5/6	C	3	P	chfsl	0-m	fri	4
Cd	50-108"			2.5Y 3/2					chsil	0-m	fir	8m

TH 2 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox			Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab.	S.	Contr.				
HTM	0-20"	C	S						fsl	1-sbk	fri	Fill
BC	20-78"	C	S	10YR 4/6					chsil	1-sbk	fri	5
Cd	78-114"			2.5Y 5/3	7.5YR 5/6	C	3	P	gchsil	0-m	fir	8m

TH 1 Soil Class Basal Till Total Depth 108" Impervious/Limiting Layer Depth NA (og) GW Seepage Depth NA SHWT 18" (og)

TH 2 Soil Class Basal Till Total Depth 114" Impervious/Limiting Layer Depth NA (og) GW Seepage Depth NA SHWT 18" (og)

Comments:

Revised 1/31/14

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources
Onsite Wastewater Treatment System Program

Site Evaluation Form
Part A – Soil Profile Description

Application Number: NA

Property Owner: Cenz Corp
Property Location: West Main Road Middletown, RI
Date of Test Hole: August 9, 2018
Soil Evaluator: Christian Sutter
License Number: D-4077
Weather: Clear, 80's
Shaded: Yes ☐ No ☑
Time: 10:00 am

TH 3 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox			Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab.	S.	Contr.				
A	0-12"	C	S	10YR 3/2					fsl	1-sbk	fri	4
Bw	12-18"	C	S	10YR 5/6	7.5YR 5/6	C	3	P	fsl	1-sbk	fri	4
BC	18-78"	C	S	2.5Y 5/3	7.5YR 5/6	C	3	P	chsil	0-m	fri	5
Cd	78-114"			2.5Y 3/2					gchsil	0-m	fir	9m

TH 4 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox			Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab.	S.	Contr.				
HTM	0-18"	C	S						fsl	1-sbk	fri	Fill
Cd1	18-96"	C	S	2.5Y 5/4	7.5YR 5/6	C	3	P	sil	1-sbk	fir	8
Cd2	96-120"			2.5Y 3/2					gchsil	0-m	fir	8m

TH 3 Soil Class Basal Till Total Depth 114" Impervious/Limiting Layer Depth NA (og) GW Seepage Depth NA SHWT 15" (og)

TH 4 Soil Class Basal Till Total Depth 120" Impervious/Limiting Layer Depth NA (og) GW Seepage Depth NA SHWT 18" (og)

Comments:

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources
Onsite Wastewater Treatment System Program

Site Evaluation Form
Part A – Soil Profile Description Application Number NA

Property Owner: Cenz Corp
Property Location: West Main Road Middletown, RI
Date of Test Hole: August 9, 2018
Soil Evaluator: Christian Sutter License Number: D-4077
Weather: Clear, 80's Shaded: Yes ☐ No ☑ Time: 10:00 am

TH 5 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox			Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab.	S.	Contr.				
HTM	0-18"	C	S						fsl			Fill/mixed
Bw	18-24"	C	S	10YR 5/6					fsl	1-sbk	fri	4
Cd1	24-60"	C	S	2.5Y 5/3	7.5YR 5/6	C	3	P	sil	0-m	fir	8
Cd2	60-108"			2.5Y 3/2					chsil	0-m	fir	8m

TH 6 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox			Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab.	S.	Contr.				
A	0-6"	C	S	10YR 3/2					fsl	1-sbk	fri	4
Bw	6-20"	C	S	10YR 5/6					sil	1-sbk	fri	4
Cd	20-108"			2.5Y 4/2					gchsil	0-m	fir	8m

TH 5 Soil Class Basal Till Total Depth 108" Impervious/Limiting Layer Depth NA (og) GW Seepage Depth NA SHWT 24" (og)

TH 6 Soil Class Basal Till Total Depth 108" Impervious/Limiting Layer Depth NA (og) GW Seepage Depth NA SHWT 20" (og)

Comments:

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
Department of Environmental Management
Office of Water Resources
Onsite Wastewater Treatment System Program

Site Evaluation Form
Part A – Soil Profile Description

Application Number: NA

Property Owner: Cenz Corp
Property Location: West Main Road Middletown, RI
Date of Test Hole: August 9, 2018
Soil Evaluator: Christian Sutter
License Number: D-4077
Weather: Clear, 80's
Shaded: Yes ☐ No ☑
Time: 10:00 am

TH 7 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox			Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab.	S.	Contr.				
A	0-8"	C	S	10YR 3/2					fsl	1-sbk	fri	4
Bw	8-36"	C	S	10YR 5/6					fsl	1-sbk	fri	4
Cd	36-102"			2.5Y 3/2	7.5YR 5/6	C	3	P	gchsil	0-m	fir	8m

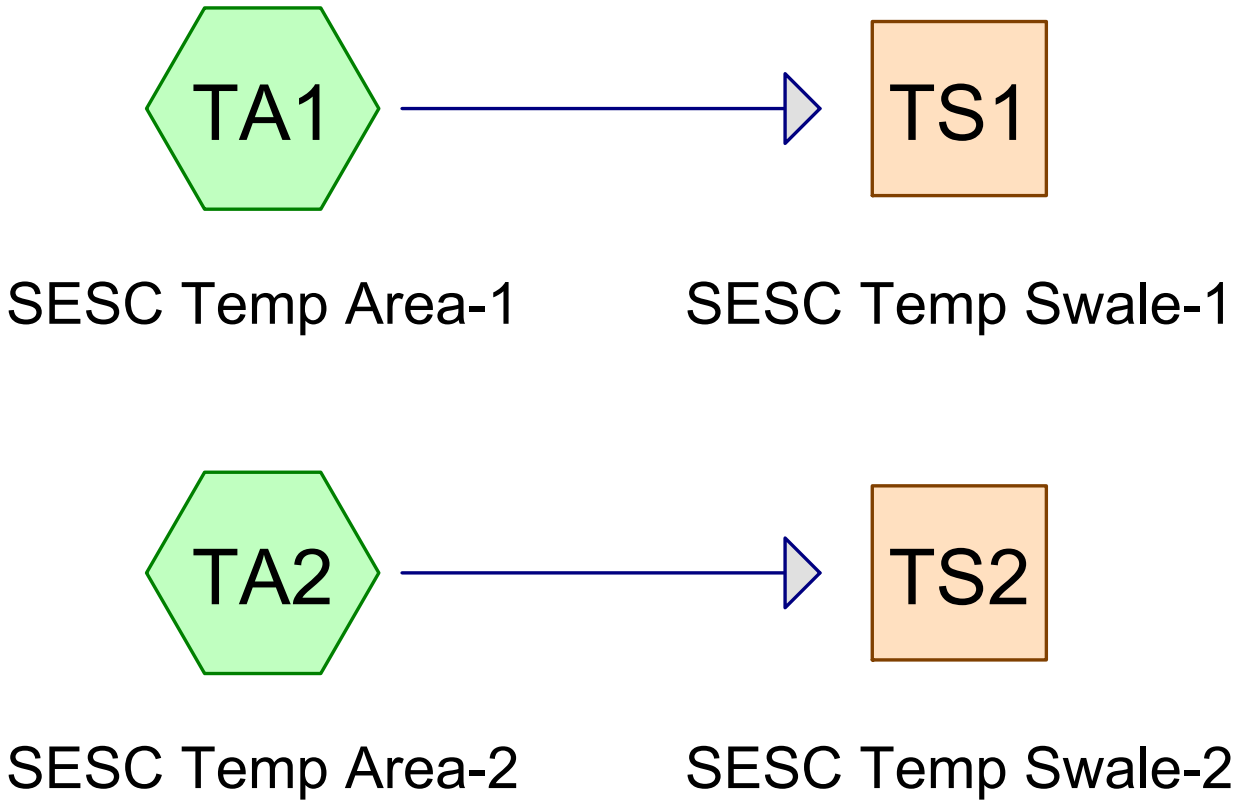
TH 8 Horizon	Depth	Horizon Boundaries		Soil Colors		Re-Dox			Texture	Structure	Consistence	Soil Category
		Dist	Topo	Matrix	Re-Dox Features	Ab.	S.	Contr.				
A	0-9"	C	S	10YR 3/2					fsl	1-sbk	fri	4
Bw	9-36"	C	S	10YR 5/6					fsl	1-sbk	fri	4
Cd	36-102"			2.5Y 3/2	7.5YR 5/6	C	3	P	gchsil	0-m	fir	8m

TH 7 Soil Class Basal Till Total Depth 102" Impervious/Limiting Layer Depth NA (og) GW Seepage Depth NA SHWT 30" (og)

TH 8 Soil Class Basal Till Total Depth 102" Impervious/Limiting Layer Depth NA (og) GW Seepage Depth NA SHWT 30" (og)

Comments:

Appendix D: Temporary Sediment Trap & Swale Calculations



Subcat Reach Pond Link

Routing Diagram for GD Middletown West Main-SESC-Temp Swales
Prepared by Green Development, LLC, Printed 3/3/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.783	74	>75% Grass cover, Good, HSG C (TA1, TA2)
0.107	70	Woods, Good, HSG C (TA1, TA2)
1.890	**74**	**TOTAL AREA**

Summary for Subcatchment TA1: SESC Temp Area-1

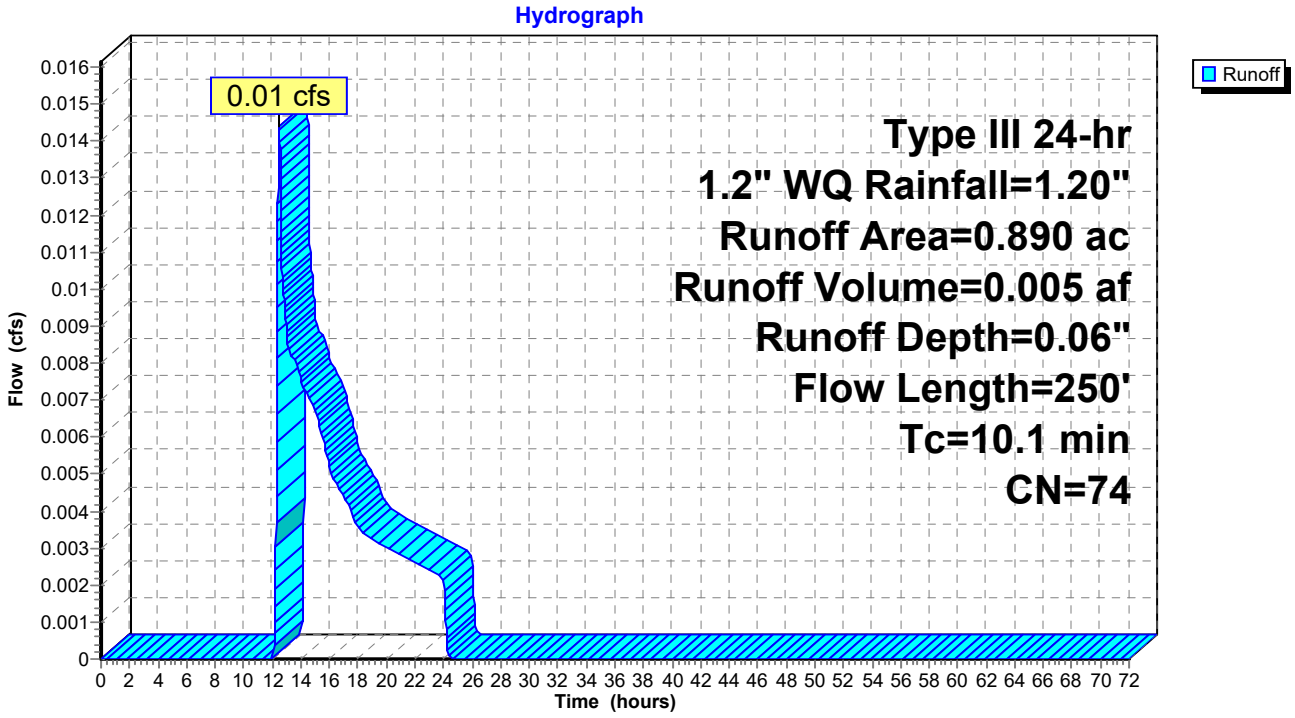
Runoff = 0.01 cfs @ 12.49 hrs, Volume= 0.005 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" WQ Rainfall=1.20"

Area (ac)	CN	Description
0.801	74	>75% Grass cover, Good, HSG C
0.089	70	Woods, Good, HSG C
0.890	74	Weighted Average
0.890		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0250	0.19		**Sheet Flow, 1-2** Grass: Short n= 0.150 P2= 3.30"
1.3	150	0.0150	1.97		**Shallow Concentrated Flow, 2-3** Unpaved Kv= 16.1 fps
10.1	250	Total			

Subcatchment TA1: SESC Temp Area-1



Summary for Subcatchment TA2: SESC Temp Area-2

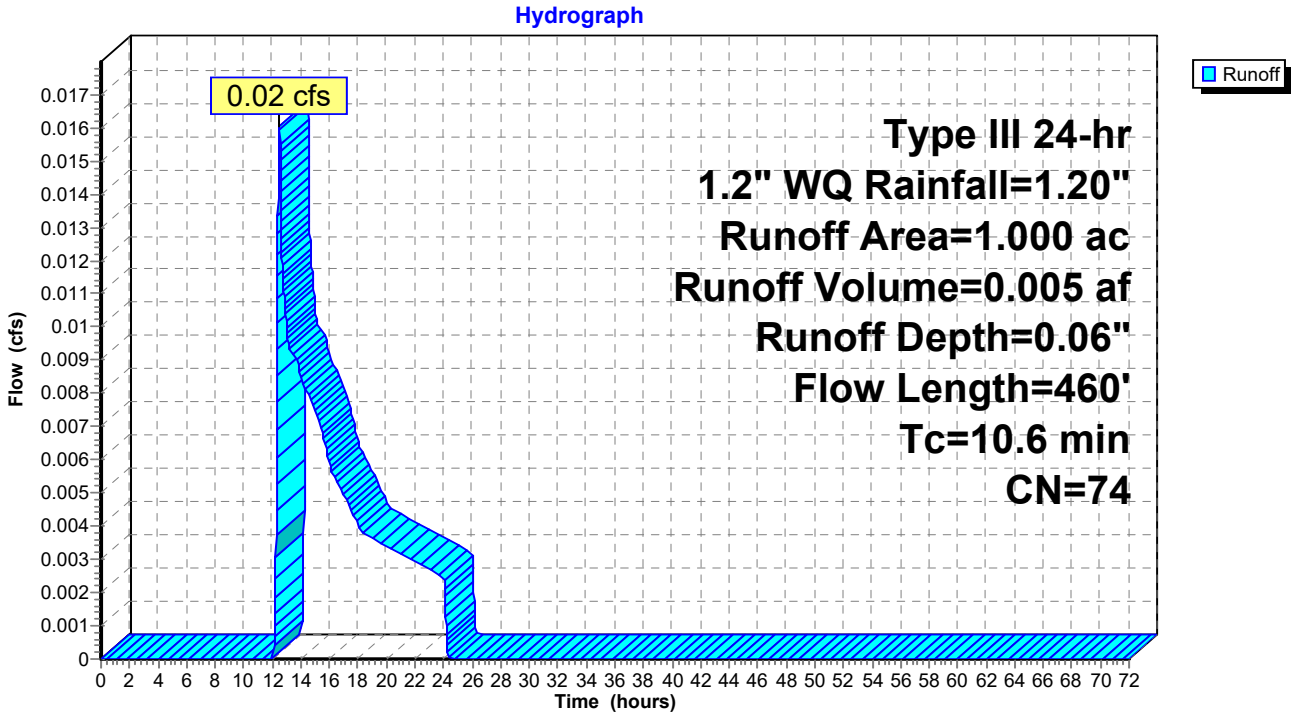
Runoff = 0.02 cfs @ 12.49 hrs, Volume= 0.005 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 1.2" WQ Rainfall=1.20"

Area (ac)	CN	Description
0.982	74	>75% Grass cover, Good, HSG C
0.018	70	Woods, Good, HSG C
1.000	74	Weighted Average
1.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0250	0.19		**Sheet Flow, 1-2** Grass: Short n= 0.150 P2= 3.30"
1.8	360	0.0430	3.34		**Shallow Concentrated Flow, 2-3** Unpaved Kv= 16.1 fps
10.6	460	Total			

Subcatchment TA2: SESC Temp Area-2



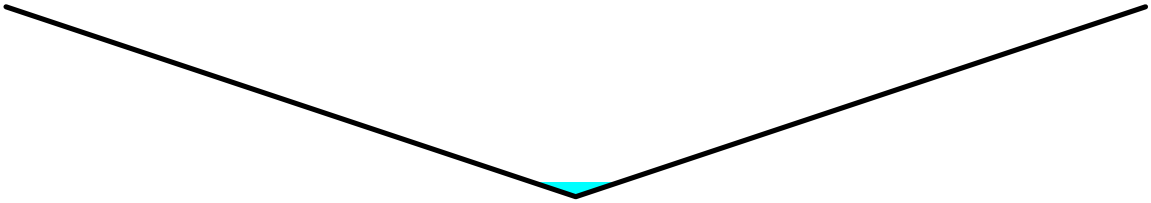
Summary for Reach TS1: SESC Temp Swale-1

Inflow Area = 0.890 ac, 0.00% Impervious, Inflow Depth = 0.06" for 1.2" WQ event
Inflow = 0.01 cfs @ 12.49 hrs, Volume= 0.005 af
Outflow = 0.01 cfs @ 12.52 hrs, Volume= 0.005 af, Atten= 2%, Lag= 2.2 min

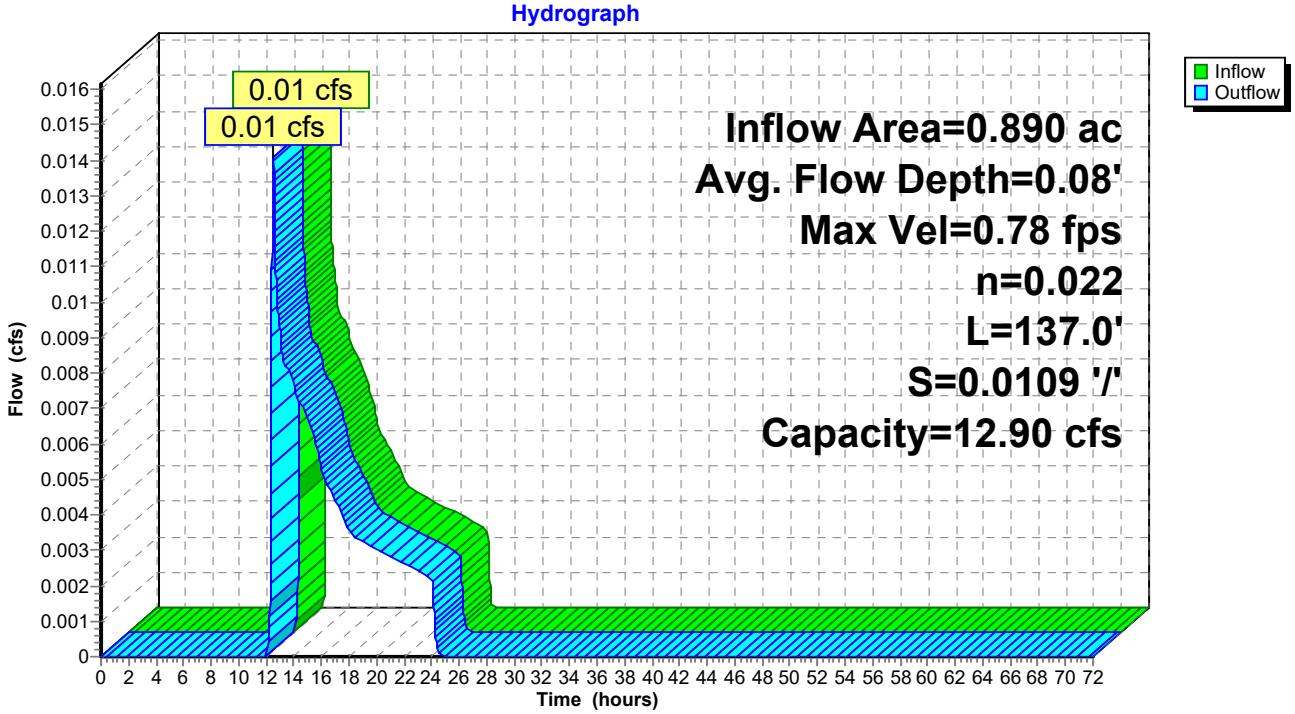
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.78 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 4.0 min

Peak Storage= 2 cf @ 12.52 hrs
Average Depth at Peak Storage= 0.08'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 12.90 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 137.0' Slope= 0.0109 '/'
Inlet Invert= 148.00', Outlet Invert= 146.50'



Reach TS1: SESC Temp Swale-1



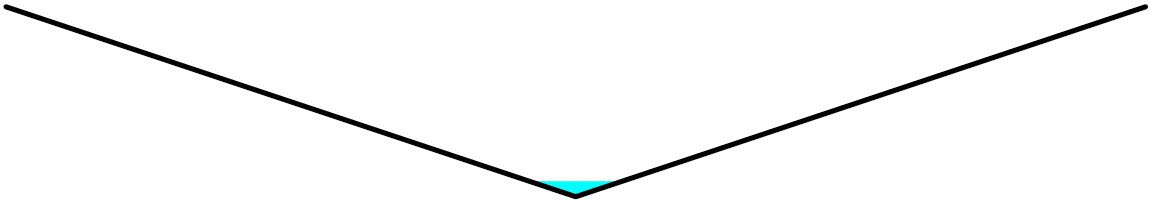
Summary for Reach TS2: SESC Temp Swale-2

Inflow Area = 1.000 ac, 0.00% Impervious, Inflow Depth = 0.06" for 1.2" WQ event
Inflow = 0.02 cfs @ 12.49 hrs, Volume= 0.005 af
Outflow = 0.02 cfs @ 12.53 hrs, Volume= 0.005 af, Atten= 2%, Lag= 2.4 min

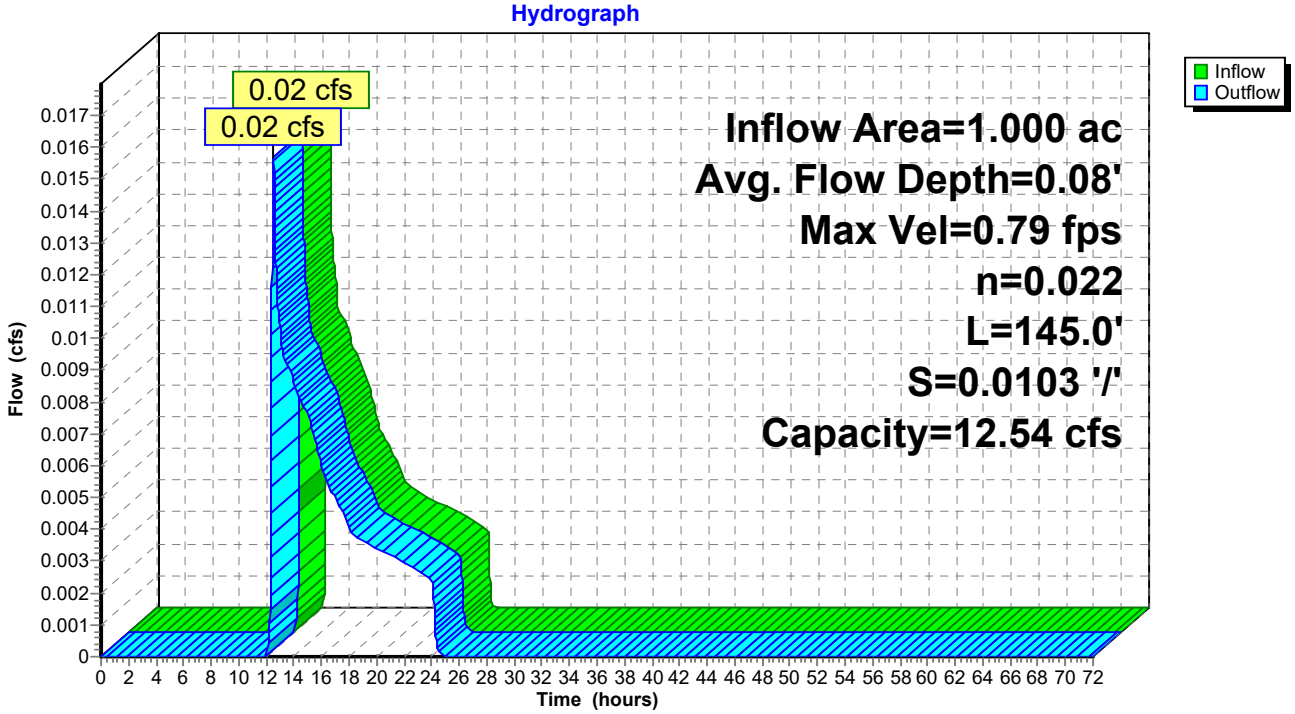
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.79 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 0.57 fps, Avg. Travel Time= 4.3 min

Peak Storage= 3 cf @ 12.53 hrs
Average Depth at Peak Storage= 0.08'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 12.54 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 145.0' Slope= 0.0103 '/'
Inlet Invert= 152.00', Outlet Invert= 150.50'



Reach TS2: SESC Temp Swale-2



Summary for Subcatchment TA1: SESC Temp Area-1

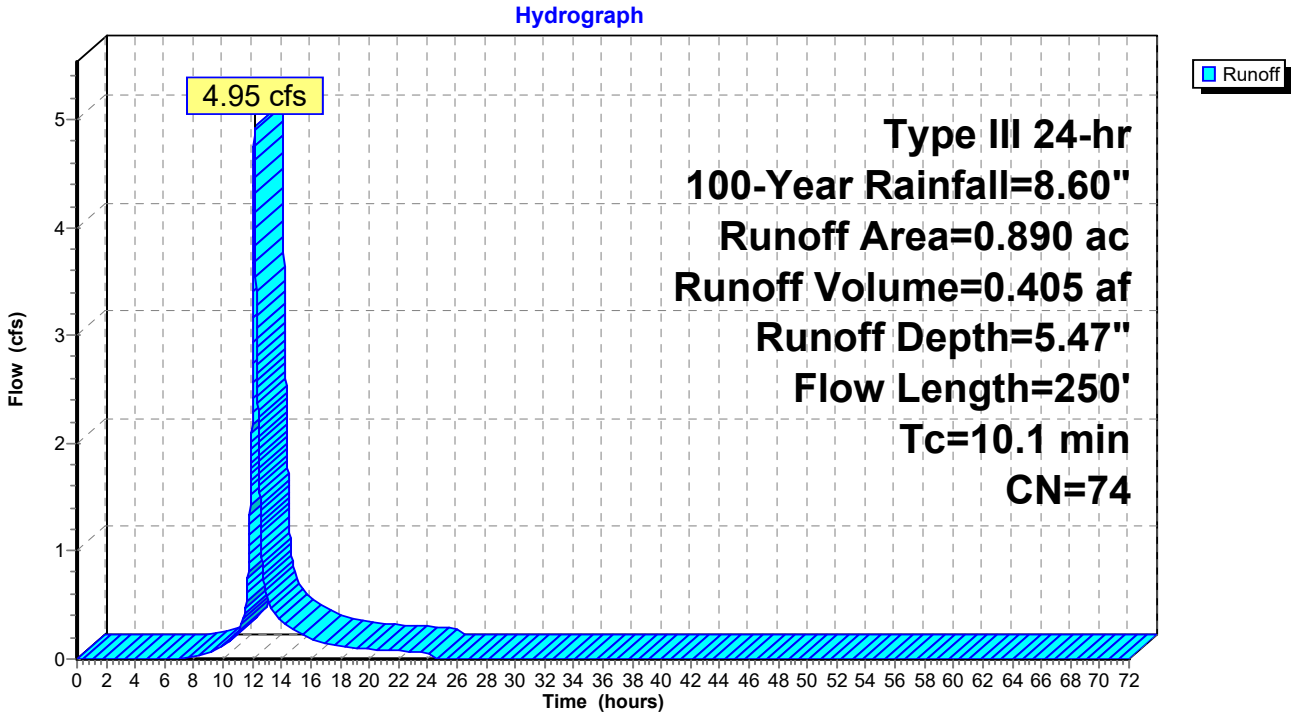
Runoff = 4.95 cfs @ 12.14 hrs, Volume= 0.405 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
0.801	74	>75% Grass cover, Good, HSG C
0.089	70	Woods, Good, HSG C
0.890	74	Weighted Average
0.890		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0250	0.19		**Sheet Flow, 1-2** Grass: Short n= 0.150 P2= 3.30"
1.3	150	0.0150	1.97		**Shallow Concentrated Flow, 2-3** Unpaved Kv= 16.1 fps
10.1	250	Total			

Subcatchment TA1: SESC Temp Area-1



Summary for Subcatchment TA2: SESC Temp Area-2

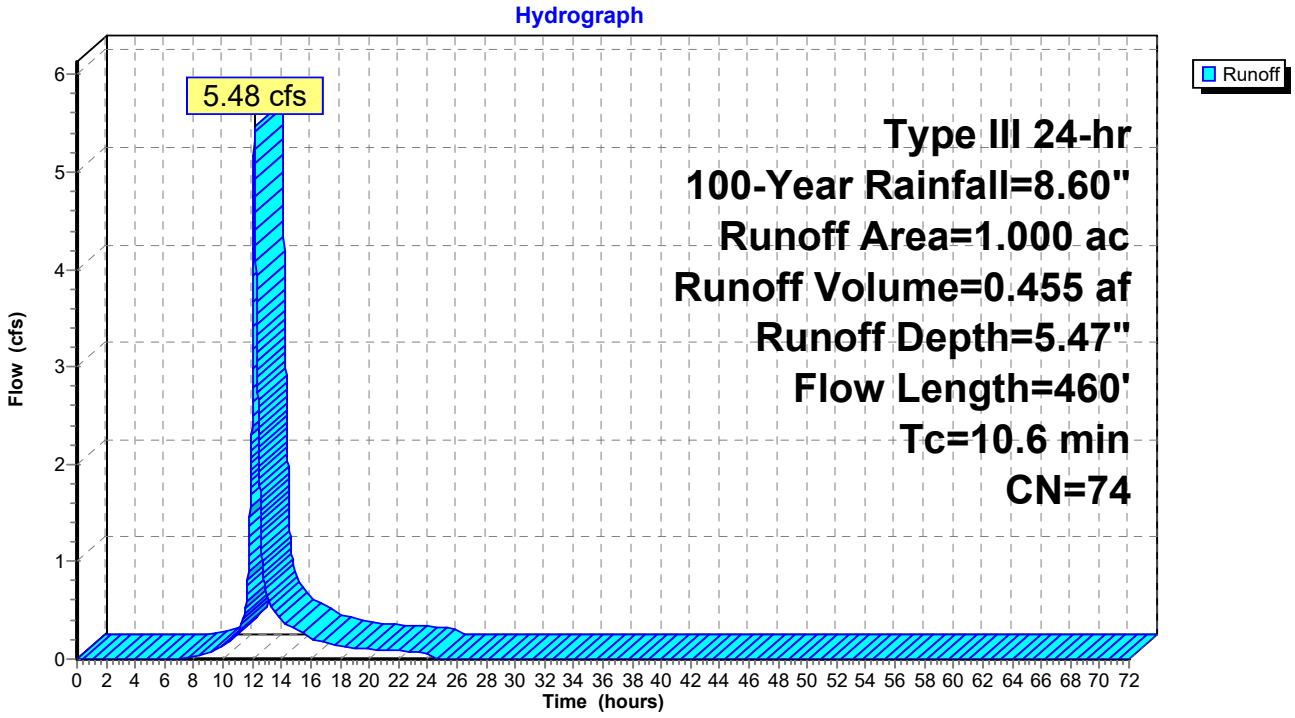
Runoff = 5.48 cfs @ 12.14 hrs, Volume= 0.455 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
0.982	74	>75% Grass cover, Good, HSG C
0.018	70	Woods, Good, HSG C
1.000	74	Weighted Average
1.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0250	0.19		**Sheet Flow, 1-2** Grass: Short n= 0.150 P2= 3.30"
1.8	360	0.0430	3.34		**Shallow Concentrated Flow, 2-3** Unpaved Kv= 16.1 fps
10.6	460	Total			

Subcatchment TA2: SESC Temp Area-2



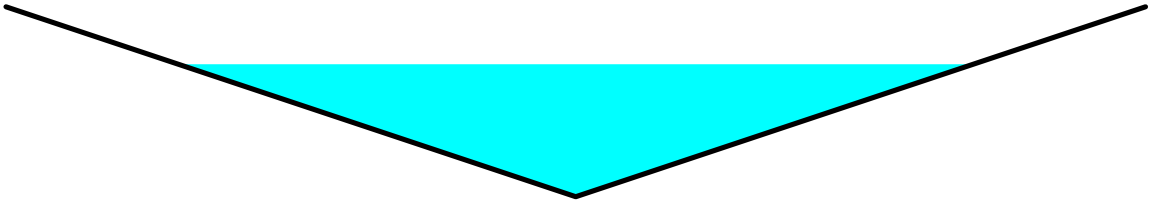
Summary for Reach TS1: SESC Temp Swale-1

Inflow Area = 0.890 ac, 0.00% Impervious, Inflow Depth = 5.47" for 100-Year event
Inflow = 4.95 cfs @ 12.14 hrs, Volume= 0.405 af
Outflow = 4.93 cfs @ 12.15 hrs, Volume= 0.405 af, Atten= 0%, Lag= 0.5 min

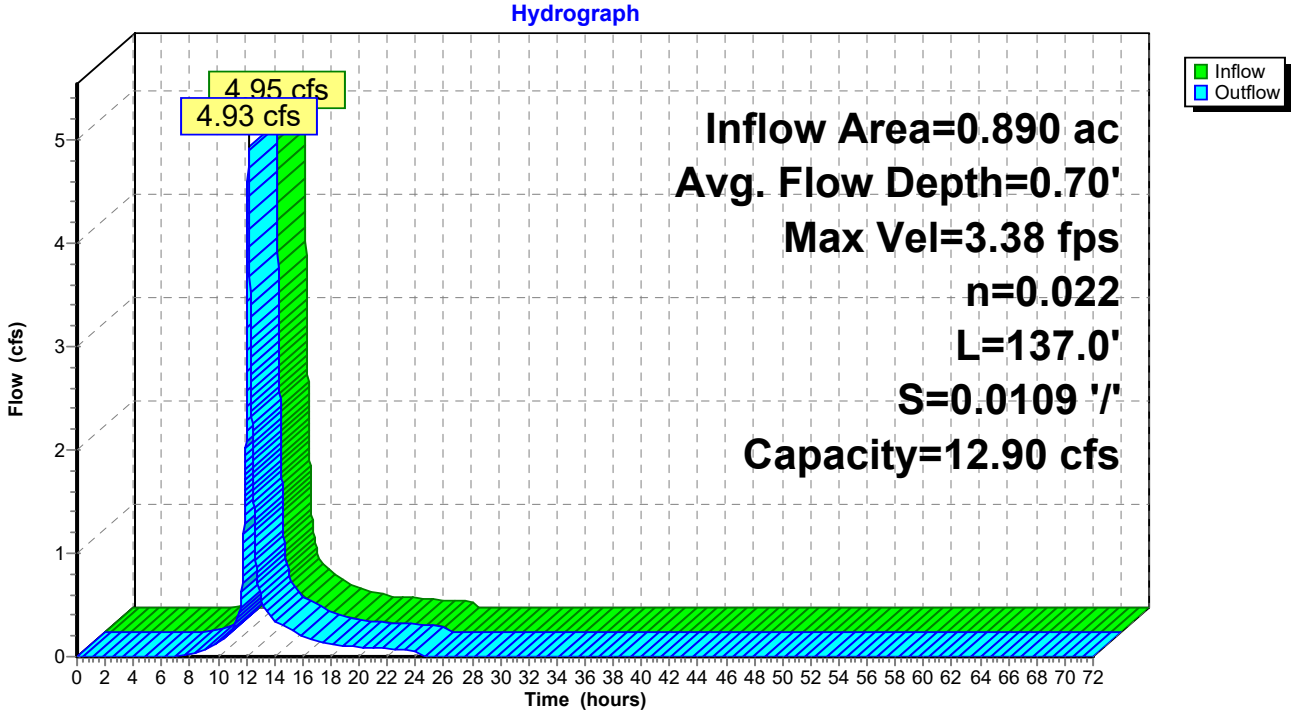
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.38 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 1.7 min

Peak Storage= 200 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.70'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 12.90 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 137.0' Slope= 0.0109 '/'
Inlet Invert= 148.00', Outlet Invert= 146.50'



Reach TS1: SESC Temp Swale-1



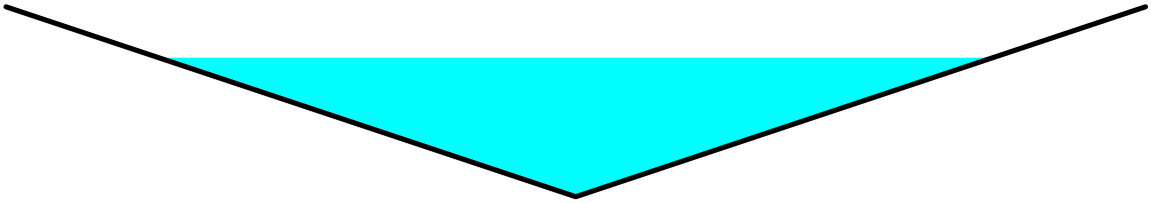
Summary for Reach TS2: SESC Temp Swale-2

Inflow Area = 1.000 ac, 0.00% Impervious, Inflow Depth = 5.47" for 100-Year event
Inflow = 5.48 cfs @ 12.14 hrs, Volume= 0.455 af
Outflow = 5.46 cfs @ 12.15 hrs, Volume= 0.455 af, Atten= 0%, Lag= 0.6 min

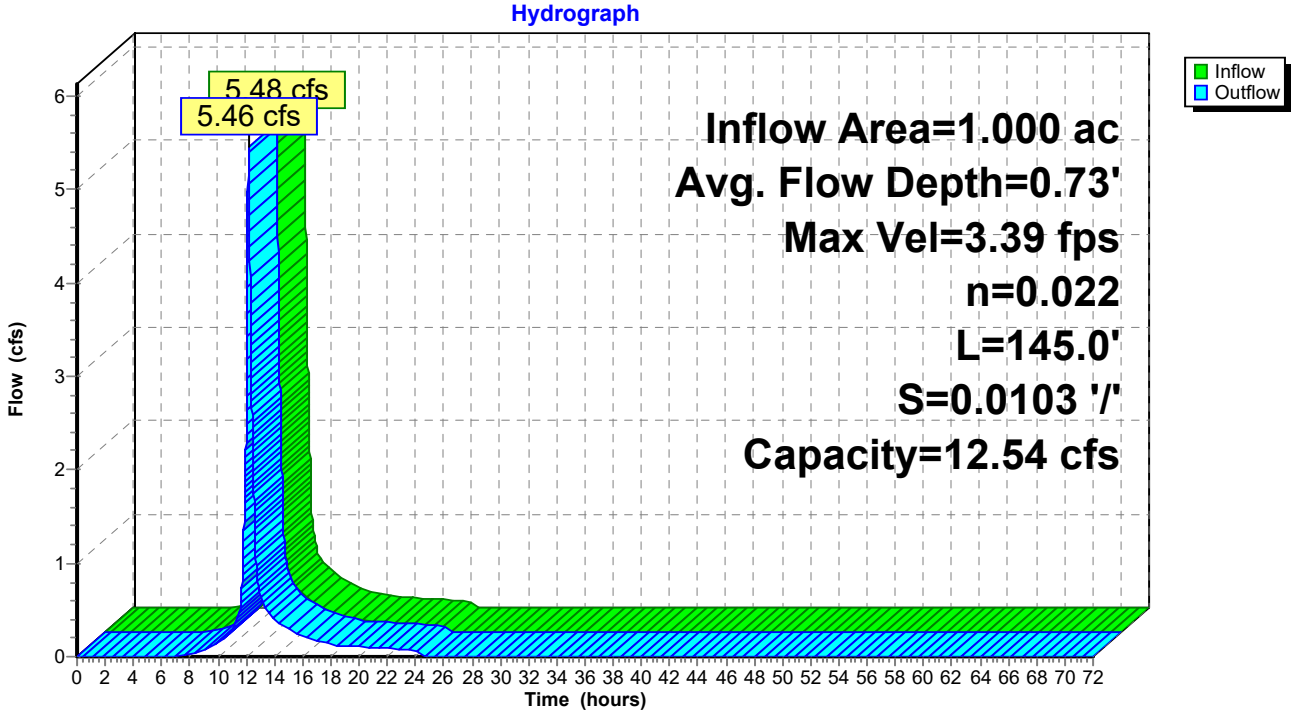
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.39 fps, Min. Travel Time= 0.7 min
Avg. Velocity = 1.37 fps, Avg. Travel Time= 1.8 min

Peak Storage= 233 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.73'
Bank-Full Depth= 1.00' Flow Area= 3.0 sf, Capacity= 12.54 cfs

0.00' x 1.00' deep channel, n= 0.022 Earth, clean & straight
Side Slope Z-value= 3.0 '/' Top Width= 6.00'
Length= 145.0' Slope= 0.0103 '/'
Inlet Invert= 152.00', Outlet Invert= 150.50'

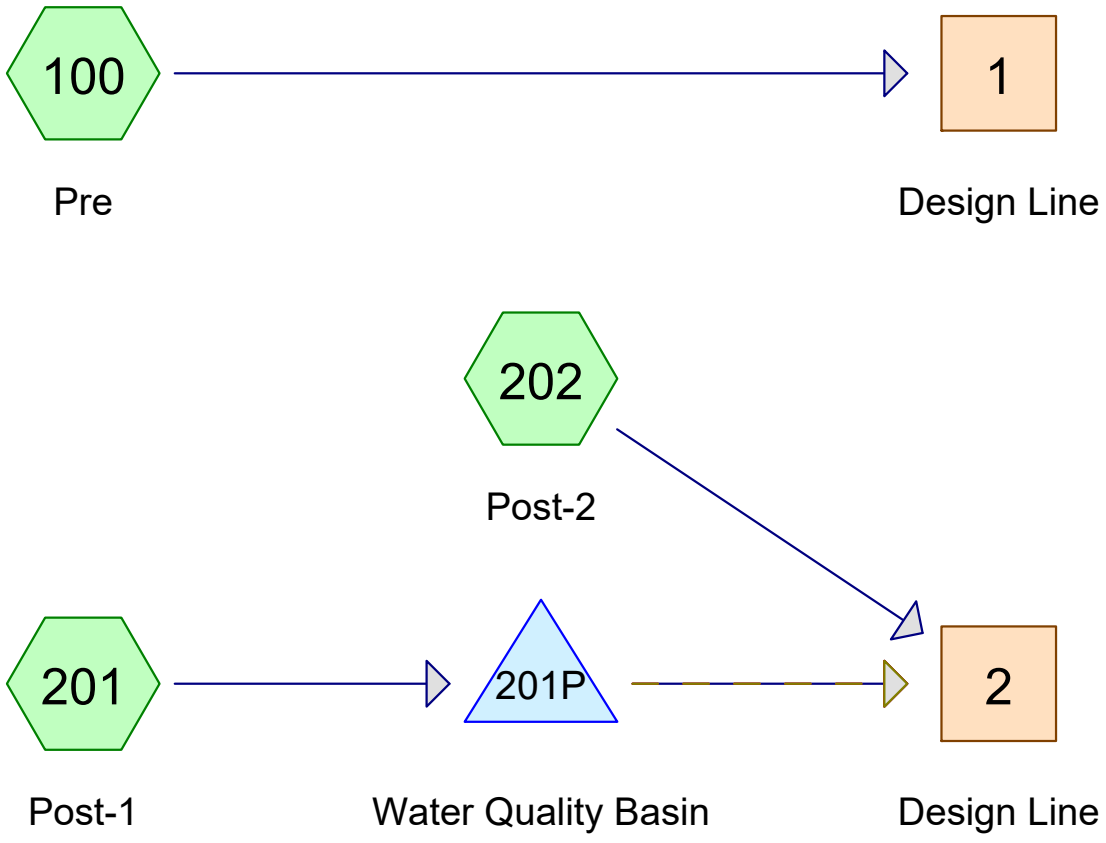


Reach TS2: SESC Temp Swale-2



Appendix E: HydroCAD

E-1: HydroCAD Diagram



Subcat Reach Pond Link

Routing Diagram for GD Middletown West Main-20220210
Prepared by Green Development, LLC, Printed 3/3/2022

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
8.349	74	>75% Grass cover, Good, HSG C (201, 202)
0.873	80	>75% Grass cover, Good, HSG D (201, 202)
8.323	69	Brush/Grass Mix, HSG C (100)
0.873	76	Brush/Grass Mix, HSG D (100)
1.334	70	Woods, Good, HSG C (100, 201, 202)
0.146	77	Woods, Good, HSG D (100, 201, 202)
19.898	**72**	**TOTAL AREA**

E-2: 1.2” Water Quality Storm Analysis

Summary for Subcatchment 100: Pre

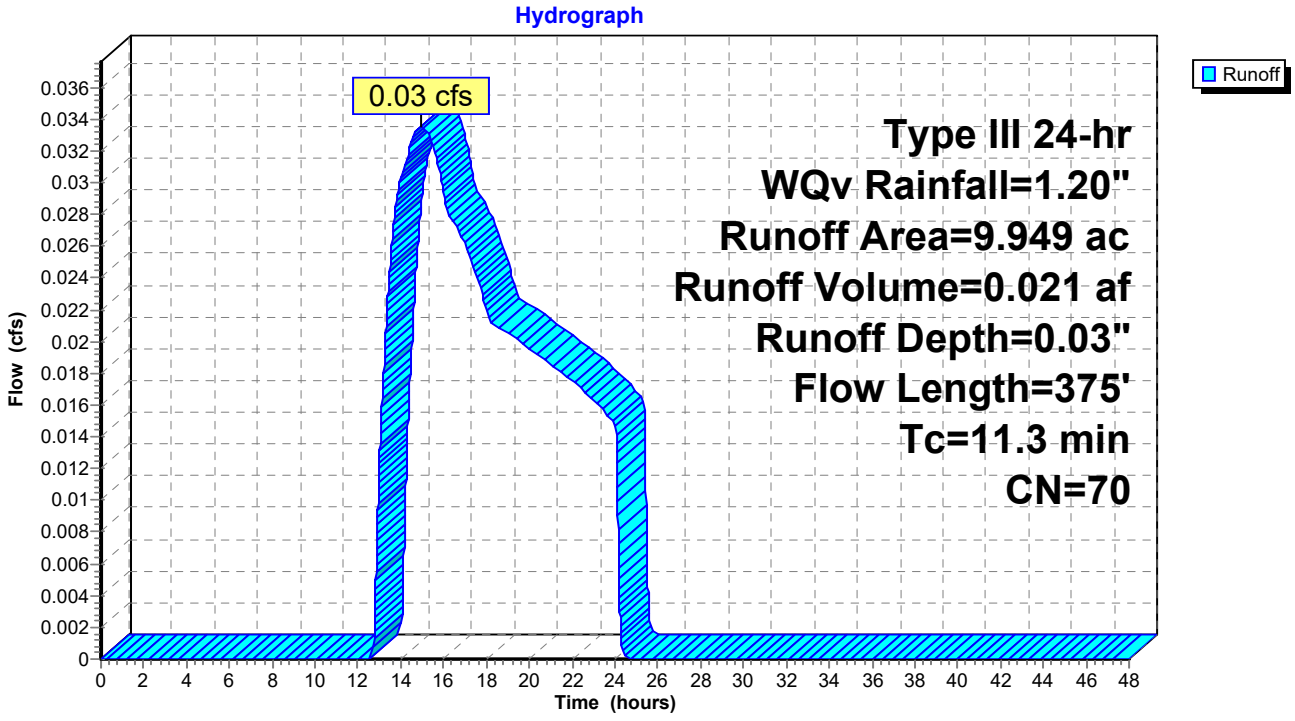
Runoff = 0.03 cfs @ 14.98 hrs, Volume= 0.021 af, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

	Area (ac)	CN	Description
*	8.323	69	Brush/Grass Mix, HSG C
*	0.873	76	Brush/Grass Mix, HSG D
	0.680	70	Woods, Good, HSG C
	0.073	77	Woods, Good, HSG D
	9.949	70	Weighted Average
	9.949	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0250	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.30"
2.5	275	0.0127	1.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
11.3	375	Total			

Subcatchment 100: Pre



Summary for Subcatchment 201: Post-1

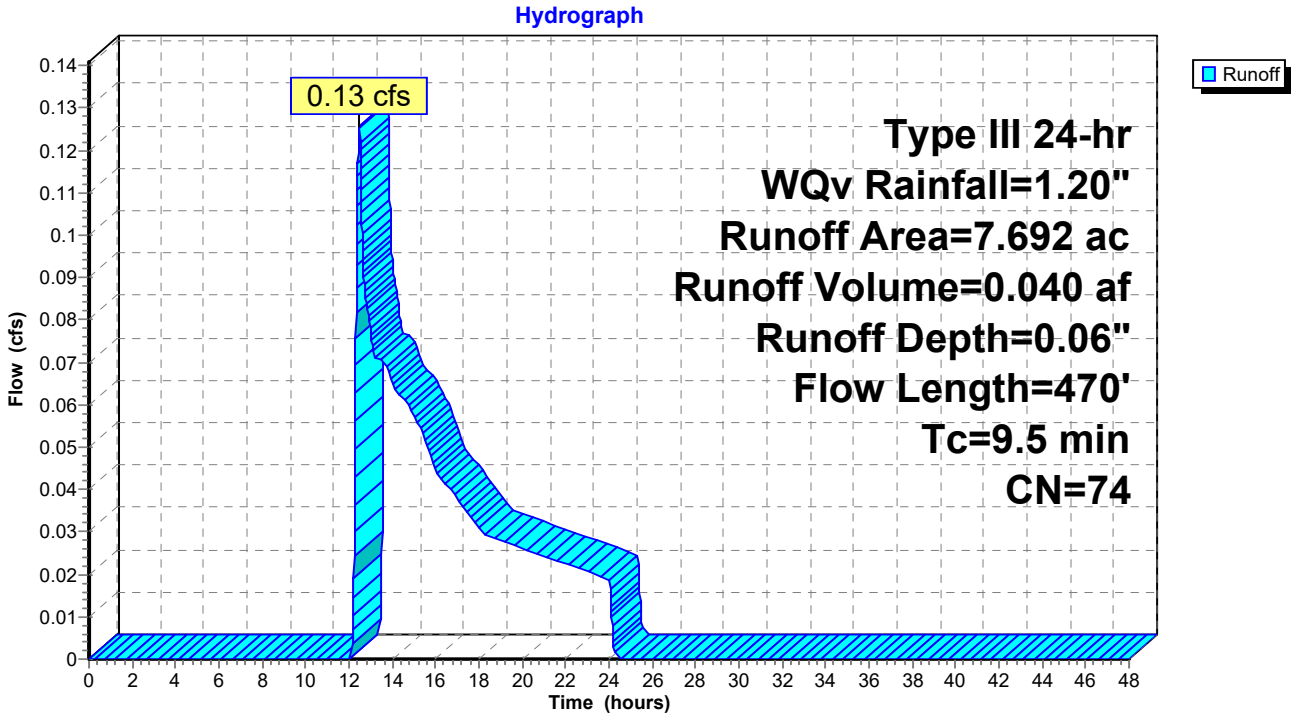
Runoff = 0.13 cfs @ 12.47 hrs, Volume= 0.040 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (ac)	CN	Description
6.822	74	>75% Grass cover, Good, HSG C
0.332	80	>75% Grass cover, Good, HSG D
0.473	70	Woods, Good, HSG C
0.065	77	Woods, Good, HSG D
7.692	74	Weighted Average
7.692	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	420	0.0393	3.19		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.5	470	Total			

Subcatchment 201: Post-1



Summary for Subcatchment 202: Post-2

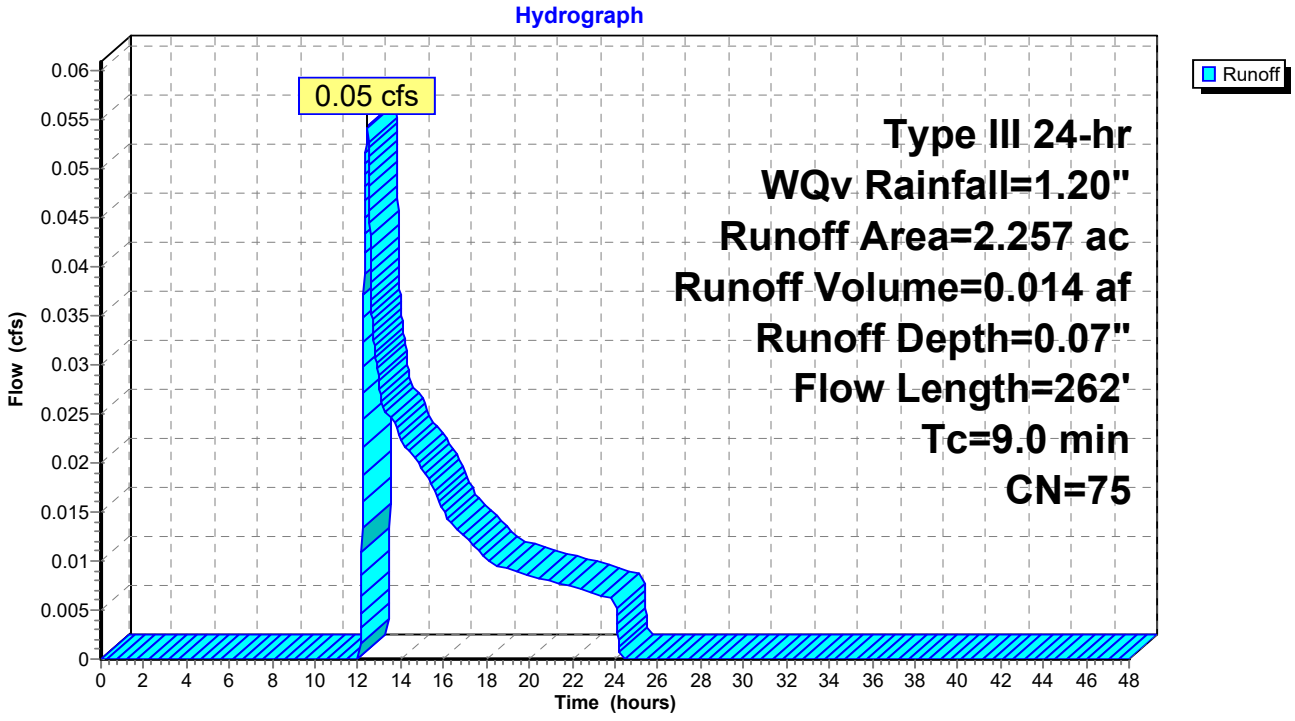
Runoff = 0.05 cfs @ 12.43 hrs, Volume= 0.014 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr WQv Rainfall=1.20"

Area (ac)	CN	Description
1.527	74	>75% Grass cover, Good, HSG C
0.541	80	>75% Grass cover, Good, HSG D
0.181	70	Woods, Good, HSG C
0.008	77	Woods, Good, HSG D
2.257	75	Weighted Average
2.257	75	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0120	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	212	0.0101	1.62		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.0	262	Total			

Subcatchment 202: Post-2

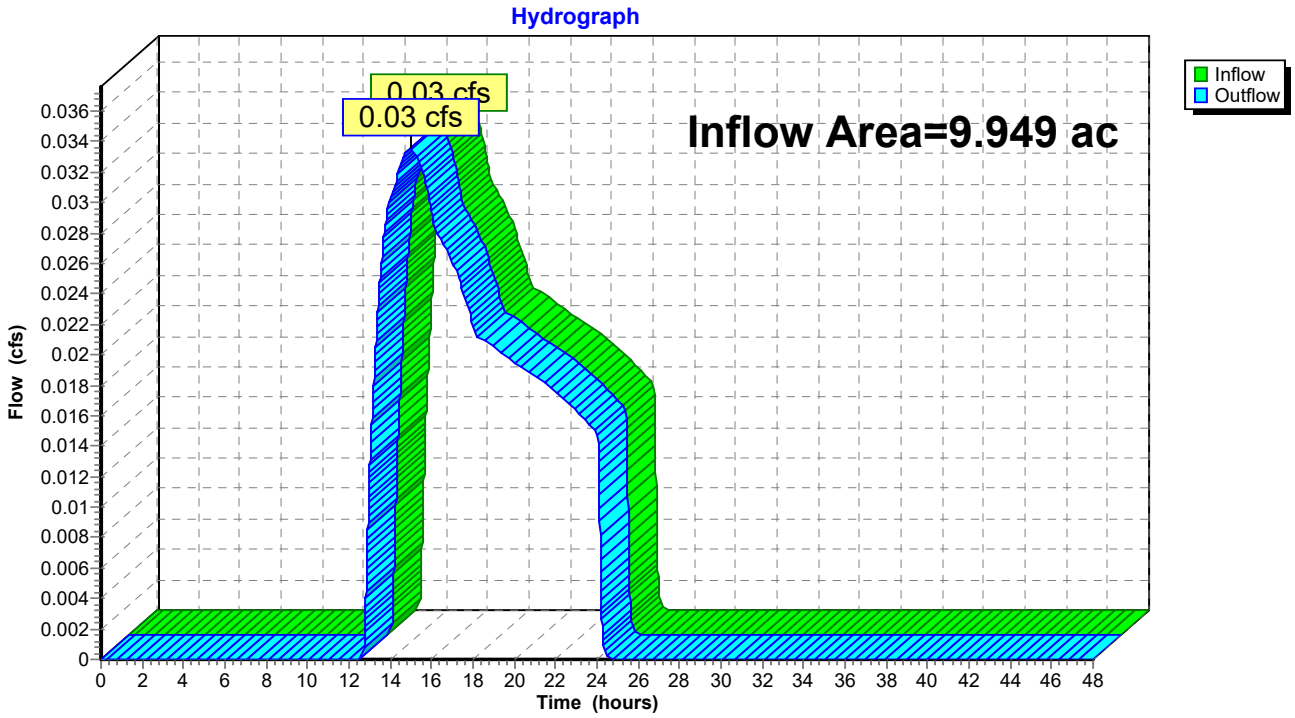


Summary for Reach 1: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 0.03" for WQv event
Inflow = 0.03 cfs @ 14.98 hrs, Volume= 0.021 af
Outflow = 0.03 cfs @ 14.98 hrs, Volume= 0.021 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 1: Design Line

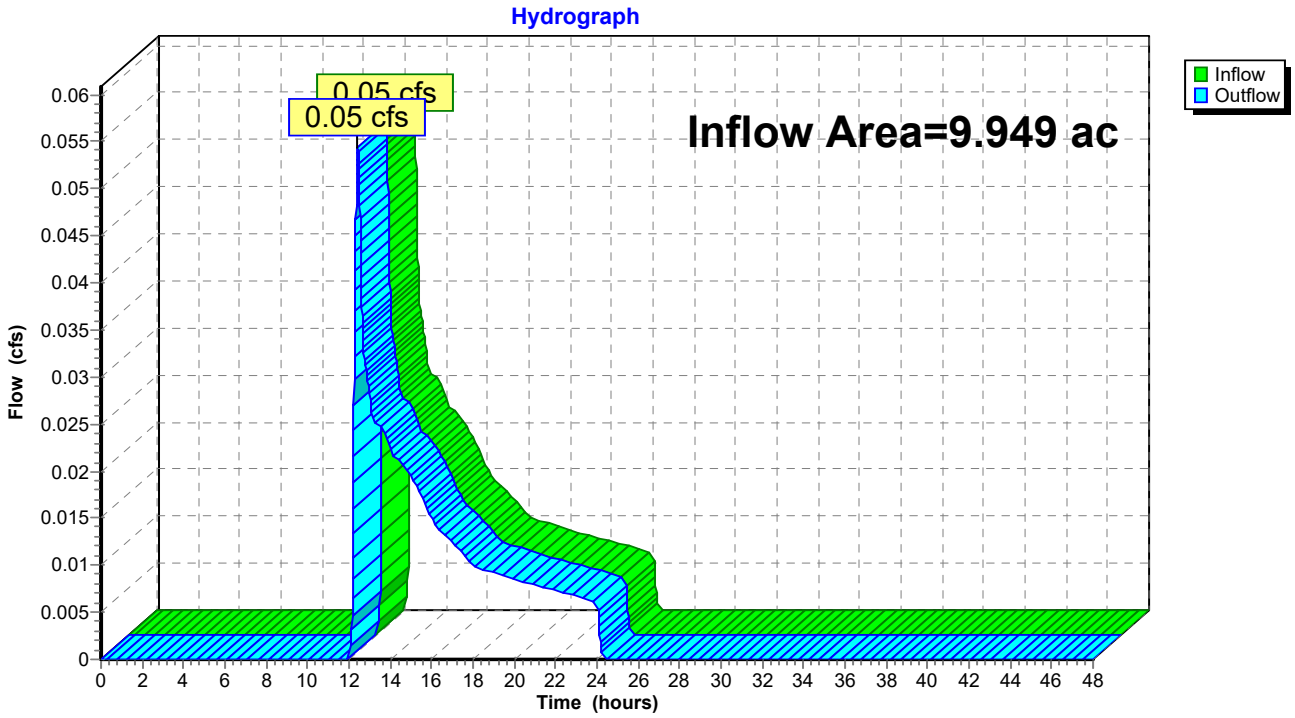


Summary for Reach 2: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 0.02" for WQv event
Inflow = 0.05 cfs @ 12.43 hrs, Volume= 0.014 af
Outflow = 0.05 cfs @ 12.43 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 2: Design Line



Summary for Pond 201P: Water Quality Basin

Inflow Area = 7.692 ac, 0.00% Impervious, Inflow Depth = 0.06" for WQv event
Inflow = 0.13 cfs @ 12.47 hrs, Volume= 0.040 af
Outflow = 0.11 cfs @ 12.58 hrs, Volume= 0.040 af, Atten= 15%, Lag= 6.5 min
Discarded = 0.11 cfs @ 12.58 hrs, Volume= 0.040 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 148.50' @ 12.58 hrs Surf.Area= 9,928 sf Storage= 45 cf

Plug-Flow detention time= 7.1 min calculated for 0.040 af (100% of inflow)
Center-of-Mass det. time= 7.1 min (999.4 - 992.3)

Volume	Invert	Avail.Storage	Storage Description
#1	148.50'	37,110 cf	**Basins (Prismatic)** Listed below (Recalc)

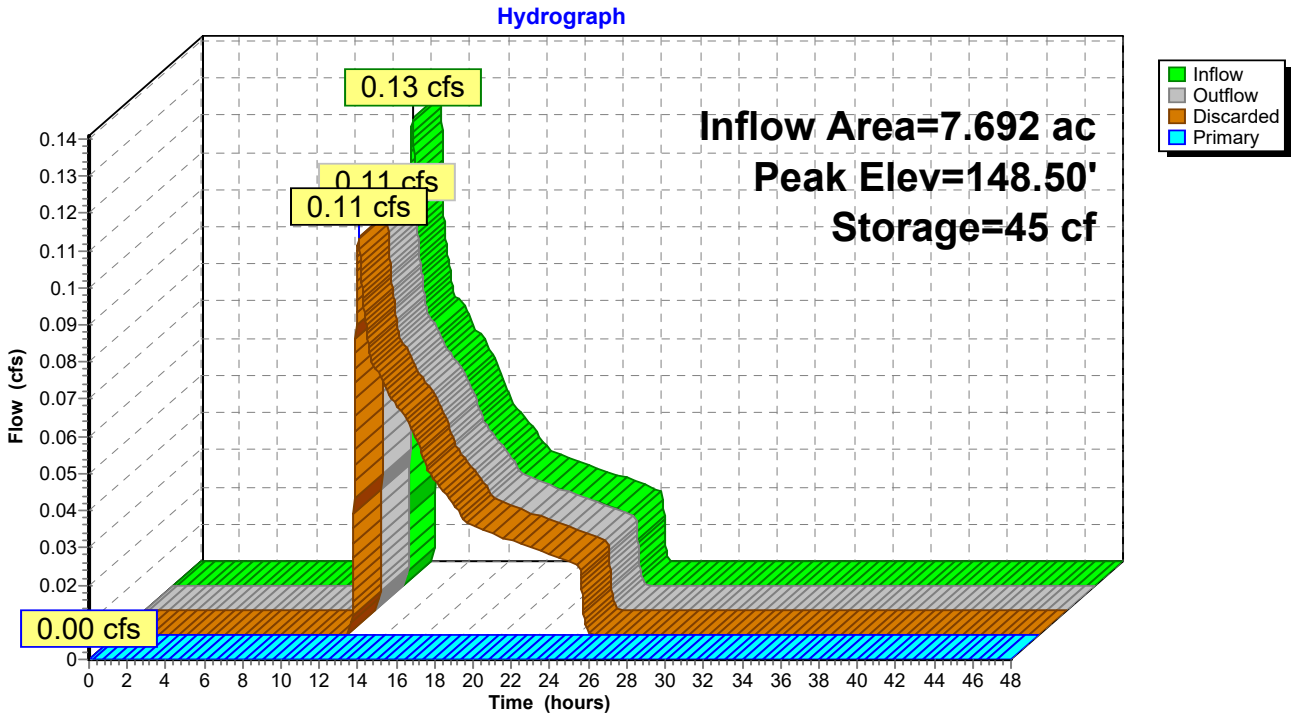
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.50	9,898	0	0
149.00	13,206	5,776	5,776
150.00	23,137	18,172	23,948
150.50	29,512	13,162	37,110

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	149.36'	**26.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.11 cfs @ 12.58 hrs HW=148.50' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=148.50' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 201P: Water Quality Basin



E-3: 1-Year Storm Analysis

Summary for Subcatchment 100: Pre

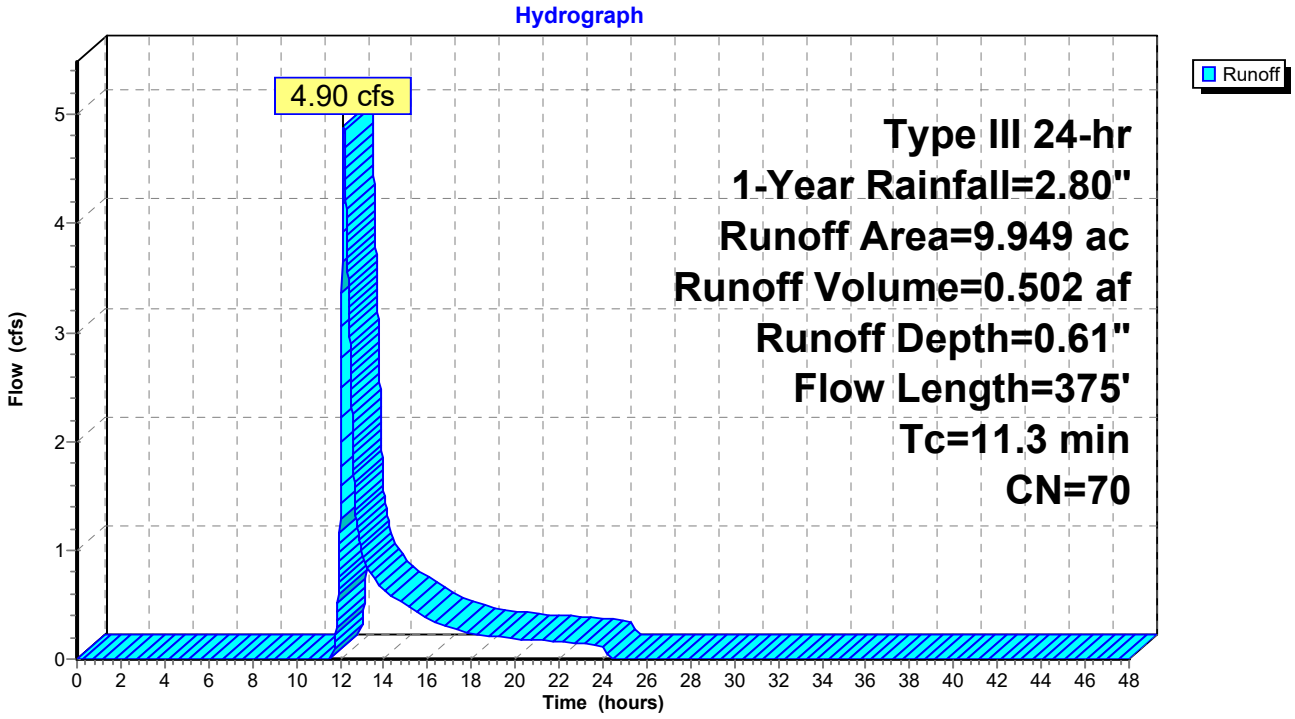
Runoff = 4.90 cfs @ 12.18 hrs, Volume= 0.502 af, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.80"

	Area (ac)	CN	Description
*	8.323	69	Brush/Grass Mix, HSG C
*	0.873	76	Brush/Grass Mix, HSG D
	0.680	70	Woods, Good, HSG C
	0.073	77	Woods, Good, HSG D
	9.949	70	Weighted Average
	9.949	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0250	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.30"
2.5	275	0.0127	1.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
11.3	375	Total			

Subcatchment 100: Pre



Summary for Subcatchment 201: Post-1

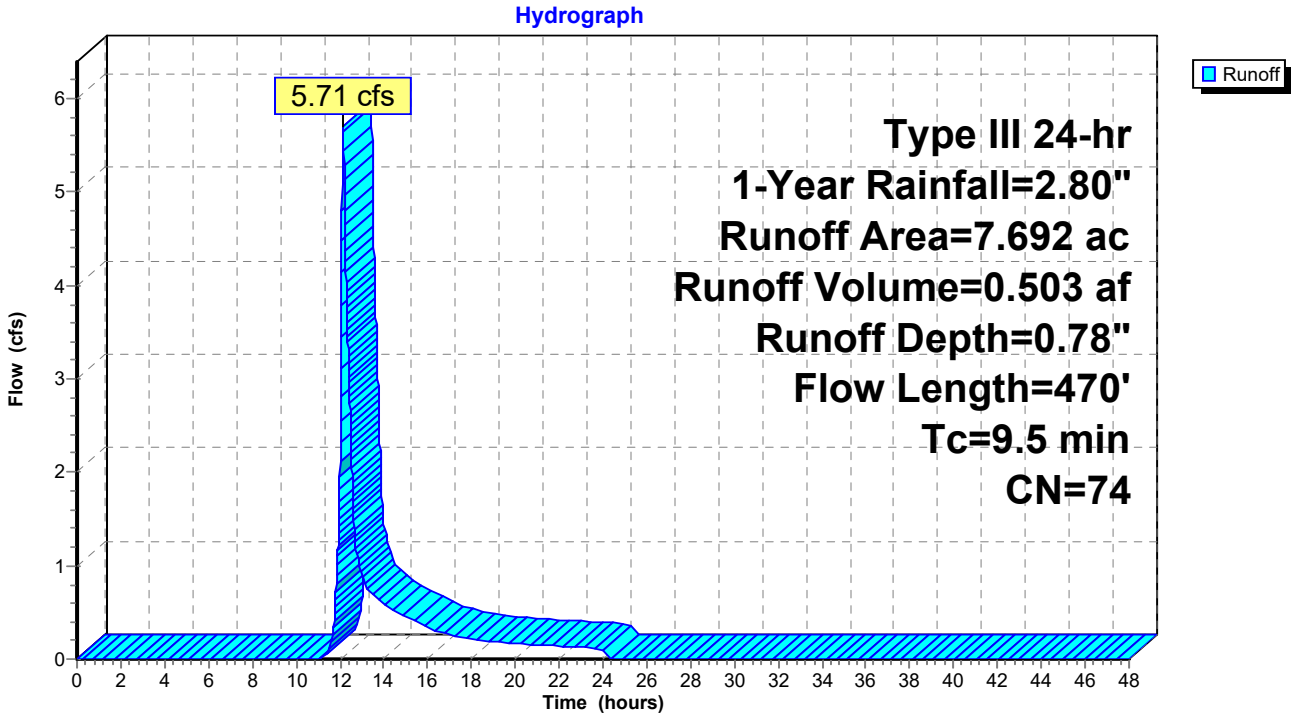
Runoff = 5.71 cfs @ 12.15 hrs, Volume= 0.503 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.80"

Area (ac)	CN	Description
6.822	74	>75% Grass cover, Good, HSG C
0.332	80	>75% Grass cover, Good, HSG D
0.473	70	Woods, Good, HSG C
0.065	77	Woods, Good, HSG D
7.692	74	Weighted Average
7.692	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	420	0.0393	3.19		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.5	470	Total			

Subcatchment 201: Post-1



Summary for Subcatchment 202: Post-2

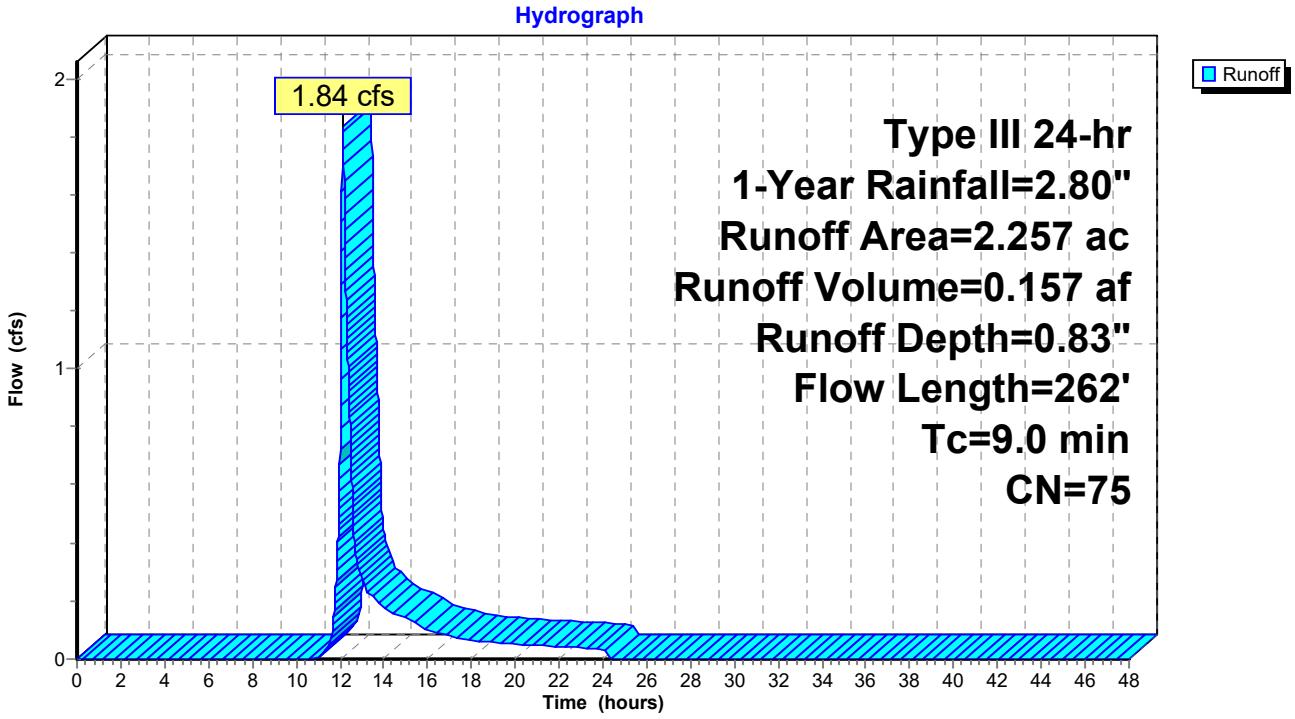
Runoff = 1.84 cfs @ 12.14 hrs, Volume= 0.157 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 1-Year Rainfall=2.80"

Area (ac)	CN	Description
1.527	74	>75% Grass cover, Good, HSG C
0.541	80	>75% Grass cover, Good, HSG D
0.181	70	Woods, Good, HSG C
0.008	77	Woods, Good, HSG D
2.257	75	Weighted Average
2.257	75	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0120	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	212	0.0101	1.62		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.0	262	Total			

Subcatchment 202: Post-2

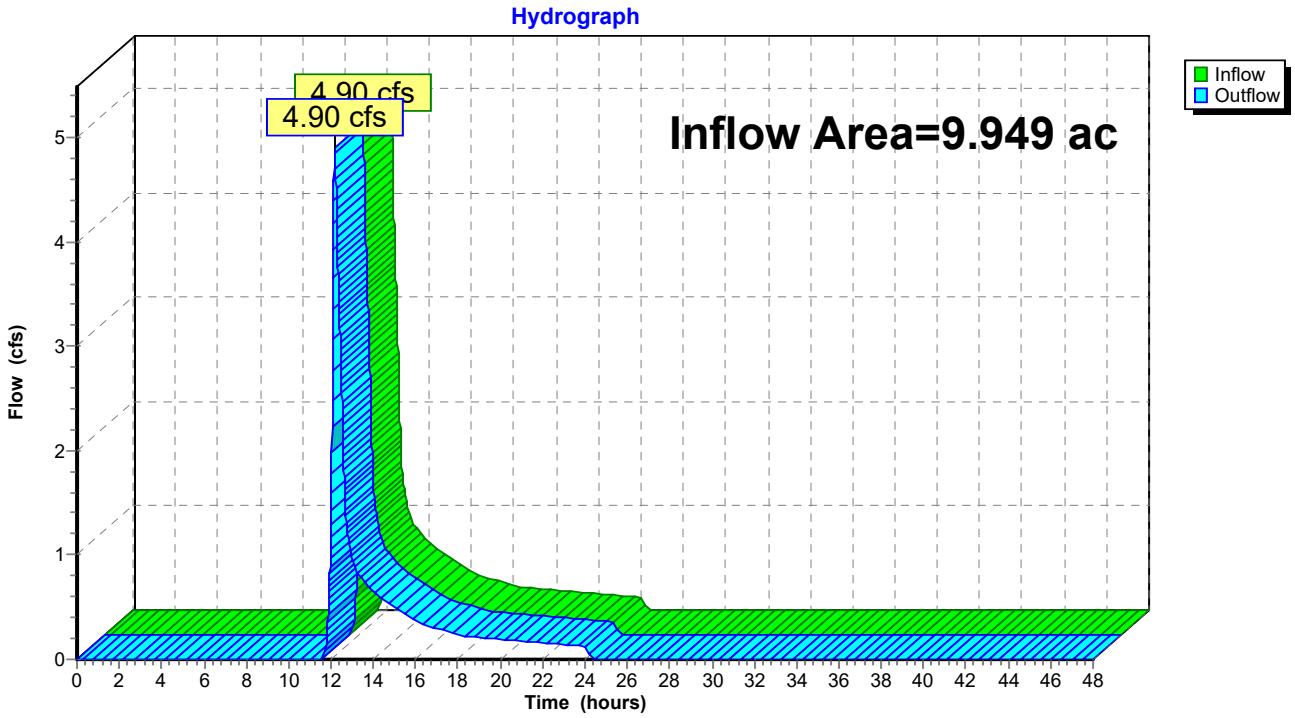


Summary for Reach 1: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 0.61" for 1-Year event
Inflow = 4.90 cfs @ 12.18 hrs, Volume= 0.502 af
Outflow = 4.90 cfs @ 12.18 hrs, Volume= 0.502 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 1: Design Line

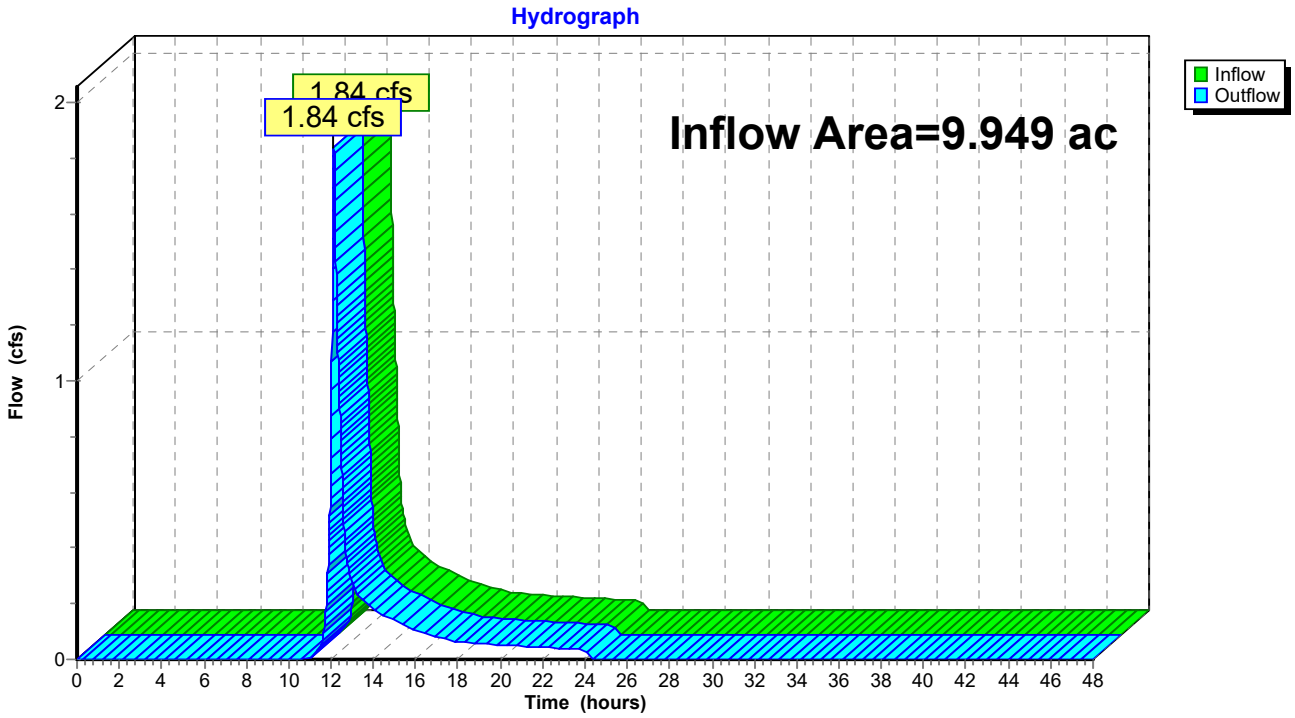


Summary for Reach 2: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 0.19" for 1-Year event
Inflow = 1.84 cfs @ 12.14 hrs, Volume= 0.157 af
Outflow = 1.84 cfs @ 12.14 hrs, Volume= 0.157 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 2: Design Line



Summary for Pond 201P: Water Quality Basin

Inflow Area = 7.692 ac, 0.00% Impervious, Inflow Depth = 0.78" for 1-Year event
Inflow = 5.71 cfs @ 12.15 hrs, Volume= 0.503 af
Outflow = 0.39 cfs @ 15.56 hrs, Volume= 0.503 af, Atten= 93%, Lag= 204.9 min
Discarded = 0.39 cfs @ 15.56 hrs, Volume= 0.503 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 149.34' @ 15.56 hrs Surf.Area= 16,589 sf Storage= 10,850 cf

Plug-Flow detention time= 337.4 min calculated for 0.502 af (100% of inflow)
Center-of-Mass det. time= 337.4 min (1,211.6 - 874.2)

Volume	Invert	Avail.Storage	Storage Description
#1	148.50'	37,110 cf	**Basins (Prismatic)** Listed below (Recalc)

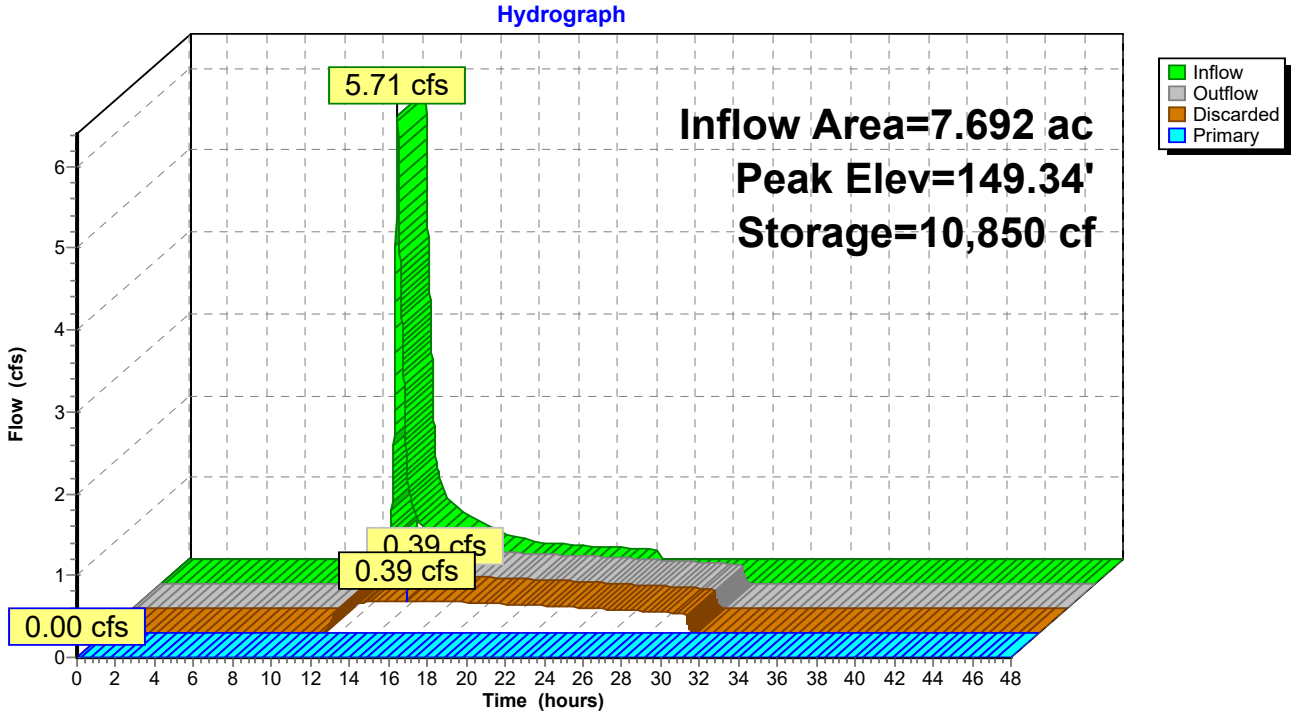
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.50	9,898	0	0
149.00	13,206	5,776	5,776
150.00	23,137	18,172	23,948
150.50	29,512	13,162	37,110

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	149.36'	**26.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.39 cfs @ 15.56 hrs HW=149.34' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.39 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=148.50' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 201P: Water Quality Basin



E-4: 2-Year Storm Analysis

Summary for Subcatchment 100: Pre

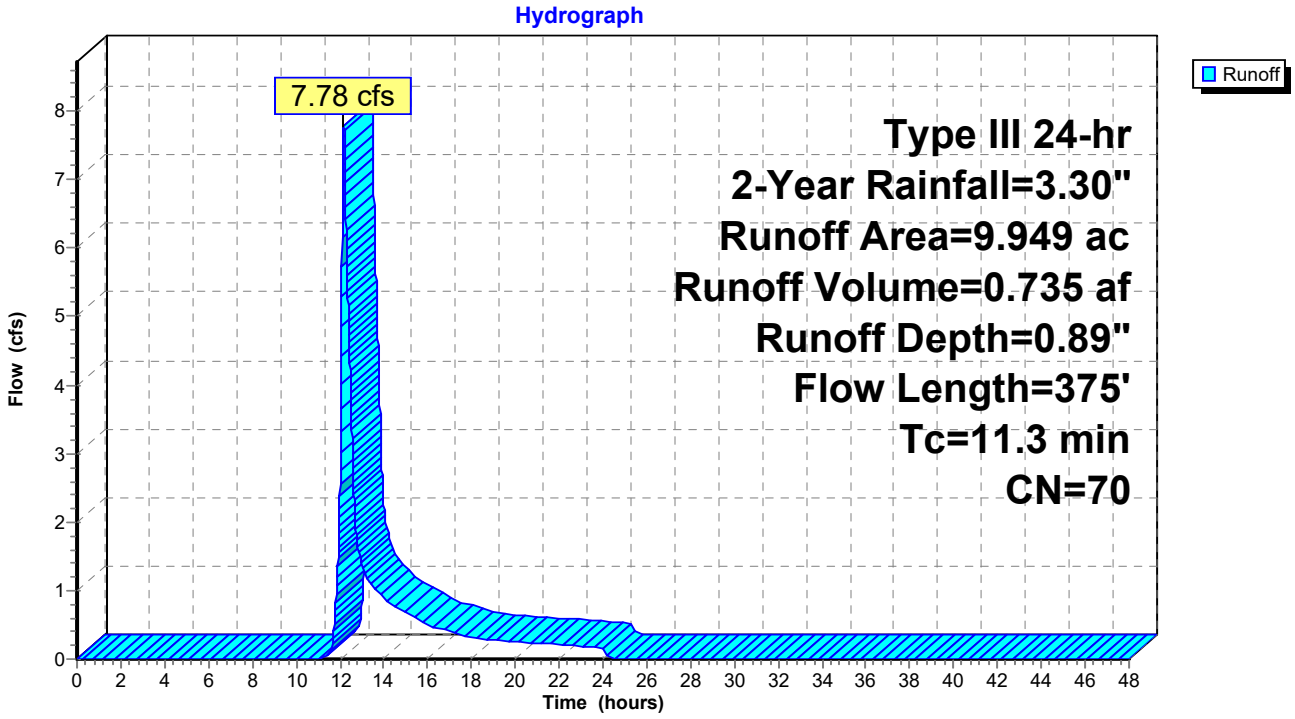
Runoff = 7.78 cfs @ 12.17 hrs, Volume= 0.735 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (ac)	CN	Description
*	8.323	69	Brush/Grass Mix, HSG C
*	0.873	76	Brush/Grass Mix, HSG D
	0.680	70	Woods, Good, HSG C
	0.073	77	Woods, Good, HSG D
	9.949	70	Weighted Average
	9.949	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0250	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.30"
2.5	275	0.0127	1.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
11.3	375	Total			

Subcatchment 100: Pre



Summary for Subcatchment 201: Post-1

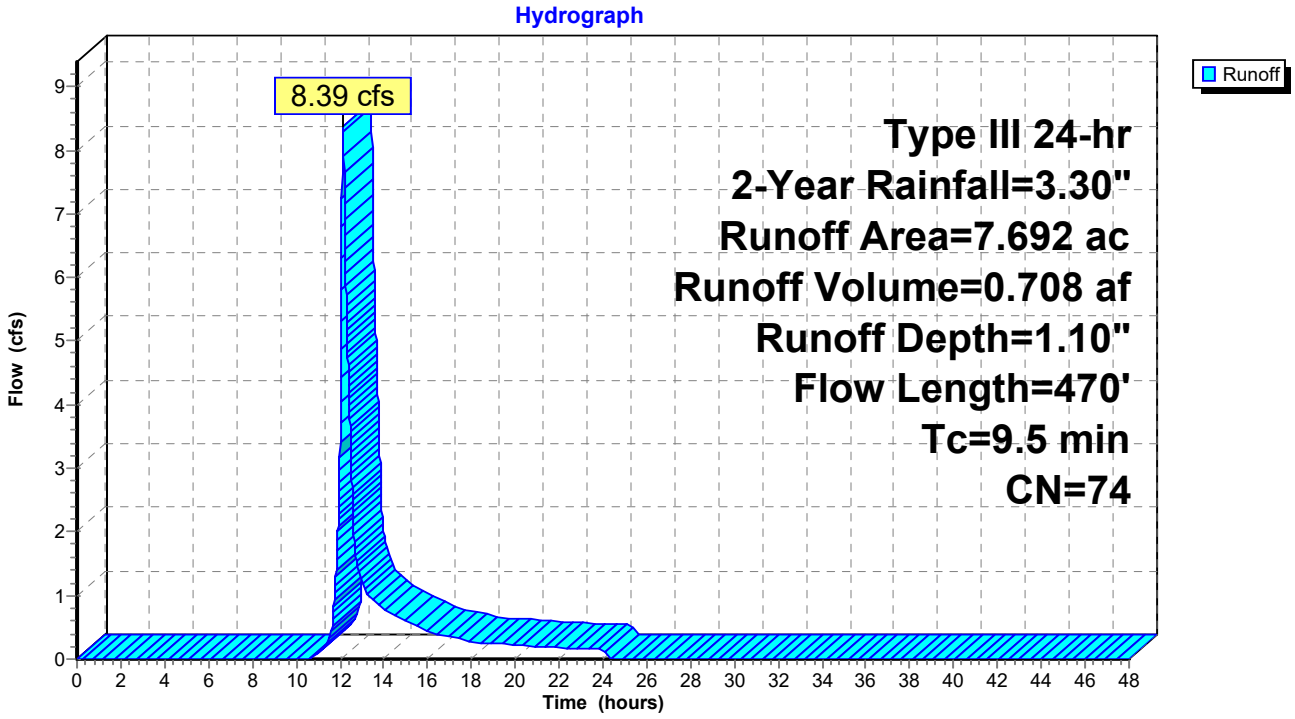
Runoff = 8.39 cfs @ 12.14 hrs, Volume= 0.708 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.30"

Area (ac)	CN	Description
6.822	74	>75% Grass cover, Good, HSG C
0.332	80	>75% Grass cover, Good, HSG D
0.473	70	Woods, Good, HSG C
0.065	77	Woods, Good, HSG D
7.692	74	Weighted Average
7.692	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	420	0.0393	3.19		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.5	470	Total			

Subcatchment 201: Post-1



Summary for Subcatchment 202: Post-2

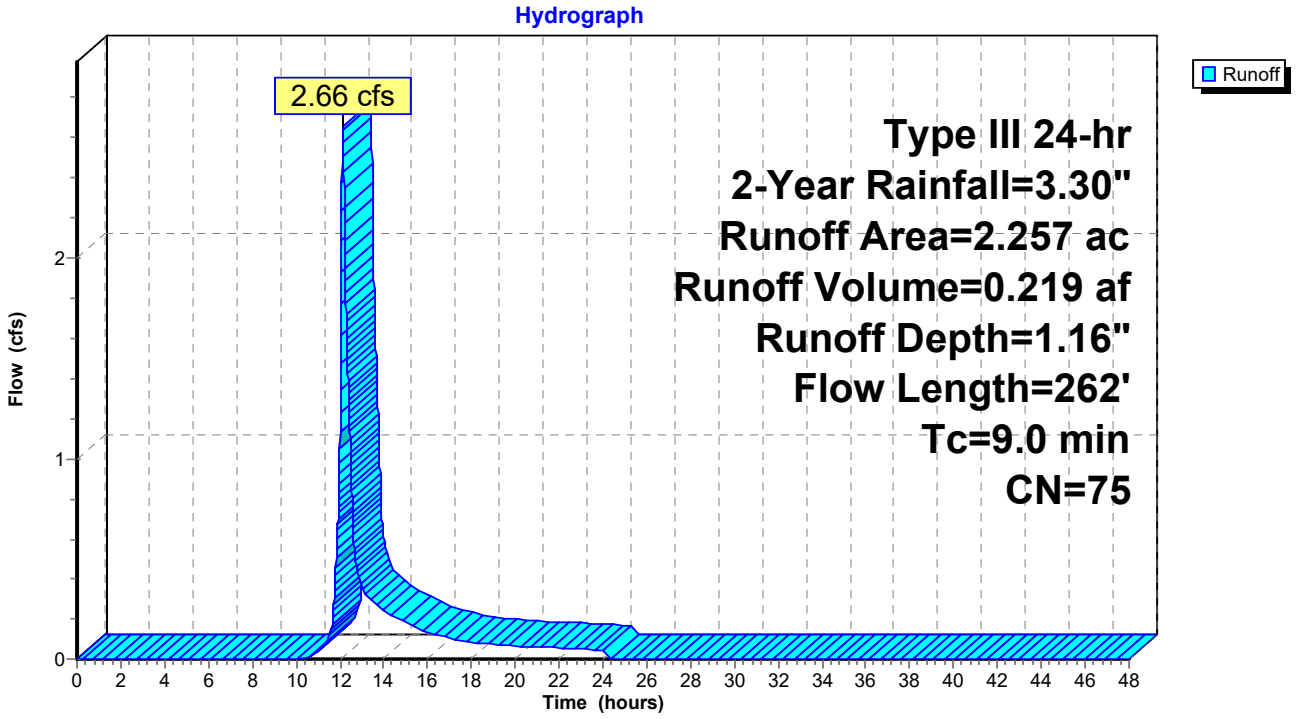
Runoff = 2.66 cfs @ 12.13 hrs, Volume= 0.219 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.30"

Area (ac)	CN	Description
1.527	74	>75% Grass cover, Good, HSG C
0.541	80	>75% Grass cover, Good, HSG D
0.181	70	Woods, Good, HSG C
0.008	77	Woods, Good, HSG D
2.257	75	Weighted Average
2.257	75	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0120	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	212	0.0101	1.62		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.0	262	Total			

Subcatchment 202: Post-2

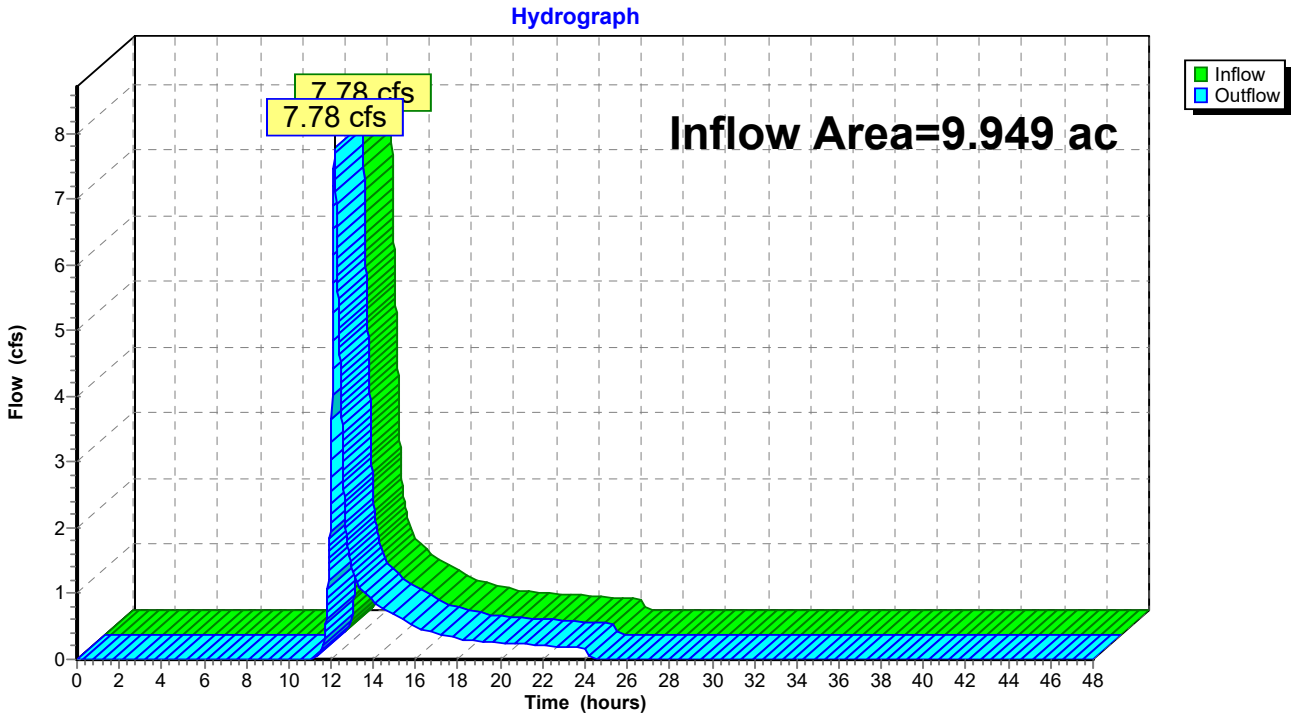


Summary for Reach 1: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 0.89" for 2-Year event
Inflow = 7.78 cfs @ 12.17 hrs, Volume= 0.735 af
Outflow = 7.78 cfs @ 12.17 hrs, Volume= 0.735 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 1: Design Line

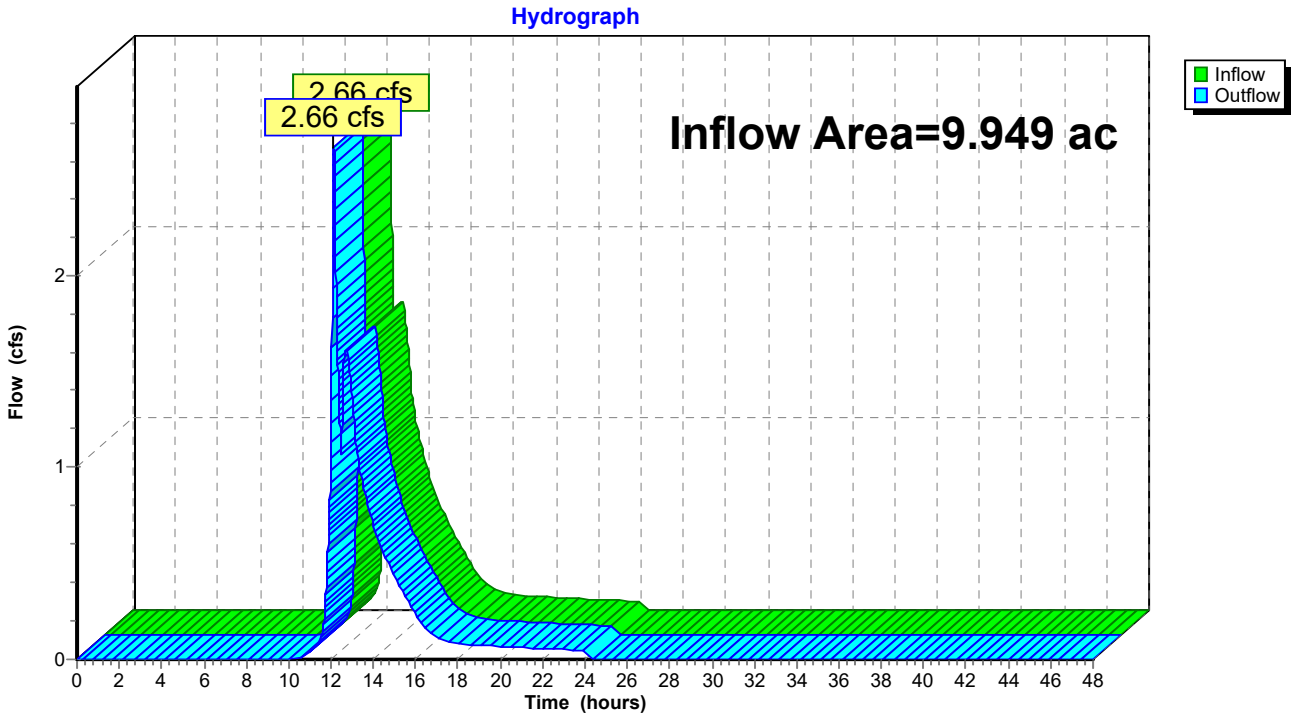


Summary for Reach 2: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 0.43" for 2-Year event
Inflow = 2.66 cfs @ 12.13 hrs, Volume= 0.360 af
Outflow = 2.66 cfs @ 12.13 hrs, Volume= 0.360 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 2: Design Line



Summary for Pond 201P: Water Quality Basin

Inflow Area = 7.692 ac, 0.00% Impervious, Inflow Depth = 1.10" for 2-Year event
Inflow = 8.39 cfs @ 12.14 hrs, Volume= 0.708 af
Outflow = 1.55 cfs @ 12.75 hrs, Volume= 0.708 af, Atten= 82%, Lag= 36.7 min
Discarded = 0.41 cfs @ 12.75 hrs, Volume= 0.567 af
Primary = 1.14 cfs @ 12.75 hrs, Volume= 0.141 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 149.42' @ 12.75 hrs Surf.Area= 17,419 sf Storage= 12,272 cf

Plug-Flow detention time= 289.2 min calculated for 0.708 af (100% of inflow)
Center-of-Mass det. time= 289.2 min (1,152.6 - 863.4)

Volume	Invert	Avail.Storage	Storage Description
#1	148.50'	37,110 cf	**Basins (Prismatic)** Listed below (Recalc)

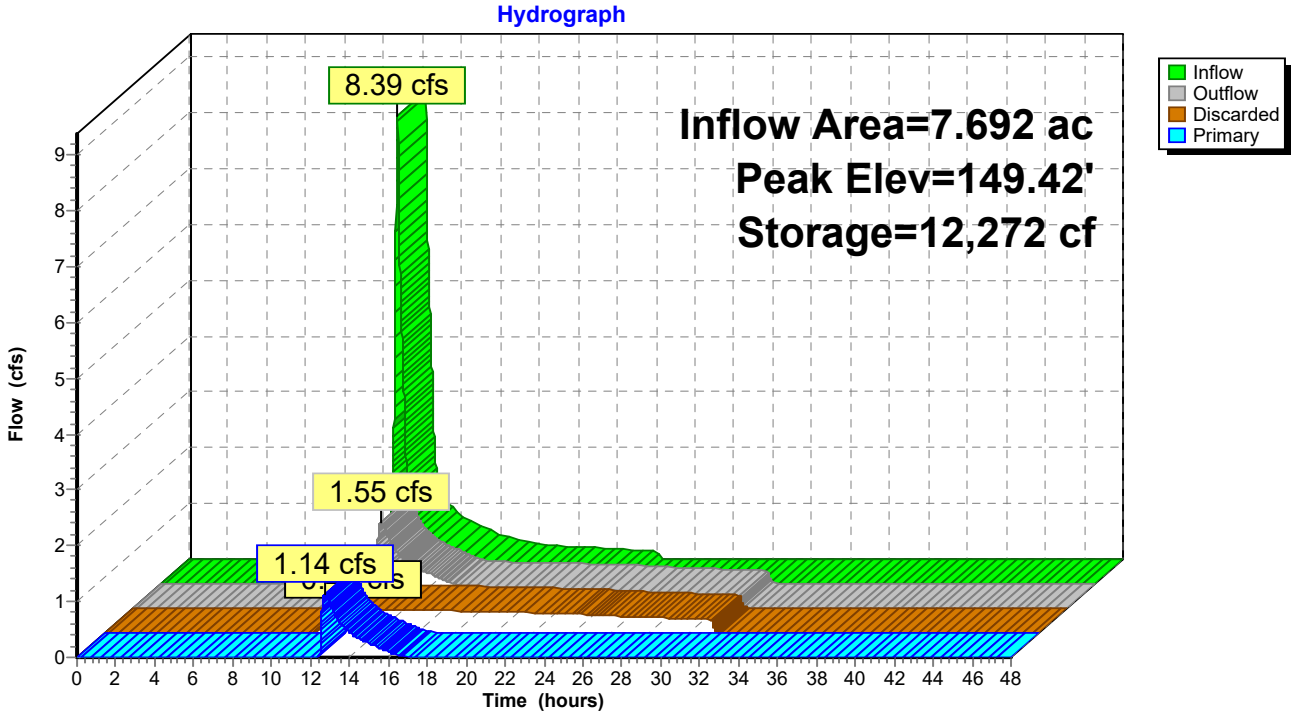
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.50	9,898	0	0
149.00	13,206	5,776	5,776
150.00	23,137	18,172	23,948
150.50	29,512	13,162	37,110

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	149.36'	**26.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.41 cfs @ 12.75 hrs HW=149.42' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.41 cfs)

Primary OutFlow Max=1.14 cfs @ 12.75 hrs HW=149.42' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 1.14 cfs @ 0.68 fps)

Pond 201P: Water Quality Basin



E-5: 10-Year Storm Analysis

Summary for Subcatchment 100: Pre

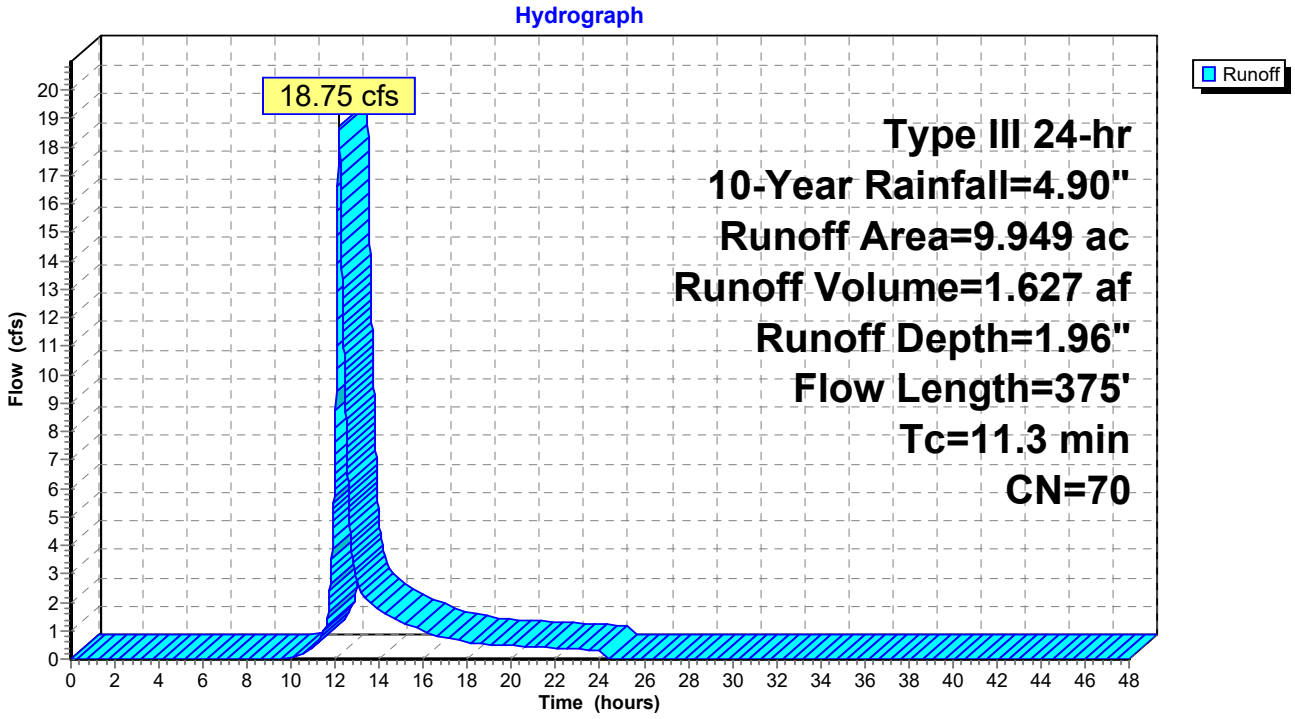
Runoff = 18.75 cfs @ 12.16 hrs, Volume= 1.627 af, Depth= 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

	Area (ac)	CN	Description
*	8.323	69	Brush/Grass Mix, HSG C
*	0.873	76	Brush/Grass Mix, HSG D
	0.680	70	Woods, Good, HSG C
	0.073	77	Woods, Good, HSG D
	9.949	70	Weighted Average
	9.949	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0250	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.30"
2.5	275	0.0127	1.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
11.3	375	Total			

Subcatchment 100: Pre



Summary for Subcatchment 201: Post-1

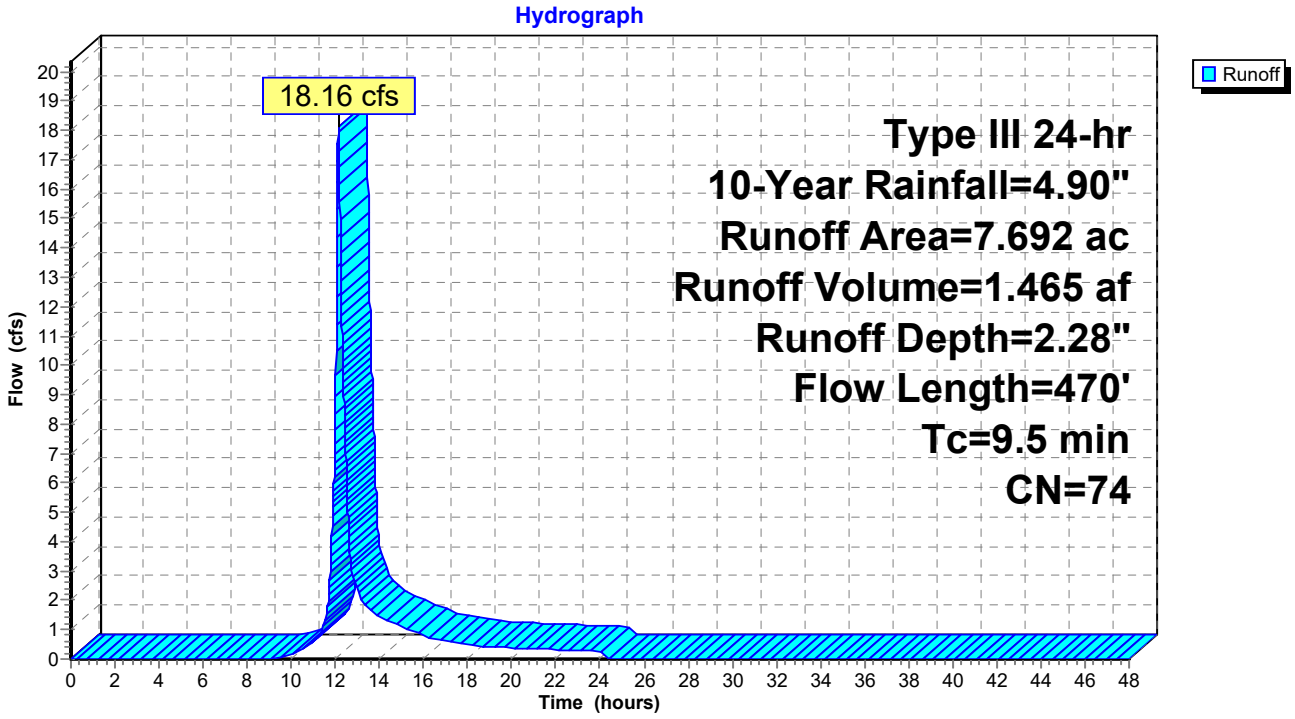
Runoff = 18.16 cfs @ 12.14 hrs, Volume= 1.465 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
6.822	74	>75% Grass cover, Good, HSG C
0.332	80	>75% Grass cover, Good, HSG D
0.473	70	Woods, Good, HSG C
0.065	77	Woods, Good, HSG D
7.692	74	Weighted Average
7.692	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	420	0.0393	3.19		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.5	470	Total			

Subcatchment 201: Post-1



Summary for Subcatchment 202: Post-2

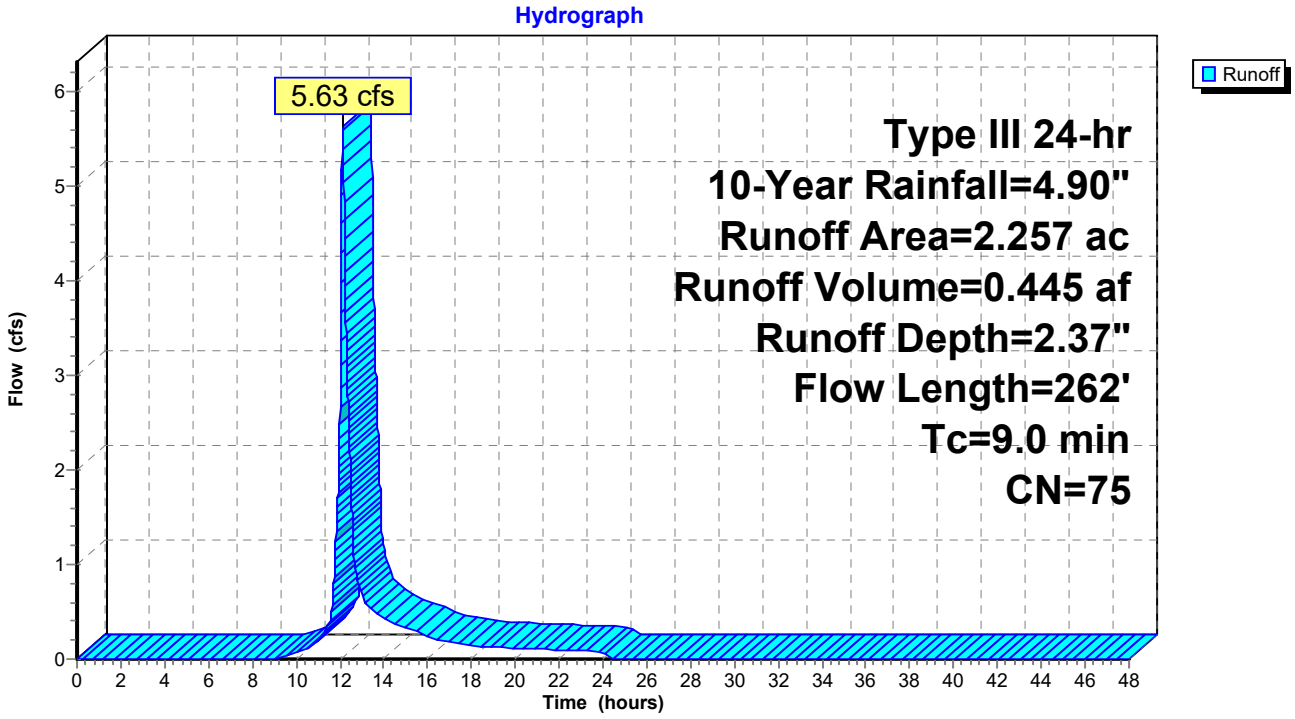
Runoff = 5.63 cfs @ 12.13 hrs, Volume= 0.445 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (ac)	CN	Description
1.527	74	>75% Grass cover, Good, HSG C
0.541	80	>75% Grass cover, Good, HSG D
0.181	70	Woods, Good, HSG C
0.008	77	Woods, Good, HSG D
2.257	75	Weighted Average
2.257	75	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0120	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	212	0.0101	1.62		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.0	262	Total			

Subcatchment 202: Post-2

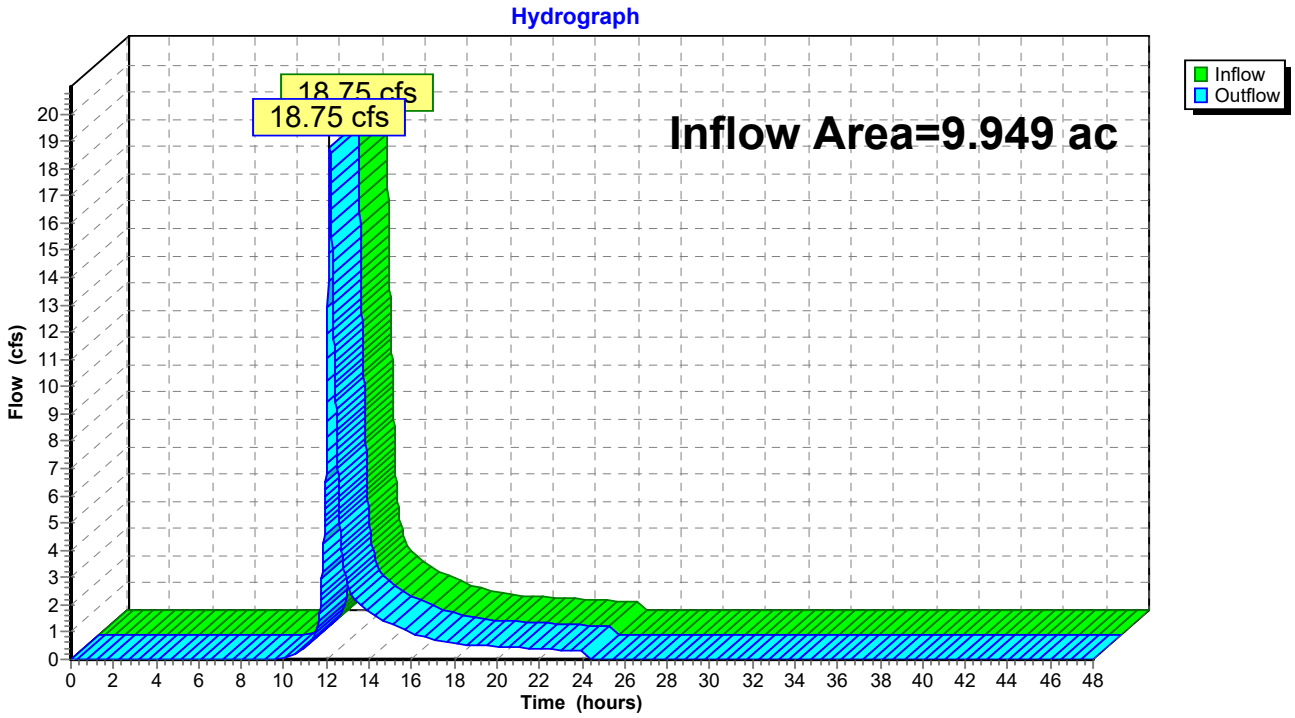


Summary for Reach 1: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 1.96" for 10-Year event
Inflow = 18.75 cfs @ 12.16 hrs, Volume= 1.627 af
Outflow = 18.75 cfs @ 12.16 hrs, Volume= 1.627 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 1: Design Line

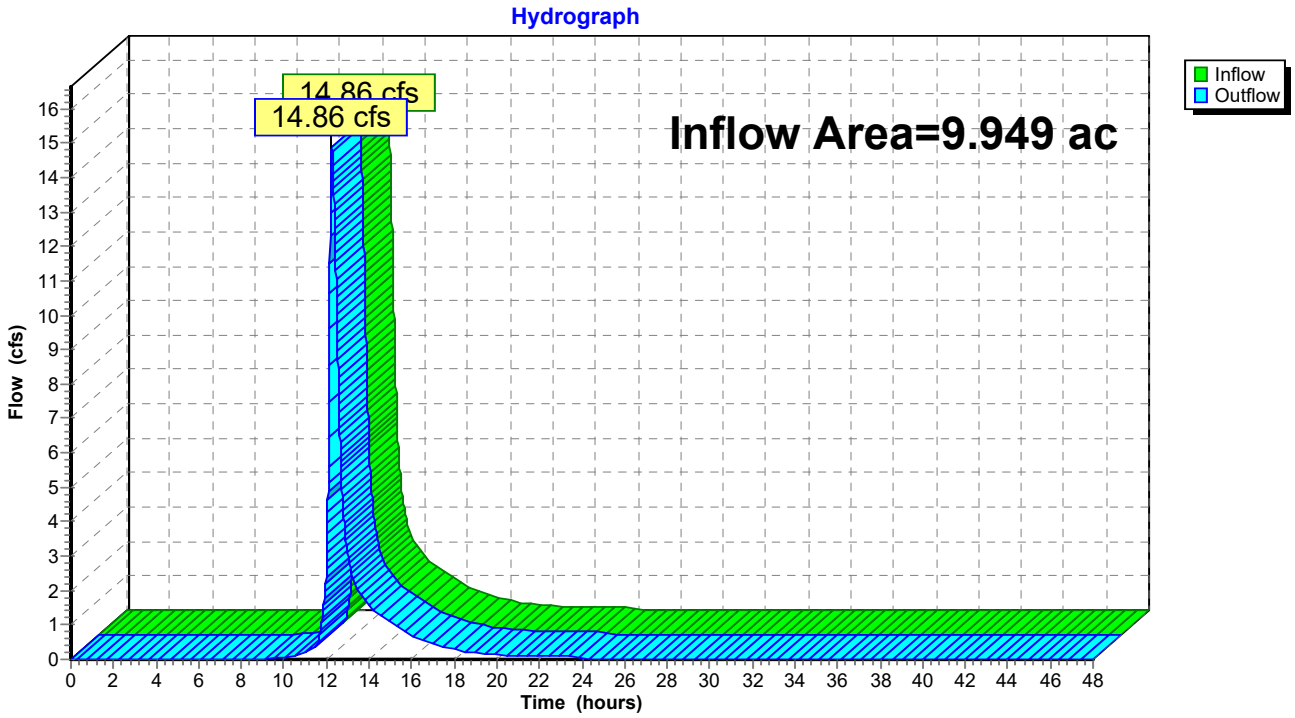


Summary for Reach 2: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 1.48" for 10-Year event
Inflow = 14.86 cfs @ 12.25 hrs, Volume= 1.226 af
Outflow = 14.86 cfs @ 12.25 hrs, Volume= 1.226 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 2: Design Line



Summary for Pond 201P: Water Quality Basin

Inflow Area = 7.692 ac, 0.00% Impervious, Inflow Depth = 2.28" for 10-Year event
Inflow = 18.16 cfs @ 12.14 hrs, Volume= 1.465 af
Outflow = 11.71 cfs @ 12.28 hrs, Volume= 1.465 af, Atten= 36%, Lag= 8.6 min
Discarded = 0.47 cfs @ 12.28 hrs, Volume= 0.684 af
Primary = 11.24 cfs @ 12.28 hrs, Volume= 0.781 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 149.65' @ 12.28 hrs Surf.Area= 19,707 sf Storage= 16,549 cf

Plug-Flow detention time= 177.0 min calculated for 1.465 af (100% of inflow)
Center-of-Mass det. time= 177.0 min (1,018.7 - 841.7)

Volume	Invert	Avail.Storage	Storage Description
#1	148.50'	37,110 cf	**Basins (Prismatic)** Listed below (Recalc)

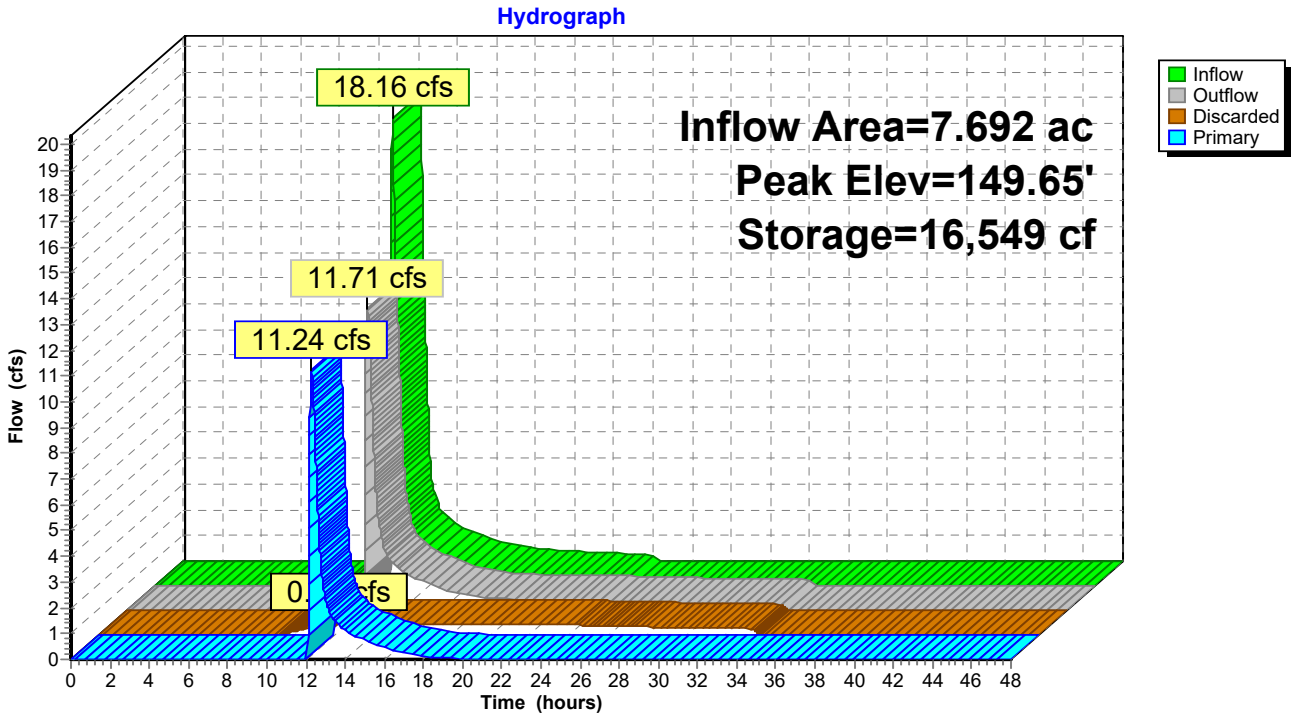
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.50	9,898	0	0
149.00	13,206	5,776	5,776
150.00	23,137	18,172	23,948
150.50	29,512	13,162	37,110

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	149.36'	**26.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.47 cfs @ 12.28 hrs HW=149.65' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.47 cfs)

Primary OutFlow Max=11.24 cfs @ 12.28 hrs HW=149.65' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 11.24 cfs @ 1.47 fps)

Pond 201P: Water Quality Basin



E-6: 25-Year Storm Analysis

Summary for Subcatchment 100: Pre

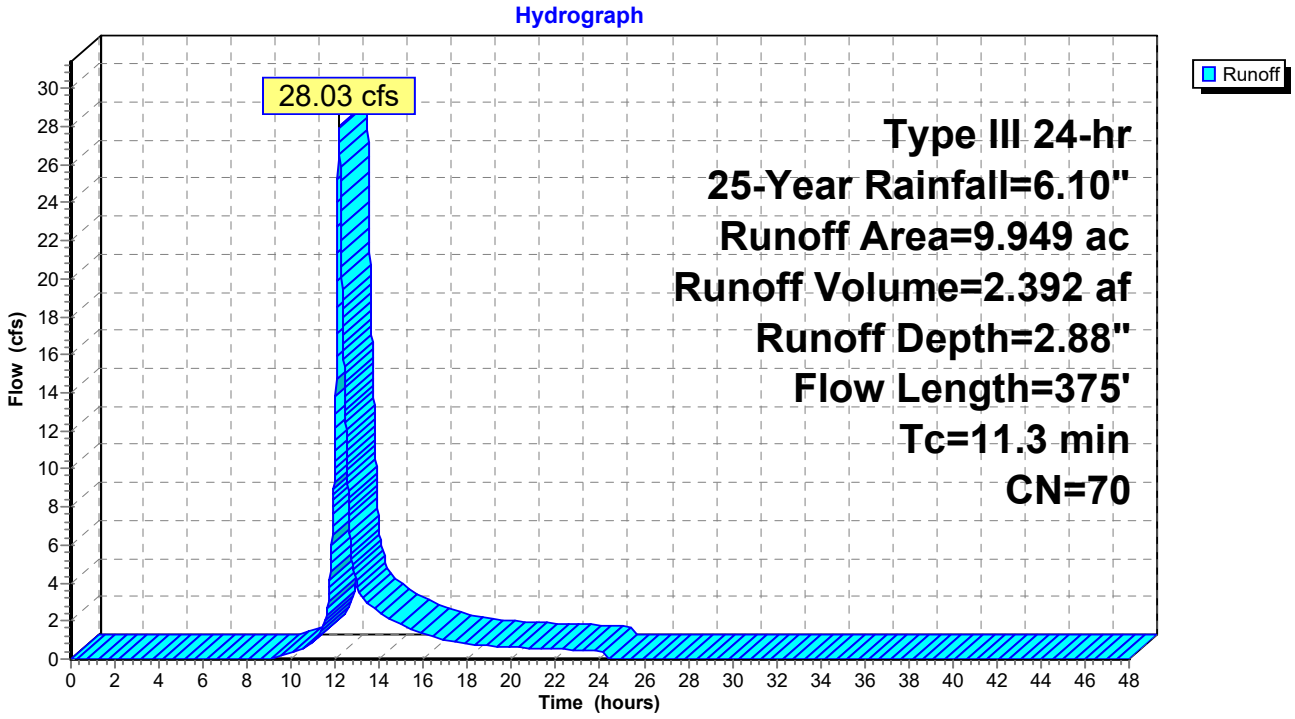
Runoff = 28.03 cfs @ 12.16 hrs, Volume= 2.392 af, Depth= 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.10"

	Area (ac)	CN	Description
*	8.323	69	Brush/Grass Mix, HSG C
*	0.873	76	Brush/Grass Mix, HSG D
	0.680	70	Woods, Good, HSG C
	0.073	77	Woods, Good, HSG D
	9.949	70	Weighted Average
	9.949	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0250	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.30"
2.5	275	0.0127	1.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
11.3	375	Total			

Subcatchment 100: Pre



Summary for Subcatchment 201: Post-1

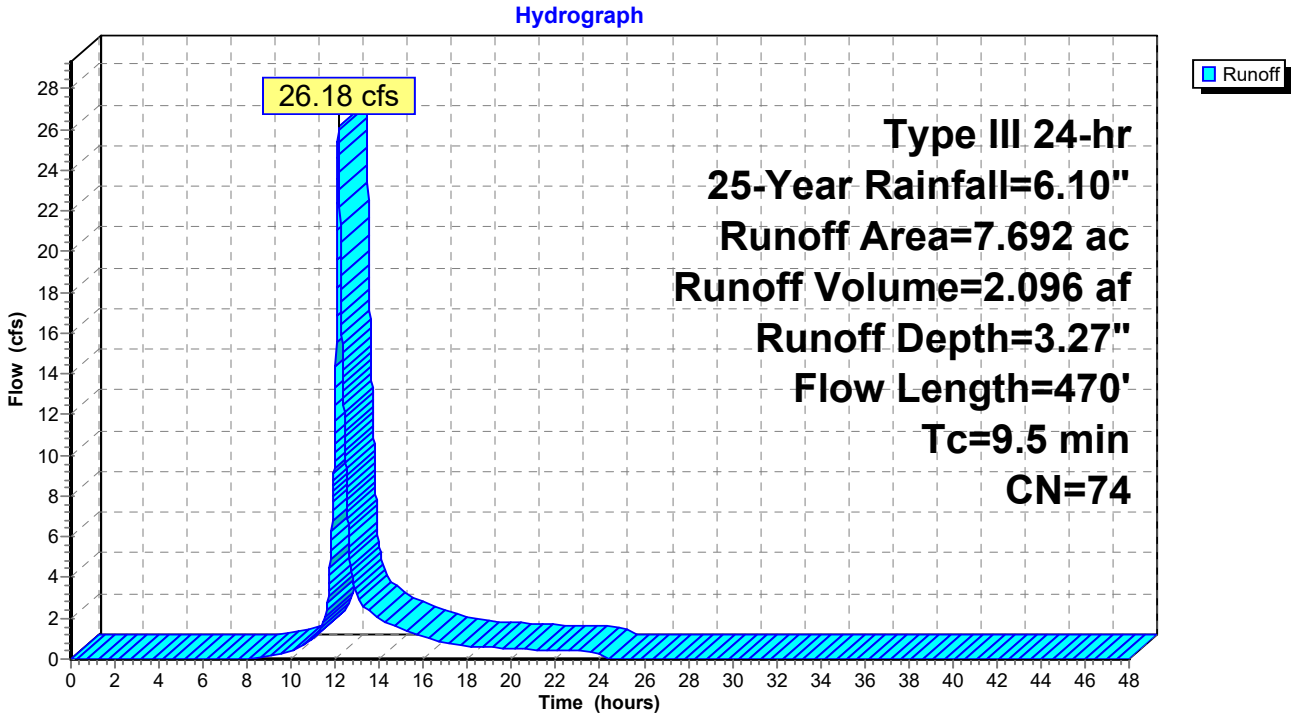
Runoff = 26.18 cfs @ 12.13 hrs, Volume= 2.096 af, Depth= 3.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.10"

Area (ac)	CN	Description
6.822	74	>75% Grass cover, Good, HSG C
0.332	80	>75% Grass cover, Good, HSG D
0.473	70	Woods, Good, HSG C
0.065	77	Woods, Good, HSG D
7.692	74	Weighted Average
7.692	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	420	0.0393	3.19		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.5	470	Total			

Subcatchment 201: Post-1



Summary for Subcatchment 202: Post-2

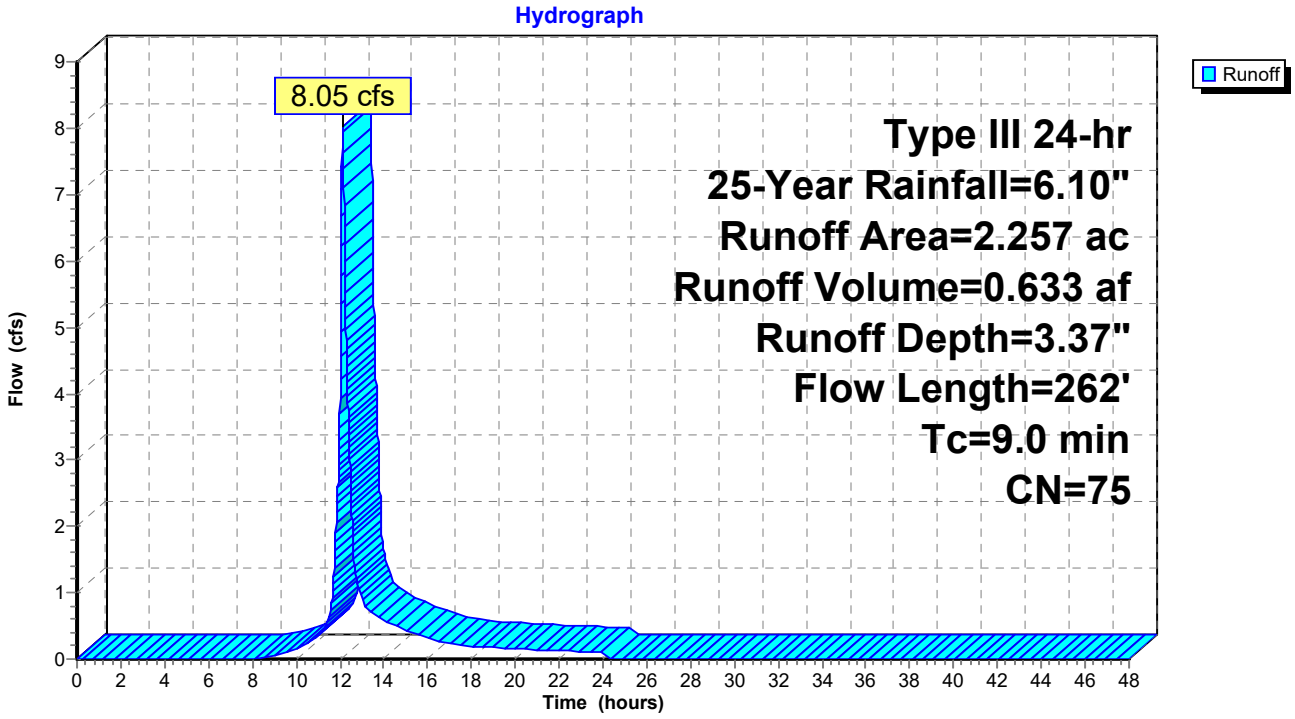
Runoff = 8.05 cfs @ 12.13 hrs, Volume= 0.633 af, Depth= 3.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.10"

Area (ac)	CN	Description
1.527	74	>75% Grass cover, Good, HSG C
0.541	80	>75% Grass cover, Good, HSG D
0.181	70	Woods, Good, HSG C
0.008	77	Woods, Good, HSG D
2.257	75	Weighted Average
2.257	75	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0120	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	212	0.0101	1.62		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.0	262	Total			

Subcatchment 202: Post-2

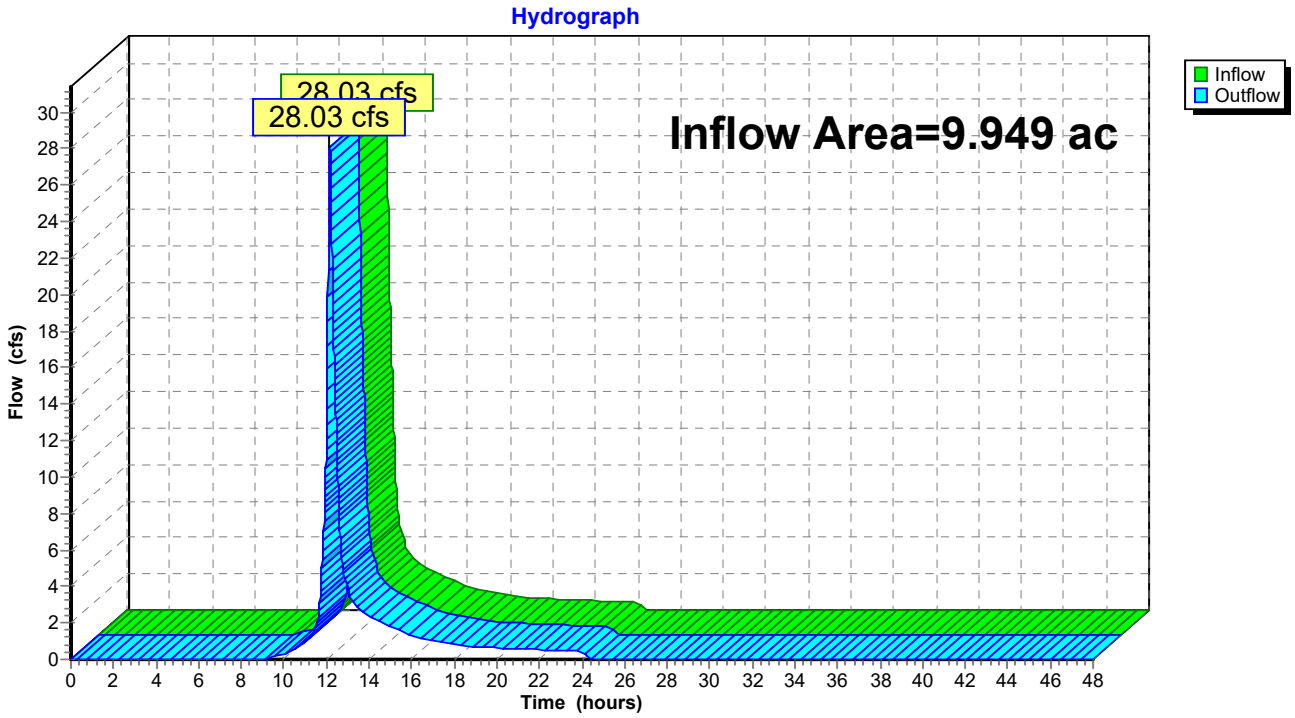


Summary for Reach 1: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 2.88" for 25-Year event
Inflow = 28.03 cfs @ 12.16 hrs, Volume= 2.392 af
Outflow = 28.03 cfs @ 12.16 hrs, Volume= 2.392 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 1: Design Line

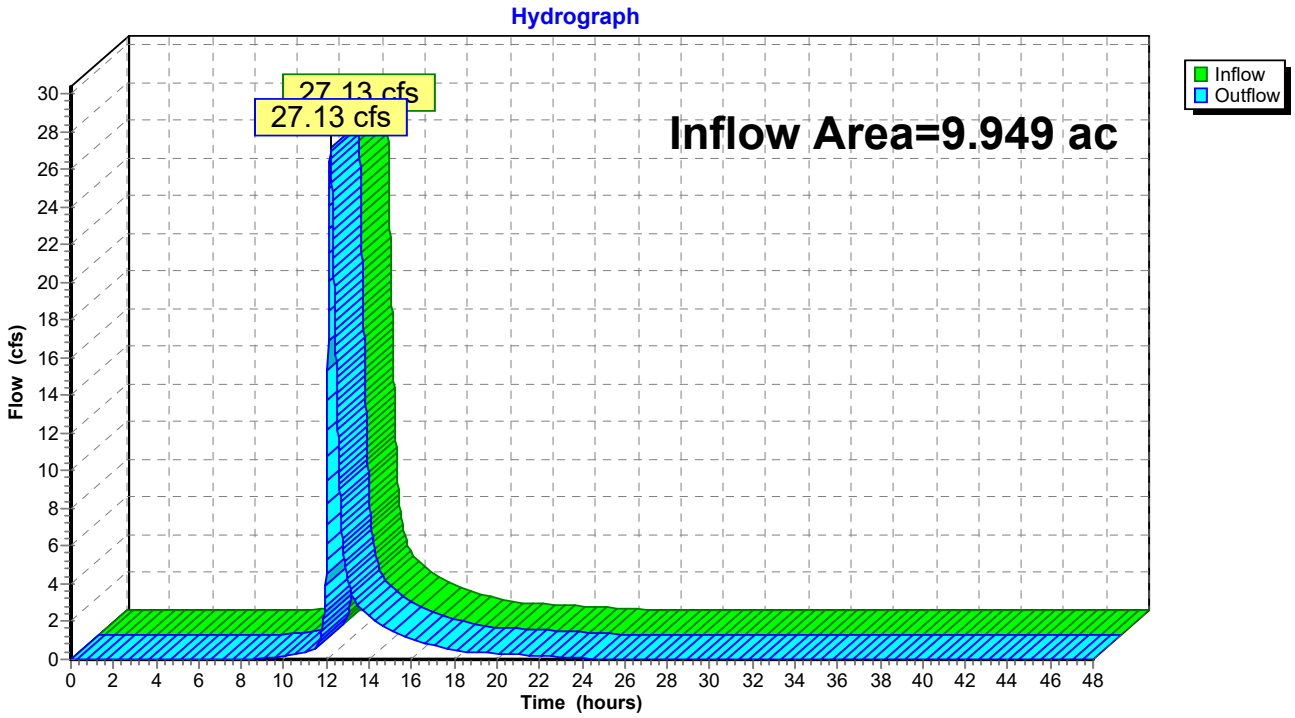


Summary for Reach 2: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 2.41" for 25-Year event
Inflow = 27.13 cfs @ 12.19 hrs, Volume= 1.998 af
Outflow = 27.13 cfs @ 12.19 hrs, Volume= 1.998 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 2: Design Line



Summary for Pond 201P: Water Quality Basin

Inflow Area = 7.692 ac, 0.00% Impervious, Inflow Depth = 3.27" for 25-Year event
Inflow = 26.18 cfs @ 12.13 hrs, Volume= 2.096 af
Outflow = 21.10 cfs @ 12.21 hrs, Volume= 2.096 af, Atten= 19%, Lag= 4.7 min
Discarded = 0.50 cfs @ 12.21 hrs, Volume= 0.731 af
Primary = 20.60 cfs @ 12.21 hrs, Volume= 1.365 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 149.80' @ 12.21 hrs Surf.Area= 21,138 sf Storage= 19,492 cf

Plug-Flow detention time= 134.1 min calculated for 2.095 af (100% of inflow)
Center-of-Mass det. time= 134.2 min (965.5 - 831.3)

Volume	Invert	Avail.Storage	Storage Description
#1	148.50'	37,110 cf	**Basins (Prismatic)** Listed below (Recalc)

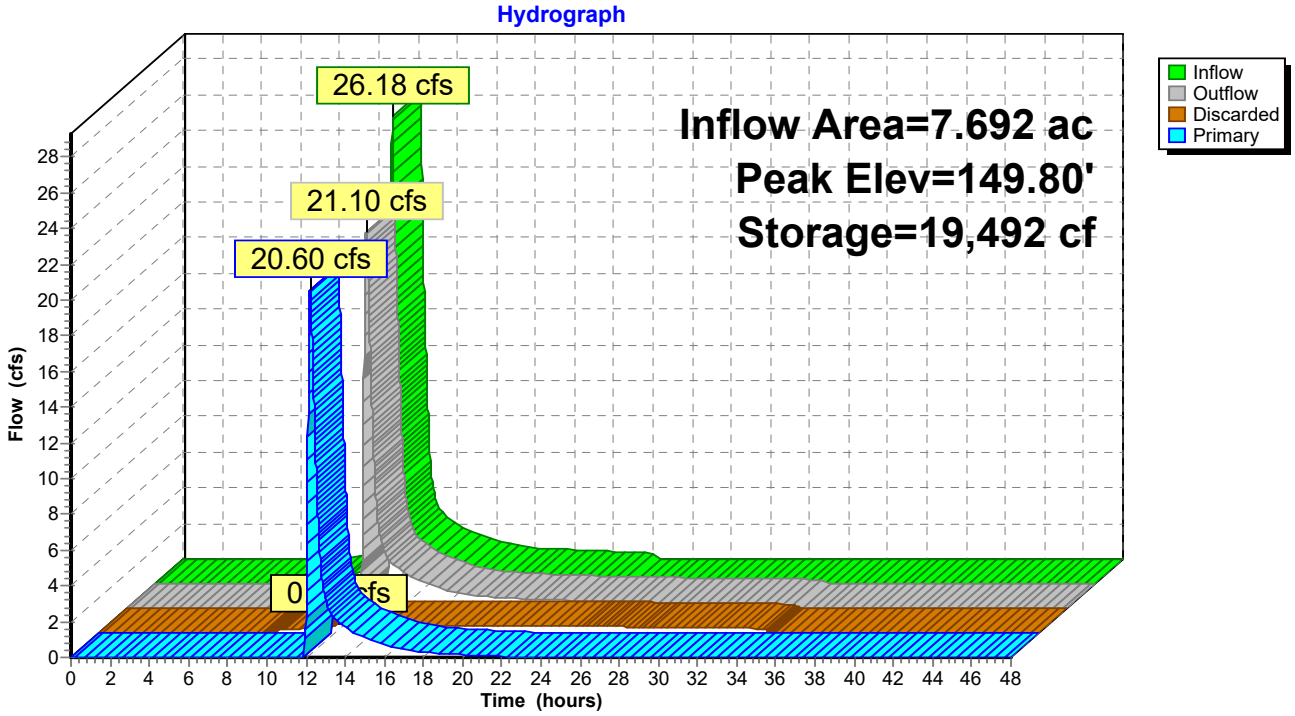
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.50	9,898	0	0
149.00	13,206	5,776	5,776
150.00	23,137	18,172	23,948
150.50	29,512	13,162	37,110

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	149.36'	**26.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.50 cfs @ 12.21 hrs HW=149.80' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.50 cfs)

Primary OutFlow Max=20.59 cfs @ 12.21 hrs HW=149.80' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 20.59 cfs @ 1.81 fps)

Pond 201P: Water Quality Basin



E-7: 100-Year Storm Analysis

Summary for Subcatchment 100: Pre

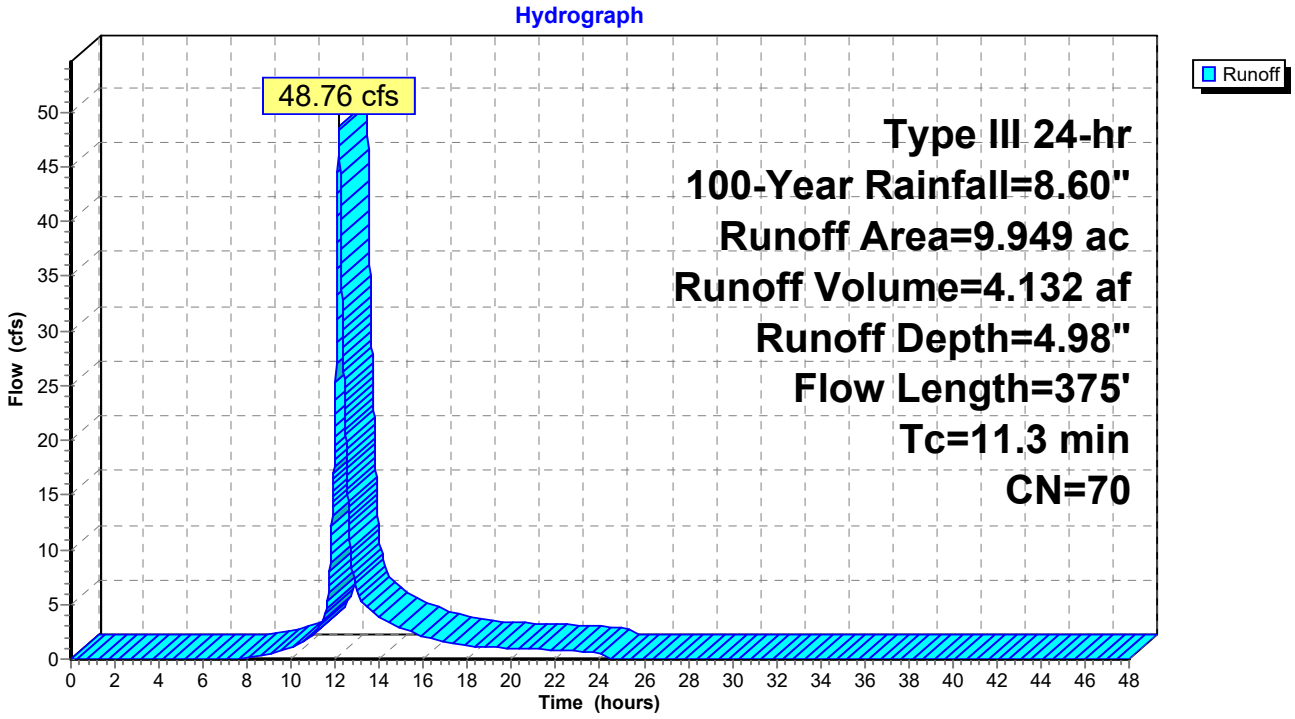
Runoff = 48.76 cfs @ 12.16 hrs, Volume= 4.132 af, Depth= 4.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

	Area (ac)	CN	Description
*	8.323	69	Brush/Grass Mix, HSG C
*	0.873	76	Brush/Grass Mix, HSG D
	0.680	70	Woods, Good, HSG C
	0.073	77	Woods, Good, HSG D
	9.949	70	Weighted Average
	9.949	70	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.0250	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.30"
2.5	275	0.0127	1.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
11.3	375	Total			

Subcatchment 100: Pre



Summary for Subcatchment 201: Post-1

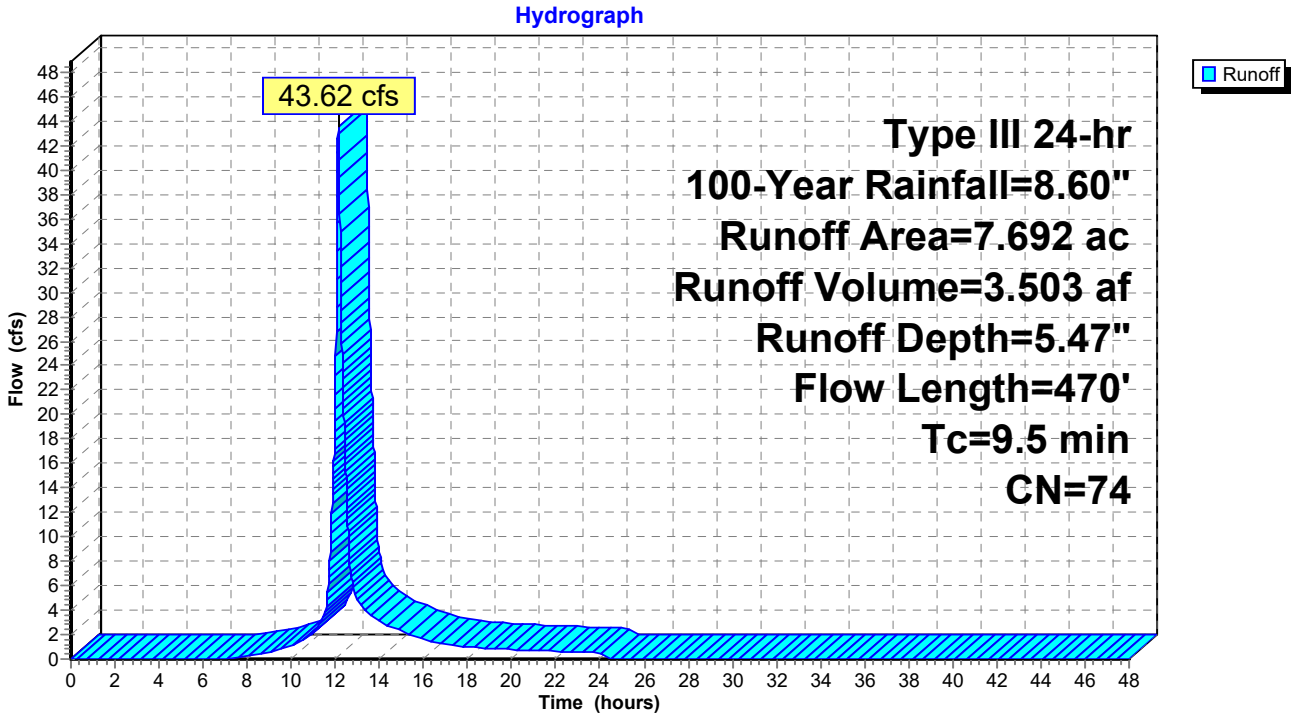
Runoff = 43.62 cfs @ 12.13 hrs, Volume= 3.503 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
6.822	74	>75% Grass cover, Good, HSG C
0.332	80	>75% Grass cover, Good, HSG D
0.473	70	Woods, Good, HSG C
0.065	77	Woods, Good, HSG D
7.692	74	Weighted Average
7.692	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	420	0.0393	3.19		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.5	470	Total			

Subcatchment 201: Post-1



Summary for Subcatchment 202: Post-2

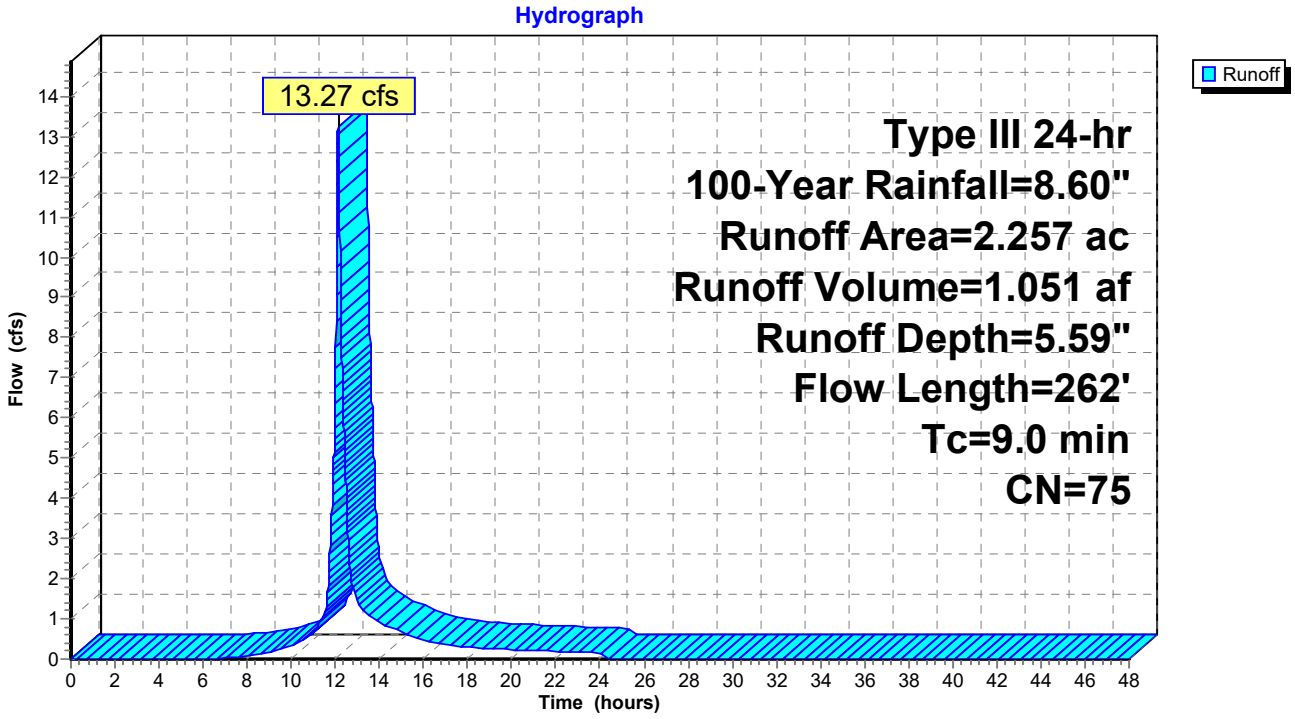
Runoff = 13.27 cfs @ 12.13 hrs, Volume= 1.051 af, Depth= 5.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.60"

Area (ac)	CN	Description
1.527	74	>75% Grass cover, Good, HSG C
0.541	80	>75% Grass cover, Good, HSG D
0.181	70	Woods, Good, HSG C
0.008	77	Woods, Good, HSG D
2.257	75	Weighted Average
2.257	75	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	50	0.0120	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.30"
2.2	212	0.0101	1.62		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.0	262	Total			

Subcatchment 202: Post-2

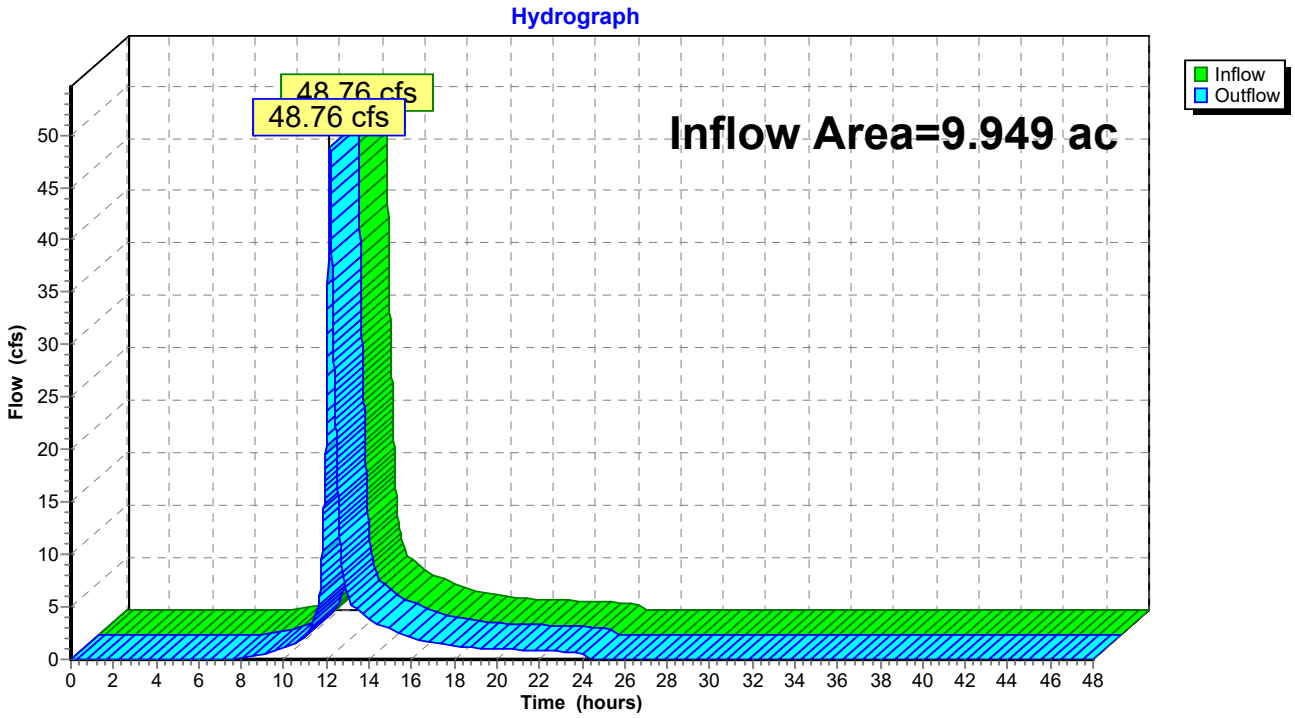


Summary for Reach 1: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 4.98" for 100-Year event
Inflow = 48.76 cfs @ 12.16 hrs, Volume= 4.132 af
Outflow = 48.76 cfs @ 12.16 hrs, Volume= 4.132 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 1: Design Line

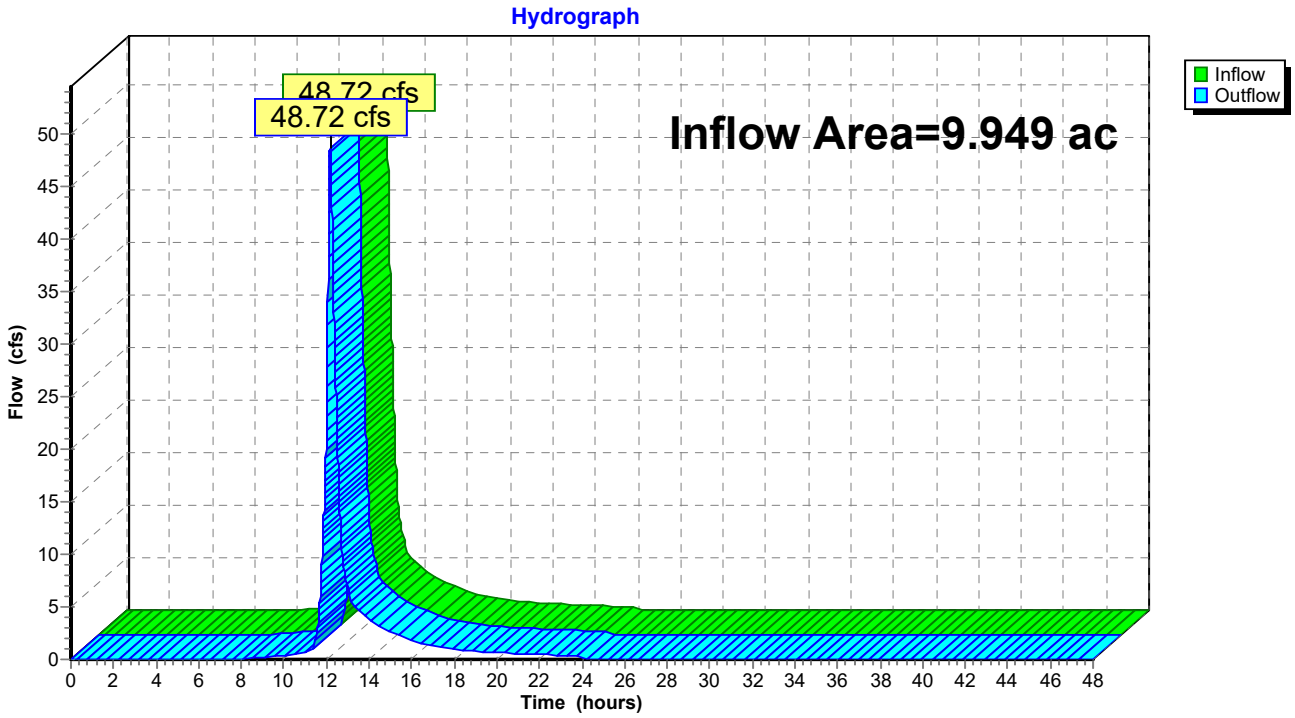


Summary for Reach 2: Design Line

Inflow Area = 9.949 ac, 0.00% Impervious, Inflow Depth = 4.54" for 100-Year event
Inflow = 48.72 cfs @ 12.17 hrs, Volume= 3.768 af
Outflow = 48.72 cfs @ 12.17 hrs, Volume= 3.768 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach 2: Design Line



Summary for Pond 201P: Water Quality Basin

Inflow Area = 7.692 ac, 0.00% Impervious, Inflow Depth = 5.47" for 100-Year event
Inflow = 43.62 cfs @ 12.13 hrs, Volume= 3.503 af
Outflow = 37.73 cfs @ 12.19 hrs, Volume= 3.503 af, Atten= 13%, Lag= 3.6 min
Discarded = 0.55 cfs @ 12.19 hrs, Volume= 0.786 af
Primary = 37.18 cfs @ 12.19 hrs, Volume= 2.717 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 150.00' @ 12.19 hrs Surf.Area= 23,179 sf Storage= 24,024 cf

Plug-Flow detention time= 88.5 min calculated for 3.503 af (100% of inflow)
Center-of-Mass det. time= 88.6 min (905.2 - 816.6)

Volume	Invert	Avail.Storage	Storage Description
#1	148.50'	37,110 cf	**Basins (Prismatic)** Listed below (Recalc)

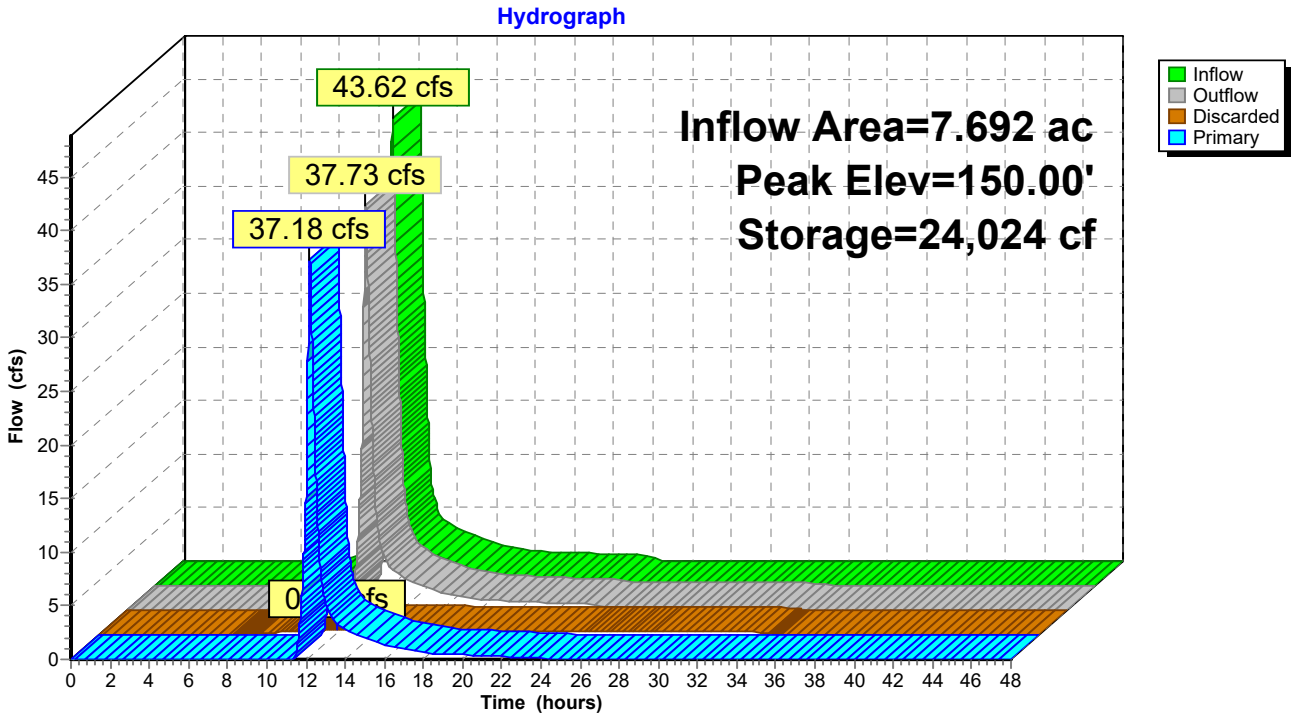
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
148.50	9,898	0	0
149.00	13,206	5,776	5,776
150.00	23,137	18,172	23,948
150.50	29,512	13,162	37,110

Device	Routing	Invert	Outlet Devices
#1	Discarded	148.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	149.36'	**26.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.55 cfs @ 12.19 hrs HW=150.00' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.55 cfs)

Primary OutFlow Max=37.17 cfs @ 12.19 hrs HW=150.00' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 37.17 cfs @ 2.22 fps)

Pond 201P: Water Quality Basin



Appendix F: Pre and Post Watershed Maps

Appendix G: Outlet Protection Calculations

OUTFALL PROTECTION CALCULATION

Applicability: Use Riprap at outfall locations to ensure that the flow velocities are non-erosive.
Riprap outlet protection is constructed in the area of an outfall to provide scour protection against discharges from pipes and channels.

Non-erosive velocities:

Min (fps)	Max (fps)
3.5	5.0

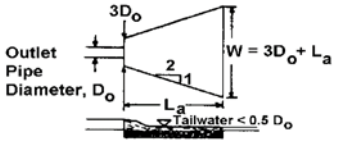
Legend	
L_a =	length of apron (ft)
D_o =	outlet pipe diameter (ft)
W =	width of apron (ft)
d_{50} =	median stone diameter (in)
T_w =	tailwater depth (ft)
Q =	Discharge flow (cfs)

Riprap Calculation Steps

(1) Equation to determine Length of apron

$$L_a = \frac{(1.7)Q}{(D_o)^{3/2}} + (8)D_o$$

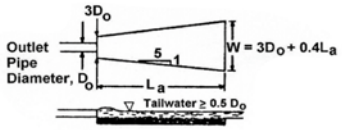
(2) Equation for discharges where $T_w < 0.5*D_o$



$$W = (3)D_o + L_a$$

OR

(2) Equation For discharges where $T_w \geq 0.5*D_o$



$$W = (3)D_o + (0.4)L_a$$

(3) Equation to determine stone diameter

$$d_{50} = \frac{0.02}{T_w} \times \frac{Q}{D_o}^{4/3}$$

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Outfall Protection Summary Table (Sized for 100 Year Storm Event)

Detention Pond-1.14 (114)								
Outlet		Q	D_o	L_a	T_w	W	d_{50}	Riprap
HydroCAD Name	Plan Name	(cfs)	(ft)	(ft)	(ft)	(ft)	(in)	Class
Primary - Overflow Weir*	OW-1	37.17	26.00		1.00			R-2

*T_w is height of weir minus 1 foot of freeboard