
***ATTACHMENT G
STORMWATER DRAINAGE CALCULATIONS***

***STORMWATER REPORT (FROM NOTICE OF INTENT
SUBMISSION TO TOWN OF ACTON CONSERVATION
COMMISSION)***

ATTACHMENT A: CHECKLIST FOR STORMWATER REPORT

ATTACHMENT B: STANDARD 2 HYDROCAD CALCULATIONS

ATTACHMENT C: SOIL INFORMATION

ATTACHMENT D: STANDARD 3 RECHARGE CALCULATIONS

ATTACHMENT E: STANDARD 4 WATER QUALITY CALCULATIONS

***ATTACHMENT F: LONG TERM POLLUTION PREVENTION PLAN
AND OPERATIONS & MAINTENANCE PLAN***

ATTACHMENT G: STORMWATER FIGURES

Stormwater Report



1900 Crown Colony Drive
Suite 402
Quincy, MA 02169
Tel: 617 657 0200
Fax: 617 657 0201
www.envpartners.com

To: Town of Acton Conservation Commission
From: Stephen C. Olson, P.E.
Cc: NOI CC list
Date: November 18, 2015
Subject: Nagog Pond Water Treatment Plant
WPA Form 3 - Notice of Intent
Stormwater Report

Environmental Partners Group, Inc. has prepared this stormwater report on behalf of the Town of Concord for the Wetlands Protection Act Notice of Intent for the Nagog Pond Water Treatment Plant project. This report has been prepared in accordance with the requirements of 310 CMR 10.00 and 310 CMR 21.00, and the guidelines of the Massachusetts Stormwater Handbook (MSH).

Project Applicant: Town of Concord Water Department
135 Keyes Road
Concord, MA 01742
Alan Cathcart, Water/Sewer Superintendent
(978) 318-3250

Preparer: Environmental Partners Group, Inc.
Stephen C. Olson, P.E.

Project Name: Nagog Pond Water Treatment Plant

Project Address: 180/182 Skyline Drive, Acton, MA 01720

The following materials are referenced as part of Stormwater Report:

- Stormwater Checklist
- Site Locus
- Demolition and Erosion Control Plan
- Site Plan and Yard Piping Plan
- Civil Details
- Stormwater Report
- Boring Logs and Sieve Analyses
- NCRS Soil Types and Soil Survey Map
- Source Control and Pollution Prevention Plan
- Stormwater Operation and Maintenance Plan

Project Type: Mix of New Development and Redevelopment

Project Narrative: The existing site is developed and includes a water treatment facility, chain link fencing, various yard piping, and an asphalt paved driveway. The site is bound to the north by Nagog Pond, to the east by wetlands and Nagog Brook, to the west by wetlands, and to the south by woods. Nagog Pond has an intake pipe, dam, and gatehouse associated with the existing water treatment plant.

The project includes the construction of a new water treatment plant, a new intake pipe, and a photovoltaic (PV) array. The new 1.5 million gallon per day drinking water treatment plant will replace the existing water treatment facility. The existing treatment facility is only operated seasonally in order to maintain an existing filtration waiver. The Town of Concord would like to construct a treatment plant capable of meeting all current drinking water regulations so that they may operate the facility on a continuous basis to meet current and future water demands. Construction activities will include architectural, structural, civil, process, HVAC, plumbing and electrical work, and the demolition of the existing treatment plant and appurtenant structures.

The new water treatment plant will be constructed over the existing water treatment facility on site, while also extending further to the west and south. Construction will begin with the installation of the PV array and all site work that will not require the treatment plant to be shut down. Since the existing facility is only operated seasonally, construction of the new water treatment plant will occur when the existing facility is not in use. The site grading will largely remain unchanged with only minor modifications to accommodate the new facilities. The paved area around the treatment plant will be sloped away from the building to direct stormwater away.

Existing Stormwater
Conditions:

The existing site has minimal stormwater management controls. Stormwater flows via sheet flow from the paved areas and roofs onto the surrounding grass, paved, rip-rap, and wooded areas. Ultimately, all stormwater is infiltrated into the ground or runs off towards Nagog Brook and through the culvert under Skyline Drive.

A rip-rap channel to the east of the existing driveway diverts driveway runoff towards a new catch basin near the intersection with Skyline Drive.

Proposed Stormwater
Conditions:

Cover type and grading will generally mimic existing conditions, with the exception of the PV array area being converted from a wooded area to an open space. The entire ground surface of the PV array area will receive a seed mix to encourage the development of a meadow.

In the vicinity of the new water treatment facility, stormwater runoff will be directed into a series of underground recharge chambers via deep sump catch basins with hoods, a drywell, and underground piping. The proposed stormwater facilities provide recharge, attenuate the peak discharge, and provide TSS removal. The overflow from this system will be equipped with a flared end section and rip-rap to provide additional velocity control and scour protection.

Runoff from the driveway will be directed towards the existing swale.

Existing and
Proposed Site Plans:

A set of full-size 22"x 34" design plans are provided as an attachment to the Notice of Intent. Existing conditions; the wetland boundary; 25-, 50-, 75- and 100-foot wetland buffer zones, and the existing water treatment facility are

shown on Sheet C-7. The proposed grading and drainage plan is shown on sheet C-11. Various civil details are shown on Sheets CD-1 through CD-7.

LID Measures: The project does not propose any disturbances to bordering vegetated wetlands.

Stormwater Standard 1: The project does not propose any new untreated discharges.

Stormwater Standard 2: The existing and proposed site conditions were analyzed for the 2, 10, and 100-year 24-hour storm events using HydroCAD Version 10. Based on these results, there is no increase in peak discharge rates for all storm events. Please refer to Table 1 below for a summary of peak rates. Please refer to the HydroCAD report in Attachment B for full details.

Table 1
Summary of Peak Discharge Rates

Storm Event	Existing Conditions	Developed Conditions
2-year	0.08 cfs	0.06 cfs
10-year	1.41 cfs	1.35 cfs
100-year	10.24 cfs	10.04 cfs

Soil type was determined using Natural Resource Conservation Service (NRCS) Soil Survey data. There are two Hydrologic Soil Groups (HSGs) on this site: HSG A and HSG D. Soil borings were conducted in the vicinity of the proposed recharge facilities to verify in situ soil conditions. Based on the sieve analyses from these soil borings, the HSG A soil in the vicinity of chamber C-2, chamber C-3, and the drywell has an infiltration rate of 5.1 inches/hour. This is consistent with the range of HSG A soil Rawls Rates listed in the MSH. The HSG D soil in the vicinity of C-1 was conservatively assumed to provide no infiltration in the HydroCAD model even though the current use of the area around C-1 for a leaching pit suggests that the soil in this location has a high infiltration rate. Soil borings and sieve analyses are provided in Attachment C.

Stormwater Standard 3: Stormwater will be recharged using underground chambers and a drywell. Recharge calculations are provided in Attachment D. Chambers C-2 and C-3 provide the *Required Recharge Volume* for this project, and the chambers will drain within the required 72 hours. Groundwater is not expected to affect recharge as there was no sign of any groundwater in any of the borings.

Stormwater Standard 4: The proposed best management practices (BMPs) treat the *Required Water Quality Volume* and provide 80% TSS removal. Based on one inch of runoff times the impervious area, the *Required Water Quality Volume* is 2,471 cf. The 2-year storm generates 2,573 cfs of runoff directed towards the BMPs around the proposed building. This is greater than the *Required Water Quality Volume*. The 2-year storm HydroCAD calculations provided in Attachment E show that proposed BMPs are sized appropriately to treat this volume. Therefore, this project meets the *Required Water Quality Volume* requirements.

Volume 2, Chapter 2 of the MSH states that subsurface structures, including underground plastic chambers, provide 80% TSS removal. Consequently, this project meets the TSS removal requirements as well.

A Long-Term Pollution Prevention Plan is combined with the Operation and Maintenance Plan (Standard 9) and is included in Attachment F.

Stormwater
Standard 5:

The water treatment process uses and will accept deliveries of various chemicals. There will be secondary containment within the delivery area to keep any spillage from migrating offsite.

Stormwater
Standard 6:

Standard 6 is applicable due to this project's proximity to Nagog Brook (a Division of Fisheries and Wildlife cold-water fishery) and Nagog Pond (Outstanding Resource Water).

As discussed above, the proposed BMPs treat the *Required Water Quality Volume* calculated using the "one-inch rule" (one-inch times the impervious area).

The project includes the use of subsurface structures, which are recommended BMPs for compliance with Standard 6. Deep sump catch basins with hoods are proposed to help provide additional TSS removal.

Stormwater
Standard 7:

"Maintenance and improvement of existing roadways" qualifies as a redevelopment project according to the MSH. In that sense, the improvement of the driveway to the facility counts as a redevelopment project. However, the entire project leads to an increase in impervious area. The increase in impervious area is generally a result of the enlarged building and the new pavement around the building. Consequently, the project proposes to meet all the Standards, and there is a particular focus on improving the stormwater management system near the proposed facility.

Stormwater
Standard 8:

A Construction Period Stormwater Pollution Prevention and Erosion and Sedimentation Control Plan (SWPPP) has not been included in this Stormwater Report. The project Contractor(s) will be required to submit a SWPPP for review and approval prior to any land disturbance.

Stormwater
Standard 9:

The Post Construction Operation and Maintenance (O&M) Plan is attached to this Stormwater Report. The O&M Plan includes the name of the stormwater management system owners, the party responsible for operation and maintenance, a schedule for implementation of routine and non-routine maintenance tasks, and a maintenance log form.

Stormwater

Standard 10: The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges. An Illicit Discharge Compliance Statement is not attached to this Stormwater Report but will be submitted prior to the discharge of any stormwater to post-construction BMPs.

Attachments:

Attachment A – Checklist for Stormwater Report

Attachment B – Standard 2 HydroCAD Calculations

Attachment C – Soil Information

Attachment D – Standard 3 Recharge Calculations

Attachment E – Standard 4 Water Quality Calculations

Attachment F – Long Term Pollution Prevention Plan and Operations & Maintenance Plan

Attachment G – Stormwater Figures

ATTACHMENT A
CHECKLIST FOR STORMWATER REPORT



Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Adam S. Kran 11/18/15
Signature and Date

Checklist

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

- New development
- Redevelopment
- Mix of New Development and Redevelopment



Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

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

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



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

Standard 4: Water Quality

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

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



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

Standard 6: Critical Areas

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



Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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



Checklist for Stormwater Report

Checklist (continued)

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

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

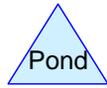
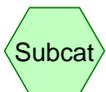
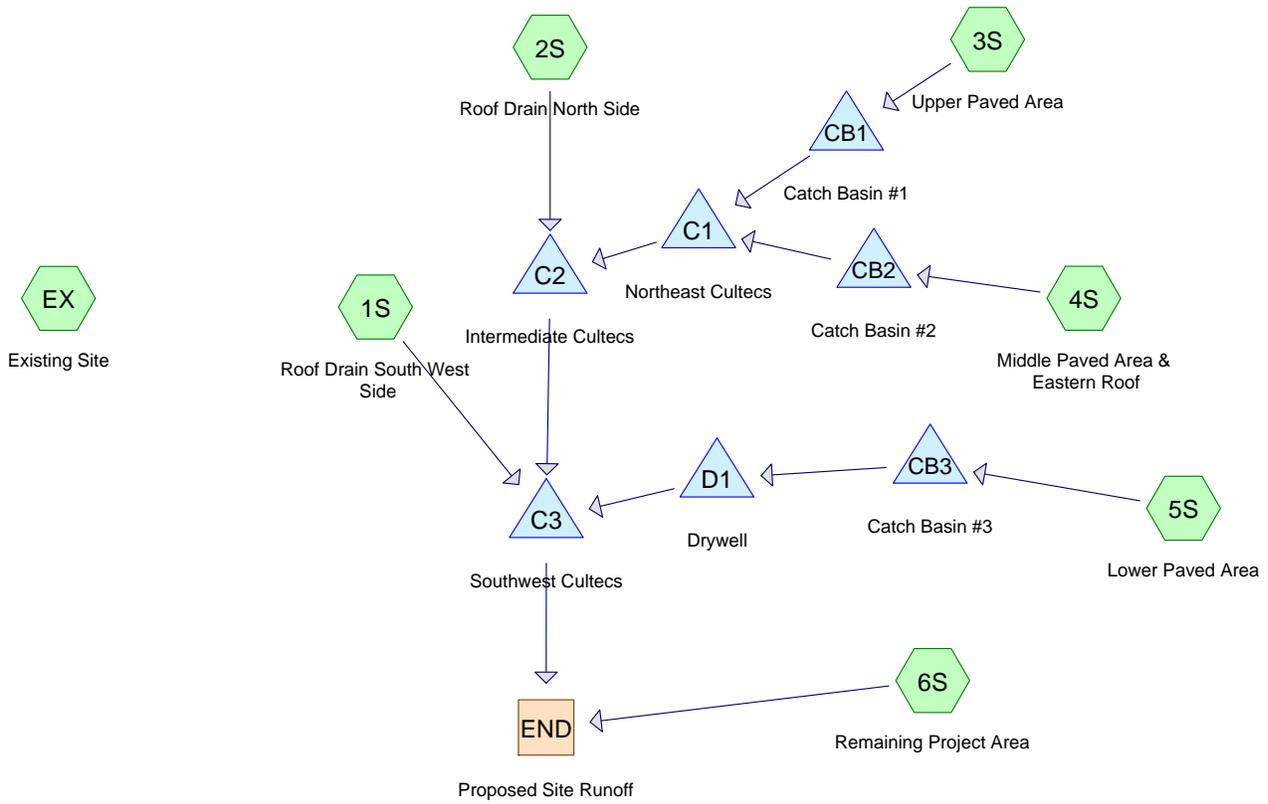
Standard 9: Operation and Maintenance Plan

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

Standard 10: Prohibition of Illicit Discharges

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

ATTACHMENT B
STANDARD 2 HYDROCAD CALCULATIONS



Nagog HydroCAD - 2015-11-16

Prepared by Environmental Partners Group

HydroCAD® 10.00-15 s/n 04622 © 2015 HydroCAD Software Solutions LLC

Printed 11/16/2015

Page 2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
37,532	49	50-75% Grass cover, Fair, HSG A (3S, 6S, EX)
12,778	76	Gravel roads, HSG A (6S, EX)
6,262	76	Gravel roads, HSG A (RIP RAP) (6S, EX)
698	76	Gravel roads, HSG A (rip rap) (3S)
39,143	30	Meadow, non-grazed, HSG A (6S)
27,757	78	Meadow, non-grazed, HSG D (6S)
39,344	98	Paved parking, HSG A (3S, 4S, 5S, 6S, EX)
7,639	98	Roofs, HSG A (1S, 2S, 4S)
224,763	30	Woods, Good, HSG A (6S, EX)
88,351	77	Woods, Good, HSG D (6S, EX)
484,267	51	TOTAL AREA

Nagog HydroCAD - 2015-11-16

Prepared by Environmental Partners Group

HydroCAD® 10.00-15 s/n 04622 © 2015 HydroCAD Software Solutions LLC

Printed 11/16/2015

Page 3

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
368,159	HSG A	1S, 2S, 3S, 4S, 5S, 6S, EX
0	HSG B	
0	HSG C	
116,108	HSG D	6S, EX
0	Other	
484,267		TOTAL AREA

Nagog HydroCAD - 2015-11-16

Prepared by Environmental Partners Group

HydroCAD® 10.00-15 s/n 04622 © 2015 HydroCAD Software Solutions LLC

Printed 11/16/2015

Page 4

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Nun
37,532	0	0	0	0	37,532	50-75% Grass cover, Fair	
19,738	0	0	0	0	19,738	Gravel roads	
39,143	0	0	27,757	0	66,900	Meadow, non-grazed	
39,344	0	0	0	0	39,344	Paved parking	
7,639	0	0	0	0	7,639	Roofs	
224,763	0	0	88,351	0	313,114	Woods, Good	
368,159	0	0	116,108	0	484,267	TOTAL AREA	

Nagog HydroCAD - 2015-11-16

Prepared by Environmental Partners Group

HydroCAD® 10.00-15 s/n 04622 © 2015 HydroCAD Software Solutions LLC

Printed 11/16/2015

Page 5

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	C1	231.67	230.95	145.0	0.0050	0.012	4.0	0.0	0.0
2	C1	232.33	231.44	145.0	0.0061	0.012	8.0	0.0	0.0
3	C2	230.00	230.00	10.0	0.0000	0.012	8.0	0.0	0.0
4	C3	230.68	230.48	20.0	0.0100	0.012	8.0	0.0	0.0
5	CB1	232.95	231.75	20.0	0.0600	0.012	6.0	0.0	0.0
6	CB2	232.95	231.75	75.0	0.0160	0.012	6.0	0.0	0.0
7	CB3	232.95	232.38	115.0	0.0050	0.012	6.0	0.0	0.0
8	D1	231.25	231.00	5.0	0.0500	0.012	6.0	0.0	0.0

Time span=0.10-24.00 hrs, dt=0.02 hrs, 1196 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Roof Drain South West Runoff Area=2,749 sf 100.00% Impervious Runoff Depth>2.83"
Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.19 cfs 647 cf

Subcatchment 2S: Roof Drain North Side Runoff Area=3,230 sf 100.00% Impervious Runoff Depth>2.83"
Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.22 cfs 761 cf

Subcatchment 3S: Upper Paved Area Runoff Area=10,259 sf 69.83% Impervious Runoff Depth>1.64"
Tc=6.0 min CN=85 Runoff=0.45 cfs 1,399 cf

Subcatchment 4S: Middle Paved Area & Runoff Area=4,232 sf 100.00% Impervious Runoff Depth>2.83"
Tc=6.0 min CN=98 Runoff=0.29 cfs 997 cf

Subcatchment 5S: Lower Paved Area Runoff Area=3,960 sf 100.00% Impervious Runoff Depth>2.83"
Tc=6.0 min CN=98 Runoff=0.27 cfs 933 cf

Subcatchment 6S: Remaining Project Area Runoff Area=217,642 sf 3.80% Impervious Runoff Depth>0.08"
Flow Length=562' Tc=15.9 min CN=49 Runoff=0.06 cfs 1,506 cf

Subcatchment EX: Existing Site Runoff Area=242,195 sf 7.17% Impervious Runoff Depth>0.10"
Flow Length=562' Tc=15.9 min CN=50 Runoff=0.08 cfs 2,027 cf

Reach END: Proposed Site Runoff Inflow=0.06 cfs 1,506 cf
Outflow=0.06 cfs 1,506 cf

Pond C1: Northeast Cultecs Peak Elev=232.17' Storage=0.025 af Inflow=0.74 cfs 2,357 cf
Discarded=0.00 cfs 0 cf Primary=0.16 cfs 1,884 cf Outflow=0.16 cfs 1,884 cf

Pond C2: Intermediate Cultecs Peak Elev=230.35' Storage=313 cf Inflow=0.33 cfs 2,645 cf
Discarded=0.06 cfs 1,899 cf Primary=0.14 cfs 746 cf Outflow=0.20 cfs 2,644 cf

Pond C3: Southwest Cultecs Peak Elev=230.33' Storage=0.012 af Inflow=0.45 cfs 1,934 cf
Discarded=0.12 cfs 1,934 cf Primary=0.00 cfs 0 cf Outflow=0.12 cfs 1,934 cf

Pond CB1: Catch Basin #1 Peak Elev=233.56' Storage=27 cf Inflow=0.45 cfs 1,399 cf
6.0" Round Culvert n=0.012 L=20.0' S=0.0600 '/' Outflow=0.45 cfs 1,380 cf

Pond CB2: Catch Basin #2 Peak Elev=233.35' Storage=24 cf Inflow=0.29 cfs 997 cf
6.0" Round Culvert n=0.012 L=75.0' S=0.0160 '/' Outflow=0.29 cfs 977 cf

Pond CB3: Catch Basin #3 Peak Elev=233.34' Storage=24 cf Inflow=0.27 cfs 933 cf
6.0" Round Culvert n=0.012 L=115.0' S=0.0050 '/' Outflow=0.27 cfs 913 cf

Pond D1: Drywell Peak Elev=231.63' Storage=35 cf Inflow=0.27 cfs 913 cf
Discarded=0.01 cfs 372 cf Primary=0.26 cfs 541 cf Outflow=0.27 cfs 913 cf

Total Runoff Area = 484,267 sf Runoff Volume = 8,270 cf Average Runoff Depth = 0.20"
90.30% Pervious = 437,284 sf 9.70% Impervious = 46,983 sf

Summary for Subcatchment 1S: Roof Drain South West Side

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 647 cf, Depth> 2.83"

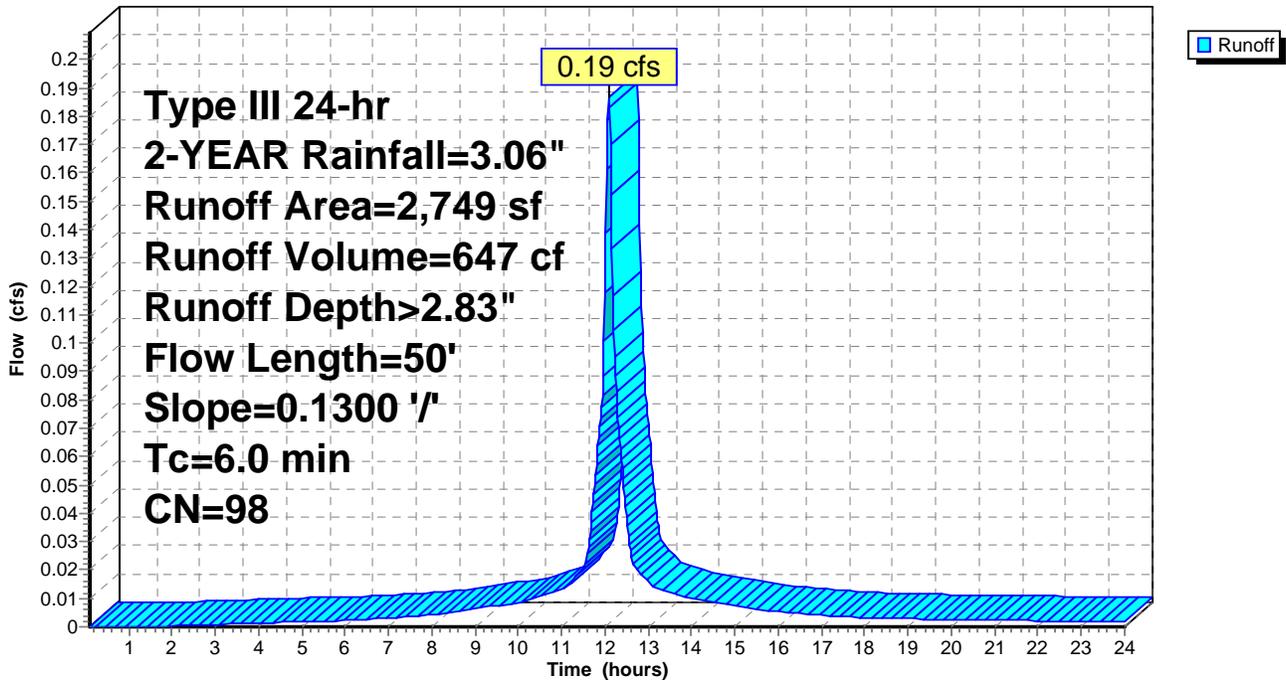
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
2,749	98	Roofs, HSG A
2,749		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 1S: Roof Drain South West Side

Hydrograph



Summary for Subcatchment 2S: Roof Drain North Side

Runoff = 0.22 cfs @ 12.08 hrs, Volume= 761 cf, Depth> 2.83"

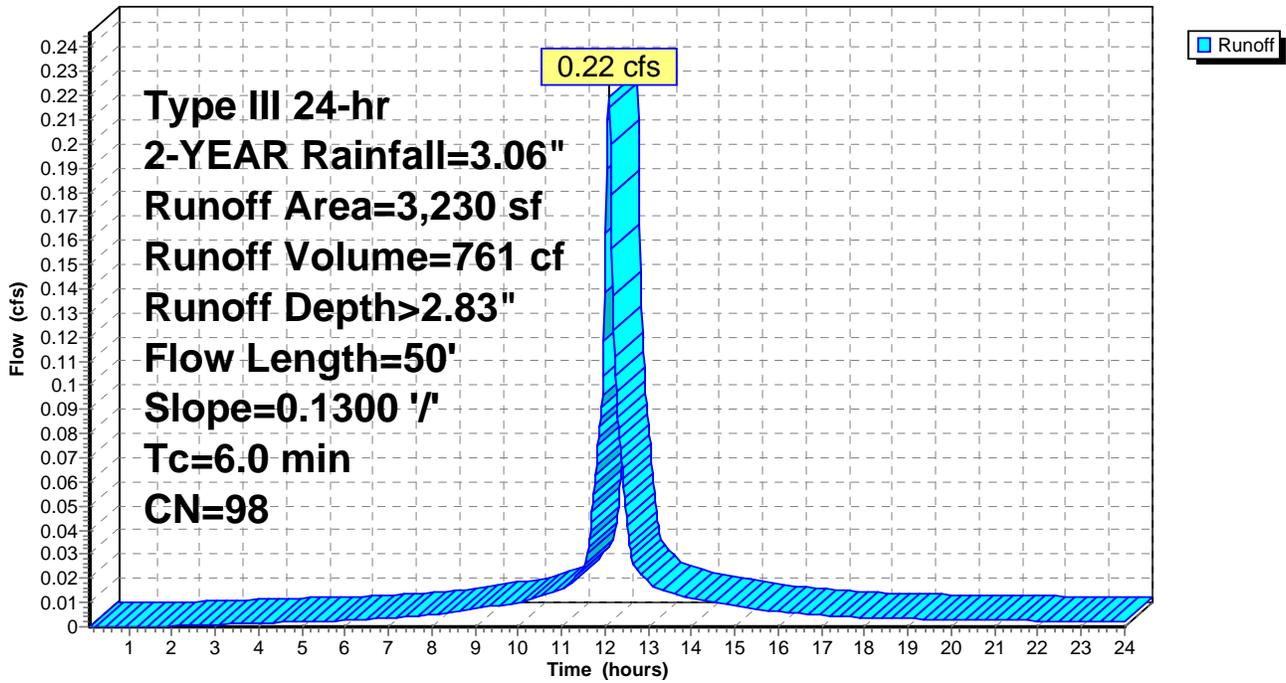
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
3,230	98	Roofs, HSG A
3,230		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 2S: Roof Drain North Side

Hydrograph



Summary for Subcatchment 3S: Upper Paved Area

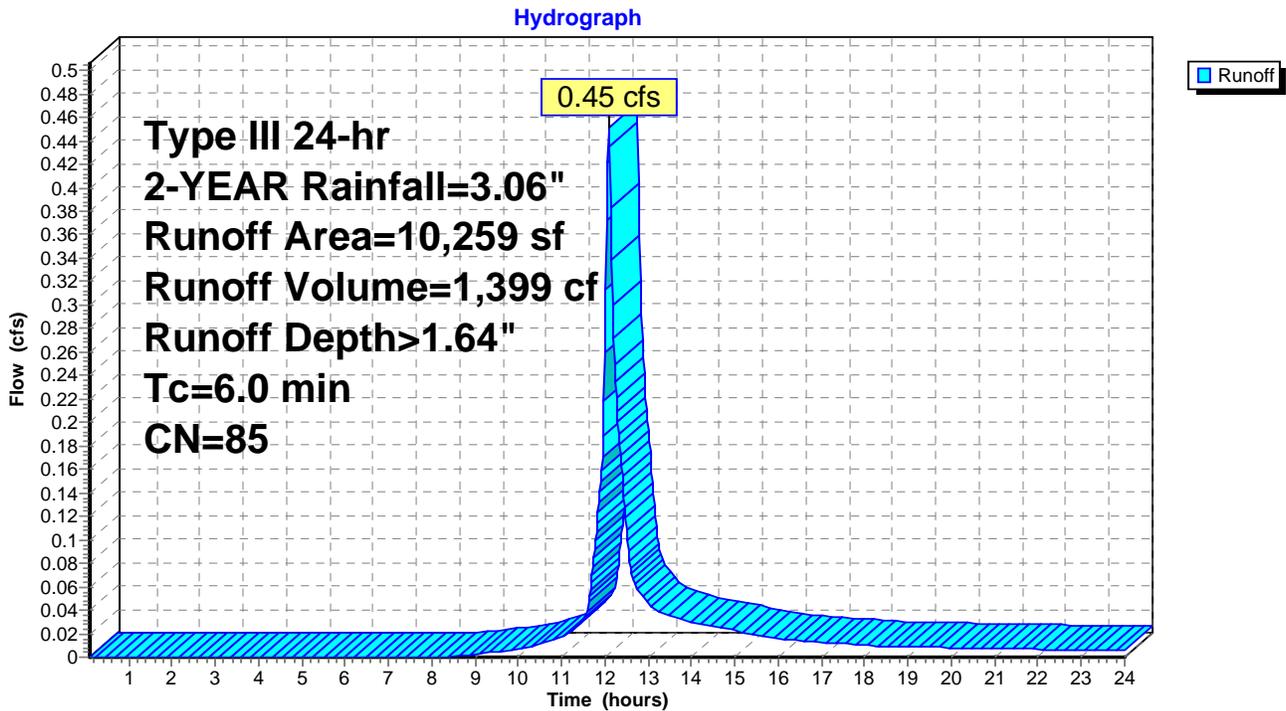
Runoff = 0.45 cfs @ 12.09 hrs, Volume= 1,399 cf, Depth> 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
7,164	98	Paved parking, HSG A
1,956	49	50-75% Grass cover, Fair, HSG A
441	49	50-75% Grass cover, Fair, HSG A
* 698	76	Gravel roads, HSG A (rip rap)
10,259	85	Weighted Average
3,095		30.17% Pervious Area
7,164		69.83% Impervious Area

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

Subcatchment 3S: Upper Paved Area



Summary for Subcatchment 4S: Middle Paved Area & Eastern Roof

Runoff = 0.29 cfs @ 12.08 hrs, Volume= 997 cf, Depth> 2.83"

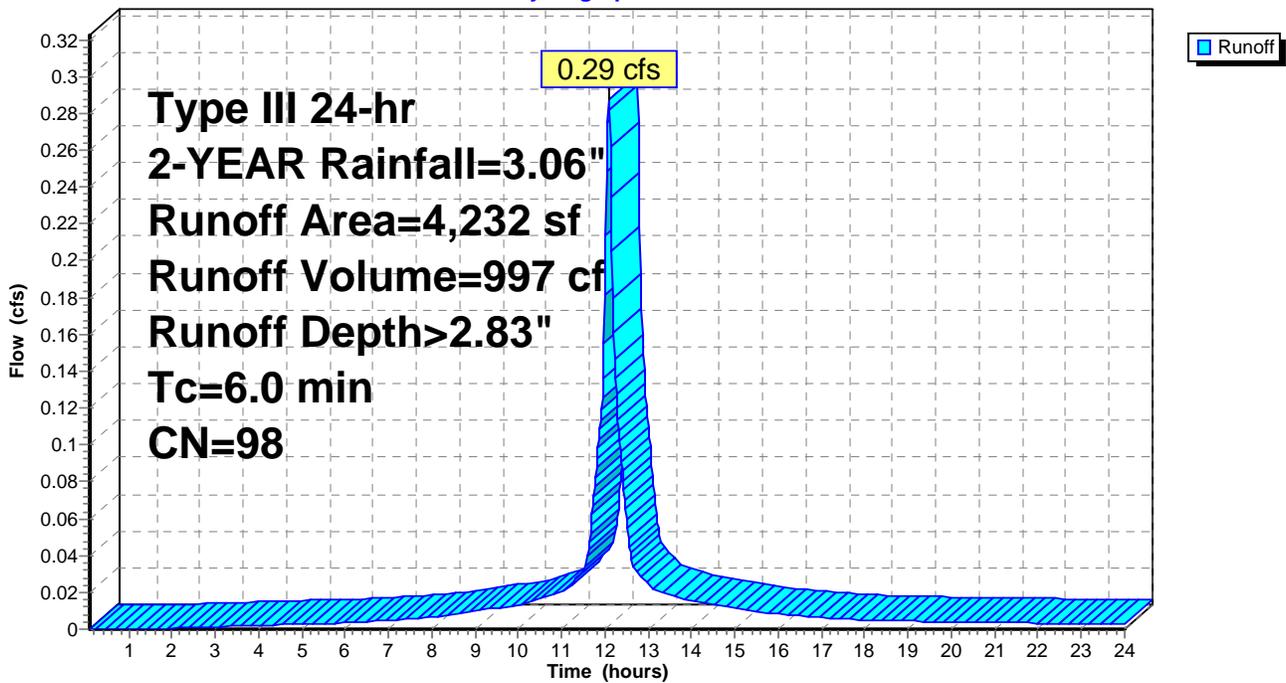
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
 Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
2,572	98	Paved parking, HSG A
1,660	98	Roofs, HSG A
4,232	98	Weighted Average
4,232		100.00% Impervious Area

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

Subcatchment 4S: Middle Paved Area & Eastern Roof

Hydrograph



Summary for Subcatchment 5S: Lower Paved Area

Runoff = 0.27 cfs @ 12.08 hrs, Volume= 933 cf, Depth> 2.83"

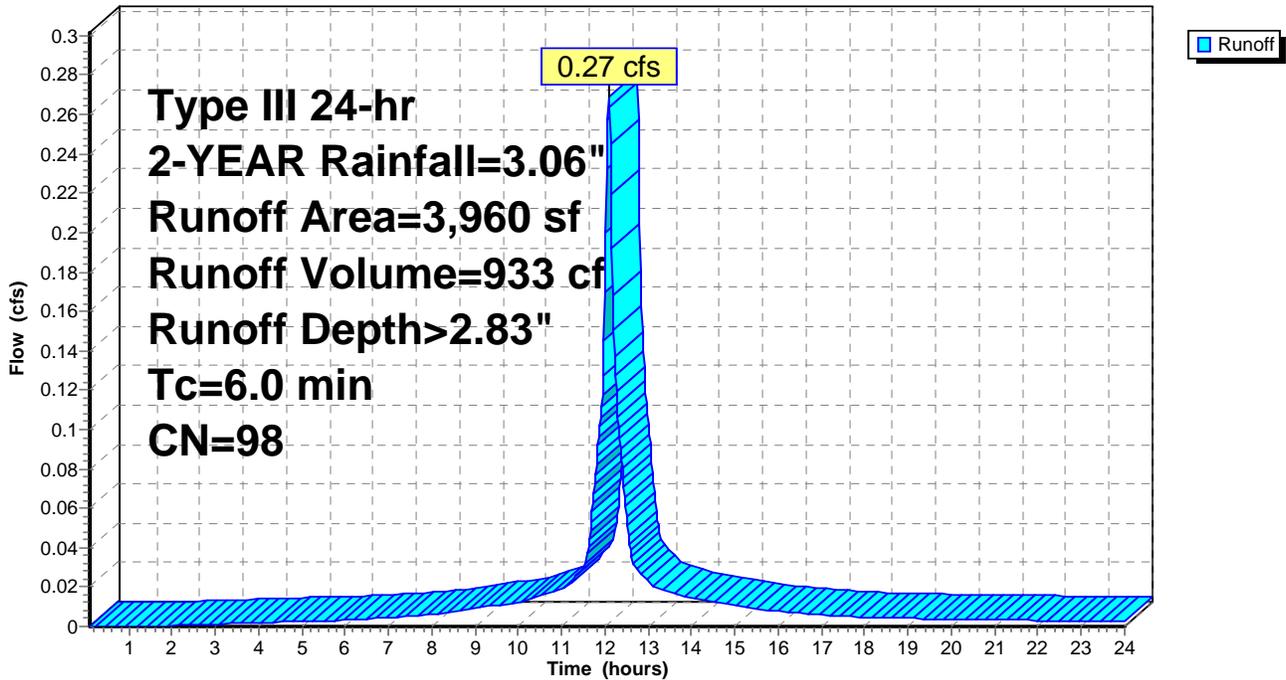
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
 Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
3,960	98	Paved parking, HSG A
3,960		100.00% Impervious Area

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

Subcatchment 5S: Lower Paved Area

Hydrograph



Summary for Subcatchment 6S: Remaining Project Area

Runoff = 0.06 cfs @ 14.72 hrs, Volume= 1,506 cf, Depth> 0.08"

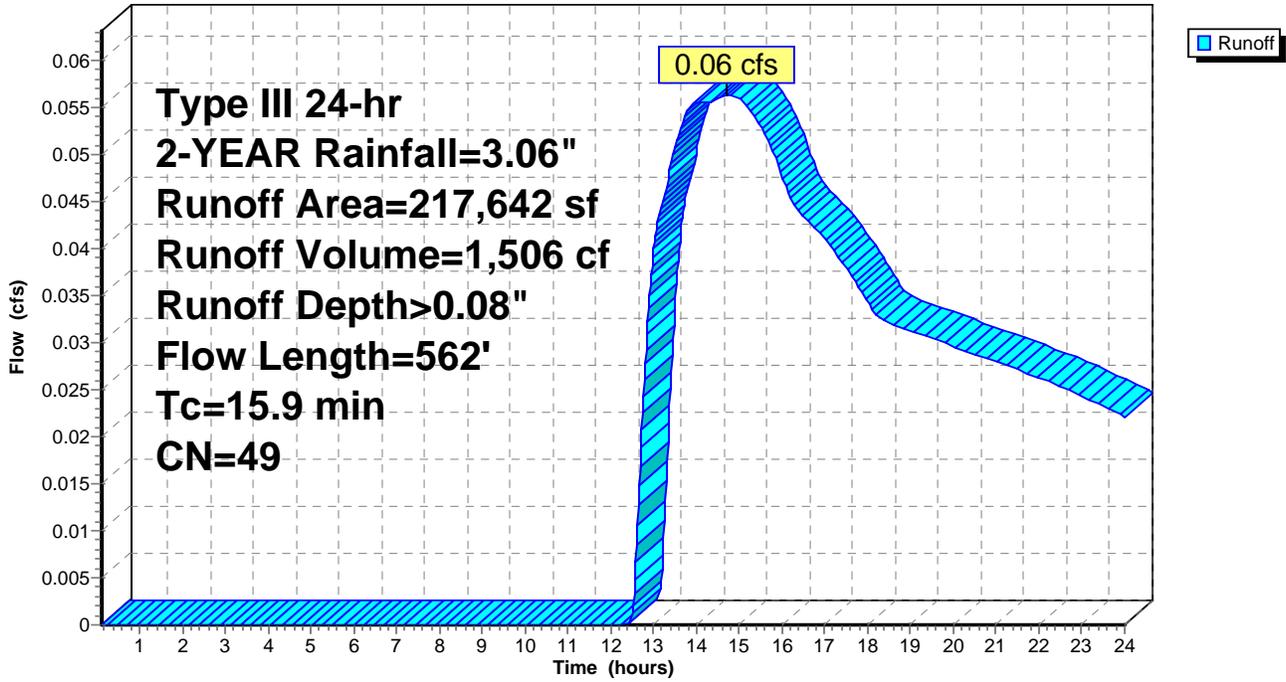
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
 Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
2,763	49	50-75% Grass cover, Fair, HSG A
9,597	76	Gravel roads, HSG A
8,274	98	Paved parking, HSG A
7,927	49	50-75% Grass cover, Fair, HSG A
27,757	78	Meadow, non-grazed, HSG D
28,946	77	Woods, Good, HSG D
78,485	30	Woods, Good, HSG A
39,143	30	Meadow, non-grazed, HSG A
11,968	30	Woods, Good, HSG A
* 2,782	76	Gravel roads, HSG A (RIP RAP)
217,642	49	Weighted Average
209,368		96.20% Pervious Area
8,274		3.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods pre grass strip Woodland Kv= 5.0 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strips (both) Short Grass Pasture Kv= 7.0 fps
0.0	12	0.0833	5.86		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			

Subcatchment 6S: Remaining Project Area

Hydrograph



Summary for Subcatchment EX: Existing Site

Runoff = 0.08 cfs @ 13.84 hrs, Volume= 2,027 cf, Depth> 0.10"

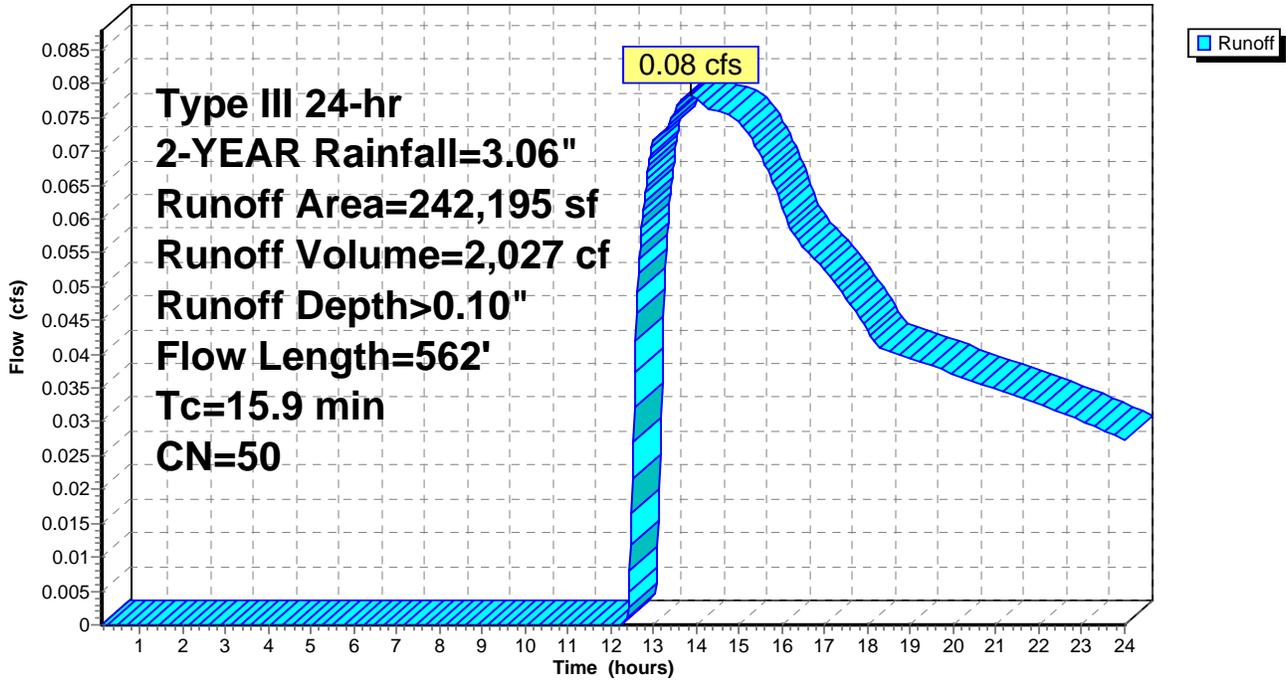
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

Area (sf)	CN	Description
11,475	49	50-75% Grass cover, Fair, HSG A
3,181	76	Gravel roads, HSG A
17,374	98	Paved parking, HSG A
4,242	49	50-75% Grass cover, Fair, HSG A
8,728	49	50-75% Grass cover, Fair, HSG A
* 3,480	76	Gravel roads, HSG A (RIP RAP)
59,405	77	Woods, Good, HSG D
82,915	30	Woods, Good, HSG A
9,737	30	Woods, Good, HSG A
41,658	30	Woods, Good, HSG A
242,195	50	Weighted Average
224,821		92.83% Pervious Area
17,374		7.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods Woodland Kv= 5.0 fps
0.0	12	0.1000	6.42		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strip (both) Short Grass Pasture Kv= 7.0 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, final grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			

Subcatchment EX: Existing Site

Hydrograph



Summary for Reach END: Proposed Site Runoff

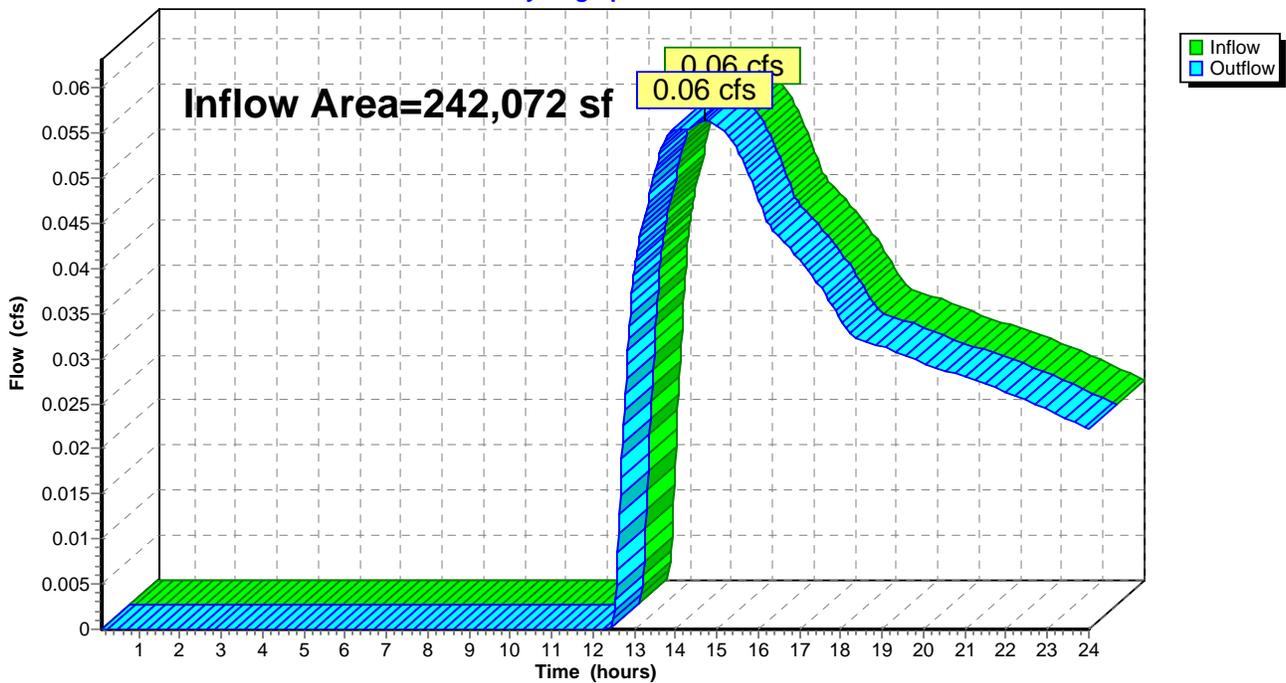
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 242,072 sf, 12.23% Impervious, Inflow Depth > 0.07" for 2-YEAR event
Inflow = 0.06 cfs @ 14.72 hrs, Volume= 1,506 cf
Outflow = 0.06 cfs @ 14.72 hrs, Volume= 1,506 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3

Reach END: Proposed Site Runoff

Hydrograph



Summary for Pond C1: Northeast Cultecs

Inflow Area = 14,491 sf, 78.64% Impervious, Inflow Depth > 1.95" for 2-YEAR event
 Inflow = 0.74 cfs @ 12.09 hrs, Volume= 2,357 cf
 Outflow = 0.16 cfs @ 13.05 hrs, Volume= 1,884 cf, Atten= 79%, Lag= 57.5 min
 Discarded = 0.00 cfs @ 0.10 hrs, Volume= 0 cf
 Primary = 0.16 cfs @ 13.05 hrs, Volume= 1,884 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 232.17' @ 12.53 hrs Surf.Area= 0.046 ac Storage= 0.025 af

Plug-Flow detention time= 171.0 min calculated for 1,884 cf (80% of inflow)
 Center-of-Mass det. time= 94.0 min (899.0 - 805.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	231.17'	0.018 af	14.50'W x 84.75'L x 2.54'H Field A 0.072 af Overall - 0.020 af Embedded = 0.052 af x 35.0% Voids
#2A	231.67'	0.020 af	Cultec R-150XLHD x 32 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
#3B	231.17'	0.012 af	14.50'W x 54.00'L x 2.54'H Field B 0.046 af Overall - 0.013 af Embedded = 0.033 af x 35.0% Voids
#4B	231.67'	0.013 af	Cultec R-150XLHD x 20 Inside #3 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
		0.062 af	Total Available Storage

Storage Group A created with Chamber Wizard
 Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	231.17'	0.090 in/hr Exfiltration X 0.00 over Surface area Phase-In= 0.01'
#2	Primary	231.67'	4.0" Round Culvert L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.67' / 230.95' S= 0.0050 '/ Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#3	Primary	232.33'	8.0" Round Culvert L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.33' / 231.44' S= 0.0061 '/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.00 cfs @ 0.10 hrs HW=231.17' (Free Discharge)
 ↳1=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.16 cfs @ 13.05 hrs HW=232.09' TW=230.33' (Dynamic Tailwater)
 ↳2=Culvert (Barrel Controls 0.16 cfs @ 1.83 fps)
 ↳3=Culvert (Controls 0.00 cfs)

Pond C1: Northeast Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)

Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf

Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap

Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

8 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 82.75' Row Length +12.0" End Stone x 2 = 84.75' Base Length

4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

32 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 876.8 cf Chamber Storage

3,123.4 cf Field - 876.8 cf Chambers = 2,246.6 cf Stone x 35.0% Voids = 786.3 cf Stone Storage

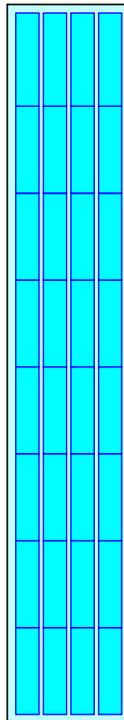
Chamber Storage + Stone Storage = 1,663.1 cf = 0.038 af

Overall Storage Efficiency = 53.2%

32 Chambers

115.7 cy Field

83.2 cy Stone



Pond C1: Northeast Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)

Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf

Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap

Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

5 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 52.00' Row Length +12.0" End Stone x 2 = 54.00' Base Length

4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

20 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 551.0 cf Chamber Storage

1,990.1 cf Field - 551.0 cf Chambers = 1,439.1 cf Stone x 35.0% Voids = 503.7 cf Stone Storage

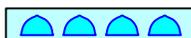
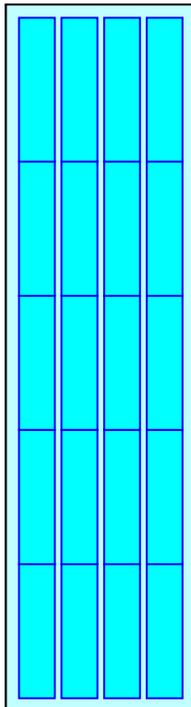
Chamber Storage + Stone Storage = 1,054.7 cf = 0.024 af

Overall Storage Efficiency = 53.0%

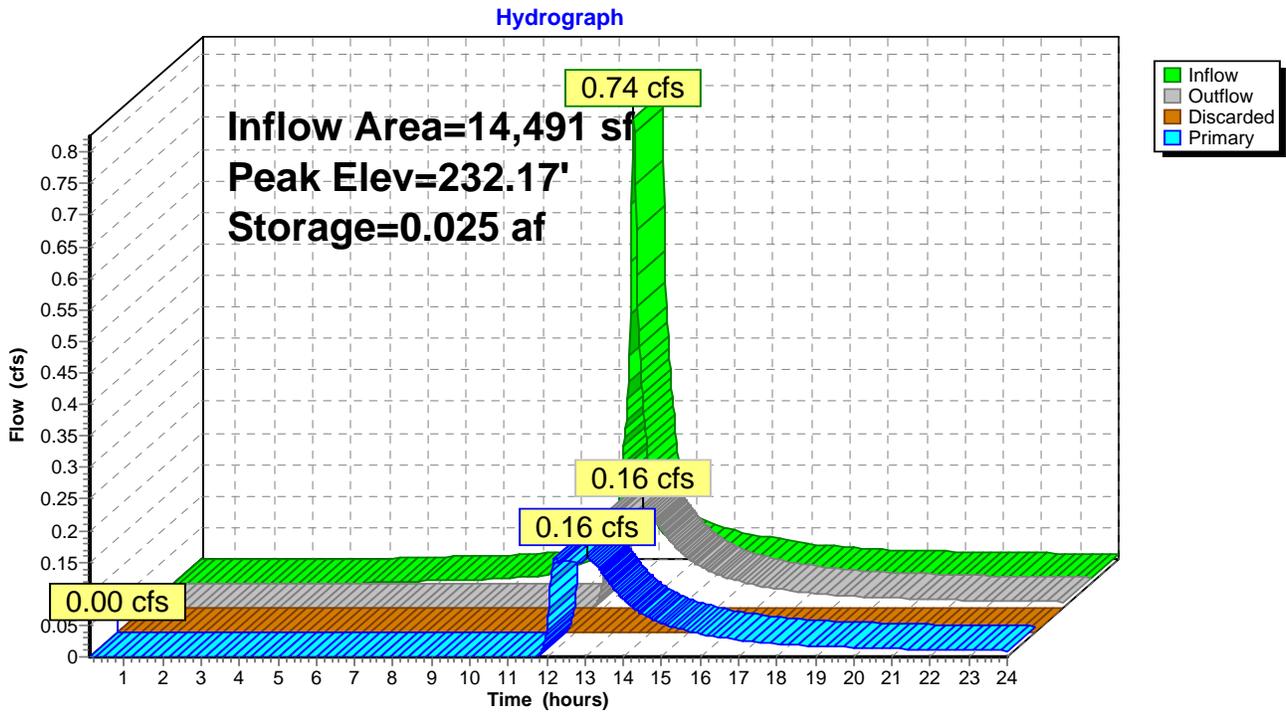
20 Chambers

73.7 cy Field

53.3 cy Stone



Pond C1: Northeast Cultecs



Summary for Pond C2: Intermediate Cultecs

Inflow Area = 17,721 sf, 82.53% Impervious, Inflow Depth > 1.79" for 2-YEAR event
 Inflow = 0.33 cfs @ 12.11 hrs, Volume= 2,645 cf
 Outflow = 0.20 cfs @ 12.48 hrs, Volume= 2,644 cf, Atten= 38%, Lag= 22.4 min
 Discarded = 0.06 cfs @ 13.35 hrs, Volume= 1,899 cf
 Primary = 0.14 cfs @ 12.48 hrs, Volume= 746 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 230.35' @ 13.35 hrs Surf.Area= 392 sf Storage= 313 cf
 Flood Elev= 233.94' Surf.Area= 392 sf Storage= 950 cf

Plug-Flow detention time= 29.6 min calculated for 2,644 cf (100% of inflow)
 Center-of-Mass det. time= 29.6 min (887.6 - 858.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	228.78'	447 cf	16.00'W x 24.50'L x 4.54'H Field A 1,780 cf Overall - 503 cf Embedded = 1,277 cf x 35.0% Voids
#2A	229.78'	503 cf	Cultec R-330XLHD x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		950 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	228.78'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'
#2	Primary	230.00'	8.0" Round Culvert L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.00' / 230.00' S= 0.0000 1/ S= 0.0000 1/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.06 cfs @ 13.35 hrs HW=230.35' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.14 cfs @ 12.48 hrs HW=230.30' TW=230.15' (Dynamic Tailwater)

↑**2=Culvert** (Barrel Controls 0.14 cfs @ 1.37 fps)

Pond C2: Intermediate Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length

3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width

12.0" Base + 30.5" Chamber Height + 12.0" Cover = 4.54' Field Height

9 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 502.9 cf Chamber Storage

1,780.3 cf Field - 502.9 cf Chambers = 1,277.4 cf Stone x 35.0% Voids = 447.1 cf Stone Storage

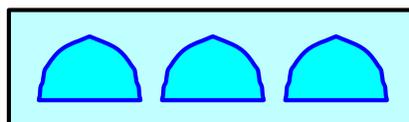
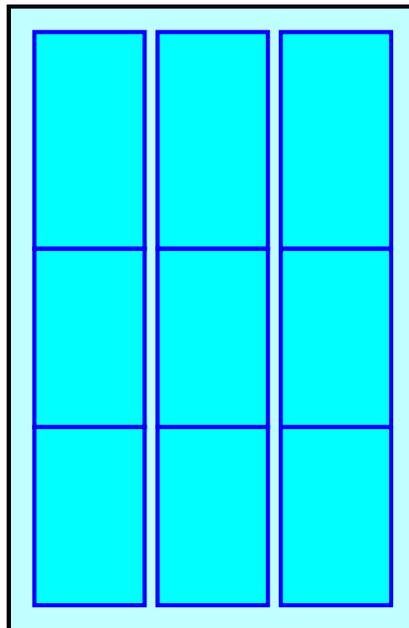
Chamber Storage + Stone Storage = 950.0 cf = 0.022 af

Overall Storage Efficiency = 53.4%

9 Chambers

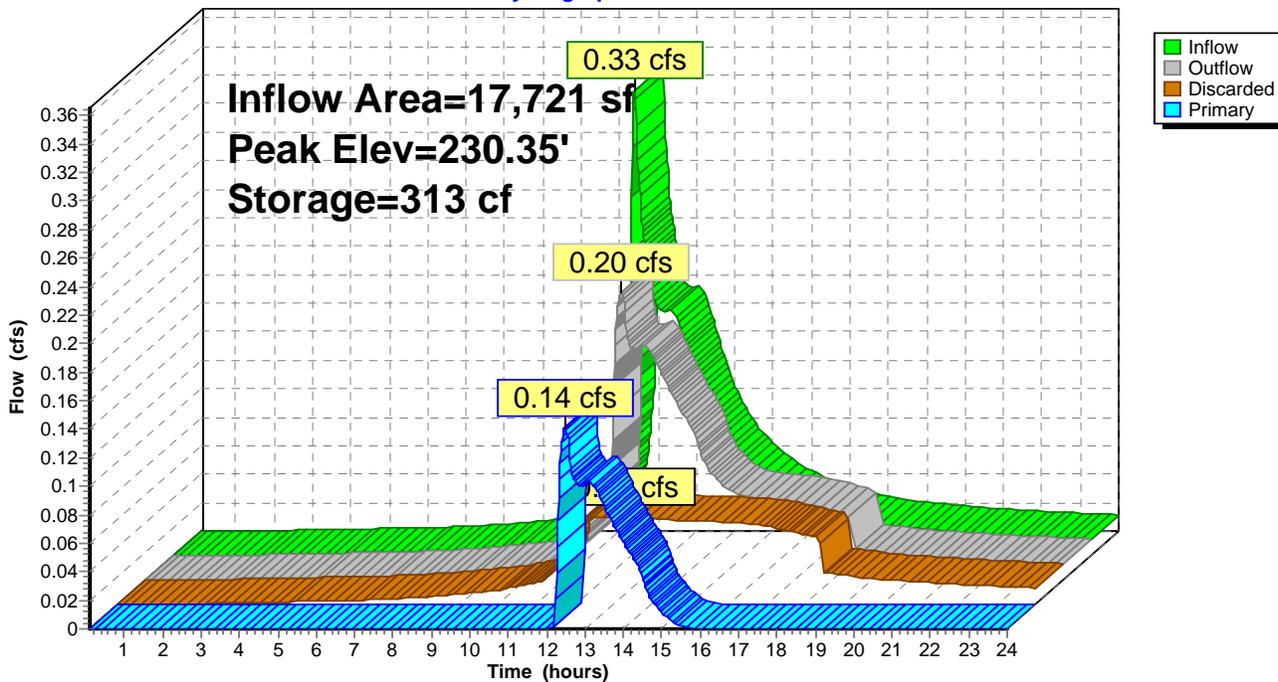
65.9 cy Field

47.3 cy Stone



Pond C2: Intermediate Cultecs

Hydrograph



Summary for Pond C3: Southwest Cultecs

Inflow Area = 24,430 sf, 87.33% Impervious, Inflow Depth > 0.95" for 2-YEAR event
 Inflow = 0.45 cfs @ 12.09 hrs, Volume= 1,934 cf
 Outflow = 0.12 cfs @ 13.41 hrs, Volume= 1,934 cf, Atten= 74%, Lag= 79.1 min
 Discarded = 0.12 cfs @ 13.41 hrs, Volume= 1,934 cf
 Primary = 0.00 cfs @ 0.10 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 230.33' @ 13.41 hrs Surf.Area= 0.017 ac Storage= 0.012 af

Plug-Flow detention time= 42.3 min calculated for 1,932 cf (100% of inflow)
 Center-of-Mass det. time= 42.3 min (808.7 - 766.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	229.07'	0.003 af	6.33'W x 24.50'L x 3.71'H Field A 0.013 af Overall - 0.004 af Embedded = 0.009 af x 35.0% Voids
#2A	229.74'	0.004 af	Cultec R-330XLHD x 3 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	229.07'	0.011 af	11.17'W x 52.50'L x 3.71'H Field B 0.050 af Overall - 0.017 af Embedded = 0.033 af x 35.0% Voids
#4B	229.74'	0.017 af	Cultec R-330XLHD x 14 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		0.036 af	Total Available Storage

Storage Group A created with Chamber Wizard
 Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	229.07'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'
#2	Primary	230.68'	8.0" Round Culvert L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.68' / 230.48' S= 0.0100 1/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.12 cfs @ 13.41 hrs HW=230.33' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.10 hrs HW=229.07' TW=0.00' (Dynamic Tailwater)

↑**2=Culvert** (Controls 0.00 cfs)

Pond C3: Southwest Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length

1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width

8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

3 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 167.6 cf Chamber Storage

575.4 cf Field - 167.6 cf Chambers = 407.8 cf Stone x 35.0% Voids = 142.7 cf Stone Storage

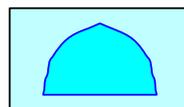
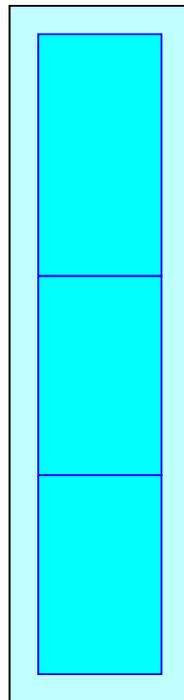
Chamber Storage + Stone Storage = 310.4 cf = 0.007 af

Overall Storage Efficiency = 53.9%

3 Chambers

21.3 cy Field

15.1 cy Stone



Pond C3: Southwest Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 2 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length

2 Rows x 52.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.17' Base Width

8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

14 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 2 Rows = 752.6 cf Chamber Storage

2,174.0 cf Field - 752.6 cf Chambers = 1,421.5 cf Stone x 35.0% Voids = 497.5 cf Stone Storage

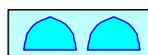
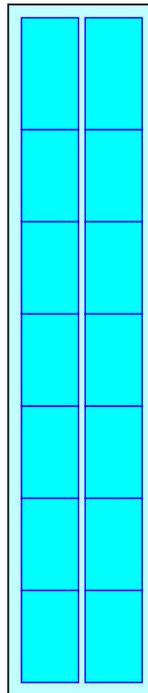
Chamber Storage + Stone Storage = 1,250.1 cf = 0.029 af

Overall Storage Efficiency = 57.5%

14 Chambers

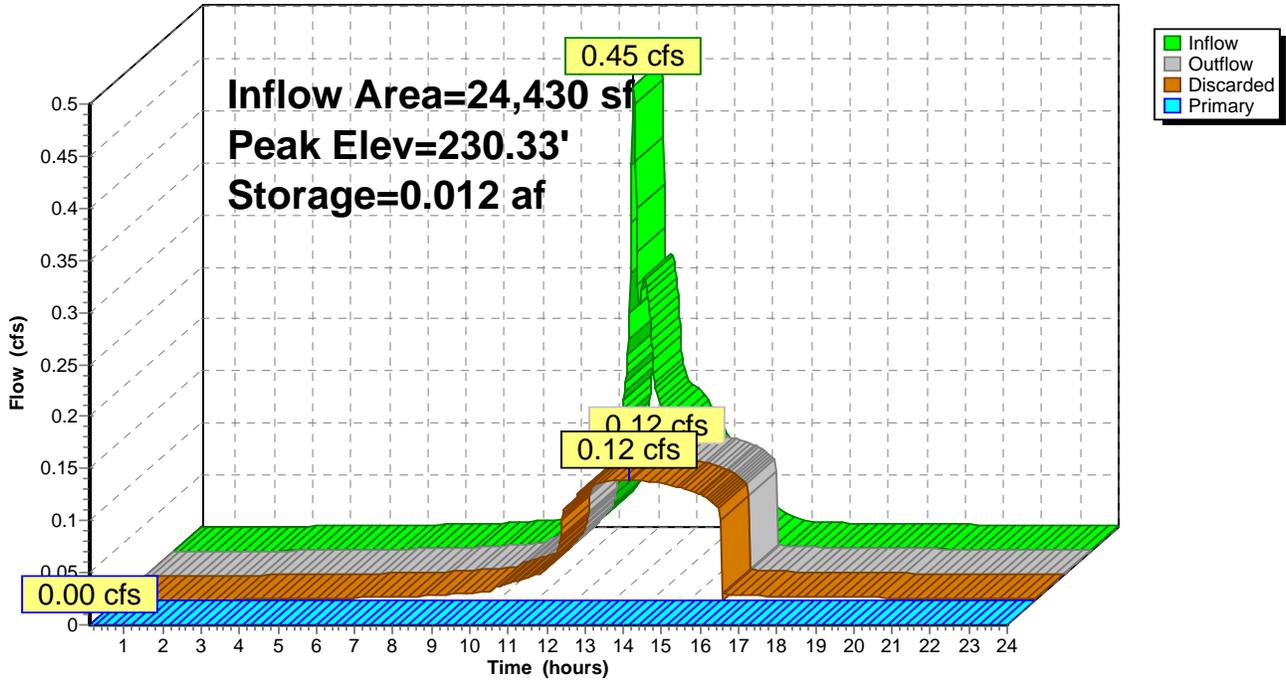
80.5 cy Field

52.6 cy Stone



Pond C3: Southwest Cultecs

Hydrograph



Summary for Pond CB1: Catch Basin #1

Inflow Area = 10,259 sf, 69.83% Impervious, Inflow Depth > 1.64" for 2-YEAR event
 Inflow = 0.45 cfs @ 12.09 hrs, Volume= 1,399 cf
 Outflow = 0.45 cfs @ 12.10 hrs, Volume= 1,380 cf, Atten= 0%, Lag= 0.4 min
 Primary = 0.45 cfs @ 12.10 hrs, Volume= 1,380 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 233.56' @ 12.10 hrs Surf.Area= 13 sf Storage= 27 cf

Plug-Flow detention time= 12.2 min calculated for 1,380 cf (99% of inflow)
 Center-of-Mass det. time= 4.0 min (831.5 - 827.4)

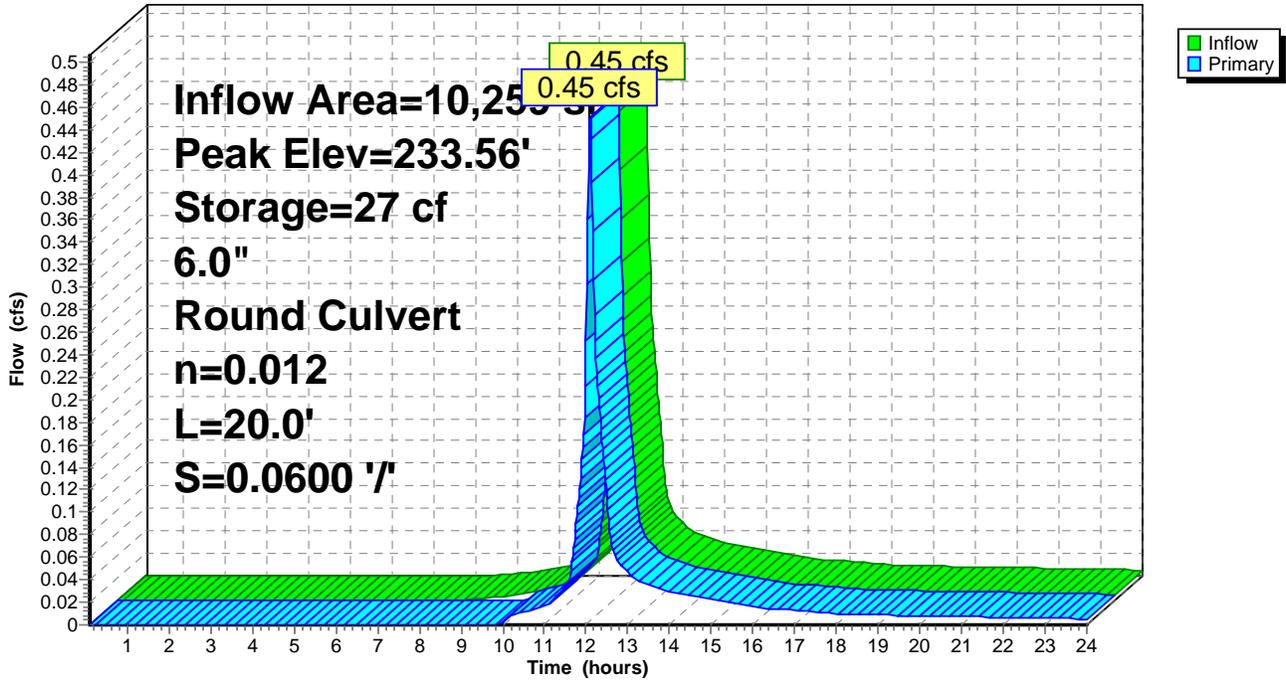
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	464 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	3,335	419	464

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0600 '/ Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.45 cfs @ 12.10 hrs HW=233.56' TW=231.96' (Dynamic Tailwater)
 ↑1=Culvert (Inlet Controls 0.45 cfs @ 2.28 fps)

Pond CB1: Catch Basin #1

Hydrograph



Summary for Pond CB2: Catch Basin #2

Inflow Area = 4,232 sf, 100.00% Impervious, Inflow Depth > 2.83" for 2-YEAR event
 Inflow = 0.29 cfs @ 12.08 hrs, Volume= 997 cf
 Outflow = 0.29 cfs @ 12.09 hrs, Volume= 977 cf, Atten= 0%, Lag= 0.2 min
 Primary = 0.29 cfs @ 12.09 hrs, Volume= 977 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 233.35' @ 12.09 hrs Surf.Area= 13 sf Storage= 24 cf

Plug-Flow detention time= 23.0 min calculated for 977 cf (98% of inflow)
 Center-of-Mass det. time= 10.8 min (767.6 - 756.8)

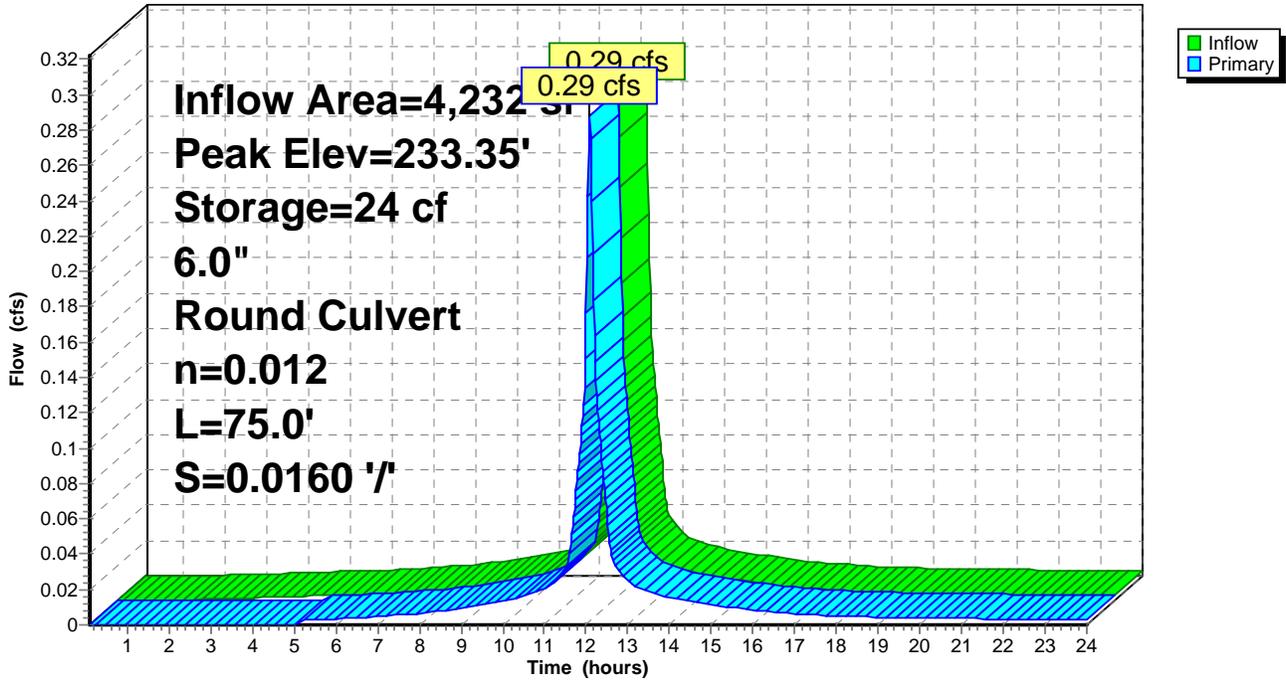
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,690	213	258

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 75.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0160 '/ Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.29 cfs @ 12.09 hrs HW=233.35' TW=231.94' (Dynamic Tailwater)
 ↑1=Culvert (Inlet Controls 0.29 cfs @ 1.70 fps)

Pond CB2: Catch Basin #2

Hydrograph



Summary for Pond CB3: Catch Basin #3

Inflow Area = 3,960 sf, 100.00% Impervious, Inflow Depth > 2.83" for 2-YEAR event
 Inflow = 0.27 cfs @ 12.08 hrs, Volume= 933 cf
 Outflow = 0.27 cfs @ 12.09 hrs, Volume= 913 cf, Atten= 0%, Lag= 0.2 min
 Primary = 0.27 cfs @ 12.09 hrs, Volume= 913 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 233.34' @ 12.09 hrs Surf.Area= 13 sf Storage= 24 cf

Plug-Flow detention time= 24.4 min calculated for 912 cf (98% of inflow)
 Center-of-Mass det. time= 11.5 min (768.3 - 756.8)

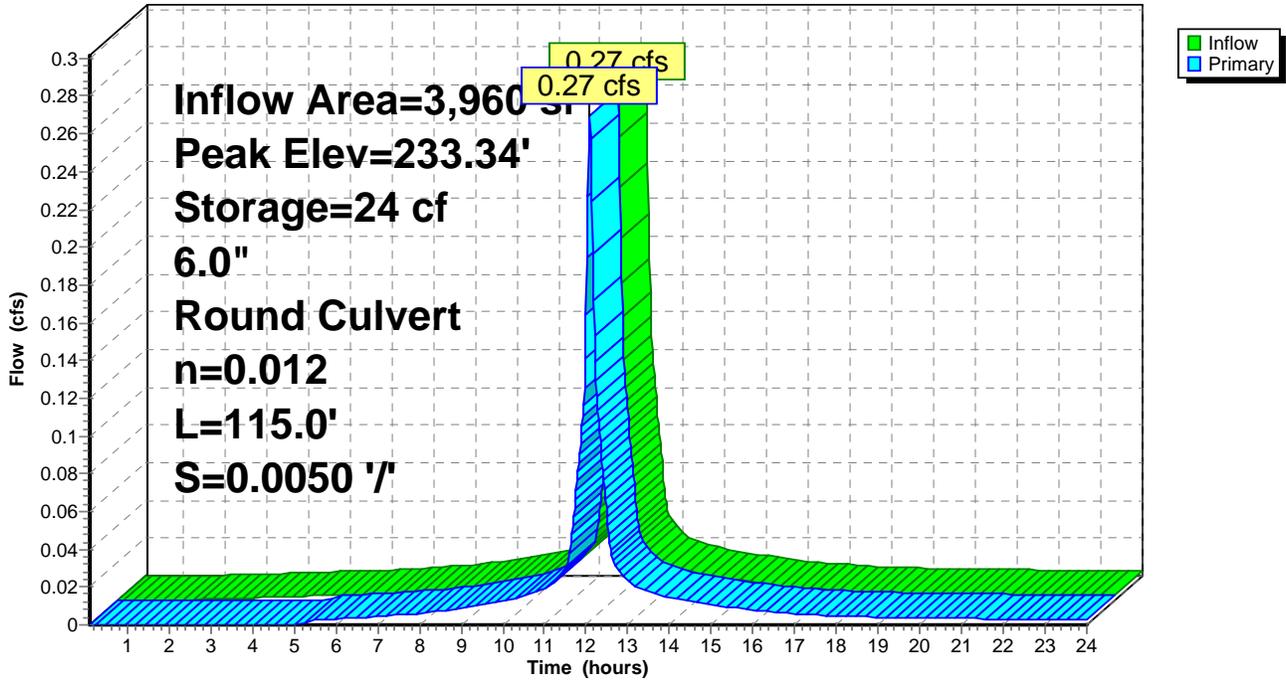
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	293 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,963	247	293

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 115.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 232.38' S= 0.0050 ' /' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.27 cfs @ 12.09 hrs HW=233.34' TW=231.62' (Dynamic Tailwater)
 ↑1=Culvert (Barrel Controls 0.27 cfs @ 2.22 fps)

Pond CB3: Catch Basin #3

Hydrograph



Summary for Pond D1: Drywell

Inflow Area = 3,960 sf, 100.00% Impervious, Inflow Depth > 2.77" for 2-YEAR event
 Inflow = 0.27 cfs @ 12.09 hrs, Volume= 913 cf
 Outflow = 0.27 cfs @ 12.09 hrs, Volume= 913 cf, Atten= 0%, Lag= 0.4 min
 Discarded = 0.01 cfs @ 12.09 hrs, Volume= 372 cf
 Primary = 0.26 cfs @ 12.09 hrs, Volume= 541 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 231.63' @ 12.09 hrs Surf.Area= 33 sf Storage= 35 cf

Plug-Flow detention time= 19.4 min calculated for 912 cf (100% of inflow)
 Center-of-Mass det. time= 19.3 min (787.6 - 768.3)

Volume	Invert	Avail.Storage	Storage Description
#1	230.00'	98 cf	5.00'D x 5.00'H Vertical Cone/Cylinder Inside #2 141 cf Overall - 6.0" Wall Thickness = 98 cf
#2	230.00'	9 cf	6.50'D x 5.00'H Vertical Cone/Cylinder 166 cf Overall - 141 cf Embedded = 25 cf x 35.0% Voids
		107 cf	Total Available Storage

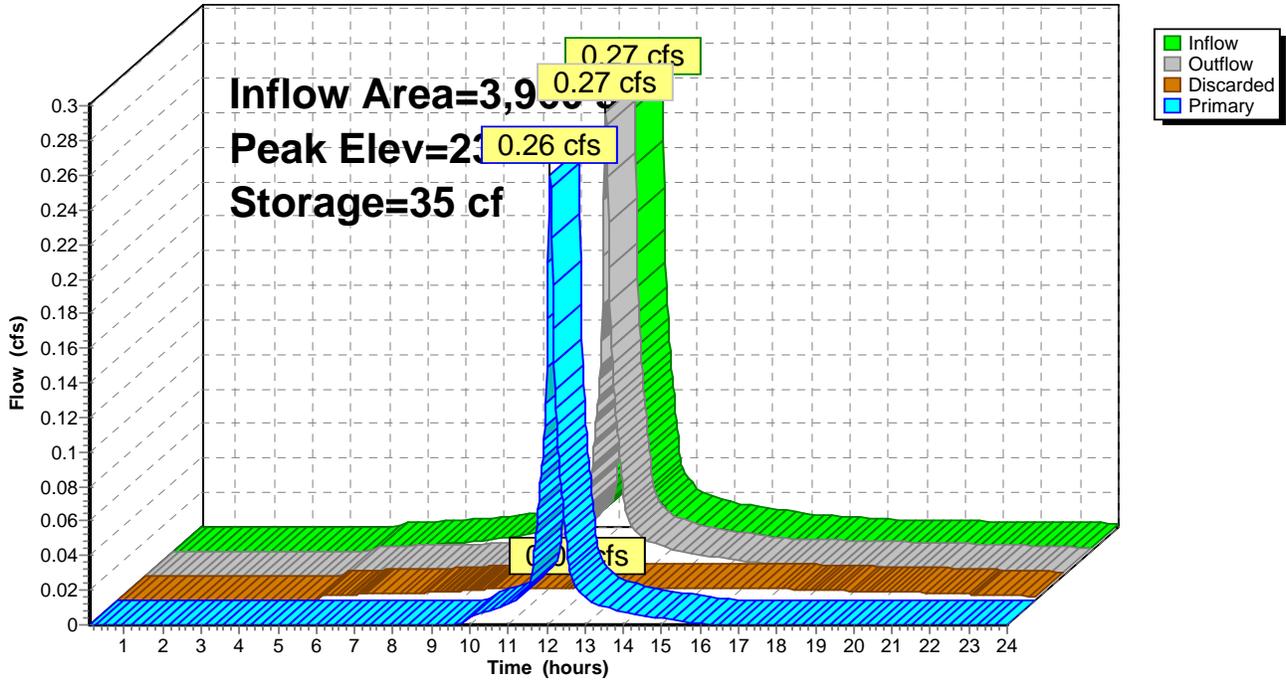
Device	Routing	Invert	Outlet Devices
#1	Primary	231.25'	6.0" Round Culvert L= 5.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.25' / 231.00' S= 0.0500 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Discarded	230.00'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'

Discarded OutFlow Max=0.01 cfs @ 12.09 hrs HW=231.62' (Free Discharge)
 ↳ **2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.26 cfs @ 12.09 hrs HW=231.62' TW=229.71' (Dynamic Tailwater)
 ↳ **1=Culvert** (Inlet Controls 0.26 cfs @ 1.64 fps)

Pond D1: Drywell

Hydrograph



Time span=0.10-24.00 hrs, dt=0.02 hrs, 1196 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Roof Drain South West Runoff Area=2,749 sf 100.00% Impervious Runoff Depth>4.33"
Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.28 cfs 992 cf

Subcatchment 2S: Roof Drain North Side Runoff Area=3,230 sf 100.00% Impervious Runoff Depth>4.33"
Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.33 cfs 1,166 cf

Subcatchment 3S: Upper Paved Area Runoff Area=10,259 sf 69.83% Impervious Runoff Depth>2.97"
Tc=6.0 min CN=85 Runoff=0.81 cfs 2,539 cf

Subcatchment 4S: Middle Paved Area & Runoff Area=4,232 sf 100.00% Impervious Runoff Depth>4.33"
Tc=6.0 min CN=98 Runoff=0.43 cfs 1,527 cf

Subcatchment 5S: Lower Paved Area Runoff Area=3,960 sf 100.00% Impervious Runoff Depth>4.33"
Tc=6.0 min CN=98 Runoff=0.41 cfs 1,429 cf

Subcatchment 6S: Remaining Project Area Runoff Area=217,642 sf 3.80% Impervious Runoff Depth>0.48"
Flow Length=562' Tc=15.9 min CN=49 Runoff=1.09 cfs 8,649 cf

Subcatchment EX: Existing Site Runoff Area=242,195 sf 7.17% Impervious Runoff Depth>0.52"
Flow Length=562' Tc=15.9 min CN=50 Runoff=1.41 cfs 10,536 cf

Reach END: Proposed Site Runoff Inflow=1.35 cfs 9,549 cf
Outflow=1.35 cfs 9,549 cf

Pond C1: Northeast Cultecs Peak Elev=232.61' Storage=0.040 af Inflow=1.24 cfs 4,027 cf
Discarded=0.00 cfs 0 cf Primary=0.39 cfs 3,526 cf Outflow=0.39 cfs 3,526 cf

Pond C2: Intermediate Cultecs Peak Elev=231.11' Storage=536 cf Inflow=0.49 cfs 4,692 cf
Discarded=0.07 cfs 2,506 cf Primary=0.34 cfs 2,185 cf Outflow=0.41 cfs 4,691 cf

Pond C3: Southwest Cultecs Peak Elev=231.04' Storage=0.021 af Inflow=0.94 cfs 4,127 cf
Discarded=0.13 cfs 3,228 cf Primary=0.31 cfs 900 cf Outflow=0.44 cfs 4,127 cf

Pond CB1: Catch Basin #1 Peak Elev=234.37' Storage=37 cf Inflow=0.81 cfs 2,539 cf
6.0" Round Culvert n=0.012 L=20.0' S=0.0600 '/' Outflow=0.81 cfs 2,519 cf

Pond CB2: Catch Basin #2 Peak Elev=233.54' Storage=26 cf Inflow=0.43 cfs 1,527 cf
6.0" Round Culvert n=0.012 L=75.0' S=0.0160 '/' Outflow=0.43 cfs 1,508 cf

Pond CB3: Catch Basin #3 Peak Elev=233.49' Storage=26 cf Inflow=0.41 cfs 1,429 cf
6.0" Round Culvert n=0.012 L=115.0' S=0.0050 '/' Outflow=0.40 cfs 1,410 cf

Pond D1: Drywell Peak Elev=231.78' Storage=38 cf Inflow=0.40 cfs 1,410 cf
Discarded=0.01 cfs 453 cf Primary=0.39 cfs 949 cf Outflow=0.40 cfs 1,403 cf

Total Runoff Area = 484,267 sf Runoff Volume = 26,838 cf Average Runoff Depth = 0.67"
90.30% Pervious = 437,284 sf 9.70% Impervious = 46,983 sf

Summary for Subcatchment 1S: Roof Drain South West Side

Runoff = 0.28 cfs @ 12.08 hrs, Volume= 992 cf, Depth> 4.33"

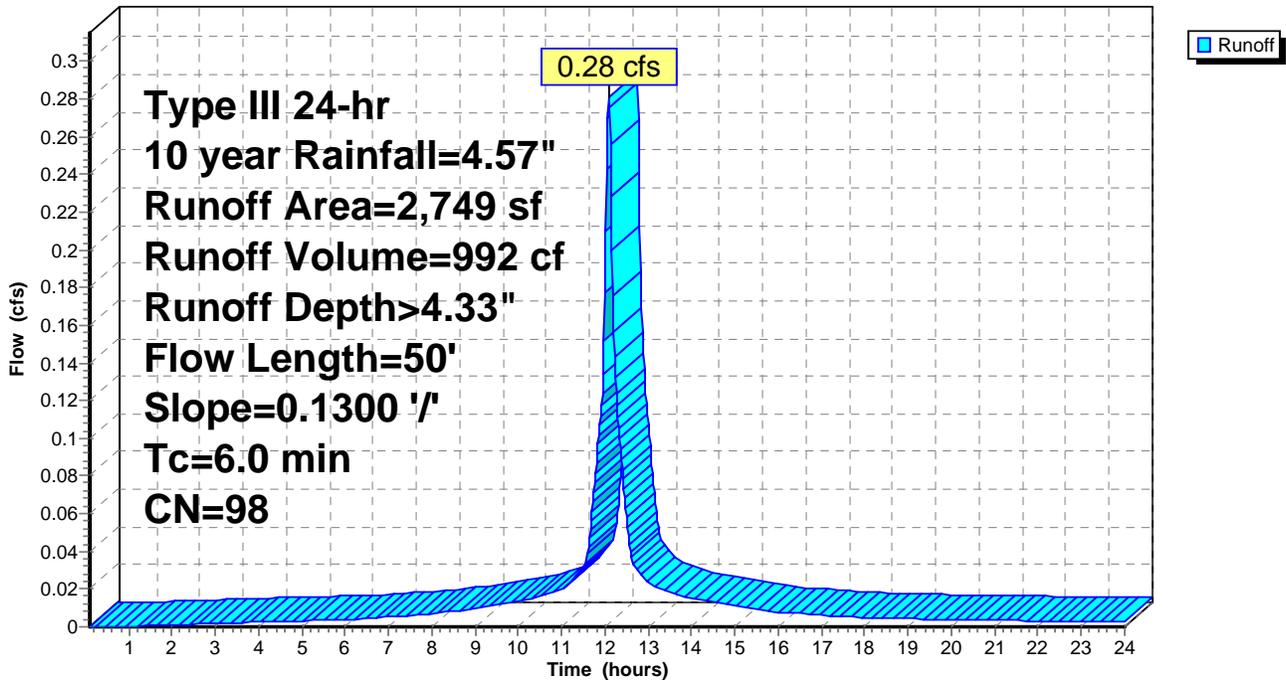
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
 Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
2,749	98	Roofs, HSG A
2,749		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 1S: Roof Drain South West Side

Hydrograph



Summary for Subcatchment 2S: Roof Drain North Side

Runoff = 0.33 cfs @ 12.08 hrs, Volume= 1,166 cf, Depth> 4.33"

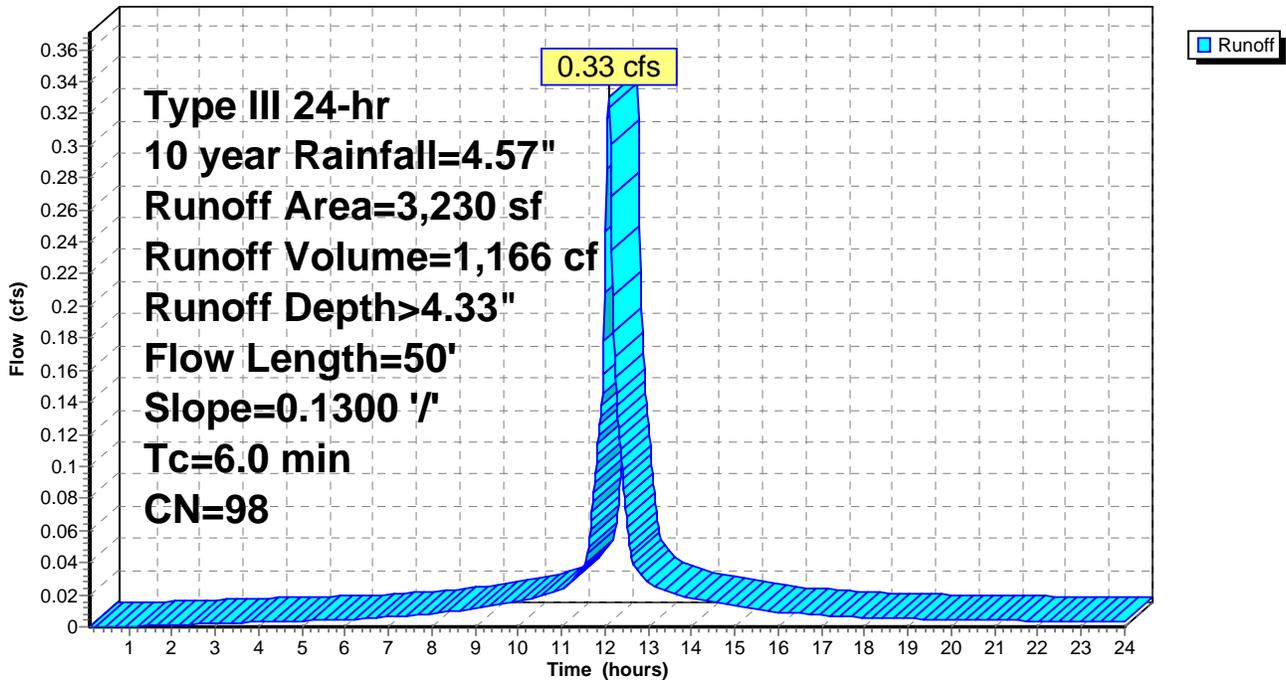
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
3,230	98	Roofs, HSG A
3,230		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 2S: Roof Drain North Side

Hydrograph



Summary for Subcatchment 3S: Upper Paved Area

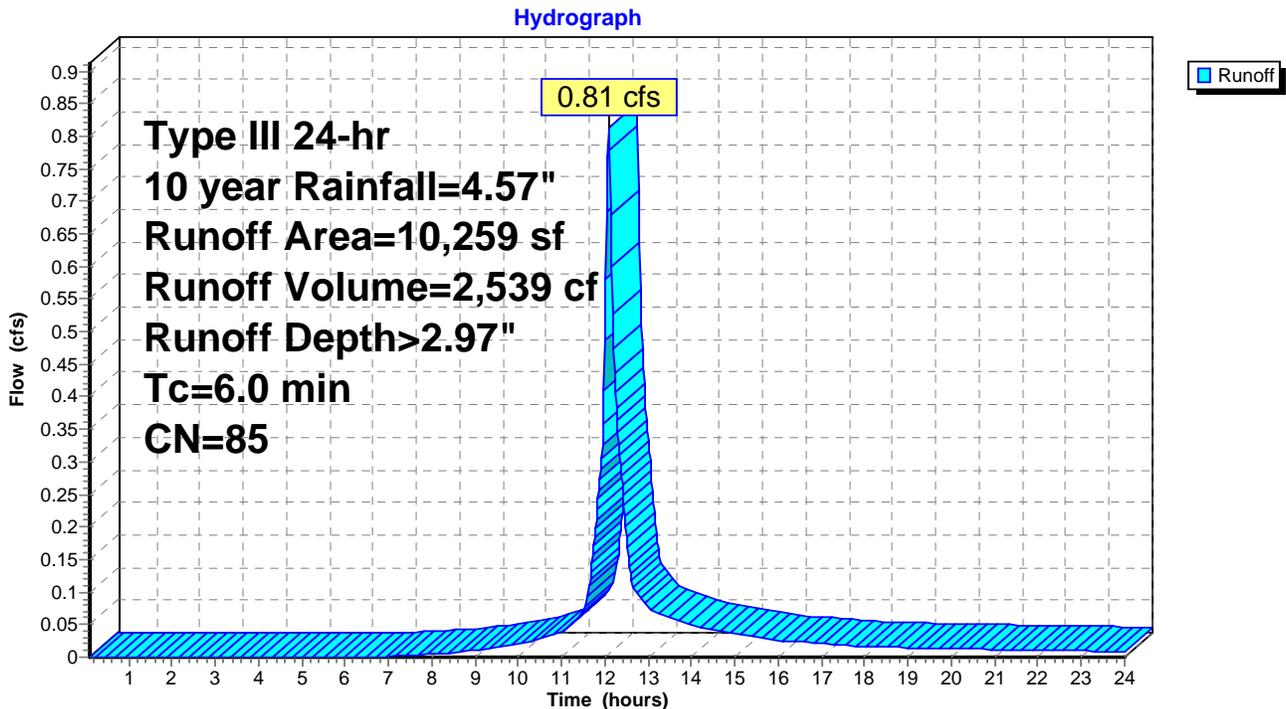
Runoff = 0.81 cfs @ 12.09 hrs, Volume= 2,539 cf, Depth> 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
 Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
7,164	98	Paved parking, HSG A
1,956	49	50-75% Grass cover, Fair, HSG A
441	49	50-75% Grass cover, Fair, HSG A
* 698	76	Gravel roads, HSG A (rip rap)
10,259	85	Weighted Average
3,095		30.17% Pervious Area
7,164		69.83% Impervious Area

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

Subcatchment 3S: Upper Paved Area



Summary for Subcatchment 4S: Middle Paved Area & Eastern Roof

Runoff = 0.43 cfs @ 12.08 hrs, Volume= 1,527 cf, Depth> 4.33"

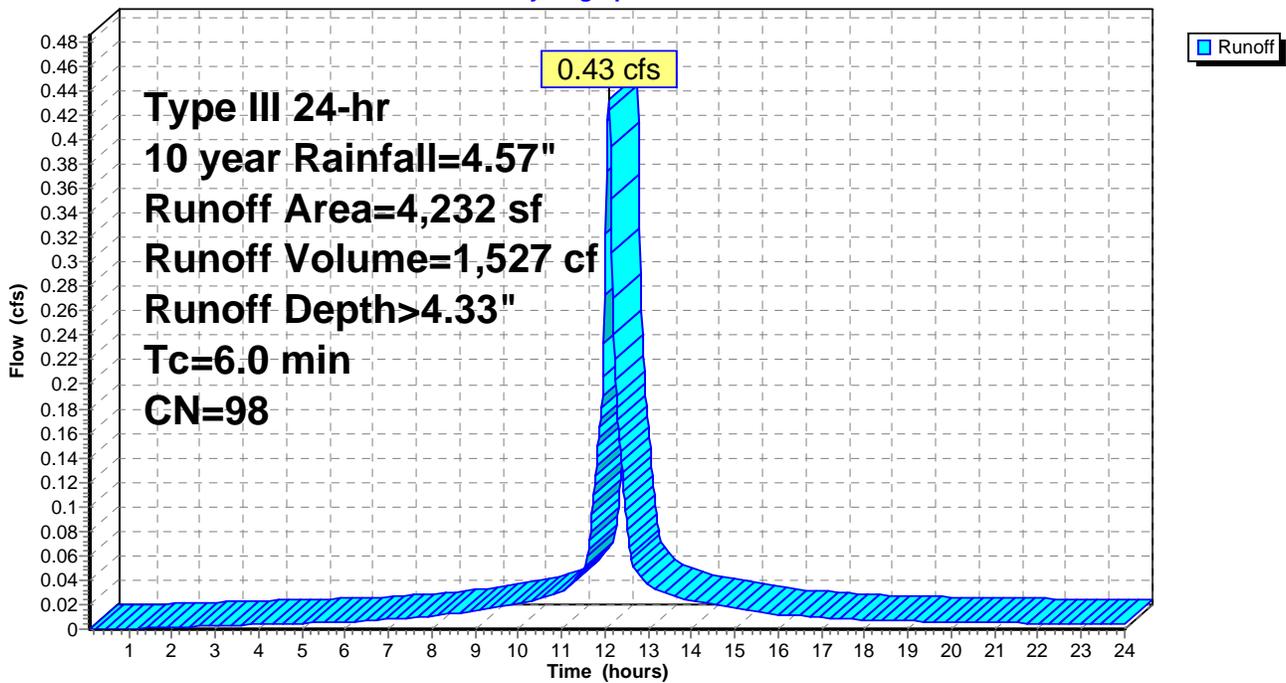
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
 Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
2,572	98	Paved parking, HSG A
1,660	98	Roofs, HSG A
4,232	98	Weighted Average
4,232		100.00% Impervious Area

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

Subcatchment 4S: Middle Paved Area & Eastern Roof

Hydrograph



Summary for Subcatchment 5S: Lower Paved Area

Runoff = 0.41 cfs @ 12.08 hrs, Volume= 1,429 cf, Depth> 4.33"

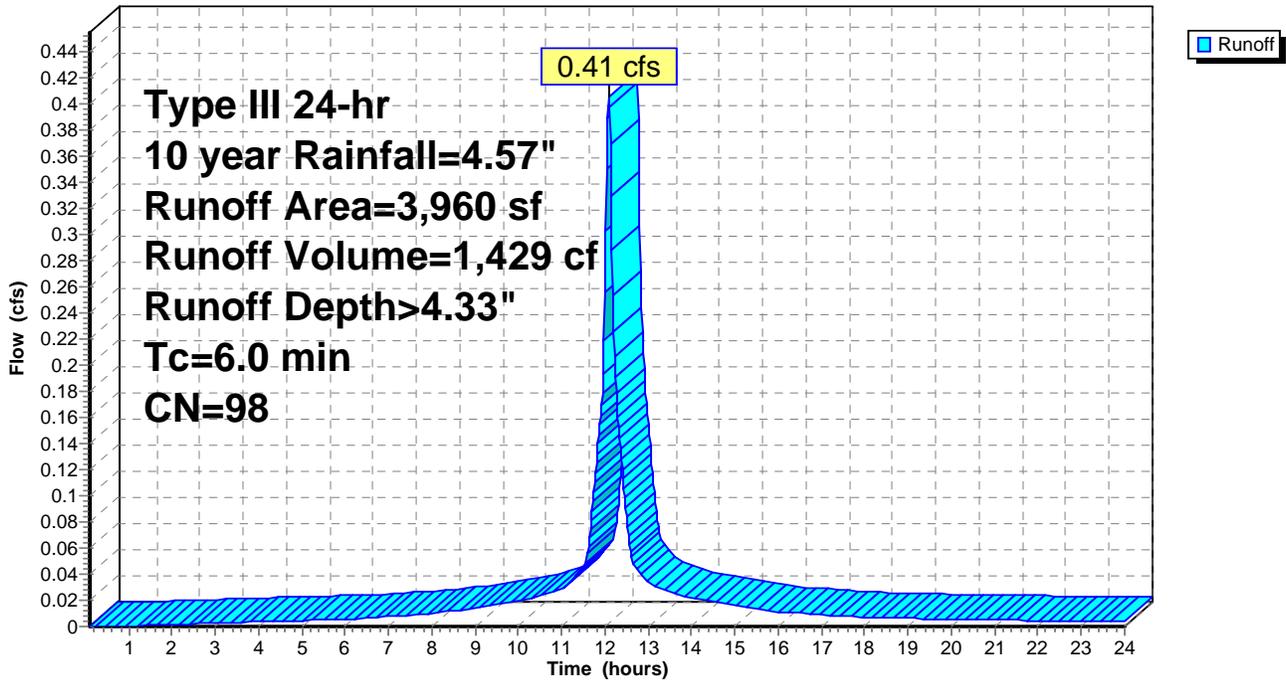
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
 Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
3,960	98	Paved parking, HSG A
3,960		100.00% Impervious Area

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

Subcatchment 5S: Lower Paved Area

Hydrograph



Summary for Subcatchment 6S: Remaining Project Area

Runoff = 1.09 cfs @ 12.42 hrs, Volume= 8,649 cf, Depth> 0.48"

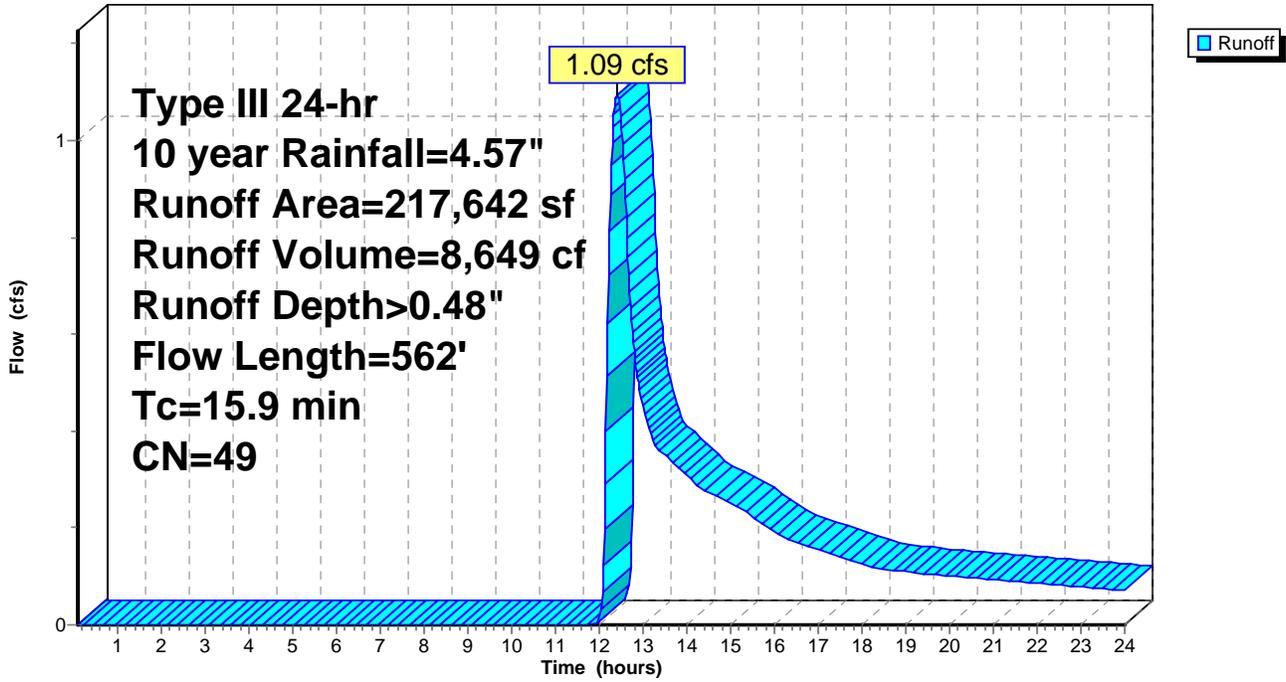
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
2,763	49	50-75% Grass cover, Fair, HSG A
9,597	76	Gravel roads, HSG A
8,274	98	Paved parking, HSG A
7,927	49	50-75% Grass cover, Fair, HSG A
27,757	78	Meadow, non-grazed, HSG D
28,946	77	Woods, Good, HSG D
78,485	30	Woods, Good, HSG A
39,143	30	Meadow, non-grazed, HSG A
11,968	30	Woods, Good, HSG A
* 2,782	76	Gravel roads, HSG A (RIP RAP)
217,642	49	Weighted Average
209,368		96.20% Pervious Area
8,274		3.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods pre grass strip Woodland Kv= 5.0 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strips (both) Short Grass Pasture Kv= 7.0 fps
0.0	12	0.0833	5.86		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			

Subcatchment 6S: Remaining Project Area

Hydrograph



Summary for Subcatchment EX: Existing Site

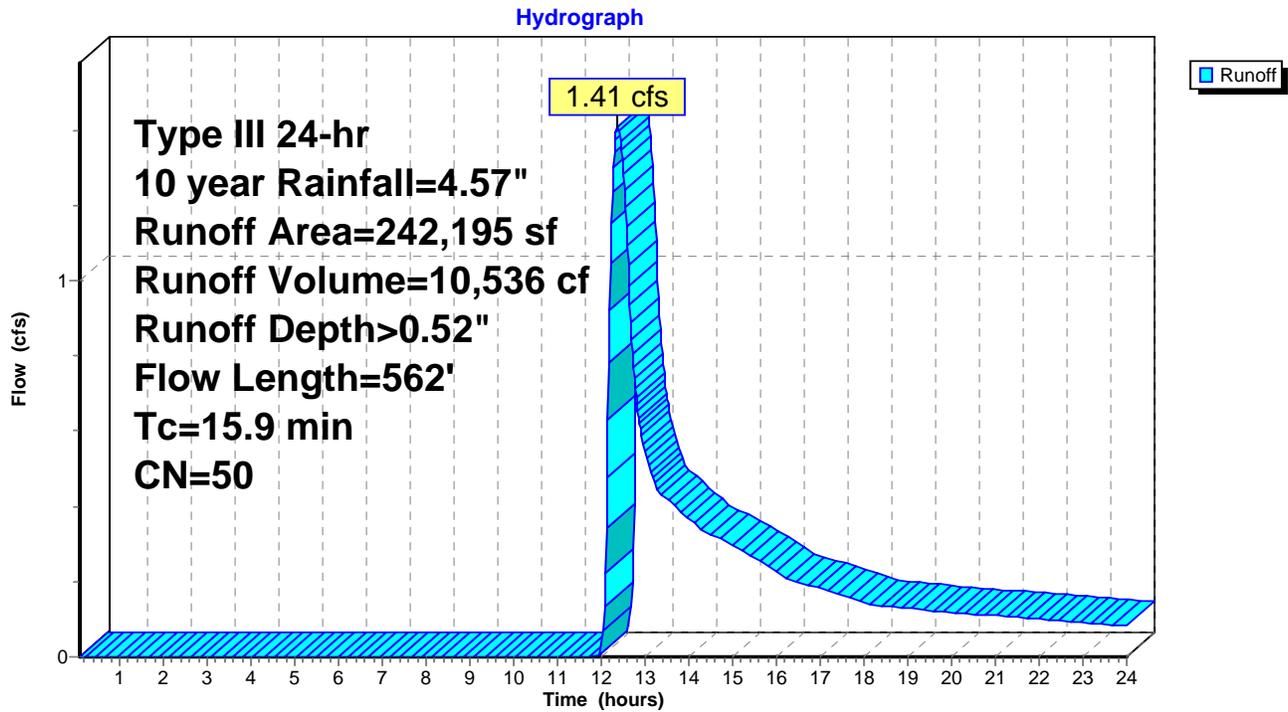
Runoff = 1.41 cfs @ 12.39 hrs, Volume= 10,536 cf, Depth> 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 year Rainfall=4.57"

Area (sf)	CN	Description
11,475	49	50-75% Grass cover, Fair, HSG A
3,181	76	Gravel roads, HSG A
17,374	98	Paved parking, HSG A
4,242	49	50-75% Grass cover, Fair, HSG A
8,728	49	50-75% Grass cover, Fair, HSG A
* 3,480	76	Gravel roads, HSG A (RIP RAP)
59,405	77	Woods, Good, HSG D
82,915	30	Woods, Good, HSG A
9,737	30	Woods, Good, HSG A
41,658	30	Woods, Good, HSG A
242,195	50	Weighted Average
224,821		92.83% Pervious Area
17,374		7.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods Woodland Kv= 5.0 fps
0.0	12	0.1000	6.42		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strip (both) Short Grass Pasture Kv= 7.0 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, final grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			

Subcatchment EX: Existing Site



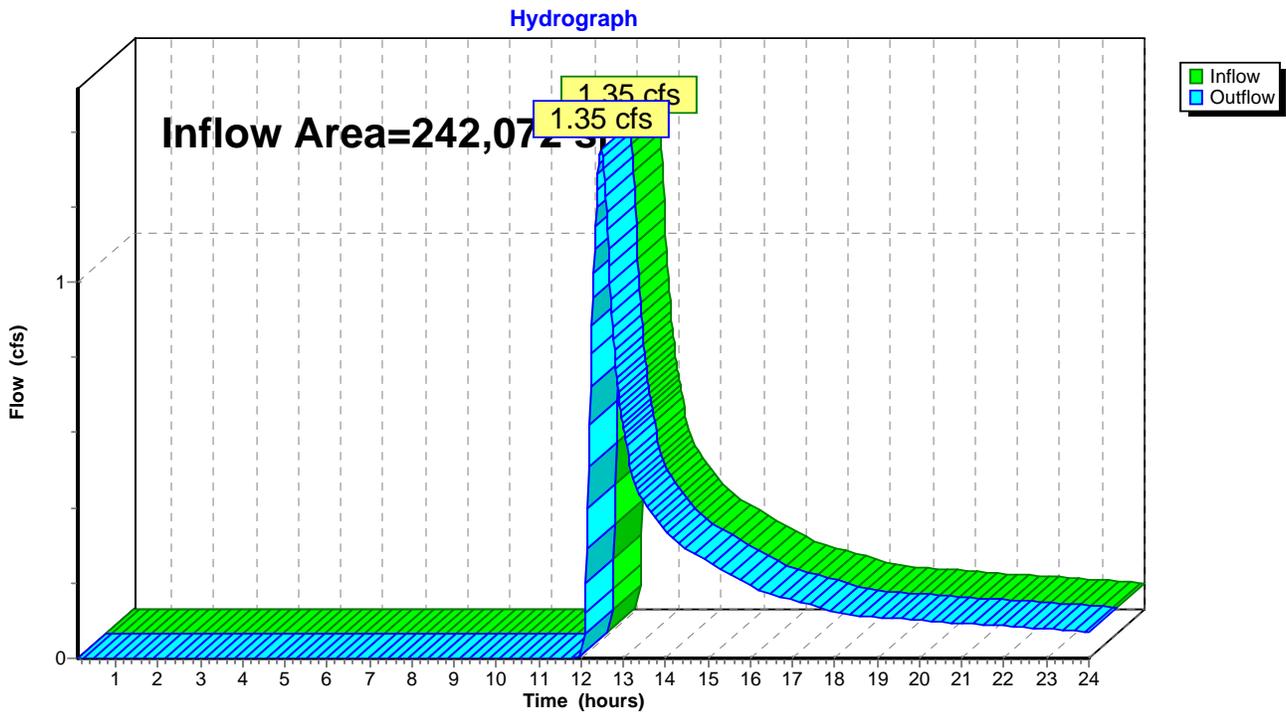
Summary for Reach END: Proposed Site Runoff

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

Inflow Area = 242,072 sf, 12.23% Impervious, Inflow Depth > 0.47" for 10 year event
Inflow = 1.35 cfs @ 12.47 hrs, Volume= 9,549 cf
Outflow = 1.35 cfs @ 12.47 hrs, Volume= 9,549 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3

Reach END: Proposed Site Runoff



Summary for Pond C1: Northeast Cultecs

Inflow Area = 14,491 sf, 78.64% Impervious, Inflow Depth > 3.34" for 10 year event
 Inflow = 1.24 cfs @ 12.09 hrs, Volume= 4,027 cf
 Outflow = 0.39 cfs @ 12.41 hrs, Volume= 3,526 cf, Atten= 69%, Lag= 18.8 min
 Discarded = 0.00 cfs @ 0.10 hrs, Volume= 0 cf
 Primary = 0.39 cfs @ 12.41 hrs, Volume= 3,526 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 232.61' @ 12.41 hrs Surf.Area= 0.046 ac Storage= 0.040 af

Plug-Flow detention time= 146.4 min calculated for 3,526 cf (88% of inflow)
 Center-of-Mass det. time= 89.8 min (882.0 - 792.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	231.17'	0.018 af	14.50'W x 84.75'L x 2.54'H Field A 0.072 af Overall - 0.020 af Embedded = 0.052 af x 35.0% Voids
#2A	231.67'	0.020 af	Cultec R-150XLHD x 32 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
#3B	231.17'	0.012 af	14.50'W x 54.00'L x 2.54'H Field B 0.046 af Overall - 0.013 af Embedded = 0.033 af x 35.0% Voids
#4B	231.67'	0.013 af	Cultec R-150XLHD x 20 Inside #3 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 4 rows
		0.062 af	Total Available Storage

Storage Group A created with Chamber Wizard
 Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	231.17'	0.090 in/hr Exfiltration X 0.00 over Surface area Phase-In= 0.01'
#2	Primary	231.67'	4.0" Round Culvert L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.67' / 230.95' S= 0.0050 '/ Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#3	Primary	232.33'	8.0" Round Culvert L= 145.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.33' / 231.44' S= 0.0061 '/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.00 cfs @ 0.10 hrs HW=231.17' (Free Discharge)
 ↳1=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.39 cfs @ 12.41 hrs HW=232.61' TW=231.02' (Dynamic Tailwater)
 ↳2=Culvert (Barrel Controls 0.19 cfs @ 2.14 fps)
 ↳3=Culvert (Inlet Controls 0.20 cfs @ 1.43 fps)

Pond C1: Northeast Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)

Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf

Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap

Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

8 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 82.75' Row Length +12.0" End Stone x 2 = 84.75' Base Length

4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

32 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 876.8 cf Chamber Storage

3,123.4 cf Field - 876.8 cf Chambers = 2,246.6 cf Stone x 35.0% Voids = 786.3 cf Stone Storage

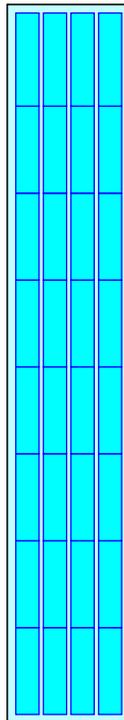
Chamber Storage + Stone Storage = 1,663.1 cf = 0.038 af

Overall Storage Efficiency = 53.2%

32 Chambers

115.7 cy Field

83.2 cy Stone



Pond C1: Northeast Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)

Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf

Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap

Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

33.0" Wide + 6.0" Spacing = 39.0" C-C Row Spacing

5 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 52.00' Row Length +12.0" End Stone x 2 = 54.00' Base Length

4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width

6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

20 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 551.0 cf Chamber Storage

1,990.1 cf Field - 551.0 cf Chambers = 1,439.1 cf Stone x 35.0% Voids = 503.7 cf Stone Storage

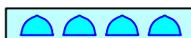
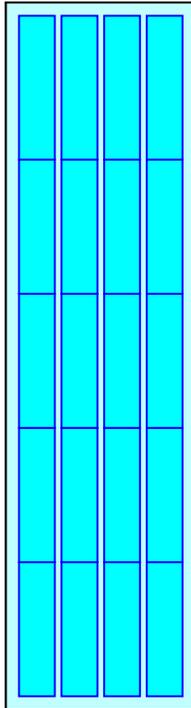
Chamber Storage + Stone Storage = 1,054.7 cf = 0.024 af

Overall Storage Efficiency = 53.0%

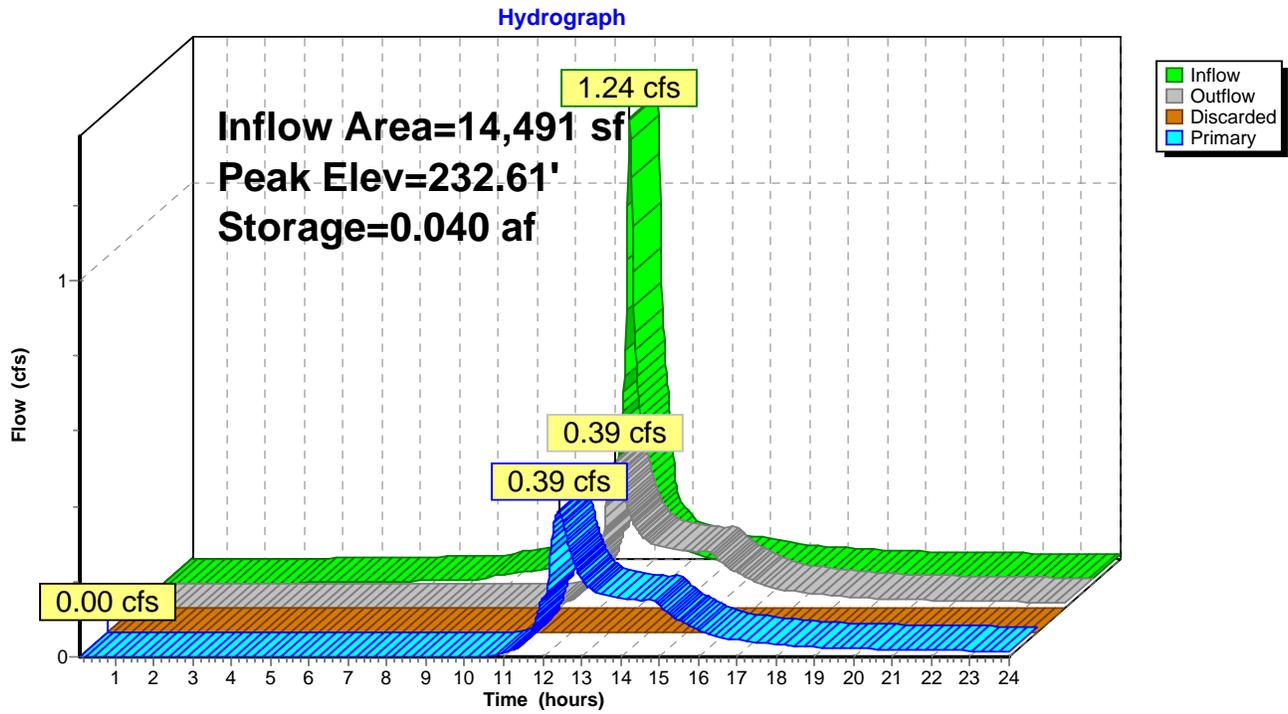
20 Chambers

73.7 cy Field

53.3 cy Stone



Pond C1: Northeast Cultecs



Summary for Pond C2: Intermediate Cultecs

Inflow Area = 17,721 sf, 82.53% Impervious, Inflow Depth > 3.18" for 10 year event
 Inflow = 0.49 cfs @ 12.34 hrs, Volume= 4,692 cf
 Outflow = 0.41 cfs @ 12.52 hrs, Volume= 4,691 cf, Atten= 17%, Lag= 10.4 min
 Discarded = 0.07 cfs @ 12.55 hrs, Volume= 2,506 cf
 Primary = 0.34 cfs @ 12.52 hrs, Volume= 2,185 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 231.11' @ 12.55 hrs Surf.Area= 392 sf Storage= 536 cf
 Flood Elev= 233.94' Surf.Area= 392 sf Storage= 950 cf

Plug-Flow detention time= 32.2 min calculated for 4,691 cf (100% of inflow)
 Center-of-Mass det. time= 32.1 min (881.1 - 849.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	228.78'	447 cf	16.00'W x 24.50'L x 4.54'H Field A 1,780 cf Overall - 503 cf Embedded = 1,277 cf x 35.0% Voids
#2A	229.78'	503 cf	Cultec R-330XLHD x 9 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		950 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	228.78'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'
#2	Primary	230.00'	8.0" Round Culvert L= 10.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.00' / 230.00' S= 0.0000 1/ S= 0.0000 1/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.07 cfs @ 12.55 hrs HW=231.11' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.34 cfs @ 12.52 hrs HW=231.10' TW=231.04' (Dynamic Tailwater)

↑**2=Culvert** (Inlet Controls 0.34 cfs @ 0.98 fps)

Pond C2: Intermediate Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length

3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width

12.0" Base + 30.5" Chamber Height + 12.0" Cover = 4.54' Field Height

9 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 502.9 cf Chamber Storage

1,780.3 cf Field - 502.9 cf Chambers = 1,277.4 cf Stone x 35.0% Voids = 447.1 cf Stone Storage

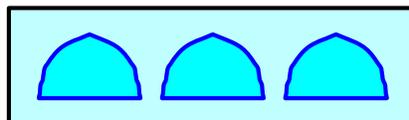
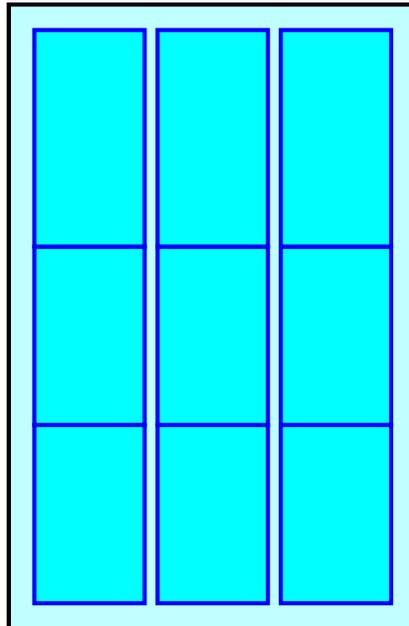
Chamber Storage + Stone Storage = 950.0 cf = 0.022 af

Overall Storage Efficiency = 53.4%

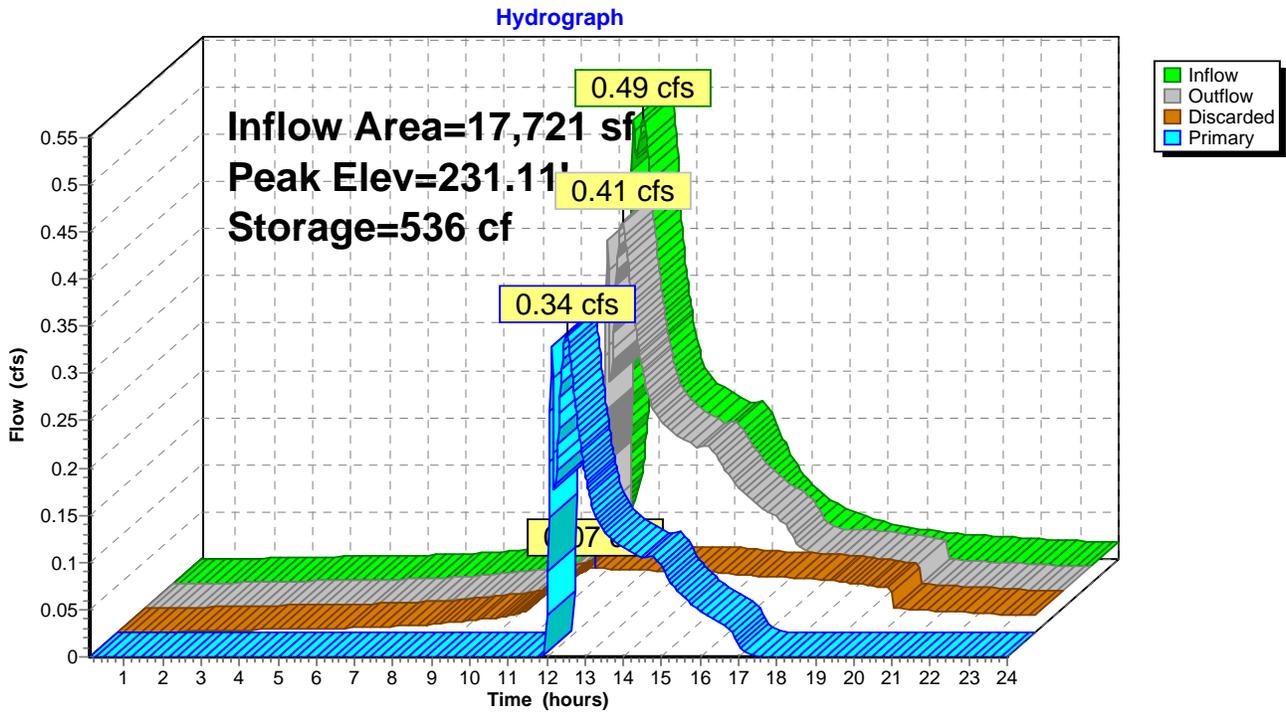
9 Chambers

65.9 cy Field

47.3 cy Stone



Pond C2: Intermediate Cultecs



Summary for Pond C3: Southwest Cultecs

Inflow Area = 24,430 sf, 87.33% Impervious, Inflow Depth > 2.03" for 10 year event
 Inflow = 0.94 cfs @ 12.11 hrs, Volume= 4,127 cf
 Outflow = 0.44 cfs @ 12.56 hrs, Volume= 4,127 cf, Atten= 53%, Lag= 26.6 min
 Discarded = 0.13 cfs @ 12.56 hrs, Volume= 3,228 cf
 Primary = 0.31 cfs @ 12.56 hrs, Volume= 900 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 231.04' @ 12.56 hrs Surf.Area= 0.017 ac Storage= 0.021 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 53.1 min (835.8 - 782.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	229.07'	0.003 af	6.33'W x 24.50'L x 3.71'H Field A 0.013 af Overall - 0.004 af Embedded = 0.009 af x 35.0% Voids
#2A	229.74'	0.004 af	Cultec R-330XLHD x 3 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 1 rows
#3B	229.07'	0.011 af	11.17'W x 52.50'L x 3.71'H Field B 0.050 af Overall - 0.017 af Embedded = 0.033 af x 35.0% Voids
#4B	229.74'	0.017 af	Cultec R-330XLHD x 14 Inside #3 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		0.036 af	Total Available Storage

Storage Group A created with Chamber Wizard
 Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	229.07'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'
#2	Primary	230.68'	8.0" Round Culvert L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.68' / 230.48' S= 0.0100 1/ Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.13 cfs @ 12.56 hrs HW=231.04' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.13 cfs)

Primary OutFlow Max=0.31 cfs @ 12.56 hrs HW=231.04' TW=0.00' (Dynamic Tailwater)

↑**2=Culvert** (Inlet Controls 0.31 cfs @ 1.62 fps)

Pond C3: Southwest Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length

1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width

8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

3 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 167.6 cf Chamber Storage

575.4 cf Field - 167.6 cf Chambers = 407.8 cf Stone x 35.0% Voids = 142.7 cf Stone Storage

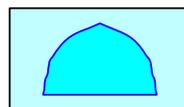
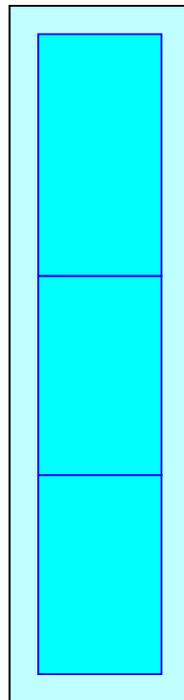
Chamber Storage + Stone Storage = 310.4 cf = 0.007 af

Overall Storage Efficiency = 53.9%

3 Chambers

21.3 cy Field

15.1 cy Stone



Pond C3: Southwest Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf

Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap

Row Length Adjustment= +1.50' x 7.45 sf x 2 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length

2 Rows x 52.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.17' Base Width

8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

14 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 2 Rows = 752.6 cf Chamber Storage

2,174.0 cf Field - 752.6 cf Chambers = 1,421.5 cf Stone x 35.0% Voids = 497.5 cf Stone Storage

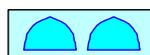
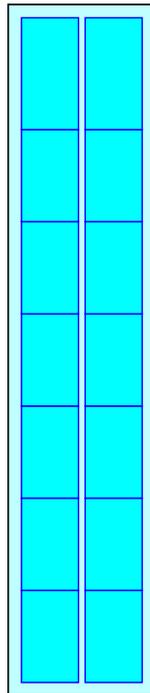
Chamber Storage + Stone Storage = 1,250.1 cf = 0.029 af

Overall Storage Efficiency = 57.5%

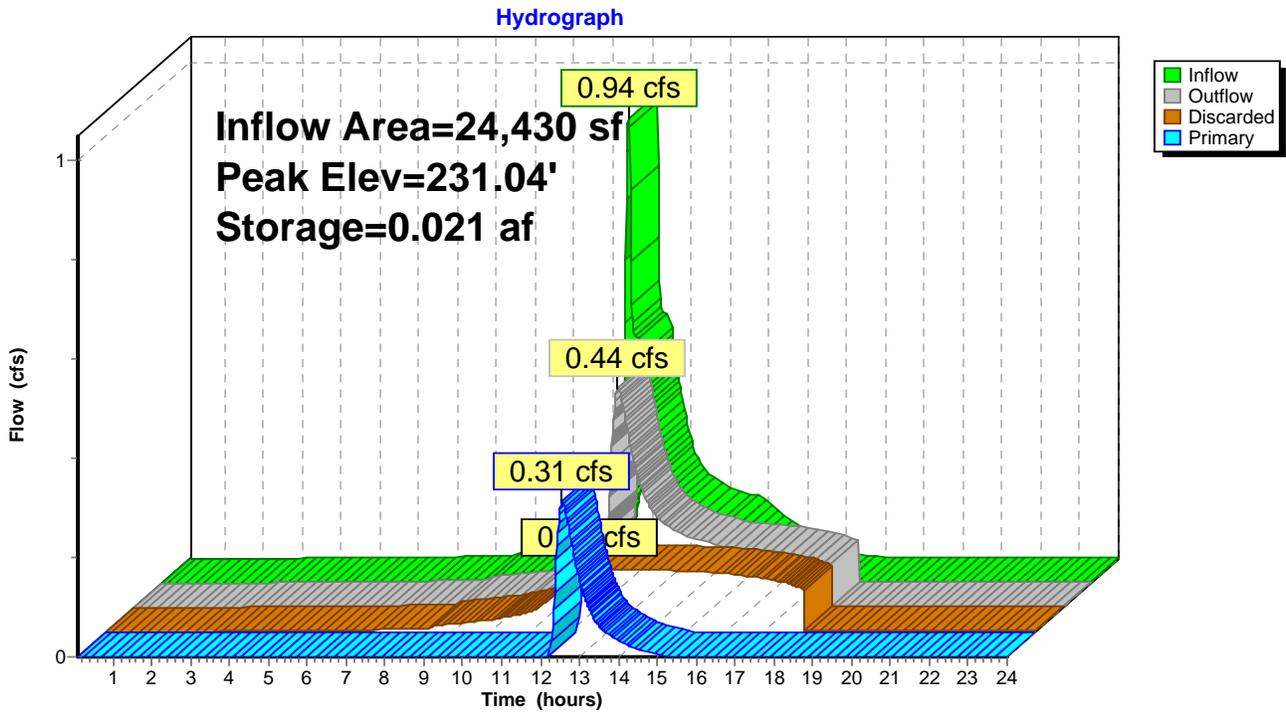
14 Chambers

80.5 cy Field

52.6 cy Stone



Pond C3: Southwest Cultecs



Summary for Pond CB1: Catch Basin #1

Inflow Area = 10,259 sf, 69.83% Impervious, Inflow Depth > 2.97" for 10 year event
 Inflow = 0.81 cfs @ 12.09 hrs, Volume= 2,539 cf
 Outflow = 0.81 cfs @ 12.10 hrs, Volume= 2,519 cf, Atten= 1%, Lag= 0.6 min
 Primary = 0.81 cfs @ 12.10 hrs, Volume= 2,519 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 234.37' @ 12.10 hrs Surf.Area= 13 sf Storage= 37 cf

Plug-Flow detention time= 7.7 min calculated for 2,517 cf (99% of inflow)
 Center-of-Mass det. time= 3.0 min (813.4 - 810.4)

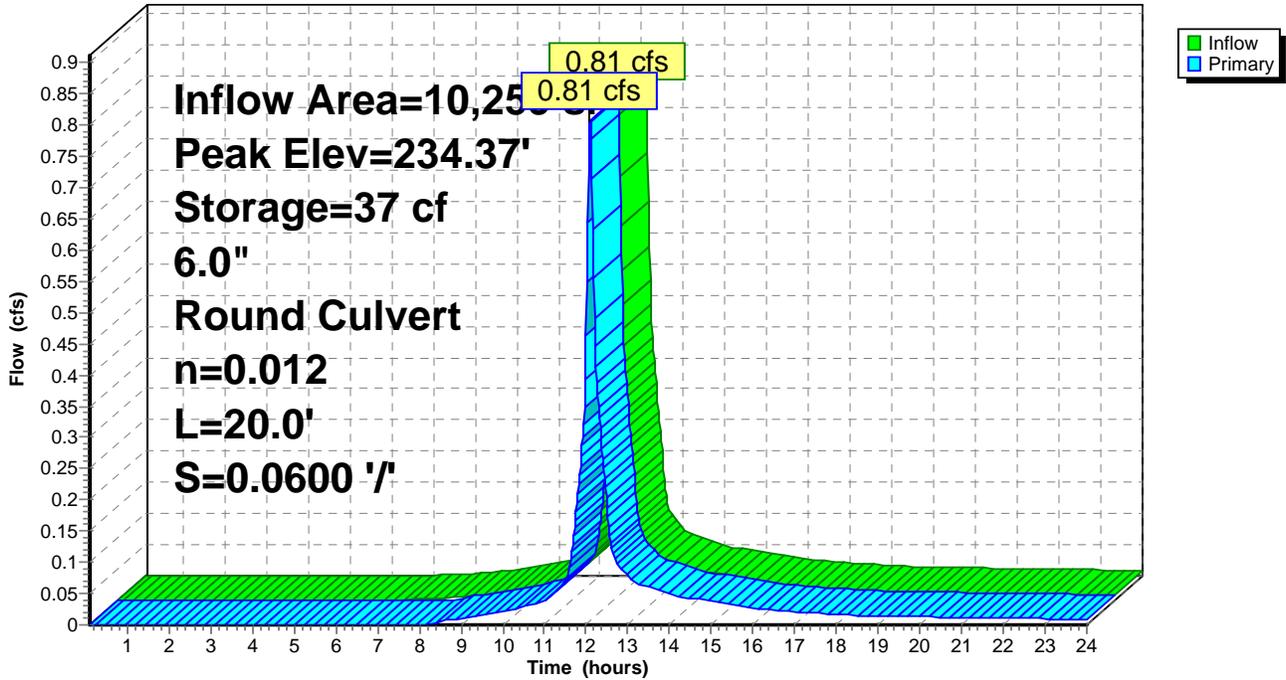
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	464 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	3,335	419	464

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0600 ' / Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.81 cfs @ 12.10 hrs HW=234.36' TW=232.30' (Dynamic Tailwater)
 ↑1=Culvert (Inlet Controls 0.81 cfs @ 4.10 fps)

Pond CB1: Catch Basin #1

Hydrograph



Summary for Pond CB2: Catch Basin #2

Inflow Area = 4,232 sf, 100.00% Impervious, Inflow Depth > 4.33" for 10 year event
 Inflow = 0.43 cfs @ 12.08 hrs, Volume= 1,527 cf
 Outflow = 0.43 cfs @ 12.09 hrs, Volume= 1,508 cf, Atten= 0%, Lag= 0.3 min
 Primary = 0.43 cfs @ 12.09 hrs, Volume= 1,508 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 233.54' @ 12.09 hrs Surf.Area= 13 sf Storage= 26 cf

Plug-Flow detention time= 16.2 min calculated for 1,508 cf (99% of inflow)
 Center-of-Mass det. time= 7.9 min (756.9 - 749.0)

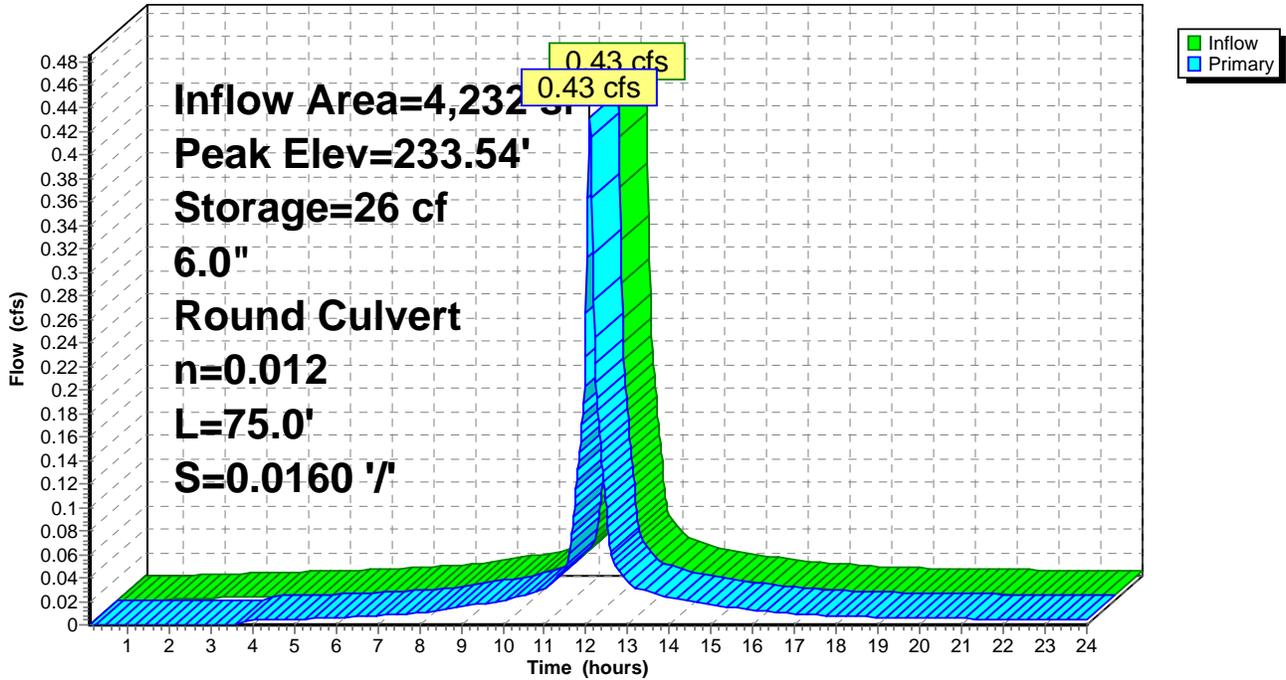
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	258 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,690	213	258

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 75.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 231.75' S= 0.0160 ' S= 0.0160 ' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.43 cfs @ 12.09 hrs HW=233.53' TW=232.28' (Dynamic Tailwater)
 ↑1=Culvert (Inlet Controls 0.43 cfs @ 2.19 fps)

Pond CB2: Catch Basin #2

Hydrograph



Summary for Pond CB3: Catch Basin #3

Inflow Area = 3,960 sf, 100.00% Impervious, Inflow Depth > 4.33" for 10 year event
 Inflow = 0.41 cfs @ 12.08 hrs, Volume= 1,429 cf
 Outflow = 0.40 cfs @ 12.09 hrs, Volume= 1,410 cf, Atten= 0%, Lag= 0.3 min
 Primary = 0.40 cfs @ 12.09 hrs, Volume= 1,410 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 233.49' @ 12.09 hrs Surf.Area= 13 sf Storage= 26 cf

Plug-Flow detention time= 17.3 min calculated for 1,410 cf (99% of inflow)
 Center-of-Mass det. time= 8.4 min (757.4 - 749.0)

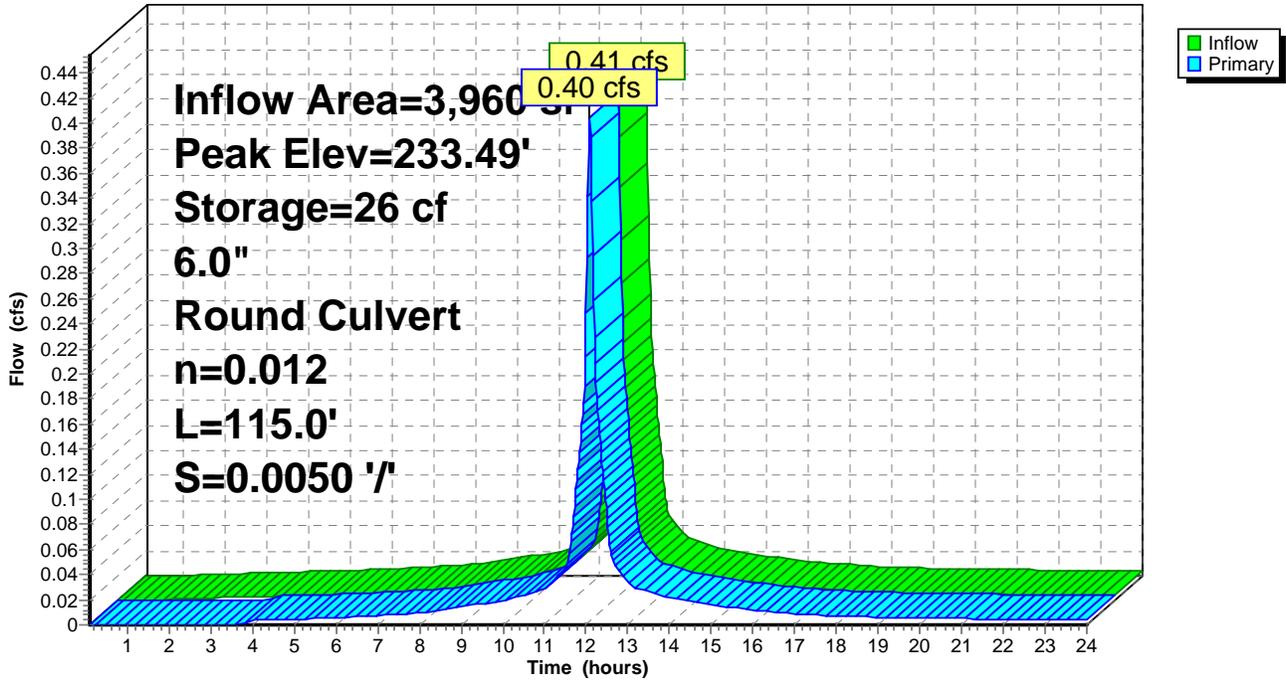
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	293 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,963	247	293

Device	Routing	Invert	Outlet Devices
#1	Primary	232.95'	6.0" Round Culvert L= 115.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 232.95' / 232.38' S= 0.0050 ' / ' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf

Primary OutFlow Max=0.40 cfs @ 12.09 hrs HW=233.49' TW=231.77' (Dynamic Tailwater)
 ↑1=Culvert (Inlet Controls 0.40 cfs @ 2.04 fps)

Pond CB3: Catch Basin #3

Hydrograph



Summary for Pond D1: Drywell

Inflow Area = 3,960 sf, 100.00% Impervious, Inflow Depth > 4.27" for 10 year event
 Inflow = 0.40 cfs @ 12.09 hrs, Volume= 1,410 cf
 Outflow = 0.40 cfs @ 12.10 hrs, Volume= 1,403 cf, Atten= 0%, Lag= 0.5 min
 Discarded = 0.01 cfs @ 12.10 hrs, Volume= 453 cf
 Primary = 0.39 cfs @ 12.10 hrs, Volume= 949 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
 Peak Elev= 231.78' @ 12.10 hrs Surf.Area= 33 sf Storage= 38 cf

Plug-Flow detention time= 17.8 min calculated for 1,401 cf (99% of inflow)
 Center-of-Mass det. time= 14.4 min (771.8 - 757.4)

Volume	Invert	Avail.Storage	Storage Description
#1	230.00'	98 cf	5.00'D x 5.00'H Vertical Cone/Cylinder Inside #2 141 cf Overall - 6.0" Wall Thickness = 98 cf
#2	230.00'	9 cf	6.50'D x 5.00'H Vertical Cone/Cylinder 166 cf Overall - 141 cf Embedded = 25 cf x 35.0% Voids
		107 cf	Total Available Storage

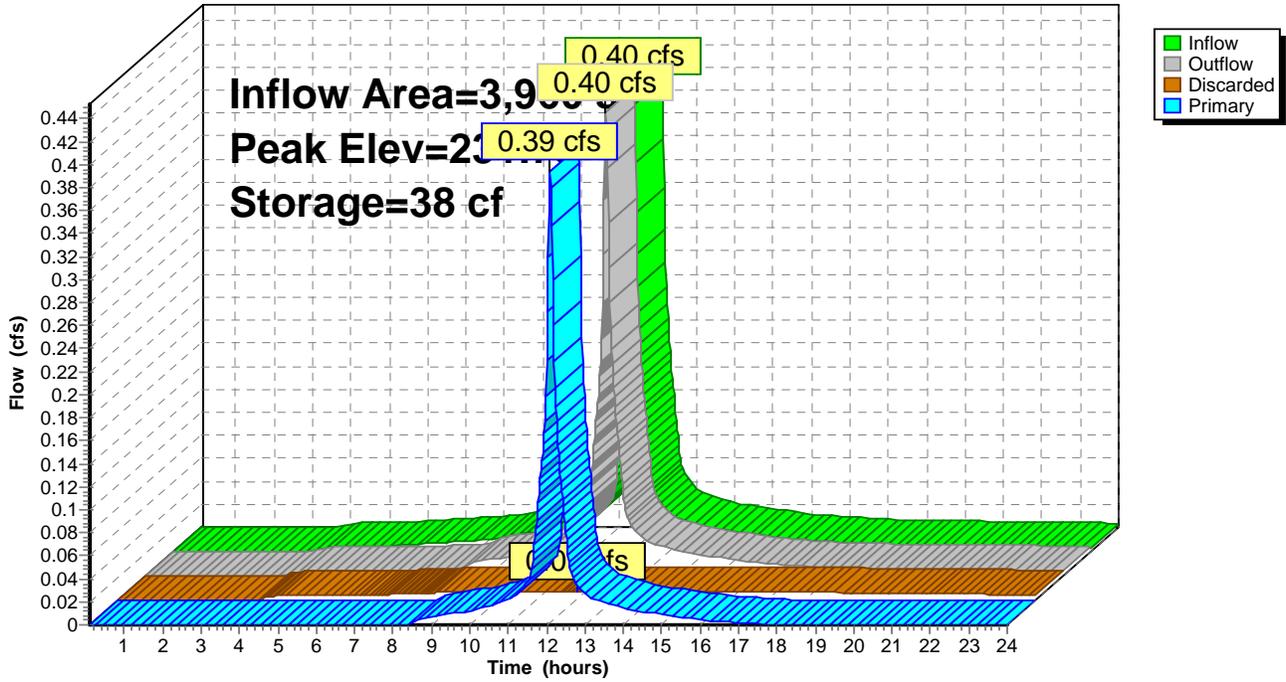
Device	Routing	Invert	Outlet Devices
#1	Primary	231.25'	6.0" Round Culvert L= 5.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 231.25' / 231.00' S= 0.0500 '/ Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Discarded	230.00'	5.100 in/hr Exfiltration over Wetted area Phase-In= 0.01'

Discarded OutFlow Max=0.01 cfs @ 12.10 hrs HW=231.78' (Free Discharge)
 ↳ **2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.39 cfs @ 12.10 hrs HW=231.78' TW=230.09' (Dynamic Tailwater)
 ↳ **1=Culvert** (Inlet Controls 0.39 cfs @ 2.00 fps)

Pond D1: Drywell

Hydrograph



Time span=0.10-24.00 hrs, dt=0.02 hrs, 1196 points x 3
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Roof Drain South West Runoff Area=2,749 sf 100.00% Impervious Runoff Depth>7.88"
Flow Length=50' Slope=0.1300 '/ Tc=6.0 min CN=98 Runoff=0.50 cfs 1,806 cf

Subcatchment 2S: Roof Drain North Side Runoff Area=3,230 sf 100.00% Impervious Runoff Depth>7.88"
Flow Length=50' Slope=0.1300 '/ Tc=6.0 min CN=98 Runoff=0.59 cfs 2,122 cf

Subcatchment 3S: Upper Paved Area Runoff Area=10,259 sf 69.83% Impervious Runoff Depth>6.33"
Tc=6.0 min CN=85 Runoff=1.68 cfs 5,414 cf

Subcatchment 4S: Middle Paved Area & Runoff Area=4,232 sf 100.00% Impervious Runoff Depth>7.88"
Tc=6.0 min CN=98 Runoff=0.77 cfs 2,781 cf

Subcatchment 5S: Lower Paved Area Runoff Area=3,960 sf 100.00% Impervious Runoff Depth>7.88"
Tc=6.0 min CN=98 Runoff=0.72 cfs 2,602 cf

Subcatchment 6S: Remaining Project Area Runoff Area=217,642 sf 3.80% Impervious Runoff Depth>2.21"
Flow Length=562' Tc=15.9 min CN=49 Runoff=8.66 cfs 40,137 cf

Subcatchment EX: Existing Site Runoff Area=242,195 sf 7.17% Impervious Runoff Depth>2.32"
Flow Length=562' Tc=15.9 min CN=50 Runoff=10.24 cfs 46,812 cf

Reach END: Proposed Site Runoff Inflow=10.04 cfs 45,495 cf
Outflow=10.04 cfs 45,495 cf

Pond C1: Northeast Cultecs Peak Elev=233.61' Storage=0.061 af Inflow=1.79 cfs 8,155 cf
Discarded=0.00 cfs 0 cf Primary=1.03 cfs 7,604 cf Outflow=1.03 cfs 7,604 cf

Pond C2: Intermediate Cultecs Peak Elev=232.78' Storage=876 cf Inflow=1.46 cfs 9,726 cf
Discarded=0.08 cfs 3,498 cf Primary=1.12 cfs 6,227 cf Outflow=1.20 cfs 9,725 cf

Pond C3: Southwest Cultecs Peak Elev=232.11' Storage=0.032 af Inflow=1.96 cfs 10,050 cf
Discarded=0.16 cfs 4,692 cf Primary=1.39 cfs 5,358 cf Outflow=1.55 cfs 10,050 cf

Pond CB1: Catch Basin #1 Peak Elev=235.19' Storage=296 cf Inflow=1.68 cfs 5,414 cf
6.0" Round Culvert n=0.012 L=20.0' S=0.0600 '/ Outflow=1.06 cfs 5,394 cf

Pond CB2: Catch Basin #2 Peak Elev=234.51' Storage=39 cf Inflow=0.77 cfs 2,781 cf
6.0" Round Culvert n=0.012 L=75.0' S=0.0160 '/ Outflow=0.75 cfs 2,761 cf

Pond CB3: Catch Basin #3 Peak Elev=234.82' Storage=43 cf Inflow=0.72 cfs 2,602 cf
6.0" Round Culvert n=0.012 L=115.0' S=0.0050 '/ Outflow=0.71 cfs 2,582 cf

Pond D1: Drywell Peak Elev=232.46' Storage=53 cf Inflow=0.71 cfs 2,582 cf
Discarded=0.01 cfs 539 cf Primary=0.68 cfs 2,017 cf Outflow=0.69 cfs 2,556 cf

Total Runoff Area = 484,267 sf Runoff Volume = 101,675 cf Average Runoff Depth = 2.52"
90.30% Pervious = 437,284 sf 9.70% Impervious = 46,983 sf

Summary for Subcatchment 1S: Roof Drain South West Side

Runoff = 0.50 cfs @ 12.08 hrs, Volume= 1,806 cf, Depth> 7.88"

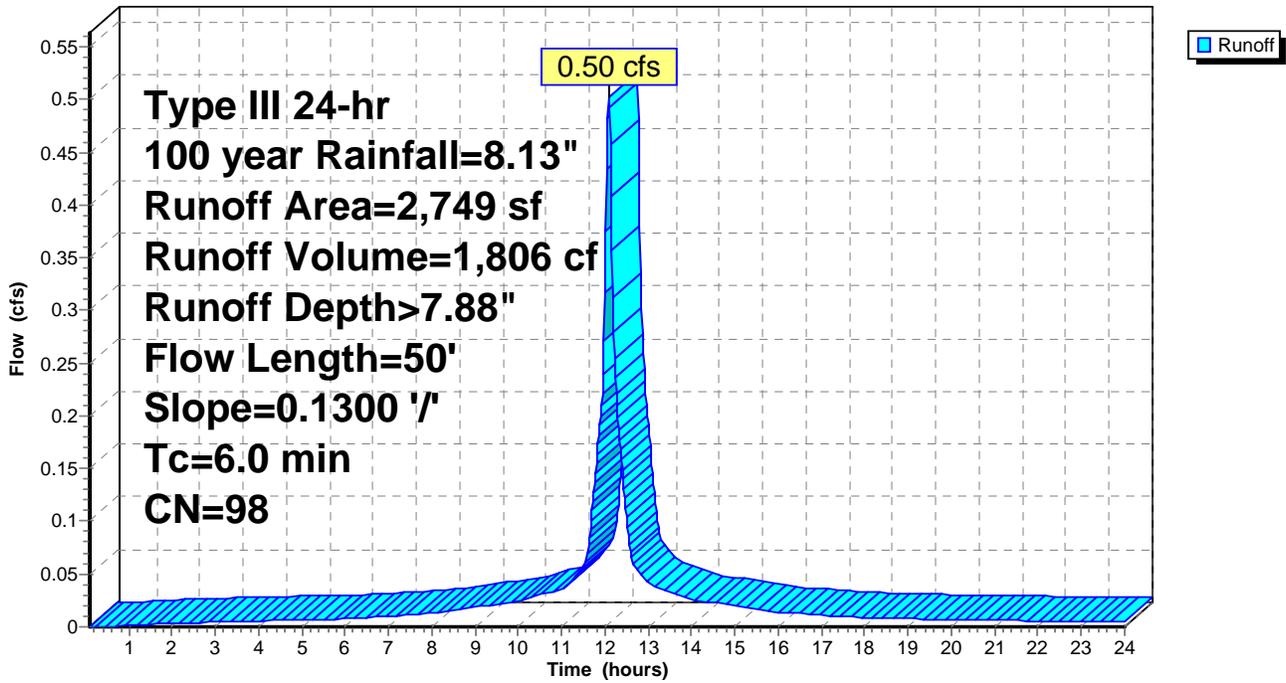
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
2,749	98	Roofs, HSG A
2,749		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 1S: Roof Drain South West Side

Hydrograph



Summary for Subcatchment 2S: Roof Drain North Side

Runoff = 0.59 cfs @ 12.08 hrs, Volume= 2,122 cf, Depth> 7.88"

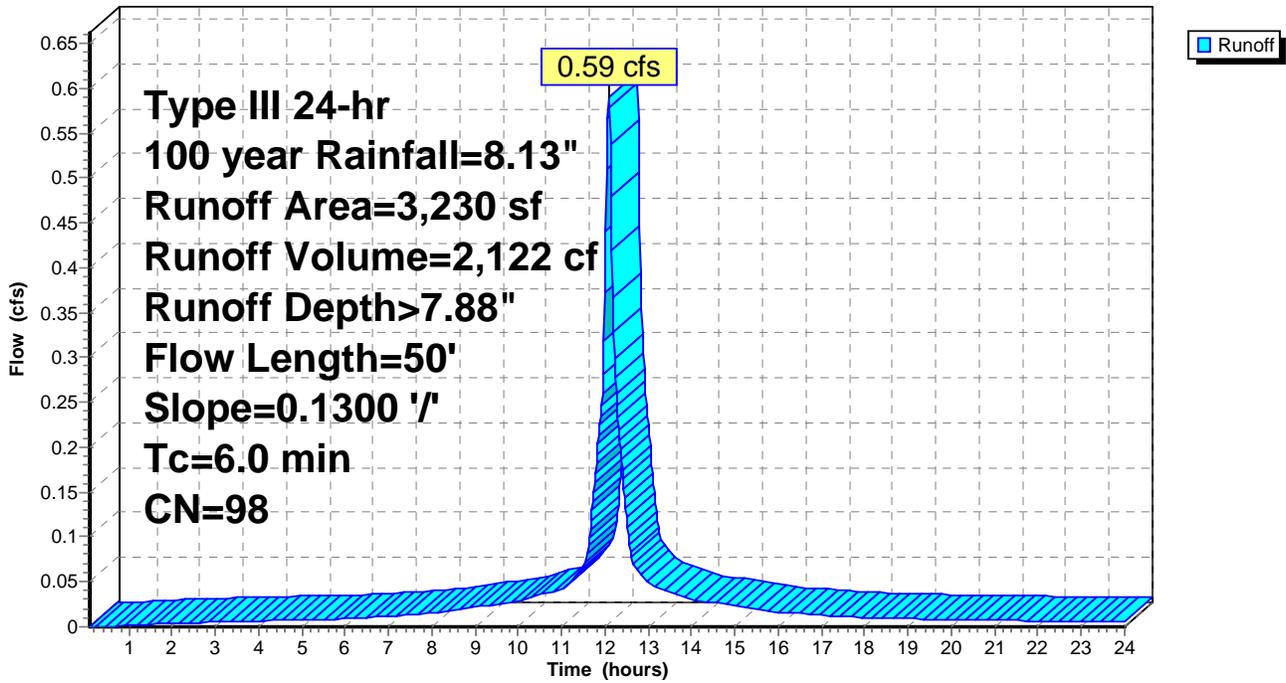
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
3,230	98	Roofs, HSG A
3,230		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.1300	0.14		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"

Subcatchment 2S: Roof Drain North Side

Hydrograph



Summary for Subcatchment 3S: Upper Paved Area

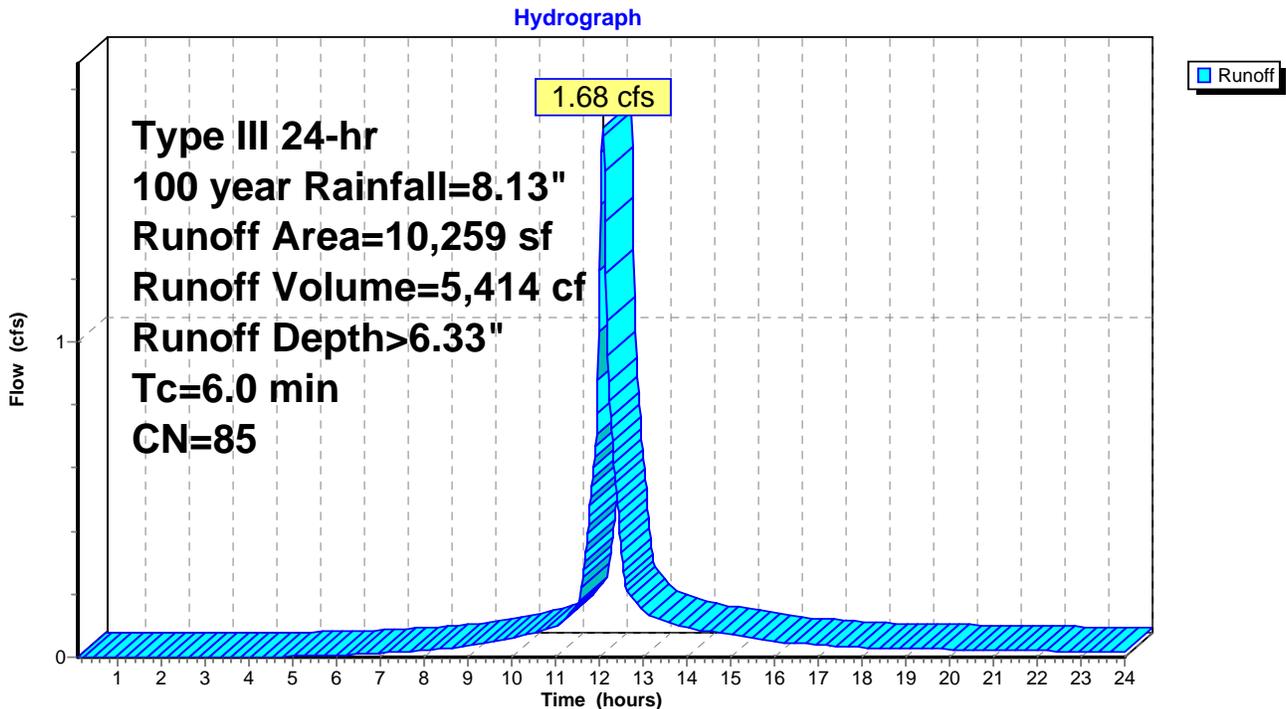
Runoff = 1.68 cfs @ 12.09 hrs, Volume= 5,414 cf, Depth> 6.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
7,164	98	Paved parking, HSG A
1,956	49	50-75% Grass cover, Fair, HSG A
441	49	50-75% Grass cover, Fair, HSG A
* 698	76	Gravel roads, HSG A (rip rap)
10,259	85	Weighted Average
3,095		30.17% Pervious Area
7,164		69.83% Impervious Area

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

Subcatchment 3S: Upper Paved Area



Summary for Subcatchment 4S: Middle Paved Area & Eastern Roof

Runoff = 0.77 cfs @ 12.08 hrs, Volume= 2,781 cf, Depth> 7.88"

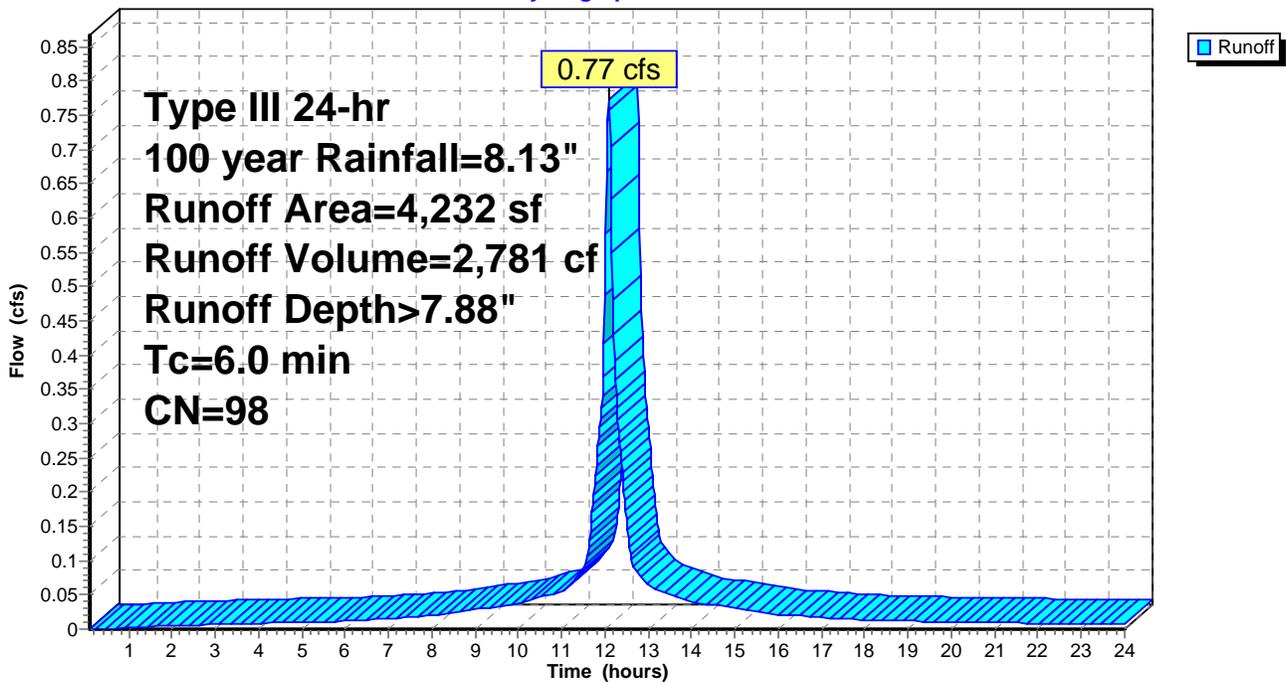
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
 Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
2,572	98	Paved parking, HSG A
1,660	98	Roofs, HSG A
4,232	98	Weighted Average
4,232		100.00% Impervious Area

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

Subcatchment 4S: Middle Paved Area & Eastern Roof

Hydrograph



Summary for Subcatchment 5S: Lower Paved Area

Runoff = 0.72 cfs @ 12.08 hrs, Volume= 2,602 cf, Depth> 7.88"

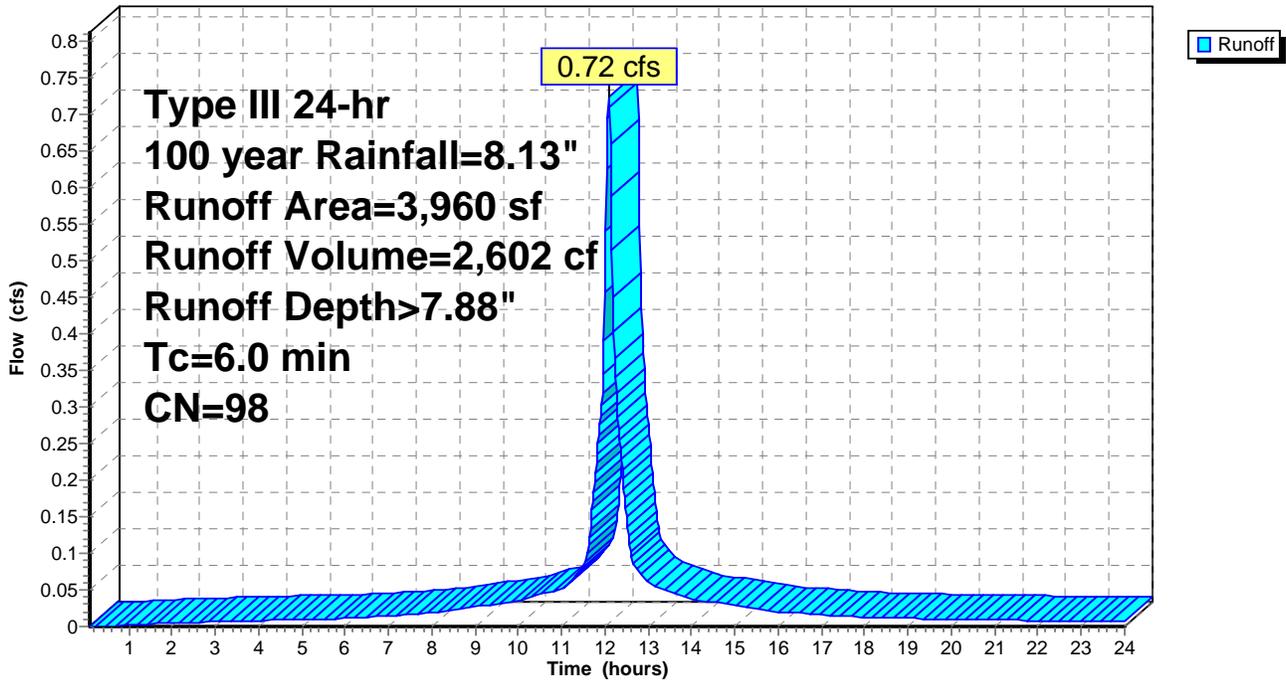
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
 Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
3,960	98	Paved parking, HSG A
3,960		100.00% Impervious Area

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

Subcatchment 5S: Lower Paved Area

Hydrograph



Summary for Subcatchment 6S: Remaining Project Area

Runoff = 8.66 cfs @ 12.24 hrs, Volume= 40,137 cf, Depth> 2.21"

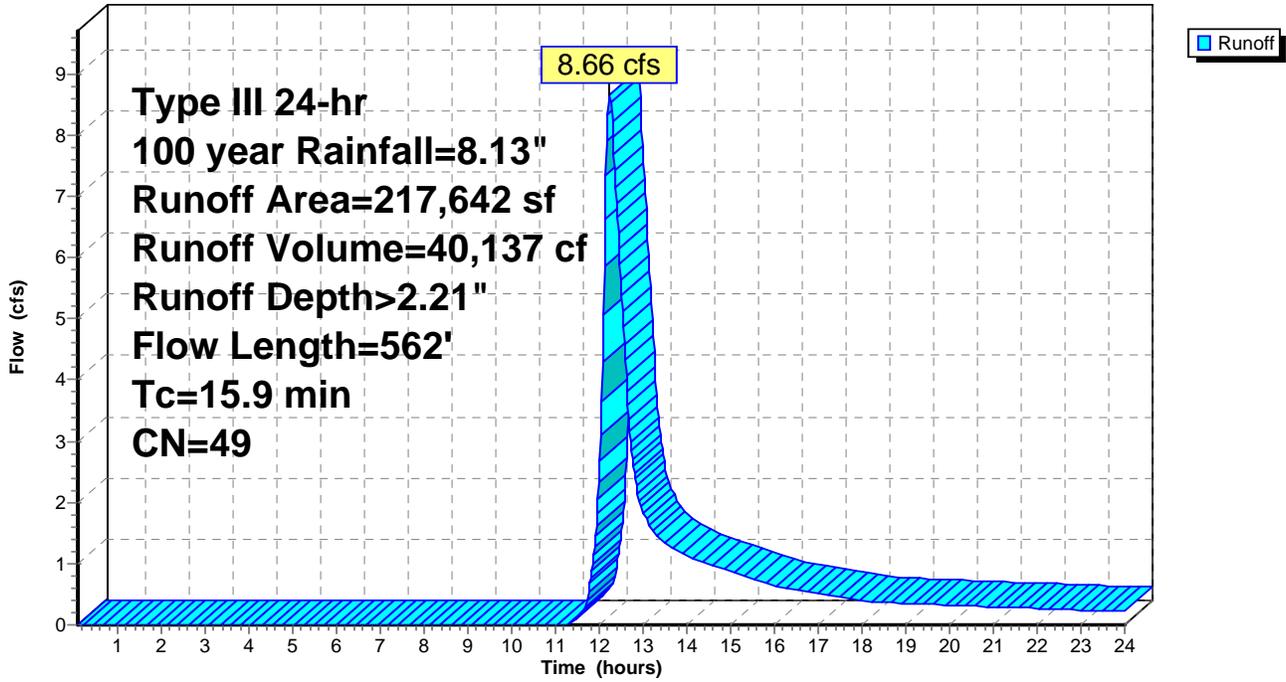
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
2,763	49	50-75% Grass cover, Fair, HSG A
9,597	76	Gravel roads, HSG A
8,274	98	Paved parking, HSG A
7,927	49	50-75% Grass cover, Fair, HSG A
27,757	78	Meadow, non-grazed, HSG D
28,946	77	Woods, Good, HSG D
78,485	30	Woods, Good, HSG A
39,143	30	Meadow, non-grazed, HSG A
11,968	30	Woods, Good, HSG A
* 2,782	76	Gravel roads, HSG A (RIP RAP)
217,642	49	Weighted Average
209,368		96.20% Pervious Area
8,274		3.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods pre grass strip Woodland Kv= 5.0 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strips (both) Short Grass Pasture Kv= 7.0 fps
0.0	12	0.0833	5.86		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			

Subcatchment 6S: Remaining Project Area

Hydrograph



Summary for Subcatchment EX: Existing Site

Runoff = 10.24 cfs @ 12.24 hrs, Volume= 46,812 cf, Depth> 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
11,475	49	50-75% Grass cover, Fair, HSG A
3,181	76	Gravel roads, HSG A
17,374	98	Paved parking, HSG A
4,242	49	50-75% Grass cover, Fair, HSG A
8,728	49	50-75% Grass cover, Fair, HSG A
* 3,480	76	Gravel roads, HSG A (RIP RAP)
59,405	77	Woods, Good, HSG D
82,915	30	Woods, Good, HSG A
9,737	30	Woods, Good, HSG A
41,658	30	Woods, Good, HSG A
242,195	50	Weighted Average
224,821		92.83% Pervious Area
17,374		7.17% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		Sheet Flow, sheet flow Woods: Light underbrush n= 0.400 P2= 3.06"
0.3	36	0.1676	2.05		Shallow Concentrated Flow, woods Woodland Kv= 5.0 fps
0.0	12	0.1000	6.42		Shallow Concentrated Flow, pavement Paved Kv= 20.3 fps
0.1	10	0.1000	2.21		Shallow Concentrated Flow, grass strip (both) Short Grass Pasture Kv= 7.0 fps
6.7	440	0.0480	1.10		Shallow Concentrated Flow, rip rap Woodland Kv= 5.0 fps
0.1	14	0.1667	2.86		Shallow Concentrated Flow, final grass strip Short Grass Pasture Kv= 7.0 fps
15.9	562	Total			