STORMWATER MANAGEMENT REPORT

PROJECT SITE:
SHINGLEMILL APARTMENTS
75-79 POND STREET
ROCKLAND, MASSACHUSETTS 02370

PREPARED FOR:
SHINGLEMILL, LLC
4 FIRST STREET
BRIDGEWATER, MASSACHUSETTS 02324

PREPARED BY:

CONECO
Engineers & Scientists

4 First Street • Bridgewater, Massachusetts 02324

Phone: (508) 697-3191 • Fax: (508) 697-5996
E-mail: DDmitruk@coneco.com

FEBRUARY 14, 2022
Revised September 23, 2022

TABLE OF CONTENTS

MASSACHUSETTS DEP CHECKLIST FOR STORMWATER REPORT

INTRODUCTION

STORMWATER MANAGEMENT SYSTEM OVERVIEW

METHODOLOGY

EXISTING CONDITIONS

Table 1 Existing Soil Classifications

PROPOSED CONDITIONS

STORMWATER MANAGEMENT STANDARDS REVIEW

Table 2 Total Suspended Solids Removal

Table 3 Vernal Pool Volume Comparisons

CONCLUSION/SUMMARY

LIST OF FIGURES

Figure 1 Aerial Map

Figure 2 USGS Topographic Map

Figure 3 Flood Insurance Rate Map

Figure 4 Natural Heritage Map

Figure 5 Critical Areas

Figure 6 Soil Survey Map

Figure 7 Existing Drainage Areas

Figure 8 Proposed Drainage Areas

APPENDIX A – EXISTING HYDROLOGICAL CONDITIONS

HydroCAD Analysis Printouts for 2-yr, 10-yr, 25-yr, & 100-yr Storm Events

APPENDIX B – PROPOSED HYDROLOGICAL CONDITIONS

HydroCAD Analysis Printouts for 2-yr, 10-yr, 25-yr & 100-yr Storm Events

APPENDIX C – DRAINAGE SYSTEM CALCULATIONS

APPENDIX D – LONG TERM POLLUTION PREVENTION PLAN

APPENDIX E – OPERATION AND MAINTENANCE PLAN AND LOG

APPENDIX F – SOIL LOGS

APPENDIX G – ILLICIT DISCHARGE COMPLIANCE STATEMENT

APPENDIX H – STORMCEPTOR SIZING REPORTS AND OWNERS MANUAL

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

Checklist for Stormwater Report

A. Introduction

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

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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

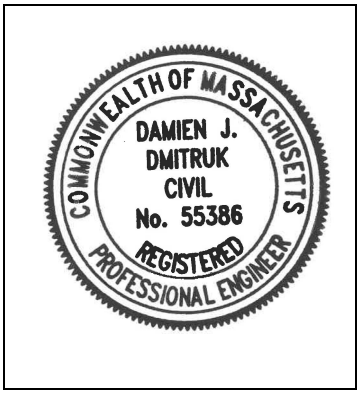
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



9/23/2022

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): _____

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

INTRODUCTION

Coneco Engineers & Scientists, Incorporated (Coneco) has completed a drainage analysis of the subject property, located at 0 Pond Street in Rockland, Massachusetts, the results of which are contained herein. The purpose of this analysis is to quantitatively understand the impacts of the proposed development of the subject property on the existing hydrologic conditions, and to mitigate any impacts through the implementation of a stormwater management system utilizing best management practices supported by an Operations and Maintenance Plan and a Long-Term Pollution Prevention Plan.

DEVELOPMENT SUMMARY

The proposed development consists of the construction of two residential apartment buildings, ancillary parking areas, pedestrian walkways, landscaping, utilities, and stormwater management system. This project is being filed under the Chapter 40B Comprehensive Permit process and will comply with the Massachusetts Department of Environmental Stormwater Management Standards.

STORMWATER MANAGEMENT SYSTEM OVERVIEW

The proposed stormwater management system consists of a closed drainage system including deep sump hooded catch basins, roof leaders, underground piping, drain manholes, proprietary particle separators, underground infiltration chambers, and outlet control structures, which will work in combination to collect, control, and treat runoff discharging from the site.

Catch basin structures will include four-foot deep sumps and oil/gas separator hoods. The deep sumps are intended to remove sediment, and the hoods are intended to remove oil and gas from the stormwater prior to release. Stormwater will then travel though a system of pipes and drain manholes. The closed drainage system has been designed to accommodate a 25-year rainfall event.

Using hydrodynamic separation, proprietary particle separators will be implemented to provide additional Total Suspended Solids (TSS) removal for downstream infiltration chamber systems.

The infiltration chamber systems with isolation rows have been designed to provide water quality treatment, groundwater recharge, and attenuation of the proposed peak flow rates and volumes to that of the existing conditions or less.

The plunge pools have been designed to include flared end inlets, a depressed center, and a level outer rim. The depressed center promotes the removal of any residual sediment, while the level outer rim dissipates the energy of the stormwater by reducing flow velocities and eliminating point discharges.

METHODOLOGY

Drainage calculations were performed to demonstrate that there will be no increase in the rate of runoff from the subject site under proposed conditions. The rate of runoff is compared at a common point, referred to as the design point, for both the pre and post development conditions (or the existing and proposed condition in the case of a redevelopment project). The hydrologic and hydraulic model created to analyze the pre and post development conditions was developed using the Soil Conservation Service (SCS) Technical Release No. 20 (TR 20, SCS unit hydrograph procedures), SCS Technical Release No. 55 (TR 55, Time of Concentration (T_c) and Curve Number (CN)), and NOAA Atlas 14 (Atlas-14, rainfall intensity), and the stormwater detention facilities were modeled using the SCS Storage Indication Method.

Time of Concentration (T_c) - Time required for stormwater runoff to travel from the most hydraulically distant point in a drainage area or subcatchment to the design point. The T_c is calculated based upon slope,

distance, surface cover and type of flow. A longer time of concentration will generally result in a smaller rate of runoff.

Curve Number (CN) - Represents the amount of runoff expected from a particular segment of the drainage area. A higher curve number will be less permeable and therefore a larger rate of runoff. The CN is based upon three factors: soil type, soil cover, and cover condition. The soil type is graded A to D; A soil is the post permeable, D is the least. The soil cover (e.g. - vegetated, developed, farmland or impervious) ranges from 30-98, with more permeable soil covers having a lower value. The final factor is the condition of the vegetated soil cover (good, fair or poor), where vegetated cover in good condition is the most permeable and allows the least runoff.

The Hydrologic Soil Group (HSG) for the drainage areas was determined from the Soil Conservation Service Soil Survey of Plymouth, Massachusetts. The soil survey contains maps which depict the extent of the various soil types. A soil type overlay plan is attached as Figure 6.

Design Software - To assist in the analysis, software entitled HydroCAD, Version 10.0 (developed by HydroCAD Software Solutions, L.L.C.) was utilized. The HydroCAD program calculates the runoff based on rainfall events and watershed characteristics, and produces a runoff hydrograph (a runoff rate versus time curve). If applicable, stage-storage-discharge curves for a specific detention facility are calculated.

Peak Attenuation - The peak rate of runoff at the design points was calculated for the existing and proposed conditions for the 2, 10, 25, and 100-year, 24-hour storm events. The peak rate of runoff was compared for each storm event to determine if there was an increase from the pre to post development condition.

Runoff Volume - The total volume of runoff for the entire site was calculated for the existing and proposed conditions for the 2, 10, 25, and 100-year, 24-hour storm events. The volume of runoff was compared for each storm event to determine if there was an increase from the pre to post development condition.

EXISTING CONDITIONS

Coneco delineated the existing drainage areas from an existing topographic survey. A site visit was conducted to evaluate the existing drainage patterns and watershed areas for the site and surrounding areas. The site is located on the southwest side of Pond Street in Rockland, Massachusetts. The property consists of mostly wetlands which surround an undeveloped upland area. The upland area is mostly wooded but also has some cleared and brush areas. Access paths connect the two major upland areas bisecting the wetland areas. Existing culverts provide a hydraulic connection between the wetlands beneath the upland access paths. Topography generally slopes from the upland area to the surrounding wetlands. The wetlands generally slope from the northeast, discharging flows along southwestern edge of the property. Grades range from approximately 0.5 to 8 percent.

The Soil Conservation Service map for the area indicates that the site is made of six soil types. Please refer to Table 1 for a summary of these soils.

Table 1

Existing Soil Classifications

SOIL MAP UNIT	*PLYMOUTH COUNTY SOIL SURVEY MAP UNIT NAME AND DESCRIPTION*	*HYDROLOGIC SOIL GROUP*
23A	Tihonet Coarse sand, 0 to 3 percent slopes	A/D
52A	Freetown muck, 0 to 1 percent slopes	B/D
427B	Newfields fine sandy loam, 3 to 8 percent slopes, extremely stony	B
619A	Deerfield-Urban land complex, 0 to 3 percent slopes	A
626B	Merrimac – Urban land complex, 0 to 8 percent slopes	A
655A	Udorthents, wet substratum, 0 to 3 percent slopes	B/D

PROPOSED CONDITIONS

The proposed development consists of two apartment buildings and neighboring recreational open space areas with associated access drives, parking areas, walkways, utilities, and drainage systems included throughout the site. These changes increase the overall impervious area found at the site. However, the proposed drainage system has been designed to capture the previously uncontrolled stormwater runoff and direct flows to storage and infiltration facilities. This results in a reduction of the peak rate of runoff. Furthermore, due to the deep sump catch basins with oil/gas hoods, proprietary separators, and infiltration facilities, the runoff from the impervious areas will undergo the required treatment prior to its discharge.

STORMWATER MANAGEMENT STANDARDS REVIEW

As part of this drainage analysis, Coneco has performed an in-depth review of the subject site for conformance with the Massachusetts Department of Environmental Protection's Stormwater Management Standards. The project is not considered a redevelopment project (as defined in Standard 7) and is therefore required to meet all of the Massachusetts Stormwater Management Standards. The following is a summary of our findings relative to our review of each of the standards. Please note that the actual text of each standard is italicized for clarity.

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

The stormwater shall be treated prior to release with deep sump catch basins with hoods, proprietary separators, and/or infiltration chamber systems. The deep sumps will provide an area for sediment to settle out and the hood will provide oil and gas separation. The proprietary separators (water quality units) will provide further treatment using hydrodynamic separation to remove pollutants before either discharging into an infiltration facility for additional treatment and groundwater recharge or, in the case of the site entrance, discharging directly to the wetlands. An isolation row will be installed at the inlet row of chambers to further filter stormwater prior to being infiltrated. Outlets from the infiltration facilities have been designed to reduce erosion and eliminate scouring within the wetland areas. A plunge pool shall be installed at each discharge point. The plunge pool will be lined with riprap and be depressed to form a pool which will enhance sediment removal prior to discharging runoff over a larger area, slowing the velocity and therefore reducing scour.

STANDARD 2: Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

The existing and proposed site conditions were analyzed for the 2, 10, 25, and 100-year 24-hour storm events using the aforementioned methodology (please refer to appendices A and B of this report for HydroCAD output support data). Due to the stormwater being captured, controlled, attenuated, and infiltrated, there is no increase in peak discharge rates or total volume for all storm events analyzed (please refer to Appendix C of this report for Peak Rate of Runoff tables).

CLOSED DRAINAGE SYSTEM CALCULATIONS

Rational Method – Sizing pipes for the 25-year storm

The Rational Method was used to calculate the peak flow through the pipes, and the Manning equation was used to determine the minimum pipe size required to pass the required flow. The closed drainage system calculations determine the rate of runoff, the time of concentration and the rainfall intensity for the drainage subcatchment. The calculations were performed for a 25-year storm event. The following standards were used:

1. The Rational Formula (Q =CIA) was used to determine the flow to each structure.

   Q = Flow cubic feet per second (CFS)
   C = Runoff coefficients
   I = Rainfall Intensity (inches per hour)
   A = Drainage Area (acres)

2. The runoff coefficients used are as follows:

   Impervious (pavement and roofs) = 0.85
   Landscaped = 0.4

3. The intensity for each area was determined by the Steel Formula for a 25-year frequency storm. The Steel Formula is:

   I = k/(t+b)
   I = Intensity
   k = 230 (25 yr)
   t = Time of Concentration
   b = 30 (25 yr)

4. The times of concentration were calculated using a spreadsheet which calculates flow time in the pipe with the Manning equation. A minimum time of concentration of six (6) minutes was utilized.

5. The Manning's formula was utilized to calculate the capacity of the individual pipes in the closed drainage system. The Manning's formula is:

   $Q = (Ap)\ (1.486/n)\ (s^{1/2})\ (h^{2/3})$
   Q = Flow in CFS
   Ap = Cross-sectional area of the pipe (square feet)
   n = Roughness coefficient
   s = slope of the pipe (ft/ft)
   h = hydraulic radius = area/wetted perimeter (sf/ft)

The closed drainage system is intended to handle the design flow as calculated, as well as maintaining a design velocity of between 2.0 feet per second (fps) and 10.0 fps. Two feet per second is considered "self-cleansing velocity" and will prevent the pipes from accumulating sediment, and ten feet per second is considered a safe maximum velocity to reduce scouring of the pipes.

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

Standard 3 requires that a certain volume of water be recharged to the site depending on existing soil types and square feet of total impervious area over each soil type. Please refer to Appendix C Stormwater Management Standard 3 - Recharge Volume for a summary of the required recharge.

In accordance with the required recharge volume calculations, the on-site infiltration system must be designed with a minimum infiltration capacity of 1,950 cubic feet. The proposed design directs 95.5% of the proposed impervious on site to recharge facilities, resulting in an adjustment factor and increasing the require recharge volume to 2,059 cf. Soils in the proposed area of the infiltration facilities are adequate for infiltration, which was confirmed with onsite soil evaluation. The bottoms of the infiltration facilities have been designed to provide four feet of separation to seasonal high groundwater elevations. Please refer to Appendix F for the test pit soil logs. The infiltration facilities as designed will provide a total static recharge volume of 11,188 cubic feet. Please refer to Appendix C for these calculations as well as 72-hour drawdown calculations.

It should be noted that the proposed Infiltration BMPs do not adversely impact nearby wetland resource areas.

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

a) Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;

b) Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and

c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

The proposed stormwater management system will achieve the 80% TSS removal requirement. Please refer to Table 2 for a TSS removal summary.

Please note that a long term pollution prevention plan has been developed as part of the analysis and can be found in Appendix D.

TREATMENT OF SUSPENDED SOLIDS:

Catch basins will be equipped with hoods and four-foot sumps to limit sediment, oils, and grease from being discharged to the drainage system.

The proprietary separators will further reduce total suspended solids (TSS) entering the infiltration facility, by the use of swirling water and baffles to remove floatables and sediments.

The inlet row of the infiltration chambers will be designed as an isolation row. The row of chambers will be wrapped in filter fabric, thus further filtering TSS from the stormwater. The isolation row is used as pretreatment to the infiltration chambers, thus allowing 80% TSS removal for the system.

Please refer to Table 2 – Total Suspended Solids Removal for this information.

Due to the site infiltration rate greater than 2.4 in/hr and the discharges to critical areas, a pretreatment requirement of 44% is necessary to receive the 80% TSS removal rate for the infiltration facilities. This requirement was met by the use of an isolation row.

Runoff from roofs will be considered clean which require no pretreatment. All other proposed impervious areas will be collected in the closed drainage system which is routed through pretreatment devices.

Due to the site conditions and constraints, the entrance access portion of the site and a minor amount of non-traffic impervious will discharge to the wetlands without entering a treatment device. These discharges are being considered as *de minimus*, and calculations have been provided in Appendix C.

Table 2

Total Suspended Solids Removal

Treatment Train 1 (Infiltration Chamber Systems A & B)

BMP	*TSS Removal Rate*	*Starting TSS Load*	*TSS Removed*	*Remaining TSS Load*
Proprietary Separator	0.80	1.00	.80	0.20
Isolation Row	0.50	0.20	Pretreatment	0.20
Subsurface Structure Infiltration Chambers	0.80	0.20	0.16	0.04
		Total Suspended Solids Removed:		**96%**

Treatment Train 2 (Infiltration Chamber System C)

BMP	*TSS Removal Rate*	*Starting TSS Load*	*TSS Removed*	*Remaining TSS Load*
Isolation Row	0.50	1.00	Pretreatment	1.00
Subsurface Structure (Infiltration Chambers)	0.80	1.00	0.80	0.20
		Total Suspended Solids Removed:		**80%**

WATER QUALITY VOLUME

Water Quality Volume(WQV) calculations must be performed per this standard based on the total site impervious area. The equation is as follows:

Water Quality Volume = Total impervious area of post-development project x 1 inch as required by the Stormwater Standards.

Water Quality Volume = 210,101 s.f. impervious area x 1.0 inches/12 inches per foot = 17,508 cubic feet

Each of the infiltration chamber systems have been sized to hold a portion of the water quality volume. See Appendix C for the required water quality volume calculations and the Simple Dynamic method sizing calculations for the infiltration BMPs.

STANDARD 5: For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

The project site is not a land use with higher potential pollutant loads, per the regulation.

STANDARD 6: Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

The project site discharges into an Outstanding Resource Water protection area. The site is not within and does not discharge near or to any other critical areas. See Figure 5, Critical Areas.

Due to the project site discharging into an Outstanding Resource Water protection area, the use of BMPs are limited to those approved by MassDEP for that protection area. In addition, the Stormwater Standards requires at least 44% TSS pretreatment prior to discharging into an infiltration facility. All infiltration chambers have been designed with an isolation row to accommodate the pretreatment requirement. The primary source of pollution for the site will be the paved roadways and parking areas, which are a necessary and integral part of the overall project. The stormwater treatment trains have been designed to meet all DEP stormwater standards.

In addition, the Table 3 compares the existing and the proposed runoff volume from the property to the existing certified vernal pool on site. As shown the proposed runoff to the vernal pool nearly matches that of the existing conditions for a 1-year 24 hour (2.78 inch) storm event. This calculation is being used to indicate that no impact to the MHW elevation within the vernal pool will occur as a result of the project. HydroCAD calculations for this analysis can be found in Appendix C of this report.

Table 3

VERNAL POOL VOLUME COMPARISON

	EXISTING CONDITIONS VOLUME (cf)	*PROPOSED CONDITIONS VOLUME (cf)*
2.78" 24-HOUR (1-YEAR)	7,596	7,601

STANDARD 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

This project is considered new development and is therefore required to fully meet all the Massachusetts Stormwater Management Standards.

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

This project will disturb more than one acre of land and will therefore be required to obtain coverage under the NPDES Construction General Permit. A Stormwater Pollution Prevention Plan (SWPPP) will be required before earth-disturbing activities commence on the project site. The SWPPP will be prepared by others per EPA NPDES NOI guidelines and submitted under a separate cover.

STANDARD 9: A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

Please refer to Appendix E for the Operation and Maintenance Plan for the proposed Stormwater Management System.

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

To our knowledge, no illicit discharges are made to the stormwater management system. An Illicit Discharge Compliance Statement is attached in Appendix G of this report.

CONCLUSION/SUMMARY:

Based on the HydroCAD analysis for the 2, 10, 25, and 100-year storm events, the peak rate of runoff and the total volume have decreased from the existing to the proposed conditions. Furthermore, effluent water quality has been enhanced and infiltration has been introduced to previously uncontrolled areas, thereby promoting/preserving the natural hydrologic conditions. In addition to these improvements, all 10 of the DEP Stormwater Standards have been met.

LIST OF FIGURES

FIGURE 1 - AERIAL MAP

FIGURE 2 - USGS TOPOGRAPHIC MAP

FIGURE 3 - FLOOD INSURANCE RATE MAP

FIGURE 4 - NATURAL HERITAGE MAP

FIGURE 5 - CRITICAL AREAS

FIGURE 6 - SOIL SURVEY MAP

FIGURE 7 - EXISTING DRAINAGE AREAS

FIGURE 8 - PROPOSED DRAINAGE AREAS

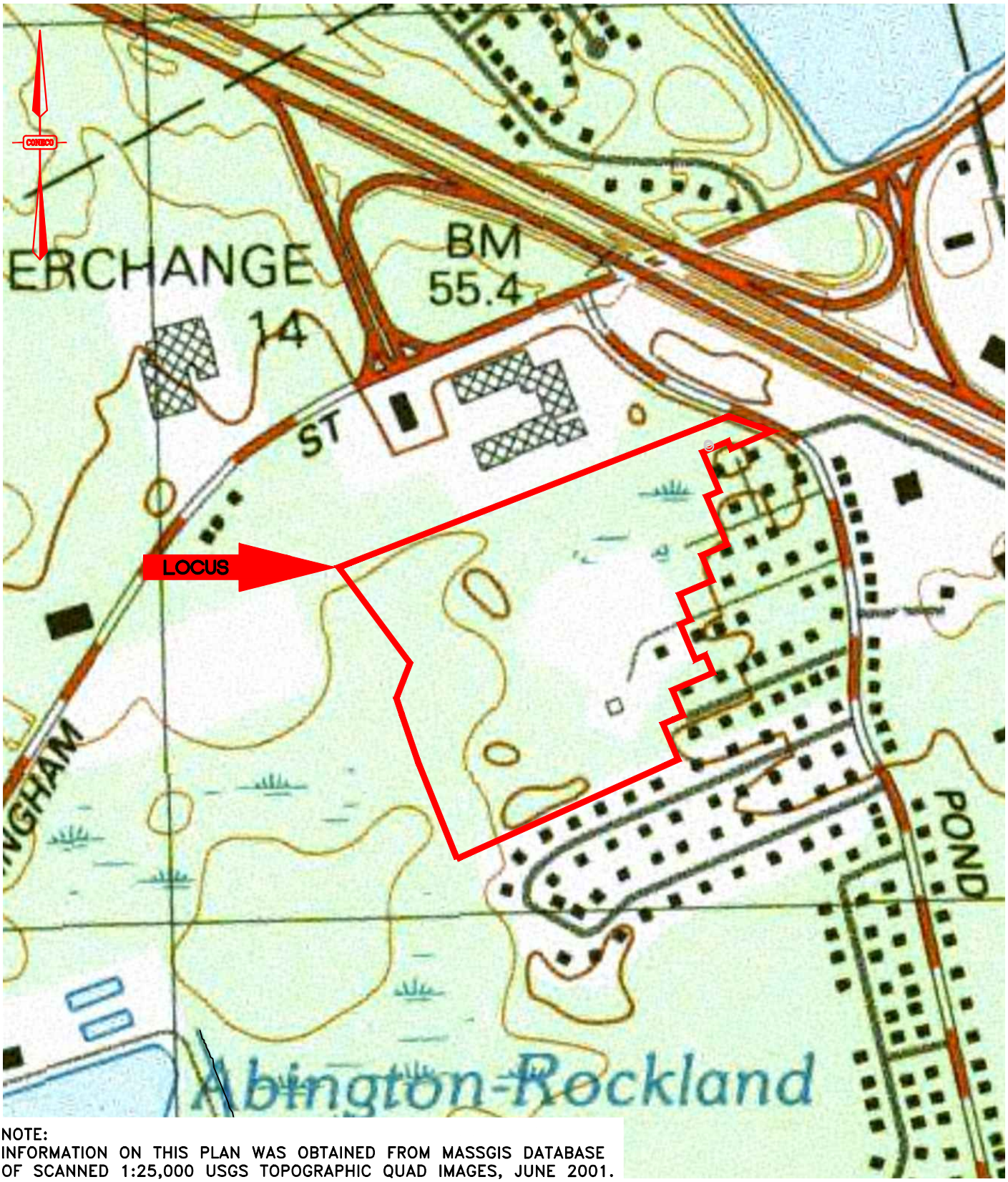
NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM MASSGIS DATABASE AERIAL PHOTOGRAPHIC IMAGES, APRIL 2008/2009.

75–79 POND STREET, ROCKLAND, MASSACHUSETTS 02370

CONECO
Engineers & Scientists
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508-697-3191 OR 800-548-3355; FAX 508-697-5996
WEBSITE: www.coneco.com

PREPARED FOR:	PLAN SET:
SHINGLEMILL, LLC	REPORT FIGURES

SCALE	DATE	PROJECT NO.	TITLE:
1" = 500'	02/14/2022	3395.1	FIGURE 1 AERIAL MAP

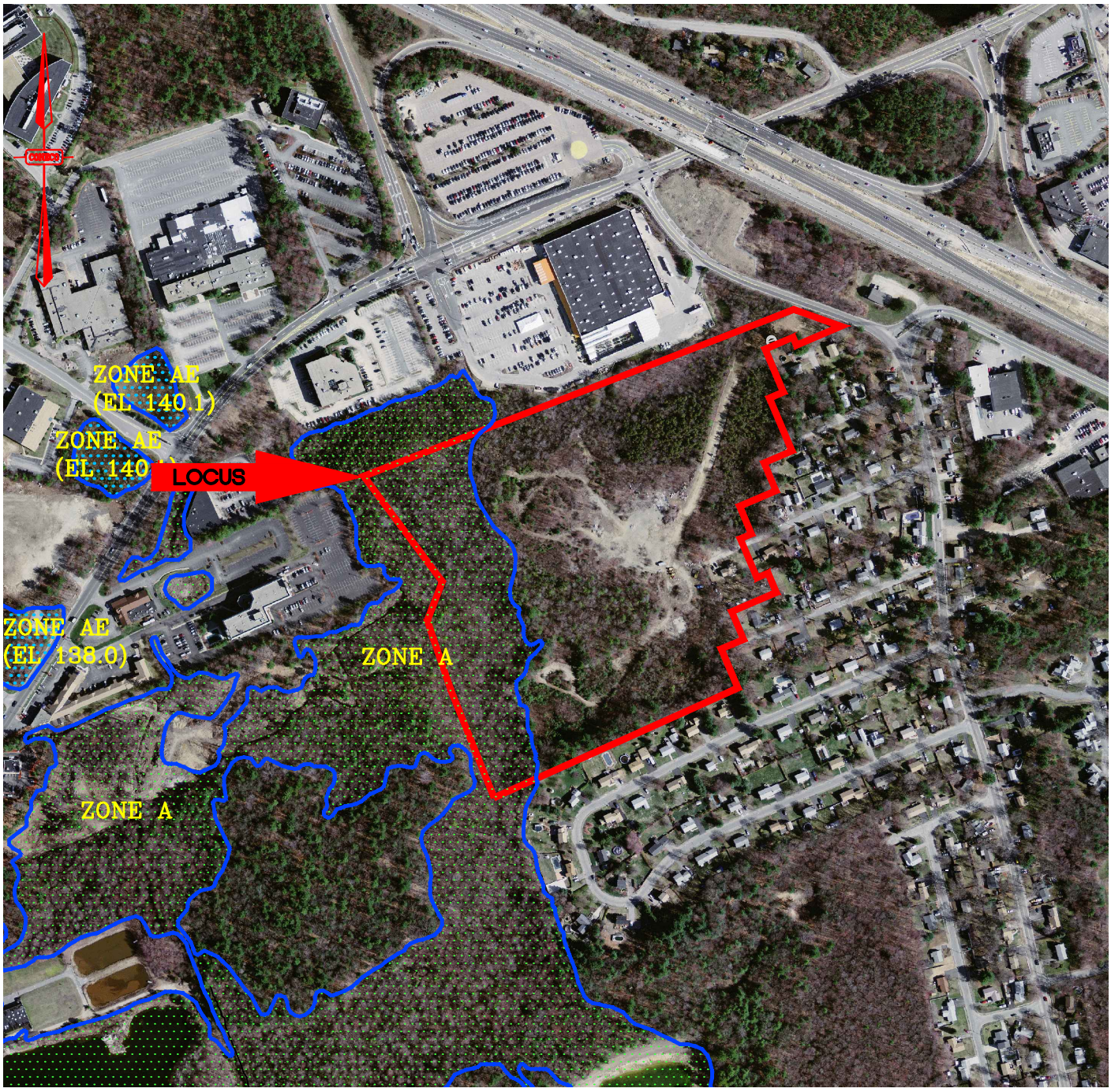


NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM MASSGIS DATABASE OF SCANNED 1:25,000 USGS TOPOGRAPHIC QUAD IMAGES, JUNE 2001.

75–79 POND STREET, ROCKLAND, MASSACHUSETTS 02370

CONECO
Engineers & Scientists
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508-697-3191 OR 800-548-3355; FAX 508-697-5996
WEBSITE: www.coneco.com

PREPARED FOR: SHINGLEMILL, LLC		PLAN SET: REPORT FIGURES	
SCALE 1" = 500'	DATE 02/14/2022	PROJECT NO. 3395.1	TITLE: FIGURE 2 USGS TOPOGRAPHIC MAP



FLOOD ZONE X, AREAS BETWEEN THE LIMITS OF 100-YEAR AND 500-YEAR FLOODS

FLOODWAY AREAS IN ZONE AE

FLOOD ZONE AE, AREAS OF 100-YEAR FLOOD, BASE FLOOD ELEVATIONS DETERMINED

FLOOD ZONE A, AREAS OF 100-YEAR FLOOD, BASE FLOOD ELEVATIONS NOT DETERMINED

NOTE:
FLOOD BOUNDARY INFORMATION ON THIS PLAN WAS DIGITIZED FROM FEMA FLOOD INSURANCE RATE MAP FOR PLYMOUTH COUNTY COMMUNITY MAP NO. 25023C0092K, EFFECTIVE JULY 06, 2021.

75-79 POND STREET, ROCKLAND, MASSACHUSETTS 02370

CONECO
Engineers & Scientists
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508-697-3191 OR 800-548-3355; FAX 508-697-5996
WEBSITE: www.coneco.com

PREPARED FOR:	PLAN SET:
SHINGLEMILL, LLC	REPORT FIGURES

SCALE	DATE	PROJECT NO.	TITLE:
1" = 500'	02/14/2022	3395.1	FIGURE 3 FLOOD INSURANCE RATE MAP

PRIORITY HABITAT OF RARE SPECIES

ESTIMATED HABITATS OF RARE WILDLIFE

CERTIFIED VERNAL POOLS

POTENTIAL VERNAL POOLS

NOTES:

1. ESTIMATED HABITATS OF RARE WILDLIFE AND PRIORITY HABITATS OF RARE SPECIES CAME FROM MASSGIS DATABASE LAST UPDATED AUGUST 2017.
2. CERTIFIED VERNAL POOL LOCATIONS WERE TAKEN FROM MASSGIS DATABASE ON OCTOBER 4, 2019. THIS DATA IS UPDATED CONTINUALLY AND SHOWN CONDITIONS MAY VARY FROM THIS DATA.
3. POTENTIAL VERNAL POOL LOCATIONS WERE TAKEN FROM MASSGIS DATABASE LAST UPDATED DECEMBER 2000.
4. THERE ARE NO ESTIMATED HABITATS OF RARE WILDLIFE OR PRIORITY HABITATS OF RARE SPECIES ON THE PROJECT SITE.

75–79 POND STREET, ROCKLAND, MASSACHUSETTS 02370

CONECO
Engineers & Scientists
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508-697-3191 OR 800-548-3355; FAX 508-697-5996
WEBSITE: www.coneco.com

PREPARED FOR:	PLAN SET:		
SHINGLEMILL, LLC	REPORT FIGURES		
SCALE 1" = 500'	DATE 02/14/2022	PROJECT NO. 3395.1	TITLE: FIGURE 4 NATURAL HERITAGE MAP

AREAS OF CRITICAL ENVIRONMENTAL CONCERN

WELLHEAD PROTECTION AREAS

OUTSTANDING RESOURCE WATERS

SURFACE WATER SUPPLY PROTECTION AREAS

NOTES:

1. AREAS OF CRITICAL ENVIRONMENTAL CONCERN WERE TAKEN FROM MASSGIS DATABASE, LAST UPDATED APRIL 2009.
2. WELLHEAD PROTECTION AREAS WERE TAKEN FROM MASSGIS DATEBASE, LAST UPDATED APRIL 2019.
3. OUTSTANDING RESOURCE WATERS WERE TAKEN FROM MASSGIS DATEBASE, LAST UPDATED MARCH 2010.
4. SURFACE WATER SUPPLY PROTECTION AREAS WERE TAKEN FROM MASSGIS DATEBASE, LAST UPDATED APRIL 2017
5. THERE ARE NO AREAS OF CRITICAL ENVIRONMENTAL CONCERN OR WELLHEAD PROTECTION AREAS ON THIS PROJECT SITE.

75-79 POND STREET, ROCKLAND, MASSACHUSETTS 02370

CONECO
Engineers & Scientists
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508-697-3191 OR 800-548-3355; FAX 508-697-5996
WEBSITE: www.coneco.com

PREPARED FOR:	PLAN SET:
SHINGLEMILL, LLC	REPORT FIGURES

SCALE	DATE	PROJECT NO.	TITLE:
1" = 500'	02/14/2022	3395.1	FIGURE 5 CRITICAL AREAS

NOTE:
INFORMATION ON THIS PLAN WAS OBTAINED FROM THE MASSGIS DATABASE, NRCS SSURGO – CERTIFIED SOILS WHICH WAS LAST UPDATED NOVEMBER 2012.

75–79 POND STREET, ROCKLAND, MASSACHUSETTS 02370

CONECO
Engineers & Scientists
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508-697-3191 OR 800-548-3355; FAX 508-697-5996
WEBSITE: www.coneco.com

PREPARED FOR:	PLAN SET:
SHINGLEMILL, LLC	REPORT FIGURES

SCALE	DATE	PROJECT NO.	TITLE:
1" = 500'	02/14/2022	3395.1	FIGURE 6 SOIL SURVEY MAP

LEGEND

SUBCATCHMENT BOUNDARY

SOILS BOUNDARY

FLOWPATH

EDGE OF ZONE A

655A
HSG B/D

427B
HSG B

626B
HSG A

23A
HSG A/D

52A
HSG B/D

23A
HSG A/D

619A
HSG A

CONECO

Existing Subcatchment: Site
Area=1,302,037 s.f.
CNwt=77
Tc=113.3 min.

Design Point:
Off Site Wetland

80' 0 80' 160'
SCALE IN FEET

REVISIONS

NO.	DATE	DESCRIPTION	DR/CK
1	7/23/2022	GRADING & DRAINAGE REDESIGN	DJD/MSD

PREPARED FOR:
SHINGLEMILL, LLC
4 FIRST STREET
BRIDGEWATER, MASSACHUSETTS 02324

DRAWING:
EXISTING DRAINAGE AREAS

PROJECT:
SHINGLEMILL APARTMENTS
75-79 POND STREET
ROCKLAND, MASSACHUSETTS 02370

PLAN SET:
REPORT FIGURES

CONECO
Engineers & Scientists
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508-697-3191 OR 800-548-3355; FAX 508-697-5996
WEBSITE: www.coneco.com

DATE	02/14/2022
DESIGNED: MVK	CHECKED: DJD
DRAFTED: MVK	IN CHARGE: DJD
SCALE:	1" = 80'
PROJECT NO.	3395.1
SHEET NO.	

FIGURE 7

LEGEND

SUBCATCHMENT BOUNDARY

SOILS BOUNDARY

FLOWPATH

EDGE OF ZONE A

655A
HSG B/D

427B
HSG B

Proposed Subcatchment: Entrance
Area=9,305 s.f.
CNwt=94
Tc=58.5 min.

CONECO

Proposed Subcatchment: A
Area=75,331 s.f.
CNwt=95
Tc=41.2 min.

Proposed Subcatchment: C
Area=125,242 s.f.
CNwt=96
Tc=44.3 min.

626B
HSG A

23A
HSG A/D

Proposed Subcatchment: B
Area=31,470 s.f.
CNwt=97
Tc=30.5 min.

52A
HSG B/D

Proposed Subcatchment: Direct to Wetland
Area=1,060,689 s.f.
CNwt=77
Tc=113.3 min.

25A
HSG A/D

619A
HSG A

Design Point:
Total Offsite

80' 0 80' 160'
SCALE IN FEET

REVISIONS			
NO.	DATE	DESCRIPTION	DR/CK
1	9/23/2022	GRADING & DRAINAGE REDESIGN	DJD/MSD

PREPARED FOR:
SHINGLEMILL, LLC
4 FIRST STREET
BRIDGEWATER, MASSACHUSETTS 02324

DRAWING:
PROPOSED DRAINAGE AREAS

PROJECT:
SHINGLEMILL APARTMENTS
75-79 POND STREET
ROCKLAND, MASSACHUSETTS 02370

PLAN SET:
REPORT FIGURES

CONECO
Engineers & Scientists
4 FIRST STREET, BRIDGEWATER, MASSACHUSETTS 02324
PHONE 508-697-3191 OR 800-548-3355; FAX 508-697-5996
WEBSITE: www.coneco.com

DATE	02/14/2022
DESIGNED: MVK	CHECKED: DJD
DRAFTED: MVK	IN CHARGE: DJD
SCALE:	1" = 80'
PROJECT NO.	3395.1
SHEET NO.	

FIGURE 8

APPENDIX A

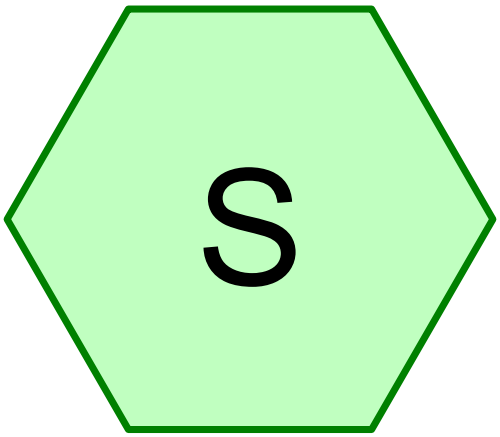
EXISTING HYDROLOGICAL CONDITIONS

2-YEAR STORM EVENT

10-YEAR STORM EVENT

25-YEAR STORM EVENT

100-YEAR STORM EVENT



Site

Subcat Reach Pond Link

Routing Diagram for 3395.1 - 0 Pond Street - Existing Conditions
Prepared by {enter your company name here}, Printed 9/19/2022

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	S	0.00	0.00	51.0	0.0017	0.011	0.0	24.0	0.0

Summary for Subcatchment S: Site

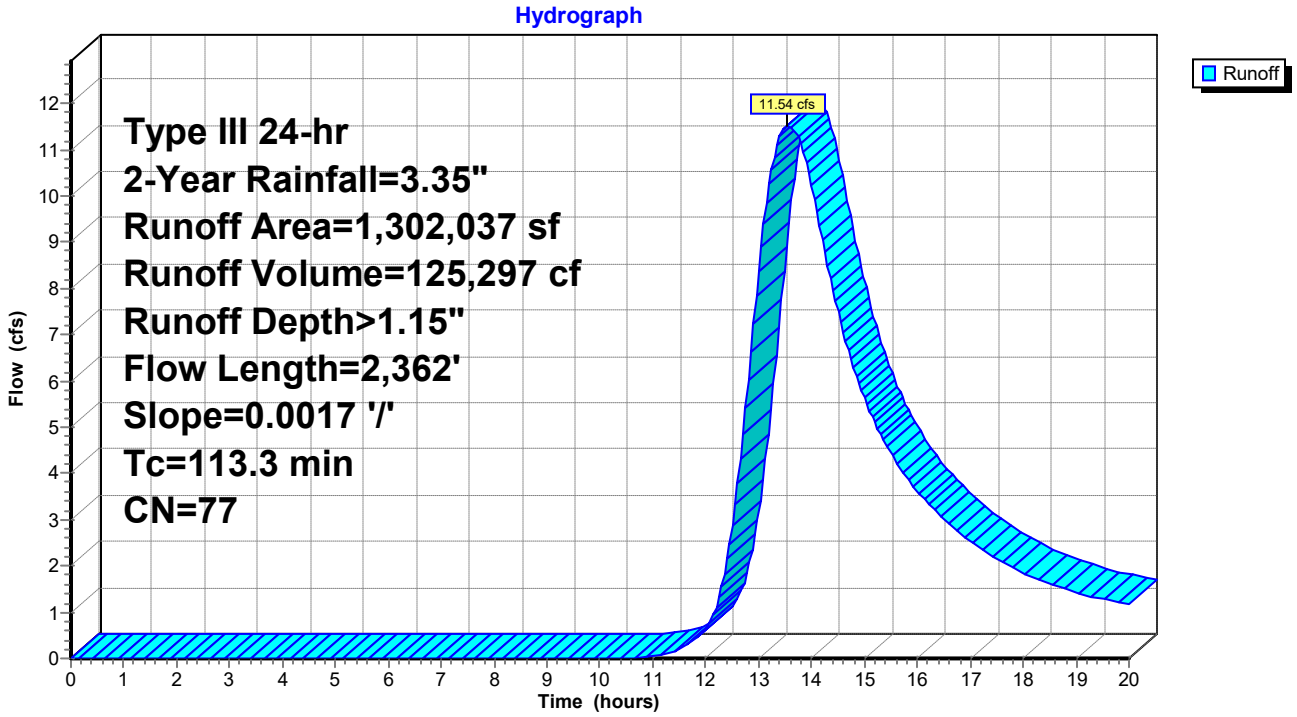
Runoff = 11.54 cfs @ 13.55 hrs, Volume= 125,297 cf, Depth> 1.15"

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

	Area (sf)	CN	Description
	14,765	30	Woods, Good, HSG A
	6,761	30	Brush, Good, HSG A
*	173	78	Wetland, HSG A
	192	98	Paved roads w/curbs & sewers, HSG A
	501	55	Woods, Good, HSG B
	1,173	48	Brush, Good, HSG B
	444,183	77	Woods, Good, HSG D
	32,809	73	Brush, Good, HSG D
	74,635	89	Dirt roads, HSG D
	1,363	91	Gravel roads, HSG D
*	720,013	78	Wetlands, HSG D
	5,469	98	Paved roads w/curbs & sewers, HSG D
	1,302,037	77	Weighted Average
	1,296,376		99.57% Pervious Area
	5,661		0.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	50	0.0017	0.01		**Sheet Flow, Wetlands AB** Woods: Dense underbrush n= 0.800 P2= 3.35"
8.6	341	0.0017	0.66		**Shallow Concentrated Flow, Wetlands BC** Unpaved Kv= 16.1 fps
0.2	51	0.0017	3.51	11.02	**Pipe Channel, Culvert CD** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
48.2	1,920	0.0017	0.66		**Shallow Concentrated Flow, Wetlands DE** Unpaved Kv= 16.1 fps
113.3	2,362	Total			

Subcatchment S: Site



Summary for Subcatchment S: Site

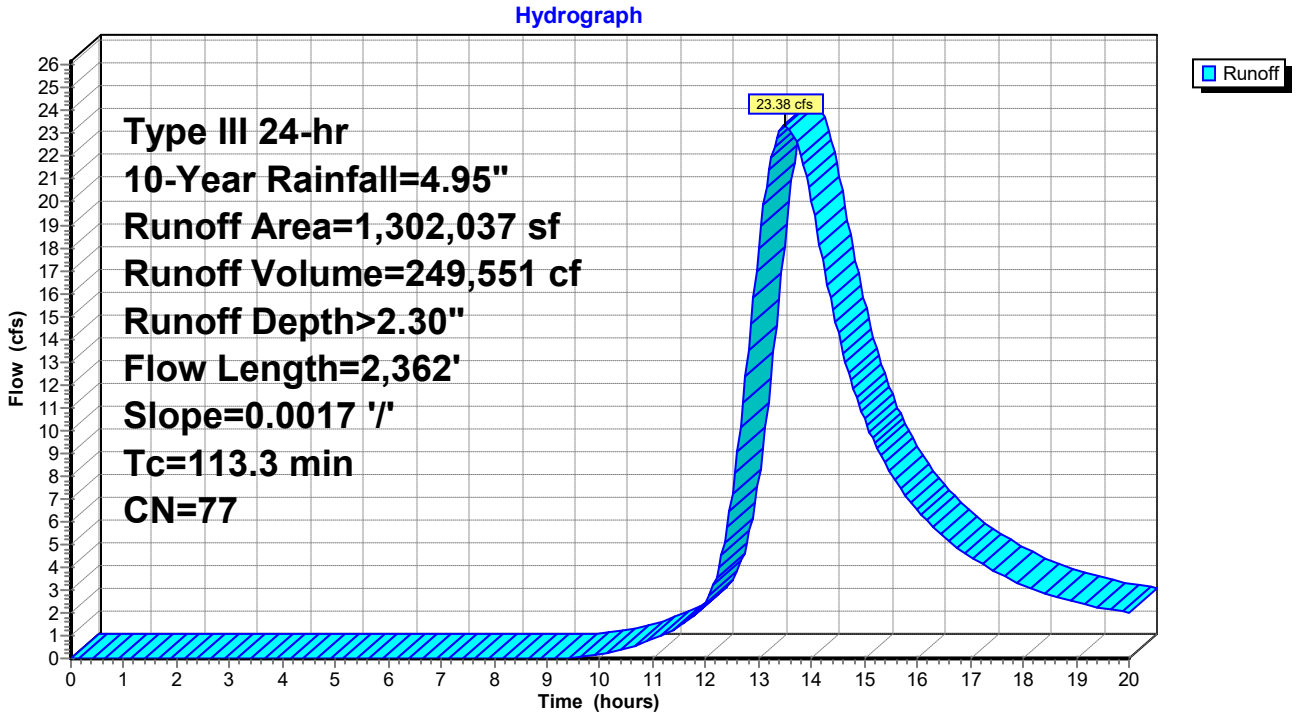
Runoff = 23.38 cfs @ 13.50 hrs, Volume= 249,551 cf, Depth> 2.30"

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

	Area (sf)	CN	Description
	14,765	30	Woods, Good, HSG A
	6,761	30	Brush, Good, HSG A
*	173	78	Wetland, HSG A
	192	98	Paved roads w/curbs & sewers, HSG A
	501	55	Woods, Good, HSG B
	1,173	48	Brush, Good, HSG B
	444,183	77	Woods, Good, HSG D
	32,809	73	Brush, Good, HSG D
	74,635	89	Dirt roads, HSG D
	1,363	91	Gravel roads, HSG D
*	720,013	78	Wetlands, HSG D
	5,469	98	Paved roads w/curbs & sewers, HSG D
	1,302,037	77	Weighted Average
	1,296,376		99.57% Pervious Area
	5,661		0.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	50	0.0017	0.01		**Sheet Flow, Wetlands AB** Woods: Dense underbrush n= 0.800 P2= 3.35"
8.6	341	0.0017	0.66		**Shallow Concentrated Flow, Wetlands BC** Unpaved Kv= 16.1 fps
0.2	51	0.0017	3.51	11.02	**Pipe Channel, Culvert CD** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
48.2	1,920	0.0017	0.66		**Shallow Concentrated Flow, Wetlands DE** Unpaved Kv= 16.1 fps
113.3	2,362	Total			

Subcatchment S: Site



Summary for Subcatchment S: Site

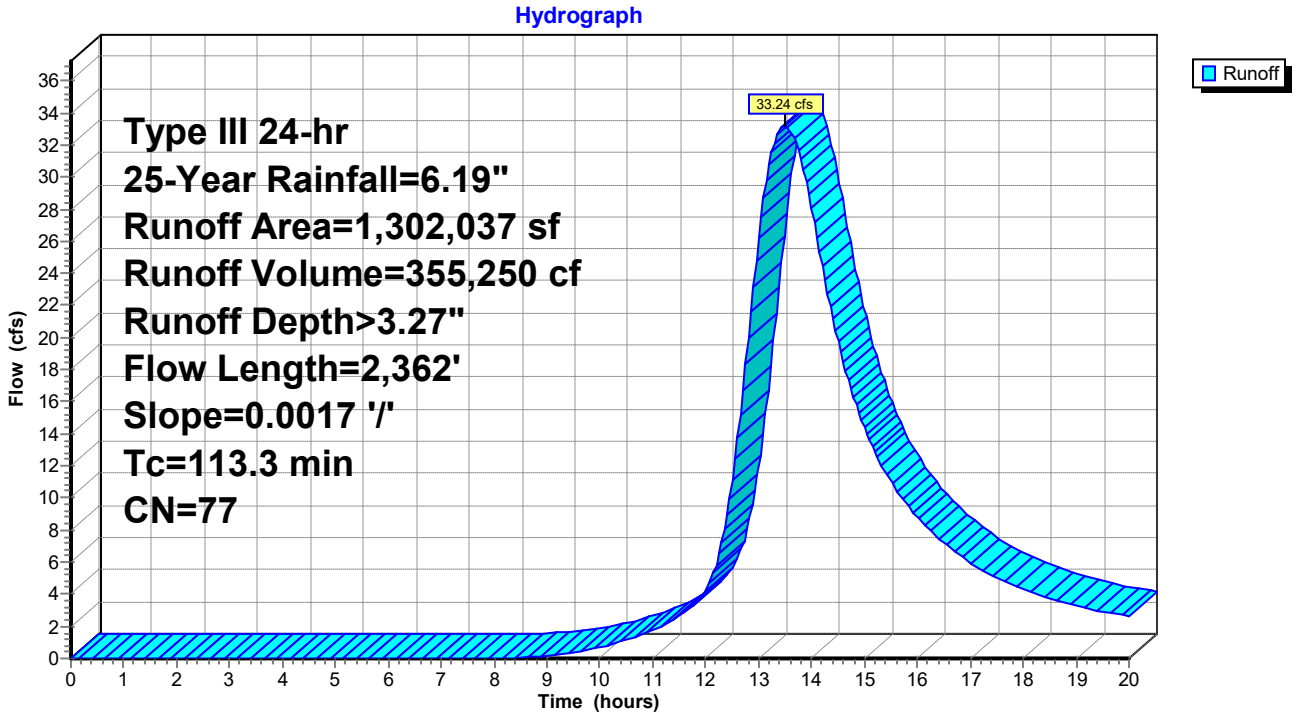
Runoff = 33.24 cfs @ 13.48 hrs, Volume= 355,250 cf, Depth> 3.27"

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

	Area (sf)	CN	Description
	14,765	30	Woods, Good, HSG A
	6,761	30	Brush, Good, HSG A
*	173	78	Wetland, HSG A
	192	98	Paved roads w/curbs & sewers, HSG A
	501	55	Woods, Good, HSG B
	1,173	48	Brush, Good, HSG B
	444,183	77	Woods, Good, HSG D
	32,809	73	Brush, Good, HSG D
	74,635	89	Dirt roads, HSG D
	1,363	91	Gravel roads, HSG D
*	720,013	78	Wetlands, HSG D
	5,469	98	Paved roads w/curbs & sewers, HSG D
	1,302,037	77	Weighted Average
	1,296,376		99.57% Pervious Area
	5,661		0.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	50	0.0017	0.01		**Sheet Flow, Wetlands AB** Woods: Dense underbrush n= 0.800 P2= 3.35"
8.6	341	0.0017	0.66		**Shallow Concentrated Flow, Wetlands BC** Unpaved Kv= 16.1 fps
0.2	51	0.0017	3.51	11.02	**Pipe Channel, Culvert CD** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
48.2	1,920	0.0017	0.66		**Shallow Concentrated Flow, Wetlands DE** Unpaved Kv= 16.1 fps
113.3	2,362	Total			

Subcatchment S: Site



Summary for Subcatchment S: Site

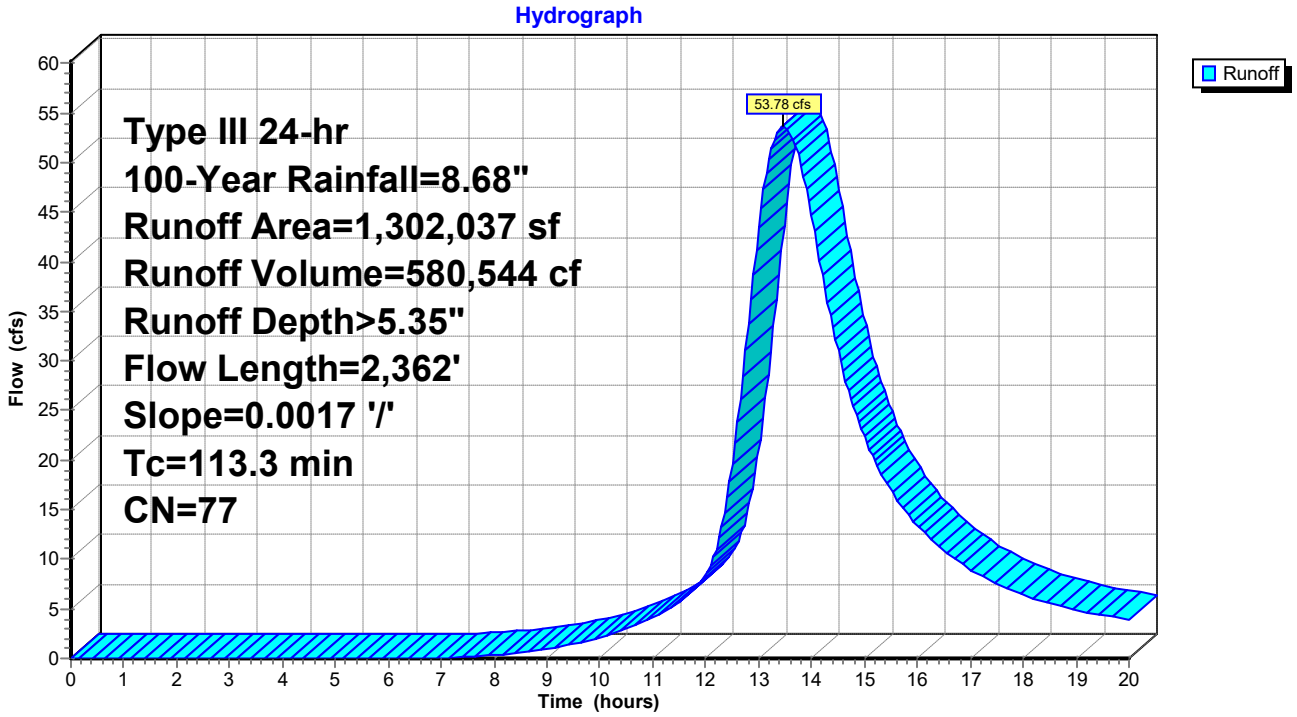
Runoff = 53.78 cfs @ 13.47 hrs, Volume= 580,544 cf, Depth> 5.35"

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

	Area (sf)	CN	Description
	14,765	30	Woods, Good, HSG A
	6,761	30	Brush, Good, HSG A
*	173	78	Wetland, HSG A
	192	98	Paved roads w/curbs & sewers, HSG A
	501	55	Woods, Good, HSG B
	1,173	48	Brush, Good, HSG B
	444,183	77	Woods, Good, HSG D
	32,809	73	Brush, Good, HSG D
	74,635	89	Dirt roads, HSG D
	1,363	91	Gravel roads, HSG D
*	720,013	78	Wetlands, HSG D
	5,469	98	Paved roads w/curbs & sewers, HSG D
	1,302,037	77	Weighted Average
	1,296,376		99.57% Pervious Area
	5,661		0.43% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	50	0.0017	0.01		**Sheet Flow, Wetlands AB** Woods: Dense underbrush n= 0.800 P2= 3.35"
8.6	341	0.0017	0.66		**Shallow Concentrated Flow, Wetlands BC** Unpaved Kv= 16.1 fps
0.2	51	0.0017	3.51	11.02	**Pipe Channel, Culvert CD** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, straight & clean
48.2	1,920	0.0017	0.66		**Shallow Concentrated Flow, Wetlands DE** Unpaved Kv= 16.1 fps
113.3	2,362	Total			

Subcatchment S: Site



APPENDIX B

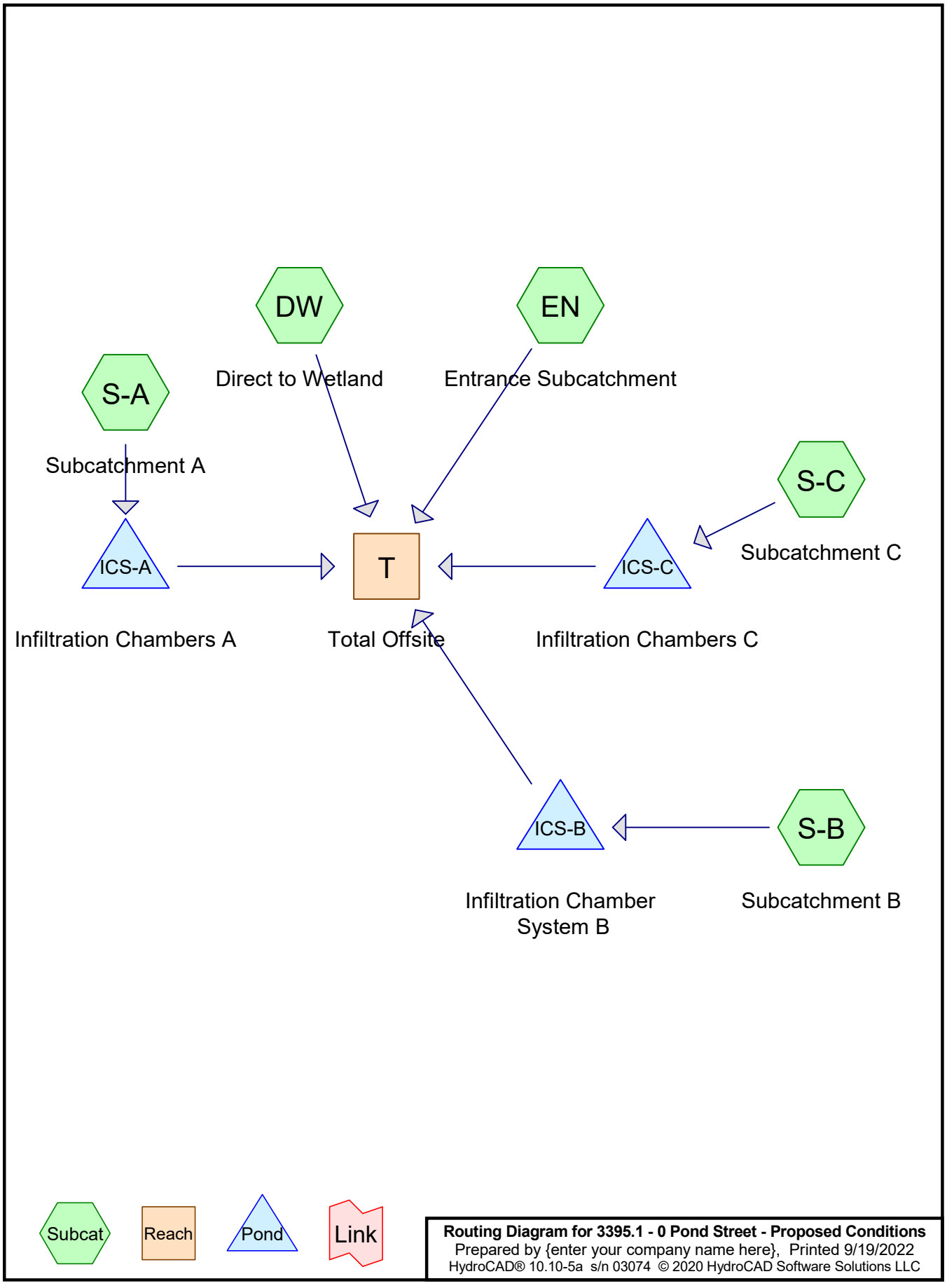
PROPOSED HYDROLOGICAL CONDITIONS

2-YEAR STORM EVENT

10-YEAR STORM EVENT

25-YEAR STORM EVENT

100-YEAR STORM EVENT



Routing Diagram for 3395.1 - 0 Pond Street - Proposed Conditions
Prepared by {enter your company name here}, Printed 9/19/2022
HydroCAD® 10.10-5a s/n 03074 © 2020 HydroCAD Software Solutions LLC

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	DW	0.00	0.00	51.0	0.0017	0.011	0.0	24.0	0.0
2	EN	0.00	0.00	31.0	0.0050	0.013	0.0	12.0	0.0
3	EN	0.00	0.00	148.0	0.0040	0.013	0.0	18.0	0.0
4	S-A	0.00	0.00	117.0	0.0100	0.013	0.0	12.0	0.0
5	S-A	0.00	0.00	50.0	0.0050	0.013	0.0	18.0	0.0
6	S-B	0.00	0.00	95.0	0.0100	0.013	0.0	12.0	0.0
7	S-B	0.00	0.00	70.0	0.0050	0.013	0.0	18.0	0.0
8	S-C	0.00	0.00	59.0	0.0100	0.013	0.0	12.0	0.0
9	S-C	0.00	0.00	444.0	0.0050	0.013	0.0	24.0	0.0
10	ICS-A	136.24	135.70	27.0	0.0200	0.013	0.0	18.0	0.0
11	ICS-A	139.50	139.40	5.0	0.0200	0.013	0.0	18.0	0.0
12	ICS-B	138.14	136.90	62.0	0.0200	0.013	0.0	18.0	0.0
13	ICS-B	138.00	138.05	5.0	-0.0100	0.013	0.0	18.0	0.0
14	ICS-C	138.51	135.65	143.0	0.0200	0.013	0.0	24.0	0.0
15	ICS-C	139.50	139.45	298.0	0.0002	0.013	0.0	24.0	0.0

Summary for Subcatchment DW: Direct to Wetland

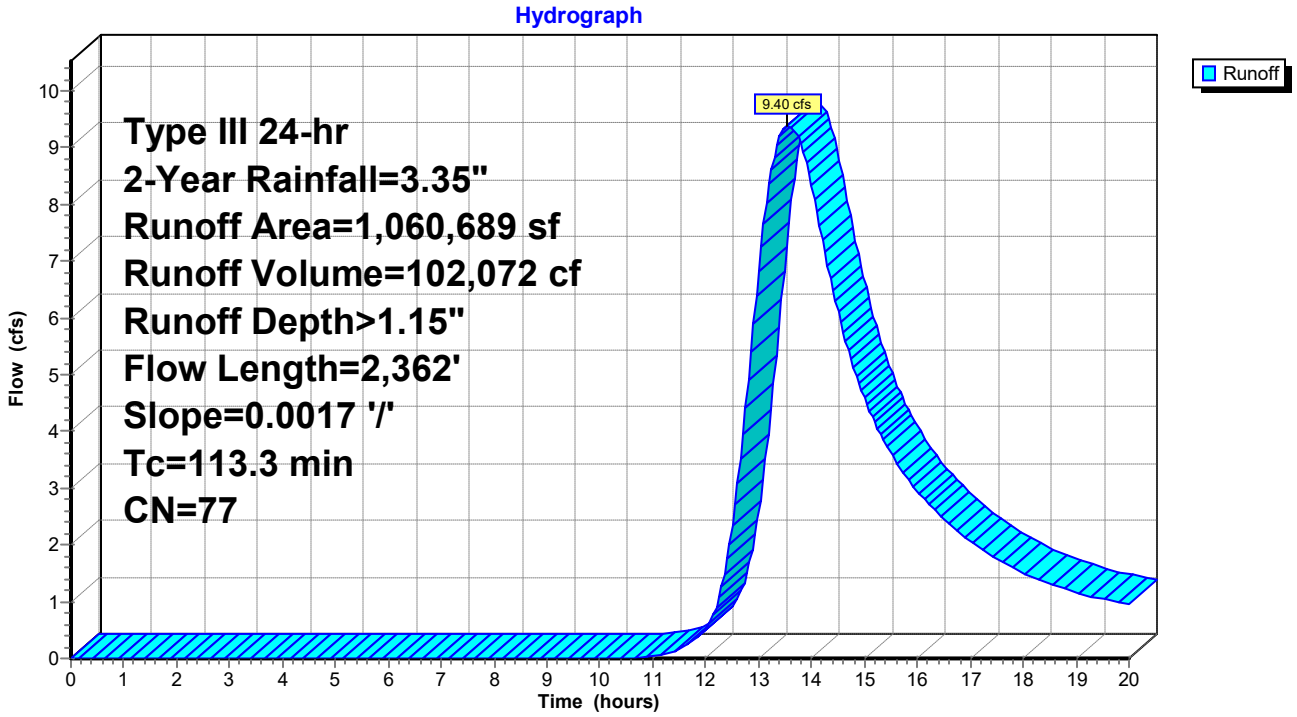
Runoff = 9.40 cfs @ 13.55 hrs, Volume= 102,072 cf, Depth> 1.15"

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

	Area (sf)	CN	Description
	15,524	30	Woods, Good, HSG A
	1,486	39	>75% Grass cover, Good, HSG A
	205	98	Paved parking, HSG A
	1,064	55	Woods, Good, HSG B
	289,391	77	Woods, Good, HSG D
	7,064	96	Gravel surface, HSG D
	23,270	80	>75% Grass cover, Good, HSG D
*	720,013	78	Wetland, HSG D
	2,672	98	Paved parking, HSG D
	1,060,689	77	Weighted Average
	1,057,812		99.73% Pervious Area
	2,877		0.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	50	0.0017	0.01		**Sheet Flow, Wooded - AB** Woods: Dense underbrush n= 0.800 P2= 3.35"
8.6	341	0.0017	0.66		**Shallow Concentrated Flow, Wooded - BC** Unpaved Kv= 16.1 fps
0.2	51	0.0017	3.51	11.02	**Pipe Channel, Culvert - CD** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011
48.2	1,920	0.0017	0.66		**Shallow Concentrated Flow, Wooded - DE** Unpaved Kv= 16.1 fps
113.3	2,362	Total			

Subcatchment DW: Direct to Wetland



Summary for Subcatchment EN: Entrance Subcatchment

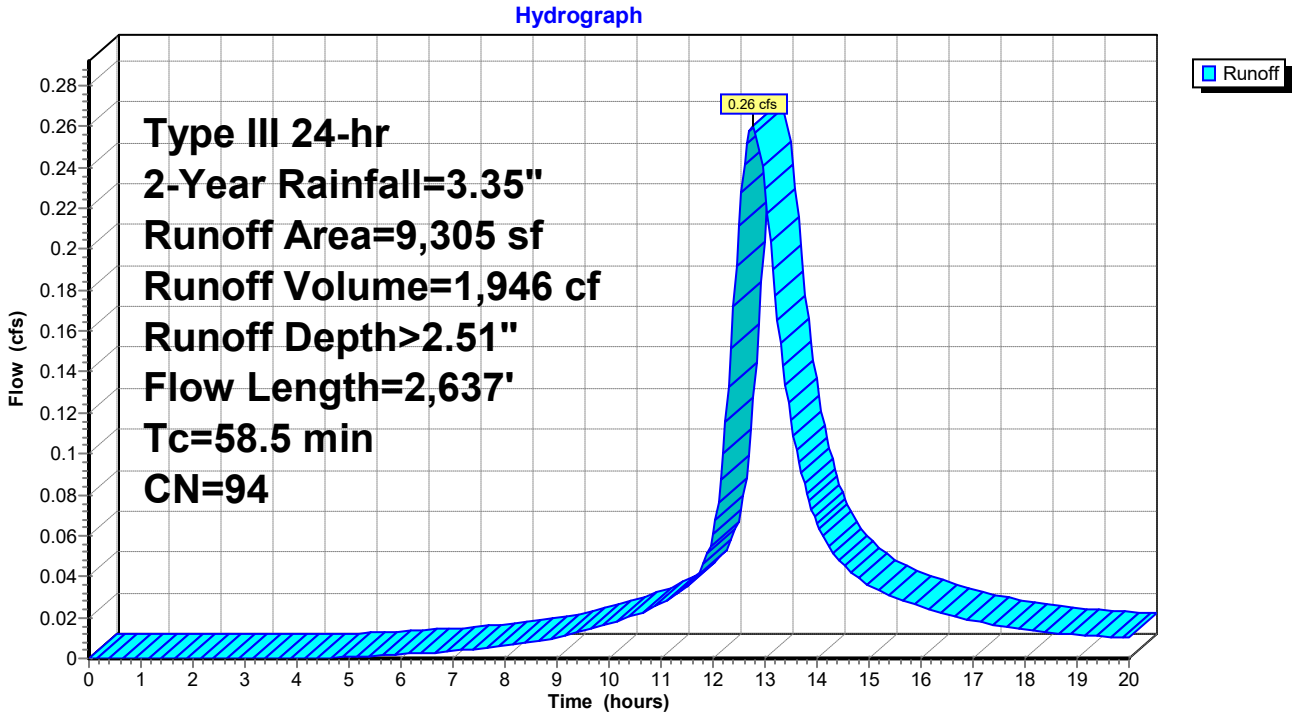
Runoff = 0.26 cfs @ 12.77 hrs, Volume= 1,946 cf, Depth> 2.51"

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

Area (sf)	CN	Description
335	39	>75% Grass cover, Good, HSG A
4,348	98	Paved parking, HSG A
140	61	>75% Grass cover, Good, HSG B
469	98	Paved parking, HSG B
630	80	>75% Grass cover, Good, HSG D
3,383	98	Paved parking, HSG D
9,305	94	Weighted Average
1,105		11.88% Pervious Area
8,200		88.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0300	1.44		**Sheet Flow, Road - AB** Smooth surfaces n= 0.011 P2= 3.35"
0.8	169	0.0300	3.52		**Shallow Concentrated Flow, Road - BC** Paved Kv= 20.3 fps
0.2	31	0.0050	3.21	2.52	**Pipe Channel, Pipe-CD** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.7	148	0.0040	3.76	6.64	**Pipe Channel, Pipe-DE** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
56.2	2,239	0.0017	0.66		**Shallow Concentrated Flow, Wooded - EF** Unpaved Kv= 16.1 fps
58.5	2,637	Total			

Subcatchment EN: Entrance Subcatchment



Summary for Subcatchment S-A: Subcatchment A

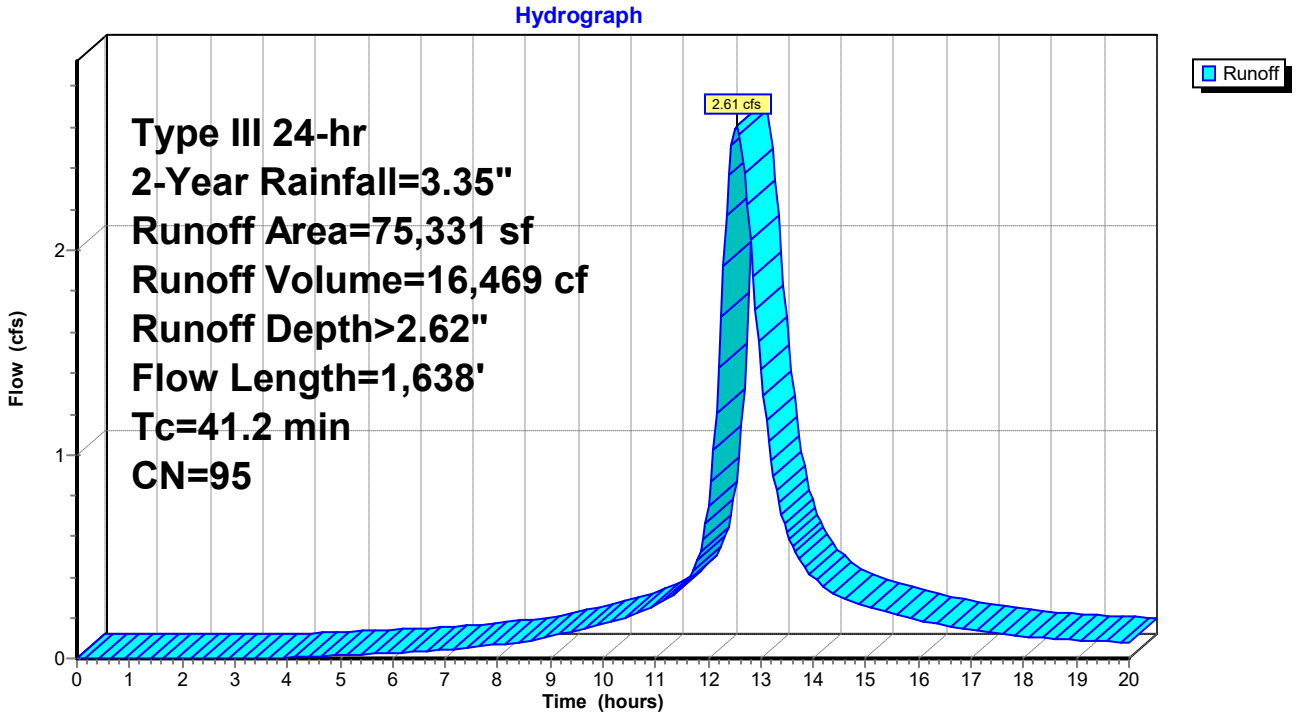
Runoff = 2.61 cfs @ 12.54 hrs, Volume= 16,469 cf, Depth> 2.62"

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

Area (sf)	CN	Description
11,823	80	>75% Grass cover, Good, HSG D
63,508	98	Paved parking, HSG D
75,331	95	Weighted Average
11,823		15.69% Pervious Area
63,508		84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		**Sheet Flow, Grass - AB** Grass: Short n= 0.150 P2= 3.35"
1.1	77	0.0050	1.14		**Shallow Concentrated Flow, Grass - BC** Unpaved Kv= 16.1 fps
1.9	188	0.0100	1.61		**Shallow Concentrated Flow, Parking - CD** Unpaved Kv= 16.1 fps
0.4	117	0.0100	4.54	3.56	**Pipe Channel, Pipe - DE** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.1	44		6.95		**Lake or Reservoir, Chambers - EF** Mean Depth= 1.50'
0.2	50	0.0050	4.20	7.43	**Pipe Channel, Pipe - FG** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.9	1,112	0.0017	0.66		**Shallow Concentrated Flow, Wooded - GH** Unpaved Kv= 16.1 fps
41.2	1,638	Total			

Subcatchment S-A: Subcatchment A



Summary for Subcatchment S-B: Subcatchment B

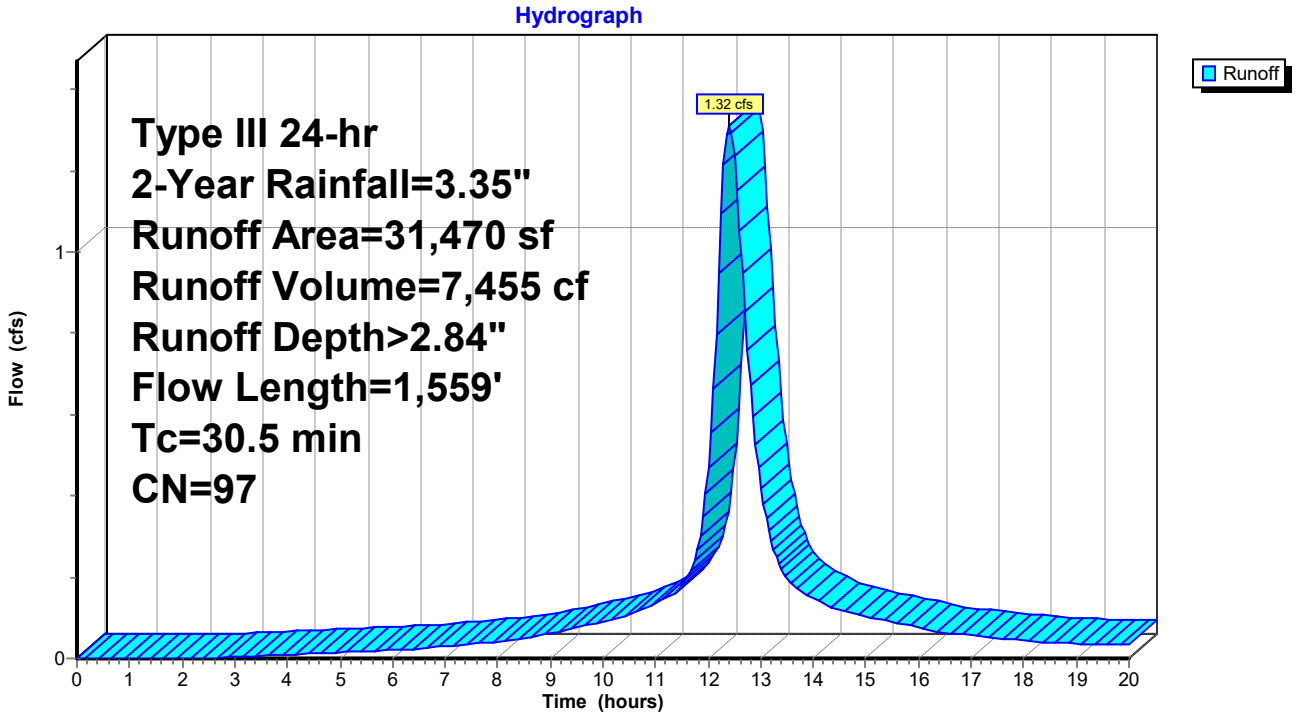
Runoff = 1.32 cfs @ 12.40 hrs, Volume= 7,455 cf, Depth> 2.84"

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

Area (sf)	CN	Description
2,392	80	>75% Grass cover, Good, HSG D
29,078	98	Paved parking, HSG D
31,470	97	Weighted Average
2,392		7.60% Pervious Area
29,078		92.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.93		**Sheet Flow, Parking - AB** Smooth surfaces n= 0.011 P2= 3.35"
1.5	184	0.0100	2.03		**Shallow Concentrated Flow, Parking - BC** Paved Kv= 20.3 fps
0.3	95	0.0100	4.54	3.56	**Pipe Channel, Pipe - CD** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.2	73		6.95		**Lake or Reservoir, Chambers - DE** Mean Depth= 1.50'
0.3	70	0.0050	4.20	7.43	**Pipe Channel, Pipe - EF** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.3	1,087	0.0017	0.66		**Shallow Concentrated Flow, Wooded - FG** Unpaved Kv= 16.1 fps
30.5	1,559	Total			

Subcatchment S-B: Subcatchment B



Summary for Subcatchment S-C: Subcatchment C

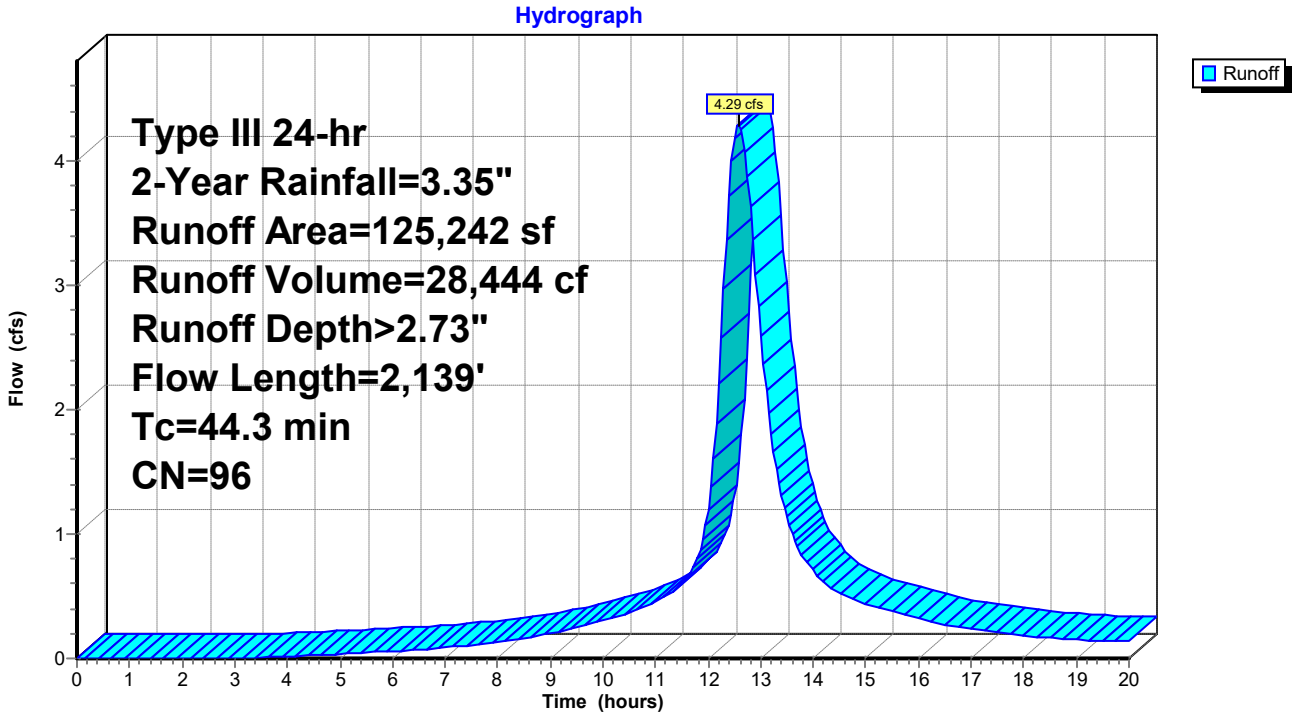
Runoff = 4.29 cfs @ 12.58 hrs, Volume= 28,444 cf, Depth> 2.73"

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

Area (sf)	CN	Description
2,830	96	Gravel surface, HSG D
15,974	80	>75% Grass cover, Good, HSG D
106,438	98	Paved parking, HSG D
125,242	96	Weighted Average
18,804		15.01% Pervious Area
106,438		84.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		**Sheet Flow, Grass - AB** Grass: Short n= 0.150 P2= 3.35"
2.4	165	0.0050	1.14		**Shallow Concentrated Flow, Grass - BC** Unpaved Kv= 16.1 fps
1.7	207	0.0100	2.03		**Shallow Concentrated Flow, Road - CD** Paved Kv= 20.3 fps
0.2	59	0.0100	4.54	3.56	**Pipe Channel, Pipe - DE** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.2	72		6.95		**Lake or Reservoir, Chambers - EF** Mean Depth= 1.50'
1.5	444	0.0050	5.09	16.00	**Pipe Channel, Pipe - FG** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
28.7	1,142	0.0017	0.66		**Shallow Concentrated Flow, Wooded - GH** Unpaved Kv= 16.1 fps
44.3	2,139	Total			

Subcatchment S-C: Subcatchment C

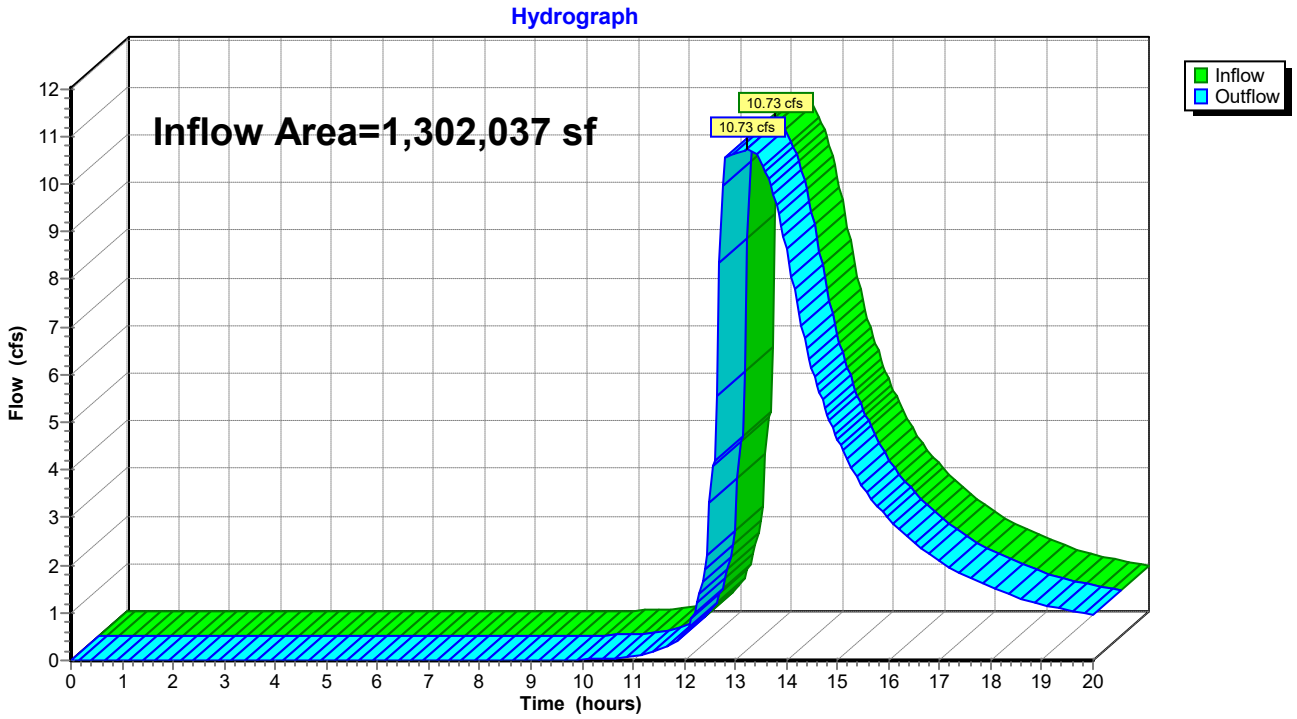


Summary for Reach T: Total Offsite

Inflow Area = 1,302,037 sf, 16.14% Impervious, Inflow Depth > 1.06" for 2-Year event
Inflow = 10.73 cfs @ 13.22 hrs, Volume= 115,026 cf
Outflow = 10.73 cfs @ 13.22 hrs, Volume= 115,026 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Reach T: Total Offsite



Summary for Pond ICS-A: Infiltration Chambers A

Inflow Area = 75,331 sf, 84.31% Impervious, Inflow Depth > 2.62" for 2-Year event
Inflow = 2.61 cfs @ 12.54 hrs, Volume= 16,469 cf
Outflow = 2.56 cfs @ 12.72 hrs, Volume= 16,463 cf, Atten= 2%, Lag= 10.5 min
Discarded = 0.36 cfs @ 11.55 hrs, Volume= 12,892 cf
Primary = 2.20 cfs @ 12.72 hrs, Volume= 3,572 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 141.58' @ 12.72 hrs Surf.Area= 1,855 sf Storage= 3,868 cf

Plug-Flow detention time= 67.3 min calculated for 16,463 cf (100% of inflow)
Center-of-Mass det. time= 67.2 min (846.2 - 779.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	138.50'	1,574 cf	**35.33'W x 52.50'L x 3.54'H Field A** 6,570 cf Overall - 2,634 cf Embedded = 3,936 cf x 40.0% Voids
#2A	139.00'	2,634 cf	**Cultec R-330XLHD** x 49 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 7 rows
		4,208 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	136.24'	**18.0" Round Culvert** L= 27.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 136.24' / 135.70' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	141.25'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	139.50'	**18.0" Round Culvert** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 139.50' / 139.40' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Discarded	138.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.36 cfs @ 11.55 hrs HW=138.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.36 cfs)

Primary OutFlow Max=2.04 cfs @ 12.72 hrs HW=141.57' (Free Discharge)
└**1=Culvert** (Passes 2.04 cfs of 18.20 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 2.04 cfs @ 1.61 fps)
└**3=Culvert** (Passes 2.04 cfs of 4.79 cfs potential flow)

Pond ICS-A: Infiltration Chambers A - 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 7 rows

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

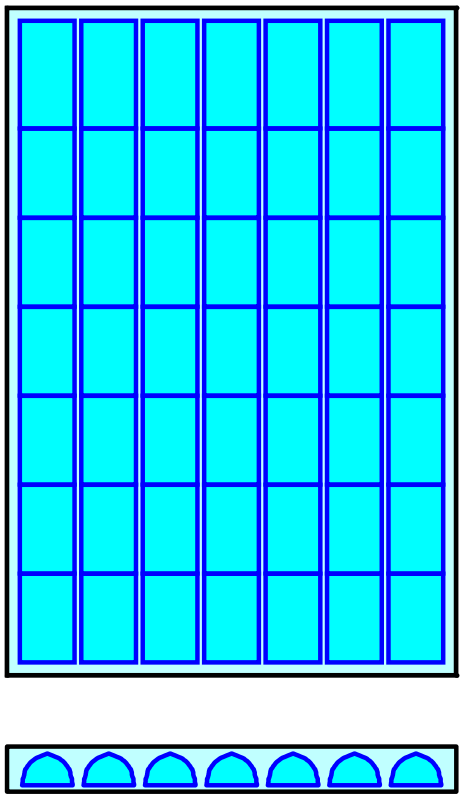
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
7 Rows x 52.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 35.33' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

49 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 7 Rows = 2,633.9 cf Chamber Storage

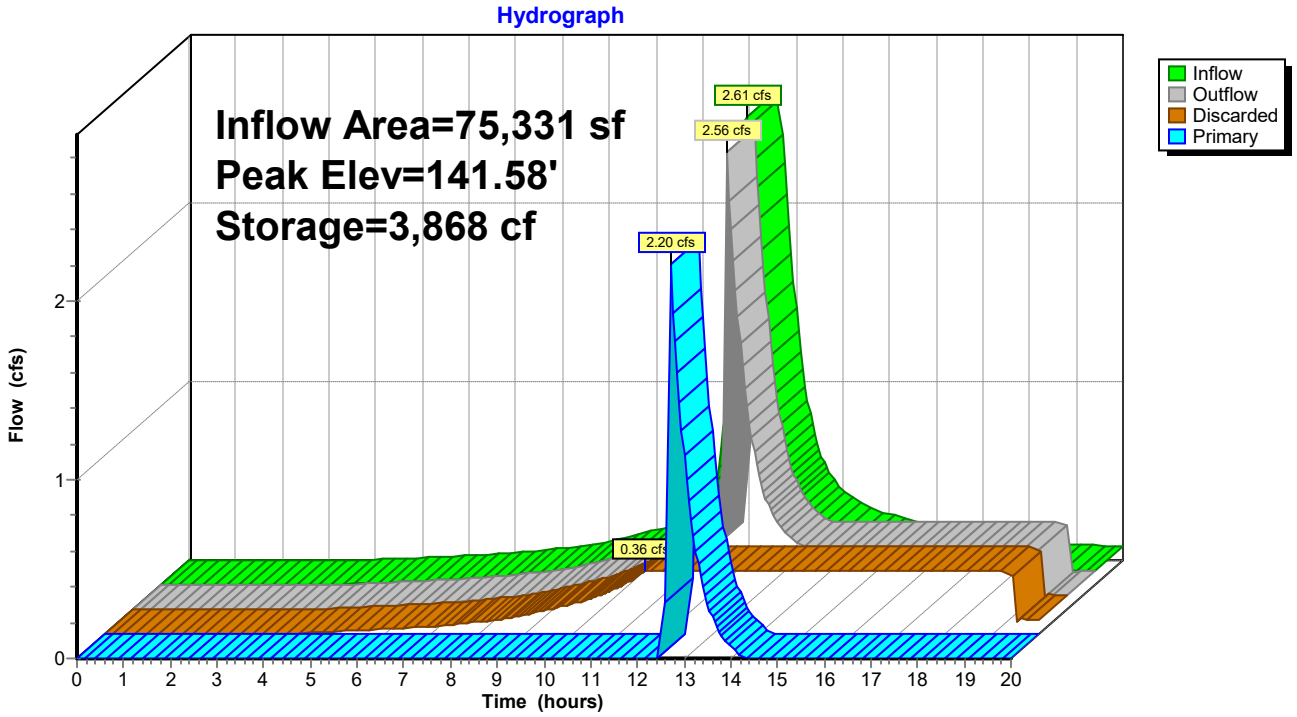
6,569.8 cf Field - 2,633.9 cf Chambers = 3,935.9 cf Stone x 40.0% Voids = 1,574.3 cf Stone Storage

Chamber Storage + Stone Storage = 4,208.3 cf = 0.097 af
Overall Storage Efficiency = 64.1%
Overall System Size = 52.50' x 35.33' x 3.54'

49 Chambers
243.3 cy Field
145.8 cy Stone



Pond ICS-A: Infiltration Chambers A



Stage-Area-Storage for Pond ICS-A: Infiltration Chambers A

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
138.50	**1,855**	0
138.55	1,855	37
138.60	1,855	74
138.65	1,855	111
138.70	1,855	148
138.75	1,855	186
138.80	1,855	223
138.85	1,855	260
138.90	1,855	297
138.95	1,855	334
139.00	1,855	371
139.05	1,855	450
139.10	1,855	529
139.15	1,855	608
139.20	1,855	687
139.25	1,855	765
139.30	1,855	844
139.35	1,855	922
139.40	1,855	1,000
139.45	1,855	1,078
139.50	1,855	1,156
139.55	1,855	1,234
139.60	1,855	1,312
139.65	1,855	1,388
139.70	1,855	1,465
139.75	1,855	1,541
139.80	1,855	1,617
139.85	1,855	1,693
139.90	1,855	1,768
139.95	1,855	1,844
140.00	1,855	1,919
140.05	1,855	1,994
140.10	1,855	2,069
140.15	1,855	2,144
140.20	1,855	2,219
140.25	1,855	2,293
140.30	1,855	2,366
140.35	1,855	2,439
140.40	1,855	2,510
140.45	1,855	2,581
140.50	1,855	2,652
140.55	1,855	2,721
140.60	1,855	2,790
140.65	1,855	2,858
140.70	1,855	2,926
140.75	1,855	2,992
140.80	1,855	3,058
140.85	1,855	3,122
140.90	1,855	3,186
140.95	1,855	3,248
141.00	1,855	3,309
141.05	1,855	3,368
141.10	1,855	3,426
141.15	1,855	3,482
141.20	1,855	3,536
141.25	1,855	3,588
141.30	1,855	3,637
141.35	1,855	3,683
141.40	1,855	3,727
141.45	1,855	3,768
141.50	1,855	3,806
141.55	1,855	3,843
141.60	1,855	3,881
141.65	1,855	3,918
141.70	1,855	3,955
141.75	1,855	3,992
141.80	1,855	4,029
141.85	1,855	4,066
141.90	1,855	4,103
141.95	1,855	4,140
142.00	1,855	**4,177**

Summary for Pond ICS-B: Infiltration Chamber System B

Inflow Area = 31,470 sf, 92.40% Impervious, Inflow Depth > 2.84" for 2-Year event
Inflow = 1.32 cfs @ 12.40 hrs, Volume= 7,455 cf
Outflow = 1.31 cfs @ 12.56 hrs, Volume= 7,452 cf, Atten= 0%, Lag= 9.2 min
Discarded = 0.15 cfs @ 11.30 hrs, Volume= 5,936 cf
Primary = 1.16 cfs @ 12.56 hrs, Volume= 1,516 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 140.82' @ 12.56 hrs Surf.Area= 802 sf Storage= 1,718 cf

Plug-Flow detention time= 68.0 min calculated for 7,452 cf (100% of inflow)
Center-of-Mass det. time= 67.8 min (824.6 - 756.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	137.50'	701 cf	**20.83'W x 38.50'L x 3.54'H Field A** 2,841 cf Overall - 1,088 cf Embedded = 1,753 cf x 40.0% Voids
#2A	138.00'	1,088 cf	**Cultec R-330XLHD** x 20 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 4 rows
		1,789 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.14'	**18.0" Round Culvert** L= 62.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 138.14' / 136.90' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	140.60'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	138.05'	**18.0" Round Culvert** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 138.00' / 138.05' S= -0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Discarded	137.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.15 cfs @ 11.30 hrs HW=137.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=1.12 cfs @ 12.56 hrs HW=140.81' (Free Discharge)
└**1=Culvert** (Passes 1.12 cfs of 11.80 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.12 cfs @ 1.30 fps)
└**3=Culvert** (Passes 1.12 cfs of 3.94 cfs potential flow)

Pond ICS-B: Infiltration Chamber System B - 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 4 rows

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

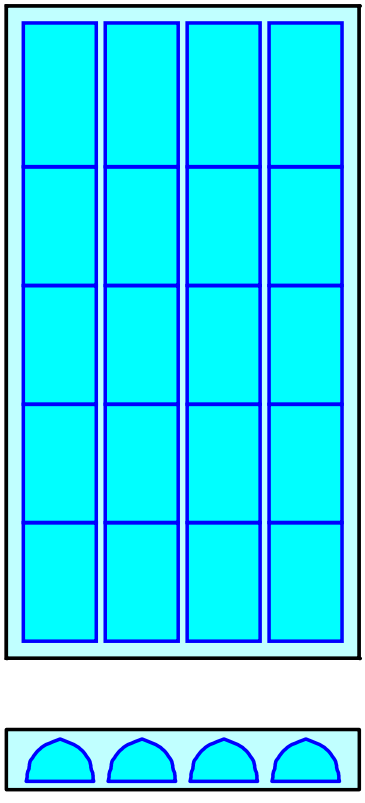
5 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 36.50' Row Length +12.0" End Stone x 2 = 38.50' Base Length
4 Rows x 52.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.83' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

20 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 4 Rows = 1,087.8 cf Chamber Storage

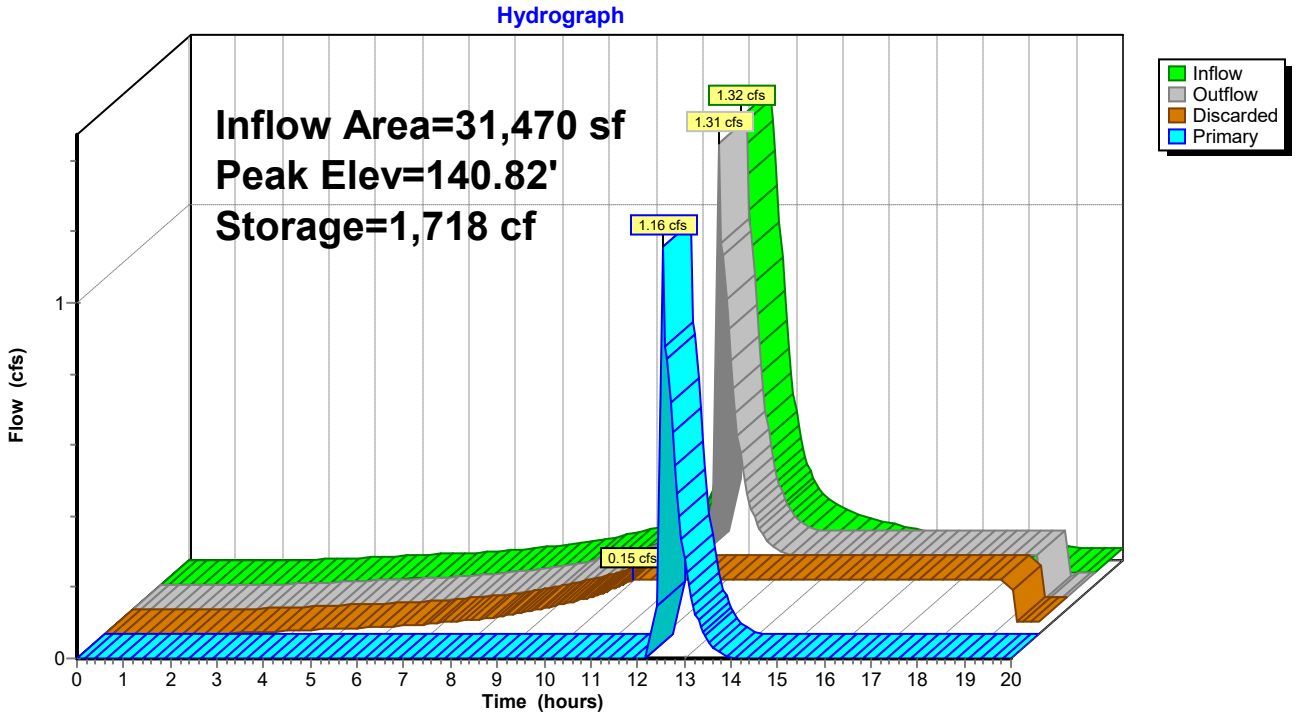
2,840.7 cf Field - 1,087.8 cf Chambers = 1,752.9 cf Stone x 40.0% Voids = 701.1 cf Stone Storage

Chamber Storage + Stone Storage = 1,789.0 cf = 0.041 af
Overall Storage Efficiency = 63.0%
Overall System Size = 38.50' x 20.83' x 3.54'

20 Chambers
105.2 cy Field
64.9 cy Stone



Pond ICS-B: Infiltration Chamber System B



Stage-Area-Storage for Pond ICS-B: Infiltration Chamber System B

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
137.50	**802**	0
137.55	802	16
137.60	802	32
137.65	802	48
137.70	802	64
137.75	802	80
137.80	802	96
137.85	802	112
137.90	802	128
137.95	802	144
138.00	802	160
138.05	802	194
138.10	802	227
138.15	802	261
138.20	802	294
138.25	802	327
138.30	802	360
138.35	802	393
138.40	802	426
138.45	802	459
138.50	802	492
138.55	802	525
138.60	802	557
138.65	802	590
138.70	802	622
138.75	802	654
138.80	802	686
138.85	802	718
138.90	802	750
138.95	802	782
139.00	802	814
139.05	802	846
139.10	802	878
139.15	802	909
139.20	802	941
139.25	802	972
139.30	802	1,003
139.35	802	1,034
139.40	802	1,064
139.45	802	1,094
139.50	802	1,124
139.55	802	1,153
139.60	802	1,183
139.65	802	1,211
139.70	802	1,240
139.75	802	1,268
139.80	802	1,296
139.85	802	1,323
139.90	802	1,350
139.95	802	1,377
140.00	802	1,402
140.05	802	1,428
140.10	802	1,452
140.15	802	1,476
140.20	802	1,499
140.25	802	1,521
140.30	802	1,542
140.35	802	1,562
140.40	802	1,581
140.45	802	1,599
140.50	802	1,615
140.55	802	1,631
140.60	802	1,647
140.65	802	1,663
140.70	802	1,679
140.75	802	1,695
140.80	802	1,711
140.85	802	1,727
140.90	802	1,744
140.95	802	1,760
141.00	802	**1,776**

Summary for Pond ICS-C: Infiltration Chambers C

Inflow Area = 125,242 sf, 84.99% Impervious, Inflow Depth > 2.73" for 2-Year event
Inflow = 4.29 cfs @ 12.58 hrs, Volume= 28,444 cf
Outflow = 3.68 cfs @ 12.81 hrs, Volume= 28,434 cf, Atten= 14%, Lag= 14.1 min
Discarded = 0.63 cfs @ 11.60 hrs, Volume= 22,514 cf
Primary = 3.05 cfs @ 12.81 hrs, Volume= 5,920 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 141.91' @ 12.81 hrs Surf.Area= 3,308 sf Storage= 6,715 cf

Plug-Flow detention time= 61.9 min calculated for 28,434 cf (100% of inflow)
Center-of-Mass det. time= 61.8 min (837.1 - 775.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	139.00'	2,768 cf	**45.00'W x 73.50'L x 3.54'H Field A** 11,714 cf Overall - 4,795 cf Embedded = 6,919 cf x 40.0% Voids
#2A	139.50'	4,795 cf	**Cultec R-330XLHD** x 90 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 9 rows
		7,562 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.51'	**24.0" Round Culvert** L= 143.0' Ke= 0.500 Inlet / Outlet Invert= 138.51' / 135.65' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	141.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	139.50'	**24.0" Round Culvert** L= 298.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 139.50' / 139.45' S= 0.0002 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#4	Discarded	139.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.63 cfs @ 11.60 hrs HW=139.04' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.63 cfs)

Primary OutFlow Max=3.01 cfs @ 12.81 hrs HW=141.90' (Free Discharge)
└**1=Culvert** (Passes 3.01 cfs of 23.41 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 3.01 cfs @ 1.86 fps)
└**3=Culvert** (Passes 3.01 cfs of 7.23 cfs potential flow)

Pond ICS-C: Infiltration Chambers C - 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 9 rows

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

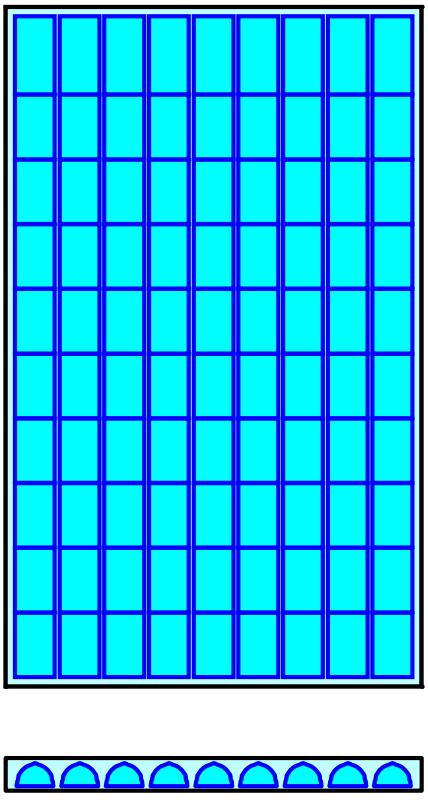
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length
9 Rows x 52.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 45.00' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

90 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 9 Rows = 4,794.7 cf Chamber Storage

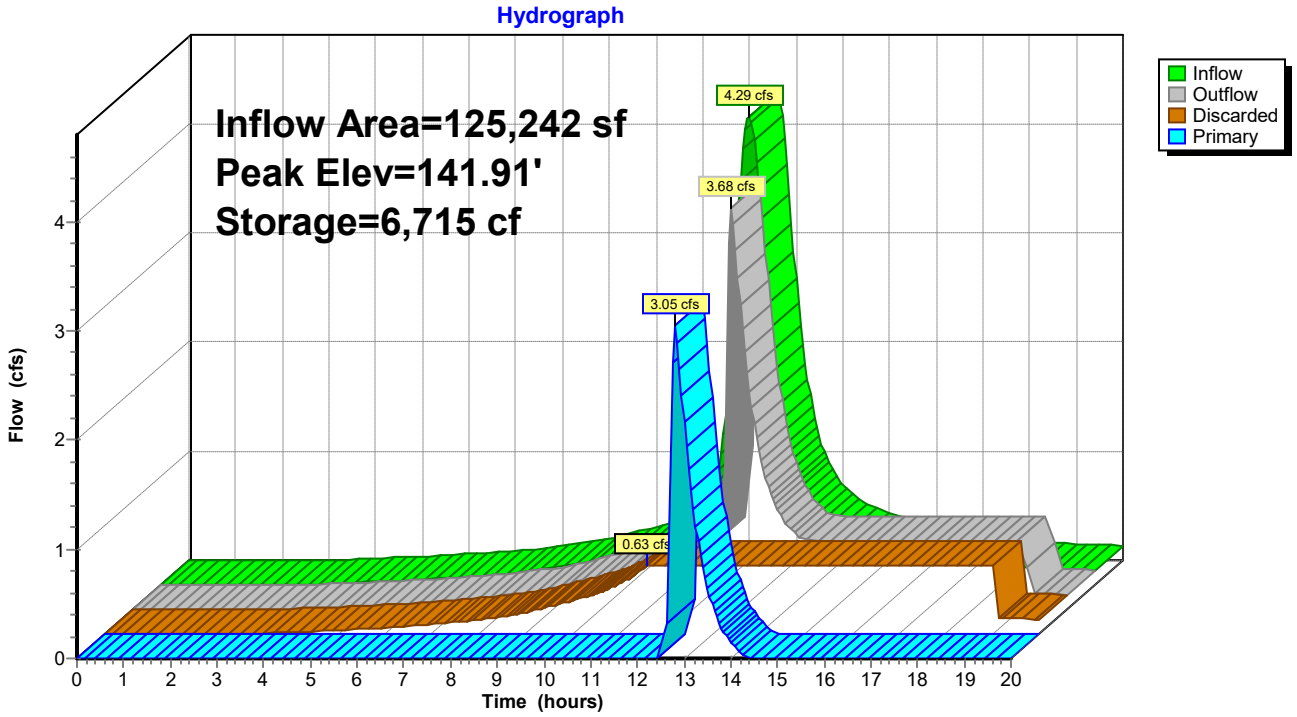
11,714.1 cf Field - 4,794.7 cf Chambers = 6,919.3 cf Stone x 40.0% Voids = 2,767.7 cf Stone Storage

Chamber Storage + Stone Storage = 7,562.5 cf = 0.174 af
Overall Storage Efficiency = 64.6%
Overall System Size = 73.50' x 45.00' x 3.54'

90 Chambers
433.9 cy Field
256.3 cy Stone



Pond ICS-C: Infiltration Chambers C



Stage-Area-Storage for Pond ICS-C: Infiltration Chambers C

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
139.00	**3,308**	0
139.05	3,308	66
139.10	3,308	132
139.15	3,308	198
139.20	3,308	265
139.25	3,308	331
139.30	3,308	397
139.35	3,308	463
139.40	3,308	529
139.45	3,308	595
139.50	3,308	662
139.55	3,308	804
139.60	3,308	947
139.65	3,308	1,089
139.70	3,308	1,231
139.75	3,308	1,372
139.80	3,308	1,513
139.85	3,308	1,654
139.90	3,308	1,795
139.95	3,308	1,936
140.00	3,308	2,077
140.05	3,308	2,217
140.10	3,308	2,357
140.15	3,308	2,496
140.20	3,308	2,633
140.25	3,308	2,771
140.30	3,308	2,907
140.35	3,308	3,044
140.40	3,308	3,180
140.45	3,308	3,316
140.50	3,308	3,452
140.55	3,308	3,587
140.60	3,308	3,722
140.65	3,308	3,857
140.70	3,308	3,992
140.75	3,308	4,125
140.80	3,308	4,257
140.85	3,308	4,388
140.90	3,308	4,517
140.95	3,308	4,645
141.00	3,308	4,772
141.05	3,308	4,897
141.10	3,308	5,021
141.15	3,308	5,144
141.20	3,308	5,265
141.25	3,308	5,384
141.30	3,308	5,502
141.35	3,308	5,618
141.40	3,308	5,732
141.45	3,308	5,844
141.50	3,308	5,954
141.55	3,308	6,061
141.60	3,308	6,165
141.65	3,308	6,265
141.70	3,308	6,362
141.75	3,308	6,455
141.80	3,308	6,543
141.85	3,308	6,625
141.90	3,308	6,703
141.95	3,308	6,777
142.00	3,308	6,846
142.05	3,308	6,912
142.10	3,308	6,978
142.15	3,308	7,044
142.20	3,308	7,110
142.25	3,308	7,177
142.30	3,308	7,243
142.35	3,308	7,309
142.40	3,308	7,375
142.45	3,308	7,441
142.50	3,308	**7,507**

Summary for Subcatchment DW: Direct to Wetland

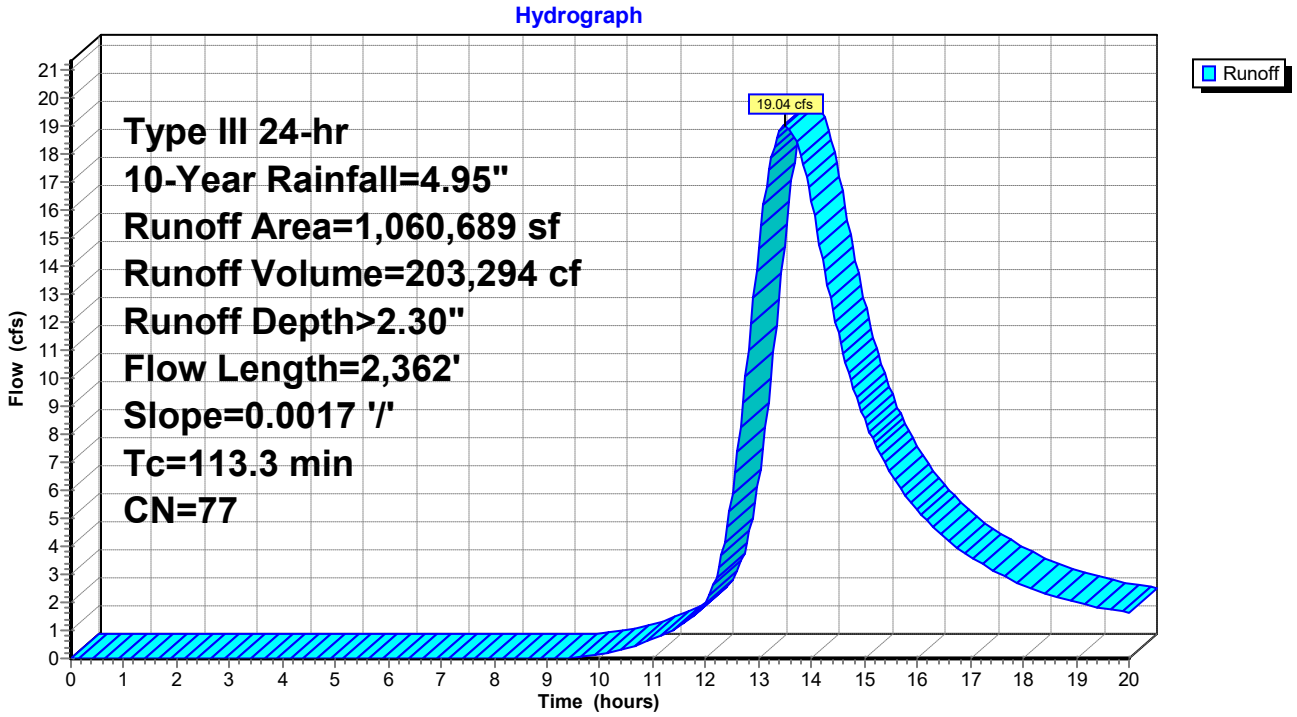
Runoff = 19.04 cfs @ 13.50 hrs, Volume= 203,294 cf, Depth> 2.30"

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

	Area (sf)	CN	Description
	15,524	30	Woods, Good, HSG A
	1,486	39	>75% Grass cover, Good, HSG A
	205	98	Paved parking, HSG A
	1,064	55	Woods, Good, HSG B
	289,391	77	Woods, Good, HSG D
	7,064	96	Gravel surface, HSG D
	23,270	80	>75% Grass cover, Good, HSG D
*	720,013	78	Wetland, HSG D
	2,672	98	Paved parking, HSG D
	1,060,689	77	Weighted Average
	1,057,812		99.73% Pervious Area
	2,877		0.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	50	0.0017	0.01		**Sheet Flow, Wooded - AB** Woods: Dense underbrush n= 0.800 P2= 3.35"
8.6	341	0.0017	0.66		**Shallow Concentrated Flow, Wooded - BC** Unpaved Kv= 16.1 fps
0.2	51	0.0017	3.51	11.02	**Pipe Channel, Culvert - CD** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011
48.2	1,920	0.0017	0.66		**Shallow Concentrated Flow, Wooded - DE** Unpaved Kv= 16.1 fps
113.3	2,362	Total			

Subcatchment DW: Direct to Wetland



Summary for Subcatchment EN: Entrance Subcatchment

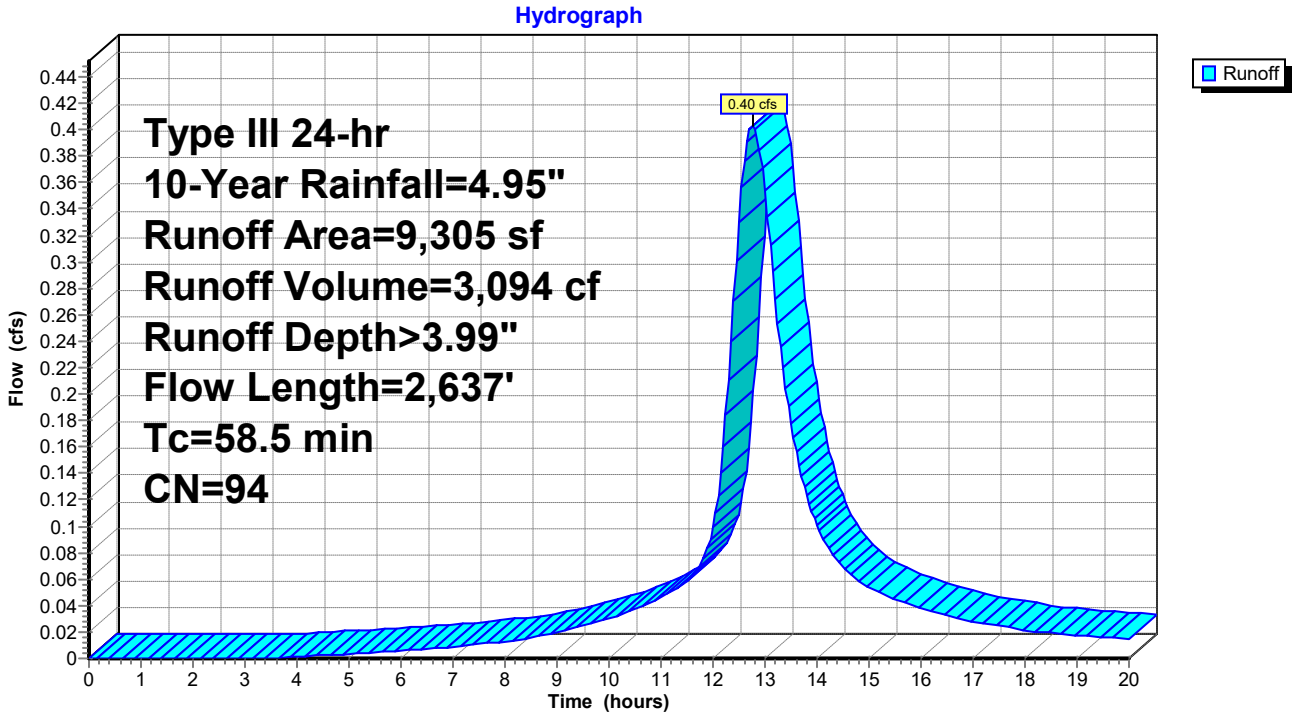
Runoff = 0.40 cfs @ 12.77 hrs, Volume= 3,094 cf, Depth> 3.99"

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

Area (sf)	CN	Description
335	39	>75% Grass cover, Good, HSG A
4,348	98	Paved parking, HSG A
140	61	>75% Grass cover, Good, HSG B
469	98	Paved parking, HSG B
630	80	>75% Grass cover, Good, HSG D
3,383	98	Paved parking, HSG D
9,305	94	Weighted Average
1,105		11.88% Pervious Area
8,200		88.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0300	1.44		**Sheet Flow, Road - AB** Smooth surfaces n= 0.011 P2= 3.35"
0.8	169	0.0300	3.52		**Shallow Concentrated Flow, Road - BC** Paved Kv= 20.3 fps
0.2	31	0.0050	3.21	2.52	**Pipe Channel, Pipe-CD** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.7	148	0.0040	3.76	6.64	**Pipe Channel, Pipe-DE** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
56.2	2,239	0.0017	0.66		**Shallow Concentrated Flow, Wooded - EF** Unpaved Kv= 16.1 fps
58.5	2,637	Total			

Subcatchment EN: Entrance Subcatchment



Summary for Subcatchment S-A: Subcatchment A

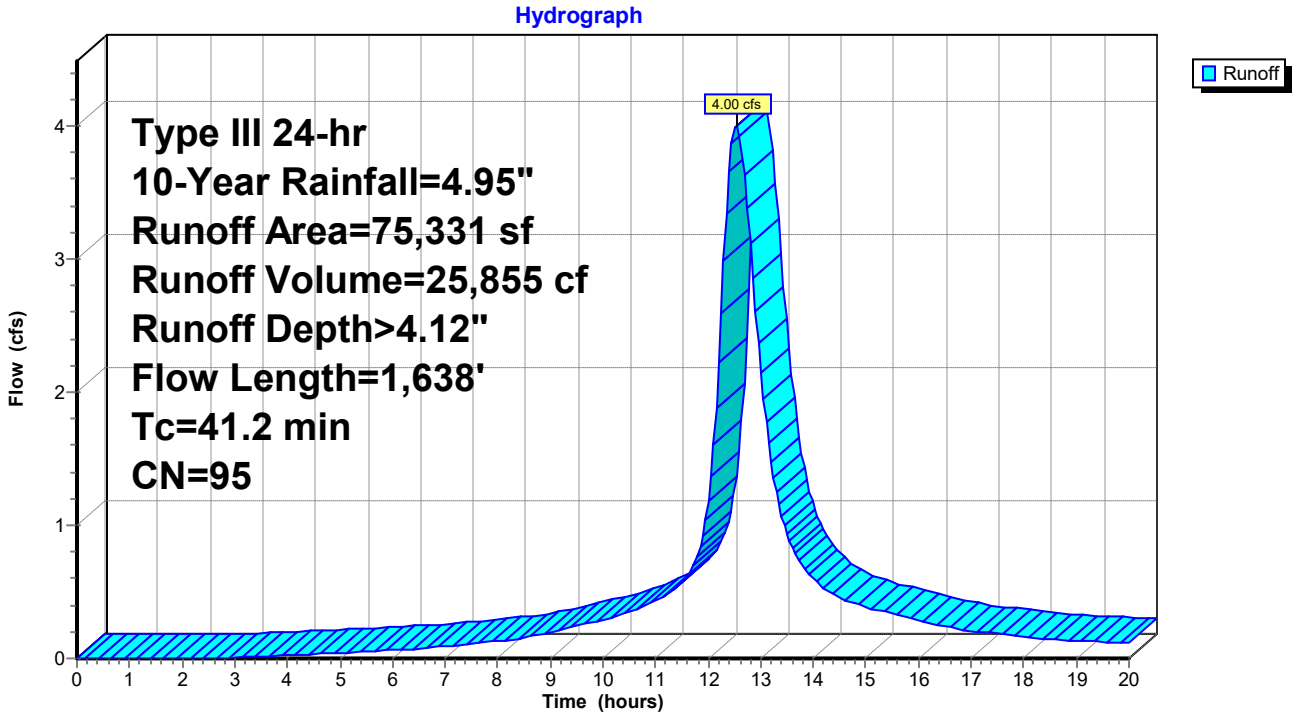
Runoff = 4.00 cfs @ 12.54 hrs, Volume= 25,855 cf, Depth> 4.12"

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

Area (sf)	CN	Description
11,823	80	>75% Grass cover, Good, HSG D
63,508	98	Paved parking, HSG D
75,331	95	Weighted Average
11,823		15.69% Pervious Area
63,508		84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		**Sheet Flow, Grass - AB** Grass: Short n= 0.150 P2= 3.35"
1.1	77	0.0050	1.14		**Shallow Concentrated Flow, Grass - BC** Unpaved Kv= 16.1 fps
1.9	188	0.0100	1.61		**Shallow Concentrated Flow, Parking - CD** Unpaved Kv= 16.1 fps
0.4	117	0.0100	4.54	3.56	**Pipe Channel, Pipe - DE** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.1	44		6.95		**Lake or Reservoir, Chambers - EF** Mean Depth= 1.50'
0.2	50	0.0050	4.20	7.43	**Pipe Channel, Pipe - FG** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.9	1,112	0.0017	0.66		**Shallow Concentrated Flow, Wooded - GH** Unpaved Kv= 16.1 fps
41.2	1,638	Total			

Subcatchment S-A: Subcatchment A



Summary for Subcatchment S-B: Subcatchment B

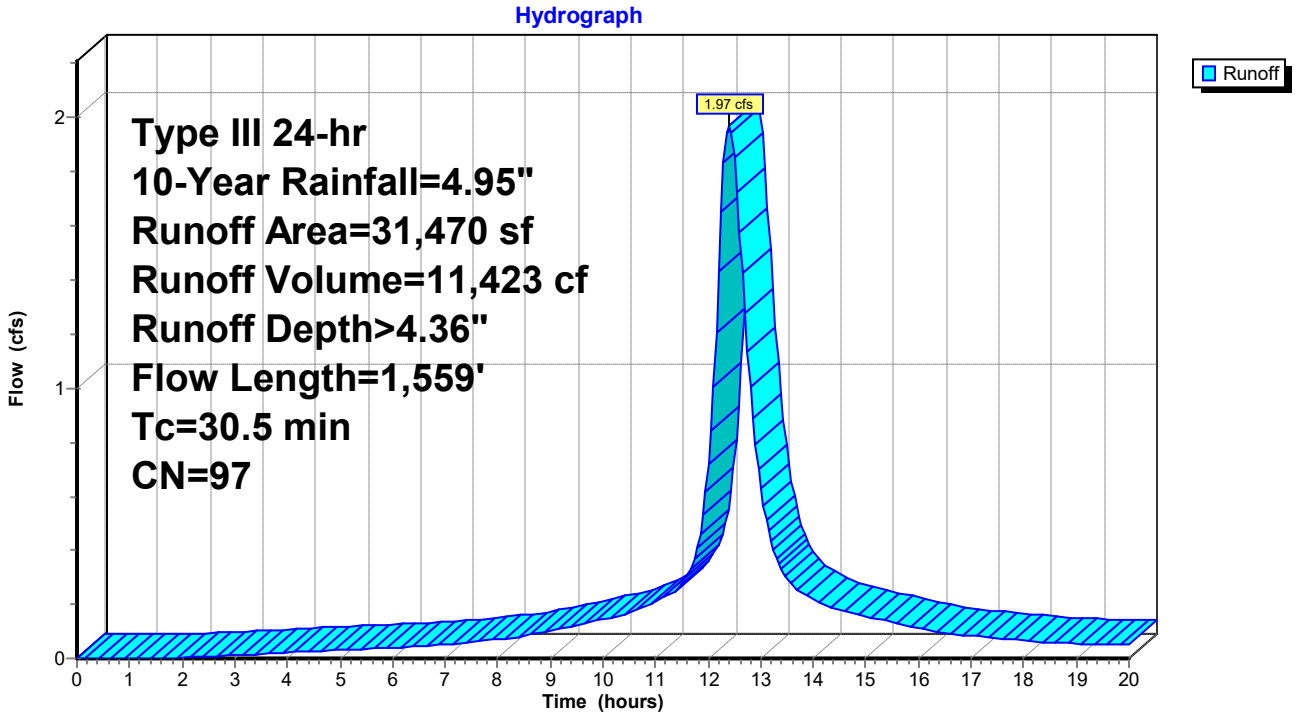
Runoff = 1.97 cfs @ 12.40 hrs, Volume= 11,423 cf, Depth> 4.36"

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

Area (sf)	CN	Description
2,392	80	>75% Grass cover, Good, HSG D
29,078	98	Paved parking, HSG D
31,470	97	Weighted Average
2,392		7.60% Pervious Area
29,078		92.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.93		**Sheet Flow, Parking - AB** Smooth surfaces n= 0.011 P2= 3.35"
1.5	184	0.0100	2.03		**Shallow Concentrated Flow, Parking - BC** Paved Kv= 20.3 fps
0.3	95	0.0100	4.54	3.56	**Pipe Channel, Pipe - CD** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.2	73		6.95		**Lake or Reservoir, Chambers - DE** Mean Depth= 1.50'
0.3	70	0.0050	4.20	7.43	**Pipe Channel, Pipe - EF** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.3	1,087	0.0017	0.66		**Shallow Concentrated Flow, Wooded - FG** Unpaved Kv= 16.1 fps
30.5	1,559	Total			

Subcatchment S-B: Subcatchment B



Summary for Subcatchment S-C: Subcatchment C

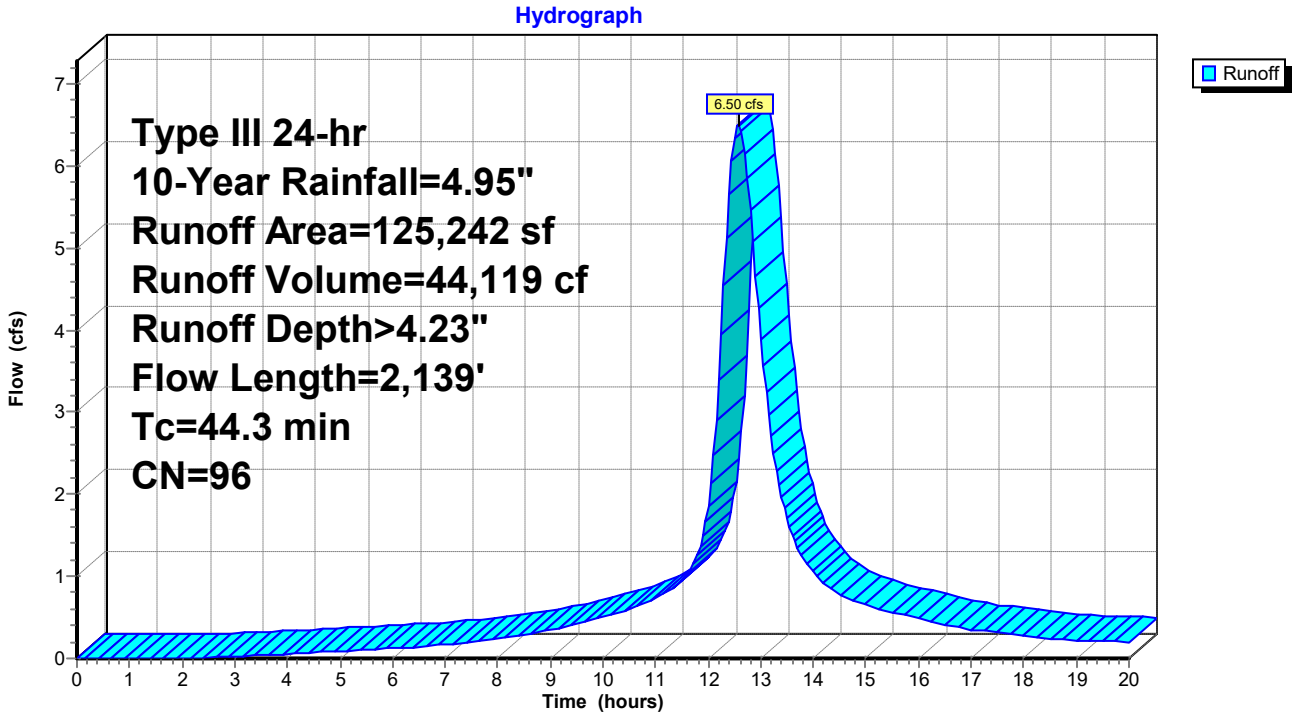
Runoff = 6.50 cfs @ 12.57 hrs, Volume= 44,119 cf, Depth> 4.23"

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

Area (sf)	CN	Description
2,830	96	Gravel surface, HSG D
15,974	80	>75% Grass cover, Good, HSG D
106,438	98	Paved parking, HSG D
125,242	96	Weighted Average
18,804		15.01% Pervious Area
106,438		84.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		**Sheet Flow, Grass - AB** Grass: Short n= 0.150 P2= 3.35"
2.4	165	0.0050	1.14		**Shallow Concentrated Flow, Grass - BC** Unpaved Kv= 16.1 fps
1.7	207	0.0100	2.03		**Shallow Concentrated Flow, Road - CD** Paved Kv= 20.3 fps
0.2	59	0.0100	4.54	3.56	**Pipe Channel, Pipe - DE** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.2	72		6.95		**Lake or Reservoir, Chambers - EF** Mean Depth= 1.50'
1.5	444	0.0050	5.09	16.00	**Pipe Channel, Pipe - FG** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
28.7	1,142	0.0017	0.66		**Shallow Concentrated Flow, Wooded - GH** Unpaved Kv= 16.1 fps
44.3	2,139	Total			

Subcatchment S-C: Subcatchment C

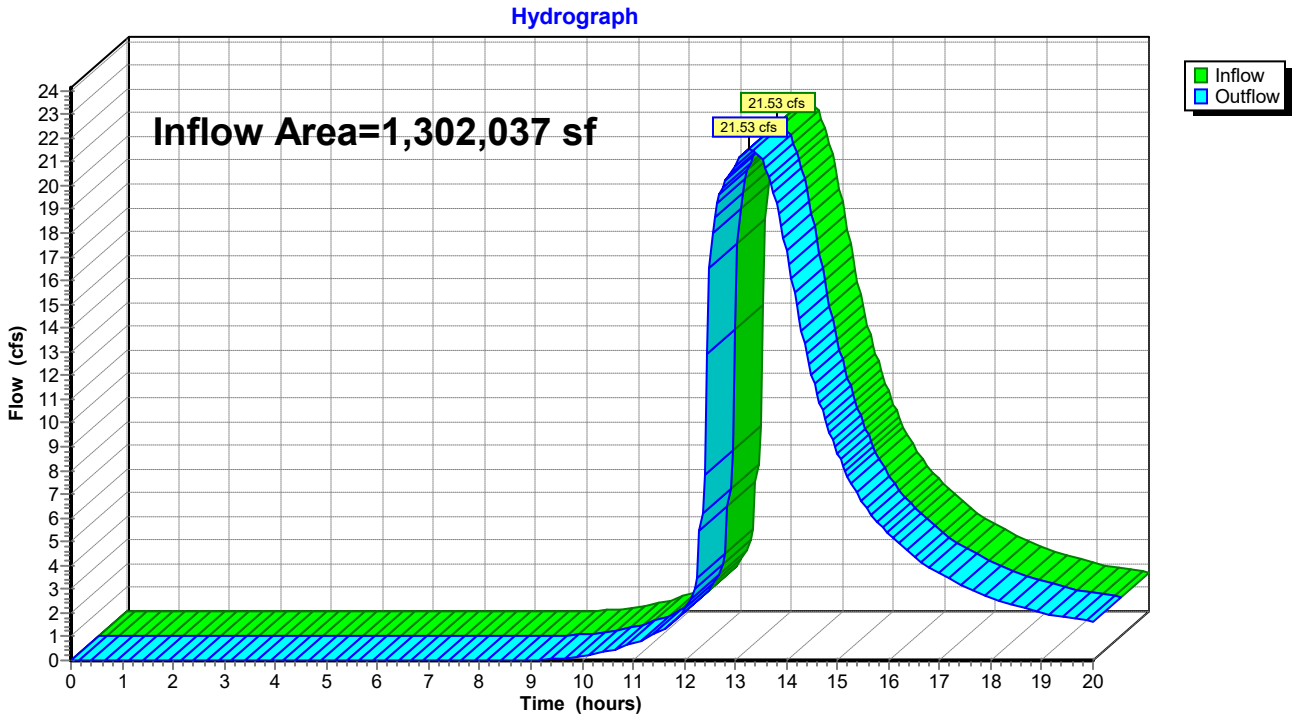


Summary for Reach T: Total Offsite

Inflow Area = 1,302,037 sf, 16.14% Impervious, Inflow Depth > 2.18" for 10-Year event
Inflow = 21.53 cfs @ 13.25 hrs, Volume= 236,304 cf
Outflow = 21.53 cfs @ 13.25 hrs, Volume= 236,304 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Reach T: Total Offsite



Summary for Pond ICS-A: Infiltration Chambers A

Inflow Area = 75,331 sf, 84.31% Impervious, Inflow Depth > 4.12" for 10-Year event
Inflow = 4.00 cfs @ 12.54 hrs, Volume= 25,855 cf
Outflow = 4.02 cfs @ 12.45 hrs, Volume= 24,977 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.36 cfs @ 10.60 hrs, Volume= 15,186 cf
Primary = 3.66 cfs @ 12.45 hrs, Volume= 9,790 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 141.71' @ 12.45 hrs Surf.Area= 1,855 sf Storage= 3,960 cf

Plug-Flow detention time= 56.2 min calculated for 24,977 cf (97% of inflow)
Center-of-Mass det. time= 43.0 min (811.9 - 768.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	138.50'	1,574 cf	**35.33'W x 52.50'L x 3.54'H Field A** 6,570 cf Overall - 2,634 cf Embedded = 3,936 cf x 40.0% Voids
#2A	139.00'	2,634 cf	**Cultec R-330XLHD** x 49 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 7 rows
		4,208 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	136.24'	**18.0" Round Culvert** L= 27.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 136.24' / 135.70' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	141.25'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	139.50'	**18.0" Round Culvert** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 139.50' / 139.40' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Discarded	138.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.36 cfs @ 10.60 hrs HW=138.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.36 cfs)

Primary OutFlow Max=3.66 cfs @ 12.45 hrs HW=141.71' (Free Discharge)
└**1=Culvert** (Passes 3.66 cfs of 18.48 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 3.66 cfs @ 2.00 fps)
└**3=Culvert** (Passes 3.66 cfs of 5.75 cfs potential flow)

Pond ICS-A: Infiltration Chambers A - 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 7 rows

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

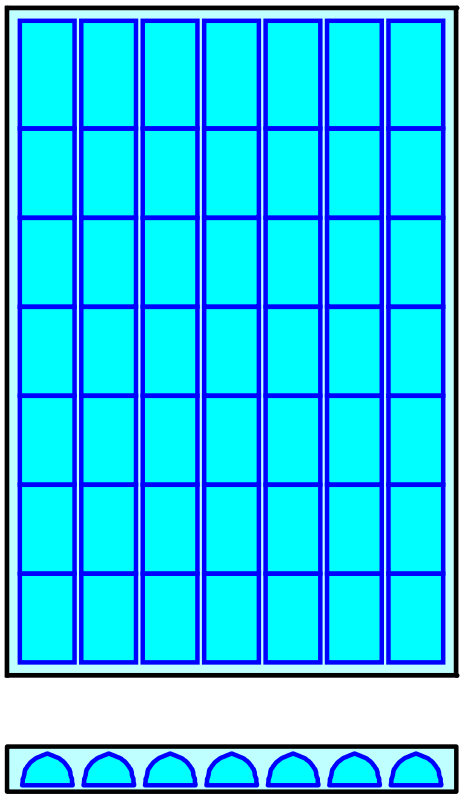
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
7 Rows x 52.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 35.33' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

49 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 7 Rows = 2,633.9 cf Chamber Storage

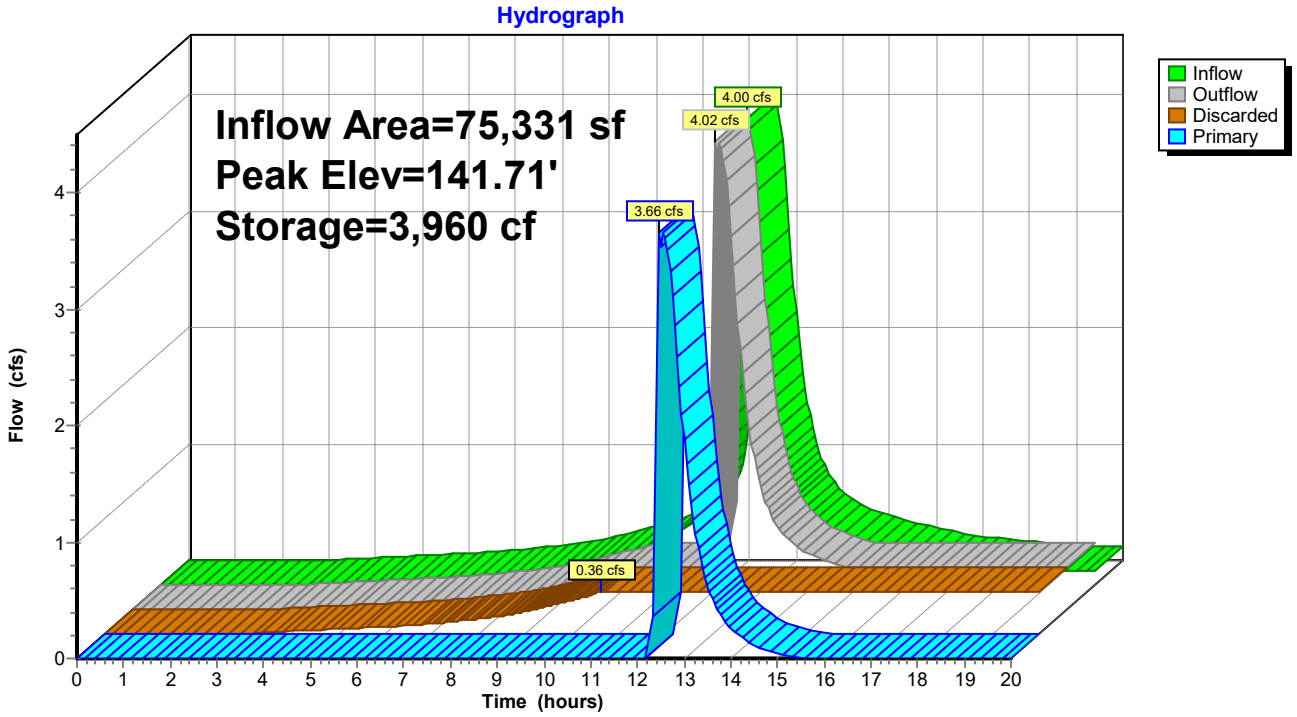
6,569.8 cf Field - 2,633.9 cf Chambers = 3,935.9 cf Stone x 40.0% Voids = 1,574.3 cf Stone Storage

Chamber Storage + Stone Storage = 4,208.3 cf = 0.097 af
Overall Storage Efficiency = 64.1%
Overall System Size = 52.50' x 35.33' x 3.54'

49 Chambers
243.3 cy Field
145.8 cy Stone



Pond ICS-A: Infiltration Chambers A



Stage-Area-Storage for Pond ICS-A: Infiltration Chambers A

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
138.50	**1,855**	0
138.55	1,855	37
138.60	1,855	74
138.65	1,855	111
138.70	1,855	148
138.75	1,855	186
138.80	1,855	223
138.85	1,855	260
138.90	1,855	297
138.95	1,855	334
139.00	1,855	371
139.05	1,855	450
139.10	1,855	529
139.15	1,855	608
139.20	1,855	687
139.25	1,855	765
139.30	1,855	844
139.35	1,855	922
139.40	1,855	1,000
139.45	1,855	1,078
139.50	1,855	1,156
139.55	1,855	1,234
139.60	1,855	1,312
139.65	1,855	1,388
139.70	1,855	1,465
139.75	1,855	1,541
139.80	1,855	1,617
139.85	1,855	1,693
139.90	1,855	1,768
139.95	1,855	1,844
140.00	1,855	1,919
140.05	1,855	1,994
140.10	1,855	2,069
140.15	1,855	2,144
140.20	1,855	2,219
140.25	1,855	2,293
140.30	1,855	2,366
140.35	1,855	2,439
140.40	1,855	2,510
140.45	1,855	2,581
140.50	1,855	2,652
140.55	1,855	2,721
140.60	1,855	2,790
140.65	1,855	2,858
140.70	1,855	2,926
140.75	1,855	2,992
140.80	1,855	3,058
140.85	1,855	3,122
140.90	1,855	3,186
140.95	1,855	3,248
141.00	1,855	3,309
141.05	1,855	3,368
141.10	1,855	3,426
141.15	1,855	3,482
141.20	1,855	3,536
141.25	1,855	3,588
141.30	1,855	3,637
141.35	1,855	3,683
141.40	1,855	3,727
141.45	1,855	3,768
141.50	1,855	3,806
141.55	1,855	3,843
141.60	1,855	3,881
141.65	1,855	3,918
141.70	1,855	3,955
141.75	1,855	3,992
141.80	1,855	4,029
141.85	1,855	4,066
141.90	1,855	4,103
141.95	1,855	4,140
142.00	1,855	**4,177**

Summary for Pond ICS-B: Infiltration Chamber System B

Inflow Area = 31,470 sf, 92.40% Impervious, Inflow Depth > 4.36" for 10-Year event
Inflow = 1.97 cfs @ 12.40 hrs, Volume= 11,423 cf
Outflow = 1.96 cfs @ 12.35 hrs, Volume= 11,053 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.15 cfs @ 10.25 hrs, Volume= 6,961 cf
Primary = 1.81 cfs @ 12.35 hrs, Volume= 4,093 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 140.89' @ 12.35 hrs Surf.Area= 802 sf Storage= 1,741 cf

Plug-Flow detention time= 57.8 min calculated for 11,026 cf (97% of inflow)
Center-of-Mass det. time= 44.8 min (793.2 - 748.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	137.50'	701 cf	**20.83'W x 38.50'L x 3.54'H Field A** 2,841 cf Overall - 1,088 cf Embedded = 1,753 cf x 40.0% Voids
#2A	138.00'	1,088 cf	**Cultec R-330XLHD** x 20 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 4 rows
		1,789 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.14'	**18.0" Round Culvert** L= 62.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 138.14' / 136.90' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	140.60'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	138.05'	**18.0" Round Culvert** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 138.00' / 138.05' S= -0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Discarded	137.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.15 cfs @ 10.25 hrs HW=137.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=1.81 cfs @ 12.35 hrs HW=140.89' (Free Discharge)
└**1=Culvert** (Passes 1.81 cfs of 12.04 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.81 cfs @ 1.54 fps)
└**3=Culvert** (Passes 1.81 cfs of 4.60 cfs potential flow)

Pond ICS-B: Infiltration Chamber System B - 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 4 rows

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

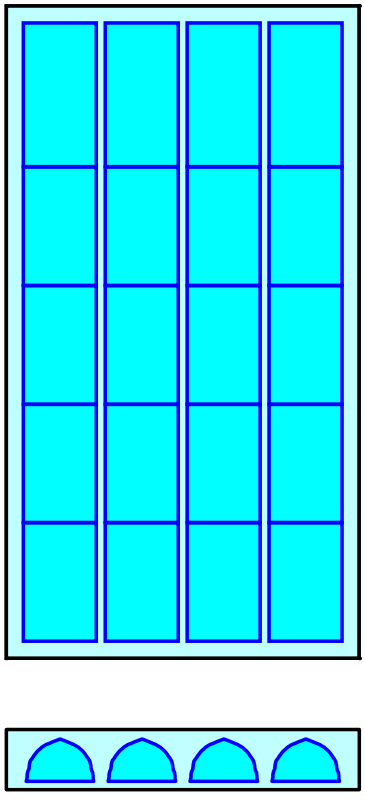
5 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 36.50' Row Length +12.0" End Stone x 2 = 38.50' Base Length
4 Rows x 52.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.83' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

20 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 4 Rows = 1,087.8 cf Chamber Storage

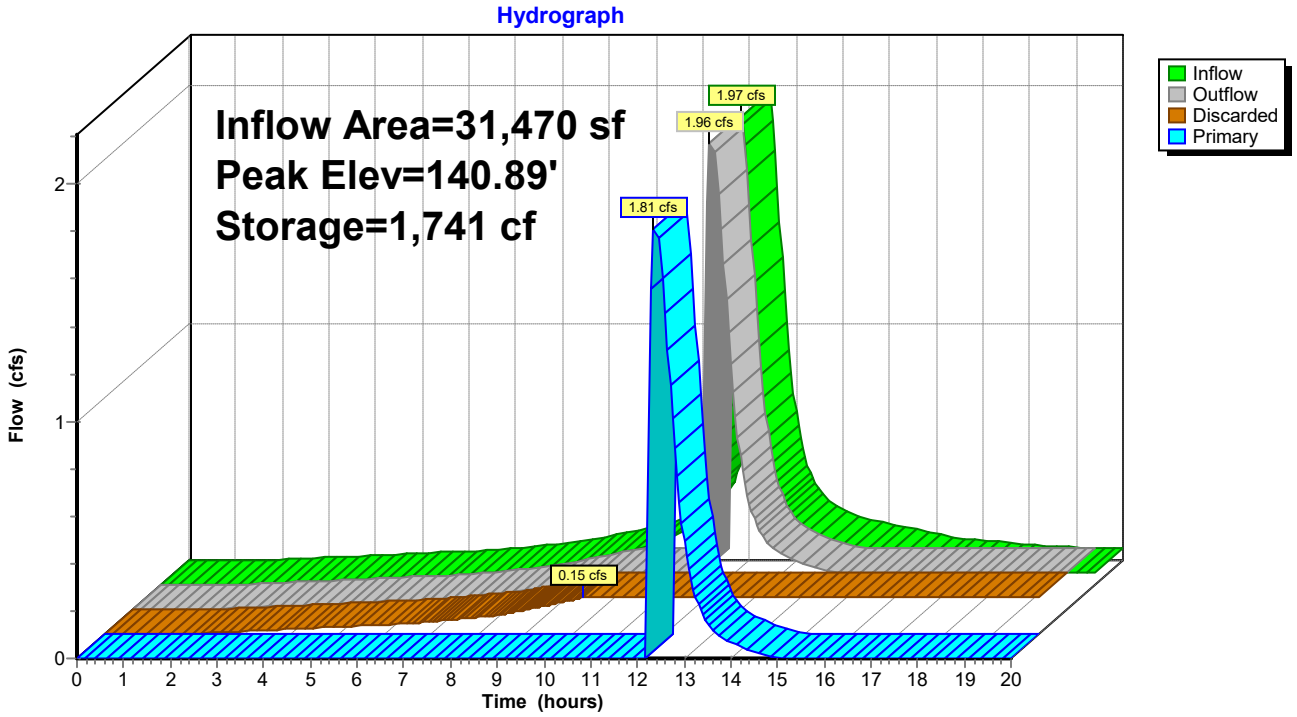
2,840.7 cf Field - 1,087.8 cf Chambers = 1,752.9 cf Stone x 40.0% Voids = 701.1 cf Stone Storage

Chamber Storage + Stone Storage = 1,789.0 cf = 0.041 af
Overall Storage Efficiency = 63.0%
Overall System Size = 38.50' x 20.83' x 3.54'

20 Chambers
105.2 cy Field
64.9 cy Stone



Pond ICS-B: Infiltration Chamber System B



Stage-Area-Storage for Pond ICS-B: Infiltration Chamber System B

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
137.50	**802**	0
137.55	802	16
137.60	802	32
137.65	802	48
137.70	802	64
137.75	802	80
137.80	802	96
137.85	802	112
137.90	802	128
137.95	802	144
138.00	802	160
138.05	802	194
138.10	802	227
138.15	802	261
138.20	802	294
138.25	802	327
138.30	802	360
138.35	802	393
138.40	802	426
138.45	802	459
138.50	802	492
138.55	802	525
138.60	802	557
138.65	802	590
138.70	802	622
138.75	802	654
138.80	802	686
138.85	802	718
138.90	802	750
138.95	802	782
139.00	802	814
139.05	802	846
139.10	802	878
139.15	802	909
139.20	802	941
139.25	802	972
139.30	802	1,003
139.35	802	1,034
139.40	802	1,064
139.45	802	1,094
139.50	802	1,124
139.55	802	1,153
139.60	802	1,183
139.65	802	1,211
139.70	802	1,240
139.75	802	1,268
139.80	802	1,296
139.85	802	1,323
139.90	802	1,350
139.95	802	1,377
140.00	802	1,402
140.05	802	1,428
140.10	802	1,452
140.15	802	1,476
140.20	802	1,499
140.25	802	1,521
140.30	802	1,542
140.35	802	1,562
140.40	802	1,581
140.45	802	1,599
140.50	802	1,615
140.55	802	1,631
140.60	802	1,647
140.65	802	1,663
140.70	802	1,679
140.75	802	1,695
140.80	802	1,711
140.85	802	1,727
140.90	802	1,744
140.95	802	1,760
141.00	802	**1,776**

Summary for Pond ICS-C: Infiltration Chambers C

Inflow Area = 125,242 sf, 84.99% Impervious, Inflow Depth > 4.23" for 10-Year event
Inflow = 6.50 cfs @ 12.57 hrs, Volume= 44,119 cf
Outflow = 6.48 cfs @ 12.60 hrs, Volume= 43,295 cf, Atten= 0%, Lag= 1.5 min
Discarded = 0.63 cfs @ 10.65 hrs, Volume= 27,261 cf
Primary = 5.85 cfs @ 12.60 hrs, Volume= 16,034 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 142.11' @ 12.60 hrs Surf.Area= 3,308 sf Storage= 6,987 cf

Plug-Flow detention time= 53.5 min calculated for 43,187 cf (98% of inflow)
Center-of-Mass det. time= 45.9 min (811.8 - 765.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	139.00'	2,768 cf	**45.00'W x 73.50'L x 3.54'H Field A** 11,714 cf Overall - 4,795 cf Embedded = 6,919 cf x 40.0% Voids
#2A	139.50'	4,795 cf	**Cultec R-330XLHD** x 90 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 9 rows
		7,562 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.51'	**24.0" Round Culvert** L= 143.0' Ke= 0.500 Inlet / Outlet Invert= 138.51' / 135.65' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	141.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	139.50'	**24.0" Round Culvert** L= 298.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 139.50' / 139.45' S= 0.0002 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#4	Discarded	139.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.63 cfs @ 10.65 hrs HW=139.04' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.63 cfs)

Primary OutFlow Max=5.84 cfs @ 12.60 hrs HW=142.11' (Free Discharge)
└**1=Culvert** (Passes 5.84 cfs of 24.38 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 5.84 cfs @ 2.41 fps)
└**3=Culvert** (Passes 5.84 cfs of 8.94 cfs potential flow)

Pond ICS-C: Infiltration Chambers C - 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 9 rows

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

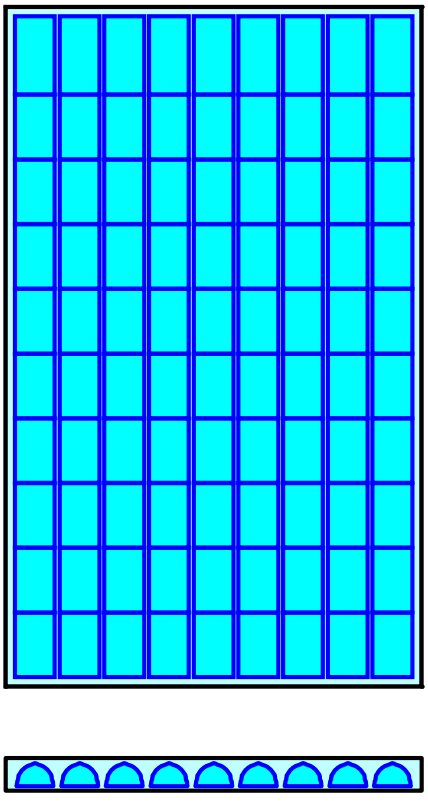
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length
9 Rows x 52.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 45.00' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

90 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 9 Rows = 4,794.7 cf Chamber Storage

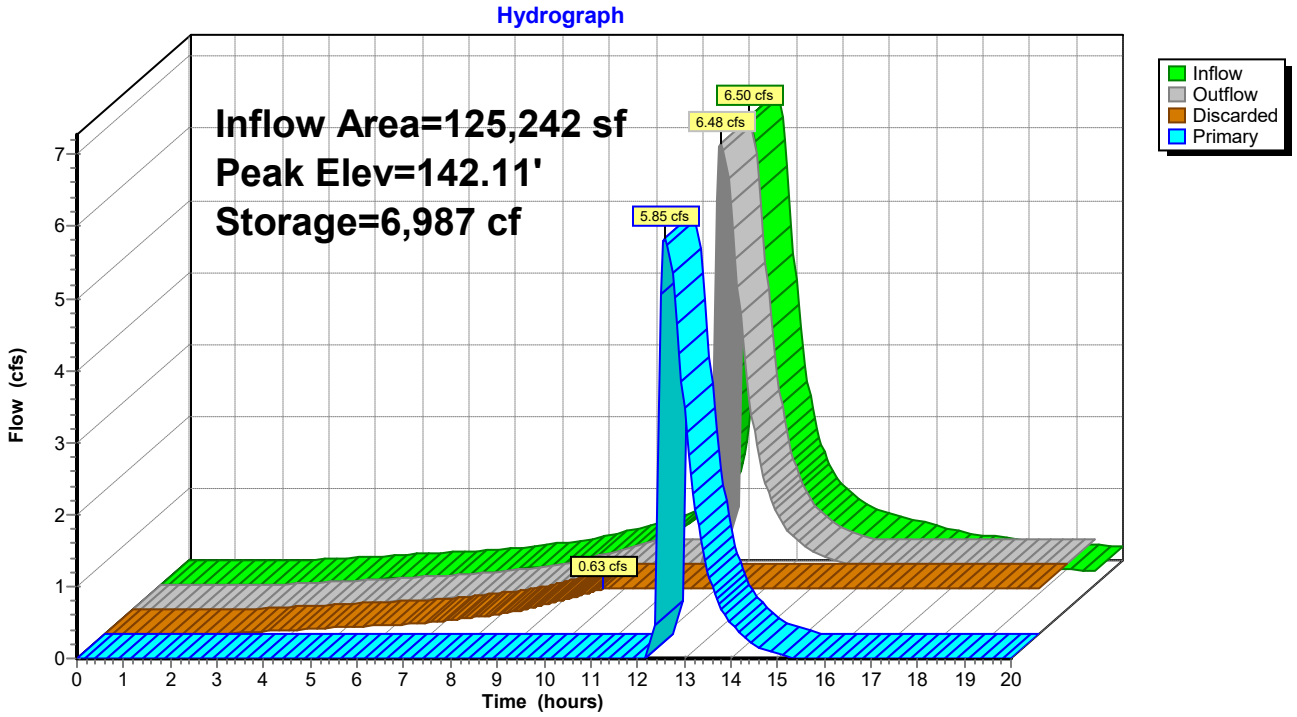
11,714.1 cf Field - 4,794.7 cf Chambers = 6,919.3 cf Stone x 40.0% Voids = 2,767.7 cf Stone Storage

Chamber Storage + Stone Storage = 7,562.5 cf = 0.174 af
Overall Storage Efficiency = 64.6%
Overall System Size = 73.50' x 45.00' x 3.54'

90 Chambers
433.9 cy Field
256.3 cy Stone



Pond ICS-C: Infiltration Chambers C



Stage-Area-Storage for Pond ICS-C: Infiltration Chambers C

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
139.00	**3,308**	0
139.05	3,308	66
139.10	3,308	132
139.15	3,308	198
139.20	3,308	265
139.25	3,308	331
139.30	3,308	397
139.35	3,308	463
139.40	3,308	529
139.45	3,308	595
139.50	3,308	662
139.55	3,308	804
139.60	3,308	947
139.65	3,308	1,089
139.70	3,308	1,231
139.75	3,308	1,372
139.80	3,308	1,513
139.85	3,308	1,654
139.90	3,308	1,795
139.95	3,308	1,936
140.00	3,308	2,077
140.05	3,308	2,217
140.10	3,308	2,357
140.15	3,308	2,496
140.20	3,308	2,633
140.25	3,308	2,771
140.30	3,308	2,907
140.35	3,308	3,044
140.40	3,308	3,180
140.45	3,308	3,316
140.50	3,308	3,452
140.55	3,308	3,587
140.60	3,308	3,722
140.65	3,308	3,857
140.70	3,308	3,992
140.75	3,308	4,125
140.80	3,308	4,257
140.85	3,308	4,388
140.90	3,308	4,517
140.95	3,308	4,645
141.00	3,308	4,772
141.05	3,308	4,897
141.10	3,308	5,021
141.15	3,308	5,144
141.20	3,308	5,265
141.25	3,308	5,384
141.30	3,308	5,502
141.35	3,308	5,618
141.40	3,308	5,732
141.45	3,308	5,844
141.50	3,308	5,954
141.55	3,308	6,061
141.60	3,308	6,165
141.65	3,308	6,265
141.70	3,308	6,362
141.75	3,308	6,455
141.80	3,308	6,543
141.85	3,308	6,625
141.90	3,308	6,703
141.95	3,308	6,777
142.00	3,308	6,846
142.05	3,308	6,912
142.10	3,308	6,978
142.15	3,308	7,044
142.20	3,308	7,110
142.25	3,308	7,177
142.30	3,308	7,243
142.35	3,308	7,309
142.40	3,308	7,375
142.45	3,308	7,441
142.50	3,308	**7,507**

Summary for Subcatchment DW: Direct to Wetland

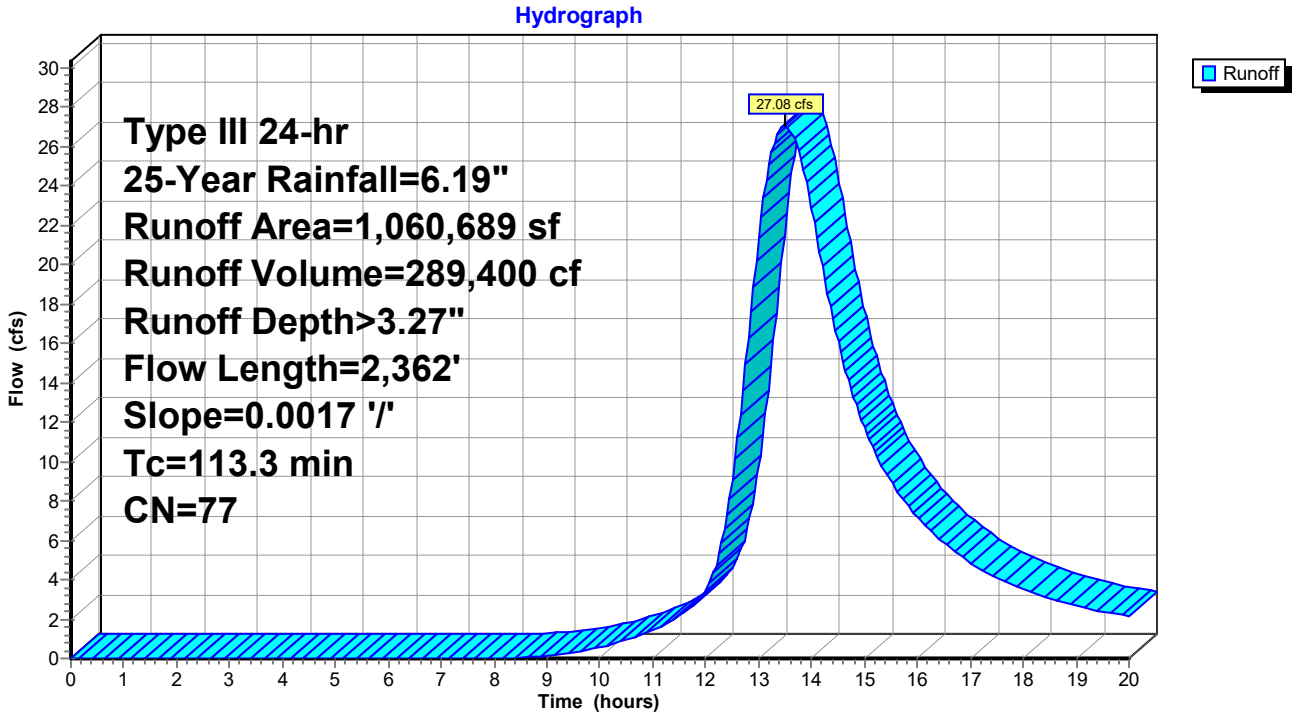
Runoff = 27.08 cfs @ 13.48 hrs, Volume= 289,400 cf, Depth> 3.27"

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

	Area (sf)	CN	Description
	15,524	30	Woods, Good, HSG A
	1,486	39	>75% Grass cover, Good, HSG A
	205	98	Paved parking, HSG A
	1,064	55	Woods, Good, HSG B
	289,391	77	Woods, Good, HSG D
	7,064	96	Gravel surface, HSG D
	23,270	80	>75% Grass cover, Good, HSG D
*	720,013	78	Wetland, HSG D
	2,672	98	Paved parking, HSG D
	1,060,689	77	Weighted Average
	1,057,812		99.73% Pervious Area
	2,877		0.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	50	0.0017	0.01		**Sheet Flow, Wooded - AB** Woods: Dense underbrush n= 0.800 P2= 3.35"
8.6	341	0.0017	0.66		**Shallow Concentrated Flow, Wooded - BC** Unpaved Kv= 16.1 fps
0.2	51	0.0017	3.51	11.02	**Pipe Channel, Culvert - CD** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011
48.2	1,920	0.0017	0.66		**Shallow Concentrated Flow, Wooded - DE** Unpaved Kv= 16.1 fps
113.3	2,362	Total			

Subcatchment DW: Direct to Wetland



Summary for Subcatchment EN: Entrance Subcatchment

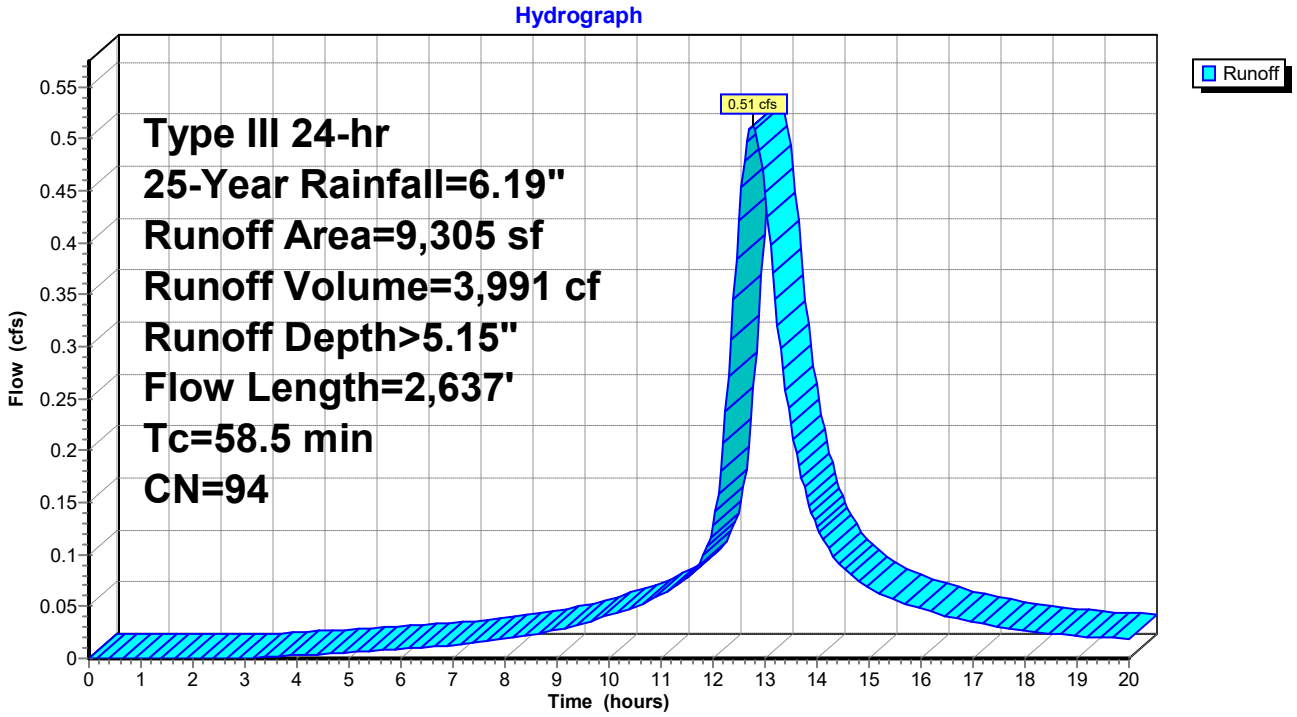
Runoff = 0.51 cfs @ 12.76 hrs, Volume= 3,991 cf, Depth> 5.15"

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

Area (sf)	CN	Description
335	39	>75% Grass cover, Good, HSG A
4,348	98	Paved parking, HSG A
140	61	>75% Grass cover, Good, HSG B
469	98	Paved parking, HSG B
630	80	>75% Grass cover, Good, HSG D
3,383	98	Paved parking, HSG D
9,305	94	Weighted Average
1,105		11.88% Pervious Area
8,200		88.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0300	1.44		**Sheet Flow, Road - AB** Smooth surfaces n= 0.011 P2= 3.35"
0.8	169	0.0300	3.52		**Shallow Concentrated Flow, Road - BC** Paved Kv= 20.3 fps
0.2	31	0.0050	3.21	2.52	**Pipe Channel, Pipe-CD** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.7	148	0.0040	3.76	6.64	**Pipe Channel, Pipe-DE** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
56.2	2,239	0.0017	0.66		**Shallow Concentrated Flow, Wooded - EF** Unpaved Kv= 16.1 fps
58.5	2,637	Total			

Subcatchment EN: Entrance Subcatchment



Summary for Subcatchment S-A: Subcatchment A

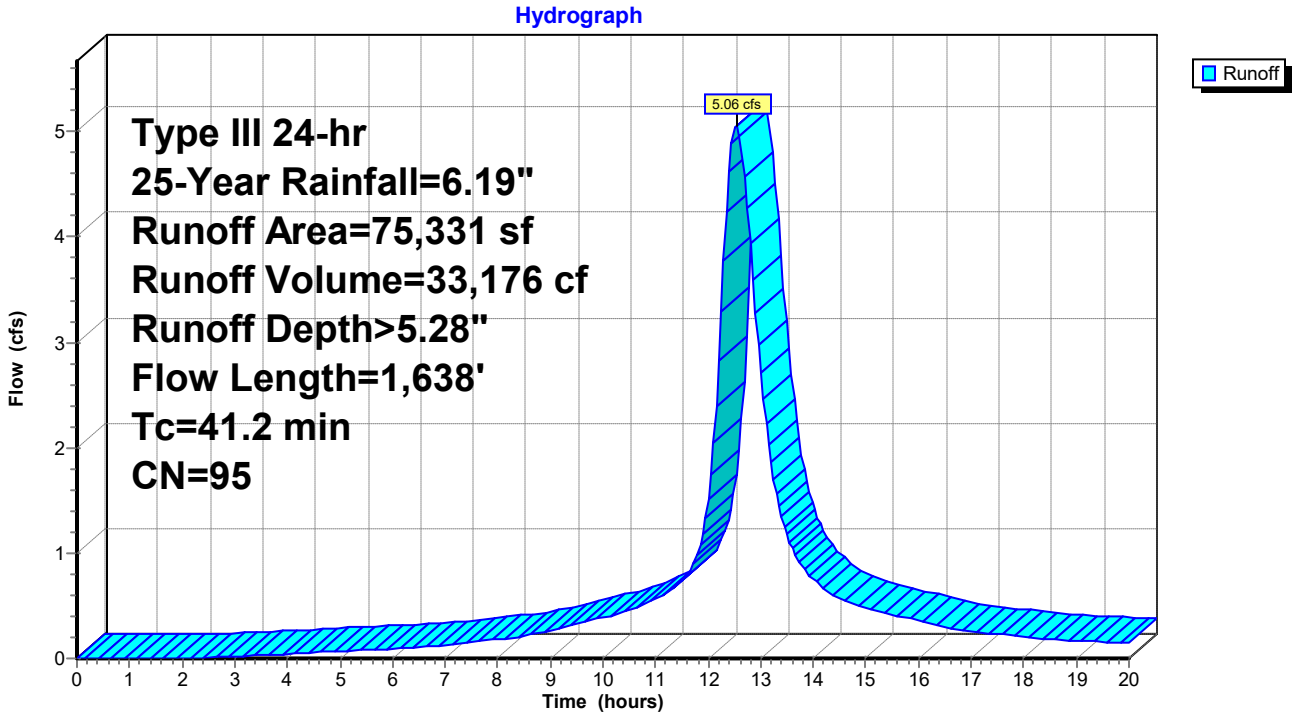
Runoff = 5.06 cfs @ 12.54 hrs, Volume= 33,176 cf, Depth> 5.28"

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

Area (sf)	CN	Description
11,823	80	>75% Grass cover, Good, HSG D
63,508	98	Paved parking, HSG D
75,331	95	Weighted Average
11,823		15.69% Pervious Area
63,508		84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		**Sheet Flow, Grass - AB** Grass: Short n= 0.150 P2= 3.35"
1.1	77	0.0050	1.14		**Shallow Concentrated Flow, Grass - BC** Unpaved Kv= 16.1 fps
1.9	188	0.0100	1.61		**Shallow Concentrated Flow, Parking - CD** Unpaved Kv= 16.1 fps
0.4	117	0.0100	4.54	3.56	**Pipe Channel, Pipe - DE** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.1	44		6.95		**Lake or Reservoir, Chambers - EF** Mean Depth= 1.50'
0.2	50	0.0050	4.20	7.43	**Pipe Channel, Pipe - FG** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.9	1,112	0.0017	0.66		**Shallow Concentrated Flow, Wooded - GH** Unpaved Kv= 16.1 fps
41.2	1,638	Total			

Subcatchment S-A: Subcatchment A



Summary for Subcatchment S-B: Subcatchment B

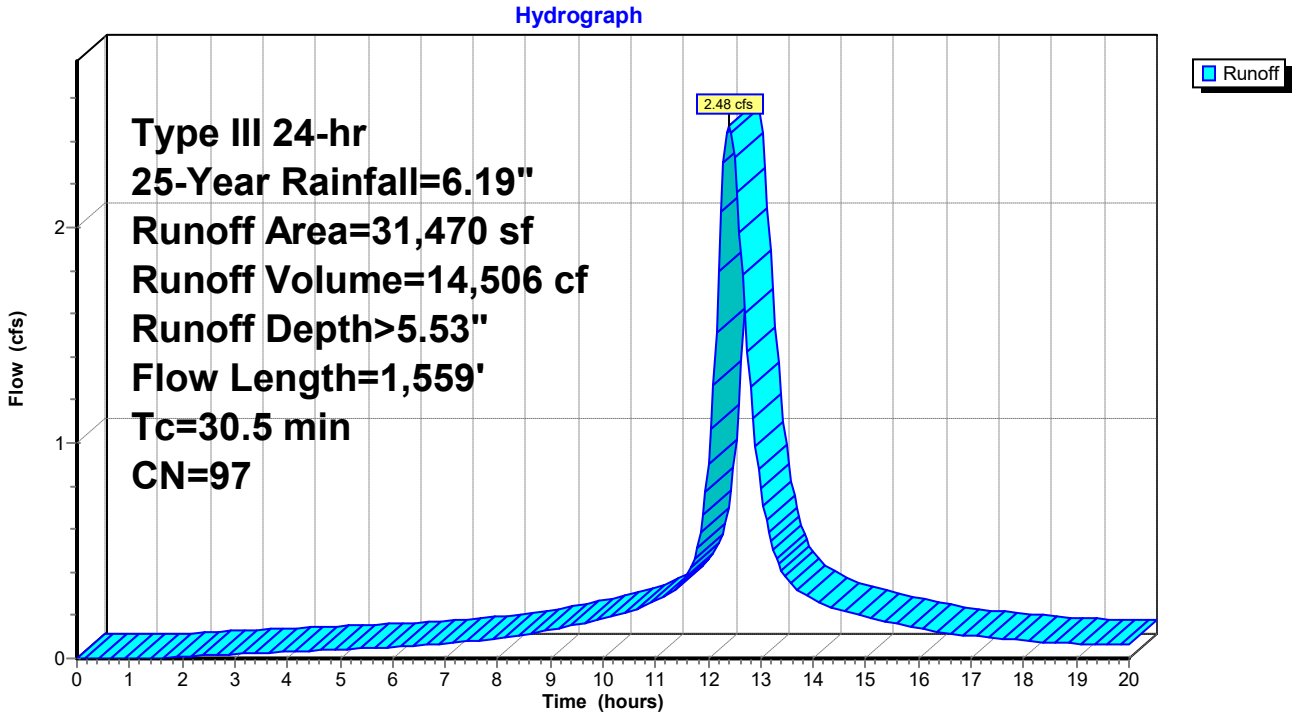
Runoff = 2.48 cfs @ 12.40 hrs, Volume= 14,506 cf, Depth> 5.53"

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

Area (sf)	CN	Description
2,392	80	>75% Grass cover, Good, HSG D
29,078	98	Paved parking, HSG D
31,470	97	Weighted Average
2,392		7.60% Pervious Area
29,078		92.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.93		**Sheet Flow, Parking - AB** Smooth surfaces n= 0.011 P2= 3.35"
1.5	184	0.0100	2.03		**Shallow Concentrated Flow, Parking - BC** Paved Kv= 20.3 fps
0.3	95	0.0100	4.54	3.56	**Pipe Channel, Pipe - CD** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.2	73		6.95		**Lake or Reservoir, Chambers - DE** Mean Depth= 1.50'
0.3	70	0.0050	4.20	7.43	**Pipe Channel, Pipe - EF** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.3	1,087	0.0017	0.66		**Shallow Concentrated Flow, Wooded - FG** Unpaved Kv= 16.1 fps
30.5	1,559	Total			

Subcatchment S-B: Subcatchment B



Summary for Subcatchment S-C: Subcatchment C

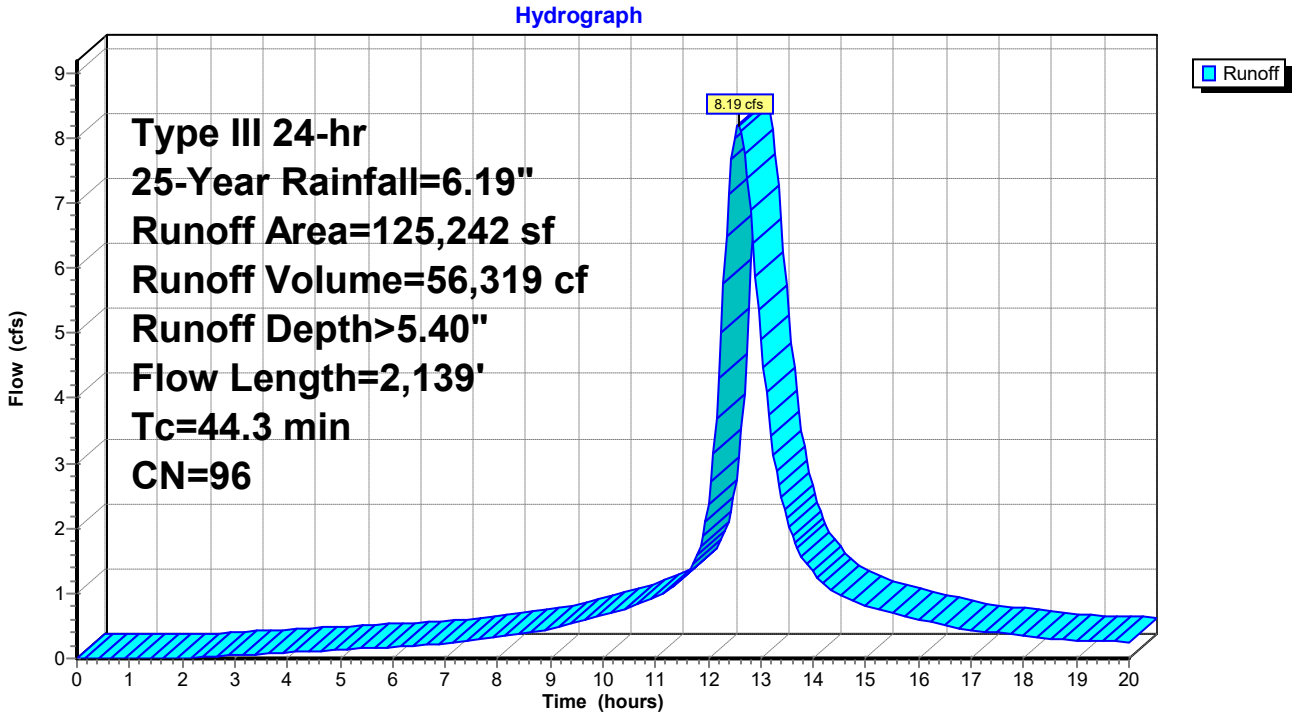
Runoff = 8.19 cfs @ 12.57 hrs, Volume= 56,319 cf, Depth> 5.40"

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

Area (sf)	CN	Description
2,830	96	Gravel surface, HSG D
15,974	80	>75% Grass cover, Good, HSG D
106,438	98	Paved parking, HSG D
125,242	96	Weighted Average
18,804		15.01% Pervious Area
106,438		84.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		**Sheet Flow, Grass - AB** Grass: Short n= 0.150 P2= 3.35"
2.4	165	0.0050	1.14		**Shallow Concentrated Flow, Grass - BC** Unpaved Kv= 16.1 fps
1.7	207	0.0100	2.03		**Shallow Concentrated Flow, Road - CD** Paved Kv= 20.3 fps
0.2	59	0.0100	4.54	3.56	**Pipe Channel, Pipe - DE** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.2	72		6.95		**Lake or Reservoir, Chambers - EF** Mean Depth= 1.50'
1.5	444	0.0050	5.09	16.00	**Pipe Channel, Pipe - FG** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
28.7	1,142	0.0017	0.66		**Shallow Concentrated Flow, Wooded - GH** Unpaved Kv= 16.1 fps
44.3	2,139	Total			

Subcatchment S-C: Subcatchment C

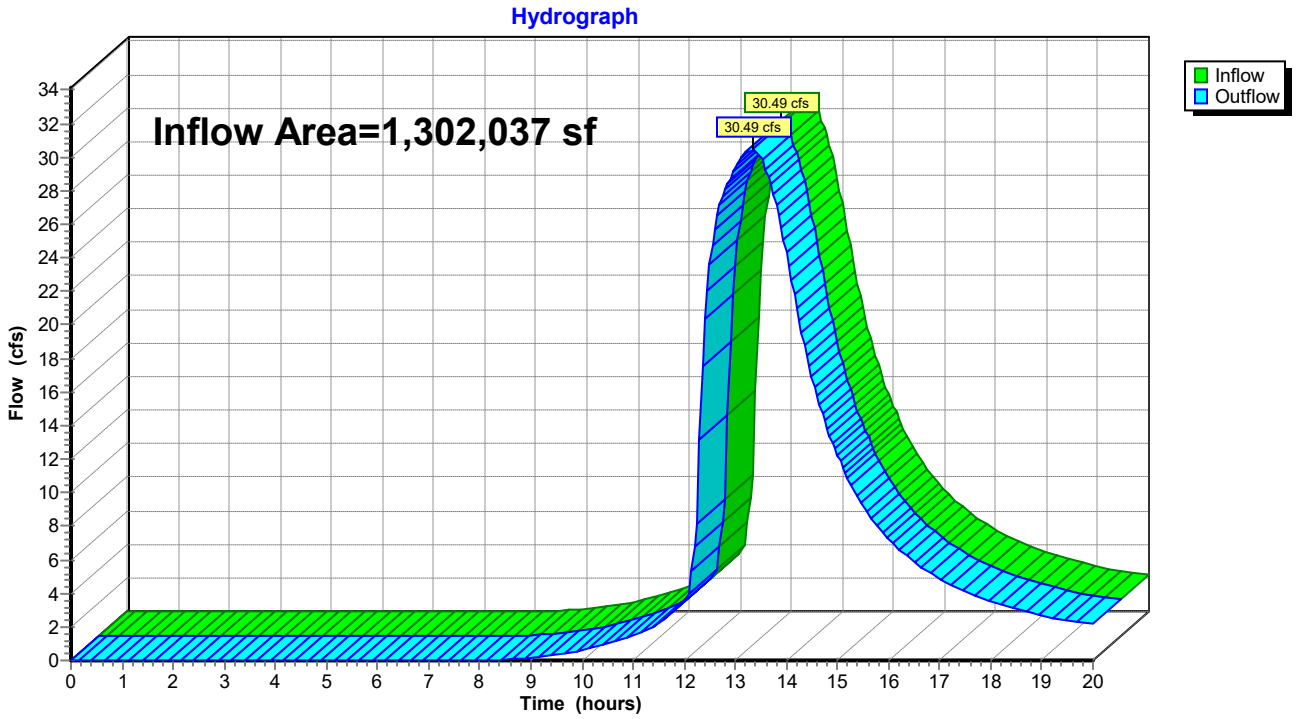


Summary for Reach T: Total Offsite

Inflow Area = 1,302,037 sf, 16.14% Impervious, Inflow Depth > 3.13" for 25-Year event
Inflow = 30.49 cfs @ 13.35 hrs, Volume= 339,998 cf
Outflow = 30.49 cfs @ 13.35 hrs, Volume= 339,998 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Reach T: Total Offsite



Summary for Pond ICS-A: Infiltration Chambers A

Inflow Area = 75,331 sf, 84.31% Impervious, Inflow Depth > 5.28" for 25-Year event
Inflow = 5.06 cfs @ 12.54 hrs, Volume= 33,176 cf
Outflow = 5.06 cfs @ 12.55 hrs, Volume= 31,561 cf, Atten= 0%, Lag= 1.0 min
Discarded = 0.36 cfs @ 9.80 hrs, Volume= 16,285 cf
Primary = 4.71 cfs @ 12.55 hrs, Volume= 15,275 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 141.78' @ 12.55 hrs Surf.Area= 1,855 sf Storage= 4,016 cf

Plug-Flow detention time= 48.1 min calculated for 31,561 cf (95% of inflow)
Center-of-Mass det. time= 29.8 min (793.4 - 763.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	138.50'	1,574 cf	**35.33'W x 52.50'L x 3.54'H Field A** 6,570 cf Overall - 2,634 cf Embedded = 3,936 cf x 40.0% Voids
#2A	139.00'	2,634 cf	**Cultec R-330XLHD** x 49 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 7 rows
		4,208 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	136.24'	**18.0" Round Culvert** L= 27.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 136.24' / 135.70' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	141.25'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	139.50'	**18.0" Round Culvert** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 139.50' / 139.40' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Discarded	138.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.36 cfs @ 9.80 hrs HW=138.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.36 cfs)

Primary OutFlow Max=4.70 cfs @ 12.55 hrs HW=141.78' (Free Discharge)
└**1=Culvert** (Passes 4.70 cfs of 18.63 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 4.70 cfs @ 2.21 fps)
└**3=Culvert** (Passes 4.70 cfs of 6.21 cfs potential flow)

Pond ICS-A: Infiltration Chambers A - 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 7 rows

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

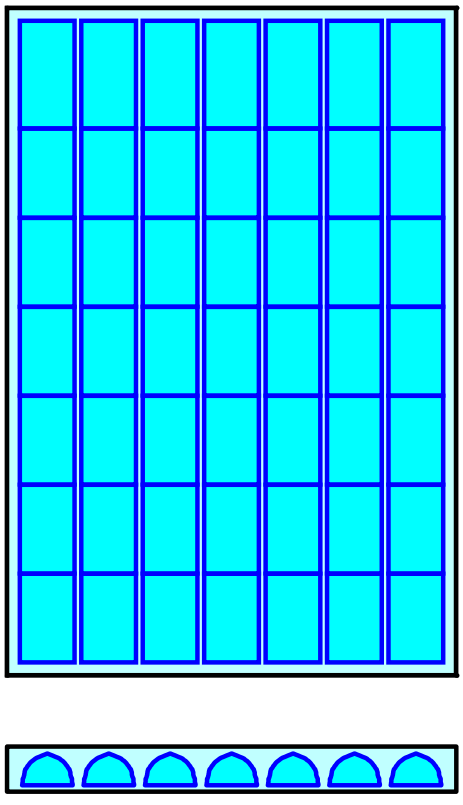
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
7 Rows x 52.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 35.33' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

49 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 7 Rows = 2,633.9 cf Chamber Storage

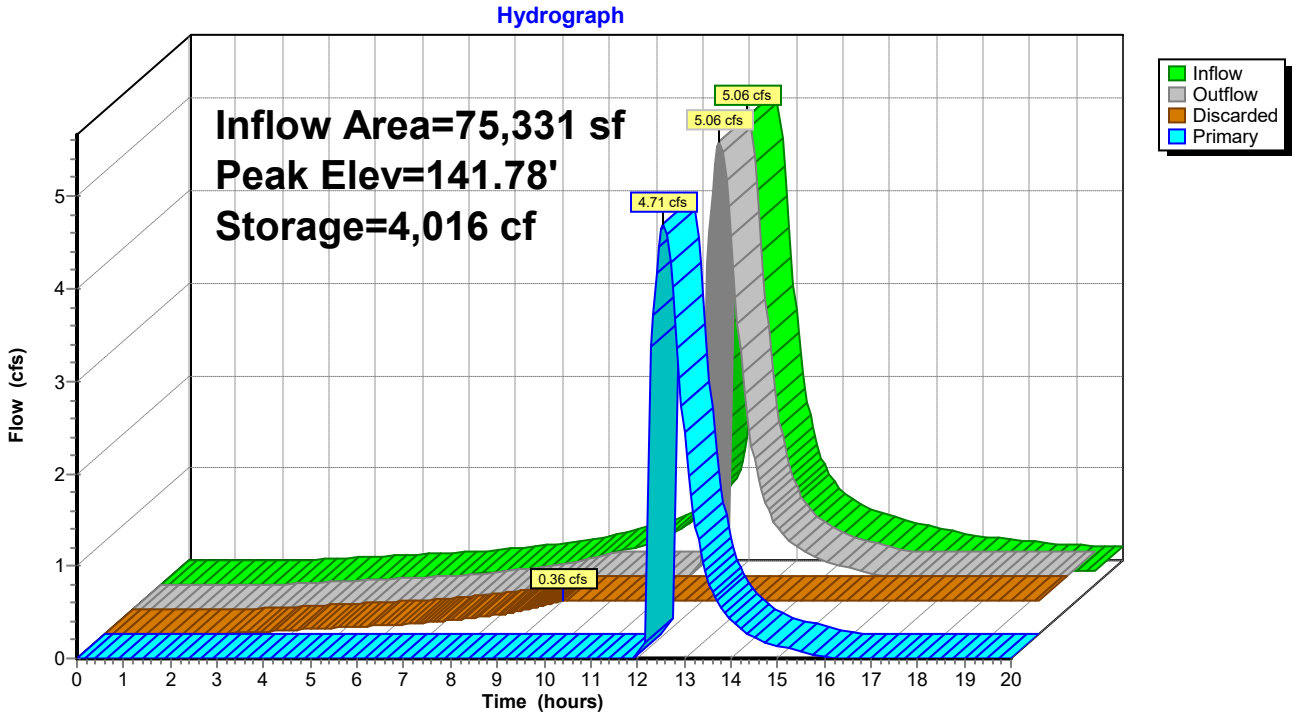
6,569.8 cf Field - 2,633.9 cf Chambers = 3,935.9 cf Stone x 40.0% Voids = 1,574.3 cf Stone Storage

Chamber Storage + Stone Storage = 4,208.3 cf = 0.097 af
Overall Storage Efficiency = 64.1%
Overall System Size = 52.50' x 35.33' x 3.54'

49 Chambers
243.3 cy Field
145.8 cy Stone



Pond ICS-A: Infiltration Chambers A



Stage-Area-Storage for Pond ICS-A: Infiltration Chambers A

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
138.50	**1,855**	0
138.55	1,855	37
138.60	1,855	74
138.65	1,855	111
138.70	1,855	148
138.75	1,855	186
138.80	1,855	223
138.85	1,855	260
138.90	1,855	297
138.95	1,855	334
139.00	1,855	371
139.05	1,855	450
139.10	1,855	529
139.15	1,855	608
139.20	1,855	687
139.25	1,855	765
139.30	1,855	844
139.35	1,855	922
139.40	1,855	1,000
139.45	1,855	1,078
139.50	1,855	1,156
139.55	1,855	1,234
139.60	1,855	1,312
139.65	1,855	1,388
139.70	1,855	1,465
139.75	1,855	1,541
139.80	1,855	1,617
139.85	1,855	1,693
139.90	1,855	1,768
139.95	1,855	1,844
140.00	1,855	1,919
140.05	1,855	1,994
140.10	1,855	2,069
140.15	1,855	2,144
140.20	1,855	2,219
140.25	1,855	2,293
140.30	1,855	2,366
140.35	1,855	2,439
140.40	1,855	2,510
140.45	1,855	2,581
140.50	1,855	2,652
140.55	1,855	2,721
140.60	1,855	2,790
140.65	1,855	2,858
140.70	1,855	2,926
140.75	1,855	2,992
140.80	1,855	3,058
140.85	1,855	3,122
140.90	1,855	3,186
140.95	1,855	3,248
141.00	1,855	3,309
141.05	1,855	3,368
141.10	1,855	3,426
141.15	1,855	3,482
141.20	1,855	3,536
141.25	1,855	3,588
141.30	1,855	3,637
141.35	1,855	3,683
141.40	1,855	3,727
141.45	1,855	3,768
141.50	1,855	3,806
141.55	1,855	3,843
141.60	1,855	3,881
141.65	1,855	3,918
141.70	1,855	3,955
141.75	1,855	3,992
141.80	1,855	4,029
141.85	1,855	4,066
141.90	1,855	4,103
141.95	1,855	4,140
142.00	1,855	**4,177**

Summary for Pond ICS-B: Infiltration Chamber System B

Inflow Area = 31,470 sf, 92.40% Impervious, Inflow Depth > 5.53" for 25-Year event
Inflow = 2.48 cfs @ 12.40 hrs, Volume= 14,506 cf
Outflow = 2.49 cfs @ 12.41 hrs, Volume= 13,812 cf, Atten= 0%, Lag= 0.5 min
Discarded = 0.15 cfs @ 9.45 hrs, Volume= 7,438 cf
Primary = 2.34 cfs @ 12.41 hrs, Volume= 6,374 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 140.94' @ 12.41 hrs Surf.Area= 802 sf Storage= 1,758 cf

Plug-Flow detention time= 50.0 min calculated for 13,777 cf (95% of inflow)
Center-of-Mass det. time= 31.5 min (775.7 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	137.50'	701 cf	**20.83'W x 38.50'L x 3.54'H Field A** 2,841 cf Overall - 1,088 cf Embedded = 1,753 cf x 40.0% Voids
#2A	138.00'	1,088 cf	**Cultec R-330XLHD** x 20 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 4 rows
		1,789 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.14'	**18.0" Round Culvert** L= 62.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 138.14' / 136.90' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	140.60'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	138.05'	**18.0" Round Culvert** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 138.00' / 138.05' S= -0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Discarded	137.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.15 cfs @ 9.45 hrs HW=137.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=2.32 cfs @ 12.41 hrs HW=140.94' (Free Discharge)
└**1=Culvert** (Passes 2.32 cfs of 12.19 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 2.32 cfs @ 1.69 fps)
└**3=Culvert** (Passes 2.32 cfs of 4.99 cfs potential flow)

Pond ICS-B: Infiltration Chamber System B - 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 4 rows

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

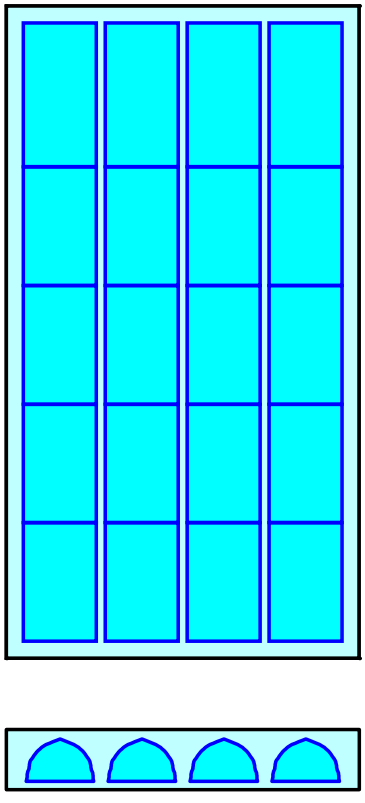
5 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 36.50' Row Length +12.0" End Stone x 2 = 38.50' Base Length
4 Rows x 52.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.83' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

20 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 4 Rows = 1,087.8 cf Chamber Storage

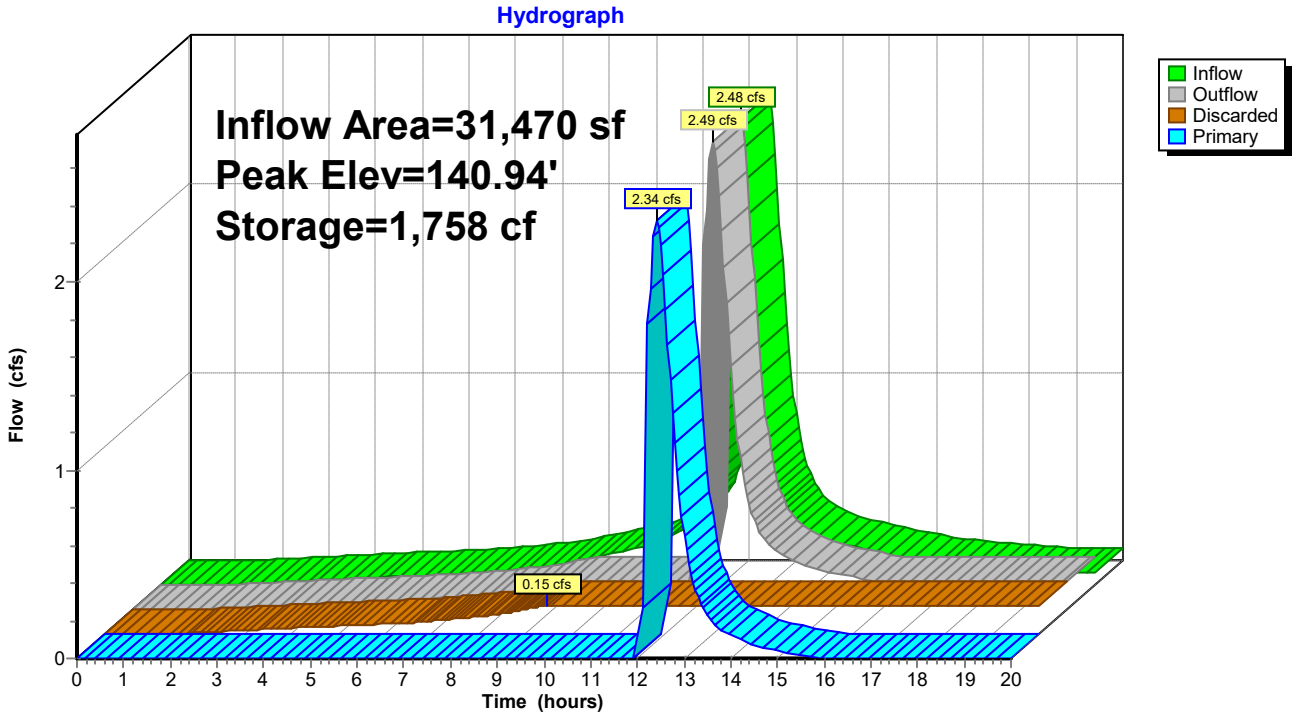
2,840.7 cf Field - 1,087.8 cf Chambers = 1,752.9 cf Stone x 40.0% Voids = 701.1 cf Stone Storage

Chamber Storage + Stone Storage = 1,789.0 cf = 0.041 af
Overall Storage Efficiency = 63.0%
Overall System Size = 38.50' x 20.83' x 3.54'

20 Chambers
105.2 cy Field
64.9 cy Stone



Pond ICS-B: Infiltration Chamber System B



Stage-Area-Storage for Pond ICS-B: Infiltration Chamber System B

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
137.50	**802**	0
137.55	802	16
137.60	802	32
137.65	802	48
137.70	802	64
137.75	802	80
137.80	802	96
137.85	802	112
137.90	802	128
137.95	802	144
138.00	802	160
138.05	802	194
138.10	802	227
138.15	802	261
138.20	802	294
138.25	802	327
138.30	802	360
138.35	802	393
138.40	802	426
138.45	802	459
138.50	802	492
138.55	802	525
138.60	802	557
138.65	802	590
138.70	802	622
138.75	802	654
138.80	802	686
138.85	802	718
138.90	802	750
138.95	802	782
139.00	802	814
139.05	802	846
139.10	802	878
139.15	802	909
139.20	802	941
139.25	802	972
139.30	802	1,003
139.35	802	1,034
139.40	802	1,064
139.45	802	1,094
139.50	802	1,124
139.55	802	1,153
139.60	802	1,183
139.65	802	1,211
139.70	802	1,240
139.75	802	1,268
139.80	802	1,296
139.85	802	1,323
139.90	802	1,350
139.95	802	1,377
140.00	802	1,402
140.05	802	1,428
140.10	802	1,452
140.15	802	1,476
140.20	802	1,499
140.25	802	1,521
140.30	802	1,542
140.35	802	1,562
140.40	802	1,581
140.45	802	1,599
140.50	802	1,615
140.55	802	1,631
140.60	802	1,647
140.65	802	1,663
140.70	802	1,679
140.75	802	1,695
140.80	802	1,711
140.85	802	1,727
140.90	802	1,744
140.95	802	1,760
141.00	802	**1,776**

Summary for Pond ICS-C: Infiltration Chambers C

Inflow Area = 125,242 sf, 84.99% Impervious, Inflow Depth > 5.40" for 25-Year event
Inflow = 8.19 cfs @ 12.57 hrs, Volume= 56,319 cf
Outflow = 8.18 cfs @ 12.60 hrs, Volume= 54,174 cf, Atten= 0%, Lag= 1.5 min
Discarded = 0.63 cfs @ 9.90 hrs, Volume= 29,217 cf
Primary = 7.54 cfs @ 12.60 hrs, Volume= 24,958 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 142.20' @ 12.60 hrs Surf.Area= 3,308 sf Storage= 7,115 cf

Plug-Flow detention time= 47.0 min calculated for 54,039 cf (96% of inflow)
Center-of-Mass det. time= 32.3 min (793.5 - 761.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	139.00'	2,768 cf	**45.00'W x 73.50'L x 3.54'H Field A** 11,714 cf Overall - 4,795 cf Embedded = 6,919 cf x 40.0% Voids
#2A	139.50'	4,795 cf	**Cultec R-330XLHD** x 90 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 9 rows
		7,562 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.51'	**24.0" Round Culvert** L= 143.0' Ke= 0.500 Inlet / Outlet Invert= 138.51' / 135.65' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	141.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	139.50'	**24.0" Round Culvert** L= 298.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 139.50' / 139.45' S= 0.0002 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#4	Discarded	139.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.63 cfs @ 9.90 hrs HW=139.04' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.63 cfs)

Primary OutFlow Max=7.54 cfs @ 12.60 hrs HW=142.20' (Free Discharge)
└**1=Culvert** (Passes 7.54 cfs of 24.82 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 7.54 cfs @ 2.68 fps)
└**3=Culvert** (Passes 7.54 cfs of 9.26 cfs potential flow)

Pond ICS-C: Infiltration Chambers C - 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 9 rows

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

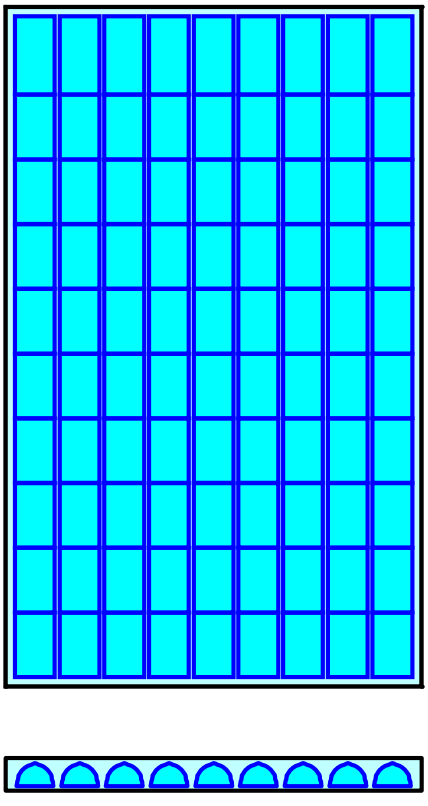
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length
9 Rows x 52.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 45.00' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

90 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 9 Rows = 4,794.7 cf Chamber Storage

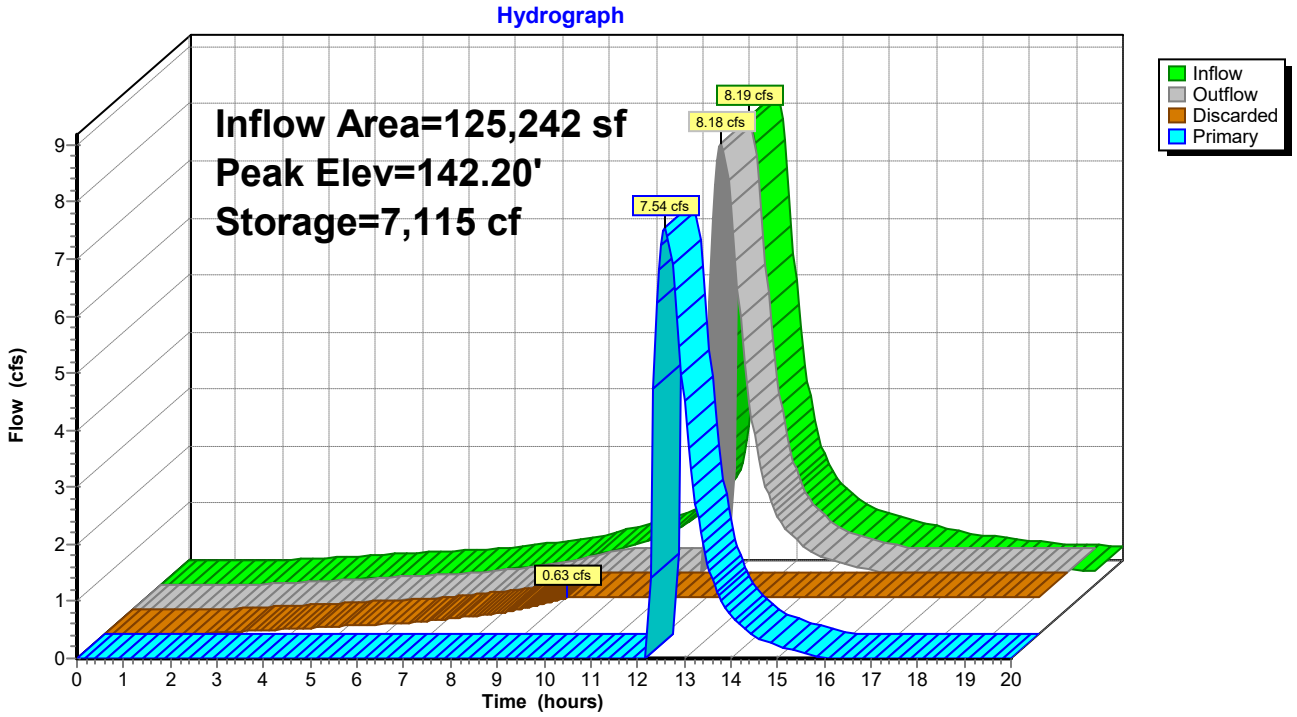
11,714.1 cf Field - 4,794.7 cf Chambers = 6,919.3 cf Stone x 40.0% Voids = 2,767.7 cf Stone Storage

Chamber Storage + Stone Storage = 7,562.5 cf = 0.174 af
Overall Storage Efficiency = 64.6%
Overall System Size = 73.50' x 45.00' x 3.54'

90 Chambers
433.9 cy Field
256.3 cy Stone



Pond ICS-C: Infiltration Chambers C



Stage-Area-Storage for Pond ICS-C: Infiltration Chambers C

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
139.00	**3,308**	0
139.05	3,308	66
139.10	3,308	132
139.15	3,308	198
139.20	3,308	265
139.25	3,308	331
139.30	3,308	397
139.35	3,308	463
139.40	3,308	529
139.45	3,308	595
139.50	3,308	662
139.55	3,308	804
139.60	3,308	947
139.65	3,308	1,089
139.70	3,308	1,231
139.75	3,308	1,372
139.80	3,308	1,513
139.85	3,308	1,654
139.90	3,308	1,795
139.95	3,308	1,936
140.00	3,308	2,077
140.05	3,308	2,217
140.10	3,308	2,357
140.15	3,308	2,496
140.20	3,308	2,633
140.25	3,308	2,771
140.30	3,308	2,907
140.35	3,308	3,044
140.40	3,308	3,180
140.45	3,308	3,316
140.50	3,308	3,452
140.55	3,308	3,587
140.60	3,308	3,722
140.65	3,308	3,857
140.70	3,308	3,992
140.75	3,308	4,125
140.80	3,308	4,257
140.85	3,308	4,388
140.90	3,308	4,517
140.95	3,308	4,645
141.00	3,308	4,772
141.05	3,308	4,897
141.10	3,308	5,021
141.15	3,308	5,144
141.20	3,308	5,265
141.25	3,308	5,384
141.30	3,308	5,502
141.35	3,308	5,618
141.40	3,308	5,732
141.45	3,308	5,844
141.50	3,308	5,954
141.55	3,308	6,061
141.60	3,308	6,165
141.65	3,308	6,265
141.70	3,308	6,362
141.75	3,308	6,455
141.80	3,308	6,543
141.85	3,308	6,625
141.90	3,308	6,703
141.95	3,308	6,777
142.00	3,308	6,846
142.05	3,308	6,912
142.10	3,308	6,978
142.15	3,308	7,044
142.20	3,308	7,110
142.25	3,308	7,177
142.30	3,308	7,243
142.35	3,308	7,309
142.40	3,308	7,375
142.45	3,308	7,441
142.50	3,308	**7,507**

Summary for Subcatchment DW: Direct to Wetland

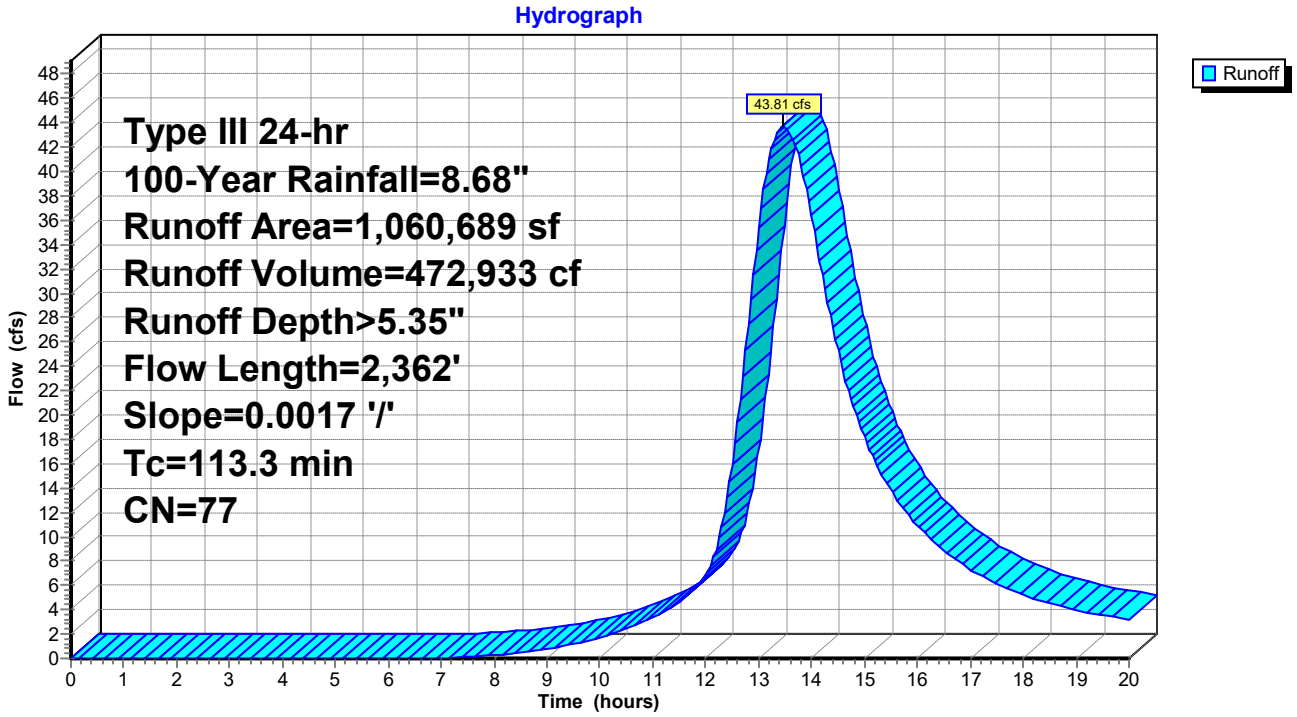
Runoff = 43.81 cfs @ 13.47 hrs, Volume= 472,933 cf, Depth> 5.35"

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

	Area (sf)	CN	Description
	15,524	30	Woods, Good, HSG A
	1,486	39	>75% Grass cover, Good, HSG A
	205	98	Paved parking, HSG A
	1,064	55	Woods, Good, HSG B
	289,391	77	Woods, Good, HSG D
	7,064	96	Gravel surface, HSG D
	23,270	80	>75% Grass cover, Good, HSG D
*	720,013	78	Wetland, HSG D
	2,672	98	Paved parking, HSG D
	1,060,689	77	Weighted Average
	1,057,812		99.73% Pervious Area
	2,877		0.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.3	50	0.0017	0.01		**Sheet Flow, Wooded - AB** Woods: Dense underbrush n= 0.800 P2= 3.35"
8.6	341	0.0017	0.66		**Shallow Concentrated Flow, Wooded - BC** Unpaved Kv= 16.1 fps
0.2	51	0.0017	3.51	11.02	**Pipe Channel, Culvert - CD** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011
48.2	1,920	0.0017	0.66		**Shallow Concentrated Flow, Wooded - DE** Unpaved Kv= 16.1 fps
113.3	2,362	Total			

Subcatchment DW: Direct to Wetland



Summary for Subcatchment EN: Entrance Subcatchment

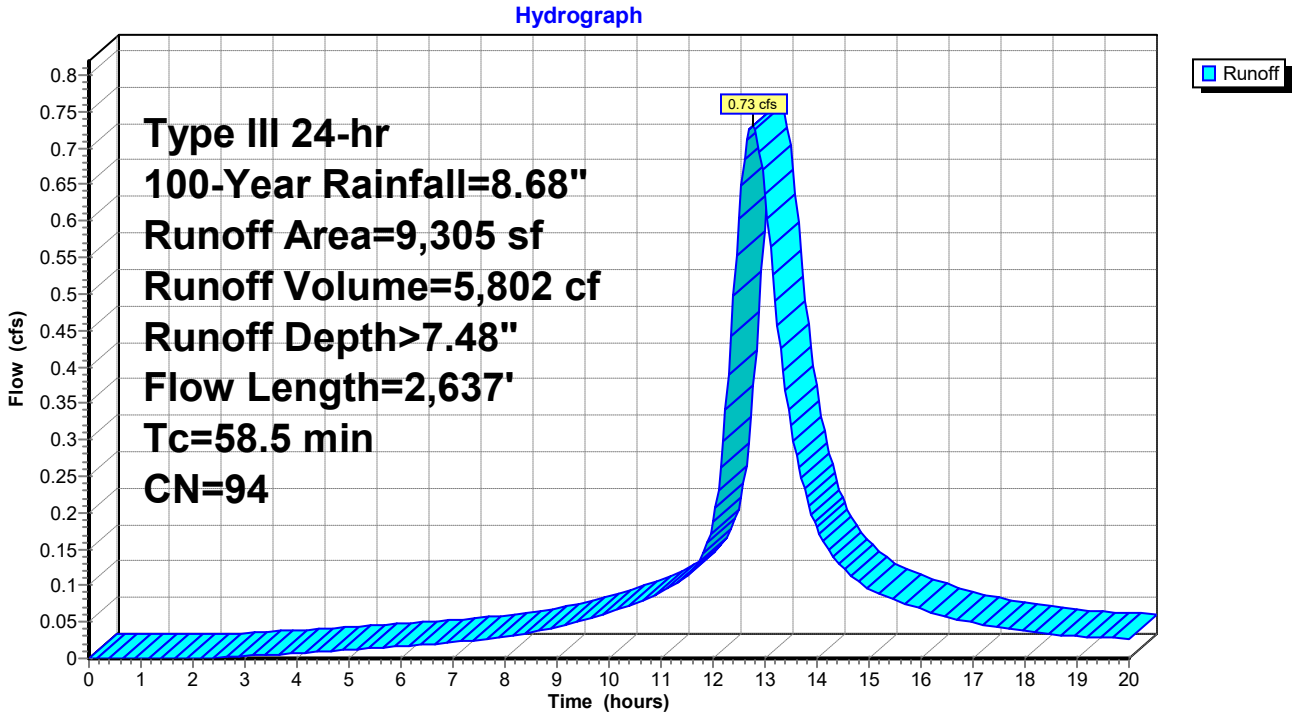
Runoff = 0.73 cfs @ 12.76 hrs, Volume= 5,802 cf, Depth> 7.48"

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

Area (sf)	CN	Description
335	39	>75% Grass cover, Good, HSG A
4,348	98	Paved parking, HSG A
140	61	>75% Grass cover, Good, HSG B
469	98	Paved parking, HSG B
630	80	>75% Grass cover, Good, HSG D
3,383	98	Paved parking, HSG D
9,305	94	Weighted Average
1,105		11.88% Pervious Area
8,200		88.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0300	1.44		**Sheet Flow, Road - AB** Smooth surfaces n= 0.011 P2= 3.35"
0.8	169	0.0300	3.52		**Shallow Concentrated Flow, Road - BC** Paved Kv= 20.3 fps
0.2	31	0.0050	3.21	2.52	**Pipe Channel, Pipe-CD** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.7	148	0.0040	3.76	6.64	**Pipe Channel, Pipe-DE** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
56.2	2,239	0.0017	0.66		**Shallow Concentrated Flow, Wooded - EF** Unpaved Kv= 16.1 fps
58.5	2,637	Total			

Subcatchment EN: Entrance Subcatchment



Summary for Subcatchment S-A: Subcatchment A

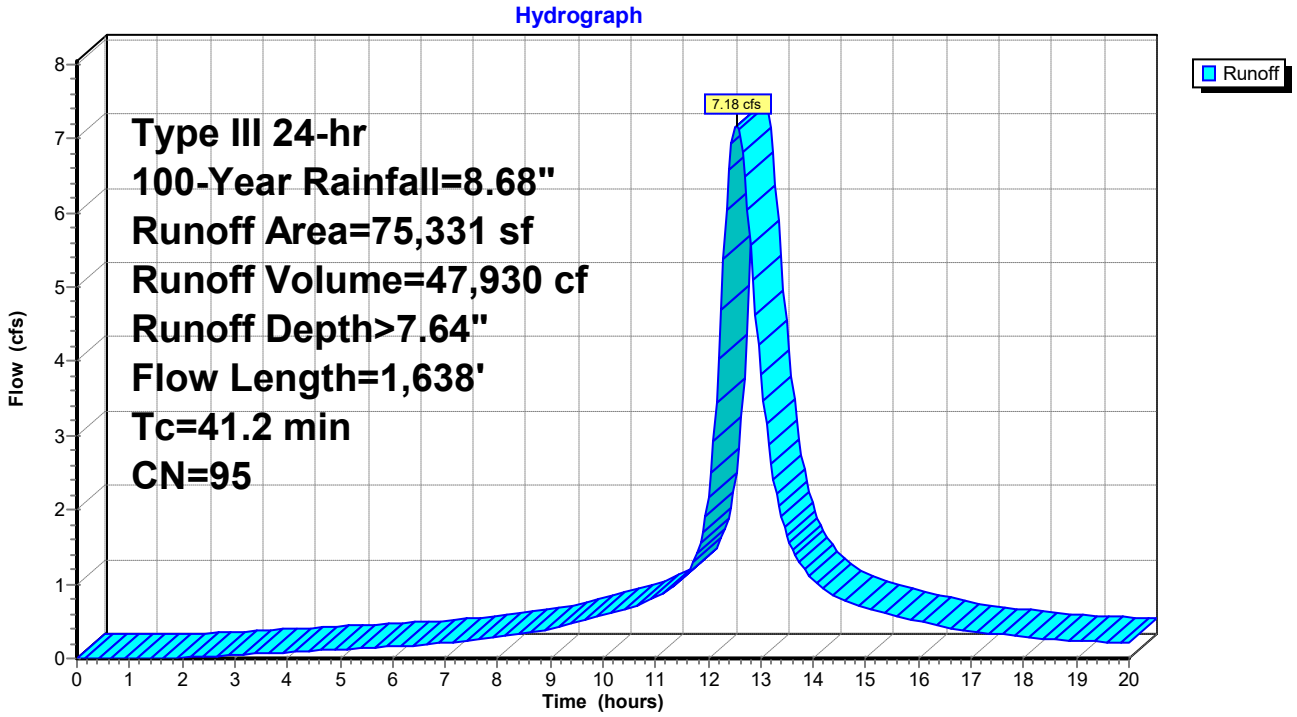
Runoff = 7.18 cfs @ 12.54 hrs, Volume= 47,930 cf, Depth> 7.64"

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

Area (sf)	CN	Description
11,823	80	>75% Grass cover, Good, HSG D
63,508	98	Paved parking, HSG D
75,331	95	Weighted Average
11,823		15.69% Pervious Area
63,508		84.31% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		**Sheet Flow, Grass - AB** Grass: Short n= 0.150 P2= 3.35"
1.1	77	0.0050	1.14		**Shallow Concentrated Flow, Grass - BC** Unpaved Kv= 16.1 fps
1.9	188	0.0100	1.61		**Shallow Concentrated Flow, Parking - CD** Unpaved Kv= 16.1 fps
0.4	117	0.0100	4.54	3.56	**Pipe Channel, Pipe - DE** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.1	44		6.95		**Lake or Reservoir, Chambers - EF** Mean Depth= 1.50'
0.2	50	0.0050	4.20	7.43	**Pipe Channel, Pipe - FG** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.9	1,112	0.0017	0.66		**Shallow Concentrated Flow, Wooded - GH** Unpaved Kv= 16.1 fps
41.2	1,638	Total			

Subcatchment S-A: Subcatchment A



Summary for Subcatchment S-B: Subcatchment B

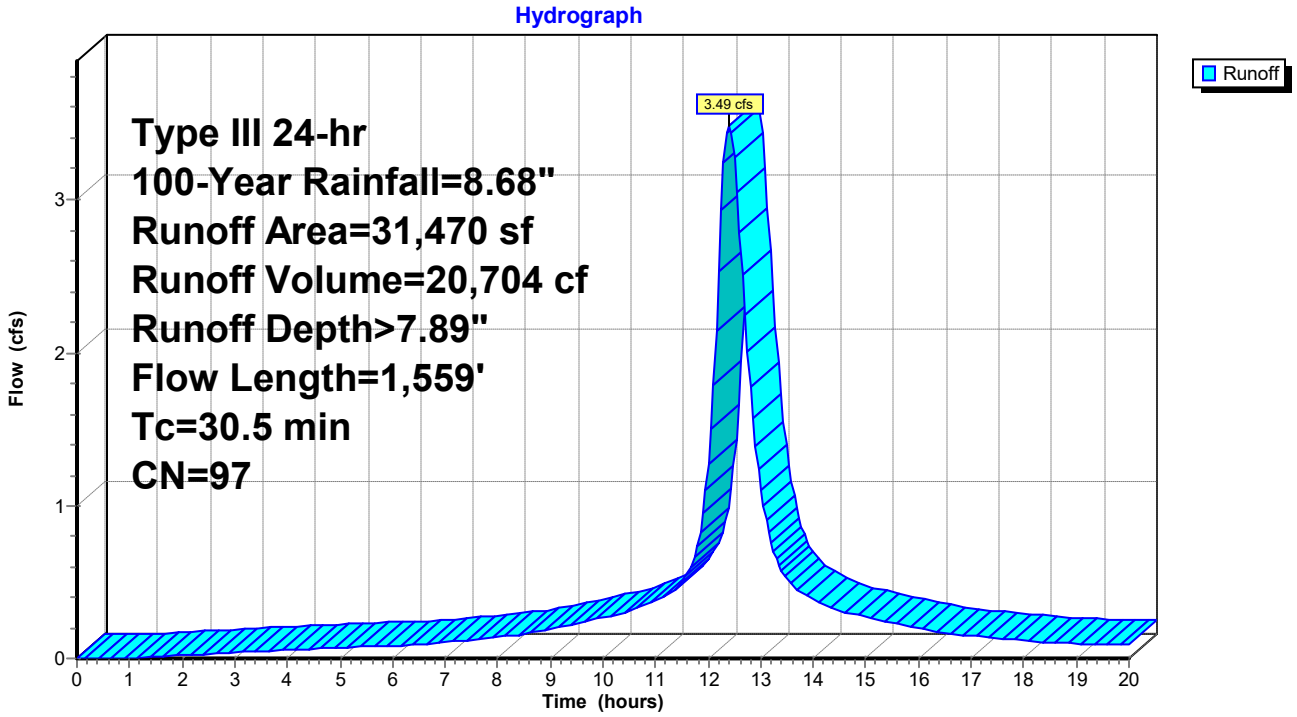
Runoff = 3.49 cfs @ 12.40 hrs, Volume= 20,704 cf, Depth> 7.89"

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

Area (sf)	CN	Description
2,392	80	>75% Grass cover, Good, HSG D
29,078	98	Paved parking, HSG D
31,470	97	Weighted Average
2,392		7.60% Pervious Area
29,078		92.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	50	0.0100	0.93		**Sheet Flow, Parking - AB** Smooth surfaces n= 0.011 P2= 3.35"
1.5	184	0.0100	2.03		**Shallow Concentrated Flow, Parking - BC** Paved Kv= 20.3 fps
0.3	95	0.0100	4.54	3.56	**Pipe Channel, Pipe - CD** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.2	73		6.95		**Lake or Reservoir, Chambers - DE** Mean Depth= 1.50'
0.3	70	0.0050	4.20	7.43	**Pipe Channel, Pipe - EF** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013
27.3	1,087	0.0017	0.66		**Shallow Concentrated Flow, Wooded - FG** Unpaved Kv= 16.1 fps
30.5	1,559	Total			

Subcatchment S-B: Subcatchment B



Summary for Subcatchment S-C: Subcatchment C

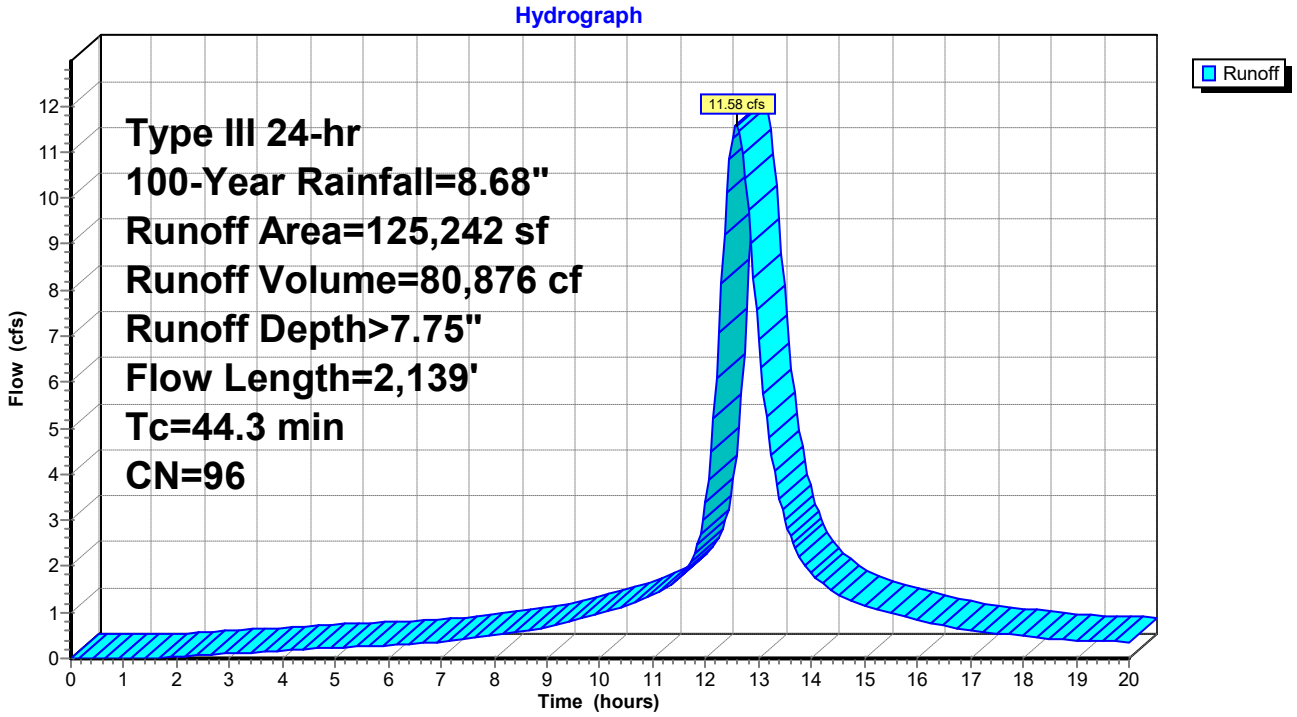
Runoff = 11.58 cfs @ 12.57 hrs, Volume= 80,876 cf, Depth> 7.75"

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

Area (sf)	CN	Description
2,830	96	Gravel surface, HSG D
15,974	80	>75% Grass cover, Good, HSG D
106,438	98	Paved parking, HSG D
125,242	96	Weighted Average
18,804		15.01% Pervious Area
106,438		84.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	50	0.0050	0.09		**Sheet Flow, Grass - AB** Grass: Short n= 0.150 P2= 3.35"
2.4	165	0.0050	1.14		**Shallow Concentrated Flow, Grass - BC** Unpaved Kv= 16.1 fps
1.7	207	0.0100	2.03		**Shallow Concentrated Flow, Road - CD** Paved Kv= 20.3 fps
0.2	59	0.0100	4.54	3.56	**Pipe Channel, Pipe - DE** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
0.2	72		6.95		**Lake or Reservoir, Chambers - EF** Mean Depth= 1.50'
1.5	444	0.0050	5.09	16.00	**Pipe Channel, Pipe - FG** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
28.7	1,142	0.0017	0.66		**Shallow Concentrated Flow, Wooded - GH** Unpaved Kv= 16.1 fps
44.3	2,139	Total			

Subcatchment S-C: Subcatchment C

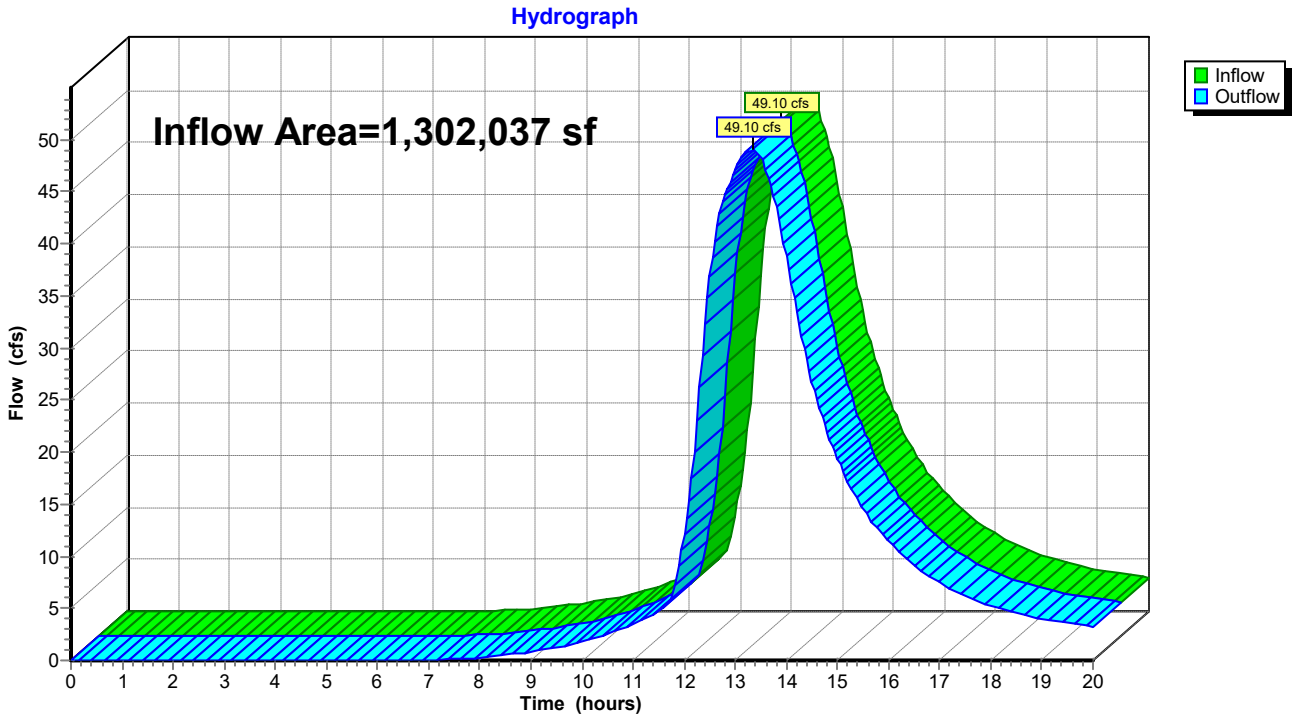


Summary for Reach T: Total Offsite

Inflow Area = 1,302,037 sf, 16.14% Impervious, Inflow Depth > 5.18" for 100-Year event
Inflow = 49.10 cfs @ 13.35 hrs, Volume= 561,895 cf
Outflow = 49.10 cfs @ 13.35 hrs, Volume= 561,895 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs

Reach T: Total Offsite



Summary for Pond ICS-A: Infiltration Chambers A

Inflow Area = 75,331 sf, 84.31% Impervious, Inflow Depth > 7.64" for 100-Year event
Inflow = 7.18 cfs @ 12.54 hrs, Volume= 47,930 cf
Outflow = 7.18 cfs @ 12.55 hrs, Volume= 45,284 cf, Atten= 0%, Lag= 1.1 min
Discarded = 0.36 cfs @ 8.75 hrs, Volume= 18,031 cf
Primary = 6.83 cfs @ 12.55 hrs, Volume= 27,253 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 141.92' @ 12.55 hrs Surf.Area= 1,855 sf Storage= 4,117 cf

Plug-Flow detention time= 38.2 min calculated for 45,284 cf (94% of inflow)
Center-of-Mass det. time= 17.6 min (774.1 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	138.50'	1,574 cf	**35.33'W x 52.50'L x 3.54'H Field A** 6,570 cf Overall - 2,634 cf Embedded = 3,936 cf x 40.0% Voids
#2A	139.00'	2,634 cf	**Cultec R-330XLHD** x 49 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 7 rows
		4,208 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	136.24'	**18.0" Round Culvert** L= 27.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 136.24' / 135.70' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	141.25'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	139.50'	**18.0" Round Culvert** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 139.50' / 139.40' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Discarded	138.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.36 cfs @ 8.75 hrs HW=138.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.36 cfs)

Primary OutFlow Max=6.90 cfs @ 12.55 hrs HW=141.92' (Free Discharge)
└**1=Culvert** (Passes 6.90 cfs of 18.89 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 6.90 cfs @ 2.58 fps)
└**3=Culvert** (Passes 6.90 cfs of 6.96 cfs potential flow)

Pond ICS-A: Infiltration Chambers A - 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 7 rows

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

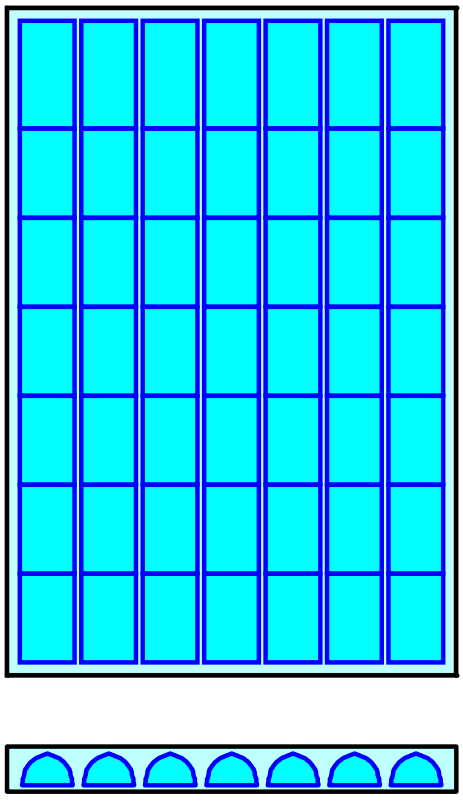
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
7 Rows x 52.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 35.33' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

49 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 7 Rows = 2,633.9 cf Chamber Storage

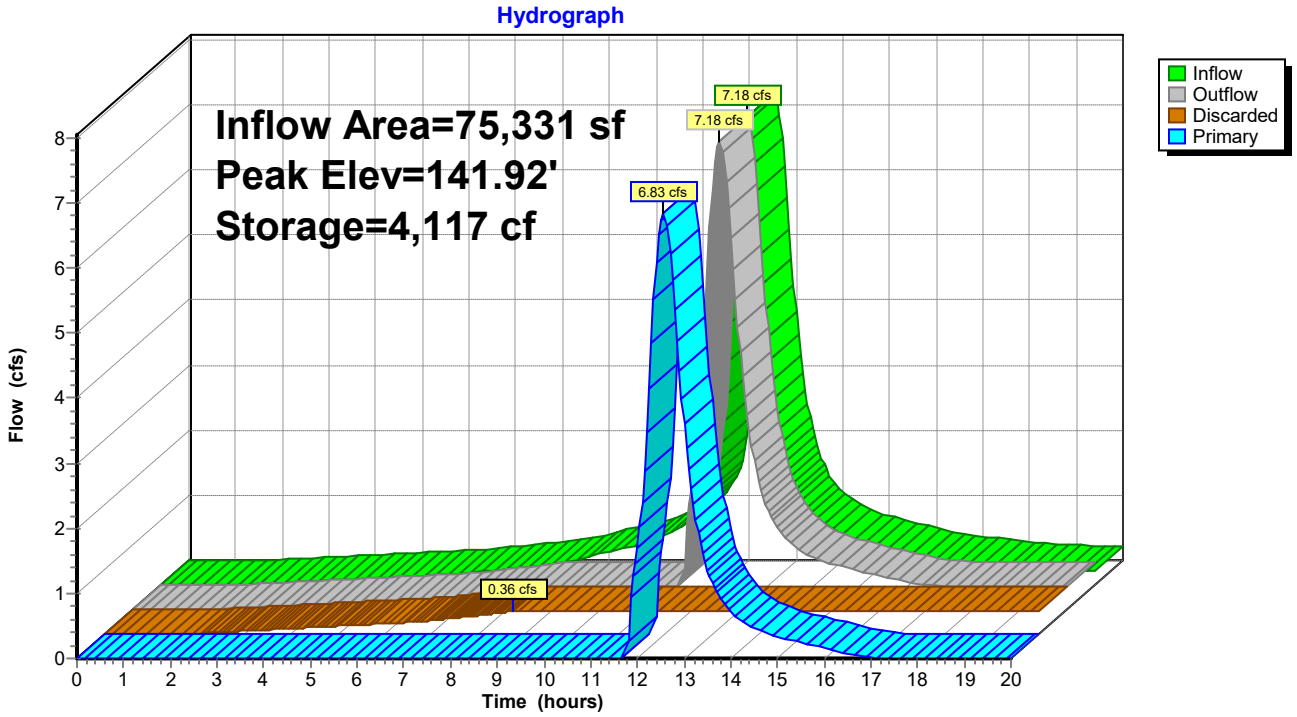
6,569.8 cf Field - 2,633.9 cf Chambers = 3,935.9 cf Stone x 40.0% Voids = 1,574.3 cf Stone Storage

Chamber Storage + Stone Storage = 4,208.3 cf = 0.097 af
Overall Storage Efficiency = 64.1%
Overall System Size = 52.50' x 35.33' x 3.54'

49 Chambers
243.3 cy Field
145.8 cy Stone



Pond ICS-A: Infiltration Chambers A



Stage-Area-Storage for Pond ICS-A: Infiltration Chambers A

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
138.50	**1,855**	0
138.55	1,855	37
138.60	1,855	74
138.65	1,855	111
138.70	1,855	148
138.75	1,855	186
138.80	1,855	223
138.85	1,855	260
138.90	1,855	297
138.95	1,855	334
139.00	1,855	371
139.05	1,855	450
139.10	1,855	529
139.15	1,855	608
139.20	1,855	687
139.25	1,855	765
139.30	1,855	844
139.35	1,855	922
139.40	1,855	1,000
139.45	1,855	1,078
139.50	1,855	1,156
139.55	1,855	1,234
139.60	1,855	1,312
139.65	1,855	1,388
139.70	1,855	1,465
139.75	1,855	1,541
139.80	1,855	1,617
139.85	1,855	1,693
139.90	1,855	1,768
139.95	1,855	1,844
140.00	1,855	1,919
140.05	1,855	1,994
140.10	1,855	2,069
140.15	1,855	2,144
140.20	1,855	2,219
140.25	1,855	2,293
140.30	1,855	2,366
140.35	1,855	2,439
140.40	1,855	2,510
140.45	1,855	2,581
140.50	1,855	2,652
140.55	1,855	2,721
140.60	1,855	2,790
140.65	1,855	2,858
140.70	1,855	2,926
140.75	1,855	2,992
140.80	1,855	3,058
140.85	1,855	3,122
140.90	1,855	3,186
140.95	1,855	3,248
141.00	1,855	3,309
141.05	1,855	3,368
141.10	1,855	3,426
141.15	1,855	3,482
141.20	1,855	3,536
141.25	1,855	3,588
141.30	1,855	3,637
141.35	1,855	3,683
141.40	1,855	3,727
141.45	1,855	3,768
141.50	1,855	3,806
141.55	1,855	3,843
141.60	1,855	3,881
141.65	1,855	3,918
141.70	1,855	3,955
141.75	1,855	3,992
141.80	1,855	4,029
141.85	1,855	4,066
141.90	1,855	4,103
141.95	1,855	4,140
142.00	1,855	**4,177**

Summary for Pond ICS-B: Infiltration Chamber System B

Inflow Area = 31,470 sf, 92.40% Impervious, Inflow Depth > 7.89" for 100-Year event
Inflow = 3.49 cfs @ 12.40 hrs, Volume= 20,704 cf
Outflow = 3.49 cfs @ 12.41 hrs, Volume= 19,546 cf, Atten= 0%, Lag= 0.4 min
Discarded = 0.15 cfs @ 8.45 hrs, Volume= 8,203 cf
Primary = 3.34 cfs @ 12.41 hrs, Volume= 11,343 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 141.03' @ 12.41 hrs Surf.Area= 802 sf Storage= 1,786 cf

Plug-Flow detention time= 40.0 min calculated for 19,498 cf (94% of inflow)
Center-of-Mass det. time= 18.7 min (757.3 - 738.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	137.50'	701 cf	**20.83'W x 38.50'L x 3.54'H Field A** 2,841 cf Overall - 1,088 cf Embedded = 1,753 cf x 40.0% Voids
#2A	138.00'	1,088 cf	**Cultec R-330XLHD** x 20 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 4 rows
		1,789 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.14'	**18.0" Round Culvert** L= 62.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 138.14' / 136.90' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	140.60'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	138.05'	**18.0" Round Culvert** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 138.00' / 138.05' S= -0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Discarded	137.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.15 cfs @ 8.45 hrs HW=137.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=3.33 cfs @ 12.41 hrs HW=141.03' (Free Discharge)
└**1=Culvert** (Passes 3.33 cfs of 12.45 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 3.33 cfs @ 1.93 fps)
└**3=Culvert** (Passes 3.33 cfs of 5.58 cfs potential flow)

Pond ICS-B: Infiltration Chamber System B - 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 4 rows

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

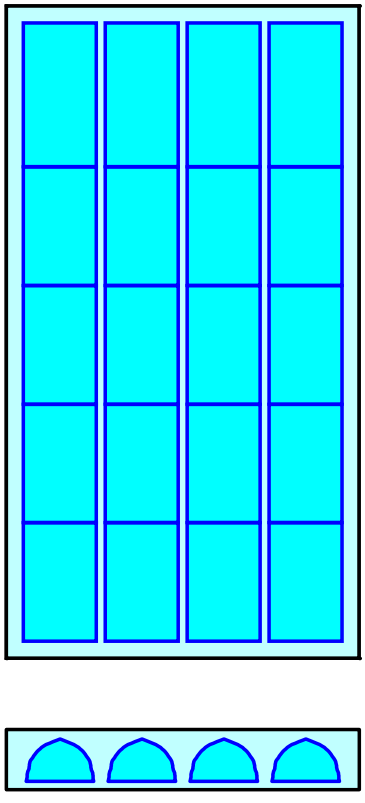
5 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 36.50' Row Length +12.0" End Stone x 2 = 38.50' Base Length
4 Rows x 52.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.83' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

20 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 4 Rows = 1,087.8 cf Chamber Storage

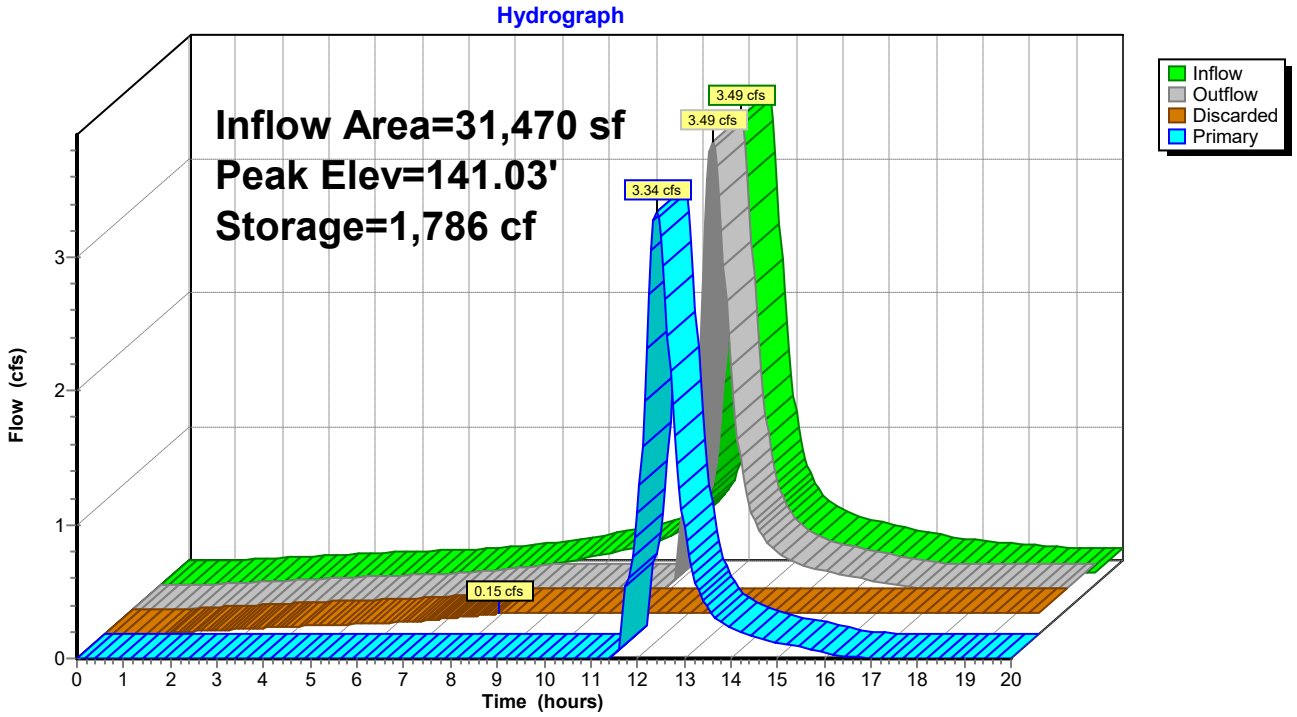
2,840.7 cf Field - 1,087.8 cf Chambers = 1,752.9 cf Stone x 40.0% Voids = 701.1 cf Stone Storage

Chamber Storage + Stone Storage = 1,789.0 cf = 0.041 af
Overall Storage Efficiency = 63.0%
Overall System Size = 38.50' x 20.83' x 3.54'

20 Chambers
105.2 cy Field
64.9 cy Stone



Pond ICS-B: Infiltration Chamber System B



Stage-Area-Storage for Pond ICS-B: Infiltration Chamber System B

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
137.50	**802**	0
137.55	802	16
137.60	802	32
137.65	802	48
137.70	802	64
137.75	802	80
137.80	802	96
137.85	802	112
137.90	802	128
137.95	802	144
138.00	802	160
138.05	802	194
138.10	802	227
138.15	802	261
138.20	802	294
138.25	802	327
138.30	802	360
138.35	802	393
138.40	802	426
138.45	802	459
138.50	802	492
138.55	802	525
138.60	802	557
138.65	802	590
138.70	802	622
138.75	802	654
138.80	802	686
138.85	802	718
138.90	802	750
138.95	802	782
139.00	802	814
139.05	802	846
139.10	802	878
139.15	802	909
139.20	802	941
139.25	802	972
139.30	802	1,003
139.35	802	1,034
139.40	802	1,064
139.45	802	1,094
139.50	802	1,124
139.55	802	1,153
139.60	802	1,183
139.65	802	1,211
139.70	802	1,240
139.75	802	1,268
139.80	802	1,296
139.85	802	1,323
139.90	802	1,350
139.95	802	1,377
140.00	802	1,402
140.05	802	1,428
140.10	802	1,452
140.15	802	1,476
140.20	802	1,499
140.25	802	1,521
140.30	802	1,542
140.35	802	1,562
140.40	802	1,581
140.45	802	1,599
140.50	802	1,615
140.55	802	1,631
140.60	802	1,647
140.65	802	1,663
140.70	802	1,679
140.75	802	1,695
140.80	802	1,711
140.85	802	1,727
140.90	802	1,744
140.95	802	1,760
141.00	802	**1,776**

Summary for Pond ICS-C: Infiltration Chambers C

Inflow Area = 125,242 sf, 84.99% Impervious, Inflow Depth > 7.75" for 100-Year event
Inflow = 11.58 cfs @ 12.57 hrs, Volume= 80,876 cf
Outflow = 11.44 cfs @ 12.63 hrs, Volume= 76,877 cf, Atten= 1%, Lag= 3.6 min
Discarded = 0.63 cfs @ 8.85 hrs, Volume= 32,313 cf
Primary = 10.80 cfs @ 12.63 hrs, Volume= 44,564 cf

Routing by Stor-Ind method, Time Span= 0.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 142.46' @ 12.63 hrs Surf.Area= 3,308 sf Storage= 7,451 cf

Plug-Flow detention time= 38.3 min calculated for 76,877 cf (95% of inflow)
Center-of-Mass det. time= 19.4 min (774.2 - 754.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	139.00'	2,768 cf	**45.00'W x 73.50'L x 3.54'H Field A** 11,714 cf Overall - 4,795 cf Embedded = 6,919 cf x 40.0% Voids
#2A	139.50'	4,795 cf	**Cultec R-330XLHD** x 90 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 9 rows
		7,562 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.51'	**24.0" Round Culvert** L= 143.0' Ke= 0.500 Inlet / Outlet Invert= 138.51' / 135.65' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	141.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	139.50'	**24.0" Round Culvert** L= 298.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 139.50' / 139.45' S= 0.0002 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#4	Discarded	139.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.63 cfs @ 8.85 hrs HW=139.04' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.63 cfs)

Primary OutFlow Max=10.78 cfs @ 12.63 hrs HW=142.45' (Free Discharge)
└**1=Culvert** (Passes 10.78 cfs of 25.95 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Passes 10.78 cfs of 12.35 cfs potential flow)
└**3=Culvert** (Outlet Controls 10.78 cfs @ 3.43 fps)

Pond ICS-C: Infiltration Chambers C - 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 9 rows

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

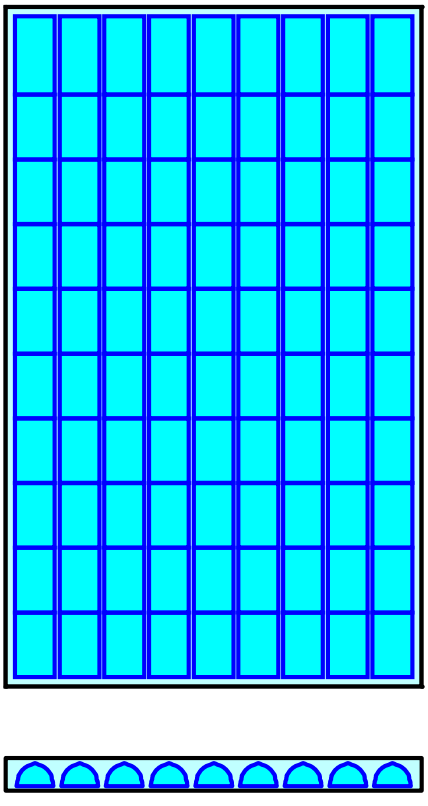
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length
9 Rows x 52.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 45.00' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

90 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 9 Rows = 4,794.7 cf Chamber Storage

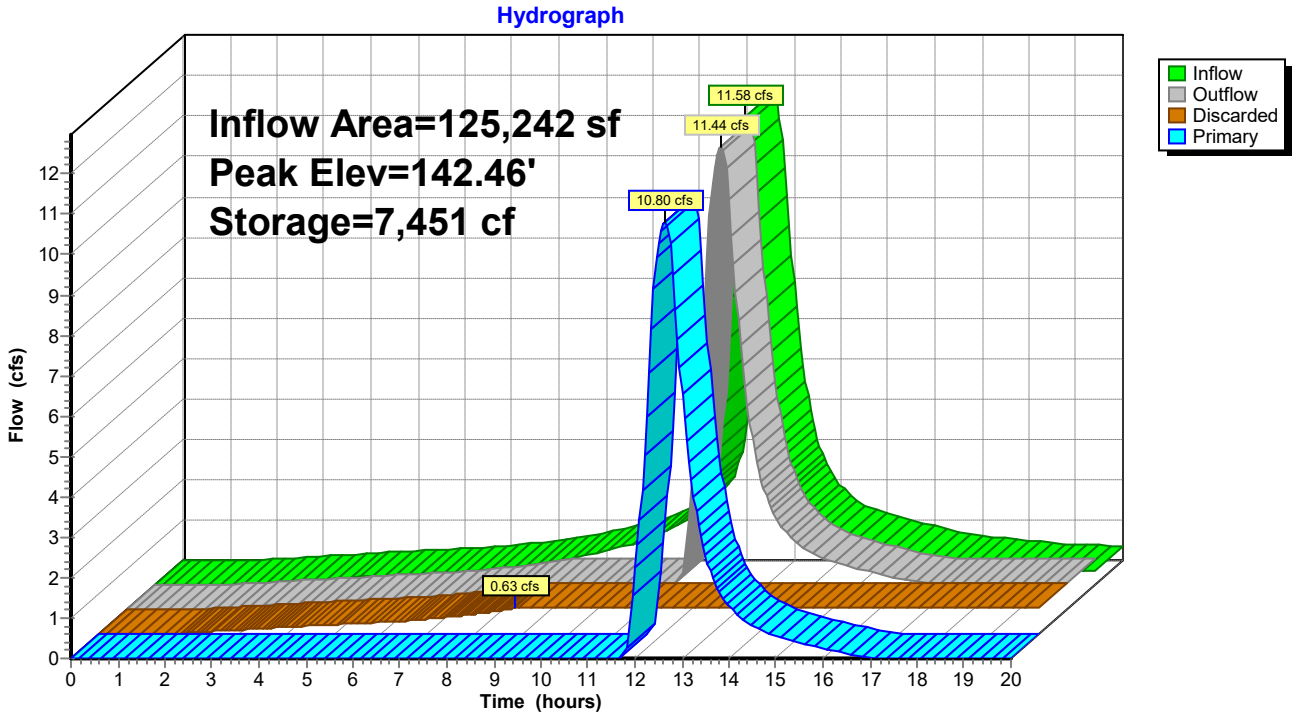
11,714.1 cf Field - 4,794.7 cf Chambers = 6,919.3 cf Stone x 40.0% Voids = 2,767.7 cf Stone Storage

Chamber Storage + Stone Storage = 7,562.5 cf = 0.174 af
Overall Storage Efficiency = 64.6%
Overall System Size = 73.50' x 45.00' x 3.54'

90 Chambers
433.9 cy Field
256.3 cy Stone



Pond ICS-C: Infiltration Chambers C



Stage-Area-Storage for Pond ICS-C: Infiltration Chambers C

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
139.00	**3,308**	0
139.05	3,308	66
139.10	3,308	132
139.15	3,308	198
139.20	3,308	265
139.25	3,308	331
139.30	3,308	397
139.35	3,308	463
139.40	3,308	529
139.45	3,308	595
139.50	3,308	662
139.55	3,308	804
139.60	3,308	947
139.65	3,308	1,089
139.70	3,308	1,231
139.75	3,308	1,372
139.80	3,308	1,513
139.85	3,308	1,654
139.90	3,308	1,795
139.95	3,308	1,936
140.00	3,308	2,077
140.05	3,308	2,217
140.10	3,308	2,357
140.15	3,308	2,496
140.20	3,308	2,633
140.25	3,308	2,771
140.30	3,308	2,907
140.35	3,308	3,044
140.40	3,308	3,180
140.45	3,308	3,316
140.50	3,308	3,452
140.55	3,308	3,587
140.60	3,308	3,722
140.65	3,308	3,857
140.70	3,308	3,992
140.75	3,308	4,125
140.80	3,308	4,257
140.85	3,308	4,388
140.90	3,308	4,517
140.95	3,308	4,645
141.00	3,308	4,772
141.05	3,308	4,897
141.10	3,308	5,021
141.15	3,308	5,144
141.20	3,308	5,265
141.25	3,308	5,384
141.30	3,308	5,502
141.35	3,308	5,618
141.40	3,308	5,732
141.45	3,308	5,844
141.50	3,308	5,954
141.55	3,308	6,061
141.60	3,308	6,165
141.65	3,308	6,265
141.70	3,308	6,362
141.75	3,308	6,455
141.80	3,308	6,543
141.85	3,308	6,625
141.90	3,308	6,703
141.95	3,308	6,777
142.00	3,308	6,846
142.05	3,308	6,912
142.10	3,308	6,978
142.15	3,308	7,044
142.20	3,308	7,110
142.25	3,308	7,177
142.30	3,308	7,243
142.35	3,308	7,309
142.40	3,308	7,375
142.45	3,308	7,441
142.50	3,308	**7,507**

TABLE OF CONTENTS

Project Reports
1 Routing Diagram
2 Pipe Listing (selected nodes)

2-Year Event
3 Subcat DW: Direct to Wetland
5 Subcat EN: Entrance Subcatchment
7 Subcat S-A: Subcatchment A
9 Subcat S-B: Subcatchment B
11 Subcat S-C: Subcatchment C
13 Reach T: Total Offsite
14 Pond ICS-A: Infiltration Chambers A
18 Pond ICS-B: Infiltration Chamber System B
22 Pond ICS-C: Infiltration Chambers C

10-Year Event
26 Subcat DW: Direct to Wetland
28 Subcat EN: Entrance Subcatchment
30 Subcat S-A: Subcatchment A
32 Subcat S-B: Subcatchment B
34 Subcat S-C: Subcatchment C
36 Reach T: Total Offsite
37 Pond ICS-A: Infiltration Chambers A
41 Pond ICS-B: Infiltration Chamber System B
45 Pond ICS-C: Infiltration Chambers C

25-Year Event
49 Subcat DW: Direct to Wetland
51 Subcat EN: Entrance Subcatchment
53 Subcat S-A: Subcatchment A
55 Subcat S-B: Subcatchment B
57 Subcat S-C: Subcatchment C
59 Reach T: Total Offsite
60 Pond ICS-A: Infiltration Chambers A
64 Pond ICS-B: Infiltration Chamber System B
68 Pond ICS-C: Infiltration Chambers C

100-Year Event
72 Subcat DW: Direct to Wetland
74 Subcat EN: Entrance Subcatchment
76 Subcat S-A: Subcatchment A
78 Subcat S-B: Subcatchment B
80 Subcat S-C: Subcatchment C
82 Reach T: Total Offsite
83 Pond ICS-A: Infiltration Chambers A
87 Pond ICS-B: Infiltration Chamber System B

91 Pond ICS-C: Infiltration Chambers C

APPENDIX C

STORMWATER MANAGEMENT STANDARD 2 – PEAK RATE OF RUNOFF

TOTAL VOLUME OF RUNOFF

STORMWATER MANAGEMENT STANDARD 3 – RECHARGE VOLUME

DRAWDOWN FOR RECHARGE STRUCTURES

STORMWATER MANAGEMENT STANDARD 4 – WATER QUALITY VOLUME

DE MINIMUS CALCULATIONS

CLOSED DRAINAGE SYSTEM/PIPE SIZING CALCULATIONS

SYMPLE DYNAMIC SIZING

VERNAL POOL CONTRIBUTING VOLUME CALCULATIONS

CONECO
Engineers & Scientists

Project Number:	3395.0	**Date:**	September 23, 2022
Project Name:	Shinglemill	**Calculations by:**	MVK
Project Address:	75-79 Pond Street	**Calculations date:**	September 23, 2022
Client:	Shinglemill, LLC	**Checked by:**	DJD
Location:	Rockland, Massachusetts	**Checked Date:**	September 23, 2022

STORMWATER MANAGEMENT STANDARD 2 - PEAK RATE OF RUNOFF

OFFSITE TO WETLAND

DESIGN STORM (YEAR)	EXISTING PEAK RUNOFF (CFS)	PROPOSEDPEAK RUNOFF (CFS)	REDUCTION IN PEAK RUNOFF
2	11.54	10.73	7.0%
10	23.38	21.53	7.9%
25	33.24	30.49	8.3%
100	53.78	49.10	8.7%

NOTE: PEAK RATES AND VOLUMES SHOWN WERE TAKEN FROM THE EXISTING AND PROPOSED HYDROCAD ANALYSES.

CONECO
Engineers & Scientists

Project Number:	3395.0	**Date:**	September 23, 2022
Project Name:	Shinglemill	**Calculations by:**	MVK
Project Address:	0 Pond Street	**Calculations date:**	September 23, 2022
Client:	Shinglemill, LLC	**Checked by:**	DJD
Location:	Rockland, Massachusetts	**Checked Date:**	September 23, 2022

VOLUME OF RUNOFF

OFFSITE TO WETLAND

DESIGN STORM (YEAR)	EXISTING RUNOFF (CF)	PROPOSED RUNOFF (CF)	REDUCTION IN PEAK RUNOFF
2	125,297	115,026	8.2%
10	249,551	236,304	5.3%
25	355,250	339,998	4.3%
100	580,544	561,895	3.2%

NOTE: PEAK RATES AND VOLUMES SHOWN WERE TAKEN FROM THE EXISTING AND PROPOSED HYDROCAD ANALYSES.

CONECO
Engineers & Scientists

Project Number:	3395	**Date:**	September 23, 2022
Project Name:	Shinglemill	**Calculations by:**	MVK
Project Address:	75-79 Pond Street	**Calculations date:**	September 23, 2022
Client:	Shinglemill, LLC	**Checked by:**	DJD
Location:	Rockland, Massachusetts	**Checked Date:**	September 23, 2022

STORMWATER MANAGEMENT STANDARD 3 - RECHARGE VOLUME

	HYDROLOGIC SOIL GROUP				TOTAL
	A	B	C	D	
IMPERVIOUS AREA (S.F.)	4,553	469	0	205,079	210,101
INCHES OF RUNOFF TO BE RECHARGED	0.60	0.35	0.25	0.10	
REQUIRED RECHARGE VOLUME (FT³)	228	14	0	1,709	**1,950**

CAPTURE AREA ADJUSTMENT - ADJUSTED MINIMUM REQUIRED RECHARGE VOLUME

MINIMUM OF 65% OF IMPERVIOUS AREA MUST BE DIRECTED TO THE RECHARGE BMP; 65 % IS =	136,566	SF		
IMPERVIOUS SITE AREA DRAINING TO BMP =	199,024	SF	94.7%	PERCENTAGE OF IMPERVIOUS AREA DIVERTED TO INFILTRATION FACILITY
RATIO OF TOTAL IMPERVIOUS AREA TO IMPERVIOUS AREA DRAINING TO RECHARGE BMP =	1.06		= TOTAL IMPERVIOUS AREA / IMPERVIOUS AREA DRAINING TO THE RECHARGE AREA	
ADJUSTED REQUIRED RECHARGE VOLUME=	**2,059**	CF	= RATIO OF IMPERVIOUS AREA x REQUIRED RECHARGE VOLUME	
PROPOSED RECHARGE VOLUME	**11,188**	CF	TOTAL AVAILABLE STATIC RECHARGE VOLUME	

CONECO
Engineers & Scientists

Project Number:	3395	**Date:**	September 23, 2022
Project Name:	Shinglemill	**Calculations by:**	MVK
Project Address:	75-79 Pond Street	**Calculations date:**	September 23, 2022
Client:	Shinglemill, LLC	**Checked by:**	DJD
Location:	Rockland, Massachusetts	**Checked Date:**	September 23, 2022

DRAWDOWN FOR RECHARGE STRUCTURES

Infiltration Chamber A

A = AREA OF PROPOSED LEACHING STRUCTURE	1,855	SQ. FT.
Rv = STORAGE VOLUME =	3,587	CU. FT.
K= SATURATED HYDRAULIC CONDUCTIVITY (RAWLS RATE) = VALUE IS BASED ON A HYDRAULIC SOIL GROUP	8.27	INCHES/HOUR
T = ALLOWABLE DRAWDOWN DURING PEAK (USE 2 HRS) =	72	HRS

DRAWDOWN TIME $T = \frac{Rv}{K \times A}$ = **2.8** HOURS TO EMPTY THE RECHARGE BMP
<72 HOURS, SO DRAWDOWN IS OK

Infiltration Chamber B

A = AREA OF PROPOSED LEACHING STRUCTURE	802	SQ. FT.
Rv = STORAGE VOLUME =	1,647	CU. FT.
K= SATURATED HYDRAULIC CONDUCTIVITY (RAWLS RATE) = VALUE IS BASED ON A HYDRAULIC SOIL GROUP	8.27	INCHES/HOUR
T = ALLOWABLE DRAWDOWN DURING PEAK (USE 2 HRS) =	72	HRS

DRAWDOWN TIME $T = \frac{Rv}{K \times A}$ = **3.0** HOURS TO EMPTY THE RECHARGE BMP
<72 HOURS, SO DRAWDOWN IS OK

Infiltration Chamber C

A = AREA OF PROPOSED LEACHING STRUCTURE	3,308	SQ. FT.
Rv = STORAGE VOLUME =	5,954	CU. FT.
K= SATURATED HYDRAULIC CONDUCTIVITY (RAWLS RATE) = VALUE IS BASED ON A HYDRAULIC SOIL GROUP	8.27	INCHES/HOUR
T = ALLOWABLE DRAWDOWN DURING PEAK (USE 2 HRS) =	72	HRS

DRAWDOWN TIME $T = \frac{Rv}{K \times A}$ = **2.6** HOURS TO EMPTY THE RECHARGE BMP
<72 HOURS, SO DRAWDOWN IS OK

CONECO
Engineers & Scientists

Project Number:	3395	**Date:**	September 23, 2022
Project Name:	Shinglemill	**Calculations by:**	MVK
Project Address:	75-79 Pond Street	**Calculations date:**	September 23, 2022
Client:	Shinglemill, LLC	**Checked by:**	DJD
Location:	Rockland, Massachusetts	**Checked Date:**	September 23, 2022

STORMWATER MANAGEMENT STANDARD 4 - WATER QUALITY VOLUME

SUBCATCHMENT	DEPTH TO TREAT (IN.)	IMPERVIOUS AREA (SF)	WATER VOLUME (CF)
Offsite at Entrance	1	8,200	683
Infiltration Chambers A (IC-A)	1	63,508	5,292
Infiltration Chamber B (IC-B)	1	29,078	2,423
Infiltration Chambers C(IC-C)	1	106,438	8,870
Direct to Wetland	1	2,877	240
NET WATER QUALITY VOLUME			**17,508**

Note: The Simple Dynamic Sizing HydroCAD calculations following this page were performed to ensure each BMP can treat the required volume per these calculations. Additional volume was included in IC-C to compensate for the WQV of the Offsite at Entrance & Direct to Wetland subcatchments.

CONECO
Engineers & Scientists

Project Number:	3395	**Date:**	September 23, 2022
Project Name:	Shinglemill	**Calculations by:**	MVK
Project Address:	75-79 Pond Street	**Calculations date:**	September 23, 2022
Client:	Shinglemill, LLC	**Checked by:**	DJD
Location:	Rockland, Massachusetts	**Checked Date:**	September 23, 2022

STORMWATER MANAGEMENT STANDARD 4 - DE MINIMUS CALCULATIONS

WEIGHTED AVERAGE TSS REMOVAL

SUBCATCHMENT	TSS REMOVAL RATE	IMPERVIOUS AREA (SF)	PRODUCT
Offsite at Entrance	0%	8,200	0
Infiltration Chambers A (IC-A)	96%	63,508	60,968
Infiltration Chamber B (IC-B)	96%	29,078	27,915
Infiltration Chambers C(IC-C)	80%	106,438	85,150
Direct to Wetland	0%	2,877	0
	Totals	210,101	174,033
WEIGHTED AVERAGE TSS REMOVAL RATE			**82.8%**

FLOW RATE CHECK (OFFSITE SOUTHEAST)

Rational Method(CFS) Q=CIA

STEEL Formula for Rainfall Intensity (Inch/hour) I=K/(Tc+b)

STEEL Design Storm 2 year

STEEL Region 3

Time of Concentration (Tc)	6.00
STEEL Constant (K)	106
STEEL Constant (b)	17.0
Steel Rainfall Intensity iph	4.61
Steel Rainfall Intensity fps (I)	0.000107
Impervious Area s.f.(A)	11,077
Runoff Coefficient (C)	0.95
FLOW RATE C.F.S. (Q)	**1.12**

CONECO
Engineers, Scientists & Surveyors

Project Number: 3395.1
Client: Shinglemill, LLC
Project Name: Shinglemill Apartments
Project Address: 0 Pond Street
Location: Rockland, MA

Calculations by: DJD
Calculations Date: 09/23/2022
Checked By: MSD
Checked Date: 09/23/2022

ENTRANCE DRAINAGE SYSTEM 25 YEAR STORM

WATERSHED CHARACTERISTICS												PIPE CHARACTERISTICS											FLOW CHARACTERISTICS			
LOCATION				LAND USE			FLOW TIME			FLOW		R = hydraulic radius = area/wetted perimeter														
Description	Cover	Increm. (ACRE)	Total_A (ACRE)	C	CA	Total CA	To Inlet (MIN)	In Pipe (MIN)	Tc (MIN)	I (IPH)	Q (CFS)	Structure	Invert	Pipe	Size (IN)	Length (FT)	Area (SF)	R (FT)	Slope	n	Qf (CFS)	Vf (FT/S)	Q/Qf	V/Vf	V (FT/S)	Tc L/V (MIN)
WS CB-E1	LANDSCAPED	0.025		0.400								From: CB-E1	Out:													
	IMPERVIOUS	0.188		0.850										HDPE	12	12	0.79	0.250	0.040	0.013	**7.13**	**9.07**	0.15	0.61	5.51	0.04
			0.214	0.797	0.170		6.00	NONE	6.00	6.39	**1.09**	To: WQU-E1	In:													
WQU-E1 TO	**FES-E1**					0.170	6.00	0.04	6.04	6.38	**1.09**	From: STC-S1	Out:													
														HDPE	12	13	0.79	0.250	0.020	0.013	**5.04**	**6.42**	**0.22**	**0.67**	**4.30**	**0.05**
												To: FES-S1	In:													

CONECO
Engineers, Scientists & Surveyors

Project Number: 3395.1
Client: Shinglemill, LLC
Project Name: Shinglemill Apartments
Project Address: 0 Pond Street
Location: Rockland, MA

Calculations by: DJD
Calculations Date: 09/23/2022
Checked By: MSD
Checked Date: 09/23/2022

TO INFILTRATION CHAMBER SYSTEM A 25 YEAR STORM

WATERSHED CHARACTERISTICS												PIPE CHARACTERISTICS											FLOW CHARACTERISTICS			
LOCATION				LAND USE			FLOW TIME			FLOW		R = hydraulic radius = area/wetted perimeter														
Description	Cover	Increm. (ACRE)	Total_A (ACRE)	C	CA	Total CA	To Inlet (MIN)	In Pipe (MIN)	Tc (MIN)	I (IPH)	Q (CFS)	Structure	Invert	Pipe	Size (IN)	Length (FT)	Area (SF)	R (FT)	Slope	n	Qf (CFS)	Vf (FT/S)	Q/Qf	V/Vf	V (FT/S)	Tc L/V (MIN)
WS DCB-A1	LANDSCAPED	0.131		0.400								From: DCB-A1	Out:													
	IMPERVIOUS	0.383		0.850										HDPE	12	91	0.79	0.250	0.005	0.013	**2.52**	**3.21**	0.96	1.03	3.32	0.46
			0.515	0.735	0.378		6.00	NONE	6.00	6.39	**2.42**	To: 0.00	In:													
WS CB-A2	LANDSCAPED	0.024		0.400								From: CB-A2	Out:													
	IMPERVIOUS	0.097		0.850										HDPE	12	76	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.16	0.62	2.82	0.45
			0.121	0.761	0.092		6.00	NONE	6.00	6.39	**0.59**	To: WQU-A1	In:													
WQU-A1 TO DMH-A1						0.979	6.00	0.46	6.46	6.31	**6.18**	From: WQU-A1	Out:													
														HDPE	12	10	0.79	0.250	0.040	0.013	**7.13**	**9.07**	**0.87**	**1.00**	**9.11**	**0.02**
												To: DMH-A1	In:													
WS ROOF	LANDSCAPED	0.000		0.400								From: ROOF	Out:													
	IMPERVIOUS	0.599		0.850										HDPE	12	442	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.91	1.02	4.63	1.59
			0.599	0.850	0.509		6.00	NONE	6.00	6.39	**3.25**	To: WQU-A1	In:													
DMH-A1 TO ICS-A						1.488	6.46	0.02	6.48	6.31	9.38	From: DMH-A1	Out:													
														HDPE	18	5	1.77	0.375	0.020	0.013	14.86	8.41	0.63	0.92	7.70	0.01
WS DCB-A3	LANDSCAPED	0.116		0.400								From: DCB-A3	Out:													
	IMPERVIOUS	0.379		0.850										HDPE	12	10	0.79	0.250	0.040	0.013	**7.13**	**9.07**	0.33	0.76	6.89	0.02
			0.495	0.744	0.369		6.00	NONE	6.00	6.39	**2.36**	To: WQU-A2	In:													
WQU-A2 TO ICS-A						0.369	6.00	0.00	6.00	6.39	**2.36**	From: WQU-A2	Out:													
														HDPE	12	13	0.79	0.250	0.040	0.013	**7.13**	**9.07**	**0.33**	**0.76**	**6.89**	**0.03**
												To: ICS-A	In:													

CONECO
Engineers, Scientists & Surveyors

Project Number: 3395.1
Client: Shinglemill, LLC
Project Name: Shinglemill Apartments
Project Address: 0 Pond Street
Location: Rockland, MA

Calculations by: DJD
Calculations Date: 09/23/2022
Checked By: MSD
Checked Date: 09/23/2022

TO INFILTRATION CHAMBER SYSTEM B - 25 YEAR STORM

WATERSHED CHARACTERISTICS												PIPE CHARACTERISTICS											FLOW CHARACTERISTICS			
LOCATION				LAND USE			FLOW TIME			FLOW		R = hydraulic radius = area/wetted perimeter														Tc
Description	Cover	Increm. (ACRE)	Total_A (ACRE)	C	CA	Total CA	To Inlet (MIN)	In Pipe (MIN)	Tc (MIN)	I (IPH)	Q (CFS)	Structure	Invert	Pipe	Size (IN)	Length (FT)	Area (SF)	R (FT)	Slope	n	Qf (CFS)	Vf (FT/S)	Q/Qf	V/Vf	V (FT/S)	L/V (MIN)
WS CB-B1	LANDSCAPED	0.010		0.400								From: CB-B1	Out:													
	IMPERVIOUS	0.089		0.850										HDPE	12	23	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.14	0.60	2.71	0.14
			0.100	0.804	0.080		6.00	NONE	6.00	6.39	**0.51**	To: DMH-B1	In:													
WS CB-B2	LANDSCAPED	0.007		0.400								From: CB-B2	Out:													
	IMPERVIOUS	0.111		0.850										HDPE	12	23	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.17	0.63	2.86	0.13
			0.119	0.822	0.097		6.00	NONE	6.00	6.39	**0.62**	To: DMH-B1	In:													
DMH-B1 TO	**WQU-B1**					0.178	6.00	0.14	6.14	6.36	**1.13**	From: DMH-B1	Out:													
														HDPE	12	74	0.79	0.250	0.010	0.013	**3.56**	**4.54**	**0.32**	**0.75**	**3.40**	**0.36**
												To: WQU-B1	In:													
WQU-B1 TO	**ICS-B**					0.178	6.14	0.36	6.50	6.30	1.12	From: WQU-B1	Out:													
														HDPE	12	21	0.79	0.25	0.040	0.013	7.13	9.07	0.16	0.61	5.55	0.06
												To: ICS-B	In:													
WS CB-B3	LANDSCAPED	0.008		0.400								From: CB-B3	Out:													
	IMPERVIOUS	0.178		0.850										HDPE	12	17	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.28	0.72	3.27	0.09
			0.186	0.832	0.154		6.00	NONE	6.00	6.39	**0.99**	To: WQU-B2	In:													
WS CB-B4	LANDSCAPED	0.030		0.400								From: CB-B4	Out:													
	IMPERVIOUS	0.289		0.850										HDPE	12	22	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.46	0.84	3.80	0.10
			0.319	0.808	0.257		6.00	NONE	6.00	6.39	**1.64**	To: WQU-B2	In:													
WQU-B2 TO	**ICS-B**					0.412	6.14	0.10	6.24	6.35	**2.61**	From: WQU-B2	Out:													
														HDPE	12	69	0.79	0.250	0.010	0.013	**3.56**	**4.54**	**0.73**	**0.96**	**4.34**	**0.26**
												To: ICS-B	In:													

CONECO
Engineers, Scientists & Surveyors

Project Number: 3395.1
Client: Shinglemill, LLC
Project Name: Shinglemill Apartments
Project Address: 0 Pond Street
Location: Rockland, MA

Calculations by: DJD
Calculations Date: 09/23/2022
Checked By: MSD
Checked Date: 09/23/2022

TO INFILTRATION CHAMBER SYSTEM C - 25 YEAR STORM

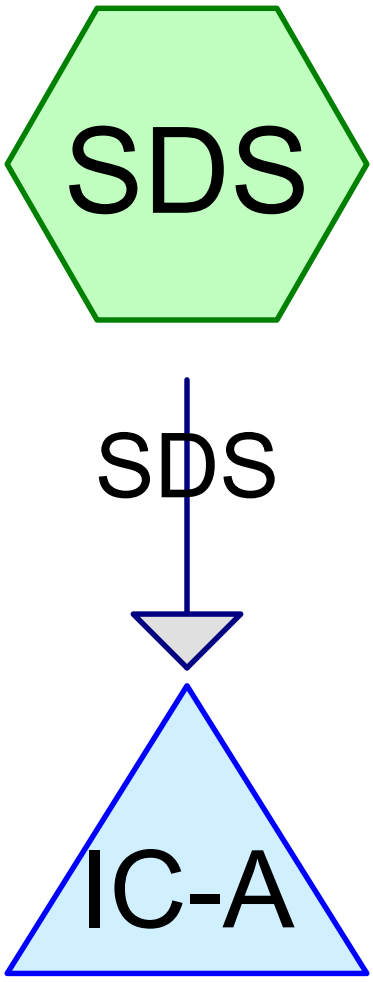
WATERSHED CHARACTERISTICS												PIPE CHARACTERISTICS											FLOW CHARACTERISTICS			
LOCATION				LAND USE			FLOW TIME			FLOW		R = hydraulic radius = area/wetted perimeter														Tc
Description	Cover	Increm. (ACRE)	Total_A (ACRE)	C	CA	Total CA	To Inlet (MIN)	In Pipe (MIN)	Tc (MIN)	I (IPH)	Q (CFS)	Structure	Invert	Pipe	Size (IN)	Length (FT)	Area (SF)	R (FT)	Slope	n	Qf (CFS)	Vf (FT/S)	Q/Qf	V/Vf	V (FT/S)	L/V (MIN)
WS ROOF DRAIN	LANDSCAPED	0.000		0.400								From: ROOF DRAIN	Out:													
	IMPERVIOUS	0.254		0.850										HDPE	12	88	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.39	0.80	3.61	0.41
			0.254	0.850	0.216		6.00	NONE	6.00	6.39	**1.38**	To: DMH-C1	In:													
WS CB-C1	LANDSCAPED	0.011		0.400								From: CB-C1	Out:													
	IMPERVIOUS	0.051		0.850										HDPE	12	32	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.08	0.51	2.32	0.23
			0.061	0.771	0.047		6.00	NONE	6.00	6.39	**0.30**	To: DMH-C1	In:													
WS DCB-C2	LANDSCAPED	0.014		0.400								From: DCB-C2	Out:													
	IMPERVIOUS	0.255		0.850										HDPE	12	26	0.79	0.250	0.005	0.013	**2.52**	**3.21**	0.56	0.89	2.85	0.15
			0.269	0.826	0.223		6.00	NONE	6.00	6.39	**1.42**	To: DMH-C1	In:													
WS DCB-C3	LANDSCAPED	0.048		0.400								From: DCB-C3	Out:													
	IMPERVIOUS	0.314		0.850										HDPE	12	75	0.79	0.250	0.005	0.013	**2.52**	**3.21**	0.73	0.95	3.06	0.41
			0.362	0.790	0.286		6.00	NONE	6.00	6.39	**1.83**	To: DMH-C1	In:													
												From: DMH-C1	Out:													
DMH-C1 TO ICS-C						0.772	6.00	0.41	6.41	6.32	**4.88**	To: ICS-C	In:	HDPE	18	3	1.77	0.375	0.010	0.013	**10.50**	**5.94**	**0.46**	**0.84**	**4.98**	**0.01**
WS DCB-C4	LANDSCAPED	0.280		0.400								From: DCB-C4	Out:													
	IMPERVIOUS	0.442		0.850										HDPE	12	47	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.88	1.01	4.57	0.17
			0.723	0.676	0.488		6.00	NONE	6.00	6.39	**3.12**	To: DMH-C2	In:													
WS DCB-C5	LANDSCAPED	0.006		0.400								From: DCB-C5	Out:													
	IMPERVIOUS	0.128		0.850										HDPE	12	38	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.20	0.66	2.98	0.21
			0.134	0.830	0.111		6.00	NONE	6.00	6.39	**0.71**	To: DMH-C2	In:													
												From: ICS-C	Out:													
DMH-C2 TO ICS-C						0.599	6.00	0.21	6.21	6.35	3.81	To: ICS-C	In:	HDPE	18	5	1.77	0.375	0.010	0.013	**10.50**	**5.94**	**0.36**	**0.78**	**4.64**	**0.02**
WS ROOF DRAIN	LANDSCAPED	0.000		0.400								From: ROOF DRAIN	Out:													
	IMPERVIOUS	0.431		0.850										HDPE	12	127	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.66	0.93	4.20	0.50
			0.431	0.850	0.366		6.00	NONE	6.00	6.39	**2.34**	To: DMH-B3	In:													
												From: DMH-C4	Out:													
DMH-C4 TO DMH-C3						0.366	0.00	0.00	0.00	7.67	2.81	To: DMH-C3	In:	HDPE	12	32	0.79	0.25	0.010	0.013	3.56	4.54	0.79	0.98	4.43	0.12

CONECO
Engineers, Scientists & Surveyors

Project Number: 3395.1
Client: Shinglemill, LLC
Project Name: Shinglemill Apartments
Project Address: 0 Pond Street
Location: Rockland, MA

Calculations by: DJD
Calculations Date: 09/23/2022
Checked By: MSD
Checked Date: 09/23/2022

WS	DCB-C6		LANDSCAPED	0.035		0.400									From:	DCB-C6	Out:									
			IMPERVIOUS	0.298		0.850												HDPE	12	25	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.48	0.85	3.84	0.11
					0.333	0.803	0.268		6.00	NONE	6.00	6.39	**1.71**		To:	DMH-C3	In:									
WS	DCB-C7		LANDSCAPED	0.038		0.400									From:	DCB-C7	Out:									
			IMPERVIOUS	0.269		0.850												HDPE	12	29	0.79	0.250	0.010	0.013	**3.56**	**4.54**	0.44	0.82	3.74	0.13
					0.307	0.795	0.244		6.00	NONE	6.00	6.39	**1.56**		To:	DMH-C3	In:									
	DMH-C3	**TO**	**ICS-C**					0.878	6.00	0.13	6.13	6.37	**5.59**		From:	DMH-C3	Out:									
															To:	ICS-C	In:	HDPE	18	4	1.77	0.375	0.010	0.013	**10.50**	**5.94**	**0.53**	**0.87**	**5.18**	**0.01**



Infiltration Chambers A

Subcat Reach Pond Link

Routing Diagram for 3395.1 - 0 Pond Street - SDS - (IC-A)
Prepared by {enter your company name here}, Printed 9/19/2022

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	IC-A	136.24	135.70	27.0	0.0200	0.013	0.0	18.0	0.0
2	IC-A	139.50	139.20	19.0	0.0158	0.013	0.0	18.0	0.0

Summary for Subcatchment SDS: SDS

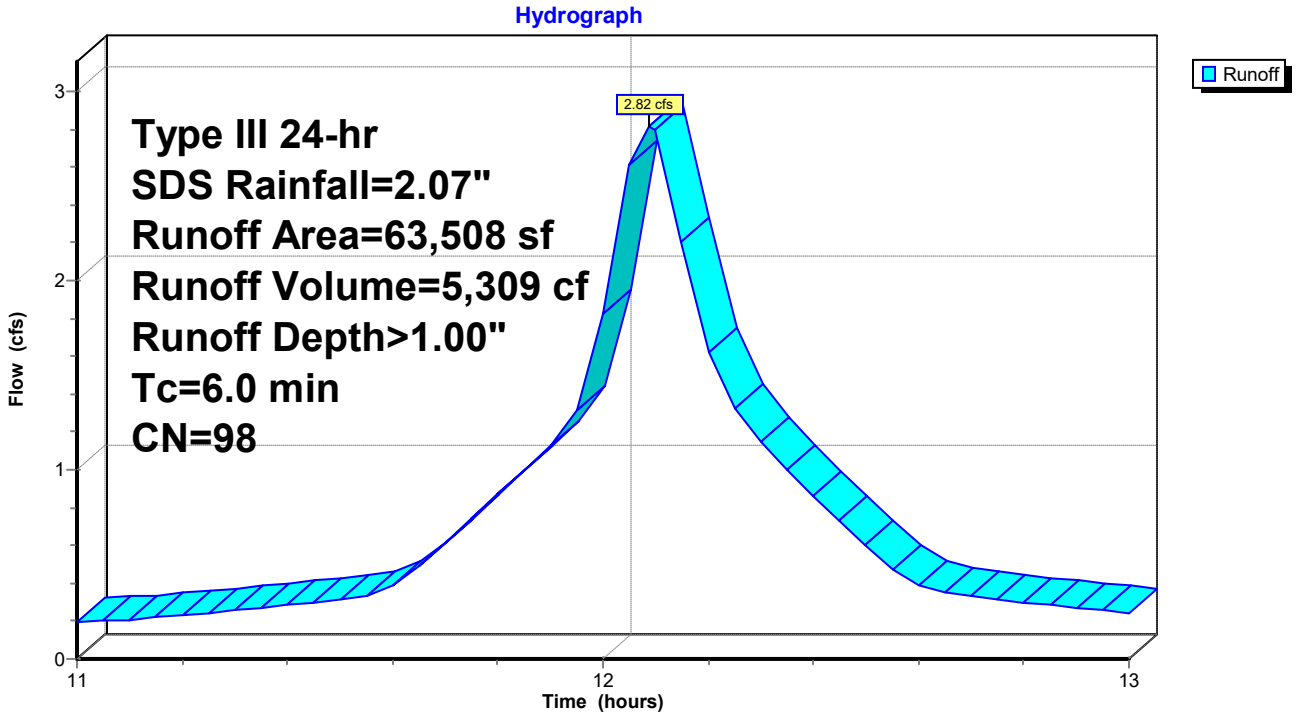
Runoff = 2.82 cfs @ 12.09 hrs, Volume= 5,309 cf, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.05 hrs
Type III 24-hr SDS Rainfall=2.07"

Area (sf)	CN	Description
63,508	98	Unconnected pavement, HSG D
63,508		100.00% Impervious Area
63,508		100.00% Unconnected

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

Subcatchment SDS: SDS



Summary for Pond IC-A: Infiltration Chambers A

Inflow Area = 63,508 sf,100.00% Impervious, Inflow Depth > 1.00" for SDS event
Inflow = 2.82 cfs @ 12.09 hrs, Volume= 5,309 cf
Outflow = 0.36 cfs @ 11.60 hrs, Volume= 2,378 cf, Atten= 87%, Lag= 0.0 min
Discarded = 0.36 cfs @ 11.60 hrs, Volume= 2,378 cf
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.05 hrs
Peak Elev= 140.77' @ 12.65 hrs Surf.Area= 1,855 sf Storage= 3,019 cf

Plug-Flow detention time= 19.9 min calculated for 2,370 cf (45% of inflow)
Center-of-Mass det. time= 0.6 min (724.9 - 724.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	138.50'	1,574 cf	**35.33'W x 52.50'L x 3.54'H Field A** 6,570 cf Overall - 2,634 cf Embedded = 3,936 cf x 40.0% Voids
#2A	139.00'	2,634 cf	**Cultec R-330XLHD** x 49 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 7 rows
		4,208 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	136.24'	**18.0" Round Culvert** L= 27.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 136.24' / 135.70' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	141.25'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	139.50'	**18.0" Round Culvert** L= 19.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 139.50' / 139.20' S= 0.0158 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Discarded	138.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.36 cfs @ 11.60 hrs HW=138.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.36 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=138.51' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 10.49 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**3=Culvert** (Controls 0.00 cfs)

Pond IC-A: Infiltration Chambers A - 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 7 rows

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

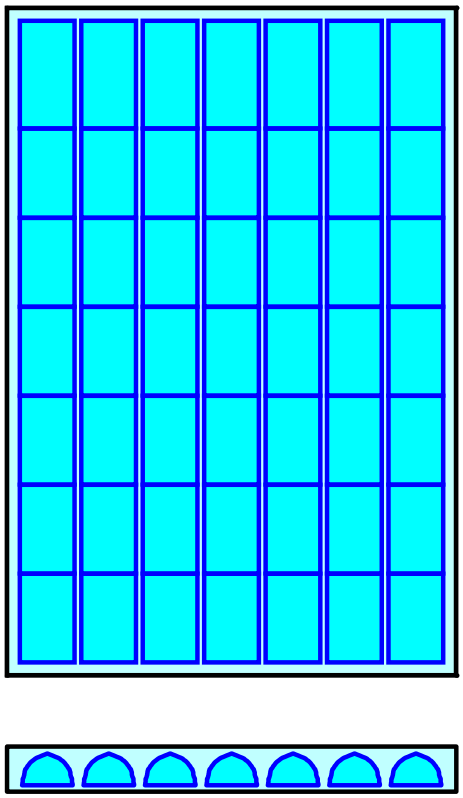
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
7 Rows x 52.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 35.33' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

49 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 7 Rows = 2,633.9 cf Chamber Storage

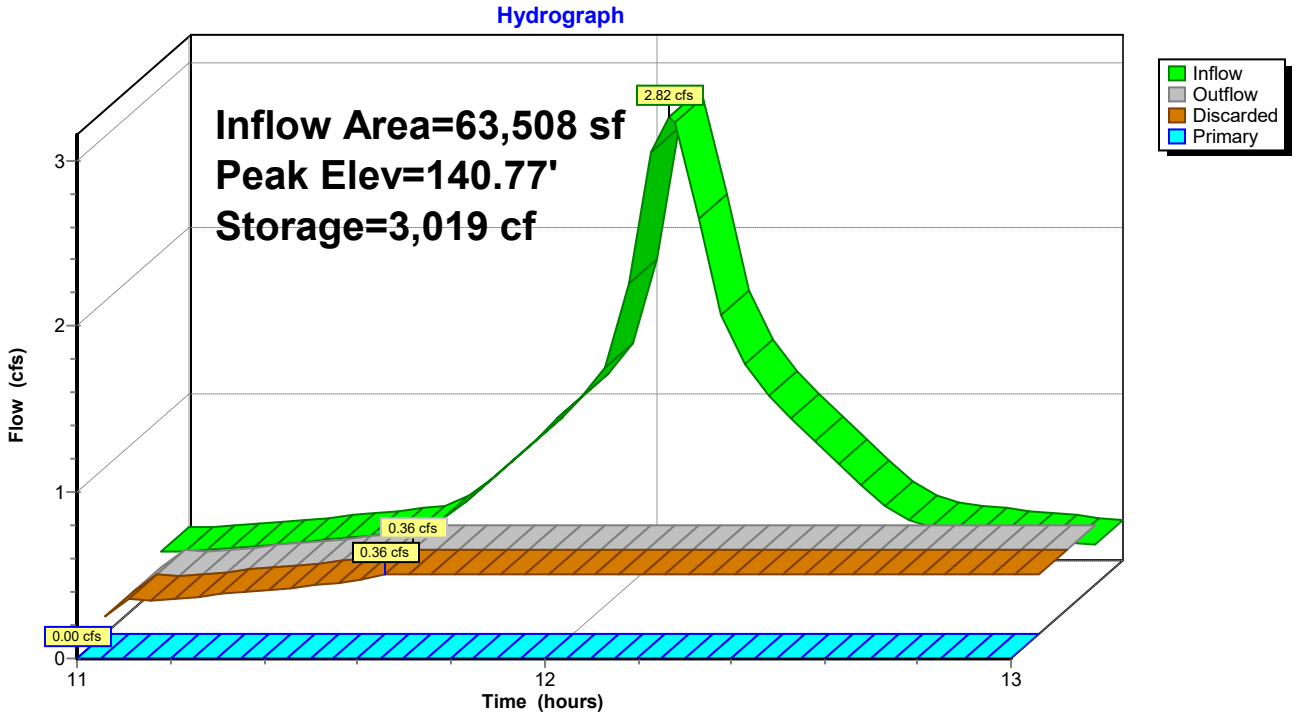
6,569.8 cf Field - 2,633.9 cf Chambers = 3,935.9 cf Stone x 40.0% Voids = 1,574.3 cf Stone Storage

Chamber Storage + Stone Storage = 4,208.3 cf = 0.097 af
Overall Storage Efficiency = 64.1%
Overall System Size = 52.50' x 35.33' x 3.54'

49 Chambers
243.3 cy Field
145.8 cy Stone

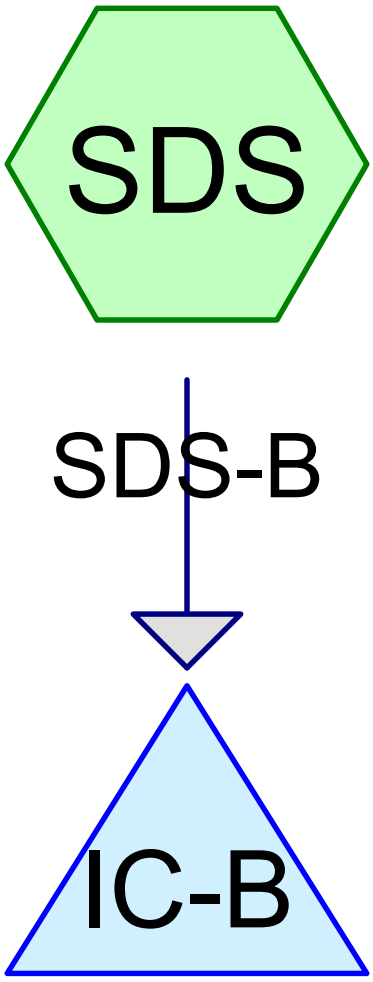


Pond IC-A: Infiltration Chambers A



Stage-Area-Storage for Pond IC-A: Infiltration Chambers A

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
138.50	**1,855**	0
138.55	1,855	37
138.60	1,855	74
138.65	1,855	111
138.70	1,855	148
138.75	1,855	186
138.80	1,855	223
138.85	1,855	260
138.90	1,855	297
138.95	1,855	334
139.00	1,855	371
139.05	1,855	450
139.10	1,855	529
139.15	1,855	608
139.20	1,855	687
139.25	1,855	765
139.30	1,855	844
139.35	1,855	922
139.40	1,855	1,000
139.45	1,855	1,078
139.50	1,855	1,156
139.55	1,855	1,234
139.60	1,855	1,312
139.65	1,855	1,388
139.70	1,855	1,465
139.75	1,855	1,541
139.80	1,855	1,617
139.85	1,855	1,693
139.90	1,855	1,768
139.95	1,855	1,844
140.00	1,855	1,919
140.05	1,855	1,994
140.10	1,855	2,069
140.15	1,855	2,144
140.20	1,855	2,219
140.25	1,855	2,293
140.30	1,855	2,366
140.35	1,855	2,439
140.40	1,855	2,510
140.45	1,855	2,581
140.50	1,855	2,652
140.55	1,855	2,721
140.60	1,855	2,790
140.65	1,855	2,858
140.70	1,855	2,926
140.75	1,855	2,992
140.80	1,855	3,058
140.85	1,855	3,122
140.90	1,855	3,186
140.95	1,855	3,248
141.00	1,855	3,309
141.05	1,855	3,368
141.10	1,855	3,426
141.15	1,855	3,482
141.20	1,855	3,536
141.25	1,855	3,588
141.30	1,855	3,637
141.35	1,855	3,683
141.40	1,855	3,727
141.45	1,855	3,768
141.50	1,855	3,806
141.55	1,855	3,843
141.60	1,855	3,881
141.65	1,855	3,918
141.70	1,855	3,955
141.75	1,855	3,992
141.80	1,855	4,029
141.85	1,855	4,066
141.90	1,855	4,103
141.95	1,855	4,140
142.00	1,855	**4,177**



Infiltration Chambers B

Subcat Reach Pond Link

Routing Diagram for 3395.1 - 0 Pond Street - SDS - (IC-B)
Prepared by {enter your company name here}, Printed 9/19/2022

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	IC-B	138.14	136.90	62.0	0.0200	0.013	0.0	18.0	0.0
2	IC-B	138.00	138.05	5.0	-0.0100	0.013	0.0	18.0	0.0

Summary for Subcatchment SDS: SDS-B

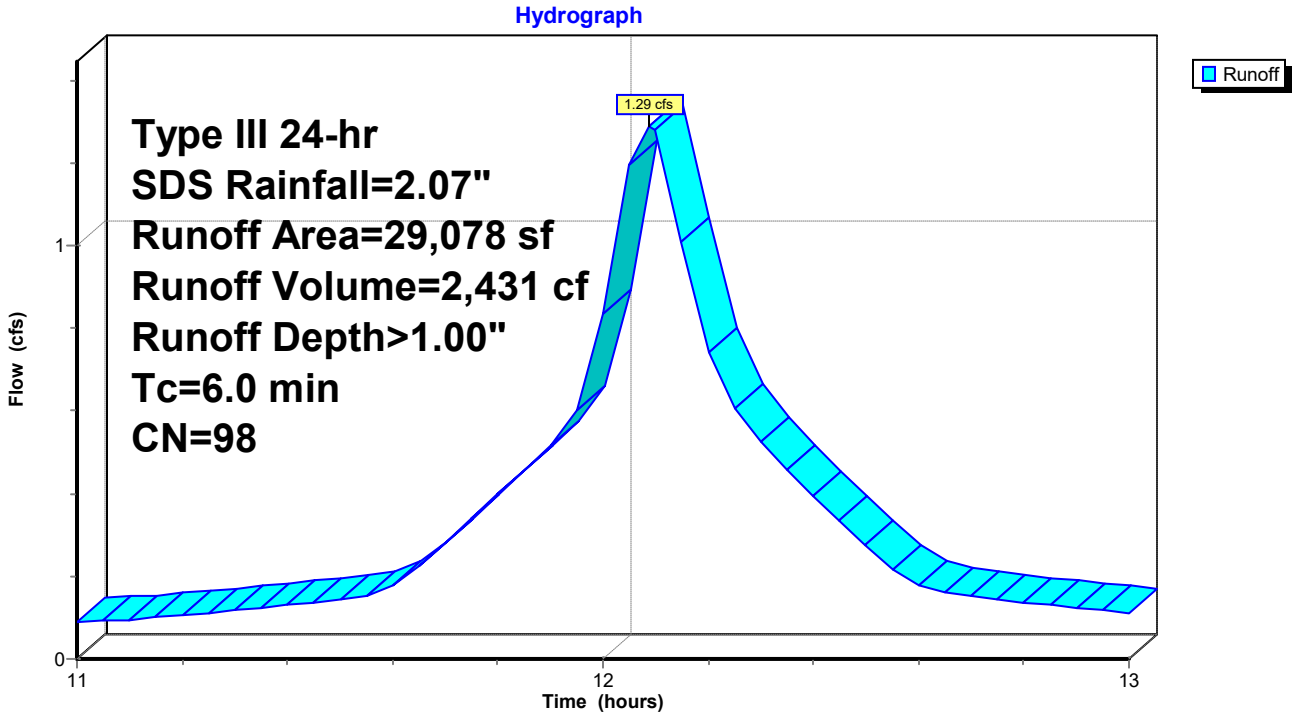
Runoff = 1.29 cfs @ 12.09 hrs, Volume= 2,431 cf, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.05 hrs
Type III 24-hr SDS Rainfall=2.07"

Area (sf)	CN	Description
29,078	98	Unconnected pavement, HSG A
29,078		100.00% Impervious Area
29,078		100.00% Unconnected

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

Subcatchment SDS: SDS-B



Summary for Pond IC-B: Infiltration Chambers B

Inflow Area = 29,078 sf,100.00% Impervious, Inflow Depth > 1.00" for SDS event
Inflow = 1.29 cfs @ 12.09 hrs, Volume= 2,431 cf
Outflow = 0.15 cfs @ 11.60 hrs, Volume= 1,041 cf, Atten= 88%, Lag= 0.0 min
Discarded = 0.15 cfs @ 11.60 hrs, Volume= 1,041 cf
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.05 hrs
Peak Elev= 140.03' @ 12.69 hrs Surf.Area= 802 sf Storage= 1,418 cf

Plug-Flow detention time= 20.2 min calculated for 1,038 cf (43% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

Volume	Invert	Avail.Storage	Storage Description
#1A	137.50'	701 cf	**20.83'W x 38.50'L x 3.54'H Field A** 2,841 cf Overall - 1,088 cf Embedded = 1,753 cf x 40.0% Voids
#2A	138.00'	1,088 cf	**Cultec R-330XLHD** x 20 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 4 rows
		1,789 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.14'	**18.0" Round Culvert** L= 62.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 138.14' / 136.90' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	140.60'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	138.05'	**18.0" Round Culvert** L= 5.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 138.00' / 138.05' S= -0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#4	Discarded	137.50'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.15 cfs @ 11.60 hrs HW=137.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=137.51' (Free Discharge)
└**1=Culvert** (Controls 0.00 cfs)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**3=Culvert** (Controls 0.00 cfs)

Pond IC-B: Infiltration Chambers B - 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 4 rows

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

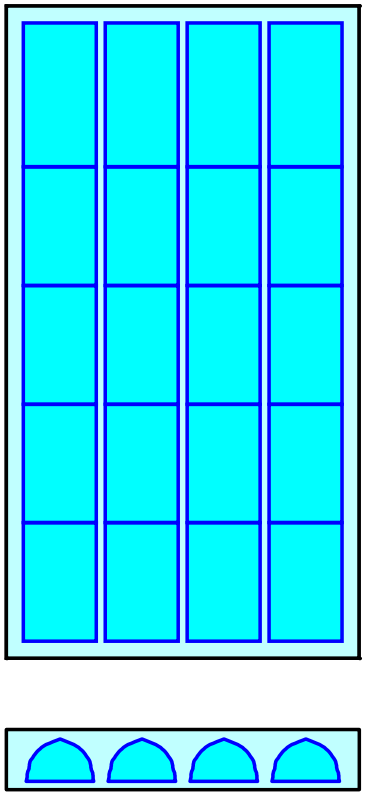
5 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 36.50' Row Length +12.0" End Stone x 2 = 38.50' Base Length
4 Rows x 52.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 20.83' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

20 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 4 Rows = 1,087.8 cf Chamber Storage

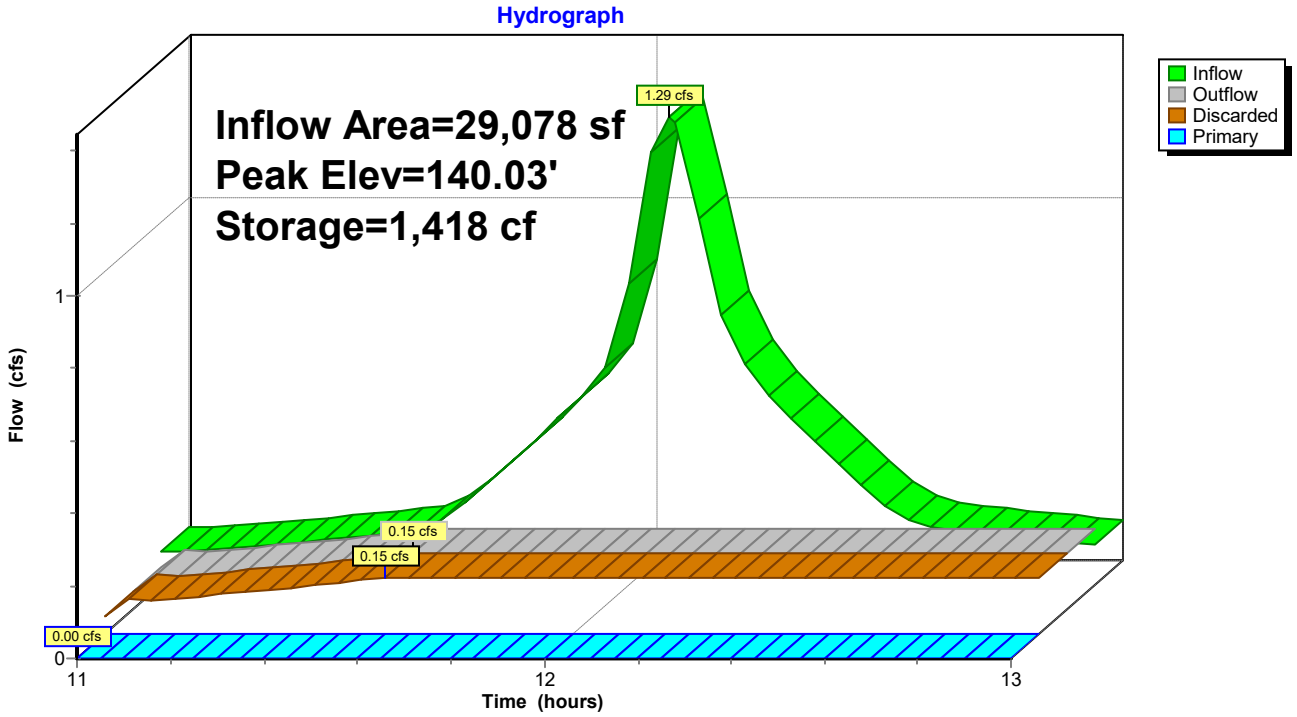
2,840.7 cf Field - 1,087.8 cf Chambers = 1,752.9 cf Stone x 40.0% Voids = 701.1 cf Stone Storage

Chamber Storage + Stone Storage = 1,789.0 cf = 0.041 af
Overall Storage Efficiency = 63.0%
Overall System Size = 38.50' x 20.83' x 3.54'

20 Chambers
105.2 cy Field
64.9 cy Stone

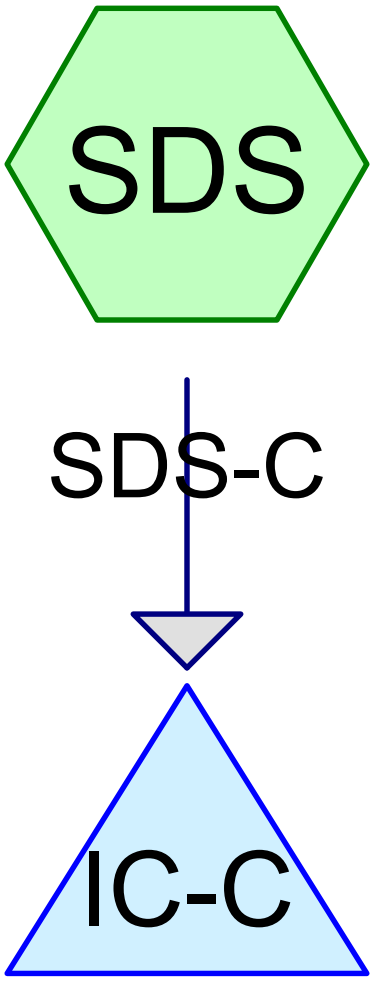


Pond IC-B: Infiltration Chambers B



Stage-Area-Storage for Pond IC-B: Infiltration Chambers B

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
137.50	**802**	0
137.55	802	16
137.60	802	32
137.65	802	48
137.70	802	64
137.75	802	80
137.80	802	96
137.85	802	112
137.90	802	128
137.95	802	144
138.00	802	160
138.05	802	194
138.10	802	227
138.15	802	261
138.20	802	294
138.25	802	327
138.30	802	360
138.35	802	393
138.40	802	426
138.45	802	459
138.50	802	492
138.55	802	525
138.60	802	557
138.65	802	590
138.70	802	622
138.75	802	654
138.80	802	686
138.85	802	718
138.90	802	750
138.95	802	782
139.00	802	814
139.05	802	846
139.10	802	878
139.15	802	909
139.20	802	941
139.25	802	972
139.30	802	1,003
139.35	802	1,034
139.40	802	1,064
139.45	802	1,094
139.50	802	1,124
139.55	802	1,153
139.60	802	1,183
139.65	802	1,211
139.70	802	1,240
139.75	802	1,268
139.80	802	1,296
139.85	802	1,323
139.90	802	1,350
139.95	802	1,377
140.00	802	1,402
140.05	802	1,428
140.10	802	1,452
140.15	802	1,476
140.20	802	1,499
140.25	802	1,521
140.30	802	1,542
140.35	802	1,562
140.40	802	1,581
140.45	802	1,599
140.50	802	1,615
140.55	802	1,631
140.60	802	1,647
140.65	802	1,663
140.70	802	1,679
140.75	802	1,695
140.80	802	1,711
140.85	802	1,727
140.90	802	1,744
140.95	802	1,760
141.00	802	**1,776**



Infiltration Chambers C

Subcat Reach Pond Link

Routing Diagram for 3395.1 - 0 Pond Street - SDS - (IC-C)
Prepared by {enter your company name here}, Printed 9/19/2022

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	IC-C	138.51	135.65	143.0	0.0200	0.013	0.0	24.0	0.0
2	IC-C	139.50	139.45	298.0	0.0002	0.013	0.0	24.0	0.0

Summary for Subcatchment SDS: SDS-C

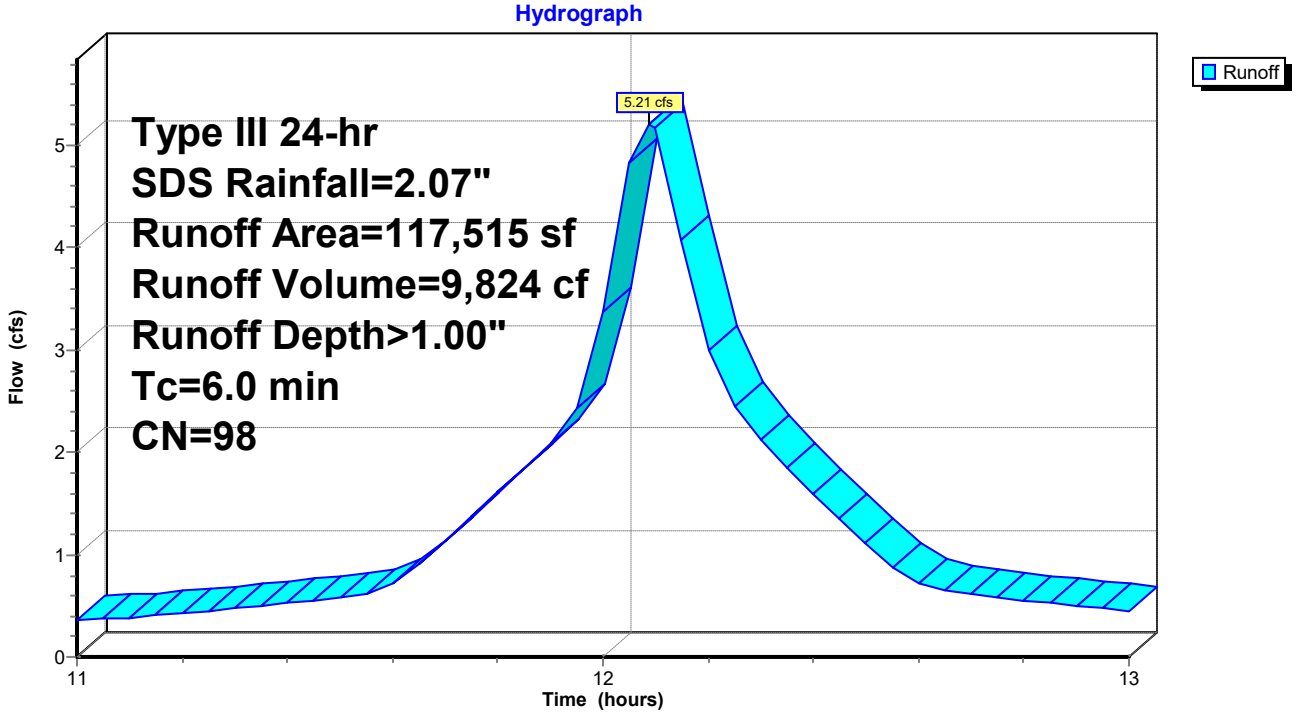
Runoff = 5.21 cfs @ 12.09 hrs, Volume= 9,824 cf, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.05 hrs
Type III 24-hr SDS Rainfall=2.07"

Area (sf)	CN	Description
117,515	98	Unconnected pavement, HSG A
117,515		100.00% Impervious Area
117,515		100.00% Unconnected

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

Subcatchment SDS: SDS-C



Summary for Pond IC-C: Infiltration Chambers C

Inflow Area = 117,515 sf,100.00% Impervious, Inflow Depth > 1.00" for SDS event
Inflow = 5.21 cfs @ 12.09 hrs, Volume= 9,824 cf
Outflow = 0.63 cfs @ 11.60 hrs, Volume= 4,275 cf, Atten= 88%, Lag= 0.0 min
Discarded = 0.63 cfs @ 11.60 hrs, Volume= 4,275 cf
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.05 hrs
Peak Elev= 141.38' @ 12.67 hrs Surf.Area= 3,308 sf Storage= 5,679 cf

Plug-Flow detention time= 20.1 min calculated for 4,260 cf (43% of inflow)
Center-of-Mass det. time= 0.2 min (724.6 - 724.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	139.00'	2,768 cf	**45.00'W x 73.50'L x 3.54'H Field A** 11,714 cf Overall - 4,795 cf Embedded = 6,919 cf x 40.0% Voids
#2A	139.50'	4,795 cf	**Cultec R-330XLHD** x 90 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 9 rows
		7,562 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	138.51'	**24.0" Round Culvert** L= 143.0' Ke= 0.500 Inlet / Outlet Invert= 138.51' / 135.65' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 3.14 sf
#2	Device 1	141.50'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Device 2	139.50'	**24.0" Round Culvert** L= 298.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 139.50' / 139.45' S= 0.0002 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#4	Discarded	139.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.63 cfs @ 11.60 hrs HW=139.04' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.63 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=139.01' (Free Discharge)
└**1=Culvert** (Passes 0.00 cfs of 1.48 cfs potential flow)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**3=Culvert** (Controls 0.00 cfs)

Pond IC-C: Infiltration Chambers C - 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 9 rows

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

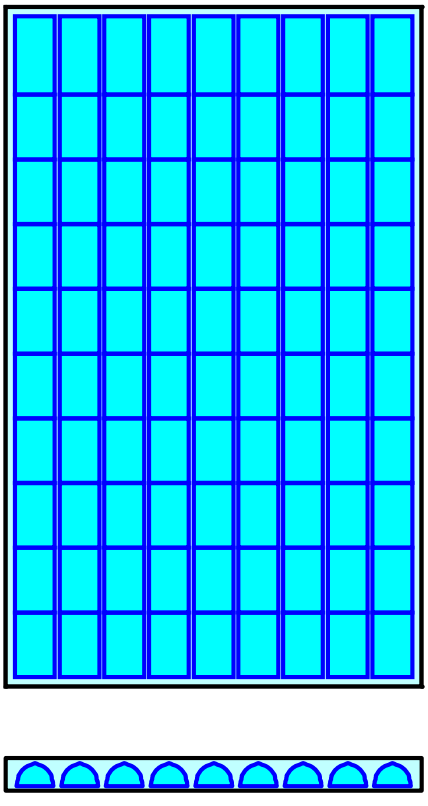
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length
9 Rows x 52.0" Wide + 6.0" Spacing x 8 + 12.0" Side Stone x 2 = 45.00' Base Width
6.0" Stone Base + 30.5" Chamber Height + 6.0" Stone Cover = 3.54' Field Height

90 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 9 Rows = 4,794.7 cf Chamber Storage

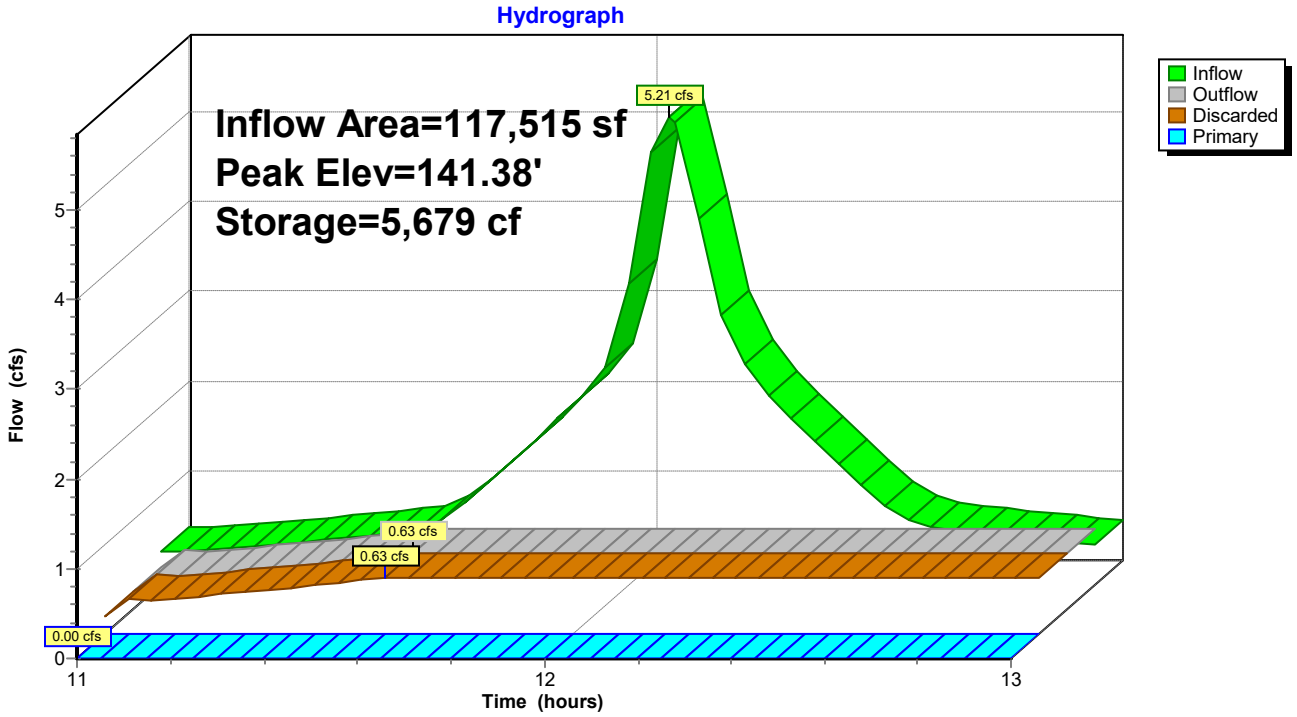
11,714.1 cf Field - 4,794.7 cf Chambers = 6,919.3 cf Stone x 40.0% Voids = 2,767.7 cf Stone Storage

Chamber Storage + Stone Storage = 7,562.5 cf = 0.174 af
Overall Storage Efficiency = 64.6%
Overall System Size = 73.50' x 45.00' x 3.54'

90 Chambers
433.9 cy Field
256.3 cy Stone

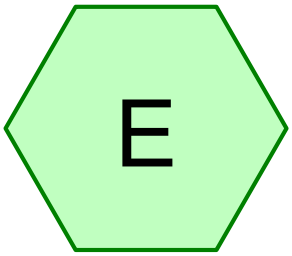


Pond IC-C: Infiltration Chambers C

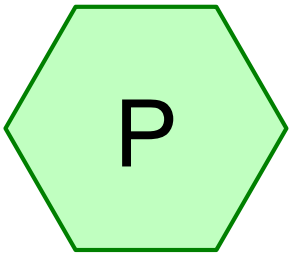


Stage-Area-Storage for Pond IC-C: Infiltration Chambers C

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
139.00	**3,308**	0
139.05	3,308	66
139.10	3,308	132
139.15	3,308	198
139.20	3,308	265
139.25	3,308	331
139.30	3,308	397
139.35	3,308	463
139.40	3,308	529
139.45	3,308	595
139.50	3,308	662
139.55	3,308	804
139.60	3,308	947
139.65	3,308	1,089
139.70	3,308	1,231
139.75	3,308	1,372
139.80	3,308	1,513
139.85	3,308	1,654
139.90	3,308	1,795
139.95	3,308	1,936
140.00	3,308	2,077
140.05	3,308	2,217
140.10	3,308	2,357
140.15	3,308	2,496
140.20	3,308	2,633
140.25	3,308	2,771
140.30	3,308	2,907
140.35	3,308	3,044
140.40	3,308	3,180
140.45	3,308	3,316
140.50	3,308	3,452
140.55	3,308	3,587
140.60	3,308	3,722
140.65	3,308	3,857
140.70	3,308	3,992
140.75	3,308	4,125
140.80	3,308	4,257
140.85	3,308	4,388
140.90	3,308	4,517
140.95	3,308	4,645
141.00	3,308	4,772
141.05	3,308	4,897
141.10	3,308	5,021
141.15	3,308	5,144
141.20	3,308	5,265
141.25	3,308	5,384
141.30	3,308	5,502
141.35	3,308	5,618
141.40	3,308	5,732
141.45	3,308	5,844
141.50	3,308	5,954
141.55	3,308	6,061
141.60	3,308	6,165
141.65	3,308	6,265
141.70	3,308	6,362
141.75	3,308	6,455
141.80	3,308	6,543
141.85	3,308	6,625
141.90	3,308	6,703
141.95	3,308	6,777
142.00	3,308	6,846
142.05	3,308	6,912
142.10	3,308	6,978
142.15	3,308	7,044
142.20	3,308	7,110
142.25	3,308	7,177
142.30	3,308	7,243
142.35	3,308	7,309
142.40	3,308	7,375
142.45	3,308	7,441
142.50	3,308	**7,507**



Existing



Proposed

Subcat Reach Pond Link

Routing Diagram for 3395.1 - 0 Pond Street - Vernal Pool
Prepared by {enter your company name here}, Printed 6/23/2022

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
1,996	80	>75% Grass cover, Good, HSG D (P)
242	30	Brush, Good, HSG A (E, P)
14,201	73	Brush, Good, HSG D (E, P)
3,166	89	Dirt roads, HSG D (E, P)
1,392	98	Unconnected pavement, HSG D (E, P)
192	98	Unconnected roofs, HSG A (E)
101,630	78	Wetlands, HSG D (E, P)
13,316	30	Woods, Good, HSG A (E, P)
108,736	77	Woods, Good, HSG D (E, P)
244,871	**75**	**TOTAL AREA**

Summary for Subcatchment E: Existing

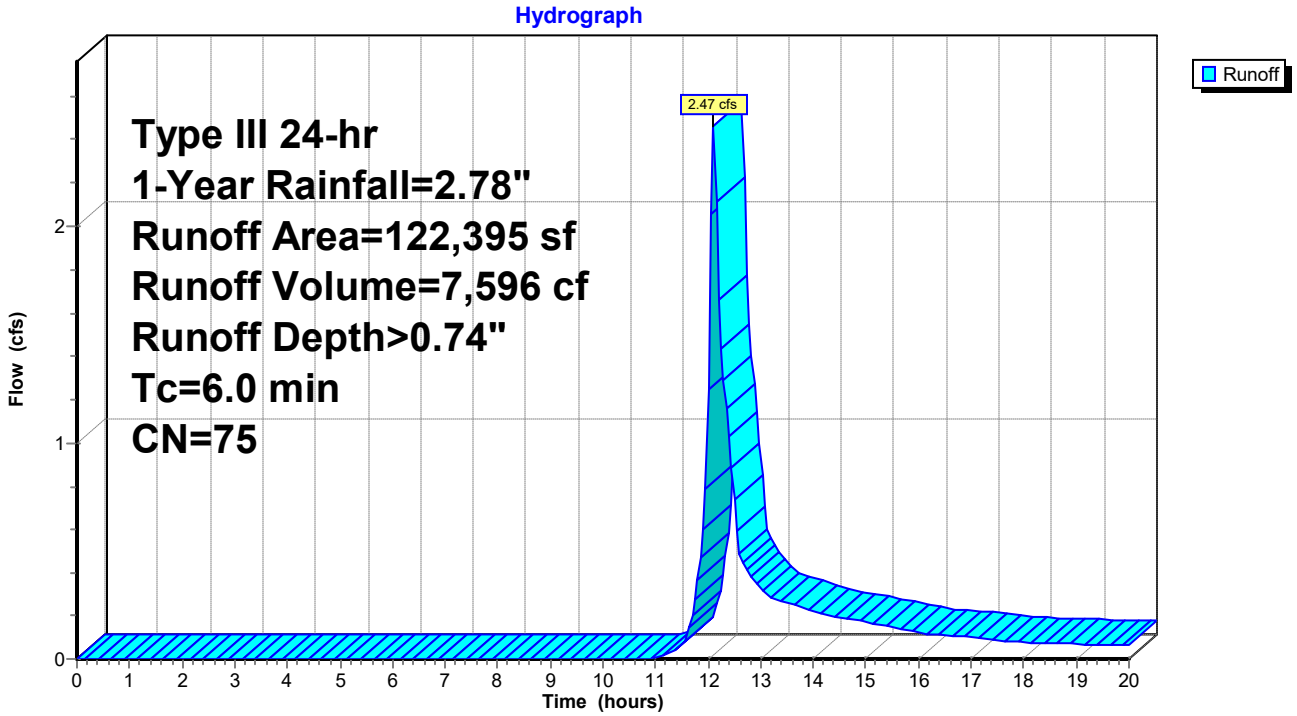
Runoff = 2.47 cfs @ 12.10 hrs, Volume= 7,596 cf, Depth> 0.74"

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

	Area (sf)	CN	Description
	6,562	30	Woods, Good, HSG A
	121	30	Brush, Good, HSG A
	192	98	Unconnected roofs, HSG A
	54,519	77	Woods, Good, HSG D
	7,301	73	Brush, Good, HSG D
	1,583	89	Dirt roads, HSG D
*	50,815	78	Wetlands, HSG D
	1,302	98	Unconnected pavement, HSG D
	122,395	75	Weighted Average
	120,901		98.78% Pervious Area
	1,494		1.22% Impervious Area
	1,494		100.00% Unconnected

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

Subcatchment E: Existing



Summary for Subcatchment P: Proposed

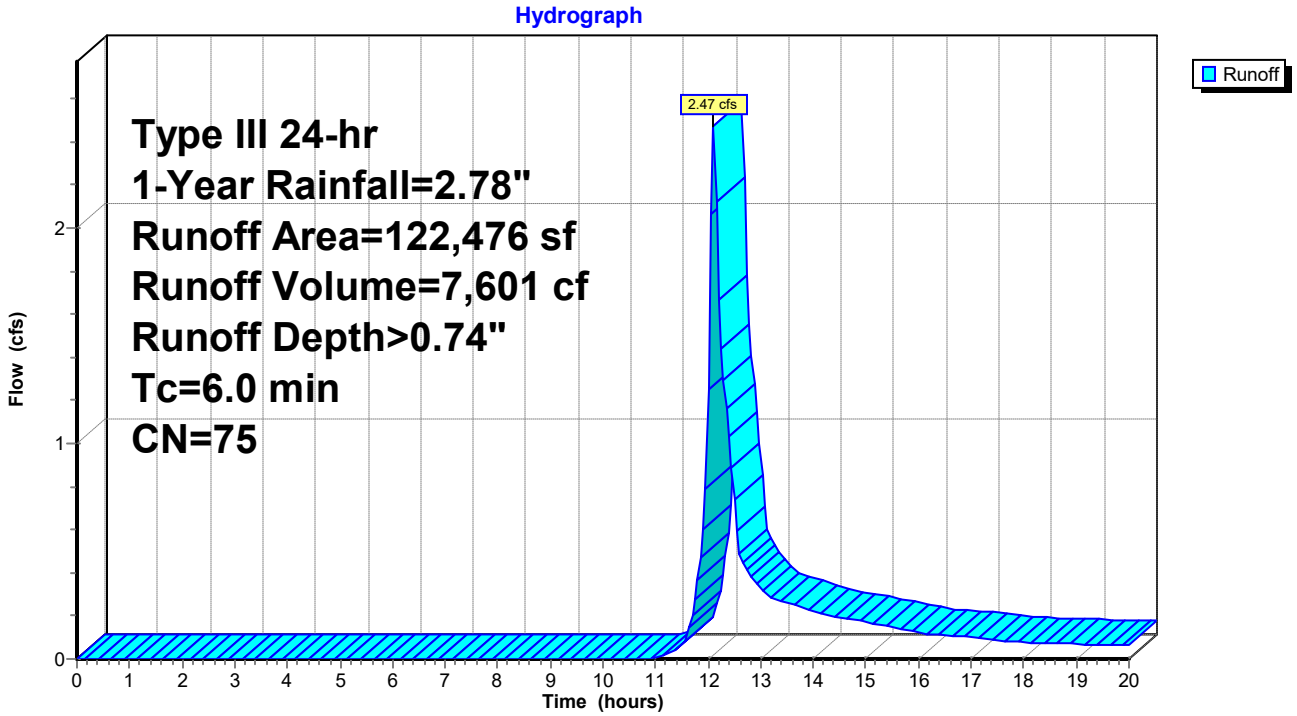
Runoff = 2.47 cfs @ 12.10 hrs, Volume= 7,601 cf, Depth> 0.74"

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

	Area (sf)	CN	Description
	6,754	30	Woods, Good, HSG A
	121	30	Brush, Good, HSG A
	54,217	77	Woods, Good, HSG D
	6,900	73	Brush, Good, HSG D
	1,583	89	Dirt roads, HSG D
	1,996	80	>75% Grass cover, Good, HSG D
*	50,815	78	Wetlands, HSG D
*	90	98	Unconnected pavement, HSG D
	122,476	75	Weighted Average
	122,386		99.93% Pervious Area
	90		0.07% Impervious Area
	90		100.00% Unconnected

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

Subcatchment P: Proposed



APPENDIX D

LONG TERM POLLUTION PREVENTION PLAN – REQUIRED BY STANDARDS 4-6

LONG TERM POLLUTION PREVENTION PLAN

To keep the Stormwater Management System (SMS) functioning properly and to ensure that the stormwater Total Suspended Solids (TSS) are reduced, a long-term pollution prevention is required. Shinglemill, LLC, the owner/operator of the facility, is responsible for the adherence to this long-term plan. The following is a guideline of the specific requirements of the plan to maintain the long term viability of the stormwater management system.

The Stormwater Pollution Prevention Plan for the site addresses many of the items in the Long-Term Pollution Prevention Plan.

Good Housekeeping Practices

Employees shall be instructed in the importance of not spilling fluids and chemicals such as oil, antifreeze, etc. onto the bare ground. All areas exposed to the weather shall be kept clean

Provisions for Storing Materials and Waste Products Inside or Under Cover

Liquid waste products shall be captured when draining from vehicles, and stored in sealed containers under cover until they are disposed of. Waste products shall be disposed of in a legal manner, at a state licensed recycling center or landfill.

Requirements for routine inspections and maintenance of stormwater BMPs;

BMPs shall be inspected on a monthly basis. BMPs shall be maintained per the Operations and Maintenance Plan.

Spill prevention and response plans;

First responders	Phone Numbers
• Rockland Fire Department	911 if emergency or (781) 878-2123
• Rockland Police Department	911 if emergency or (781) 871-3890
• Mass Department of Environmental Protection	
Emergency Response	1-888-304-1133

Requirements for storage and use of fertilizers, herbicides, and pesticides;

Fertilizers shall not be used within 25 feet of the wetland resource areas. Excess fertilizers shall be swept up from all impervious surfaces and not allowed to run into the drainage system.

All fertilizer, herbicides, and pesticides shall be stored at least 100 feet away from the wetland line. If stored on site, these materials should be kept in a wrapped or sealed container, and kept under cover out of the rain and snow.

Provisions for solid waste management;

Solid waste shall be collected at a minimum of once per week and disposed of in an appropriate dumpster or garbage truck. Waste shall be disposed of in a legal manner, at a state licensed recycling center or landfill.

Winter Road Salt and/or Sand Use and Storage restrictions

Road salt shall not be used on this site.

Street sweeping schedules;

Street Sweeping shall be performed on paved surfaces no less than once per year, preferably in the spring months.

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;

Oil booms shall be kept on site in a readily accessible area in the event of an oil spill. If an oil spill occurs, the booms shall be placed and secured at the overflow spillway and in front of the entrance to the Stormceptors.

Routine Inspections and Maintenance of SMS BMP's

Routine inspections and maintenance shall be performed in accordance with the Operations and Maintenance Plan

APPENDIX E

OPERATION AND MAINTENANCE PLAN - REQUIRED BY STANDARD 9

OPERATION AND MAINTENANCE PLAN

To keep the Stormwater Management System (SMS) functioning properly and to ensure that the Total Suspended Solids (TSS) are reduced, periodic maintenance is required. The owner/operator of the facility is responsible for the periodic maintenance requirements of the SMS. Shinglemill, LLC is the owner and will be the party responsible for the maintenance of the SMS. The following is a guideline of the specific maintenance schedules and tasks required to keep the SMS functioning properly.

- Deep Sump Catch Basins
  - General Maintenance
    - Remove any accumulated leaves from the grates during the fall and spring.
  - Quarterly Maintenance
    - Inspect sumps for accumulated sediment. If sediment has reached a depth of eighteen inches (18”), remove via clamshell bucket or vacuum truck.
  - Annual Maintenance
    - Inspect hood to ensure that it is properly secured.
    - Remove accumulated sediment via clamshell bucket or vacuum truck.
- Proprietary Separators
  - General Maintenance
    - All operation and maintenance to follow Proprietary Separator Manufacturer’s guideline.
    - Sediment to be removed once it reaches approximately 15% of unit storage capacity. Approximate Depths for Stormceptors on site:
      - Stormceptor 900 – 8”
    - Units to be cleaned immediately after an oil, fuel, or chemical spill.
  - Quarterly Maintenance
    - Inspect structure for accumulated sediment and oil. Remove sediment if sediment has reached maximum depth. If oil is present, pump off oil layer.
  - Annual Maintenance
    - Inspect structure for accumulated sediment and oil. Remove sediment if sediment has reached maximum depth. If oil is present, pump off oil layer.
- Infiltration Chambers
  - General Maintenance
    - Inspect subsurface infiltration facilities twice a year.
    - Remove any debris that may clog the system via vacuum truck.
- Plunge Pools/Splash Pads
  - General Maintenance
    - During the fall and the spring remove any accumulated leaves or large debris.
  - Annual Maintenance
    - Check for signs of erosion and repair as needed.
    - Remove any branches, trash or other large debris that could interfere with the proper operation of the inlet or outlet of the basin. Remove any accumulated sediment, by the use of hand tools (shovels, rakes, wheelbarrows, etc.) when it exceeds three-inches (3”) but not less than annually.

SHINGLEMILL, LLC			
SHINGLEMILL			
0 POND STREET, ROCKLAND, MASSACHUSETTS			
STORMWATER MANAGEMENT SYSTEM OPERATION & MAINTENANCE LOG			
DATE	**TIME**	**MAINTENANCE ACTIVITY**	**MAINTENANCE PERFORMED, OBSERVATIONS**

APPENDIX F

SOIL LOGS

Job No.: 3395.1 | Soil Evaluator: Damien Dmitruk

Client: | Witness:

Site Location: 0 Pond St., Rockland, MA | Excavator: Iaria Brothers - Vinny

Land Use: Vacant lot | Date: October 2, 2019

Parent Material: | Weather: Cloudy, 75˚

Water Resource Conditions: Normal: | Above: | Below: X

TP # 3

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-24	Fill			Change in redox color at 11"	Depth		Mottling	4"
24-40	Ab	Loam	5Y 2.5/1		0-15 Min.			
40-58	C1	Sand	2.5Y 5/1	5% Gravel, 5% Cob./Stones	15-30 Min.		Weeping	
58-90	C2	Coarse Sand	2.5Y 5/1	10% Gravel, 10% Cob./Stones	30-45 Min.			
					45-60 Min.		Standing	40"
					60-75 Min.			
					Rate	"/hr		

TP # 4

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-24	Fill				Depth		Mottling	31"
24-30	Ab	Coarse Sand	10YR 4/1		0-15 Min.			
30-35	Bw	Coarse Sand	10YR 5/6		15-30 Min.		Weeping	
35-79	C	Coarse Sand	10YR 4/4	10% Gravel, 10% Cob./Stones	30-45 Min.			
					45-60 Min.		Standing	40"
					60-75 Min.			
					Rate	"/hr		

TP # 5

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-2	O				Depth		Mottling	6"
2-4	A	Loamy Sand	10YR 4/3	10% Gravel, 10% Cob./Stones	0-15 Min.			
4-13	Bw	Sand	2.5Y 5/4	10% Gravel, 10% Cob./Stones, heavier mottling at 26"	15-30 Min.		Weeping	25"
13-72	C	Sand	2.5Y 6/3	10% Gravel, 10% Cob./Stones	30-45 Min.			
					45-60 Min.		Standing	36"
					60-75 Min.			
					Rate	"/hr		

TP # 6

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-15	Fill				Depth		Mottling	10"
15-23	Ab	Loamy Sand	10YR 2/1	10% Gravel, 10% Cob./Stones	0-15 Min.			
23-29	Bw	Sand	10YR 5/6	10% Gravel, 10% Cob./Stones	15-30 Min.		Weeping	28"
29-105	C	Sand	2.5Y 5/1	10% Gravel, 10% Cob./Stones, Heavier mottling at 55"	30-45 Min.			
					45-60 Min.		Standing	48"
					60-75 Min.			
					Rate	"/hr		

TP # 7

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-113	Fill			60" to organic fill, roots at 86"	Depth		Mottling	
113-123	Ab	Loamy Sand	10YR 2/1		0-15 Min.			
123-131	Cg	Sand	5GY 5/2	10% Gravel, 5% Cob./Stones	15-30 Min.		Weeping	54"
					30-45 Min.			
					45-60 Min.		Standing	123"
					60-75 Min.			
					Rate	"/hr		

TP # 8

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-3	A	Sand	10YR 3/1	30% Gravel	Depth		Mottling	47"
3-6	Bw	Sand	10YR 4/4	20% Gravel, 30% Cob./Stones	0-15 Min.			
6-95	C1	Coarse Sand	2.5Y 5/4	20% Gravel, 30% Cob./Stones	15-30 Min.		Weeping	
					30-45 Min.			
					45-60 Min.		Standing	59"
					60-75 Min.			
					Rate	"/hr		

TP # 10

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-31	Fill			20% Gravel, 30% Cob./Stones	Depth		Mottling	45"
31-100	C1	Sand	2.5Y 5/2	10% Gravel, 10% Cob./Stones	0-15 Min.			
					15-30 Min.		Weeping	
					30-45 Min.			
					45-60 Min.		Standing	59"
					60-75 Min.			
					Rate	"/hr		

TP # 12

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-27	Fill				Depth		Mottling	42"
27-29	Ab	Loamy Sand			0-15 Min.			
29-42	Bw	Loamy Sand	10YR 5/6	10% Gravel, 10% Cob./Stones	15-30 Min.		Weeping	84"
42-56	C	Sand	10YR 4/2	10% Gravel, 10% Cob./Stones	30-45 Min.			
56-100	2C	Coarse Sand	10YR 6/1	10% Gravel, 10% Cob./Stones	45-60 Min.		Standing	90"
					60-75 Min.			
					Rate	"/hr		

TP # 13

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-10	Fill				Depth		Mottling	28"
10-17	Ab	Fine Sand	10YR 2/1	Heavy organic	0-15 Min.			
17-31	Bw	Sand	10YR 5/8		15-30 Min.		Weeping	48"
31-76	C1	Coarse Sand	2.5Y 4/4		30-45 Min.			
76-92	C2	Coarse Sand	2.5Y 5/1	10% Gravel, 30% Cob./Stones, 10% Small Boulders	45-60 Min.		Standing	48"
					60-75 Min.			
					Rate	"/hr		

TP # 14

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-36	Fill				Depth		Mottling	40"
36-41	Ab	Sandy Loam	10YR 2/1		0-15 Min.			
41-50	Bw	Loamy Sand	10YR 5/6		15-30 Min.		Weeping	
50-117	C	Medium Sand	2.5Y 4/4	20% Gravel, 5% Cob./Stones	30-45 Min.			
					45-60 Min.		Standing	56"
					60-75 Min.			
					Rate	"/hr		

Job No.: 3395.1 | Soil Evaluator: Damien Dmitruk

Client: | Witness:

Site Location: 0 Pond St., Rockland, MA | Excavator: Iaria Brothers - Vinny

Land Use: Vacant lot | Date: October 3, 2019

Parent Material: | Weather: Cloudy, 55˚

Water Resource Conditions: Normal: | Above: | Below: X

TP # 1

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-100	Fill			Scrap, fill until water surface 75", sand @ bottom of pit	Depth		Mottling	
					0-15 Min.			
					15-30 Min.		Weeping	
					30-45 Min.			
					45-60 Min.		Standing	44"
					60-75 Min.			
					Rate	"/hr		

TP # 2

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-70	Fill				Depth		Mottling	18"
70-97	C	Sand		10% Gravel, 10% Cob./Stone	0-15 Min.			
					15-30 Min.		Weeping	
					30-45 Min.			
					45-60 Min.		Standing	45"
					60-75 Min.			
					Rate	"/hr		

TP # 9

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-22	Fill				Depth		Mottling	27"
22-60	C1	Sand		Denser mottling @32"	0-15 Min.			
60-63	C2	Sand		10% Gravel, 10% Stone, Black	15-30 Min.		Weeping	
63-90	C3	Sand	5YR 4/6	10% Gravel, 10% Cob./Stone	30-45 Min.			
					45-60 Min.		Standing	44"
					60-75 Min.			
					Rate	"/hr		

TP # 11

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-18	Fill				Depth		Mottling	36"
18-33	C1	Coarse Sand	10YR 6/6	10% Gravel, 10% Cob./Stone	0-15 Min.			
33-67	C2	Fine Sand	2.5Y 6/2	10% Gravel, 10% Cob./Stone	15-30 Min.		Weeping	
67-90	C3	Coarse Sand	5Y 5/3	10% Gravel, 10% Cob./Stone	30-45 Min.			
					45-60 Min.		Standing	53"
					60-75 Min.			
					Rate	"/hr		

TP # 15

Depth	Horizon	Texture	Color	Comments	Infiltration Test		Groundwater	
0-54	Fill	Coarse Loamy Sand			Depth		Mottling	21"
54-69	Ab	Silt loam	10YR 2/1		0-15 Min.			
69-99	C1	Coarse Sand	5Y 4/2	20% Gravel, 20% Cob./Stone	15-30 Min.		Weeping	48"
					30-45 Min.			
					45-60 Min.		Standing	87"
					60-75 Min.			
					Rate	"/hr		

APPENDIX G

ILLICIT DISCHARGE COMPLIANCE STATEMENT- REQUIRED BY STANDARD 10

Illicit Discharge Compliance Statement

Responsibility:

The Owner is responsible for ultimate compliance with all provisions of the Massachusetts Stormwater Management Policy, the USEPA NPDES Construction General Permit and responsible for identifying and eliminating illicit discharges (as defined by the USEPA).

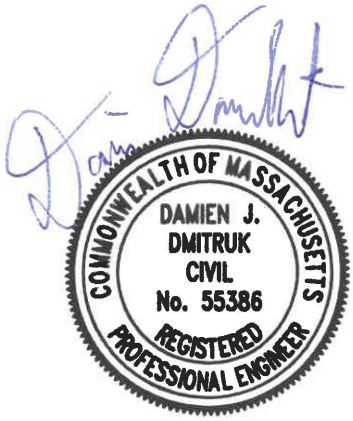
OWNER NAME:	Shinglemill, LLC
ADDRESS:	4 First Street
	Bridgewater, MA 02324
TEL. NUMBER:	(508) 697-3191

Engineer's Compliance Statement:

To the best of my knowledge, the attached plans, computations and specifications meet the requirements of Standard 10 of the Massachusetts Stormwater Handbook regarding illicit discharges to the stormwater management system and that no detectable illicit discharges exist on the site. All documents and attachments were prepared under my direction and qualified personnel properly gathered and evaluated the information submitted, to the best of my knowledge.

Included with this statement are site plans, drawn to scale, that identify the location of systems for conveying stormwater on the site and show that these systems do not allow the entry of any illicit discharges into the stormwater management system. The plans also show any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater systems.

For a redevelopment project (if applicable), all actions taken to identify and remove illicit discharges, including without limitation, visual screening, dye or smoke testing, and the removal of any sources of illicit discharges to the stormwater management system are documented and included with this statement.



Damien J. Dmitruk, P.E.
Civil Engineer

APPENDIX H

STORMCEPTOR SIZING REPORTS

RINKER STORMCEPTOR OWNER'S MANUAL

STEP - STORMCEPTOR FACT SHEET

Detailed Stormceptor Sizing Report – WQU-E1

Project Information & Location			
Project Name	Shinglemill Apartments	**Project Number**	3395.1
City	Rockland	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/7/2020
Designer Information		**EOR Information (optional)**	
Name	Coneco Coneco	**Name**	
Company	Coneco Engineers & Scientists	**Company**	
Phone #	508-697-3191	**Phone #**	
Email	Stormceptor@coneco.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	WQU-E1
Recommended Stormceptor Model	STC 450i
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	91
PSD	Fine Distribution
Rainfall Station	BLUE HILL

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	91
STC 900	95
STC 1200	95
STC 1800	95
STC 2400	96
STC 3600	97
STC 4800	97
STC 6000	98
STC 7200	98
STC 11000	99
STC 13000	99
STC 16000	99

Stormceptor
The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology
Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:
• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Massachusetts	**Total Number of Rainfall Events**	8652
Rainfall Station Name	BLUE HILL	**Total Rainfall (in)**	2849.7
Station ID #	0736	**Average Annual Rainfall (in)**	49.1
Coordinates	42°12'44"N, 71°6'53"W	**Total Evaporation (in)**	211.0
Elevation (ft)	630	**Total Infiltration (in)**	332.0
Years of Rainfall Data	58	**Total Rainfall that is Runoff (in)**	2306.7

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (acres)	0.21
Imperviousness %	88.1

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Design Details	
Stormceptor Inlet Invert Elev (ft)	
Stormceptor Outlet Invert Elev (ft)	
Stormceptor Rim Elev (ft)	
Normal Water Level Elevation (ft)	
Pipe Diameter (in)	
Pipe Material	HDPE - plastic
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	WQU-E1

Site Details

Drainage Area

Total Area (acres)	0.21
Imperviousness %	88.1

Surface Characteristics

Width (ft)	191.00
Slope %	2
Impervious Depression Storage (in)	0.02
Pervious Depression Storage (in)	0.2
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Maintenance Frequency (months) >	12

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (in/hr)	2.44
Min. Infiltration Rate (in/hr)	0.4
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation

Daily Evaporation Rate (in/day)	0.1

Dry Weather Flow

Dry Weather Flow (cfs)	0

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	

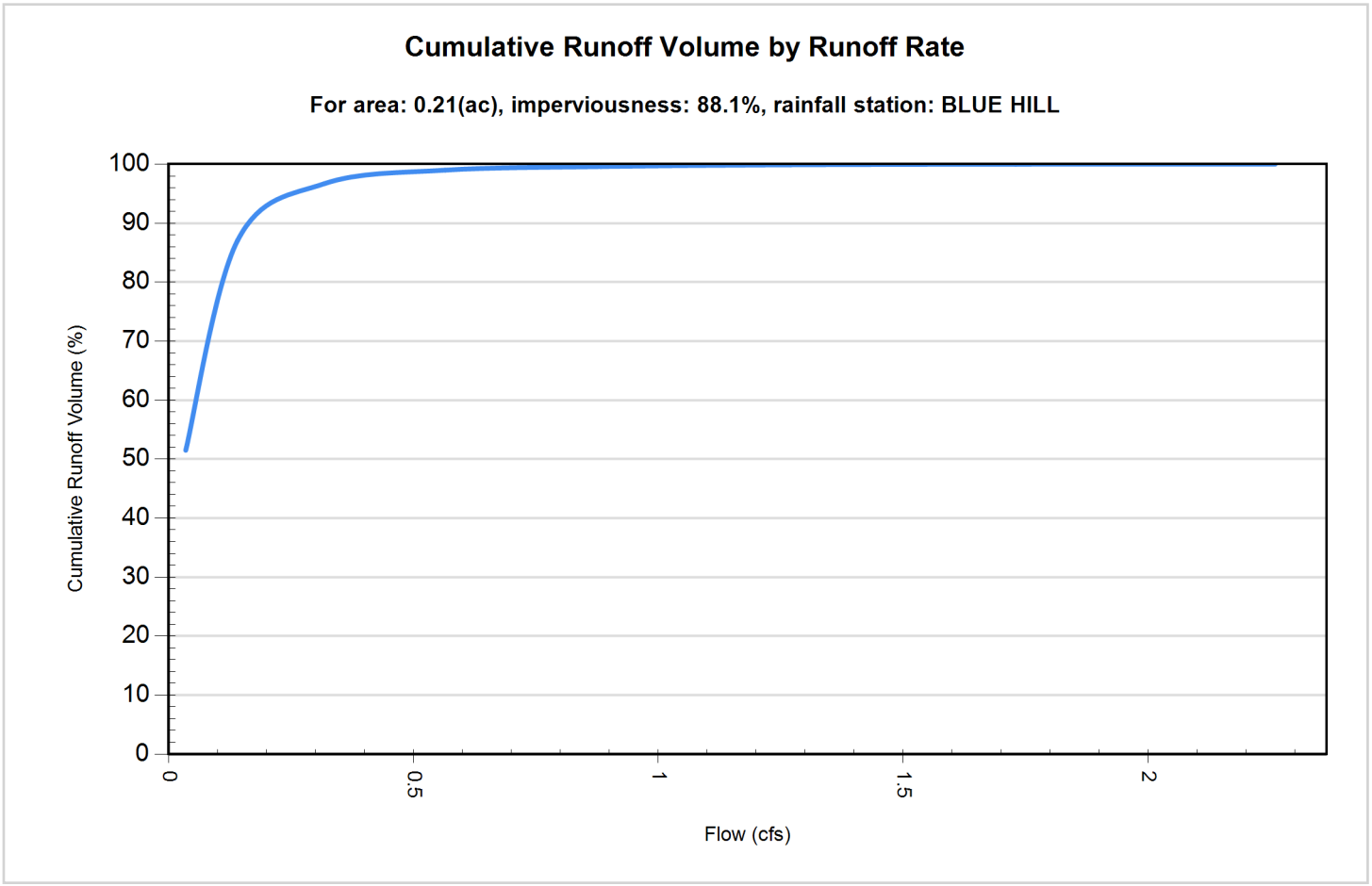
Buildup/Wash-off Parameters

Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

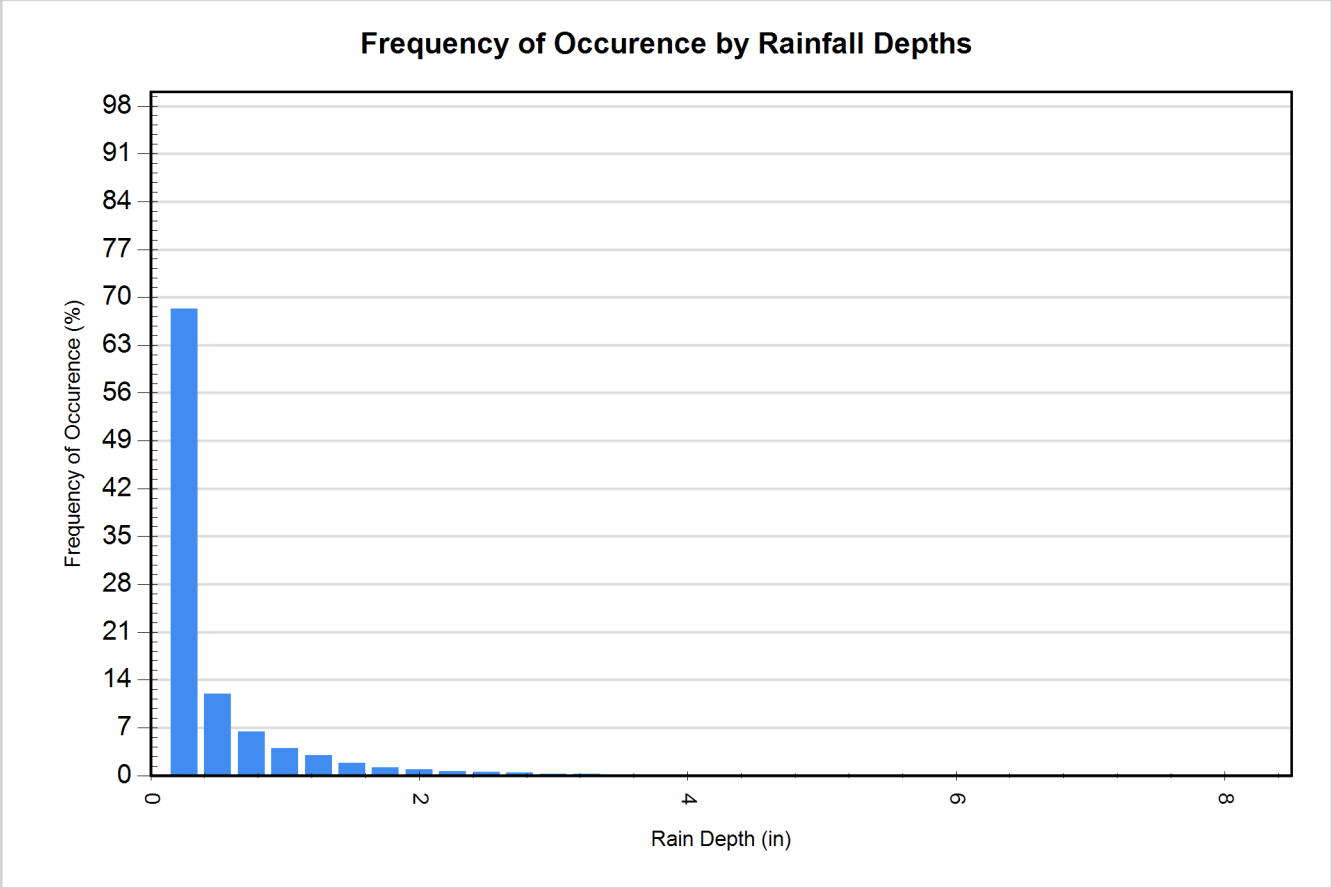
TSS Availability Parameters

Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (cfs)	**Runoff Volume (ft³)**	**Volume Over (ft³)**	**Cumulative Runoff Volume (%)**
0.035	939822	886724	51.5
0.141	1590379	235666	87.1
0.318	1766398	59515	96.7
0.565	1806734	19149	99.0
0.883	1819109	6766	99.6
1.271	1823649	2225	99.9
1.730	1825191	682	100.0
2.260	1825668	206	100.0



Rainfall Event Analysis				
Rainfall Depth (in)	**No. of Events**	**Percentage of Total Events (%)**	**Total Volume (in)**	**Percentage of Annual Volume (%)**
0.25	5908	68.3	386	13.6
0.50	1039	12.0	381	13.4
0.75	555	6.4	344	12.1
1.00	349	4.0	301	10.6
1.25	262	3.0	292	10.3
1.50	154	1.8	211	7.4
1.75	104	1.2	168	5.9
2.00	75	0.9	140	4.9
2.25	48	0.6	102	3.6
2.50	43	0.5	102	3.6
2.75	33	0.4	87	3.0
3.00	17	0.2	49	1.7
3.25	18	0.2	56	2.0
3.50	8	0.1	27	0.9
3.75	7	0.1	25	0.9
4.00	4	0.0	15	0.5
4.25	1	0.0	4	0.1
4.50	4	0.0	18	0.6
4.75	3	0.0	14	0.5
5.00	1	0.0	5	0.2
5.25	1	0.0	5	0.2
5.50	4	0.0	21	0.7
5.75	2	0.0	11	0.4
6.00	4	0.0	23	0.8
6.25	0	0.0	0	0.0
6.50	0	0.0	0	0.0
6.75	1	0.0	7	0.2
7.00	1	0.0	7	0.2
7.25	2	0.0	14	0.5
7.50	0	0.0	0	0.0
7.75	1	0.0	8	0.3
8.00	1	0.0	8	0.3
8.25	0	0.0	0	0.0
8.25	2	0.0	17	0.6



For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Detailed Stormceptor Sizing Report – WQU-A1

Project Information & Location			
Project Name	Shinglemill Apartments	**Project Number**	3395.1
City	Rockland	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/7/2020
Designer Information		**EOR Information (optional)**	
Name	Coneco Coneco	**Name**	
Company	Coneco Engineers & Scientists	**Company**	
Phone #	508-697-3191	**Phone #**	
Email	Stormceptor@coneco.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	WQU-A1
Recommended Stormceptor Model	STC 450i
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	84
PSD	Fine Distribution
Rainfall Station	BLUE HILL

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	84
STC 900	90
STC 1200	90
STC 1800	90
STC 2400	93
STC 3600	93
STC 4800	95
STC 6000	95
STC 7200	96
STC 11000	97
STC 13000	97
STC 16000	98

Stormceptor
The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology
Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:
• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Massachusetts	**Total Number of Rainfall Events**	8652
Rainfall Station Name	BLUE HILL	**Total Rainfall (in)**	2849.7
Station ID #	0736	**Average Annual Rainfall (in)**	49.1
Coordinates	42°12'44"N, 71°6'53"W	**Total Evaporation (in)**	191.5
Elevation (ft)	630	**Total Infiltration (in)**	682.6
Years of Rainfall Data	58	**Total Rainfall that is Runoff (in)**	1975.6

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (acres)	0.64
Imperviousness %	75.6

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Design Details	
Stormceptor Inlet Invert Elev (ft)	
Stormceptor Outlet Invert Elev (ft)	
Stormceptor Rim Elev (ft)	
Normal Water Level Elevation (ft)	
Pipe Diameter (in)	12
Pipe Material	HDPE - plastic
Multiple Inlets (Y/N)	Yes
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	WQU-A1

Site Details

Drainage Area

Total Area (acres)	0.64
Imperviousness %	75.6

Surface Characteristics

Width (ft)	334.00
Slope %	2
Impervious Depression Storage (in)	0.02
Pervious Depression Storage (in)	0.2
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Maintenance Frequency (months) >	12

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (in/hr)	2.44
Min. Infiltration Rate (in/hr)	0.4
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation

Daily Evaporation Rate (in/day)	0.1

Dry Weather Flow

Dry Weather Flow (cfs)	0

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	

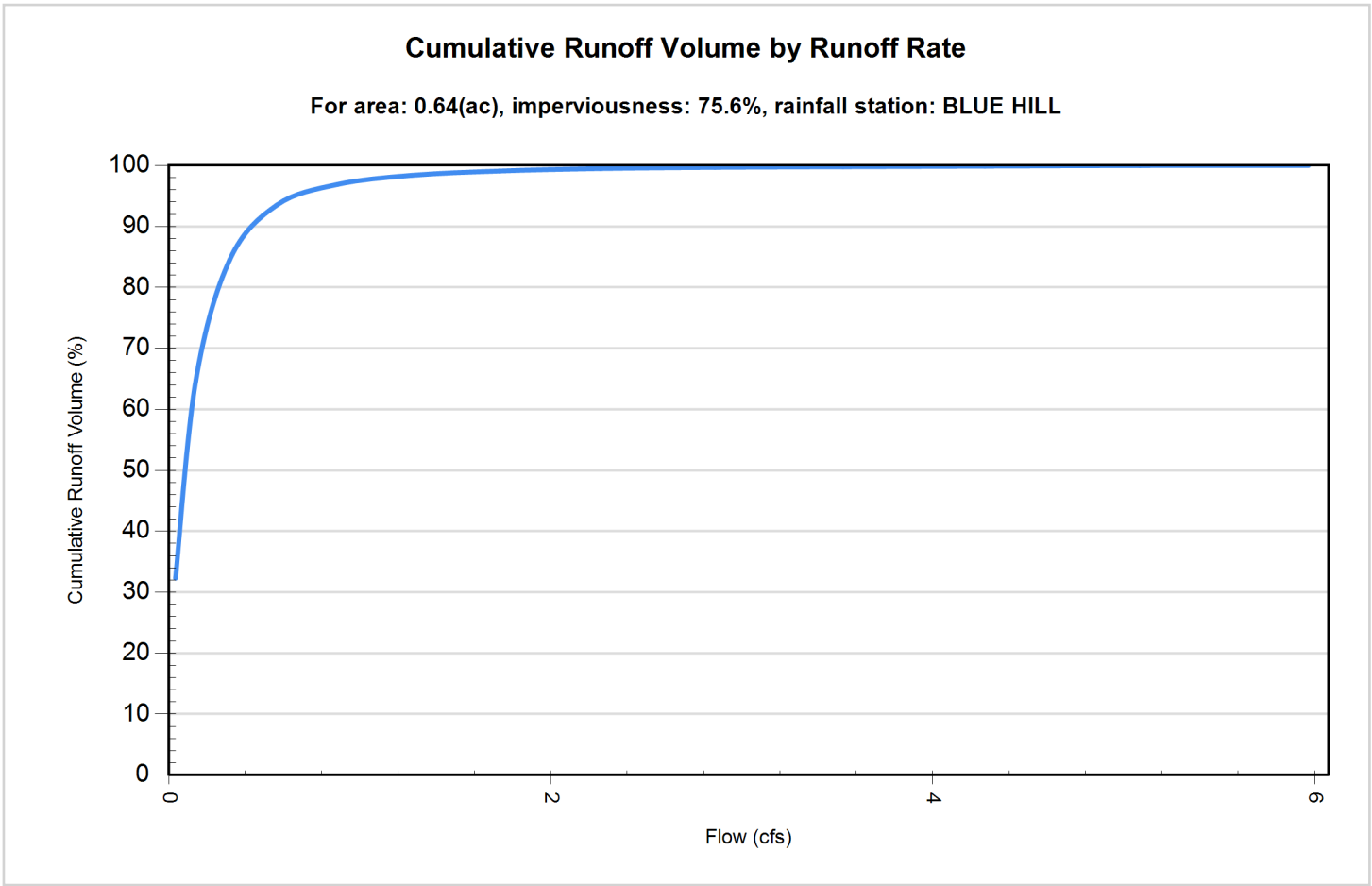
Buildup/Wash-off Parameters

Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

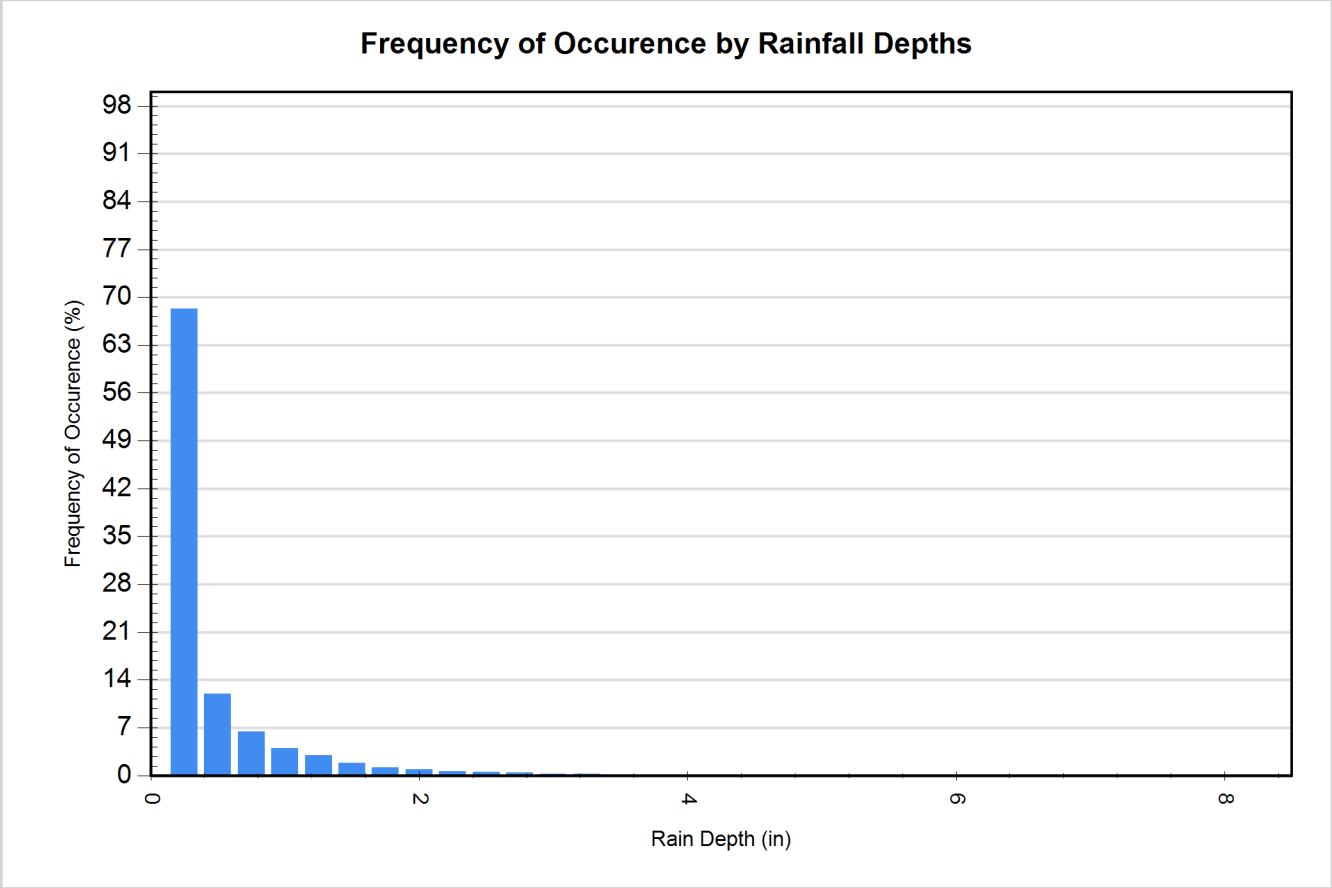
TSS Availability Parameters

Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (cfs)	Runoff Volume (ft³)	Volume Over (ft³)	Cumulative Runoff Volume (%)
0.035	1539934	3232558	32.3
0.141	3086645	1685148	64.7
0.318	4031893	740030	84.5
0.565	4459299	312050	93.5
0.883	4623370	147977	96.9
1.271	4692902	78382	98.4
1.730	4727321	43956	99.1
2.260	4746449	24824	99.5
2.860	4757685	13574	99.7
3.531	4763737	7517	99.8
4.273	4767403	3849	99.9
5.085	4769202	2051	100.0
5.968	4770032	1221	100.0



Rainfall Event Analysis				
Rainfall Depth (in)	**No. of Events**	**Percentage of Total Events (%)**	**Total Volume (in)**	**Percentage of Annual Volume (%)**
0.25	5908	68.3	386	13.6
0.50	1039	12.0	381	13.4
0.75	555	6.4	344	12.1
1.00	349	4.0	301	10.6
1.25	262	3.0	292	10.3
1.50	154	1.8	211	7.4
1.75	104	1.2	168	5.9
2.00	75	0.9	140	4.9
2.25	48	0.6	102	3.6
2.50	43	0.5	102	3.6
2.75	33	0.4	87	3.0
3.00	17	0.2	49	1.7
3.25	18	0.2	56	2.0
3.50	8	0.1	27	0.9
3.75	7	0.1	25	0.9
4.00	4	0.0	15	0.5
4.25	1	0.0	4	0.1
4.50	4	0.0	18	0.6
4.75	3	0.0	14	0.5
5.00	1	0.0	5	0.2
5.25	1	0.0	5	0.2
5.50	4	0.0	21	0.7
5.75	2	0.0	11	0.4
6.00	4	0.0	23	0.8
6.25	0	0.0	0	0.0
6.50	0	0.0	0	0.0
6.75	1	0.0	7	0.2
7.00	1	0.0	7	0.2
7.25	2	0.0	14	0.5
7.50	0	0.0	0	0.0
7.75	1	0.0	8	0.3
8.00	1	0.0	8	0.3
8.25	0	0.0	0	0.0
8.25	2	0.0	17	0.6



For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Detailed Stormceptor Sizing Report – WQU-A2

Project Information & Location			
Project Name	Shinglemill Apartments	**Project Number**	3395.1
City	Rockland	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/7/2020
Designer Information		**EOR Information (optional)**	
Name	Coneco Coneco	**Name**	
Company	Coneco Engineers & Scientists	**Company**	
Phone #	508-697-3191	**Phone #**	
Email	Stormceptor@coneco.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	WQU-A2
Recommended Stormceptor Model	STC 450i
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	86
PSD	Fine Distribution
Rainfall Station	BLUE HILL

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	86
STC 900	91
STC 1200	91
STC 1800	91
STC 2400	94
STC 3600	94
STC 4800	95
STC 6000	96
STC 7200	96
STC 11000	98
STC 13000	98
STC 16000	98

Stormceptor

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Massachusetts	**Total Number of Rainfall Events**	8652
Rainfall Station Name	BLUE HILL	**Total Rainfall (in)**	2849.7
Station ID #	0736	**Average Annual Rainfall (in)**	49.1
Coordinates	42°12'44"N, 71°6'53"W	**Total Evaporation (in)**	191.3
Elevation (ft)	630	**Total Infiltration (in)**	654.8
Years of Rainfall Data	58	**Total Rainfall that is Runoff (in)**	2003.6

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (acres)	0.5
Imperviousness %	76.6

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Design Details	
Stormceptor Inlet Invert Elev (ft)	
Stormceptor Outlet Invert Elev (ft)	
Stormceptor Rim Elev (ft)	
Normal Water Level Elevation (ft)	
Pipe Diameter (in)	12
Pipe Material	HDPE - plastic
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	WQU-A2

Site Details

Drainage Area

Total Area (acres)	0.5
Imperviousness %	76.6

Surface Characteristics

Width (ft)	295.00
Slope %	2
Impervious Depression Storage (in)	0.02
Pervious Depression Storage (in)	0.2
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Maintenance Frequency (months) >	12

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (in/hr)	2.44
Min. Infiltration Rate (in/hr)	0.4
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation

Daily Evaporation Rate (in/day)	0.1

Dry Weather Flow

Dry Weather Flow (cfs)	0

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	

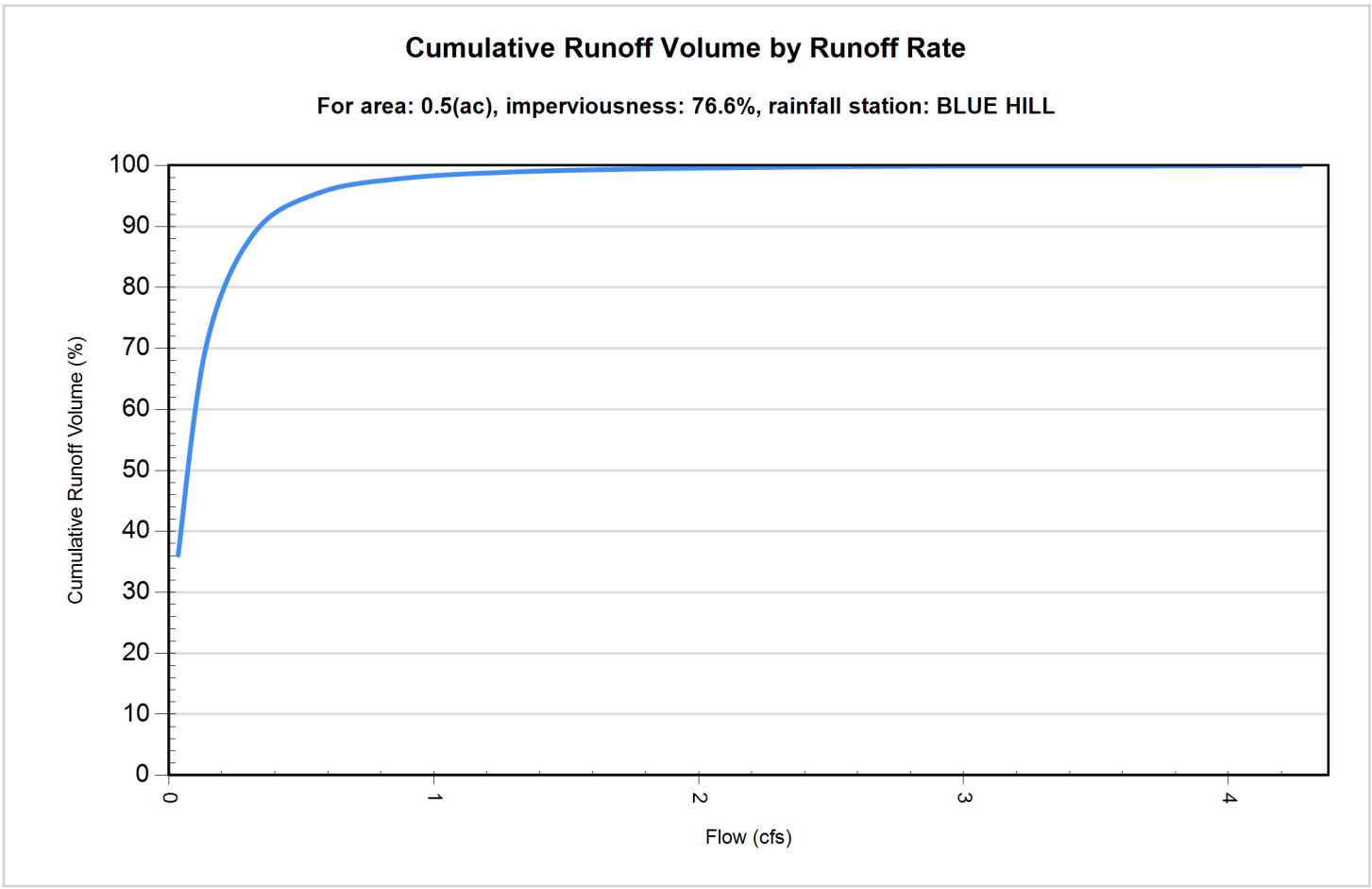
Buildup/Wash-off Parameters

Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

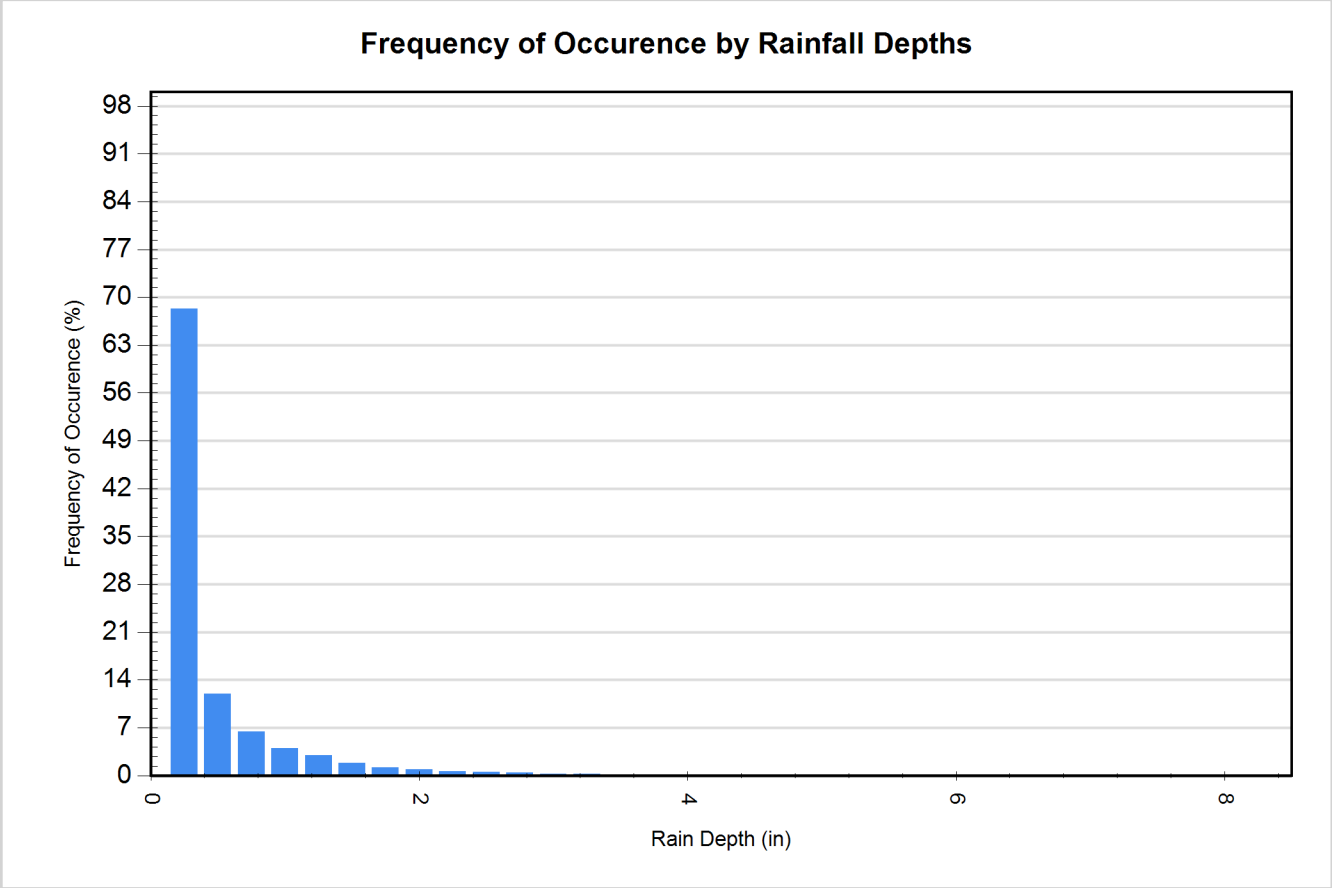
TSS Availability Parameters

Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (cfs)	Runoff Volume (ft³)	Volume Over (ft³)	Cumulative Runoff Volume (%)
0.035	1365204	2417568	36.1
0.141	2663174	1119290	70.4
0.318	3353216	428692	88.7
0.565	3611991	169550	95.5
0.883	3703110	78387	97.9
1.271	3741281	40178	98.9
1.730	3760450	21000	99.4
2.260	3770838	10605	99.7
2.860	3776070	5372	99.9
3.531	3778979	2462	99.9
4.273	3780108	1333	100.0



Rainfall Event Analysis				
Rainfall Depth (in)	**No. of Events**	**Percentage of Total Events (%)**	**Total Volume (in)**	**Percentage of Annual Volume (%)**
0.25	5908	68.3	386	13.6
0.50	1039	12.0	381	13.4
0.75	555	6.4	344	12.1
1.00	349	4.0	301	10.6
1.25	262	3.0	292	10.3
1.50	154	1.8	211	7.4
1.75	104	1.2	168	5.9
2.00	75	0.9	140	4.9
2.25	48	0.6	102	3.6
2.50	43	0.5	102	3.6
2.75	33	0.4	87	3.0
3.00	17	0.2	49	1.7
3.25	18	0.2	56	2.0
3.50	8	0.1	27	0.9
3.75	7	0.1	25	0.9
4.00	4	0.0	15	0.5
4.25	1	0.0	4	0.1
4.50	4	0.0	18	0.6
4.75	3	0.0	14	0.5
5.00	1	0.0	5	0.2
5.25	1	0.0	5	0.2
5.50	4	0.0	21	0.7
5.75	2	0.0	11	0.4
6.00	4	0.0	23	0.8
6.25	0	0.0	0	0.0
6.50	0	0.0	0	0.0
6.75	1	0.0	7	0.2
7.00	1	0.0	7	0.2
7.25	2	0.0	14	0.5
7.50	0	0.0	0	0.0
7.75	1	0.0	8	0.3
8.00	1	0.0	8	0.3
8.25	0	0.0	0	0.0
8.25	2	0.0	17	0.6



For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Detailed Stormceptor Sizing Report – WQU-B1

Project Information & Location			
Project Name	Shinglemill Apartments	**Project Number**	3395.1
City	Rockland	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/7/2020
Designer Information		**EOR Information (optional)**	
Name	Coneco Coneco	**Name**	
Company	Coneco Engineers & Scientists	**Company**	
Phone #	508-697-3191	**Phone #**	
Email	Stormceptor@coneco.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	WQU-B1
Recommended Stormceptor Model	STC 450i
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	90
PSD	Fine Distribution
Rainfall Station	BLUE HILL

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	90
STC 900	94
STC 1200	94
STC 1800	94
STC 2400	96
STC 3600	96
STC 4800	97
STC 6000	97
STC 7200	98
STC 11000	99
STC 13000	99
STC 16000	99

Stormceptor
The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology
Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:
• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Massachusetts	**Total Number of Rainfall Events**	8652
Rainfall Station Name	BLUE HILL	**Total Rainfall (in)**	2849.7
Station ID #	0736	**Average Annual Rainfall (in)**	49.1
Coordinates	42°12'44"N, 71°6'53"W	**Total Evaporation (in)**	220.5
Elevation (ft)	630	**Total Infiltration (in)**	226.0
Years of Rainfall Data	58	**Total Rainfall that is Runoff (in)**	2403.2

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (acres)	0.22
Imperviousness %	91.9

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Design Details	
Stormceptor Inlet Invert Elev (ft)	
Stormceptor Outlet Invert Elev (ft)	
Stormceptor Rim Elev (ft)	
Normal Water Level Elevation (ft)	
Pipe Diameter (in)	12
Pipe Material	HDPE - plastic
Multiple Inlets (Y/N)	Yes
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	WQU-B1

Site Details

Drainage Area

Total Area (acres)	0.22
Imperviousness %	91.9

Surface Characteristics

Width (ft)	196.00
Slope %	2
Impervious Depression Storage (in)	0.02
Pervious Depression Storage (in)	0.2
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Maintenance Frequency (months) >	12

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (in/hr)	2.44
Min. Infiltration Rate (in/hr)	0.4
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation

Daily Evaporation Rate (in/day)	0.1

Dry Weather Flow

Dry Weather Flow (cfs)	0

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	

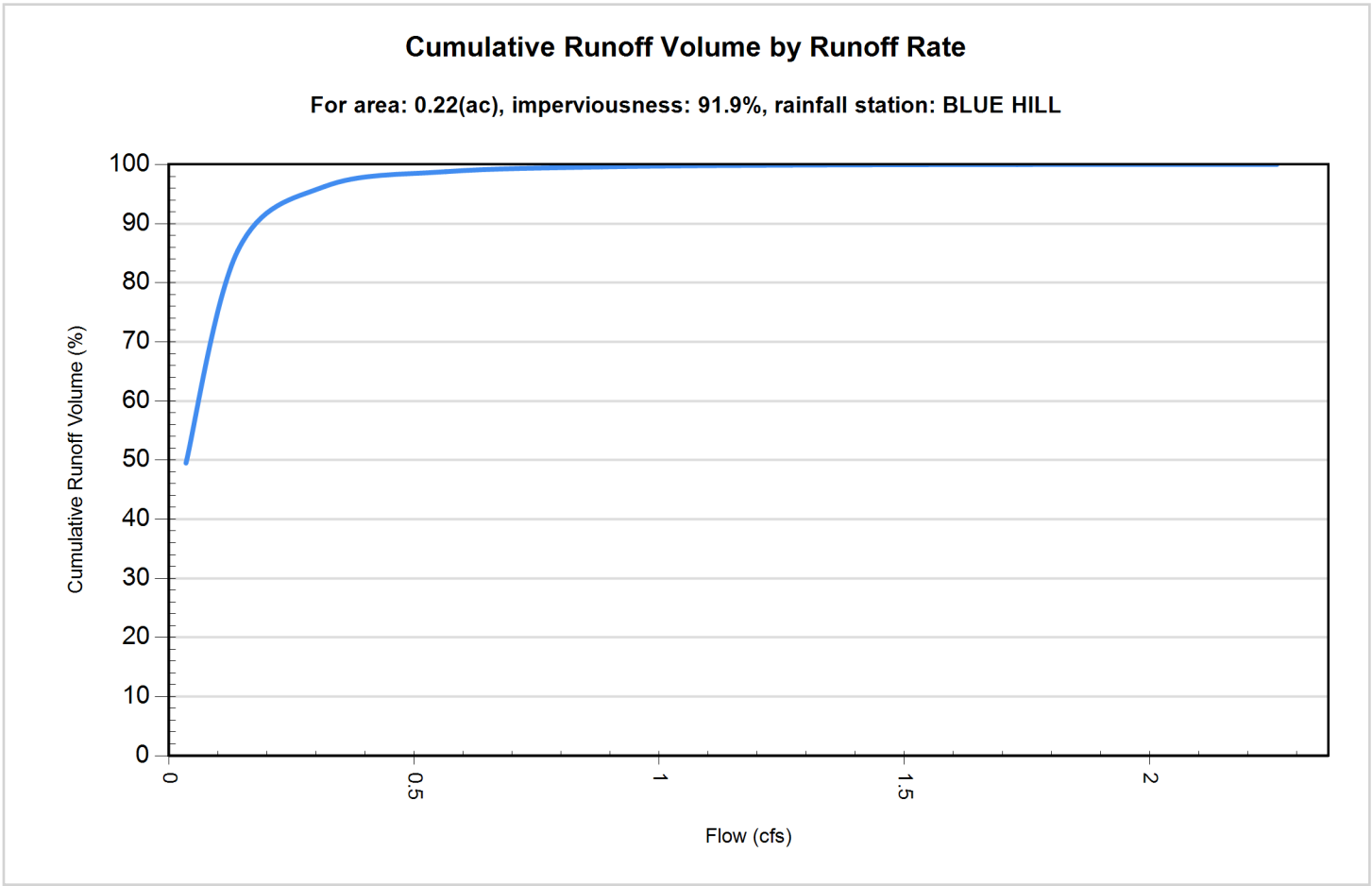
Buildup/Wash-off Parameters

Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

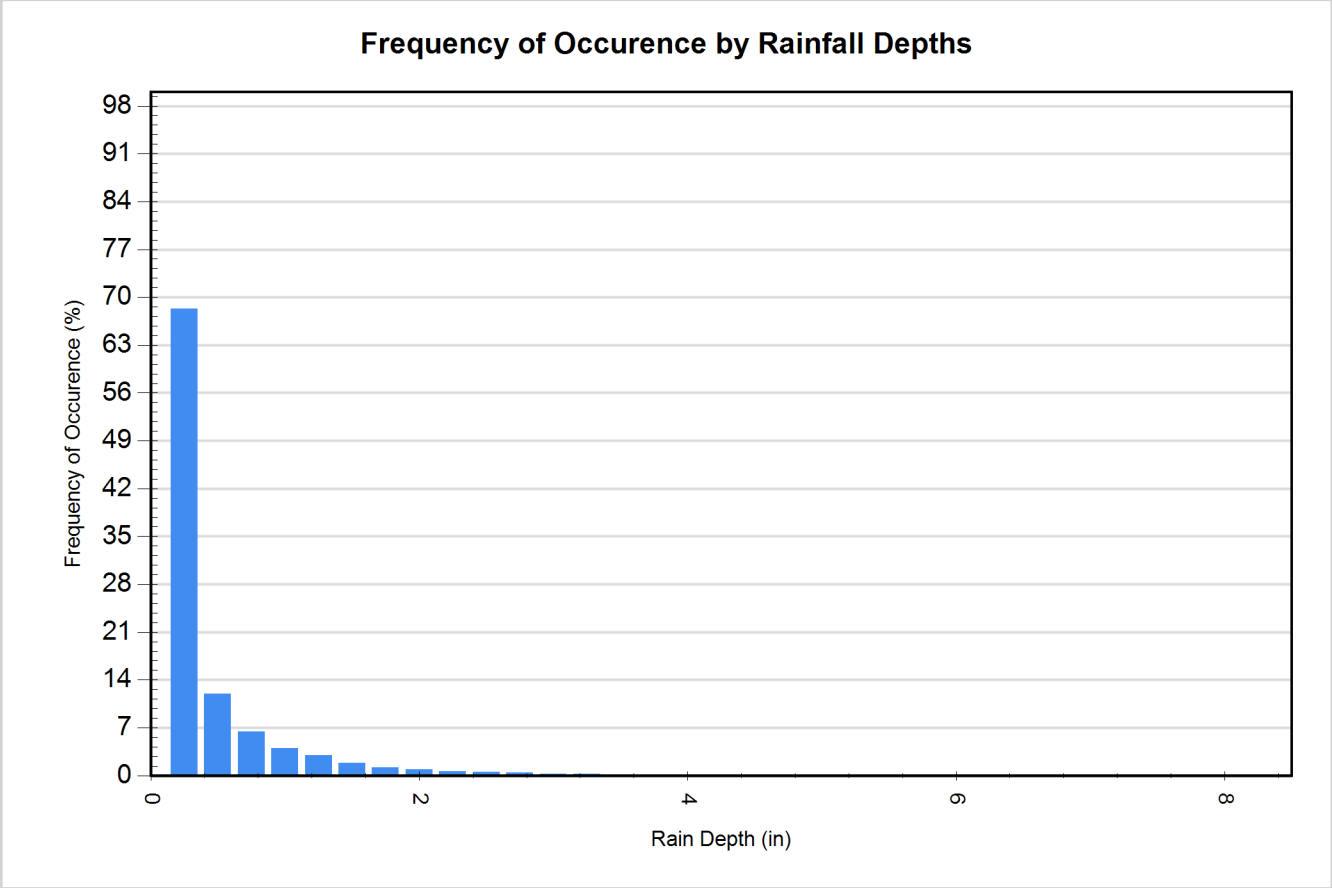
TSS Availability Parameters

Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (cfs)	**Runoff Volume (ft³)**	**Volume Over (ft³)**	**Cumulative Runoff Volume (%)**
0.035	985712	1007142	49.5
0.141	1703873	288827	85.5
0.318	1918379	74295	96.3
0.565	1969013	23648	98.8
0.883	1984182	8477	99.6
1.271	1989829	2831	99.9
1.730	1991792	868	100.0
2.260	1992332	328	100.0



Rainfall Event Analysis				
Rainfall Depth (in)	**No. of Events**	**Percentage of Total Events (%)**	**Total Volume (in)**	**Percentage of Annual Volume (%)**
0.25	5908	68.3	386	13.6
0.50	1039	12.0	381	13.4
0.75	555	6.4	344	12.1
1.00	349	4.0	301	10.6
1.25	262	3.0	292	10.3
1.50	154	1.8	211	7.4
1.75	104	1.2	168	5.9
2.00	75	0.9	140	4.9
2.25	48	0.6	102	3.6
2.50	43	0.5	102	3.6
2.75	33	0.4	87	3.0
3.00	17	0.2	49	1.7
3.25	18	0.2	56	2.0
3.50	8	0.1	27	0.9
3.75	7	0.1	25	0.9
4.00	4	0.0	15	0.5
4.25	1	0.0	4	0.1
4.50	4	0.0	18	0.6
4.75	3	0.0	14	0.5
5.00	1	0.0	5	0.2
5.25	1	0.0	5	0.2
5.50	4	0.0	21	0.7
5.75	2	0.0	11	0.4
6.00	4	0.0	23	0.8
6.25	0	0.0	0	0.0
6.50	0	0.0	0	0.0
6.75	1	0.0	7	0.2
7.00	1	0.0	7	0.2
7.25	2	0.0	14	0.5
7.50	0	0.0	0	0.0
7.75	1	0.0	8	0.3
8.00	1	0.0	8	0.3
8.25	0	0.0	0	0.0
8.25	2	0.0	17	0.6



For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Detailed Stormceptor Sizing Report – WQU-B2

Project Information & Location			
Project Name	Shinglemill Apartments	**Project Number**	3395.1
City	Rockland	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/7/2020
Designer Information		**EOR Information (optional)**	
Name	Coneco Coneco	**Name**	
Company	Coneco Engineers & Scientists	**Company**	
Phone #	508-697-3191	**Phone #**	
Email	Stormceptor@coneco.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	WQU-B2
Recommended Stormceptor Model	STC 450i
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	85
PSD	Fine Distribution
Rainfall Station	BLUE HILL

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	85
STC 900	91
STC 1200	91
STC 1800	91
STC 2400	93
STC 3600	93
STC 4800	95
STC 6000	95
STC 7200	96
STC 11000	97
STC 13000	97
STC 16000	98

Stormceptor
The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology
Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:
• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Massachusetts	**Total Number of Rainfall Events**	8652
Rainfall Station Name	BLUE HILL	**Total Rainfall (in)**	2849.7
Station ID #	0736	**Average Annual Rainfall (in)**	49.1
Coordinates	42°12'44"N, 71°6'53"W	**Total Evaporation (in)**	233.5
Elevation (ft)	630	**Total Infiltration (in)**	206.5
Years of Rainfall Data	58	**Total Rainfall that is Runoff (in)**	2409.7

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (acres)	0.5
Imperviousness %	92.6

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Design Details	
Stormceptor Inlet Invert Elev (ft)	
Stormceptor Outlet Invert Elev (ft)	
Stormceptor Rim Elev (ft)	
Normal Water Level Elevation (ft)	
Pipe Diameter (in)	12
Pipe Material	HDPE - plastic
Multiple Inlets (Y/N)	Yes
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	WQU-B2

Site Details

Drainage Area

Total Area (acres)	0.5
Imperviousness %	92.6

Surface Characteristics

Width (ft)	295.00
Slope %	2
Impervious Depression Storage (in)	0.02
Pervious Depression Storage (in)	0.2
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Maintenance Frequency (months) >	12

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (in/hr)	2.44
Min. Infiltration Rate (in/hr)	0.4
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation

Daily Evaporation Rate (in/day)	0.1

Dry Weather Flow

Dry Weather Flow (cfs)	0

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	

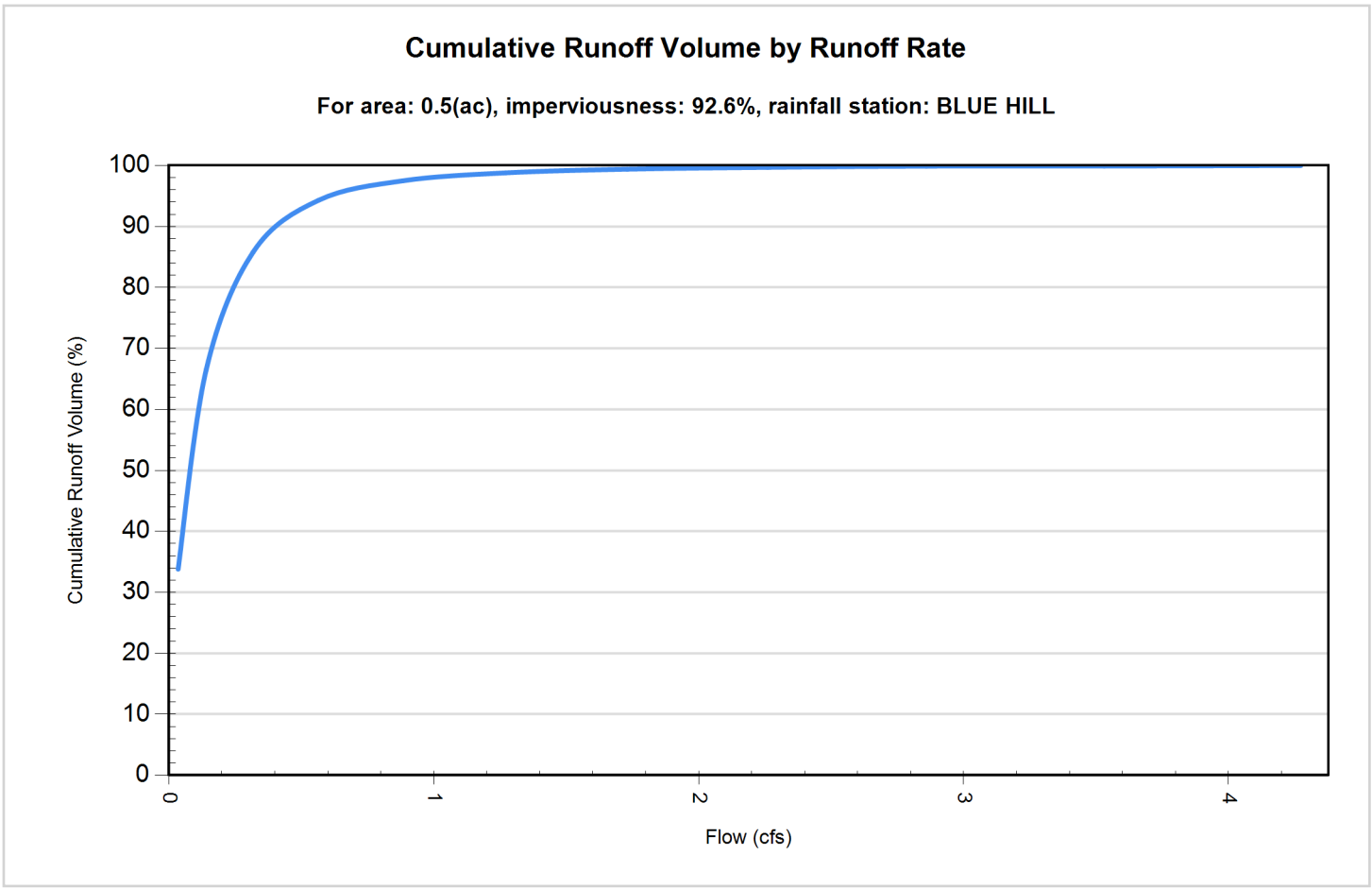
Buildup/Wash-off Parameters

Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

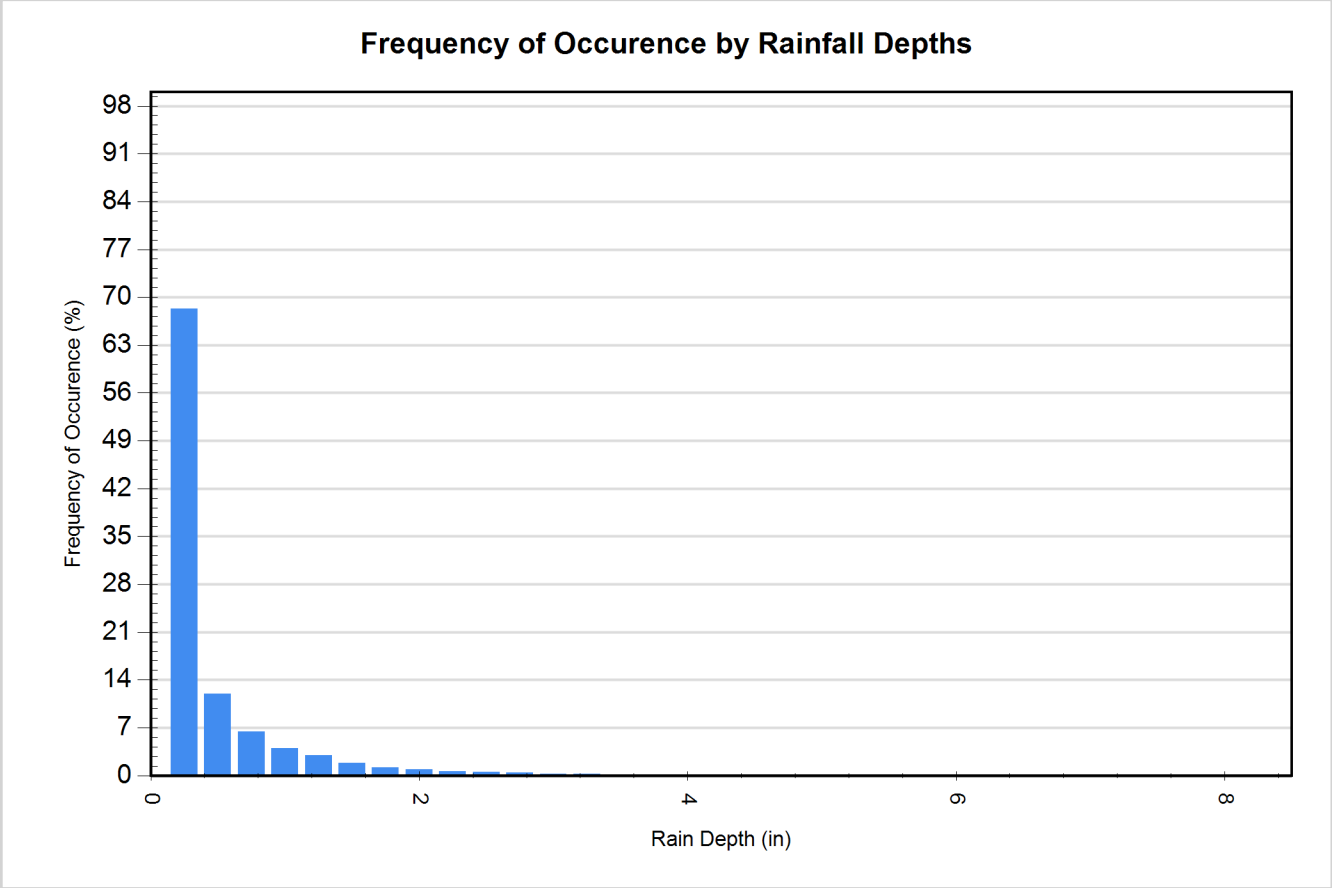
TSS Availability Parameters

Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (cfs)	Runoff Volume (ft³)	Volume Over (ft³)	Cumulative Runoff Volume (%)
0.035	1534037	3007123	33.8
0.141	3021278	1519677	66.5
0.318	3898151	643051	85.8
0.565	4282643	258174	94.3
0.883	4427194	113640	97.5
1.271	4486134	54659	98.8
1.730	4513369	27435	99.4
2.260	4527101	13690	99.7
2.860	4534112	6680	99.9
3.531	4537678	3113	99.9
4.273	4539259	1532	100.0



Rainfall Event Analysis				
Rainfall Depth (in)	**No. of Events**	**Percentage of Total Events (%)**	**Total Volume (in)**	**Percentage of Annual Volume (%)**
0.25	5908	68.3	386	13.6
0.50	1039	12.0	381	13.4
0.75	555	6.4	344	12.1
1.00	349	4.0	301	10.6
1.25	262	3.0	292	10.3
1.50	154	1.8	211	7.4
1.75	104	1.2	168	5.9
2.00	75	0.9	140	4.9
2.25	48	0.6	102	3.6
2.50	43	0.5	102	3.6
2.75	33	0.4	87	3.0
3.00	17	0.2	49	1.7
3.25	18	0.2	56	2.0
3.50	8	0.1	27	0.9
3.75	7	0.1	25	0.9
4.00	4	0.0	15	0.5
4.25	1	0.0	4	0.1
4.50	4	0.0	18	0.6
4.75	3	0.0	14	0.5
5.00	1	0.0	5	0.2
5.25	1	0.0	5	0.2
5.50	4	0.0	21	0.7
5.75	2	0.0	11	0.4
6.00	4	0.0	23	0.8
6.25	0	0.0	0	0.0
6.50	0	0.0	0	0.0
6.75	1	0.0	7	0.2
7.00	1	0.0	7	0.2
7.25	2	0.0	14	0.5
7.50	0	0.0	0	0.0
7.75	1	0.0	8	0.3
8.00	1	0.0	8	0.3
8.25	0	0.0	0	0.0
8.25	2	0.0	17	0.6



For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

CONTECH®
ENGINEERED SOLUTIONS

Stormceptor® STC
Owner's Manual

Stormceptor® STC

Table of Contents

TITLE ..... SECTION

Stormceptor Overview 1

Stormceptor Operation and Components 2

Stormceptor Identification 3

Stormceptor Inspection and Maintenance 4

Recommended Stormceptor Inspection Procedure

Recommended Stormceptor Maintenance Procedure

Contact Information 5

For patent information, go to www.ContechES.com/ip.

Your selection of a Stormceptor® means that you have chosen the most recognized and efficient stormwater oil/sediment separator available for protecting the environment. Stormceptor is a pollution control device often referred to as a "Hydrodynamic Separator (HDS)" or an "Oil Grit Separator (OGS)", engineered to remove and retain pollutants from stormwater runoff to protect our lakes, rivers and streams from the harmful effects of non-point source pollution.

1 – Stormceptor Overview

Stormceptor is a patented stormwater quality structure most often utilized as a treatment component of the underground storm drain network for stormwater pollution prevention. Stormceptor is designed to remove sediment, total suspended solids (TSS), other pollutants attached to sediment, hydrocarbons and free oil from stormwater runoff. Collectively the Stormceptor provides spill protection and prevents non-point source pollution from entering downstream waterways.

Key benefits of Stormceptor include:

- Removes sediment, suspended solids, debris, nutrients, heavy metals, and hydrocarbons (oil and grease) from runoff and snowmelt.
- Will not scour or re-suspend trapped pollutants.
- Provides sediment and oil storage.
- Provides spill control for accidents, commercial and industrial developments.
- Easy to inspect and maintain (vacuum truck).
- "STORMCEPTOR" is clearly marked on the access cover (excluding inlet designs).
- Relatively small footprint.
- 3rd Party tested and independently verified.
- Dedicated team of experts available to provide support.

Model Types:

- STC (Standard)
- EOS (Extended Oil Storage)
- OSR (Oil and Sand Removal)
- MAX (Custom designed unit, specific to site)

Configuration Types:

- Inlet unit (accommodates inlet flow entry, and multi-pipe entry)
- In-Line (accommodates multi-pipe entry)
- Submerged Unit (accommodates the site's tailwater conditions)
- Series Unit (combines treatment in two systems)

PLEASE MAINTAIN YOUR STORMCEPTOR

To ensure long-term environmental protection through continued performance as originally designed for your site, Stormceptor must be maintained, as any stormwater treatment practice does. The need for maintenance is determined through inspection of the Stormceptor. Procedures for inspection are provided within this document. Maintenance of the Stormceptor is performed from the surface via vacuum truck.

If you require information about Stormceptor, or assistance in finding resources to facilitate inspections or maintenance of your Stormceptor please call Contech at 1-800-338-1122.

2 – Stormceptor Operation and Components

Stormceptor is a flexibly designed underground stormwater quality treatment device that is unparalleled in its effectiveness for pollutant capture and retention using patented flow separation technology. Stormceptor creates a non-turbulent treatment environment below the insert platform within the system. The insert diverts water into the lower chamber, allowing free oils and debris to rise, and sediment to settle under relatively low velocity conditions. These pollutants are trapped and stored below the insert and protected from large runoff events for later removal during the maintenance procedure.

With thousands of units operating worldwide, Stormceptor delivers reliable protection every day, in every storm. The patented Stormceptor design prohibits the scour and release of captured pollutants, ensuring superior water quality treatment and protection during even the most extreme storm events. Stormceptor's proven performance is backed by the longest record of lab and field verification in the industry.

Stormceptor Schematic and Component Functions

Below are schematics of two common Stormceptor configurations with key components identified and their functions briefly described.

- **Manhole access cover** – provides access to the subsurface components
- **Precast reinforced concrete structure** – provides the vessel's watertight structural support
- **Fiberglass insert** – separates vessel into upper and lower chambers
- **Weir** – directs incoming stormwater and oil spills into the lower chamber
- **Orifice plate** – prevents scour of accumulated pollutants
- **Inlet drop tee** – conveys stormwater into the lower chamber
- **Fiberglass skirt** – provides double-wall containment of hydrocarbons
- **Outlet riser pipe** – conveys treated water to the upper chamber; primary vacuum line access port for sediment removal
- **Oil inspection port** – primary access for measuring oil depth and oil removal
- **Safety grate** – safety measure to cover riser pipe in the event of manned entry into vessel

Figure 1.

Inline Stormceptor

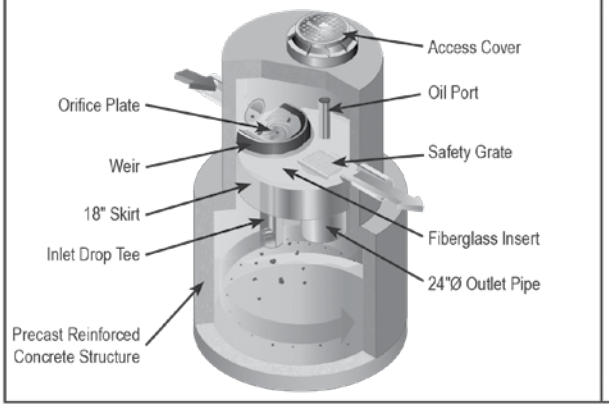
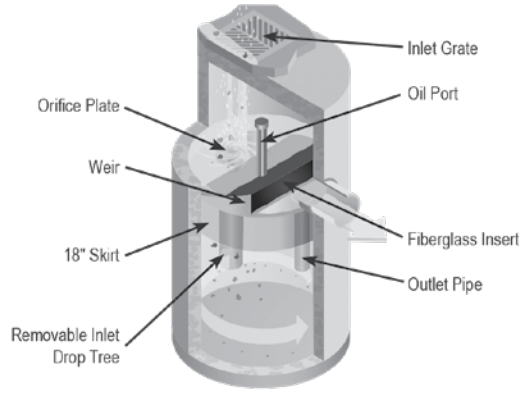


Figure 2.

Inlet Stormceptor



3 – Stormceptor Identification

Stormceptor is available in both precast concrete and fiberglass vessels, with precast concrete often being the dominant material of construction.

In the Stormceptor, a patented, engineered fiberglass insert separates the structure into an upper chamber and lower chamber. The lower chamber will remain full of water, as this is where the pollutants are sequestered for later removal. Multiple Stormceptor model (STC, OSR, EOS and MAX) configurations exist, each to be inspected and maintained in a similar fashion.

Each unit is easily identifiable as a Stormceptor by the trade name "Stormceptor" embossed on each access cover at the surface. To determine the location of "inlet" Stormceptor units with horizontal catch basin inlet, look down into the grate as the Stormceptor insert will be visible. The name "Stormceptor" is not embossed on inlet models due to the variability of inlet grates used/approved across North America.

Once the location of the Stormceptor is determined, the model number may be identified by comparing the measured depth from the fiberglass insert level at the outlet pipe's invert (water level) to the bottom of the tank using Table 1.

In addition, starting in 1996 a metal serial number tag containing the model number has been affixed to the inside of the unit, on the fiberglass insert. If the unit does not have a serial number, or if there is any uncertainty regarding the size of the unit using depth measurements, please contact your local Contech Representative for assistance.

Sizes/Models

Typical general dimensions and capacities of the standard precast STC, EOS and OSR Stormceptor models are provided in Tables 1 and 2. Typical rim to invert measurements are provided later in this document. The total depth for cleaning will be the sum of the depth from outlet pipe invert (generally the water level) to rim (grade) and the depth from outlet pipe invert to the precast bottom of the unit. Note that depths and capacities may vary slightly between regions.

Table 1. Stormceptor Dimensions - Insert to Base of Structure

STC Model	Insert to Base (in.)
450	60
900	55
1200	71
1800	105
2400	94
3600	134
4800	128
6000	150
7200	134
11000*	128
13000*	150
16000*	134

Notes:

1. Depth Below Pipe Inlet Invert to the Inside Top Base Slab can vary slightly by manufacturing facility, and can be modified to accommodate specific site designs, pollutant loads or site conditions. Contact your local representative for assistance.

**Consist of two chamber structures in series.*

Table 2. Storage Capacities

STC Model	Hydrocarbon Storage Capacity (gal)	Sediment Capacity (ft^3)
450	86	46
900	251	89
1200	251	127
1800	251	207
2400	840	205
3600	840	373
4800	909	543
6000	909	687
7200	1059	839
11000*	2797	1089
13000*	2797	1374
16000*	3055	1677

Notes:

1. Hydrocarbon and Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.

**Consist of two chamber structures in series*

4 – Stormceptor Inspection and Maintenance

Regular inspection and maintenance is a proven, cost-effective way to maximize water resource protection for all stormwater pollution control practices, and is required to insure proper functioning of the Stormceptor. Both inspection and maintenance of the Stormceptor is easily performed from the surface. Stormceptor's patented technology has no moving parts, simplifying the inspection and maintenance process.

Please refer to the following information and guidelines before conducting inspection and maintenance activities.

When is inspection needed?

- Post-construction inspection is required prior to putting the Stormceptor into service.
- Routine inspections are recommended during the first year of operation to accurately assess the sediment accumulation.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after oil, fuel, or other chemical spills.

When is maintenance cleaning needed?

- For optimum performance, the unit should be cleaned out once the sediment depth reaches the recommended maintenance sediment depth, which is approximately 15% of the unit's total storage capacity (see Table 3). The frequency should be adjusted based on historical inspection results due to variable site pollutant loading.
- Sediment removal is easier when removed on a regular basis at or prior to the recommended maintenance sediment depths, as sediment build-up can compact making removal more difficult.
- The unit should be cleaned out immediately after an oil, fuel or chemical spill.

What conditions can compromise Stormceptor performance?

- If construction sediment and debris is not removed prior to activating the Stormceptor unit, maintenance frequency may be reduced.
- If the system is not maintained regularly and fills with sediment and debris beyond the capacity as indicated in Table 2, pollutant removal efficiency may be reduced.
- If an oil spill(s) exceeds the oil capacity of the system, subsequent spills may not be captured.
- If debris clogs the inlet of the system, removal efficiency of sediment and hydrocarbons may be reduced.
- If a downstream blockage occurs, a backwater condition may occur for the Stormceptor and removal efficiency of sediment and hydrocarbons may be reduced.

What training is required?

The Stormceptor is to be inspected and maintained by professional vacuum cleaning service providers with experience in the maintenance of underground tanks, sewers and catch basins.

For typical inspection and maintenance activities, no specific supplemental training is required

Recommended Stormceptor Inspection Procedure:

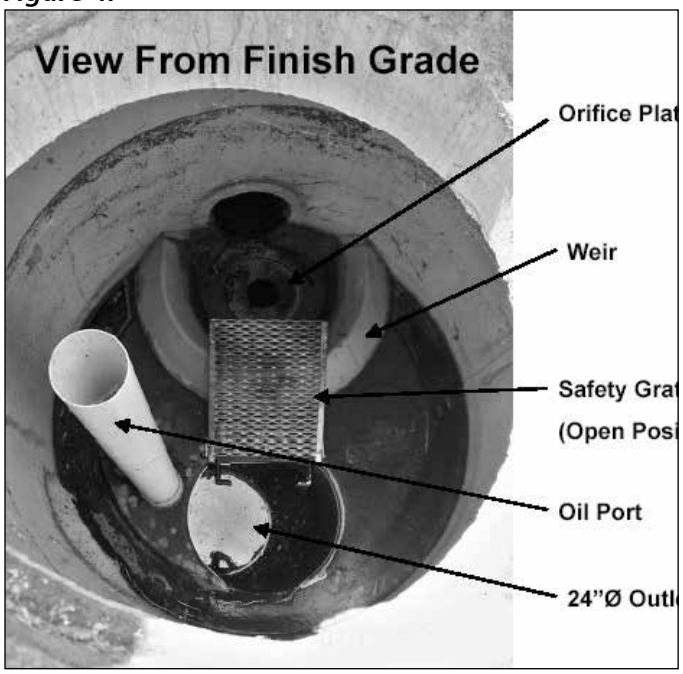
- Stormceptor is to be inspected from grade through a standard surface manhole access cover.
- Sediment and oil depth inspections are performed with a sediment probe and oil dipstick.
- Oil depth is measured through the oil inspection port, either a 4-inch or 6-inch diameter port.
- Sediment depth can be measured through the oil inspection port or the 24-inch diameter outlet riser pipe.
- Inspections also involve a visual inspection of the internal components of the system.

What equipment is typically required for maintenance?

- Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, hoist and safety harness for specially trained personnel if confined space entry is required

Figure 3.

Figure 4.



Recommended Stormceptor Maintenance Procedure

Maintenance of Stormceptor is performed using a vacuum truck. No entry into the unit is required for maintenance. DO NOT ENTER THE STORMCEPTOR CHAMBER unless you have the proper personal safety equipment, have been trained and are qualified to enter a confined space, as identified by local Occupational Safety and Health Regulations (e.g. 29 CFR 1910.146). Without the proper equipment, training and permit, entry into confined spaces can result in serious bodily harm and potentially death. Consult local and/or state regulations to determine the requirements for confined space entry. Be aware, and take precaution that the Stormceptor fiberglass insert may be slippery. In addition, be aware that some units do not have a safety grate to cover the outlet riser pipe that leads to the submerged, lower chamber.

- Ideally maintenance should be conducted during dry weather conditions when no flow is entering the unit.
- Stormceptor is to be maintained through a standard surface manhole access cover.
- Insert the oil dipstick into the oil inspection port. If oil is present, pump off the oil layer into separate containment using a small pump and tubing.
- Maintenance cleaning of accumulated sediment is performed with a vacuum truck.
  - » For 6-ft diameter models and larger, the vacuum hose is inserted into the lower chamber via the 24-inch outlet riser pipe (See Fig. 5).
  - » For 4-ft diameter model, the removable drop tee is lifted out, and the vacuum hose is inserted into the lower chamber via the 12-inch drop tee hole (See Fig. 6).

Figure 5.

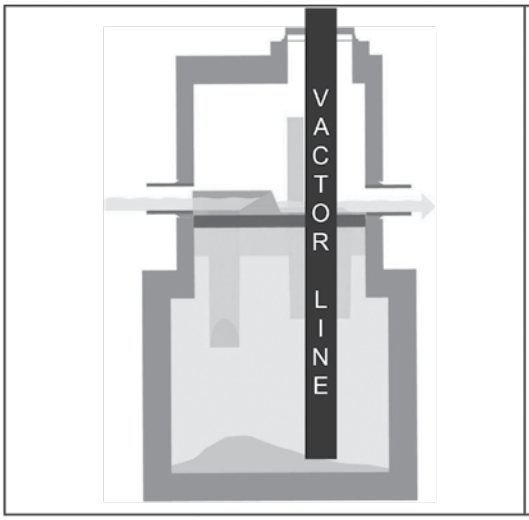
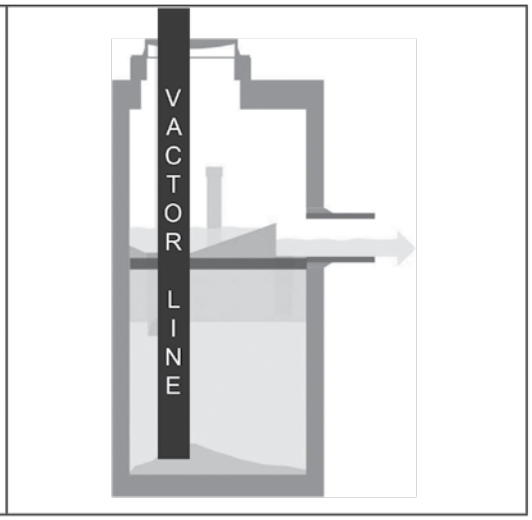


Figure 6.



- Using the vacuum hose, decant the water from the lower chamber into a separate containment tank or to the sanitary sewer, if permitted by the local regulating authority.
- Remove the sediment sludge from the bottom of the unit using the vacuum hose. For large Stormceptor units, a flexible hose is often connected to the primary vacuum line for ease of movement in the lower chamber.
- Units that have not been maintained regularly, have surpassed the maximum recommended sediment capacity, or contain damaged components may require manned entry by trained personnel using safe and proper confined space entry procedures.

What is required for proper disposal?

The requirements for the disposal of material removed from Stormceptor units are similar to that of any other stormwater treatment Best Management Practices (BMP). Local guidelines should be consulted prior to disposal of the separator contents. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste. This could be site and pollutant dependent. In some cases, approval from the disposal facility operator/agency may be required.

What about oil spills?

Stormceptor is often implemented in areas where there is high potential for oil, fuel or other hydrocarbon or chemical spills. Stormceptor units should be cleaned immediately after a spill occurs by a licensed liquid waste hauler. You should also notify the appropriate regulatory agencies as required in the event of a spill.

What if I see an oil rainbow or sheen at the Stormceptor outlet?

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a hydrocarbon rainbow or sheen can be seen at very small oil concentrations (< 10 ppm). Stormceptor is effective at removing 95% of free oil, and the appearance of a sheen at the outlet with high influent oil concentrations does not mean unit is not working to this level of removal. In addition, if the influent oil is emulsified, the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified or dissolved oil conditions.

What factors affect the costs involved with inspection/maintenance?

The Vacuum Service Industry for stormwater drainage and sewer systems is a well-established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean Stormceptor units will vary. Inspection and maintenance costs are most often based on unit size, the number of units on a site, sediment/oil/hazardous material loads, transportation distances, tipping fees, disposal requirements and other local regulations.

What factors predict maintenance frequency?

Maintenance frequency will vary with the amount of pollution on your site (number of hydrocarbon spills, amount of sediment, site activity and use, etc.). It is recommended that the frequency of maintenance be increased or reduced based on local conditions. If the sediment load is high from an unstable site or sediment loads transported from upstream catchments, maintenance may be required semi-annually. Conversely once a site has stabilized, maintenance may be required less frequently (for example: two to seven year, site and situation dependent). Maintenance should be performed immediately after an oil spill or once the sediment depth in Stormceptor reaches the value specified in Table 3 based on the unit size.

Table 3. Recommended Sediment Depths Indicating Maintenance

STC Model	Maintenance Sediment Depth (in)
450	8
900	8
1200	10
1800	15
2400	12
3600	17
4800	15
6000	18
7200	15
11000*	17
13000*	20
16000*	17

Notes:

1. The values above are for typical standard units.

** Per structure.*

Replacement parts

Since there are no moving parts during operation in a Stormceptor, broken, damaged, or worn parts are not typically encountered. Therefore, inspection and maintenance activities are generally focused on pollutant removal. However, if replacements parts are necessary, they may be purchased by contacting your local Contech Representative or call 800-338-1122.

The benefits of regular inspection and maintenance are many – from ensuring maximum operation efficiency, to keeping maintenance costs low, to the continued protection of natural waterways – and provide the key to Stormceptor's long and effective service life.

Stormceptor Inspection and Maintenance Log

Stormceptor Model No: _____

Allowable Sediment Depth: _____

Serial Number: _____

Installation Date: _____

Location Description of Unit: _____

Other Comments: _____

5 – Contact Information

Questions regarding the Stormceptor can be addressed by contacting your local Contech representative or by calling 800-338-1122.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, and earth stabilization products. For information, visit www.ContechES.com or call 800.338.1122

CONTECH
ENGINEERED SOLUTIONS
800-925-5240
www.ContechES.com

Fact Sheet #4

Stormwater Technology: Stormceptor

(Hydro Conduit, formerly CSR New England Pipe)

Revised February 2003

*The **Stormceptor Fact Sheet** is one in a series of fact sheets for stormwater technologies and related performance evaluations, which are undertaken by the **Massachusetts STrategic Envirotechnology Partnership (STEP).***

The STEP evaluation entitled, *Technology Assessment, Stormceptor CSR New England Pipe*, January 1998 is the information source for this fact sheet. When a more thorough understanding of a system is required, the full *Technology Assessment* should be reviewed. Copies are available for downloading from the STEP Web site (www.STEPSITE.org/) or by contacting the STEP Program (Phone: 617/626/1197, FAX: 617/626/1180, email: linda.benevides@state.ma.us). This fact sheet is subject to future updates as additional performance information becomes available.

Description/Definition

Stormceptor is a prefabricated, underground unit that separates oils, grease, and sediment from stormwater runoff when installed with an existing or new pipe conveyance system. The unit is divided into two chambers–a treatment and a flow bypass chamber. During typical storm events, runoff is directed by the inflow weir through a drop pipe into the lower treatment chamber where sediment, oil, and grease are separated from the flow by gravity. The bypass chamber is designed to convey excess stormwater, which overtops the inflow weir, through the system without treatment.

Equipment and Sizing

The on-line Stormceptor units are available in eight sizes ranging from six and twelve feet in diameter with capacities of 900 to 7200 gallons. Since issuing the STEP assessment in 1998, the manufacturer has expanded the Stormceptor product line to include a storm drain inlet (STC 450i) and three units (Models STC 11000, STC 13000, and STC16000). These systems are not included in the STEP evaluation. Users and decision-makers may require additional field test results and new data for these new systems in order to accept performance ratings, particularly if they are higher than those reported in the STEP technology assessment and this fact sheet.

Stormceptor units are available in either precast concrete or fiberglass for special applications. Concrete units are pre-engineered for HS-20 min. traffic loading at the surface. Fiberglass units can be used in areas where there is a potential for oil and chemical spills.

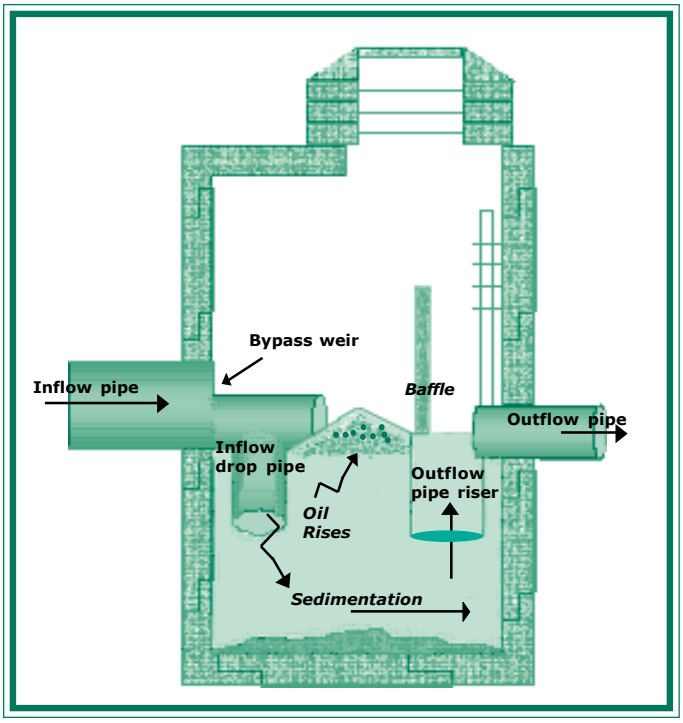


Figure 1. Stormceptor operation during average flow conditions.

Performance/Effectiveness

The system is designed to provide separation of sediment, oil, and grease from stormwater by routing runoff into a low-turbulence environment where solids settle and oils float out of solution. The system sizing is based on the drainage area, historical rainfall data, and the solids removal efficiency required. It is recommended that the system be used in combination with other stormwater controls to conform with the Massachusetts Stormwater Management Policy and standards.

An Imperial Model STC 2000 (equivalent to the Model STC 2400) in Edmonton, Canada treats flow from a 9.8 acre commercial parking lot. This system was monitored during four storm events in 1996 and shown to have an average total suspended solids (TSS) removal efficiency of 52 percent. In designing a system to achieve a comparable removal efficiency, the relationship between system size and impervious drainage area should be considered, as detailed in Table 1 and the Technology Assessment Report.

A Model STC 1200 in Westwood, Massachusetts treats flow from 0.65 acres consisting of a paved truck loading area at a manufacturing facility. The unit was monitored for six storm events in 1997, but only four events had measurable TSS influent concentrations. Of these four events, the average TSS removal efficiency was calculated to be 77 percent, which is less than the 80 percent removal targeted by the manufacturer.

Based on these field monitoring results, and when the unit sizing follows the guidance in Table 1, removal efficiencies between 52 percent and 77 percent may be achieved where installations have similar rainfall and land use characteristics as those reviewed for the STEP evaluation. It is recommended that additional field research and new data be evaluated to validate performance ratings higher than those verified by STEP.

Specific performance claims for oil and grease were not evaluated by STEP. However, total petroleum hydrocarbons (TPH) were analyzed during the Westwood study. Results indicated that the unit was effective in capturing oils.

Stormceptor Model Number	Maximum Impervious Area (acres)	
	77% TSS removal	52% TSS removal
STC 900	0.45	0.9
STC 1200	0.7	1.45
STC 1800	1.25	2.55
STC 2400	1.65	3.35
STC 3600	2.6	5.3
STC 4800	3.6	7.25
STC 6000	4.6	9.25
STC 7200	5.55	11.25

Table 1: Sizing for TSS removal (adapted from the manufacturer's sizing in the 1998 STEP Report) Use the table to determine a TSS removal rate. Use the new Rinker method for sizing Stormceptor units. The sizing method has been changed since publication of the STEP Report. **Note:** To achieve 52% and 77% TSS removal rates on some sites, it may be necessary to use lower maximum impervious areas than those in Table 1.

Technology Status

The Stormceptor system provides greater solids separation and higher TSS removal efficiencies than oil and grit separators. Stormceptor systems are among the category of hydrodynamic separators, which are flow-through devices with the capacity to settle or separate grit, oil, sediment, or other pollutants from stormwater. According to the U.S. Environmental Protection Agency, "Hydrodynamic separators are most effective where the materials to be removed from runoff are heavy particulates - which can be settled - or floatables - which can be captured, rather than solids with poor settleability or dissolved pollutants."

The field studies evaluated for the STEP assessment predate the Stormwater Best Management Practice Demonstration Tier II Protocol (2001), which is applicable in Massachusetts and other states in the Technology Acceptance Reciprocity Partnership (TARP), to ensure quality controlled studies that can be shared among participating states. Therefore, interstate reciprocity is not available to the manufacturer, based on performance claims that were evaluated by STEP in 1998. If the TARP Protocol requirements are fulfilled in the future, the manufacturer could pursue reciprocal verification for Stormceptor systems in participating TARP states. More information on the TARP Protocol is available on the following Web site: www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp.

Applications/Advantages

- Stormceptor systems identified in Table 1 should be used in combination with other BMPs to remove 80 percent of the average annual load of TSS (DEP Stormwater Policy Standard 4). Systems may be well suited for pretreatment in a mixed component system designed for stormwater recharge.
- Performance data show that Stormceptor may provide TSS removal rates in the range of 52 percent to 77 percent when sized according to Table 1. Higher TSS removal rates were achieved during low flow, low intensity storms with less than one third of an inch of runoff. Also, by reducing the impervious drainage area, relative to the system size, the STEP Technology Assessment Report indicated that higher removal efficiencies may be achievable. However, STEP recommends collection of additional data "representing a varied set of operating conditions over a realistic maintenance cycle to verify TSS removal rates greater than 80 percent."
- The Stormceptor system is suitable for new and retrofit applications. For retrofit applications, it should not

take the place of a catch basin for the systems that have been verified. Also, for retrofit applications, it should be installed in lateral lines and not main trunk lines.

- The system is particularly well suited in constricted areas and where space is limited.
- It also is suitable for use in areas of high potential pollutant loads (DEP Stormwater Policy Standard 5), where it may be used effectively in capturing and containing oil and chemical spills. *Web site:* www.state.ma.us/dep/brp/stormwtr/stormpub.htm.

Considerations/Limitations

- Systems are not expected to provide significant nutrient (nitrogen and phosphorus) or fecal coliform removal.
- The systems are not recommended for use in critical areas, such as public drinking water supplies, certified vernal pools, public swimming beaches, shellfish growing areas, cold water fisheries, and some Areas of Critical Environmental Concern (ACECs), except as a pretreatment device for BMPs that have been approved by DEP for use in critical areas. The structural BMPs approved for use in critical areas are described in Standard 6 of the Stormwater Management Policy, www.state.ma.us/dep/brp/stormwtr/stormpub.htm.
- There is a limited set of useful data for predicting the relationship between treatment efficiency and loading rates. Removal efficiencies have not been demonstrated for all unit sizes.
- Further research is needed to determine how much TSS bypasses the treatment chamber during certain, higher velocity storm events which recur less frequently.
- Systems require regular maintenance to minimize the potential for washout of the accumulated sediments.

Reliability/Maintenance

All BMPs require scheduled, routine maintenance to ensure that they operate as efficiently as possible. Although maintenance requirements are site specific, a general relationship between cleaning needs and depths of sediment has been established by the manufacturer. Inspection of the Stormceptor interior should be done after major storm events, particularly in the first year of operation. It is recommended that material in the treatment chamber be pumped out by a vacuum truck semiannually, or when the sediment and pollutant loads reach about 15 percent of the total storage. If the unit is used for spill containment, it should be pumped after the event is contained. Typical cleaning costs were estimated by the manufacturer in 1998 to be $250, with disposal costs averaging $300 to $500. The expected life of a system has been estimated to be 50 to 100 years.

Sediment Depths Indicating Required Maintenance	
Model Number	**Sediment Depth (feet)**
STC 900	0.5
STC 1200	0.75
STC 1800	1
STC 2400	1
STC 3600	1.25
STC 4800	1
STC 6000	1.5
STC 7200	1.25

Table 2: The Stormceptor clean out is based on 15 percent of the sediment storage volume in the

References

Winkler, E.S. 1998. "Technology Assessment, Stormceptor." University of Massachusetts, Amherst, MA. *STEP Web site:* www.STEPSITE.org/

Massachusetts Department of Environmental Protection and Office of Coastal Zone Management. 1997. "Stormwater Management Handbooks, Volumes One and Two." Boston, MA. *Handbooks Web site:* www.state.ma.us/dep/brp/stormwtr/stormpub.htm.

United States Environmental Protection Agency. "Storm Water Technology Fact Sheet Hydrodynamic Separators." EPA 832-F-99-017.

Stormceptor Web sites: www.rinkermaterials.com/stormceptor

TARP Web site: www.dep.state.pa.us/dep/deputate/pollprev/techservices/tarp

STEP Verification vs. Regulatory Approval

STEP assistance to developers of innovative technologies and STEP verification of stormwater treatment systems is not required to receive necessary approvals from conservation commissions or the Department of Environmental Protection (DEP). However, if a system has received verfication, a conservation commission shall presume that the technology will function as proposed, provided the conditions are similar to those in which performance was verified. STEP reports are not technology approvals, and do not constitute an endorsement or recommendation for use. Questions on regulatory issues should be referred to the DEP regional offices.