Nagog Pond Water Treatment Plant
Acton, Massachusetts
Notice of Intent

WPA Form 3
DEP Transmittal X268171

Prepared For:
Town of Concord
Public Works Department
November 2015

Environmental Partners GROUP
A partnership for engineering solutions

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Stormwater Report

1900 Crown Colony Drive
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To: Town of Acton Conservation Commission

From: Stephen C. Olson, P.E.

Cc: NOI CC list

Date: November 18, 2015

Subject: Nagog Pond Water Treatment Plant
WPA Form 3 - Notice of Intent
Stormwater Report

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

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

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

Project Name: Nagog Pond Water Treatment Plant

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

The following materials are referenced as part of Stormwater Report:

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

Project Type: Mix of New Development and Redevelopment

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

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

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

Existing Stormwater Conditions:

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

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

Proposed Stormwater Conditions:

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

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

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

Existing and Proposed Site Plans:

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

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

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

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

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

Table 1
Summary of Peak Discharge Rates

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

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

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

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

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

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

Stormwater Standard 5:

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

Stormwater Standard 6:

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

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

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

Stormwater Standard 7:

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

Stormwater Standard 8:

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

Stormwater Standard 9:

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

Stormwater

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

Attachments:

Attachment A – Checklist for Stormwater Report

Attachment B – Standard 2 HydroCAD Calculations

Attachment C – Soil Information

Attachment D – Standard 3 Recharge Calculations

Attachment E – Standard 4 Water Quality Calculations

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

Attachment G – Stormwater Figures

ATTACHMENT A
CHECKLIST FOR STORMWATER REPORT

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

11/18/15
Signature and Date

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

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

☐ Reduced Impervious Area (Redevelopment Only)

☐ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

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

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

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☒ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): _____

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic 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.

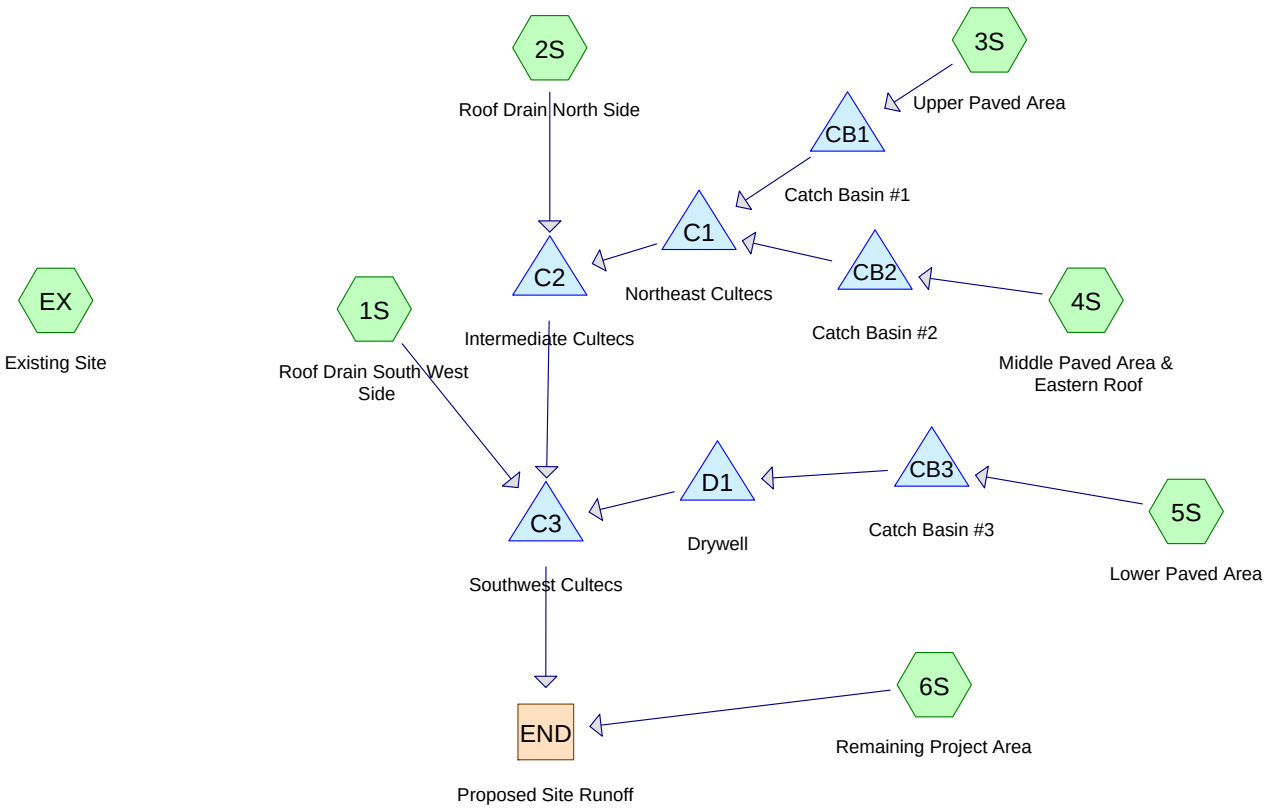
Standard 10: Prohibition of Illicit Discharges

☒ 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.

ATTACHMENT B
STANDARD 2 HYDROCAD CALCULATIONS



Subcat Reach Pond Link

Routing Diagram for Nagog HydroCAD - 2015-11-16
Prepared by Environmental Partners Group, Printed 11/16/2015

Area Listing (all nodes)

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

Soil Listing (all nodes)

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

Ground Covers (all nodes)

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

Pipe Listing (all nodes)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Summary for Subcatchment 1S: Roof Drain South West Side

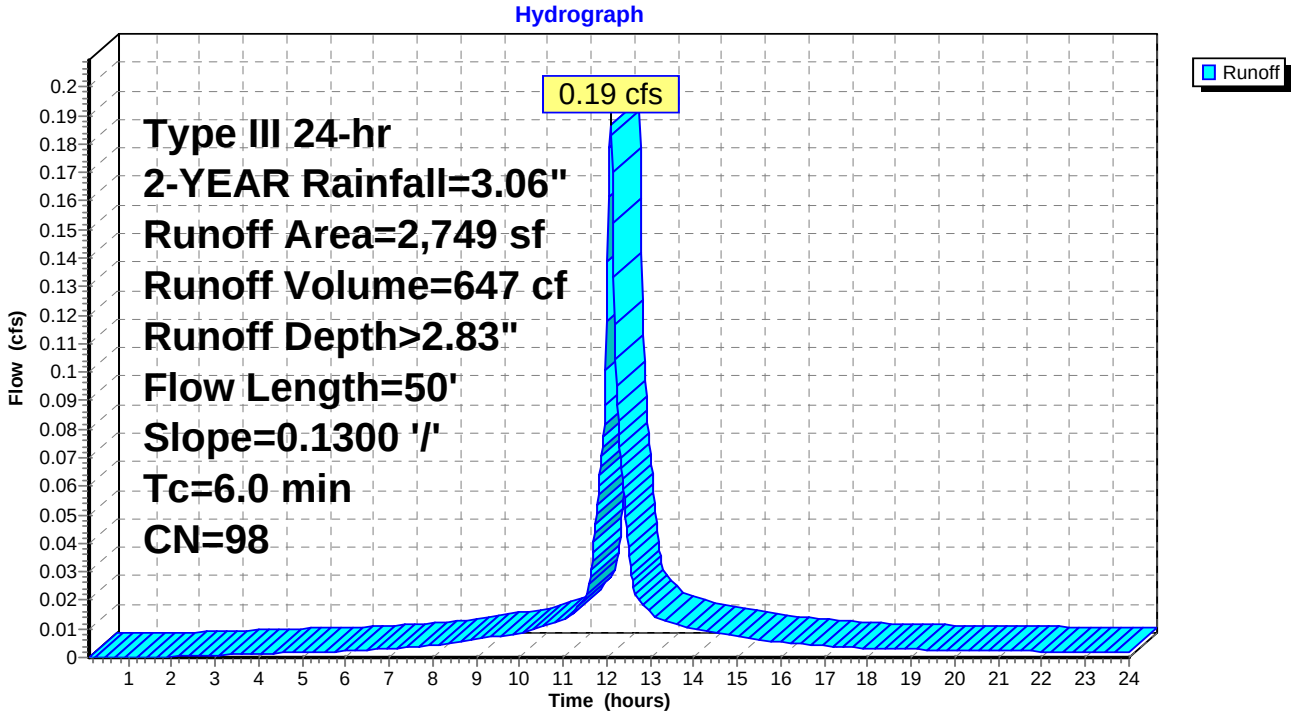
Runoff = 0.19 cfs @ 12.08 hrs, Volume= 647 cf, Depth> 2.83"

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

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

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

Subcatchment 1S: Roof Drain South West Side



Summary for Subcatchment 2S: Roof Drain North Side

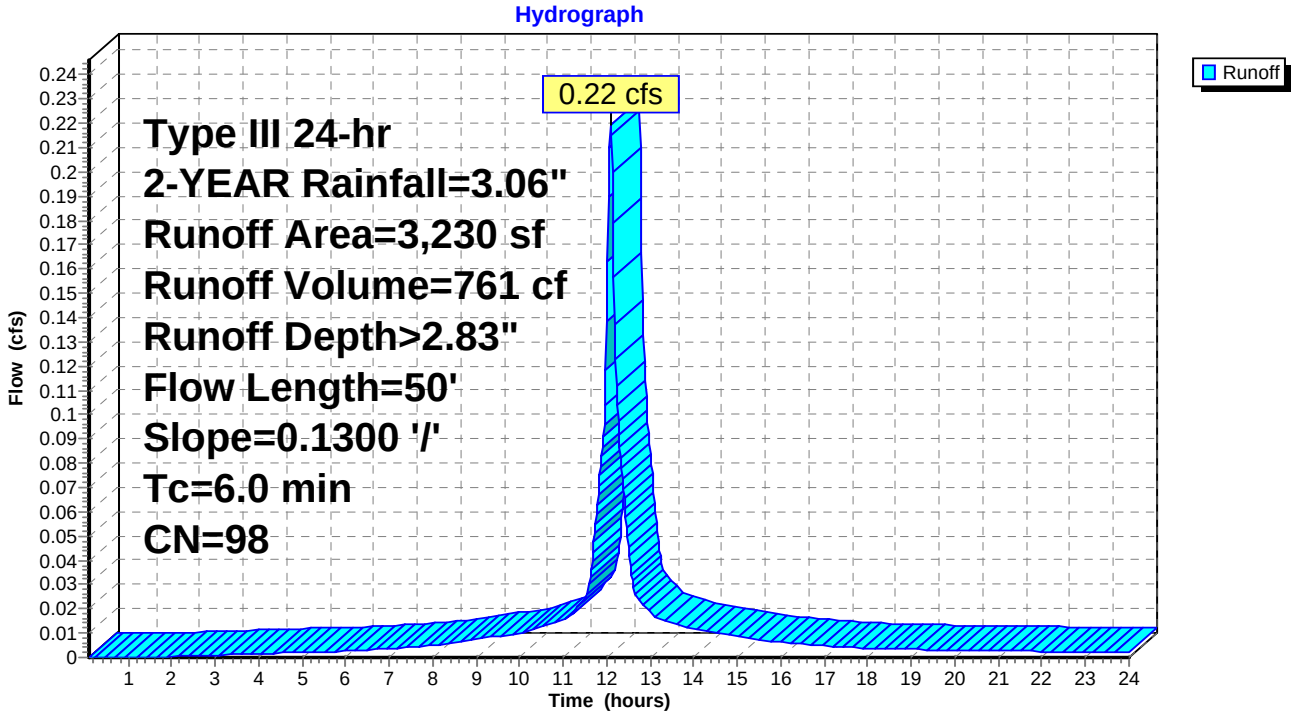
Runoff = 0.22 cfs @ 12.08 hrs, Volume= 761 cf, Depth> 2.83"

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

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

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

Subcatchment 2S: Roof Drain North Side



Summary for Subcatchment 3S: Upper Paved Area

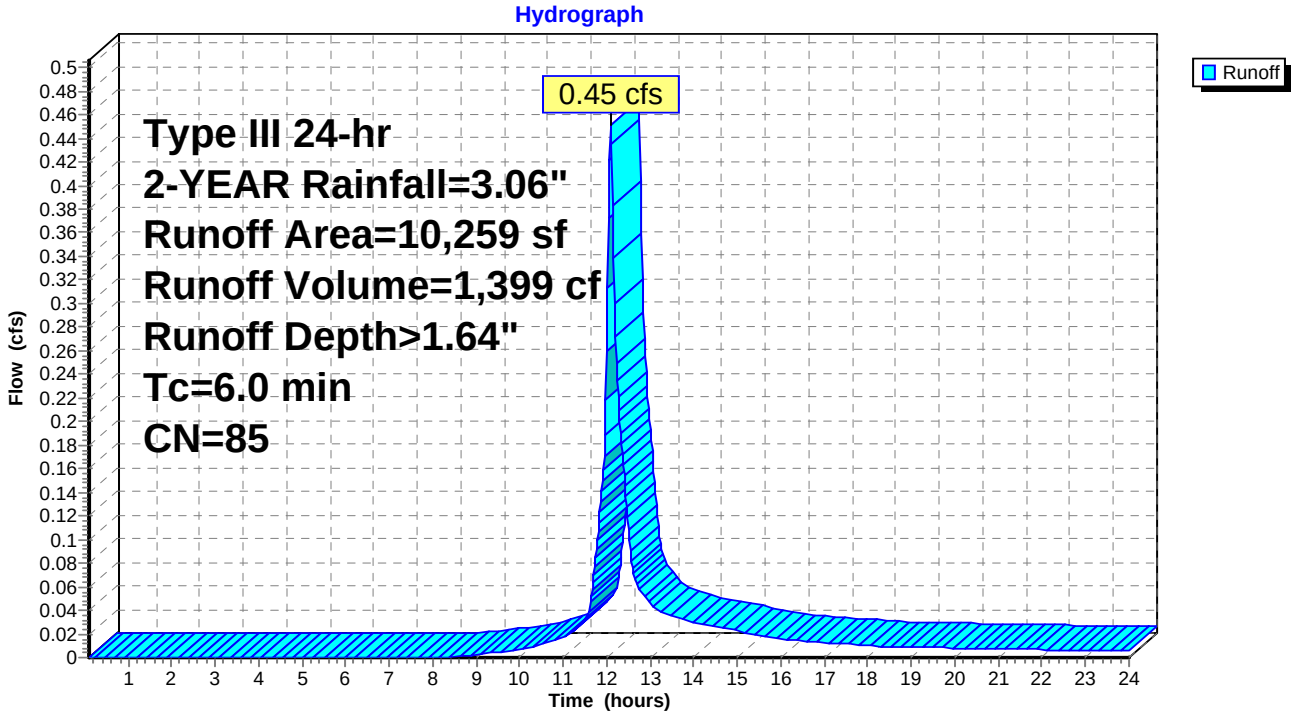
Runoff = 0.45 cfs @ 12.09 hrs, Volume= 1,399 cf, Depth> 1.64"

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

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

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

Subcatchment 3S: Upper Paved Area



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

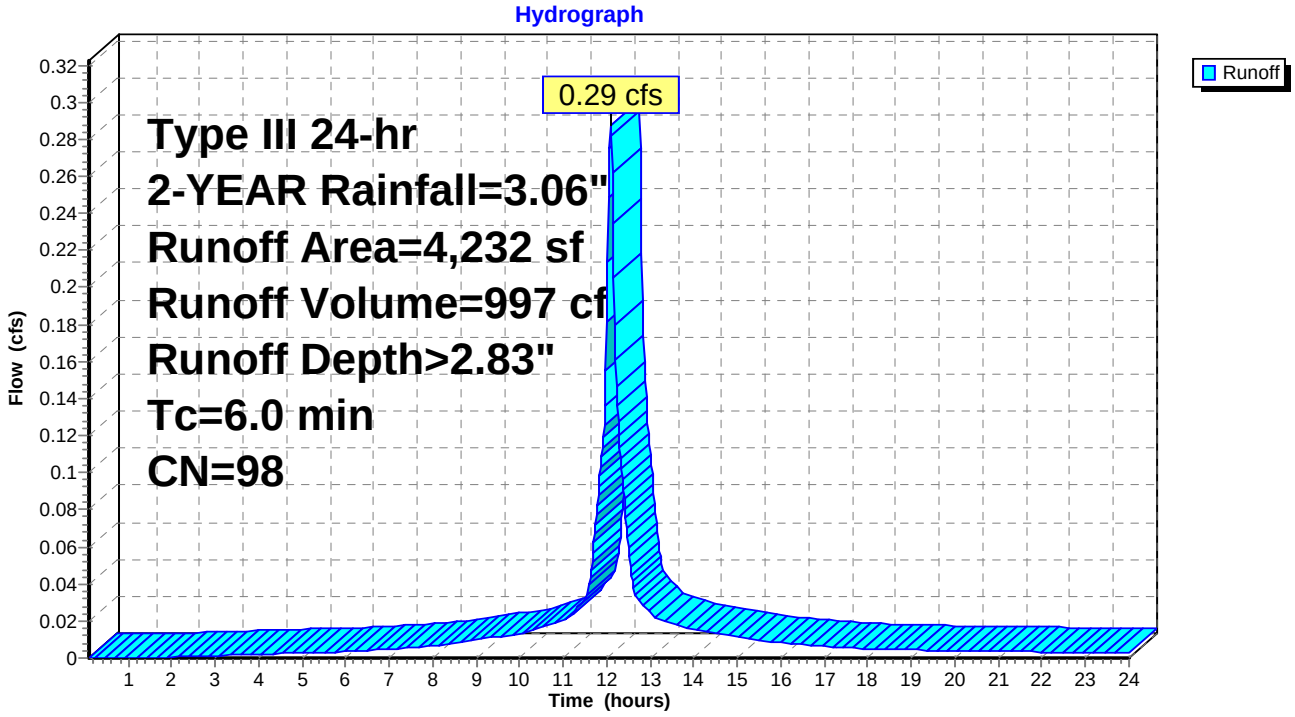
Runoff = 0.29 cfs @ 12.08 hrs, Volume= 997 cf, Depth> 2.83"

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

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

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

Subcatchment 4S: Middle Paved Area & Eastern Roof



Summary for Subcatchment 5S: Lower Paved Area

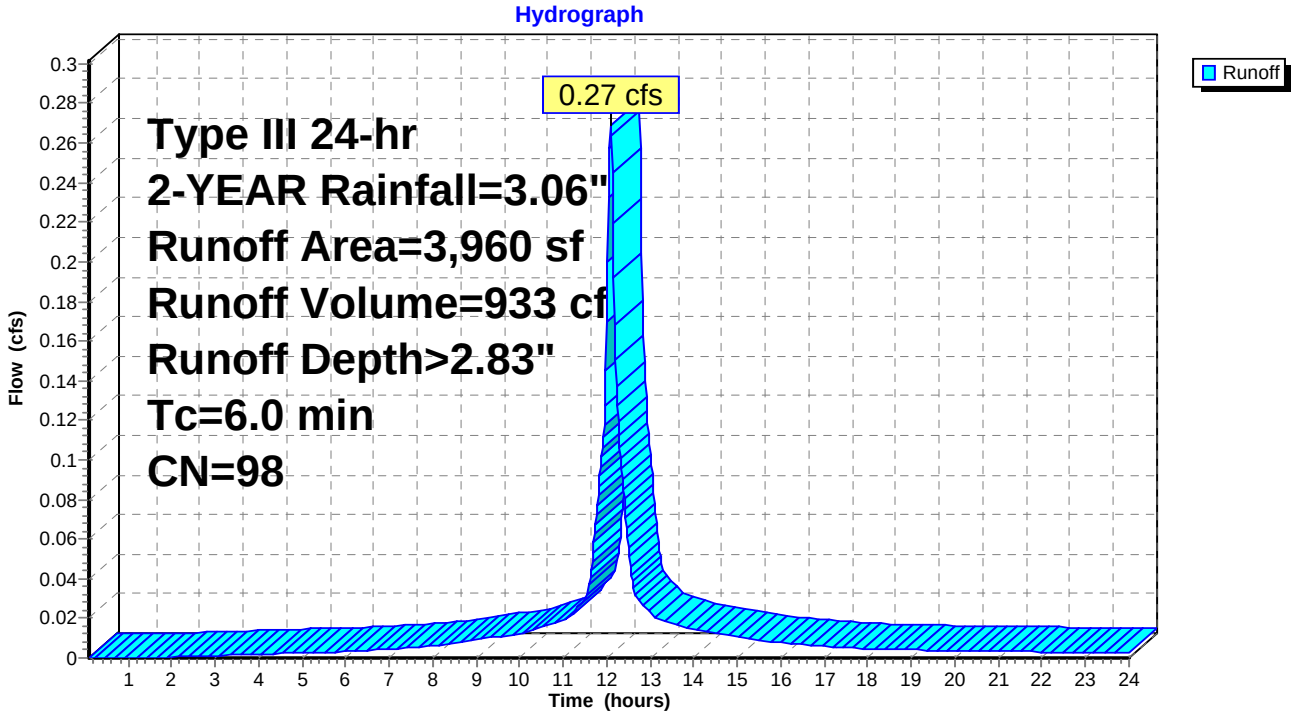
Runoff = 0.27 cfs @ 12.08 hrs, Volume= 933 cf, Depth> 2.83"

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

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

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

Subcatchment 5S: Lower Paved Area



Summary for Subcatchment 6S: Remaining Project Area

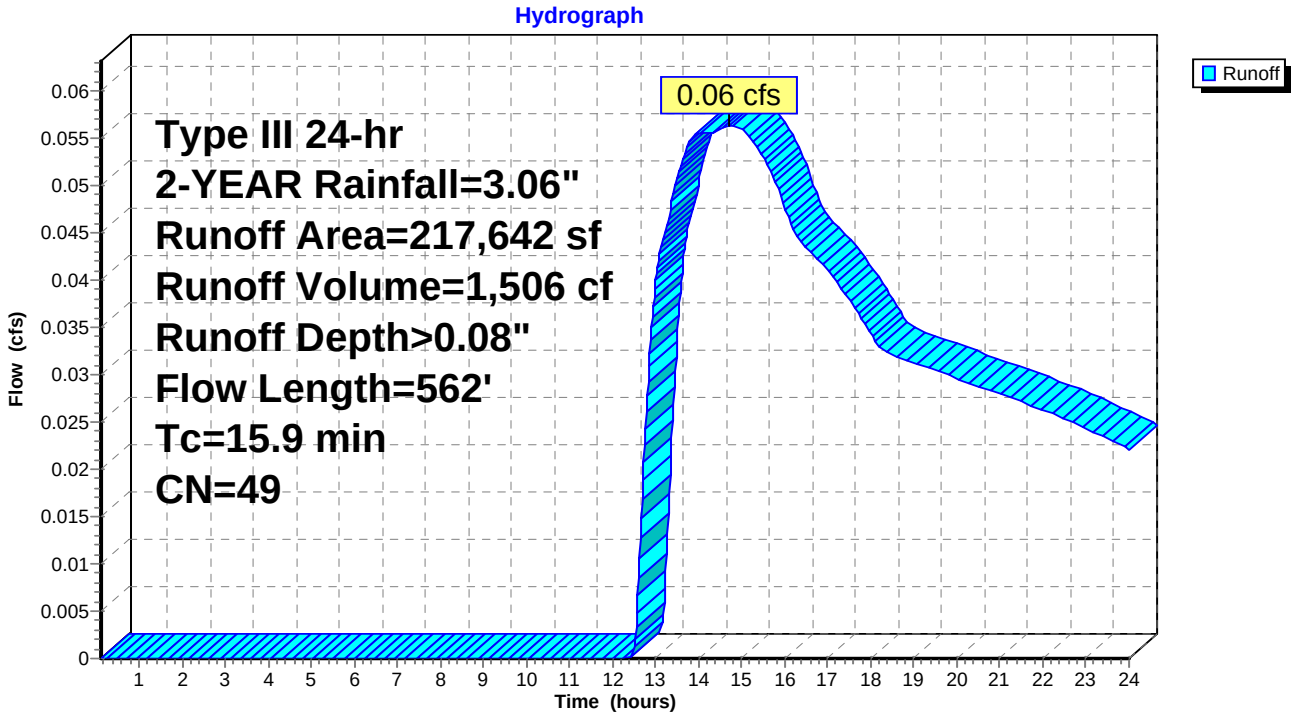
Runoff = 0.06 cfs @ 14.72 hrs, Volume= 1,506 cf, Depth> 0.08"

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

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

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

Subcatchment 6S: Remaining Project Area



Summary for Subcatchment EX: Existing Site

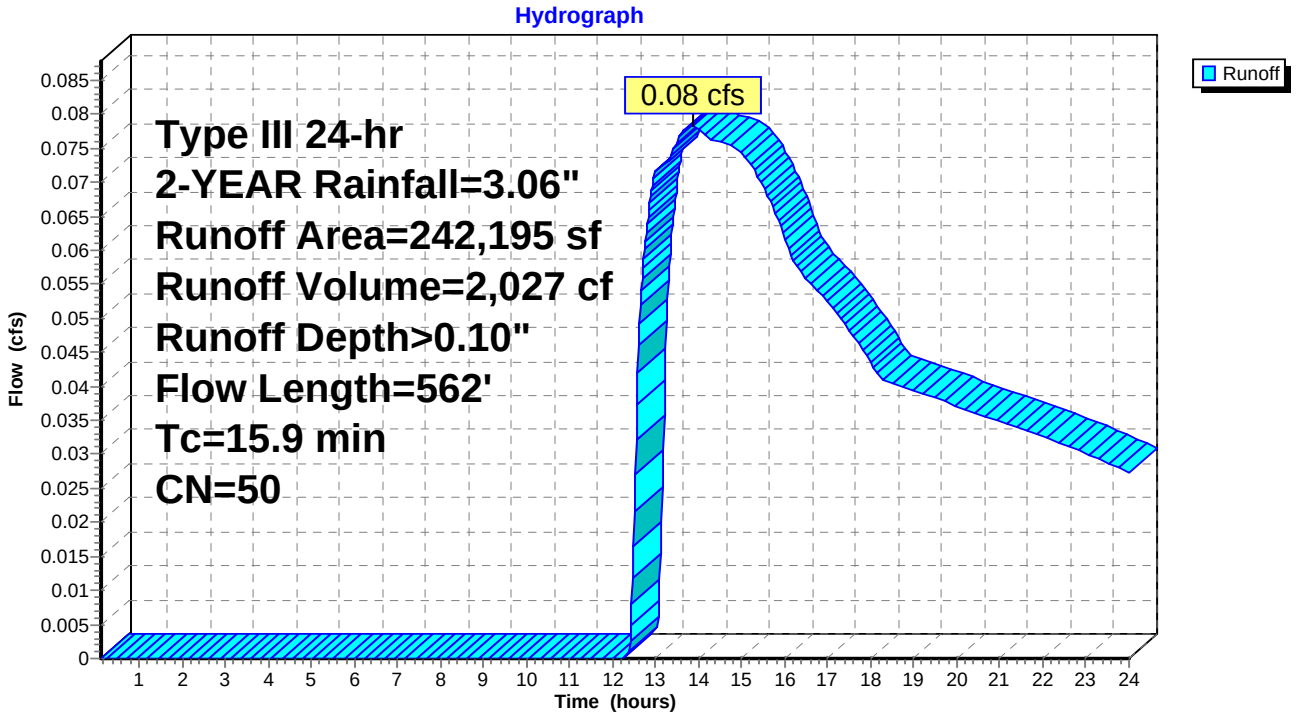
Runoff = 0.08 cfs @ 13.84 hrs, Volume= 2,027 cf, Depth> 0.10"

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

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

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

Subcatchment EX: Existing Site



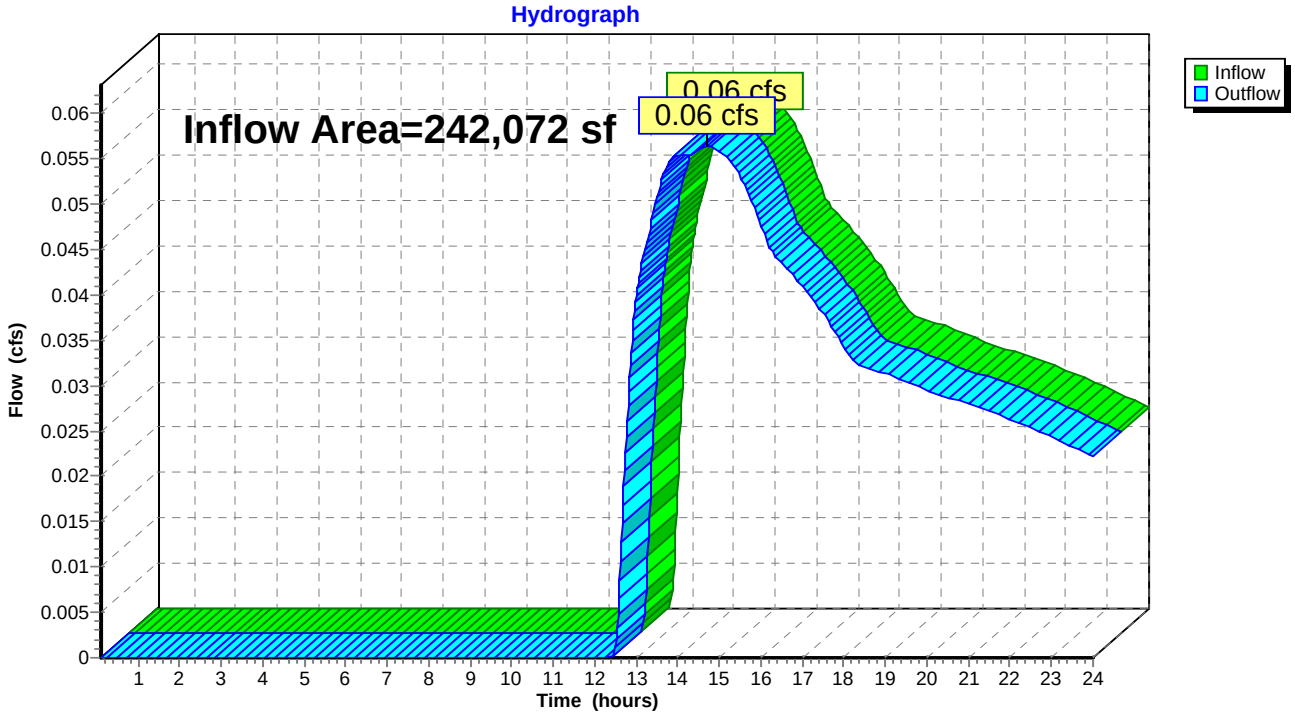
Summary for Reach END: Proposed Site Runoff

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

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

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

Reach END: Proposed Site Runoff



Summary for Pond C1: Northeast Cultecs

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

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

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

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

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

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

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

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

Pond C1: Northeast Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

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

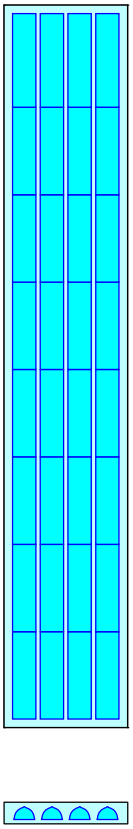
8 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 82.75' Row Length +12.0" End Stone x 2 = 84.75' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

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

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

Chamber Storage + Stone Storage = 1,663.1 cf = 0.038 af
Overall Storage Efficiency = 53.2%

32 Chambers
115.7 cy Field
83.2 cy Stone



Pond C1: Northeast Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

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

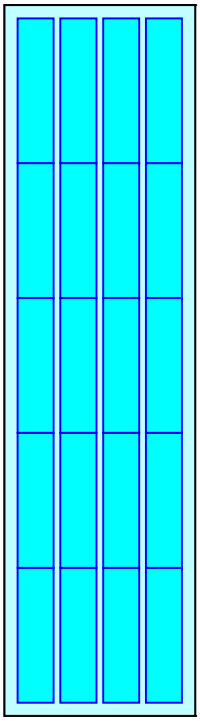
5 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 52.00' Row Length +12.0" End Stone x 2 = 54.00' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

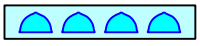
20 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 551.0 cf Chamber Storage

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

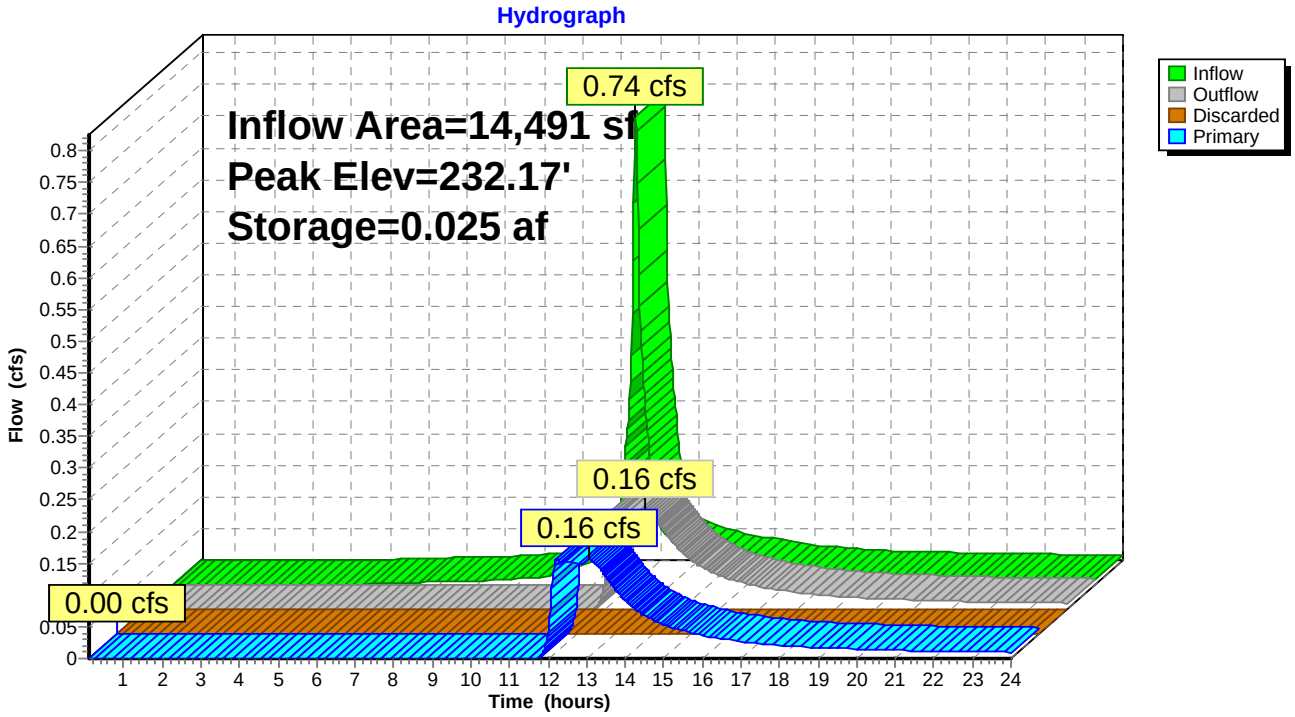
Chamber Storage + Stone Storage = 1,054.7 cf = 0.024 af
Overall Storage Efficiency = 53.0%

20 Chambers
73.7 cy Field
53.3 cy Stone





Pond C1: Northeast Cultecs



Summary for Pond C2: Intermediate Cultecs

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

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

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

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

Storage Group A created with Chamber Wizard

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

Discarded OutFlow Max=0.06 cfs @ 13.35 hrs HW=230.35' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.14 cfs @ 12.48 hrs HW=230.30' TW=230.15' (Dynamic Tailwater)
↑—**2=Culvert** (Barrel Controls 0.14 cfs @ 1.37 fps)

Pond C2: Intermediate Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

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

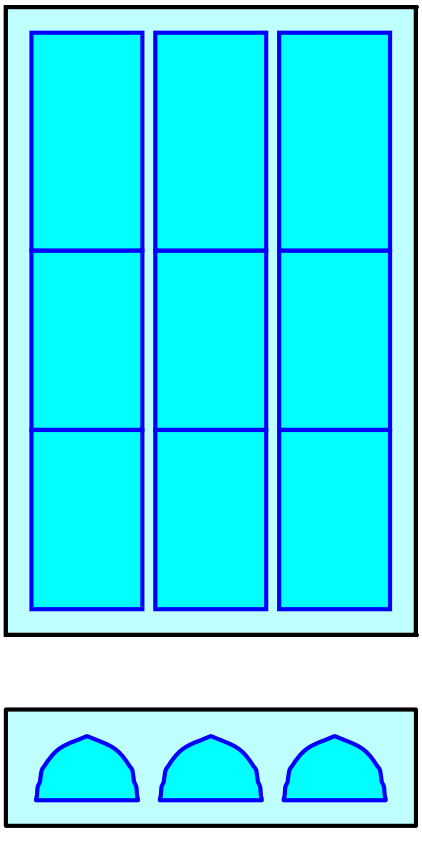
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
12.0" Base + 30.5" Chamber Height + 12.0" Cover = 4.54' Field Height

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

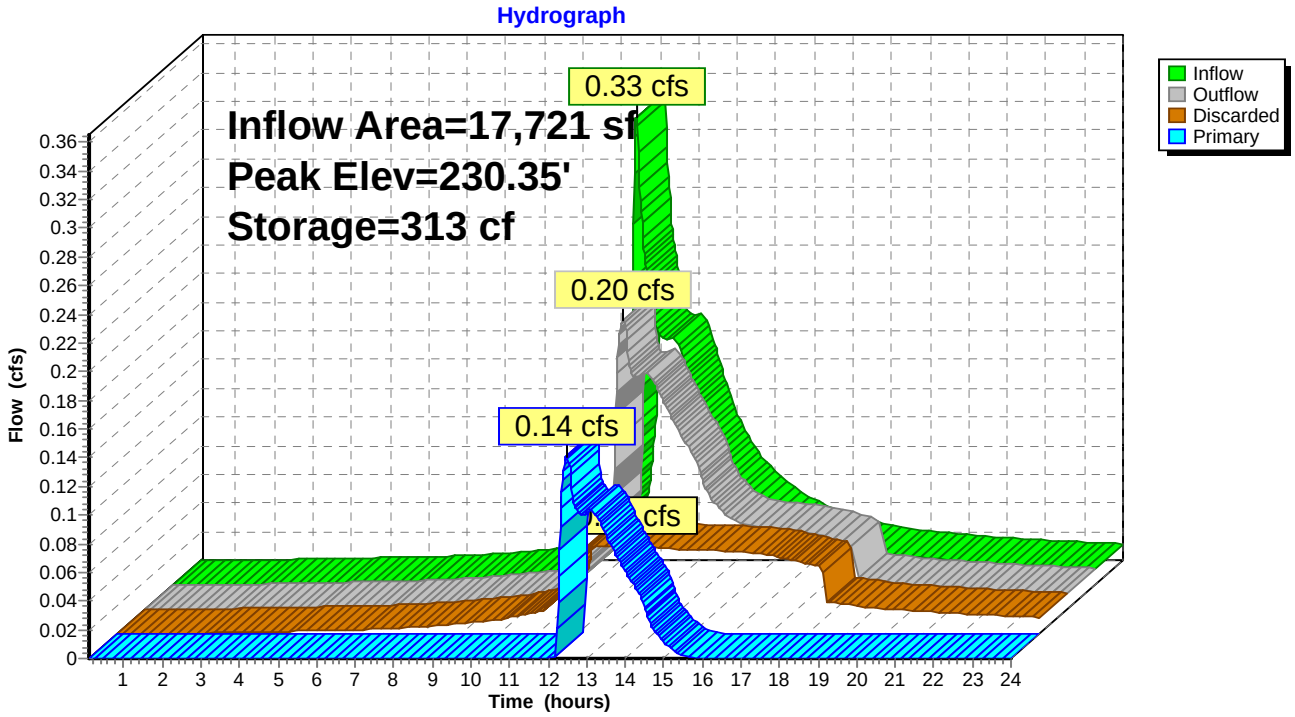
1,780.3 cf Field - 502.9 cf Chambers = 1,277.4 cf Stone x 35.0% Voids = 447.1 cf Stone Storage

Chamber Storage + Stone Storage = 950.0 cf = 0.022 af
Overall Storage Efficiency = 53.4%

9 Chambers
65.9 cy Field
47.3 cy Stone



Pond C2: Intermediate Cultecs



Summary for Pond C3: Southwest Cultecs

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

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

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

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

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

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

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

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

Pond C3: Southwest Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

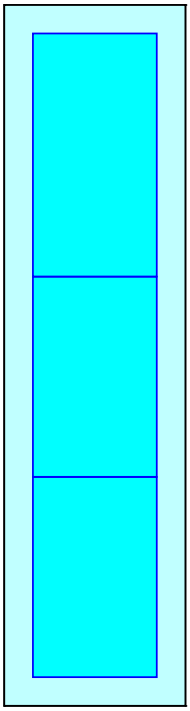
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

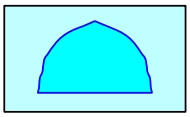
3 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 167.6 cf Chamber Storage

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

Chamber Storage + Stone Storage = 310.4 cf = 0.007 af
Overall Storage Efficiency = 53.9%

3 Chambers
21.3 cy Field
15.1 cy Stone





Pond C3: Southwest Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 2 rows

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

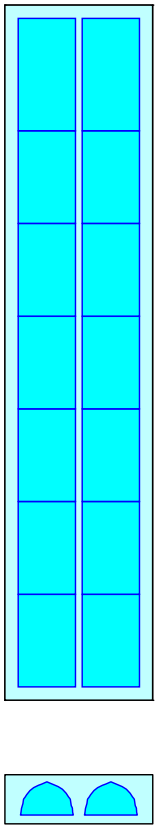
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
2 Rows x 52.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.17' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

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

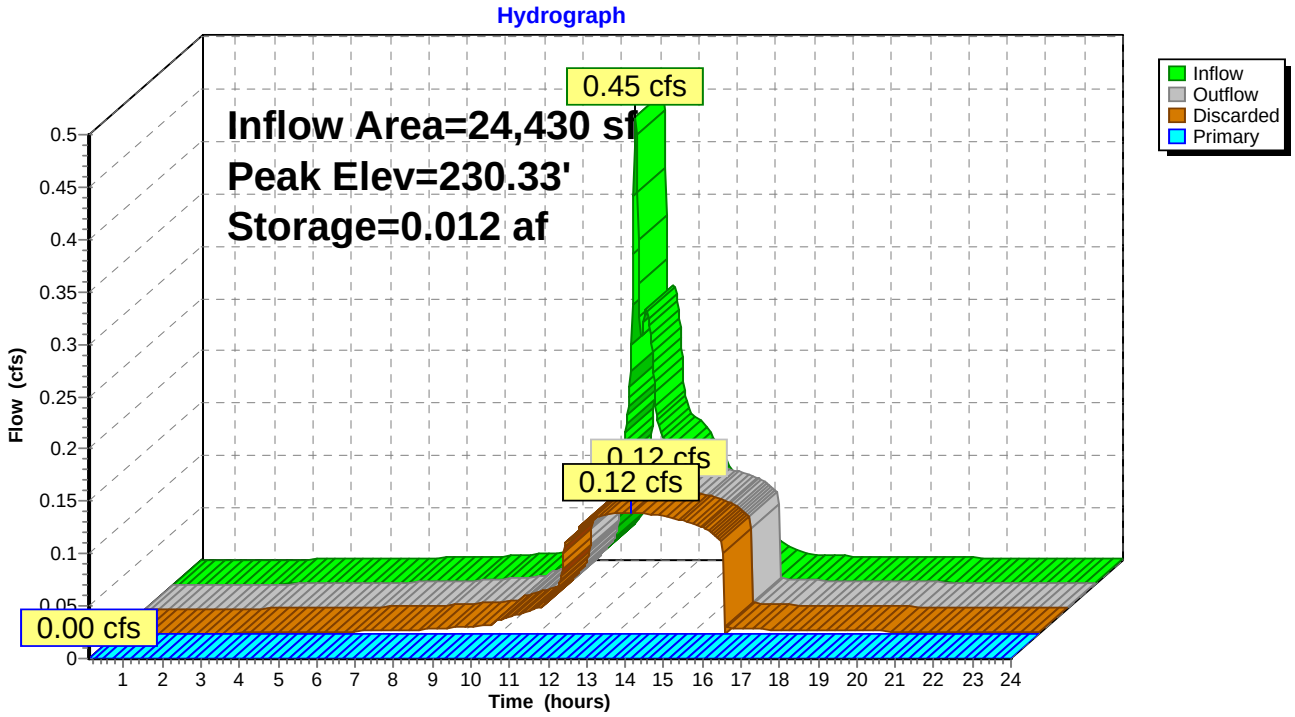
2,174.0 cf Field - 752.6 cf Chambers = 1,421.5 cf Stone x 35.0% Voids = 497.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,250.1 cf = 0.029 af
Overall Storage Efficiency = 57.5%

14 Chambers
80.5 cy Field
52.6 cy Stone



Pond C3: Southwest Cultecs



Summary for Pond CB1: Catch Basin #1

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

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

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

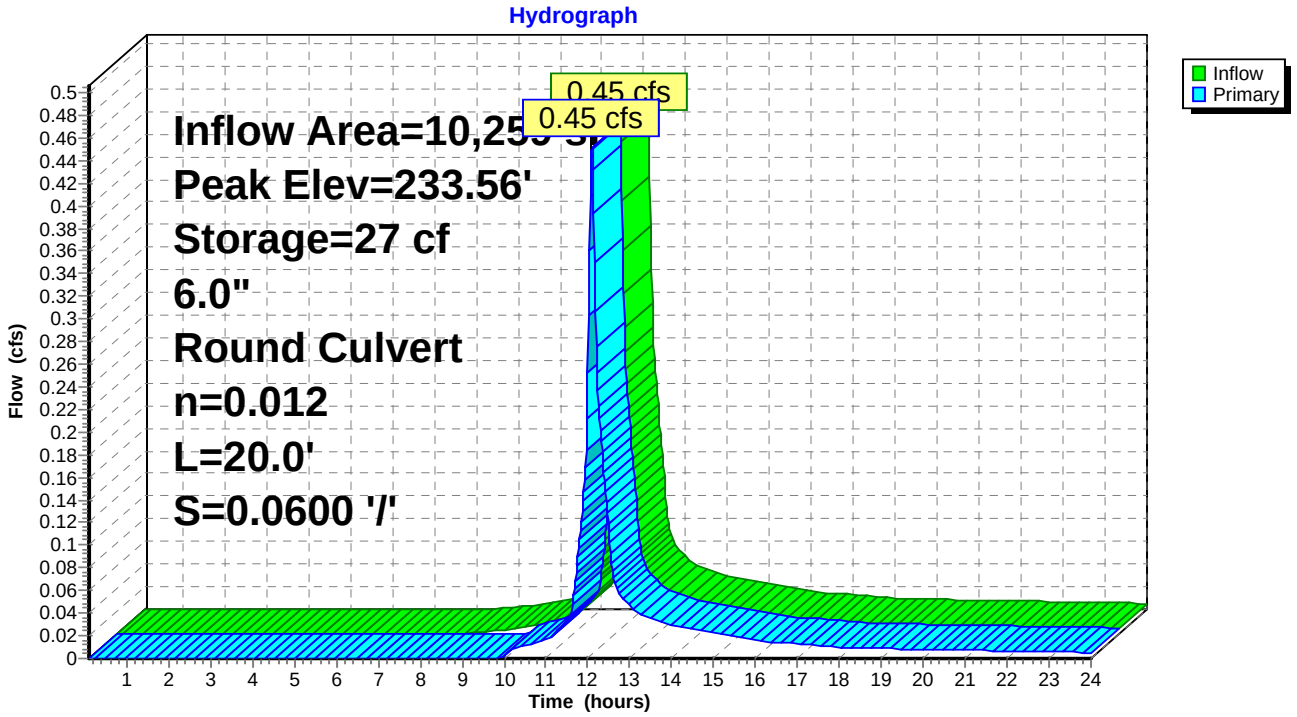
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	464 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	3,335	419	464

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

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

Pond CB1: Catch Basin #1



Summary for Pond CB2: Catch Basin #2

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

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

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

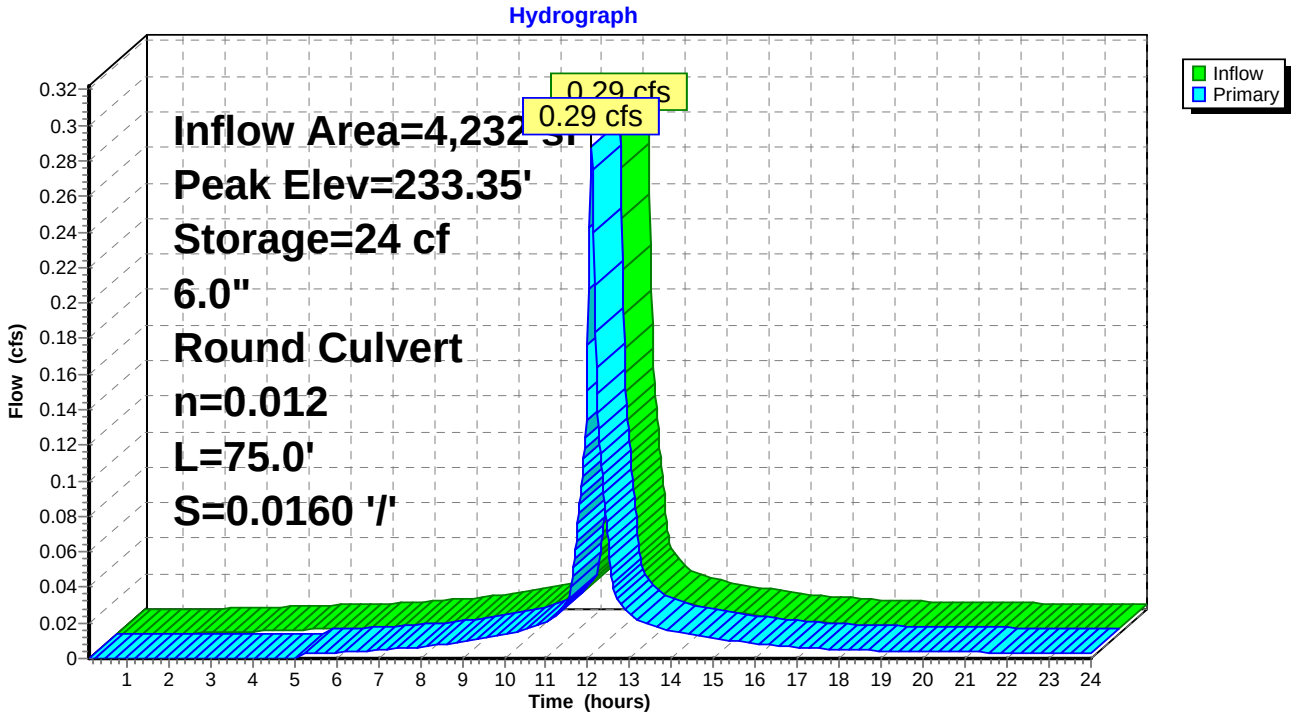
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	258 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,690	213	258

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

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

Pond CB2: Catch Basin #2



Summary for Pond CB3: Catch Basin #3

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

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

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

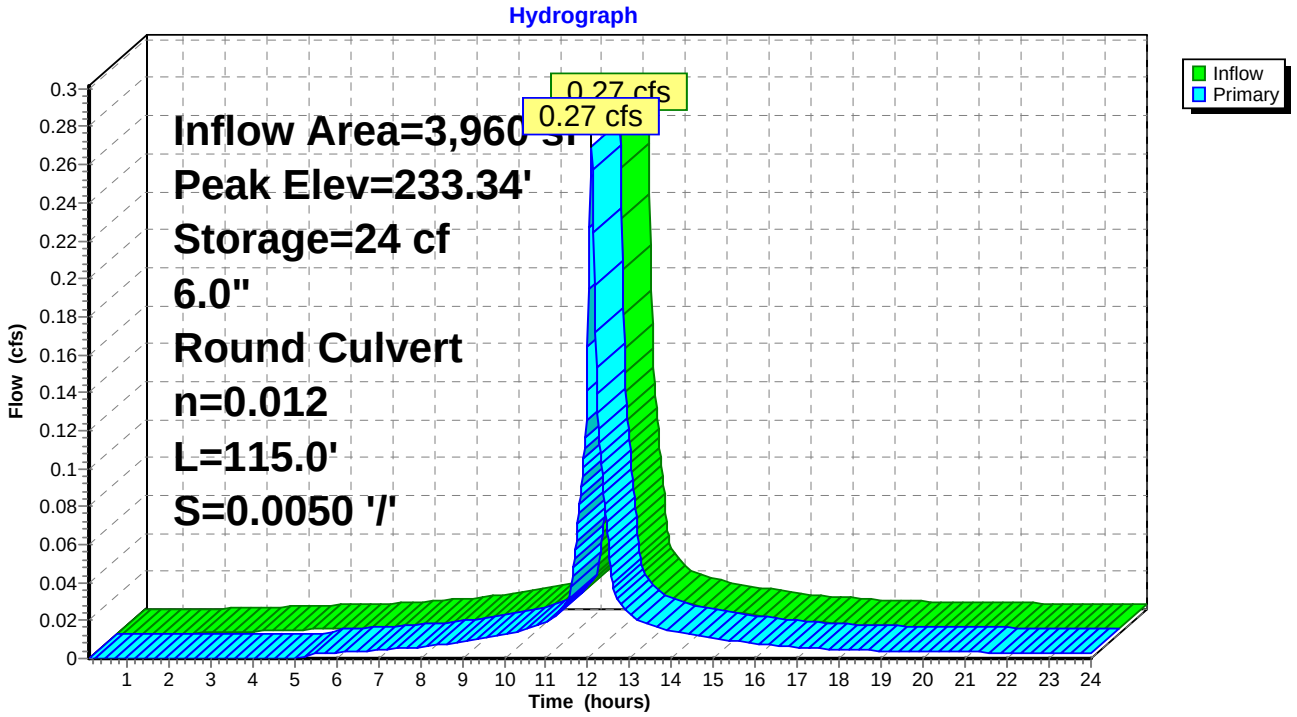
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	293 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,963	247	293

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

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

Pond CB3: Catch Basin #3



Summary for Pond D1: Drywell

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

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

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

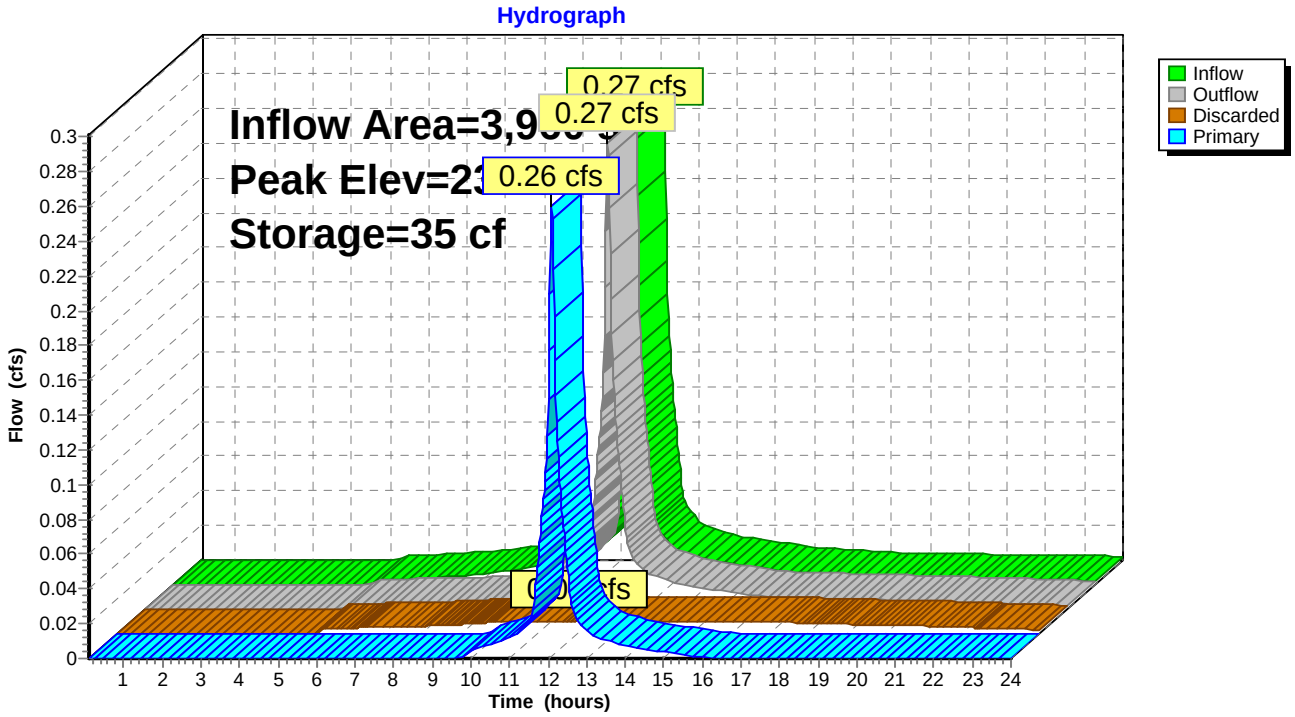
Volume	Invert	Avail.Storage	Storage Description
#1	230.00'	98 cf	**5.00'D x 5.00'H Vertical Cone/Cylinder** Inside #2 141 cf Overall - 6.0" Wall Thickness = 98 cf
#2	230.00'	9 cf	**6.50'D x 5.00'H Vertical Cone/Cylinder** 166 cf Overall - 141 cf Embedded = 25 cf x 35.0% Voids
		107 cf	Total Available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

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

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

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

Pond D1: Drywell



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Summary for Subcatchment 1S: Roof Drain South West Side

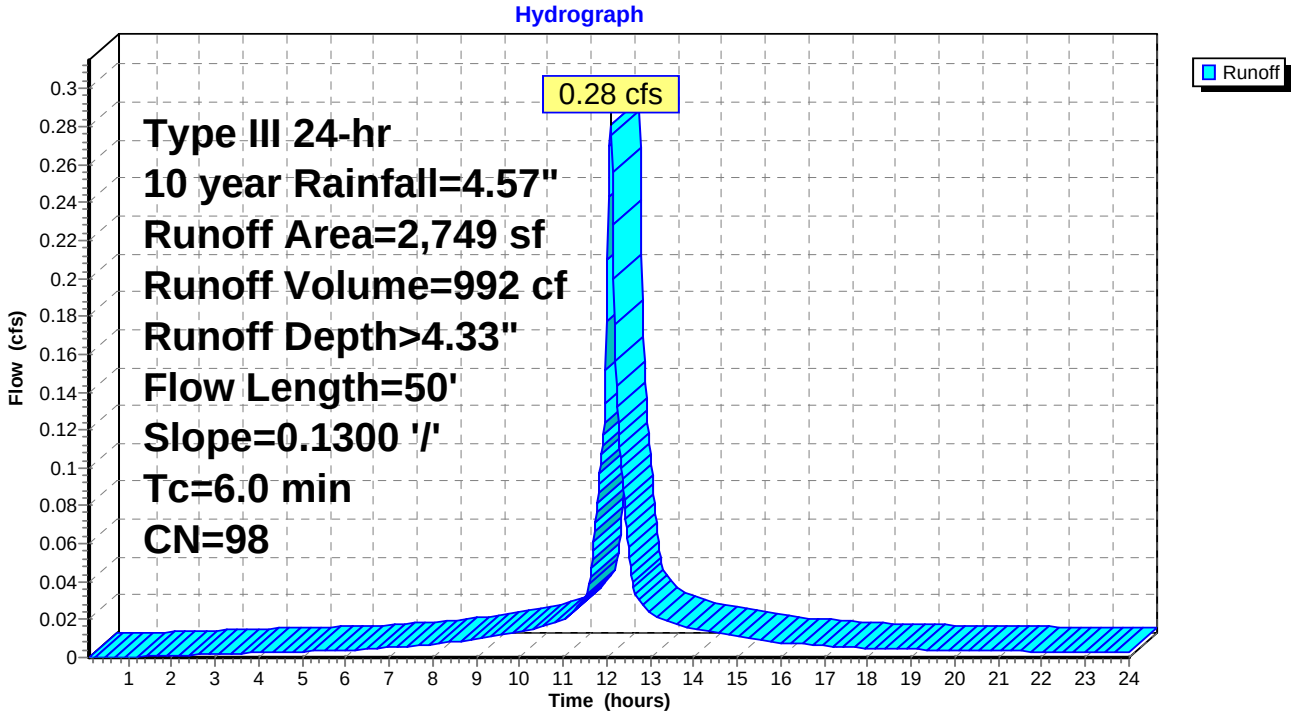
Runoff = 0.28 cfs @ 12.08 hrs, Volume= 992 cf, Depth> 4.33"

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

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

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

Subcatchment 1S: Roof Drain South West Side



Summary for Subcatchment 2S: Roof Drain North Side

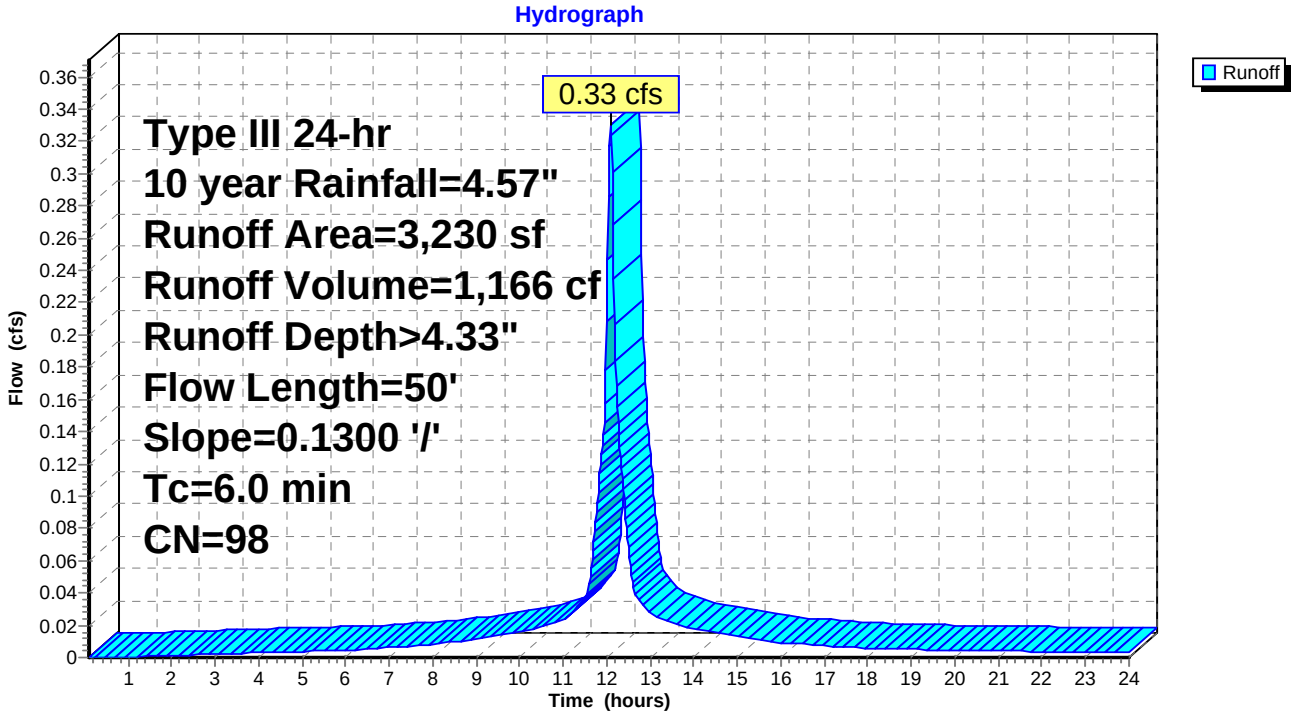
Runoff = 0.33 cfs @ 12.08 hrs, Volume= 1,166 cf, Depth> 4.33"

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

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

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

Subcatchment 2S: Roof Drain North Side



Summary for Subcatchment 3S: Upper Paved Area

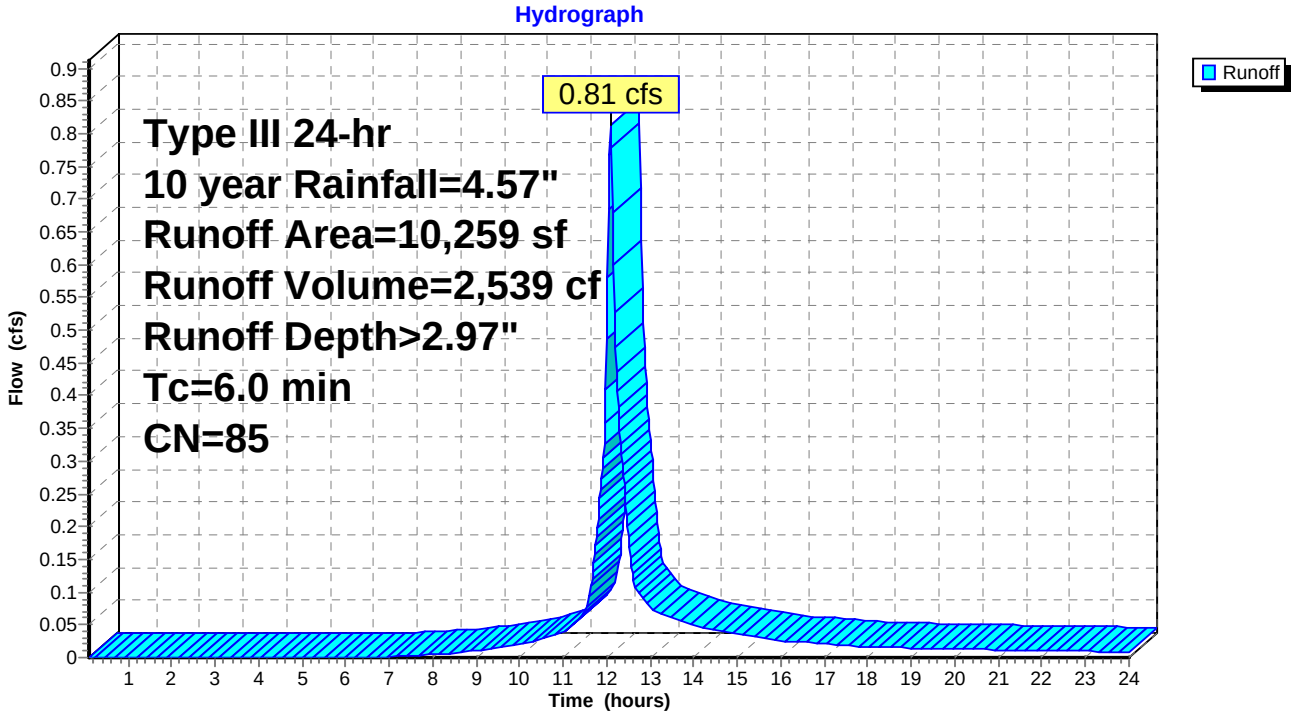
Runoff = 0.81 cfs @ 12.09 hrs, Volume= 2,539 cf, Depth> 2.97"

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

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

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

Subcatchment 3S: Upper Paved Area



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

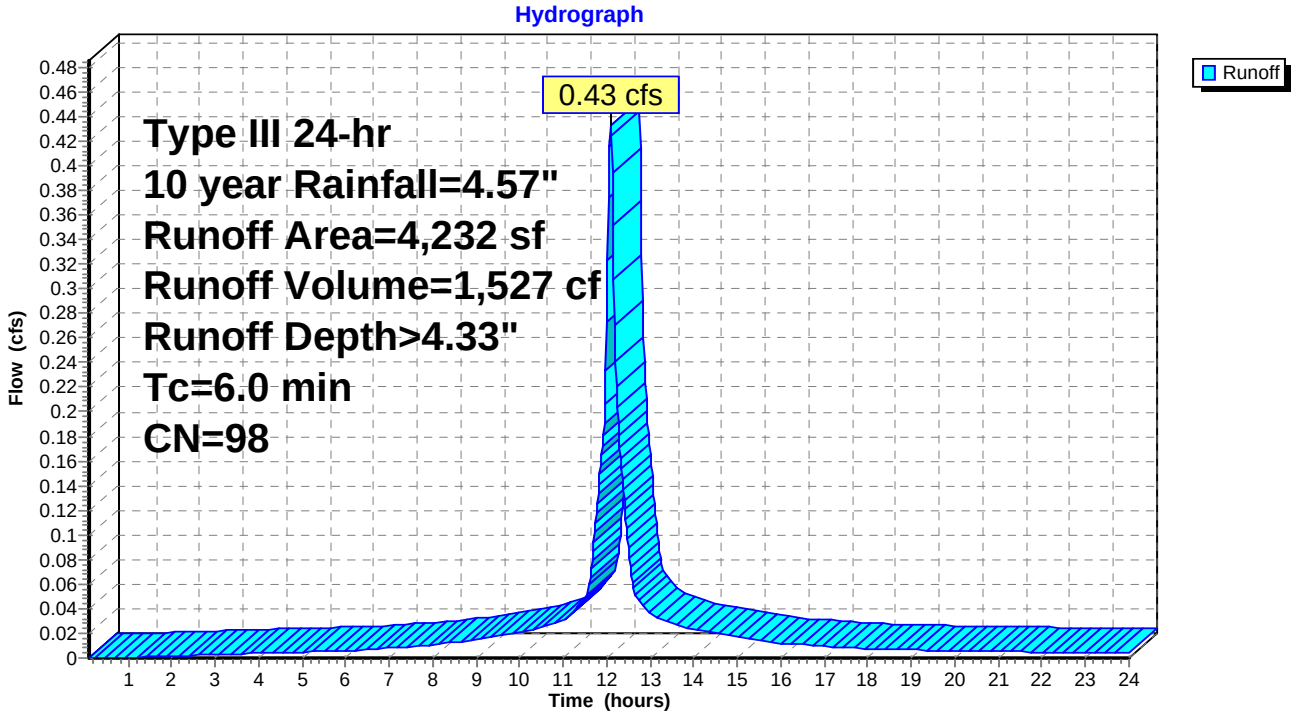
Runoff = 0.43 cfs @ 12.08 hrs, Volume= 1,527 cf, Depth> 4.33"

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

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

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

Subcatchment 4S: Middle Paved Area & Eastern Roof



Summary for Subcatchment 5S: Lower Paved Area

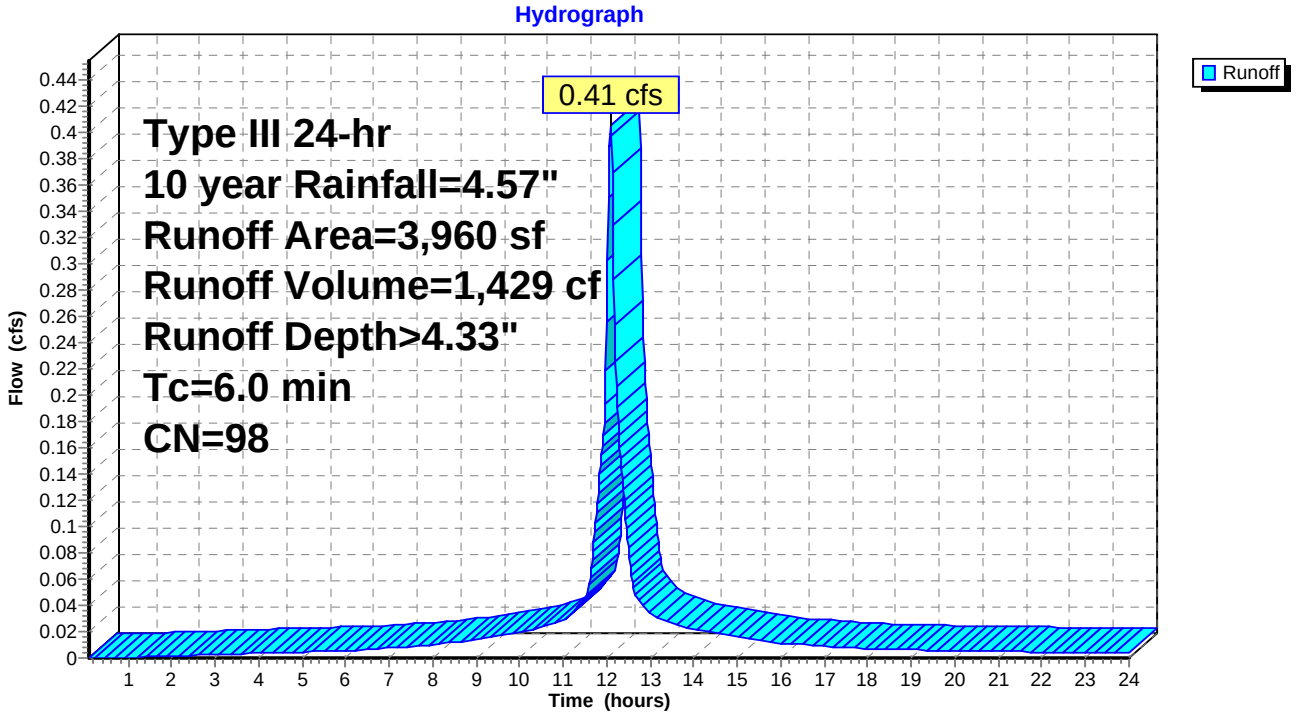
Runoff = 0.41 cfs @ 12.08 hrs, Volume= 1,429 cf, Depth> 4.33"

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

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

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

Subcatchment 5S: Lower Paved Area



Summary for Subcatchment 6S: Remaining Project Area

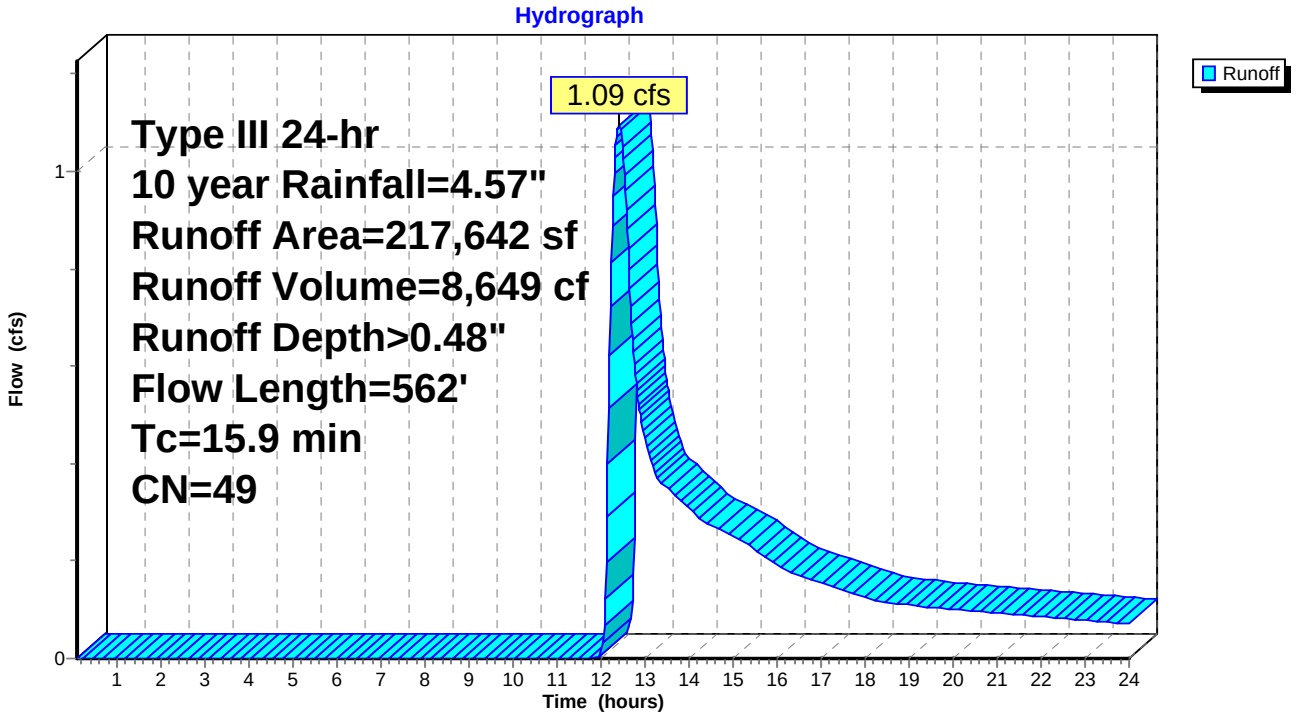
Runoff = 1.09 cfs @ 12.42 hrs, Volume= 8,649 cf, Depth> 0.48"

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

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

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

Subcatchment 6S: Remaining Project Area



Summary for Subcatchment EX: Existing Site

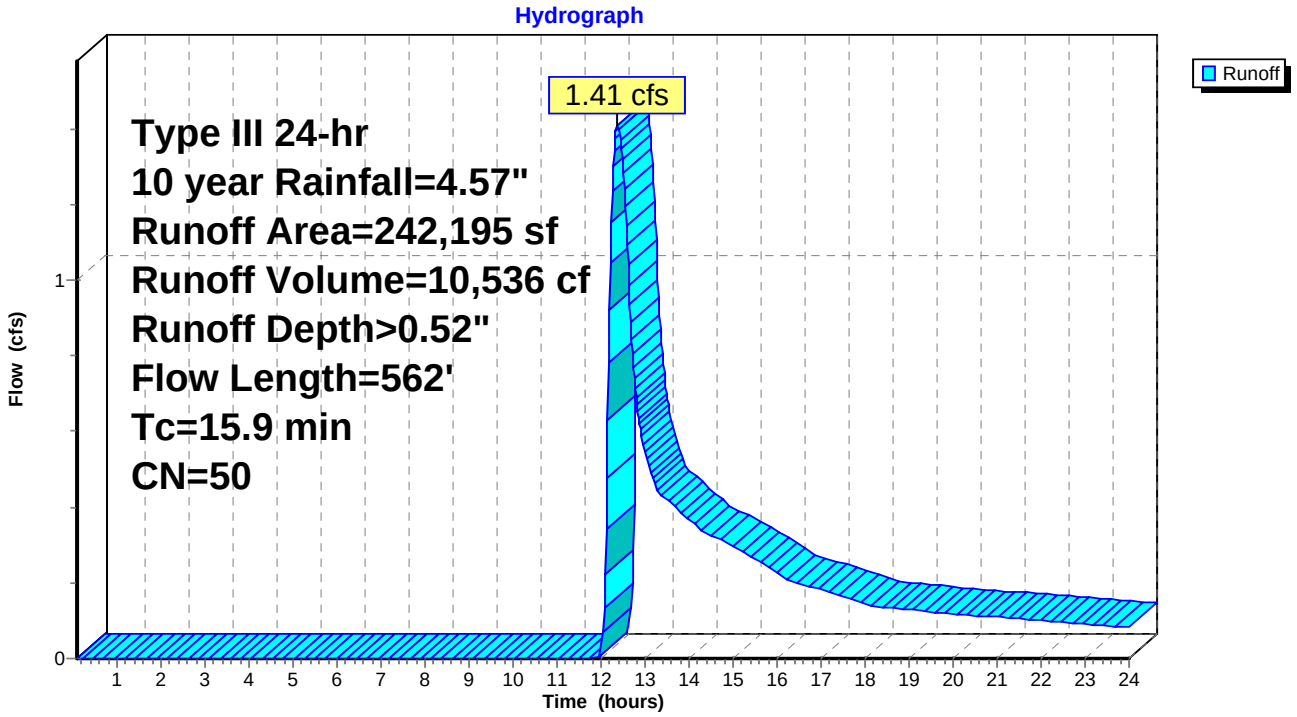
Runoff = 1.41 cfs @ 12.39 hrs, Volume= 10,536 cf, Depth> 0.52"

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

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

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

Subcatchment EX: Existing Site



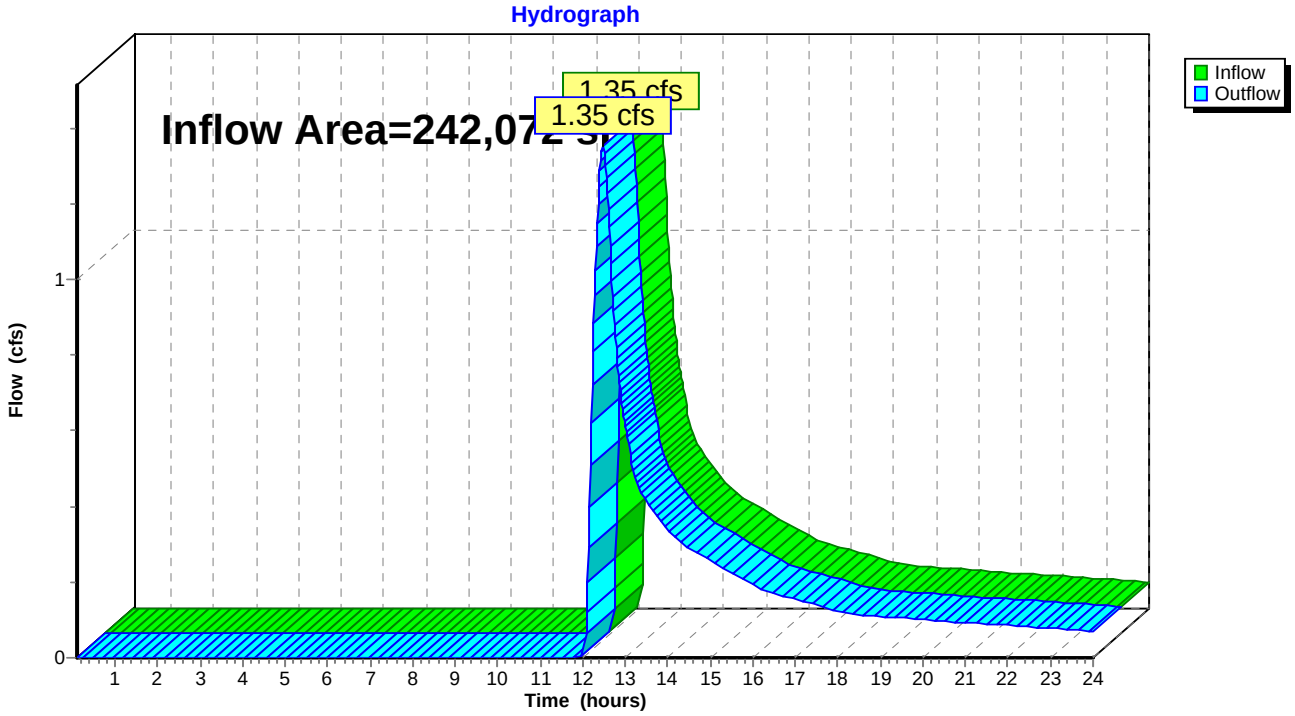
Summary for Reach END: Proposed Site Runoff

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

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

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

Reach END: Proposed Site Runoff



Summary for Pond C1: Northeast Cultecs

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

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

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

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

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

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

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

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

Pond C1: Northeast Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

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

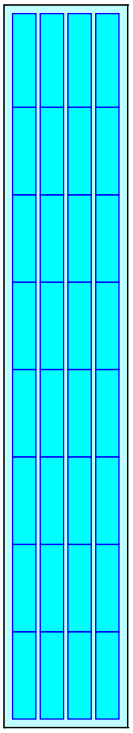
8 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 82.75' Row Length +12.0" End Stone x 2 = 84.75' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

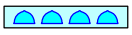
32 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 876.8 cf Chamber Storage

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

Chamber Storage + Stone Storage = 1,663.1 cf = 0.038 af
Overall Storage Efficiency = 53.2%

32 Chambers
115.7 cy Field
83.2 cy Stone





Pond C1: Northeast Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

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

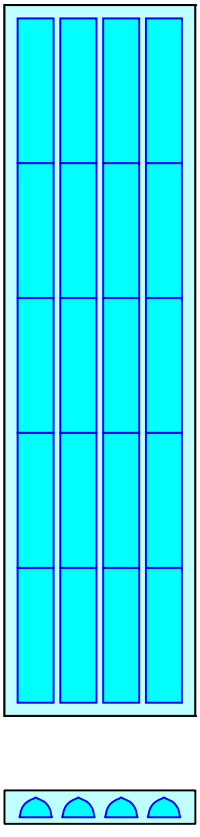
5 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 52.00' Row Length +12.0" End Stone x 2 = 54.00' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

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

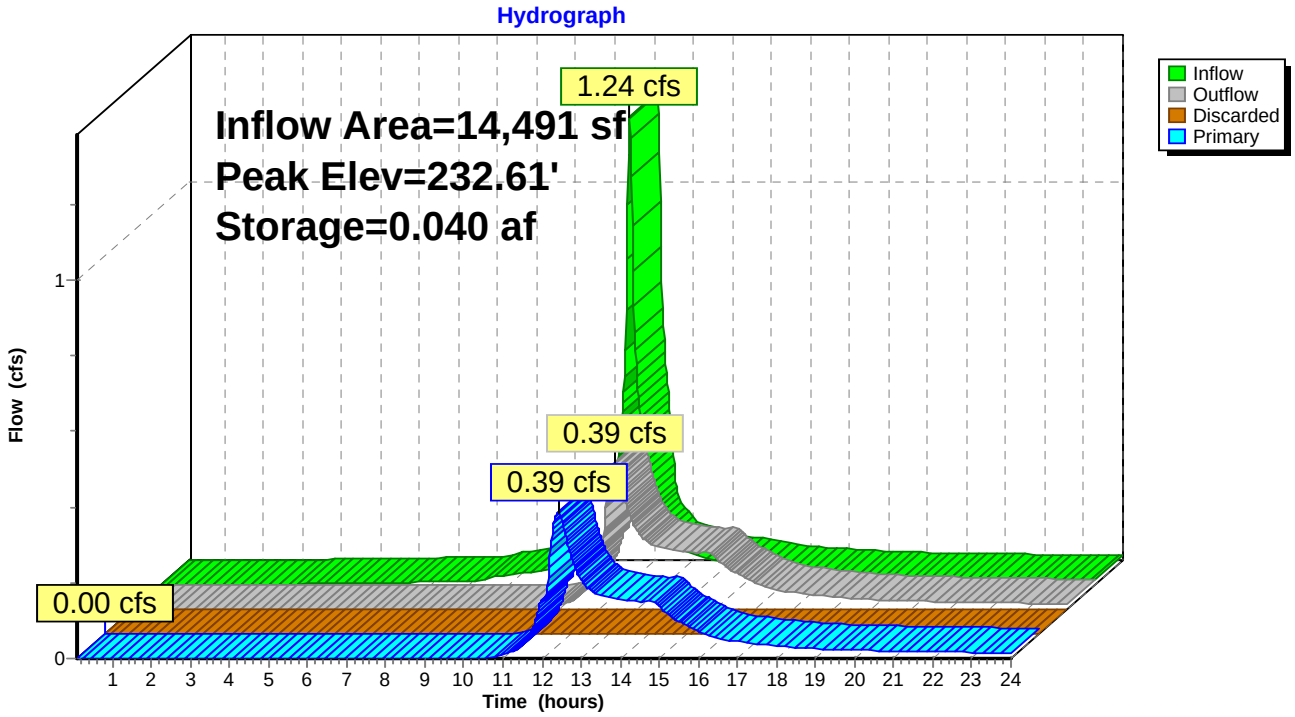
1,990.1 cf Field - 551.0 cf Chambers = 1,439.1 cf Stone x 35.0% Voids = 503.7 cf Stone Storage

Chamber Storage + Stone Storage = 1,054.7 cf = 0.024 af
Overall Storage Efficiency = 53.0%

20 Chambers
73.7 cy Field
53.3 cy Stone



Pond C1: Northeast Cultecs



Summary for Pond C2: Intermediate Cultecs

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

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

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

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

Storage Group A created with Chamber Wizard

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

Discarded OutFlow Max=0.07 cfs @ 12.55 hrs HW=231.11' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.34 cfs @ 12.52 hrs HW=231.10' TW=231.04' (Dynamic Tailwater)
└**2=Culvert** (Inlet Controls 0.34 cfs @ 0.98 fps)

Pond C2: Intermediate Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

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

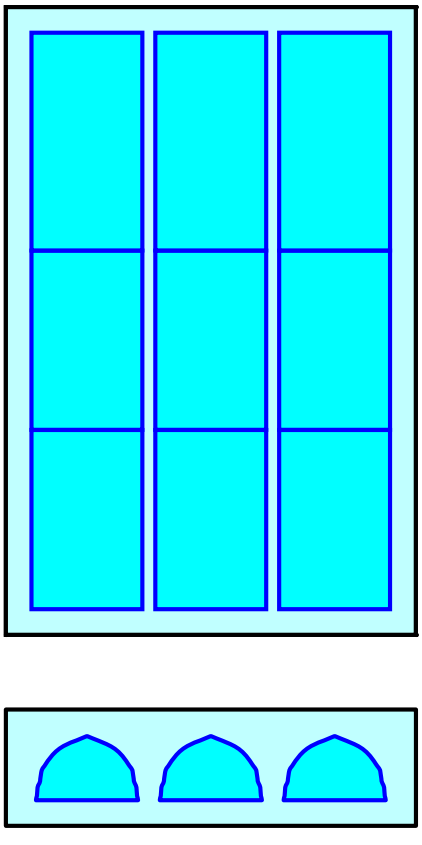
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
12.0" Base + 30.5" Chamber Height + 12.0" Cover = 4.54' Field Height

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

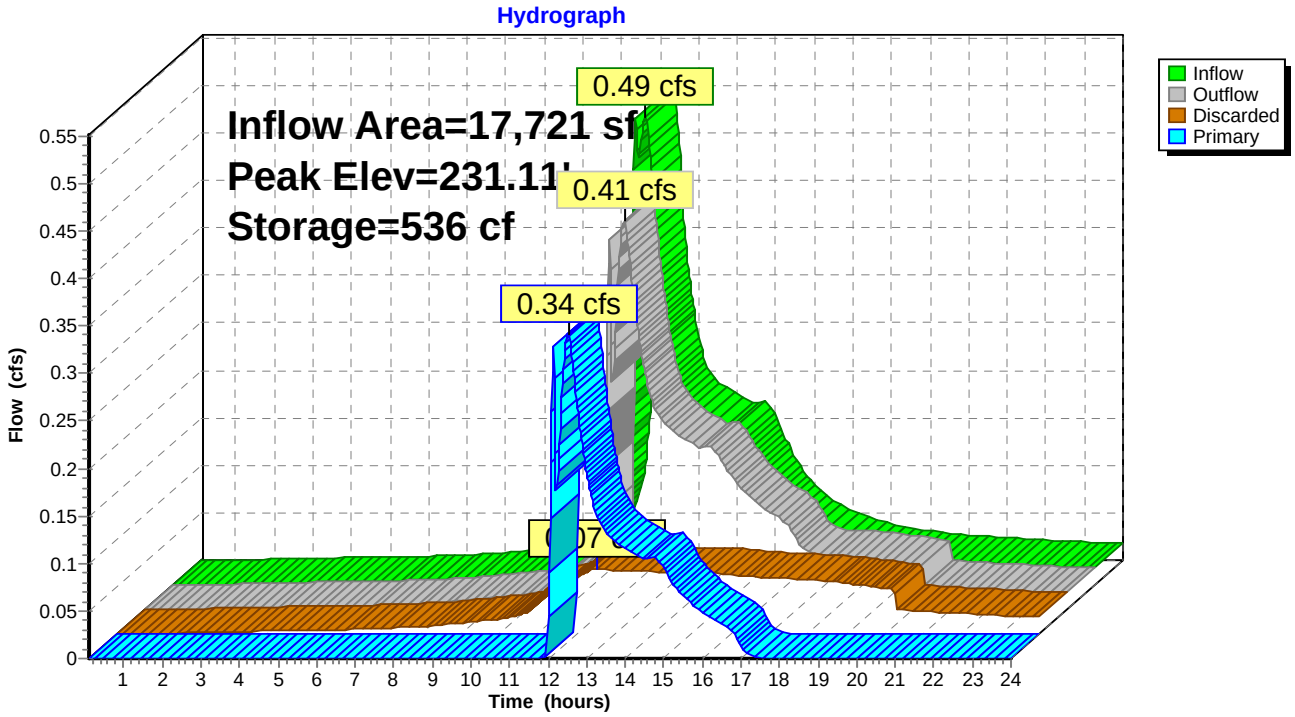
1,780.3 cf Field - 502.9 cf Chambers = 1,277.4 cf Stone x 35.0% Voids = 447.1 cf Stone Storage

Chamber Storage + Stone Storage = 950.0 cf = 0.022 af
Overall Storage Efficiency = 53.4%

9 Chambers
65.9 cy Field
47.3 cy Stone



Pond C2: Intermediate Cultecs



Summary for Pond C3: Southwest Cultecs

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

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

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

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

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

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

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

Primary OutFlow Max=0.31 cfs @ 12.56 hrs HW=231.04' TW=0.00' (Dynamic Tailwater)
2=Culvert (Inlet Controls 0.31 cfs @ 1.62 fps)

Pond C3: Southwest Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

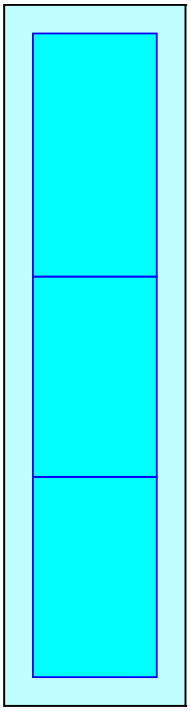
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

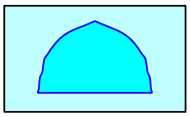
3 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 167.6 cf Chamber Storage

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

Chamber Storage + Stone Storage = 310.4 cf = 0.007 af
Overall Storage Efficiency = 53.9%

3 Chambers
21.3 cy Field
15.1 cy Stone





Pond C3: Southwest Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 2 rows

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

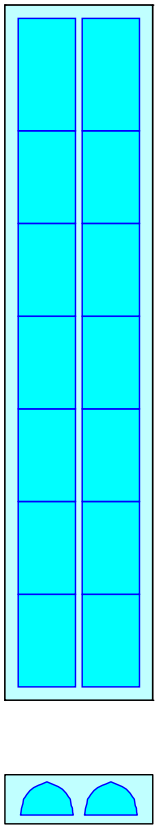
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
2 Rows x 52.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.17' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

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

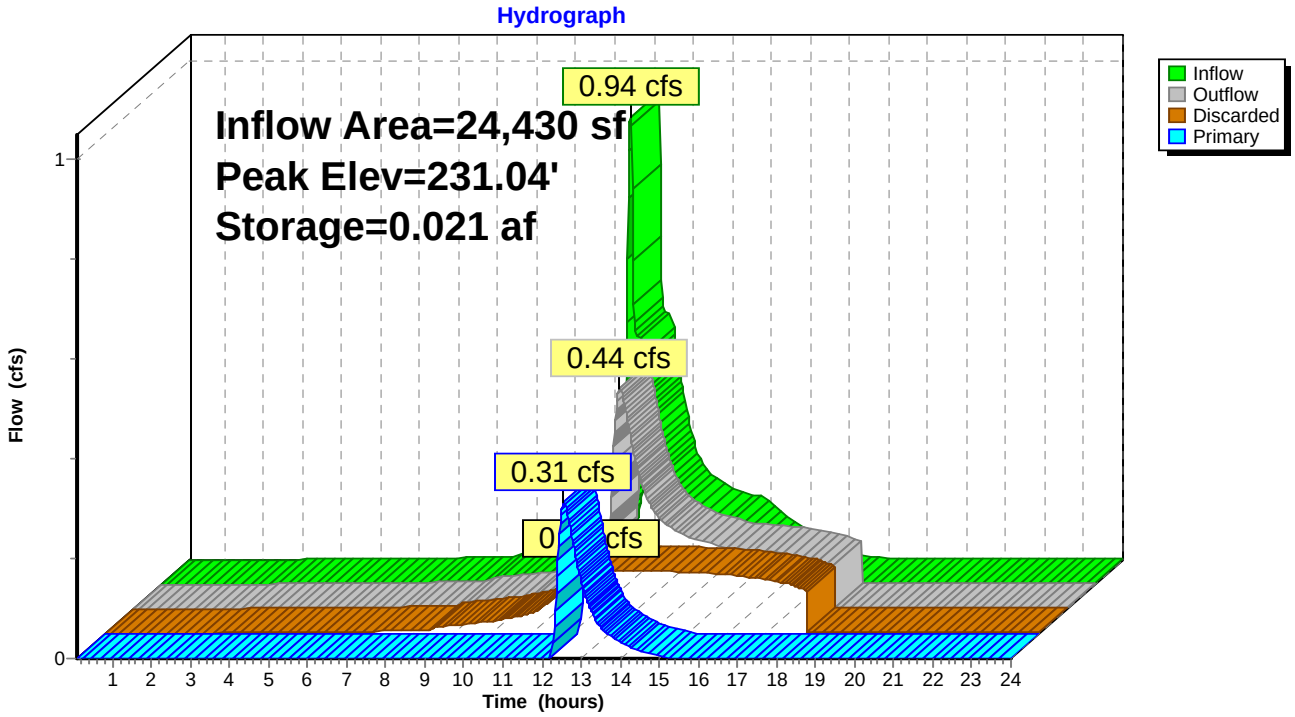
2,174.0 cf Field - 752.6 cf Chambers = 1,421.5 cf Stone x 35.0% Voids = 497.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,250.1 cf = 0.029 af
Overall Storage Efficiency = 57.5%

14 Chambers
80.5 cy Field
52.6 cy Stone



Pond C3: Southwest Cultecs



Summary for Pond CB1: Catch Basin #1

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

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

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

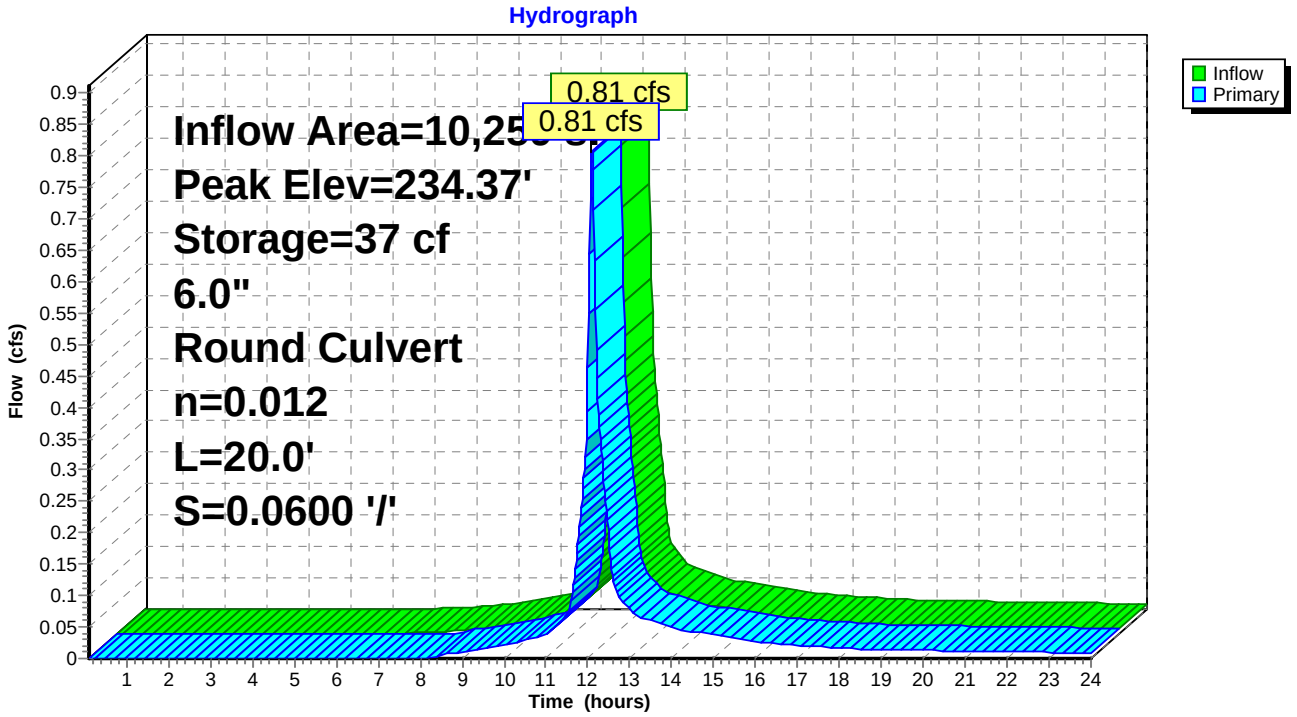
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	464 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	3,335	419	464

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

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

Pond CB1: Catch Basin #1



Summary for Pond CB2: Catch Basin #2

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

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

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

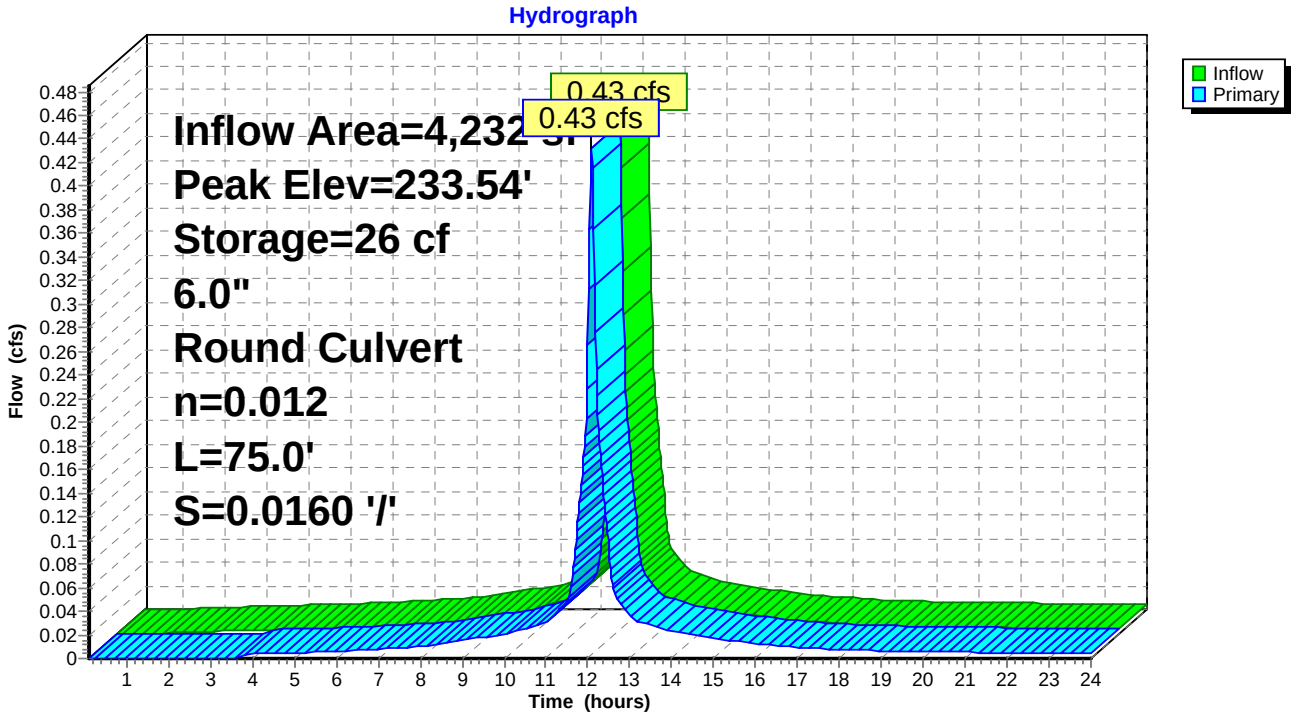
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	258 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,690	213	258

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

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

Pond CB2: Catch Basin #2



Summary for Pond CB3: Catch Basin #3

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

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

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

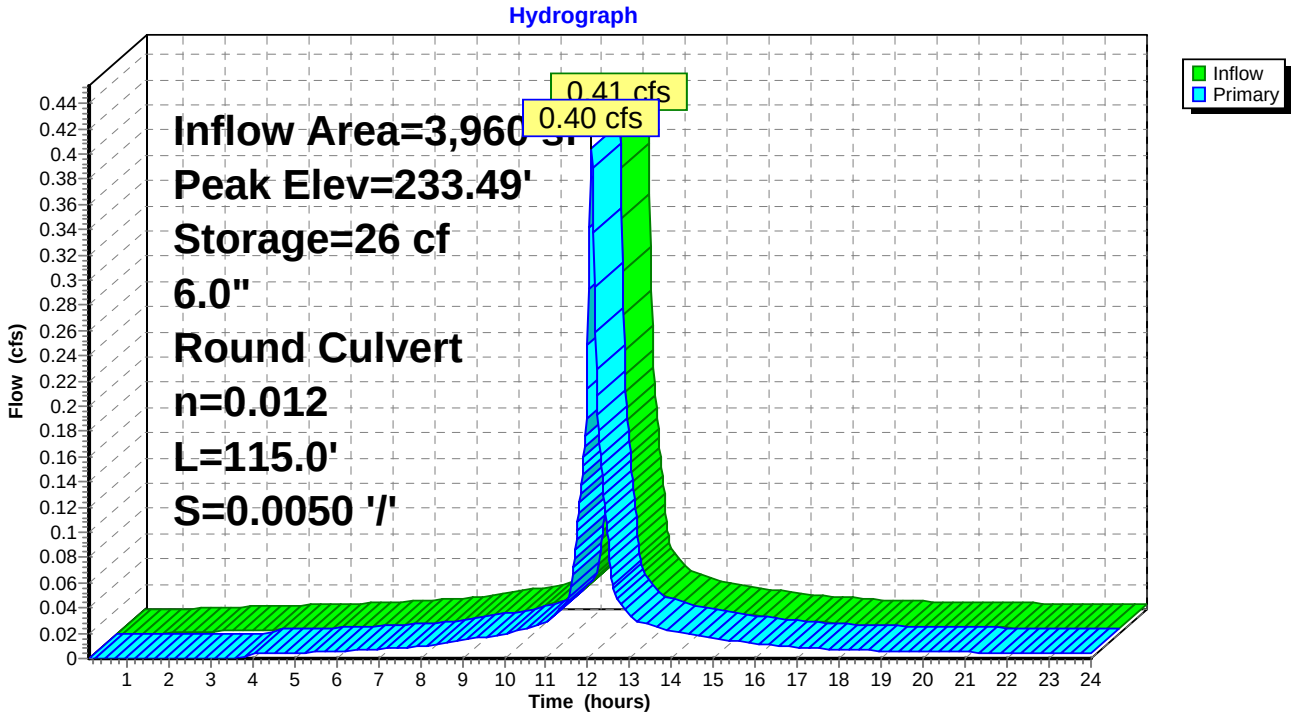
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	293 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,963	247	293

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

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

Pond CB3: Catch Basin #3



Summary for Pond D1: Drywell

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

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

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

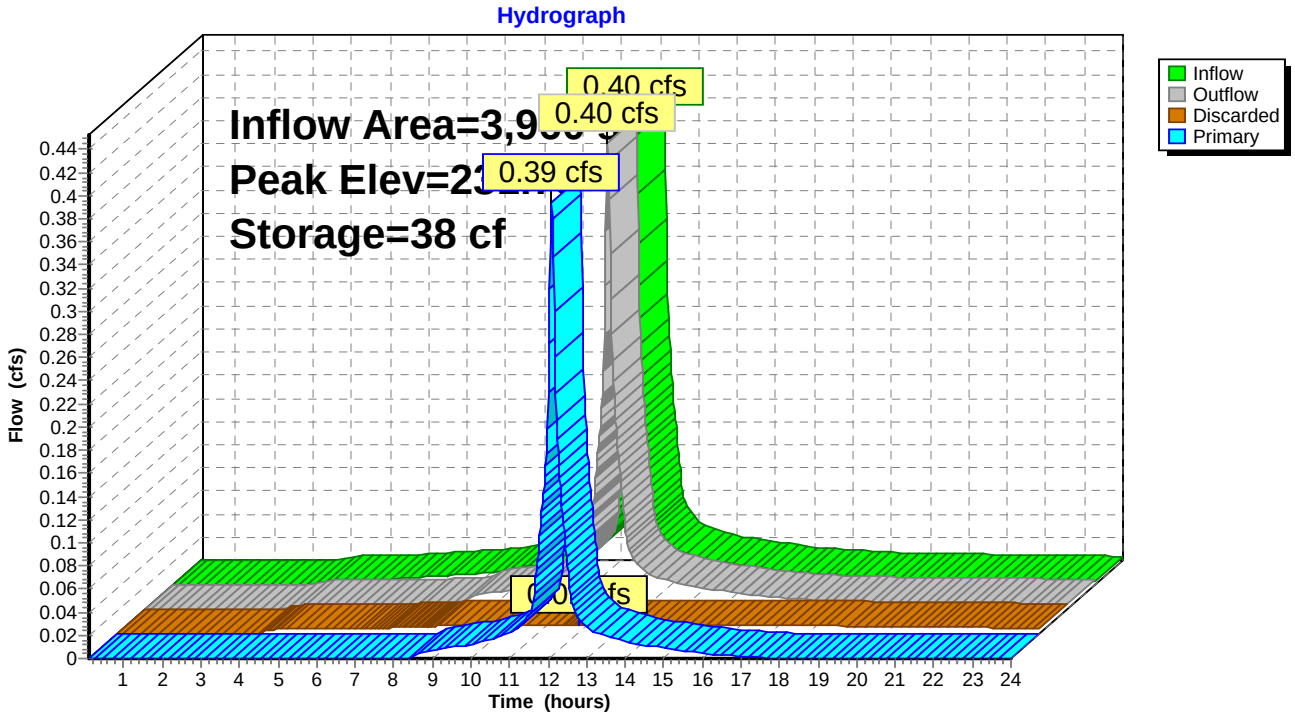
Volume	Invert	Avail.Storage	Storage Description
#1	230.00'	98 cf	**5.00'D x 5.00'H Vertical Cone/Cylinder** Inside #2 141 cf Overall - 6.0" Wall Thickness = 98 cf
#2	230.00'	9 cf	**6.50'D x 5.00'H Vertical Cone/Cylinder** 166 cf Overall - 141 cf Embedded = 25 cf x 35.0% Voids
		107 cf	Total Available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

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

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

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

Pond D1: Drywell



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Summary for Subcatchment 1S: Roof Drain South West Side

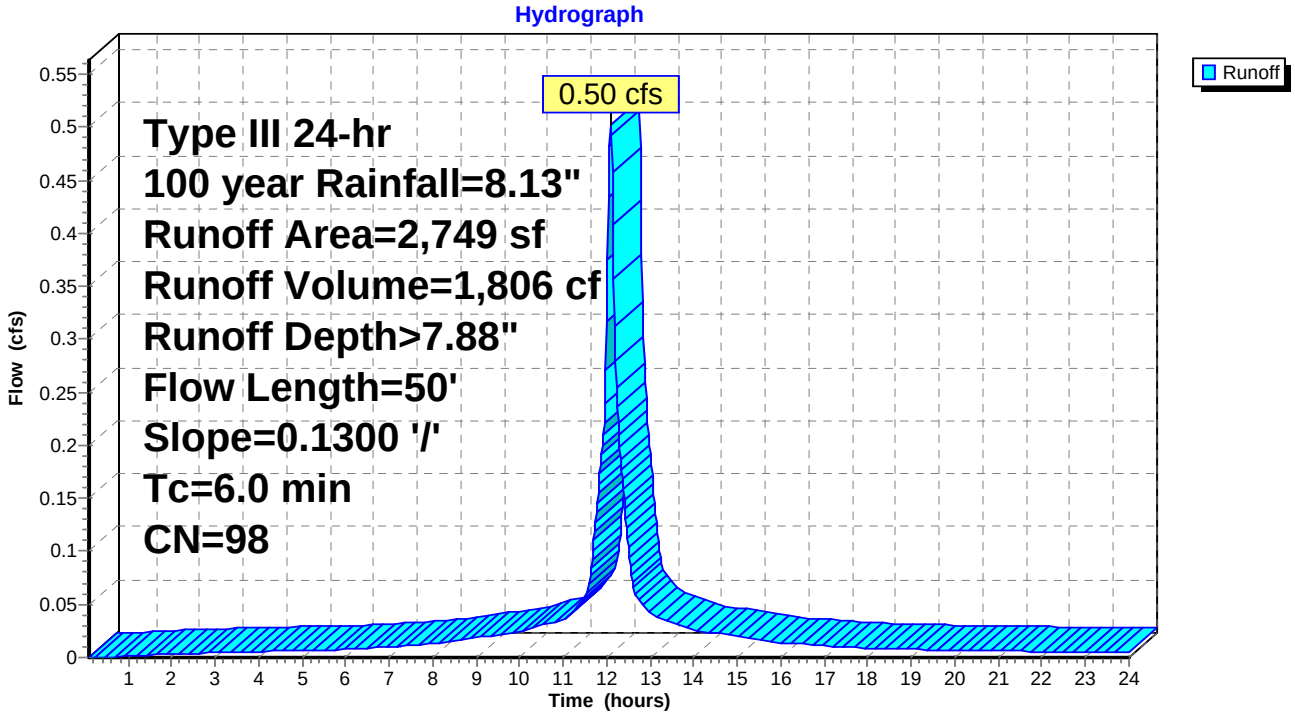
Runoff = 0.50 cfs @ 12.08 hrs, Volume= 1,806 cf, Depth> 7.88"

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

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

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

Subcatchment 1S: Roof Drain South West Side



Summary for Subcatchment 2S: Roof Drain North Side

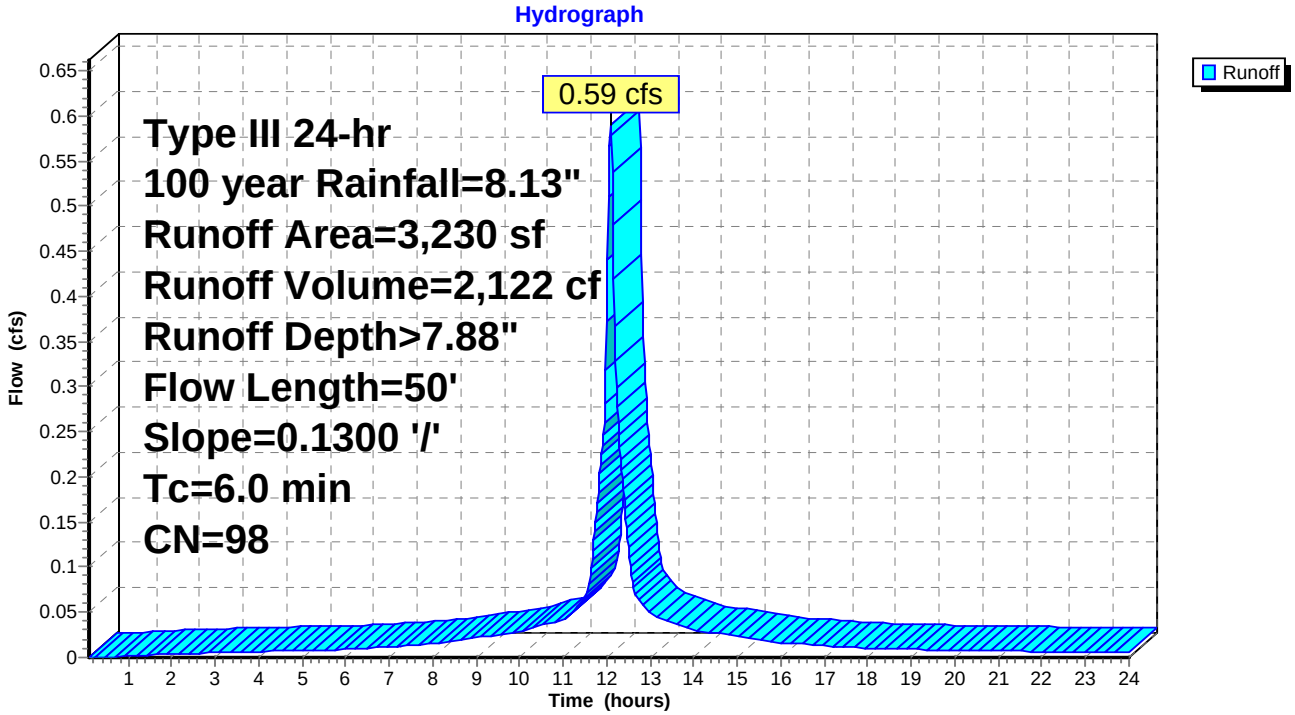
Runoff = 0.59 cfs @ 12.08 hrs, Volume= 2,122 cf, Depth> 7.88"

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

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

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

Subcatchment 2S: Roof Drain North Side



Summary for Subcatchment 3S: Upper Paved Area

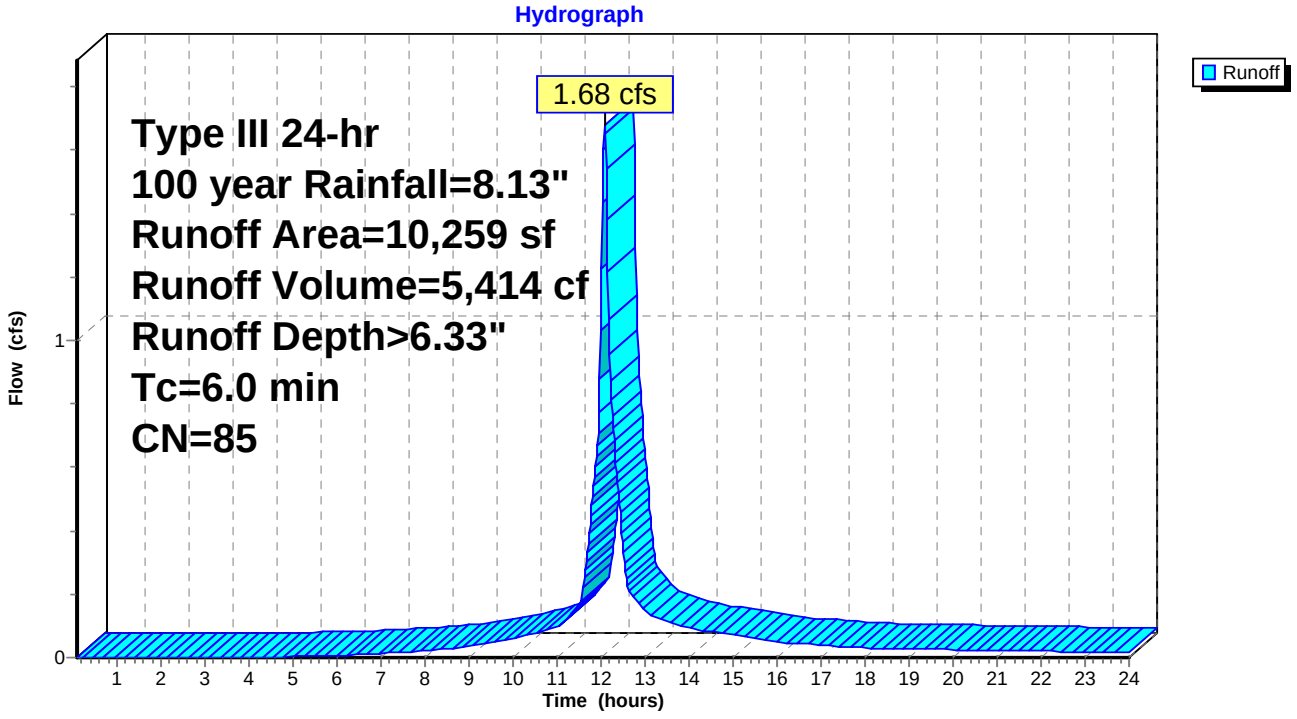
Runoff = 1.68 cfs @ 12.09 hrs, Volume= 5,414 cf, Depth> 6.33"

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

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

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

Subcatchment 3S: Upper Paved Area



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

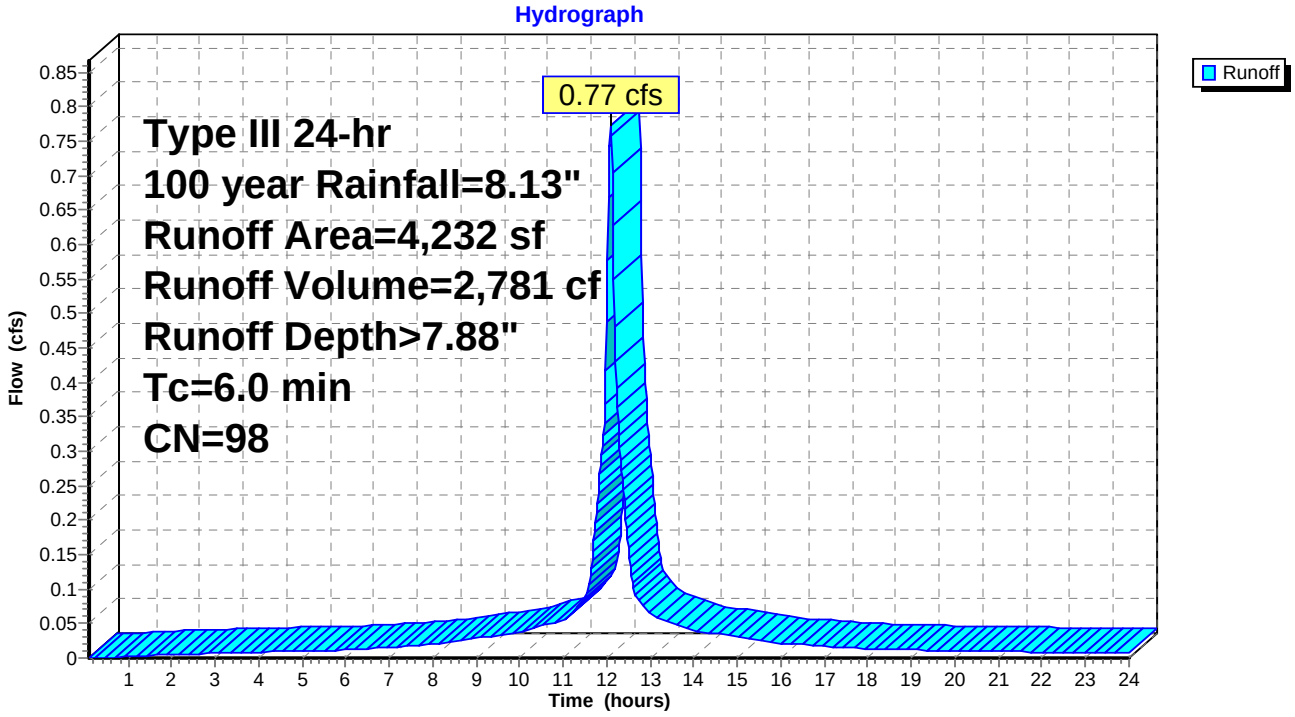
Runoff = 0.77 cfs @ 12.08 hrs, Volume= 2,781 cf, Depth> 7.88"

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

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

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

Subcatchment 4S: Middle Paved Area & Eastern Roof



Summary for Subcatchment 5S: Lower Paved Area

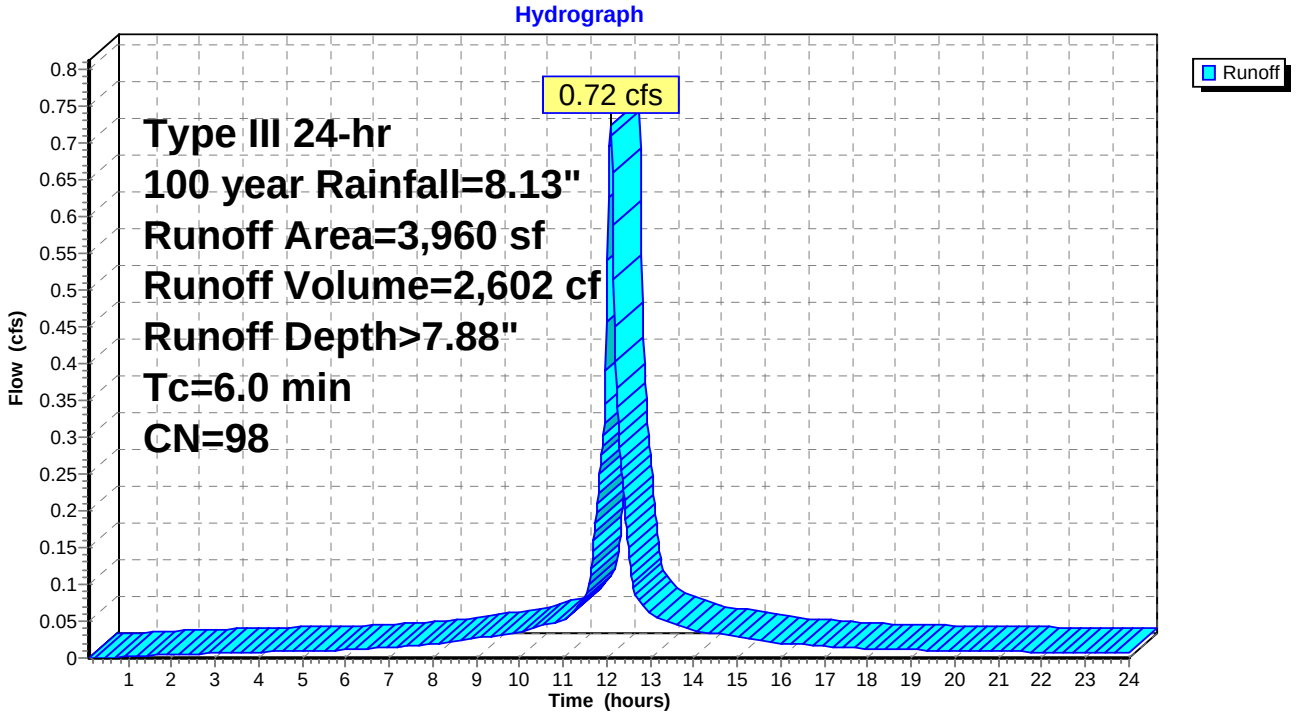
Runoff = 0.72 cfs @ 12.08 hrs, Volume= 2,602 cf, Depth> 7.88"

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

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

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

Subcatchment 5S: Lower Paved Area



Summary for Subcatchment 6S: Remaining Project Area

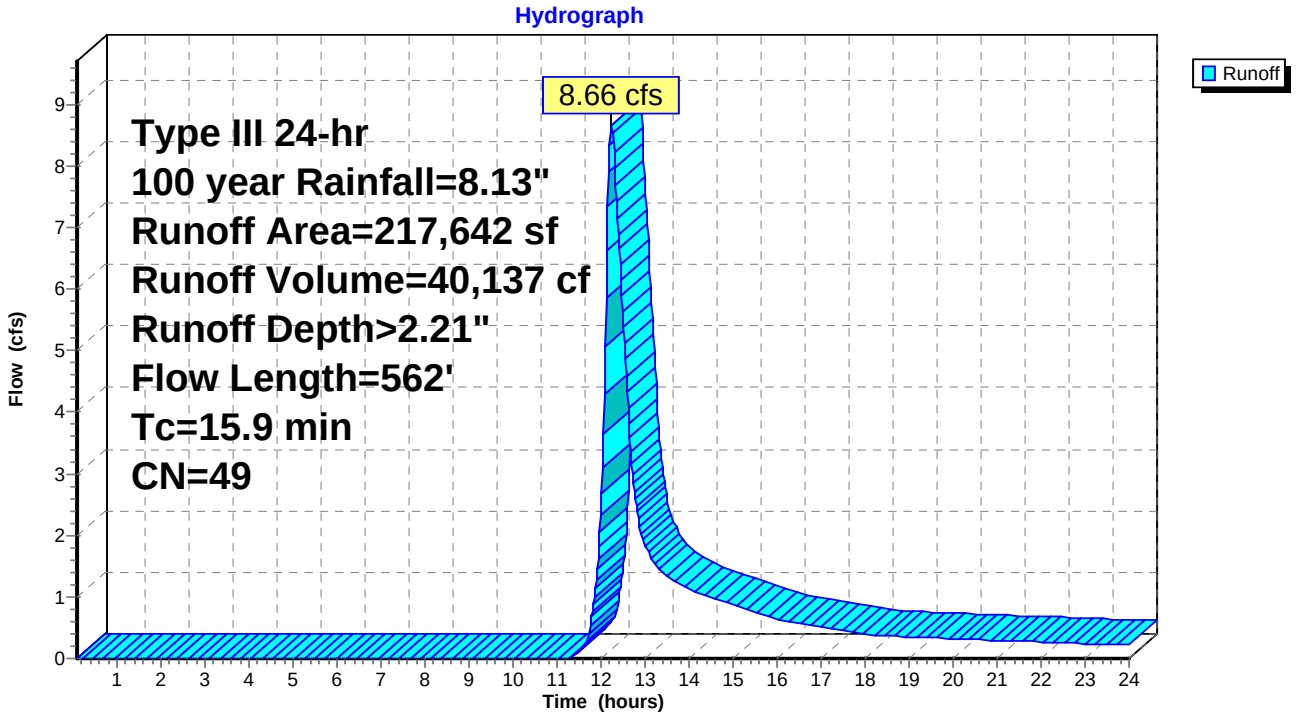
Runoff = 8.66 cfs @ 12.24 hrs, Volume= 40,137 cf, Depth> 2.21"

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

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

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

Subcatchment 6S: Remaining Project Area



Summary for Subcatchment EX: Existing Site

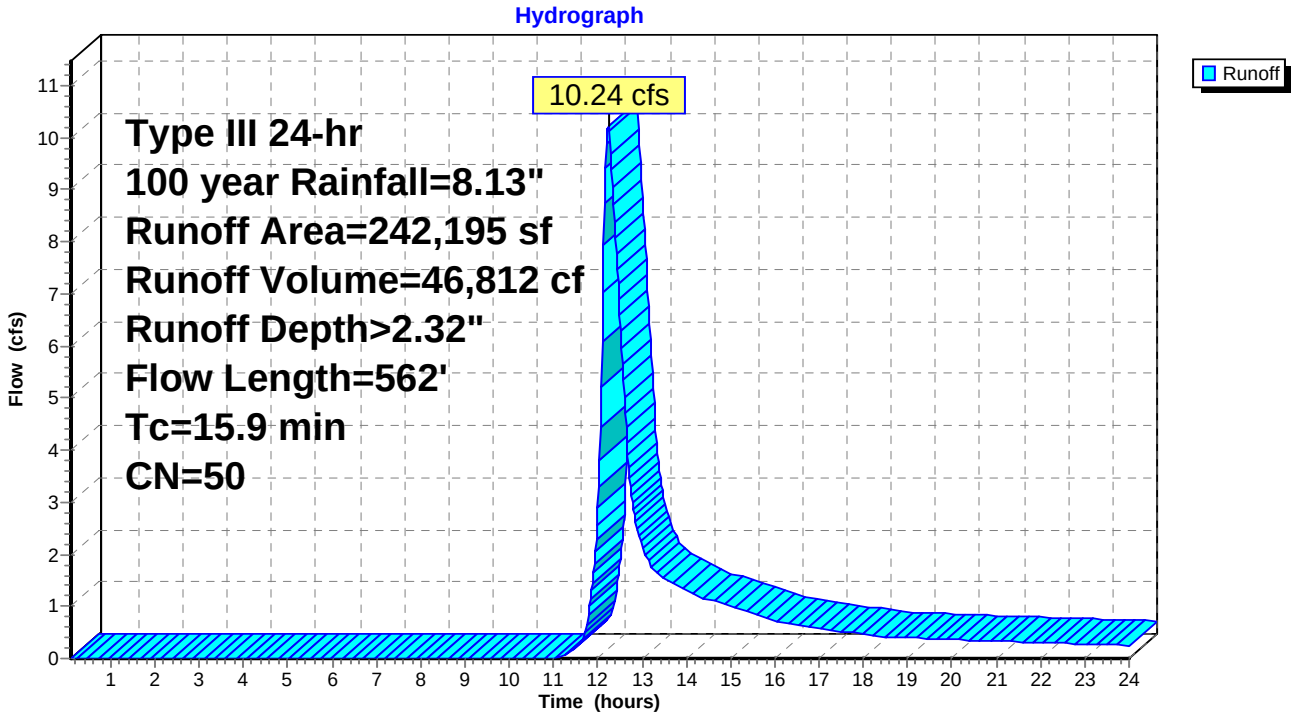
Runoff = 10.24 cfs @ 12.24 hrs, Volume= 46,812 cf, Depth> 2.32"

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

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

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

Subcatchment EX: Existing Site



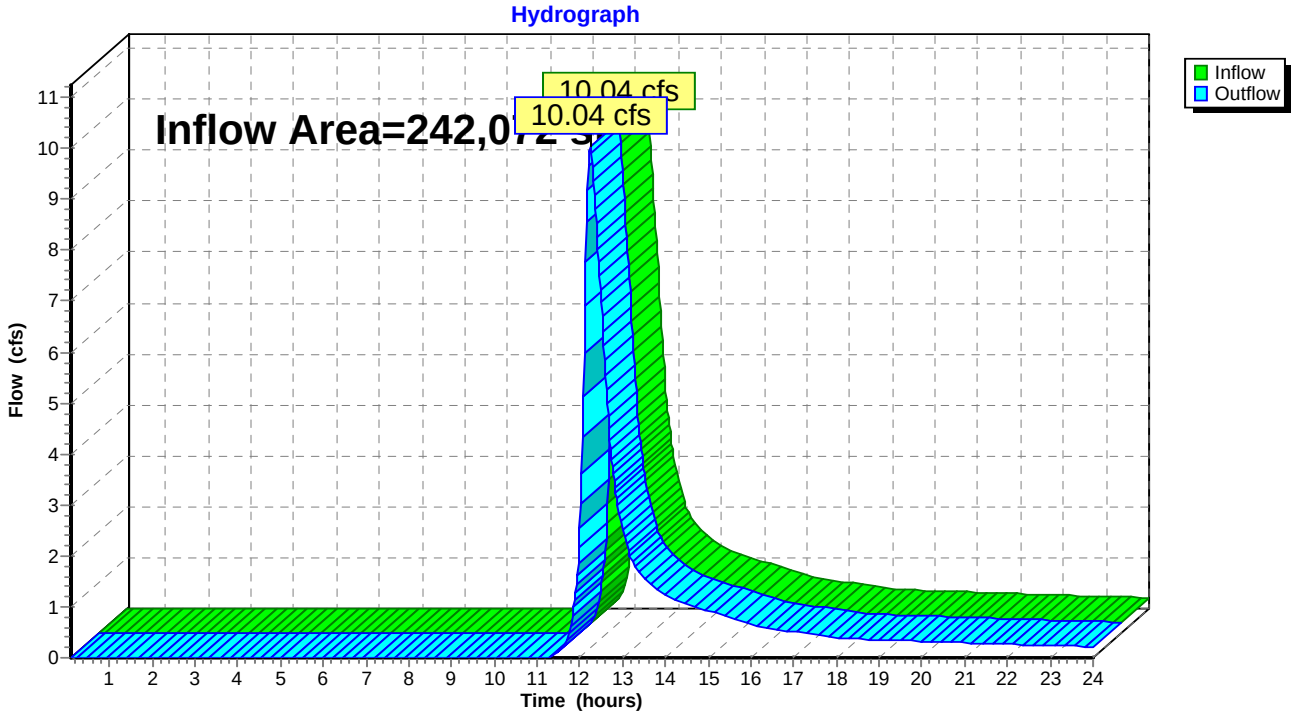
Summary for Reach END: Proposed Site Runoff

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

Inflow Area = 242,072 sf, 12.23% Impervious, Inflow Depth > 2.26" for 100 year event
Inflow = 10.04 cfs @ 12.24 hrs, Volume= 45,495 cf
Outflow = 10.04 cfs @ 12.24 hrs, Volume= 45,495 cf, Atten= 0%, Lag= 0.0 min

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

Reach END: Proposed Site Runoff



Summary for Pond C1: Northeast Cultecs

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=1)

Inflow Area = 14,491 sf, 78.64% Impervious, Inflow Depth > 6.75" for 100 year event
Inflow = 1.79 cfs @ 12.10 hrs, Volume= 8,155 cf
Outflow = 1.03 cfs @ 12.44 hrs, Volume= 7,604 cf, Atten= 43%, Lag= 20.5 min
Discarded = 0.00 cfs @ 0.10 hrs, Volume= 0 cf
Primary = 1.03 cfs @ 12.44 hrs, Volume= 7,604 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
Peak Elev= 233.61' @ 12.43 hrs Surf.Area= 0.046 ac Storage= 0.061 af

Plug-Flow detention time= 105.2 min calculated for 7,604 cf (93% of inflow)
Center-of-Mass det. time= 69.0 min (845.3 - 776.3)

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

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

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

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

Primary OutFlow Max=1.03 cfs @ 12.44 hrs HW=233.61' TW=232.76' (Dynamic Tailwater)
├**2=Culvert** (Outlet Controls 0.15 cfs @ 1.70 fps)
└**3=Culvert** (Outlet Controls 0.88 cfs @ 2.52 fps)

Pond C1: Northeast Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

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

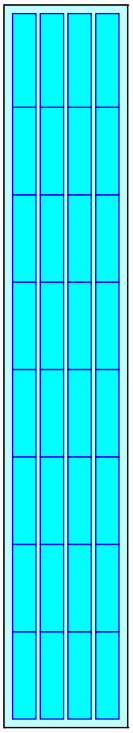
8 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 82.75' Row Length +12.0" End Stone x 2 = 84.75' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

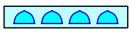
32 Chambers x 27.2 cf +0.75' Row Adjustment x 2.65 sf x 4 Rows = 876.8 cf Chamber Storage

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

Chamber Storage + Stone Storage = 1,663.1 cf = 0.038 af
Overall Storage Efficiency = 53.2%

32 Chambers
115.7 cy Field
83.2 cy Stone





Pond C1: Northeast Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

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

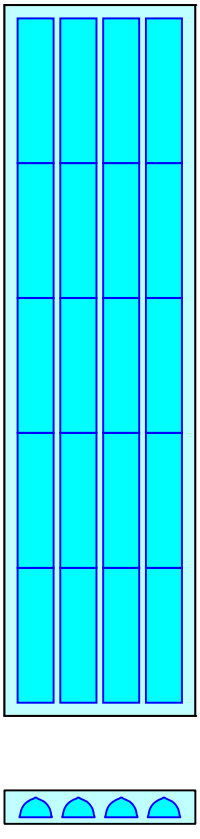
5 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 52.00' Row Length +12.0" End Stone x 2 = 54.00' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

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

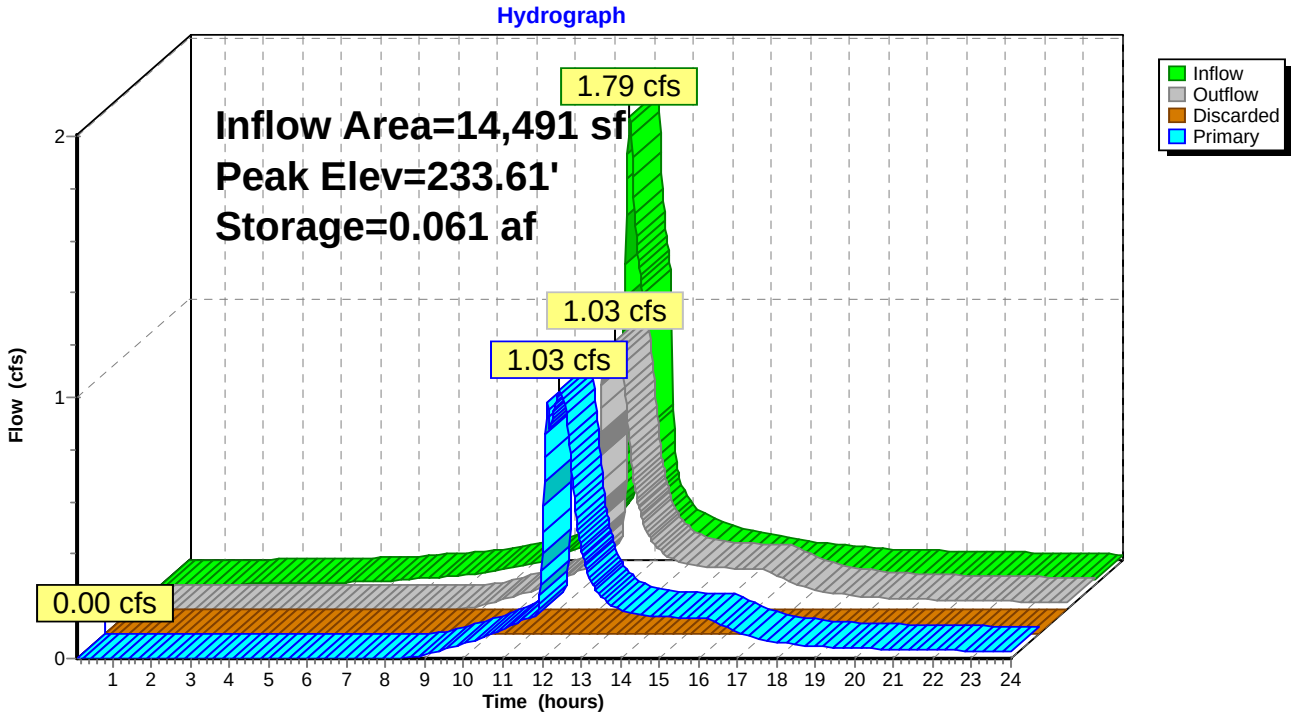
1,990.1 cf Field - 551.0 cf Chambers = 1,439.1 cf Stone x 35.0% Voids = 503.7 cf Stone Storage

Chamber Storage + Stone Storage = 1,054.7 cf = 0.024 af
Overall Storage Efficiency = 53.0%

20 Chambers
73.7 cy Field
53.3 cy Stone



Pond C1: Northeast Cultecs



Summary for Pond C2: Intermediate Cultecs

Inflow Area = 17,721 sf, 82.53% Impervious, Inflow Depth > 6.59" for 100 year event
Inflow = 1.46 cfs @ 12.13 hrs, Volume= 9,726 cf
Outflow = 1.20 cfs @ 12.45 hrs, Volume= 9,725 cf, Atten= 18%, Lag= 19.4 min
Discarded = 0.08 cfs @ 12.37 hrs, Volume= 3,498 cf
Primary = 1.12 cfs @ 12.45 hrs, Volume= 6,227 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
Peak Elev= 232.78' @ 12.37 hrs Surf.Area= 392 sf Storage= 876 cf
Flood Elev= 233.94' Surf.Area= 392 sf Storage= 950 cf

Plug-Flow detention time= 26.9 min calculated for 9,725 cf (100% of inflow)
Center-of-Mass det. time= 26.8 min (849.3 - 822.4)

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

Storage Group A created with Chamber Wizard

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

Discarded OutFlow Max=0.08 cfs @ 12.37 hrs HW=232.78' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=1.12 cfs @ 12.45 hrs HW=232.76' TW=232.04' (Dynamic Tailwater)
└**2=Culvert** (Inlet Controls 1.12 cfs @ 3.21 fps)

Pond C2: Intermediate Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

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

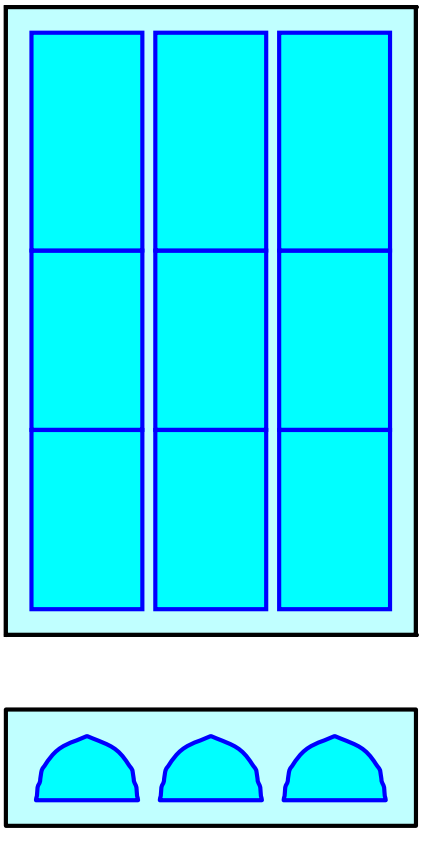
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
12.0" Base + 30.5" Chamber Height + 12.0" Cover = 4.54' Field Height

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

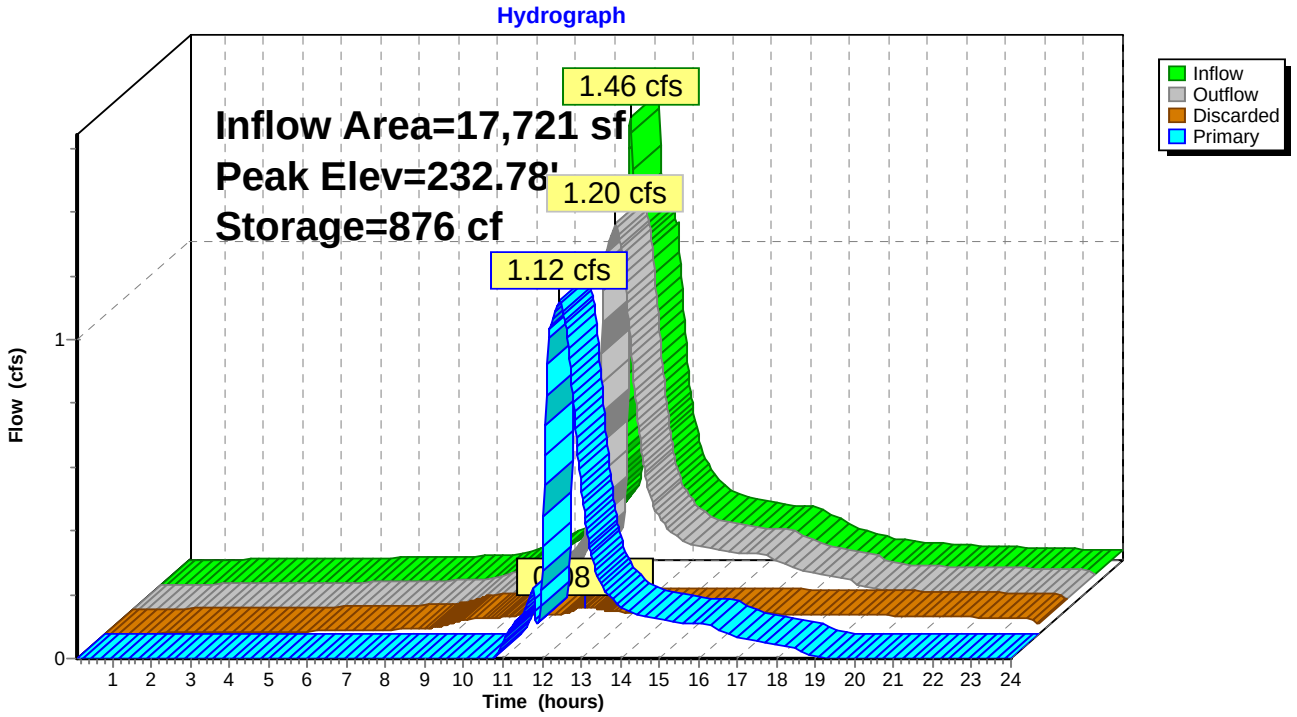
1,780.3 cf Field - 502.9 cf Chambers = 1,277.4 cf Stone x 35.0% Voids = 447.1 cf Stone Storage

Chamber Storage + Stone Storage = 950.0 cf = 0.022 af
Overall Storage Efficiency = 53.4%

9 Chambers
65.9 cy Field
47.3 cy Stone



Pond C2: Intermediate Cultecs



Summary for Pond C3: Southwest Cultecs

Inflow Area = 24,430 sf, 87.33% Impervious, Inflow Depth > 4.94" for 100 year event
Inflow = 1.96 cfs @ 12.14 hrs, Volume= 10,050 cf
Outflow = 1.55 cfs @ 12.30 hrs, Volume= 10,050 cf, Atten= 21%, Lag= 9.9 min
Discarded = 0.16 cfs @ 12.30 hrs, Volume= 4,692 cf
Primary = 1.39 cfs @ 12.30 hrs, Volume= 5,358 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
Peak Elev= 232.11' @ 12.30 hrs Surf.Area= 0.017 ac Storage= 0.032 af

Plug-Flow detention time= 34.7 min calculated for 10,042 cf (100% of inflow)
Center-of-Mass det. time= 34.6 min (812.7 - 778.1)

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

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

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

Discarded OutFlow Max=0.16 cfs @ 12.30 hrs HW=232.11' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=1.39 cfs @ 12.30 hrs HW=232.11' TW=0.00' (Dynamic Tailwater)
2=Culvert (Inlet Controls 1.39 cfs @ 3.99 fps)

Pond C3: Southwest Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

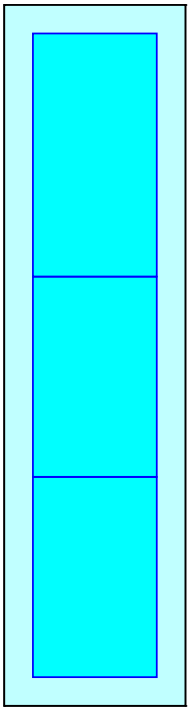
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

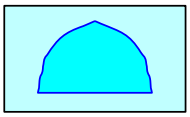
3 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 167.6 cf Chamber Storage

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

Chamber Storage + Stone Storage = 310.4 cf = 0.007 af
Overall Storage Efficiency = 53.9%

3 Chambers
21.3 cy Field
15.1 cy Stone





Pond C3: Southwest Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 2 rows

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

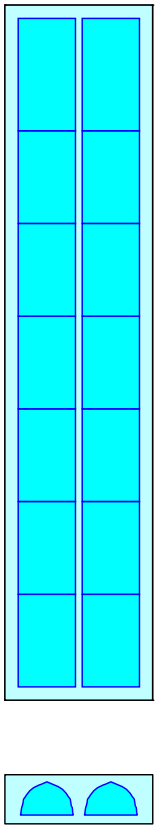
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
2 Rows x 52.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.17' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

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

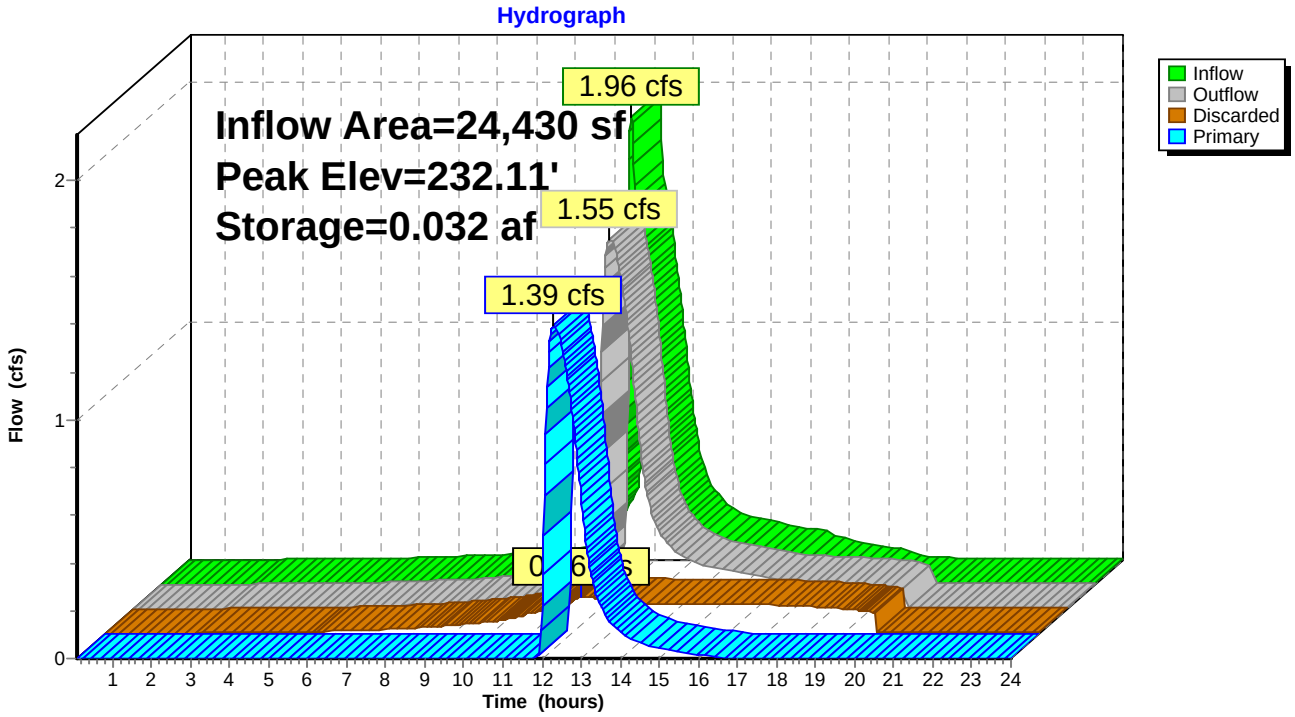
2,174.0 cf Field - 752.6 cf Chambers = 1,421.5 cf Stone x 35.0% Voids = 497.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,250.1 cf = 0.029 af
Overall Storage Efficiency = 57.5%

14 Chambers
80.5 cy Field
52.6 cy Stone



Pond C3: Southwest Cultecs



Summary for Pond CB1: Catch Basin #1

Inflow Area = 10,259 sf, 69.83% Impervious, Inflow Depth > 6.33" for 100 year event
Inflow = 1.68 cfs @ 12.09 hrs, Volume= 5,414 cf
Outflow = 1.06 cfs @ 12.17 hrs, Volume= 5,394 cf, Atten= 37%, Lag= 5.2 min
Primary = 1.06 cfs @ 12.17 hrs, Volume= 5,394 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
Peak Elev= 235.19' @ 12.18 hrs Surf.Area= 2,578 sf Storage= 296 cf

Plug-Flow detention time= 5.0 min calculated for 5,390 cf (100% of inflow)
Center-of-Mass det. time= 2.7 min (792.1 - 789.4)

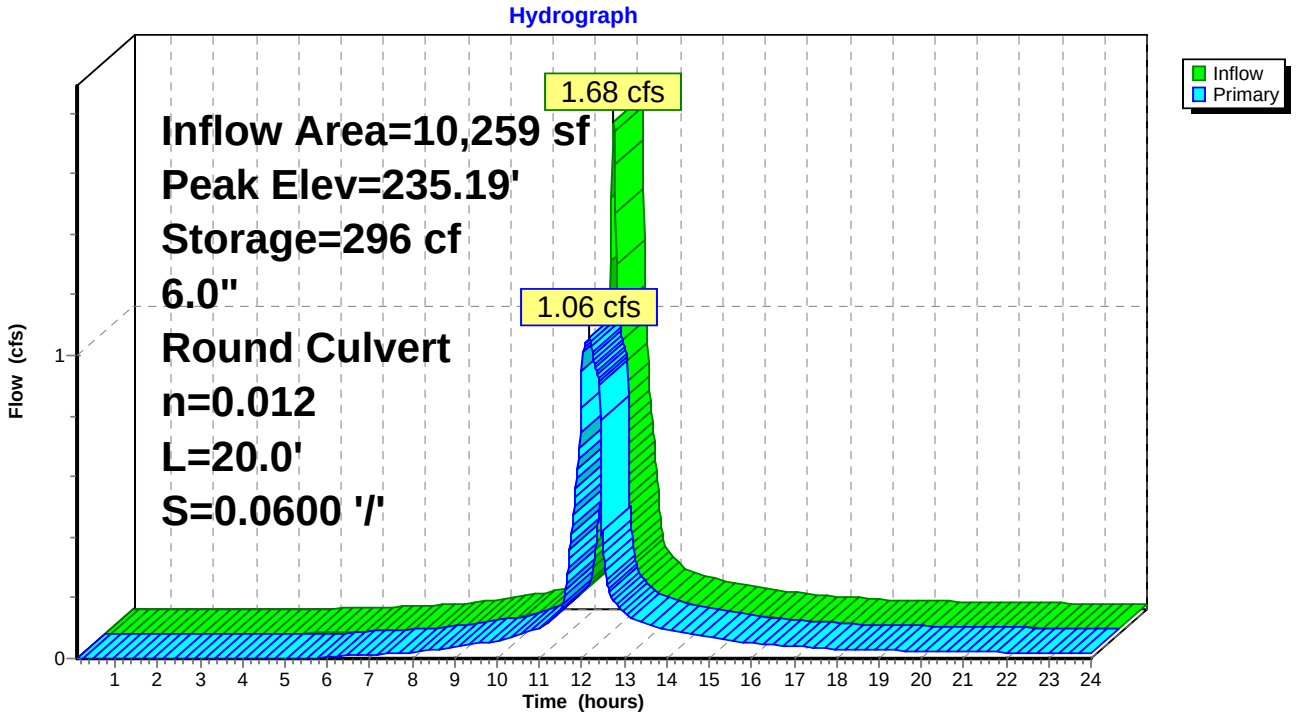
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	464 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	3,335	419	464

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

Primary OutFlow Max=1.05 cfs @ 12.17 hrs HW=235.19' TW=233.15' (Dynamic Tailwater)
1=Culvert (Inlet Controls 1.05 cfs @ 5.36 fps)

Pond CB1: Catch Basin #1



Summary for Pond CB2: Catch Basin #2

Inflow Area = 4,232 sf,100.00% Impervious, Inflow Depth > 7.88" for 100 year event
Inflow = 0.77 cfs @ 12.08 hrs, Volume= 2,781 cf
Outflow = 0.75 cfs @ 12.10 hrs, Volume= 2,761 cf, Atten= 3%, Lag= 0.8 min
Primary = 0.75 cfs @ 12.10 hrs, Volume= 2,761 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
Peak Elev= 234.51' @ 12.11 hrs Surf.Area= 13 sf Storage= 39 cf

Plug-Flow detention time= 9.7 min calculated for 2,761 cf (99% of inflow)
Center-of-Mass det. time= 4.9 min (745.4 - 740.5)

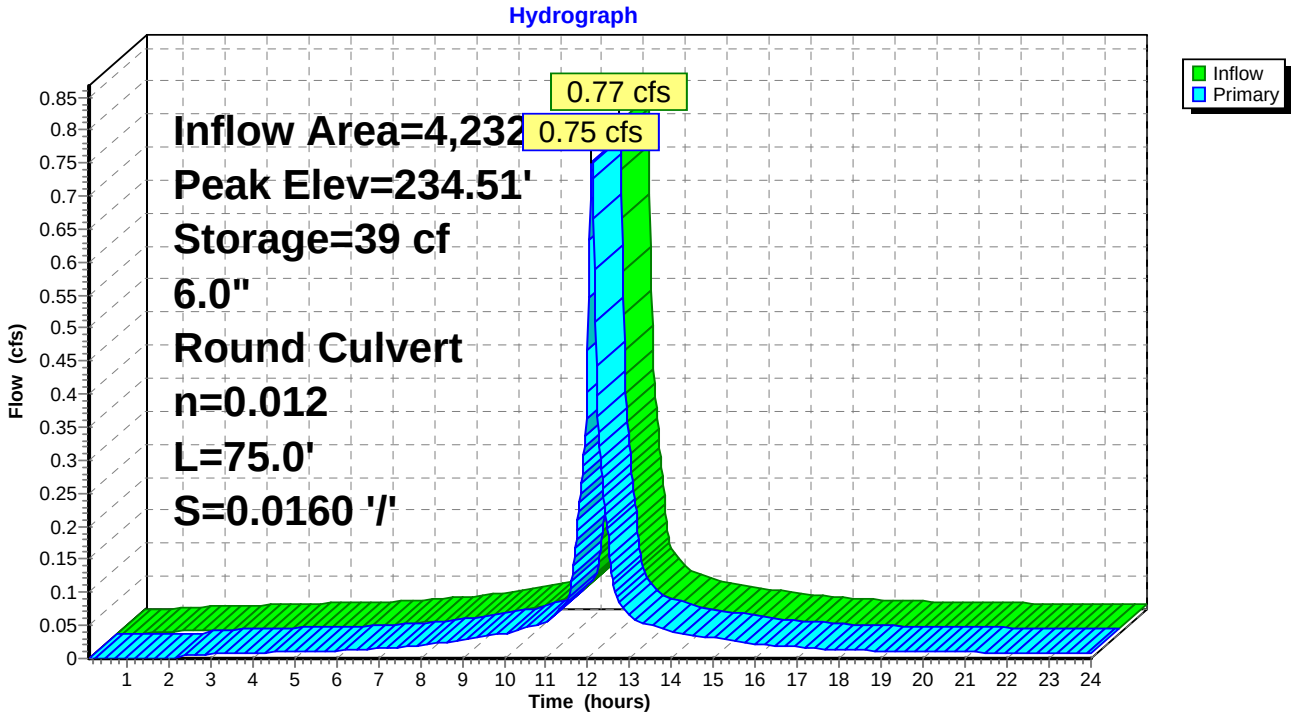
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	258 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,690	213	258

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

Primary OutFlow Max=0.75 cfs @ 12.10 hrs HW=234.49' TW=232.92' (Dynamic Tailwater)
1=Culvert (Outlet Controls 0.75 cfs @ 3.81 fps)

Pond CB2: Catch Basin #2



Summary for Pond CB3: Catch Basin #3

Inflow Area = 3,960 sf,100.00% Impervious, Inflow Depth > 7.88" for 100 year event
Inflow = 0.72 cfs @ 12.08 hrs, Volume= 2,602 cf
Outflow = 0.71 cfs @ 12.10 hrs, Volume= 2,582 cf, Atten= 2%, Lag= 1.1 min
Primary = 0.71 cfs @ 12.10 hrs, Volume= 2,582 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
Peak Elev= 234.82' @ 12.10 hrs Surf.Area= 13 sf Storage= 43 cf

Plug-Flow detention time= 10.3 min calculated for 2,582 cf (99% of inflow)
Center-of-Mass det. time= 5.2 min (745.7 - 740.5)

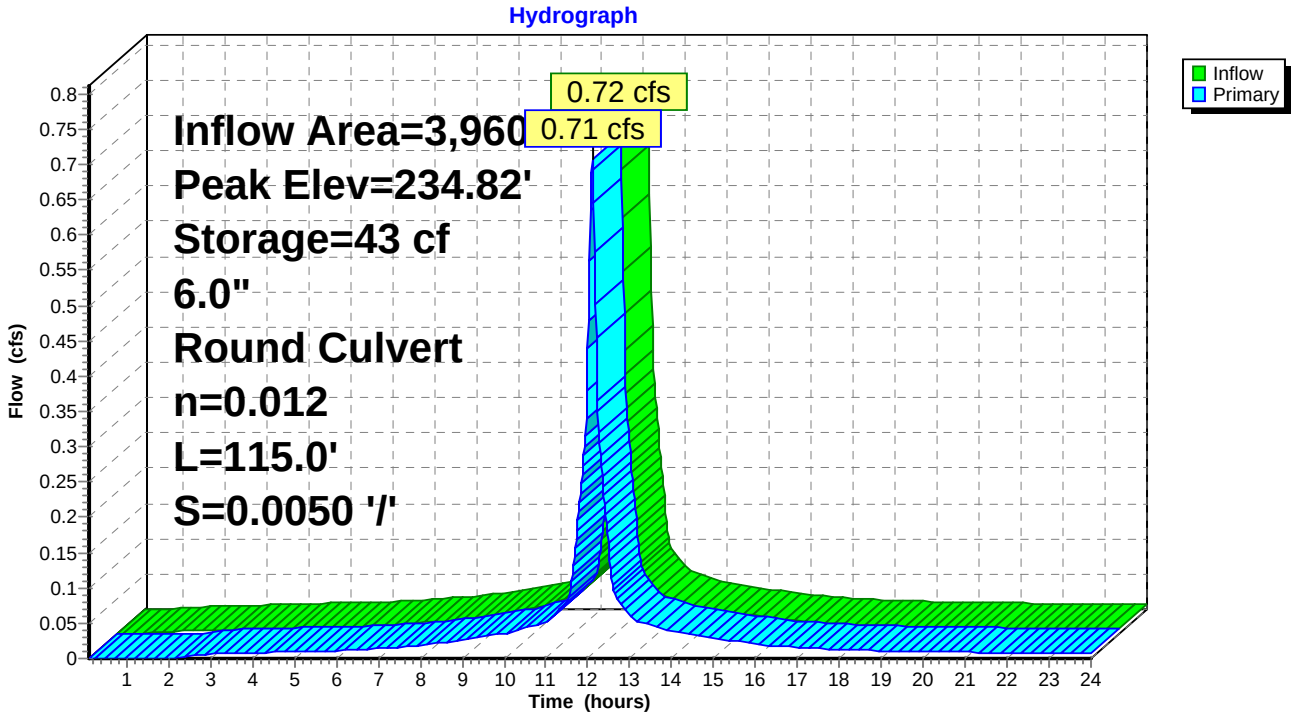
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	293 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,963	247	293

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

Primary OutFlow Max=0.71 cfs @ 12.10 hrs HW=234.82' TW=232.34' (Dynamic Tailwater)
1=Culvert (Barrel Controls 0.71 cfs @ 3.60 fps)

Pond CB3: Catch Basin #3



Summary for Pond D1: Drywell

Inflow Area = 3,960 sf,100.00% Impervious, Inflow Depth > 7.82" for 100 year event
Inflow = 0.71 cfs @ 12.10 hrs, Volume= 2,582 cf
Outflow = 0.69 cfs @ 12.10 hrs, Volume= 2,556 cf, Atten= 3%, Lag= 0.1 min
Discarded = 0.01 cfs @ 12.15 hrs, Volume= 539 cf
Primary = 0.68 cfs @ 12.10 hrs, Volume= 2,017 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.10-24.00 hrs, dt= 0.02 hrs / 3
Peak Elev= 232.46' @ 12.15 hrs Surf.Area= 33 sf Storage= 53 cf

Plug-Flow detention time= 13.2 min calculated for 2,556 cf (99% of inflow)
Center-of-Mass det. time= 6.4 min (752.1 - 745.7)

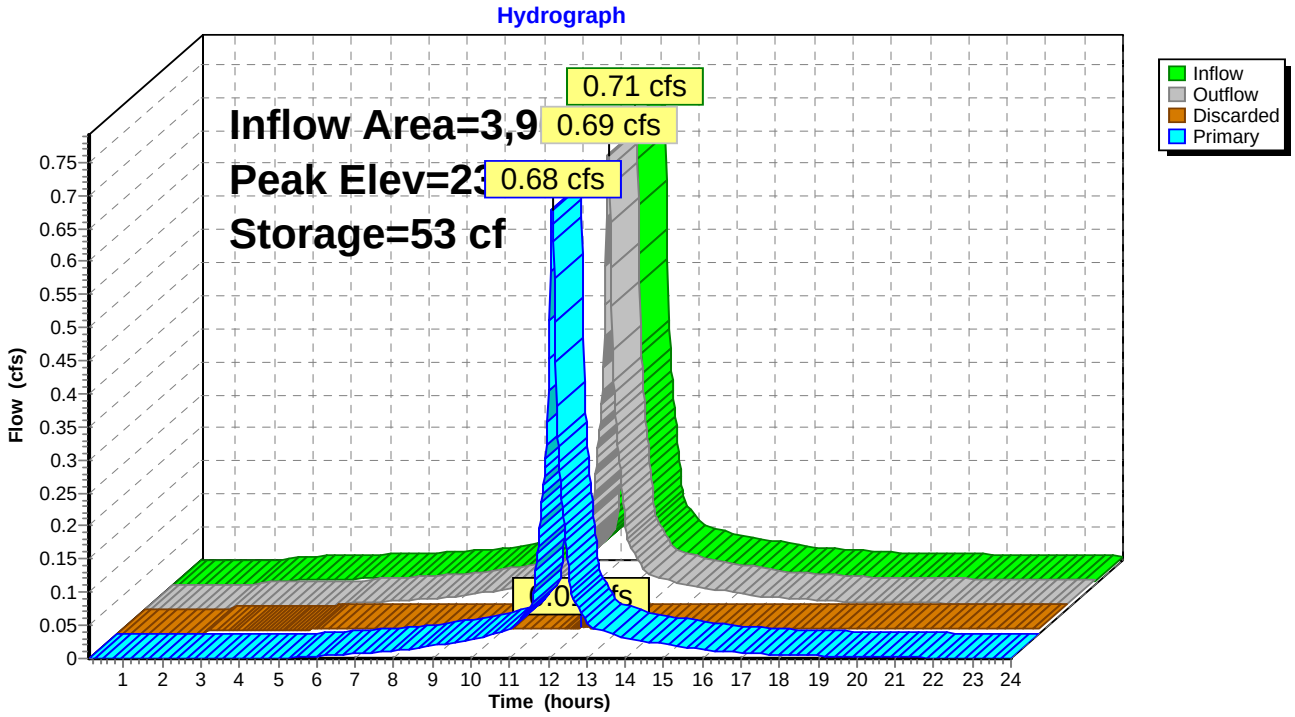
Volume	Invert	Avail.Storage	Storage Description
#1	230.00'	98 cf	**5.00'D x 5.00'H Vertical Cone/Cylinder** Inside #2 141 cf Overall - 6.0" Wall Thickness = 98 cf
#2	230.00'	9 cf	**6.50'D x 5.00'H Vertical Cone/Cylinder** 166 cf Overall - 141 cf Embedded = 25 cf x 35.0% Voids
		107 cf	Total Available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

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

Discarded OutFlow Max=0.01 cfs @ 12.15 hrs HW=232.46' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.67 cfs @ 12.10 hrs HW=232.35' TW=231.53' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.67 cfs @ 3.43 fps)

Pond D1: Drywell



ATTACHMENT C
SOIL INFORMATION

Boring Log B-1

Boring Log B-2

Boring Log B-1 Sieve Analysis

BORING LOG

Project: Nagog Water Treatment Plant
Location: Concord, MA
Client: Town of Concord
Driller: Crawford Drilling Services, LLC
Drilling Methods: Hollow Stem Auger, Drive and Wash
Weather: 49 degrees, clear
Performed By: LEU Date: 9/24/2015
Checked By: ZFK Time: 7:50 AM

Proposed Building

Boring Locus Map

Boring: **B-1**
Location: See Plan
Approx. Ground Elevation: Unknown
Approx. Groundwater Elevation: Unknown
Date/Time
Datum: G.S.
Project No. 200-1501

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description		Stratum Change Depth (feet)	Note No.
1	S1	4-62-25-28	24/14	Fine SAND, brown, fragments of rock			
2							
3	S2	12-20-15-15	24/8.5	Fine SAND, brown and dark grey, fragments of rock			
4							
5	S3	20-9-7-10	24/10.5	Coarse SAND with some gravel, dark brown. Isolated rock fragments			
6							
7							
8	S4	5-6-7-7	24/10.5	Coarse SAND with some gravel, medium brown to dark grey. Isolated rock fragments			1
9							
10	C1	N/A	60/29	RQD = 91.4%			2
11							
12							
13							
14							
15	C2	N/A	60/23	Predominately fractured ledge. RQD = 21.7%			3
16							
17							
18							
19							
20				Boring terminated at BGF 19'			
21							
22							
23							
24							
25							

NOTES:

1 2" split spoon refusal at 9' BGS
2 Drive and wash 9' to 19' BGS
3 Lost 600 gallons of water

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers
UT - Undisturbed Tube Sample	
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%
Little - Approximately 10 to 20%	And - Approximately 35 to 50%
0-4 Coarse Soil N Value - Very Loose	11-30 Coarse Soil N Value - Medium Dense
5-10 Coarse Soil N Value - Loose	31-50 Coarse Soil N Value - Dense
0-2 Fine Soil N Value - Very Soft	4-8 Fine Soil N Value - Medium Stiff
2-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff

BORING LOG

Project: Nagog Water Treatment Plant
Location: Concord, MA
Client: Town of Concord
Driller: Crawford Drilling Services, LLC
Drilling Methods: Hollow Stem Auger
Weather: 64 degrees, sunny and clear
Performed By: LEU Date: 9/24/2015
Checked By: ZFK Time: 9:45 AM

Proposed Building

Boring Locus Map

Boring: **B-2**
Location: See Plan
Approx. Ground Elevation: Unknown
Approx. Groundwater Elevation: Unknown
Date/Time
Datum: G.S.
Project No. 200-1501

Depth (feet)	Sample No.	Blows per 6-inch	Pen./ Rec.	Soil Description		Stratum Change Depth (feet)	Note No.
1	S1	10-22-26-30	24/18	Fine SAND with some gravel, brown, medium brown to light grey, angular rock			
2							
3							
4							
5							
6							
7							
8	S2	40-80	12/10	Fine SAND, some gravel, some angular rock. Medium brown to light grey			
9							
10				Boring terminated at 9' due to split spoon refusal			Refusal
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

NOTES:

1 2" split spoon

LEGEND

S - Split Spoon Sample	O/A - Sample Collected Off the Augers
UT - Undisturbed Tube Sample	
Trace - Approximately 0 to 10%	Some - Approximately 20 to 35%
Little - Approximately 10 to 20%	And - Approximately 35 to 50%
0-4 Coarse Soil N Value - Very Loose	11-30 Coarse Soil N Value - Medium Dense
5-10 Coarse Soil N Value - Loose	31-50 Coarse Soil N Value - Dense
0-2 Fine Soil N Value - Very Soft	4-8 Fine Soil N Value - Medium Stiff
2-4 Fine Soil N Value - Soft	8-15 Fine Soil N Value - Stiff

Briggs Engineering & Testing
A Division of PK Associates, Inc.

Environmental Partners Group
1900 Crown Colony Drive
Suite 200
Quincy, MA 02169
Attn: Mr. Ziad Kary

Report Date: 11/2/15

Project: **E.P.G./Nagog Pond WWTP**
Briggs #: 24077

Tested: 10/30/15
Received: 10/22/15

	Sample No.	Description	Source of Material
1	M-26570	Soil Boring	B1, S3 5'-7'

2. Sieve Analysis {ASTM C 136, and ASTM C 117}

Sieve Size		Results	Specifications
Standard	Alternate	{% Passing by Wt.}	
100 mm	4"	100	
75 mm	3"	100	
63 mm	2-1/2"	100	
50 mm	2"	100	
37.5 mm	1-1/2"	100	
25 mm	1"	100	
19 mm	3/4"	73	
12.5 mm	1/2"	63	
9.5 mm	3/8"	57	
4.75 mm	#4	51	
2.36 mm	#8	45	
1.18 mm	#16	39	
0.600 mm	#30	31	
0.300 mm	#50	21	
0.150 mm	#100	19	
0.075 mm	#200	12.4	

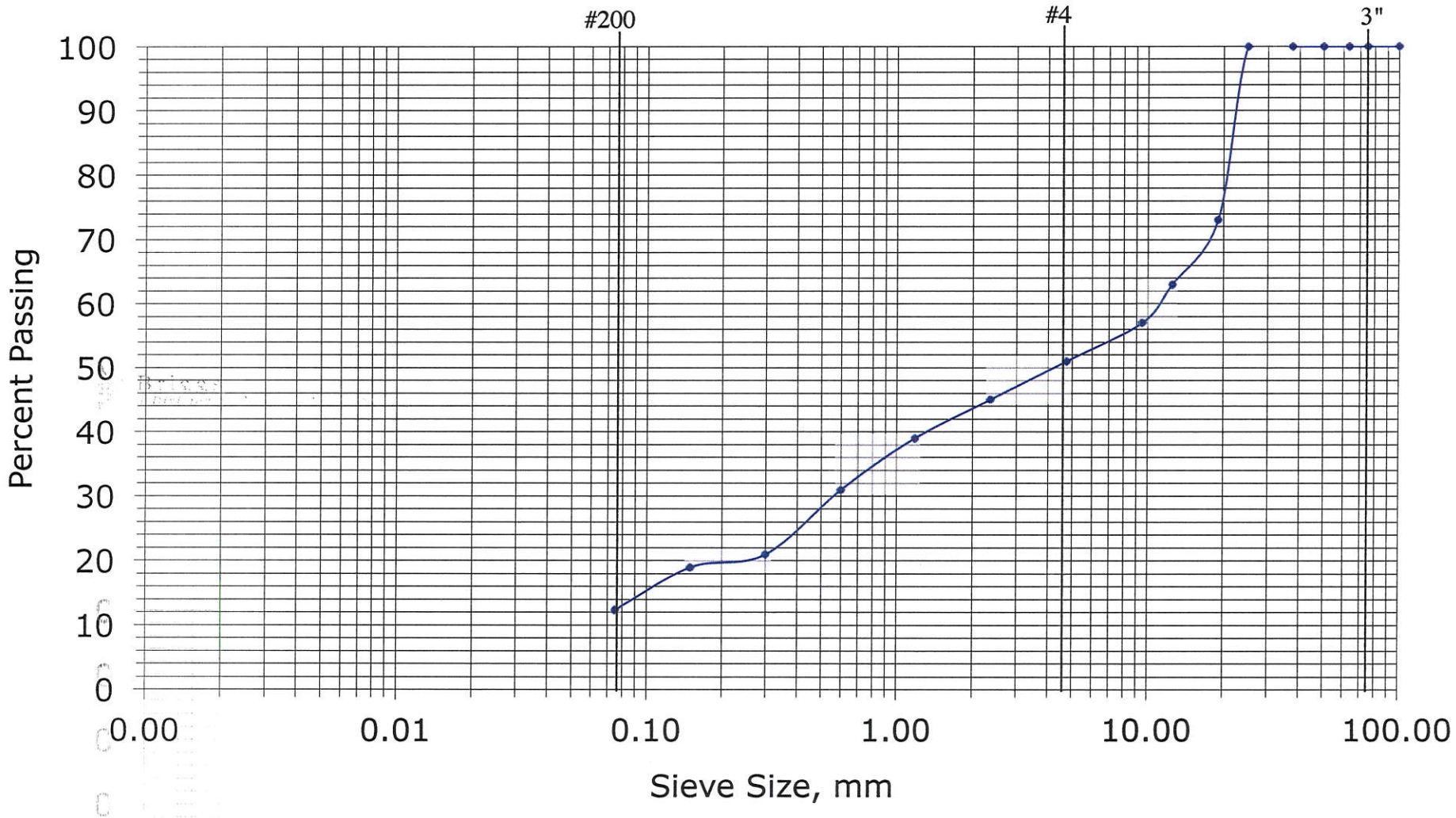
BRIGGS ENGINEERING & TESTING
A Division of PK Associates, Inc.

Sean Skorohod
Director of Testing Services
Construction Technology Division

Briggs Engineering & Testing
A Division of PK Associates, Inc.

Project:	E.P.G./Nagog Pond WWTP
Date Tested:	10/30/15
Lab Ref. No.:	M-26570

Sieve Analysis



ATTACHMENT D
STANDARD 3 RECHARGE CALCULATIONS

Standard 3 Stormwater Calculations:

Required Recharge Volume:

Required Recharge Volume=Rv
Rv (cf) = F x Impervious Area (Post-Development)

NRCS HYDROLOGIC SOIL TYPE	APPROX SOIL TEXTURE	TARGET DEPTH FACTOR (F)
A	sand	**0.6-inch**
B	loam	**0.35-inch**
C	silty loam	**0.25-inch**
D	clay	**0.1-inch**

area (sf)	soil type	F (in)	F (ft)	Rv (cf)
19262.14	A	0.6	0.05	963.107
4343.524	A	0.6	0.05	217.1762
1437.48	D	0.1	0.008333	11.979
4613.726	D	0.1	0.008333	38.44772
29,656.87			**Total:**	**1,230.71**

Recharge Sizing Calcs

See HydroCAD Report of this attachment

Capture Area Adjustment:

(total site impervious area/site impervious area draining to recharge facilities)*Rv

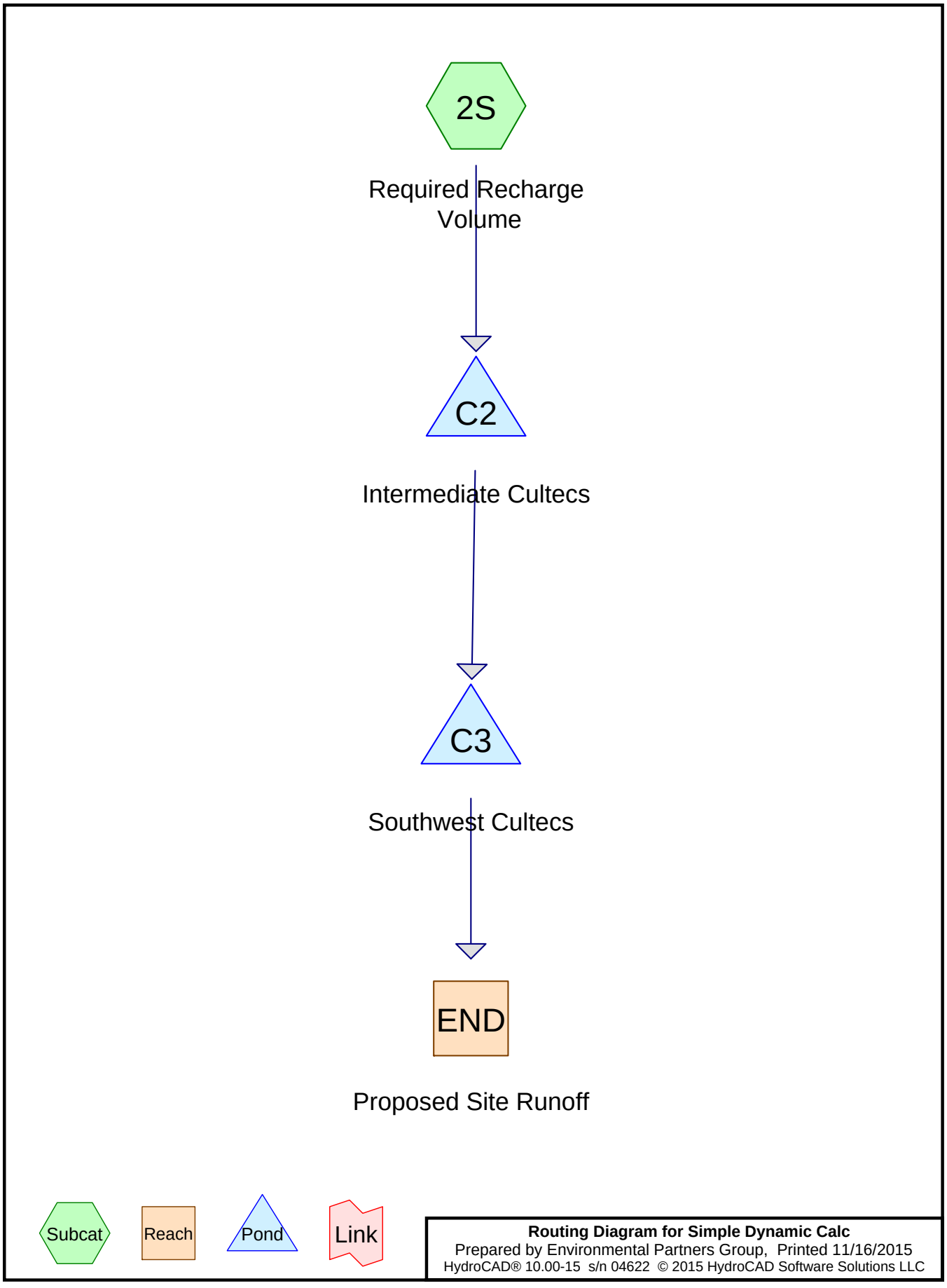
Total Site Impervious Area (sf)=	29,656.87	
Impervious Area to Recharge (sf)=	20,730.90	
Ratio=	0.70	72%>65%, requirement satisfied
1/Ratio=	1.43	
Capture Area Adjustment (sf)=	**1,760.61**	

72 Hour Drawdown:

Tdrawdown=Rv/(K*bottom area)

			330 XLHD Total Area	
			Area/Chamber (sf)	27.88
Rv(cf)=	1,760.61	(Capture Area adjustment used)	# of Chambers	26
K(in/hr)=	5.1	(Determined from sieve analysis	Total Area (sf)	724.88
K(ft/hr)=	0.425	correlation using attached sieve analysis)		
A(sf)=	724.88	Surface Area of Cultec Chambers in A type soil		

$T_{drawdown}$(hr)=	**5.71**


2S
Required Recharge Volume
C2
Intermediate Cultecs
C3
Southwest Cultecs
END
Proposed Site Runoff
Subcat
Reach
Pond
Link
Routing Diagram for Simple Dynamic Calc
Prepared by Environmental Partners Group, Printed 11/16/2015
HydroCAD® 10.00-15 s/n 04622 © 2015 HydroCAD Software Solutions LLC

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	C2	230.00	230.00	10.0	0.0000	0.012	8.0	0.0	0.0
2	C3	230.61	230.41	20.0	0.0100	0.012	8.0	0.0	0.0

Time span=11.00-13.00 hrs, dt=0.02 hrs, 101 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Required Recharge Runoff Area=5,205 sf 100.00% Impervious Runoff Depth>4.06"
Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.95 cfs 1,761 cf

Reach END: Proposed Site Runoff Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond C2: Intermediate Cultecs Peak Elev=230.78' Storage=440 cf Inflow=0.95 cfs 1,761 cf
Discarded=0.07 cfs 420 cf Primary=0.76 cfs 1,011 cf Outflow=0.83 cfs 1,431 cf

Pond C3: Southwest Cultecs Peak Elev=230.55' Storage=0.015 af Inflow=0.76 cfs 1,011 cf
Discarded=0.12 cfs 463 cf Primary=0.00 cfs 0 cf Outflow=0.12 cfs 463 cf

Total Runoff Area = 5,205 sf Runoff Volume = 1,761 cf Average Runoff Depth = 4.06"
0.00% Pervious = 0 sf 100.00% Impervious = 5,205 sf

Summary for Subcatchment 2S: Required Recharge Volume

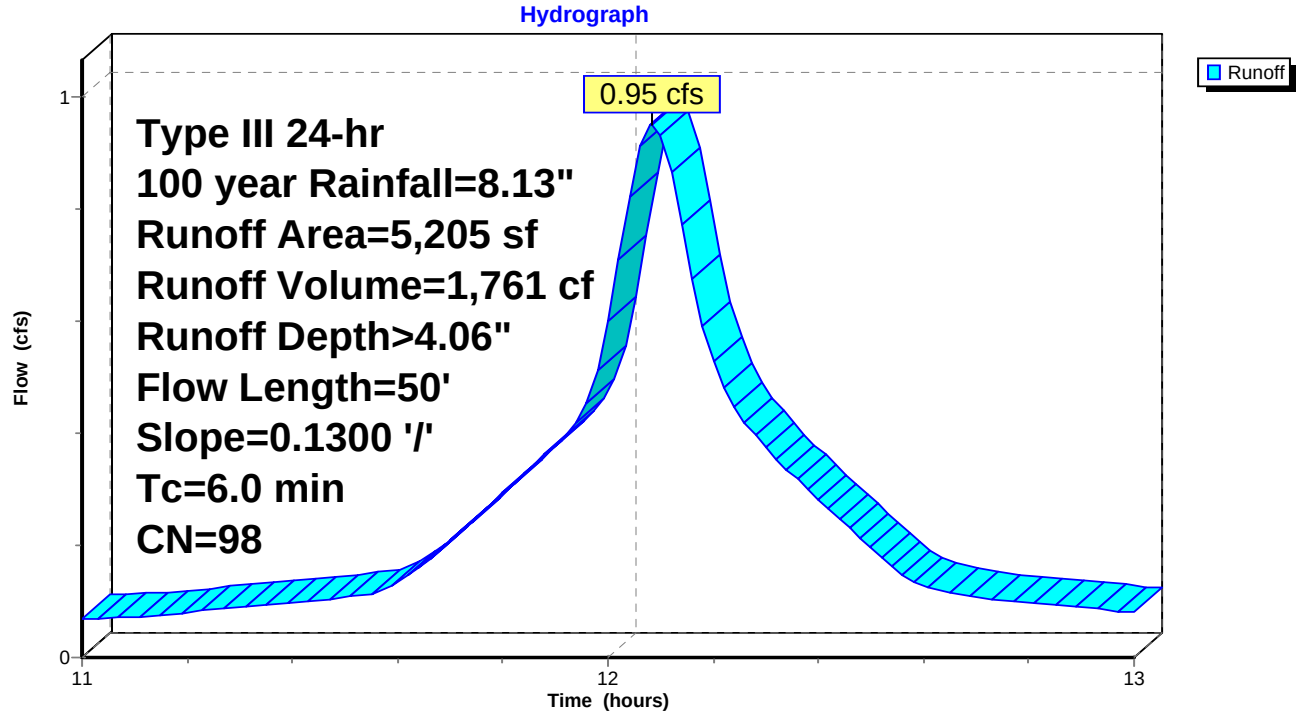
Runoff = 0.95 cfs @ 12.08 hrs, Volume= 1,761 cf, Depth> 4.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 year Rainfall=8.13"

Area (sf)	CN	Description
5,205	98	Roofs, HSG A
5,205		100.00% Impervious Area

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

Subcatchment 2S: Required Recharge Volume



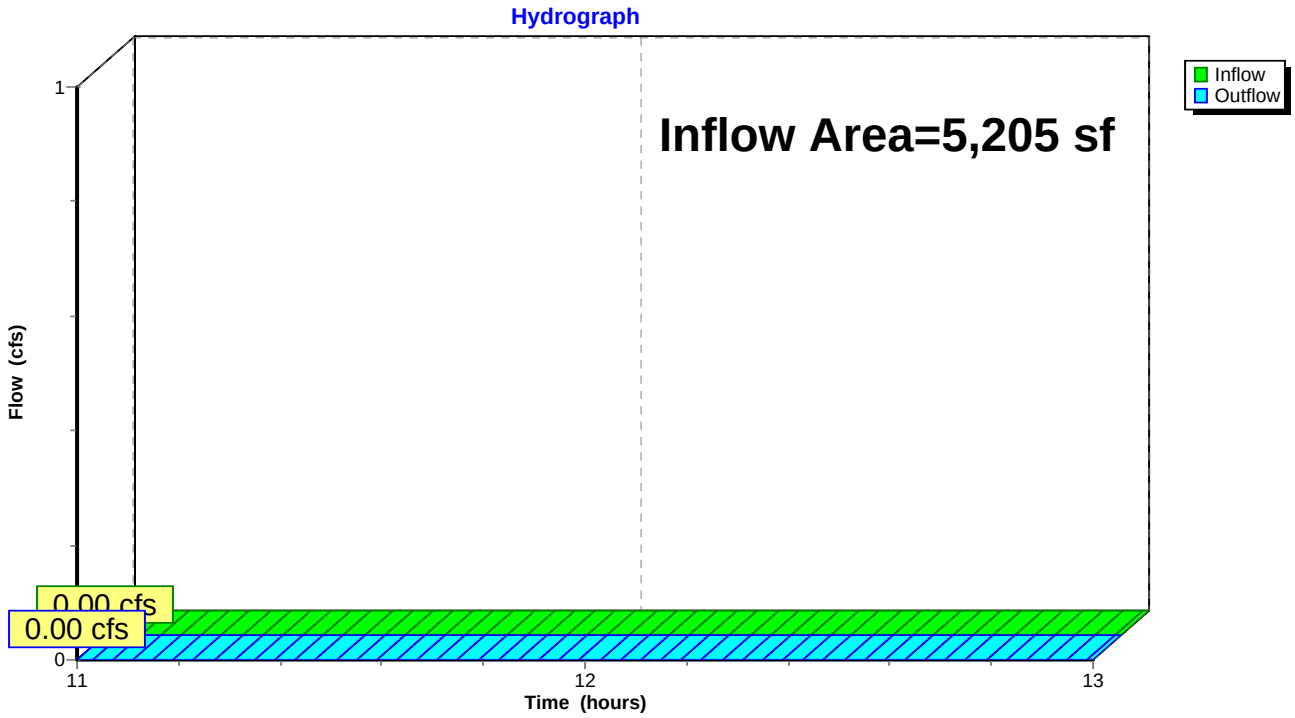
Summary for Reach END: Proposed Site Runoff

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

Inflow Area = 5,205 sf,100.00% Impervious, Inflow Depth = 0.00" for 100 year event
Inflow = 0.00 cfs @ 11.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 11.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs

Reach END: Proposed Site Runoff



Summary for Pond C2: Intermediate Cultecs

[82] Warning: Early inflow requires earlier time span

Inflow Area = 5,205 sf,100.00% Impervious, Inflow Depth > 4.06" for 100 year event
Inflow = 0.95 cfs @ 12.08 hrs, Volume= 1,761 cf
Outflow = 0.83 cfs @ 12.13 hrs, Volume= 1,431 cf, Atten= 13%, Lag= 2.8 min
Discarded = 0.07 cfs @ 12.13 hrs, Volume= 420 cf
Primary = 0.76 cfs @ 12.13 hrs, Volume= 1,011 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 230.78' @ 12.13 hrs Surf.Area= 392 sf Storage= 440 cf
Flood Elev= 233.94' Surf.Area= 392 sf Storage= 950 cf

Plug-Flow detention time= 14.6 min calculated for 1,416 cf (80% of inflow)
Center-of-Mass det. time= 7.2 min (731.2 - 723.9)

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

Storage Group A created with Chamber Wizard

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

Discarded OutFlow Max=0.07 cfs @ 12.13 hrs HW=230.77' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.76 cfs @ 12.13 hrs HW=230.77' TW=229.92' (Dynamic Tailwater)
2=Culvert (Barrel Controls 0.76 cfs @ 2.35 fps)

Pond C2: Intermediate Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

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

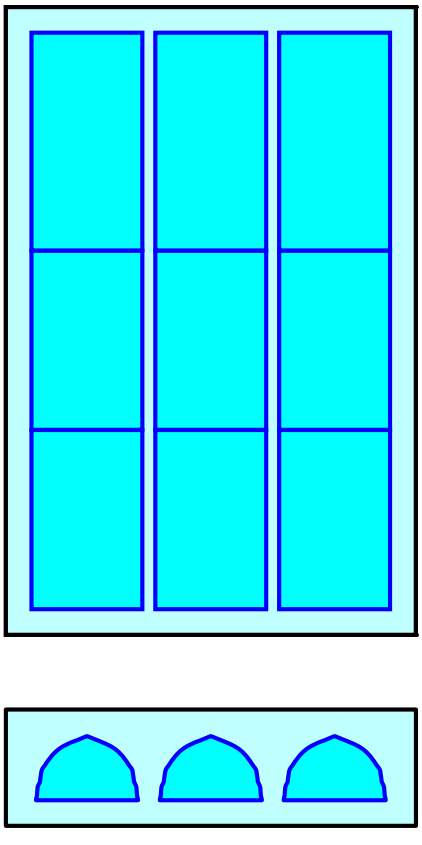
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
12.0" Base + 30.5" Chamber Height + 12.0" Cover = 4.54' Field Height

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

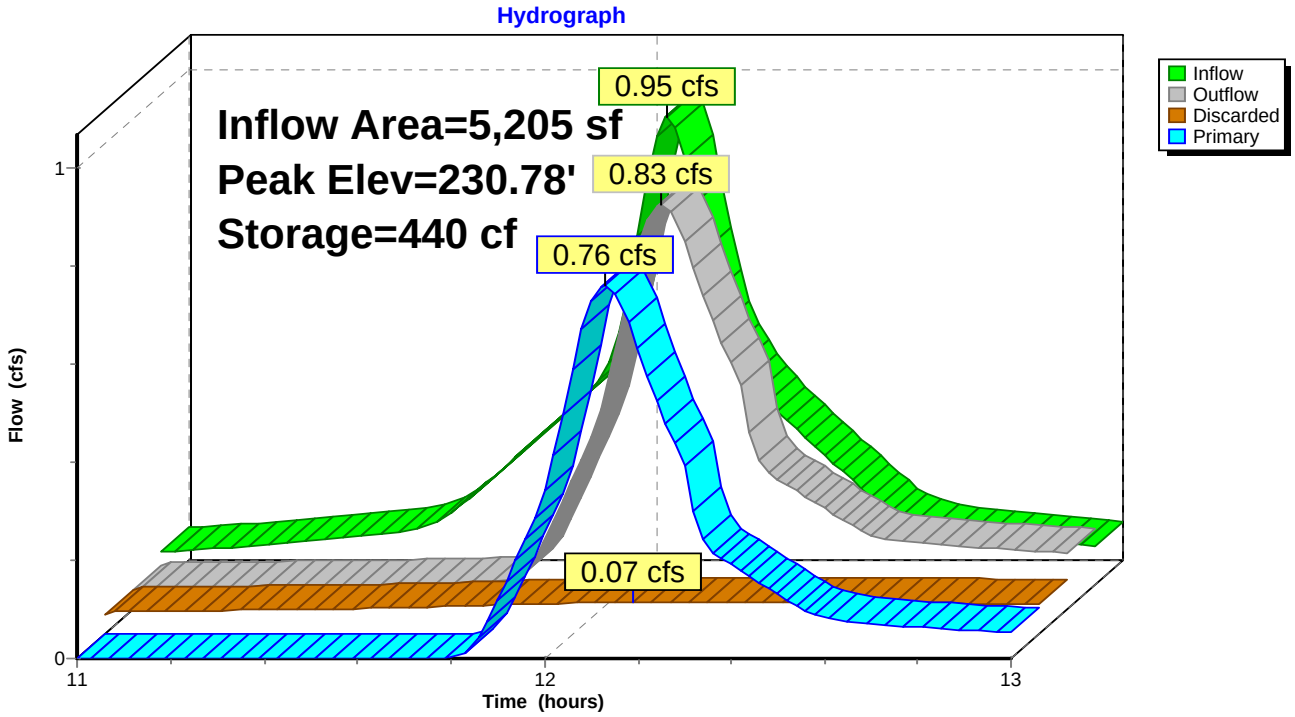
1,780.3 cf Field - 502.9 cf Chambers = 1,277.4 cf Stone x 35.0% Voids = 447.1 cf Stone Storage

Chamber Storage + Stone Storage = 950.0 cf = 0.022 af
Overall Storage Efficiency = 53.4%

9 Chambers
65.9 cy Field
47.3 cy Stone



Pond C2: Intermediate Cultecs



Summary for Pond C3: Southwest Cultecs

Inflow Area = 5,205 sf,100.00% Impervious, Inflow Depth > 2.33" for 100 year event
Inflow = 0.76 cfs @ 12.13 hrs, Volume= 1,011 cf
Outflow = 0.12 cfs @ 12.52 hrs, Volume= 463 cf, Atten= 84%, Lag= 23.2 min
Discarded = 0.12 cfs @ 12.52 hrs, Volume= 463 cf
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 230.55' @ 12.52 hrs Surf.Area= 0.017 ac Storage= 0.015 af

Plug-Flow detention time= 23.8 min calculated for 459 cf (45% of inflow)
Center-of-Mass det. time= 13.4 min (747.8 - 734.3)

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

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

Device	Routing	Invert	Outlet Devices
#1	Discarded	229.07'	**5.100 in/hr Exfiltration over Wetted area** Phase-In= 0.01'
#2	Primary	230.61'	**8.0" Round Culvert** L= 20.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 230.61' / 230.41' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.35 sf

Discarded OutFlow Max=0.12 cfs @ 12.52 hrs HW=230.55' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=229.07' TW=0.00' (Dynamic Tailwater)
2=Culvert (Controls 0.00 cfs)

Pond C3: Southwest Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

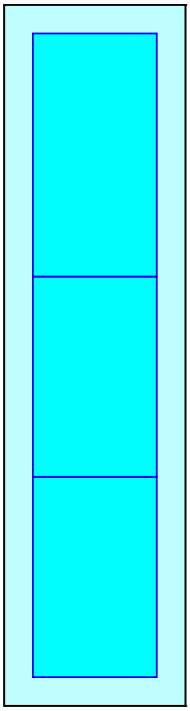
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

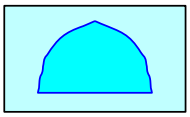
3 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 167.6 cf Chamber Storage

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

Chamber Storage + Stone Storage = 310.4 cf = 0.007 af
Overall Storage Efficiency = 53.9%

3 Chambers
21.3 cy Field
15.1 cy Stone





Pond C3: Southwest Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 2 rows

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

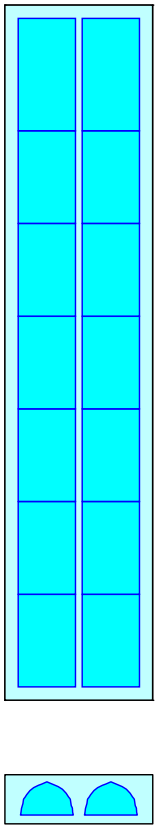
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
2 Rows x 52.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.17' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

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

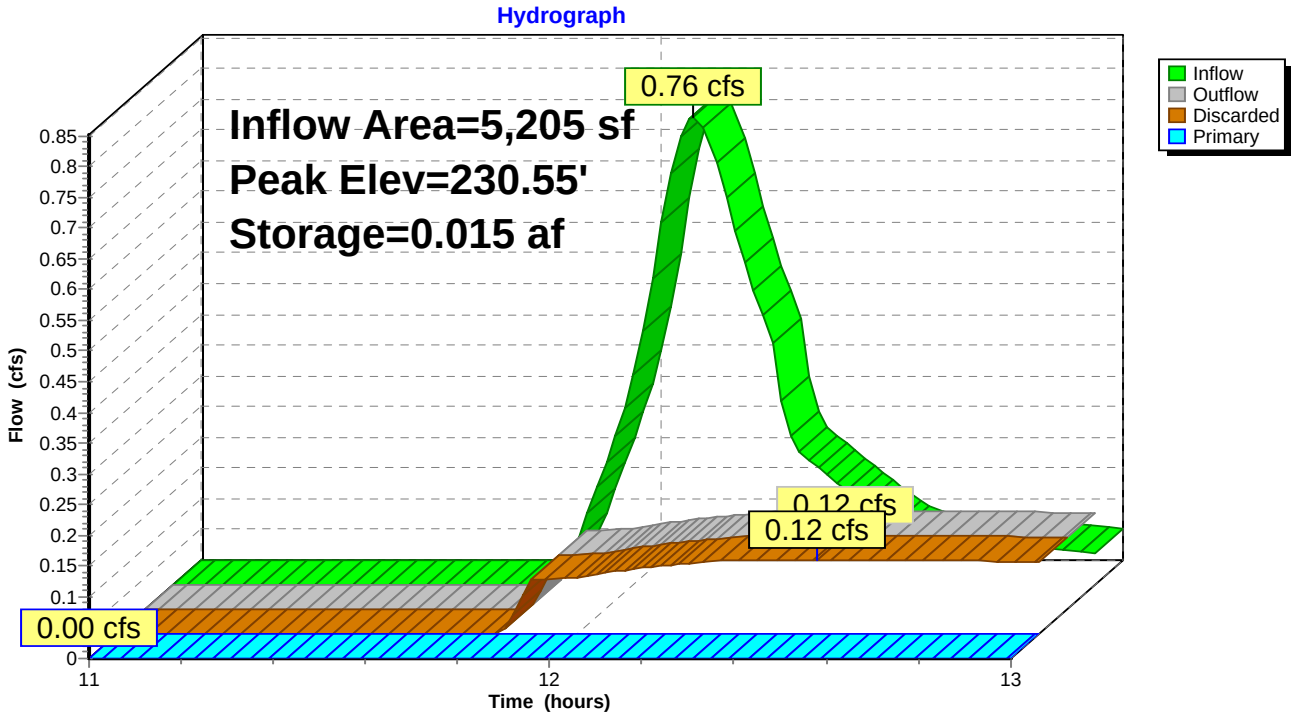
2,174.0 cf Field - 752.6 cf Chambers = 1,421.5 cf Stone x 35.0% Voids = 497.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,250.1 cf = 0.029 af
Overall Storage Efficiency = 57.5%

14 Chambers
80.5 cy Field
52.6 cy Stone



Pond C3: Southwest Cultecs



ATTACHMENT E
STANDARD 4 WATER QUALITY CALCULATIONS

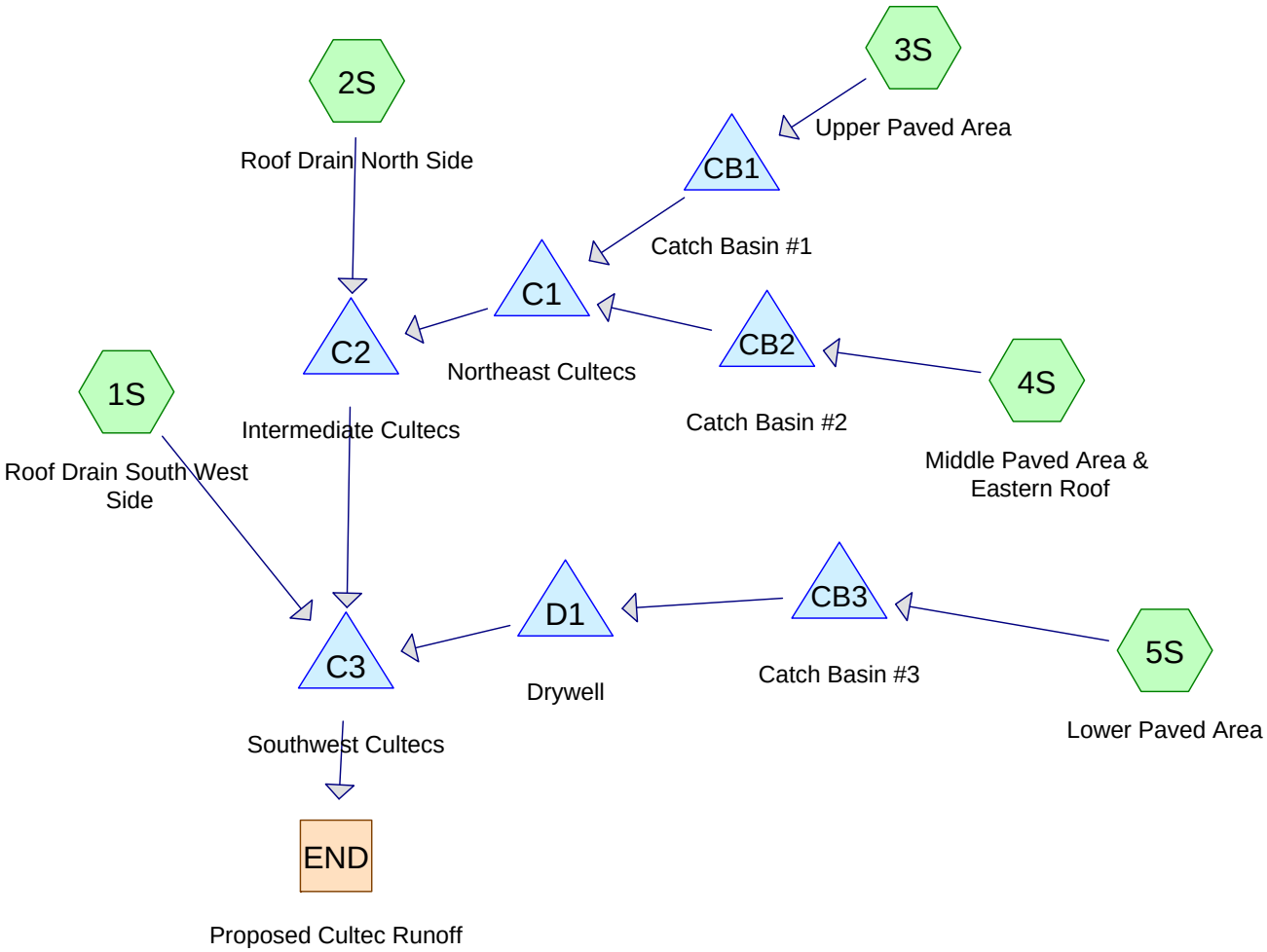
Standard 4 Stormwater Calculations:

Water Quality Treatment Volume

Vwq(cf)=(1/12)*impervious area

Imperv. Area (sf)= 29,656.87

V_{WQ}(cf)=	**2471.41**



Subcat Reach Pond Link

Routing Diagram for WQ Volume Calc

Prepared by Environmental Partners Group, Printed 11/16/2015

Pipe Listing (all nodes)

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

Time span=11.00-13.00 hrs, dt=0.02 hrs, 101 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Roof Drain South West Runoff Area=2,749 sf 100.00% Impervious Runoff Depth>1.50"
Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.19 cfs 345 cf

Subcatchment 2S: Roof Drain North Side Runoff Area=3,230 sf 100.00% Impervious Runoff Depth>1.50"
Flow Length=50' Slope=0.1300 '/' Tc=6.0 min CN=98 Runoff=0.22 cfs 405 cf

Subcatchment 3S: Upper Paved Area Runoff Area=10,259 sf 69.83% Impervious Runoff Depth>0.93"
Tc=6.0 min CN=85 Runoff=0.45 cfs 797 cf

Subcatchment 4S: Middle Paved Area & Runoff Area=4,232 sf 100.00% Impervious Runoff Depth>1.50"
Tc=6.0 min CN=98 Runoff=0.29 cfs 530 cf

Subcatchment 5S: Lower Paved Area Runoff Area=3,960 sf 100.00% Impervious Runoff Depth>1.50"
Tc=6.0 min CN=98 Runoff=0.27 cfs 496 cf

Reach END: Proposed Cultec Runoff Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond C1: Northeast Cultecs Peak Elev=232.05' Storage=0.021 af Inflow=0.74 cfs 1,286 cf
Discarded=0.00 cfs 0 cf Primary=0.15 cfs 433 cf Outflow=0.15 cfs 433 cf

Pond C2: Intermediate Cultecs Peak Elev=230.36' Storage=315 cf Inflow=0.25 cfs 838 cf
Discarded=0.05 cfs 275 cf Primary=0.13 cfs 246 cf Outflow=0.18 cfs 522 cf

Pond C3: Southwest Cultecs Peak Elev=230.35' Storage=0.012 af Inflow=0.45 cfs 994 cf
Discarded=0.09 cfs 472 cf Primary=0.00 cfs 0 cf Outflow=0.09 cfs 472 cf

Pond CB1: Catch Basin #1 Peak Elev=233.56' Storage=27 cf Inflow=0.45 cfs 797 cf
6.0" Round Culvert n=0.012 L=20.0' S=0.0600 '/' Outflow=0.45 cfs 776 cf

Pond CB2: Catch Basin #2 Peak Elev=233.35' Storage=24 cf Inflow=0.29 cfs 530 cf
6.0" Round Culvert n=0.012 L=75.0' S=0.0160 '/' Outflow=0.29 cfs 510 cf

Pond CB3: Catch Basin #3 Peak Elev=233.34' Storage=24 cf Inflow=0.27 cfs 496 cf
6.0" Round Culvert n=0.012 L=115.0' S=0.0050 '/' Outflow=0.27 cfs 476 cf

Pond D1: Drywell Peak Elev=231.63' Storage=35 cf Inflow=0.27 cfs 476 cf
Discarded=0.01 cfs 44 cf Primary=0.26 cfs 404 cf Outflow=0.27 cfs 448 cf

Total Runoff Area = 24,430 sf Runoff Volume = 2,573 cf Average Runoff Depth = 1.26"
12.67% Pervious = 3,095 sf 87.33% Impervious = 21,335 sf

Summary for Subcatchment 1S: Roof Drain South West Side

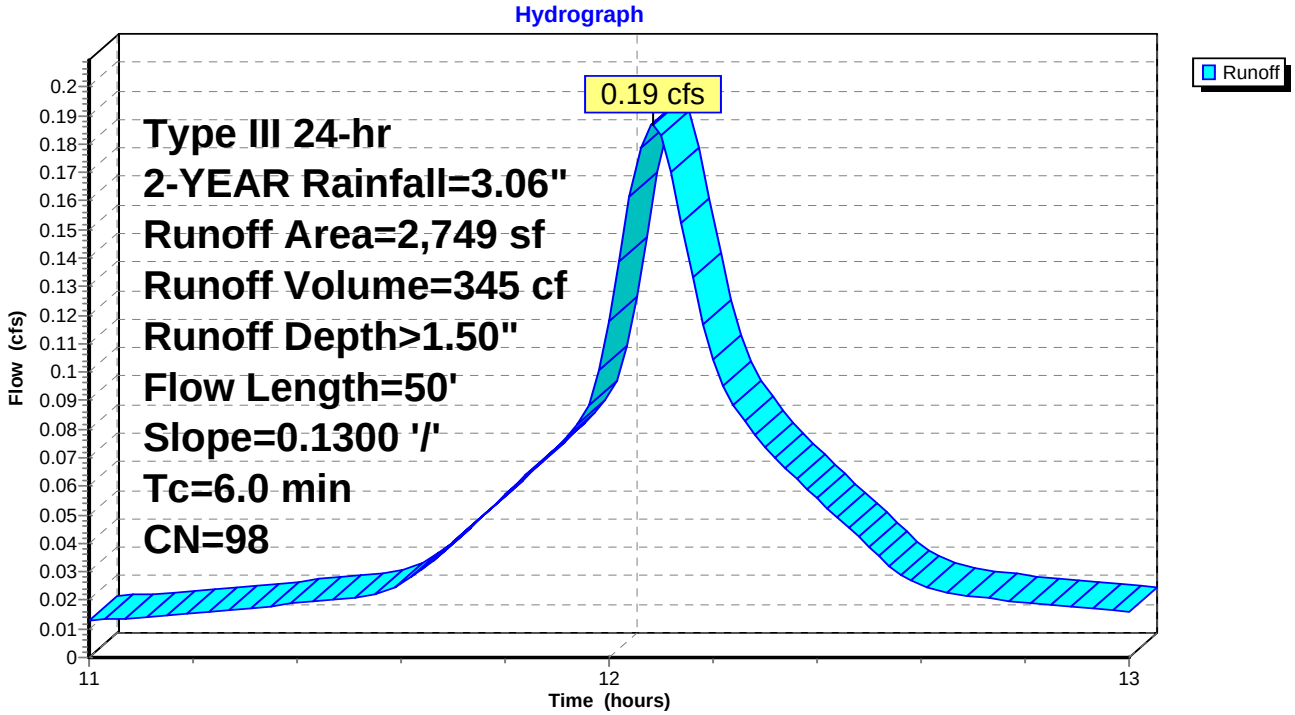
Runoff = 0.19 cfs @ 12.08 hrs, Volume= 345 cf, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

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

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

Subcatchment 1S: Roof Drain South West Side



Summary for Subcatchment 2S: Roof Drain North Side

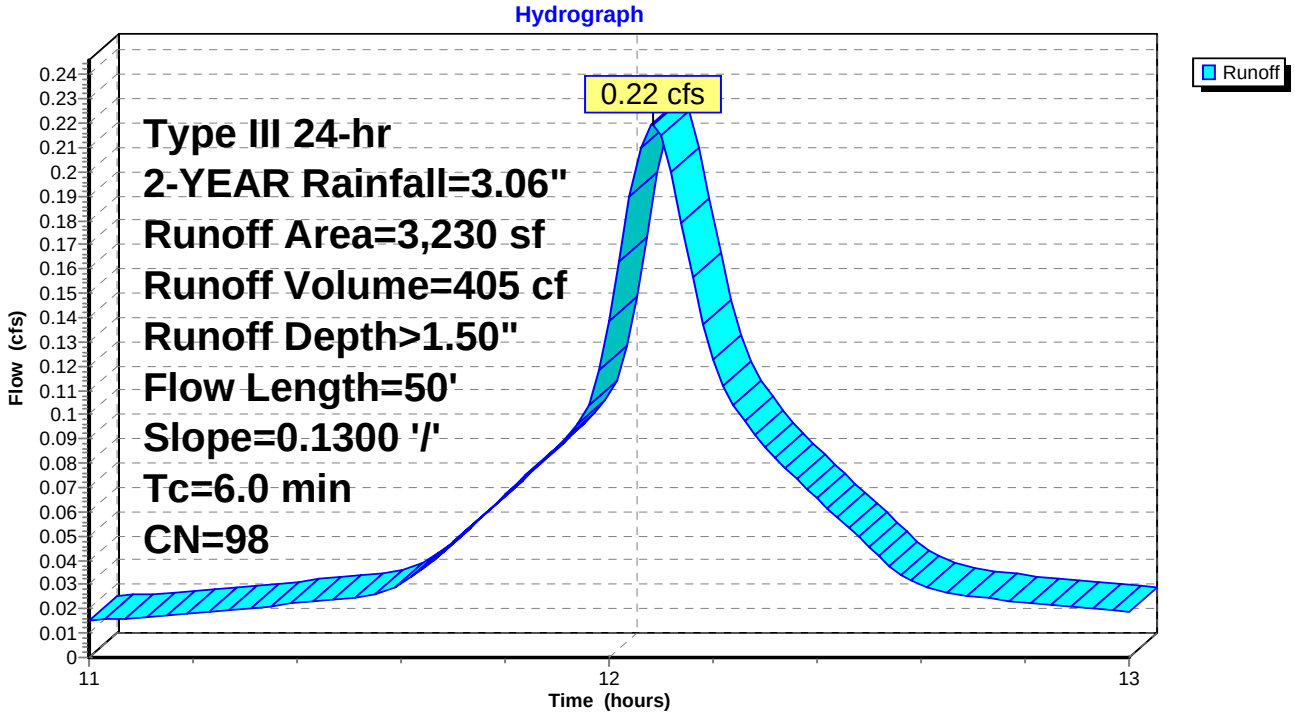
Runoff = 0.22 cfs @ 12.08 hrs, Volume= 405 cf, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

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

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

Subcatchment 2S: Roof Drain North Side



Summary for Subcatchment 3S: Upper Paved Area

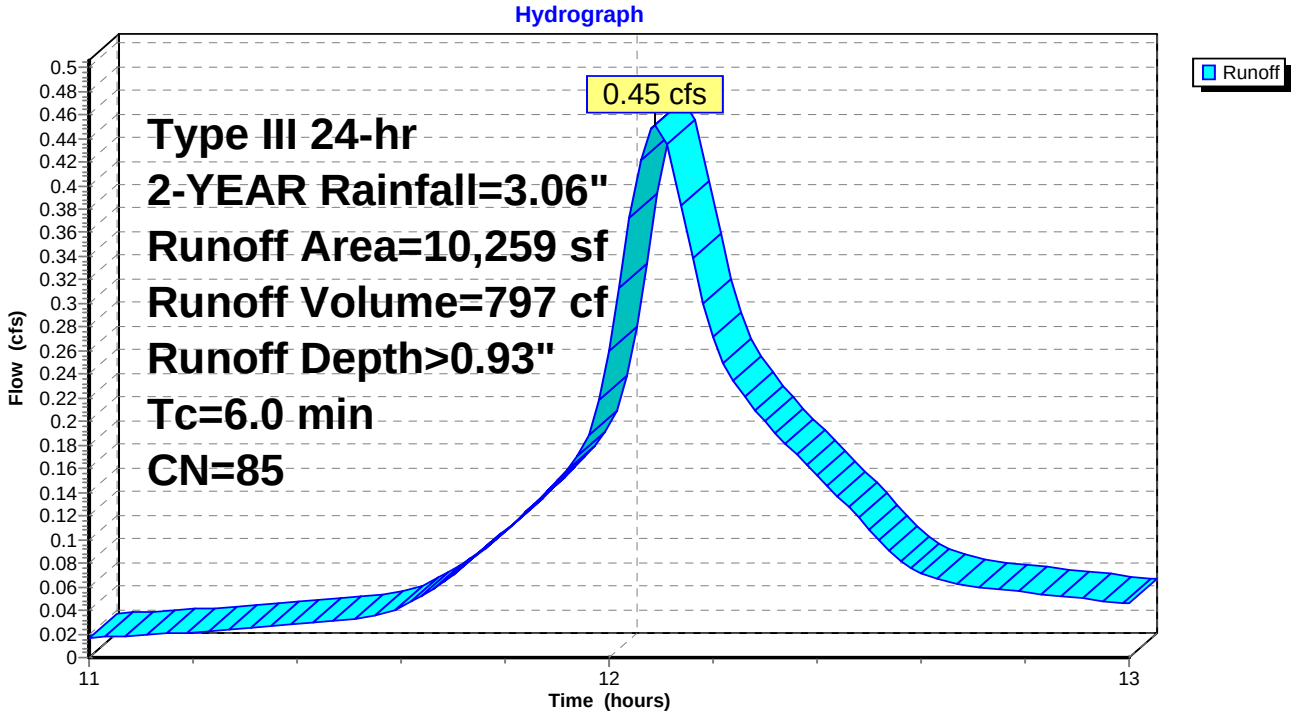
Runoff = 0.45 cfs @ 12.09 hrs, Volume= 797 cf, Depth> 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

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

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

Subcatchment 3S: Upper Paved Area



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

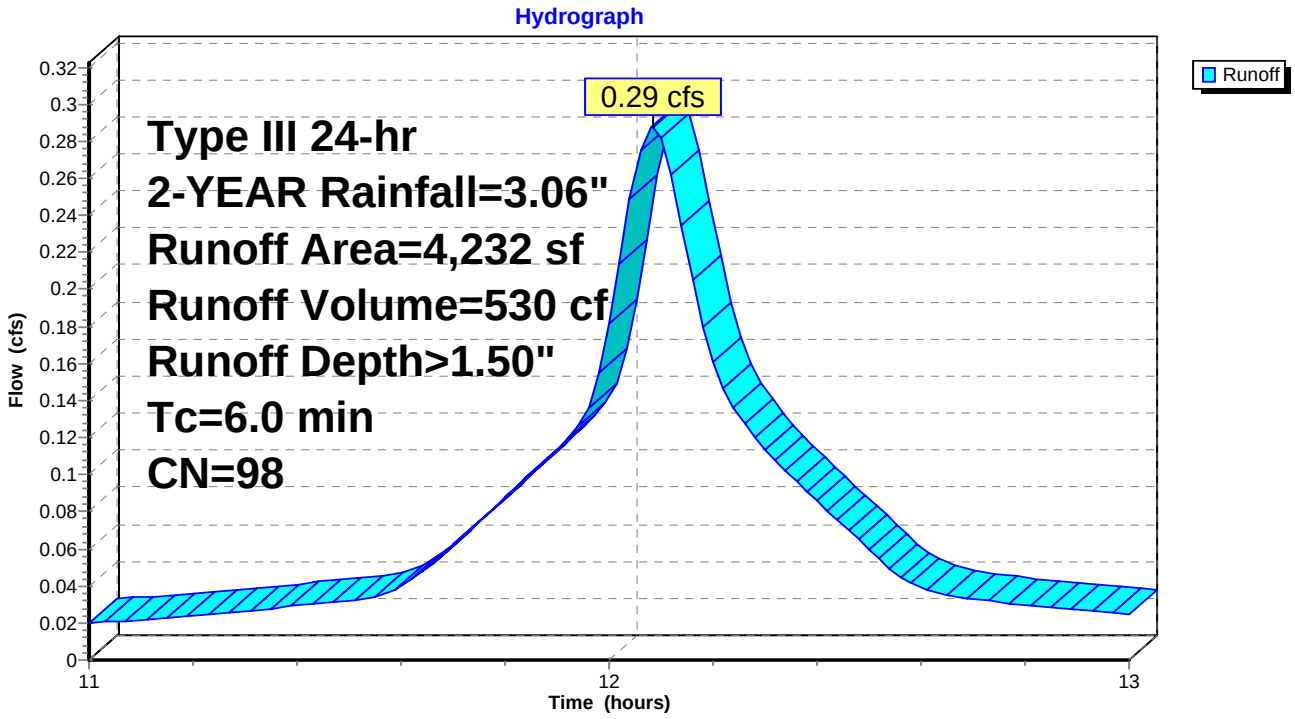
Runoff = 0.29 cfs @ 12.08 hrs, Volume= 530 cf, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

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

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

Subcatchment 4S: Middle Paved Area & Eastern Roof



Summary for Subcatchment 5S: Lower Paved Area

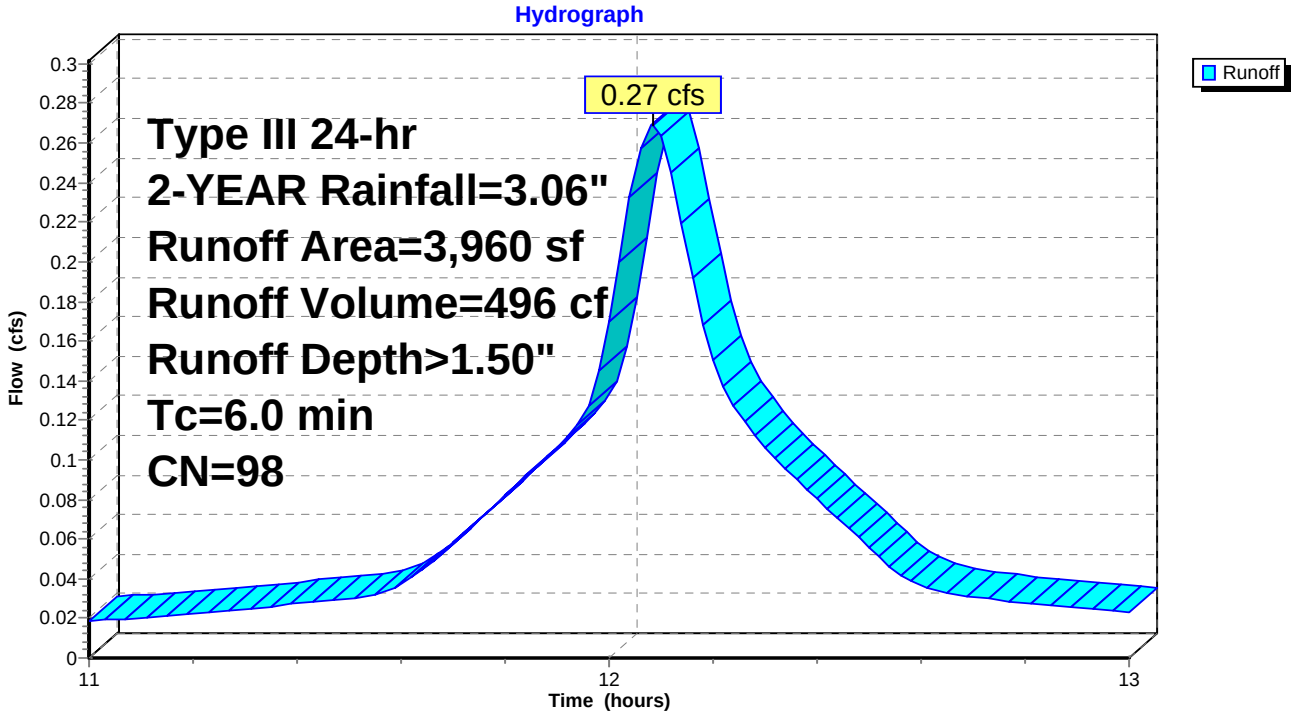
Runoff = 0.27 cfs @ 12.08 hrs, Volume= 496 cf, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-YEAR Rainfall=3.06"

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

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

Subcatchment 5S: Lower Paved Area



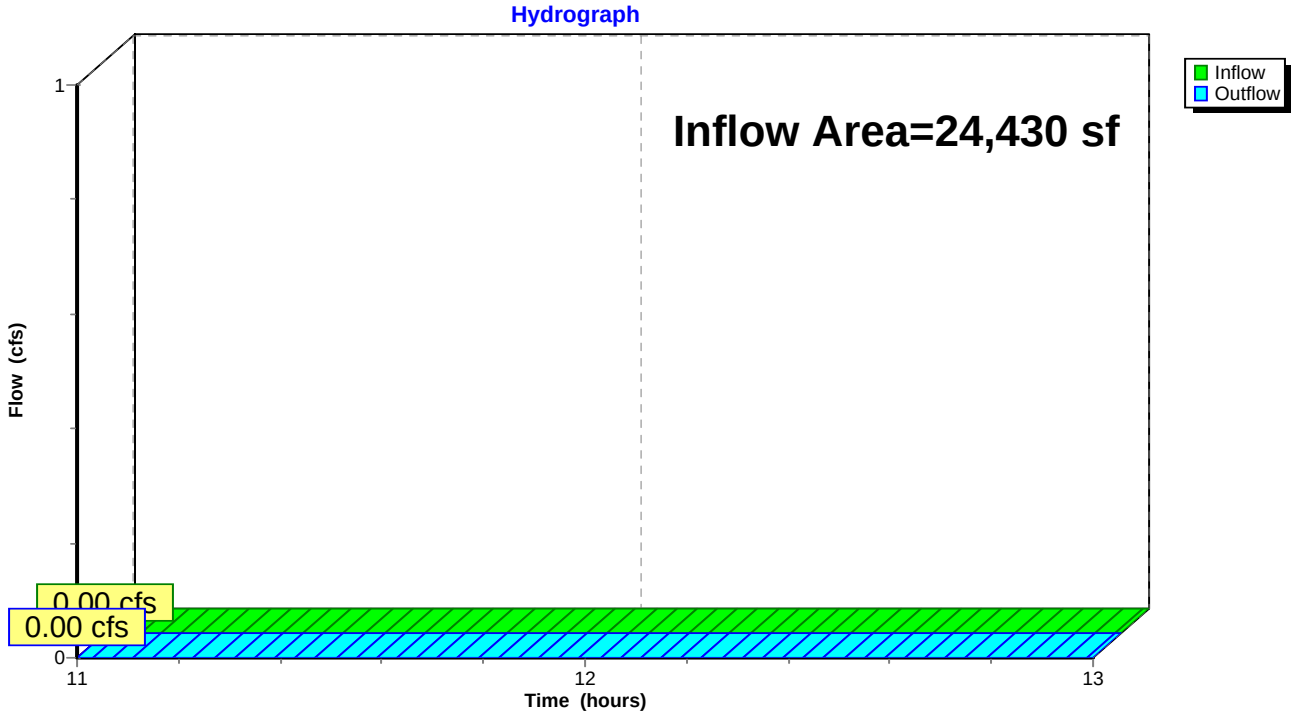
Summary for Reach END: Proposed Cultec Runoff

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

Inflow Area = 24,430 sf, 87.33% Impervious, Inflow Depth = 0.00" for 2-YEAR event
Inflow = 0.00 cfs @ 11.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 11.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs

Reach END: Proposed Cultec Runoff



Summary for Pond C1: Northeast Cultecs

Inflow Area = 14,491 sf, 78.64% Impervious, Inflow Depth > 1.07" for 2-YEAR event
Inflow = 0.74 cfs @ 12.09 hrs, Volume= 1,286 cf
Outflow = 0.15 cfs @ 12.53 hrs, Volume= 433 cf, Atten= 80%, Lag= 26.3 min
Discarded = 0.00 cfs @ 11.00 hrs, Volume= 0 cf
Primary = 0.15 cfs @ 12.53 hrs, Volume= 433 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 232.05' @ 12.53 hrs Surf.Area= 0.046 ac Storage= 0.021 af

Plug-Flow detention time= 45.9 min calculated for 429 cf (33% of inflow)
Center-of-Mass det. time= 25.9 min (754.6 - 728.7)

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

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

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

Discarded OutFlow Max=0.00 cfs @ 11.00 hrs HW=231.17' (Free Discharge)
└**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.15 cfs @ 12.53 hrs HW=232.05' TW=230.29' (Dynamic Tailwater)
├**2=Culvert** (Barrel Controls 0.15 cfs @ 1.88 fps)
└**3=Culvert** (Controls 0.00 cfs)

Pond C1: Northeast Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

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

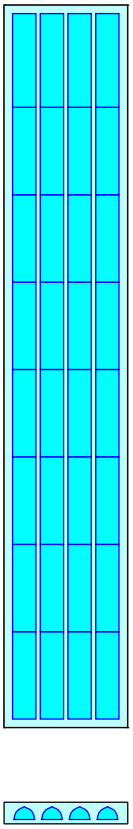
8 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 82.75' Row Length +12.0" End Stone x 2 = 84.75' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

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

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

Chamber Storage + Stone Storage = 1,663.1 cf = 0.038 af
Overall Storage Efficiency = 53.2%

32 Chambers
115.7 cy Field
83.2 cy Stone



Pond C1: Northeast Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-150XLHD (Cultec Recharger® 150XLHD)
Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf
Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap
Row Length Adjustment= +0.75' x 2.65 sf x 4 rows

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

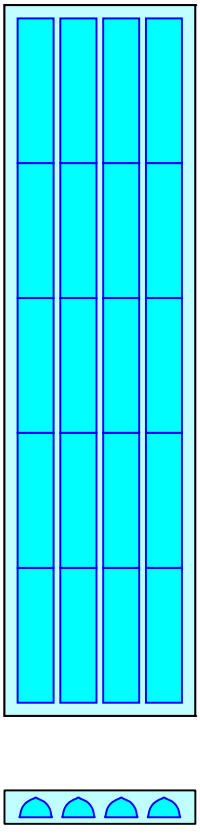
5 Chambers/Row x 10.25' Long +0.75' Row Adjustment = 52.00' Row Length +12.0" End Stone x 2 = 54.00' Base Length
4 Rows x 33.0" Wide + 6.0" Spacing x 3 + 12.0" Side Stone x 2 = 14.50' Base Width
6.0" Base + 18.5" Chamber Height + 6.0" Cover = 2.54' Field Height

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

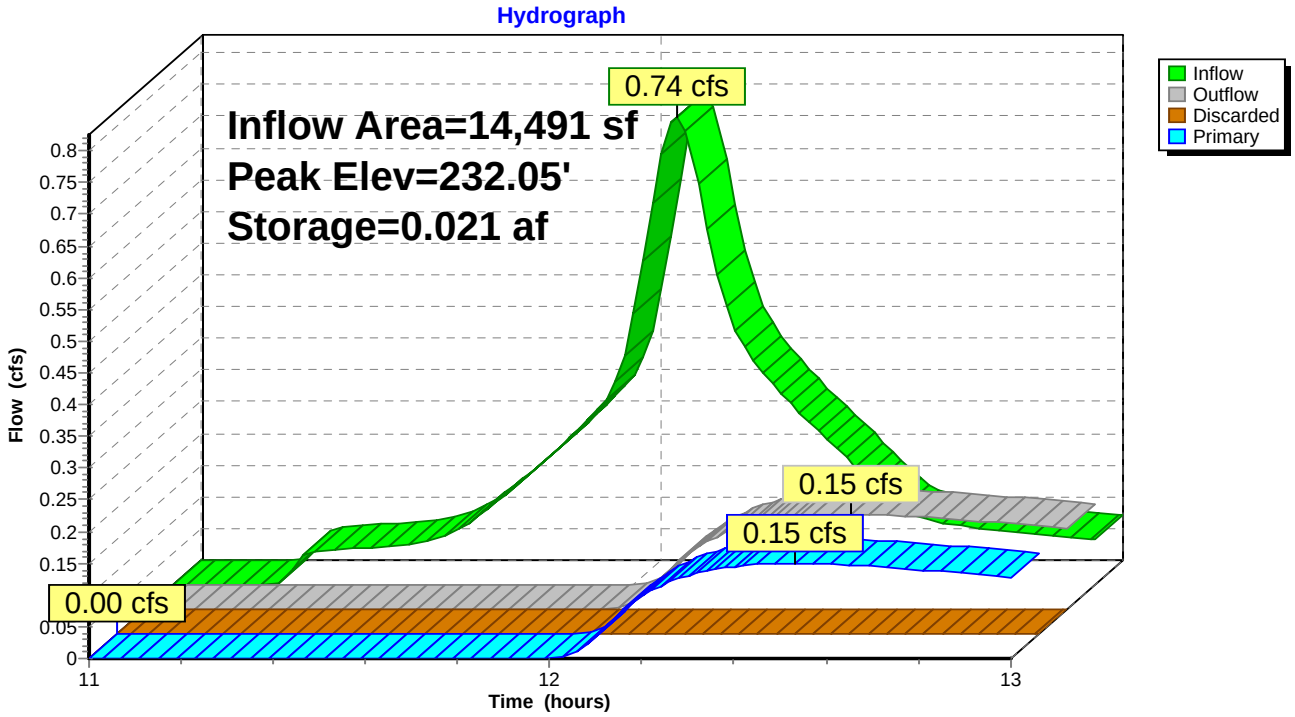
1,990.1 cf Field - 551.0 cf Chambers = 1,439.1 cf Stone x 35.0% Voids = 503.7 cf Stone Storage

Chamber Storage + Stone Storage = 1,054.7 cf = 0.024 af
Overall Storage Efficiency = 53.0%

20 Chambers
73.7 cy Field
53.3 cy Stone



Pond C1: Northeast Cultecs



Summary for Pond C2: Intermediate Cultecs

[82] Warning: Early inflow requires earlier time span

Inflow Area = 17,721 sf, 82.53% Impervious, Inflow Depth > 0.57" for 2-YEAR event
Inflow = 0.25 cfs @ 12.11 hrs, Volume= 838 cf
Outflow = 0.18 cfs @ 12.59 hrs, Volume= 522 cf, Atten= 28%, Lag= 28.7 min
Discarded = 0.05 cfs @ 11.84 hrs, Volume= 275 cf
Primary = 0.13 cfs @ 12.59 hrs, Volume= 246 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 230.36' @ 13.00 hrs Surf.Area= 392 sf Storage= 315 cf
Flood Elev= 233.94' Surf.Area= 392 sf Storage= 950 cf

Plug-Flow detention time= 18.7 min calculated for 516 cf (62% of inflow)
Center-of-Mass det. time= 4.1 min (744.0 - 739.9)

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

Storage Group A created with Chamber Wizard

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

Discarded OutFlow Max=0.05 cfs @ 11.84 hrs HW=228.84' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.13 cfs @ 12.59 hrs HW=230.29' TW=230.20' (Dynamic Tailwater)
2=Culvert (Barrel Controls 0.13 cfs @ 1.34 fps)

Pond C2: Intermediate Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

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

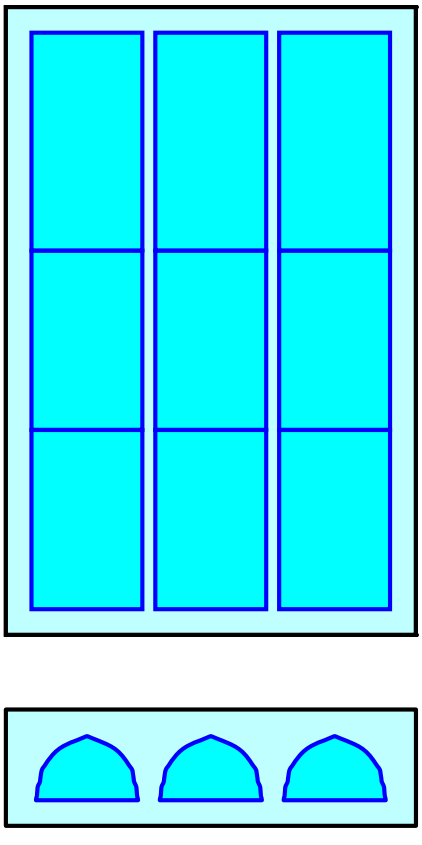
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width
12.0" Base + 30.5" Chamber Height + 12.0" Cover = 4.54' Field Height

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

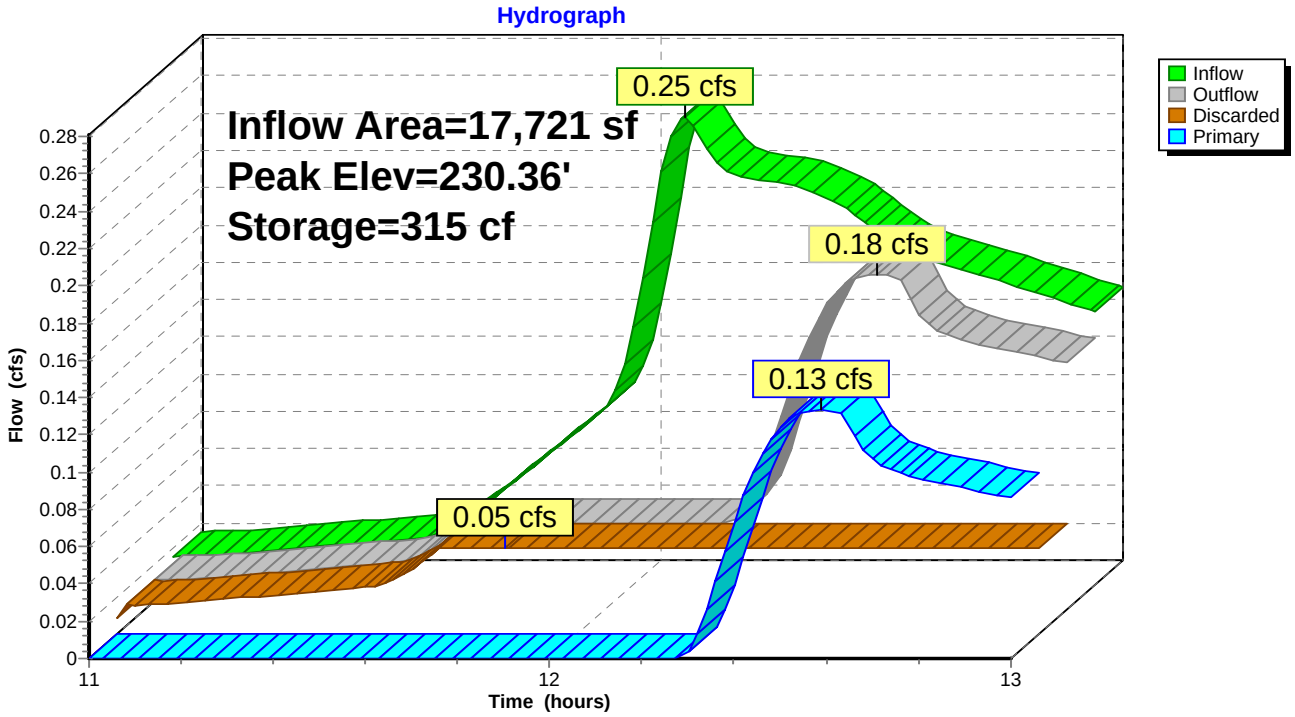
1,780.3 cf Field - 502.9 cf Chambers = 1,277.4 cf Stone x 35.0% Voids = 447.1 cf Stone Storage

Chamber Storage + Stone Storage = 950.0 cf = 0.022 af
Overall Storage Efficiency = 53.4%

9 Chambers
65.9 cy Field
47.3 cy Stone



Pond C2: Intermediate Cultecs



Summary for Pond C3: Southwest Cultecs

When the time span is extended beyond 13 hours, the peak elevation during the 2-year storm is 230.39' at 13.5 hours. The elevation begins to decline at 13.70 hours. The peak elevation is below the culvert invert, so all water will be exfiltrated.

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[82] Warning: Early inflow requires earlier time span

Inflow Area = 24,430 sf, 87.33% Impervious, Inflow Depth > 0.49" for 2-YEAR event
Inflow = 0.45 cfs @ 12.09 hrs, Volume= 994 cf
Outflow = 0.09 cfs @ 11.80 hrs, Volume= 472 cf, Atten= 80%, Lag= 0.0 min
Discarded = 0.09 cfs @ 11.80 hrs, Volume= 472 cf
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 230.35' @ 13.00 hrs Surf.Area= 0.017 ac Storage= 0.012 af

Plug-Flow detention time= 18.4 min calculated for 467 cf (47% of inflow)
Center-of-Mass det. time= (not calculated: outflow precedes inflow)

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

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

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

Discarded OutFlow Max=0.09 cfs @ 11.80 hrs HW=229.11' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=229.07' TW=0.00' (Dynamic Tailwater)
2=Culvert (Controls 0.00 cfs)

Pond C3: Southwest Cultecs - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 1 rows

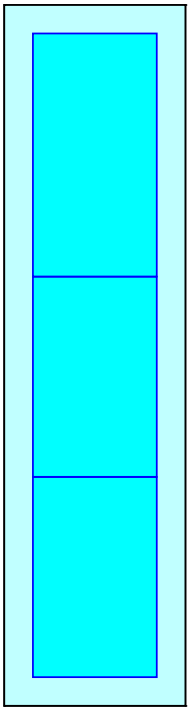
3 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 22.50' Row Length +12.0" End Stone x 2 = 24.50' Base Length
1 Rows x 52.0" Wide + 12.0" Side Stone x 2 = 6.33' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

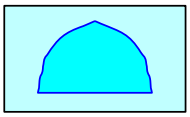
3 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 1 Rows = 167.6 cf Chamber Storage

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

Chamber Storage + Stone Storage = 310.4 cf = 0.007 af
Overall Storage Efficiency = 53.9%

3 Chambers
21.3 cy Field
15.1 cy Stone





Pond C3: Southwest Cultecs - Chamber Wizard Field B

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)
Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
Row Length Adjustment= +1.50' x 7.45 sf x 2 rows

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

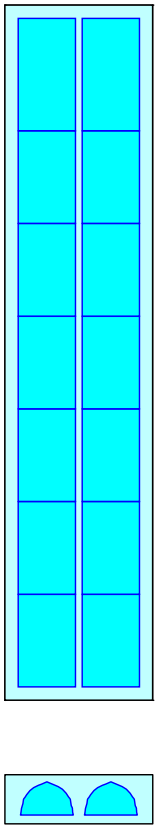
7 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 50.50' Row Length +12.0" End Stone x 2 = 52.50' Base Length
2 Rows x 52.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.17' Base Width
8.0" Base + 30.5" Chamber Height + 6.0" Cover = 3.71' Field Height

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

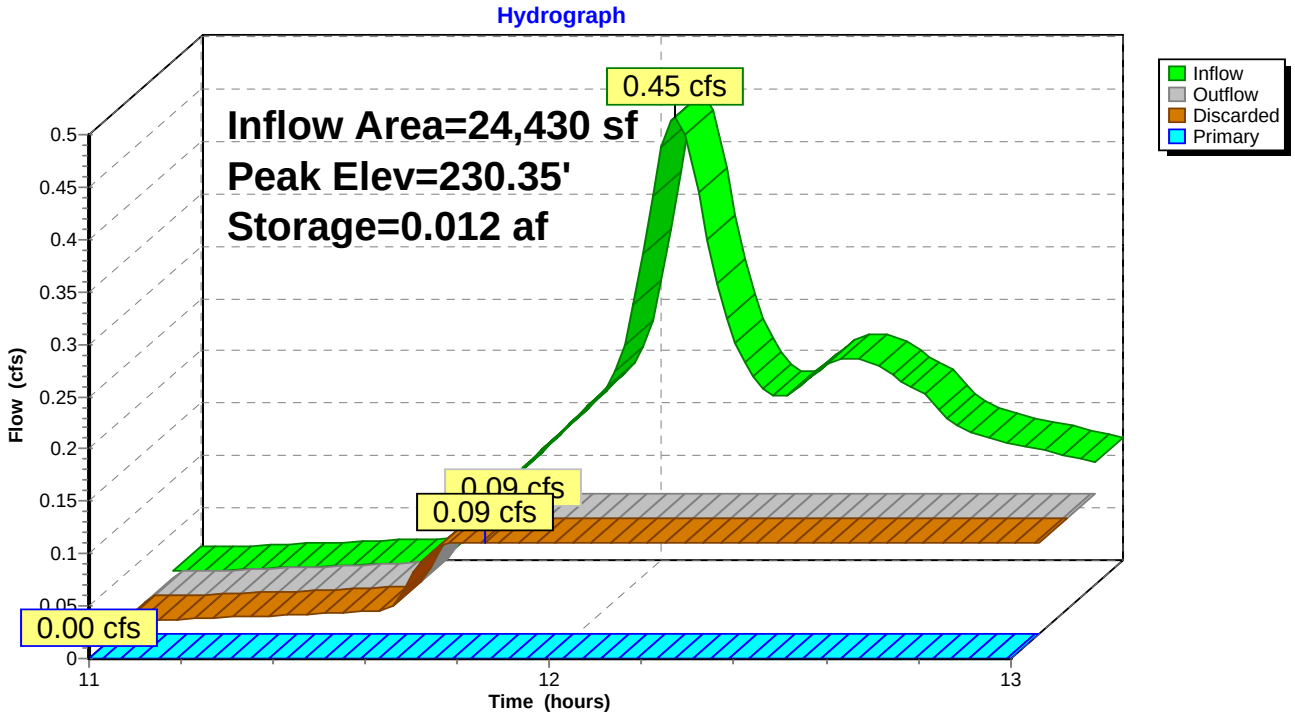
2,174.0 cf Field - 752.6 cf Chambers = 1,421.5 cf Stone x 35.0% Voids = 497.5 cf Stone Storage

Chamber Storage + Stone Storage = 1,250.1 cf = 0.029 af
Overall Storage Efficiency = 57.5%

14 Chambers
80.5 cy Field
52.6 cy Stone



Pond C3: Southwest Cultecs



Summary for Pond CB1: Catch Basin #1

[82] Warning: Early inflow requires earlier time span

Inflow Area = 10,259 sf, 69.83% Impervious, Inflow Depth > 0.93" for 2-YEAR event
Inflow = 0.45 cfs @ 12.09 hrs, Volume= 797 cf
Outflow = 0.45 cfs @ 12.10 hrs, Volume= 776 cf, Atten= 0%, Lag= 0.4 min
Primary = 0.45 cfs @ 12.10 hrs, Volume= 776 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 233.56' @ 12.10 hrs Surf.Area= 13 sf Storage= 27 cf

Plug-Flow detention time= 3.1 min calculated for 768 cf (96% of inflow)
Center-of-Mass det. time= 1.8 min (730.1 - 728.3)

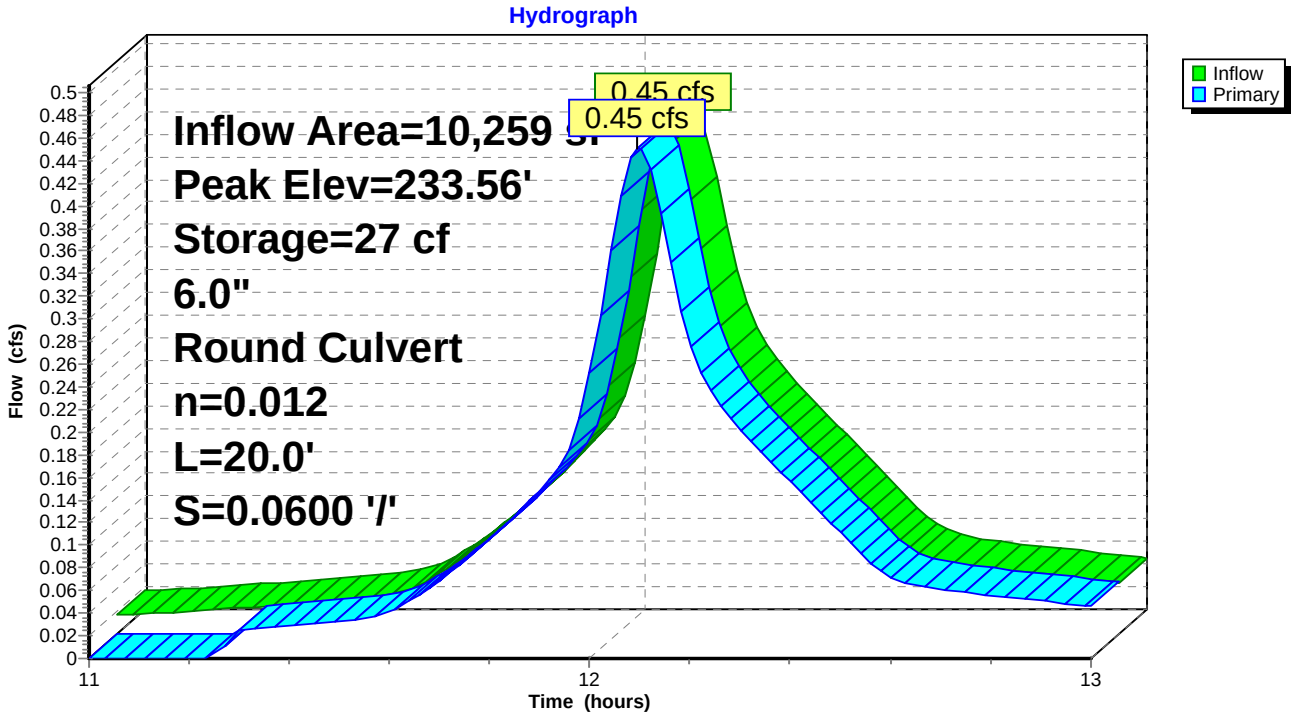
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	464 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	3,335	419	464

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

Primary OutFlow Max=0.45 cfs @ 12.10 hrs HW=233.56' TW=231.81' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.45 cfs @ 2.28 fps)

Pond CB1: Catch Basin #1



Summary for Pond CB2: Catch Basin #2

[82] Warning: Early inflow requires earlier time span

Inflow Area = 4,232 sf,100.00% Impervious, Inflow Depth > 1.50" for 2-YEAR event
Inflow = 0.29 cfs @ 12.08 hrs, Volume= 530 cf
Outflow = 0.29 cfs @ 12.09 hrs, Volume= 510 cf, Atten= 0%, Lag= 0.2 min
Primary = 0.29 cfs @ 12.09 hrs, Volume= 510 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 233.35' @ 12.09 hrs Surf.Area= 13 sf Storage= 24 cf

Plug-Flow detention time= 4.6 min calculated for 509 cf (96% of inflow)
Center-of-Mass det. time= 2.5 min (726.6 - 724.1)

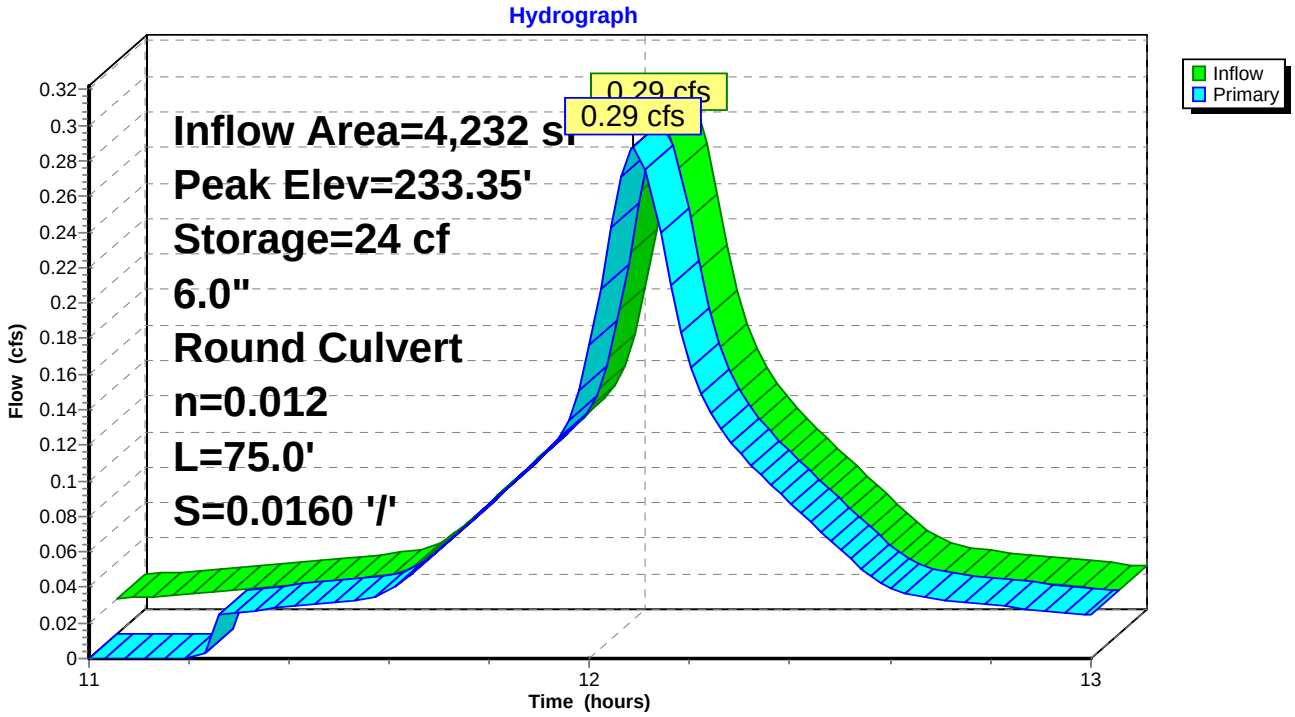
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	258 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,690	213	258

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

Primary OutFlow Max=0.29 cfs @ 12.09 hrs HW=233.35' TW=231.80' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.29 cfs @ 1.70 fps)

Pond CB2: Catch Basin #2



Summary for Pond CB3: Catch Basin #3

[82] Warning: Early inflow requires earlier time span

Inflow Area = 3,960 sf,100.00% Impervious, Inflow Depth > 1.50" for 2-YEAR event
Inflow = 0.27 cfs @ 12.08 hrs, Volume= 496 cf
Outflow = 0.27 cfs @ 12.09 hrs, Volume= 476 cf, Atten= 0%, Lag= 0.2 min
Primary = 0.27 cfs @ 12.09 hrs, Volume= 476 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 233.34' @ 12.09 hrs Surf.Area= 13 sf Storage= 24 cf

Plug-Flow detention time= 4.8 min calculated for 471 cf (95% of inflow)
Center-of-Mass det. time= 2.6 min (726.8 - 724.1)

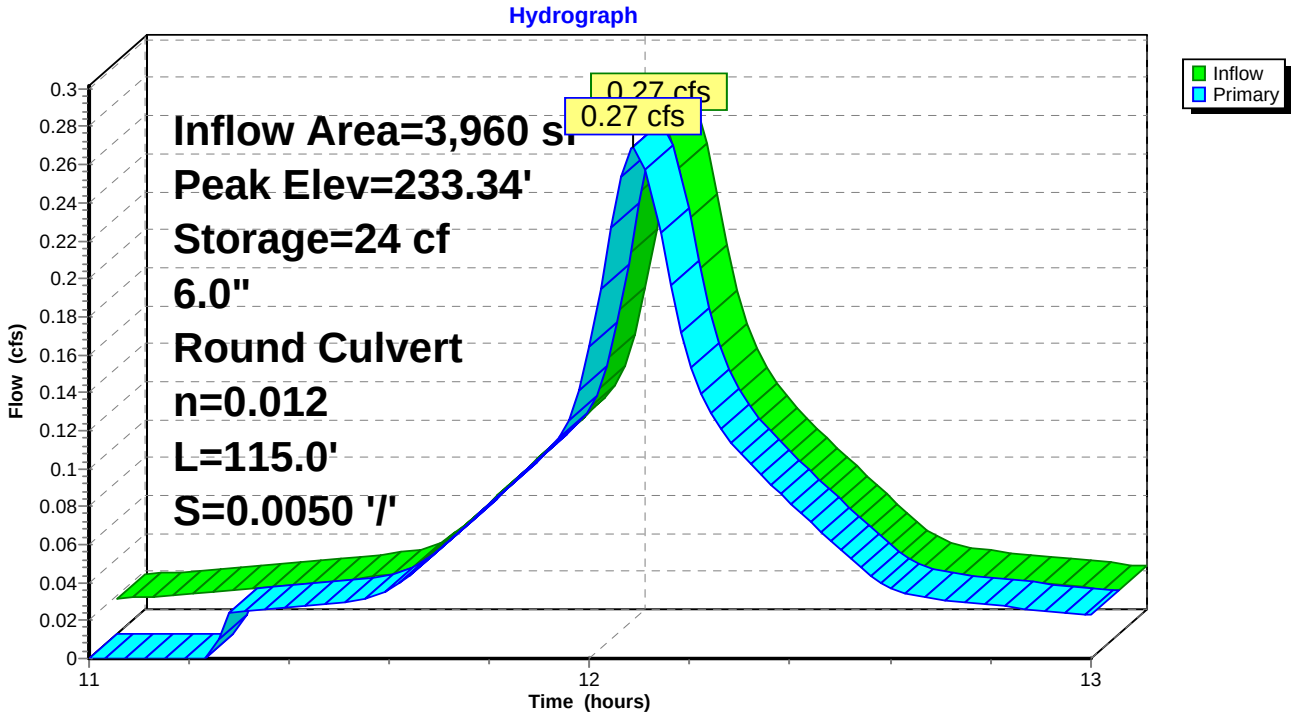
Volume	Invert	Avail.Storage	Storage Description
#1	231.50'	293 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
231.50	13	0	0
235.00	13	46	46
235.25	1,963	247	293

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

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

Pond CB3: Catch Basin #3



Summary for Pond D1: Drywell

Inflow Area = 3,960 sf,100.00% Impervious, Inflow Depth > 1.44" for 2-YEAR event
Inflow = 0.27 cfs @ 12.09 hrs, Volume= 476 cf
Outflow = 0.27 cfs @ 12.09 hrs, Volume= 448 cf, Atten= 0%, Lag= 0.4 min
Discarded = 0.01 cfs @ 12.09 hrs, Volume= 44 cf
Primary = 0.26 cfs @ 12.09 hrs, Volume= 404 cf

Routing by Dyn-Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.02 hrs
Peak Elev= 231.63' @ 12.09 hrs Surf.Area= 33 sf Storage= 35 cf

Plug-Flow detention time= 5.7 min calculated for 448 cf (94% of inflow)
Center-of-Mass det. time= 2.9 min (729.7 - 726.8)

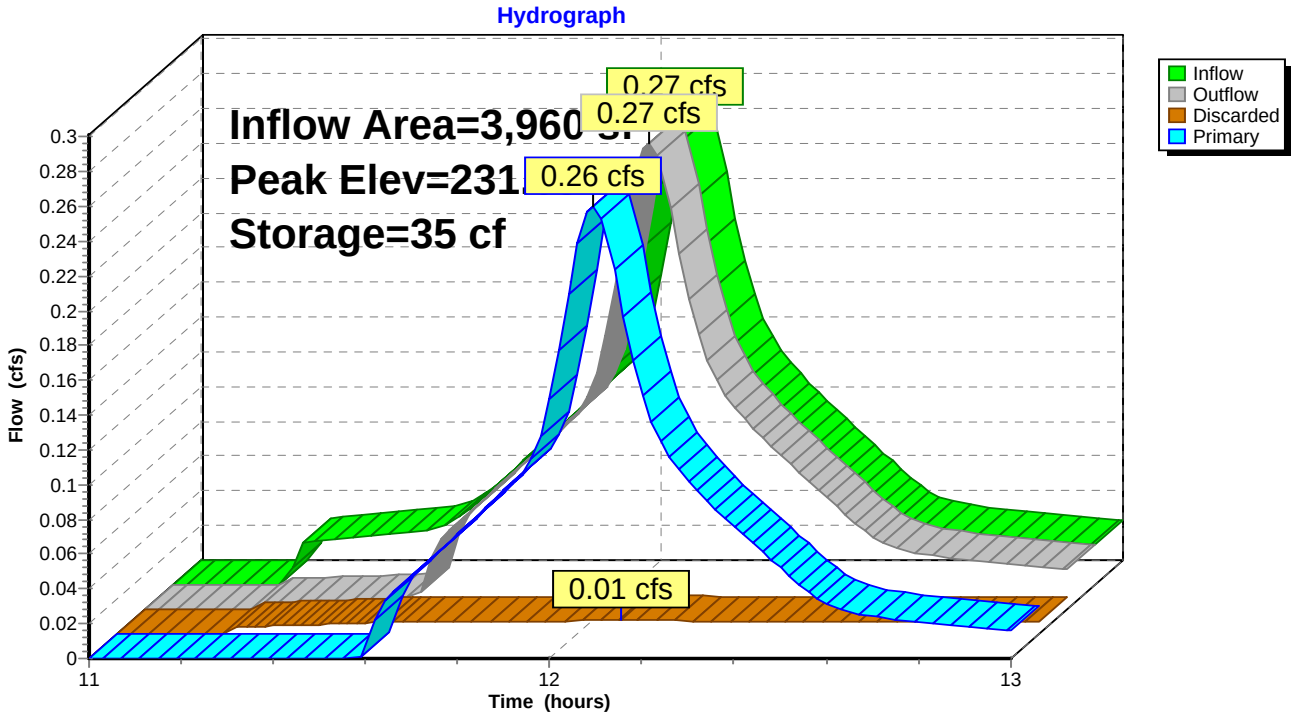
Volume	Invert	Avail.Storage	Storage Description
#1	230.00'	98 cf	**5.00'D x 5.00'H Vertical Cone/Cylinder** Inside #2 141 cf Overall - 6.0" Wall Thickness = 98 cf
#2	230.00'	9 cf	**6.50'D x 5.00'H Vertical Cone/Cylinder** 166 cf Overall - 141 cf Embedded = 25 cf x 35.0% Voids
		107 cf	Total Available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

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

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

Primary OutFlow Max=0.26 cfs @ 12.09 hrs HW=231.62' TW=229.72' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.26 cfs @ 1.64 fps)

Pond D1: Drywell



ATTACHMENT F
LONG TERM POLLUTION PREVENTION PLAN AND OPERATIONS AND MAINTENANCE PLAN

1. Long Term Pollution Prevention Plan

This Long Term Pollution Prevention Plan (LTPPP) was prepared in accordance with Standard 4 of the Massachusetts Stormwater Management Handbook, the Massachusetts Department of Environmental Protection Stormwater Management Policy and the Massachusetts Wetlands Protection regulations (310 CMR 10.00). This LTPPP was prepared to address long term pollution prevention measures at the Nagog Pond Water Treatment Plant to be located at 180 Skyline Drive in Acton, Massachusetts (Site Locus, Attachment 1, Appendix B).

Good Housekeeping Practices

All chemicals will be stored inside. All treatment plant operators/employees will be instructed in the importance of not spilling fluids and chemicals onto the ground. All areas in the immediate vicinity of the treatment plant will be kept clean of excess debris.

Storing Materials and Waste Products

All chemicals and treatment process waste will be stored in adequately sized containers within the treatment plant. All treatment waste products will be disposed of in a legal manner at a state licensed recycling center or landfill. General trash generated by treatment plant personnel will be collected in standard trash barrels and disposed of at the public waste facility.

Vehicle Washing

Due to the nature of the site, very few vehicles will be accessing the site on a daily basis. Vehicle washing will not be allowed on the property to limit any potential contamination.

Routine Inspections and Maintenance of Stormwater BMPs

Refer to Stormwater Operation and Maintenance Plan within this Appendix.

Spill Prevention

The following measures will be taken at all loading/ unloading areas:

1. A significant amount of debris can accumulate outside uncovered loading/unloading areas. Sweep these surfaces frequently to remove material that could otherwise be washed off by stormwater. Sweep outside areas that are covered for a period of time by containers, logs, or other material after the areas are cleared.
2. Place drip pans, or other appropriate temporary containment device, at locations where leaks or spills may occur, such as hose connections, hose reels and filler

nozzles. Always use drip pans when making and breaking connections. Check loading and unloading equipment such as valves, pumps, flanges, and connections regularly for leaks and repair as needed.

Maintenance of Lawns, Gardens, and Other Landscaped Areas

A special wetland mix has been selected for the lawn area that will be under the PV array that will only require mowing on a biannual basis. The remaining landscaped area will be trimmed and maintained on an as needed basis. Any loose vegetation created from maintenance will be disposed of offsite.

Pet Waste Management

The proposed fencing is designed to limit pedestrian access to the site and surrounding areas, so pet waste is not expected to be a concern.

Proper Management of Deicing Chemicals

Any deicing chemicals, such as road salt, will be stored inside.

1. **Introduction**

This Stormwater Management Operations and Maintenance Plan (O&M Plan) was prepared in accordance with Standard 9 of the Massachusetts Stormwater Management Handbook, the Massachusetts Department of Environmental Protection Stormwater Management Policy and the Massachusetts Wetlands Protection regulations (310 CMR 10.00). This O&M Plan was prepared for the stormwater management system proposed for the Nagog Pond Water Treatment Plant to be located at 180 Skyline Drive in Acton, Massachusetts (Site Locus, Attachment 1, Appendix B). This O&M plan addresses both construction and post-development stormwater management. The proposed construction stormwater management system is shown on the Erosion Control Plans (Sheets C-4 and C-8 of Appendix C). The proposed post-development stormwater management system is shown on the WTP and Solar Array Grading and Drainage Plan (Sheet C-11 of Appendix C). The construction details for typical construction and the proposed post-development stormwater management system are provided within Appendix C (Sheets CD-1 through CD-7).

This O&M Plan serves to identify the following:

- The Owner of the stormwater management system at the Nagog Pond Water Treatment Plant;
- The party responsible for the operation and maintenance of the stormwater management systems;
- The typical/proposed components of both systems;
- The construction details of both systems;
- The routine and non-routine maintenance tasks to be undertaken;
- A schedule for inspection and maintenance of both systems; and
- An inspection and maintenance log template.

2. Ownership and Operation/Maintenance

The Nagog Pond Water Treatment Plant and its stormwater management system will be located on the southeast portion of a 56 acre parcel owned by the Town of Concord. The parcel is partially developed with the existing Nagog Pond Water Treatment Plant and its ancillary facilities, and partially forested. The existing treatment facility and proposed treatment facility will be operated by the Town of Concord's Water Department, which is a division of the Concord Department of Public Works. Therefore, the Town of Concord is identified as the Owner of the proposed post-development stormwater management system for the Nagog Pond Water Treatment Plant. A General Contractor selected through the public bidding process will be responsible for the operation and maintenance of the construction stormwater management system throughout the construction of the new treatment facility, PV Array, and raw water intake. The Water Department will be charged with the operation and maintenance responsibilities for the proposed post-development stormwater management system.

3. Description of the Proposed Construction Stormwater Management System

The goal of the proposed construction stormwater management system is to prevent off-site (i.e. Nagog Pond, wetlands) migration of stormwater pollution and/or soil erosion. Generally, the means of accomplishing this goal are achieved through proper planning, soil stabilization, runoff control and sediment control.

Prior to the start of construction, a system of straw wattles will be installed between the limits of work and the sensitive resource areas (i.e., Nagog Pond and wetlands). During construction, efforts should be made to maximize the preservation of natural vegetation within the limits of work and to minimize the amount of disturbed area. Dust control activities should be implemented to prevent the aerial transport of dust off-site. During clearing, grading, and excavation operations, temporary stormwater runoff diversions should be constructed to divert flow away from sensitive receptors. The stormwater diversions should incorporate sediment traps/barriers and inlet/outlet protection. Stockpiled aggregate materials should be stabilized (poly-sheeting, temporary seeding, etc.) and protected with sediment trap/barriers. The proposed construction stormwater management system is shown on the Erosion Control Plans (Sheets C-4 and C-8 of Appendix C). Typical construction details are shown on the Sheets CD-1 through CD-7 of Appendix C.

The construction Stormwater Pollution Prevention Plan will be defined in greater detail in the Contractor's erosion and sediment control plan, which will also account for conditions detailed in the Town of Acton's Conservation Commission Order of Conditions.

4. Description of the Proposed Post-Development Stormwater Management System

The proposed post-development stormwater management system is comprised of storm drains with deep sump catch basins, HDPE drainage pipe, R-150XLHD and R-330XLHD Cultec chambers, a dry well, and improved use of an existing rip rap swale. The proposed post-development Stormwater Management system is shown on the WTP and Solar Array Grading and Drainage Plan (Sheet C-11 of Appendix C) and typical construction details are provided on the construction detail sheets of Appendix C.

Storm Drains and Deep Sump Catch Basins

Storm drains with deep sump catch basins will be installed for pretreatment of stormwater runoff. Storm drains will be installed in the paved driveways and parking areas of the new facility. Two storm drains will be located on the eastern side of the facility and one will be located on the southern side of the facility. The storm drains will receive storm water runoff from the paved areas, which will be sloped to convey sheet flow towards the drains. The drains will be comprised of removable grated covers overlying deep sump catch basins. The deep sump catch basins are designed to remove trash, debris, sediment, and oil and grease. Stormwater flow will enter the catch basin through the grated cover and then flow through the inverted opening of a drain pipe, which either connects to a drywell or Cultec structure.

Cultec Chambers

Model R-150 XLHD and R-330 XLHD Cultec Chambers, as manufactured by CULTEC, Inc., will be installed for infiltration and detention of stormwater runoff. Three sets of clusters will be installed, with one set installed to the east of the proposed treatment plant and two installed to the west of the proposed treatment plant. The cluster to the east will consist of 52 Cultec R-150XLHD chambers, the cluster to the northwest will consist of 9 Cultec R-330 XLHD chambers, and the cluster to the immediate west will consist of 17 Cultec R-330 XLHD chambers. All clusters will be interconnected, with the cluster to the east connecting to the cluster in the northwest with an 8” and 4” HDPE drain pipe, followed by the cluster to the northwest connecting to the cluster in the west with a 6” HDPE drain pipe. The final cluster located in the west will be equipped with an overflow directed towards the wetlands.

Drywell

A drywell will be installed to the southwest of the proposed facility to provide additional infiltration detention time for runoff flowing to the southernmost catch basin. The drywell will connect the southernmost catch basin to the cultic chamber cluster in the west, while also serving as a means to increase detention time and provide some pre-infiltration before the runoff reaches the cultec cluster.

Existing Rip Rap Swale

The existing rip rap swale runs parallel to the existing access road a few feet to the east. The eastern limits of the proposed access road will extend to the top of the existing swale to increase the amount of runoff that is diverted to the rip rap swale. The swale has a high point in the same location as the proposed access road, so all runoff from the swale that is north of the highpoint will be directed to the proposed deep sump catch basins, while the runoff from the swale on the south side of the high point will be directed to an existing catch basin at the bottom of the access road. In addition to increasing the runoff directed to the swale, the proposed maintenance and inspection activities aim to improve the existing swale to ensure that it functions as efficiently as possible at all times by means of continuous upkeep.

5. Maintenance and Inspection Activities

Construction Stormwater Management System

During the course of the construction phase of the project, the Town's General Contractor shall be responsible for the maintenance and inspection of the stormwater management system and erosion and sediment controls.

The Town's General Contractor shall conduct weekly inspections of the stormwater management system and erosion/sediment controls for stability and operation. In addition to the weekly inspections, the General Contractor shall inspect the stormwater system and controls within 24-hours of any runoff producing precipitation event. Any needed repairs will be made immediately to maintain barriers and controls.

Maintenance will include:

- Removing built up sediment at sediment traps and sediment barriers;
- Repairing straw wattle that become damaged or displaced;
- Remove built up sediment at truck tracking pads and wheel wash stations;
- Clean or replace gravel/stone when the sediment traps and/or truck pads/washes no longer drain properly;
- Maintain stormwater diversions to control stormwater flow and limit erosion;
- Identify and address locations of stormwater scouring or erosion;
- Practice good site housekeeping (i.e., trash collection, material staging areas, management of aggregate stockpiles);
- All seeded areas will be fertilized and reseeded, as necessary, and mulched according to contract specifications; and
- Comply with the conditions of Acton Conservation Commission's Order of Conditions.

Post-Development Stormwater Management System

After receiving a Certificate of Compliance from the Acton Conservation Commission and achieving "Substantial Completion" of construction, the Town (Concord Water Department) will take over all maintenance responsibilities for the post-development stormwater management system.

Storm Drains, Deep Sump Catch Basins, Drywell, Cultec Chambers, and Rip Rap Swale

Regular maintenance of the storm drains, deep sump catch basins, drywell, and Cultec chambers is essential to their proper operation. Therefore, regular maintenance and inspection activities include:

- Good housekeeping practices within driveways and parking areas (i.e., routine collection of trash from trash receptacles, keeping storm drain grates clear of obstructions, etc.);
- Monthly inspection of storm drains and deep sump catch basins;
- Quarterly cleaning of deep sump catch basins to remove built up sediments, debris, and oil and grease;
- Annual street sweeping of driveways and parking areas; and
- Disposal of removed catch basin cleanings in accordance with applicable state, local, and federal guidelines and regulations.

6. Maintenance Schedule

Construction Stormwater Management System

During the construction phase, the Town's General Contractor should provide a maintenance and inspection schedule for the stormwater management system for the Town's approval. A typical maintenance and inspection schedule is as follows:

Daily:	Repair stormwater, erosion, and sedimentation controls as necessary;
Weekly:	Inspect stormwater management system for effective and proper operation; repair as necessary.
Run-off Events:	Inspect stormwater management system within 24-hours of event; repair as necessary;

Post-Development Stormwater Management System

Following substantial completion of construction, the Town (Water Department) shall finalize a maintenance and inspection schedule for the stormwater management system

and have it on file at the treatment facility and at the Department of Public Works main office. The proposed maintenance and inspection schedule is as follows:

Daily/Weekly:	Repair stormwater, erosion, and sedimentation controls as necessary; Promote good housekeeping practices in driveways, parking areas, and stormwater management areas;
Monthly:	Inspect storm drains and deep sump catch basins for proper operation;
Quarterly:	Clean out sediments from deep sump catch basins;
Semi-Annual:	Inspect water quality swales for proper operation and condition;
Annual:	Removal of sediment from water quality swales;

7. Maintenance Log Form

The following is a typical maintenance and inspection form for the stormwater management system.

Date: _____
Name of Inspector: _____
Organization: _____

Type of Inspection
(Circle One): Daily / Weekly / Monthly / Quarterly / Semi-Annual / Annual

Reason for Inspection
(Circle All that Apply): Routine Maintenance / Routine Inspection / Run-Off Event / Emergency

Stormwater Control:
Condition (Circle One): Excellent / Good / Poor / Not Operational
Notes:
Action Items:

Stormwater Control:
Condition (Circle One): Excellent / Good / Poor / Not Operational
Notes:
Action Items:

Stormwater Control:
Condition (Circle One): Excellent / Good / Poor / Not Operational
Notes:
Action Items:

Stormwater Control:
Condition (Circle One): Excellent / Good / Poor / Not Operational
Notes:
Action Items:

Additional Notes:

_____
_____
_____
_____
_____
_____

Signature: _____ Date: _____

CULTEC STORMWATER CHAMBERS OPERATION AND MAINTENANCE GUIDELINES

Contactor® & Recharger®
Stormwater Chambers The Chamber With The Stripe®

Operation and Maintenance Guidelines

CULTEC™

Operation & Maintenance

This manual contains guidelines recommended by CULTEC, Inc. and may be used in conjunction with, but not to supersede, local regulations or regulatory authorities. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Introduction

The CULTEC Subsurface Stormwater Management System is a high-density polyethylene (HDPE) chamber system arranged in parallel rows surrounded by washed stone. The CULTEC chambers create arch-shaped voids within the washed stone to provide stormwater detention, retention, infiltration, and reclamation. Filter fabric is placed between the native soil and stone interface to prevent the intrusion of fines into the system. In order to minimize the amount of sediment which may enter the CULTEC system, a sediment collection device (stormwater pretreatment device) is recommended upstream from the CULTEC chamber system. Examples of pretreatment devices include, but are not limited to, an appropriately sized catch basin with sump, pretreatment catchment device, oil grit separator, or baffled distribution box. Manufactured pretreatment devices may also be used in accordance with CULTEC chambers. Installation, operation, and maintenance of these devices shall be in accordance with manufacturer's recommendations. Almost all of the sediment entering the stormwater management system will be collected within the pretreatment device.

Best Management Practices allow for the maintenance of the preliminary collection systems prior to feeding the CULTEC chambers. The pretreatment structures shall be inspected for any debris that will restrict inlet flow rates. Outfall structures, if any, such as outlet control must also be inspected for any obstructions that would restrict outlet flow rates. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Operation and Maintenance Requirements

I. Operation

CULTEC stormwater management systems shall be operated to receive only stormwater run-off in accordance with applicable local regulations. CULTEC subsurface stormwater management chambers operate at peak performance when installed in series with pretreatment. Pretreatment of suspended solids is superior to treatment of solids once they have been introduced into the system. The use of pretreatment is adequate as long as the structure is maintained and the site remains stable with finished impervious surfaces such as parking lots, walkways, and pervious areas are properly maintained. If there is to be an unstable condition, such as improvements to buildings or parking areas, all proper silt control measures shall be implemented according to local regulations.

II. Inspection and Maintenance Options

A. The CULTEC system may be equipped with an inspection port located on the inlet row. The inspection port is a circular cast box placed in a rectangular concrete collar. When the lid is removed, a 6-inch (150 mm) pipe with a screw-in plug will be exposed. Remove the plug. This will provide access to the CULTEC Chamber row below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment if any in this row. If the depth of sediment is in excess of 3 inches (76 mm), then this row should be cleaned with high pressure water through a culvert cleaning nozzle. This would be carried out through an upstream manhole or through the CULTEC StormFilter Unit (or other pre-treatment device). CCTV inspection of this row can be deployed through this access port to determine if any sediment has accumulated in the inlet row.

B. If the CULTEC bed is not equipped with an inspection port, then access to the inlet row will be through an upstream manhole or the CULTEC StormFilter.

1. Manhole Access

This inspection should only be carried out by persons trained in confined space entry and sewer inspection services. After the manhole cover has been removed a gas detector must be lowered into the manhole to ensure that there are not high concentrations of toxic gases present. The inspector should be lowered into the manhole with the proper safety equipment as per OSHA requirements. The inspector may be able to observe sediment from this location. If this is not possible, the inspector will need to deploy a CCTV robot to permit viewing of the sediment.

2. StormFilter Access
Remove the manhole cover to allow access to the unit. Typically a 30-inch (750 mm) pipe is used as a riser from the StormFilter to the surface. As in the case with manhole access, this access point requires a technician trained in confined space entry with proper gas detection equipment. This individual must be equipped with the proper safety equipment for entry into the StormFilter. The technician will be lowered onto the StormFilter unit. The hatch on the unit must be removed. Inside the unit are two filters which may be removed according to StormFilter maintenance guidelines. Once these filters are removed the inspector can enter the StormFilter unit to launch the CCTV camera robot.

C. The inlet row of the CULTEC system is placed on a polyethylene liner to prevent scouring of the washed stone beneath this row. This also facilitates the flushing of this row with high pressure water through a culvert cleaning nozzle. The nozzle is deployed through a manhole or the StormFilter and extended to the end of the row. The water is turned on and the inlet row is back-flushed into the manhole or StormFilter. This water is to be removed from the manhole or StormFilter using a vacuum truck.

III. Maintenance Guidelines

The following guidelines shall be adhered to for the operation and maintenance of the CULTEC stormwater management system:

A. The owner shall keep a maintenance log which shall include details of any events which would have an effect on the system's operational capacity.

B. The operation and maintenance procedure shall be reviewed periodically and changed to meet site conditions.

C. Maintenance of the stormwater management system shall be performed by qualified workers and shall follow applicable occupational health and safety requirements.

D. Debris removed from the stormwater management system shall be disposed of in accordance with applicable laws and regulations.

IV. Suggested Maintenance Schedules

A. Minor Maintenance
The following suggested schedule shall be followed for routine maintenance during the regular operation of the stormwater system:

Frequency	Action
Monthly in first year	Check inlets and outlets for clogging and remove any debris as required.
Spring and Fall	Check inlets and outlets for clogging and remove any debris as required.
One year after commissioning and every third year following	Check inlets and outlets for clogging and remove any debris as required.

B. Major Maintenance
The following suggested maintenance schedule shall be followed to maintain the performance of the CULTEC stormwater management chambers. Additional work may be necessary due to insufficient performance and other issues that might be found during the inspection of the stormwater management chambers. (See table on next page)

Major Maintenance *(continued)*

	Frequency	Action
Inlets and Outlets	Every 3 years	• Obtain documentation that the inlets, outlets and vents have been cleaned and will function as intended.
	Spring and Fall	• Check inlet and outlets for clogging and remove any debris as required.
CULTEC Stormwater Chambers	2 years after commissioning	• Inspect the interior of the stormwater management chambers through inspection port for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors will function as anticipated.
	9 years after commissioning every 9 years following	• Clean stormwater management chambers and feed connectors of any debris. • Inspect the interior of the stormwater management structures for deficiencies using CCTV or comparable technique. • Obtain documentation that the stormwater management chambers and feed connectors have been cleaned and will function as intended.
	45 years after commissioning	• Clean stormwater management chambers and feed connectors of any debris. • Determine the remaining life expectancy of the stormwater management chambers and recommended schedule and actions to rehabilitate the stormwater management chambers as required. • Inspect the interior of the stormwater management chambers for deficiencies using CCTV or comparable technique.
	45 to 50 years after commissioning	• Replace or restore the stormwater management chambers in accordance with the schedule determined at the 45-year inspection. • Attain the appropriate approvals as required. • Establish a new operation and maintenance schedule.
Surrounding Site	Monthly in 1st year	• Check for depressions in areas over and surrounding the stormwater management system.
	Spring and Fall	• Check for depressions in areas over and surrounding the stormwater management system.
	Yearly	• Confirm that no unauthorized modifications have been performed to the site.

For additional information concerning the maintenance of CULTEC Subsurface Stormwater Management Chambers, please contact CULTEC, Inc. at 1-800-428-5832.

CULTEC™
Chamber of Choice™

CULTEC, Inc.
878 Federal Road • P.O. Box 280 • Brookfield, CT 06804
Phone: 203-775-4416 • Toll Free: 800-4-CULTEC • Fax: 203-775-1462
Web: www.cultec.com • E-mail: custservice@cultec.com

ATTACHMENT G
STORMWATER FIGURES

SW-1: Existing Soil Conditions and Boring Locations

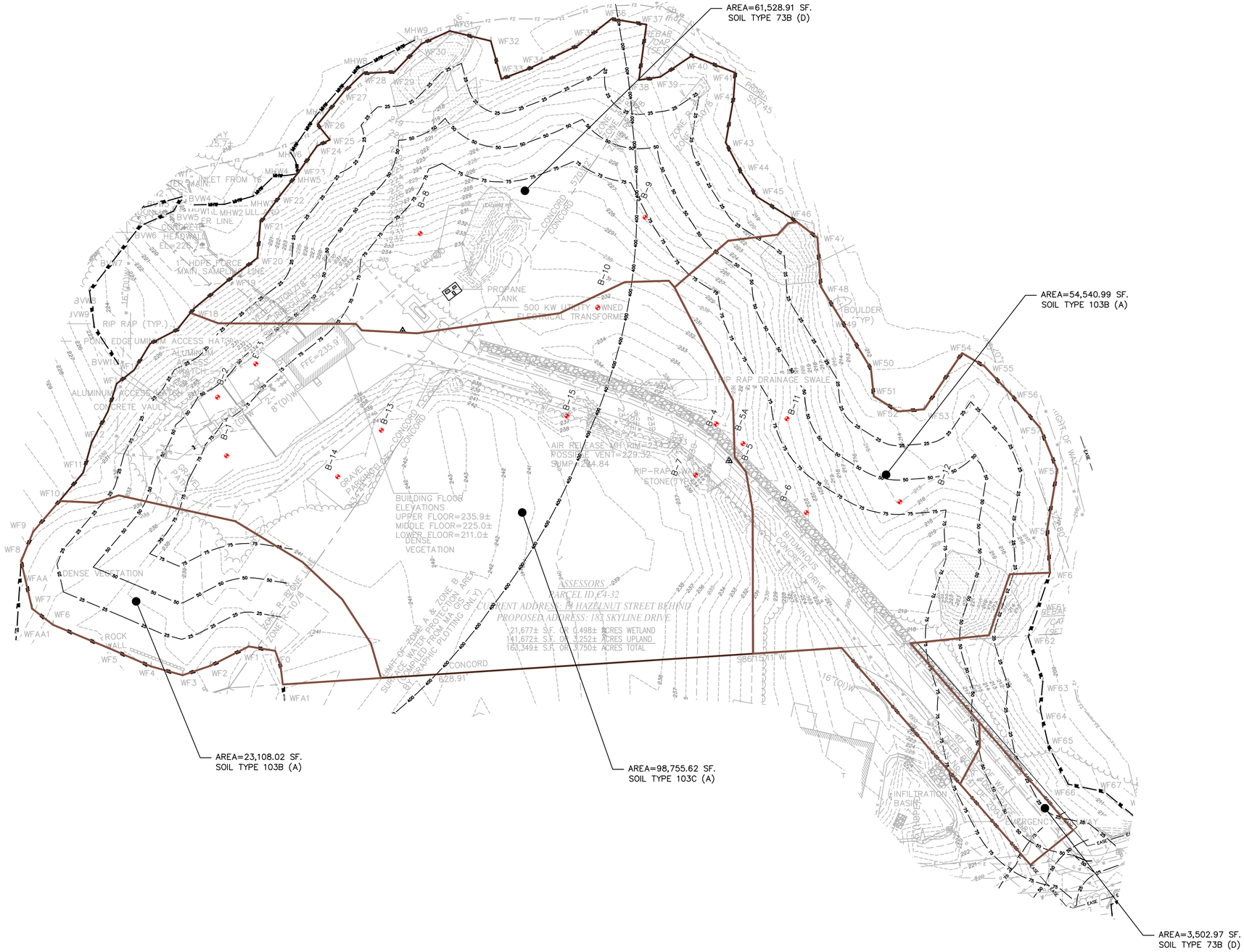
SW-2: Existing Cover Type Areas and Tc Path

SW-3: Proposed Cover Type Areas

SW-4: Proposed BMP Structures and Catchment Areas

LEGEND

EXISTING SOIL CONDITION LIMITS



Environmental Partners GROUP
A partnership for engineering solutions.

LIN ASSOCIATES, INC.
CONSULTING ENGINEERS

DiMarinisi & Wolfe
ARCHITECTS • URBAN DESIGNERS
BOSTON, MASSACHUSETTS

MARK	DATE	DESCRIPTION

Scale	1"=40'
Date	NOVEMBER 2015
Job No.	200-1501
Designed by	ASK
Drawn by	JFB
Checked by	DNRP
Approved by	SCO

THIS LINE IS ONE INCH LONG WHEN PLOTTED AT FULL SCALE ON A 22" X 34" DRAWING

NAGOG POND WATER TREATMENT PLANT

TOWN OF CONCORD, MASSACHUSETTS

EXISTING SOIL CONDITIONS AND BORING LOCATIONS

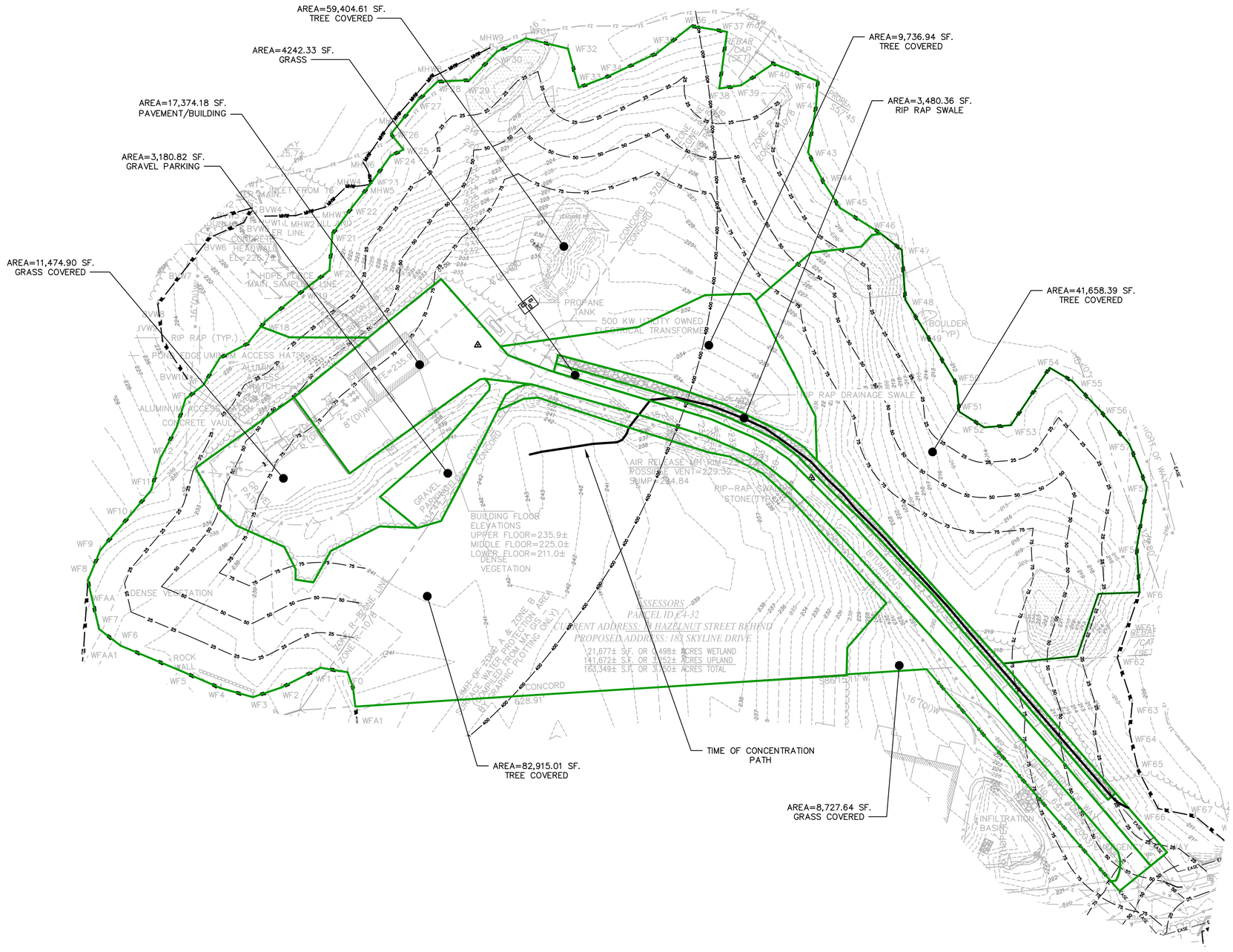
FOR PERMITTING

Sheet No.

SW-1

LEGEND

EXISTING COVER TYPE LIMITS



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BOSTON, MASSACHUSETTS

MARK	DATE	DESCRIPTION

Scale	1"=40'
Date	NOVEMBER 2015
Job No.	200-1501
Designed by	ASK/JFB
Drawn by	JFB
Checked by	DNRP
Approved by	SCO

THIS LINE IS ONE INCH LONG WHEN PLOTTED AT FULL SCALE ON A 22" X 34" DRAWING

NAGOG POND WATER TREATMENT PLANT

TOWN OF CONCORD, MASSACHUSETTS

EXISTING COVER TYPE AREAS AND Tc PATH

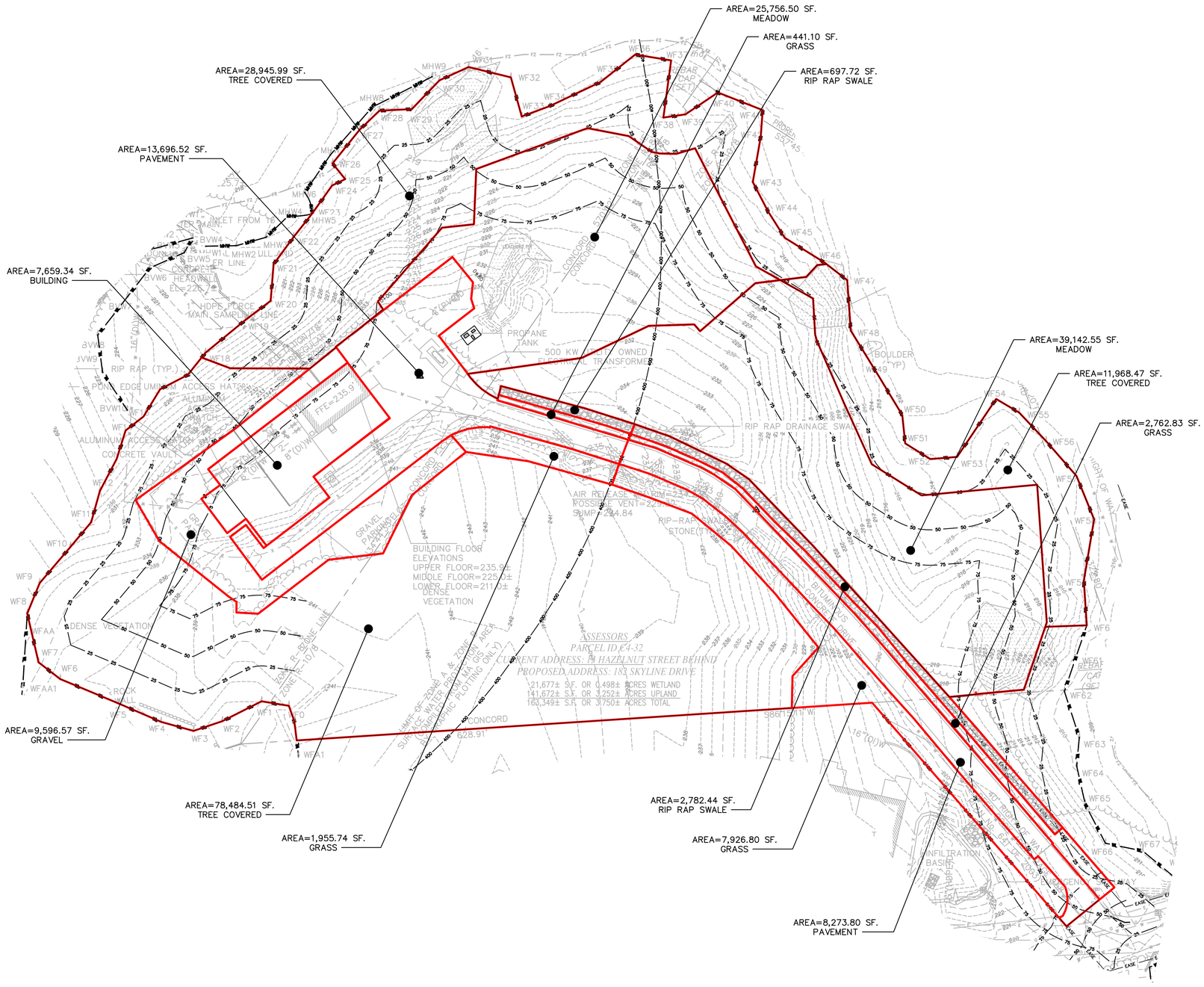
FOR PERMITTING

Sheet No.

SW-2

LEGEND

PROPOSED COVER TYPE LIMITS



			Scale	1"=40'
			Date	NOVEMBER 2015
			Job No.	200-1501
			Designed by	ASK/JFB
			Drawn by	JFB
			Checked by	DNRP
MARK	DATE	DESCRIPTION	Approved by	SCO

THIS LINE IS ONE INCH LONG WHEN PLOTTED AT FULL SCALE ON A 22" X 34" DRAWING

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CONSULTING ENGINEERS

DiMarinisi & Wolfe
ARCHITECTS • URBAN DESIGNERS
BOSTON, MASSACHUSETTS

NAGOG POND WATER TREATMENT PLANT

TOWN OF CONCORD, MASSACHUSETTS

PROPOSED COVER TYPE AREAS

FOR PERMITTING

Sheet No.

SW-3

Drawing file: I:\Concord 200\200-1501 Nagog Pond WTP Conceptual Design\Permitting\NOI\Appendix D-Stormwater Report\watershed areas.dwg Plot Date: Nov 17,2015-5:08pm

LEGEND

- PROPOSED CATCHMENT AREAS
- PROPOSED DRAINAGE PIPE
- PROPOSED CATCH BASIN
- PROPOSED DRYWELL
- PROPOSED R-150 XLHD CHAMBER
- PROPOSED R-330 XLHD CHAMBER

SUBSURFACE CHAMBERS, C-1
52 CULTEC R-150XLHD CHAMBERS
INV. IN(CB-1) = 231.75'
INV. IN(CB-2) = 231.75'
INV. OUT(8") = 232.33'
SLOPE OUT(8") = 0.61%
INV. OUT(4") = 231.67'
SLOPE OUT(4") = 0.5%

CB-1
RIM = 235.0'
INV. OUT = 232.95'
SLOPE OUT = 6.0%

CB-2
RIM = 235.0'
INV. OUT = 232.95'
SLOPE OUT = 1.6%

8" HDPE DRAIN PIPE

4" HDPE DRAIN PIPE

SUBSURFACE CHAMBERS, C-2
9 CULTEC R-330XLHD CHAMBERS
INV. IN(8") = 231.44'
INV. IN(4") = 230.95'
INV. OUT = 230.00'
SLOPE OUT = 0.0%

SUBSURFACE CHAMBERS, C-3
17 CULTEC R-330XLHD CHAMBERS
INV. IN(C-2) = 230.00'
INV. IN(DRYWELL) = 231.00'
INV. OUT = 230.68'
SLOPE OUT = 1.0%

FLARED END-SECTION
WITH RIP RAP PROTECTION

8" HDPE DRAIN PIPE
INV. OUT = 230.48'
SLOPE OUT = 1.0%

DRYWELL, D-1
INV. IN = 232.38'
INV. OUT = 231.25'
SLOPE OUT = 5.0%

CLEAN OUT (TYP.)

CB-3
RIM = 235.0'
INV. OUT = 232.95'
SLOPE OUT = 0.5%

PROPANE TANK

500 KW UTILITY OWNED ELECTRICAL TRANSFORMER

RIP RAP DRAINAGE SWALE

AIR RELEASE MH RIM=234.43
POSSIBLE VENT=229.32
SUMP=224.84

RIP-RAP SWALE STONE(TYP.)

BUILDING FLOOR ELEVATIONS
UPPER FLOOR=235.9±
MIDDLE FLOOR=225.0±
LOWER FLOOR=211.0±

DENSE VEGETATION

ASSESSORS
PARCEL ID C4-32
CURRENT ADDRESS: 19 HAZELNUT STREET BEHIND
PROPOSED ADDRESS: 182 SKYLINE DRIVE
21,677± S.F. OR 0.498± ACRES WETLAND
141,672± S.F. OR 3.252± ACRES UPLAND
160,349± S.F. OR 3.750± ACRES TOTAL

INFILTRATION BASIN

EMERGENCY WAY

NOTES:

1. ALL DRAINAGE PIPES TO BE 6" HDPE (ADS N-12 OR EQUAL) UNLESS OTHERWISE NOTED.

Drawing file: I:\Concord 200\200-1501 Nagog Pond WTP Conceptual Design\Permitting\NOI\Appendix D-Stormwater Report\watershed areas.dwg Plot Date: Nov 17,2015 6:10pm

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A partnership for engineering solutions.

LIN ASSOCIATES, INC.
CONSULTING ENGINEERS

DiMarinisi & Wolfe
ARCHITECTS • URBAN DESIGNERS
BOSTON, MASSACHUSETTS

MARK	DATE	DESCRIPTION

Scale	1"=40'
Date	NOVEMBER 2015
Job No.	200-1501
Designed by	ASK/JFB
Drawn by	JFB
Checked by	DNRP
Approved by	SCO

THIS LINE IS ONE INCH LONG WHEN PLOTTED AT FULL SCALE ON A 22" X 34" DRAWING

NAGOG POND WATER TREATMENT PLANT

TOWN OF CONCORD, MASSACHUSETTS

PROPOSED BMP STRUCTURES AND CATCHMENT AREAS

FOR PERMITTING

Sheet No.

SW-4

APPENDIX E
WETLANDS DELINEATION REPORT

PINEBROOK CONSULTING

April 29, 2015

ENVIRONMENTAL PARTNERS GROUP
1900 Crown Colony Drive, Suite 402
Quincy, Massachusetts 02169
Attention: Alex Richards

RE: Wetland Evaluation/Delineation at the Nagog Pond Disinfection Facility
Off Acorn Park Drive/Hazelnut Road, Acton, Massachusetts

Dear Alex:

On April 20, 2015, I investigated the above-referenced property (hereinafter referred to as the site) for the presence of wetland resource areas as defined under the Massachusetts Wetlands Protection Act (M.G.L. Chapter 131, Section 40) and the associated regulations, 310 CMR 10.00 (Regulations). The property, which is located west of the residential neighborhood (s) of Acorn Park Drive in Acton, supports the Nagog Pond Disinfection Facility (Facility) operated by the Town of Concord Department of Public Works (DPW). The purpose of the investigation was to identify any wetland resource areas near the Facility to be located and addressed for the improvement project proposed by the Concord DPW. The following provides a description of my findings.

Four different resource areas, as defined under Section 10.54, 10.56, 10.55 and 10.58, exist in the vicinity of the Facility; bank, land under a waterway/waterbody (LUWW), bordering vegetated wetland (BVW) and riverfront area, respectively. The most encompassing of the resource areas; BVW and riverfront; were identified/flagged in the field to establish the 100-foot buffer zone and the 100- and 200-foot riverfront areas.

Under Section 10.54 and 10.56 of the Regulations Nagog Pond (Pond) and Nagog Brook (Brook) are defined as bank and LUWW; the small intermittent stream, that flows from the wetland on/off the southwesterly side of the site, is defined as LUWW; and Nagog Brook has a 100 and 200-foot riverfront area associated with it. The Pond and Brook, located on the westerly portion of the site and the stream are all located within/encompassed by the flagged boundary of the BVW. The BVW, which would be most closely characterized as a wooded shrub swamp system was identified, primarily, by the presence of wetland and transitional vegetation such as: red maple (Acer rubrum), black birch (Betula lenta), tupelo (Nyssa sylvatica), shagbark hickory ((Carya ovata), hemlock (Tsuga canadensis) and white pine (Pinus strobus) in the overstory; highbush blueberry (Vaccinium corymbosum), sweet pepperbush (Clethra alnifolia), arrow-wood (Viburnum dentatum), and witch hazel (Hamamelis virginiana) in the shrub layer; and skunk cabbage (Symplocarpus foetidus), cinnamon fern (Osmunda cinnamomea), Massachusetts fern (Thelypteris simulata), sedges (Carex, spp.), princess pine (Lycopodium obscurum) and teaberry (Gaultheria procumbens) in the herbaceous layer.

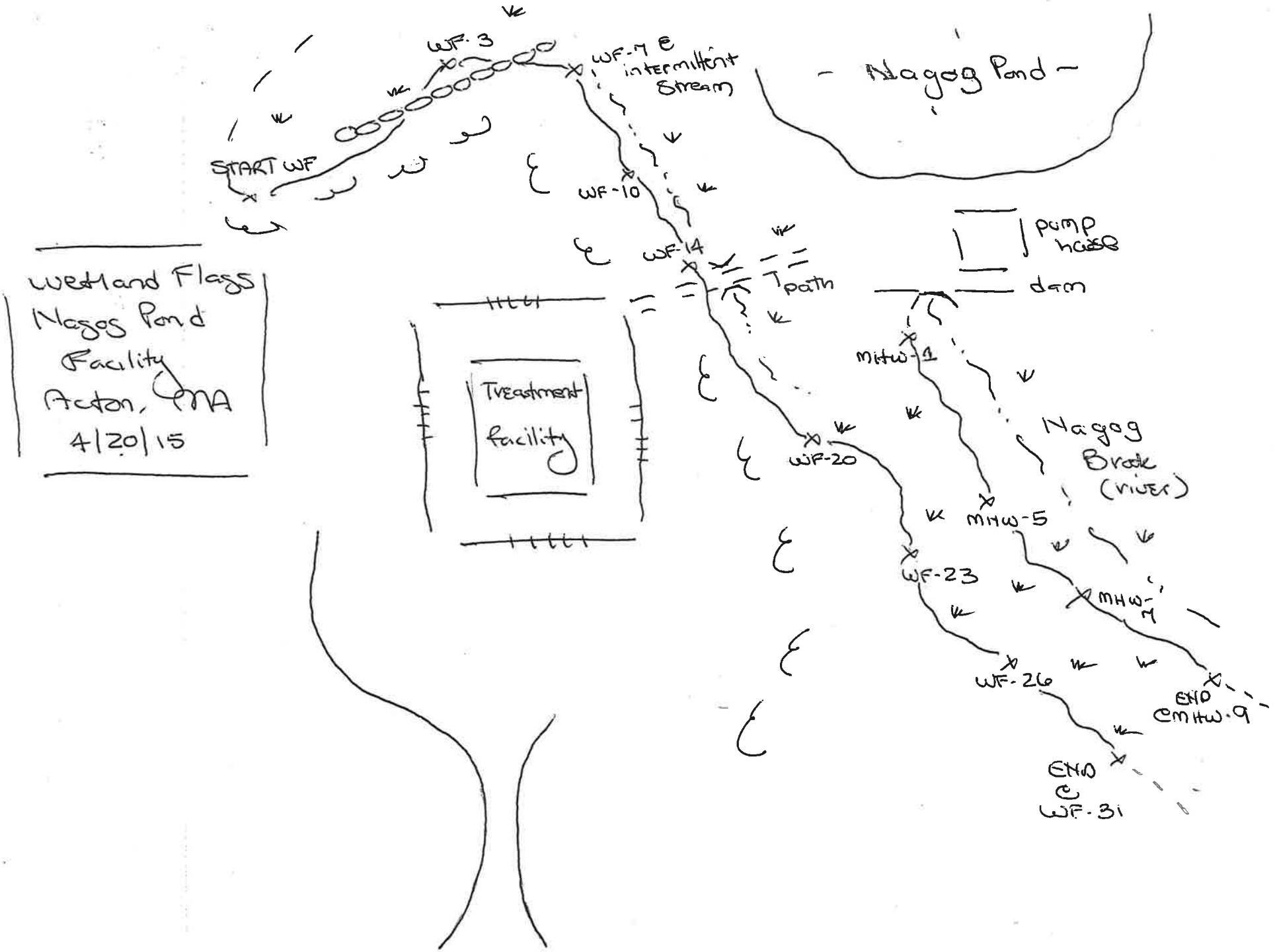
Other hydrological indicators, such as stained/matted leaves, saturated soils and buttressed root systems were also evident within the BVW and used to establish the BVW boundary. The BVW was flagged in the field with pink flags labeled WF-1 through WF-31 (with a start flag) (see attached sketch of the wetland flags). The BVW flags commence on the southerly side of the site, extend in a northerly then easterly direction around the Facility building, to where they terminate on the north-northeasterly side of the site. The mean high water (MHW) associated with Nagog Brook, from where it exits the Pond by the existing gatehouse, was identified/flagged in the field with blue flags labeled MHW-1 through MHW-9 (refer to sketch). The MHW flags, which generally coincide with the bank of the Brook, are the point from which the 100 and 200-foot riverfront areas are measured. It is my understanding that the flags identifying the BVW and MHW are to be surveyed and put on a plan to be submitted with a Notice of Intent (NOI) detailing the proposed project activities.

According to the most recent Massachusetts Natural Heritage Atlas (13th Edition) dated October 1, 2008, the site is not mapped as estimated and/or priority habitat for rare wildlife or rare species nor are there any certified/mapped vernal pools within the area.

If you have any questions regarding these findings and/or you need additional information, please feel free to call me at any time. I am glad I could assist you with this project and let me know if I can be of any help in the future.

Sincerely,
PINEBROOK CONSULTING

Brooke Monroe
Environmental Scientist


Wetland Flags
Nagog Pond
Facility
Acton, MA
4/20/15
START WF
WF-3
WF-7 & intermittent Stream
WF-10
WF-14
Nagog Pond
pump house
dam
path
Treatment facility
MHW-1
WF-20
Nagog Brook (river)
MHW-5
WF-23
MHW-7
WF-26
END @ MHW-9
END @ WF-31

PINEBROOK CONSULTING

ENVIRONMENTAL PARTNERS GROUP
1900 Crown Colony Drive, Suite 402
Quincy, Massachusetts 02169
Attention: Alex Richards

RE: Wetland Evaluation/Delineation at the Nagog Pond Disinfection Facility
Off Acorn Park Drive/Hazelnut Road, Acton, Massachusetts

Dear Alex:

On April 20, 2015, I delineated/flagged the wetland resource areas on the above-referenced property (hereinafter referred to as the site) in preparation for improvements proposed at Nagog Pond Disinfection Facility (Facility) (see Letter/Report from Pinebrook Consulting dated April 24, 2015). The wetland delineation consisted of the extent of the resource areas within 100 feet of the Facility building. On August 11, 2015, I re-visited the site to continue the delineation in an easterly direction, to the vicinity of Hazelnut Road, in preparation for the installation of a solar array proposed northeast of the Facility. Wetland flags labeled WF-32 through WF-68 were placed in the field to complete the delineation. The WF flags, which represent the boundary of the bordering vegetated wetland (BVW) associated with Nagog Brook, commence at previous flag WF-31 and extend to the culvert under the driveway into the Facility (WF-68), and in the vicinity of Hazelnut Road. The same method for determining the BVW boundary in April was used for the remaining delineation (refer to the Letter/Report mentioned above).

If you have any questions regarding this delineation and/or you need additional information, please feel to call me at any time. I am glad I could assist you this project and please let me know if I can be of any help in the future.

Sincerely,
PINEBROOK CONSULTING

Brooke Monroe
Environmental Scientist

PINEBROOK  **CONSULTING**

October 15, 2015

ENVIRONMENTAL PARTNERS GROUP
1900 Crown Colony Drive, Suite 402
Quincy, Massachusetts 02169
Attention: Alex Richards

RE: Wetland Evaluation/Delineation at the Nagog Pond Disinfection Facility
Off Acorn Park Drive/Hazelnut Road, Acton, Massachusetts

Dear Alex:

On April 20, 2015 I delineated/flagged the wetland resource areas on the above-referenced property (hereinafter referred to as the site) in preparation for improvements proposed at Nagog Pond Disinfection Facility (Facility) (see Letter/Report from Pinebrook Consulting dated April 24, 2015). On August 11, 2015, I delineated an additional area on the site for the potential solar array. On October 3, 2105, at your request, I hung additional flags off the site to the south. This wetland delineation; which consists of the bordering vegetated wetland (BVW) boundary previously delineated for the adjacent residential development off Hazelnut Drive; is identified with flags BVWA-1 thru BVW-A-12 and BVWAA-1 thru BVWAA-11. The vernal pool located within the BVW was also identified with flags VP-1 thru VP-7. The same method for determining the BVW boundary in April and was used for the remaining delineation (refer to the Letter/Report mentioned above).

If you have any questions regarding this delineation and/or you need additional information, please feel to call me at any time. I am glad I could assist you this project and please let me know if I can be of any help in the future.

Sincerely,
PINEBROOK CONSULTING

Brooke Monroe
Environmental Scientist

PINEBROOK CONSULTING

November 5, 2015

ENVIRONMENTAL PARTNERS GROUP
1900 Crown Colony Drive, Suite 402
Quincy, Massachusetts 02169
Attention: Steve Olsen

RE: Wetland Evaluation/Delineation at the Nagog Pond Disinfection Facility
Off Acorn Park Drive/Hazelnut Road, Acton, Massachusetts

Dear Steve:

On April 20, 2015, I delineated/flagged the wetland resource areas on the above-referenced property (hereinafter referred to as the site) in preparation for improvements proposed at Nagog Pond Disinfection Facility (Facility) (see Letter/Report from Pinebrook Consulting dated April 24, 2015). On August 11, 2015, I delineated an additional area on the site for the potential solar array. On October 3, 2015, at your request, I hung additional flags to delineate the wetland off the site to the south (see Letter dated October 15, 2015). On November 4, 2015, in preparation for proposed work on the dam located on Nagog Pond, I also delineated the resource area directly adjacent to the dam. These wetland flags; labeled BVW-1 through BVW-11; delineate a small freshwater marsh that supports such herbaceous species as cattails (Typha, spp.), tussock sedge (Carex stricta), sensitive fern (Onoclea sensibilis), marsh fern (Thelypteris thelypteroides) and woolgrass (Scirpus cyperinus). The flags extend from the culverts associated with the dam and connect to the wetland system (WF flags) associated with Nagog Brook that was delineated in April of 2015.

If you have any questions regarding this delineation and/or you need additional information, please feel to call me at any time. I am glad I could assist you this project and please let me know if I can be of any help in the future.

Sincerely,
PINEBROOK CONSULTING

Brooke Monroe
Environmental Scientist

APPENDIX F
ABUTTER NOTIFICATION LETTER

NOTIFICATION TO ABUTTERS
UNDER THE MASSACHUSETTS WETLANDS PROTECTION ACT
AND THE TOWN OF ACTON WETLANDS BYLAW

In accordance with the second paragraph of Massachusetts General Laws Chapter 131, Section 40 and the Town of Acton Bylaws, you are hereby notified of the following:

The Applicant: Town of Concord Water Department

Address 135 Keyes Road, Concord, MA 01742 Phone 978-318-3250

has filed a Notice of Intent with the Acton Conservation Commission seeking permission to remove, fill, dredge or alter an Area Subject to Protection under the Wetlands Protection Act.

Applicant's Representative: Environmental Partners Group, Inc.

Address 1900 Crown Colony Drive, Suite 402 Phone 617-657-0200

The address of the property where the activity is proposed 180/182 Skyline Drive, Acton, MA 01720

Town Atlas Plate/Map C4/C4 Parcel/Lot 14/32

Project Description Replacing the 100-year old cast iron intake pipe within Nagog Pond, demolishing the existing ozone disinfection facility, constructing a new water treatment plant on the site of the existing facility, construction of an accessory solar photovoltaic array system to power the facilities.

For more information please contact the Conservation Office at 978-929-6634 or email NR@acton-ma.gov. Copies of the Notice of Intent may be examined at the Conservation Office, Acton Town Hall, 472 Main Street, Acton between the hours of 9:00 A.M. and 4:30 P.M. Monday through Friday.

A Public Hearing will be held at the Acton Town Hall, 472 Main Street, on Wednesday,

December 2, 2015 (date) at 7:30 P.M.

The notice of the public hearing will be published at least five (5) days in advance in the Acton edition of the *Beacon* newspaper or *Metrowest Daily News*.

NOTE: You may also contact your local conservation commission or the nearest Department of Environmental Protection Regional Office* for the information about this application or, the Wetlands Protection Act. Acton is in the Central Region. To contact DEP, call:

***DEP Central Region: 508-792-7650**
627 Main Street, Worcester MA 01608

AFFIDAVIT OF SERVICE

Under the Massachusetts Wetlands Protection Act

(to be submitted to the Massachusetts Department of Environmental Protection and the Conservation Commission when filing a Notice of Intent)

I, Stephen C. Olson, P.E., hereby certify under the pains and penalties of perjury that on _____ (*date*) I gave notification to abutters in compliance with the second paragraph of Massachusetts General Laws Chapter 131, Section 40, and the DEP Guide to Abutter Notification dated April 8, 1994, in connection with the following matter:

A Notice of Intent filed under the Massachusetts Wetlands Protection Act by Environmental Partners Group, Inc. with the Acton Conservation Commission on _____ (*date*) for property located at 180/182 Skyline Drive (*project location*), Acton.

The form of the notification, and a list of the abutters to whom it was given and their addresses, are attached to this Affidavit of Service.

_____ _____

Name Date

Town of Acton
472 Main Street
Acton, MA 01720
Telephone (978) 929-6621
Fax (978) 929-6340

Brian McMullen
Principal Assessor

Parcel Location 180 + 182 Skyline Drive
Parcel I.D.: C4-13 + C4-32

Location	Parcel ID	Owner	Co-Owner	Mailing Address	Address 2
B4-16	5 BREEZY POINT RD	KLIGER HAROLD M	NICHOLLS DEBORAH E	5 BREEZY POINT RD	ACTON, MA 01720
C3-8	287 NAGOG HILL RD	ACTON WATER DISTRICT		PO BOX 953	ACTON, MA 01720
C4-1	14 BREEZY POINT RD	BRENNAN AINSLIE S		14 BREEZY POINT RD	ACTON, MA 01720
C4-1-1	11 BREEZY POINT RD	FRY WILLIAM A	FRY KELLY J	11 BREEZY POINT RD	ACTON, MA 01720
C4-1-2	9 BREEZY POINT RD	YANG WEI	CHEN WEI GANG	9 BREEZY POINT RD	ACTON, MA 01720
C4-12-5	8 BREEZY POINT RD	SCHENA DAVID	LOESCHORN CAROL A	8 BREEZY POINT RD	ACTON, MA 01720
C4-12-6	6 BREEZY POINT RD	WEISS ERIC H + ALISSA		6 BREEZY POINT RD	ACTON, MA 01720
C4-1-3	7 BREEZY POINT RD	LUO PENG	WANG JINGHONG	7 BREEZY POINT RD	ACTON, MA 01720
C4-14	339 NAGOG HILL RD	TOWN OF CONCORD	WATER DEPT	135 KEYES RD	CONCORD, MA 01742
C4-1-4	3 BREEZY POINT RD	LIU XINBING	JIANG MIN	3 BREEZY POINT RD	ACTON, MA 01720
C4-15	484 GREAT RD	GOULD SHERRILL R TRUSTEE	486 REALTY TRUST	311 GREAT RD	LITTLETON, MA 01460
C4-1-5	12 BREEZY POINT RD	MANNING JOHN J	MANNING LORA L	12 BREEZY POINT ROAD	ACTON, MA 01720
C4-21-24	3 BEECHNUT ST	RUSHKIN ILYA	LIN JIAN	3 BEECHNUT ST	ACTON, MA 01720
C4-21-25	5 BEECHNUT ST	BOLEN KEVIN R	BOLEN PAMELA S	5 BEECHNUT ST	ACTON, MA 01720
C4-21-26	7 BEECHNUT ST	COLLINS LAWRENCE T	COLLINS LINDA M	7 BEECHNUT ST	ACTON, MA 01720
C4-21-27	9 BEECHNUT ST	GANESAN VEDAVINAYAGAM		9 BEECHNUT ST	ACTON, MA 01720
C4-21-28	6 BEECHNUT ST	RAVIS JOHN G	RAVIS JERI L	6 BEECHNUT ST	ACTON, MA 01720
C4-21-29	4 BEECHNUT ST	FRIEDMAN G STODEL	SUAREZ STEPHANIE COX	4 BEECHNUT ST	ACTON, MA 01720
C4-21-30	2 BEECHNUT ST	LI HAILONG	YU LING	2 BEECHNUT ST	ACTON, MA 01720
C4-21-31	1 HAZELNUT ST	PETRAITIS MARTIN S	PETRAITIS DEBRA S	1 HAZELNUT ST	ACTON, MA 01720
C4-21-32	3 HAZELNUT ST	TAO ZHONG	WANG JIE	3 HAZELNUT ST	ACTON, MA 01720
C4-21-33	5 HAZELNUT ST	GU QI	XIE FANG	5 HAZELNUT ST	ACTON, MA 01720
C4-21-34	7 HAZELNUT ST	PURDOM GEOFFREY J	PURDOM DIANE K	7 HAZELNUT ST	ACTON, MA 01720
C4-21-35	9 HAZELNUT ST	CAI YAO YONG	ZHANG MIN	9 HAZELNUT ST	ACTON, MA 01720
C4-21-36	11 HAZELNUT ST	WONN DAVID M	WONN MARY ANNE	11 HAZELNUT ST	ACTON, MA 01720
C4-21-37	8 HAZELNUT ST	HUANG HAIBIN	ZHENG MENGQIU	8 HAZELNUT ST	ACTON, MA 01720
C4-21-38	10 HAZELNUT ST	CAO ZHU ALEXANDER	ZHU WENJING SUZANNE	10 HAZELNUT ST	ACTON, MA 01720
C4-21-41	2 HAZELNUT ST	ONKEN MATTHEW T	HENLEY-ONKEN ERIKA L	2 HAZELNUT ST	ACTON, MA 01720
C4-21-42	4 HAZELNUT ST	TURNER KATHERINE J TRUSTEE	TURNER REALTY TRUST	4 HAZELNUT ST	ACTON, MA 01720
C4-21-43	6 HAZELNUT ST	RAO JEETENDRA	SALONI	6 HAZELNUT ST	ACTON, MA 01720

C4-21-44	15 HAZELNUT ST	LI WUJUN	LI WEI	15 HAZELNUT ST	ACTON, MA 01720
C4-21-45	17 HAZELNUT ST	LIU YANG	ZHONG YINGMY	17 HAZELNUT ST	ACTON, MA 01720
C4-21-46	521 ACORN PARK DR	KRISHNAN ANURADHA	KRISHNAN SUDHIR	521 ACORN PARK DR	ACTON, MA 01720
C4-21-47	523 ACORN PARK DR	SUNEEL KRISHNASWAMY	SUNEEL SOWMYA	523 ACORN PARK DR	ACTON, MA 01720
C4-21-48	525 ACORN PARK DR	LAPINSKI RONALD	LAPINSKI LISA B	525 ACORN PARK DR	ACTON, MA 01720
C4-21-49	529 ACORN PARK DR	JANI AJIT	JANI TRUPTI	529 ACORN PARK DR	ACTON, MA 01720
C4-21-50	531 ACORN PARK DR	HUANG ZHONG FEI	SIU KI	531 ACORN PARK DR	ACTON, MA 01720
C4-21-51	535 ACORN PARK DR	VANGURI SHANTI		535 ACORN PARK DR	ACTON, MA 01720
C4-21-52	537 ACORN PARK DR	CHOI YUNHEE	LIM SUNGYUNG	537 ACORN PARK DR	ACTON, MA 01720
C4-21-53	539 ACORN PARK DR	PENTZ THERESA M		539 ACORN PARK DR	ACTON, MA 01720
C4-21-54	527 ACORN PARK DR	UTT JR JAMES WARREN	UTT CATHERINE GOUCHER	527 ACORN PARK DR	ACTON, MA 01720
C4-21-55	520 ACORN PARK DR	GROVES ERIC S	GROVES TRACY H	520 ACORN PARK DR	ACTON, MA 01720
C4-24	281 NAGOG HILL RD	CONANT PHOEBE M	C/O BREWSTER CONANT	151 NAGOG HILL RD	ACTON, MA 01720
C4-27-1	2 PALMER LN	SHIMIZU K, GROVES E, CREMMEN R et al		1 PALMER LN	ACTON, MA 01720
C4-27-6	6 PALMER LN	REICHERT DEBORAH L		6 PALMER LN	ACTON, MA 01720
C4-27-7	3 PALMER LN	IYER NEHA B	IYER KRISHNAN S	3 PALMER LN	ACTON, MA 01720
C4-27-8	5 PALMER LN	LILLIE MICHAEL W	LILLIE KATE B	5 PALMER LN	ACTON, MA 01720
C4-27-9	8 PALMER LN	GORE JEFFREY K	GORE VALERIE L BAUER	8 PALMER LN	ACTON, MA 01720
C4-28-A01	420 GREAT RD #A1	CRONE DIANE M		420 GREAT RD #A1	ACTON, MA 01720
C4-28-A02	420 GREAT RD #A2	BUONOPANE PAUL P		420 GREAT ROAD #A2	ACTON,, MA 01720
C4-28-A03	420 GREAT RD #A3	CHOU CHIA CHEN		420 GREAT RD #A3	ACTON, MA 01720
C4-28-A04	420 GREAT RD #A4	CHADSEY DEXTER		4 CARTER DR	NATICK, MA 01760
C4-28-A05	420 GREAT RD #A5	RODROG ASSOCIATES	C/O RODNEY HASS	3 SANDALWOOD ROAD	ACTON, MA 01720
C4-28-A06	420 GREAT RD #A6	TRAPELO PARK ASSOCIATES LLC		12 BROOK ST	FITCHBURG, MA 01420
C4-28-A08	420 GREAT RD #A8	ROSA FRANCISCO	GONCALVES TERESA	77 CIDER MILL RD	SUDBURY, MA 01776
C4-28-A09	420 GREAT RD #A9	JENKINS GARY W		397 PINE CONE STRAND	ACTON, MA 01718
C4-28-A10	420 GREAT RD #A10	BAMFORD RAYMOND L	BAMFORD BROOKE E	420 GREAT RD #A10	ACTON, MA 01720
C4-28-B01	420 GREAT RD #B1	B + E PROPERTIES LLC		422 W 39TH AVE	SAN MATEO, CA 94403
C4-28-B02	420 GREAT RD #B2	MEEHAN MICHAEL P.		420 GREAT RD #B2	ACTON, MA 01720
C4-28-B03	420 GREAT RD #B3	FLOOD KELLY		420 GREAT RD #B3	ACTON, MA 01720
C4-28-B04	420 GREAT RD #B4	CORTEZ LUIZ P		420 GREAT RD #B4	ACTON, MA 01720
C4-28-B05	420 GREAT RD #B5	FISCHER SUSAN		420 GREAT RD #B5	ACTON, MA 01720
C4-28-B06	420 GREAT RD #B6	SUN HONGYAN	FU QINGWEI	420 GREAT RD # B6	ACTON, MA 01720
C4-28-B07	420 GREAT RD #B7	FLOOD KELLY K		34 BRANDYMEADE CIRCLE	STOW, MA 01775
C4-28-B08	420 GREAT RD #B8	PHO SON B	NGUYEN NGOC	104 CONCORD RD	CHELMSFORD, MA 0182
C4-28-B09	420 GREAT RD #B9	YING CHAOMING	ZHOU JINGHUA	39 LEXINGTON DR	ACTON, MA 01720
C4-28-B10	420 GREAT RD #B10	LALA KANAYO H	LALA SONI K	4 WEST ROAD	ACTON, MA 01720
C4-28-C01	420 GREAT RD #C1	BARRETT ANDREW D	BARRETT PETER	330 W 17TH 1W	NEW YORK, NY 10011
C4-28-C02	420 GREAT RD #C2	YING PROPERTIES LLC		39 LEXINGTON DR	ACTON, MA 01720
C4-28-C03	420 GREAT RD #C3	LALA SONI + KANAYO		420 GREAT RD #C3	ACTON, MA 01720
C4-28-C04	420 GREAT RD #C4	CARLOUGH JUDITH M		420 GREAT RD #C4	ACTON, MA 01720
C4-28-C05	420 GREAT RD #C5	RICHMOND HOUSE REALTY COMPAN\	C/O PAGIARLAS STEPHANIE	420 GREAT ROAD #C5	ACTON, MA 01720
C4-28-C06	420 GREAT RD #C6	KYZIVAT, KEITH T		420 GREAT RD #C6	ACTON, MA 01720

C4-28-C07	420 GREAT RD #C7	ZALESKI STEPHEN J		7 LOCUST STREET	MARBLEHEAD, MA 0172
C4-28-C08	420 GREAT RD #C8	CARISTI LINDA T		12 GLEN ST	SOMERVILLE, MA 02145
C4-28-C09	420 GREAT RD #C9	WHITEHEAD RAY B		68 OLD FARM RD	DOUGLAS, MA 01516
C4-28-C10	420 GREAT RD #C10	LEVIN YURY A	LEVIN OLGA	13 NORTH PARK ST	WATERTOWN, MA 0247
C4-32	13 HAZELNUT ST BEHIND	CONCORD TOWN OF		133 KEYES RD	CONCORD, MA 01742
C4-7-1	10 BREEZY POINT RD	HUANG YAOYAO	SUN JIAN-RONG	10 BREEZY POINT RD	ACTON, MA 01720
D4-1-3	257 NAGOG HILL RD	TOWN OF ACTON		472 MAIN STREET	ACTON, MA 01720
D4-15	568 MAIN ST REAR	TOWN OF ACTON		472 MAIN ST	ACTON, MA 01720
D4-17	28 SKYLINE DR	PALMER GLORIA W TRUSTEE		28 SKYLINE DR	ACTON, MA 01720
D4-18	358 GREAT RD	BENSON & EVAN REAL ESTATE LLC		358 GREAT RD	ACTON, MA 01720
D4-18-1	360 GREAT RD	XIE NING	GENG GANG	360 GREAT RD	ACTON, MA 01720
D4-19	361 GREAT RD	PARSONS ANNE	C/O RALPH PARSONS	S41 W 26985 OAK GROVE LANE	WAUKESHA, WI 53189
D4-201-1	368 GREAT RD #1	KOHLER ROBERT M		368 GREAT RD #1	ACTON, MA 01720
D4-201-2	368 GREAT RD #2	IRMIGER RIA M	IRMIGER LILIAN M	368 GREAT RD #2	ACTON, MA 01720
D4-201-3	368 GREAT RD #3	HARRIS, PATRICIA A		368 GREAT RD #3	ACTON, MA 01720
D4-201-4	368 GREAT RD #4	BOMBARDIERI ROCCO A		368 GREAT RD #4	ACTON, MA 01720
D4-201-5	370 GREAT RD #5	GARABEDIAN MARK L		PO BOX 2725	ACTON, MA 01720
D4-201-6	370 GREAT RD #6	WU MICHAEL		31 KENDALL CT APT 32	BEDFORD, MA 01730
D4-201-7	368 GREAT RD #7	DAVID OWEN		PO BOX 12374	THORNDON WELLINGT
D4-201-8	370 GREAT RD #8	MCNEIL MARTHA M		370 GREAT RD #8	ACTON, MA 01720
D4-202-10	374 GREAT RD #10	REED MARYELLYN		374 GREAT RD #10	ACTON, MA 01720
D4-202-11	374 GREAT RD #11	MANGYN JOHN		374 GREAT ROAD #11	ACTON, MA 01720
D4-202-12	374 GREAT RD #12	TROUGHTON HOWARD	SABININ POLINA	374 GREAT RD #12	ACTON, MA 01720
D4-202-13	376 GREAT RD #13	REEN JENNIFER		376 GREAT RD #13	ACTON, MA 01720
D4-202-14	376 GREAT RD #14	TIPNIS SUPRIYA		376 GREAT RD #14	ACTON, MA 01720
D4-202-15	376 GREAT RD #15	POPIENIUCK MATTHEW B		376 GREAT RD #15	ACTON, MA 01720
D4-202-16	376 GREAT RD #16	MOREL SUSANNE		376 GREAT RD #16	ACTON, MA 01720
D4-21	588 MAIN ST REAR	TOWN OF ACTON		472 MAIN ST	ACTON, MA 01720
D4-23	592 MAIN ST REAR	COMMONWEALTH OF MASS	DIV OF FISHERIES & WILDLIFE	66 HARRIS ST	ACTON, MA 01720
D4-25-B01	5 WAMPUS AV #B1	KERR WARREN		5 WAMPUS AV #B1	ACTON, MA 01720
D4-25-B02	5 WAMPUS AV #B2	TILTON JOHN		88 DEERGRASS LANE	CONCORD, MA 01742
D4-25-B03	5 WAMPUS AV #B3	BLEAKLEY JAMES TRUSTEE		20 LIBERTY AVENUE	LEXINGTON, MA 02420
D4-25-B04	5 WAMPUS AV #B4	SPINELLI CARMEN F	SPINELLI MARGARET F	121 HARRINGTON AVE.	CONCORD, MA 01742
D4-25-B05	5 WAMPUS AV #B5	AMIS GREGORY P	FERREIRA KAREN	20 ABBOT ST	WESTFORD, MA 01720
D4-25-B06	5 WAMPUS AV #B6	ROESLER MARTIN		5 WAMPUS AV #B6	ACTON, MA 01720
D4-25-B07	5 WAMPUS AV #B7	ZUPPE JOHN B		137 WILLIS RD	GARDNER, MA 01440
D4-25-B08	5 WAMPUS AV #B8	ACTON CRESTFIELD LLC		21 ALASKA AVE	BEDFORD, MA 01730
D4-25-B09	5 WAMPUS AV #B9	GOYKHMAN DMITRY		78 BOURNE STREET	AUBURNDALE, MA 0246
D4-25-B11	7 WAMPUS AV #B11	LEWIS JR GORDON W		2 RACHEL RD	BOYLSTON, MA 01505
D4-25-B12	7 WAMPUS AV #B12	RRIVERS LLC		12 BROOKS ST	FITCHBURG, MA 01420
D4-25-B13	7 WAMPUS AV #B13	YAN MING		7 WAMPUS AV #B13	ACTON, MA 01720
D4-25-B14	7 WAMPUS AV #B14	CHOU GEORGE	CHOU ANNA	7 WAMPUS AV #B14	ACTON, MA 01720
D4-25-B15	7 WAMPUS AV #B15	BRAHMACHARI ABHIJIT	BRAHMACHARI DEBJANI	592 MASSAPOAG AVE	SHARON, MA 02067

D4-25-B16	7 WAMPUS AV #B16	ZHANG QING		7 WAMPUS AV #B16	ACTON, MA 01720
D4-25-B17	7 WAMPUS AV #B17	BARKWELL REX ET AL		322 CLINTON ROAD	ATRIM, NH 03440
D4-25-B18	7 WAMPUS AV #B18	TULLY RYAN		7 WAMPUS AV #B18	ACTON, MA 01720
D4-28	340 GREAT RD	ACTON WOODS ASSOC	C/O CRES LLC	50 SALEM ST	LYNNFIELD, MA 01940
D4-28-1	630 MAIN ST	WURMAN PETER R	WURMAN NANCY A	630 MAIN ST	ACTON, MA 01720
D4-28-2	626 MAIN ST	HARPELL GEORGE F JR	DIANE C POULOS-HARPELL	626 MAIN ST	ACTON, MA 01720
D4-38	341 GREAT RD	341 GREAT ROAD REALTY LLC		341 GREAT RD	ACTON, MA 01720
D4-380-A-101	380 GREAT RD A101	ACTON HOUSING AUTHORITY		P.O. BOX 681	ACTON,, MA 01720
D4-380-A-102	380 GREAT RD A102	MORONG ROBERT S JR		380 GREAT RD A102	ACTON, MA 01720
D4-380-A-103	380 GREAT RD A103	LI GANG & SUN DAN		57 HOSMER ST	ACTON, MA 01720
D4-380-A-104	380 GREAT RD A104	MARSH PATRICK TRUSTEE	MARSH CONDO REALTY TRUST	20 OAK STREET	BEVERLY, MA 01915
D4-380-A-201	380 GREAT RD A201	METHRATTA ABSU P		11 ROSEANNA PARK DRIVE	WALTHAM, MA 02452
D4-380-A-202	380 GREAT RD A202	RUSSELL MCKINNEY H	KOUTSOPODIOTIS	380A GREAT RD #202	ACTON, MA 01720
D4-380-A-203	380 GREAT RD A203	RYAN ERIN M	MCGARRY JOHN J III	380 GREAT RD A203	ACTON, MA 01720
D4-380-A-204	380 GREAT RD A204	HILMY AHMED		64 WOBURN ST	LEXINGTON, MA 02420
D4-380-A-301	380 GREAT RD A301	SHAW NANCY A		380A GREAT RD	ACTON, MA 01720
D4-380-A-302	380 GREAT RD A302	SAVCHENKO OLEKSH		380 GREAT RD A302	ACTON, MA 01720
D4-380-A-303	380 GREAT RD A303	XIONG JAY + NANCY		1 FARMERS ROW	ACTON, MA 01720
D4-380-A-304	380 GREAT RD A304	LEIBY RUTH D		380A GREAT RD	ACTON, MA 01720
D4-380-B-101	380 GREAT RD B101	VALI SETAREH		380 GREAT RD B101	ACTON, MA 01720
D4-380-B-103	380 GREAT RD B103	CHRISTMAS DAVID A TRUSTEE	DAVID A CHRISTMAS TRUST 2000	190 POPE ROAD	ACTON, MA 01720
D4-380-B-201	380 GREAT RD B201	HOWELL KENNETH	BENT MICHELLE	10 HARRISON STREET UNIT 2	NEWTON, MA 02461
D4-380-B-202	380 GREAT RD B202	KAEWSIRIPONG SRIRATH	TECHASOUVAPAK PRAYONG	380B GREAT RD	ACTON, MA 01720
D4-380-B-203	380 GREAT RD B203	LENG MARIA CLAIRE		380 GREAT RD B203	ACTON, MA 01720
D4-380-B-204	380 GREAT RD B204	GASSIAN STUART E	FRIEDMAN NANCY	401 BEACON STREET	NEWTON, MA 02467
D4-380-B-302	380 GREAT RD B302	XIONG JAY + NANCY		1 FARMERS ROW	ACTON, MA 01720
D4-380-B-304	380 GREAT RD B304	MORSE KENNETH	MORSE LINDA	269 JOSEPH RD	BOXBOROUGH, MA 017
D4-382-A-101	382 GREAT RD A101	ARUMUGASAMY JEEVANANDAM		88 JOYCE LN	BOXBOROUGH, MA 017
D4-382-A-102	382 GREAT RD A102	KILEY ROBERT M		382A GREAT RD	ACTON, MA 01720
D4-382-A-103	382 GREAT RD A103	ANGADI SANTOSH		382A GREAT RD	ACTON, MA 01720
D4-382-A-104	382 GREAT RD A104	KERAMARIS JOHN		16 STRAWBERRY HILL RD	ACTON, MA 01720
D4-382-A-201	382 GREAT RD A201	FRIEDMAN NANCY	GRASSIAN STUART	401 BEACON STREET	CHESTNUT HILL, MA 02
D4-382-A-202	382 GREAT RD A202	ELKIN ALEX		382 GREAT RD A202	ACTON, MA 01720
D4-382-A-203	382 GREAT RD A203	LIU YING + CHEN JIE		4 CEDAR TER	ACTON, MA 01720
D4-382-A-204	382 GREAT RD A204	REN BIAO	QIN WENJIA	1 SHADY LN	ACTON, MA 01720
D4-382-A-301	382 GREAT RD A301	IVERSEN PAUL J		382A GREAT RD	ACTON, MA 01720
D4-382-A-302	382 GREAT RD A302	GARABEDIAN MARK L		PO BOX 2725	ACTON, MA 01720
D4-382-A-303	382 GREAT RD A303	PATEL JAGDISH A	PATEL HEMLATA J	382A GREAT RD	ACTON, MA 01720
D4-382-A-304	382 GREAT RD A304	ALCO CONDO TRUST	THE 21 CONDO PARTNERSHIP	3 BESSOM STREET #151	MARBLEHEAD, MA 0194
D4-382-B-101	382 GREAT RD B101	BROOKS MARK TRUSTEE	JJEM REALTY TRUST	PO BOX 683	ACTON, MA 01720
D4-382-B-102	382 GREAT RD B102	FRANCIS NICHOLAS R	IMHOFF KATHERINE A	382B GREAT RD	ACTON, MA 01720
D4-382-B-103	382 GREAT RD B103	YARIN JAMES		382B GREAT RD B103	ACTON, MA 01720
D4-382-B-104	382 GREAT RD B104	GARCIA EDITH		382 GREAT RD B104	ACTON, MA 01720

D4-382-B-201	382 GREAT RD B201	TUN MAUNG ZAW + HLA KHIN		382 GREAT RD B201	ACTON, MA 01720
D4-382-B-202	382 GREAT RD B202	FRUSCIONE EDITH E TRUSTEE		754 MAIN ST	CONCORD, MA 01742
D4-382-B-203	382 GREAT RD B203	ARRIA RICHARD		382 GREAT RD B203	ACTON, MA 01720
D4-382-B-204	382 GREAT RD B204	KESILMAN YEFIM S ET AL		382B GREAT RD	ACTON, MA 01720
D4-382-B-301	382 GREAT RD B301	BRIGHAM INVESTMENTS LLC		19 CORTLAND DR	HUDSON, MA 01749
D4-382-B-302	382 GREAT RD B302	BARRERA JAYRON O		382 GREAT RD B302	ACTON, MA 01720
D4-382-B-303	382 GREAT RD B303	WU ERIC Y		382 GREAT RD B303	ACTON, MA 01720
D4-384-A-101	384 GREAT RD A101	SHARMA ANURAG K		18 MILESTONE LN	NORTHBORO, MA 01532
D4-384-A-102	384 GREAT RD A102	APEX REALTY TRUST	C/O JOHN DICECCA	384A GREAT RD	ACTON, MA 01720
D4-384-A-103	384 GREAT RD A103	PRATHIPATI GURAVAIAH	TALLURI KRANTHI	384 GREAT RD A103	ACTON, MA 01720
D4-384-A-104	384 GREAT RD A104	CHRISTMAS MAUREEN H + DAVID A		190 POPE ROAD	ACTON, MA 01720
D4-384-A-201	384 GREAT RD A201	GRASSIAN STUART E	FRIEDMAN NANCY	401 BEACON STREET	NEWTON, MA 02467
D4-384-A-202	384 GREAT RD A202	HANNA DRAYTON L		384 GREAT RD A202	ACTON, MA 01720
D4-384-A-203	384 GREAT RD A203	BERGAN KENDRA A	GEORGE DAVID	384 GREAT RD A203	ACTON, MA 01720
D4-384-A-204	384 GREAT RD A204	CHATWANI ASHOK U	CHATWANI REKHA R	2730 WASHINGTON BLVD	FREMONT, CA 94539
D4-384-A-301	384 GREAT RD A301	LIAO HSINI	CHANG CHIA-CHIEN	7 CAESAR JONES WY	BEDFORD, MA 01730
D4-384-A-302	384 GREAT RD A302	BANIA JOSEPH		349 BUSINESS ROUTE 4	CENTER RUTLAND, VT (
D4-384-A-303	384 GREAT RD A303	BAKHUMTSKY IRINA		402 PARIDISE RD APT 3B	SWAMPSCOTT, MA 019(
D4-384-A-304	384 GREAT RD A304	DONNELLAN PATRICIA L		384A GREAT RD	ACTON, MA 01720
D4-384-B-101	384 GREAT RD B101	YAO JUNMEI	JIN HONG	384 GREAT RD B101	ACTON, MA 01720
D4-384-B-102	384 GREAT RD B102	KILPI RIIKO		2023 N ATLANTIC AVE #231	COCOA BEACH, FL 3293
D4-384-B-103	384 GREAT RD B103	MONAGHAN DAVID W/SHARON L TRSTEE		46 STRICHEN LANE	BELLA VISTA, AR 72739
D4-384-B-104	384 GREAT RD B104	CHON BOO ILL	CHON SOO YEON	384B GREAT RD	ACTON, MA 01720
D4-384-B-201	384 GREAT RD B201	FITZGIBBON PATRICIA		384B GREAT RD	ACTON, MA 01720
D4-384-B-202	384 GREAT RD B202	KELLEY BRIAN J	KELLEY LILY W	384 GREAT RD B202	ACTON, MA 01720
D4-384-B-203	384 GREAT RD B203	WILSON BRYAN P & SYLVIA E TR	ACTON TRUST #1	28 MUZZEY STREET	LEXINGTON, MA 02421
D4-384-B-301	384 GREAT RD B301	LITOPOULOS LEMONIA		384 GREAT RD B301	ACTON, MA 01720
D4-384-B-302	384 GREAT RD B302	VEERAMANI ASOKARAJ	ASOKARAJ SUBITHA	78 STACEY RD	SUDBURY, MA 01752
D4-384-B-304	384 GREAT RD B304	OLEARY ALLISON E		394 RIDGE STREET	ARLINGTON, MA 02474
D4-386-A-1	386 GREAT RD A1	PROBST PATRICIA L		386A GREAT RD	ACTON, MA 01720
D4-386-A-10	386 GREAT RD A10	STOCKTON AMY C	MANNING KENNETH + STAR KAILIA	112 POWERS ROAD	SUDBURY, MA 01776
D4-386-A-11	386 GREAT RD A11	INVESTORS TRUST	C/O LUIZ DA SILVA COSTA ET AL TR	23 JOHNSON ROAD	ARLINGTON, MA 02474
D4-386-A-12	386 GREAT RD A12	PALKHIWALA NICK		10 TOWER OFFICE PK #304	WOBURN, MA 01801
D4-386-A-2	386 GREAT RD A2	MANERO STEPHEN		173 BELKNAP ST	CONCORD, MA 01742
D4-386-A-3	386 GREAT RD A3	DOW TAMMY D		386 GREAT RD A3	ACTON, MA 01720
D4-386-A-4	386 GREAT RD A4	WILSON JOHN F		386A GREAT RD	ACTON, MA 01720
D4-386-A-5	386 GREAT RD A5	RIESMAN ELAN M		386A GREAT RD	ACTON, MA 01720
D4-386-A-6	386 GREAT RD A6	ROMAN JOHN S		386 GREAT RD A6	ACTON, MA 01720
D4-386-A-7	386 GREAT RD A7	BROOKS MARK TR	JJEM REALTY TRUST	PO BOX 683	ACTON, MA 1720
D4-386-A-8	386 GREAT RD A8	LILENFIELD JUDITH		386A GREAT RD	ACTON, MA 01720
D4-386-A-9	386 GREAT RD A9	MONAGHAN SHARON L/DAVID W TRSTEE		46 STRICHEN LANE	BELLA VISTA, AR 72739
D4-386-B-14	386 GREAT RD B14	DAVU RAMANA V		386 GREAT RD B14	ACTON, MA 01720
D4-386-B-15	386 GREAT RD B15	PETROV SERGEI		386 GREAT RD B15	ACTON, MA 01720

D4-386-B-16	386 GREAT RD B16	CHANDLER SUSAN L	C/O SUSAN BRUSH	972 LONG LEAF LANE	THE VILLAGES, FL 3216:
D4-386-B-17	386 GREAT RD B17	BELLOWS ROBERT E	BELLOWS DELIA E	386B GREAT RD	ACTON, MA 01720
D4-386-B-18	386 GREAT RD B18	WABEL TRUST	R. WALSH & C. BELLISARIO	1 FLORENCE STREET	CAMBRIDGE,, MA 02139
D4-386-B-19	386 GREAT RD B19	BEAULIEU DANIELLE R	BEAULIEU ROBERT G	386 GREAT RD B19	ACTON, MA 01720
D4-386-B-20	386 GREAT RD B20	NECKERS NELSON		12 BRIARWOOD AVE.	PEABODY, MA 01960
D4-386-B-21	386 GREAT RD B21	PAULSON KARL		386 GREAT RD B21	ACTON, MA 01720
D4-386-B-22	386 GREAT RD B22	TABARES GUSTAVO		386 GREAT RD B22	ACTON, MA 01720
D4-386-B-23	386 GREAT RD B23	BENTLEY GLEN + KIMBERLY TRUSTEES		1121 CORTEZ AV	BURLINGAME, CA 94010
D4-386-B-24	386 GREAT RD B24	VARUGHESE REJI	VARUGHESE LIJO L	386 GREAT RD	ACTON, MA 01720
D4-388-A-1	388 GREAT RD A1	O'ROUKE SUSAN		388 GREAT RD A1	ACTON, MA 01720
D4-388-A-10	388 GREAT RD A10	NG DAVID		388 GREAT RD A10	ACTON, MA 01720
D4-388-A-11	388 GREAT RD A11	SHIRGURKAR SHREEDHAR	CHENNAGIRI NIRUPAMA	388 GREAT RD A11	ACTON, MA 01720
D4-388-A-12	388 GREAT RD A12	SORDILLO ANTONIO G		153 PALMER ST	ARLINGTON, MA 02474
D4-388-A-2	388 GREAT RD A2	QUINN BRIAN M		20 ROCK AVE	HUDSON, MA 01749
D4-388-A-3	388 GREAT RD A3	VITORINO LEONARDO B		388 GREAT RD A3	ACTON, MA 01720
D4-388-A-4	388 GREAT RD A4	ALLEN TIMOTHY	ALLEN SUSAN	81 SALISBURY RD	MONT VERNON, NH 030
D4-388-A-5	388 GREAT RD A5	ZHANG MING	LIAN QING	15 PATRIOT LANE	WESTFORD, MA 01886
D4-388-A-6	388 GREAT RD A6	GRITSEVSKIY VLADIMIR		388 GREAT RD A6	ACTON, MA 01720
D4-388-A-7	388 GREAT RD A7	DANFORTH DAILAN LIU		388 GREAT RD A7	ACTON, MA 01720
D4-388-A-8	388 GREAT RD A8	FARMER WILLIAM RAY	FARMER ELLEN	388 GREAT RD A8	ACTON, MA 01720
D4-388-A-9	388 GREAT RD A9	MA YAN		210 MEADOWS EDGE	ACTON, MA 01718
D4-388-B-13	388 GREAT RD B13	HUYNH TUAN D		192 MILL RD	CHELMSFORD, MA 0182
D4-388-B-14	388 GREAT RD B14	PANZA BARBARA J		388 GREAT RD B14	ACTON, MA 01720
D4-388-B-15	388 GREAT RD B15	LIN SHUHONG	WANG LIN	388 GREAT RD B15	ACTON, MA 01720
D4-388-B-16	388 GREAT RD B16	NECKERS NELSON S		12 BRIARWOOD AVENUE	PEABODY, MA 01960
D4-388-B-17	388 GREAT RD B17	SZONERT DOROTA		388 GREAT RD B17	ACTON, MA 01720
D4-388-B-18	388 GREAT RD B18	FRIEDMAN NANCY	GRASSIAN STUART	401 BEACON STREET	CHESTNUT HILL, MA 02
D4-388-B-19	388 GREAT RD B19	STERN ALAN E		388 GREAT RD B19	ACTON, MA 01720
D4-388-B-20	388 GREAT RD B20	MALHARI RANJEET S	MALHARI SIMRANJEET K	388 GREAT RD B20	ACTON, MA 01720
D4-388-B-21	388 GREAT RD B21	BONNER PETER J		PO BOX 711	ACTON, MA 1720
D4-388-B-22	388 GREAT RD B22	SHEN LINA		388 GREAT RD #B22	ACTON, MA 01720
D4-388-B-23	388 GREAT RD B23	WHITE ECATERINA	PAUL CRISTINA	388 GREAT RD B23	ACTON, MA 1720
D4-388-B-24	388 GREAT RD B24	MONAGHAN SHARON L		46 STRICHEN LANE	BELLA VISTA, AR 72739
D4-39	35 SKYLINE DR	SONG WEI		35 SKYLINE DR	ACTON, MA 01720
D4-390-A-1	390 GREAT RD A1	GOLDIN STANLEY M		390A GREAT RD	ACTON, MA 01720
D4-390-A-10	390 GREAT RD A10	ASSAD RENATE		390 GREAT RD A10	ACTON, MA 01720
D4-390-A-11	390 GREAT RD A11	HASSAN DEWAN RAISUL		PO BOX 151394	ARLINGTON, TX 76015
D4-390-A-12	390 GREAT RD A12	MORALES MATTHEW F		390 GREAT RD A12	ACTON, MA 01720
D4-390-A-2	390 GREAT RD A2	FUSCO DANIEL J	STILLINGS RACHAEL A	390 GREAT RD A2	ACTON, MA 01720
D4-390-A-3	390 GREAT RD A3	ACTON HOUSING AUTHORITY		P.O. BOX 681	ACTON,, MA 1720
D4-390-A-4	390 GREAT RD A4	FEOLA JOHN M		390 GREAT RD A4	ACTON, MA 01720
D4-390-A-5	390 GREAT RD A5	O'SULLIVAN PAULA J		PO BOX 2421	ACTON, MA 01720
D4-390-A-6	390 GREAT RD A6	TERRERI MARY LOU		390 GREAT RD A6	ACTON, MA 01720

D4-390-A-7	390 GREAT RD A7	CLINTON DENISE		109 CUSHING STREET	CAMBRIDGE, MA 02138
D4-390-A-8	390 GREAT RD A8	GLORIA JOHN J		PO BOX 2201	MASHPEE, MA 02649
D4-390-A-9	390 GREAT RD A9	GONCHAROV VLADIMIR A	GONCHAROVA OLGA G	390A GREAT RD	ACTON, MA 01720
D4-390-B-13	390 GREAT RD B13	HUFF CYNTHIA		390 GREAT RD B13	ACTON, MA 01720
D4-390-B-14	390 GREAT RD B14	DAY NANCY E/DAVIDSON ROBERT D T	DAY REALTY TRUST	390B GREAT RD	ACTON, MA 01720
D4-390-B-15	390 GREAT RD B15	UNIFIED GREAT ROAD LLC		311 LAWS BROOK RD	CONCORD, MA 01742
D4-390-B-16	390 GREAT RD B16	CARR DAVID W		PO BOX 2783	ACTON, MA 01720
D4-390-B-17	390 GREAT RD B17	LAM PUI LING		390 GREAT RD B17	ACTON, MA 01720
D4-390-B-18	390 GREAT RD B18	MONAGHAN SHARON L/DAVID W TRSTEE		46 STRICHEN LANE	BELLA VISTA, AR 72739
D4-390-B-19	390 GREAT RD B19	BRIGHAM INVESTMENTS LLC		19 CORTLAND DR	HUDSON, MA 01749
D4-390-B-20	390 GREAT RD B20	GUO RIBO	LI BIHUA	390 GREAT RD B20	ACTON, MA 01720
D4-390-B-21	390 GREAT RD B21	BRIGHAM INVESTMENTS LLC		19 CORTLAND DR	HUDSON, MA 01749
D4-390-B-22	390 GREAT RD B22	BREESE BARBARA A		19 HARRIS LN	HARVARD, MA 01451
D4-390-B-23	390 GREAT RD B23	BENTLEY GLEN + KIMBERLY TRUSTEES		1121 CORTEZ AV	BURLINGAME, CA 94010
D4-390-B-24	390 GREAT RD B24	ATHERTON-ZEMAN BENEDICT		7 RIVERVIEW AVE	MAYNARD, MA 01754
D4-392-A-101	392 GREAT RD A101	ACTON HOUSING AUTHORITY		P.O. BOX 681	ACTON, MA 01720
D4-392-A-102	392 GREAT RD A102	DJ + Z MANAGEMENT GROUP LLC		101 GRANT AVE	NEWTON, MA 02459
D4-392-A-103	392 GREAT RD A103	KOSTIKIN PAVEL	KOSTIKINA NATALYA	392 GREAT RD A103	ACTON, MA 01720
D4-392-A-104	392 GREAT RD A104	CHATWANI ASHOK U	CHATWANI REKHA R	2730 WASHINGTON BLVD	FREMONT, CA 94539
D4-392-A-201	392 GREAT RD A201	SUN HONGYAN	LIU YANMEI	1224 LEXINGTON RIDGE DR	LEXINGTON, MA 2421
D4-392-A-202	392 GREAT RD A202	MELLOR CYNTHIA A		392 GREAT RD	ACTON, MA 01720
D4-392-A-203	392 GREAT RD A203	LUCKETT ANDREINA FARIAS		10 CENTRAL CLOSE	NEWTON, MA 02466
D4-392-A-204	392 GREAT RD A204	GERRISH KATHERINE T		392A GREAT RD	ACTON, MA 01720
D4-392-A-301	392 GREAT RD A301	OLIVEIRA PLINIO	OLIVERIRA CRISTINA	392 GREAT RD	ACTON, MA 01720
D4-392-A-302	392 GREAT RD A302	CHATWANI ASHOK U	CHATWANI REKHA R	2730 WASHINGTON BLVD	FREMONT, CA 94539
D4-392-A-303	392 GREAT RD A303	AGARWAL NAVEEN K	MOHANKA RACHNA	68 GRIST MILL RD	LITTLETON, MA 01460
D4-392-A-304	392 GREAT RD A304	SHAMS KAZI M		6 VALLEY VIEW DRIVE	NORTH GRAFTON, MA 0
D4-392-B-101	392 GREAT RD B101	MEHRA VIVEK	MEHRA SONIKA	99 MAIN ST	WESTBORD, MA 01886
D4-392-B-102	392 GREAT RD B102	FARNSWORTH MARGUERITE TR		55 PINE GROVE AVENUE	NEWTON LOWER FALLS
D4-392-B-103	392 GREAT RD B103	CELESTIN JEAN JULES		392 GREAT RD B103	ACTON, MA 01720
D4-392-B-104	392 GREAT RD B104	ACTON HOUSING AUTHORITY		P.O. BOX 681	ACTON, MA 01720
D4-392-B-201	392 GREAT RD B201	BRIGHAM INVESTMENTS LLC		19 CORTLAND DR	HUDSON, MA 01749
D4-392-B-202	392 GREAT RD B202	SHROFF ANKIT P	MEHTA SHIVANI N	42 STONYBROOK LN	SHREWSBURY, MA 015
D4-392-B-203	392 GREAT RD B203	KUCHARSKI THOMAS		392 GREAT RD B203	ACTON, MA 01720
D4-392-B-204	392 GREAT RD B204	ATKINS JENNIFER L		392B GREAT RD	ACTON, MA 01720
D4-392-B-301	392 GREAT RD B301	COMET NOMINEE TR	C/O THE GROWTH COMPANIES	1234 BOYLSTON STREET	CHESTNUT HILL, MA 02
D4-392-B-302	392 GREAT RD B302	RABINOVICH ALEXANDER		392B GREAT RD	ACTON, MA 01720
D4-392-B-303	392 GREAT RD B303	YADAV VIJAY K	SINGH SEEMA	1761 TERESA COURT	DOWNINGTOWN, PA 19
D4-392-B-304	392 GREAT RD B304	QINGHUA CHEN		392 GREAT RD B304	ACTON, MA 01720
D4-4	354 GREAT RD	PULTE HOMES OF NEW ENGLAND LLC		115 FLANDERS RD	WESTBOROUGH, MA 01
D4-6	221 NAGOG HILL RD	TOWN OF ACTON		472 MAIN STREET	ACTON, MA 01720
D5-17-1011	10 WAMPUS AVE #11	WALSH PAULA		10 WAMPUS AVE #11	ACTON, MA 01720
D5-17-1012	10 WAMPUS AVE #12	SPINOSA ROBERT LIFE ESTATE	SPINOSA KRISTIN ANNE	10 WAMPUS AVE #12	ACTON, MA 01720

D5-17-1013	10 WAMPUS AVE #13	WANG DOUGHUI		140 DAVIS RD	ACTON, MA 01720
D5-17-1014	10 WAMPUS AVE #14	BASSALEH RITA		10 WAMPUS AVE #14	ACTON, MA 01720
D5-17-1021	10 WAMPUS AVE #21	SEIR DE LEVY REBECA		10 WAMPUS AVE #21	ACTON, MA 01720
D5-17-1022	10 WAMPUS AVE #22	ACTON HOUSING AUTHORITY		PO BOX 681	ACTON, MA 01720
D5-17-1023	10 WAMPUS AVE #23	GAITA DAVID		10 WAMPUS AVE #23	ACTON, MA 01720
D5-17-1024	10 WAMPUS AVE #24	WALTERS CARRIE		30 LEDEWOOD HILLS DR APT 101	NASHUA, NH 03062
D5-17-1031	10 WAMPUS AVE #31	CHEN KENNARD P		10 WAMPUS AVE #31	ACTON, MA 01720
D5-17-1032	10 WAMPUS AVE #32	WANG DONGHUI		140 DAVIS RD	ACTON, MA 01720
D5-17-1033	10 WAMPUS AVE #33	DUNNIGAN KAREN		10 WAMPUS AVE #33	ACTON, MA 01720
D5-17-1034	10 WAMPUS AVE #34	ASKARI MOHSIN		500 WESTOVER DR #6061	SANFORD, NC 27330
D5-17-1211	12 WAMPUS AVE #11	WANG DOUGHUI		140 DAVIS RD	ACTON, MA 01720
D5-17-1212	12 WAMPUS AVE #12	JONES MAUREEN G		48 ALTON AVENUE	SAN FRANCISCO, CA 94
D5-17-1213	12 WAMPUS AVE #13	PELLETIER TUCKER J		12 WAMPUS AVE #13	ACTON, MA 01720
D5-17-1214	12 WAMPUS AVE #14	VINCENT ERIC J		12 WAMPUS AVE #14	ACTON, MA 01720
D5-17-1221	12 WAMPUS AVE #21	MATARESE MAURA A		12 WAMPUS AVE #21	ACTON, MA 01720
D5-17-1222	12 WAMPUS AVE #22	PERKINS DIANE M		74 AMHERST AV	WALTHAM, MA 02451
D5-17-1223	12 WAMPUS AVE #23	SICILIANO ANTHONY J		12 WAMPUS AVE #23	ACTON, MA 01720
D5-17-1224	12 WAMPUS AVE #24	PARADIS HEATHER		12 WAMPUS AVE #24	ACTON, MA 01720
D5-17-1231	12 WAMPUS AVE #31	SCHOFFEL JESSICA		12 WAMPUS AVE #31	ACTON, MA 01720
D5-17-1232	12 WAMPUS AVE #32	COULOMBRE LEIGH		12 WAMPUS AVE #32	ACTON, MA 01720
D5-17-1233	12 WAMPUS AVE #33	LAWRENCE ANNABELLE L		12 WAMPUS AVE #33	ACTON, MA 01720
D5-17-1234	12 WAMPUS AVE #34	DIPALMA MICHAEL L		12 WAMPUS AVE #34	ACTON, MA 01720
D5-17-1411	14 WAMPUS AVE #11	ROBINSON TANYA D		14 WAMPUS AVE #11	ACTON, MA 01720
D5-17-1412	14 WAMPUS AVE #12	HARTEL REED	HARTEL LYN	301 FERGUSON BEND	YORTOWN, VA 23693
D5-17-1413	14 WAMPUS AVE #13	TOOMEY RENEE M		248 PINE CONE STRAND	ACTON, MA 01718
D5-17-1414	14 WAMPUS AVE #14	HIPKE JEANNE		14 WAMPUS AVE #14	ACTON, MA 01720
D5-17-1421	14 WAMPUS AVE #21	JOSHI VINEETA	SHARMA SHAKUNTALA	PO BOX 2669	ACTON, MA 01720
D5-17-1422	14 WAMPUS AVE #22	OSTAPCHENKO TATYANA		14 WAMPUS AVE #22	ACTON, MA 01720
D5-17-1423	14 WAMPUS AVE #23	JOHNSTON DAVID J		12 TRAVIS DR	FRAMINGHAM, MA 0172
D5-17-1424	14 WAMPUS AVE #24	POLLOCK PATRICIA		14 WAMPUS AVE #24	ACTON, MA 01720
D5-17-1431	14 WAMPUS AVE #31	KONGALA SAMPATH KUMAR	ERIKIPATI DEEPTI HARRIET	14 WAMPUS AVE #31	ACTON, MA 01720
D5-17-1432	14 WAMPUS AVE #32	WARD PATRICIA M		14 WAMPUS AVE #32	ACTON, MA 01720
D5-17-1433	14 WAMPUS AVE #33	ATALAY NURETTIN		14 WAMPUS AVE #33	ACTON, MA 01720
D5-17-1434	14 WAMPUS AVE #34	OBER BARRY F		14 WAMPUS AVE #34	ACTON, MA 01720
D5-17-1611	16 WAMPUS AVE #11	CAMPOS-NAVA AIDA		115 COLLEGE ST	HUDSON, MA 44236
D5-17-1612	16 WAMPUS AVE #12	JOHNSON TERESA M		16 WAMPUS AVE #12	ACTON, MA 01720
D5-17-1613	16 WAMPUS AVE #13	DOUNG DONNA + NG KING		6 MARY SHEPARD RD	LITTLETON, MA 01720
D5-17-1614	16 WAMPUS AVE #14	CARDONA IVAN	VELEZ-LEMA CHERYL ANN	16 WAMPUS AVE #14	ACTON, MA 01720
D5-17-1621	16 WAMPUS AVE #21	OMOBONO DENISE M		12 SHALLOO RD	BILLERICA, MA 01821
D5-17-1622	16 WAMPUS AVE #22	ACTON HOUSING AUTHORITY		PO BOX 681	ACTON, MA 01720
D5-17-1623	16 WAMPUS AVE #23	ZSCHOKKE CHRISTINE		16 WAMPUS AVE #23	ACTON, MA 01720
D5-17-1624	16 WAMPUS AVE #24	MIQUEL CLAUDE R	MIQUEL GERTRUDE M	16 WAMPUS AVE #24	ACTON, MA 01720
D5-17-1631	16 WAMPUS AVE #31	GAUDETTE KRYSTEN		16 WAMPUS AVE #31	ACTON, MA 01720

D5-17-1632	16 WAMPUS AVE #32	GOLDLUST ANDREANA		403 GREAT RD #4	ACTON, MA 01720
D5-17-1633	16 WAMPUS AVE #33	HILL CHRISTINA		16 WAMPUS AVE #33	ACTON, MA 01720
D5-17-1634	16 WAMPUS AVE #34	PARKER MAUREEN		16 WAMPUS AVE #34	ACTON, MA 01720
D5-39-A01	9 WAMPUS AV #A1	LESSARD ROBERT M		9 WAMPUS AVE #A1	ACTON, MA 01720
D5-39-A02	9 WAMPUS AV #A2	MAYOR THOMAS		55 BAYARD STREET	DEDHAM, MA 02026
D5-39-A03	9 WAMPUS AV #A3	FULLERTON LINCOLN R		9 WAMPUS AV #A3	ACTON, MA 01720
D5-39-A04	9 WAMPUS AV #A4	COSTELLO MICHAEL D		9 WAMPUS AV #A4	ACTON, MA 01720
D5-39-A05	9 WAMPUS AV #A5	ACTON CRESTFIELD LLC		21 ALASKA AVE	BEDFORD, MA 01730
D5-39-A06	9 WAMPUS AV #A6	CRUZ ROBERT TRUSTEE	ROBERT CRUZ TRUST	8 WAMPANOAG DR	ACTON, MA 01720
D5-39-A07	9 WAMPUS AV #A7	JENKINS ANDREW		548 HOLLY ST	ELIZABETHTOWN, PA 17
D5-39-A08	9 WAMPUS AV #A8	DOMBROWSKI JEAN A		50 CAREY AV APT 3	WATERTOWN, MA 0247
D5-39-A09	9 WAMPUS AV #A9	BATES THOMAS M		9 WAMPUS AV #A9	ACTON, MA 01720
D5-39-A10	11 WAMPUS AV #A10	REGAN THOMAS A		31 CEDAR HILL ROAD	DOVER, MA 02030
D5-39-A11	11 WAMPUS AV #A11	MAYOR THOMAS P		55 BAYARD STREET	DEDHAM, MA 02026
D5-39-A12	11 WAMPUS AV #A12	LEWIS GORDON W JR		2 RACHEL RD	BOYLSTON, MA 01505
D5-39-A13	11 WAMPUS AV #A13	CHEN YUAN QUAN		148 HOBART ST	BRAINTREE, MA 02184
D5-39-A14	11 WAMPUS AV #A14	ACTON CRESTFIELD LLC		21 ALASKA AVE	BEDFORD, MA 01730
D5-39-A15	11 WAMPUS AV #A15	BROOKS MARK B TRUSTEE	RAYMOND REALTY TRUST	PO BOX 683	ACTON, MA 01720
D5-39-A16	11 WAMPUS AV #A16	LEACH DIANE C		7 KNOX RD	DENNISPORT, MA 0263
D5-39-A17	11 WAMPUS AV #A17	ACTON CRESTFIELD LLC		21 ALASKA AVE	BEDFORD, MA 01730
D5-39-A18	11 WAMPUS AV #A18	KHAN NISH	YASMIN J	20398 CLAY STREET.	CUPERTINO, CA 95014
D5-40	664 MAIN ST	341 GREAT ROAD REALTY LLC		341 GREAT RD	ACTON, MA 01720
E4-9	554 MAIN ST	CONANT BREWSTER		562 MAIN STREET	ACTON, MA 01720

Abutters and owners of land directly opposite on any public or private street or way and abutters to the abutters within three hundred feet of the property line all as they appear on the most recent applicable tax list.

HEARING NOTICES FOR ALL SPECIAL PERMITS MUST BE SENT TO THE PLANNING BOARD, TOWN HALL IN THE FOLLOWING TOWNS:

Boxborough, MA 01729	Maynard, MA 01754	Concord, MA 01742	Littleton, MA 01460
Carlisle, MA 01741	Stow, MA 01775	Westford, MA 01886	Sudbury, MA 01776

Brian McMullen
Principal Assessor

22-Oct-15

www.envpartners.com