STORMWATER REPORT

for

ADESA Holliston

194 Lowland Street, Holliston, MA

May 12, 2020

Prepared for:
ADESA, Inc.
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Project Information

Proposed Development

ADESA is proposing a parking area for vehicle staging on a 41.3 acre site in the Town of Holliston. The project will include asphalt paving for parking, landscaping, and stormwater management improvements. The project will be completed in one phase.

Location

The project site is located at 194 Lowland Street in Holliston, MA. The existing site is relatively flat and with areas of impacted topography given its prior use as a gravel pit and location for material stockpiles. The site is bordered by industrial properties to the north, wetlands and transmission line ROW to the east, Bogastow Brook to the south, and Lowland Street to the west.

Existing Conditions

The site was previously disturbed for commercial gravel pit operations and is currently a storage yard for aggregate and landscape materials with various material stockpiles. The property also includes two existing building structures with associated utility service lines. A large pond is located on the northern section of the property as well. Elevations across the site range from 153 to 170. The site topography has been heavily impacted in all areas due to its history as a commercial gravel pit.

Soils

A geotechnical study of the property has not yet been performed to provide accurate soil or strata data.

Stormwater Management

Design Criteria

Stormwater management systems have been designed in accordance with the Regulations and the Stormwater Management Policy promulgated by the Massachusetts Department of Environmental Protection (Mass. DEP) and the United States Environmental Protection Agency.

Outfalls

Runoff from the site will generally discharge to two separate outfalls, maintaining existing drainage boundaries to the maximum extent practicable. Approximately 1.86 acres of drainage area will be directed to outfall #1 at the northern portion of the site. Approximately 3.19 acres of drainage area will be directed to outfall #2 at the southern portion of the site. The remaining 0.97 acres of drainage area consists of grassed areas along the perimeter of the parcel which will drain away from the proposed development. All of this drainage eventually ends up at the same ultimate outfall points at outfalls #1 and 2 on the subject site. The two outfalls are defined below.

Northern Outfall (POI#1)

Currently, a portion of the site's runoff sheet flows towards the existing pond at the north end of the property. The proposed storm system has been designed so that the post-development drainage area is as close as possible to the pre-development area draining to the existing pond today. An

underground detention facility with an outlet control structure is proposed at the northern part of the site. Stormwater will discharge from the underground detention facility into an area adjacent to the pond and from there it will sheet flow into the existing pond.

Southern Outfall (POI#2)

Currently, a portion of the site's runoff sheet flows towards Bogastow Brook at the south end of the property. The proposed storm system has been designed so that the post-development drainage area is as close as possible to the pre-development area draining to the Brook today. An underground detention facility with an outlet control system is proposed at the southern part of the site. Stormwater will discharge from the underground detention facility into an area adjacent to Bogastow Brook and from there it will sheet flow into Bogastow Brook.

STORMWATER CHECKLIST – REVIEW OF MASSDEP STANDARDS

Standard #1 – No New Untreated Discharges

No new untreated discharges are proposed with the project.

Standard #2 – Peak Rate Attenuation

Outfall #1

On-site quantity control has been provided by the inclusion of an underground detention basin in the parking lot. The underground detention area is proposed to address the stormwater quality requirements for the site and it will also provide quantity control by infiltrating and storing stormwater runoff during rainfall events.

Outfall #2

On-site quantity control has been provided by the inclusion of an underground detention basin in the parking lot. This underground detention basin is proposed to address the stormwater quality requirements for the site, and it will also provide quantity control by infiltrating and storing stormwater runoff during rainfall events.

Standard #3 – Recharge

The proposed project area is located in an area with a high groundwater table and organic soil material that is not conducive to recharge, however multiple underground detention areas are proposed with the project to attempt to recharge as much stormwater generated from the site as possible.

Standard #4 – Water Quality

Stormwater quality for the project will be separated by the site's two outfall locations. All drainage that reaches outfall #1 and #2 will be treated in the proposed underground detention facilities.

There will generally be two treatment areas for all drainage reaching outfall #1 and #2. Before stormwater discharges from either outfall, it will be conveyed through deep sump catch basins followed by an underground detention system consisting of a StormTech ADS Chamber design or approved equal.

Standard #5 – Land Uses with Higher Potential Pollutant Loads (LUHPPL's)

Not applicable to site

Standard #6 – Critical Areas

The proposed project area discharges within a Zone II, Interim Wellhead Protection Area. A source control pollution prevention plan utilizing on-site drainage infrastructure has been identified in a long-term pollution prevention plan that has been submitted with the project.

Standard #7 – Redevelopments and Other Projects Subject to the Standards Only to the Maximum Extent Practicable

The project is located on an existing property that has previously been disturbed for commercial operations; therefore, the site should be considered as a redevelopment site.

Standard #8 – Construction Period Pollution Prevention and Erosion and Sedimentation Control

A detailed Erosion and Sediment Control Plan, with associated Details, has been provided with the Site Plan construction documents.

Standard #9 – Operation and Maintenance Plan

A stand-alone O&M Plan has been prepared for all stormwater facilities on site, including underground detention areas, and is included as Attachment F in the project Notice of Intent submittal package.

Standard #10 – Illicit Discharges

An Illicit Discharge Statement is attached and can be found in the Table of Contents. The Long Term Pollution Prevention Plan can be found is **Appendix D**

Appendix

Appendix A: Checklist for Stormwater Report

Appendix B: Existing Conditions Analysis

Appendix C: Proposed Conditions Analysis

Appendix D: Best Management Practices

Appendix E: Pipe Sizing Calculations

Appendix F: Reference Documents

APPENDIX A

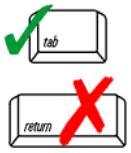
Checklist for Stormwater Report

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.

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

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

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

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): Underground detention system in development footprint

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

☒ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B
Existing Conditions Analysis

STORMWATER PEAK RATE SUMMARY

PROJECT: ***ADESA Holliston***
194 Lowland Street
Town of Holliston, MA

DATE: ***5/12/2020***
BY: ***TGK***
CHECKED BY: ***BJB***
REVISION: ***0***

Point of Interest #1 - Stormwater Peak Rate Summary

Hydrograph	2	10	100	
Pre-Development Flow (cfs)	0.91	1.95	3.72	
Allowable Total Post Development Flow (cfs)*	**0.91**	**1.95**	**3.72**	
	2 Yr Pre *	**10 Yr Pre***	**100 Yr Pre***	
Provided Post Development Flow (cfs)	**0.59**	**1.16**	**4.06**	**
Difference (cfs)	**-0.32**	**-0.79**	**0.34**	

*Post development peak rates to be less than or equal to the provided design storm
**Stormwater ultimately discharges to POI 2 and the combination of POI 1 and POI 2 peak rates will be less than existing pre-development peak rates for the 100-yr design storm

STORMWATER PEAK RATE SUMMARY

PROJECT: ***ADESA Holliston***
194 Lowland Street
Town of Holliston, MA

DATE: ***5/12/2020***
BY: ***TGK***
CHECKED BY: ***BJB***
REVISION: ***0***

Point of Interest #2 - Stormwater Peak Rate Summary

Hydrograph	2	10	100
Pre-Development Flow (cfs)	4.93	10.35	19.49
Allowable Total Post Development Flow (cfs)*	**4.93**	**10.35**	**19.49**
	2 Yr Pre *	**10 Yr Pre***	**100 Yr Pre***
Provided Post Development Flow (cfs)	**2.27**	**5.68**	**10.06**
Difference (cfs)	**-2.66**	**-4.67**	**-9.43**

*Post development peak rates to be less than or equal to the provided design storm

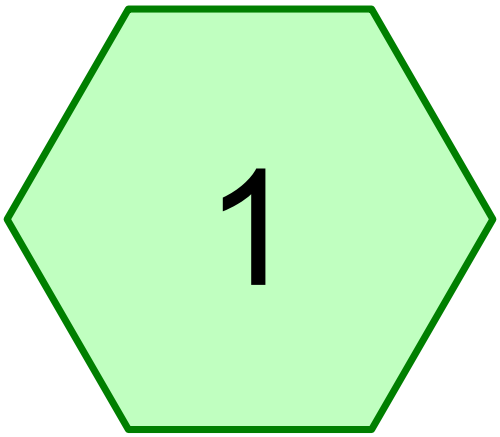
COMPUTATION SHEET: SCS RUNOFF COEFFICIENT (CN)

PROJECT: ***ADESA Holliston***
Lowland Street - Town of Holliston
Massachusetts

DATE: ***4/13/2020***
BY: ***TGK***
CHECKED BY: ***-***
REVISION: ***0***

ACTUAL PRE-DEVELOPMENT DRAINAGE AREAS

Cover Type Description	Soil HSG	CN	1 DA to Pre-Dev POI#1 (Acres)	2 DA to Pre-Dev POI#2 (Acres)	(Acres)	(Acres)
Meadow	A	30				
Wooded	A	30				
Meadow	B	58				
Wooded	B	55				
Meadow	D	78	0.570	4.403		
Wooded	D	77	0.100	0.713		
Impervious	ALL	98	0.020	0.256		
		Total Area (Ac)	0.690	5.372		
		SCS Runoff Coefficient (CN)	78	79		
		Time of Concentration (Tc)	11.9	32.7	6.0	6.0



DA to Pre-Dev POI#1

Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-0
Prepared by Kimley-Horn and Associates, Printed 5/12/2020

Summary for Subcatchment 1: DA to Pre-Dev POI#1

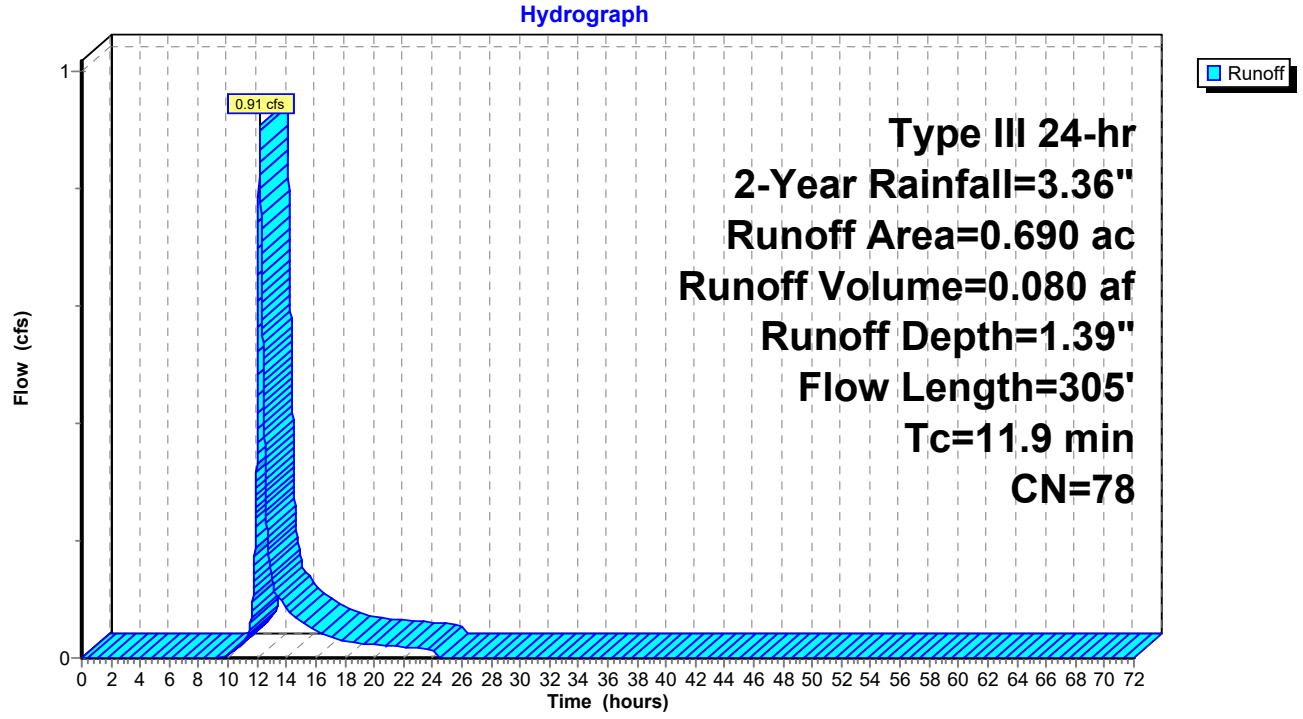
Runoff = 0.91 cfs @ 12.17 hrs, Volume= 0.080 af, Depth= 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
0.570	78	Meadow, non-grazed, HSG D
0.100	77	Woods, Good, HSG D
0.020	98	Paved parking, HSG D
0.690	78	Weighted Average
0.670		97.10% Pervious Area
0.020		2.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0215	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
0.9	140	0.0268	2.64		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
1.7	65	0.0165	0.64		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
11.9	305	Total			

Subcatchment 1: DA to Pre-Dev POI#1



Summary for Subcatchment 1: DA to Pre-Dev POI#1

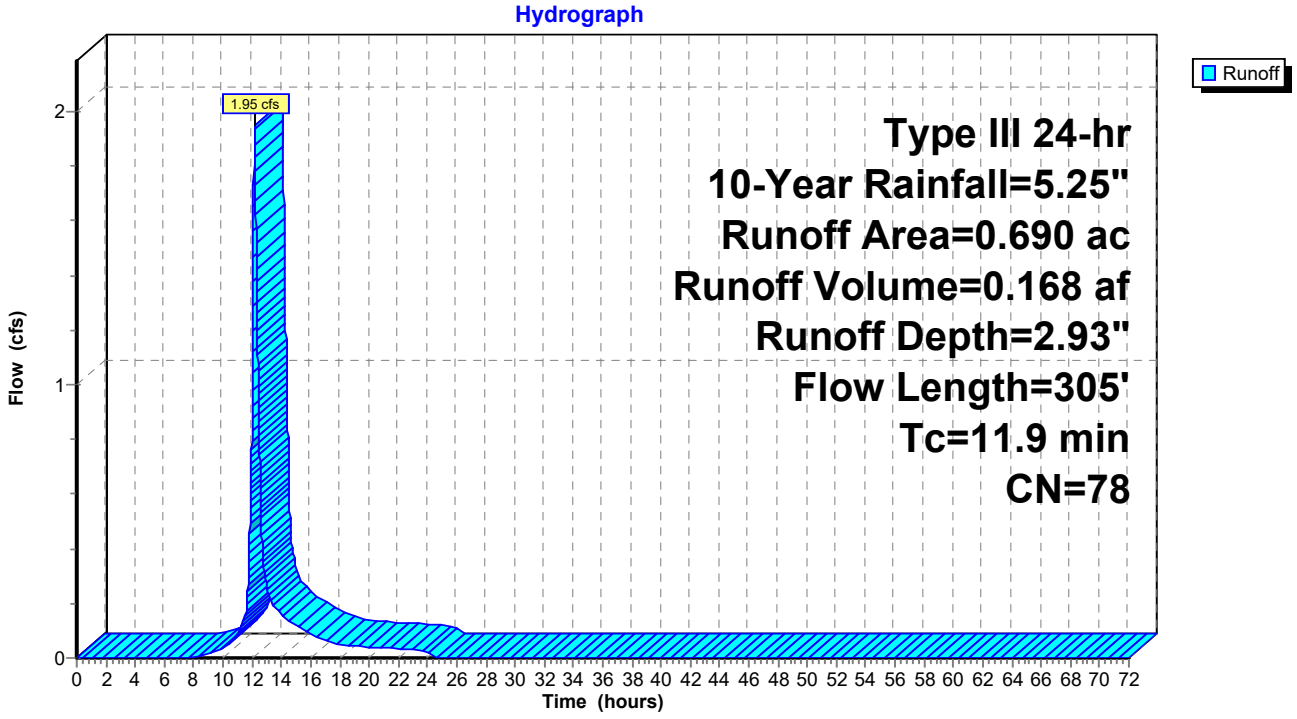
Runoff = 1.95 cfs @ 12.16 hrs, Volume= 0.168 af, Depth= 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
0.570	78	Meadow, non-grazed, HSG D
0.100	77	Woods, Good, HSG D
0.020	98	Paved parking, HSG D
0.690	78	Weighted Average
0.670		97.10% Pervious Area
0.020		2.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0215	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
0.9	140	0.0268	2.64		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
1.7	65	0.0165	0.64		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
11.9	305	Total			

Subcatchment 1: DA to Pre-Dev POI#1



Summary for Subcatchment 1: DA to Pre-Dev POI#1

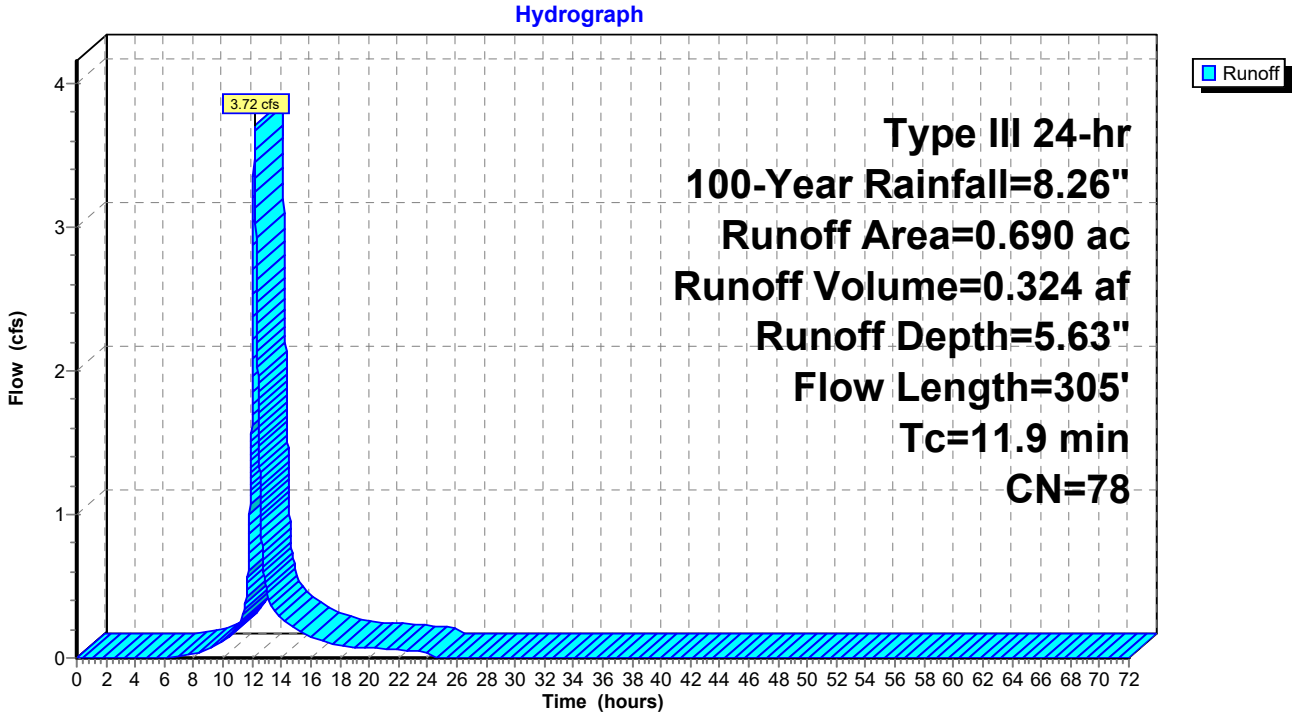
Runoff = 3.72 cfs @ 12.16 hrs, Volume= 0.324 af, Depth= 5.63"

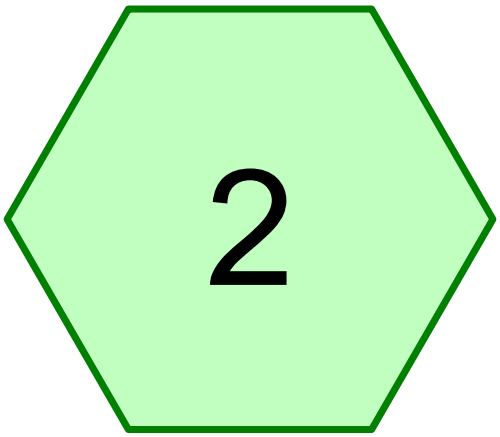
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
0.570	78	Meadow, non-grazed, HSG D
0.100	77	Woods, Good, HSG D
0.020	98	Paved parking, HSG D
0.690	78	Weighted Average
0.670		97.10% Pervious Area
0.020		2.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0215	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
0.9	140	0.0268	2.64		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
1.7	65	0.0165	0.64		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
11.9	305	Total			

Subcatchment 1: DA to Pre-Dev POI#1





DA to Pre-Dev POI#2

Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-0
Prepared by Kimley-Horn and Associates, Printed 5/12/2020

Summary for Subcatchment 2: DA to Pre-Dev POI#2

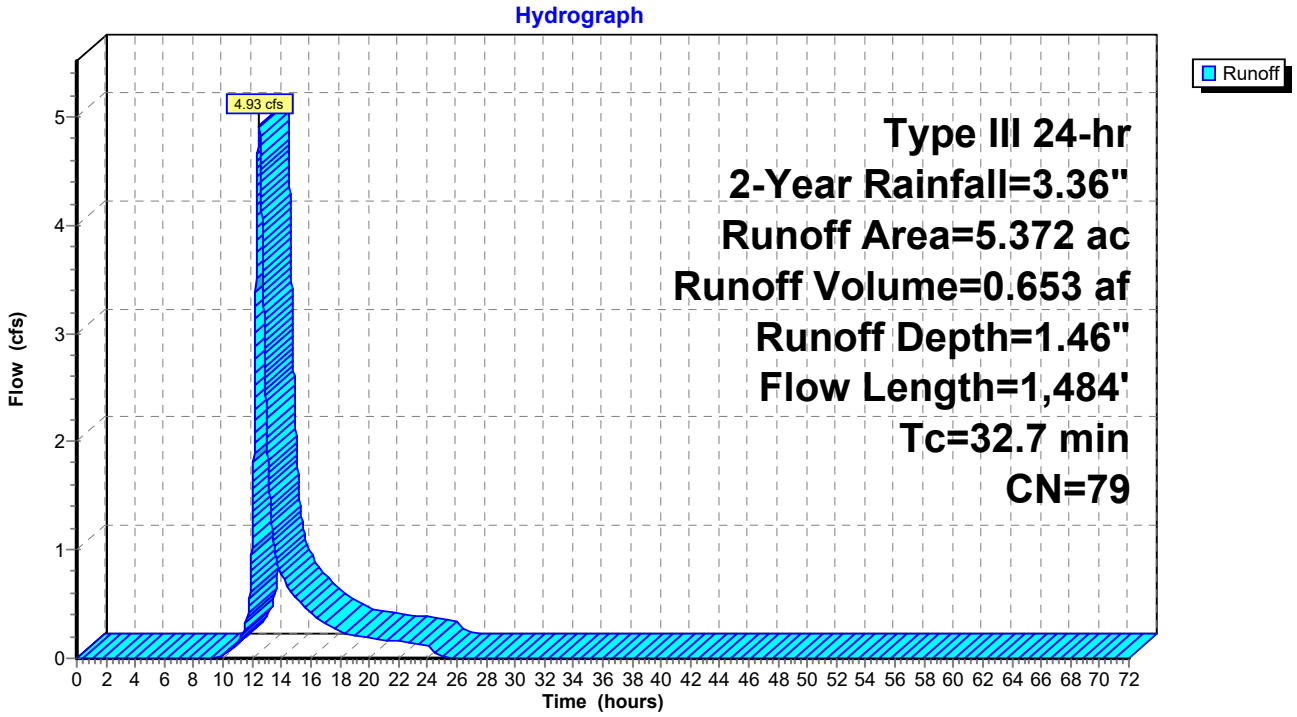
Runoff = 4.93 cfs @ 12.46 hrs, Volume= 0.653 af, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
4.403	78	Meadow, non-grazed, HSG D
0.713	77	Woods, Good, HSG D
0.256	98	Paved parking, HSG D
5.372	79	Weighted Average
5.116		95.23% Pervious Area
0.256		4.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.6	150	0.0113	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
1.2	195	0.0288	2.73		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.1	212	0.0133	0.58		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
8.8	927	0.0032	1.76	19.36	**Channel Flow, D-E** Area= 11.0 sf Perim= 22.1' r= 0.50' n= 0.030 Stream, clean & straight
32.7	1,484	Total			

Subcatchment 2: DA to Pre-Dev POI#2



Summary for Subcatchment 2: DA to Pre-Dev POI#2

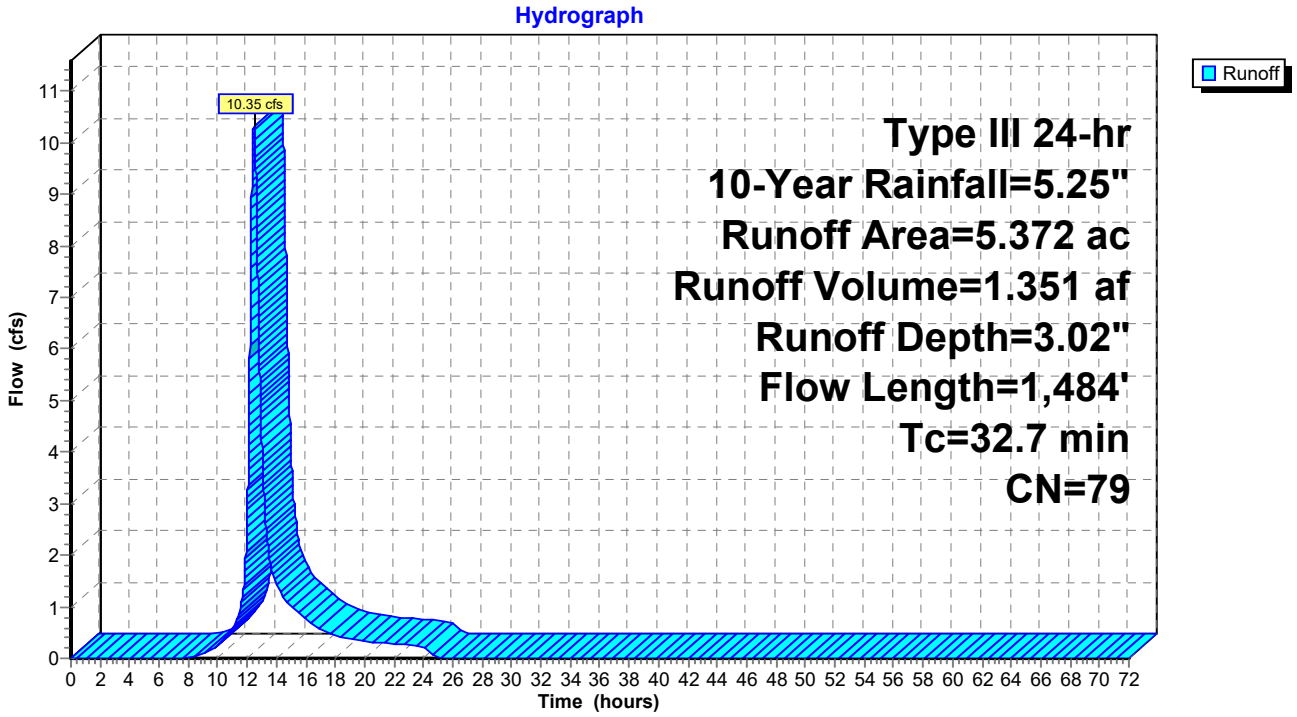
Runoff = 10.35 cfs @ 12.46 hrs, Volume= 1.351 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
4.403	78	Meadow, non-grazed, HSG D
0.713	77	Woods, Good, HSG D
0.256	98	Paved parking, HSG D
5.372	79	Weighted Average
5.116		95.23% Pervious Area
0.256		4.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.6	150	0.0113	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
1.2	195	0.0288	2.73		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.1	212	0.0133	0.58		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
8.8	927	0.0032	1.76	19.36	**Channel Flow, D-E** Area= 11.0 sf Perim= 22.1' r= 0.50' n= 0.030 Stream, clean & straight
32.7	1,484	Total			

Subcatchment 2: DA to Pre-Dev POI#2



Summary for Subcatchment 2: DA to Pre-Dev POI#2

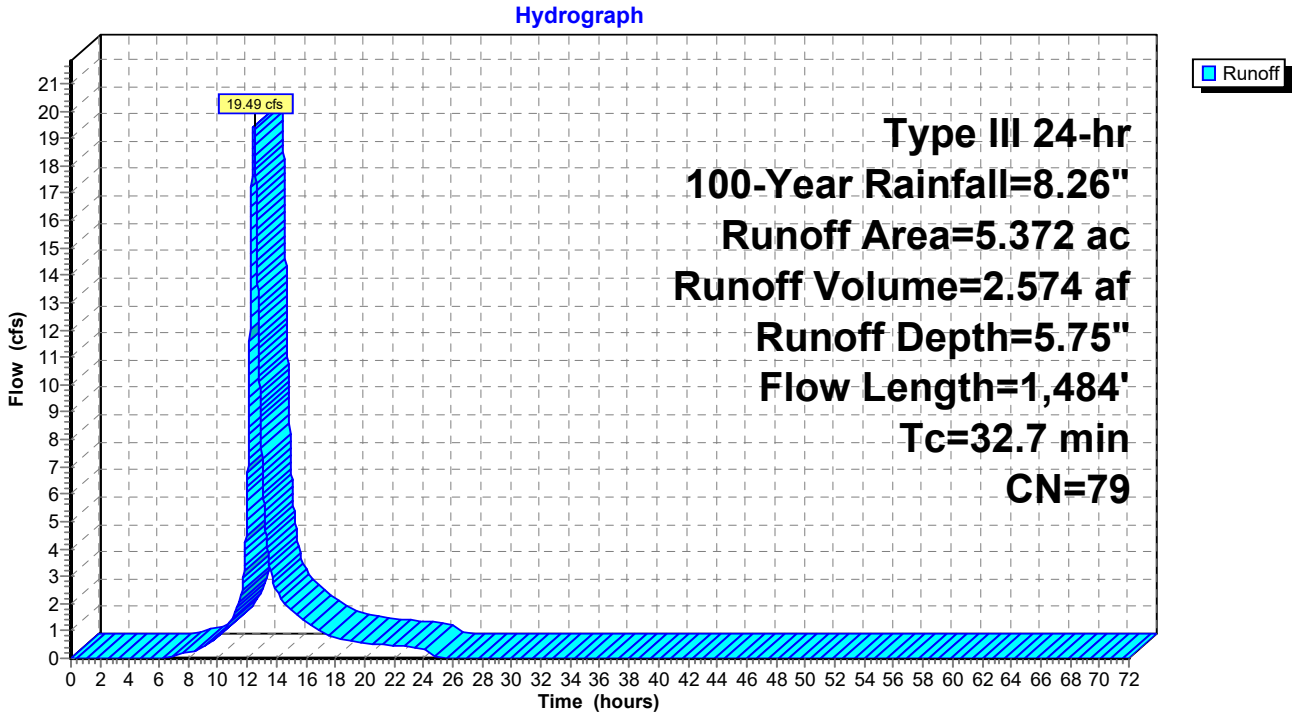
Runoff = 19.49 cfs @ 12.46 hrs, Volume= 2.574 af, Depth= 5.75"

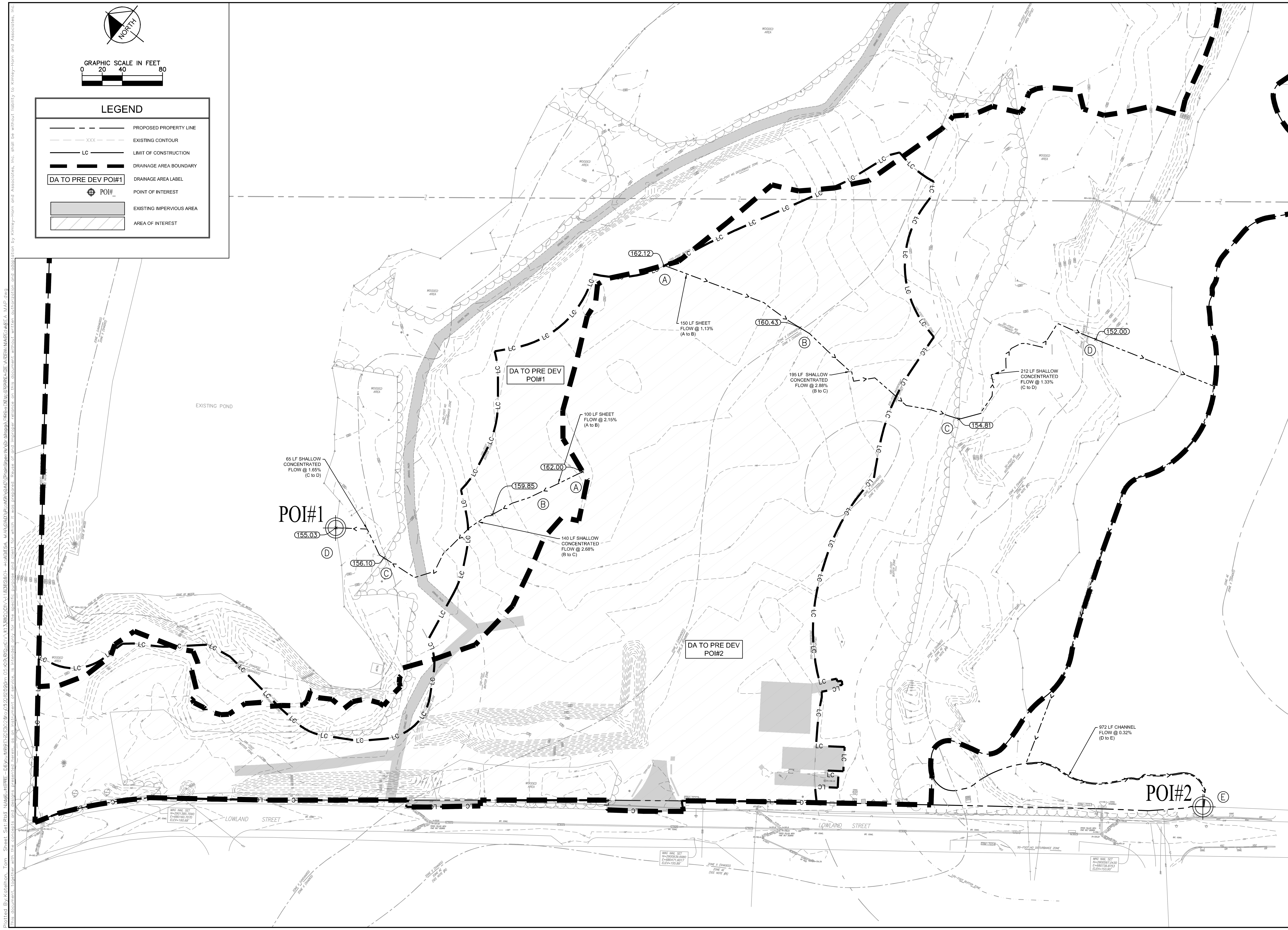
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
4.403	78	Meadow, non-grazed, HSG D
0.713	77	Woods, Good, HSG D
0.256	98	Paved parking, HSG D
5.372	79	Weighted Average
5.116		95.23% Pervious Area
0.256		4.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.6	150	0.0113	0.15		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36"
1.2	195	0.0288	2.73		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
6.1	212	0.0133	0.58		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
8.8	927	0.0032	1.76	19.36	**Channel Flow, D-E** Area= 11.0 sf Perim= 22.1' r= 0.50' n= 0.030 Stream, clean & straight
32.7	1,484	Total			

Subcatchment 2: DA to Pre-Dev POI#2





No.	REVISIONS	DATE	BY

Kimley»Horn
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LICENSED PROFESSIONAL
COMMONWEALTH OF MASSACHUSETTS
BRIAN J. BREHER
CIVIL
No. 46948
05-12-20
REGISTERED PROFESSIONAL ENGINEER
DATE:

KHA PROJECT 113382001
DATE 04/28/2020
SCALE AS SHOWN
DESIGNED BY TGK
DRAWN BY TGK
CHECKED BY BJB

PREDEVELOPMENT DRAINAGE AREA MAP

ADESA HOLLISTON
PREPARED FOR
ADESA, INC.
TOWN OF HOLLISTON MA

SHEET NUMBER
DA-1

APPENDIX C
Proposed Conditions Analysis

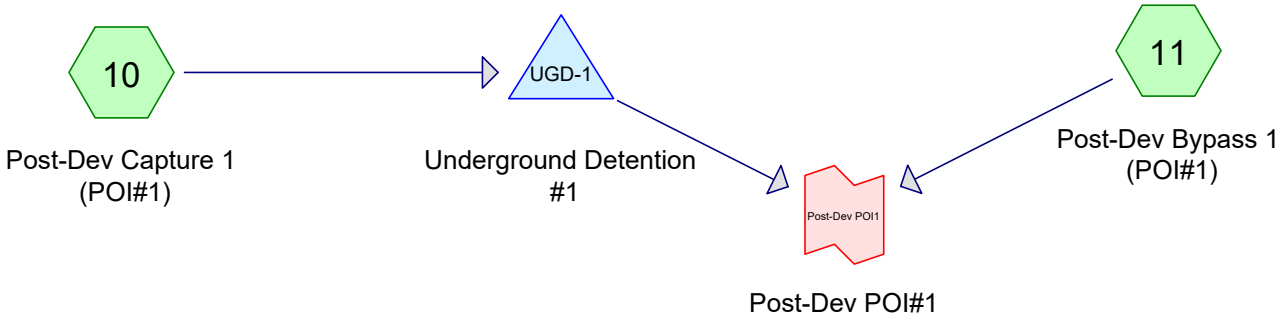
COMPUTATION SHEET: SCS RUNOFF COEFFICIENT (CN)

PROJECT: ***ADESA Holliston***
Lowland Street - Town of Holliston
Massachusetts

DATE: ***4/13/2020***
BY: ***TGK***
CHECKED BY: ***-***
REVISION: ***0***

POST-DEVELOPMENT DRAINAGE AREAS

Cover Type Description	Soil HSG	CN	10 Post Dev Capture 1 (POI#1) (Acres)	11 Post Dev Bypass 1 (POI#1) (Acres)	12 Post Dev Capture 2 (POI#2) (Acres)	13 Post Dev Bypass 2 (POI#2) (Acres)
Meadow	A	30				
Wooded	A	30				
Lawn	A	39				
Meadow	B	58				
Wooded	B	55				
Lawn	B	61				
Meadow	D	78				
Wooded	D	77				
Lawn	D	80	0.080	0.220	0.429	0.734
Impervious	ALL	98	1.775		2.765	0.019
		Total Area	1.855	0.220	3.193	0.753
		SCS Runoff Coefficient (CN)	97	80	96	80
		Time of Concentration (Tc)	6.0	6.0	6.0	6.0



Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-0
Prepared by Kimley-Horn and Associates, Printed 5/12/2020

Summary for Subcatchment 10: Post-Dev Capture 1 (POI#1)

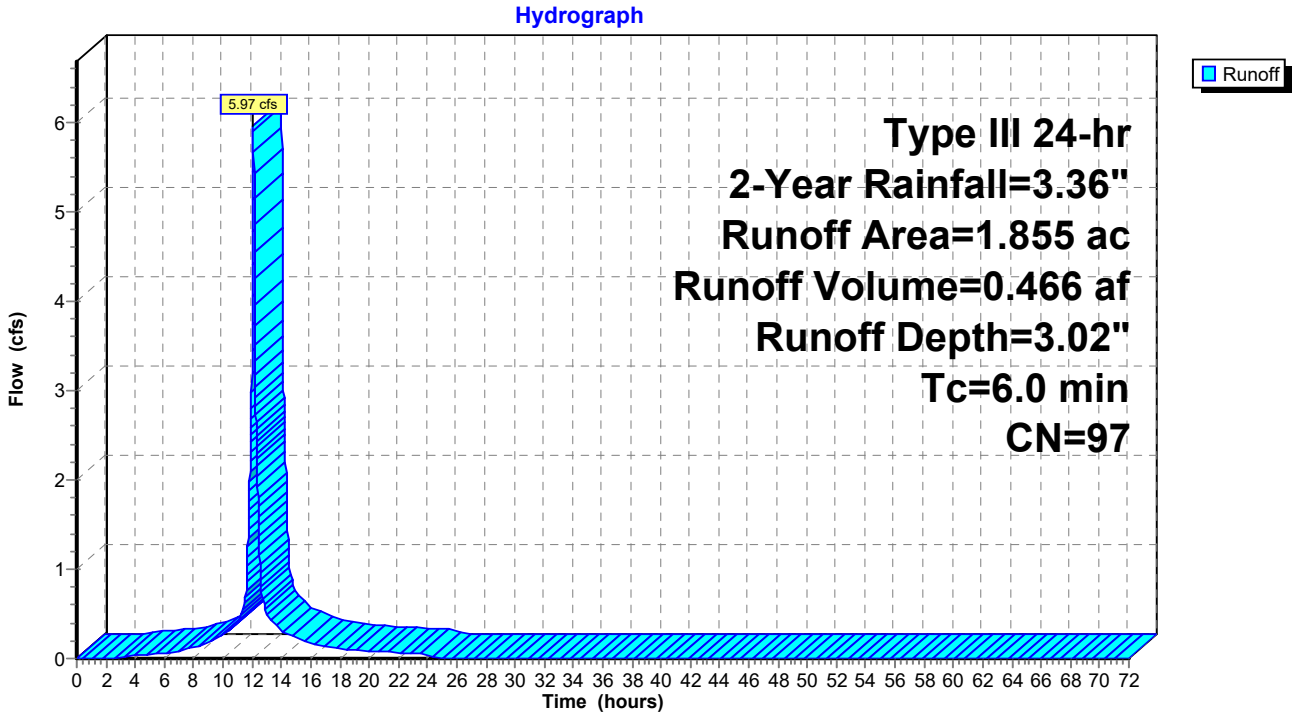
Runoff = 5.97 cfs @ 12.08 hrs, Volume= 0.466 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
0.080	80	>75% Grass cover, Good, HSG D
1.775	98	Paved parking, HSG D
1.855	97	Weighted Average
0.080		4.31% Pervious Area
1.775		95.69% Impervious Area

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

Subcatchment 10: Post-Dev Capture 1 (POI#1)



Summary for Subcatchment 11: Post-Dev Bypass 1 (POI#1)

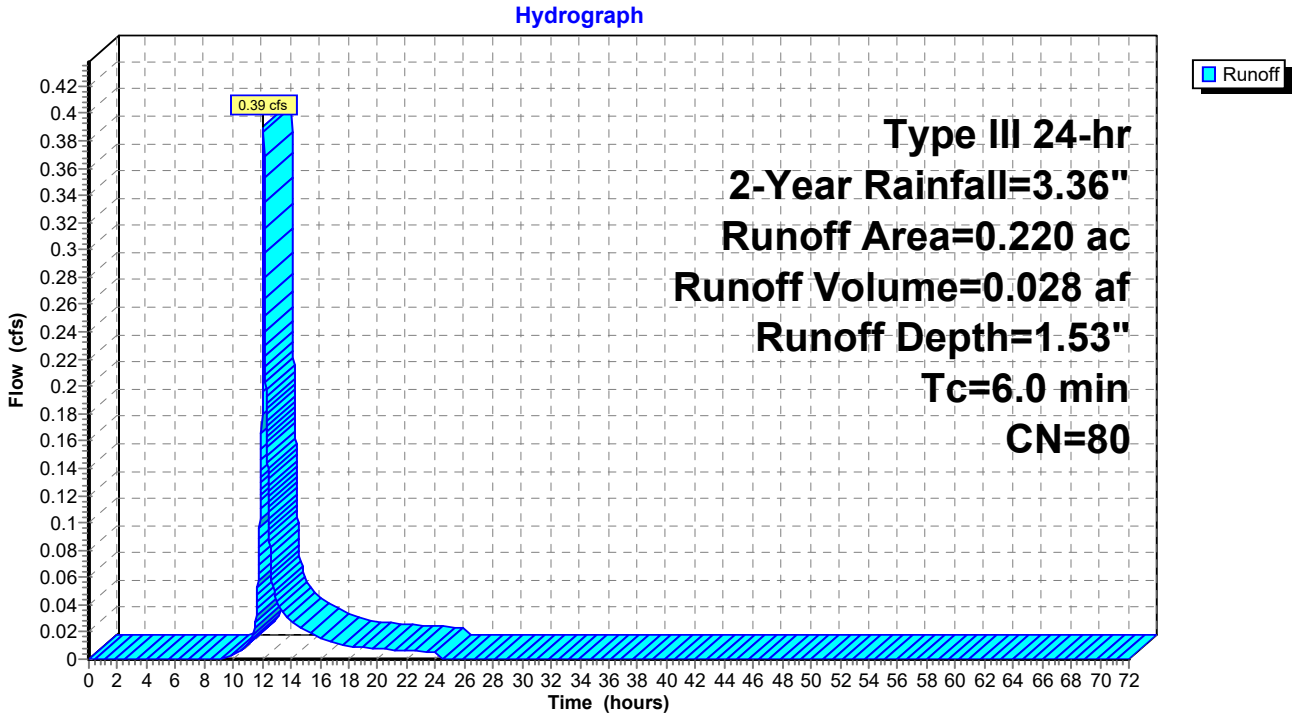
Runoff = 0.39 cfs @ 12.09 hrs, Volume= 0.028 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
0.220	80	>75% Grass cover, Good, HSG D
0.220		100.00% Pervious Area

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

Subcatchment 11: Post-Dev Bypass 1 (POI#1)



Summary for Pond UGD-1: Underground Detention #1

Inflow Area = 1.855 ac, 95.69% Impervious, Inflow Depth = 3.02" for 2-Year event
Inflow = 5.97 cfs @ 12.08 hrs, Volume= 0.466 af
Outflow = 0.51 cfs @ 13.00 hrs, Volume= 0.466 af, Atten= 92%, Lag= 55.0 min
Discarded = 0.17 cfs @ 9.01 hrs, Volume= 0.295 af
Primary = 0.34 cfs @ 13.00 hrs, Volume= 0.171 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 155.80' @ 13.00 hrs Surf.Area= 11,385 sf Storage= 9,544 cf

Plug-Flow detention time= 225.7 min calculated for 0.466 af (100% of inflow)
Center-of-Mass det. time= 225.7 min (990.6 - 764.8)

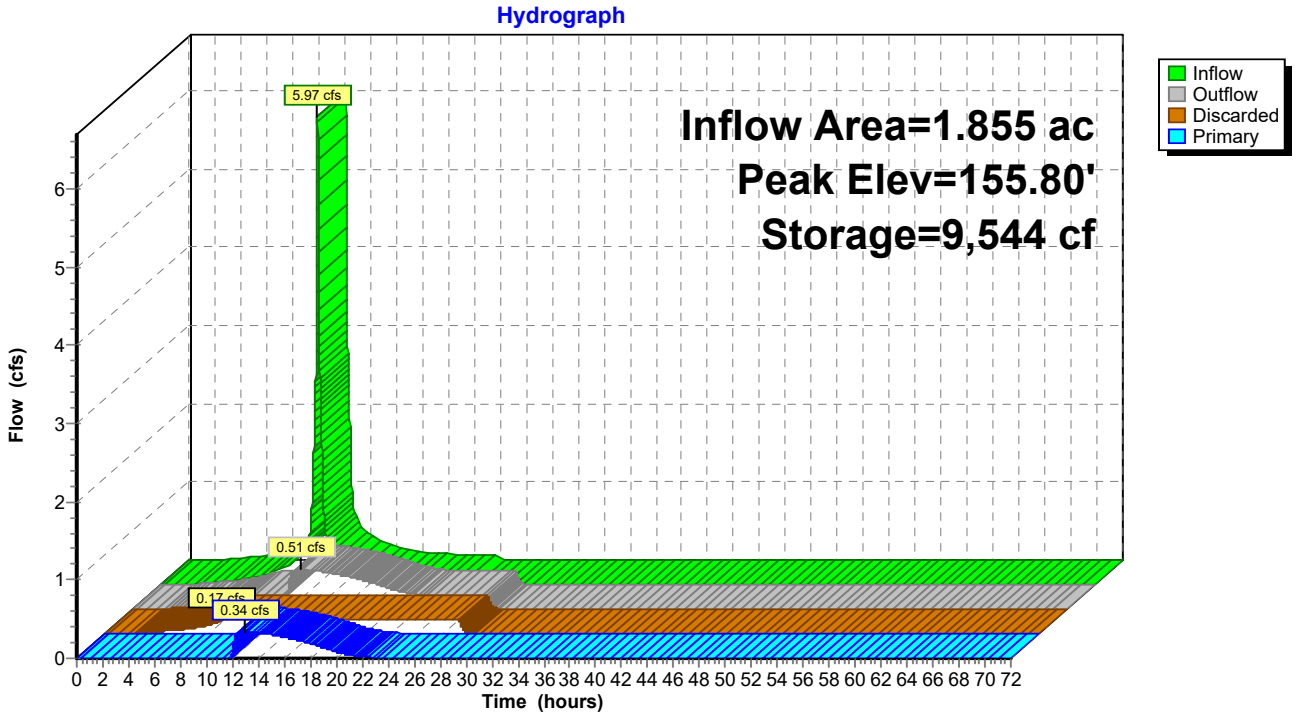
Volume	Invert	Avail.Storage	Storage Description
#1	154.50'	10,576 cf	**68.00'W x 158.64'L x 3.50'H Prismatoid Z=1.0** 40,590 cf Overall - 14,150 cf Embedded = 26,440 cf x 40.0% Voids
#2	155.00'	14,150 cf	**ADS_StormTech SC-740 +Cap** x 308 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		24,726 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	155.00'	**12.0" Round Culvert** L= 325.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 155.00' / 153.37' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	155.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	157.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	154.50'	**0.17 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.17 cfs @ 9.01 hrs HW=154.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=0.34 cfs @ 13.00 hrs HW=155.80' (Free Discharge)
└**1=Culvert** (Passes 0.34 cfs of 1.67 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.34 cfs @ 3.84 fps)
  └**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond UGD-1: Underground Detention #1

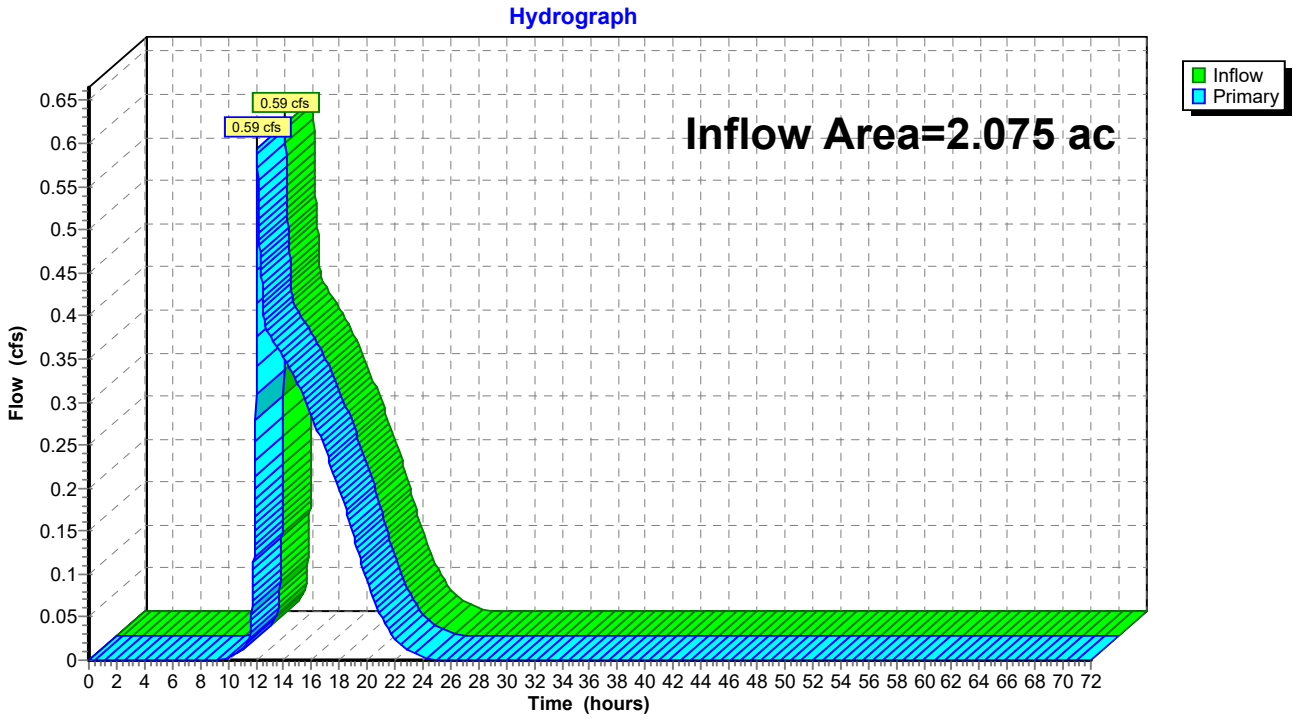


Summary for Link Post-Dev POI1: Post-Dev POI#1

Inflow Area = 2.075 ac, 85.54% Impervious, Inflow Depth = 1.15" for 2-Year event
Inflow = 0.59 cfs @ 12.11 hrs, Volume= 0.199 af
Primary = 0.59 cfs @ 12.11 hrs, Volume= 0.199 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI1: Post-Dev POI#1



Summary for Subcatchment 10: Post-Dev Capture 1 (POI#1)

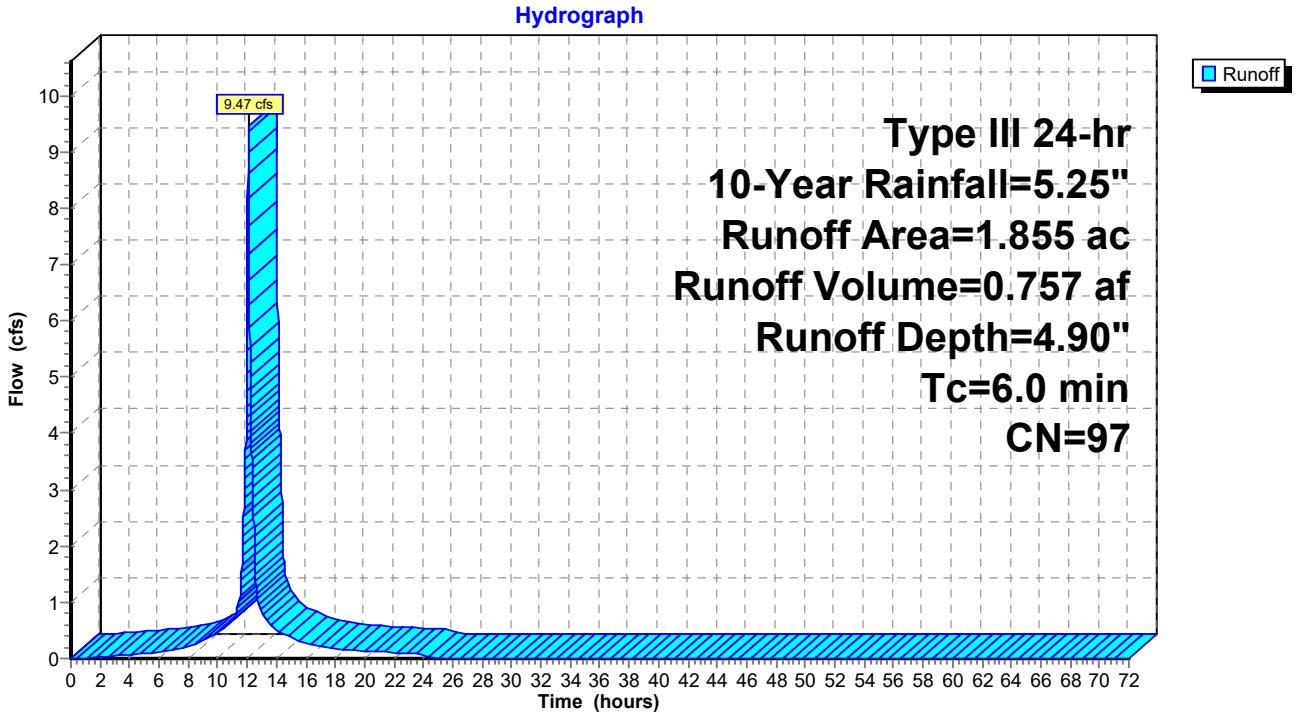
Runoff = 9.47 cfs @ 12.08 hrs, Volume= 0.757 af, Depth= 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
0.080	80	>75% Grass cover, Good, HSG D
1.775	98	Paved parking, HSG D
1.855	97	Weighted Average
0.080		4.31% Pervious Area
1.775		95.69% Impervious Area

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

Subcatchment 10: Post-Dev Capture 1 (POI#1)



Summary for Subcatchment 11: Post-Dev Bypass 1 (POI#1)

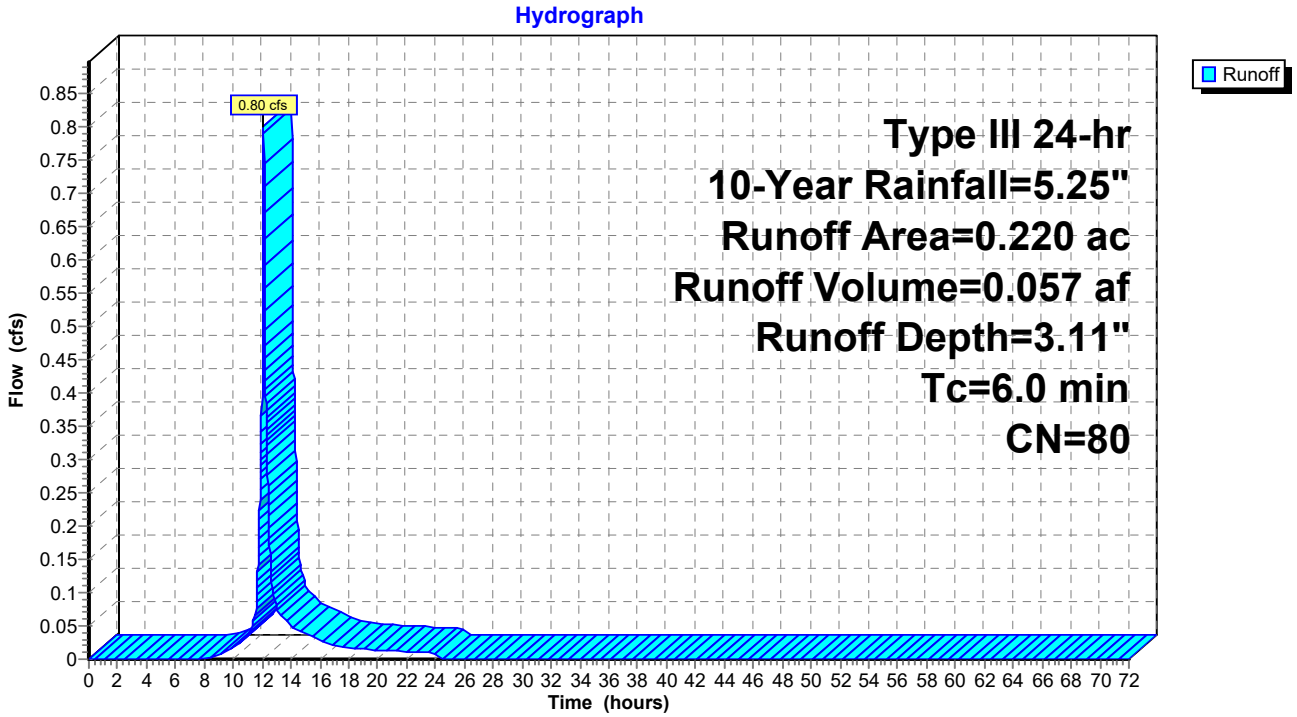
Runoff = 0.80 cfs @ 12.09 hrs, Volume= 0.057 af, Depth= 3.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
0.220	80	>75% Grass cover, Good, HSG D
0.220		100.00% Pervious Area

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

Subcatchment 11: Post-Dev Bypass 1 (POI#1)



Summary for Pond UGD-1: Underground Detention #1

Inflow Area = 1.855 ac, 95.69% Impervious, Inflow Depth = 4.90" for 10-Year event
Inflow = 9.47 cfs @ 12.08 hrs, Volume= 0.757 af
Outflow = 0.68 cfs @ 13.22 hrs, Volume= 0.757 af, Atten= 93%, Lag= 67.9 min
Discarded = 0.17 cfs @ 7.37 hrs, Volume= 0.368 af
Primary = 0.51 cfs @ 13.22 hrs, Volume= 0.389 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 156.67' @ 13.22 hrs Surf.Area= 11,789 sf Storage= 16,850 cf

Plug-Flow detention time= 290.7 min calculated for 0.757 af (100% of inflow)
Center-of-Mass det. time= 290.7 min (1,045.5 - 754.8)

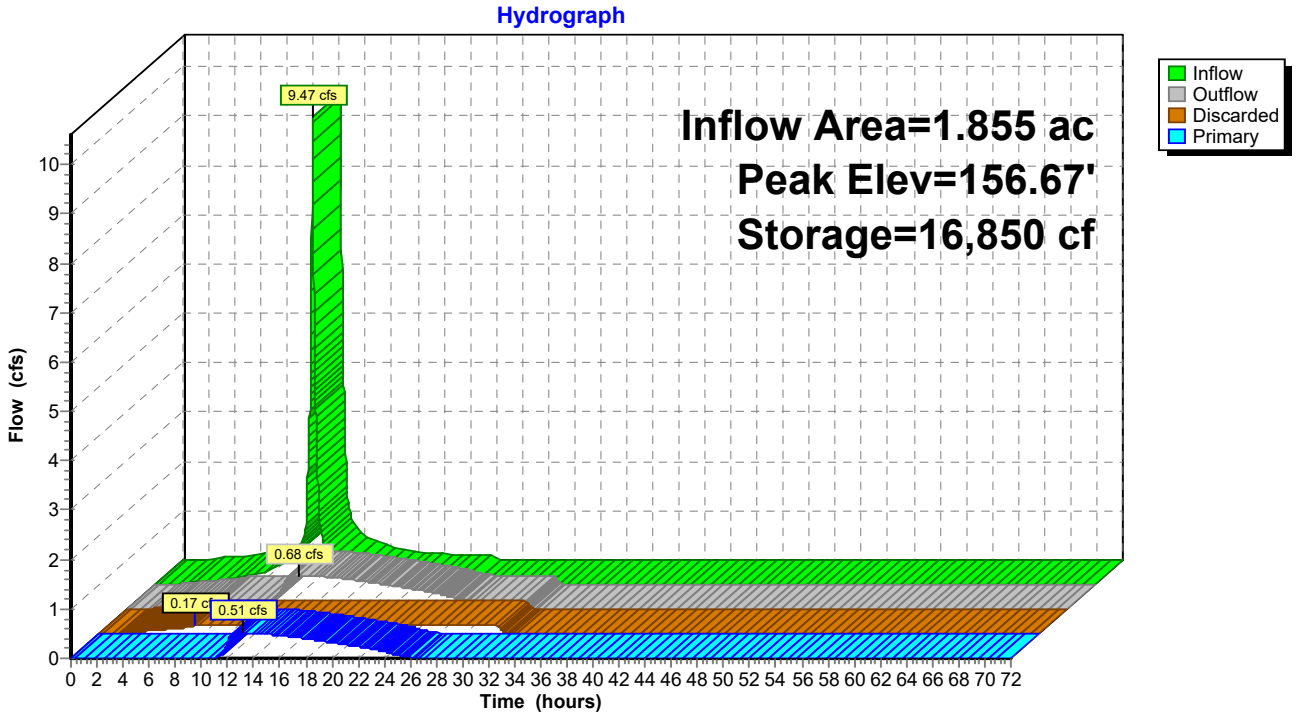
Volume	Invert	Avail.Storage	Storage Description
#1	154.50'	10,576 cf	**68.00'W x 158.64'L x 3.50'H Prismatoid Z=1.0** 40,590 cf Overall - 14,150 cf Embedded = 26,440 cf x 40.0% Voids
#2	155.00'	14,150 cf	**ADS_StormTech SC-740 +Cap** x 308 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		24,726 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	155.00'	**12.0" Round Culvert** L= 325.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 155.00' / 153.37' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	155.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	157.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	154.50'	**0.17 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.17 cfs @ 7.37 hrs HW=154.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=0.51 cfs @ 13.22 hrs HW=156.67' (Free Discharge)
└**1=Culvert** (Passes 0.51 cfs of 2.79 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.51 cfs @ 5.90 fps)
  └**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond UGD-1: Underground Detention #1

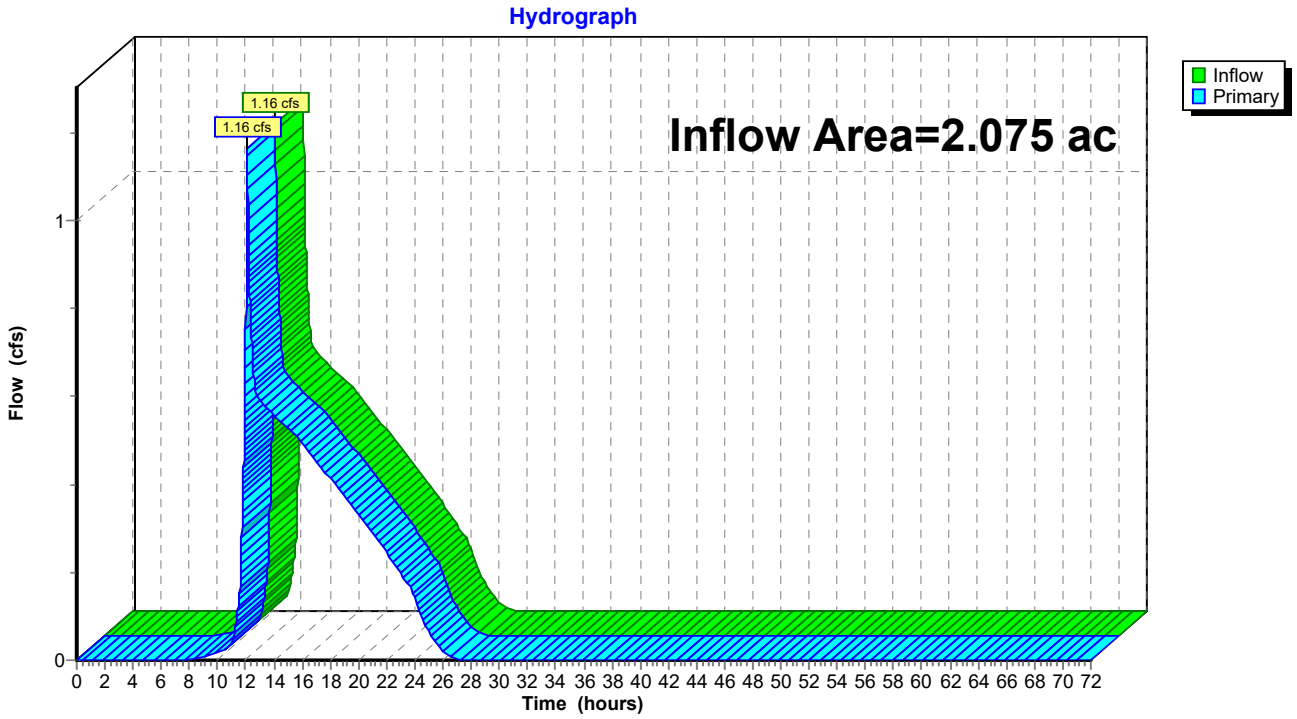


Summary for Link Post-Dev POI1: Post-Dev POI#1

Inflow Area = 2.075 ac, 85.54% Impervious, Inflow Depth = 2.58" for 10-Year event
Inflow = 1.16 cfs @ 12.10 hrs, Volume= 0.446 af
Primary = 1.16 cfs @ 12.10 hrs, Volume= 0.446 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI1: Post-Dev POI#1



Summary for Subcatchment 10: Post-Dev Capture 1 (POI#1)

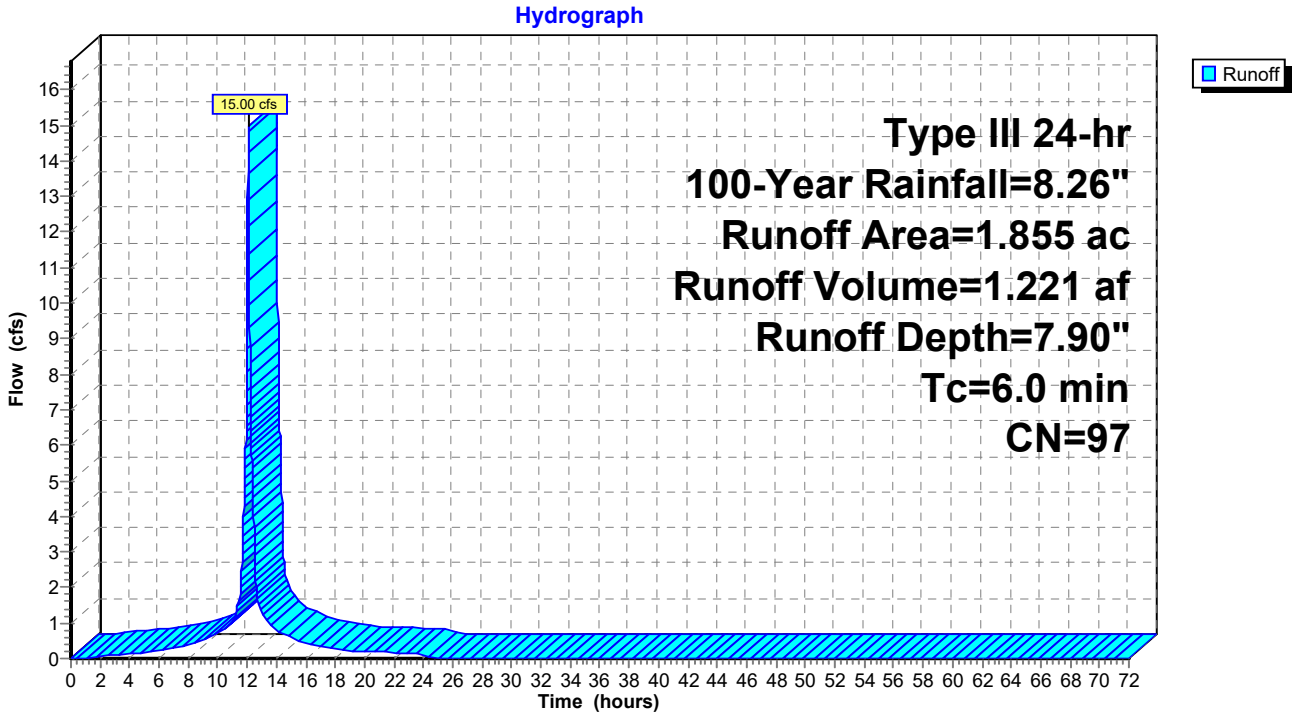
Runoff = 15.00 cfs @ 12.08 hrs, Volume= 1.221 af, Depth= 7.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
0.080	80	>75% Grass cover, Good, HSG D
1.775	98	Paved parking, HSG D
1.855	97	Weighted Average
0.080		4.31% Pervious Area
1.775		95.69% Impervious Area

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

Subcatchment 10: Post-Dev Capture 1 (POI#1)



Summary for Subcatchment 11: Post-Dev Bypass 1 (POI#1)

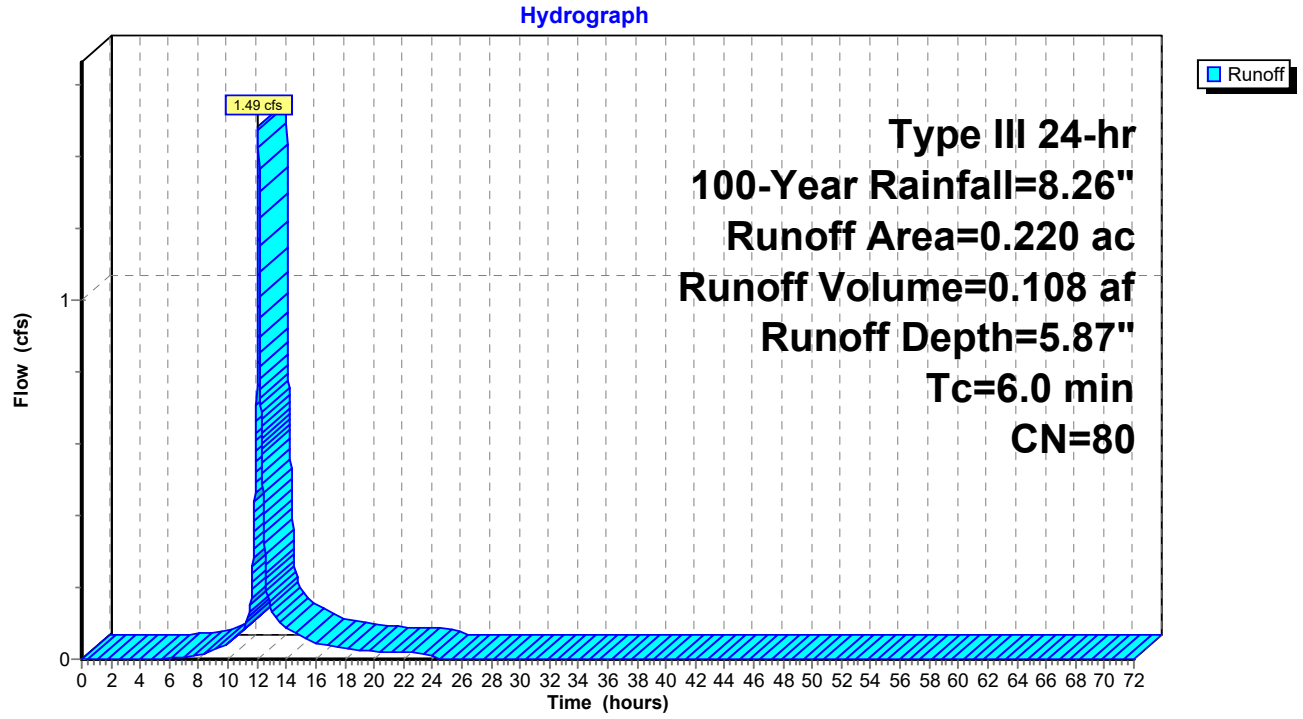
Runoff = 1.49 cfs @ 12.09 hrs, Volume= 0.108 af, Depth= 5.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
0.220	80	>75% Grass cover, Good, HSG D
0.220		100.00% Pervious Area

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

Subcatchment 11: Post-Dev Bypass 1 (POI#1)



Summary for Pond UGD-1: Underground Detention #1

Inflow Area = 1.855 ac, 95.69% Impervious, Inflow Depth = 7.90" for 100-Year event
Inflow = 15.00 cfs @ 12.08 hrs, Volume= 1.221 af
Outflow = 3.63 cfs @ 12.46 hrs, Volume= 1.221 af, Atten= 76%, Lag= 22.6 min
Discarded = 0.17 cfs @ 4.98 hrs, Volume= 0.432 af
Primary = 3.46 cfs @ 12.46 hrs, Volume= 0.789 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 157.89' @ 12.46 hrs Surf.Area= 12,372 sf Storage= 24,196 cf

Plug-Flow detention time= 280.1 min calculated for 1.221 af (100% of inflow)
Center-of-Mass det. time= 280.2 min (1,026.8 - 746.6)

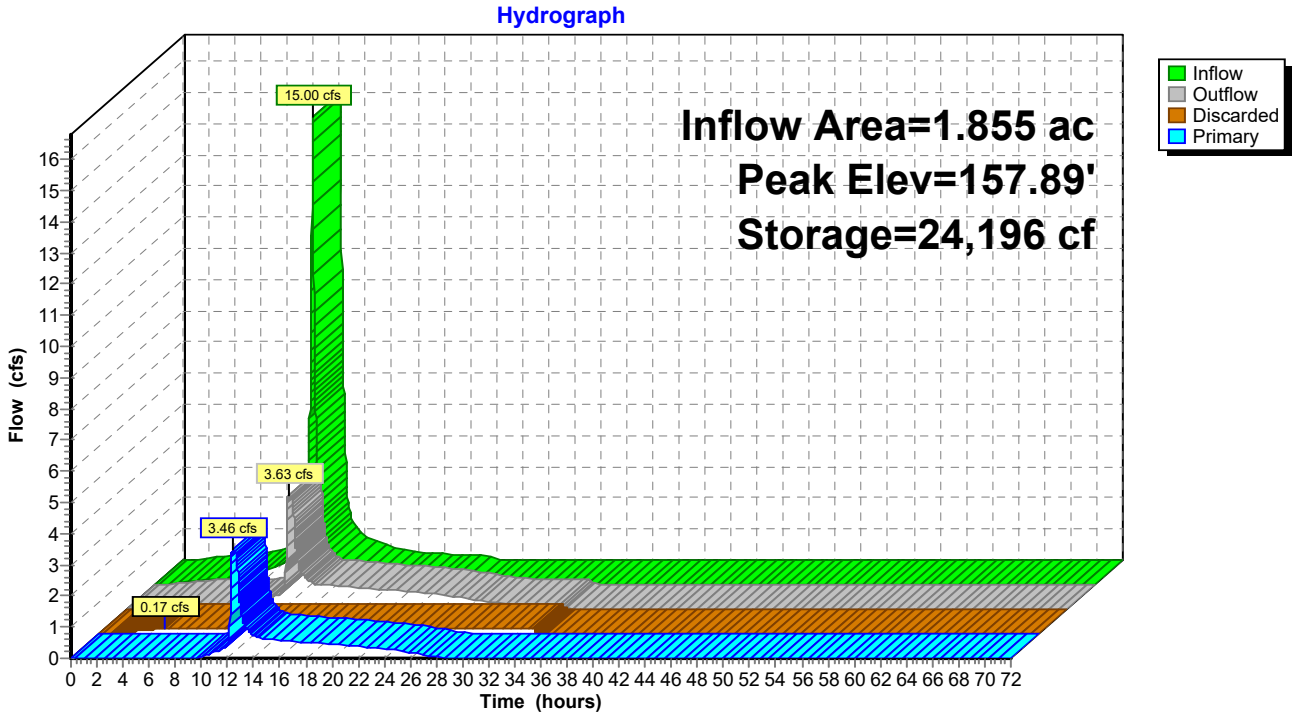
Volume	Invert	Avail.Storage	Storage Description
#1	154.50'	10,576 cf	**68.00'W x 158.64'L x 3.50'H Prismatoid Z=1.0** 40,590 cf Overall - 14,150 cf Embedded = 26,440 cf x 40.0% Voids
#2	155.00'	14,150 cf	**ADS_StormTech SC-740 +Cap** x 308 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		24,726 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	155.00'	**12.0" Round Culvert** L= 325.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 155.00' / 153.37' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	155.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	157.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	154.50'	**0.17 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.17 cfs @ 4.98 hrs HW=154.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=3.46 cfs @ 12.46 hrs HW=157.89' (Free Discharge)
└**1=Culvert** (Barrel Controls 3.46 cfs @ 4.40 fps)
  ├**2=Orifice/Grate** (Passes < 0.69 cfs potential flow)
  └**3=Sharp-Crested Rectangular Weir** (Passes < 6.53 cfs potential flow)

Pond UGD-1: Underground Detention #1

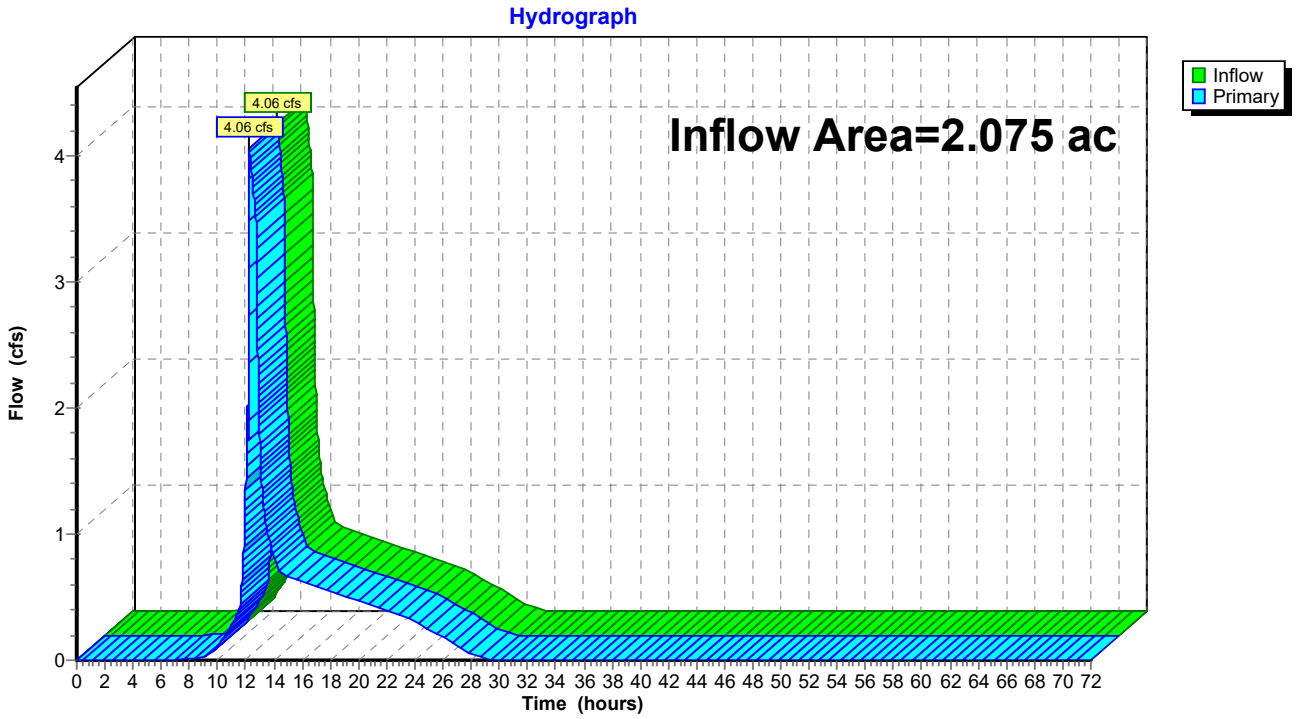


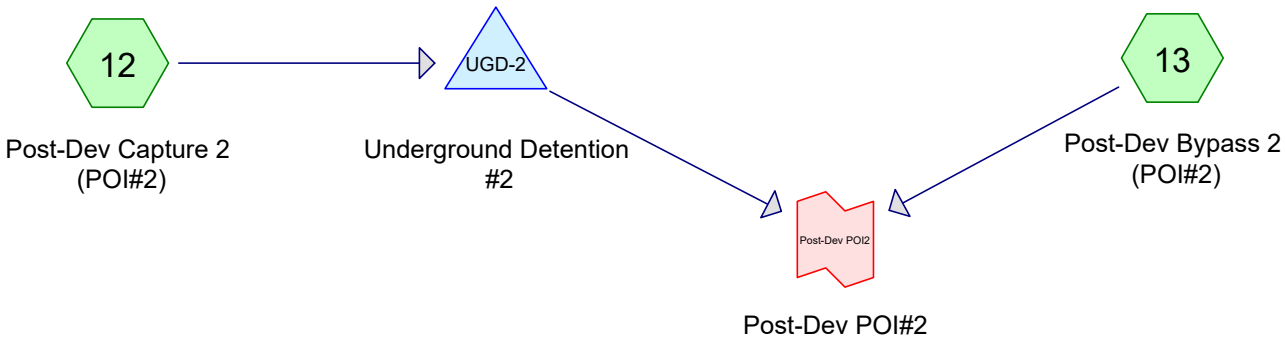
Summary for Link Post-Dev POI1: Post-Dev POI#1

Inflow Area = 2.075 ac, 85.54% Impervious, Inflow Depth = 5.19" for 100-Year event
Inflow = 4.06 cfs @ 12.24 hrs, Volume= 0.897 af
Primary = 4.06 cfs @ 12.24 hrs, Volume= 0.897 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI1: Post-Dev POI#1





Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-0
Prepared by Kimley-Horn and Associates, Printed 5/12/2020

Summary for Subcatchment 12: Post-Dev Capture 2 (POI#2)

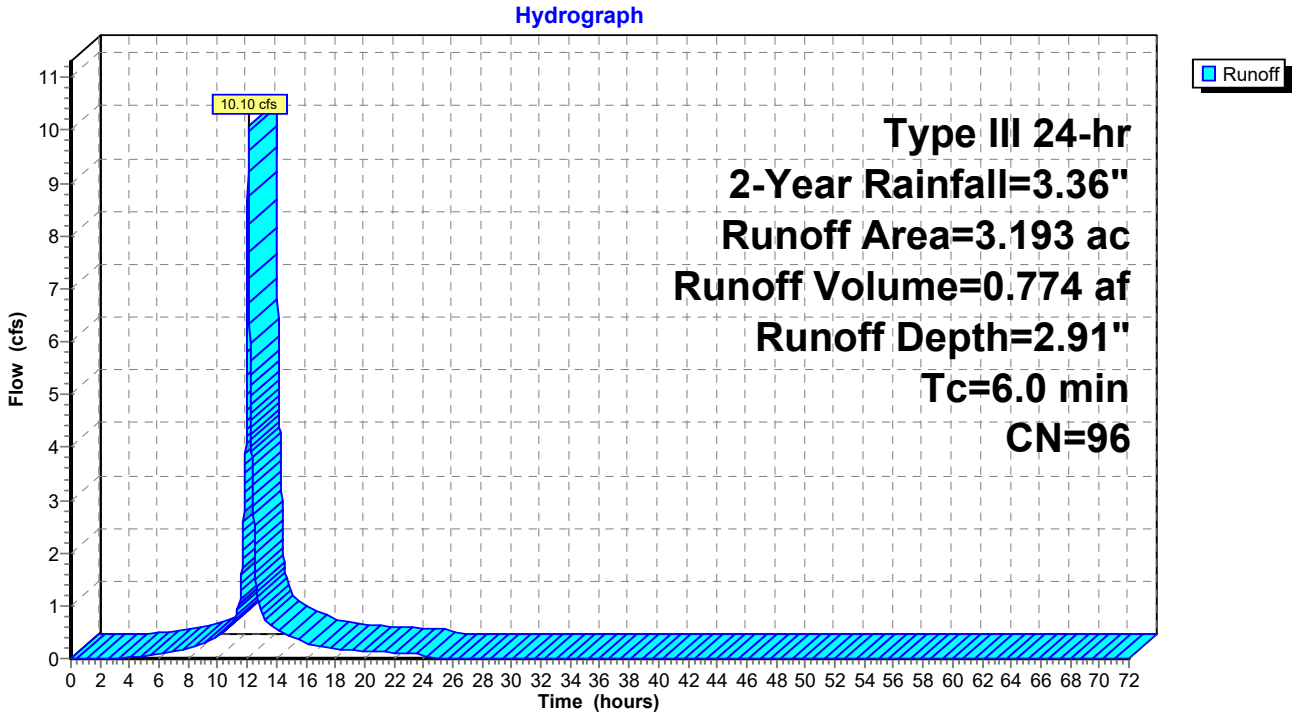
Runoff = 10.10 cfs @ 12.08 hrs, Volume= 0.774 af, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
0.429	80	>75% Grass cover, Good, HSG D
2.764	98	Paved parking, HSG D
3.193	96	Weighted Average
0.429		13.44% Pervious Area
2.764		86.56% Impervious Area

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

Subcatchment 12: Post-Dev Capture 2 (POI#2)



Summary for Subcatchment 13: Post-Dev Bypass 2 (POI#2)

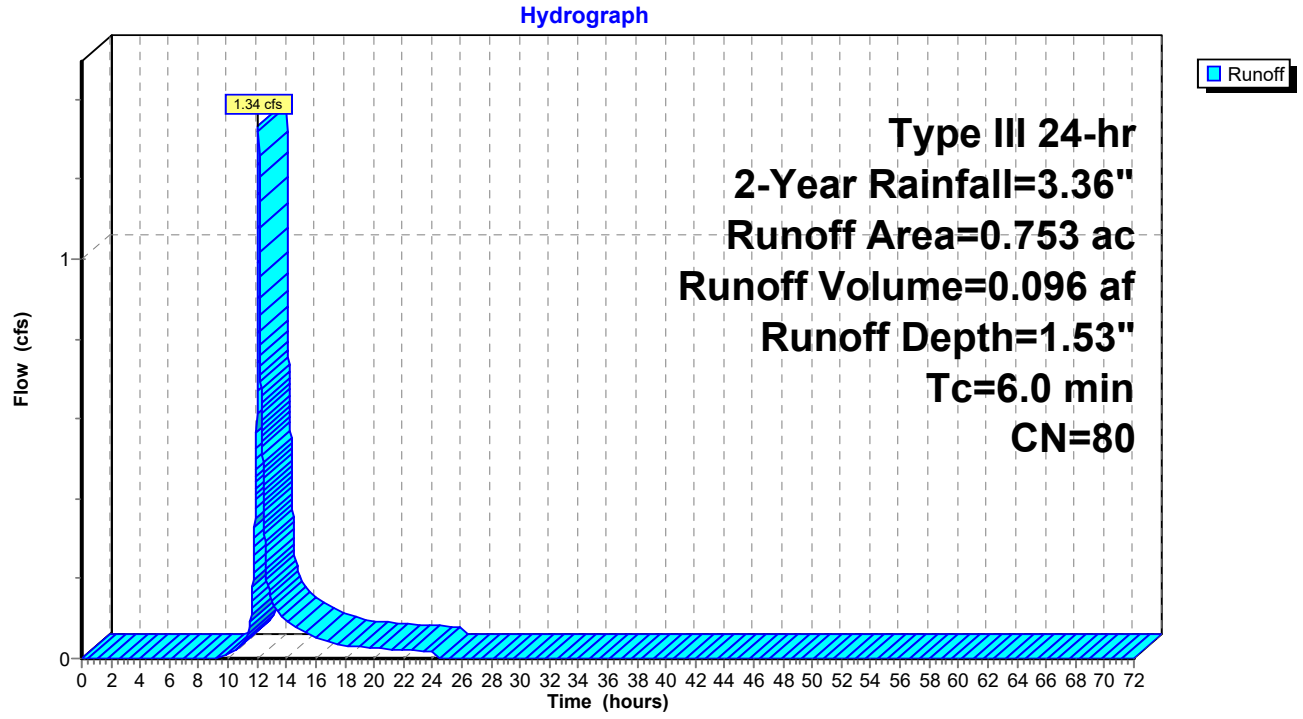
Runoff = 1.34 cfs @ 12.09 hrs, Volume= 0.096 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.36"

Area (ac)	CN	Description
0.734	80	>75% Grass cover, Good, HSG D
0.019	98	Paved parking, HSG D
0.753	80	Weighted Average
0.734		97.48% Pervious Area
0.019		2.52% Impervious Area

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

Subcatchment 13: Post-Dev Bypass 2 (POI#2)



Summary for Pond UGD-2: Underground Detention #2

Inflow Area = 3.193 ac, 86.56% Impervious, Inflow Depth = 2.91" for 2-Year event
Inflow = 10.10 cfs @ 12.08 hrs, Volume= 0.774 af
Outflow = 2.02 cfs @ 12.51 hrs, Volume= 0.774 af, Atten= 80%, Lag= 25.6 min
Discarded = 0.17 cfs @ 8.21 hrs, Volume= 0.361 af
Primary = 1.85 cfs @ 12.51 hrs, Volume= 0.413 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 154.75' @ 12.51 hrs Surf.Area= 19,024 sf Storage= 15,294 cf

Plug-Flow detention time= 221.4 min calculated for 0.773 af (100% of inflow)
Center-of-Mass det. time= 221.5 min (994.2 - 772.7)

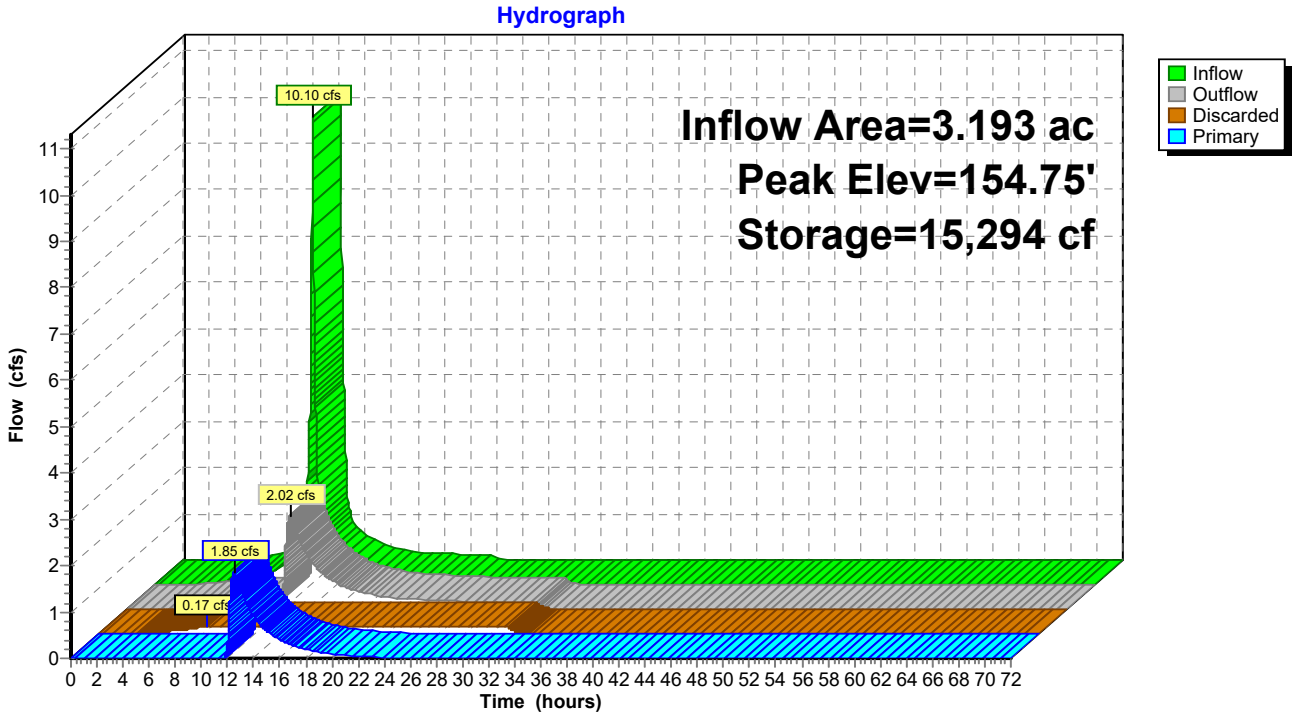
Volume	Invert	Avail.Storage	Storage Description
#1	153.50'	17,579 cf	**63.25'W x 286.80'L x 3.50'H Prismatoid Z=1.0** 67,836 cf Overall - 23,889 cf Embedded = 43,947 cf x 40.0% Voids
#2	154.00'	23,889 cf	**ADS_StormTech SC-740 +Cap** x 520 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		41,468 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	154.00'	**15.0" Round Culvert** L= 196.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 154.00' / 153.00' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Discarded	153.50'	**0.17 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.17 cfs @ 8.21 hrs HW=153.54' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=1.85 cfs @ 12.51 hrs HW=154.75' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.85 cfs @ 3.43 fps)

Pond UGD-2: Underground Detention #2

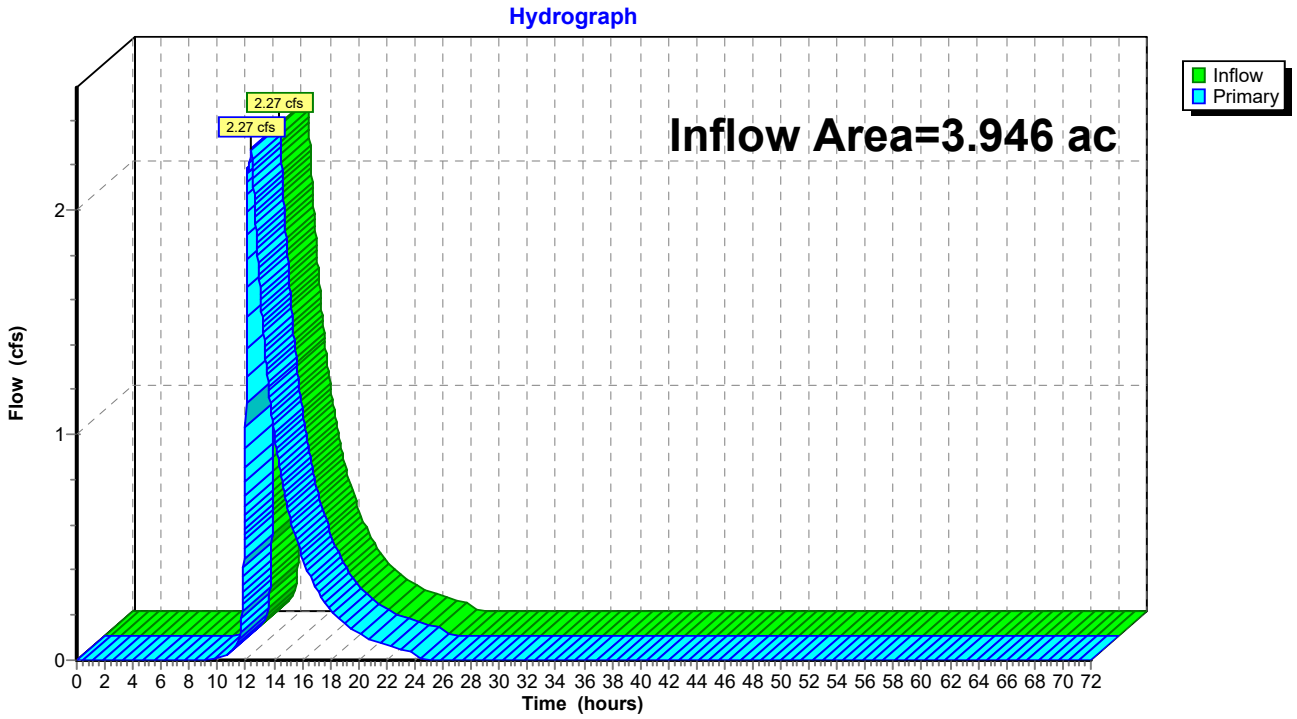


Summary for Link Post-Dev POI2: Post-Dev POI#2

Inflow Area = 3.946 ac, 70.53% Impervious, Inflow Depth = 1.55" for 2-Year event
Inflow = 2.27 cfs @ 12.38 hrs, Volume= 0.509 af
Primary = 2.27 cfs @ 12.38 hrs, Volume= 0.509 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI2: Post-Dev POI#2



Summary for Subcatchment 12: Post-Dev Capture 2 (POI#2)

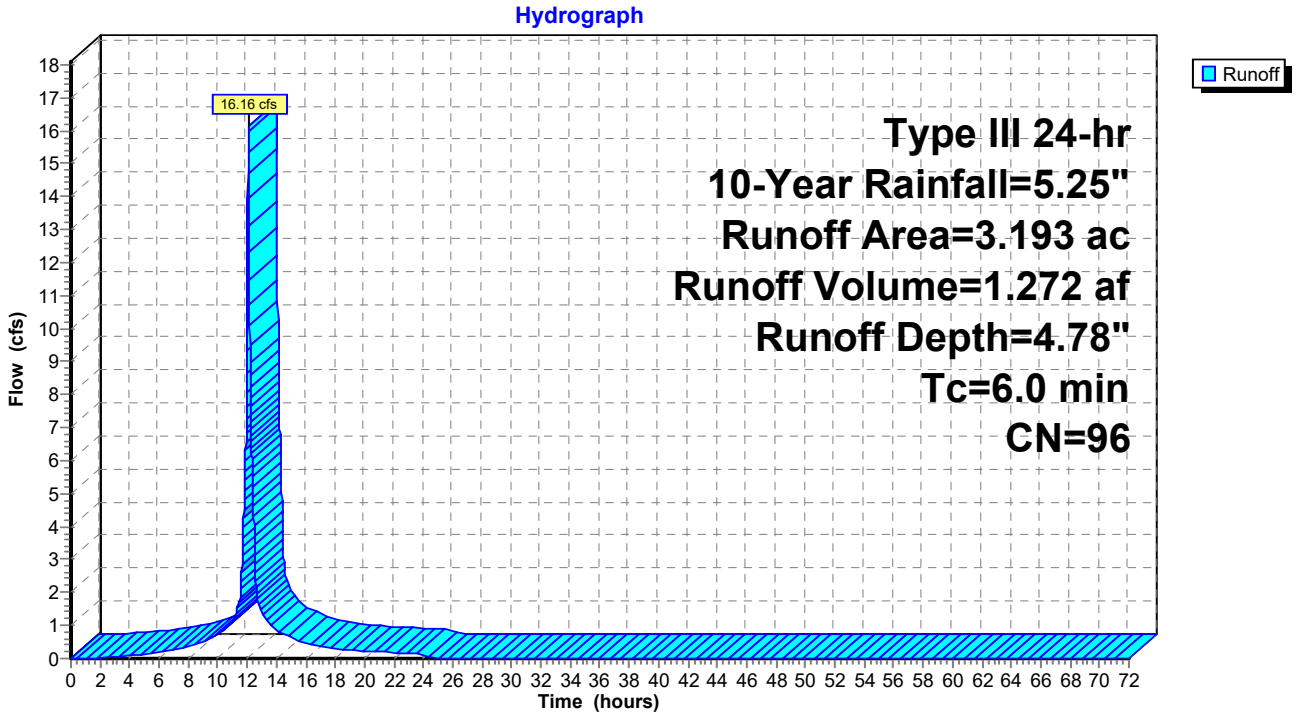
Runoff = 16.16 cfs @ 12.08 hrs, Volume= 1.272 af, Depth= 4.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
0.429	80	>75% Grass cover, Good, HSG D
2.764	98	Paved parking, HSG D
3.193	96	Weighted Average
0.429		13.44% Pervious Area
2.764		86.56% Impervious Area

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

Subcatchment 12: Post-Dev Capture 2 (POI#2)



Summary for Subcatchment 13: Post-Dev Bypass 2 (POI#2)

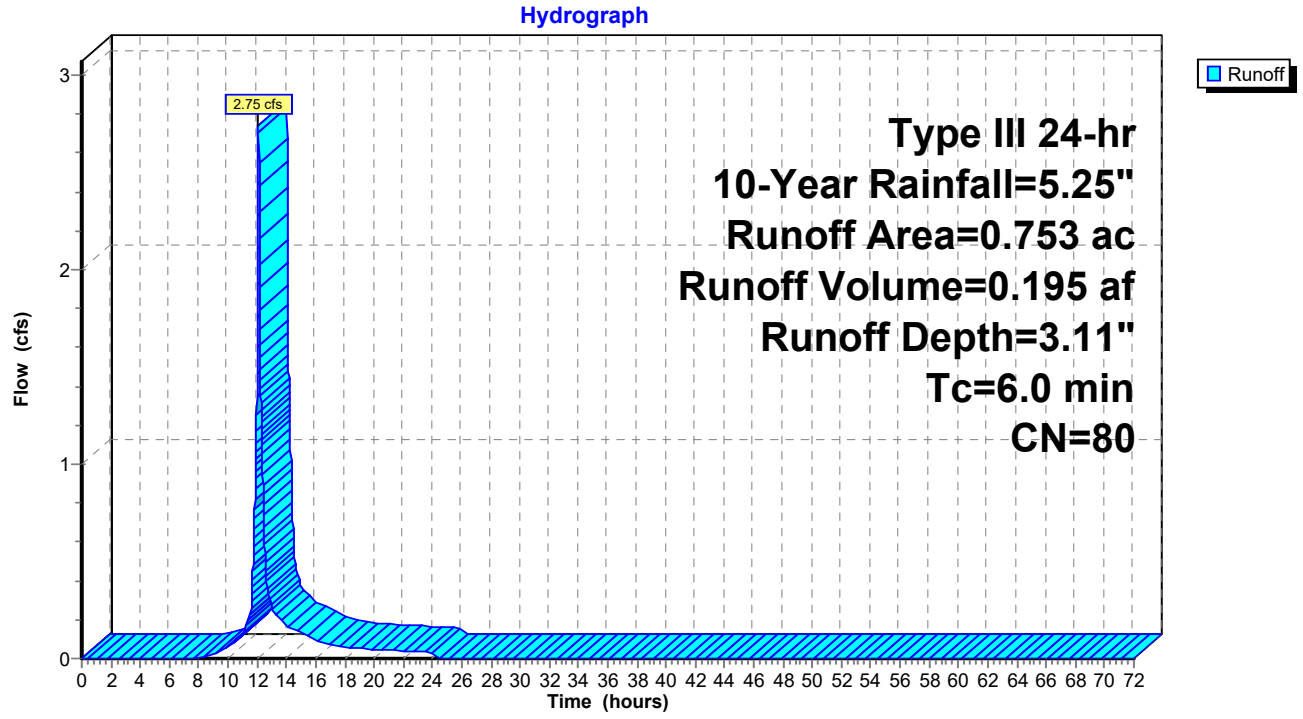
Runoff = 2.75 cfs @ 12.09 hrs, Volume= 0.195 af, Depth= 3.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.25"

Area (ac)	CN	Description
0.734	80	>75% Grass cover, Good, HSG D
0.019	98	Paved parking, HSG D
0.753	80	Weighted Average
0.734		97.48% Pervious Area
0.019		2.52% Impervious Area

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

Subcatchment 13: Post-Dev Bypass 2 (POI#2)



Summary for Pond UGD-2: Underground Detention #2

Inflow Area = 3.193 ac, 86.56% Impervious, Inflow Depth = 4.78" for 10-Year event
Inflow = 16.16 cfs @ 12.08 hrs, Volume= 1.272 af
Outflow = 4.44 cfs @ 12.43 hrs, Volume= 1.272 af, Atten= 73%, Lag= 20.5 min
Discarded = 0.17 cfs @ 6.28 hrs, Volume= 0.407 af
Primary = 4.27 cfs @ 12.43 hrs, Volume= 0.865 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 155.31' @ 12.43 hrs Surf.Area= 19,421 sf Storage= 23,447 cf

Plug-Flow detention time= 180.4 min calculated for 1.272 af (100% of inflow)
Center-of-Mass det. time= 180.4 min (941.7 - 761.2)

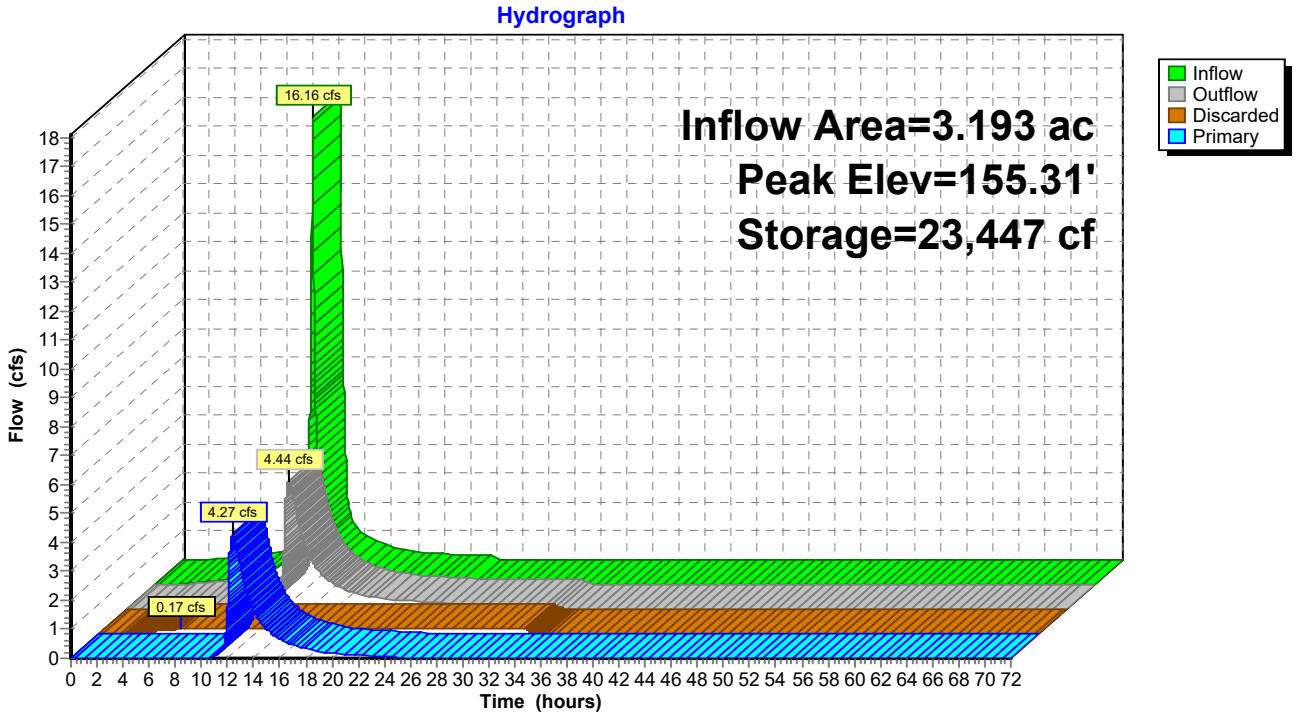
Volume	Invert	Avail.Storage	Storage Description
#1	153.50'	17,579 cf	**63.25'W x 286.80'L x 3.50'H Prismatoid Z=1.0** 67,836 cf Overall - 23,889 cf Embedded = 43,947 cf x 40.0% Voids
#2	154.00'	23,889 cf	**ADS_StormTech SC-740 +Cap** x 520 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		41,468 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	154.00'	**15.0" Round Culvert** L= 196.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 154.00' / 153.00' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Discarded	153.50'	**0.17 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.17 cfs @ 6.28 hrs HW=153.54' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=4.27 cfs @ 12.43 hrs HW=155.31' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 4.27 cfs @ 4.13 fps)

Pond UGD-2: Underground Detention #2

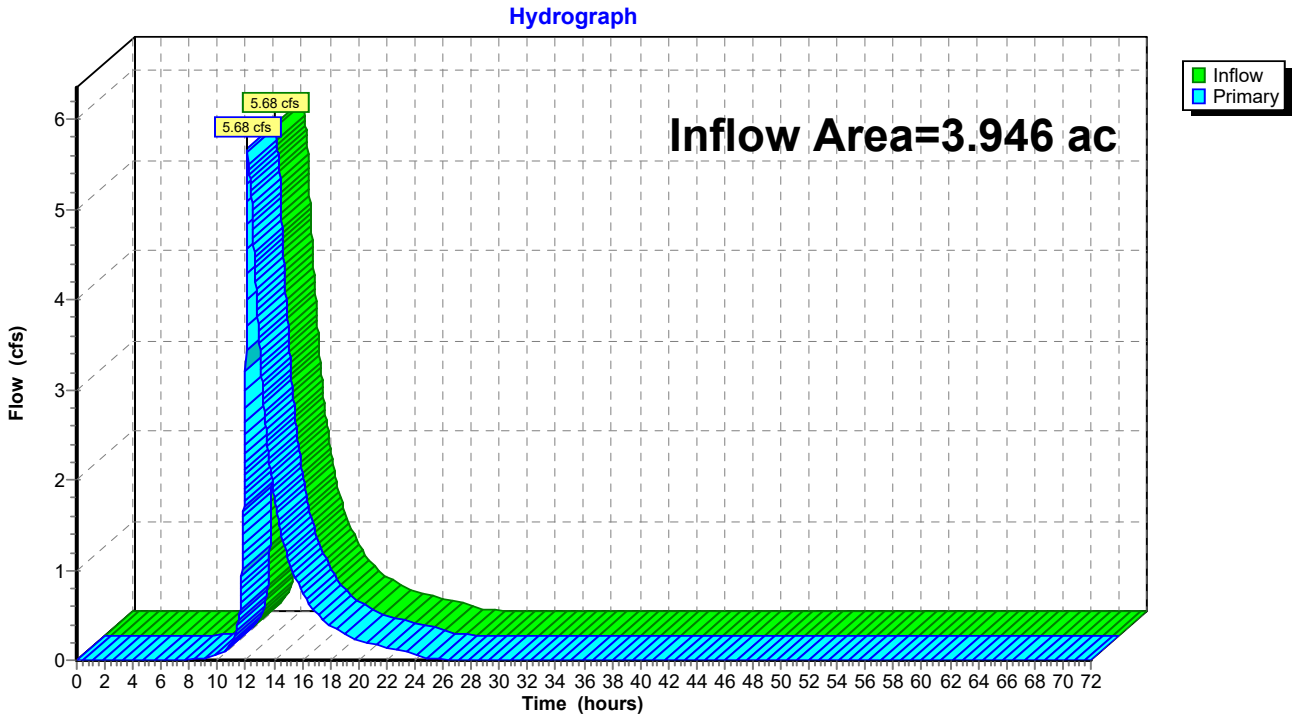


Summary for Link Post-Dev POI2: Post-Dev POI#2

Inflow Area = 3.946 ac, 70.53% Impervious, Inflow Depth = 3.23" for 10-Year event
Inflow = 5.68 cfs @ 12.13 hrs, Volume= 1.060 af
Primary = 5.68 cfs @ 12.13 hrs, Volume= 1.060 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI2: Post-Dev POI#2



Summary for Subcatchment 12: Post-Dev Capture 2 (POI#2)

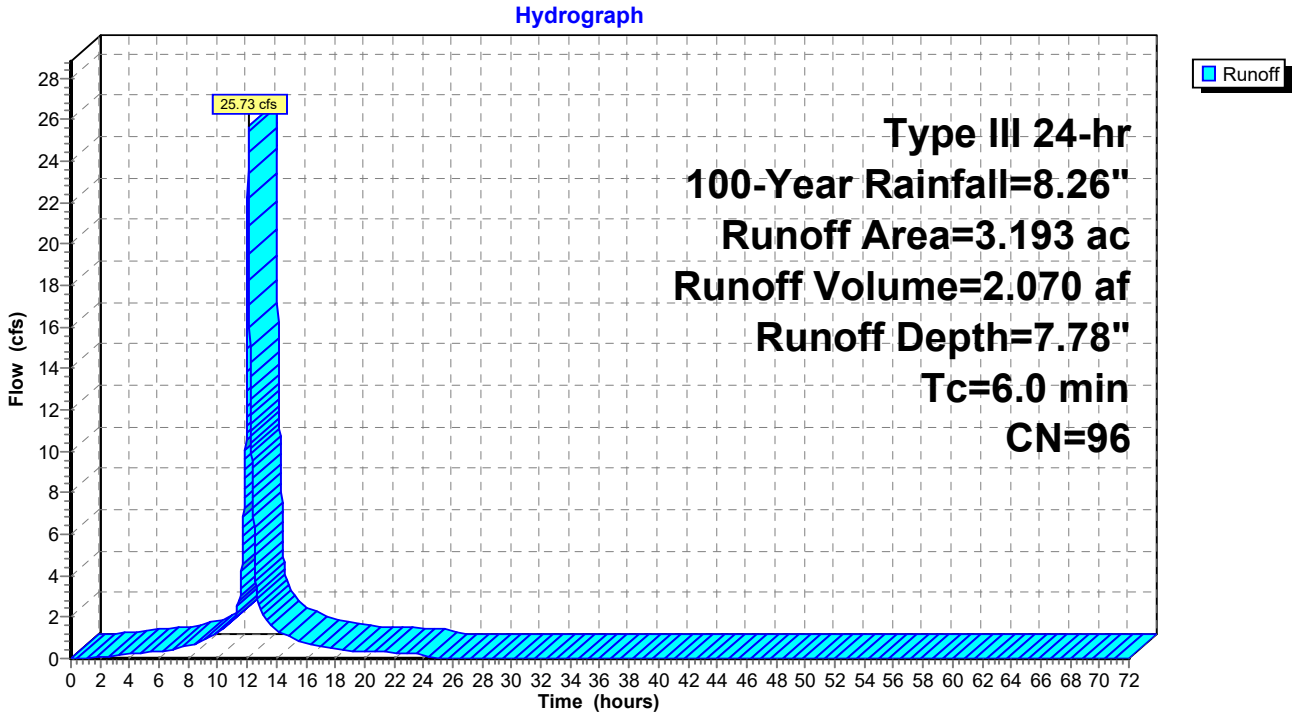
Runoff = 25.73 cfs @ 12.08 hrs, Volume= 2.070 af, Depth= 7.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
0.429	80	>75% Grass cover, Good, HSG D
2.764	98	Paved parking, HSG D
3.193	96	Weighted Average
0.429		13.44% Pervious Area
2.764		86.56% Impervious Area

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

Subcatchment 12: Post-Dev Capture 2 (POI#2)



Summary for Subcatchment 13: Post-Dev Bypass 2 (POI#2)

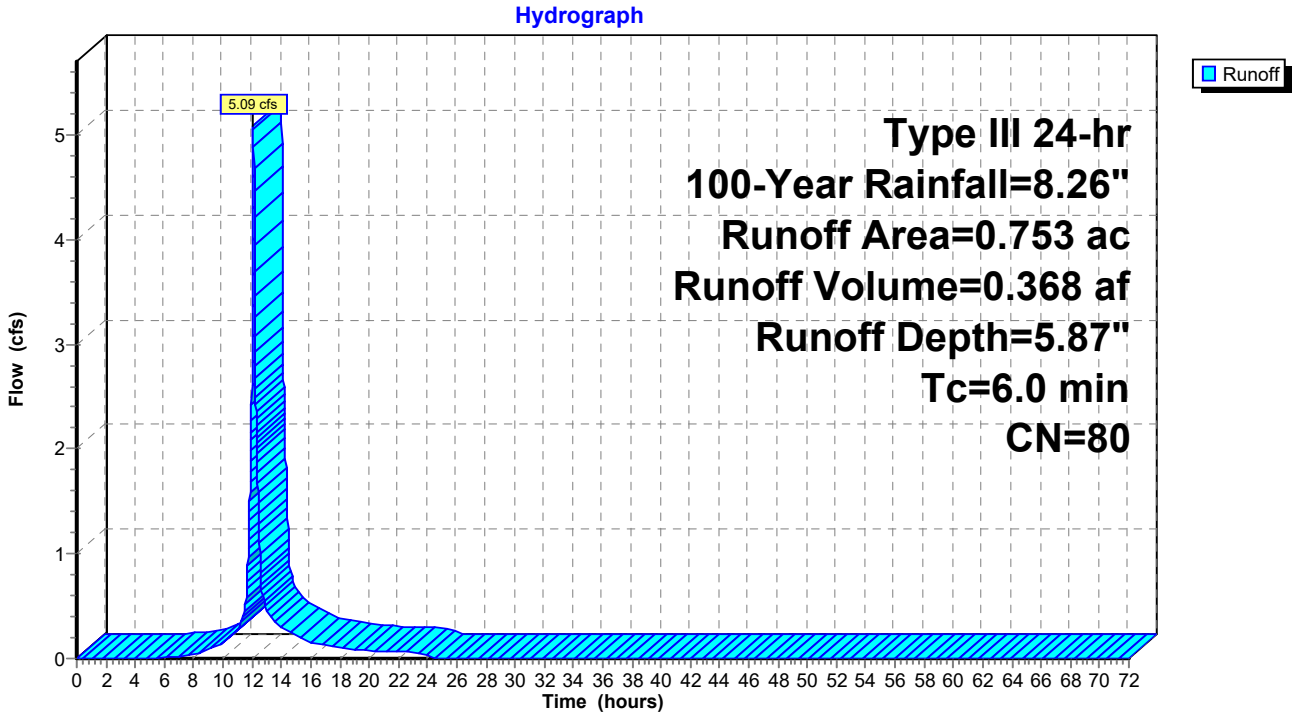
Runoff = 5.09 cfs @ 12.09 hrs, Volume= 0.368 af, Depth= 5.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.26"

Area (ac)	CN	Description
0.734	80	>75% Grass cover, Good, HSG D
0.019	98	Paved parking, HSG D
0.753	80	Weighted Average
0.734		97.48% Pervious Area
0.019		2.52% Impervious Area

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

Subcatchment 13: Post-Dev Bypass 2 (POI#2)



Summary for Pond UGD-2: Underground Detention #2

Inflow Area = 3.193 ac, 86.56% Impervious, Inflow Depth = 7.78" for 100-Year event
Inflow = 25.73 cfs @ 12.08 hrs, Volume= 2.070 af
Outflow = 6.07 cfs @ 12.47 hrs, Volume= 2.070 af, Atten= 76%, Lag= 23.0 min
Discarded = 0.17 cfs @ 3.78 hrs, Volume= 0.446 af
Primary = 5.90 cfs @ 12.47 hrs, Volume= 1.624 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 156.43' @ 12.47 hrs Surf.Area= 20,224 sf Storage= 36,781 cf

Plug-Flow detention time= 155.5 min calculated for 2.070 af (100% of inflow)
Center-of-Mass det. time= 155.5 min (907.2 - 751.7)

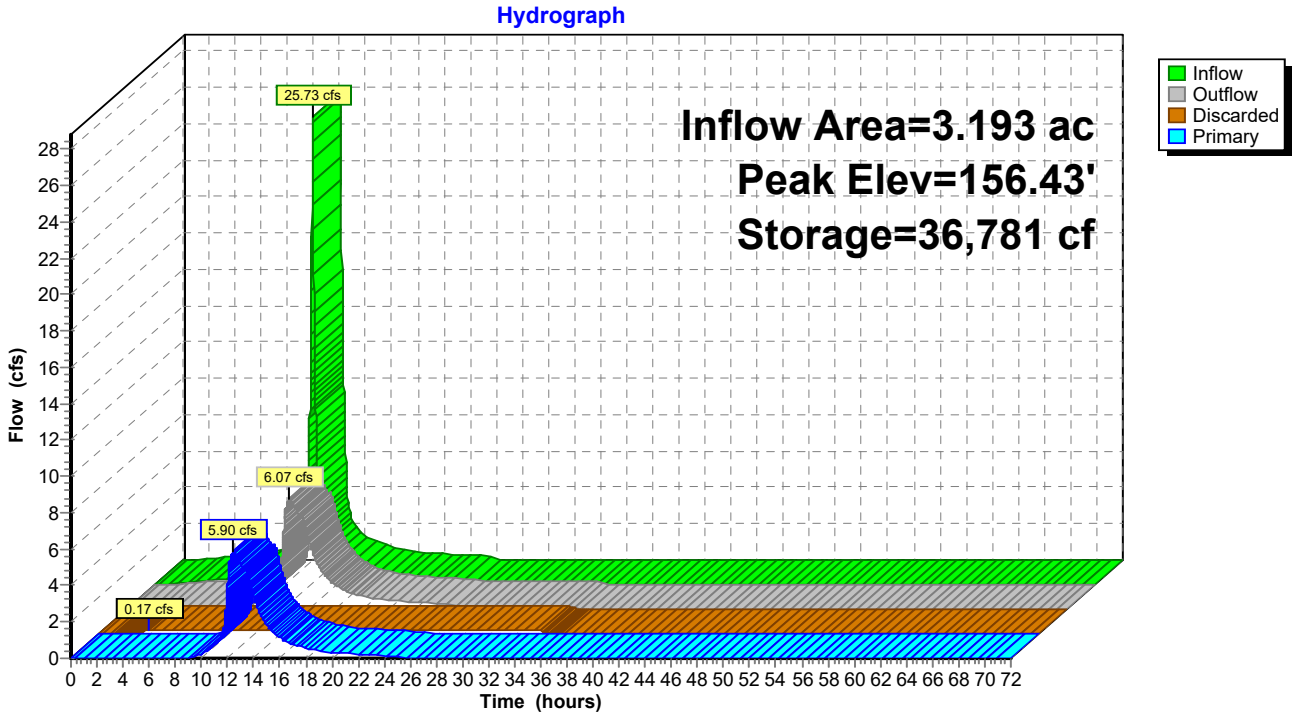
Volume	Invert	Avail.Storage	Storage Description
#1	153.50'	17,579 cf	**63.25'W x 286.80'L x 3.50'H Prismatoid Z=1.0** 67,836 cf Overall - 23,889 cf Embedded = 43,947 cf x 40.0% Voids
#2	154.00'	23,889 cf	**ADS_StormTech SC-740 +Cap** x 520 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		41,468 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	154.00'	**15.0" Round Culvert** L= 196.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 154.00' / 153.00' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Discarded	153.50'	**0.17 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.17 cfs @ 3.78 hrs HW=153.54' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=5.90 cfs @ 12.47 hrs HW=156.43' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 5.90 cfs @ 4.81 fps)

Pond UGD-2: Underground Detention #2

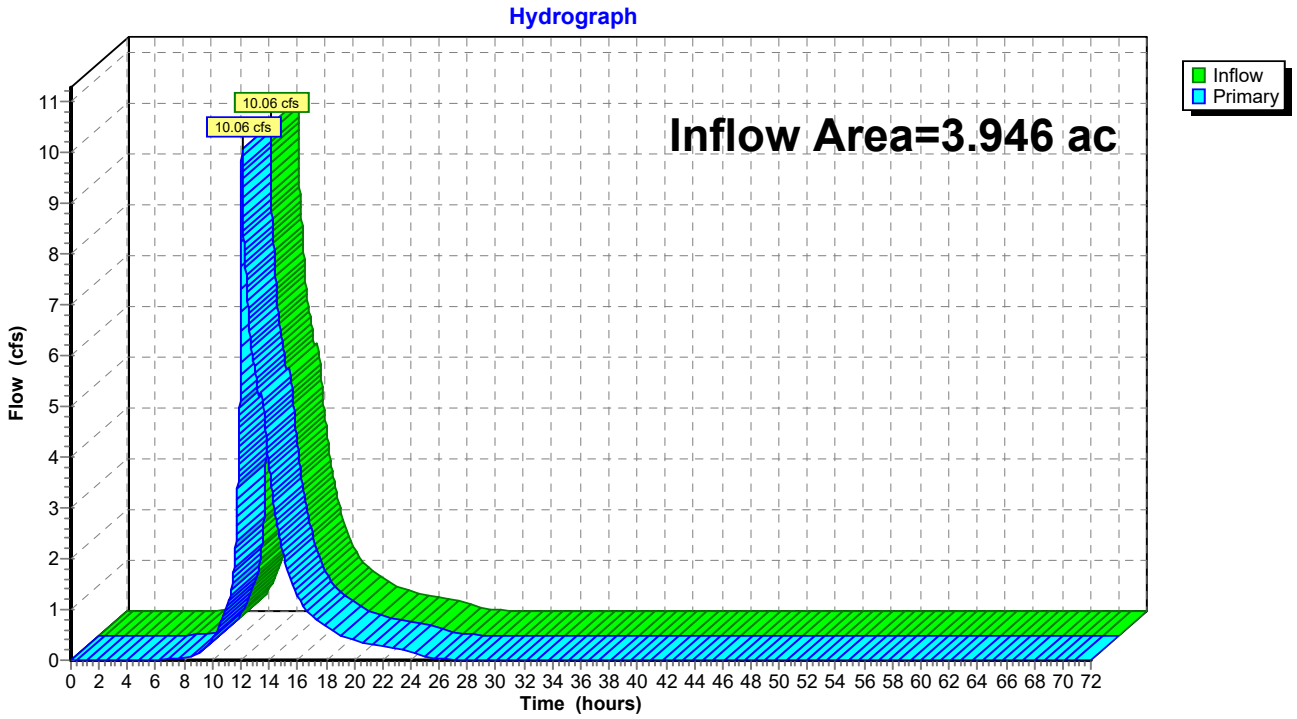


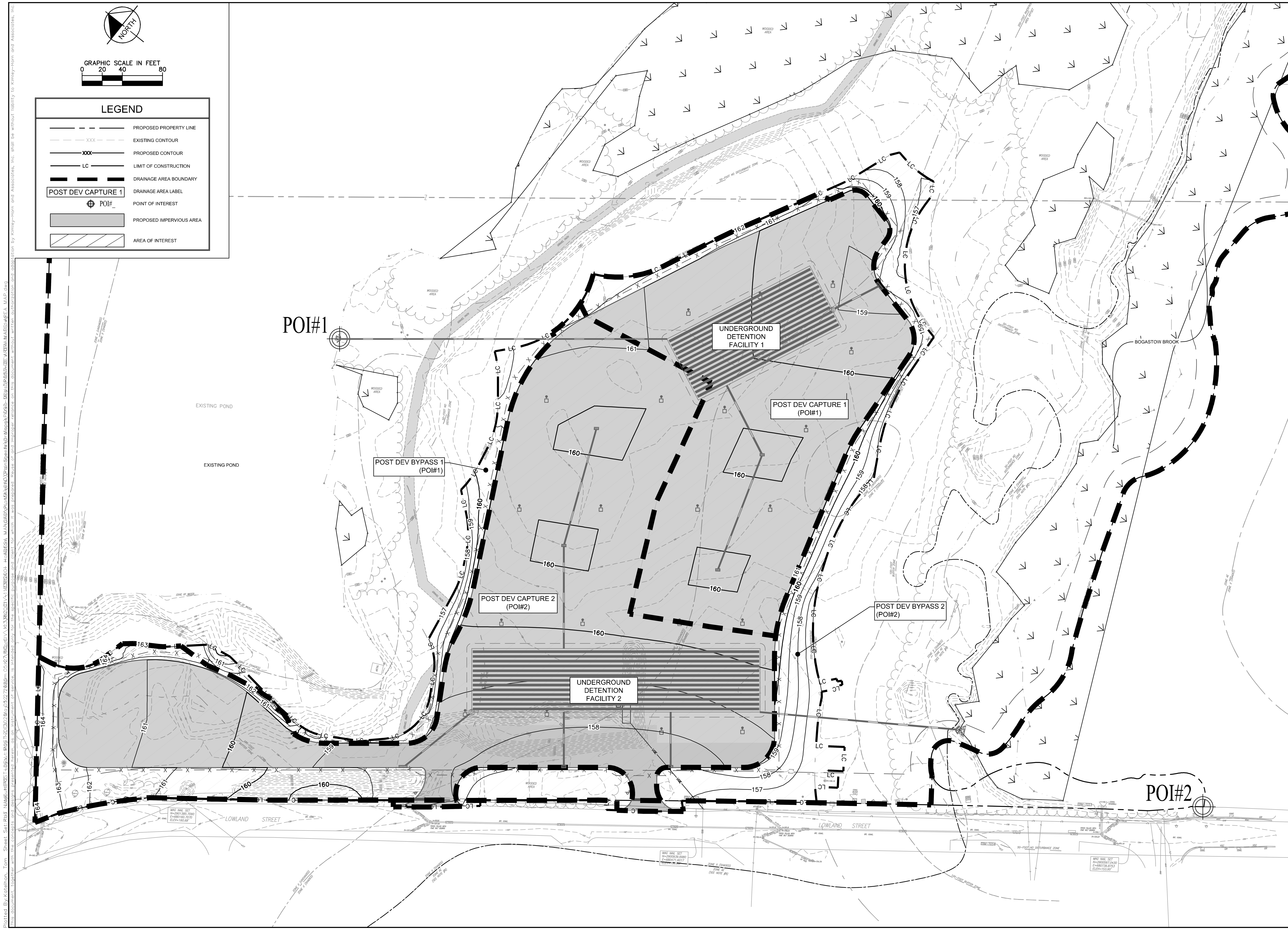
Summary for Link Post-Dev POI2: Post-Dev POI#2

Inflow Area = 3.946 ac, 70.53% Impervious, Inflow Depth = 6.06" for 100-Year event
Inflow = 10.06 cfs @ 12.09 hrs, Volume= 1.993 af
Primary = 10.06 cfs @ 12.09 hrs, Volume= 1.993 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link Post-Dev POI2: Post-Dev POI#2





No.	REVISIONS	DATE	BY

Kimley»Horn

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LICENSED PROFESSIONAL

DATE:

KHA PROJECT	113382001
DATE	04/27/2020
SCALE	AS SHOWN
DESIGNED BY	TGK
DRAWN BY	TGK
CHECKED BY	BJB

POST-DEVELOPMENT DRAINAGE AREA MAP

ADESA HOLLISTON

PREPARED FOR
ADESA, INC.

TOWN OF HOLLISTON MA

SHEET NUMBER
DA-2

APPENDIX D

Best Management Practices

Required Dedicated Recharge Volume

The storage volume is the volume of the basin, chamber, or voids that must be constructed in order to hold the required recharge volume. The "static" method is used to determine the storage volume to make sure the most conservative measures are being used to size the stormwater facilities.

Required Dedicated Recharge Volume (*Rv) = F x impervious area where:*

Rv	= required recharge volume (cu.ft.)
F	= Target Depth Factor associated with each hydrologic soil group
Impervious Area	= pavement and rooftop area on site conveying to each stormwater management facility

Post Dev Capture 1

Required Dedicated Recharge Volume = 77,317 s.f.*0.17"/12 (Hydrologic Group C/D soils)

= **1,095 cu. ft.**

Provided Recharge Volume = **2,180 cu. ft.*** (Underground Detention Basin 1 at Elev. 155.00)

Post Dev Capture 2

Required Dedicated Recharge Volume = 120,812 s.f.*0.17"/12 (Hydrologic Group C/D soils)

= **1,712 cu. ft.**

Provided Recharge Volume = **3,663 cu. ft.*** (Underground Detention Basin 2 at Elev. 154.00)

*Provided Recharge Volume provided in stage-storage tables for each facility.

Water Quality Detention Volumes

Required Water Quality Volume = 1.0” times the impervious area

Underground Detention Facility 1

Required = 1 in. x 1/12 x 77,317 s.f. = **6,443 cu. ft.**

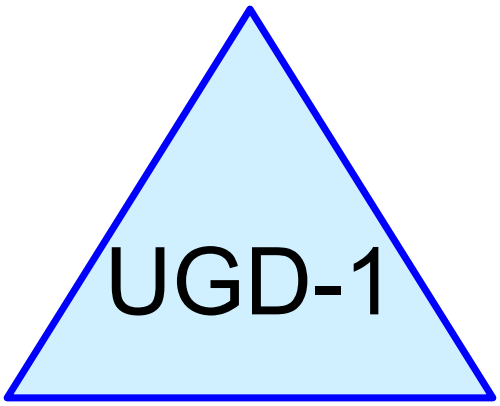
Provided = 24,726 cu. ft.* @ Elevation 158.00

Underground Detention Facility 2

Required = 1 in. x 1/12 x 120,812 s.f. = **10,068 cu. ft.**

Provided = **41,468 cu. ft.*** @ Elevation 157.00

*Provided Recharge Volume provided in stage-storage tables for each facility.



Underground Detention #1

Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-0
Prepared by Kimley-Horn and Associates, Printed 5/12/2020

Summary for Pond UGD-1: Underground Detention #1

Inflow Area = 1.855 ac, 95.69% Impervious, Inflow Depth = 7.90" for 100-Year event
Inflow = 15.00 cfs @ 12.08 hrs, Volume= 1.221 af
Outflow = 3.63 cfs @ 12.46 hrs, Volume= 1.221 af, Atten= 76%, Lag= 22.6 min
Discarded = 0.17 cfs @ 4.98 hrs, Volume= 0.432 af
Primary = 3.46 cfs @ 12.46 hrs, Volume= 0.789 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 157.89' @ 12.46 hrs Surf.Area= 12,372 sf Storage= 24,196 cf

Plug-Flow detention time= 280.1 min calculated for 1.221 af (100% of inflow)
Center-of-Mass det. time= 280.2 min (1,026.8 - 746.6)

Volume	Invert	Avail.Storage	Storage Description
#1	154.50'	10,576 cf	**68.00'W x 158.64'L x 3.50'H Prismatoid Z=1.0** 40,590 cf Overall - 14,150 cf Embedded = 26,440 cf x 40.0% Voids
#2	155.00'	14,150 cf	**ADS_StormTech SC-740 +Cap** x 308 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		24,726 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	155.00'	**12.0" Round Culvert** L= 325.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 155.00' / 153.37' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	155.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	157.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	154.50'	**0.17 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.17 cfs @ 4.98 hrs HW=154.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.17 cfs)

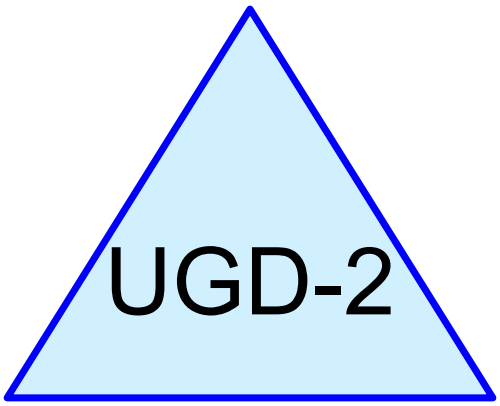
Primary OutFlow Max=3.46 cfs @ 12.46 hrs HW=157.89' (Free Discharge)
└**1=Culvert** (Barrel Controls 3.46 cfs @ 4.40 fps)
  ├**2=Orifice/Grate** (Passes < 0.69 cfs potential flow)
  └**3=Sharp-Crested Rectangular Weir** (Passes < 6.53 cfs potential flow)

Stage-Area-Storage for Pond UGD-1: Underground Detention #1

Elevation (feet)	Storage (cubic-feet)
154.50	0
154.55	216
154.60	432
154.65	649
154.70	867
154.75	1,084
154.80	1,303
154.85	1,521
154.90	1,741
154.95	1,960
155.00	2,180
155.05	2,645
155.10	3,111
155.15	3,576
155.20	4,040
155.25	4,504
155.30	4,966
155.35	5,427
155.40	5,887
155.45	6,346
155.50	6,803
155.55	7,259
155.60	7,713
155.65	8,166
155.70	8,616
155.75	9,065
155.80	9,512
155.85	9,957
155.90	10,400
155.95	10,841
156.00	11,279
156.05	11,715
156.10	12,149
156.15	12,580
156.20	13,007
156.25	13,432
156.30	13,854
156.35	14,272
156.40	14,688
156.45	15,099
156.50	15,507
156.55	15,912
156.60	16,312
156.65	16,708
156.70	17,098
156.75	17,483
156.80	17,862
156.85	18,236
156.90	18,604
156.95	18,966
157.00	19,321
157.05	19,668
157.10	20,007
157.15	20,335
157.20	20,650
157.25	20,949
157.30	21,233
157.35	21,503
157.40	21,764
157.45	22,018
157.50	22,265
157.55	22,509
157.60	22,753
157.65	22,998
157.70	23,244
157.75	23,489
157.80	23,736
157.85	23,982
157.90	24,230
157.95	24,477
158.00	**24,726**

Water recharge storage at Elev. 155.00

Water quality storage at Elev. 158.00



Underground Detention #2

Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-0
Prepared by Kimley-Horn and Associates, Printed 5/12/2020

Summary for Pond UGD-2: Underground Detention #2

Inflow Area = 3.193 ac, 86.56% Impervious, Inflow Depth = 7.78" for 100-Year event
Inflow = 25.73 cfs @ 12.08 hrs, Volume= 2.070 af
Outflow = 6.07 cfs @ 12.47 hrs, Volume= 2.070 af, Atten= 76%, Lag= 23.0 min
Discarded = 0.17 cfs @ 3.78 hrs, Volume= 0.446 af
Primary = 5.90 cfs @ 12.47 hrs, Volume= 1.624 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 156.43' @ 12.47 hrs Surf.Area= 20,224 sf Storage= 36,781 cf

Plug-Flow detention time= 155.5 min calculated for 2.070 af (100% of inflow)
Center-of-Mass det. time= 155.5 min (907.2 - 751.7)

Volume	Invert	Avail.Storage	Storage Description
#1	153.50'	17,579 cf	**63.25'W x 286.80'L x 3.50'H Prismatoid Z=1.0** 67,836 cf Overall - 23,889 cf Embedded = 43,947 cf x 40.0% Voids
#2	154.00'	23,889 cf	**ADS_StormTech SC-740 +Cap** x 520 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		41,468 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	154.00'	**15.0" Round Culvert** L= 196.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 154.00' / 153.00' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Discarded	153.50'	**0.17 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.17 cfs @ 3.78 hrs HW=153.54' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=5.90 cfs @ 12.47 hrs HW=156.43' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 5.90 cfs @ 4.81 fps)

Stage-Area-Storage for Pond UGD-2: Underground Detention #2

Elevation (feet)	Storage (cubic-feet)
153.50	0
153.55	363
153.60	727
153.65	1,092
153.70	1,457
153.75	1,823
153.80	2,189
153.85	2,557
153.90	2,925
153.95	3,294
154.00	3,663
154.05	4,446
154.10	5,230
154.15	6,012
154.20	6,794
154.25	7,574
154.30	8,352
154.35	9,128
154.40	9,902
154.45	10,674
154.50	11,444
154.55	12,210
154.60	12,974
154.65	13,735
154.70	14,493
154.75	15,247
154.80	15,999
154.85	16,747
154.90	17,491
154.95	18,232
155.00	18,969
155.05	19,702
155.10	20,430
155.15	21,153
155.20	21,872
155.25	22,585
155.30	23,293
155.35	23,996
155.40	24,693
155.45	25,383
155.50	26,068
155.55	26,747
155.60	27,418
155.65	28,082
155.70	28,736
155.75	29,381
155.80	30,017
155.85	30,643
155.90	31,260
155.95	31,866
156.00	32,460
156.05	33,041
156.10	33,608
156.15	34,156
156.20	34,684
156.25	35,183
156.30	35,656
156.35	36,106
156.40	36,541
156.45	36,964
156.50	37,376
156.55	37,782
156.60	38,188
156.65	38,596
156.70	39,004
156.75	39,413
156.80	39,822
156.85	40,232
156.90	40,643
156.95	41,055
157.00	**41,468**

Water recharge storage at elev. 154.00

Water quality storage at elev. 157.00

Drain Down Time

Draw down analysis is based on soil texture from NRCS soil survey. Basins are located in Hydrologic Group C/D soils. An infiltration rate of 0.17 in/hr (assumed) is used.

Underground Detention Facility 1

Bottom Contact Area = 10,787.52 s.f.

Recharge Rate = 10,787.52 s.f. * 0.17 in/hr *1/12 = 152.82 cu.ft/hr

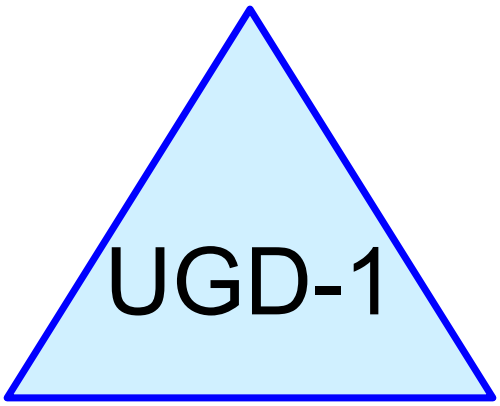
Drain Time for recharge volume = 2,180 cu.ft/ 152.82 cu.ft/hr = **14.26 hours**

Underground Detention Facility 2

Bottom Contact Area = 18,140.10 s.f.

Recharge Rate = 18,140.10 s.f. * 0.17 in/hr *1/12 = 254.98 cu.ft/hr

Drain Time for recharge volume = 3,663 cu.ft/ 154.45 cu.ft/hr = **14.25 hours**



Underground Detention #1

Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-0
Prepared by Kimley-Horn and Associates, Printed 5/12/2020

Summary for Pond UGD-1: Underground Detention #1

Inflow Area = 1.855 ac, 95.69% Impervious, Inflow Depth = 7.90" for 100-Year event
Inflow = 15.00 cfs @ 12.08 hrs, Volume= 1.221 af
Outflow = 3.63 cfs @ 12.46 hrs, Volume= 1.221 af, Atten= 76%, Lag= 22.6 min
Discarded = 0.17 cfs @ 4.98 hrs, Volume= 0.432 af
Primary = 3.46 cfs @ 12.46 hrs, Volume= 0.789 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 157.89' @ 12.46 hrs Surf.Area= 12,372 sf Storage= 24,196 cf

Plug-Flow detention time= 280.1 min calculated for 1.221 af (100% of inflow)
Center-of-Mass det. time= 280.2 min (1,026.8 - 746.6)

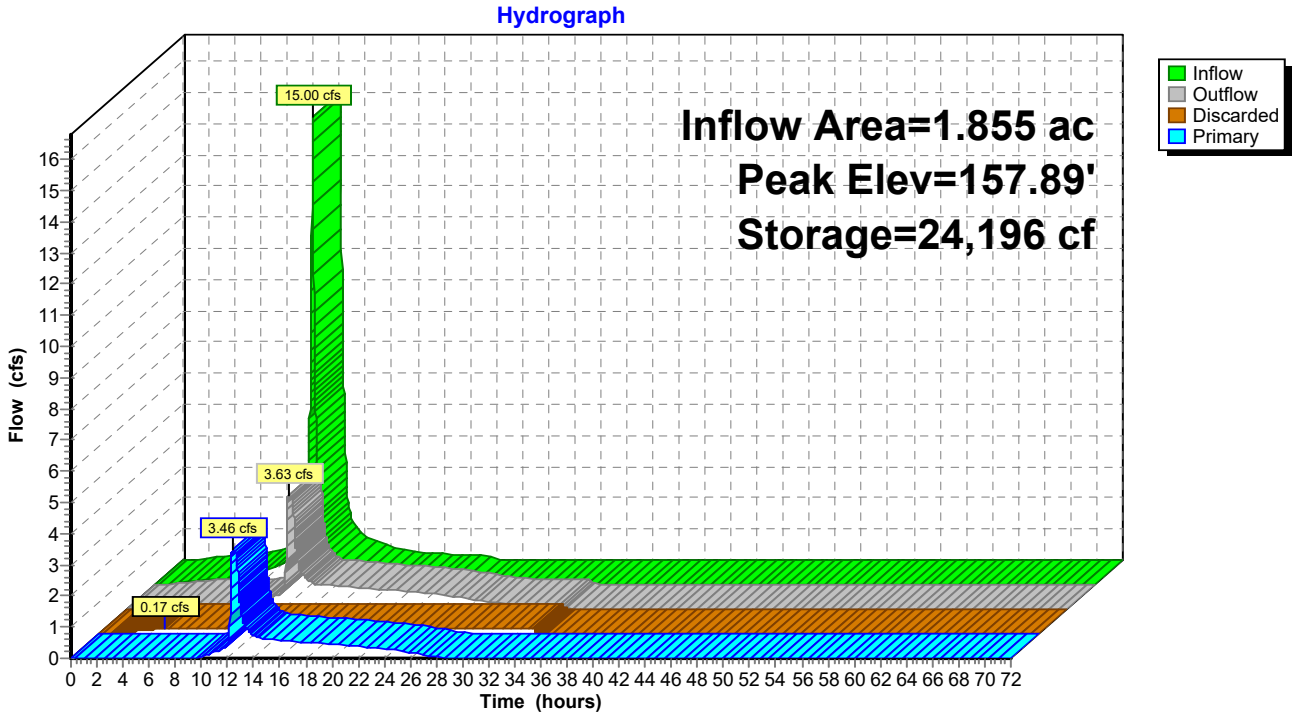
Volume	Invert	Avail.Storage	Storage Description
#1	154.50'	10,576 cf	**68.00'W x 158.64'L x 3.50'H Prismatoid Z=1.0** 40,590 cf Overall - 14,150 cf Embedded = 26,440 cf x 40.0% Voids
#2	155.00'	14,150 cf	**ADS_StormTech SC-740 +Cap** x 308 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		24,726 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	155.00'	**12.0" Round Culvert** L= 325.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 155.00' / 153.37' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	155.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	157.25'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	154.50'	**0.17 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.17 cfs @ 4.98 hrs HW=154.54' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=3.46 cfs @ 12.46 hrs HW=157.89' (Free Discharge)
└**1=Culvert** (Barrel Controls 3.46 cfs @ 4.40 fps)
  ├**2=Orifice/Grate** (Passes < 0.69 cfs potential flow)
  └**3=Sharp-Crested Rectangular Weir** (Passes < 6.53 cfs potential flow)

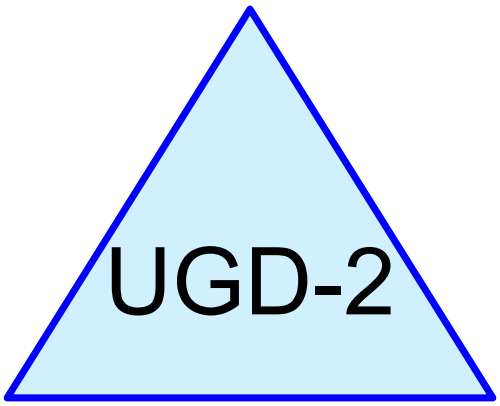
Pond UGD-1: Underground Detention #1



Hydrograph for Pond UGD-1: Underground Detention #1

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	154.50	0.00	0.00	0.00
2.00	0.06	48	154.51	0.05	0.05	0.00
4.00	0.14	120	154.53	0.14	**0.14**	0.00
6.00	0.21	243	154.56	0.17	**0.17**	0.00
8.00	0.37	1,079	154.75	0.17	0.17	0.00
10.00	0.72	3,661	155.16	0.23	0.17	0.06
12.00	**9.45**	**14,050**	**156.32**	**0.62**	0.17	**0.45**
14.00	**0.79**	**21,204**	**157.29**	**0.91**	0.17	**0.74**
16.00	0.42	19,831	157.07	0.75	0.17	0.58
18.00	0.25	17,028	156.69	0.69	0.17	0.52
20.00	0.20	13,944	156.31	0.62	0.17	0.45
22.00	0.17	11,071	155.98	0.55	0.17	0.38
24.00	0.13	8,475	155.68	0.47	0.17	0.30
26.00	0.00	5,523	155.36	0.35	0.17	0.18
28.00	0.00	3,494	155.14	0.22	0.17	0.05
30.00	0.00	2,164	155.00	0.17	0.17	0.00
32.00	0.00	940	154.72	0.17	0.17	0.00
34.00	0.00	8	154.50	0.01	0.01	0.00
36.00	0.00	0	154.50	0.00	0.00	0.00
38.00	0.00	0	154.50	0.00	0.00	0.00
40.00	0.00	0	154.50	0.00	0.00	0.00
42.00	0.00	0	154.50	0.00	0.00	0.00
44.00	0.00	0	154.50	0.00	0.00	0.00
46.00	0.00	0	154.50	0.00	0.00	0.00
48.00	0.00	0	154.50	0.00	0.00	0.00
50.00	0.00	0	154.50	0.00	0.00	0.00
52.00	0.00	0	154.50	0.00	0.00	0.00
54.00	0.00	0	154.50	0.00	0.00	0.00
56.00	0.00	0	154.50	0.00	0.00	0.00
58.00	0.00	0	154.50	0.00	0.00	0.00
60.00	0.00	0	154.50	0.00	0.00	0.00
62.00	0.00	0	154.50	0.00	0.00	0.00
64.00	0.00	0	154.50	0.00	0.00	0.00
66.00	0.00	0	154.50	0.00	0.00	0.00
68.00	0.00	0	154.50	0.00	0.00	0.00
70.00	0.00	0	154.50	0.00	0.00	0.00
72.00	0.00	0	154.50	0.00	0.00	0.00

Dewatered at 36 hours



Underground Detention #2

Subcat Reach Pond Link

Routing Diagram for 113382001 - Rev-0
Prepared by Kimley-Horn and Associates, Printed 5/12/2020

Summary for Pond UGD-2: Underground Detention #2

Inflow Area = 3.193 ac, 86.56% Impervious, Inflow Depth = 7.78" for 100-Year event
Inflow = 25.73 cfs @ 12.08 hrs, Volume= 2.070 af
Outflow = 6.07 cfs @ 12.47 hrs, Volume= 2.070 af, Atten= 76%, Lag= 23.0 min
Discarded = 0.17 cfs @ 3.78 hrs, Volume= 0.446 af
Primary = 5.90 cfs @ 12.47 hrs, Volume= 1.624 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 156.43' @ 12.47 hrs Surf.Area= 20,224 sf Storage= 36,781 cf

Plug-Flow detention time= 155.5 min calculated for 2.070 af (100% of inflow)
Center-of-Mass det. time= 155.5 min (907.2 - 751.7)

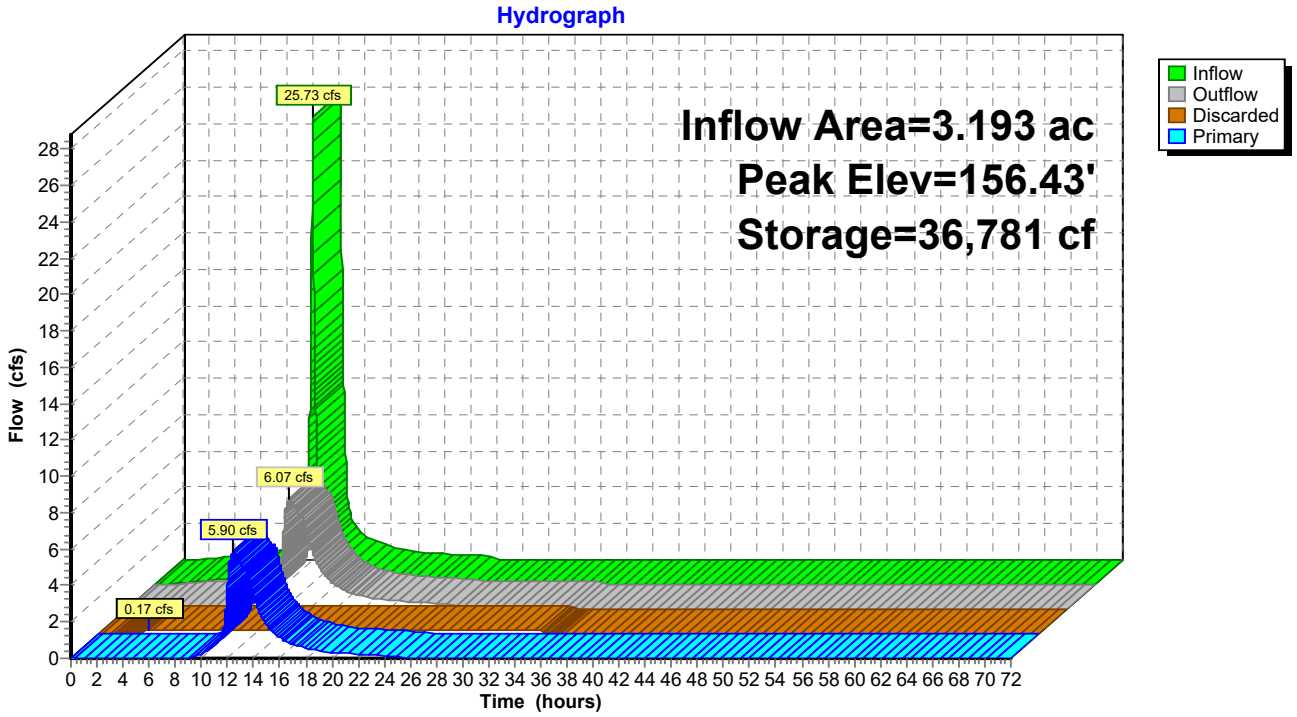
Volume	Invert	Avail.Storage	Storage Description
#1	153.50'	17,579 cf	**63.25'W x 286.80'L x 3.50'H Prismatoid Z=1.0** 67,836 cf Overall - 23,889 cf Embedded = 43,947 cf x 40.0% Voids
#2	154.00'	23,889 cf	**ADS_StormTech SC-740 +Cap** x 520 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
		41,468 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	154.00'	**15.0" Round Culvert** L= 196.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 154.00' / 153.00' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Discarded	153.50'	**0.17 cfs Exfiltration at all elevations**

Discarded OutFlow Max=0.17 cfs @ 3.78 hrs HW=153.54' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=5.90 cfs @ 12.47 hrs HW=156.43' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 5.90 cfs @ 4.81 fps)

Pond UGD-2: Underground Detention #2



Hydrograph for Pond UGD-2: Underground Detention #2

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	153.50	0.00	0.00	0.00
2.00	0.07	69	153.51	0.05	**0.05**	0.00
4.00	0.21	283	153.54	0.17	**0.17**	0.00
6.00	0.33	1,041	153.64	0.17	0.17	0.00
8.00	0.60	3,157	153.93	0.17	0.17	0.00
10.00	1.21	7,913	154.27	0.43	0.17	0.26
12.00	**16.18**	**21,742**	**155.19**	**3.96**	0.17	**3.79**
14.00	**1.36**	**20,811**	**155.13**	**3.68**	0.17	**3.51**
16.00	0.72	12,579	154.57	1.30	0.17	1.13
18.00	0.44	9,781	154.39	0.72	0.17	0.55
20.00	0.35	8,356	154.30	0.49	0.17	0.32
22.00	0.29	7,522	154.25	0.39	0.17	0.22
24.00	0.23	6,862	154.20	0.32	0.17	0.15
26.00	0.00	5,148	154.09	0.20	0.17	0.03
28.00	0.00	3,848	154.01	0.17	0.17	0.00
30.00	0.00	2,623	153.86	0.17	0.17	0.00
32.00	0.00	1,399	153.69	0.17	0.17	0.00
34.00	0.00	186	153.53	0.12	0.12	0.00
36.00	0.00	2	153.50	0.00	0.00	0.00
38.00	0.00	0	153.50	0.00	0.00	0.00
40.00	0.00	0	153.50	0.00	0.00	0.00
42.00	0.00	0	153.50	0.00	0.00	0.00
44.00	0.00	0	153.50	0.00	0.00	0.00
46.00	0.00	0	153.50	0.00	0.00	0.00
48.00	0.00	0	153.50	0.00	0.00	0.00
50.00	0.00	0	153.50	0.00	0.00	0.00
52.00	0.00	0	153.50	0.00	0.00	0.00
54.00	0.00	0	153.50	0.00	0.00	0.00
56.00	0.00	0	153.50	0.00	0.00	0.00
58.00	0.00	0	153.50	0.00	0.00	0.00
60.00	0.00	0	153.50	0.00	0.00	0.00
62.00	0.00	0	153.50	0.00	0.00	0.00
64.00	0.00	0	153.50	0.00	0.00	0.00
66.00	0.00	0	153.50	0.00	0.00	0.00
68.00	0.00	0	153.50	0.00	0.00	0.00
70.00	0.00	0	153.50	0.00	0.00	0.00
72.00	0.00	0	153.50	0.00	0.00	0.00

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: 194 Lowland Street (Underground Detention Facility 1)

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Street Sweeping - 5%	0.05	**1.00**	0.05	0.05
Deep Sump and Hooded Catch Basin	0.25	0.95	0.24	0.71
Barracuda Separator	0.50	0.71	0.36	0.35
Subsurface Infiltration Structure	0.80	0.35	0.28	0.07

Total TSS Removal = 93%

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

Project: ADESA HOLLISTON

Prepared By: TGK

Date: 5/12/2020

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: 194 Lowland Street (Underground Detention Facility 2)

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Street Sweeping - 5%	0.05	**1.00**	0.05	0.05
Deep Sump and Hooded Catch Basin	0.25	0.95	0.24	0.71
Barracuda Separator	0.50	0.71	0.36	0.35
Subsurface Infiltration Structure	0.80	0.35	0.28	0.07

Total TSS Removal = 93%

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

Project: ADESA HOLLISTON

Prepared By: TGK

Date: 5/12/2020

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

BAYSAVER TECHNOLOGIES®

ADS®

Barracuda

The Barracuda is a market-changing stormwater quality technology. This high performance vortex hydrodynamic separator is designed to remove total suspended solids in order to protect our precious receiving waters. The Barracuda is also an outstanding value that offers multiple pipe configurations, and quick installation.

Variable inlet/outlet angle configurations

FEATURES:

- Single manhole design
- No elevation loss between the inlet and outlet
- Variable inlet/outlet angle configurations (not just 180 degree orientation)
- Internal bypass for inline installation (where applicable)
- Revolutionary, patent pending “teeth” mitigate turbulence in the sump area to prevent resuspension of captured contaminants
- Available with grated drop inlet configuration
- Available with trash and/or oil capture add-ons

BENEFITS:

- Internal components are in stock for quick delivery
- The S3, S4, S6, and S8 can be installed in a standard 36” (900 m), 48” (1200 mm), 72” (1800 mm), and 96” (2400 mm) precast manhole, respectively
- The S3 and S4 can be provided factory installed within a 36” (0.91 m) and 48” (1.22 m) ADS HP manhole and delivered to the jobsite
- The Barracuda “teeth” apparatus is fabricated and designed for quick and easy field assembly
- Designed for easy maintenance using a vacuum truck or similar equipment.
- Inspection and maintenance are performed from the surface with no confined space entry

ADS Service: ADS representatives are committed to providing you with the answers to all your questions, including specifications, installation and more.

BARRACUDA SPECIFICATION

MATERIALS AND DESIGN

- Concrete Structures: Designed for H-20 traffic loading and applicable soil loads or as otherwise determined by a Licensed Professional Engineer. The materials and structural design of the devices shall be per ASTM C857 and ASTM C858.
- The 36" and 48" HP Manhole Structures: Made from an impact modified copolymer polypropylene meeting the material requirements of ASTM F2764. The eccentric cone reducer shall be manufactured from polyethylene material meeting ASTM D3350 cell class 213320C. Gaskets shall be made of material meeting the requirements of ASTM F477.
- Separator internals shall be substantially constructed of stainless steel, polyethylene or other thermoplastic material approved by the manufacturer.

PERFORMANCE

- The stormwater treatment unit shall be an inline unit capable of conveying 100% of the design peak flow. If peak flow rates exceed maximum hydraulic rate, the unit shall be installed offline.

- The Barracuda unit shall be designed to remove at least 80% of the suspended solids on an annual aggregate removal basis. Said removal shall be based on full-scale third party testing using OK-110 media gradation or equivalent and 300 mg/L influent concentration. Said full scale testing shall have included sediment capture based on actual total mass collected by the stormwater treatment unit.

- OR -

The Barracuda unit shall be designed to remove at least 50% of TSS using a media mix with d_{50}=75 micron and 200 mg/L influent concentration.

- OR -

The Barracuda unit shall be designed to remove at least 50% of TSS per current NJDEP/NJCAT HDS protocol.

- The stormwater treatment unit internals shall consist of (1) separator cone assembly, and (1) sump assembly which includes (4) legs with "teeth".

Barracuda Model	Manhole Diameter	OK-110 (80% removal)	Pretreatment for infiltration[1]
S3	3 ft (0.91 m)	0.61 CFS	1.20 CFS
S4	4 ft (1.83 m)	1.08 CFS	2.13 CFS
S6	6 ft (1.83 m)	2.43 CFS	4.80 CFS
S8	8 ft (2.44 m)	4.32 CFS	8.54 CFS

* Peak bypass flows are dependent on final design.
[1] 50% removal of OK-110.

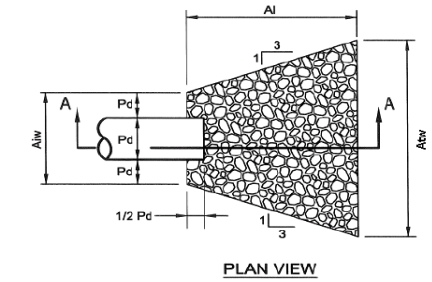
INSTALLATION

Installation of the stormwater treatment unit(s) shall be performed per manufacturer's installation instructions. Such instructions can be obtained by calling Advanced Drainage Systems at (800) 821-6710 or by logging on to www.ads-pipe.com or www.baysaver.com.

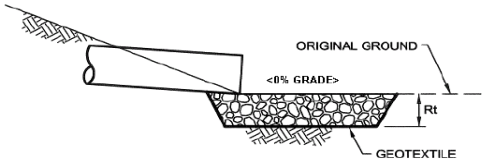
Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

Standard E&S Worksheet # 20
Riprap Apron Outlet Protection

Project Name:	ADESA Holliston		
Location:	Town of Holliston, Middlesex County, MA		
Prepared By	TGK	Date:	5/12/2020
Checked By:	-	Date:	-



PLAN VIEW



SECTION A - A

Riprap Apron No.	Outlet	Diameter Pd (in)	Tail Water Cond. (Max or Min)	Man. "n" for Pipe	Pipe Slope (Ft/Ft)	Q (CFS)	V* (FPS)	RIPRAP SIZE	Rt (in)	Al (ft)	Aiw (ft)	Atw (ft)
1	G0	15	Min	0.013	0.0051	4.27	4.35	R-3	9.00	8	3.75	11.75
2	H0	12	Max	0.013	0.0050	0.51	1.68	R-3	9.00	4	3.00	4.60

E&S WORKSHEET
COMPOST SOCK SEDIMENT TRAP DESIGN DATA

PROJECT NAME: ***ADESA Holliston***
LOCATION: ***Town of Holliston, Middlesex County, MA***
PREPARED BY: ***Town of Holliston, Middlesex County, MA*** DATE: ***5/7/2020***
CHECKED BY: ***TGK*** DATE:

TRAP NUMBER	***1***			
DRAINAGE AREA (5 ACRES MAX) (AC)	**1.85**			
REQUIRED CAPACITY (2000 CF/AC) (CF)	**3,699**			
CAPACITY PROVIDED AT ELEVATION h (CF)	**7,462**			
SOIL TYPES IN DRAINAGE AREA	**655**			
REQUIRED SURFACE AREA (5,300xAC)[1] (SQ.FT.)	**9,804**			
* AVERAGE BOTTOM LENGTH (FT)	**47.00**			
* AVERAGE BOTTOM WIDTH (FT)	**26.00**			
* AVERAGE TRAP LENGTH AT ELEVATION h (FT)	**123.00**			
* AVERAGE TRAP WIDTH AT ELEVATION h (FT)	**76.00**			
SURFACE AREA AT ELEVATION h (SF)	**7,549**			
BOTTOM ELEVATION	**155.00**			
CLEAN-OUT ELEVATION (@ 700 CF/AC)[2] (FT)	**156.00**			
1.5 CFS/AC. DISCHARGE ELEVATION (FT)	**157.00**			
TOP OF EMBANKMENT ELEVATION[3] (FT)	**157.00**			
EMBANKMENT HEIGHT (FT)	**2.00**			
CREST OF SPILLWAY ELEVATION[4] (FT)	**n/a**			
FLOW LENGTH AT ELEVATION h (FT)	**n/a**			
FLOW LENGTH / WIDTH RATIO AT ELEV. h[5] (2:1 MIN)	**n/a**			

1 If sandy clays, silty clays, silty clay loams, clay loams, or clay perdominate soil types.

2 Minimum 12" above bottom of trap.

3 Minimum 12" above elevation at which 1.5 cfs/acre discharge capacity is provided.

4 Minimum 24" above bottom of trap.

5 4:1 Flow Length:Width ratio required for HQ and EV watersheds

EMBANKMENT SPILLWAYS

OUTLET WIDTH (2x # ACRES MIN.)[1] (FT)	**n/a**			
SPILLWAY HEIGHT h (FT)	**n/a**			
OUTLET SIDE SLOPES (2H:1V MAX.)	**n/a**			
SPILLWAY OUTSIDE SLOPE Z1 (2 MIN.)	**n/a**			
SPILLWAY INSIDE SLOPE Z2 (2 MIN.)	**n/a**			

1 6 x # Acres Min. if not discharging directly to a waterway

RISER PIPE SPILLWAYS

D_r (RISER PERIMETER) (FT)	**n/a**			
D_b (BARREL DIAMETER, 6" MIN) (IN)	**n/a**			
SPILLWAY CAPACITY WITH 12" FREEBOARD (CFS)	**n/a**			
BARREL OUTLET ELEVATION (FT)	**n/a**			
MAX WATER SURFACE ELEVATION (@1.5 CFS/AC DISCHARGE) (FT)	**n/a**			

OUTLET BASIN

LENGTH (6Db) (FT)	**n/a**			
WIDTH (3 D_b) (FT)	**n/a**			
DEPTH (D_b) (FT)	**n/a**			
RIP-RAP PROTECTION (R-Size, R-3 min.)	**n/a**			

E&S WORKSHEET

Sediment Basin Storage Data

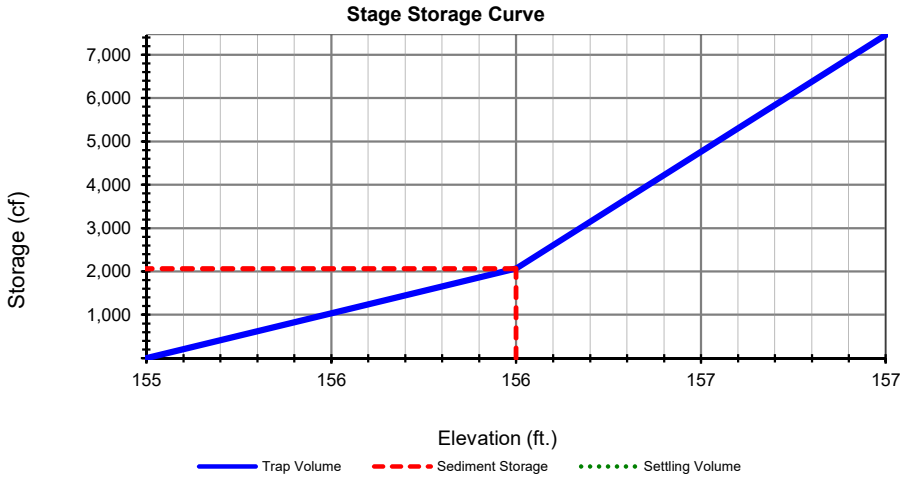
Project Name: ADESA Holliston

Location: Town of Holliston, Middlesex County, MA

Prepared By: Town of Holliston, Middlesex County, MA Date: 5/7/2020

Checked By: Date:

Water Surface Elevation (ft)	Area (s.f.)	Average Area (s.f.)	Difference in Elevation (ft)	Storage Volume (cuft)	
				Incremental	Total
155.00	885				
		2,065	1.00	2,065	
156.00	3,245				2,065
		5,397	1.00	5,397	
157.00	7,549				7,462



Cleanout Elevation		156.00	
	Required	Provided	
Depth to bottom	1.00	1.00	ft
Volume at elevation	1,295	2,065	cuft *(required = 700 cuft/acre)*

1.5 cfs/acre Elevation (ELEV. h)		157.00	
	Required	Provided	
Depth to cleanout	1.00	1.00	ft
Volume at elevation	3,699	7,462	cuft *(required = 1,300 cuft/acre)*

APPENDIX E

Pipe Sizing Calculations

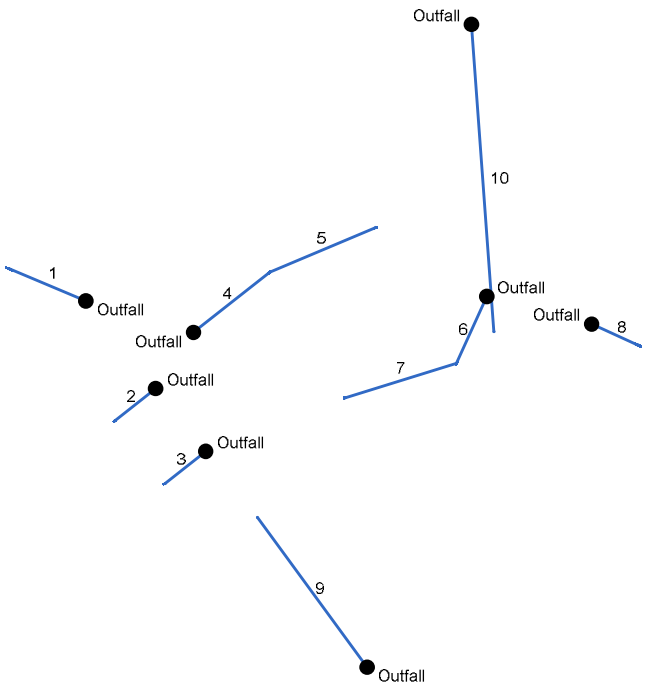
COMPUTATION SHEET : COMPOSITE RATIONAL RUNOFF COEFFICIENT (C)

PROJECT: ***ADESA Hollison***
194 Lowland Street
Town of Holliston, MA

DATE: ***4/25/2020***
BY: ***TGK***
CHECKED BY: ***BJB***
REVISION: ***0***

Inlet Drainage Area ID	Impervious (Acres) 0.90	Pervious (Acres) 0.35	Total Area (Acres)	Composite Runoff Coefficient	Time of Concentration (min)
A1	0.549	0.421	0.971	**0.66**	6.00
B1	0.700		0.700	**0.90**	6.00
C1	0.508		0.508	**0.90**	6.00
D1	0.415		0.415	**0.90**	6.00
D2	0.593	0.007	0.600	**0.89**	6.00
E1	0.459		0.459	**0.90**	6.00
E2	0.396		0.396	**0.90**	6.00
F1	0.920	0.080	1.001	**0.86**	6.00

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Project File: 113382001 - Rev-0.stm	Number of lines: 10	Date: 5/12/2020

Storm Sewer Inventory Report

Line No.	Alignment				Flow Data				Physical Data								Line ID
	Dnstr Line No.	Line Length (ft)	Defl angle (deg)	Junc Type	Known Q (cfs)	Drng Area (ac)	Runoff Coeff (C)	Inlet Time (min)	Invert El Dn (ft)	Line Slope (%)	Invert El Up (ft)	Line Size (in)	Line Shape	N Value (n)	J-Loss Coeff (K)	Inlet/ Rim El (ft)	
1	End	87.748	-157.123	Comb	0.00	0.97	0.69	6.0	154.13	0.50	154.57	15	Cir	0.013	1.00	158.00	A1-A0
2	End	55.000	141.542	Comb	0.00	0.70	0.95	6.0	154.13	0.51	154.41	15	Cir	0.013	1.00	157.01	B1-B0
3	End	55.000	141.542	Comb	0.00	0.51	0.95	6.0	154.13	0.51	154.41	15	Cir	0.013	1.00	157.04	C1-C0
4	End	102.436	-38.458	DrGrt	0.00	0.42	0.95	6.0	154.13	0.90	155.05	15	Cir	0.013	0.50	159.70	D1-D0
5	4	120.766	15.575	DrGrt	0.00	0.60	0.94	6.0	155.15	0.80	156.12	15	Cir	0.013	1.00	159.62	D2-D1
6	End	77.434	114.433	DrGrt	0.00	0.46	0.95	6.0	155.13	0.50	155.52	18	Cir	0.013	1.18	159.71	E1-E0
7	6	122.722	48.202	DrGrt	0.00	0.40	0.95	6.0	155.62	0.50	156.23	15	Cir	0.013	1.00	159.75	E2-E1
8	End	53.422	24.433	Comb	0.00	1.00	0.90	6.0	155.13	0.51	155.40	18	Cir	0.013	1.00	158.50	F1-F0
9	End	195.929	-126.063	None	4.27	0.00	0.00	6.0	153.00	0.51	154.00	15	Cir	0.013	1.00	159.25	G1-G0
10	End	325.149	85.846	None	0.51	0.00	0.00	6.0	153.37	0.50	155.00	12	Cir	0.013	1.00	160.84	H1-H0

Project File: 113382001 - Rev-0.stm | Number of lines: 10 | Date: 5/12/2020

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	A1-A0	4.66	15	Cir	87.748	154.13	154.57	0.501	155.31	155.69	0.25	155.94	End	Combination
2	B1-B0	4.63	15	Cir	55.000	154.13	154.41	0.509	155.31	155.54	0.24	155.79	End	Combination
3	C1-C0	3.37	15	Cir	55.000	154.13	154.41	0.509	155.31	155.42	0.16	155.58	End	Combination
4	D1-D0	6.54	15	Cir	102.436	154.13	155.05	0.898	155.31	156.21	0.24	156.45	End	DropGrate
5	D2-D1	3.92	15	Cir	120.766	155.15	156.12	0.803	156.45	156.92	n/a	157.27 j	4	DropGrate
6	E1-E0	5.49	18	Cir	77.434	155.13	155.52	0.504	156.67	156.85	0.20	157.05	End	DropGrate
7	E2-E1	2.64	15	Cir	122.722	155.62	156.23	0.497	157.05	157.24	0.10	157.33	6	DropGrate
8	F1-F0	6.26	18	Cir	53.422	155.13	155.40	0.505	156.67	156.84	0.20	157.04	End	Combination
9	G1-G0	4.27	15	Cir	195.929	153.00	154.00	0.510	153.84	155.06	0.23	155.29	End	None
10	H1-H0	0.51	12	Cir	325.149	153.37	155.00	0.501	154.20	155.30	0.11	155.30	End	None

Project File: 113382001 - Rev-0.stm | Number of lines: 10 | Run Date: 5/12/2020

NOTES: Return period = 10 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	87.748	0.97	0.97	0.69	0.67	0.67	6.0	6.0	7.0	4.66	4.57	3.95	15	0.50	154.13	154.57	155.31	155.69	158.67	158.00	A1-A0
2	End	55.000	0.70	0.70	0.95	0.67	0.67	6.0	6.0	7.0	4.63	4.61	3.91	15	0.51	154.13	154.41	155.31	155.54	158.34	157.01	B1-B0
3	End	55.000	0.51	0.51	0.95	0.48	0.48	6.0	6.0	7.0	3.37	4.61	2.99	15	0.51	154.13	154.41	155.31	155.42	158.50	157.04	C1-C0
4	End	102.436	0.42	1.02	0.95	0.40	0.96	6.0	6.6	6.8	6.54	6.12	5.48	15	0.90	154.13	155.05	155.31	156.21	159.62	159.70	D1-D0
5	4	120.766	0.60	0.60	0.94	0.56	0.56	6.0	6.0	7.0	3.92	5.79	3.95	15	0.80	155.15	156.12	156.45	156.92	159.70	159.62	D2-D1
6	End	77.434	0.46	0.86	0.95	0.44	0.82	6.0	6.9	6.7	5.49	7.45	3.21	18	0.50	155.13	155.52	156.67	156.85	160.50	159.71	E1-E0
7	6	122.722	0.40	0.40	0.95	0.38	0.38	6.0	6.0	7.0	2.64	4.55	2.33	15	0.50	155.62	156.23	157.05	157.24	159.71	159.75	E2-E1
8	End	53.422	1.00	1.00	0.90	0.90	0.90	6.0	6.0	7.0	6.26	7.47	3.57	18	0.51	155.13	155.40	156.67	156.84	159.07	158.50	F1-F0
9	End	195.929	0.00	0.00	0.00	0.00	0.00	6.0	6.0	0.0	4.27	4.61	4.35	15	0.51	153.00	154.00	153.84	155.06	153.00	159.25	G1-G0
10	End	325.149	0.00	0.00	0.00	0.00	0.00	6.0	6.0	0.0	0.51	2.52	1.68	12	0.50	153.37	155.00	154.20	155.30	153.37	160.84	H1-H0

Project File: 113382001 - Rev-0.stm | Number of lines: 10 | Run Date: 5/12/2020

NOTES:Intensity = 88.24 / (Inlet time + 15.50) ^ 0.83; Return period =Yrs. 10 ; c = cir e = ellip b = box

Inlet Drainage Area ID	Impervious (Acres) 0.90	Pervious (Acres) 0.35	Total Area (Acres)	Composite Runoff Coefficient	Time of Concentration (min)
A1	0.549	0.421	0.971	**0.66**	6.00
B1	0.700		0.700	**0.90**	6.00
C1	0.508		0.508	**0.90**	6.00
D1	0.415		0.415	**0.90**	6.00
D2	0.593	0.007	0.600	**0.89**	6.00
E1	0.459		0.459	**0.90**	6.00
E2	0.396		0.396	**0.90**	6.00
F1	0.920	0.080	1.001	**0.86**	6.00

NORTH

GRAPHIC SCALE IN FEET
0 20 40 80

LEGEND

- PROPOSED PROPERTY LINE
- EXISTING CONTOUR
- PROPOSED CONTOUR
- LIMIT OF CONSTRUCTION
- DRAINAGE AREA BOUNDARY
- A1 — DRAINAGE AREA LABEL
- POI#_ — POINT OF INTEREST
- PROPOSED IMPERVIOUS AREA
- AREA OF INTEREST

POI#1

POI#2

EXISTING POND

LOWLAND STREET

Plotted By: Kotelhon, Tom Sheet Set: Full Name: I:\NES\TM\ENGINEERING\SHEET MAP.dwg

No.	REVISIONS	DATE	BY

Kimley»Horn
© 2020 KIMLEY-HORN AND ASSOCIATES, INC.
1700 WILLOW LAWN DR., SUITE 200, RICHMOND, VA 23230
PHONE: 804-673-3882
WWW.KIMLEY-HORN.COM

LICENSED PROFESSIONAL ENGINEER — COMMONWEALTH OF VIRGINIA — CHRISTOPHER B. KOTELHON — CIVIL — No. 46948 — 05-27-20 — REGISTERED PROFESSIONAL ENGINEER — DATE:

KHA PROJECT 113382001
DATE 04/27/2020
SCALE AS SHOWN
DESIGNED BY TGK
DRAWN BY TGK
CHECKED BY BJB

POST-DEVELOPMENT INLET AREA MAP

ADESA HOLLISTON
PREPARED FOR
ADESA, INC.
TOWN OF HOLLISTON MA

SHEET NUMBER
DA-3

APPENDIX F

Reference Documents

12$$ $WODV 9ROXPH 9HUVLRQ
/RFDWLRQ +DQFRFN 0DVVDFKXVHWWV 86$
/DWLWXGH /RQJLWXGH
(OHYDWLRQ IW
VRXUFH (65, 0DSV
VRXUFH 86*6

32,17 35(&,3,7$7,21)5(48(1&< (67,0$7(6

6DQMD 3HULFD 6DQGUD 3DYORYLF 6DUDK 'LHWHU ,VKDQL 5R\ 0LFKDHO 6W /DXUHQW &DUO 7UXSS 'DOH 8QUXK 0LFKDHO <HNWD *HRIIHU\ %RQQLQ 'HERUDK 0DUWLQ /LOOLDQ 7XUQHU 7ULQK 7UXQJ /XNH 'DYLV +DQJ <X .HLWK :LOOLDPV -RKQ %UDGOH\ -LQ ;X

12$$ 1DWLRQDO :HDWKHU 6HUYLFH 6LOYHU 6SULQJ 0DU\ODQG

3)BWDEXODU 3)BJUDSKLFDO 0DSV B DHULDOV

3) WDEXODU

3'6 EDVHG SRLQW SUHFLSLWDWLRQ IUHTXHQF\ HVWLPDWHV ZLWK FRQILGHQFH LQWHUYDOV LQ LQFKHV

'XUDWLRQ	$YHUDJH UHFXUUHQFH LQWHUYDO									
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PLQ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PLQ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PLQ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PLQ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PLQ	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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KU	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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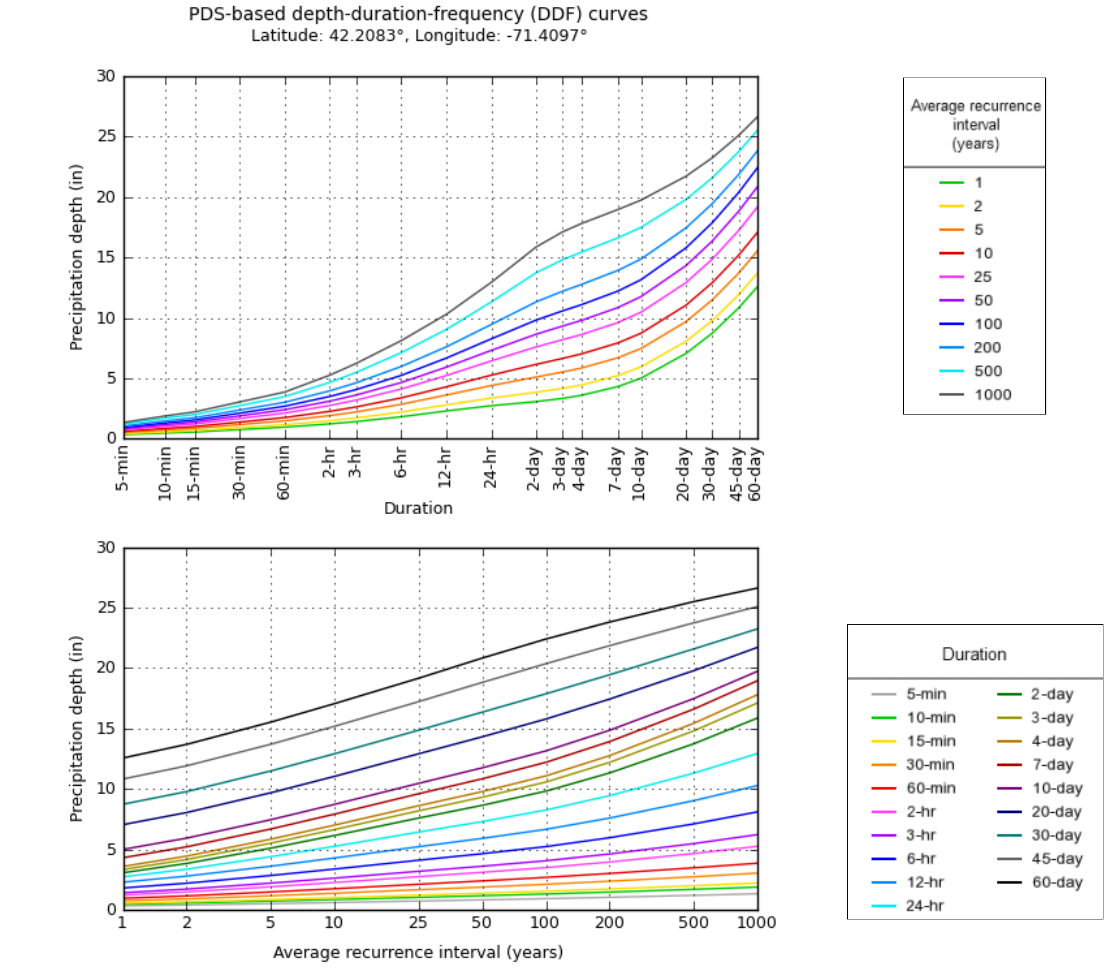

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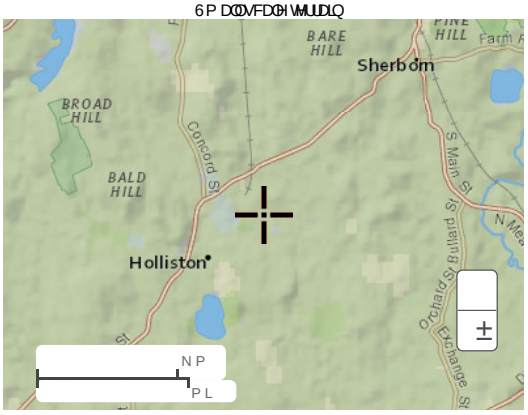

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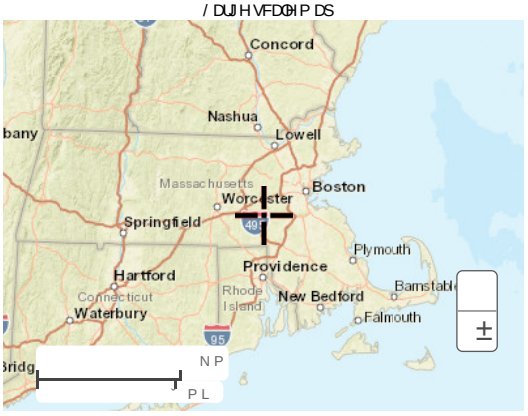

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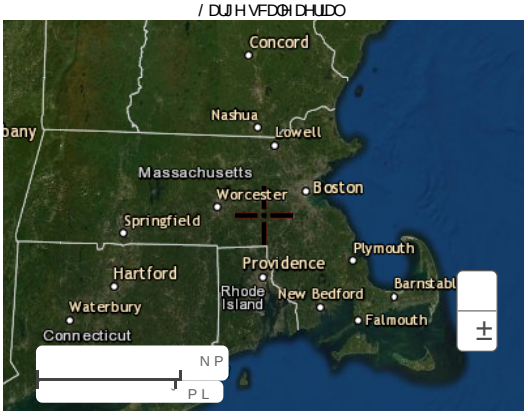

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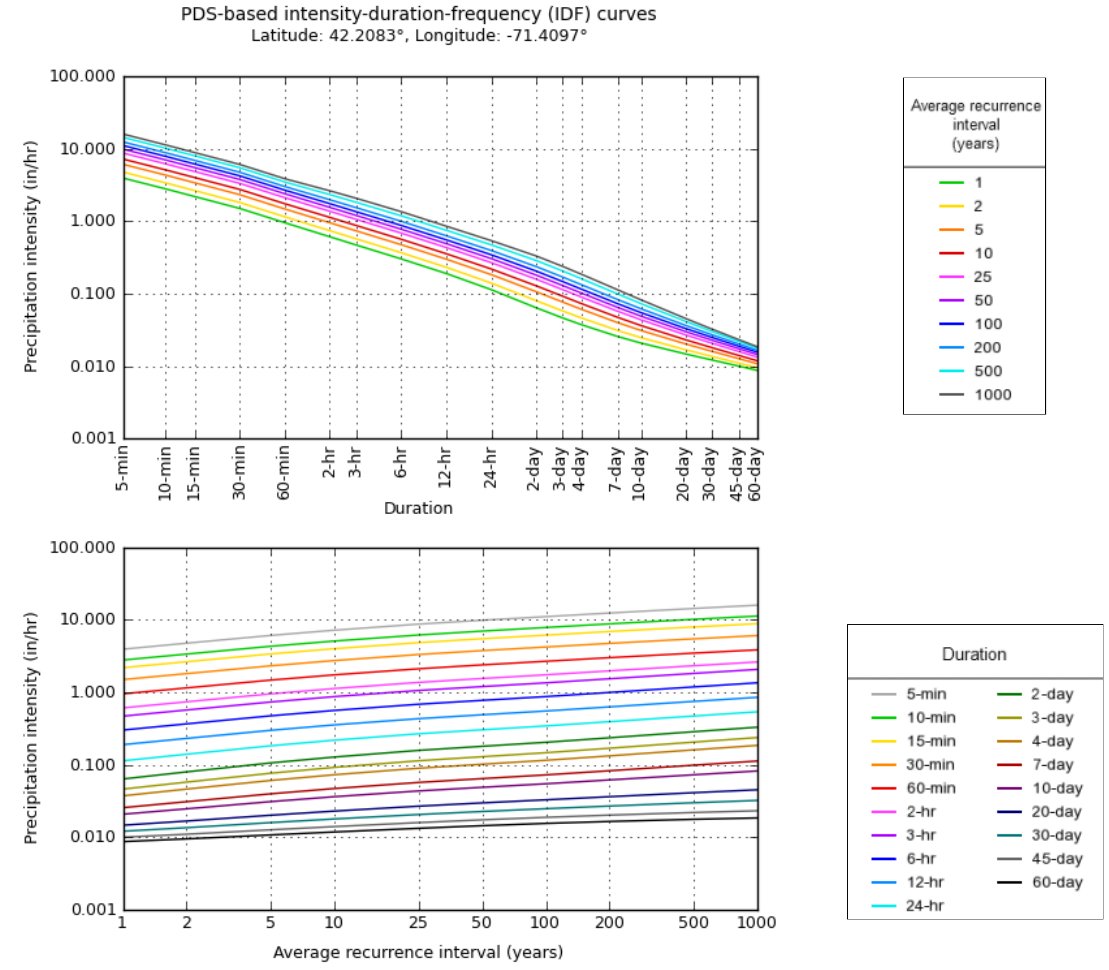

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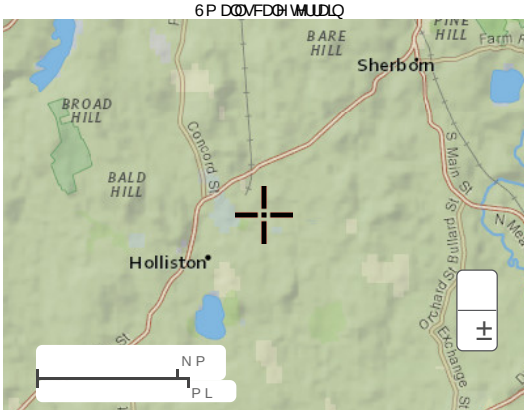

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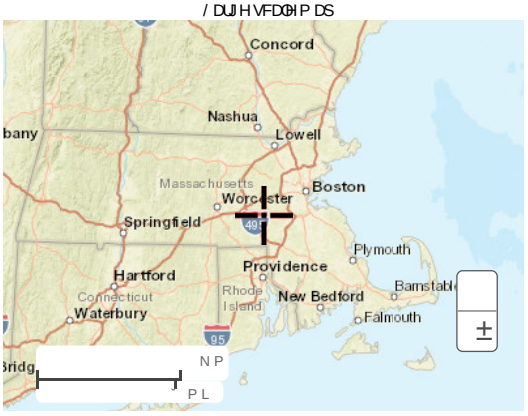

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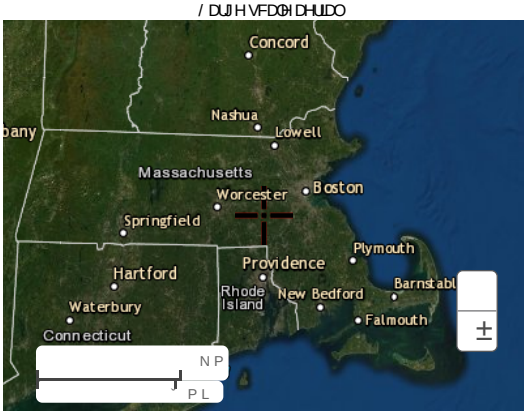

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Attention must be given to ensure consistency in units. In particular, the Target Depth Factors must be converted to feet.

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**

Table 2.3.2: Recharge Target Depth by Hydrologic Soil Group

When a site contains multiple Hydrologic Soil Groups, determine the *Required Recharge Volume* for each impervious area by Hydrologic Soil Group and then add the volumes together.

Example: Assume a ten (10) acre site. 5.0 acres are proposed to be developed for a retail use. A section of the entrance roadway is to be bridged over a stream that is classified as land under water. As such, the bridging is subject to the Wetlands Protection Act Regulations, and the Stormwater Management Standards apply to stormwater runoff from all proposed roads, parking areas, and rooftops. Of the 5.0 acres proposed to be developed, 2 acres of impervious surfaces are proposed atop Hydrologic Soil Group (HSG) "A" soils, 1 acre of impervious surfaces atop HSG "B" soil, 1.5 acres of impervious surfaces atop HSG "C" soil, and 0.5 acres are proposed to be landscaped area. The remaining 5.0 acres, located on HSG "A" soil, are proposed to remain forested. Determine the *Required Recharge Volume*.

Solution: The *Required Recharge Volume* is determined only for the impervious surfaces. The 5.0-acre forested area and the 0.5-acre landscaped area are not impervious areas. Although converted from forest, landscaped area is pervious area for purposes of Standard 3. Use *Equation (1)* to determine the *Required Recharge Volume* for each Hydrologic Soil Group covered by impervious area. Add together the *Required Recharge Volumes* determined for each HSG.

Rv = F x impervious area

$Rv = [(F_{HSG\ "A"})\ (Area_1)] + [(F_{HSG\ "B"})\ (Area_2)] + [(F_{HSG\ "C"})(Area_3)] + [(F_{HSG\ "D"})(Area_4)]$ ***Equation (2)***

Rv = [(0.6-in/12)(2 acres)] + [(0.35-in/12)(1 acre)] + [(0.25-in/12)(1.5 acres)] + [(0.1-in/12)(0 acres)]

Rv = 0.1605 acre-feet

Rv = 0.1605 acre-feet x 43560 square feet/acre-feet = 6,991 cubic feet or *258.9 cubic yards*

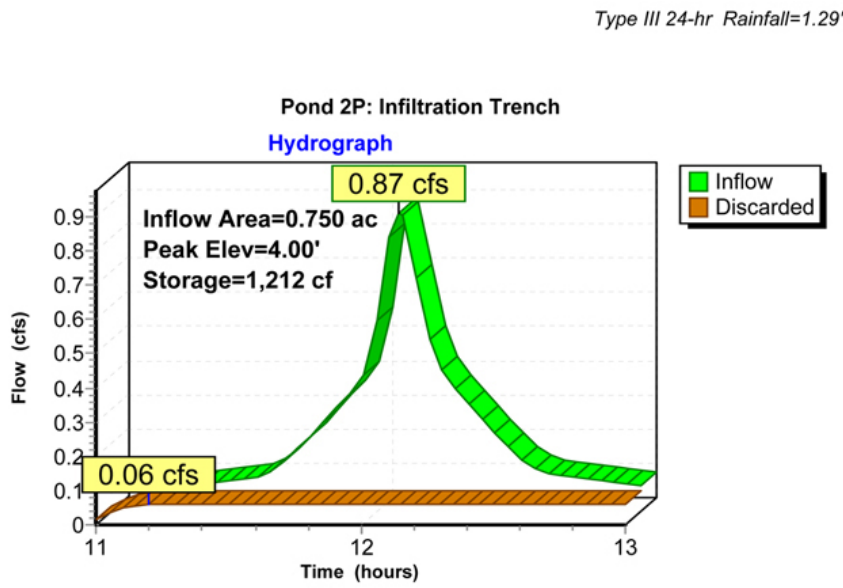


Table 2.3.3. 1982 Rawls Rates[18]

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

[18] Rawls, Brakensiek and Saxton, 1982

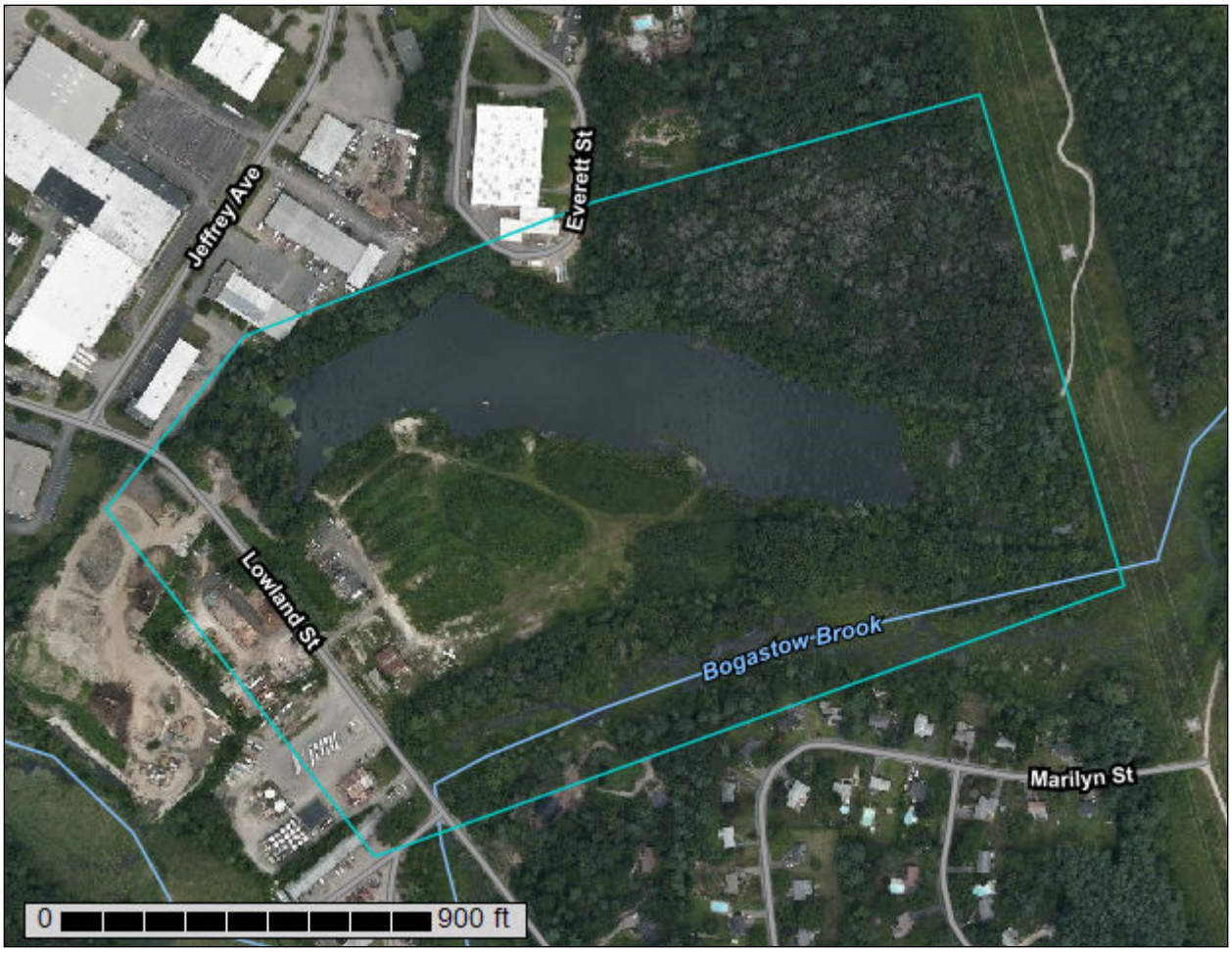
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Middlesex County, Massachusetts



April 10, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

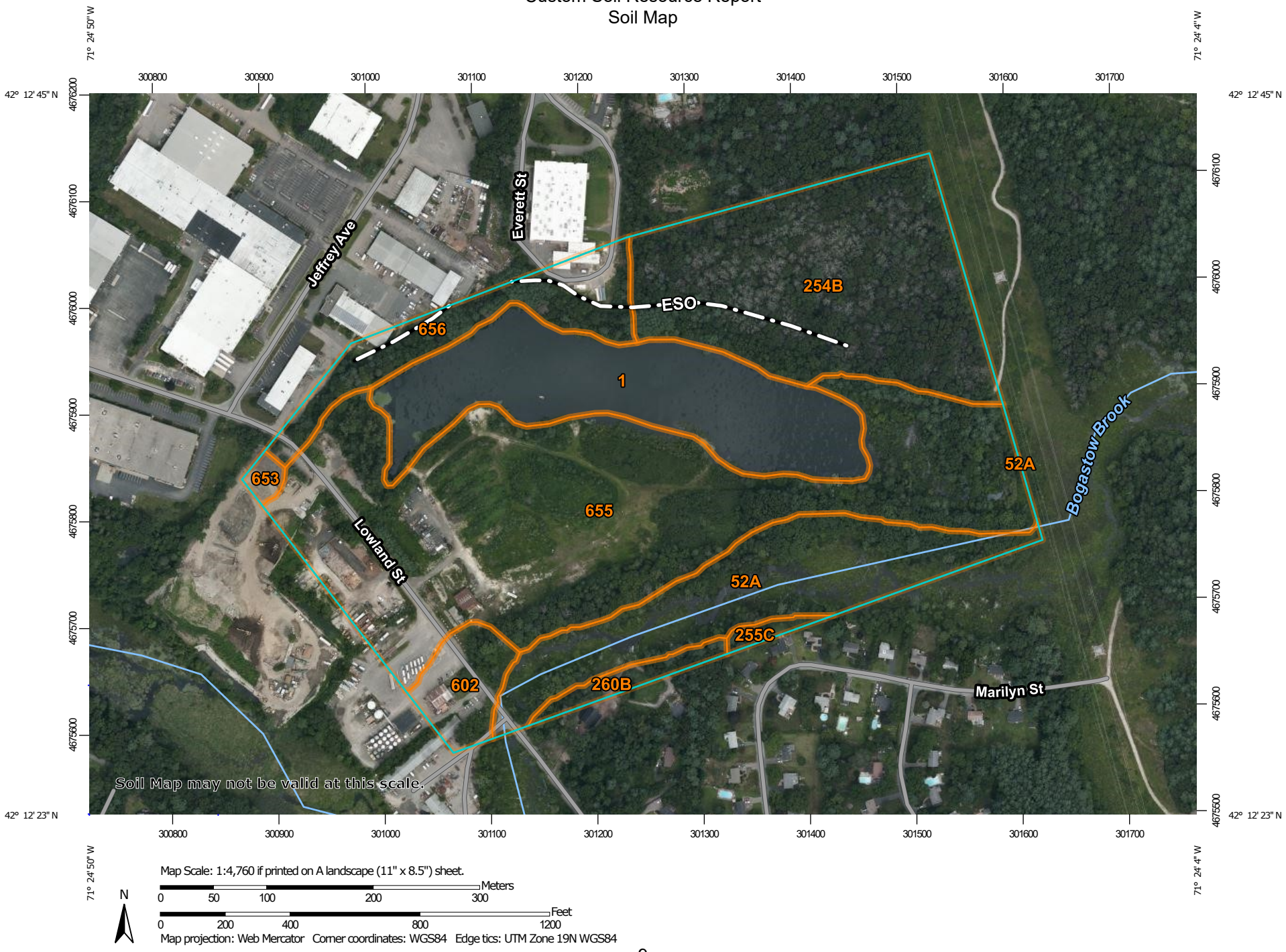
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:4,760 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 19, Sep 12, 2019

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

Date(s) aerial images were photographed: Jul 28, 2019—Aug 15, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	9.7	15.4%
52A	Freetown muck, 0 to 1 percent slopes	7.9	12.6%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	13.2	20.9%
255C	Windsor loamy sand, 8 to 15 percent slopes	0.3	0.5%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	0.9	1.4%
602	Urban land	1.9	3.0%
653	Udorthents, sandy	0.3	0.5%
655	Udorthents, wet substratum	24.8	39.4%
656	Udorthents-Urban land complex	4.0	6.3%
Totals for Area of Interest		**62.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit

descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Middlesex County, Massachusetts

1—Water

Map Unit Setting

National map unit symbol: 996p
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Setting

Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Freetown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Kettles, depressions, depressions, bogs, marshes, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Percent of area covered with surface fragments: 0.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water storage in profile: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Kettles, depressions, depressions, marshes, bogs, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

254B—Merrimac fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyqs
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Merrimac and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Moraines, outwash plains, kames, eskers, outwash terraces
Landform position (two-dimensional): Backslope, footslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Sudbury
Percent of map unit: 5 percent
Landform: Terraces, deltas, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Hinckley
Percent of map unit: 5 percent
Landform: Deltas, outwash plains, kames, eskers
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Windsor
Percent of map unit: 3 percent
Landform: Outwash plains, deltas, dunes, outwash terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Agawam
Percent of map unit: 2 percent
Landform: Moraines, outwash plains, kames, stream terraces, eskers, outwash terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

255C—Windsor loamy sand, 8 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2svkq
Elevation: 0 to 1,260 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Windsor and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: — error in exists on —
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, riser
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
Ap - 1 to 11 inches: loamy sand
Bw - 11 to 31 inches: loamy sand
C - 31 to 65 inches: sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 10 percent
Landform: Outwash plains, eskers, deltas, kames
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, head slope, nose slope, side slope, rise
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Deerfield

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

260B—Sudbury fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9915
Elevation: 0 to 2,100 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sudbury and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sudbury

Setting

Landform: Plains, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable loamy eolian deposits over loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 20 inches: fine sandy loam
H3 - 20 to 27 inches: loamy sand
H4 - 27 to 65 inches: stratified gravelly coarse sand to sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 8 percent
Landform: Plains, terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Wareham

Percent of map unit: 4 percent
Landform: Depressions, terraces, deltas
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Windsor

Percent of map unit: 2 percent
Landform: Flats, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Unnamed

Percent of map unit: 1 percent

602—Urban land

Map Unit Setting

National map unit symbol: 9950
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Rock outcrop

Percent of map unit: 5 percent
Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave

Udorthents, wet substratum

Percent of map unit: 5 percent
Hydric soil rating: No

Udorthents, loamy

Percent of map unit: 5 percent
Hydric soil rating: No

653—Udorthents, sandy

Map Unit Setting

National map unit symbol: vr1k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, sandy, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Sandy

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Udorthents, loamy

Percent of map unit: 5 percent
Hydric soil rating: No

Urban land

Percent of map unit: 5 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Unnamed

Percent of map unit: 5 percent

655—Udorthents, wet substratum

Map Unit Setting

National map unit symbol: vr1n
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, wet substratum, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Wet Substratum

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Urban land

Percent of map unit: 8 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Freetown

Percent of map unit: 4 percent
Landform: Depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

656—Udorthents-Urban land complex

Map Unit Setting

National map unit symbol: 995k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 40 percent
Urban land: 40 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Canton

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Terraces, plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Paxton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

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