HANCOCK ASSOCIATES

Preliminary Stormwater Report

In Support of

Chapter 40B Filing

for

Villebridge Development LLC
Parcel ID # 0025-0000-0067 (18 Boston Street)
Parcel ID # 0025-0000-0066 (10 Boston Street)
Parcel ID # 0025-0000-0065 (49 S. Main Street)

Middleton, MA

COMMONWEALTH OF MASSACHUSETTS
JOSEPH D. PEZNOLA
CIVIL
No. 38117
REGISTERED PROFESSIONAL ENGINEER

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Prepared For:
VILLEBRIDGE DEVELOPMENT LLC.

8/22/2023

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Introduction

VILLEBRIDGE DEVELOPMENT LLC. proposes to construct affordable housing units on one of the subdivided lots originating from the combination of 10 & 18 Boston Street and 49 South Main Street, Middleton, MA. Associated improvements will include paved vehicular and pedestrian areas, recreational areas, landscaped areas, stormwater management systems, and utility services. The project area is currently comprised of a building, paved vehicular areas, and some gravel and vegetation. The project area is accessed by Boston Street, and consists of 2.28± acres and is bounded by Boston Street to the west, Rowell Lane to the east, and South Main Street to the north.

The project is not considered a redevelopment project under MassDEP Stormwater **Standard 7**. The project will fully comply with Mass DEP Stormwater Requirements.

- Existing Impervious Area = 37,931 SF
- Proposed Impervious Area = 65,597 SF
- Increase in Impervious Area = 27,666 SF

The proposed stormwater management system will include deep sump catch basins, subsurface infiltration systems, outlet control structures, drain manholes, and area drains. The following report describes the system's compliance with the Massachusetts Stormwater Handbook and Middleton's Stormwater Standards.

Standard 1: No New Untreated Discharges

The Massachusetts Stormwater Handbook states that no new stormwater conveyances may discharge untreated stormwater directly to or cause erosions in wetlands or waters of the Commonwealth. The project does not include new stormwater conveyances.

All new stormwater runoff requiring treatment will be treated through two subsurface infiltration systems before being discharged to the existing 12" drain outfall on South Main Street.

Standard 2: Peak Rate Attenuation

The Massachusetts Stormwater Handbook states that stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. A summary of the existing and proposed discharge rates follows. The proposed condition discharge rates of runoff are at or below the existing rates to the same discharge points. Please see refer to Appendix 5 (Existing and Proposed Watersheds) and Appendix 6 (HydroCAD Output) for more information.

The table summary below shows that the post-development discharge rates will not exceed the pre-development discharge rates.

	Pre- Rate (CFS)	Post – Rate (CFS)
2-year storm	1.51 CFS	0.77 CFS
10-year storm	3.54 CFS	3.37 CFS
100-year storm	7.09 CFS	6.96 CFS

Runoff attenuated for the 2-, 10- and 100-year storms are based on Type III 24-hour storm period rainfall data provided through NOAA ATLAS 14 precipitation frequencies (see Appendix 3).

Standard 3: Recharge

The Massachusetts Stormwater Handbook states that loss of annual recharge to groundwater shall be eliminated or minimized. The annual recharge from the post-development site shall approximate the annual recharge from the pre-development conditions based on soil type. Recharge volumes are provided for all of the proposed impervious areas. For the purpose of these calculations, all of the project areas are considered to be Hydrologic Soil Group B based on the findings from the USGS web soil survey.

The required recharge volume is 0.35" multiplied by the area of impervious surfaces.

For post-development Watershed P1:

Required Recharge Volume, HSG B =
Target Depth * Impervious Area = (0.35"/12) * SF = 56,777 SF = 1,656 CF

The recharge volume is provided below the orifice (elevation 101.8) within the outlet control structure. The volume provided is 2,822.2 cubic feet. Since the volume provided is greater than the required recharge volume, the standard is met.

For post-development Watershed P2:

Required Recharge Volume, HSG B =
Target Depth * Impervious Area = (0.35"/12) * 8,820 SF = 257.5 CF

The recharge volume is provided below the orifice (elevation 103.0) within the outlet control structure. The volume provided is 357.1 cubic feet. Since the volume provided is greater than the required recharge volume, the standard is met.

The Massachusetts Stormwater Handbook states that the recharge volume must drain within 72 hours. The following "drawdown" calculation assumes a Rawl's Rate of 1.02 inches per hour, corresponding to hydrologic soil group B.

Since the drawdown time of 2.8 hours and 10.4 hours were calculated for the two watersheds, P1 and P2, and both are less than 72 hours, the requirement is met.

Standard 4: Water Quality

The Massachusetts Stormwater Handbook states that systems shall be designed to remove 80% of the average annual post-development construction load of Total Suspended Solids (TSS). The treatment BMP's have been sized to provide at least 80% TSS removal and measures will be taken for long-term pollution prevention.

Stormwater runoff from vehicular paved areas will be treated for at least 80% TSS removal via StormTech Isolator rows (or approved equal). The treatment train computation is as follows:

Table 1: Treatment Train Calculation

BMP	TSS Removal Rate	Starting TSS Load	Amount Removed	Remaining Load
StormTech Isolator Row	0.84	1	0.84	0.16
Total TSS Removal				0.84

For proposed Watershed P1, StormTech chambers with isolator rows provided 2822.2 CF of water quality volume for 0.50 inches of runoff over 56,777 SF of impervious area, which is greater than the 2365.7 CF required, so standard # 4 is met.

For proposed Watershed P2, StormTech chambers with isolator rows provided 390.9 CF of water quality volume for 0.50 inches of runoff over 8,820 SF of impervious area, which is greater than the 368.2 CF required, so standard # 4 is met.

Standard 5: Land Uses with Higher Potential Pollutant Loads

The proposed project is not a Land Use with Higher Potential Pollutant Load (LUHPPL). Standard 5 does not apply, but a Stormwater Pollution Prevention Plan will be submitted prior to the discharge of stormwater to post-construction stormwater BMPs.

Standard 6: Critical Area

The proposed project is not within a Critical Area. Standard 6 does not apply.

Standard 7: Redevelopment

The proposed project is not a redevelopment because there is an increase in impervious area after proposed conditions.

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

Best management practices (BMP) for erosion and sedimentation control are staked straw bales, filter fences, wattles, hydro seeding, and phased development. Many stormwater BMP technologies (e.g., infiltration technologies) are not designed to handle the high concentrations of sediments typically found in construction runoff and must be protected from construction-related sediment loadings. Construction BMP's **must** be maintained. In developing the proposed project certain measures will be implemented to minimize impacts erosion and sedimentation could have on surrounding areas. This section addresses items that involve proper construction techniques, close surveillance of workmanship, and immediate response to emergency situations. The developer must be prepared to provide whatever reasonable measures are necessary to protect the environment during construction and to stabilize all disturbed areas as soon as construction ends. Construction period pollution prevention and erosion and sediment control shall meet the requirements for the 2022 EPA Construction General Permit for all projects requiring coverage under the CGP.

Pre-Construction

1. The contractor shall have a stockpile of materials required to control erosion on-site to be used to supplement or repair erosion control devices. These materials shall include, but are not limited to straw bales, silt fence, wattles and crushed stone.
2. The contractor is responsible for erosion control on site and shall utilize erosion control measures where needed, regardless of whether the measures are specified on the plan or in the order of conditions.

Preliminary Site Work

1. Excavated materials should be stockpiled, separating the topsoil for future use on the site. Erosion control shall be utilized along the down slope side of the piles and side slopes shall not exceed 2:1.
2. If intense rainfall is anticipated, the installation of supplemental straw bale dikes, silt fences, or armored dikes shall be considered.
3. Unsuitable excavated material shall be removed from the site.
4. Construction entrance shall be installed.
5. Existing catch basins shall be protected with silt sacks.

Ongoing Site Work

1. Erosion control measures shall be regularly inspected and replaced as needed.
2. Dewatering shall be done in a manner so as not to transmit silt, sand or particulate matter to the receiving water or existing drainage system.

Landscaping

1. Landscaping shall occur as soon as possible to provide permanent stabilization of disturbed surfaces.
2. If the season or adverse weather conditions do not allow the establishment of vegetation, temporary mulching with straw, wood chips weighted with snow fence or branches, or other methods shall be provided.
3. A minimum of 4 inches of topsoil shall be placed and its surface smoothed to the specified grades.
4. The use of herbicides is strongly discouraged.
5. Hydro seeding is encouraged for steep slopes. Application rates on slopes greater than 3:1 shall have a minimum seeding rate of 5-lbs/1000 SF. A latex or fiber tackifier shall be used on these slopes at a minimum rate of 50 lbs. of tackifier per 500 gallons of water used.

<u>Standard 9: Operations and Maintenance Plan</u>

The information provided herein is intended to provide the base information for operation and maintenance of the site in perpetuity subject to updates and revisions as required at a future date. As such all future property owners must be notified in writing of this plan and be provided with a copy of this plan, a complete set of the design drawings and/or a completed as-built plan showing all the drainage features as they were constructed, which are considered part of this document. Please see the attached Operations and Maintenance Log (Appendix VII).

Stormwater management system owner:	VILLEBRIDGE DEVELOPMENT LLC.
The party responsible for operation and maintenance:	VILLEBRIDGE DEVELOPMENT LLC.

Preliminary Stormwater Operation and Maintenance Budget
Quarterly Inspection and Maintenance x $2,500 per visit = $10,000 annually

Illicit Discharge - Practices to Minimize Storm Water Contamination

- All waste materials will be collected and stored in a securely lidded metal dumpster.
- All trash and debris from the site will be deposited in the dumpster. The dumpster will be emptied on a regular schedule prior to being over full.
- All personnel will be instructed regarding the correct procedure for waste disposal.
- Good housekeeping and spill control practices will be followed to minimize storm water contamination from petroleum products, paints, and cleaning products.
- All site vehicles will be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage.
- Spill kits will be provided with any activity that could provide contamination.
- All paint containers and curing compounds will be tightly sealed and stored when not required for use. Excess paint will not be discharged to the storm sewers, but will be properly disposed according to the manufacturer's instructions.
- All spills will be cleaned up immediately upon discovery. Spills large enough to reach the storm sewers will be reported to the Massachusetts Department of Environmental Protection Northeast Regional Office at 1-888-304-1133.

Deep Sump Hooded Catch Basins
Inspect deep sump catch basins four times per year including the end of the foliage and snow removal seasons. Sediments must also be removed four times per year or when the depth of deposits is greater than or equal to one half the depth of the sump. Vacuum trucks are to be used to remove trapped sediment and supernatant.

Although catch basin debris often contains concentrations of oil and hazardous materials such as petroleum hydrocarbons and metals, MassDEP classifies them as solid waste. Any contaminated materials must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.00, and handled as hazardous waste. MassDEP regulations prohibit landfills from accepting materials that contain free draining liquids.

Isolator Row & Outlet Control Structures
The isolator row shall be inspected after every major storm for the first few months to ensure it is stabilized and functioning properly. If necessary, corrective action shall be taken until the system functions properly. Inspectors should note how long water remains standing in the inspection port after a storm; standing water within the basin 48 to 72 hours after a storm indicates that the infiltration capacity may have been overestimated. If the ponding is due to clogging, immediately address the reasons for the clogging. Thereafter, inspect the isolator row at least twice per year. Outlet control structures should be cleaned as required for proper function.

Roof Drain Leaders
Routine roof inspections shall be performed two times per year. The roof shall be kept clean and free of debris, and the roof drainage systems shall be kept clear. Gutters and downspouts shall be cleaned at least twice per year, or more frequently as necessary.

Vegetated Areas Maintenance
Although not a structural component of the drainage system, the maintenance of vegetated areas may affect the functioning of stormwater management practices. This includes the health/density of vegetative

cover and activities such as the application and disposal of lawn and garden care products, disposal of leaves and yard trimmings.

Initial Post-Construction Inspection
During the initial period of vegetation establishment pruning and weeding are required twice in first year by contractor or owner. Any dead vegetation/plantings found after the first year will be replaced. Proper mulching is mandatory and regular watering may be required initially to ensure proper establishment of new vegetation.

Long-Term Maintenance
The planted areas shall be inspected on a semi-annual basis and any litter removed. Weeds and invasive plant species shall be removed by hand. Maintain planted areas adjacent to pavement to prevent soil washout. Immediately clean any soil deposits on pavement. Leaf litter and other detritus shall be removed twice per year. If needed to maintain aesthetic appearance, perennial plantings may be trimmed at the end of the growing season.

Trees and shrubs shall be inspected twice per year to evaluate health and attended to as necessary. Seeded ground cover or grass areas shall not receive mulching. Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming. Plant alternative mixtures of grass species in the event of unsuccessful establishment. The grass vegetation should not be cut to a height less than four inches.

Pesticide/Herbicide Usage
No pesticides are to be used unless a single spot treatment is required for a specific control application.

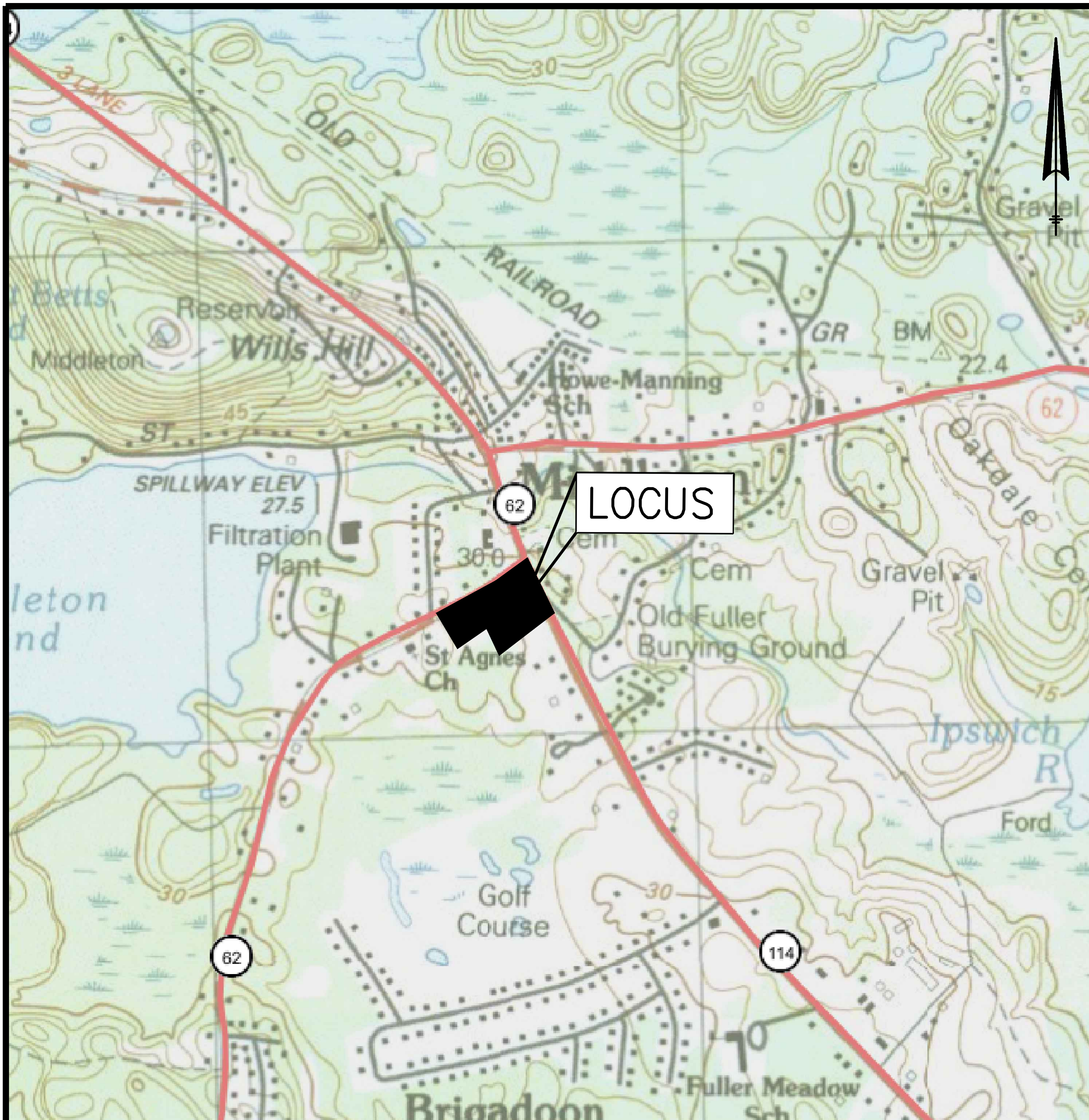
Standard 10: Prohibition of Illicit Discharges

No illicit discharges currently exist, and no future illicit discharges will be allowed including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, soil, or grease. Prior to discharge of stormwater to post construction BMPs, a no illicit discharge statement will be submitted by the owner.

APPENDIX

A.1

LOCUS MAP



USGS LOCUS MAP

MIDDLETON
10 & 18 BOSTON STREET
49 SOUTH MAIN STREET
MIDDLETON, MA 01949

HANCOCK ASSOCIATES

121 E. BERKELEY ST., BOSTON, MA. 02118
VOICE (617) 357-8145, FAX (617) 357-9495

DATE: 08/22/23	
SCALE: 1"=1,000'	
DESIGN:	CMK
DRAWN:	CMK
LAYOUT: *LOCUS*	
JOB NO.: 25912	

PLOT DATE: Aug 18, 2023 DWG: Locus Map.dwg

A.2

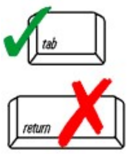
Mass DEP Stormwater Checklist

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Joseph D. Peznola 8-18-23

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 (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): Subsurface Infiltration System

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 (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 (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 (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 (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 (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.

A.3

NOAA Rainfall Data

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: MA

Data description

Data type: Precipitation depth **Units:** English **Time series type:** Partial duration

Select location

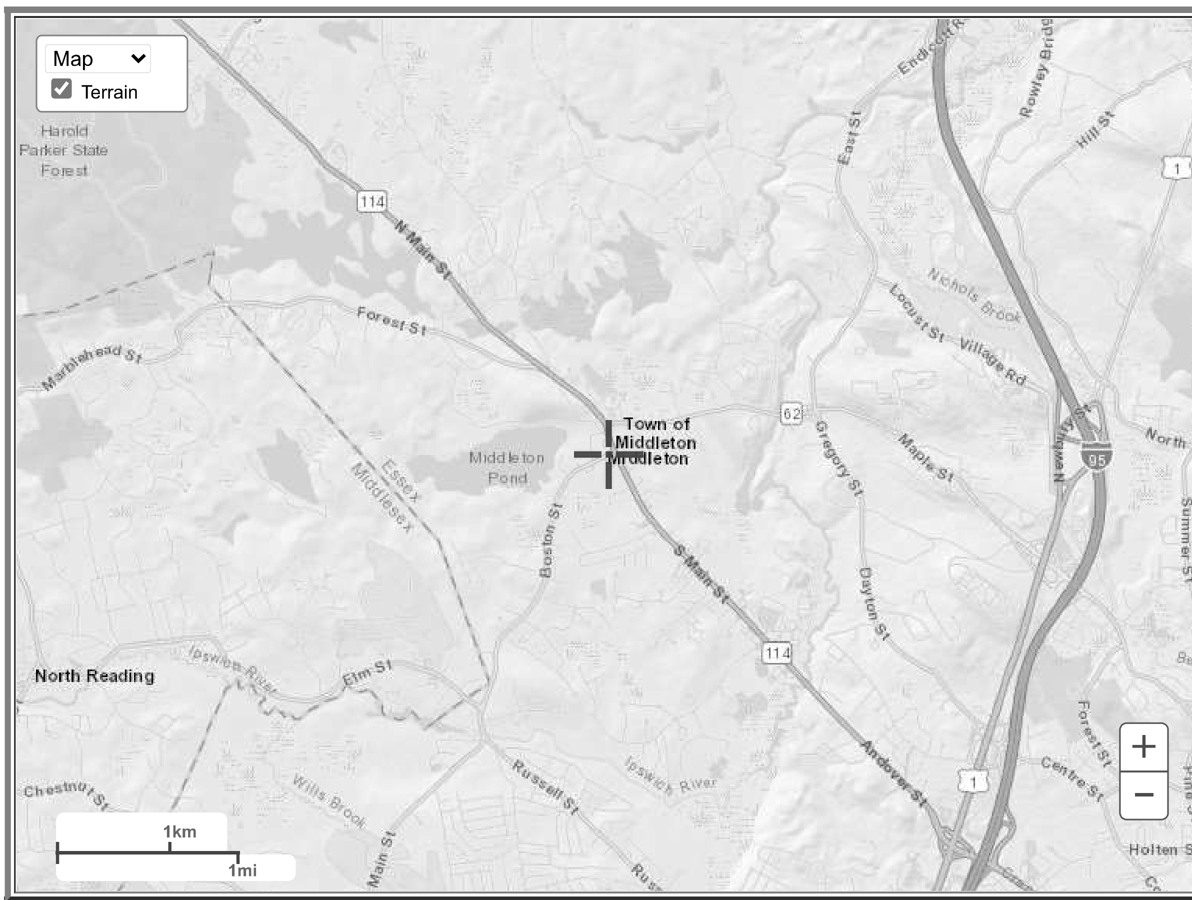
1) Manually:

a) By location (decimal degrees, use "-" for S and W): Latitude: Longitude: Submit

b) By station (list of MA stations): Select station

c) By address 49 S Main Street, Middleton, MA, 019

2) Use map:



a) Select location
Move crosshair or double click

b) Click on station icon
☐ Show stations on map

Location information:
Name: Middleton, Massachusetts, USA*
Latitude: 42.5924°
Longitude: -71.0152°
Elevation: 105 ft **

* Source: ESRI Maps
** Source: USGS

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 10, Version 3

PF tabular | PF graphical | Supplementary information | Print page

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.312** (0.243-0.389)	**0.374** (0.291-0.467)	**0.476** (0.369-0.594)	**0.560** (0.432-0.705)	**0.676** (0.505-0.890)	**0.763** (0.559-1.03)	**0.855** (0.609-1.20)	**0.960** (0.646-1.37)	**1.11** (0.720-1.64)	**1.24** (0.783-1.86)
10-min	**0.442** (0.344-0.550)	**0.530** (0.413-0.661)	**0.674** (0.523-0.844)	**0.793** (0.612-0.998)	**0.958** (0.716-1.26)	**1.08** (0.793-1.46)	**1.21** (0.863-1.69)	**1.36** (0.917-1.94)	**1.58** (1.02-2.33)	**1.75** (1.11-2.64)
15-min	**0.520** (0.405-0.648)	**0.623** (0.485-0.778)	**0.792** (0.614-0.991)	**0.933** (0.719-1.17)	**1.13** (0.842-1.48)	**1.27** (0.932-1.71)	**1.43** (1.02-1.99)	**1.60** (1.08-2.28)	**1.85** (1.20-2.74)	**2.06** (1.30-3.10)
30-min	**0.715** (0.557-0.891)	**0.858** (0.668-1.07)	**1.09** (0.847-1.37)	**1.28** (0.991-1.62)	**1.55** (1.16-2.04)	**1.75** (1.28-2.36)	**1.96** (1.40-2.74)	**2.20** (1.48-3.14)	**2.55** (1.65-3.77)	**2.84** (1.80-4.28)
60-min	**0.911** (0.710-1.14)	**1.09** (0.850-1.36)	**1.39** (1.08-1.74)	**1.64** (1.26-2.06)	**1.98** (1.48-2.60)	**2.23** (1.63-3.00)	**2.50** (1.78-3.49)	**2.80** (1.89-4.00)	**3.25** (2.10-4.80)	**3.62** (2.29-5.45)
2-hr	**1.17** (0.922-1.45)	**1.43** (1.12-1.77)	**1.84** (1.44-2.29)	**2.18** (1.70-2.73)	**2.65** (2.00-3.48)	**3.00** (2.22-4.04)	**3.38** (2.44-4.74)	**3.84** (2.59-5.44)	**4.53** (2.95-6.66)	**5.13** (3.26-7.68)
3-hr	**1.36** (1.07-1.68)	**1.66** (1.31-2.05)	**2.15** (1.69-2.67)	**2.56** (2.00-3.19)	**3.13** (2.37-4.10)	**3.54** (2.64-4.75)	**4.00** (2.90-5.60)	**4.56** (3.08-6.44)	**5.42** (3.53-7.93)	**6.16** (3.92-9.19)
6-hr	**1.75** (1.39-2.14)	**2.14** (1.70-2.63)	**2.79** (2.21-3.43)	**3.33** (2.62-4.12)	**4.06** (3.11-5.29)	**4.61** (3.46-6.15)	**5.20** (3.80-7.26)	**5.94** (4.04-8.35)	**7.10** (4.64-10.3)	**8.10** (5.17-12.0)
12-hr	**2.22** (1.78-2.70)	**2.72** (2.18-3.31)	**3.54** (2.83-4.33)	**4.22** (3.36-5.19)	**5.16** (3.97-6.67)	**5.85** (4.41-7.75)	**6.61** (4.86-9.14)	**7.54** (5.15-10.5)	**8.99** (5.89-13.0)	**10.2** (6.55-15.1)
24-hr	**2.66** (2.16-3.22)	**3.30** (2.67-3.99)	**4.35** (3.50-5.28)	**5.22** (4.18-6.37)	**6.41** (4.98-8.25)	**7.29** (5.54-9.62)	**8.26** (6.12-11.4)	**9.47** (6.50-13.1)	**11.4** (7.48-16.3)	**13.0** (8.37-19.1)
2-day	**3.03** (2.48-3.64)	**3.83** (3.13-4.61)	**5.14** (4.18-6.20)	**6.23** (5.03-7.55)	**7.72** (6.05-9.91)	**8.81** (6.77-11.6)	**10.0** (7.52-13.9)	**11.6** (8.00-16.0)	**14.2** (9.34-20.2)	**16.4** (10.6-23.8)
3-day	**3.33** (2.73-3.98)	**4.19** (3.44-5.02)	**5.60** (4.57-6.72)	**6.77** (5.49-8.17)	**8.38** (6.59-10.7)	**9.54** (7.36-12.5)	**10.9** (8.17-14.9)	**12.6** (8.68-17.2)	**15.4** (10.1-21.8)	**17.8** (11.5-25.8)
4-day	**3.61** (2.97-4.30)	**4.50** (3.70-5.37)	**5.95** (4.87-7.12)	**7.15** (5.82-8.61)	**8.81** (6.95-11.2)	**10.0** (7.75-13.1)	**11.4** (8.58-15.6)	**13.1** (9.09-18.0)	**16.0** (10.6-22.7)	**18.6** (12.0-26.8)
7-day	**4.37** (3.63-5.19)	**5.29** (4.39-6.28)	**6.80** (5.61-8.09)	**8.04** (6.59-9.63)	**9.76** (7.74-12.3)	**11.0** (8.56-14.3)	**12.4** (9.38-16.9)	**14.2** (9.88-19.3)	**17.2** (11.4-24.1)	**19.8** (12.8-28.3)
10-day	**5.06** (4.22-5.98)	**6.00** (5.00-7.10)	**7.54** (6.26-8.96)	**8.82** (7.27-10.5)	**10.6** (8.42-13.3)	**11.9** (9.24-15.3)	**13.3** (10.1-17.9)	**15.1** (10.5-20.5)	**18.0** (12.0-25.2)	**20.5** (13.3-29.3)
20-day	**7.00** (5.88-8.21)	**8.03** (6.74-9.43)	**9.71** (8.12-11.4)	**11.1** (9.23-13.2)	**13.0** (10.4-16.1)	**14.5** (11.3-18.3)	**16.0** (12.0-21.0)	**17.8** (12.5-23.9)	**20.4** (13.6-28.3)	**22.5** (14.7-32.0)
30-day	**8.60** (7.27-10.1)	**9.70** (8.20-11.4)	**11.5** (9.68-13.5)	**13.0** (10.9-15.4)	**15.1** (12.1-18.5)	**16.6** (13.0-20.8)	**18.2** (13.6-23.6)	**20.0** (14.1-26.6)	**22.3** (15.0-30.9)	**24.2** (15.8-34.2)
45-day	**10.6** (9.05-12.4)	**11.8** (10.0-13.8)	**13.8** (11.6-16.1)	**15.4** (12.9-18.1)	**17.6** (14.1-21.4)	**19.3** (15.0-23.9)	**21.0** (15.6-26.8)	**22.6** (16.0-30.1)	**24.8** (16.7-34.1)	**26.4** (17.2-37.2)
60-day	**12.4** (10.6-14.4)	**13.6** (11.6-15.8)	**15.7** (13.3-18.2)	**17.3** (14.6-20.3)	**19.6** (15.8-23.8)	**21.5** (16.8-26.5)	**23.2** (17.3-29.5)	**24.9** (17.7-32.9)	**26.9** (18.2-36.9)	**28.4** (18.5-39.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

A.4

NRCS Web Soil Survey

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
Essex County, Massachusetts, Southern Part

August 18, 2023

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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

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.

Soil Map

Map Scale: 1:1,730 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 25, 50, 100, 150

Feet: 0, 50, 100, 200, 300

N

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 1:15,800.

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: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 19, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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
420B	Canton fine sandy loam, 3 to 8 percent slopes	3.9	57.3%
602	Urban land	2.9	42.7%
Totals for Area of Interest		**6.8**	**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.

Essex County, Massachusetts, Southern Part

420B—Canton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w81b
Elevation: 0 to 1,180 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

Canton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton

Setting

Landform: Hills, moraines, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: gravelly fine sandy loam
2C - 26 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
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: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Scituate

Percent of map unit: 10 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Montauk

Percent of map unit: 5 percent
Landform: Moraines, ground moraines, hills, drumlins
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Charlton

Percent of map unit: 4 percent
Landform: Ridges, ground moraines, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 1 percent
Landform: Marshes, depressions, bogs, swamps, kettles
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

602—Urban land

Map Unit Setting

National map unit symbol: vkjv
Frost-free period: 145 to 175 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Parent material: Excavated, filled, and made land

Minor Components

Udorthents

Percent of map unit: 7 percent
Hydric soil rating: No

Hollis

Percent of map unit: 5 percent

Whitman

Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: Yes

Whately variant

Percent of map unit: 1 percent
Landform: Glacial lakes (relict)
Hydric soil rating: Yes

Maybid

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Swansea

Percent of map unit: 1 percent
Landform: Bogs
Hydric soil rating: Yes

Scarboro

Percent of map unit: 1 percent
Landform: Terraces
Hydric soil rating: Yes

Freetown

Percent of map unit: 1 percent
Landform: Bogs
Hydric soil rating: Yes

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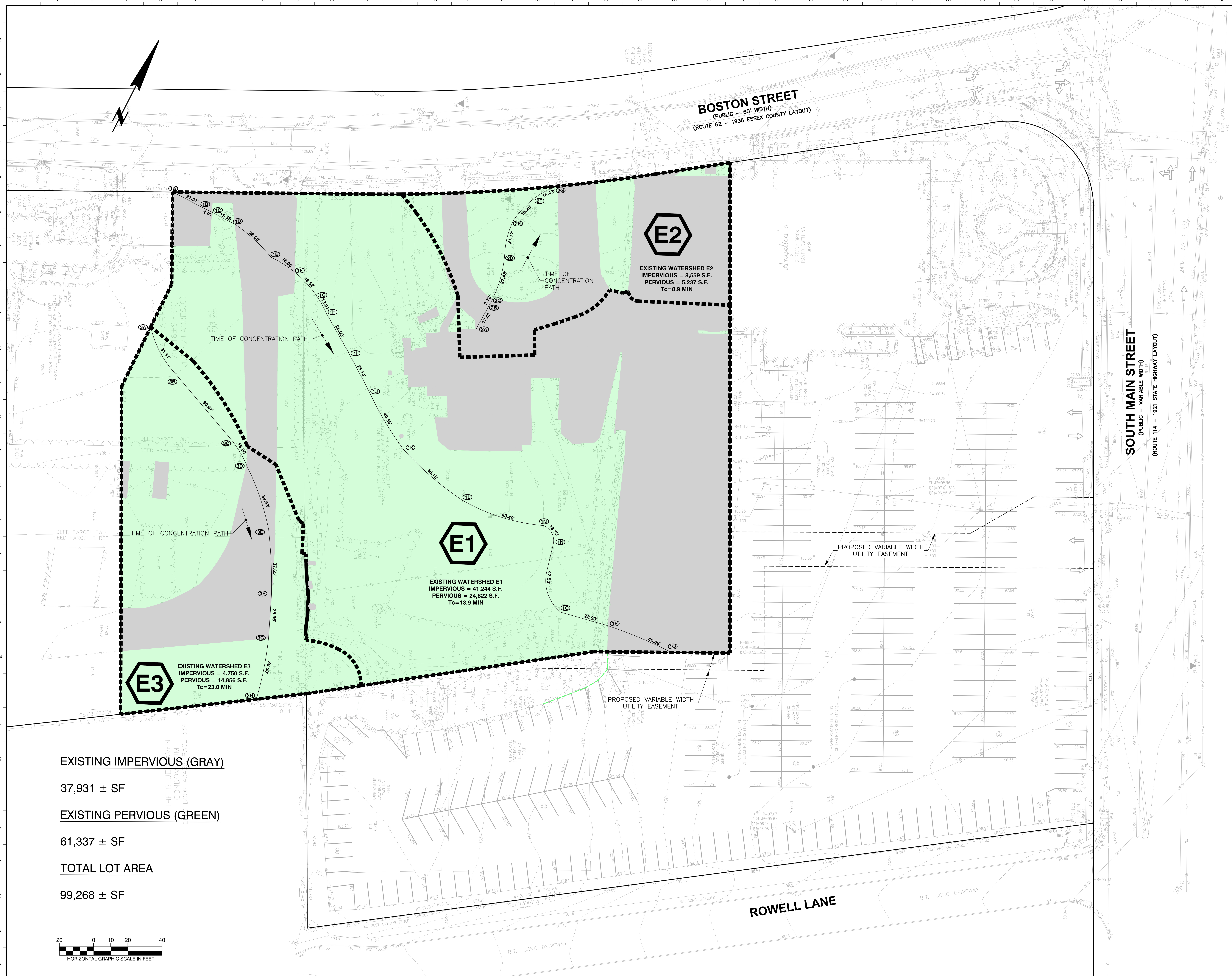
A.5

Existing and Proposed Watersheds



MIDDLETON

10 & 18 Boston Street &
49 South Main Street
Middleton, Massachusetts 01949

PREPARED FOR:

VILLEBRIDGE DEVELOPMENT LLC.

1150 Great Plain Avenue
Needham, Massachusetts 02492

HANCOCK ASSOCIATES

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Land Surveyors

Wetland Scientists

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VOICE (617) 357-8145, FAX (617) 357-9495
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NO.	BY	APP	DATE	ISSUE/REVISION DESCRIPTION

DATE:	08/22/23	SCALE:	1"=20'
DRAWN BY:	CMK	DESIGNED BY:	FAK
CHECKED BY:	FAK	APPROVED BY:	JP

EXISTING WATERSHED ANALYSIS

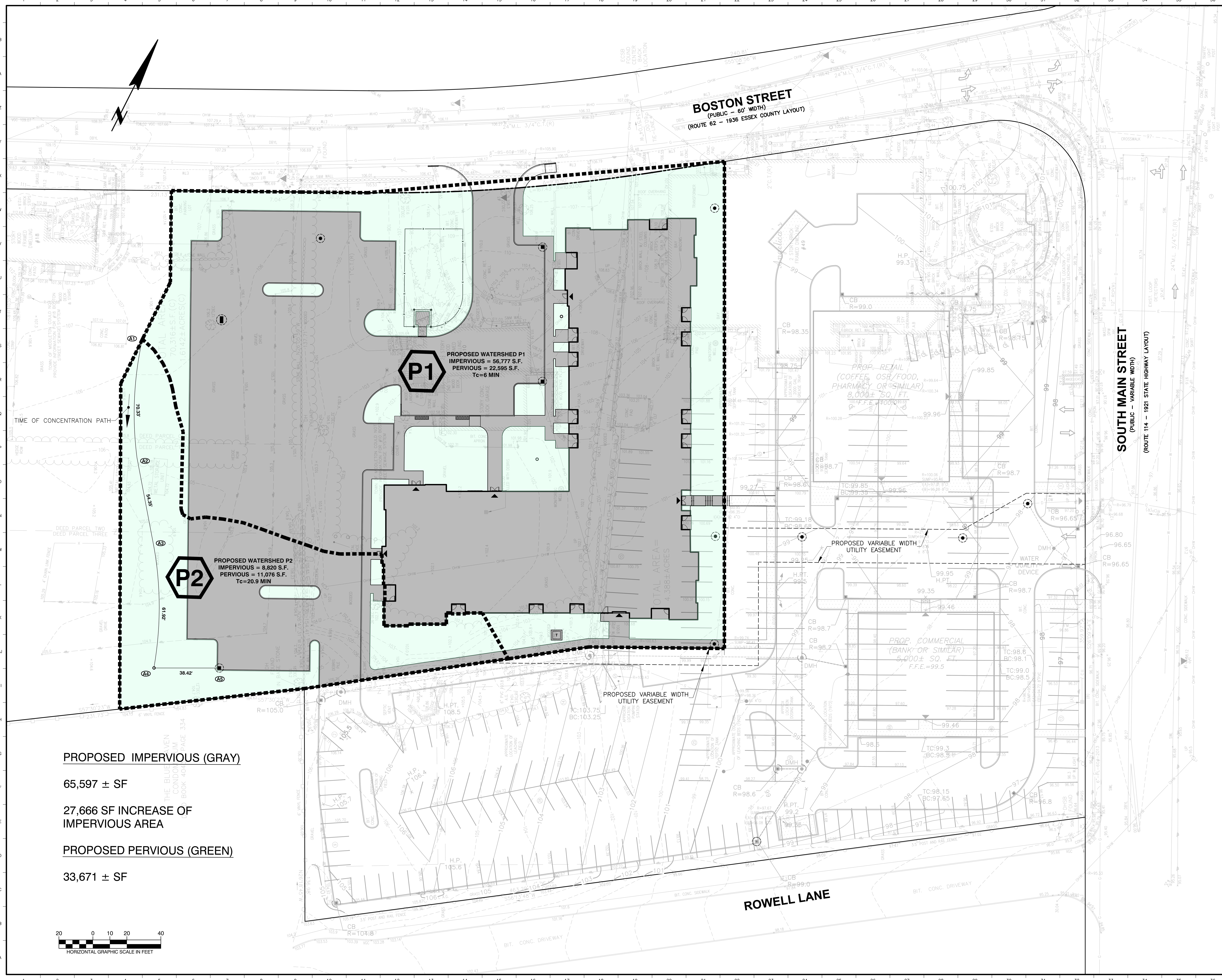
PLOT DATE: Aug 18, 2023 11:39 am
O:\Civil 3D Projects\25912 – Lara – Middleton\Eng\DWG\

DWG: 25912sp29.dwg

LAYOUT: EX-WSHD

SHEET: EW-1

PROJECT NO.: 25912



PROPOSED IMPERVIOUS (GRAY)

65,597 ± SF

27,666 SF INCREASE OF IMPERVIOUS AREA

PROPOSED PERVIOUS (GREEN)

33,671 ± SF

MIDDLETON

10 & 18 Boston Street &
49 South Main Street
Middleton, Massachusetts 01949

PREPARED FOR:

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NO.	BY	APP	DATE	ISSUE/REVISION DESCRIPTION

DATE:	08/22/23	SCALE:	1"=20'
DRAWN BY:	CMK	DESIGNED BY:	FAK
CHECKED BY:	FAK	APPROVED BY:	JP

PROPOSED WATERSHED ANALYSIS

PLOT DATE: Aug 18, 2023 11:38 am
O:\Civil 3D Projects\25912 - Lans - Middleton\Eng\DWG\

DWG: 25912sp29.dwg

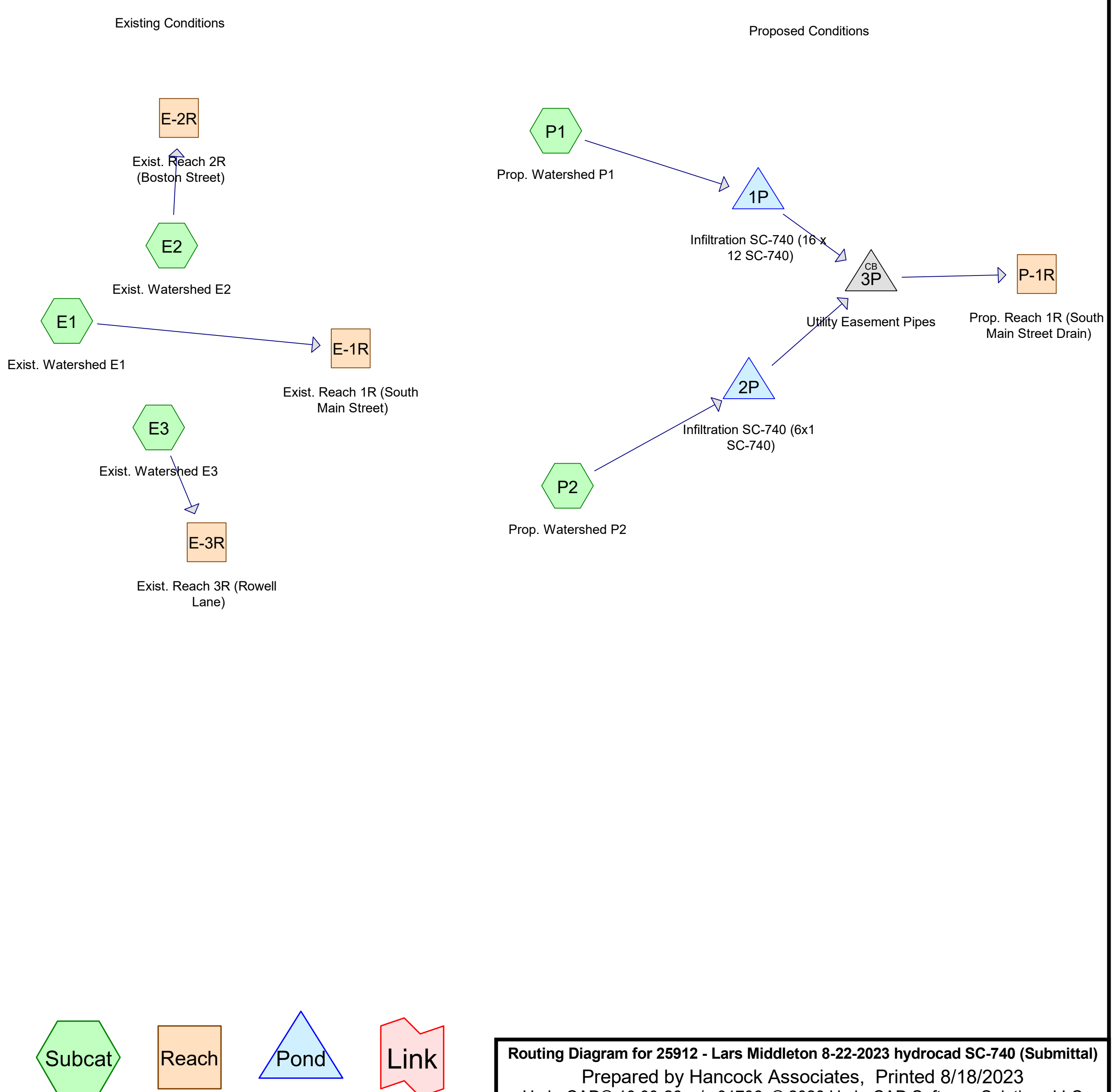
LAYOUT: PR-WSHD

SHEET: PW-1

PROJECT NO.: 25912

A.6

HydroCAD Output



Routing Diagram for 25912 - Lars Middleton 8-22-2023 hydrocad SC-740 (Submittal)

Prepared by Hancock Associates, Printed 8/18/2023

HydroCAD® 10.00-26 s/n 01706 © 2020 HydroCAD Software Solutions LLC

Summary for Subcatchment E1: Exist. Watershed E1

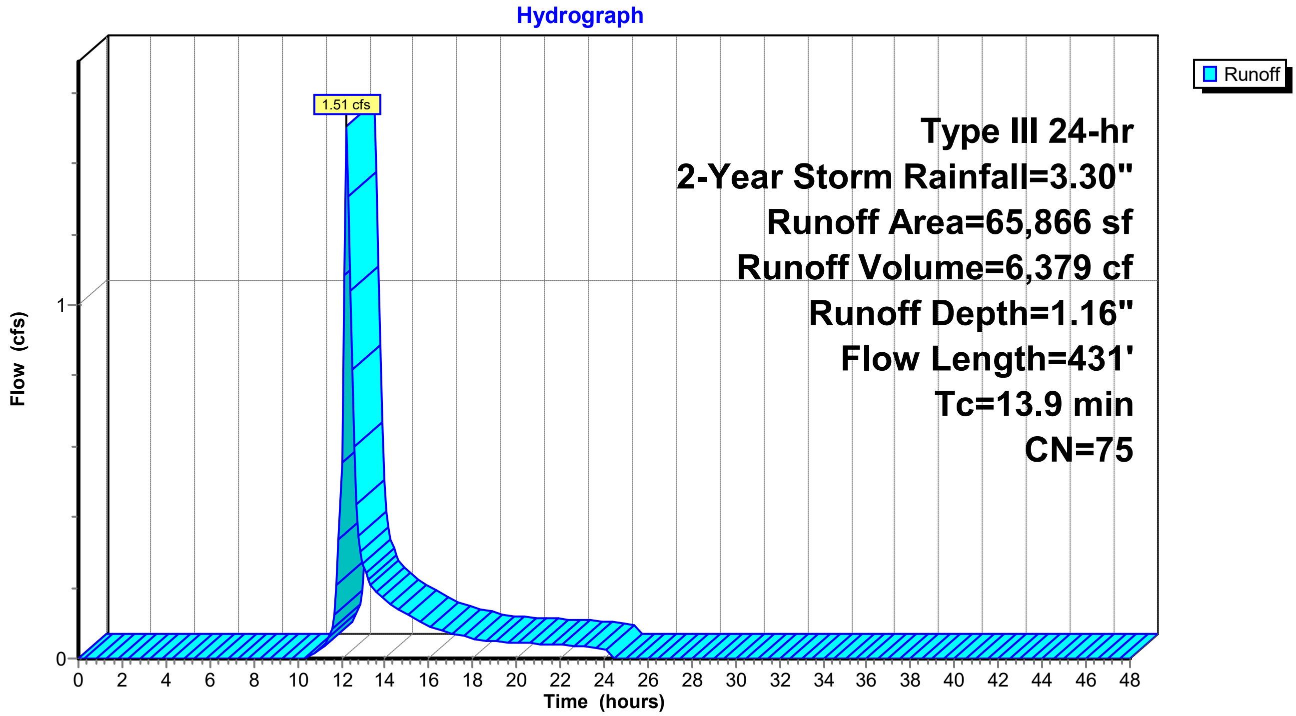
Runoff = 1.51 cfs @ 12.22 hrs, Volume= 6,379 cf, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

	Area (sf)	CN	Description
*	24,622	98	Impervious (Roof, drives, walks, walls, pads)
	41,244	61	>75% Grass cover, Good, HSG B
	65,866	75	Weighted Average
	41,244		62.62% Pervious Area
	24,622		37.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	22	0.0200	1.03		**Sheet Flow, 1A to 1B** Smooth surfaces n= 0.011 P2= 3.30"
0.1	4	0.0270	0.83		**Sheet Flow, 1B to 1C** Smooth surfaces n= 0.011 P2= 3.30"
2.1	16	0.0220	0.12		**Sheet Flow, 1C to 1D** Grass: Short n= 0.150 P2= 3.30"
0.5	29	0.0190	1.07		**Sheet Flow, 1D to 1E** Smooth surfaces n= 0.011 P2= 3.30"
0.5	16	0.0050	0.56		**Sheet Flow, 1E to 1F** Smooth surfaces n= 0.011 P2= 3.30"
4.5	19	0.0350	0.07		**Sheet Flow, 1F to 1G** Woods: Light underbrush n= 0.400 P2= 3.30"
1.8	13	0.0210	0.12		**Sheet Flow, 1G to 1H** Grass: Short n= 0.150 P2= 3.30"
0.3	25	0.0400	1.40		**Shallow Concentrated Flow, 1H to 1I** Short Grass Pasture Kv= 7.0 fps
0.3	25	0.0398	1.40		**Shallow Concentrated Flow, 1I to 1J** Short Grass Pasture Kv= 7.0 fps
1.1	41	0.0073	0.60		**Shallow Concentrated Flow, 1J to 1K** Short Grass Pasture Kv= 7.0 fps
0.6	46	0.0073	1.38		**Shallow Concentrated Flow, 1K to 1L** Unpaved Kv= 16.1 fps
0.6	49	0.0073	1.38		**Shallow Concentrated Flow, 1L to 1M** Unpaved Kv= 16.1 fps
0.1	14	0.0787	4.52		**Shallow Concentrated Flow, 1M to 1N** Unpaved Kv= 16.1 fps
0.3	43	0.0254	2.57		**Shallow Concentrated Flow, 1N to 1O** Unpaved Kv= 16.1 fps
0.5	29	0.0374	0.97		**Shallow Concentrated Flow, 1O to 1P** Woodland Kv= 5.0 fps
0.2	40	0.0185	2.76		**Shallow Concentrated Flow, 1P to 1Q** Paved Kv= 20.3 fps
13.9	431	Total			

Subcatchment E1: Exist. Watershed E1



Summary for Subcatchment E2: Exist. Watershed E2

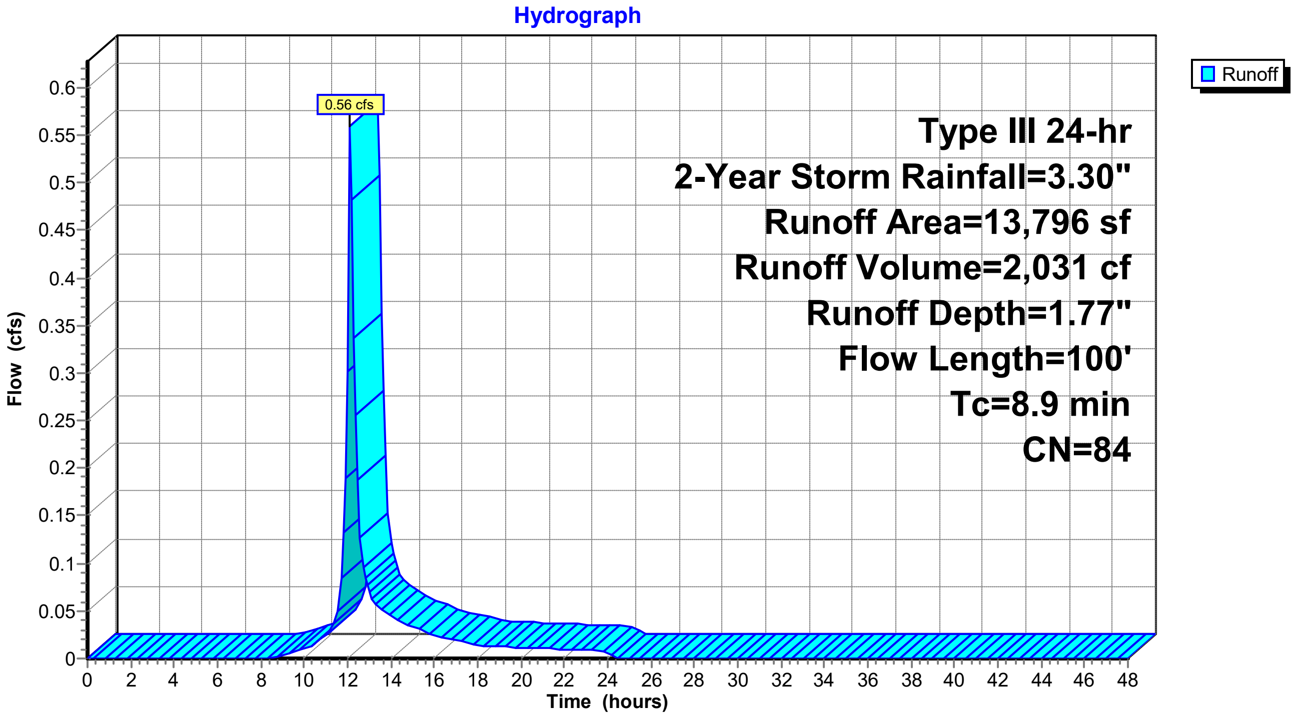
Runoff = 0.56 cfs @ 12.13 hrs, Volume= 2,031 cf, Depth= 1.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

	Area (sf)	CN	Description
*	8,559	98	Impervious (Roof, drives, walks, walls, pads)
	5,237	61	>75% Grass cover, Good, HSG B
	13,796	84	Weighted Average
	5,237		37.96% Pervious Area
	8,559		62.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0440	1.34		**Sheet Flow, 2A to 2B** Smooth surfaces n= 0.011 P2= 3.30"
0.0	3	0.0590	1.07		**Sheet Flow, 2B to 2C** Smooth surfaces n= 0.011 P2= 3.30"
2.8	27	0.0310	0.16		**Sheet Flow, 2C to 2D** Grass: Short n= 0.150 P2= 3.30"
2.0	21	0.0470	0.18		**Sheet Flow, 2D to 2E** Grass: Short n= 0.150 P2= 3.30"
2.1	16	0.0240	0.13		**Sheet Flow, 2E to 2F** Grass: Short n= 0.150 P2= 3.30"
1.8	16	0.0322	0.14		**Sheet Flow, 2F to 2G** Grass: Short n= 0.150 P2= 3.30"
8.9	100	Total			

Subcatchment E2: Exist. Watershed E2



Summary for Subcatchment E3: Exist. Watershed E3

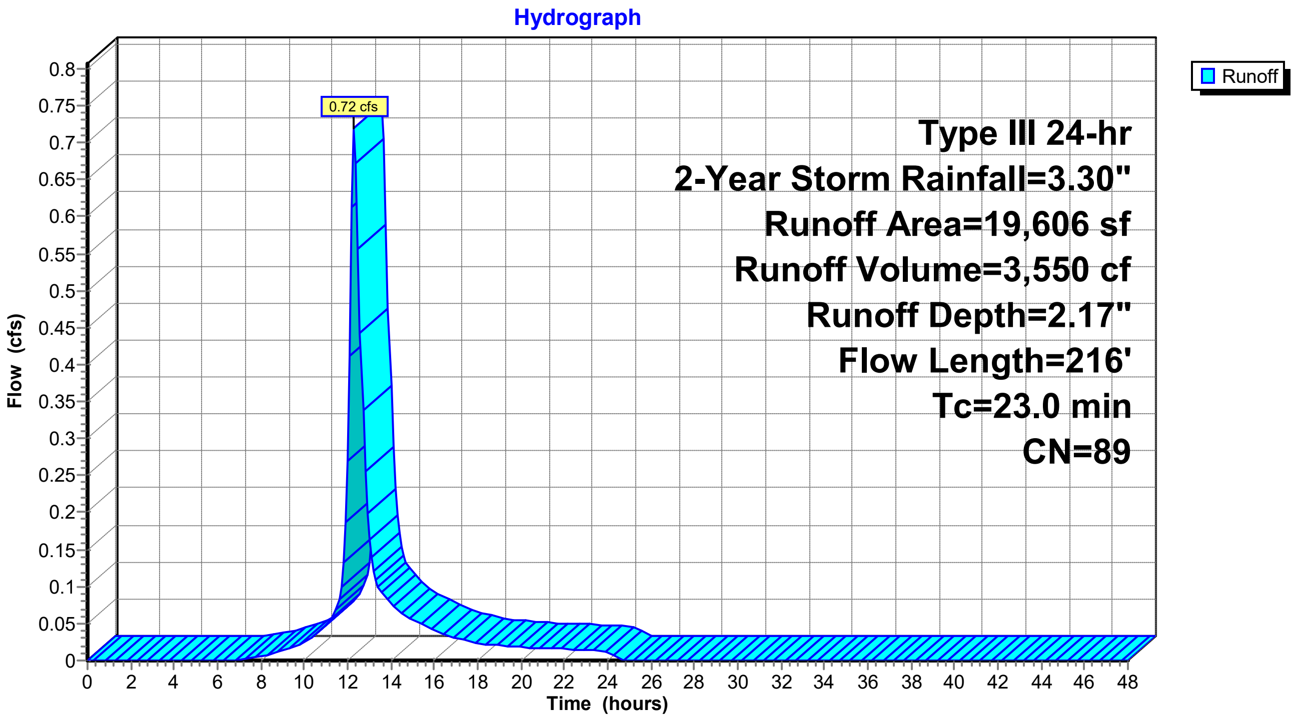
Runoff = 0.72 cfs @ 12.32 hrs, Volume= 3,550 cf, Depth= 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

	Area (sf)	CN	Description
*	14,856	98	Impervious (Roof, drives, walks, walls, pads)
	4,750	61	>75% Grass cover, Good, HSG B
	19,606	89	Weighted Average
	4,750		24.23% Pervious Area
	14,856		75.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	32	0.0150	0.12		**Sheet Flow, 3A to 3B** Grass: Short n= 0.150 P2= 3.30"
3.9	31	0.0180	0.13		**Sheet Flow, 3B to 3C** Grass: Short n= 0.150 P2= 3.30"
11.5	18	0.0030	0.03		**Sheet Flow, 3C to 3D** Woods: Light underbrush n= 0.400 P2= 3.30"
0.6	34	0.0120	0.92		**Sheet Flow, 3D to 3E** Smooth surfaces n= 0.011 P2= 3.30"
0.4	38	0.0053	1.48		**Shallow Concentrated Flow, 3E to 3F** Paved Kv= 20.3 fps
0.3	26	0.0038	1.25		**Shallow Concentrated Flow, 3F to 3G** Paved Kv= 20.3 fps
1.9	37	0.0022	0.33		**Shallow Concentrated Flow, 3G to 3H** Short Grass Pasture Kv= 7.0 fps
23.0	216	Total			

Subcatchment E3: Exist. Watershed E3



Summary for Subcatchment P1: Prop. Watershed P1

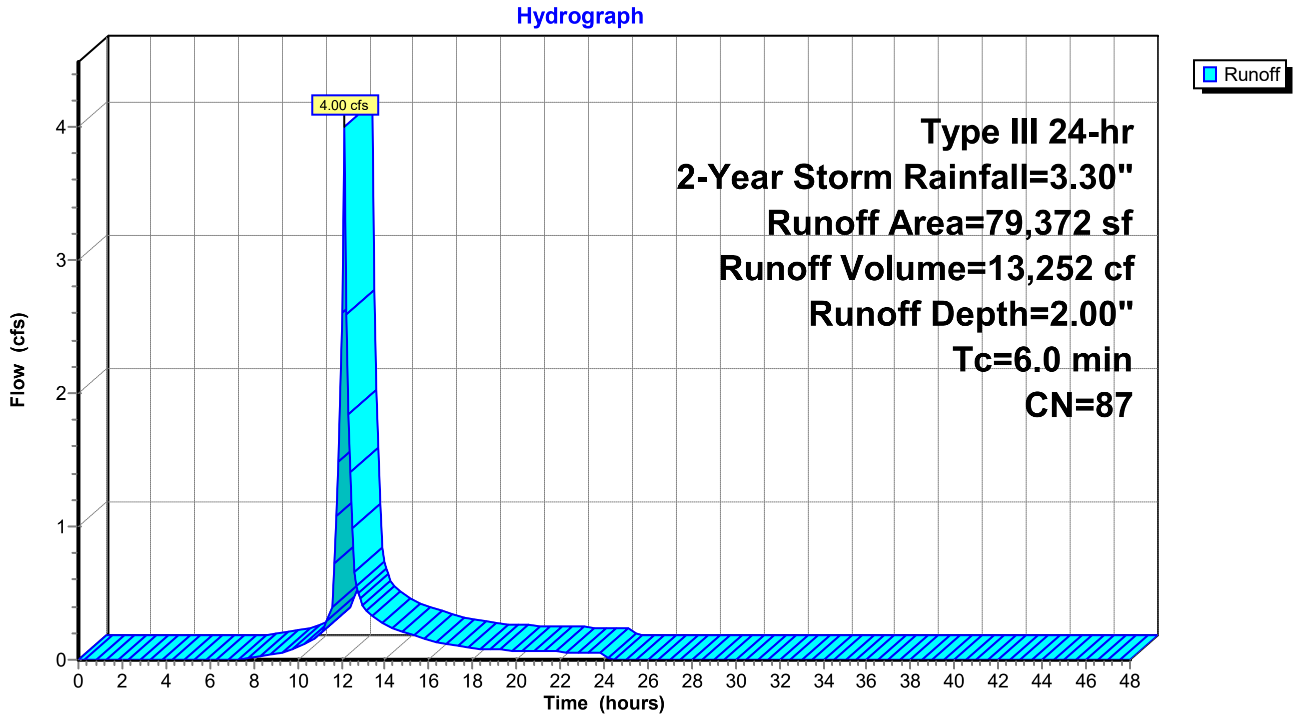
Runoff = 4.00 cfs @ 12.10 hrs, Volume= 13,252 cf, Depth= 2.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

	Area (sf)	CN	Description
*	56,777	98	Impervious (Roof, drives, walks, walls, pads)
	22,595	61	>75% Grass cover, Good, HSG B
	79,372	87	Weighted Average
	22,595		28.47% Pervious Area
	56,777		71.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TC for Proposed Watershed 3**

Subcatchment P1: Prop. Watershed P1



Summary for Subcatchment P2: Prop. Watershed P2

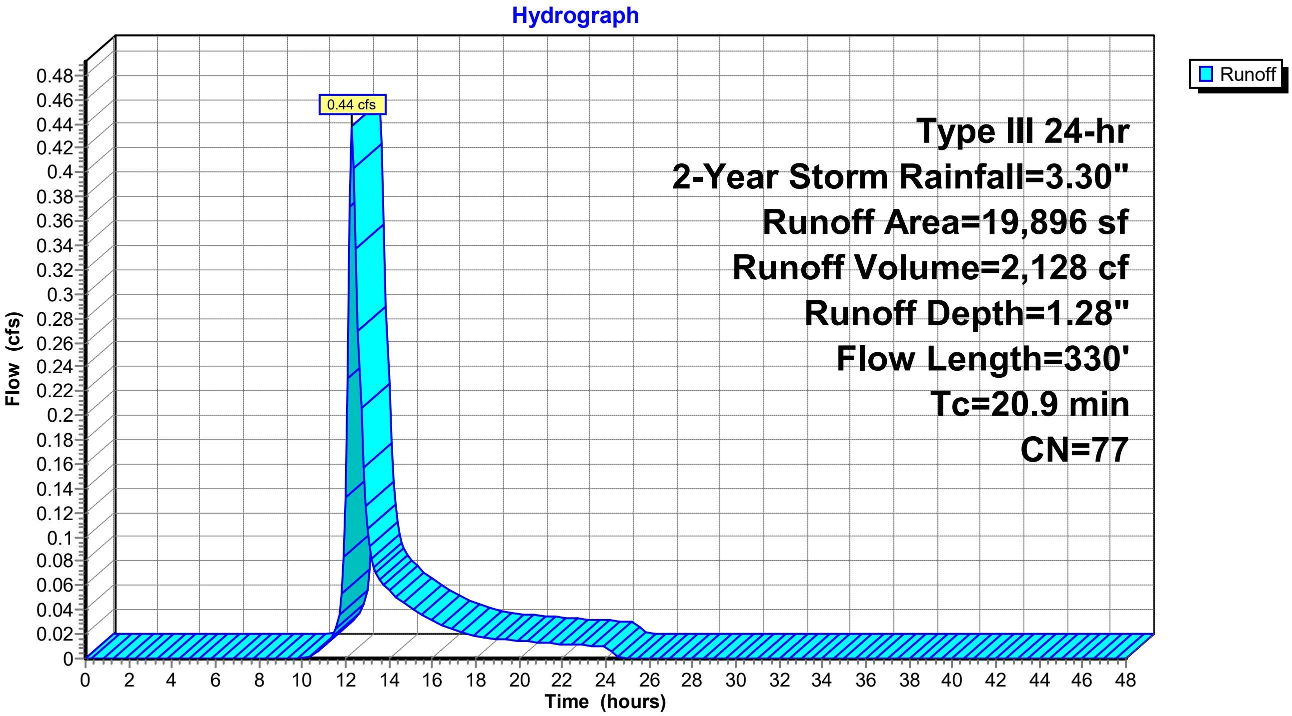
Runoff = 0.44 cfs @ 12.32 hrs, Volume= 2,128 cf, Depth= 1.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Storm Rainfall=3.30"

Area (sf)	CN	Description
11,076	61	>75% Grass cover, Good, HSG B
8,820	98	Paved parking, HSG B
19,896	77	Weighted Average
11,076		55.67% Pervious Area
8,820		44.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	70	0.0071	0.11		**Sheet Flow, A1 to A2** Grass: Short n= 0.150 P2= 3.30"
8.1	54	0.0090	0.11		**Sheet Flow, A2 to A3** Grass: Short n= 0.150 P2= 3.30"
1.2	62	0.0160	0.89		**Shallow Concentrated Flow, A3 to A4** Short Grass Pasture Kv= 7.0 fps
0.2	38	0.0100	4.09	1.43	**Pipe Channel, A4 to A5** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 Concrete pipe, straight & clean
0.4	106	0.0100	4.09	1.43	**Pipe Channel, A5 to smaller infiltration system** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 Concrete pipe, straight & clean
20.9	330	Total			

Subcatchment P2: Prop. Watershed P2

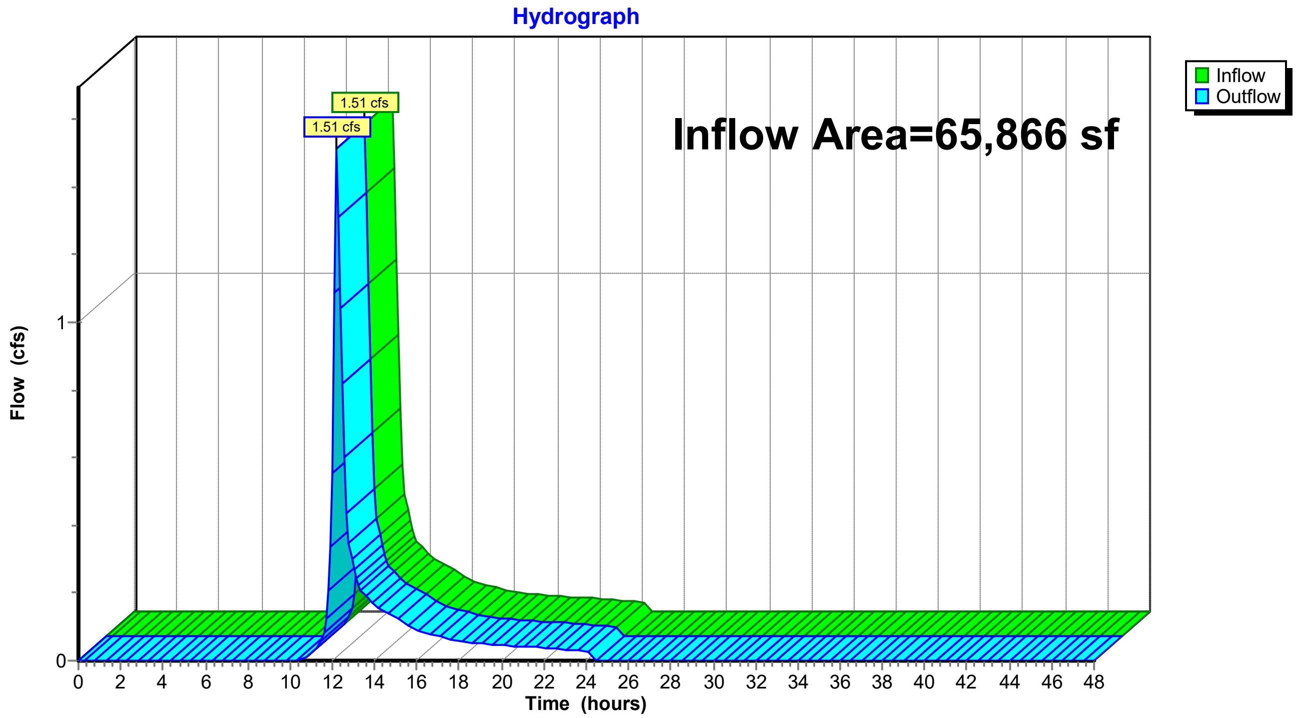


Summary for Reach E-1R: Exist. Reach 1R (South Main Street)

Inflow Area =	65,866 sf,	37.38% Impervious,	Inflow Depth = 1.16"	for 2-Year Storm event
Inflow =	1.51 cfs @	12.22 hrs, Volume=	6,379 cf	
Outflow =	1.51 cfs @	12.22 hrs, Volume=	6,379 cf,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach E-1R: Exist. Reach 1R (South Main Street)

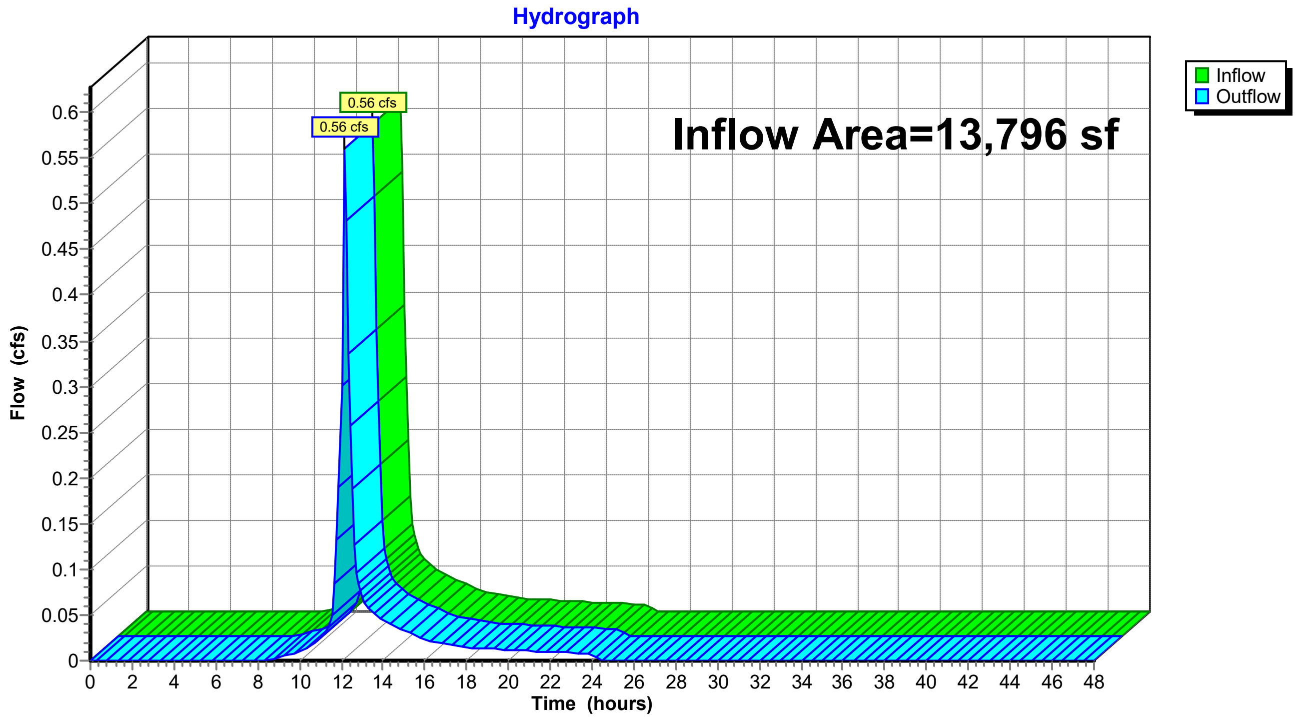


Summary for Reach E-2R: Exist. Reach 2R (Boston Street)

Inflow Area = 13,796 sf, 62.04% Impervious, Inflow Depth = 1.77" for 2-Year Storm event
Inflow = 0.56 cfs @ 12.13 hrs, Volume= 2,031 cf
Outflow = 0.56 cfs @ 12.13 hrs, Volume= 2,031 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach E-2R: Exist. Reach 2R (Boston Street)

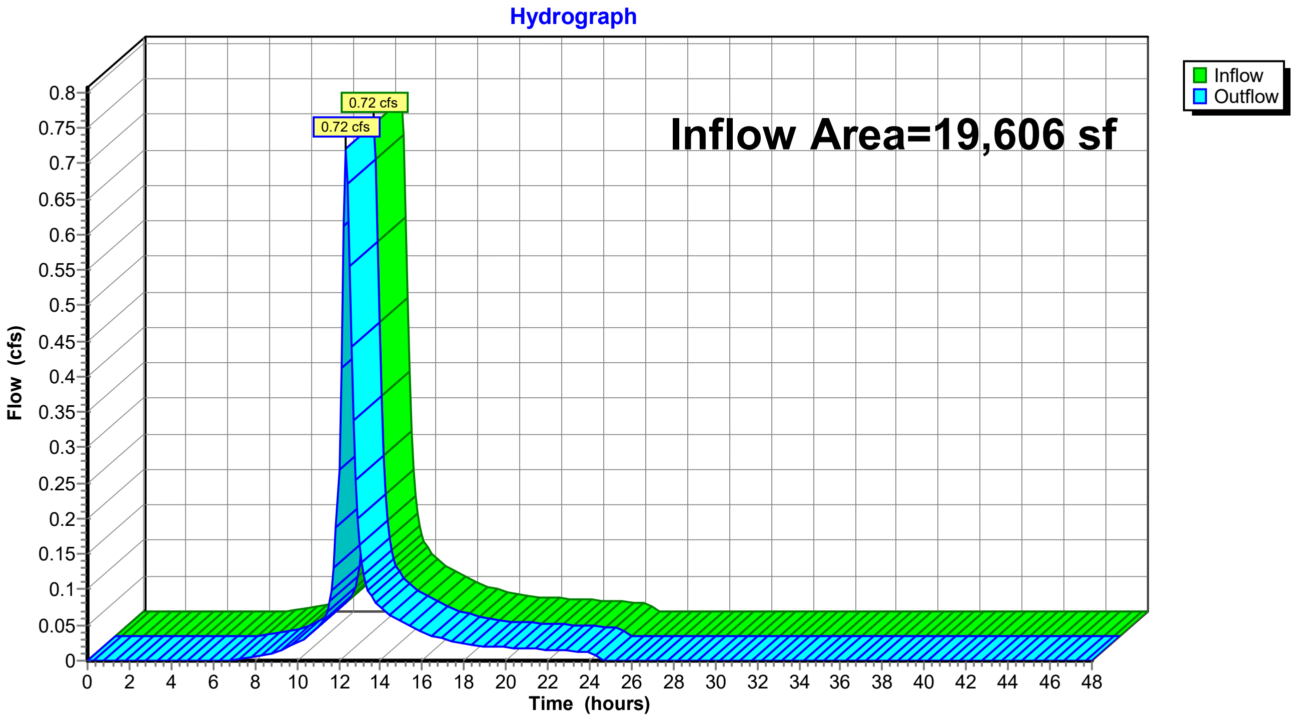


Summary for Reach E-3R: Exist. Reach 3R (Rowell Lane)

Inflow Area = 19,606 sf, 75.77% Impervious, Inflow Depth = 2.17" for 2-Year Storm event
Inflow = 0.72 cfs @ 12.32 hrs, Volume= 3,550 cf
Outflow = 0.72 cfs @ 12.32 hrs, Volume= 3,550 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach E-3R: Exist. Reach 3R (Rowell Lane)

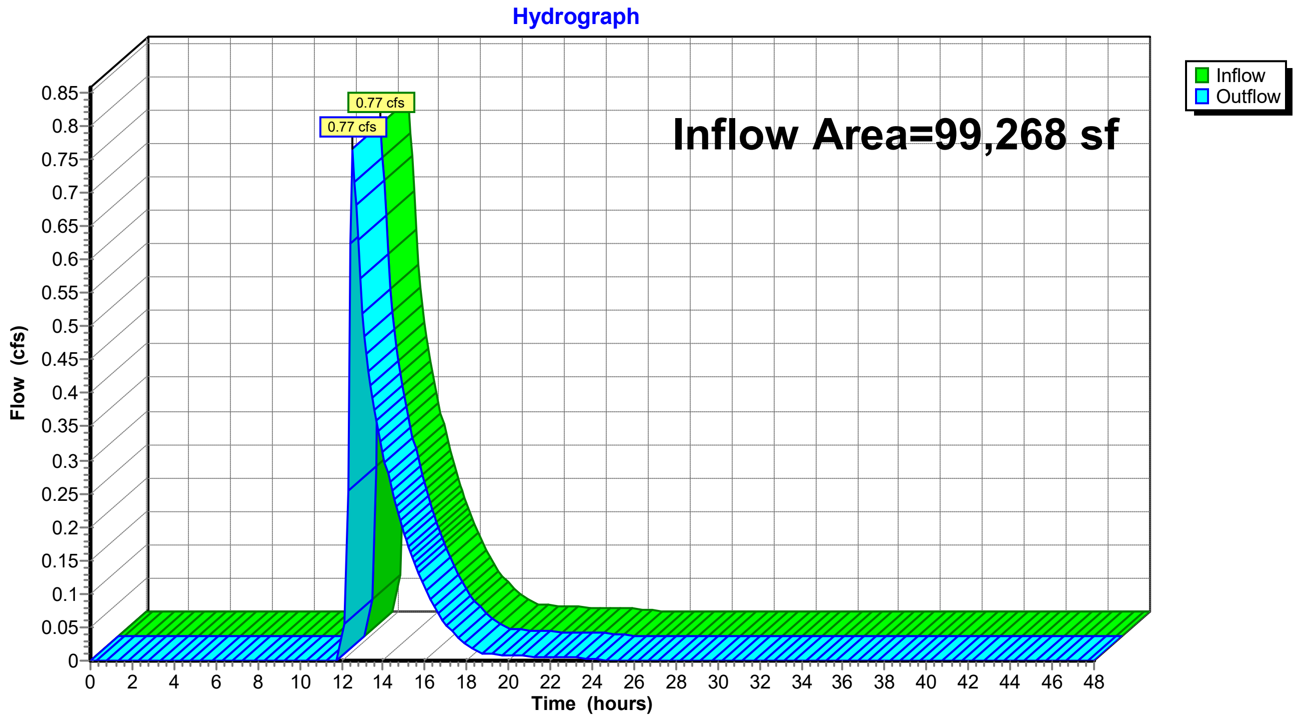


Summary for Reach P-1R: Prop. Reach 1R (South Main Street Drain)

Inflow Area = 99,268 sf, 66.08% Impervious, Inflow Depth = 0.62" for 2-Year Storm event
Inflow = 0.77 cfs @ 12.53 hrs, Volume= 5,094 cf
Outflow = 0.77 cfs @ 12.53 hrs, Volume= 5,094 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach P-1R: Prop. Reach 1R (South Main Street Drain)



Summary for Pond 1P: Infiltration SC-740 (16 x 12 SC-740)

Inflow Area = 79,372 sf, 71.53% Impervious, Inflow Depth = 2.00" for 2-Year Storm event
Inflow = 4.00 cfs @ 12.10 hrs, Volume= 13,252 cf
Outflow = 0.59 cfs @ 12.67 hrs, Volume= 13,269 cf, Atten= 85%, Lag= 34.2 min
Discarded = 0.16 cfs @ 11.50 hrs, Volume= 9,541 cf
Primary = 0.43 cfs @ 12.67 hrs, Volume= 3,728 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Peak Elev= 102.20' @ 12.67 hrs Surf.Area= 6,902 sf Storage= 5,423 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 180.1 min (997.7 - 817.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	101.00'	6,134 cf	**77.50'W x 89.06'L x 3.50'H Field A** 24,157 cf Overall - 8,820 cf Embedded = 15,336 cf x 40.0% Voids
#2A	101.50'	8,820 cf	**ADS_StormTech SC-740 +Cap** x 192 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 192 Chambers in 16 Rows
#3	101.50'	283 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder** x 5 -Impervious
		15,238 cf	Total Available Storage

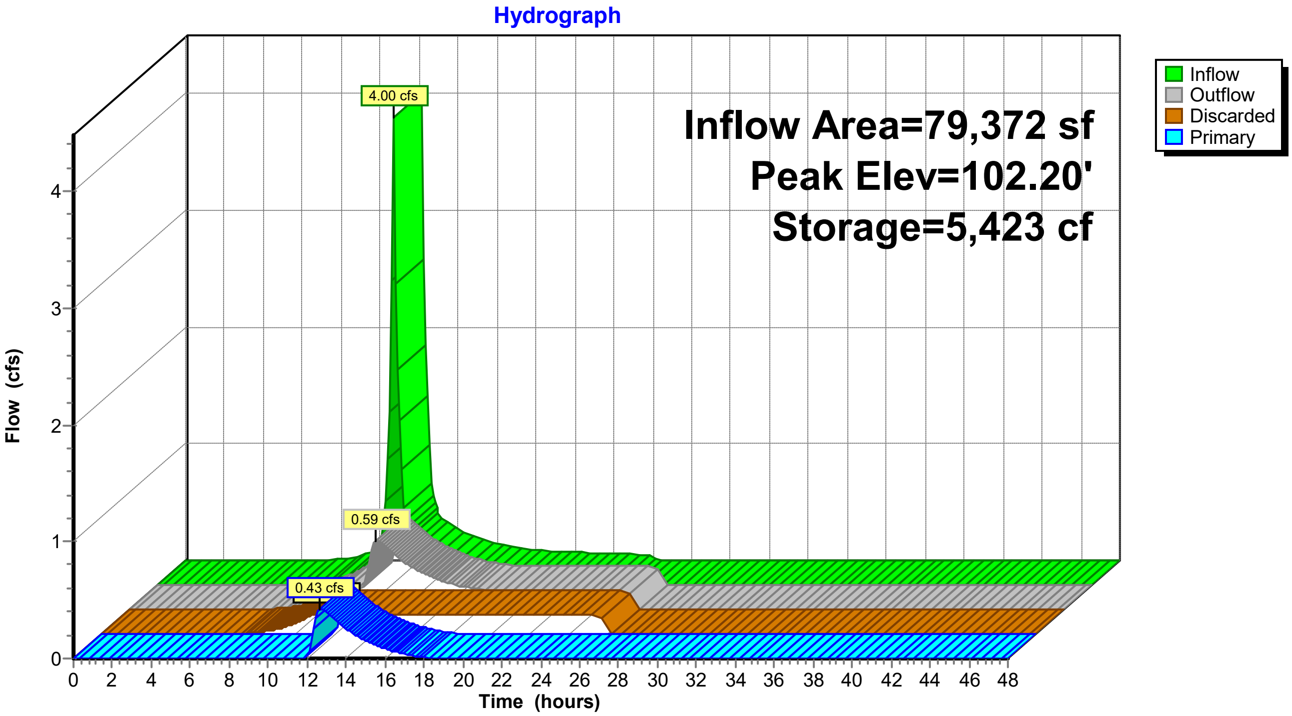
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	101.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	97.75'	**12.0" Round Culvert - 189.0 ft** L= 189.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 97.75' / 96.75' S= 0.0053 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	99.00'	**12.0" Round Culvert - 88.5** L= 119.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 99.00' / 97.75' S= 0.0105 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#4	Device 3	102.80'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#5	Device 3	101.75'	**6.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.16 cfs @ 11.50 hrs HW=101.07' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.43 cfs @ 12.67 hrs HW=102.20' TW=97.92' (Dynamic Tailwater)
└─**2=Culvert - 189.0 ft** (Passes 0.43 cfs of 5.44 cfs potential flow)
  └─**3=Culvert - 88.5** (Passes 0.43 cfs of 5.73 cfs potential flow)
    ├─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
    └─**5=Orifice/Grate** (Orifice Controls 0.43 cfs @ 2.28 fps)

Pond 1P: Infiltration SC-740 (16 x 12 SC-740)



Summary for Pond 2P: Infiltration SC-740 (6x1 SC-740)

Inflow Area = 19,896 sf, 44.33% Impervious, Inflow Depth = 1.28" for 2-Year Storm event
Inflow = 0.44 cfs @ 12.32 hrs, Volume= 2,128 cf
Outflow = 0.36 cfs @ 12.51 hrs, Volume= 2,129 cf, Atten= 18%, Lag= 11.5 min
Discarded = 0.01 cfs @ 11.30 hrs, Volume= 762 cf
Primary = 0.35 cfs @ 12.51 hrs, Volume= 1,366 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Peak Elev= 103.92' @ 12.52 hrs Surf.Area= 290 sf Storage= 534 cf

Plug-Flow detention time= 250.5 min calculated for 2,124 cf (100% of inflow)
Center-of-Mass det. time= 252.2 min (1,116.6 - 864.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	101.00'	295 cf	**6.25'W x 46.34'L x 3.50'H Field A**
			1,014 cf Overall - 276 cf Embedded = 738 cf x 40.0% Voids
#2A	101.50'	276 cf	**ADS_StormTech SC-740 +Cap** x 6 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
#3	101.50'	57 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder** -Impervious
		627 cf	Total Available Storage

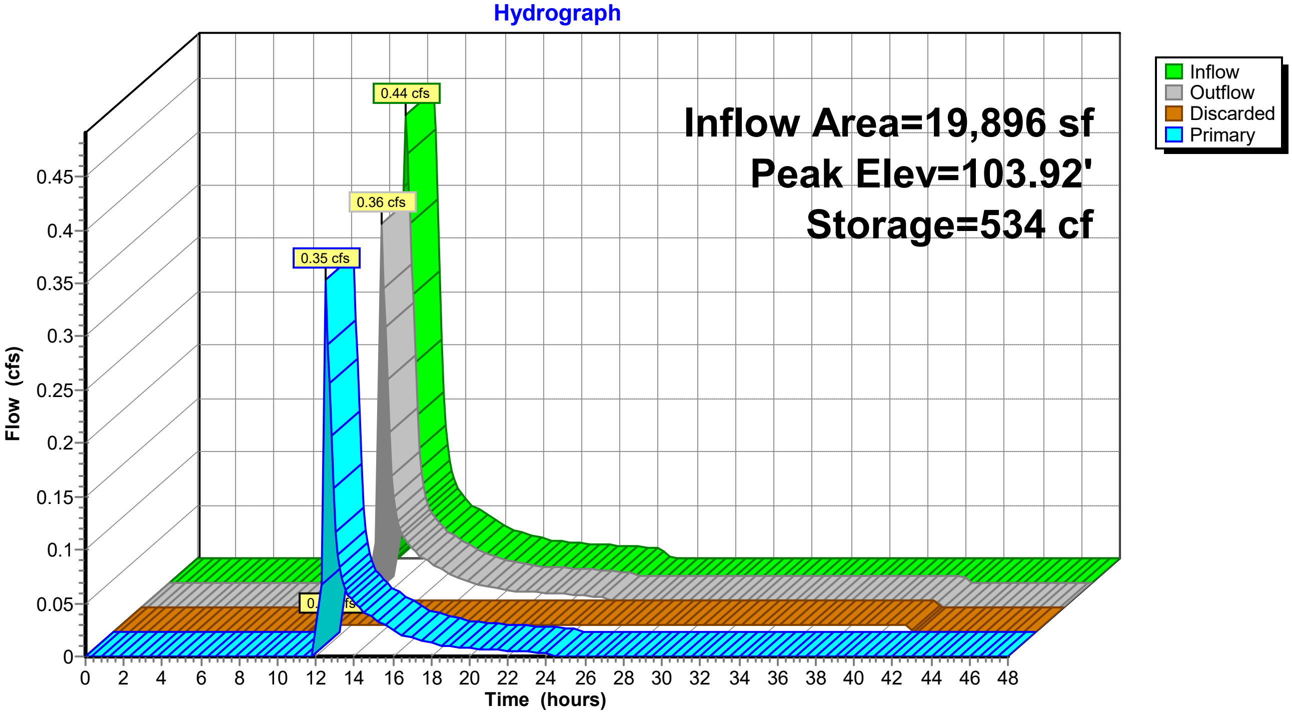
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	101.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	97.75'	**12.0" Round Culvert - 50 ft**
			L= 60.0' RCP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 97.75' / 97.15' S= 0.0100 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	100.00'	**12.0" Round Culvert - 134 ft**
			L= 134.0' RCP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 100.00' / 97.75' S= 0.0168 '/' Cc= 0.900
			n= 0.011, Flow Area= 0.79 sf
#4	Device 3	103.90'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#5	Device 3	103.20'	**4.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.01 cfs @ 11.30 hrs HW=101.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.34 cfs @ 12.51 hrs HW=103.91' TW=97.94' (Dynamic Tailwater)
└─**2=Culvert - 50 ft** (Passes 0.34 cfs of 8.97 cfs potential flow)
  └─**3=Culvert - 134 ft** (Passes 0.34 cfs of 6.74 cfs potential flow)
    ├─**4=Sharp-Crested Rectangular Weir** (Weir Controls 0.03 cfs @ 0.38 fps)
    └─**5=Orifice/Grate** (Orifice Controls 0.31 cfs @ 3.56 fps)

Pond 2P: Infiltration SC-740 (6x1 SC-740)



Summary for Pond 3P: Utility Easement Pipes

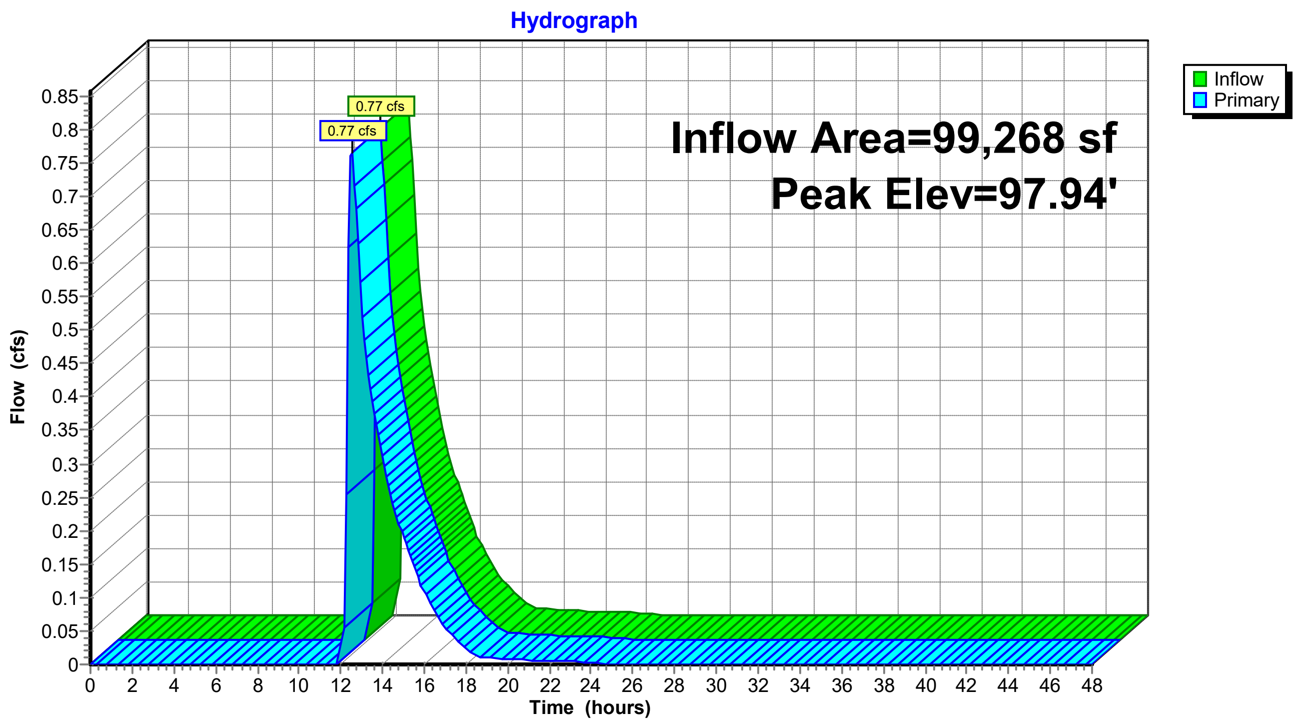
Inflow Area = 99,268 sf, 66.08% Impervious, Inflow Depth = 0.62" for 2-Year Storm event
Inflow = 0.77 cfs @ 12.53 hrs, Volume= 5,094 cf
Outflow = 0.77 cfs @ 12.53 hrs, Volume= 5,094 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.77 cfs @ 12.53 hrs, Volume= 5,094 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Peak Elev= 97.94' @ 12.53 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	94.60'	**12.0" Round Culvert from Contour 99 to 98** L= 40.5' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 94.60' / 94.00' S= 0.0148 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#2	Device 1	97.50'	**12.0" Round Culvert from Convergence to Contour 99** L= 142.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 97.50' / 94.60' S= 0.0204 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=0.75 cfs @ 12.53 hrs HW=97.94' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert from Contour 99 to 98** (Passes 0.75 cfs of 6.37 cfs potential flow)
  └─**2=Culvert from Convergence to Contour 99** (Inlet Controls 0.75 cfs @ 2.26 fps)

Pond 3P: Utility Easement Pipes



Summary for Subcatchment E1: Exist. Watershed E1

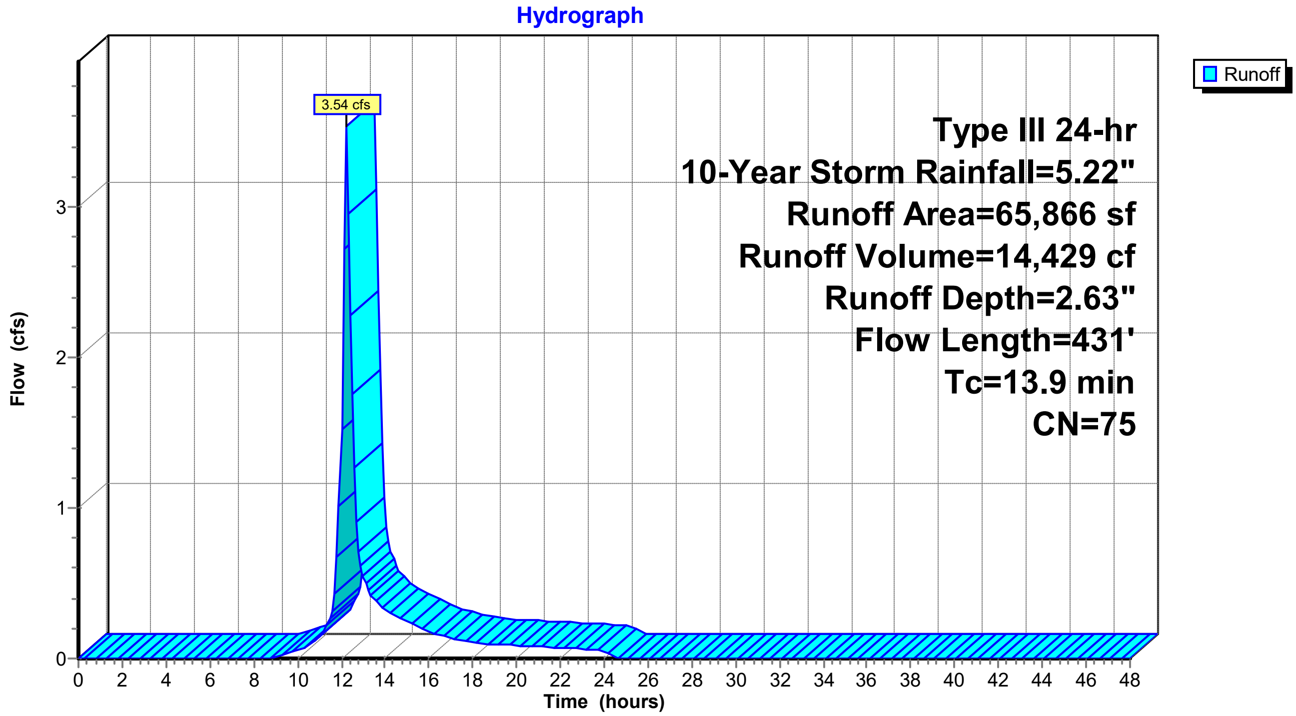
Runoff = 3.54 cfs @ 12.21 hrs, Volume= 14,429 cf, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Storm Rainfall=5.22"

	Area (sf)	CN	Description
*	24,622	98	Impervious (Roof, drives, walks, walls, pads)
	41,244	61	>75% Grass cover, Good, HSG B
	65,866	75	Weighted Average
	41,244		62.62% Pervious Area
	24,622		37.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	22	0.0200	1.03		**Sheet Flow, 1A to 1B** Smooth surfaces n= 0.011 P2= 3.30"
0.1	4	0.0270	0.83		**Sheet Flow, 1B to 1C** Smooth surfaces n= 0.011 P2= 3.30"
2.1	16	0.0220	0.12		**Sheet Flow, 1C to 1D** Grass: Short n= 0.150 P2= 3.30"
0.5	29	0.0190	1.07		**Sheet Flow, 1D to 1E** Smooth surfaces n= 0.011 P2= 3.30"
0.5	16	0.0050	0.56		**Sheet Flow, 1E to 1F** Smooth surfaces n= 0.011 P2= 3.30"
4.5	19	0.0350	0.07		**Sheet Flow, 1F to 1G** Woods: Light underbrush n= 0.400 P2= 3.30"
1.8	13	0.0210	0.12		**Sheet Flow, 1G to 1H** Grass: Short n= 0.150 P2= 3.30"
0.3	25	0.0400	1.40		**Shallow Concentrated Flow, 1H to 1I** Short Grass Pasture Kv= 7.0 fps
0.3	25	0.0398	1.40		**Shallow Concentrated Flow, 1I to 1J** Short Grass Pasture Kv= 7.0 fps
1.1	41	0.0073	0.60		**Shallow Concentrated Flow, 1J to 1K** Short Grass Pasture Kv= 7.0 fps
0.6	46	0.0073	1.38		**Shallow Concentrated Flow, 1K to 1L** Unpaved Kv= 16.1 fps
0.6	49	0.0073	1.38		**Shallow Concentrated Flow, 1L to 1M** Unpaved Kv= 16.1 fps
0.1	14	0.0787	4.52		**Shallow Concentrated Flow, 1M to 1N** Unpaved Kv= 16.1 fps
0.3	43	0.0254	2.57		**Shallow Concentrated Flow, 1N to 1O** Unpaved Kv= 16.1 fps
0.5	29	0.0374	0.97		**Shallow Concentrated Flow, 1O to 1P** Woodland Kv= 5.0 fps
0.2	40	0.0185	2.76		**Shallow Concentrated Flow, 1P to 1Q** Paved Kv= 20.3 fps
13.9	431	Total			

Subcatchment E1: Exist. Watershed E1



Summary for Subcatchment E2: Exist. Watershed E2

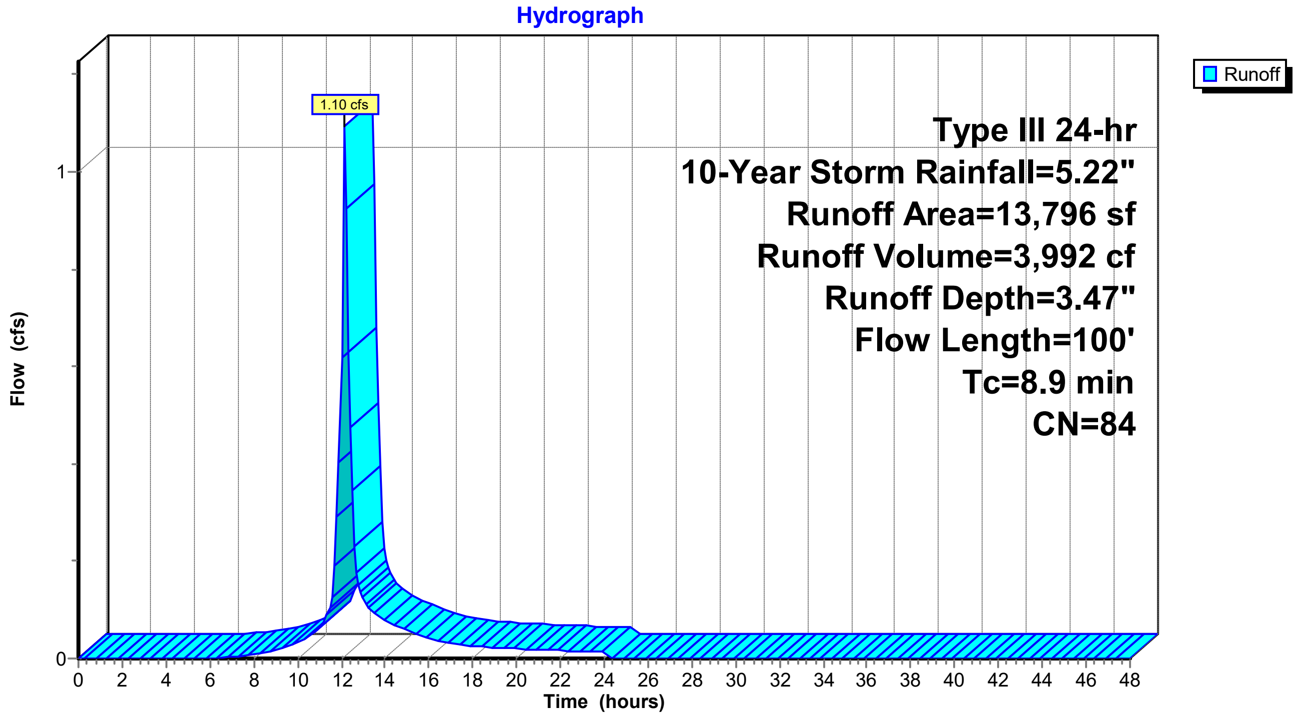
Runoff = 1.10 cfs @ 12.12 hrs, Volume= 3,992 cf, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Storm Rainfall=5.22"

	Area (sf)	CN	Description
*	8,559	98	Impervious (Roof, drives, walks, walls, pads)
	5,237	61	>75% Grass cover, Good, HSG B
	13,796	84	Weighted Average
	5,237		37.96% Pervious Area
	8,559		62.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0440	1.34		**Sheet Flow, 2A to 2B** Smooth surfaces n= 0.011 P2= 3.30"
0.0	3	0.0590	1.07		**Sheet Flow, 2B to 2C** Smooth surfaces n= 0.011 P2= 3.30"
2.8	27	0.0310	0.16		**Sheet Flow, 2C to 2D** Grass: Short n= 0.150 P2= 3.30"
2.0	21	0.0470	0.18		**Sheet Flow, 2D to 2E** Grass: Short n= 0.150 P2= 3.30"
2.1	16	0.0240	0.13		**Sheet Flow, 2E to 2F** Grass: Short n= 0.150 P2= 3.30"
1.8	16	0.0322	0.14		**Sheet Flow, 2F to 2G** Grass: Short n= 0.150 P2= 3.30"
8.9	100	Total			

Subcatchment E2: Exist. Watershed E2



Summary for Subcatchment E3: Exist. Watershed E3

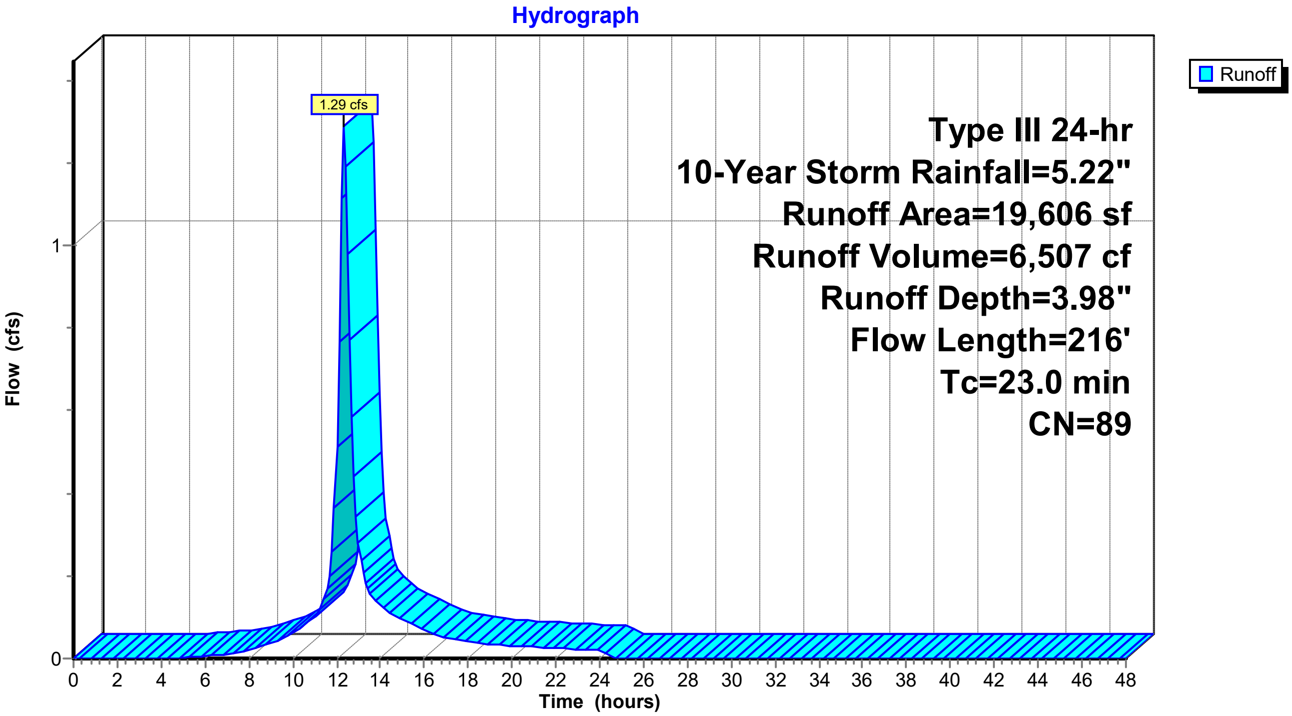
Runoff = 1.29 cfs @ 12.31 hrs, Volume= 6,507 cf, Depth= 3.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Storm Rainfall=5.22"

	Area (sf)	CN	Description
*	14,856	98	Impervious (Roof, drives, walks, walls, pads)
	4,750	61	>75% Grass cover, Good, HSG B
	19,606	89	Weighted Average
	4,750		24.23% Pervious Area
	14,856		75.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	32	0.0150	0.12		**Sheet Flow, 3A to 3B** Grass: Short n= 0.150 P2= 3.30"
3.9	31	0.0180	0.13		**Sheet Flow, 3B to 3C** Grass: Short n= 0.150 P2= 3.30"
11.5	18	0.0030	0.03		**Sheet Flow, 3C to 3D** Woods: Light underbrush n= 0.400 P2= 3.30"
0.6	34	0.0120	0.92		**Sheet Flow, 3D to 3E** Smooth surfaces n= 0.011 P2= 3.30"
0.4	38	0.0053	1.48		**Shallow Concentrated Flow, 3E to 3F** Paved Kv= 20.3 fps
0.3	26	0.0038	1.25		**Shallow Concentrated Flow, 3F to 3G** Paved Kv= 20.3 fps
1.9	37	0.0022	0.33		**Shallow Concentrated Flow, 3G to 3H** Short Grass Pasture Kv= 7.0 fps
23.0	216	Total			

Subcatchment E3: Exist. Watershed E3



Summary for Subcatchment P1: Prop. Watershed P1

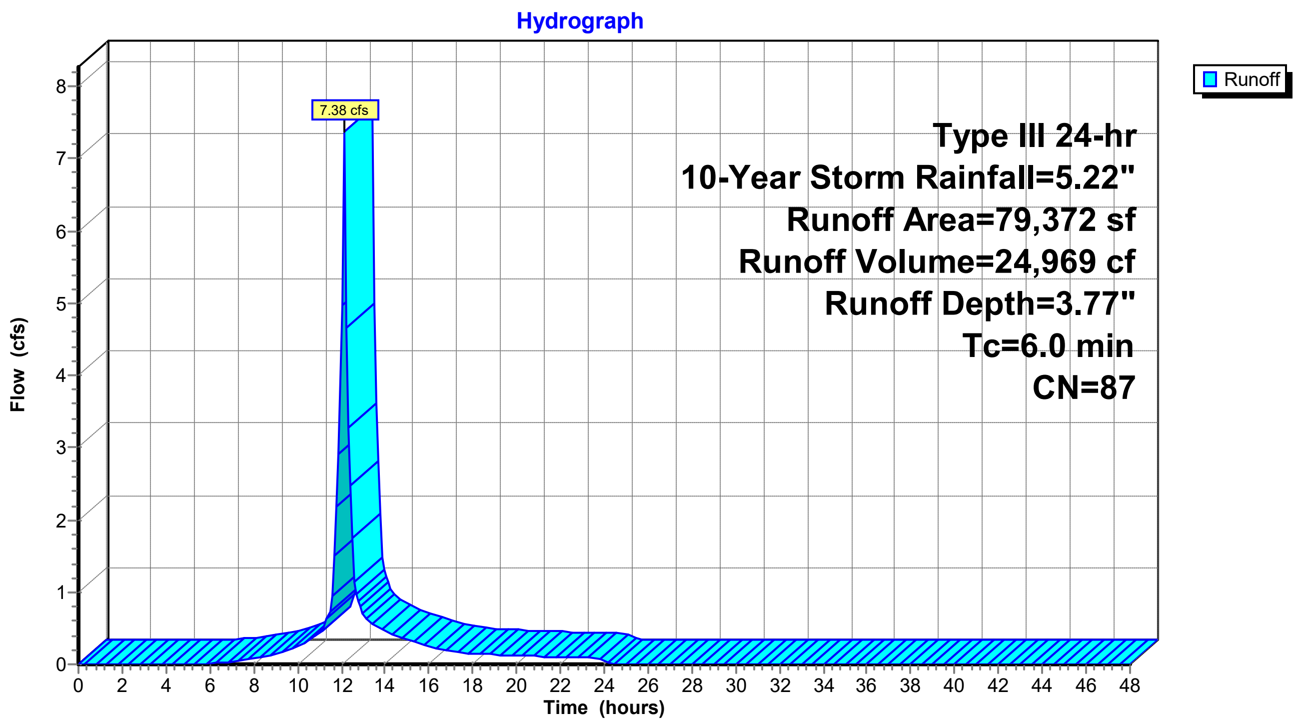
Runoff = 7.38 cfs @ 12.10 hrs, Volume= 24,969 cf, Depth= 3.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Storm Rainfall=5.22"

	Area (sf)	CN	Description
*	56,777	98	Impervious (Roof, drives, walks, walls, pads)
	22,595	61	>75% Grass cover, Good, HSG B
	79,372	87	Weighted Average
	22,595		28.47% Pervious Area
	56,777		71.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TC for Proposed Watershed 3**

Subcatchment P1: Prop. Watershed P1



Summary for Subcatchment P2: Prop. Watershed P2

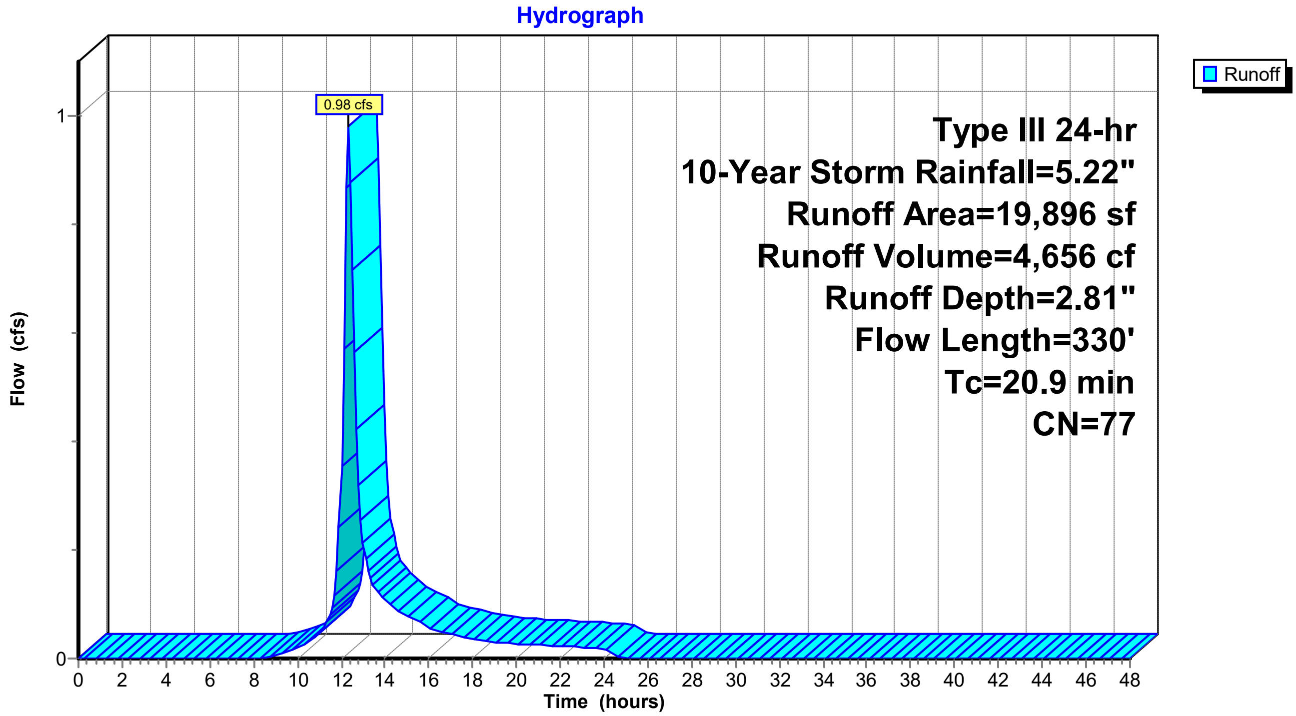
Runoff = 0.98 cfs @ 12.30 hrs, Volume= 4,656 cf, Depth= 2.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Storm Rainfall=5.22"

Area (sf)	CN	Description
11,076	61	>75% Grass cover, Good, HSG B
8,820	98	Paved parking, HSG B
19,896	77	Weighted Average
11,076		55.67% Pervious Area
8,820		44.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	70	0.0071	0.11		**Sheet Flow, A1 to A2**
					Grass: Short n= 0.150 P2= 3.30"
8.1	54	0.0090	0.11		**Sheet Flow, A2 to A3**
					Grass: Short n= 0.150 P2= 3.30"
1.2	62	0.0160	0.89		**Shallow Concentrated Flow, A3 to A4**
					Short Grass Pasture Kv= 7.0 fps
0.2	38	0.0100	4.09	1.43	**Pipe Channel, A4 to A5**
					8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17'
					n= 0.011 Concrete pipe, straight & clean
0.4	106	0.0100	4.09	1.43	**Pipe Channel, A5 to smaller infiltration system**
					8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17'
					n= 0.011 Concrete pipe, straight & clean
20.9	330	Total			

Subcatchment P2: Prop. Watershed P2

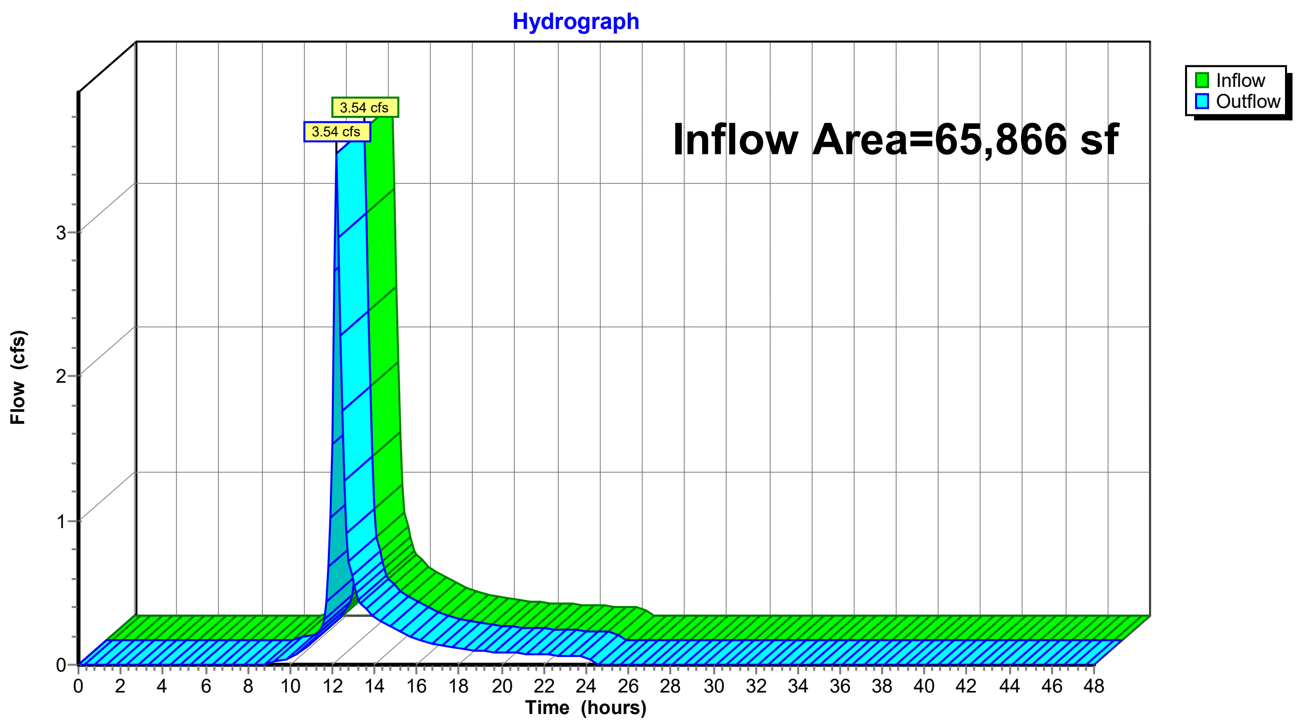


Summary for Reach E-1R: Exist. Reach 1R (South Main Street)

Inflow Area = 65,866 sf, 37.38% Impervious, Inflow Depth = 2.63" for 10-Year Storm event
Inflow = 3.54 cfs @ 12.21 hrs, Volume= 14,429 cf
Outflow = 3.54 cfs @ 12.21 hrs, Volume= 14,429 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach E-1R: Exist. Reach 1R (South Main Street)

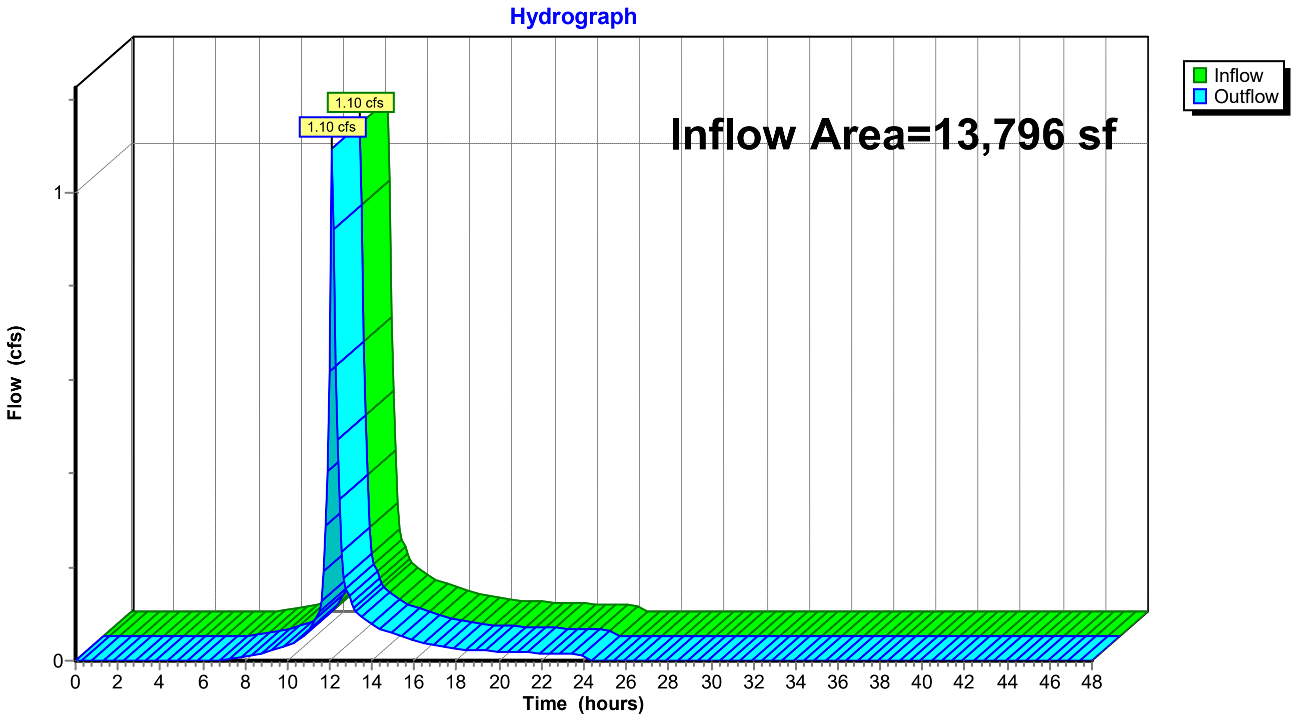


Summary for Reach E-2R: Exist. Reach 2R (Boston Street)

Inflow Area =	13,796 sf, 62.04% Impervious,	Inflow Depth = 3.47"	for 10-Year Storm event	
Inflow =	1.10 cfs @ 12.12 hrs,	Volume=	3,992 cf	
Outflow =	1.10 cfs @ 12.12 hrs,	Volume=	3,992 cf,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach E-2R: Exist. Reach 2R (Boston Street)

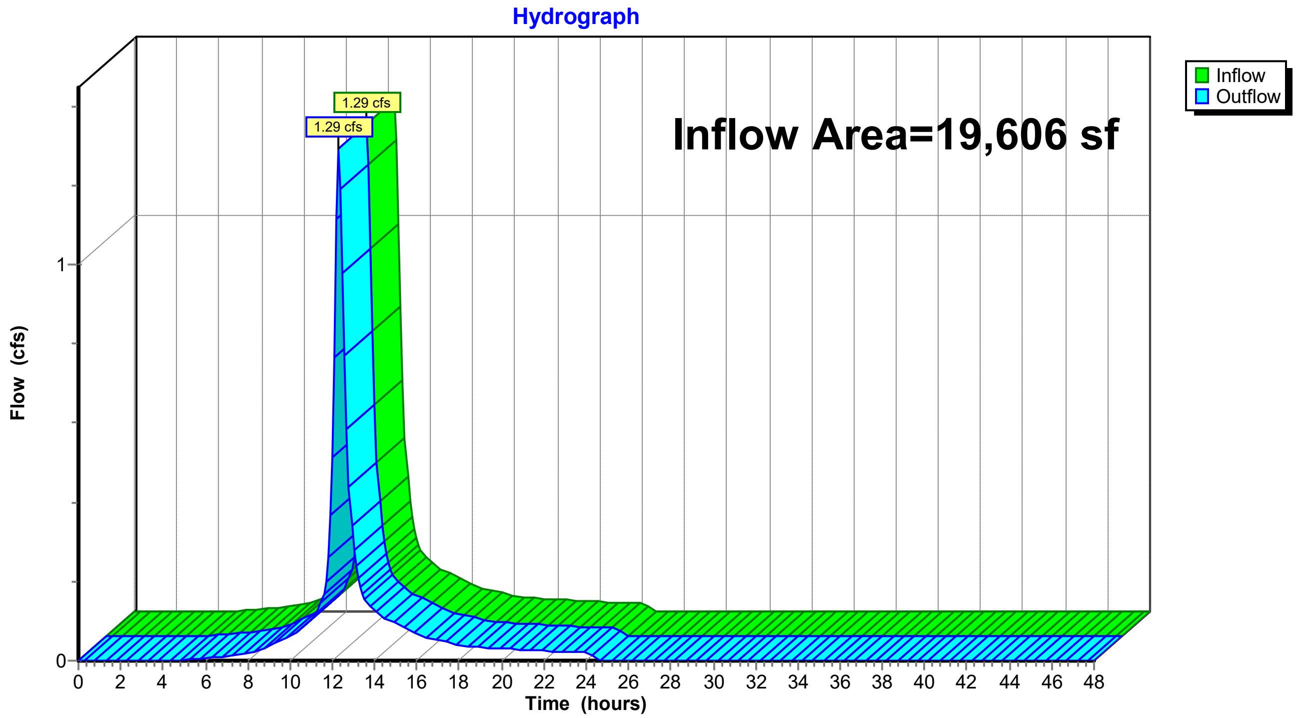


Summary for Reach E-3R: Exist. Reach 3R (Rowell Lane)

Inflow Area =	19,606 sf,	75.77% Impervious,	Inflow Depth = 3.98"	for 10-Year Storm event
Inflow =	1.29 cfs @	12.31 hrs, Volume=	6,507 cf	
Outflow =	1.29 cfs @	12.31 hrs, Volume=	6,507 cf,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach E-3R: Exist. Reach 3R (Rowell Lane)

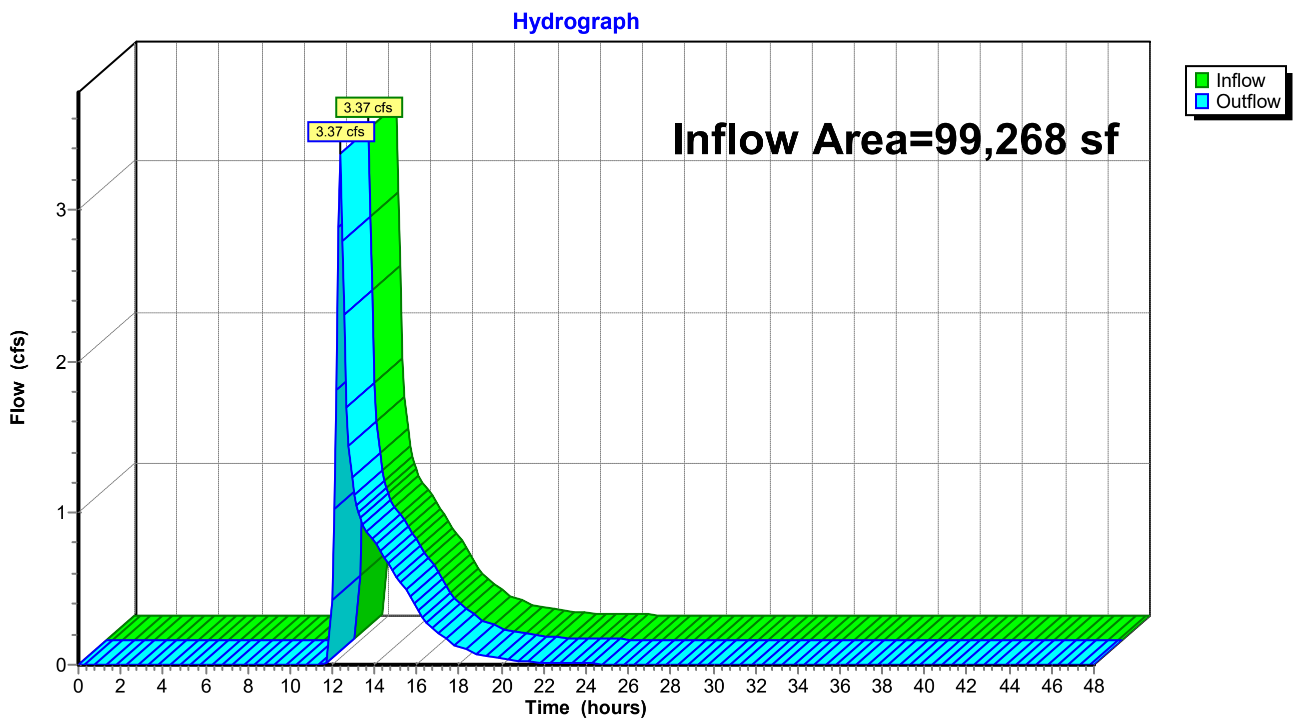


Summary for Reach P-1R: Prop. Reach 1R (South Main Street Drain)

Inflow Area = 99,268 sf, 66.08% Impervious, Inflow Depth = 2.06" for 10-Year Storm event
Inflow = 3.37 cfs @ 12.40 hrs, Volume= 17,004 cf
Outflow = 3.37 cfs @ 12.40 hrs, Volume= 17,004 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach P-1R: Prop. Reach 1R (South Main Street Drain)



Summary for Pond 1P: Infiltration SC-740 (16 x 12 SC-740)

Inflow Area = 79,372 sf, 71.53% Impervious, Inflow Depth = 3.77" for 10-Year Storm event
Inflow = 7.38 cfs @ 12.10 hrs, Volume= 24,969 cf
Outflow = 2.57 cfs @ 12.41 hrs, Volume= 24,995 cf, Atten= 65%, Lag= 18.8 min
Discarded = 0.16 cfs @ 10.20 hrs, Volume= 11,838 cf
Primary = 2.41 cfs @ 12.41 hrs, Volume= 13,157 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Peak Elev= 103.00' @ 12.41 hrs Surf.Area= 6,902 sf Storage= 9,679 cf

Plug-Flow detention time= 150.9 min calculated for 24,943 cf (100% of inflow)
Center-of-Mass det. time= 151.7 min (951.4 - 799.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	101.00'	6,134 cf	**77.50'W x 89.06'L x 3.50'H Field A** 24,157 cf Overall - 8,820 cf Embedded = 15,336 cf x 40.0% Voids
#2A	101.50'	8,820 cf	**ADS_StormTech SC-740 +Cap** x 192 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 192 Chambers in 16 Rows
#3	101.50'	283 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder** x 5 -Impervious
		15,238 cf	Total Available Storage

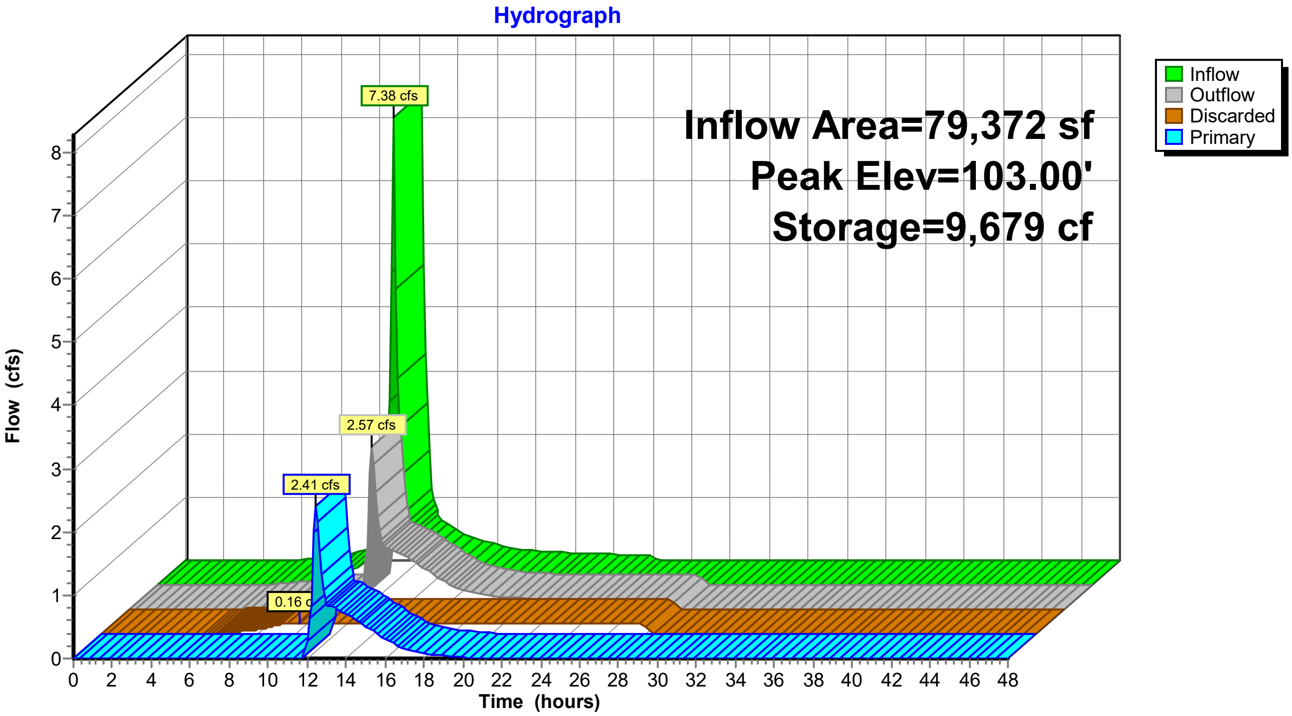
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	101.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	97.75'	**12.0" Round Culvert - 189.0 ft** L= 189.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 97.75' / 96.75' S= 0.0053 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	99.00'	**12.0" Round Culvert - 88.5** L= 119.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 99.00' / 97.75' S= 0.0105 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#4	Device 3	102.80'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#5	Device 3	101.75'	**6.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.16 cfs @ 10.20 hrs HW=101.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=2.37 cfs @ 12.41 hrs HW=103.00' TW=98.77' (Dynamic Tailwater)
└─**2=Culvert - 189.0 ft** (Passes 2.37 cfs of 5.41 cfs potential flow)
  └─**3=Culvert - 88.5** (Passes 2.37 cfs of 6.34 cfs potential flow)
    ├─**4=Sharp-Crested Rectangular Weir** (Weir Controls 1.43 cfs @ 1.46 fps)
    └─**5=Orifice/Grate** (Orifice Controls 0.94 cfs @ 4.81 fps)

Pond 1P: Infiltration SC-740 (16 x 12 SC-740)



Summary for Pond 2P: Infiltration SC-740 (6x1 SC-740)

Inflow Area = 19,896 sf, 44.33% Impervious, Inflow Depth = 2.81" for 10-Year Storm event
Inflow = 0.98 cfs @ 12.30 hrs, Volume= 4,656 cf
Outflow = 0.98 cfs @ 12.20 hrs, Volume= 4,656 cf, Atten= 1%, Lag= 0.0 min
Discarded = 0.01 cfs @ 9.70 hrs, Volume= 810 cf
Primary = 0.97 cfs @ 12.20 hrs, Volume= 3,847 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Peak Elev= 104.01' @ 12.20 hrs Surf.Area= 290 sf Storage= 546 cf

Plug-Flow detention time= 120.5 min calculated for 4,647 cf (100% of inflow)
Center-of-Mass det. time= 122.5 min (964.0 - 841.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	101.00'	295 cf	**6.25'W x 46.34'L x 3.50'H Field A** 1,014 cf Overall - 276 cf Embedded = 738 cf x 40.0% Voids
#2A	101.50'	276 cf	**ADS_StormTech SC-740 +Cap** x 6 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
#3	101.50'	57 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder** -Impervious
		627 cf	Total Available Storage

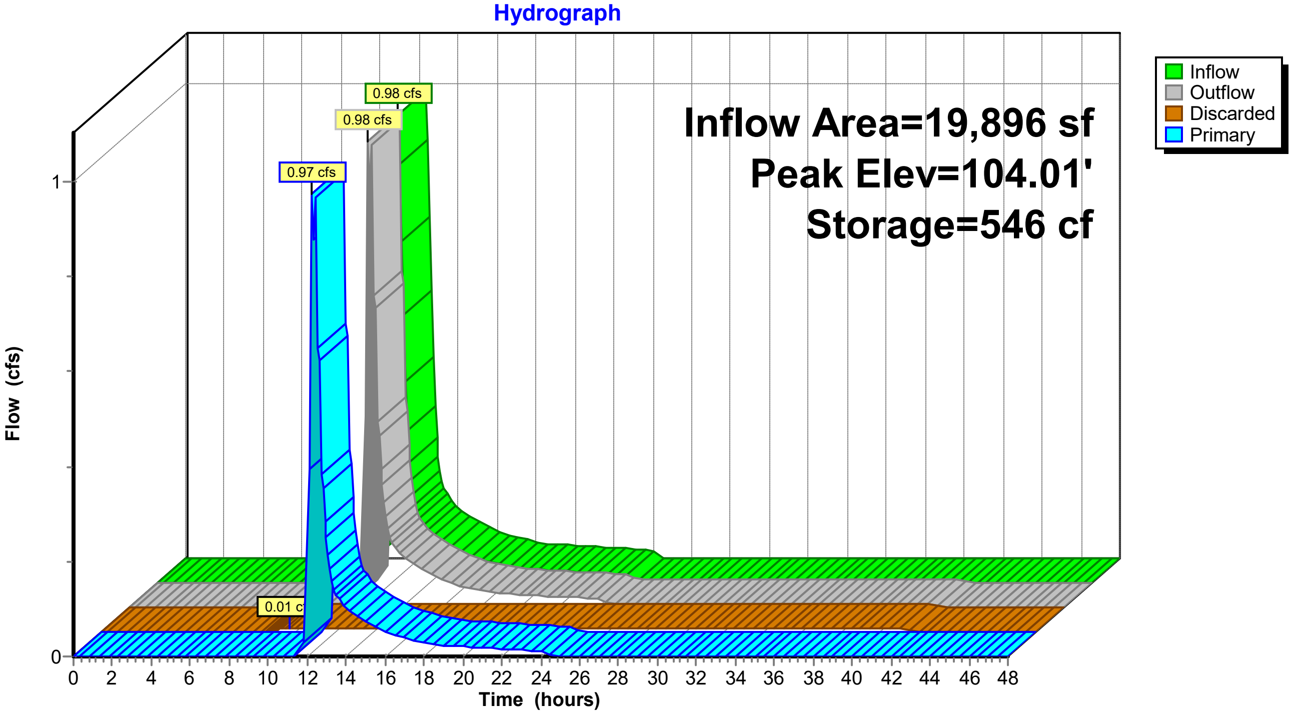
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	101.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	97.75'	**12.0" Round Culvert - 50 ft** L= 60.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 97.75' / 97.15' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	100.00'	**12.0" Round Culvert - 134 ft** L= 134.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 100.00' / 97.75' S= 0.0168 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#4	Device 3	103.90'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#5	Device 3	103.20'	**4.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.01 cfs @ 9.70 hrs HW=101.07' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.97 cfs @ 12.20 hrs HW=104.01' TW=98.24' (Dynamic Tailwater)
└─**2=Culvert - 50 ft** (Passes 0.97 cfs of 8.98 cfs potential flow)
  └─**3=Culvert - 134 ft** (Passes 0.97 cfs of 6.81 cfs potential flow)
    ├─**4=Sharp-Crested Rectangular Weir** (Weir Controls 0.63 cfs @ 1.11 fps)
    └─**5=Orifice/Grate** (Orifice Controls 0.34 cfs @ 3.88 fps)

Pond 2P: Infiltration SC-740 (6x1 SC-740)



Summary for Pond 3P: Utility Easement Pipes

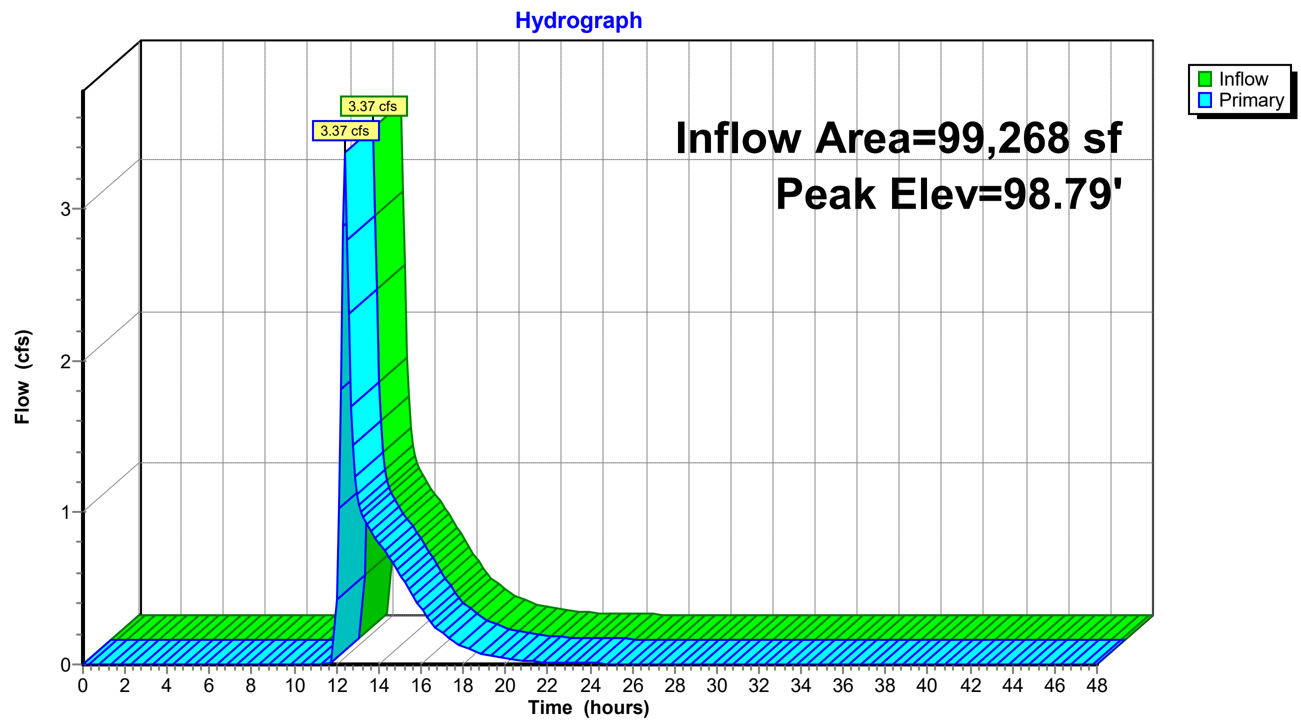
Inflow Area =	99,268 sf, 66.08% Impervious,	Inflow Depth = 2.06"	for 10-Year Storm event	
Inflow =	3.37 cfs @	12.40 hrs, Volume=	17,004 cf	
Outflow =	3.37 cfs @	12.40 hrs, Volume=	17,004 cf,	Atten= 0%, Lag= 0.0 min
Primary =	3.37 cfs @	12.40 hrs, Volume=	17,004 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Peak Elev= 98.79' @ 12.40 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	94.60'	**12.0" Round Culvert from Contour 99 to 98** L= 40.5' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 94.60' / 94.00' S= 0.0148 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#2	Device 1	97.50'	**12.0" Round Culvert from Convergence to Contour 99** L= 142.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 97.50' / 94.60' S= 0.0204 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=3.35 cfs @ 12.40 hrs HW=98.78' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert from Contour 99 to 98** (Passes 3.35 cfs of 7.26 cfs potential flow)
 └─**2=Culvert from Convergence to Contour 99** (Inlet Controls 3.35 cfs @ 4.26 fps)

Pond 3P: Utility Easement Pipes



Summary for Subcatchment E1: Exist. Watershed E1

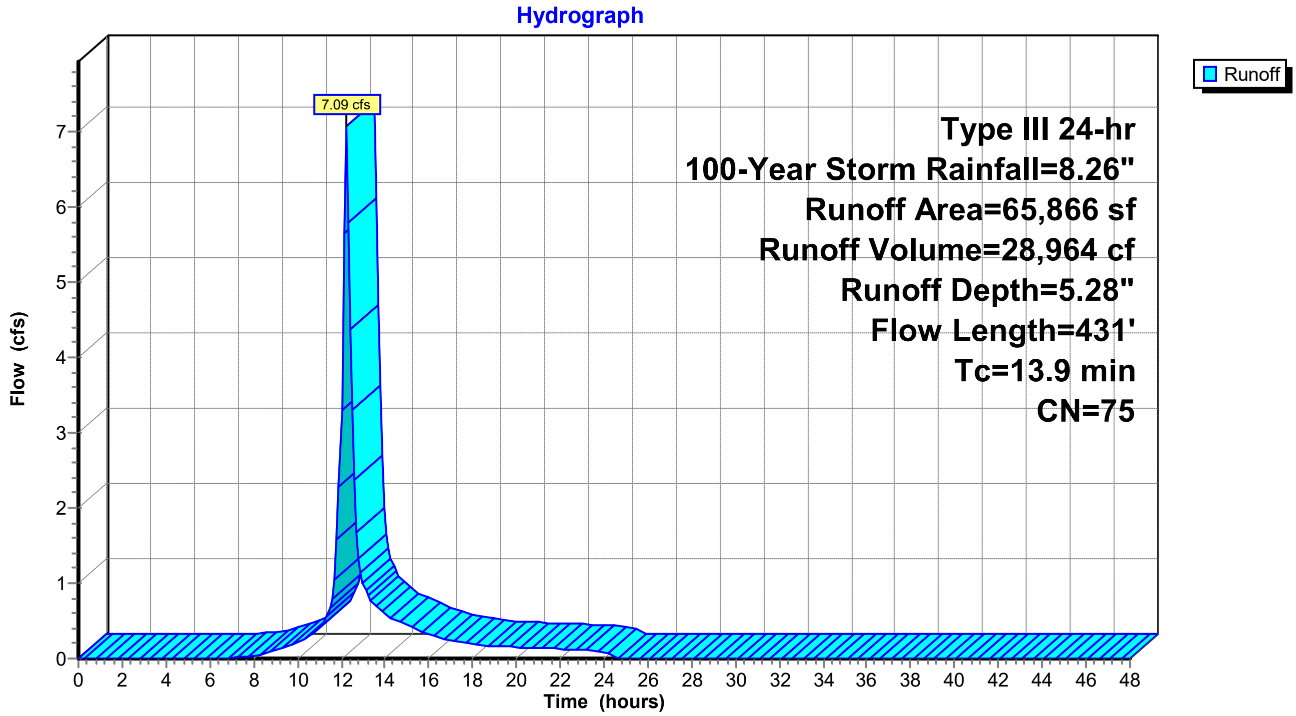
Runoff = 7.09 cfs @ 12.20 hrs, Volume= 28,964 cf, Depth= 5.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Storm Rainfall=8.26"

	Area (sf)	CN	Description
*	24,622	98	Impervious (Roof, drives, walks, walls, pads)
	41,244	61	>75% Grass cover, Good, HSG B
	65,866	75	Weighted Average
	41,244		62.62% Pervious Area
	24,622		37.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	22	0.0200	1.03		**Sheet Flow, 1A to 1B** Smooth surfaces n= 0.011 P2= 3.30"
0.1	4	0.0270	0.83		**Sheet Flow, 1B to 1C** Smooth surfaces n= 0.011 P2= 3.30"
2.1	16	0.0220	0.12		**Sheet Flow, 1C to 1D** Grass: Short n= 0.150 P2= 3.30"
0.5	29	0.0190	1.07		**Sheet Flow, 1D to 1E** Smooth surfaces n= 0.011 P2= 3.30"
0.5	16	0.0050	0.56		**Sheet Flow, 1E to 1F** Smooth surfaces n= 0.011 P2= 3.30"
4.5	19	0.0350	0.07		**Sheet Flow, 1F to 1G** Woods: Light underbrush n= 0.400 P2= 3.30"
1.8	13	0.0210	0.12		**Sheet Flow, 1G to 1H** Grass: Short n= 0.150 P2= 3.30"
0.3	25	0.0400	1.40		**Shallow Concentrated Flow, 1H to 1I** Short Grass Pasture Kv= 7.0 fps
0.3	25	0.0398	1.40		**Shallow Concentrated Flow, 1I to 1J** Short Grass Pasture Kv= 7.0 fps
1.1	41	0.0073	0.60		**Shallow Concentrated Flow, 1J to 1K** Short Grass Pasture Kv= 7.0 fps
0.6	46	0.0073	1.38		**Shallow Concentrated Flow, 1K to 1L** Unpaved Kv= 16.1 fps
0.6	49	0.0073	1.38		**Shallow Concentrated Flow, 1L to 1M** Unpaved Kv= 16.1 fps
0.1	14	0.0787	4.52		**Shallow Concentrated Flow, 1M to 1N** Unpaved Kv= 16.1 fps
0.3	43	0.0254	2.57		**Shallow Concentrated Flow, 1N to 1O** Unpaved Kv= 16.1 fps
0.5	29	0.0374	0.97		**Shallow Concentrated Flow, 1O to 1P** Woodland Kv= 5.0 fps
0.2	40	0.0185	2.76		**Shallow Concentrated Flow, 1P to 1Q** Paved Kv= 20.3 fps
13.9	431	Total			

Subcatchment E1: Exist. Watershed E1



Summary for Subcatchment E2: Exist. Watershed E2

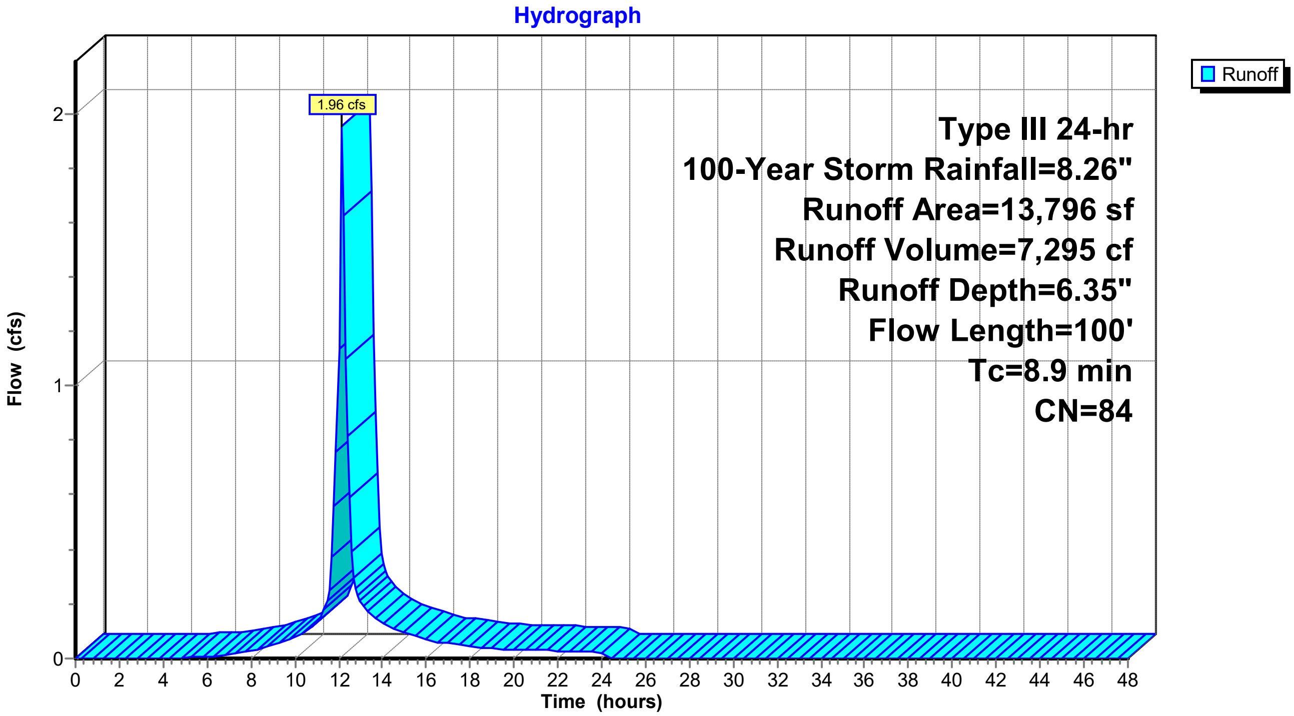
Runoff = 1.96 cfs @ 12.12 hrs, Volume= 7,295 cf, Depth= 6.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Storm Rainfall=8.26"

	Area (sf)	CN	Description
*	8,559	98	Impervious (Roof, drives, walks, walls, pads)
	5,237	61	>75% Grass cover, Good, HSG B
	13,796	84	Weighted Average
	5,237		37.96% Pervious Area
	8,559		62.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	17	0.0440	1.34		**Sheet Flow, 2A to 2B** Smooth surfaces n= 0.011 P2= 3.30"
0.0	3	0.0590	1.07		**Sheet Flow, 2B to 2C** Smooth surfaces n= 0.011 P2= 3.30"
2.8	27	0.0310	0.16		**Sheet Flow, 2C to 2D** Grass: Short n= 0.150 P2= 3.30"
2.0	21	0.0470	0.18		**Sheet Flow, 2D to 2E** Grass: Short n= 0.150 P2= 3.30"
2.1	16	0.0240	0.13		**Sheet Flow, 2E to 2F** Grass: Short n= 0.150 P2= 3.30"
1.8	16	0.0322	0.14		**Sheet Flow, 2F to 2G** Grass: Short n= 0.150 P2= 3.30"
8.9	100	Total			

Subcatchment E2: Exist. Watershed E2



Summary for Subcatchment E3: Exist. Watershed E3

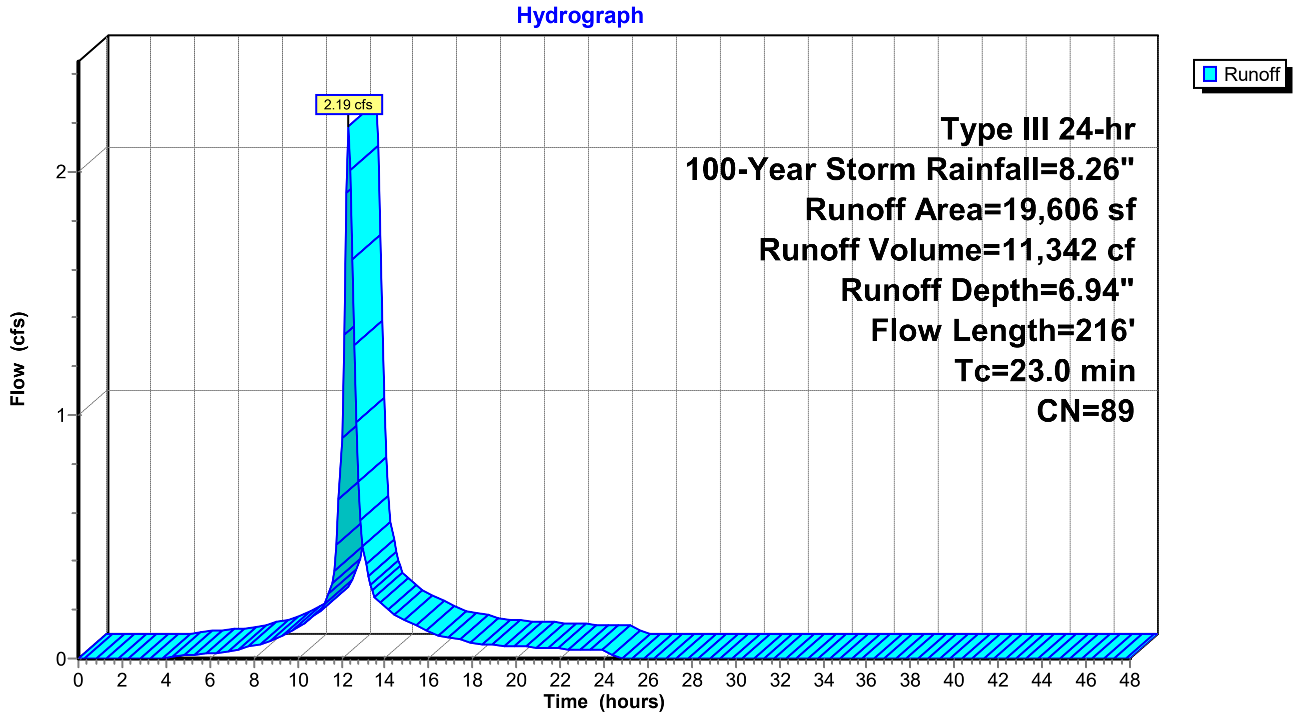
Runoff = 2.19 cfs @ 12.31 hrs, Volume= 11,342 cf, Depth= 6.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Storm Rainfall=8.26"

	Area (sf)	CN	Description
*	14,856	98	Impervious (Roof, drives, walks, walls, pads)
	4,750	61	>75% Grass cover, Good, HSG B
	19,606	89	Weighted Average
	4,750		24.23% Pervious Area
	14,856		75.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.4	32	0.0150	0.12		**Sheet Flow, 3A to 3B** Grass: Short n= 0.150 P2= 3.30"
3.9	31	0.0180	0.13		**Sheet Flow, 3B to 3C** Grass: Short n= 0.150 P2= 3.30"
11.5	18	0.0030	0.03		**Sheet Flow, 3C to 3D** Woods: Light underbrush n= 0.400 P2= 3.30"
0.6	34	0.0120	0.92		**Sheet Flow, 3D to 3E** Smooth surfaces n= 0.011 P2= 3.30"
0.4	38	0.0053	1.48		**Shallow Concentrated Flow, 3E to 3F** Paved Kv= 20.3 fps
0.3	26	0.0038	1.25		**Shallow Concentrated Flow, 3F to 3G** Paved Kv= 20.3 fps
1.9	37	0.0022	0.33		**Shallow Concentrated Flow, 3G to 3H** Short Grass Pasture Kv= 7.0 fps
23.0	216	Total			

Subcatchment E3: Exist. Watershed E3



Summary for Subcatchment P1: Prop. Watershed P1

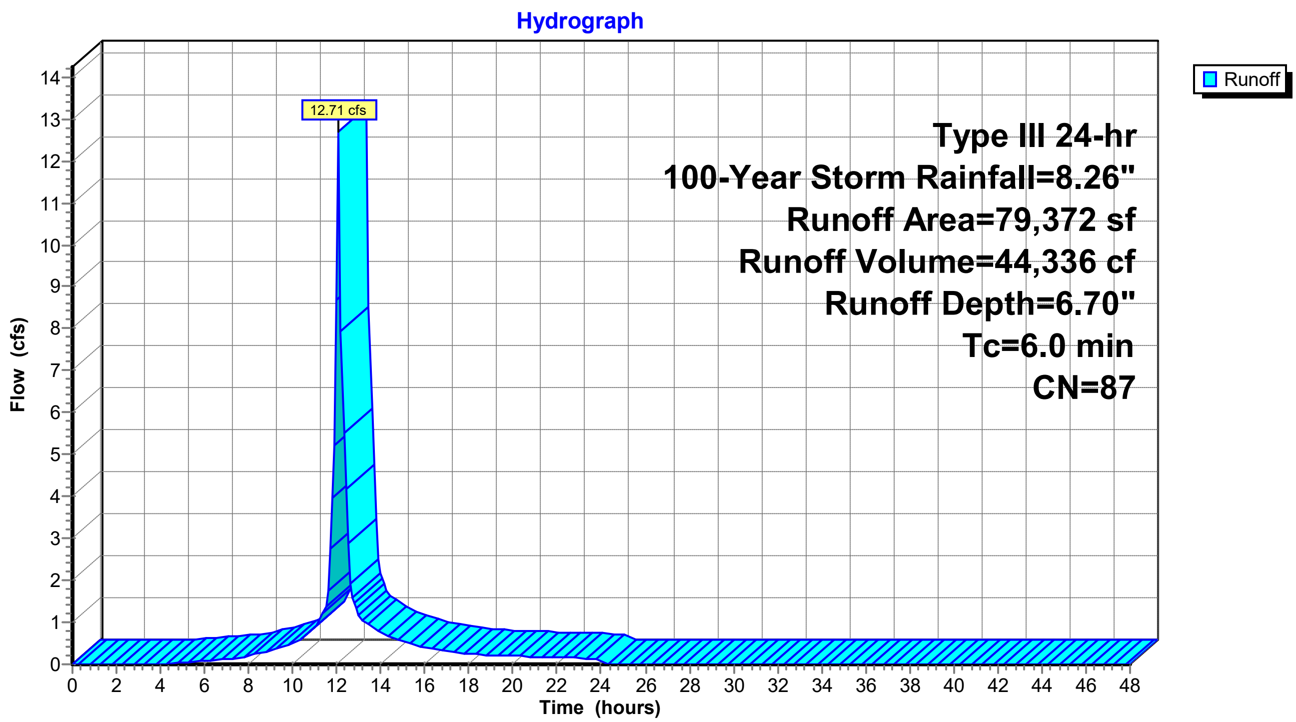
Runoff = 12.71 cfs @ 12.10 hrs, Volume= 44,336 cf, Depth= 6.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Storm Rainfall=8.26"

	Area (sf)	CN	Description
*	56,777	98	Impervious (Roof, drives, walks, walls, pads)
	22,595	61	>75% Grass cover, Good, HSG B
	79,372	87	Weighted Average
	22,595		28.47% Pervious Area
	56,777		71.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TC for Proposed Watershed 3**

Subcatchment P1: Prop. Watershed P1



Summary for Subcatchment P2: Prop. Watershed P2

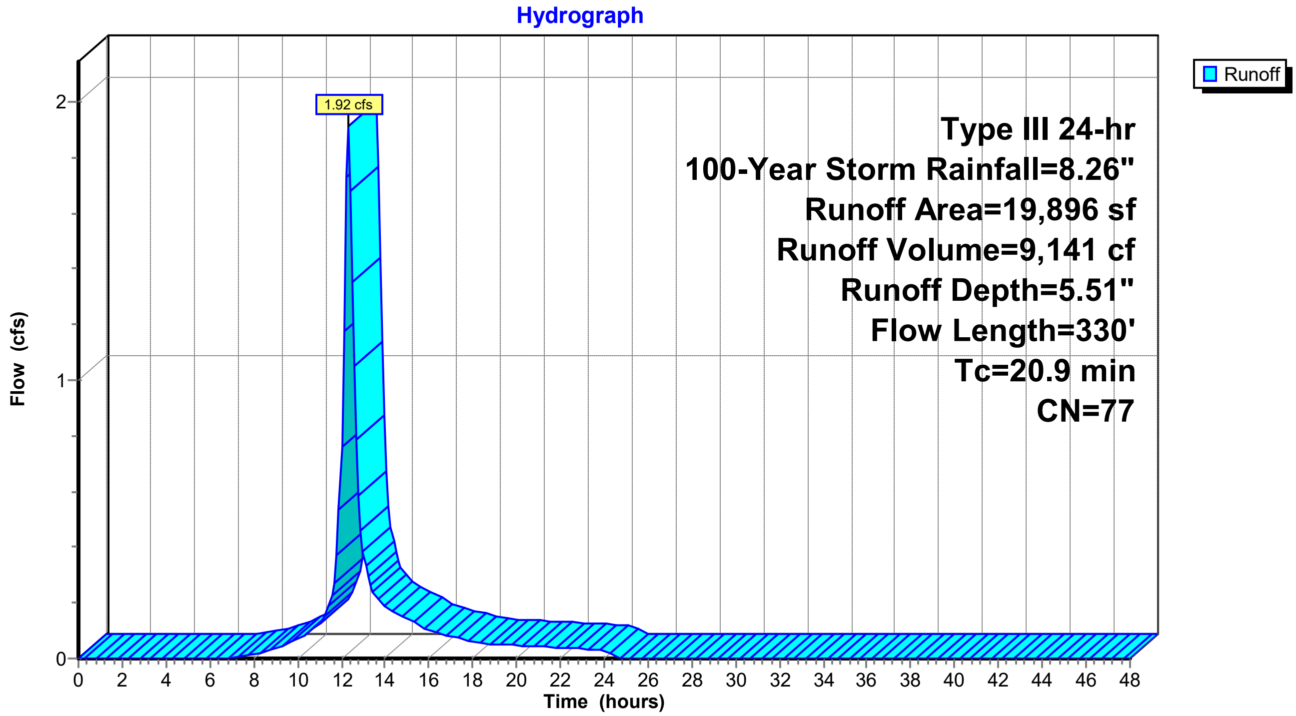
Runoff = 1.92 cfs @ 12.29 hrs, Volume= 9,141 cf, Depth= 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Storm Rainfall=8.26"

Area (sf)	CN	Description
11,076	61	>75% Grass cover, Good, HSG B
8,820	98	Paved parking, HSG B
19,896	77	Weighted Average
11,076		55.67% Pervious Area
8,820		44.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	70	0.0071	0.11		**Sheet Flow, A1 to A2** Grass: Short n= 0.150 P2= 3.30"
8.1	54	0.0090	0.11		**Sheet Flow, A2 to A3** Grass: Short n= 0.150 P2= 3.30"
1.2	62	0.0160	0.89		**Shallow Concentrated Flow, A3 to A4** Short Grass Pasture Kv= 7.0 fps
0.2	38	0.0100	4.09	1.43	**Pipe Channel, A4 to A5** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 Concrete pipe, straight & clean
0.4	106	0.0100	4.09	1.43	**Pipe Channel, A5 to smaller infiltration system** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 Concrete pipe, straight & clean
20.9	330	Total			

Subcatchment P2: Prop. Watershed P2

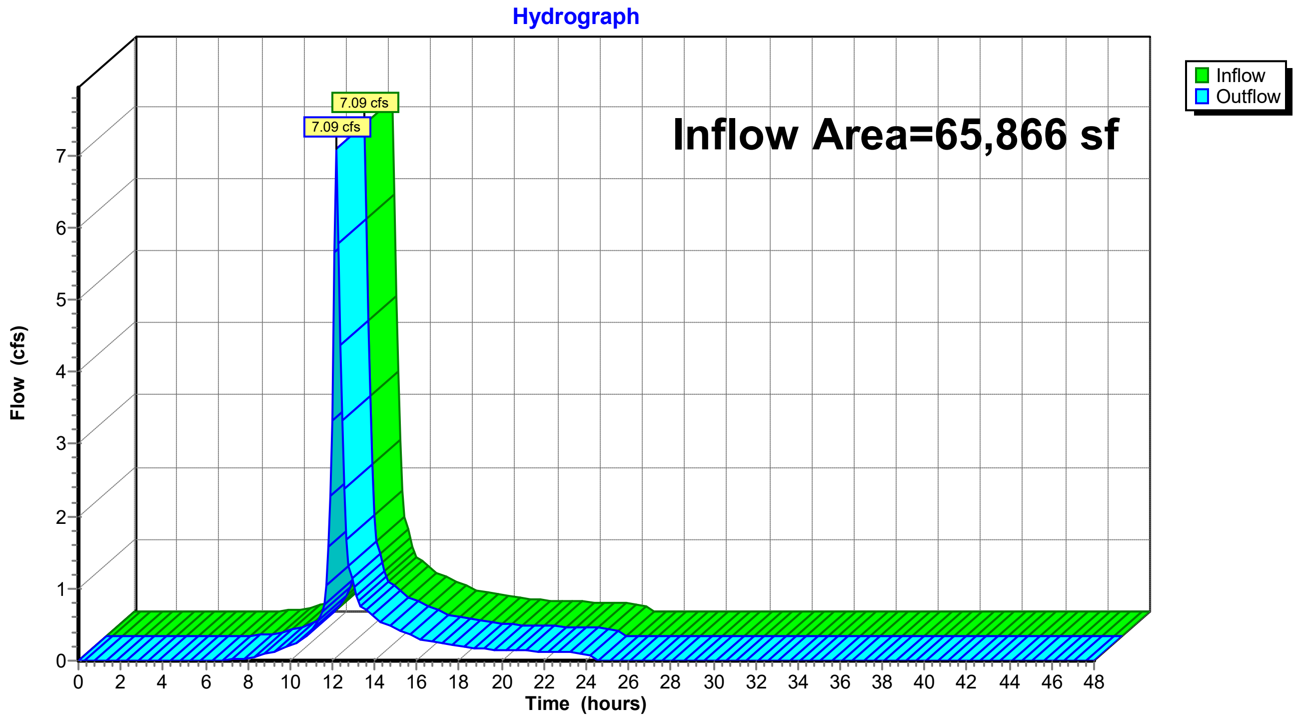


Summary for Reach E-1R: Exist. Reach 1R (South Main Street)

Inflow Area =	65,866 sf,	37.38% Impervious,	Inflow Depth = 5.28"	for 100-Year Storm event
Inflow =	7.09 cfs @	12.20 hrs, Volume=	28,964 cf	
Outflow =	7.09 cfs @	12.20 hrs, Volume=	28,964 cf, Atten= 0%, Lag= 0.0 min	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach E-1R: Exist. Reach 1R (South Main Street)

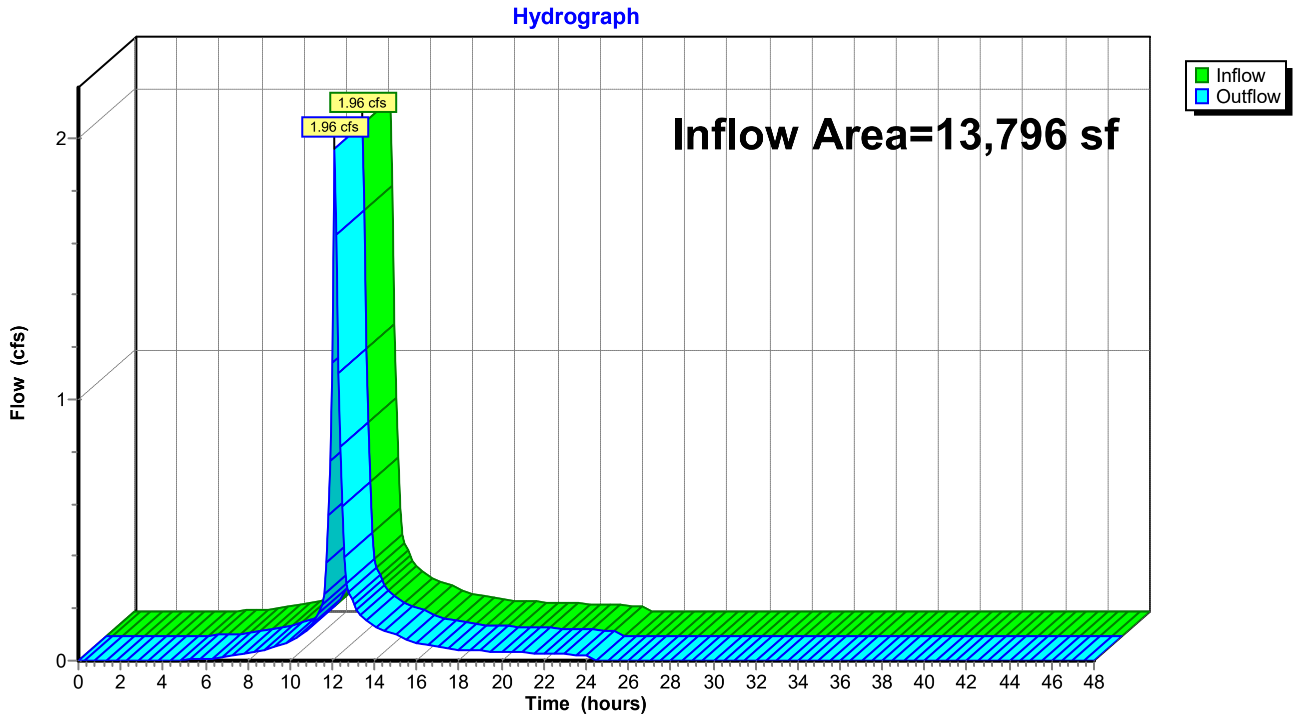


Summary for Reach E-2R: Exist. Reach 2R (Boston Street)

Inflow Area = 13,796 sf, 62.04% Impervious, Inflow Depth = 6.35" for 100-Year Storm event
Inflow = 1.96 cfs @ 12.12 hrs, Volume= 7,295 cf
Outflow = 1.96 cfs @ 12.12 hrs, Volume= 7,295 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach E-2R: Exist. Reach 2R (Boston Street)

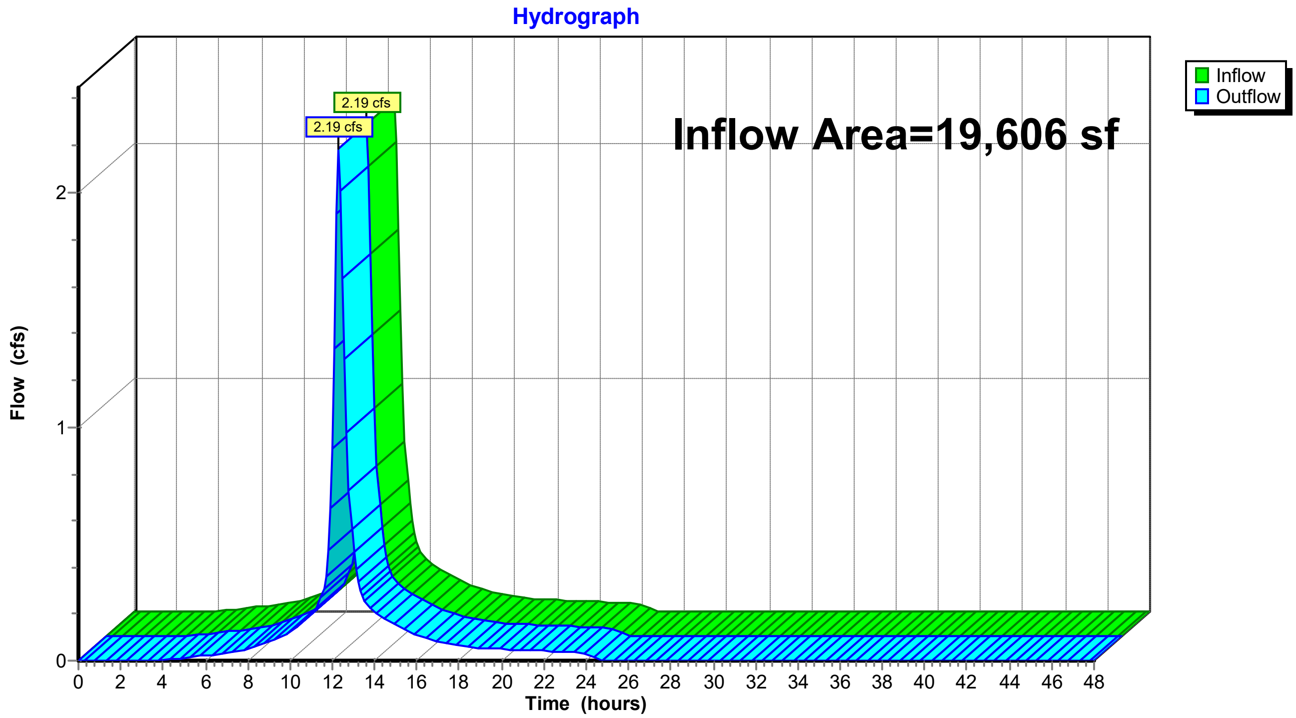


Summary for Reach E-3R: Exist. Reach 3R (Rowell Lane)

Inflow Area = 19,606 sf, 75.77% Impervious, Inflow Depth = 6.94" for 100-Year Storm event
Inflow = 2.19 cfs @ 12.31 hrs, Volume= 11,342 cf
Outflow = 2.19 cfs @ 12.31 hrs, Volume= 11,342 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach E-3R: Exist. Reach 3R (Rowell Lane)

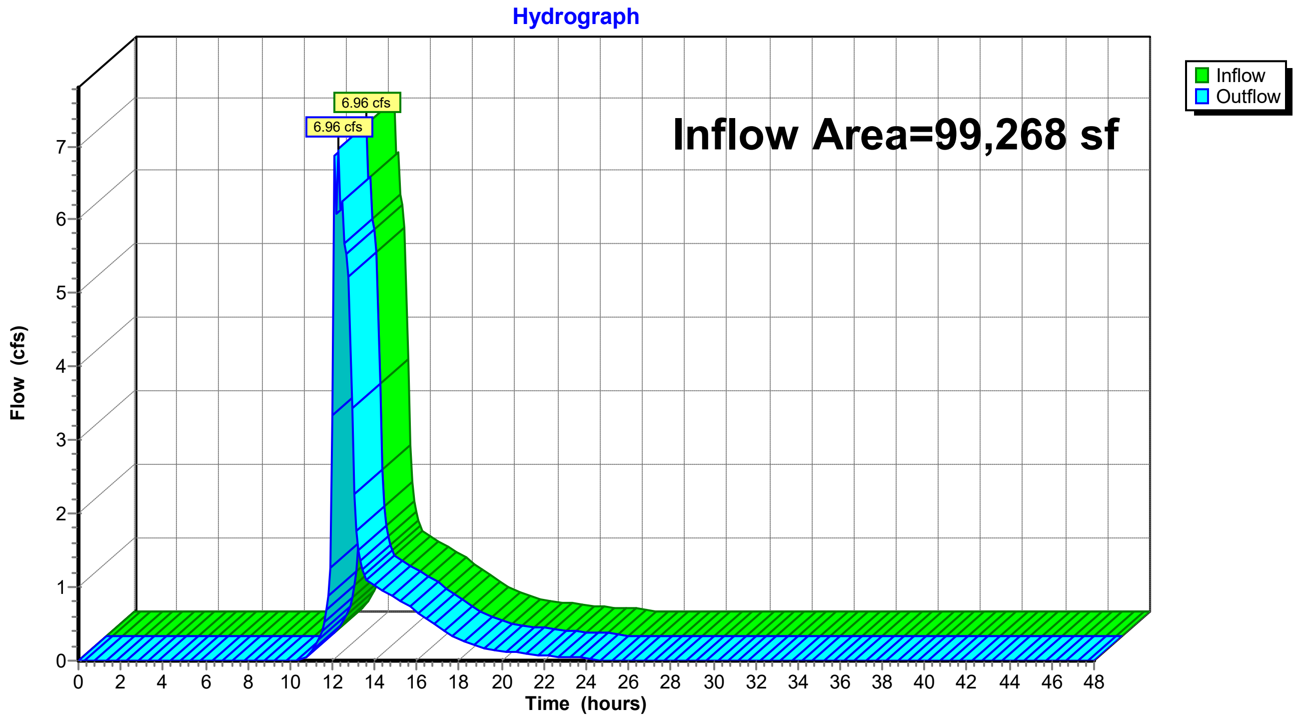


Summary for Reach P-1R: Prop. Reach 1R (South Main Street Drain)

Inflow Area = 99,268 sf, 66.08% Impervious, Inflow Depth = 4.69" for 100-Year Storm event
Inflow = 6.96 cfs @ 12.30 hrs, Volume= 38,805 cf
Outflow = 6.96 cfs @ 12.30 hrs, Volume= 38,805 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs

Reach P-1R: Prop. Reach 1R (South Main Street Drain)



Summary for Pond 1P: Infiltration SC-740 (16 x 12 SC-740)

Inflow Area =	79,372 sf, 71.53% Impervious,	Inflow Depth = 6.70"	for 100-Year Storm event	
Inflow =	12.71 cfs @	12.10 hrs, Volume=	44,336 cf	
Outflow =	5.97 cfs @	12.12 hrs, Volume=	44,353 cf,	Atten= 53%, Lag= 1.5 min
Discarded =	0.16 cfs @	8.60 hrs, Volume=	13,830 cf	
Primary =	5.81 cfs @	12.12 hrs, Volume=	30,523 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Peak Elev= 104.32' @ 12.35 hrs Surf.Area= 6,902 sf Storage= 14,628 cf

Plug-Flow detention time= 116.5 min calculated for 44,260 cf (100% of inflow)
Center-of-Mass det. time= 117.2 min (901.1 - 784.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	101.00'	6,134 cf	**77.50'W x 89.06'L x 3.50'H Field A** 24,157 cf Overall - 8,820 cf Embedded = 15,336 cf x 40.0% Voids
#2A	101.50'	8,820 cf	**ADS_StormTech SC-740 +Cap** x 192 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 192 Chambers in 16 Rows
#3	101.50'	283 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder** x 5 -Impervious
		15,238 cf	Total Available Storage

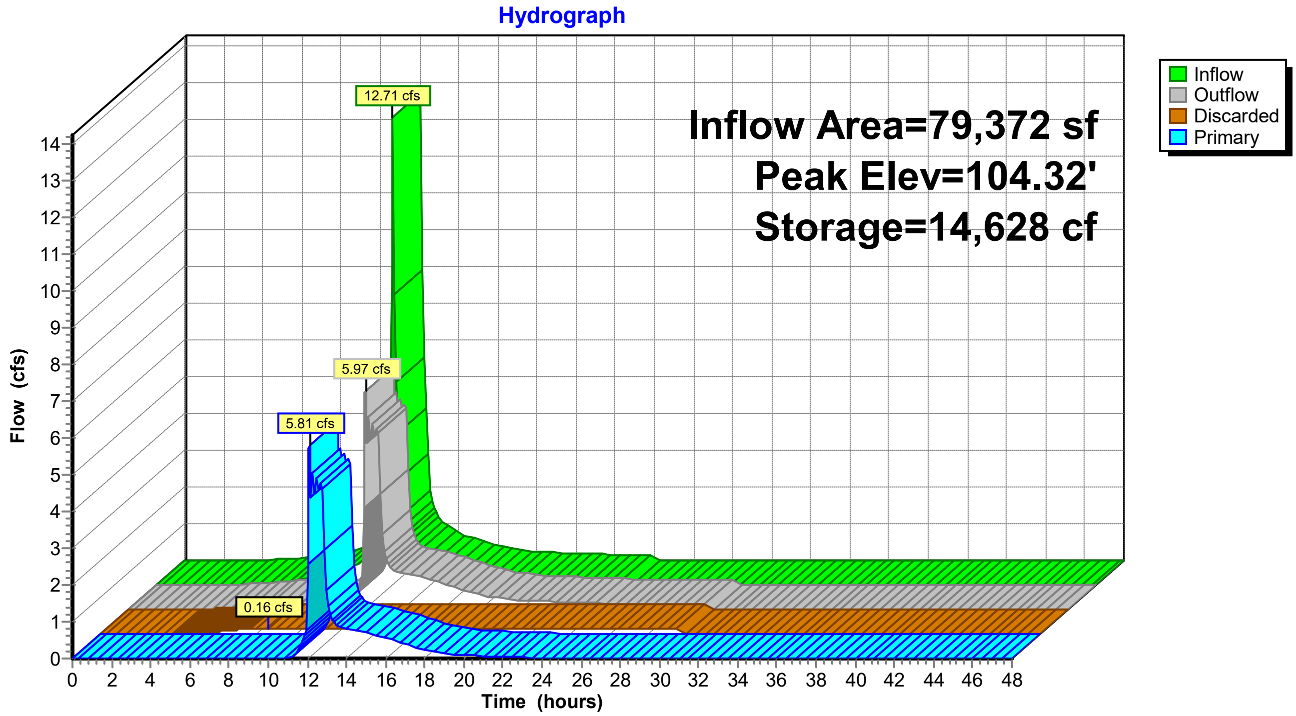
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	101.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	97.75'	**12.0" Round Culvert - 189.0 ft** L= 189.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 97.75' / 96.75' S= 0.0053 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	99.00'	**12.0" Round Culvert - 88.5** L= 119.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 99.00' / 97.75' S= 0.0105 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#4	Device 3	102.80'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#5	Device 3	101.75'	**6.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.16 cfs @ 8.60 hrs HW=101.06' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=4.13 cfs @ 12.12 hrs HW=103.62' TW=101.15' (Dynamic Tailwater)
└─**2=Culvert - 189.0 ft** (Outlet Controls 4.13 cfs @ 5.26 fps)
  └─**3=Culvert - 88.5** (Passes 4.13 cfs of 4.85 cfs potential flow)
    ├─**4=Sharp-Crested Rectangular Weir** (Passes < 11.81 cfs potential flow)
    └─**5=Orifice/Grate** (Passes < 1.20 cfs potential flow)

Pond 1P: Infiltration SC-740 (16 x 12 SC-740)



Summary for Pond 2P: Infiltration SC-740 (6x1 SC-740)

Inflow Area = 19,896 sf, 44.33% Impervious, Inflow Depth = 5.51" for 100-Year Storm event
Inflow = 1.92 cfs @ 12.29 hrs, Volume= 9,141 cf
Outflow = 1.91 cfs @ 12.30 hrs, Volume= 9,142 cf, Atten= 0%, Lag= 0.2 min
Discarded = 0.01 cfs @ 7.90 hrs, Volume= 860 cf
Primary = 1.91 cfs @ 12.30 hrs, Volume= 8,282 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Peak Elev= 104.11' @ 12.30 hrs Surf.Area= 290 sf Storage= 558 cf

Plug-Flow detention time= 66.4 min calculated for 9,123 cf (100% of inflow)
Center-of-Mass det. time= 68.4 min (890.7 - 822.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	101.00'	295 cf	**6.25'W x 46.34'L x 3.50'H Field A** 1,014 cf Overall - 276 cf Embedded = 738 cf x 40.0% Voids
#2A	101.50'	276 cf	**ADS_StormTech SC-740 +Cap** x 6 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
#3	101.50'	57 cf	**4.00'D x 4.50'H Vertical Cone/Cylinder** -Impervious
		627 cf	Total Available Storage

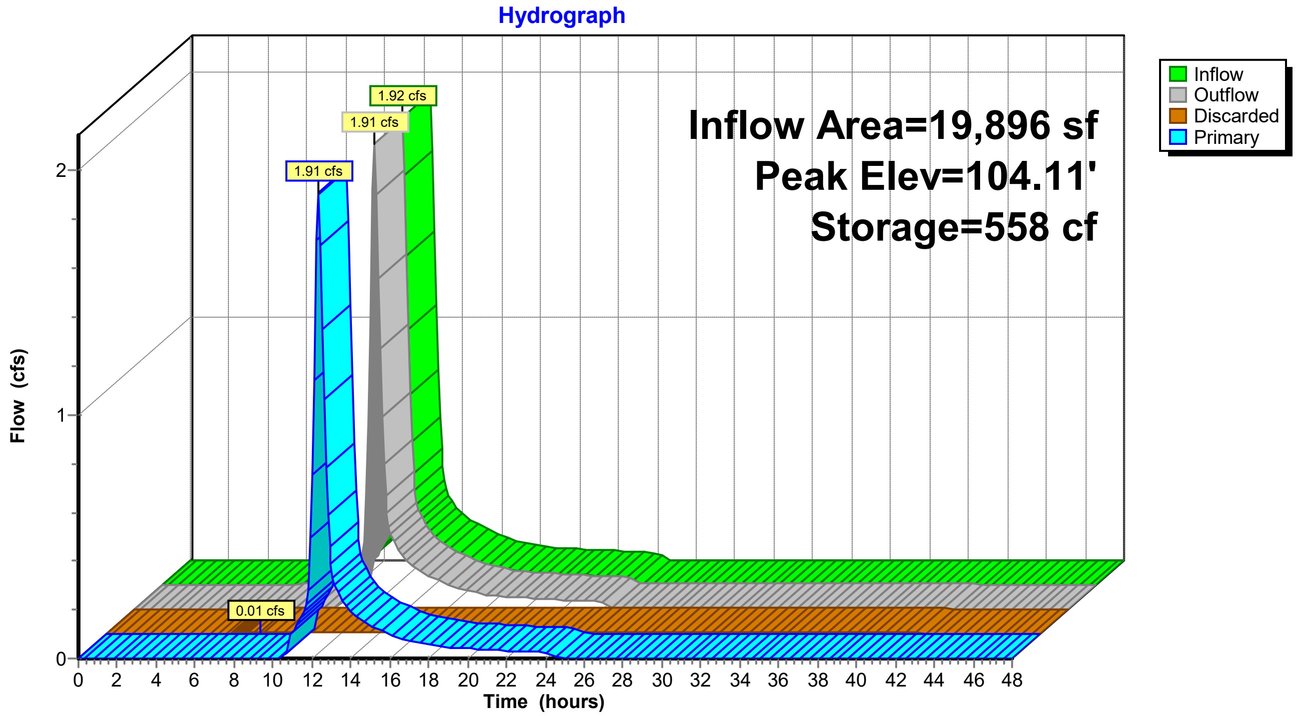
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	101.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	97.75'	**12.0" Round Culvert - 50 ft** L= 60.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 97.75' / 97.15' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	100.00'	**12.0" Round Culvert - 134 ft** L= 134.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 100.00' / 97.75' S= 0.0168 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#4	Device 3	103.90'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#5	Device 3	103.20'	**4.0" Vert. Orifice/Grate** C= 0.600

Discarded OutFlow Max=0.01 cfs @ 7.90 hrs HW=101.07' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=1.90 cfs @ 12.30 hrs HW=104.11' TW=101.36' (Dynamic Tailwater)
└─**2=Culvert - 50 ft** (Passes 1.90 cfs of 6.19 cfs potential flow)
  └─**3=Culvert - 134 ft** (Passes 1.90 cfs of 4.91 cfs potential flow)
    ├─**4=Sharp-Crested Rectangular Weir** (Weir Controls 1.54 cfs @ 1.49 fps)
    └─**5=Orifice/Grate** (Orifice Controls 0.36 cfs @ 4.15 fps)

Pond 2P: Infiltration SC-740 (6x1 SC-740)



Summary for Pond 3P: Utility Easement Pipes

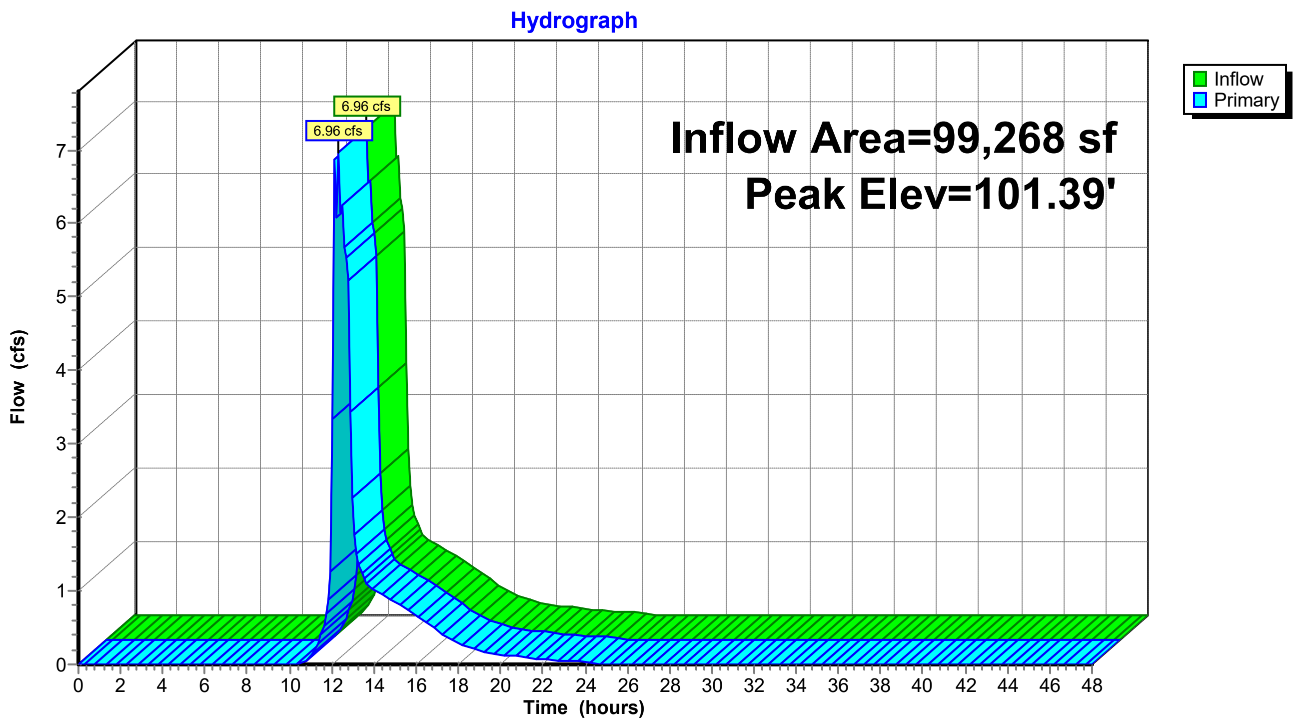
Inflow Area = 99,268 sf, 66.08% Impervious, Inflow Depth = 4.69" for 100-Year Storm event
Inflow = 6.96 cfs @ 12.30 hrs, Volume= 38,805 cf
Outflow = 6.96 cfs @ 12.30 hrs, Volume= 38,805 cf, Atten= 0%, Lag= 0.0 min
Primary = 6.96 cfs @ 12.30 hrs, Volume= 38,805 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.10 hrs
Peak Elev= 101.39' @ 12.30 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	94.60'	**12.0" Round Culvert from Contour 99 to 98** L= 40.5' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 94.60' / 94.00' S= 0.0148 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf
#2	Device 1	97.50'	**12.0" Round Culvert from Convergence to Contour 99** L= 142.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 97.50' / 94.60' S= 0.0204 '/' Cc= 0.900 n= 0.011, Flow Area= 0.79 sf

Primary OutFlow Max=6.95 cfs @ 12.30 hrs HW=101.37' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert from Contour 99 to 98** (Passes 6.95 cfs of 9.47 cfs potential flow)
 └─**2=Culvert from Convergence to Contour 99** (Inlet Controls 6.95 cfs @ 8.84 fps)

Pond 3P: Utility Easement Pipes



A.7

Recharge Volume and Drawdown Calculations

H.W.Moore
CIVIL ENGINEERING | LAND PLANNING

Middleton Project # 25912

DATE: 8/18/23
REVISED:

STANDARD #3

INFILTRATION SYSTEM 1 CALCULATIONS

INFILTRATION SYSTEM STORAGE VOLUME

SC-740 CHAMBER VOLUME

	OUTLET ORIFICE INVERT	I_W	=	101.8	ft.
	BOTTOM INVERT CHAMBERS	I_C	=	101.5	ft.
	STORMWATER DEPTH	D_C	=	0.3	ft.
	VOLUME PER CHAMBER	V_C	=	6.6	cf.
	NUMER OF ROWS	R_C	=	16	
	CHAMBERS PER ROW	C_C	=	12	
$N_C = (R_C * C_C)$	NUMBER OF CHAMBERS	N_C	=	192	
$V_{CHAMBERS} = (V_C * N_C)$	TOTAL VOLUME OF CHAMBERS BELOW OUTLET	$V_{CHAMBERS}$	=	1263.9	cf.

STONE VOLUME

	STONE BOTTOM INVERT	I_S	=	101.0	ft.
$D_S = I_W - I_S$	STONE STORMWATER DEPTH	D_S		0.8	
	STONE WIDTH	W_S	=	77.5	ft.
	STONE LENGTH	L_S	=	88.8	ft.
	% VOIDS	VOIDS	=	40%	
$V_{STONE} = [(W_S * L_S * (I_W - I_S)) - V_{CHAMBERS}] * VOIDS$	STONE VOLUME	V_{stone}	=	1558.3	cf.

TOTAL VOLUME BELOW INVERT

$V_{TOTAL} = V_{CHAMBERS} + V_{STONE}$	**TOTAL STORAGE VOLUME**	V_{TOTAL}	=	**2822.2**	cf.

BOTTOM AREA

$A_{bottom} = W_S * L_S$	BOTTOM SURFACE AREA	A_{bottom}	=	**6879.7**	sf.

REQUIRED RECHARGE VOLUME

STATIC METHOD

	SOIL TYPE		=	B	
	RECHARGE DEPTH	F	=	0.35	in.
	IMPERVIOUS AREA	A_{IMP}	=	**1.30**	ac.
	% IMPERVIOUS AREA CAPTURED		=	100%	
$Rv = (F * A_{imp})$	RECHARGE STORAGE VOLUME	Rv	=	**1651.7**	cf.

2822.2 cf. >>> 1651.7 cf.

STANDARD 3 SATISFIED

72 HOUR DRAWDOWN

	SOIL TYPE		=	B	
	RAWLS RATE	K	=	1.02	in/hr
	REQUIRED RECHARGE VOLUME	Rv	=	1651.7	cf.
	BOTTOM AREA	A_{bottom}	=	6879.7	sf.
$T_D = (Rv) / (K * A_{bottom})$	DRAWDOWN TIME	T_D	=	**2.8**	hr.

2.8 hr. <<< 72.0 hr.

72 DRAWDOWN SATISFIED

H.W.Moore
CIVIL ENGINEERING | LAND PLANNING

Middleton Project # 25912

DATE: 8/18/23
REVISED:

STANDARD #3

INFILTRATION SYSTEM 2 CALCULATIONS

INFILTRATION SYSTEM STORAGE VOLUME

SC-740 CHAMBER VOLUME

	OUTLET ORIFICE INVERT	I_W	=	103.2	ft.
	BOTTOM INVERT CHAMBERS	I_C	=	101.5	ft.
	STORMWATER DEPTH	D_C	=	1.7	ft.
	VOLUME PER CHAMBER	V_C	=	38.2	cf.
	NUMER OF ROWS	R_C	=	1	
	CHAMBERS PER ROW	C_C	=	6	
$N_C = (R_C * C_C)$	NUMBER OF CHAMBERS	N_C	=	6	
$V_{CHAMBERS} = (V_C * N_C)$	TOTAL VOLUME OF CHAMBERS BELOW OUTLET	$V_{CHAMBERS}$	=	229.3	cf.

STONE VOLUME

	STONE BOTTOM INVERT	I_S	=	101.0	ft.
$D_S = I_W - I_S$	STONE STORMWATER DEPTH	D_S		2.2	
	STONE WIDTH	W_S	=	6.3	ft.
	STONE LENGTH	L_S	=	46.1	ft.
	% VOIDS	VOIDS	=	40%	
$V_{STONE} = [(W_S * L_S * (I_W - I_S)) - V_{CHAMBERS}] * VOIDS$	STONE VOLUME	V_{stone}	=	161.5	cf.

TOTAL VOLUME BELOW INVERT

$V_{TOTAL} = V_{CHAMBERS} + V_{STONE}$	**TOTAL STORAGE VOLUME**	V_{TOTAL}	=	**390.9**	cf.

BOTTOM AREA

$A_{bottom} = W_S * L_S$	BOTTOM SURFACE AREA	A_{bottom}	=	**287.8**	sf.

REQUIRED RECHARGE VOLUME

STATIC METHOD

	SOIL TYPE		=	B	
	RECHARGE DEPTH	F	=	0.35	in.
	IMPERVIOUS AREA	A_{IMP}	=	**0.20**	ac.
	% IMPERVIOUS AREA CAPTURED		=	100%	
$Rv = (F * A_{imp})$	RECHARGE STORAGE VOLUME	Rv	=	**254.1**	cf.

390.9 cf. >>> 254.1 cf.

STANDARD 3 SATISFIED

72 HOUR DRAWDOWN

	SOIL TYPE		=	B	
	RAWLS RATE	K	=	1.02	in/hr
	REQUIRED RECHARGE VOLUME	Rv	=	254.1	cf.
	BOTTOM AREA	A_{bottom}	=	287.8	sf.
$T_D = (Rv) / (K * A_{bottom})$	DRAWDOWN TIME	T_D	=	**10.4**	hr.

10.4 hr. <<< 72.0 hr.

72 DRAWDOWN SATISFIED

A.8

Water Quality Volume Calculation

Middleton Project # 25912

H.W.Moore
CIVIL ENGINEERING | LAND PLANNING

PAGE: 1 of 1
DATE: 8/18/23
REVISED:

STORMWATER MANAGEMENT STANDARDS

STANDARD # 4

WATER QUALITY VOLUME (WQV)

TOTAL PROPOSED IMPERVIOUS AREA = 56777.00 sf.

[ ] CRITICAL AREA

WQV = **1.00** inch runoff x TOTAL IMPERVIOUS AREA

[X] OTHER AREA

WQV = **0.50** inch runoff x TOTAL IMPERVIOUS AREA

0.50 x **56777.00** = 2,365.7 cf.

TOTAL WATER QUALITY VOLUME REQUIRED = 2365.7 cf.

WATER QUALITY VOLUME

INFILTRATION SYSTEM 1 = **2822.2** cf.

TOTAL WATER QUALITY VOLUME PROVIDED = 2822.2 cf.

2822.2 cf >>> 2365.7 cf STANDARD #4 SATISFIED

Middleton Project # 25912

H.W.Moore
CIVIL ENGINEERING | LAND PLANNING

DATE: 8/18/23
REVISED:

STORMWATER MANAGEMENT STANDARDS

STANDARD # 4

WATER QUALITY VOLUME (WQV)

TOTAL PROPOSED IMPERVIOUS AREA = 8820.00 sf.

[ ] CRITICAL AREA

WQV = **1.00** inch runoff x TOTAL IMPERVIOUS AREA

[X] OTHER AREA

WQV = **0.50** inch runoff x TOTAL IMPERVIOUS AREA

0.50 x **8820.00** = 367.5 cf.

TOTAL WATER QUALITY VOLUME REQUIRED = 367.5 cf.

WATER QUALITY VOLUME

INFILTRATION SYSTEM 1 = **390.9** cf.

TOTAL WATER QUALITY VOLUME PROVIDED = 390.9 cf.

390.9 cf **>>>** **367.5 cf** **STANDARD #4 SATISFIED**

A.9

Operations and Maintenance Log

HANCOCK ASSOCIATES

Villebridge Development LLC

Operations and Maintenance Log

Inspections for Year:____________

Structural Best Management Practice	Action	Date Completed	Completed By	Comments
Deep Sump Hooded Catch Basin– Inspect/clean four times per year. Clean when sump is 33% full.	Inspect/ Clean			
	Inspect/ Clean			
	Inspect/ Clean			
	Inspect/ Clean			
	Inspect/ Clean			
Infiltration Chambers Inspect twice a year – spring and fall. Clean as required (if sediment is observed in infiltration units or there is standing water).	Inspect			
	Inspect			
Roof Drain Leaders – Inspect/clean twice per year.	Inspect/Clean			
	Inspect/Clean			
Parking Lot/Paved areas sweeping and debris – inspect four times a year. Sweep paved areas and remove litter in Spring and Fall after fallen leaves.	Inspect/Clean			
Vegetated Areas Maintenance – Inspect twice per year. Maintain as required.	Inspect			
	Inspect			