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DRAINAGE REPORT

For

Park Silver
DEVELOPMENT, LLC

PROPOSED

Extended Stay Hotel

277 Providence Street
Worcester, Massachusetts
Worcester County

Prepared by:

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EXECUTIVE SUMMARY

This report examines the changes in drainage that can be expected as the result of the development of a proposed extended stay hotel located at 277 Providence Street in Worcester, Massachusetts which contains approximately 2.96 acres of wooded undeveloped land.

The proposed project includes the construction of a new 122 room extended stay hotel along with new paved parking areas, landscaping, storm water management components and associated utilities. This report addresses a comparative analysis of the pre- and post-development site runoff conditions. Additionally, this report provides calculations documenting the design of the proposed stormwater conveyance/management system as illustrated within the accompanying Site Development Plans prepared by Bohler. The project will also provide erosion and sedimentation controls during the demolition and construction periods, as well as long term stabilization of the site.

For the purposes of this analysis the pre- and post-development drainage conditions were analyzed at one (1) "design point" where stormwater runoff currently drains to under existing conditions. This design point is described in further detail in **Section II** below. A summary of the existing and proposed conditions peak runoff rates and volumes for the 2-, 10-, 25-, and 100-year storms can be found in **Table 1.1** below. In addition, the project has been designed to meet or exceed the Stormwater Management Standards as detailed herein.

Table 1.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP1	2.38	2.31	**-0.07**	10.42	8.70	**-1.72**	18.59	17.67	**-0.92**	34.29	32.78	**-1.51**

**Flows are represented in cubic feet per second (cfs)*

I. EXISTING SITE CONDITIONS

Existing Site Description

The site consists of approximately 2.96 acres of land located along the northeasterly side of Millbury Street in the City of Worcester, Massachusetts. The western portion of the site contains an existing asphalt access drive, while the remaining portion of the site consists of undeveloped of wooded areas. An existing gravel parking area used by the adjacent American Legion Hall is located upland and to the north of the subject parcel. Located on a hillside, the site contains slopes that are generally more than 15%, and an area of fill has created slopes that are nearly 1:1. The hillside above the site is forested with large areas of rock outcroppings. Soils at the site are primarily Fill, Canton Fine Sandy Loam, and Chatfield-Hollis-Rock Outcrop types of Natural Resource Conservation Service (NRCS) hydrologic soil type B.

On-Site Soil Information

Soils within the analyzed area consist of the following as classified by the Natural Resource Conservation Service (NRCS):

Table 2.1: Existing Soil Information

Soil Unit Symbol	Soil Name / Description	Hydrologic Soil Group (HSG)
102C	Chatfield-Hollis-Rock Outcrop	B
102D	Chatfield-Hollis-Rock Outcrop	B
421C	Canton Fine Sandy Loam	B
602	Urban Land (Fill)	N/A

Onsite soil testing was performed by Bohler on October 30th, 2024. Refer to **Appendix C** for additional information.

Existing Collection and Conveyance

Ultimately, the entire existing site drains into the existing Millbury Street drainage system. Runoff areas above the site appear to be collected at a point upgradient from the existing American Legion Hall located at the corner of Providence and Millbury Street and diverted into the Legion's parking lot storm sewer. Runoff from the hill that bypasses the American Legion storm sewer enters a swale just below the American Legion Hall building. The swale discharges in two ways; the first is through a double catch basin grate to a 12" pipe that appears to tie into the existing Millbury Street drainage system via the old Providence Street storm system. The second means

of discharge is through an 18" culvert just above the aforementioned catch basin, which runs under the American Legion Hall driveway. The invert of the 18" pipe is approximately 1.1 feet higher than the catch basin, so it functions only as an overflow for large storms. The 18" pipe discharges to a swale which leads to a 12" pipe under Millbury Street.

Existing Watersheds and Design Point Information

For the purposes of this analysis, the pre- and post-development drainage conditions were analyzed at one (1) "design point" as described below where stormwater runoff currently drains to under existing conditions. The existing site was subdivided into two (2) separate sub catchments, as described below, to analyze existing and proposed flow rates at each design point. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr).

Design Point #1 (DP1) is the existing Millbury Street Drainage. Under existing conditions, this design point receives stormwater flows from approximately 7.14 acres of land, designated as watershed "E1". Refer to Table 2.2 below for additional detail.

Table 2.2: Existing Sub-Catchment Summary

Sub-catchment Name	Total Area (acres)	Cover Description	Curve Number (CN)	Time of Concentration (Tc, minutes)
ED1.1	3.46±	Woods & Paved Parking	59	11.0
ED1.2	3.68±	Woods	55	12.9

Refer to **Table 1.1 and 6.1** for the existing conditions peak rates of runoff. Refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the existing drainage areas.

II. PROPOSED SITE CONDITIONS

Proposed Development Description

The proposed project consists of the construction of a new 122-bedroom extended stay hotel including paved parking areas, landscaping, associated utilities, and a new stormwater management system. The site, including the proposed parking areas, has been designed to drain to deep-sump, hooded catch basins. The catch basins will capture and convey stormwater runoff, via an underground pipe system, to a proposed underground detention basin. Pretreatment of stormwater runoff will be provided by a combination of the deep-sump, hooded catch basins and proposed isolator rows within the proposed subsurface detention/infiltration basin. Rooftop runoff has been designed to flow to the subsurface basin as well. Runoff from the upland area is proposed to be captured via deep-sump hooded catch basins and piped directly into the existing stormwater drainage in Millbury Street typical to existing condition.

Proposed Development Collection and Conveyance

Deep sump hooded catch basins are proposed to collect and route runoff from the paved parking areas to the proposed subsurface infiltration/detention stormwater basin. Pipes have been designed for the 25-year storm using Rational Method. Pipe, inlet, and outlet protection sizing calculations are included in **Appendix F**.

The best management practices (BMPs) incorporated into the proposed stormwater management system have been designed to meets, or exceeds, the standards set forth in the Massachusetts Department of Environmental Protection Stormwater Handbook standards. Refer to **Section V** for additional information.

Proposed Watersheds and Design Point Information

The project has been designed to maintain existing drainage watersheds to the greatest extent possible, with the same design point described in **Section II** above. The site was subdivided into two (2) separate sub catchments for the proposed conditions as described below. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr).

Under proposed conditions DP#1 receives stormwater flows from approximately 7.14 acres of land, designated as watershed “PD-1.1” and “PD-1.2”. Refer to Table 3.1 below for additional detail.

Table 3.1: Proposed Sub-catchment Summary

Sub-catchment Name	Total Area (acres)	Cover Description	Curve Number (CN)	Time of Concentration (Tc, minutes)	Hydrologic Routing
PD1.1	1.83±	Rooftops, paved parking/sidewalks, & grass	96	6.0	Basin #1 / DP#1
PD1.2	5.31±	Paved sidewalks, grass, & Woods	55	6.0	DP#1

Refer to **Table 1.1 and 6.1** for the calculated proposed conditions peak rates of runoff. For additional hydrologic information, refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the proposed drainage areas.

III. METHODOLOGY

Peak Flow Calculations

Methodology utilized to design the proposed stormwater management system includes compliance with the guidelines set forth in the latest edition of the Massachusetts DEP Stormwater Handbook. The pre- and post-development runoff rates being discharged from the site were computed using the HydroCAD computer program. The drainage area and outlet information were entered into the program, which routes storm flows based on NRCS TR-20 and TR-55 methods. The other components of the model were determined following standard NRCS procedures for Curve Numbers (CNs) and times of concentrations documented in the appendices of this report. The rainfall data utilized and listed below in table 4.1 below for stormwater calculations is based on the upper bounds from NOAA. Refer to **Appendix F** for more information.

Table 4.1: Worcester County NOAA Rainfall Intensities

Frequency	2 year	10 year	25 year	100 year
Rainfall* (inches)	3.84	6.01	7.75	10.7

Values derived from the upper bounds of the NOAA ATLAS 14 on 11/01/2024

The proposed stormwater management as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year design storm events. Additionally, the proposed project meets, or exceeds, the MADEP Stormwater Management standards. Compliance with these standards is described further below.

IV. STORMWATER MANAGEMENT STANDARDS

Standard #1: No New Untreated Discharges

The project has been designed so that proposed impervious area shall be collected and passed through the proposed drainage system for treatment prior to discharge.

Standard #2: Peak Rate Attenuation

As outlined in **Table 1.1** and **Table 6.1**, the development of the site and the proposed stormwater management system, have been designed so that post-development peak rates of runoff are below pre-development conditions for the 2-, 10-, 25- and 100-year storm events at all design points.

Standard #3: Recharge

The stormwater runoff from the project will be collected and diverted to a proposed subsurface infiltration/detention stormwater basin. The project as proposed will involve the creation of 61,098± square feet of new impervious area and is required to infiltrate 1,767 cubic feet of stormwater as defined in Stormwater Standard 3. The proposed infiltration basin will provide 9,190 cubic feet of volume below the lowest outlet for groundwater recharge. Refer to **Appendix F** of this report for calculations documenting required and provided recharge volumes.

The DEP Stormwater Standards require that the infiltration BMP drains completely within 72 hours of the end of the storm event. Calculations showing that the proposed infiltration basin will drain within 13.7 hours are included in **Appendix F** of this report.

Infiltration is not used as a peak rate mitigator therefore a ground water mounding analysis is not required.

Standard #4: Water Quality

Water quality treatment is provided via deep sump catch basins, Isolator rows and an infiltration basin. TSS removal calculations are included in **Appendix F** of this report. The project as proposed will involve the creation of 61,098 square feet of new impervious area and is required to treat 6,306 cubic feet of water quality volume as defined in Stormwater Standard 4. The proposed infiltration basin provides 9,190 cubic feet of water quality volume below the lowest outlet for water quality treatment. Refer to **Appendix F** of this report for calculations documenting required and provided water quality volumes.

Standard #5: Land Use with Higher Potential Pollutant Loads

Not Applicable for this project.

Standard #6: Critical Areas

Not Applicable for this project.

Standard #7: Redevelopment

Not Applicable for this project.

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

The proposed project will provide construction period erosion and sedimentation controls as indicated within the site plan set provided for this project. This includes a proposed construction exit, protection for stormwater inlets, protection around temporary material stock piles and various other techniques as outlined on the erosion and sediment control sheets. Additionally, the project is required to file a Notice of Intent with the US EPA and implement a Stormwater Pollution Prevention Plan (SWPPP) during the construction period. The SWPPP will be prepared prior to the start of construction and will be implemented by the site contractor under the guidance and responsibility of the project's proponent. Refer to **Appendix H**.

Standard #9: Operation and Maintenance Plan (O&M Plan)

An Operation and Maintenance (O&M) Plan for this site has been prepared and is included in **Appendix G** of this report. The O&M Plan outlines procedures and time tables for the long term operation and maintenance of the proposed site stormwater management system, including initial inspections upon completion of construction, and periodic monitoring of the system components, in accordance with established practices and the manufacturer's recommendations. The O&M Plan includes a list of responsible parties and frequency for inspections and maintenance.

Standard #10: Prohibition of Illicit Discharges

The proposed stormwater system will only convey allowable non-stormwater discharges (firefighting waters, irrigation, air conditioning condensates, etc.) and will not contain any illicit discharges from prohibited sources. An Illicit Discharge Statement is included in **Appendix G** of this report and will be signed prior to the start of construction.

V. SUMMARY

In summary, the proposed stormwater management system illustrated on the drawings prepared by Bohler results in a reduction in peak rates of runoff from the subject site when compared to pre-development conditions for the 2-, 10-, 25- and 100-year storm frequencies. In addition, the proposed best management practices will result in an effective removal of total suspended solids from the post-development runoff. The pre-development versus post-development stormwater discharge comparisons are contained in **Table 6.1** below:

Table 6.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP1	2.38	2.31	**-0.07**	10.42	8.70	**-1.72**	18.59	17.67	**-0.92**	34.29	32.78	**-1.51**

**Flows are represented in cubic feet per second (cfs)*

As outlined in the table above, the proposed stormwater management system as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year storm events. Additionally, the project meets or exceeds the MADEP Stormwater Management Standards as described further herein.

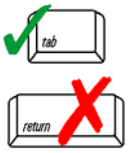
APPENDIX A: MASSACHUSETTS STORMWATER MANAGEMENT CHECKLIST

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.

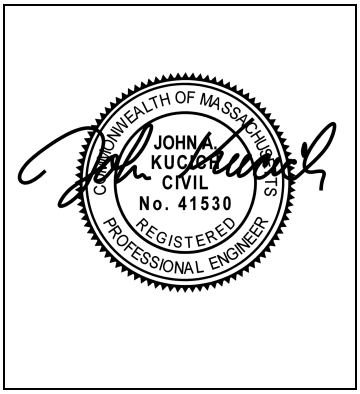
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



11/14/2024

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

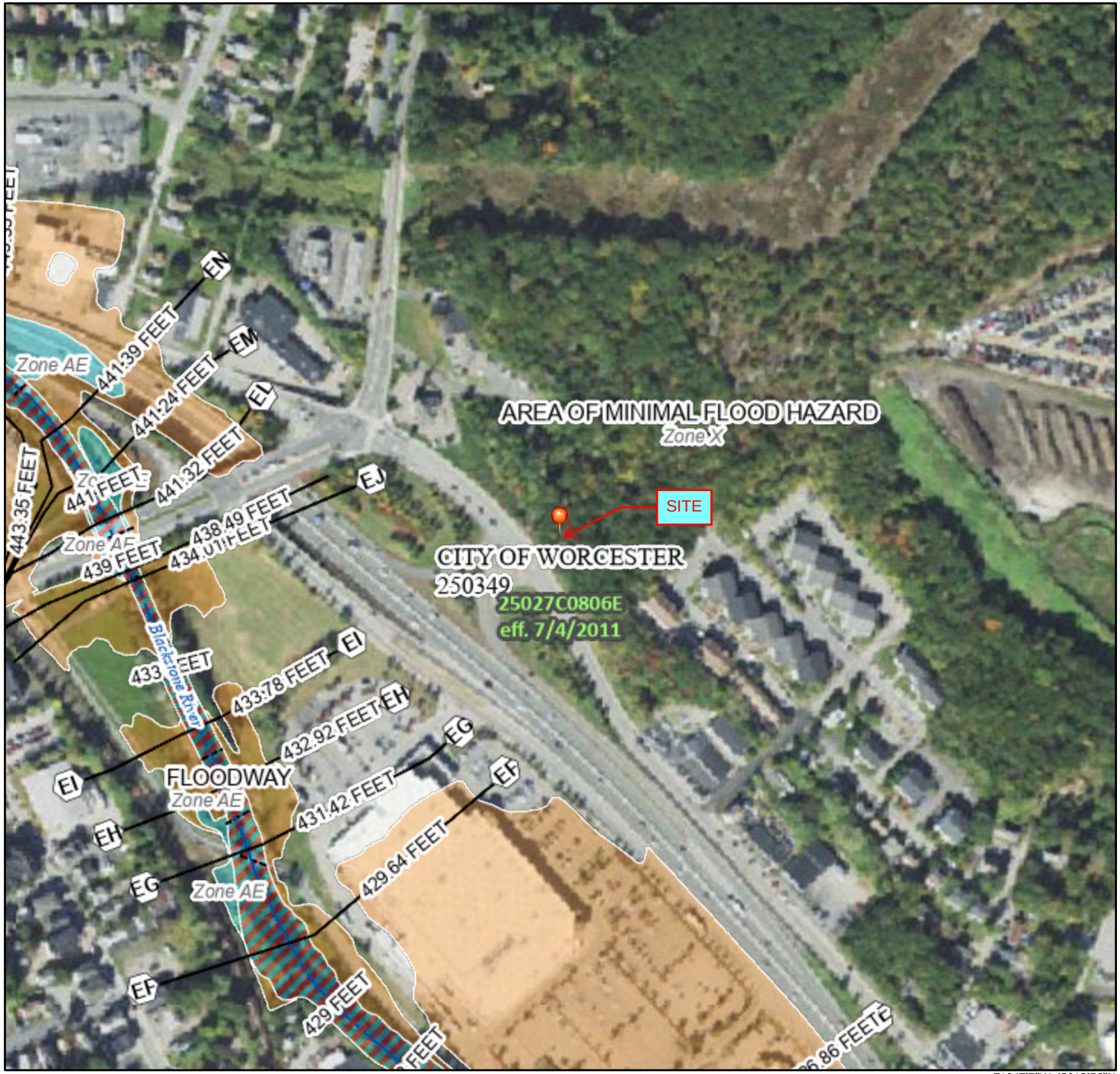
APPENDIX B: PROJECT LOCATION MAPS

- *USGS MAP*
- *FEMA FIRMETTE*

National Flood Hazard Layer FIRMette

FEMA

71°47'45"W 42°14'22"N



71°47'7"W 42°13'56"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

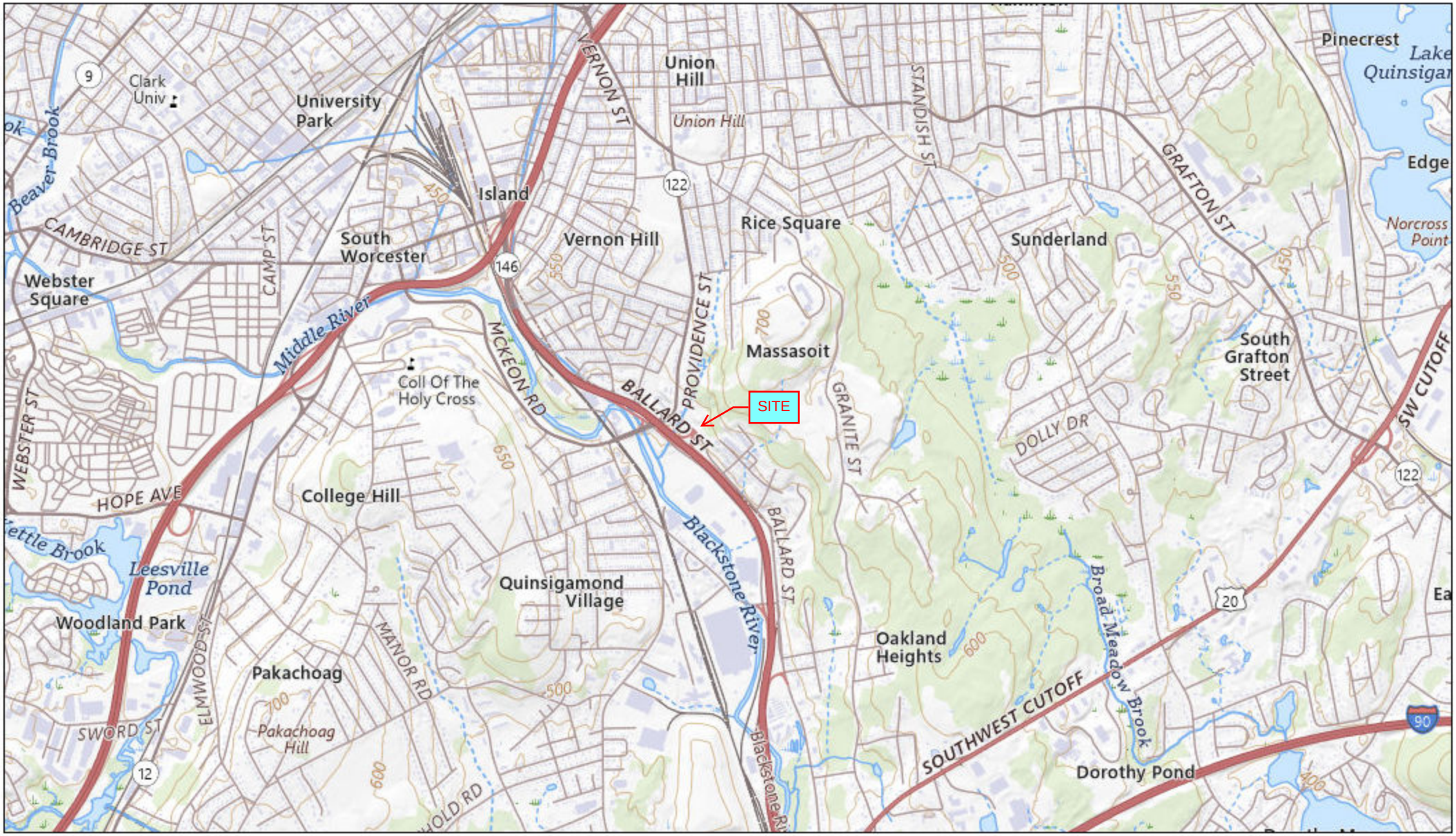
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/13/2024 at 9:26 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

The National Map Advanced Viewer



11/7/2024, 3:57:41 PM

1:36,112

0 0.23 0.45 0.9 mi

0 0.35 0.7 1.4 km

APPENDIX C: SOIL AND WETLAND INFORMATION

- *NCRS CUSTOM SOIL RESOURCE REPORT*
- *REPORT OF GEOTECHNICAL INVESTIGATION*
- *STORMWATER OBSERVATION TEST PIT LOGS*

GEOTECHNICAL ENGINEERING REPORT
PROPOSED HOTEL
277 PROVIDENCE STREET
WORCESTER, MASSACHUSETTS

Prepared for:

Park Silver Development LLC
8171 Maple Lawn Boulevard, Suite 380
Fulton, Maryland 20759

Prepared by:

Ransom Consulting, LLC
50 High Street, Suite 25
North Andover, Massachusetts
(978)465-1822

Project 242.01023.002
October 4, 2024

Jay P. Johonnett P.E.
Geotechnical Engineering Consultant

Brian R. Pettingill, P.G.
Vice President

EXECUTIVE SUMMARY

Ransom Consulting, LLC (Ransom) has prepared this Geotechnical Engineering Report for the proposed development of a hotel at 277 Providence Street in Worcester, Massachusetts (the "Site"). This geotechnical engineering evaluation was performed to obtain site-specific subsurface soil information and to make geotechnical evaluations and recommendations for design and construction of a proposed hotel at the Site as understood by Ransom at the time of the investigation.

The following information was obtained during the process of completing a Phase I Environmental Site Assessment (Phase I ESA) for the Site for Park Silver Development (Park Silver). The Site is identified as 277 Providence Street and consists of 2.56 acres of undeveloped woodland. Ransom's review of historical information indicated that the Site has been undeveloped since at least 1910. The Site is located in a commercial area. Abutting and nearby properties include an apartment building, a bank, undeveloped wooded land, and roadways.

The Site has not been developed and the topography is sloped downward to the southwest. Based on the Worcester, Massachusetts United States Geological Survey (USGS) Quadrangle, the elevation of the Site is approximately 470 feet above mean sea level (MSL) in the area of the proposed hotel, as referenced to the National Geodetic Vertical Datum (NGVD). Topography at the Site slopes moderately down from northeast to southwest.

Ransom's understanding of the proposed development is based on review of the plan titled "Grading and Drainage Plan (C-402)," prepared by Bohler Engineering, dated June 20, 2024. We understand that Park Silver plans to construct a four-story hotel with associated parking and driveways at the Site. We understand that the proposed hotel is planned to be constructed on a slab-on-grade with a footprint of approximately 11,250 square feet.

According to Bohler's Grading and Drainage Plan, the proposed finished floor elevation (FFE) of the hotel is proposed to be 475 feet above MSL. It appears that grade fills of approximately 5 feet in the southern portion of the proposed building and up to approximately 17 feet in the northern portion of the proposed building will be required at the Site to achieve the proposed FFE. Additionally, grade raise fills of up to approximately 10 feet are anticipated in the southwest portion of the Site, and grade cuts of approximately 3 to 9 feet and grade fills of 10 to 12 feet are proposed in the northern area of the Site.

The geotechnical subsurface exploration program was conducted for the Site on September 9 and 10, 2024. The subsurface exploration program consisted of the advancement of nine soil borings (designated B1 through B10, soil boring B5 was not completed), as shown on Figure 2. Boring B3 was inadvertently advanced off the Site due to heavy vegetation and a lack of visual reference points to properly site the boring. Test drilling was performed by GeoSearch, Inc. of Sterling, Massachusetts, using a track-mounted drill rig. Test borings were advanced to depths ranging from approximately 5.5 feet to 17.5 feet below existing grades. The subsurface explorations generally encountered localized areas of fill materials overlying silt and sand, and bedrock. The ground surface at the Site generally consists of forest duff with scattered cobbles and boulders. Bedrock outcrops were observed throughout the Site.

Drilling refusal was encountered at each boring location at depths ranging from approximately 5.5 to 17.5 feet below grade. The refusal elevations range from approximately 445 to 488 feet above MSL. The elevations were not surveyed and should be considered approximate. The elevation of bedrock should be

considered when designing future grading plans and structure/pavement elevations. If the refusal elevations and corresponding inferred bedrock surface is considered when designing the building foundation element elevations, the amount of bedrock removal could be minimized. Bedrock removal could be required for excavations, particularly on the uphill (northeast) side of the Site. Boulders, cobbles, and bedrock could be processed to produce structural fill materials to be used in the proposed construction.

Water-saturated soils were not encountered in the soil borings conducted to depths up to 17 feet below grade.

Fill materials were observed in borings B1, B6, and B7. These soils are believed to have been placed in the northwest area of the Site during relocation of the adjacent Providence Street or other property-adjacent construction activities. A 4-foot-thick unit of silty clay with organics was observed at boring location B2 in the northwest corner of the Site. The fill materials and organic silty clay unit are considered unsuitable for providing support to the proposed structure and/or pavements and will require removal prior to construction. The fill materials could potentially remain in place following compaction, proof-rolling, and review by the project geotechnical engineer at the time of construction.

The naturally-occurring silt and sand deposit soils are considered the uppermost suitable bearing stratum for proposed foundations at the Site. Proposed structures could be supported on conventional, shallow foundation systems of spread and continuous footings that bear on the naturally-occurring silt and sand soils, or on structural fill placed and properly compacted above these soils. Foundation elements should be proportioned using a maximum allowable contact pressure of 4,000 pounds per square foot (psf). Post-construction total and differential settlements are anticipated to be no more than approximately 1 inch and 0.5 inch, respectively.

Subsurface conditions are suitable for a slab-on-grade ground floor. The uppermost 12 inches of material beneath all slabs-on-grade should consist of compacted structural fill that conforms to the gradation specification in this report. Subsurface conditions are suitable for rigid and bituminous asphalt pavement surfacing.

Ransom should be provided the opportunity to review final site design plans and specifications when complete and provide a report addendum if necessary.

TABLE OF CONTENTS

1.0 INTRODUCTION

Ransom Consulting, LLC (Ransom) has prepared this Geotechnical Engineering Report for the proposed development of a hotel at 277 Providence Street in Worcester, Massachusetts (the "Site"). This geotechnical report has been prepared in general accordance with our proposed scope of work dated May 31, 2024.

This geotechnical engineering evaluation was performed to obtain site-specific subsurface soil information and to make geotechnical evaluations and recommendations for design and construction of a proposed hotel at the Site as understood by Ransom at the time of the investigation. As completed, Ransom's scope of services included the following items:

1. Subcontracting and coordinating with a drilling contractor and contacting the underground utility clearance system as required by law.

2. Providing technical monitoring for the subsurface explorations, obtaining soil samples, and preparing test boring logs.

3. Evaluating the geotechnical data with respect to the proposed development and preparing this report of our findings, evaluations, and recommendations for potential future design and construction.

2.0 SITE AND PROJECT DESCRIPTIONS

This geotechnical investigation was performed for the proposed hotel development at 277 Providence Street in Worcester, Massachusetts. A Site Location Map and a Subsurface Exploration Plan showing the boring locations and existing Site conditions are provided as Figures 1 and 2, respectively.

2.1 Existing Conditions

The following information was obtained during the process of completing a Phase I Environmental Site Assessment (Phase I ESA) for the Site for Park Silver Development (Park Silver). The Site is identified as 277 Providence Street and consists of 2.56 acres of undeveloped woodland. Ransom's review of historical information indicated that the Site has been undeveloped since at least 1910. The Site is located in a commercial area. Abutting and nearby properties include an apartment building, a bank, undeveloped wooded land, and roadways.

The Site has not been developed and the topography is sloped downward to the southwest. Based on the Worcester, Massachusetts United States Geological Survey (USGS) Quadrangle and the Bohler Engineering "Grading and Drainage Plan," dated June 20, 2024, the elevation of the Site is approximately 458 to 500 feet above mean sea level (MSL) in the area of the proposed hotel, as referenced to the National Geodetic Vertical Datum (NGVD). Topography at the Site slopes moderately down from northeast to southwest.

2.2 Proposed Development

Ransom's understanding of the proposed development is based on review of the plan titled "Grading and Drainage Plan (C-402)," prepared by Bohler Engineering, dated June 20, 2024. We understand that Park Silver plans to construct a four-story hotel with associated parking and driveways at the Site. We understand that the proposed hotel is planned to be constructed on a slab on grade with a footprint of approximately 11,250 square feet.

Based on review of the Grading and Drainage Plan prepared by Bohler Engineering, the proposed finished floor elevation (FFE) of the hotel is proposed to be 475 feet above MSL. It appears that grade fills of approximately 5 feet in the southern portion of the proposed building and up to approximately 17 feet in the northern portion of the proposed building will be required at the Site to achieve the proposed FFE. Additionally, grade raise fills of up to approximately 10 feet are anticipated in the southwest portion of the Site, and grade cuts of approximately 3 to 9 feet and grade fills of 10 to 12 feet are proposed in the northern area of the Site. Ransom's geotechnical investigation did not include evaluations of Site soils with respect to infiltration potential for stormwater management.

3.0 SUBSURFACE INVESTIGATION

The geotechnical subsurface exploration program was conducted for the Site on September 9 and 10, 2024. The subsurface exploration program consisted of the advancement of nine soil borings (designated B1 through B10, as shown on Figure 2. Soil boring B5 was not completed as a result of heavy vegetation and a small group of homeless occupying the area, and boring B3 was inadvertently advanced off the Site due to heavy vegetation and a lack of visual reference points to properly site the boring. Test drilling was performed by GeoSearch, Inc. of Sterling, Massachusetts, using a track-mounted drill rig with a 4¼-inch inside-diameter (ID) hollow-stem auger. Split-barrel sampling with standard penetration testing (ASTM D1586), using a 140-pound drive hammer, was conducted from the ground surface to a depth of 6 feet below grade, and at 5-foot intervals thereafter to the bottoms of the borings. The explorations were not surveyed; their locations and elevations should be considered approximate.

A Ransom representative monitored the advancement of the soil borings, collected soil samples, prepared field boring logs, and measured depths to groundwater and refusal, where encountered. Soil samples were placed in sealed containers and returned to Ransom's office for further evaluation. Soil samples were visually classified in general accordance with visual manual procedures (ASTM D2488) and described using modified Burmister Soil Classification System descriptors. Exploration logs are attached in Appendix A.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the Site were characterized by drilling into the unconsolidated, overburden soil formations at accessible locations at the Site. The soil borings were advanced in locations and to depths to evaluate the proposed hotel building, driveways and parking areas. Figure 2 illustrates the existing and proposed Site features and approximate test boring locations. The general characteristics of the subsurface strata are described below; refer to the logs in Appendix A for more detailed soil descriptions at specific locations and depths.

4.1 Subsurface Soils

Test borings were advanced to depths ranging from approximately 5.5 feet to 17.5 feet below existing grades. The subsurface explorations generally encountered localized areas of fill materials overlying silt and sand, and bedrock. The ground surface at the Site generally consists of forest duff with scattered cobbles and boulders. Bedrock outcrops were observed throughout the Site.

The general characteristics of the subsurface layers are described below in order of increasing depth encountered below the ground surface.

4.1.1 Fill Materials

Fill materials were observed in borings B1, B6, and B7 from the ground surface to depths up to 12 feet below grade (B7). The fill materials were observed to generally consist of brown sand with varying amounts of silt, gravel, and cobbles. The fill materials were generally observed to be in a medium dense condition. We believe the fill materials were likely placed in the northwestern area of the site during the relocation of the adjacent Providence Street. These soils are classified as silty sand (SM) or silty sand with gravel (SM) in general accordance with the Unified Soil Classification System (USCS).

4.1.2 Silt and Sand

A deposit of sand and silt was encountered under the fill materials, where present, or from below the surficial materials. This unit generally consisted of brown or tan medium-grained sand with varying amounts of silt and cobbles. The silt and clay soils were generally observed to be in a medium stiff to very dense condition. The silt and sand deposit is classified as silty sand (SM) or silty sand with gravel (SM) in general accordance with the USCS.

4.1.3 Silty Clay

A unit of brown to dark brown silty clay was encountered at boring B2 from 2 to 10 feet below grade. The silty clay was noted to be anoxic and possibly containing organics. The silty clay soils were generally observed to be in a medium stiff condition. The silty clay soils are classified as silty clay (CL-ML) in general accordance with the USCS.

4.2 Drilling Refusal/Bedrock

Drilling refusal was encountered at each boring location at depths ranging from approximately 5.5 to 17.5 feet below grade. The refusal elevations range from approximately 445 to 488 feet above MSL. The elevations were not surveyed and should be considered approximate. The elevations were estimated from aerial imagery. We infer that the drilling refusals were likely the result of encountering the bedrock surface. It is possible that the refusals were the result of encountering boulders.

4.3 Groundwater

Water-saturated soils were not encountered in the soil borings conducted to depths up to 17 feet below grade. Groundwater levels at the Site will fluctuate due to season, temperature, precipitation, nearby underground utilities, and construction activity. Therefore, water levels at other times may differ from the soil moisture observations and measurements made by Ransom at the time of the soil borings.

5.0 ENGINEERING EVALUATIONS

The subsurface explorations encountered sand overlying a unit of fine-grained silt, sand, and occasionally clay with depth. The controlling geotechnical features for the proposed development at the Site are:

1. Foundation-Bearing Soils. The naturally-occurring silt and sand deposit soils are considered the uppermost suitable bearing stratum for proposed foundations at the Site. Proposed structures could be supported on conventional, shallow foundation systems of spread and continuous footings that bear on the naturally-occurring silt and sand soils, or on structural fill placed and properly compacted above these soils.

2. Unsuitable Soils. Fill materials were observed in borings B1, B6, and B7. These soils are believed to have been placed in the northwest area of the Site during relocation of the adjacent Providence Street or other property-adjacent construction activities. A 4-foot-thick unit of silty clay with organics was observed at boring location B2. The fill materials and organic silty clay unit are considered unsuitable for providing support to the proposed structures and/or pavements. Due to its generally granular nature and medium dense condition, the fill soils identified near the northwest corner of the proposed building could potentially be left in place provided the geotechnical engineer reviews and approves the material during construction activities. The fill materials should be compacted, proof-rolled, and reviewed by the project geotechnical engineer to evaluate performance during construction.

3. Bedrock and Boulders. Drilling refusal was observed at depths ranging from approximately 5.5 to 17.5 feet below grade, corresponding to elevations ranging from 445 to 488 feet above MSL. The drilling refusals observed are likely the result of encountering bedrock or boulders. The elevation of bedrock should be considered when designing future grading plans and structure/pavement elevations. If the refusal elevations and corresponding inferred bedrock surface is considered when designing the building foundation element elevations, the amount of bedrock removal could be minimized. Bedrock removal could be required for excavations particularly on the uphill (northeast) side of the Site. Boulders, cobbles, and bedrock could be processed to produce structural fill materials to be used in the proposed construction.

Geotechnical engineering evaluations for this project are based on the subsurface conditions interpreted from widely spaced subsurface explorations and the project information currently available regarding proposed Site development. As development plans progress, the following evaluations and recommendations should be reviewed by Ransom, and modifications to these evaluations may be necessary. Additional explorations may be necessary.

6.0 DESIGN RECOMMENDATIONS

Based on the subsurface explorations and our geotechnical evaluations, Ransom presents the following recommendations for the proposed hotel development at 277 Providence Street in Worcester, Massachusetts.

6.1 Foundations

The subsurface conditions generally consist of silt and sand overlying bedrock with localized areas of fill materials. The fill materials and organic silty clay unit are considered unsuitable for providing support to the proposed structures and will require removal prior to construction. Due to its generally granular nature and medium dense condition, the fill soils identified near the northwest corner of the proposed building could potentially be left in place provided the geotechnical engineer reviews and approves the material during construction activities. The fill materials should be compacted, proof-rolled, and reviewed by the project geotechnical engineer to evaluate performance during construction. With the exception of the above note regarding the fill, the naturally occurring silt and sand deposit soils are considered the uppermost suitable bearing stratum for proposed foundations at the Site. With proper Site preparation, proposed foundations could bear directly on native soils, or compacted structural fill placed above the native soils or the fill after approval by the geotechnical engineer.

Foundation elements should be proportioned using a maximum allowable contact pressure of 4,000 pounds per square foot (psf). Spread footings should be at least 2 feet wide and continuous footings should be at least 1.5 feet wide. Post-construction total and differential settlements are anticipated to be no more than approximately 1 inch and 0.5 inch, respectively.

Lateral loads may be resisted by friction between the bottoms of footings and supporting subgrades, and by passive earth pressure against the sides of the foundation. A friction coefficient of 0.40 and an equivalent fluid unit weight of 200 pounds per cubic foot (pcf) against the sides of footings should be used.

Exterior footings should be placed a minimum of 4 feet below the lowest existing or proposed adjacent ground surface exposed to freezing. Interior footings should be placed a minimum of 2 feet below the top of proposed ground floor slabs. If exposure to freezing is anticipated during or after construction, interior footings should be lowered to bear 4 feet below the top of the ground floor slab or protected from frost.

6.2 Floor Slabs

The fill materials and organic silty clay unit are considered unsuitable for providing support to the proposed floor slab and, if present, will require removal prior to construction. As noted above, the fill soil identified near the northwest corner of the proposed building could potentially be left in place below the proposed floor slab provided the geotechnical engineer reviews and approves the material during construction activities. Following removal of the unsuitable soils, subsurface conditions are suitable for a slab-on-grade ground floor. The uppermost 12 inches of material beneath all slabs-on-grade should consist of compacted structural fill that conforms to the gradation specification in this report. A modulus of subgrade reaction of 250 pounds per cubic inch (pci) should be used to proportion the slabs-on-grade constructed on properly compacted structural fill.

Exterior slabs at entrances should be underlain by at least 4 feet of free-draining material, such as structural fill or crushed stone, to reduce the potential for frost heaving. Surrounding grades should be sloped away from the building in order to reduce available moisture for forming frost and ice.

6.3 Pavements

Subsurface conditions are suitable for rigid and bituminous asphalt pavement surfacing. Traffic loading data specific to potential future pavements was not available for consideration at the time of this report. We anticipate that pavement subgrades will consist of the existing native silt and sand soils, existing fill materials, or common fill placed to raise the site grades. Fill materials can likely remain in place beneath pavement areas provided that the material performs well during compaction and proof-rolling and is approved by the project geotechnical engineer. All flexible and rigid pavements should be constructed in accordance with current Massachusetts Department of Transportation (NHDOT) 2024 *Standard Specifications for Highways and Bridges*. Ransom can perform a detailed analysis of traffic loading data once developed to optimize the design of Site pavements.

6.4 Seismic Considerations

For the purposes of seismic design, the soil profile constitutes a "stiff soil" profile, and we assign a seismic site class of "D" to the Site based on the conditions encountered to a depth up to 17.5 feet. It is our opinion that the Site soils are not susceptible to liquefaction during seismic events.

6.5 Groundwater and Drainage Issues

Water-saturated soils were not encountered in the soil borings which were advanced to depths up to 17 feet below grade. It is our opinion that underslab drainage systems and vapor barriers are not necessary for geotechnical considerations. Due to the fine-grained nature of native soils and inferred low permeability, we recommend that the proposed building be constructed with a perimeter foundation drainage system.

The perimeter drainage system should consist of 4-inch-diameter, rigid polyvinyl chloride (PVC) SDR35 pipe with perforations of ¼ to ½ inch (openings should be oriented downward). The drain lines should be surrounded by a minimum of 6 inches of ¾-inch crushed stone wrapped in a nonwoven geotextile filter fabric (Mirafi 140N or approved equivalent). The foundation drains should be placed adjacent to the exterior sides of the spread footings at a minimum depth of 4 feet below adjacent exterior grades to protect against frost.

Where possible, the foundation drains should be pitched down at a minimum slope of 0.5 percent in the direction of flow. Cleanouts should be provided at every other 90-degree bend in order to provide for future flushing of the system as needed.

The foundation drains should be gravity drained to daylight or to a suitable system outlet. The final outlet of the drainage systems should be designed by the project Civil Engineer in consideration of all applicable municipal, state, and federal regulations.

An impervious cover, such as asphalt pavement, should be maintained at the exterior ground surface adjacent to proposed future foundation elements to reduce infiltration of surface runoff to foundation elevations. Surrounding Site grades should be sloped away from the proposed foundations in order to reduce the moisture available for forming frost and ice. Roof downspout drains should not be connected to the foundation drain system. Roof downspouts should be separately tight-lined to their discharge outlets.

7.0 EARTHWORK AND CONSTRUCTION RECOMMENDATIONS

Based on the subsurface explorations and our geotechnical evaluations, Ransom presents the following recommendations for the proposed hotel development at 277 Providence Street in Worcester, Massachusetts.

7.1 Subgrade Preparation

The fill materials and organic silty clay unit are considered unsuitable for providing support to the proposed foundations and slab and will require removal prior to construction. The native silt and sand soils are considered to be the uppermost suitable bearing strata at this Site. Due to its generally granular nature and medium dense condition, the fill identified near the northwest corner of the proposed building could potentially be left in place provided the geotechnical engineer reviews and approves the material during construction activities. The fill materials should be compacted, proof-rolled, and reviewed by the project geotechnical engineer to evaluate performance during construction.

All topsoil, debris, fill materials, organic soils, and loose or disturbed soils should be removed from below areas planned for construction of structural elements. These unsuitable materials should be completely removed from foundation bearing zones (to the lateral limits defined by a one horizontal to one vertical (1H:1V) line sloped down and away from the bottom edge of foundations to the top of undisturbed native soils) and replaced with compacted structural fill. The fill materials observed in the northwest area of the site can likely remain in place beneath proposed pavement areas with approval of the project geotechnical engineer following compaction and proof-rolling.

After site stripping has been completed, the subgrade beneath proposed structures and pavements and 10 feet beyond should be compacted with at least four complete passes of a 15-ton vibratory drum roller in directions perpendicular to one another. Silty subgrades which are saturated or are observed to pump and weave during rolling should be rolled statically.

Unstable subgrade areas would be characterized by weaving or rutting of more than one inch during proof-rolling. Any unstable areas identified should be undercut at least 12 inches, or to competent soil, and replaced with compacted structural fill, crushed stone, or common fill. The depth of undercutting and type of backfill material should be selected with consideration of proposed use and soil and weather conditions encountered during construction.

7.2 Rock Excavations

Drilling refusal was observed at depths ranging from approximately 5.5 to 17.5 feet below grade, corresponding to elevations ranging from 445 to 488 feet above MSL. The drilling refusals observed are likely the result of encountering bedrock or boulders. Bedrock outcrops were observed at the Site. We expect that the upper 2 to 3 feet of bedrock can be removed using mechanical methods such as ripping and hammering. Deeper excavations into bedrock will likely require blasting. It is our opinion that bedrock removal can be minimized if the proposed design considers the elevation of bedrock/drilling refusals. The bedrock surface is likely irregular, and areas of bedrock shallower than the elevations in the site test borings should be anticipated during design and construction. Boulders, cobbles, and bedrock could be processed to produce structural fill materials to be used in the proposed construction.

7.3 Temporary Excavations

Construction site safety, means and methods, and sequencing of construction activities are the sole responsibility of the contractor. Under no circumstances should the following information be interpreted to mean that Ransom is assuming responsibility for construction site safety, trench protection, or the contractor's responsibilities. Such responsibility is not being implied and should not be inferred.

All temporary excavations should be performed according to Occupational Safety and Health Administration (OSHA) Standards (29 CFR 1926 Subpart P). The native soils are considered OSHA Type C soils, and temporary unbraced excavations in the native sand soils should be cut no steeper than 1.5H:1V under dry or dewatered conditions.

Excavations should be properly sloped and/or shored to prevent shifting and/or settlement of adjacent structures, utilities, sidewalks, and streets. Shoring, if required, should be designed by a professional engineer licensed in the State of Massachusetts.

7.4 Dewatering and Runoff Control

Water-saturated soils were not encountered in the soil borings. Surface water runoff should be directed away from excavations to reduce dewatering efforts and to protect subgrades from becoming soft and unstable. The contractor should anticipate the need for controlling runoff during wet periods; pumping from open sumps will likely provide adequate control of water within excavations during construction.

Earthwork should be completed "in the dry." Subgrade soils that become unstable should be undercut and replaced with structural fill or crushed stone, as necessary. Excavation side slopes should be monitored for potential seepage and maintained to promote stability, accordingly. Temporary detention ponds, trenches, ditches, and dewatering sumps should not be made in areas to be filled.

7.5 Reuse of Site Materials

A preliminary assessment of the suitability of reusing the Site soils in the proposed construction indicate that the naturally-occurring silt and sand soils are suitable for reuse only as common fill below non-structural areas and landscaped areas.

7.6 Placement of Granular Engineered Fills

Engineered fills may be required to achieve the final design grades in areas of the Site. The table below presents recommended gradation specifications for soils used in engineered fills at the Site. Reference is made to materials, described by the MHD *Standard Specifications for Highways and Bridges*, as possible alternatives. The different granular fill types should be used as follows:

1. Structural Fill should be used for engineered fills below proposed building and foundation areas.

2. Common Fill should be used for engineered fills below roadway, parking, and other non-structural areas.

Type	Size	% Passing
Structural Fill; MHD M1.03.0a	6" (150 mm) 1/2" (12.5 mm) No. 4 (4.75 µm) No. 50 (300 µm) No. 200 (75 µm)	100 50–85 40–75 8–28 0–10
Common Fill	8" No. 200 (75 µm)	100 0–15 (when placed within 4 feet of finished grade in paved areas)

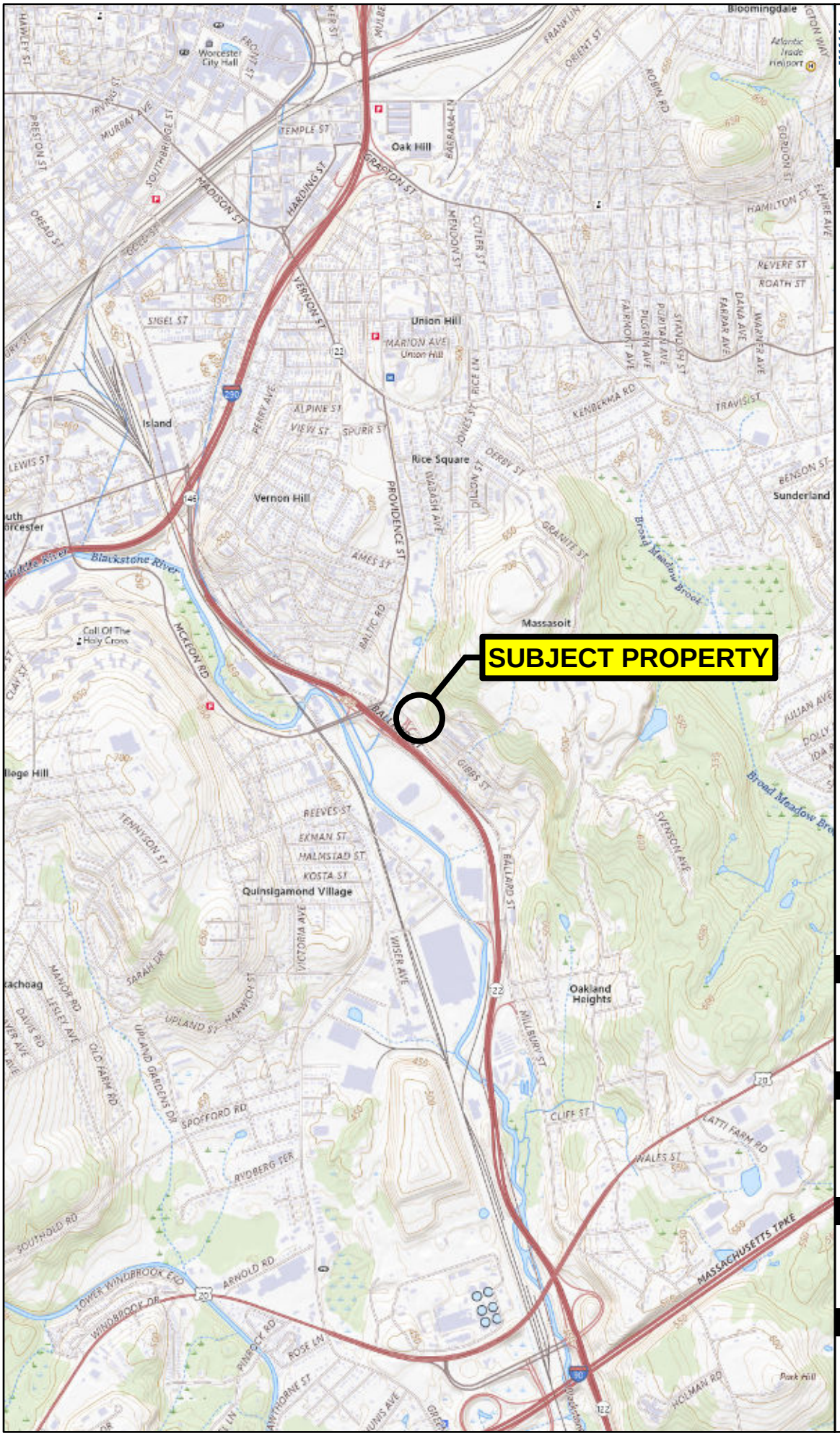
All granular fills should be placed in 12-inch maximum loose lifts and should be compacted to a minimum of 95 percent of the material's maximum dry density, as determined by ASTM D1557 (modified proctor test) and confirmed through field density testing (ASTM D6938 or equivalent method). Lift thickness should be a maximum of 6-inch loose lifts when compacted with hand-guided equipment.

Where subgrades become saturated, unstable, and/or difficult to compact, ¾-inch crushed stone (or approved equivalent) should be placed and compacted in lieu of structural fill. Crushed stone, when used, should be wrapped in a geotextile filter fabric, such as Mirafi 140N or equal. At no time should structural fill or common fill be placed over crushed stone that has not been wrapped in a geotextile filter fabric.

8.0 CONCLUDING COMMENTS

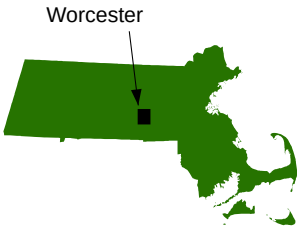
This report has been prepared for general application to the proposed hotel development at 277 Providence Street in Worcester, Massachusetts as understood by Ransom at the time of the work. Ransom should be provided the opportunity to review final design site plans and specifications when complete and provide a report addendum if necessary.

The findings, recommendations, and professional opinions contained within this project geotechnical report have been prepared in accordance with generally accepted professional geotechnical engineering practice. No other warranties are implied or expressed.



RANSOM Consulting, LLC
a PINCHIN company

Regional Locator Map



Notes

1. Data Source: Copyright: © 2013 National Geographic Society, i-cubed
2. USGS Quad Names: Winchendon and Worcester South, Massachusetts
3. Latitude: 42°14'9"N
   Longitude: 71°47'26"W

Scale and Orientation

0 1,000 2,000

1 inch = 2,000 feet

Prepared For

Mr. Gregory T. Heflin
Park Silver Development LLC
8171 Maple Lawn Boulevard,
Suite 380
Fulton, Maryland 20759

Subject Property Address

277 Providence Street
Worcester, MA

242.01023 | Oct 2024

Figure 1

Subject Property Location Map

RANSOM Consulting, LLC
PINCHIN company

Legend & Notes

- Subject Property
- Proposed Building
- Soil Boring Location

Notes

1. Site Plan based on MassGIS, 2019
2. Some features are approximate in location and scale
3. This plan has been prepared for Sunburst Hospitality Corporation. All other uses are not authorized unless written permission is obtained from Ransom Consulting, LLC.

Scale & Orientation

0 40 80

1 inch = 80 feet

Prepared For

Mr. Gregory T. Heflin
Park Silver Development LLC
8171 Maple Lawn Boulevard,
Suite 380
Fulton, Maryland 20759

Subject Property Address

277 Providence Street
Worcester, MA

242.01023 | Oct 2024

Figure 2
Subsurface Exploration Plan

X:\Ransom_NewEngland\Massachusetts\Worcester_MA\277ProvidenceStreet\277PS_WorcesterMA.aprx; 277PS_WorcesterMA-F2_SubsurfaceExp

APPENDIX A

Exploration Logs

Geotechnical Engineering Report
Proposed Hotel
277 Providence Street
Worcester, Massachusetts

RANSOM
Consulting, LLC
a PINCHIN company

BORING AND MONITORING WELL LOG

B1

Project Number: 242 01023.002	Drilling Company: Geosearch	Total Depth: 11.5
Project: 277 Providence St	Drilling Method: Hollow Stem Auger	Start Date: 9/9/24
Site Location: Worcester MA	Boring Diameter: 6"	Date Completed: 9/9/24
	Elevation: 476' +/-	Logged by: JRJ
Client: Park Silver Development LLC	Groundwater Observed: NO	Reviewed by: BRP

DESCRIPTION Based on USCS and Modified Burmister Soil Classification System	SAMPLE*	SAMPLE NUMBER	BLOWS (PER 6")	PENETRATION / RECOVERY	PID/FID (PPM)	DEPTH (FT.)	WELL CONSTRUCTION
S1 (0-2') Medium dense, brown sand, silt, gravel, FILL, dry		S1	8-13-8-11	12/24		1	
S2 (2-4') Medium dense, brown sand, silt, gravel, FILL, dry		S2	12-12-13-15	18/24		2 3	
S3 (4-6') Medium dense, brown SILT with sand, medium grained with random cobbles		S3	9-17-11-11	20/24		4 5	
Dark brown SAND, dry, medium grained.						6 7	
Boulder @ 8-9'						8 9	
S4 (10-11.5') Very dense, brown SAND, fine to medium grained, dry, Gneiss		S4	37-40-60 (4")	12/16		10 11	
REFUSAL @ 11.5 feet						12 13 14 15 16 17 18 19	

Notes:

Well Legend:

FS	NF	B	BG	C	
Filter Sand	Native Fill	Bentonite	Bentonite Grout	Concrete	PVC Screen

NA=not applicable; NM=not measured; NE=not encountered
*Sample designated with black fill submitted for laboratory analysis.

BORING AND MONITORING WELL LOG

B2

Project Number: 242 01023.002	Drilling Company: Geosearch	Total Depth: 12.0
Project: 277 Providence St	Drilling Method: Hollow Stem Auger	Start Date: 9/9/24
Site Location: Worcester MA	Boring Diameter: 6"	Date Completed: 9/9/24
	Elevation: 475' +/-	Logged by: JRJ
Client: Park Silver Development LLC	Groundwater Observed: NO	Reviewed by: BRP

DESCRIPTION Based on USCS and Modified Burmister Soil Classification System	SAMPLE*	SAMPLE NUMBER	BLOWS (PER 6")	PENETRATION / RECOVERY	PID/FID (PPM)	DEPTH (FT.)	WELL CONSTRUCTION
S1 (0-2') Medium dense, brown SILT mixed with sand, dry over tan medium grained SAND with cobbles		S1	3-5-12-16	20/24		1	
S2 (2-4') M. dense, brown-gray SAND, with silt, gravel, dry grading to silty CLAY moderate stiffness, dark brown, moist, possibly anoxic with organics.		S2	10-6-6-3	18/24		2 3	
S3 (4-6') Soft, silty CLAY, dark brown, moist, possibly anoxic with organics.		S3	2-1-2-2	18/24		4 5	
(6-10') Silty CLAY moderate stiffness, with some sand, medium grained, black, dark brown, moist, possibly anoxic with organics. Based on cuttings						6 7 8 9 10	
S4 (10-11.5') M. dense, black SAND, course grained with fine gravel, moist.		S4	4-4-10-10	4/24		11	
REFUSAL @ 12 feet						12 13 14 15 16 17 18 19	

Notes:

Well Legend:

FS	NF	B	BG	C	
Filter Sand	Native Fill	Bentonite	Bentonite Grout	Concrete	PVC Screen

NA=not applicable; NM=not measured; NE=not encountered
*Sample designated with black fill submitted for laboratory analysis.

BORING AND MONITORING WELL LOG

B3

Project Number: 242 01023.002	Drilling Company: Geosearch	Total Depth: 6.0
Project: 277 Providence St	Drilling Method: Hollow Stem Auger	Start Date: 9/10/24
Site Location: Worcester MA	Boring Diameter: 6"	Date Completed: 9/10/24
	Elevation: 480' +/-	Logged by: JRJ
Client: Park Silver Development LLC	Groundwater Observed: NO	Reviewed by: BRP

DESCRIPTION Based on USCS and Modified Burmister Soil Classification System	SAMPLE*	SAMPLE NUMBER	BLOWS (PER 6")	PENETRATION / RECOVERY	PID/FID (PPM)	DEPTH (FT.)	WELL CONSTRUCTION
S1 (0-2') M. dense, brown SAND, fine grained, dry, cobble (1-2') over tan SAND, medium grained, dry		S1	7-9-6-7	8/24		1	
S2 (2-4') Very dense, tan SAND, medium grained, dry		S2	7-13-50 (2")	10/24		2 3 4	
S3 (4-5.5') Very dense, light tan SAND, fine to medium grained, dry, over moderate cobble, Gneiss		S3	16-27-50 (2"	8/24		5	
REFUSAL @ 6.0'						6 7 8 9 10 11 12 13 14 15 16 17 18 19	

Notes:

Well Legend:

FS	NF	B	BG	C	
Filter Sand	Native Fill	Bentonite	Bentonite Grout	Concrete	PVC Screen

NA=not applicable; NM=not measured; NE=not encountered
*Sample designated with black fill submitted for laboratory analysis.

BORING AND MONITORING WELL LOG

B4

Project Number: 242 01023.002	Drilling Company: Geosearch	Total Depth: 7.0
Project: 277 Providence St	Drilling Method: Hollow Stem Auger	Start Date: 9/10/24
Site Location: Worcester MA	Boring Diameter: 6"	Date Completed: 9/10/24
	Elevation: 495' +/-	Logged by: JRJ
Client: Park Silver Development LLC	Groundwater Observed: NO	Reviewed by: BRP

DESCRIPTION Based on USCS and Modified Burmister Soil Classification System	SAMPLE*	SAMPLE NUMBER	BLOWS (PER 6")	PENETRATION / RECOVERY	PID/FID (PPM)	DEPTH (FT.)	WELL CONSTRUCTION
S1 (0-2') M. dense, brown SAND, fine grained, dry, cobble (1-2') over tan SAND, medium grained, dry		S1	6-6-8-9	8/24		1	
S2 (2-4') M. dense, tan SAND, medium grained, dry		S2	14-9-6-8	18/24		2 3 4	
S3 (4-6') M. dense, tan SAND, fine to medium grained, dry, random cobbles 6-7' Tan sand over Gneiss		S3	6-6-8-8	18/24		5 6	
REFUSAL @ 7.0'						7 8 9 10 11 12 13 14 15 16 17 18 19	

Notes:

Well Legend:

FS	NF	B	BG	C	
Filter Sand	Native Fill	Bentonite	Bentonite Grout	Concrete	PVC Screen

NA=not applicable; NM=not measured; NE=not encountered
*Sample designated with black fill submitted for laboratory analysis.

BORING AND MONITORING WELL LOG

B6

Project Number: 242 01023.002	Drilling Company: Geosearch	Total Depth: 9.5
Project: 277 Providence St	Drilling Method: Hollow Stem Auger	Start Date: 9/9/24
Site Location: Worcester MA	Boring Diameter: 6"	Date Completed: 9/9/24
	Elevation: 462' +/-	Logged by: JRJ
Client: Park Silver Development LLC	Groundwater Observed: NO	Reviewed by: BRP

DESCRIPTION Based on USCS and Modified Burmister Soil Classification System	SAMPLE*	SAMPLE NUMBER	BLOWS (PER 6")	PENETRATION / RECOVERY	PID/FID (PPM)	DEPTH (FT.)	WELL CONSTRUCTION
S1 (0-2') M. dense, tan sand, FILL, medium grained, dry over brown sand, FILL medium grained with silt, dry.		S1	6-8-14-30	16/24		1	
Boulder between 2-3'.						2	
S2 (3-4') Dense, brown silty-sand, FILL, medium to fine grained, dry, possible boulder at base.		S2	14-35 (2")	12/14		3	
						4	
Augering very difficult from 4-7'.						5	
						6	
S3 (7-9') Dense, tan SAND, medium grained, dry		S3	19-25-18-17	18/24		7	
						8	
						9	
REFUSAL @ 9.5						10	
						11	
						12	
						13	
						14	
						15	
						16	
						17	
						18	
						19	

Notes:

Well Legend:

FS	NF	B	BG	C	
Filter Sand	Native Fill	Bentonite	Bentonite Grout	Concrete	PVC Screen

NA=not applicable; NM=not measured; NE=not encountered

*Sample designated with black fill submitted for laboratory analysis.

BORING AND MONITORING WELL LOG

B7

Project Number: 242 01023.002	Drilling Company: Geosearch	Total Depth: 17.5
Project: 277 Providence St	Drilling Method: Hollow Stem Auger	Start Date: 9/9/24
Site Location: Worcester MA	Boring Diameter: 6"	Date Completed: 9/9/24
	Elevation: 487' +/-	Logged by: JRJ
Client: Park Silver Development LLC	Groundwater Observed: NO	Reviewed by: BRP

DESCRIPTION Based on USCS and Modified Burmister Soil Classification System	SAMPLE*	SAMPLE NUMBER	BLOWS (PER 6")	PENETRATION / RECOVERY	PID/FID (PPM)	DEPTH (FT.)	WELL CONSTRUCTION
S1 (0-2') Brown sand, FILL, medium grained, dry with random cobbles.		S1	7-10-12-11	12/24		1	
						2	
S2 (2-4') M. dense, brown sand, FILL, medium grained, dry with random cobbles.		S2	14-9-6-35	12/24		3	
						4	
S3 (4-6') M. dense, brown sand, FILL, medium grained, dry with random cobbles.		S3	12-9-10-11	14/24		5	
						6	
						7	
						8	
						9	
S4 (10-12') Dense, brown sand, FILL, medium grained, dry with random cobbles.		S4	15-14-18-20	14/24		10	
						11	
						12	
						13	
						14	
S5 (15-17') V. dense, tan sandy-SILT, dry over possible granite boulder or Gneiss ledge.		S5	21-55-60 (4")	20/22		15	
						16	
						17	
REFUSAL @ 17.5						18	
						19	

Notes:

Well Legend:

FS	NF	B	BG	C	
Filter Sand	Native Fill	Bentonite	Bentonite Grout	Concrete	PVC Screen

NA=not applicable; NM=not measured; NE=not encountered
*Sample designated with black fill submitted for laboratory analysis.

BORING AND MONITORING WELL LOG

B8

Project Number: 242 01023.002	Drilling Company: Geosearch	Total Depth: 5.5
Project: 277 Providence St	Drilling Method: Hollow Stem Auger	Start Date: 9/9/24
Site Location: Worcester MA	Boring Diameter: 6"	Date Completed: 9/9/24
	Elevation: 471' +/-	Logged by: JRJ
Client: Park Silver Development LLC	Groundwater Observed: NO	Reviewed by: BRP

DESCRIPTION Based on USCS and Modified Burmister Soil Classification System	SAMPLE*	SAMPLE NUMBER	BLOWS (PER 6")	PENETRATION / RECOVERY	PID/FID (PPM)	DEPTH (FT.)	WELL CONSTRUCTION
S1 (0-2') Loose, brown-black SILT, dry.		S1	2-3-4-4	8/24		1	
						2	
S2 (2-4') M. dense, brown-black SILT, dry, over tan SAND, medium to fine grained, dry.		S2	14-9-6-35	12/24		3	
						4	
S3 (4-6') Brown SILT with sand, brown, fine medium to fine grained, dry, over, Gneiss		S3	20-50 (4")	6/16		5	
REFUSAL @ 5.5						6	
						7	
						8	
						9	
						10	
						11	
						12	
						13	
						14	
						15	
						16	
						17	
						18	
						19	

Notes:

Well Legend:

FS	NF	B	BG	C	
Filter Sand	Native Fill	Bentonite	Bentonite Grout	Concrete	PVC Screen

NA=not applicable; NM=not measured; NE=not encountered
*Sample designated with black fill submitted for laboratory analysis.

BORING AND MONITORING WELL LOG

B9

Project Number: 242 01023.002	Drilling Company: Geosearch	Total Depth: 13.5
Project: 277 Providence St	Drilling Method: Hollow Stem Auger	Start Date: 9/9/24
Site Location: Worcester MA	Boring Diameter: 6"	Date Completed: 9/9/24
	Elevation: 462' +/-	Logged by: JRJ
Client: Park Silver Development LLC	Groundwater Observed: NO	Reviewed by: BRP

DESCRIPTION Based on USCS and Modified Burmister Soil Classification System	SAMPLE*	SAMPLE NUMBER	BLOWS (PER 6")	PENETRATION / RECOVERY	PID/FID (PPM)	DEPTH (FT.)	WELL CONSTRUCTION
S1 (0-2') Loose, brown SILT, dry, over tan, SAND, fine grained, dry.		S1	3-4-5-5	12/24		1	
						2	
S2 (2-4') M. dense, brown-tan SAND, fine to medium grained, dry.		S2	4-6-10-14	18/24		3	
						4	
S3 (4-6') Dense, brown SILT with sand, dry, over tan silty-SAND, fine to medium grained, dry, mixed with cobbles.		S3	6-14-19-16	18/24		5	
						6	
(6-10') Brown-tan silty SAND, dry						7	
						8	
						9	
						10	
S4 (10-12') Dense, tan-gray SAND, medium grained, mixed with silt, dry, random cobbles, over brown, sandy-SILT, dry, over Gneiss.		S4	19-18-17-15	24/24		11	
						12	
						13	
						14	
REFUSAL @ 13.5						15	
						16	
						17	
						18	
						19	

Notes:

Well Legend:

FS	NF	B	BG	C	
Filter Sand	Native Fill	Bentonite	Bentonite Grout	Concrete	PVC Screen

NA=not applicable; NM=not measured; NE=not encountered
*Sample designated with black fill submitted for laboratory analysis.

BORING AND MONITORING WELL LOG

B10

Project Number: 242 01023.002	Drilling Company: Geosearch	Total Depth: 7.5
Project: 277 Providence St	Drilling Method: Hollow Stem Auger	Start Date: 9/9/24
Site Location: Worcester MA	Boring Diameter: 6"	Date Completed: 9/9/24
	Elevation: 470' +/-	Logged by: JRJ
Client: Park Silver Development LLC	Groundwater Observed: NO	Reviewed by: BRP

DESCRIPTION Based on USCS and Modified Burmister Soil Classification System	SAMPLE*	SAMPLE NUMBER	BLOWS (PER 6")	PENETRATION / RECOVERY	PID/FID (PPM)	DEPTH (FT.)	WELL CONSTRUCTION
S1 (0-2') M. dense, brown SILT, dry, over tan-gray, SAND, fine to medium grained, dry.		S1	1-2-8-7	14/24		1	
						2	
S2 (2-4') M. dense, tan SAND, fine to medium grained, dry, mixed with random cobbles.		S2	3-6-12-14	16/24		3	
						4	
S3 (4-6') Dense, tan SAND, medium grained, dry, possible hardpan till.		S3	10-19-16-15	20/24		5	
						6	
(6-7.5) Tan SAND, medium grained, some gravels, Gneiss						7	
REFUSAL @ 7.5						8	
						9	
						10	
						11	
						12	
						13	
						14	
						15	
						16	
						17	
						18	
						19	

Notes:

Well Legend:

FS	NF	B	BG	C	
Filter Sand	Native Fill	Bentonite	Bentonite Grout	Concrete	PVC Screen

NA=not applicable; NM=not measured; NE=not encountered
*Sample designated with black fill submitted for laboratory analysis.

Site Location or lot #	277 Providence Street, Worcester				DEEP HOLE # 1
Applicant/owner:					
DATE:	10/30/2024	WEATHER:	Sunny	TEMP: 65 º	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Owen Ryan (SE #14797)				
WITNESSED BY:	N/A (for drainage only)				
Land Use:	Grassed Area Adjacent to Swale		Landform:	Moraines	
Vegetation:	Grass/Weeds		Slope:	15-20%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☒ Y ☐ N	

Distance From:			
Open Water Bodies:	>100 ft.	Possible Wet Area:	>100 ft.
Drinking Water Well:	>100 ft.	Drainageway:	20 ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-66"	FILL	Sandy Loam	10yr 5/4	Massive, Friable, 10-15% stone/gravel, boulders present, stronger cast than #2
66-72"	FILL	Sandy Loam	10yr 4/4	Soil Texture = FSL; Massive Friable, 0-5% stone, 5-10% boulders
	-	-		
	-	-		

Parent Material (geologic):	-	Depth to Bedrock:	72"+
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		72"+

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:		None			
		Depth to weeping from side of obs. hole:		None			
		Depth to soil mottles, description:		None			
		Groundwater adjustment:		72"+			
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes:	Adjacent to Rip-Rap waterway, very rocky, chunks of silt/clay (gray color); Appeard to be entirely fill, however second horizon was broken out due to a darker color and more fine texture. Soil Texture provided for reference only.

Site Location or lot #	277 Providence Street, Worcester				DEEP HOLE # 2
Applicant/owner:					
DATE:	10/30/2024	WEATHER:	Sunny	TEMP: 75 º	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Owen Ryan (SE #14797)				
WITNESSED BY:	N/A (for drainage only)				
Land Use:	Woods		Landform:	Moraines	
Vegetation:	Wooded		Slope:	0-10 (flat area at top of slope)	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☒ Y ☐ N	

Distance From:			
Open Water Bodies:	>100 ft.	Possible Wet Area:	>100 ft.
Drinking Water Well:	>100 ft.	Drainageway:	>100 ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-84"+	FILL	Sandy Loam	10yr 5/4	10-15% stones and gravel, massive, friable small boulders, moderate staining
	-	-		
	-	-		
	-	-		

Parent Material (geologic):	-	Depth to Bedrock:	84"+
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		84"+

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:		NA			
		Depth to weeping from side of obs. hole:		NA			
		Depth to soil mottles, description:		NA			
		Groundwater adjustment:		NA			
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes:	Immediately adjacent to steep slopes, extremely rocky fill/debris, boulders Soil Texture provided for reference only.

Site Location or lot #	277 Providence Street, Worcester	DEEP HOLE # 3
Applicant/owner:		

DATE:	10/30/2024	WEATHER:	Sunny	TEMP: 70 º
LOCATION: (Refer to sketch attached)				
PERFORMED BY:	Owen Ryan (SE #14797)			
WITNESSED BY:	N/A (for drainage only)			

Land Use:	Vacant land	Landform:	Moraines
Vegetation:	Wooded	Slope:	5-15
Stone Walls:	☐ Y ☒ N	Surface Stones:	☒ Y ☐ N

Distance From:

Open Water Bodies:	>100 ft.	Possible Wet Area:	>100 ft.
Drinking Water Well:	>100 ft.	Drainageway:	>100 ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-10"	Ap	Sandy Loam	10yr 4/4	Soil Texture is FSL; Massive, granular, 0-5% stones, 0 boulders, organics present
10-62"	Bw	Sandy Loam	10yr 5/4	Soil Texture is FSL; Massive, friable, 5-10% stone, boulder present, moderate staining, bedrock hit
	-	-		
	-	-		

Parent Material (geologic):	-	Depth to Bedrock:	62
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		62"+

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:	Depth observed standing in obs. hole:	NA
	Depth to weeping from side of obs. hole:	NA
	Depth to soil mottles, description:	NA
	Groundwater adjustment:	NA

Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes:	Rocks visible nearby, ledge face 50-100' away.

Site Location or lot #	277 Providence Street, Worcester				DEEP HOLE # 4
Applicant/owner:					
DATE:	10/30/2024	WEATHER:	Sunny	TEMP: 70 º	
LOCATION: (Refer to sketch attached)					
PERFORMED BY:	Owen Ryan (SE #14797)				
WITNESSED BY:	N/A (for drainage only)				
Land Use:	Vacant Land		Landform:	Moraines	
Vegetation:	Wooded		Slope:	5-15%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☒ Y ☐ N	

Distance From:			
Open Water Bodies:	>100 ft.	Possible Wet Area:	>100 ft.
Drinking Water Well:	>100 ft.	Drainageway:	>100 ft.
Property Line:	ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-7"	Ap	-	10yr 4/4	Massive, granular, 0-5% stone & gravel
7-20"	Bw	Sandy Loam	10yr 5/4	Soil Texture FSL; Massive, Friable, 5-10% stone, boulders present, moderate staining, dry
20-56"	C	Sandy Loam	10yr 6/4	Soil Texture is FSL; Massive. friable, 5-10% stone, boulders
	-	-		

Parent Material (geologic):	-	Depth to Bedrock:	56"
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		56"+

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:		NA			
		Depth to weeping from side of obs. hole:		NA			
		Depth to soil mottles, description:		NA			
		Groundwater adjustment:		NA			
Index Well #:		Reading Date:		Index Well Level:		Adj. Factor:	
Adj. ground water level:							

Notes:	Bw & C were generally the same, however, a slight difference in color was noticed.

Map Scale: 1:7,970 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

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 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 19, Aug 27, 2024

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
1	Water	1.0	0.3%
51A	Swansea muck, 0 to 1 percent slopes	3.0	1.0%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	9.5	3.1%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	0.1	0.0%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	127.6	41.1%
102D	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	32.9	10.6%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	11.8	3.8%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	5.9	1.9%
306C	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	18.7	6.0%
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	1.4	0.5%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	3.6	1.2%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	2.4	0.8%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	27.4	8.8%
602	Urban land	49.9	16.1%
651	Udorthents, smoothed	15.2	4.9%
Totals for Area of Interest		**310.5**	**100.0%**

PROP WORCESTER DRIVEWAY OPENING (TYP)

GATEWAY–ACCESS, DRAINAGE, UTILITY AND PARKING EASEMENT PER PLAN BOOK 889 PLAN 4

EXISTING DRAINAGE STRUCTURES TO BE RELOCATED AND RECONSTRUCTED

Field Location

T-1

T-2

T-3

CHB=S54°50'07"E
CHD=318.67'

Now or Formerly
AMERICAN LEGION INC.
VERNON HILL POST 435
BOOK 4232, PAGE 486
PLAN BOOK 256, PLAN 47
PARCEL ID 35-035-00003

PROP ACCESSIBLE PARKING AREA (TYP). 2.0% MAX SLOPE IN ALL DIRECTIONS

APPROXIMATE ZONING DISTRICT BOUNDARY

Now or Formerly
DEPOT ASSOCIATES
BOOK 10384, PAGE 112
PARCEL ID 31-015-0002

PROP 4 STORY WOOD SPRING SUITES HOTEL 122 ROOMS

FF 475.00

L=150.48'
R=1207.00'
Δ=02°23'47"
CHB=N49°53'25"W
CHD=50.48'

L=179.34'
R=1207.00'
Δ=8°30'47"
CHB=N44°26'12"W
CHD=179.18'

L=244.46'
R=997.00'
Δ=14°02'55"
CHB=N33°09'21"W
CHD=243.85'

S43°37'51"E
386.88'

l=456.3'
18" CPP

l=454.5'
36" RCP

EXISTING DRAINAGE STRUCTURES TO BE RELOCATED AND RECONSTRUCTED

l=454.8'
36" RCP

APPROX LOCATION OF PROP UNDERGROUND STORMWATER MANAGEMENT SYSTEM

PROP LANDSCAPE WALL

B-1

B-2

APPROXIMATE ZONING DISTRICT BOUNDARY

BASIS OF BRG(D) S36°50'02"E 3.15' OFF

THIS PLAN TO BE UTILIZED FOR SITE GRADING PURPOSES ONLY

20 10 5 0 20
SCALE: 1" = 20'

BOHLER
SITE CIVIL AND CONSULTING ENGINEERING
LAND SURVEYING
PROGRAM MANAGEMENT
LANDSCAPE ARCHITECTURE
INDUSTRIAL DESIGN
PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY

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PRELIMINARY

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PROJECT No.:	MAA240174.00-0A
DRAWN BY:	OCR/CJP
CHECKED BY:	MMA
DATE:	06/20/2024
CAD I.D.:	P-GEOE-ALGN

PROJECT:

SITE DEVELOPMENT PLANS

FOR

Park Silver DEVELOPMENT

PROPOSED DEVELOPMENT

MAP: 31 | BLK: 15 | LOT: 2
277 PROVIDENCE STREET
WORCESTER COUNTY
WORCESTER, MASSACHUSETTS

BOHLER
352 TURNPIKE ROAD, 3rd FLOOR
SOUTHBOROUGH, MA 01772
Phone: (508) 480-9900
www.BohlerEngineering.com

DRAFT: 10/29/24

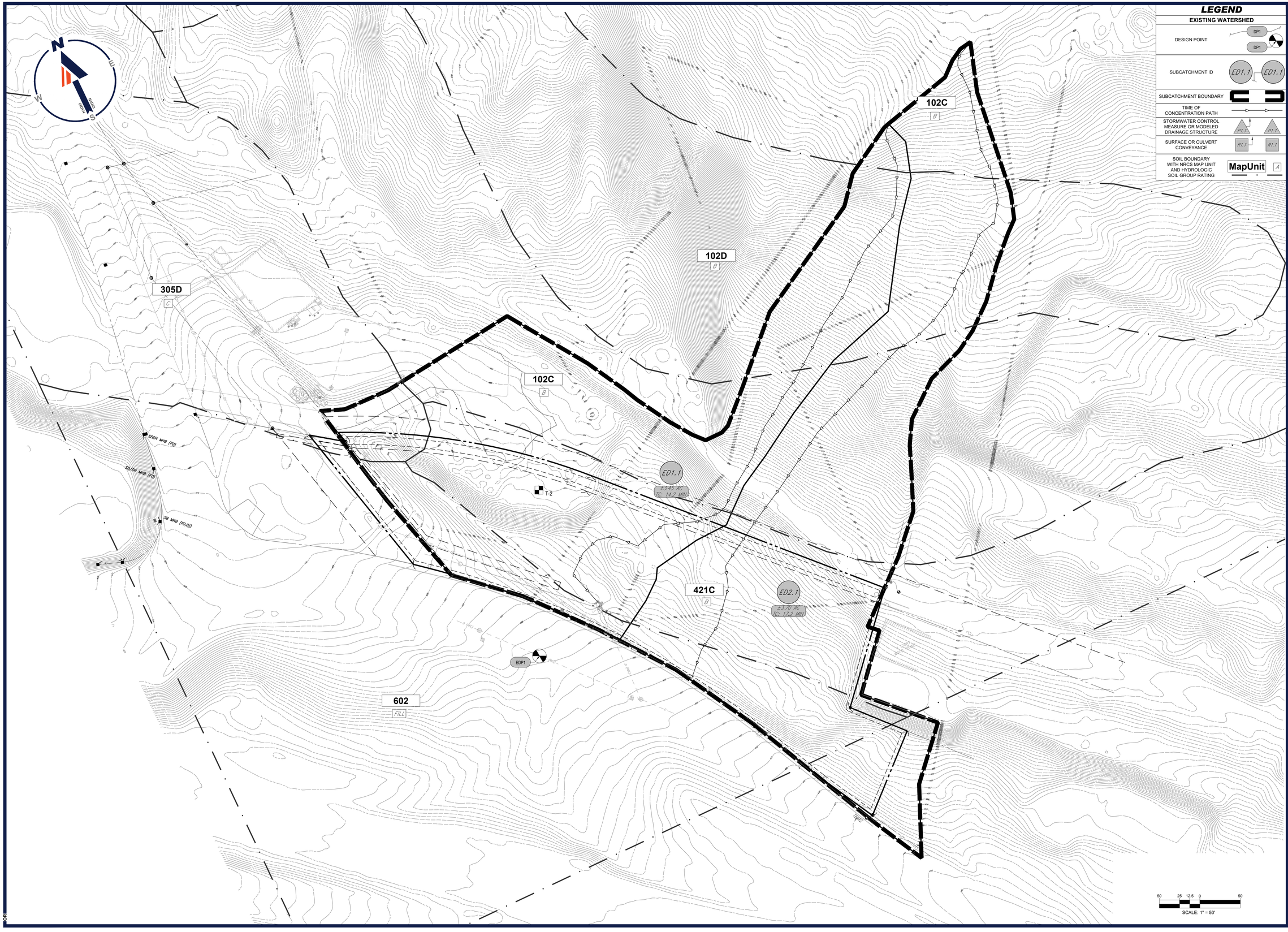
SHEET TITLE:

SHEET NUMBER:

ORG. DATE - 06/20/2024

APPENDIX D: EXISTING CONDITIONS HYDROLOGIC ANALYSIS

- *EXISTING CONDITIONS DRAINAGE MAP*
- *EXISTING CONDITIONS HYDROCAD COMPUTATIONS*



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SITE CIVIL AND CONSULTING ENGINEERING
LAND SURVEYING
PROGRAM MANAGEMENT
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ENVIRONMENTAL SERVICES
PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY

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PROJECT No.:	MAA240174.00-2A
DRAWN BY:	OCR/CJP
CHECKED BY:	MMA
DATE:	11/14/2024
CAD I.D.:	P-CIVL-HYDR

PROJECT:

SITE DEVELOPMENT PLANS

FOR

Park Silver DEVELOPMENT

PROPOSED DEVELOPMENT

MAP: 31 | BLK: 15 | LOT: 2
277 PROVIDENCE STREET
WORCESTER COUNTY
WORCESTER, MASSACHUSETTS

BOHLER
352 TURNPIKE ROAD, 3rd FLOOR
SOUTHBOROUGH, MA 01772
Phone: (508) 480-9900
www.BohlerEngineering.com

J.A. KUCICH

PROFESSIONAL ENGINEER
MASSACHUSETTS LICENSE No. 41530
NEW HAMPSHIRE LICENSE No. 15476
CONNECTICUT LICENSE No. 26177
RHODE ISLAND LICENSE No. 9616
MAINE LICENSE No. 12553

SHEET TITLE:

PRE-DEVELOPMENT DRAINAGE MAP

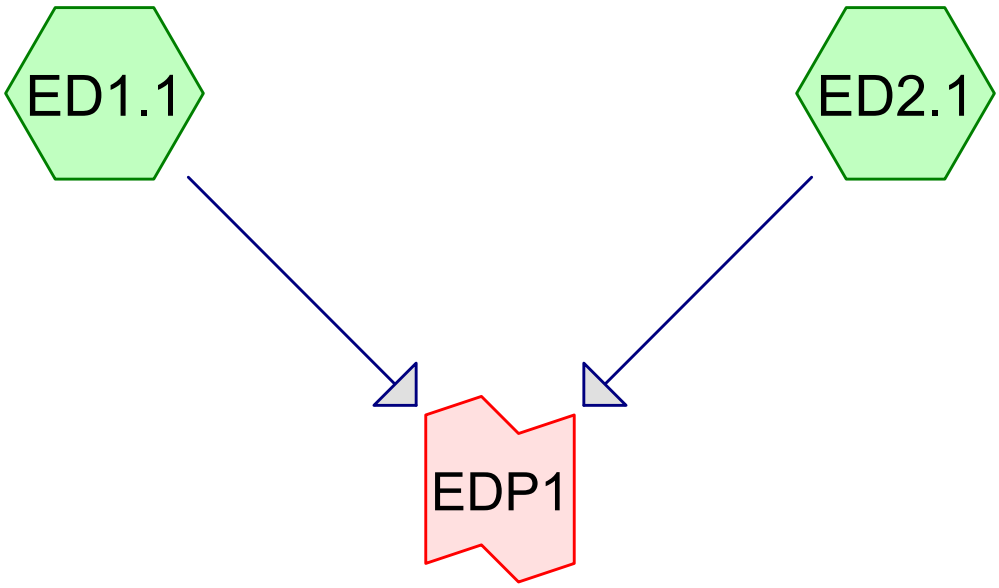
SHEET NUMBER:

C-402

ORG. DATE - 11/14/2024

I:\BOHLER\ENG\-NET\SHARE\SMA-PROJECTS\2024\MAA240174.00\CAD\DRAWINGS\PLAN SETS\CIVIL SITE PLANS\SP-CIVIL-HYDR-MAA240174.00-2A-----LAYOUT: C-402 PRED

EXISTING



MILLBURY STREET

Subcat Reach Pond Link

Routing Diagram for MAA220174 - Pre & Post
Prepared by Bohler, Printed 11/14/2024

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.84	2
2	10-Year	Type III 24-hr		Default	24.00	1	6.01	2
3	25-Year	Type III 24-hr		Default	24.00	1	7.75	2
4	100-Year	Type III 24-hr		Default	24.00	1	10.70	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.346	98	Paved parking, HSG B (ED1.1)
6.796	55	Woods, Good, HSG B (ED1.1, ED2.1)
7.142	**57**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
7.142	HSG B	ED1.1, ED2.1
0.000	HSG C	
0.000	HSG D	
0.000	Other	
7.142		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.346	0.000	0.000	0.000	0.346	Paved parking	ED1.1
0.000	6.796	0.000	0.000	0.000	6.796	Woods, Good	ED1.1, ED2.1
0.000	**7.142**	**0.000**	**0.000**	**0.000**	**7.142**	**TOTAL AREA**	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentED1.1: Runoff Area=150,847 sf 9.99% Impervious Runoff Depth=0.64"
Flow Length=809' Tc=11.0 min CN=59 Runoff=1.57 cfs 0.184 af

SubcatchmentED2.1: Runoff Area=160,255 sf 0.00% Impervious Runoff Depth=0.47"
Flow Length=932' Tc=12.9 min CN=55 Runoff=0.90 cfs 0.143 af

Link EDP1: MILLBURY STREET Inflow=2.38 cfs 0.328 af
Primary=2.38 cfs 0.328 af

Total Runoff Area = 7.142 ac Runoff Volume = 0.328 af Average Runoff Depth = 0.55"
95.16% Pervious = 6.796 ac 4.84% Impervious = 0.346 ac

Summary for Subcatchment ED1.1:

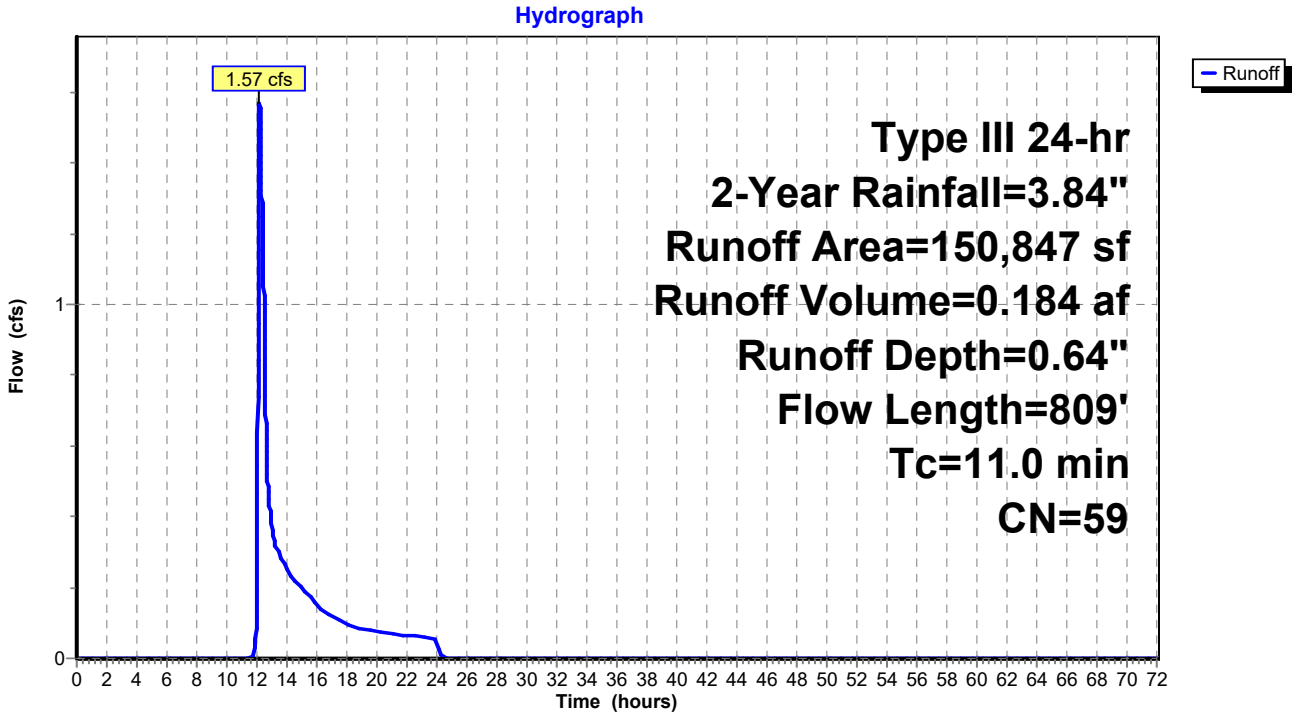
Runoff = 1.57 cfs @ 12.19 hrs, Volume= 0.184 af, Depth= 0.64"
Routed to Link EDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.84"

Area (sf)	CN	Description
135,783	55	Woods, Good, HSG B
15,064	98	Paved parking, HSG B
150,847	59	Weighted Average
135,783		90.01% Pervious Area
15,064		9.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.2720	0.19		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
3.0	433	0.2305	2.40		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.3	20	0.0494	1.11		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
0.3	63	0.3640	3.02		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
3.1	243	0.0681	1.30		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
11.0	809	Total			

Subcatchment ED1.1:



Summary for Subcatchment ED2.1:

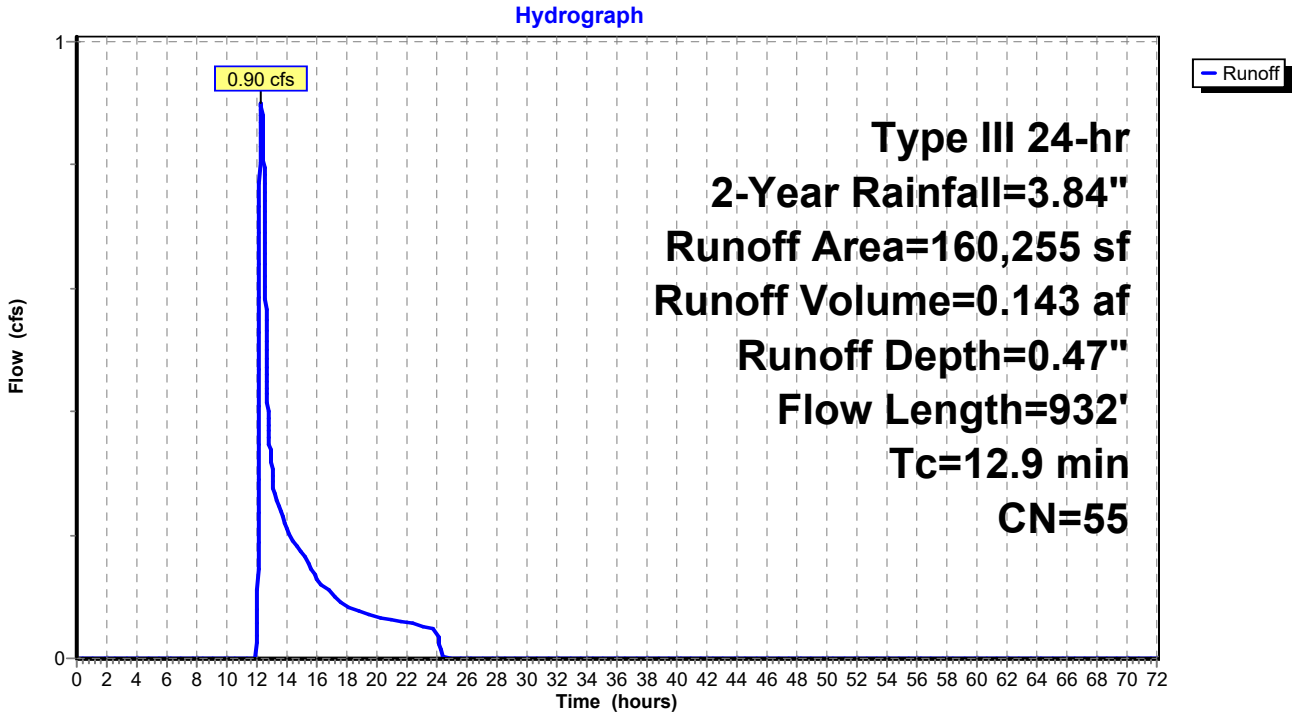
Runoff = 0.90 cfs @ 12.29 hrs, Volume= 0.143 af, Depth= 0.47"
Routed to Link EDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.84"

Area (sf)	CN	Description
160,255	55	Woods, Good, HSG B
160,255		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1260	0.14		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
1.2	158	0.1910	2.19		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.5	51	0.1087	1.65		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
1.6	179	0.1329	1.82		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
1.4	226	0.2702	2.60		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
0.3	26	0.0777	1.39		**Shallow Concentrated Flow, F** Woodland Kv= 5.0 fps
2.0	242	0.1668	2.04		**Shallow Concentrated Flow, G** Woodland Kv= 5.0 fps
12.9	932	Total			

Subcatchment ED2.1:

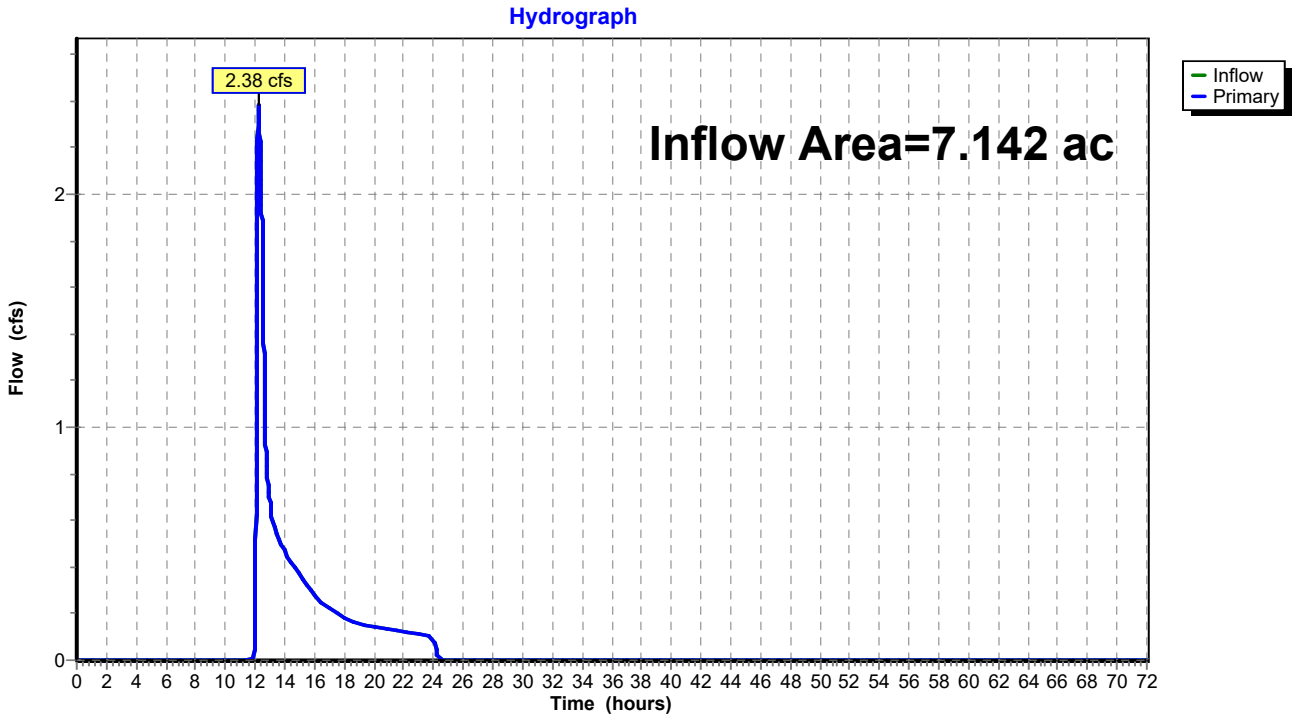


Summary for Link EDP1: MILLBURY STREET

Inflow Area = 7.142 ac, 4.84% Impervious, Inflow Depth = 0.55" for 2-Year event
Inflow = 2.38 cfs @ 12.22 hrs, Volume= 0.328 af
Primary = 2.38 cfs @ 12.22 hrs, Volume= 0.328 af, Atten= 0%, Lag= 0.0 min

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

Link EDP1: MILLBURY STREET



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentED1.1: Runoff Area=150,847 sf 9.99% Impervious Runoff Depth=1.85"
Flow Length=809' Tc=11.0 min CN=59 Runoff=5.90 cfs 0.532 af

SubcatchmentED2.1: Runoff Area=160,255 sf 0.00% Impervious Runoff Depth=1.52"
Flow Length=932' Tc=12.9 min CN=55 Runoff=4.63 cfs 0.467 af

Link EDP1: MILLBURY STREET Inflow=10.42 cfs 1.000 af
Primary=10.42 cfs 1.000 af

Total Runoff Area = 7.142 ac Runoff Volume = 1.000 af Average Runoff Depth = 1.68"
95.16% Pervious = 6.796 ac 4.84% Impervious = 0.346 ac

Summary for Subcatchment ED1.1:

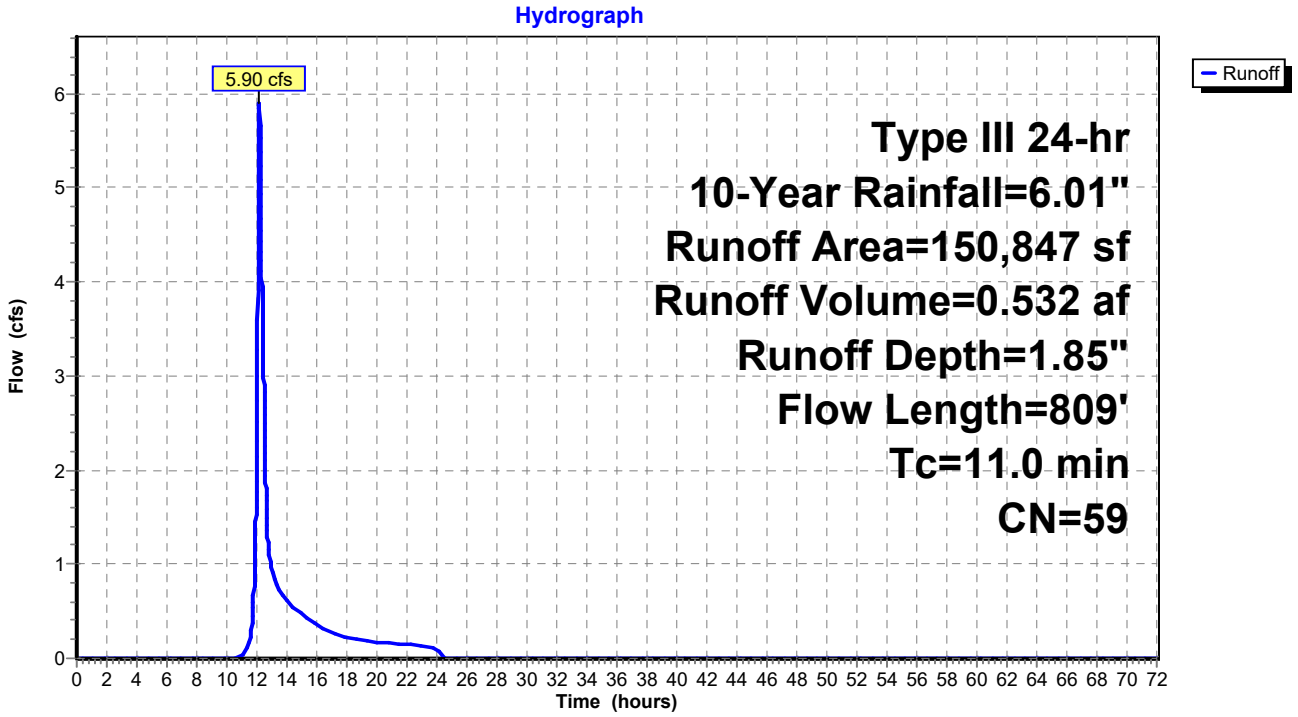
Runoff = 5.90 cfs @ 12.16 hrs, Volume= 0.532 af, Depth= 1.85"
Routed to Link EDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.01"

Area (sf)	CN	Description
135,783	55	Woods, Good, HSG B
15,064	98	Paved parking, HSG B
150,847	59	Weighted Average
135,783		90.01% Pervious Area
15,064		9.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.2720	0.19		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
3.0	433	0.2305	2.40		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.3	20	0.0494	1.11		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
0.3	63	0.3640	3.02		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
3.1	243	0.0681	1.30		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
11.0	809	Total			

Subcatchment ED1.1:



Summary for Subcatchment ED2.1:

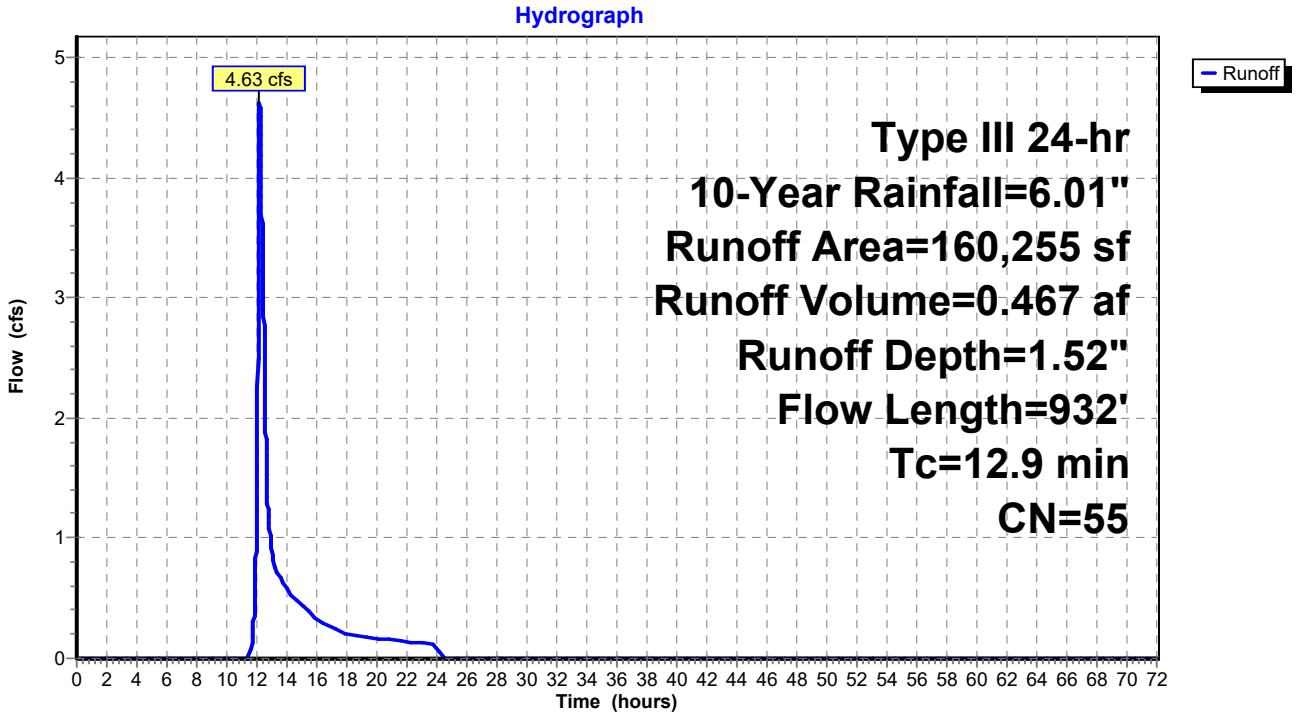
Runoff = 4.63 cfs @ 12.20 hrs, Volume= 0.467 af, Depth= 1.52"
Routed to Link EDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.01"

Area (sf)	CN	Description
160,255	55	Woods, Good, HSG B
160,255		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1260	0.14		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
1.2	158	0.1910	2.19		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.5	51	0.1087	1.65		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
1.6	179	0.1329	1.82		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
1.4	226	0.2702	2.60		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
0.3	26	0.0777	1.39		**Shallow Concentrated Flow, F** Woodland Kv= 5.0 fps
2.0	242	0.1668	2.04		**Shallow Concentrated Flow, G** Woodland Kv= 5.0 fps
12.9	932	Total			

Subcatchment ED2.1:

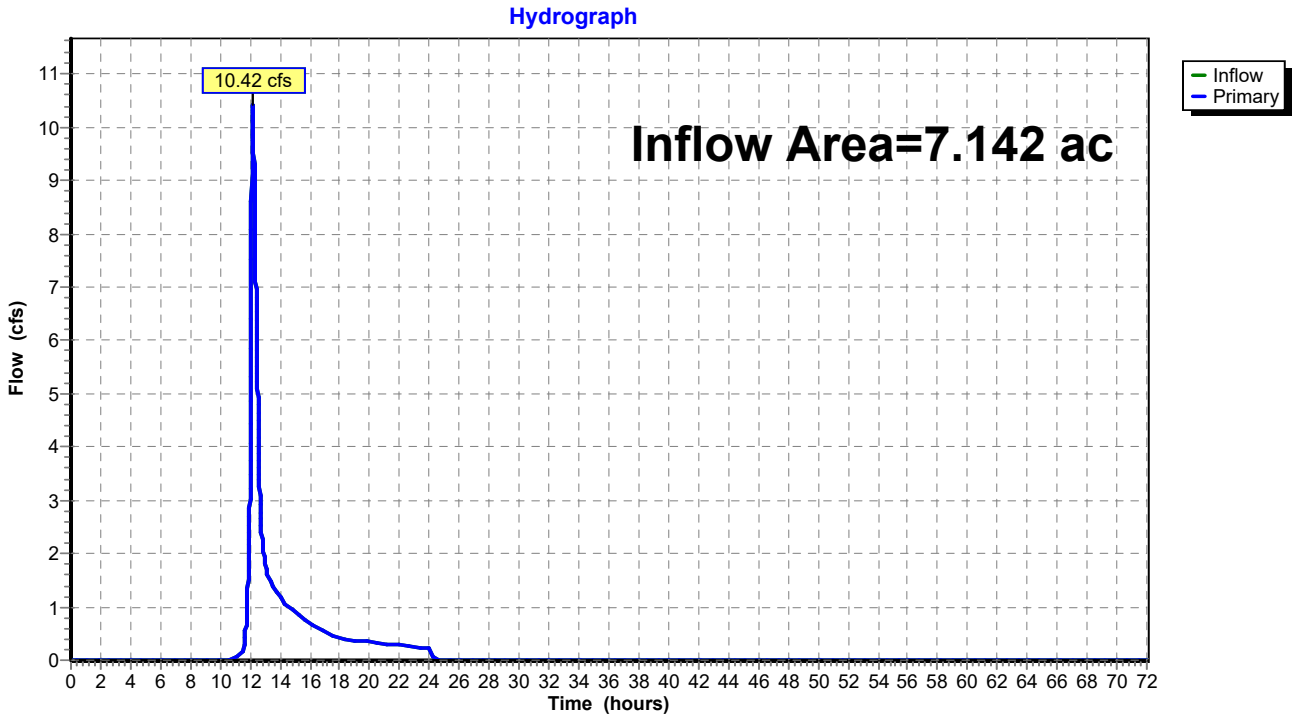


Summary for Link EDP1: MILLBURY STREET

Inflow Area = 7.142 ac, 4.84% Impervious, Inflow Depth = 1.68" for 10-Year event
Inflow = 10.42 cfs @ 12.18 hrs, Volume= 1.000 af
Primary = 10.42 cfs @ 12.18 hrs, Volume= 1.000 af, Atten= 0%, Lag= 0.0 min

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

Link EDP1: MILLBURY STREET



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentED1.1: Runoff Area=150,847 sf 9.99% Impervious Runoff Depth=3.04"
Flow Length=809' Tc=11.0 min CN=59 Runoff=10.18 cfs 0.877 af

SubcatchmentED2.1: Runoff Area=160,255 sf 0.00% Impervious Runoff Depth=2.61"
Flow Length=932' Tc=12.9 min CN=55 Runoff=8.56 cfs 0.802 af

Link EDP1: MILLBURY STREET Inflow=18.59 cfs 1.679 af
Primary=18.59 cfs 1.679 af

Total Runoff Area = 7.142 ac Runoff Volume = 1.679 af Average Runoff Depth = 2.82"
95.16% Pervious = 6.796 ac 4.84% Impervious = 0.346 ac

Summary for Subcatchment ED1.1:

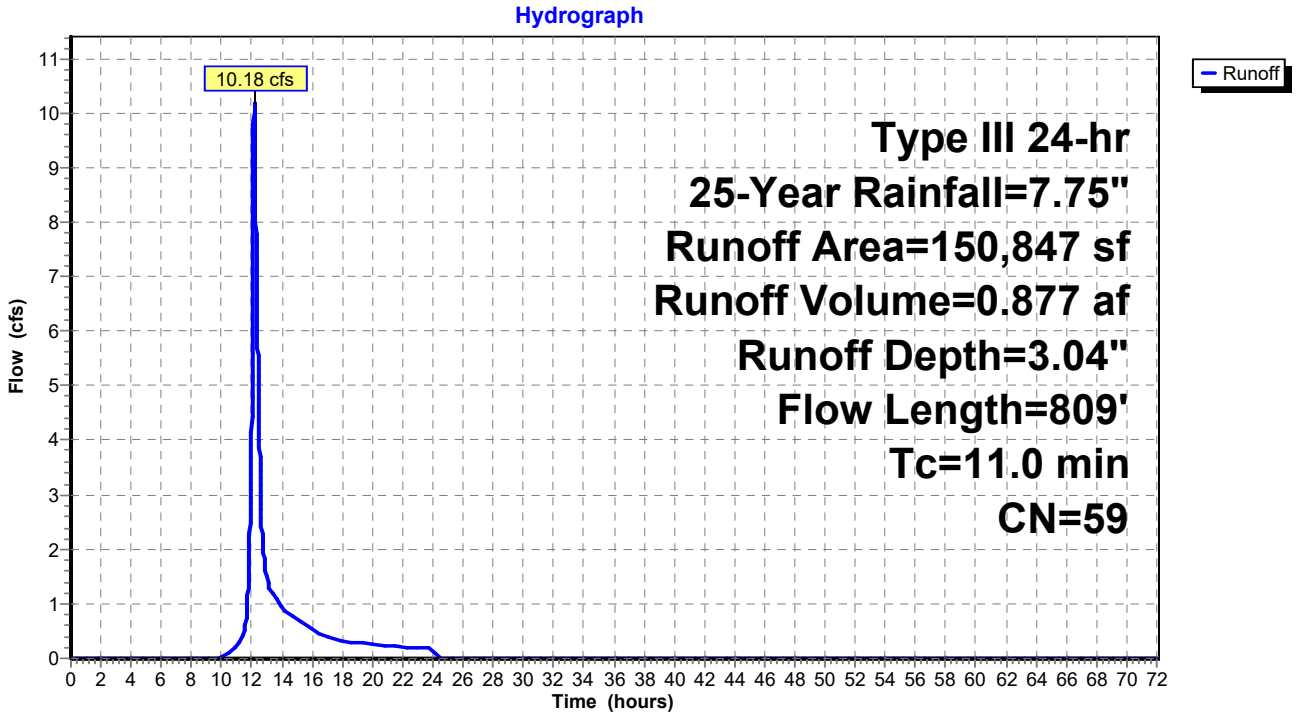
Runoff = 10.18 cfs @ 12.16 hrs, Volume= 0.877 af, Depth= 3.04"
Routed to Link EDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=7.75"

Area (sf)	CN	Description
135,783	55	Woods, Good, HSG B
15,064	98	Paved parking, HSG B
150,847	59	Weighted Average
135,783		90.01% Pervious Area
15,064		9.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.2720	0.19		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
3.0	433	0.2305	2.40		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.3	20	0.0494	1.11		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
0.3	63	0.3640	3.02		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
3.1	243	0.0681	1.30		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
11.0	809	Total			

Subcatchment ED1.1:



Summary for Subcatchment ED2.1:

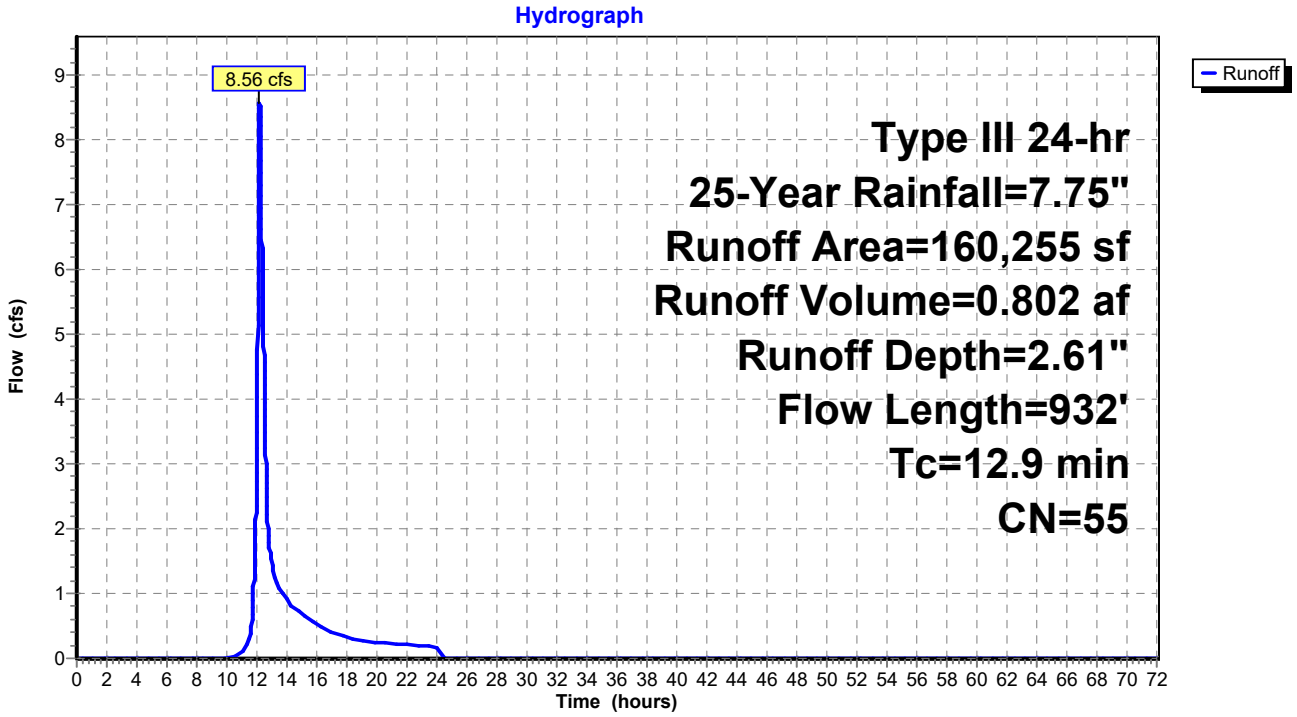
Runoff = 8.56 cfs @ 12.19 hrs, Volume= 0.802 af, Depth= 2.61"
Routed to Link EDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=7.75"

Area (sf)	CN	Description
160,255	55	Woods, Good, HSG B
160,255		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1260	0.14		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
1.2	158	0.1910	2.19		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.5	51	0.1087	1.65		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
1.6	179	0.1329	1.82		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
1.4	226	0.2702	2.60		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
0.3	26	0.0777	1.39		**Shallow Concentrated Flow, F** Woodland Kv= 5.0 fps
2.0	242	0.1668	2.04		**Shallow Concentrated Flow, G** Woodland Kv= 5.0 fps
12.9	932	Total			

Subcatchment ED2.1:

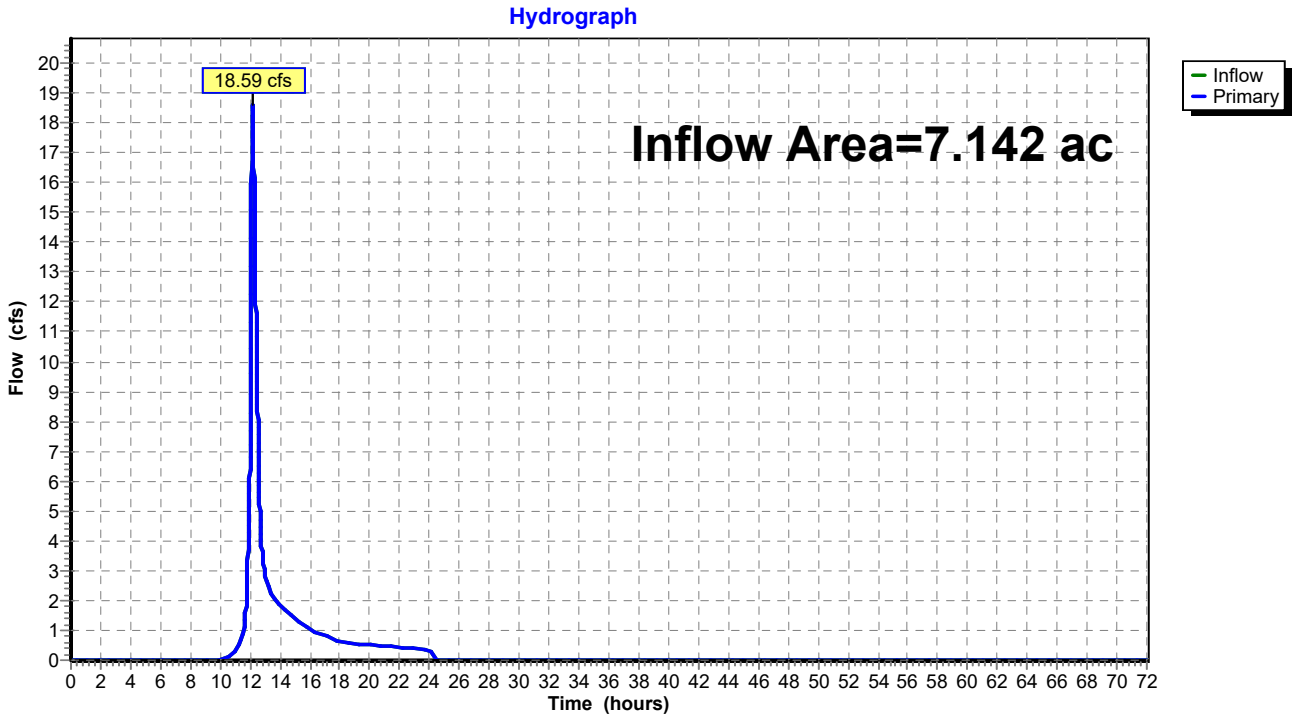


Summary for Link EDP1: MILLBURY STREET

Inflow Area = 7.142 ac, 4.84% Impervious, Inflow Depth = 2.82" for 25-Year event
Inflow = 18.59 cfs @ 12.17 hrs, Volume= 1.679 af
Primary = 18.59 cfs @ 12.17 hrs, Volume= 1.679 af, Atten= 0%, Lag= 0.0 min

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

Link EDP1: MILLBURY STREET



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentED1.1: Runoff Area=150,847 sf 9.99% Impervious Runoff Depth=5.33"
Flow Length=809' Tc=11.0 min CN=59 Runoff=18.27 cfs 1.538 af

SubcatchmentED2.1: Runoff Area=160,255 sf 0.00% Impervious Runoff Depth=4.76"
Flow Length=932' Tc=12.9 min CN=55 Runoff=16.24 cfs 1.460 af

Link EDP1: MILLBURY STREET Inflow=34.29 cfs 2.999 af
Primary=34.29 cfs 2.999 af

Total Runoff Area = 7.142 ac Runoff Volume = 2.999 af Average Runoff Depth = 5.04"
95.16% Pervious = 6.796 ac 4.84% Impervious = 0.346 ac

Summary for Subcatchment ED1.1:

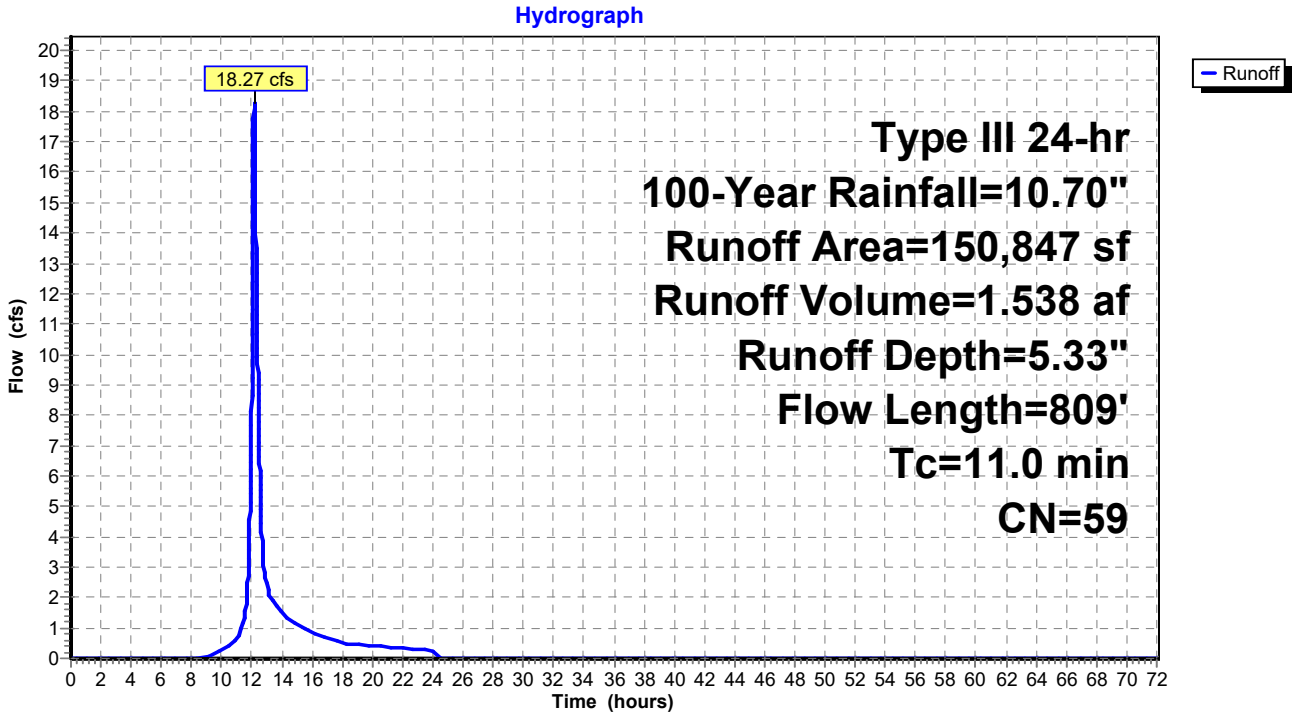
Runoff = 18.27 cfs @ 12.16 hrs, Volume= 1.538 af, Depth= 5.33"
Routed to Link EDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=10.70"

Area (sf)	CN	Description
135,783	55	Woods, Good, HSG B
15,064	98	Paved parking, HSG B
150,847	59	Weighted Average
135,783		90.01% Pervious Area
15,064		9.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.2720	0.19		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
3.0	433	0.2305	2.40		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.3	20	0.0494	1.11		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
0.3	63	0.3640	3.02		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
3.1	243	0.0681	1.30		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
11.0	809	Total			

Subcatchment ED1.1:



Summary for Subcatchment ED2.1:

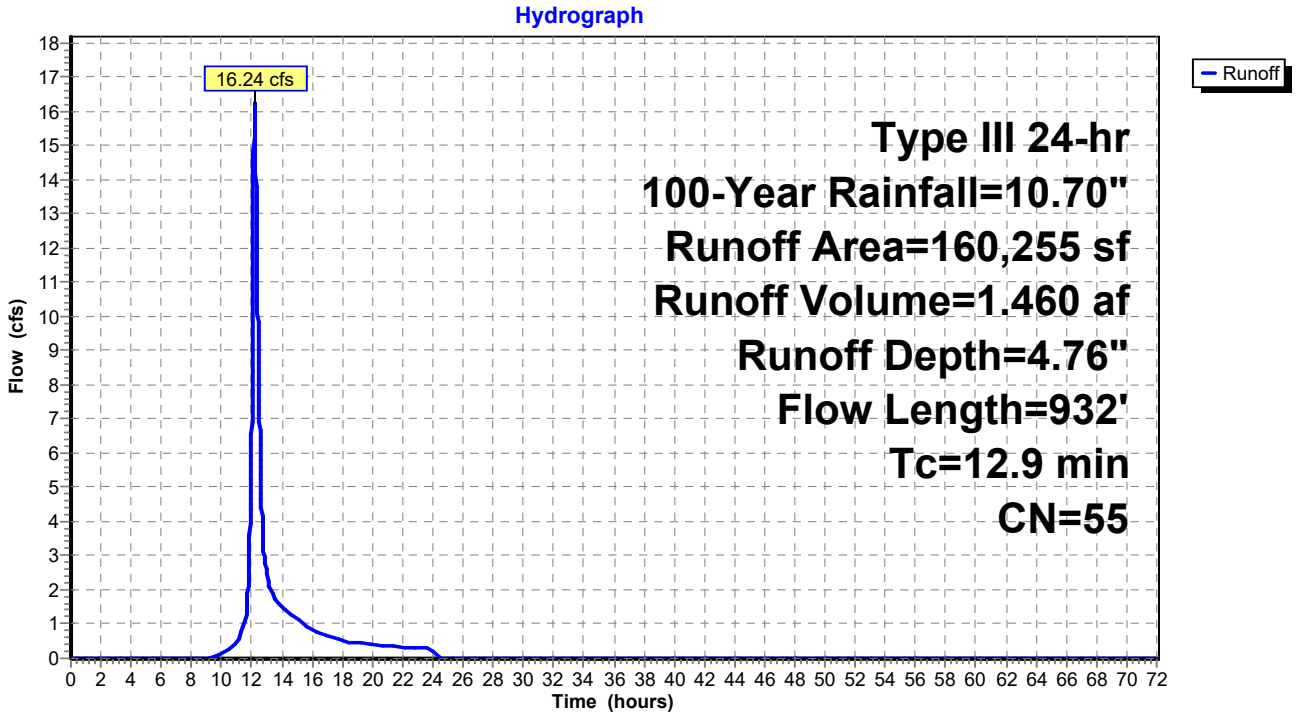
Runoff = 16.24 cfs @ 12.18 hrs, Volume= 1.460 af, Depth= 4.76"
Routed to Link EDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=10.70"

Area (sf)	CN	Description
160,255	55	Woods, Good, HSG B
160,255		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1260	0.14		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
1.2	158	0.1910	2.19		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.5	51	0.1087	1.65		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
1.6	179	0.1329	1.82		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
1.4	226	0.2702	2.60		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
0.3	26	0.0777	1.39		**Shallow Concentrated Flow, F** Woodland Kv= 5.0 fps
2.0	242	0.1668	2.04		**Shallow Concentrated Flow, G** Woodland Kv= 5.0 fps
12.9	932	Total			

Subcatchment ED2.1:

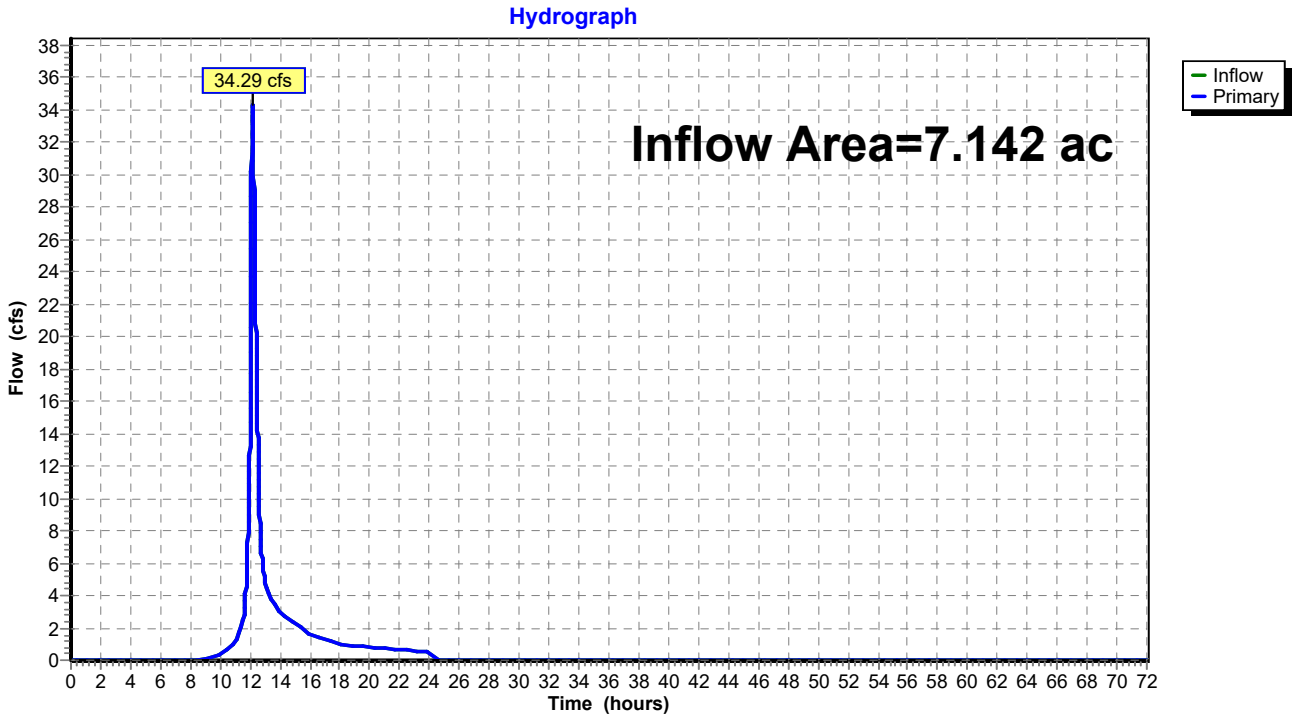


Summary for Link EDP1: MILLBURY STREET

Inflow Area = 7.142 ac, 4.84% Impervious, Inflow Depth = 5.04" for 100-Year event
Inflow = 34.29 cfs @ 12.17 hrs, Volume= 2.999 af
Primary = 34.29 cfs @ 12.17 hrs, Volume= 2.999 af, Atten= 0%, Lag= 0.0 min

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

Link EDP1: MILLBURY STREET



APPENDIX E: PROPOSED CONDITIONS HYDROLOGIC ANALYSIS

- *PROPOSED CONDITIONS DRAINAGE MAP*
- *PROPOSED CONDITIONS HYDROCAD CALCULATIONS*

LEGEND

PROPOSED WATERSHED

DESIGN POINT	DP1 / DP1
SUBCATCHMENT ID	PD1.1 — PD1.1
SUBCATCHMENT BOUNDARY	
TIME OF CONCENTRATION PATH	
STORMWATER CONTROL MEASURE OR MODELED DRAINAGE STRUCTURE	P1.1 — P1.1
SURFACE OR CULVERT CONVEYANCE	R1.1 — R1.1
SOIL BOUNDARY WITH NRCS MAP UNIT AND HYDROLOGIC SOIL GROUP RATING	MapUnit A

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LANDSCAPE ARCHITECTURE
CULTURAL RESOURCES
PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY

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ALWAYS CALL 811
It's fast. It's free. It's the law.

PERMIT SET

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DRAWN BY:	OCR/CJP
CHECKED BY:	MMA
DATE:	11/14/2024
CAD I.D.:	P-CIVIL-HYDR

PROJECT:

SITE DEVELOPMENT PLANS

FOR

Park Silver Development

PROPOSED DEVELOPMENT

MAP: 31 | BLK: 15 | LOT: 2
277 PROVIDENCE STREET
WORCESTER COUNTY
WORCESTER, MASSACHUSETTS

BOHLER

352 TURNPIKE ROAD, 3rd FLOOR
SOUTHBOROUGH, MA 01772
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SHEET TITLE:

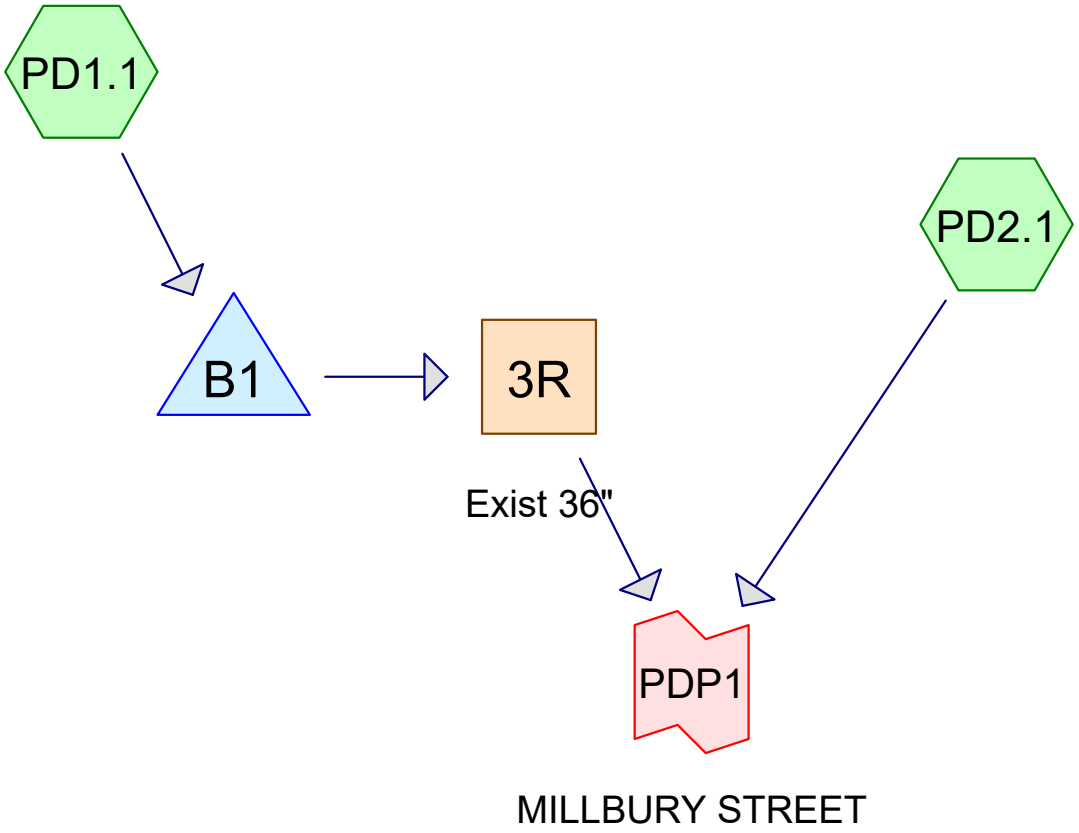
POST-DEVELOPMENT DRAINAGE MAP

SHEET NUMBER:

C-403

ORG. DATE - 11/14/2024

PROPOSED



Subcat Reach Pond Link

Routing Diagram for MAA220174 - Pre & Post
Prepared by Bohler, Printed 11/14/2024

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.84	2
2	10-Year	Type III 24-hr		Default	24.00	1	6.01	2
3	25-Year	Type III 24-hr		Default	24.00	1	7.75	2
4	100-Year	Type III 24-hr		Default	24.00	1	10.70	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.305	61	>75% Grass cover, Good, HSG B (PD1.1, PD2.1)
0.335	98	Existing Paved parking (PD1.1)
1.112	98	Paved roads w/curbs & sewers, HSG B (PD1.1)
0.291	98	Roofs, HSG B (PD1.1)
0.005	98	Unconnected pavement, HSG B (PD2.1)
5.094	55	Woods, Good, HSG B (PD2.1)
7.142	**66**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
6.807	HSG B	PD1.1, PD2.1
0.000	HSG C	
0.000	HSG D	
0.335	Other	PD1.1
7.142		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.305	0.000	0.000	0.000	0.305	>75% Grass cover, Good	PD 1.1, PD 2.1
0.000	0.000	0.000	0.000	0.335	0.335	Existing Paved parking	PD 1.1
0.000	1.112	0.000	0.000	0.000	1.112	Paved roads w/curbs & sewers	PD 1.1
0.000	0.291	0.000	0.000	0.000	0.291	Roofs	PD 1.1
0.000	0.005	0.000	0.000	0.000	0.005	Unconnected pavement	PD 2.1
0.000	5.094	0.000	0.000	0.000	5.094	Woods, Good	PD 2.1
0.000	**6.807**	**0.000**	**0.000**	**0.335**	**7.142**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	PD2.1	0.00	0.00	156.0	0.0160	0.013	0.00	18.00	0.00	
2	PD2.1	0.00	0.00	74.0	0.0190	0.013	0.00	18.00	0.00	
3	PD2.1	0.00	0.00	126.0	0.0200	0.013	0.00	18.00	0.00	
4	3R	458.08	454.00	700.0	0.0058	0.012	0.00	36.00	0.00	
5	B1	464.50	464.25	50.0	0.0050	0.013	0.00	18.00	0.00	

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPD1.1: Runoff Area=79,921 sf 94.68% Impervious Runoff Depth=3.38"
Tc=6.0 min CN=96 Runoff=6.69 cfs 0.517 af

SubcatchmentPD2.1: Runoff Area=231,174 sf 0.10% Impervious Runoff Depth=0.47"
Flow Length=1,239' Tc=12.4 min CN=55 Runoff=1.31 cfs 0.207 af

Reach 3R: Exist 36" Avg. Flow Depth=0.30' Max Vel=3.13 fps Inflow=1.16 cfs 0.306 af
36.00" Round Pipe n=0.012 L=700.0' S=0.0058 '/' Capacity=55.16 cfs Outflow=1.15 cfs 0.306 af

Pond B1: Peak Elev=468.69' Storage=13,281 cf Inflow=6.69 cfs 0.517 af
Outflow=1.16 cfs 0.306 af

Link PDP1: MILLBURY STREET Inflow=2.31 cfs 0.513 af
Primary=2.31 cfs 0.513 af

Total Runoff Area = 7.142 ac Runoff Volume = 0.724 af Average Runoff Depth = 1.22"
75.60% Pervious = 5.399 ac 24.40% Impervious = 1.742 ac

Summary for Subcatchment PD1.1:

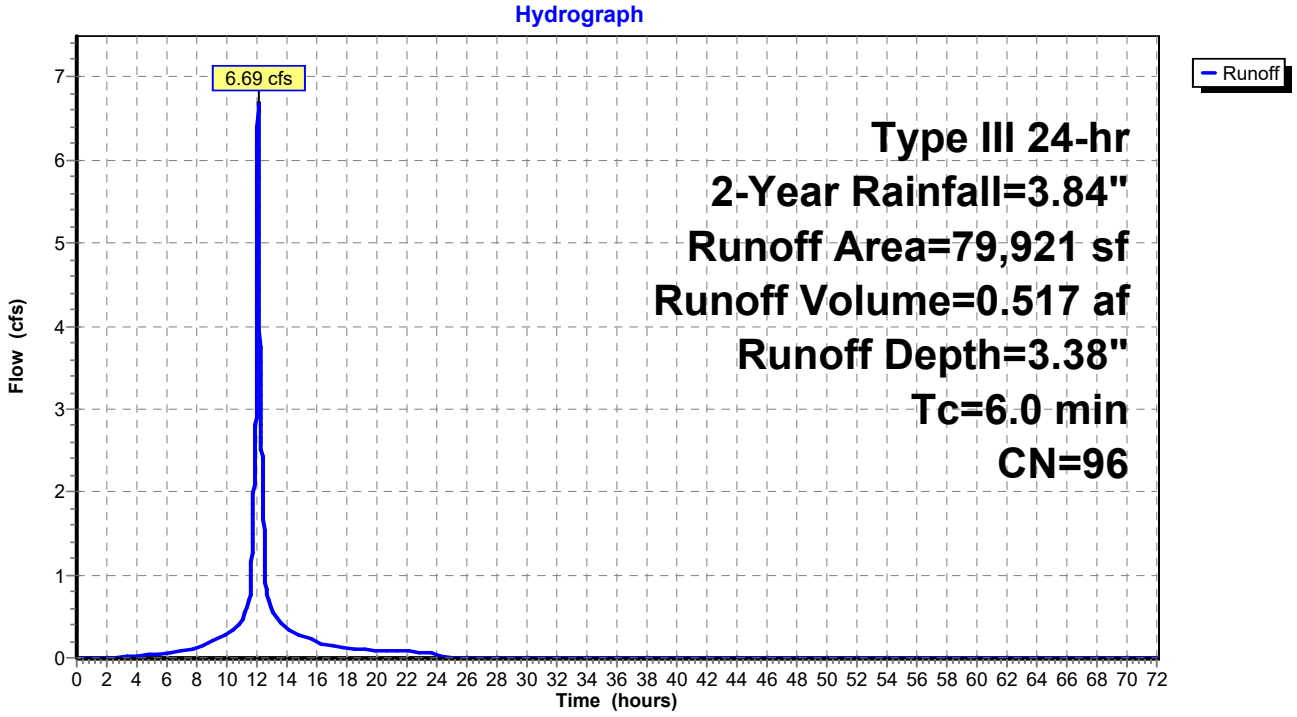
Runoff = 6.69 cfs @ 12.08 hrs, Volume= 0.517 af, Depth= 3.38"
Routed to Pond B1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.84"

	Area (sf)	CN	Description
	12,680	98	Roofs, HSG B
	48,418	98	Paved roads w/curbs & sewers, HSG B
	4,251	61	>75% Grass cover, Good, HSG B
*	14,572	98	Existing Paved parking
	79,921	96	Weighted Average
	4,251		5.32% Pervious Area
	75,670		94.68% Impervious Area

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

Subcatchment PD1.1:



Summary for Subcatchment PD2.1:

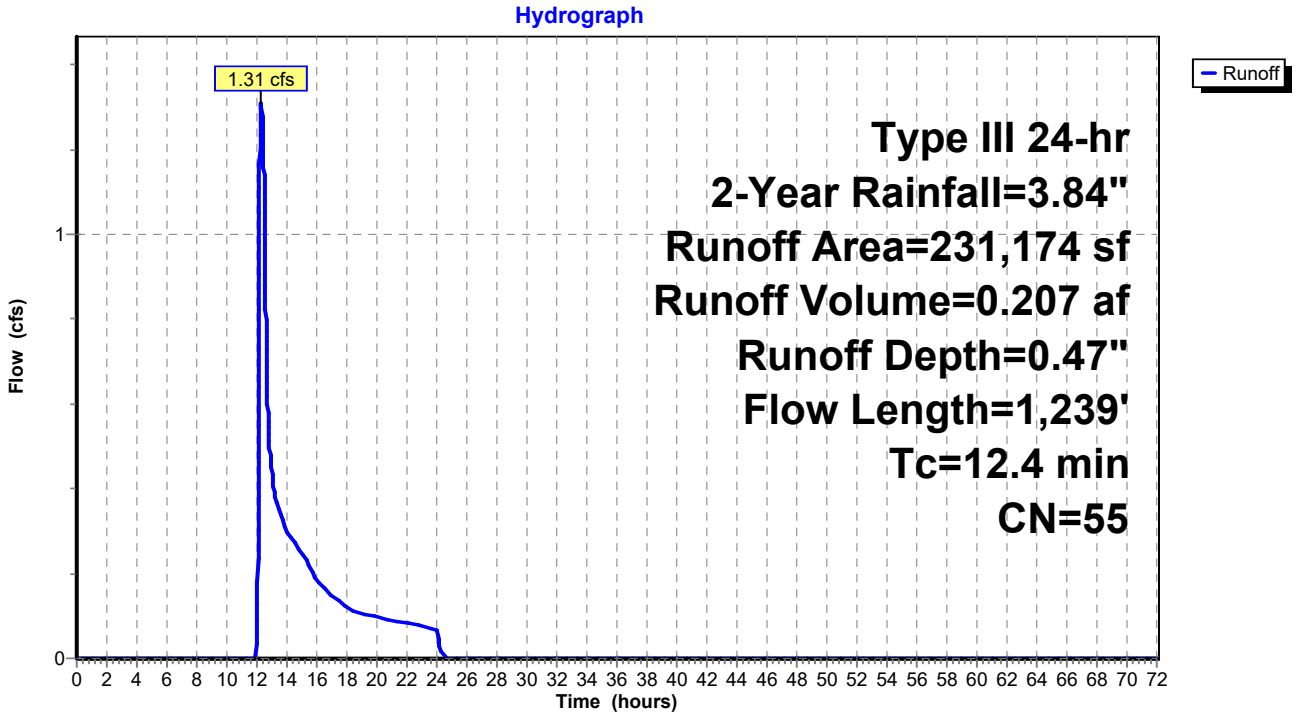
Runoff = 1.31 cfs @ 12.28 hrs, Volume= 0.207 af, Depth= 0.47"
Routed to Link PDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.84"

Area (sf)	CN	Description
221,903	55	Woods, Good, HSG B
9,045	61	>75% Grass cover, Good, HSG B
226	98	Unconnected pavement, HSG B
231,174	55	Weighted Average
230,948		99.90% Pervious Area
226		0.10% Impervious Area
226		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1260	0.14		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
1.2	158	0.1910	2.19		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.5	51	0.1087	1.65		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
1.6	179	0.1329	1.82		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
1.4	226	0.2702	2.60		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
0.3	26	0.0777	1.39		**Shallow Concentrated Flow, F** Woodland Kv= 5.0 fps
0.3	52	0.2692	2.59		**Shallow Concentrated Flow, G** Woodland Kv= 5.0 fps
0.5	141	0.0893	4.48		**Shallow Concentrated Flow, H** Grassed Waterway Kv= 15.0 fps
0.3	156	0.0160	7.52	13.29	**Pipe Channel, I** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.2	74	0.0190	8.19	14.48	**Pipe Channel, J** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.2	126	0.0200	8.41	14.86	**Pipe Channel, K** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
12.4	1,239	Total			

Subcatchment PD2.1:



Summary for Reach 3R: Exist 36"

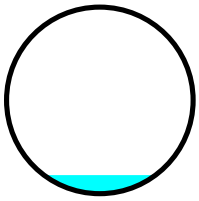
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.835 ac, 94.68% Impervious, Inflow Depth = 2.00" for 2-Year event
Inflow = 1.16 cfs @ 12.54 hrs, Volume= 0.306 af
Outflow = 1.15 cfs @ 12.59 hrs, Volume= 0.306 af, Atten= 0%, Lag= 3.0 min
Routed to Link PDP1 : MILLBURY STREET

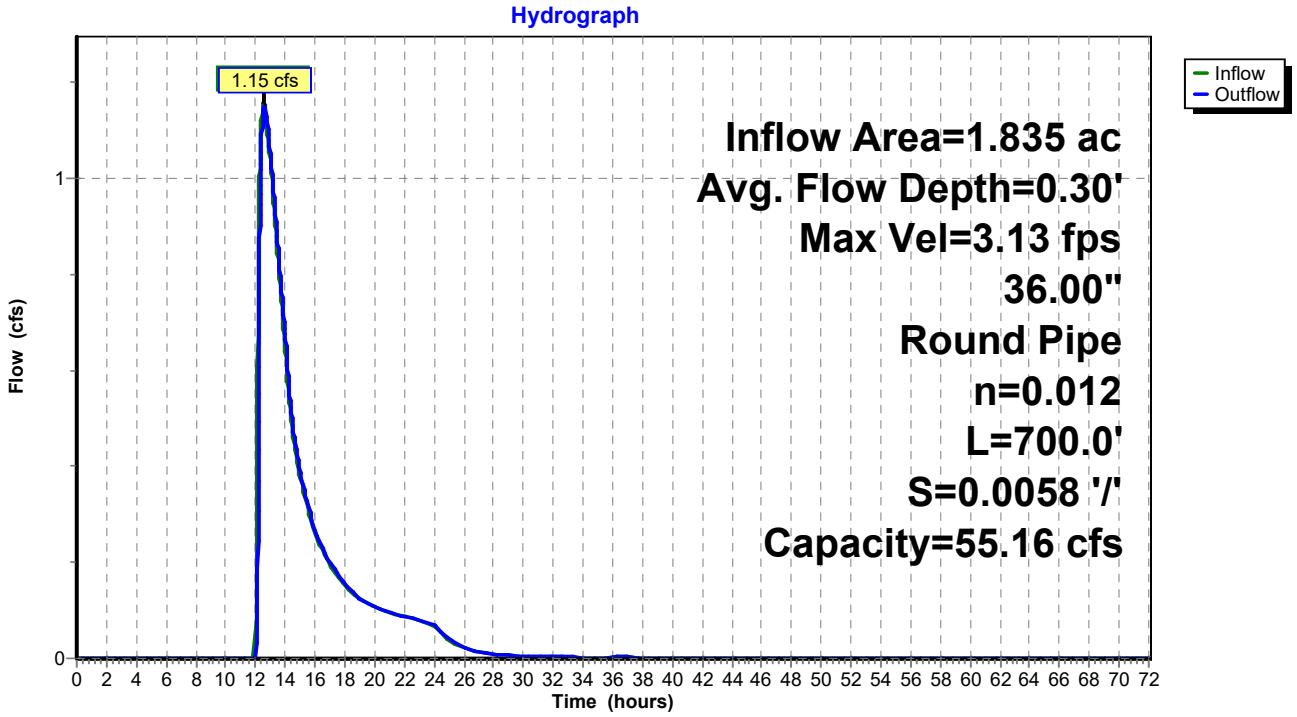
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.13 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 1.18 fps, Avg. Travel Time= 9.9 min

Peak Storage= 257 cf @ 12.59 hrs
Average Depth at Peak Storage= 0.30' , Surface Width= 1.80'
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 55.16 cfs

36.00" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 700.0' Slope= 0.0058 '/'
Inlet Invert= 458.08', Outlet Invert= 454.00'



Reach 3R: Exist 36"



Summary for Pond B1:

Inflow Area = 1.835 ac, 94.68% Impervious, Inflow Depth = 3.38" for 2-Year event
Inflow = 6.69 cfs @ 12.08 hrs, Volume= 0.517 af
Outflow = 1.16 cfs @ 12.54 hrs, Volume= 0.306 af, Atten= 83%, Lag= 27.4 min
Primary = 1.16 cfs @ 12.54 hrs, Volume= 0.306 af
Routed to Reach 3R : Exist 36"

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 468.69' @ 12.54 hrs Surf.Area= 7,379 sf Storage= 13,281 cf

Plug-Flow detention time= 271.6 min calculated for 0.306 af (59% of inflow)
Center-of-Mass det. time= 165.3 min (934.4 - 769.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	466.00'	12,498 cf	**87.25'W x 84.57'L x 6.25'H Field A** 46,117 cf Overall - 14,871 cf Embedded = 31,246 cf x 40.0% Voids
#2A	467.00'	14,871 cf	**ADS_StormTech MC-3500 d +Cap** x 132 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 132 Chambers in 12 Rows Cap Storage= 14.9 cf x 2 x 12 rows = 357.6 cf
		27,370 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	464.50'	**18.00" Round Culvert** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 464.50' / 464.25' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	469.50'	**16.00" W x 8.00" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	468.00'	**12.00" W x 4.00" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	471.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.16 cfs @ 12.54 hrs HW=468.69' TW=458.38' (Dynamic Tailwater)
- **1=Culvert** (Passes 1.16 cfs of 15.65 cfs potential flow)
  - **2=Orifice/Grate** (Controls 0.00 cfs)
  - **3=Orifice/Grate** (Orifice Controls 1.16 cfs @ 3.47 fps)
  - **4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond B1: - Chamber Wizard Field A

Chamber Model = ADS_StormTechMC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= 14.9 cf x 2 x 12 rows = 357.6 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

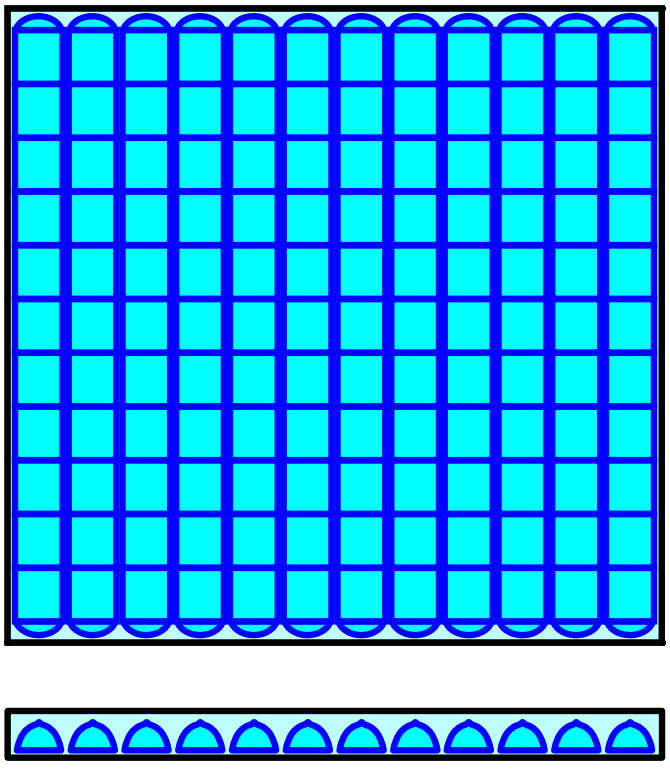
11 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 82.57' Row Length +12.0" End Stone x 2 = 84.57' Base Length
12 Rows x 77.0" Wide + 9.0" Spacing x 11 + 12.0" Side Stone x 2 = 87.25' Base Width
12.0" Stone Base + 45.0" Chamber Height + 18.0" Stone Cover = 6.25' Field Height

132 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 12 Rows = 14,871.3 cf Chamber Storage

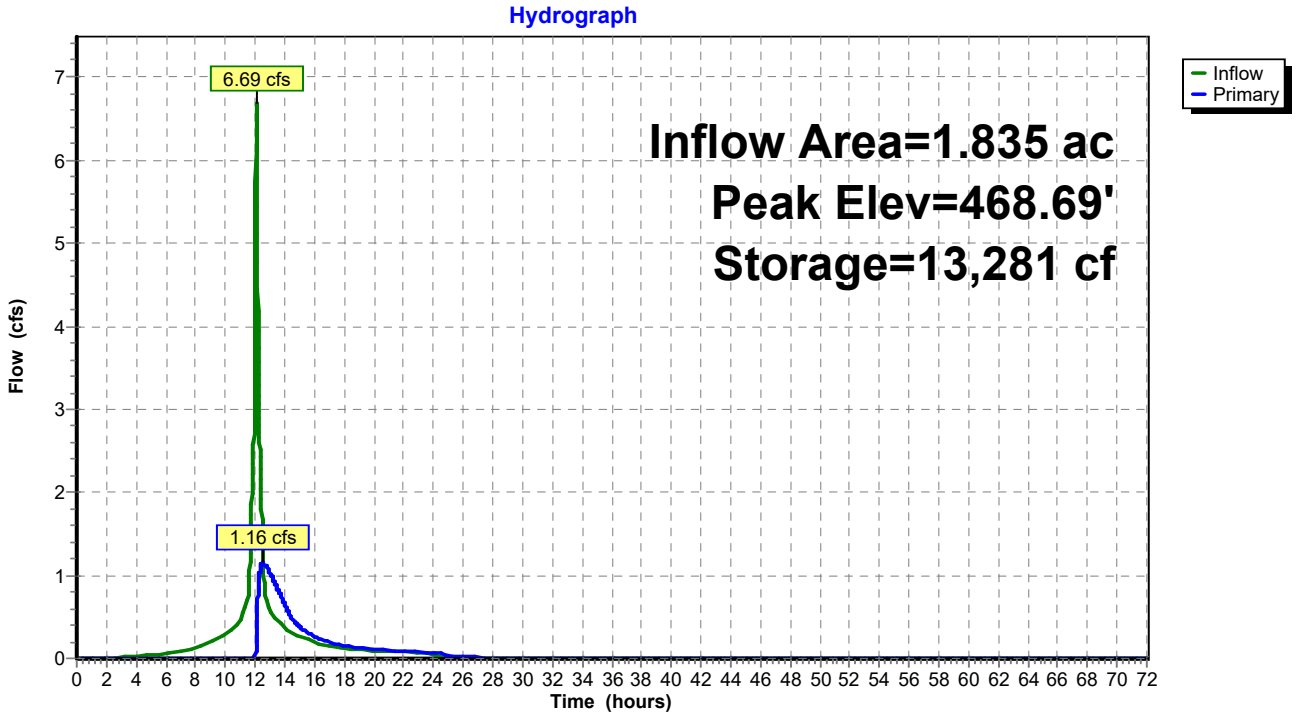
46,117.1 cf Field - 14,871.3 cf Chambers = 31,245.8 cf Stone x 40.0% Voids = 12,498.3 cf Stone Storage

Chamber Storage + Stone Storage = 27,369.6 cf = 0.628 af
Overall Storage Efficiency = 59.3%
Overall System Size = 84.57' x 87.25' x 6.25'

132 Chambers
1,708.0 cy Field
1,157.3 cy Stone



Pond B1:

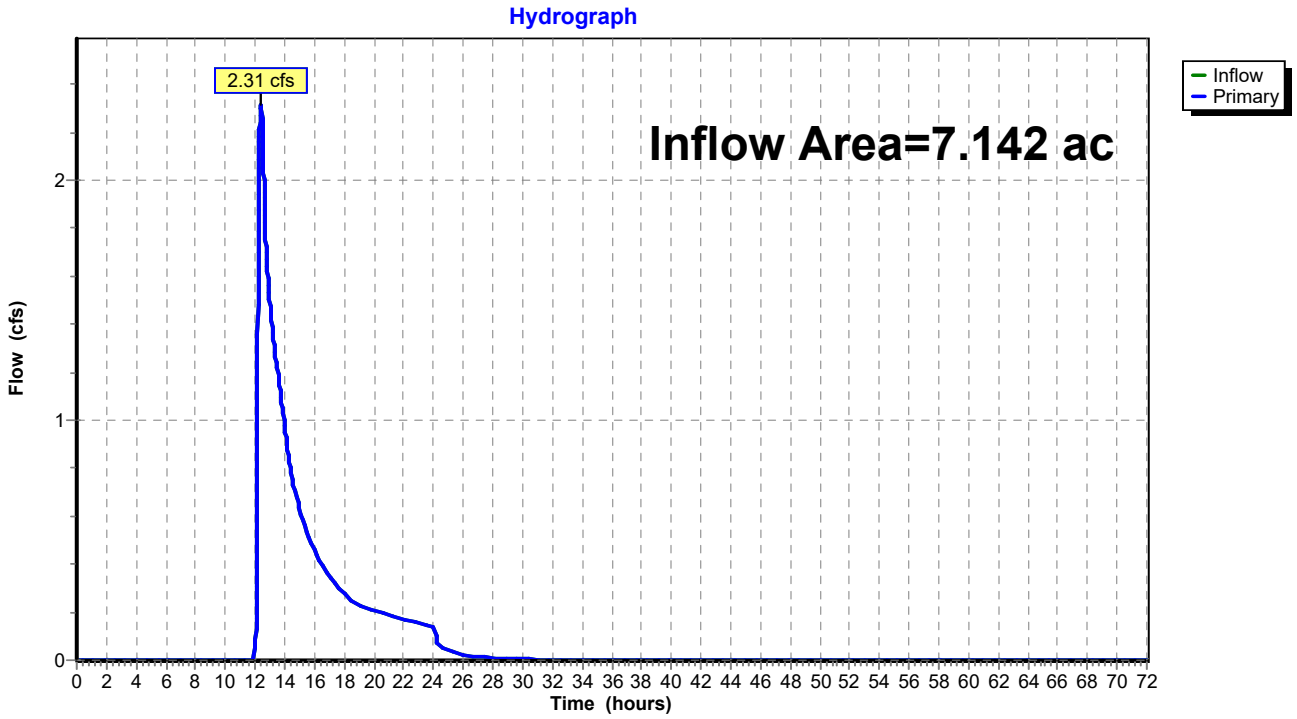

Hydrograph
Inflow Area=1.835 ac
Peak Elev=468.69'
Storage=13,281 cf
6.69 cfs
1.16 cfs
Inflow
Primary
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Summary for Link PDP1: MILLBURY STREET

Inflow Area = 7.142 ac, 24.40% Impervious, Inflow Depth = 0.86" for 2-Year event
Inflow = 2.31 cfs @ 12.39 hrs, Volume= 0.513 af
Primary = 2.31 cfs @ 12.39 hrs, Volume= 0.513 af, Atten= 0%, Lag= 0.0 min

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

Link PDP1: MILLBURY STREET



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPD1.1: Runoff Area=79,921 sf 94.68% Impervious Runoff Depth=5.54"
Tc=6.0 min CN=96 Runoff=10.68 cfs 0.847 af

SubcatchmentPD2.1: Runoff Area=231,174 sf 0.10% Impervious Runoff Depth=1.52"
Flow Length=1,239' Tc=12.4 min CN=55 Runoff=6.77 cfs 0.674 af

Reach 3R: Exist 36" Avg. Flow Depth=0.48' Max Vel=4.19 fps Inflow=3.07 cfs 0.636 af
36.00" Round Pipe n=0.012 L=700.0' S=0.0058 '/' Capacity=55.16 cfs Outflow=3.05 cfs 0.636 af

Pond B1: Peak Elev=469.87' Storage=19,576 cf Inflow=10.68 cfs 0.847 af
Outflow=3.07 cfs 0.636 af

Link PDP1: MILLBURY STREET Inflow=8.70 cfs 1.309 af
Primary=8.70 cfs 1.309 af

Total Runoff Area = 7.142 ac Runoff Volume = 1.520 af Average Runoff Depth = 2.55"
75.60% Pervious = 5.399 ac 24.40% Impervious = 1.742 ac

Summary for Subcatchment PD1.1:

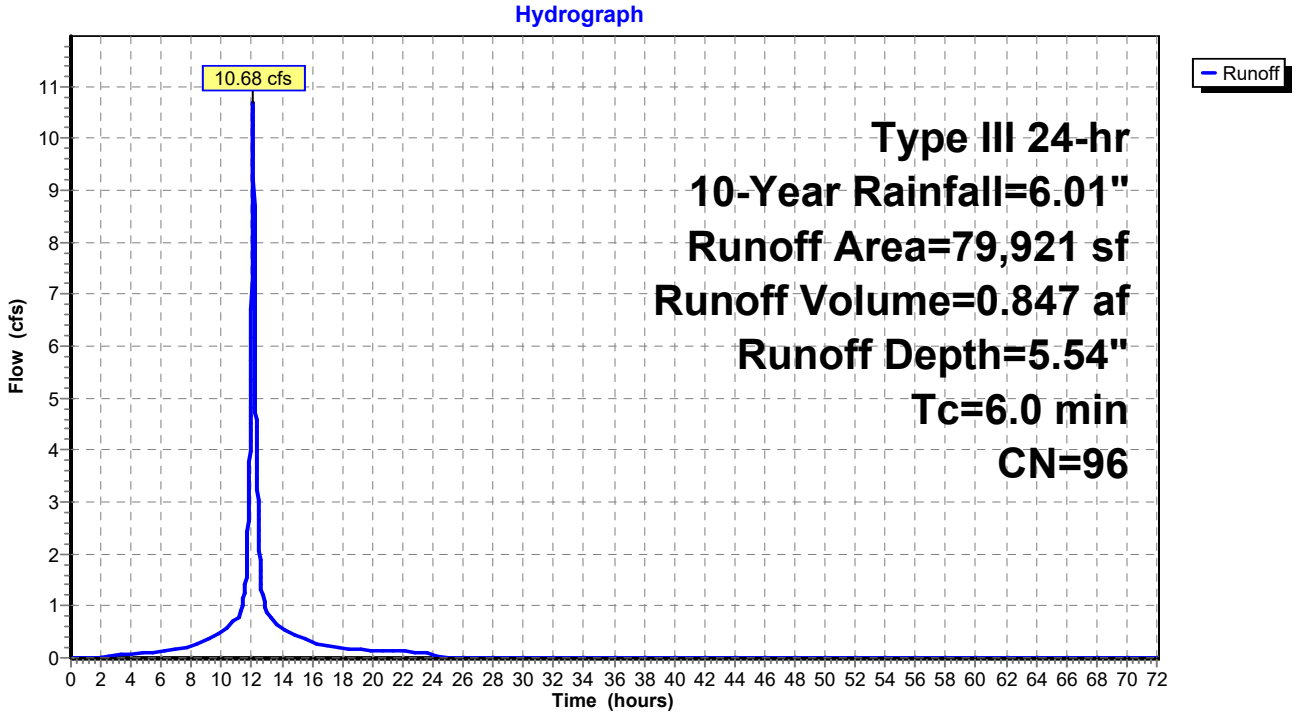
Runoff = 10.68 cfs @ 12.08 hrs, Volume= 0.847 af, Depth= 5.54"
Routed to Pond B1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.01"

	Area (sf)	CN	Description
	12,680	98	Roofs, HSG B
	48,418	98	Paved roads w/curbs & sewers, HSG B
	4,251	61	>75% Grass cover, Good, HSG B
*	14,572	98	Existing Paved parking
	79,921	96	Weighted Average
	4,251		5.32% Pervious Area
	75,670		94.68% Impervious Area

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

Subcatchment PD1.1:



Summary for Subcatchment PD2.1:

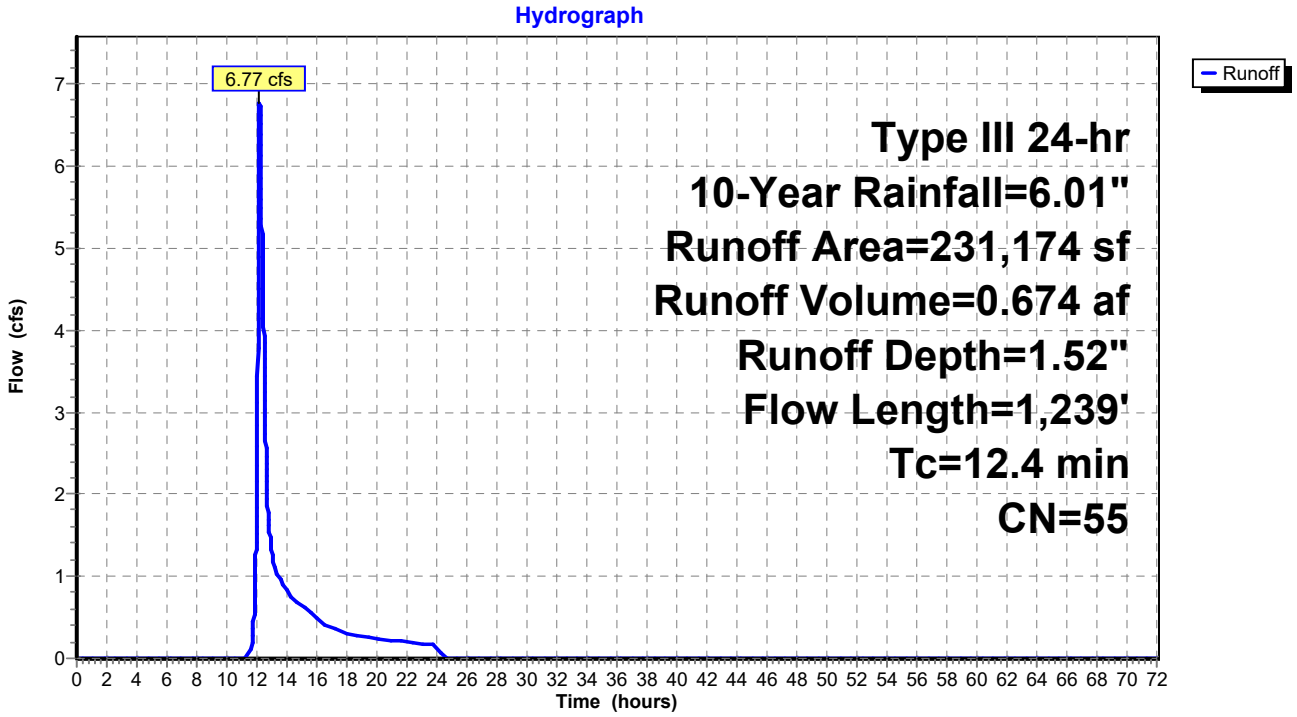
Runoff = 6.77 cfs @ 12.19 hrs, Volume= 0.674 af, Depth= 1.52"
Routed to Link PDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=6.01"

Area (sf)	CN	Description
221,903	55	Woods, Good, HSG B
9,045	61	>75% Grass cover, Good, HSG B
226	98	Unconnected pavement, HSG B
231,174	55	Weighted Average
230,948		99.90% Pervious Area
226		0.10% Impervious Area
226		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1260	0.14		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
1.2	158	0.1910	2.19		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.5	51	0.1087	1.65		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
1.6	179	0.1329	1.82		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
1.4	226	0.2702	2.60		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
0.3	26	0.0777	1.39		**Shallow Concentrated Flow, F** Woodland Kv= 5.0 fps
0.3	52	0.2692	2.59		**Shallow Concentrated Flow, G** Woodland Kv= 5.0 fps
0.5	141	0.0893	4.48		**Shallow Concentrated Flow, H** Grassed Waterway Kv= 15.0 fps
0.3	156	0.0160	7.52	13.29	**Pipe Channel, I** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.2	74	0.0190	8.19	14.48	**Pipe Channel, J** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.2	126	0.0200	8.41	14.86	**Pipe Channel, K** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
12.4	1,239	Total			

Subcatchment PD2.1:



Summary for Reach 3R: Exist 36"

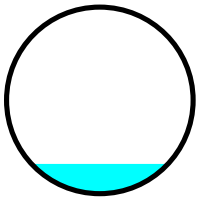
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.835 ac, 94.68% Impervious, Inflow Depth = 4.16" for 10-Year event
Inflow = 3.07 cfs @ 12.41 hrs, Volume= 0.636 af
Outflow = 3.05 cfs @ 12.45 hrs, Volume= 0.636 af, Atten= 1%, Lag= 2.1 min
Routed to Link PDP1 : MILLBURY STREET

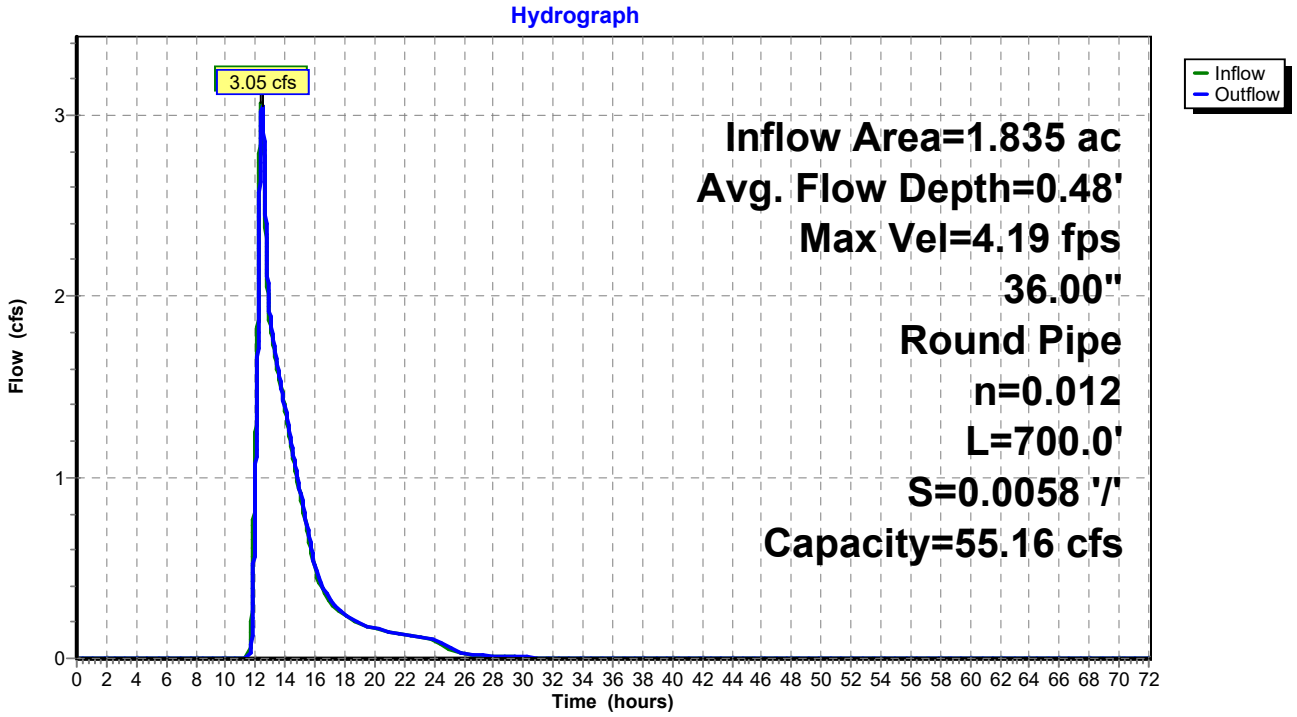
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.19 fps, Min. Travel Time= 2.8 min
Avg. Velocity = 1.34 fps, Avg. Travel Time= 8.7 min

Peak Storage= 509 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.48' , Surface Width= 2.20'
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 55.16 cfs

36.00" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 700.0' Slope= 0.0058 '/'
Inlet Invert= 458.08', Outlet Invert= 454.00'



Reach 3R: Exist 36"



Summary for Pond B1:

Inflow Area = 1.835 ac, 94.68% Impervious, Inflow Depth = 5.54" for 10-Year event
Inflow = 10.68 cfs @ 12.08 hrs, Volume= 0.847 af
Outflow = 3.07 cfs @ 12.41 hrs, Volume= 0.636 af, Atten= 71%, Lag= 19.7 min
Primary = 3.07 cfs @ 12.41 hrs, Volume= 0.636 af
Routed to Reach 3R : Exist 36"

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 469.87' @ 12.41 hrs Surf.Area= 7,379 sf Storage= 19,576 cf

Plug-Flow detention time= 223.7 min calculated for 0.636 af (75% of inflow)
Center-of-Mass det. time= 137.9 min (896.1 - 758.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	466.00'	12,498 cf	**87.25'W x 84.57'L x 6.25'H Field A** 46,117 cf Overall - 14,871 cf Embedded = 31,246 cf x 40.0% Voids
#2A	467.00'	14,871 cf	**ADS_StormTech MC-3500 d +Cap** x 132 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 132 Chambers in 12 Rows Cap Storage= 14.9 cf x 2 x 12 rows = 357.6 cf
		27,370 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	464.50'	**18.00" Round Culvert** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 464.50' / 464.25' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	469.50'	**16.00" W x 8.00" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	468.00'	**12.00" W x 4.00" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	471.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=3.07 cfs @ 12.41 hrs HW=469.87' TW=458.56' (Dynamic Tailwater)
└─**1=Culvert** (Passes 3.07 cfs of 18.29 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.97 cfs @ 1.96 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 2.10 cfs @ 6.29 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond B1: - Chamber Wizard Field A

Chamber Model = ADS_StormTechMC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= 14.9 cf x 2 x 12 rows = 357.6 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

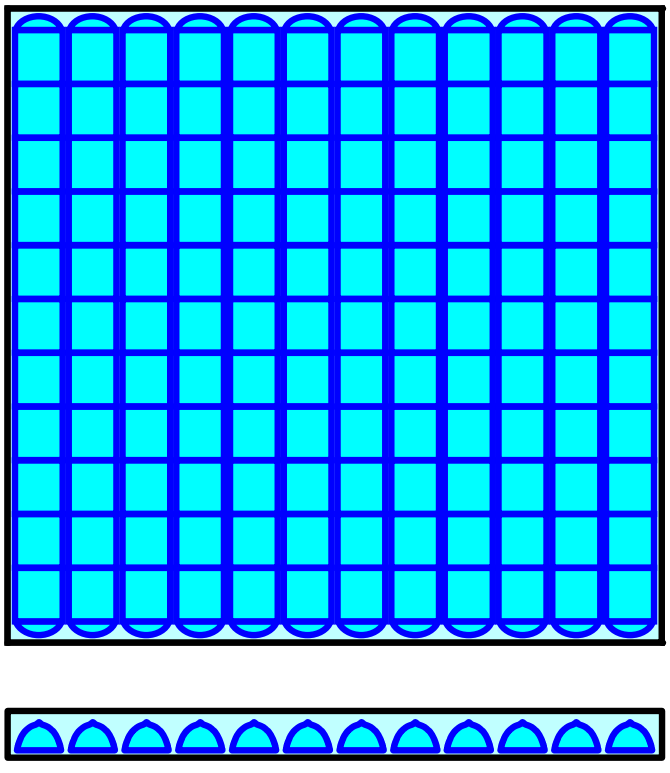
11 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 82.57' Row Length +12.0" End Stone x 2 = 84.57' Base Length
12 Rows x 77.0" Wide + 9.0" Spacing x 11 + 12.0" Side Stone x 2 = 87.25' Base Width
12.0" Stone Base + 45.0" Chamber Height + 18.0" Stone Cover = 6.25' Field Height

132 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 12 Rows = 14,871.3 cf Chamber Storage

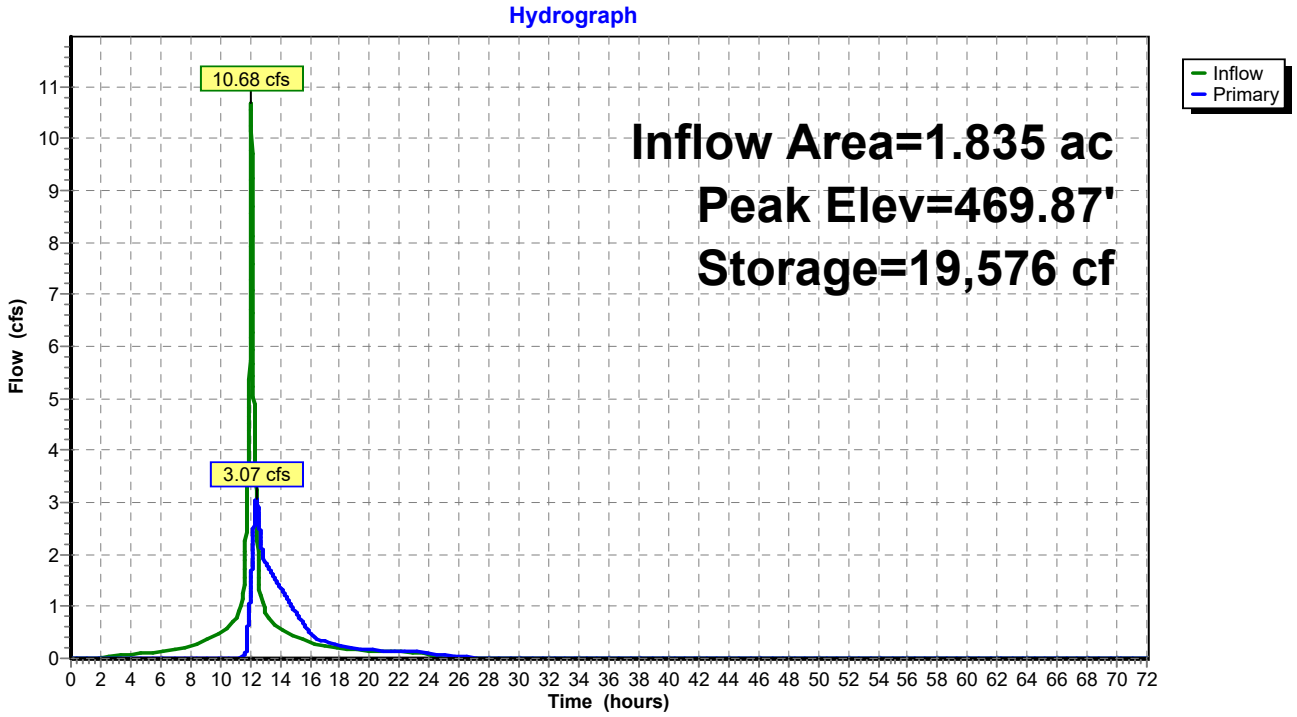
46,117.1 cf Field - 14,871.3 cf Chambers = 31,245.8 cf Stone x 40.0% Voids = 12,498.3 cf Stone Storage

Chamber Storage + Stone Storage = 27,369.6 cf = 0.628 af
Overall Storage Efficiency = 59.3%
Overall System Size = 84.57' x 87.25' x 6.25'

132 Chambers
1,708.0 cy Field
1,157.3 cy Stone



Pond B1:

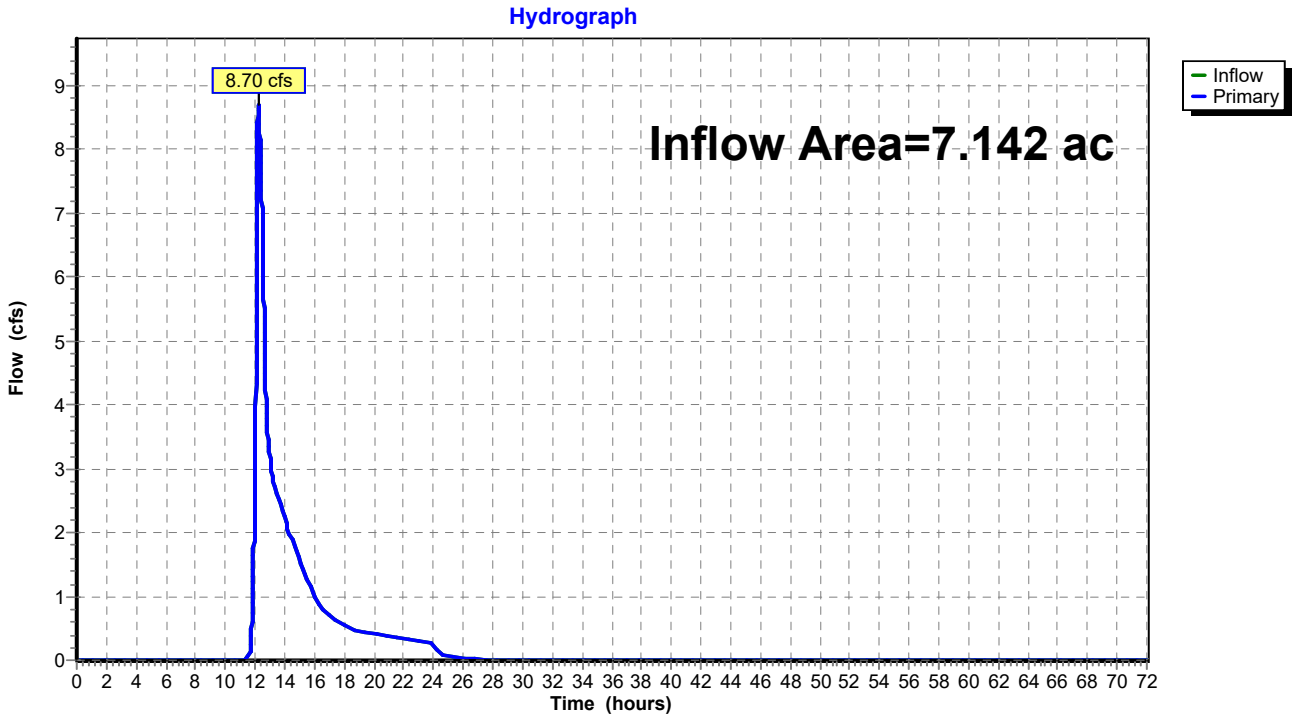

Hydrograph
Inflow
Primary
10.68 cfs
3.07 cfs
Inflow Area=1.835 ac
Peak Elev=469.87'
Storage=19,576 cf
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9 10 11
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Summary for Link PDP1: MILLBURY STREET

Inflow Area = 7.142 ac, 24.40% Impervious, Inflow Depth = 2.20" for 10-Year event
Inflow = 8.70 cfs @ 12.22 hrs, Volume= 1.309 af
Primary = 8.70 cfs @ 12.22 hrs, Volume= 1.309 af, Atten= 0%, Lag= 0.0 min

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

Link PDP1: MILLBURY STREET



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPD1.1: Runoff Area=79,921 sf 94.68% Impervious Runoff Depth=7.27"
Tc=6.0 min CN=96 Runoff=13.85 cfs 1.112 af

SubcatchmentPD2.1: Runoff Area=231,174 sf 0.10% Impervious Runoff Depth=2.61"
Flow Length=1,239' Tc=12.4 min CN=55 Runoff=12.52 cfs 1.156 af

Reach 3R: Exist 36" Avg. Flow Depth=0.66' Max Vel=5.08 fps Inflow=5.90 cfs 0.901 af
36.00" Round Pipe n=0.012 L=700.0' S=0.0058 '/' Capacity=55.16 cfs Outflow=5.87 cfs 0.901 af

Pond B1: Peak Elev=470.50' Storage=22,155 cf Inflow=13.85 cfs 1.112 af
Outflow=5.90 cfs 0.901 af

Link PDP1: MILLBURY STREET Inflow=17.67 cfs 2.057 af
Primary=17.67 cfs 2.057 af

Total Runoff Area = 7.142 ac Runoff Volume = 2.268 af Average Runoff Depth = 3.81"
75.60% Pervious = 5.399 ac 24.40% Impervious = 1.742 ac

Summary for Subcatchment PD1.1:

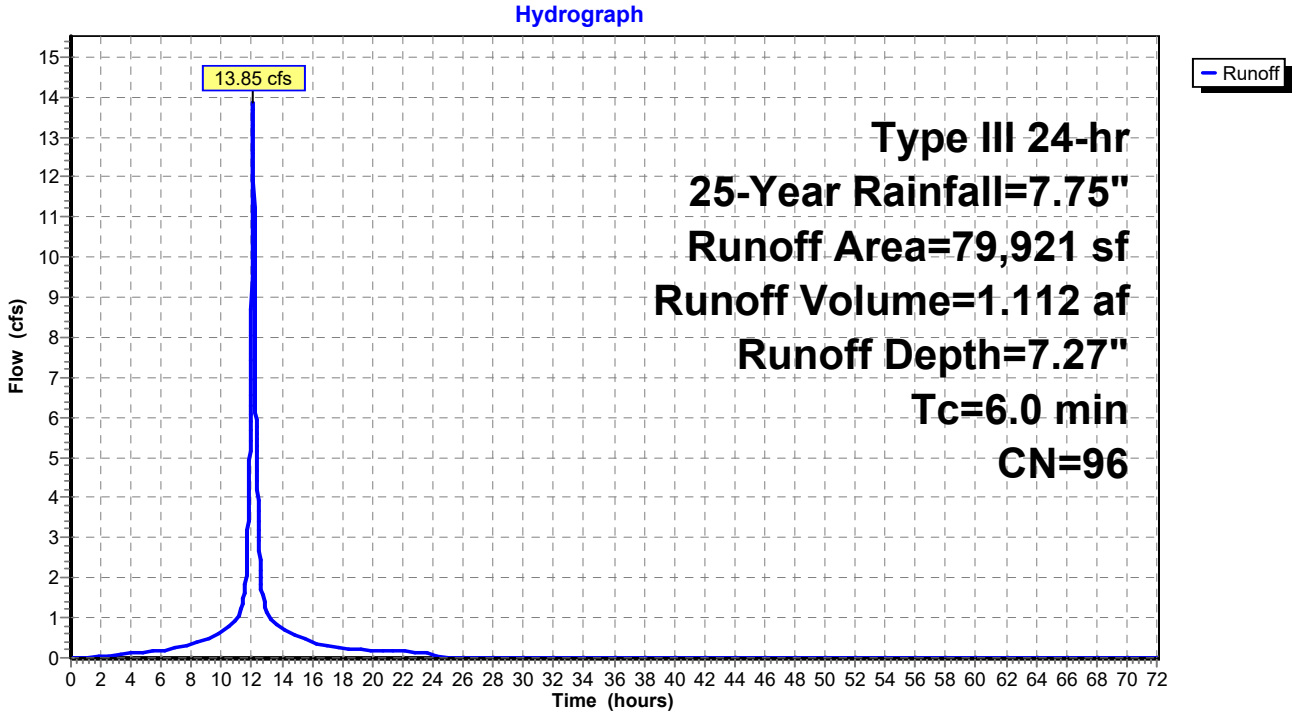
Runoff = 13.85 cfs @ 12.08 hrs, Volume= 1.112 af, Depth= 7.27"
Routed to Pond B1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=7.75"

	Area (sf)	CN	Description
	12,680	98	Roofs, HSG B
	48,418	98	Paved roads w/curbs & sewers, HSG B
	4,251	61	>75% Grass cover, Good, HSG B
*	14,572	98	Existing Paved parking
	79,921	96	Weighted Average
	4,251		5.32% Pervious Area
	75,670		94.68% Impervious Area

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

Subcatchment PD1.1:



Summary for Subcatchment PD2.1:

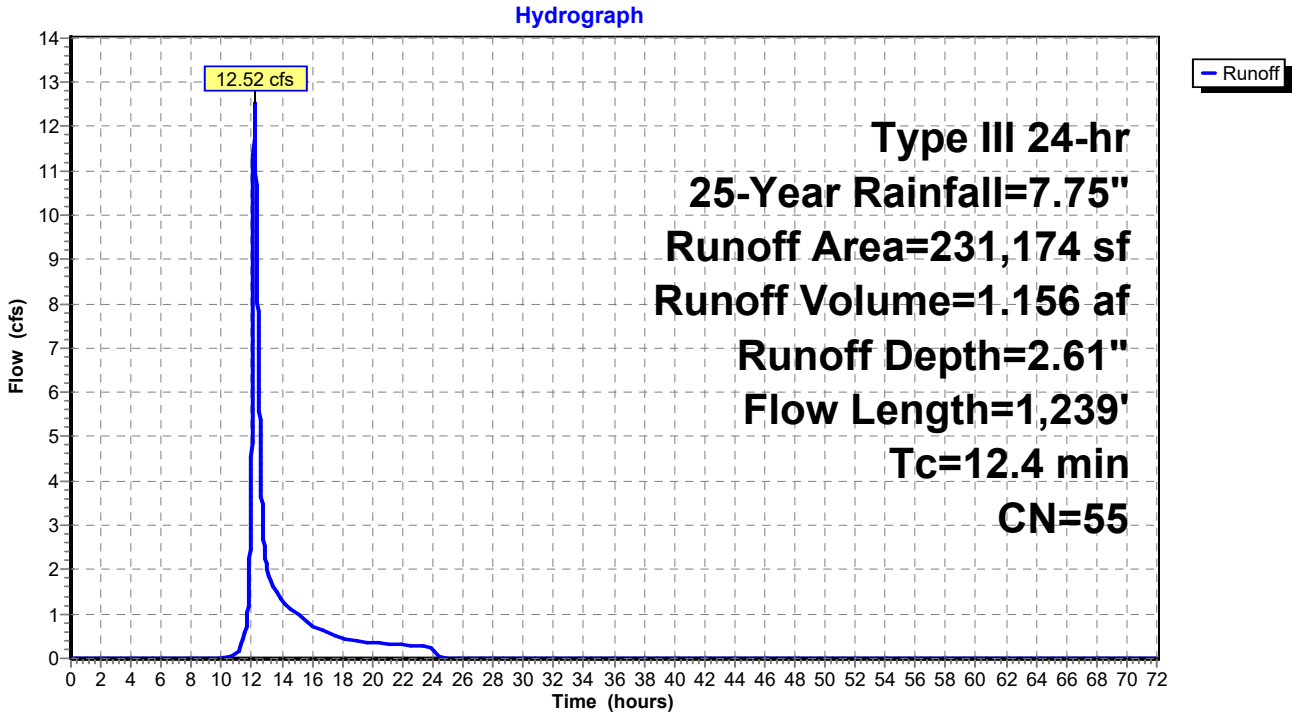
Runoff = 12.52 cfs @ 12.18 hrs, Volume= 1.156 af, Depth= 2.61"
Routed to Link PDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=7.75"

Area (sf)	CN	Description
221,903	55	Woods, Good, HSG B
9,045	61	>75% Grass cover, Good, HSG B
226	98	Unconnected pavement, HSG B
231,174	55	Weighted Average
230,948		99.90% Pervious Area
226		0.10% Impervious Area
226		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1260	0.14		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
1.2	158	0.1910	2.19		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.5	51	0.1087	1.65		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
1.6	179	0.1329	1.82		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
1.4	226	0.2702	2.60		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
0.3	26	0.0777	1.39		**Shallow Concentrated Flow, F** Woodland Kv= 5.0 fps
0.3	52	0.2692	2.59		**Shallow Concentrated Flow, G** Woodland Kv= 5.0 fps
0.5	141	0.0893	4.48		**Shallow Concentrated Flow, H** Grassed Waterway Kv= 15.0 fps
0.3	156	0.0160	7.52	13.29	**Pipe Channel, I** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.2	74	0.0190	8.19	14.48	**Pipe Channel, J** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.2	126	0.0200	8.41	14.86	**Pipe Channel, K** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
12.4	1,239	Total			

Subcatchment PD2.1:



Summary for Reach 3R: Exist 36"

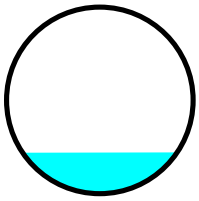
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.835 ac, 94.68% Impervious, Inflow Depth = 5.89" for 25-Year event
Inflow = 5.90 cfs @ 12.27 hrs, Volume= 0.901 af
Outflow = 5.87 cfs @ 12.31 hrs, Volume= 0.901 af, Atten= 1%, Lag= 2.0 min
Routed to Link PDP1 : MILLBURY STREET

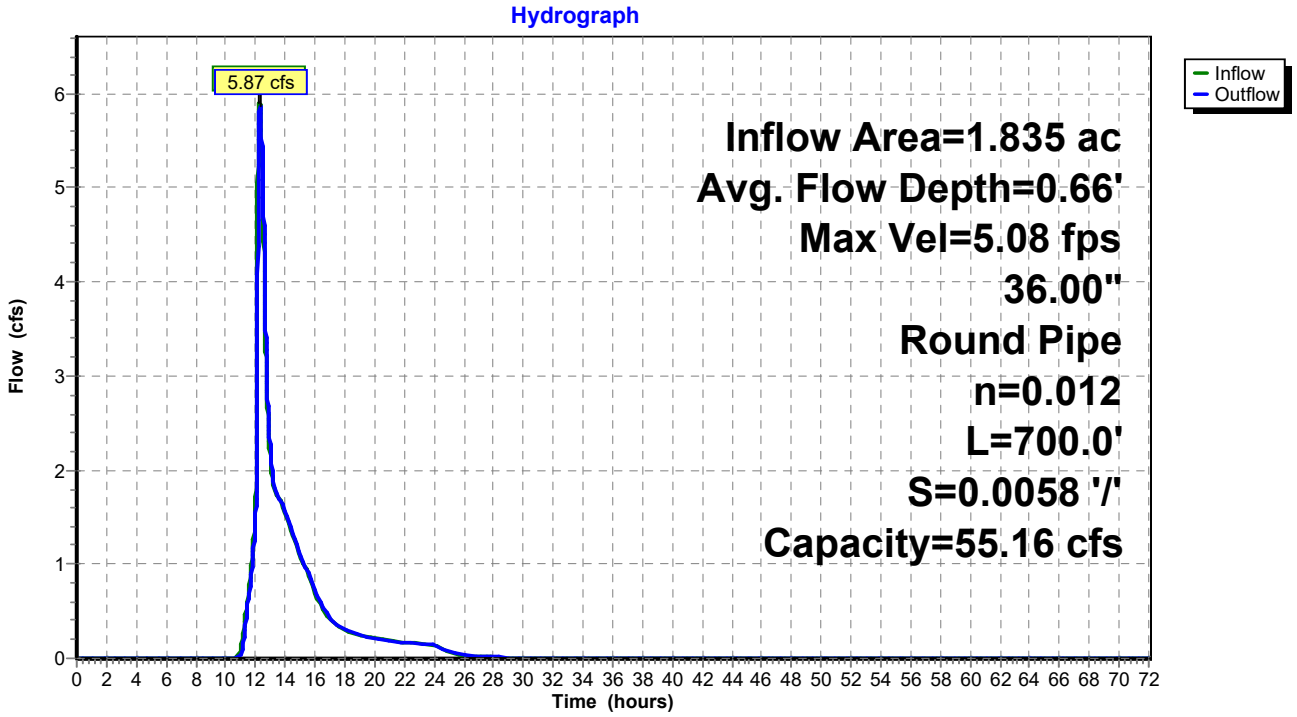
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.08 fps, Min. Travel Time= 2.3 min
Avg. Velocity = 1.43 fps, Avg. Travel Time= 8.2 min

Peak Storage= 809 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.66' , Surface Width= 2.49'
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 55.16 cfs

36.00" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 700.0' Slope= 0.0058 '/'
Inlet Invert= 458.08', Outlet Invert= 454.00'



Reach 3R: Exist 36"



Summary for Pond B1:

Inflow Area = 1.835 ac, 94.68% Impervious, Inflow Depth = 7.27" for 25-Year event
Inflow = 13.85 cfs @ 12.08 hrs, Volume= 1.112 af
Outflow = 5.90 cfs @ 12.27 hrs, Volume= 0.901 af, Atten= 57%, Lag= 11.3 min
Primary = 5.90 cfs @ 12.27 hrs, Volume= 0.901 af
Routed to Reach 3R : Exist 36"

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 470.50' @ 12.27 hrs Surf.Area= 7,379 sf Storage= 22,155 cf

Plug-Flow detention time= 196.5 min calculated for 0.901 af (81% of inflow)
Center-of-Mass det. time= 121.9 min (874.9 - 753.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	466.00'	12,498 cf	**87.25'W x 84.57'L x 6.25'H Field A** 46,117 cf Overall - 14,871 cf Embedded = 31,246 cf x 40.0% Voids
#2A	467.00'	14,871 cf	**ADS_StormTech MC-3500 d +Cap** x 132 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 132 Chambers in 12 Rows Cap Storage= 14.9 cf x 2 x 12 rows = 357.6 cf
		27,370 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	464.50'	**18.00" Round Culvert** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 464.50' / 464.25' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	469.50'	**16.00" W x 8.00" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	468.00'	**12.00" W x 4.00" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	471.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=5.90 cfs @ 12.27 hrs HW=470.50' TW=458.74' (Dynamic Tailwater)
└─**1=Culvert** (Passes 5.90 cfs of 19.49 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 3.45 cfs @ 3.88 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 2.45 cfs @ 7.35 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond B1: - Chamber Wizard Field A

Chamber Model = ADS_StormTechMC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= 14.9 cf x 2 x 12 rows = 357.6 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

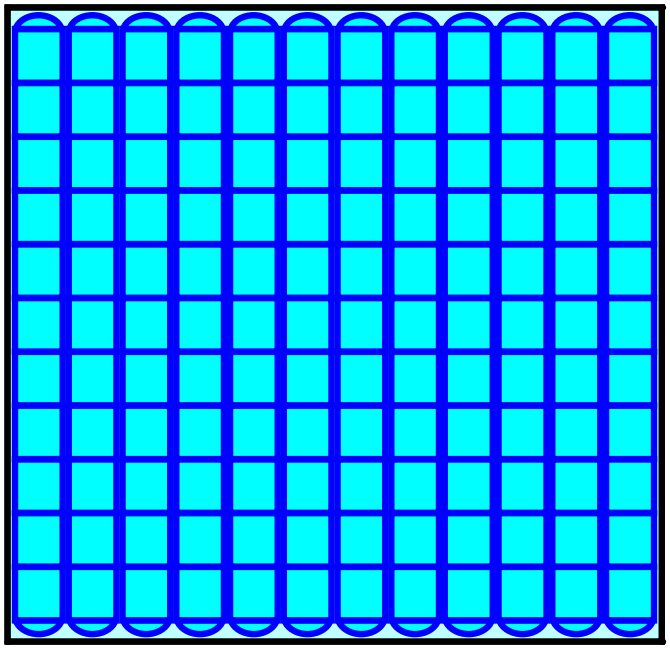
11 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 82.57' Row Length +12.0" End Stone x 2 = 84.57' Base Length
12 Rows x 77.0" Wide + 9.0" Spacing x 11 + 12.0" Side Stone x 2 = 87.25' Base Width
12.0" Stone Base + 45.0" Chamber Height + 18.0" Stone Cover = 6.25' Field Height

132 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 12 Rows = 14,871.3 cf Chamber Storage

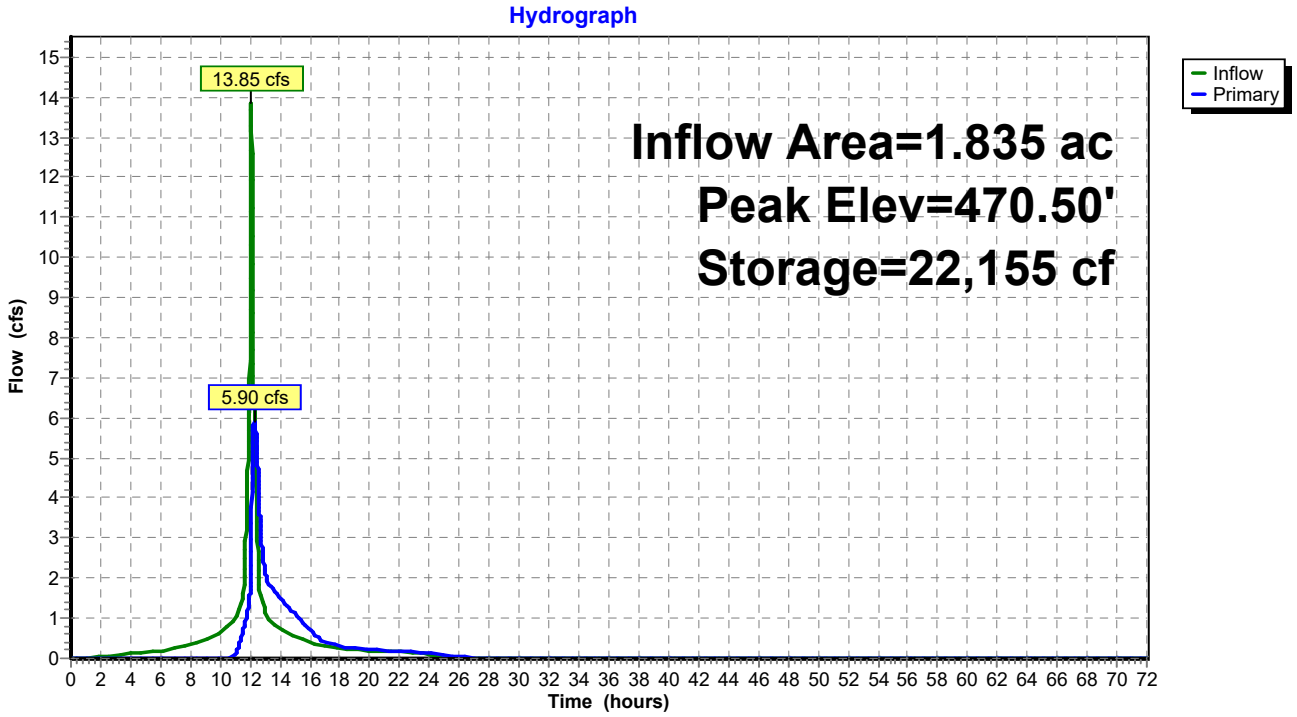
46,117.1 cf Field - 14,871.3 cf Chambers = 31,245.8 cf Stone x 40.0% Voids = 12,498.3 cf Stone Storage

Chamber Storage + Stone Storage = 27,369.6 cf = 0.628 af
Overall Storage Efficiency = 59.3%
Overall System Size = 84.57' x 87.25' x 6.25'

132 Chambers
1,708.0 cy Field
1,157.3 cy Stone



Pond B1:

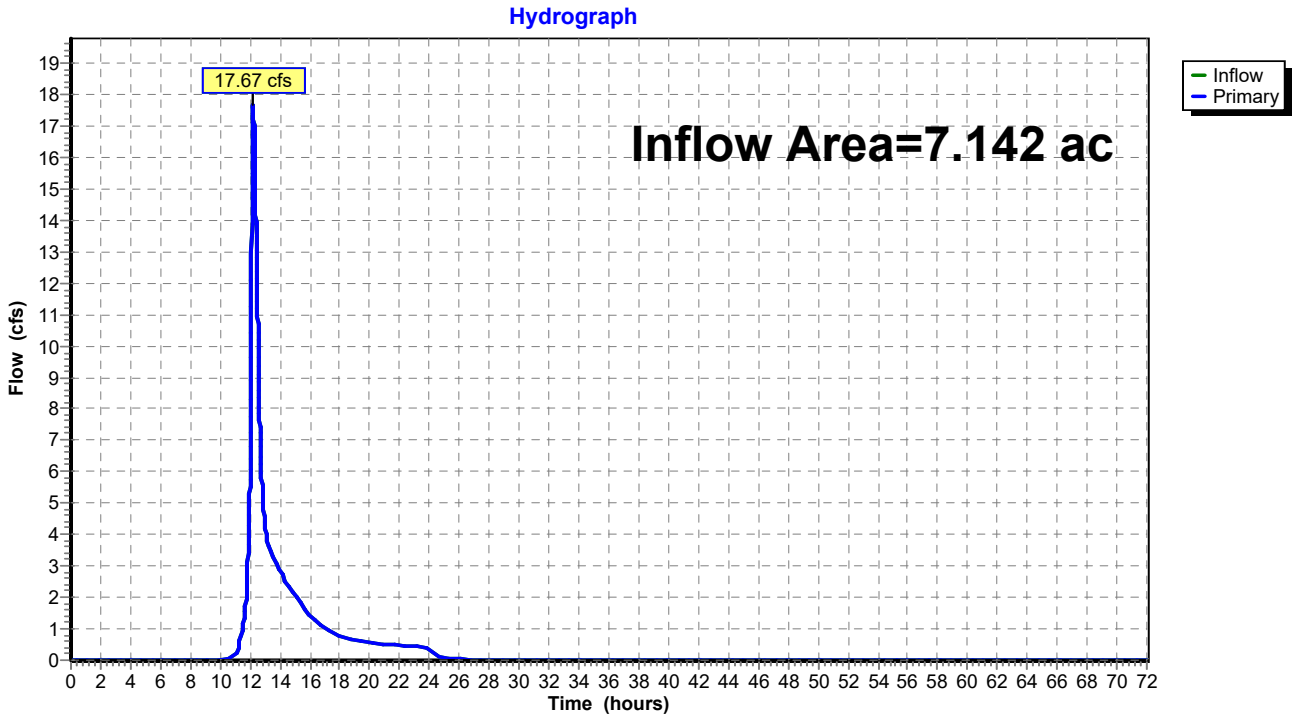

Hydrograph
Inflow Area=1.835 ac
Peak Elev=470.50'
Storage=22,155 cf
13.85 cfs
5.90 cfs
Inflow
Primary
Flow (cfs)
Time (hours)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Summary for Link PDP1: MILLBURY STREET

Inflow Area = 7.142 ac, 24.40% Impervious, Inflow Depth = 3.46" for 25-Year event
Inflow = 17.67 cfs @ 12.20 hrs, Volume= 2.057 af
Primary = 17.67 cfs @ 12.20 hrs, Volume= 2.057 af, Atten= 0%, Lag= 0.0 min

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

Link PDP1: MILLBURY STREET



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

SubcatchmentPD1.1: Runoff Area=79,921 sf 94.68% Impervious Runoff Depth=10.22"
Tc=6.0 min CN=96 Runoff=19.22 cfs 1.562 af

SubcatchmentPD2.1: Runoff Area=231,174 sf 0.10% Impervious Runoff Depth=4.76"
Flow Length=1,239' Tc=12.4 min CN=55 Runoff=23.79 cfs 2.107 af

Reach 3R: Exist 36" Avg. Flow Depth=0.85' Max Vel=5.89 fps Inflow=9.91 cfs 1.351 af
36.00" Round Pipe n=0.012 L=700.0' S=0.0058 '/' Capacity=55.16 cfs Outflow=9.78 cfs 1.351 af

Pond B1: Peak Elev=471.85' Storage=26,192 cf Inflow=19.22 cfs 1.562 af
Outflow=9.91 cfs 1.351 af

Link PDP1: MILLBURY STREET Inflow=32.78 cfs 3.458 af
Primary=32.78 cfs 3.458 af

Total Runoff Area = 7.142 ac Runoff Volume = 3.669 af Average Runoff Depth = 6.16"
75.60% Pervious = 5.399 ac 24.40% Impervious = 1.742 ac

Summary for Subcatchment PD1.1:

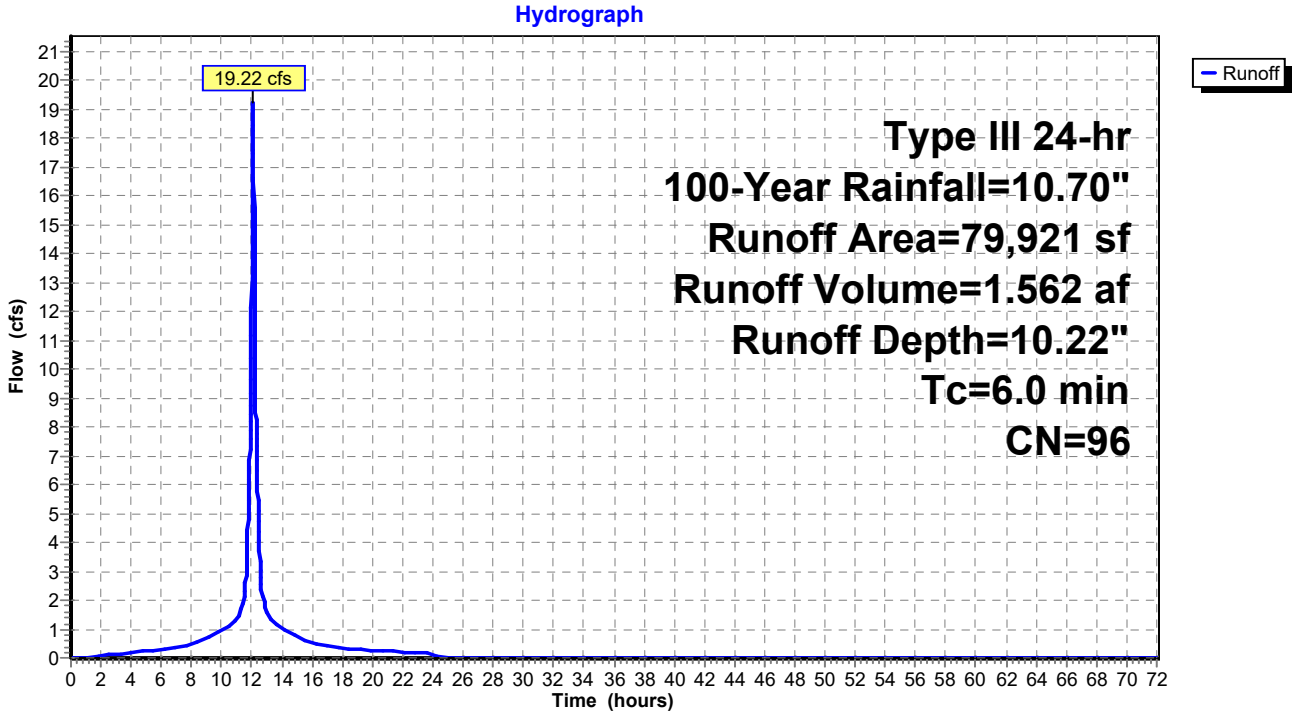
Runoff = 19.22 cfs @ 12.08 hrs, Volume= 1.562 af, Depth=10.22"
Routed to Pond B1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=10.70"

	Area (sf)	CN	Description
	12,680	98	Roofs, HSG B
	48,418	98	Paved roads w/curbs & sewers, HSG B
	4,251	61	>75% Grass cover, Good, HSG B
*	14,572	98	Existing Paved parking
	79,921	96	Weighted Average
	4,251		5.32% Pervious Area
	75,670		94.68% Impervious Area

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

Subcatchment PD1.1:



Summary for Subcatchment PD2.1:

[47] Hint: Peak is 179% of capacity of segment #9
[47] Hint: Peak is 164% of capacity of segment #10
[47] Hint: Peak is 160% of capacity of segment #11

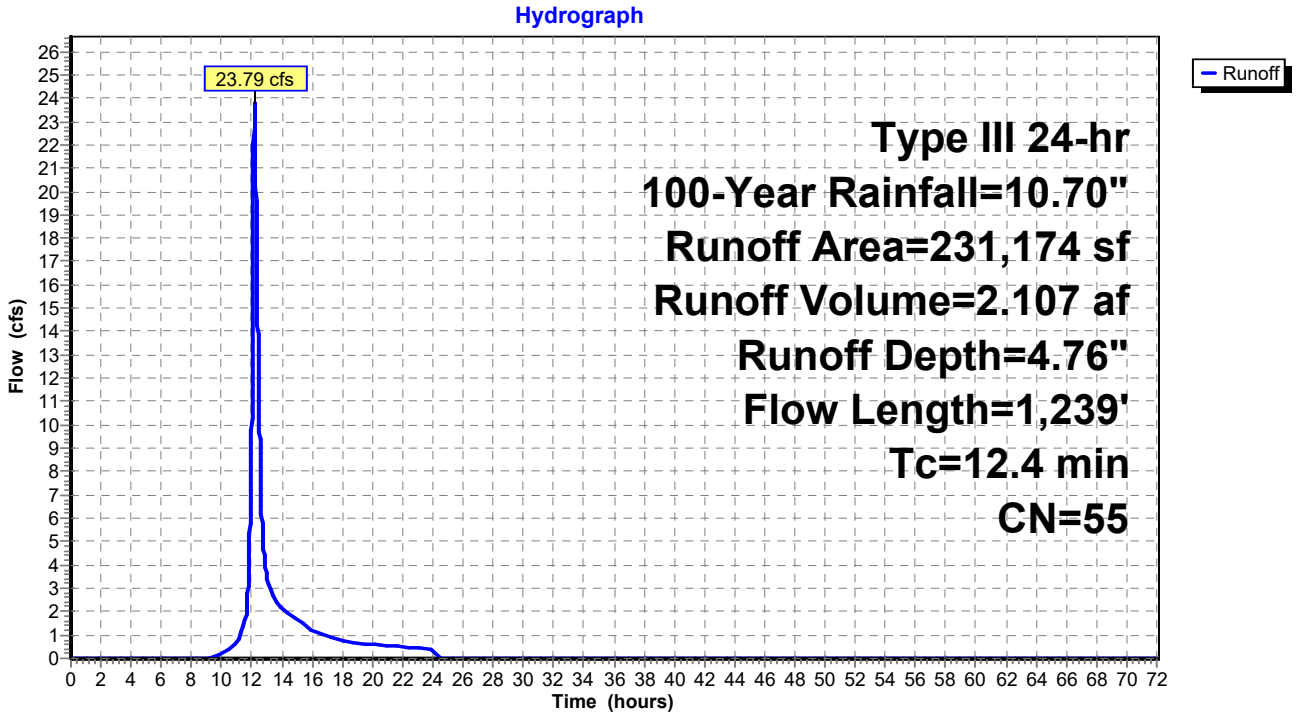
Runoff = 23.79 cfs @ 12.17 hrs, Volume= 2.107 af, Depth= 4.76"
Routed to Link PDP1 : MILLBURY STREET

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=10.70"

Area (sf)	CN	Description
221,903	55	Woods, Good, HSG B
9,045	61	>75% Grass cover, Good, HSG B
226	98	Unconnected pavement, HSG B
231,174	55	Weighted Average
230,948		99.90% Pervious Area
226		0.10% Impervious Area
226		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.9	50	0.1260	0.14		**Sheet Flow, A** Woods: Light underbrush n= 0.400 P2= 3.25"
1.2	158	0.1910	2.19		**Shallow Concentrated Flow, B** Woodland Kv= 5.0 fps
0.5	51	0.1087	1.65		**Shallow Concentrated Flow, C** Woodland Kv= 5.0 fps
1.6	179	0.1329	1.82		**Shallow Concentrated Flow, D** Woodland Kv= 5.0 fps
1.4	226	0.2702	2.60		**Shallow Concentrated Flow, E** Woodland Kv= 5.0 fps
0.3	26	0.0777	1.39		**Shallow Concentrated Flow, F** Woodland Kv= 5.0 fps
0.3	52	0.2692	2.59		**Shallow Concentrated Flow, G** Woodland Kv= 5.0 fps
0.5	141	0.0893	4.48		**Shallow Concentrated Flow, H** Grassed Waterway Kv= 15.0 fps
0.3	156	0.0160	7.52	13.29	**Pipe Channel, I** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.2	74	0.0190	8.19	14.48	**Pipe Channel, J** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
0.2	126	0.0200	8.41	14.86	**Pipe Channel, K** 18.00" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
12.4	1,239	Total			

Subcatchment PD2.1:



Summary for Reach 3R: Exist 36"

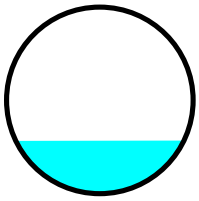
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.835 ac, 94.68% Impervious, Inflow Depth = 8.84" for 100-Year event
Inflow = 9.91 cfs @ 12.22 hrs, Volume= 1.351 af
Outflow = 9.78 cfs @ 12.24 hrs, Volume= 1.351 af, Atten= 1%, Lag= 1.6 min
Routed to Link PDP1 : MILLBURY STREET

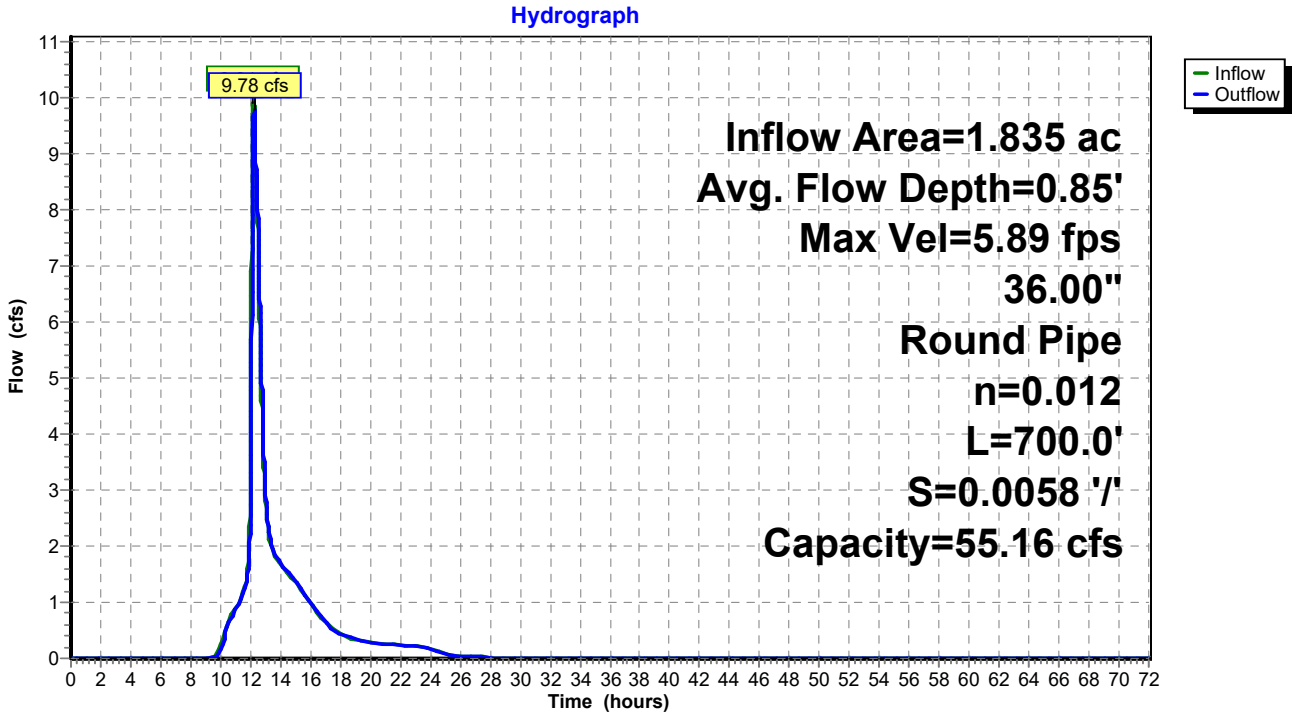
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.89 fps, Min. Travel Time= 2.0 min
Avg. Velocity = 1.56 fps, Avg. Travel Time= 7.5 min

Peak Storage= 1,162 cf @ 12.24 hrs
Average Depth at Peak Storage= 0.85' , Surface Width= 2.71'
Bank-Full Depth= 3.00' Flow Area= 7.1 sf, Capacity= 55.16 cfs

36.00" Round Pipe
n= 0.012 Concrete pipe, finished
Length= 700.0' Slope= 0.0058 '/'
Inlet Invert= 458.08', Outlet Invert= 454.00'



Reach 3R: Exist 36"



Summary for Pond B1:

Inflow Area = 1.835 ac, 94.68% Impervious, Inflow Depth = 10.22" for 100-Year event
Inflow = 19.22 cfs @ 12.08 hrs, Volume= 1.562 af
Outflow = 9.91 cfs @ 12.22 hrs, Volume= 1.351 af, Atten= 48%, Lag= 8.0 min
Primary = 9.91 cfs @ 12.22 hrs, Volume= 1.351 af
Routed to Reach 3R : Exist 36"

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 471.85' @ 12.22 hrs Surf.Area= 7,379 sf Storage= 26,192 cf

Plug-Flow detention time= 167.2 min calculated for 1.351 af (86% of inflow)
Center-of-Mass det. time= 106.0 min (853.2 - 747.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	466.00'	12,498 cf	**87.25'W x 84.57'L x 6.25'H Field A** 46,117 cf Overall - 14,871 cf Embedded = 31,246 cf x 40.0% Voids
#2A	467.00'	14,871 cf	**ADS_StormTech MC-3500 d +Cap**x 132 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 132 Chambers in 12 Rows Cap Storage= 14.9 cf x 2 x 12 rows = 357.6 cf
		27,370 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	464.50'	**18.00" Round Culvert** L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 464.50' / 464.25' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	469.50'	**16.00" W x 8.00" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	468.00'	**12.00" W x 4.00" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	471.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=9.91 cfs @ 12.22 hrs HW=471.85' TW=458.93' (Dynamic Tailwater)
- **1=Culvert** (Passes 9.91 cfs of 21.86 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 6.07 cfs @ 6.83 fps)
  - **3=Orifice/Grate** (Orifice Controls 3.08 cfs @ 9.24 fps)
  - **4=Sharp-Crested Rectangular Weir** (Weir Controls 0.76 cfs @ 1.27 fps)

Pond B1: - Chamber Wizard Field A

Chamber Model = ADS_StormTechMC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= 14.9 cf x 2 x 12 rows = 357.6 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

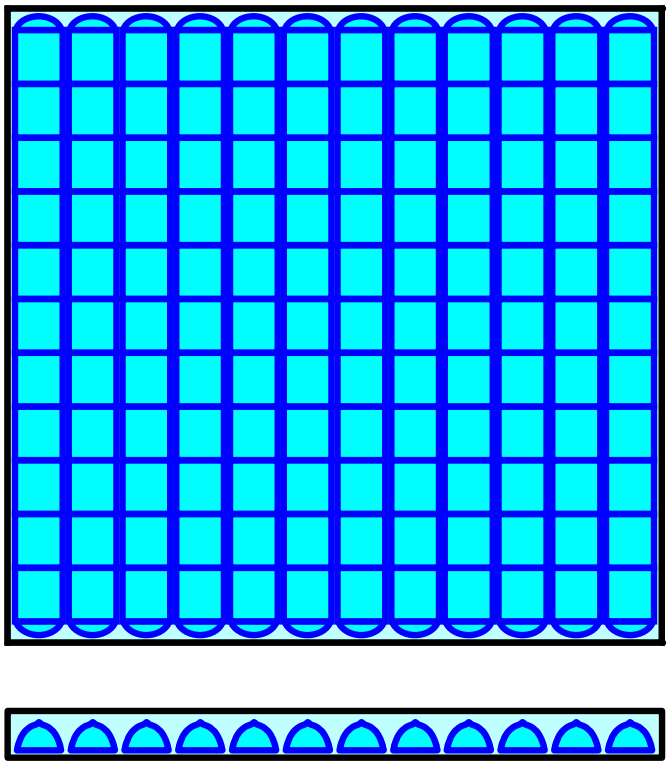
11 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 82.57' Row Length +12.0" End Stone x 2 = 84.57' Base Length
12 Rows x 77.0" Wide + 9.0" Spacing x 11 + 12.0" Side Stone x 2 = 87.25' Base Width
12.0" Stone Base + 45.0" Chamber Height + 18.0" Stone Cover = 6.25' Field Height

132 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 12 Rows = 14,871.3 cf Chamber Storage

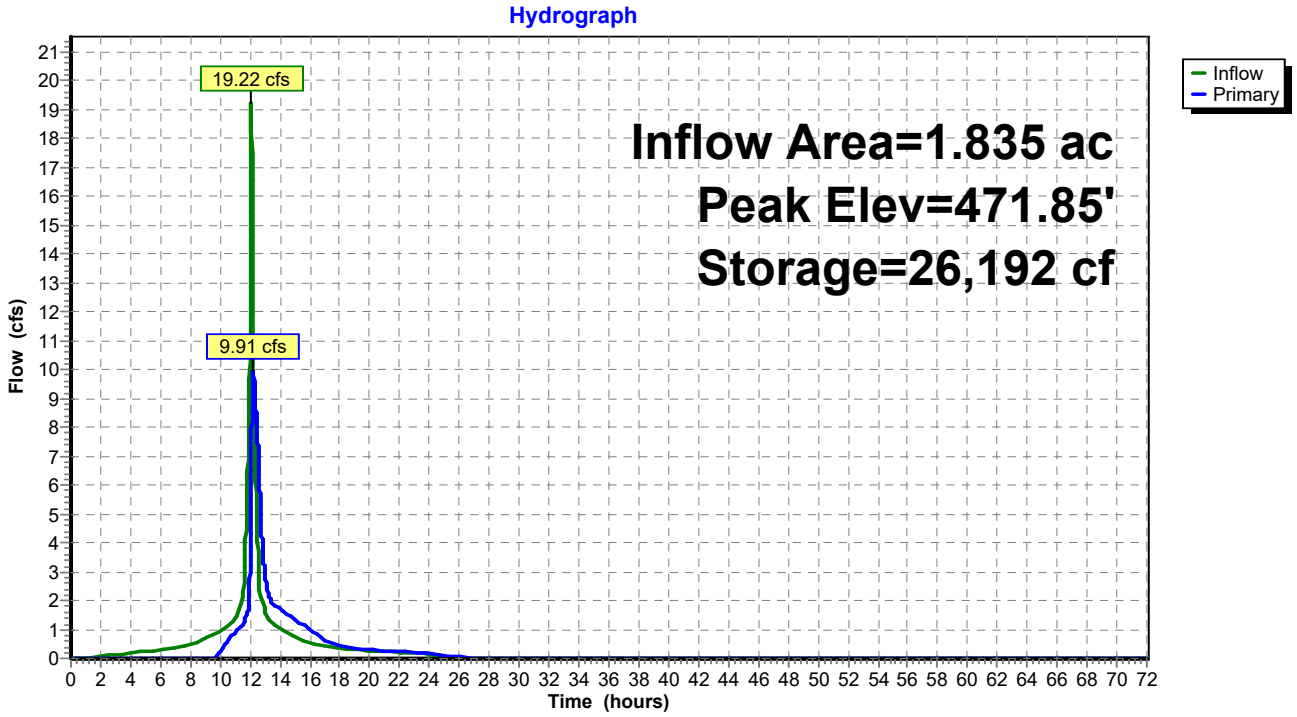
46,117.1 cf Field - 14,871.3 cf Chambers = 31,245.8 cf Stone x 40.0% Voids = 12,498.3 cf Stone Storage

Chamber Storage + Stone Storage = 27,369.6 cf = 0.628 af
Overall Storage Efficiency = 59.3%
Overall System Size = 84.57' x 87.25' x 6.25'

132 Chambers
1,708.0 cy Field
1,157.3 cy Stone



Pond B1:

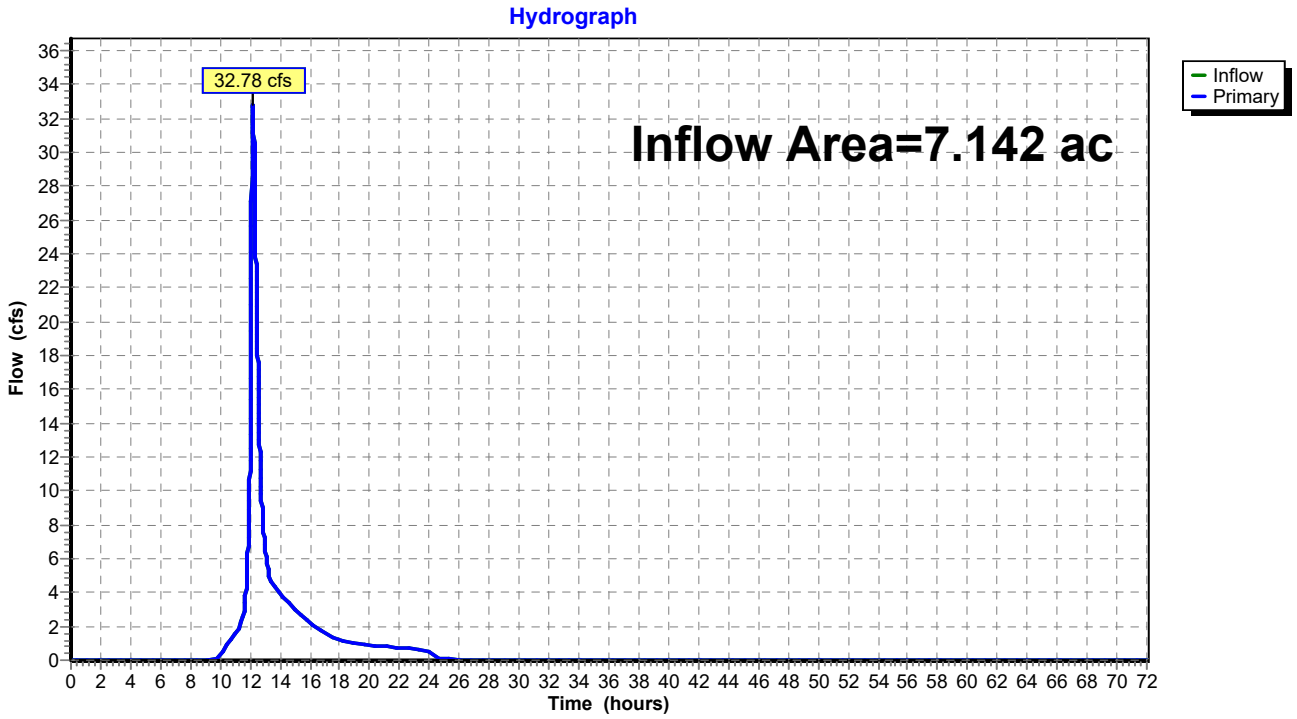

Hydrograph
Inflow Area=1.835 ac
Peak Elev=471.85'
Storage=26,192 cf
19.22 cfs
9.91 cfs
Inflow
Primary
Flow (cfs)
Time (hours)

Summary for Link PDP1: MILLBURY STREET

Inflow Area = 7.142 ac, 24.40% Impervious, Inflow Depth = 5.81" for 100-Year event
Inflow = 32.78 cfs @ 12.19 hrs, Volume= 3.458 af
Primary = 32.78 cfs @ 12.19 hrs, Volume= 3.458 af, Atten= 0%, Lag= 0.0 min

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

Link PDP1: MILLBURY STREET



APPENDIX F: STORMWATER CALCULATIONS

- *MA STANDARD #3 – RECHARGE AND DRAWDOWN TIME*
- *MA STANDARD #4 – WATER QUALITY AND TSS REMOVAL*
- *NOAA RAINFALL DATA*
- *PIPE SIZING*
- *STORAGE TABLE*

Park Silver
277 Providence Street
Worcester, MA
Bohler Job Number: MAA240174.00
November 14, 2024

MA DEP Standard 3: Recharge Volume Calculations

Required Recharge Volume - A Soils (0.60 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

Required Recharge Volume - B Soils (0.35 in.)	
Existing Site Impervious Area (ac)	0.346
Proposed Site Impervious Area (ac)	1.737
Proposed Increase in Site Impervious Area (ac)	1.391
Recharge Volume Required (cf)	**1,767**

Required Recharge Volume - C Soils (0.25 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

Required Recharge Volume - D Soils (0.10 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

Total Recharge Volume Required (cf)	**1,767**

Recharge Volume Adjustment Factor	
Impervious Area Directed to Infiltration BMP (ac)	**1.737**
%Impervious Directed to Infiltration BMP	100%
Adjustment Factor	1.00
Adjusted Total Recharge Volume Required (cf)	**1,767**

Provided Recharge Volume*	
Basin 1 (B1)	9,190
Total Recharge Volume Provided (cf)	**9,190**

Provided greater than or Equal to Required

*Volume provided below lowest outlet in cubic feet (cf)

Prepared By:
BOHLER
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

Park Silver
277 Providence Street
Worcester, MA
Bohler Job Number: MAA240174.00
November 13, 2024

MA DEP Standard 3: Drawdown Time Calculations

Drawdown Time - BMP #1 Name from HydroCAD	
Volume below outlet pipe (Rv) (cf)	9,190
Soil Type	Sandy Loam - B
Infiltration rate (K)*	1.02
Bottom Area (sf)	7,909
Drawdown time (Hours)*	**13.7**

*Infiltration Rates taken from Rawls Table
**Drawdown time = Rv / (K) x (bottom area)

Prepared By:
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November 14, 2024

MA DEP Standard 4: Water Quality Volume Calculations

Water Quality Volume Required	
Water Quality Volume runoff (in.)*	1.0
Total Post Development Impervious Area (sf)	75,670
Required Water Quality Volume (cf)	**6,306**
*Water Quality volume runoff is equal to 0.5 or 1.0 inches of runoff times the total impervious area of the post development project site.	

Water Quality Volume Provided*	
Basin 1 (B1)	9,190
Total Provided Water Quality Volume (cf)	**9,190**

Required Water Quality Volume Provided

*Volume provided below lowest outlet pipe in cubic feet (cf)

Prepared By:
BOHLER
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

Park Silver
277 Providence Street
Worcester, MA
Bohler Job Number: MAA240174.00
November 13, 2024

MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: Treatment Train for Storm Network Structures A-10 to A140

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep-Sump Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Underground Detention Basin With Isolator Row	**0.80**	**0.75**	**0.60**	**0.15**
		Total TSS Removal =	**85%**	

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

Prepared By:
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352 Turnpike Road
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Park Silver
277 Providence Street
Worcester, MA
Bohler Job Number: MAA240174.00
November 13, 2024

Rational Pipe Sizing Calculations

Design Period Storm:		25	Year		Design Period Intensity*		8.39	in/hr									
LOCATION		IMPERVIOUS			OTHER			SUM CA	Tc (min)	I (in/hr)	Q (cfs)	D (in)	S (ft/ft)	Material	n	Q Full (cfs)	V Full (fps)
FROM	TO	A	C	CA	A	C	CA										
A-10	A-90	0.37	0.95	0.36	0.04	0.30	0.01	0.37	6	8.39	3.10	18	0.006	HDPE	0.012	8.81	4.99
A-20	A-90	0.04	0.95	0.04	0.00	0.30	0.00	0.04	6	8.39	0.34	12	0.035	HDPE	0.012	7.22	9.19
A-90	A-100	0.42	0.95	0.39	0.05	0.30	0.01	0.41	6	8.39	3.43	18	0.006	HDPE	0.012	8.81	4.99
A-30	A-100	0.11	0.95	0.11	0.01	0.30	0.00	0.11	6	8.39	0.95	12	0.033	HDPE	0.012	7.01	8.93
A-100	A-110	0.53	0.95	0.50	0.06	0.30	0.02	0.52	6	8.39	4.38	18	0.008	HDPE	0.012	10.18	5.76
A-40	A-110	0.10	0.95	0.10	0.02	0.30	0.00	0.10	6	8.39	0.87	12	0.008	HDPE	0.012	3.45	4.40
A-110	A-120	0.63	0.95	0.60	0.08	0.30	0.02	0.63	6	8.39	5.25	18	0.008	HDPE	0.012	10.18	5.76
A-50	A-120	0.21	0.95	0.20	0.04	0.30	0.01	0.21	6	8.39	1.74	12	0.008	HDPE	0.012	3.45	4.40
A-120	A-140	0.84	0.95	0.80	0.11	0.30	0.03	0.83	6	8.39	6.98	18	0.008	HDPE	0.012	10.18	5.76
A-60	Basin	0.02	0.95	0.02	0.00	0.30	0.00	0.02	6	8.39	0.18	12	0.008	HDPE	0.012	3.45	4.40
A-70	A-150	0.24	0.95	0.23	0.03	0.30	0.01	0.24	6	8.39	2.01	12	0.008	HDPE	0.012	3.45	4.40
Direct to Millbury Street																	
A-200	A-210	0.33	0.95	0.32	0.54	0.30	0.16	0.48	6	8.39	4.02	12	0.040	HDPE	0.012	7.72	9.83
A-190	A-220	0.00	0.95	0.00	3.40	0.30	1.02	1.02	6	8.39	8.56	18	0.016	HDPE	0.012	14.39	8.15
A-220	A-230	0.00	0.95	0.00	3.40	0.30	1.02	1.02	6	8.39	8.56	18	0.019	HDPE	0.012	15.69	8.88
A-230	A-180	0.00	0.95	0.00	3.40	0.30	1.02	1.02	6	8.39	8.56	18	0.020	HDPE	0.012	16.09	9.11

*Rainfall intensity provided by TR55 Exhibit X-XX or Cornell University's NRCC Atlas of Precipitation Extremes for the North Eastern United States and Canada or NOAA Atlas 14, Volume 10, Version 2 on D

Prepared By:
BOHLER
352 Turnpike Road
Southborough, MA 01772
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Rainfall Events Listing (selected events)

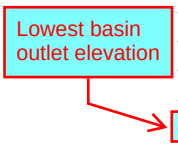
Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	100-Year	Type III 24-hr		Default	24.00	1	10.70	2

Stage-Area-Storage for Pond B1:

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
466.00	0	466.52	1,535	467.04	3,206
466.01	30	466.53	1,564	467.05	3,270
466.02	59	466.54	1,594	467.06	3,333
466.03	89	466.55	1,623	467.07	3,397
466.04	118	466.56	1,653	467.08	3,460
466.05	148	466.57	1,682	467.09	3,524
466.06	177	466.58	1,712	467.10	3,587
466.07	207	466.59	1,741	467.11	3,651
466.08	236	466.60	1,771	467.12	3,714
466.09	266	466.61	1,800	467.13	3,777
466.10	295	466.62	1,830	467.14	3,841
466.11	325	466.63	1,859	467.15	3,904
466.12	354	466.64	1,889	467.16	3,968
466.13	384	466.65	1,918	467.17	4,031
466.14	413	466.66	1,948	467.18	4,094
466.15	443	466.67	1,978	467.19	4,157
466.16	472	466.68	2,007	467.20	4,220
466.17	502	466.69	2,037	467.21	4,284
466.18	531	466.70	2,066	467.22	4,347
466.19	561	466.71	2,096	467.23	4,410
466.20	590	466.72	2,125	467.24	4,473
466.21	620	466.73	2,155	467.25	4,536
466.22	649	466.74	2,184	467.26	4,599
466.23	679	466.75	2,214	467.27	4,662
466.24	708	466.76	2,243	467.28	4,725
466.25	738	466.77	2,273	467.29	4,788
466.26	767	466.78	2,302	467.30	4,851
466.27	797	466.79	2,332	467.31	4,914
466.28	826	466.80	2,361	467.32	4,977
466.29	856	466.81	2,391	467.33	5,040
466.30	885	466.82	2,420	467.34	5,103
466.31	915	466.83	2,450	467.35	5,166
466.32	944	466.84	2,479	467.36	5,229
466.33	974	466.85	2,509	467.37	5,292
466.34	1,004	466.86	2,538	467.38	5,354
466.35	1,033	466.87	2,568	467.39	5,417
466.36	1,063	466.88	2,597	467.40	5,480
466.37	1,092	466.89	2,627	467.41	5,543
466.38	1,122	466.90	2,656	467.42	5,605
466.39	1,151	466.91	2,686	467.43	5,668
466.40	1,181	466.92	2,715	467.44	5,730
466.41	1,210	466.93	2,745	467.45	5,793
466.42	1,240	466.94	2,774	467.46	5,856
466.43	1,269	466.95	2,804	467.47	5,918
466.44	1,299	466.96	2,833	467.48	5,981
466.45	1,328	466.97	2,863	467.49	6,043
466.46	1,358	466.98	2,892	467.50	6,105
466.47	1,387	466.99	2,922	467.51	6,168
466.48	1,417	467.00	2,951	467.52	6,230
466.49	1,446	467.01	3,015	467.53	6,293
466.50	1,476	467.02	3,079	467.54	6,355
466.51	1,505	467.03	3,142	467.55	6,417

Stage-Area-Storage for Pond B1: (continued)

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
467.56	6,480	468.08	9,675	468.60	12,764
467.57	6,542	468.09	9,736	468.61	12,822
467.58	6,604	468.10	9,796	468.62	12,880
467.59	6,666	468.11	9,857	468.63	12,938
467.60	6,729	468.12	9,917	468.64	12,996
467.61	6,791	468.13	9,977	468.65	13,054
467.62	6,853	468.14	10,038	468.66	13,111
467.63	6,915	468.15	10,098	468.67	13,169
467.64	6,977	468.16	10,158	468.68	13,227
467.65	7,039	468.17	10,218	468.69	13,285
467.66	7,101	468.18	10,279	468.70	13,342
467.67	7,163	468.19	10,339	468.71	13,400
467.68	7,225	468.20	10,399	468.72	13,457
467.69	7,287	468.21	10,459	468.73	13,515
467.70	7,349	468.22	10,519	468.74	13,572
467.71	7,411	468.23	10,579	468.75	13,629
467.72	7,473	468.24	10,639	468.76	13,686
467.73	7,534	468.25	10,699	468.77	13,744
467.74	7,596	468.26	10,758	468.78	13,801
467.75	7,658	468.27	10,818	468.79	13,858
467.76	7,719	468.28	10,878	468.80	13,915
467.77	7,781	468.29	10,938	468.81	13,972
467.78	7,843	468.30	10,997	468.82	14,029
467.79	7,904	468.31	11,057	468.83	14,086
467.80	7,966	468.32	11,116	468.84	14,142
467.81	8,027	468.33	11,176	468.85	14,199
467.82	8,089	468.34	11,235	468.86	14,256
467.83	8,150	468.35	11,295	468.87	14,312
467.84	8,212	468.36	11,354	468.88	14,369
467.85	8,273	468.37	11,413	468.89	14,425
467.86	8,334	468.38	11,473	468.90	14,482
467.87	8,396	468.39	11,532	468.91	14,538
467.88	8,457	468.40	11,591	468.92	14,594
467.89	8,518	468.41	11,650	468.93	14,650
467.90	8,580	468.42	11,709	468.94	14,707
467.91	8,641	468.43	11,768	468.95	14,763
467.92	8,702	468.44	11,827	468.96	14,819
467.93	8,763	468.45	11,886	468.97	14,875
467.94	8,824	468.46	11,945	468.98	14,930
467.95	8,885	468.47	12,004	468.99	14,986
467.96	8,946	468.48	12,063	469.00	15,042
467.97	9,007	468.49	12,121	469.01	15,098
467.98	9,068	468.50	12,180	469.02	15,153
467.99	9,129	468.51	12,239	469.03	15,209
468.00	9,190	468.52	12,297	469.04	15,264
468.01	9,251	468.53	12,356	469.05	15,320
468.02	9,311	468.54	12,414	469.06	15,375
468.03	9,372	468.55	12,472	469.07	15,430
468.04	9,433	468.56	12,531	469.08	15,485
468.05	9,493	468.57	12,589	469.09	15,540
468.06	9,554	468.58	12,647	469.10	15,595
468.07	9,615	468.59	12,706	469.11	15,650



Stage-Area-Storage for Pond B1: (continued)

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
469.12	15,705	469.64	18,442	470.16	20,874
469.13	15,760	469.65	18,492	470.17	20,917
469.14	15,815	469.66	18,542	470.18	20,959
469.15	15,869	469.67	18,592	470.19	21,001
469.16	15,924	469.68	18,642	470.20	21,043
469.17	15,978	469.69	18,691	470.21	21,084
469.18	16,033	469.70	18,741	470.22	21,126
469.19	16,087	469.71	18,790	470.23	21,167
469.20	16,141	469.72	18,840	470.24	21,208
469.21	16,196	469.73	18,889	470.25	21,249
469.22	16,250	469.74	18,938	470.26	21,289
469.23	16,304	469.75	18,987	470.27	21,329
469.24	16,358	469.76	19,036	470.28	21,369
469.25	16,411	469.77	19,084	470.29	21,408
469.26	16,465	469.78	19,133	470.30	21,447
469.27	16,519	469.79	19,181	470.31	21,486
469.28	16,572	469.80	19,230	470.32	21,525
469.29	16,626	469.81	19,278	470.33	21,563
469.30	16,679	469.82	19,326	470.34	21,601
469.31	16,733	469.83	19,374	470.35	21,638
469.32	16,786	469.84	19,422	470.36	21,675
469.33	16,839	469.85	19,469	470.37	21,712
469.34	16,892	469.86	19,517	470.38	21,748
469.35	16,945	469.87	19,564	470.39	21,784
469.36	16,998	469.88	19,612	470.40	21,820
469.37	17,051	469.89	19,659	470.41	21,855
469.38	17,104	469.90	19,706	470.42	21,890
469.39	17,157	469.91	19,753	470.43	21,924
469.40	17,209	469.92	19,799	470.44	21,959
469.41	17,262	469.93	19,846	470.45	21,993
469.42	17,314	469.94	19,892	470.46	22,027
469.43	17,366	469.95	19,939	470.47	22,061
469.44	17,418	469.96	19,985	470.48	22,094
469.45	17,471	469.97	20,031	470.49	22,127
469.46	17,523	469.98	20,077	470.50	22,160
469.47	17,575	469.99	20,123	470.51	22,193
469.48	17,626	470.00	20,168	470.52	22,226
469.49	17,678	470.01	20,214	470.53	22,259
469.50	17,730	470.02	20,259	470.54	22,291
469.51	17,781	470.03	20,304	470.55	22,323
469.52	17,833	470.04	20,349	470.56	22,356
469.53	17,884	470.05	20,394	470.57	22,388
469.54	17,935	470.06	20,438	470.58	22,420
469.55	17,986	470.07	20,483	470.59	22,452
469.56	18,037	470.08	20,527	470.60	22,483
469.57	18,088	470.09	20,571	470.61	22,515
469.58	18,139	470.10	20,615	470.62	22,546
469.59	18,190	470.11	20,658	470.63	22,578
469.60	18,240	470.12	20,702	470.64	22,609
469.61	18,291	470.13	20,745	470.65	22,640
469.62	18,341	470.14	20,788	470.66	22,671
469.63	18,392	470.15	20,831	470.67	22,702

Stage-Area-Storage for Pond B1: (continued)

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
470.68	22,732	471.20	24,271	471.72	25,805
470.69	22,763	471.21	24,300	471.73	25,835
470.70	22,793	471.22	24,330	471.74	25,864
470.71	22,823	471.23	24,359	471.75	25,894
470.72	22,853	471.24	24,389	471.76	25,923
470.73	22,883	471.25	24,418	471.77	25,953
470.74	22,913	471.26	24,448	471.78	25,982
470.75	22,942	471.27	24,477	471.79	26,012
470.76	22,972	471.28	24,507	471.80	26,041
470.77	23,001	471.29	24,536	471.81	26,071
470.78	23,031	471.30	24,566	471.82	26,100
470.79	23,060	471.31	24,595	471.83	26,130
470.80	23,090	471.32	24,625	471.84	26,159
470.81	23,119	471.33	24,654	471.85	26,189
470.82	23,149	471.34	24,684	471.86	26,219
470.83	23,178	471.35	24,713	471.87	26,248
470.84	23,208	471.36	24,743	471.88	26,278
470.85	23,237	471.37	24,772	471.89	26,307
470.86	23,267	471.38	24,802	471.90	26,337
470.87	23,297	471.39	24,831	471.91	26,366
470.88	23,326	471.40	24,861	471.92	26,396
470.89	23,356	471.41	24,890	471.93	26,425
470.90	23,385	471.42	24,920	471.94	26,455
470.91	23,415	471.43	24,949	471.95	26,484
470.92	23,444	471.44	24,979	471.96	26,514
470.93	23,474	471.45	25,008	471.97	26,543
470.94	23,503	471.46	25,038	471.98	26,573
470.95	23,533	471.47	25,067	471.99	26,602
470.96	23,562	471.48	25,097	472.00	26,632
470.97	23,592	471.49	25,126	472.01	26,661
470.98	23,621	471.50	25,156	472.02	26,691
470.99	23,651	471.51	25,185	472.03	26,720
471.00	23,680	471.52	25,215	472.04	26,750
471.01	23,710	471.53	25,245	472.05	26,779
471.02	23,739	471.54	25,274	472.06	26,809
471.03	23,769	471.55	25,304	472.07	26,838
471.04	23,798	471.56	25,333	472.08	26,868
471.05	23,828	471.57	25,363	472.09	26,897
471.06	23,857	471.58	25,392	472.10	26,927
471.07	23,887	471.59	25,422	472.11	26,956
471.08	23,916	471.60	25,451	472.12	26,986
471.09	23,946	471.61	25,481	472.13	27,015
471.10	23,975	471.62	25,510	472.14	27,045
471.11	24,005	471.63	25,540	472.15	27,074
471.12	24,034	471.64	25,569	472.16	27,104
471.13	24,064	471.65	25,599	472.17	27,133
471.14	24,093	471.66	25,628	472.18	27,163
471.15	24,123	471.67	25,658	472.19	27,192
471.16	24,152	471.68	25,687	472.20	27,222
471.17	24,182	471.69	25,717	472.21	27,252
471.18	24,211	471.70	25,746	472.22	27,281
471.19	24,241	471.71	25,776	472.23	27,311

Stage-Area-Storage for Pond B1: (continued)

Elevation (feet)	Storage (cubic-feet)
472.24	27,340
472.25	**27,370**

NOAA Atlas 14, Volume 10, Version 3
Location name: Worcester, Massachusetts, USA*
Latitude: 42.2358°, Longitude: -71.7906°
Elevation: 463 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point 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	**0.341** (0.272-0.422)	**0.402** (0.321-0.499)	**0.502** (0.399-0.625)	**0.585** (0.462-0.733)	**0.699** (0.532-0.919)	**0.786** (0.583-1.06)	**0.875** (0.627-1.22)	**0.972** (0.659-1.40)	**1.11** (0.719-1.66)	**1.21** (0.768-1.87)
10-min	**0.483** (0.386-0.598)	**0.570** (0.454-0.707)	**0.712** (0.566-0.887)	**0.829** (0.654-1.04)	**0.991** (0.753-1.30)	**1.11** (0.827-1.50)	**1.24** (0.888-1.74)	**1.38** (0.935-1.99)	**1.57** (1.02-2.36)	**1.72** (1.09-2.65)
15-min	**0.568** (0.454-0.704)	**0.670** (0.535-0.831)	**0.837** (0.665-1.04)	**0.975** (0.770-1.22)	**1.16** (0.886-1.53)	**1.31** (0.972-1.76)	**1.46** (1.04-2.04)	**1.62** (1.10-2.34)	**1.84** (1.20-2.78)	**2.02** (1.28-3.12)
30-min	**0.772** (0.617-0.956)	**0.911** (0.727-1.13)	**1.14** (0.905-1.42)	**1.33** (1.05-1.66)	**1.59** (1.21-2.08)	**1.78** (1.32-2.40)	**1.99** (1.42-2.78)	**2.21** (1.50-3.19)	**2.51** (1.63-3.78)	**2.76** (1.74-4.25)
60-min	**0.976** (0.779-1.21)	**1.15** (0.919-1.43)	**1.44** (1.14-1.79)	**1.68** (1.32-2.10)	**2.01** (1.53-2.64)	**2.26** (1.68-3.04)	**2.52** (1.80-3.52)	**2.79** (1.90-4.04)	**3.18** (2.07-4.79)	**3.49** (2.21-5.38)
2-hr	**1.24** (0.995-1.52)	**1.47** (1.18-1.81)	**1.85** (1.48-2.29)	**2.16** (1.72-2.70)	**2.60** (1.99-3.40)	**2.92** (2.19-3.92)	**3.26** (2.36-4.58)	**3.66** (2.49-5.26)	**4.24** (2.76-6.34)	**4.71** (2.99-7.22)
3-hr	**1.42** (1.14-1.74)	**1.69** (1.36-2.08)	**2.14** (1.71-2.63)	**2.51** (2.00-3.11)	**3.02** (2.32-3.94)	**3.39** (2.55-4.55)	**3.80** (2.77-5.33)	**4.28** (2.92-6.13)	**4.99** (3.26-7.44)	**5.59** (3.56-8.53)
6-hr	**1.77** (1.44-2.16)	**2.13** (1.73-2.60)	**2.72** (2.20-3.34)	**3.21** (2.58-3.96)	**3.88** (3.01-5.06)	**4.38** (3.32-5.86)	**4.92** (3.61-6.89)	**5.57** (3.81-7.93)	**6.55** (4.29-9.71)	**7.39** (4.71-11.2)
12-hr	**2.19** (1.79-2.65)	**2.66** (2.17-3.23)	**3.43** (2.78-4.17)	**4.06** (3.28-4.98)	**4.94** (3.85-6.40)	**5.59** (4.26-7.43)	**6.30** (4.65-8.76)	**7.14** (4.91-10.1)	**8.42** (5.54-12.4)	**9.52** (6.09-14.3)
24-hr	**2.60** (2.14-3.13)	**3.18** (2.61-3.84)	**4.14** (3.38-5.01)	**4.93** (4.01-6.01)	**6.02** (4.72-7.75)	**6.83** (5.23-9.03)	**7.70** (5.72-10.7)	**8.76** (6.04-12.3)	**10.4** (6.84-15.2)	**11.8** (7.56-17.6)
2-day	**2.97** (2.46-3.55)	**3.65** (3.02-4.38)	**4.78** (3.93-5.74)	**5.70** (4.66-6.90)	**6.99** (5.51-8.95)	**7.93** (6.12-10.4)	**8.96** (6.70-12.4)	**10.2** (7.08-14.3)	**12.2** (8.07-17.7)	**13.9** (8.95-20.6)
3-day	**3.23** (2.68-3.85)	**3.97** (3.29-4.73)	**5.18** (4.28-6.20)	**6.18** (5.07-7.45)	**7.56** (5.98-9.65)	**8.58** (6.64-11.2)	**9.69** (7.27-13.3)	**11.1** (7.68-15.4)	**13.2** (8.75-19.1)	**15.1** (9.71-22.3)
4-day	**3.46** (2.89-4.12)	**4.24** (3.53-5.05)	**5.51** (4.56-6.58)	**6.56** (5.40-7.89)	**8.01** (6.35-10.2)	**9.08** (7.04-11.9)	**10.2** (7.70-14.0)	**11.7** (8.12-16.2)	**13.9** (9.24-20.1)	**15.8** (10.2-23.4)
7-day	**4.14** (3.46-4.89)	**4.98** (4.16-5.89)	**6.36** (5.30-7.56)	**7.50** (6.21-8.98)	**9.08** (7.23-11.5)	**10.2** (7.97-13.3)	**11.5** (8.66-15.6)	**13.0** (9.10-18.0)	**15.4** (10.2-22.1)	**17.4** (11.2-25.5)
10-day	**4.80** (4.03-5.66)	**5.68** (4.77-6.70)	**7.12** (5.95-8.44)	**8.32** (6.90-9.92)	**9.96** (7.95-12.5)	**11.2** (8.71-14.4)	**12.5** (9.39-16.8)	**14.0** (9.83-19.3)	**16.4** (10.9-23.4)	**18.3** (11.9-26.7)
20-day	**6.85** (5.80-8.02)	**7.78** (6.58-9.12)	**9.31** (7.83-11.0)	**10.6** (8.84-12.5)	**12.3** (9.87-15.3)	**13.6** (10.6-17.3)	**15.0** (11.2-19.8)	**16.5** (11.6-22.4)	**18.5** (12.4-26.2)	**20.1** (13.1-29.2)
30-day	**8.56** (7.27-9.99)	**9.53** (8.08-11.1)	**11.1** (9.37-13.0)	**12.4** (10.4-14.6)	**14.2** (11.4-17.4)	**15.6** (12.2-19.6)	**17.0** (12.7-22.1)	**18.4** (13.0-24.9)	**20.2** (13.6-28.4)	**21.5** (14.0-31.1)
45-day	**10.7** (9.12-12.4)	**11.7** (9.96-13.6)	**13.3** (11.3-15.6)	**14.7** (12.4-17.2)	**16.5** (13.3-20.2)	**18.0** (14.1-22.4)	**19.4** (14.4-25.0)	**20.7** (14.7-27.9)	**22.3** (15.0-31.2)	**23.3** (15.2-33.6)
60-day	**12.5** (10.7-14.4)	**13.5** (11.5-15.7)	**15.2** (12.9-17.7)	**16.6** (14.0-19.4)	**18.5** (14.9-22.5)	**20.0** (15.7-24.8)	**21.5** (16.0-27.4)	**22.7** (16.2-30.5)	**24.1** (16.3-33.7)	**25.0** (16.4-35.9)

[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.

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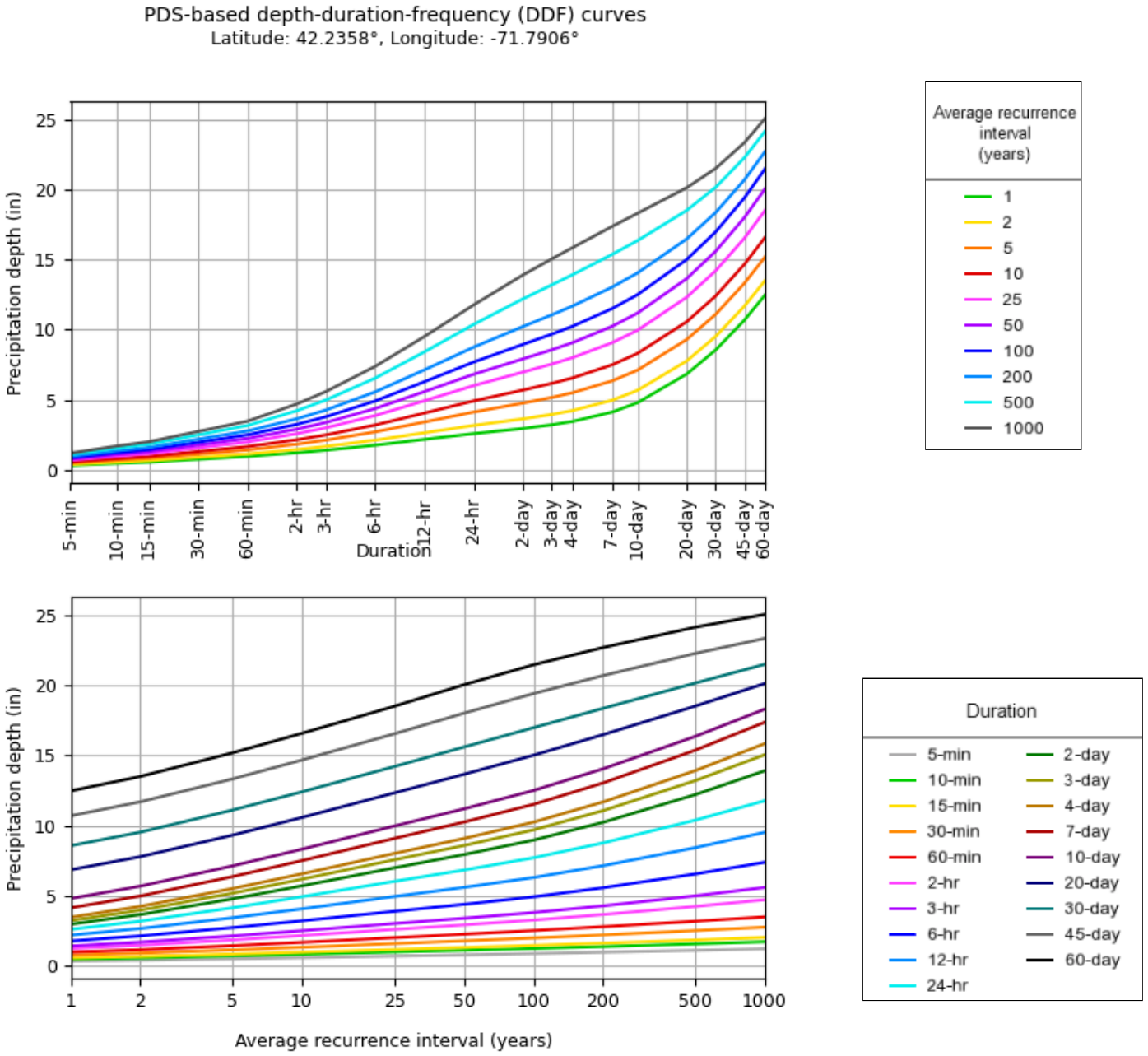
PF graphical



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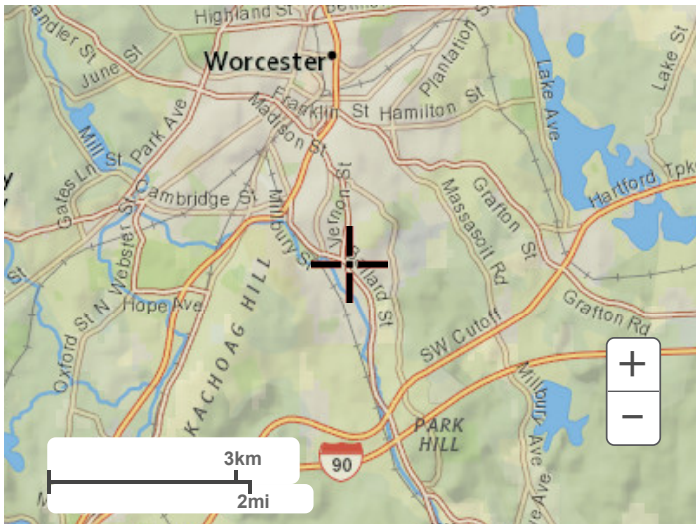
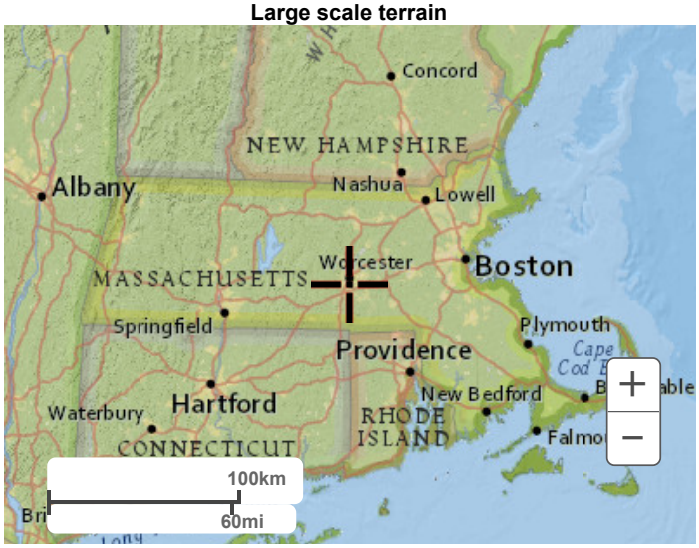
Maps & aerials

Small scale terrain



Large scale terrain



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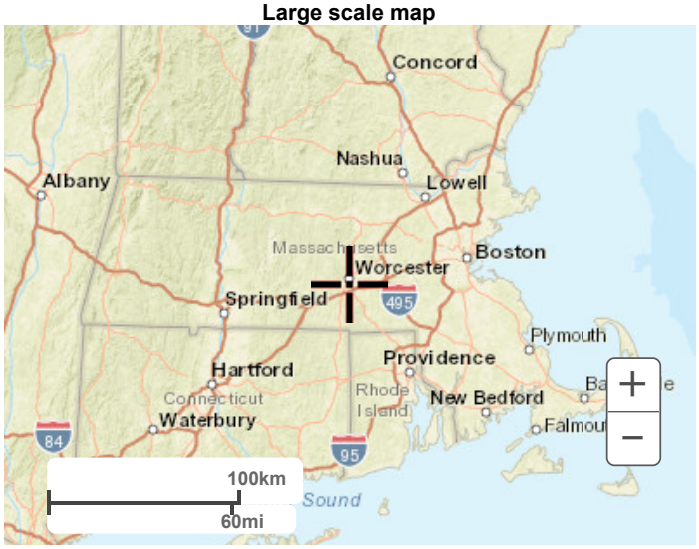
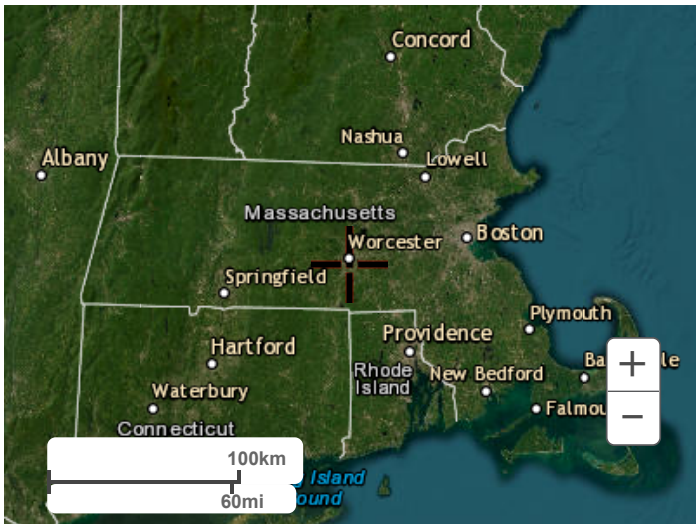


Large scale aerial



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National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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NOAA Atlas 14, Volume 10, Version 3
Location name: Worcester, Massachusetts, USA*
Latitude: 42.2358°, Longitude: -71.7906°
Elevation: 463 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**4.09** (3.26-5.06)	**4.82** (3.85-5.99)	**6.02** (4.79-7.50)	**7.02** (5.54-8.80)	**8.39** (6.38-11.0)	**9.43** (7.00-12.7)	**10.5** (7.52-14.7)	**11.7** (7.91-16.9)	**13.3** (8.63-20.0)	**14.6** (9.22-22.4)
10-min	**2.90** (2.32-3.59)	**3.42** (2.72-4.24)	**4.27** (3.40-5.32)	**4.97** (3.92-6.23)	**5.95** (4.52-7.81)	**6.68** (4.96-8.99)	**7.44** (5.33-10.4)	**8.26** (5.61-12.0)	**9.41** (6.11-14.2)	**10.3** (6.53-15.9)
15-min	**2.27** (1.82-2.82)	**2.68** (2.14-3.32)	**3.35** (2.66-4.16)	**3.90** (3.08-4.89)	**4.66** (3.54-6.12)	**5.24** (3.89-7.05)	**5.84** (4.18-8.16)	**6.48** (4.40-9.37)	**7.38** (4.80-11.1)	**8.09** (5.12-12.5)
30-min	**1.54** (1.23-1.91)	**1.82** (1.45-2.26)	**2.28** (1.81-2.83)	**2.65** (2.10-3.33)	**3.17** (2.41-4.17)	**3.57** (2.65-4.80)	**3.97** (2.85-5.56)	**4.41** (3.00-6.38)	**5.02** (3.27-7.56)	**5.51** (3.49-8.49)
60-min	**0.976** (0.779-1.21)	**1.15** (0.919-1.43)	**1.44** (1.14-1.79)	**1.68** (1.32-2.10)	**2.01** (1.53-2.64)	**2.26** (1.68-3.04)	**2.52** (1.80-3.52)	**2.79** (1.90-4.04)	**3.18** (2.07-4.79)	**3.49** (2.21-5.38)
2-hr	**0.619** (0.497-0.762)	**0.735** (0.590-0.906)	**0.924** (0.739-1.14)	**1.08** (0.859-1.35)	**1.30** (0.994-1.70)	**1.46** (1.09-1.96)	**1.63** (1.18-2.29)	**1.83** (1.24-2.63)	**2.12** (1.38-3.17)	**2.36** (1.50-3.61)
3-hr	**0.471** (0.380-0.578)	**0.562** (0.453-0.691)	**0.711** (0.570-0.877)	**0.834** (0.665-1.04)	**1.00** (0.772-1.31)	**1.13** (0.850-1.52)	**1.26** (0.922-1.78)	**1.42** (0.971-2.04)	**1.66** (1.08-2.48)	**1.86** (1.18-2.84)
6-hr	**0.296** (0.240-0.361)	**0.356** (0.288-0.435)	**0.454** (0.367-0.557)	**0.536** (0.430-0.661)	**0.648** (0.502-0.844)	**0.732** (0.554-0.978)	**0.821** (0.603-1.15)	**0.930** (0.636-1.32)	**1.09** (0.716-1.62)	**1.23** (0.786-1.87)
12-hr	**0.181** (0.148-0.220)	**0.220** (0.180-0.267)	**0.284** (0.231-0.346)	**0.337** (0.272-0.413)	**0.410** (0.319-0.530)	**0.464** (0.353-0.616)	**0.522** (0.385-0.726)	**0.592** (0.407-0.839)	**0.699** (0.459-1.03)	**0.790** (0.505-1.19)
24-hr	**0.108** (0.089-0.130)	**0.132** (0.108-0.159)	**0.172** (0.141-0.208)	**0.205** (0.166-0.250)	**0.250** (0.196-0.322)	**0.284** (0.217-0.376)	**0.320** (0.238-0.444)	**0.365** (0.251-0.513)	**0.432** (0.285-0.632)	**0.490** (0.314-0.733)
2-day	**0.061** (0.051-0.073)	**0.076** (0.062-0.091)	**0.099** (0.081-0.119)	**0.118** (0.097-0.143)	**0.145** (0.114-0.186)	**0.165** (0.127-0.217)	**0.186** (0.139-0.257)	**0.213** (0.147-0.297)	**0.254** (0.168-0.369)	**0.289** (0.186-0.430)
3-day	**0.044** (0.037-0.053)	**0.055** (0.045-0.065)	**0.071** (0.059-0.086)	**0.085** (0.070-0.103)	**0.105** (0.083-0.133)	**0.119** (0.092-0.156)	**0.134** (0.100-0.185)	**0.153** (0.106-0.213)	**0.183** (0.121-0.265)	**0.209** (0.134-0.309)
4-day	**0.036** (0.030-0.042)	**0.044** (0.036-0.052)	**0.057** (0.047-0.068)	**0.068** (0.056-0.082)	**0.083** (0.066-0.106)	**0.094** (0.073-0.123)	**0.106** (0.080-0.146)	**0.121** (0.084-0.168)	**0.144** (0.096-0.209)	**0.165** (0.106-0.243)
7-day	**0.024** (0.020-0.029)	**0.029** (0.024-0.035)	**0.037** (0.031-0.044)	**0.044** (0.036-0.053)	**0.054** (0.043-0.068)	**0.060** (0.047-0.079)	**0.068** (0.051-0.092)	**0.077** (0.054-0.107)	**0.091** (0.060-0.131)	**0.103** (0.066-0.151)
10-day	**0.020** (0.016-0.023)	**0.023** (0.019-0.027)	**0.029** (0.024-0.035)	**0.034** (0.028-0.041)	**0.041** (0.033-0.052)	**0.046** (0.036-0.060)	**0.052** (0.039-0.070)	**0.058** (0.040-0.080)	**0.068** (0.045-0.097)	**0.076** (0.049-0.111)
20-day	**0.014** (0.012-0.016)	**0.016** (0.013-0.019)	**0.019** (0.016-0.022)	**0.022** (0.018-0.026)	**0.025** (0.020-0.031)	**0.028** (0.022-0.036)	**0.031** (0.023-0.041)	**0.034** (0.024-0.046)	**0.038** (0.025-0.054)	**0.041** (0.027-0.060)
30-day	**0.011** (0.010-0.013)	**0.013** (0.011-0.015)	**0.015** (0.013-0.018)	**0.017** (0.014-0.020)	**0.019** (0.015-0.024)	**0.021** (0.016-0.027)	**0.023** (0.017-0.030)	**0.025** (0.018-0.034)	**0.027** (0.018-0.039)	**0.029** (0.019-0.043)
45-day	**0.009** (0.008-0.011)	**0.010** (0.009-0.012)	**0.012** (0.010-0.014)	**0.013** (0.011-0.015)	**0.015** (0.012-0.018)	**0.016** (0.013-0.020)	**0.017** (0.013-0.023)	**0.019** (0.013-0.025)	**0.020** (0.013-0.028)	**0.021** (0.014-0.031)
60-day	**0.008** (0.007-0.010)	**0.009** (0.008-0.010)	**0.010** (0.008-0.012)	**0.011** (0.009-0.013)	**0.012** (0.010-0.015)	**0.013** (0.010-0.017)	**0.014** (0.011-0.019)	**0.015** (0.011-0.021)	**0.016** (0.011-0.023)	**0.017** (0.011-0.024)

[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.

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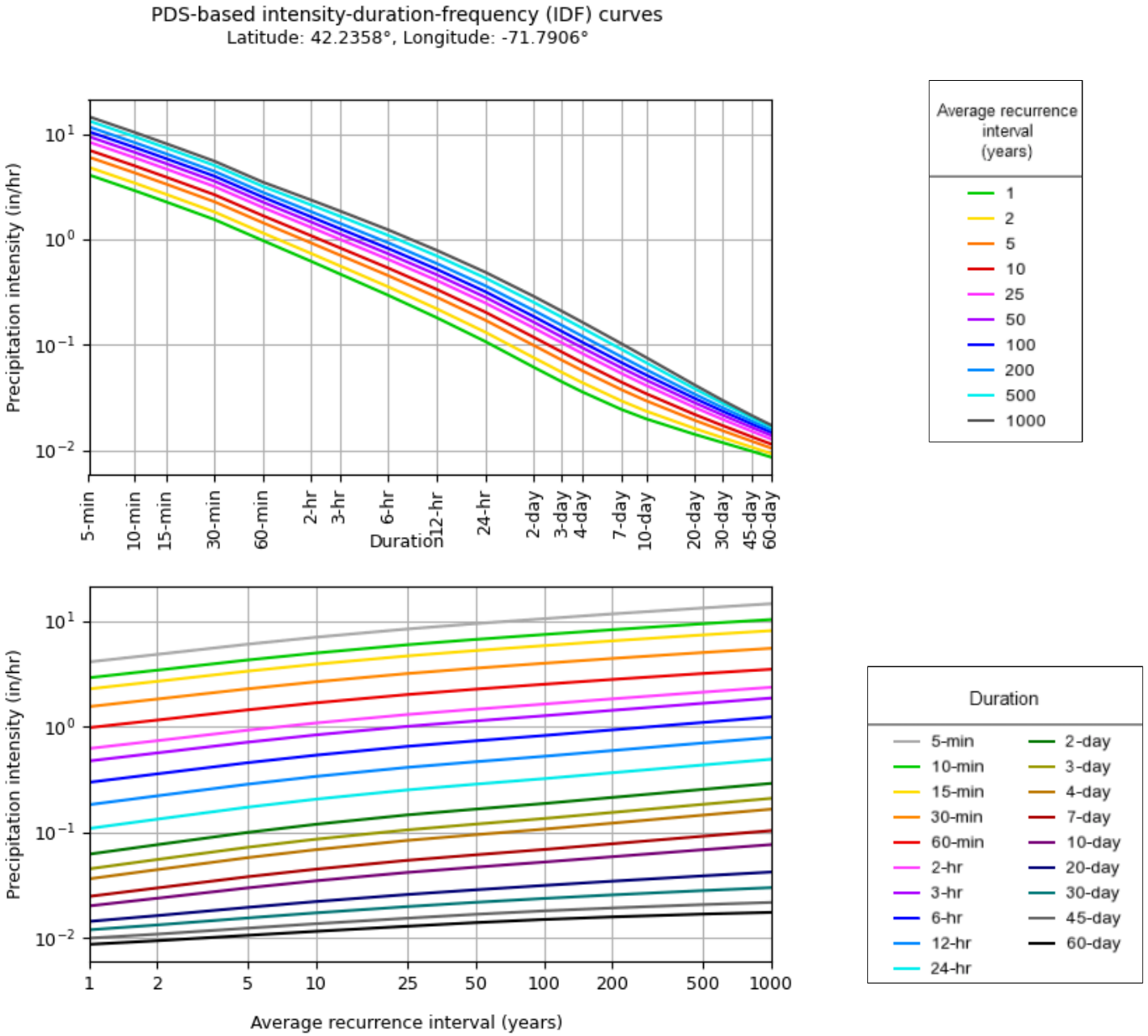
PF graphical



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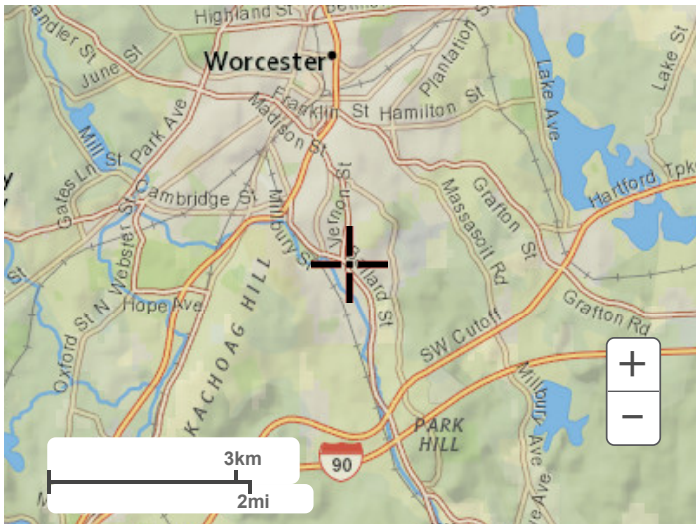
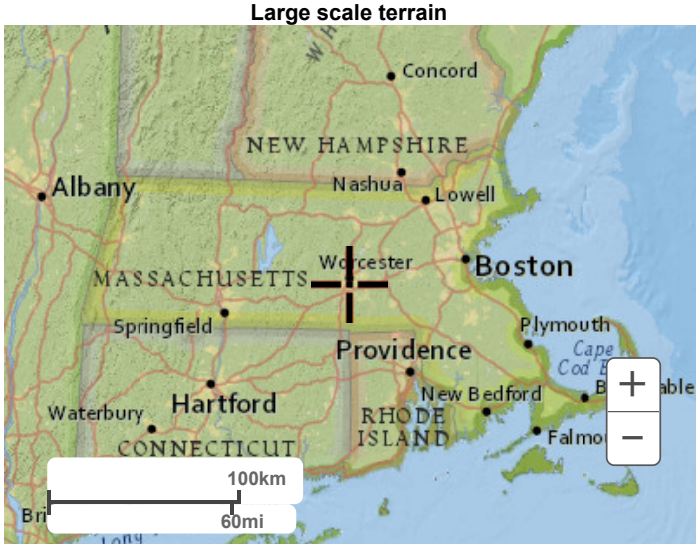
Maps & aerials

Small scale terrain



Large scale terrain



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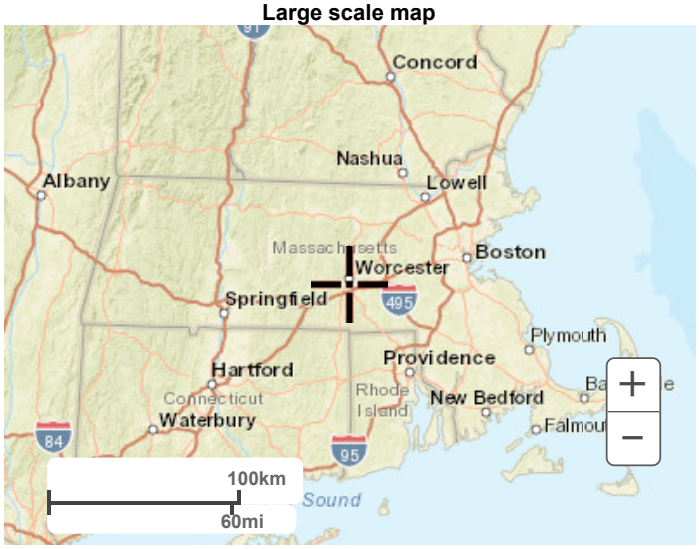

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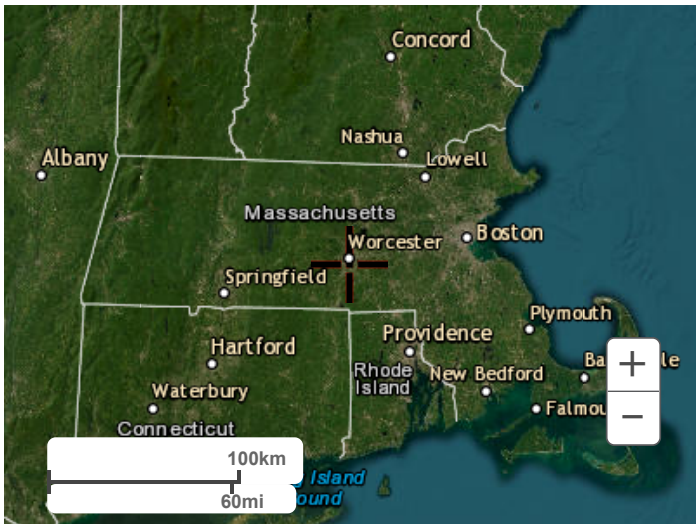

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APPENDIX G: OPERATION AND MAINTENANCE

- *STORMWATER OPERATION AND MAINTENANCE PLAN*
- *INSPECTION REPORT*
- *INSPECTION AND MAINTENANCE LOG FORM*
- *LONG-TERM POLLUTION PREVENTION PLAN*
- *ILLICIT DISCHARGE STATEMENT EXAMPLE*
- *SPILL PREVENTION*
- *MANUFACTURER'S INSPECTION AND MAINTENANCE MANUALS*

STORMWATER OPERATION AND MAINTENANCE PLAN

Park Silver
277 Providence Street
Worcester, MA

RESPONSIBLE PARTY DURING CONSTRUCTION:

TBD

RESPONSIBLE PARTY POST CONSTRUCTION:

Park Silver
8171 Maple Lawn Blvd, Suite 375 & 380
Fulton, MD

Construction Phase

During the construction phase, all erosion control devices and measures shall be maintained in accordance with the final record plans, local/state approvals and conditions, the EPA Construction General Permit and the Stormwater Pollution Prevention Plan (SWPPP) if applicable. Additionally, the maintenance of all erosion / siltation control measures during construction shall be the responsibility of the general contractor. Contact information of the OWNER and CONTRACTOR shall be listed in the SWPPP for this site. The SWPPP also includes information regarding construction period allowable and illicit discharges, housekeeping and emergency response procedures. Upon proper notice to the property owner, the Town/City or its authorized designee shall be allowed to enter the property at a reasonable time and in a reasonable manner for the purposes of inspection.

Post Development Controls

Once construction is completed, the post development stormwater controls are to be operated and maintained in compliance with the following permanent procedures (note that the continued implementation of these procedures shall be the responsibility of the Owner or its assignee):

1. Parking lots: Sweep at least two (2) times per year and on a more frequent basis depending on sanding operations. Swept areas shall include all parking, drive aisles, and access aisles All resulting sweepings shall be collected and properly disposed of offsite in accordance with MADEP and other applicable requirements.

2. Catch basins, yard drains, trench drains, manholes and piping: Inspect two (2) times per year and at the end of foliage and snow-removal seasons. These features shall be cleaned two (2) times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the catch basin or underground system. Accumulated sediment and hydrocarbons present must be removed and properly disposed of off-site in accordance with MADEP and other applicable requirements.

3. Underground Infiltration Basins: Preventative maintenance after every major storm event during the first three (3) months of operation and at least twice per year thereafter. Inspect structure and pretreatment BMP to ensure proper operation after every major storm event

(generally equal or greater to 3.0 inches in 24 hours) for the first three months. The outlet of the basin, if any, shall be inspected for erosion and sedimentation, and riprap shall be promptly repaired in the case of erosion. Sediment collecting in the bottom of the basin shall be inspected twice annually, and removal shall commence any time the sediment reaches a depth of six inches anywhere in the basin. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements.

All components of the stormwater system will be accessible by the owner or their assignee.

STORMWATER MANAGEMENT SYSTEM

POST-CONSTRUCTION INSPECTION REPORT

LOCATION:

Park Silver
277 Providence Street
Worcester, MA

RESPONSIBLE PARTY:

Park Silver
8171 Maple Lawn Blvd, Suite 375 & 380
Fulton, MD

NAME OF INSPECTOR:	INSPECTION DATE:
Note Condition of the Following (sediment depth, debris, standing water, damage, etc.):	
Parking Lots:	
Catch Basins:	
Underground Infiltration Basin:	
Other:	

Note Recommended Actions to be taken on the Following (sediment and/or debris removal, repairs, etc.):
Parking Lots:
Catch Basins:
Underground Infiltration Basin:
Other:
Comments:

APPENDIX H: CONSTRUCTION INSPECTION AND CONTROL

- *STORMWATER INSPECTION REPORT*
- *STORMWATER SEDIMENTATION AND EROSION CONTROL PLANS (PROVIDED UNDER SEPARATE COVER)*

STORMWATER INSPECTION AND MAINTENANCE LOG FORM			
Park Silver ***277 Providence Street Worcester, MA***			
Stormwater Management Practice	Responsible Party	Date	Maintenance Activity Performed

LONG-TERM POLLUTION PREVENTION PLAN

Park Silver
277 Providence Street
Worcester, MA

RESPONSIBLE PARTY DURING CONSTRUCTION:

TBD

RESPONSIBLE PARTY POST CONSTRUCTION:

Park Silver
8171 Maple Lawn Blvd, Suite 375 & 380
Fulton, MD

For this site, the Long-Term Pollution Prevention Plan will consist of the following:

- The property owner shall be responsible for "good housekeeping" including proper periodic maintenance of building and pavement areas, curbing, landscaping, etc.
- Proper storage and removal of solid waste (dumpsters).
- Sweeping of parking lots, drive aisles and access aisles a minimum of twice per year with a commercial cleaning unit. Any sediment removed shall be disposed of in accordance with applicable local and state requirements.
- Regular inspections and maintenance of Stormwater Management System as noted in the "O&M Plan".
- Snow removal shall be the responsibility of the property owner. Snow shall not be plowed, dumped and/or placed in forebays, infiltration basins or similar stormwater controls. Salting and/or sanding of pavement / walkway areas during winter conditions shall only be done in accordance with all state/local requirements and approvals.

OPERATON AND MAINTENANCE TRAINING PROGRAM

The Owner will coordinate an annual in-house training session to discuss the Operations and Maintenance Plan, the Long-Term Pollution Prevention Plan, and the Spill Prevention Plan and response procedures. Annual training will include the following:

Discuss the Operations and Maintenance Plan:

- Explain the general operations of the stormwater management system and its BMPs
- Identify potential sources of stormwater pollution and measures / methods of reducing or eliminating that pollution
- Emphasize good housekeeping measures

Discuss the Spill Prevention and Response Procedures:

- Explain the process in the event of a spill
- Identify potential sources of spills and procedures for cleanup and /or reporting and notification
- Complete a yearly inventory or Materials Safety Data sheets of all tenants and confirm that no potentially harmful chemicals are in use.

ILLICIT DISCHARGE STATEMENT

Certain types of non-stormwater discharges are allowed under the U.S. Environmental Protection Agency Construction General Permit. These types of discharges will be allowed under the conditions that no pollutants will be allowed to come in contact with the water prior to or after its discharge. The control measures which have been outlined previously in this LTPPP will be strictly followed to ensure that no contamination of these non-storm water discharges takes place. Any existing illicit discharges, if discovered during the course of the work, will be reported to MassDEP and the local DPW, as applicable, to be addressed in accordance with their respective policies. No illicit discharges will be allowed in conjunction with the proposed improvements.

Duly Acknowledged:

_____

Name & Title Date

SPILL PREVENTION AND RESPONSE PROCEDURES (POST CONSTRUCTION)

In order to prevent or minimize the potential for a spill of Hazardous Substances or Oil or come into contact with stormwater, the following steps will be implemented:

1. All Hazardous Substances or Oil (such as pesticides, petroleum products, fertilizers, detergents, acids, paints, paint solvents, cleaning solvents, etc.) will be stored in a secure location, with their lids on, preferably under cover, when not in use.

2. The minimum practical quantity of all such materials will be kept on site.

3. A spill control and containment kit (containing, for example, absorbent materials, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, goggles, plastic and metal trash containers, etc.) will be provided on site.

4. Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be trained regarding these procedures and the location of the information and cleanup supplies.

5. It is the OWNER's responsibility to ensure that all Hazardous Waste on site is disposed of properly by a licensed hazardous material disposal company. The OWNER is responsible for not exceeding Hazardous Waste storage requirements mandated by the EPA or state and local authorities.

In the event of a spill of Hazardous Substances or Oil, the following procedures should be followed:

1. All measures should be taken to contain and abate the spill and to prevent the discharge of the Hazardous Substance or Oil to stormwater or off-site. (The spill area should be kept well ventilated and personnel should wear appropriate protective clothing to prevent injury from contact with the Hazardous Substances.)

2. For spills of less than five (5) gallons of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.

3. For spills greater than five (5) gallons of material immediately contact the MADEP at the toll-free 24-hour statewide emergency number: **1-888-304-1133**, the local fire department (**9-1-1**) and an approved emergency response contractor. Provide information on the type of material spilled, the location of the spill, the quantity spilled, and the time of the spill to the emergency response contractor or coordinator, and proceed with prevention, containment and/or clean-up if so desired. (Use the form provided, or similar).

4. If there is a Reportable Quantity (RQ) release, then the National Response Center should be notified immediately at (800) 424-8802; within 14 days a report should be submitted to the EPA regional office describing the release, the date and circumstances of the release and the steps taken to prevent another release. This Pollution Prevention Plan should be updated to reflect any such steps or actions taken and measures to prevent the same from reoccurring.

SPILL PREVENTION CONTROL AND COUNTERMEASURE FORM

Park Silver
277 Providence Street
Worcester, MA

Where a release containing a hazardous substance occurs, the following steps shall be taken by the facility manager and/or supervisor:

1. Immediately notify The Johnston Fire Department (at **9-1-1**)

2. All measures must be taken to contain and abate the spill and to prevent the discharge of the pollutant(s) to off-site locations, receiving waters, wetlands and/or resource areas.

3. Notify the City of Worcester Health Department at (508) 799-8531

4. Provide documentation from licensed contractor showing disposal and cleanup procedures were completed as well as details on chemicals that were spilled to the Massachusetts Department of Environmental Protection and the City of Worcester Department of Health.

Date of spill:_____ Time:_____ Reported By:_____

Weather Conditions:_____

Material Spilled	**Location of Spill**	**Approximate Quantity of Spill (in gallons)**	**Agency(s) Notified**	**Date of Notification**

Cause of Spill: _____

_____

Measures Taken to Clean up Spill: _____

_____

Type of equipment: _____ Make: _____ Size: _____

License or S/N: _____

Location and Method of Disposal _____

_____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring: _____

_____

_____

Additional Contact Numbers:

- DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP) EMERGENCY PHONE: 1-888-304-1133
- NATIONAL RESPONSE CENTER PHONE: (800) 424-8802
- U.S. ENVIRONMENTAL PROTECTION AGENCY PHONE: (888) 372-7341

Isolator® Row Plus
O&M Manual

ADS StormTech™

The Isolator® Row Plus

Introduction

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row Plus is a technique to inexpensively enhance Total Suspended Solids (TSS), Total Phosphorus (TP), Total Petroluem Hydrocarbons (TPH) and Total Nitrogen (TN) removal with easy access for inspection and maintenance.

The Isolator Row Plus

The Isolator Row Plus is a row of StormTech chambers, either SC-160, SC-310, SC-310-3, SC-740, DC-780, SC-800, MC-3500, MC-4500 or MC-7200 models, are lined with filter fabric and connected to a closely located manhole for easy access. The fabric lined chambers provide for sediment settling and filtration as stormwater rises in the Isolator Row Plus and passes through the filter fabric. The open bottom chambers allow stormwater to flow vertically out of the chambers. Sediments are captured in the Isolator Row Plus protecting the adjacent stone and chambers storage areas from sediment accumulation.

ADS Isolator Row and Plus fabric are placed between the stone and the Isolator Row Plus chambers. The woven geotextile provides a media for stormwater filtration, a durable surface for maintenance, prevents scour of the underlying stone and remains intact during high pressure jetting.

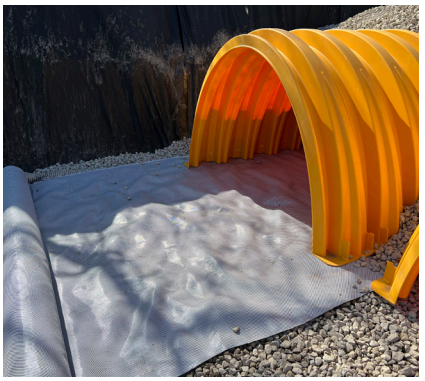
The Isolator Row Plus is designed to capture the “first flush” runoff and offers the versatility to be sized on a volume basis or a flow-rate basis. An upstream manhole provides access to the Isolator Row Plus and includes a high/low concept such that stormwater flow rates or volumes that exceed the capacity of the Isolator Row Plus bypass through a manifold to the other chambers. This is achieved with an elevated bypass manifold or a high-flow weir. This creates a differential between the Isolator Row Plus row of chambers and the manifold to the rest of the system, thus allowing for settlement time in the Isolator Row Plus. After Stormwater flows through the Isolator Row Plus and into the rest of the chamber system it is either exfiltrated into the soils below or passed at a controlled rate through an outlet manifold and outlet control structure.

The Isolator Row Plus Flamp™ is a flared end ramp apparatus attached to the inlet pipe on the inside of the chamber end cap. The FLAMP provides a smooth transition from pipe invert to fabric bottom. It is configured to improve chamber function performance by enhancing outflow of solid debris that would otherwise collect at the chamber's end, or more difficult to remove and require confined space entry into the chamber area. It also serves to improve the fluid and solid flow into the access pipe during maintenance and cleaning and to guide cleaning and inspection equipment back into the inlet pipe when complete.

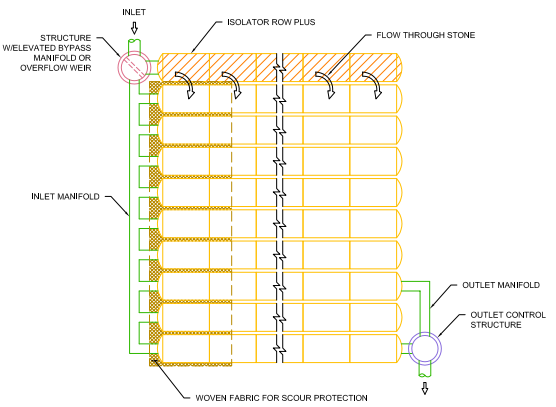
The Isolator Row Plus may be part of a treatment train system. The treatment train design and pretreatment device selection by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, StormTech recommend using the Isolator Row Plus to minimize maintenance requirements and maintenance costs.

Note: *See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row Plus.*

Looking down the Isolator Row Plus from the manhole opening, ADS Plus Fabric is shown between the chamber and stone base.



StormTech Isolator Row Plus with Overflow Structure (not to scale)



Isolator Row Plus Inspection/Maintenance

Inspection

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row Plus should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

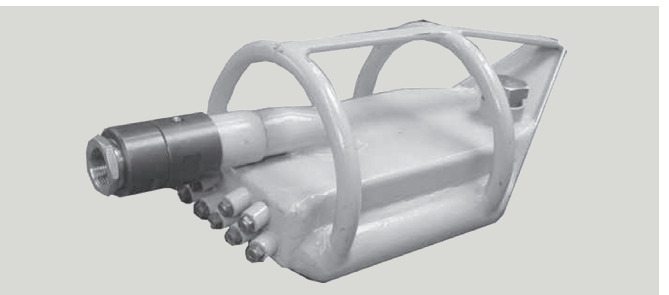
The Isolator Row Plus incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3" (75 mm) throughout the length of the Isolator Row Plus, clean-out should be performed.

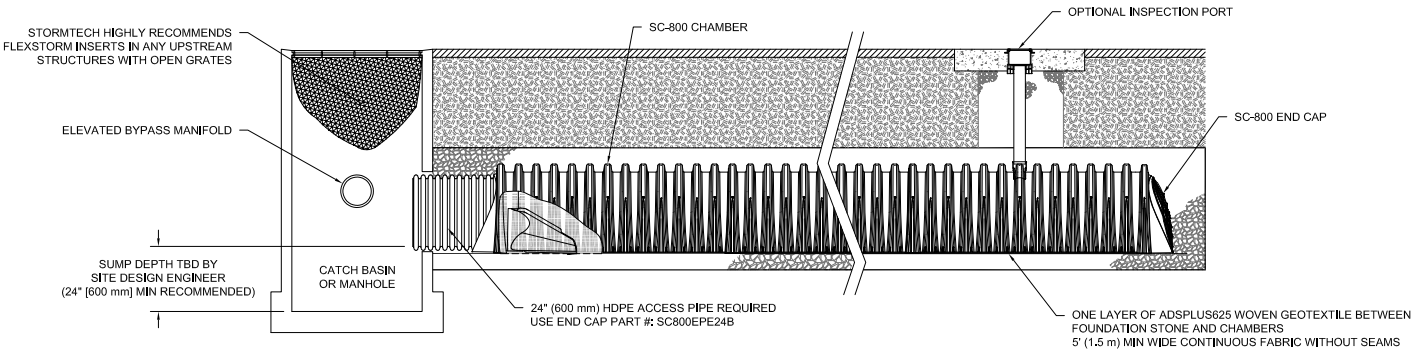
Maintenance

The Isolator Row Plus was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entry.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row Plus while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. StormTech recommends a maximum nozzle pressure of 2000 psi be utilized during cleaning. JetVac reels can vary in length. For ease of maintenance, ADS recommends Isolator Row Plus lengths up to 200' (61 m). **The JetVac process shall only be performed on StormTech Isolator Row Plus that have ADS Plus Fabric (as specified by StormTech) over their angular base stone.**



StormTech Isolator Row Plus (*not to scale*)



Isolator Row Plus Step By Step Maintenance Procedures

Step 1

Inspect Isolator Row Plus for sediment.

A) Inspection ports (if present)
   i. Remove lid from floor box frame
   ii. Remove cap from inspection riser
   iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
   iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.

B) All Isolator Row Plus
   i. Remove cover from manhole at upstream end of Isolator Row Plus
   ii. Using a flashlight, inspect down Isolator Row Plus through outlet pipe
      1. Mirrors on poles or cameras may be used to avoid a confined space entry
      2. Follow OSHA regulations for confined space entry if entering manhole
   iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2.
   If not, proceed to Step 3.

Step 2

Clean out Isolator Row Plus using the JetVac process.

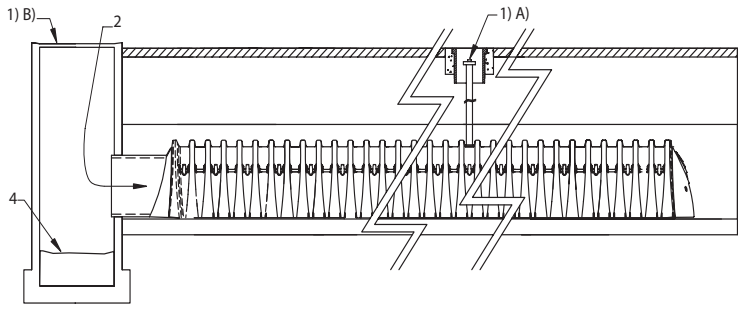
A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

Step 3

Replace all caps, lids and covers, record observations and actions.

Step 4

Inspect & clean catch basins and manholes upstream of the StormTech system.



Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row Plus, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

adspipe.com

800-821-6710