Stormwater Management Report

Definitive Site Plan

79 Pullman Street
Worcester, Massachusetts

Prepared for: **Galaxy Topaz, LLC**
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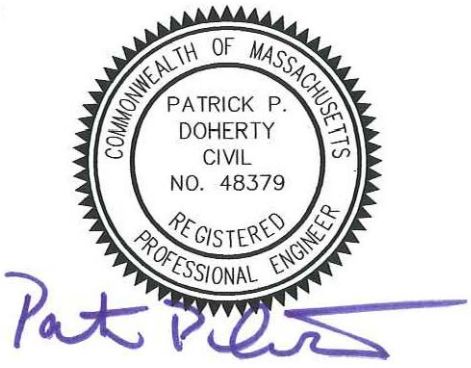

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Project Summary

The Site is a parcel of land located at 79 Pullman Street in Worcester, Massachusetts (see Figure 1). The Site is approximately 0.68 acres and is bounded by West Mountain Street to the north, a commercial use property to the south, Brooks Street to the west and Pullman Street to the east. The north portion of the property is located in a ML-0.5 and the south portion of the property is located in a MG 0.5 Zoning district. The site is currently vacant and a commercial use building that was used by Sylvan Learning Center was recently razed. The parking area supporting that building remains.

The proposed development will remove all remaining improvements associated with past use to allow redevelopment of the site. The redevelopment includes construction of a new 2,328 sf building with food service with drive thru use. consist Associated driveways, parking areas, site lighting, and stormwater management system will also be constructed. Access to the site will remain via a curb cut onto Pullman Street. This curb cut will however be relocated slightly south of where it exists today.

The site has been designed to meet requirement of the City of Worcester Wetlands Protection Ordinance by implementing a stormwater management system that complies with Massachusetts Stormwater Handbook. The stormwater management system will meet the objectives of the Massachusetts Stormwater Handbook and Regulations by inclusion of stormwater Best Management Practices (BMP's) such as source reduction, deep sump hooded catch basins, and an underground recharge chamber system with isolator row. These BMP's will reduce total suspended solids from stormwater discharges and approximate annual groundwater recharge. Additionally the BMP's will attenuate stormwater discharge so that there will be no increase in peak discharge rates between the pre- and post-development conditions. Details of the proposed stormwater management system can be found in the following sections of the report.

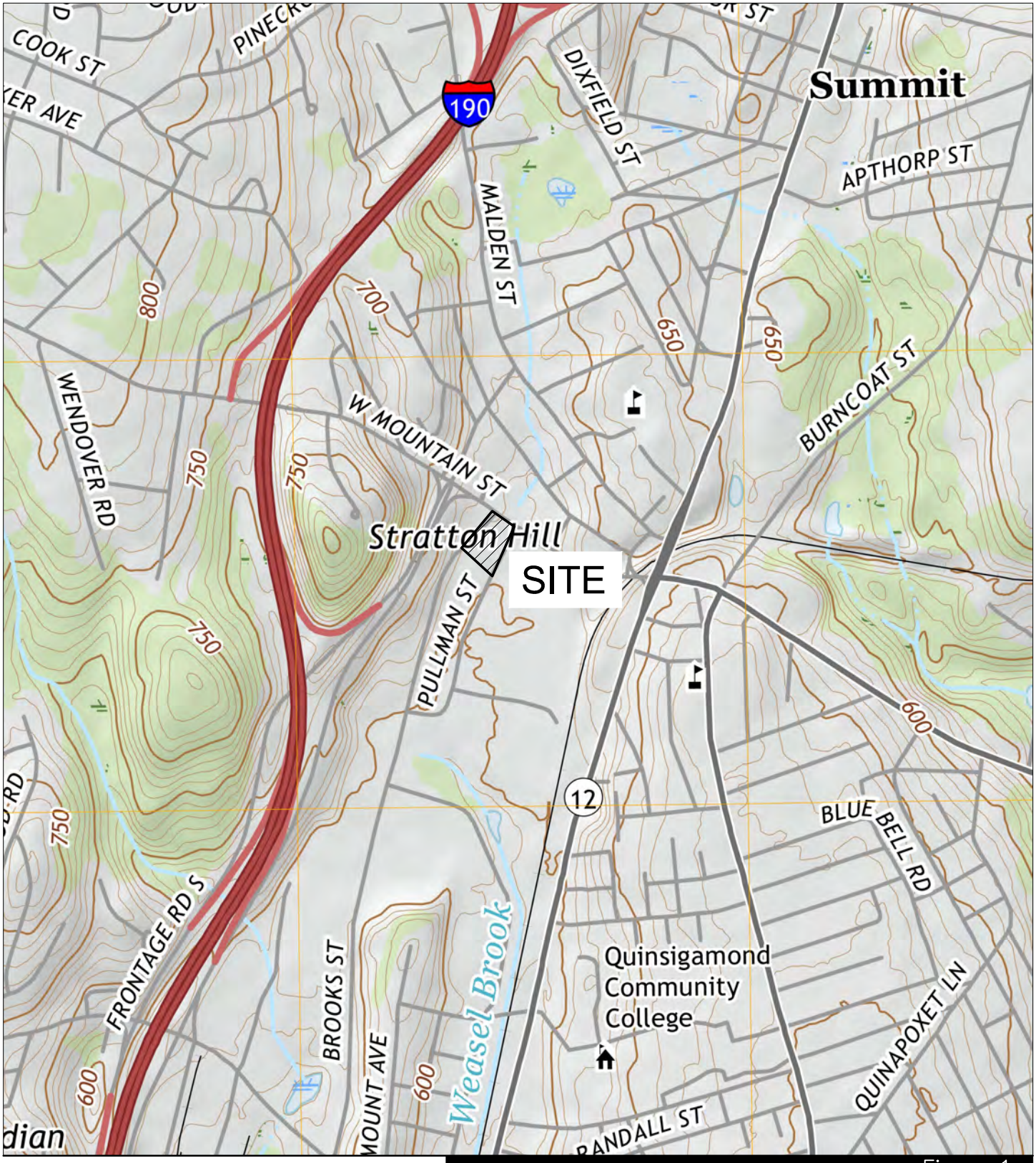

Figure 1

0 500 1000 Feet

Site Location Map
79 Pullman Street
Worcester, MA

MIDPOINT
ENGINEERING + CONSULTING

37 SUTTON ROAD
WEBSTER, MA 01570
508 721-1900
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Existing Conditions

Summary

The Site is a parcel of land located at 79 Pullman Street in Worcester, Massachusetts (see Figure 1). The Site is approximately 0.68 acres and is bounded by West Mountain Street to the north, a commercial use property to the south, Brooks Street to the west and Pullman Street to the east. The north portion of the property is located in a ML-0.5 and the south portion of the property is located in a MG 0.5 Zoning district.

The parcel is generally flat and slopes from south to north west to south east to allow spot in the existing parking area. A catch basin which connects to the City drainage system is located at this low spot.

There are no regulated areas as defined in the Massachusetts Wetlands Protection Act on or within 100 feet of the property. There are inlets to storm drains located on and within 100 feet of the site that are regulated areas as defined in the City Wetlands Protection Ordinance. The project site is not located within an area designated as Priority or Estimated Habitat of Rare Species by the Natural Heritage & Endangered Species Program (NHESP) 2021 Maps. No Certified or Potential Vernal Pools are located in this area of the City. The closest Area of Critical Environmental Concern (ACEC), the Central Nashua River Valley in Lancaster, is approximately 8.5 miles northeast of the project site.

Based upon a review of the NRCS Soil maps, soils located on site are classified as Urban Land which are assumed to be HSG C soils which corresponds with adjacent soils that have been mapped.

Hydrologic Information

For the existing conditions hydrologic analysis, the site was considered 1 drainage areas that contribute flow to a design point where peak discharge rate was evaluated (see Figure 2). The design points is the discharge from the existing onsite catch basin.

Drainage Area EX1 – Consists of the boundary of the site which contributes stormwater flow to the existing catch basin located in the parking area of the former building.

Table 1 summarizes the key hydrologic parameters for each drainage area used in the existing conditions analysis.

Table 1
Existing Conditions Hydrologic Data

(Drainage Area #)	Discharge Location	Design Point	Impervious Area (acres)	Area (acres)	Curve Number	Time of Concentration (min)
EX1	*Catch Basin Outlet*	*DP1*	*0.34*	*0.68*	*86*	*5*

Proposed Conditions

Summary

The project, which will include the construction of a 2,328 sf commercial use building and associated parking area, was designed to comply fully with the Massachusetts Stormwater Management Policy and the City of Worcester Zoning and Conservation Commission Regulations. Existing drainage and grading patterns were maintained to the maximum extent possible. Low impact development stormwater management techniques have been incorporated into the design. These practices are focused at decentralizing stormwater management at the site and incorporating smaller stormwater management techniques into the design that will reduce peak runoff rates, maximizing groundwater recharge and improve water quality.

Impervious areas of the site under proposed conditions consist of roof area, parking area and driveways. The total impervious coverage is approximately 0.45 acres or 71% percent of the site. This represents an increase of impervious coverage compared to existing conditions. An analysis has been performed to confirm that post development stormwater runoff rates will not exceed predevelopment rates due to this increase in impervious coverage. Additionally, recharge to ground water will approximate pre-development conditions by recharging parking lot and roof runoff.

There are no areas considered Land Uses with Higher Potential Pollution Loading (LUHPPL) on the site or Outstanding Resource Waters (ORW) near the site.

Under proposed conditions, storm water runoff will be renovated through use of Stormwater Best Management Practices (BMPs). Source control will include providing enclosed and covered dumpsters as well as regular sweeping of paved surfaces. Pretreatment BMP's include deep sump hooded catch basins and Infiltration devices include an underground recharge chamber system.

Details of the stormwater water management system features are as follows:

Water Quantity and Quality Control

Site Layout

The site has been designed to minimize impacts by redeveloping a previously disturbed site. There are no sensitive environmental areas near the site.

Source Control

A comprehensive source control program will be implemented at the site, which includes regular pavement sweeping, catch basin cleaning, and maintenance of service and lawn areas. Trash will be managed by the use of a covered container.

Snow Management

Snow storage areas are shown on the project site plans. No snow will be placed in stormwater management components. As much as possible snow will be allowed to melt toward pavement where debris and sand may be deposited and swept up for disposal and snow melt will enter the stormwater management system where it will receive proper treatment.

Spill Prevention

Spill prevention is achieved with the proper storage and handling of hazardous materials. During construction, this is addressed in the Stormwater Pollution Prevention Plan (SWPPP) for Construction Activities to be prepared and implemented by the Site Contractor.

Catch Basins with Sumps and Oil/debris Traps

Catch basins at the site are to be constructed with sumps (minimum 4-feet) and oil/debris traps to prevent the discharge of sediments and floating contaminants. Catch basins will be inspected four times per year and cleaned when deposits reach a depth of two feet.

Subsurface Chamber Detention Basins

An underground stormwater recharge system will control post development peak runoff rates by utilizing an outlet control device. This system will incorporate an "isolator row" wrapped in geotextile filter fabric to renovate and remove TSS prior to discharge.

Hydrologic Information

For the proposed conditions, hydrologic analysis, the site was divided into two (2) drainage areas (see Figure 3). These areas discharge to the design point where peak discharge rate was evaluated for both existing and proposed conditions.

Drainage Subarea P1– Consists of the site with exception of the building roof area..

Drainage Subarea P2– Consists of the roof area of the commercial building.

Table 2 summarizes the key hydrologic parameters for each drainage area used in the proposed conditions analyses.

Table 2
Proposed Conditions Hydrologic Data

Drainage Area #	Treatment BMP	Design Point	Impervious Area (Acres)	Total Area (acres)	Curve Number	Time of Concentration (min)
DA P1	*Infiltration (UG 1)*	*DP1*	*0.41*	*0.62*	*89*	*5.0*
DA P2	*N/A roof area only*	*DP1*	*0.05*	*0.06*	*98*	*5.0*

The site complies fully with the total suspended solids removal requirements of the Stormwater Management Policy. The calculated TSS removal rates for discharges from the site are shown on the Worksheets included in Appendix E.

Analysis Summary

Hydrologic Analysis

The rainfall-runoff response of the Site under existing and proposed conditions was evaluated for storm events with recurrence intervals of 2, 10, 25 and 100-years. Rainfall depths used for this analysis were based on the upper limit of NOAA ATLAS 14, Volume 10 Version 3; they were 3.85, 5.98, 7.68, and 10.5-inches respectively. Runoff coefficients for the pre- and post-development conditions, as previously shown in Tables 1 and 2 respectively, were determined using NRCS Technical Release 55 (TR-55) methodology as provided in HydroCAD.

Drainage areas used in the analyses were described in previous sections and shown on Figures 2 and 3. The HydroCAD model is based on the NRCS Technical Release 20 (TR-20) Model for Project Formulation Hydrology. Detailed printouts of the HydroCAD analyses are included in Appendix D. Table 3 presents a summary of the existing and proposed conditions peak discharge rates.

Table 3
Peak Discharge Rates (cfs*)

Design Point	2-year	10-year	25-year	100-year
Design Point DP1:				
Existing	2.0	3.5	4.8	6.8
Proposed	1.8	3.0	4.4	4.8

* Expressed in cubic feet per second

The results of the analysis indicate that there is no increase in peak discharge rates for the total off-site flow between the pre- and post-development conditions

Hydraulic Analysis

The closed drainage system was designed for the 10-year storm event.

Drainage pipes were sized using Manning's Equation for full-flow capacity and the Rational Method. Pipe sizing calculations are included in Appendix E of this report.

Water Quality / TSS Reduction

TSS Reduction Calculations are included in Appendix E of this report. Methodologies utilized to perform the calculation were based upon the Massachusetts Stormwater Handbook

Table 4
TSS Removal Calculations

Drainage Area #	Impervious Area (Acres)	Treatment Train TSS Removal (%)
DA P1	*041*	*93%*

The site complies fully with TSS reduction targets of Mass Stormwater Manual and EPA general permit.

Groundwater Recharge

Groundwater Recharge Calculations are included in Appendix E of this report. Methodologies utilized to perform the calculation were based upon the Massachusetts Stormwater Handbook

Table 5
Required Groundwater Recharge Calculations

Soil Hyd Group	Impervious Area (Acres)	Required Recharge (in)	Recharge Volume (cf)
A	*0*	*0.60*	*0*
B	*0*	*0.35*	*0*
C	*0.45*	*0.25*	*404*
D	*0*	*0.10*	*0*
Required Recharge			*404 cf*

Table 6
Provided Groundwater Recharge Calculations

Infiltration BMP	Storage Volume (cf)	Potential Recharge Volume (cf)	Credited Recharge Volume (cf) *
Recharge Basin volume below outlet elev. 601.04	*786 cf*	*786 cf*	*786 cf*
Totals		*786 cf*	*786 cf*

* Credited Recharge Volume is a conservative estimate of recharge volume. Actual recharge realized will be higher than shown as the static method was utilized to determine potential recharge. No recharge credit is not taken for potential infiltration during a storm event.

Stormwater Management Regulations

The purpose of the Stormwater Management Plan (the Plan) is to provide long-term protection of natural resources in and around the Site. This is achieved by implementing water quality and quantity control measures designed to decrease the amount of pollutants discharged from the Site, increase the quality of stormwater recharged on the Site, and control discharge rates.

The following sections describe the regulations pertinent to stormwater management and the specific components of the Plan to be implemented.

Stormwater Regulations and Permitting

The following stormwater related regulations and guidelines apply to the proposed site development:

- Massachusetts State Stormwater Management Performance Standards and Guidelines, Department of Environmental Protection and Office of Coastal Zone Management (DEP/CZM, 2008).

Compliance with these regulations is described in the following sections.

Stormwater Management Standards and Guidelines

The methods for compliance with the ten stormwater performance standards developed by the MA DEP are summarized below.

Standard 1: (Untreated discharges)

No new stormwater conveyances (e.g., outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. Same rule applies for new developments and redevelopments.

- ***What BMPs are proposed to ensure that all new discharges associated with the discharge are adequately treated?***
  Response: Source control such as regular pavement sweeping and covering dumpsters will be implemented. Hooded- Deep Sump catch basins and proprietary

water quality treatment units will be used as pretreatment devices. An underground basins will be used as final treatment devices.

- ***What BMPs are proposed to ensure that no new discharges cause erosion in wetlands or waters of the Commonwealth?***
  Response: There will be no point discharges from the proposed site to any wetlands or waters of the Commonwealth.

- ***Will the proposed discharge comply with all applicable requirements of the Massachusetts Clean Waters Act and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00?***
  Response: Yes.

- ***What BMPs have been considered to prevent erosion from existing stormwater discharges?***
  Response: N/A

Standard 2: Peak rate control and flood prevention

Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for land subject to coastal storm flowage.

- ***Does the redevelopment design meet Standard 2, comparing post-development to pre-development conditions?***
  Response: Yes, the redevelopment design fully complies with Standard 2. There will be no increase in peak discharge rates from the pre-development to the post-development conditions for the 2, 10, and 100-year storm events. See Table 3 in Section 4 and supporting calculations in Appendix D.

Standard 3: (Recharge to Ground water)

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

- ***Does the redevelopment design meet Standard 3, comparing post-development to pre-development conditions?***
  Response: Yes, the project will include recharge systems so that post development recharge will be in excess of predevelopment rates.

- ***If not, the applicant shall document an analysis of alternative approaches for meeting the Standard?***
  Response: N/A

- ***What soil types are present on the site? Is the site is comprised solely of C and D soils and bedrock at the land surface?***

Response: The site is comprised of Urban land which has been assumed to be a HSG C soil.

- ***Does the project include sites where recharge is proposed at or adjacent to an area classified as contaminated, sites where contamination has been capped in place, sites that have an Activity and Use Limitation (AUL) that precludes inducing runoff to the groundwater, pursuant to MGL Chapter 21E and the Massachusetts Contingency Plan 310 CMR 40.0000; sites that are the location of a solid waste landfill as defined in 310 CMR 19.000; or sites where groundwater from the recharge location flows directly toward a solid waste landfill or 21E site?***[1]
  Response: No.

- ***Is the stormwater runoff from a land use with a higher potential pollutant load?***
  Response: No

- ***Is the discharge to the ground located within the Zone II or Interim Wellhead Protection Area of a public water supply?***
  Response: No

- ***Does the site have an infiltration rate greater than 2.4 inches per hour?***
  Response: No.

Standard 4: (80% TSS Removal)

Stormwater management systems must be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:
a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan and thereafter are implemented and maintained;
b. Stormwater BMPs are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

- ***Has the proponent developed a long-term pollution plan that fully meets the requirements of Standard 4?***
  Response: Yes, the long-term pollution prevention plan is included in Appendix G.

- ***Does the pollution prevention plan include the following source control measures?***
  - ***Street sweeping***
  - ***Proper management of snow, salt, sand and other deicing chemicals***
  - ***Proper management of fertilizers, herbicides and pesticides***
  - ***Stabilization of existing eroding surfaces***

  Response: Yes

- ***Does the redevelopment design provide for treatment of all runoff from existing (as well as new) impervious areas to achieve 80% TSS removal? If 80% TSS removal is not achieved, has the stormwater management system been designed to remove TSS to the maximum extent practicable?***
  Response: Yes

▼

- ***Have the proposed stormwater BMPs been properly sized to capture the prescribed runoff volume?***
  - ***One inch rule applies for discharge***
    - ***within a Zone II or Interim Wellhead Protection Area,***
    - ***near or to another critical area,***
    - ***from a land use with a higher potential pollutant load***
    - ***to the ground where the infiltration rate is greater than 2.4 inches per hour***

  Response: Yes

- ***Has adequate pretreatment been proposed?***
  - ***44% TSS Removal Pretreatment Requirement applies if:***
- ***Stormwater runoff is from a land use with a higher potential pollutant load***
- ***Stormwater is discharged***
  - ***To the ground within the Zone II or Interim Wellhead Protection Area of a Public Water Supply***
  - ***To the ground with an infiltration rate greater than 2.4 inches per hour***
  - ***Near or to an Outstanding Resource Water, Special Resource Water, Cold-Water Fishery, Shellfish Growing Area, or Bathing Beach.***

Response: N/A

Standard 5 (Higher Potential Pollutant Loads (HPPL)

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

Full compliance for any component that is not a redevelopment.
Full compliance with pollution prevention requirements for new developments and redevelopments.

Pollution Prevention

- ***Has the proponent considered any of the following operational source control measures?***
  - ***Formation of a pollution prevention team,***
  - ***Good housekeeping practices,***
  - ***Preventive maintenance procedures,***
  - ***Spill prevention and clean up,***
  - ***Employee training, and***
  - ***Regular inspection of pollutant sources.***

  Response: Yes the proposed auto refueling tenant will properly train all employees for property pollution prevention.

- ***Has the proponent considered implementation of any of the following operational changes to reduce the quantity of pollutants on site?***
  - ***Process changes,***
  - ***Raw material changes,***
  - ***Product changes, or***
  - ***Recycling.***

  Response: N/A

- ***Has the proponent considered making capital improvements to protect the land uses with higher potential pollutant loads from exposure to rain, snow, snow melt, and stormwater runoff?***
  - ***Enclosing and/or covering pollutant sources (e.g. placing pollutant sources within a building or other enclosure, placing a roof over storage and working areas, placing tarps under pollutant source)***
  - ***Installing a containment system with an emergency shutoff to contain spills?***
  - ***Physically segregating the pollutant source to prevent run-on of uncontaminated stormwater?***

  Response: N/A

Treatment

- ***If applicable, compliance with the treatment and pretreatment requirements of Standard 5 only to the Maximum Extent Practicable by directing the stormwater runoff from land uses with higher potential pollutant loads to appropriate stormwater BMPs.***
  - ***Are the BMPs selected capable of removing the pollutants associated with the higher potential pollutant load land ("LUHPPL") use?***

  Response: Yes

  - ***Is the land use likely to generate stormwater with high concentrations of oil and grease? If so has an oil grit separator, sand filter, filtering bioretention area or equivalent been proposed for pretreatment?***

  Response: Yes

- ***What specific measures have been considered to offset the anticipated impacts of land uses with higher potential pollutant loads?***

  Response: Fueling area will be covered by a canopy. Concrete pad in the vicinity of the fuel islands will be scored to collect small spills. Catch basins will be provided with hood to collect floatable materials. A proprietary water quality unit is proposed with additional floatable material capture capacity.

- ***If the development proposal is a brownfield project, the applicant shall demonstrate how the stormwater management measures have been designed to prevent mobilization or remobilization of soil and groundwater contamination. (See Brownfield section)***

  Response: The proposal is not a brownfield project.

<u>Other Requirements</u>

- ***Does the discharge comply with all applicable requirements of the Massachusetts Clean Waters Act, 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00?***

  Response: Yes.

Standard 6 (Critical Areas)

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

Response: N/A

Standard 7: Redevelopment

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

Response: The project has not been considered a redevelopment project.

Standard 8: (Erosion, Sediment Control)

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

- ***Has the proponent submitted a construction period erosion, sedimentation and pollution prevention plan that meets the requirements of Standard 8?***
  Response: Yes

Standard 9: (Operation and Maintenance)

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

- ***Has the proponent submitted a long-term Operation and Maintenance plan that meets the requirements of Standard 9?***
  Response: Yes

Standard 10 (Illicit Discharges)

All illicit discharges to the stormwater management system are prohibited.

- ***Are there any known or suspected illicit discharges to the stormwater management system at the redevelopment project site?***

Response: There are no known illicit discharges to the stormwater management system at the site.

- ***Has an illicit connection detection program been implemented using visual screening, dye or smoke testing?***
  Response: All existing utilities on the site will be removed during construction. No illicit discharges are proposed in our plans to be implemented by the contractor.

- ***Have an Illicit Discharge Compliance Statement and associated site map been submitted verifying that there are no illicit discharges to the stormwater management system at the site?***
  Response: To the best of our information, knowledge, and belief there are no existing or proposed illicit discharges at the site. If any do exist, none would remain after the project is developed.

The Stormwater Management Policy issued by the DEP states that the "use of the standards should prevent or minimize adverse environmental impacts due to unmanaged stormwater while limiting undue costs and recognizing site constraints."
The Stormwater Management Policy issued by the DEP states that the "use of the standards should prevent or minimize adverse environmental impacts due to unmanaged stormwater while limiting undue costs and recognizing site constraints."

■

Federal NPDES Construction-Related General Stormwater Permits

The proposed project will result in the disturbance of less than one acre of land and does not require the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP) by the **site contractor** and **owner** in accordance with the Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) General Permit Program for Stormwater Discharges from Construction Sites. The SWPPP is not included in this report. However, standard recommended components of the Stormwater Pollution Prevention Plan for construction phases of the development to be prepared and implemented by the site contractor are described in Appendix F.

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.

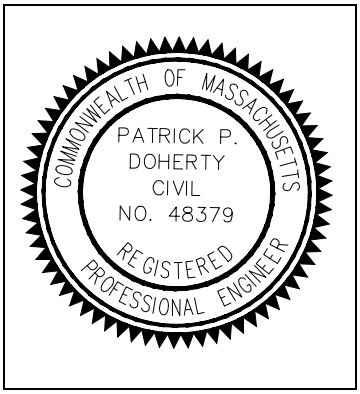
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



2/28/2024

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:

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

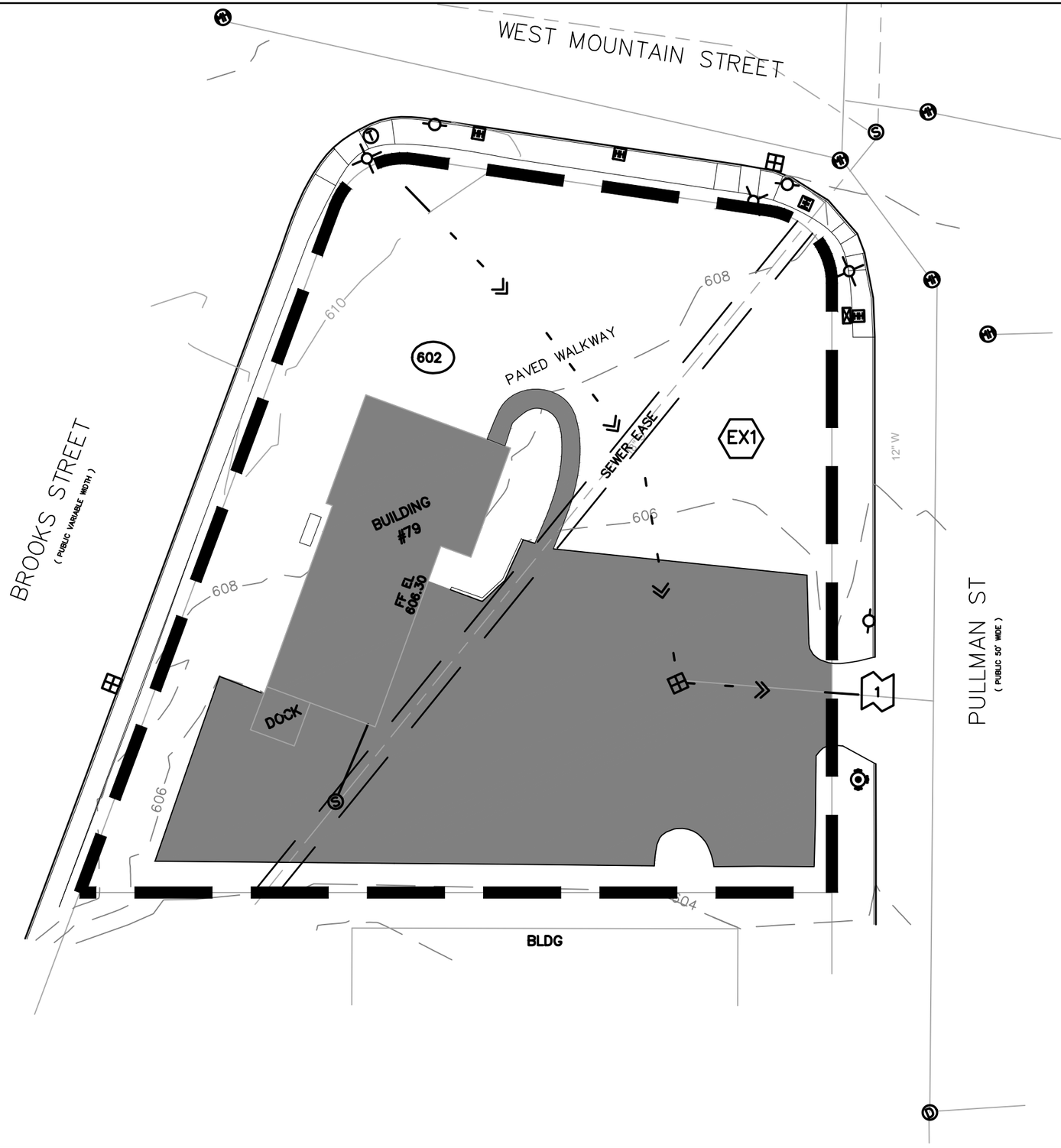
☐ An Illicit Discharge Compliance Statement is attached;

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

Appendix A:
Existing/Proposed Conditions Plans

MIDPOINT
ENGINEERING + CONSULTING

37 SUTTON ROAD
WEBSTER, MA 01570
(508) 721-1900
pdoherty@midpointengineering.com



LEGEND

- 1 — DESIGN POINT
- 1 — POND
- 1 — DRAINAGE AREA DESIGNATION
- DRAINAGE AREA BOUNDARY
- TIME OF CONCENTRATION FLOW LINE
- SOIL BOUNDARY

NRCS SOIL CLASSIFICATIONS

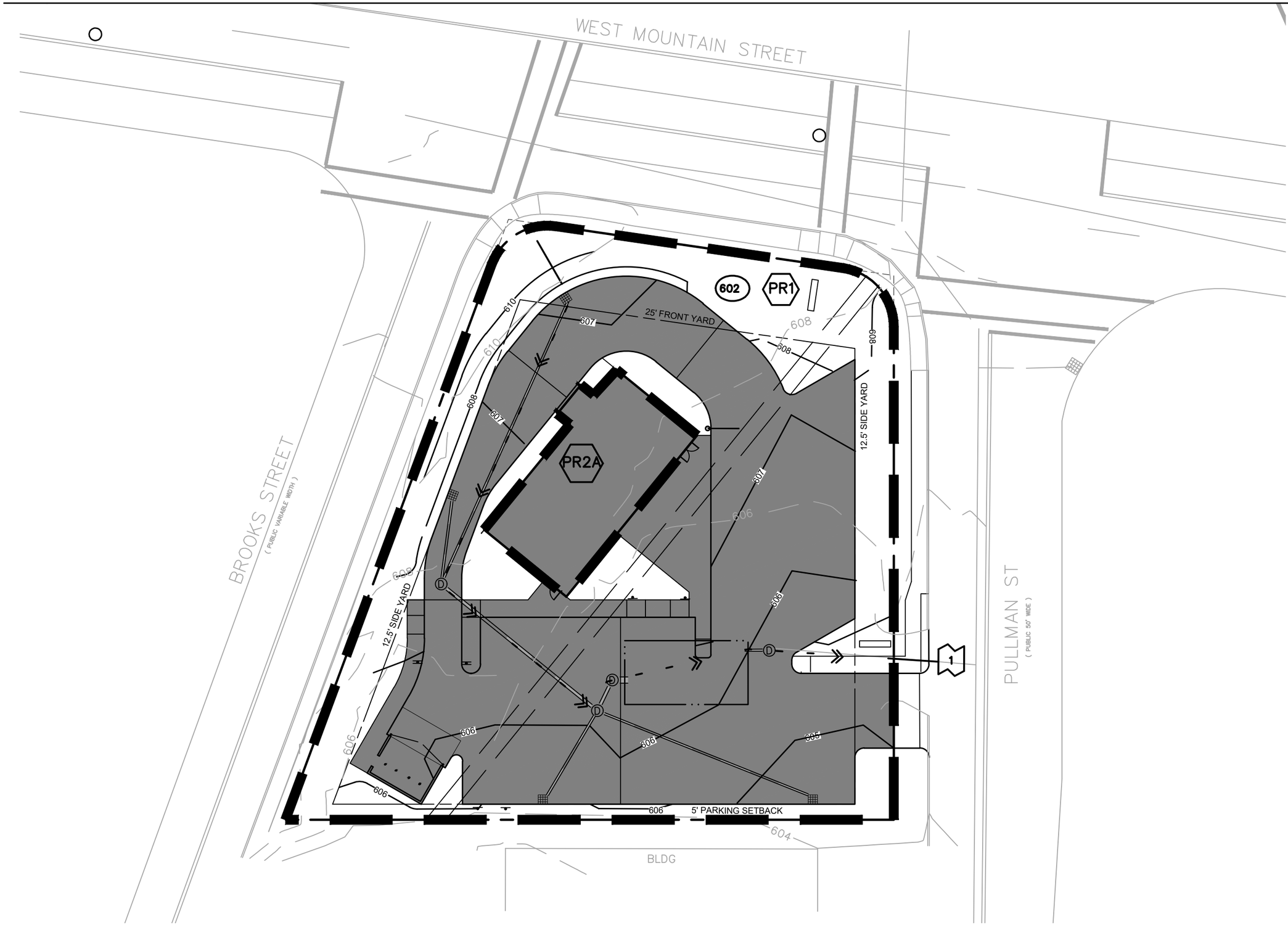
- 602 — URBAN LAND ASSUMED HSG C

- IMPERVIOUS COVERAGE

0 15 30 Feet

Figure 2

Existing Conditions Drainage Areas



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LEGEND

- 1 — DESIGN POINT
- 1 — POND
- 1 — DRAINAGE AREA DESIGNATION
- DRAINAGE AREA BOUNDARY
- TIME OF CONCENTRATION FLOW LINE
- SOIL BOUNDARY

NRCS SOIL CLASSIFICATIONS

- 602 — URBAN LAND ASSUMED HSG C

- IMPERVIOUS COVERAGE

0 15 30 Feet

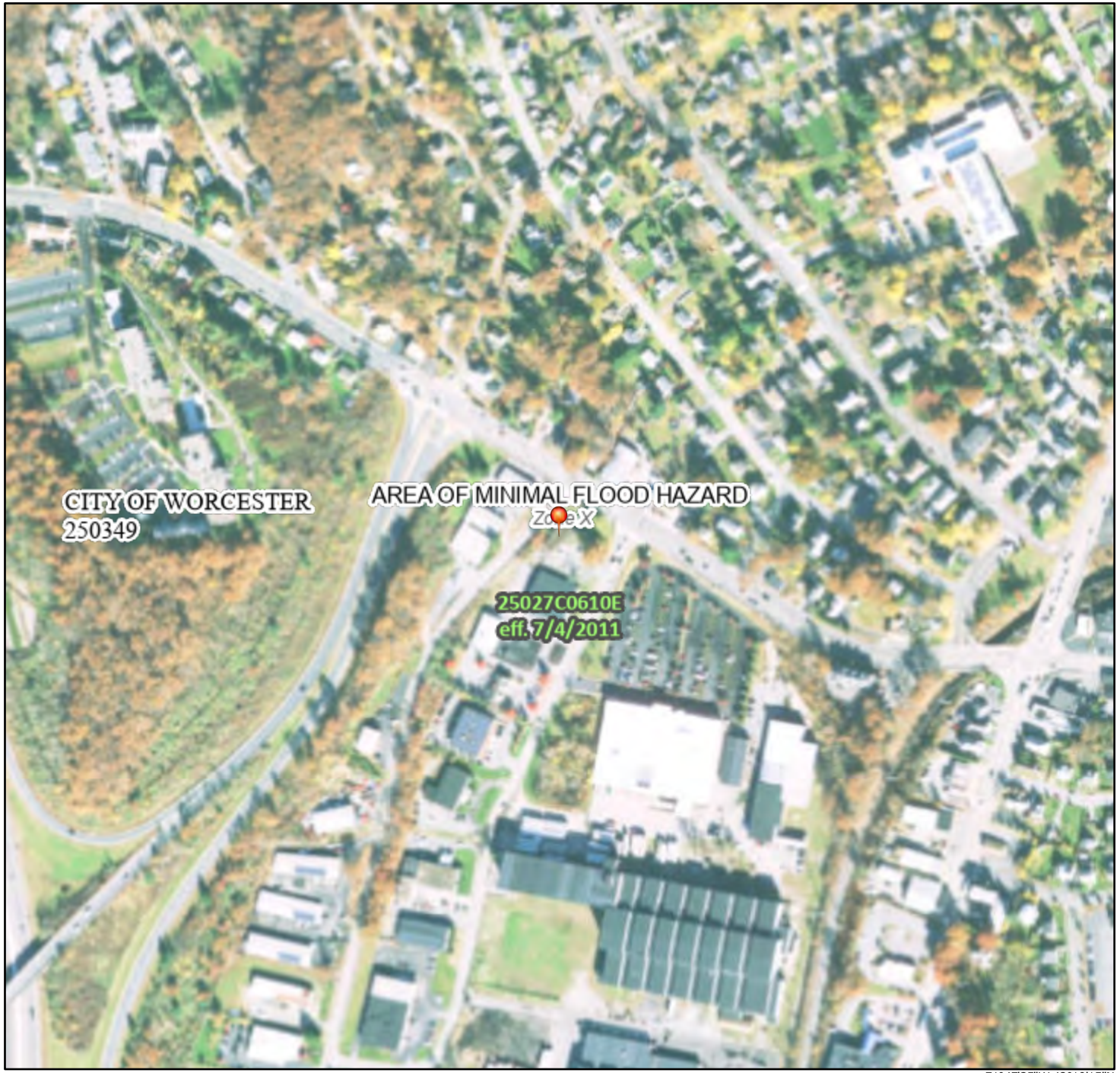
Figure 3

Proposed Conditions Drainage Areas

Appendix B: Floodplain Information

National Flood Hazard Layer FIRMette

71°48'12"W 42°19'42"N



71°47'35"W 42°19'15"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 2/27/2024 at 1:55 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.

Appendix C:
NRCS Soil Survey Information

Map Scale: 1:721 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 10 20 40 60

Feet
0 35 70 140 210

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 18, Sep 10, 2023

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

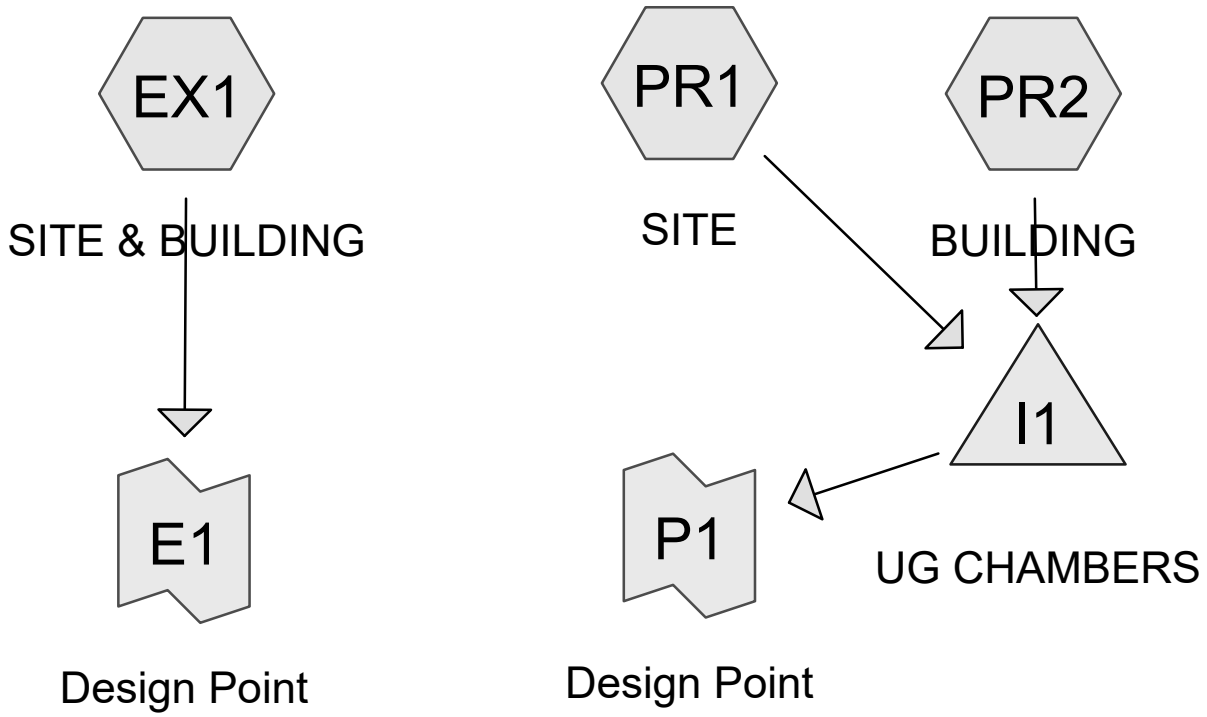
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
602	Urban land	1.1	100.0%
Totals for Area of Interest		**1.1**	**100.0%**

Appendix D:
Hydrologic Analysis

HydroCAD Analysis:



Subcat Reach Pond Link

Routing Diagram for 79 Pulman Atlas UL
Prepared by MidPoint Engineering, Printed 3/28/2024

Time span=4.00-20.00 hrs, dt=0.01 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX1: SITE & BUILDING Runoff Area=29,536 sf 49.45% Impervious Runoff Depth>2.26"
Tc=5.0 min CN=86 Runoff=1.98 cfs 0.128 af

Subcatchment PR1: SITE Runoff Area=27,208 sf 62.83% Impervious Runoff Depth>2.52"
Tc=5.0 min CN=89 Runoff=2.01 cfs 0.131 af

Subcatchment PR2: BUILDING Runoff Area=2,328 sf 100.00% Impervious Runoff Depth>3.40"
Tc=5.0 min CN=98 Runoff=0.21 cfs 0.015 af

Pond I1: UG CHAMBERS Peak Elev=601.94' Storage=1,387 cf Inflow=2.21 cfs 0.147 af
Discarded=0.01 cfs 0.006 af Primary=1.83 cfs 0.120 af Outflow=1.83 cfs 0.127 af

Link E1: Design Point Inflow=1.98 cfs 0.128 af
Primary=1.98 cfs 0.128 af

Link P1: Design Point Inflow=1.83 cfs 0.120 af
Primary=1.83 cfs 0.120 af

Total Runoff Area = 1.356 ac Runoff Volume = 0.274 af Average Runoff Depth = 2.43"
42.40% Pervious = 0.575 ac 57.60% Impervious = 0.781 ac

Summary for Subcatchment EX1: SITE & BUILDING

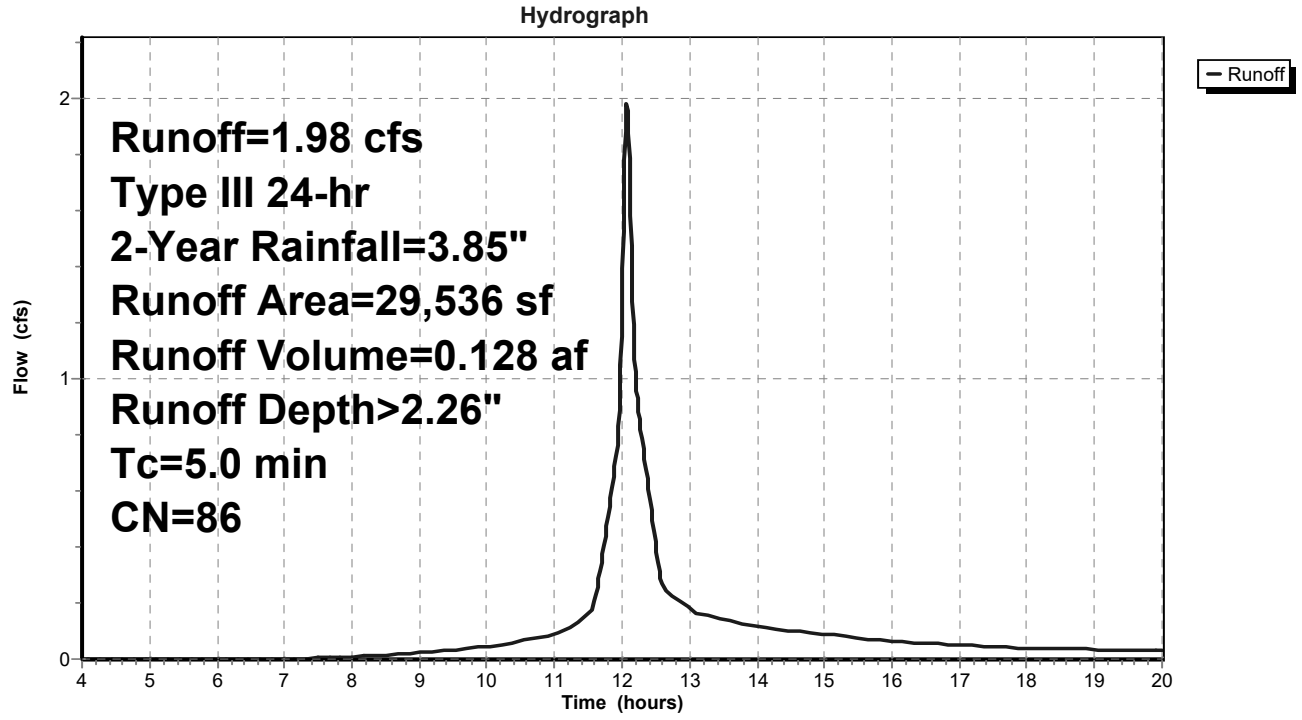
Runoff = 1.98 cfs @ 12.07 hrs, Volume= 0.128 af, Depth> 2.26"
Routed to Link E1 : Design Point

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.85"

Area (sf)	CN	Description
14,605	98	Paved parking, HSG C
14,931	74	>75% Grass cover, Good, HSG C
29,536	86	Weighted Average
14,931		50.55% Pervious Area
14,605		49.45% Impervious Area

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

Subcatchment EX1: SITE & BUILDING



Summary for Subcatchment PR1: SITE

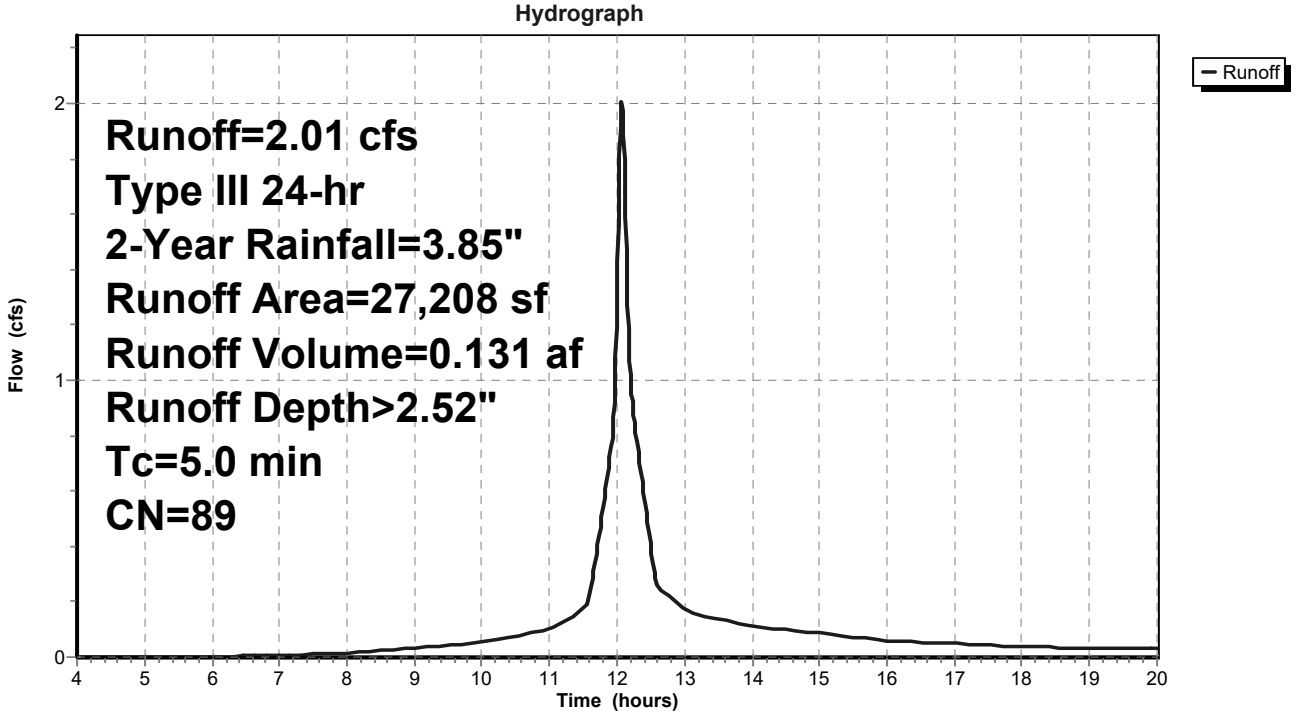
Runoff = 2.01 cfs @ 12.07 hrs, Volume= 0.131 af, Depth> 2.52"
Routed to Pond I1 : UG CHAMBERS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.85"

Area (sf)	CN	Description
17,094	98	Paved parking, HSG C
10,114	74	>75% Grass cover, Good, HSG C
27,208	89	Weighted Average
10,114		37.17% Pervious Area
17,094		62.83% Impervious Area

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

Subcatchment PR1: SITE



Summary for Subcatchment PR2: BUILDING

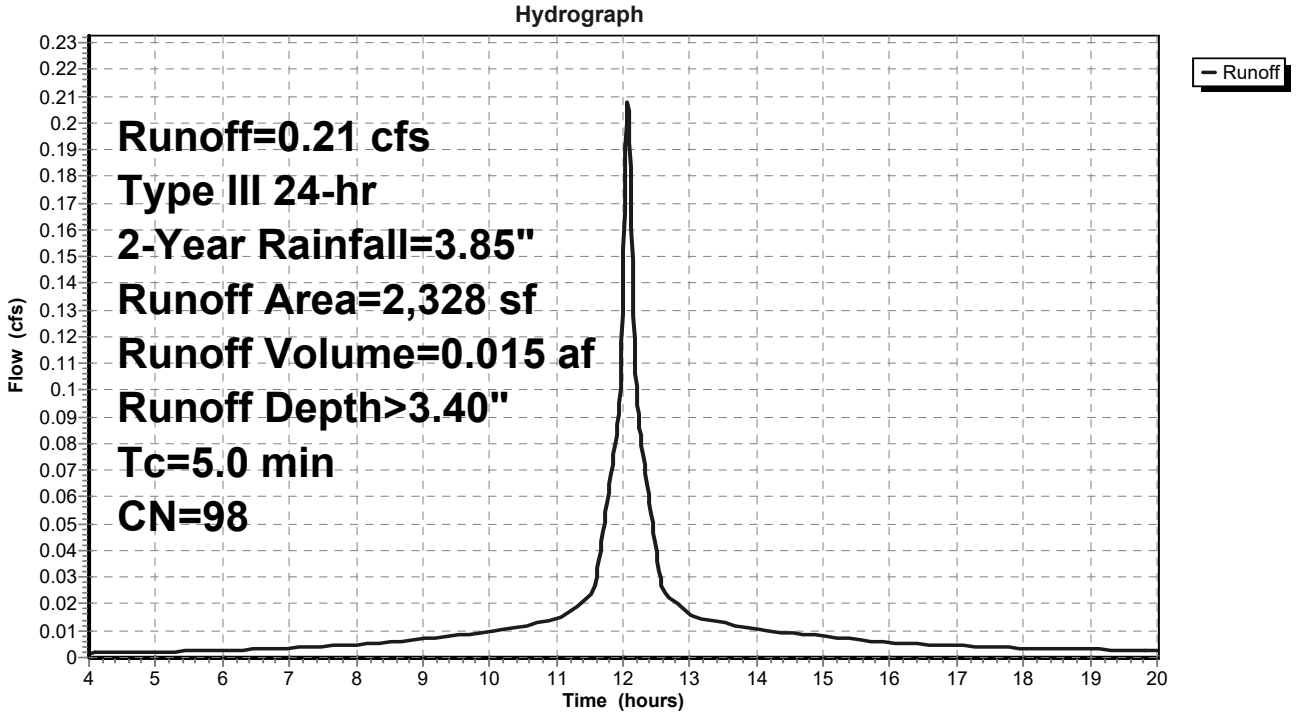
Runoff = 0.21 cfs @ 12.07 hrs, Volume= 0.015 af, Depth> 3.40"
Routed to Pond I1 : UG CHAMBERS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.85"

Area (sf)	CN	Description
2,328	98	Roofs, HSG C
2,328		100.00% Impervious Area

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

Subcatchment PR2: BUILDING



Summary for Pond I1: UG CHAMBERS

Inflow Area = 0.678 ac, 65.76% Impervious, Inflow Depth > 2.59" for 2-Year event
Inflow = 2.21 cfs @ 12.07 hrs, Volume= 0.147 af
Outflow = 1.83 cfs @ 12.12 hrs, Volume= 0.127 af, Atten= 17%, Lag= 3.0 min
Discarded = 0.01 cfs @ 11.36 hrs, Volume= 0.006 af
Primary = 1.83 cfs @ 12.12 hrs, Volume= 0.120 af
Routed to Link P1 : Design Point

Routing by Stor-Ind method, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 601.94' @ 12.12 hrs Surf.Area= 904 sf Storage= 1,387 cf

Plug-Flow detention time= 71.9 min calculated for 0.127 af (86% of inflow)
Center-of-Mass det. time= 30.7 min (797.7 - 767.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	599.50'	758 cf	**20.50'W x 39.22'L x 3.50'H Field A** 2,814 cf Overall - 919 cf Embedded = 1,895 cf x 40.0% Voids
#2A	600.00'	919 cf	**ADS_StormTech SC-740 +Cap** x 20 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 20 Chambers in 4 Rows
#3	601.00'	6,625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
		8,302 cf	Total Available Storage

Storage Group A created with Chamber Wizard

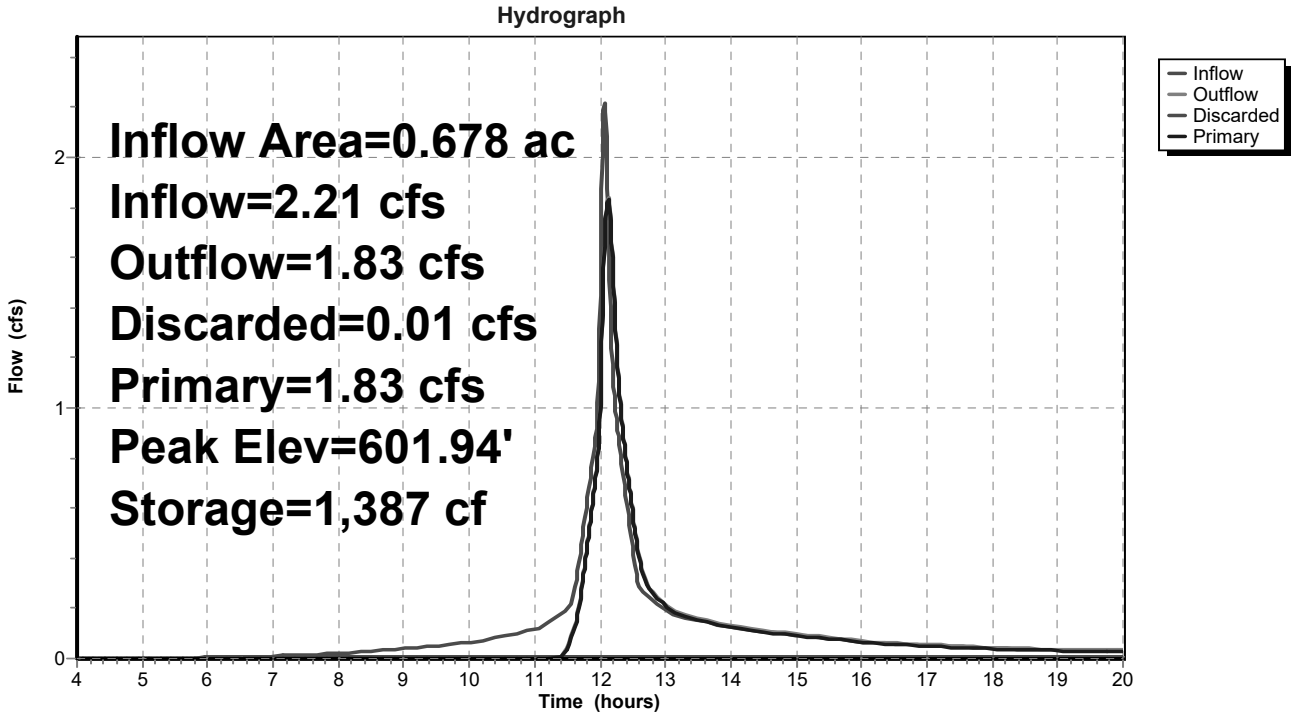
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
601.00	100	0	0
604.00	100	300	300
604.50	100	50	350
605.00	5,000	1,275	1,625
606.00	5,000	5,000	6,625

Device	Routing	Invert	Outlet Devices
#1	Discarded	599.50'	**0.270 in/hr Exfiltration over Horizontal area**
#2	Primary	601.04'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 11.36 hrs HW=601.00' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=1.83 cfs @ 12.12 hrs HW=601.94' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 1.83 cfs @ 3.35 fps)

Pond I1: UG CHAMBERS

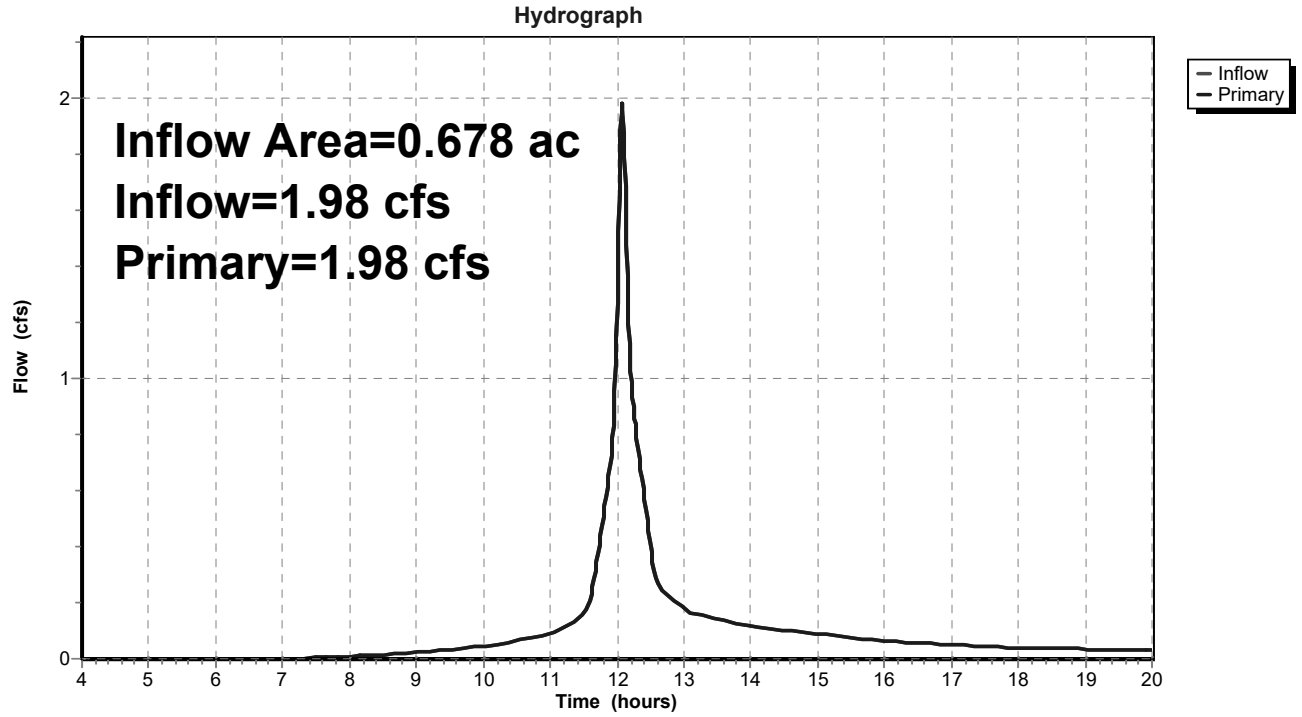


Summary for Link E1: Design Point

Inflow Area = 0.678 ac, 49.45% Impervious, Inflow Depth > 2.26" for 2-Year event
Inflow = 1.98 cfs @ 12.07 hrs, Volume= 0.128 af
Primary = 1.98 cfs @ 12.07 hrs, Volume= 0.128 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs

Link E1: Design Point

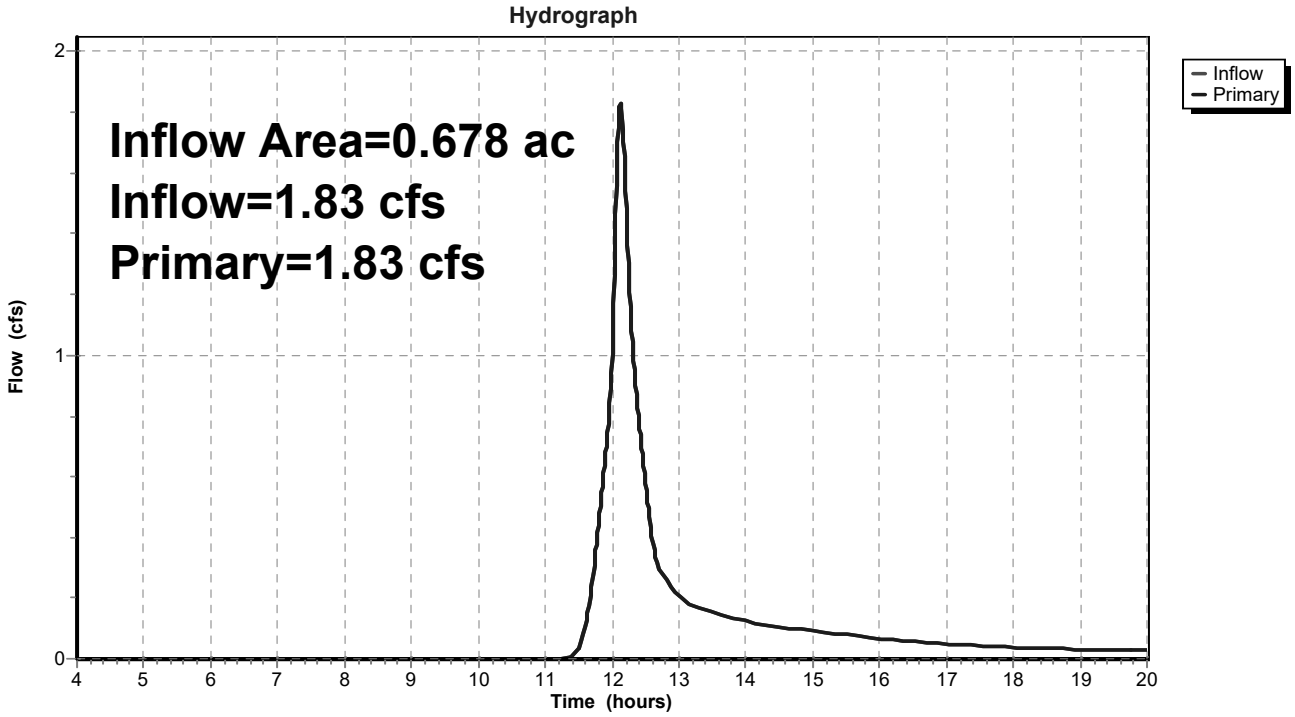


Summary for Link P1: Design Point

Inflow Area = 0.678 ac, 65.76% Impervious, Inflow Depth > 2.13" for 2-Year event
Inflow = 1.83 cfs @ 12.12 hrs, Volume= 0.120 af
Primary = 1.83 cfs @ 12.12 hrs, Volume= 0.120 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs

Link P1: Design Point



Time span=4.00-20.00 hrs, dt=0.01 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX1: SITE & BUILDING Runoff Area=29,536 sf 49.45% Impervious Runoff Depth>4.14"
Tc=5.0 min CN=86 Runoff=3.53 cfs 0.234 af

Subcatchment PR1: SITE Runoff Area=27,208 sf 62.83% Impervious Runoff Depth>4.46"
Tc=5.0 min CN=89 Runoff=3.44 cfs 0.232 af

Subcatchment PR2: BUILDING Runoff Area=2,328 sf 100.00% Impervious Runoff Depth>5.37"
Tc=5.0 min CN=98 Runoff=0.32 cfs 0.024 af

Pond I1: UG CHAMBERS Peak Elev=602.74' Storage=1,767 cf Inflow=3.76 cfs 0.256 af
Discarded=0.01 cfs 0.007 af Primary=2.97 cfs 0.229 af Outflow=2.98 cfs 0.236 af

Link E1: Design Point Inflow=3.53 cfs 0.234 af
Primary=3.53 cfs 0.234 af

Link P1: Design Point Inflow=2.97 cfs 0.229 af
Primary=2.97 cfs 0.229 af

Total Runoff Area = 1.356 ac Runoff Volume = 0.490 af Average Runoff Depth = 4.34"
42.40% Pervious = 0.575 ac 57.60% Impervious = 0.781 ac

Summary for Subcatchment EX1: SITE & BUILDING

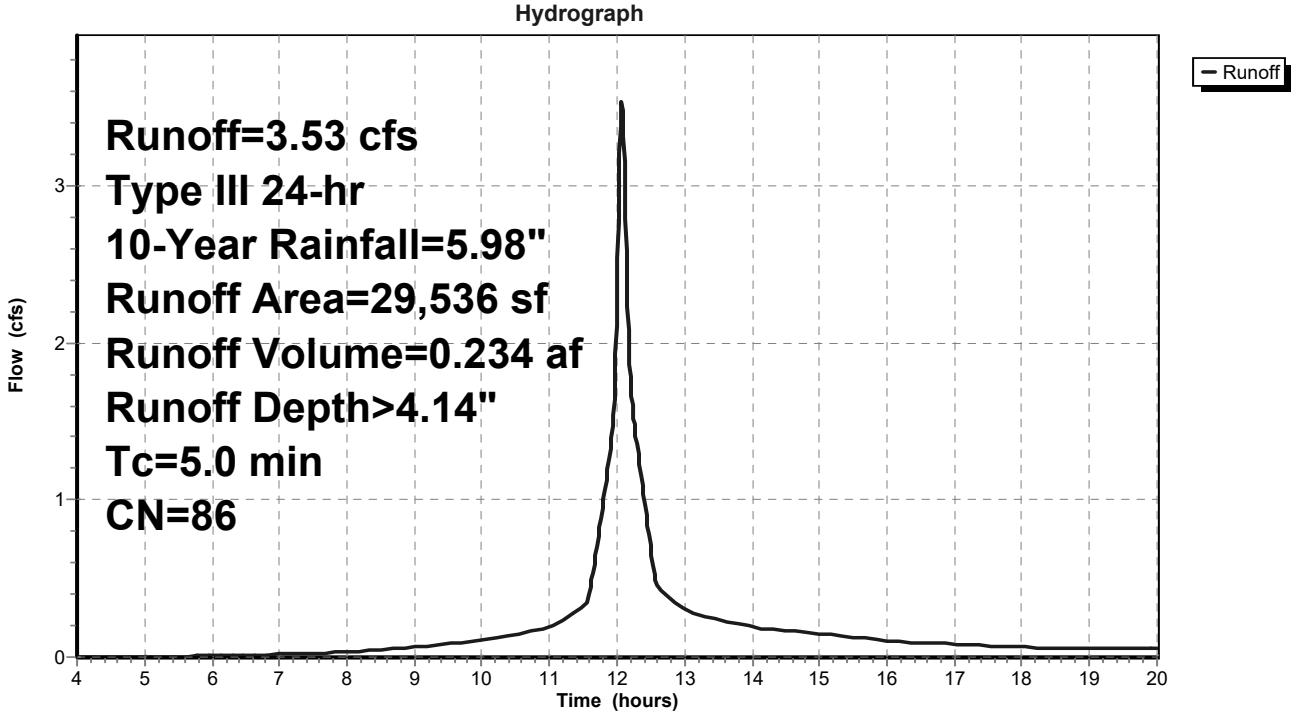
Runoff = 3.53 cfs @ 12.07 hrs, Volume= 0.234 af, Depth> 4.14"
Routed to Link E1 : Design Point

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.98"

Area (sf)	CN	Description
14,605	98	Paved parking, HSG C
14,931	74	>75% Grass cover, Good, HSG C
29,536	86	Weighted Average
14,931		50.55% Pervious Area
14,605		49.45% Impervious Area

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

Subcatchment EX1: SITE & BUILDING



Summary for Subcatchment PR1: SITE

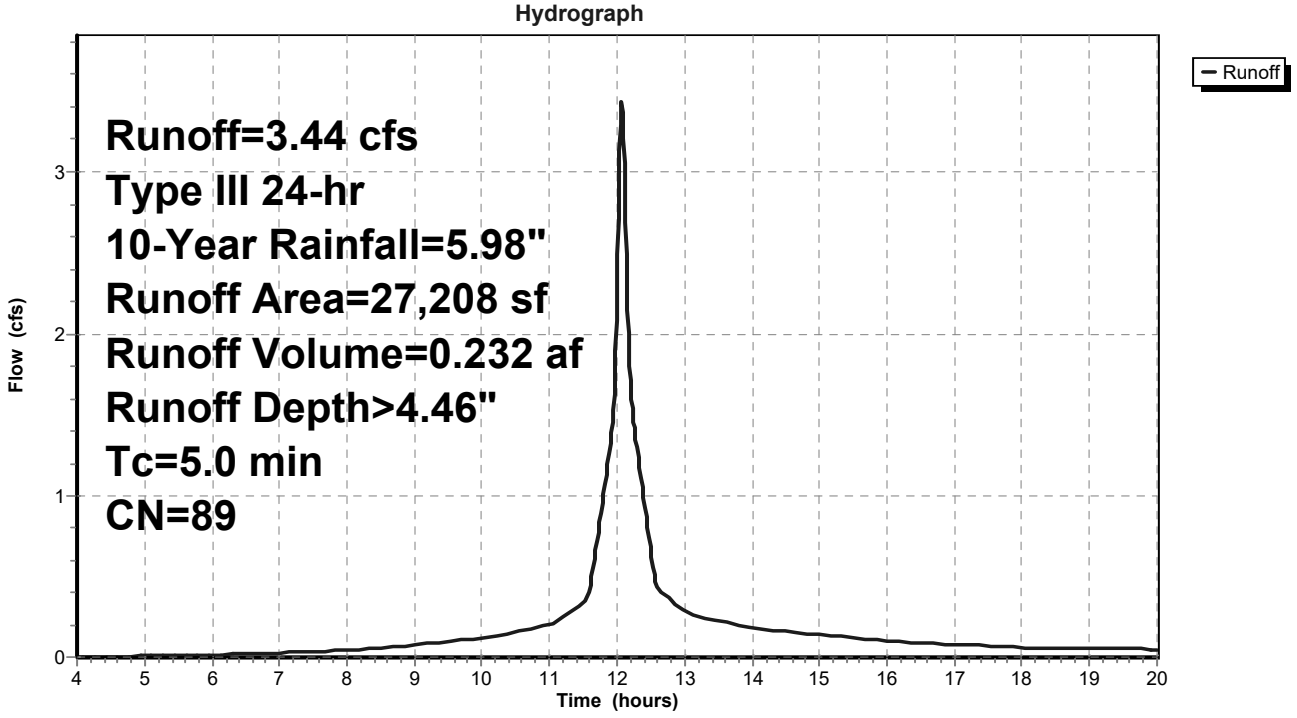
Runoff = 3.44 cfs @ 12.07 hrs, Volume= 0.232 af, Depth> 4.46"
Routed to Pond I1 : UG CHAMBERS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.98"

Area (sf)	CN	Description
17,094	98	Paved parking, HSG C
10,114	74	>75% Grass cover, Good, HSG C
27,208	89	Weighted Average
10,114		37.17% Pervious Area
17,094		62.83% Impervious Area

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

Subcatchment PR1: SITE



Summary for Subcatchment PR2: BUILDING

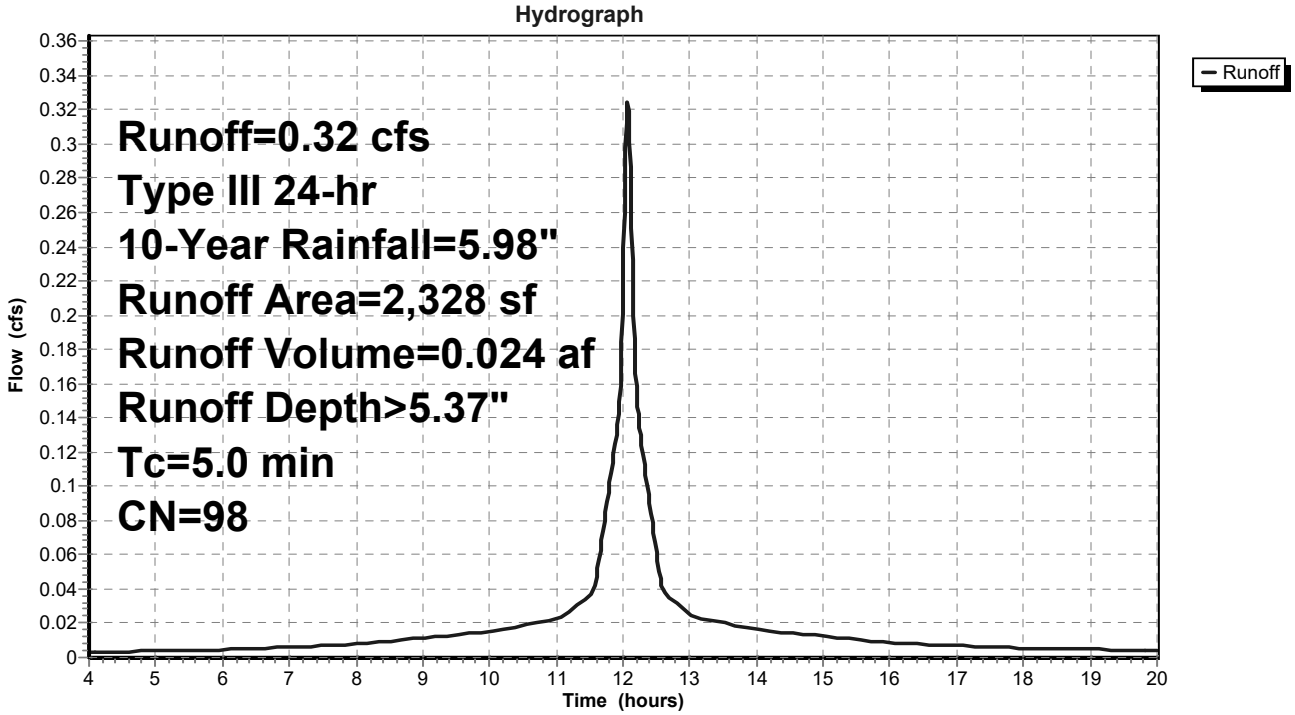
Runoff = 0.32 cfs @ 12.07 hrs, Volume= 0.024 af, Depth> 5.37"
Routed to Pond I1 : UG CHAMBERS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.98"

Area (sf)	CN	Description
2,328	98	Roofs, HSG C
2,328		100.00% Impervious Area

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

Subcatchment PR2: BUILDING



Summary for Pond I1: UG CHAMBERS

Inflow Area = 0.678 ac, 65.76% Impervious, Inflow Depth > 4.53" for 10-Year event
Inflow = 3.76 cfs @ 12.07 hrs, Volume= 0.256 af
Outflow = 2.98 cfs @ 12.13 hrs, Volume= 0.236 af, Atten= 21%, Lag= 3.4 min
Discarded = 0.01 cfs @ 9.84 hrs, Volume= 0.007 af
Primary = 2.97 cfs @ 12.13 hrs, Volume= 0.229 af
Routed to Link P1 : Design Point

Routing by Stor-Ind method, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 602.74' @ 12.13 hrs Surf.Area= 904 sf Storage= 1,767 cf

Plug-Flow detention time= 54.2 min calculated for 0.236 af (92% of inflow)
Center-of-Mass det. time= 26.2 min (780.8 - 754.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	599.50'	758 cf	**20.50'W x 39.22'L x 3.50'H Field A** 2,814 cf Overall - 919 cf Embedded = 1,895 cf x 40.0% Voids
#2A	600.00'	919 cf	**ADS_StormTech SC-740 +Cap** x 20 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 20 Chambers in 4 Rows
#3	601.00'	6,625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
		8,302 cf	Total Available Storage

Storage Group A created with Chamber Wizard

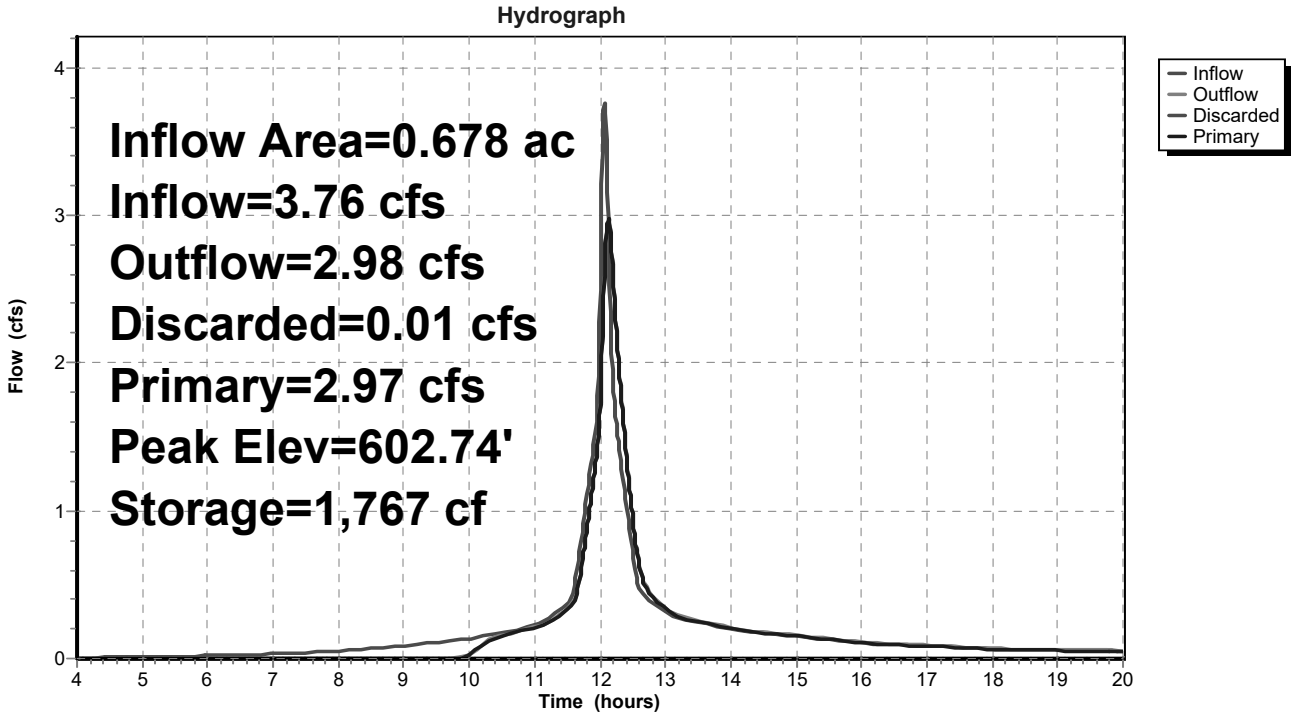
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
601.00	100	0	0
604.00	100	300	300
604.50	100	50	350
605.00	5,000	1,275	1,625
606.00	5,000	5,000	6,625

Device	Routing	Invert	Outlet Devices
#1	Discarded	599.50'	**0.270 in/hr Exfiltration over Horizontal area**
#2	Primary	601.04'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 9.84 hrs HW=601.01' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=2.97 cfs @ 12.13 hrs HW=602.74' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 2.97 cfs @ 5.45 fps)

Pond I1: UG CHAMBERS

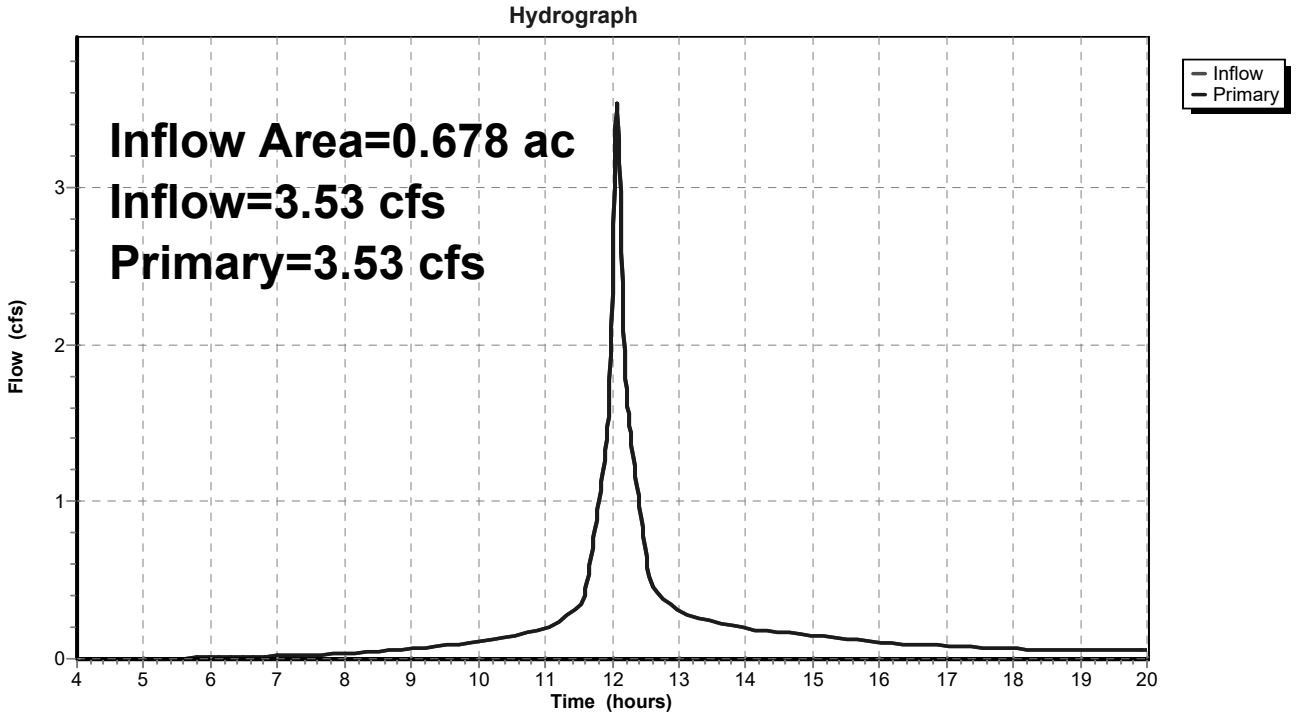


Summary for Link E1: Design Point

Inflow Area = 0.678 ac, 49.45% Impervious, Inflow Depth > 4.14" for 10-Year event
Inflow = 3.53 cfs @ 12.07 hrs, Volume= 0.234 af
Primary = 3.53 cfs @ 12.07 hrs, Volume= 0.234 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs

Link E1: Design Point

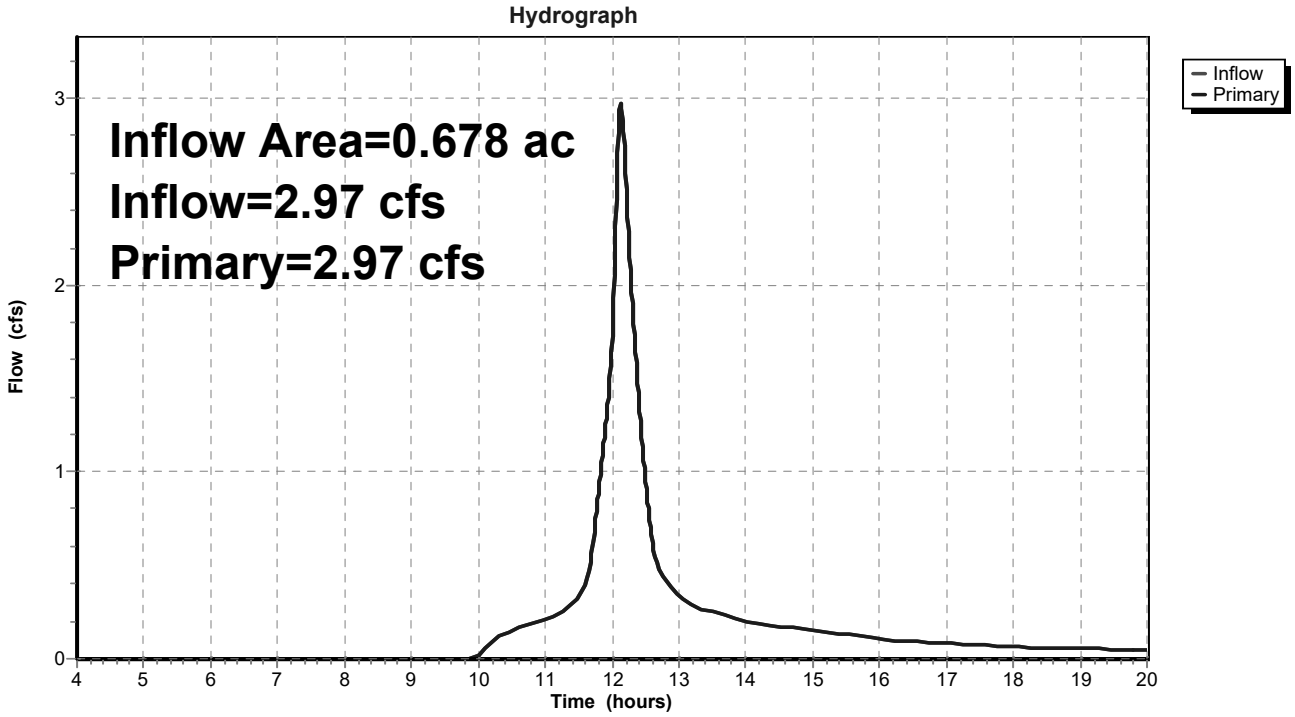


Summary for Link P1: Design Point

Inflow Area = 0.678 ac, 65.76% Impervious, Inflow Depth > 4.05" for 10-Year event
Inflow = 2.97 cfs @ 12.13 hrs, Volume= 0.229 af
Primary = 2.97 cfs @ 12.13 hrs, Volume= 0.229 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs

Link P1: Design Point



Time span=4.00-20.00 hrs, dt=0.01 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX1: SITE & BUILDING Runoff Area=29,536 sf 49.45% Impervious Runoff Depth>5.70"
Tc=5.0 min CN=86 Runoff=4.77 cfs 0.322 af

Subcatchment PR1: SITE Runoff Area=27,208 sf 62.83% Impervious Runoff Depth>6.04"
Tc=5.0 min CN=89 Runoff=4.57 cfs 0.314 af

Subcatchment PR2: BUILDING Runoff Area=2,328 sf 100.00% Impervious Runoff Depth>6.94"
Tc=5.0 min CN=98 Runoff=0.42 cfs 0.031 af

Pond I1: UG CHAMBERS Peak Elev=604.23' Storage=2,000 cf Inflow=4.98 cfs 0.345 af
Discarded=0.01 cfs 0.007 af Primary=4.38 cfs 0.318 af Outflow=4.38 cfs 0.325 af

Link E1: Design Point Inflow=4.77 cfs 0.322 af
Primary=4.77 cfs 0.322 af

Link P1: Design Point Inflow=4.38 cfs 0.318 af
Primary=4.38 cfs 0.318 af

Total Runoff Area = 1.356 ac Runoff Volume = 0.667 af Average Runoff Depth = 5.90"
42.40% Pervious = 0.575 ac 57.60% Impervious = 0.781 ac

Summary for Subcatchment EX1: SITE & BUILDING

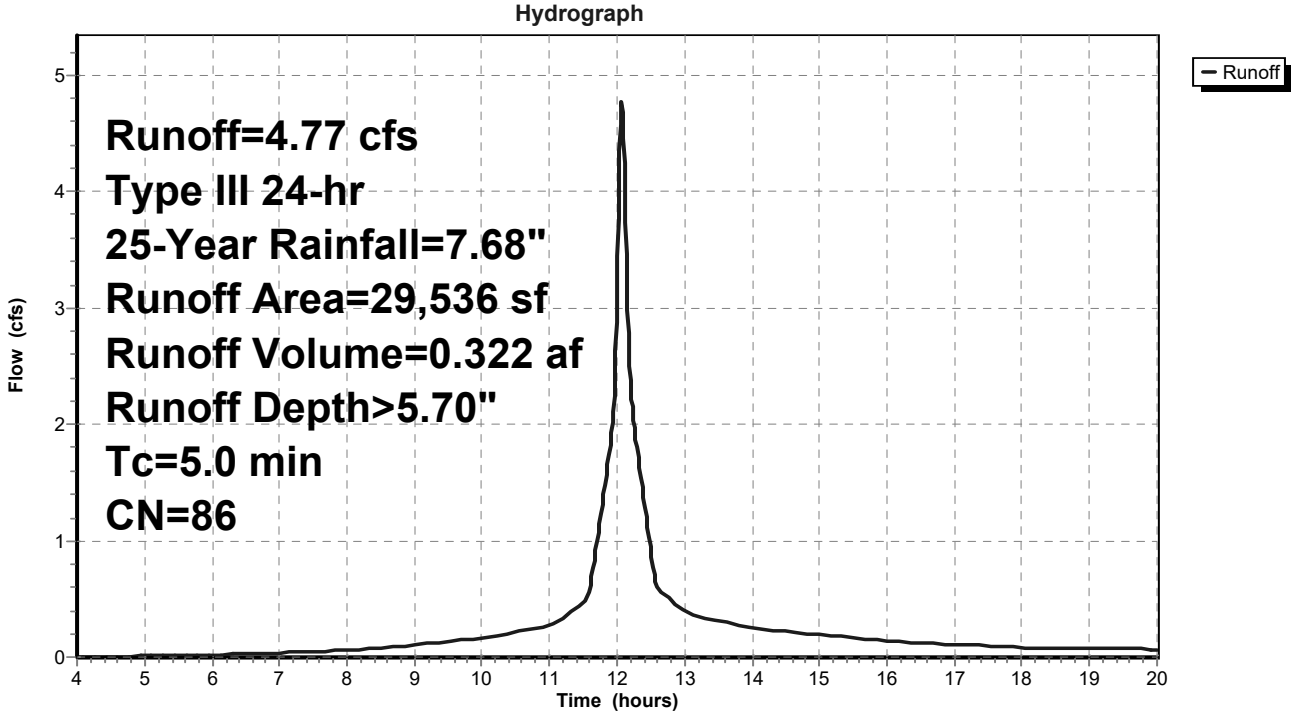
Runoff = 4.77 cfs @ 12.07 hrs, Volume= 0.322 af, Depth> 5.70"
Routed to Link E1 : Design Point

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=7.68"

Area (sf)	CN	Description
14,605	98	Paved parking, HSG C
14,931	74	>75% Grass cover, Good, HSG C
29,536	86	Weighted Average
14,931		50.55% Pervious Area
14,605		49.45% Impervious Area

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

Subcatchment EX1: SITE & BUILDING



Summary for Subcatchment PR1: SITE

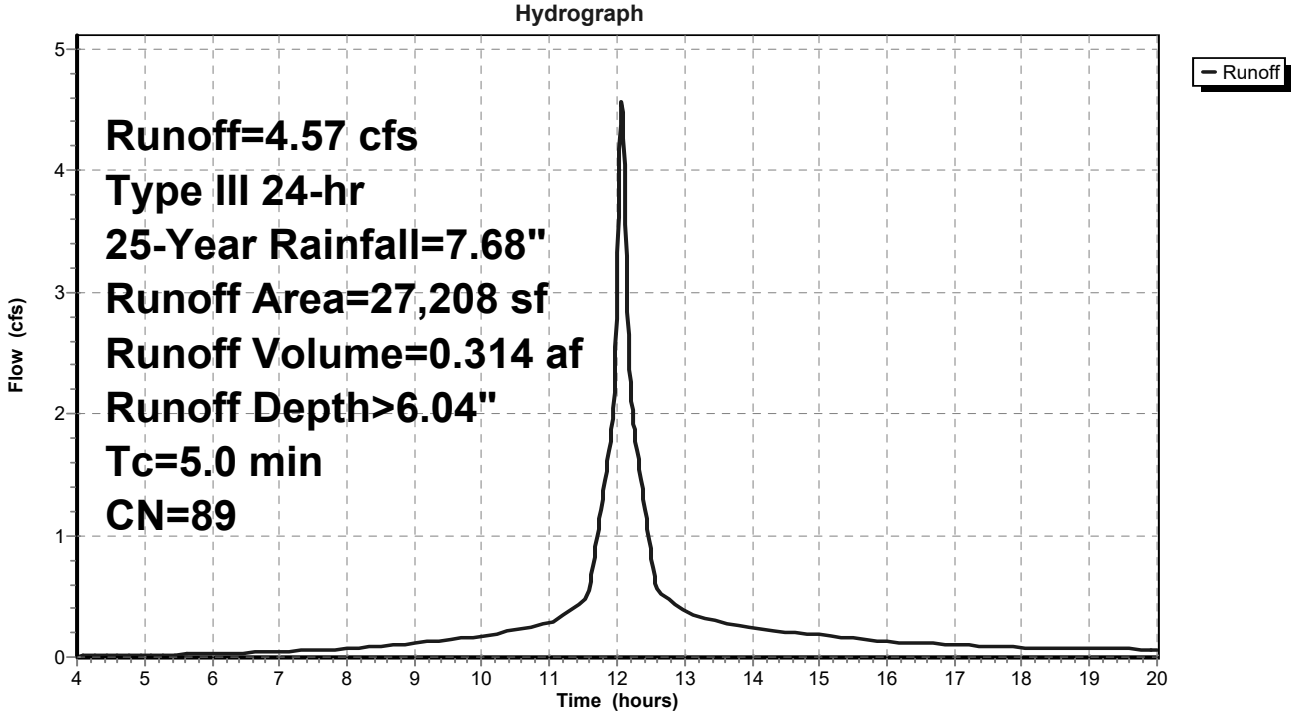
Runoff = 4.57 cfs @ 12.07 hrs, Volume= 0.314 af, Depth> 6.04"
Routed to Pond I1 : UG CHAMBERS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=7.68"

Area (sf)	CN	Description
17,094	98	Paved parking, HSG C
10,114	74	>75% Grass cover, Good, HSG C
27,208	89	Weighted Average
10,114		37.17% Pervious Area
17,094		62.83% Impervious Area

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

Subcatchment PR1: SITE



Summary for Subcatchment PR2: BUILDING

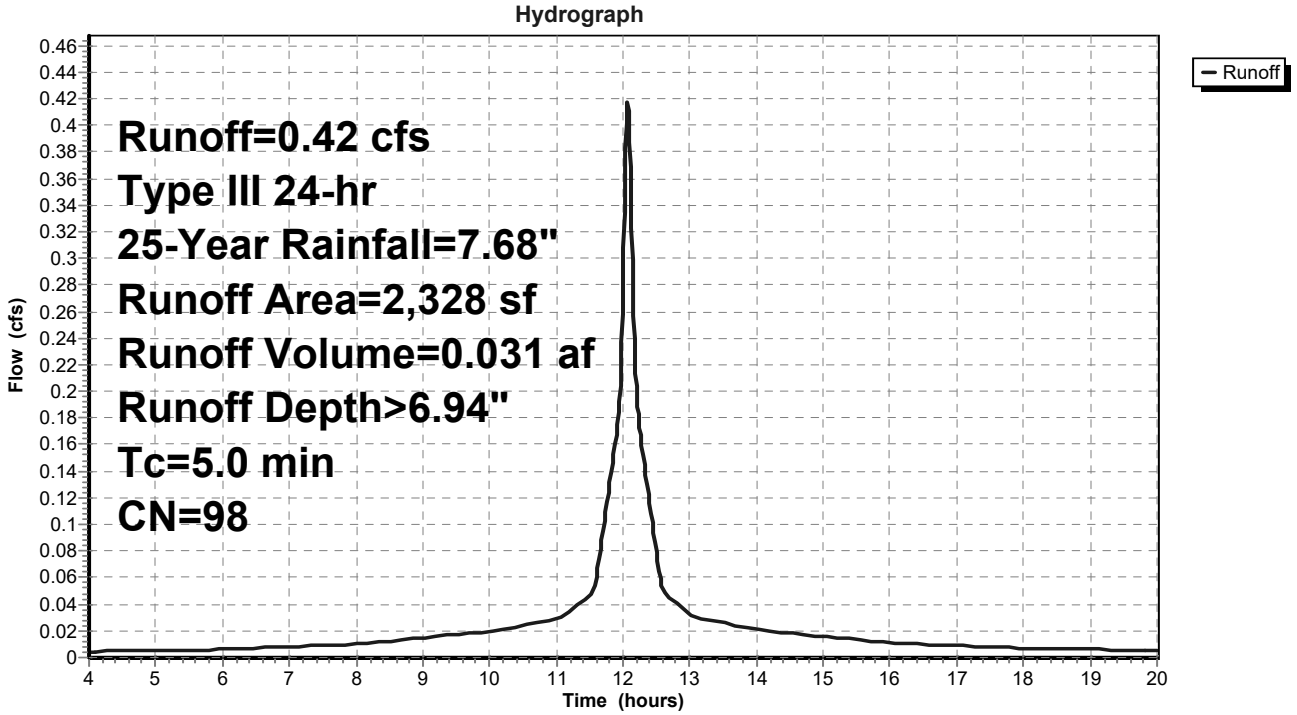
Runoff = 0.42 cfs @ 12.07 hrs, Volume= 0.031 af, Depth> 6.94"
Routed to Pond I1 : UG CHAMBERS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=7.68"

Area (sf)	CN	Description
2,328	98	Roofs, HSG C
2,328		100.00% Impervious Area

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

Subcatchment PR2: BUILDING



Summary for Pond I1: UG CHAMBERS

Inflow Area = 0.678 ac, 65.76% Impervious, Inflow Depth > 6.11" for 25-Year event
Inflow = 4.98 cfs @ 12.07 hrs, Volume= 0.345 af
Outflow = 4.38 cfs @ 12.11 hrs, Volume= 0.325 af, Atten= 12%, Lag= 2.5 min
Discarded = 0.01 cfs @ 8.89 hrs, Volume= 0.007 af
Primary = 4.38 cfs @ 12.11 hrs, Volume= 0.318 af
Routed to Link P1 : Design Point

Routing by Stor-Ind method, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 604.23' @ 12.11 hrs Surf.Area= 904 sf Storage= 2,000 cf

Plug-Flow detention time= 45.8 min calculated for 0.324 af (94% of inflow)
Center-of-Mass det. time= 23.4 min (771.8 - 748.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	599.50'	758 cf	**20.50'W x 39.22'L x 3.50'H Field A** 2,814 cf Overall - 919 cf Embedded = 1,895 cf x 40.0% Voids
#2A	600.00'	919 cf	**ADS_StormTech SC-740 +Cap** x 20 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 20 Chambers in 4 Rows
#3	601.00'	6,625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
		8,302 cf	Total Available Storage

Storage Group A created with Chamber Wizard

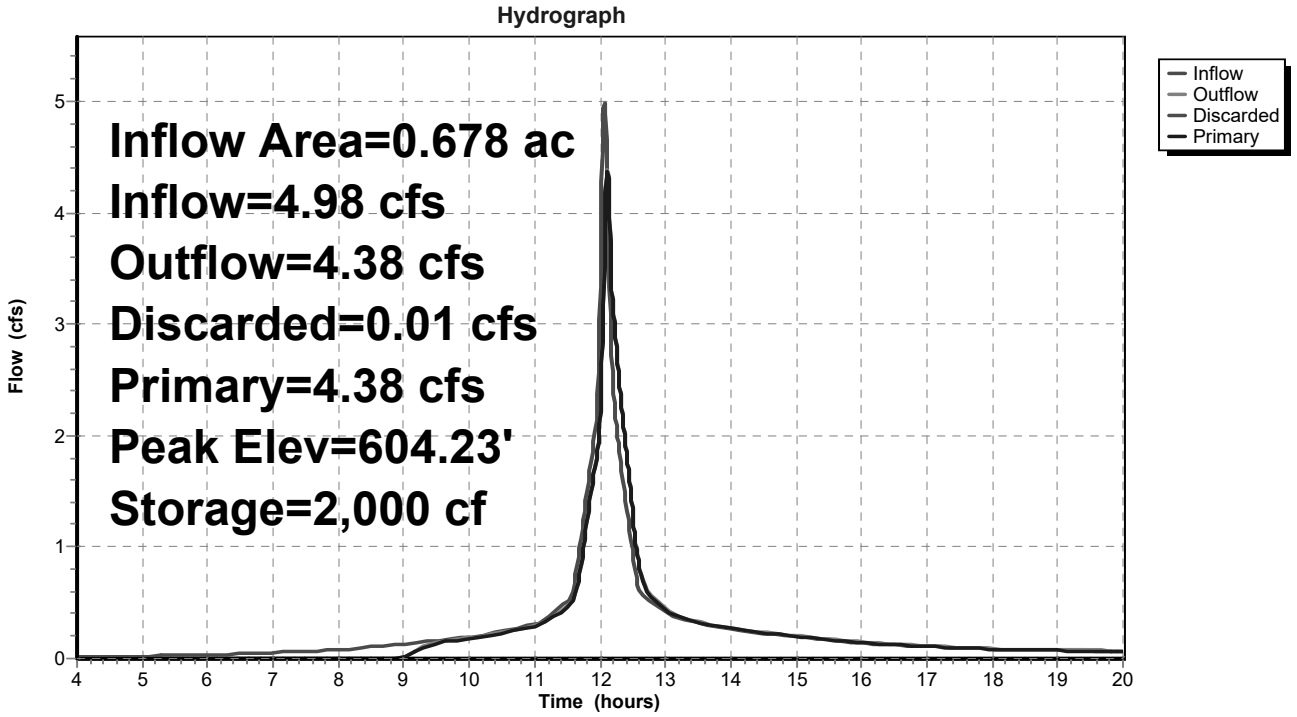
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
601.00	100	0	0
604.00	100	300	300
604.50	100	50	350
605.00	5,000	1,275	1,625
606.00	5,000	5,000	6,625

Device	Routing	Invert	Outlet Devices
#1	Discarded	599.50'	**0.270 in/hr Exfiltration over Horizontal area**
#2	Primary	601.04'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 8.89 hrs HW=601.00' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=4.37 cfs @ 12.11 hrs HW=604.23' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 4.37 cfs @ 8.01 fps)

Pond I1: UG CHAMBERS

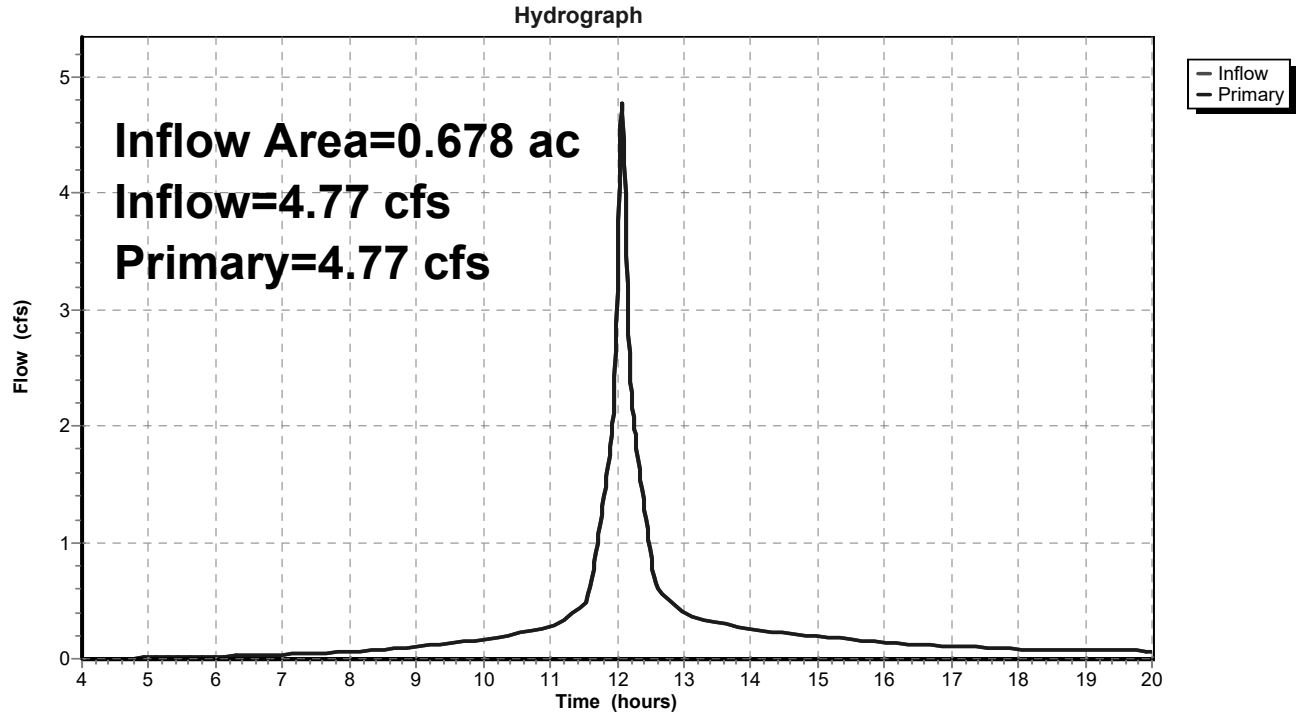


Summary for Link E1: Design Point

Inflow Area = 0.678 ac, 49.45% Impervious, Inflow Depth > 5.70" for 25-Year event
Inflow = 4.77 cfs @ 12.07 hrs, Volume= 0.322 af
Primary = 4.77 cfs @ 12.07 hrs, Volume= 0.322 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs

Link E1: Design Point

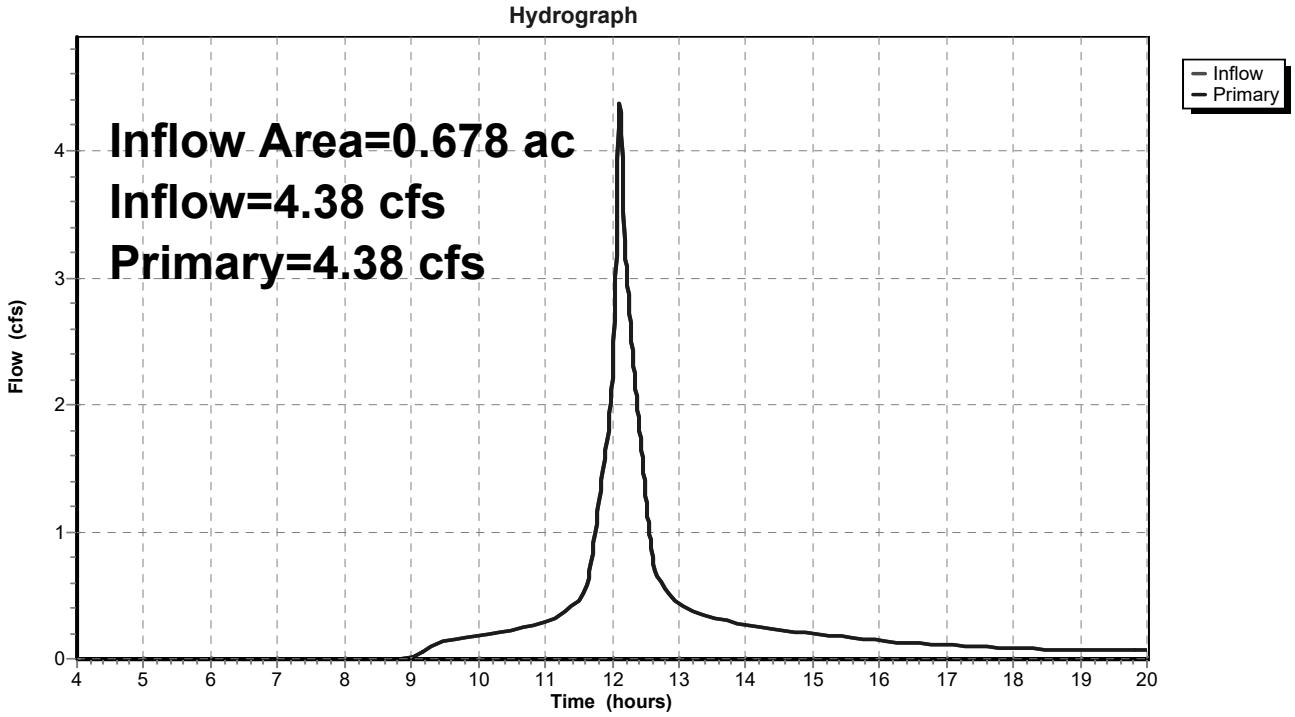


Summary for Link P1: Design Point

Inflow Area = 0.678 ac, 65.76% Impervious, Inflow Depth > 5.62" for 25-Year event
Inflow = 4.38 cfs @ 12.11 hrs, Volume= 0.318 af
Primary = 4.38 cfs @ 12.11 hrs, Volume= 0.318 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs

Link P1: Design Point



Time span=4.00-20.00 hrs, dt=0.01 hrs, 1601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX1: SITE & BUILDING Runoff Area=29,536 sf 49.45% Impervious Runoff Depth>8.31"
Tc=5.0 min CN=86 Runoff=6.80 cfs 0.470 af

Subcatchment PR1: SITE Runoff Area=27,208 sf 62.83% Impervious Runoff Depth>8.67"
Tc=5.0 min CN=89 Runoff=6.42 cfs 0.451 af

Subcatchment PR2: BUILDING Runoff Area=2,328 sf 100.00% Impervious Runoff Depth>9.53"
Tc=5.0 min CN=98 Runoff=0.57 cfs 0.042 af

Pond I1: UG CHAMBERS Peak Elev=604.84' Storage=2,634 cf Inflow=6.99 cfs 0.494 af
Discarded=0.03 cfs 0.008 af Primary=4.83 cfs 0.465 af Outflow=4.86 cfs 0.473 af

Link E1: Design Point Inflow=6.80 cfs 0.470 af
Primary=6.80 cfs 0.470 af

Link P1: Design Point Inflow=4.83 cfs 0.465 af
Primary=4.83 cfs 0.465 af

Total Runoff Area = 1.356 ac Runoff Volume = 0.963 af Average Runoff Depth = 8.52"
42.40% Pervious = 0.575 ac 57.60% Impervious = 0.781 ac

Summary for Subcatchment EX1: SITE & BUILDING

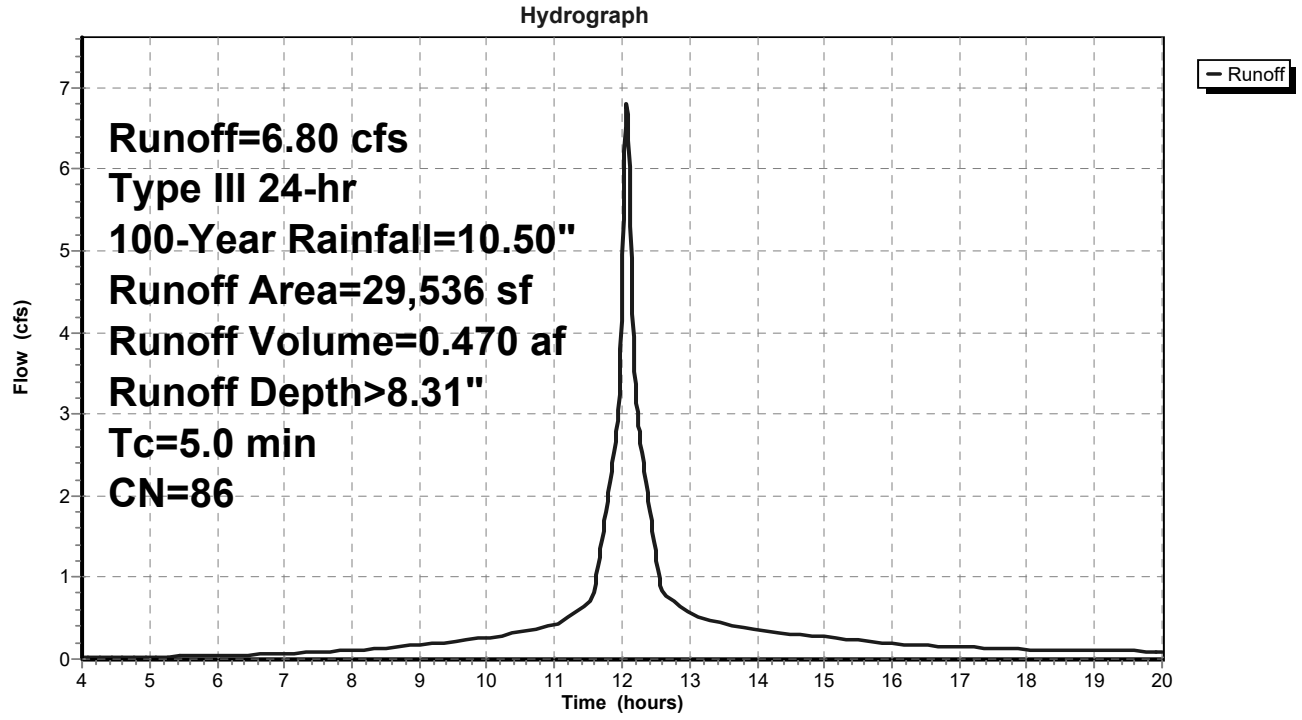
Runoff = 6.80 cfs @ 12.07 hrs, Volume= 0.470 af, Depth> 8.31"
Routed to Link E1 : Design Point

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=10.50"

Area (sf)	CN	Description
14,605	98	Paved parking, HSG C
14,931	74	>75% Grass cover, Good, HSG C
29,536	86	Weighted Average
14,931		50.55% Pervious Area
14,605		49.45% Impervious Area

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

Subcatchment EX1: SITE & BUILDING



Summary for Subcatchment PR1: SITE

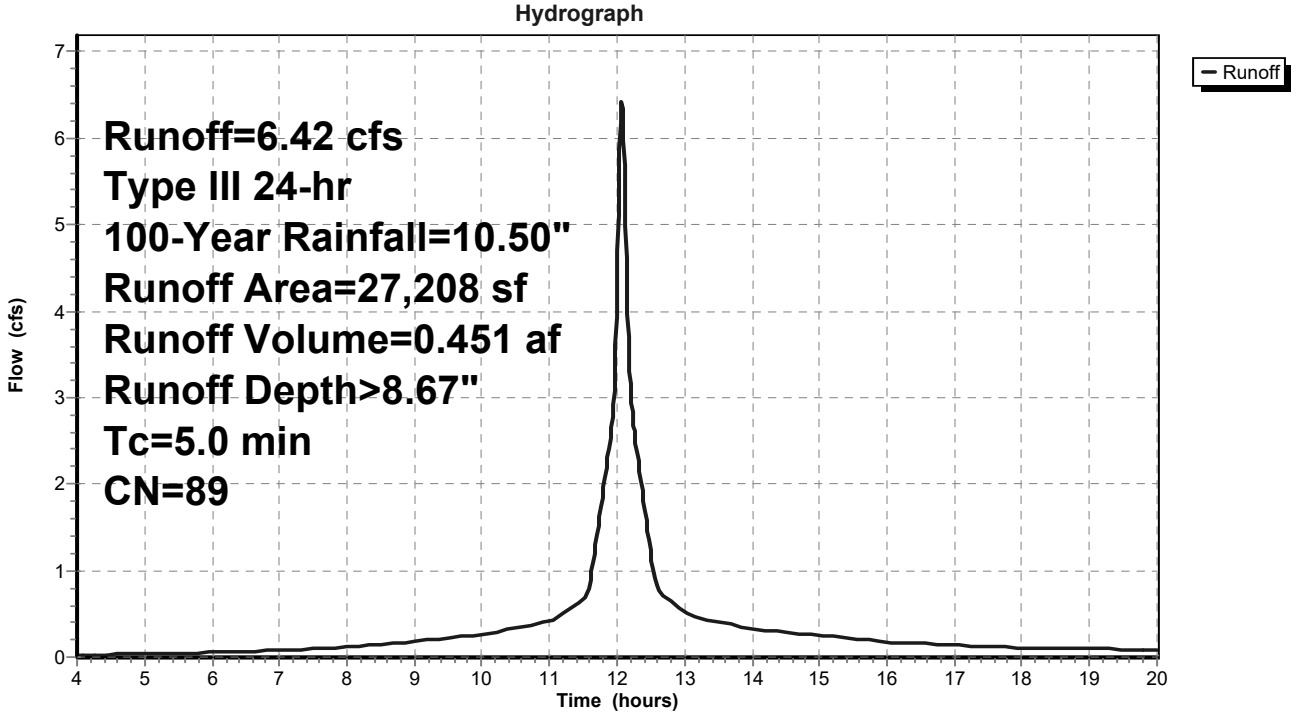
Runoff = 6.42 cfs @ 12.07 hrs, Volume= 0.451 af, Depth> 8.67"
Routed to Pond I1 : UG CHAMBERS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=10.50"

Area (sf)	CN	Description
17,094	98	Paved parking, HSG C
10,114	74	>75% Grass cover, Good, HSG C
27,208	89	Weighted Average
10,114		37.17% Pervious Area
17,094		62.83% Impervious Area

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

Subcatchment PR1: SITE



Summary for Subcatchment PR2: BUILDING

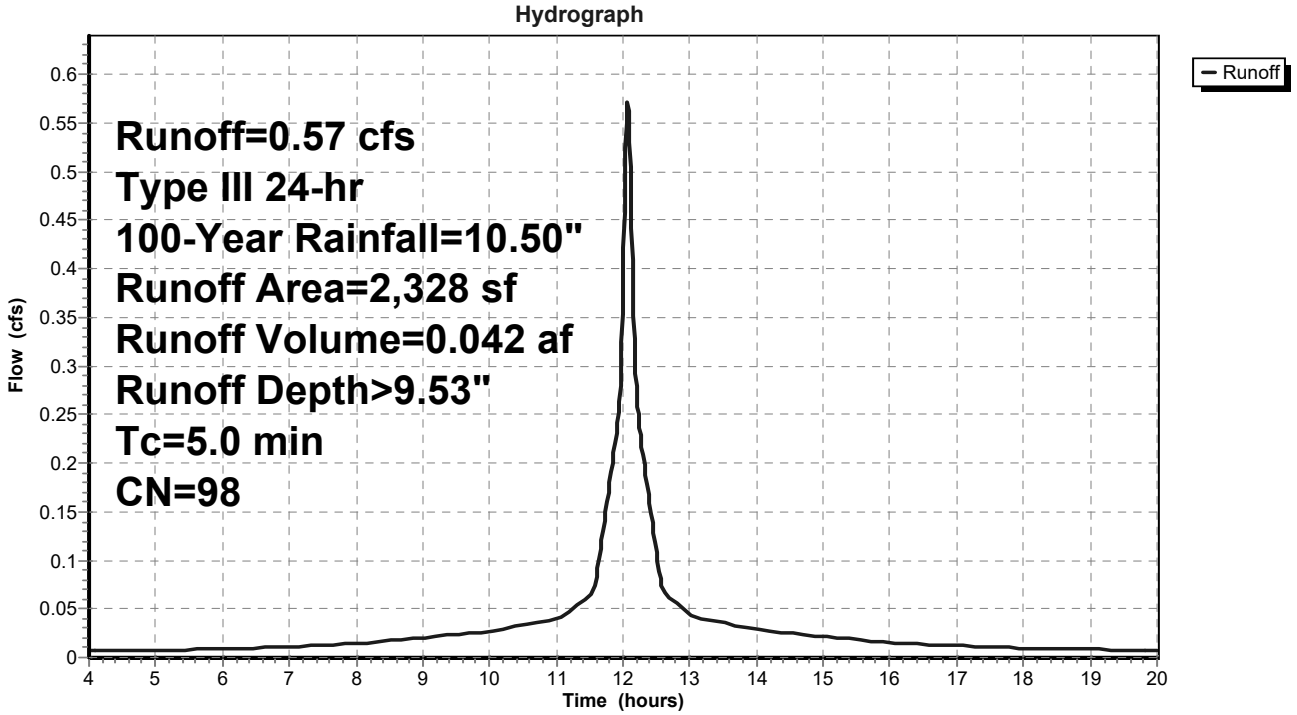
Runoff = 0.57 cfs @ 12.07 hrs, Volume= 0.042 af, Depth> 9.53"
Routed to Pond I1 : UG CHAMBERS

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=10.50"

Area (sf)	CN	Description
2,328	98	Roofs, HSG C
2,328		100.00% Impervious Area

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

Subcatchment PR2: BUILDING



Summary for Pond I1: UG CHAMBERS

Inflow Area = 0.678 ac, 65.76% Impervious, Inflow Depth > 8.74" for 100-Year event
Inflow = 6.99 cfs @ 12.07 hrs, Volume= 0.494 af
Outflow = 4.86 cfs @ 12.14 hrs, Volume= 0.473 af, Atten= 31%, Lag= 4.5 min
Discarded = 0.03 cfs @ 12.14 hrs, Volume= 0.008 af
Primary = 4.83 cfs @ 12.14 hrs, Volume= 0.465 af
Routed to Link P1 : Design Point

Routing by Stor-Ind method, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 604.84' @ 12.14 hrs Surf.Area= 4,255 sf Storage= 2,634 cf

Plug-Flow detention time= 37.0 min calculated for 0.473 af (96% of inflow)
Center-of-Mass det. time= 20.0 min (761.9 - 741.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	599.50'	758 cf	**20.50'W x 39.22'L x 3.50'H Field A** 2,814 cf Overall - 919 cf Embedded = 1,895 cf x 40.0% Voids
#2A	600.00'	919 cf	**ADS_StormTech SC-740 +Cap** x 20 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 20 Chambers in 4 Rows
#3	601.00'	6,625 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)
		8,302 cf	Total Available Storage

Storage Group A created with Chamber Wizard

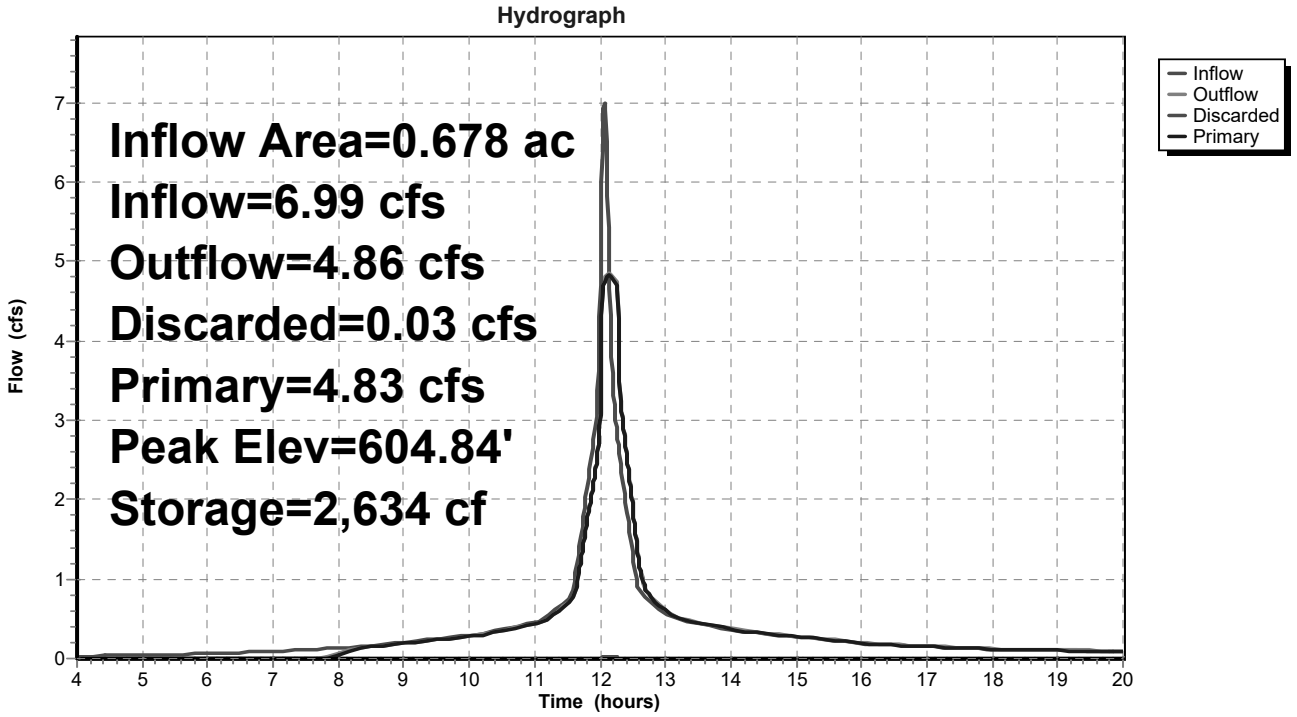
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
601.00	100	0	0
604.00	100	300	300
604.50	100	50	350
605.00	5,000	1,275	1,625
606.00	5,000	5,000	6,625

Device	Routing	Invert	Outlet Devices
#1	Discarded	599.50'	**0.270 in/hr Exfiltration over Horizontal area**
#2	Primary	601.04'	**10.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.03 cfs @ 12.14 hrs HW=604.84' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=4.83 cfs @ 12.14 hrs HW=604.84' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 4.83 cfs @ 8.86 fps)

Pond I1: UG CHAMBERS

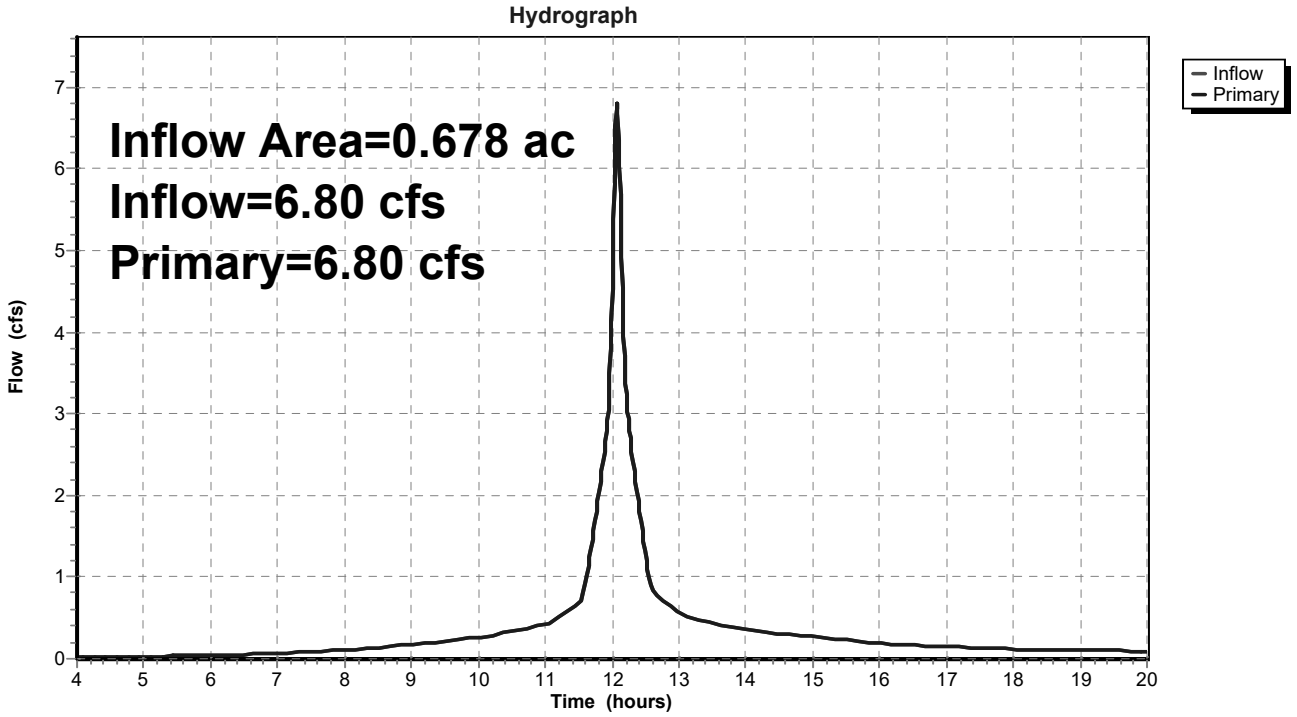


Summary for Link E1: Design Point

Inflow Area = 0.678 ac, 49.45% Impervious, Inflow Depth > 8.31" for 100-Year event
Inflow = 6.80 cfs @ 12.07 hrs, Volume= 0.470 af
Primary = 6.80 cfs @ 12.07 hrs, Volume= 0.470 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs

Link E1: Design Point

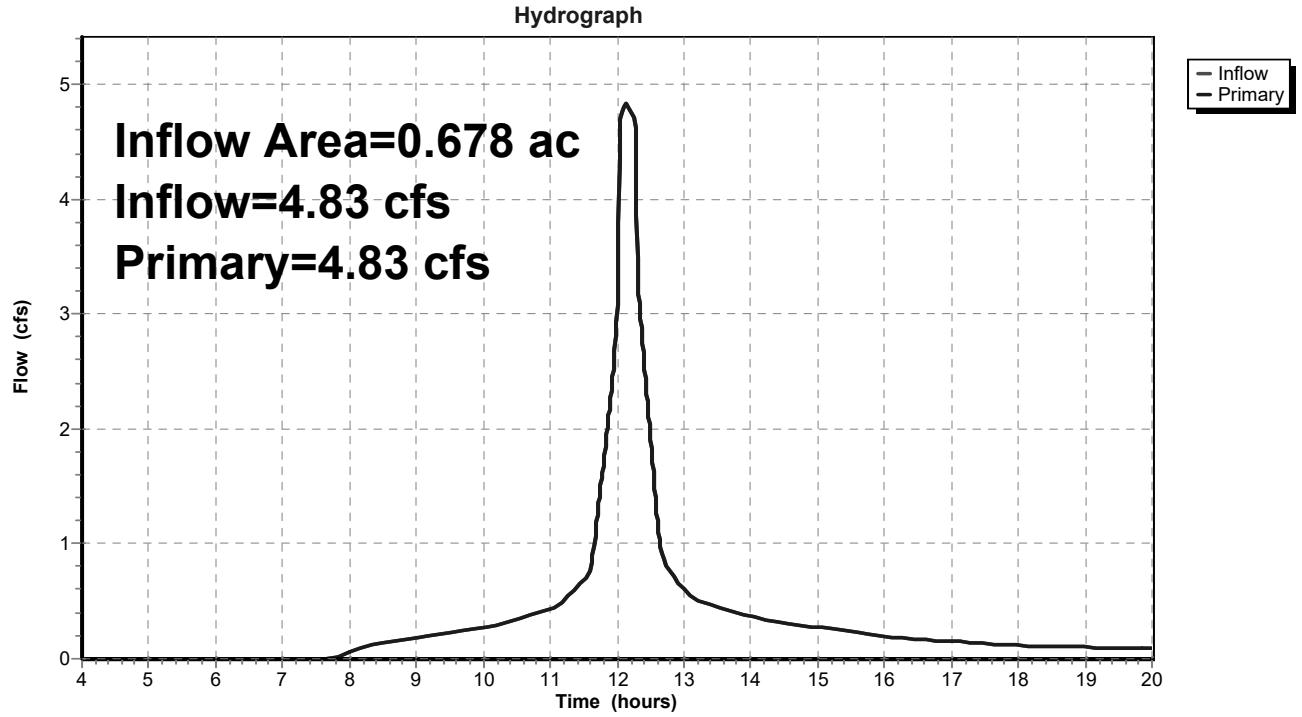


Summary for Link P1: Design Point

Inflow Area = 0.678 ac, 65.76% Impervious, Inflow Depth > 8.23" for 100-Year event
Inflow = 4.83 cfs @ 12.14 hrs, Volume= 0.465 af
Primary = 4.83 cfs @ 12.14 hrs, Volume= 0.465 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 4.00-20.00 hrs, dt= 0.01 hrs

Link P1: Design Point



NOAA Atlas 14, Volume 10, Version 3
Location name: Worcester, Massachusetts, USA*
Latitude: 42.3246°, Longitude: -71.7982°
Elevation: 607 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	**0.346** (0.274-0.431)	**0.405** (0.320-0.505)	**0.500** (0.394-0.627)	**0.579** (0.453-0.730)	**0.688** (0.520-0.905)	**0.771** (0.569-1.04)	**0.857** (0.611-1.19)	**0.949** (0.642-1.36)	**1.08** (0.699-1.61)	**1.18** (0.745-1.80)
10-min	**0.490** (0.388-0.611)	**0.573** (0.453-0.715)	**0.708** (0.557-0.886)	**0.820** (0.642-1.03)	**0.975** (0.736-1.28)	**1.09** (0.806-1.47)	**1.21** (0.865-1.69)	**1.34** (0.910-1.93)	**1.52** (0.990-2.28)	**1.67** (1.06-2.54)
15-min	**0.577** (0.457-0.719)	**0.674** (0.533-0.841)	**0.833** (0.655-1.04)	**0.965** (0.755-1.22)	**1.15** (0.866-1.51)	**1.29** (0.948-1.73)	**1.43** (1.02-1.99)	**1.58** (1.07-2.27)	**1.79** (1.16-2.68)	**1.96** (1.24-2.99)
30-min	**0.777** (0.615-0.968)	**0.910** (0.719-1.14)	**1.13** (0.888-1.41)	**1.31** (1.02-1.65)	**1.56** (1.17-2.04)	**1.74** (1.29-2.34)	**1.94** (1.38-2.70)	**2.14** (1.45-3.08)	**2.43** (1.58-3.63)	**2.66** (1.68-4.06)
60-min	**0.978** (0.774-1.22)	**1.15** (0.906-1.43)	**1.42** (1.12-1.78)	**1.65** (1.29-2.08)	**1.96** (1.48-2.58)	**2.20** (1.62-2.96)	**2.45** (1.74-3.41)	**2.71** (1.83-3.89)	**3.07** (2.00-4.58)	**3.36** (2.13-5.13)
2-hr	**1.23** (0.980-1.52)	**1.46** (1.16-1.80)	**1.83** (1.45-2.27)	**2.14** (1.68-2.67)	**2.56** (1.95-3.36)	**2.88** (2.15-3.87)	**3.22** (2.32-4.50)	**3.61** (2.45-5.16)	**4.18** (2.72-6.21)	**4.66** (2.96-7.07)
3-hr	**1.40** (1.12-1.73)	**1.68** (1.34-2.07)	**2.12** (1.69-2.62)	**2.48** (1.97-3.10)	**2.99** (2.29-3.92)	**3.37** (2.52-4.52)	**3.77** (2.74-5.28)	**4.25** (2.89-6.06)	**4.97** (3.24-7.35)	**5.58** (3.55-8.43)
6-hr	**1.76** (1.42-2.16)	**2.12** (1.71-2.60)	**2.71** (2.18-3.34)	**3.20** (2.55-3.96)	**3.87** (2.98-5.04)	**4.37** (3.30-5.84)	**4.91** (3.60-6.85)	**5.56** (3.80-7.87)	**6.55** (4.28-9.62)	**7.39** (4.72-11.1)
12-hr	**2.20** (1.79-2.67)	**2.67** (2.16-3.24)	**3.43** (2.77-4.19)	**4.06** (3.26-4.99)	**4.93** (3.82-6.38)	**5.57** (4.23-7.39)	**6.27** (4.61-8.68)	**7.10** (4.87-9.99)	**8.36** (5.50-12.2)	**9.44** (6.04-14.1)
24-hr	**2.61** (2.14-3.15)	**3.19** (2.60-3.85)	**4.12** (3.36-5.00)	**4.90** (3.96-5.98)	**5.97** (4.66-7.68)	**6.77** (5.16-8.92)	**7.62** (5.64-10.5)	**8.66** (5.96-12.1)	**10.2** (6.73-14.8)	**11.5** (7.41-17.1)
2-day	**2.96** (2.44-3.54)	**3.62** (2.98-4.35)	**4.72** (3.87-5.68)	**5.62** (4.58-6.82)	**6.87** (5.40-8.79)	**7.80** (5.99-10.2)	**8.80** (6.56-12.1)	**10.0** (6.94-13.9)	**11.9** (7.88-17.2)	**13.6** (8.73-19.9)
3-day	**3.20** (2.66-3.82)	**3.92** (3.25-4.69)	**5.10** (4.20-6.12)	**6.08** (4.98-7.34)	**7.43** (5.86-9.45)	**8.42** (6.50-11.0)	**9.50** (7.11-13.0)	**10.8** (7.51-15.0)	**12.9** (8.54-18.5)	**14.7** (9.46-21.5)
4-day	**3.44** (2.86-4.09)	**4.19** (3.48-4.99)	**5.43** (4.48-6.49)	**6.45** (5.30-7.76)	**7.86** (6.22-9.98)	**8.90** (6.89-11.6)	**10.0** (7.53-13.7)	**11.4** (7.94-15.8)	**13.6** (9.01-19.4)	**15.4** (9.97-22.5)
7-day	**4.10** (3.43-4.85)	**4.92** (4.11-5.83)	**6.26** (5.21-7.44)	**7.38** (6.09-8.82)	**8.91** (7.08-11.2)	**10.0** (7.80-13.0)	**11.3** (8.46-15.2)	**12.7** (8.89-17.5)	**15.0** (9.98-21.3)	**16.9** (10.9-24.6)
10-day	**4.76** (4.00-5.61)	**5.62** (4.71-6.63)	**7.02** (5.86-8.31)	**8.18** (6.78-9.75)	**9.78** (7.79-12.2)	**11.0** (8.52-14.1)	**12.2** (9.18-16.4)	**13.7** (9.61-18.7)	**15.9** (10.6-22.6)	**17.8** (11.5-25.8)
20-day	**6.81** (5.76-7.96)	**7.71** (6.52-9.04)	**9.20** (7.74-10.8)	**10.4** (8.71-12.3)	**12.1** (9.70-15.0)	**13.4** (10.4-16.9)	**14.7** (11.0-19.3)	**16.2** (11.4-21.8)	**18.1** (12.1-25.4)	**19.6** (12.8-28.2)
30-day	**8.52** (7.24-9.93)	**9.46** (8.02-11.0)	**11.0** (9.28-12.9)	**12.3** (10.3-14.4)	**14.0** (11.2-17.2)	**15.4** (12.0-19.2)	**16.7** (12.5-21.6)	**18.0** (12.8-24.3)	**19.8** (13.3-27.6)	**21.0** (13.7-30.1)
45-day	**10.7** (9.09-12.4)	**11.6** (9.91-13.5)	**13.2** (11.2-15.4)	**14.5** (12.2-17.1)	**16.4** (13.2-19.9)	**17.8** (13.9-22.1)	**19.2** (14.3-24.5)	**20.4** (14.5-27.3)	**21.9** (14.8-30.5)	**22.9** (15.0-32.7)
60-day	**12.4** (10.6-14.4)	**13.4** (11.5-15.6)	**15.1** (12.8-17.5)	**16.5** (13.9-19.2)	**18.3** (14.8-22.2)	**19.8** (15.5-24.5)	**21.2** (15.8-27.0)	**22.4** (16.0-29.9)	**23.8** (16.1-33.0)	**24.7** (16.2-35.1)

[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

Appendix E: Hydraulic Analysis

Hydraulic Spreadsheet

Recharge Calculations

Water Quality Volume Calculations

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PIPE DESIGN CALCULATIONS

Project: 79 Pullman St Location: Worcester, MA

Date: 2/28/2024 Design By: ppd

rev

DESIGN STORM: 10-year Mannings Coeff: 0.013

LOCATION			DRAINAGE AREA				FLOW TIME (min)			RUNOFF (cfs)		Other Flow (CFS)		PIPE DATA					FULL FLOW		COVER		RIM		INVERT	
Description	From	To	Area (Ac.)	Runoff Coeff.C	Incr. CA	Sum CA	Overld Time	Time In Pipe	Tc	Intensity (In/Hr)	Peak Flow		Design Flow	Diam (In.)	Drop (Ft.)	Length (Ft.)	Slope (Ft./Ft.)	Manning Coeff.	Capacity (Cfs)	Velocity (Fps)	Upper (Ft.)	Lower (Ft.)	Upper	Lower	Upper	Lower
CB-1	CB-1	DMH-1	0.08	0.57	0.046	0.046	5	0.34	5.0	6.0	0.28		0.28	8	1.72	95	0.0181	0.013	1.63	4.66	2.08	4.21	606.86	607.27	603.86	602.14
CB-2	CB-2	DMH-1	0.07	0.54	0.039	0.039	5	0.06	5.0	6.0	0.23		0.23	8	1.01	25	0.0404	0.013	2.43	6.96	2.08	4.21	606.15	607.27	603.15	602.14
RD	RD-1	DMH-1	0.05	0.90	0.048	0.048	5	0.07	5.0	6.0	0.29		0.29	8	0.4	20	0.0200	0.013	1.71	4.90	3.08	2.75	608.00	607.27	604.00	603.60
	DMH-1	DMH-2				0.133	5	0.22	5.3	5.9	0.78		0.78	12	0.6	60	0.0100	0.013	3.56	4.54	4.21	3.68	607.27	606.14	601.81	601.21
CB-3	CB-3	DMH-2	0.13	0.78	0.105	0.105	5	0.09	5.0	6.0	0.63		0.63	8	0.81	30	0.0270	0.013	1.99	5.69	2.08	3.78	605.25	606.14	602.25	601.44
CB-4	CB-4	DMH-2	0.28	0.77	0.216	0.216	5	0.38	5.0	6.0	1.29		1.29	8	0.56	70	0.0080	0.013	1.08	3.10	1.58	3.78	604.50	606.14	602.00	601.44
	DMH-2	DMH-3				0.453	5	0.01	5.7	5.8	2.63		2.63	12	0.11	5	0.0220	0.013	5.28	6.73	3.78	4.18	606.14	606.43	601.11	601.00

Project Name: **79 Pullman St**

Project Location: **Worcester, MA** Date: 2/28/2024

Calculated by: ppd

Design Parameters

Required Separation to Groundwater is 2'

Required Recharge is 0.25" x impervious area (Hyd Group C soils)

Required Water Quality Volume is .5"

Required TSS Removal is 80%

Recharge Volume determined based on Static Method - Rawls rate is 0.27 for Silt Loam

Basin drawdown is less than 72 hours

Drainage Area P1 - Parking Area Impervious Area = 17,094 SF

Drainage Area P - Roof Area Impervious Area = 2328 SF

Recharge Requirements

	Soil Hyd Group	Imperviou s Area	Requuired Recharge (in)	Recharge Volume Required (cubic	Infiltration BMP
Subarea P1	C	17094.00	0.25	356	Yes
Subarea P2	C	2328.00	0.25	49	Yes
			Site recharge required	**405**	

Water Quality Volume Calculation

	Area (Acres)	Runoff Depth (in)	Water Quality Volume Required (cubic feet)	Infiltration BMP	TSS Remvoal %
Subarea P1	17094.00	0.5	712	YES	93

UG-1 Basin Data

StormTech SC 740	Elevation	(cf)	
4 x 5 Chamber Configuration	599.50	0	Bottom of Stone
Recharge Basin	600.00	177	Bottom of Chamber
	601.04	**786**	Outlet Invert
	602.50	1,666	Top of Chamber
	603.00	1,861	Top of Stone

Drawdown Tiime

$$\text{Time} = \frac{\text{Volume}}{(k) \times \text{bottom area} \times n}$$

	k (in/hr)	Volume (cf)	Bottom Area (sf)	Drawdown Time (hrs)
UG-1	0.27	786.0	820	43

Compliance:

Recharge Basin volume below the outlet invert is greater than required Recharge volumes and Water Quality Volume requirements

TSS Removal is greater than 80%

UG-1 Recharge System will drain within 72 hours

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TSS Removal Calculation Worksheet

Project Name:	79 Pullman St	Sheet:	1 of 1
Project Number:		Date:	28-Feb-2024
Location:	Worcester, MA	Computed by:	ppd
Discharge Point:	1	Checked by:	
Drainage Area(s):	PR-1		

A	B	C	D	E
BMP*	TSS Removal Rate*	Starting TSS Load**	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	25%	1.00	0.25	0.75
Isolator Row	50%	0.75	0.38	0.38
Infiltration Basin	80%	0.38	0.30	0.08
	0%	0.08	0.00	0.08
	0%	0.08	0.00	0.08

* BMP and TSS Removal Rate Values from the MassDEP Stormwater Handbook Vol. 1.
Removal rates for proprietary devices are from approved studies and/or manufacturer data (attach study or data source, or remove this sentence if not applicable).
** Equals remaining load from previous BMP (E)

Treatment Train TSS Removal = **93%**

Appendix F: Erosion and Sedimentation Control Measures

Erosion and Sedimentation Control Measures

The following erosion and sedimentation controls are for use during the earthwork and construction phases of the project. The following controls are provided as recommendations for the site contractor and do not constitute or replace the final Stormwater Pollution Prevention Plan that must be fully implemented by the Contractor and owner in Compliance with EPA NPDES regulations.

Perimeter Controls

Compost Filter Socks will be placed to trap sediment transported by runoff before it reaches the drainage system or leaves the construction site. Filter socks will be set at on the existing ground and staked at 10 feet on center.

Catch Basin Protection

Newly constructed and existing catch basins will be protected with silt sacks throughout construction.

Gravel and Construction Entrance/Exit

A temporary crushed-stone construction entrance/exit will be constructed. A cross slope will be placed in the entrance to direct runoff to a protected catch basin inlet or settling area. If deemed necessary after construction begins, a wash pad may be included to wash off vehicle wheels before leaving the project site.

Diversion Channels

Diversion channels will be used to collect runoff from construction areas and discharge to either sedimentation basins or protected catch basin inlets.

Temporary Sediment Basins

Temporary sediment basins will be designed either as excavations or bermed stormwater detention structures (depending on grading) that will retain runoff for a sufficient period of time to allow suspended soil particles to settle out prior to discharge. These temporary basins will be located based on construction needs as determined by the contractor and outlet devices will be designed to control velocity and sediment. Points of discharge from sediment basins will be stabilized to minimize erosion.

Vegetative Slope Stabilization

Stabilization of open soil surfaces will be implemented within 14 days after grading or construction activities have temporarily or permanently ceased, unless there is sufficient snow cover to prohibit implementation. Vegetative slope stabilization will be used to minimize erosion on slopes of 3:1 or flatter. Annual grasses, such as annual rye, will be used to ensure rapid germination and production of root mass. Permanent stabilization will be completed with the planting of perennial grasses or legumes. Establishment of temporary and permanent vegetative cover may be established by hydro-seeding or sodding. A suitable topsoil, good seedbed preparation, and adequate lime, fertilizer and water will be provided for effective establishment of these vegetative stabilization methods. Mulch will also be used after permanent seeding to protect soil from the impact of falling rain and to increase the capacity of the soil to absorb water.

Maintenance

- The contractor or subcontractor will be responsible for implementing each control shown on the Sedimentation and Erosion Control Plan. In accordance with EPA regulations, the contractor must sign a copy of a certification to verify that a plan has been prepared and that permit regulations are understood.

- The on-site contractor will inspect all sediment and erosion control structures periodically and after each rainfall event. Records of the inspections will be prepared and maintained on-site by the contractor.

- Silt shall be removed from behind barriers if greater than 6-inches deep or as needed.

- Damaged or deteriorated items will be repaired immediately after identification.

- Sediment that is collected in structures shall be disposed of properly and covered if stored on-site.

- Erosion control structures shall remain in place until all disturbed earth has been securely stabilized. After removal of structures, disturbed areas shall be regraded and stabilized as necessary.

The sedimentation and erosion control plan is included in project plan set; a reduced version and Erosion Control Maintenance checklist is included here for quick reference.

Construction Best Management Practices - Maintenance/Evaluation Checklist

79 Pullman Street
Worcester, MA

Construction Best Management Practices - Maintenance Evaluation Checklist

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and key items to check	Cleaning/Repair Needed Y/N Describe	Date of Cleaning/Repair	Performed by:
Gravel Construction Entrance	Once Per Week						
Catch Basin Protection	Once Per Week or after rain event						
Diversion Channels (if applicable)	Once Per Week or after rain event						
Compost Filter Sock	Once Per Week or after rain event						
Vegetated Slope Stabilization	Once Per Week or after rain event						

Appendix G: Long Term Stormwater Operation and Maintenance Measures

Long Term Stormwater Operation and Maintenance Plan

BMP's Ownership
The OWNERS of the BMP's shall be the person, persons, trust, corporation, etc., or their successors who have title to the land on which the BMP is located. It is anticipated that all BMP's will be owned and maintained by Lacy Topaz, LLC, until the title of land upon which they are located is transferred. At that time, the purchaser of the property will assume all responsibilities set forth within this document.

This project is subject to review and issuance of an Order of Conditions (OOC) by the City of Worcester Conservation Commission. The decision and OOC issued by the Commission, which references this document, shall be recorded at the Worcester County Registry of deeds to ensure future owners of the property will have knowledge of the requirements of the Long Term Stormwater Operation and Maintenance Procedures.

Operation and Maintenance Responsibilities:
The party or parties responsible for the funding, operation and maintenance of the BMP's shall be the OWNER or their designees. BMP's each have specific maintenance requirements to ensure long-term effectiveness. These stormwater management systems will be operated, inspected and maintained on a regular basis **by a qualified professional with expertise in inspecting drainage system components**. All of the stormwater BMP's shall be kept in good working order at all times.

Approximate estimated annual maintenance costs for the site are:

Street Sweeping - $2,000
Deep sump hooded catch basins - $800
Subsurface Infiltration Systems - $500

Total Estimated Annual maintenance Cost - $3,200.00

Description of site BMPs with maintenance requirements

Pavement Systems

Standard Asphalt Pavement

- Sweep or vacuum standard asphalt pavement areas at least four times per year with a commercial cleaning unit and properly dispose of removed material.
- Recommended sweeping schedule:
    - Oct/Nov
    - Feb/Mar
    - Apr/May
    - Aug/Sep

- More frequent sweeping of paved surfaces will result in less accumulation in catch basins, less cleaning of subsurface structures, and less disposal costs.
- Check loading docks and dumpster areas frequently for spillage and/or pavement staining and clean as necessary.

Structural Stormwater Management Devices

Catch Basins

- All catch basins shall be inspected a minimum of four times per year.
- Sediment (if more than 24 inches deep) and/or floatable pollutants shall be pumped from the basin and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

Subsurface Recharge Chamber System

- The subsurface infiltration systems will be inspected at least twice each year by removing the manhole/access port covers and determining the thickness of sediment that has accumulated.
- If sediment is more than three inches deep, it must be suspended via flushing with clean water and removed using a vactor truck.
- Manufacturer's specifications and instructions for cleaning the sediment removal row is provided as an attachment to this section.
- System will be observed after rainfalls to see if it is properly draining.

Vegetated Stormwater Management Devices

Vegetated Areas Maintenance

Although not a structural component of the drainage system, the maintenance of vegetated areas may affect the functioning of stormwater management practices. This includes the health/density of vegetative cover and activities such as the application and disposal of lawn and garden care products, disposal of leaves and yard trimmings.

- Inspect planted areas on a semi-annual basis and remove any litter.
- Maintain planted areas adjacent to pavement to prevent soil washout.
- Immediately clean any soil deposited on pavement.
- Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming.
- Plant alternative mixture of grass species in the event of unsuccessful establishment.
- The grass vegetation should not be cut to a height less than four inches.
- Pesticide/Herbicide Usage – No pesticides are to be used unless a single spot treatment is required for a specific control application.

- Fertilizer usage should be avoided. If deemed necessary, slow release fertilizer should be used. Fertilizer may be used to begin the establishment of vegetation in bare or damaged areas, but should not be applied on a regular basis unless necessary.

- The Long-Term BMP Maintenance/Evaluation Map and Checklist is attached.

79 Pullman St
Worcester, MA

Long Term Best Management Practices - Maintenance/Evaluation Checklist

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and key items to check	Cleaning/Repair Needed Y/N Describe	Date of Cleaning/Repair	Performed by:
Deep Sump Hooded Catch Basin	4 times per year			clean when deposits accumulate to halfway between invert and bottom of unit			
Vegetated Areas	4 times per year and after major storm events			Mow a minimum of twice per year.			
UG infiltration Chamber	2 times per year			Measure accumulated sediment. Remove with vac-truck if sediment is 3" thick			