STORMWATER MANAGEMENT REPORT

PROPOSED 7-UNIT RESIDENTIAL DEVELOPMENT

373 PLEASANT STREET
MELROSE, MA 02176

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Date:
May 4, 2021
Revised: August 13, 2021

FODERA
ENGINEERING

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APPENDICIES

1.0: INTRODUCTION

The proposed project is a seven (7) unit multi-family development project located on map B5 lot 122 (373 Pleasant Street) in Melrose Massachusetts. The parcel is 13,186 square feet (0.30 acres) and contains a single-family dwelling and detached garage accessed from Pleasant Street.

Stormwater design has been completed in accordance with the provisions of the City of Melrose Regulations and the standards set forth in the Massachusetts Stormwater Handbook.

2.0: EXISTING CONDITIONS

2.1: EXISTING SITE CONDITONS

The subject parcel is in the Urban Residence C (UR-C) zoning district and is adjacent to the Urban Residence B (UR-B) zoning district to the west. The parcel has 65.60 ft of frontage on the west boundary along Pleasant Street. The existing dwelling is at the western portion of the lot with a shared driveway from Pleasant Street to the existing detached garage centrally located on site. The site has a grassed back yard with an extensive tree canopy within the eastern portion of the lot. There is a permanent surface easement located in the rear of the property which abuts the MBTA Commuter rail property. No permanent structures can be built in this area. The driveway entrance and a portion of the shared driveway is located on the adjacent property to the south, map B5 lot 123. There is a ten (10) foot by 100-foot access easement spanning parallel to the southern property line on map B5 lot 123 for access to map B5 lot 122 (Site).

2.2: RESOURCE AREAS

The following protected resource areas as defined by the Massachusetts Department of Environmental Protection (MassDEP) are located outside of the subject site. The nearest certified vernal pool is a half mile west of the site. Areas designated as Natural Heritage of Endangered Species Programs (NHESP) were found to be a quarter mile west of the site. There are no areas of environmental concern. The site is outside of any wellhead protection and drinking supply areas. Areas subject to a 1% annual chance of flooding is located away from the site as displayed on the Flood Insurance Rate Map (FIRM) 25017C0429E with an effective date of 6/4/2010.

The only resource area on-site is the buffer zone from Spot Pond Brook located over fifty (50) feet south of the site. The brook has a significant portion that travels underground through the city and daylights from a culvert in the section south of the subject site. This section of the brook appears to be man-made and continues to flow runoff in the south direction. A certified wetlands scientist inspected the section south of the site in November 2020 and determined the boundaries of the brook to be the daylight opening at the culvert and delineated the man-made brook. The provided site plans display the off-site field located wetland boundary and associated buffers.

2.3: TOPOGRAPHY, SITE SOILS & GROUNDWATER

The site is relatively flat with an overall slight pitch to the southeast, towards Spot Pond Brook. A small portion of the front yard has a minor slope to the west towards Pleasant Street but falls within the same subbasin area and overall major watershed as the entire site. The highest portions of the site are at the northern boundary with an associated elevation of 106, on an assumed vertical datum, and appears to be closely due to the north abutting development. Topography slopes downgradient for a short section at a 3:1 pitch towards the middle of the site to an elevation of 102 and gradually tapers flatter throughout the remainder of the site. The rest of the site is relatively flat with even gradual slopes down to elevation 99 located along the eastern property line.

Site soils were determined by online data research from the Natural Resources Conservation Service (NRCS) mapping system. Soil maps from the NRCS has the site being located within an area of soils determined to be Urban Land, however, the overall area contains nearby soils to be Charlton-Urban land-Hollis complex with an associated Hydrologic Soil Group A (HSG-A). Soils classified as HSG-A have a high infiltration rate and generally has deep groundwater. The soils map can be found in Appendix B.

Soils were tested by deep observation test hole on July 23, 2021 by a certified soil evaluator MA #1848 and determined soil to be sand approximately two (2) feet below surface. Sand is classified as HSG-A. The estimated seasonal high-water table was determined to be about 7.5' – 8' below surface and at an elevation of 94.2 with respect to the site plans topography. Test hole locations and profile summaries are displayed on Sheet C4 of the site plans and evaluator's report is attached in Appendix B.

2.4: EXISTING UTILITIES & STORMWATER INFRASTRUCTURE

The existing dwelling on site is serviced by public and private utilities. Public water and sanitary sewer provided by the City of Melrose are currently in place. Private companies providing gas and electricity separately are also in place. There are no known stormwater facilities currently on site to mitigate on-site runoff. There is an existing stormwater collection system within Pleasant Street near the subject site. On-site runoff is ultimately directed to the southernly located Spot Pond Brook.

3.0: PROPOSED CONDITIONS

3.1: PROPOSED SITE CONDITONS

The project proposes to demolish the existing on-site structures and to construct seven (7) units with associated driveway access, parking, utilities, and stormwater recharge. The proposed work within the permanent surface easement has been limited to the driveway end and snow storage. The remainder of this area will be used as green space. Refer to Table 4.2.2(1) as a summary of resulting surface types from the project.

3.2: PROJECT RESOURCE AREAS

Work will be located within the 100-foot wetland buffer of Spot Pond Brook and will be performed in accordance with local and state bylaws.

3.3: PROJECT TOPOGRAPHY, SITE SOILS & GROUNDWATER

Topography of the site will generally remain in the similar nature of the existing conditions with changes to surface types and improvements to drainage patterns. The site will maintain the natural pitch to the southeast towards the daylighted section of Spot Pond Brook.

Site soils as previously determined to be sand will remain unchanged and used to support stormwater infiltration. In accordance with the Rawls Rates for infiltration of different soil types, sand is categorized as HSG-A with an associated infiltration rate of 8.27 inches per hour. The proposed infiltration system has a bottom bed elevation at 96.20 and is separated above the estimated seasonal high-water table by two (2) feet.

3.4: PROPOSED UTILITIES & STORMWATER INFRASTRUCTURE

The proposed project will utilize all available public and private utilities. Existing utility connections will be cut and capped for the connections of new utility services. Proposed domestic water service and fire protection line will be tapped from the water main in Pleasant Street. Sewer services will be connected by gravity flow to the sewer main. Electric and gas services will be installed in coordination with their respective utility companies.

Stormwater measures are proposed to mitigate site improvements. All stormwater from roof runoff and the new driveway will be captured and directed to the subsurface infiltration system. The system is a sixteen (16) chamber StormTech® SC-740 system. Overflow from the recharge system will be directed to an outlet opening pipe located at the southern property line towards Spot Pond Brook. No new runoff will be directed to Pleasant Street and will all be contained on-site and directed as clean runoff to Spot Pond Brook. The following sections demonstrate compliance with stormwater regulations.

4.0: MASSACHUSETTS STORMWATER MANAGEMENT STANDARDS

4.1: STANDARD 1 – NO NEW UNTREATED STORMWATER DISCHARGES

The Massachusetts Stormwater Handbook has been revised to meet wetland regulations, 310 CMR 10.00 and water quality regulations, 314 CMR 9.00. Volume 1, Chapter 1 of the handbook states that new stormwater conveyances shall not discharge untreated stormwater directly to open waters or wetlands of the Commonwealth. The level of stormwater treatment depends on project location and site soils and are regulated by requirements in the following standards.

The proposed development project has been designed in accordance with the City of Melrose stormwater bylaws and regulations, in addition to the Massachusetts Stormwater Handbook and Standards. All new stormwater conveyances will be treated in compliance with the following standards. Computations and strategies in the following section will demonstrate compliance.

4.2: STANDARD 2 – PEAK RATE OF DISCHARGE

Development projects resulting in new impervious surfaces generates stormwater runoff at high flow rates than previous site conditions. Standard 2 has been made for developments to attenuate runoff flow rates

and to not exceed previously developed conditions. This Standard requires that the post-development peak discharge rate is equal to or less than the pre-development rate from the 2-year and the 10-year, 24-hour storms. Additionally, calculations provide analysis and mitigation of the 25-year and 100-year, 24-hour storms.

The drainage analysis was performed using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies and the computer program HydroCAD 10.00 by HydroCAD Software Solutions, LLC. The analysis was performed on the 2-, 10-, 25-, and 100-year frequency rainfall events. The events were based on the 24 hour type-III duration storm. The 'time of concentration' (Tc) for each watershed was determined by finding the time necessary for runoff to travel from the most hydraulically distant point in the watershed to the point of concentration. The travel path was drawn based on the topography and the time was calculated using the TR-55 Method and HydroCAD. A minimum Tc of 6.0 minutes was used. Curve numbers were developed for each of the different use categories and hydrologic soil group types within each sub-area. The curve numbers were based on the SCS TR-55 methodology and are included in the HydroCAD input and output found in the Attachments. Rainfall depths were acquired from National Oceanic and Atmospheric Administration (NOAA), Atlas 14, Volume 10 for the specific site location. NOAA rainfall data is attached in Appendix C and the associated rainfall depths are summarized below.

Storm Event	Rainfall Depth
2-Year	3.28 inches
10-Year	5.17 inches
25-Year	6.34 inches
100-Year	8.15 inches

The overall site was analyzed as one (1) analysis point without separation into subcatchment areas due to the site being located within the same localized subbasin area, and that the proposed conditions eliminate runoff to Pleasant Street. The following assumptions were made for the purpose of this hydrologic analysis:

- Whenever possible, the property line and/or an arbitrary line, outside the limit of proposed work was delineated as the watershed boundary.
- The total watershed area for the existing condition is used as the comparison base for the watershed area in the proposed condition.
- There are no known existing roof runoff discharge connection and is assumed to runoff from surface overland.

4.2.1: EXISTING PEAK RATE OF DISCHARGE

Existing watershed area E1 discharges the majority of runoff overland by the natural slope directed to the east and ultimately towards Spot Pond Brook. A small section of the front yard is directed to Pleasant Street. This land is a mixture of impervious roof and asphalt with grass and wooded covered tree canopy. The most hydraulicly distant path was determined to travel through the wooded tree canopy and has a time of concentration greater than the minimum. Please refer to Appendix C for the pre-development drainage map and the tables below for a peak rate summary.

4.2.2: PROPOSED PEAK RATE OF DISCHARGE

Proposed subcatchment P1 captures roof runoff and all runoff from the paved driveway and directed to the subsurface infiltration system. Runoff from the driveway enters a catch basin with a deep sump for pretreatment and then directed to the isolator row for additional treatment prior to recharge. Any overflow during a severe storm event will backflow to an outlet pipe towards the southeast. Proposed subcatchment P2 is the remaining area that flows overland to the southeast. Runoff from P2 does not require treatment since it does not come from the vehicular driveway path and flows overland as clean runoff. Time of concentration for both P1 and P2 were determined to be set at the minimum of 6.0 minutes. A summary of the pre- and post-development areas and peak rate of discharge are in the following tables. HydroCAD calculations for peak rate discharges can be found in Appendix C.

Table 4.2.2(1): Areas Summary

	PRE-Development	POST-Development	
	E1 Overland Runoff	**P1 To Infiltration**	**P2 Overland Runoff**
Impervious, sq-ft	3,581	9,089	1,300
Grass, sq-ft	4,245	8	2,391
Wooded, sq-ft	5,360	0	398
Total Area, sq-ft	13,186	9,097	4,089
Tc, minutes	8.8	6.0	6.0
CN	52	98	57

Table 4.2.2(2): Peak Rate of Discharge Summary

Storm Intensity	PRE-Development cfs	POST-Development cfs
2-year Storm 3.28 inches	0.02	0.02
10-year Storm 5.17 inches	0.20	0.10
25-year Storm 6.34 inches	0.39	0.18
100-year Storm 8.15 inches	0.74	0.46

HydroCAD reports of existing and proposed peak rate discharges can be found in Appendix C.

4.3: STANDARD 3 – GROUNDWATER RECHARGE

As impervious surfaces are constructed from developments, exposed natural surfaces decrease resulting in the loss of natural rainfall infiltration from the new impervious surfaces. Standard 3 was implemented to design for recharge to, at a minimum, meet the natural conditions prior to constructed impervious surfaces. The post-development impervious area and properties of site soils are used to assist in determining the volume required for groundwater recharge.

As discussed in previous sections, data from NRCS determined site soils to be classified as hydraulic group "A". This data is similar to results performed by deep observation testing completed at the subject site on July 23, 2021. Refer to Appendix B for soil reports.

The method used to determine the required recharge volume for this project is the "static method" as detailed in Volume 3, Chapter 1 of the Massachusetts Stormwater Handbook. The static method is computed by the assumption that no infiltration occurs until the infiltration system is filled to the elevation associated with the required recharge volume. Computations to determine the required recharge volume use the rates specified by Rawls 1982. The associated Rawls rate below is multiplied by the added impervious area from the development to determine the required recharge volume.

Rawls rate: Hydraulic group A = 0.60 inches of runoff

Once the required recharge volume is determined, appropriate sizing of bottom area for the infiltration system is used to determine the drawdown time. Drawdown time is the time of required recharge volume to fully infiltrate through the bottom bed of the system and is calculated using the equation below.

$$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ Area)}$$

Where:
Rv = Storage Volume
K = Saturated Hydraulic Conductivity for the static method (Rawls Rate)
Bottom Area = Bottom Area of Recharge Structure

The proposed project has one (1) recharge system and is two (2) feet above the ESHGT. The system is made up of StormTech® SC-740 chambers. All computations for Standard 3 are in Appendix C and demonstrate that the proposed project meets this standard.

4.4: STANDARD 4 – WATER QUALITY

Runoff from impervious surfaces flow overland and gather solids as the stormwater is directed into conveyance systems and can have adverse effects to water pollution. Standard 4 was implemented for stormwater management systems to be designed to remove 80% of the average annual post-development load of Total Suspended Solids (TSS). Runoff volume requiring appropriate TSS treatment is known as the required water quality volume.

Water quality volume for the proposed project is calculated by the post-development impervious ground area multiplied by one (1.0) inch of runoff due to the project site located within an area with a rapid infiltration rate (greater than 2.4 inches per hour). Soil tests determined site soils to be sand and has an associated infiltration rate of 8.27 inches/ hour, as determined by the 1982 Rawls Rates displayed in Table 4.4(1).

Table 4.4(1): Rawls Rates

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27

The proposed recharge system provide sufficient volume to demonstrate that the required water quality volume is fully contained within each system.

Computations for TSS removal are required as pre-treatment prior to stormwater discharge. The project site is located in an area with rapid infiltration rate and therefore requires 44% TSS removal prior to discharge to infiltration.

The proposed project contains two (2) treatment trains and both meet the required 44% TSS pre-treatment removal in accordance with the MA Stormwater Handbook. Both pre-treatment trains contain a deep sump catch basin directed (25% TSS removal) to a deep sump manhole (25% TSS removal) which is then directed to the infiltration system.

The Massachusetts Stormwater Handbook state that 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) Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and

c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

The proposed project meets this standard and all computations are in Appendix C.

4.5: STANDARD 5 – LAND USES WITH HIGHER POLLUTION PREVENTION LOADS

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. Due to the generally low-intensity-use of the proposed project, the site is not considered a Land Use with High Potential Pollutant Loads (LUHPPL).

4.6: STANDARD 6 – CRITICAL AREAS

Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. The project site does not discharge to a critical area and therefore, Standard 6 is not applicable.

4.7: STANDARD 7 – REDEVELOPMENT PROJECTS

For purposes of the Stormwater Management Standards, redevelopment projects are defined to include the following:

1. Maintenance and improvement of existing roadways, including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems, and repaving;
2. Development, rehabilitation, expansion and phased projects on previously developed sites, provided the redevelopment results in no net increase in impervious area; and
3. Remedial projects specifically designed to provide improved stormwater management, such as projects to separate storm drains and sanitary sewers and stormwater retrofit projects.

All redevelopment projects must fully comply with the provisions of the Stormwater Management Standards requiring the development and implementation of a construction period erosion and sedimentation control plan, a pollution prevention plan, an operation and maintenance plan, and the prohibition of illicit discharges. All redevelopment projects are also required to meet the following 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.

The proposed project does not fit the category of a redevelopment and therefore, Standard 7 is not applicable.

4.8: STANDARD 8 – TEMPORARY EROSION, SEDIMENTATION, AND POLLUTION PREVENTION

During land disturbance and construction activities, project proponents must implement controls that prevent erosion, control sediment movement, and stabilize exposed soils to prevent pollutants from moving offsite or entering wetlands or waters. Land disturbance activities include demolition, construction, clearing, excavation, grading, filling, and reconstruction. Please refer to the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas provided by MassDEP for more detailed information.

Erosion control silt fence will be a minimum of two (2) feet high and straw wattles will be a minimum of 9” in diameter, as detailed on the civil site plan set. With proper care and maintenance as outlined within this report, it is determined that these barriers will suffice as sedimental transfer protection to outside areas.

4.8.1: STABILIZATION SCHEDULE

The site shall be controlled and maintained with stabilization methods on disturbed areas. Disturbed areas are areas that will be exposed of dirt from construction activities. A temporary vegetative cover will be established on areas of exposed soils (including stockpiles) as described in Table 4.8.1(1). Disturbed areas shall be periodically inspected and after ever storm event of 0.5” of rainfall.

Table 4.8.1(1): Temporary Construction Stabilization Schedule

Area requiring permanent stabilization	Time frame to apply erosion controls
Any disturbed areas within 50 feet of a surface water of the State and not at final grade	Within two days of the most recent disturbance if the area will remain idle for more than 14 days

For all construction activities, any disturbed areas that will be dormant for more than fourteen (14) days but less than one year, and not within 50 feet of a surface water of the State	Within five (5) days of the most recent disturbance within the area. For residential subdivisions, disturbed areas must be stabilized at least seven days prior to transfer of permit coverage for the individual lot(s).
Disturbed areas that will be idle over winter	Prior to the onset of winter weather

4.8.2: POTENTIAL STORMWATER CONTAMINANTS

The purpose of this section is to identify methods to minimize potential pollutants that could impact storm water during construction. Pollutants that result from clearing, grading, excavation, and building materials and have the potential to be present in stormwater runoff.

To minimize the potential for stormwater contamination the following practices shall be followed:

- No solid or liquid waste, including building materials or their packaging, shall be discharged in stormwater runoff.
- Concrete trucks are not permitted to wash out directly into storm sewers, streams or drainage channels.
- Off-site tracking of sediments by construction vehicles must be minimized.
- Contaminated soils or soils where construction site chemicals have been spilled must be removed from the site and disposed of in accordance with federal, state and local regulations.
- Stormwater that comes in contact with contaminated soils or solid & industrial waste must be collected and disposed of as a wastewater.
- Fuel tanks and drums or other containers holding construction site chemicals must be stored within a diked area.
- Sediment-laden trench or groundwater must pass through a sediment-settling pond, or be dewatered in place using a sump pit, filter bag or other comparable method, prior to being discharged from the site.
- Trench and ground water free from sediment or other pollutants may be discharged without treatment, provided this water does not become pollutant-laden by traversing over disturbed soils or other pollutant sources.

4.9: STANDARD 9 – LONG-TERM OPERATION AND MAINTENANCE PLAN

The goal of the operation and maintenance plan is to protect resources in the region that may be adversely impacted by the proposed development. Water quality treatment measures and the implementation of Best Management Practices (BMP's) for structural controls will result in the treatment of site stormwater and the removal of a minimum of 80% of the TSS load in runoff prior to discharge from the site, consistent with the MA Stormwater Management Handbook.

The stormwater management system will be owned by the future landowner(s) who will be responsible for operation and maintenance. The estimated operation and maintenance budget is estimated to be approximately $2,000 (two-thousand) annually. Inspections shall be made for the following maintenance systems and shall be recorded with information of the inspection date, inspector’s name, system

inspected, findings of inspection, and actions made for maintenance. A log for these inspections is attached in Appendix D.

4.9.1: STRUCTURAL POLLUTANT CONTROLS AND MAINTENANCE

The proposed stormwater management system(s) is(are) designed to protect runoff water quality through the removal of sediment and pollutants. Structural pollutant controls used to separate and capture stormwater pollutants are described below.

(1) Catch Basins / Inlets & Manholes

Proposed catch basins/ inlets at the site will be equipped with deep sumps and hooded outlets that trap debris, sediments, and floating contaminants, which are the largest constituents of urban runoff. The proper removal of sediments and associated pollutants and trash occurs only when catch basin inlets and sumps are cleaned out regularly. The more frequent the cleaning, the less likely sediments will be re-suspended and subsequently discharged. In addition, frequent cleaning also results in more volume available for future deposition and enhances overall performance.

Maintenance: All catch basins and inlets will be inspected at a minimum of at least once per year and cleaned when the sump has accumulated to a depth of one (1) foot of sediment. Sediment and/or floatable pollutants will be pumped from the inlet drain opening 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, catch basin and inlet grates will be kept free of snow and ice. During warmer periods, catch basin and inlet grates will be kept free of leaves, litter, sand, and debris. Regular maintenance and cleaning of catch basins and inlets will assure adequate performance of these structures.

(2) Subsurface Infiltration System

The stormwater management system includes a subsurface infiltration system to provide water quality treatment and recharge, as well as attenuate peak flows. The maintenance of the system may affect the functioning of stormwater management practices.

Maintenance: Visual inspection of the subsurface infiltration system will occur twice per year and after every major storm during the first 3 months of operation. Remove any debris that might clog the system. If water is observed and it is at least 72 hours after a rain event, the system will require to be cleaned to remove any built-up sediment.

(3) Subsurface Infiltration System Isolator Row

The stormwater management system(s) include the use of an isolator row in the subsurface infiltration system to enhance total suspended solids removal and provide easier access for cleaning and maintenance. The proper function of these items is crucial to providing adequate groundwater recharge and flood control.

Maintenance: Subsurface infiltration system isolator row may affect the functioning of stormwater management practices. Visual inspection of the isolator row through the inspection port is to occur every six months in the first year of use. After the first year of use, visually inspect annually at a minimum. The isolator row shall be cleaned when the average depth of sediment exceeds three (3) inches. Refer to StormTech® Isolator Row O&M manual for cleaning procedure. For more information and details on maintenance and cleaning of this particular product, it is recommended to seek advice from the manufacturer - StormTech®. StormTech® can be contacted by phone at 888-892-2694.

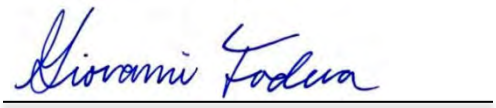
4.10: STANDARD 10 – PROHIBITED ILLICIT DISCHARGES

Standard 10 prohibits illicit discharges to stormwater management systems. The stormwater management system is the system for conveying, treating, and infiltrating stormwater on-site, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater.

Proponents of projects within Wetlands jurisdiction must demonstrate compliance with this requirement by submitting to the issuing authority an Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the site and by including in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease.

Illicit Discharge Compliance Statement

The proposed project located at 373 Pleasant Street in Melrose, Massachusetts has been designed in accordance with the Massachusetts Stormwater Handbook, and demonstrates that all proponents of the stormwater management design systems do not contain any new illicit discharges, in accordance with Standard 10. Please refer to the following appendices and civil design plans for compliance.



Date: August 13, 2021

Giovanni G. Fodera, P.E.
Principal Engineer
FODERA Engineering
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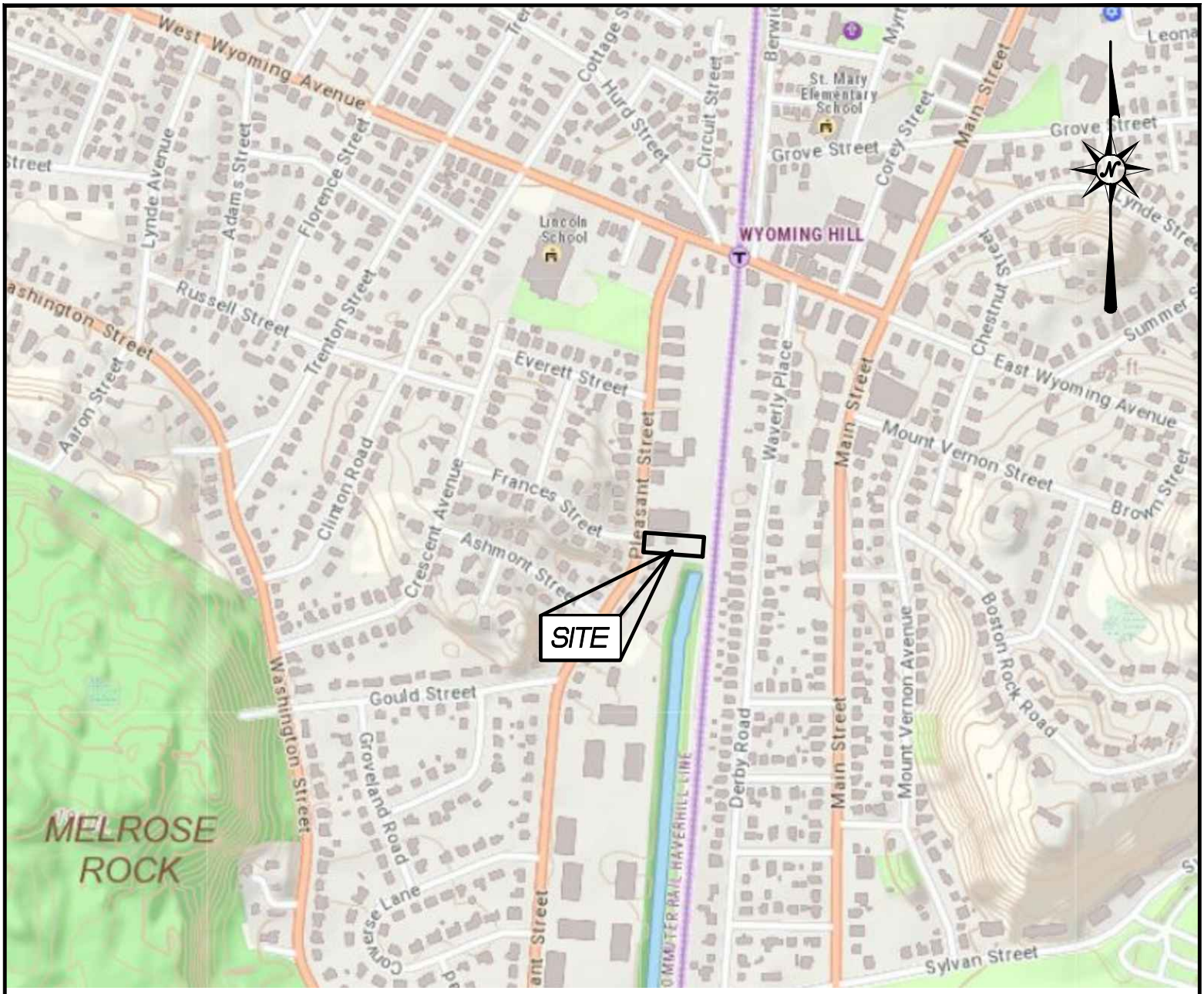
APPENDIX A – SITE LOCATION

LOCUS MAP

FEMA FIRMETTE MAP



U.S.G.S. LOCUS MAP

SCALE: 1" = 500'

PROFESSIONAL SEAL:

DATE: 5/4/21

PROJECT LOCATION:
373 PLEASANT STREET
MELROSE, MA 02176

PLAN SET:
PROPOSED 7-UNIT DEVELOPMENT

PREPARED FOR:
BOGHOS PROPERTIES
655 E 2ND STREET, SUITE 204
BOSTON, MA 02127

PREPARED BY:
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REVISION		DATE

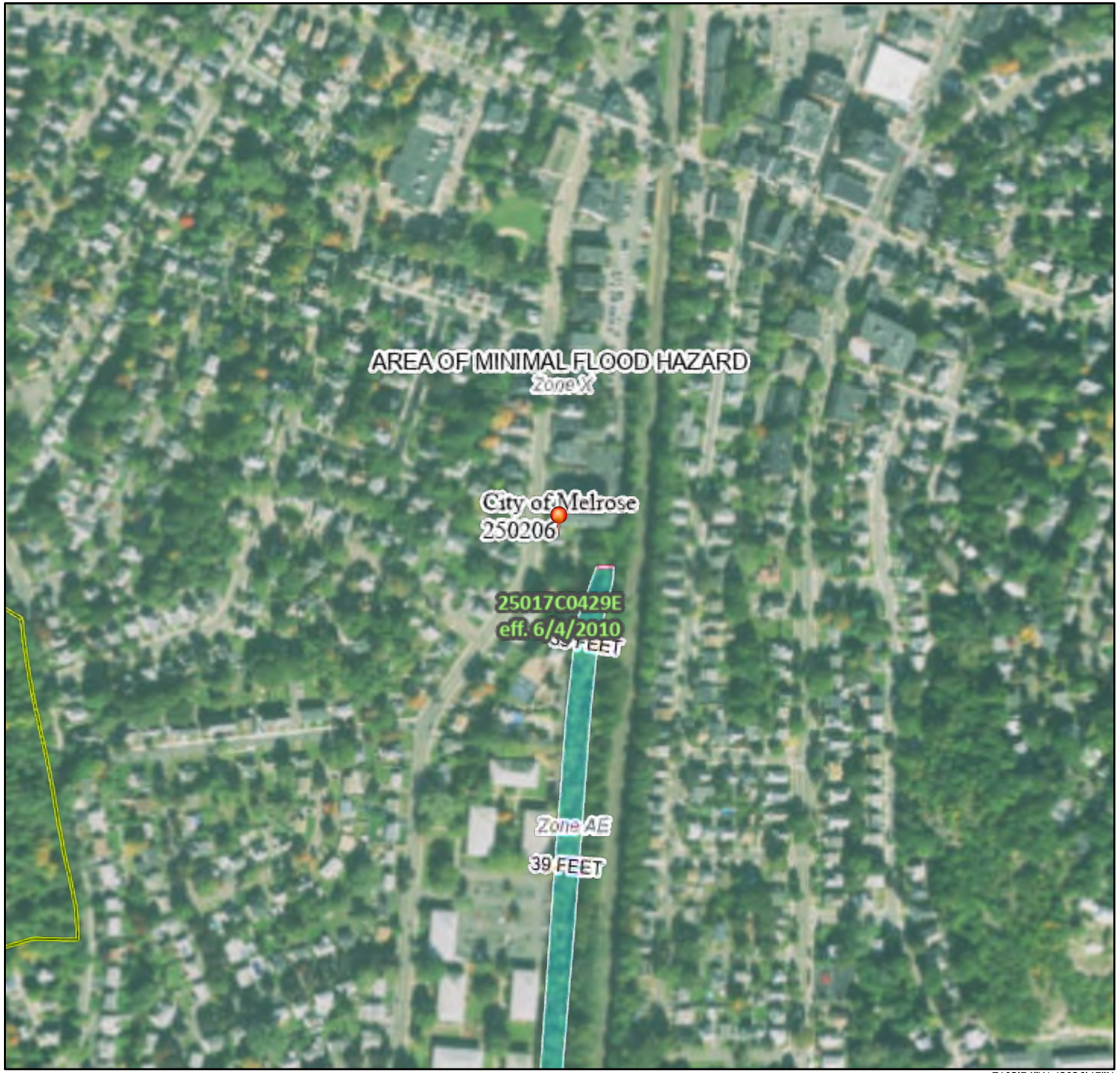
SHEET TITLE: **LOCUS MAP**

JOB NO.: **20160-149**

SHEET NUMBER: **1 OF 1**

National Flood Hazard Layer FIRMette

71°4'32"W 42°27'11"N



71°3'54"W 42°26'45"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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
- 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 5/3/2021 at 9:01 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 B – SOIL CONDITIONS

NRCS HYDROLOGIC SOIL GROUP MAP

SOIL TESTING REPORT

Map Scale: 1:4,590 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 200 400 800 1200

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 20, Jun 9, 2020

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

Date(s) aerial images were photographed: Sep 11, 2019—Oct 5, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		1.2	1.2%
603	Urban land, wet substratum		64.6	66.4%
631C	Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky	A	31.5	32.4%
Totals for Area of Interest			**97.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

SOIL SUITABILITY ASSESSMENT REPORT

COMMONWEALTH OF MASSACHUSETTS

MELROSE, MASSACHUSETTS

SOIL EVALUATION FOR DETERMINATION OF SOIL TYPE AND GROUNDWATER TABLE ELEVATIONS

SITE INFORMATION

Street Address: 373 Pleasant Street Town: Melrose State: Massachusetts Zip Code: 02176 County: Middlesex

Land Use: Residential Latitude: ~42° 26' 57.7" N Longitude: ~71° 04' 13.6" W

PUBLISHED SOIL DATA AND MAP UNIT DESCRIPTION

Physiographic Division: Appalachian Highlands Province: New England Section: Seaboard lowland section

Soil survey area: Middlesex County, Massachusetts Series name: 603 – Urban land

Soil Order: _____ Soil Suborder: _____ Soil Family: _____

Soil moisture regime: Udic Soil temperature regime: Mesic Land Cover: Grass lawn Runoff class: Low

Soil hydric or upland: Upland Average depth to water table: > 80" Depth to restrictive feature: > 80"

Frequency of flooding: None Frequency of ponding: None Available water capacity: _____

Drainage Class: _____ Hydrologic Soil Group: ___ Ksat: _____

Ecological site: Well drained outwash

WETLAND AREA & USGS WELL MEASUREMENTS

National Wetland Inventory Map: NA Wetlands Conservancy Program: NA Bordering vegetative wetland: NA

Current Water Resource Condition (USGS*):* Well Site # 423115071032001- MA-WAW 38 Wakefield, MA

Middlesex County, Massachusetts, Hydrologic Unit 01090001 Latitude: ~42° 31 '00.2" N Longitude: ~71° 02' 54.4" W

Well depth: 25.5 feet Borehole depth: 28.2 feet Land surface altitude: 80.00 feet above NGVD29

Most recent data value: 5.50' on 07/22/2021 (depth to water level in feet below land surface). Range: High

SURFICIAL GEOLOGY

Surficial Geology: Qcs: Collapsed stratified sand deposits

Geologic parent material: Glaciofluvial outwash deposits Geomorphic landform: Outwash plain

Slope aspect: Southerly Landform position (2D): Backslope Landform position (3D): Side slope

Slope gradient: ~0-2% Down slope shape: Convex Across slope shape: Linear Slope complexity: Simple

Bedrock outcropping in vicinity: None observed Glacial erratics in vicinity: None observed

Bedrock Type: Lynn Volcanic Complex; Rhyolite, agglomerate and tuff.

TP 21-1 DEEP OBSERVATION HOLE

373 Pleasant Street, Melrose, Massachusetts

Date: Thursday, July 22, 2021 Time: 08:38 Weather: Sunny, ~75-80ºF, still and humid

Landscape: Upland Landform: Outwash plain Position on landscape: Side slope

Slope aspect: Southerly Slope (%): 00- 02% Slope complexity: Simple Land Cover: Grass lawn

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet Abutting septic system: 50^{+} feet

Wetlands: 100^{+} feet Public water supply reservoir: 400^{+} feet Tributary to reservoir: 200^{+} feet

SOIL PROFILE ► TP 21-1

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00" → 16"	A_P	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade; fine-to-medium granular structure; somewhat cohesive; fine grained mineral content; slightly damp; non-sticky; non-plastic; many fine grass roots; free of clasts; clear wavy boundary.
16" → 21"	B_W	Sandy Loam	10YR 5/8 yellowish brown	none observed	Very friable; moderate-grade, fine, sub-angular blocky structure; non-cohesive; mixed medium to mostly fine-grained mineral content; slightly damp; non-sticky; non-plastic; few fine grass roots; ~05% rounded to sub-rounded gravel content of mixed lithology; gradual wavy boundary.
21" → 120"	2C	Sand	5Y 5/2 olive gray	100" (m,2-3,p) 2.5YR 4/6 10YR 7/1	Very friable; structureless; non-cohesive matrix; mixed medium to fine-grained mineral content; slightly damp matrix; non-sticky; non-plastic; poorly graded/ well sorted; high and low chroma colors dispersed within matrix at 100"; apparent water observed at 106"; no bedrock refusal at test hole depth.

Depth to bedrock: > 120" Seasonal High Groundwater Table: 100" Apparent water table: 106"

TP 21-1 DEEP OBSERVATION HOLE

373 Pleasant Street, Melrose, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 106" (below land surface) Depth to stabilized apparent water: ___ (below land surface)

Soil moisture state: Damp to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth below grade to observed Estimated Seasonal High Groundwater Table: 100"

Kind: Iron concentrations; iron coating on sand grains Location: 2C matrix Shape: Amorphous

Hardness: Soft Boundary: Diffuse Abundance: Many Size: Medium to coarse Contrast: Prominent

Concentration color: 2.5YR 4/6 red Reduction color: 10YR 7/1 light gray Moisture state: Damp

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to redoximorphic features: 100" inches below grade

Observed water weeping from side of deep hole: 106" inches below grade

Observed depth to stabilized phreatic water: ___ inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 8.66 feet

Depth of naturally occurring pervious material in TP21-1 Upper boundary: 16"
Lower boundary: 120"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *#1848* June 1998

Massachusetts Evaluator & Certification number Date of Soil Evaluator Certification

TP 21-2 DEEP OBSERVATION HOLE

373 Pleasant Street, Melrose, Massachusetts

Date: Thursday, July 22, 2021 Time: 09:19 Weather: Sunny, ~75-80°F, still and humid

Landscape: Upland Landform: Outwash plain Position on landscape: Side slope

Slope aspect: Southerly Slope (%): 00- 02% Slope complexity: Simple Land Cover: Grass lawn

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet Abutting septic system: 50^{+} feet

Wetlands: 100^{+} feet Public water supply reservoir: 400^{+} feet Tributary to reservoir: 200^{+} feet

SOIL PROFILE ► TP 21-2

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00" → 22"	A_P	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade; fine-to-medium granular structure; somewhat cohesive; fine grained mineral content; slightly damp; non-sticky; non-plastic; many fine grass roots; some loam added as fill material; free of clasts; clear wavy boundary.
22" → 28"	B_W	Sandy Loam	10YR 5/8 yellowish brown	none observed	Very friable; moderate-grade, fine, sub-angular blocky structure; non-cohesive; mixed medium to mostly fine-grained mineral content; slightly damp; non-sticky; non-plastic; few fine grass roots; ~05% rounded to sub-rounded gravel content of mixed lithology; gradual wavy boundary.
28" → 120"	$2C$	Sand	5Y 5/2 olive gray	89" (m,2-3,p) 2.5YR 4/6 10YR 7/1	Very friable; structureless; non-cohesive matrix; mixed medium to fine-grained mineral content; slightly damp matrix; non-sticky; non-plastic; poorly graded/ well sorted; high and low chroma colors dispersed within matrix at 89"; apparent water observed at 95"; no bedrock refusal at test hole depth.

Depth to bedrock: > 120" Seasonal High Groundwater Table: 89" Apparent water table: 95"

TP 21-2 DEEP OBSERVATION HOLE

373 Pleasant Street, Melrose, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 95" (below land surface) Depth to stabilized apparent water: ___ (below land surface)

Soil moisture state: Damp to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth below grade to observed Estimated Seasonal High Groundwater Table: 89"

Kind: Iron concentrations; iron coating on sand grains Location: 2C matrix Shape: Amorphous

Hardness: Soft Boundary: Diffuse Abundance: Many Size: Medium to coarse Contrast: Prominent

Concentration color: 2.5YR 4/6 red Reduction color: 10YR 7/1 light gray Moisture state: Damp

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to redoximorphic features: 89" inches below grade

Observed water weeping from side of deep hole: 95" inches below grade

Observed depth to stabilized phreatic water: ___ inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 8.16 feet

Depth of naturally occurring pervious material in TP21-2 Upper boundary: 22"
Lower boundary: 120"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *#1848* June 1998

Massachusetts Evaluator & Certification number Date of Soil Evaluator Certification

APPENDIX C – STORMWATER CALCULATIONS

STANDARD 2 – PRE-DEVELOPMENT DRAINAGE MAP & RUNOFF CALCULATIONS

STANDARD 2 – POST-DEVELOPMENT DRAINAGE MAP & RUNOFF CALCULATIONS

STANDARD 3 – RECHARGE VOLUME AND DRAWDOWN TIME

STANDARD 4 – WATER QUALITY AND TSS REMOVAL

NOAA Atlas 14, Volume 10, Version 3
Location name: Melrose, Massachusetts, USA*
Latitude: 42.4486°, Longitude: -71.0707°
Elevation: 41.56 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	**0.306** (0.235-0.388)	**0.371** (0.286-0.472)	**0.478** (0.367-0.610)	**0.568** (0.433-0.730)	**0.691** (0.513-0.936)	**0.782** (0.571-1.09)	**0.880** (0.628-1.28)	**1.00** (0.670-1.48)	**1.18** (0.766-1.82)	**1.34** (0.849-2.10)
10-min	**0.433** (0.333-0.550)	**0.526** (0.404-0.669)	**0.678** (0.520-0.866)	**0.804** (0.612-1.03)	**0.978** (0.727-1.33)	**1.11** (0.808-1.54)	**1.25** (0.890-1.82)	**1.42** (0.949-2.09)	**1.68** (1.08-2.57)	**1.90** (1.20-2.98)
15-min	**0.509** (0.392-0.647)	**0.619** (0.476-0.787)	**0.798** (0.612-1.02)	**0.947** (0.722-1.22)	**1.15** (0.855-1.56)	**1.30** (0.950-1.81)	**1.47** (1.05-2.13)	**1.67** (1.12-2.46)	**1.97** (1.28-3.03)	**2.24** (1.42-3.50)
30-min	**0.700** (0.538-0.889)	**0.850** (0.654-1.08)	**1.10** (0.840-1.40)	**1.30** (0.991-1.67)	**1.58** (1.18-2.15)	**1.79** (1.31-2.49)	**2.02** (1.44-2.94)	**2.30** (1.54-3.39)	**2.72** (1.76-4.17)	**3.09** (1.95-4.83)
60-min	**0.890** (0.685-1.13)	**1.08** (0.832-1.38)	**1.40** (1.07-1.78)	**1.66** (1.26-2.13)	**2.02** (1.50-2.73)	**2.28** (1.67-3.18)	**2.57** (1.84-3.74)	**2.92** (1.96-4.32)	**3.47** (2.24-5.32)	**3.94** (2.49-6.17)
2-hr	**1.14** (0.887-1.44)	**1.41** (1.09-1.77)	**1.83** (1.42-2.32)	**2.19** (1.68-2.79)	**2.67** (2.00-3.61)	**3.03** (2.23-4.20)	**3.43** (2.47-4.97)	**3.92** (2.64-5.74)	**4.70** (3.05-7.13)	**5.37** (3.41-8.33)
3-hr	**1.33** (1.03-1.67)	**1.64** (1.27-2.06)	**2.14** (1.66-2.70)	**2.56** (1.97-3.25)	**3.13** (2.35-4.21)	**3.55** (2.63-4.90)	**4.02** (2.91-5.81)	**4.61** (3.11-6.70)	**5.53** (3.59-8.34)	**6.34** (4.03-9.76)
6-hr	**1.72** (1.35-2.15)	**2.12** (1.66-2.64)	**2.76** (2.16-3.47)	**3.30** (2.56-4.16)	**4.04** (3.06-5.38)	**4.59** (3.41-6.26)	**5.18** (3.77-7.41)	**5.93** (4.02-8.54)	**7.10** (4.63-10.6)	**8.12** (5.18-12.4)
12-hr	**2.20** (1.74-2.73)	**2.70** (2.13-3.35)	**3.51** (2.77-4.38)	**4.19** (3.28-5.25)	**5.12** (3.89-6.74)	**5.80** (4.33-7.84)	**6.55** (4.77-9.24)	**7.46** (5.08-10.6)	**8.87** (5.81-13.1)	**10.1** (6.46-15.2)
24-hr	**2.65** (2.12-3.27)	**3.28** (2.61-4.05)	**4.31** (3.42-5.33)	**5.17** (4.07-6.42)	**6.34** (4.86-8.30)	**7.20** (5.42-9.67)	**8.15** (5.98-11.4)	**9.33** (6.37-13.2)	**11.2** (7.33-16.3)	**12.8** (8.18-19.0)
2-day	**3.01** (2.42-3.68)	**3.79** (3.04-4.64)	**5.08** (4.06-6.23)	**6.14** (4.88-7.58)	**7.61** (5.88-9.92)	**8.68** (6.59-11.6)	**9.87** (7.33-13.8)	**11.4** (7.82-16.0)	**13.9** (9.14-20.1)	**16.0** (10.3-23.6)
3-day	**3.28** (2.65-4.00)	**4.13** (3.33-5.03)	**5.51** (4.42-6.74)	**6.66** (5.31-8.18)	**8.23** (6.39-10.7)	**9.38** (7.15-12.5)	**10.7** (7.95-14.9)	**12.3** (8.48-17.1)	**15.0** (9.91-21.6)	**17.4** (11.2-25.4)
4-day	**3.55** (2.88-4.31)	**4.42** (3.58-5.37)	**5.85** (4.71-7.13)	**7.03** (5.63-8.62)	**8.66** (6.74-11.2)	**9.85** (7.52-13.0)	**11.2** (8.34-15.5)	**12.9** (8.87-17.8)	**15.6** (10.3-22.4)	**18.1** (11.7-26.3)
7-day	**4.31** (3.51-5.20)	**5.22** (4.25-6.30)	**6.70** (5.44-8.12)	**7.94** (6.40-9.67)	**9.64** (7.53-12.3)	**10.9** (8.34-14.3)	**12.3** (9.16-16.8)	**14.0** (9.69-19.2)	**16.8** (11.1-23.8)	**19.3** (12.5-27.8)
10-day	**5.00** (4.09-6.01)	**5.94** (4.85-7.15)	**7.47** (6.08-9.02)	**8.75** (7.07-10.6)	**10.5** (8.22-13.3)	**11.8** (9.04-15.3)	**13.2** (9.85-17.9)	**15.0** (10.4-20.4)	**17.7** (11.8-24.9)	**20.1** (13.0-28.8)
20-day	**6.97** (5.75-8.32)	**8.01** (6.59-9.57)	**9.69** (7.95-11.6)	**11.1** (9.04-13.4)	**13.0** (10.2-16.3)	**14.5** (11.1-18.5)	**16.0** (11.9-21.1)	**17.7** (12.4-23.9)	**20.2** (13.5-28.1)	**22.3** (14.5-31.6)
30-day	**8.62** (7.14-10.2)	**9.72** (8.04-11.6)	**11.5** (9.50-13.7)	**13.0** (10.7-15.6)	**15.1** (11.9-18.7)	**16.6** (12.8-21.0)	**18.3** (13.5-23.8)	**19.9** (14.0-26.7)	**22.3** (14.9-30.7)	**24.1** (15.7-33.9)
45-day	**10.7** (8.91-12.7)	**11.9** (9.88-14.1)	**13.8** (11.4-16.4)	**15.4** (12.7-18.4)	**17.6** (13.9-21.7)	**19.3** (14.9-24.2)	**21.0** (15.5-27.0)	**22.7** (16.0-30.1)	**24.8** (16.7-33.9)	**26.3** (17.2-36.8)
60-day	**12.5** (10.4-14.7)	**13.7** (11.4-16.2)	**15.7** (13.1-18.6)	**17.4** (14.4-20.7)	**19.7** (15.6-24.1)	**21.5** (16.6-26.7)	**23.3** (17.1-29.6)	**24.9** (17.6-32.9)	**26.9** (18.1-36.6)	**28.2** (18.5-39.3)

[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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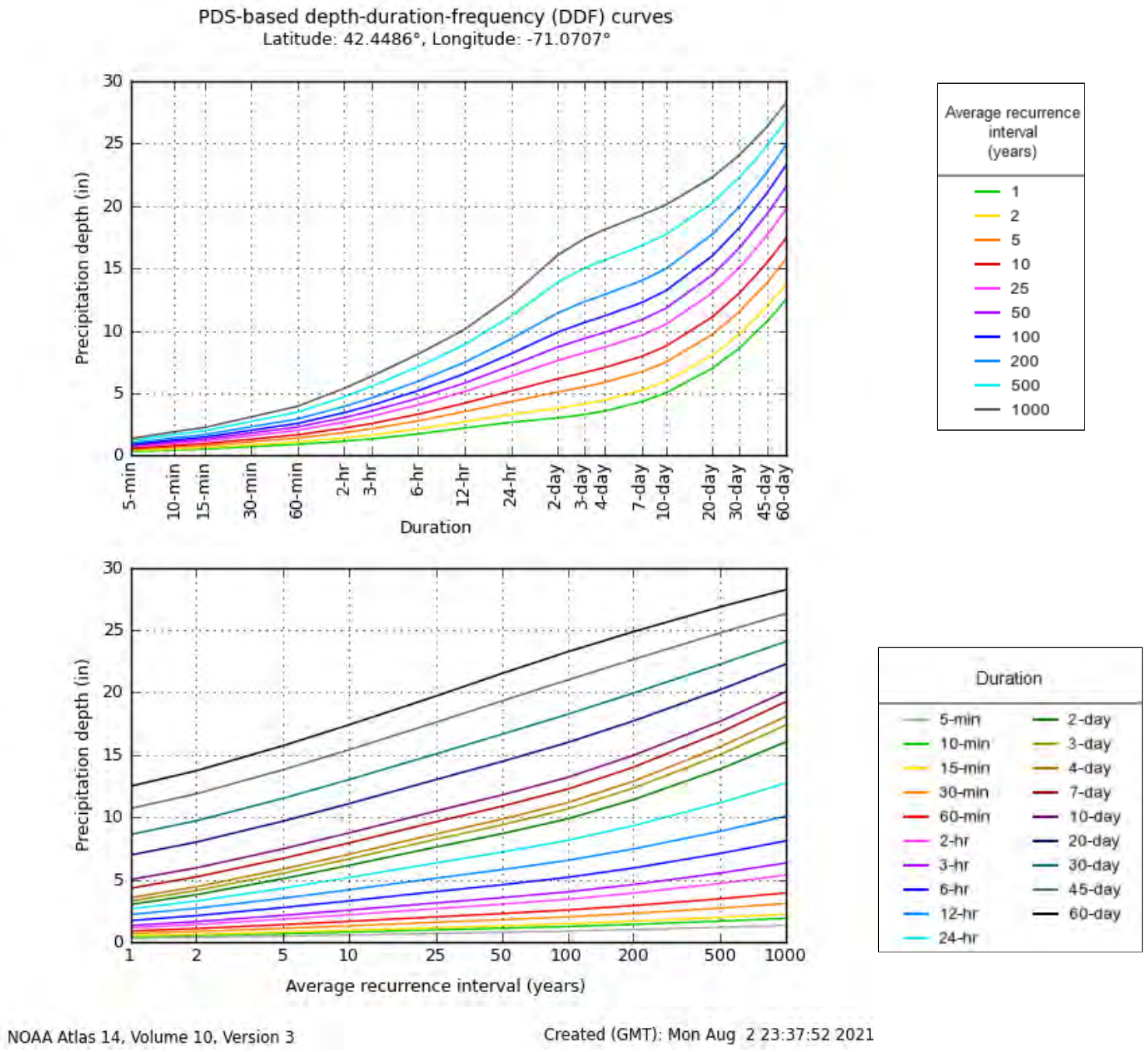
PF graphical



NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Mon Aug 2 23:37:52 2021

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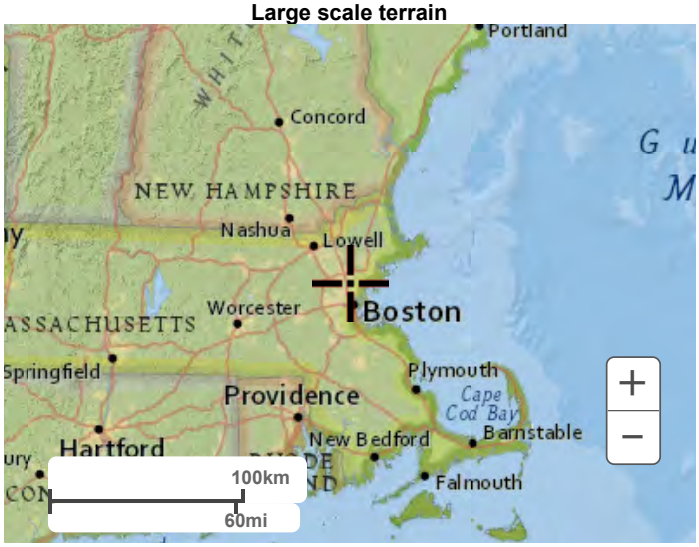
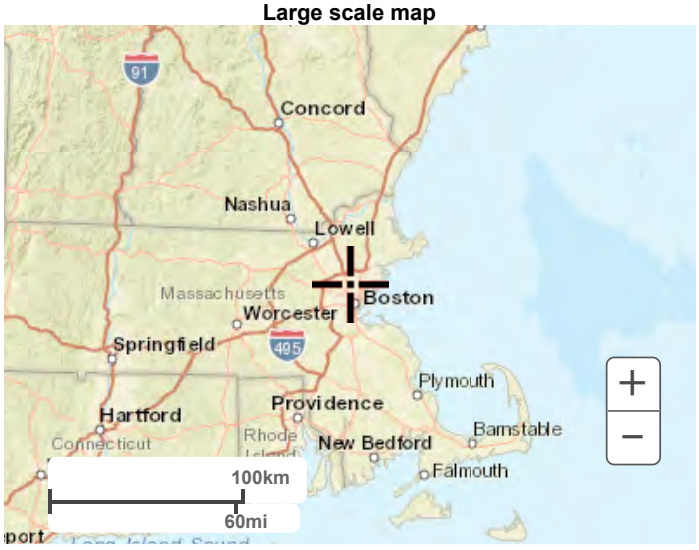
Maps & aerials

Small scale terrain

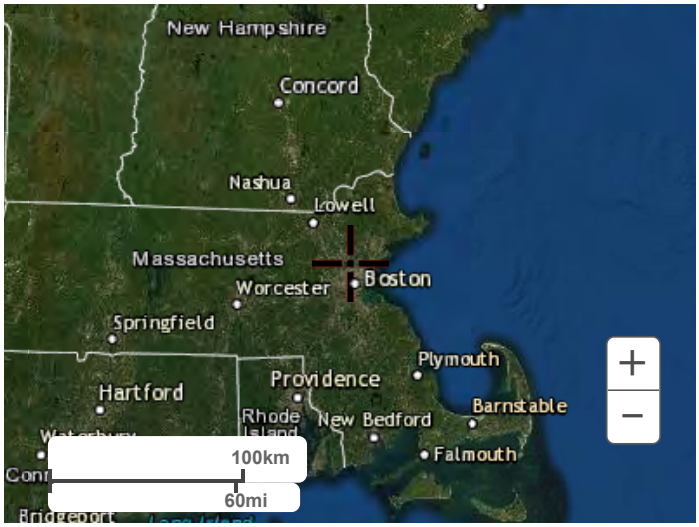
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

E1

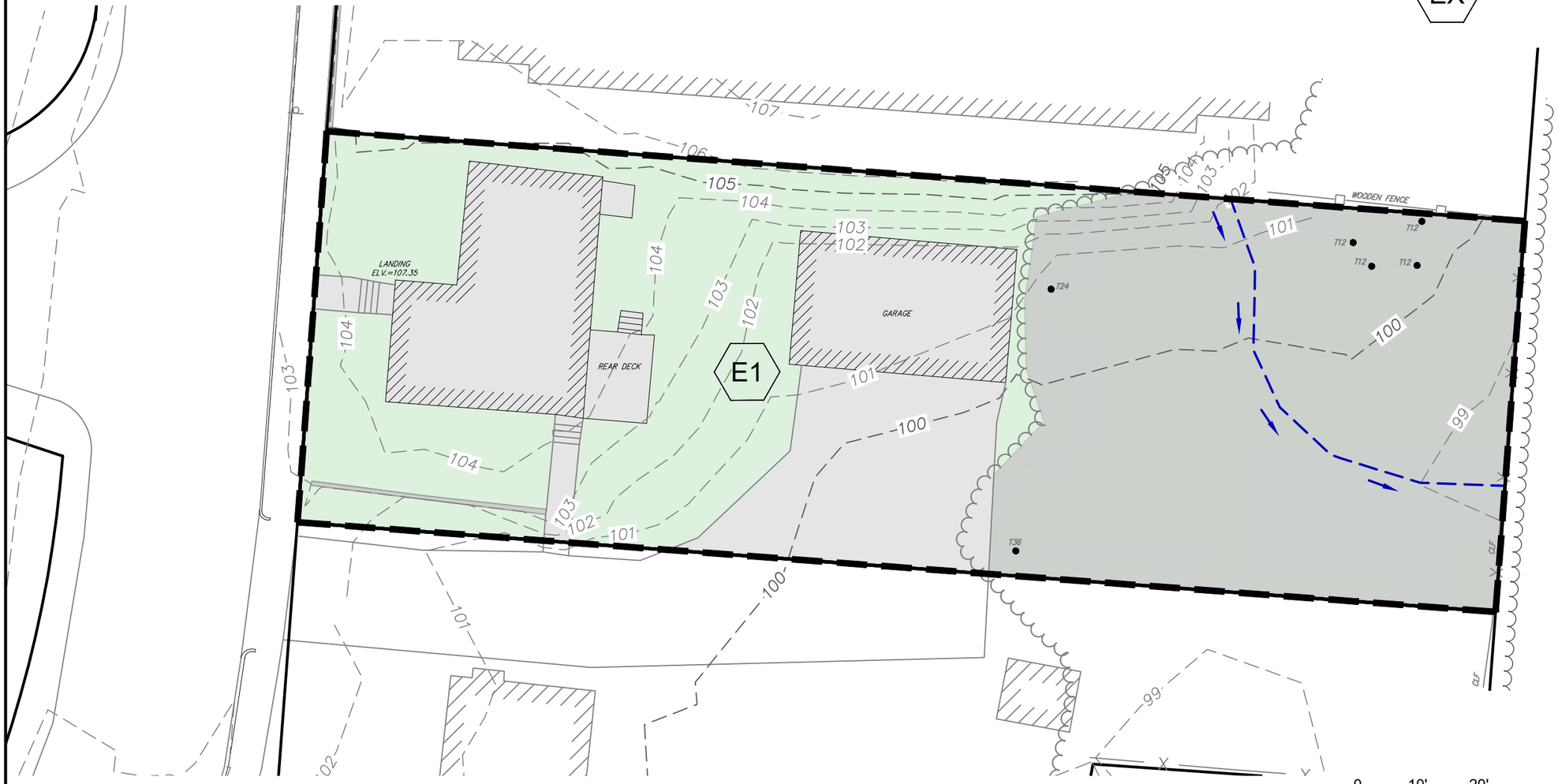
SUBCATCHMENT E-1
PRE-DEVELOPMENT AREA
(HSG-A)

SURFACE	AREA (SQ-FT)
IMPERVIOUS	3,581
GRASS	4,245
WOODS	5,360
TOTAL	13,186

SUBCATCHMENT E-1
TIME OF CONCENTRATION = 8.8 MINUTES

LEGEND

- IMPERVIOUS
- GRASS
- WOODS
- TIME OF CONCENTRATION PATH OF TRAVEL
- SUBCATCHMENT BOUNDARY
- EX — SUBCATCHMENT NODE



0 10' 20' 40' 60'
SCALE: 1"=20'

PRE-DEVELOPMENT DRAINAGE AREAS

PREPARED BY:
FODERA
ENGINEERING
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gfodera@foderaengineering.com
28 Harbor St., Suite 204
Danvers, MA 01923

PREPARED FOR:
BOGHOS PROPERTIES
655 E 2nd Street, 204
Boston, MA 02127
781-820-5129

PROJECT LOCATION:
373 PLEASANT STREET
MELROSE, MA 02176

PLAN SET:
PROPOSED 7-UNIT
MULTI-FAMILY BUILDING

DATE: 5/3/2021

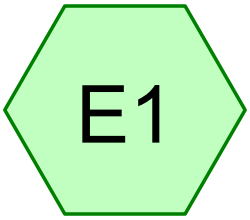
PROFESSIONAL SEAL:

REVISION	DATE

JOB NO.: 20179-176

SHEET TITLE:
PRE-DEVELOPMENT
DRAINAGE AREAS

SHEET NUMBER:
1 OF 1



Pre-Development Area

Subcat Reach Pond Link

Routing Diagram for PRE_2021-08-13
Prepared by {enter your company name here}, Printed 8/13/2021

Summary for Subcatchment E1: Pre-Development Area

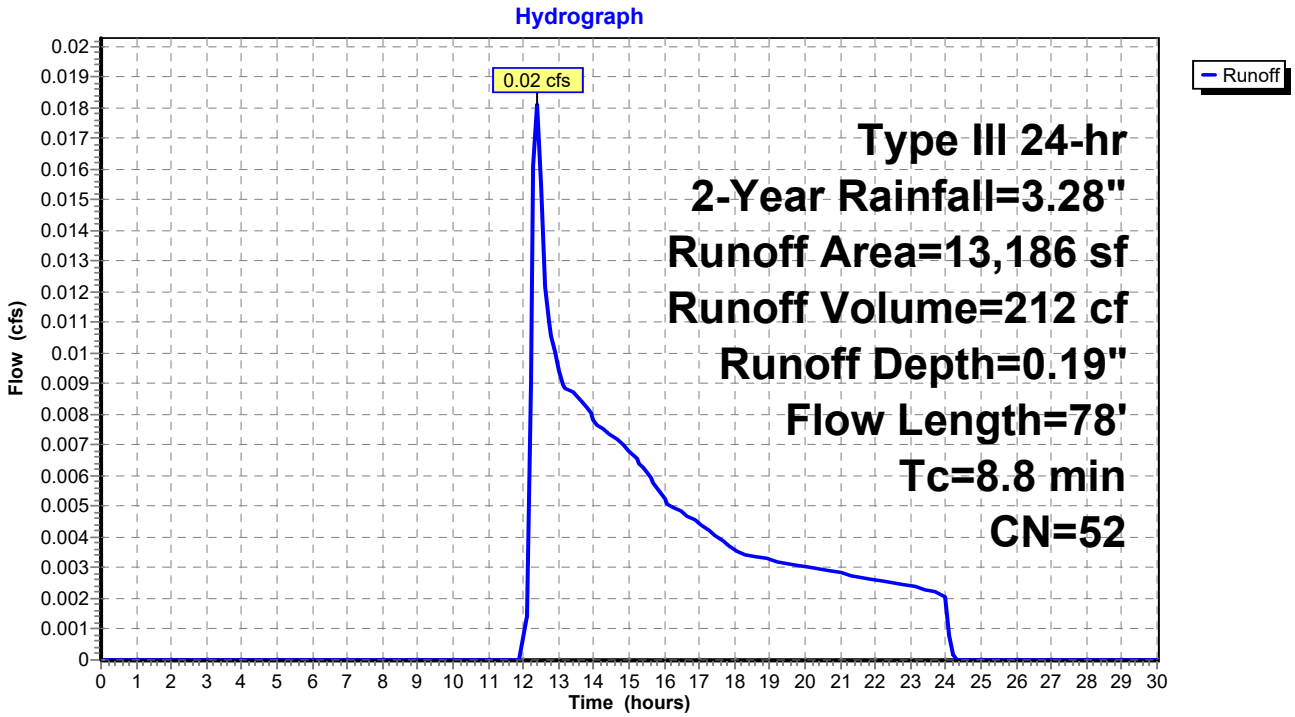
Runoff = 0.02 cfs @ 12.39 hrs, Volume= 212 cf, Depth= 0.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.28"

	Area (sf)	CN	Description
*	3,581	98	Impervious
	4,245	39	>75% Grass cover, Good, HSG A
	5,360	32	Woods/grass comb., Good, HSG A
	13,186	52	Weighted Average
	9,605		72.84% Pervious Area
	3,581		27.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
0.5	28	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.8	78	Total			

Subcatchment E1: Pre-Development Area



Summary for Subcatchment E1: Pre-Development Area

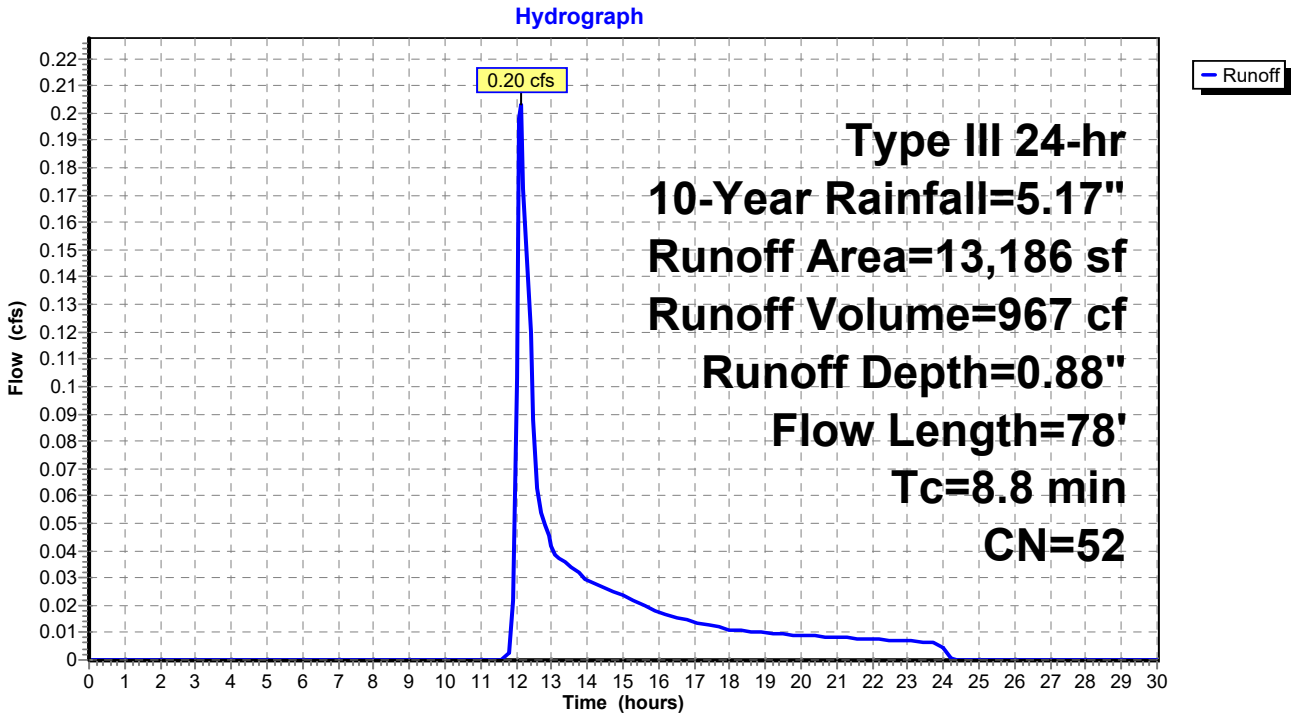
Runoff = 0.20 cfs @ 12.13 hrs, Volume= 967 cf, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=5.17"

	Area (sf)	CN	Description
*	3,581	98	Impervious
	4,245	39	>75% Grass cover, Good, HSG A
	5,360	32	Woods/grass comb., Good, HSG A
	13,186	52	Weighted Average
	9,605		72.84% Pervious Area
	3,581		27.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
0.5	28	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.8	78	Total			

Subcatchment E1: Pre-Development Area



Summary for Subcatchment E1: Pre-Development Area

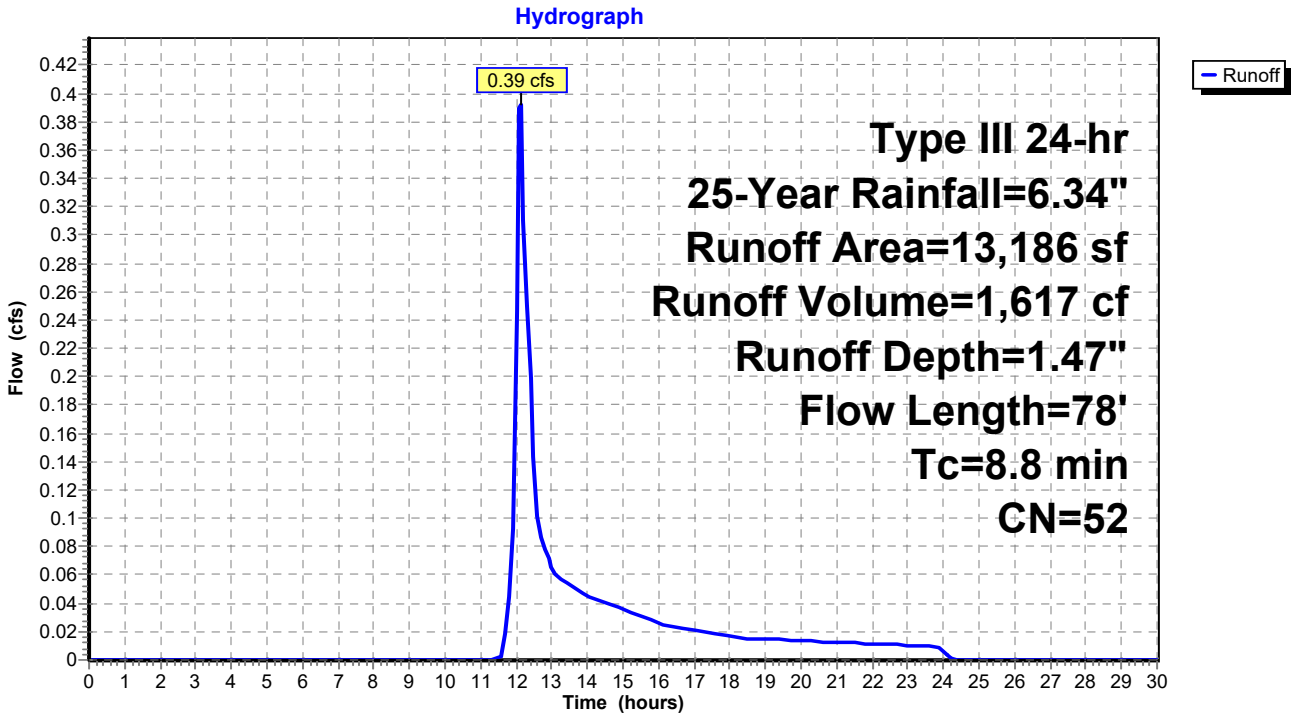
Runoff = 0.39 cfs @ 12.11 hrs, Volume= 1,617 cf, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=6.34"

	Area (sf)	CN	Description
*	3,581	98	Impervious
	4,245	39	>75% Grass cover, Good, HSG A
	5,360	32	Woods/grass comb., Good, HSG A
	13,186	52	Weighted Average
	9,605		72.84% Pervious Area
	3,581		27.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
0.5	28	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.8	78	Total			

Subcatchment E1: Pre-Development Area



Summary for Subcatchment E1: Pre-Development Area

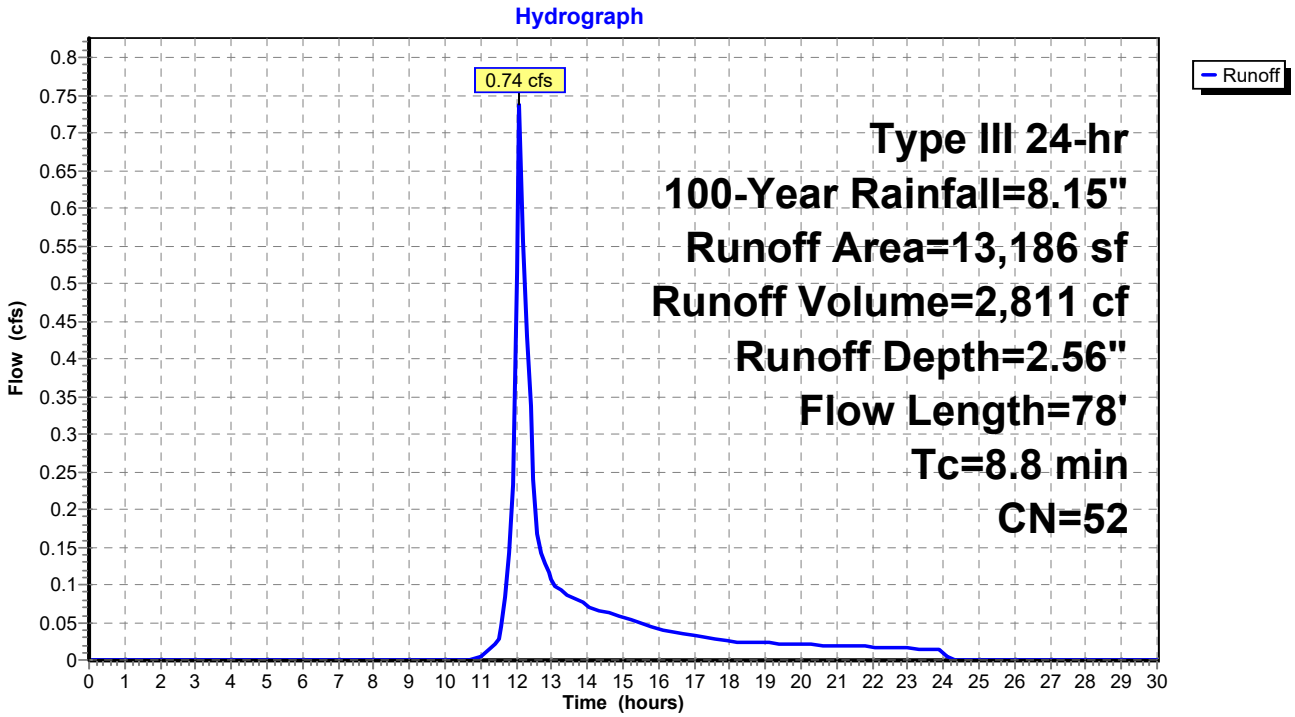
Runoff = 0.74 cfs @ 12.11 hrs, Volume= 2,811 cf, Depth= 2.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=8.15"

	Area (sf)	CN	Description
*	3,581	98	Impervious
	4,245	39	>75% Grass cover, Good, HSG A
	5,360	32	Woods/grass comb., Good, HSG A
	13,186	52	Weighted Average
	9,605		72.84% Pervious Area
	3,581		27.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.3	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
0.5	28	0.0400	1.00		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.8	78	Total			

Subcatchment E1: Pre-Development Area



Events for Subcatchment E1: Pre-Development Area

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	3.28	0.02	212	0.19
10-Year	5.17	0.20	967	0.88
25-Year	6.34	0.39	1,617	1.47
100-Year	**8.15**	**0.74**	**2,811**	**2.56**

P1

SUBCATCHMENT P–1
POST–DEVELOPMENT AREA
(HSG–A)

SURFACE	AREA (SQ–FT)
IMPERVIOUS	9,089
GRASS	8
TOTAL	9,097

SUBCATCHMENT P–1
TIME OF CONCENTRATION = 6.0 MINUTES

P2

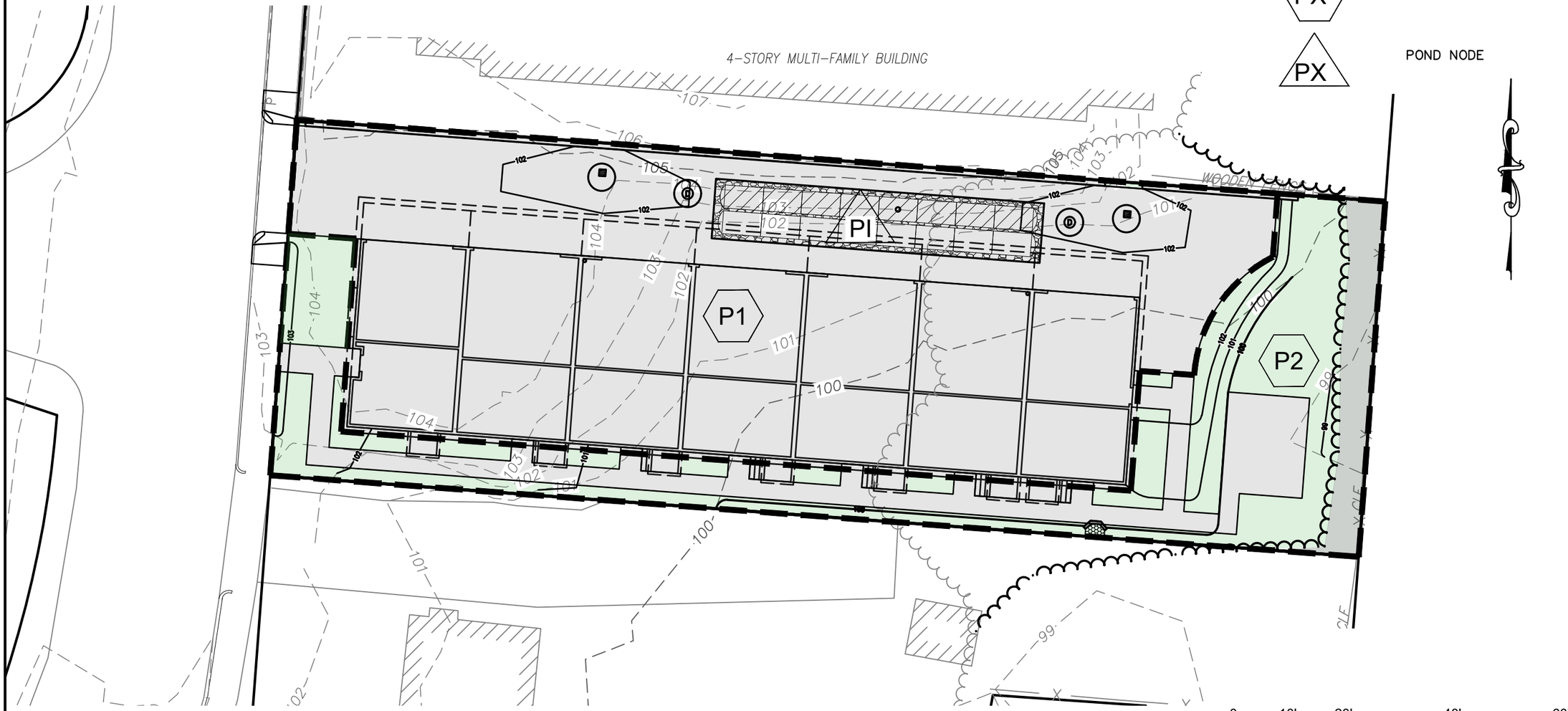
SUBCATCHMENT P–2
POST–DEVELOPMENT AREA
(HSG–A)

SURFACE	AREA (SQ–FT)
IMPERVIOUS	1,300
GRASS	2,391
WOODS	398
TOTAL	4,089

SUBCATCHMENT P–2
TIME OF CONCENTRATION = 6.0 MINUTES

LEGEND

- IMPERVIOUS
- GRASS
- WOODS
- TIME OF CONCENTRATION PATH OF TRAVEL
- SUBCATCHMENT BOUNDARY
- PX — SUBCATCHMENT NODE
- PX — POND NODE



POST–DEVELOPMENT DRAINAGE AREAS

PREPARED BY:
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Danvers, MA 01923

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PROJECT LOCATION:
373 PLEASANT STREET
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PLAN SET:
PROPOSED 7-UNIT
MULTI-FAMILY BUILDING

DATE: 5/3/2021

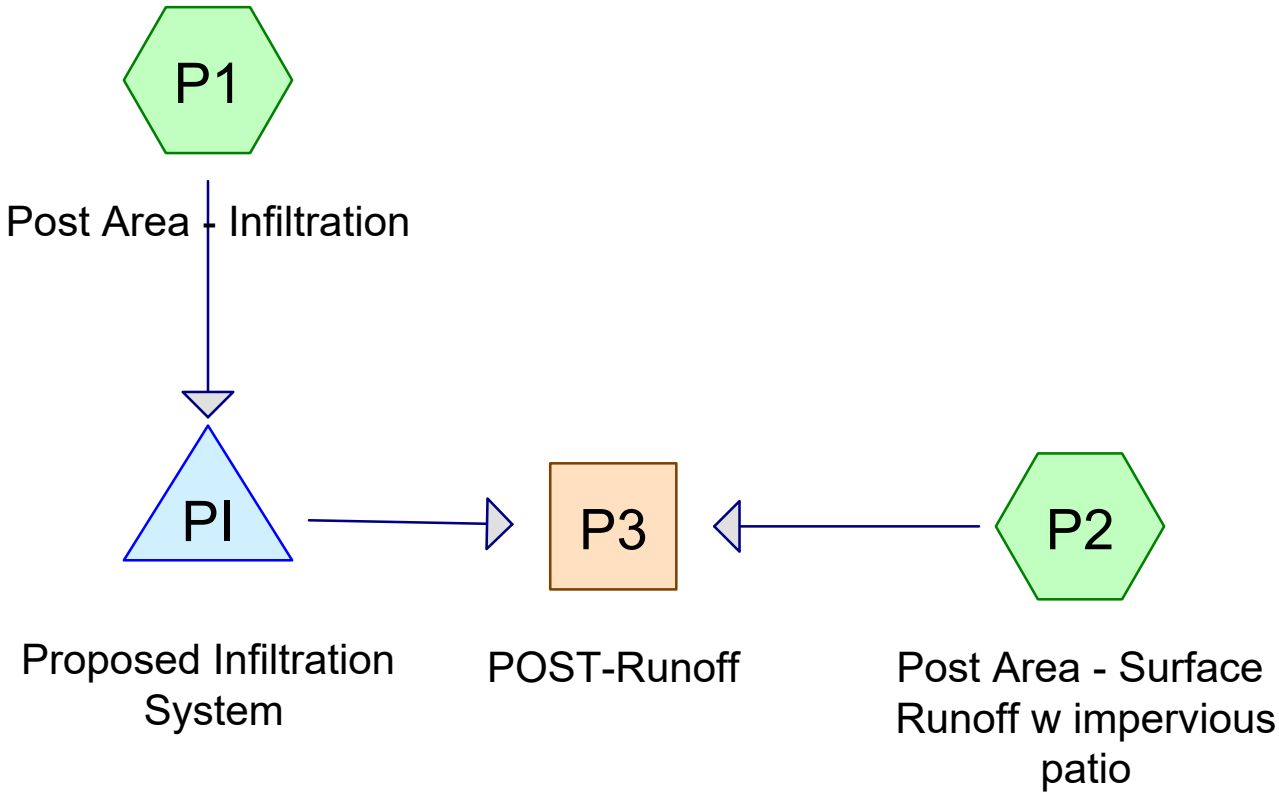
PROFESSIONAL SEAL:

REVISION	DATE
REVISION 1	8/13/21

JOB NO.: 20179–176

SHEET TITLE:
POST–DEVELOPMENT DRAINAGE AREAS

SHEET NUMBER:
1 OF 1



Subcat Reach Pond Link

Routing Diagram for POST_2021-08-13
Prepared by {enter your company name here}, Printed 8/13/2021

Summary for Subcatchment P1: Post Area - Infiltration

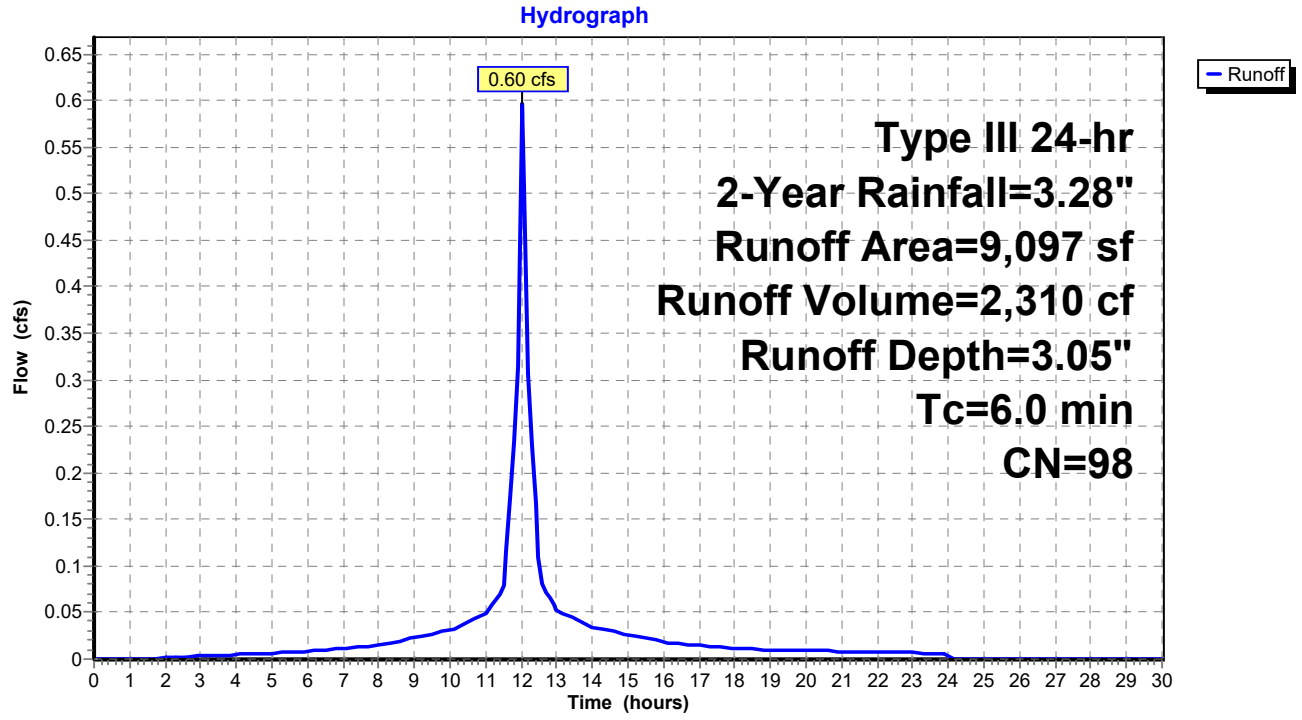
Runoff = 0.60 cfs @ 12.03 hrs, Volume= 2,310 cf, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.28"

	Area (sf)	CN	Description
*	9,089	98	Impervious
	8	39	>75% Grass cover, Good, HSG A
	9,097	98	Weighted Average
	8		0.09% Pervious Area
	9,089		99.91% Impervious Area

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

Subcatchment P1: Post Area - Infiltration



Summary for Subcatchment P2: Post Area - Surface Runoff w impervious patio

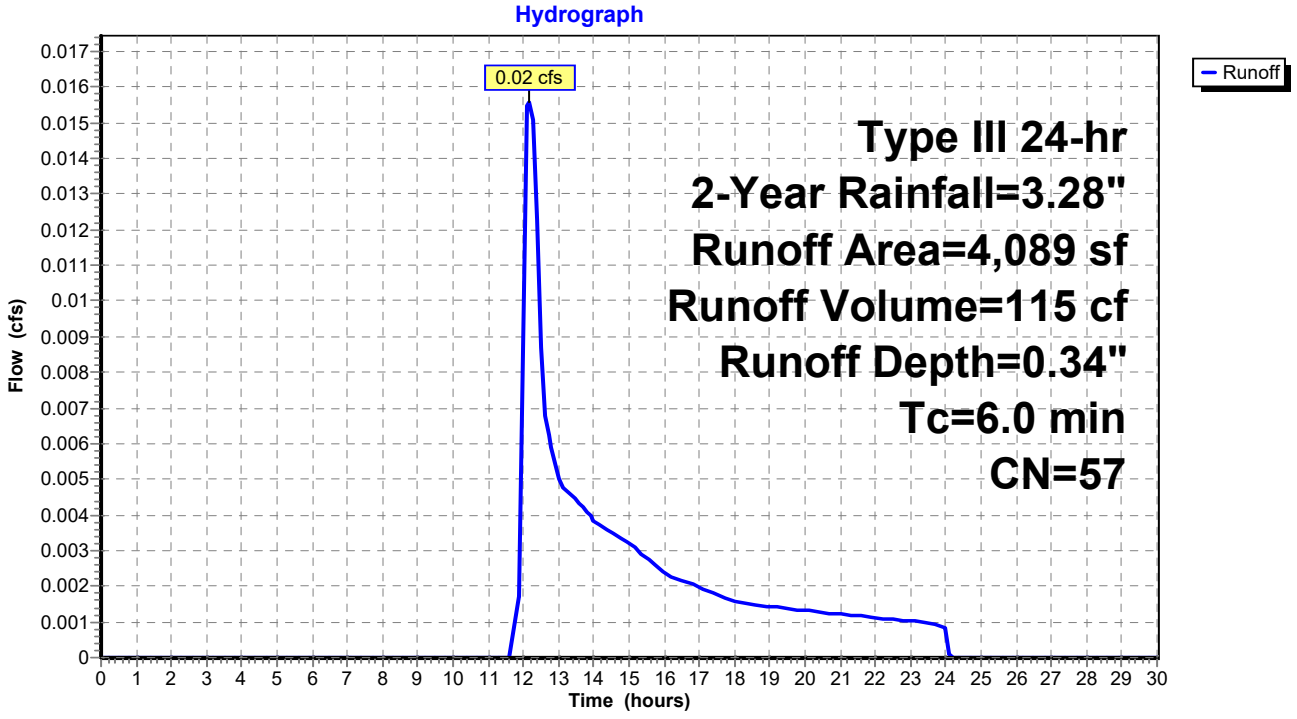
Runoff = 0.02 cfs @ 12.15 hrs, Volume= 115 cf, Depth= 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 2-Year Rainfall=3.28"

	Area (sf)	CN	Description
*	1,300	98	Impervious
	2,391	39	>75% Grass cover, Good, HSG A
	398	32	Woods/grass comb., Good, HSG A
	4,089	57	Weighted Average
	2,789		68.21% Pervious Area
	1,300		31.79% Impervious Area

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

Subcatchment P2: Post Area - Surface Runoff w impervious patio

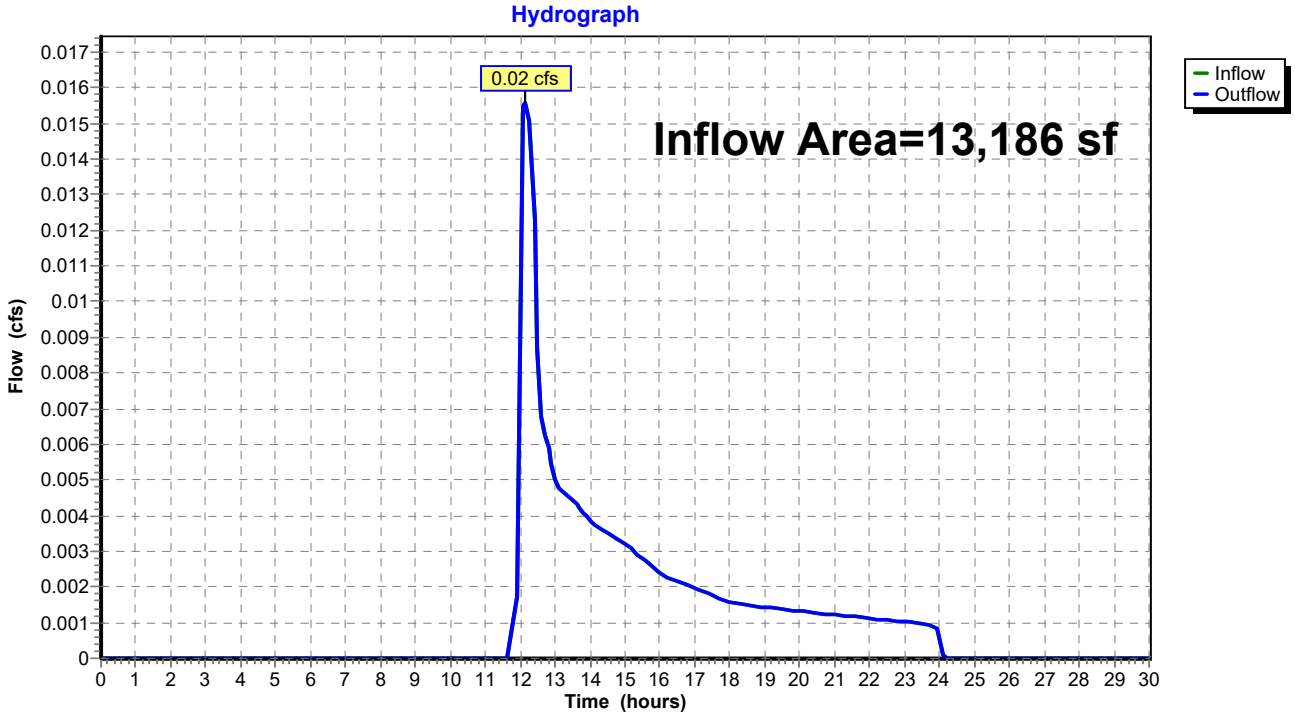


Summary for Reach P3: POST-Runoff

Inflow Area = 13,186 sf, 78.79% Impervious, Inflow Depth = 0.10" for 2-Year event
Inflow = 0.02 cfs @ 12.15 hrs, Volume= 115 cf
Outflow = 0.02 cfs @ 12.15 hrs, Volume= 115 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Reach P3: POST-Runoff



Summary for Pond PI: Proposed Infiltration System

Inflow Area = 9,097 sf, 99.91% Impervious, Inflow Depth = 3.05" for 2-Year event
Inflow = 0.60 cfs @ 12.03 hrs, Volume= 2,310 cf
Outflow = 0.13 cfs @ 11.70 hrs, Volume= 2,308 cf, Atten= 79%, Lag= 0.0 min
Discarded = 0.13 cfs @ 11.70 hrs, Volume= 2,308 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 97.51' @ 12.48 hrs Surf.Area= 666 sf Storage= 544 cf

Plug-Flow detention time= 22.6 min calculated for 2,301 cf (100% of inflow)
Center-of-Mass det. time= 22.1 min (775.0 - 752.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	96.20'	683 cf	**11.00'W x 60.58'L x 3.67'H Field A** 2,443 cf Overall - 735 cf Embedded = 1,708 cf x 40.0% Voids
#2A	96.70'	735 cf	**ADS_StormTech SC-740 +Cap** x 16 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 16 Chambers in 2 Rows
		1,418 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	99.65'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	96.20'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.13 cfs @ 11.70 hrs HW=96.26' (Free Discharge)
↑└**2=Exfiltration** (Exfiltration Controls 0.13 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.20' (Free Discharge)
↑└**1=Orifice/Grate** (Controls 0.00 cfs)

Pond PI: Proposed Infiltration System - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
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

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

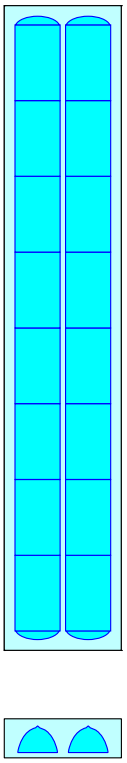
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 8.0" Stone Cover = 3.67' Field Height

16 Chambers x 45.9 cf = 735.0 cf Chamber Storage

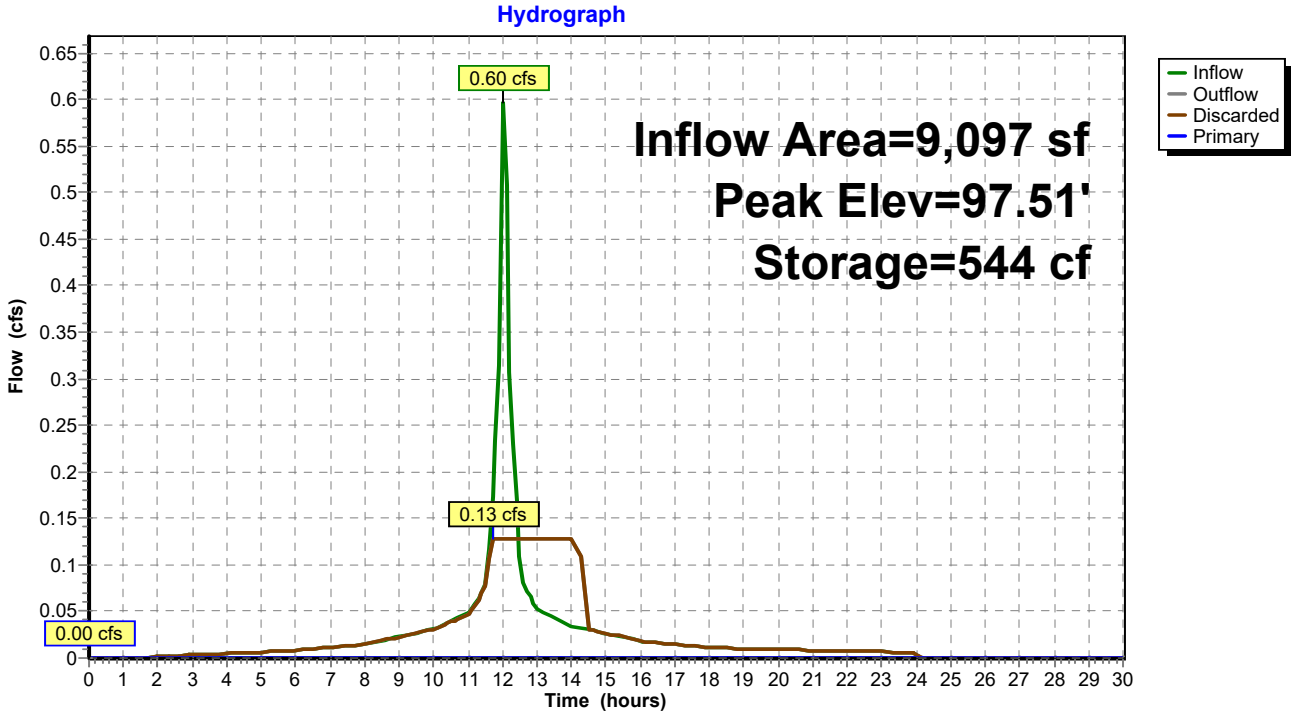
2,443.3 cf Field - 735.0 cf Chambers = 1,708.2 cf Stone x 40.0% Voids = 683.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,418.3 cf = 0.033 af
Overall Storage Efficiency = 58.1%
Overall System Size = 60.58' x 11.00' x 3.67'

16 Chambers @ $ 0.00 /ea = $ 0.00
90.5 cy Field Excavation @ $ 5.00 /cy = $ 452.46
63.3 cy Stone @ $ 0.00 /cy = $ 0.00
Total Cost = $ 452.46



Pond PI: Proposed Infiltration System



Summary for Subcatchment P1: Post Area - Infiltration

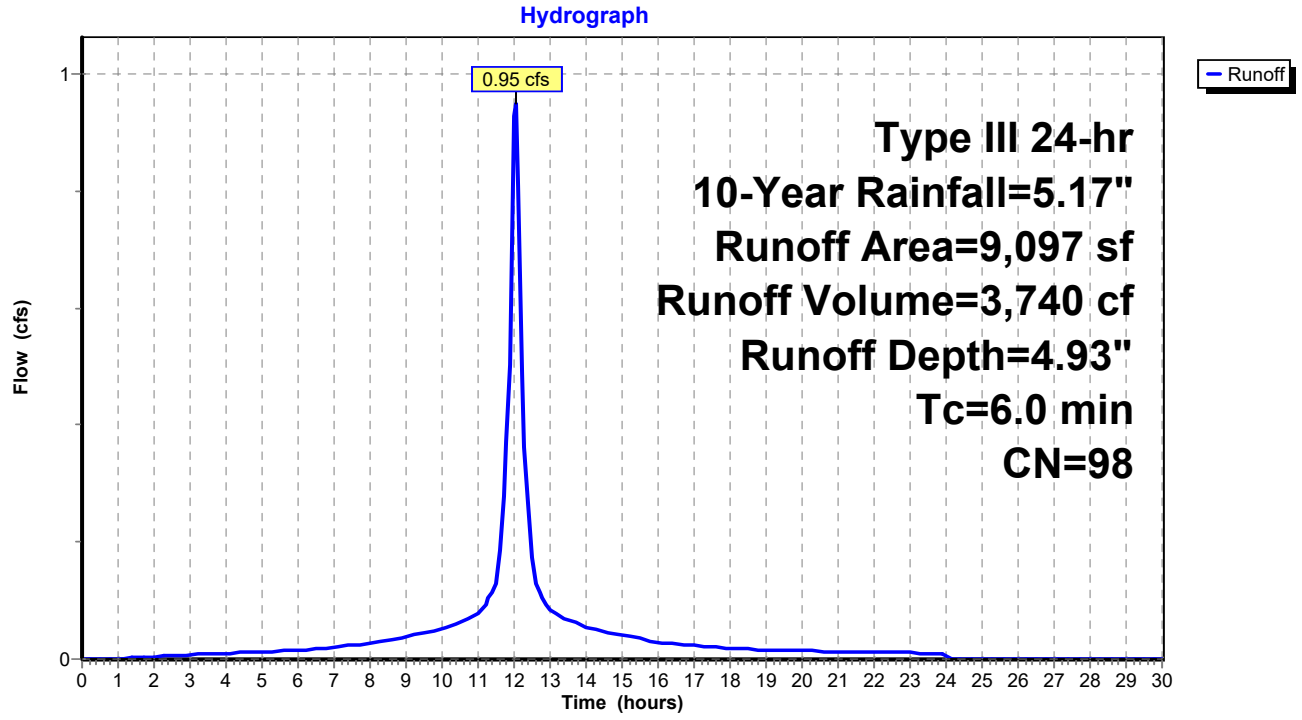
Runoff = 0.95 cfs @ 12.03 hrs, Volume= 3,740 cf, Depth= 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=5.17"

	Area (sf)	CN	Description
*	9,089	98	Impervious
	8	39	>75% Grass cover, Good, HSG A
	9,097	98	Weighted Average
	8		0.09% Pervious Area
	9,089		99.91% Impervious Area

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

Subcatchment P1: Post Area - Infiltration



Summary for Subcatchment P2: Post Area - Surface Runoff w impervious patio

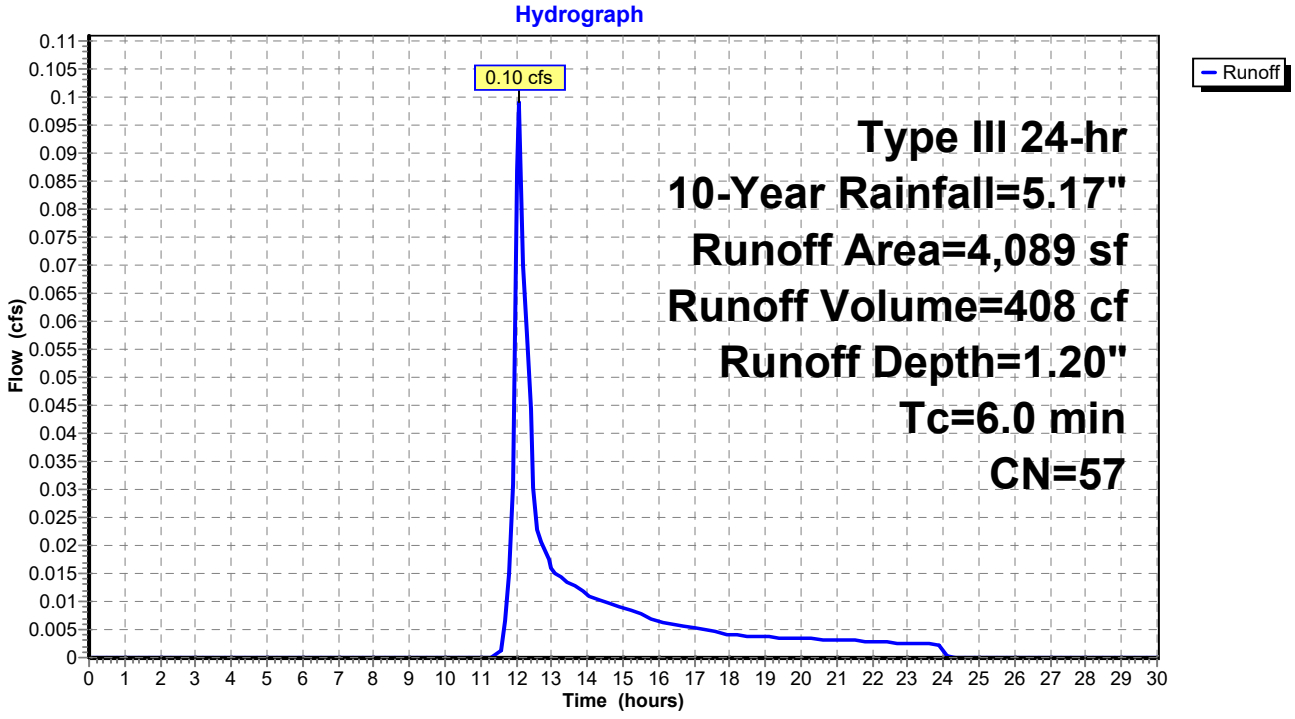
Runoff = 0.10 cfs @ 12.08 hrs, Volume= 408 cf, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 10-Year Rainfall=5.17"

	Area (sf)	CN	Description
*	1,300	98	Impervious
	2,391	39	>75% Grass cover, Good, HSG A
	398	32	Woods/grass comb., Good, HSG A
	4,089	57	Weighted Average
	2,789		68.21% Pervious Area
	1,300		31.79% Impervious Area

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

Subcatchment P2: Post Area - Surface Runoff w impervious patio

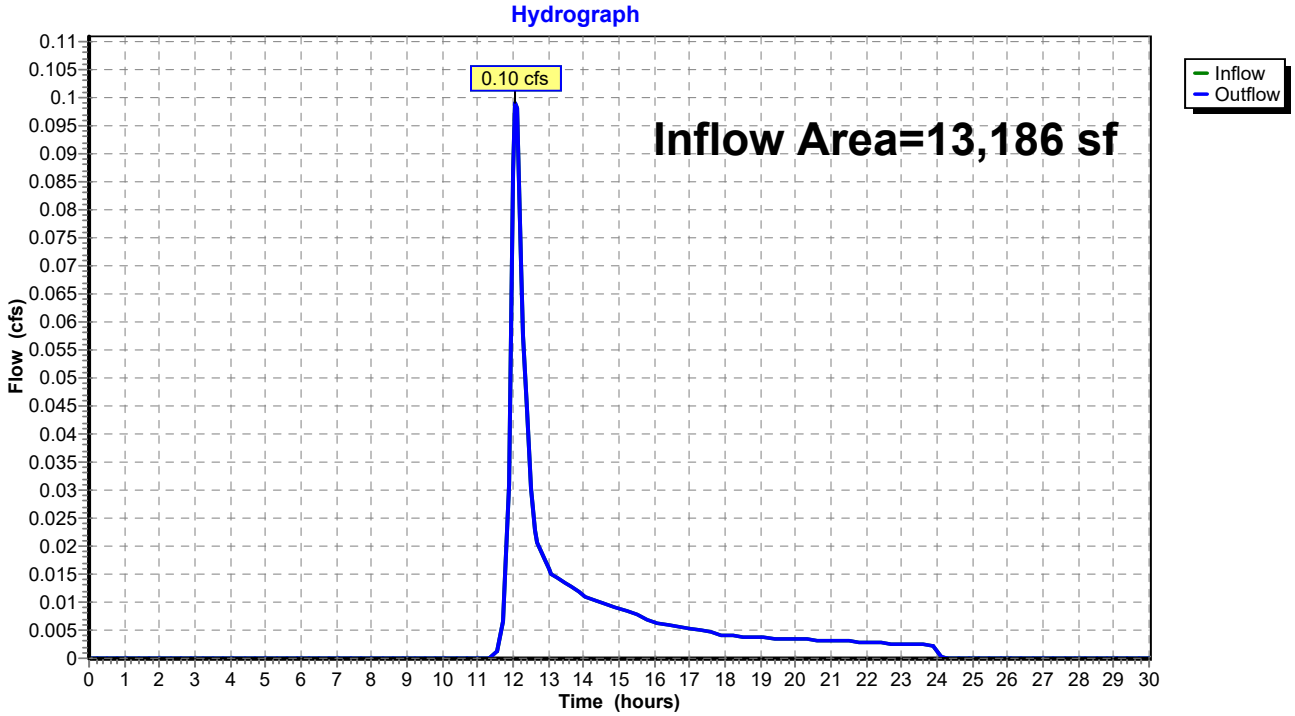


Summary for Reach P3: POST-Runoff

Inflow Area = 13,186 sf, 78.79% Impervious, Inflow Depth = 0.37" for 10-Year event
Inflow = 0.10 cfs @ 12.08 hrs, Volume= 408 cf
Outflow = 0.10 cfs @ 12.08 hrs, Volume= 408 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Reach P3: POST-Runoff



Summary for Pond PI: Proposed Infiltration System

Inflow Area = 9,097 sf, 99.91% Impervious, Inflow Depth = 4.93" for 10-Year event
Inflow = 0.95 cfs @ 12.03 hrs, Volume= 3,740 cf
Outflow = 0.13 cfs @ 11.60 hrs, Volume= 3,733 cf, Atten= 87%, Lag= 0.0 min
Discarded = 0.13 cfs @ 11.60 hrs, Volume= 3,733 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 98.81' @ 12.63 hrs Surf.Area= 666 sf Storage= 1,121 cf

Plug-Flow detention time= 54.4 min calculated for 3,721 cf (100% of inflow)
Center-of-Mass det. time= 53.1 min (797.6 - 744.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	96.20'	683 cf	**11.00'W x 60.58'L x 3.67'H Field A** 2,443 cf Overall - 735 cf Embedded = 1,708 cf x 40.0% Voids
#2A	96.70'	735 cf	**ADS_StormTech SC-740 +Cap** x 16 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 16 Chambers in 2 Rows
		1,418 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	99.65'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	96.20'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.13 cfs @ 11.60 hrs HW=96.28' (Free Discharge)
↑└**2=Exfiltration** (Exfiltration Controls 0.13 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=96.20' (Free Discharge)
↑└**1=Orifice/Grate** (Controls 0.00 cfs)

Pond PI: Proposed Infiltration System - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
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

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

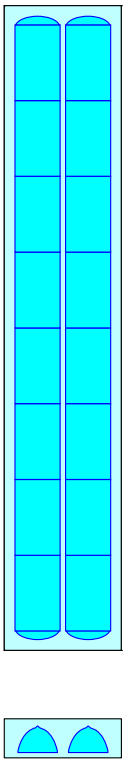
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 8.0" Stone Cover = 3.67' Field Height

16 Chambers x 45.9 cf = 735.0 cf Chamber Storage

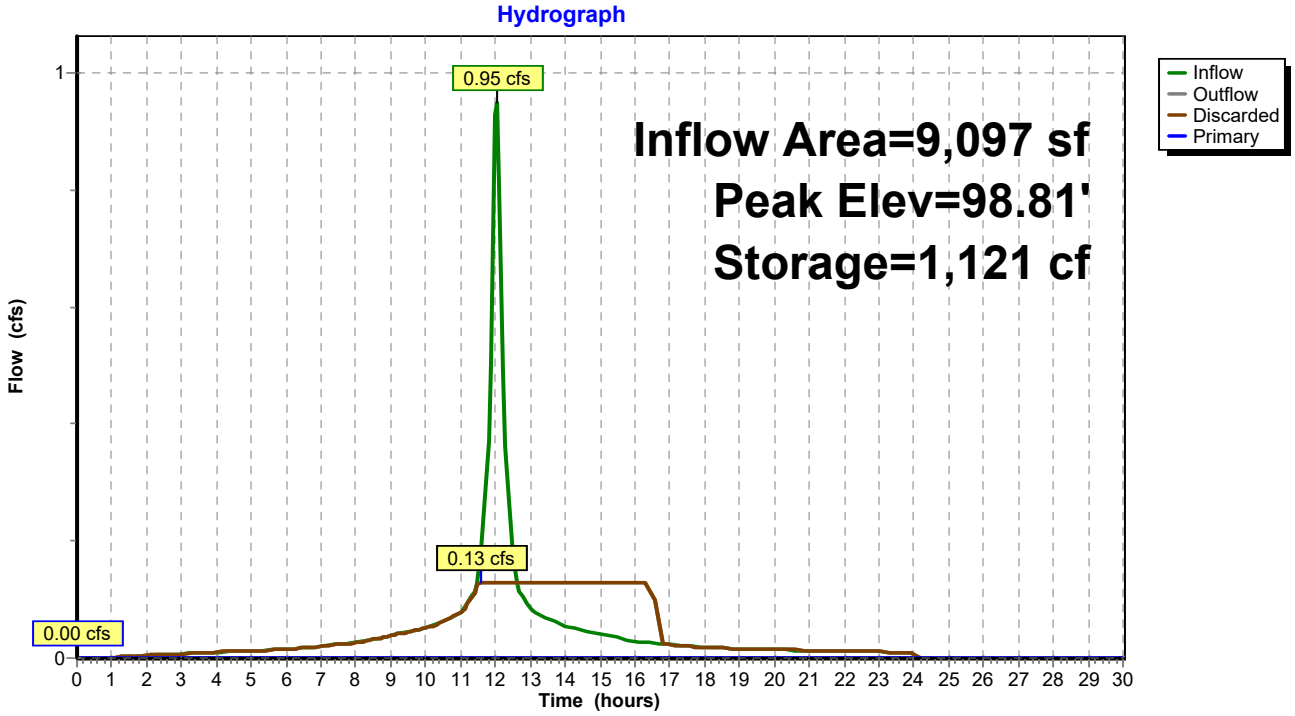
2,443.3 cf Field - 735.0 cf Chambers = 1,708.2 cf Stone x 40.0% Voids = 683.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,418.3 cf = 0.033 af
Overall Storage Efficiency = 58.1%
Overall System Size = 60.58' x 11.00' x 3.67'

16 Chambers @ $ 0.00 /ea = $ 0.00
90.5 cy Field Excavation @ $ 5.00 /cy = $ 452.46
63.3 cy Stone @ $ 0.00 /cy = $ 0.00
Total Cost = $ 452.46



Pond PI: Proposed Infiltration System



Summary for Subcatchment P1: Post Area - Infiltration

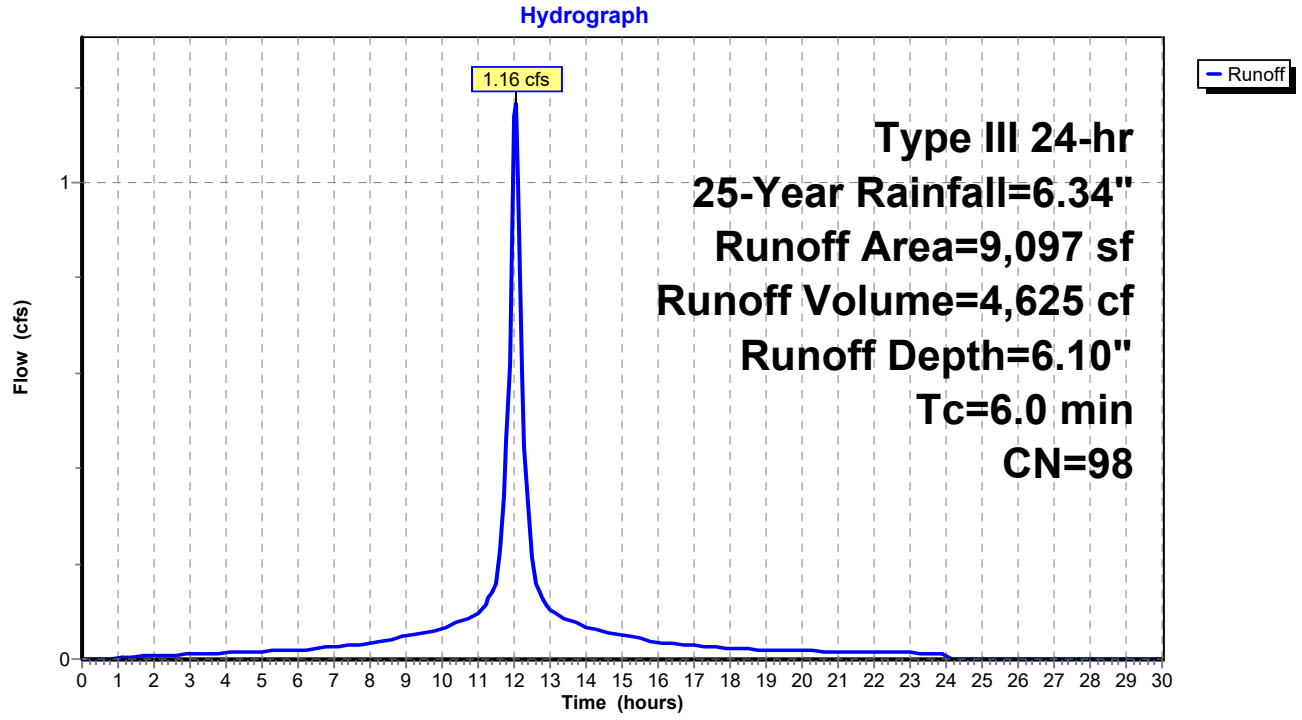
Runoff = 1.16 cfs @ 12.03 hrs, Volume= 4,625 cf, Depth= 6.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=6.34"

	Area (sf)	CN	Description
*	9,089	98	Impervious
	8	39	>75% Grass cover, Good, HSG A
	9,097	98	Weighted Average
	8		0.09% Pervious Area
	9,089		99.91% Impervious Area

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

Subcatchment P1: Post Area - Infiltration



Summary for Subcatchment P2: Post Area - Surface Runoff w impervious patio

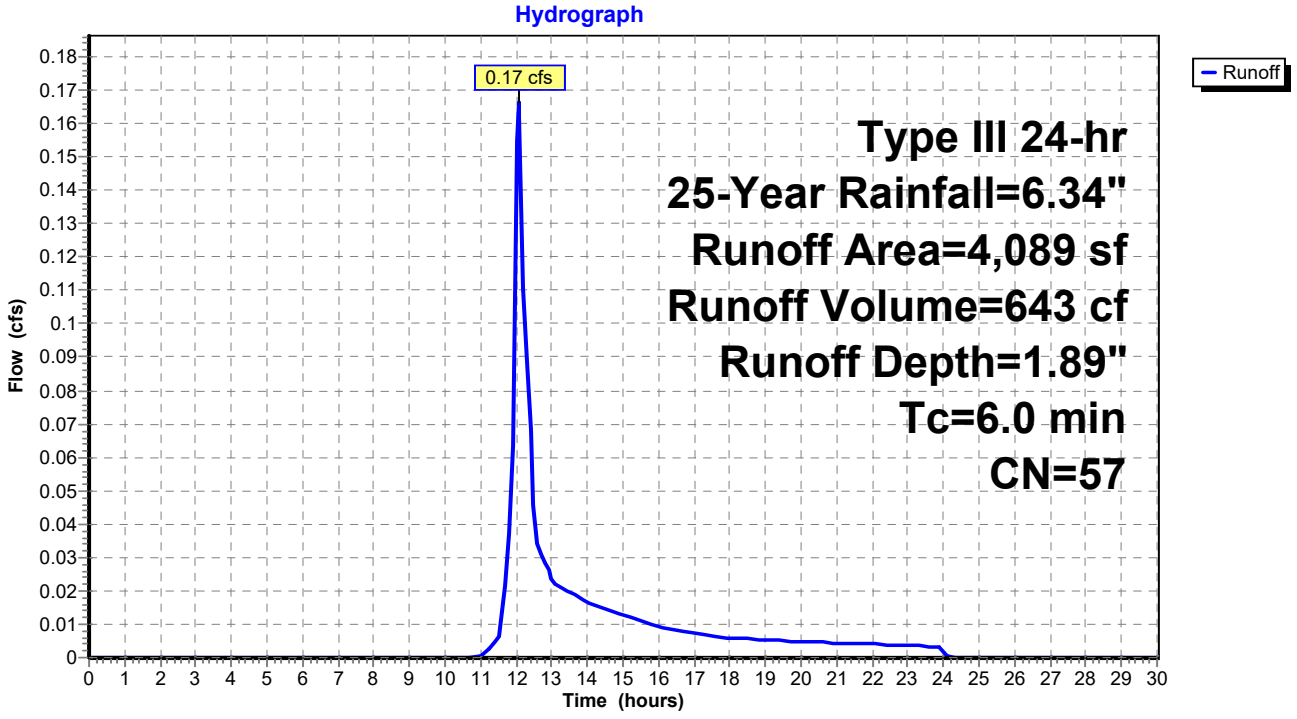
Runoff = 0.17 cfs @ 12.06 hrs, Volume= 643 cf, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 25-Year Rainfall=6.34"

	Area (sf)	CN	Description
*	1,300	98	Impervious
	2,391	39	>75% Grass cover, Good, HSG A
	398	32	Woods/grass comb., Good, HSG A
	4,089	57	Weighted Average
	2,789		68.21% Pervious Area
	1,300		31.79% Impervious Area

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

Subcatchment P2: Post Area - Surface Runoff w impervious patio

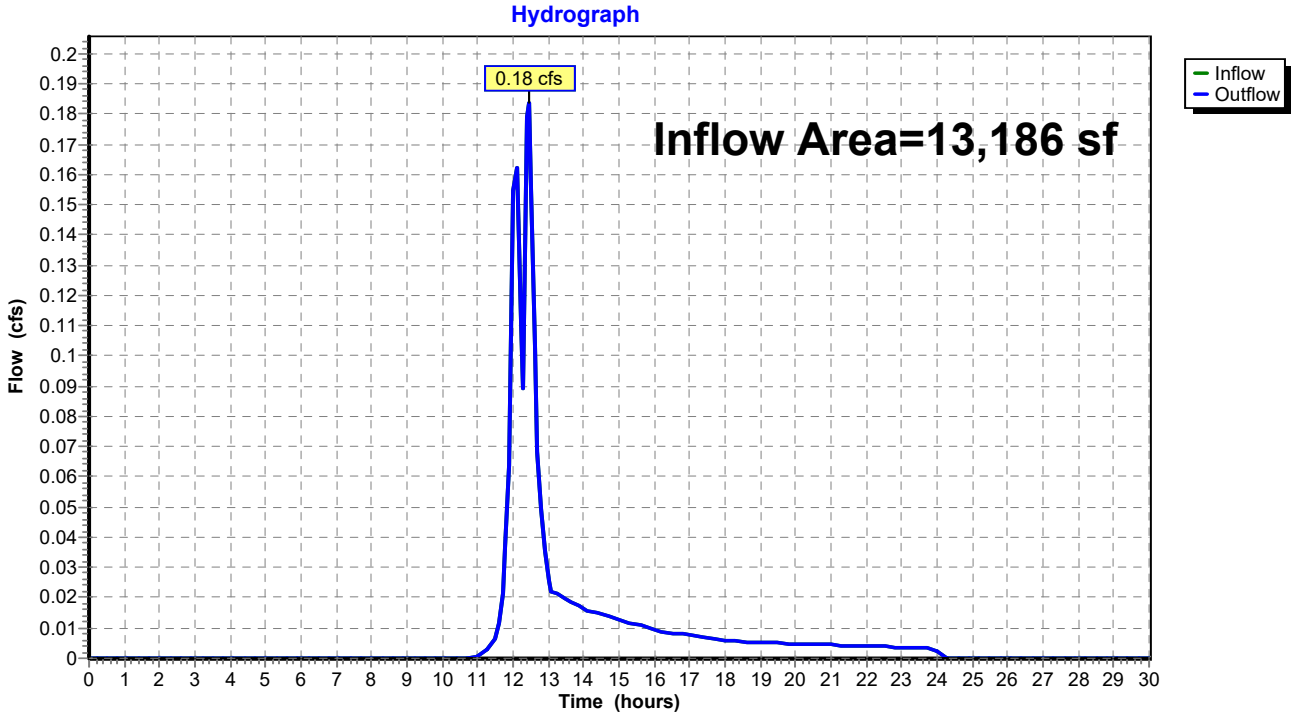


Summary for Reach P3: POST-Runoff

Inflow Area = 13,186 sf, 78.79% Impervious, Inflow Depth = 0.70" for 25-Year event
Inflow = 0.18 cfs @ 12.43 hrs, Volume= 772 cf
Outflow = 0.18 cfs @ 12.43 hrs, Volume= 772 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Reach P3: POST-Runoff



Summary for Pond PI: Proposed Infiltration System

Inflow Area = 9,097 sf, 99.91% Impervious, Inflow Depth = 6.10" for 25-Year event
Inflow = 1.16 cfs @ 12.03 hrs, Volume= 4,625 cf
Outflow = 0.25 cfs @ 12.45 hrs, Volume= 4,628 cf, Atten= 78%, Lag= 25.2 min
Discarded = 0.13 cfs @ 11.40 hrs, Volume= 4,499 cf
Primary = 0.12 cfs @ 12.45 hrs, Volume= 129 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 99.88' @ 12.45 hrs Surf.Area= 666 sf Storage= 1,418 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 68.3 min (809.6 - 741.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	96.20'	683 cf	**11.00'W x 60.58'L x 3.67'H Field A** 2,443 cf Overall - 735 cf Embedded = 1,708 cf x 40.0% Voids
#2A	96.70'	735 cf	**ADS_StormTech SC-740 +Cap** x 16 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 16 Chambers in 2 Rows
		1,418 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	99.65'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	96.20'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.13 cfs @ 11.40 hrs HW=96.25' (Free Discharge)
↑└**2=Exfiltration** (Exfiltration Controls 0.13 cfs)

Primary OutFlow Max=0.11 cfs @ 12.45 hrs HW=99.85' (Free Discharge)
↑└**1=Orifice/Grate** (Orifice Controls 0.11 cfs @ 1.51 fps)

Pond PI: Proposed Infiltration System - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
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

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

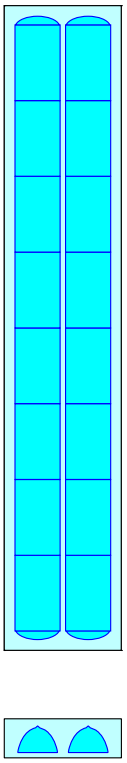
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 8.0" Stone Cover = 3.67' Field Height

16 Chambers x 45.9 cf = 735.0 cf Chamber Storage

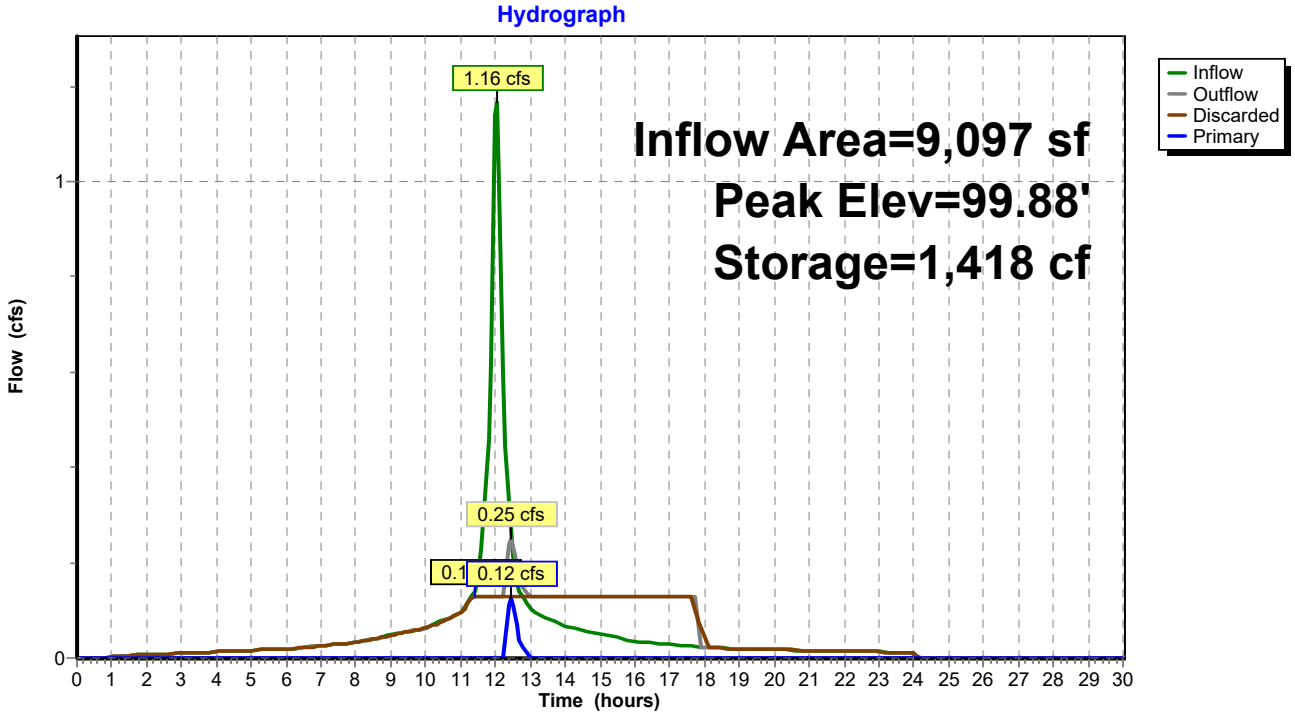
2,443.3 cf Field - 735.0 cf Chambers = 1,708.2 cf Stone x 40.0% Voids = 683.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,418.3 cf = 0.033 af
Overall Storage Efficiency = 58.1%
Overall System Size = 60.58' x 11.00' x 3.67'

16 Chambers @ $ 0.00 /ea = $ 0.00
90.5 cy Field Excavation @ $ 5.00 /cy = $ 452.46
63.3 cy Stone @ $ 0.00 /cy = $ 0.00
Total Cost = $ 452.46



Pond PI: Proposed Infiltration System



Summary for Subcatchment P1: Post Area - Infiltration

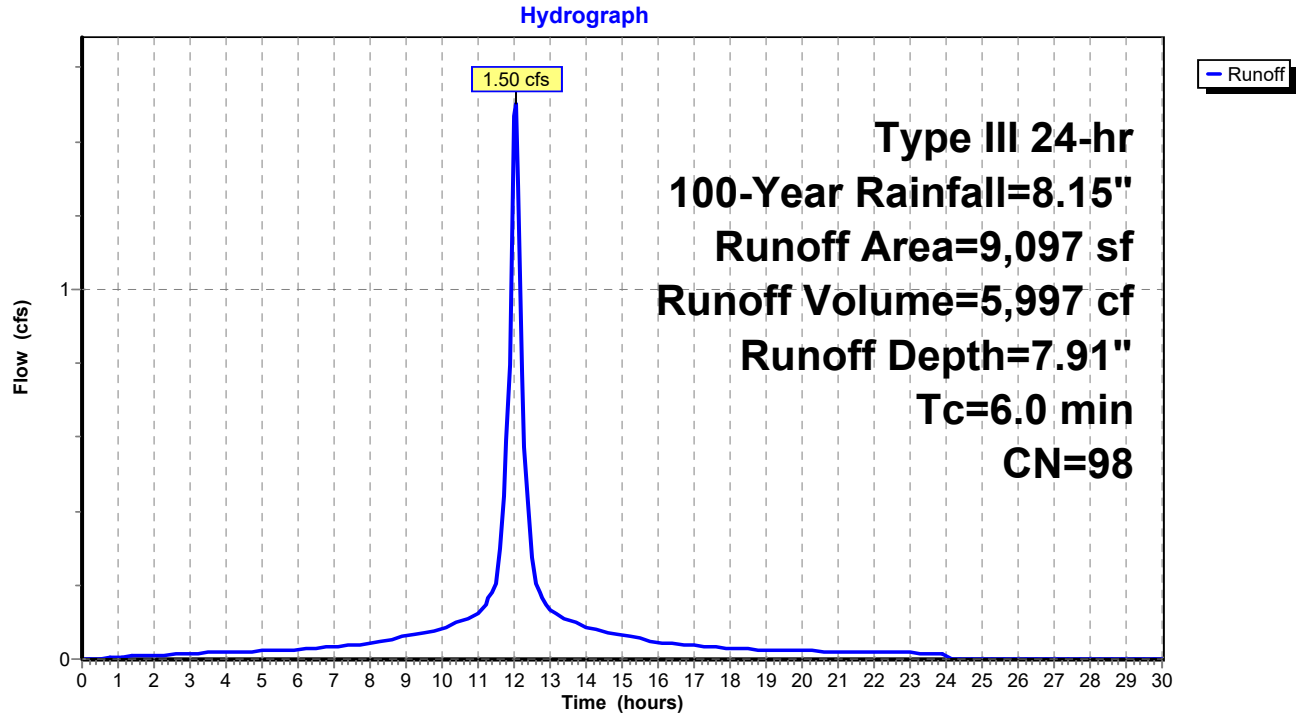
Runoff = 1.50 cfs @ 12.03 hrs, Volume= 5,997 cf, Depth= 7.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=8.15"

	Area (sf)	CN	Description
*	9,089	98	Impervious
	8	39	>75% Grass cover, Good, HSG A
	9,097	98	Weighted Average
	8		0.09% Pervious Area
	9,089		99.91% Impervious Area

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

Subcatchment P1: Post Area - Infiltration



Summary for Subcatchment P2: Post Area - Surface Runoff w impervious patio

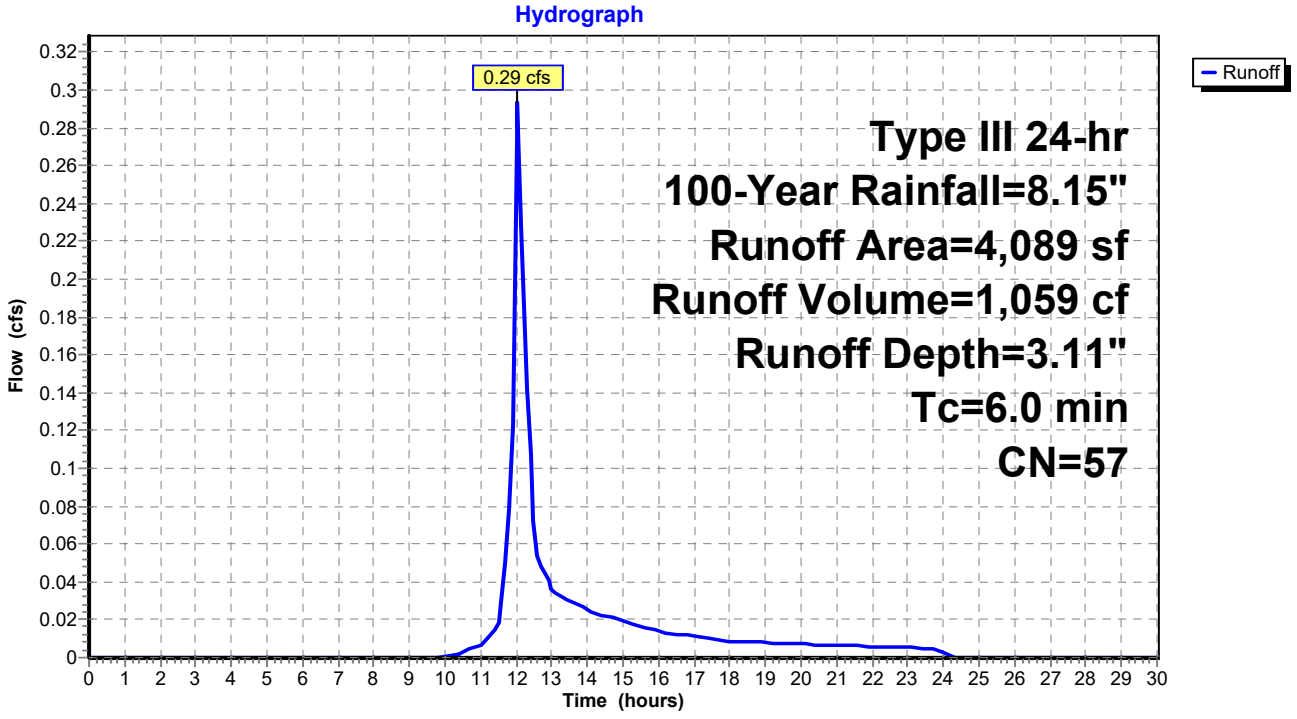
Runoff = 0.29 cfs @ 12.05 hrs, Volume= 1,059 cf, Depth= 3.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs
Type III 24-hr 100-Year Rainfall=8.15"

	Area (sf)	CN	Description
*	1,300	98	Impervious
	2,391	39	>75% Grass cover, Good, HSG A
	398	32	Woods/grass comb., Good, HSG A
	4,089	57	Weighted Average
	2,789		68.21% Pervious Area
	1,300		31.79% Impervious Area

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

Subcatchment P2: Post Area - Surface Runoff w impervious patio

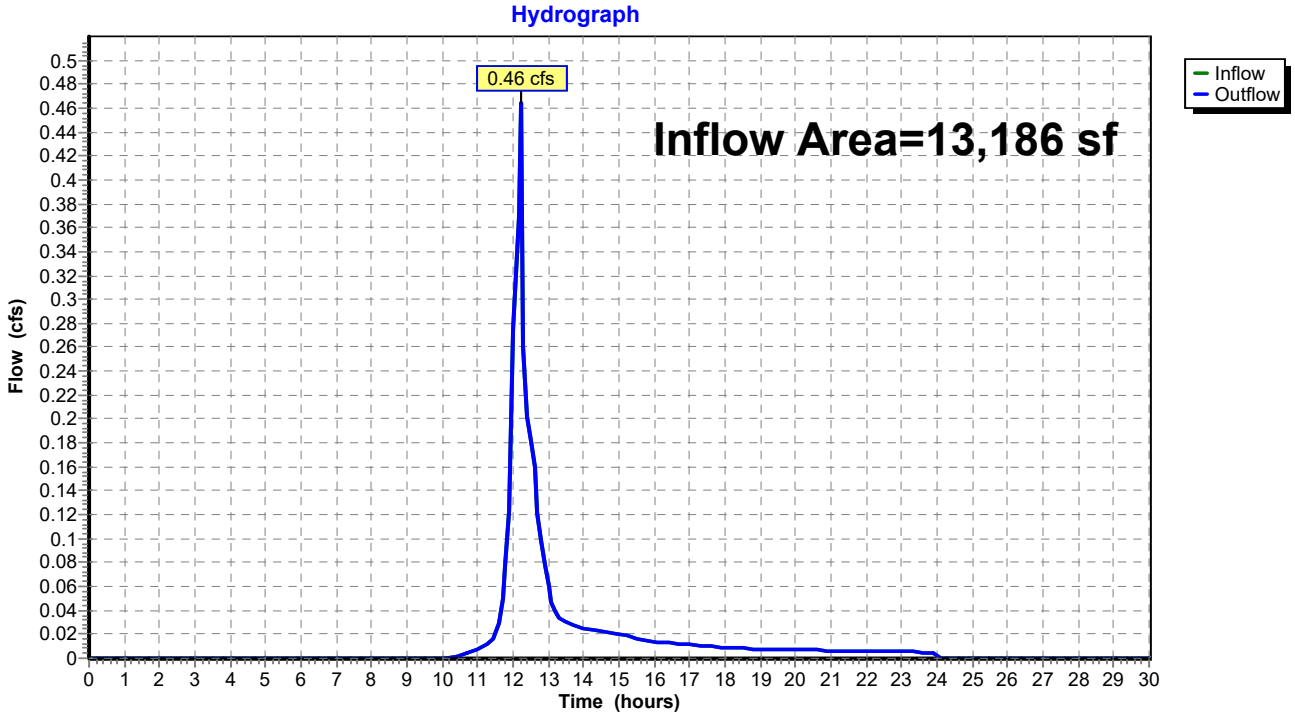


Summary for Reach P3: POST-Runoff

Inflow Area = 13,186 sf, 78.79% Impervious, Inflow Depth = 1.27" for 100-Year event
Inflow = 0.46 cfs @ 12.20 hrs, Volume= 1,391 cf
Outflow = 0.46 cfs @ 12.20 hrs, Volume= 1,391 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs

Reach P3: POST-Runoff



Summary for Pond PI: Proposed Infiltration System

Inflow Area = 9,097 sf, 99.91% Impervious, Inflow Depth = 7.91" for 100-Year event
Inflow = 1.50 cfs @ 12.03 hrs, Volume= 5,997 cf
Outflow = 0.41 cfs @ 12.21 hrs, Volume= 5,539 cf, Atten= 72%, Lag= 11.1 min
Discarded = 0.13 cfs @ 11.10 hrs, Volume= 5,208 cf
Primary = 0.29 cfs @ 12.21 hrs, Volume= 331 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 100.01' @ 12.22 hrs Surf.Area= 666 sf Storage= 1,418 cf

Plug-Flow detention time= 110.0 min calculated for 5,539 cf (92% of inflow)
Center-of-Mass det. time= 68.6 min (806.6 - 738.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	96.20'	683 cf	**11.00'W x 60.58'L x 3.67'H Field A** 2,443 cf Overall - 735 cf Embedded = 1,708 cf x 40.0% Voids
#2A	96.70'	735 cf	**ADS_StormTech SC-740 +Cap** x 16 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 16 Chambers in 2 Rows
		1,418 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	99.65'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Discarded	96.20'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.13 cfs @ 11.10 hrs HW=96.24' (Free Discharge)
↑└**2=Exfiltration** (Exfiltration Controls 0.13 cfs)

Primary OutFlow Max=0.26 cfs @ 12.21 hrs HW=99.97' (Free Discharge)
↑└**1=Orifice/Grate** (Orifice Controls 0.26 cfs @ 1.93 fps)

Pond PI: Proposed Infiltration System - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
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

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

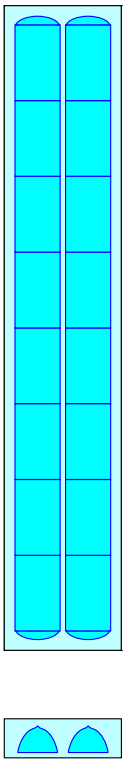
8 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 58.58' Row Length +12.0" End Stone x 2 = 60.58' Base Length
2 Rows x 51.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 11.00' Base Width
6.0" Stone Base + 30.0" Chamber Height + 8.0" Stone Cover = 3.67' Field Height

16 Chambers x 45.9 cf = 735.0 cf Chamber Storage

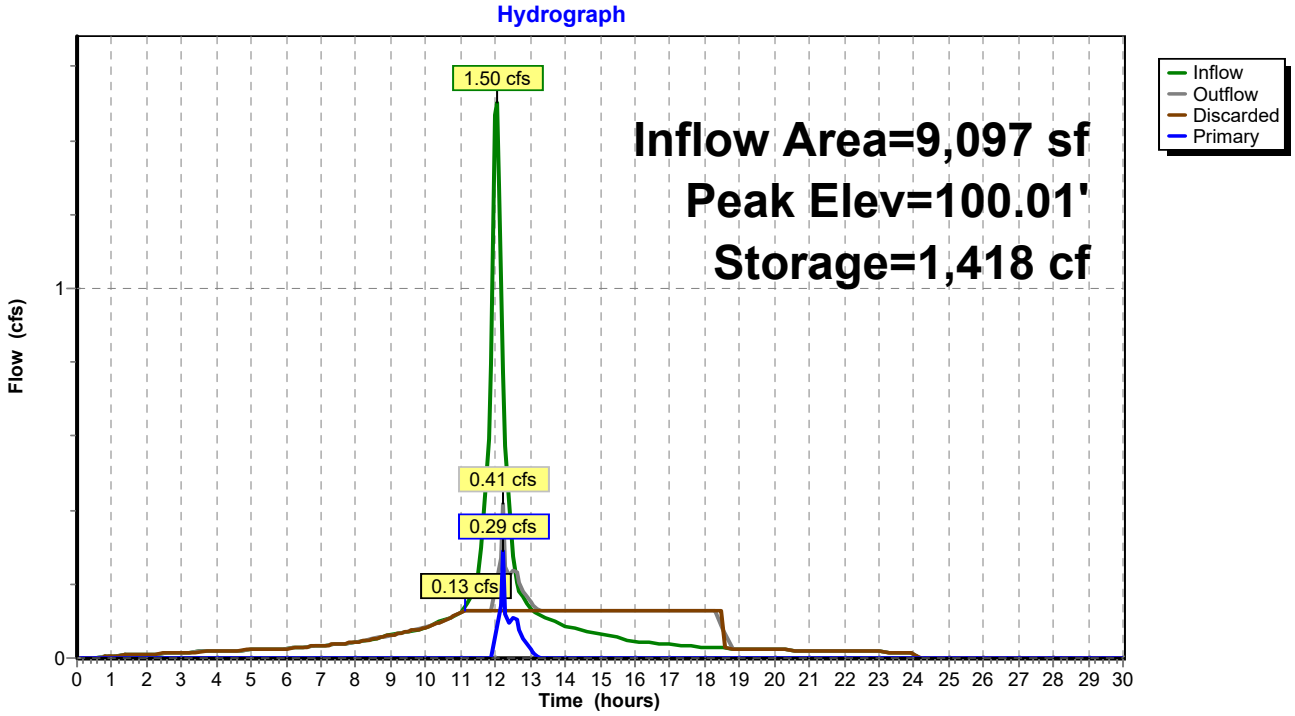
2,443.3 cf Field - 735.0 cf Chambers = 1,708.2 cf Stone x 40.0% Voids = 683.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,418.3 cf = 0.033 af
Overall Storage Efficiency = 58.1%
Overall System Size = 60.58' x 11.00' x 3.67'

16 Chambers @ $ 0.00 /ea = $ 0.00
90.5 cy Field Excavation @ $ 5.00 /cy = $ 452.46
63.3 cy Stone @ $ 0.00 /cy = $ 0.00
Total Cost = $ 452.46



Pond PI: Proposed Infiltration System



Events for Subcatchment P1: Post Area - Infiltration

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	3.28	0.60	2,310	3.05
10-Year	5.17	0.95	3,740	4.93
25-Year	6.34	1.16	4,625	6.10
100-Year	**8.15**	**1.50**	**5,997**	**7.91**

Events for Subcatchment P2: Post Area - Surface Runoff w impervious patio

Event	Rainfall (inches)	Runoff (cfs)	Volume (cubic-feet)	Depth (inches)
2-Year	3.28	0.02	115	0.34
10-Year	5.17	0.10	408	1.20
25-Year	6.34	0.17	643	1.89
100-Year	**8.15**	**0.29**	**1,059**	**3.11**

Events for Reach P3: POST-Runoff

Event	Inflow (cfs)	Outflow (cfs)	Elevation (feet)	Storage (cubic-feet)
2-Year	0.02	0.02	**0.00**	**0**
10-Year	0.10	0.10	0.00	0
25-Year	0.18	0.18	0.00	0
100-Year	**0.46**	**0.46**	0.00	0

Events for Pond PI: Proposed Infiltration System

Event	Inflow (cfs)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)	Elevation (feet)	Storage (cubic-feet)
2-Year	0.60	0.13	**0.13**	0.00	97.51	544
10-Year	0.95	0.13	0.13	0.00	98.81	1,121
25-Year	1.16	0.25	0.13	0.12	99.88	**1,418**
100-Year	**1.50**	**0.41**	0.13	**0.29**	**100.01**	1,418

FODERA ENGINEERING

Project: *7-Unit Multi-Family Building*
Address *373 Pleasant Street, Melrose MA*
Calculated By: *Giovanni G. Fodera, P.E.*
Date: *8/13/2021*

Standard 3 in the Massachusetts Stormwater Handbook, completed in accordance with 310 CMR 10.00 and 314 CMR 9.00

STANDARD 3 - PART 1: RECHARGE VOLUME CALCULATIONS, VOLUME

The intent of this standard is to ensure that the infiltration volume of precipitation into the ground under post-development conditions is at least as much as the infiltration volume under pre-development conditions. Standard 3 requires the restoration of recharge, using infiltration measures and careful site design. Through judicious use of low impact development techniques and other approaches that minimize impervious surfaces and mimic natural conditions, new developments can approximate pre-development recharge for most storms.

Soil Evaluation: Soil test were completed by a MassDEP approved soil evaluator (#1848) on July 23, 2021 by deep observation holes and determined the soils to be sand. Additionally the Natural Resources Conservation Service (NRCS) determined the site's soils to be classified as Hydrologic Soil Group "A", according to the Web Soil Survey.

Hydrologic Group Volume to Recharge (x Total Impervious Area)			
Hydrologic Soil Group	Soil Texture	Target Depth Factor (F)	
A	Sand	0.60	inches
B	Loam	0.35	inches
C	Silty Loam	0.25	inches
D	Clay	0.10	inches

Impervious Area Analysis:

	Pre-Development Impervious Area	Post-Development Impervious Area	Δ Impervious Area
Total	3,581	10,389	**6,808**

Required Recharge Volume:

Added Impervious Area (sf)	Target Depth (in)	Volume Required (cf)*
6,808	0.60	340

Required minimum 65% of site impervious directed to infiltration systems =	6,753	sf
Amount of site impervious directed to infiltration systems =	9,089	sf
Capture Area Adjustment (post dev. imp. area/imp. area routed through infiltration systems) =	1.143	
Therefore, total required recharge volume =	**389**	**cf**

Recharge Volume Provided:

Recharge System 1

Impervious area contributing to System 1: 9,089 sf
Total System 1 volume (per HydroCAD): **1,418 cf**

Total Volume of Recharge =	**1,418**	**>**	**389**	**(standard is met)**

FODERA ENGINEERING

Project: *7-Unit Multi-Family Building*
Address *373 Pleasant Street, Melrose MA*
Calculated By: *Giovanni G. Fodera, P.E.*
Date: *8/13/2021*

Standard 3 in the Massachusetts Stormwater Handbook, completed in accordance with 310 CMR 10.00 and 314 CMR 9.00

STANDARD 3 - PART 2: RECHARGE VOLUME CALCULATIONS, DRAWDOWN TIME

The intent of this standard is to ensure that the infiltration volume of precipitation into the ground under post-development conditions is at least as much as the infiltration volume under pre-development conditions. Standard 3 requires the restoration of recharge, using infiltration measures and careful site design. Through judicious use of low impact development techniques and other approaches that minimize impervious surfaces and mimic natural conditions, new developments can approximate pre-development recharge for most storms. The intent of this calculation is to size an infiltration system that will approximate the annual recharge from the existing conditions.

Soil Evaluation: Soil test were completed by a MassDEP approved soil evaluator (#1848) on July 23, 2021 by deep observation holes and determined the soils to be sand. Additionally the Natural Resources Conservation Service (NRCS) determined the site's soils to be classified as Hydrologic Soil Group "A", according to the Web Soil Survey.

Hydrologic Group Volume to Recharge (x Total Impervious Area)			
Hydrologic Soil Group	Soil Texture	Target Depth Factor (F)	
A	Sand	0.60	inches
B	Loam	0.35	inches
C	Silty Loam	0.25	inches
D	Clay	0.10	inches

Required Drawdown Time: Drawdown time calculated below must meet a minimum of 72 hours to conform to the MA Stormwater Handbook.

$$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ Area)}$$

Rv = Storage Volume
K = Saturated Hydraulic Conductivity for the static method (Rawls Rate)
Bottom Area = Bottom Area of Recharge Structure

Recharge System 1

Rv (cu-ft) = 1,418
K = 0.60
Bottom Area (sq-ft) = 666

Drawdown Time (hrs) = 3.55 **(Conforms to Standard 3)**

FODERA ENGINEERING

Project: *7-Unit Multi-Family Building*
Address *373 Pleasant Street, Melrose MA*
Calculated By: *Giovanni G. Fodera, P.E.*
Date: *8/13/2021*

Standard 4 in the Massachusetts Stormwater Handbook, completed in accordance with 310 CMR 10.00 and 314 CMR 9.00

STANARD 4 - WATER QUALITY CALCULATIONS, WQ VOLUME

Runoff from impervious surfaces flow overland and gather solids as the stormwater is directed into conveyance systems, and can have adverse effects to water pollution. Standard 4 was implemented for stormwater management systems to be designed to remove 80% of the average annual post-development load of Total Suspended Solids (TSS). Runoff volume requiring appropriate TSS treatment is known as the required water quality volume.

Pavement Area Analysis:

	Pre-Development Impervious Area	Post-Development Impervious Area	Δ Impervious Area
Total Pavement Driving Surface	1,259	3,741	**2,482**

Land Type: 1" of runoff multipled by post-development impervious area for sites located in LUHPPL, rapid infiltration rates, Zone II, Interim Wellhead Protection Areas, or critical areas.
0.5" of runoff multipled by post-development imperious area for all other land types.

Design Calculation: WQ Volume = 1" x post-development impervious area
(Site is in an area of rapid infiltration)

Required Water Quality Volume:

Post-development Impervious Area (sf)	Target Depth (in)	Volume Required (cf)*
2,482	1.0	207

Total required WQ volume = 207 cf

Basin Volume Provided:

Recharge System 1
Total System 1 volume (per HydroCAD): **1,418 cf**

Total WQ Volume Recharged =	**1,418**	**>**	**207**	**(standard is met)**

FODERA ENGINEERING

Project: *7-Unit Multi-Family Building*
Address *373 Pleasant Street, Melrose MA*
Calculated By: *Giovanni G. Fodera, P.E.*
Date: *8/13/2021*

Standard 4 in the Massachusetts Stormwater Handbook, completed in accordance with 310 CMR 10.00 and 314 CMR 9.00

STANDARD 4 -WATER QUALITY CALCULATIONS, TSS REMOVAL

Runoff from impervious surfaces flow overland and gather solids as the stormwater is directed into conveyance systems, and can have adverse effects to water pollution. Standard 4 was implemented for stormwater management systems to be designed to remove 80% of the average annual post-development load of Total Suspended Solids (TSS). Runoff volume requiring appropriate TSS treatment is known as the required water quality volume.

Treatment Train 1:

1. **Catch Basin with Deep Sump & Hood**
2. **Manhole with Deep Sump & Hood**
3. **StormTech Infiltration System & Isolator Row**

	B	C	D	E	F
Pretreatment BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (BxC)	Remaining Load (C-D)	TSS Removal Rate
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**	**25%**
Deep Sump and Hooded Catch Basin	**0.25**	**0.75**	**0.19**	**0.56**	**44%**

	B	C	D	E	F
Treatment BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (BxC)	Remaining Load (C-D)	TSS Removal Rate
Subsurface Infiltration Structure	**0.80**	**0.56**	**0.45**	**0.11**	**89%**

Pretreatment TSS Removal =	**44%**	**(standard is met)**
Treatment TSS Removal =	**89%**	**(standard is met)**

Note: Roof runoff does not require pretreatment

APPENDIX D – OPERATION & MAINTENANCE

O & M INSPECTION LOG

STORMTECH ISOLATOR ROW MAINTENCE MANUAL

OPERATION & MAINTENANCE LOG

Inspection Date:_____

Inspector's Name:_____

System Inspected	Finding of Inspection	Actions Made for Maintenance
Catch Basin / Inlets: Inspect at least once per year and cleaned when the sump has accumulated to a depth of one (1) foot of sediment.		
Subsurface Infiltration and Isolator Row: Inspect through inspection port as detailed in the Long-Term Operation and Maintenance Plan, and/ or as detailed in the StormTech® Isolator Row O&M Manual.		

StormTech®
Detention • Retention • Water Quality
An ADS company

Isolator® Row O&M Manual


SC-740


MC-3500


MC-4500

*THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™*

ADS®

THE ISOLATOR® ROW

INTRODUCTION

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

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The woven geotextile provides a media for stormwater filtration, a durable surface for maintenance, prevents scour of the underlying stone and remains intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole provides access to the Isolator Row and typically includes a high flow weir. When flow rates or volumes exceed the Isolator Row weir capacity the water will flow over the weir and discharge through a manifold to the other chambers.

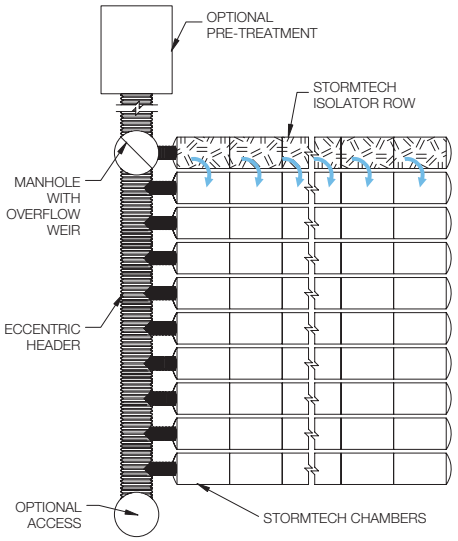
Another acceptable design uses one open grate inlet structure. Using a "high/low" design (low invert elevation on the Isolator Row and a higher invert elevation on the manifold) an open grate structure can provide the advantages of the Isolator Row by creating a differential between the Isolator Row and manifold thus allowing for settlement in the Isolator Row.

The Isolator Row may be part of a treatment train system. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

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

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

StormTech Isolator Row with Overflow Spillway (not to scale)



ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

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

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

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

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

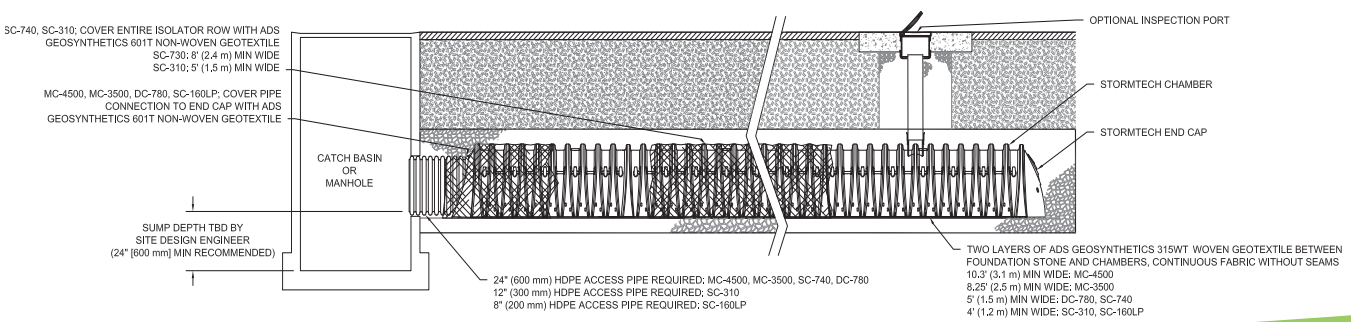
MAINTENANCE

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

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

STEP 1

Inspect Isolator Row for sediment.

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

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

STEP 2

Clean out Isolator Row using the JetVac process.

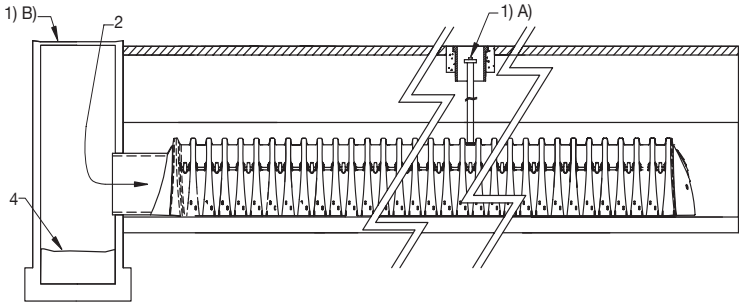
A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

STEP 3

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

STEP 4

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



SAMPLE MAINTENANCE LOG

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

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