STORMWATER MANAGEMENT REPORT

Bonney Drive Extension
Holliston, Massachusetts

September 7, 2023
Revised: January 17, 2024

Prepared for:

Murch Prentice Realty Trust
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Project Introduction:

The applicant, Murch Prentice Realty Trust, is proposing to develop a three (3) lot single family Open Space Residential Subdivision located off Bonney Drive in Holliston, Massachusetts. The existing property consist of approximately 7.75 acres of land area.

The Project will be serviced by town water, onsite sewage disposal systems and other available public utilities. The stormwater generated from the Project will be captured, conveyed, treated and mitigated on-site utilizing Best Management Practices.

The purpose of these calculations is to demonstrate design compliance of the Project's stormwater management system for water quality and quantity, specifically post-development peak discharge rates per the DEP's Stormwater Management Policy, the Town of Holliston Land Subdivision Regulations. As designed, the system will mitigate peak rates of runoff for storms up to and including the 100-year event under post-construction conditions.

Methodology/Sources of Data:

The pre- and post-development drainage calculations were prepared using the U.S. Soil Conservation Service Technical Release20 - Urban Hydrology for storm Small Watersheds. Rainfall calculations for Stormwater management BMP's shall be as per the National Resources Conservation Service Precipitation Frequency Analysis for New York and the New England States.

The overall storm water management plan for the project is designed to maintain the peak rate of storm water runoff and runoff volumes from the site after development. The Soil Conservation Service Modified Soil Cover Complex Method, the computer program "HydroCAD" by Applied Microcomputer Systems, and the procedures specified in Urban Hydrology for storm Small Watersheds were used to determine pre-and post-developed peak flow rates of runoff from the site. The 2-year, 10-year, 25-year and 100-year storm events have been utilized for hydrology calculations. The rainfall data for the Type III, 24-hour storm events follow:

24-Hour Storm	Rainfall (inches)
2	3.47
10	4.75
25	6.00
50	7.30
100	8.57

The storm water runoff will be controlled through the use of "Best Management Practices" and in conformance with the MADEP Stormwater Management Policy. The proposed Project will result in an improvement over the existing conditions, by constructing a storm water management system that will provide treatment, groundwater recharge and reduce the peak rates of runoff and offsite runoff volumes.

The piped drainage system has been designed utilizing the Rational Method for the 25 year storm event to size street drains.

Soils:

The Natural Resources Conservation Service (NRCS), Hydrologic Soils Group Map for Middlesex county, Massachusetts indicates that the on-site soils consist of Merrimac fine sand-254B. NRCS assigned hydrologic soil rating for these soils A classification. On-site soil testing was performed to determine groundwater elevations and confirm soil classifications.

The soils are classified as Hydrologic Group A, Sand. The Rawles Rate of 8.27 inches/hour was used in the calculations. (See Table)

Table 2.3.3. 1982 Rawls Rates

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

Existing Conditions Overview:

The Project is located off Bonnie Drive and identified as Assessor Map 7, Block 4, Lot 55.D containing approximately 7.75 +/- acres. The site is currently undeveloped woodland. There is a bordering vegetated wetland area located at the rear of property.

The existing site is divided into two (2) existing watershed subcatchment areas. See the attached Pre-Development Subcatchment Area Plan for delineations. Subcatchment E1 flows via overland in a westerly direction to the wetland area. Subcatment E2 flows via overland to the easterly wetland area..

Proposed Conditions Overview:

The proposal is to subdivide the property as an Open Space Residential Subdivision consisting of three (3) single family dwellings. The proposed roadway extends from Bonnie Drive to a cul-de-sac approximately three-hundred (300) feet in length. The proposed stormwater drainage system is designed to capture the runoff utilizing catch basins, manholes and culverts to convey the stormwater to a drainage basin located at the end of the proposed roadway. The roof runoff from the proposed dwellings will be conveyed via gutters and downspouts to underground recharge systems.

The proposed runoff areas have been divided into three (3) subcatchments. Subcatchment P1 captures the roadway runoff and discharges to the proposed recharge basin. Subcathment P2 bypasses the basin and flows via overland to the easterly wetland area. Subcatchment P3 flows via overland to the westerly wetland area. The drainage basin has been design to infiltrate the runoff for the all storm events.

The proposed systems will reduce all post-development flow rates and volumes of runoff up to and including the 100-year event to existing levels at all abutting areas. Existing uncaptured off-site runoff not associated with the Project will continue to flow overland without change.

The following is summary comparison of Pre- and Post-Developed Rates and Volumes of Runoff:

Summary of Peak Stormwater Runoff Rates:										
Design Point	**2-Yr Peak Flow (cfs)**		**10-Yr Peak Flow (cfs)**		**25-Yr Peak Flow (cfs)**		**50-Yr Peak Flow (cfs)**		**100-Yr Peak Flow (cfs)**	
	Exist	***Prop.***	***Exist***	***Prop.***	***Exist***	***Prop.***	***Exist***	***Prop.***	***Exist***	***Prop.***
E1/ P2	0.00	0.00	0.01	0.01	0.03	0.04	0.07	0.13	0.26	0.31
E2/ P3	0.00	0.00	0.00	0.00	0.03	0.04	0.06	0.14	0.23	0.30

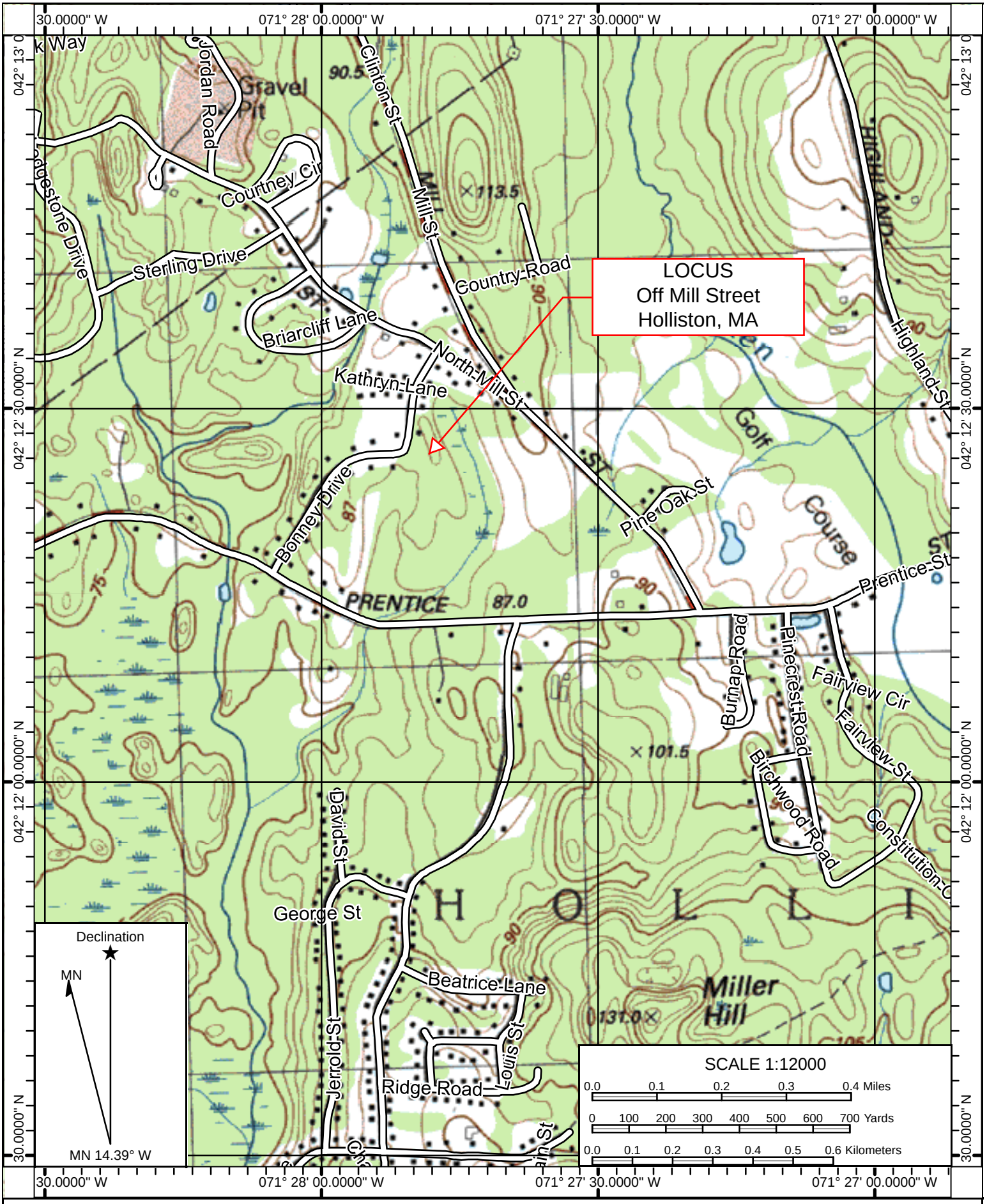
Summary of Peak Stormwater Volumes of Runoff:										
Design Point	**2-Yr Peak Volume (af)**		**10-Yr Peak Volume (af)**		**25-Yr Peak Volume (af)**		**50-Yr Peak Volume (af)**		**100-Yr Peak Volume (af)**	
	Exist	***Prop.***	***Exist***	***Prop.***	***Exist***	***Prop.***	***Exist***	***Prop.***	***Exist***	***Prop.***
E1/ P2	0.00	0.00	0.00	0.00	0.02	0.02	0.04	0.04	0.07	0.07
E2/ P3	0.00	0.00	0.00	0.00	0.01	0.01	0.04	0.04	0.06	0.06

The following is a summary of the Retention Basin:

Summary of Retention Basin										
Design Point	**2-Yr Peak Storm**		**10-Yr Peak Storm**		**25-Yr Peak Storm**		**50-Yr Peak Storm**		**100-Yr Peak Storm**	
	Peak Elev.Ft.	***Inflow (cfs)***	***Peak Elev. Ft.***	***Inflow (cfs)***	***Peak Elev.Ft.***	***Inflow (cfs)***	***Peak Elev.Ft.***	***Inflow (cfs)***	***Peak Elev.Ft.***	***Inflow (cfs)***
1P	276.63	0.29	277.35	1.35	277.80	2.06	278.16	2.69	278.55	3.41

Summary:

The calculations performed for all design storm events indicate that the total peak rates and volume s of runoff will have no significant adverse impact to the abutting resource areas. With the implementation of the stormwater management system as designed, along with the Operation and Maintenance plan contained herein, all of the objectives of the DEP's Stormwater Management Regulations are satisfied.

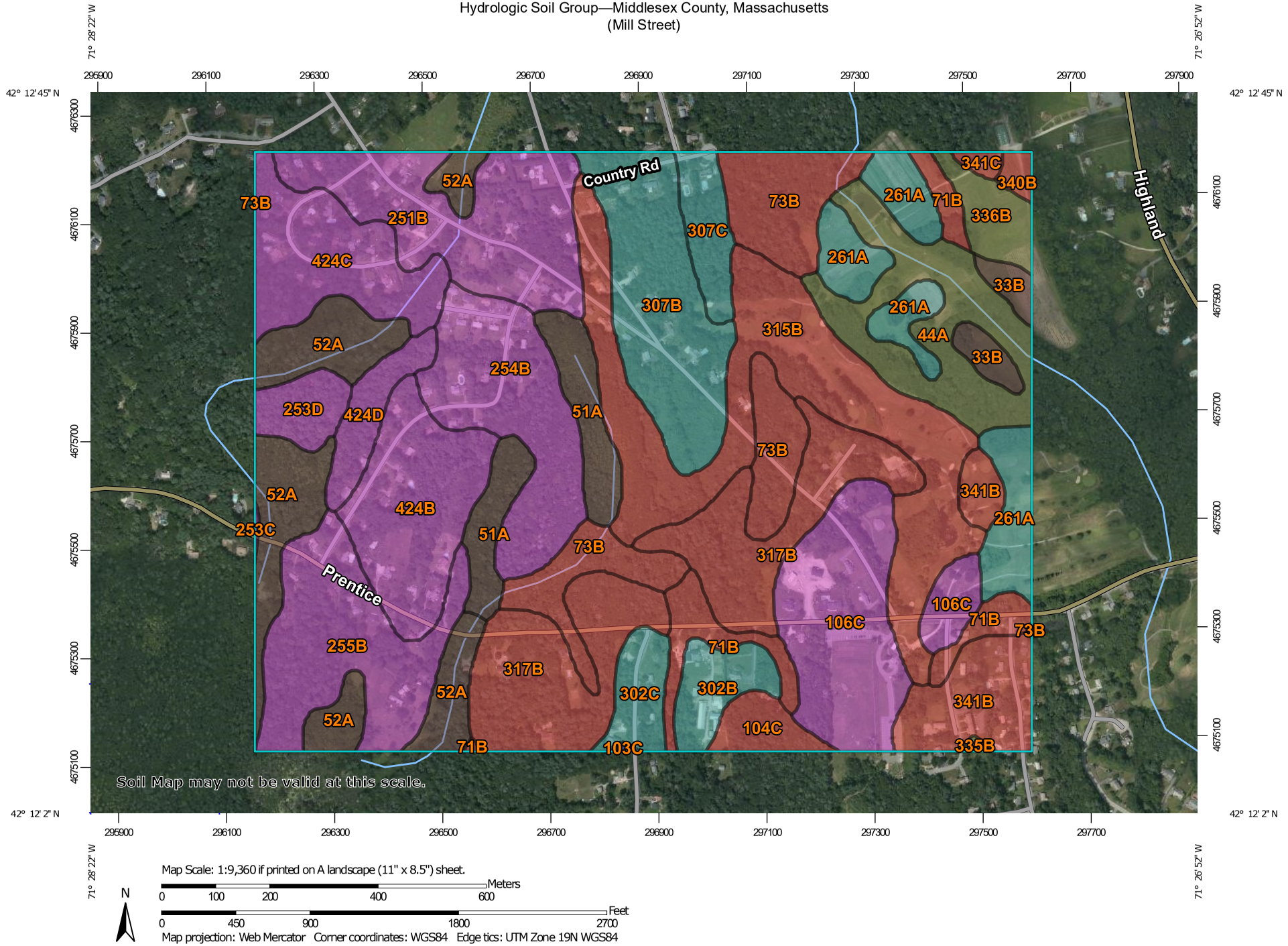


Name: MEDFIELD
Date: 07/26/19
Scale: 1 inch = 1,000 ft.

Location: 042° 12' 14.5689" N, 071° 27' 41.4534" W
Lot 12 Prentice Street, Holliston, MA

Datum: NAD27

Hydrologic Soil Group—Middlesex County, Massachusetts
(Mill Street)



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 19, Sep 12, 2019

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

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

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
33B	Raypol silt loam, 0 to 5 percent slopes	B/D	3.8	1.0%
44A	Birdsall mucky silt loam, 0 to 1 percent slopes	C/D	19.1	4.9%
51A	Swansea muck, 0 to 1 percent slopes	B/D	11.8	3.0%
52A	Freetown muck, 0 to 1 percent slopes	B/D	25.2	6.4%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	9.9	2.5%
73B	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	D	24.1	6.1%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	B	0.2	0.0%
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes	D	4.0	1.0%
106C	Narragansett-Hollis-Rock outcrop complex, 3 to 15 percent slopes	A	25.7	6.5%
251B	Haven silt loam, 3 to 8 percent slopes	A	24.8	6.3%
253C	Hinckley loamy sand, 8 to 15 percent slopes	A	0.1	0.0%
253D	Hinckley loamy sand, 15 to 25 percent slopes	A	4.8	1.2%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	21.6	5.5%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	23.2	5.9%
261A	Tisbury silt loam, 0 to 3 percent slopes	C	16.8	4.3%
302B	Montauk fine sandy loam, 0 to 8 percent slopes, extremely stony	C	6.1	1.5%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
302C	Montauk fine sandy loam, 8 to 15 percent slopes, extremely stony	C	5.2	1.3%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	C	23.2	5.9%
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	C	5.7	1.5%
315B	Scituate fine sandy loam, 3 to 8 percent slopes	D	41.2	10.4%
317B	Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony	D	35.8	9.1%
335B	Rainbow silt loam, 3 to 8 percent slopes	C/D	0.2	0.1%
336B	Rainbow silt loam, 3 to 8 percent slopes, very stony	C/D	5.0	1.3%
340B	Broadbrook very fine sandy loam, 3 to 8 percent slopes	D	1.1	0.3%
341B	Broadbrook very fine sandy loam, 3 to 8 percent slopes, very stony	D	12.8	3.2%
341C	Broadbrook very fine sandy loam, 8 to 15 percent slopes, very stony	D	0.8	0.2%
424B	Canton fine sandy loam, 3 to 8 percent slopes, extremely bouldery	A	19.5	4.9%
424C	Canton fine sandy loam, 8 to 15 percent slopes, extremely bouldery	A	16.9	4.3%
424D	Canton fine sandy loam, 15 to 25 percent slopes, extremely bouldery	A	5.6	1.4%
Totals for Area of Interest			**394.2**	**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

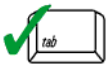
Tie-break Rule: Higher

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

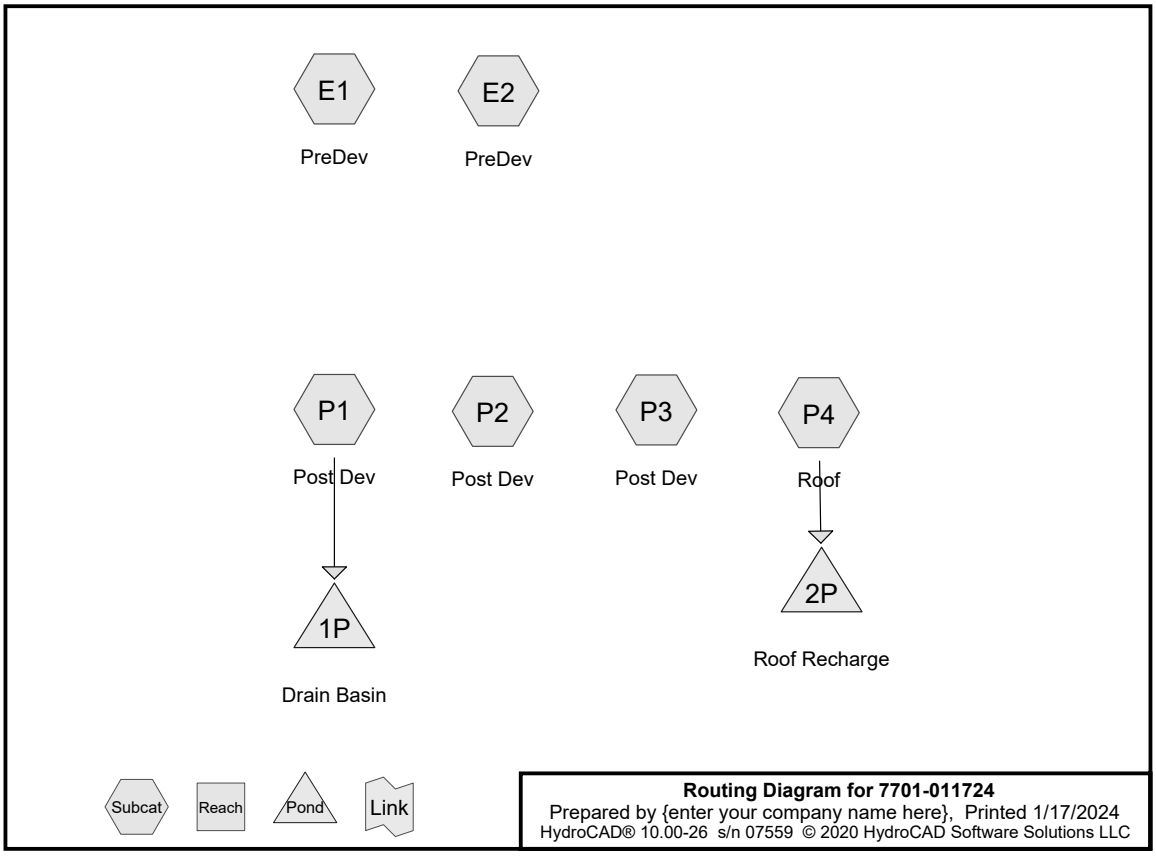
☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX – A

Hydrogeological Calculations for Pre & Post Development
Hydraulic Design (Manning's Equation)

Standard 2



Summary for Subcatchment E1: PreDev

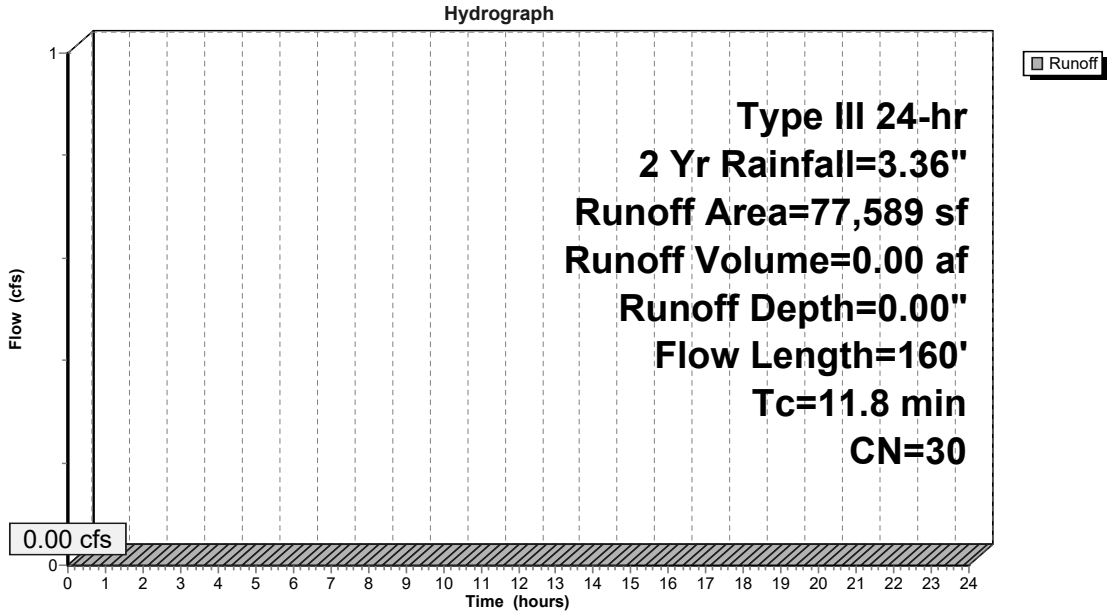
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.00 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.36"

Area (sf)	CN	Description
77,589	30	Woods, Good, HSG A
77,589		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	50	0.0250	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	110	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
11.8	160	Total			

Subcatchment E1: PreDev



Summary for Subcatchment E2: PreDev

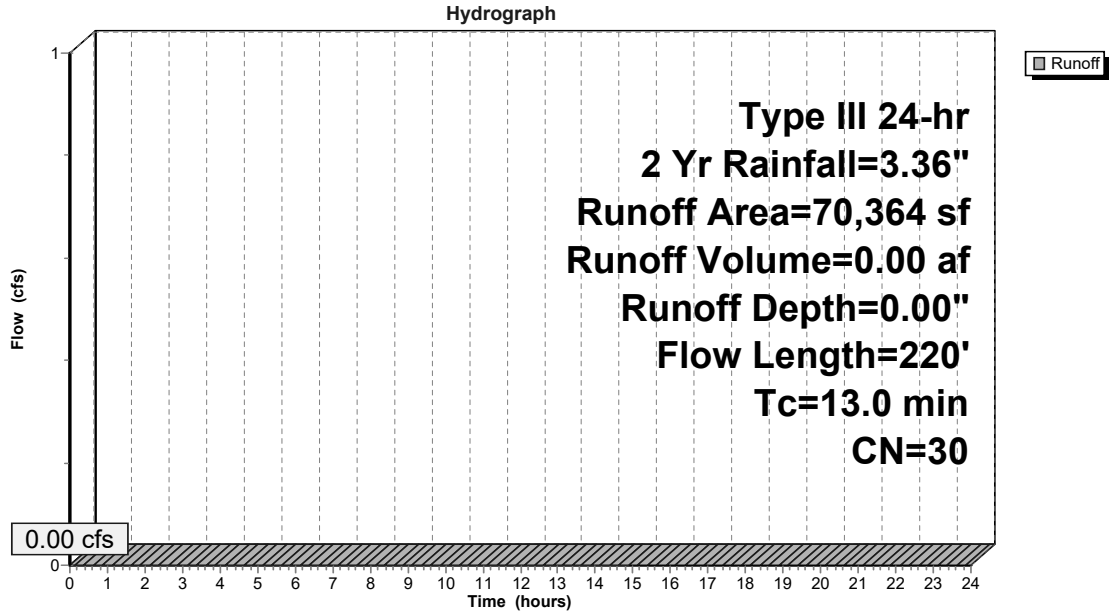
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.00 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.36"

Area (sf)	CN	Description
70,364	30	Woods, Good, HSG A
70,364		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	170	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
13.0	220	Total			

Subcatchment E2: PreDev



Summary for Subcatchment P1: Post Dev

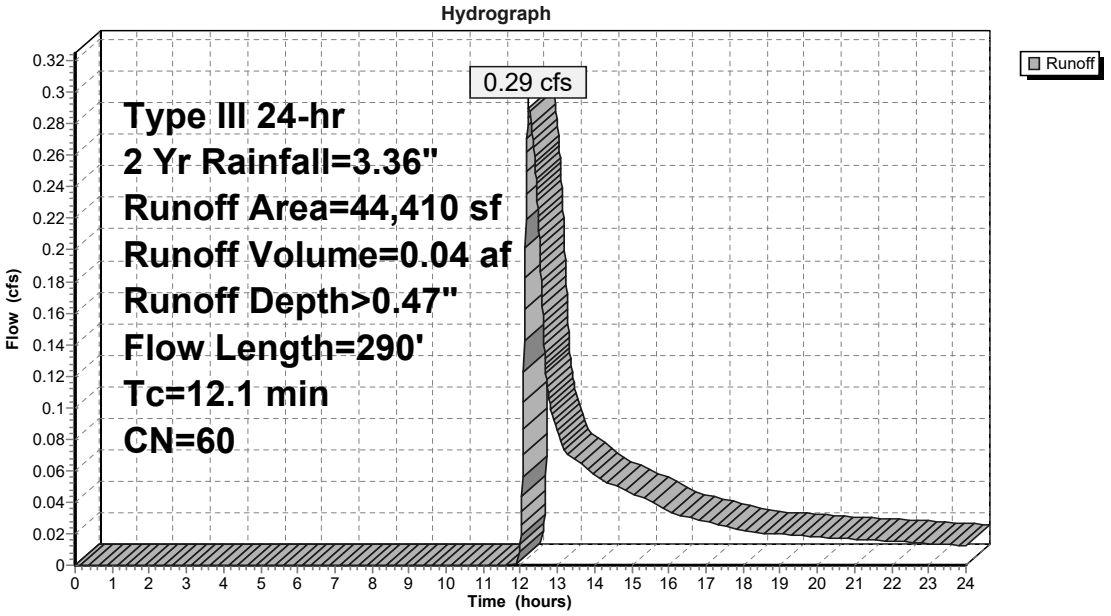
Runoff = 0.29 cfs @ 12.23 hrs, Volume= 0.04 af, Depth> 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.36"

	Area (sf)	CN	Description
*	15,463	98	Road, Drive, Walks, HSG A
	28,947	39	>75% Grass cover, Good, HSG A
	44,410	60	Weighted Average
	28,947		65.18% Pervious Area
	15,463		34.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.3	240	0.0050	3.18	2.47	**Pipe Channel, B-C** 12.0" Round w/ 0.5" inside fill Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
12.1	290	Total			

Subcatchment P1: Post Dev



Summary for Subcatchment P2: Post Dev

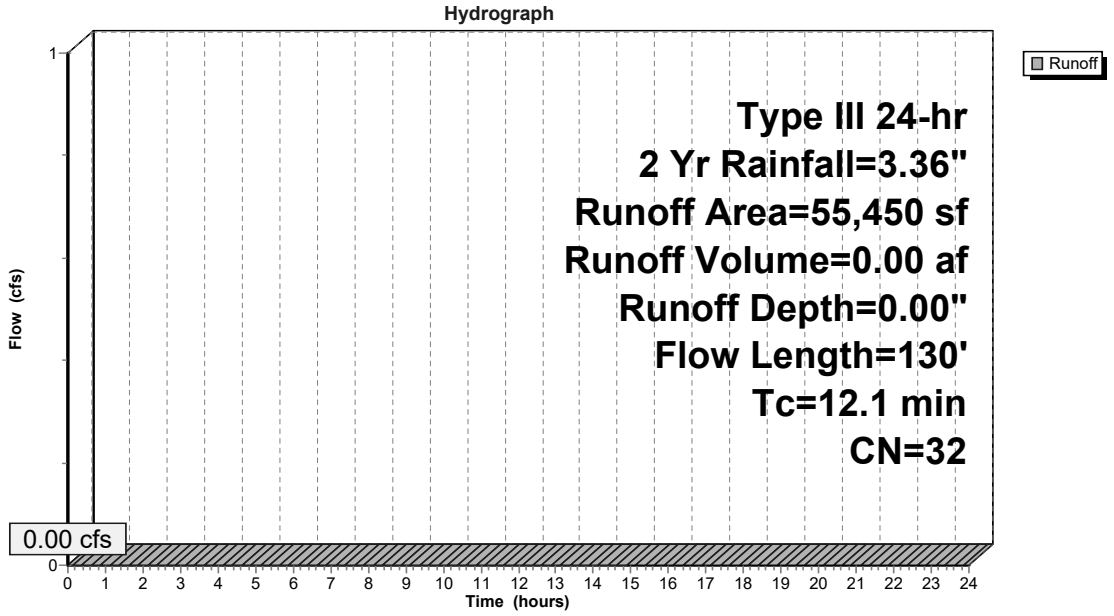
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.00 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.36"

Area (sf)	CN	Description
40,284	30	Woods, Good, HSG A
15,166	39	>75% Grass cover, Good, HSG A
55,450	32	Weighted Average
55,450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0080	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
0.3	80	0.0800	4.55		**Shallow Concentrated Flow, 27** Unpaved Kv= 16.1 fps
12.1	130	Total			

Subcatchment P2: Post Dev



Summary for Subcatchment P3: Post Dev

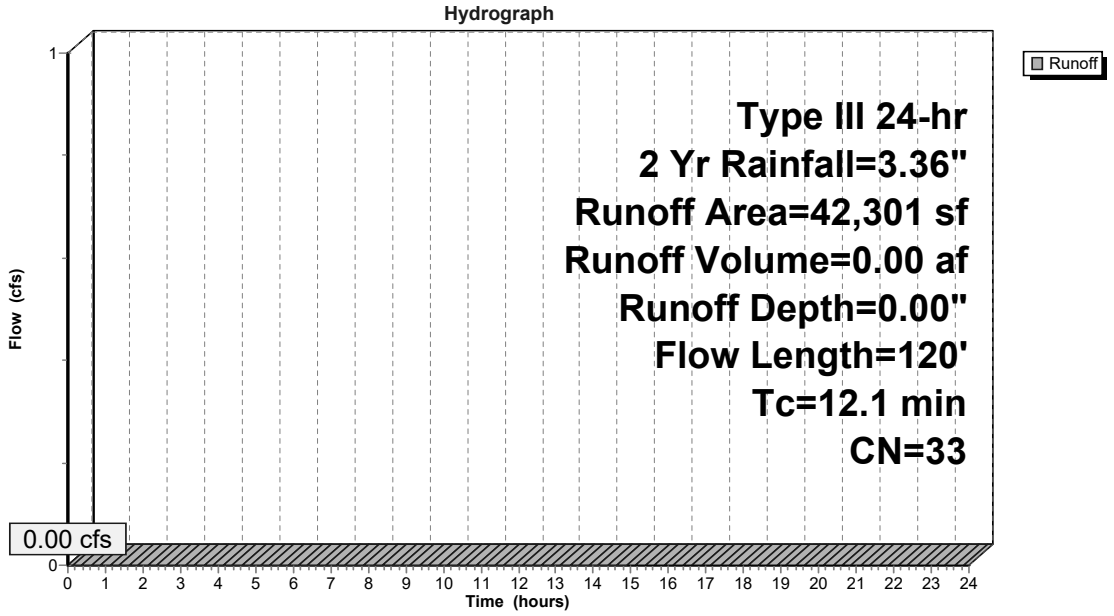
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.00 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.36"

Area (sf)	CN	Description
27,678	30	Woods, Good, HSG A
14,623	39	>75% Grass cover, Good, HSG A
42,301	33	Weighted Average
42,301		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0080	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
0.3	70	0.0800	4.55		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
12.1	120	Total			

Subcatchment P3: Post Dev



Summary for Subcatchment P4: Roof

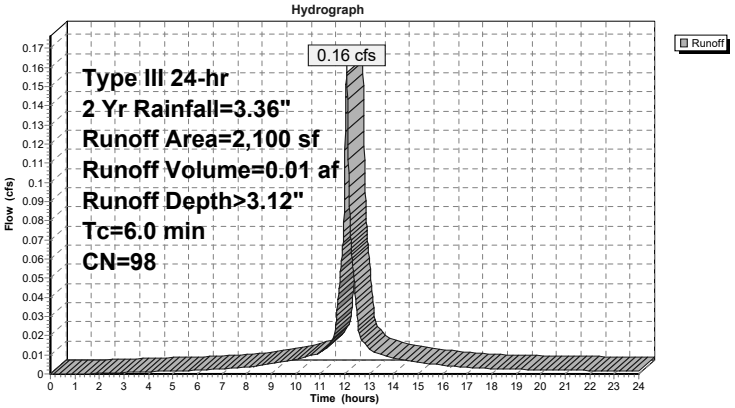
Runoff = 0.16 cfs @ 12.08 hrs, Volume= 0.01 af, Depth> 3.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Yr Rainfall=3.36"

	Area (sf)	CN	Description
*	2,100	98	Roof Area
	2,100		100.00% Impervious Area

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

Subcatchment P4: Roof



Summary for Pond 1P: Drain Basin

Inflow Area = 1.020 ac, 34.82% Impervious, Inflow Depth > 0.47" for 2 Yr event
Inflow = 0.29 cfs @ 12.23 hrs, Volume= 0.04 af
Outflow = 0.21 cfs @ 12.51 hrs, Volume= 0.04 af, Atten= 28%, Lag= 16.8 min
Discarded = 0.21 cfs @ 12.51 hrs, Volume= 0.04 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.00 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 276.63' @ 12.51 hrs Surf.Area= 1,042 sf Storage= 120 cf

Plug-Flow detention time= 5.4 min calculated for 0.04 af (100% of inflow)
Center-of-Mass det. time= 4.4 min (921.5 - 917.1)

Volume	Invert	Avail.Storage	Storage Description
#1	276.50'	17,878 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

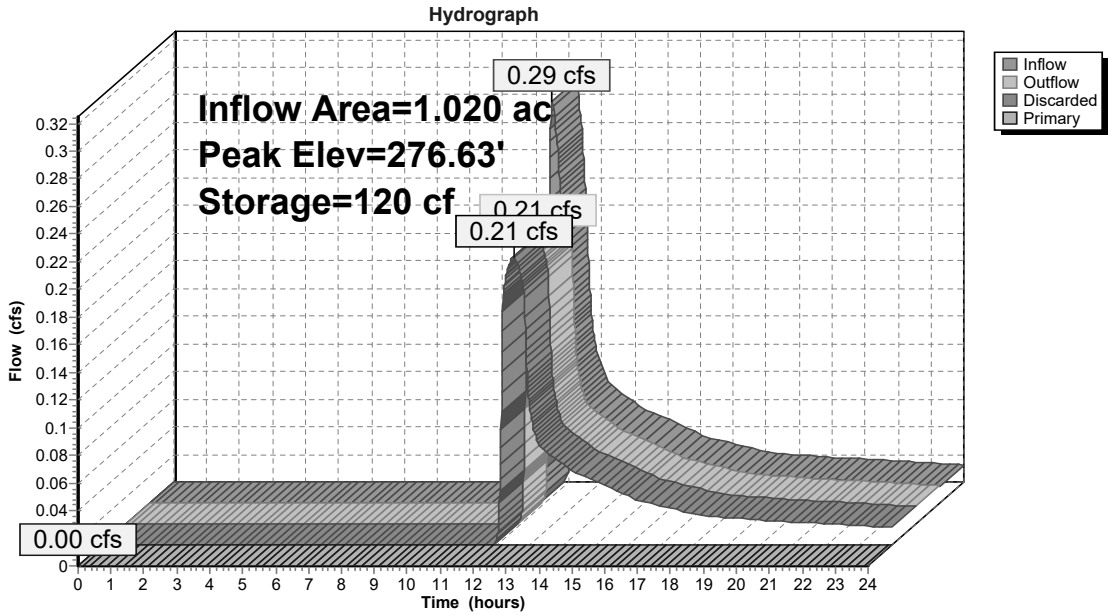
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
276.50	854	171.0	0	0	854
277.00	1,710	271.0	629	629	4,373
278.00	2,415	332.0	2,052	2,681	7,316
278.50	2,750	339.0	1,290	3,971	7,725
278.60	2,815	340.0	278	4,250	7,789
280.00	3,790	356.0	4,607	8,856	8,800
282.00	5,272	383.0	9,021	17,878	10,552

Device	Routing	Invert	Outlet Devices
#1	Discarded	276.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 274.00'
#2	Primary	281.00'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.1' Crest Height

Discarded OutFlow Max=0.21 cfs @ 12.51 hrs HW=276.63' (Free Discharge)
└**1=Exfiltration** (Controls 0.21 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=276.50' (Free Discharge)
└**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Drain Basin



Summary for Pond 2P: Roof Recharge

Inflow Area = 0.048 ac,100.00% Impervious, Inflow Depth > 3.12" for 2 Yr event
Inflow = 0.16 cfs @ 12.08 hrs, Volume= 0.01 af
Outflow = 0.06 cfs @ 12.33 hrs, Volume= 0.01 af, Atten= 64%, Lag= 14.8 min
Discarded = 0.06 cfs @ 12.33 hrs, Volume= 0.01 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 278.96' @ 12.33 hrs Surf.Area= 189 sf Storage= 86 cf

Plug-Flow detention time= 7.9 min calculated for 0.01 af (100% of inflow)
Center-of-Mass det. time= 7.8 min (762.6 - 754.8)

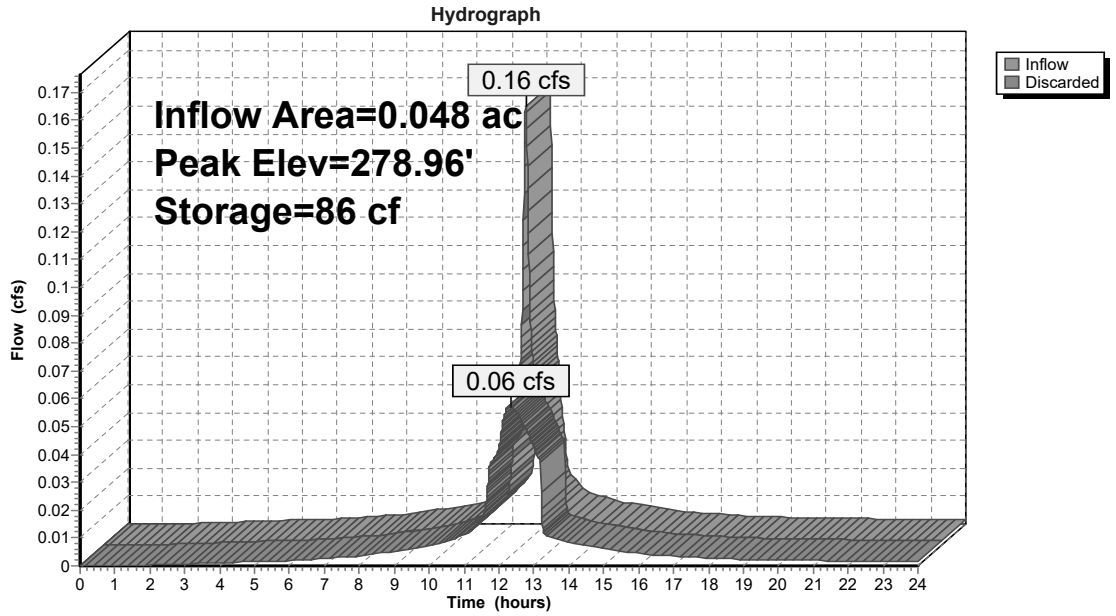
Volume	Invert	Avail.Storage	Storage Description
#1A	278.00'	208 cf	**9.00'W x 21.00'L x 3.67'H Field A** 693 cf Overall - 173 cf Embedded = 520 cf x 40.0% Voids
#2A	278.50'	125 cf	**Concrete Galley 4x4x3** x 4 Inside #1 Inside= 42.0"W x 30.0"H => 8.91 sf x 3.50'L = 31.2 cf Outside= 48.0"W x 36.0"H => 10.81 sf x 4.00'L = 43.2 cf
		333 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	278.00'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 274.00'

Discarded OutFlow Max=0.06 cfs @ 12.33 hrs HW=278.96' (Free Discharge)
1=Exfiltration (Controls 0.06 cfs)

Pond 2P: Roof Recharge



Summary for Subcatchment E1: PreDev

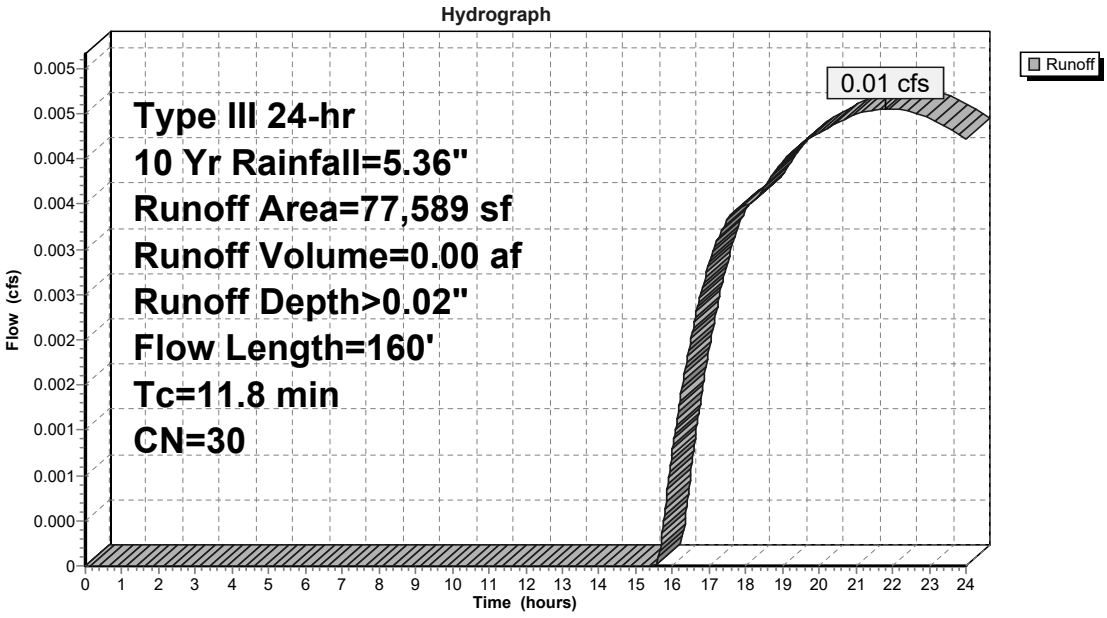
Runoff = 0.01 cfs @ 21.83 hrs, Volume= 0.00 af, Depth> 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=5.36"

Area (sf)	CN	Description
77,589	30	Woods, Good, HSG A
77,589		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	50	0.0250	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	110	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
11.8	160	Total			

Subcatchment E1: PreDev



Summary for Subcatchment E2: PreDev

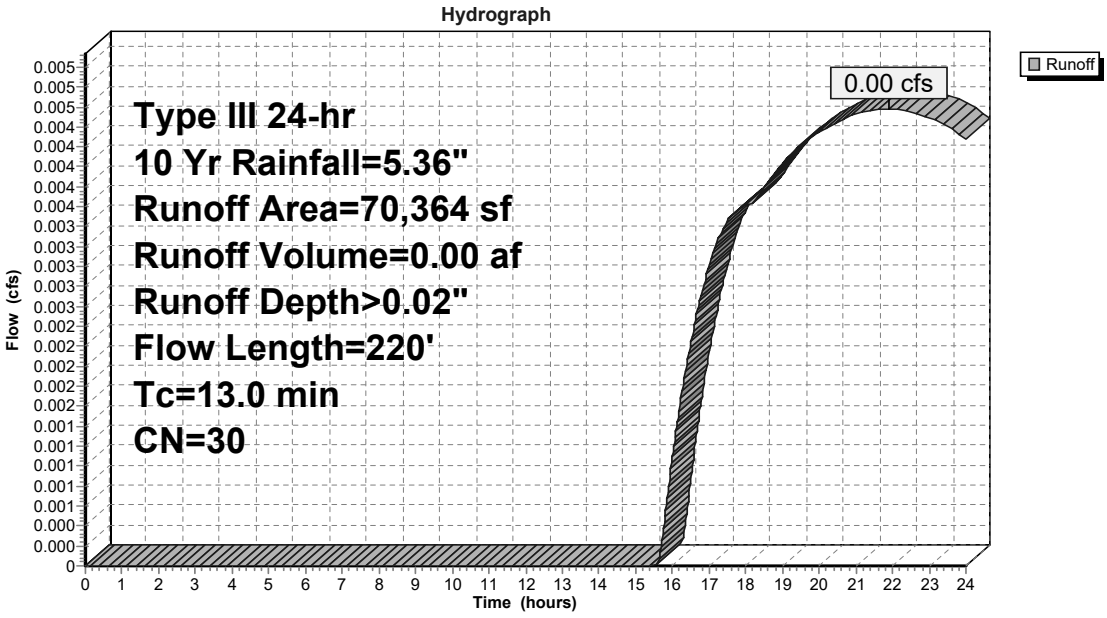
Runoff = 0.00 cfs @ 21.91 hrs, Volume= 0.00 af, Depth> 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=5.36"

Area (sf)	CN	Description
70,364	30	Woods, Good, HSG A
70,364		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	170	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
13.0	220	Total			

Subcatchment E2: PreDev



Summary for Subcatchment P1: Post Dev

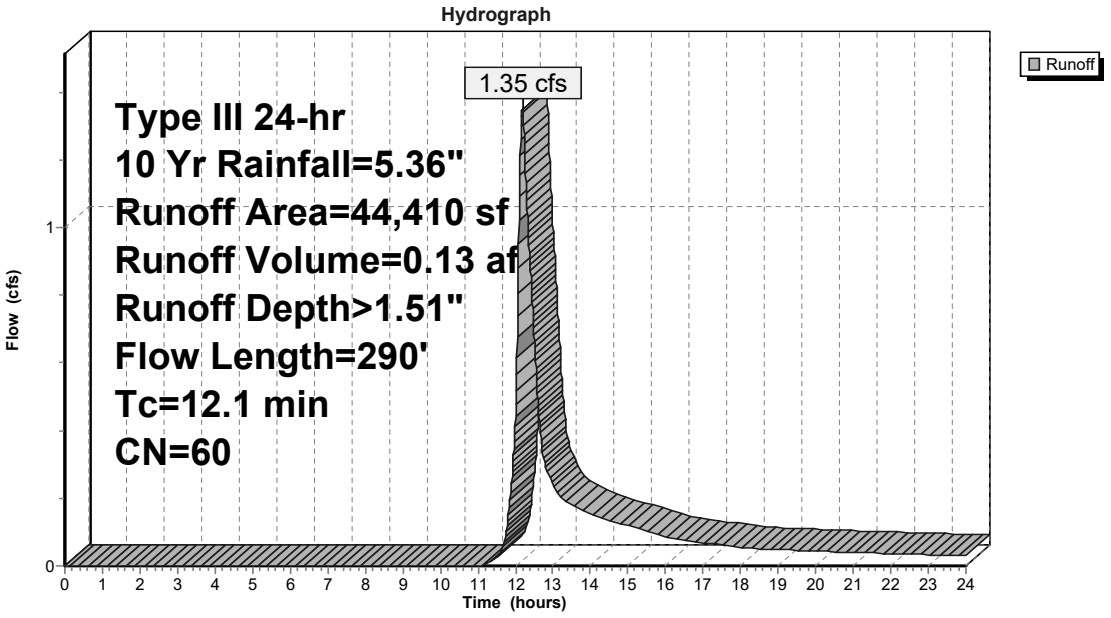
Runoff = 1.35 cfs @ 12.18 hrs, Volume= 0.13 af, Depth> 1.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=5.36"

	Area (sf)	CN	Description
*	15,463	98	Road, Drive, Walks, HSG A
	28,947	39	>75% Grass cover, Good, HSG A
	44,410	60	Weighted Average
	28,947		65.18% Pervious Area
	15,463		34.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.3	240	0.0050	3.18	2.47	**Pipe Channel, B-C** 12.0" Round w/ 0.5" inside fill Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
12.1	290	Total			

Subcatchment P1: Post Dev



Summary for Subcatchment P2: Post Dev

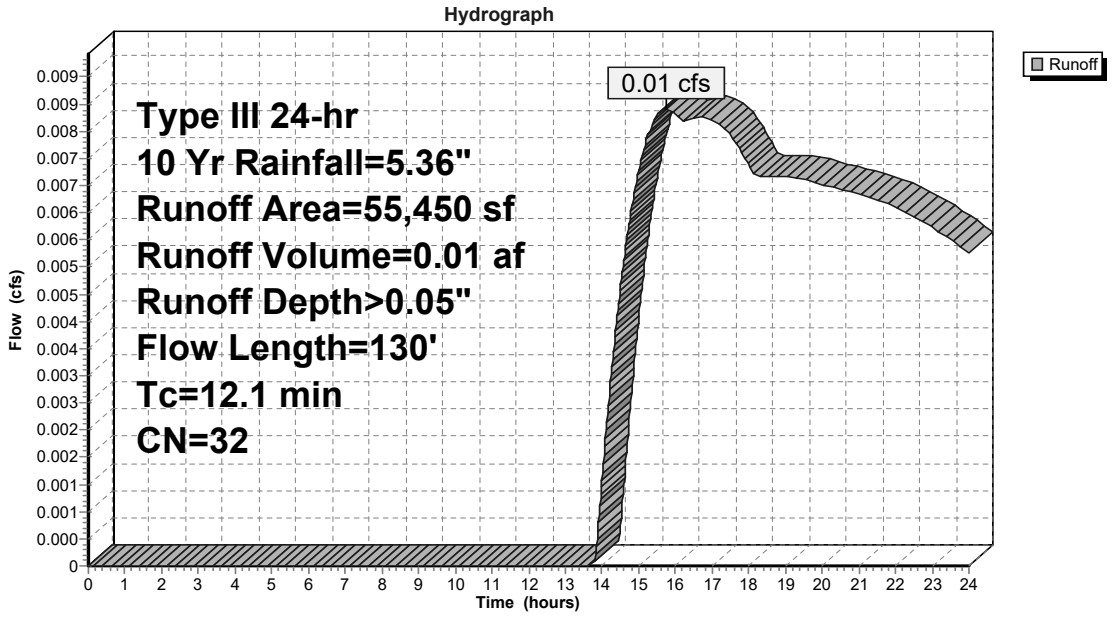
Runoff = 0.01 cfs @ 15.77 hrs, Volume= 0.01 af, Depth> 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=5.36"

Area (sf)	CN	Description
40,284	30	Woods, Good, HSG A
15,166	39	>75% Grass cover, Good, HSG A
55,450	32	Weighted Average
55,450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0080	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
0.3	80	0.0800	4.55		**Shallow Concentrated Flow, 27** Unpaved Kv= 16.1 fps
12.1	130	Total			

Subcatchment P2: Post Dev



Summary for Subcatchment P3: Post Dev

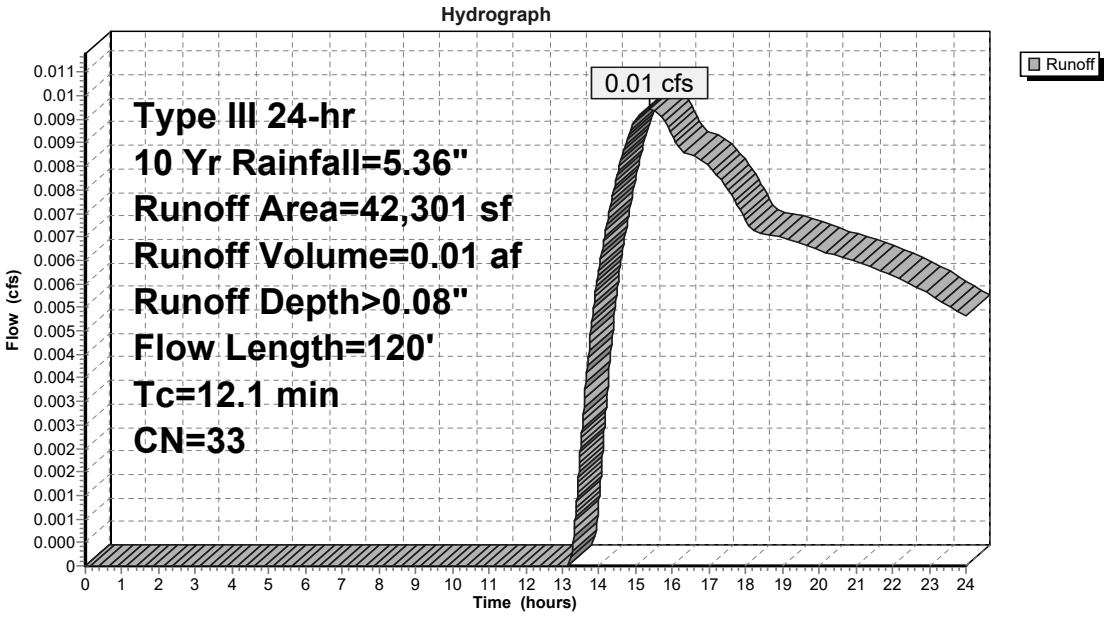
Runoff = 0.01 cfs @ 15.37 hrs, Volume= 0.01 af, Depth> 0.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=5.36"

Area (sf)	CN	Description
27,678	30	Woods, Good, HSG A
14,623	39	>75% Grass cover, Good, HSG A
42,301	33	Weighted Average
42,301		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0080	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
0.3	70	0.0800	4.55		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
12.1	120	Total			

Subcatchment P3: Post Dev



Summary for Subcatchment P4: Roof

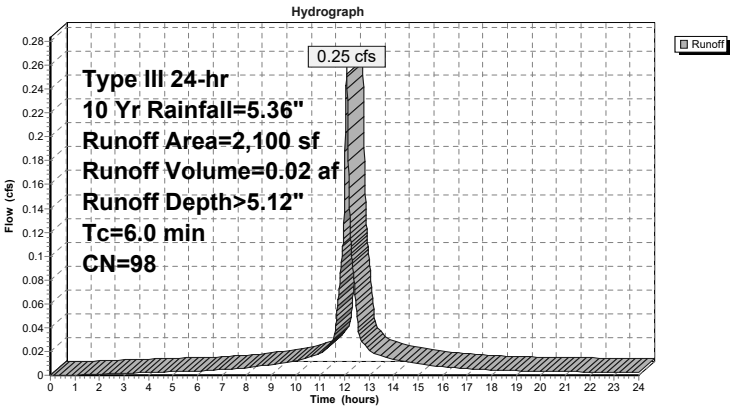
Runoff = 0.25 cfs @ 12.08 hrs, Volume= 0.02 af, Depth> 5.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr Rainfall=5.36"

Area (sf)	CN	Description
* 2,100	98	Roof Area
2,100		100.00% Impervious Area

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

Subcatchment P4: Roof



Summary for Pond 1P: Drain Basin

Inflow Area = 1.020 ac, 34.82% Impervious, Inflow Depth > 1.51" for 10 Yr event
Inflow = 1.35 cfs @ 12.18 hrs, Volume= 0.13 af
Outflow = 0.46 cfs @ 12.62 hrs, Volume= 0.13 af, Atten= 66%, Lag= 25.9 min
Discarded = 0.46 cfs @ 12.62 hrs, Volume= 0.13 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.00 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 277.35' @ 12.62 hrs Surf.Area= 1,941 sf Storage= 1,263 cf

Plug-Flow detention time= 21.4 min calculated for 0.13 af (100% of inflow)
Center-of-Mass det. time= 20.6 min (894.7 - 874.1)

Volume	Invert	Avail.Storage	Storage Description
#1	276.50'	17,878 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

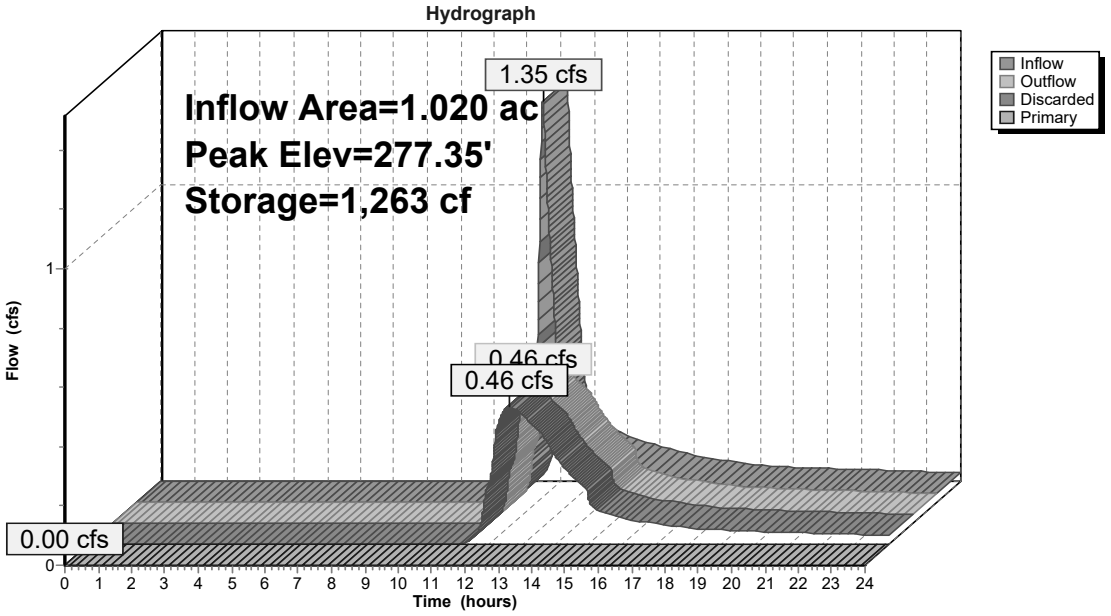
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
276.50	854	171.0	0	0	854
277.00	1,710	271.0	629	629	4,373
278.00	2,415	332.0	2,052	2,681	7,316
278.50	2,750	339.0	1,290	3,971	7,725
278.60	2,815	340.0	278	4,250	7,789
280.00	3,790	356.0	4,607	8,856	8,800
282.00	5,272	383.0	9,021	17,878	10,552

Device	Routing	Invert	Outlet Devices
#1	Discarded	276.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 274.00'
#2	Primary	281.00'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.1' Crest Height

Discarded OutFlow Max=0.46 cfs @ 12.62 hrs HW=277.35' (Free Discharge)
↑**1=Exfiltration** (Controls 0.46 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=276.50' (Free Discharge)
↑**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Drain Basin



Summary for Pond 2P: Roof Recharge

Inflow Area = 0.048 ac,100.00% Impervious, Inflow Depth > 5.12" for 10 Yr event
Inflow = 0.25 cfs @ 12.08 hrs, Volume= 0.02 af
Outflow = 0.08 cfs @ 12.38 hrs, Volume= 0.02 af, Atten= 69%, Lag= 18.0 min
Discarded = 0.08 cfs @ 12.38 hrs, Volume= 0.02 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 279.87' @ 12.38 hrs Surf.Area= 189 sf Storage= 179 cf

Plug-Flow detention time= 13.6 min calculated for 0.02 af (100% of inflow)
Center-of-Mass det. time= 13.5 min (759.8 - 746.3)

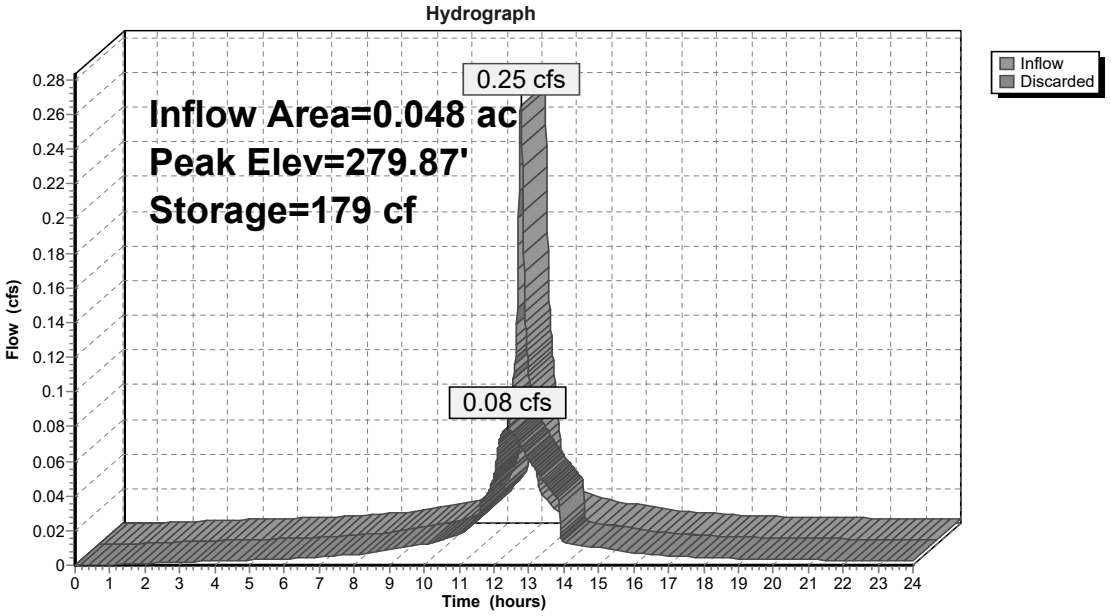
Volume	Invert	Avail.Storage	Storage Description
#1A	278.00'	208 cf	**9.00'W x 21.00'L x 3.67'H Field A** 693 cf Overall - 173 cf Embedded = 520 cf x 40.0% Voids
#2A	278.50'	125 cf	**Concrete Galley 4x4x3** x 4 Inside #1 Inside= 42.0"W x 30.0"H => 8.91 sf x 3.50'L = 31.2 cf Outside= 48.0"W x 36.0"H => 10.81 sf x 4.00'L = 43.2 cf
		333 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	278.00'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 274.00'

Discarded OutFlow Max=0.08 cfs @ 12.38 hrs HW=279.87' (Free Discharge)
↑**1=Exfiltration** (Controls 0.08 cfs)

Pond 2P: Roof Recharge



Summary for Subcatchment E1: PreDev

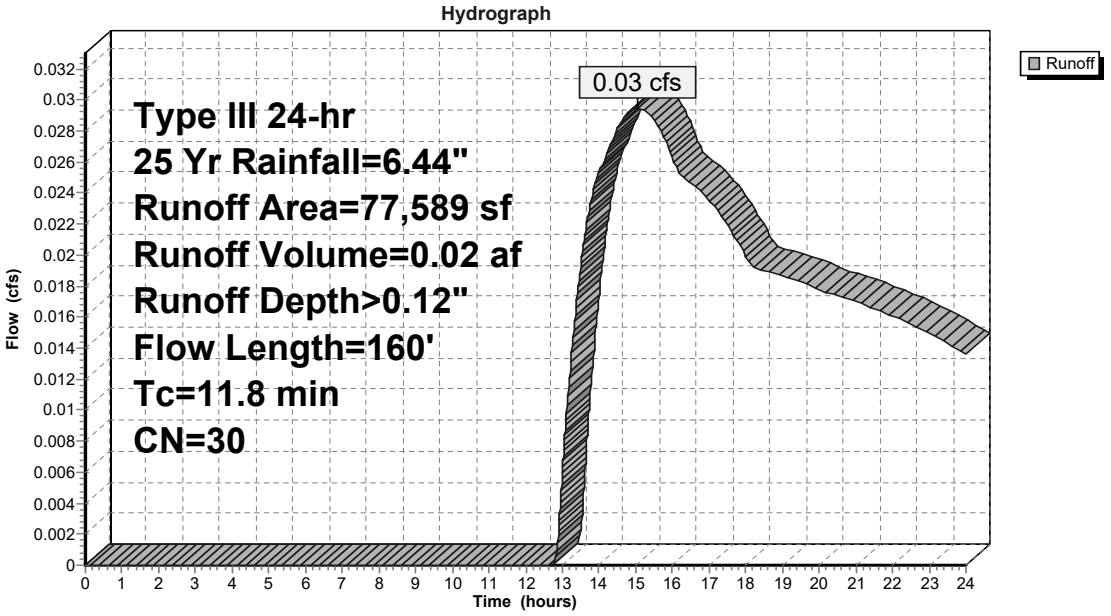
Runoff = 0.03 cfs @ 15.04 hrs, Volume= 0.02 af, Depth> 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=6.44"

Area (sf)	CN	Description
77,589	30	Woods, Good, HSG A
77,589		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	50	0.0250	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	110	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
11.8	160	Total			

Subcatchment E1: PreDev



Summary for Subcatchment E2: PreDev

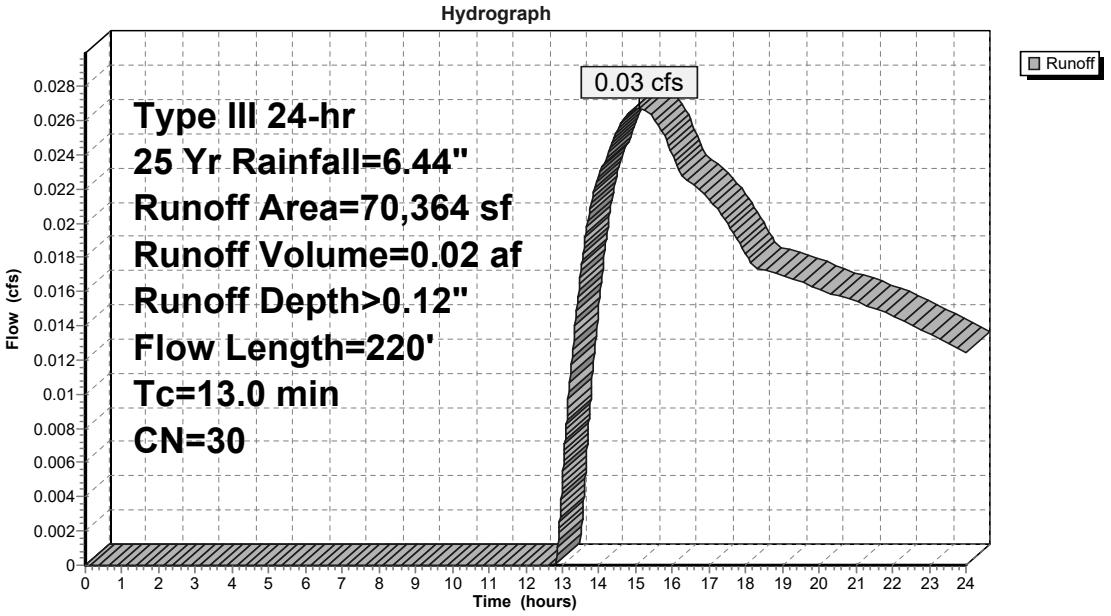
Runoff = 0.03 cfs @ 15.09 hrs, Volume= 0.02 af, Depth> 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=6.44"

Area (sf)	CN	Description
70,364	30	Woods, Good, HSG A
70,364		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	170	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
13.0	220	Total			

Subcatchment E2: PreDev



Summary for Subcatchment P1: Post Dev

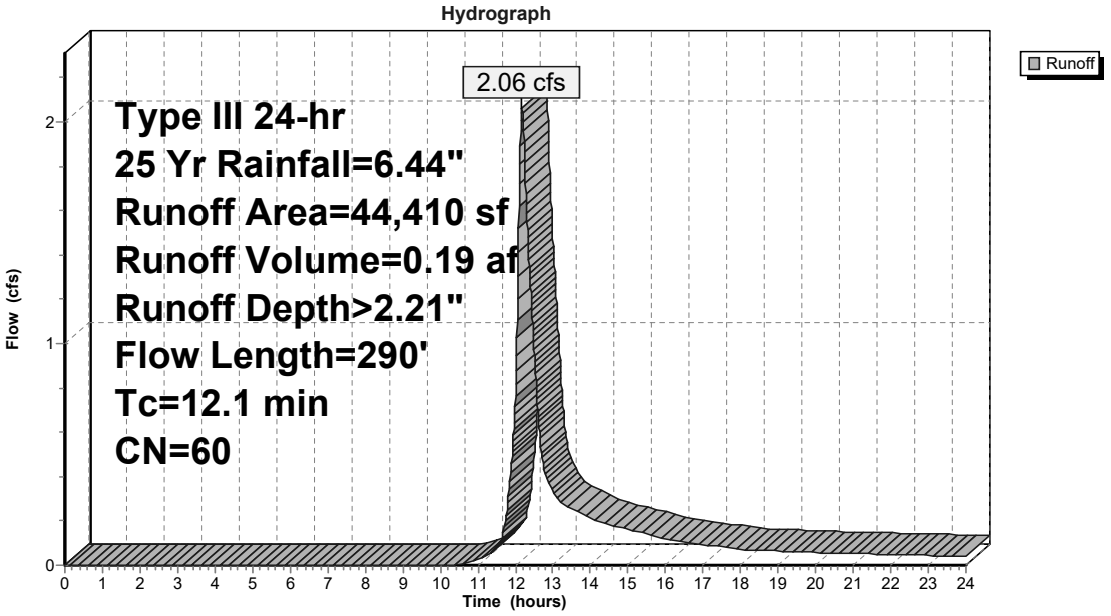
Runoff = 2.06 cfs @ 12.18 hrs, Volume= 0.19 af, Depth> 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=6.44"

	Area (sf)	CN	Description
*	15,463	98	Road, Drive, Walks, HSG A
	28,947	39	>75% Grass cover, Good, HSG A
	44,410	60	Weighted Average
	28,947		65.18% Pervious Area
	15,463		34.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.3	240	0.0050	3.18	2.47	**Pipe Channel, B-C** 12.0" Round w/ 0.5" inside fill Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
12.1	290	Total			

Subcatchment P1: Post Dev



Summary for Subcatchment P2: Post Dev

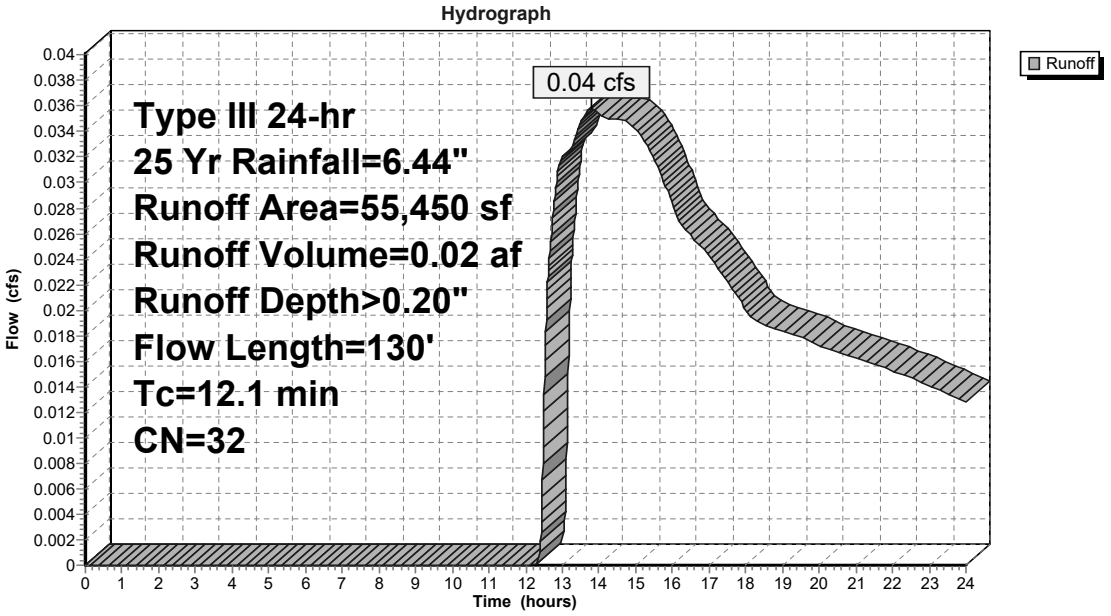
Runoff = 0.04 cfs @ 13.81 hrs, Volume= 0.02 af, Depth> 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=6.44"

Area (sf)	CN	Description
40,284	30	Woods, Good, HSG A
15,166	39	>75% Grass cover, Good, HSG A
55,450	32	Weighted Average
55,450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0080	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
0.3	80	0.0800	4.55		**Shallow Concentrated Flow, 27** Unpaved Kv= 16.1 fps
12.1	130	Total			

Subcatchment P2: Post Dev



Summary for Subcatchment P3: Post Dev

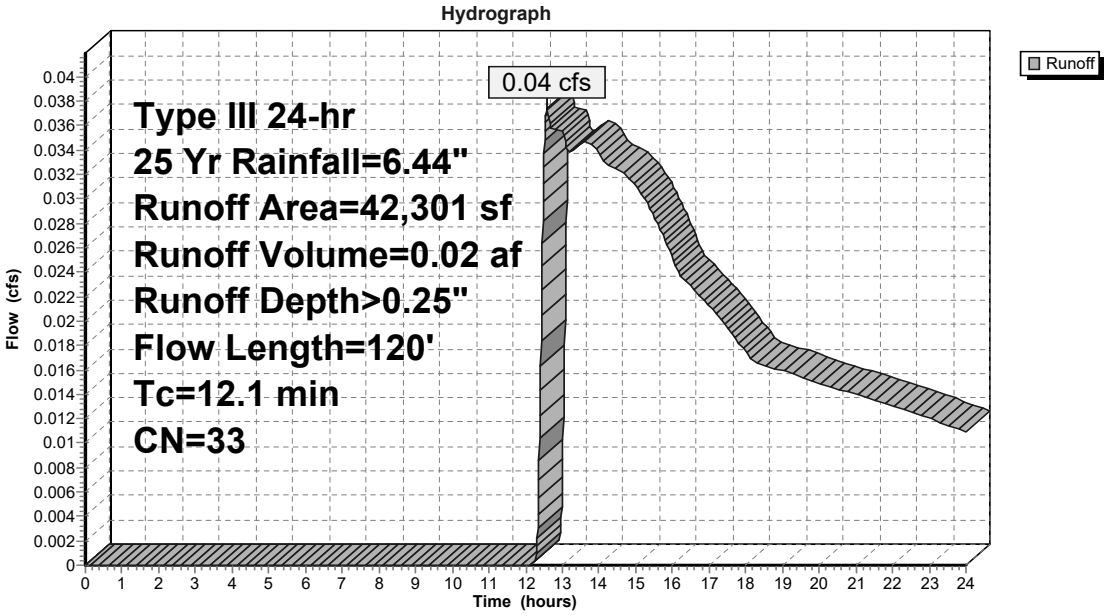
Runoff = 0.04 cfs @ 12.58 hrs, Volume= 0.02 af, Depth> 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=6.44"

Area (sf)	CN	Description
27,678	30	Woods, Good, HSG A
14,623	39	>75% Grass cover, Good, HSG A
42,301	33	Weighted Average
42,301		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0080	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
0.3	70	0.0800	4.55		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
12.1	120	Total			

Subcatchment P3: Post Dev



Summary for Subcatchment P4: Roof

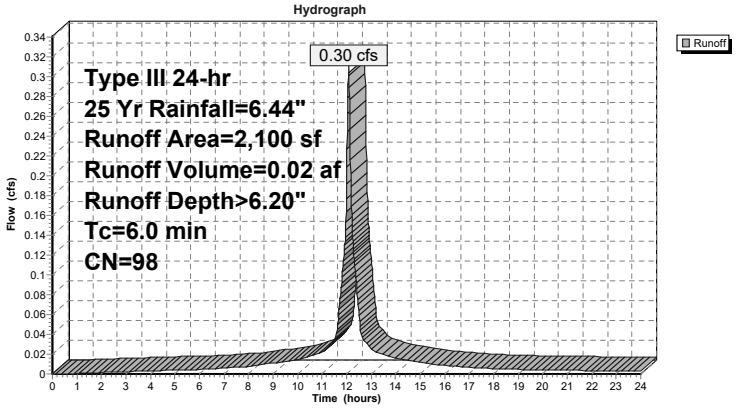
Runoff = 0.30 cfs @ 12.08 hrs, Volume= 0.02 af, Depth> 6.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr Rainfall=6.44"

	Area (sf)	CN	Description
*	2,100	98	Roof Area
	2,100		100.00% Impervious Area

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

Subcatchment P4: Roof



Summary for Pond 1P: Drain Basin

Inflow Area = 1.020 ac, 34.82% Impervious, Inflow Depth > 2.21" for 25 Yr event
Inflow = 2.06 cfs @ 12.18 hrs, Volume= 0.19 af
Outflow = 0.59 cfs @ 12.65 hrs, Volume= 0.19 af, Atten= 71%, Lag= 28.2 min
Discarded = 0.59 cfs @ 12.65 hrs, Volume= 0.19 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.00 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 277.80' @ 12.65 hrs Surf.Area= 2,264 sf Storage= 2,213 cf

Plug-Flow detention time= 32.4 min calculated for 0.19 af (100% of inflow)
Center-of-Mass det. time= 31.6 min (893.9 - 862.3)

Volume	Invert	Avail.Storage	Storage Description
#1	276.50'	17,878 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

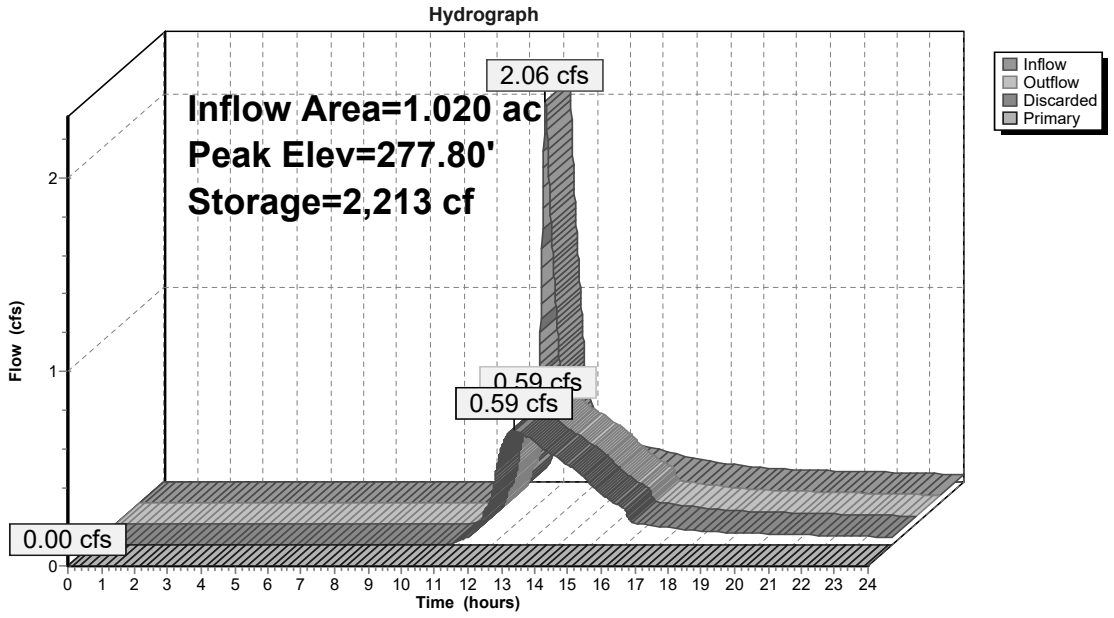
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
276.50	854	171.0	0	0	854
277.00	1,710	271.0	629	629	4,373
278.00	2,415	332.0	2,052	2,681	7,316
278.50	2,750	339.0	1,290	3,971	7,725
278.60	2,815	340.0	278	4,250	7,789
280.00	3,790	356.0	4,607	8,856	8,800
282.00	5,272	383.0	9,021	17,878	10,552

Device	Routing	Invert	Outlet Devices
#1	Discarded	276.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 274.00'
#2	Primary	281.00'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.1' Crest Height

Discarded OutFlow Max=0.59 cfs @ 12.65 hrs HW=277.80' (Free Discharge)
↑**1=Exfiltration** (Controls 0.59 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=276.50' (Free Discharge)
↑**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Drain Basin



Summary for Pond 2P: Roof Recharge

Inflow Area = 0.048 ac,100.00% Impervious, Inflow Depth > 6.20" for 25 Yr event
Inflow = 0.30 cfs @ 12.08 hrs, Volume= 0.02 af
Outflow = 0.09 cfs @ 12.39 hrs, Volume= 0.02 af, Atten= 70%, Lag= 18.7 min
Discarded = 0.09 cfs @ 12.39 hrs, Volume= 0.02 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 280.38' @ 12.39 hrs Surf.Area= 189 sf Storage= 230 cf

Plug-Flow detention time= 16.0 min calculated for 0.02 af (100% of inflow)
Center-of-Mass det. time= 15.8 min (759.4 - 743.6)

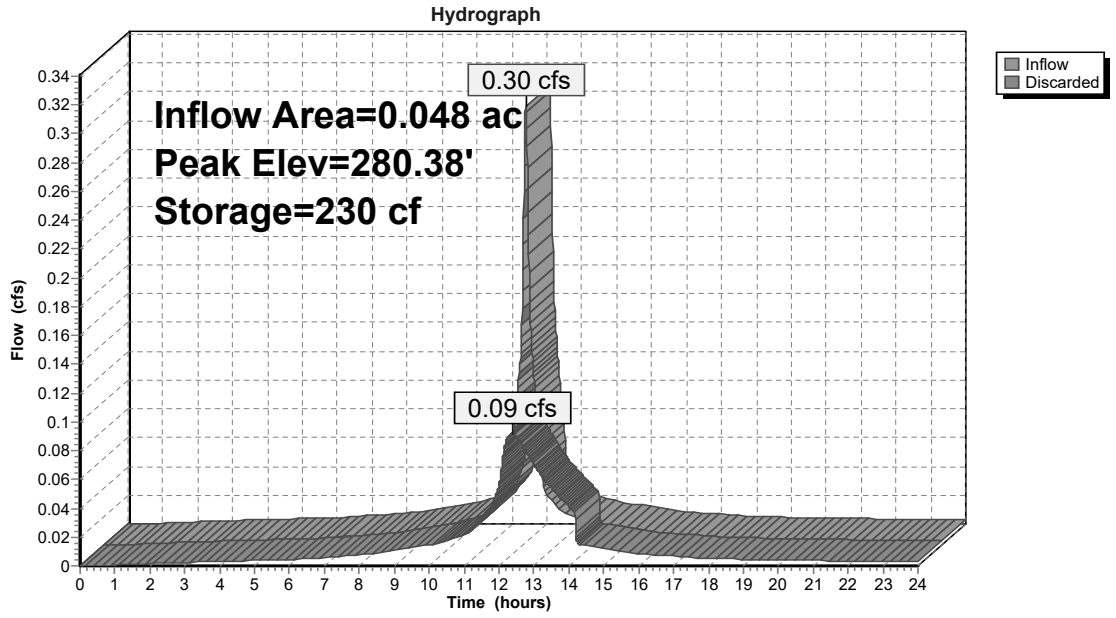
Volume	Invert	Avail.Storage	Storage Description
#1A	278.00'	208 cf	**9.00'W x 21.00'L x 3.67'H Field A** 693 cf Overall - 173 cf Embedded = 520 cf x 40.0% Voids
#2A	278.50'	125 cf	**Concrete Galley 4x4x3** x 4 Inside #1 Inside= 42.0"W x 30.0"H => 8.91 sf x 3.50'L = 31.2 cf Outside= 48.0"W x 36.0"H => 10.81 sf x 4.00'L = 43.2 cf
		333 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	278.00'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 274.00'

Discarded OutFlow Max=0.09 cfs @ 12.39 hrs HW=280.38' (Free Discharge)
1=Exfiltration (Controls 0.09 cfs)

Pond 2P: Roof Recharge



Summary for Subcatchment E1: PreDev

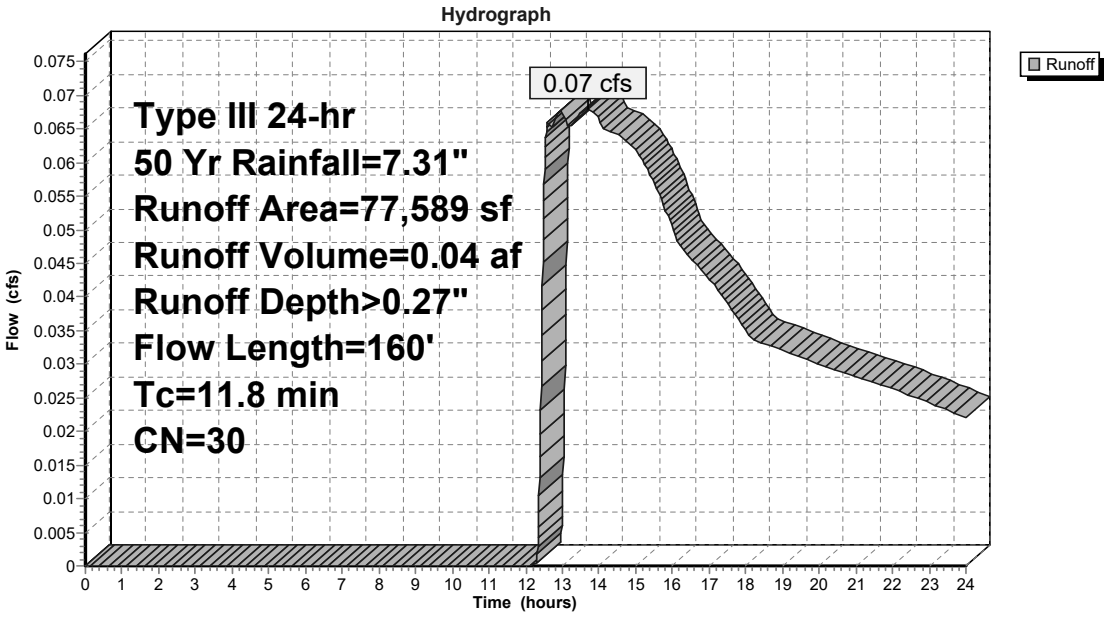
Runoff = 0.07 cfs @ 13.70 hrs, Volume= 0.04 af, Depth> 0.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Yr Rainfall=7.31"

Area (sf)	CN	Description
77,589	30	Woods, Good, HSG A
77,589		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	50	0.0250	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	110	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
11.8	160	Total			

Subcatchment E1: PreDev



Summary for Subcatchment E2: PreDev

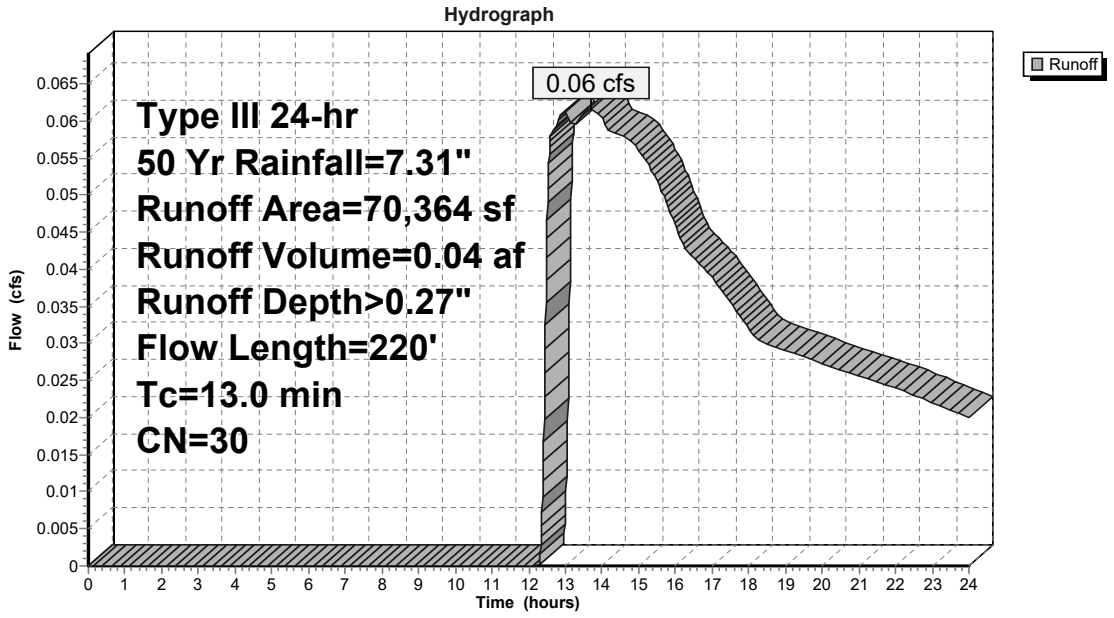
Runoff = 0.06 cfs @ 13.71 hrs, Volume= 0.04 af, Depth> 0.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Yr Rainfall=7.31"

Area (sf)	CN	Description
70,364	30	Woods, Good, HSG A
70,364		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	170	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
13.0	220	Total			

Subcatchment E2: PreDev



Summary for Subcatchment P1: Post Dev

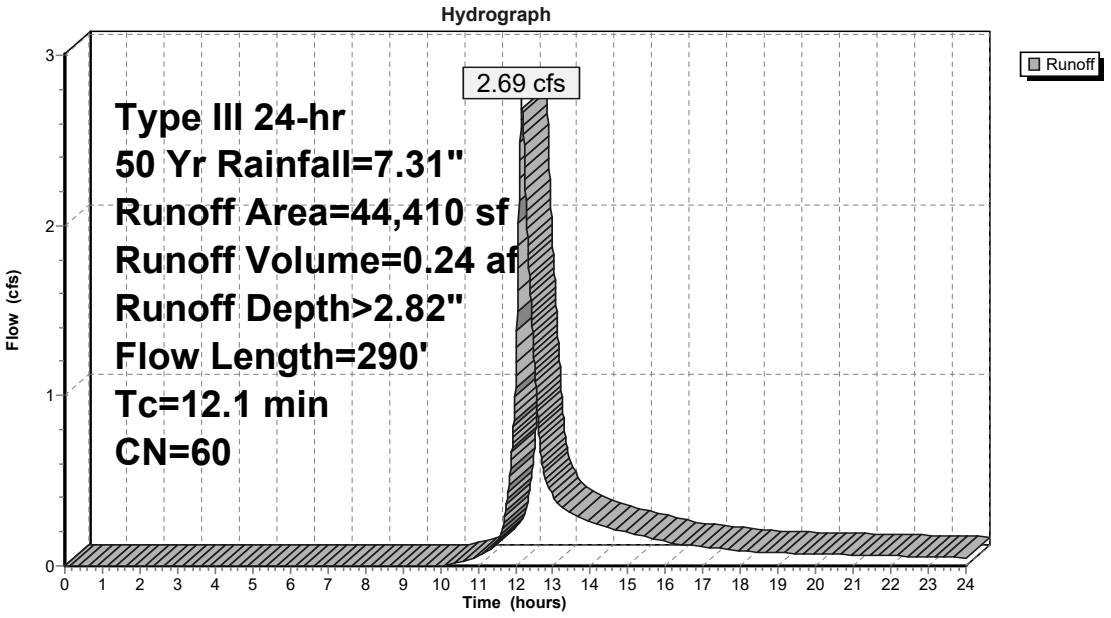
Runoff = 2.69 cfs @ 12.17 hrs, Volume= 0.24 af, Depth> 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Yr Rainfall=7.31"

	Area (sf)	CN	Description
*	15,463	98	Road, Drive, Walks, HSG A
	28,947	39	>75% Grass cover, Good, HSG A
	44,410	60	Weighted Average
	28,947		65.18% Pervious Area
	15,463		34.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.3	240	0.0050	3.18	2.47	**Pipe Channel, B-C** 12.0" Round w/ 0.5" inside fill Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
12.1	290	Total			

Subcatchment P1: Post Dev



Summary for Subcatchment P2: Post Dev

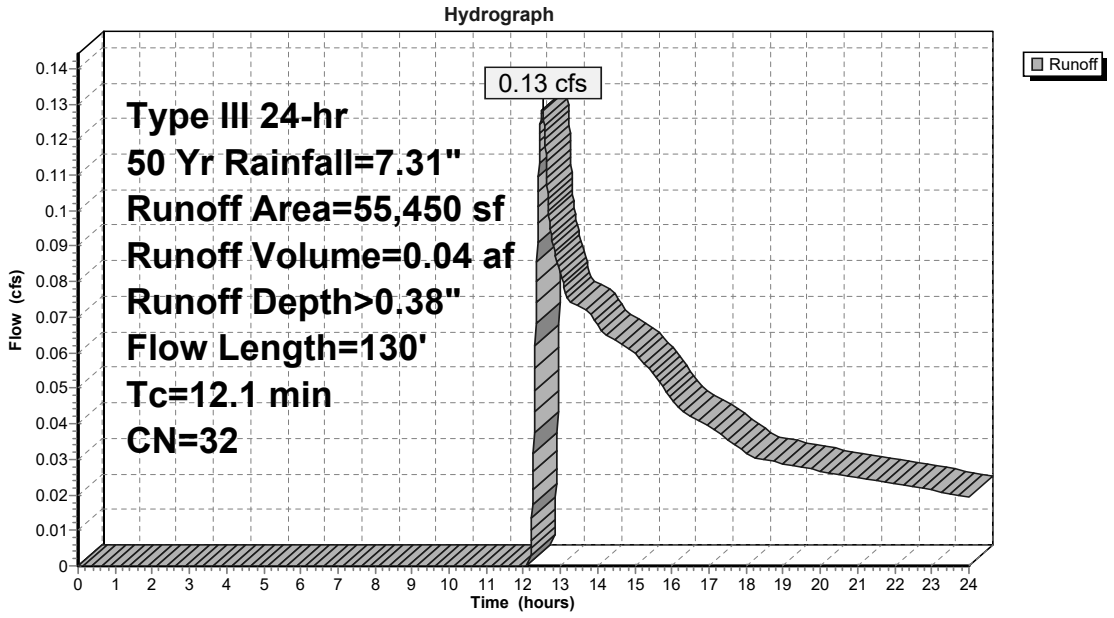
Runoff = 0.13 cfs @ 12.51 hrs, Volume= 0.04 af, Depth> 0.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Yr Rainfall=7.31"

Area (sf)	CN	Description
40,284	30	Woods, Good, HSG A
15,166	39	>75% Grass cover, Good, HSG A
55,450	32	Weighted Average
55,450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0080	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
0.3	80	0.0800	4.55		**Shallow Concentrated Flow, 27** Unpaved Kv= 16.1 fps
12.1	130	Total			

Subcatchment P2: Post Dev



Summary for Subcatchment P3: Post Dev

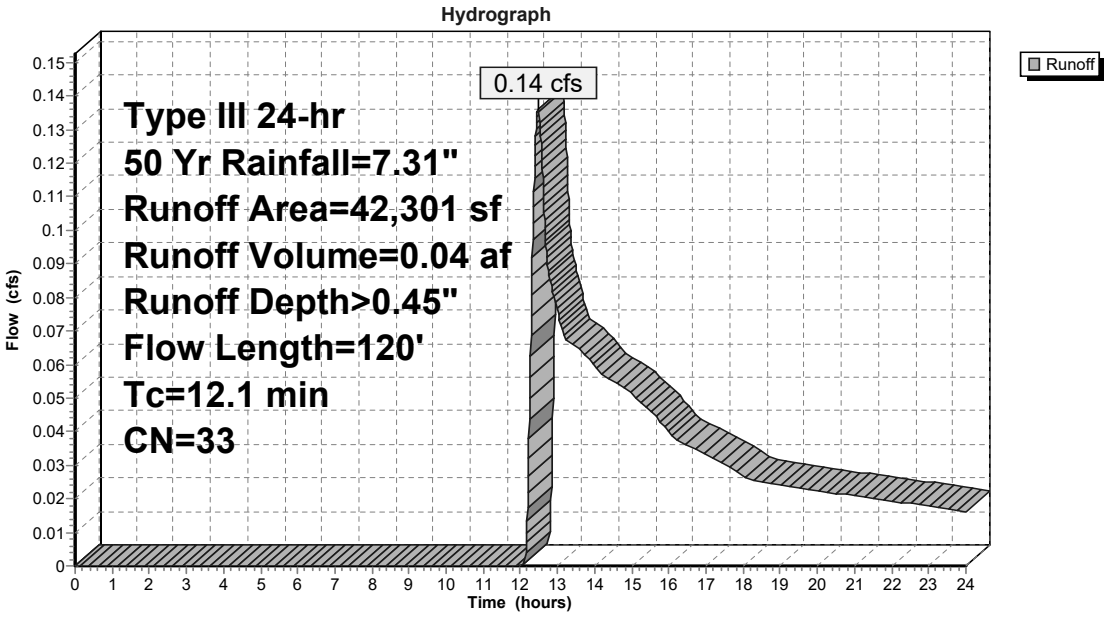
Runoff = 0.14 cfs @ 12.48 hrs, Volume= 0.04 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Yr Rainfall=7.31"

Area (sf)	CN	Description
27,678	30	Woods, Good, HSG A
14,623	39	>75% Grass cover, Good, HSG A
42,301	33	Weighted Average
42,301		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0080	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
0.3	70	0.0800	4.55		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
12.1	120	Total			

Subcatchment P3: Post Dev



Summary for Subcatchment P4: Roof

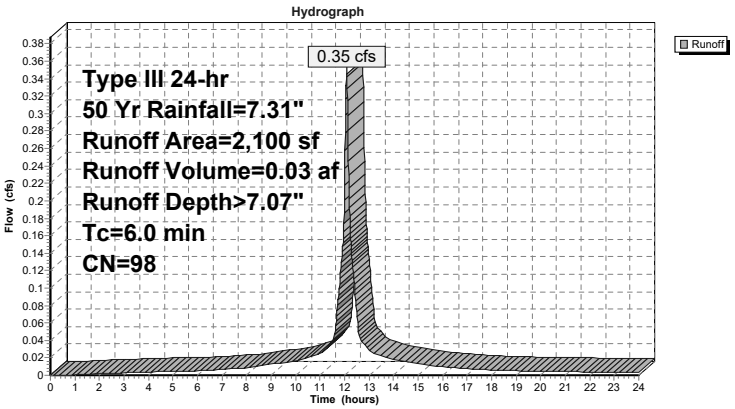
Runoff = 0.35 cfs @ 12.08 hrs, Volume= 0.03 af, Depth> 7.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50 Yr Rainfall=7.31"

	Area (sf)	CN	Description
*	2,100	98	Roof Area
	2,100		100.00% Impervious Area

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

Subcatchment P4: Roof



Summary for Pond 1P: Drain Basin

Inflow Area = 1.020 ac, 34.82% Impervious, Inflow Depth > 2.82" for 50 Yr event
Inflow = 2.69 cfs @ 12.17 hrs, Volume= 0.24 af
Outflow = 0.70 cfs @ 12.66 hrs, Volume= 0.24 af, Atten= 74%, Lag= 29.3 min
Discarded = 0.70 cfs @ 12.66 hrs, Volume= 0.24 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.00 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 278.16' @ 12.66 hrs Surf.Area= 2,520 sf Storage= 3,077 cf

Plug-Flow detention time= 40.4 min calculated for 0.24 af (100% of inflow)
Center-of-Mass det. time= 39.7 min (894.7 - 855.0)

Volume	Invert	Avail.Storage	Storage Description
#1	276.50'	17,878 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

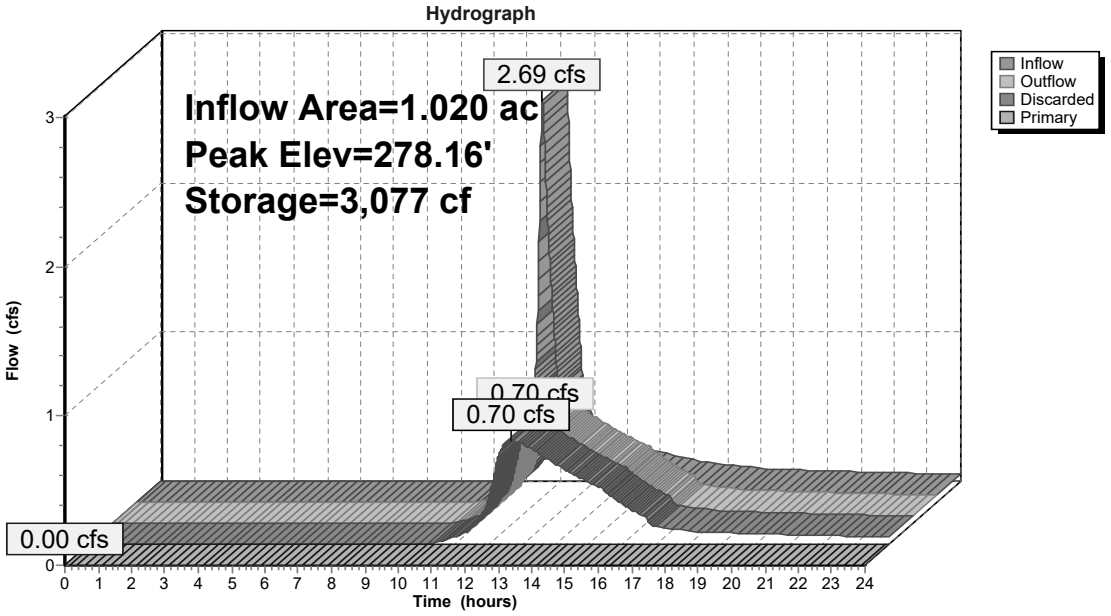
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
276.50	854	171.0	0	0	854
277.00	1,710	271.0	629	629	4,373
278.00	2,415	332.0	2,052	2,681	7,316
278.50	2,750	339.0	1,290	3,971	7,725
278.60	2,815	340.0	278	4,250	7,789
280.00	3,790	356.0	4,607	8,856	8,800
282.00	5,272	383.0	9,021	17,878	10,552

Device	Routing	Invert	Outlet Devices
#1	Discarded	276.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 274.00'
#2	Primary	281.00'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.1' Crest Height

Discarded OutFlow Max=0.70 cfs @ 12.66 hrs HW=278.16' (Free Discharge)
1=Exfiltration (Controls 0.70 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=276.50' (Free Discharge)
2=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 1P: Drain Basin



Summary for Pond 2P: Roof Recharge

Inflow Area = 0.048 ac,100.00% Impervious, Inflow Depth > 7.07" for 50 Yr event
Inflow = 0.35 cfs @ 12.08 hrs, Volume= 0.03 af
Outflow = 0.10 cfs @ 12.40 hrs, Volume= 0.03 af, Atten= 70%, Lag= 19.0 min
Discarded = 0.10 cfs @ 12.40 hrs, Volume= 0.03 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 280.79' @ 12.40 hrs Surf.Area= 189 sf Storage= 272 cf

Plug-Flow detention time= 17.6 min calculated for 0.03 af (100% of inflow)
Center-of-Mass det. time= 17.5 min (759.3 - 741.8)

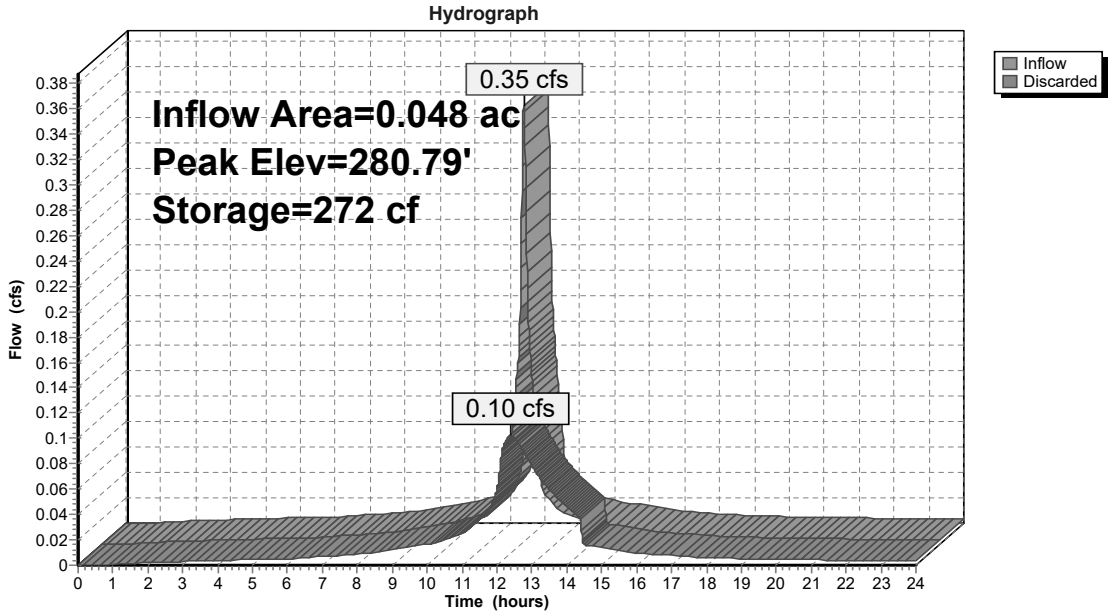
Volume	Invert	Avail.Storage	Storage Description
#1A	278.00'	208 cf	**9.00'W x 21.00'L x 3.67'H Field A** 693 cf Overall - 173 cf Embedded = 520 cf x 40.0% Voids
#2A	278.50'	125 cf	**Concrete Galley 4x4x3** x 4 Inside #1 Inside= 42.0"W x 30.0"H => 8.91 sf x 3.50'L = 31.2 cf Outside= 48.0"W x 36.0"H => 10.81 sf x 4.00'L = 43.2 cf
		333 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	278.00'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 274.00'

Discarded OutFlow Max=0.10 cfs @ 12.40 hrs HW=280.79' (Free Discharge)
1=Exfiltration (Controls 0.10 cfs)

Pond 2P: Roof Recharge



Summary for Subcatchment E1: PreDev

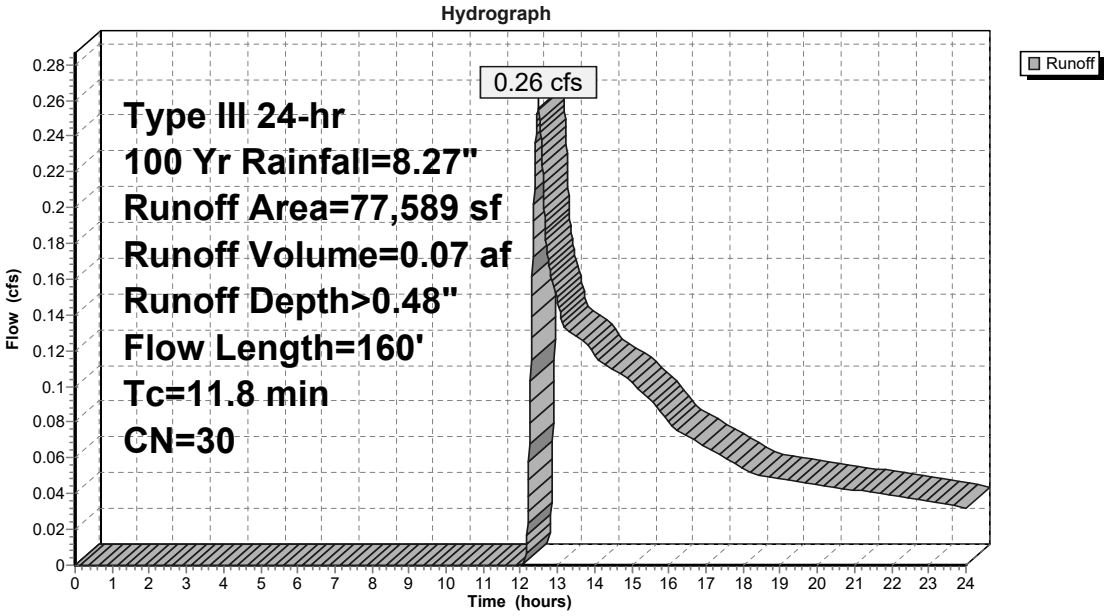
Runoff = 0.26 cfs @ 12.49 hrs, Volume= 0.07 af, Depth> 0.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=8.27"

Area (sf)	CN	Description
77,589	30	Woods, Good, HSG A
77,589		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.3	50	0.0250	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.5	110	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
11.8	160	Total			

Subcatchment E1: PreDev



Summary for Subcatchment E2: PreDev

Runoff = 0.23 cfs @ 12.50 hrs, Volume= 0.06 af, Depth> 0.48"

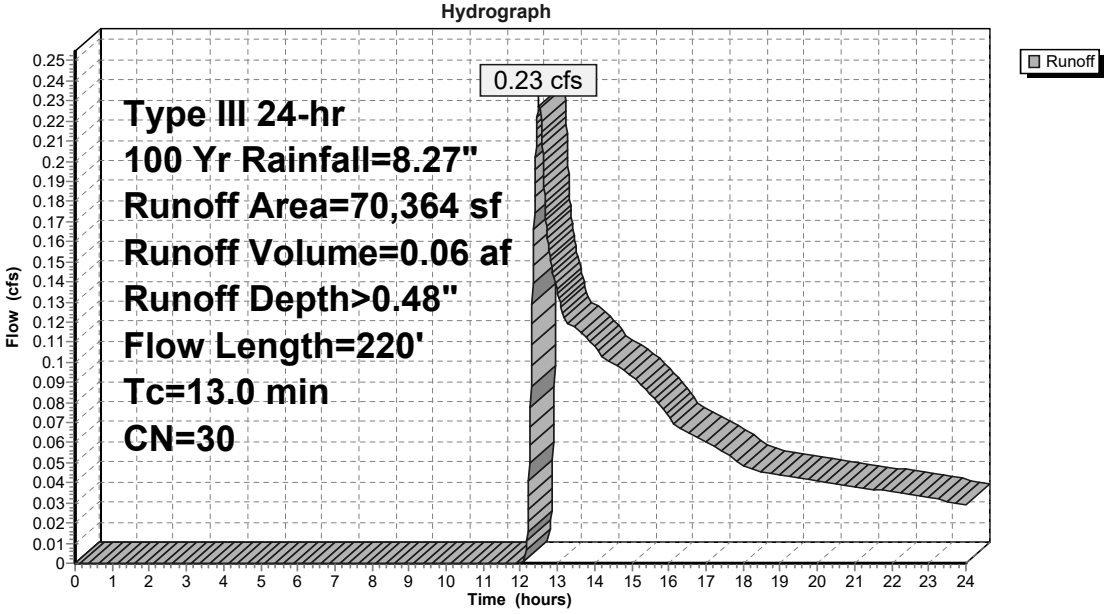
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=8.27"

Area (sf)	CN	Description
70,364	30	Woods, Good, HSG A
70,364		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	170	0.0600	3.94		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
13.0	220	Total			

Subcatchment E2: PreDev

Hydrograph



Summary for Subcatchment P1: Post Dev

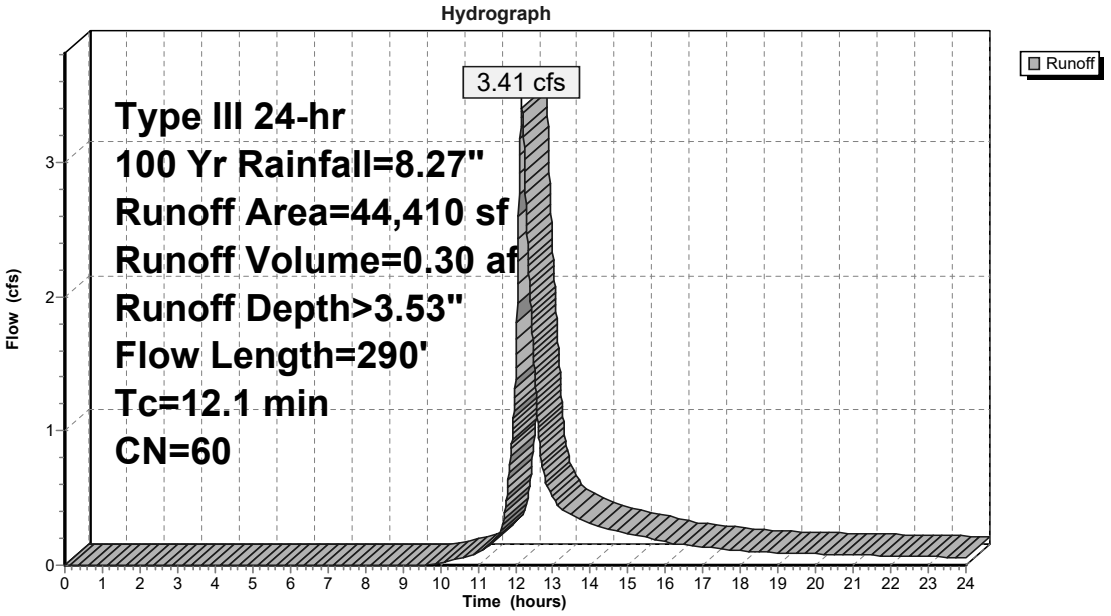
Runoff = 3.41 cfs @ 12.17 hrs, Volume= 0.30 af, Depth> 3.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=8.27"

	Area (sf)	CN	Description
*	15,463	98	Road, Drive, Walks, HSG A
	28,947	39	>75% Grass cover, Good, HSG A
	44,410	60	Weighted Average
	28,947		65.18% Pervious Area
	15,463		34.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.3	240	0.0050	3.18	2.47	**Pipe Channel, B-C** 12.0" Round w/ 0.5" inside fill Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
12.1	290	Total			

Subcatchment P1: Post Dev



Summary for Subcatchment P2: Post Dev

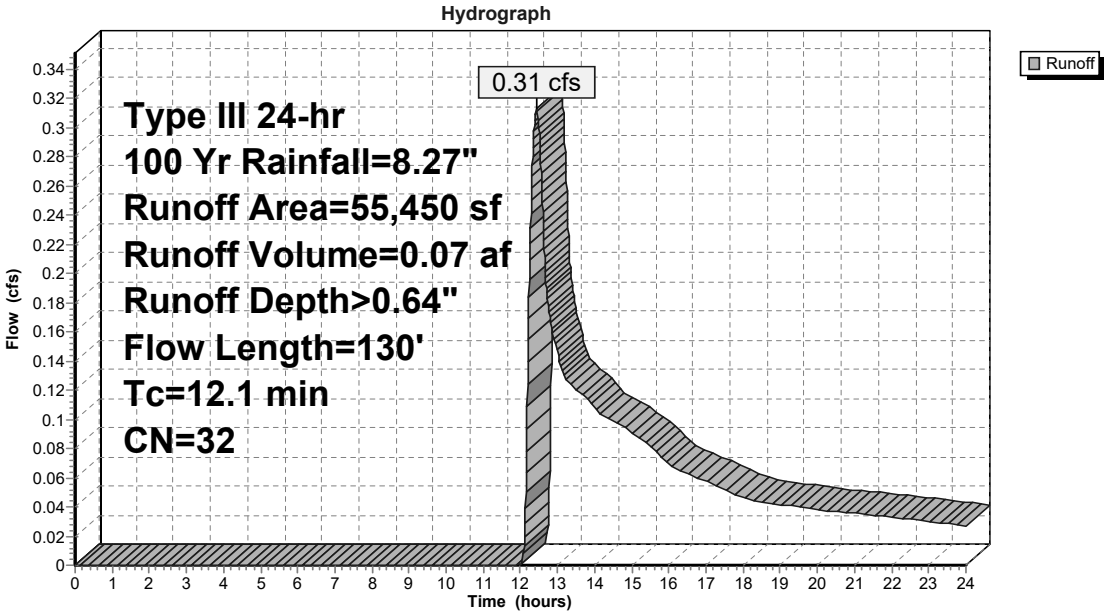
Runoff = 0.31 cfs @ 12.43 hrs, Volume= 0.07 af, Depth> 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=8.27"

Area (sf)	CN	Description
40,284	30	Woods, Good, HSG A
15,166	39	>75% Grass cover, Good, HSG A
55,450	32	Weighted Average
55,450		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0080	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
0.3	80	0.0800	4.55		**Shallow Concentrated Flow, 27** Unpaved Kv= 16.1 fps
12.1	130	Total			

Subcatchment P2: Post Dev



Summary for Subcatchment P3: Post Dev

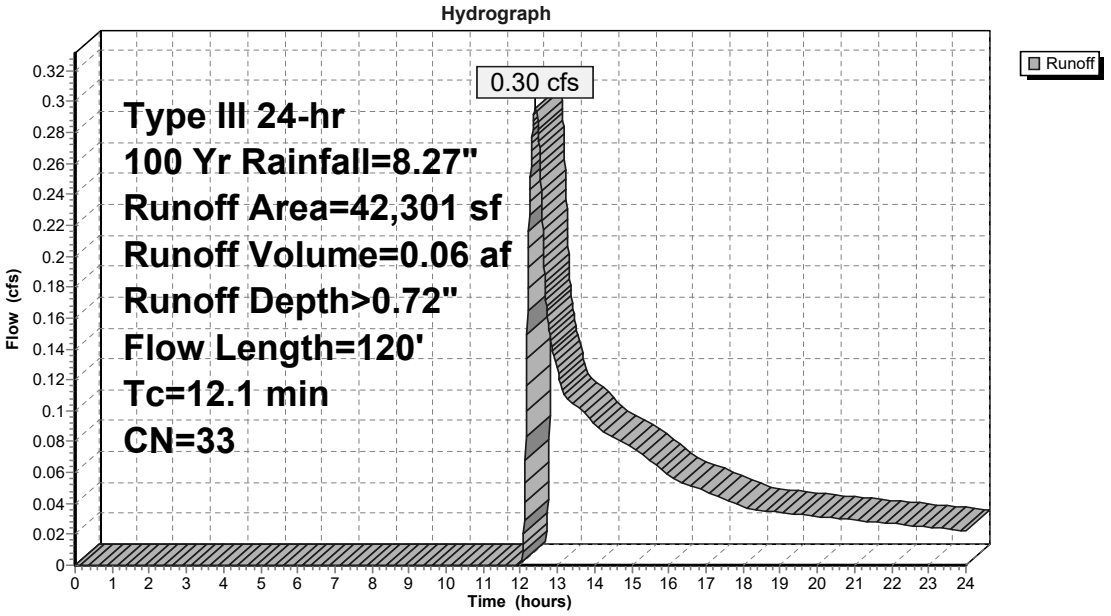
Runoff = 0.30 cfs @ 12.41 hrs, Volume= 0.06 af, Depth> 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=8.27"

Area (sf)	CN	Description
27,678	30	Woods, Good, HSG A
14,623	39	>75% Grass cover, Good, HSG A
42,301	33	Weighted Average
42,301		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.8	50	0.0080	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
0.3	70	0.0800	4.55		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
12.1	120	Total			

Subcatchment P3: Post Dev



Summary for Subcatchment P4: Roof

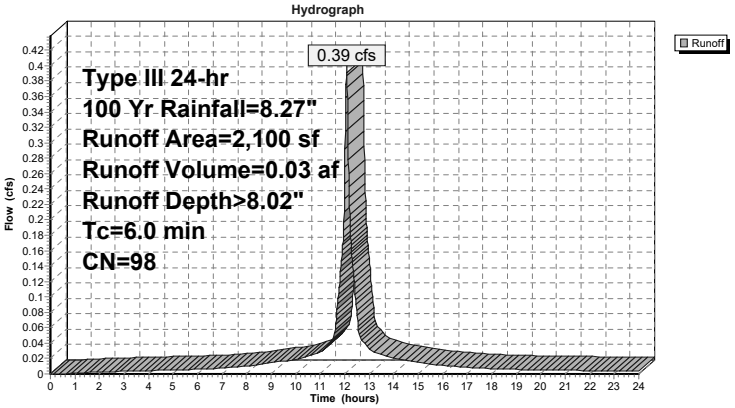
Runoff = 0.39 cfs @ 12.08 hrs, Volume= 0.03 af, Depth> 8.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr Rainfall=8.27"

	Area (sf)	CN	Description
*	2,100	98	Roof Area
	2,100		100.00% Impervious Area

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

Subcatchment P4: Roof



Summary for Pond 1P: Drain Basin

Inflow Area = 1.020 ac, 34.82% Impervious, Inflow Depth > 3.53" for 100 Yr event
Inflow = 3.41 cfs @ 12.17 hrs, Volume= 0.30 af
Outflow = 0.82 cfs @ 12.68 hrs, Volume= 0.30 af, Atten= 76%, Lag= 30.3 min
Discarded = 0.82 cfs @ 12.68 hrs, Volume= 0.30 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.00 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 278.55' @ 12.68 hrs Surf.Area= 2,785 sf Storage= 4,119 cf

Plug-Flow detention time= 48.5 min calculated for 0.30 af (100% of inflow)
Center-of-Mass det. time= 47.8 min (896.2 - 848.4)

Volume	Invert	Avail.Storage	Storage Description
#1	276.50'	17,878 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

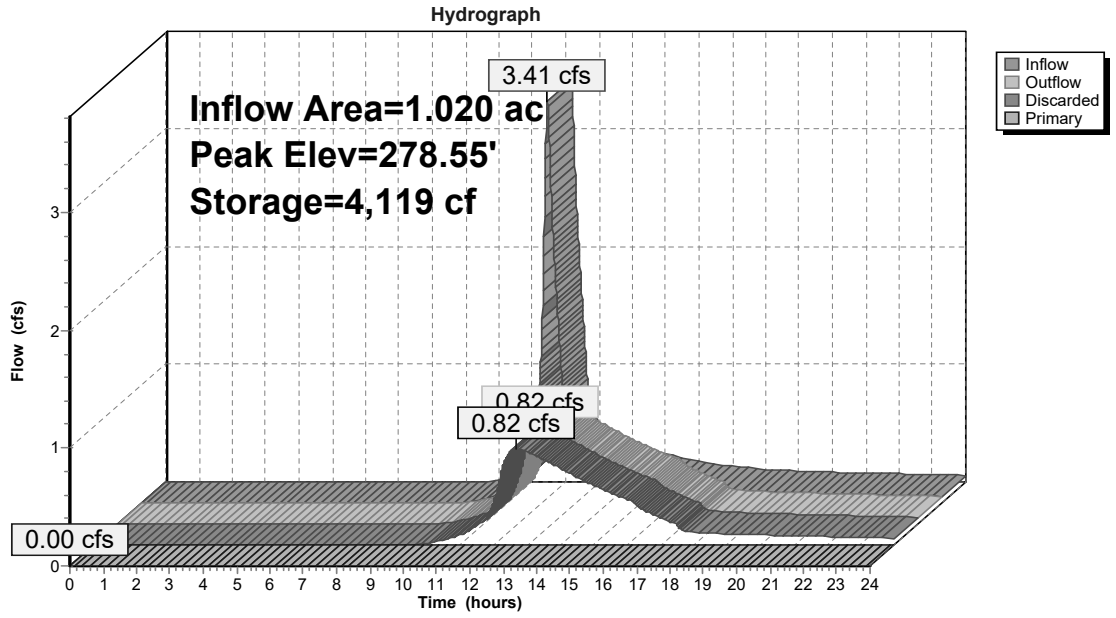
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
276.50	854	171.0	0	0	854
277.00	1,710	271.0	629	629	4,373
278.00	2,415	332.0	2,052	2,681	7,316
278.50	2,750	339.0	1,290	3,971	7,725
278.60	2,815	340.0	278	4,250	7,789
280.00	3,790	356.0	4,607	8,856	8,800
282.00	5,272	383.0	9,021	17,878	10,552

Device	Routing	Invert	Outlet Devices
#1	Discarded	276.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 274.00'
#2	Primary	281.00'	**1.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.1' Crest Height

Discarded OutFlow Max=0.82 cfs @ 12.68 hrs HW=278.55' (Free Discharge)
1=Exfiltration (Controls 0.82 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=276.50' (Free Discharge)
2=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 1P: Drain Basin



Summary for Pond 2P: Roof Recharge

Inflow Area = 0.048 ac,100.00% Impervious, Inflow Depth > 8.02" for 100 Yr event
Inflow = 0.39 cfs @ 12.08 hrs, Volume= 0.03 af
Outflow = 0.12 cfs @ 12.39 hrs, Volume= 0.03 af, Atten= 69%, Lag= 18.3 min
Discarded = 0.12 cfs @ 12.39 hrs, Volume= 0.03 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 281.43' @ 12.39 hrs Surf.Area= 189 sf Storage= 317 cf

Plug-Flow detention time= 19.0 min calculated for 0.03 af (100% of inflow)
Center-of-Mass det. time= 18.9 min (759.2 - 740.3)

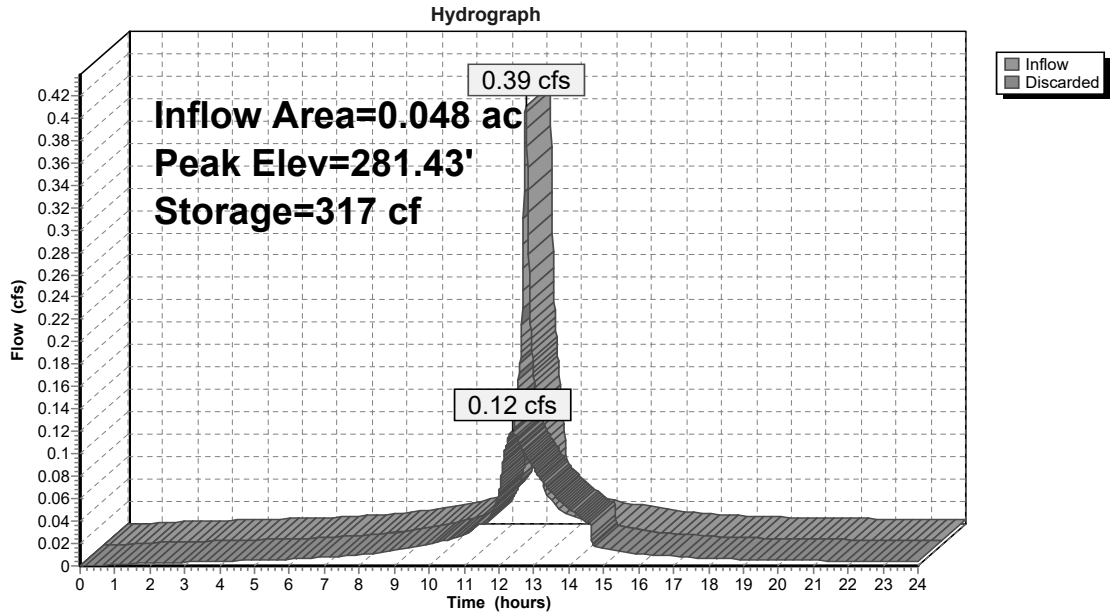
Volume	Invert	Avail.Storage	Storage Description
#1A	278.00'	208 cf	**9.00'W x 21.00'L x 3.67'H Field A** 693 cf Overall - 173 cf Embedded = 520 cf x 40.0% Voids
#2A	278.50'	125 cf	**Concrete Galley 4x4x3** x 4 Inside #1 Inside= 42.0"W x 30.0"H => 8.91 sf x 3.50'L = 31.2 cf Outside= 48.0"W x 36.0"H => 10.81 sf x 4.00'L = 43.2 cf
		333 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	278.00'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 274.00'

Discarded OutFlow Max=0.12 cfs @ 12.39 hrs HW=281.43' (Free Discharge)
1=Exfiltration (Controls 0.12 cfs)

Pond 2P: Roof Recharge



APPENDIX – B

Hydraulic Design (Manning's Equation)
Time of Flow, Average CN values
Groundwater Mounding Calculations
Precipitation Chart
NOAA Atlas 14 Precipitation Rates

Standard 2

STORM DRAINAGE CALCULATIONS

Pipe Flow Calculations - Manning's Equation

i = Rainfall Intensity at 25 Year Storm

Date: **5/30/23**
Revised:
Job No: **7,701**
Calc. by: **rst**

Project: **Bonnie Dr. Ext.**
Town: **Holliston, MA**

Line		Length	Drain Area	Total Area	Runoff	Time of Concentration (min.)			Rainfall i	Required Capacity Q(cfs)		Pipe Diameter	Slope	Design Conditions		Invert Elevation		Rim Elev.	n
From	To	(Feet)	(Ac)	(Ac)	"C"	Upper End	In Pipe	Total	(in./hr.)	Inlet	Pipe	(in.)	(ft./ft.)	Depth (in.)	Velocity (f.p.s.)	Upper	Lower	Upper	
CB 1	DMH 3	10	0.08		0.45	15.89	0.07	15.96	4.36	0.16		12	0.010	1.70	2.30	280.10	280.00	283.13	0.013
CB 2	DMH 3	5	0.11		0.55	14.07	0.02	14.09	4.57	0.29		12	0.020	2.00	3.50	280.10	280.00	283.13	0.013
DMH 3	DMH 4	200		0.19	0.51	15.96	1.39	17.35	4.35		0.43	12	0.005	3.40	2.40	279.90	278.90	283.44	0.013
CB 5	DMH 4	10	0.59		0.58	15.83	0.02	15.85	4.36	1.47		12	0.060	3.30	8.30	279.50	278.90	283.00	0.013
DMH 4	HW 6	40		0.78	0.56	17.35	0.16	17.51	4.20		1.83	12	0.008	6.50	4.20	278.80	278.50	283.13	0.013

AVERAGE 'c' VALUE FOR STRUCTURES

STORM RUNOFF DATA

Date: **5/30/23**
Revised:

Project: **Bonnie Dr. Ext.**
Town: **Holliston, MA**

Job No: **7,701**
Calc. by: **RST**

Structure	Total Area (SF)	Ground Cover	Area (SF)	c	Σ(Area*c)	Average c	Total Area (Ac)
CB#1	3,534	imp	800	0.95	760.00	0.45	0.081
		lawn	2,734	0.30	820.20		
		wooded	0	0.20	0.00		
CB#2	4,924	imp	1,920	0.95	1,824.00	0.55	0.113
		lawn	3,004	0.30	901.20		
		wooded	0	0.20	0.00		
CB#5	25,535	imp	10,815	0.95	10,274.25	0.58	0.586
		lawn	14,720	0.30	4,416.00		
		wooded	0	0.20	0.00		

OVERLAND FLOW TRAVEL TIME

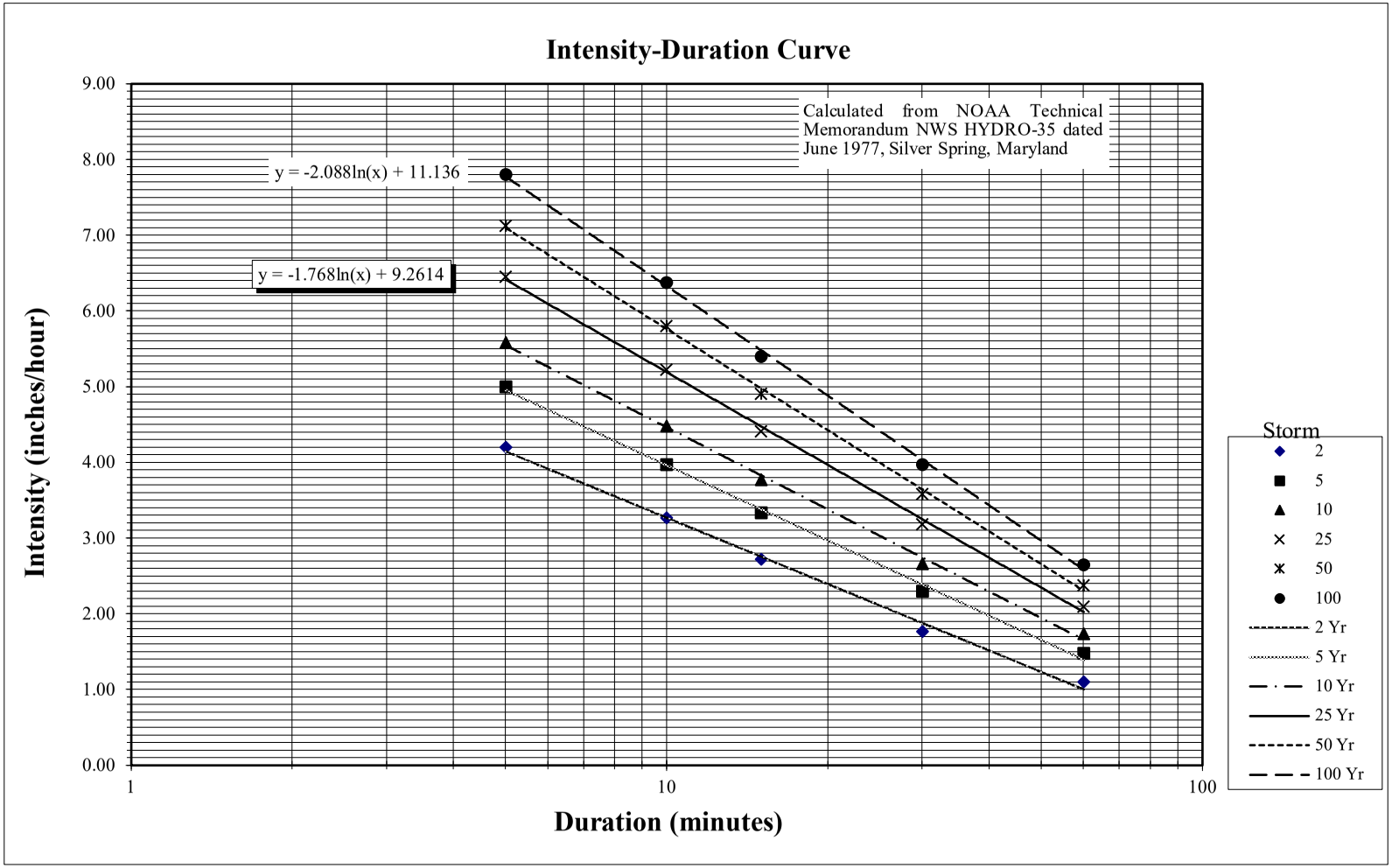
STORM RUNOFF DATA

Date: **5/30/23**
Revised:

Project: **Bonnie Dr. Ext.**
Town: **Holliston, MA**

Job No: **7,701**
Calc. by: **rst**

Structure	Impervious			Lawn			Wooded			Total
	Length (ft)	Slope ('/')	Time (min.)	Length (ft)	Slope ('/')	Time (min.)	Length (ft)	Slope ('/')	Time (min.)	Travel Time (min.)
1	85	0.010	1.41	80	0.020	14.48				15.89
2	85	0.010	1.41	60	0.020	12.66				14.07
5	195	0.010	2.66	80	0.030	13.16				15.83


Intensity-Duration Curve
Calculated from NOAA Technical Memorandum NWS HYDRO-35 dated June 1977, Silver Spring, Maryland
y = -2.088ln(x) + 11.136
y = -1.768ln(x) + 9.2614
Intensity (inches/hour)
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1
10
100
Duration (minutes)
Storm
2
5
10
25
50
100
2 Yr
5 Yr
10 Yr
25 Yr
50 Yr
100 Yr

NOAA Atlas 14, Volume 10, Version 3
Location name: Holliston, Massachusetts, USA*
Latitude: 42.2002°, Longitude: -71.4242°
Elevation: 191 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	**0.330** (0.256-0.423)	**0.398** (0.308-0.511)	**0.509** (0.393-0.656)	**0.601** (0.461-0.779)	**0.728** (0.541-0.987)	**0.823** (0.601-1.14)	**0.923** (0.654-1.33)	**1.03** (0.696-1.52)	**1.19** (0.773-1.82)	**1.32** (0.837-2.06)
10-min	**0.468** (0.362-0.600)	**0.564** (0.436-0.724)	**0.721** (0.556-0.929)	**0.851** (0.653-1.10)	**1.03** (0.767-1.40)	**1.17** (0.850-1.62)	**1.31** (0.926-1.88)	**1.47** (0.986-2.16)	**1.69** (1.09-2.58)	**1.87** (1.19-2.92)
15-min	**0.550** (0.426-0.706)	**0.663** (0.513-0.852)	**0.848** (0.654-1.09)	**1.00** (0.769-1.30)	**1.21** (0.902-1.64)	**1.37** (1.00-1.90)	**1.54** (1.09-2.21)	**1.72** (1.16-2.54)	**1.99** (1.29-3.04)	**2.20** (1.40-3.44)
30-min	**0.754** (0.584-0.967)	**0.909** (0.704-1.17)	**1.16** (0.897-1.50)	**1.37** (1.05-1.78)	**1.66** (1.24-2.26)	**1.88** (1.37-2.61)	**2.11** (1.50-3.04)	**2.36** (1.59-3.49)	**2.73** (1.77-4.17)	**3.02** (1.91-4.71)
60-min	**0.957** (0.742-1.23)	**1.16** (0.894-1.48)	**1.48** (1.14-1.90)	**1.75** (1.34-2.26)	**2.12** (1.57-2.87)	**2.39** (1.74-3.32)	**2.68** (1.90-3.86)	**3.01** (2.02-4.43)	**3.47** (2.24-5.30)	**3.84** (2.43-5.99)
2-hr	**1.22** (0.955-1.56)	**1.48** (1.16-1.89)	**1.90** (1.48-2.44)	**2.26** (1.74-2.90)	**2.74** (2.05-3.70)	**3.10** (2.28-4.29)	**3.48** (2.50-5.03)	**3.94** (2.66-5.78)	**4.64** (3.01-7.04)	**5.22** (3.32-8.10)
3-hr	**1.41** (1.11-1.80)	**1.72** (1.34-2.18)	**2.21** (1.72-2.82)	**2.62** (2.03-3.36)	**3.18** (2.40-4.30)	**3.60** (2.66-4.98)	**4.05** (2.92-5.85)	**4.60** (3.11-6.73)	**5.46** (3.55-8.26)	**6.19** (3.94-9.56)
6-hr	**1.81** (1.42-2.28)	**2.20** (1.73-2.78)	**2.84** (2.22-3.60)	**3.37** (2.62-4.30)	**4.10** (3.10-5.50)	**4.63** (3.45-6.38)	**5.22** (3.80-7.52)	**5.95** (4.04-8.64)	**7.09** (4.62-10.7)	**8.08** (5.15-12.4)
12-hr	**2.29** (1.81-2.87)	**2.79** (2.21-3.50)	**3.61** (2.84-4.54)	**4.29** (3.36-5.43)	**5.22** (3.97-6.96)	**5.91** (4.42-8.08)	**6.66** (4.86-9.52)	**7.59** (5.17-11.0)	**9.03** (5.91-13.5)	**10.3** (6.58-15.7)
24-hr	**2.73** (2.17-3.40)	**3.36** (2.68-4.19)	**4.40** (3.49-5.50)	**5.26** (4.14-6.62)	**6.44** (4.93-8.55)	**7.31** (5.50-9.95)	**8.27** (6.07-11.8)	**9.46** (6.46-13.6)	**11.3** (7.44-16.8)	**13.0** (8.31-19.6)
2-day	**3.07** (2.46-3.80)	**3.85** (3.08-4.76)	**5.11** (4.08-6.35)	**6.16** (4.88-7.70)	**7.61** (5.86-10.1)	**8.66** (6.56-11.8)	**9.84** (7.29-14.0)	**11.3** (7.78-16.2)	**13.8** (9.06-20.3)	**15.9** (10.2-23.9)
3-day	**3.34** (2.68-4.11)	**4.17** (3.35-5.14)	**5.53** (4.42-6.84)	**6.66** (5.29-8.29)	**8.21** (6.35-10.8)	**9.34** (7.10-12.6)	**10.6** (7.88-15.0)	**12.2** (8.40-17.4)	**14.8** (9.79-21.8)	**17.1** (11.1-25.7)
4-day	**3.60** (2.90-4.42)	**4.46** (3.59-5.48)	**5.86** (4.70-7.24)	**7.03** (5.60-8.73)	**8.64** (6.69-11.3)	**9.81** (7.47-13.2)	**11.1** (8.27-15.7)	**12.8** (8.80-18.1)	**15.5** (10.2-22.7)	**17.8** (11.5-26.7)
7-day	**4.32** (3.50-5.28)	**5.23** (4.23-6.40)	**6.71** (5.41-8.24)	**7.95** (6.36-9.81)	**9.64** (7.49-12.5)	**10.9** (8.30-14.5)	**12.3** (9.11-17.1)	**14.0** (9.65-19.7)	**16.7** (11.0-24.3)	**19.0** (12.3-28.3)
10-day	**5.01** (4.07-6.10)	**5.95** (4.83-7.25)	**7.49** (6.05-9.16)	**8.76** (7.04-10.8)	**10.5** (8.18-13.6)	**11.8** (9.00-15.6)	**13.2** (9.80-18.3)	**14.9** (10.3-20.9)	**17.5** (11.7-25.5)	**19.8** (12.8-29.3)
20-day	**7.07** (5.78-8.55)	**8.08** (6.60-9.78)	**9.72** (7.91-11.8)	**11.1** (8.96-13.5)	**13.0** (10.1-16.5)	**14.4** (11.0-18.7)	**15.9** (11.7-21.5)	**17.5** (12.2-24.3)	**19.9** (13.3-28.6)	**21.8** (14.2-32.1)
30-day	**8.76** (7.19-10.6)	**9.81** (8.04-11.8)	**11.5** (9.41-13.9)	**12.9** (10.5-15.8)	**14.9** (11.6-18.9)	**16.4** (12.5-21.2)	**17.9** (13.2-24.0)	**19.5** (13.6-27.0)	**21.6** (14.5-31.0)	**23.3** (15.2-34.2)
45-day	**10.9** (8.94-13.0)	**11.9** (9.82-14.3)	**13.7** (11.3-16.6)	**15.2** (12.4-18.4)	**17.3** (13.5-21.7)	**18.8** (14.4-24.1)	**20.4** (14.9-26.9)	**21.9** (15.4-30.1)	**23.8** (16.0-33.9)	**25.1** (16.4-36.7)
60-day	**12.6** (10.4-15.1)	**13.7** (11.3-16.4)	**15.6** (12.8-18.7)	**17.1** (13.9-20.6)	**19.2** (15.0-24.0)	**20.8** (15.9-26.5)	**22.4** (16.4-29.4)	**23.8** (16.8-32.7)	**25.5** (17.2-36.3)	**26.6** (17.4-38.8)

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

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

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

APPENDIX – C

Stormwater Recharge Calculations, Water Quality Volumes, TSS Removal & Infiltration BMP Drain Time
Groundwater Mounding Calculations

Standards 3 & 4:

APPENDIX – B
Stormwater Recharge, Water Quality & Forebay Calculations
Standard 3 & 4:

Project:
Bonnie Drive Extension
Holliston, Massachusetts
Date: May 30, 2023
Revised: Jan. 17, 2024

Water Quality Volume (WQV): Based on 1.0 inch rainfall
Recharge Volume(Rv): Based on Soil Classification

Rv = F * Impervious Area
Rv = Required Recharge Volume
F = Depth Factor
Soil Type A – 0.60 inch

Total Impervious Area:
Roadway/Drives: 15,463 s.f. (To drainage basin)
Roof: (To Infiltration) 5,792 s.f.
Total Imp. Area: 21,255 s.f.

Total Impervious to Drainage Basins: 15,463 s.f.
Total Impervious to Infiltraion Chambers (roofs): 5,792 s.f.

Recharge Volume required Roof Area:
Each system captures entire roof area.
Roof Area: (Largest house) 2,100 s.f
Rv = (0.60 inch * 2100 s.f.)/ 12 = 105 c.f.

Recharge Volume Provided:
Concrete Galley's w/stone:
Tot. Volume: 332 c.f.

Time to drain:
Drawdown time = Volume/(K*Bottom Area)
Volume = 105 cf
K=8.27 in/hr = 0.69 ft/hr
Bottom Area = 189 sf
Drawdown time = 105/(0.69 ft/hr x 189 sf)
Drawdown time = 1 hr < 72 hr ***ok***

Drainage Basin #1 :
Imp. Area Pavement: 15,463 s.f.
WQV = (15,463 sf * 1.0 in)/12 = 1,289 c.f.

Recharge Volume Required:
Tot. Imp Area: 15,463 s.f.
Rv = (15,463 sf * 0.60 inch)/12 = 773 c.f.

Drainage Basin "Static" Storage Volume Provided:
Volume (Overflow El.=281.0) provided = 13,000 c.f.
13,000 > 1,289 c.f. **OK**

Forebay Sizing:
Forebay Volume Required: (Paved Area) x 0.10 inch of runoff
(15,463 s.f. x 0.10 in)/12 =129 cu.ft.
Forebay Volume Provided:

Elev. (ft.)	Area (s.f.)	Inc.Store (cu.ft.)	Cum.Store (cu.ft.)
277.0	892	0	0
278.0	1152	1022	1022
278.5	1343	624	1046

Total Storage Povided: 1046 c.f.
1046 cf > 129 cf ***ok***

Time to for basin to drain: (Volume Full)
Drawdown time = Volume/(K*Bottom Area)
Volume (Full) = 13,000 cf
K=8.27 in/hr = 0.69 ft/hr
Bottom Area (El, 276.5) = 854 sf
Drawdown time = 13,000/(0.69 ft/hr x 854 sf)
Drawdown time = 22 hr < 72 hr ***ok***

Mound Calculation Basin
Bonnie Drive Extension, Holliston, MA
Date: 05/13/2023

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

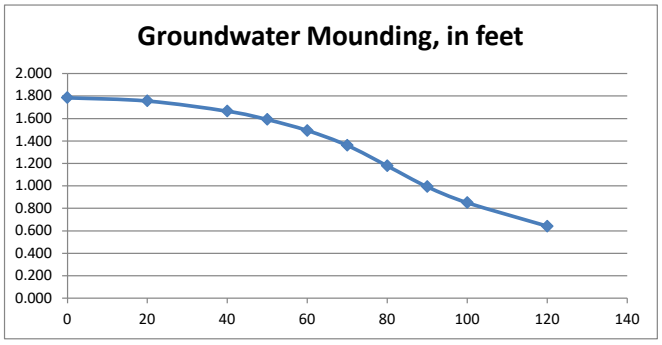
Input Values

7.4500	***R***	**Recharge (infiltration) rate (feet/day)**
0.320	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
165.40	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
80.000	**x**	**1/2 length of basin (x direction, in feet)**
12.000	**y**	**1/2 width of basin (y direction, in feet)**
1.000	**t**	**duration of infiltration period (days)**
25.000	**hi(0)**	**initial thickness of saturated zone (feet)**

26.785	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
1.785	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
1.785	**0**
1.757	**20**
1.665	**40**
1.591	**50**
1.493	**60**
1.361	**70**
1.179	**80**
0.993	**90**
0.851	**100**
0.641	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

APPENDIX – D

Stormwater Operation and Maintenance Plan
and
Long Term Pollution Prevention Plan

Standard 9

Stormwater Management Operation and Maintenance Plan And Long Term Pollution Prevention Plan

Bonnie Drive Extension
Holliston, Massachusetts

September 7, 2023

In accordance with Standard 9 of the Massachusetts Department of Environmental Protection Stormwater Handbook (February 2008), the attached on-site maintenance program for the proposed stormwater management system has been developed to ensure the Best Management Practices (BMP's) in place will remain functioning as designed. The Plan contains both construction period operations and maintenance as well as post construction responsibilities that shall "run" with the property if ownership is transferred.

Land Owner/Operator:

Thomas Murch
Murch Prentice Realty Trust
5855 Lyman Road
Turin, NY 13473

_____ _____
Date

Estimated Maintenance Yearly Budget:

Annual Catch Basin and Oil/Grit Chamber Cleaning:	$ 600.00
Mowing, vegetation maintenance of Drainage Basins:	$ 300.00
Repairs:	$ 250.00
Total	$1,150.00

Construction Period Operation and Maintenance:

Good Housekeeping Practices:

- Remove all debris from site and dispose of in trash dumpsters
- Plan for adequate disposal of scrap, waste and surplus materials
- Keep work area clean
- Secure loose or light material that is stored on the site
- Store flammable materials apart from other materials
- Secure all materials at the end of each work day
- Maintain a clean neat and orderly site

Safety:

Keep safety considerations at the forefront of inspection procedures at all times. Likely hazards should be anticipated and avoided. Never enter a confined space (outlet structure, manhole, etc) without proper training or equipment. A confined space should never be entered without at least one additional person present. If a toxic or flammable substance is discovered, leave the immediate area and contact the local authorities at 911.

All cast iron storm water structure grates and covers shall be kept in good condition and kept closed at all times. Any damaged or broken structures will be replaced immediately upon discovery.

Erosion Control Barriers:

Compost filter socks shall be installed where indicated on the plans and in other appropriate locations where warranted. These barriers shall be installed prior to the commencement of any work on-site and in accordance with the construction plans. A supply of filter socks and compost filter material shall be kept on-site to replace and/or repair barriers that are damaged or degraded. The barriers shall be observed and maintained on a weekly basis during construction.

Construction Entrances:

The existing paved site entrance shall be utilized for construction access.

Catch Basin Protection:

Temporary inlet protection barriers consisting of Silt Sacks® will be placed within all constructed inlets to prevent inflow of sediments into the constructed drainage system. The barriers shall remain in place until a permanent cover is established or diversions away from the inlets are constructed. The barriers shall be observed and maintained as necessary on a weekly basis and after every rainfall of 0.5 inches or more.

Dust Control:

Soils information for the site indicates that it is comprised of sandy soils. Therefore, Dust control BMPs to reduce surface activities and air movement that causes dust to be generated from disturbed soil surfaces will be required. The preferred measure for dust control is sprinkling/irrigation. This is an on-going/as-needed requirement until surfaces have been stabilized. There shall be a water truck on-site available as needed.

Spill Control:

A contingency plan to address the spillage/release of petroleum products and any hazardous materials will be implemented for the site during construction. The plan will include the following measures:

- Equipment necessary to quickly attend to inadvertent spills or leaks shall be on-site in a secure but accessible location. Such equipment will include, but not be limited to, the following: urethane drain cover seals (mats), a spill containment kit which includes sand and shovels, suitable absorbent materials, storage containers, safety goggles, chemically resistant gloves and overshoe boots, water and chemical fire extinguishers, and first aid equipment.
- Spills or leaks will be treated properly according to material type, volume of spillage and location of spill. Mitigation will include preventing further spillage, containing any spilled material to the smallest practical area, removing spilled material in a safe and environmentally friendly manner, and remediating any damage to the environment.
- The contractor shall be familiar with the reporting requirements of the Massachusetts Contingency Plan (310 CMR 40.00) as issued by the Massachusetts Department of Environmental Protection (DEP); specifically Subpart C Notification of Releases and Threats of Release of Oil and Hazardous Materials and Subpart D Preliminary Response Activities and Risk Reduction Measures.
- For any large spills. The Massachusetts DEP Hazardous Waste Incident Response Group shall be notified immediately at 1-617-792-7653 and an emergency response contractor will be called in.

Post-Construction Period Operation and Maintenance:

Pavement Sweeping:
Sweeping has been shown to be an effective initial treatment for reducing contaminants in stormwater runoff. Sweeping is not required to meet TSS removal goals in this case but should be performed in the spring to remove winter accumulations or at other when warranted.

Gutter Cleaning:
Gutter cleaning shall be done at least once per year, in the fall after the trees have dropped their leaves. Inspect downspouts and overflows periodically to prevent debris buildup.

Deep Sump Catch Basins:
Deep sump catch basins remain effective at removing pollutants only if they are cleaned out frequently. Inspection should be done four (4) times per year and cleaned when sediment depth of deposits is greater than or equal to one half the depth from the bottom of the invert to the lowest pipe in the basin. Catch basins shall be cleaned at least once (1) time per year, at the end of the foliage and snow removal seasons. Clamshell buckets or vacuum trucks shall be utilized.

Drainage Basin & Forebay:
Vehicle access if necessary will be via the 10 foot wide access around the top of the retention basin. The drainage easement shall be mowed twice a year and kept clear of any trees. The easement will be used for access to the basin.

Inspect it after every major storm for the first few months to ensure it is stabilized and functioning properly and if necessary to take corrective action. Also inspect the basin every time there is a discharge through the high outlet weir. A major storm is defined as a storm that is equal to or greater than the 2.5 inches in a 24-hour storm. Note how long the water remains standing after a storm. If longer than 72 hours, there may be clogging of the infiltrative surfaces. Inspect the basin and mow it as needed. When mowing keep the grass height no greater than 6 inches. Set mower blades no lower than 3 to 4 inches. Remove grass clippings, organic matter and trash. Use deep tilling to break up compacted or clogged surfaces.

Check for signs of gullying and repair as needed. After removing the sediment, replace any vegetation damaged during the clean-out by reseeding.

Outlet Structure:
Inspection: Inspect semi-annually the first year, and at least once a year thereafter. Inspect the grass for growth and the side slopes for signs of erosion and formation of rills and gullies. Plant an alternative grass species if the original grass cover is not successfully established.
The stone riprap outlet channel shall be inspected semi-annually for debri, sediment buildup and any vegetated growth.
Sediment Removal: Check on a yearly basis and clean as needed. Use hand methods (i.e., a person with a shovel) when cleaning to minimize disturbance to vegetation and underlying soils.

Snow Removal and De-icing:

The use of Sodium Chloride ("rock salt") for de-icing of paved surfaces will be limited; except when found to be necessary for safety of the workers. Sand will be the primary icing control agent. Alternative de-icing products such as calcium chloride may be used as temperatures or other conditions warrant.

Fertilizer:

Slow release organic fertilizers will be used in landscape areas to limit nutrient transport to groundwater and wetland areas. Application will be limited to 3 lbs. per 1000 sf of lawn area.

Spill Control:

See Construction Period Spill control requirements.

Stormwater Construction Site Inspection Report

General Information			
Project Name			
MA DEP File No.		**Location**	
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Inspector's Qualifications			
Describe present phase of construction			
Type of Inspection: ❑ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event			
Weather Information			
Has there been a storm event since the last inspection? ❑Yes ❑No **If yes, provide:** Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in):			
Weather at time of this inspection? ❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds ❑ Other: Temperature:			
Have any discharges occurred since the last inspection? ❑Yes ❑No **If yes, describe:**			
Are there any discharges at the time of inspection? ❑Yes ❑No **If yes, describe:**			

Site-specific BMPs

- *Number the structural and non-structural BMPs identified in your SWPPP on your site map and list them below (add as many BMPs as necessary). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required BMPs at your site.*
- *Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.*

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
1	Deep Sump Catch Basins (Inspections 4 times per year & cleaning a min. of 1 time per year)	❑Yes ❑No	❑Yes ❑No	
2	Drainage Basin (Siltation buildup, grass mowing, side slopes and removal of sediment)	❑Yes ❑No	❑Yes ❑No	
3	Outlet Structure (Inspect semi annually, riprap, debri, sediment buildup and vegetative	❑Yes ❑No	❑Yes ❑No	

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
	growth)			
		❑Yes ❑No	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance not described above:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: _____

Signature:_____ **Date:**_____

APPENDIX – E

Illicit Discharge Statement

Standard 10

Illicit Discharge Compliance Statement

Bonnie Drive Extension
Holliston, Massachusetts

Sept 7, 2023

This statement is provided in accordance with the provisions of the Massachusetts Stormwater Management Standard #10.

To the best of the applicant's/owners knowledge there are no illicit discharges to the site's stormwater manangement system.

All proposed uses on the site will not generate, store or discharge any pollutants to the groundwater and/or wetland resource areas.

Any illicit discharges identified during or after construction will be terminated immediately.

APPENDIX – F

Soil Evaluation Forms

Re: Definitive Subdivision Plan
Triangle Farm
Holliston, MA

Soil Test Groundwater Elevations: Monitored 3/30/2022

Test Pit #	Groundwater Monitored 3/30/22	Surface Elevation (feet)	Grd Water Elevation (feet)
12	7.5’	282.1	274.6
12B2	7.5’	282.0	274.5
14A	9.0’	282.9	273.9
14B	9.1 dry	283.0	274.0
11A	8.0	282.8	274.8
11B	7.5’	282.5	275.0

19 Exchange Street, Holliston, MA 01746 • 508-429-1100 • Fax 508-429-7160 • GLMengineering.com

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Thomas Murch
Owner Name

5855 Lyman Road
Street Address

Map 7, Block 4, Parcel 55.D
Map/Lot #

Turin
City

NY
State

13473
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: _____ Source 254B Soil Map Unit

Merrimac
Soil Name

Soil Limitations

Sand
Soil Parent material

Morraine
Landform

3. Surficial Geological Report Available? ☐ Yes ☐ No If yes: _____ Year Published/Source _____ Map Unit

Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: _____ Wetland Type

7. Current Water Resource Conditions (USGS): _____ Month/Day/ Year Range: ☐ Above Normal ☐ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 11A (Hole #) | 5/14/97 (Date) | am (Time) | _____ (Weather) | _____ (Latitude) | _____ (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Forest (Vegetation) | none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | _____ (Slope (%))

Description of Location: _____

2. Soil Parent Material: Sand | _____ (Landform) | _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n.a. feet | Drainage Way n.a. feet | Wetlands 100+ feet
Property Line 100 feet | Drinking Water Well n.a. feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 96" Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
4	A	L	10YR3/2								
30	B	SL	10yr5/6								
132	C1	S	2.5y5/4								Med-Coarse Sand

Additional Notes:
Water encountered at 96"

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 11B (Hole #) 5/14/97 (Date) am (Time) _____ (Weather) _____ (Latitude) _____ Longitude:

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Forest (Vegetation) _____ (Surface Stones (e.g., cobbles, stones, boulders, etc.)) _____ (Slope (%))

Description of Location: _____

2. Soil Parent Material: Sand _____ (Landform) _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n.a. feet Drainage Way n.a. feet Wetlands 100+ feet
Property Line 100 feet Drinking Water Well n.a. feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: ____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
6	A	L	10yr3/2								
30	B	SL	10yr5/6								
36	C1	S	2.5y5/4						Coarse 70% Gravel		
130	C2	LS	2.5y5/2						Fine-Med Sand		

Additional Notes:
No water encountered

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 12A (Hole #) | 5/14/97 (Date) | am (Time) | _____ (Weather) | _____ (Latitude) | _____ (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Forest (Vegetation) | none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | _____ (Slope (%))

Description of Location: _____

2. Soil Parent Material: Sand | _____ (Landform) | _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n.a. feet | Drainage Way n.a. feet | Wetlands 100+ feet
Property Line 100 feet | Drinking Water Well n.a. feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 134" Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
8	A	L	10YR3/2								
22	B	SL	10yr5/6								
45	C1	S	2.5y5/4								Coarse 70% Gravel
144	C2	S	2.5y5/1								Very fine-Med Sand w/cobs-stone

Additional Notes:
Water encountered at 134"

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 12B (Hole #) 5/14/97 (Date) am (Time) _____ (Weather) _____ (Latitude) _____ (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Forest (Vegetation) _____ (Surface Stones (e.g., cobbles, stones, boulders, etc.)) _____ (Slope (%))

Description of Location: _____

2. Soil Parent Material: Sand _____ (Landform) _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n.a. feet Drainage Way n.a. feet Wetlands 100+ feet
Property Line 100 feet Drinking Water Well n.a. feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 108' Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
6	A	L	10yr3/2								
32	B	SL	10yr5/6								
48	C1	S	2.5y5/4						Coarse 70% Gravel		
138	C2	S	2.5y5/2						Fine-Med 40% Gravel		

Additional Notes:
Water encountered at 108"

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 14A (Hole #) | 5/14/97 (Date) | am (Time) | (Weather) | (Latitude) | (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Forest (Vegetation) | none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | (Slope (%))

Description of Location:

2. Soil Parent Material: Sand | (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n.a. feet | Drainage Way n.a. feet | Wetlands 100+ feet
Property Line 100 feet | Drinking Water Well n.a. feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: None Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
8	A	L	10YR3/2								
22	B	SL	10yr5/6								
45	C1	S	2.5y5/4								Coarse 70% Gravel
120	C2	S	2.5y5/1								Very fine-Med Sand w/cobs-stone

Additional Notes:

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 14B (Hole #) 5/14/97 (Date) am (Time) _____ (Weather) _____ (Latitude) _____ Longitude:

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Forest (Vegetation) _____ (Surface Stones (e.g., cobbles, stones, boulders, etc.)) _____ (Slope (%))

Description of Location: _____

2. Soil Parent Material: Sand _____ (Landform) _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n.a. feet Drainage Way n.a. feet Wetlands 100+ feet
Property Line 100 feet Drinking Water Well n.a. feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: None Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
6	A	L	10yr3/2								
32	B	SL	10yr5/6								
48	C1	S	2.5y5/4						Coarse 70% Gravel		
132	C2	S	2.5y5/2						Fine-Med 40% Gravel		

Additional Notes: _____

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 14-HSE (Hole #) | 5/14/97 (Date) | am (Time) | (Weather) | (Latitude) | (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Forest (Vegetation) | none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | (Slope (%))

Description of Location:

2. Soil Parent Material: Sand | (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n.a. feet | Drainage Way n.a. feet | Wetlands 100+ feet
Property Line 100 feet | Drinking Water Well n.a. feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: None Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
8	A	L	10YR3/2								
22	B	SL	10yr5/6								
45	C1	S	2.5y5/4								Coarse 70% Gravel
120	C2	S	2.5y5/1								Very fine-Med Sand w/cobs-stone

Additional Notes:

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole #	Obs. Hole #_____
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☐ Depth to soil redoximorphic features (mottles)	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number

_____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well#	S_c	S_r	OW_c	OW_{max}	OW_r	S_h

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil 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 15.100 through 15.107.

Signature of Soil Evaluator	Date
Joseph Nihill SE#1746	
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License
William Domey	BOH Agent
Name of Approving Authority Witness	Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Thomas Murch
Owner Name

5855 Lyman Road
Street Address

Map 7, Block 4, Parcel 55.D
Map/Lot #

Turin
City

NY
State

13473
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Source: 103C (Soil Map Unit)

   Merrima
   Soil Name

   Soil Limitations

   Sand
   Soil Parent material

   Morraine
   Landform

3. Surficial Geological Report Available? ☐ Yes ☐ No If yes:
   Year Published/Source
   Map Unit

   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer:
   Wetland Type

7. Current Water Resource Conditions (USGS): Range: ☐ Above Normal ☐ Normal ☐ Below Normal
   Month/Day/ Year

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 22-1 (Hole #) 3/30/22 (Date) am (Time) _____ (Weather) _____ (Latitude) _____ (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Forest (Vegetation) none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) _____ (Slope (%))

Description of Location:

2. Soil Parent Material: Sand

Landform _____ Position on Landscape (SU, SH, BS, FS, TS) _____

3. Distances from: Open Water Body n.a. feet; Drainage Way n.a. feet; Wetlands 100+ feet; Property Line 100 feet; Drinking Water Well n.a. feet; Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
4	A	SL	10YR3/2								
24	B	SL	10yr5/6								
40	C1	S	2.5y4/3								Med-Coarse Sand
120	C2	S	2.5Y5/2								Fine Sane

Additional Notes:
No Water encountered

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 22-2 (Hole #) 3/30/22 (Date) am (Time) Weather Latitude Longitude:

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Forest (Vegetation) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)

Description of Location:

2. Soil Parent Material: Sand Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body n.a. feet; Drainage Way n.a. feet; Wetlands 100+ feet; Property Line 100 feet; Drinking Water Well n.a. feet; Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 88" Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
4	A	SL	10YR3/2								
24	B	SL	10yr5/6								
36	C1	S	10yr4/3						Med-Coarse Gravel		
120	C2	S	2.5y5/2						Fine Sand		

Additional Notes:
Water Encountered at 88"

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 22-3 (Hole #) | 3/30/22 (Date) | am (Time) | _____ (Weather) | _____ (Latitude) | _____ (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Forest (Vegetation) | none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | _____ (Slope (%))

Description of Location: _____

2. Soil Parent Material: Sand | _____ (Landform) | _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n.a. feet | Drainage Way n.a. feet | Wetlands 100+ feet
Property Line 100 feet | Drinking Water Well n.a. feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 116" Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
4	A	SL	10YR3/2								
24	B	SL	10yr5/6								
50	C1	S	2.5y4/3								Med-Coarse Sand
120	C2	S	2.5Y5/2								Fine Sane

Additional Notes:
Water encountered at 116"

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 22-4 (Hole #) 3/30/22 (Date) am (Time) _____ (Weather) _____ (Latitude) _____ Longitude:

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) Forest (Vegetation) _____ (Surface Stones (e.g., cobbles, stones, boulders, etc.)) _____ (Slope (%))

Description of Location: _____

2. Soil Parent Material: Sand _____ (Landform) _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n.a. feet Drainage Way n.a. feet Wetlands 100+ feet
Property Line 100 feet Drinking Water Well n.a. feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 120" Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
4	A	SL	10yr3/2								
24	B	SL	10yr5/6								
48	C1	S	10yr4/3						Med-Coarse Gravel		
123	C2	S	2.5y5/2	57"	10yr5/6				Fine Sand		

Additional Notes:
Mottles encountered at 57"

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: 22-5 (Hole #) | 3/30/22 (Date) | am (Time) | _____ (Weather) | _____ (Latitude) | _____ (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Forest (Vegetation) | none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | _____ (Slope (%))

Description of Location: _____

2. Soil Parent Material: Sand | _____ (Landform) | _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n.a. feet | Drainage Way n.a. feet | Wetlands 100+ feet
Property Line 100 feet | Drinking Water Well n.a. feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
4	A	SL	10YR3/2								
24	B	SL	10yr5/6								
68	C1	S	2.5y4/3	68"	10yr5/6						Med-Coarse Sand
132	C2	S	2.5Y5/2								Fine Sane

Additional Notes:
Mottles encountered at 68"

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole #	Obs. Hole #_____
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☐ Depth to soil redoximorphic features (mottles)	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

Index Well Number Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well#	S_c	S_r	OW_c	OW_{max}	OW_r	S_h

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: inches Lower boundary: inches

c. If no, at what depth was impervious material observed? Upper boundary: inches Lower boundary: inches

Commonwealth of Massachusetts
City/Town of Holliston

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil 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 15.100 through 15.107.

Signature of Soil Evaluator

Date

Robert Truax SE#1746
Typed or Printed Name of Soil Evaluator / License #

Expiration Date of License

Scott Moles
Name of Approving Authority Witness

BOH Agent
Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

APPENDIX – G

Supplemental Stormwater Plans

Pre-Development Subcatchment Areas
Post-Development Subcatchment Areas
Hydraulic Subcatchment Areas

BONNEY DRIVE
(PUBLIC 50'-WIDE)

HARGRAVE AVENUE
(PUBLIC 50'-WIDE)

N/F
ROBERT F. AND
ANNE LOUISE MAXCY
13747\299

N/F
MARIA HOFFEY
62942/559

N/F
GEORGE VOORHEES
62628/448

N/F
OLIMPIO POCAS
22923\191

N/F
ELITE HOME BUILDERS LLC

N/F
MURCH PRENTICE REALTY TRUST

CB#1
1,534 S.F.

CB#2
4,294 S.F.

CB#5
25,535 S.F.

GRAPHIC SCALE
40 0 20 40 80 160
(IN FEET)
1 inch = 40 ft.

CATCH BASIN DRAINAGE AREAS

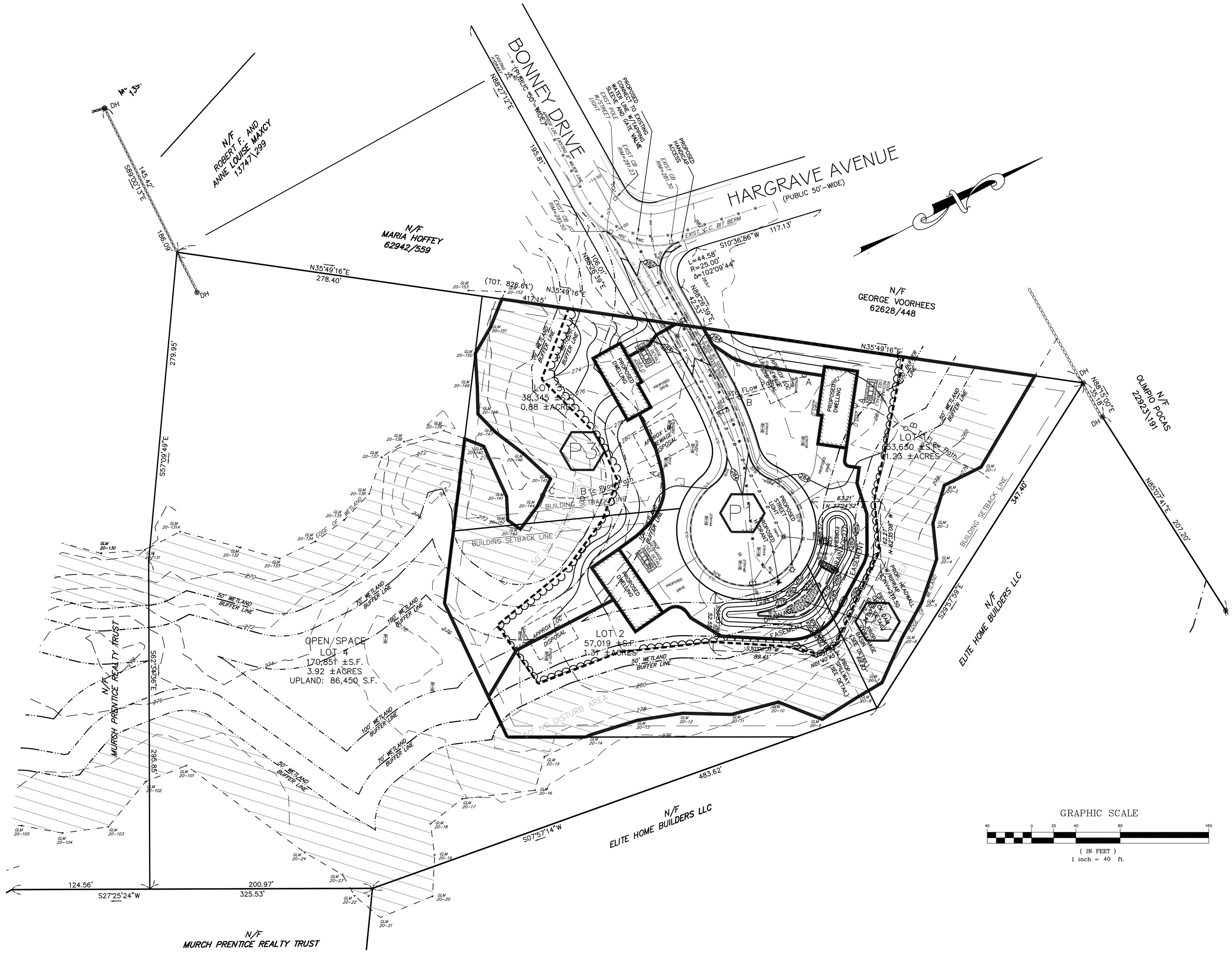
REVISIONS		
No.	DATE	DESCRIPTION
1	1/18/2024	REVIEW COMMENTS

DEFINITIVE OPEN SPACE SUBDIVISION
"BONNEY DRIVE EXTENSION"
A 3 LOT SINGLE FAMILY SUBDIVISION
HOLLISTON, MASSACHUSETTS

PREPARED FOR:
THOMAS MURCH et.al., TRUSTEE
MURCH PRENTICE REALTY TRUST
5855 LYMAN ROAD
TURIN, NY 13473

GLM Engineering Consultants, Inc.
19 EXCHANGE STREET
HOLLISTON, MA 01746
P: 508-429-1100
F: 508-429-7160
www.GLMengineering.com

JOB No.	7701DEF
DATE:	AUG. 29, 2023
SCALE:	1"=40'
SHEET:	3 of 3
PLAN #:	27,404



POST-DEVELOPED RUNOFF

REVISIONS		
No.	DATE	DESCRIPTION
1	1/18/2024	REVIEW COMMENTS

DEFINITIVE OPEN SPACE SUBDIVISION "BONNEY DRIVE EXTENSION" A 3 LOT SINGLE FAMILY SUBDIVISION HOLLISTON, MASSACHUSETTS

PREPARED FOR:
THOMAS MURCH et.al., TRUSTEE
MURCH PRENTICE REALTY TRUST
5855 LYMAN ROAD
TURIN, NY 13473

GLM Engineering Consultants, Inc.
19 EXCHANGE STREET
HOLLISTON, MA 01746
P: 508-429-1100
F: 508-429-7160
www.GLMengineering.com

JOB No.	7701DEF
DATE:	AUG. 29, 2023
SCALE:	1"=40'
SHEET:	2 fo 3
PLAN #:	27,404

BONNEY DRIVE
(PUBLIC 50'-WIDE)

HARGRAVE AVENUE
(PUBLIC 50'-WIDE)

N/F
ROBERT F. AND
ANNE LOUISE MAXCY
137/47\299

N/F
MARIA HOFFEY
62942/559

N/F
GEORGE VOORHEES
62628/448

N/F
OLIMPIO POCAS
22923\191

N/F
ELITE HOME BUILDERS LLC

N/F
MURCH PRENTICE REALTY TRUST

N/F
MURCH PRENTICE REALTY TRUST

N89°27'12"E 193.61'

N89°01'13"E 145.42'

186.09'

N35°49'16"E 278.40'

(TOT. 826.61')

N35°49'16"E 417.15'

N89°26'39"E 108.01'

S10°36'56"W 117.13'

L=44.58'
R=25.00'
Δ=102°09'44"

N89°27'39"E 42.53'

N35°49'16"E

N89°15'00"E 35.18'

N85°07'41"E 207.20'

347.40'

S23°57'59"E

483.62'

S07°57'14"W

200.97'

124.56'

S27°25'24"W

325.53'

279.95'

S57°09'49"E

295.85'

S69°23'49"E 3.96'

EXISTING HYDRANT

EXIST POLE W/STREET LIGHT

EXIST CB RIM=281.23

EXIST CB RIM=281.30

EXIST CB RIM=281.50

EXISTING 7" WIRE LINE

EXIST. C.C. BIT BERM

EXISTING BIT PAVEMENT

50' WETLAND BUFFER LINE

70' WETLAND BUFFER LINE

100' WETLAND BUFFER LINE

EDGE OF WETLAND

50' NO DISTURB AREA

E1

E2

A

B

C

Tc Flow Path

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

PRE-DEVELOPED RUNOFF

REVISIONS

No.	DATE	DESCRIPTION
1	1/18/2024	REVIEW COMMENTS

DEFINITIVE OPEN SPACE SUBDIVISION
"BONNEY DRIVE EXTENSION"
A 3 LOT SINGLE FAMILY SUBDIVISION
HOLLISTON, MASSACHUSETTS

PREPARED FOR:
THOMAS MURCH et al., TRUSTEE
MURCH PRENTICE REALTY TRUST
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TURIN, NY 13473

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JOB No.	7701DEF
DATE:	AUG. 29, 2023
SCALE:	1"=40'
SHEET:	1 of 3
PLAN #:	27,404