STORMWATER MANAGEMENT REPORT

National Grid Temporary Substation
0 & 14 Mill Street, Amesbury, MA

20 October 2025

SGH Project 211340.01

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PREPARED FOR
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1. INTRODUCTION

Simpson Gumpertz & Heger Inc. (SGH) prepared this Stormwater Management Report on behalf of National Grid for the proposed construction of a new temporary substation (Project), located at 0 & 14 Mill Street in Amesbury, Massachusetts (Site). This report summarizes the proposed stormwater management plan and relevant analyses for the Project. Refer to the Permit Drawings (attached under separate cover) titled "National Grid Temporary Substation," prepared by SGH and dated 20 October 2025 for the proposed scope of work.

2. OBJECTIVE

The objective of this report is to summarize the proposed stormwater management improvements that provide protection of natural resources downstream of the site from degradation because of stormwater discharge from the site. Additionally, the report outlines the Project's approach to meeting the Massachusetts Stormwater Management Standards.

3. BACKGROUND

The Amesbury No. 5 National Grid Substation is located along the Powwow River in Amesbury, Massachusetts. Beginning in December 2021, National Grid observed localized areas of subsidence (soil loss) within the existing substation. Accordingly, National Grid has completed subsurface investigations and equipment removal to mitigate potential issues with soil loss. In February 2022, National Grid installed a spare transformer south of the existing substation to take on the load of Transformer T2, which was removed as part of the mitigative work.

Beginning in September 2024, National Grid observed soil loss at additional locations around essential equipment and closer to the existing retaining walls. The purpose of this project is to construct a temporary substation to the south of the existing substation so that all major equipment can be removed from the existing substation in response to the additional soil loss. The proposed temporary substation will serve as the primary substation until the electrical load can be transferred to the upgraded Hillside No. 66 Substation, located off Allenclair Drive, in late 2028 or early 2029 (design by others). Additionally, the temporary substation will allow National Grid to remove spare transformer (T2). The temporary substation will be deconstructed, and the site will be restored to pre-construction conditions once the new Hillside No. 66 Substation is operational.

The proposed temporary substation (Project) is located within the Central Industrial (IC) Zoning District, per the City of Amesbury Zoning Map. The site is bounded by National Grid properties to the north (existing substation site) and south, the Powwow River to the east, and Mill Street/Mill Street Extension to the west. See Figure 1 for additional information.

The proposed work is located within the 200 ft riverfront area. Accordingly, the Project requires a Notice of Intent (NOI) filing through the City's Conservation Commission. Portions of the proposed work lie within FEMA Flood Zone X (no base elevation) per the FEMA Flood Insurance

Rate Map Number 25009C0106G, dated 08 July 2025 (See Appendix B). Zone AE, with a Base Flood Elevation of 10.8 (NAVD 88), abuts the proposed work.

4. EXISTING CONDITIONS

We base our current understanding of the existing (pre-construction) site conditions on visual field observations, survey data, aerial imagery, and available record drawings.

The site generally consists of greenspace with an existing gravel access drive, and wooden utility poles with overhead wires that serve the existing substation. Under existing conditions, runoff generally flows overland from west to the east/southeast towards the Powwow River. Existing slopes range from approximately 1% to 7%, with an average slope of approximately 4%.

5. PROPOSED CONDITIONS

The proposed temporary substation project consists of the substation equipment, security fencing and access gates, and crushed stone surfacing for equipment installation and access. The project also includes new underground utility connections from the equipment to existing and new utility poles. The proposed stormwater management improvements include a proposed trench with crushed stone and perforated piping on the east side of the site to collect and convey runoff to the Project's stormwater management system. The proposed stormwater management system includes a deep sump catch basin, drain manhole, and associated drain lines which convey stormwater to a drywell.

Under proposed conditions, runoff from the site will generally flow overland west to east/southeast towards the Powwow River, similar to existing conditions. Proposed grading is sloped uniformly within the temporary substation limits with a slope of approximately 1.5% +/-.

6. STORMWATER MANAGEMENT ANALYSIS

6.1 Method of Calculation

We utilized the Soil Conservation Service (SCS) Technical Release No. 20 (SCS Unit Hydrograph runoff procedure), SCS Technical Release No. 55 (Runoff Curve Numbers and calculating Time of Concentration), and rainfall data obtained from the National Oceanic and Atmospheric Administration (NOAA) precipitation frequency tables to perform the hydrologic analysis for the site. The hydrologic model was created with HydroCAD, Version 10.20 software, developed by HydroCAD Software Solutions, LLC. We used a synthetic Type III 24-hr storm for the calculations.

6.2 Sources of Data

- SCS Technical Release No. 20 (TR-20).
- SCS Technical Release No. 55 (TR-55).
- NOAA Atlas 14 Point Precipitation Frequency Estimates
- Natural Resources Conservation Service (NRCS) Custom Soil Resource Report for Essex County, Massachusetts, Northern Part.

6.3 Rainfall Depths

In accordance with the DEP Stormwater Management Guidelines, we analyzed the 2, 10, 25, and 100-Year storm events. The following are the rainfall depths used for each storm event.

Table 1: Rainfall Depths

Storm Event	24 Hour Rainfall
2-Year	3.39 in.
10-Year	5.36 in.
25-Year	6.59 in.
100-Year	8.49 in.

6.4 Soil and Groundcover Conditions

Ground cover characteristics under existing (pre-construction) conditions generally consist of grasslands and an existing gravel access drive. Based on the Natural Resources Conservation

Service (NRCS) Soil Resource Report for Essex County, the existing site soils are classified as Urban Fill with an undefined Hydrologic Soil Group (HSG). For the purposes of our calculations, we assumed an HSG A classification based on soil data for the existing substation site, located to the north of the proposed temporary substation.

The existing site and proposed improvements consist of impervious and pervious surfaces. We assigned the following NRCS Curve Numbers (CN) for the ground cover as follows:

- Impervious (e.g., substation equipment) CN=98
- Mostly Impervious (e.g., compacted gravel) CN=96
- Crushed Stone Surfacing CN=77
- Pervious (i.e., grasslands and greenspace) CN=39

The assumed CN for crushed stone is based on the bare soil underlying the 2-inch crushed stone surfacing.

6.5 Existing Conditions Runoff Calculations

The Existing Stormwater Management Plan (SW-1) consists of two (2) catchment areas that flow to Point of Analysis 1 (POA-1) and Point of Analysis 2 (POA-2). POA-1 represents runoff discharging offsite to the Powwow River via overland flow at a localized low point along the riverbank. POA-2 represents runoff discharging offsite to the Powwow River via overland flow to the southeast of the temporary substation site. Existing Catchment Area ECA-1 is approximately 13,781 sf and consists of existing grasslands with a weighed curve number of 39. Existing Catchment Area ECA-2 is approximately 13,990 sf and consists of existing grasslands and gravel access drive with a weighed curve number of 60. See Figure 2 (SW-1) for additional information.

We generated runoff hydrographs using SCS TR-20 and TR-55 methodology to determine the peak rate of discharge for existing conditions. Table 2 below summarizes the peak rates of runoff under existing conditions. See Appendix E for HydroCAD Input/Output Data.

Table 2: Existing Peak Runoff Rates

Peak Runoff (cubic feet per second)				
POA	**2-Year Storm**	**10-Year Storm**	**25-Year Storm**	**100-Year Storm**
POA-1	0.00	0.02	0.09	0.33
POA-2	0.10	0.46	0.73	1.21

6.6 Proposed Conditions Runoff Calculations

The Proposed Stormwater Management Plan (SW-2) consists of three (3) catchment areas that flow to Point of Analysis 1 (POA-1) and Point of Analysis 2 (POA-2). Proposed Catchment Area PCA-1 is approximately 12,729 sf and consists of crushed stone surfacing, proposed equipment, utility covers, and greenspace with a weighed curve number of 70. Proposed Catchment Area PCA-2 is approximately 1,660 sf and consists of greenspace with a weighed curve number of 39. Proposed Catchment Area PCA-3 is approximately 13,382 sf and consists of gravel and crushed stone surfacing, utility covers, and greenspace with a weighted curve number of 60. See Figure 3 (SW-2) for additional information.

We generated runoff hydrographs using SCS TR-20 and TR-55 methodology to determine the peak rate of discharge for proposed conditions. Table 3 below summarizes the peak rates of runoff under proposed conditions. See Appendix E for HydroCAD Input/Output Data.

Table 3: Proposed Peak Runoff Rates

Peak Runoff (cubic feet per second)[3]				
Study Point	**2-Year Storm**	**10-Year Storm**	**25-Year Storm**	**100-Year Storm**
POA-1	0.00	0.19	1.38	1.64
POA-2	0.10	0.44	0.70	1.15

6.7 Recharge Volume

We calculated the required recharge volume based on an existing Hydrologic Soil Group (HSG) A as indicated in Table 4 below. In accordance with MassDEP Stormwater Management Standards, the required recharge volume is equal to 0.60 inches of runoff for HSG A times the total impervious area.

Table 4: Recharge Volume

Runoff Depth	Post-Development Impervious Area (sf)	Required Recharge Volume (cubic feet)
0.6"	5,593[1]	280

[1] The impervious area indicated includes the re-surfaced gravel access drive.

6.8 Water Quality Volume

We calculated the water quality volume using 1 inch of runoff times the impervious area of the post development conditions, as indicated in Table 5 below.

Table 5: Water Quality Volume

Runoff Depth	Post-Development Impervious Area (sf)	Water Quality Volume (cubic feet)
1"	5,593[1]	466

[1] The impervious area indicated includes the re-surfaced gravel access drive.

7. MASS DEP STORMWATER STANDARDS

The ten (10) standards set forth in the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards address the protection of wetlands and water bodies, control of stormwater quantity and quality, groundwater recharge, erosion and sedimentation control, and long-term system maintenance. The following summarizes the project's approach related to the stormwater management standards.

7.1 Standard #1 – No New Untreated Discharges

The Project does not result new untreated discharges to wetlands or waters of the Commonwealth.

7.2 Standard #2 – Peak Rate Attenuation

The proposed stormwater management system is designed so that peak rates of discharge under proposed conditions do not exceed peak rates of discharge under existing conditions up to the 2-year storm event at Point of Analysis 1 (POA-1), and for all storm events at Point of

Analysis 2 (POA-2). Table 6 below summarizes the existing and proposed peak runoff discharge rates determined in the hydrologic/hydraulic analyses. Refer to Figure 2 (SW-1), Figure 3 (SW-2), and the HydroCAD output files for additional information (Appendix E).

Table 6: Comparison of Peak Discharge Rates

Peak Discharge Rates (cubic feet per second)												
Existing Conditions vs. Proposed Conditions												
Study Point	**2-Year Storm**			**10-Year Storm**			**25-Year Storm**			**100-Year Storm**		
	Pre	**Post**	**Δ**	**Pre**	**Post**	**Δ**	**Pre**	**Post**	**Δ**	**Pre**	**Post**	**Δ**
POA-1	0.00	0.00	**0.00**	0.02	0.19	**0.17**	0.09	1.38	**1.29**	0.33	1.64	**1.31**
POA-2	0.10	0.10	**0.00**	0.46	0.44	**-0.02**	0.73	0.70	**-0.03**	1.21	1.15	**-0.06**

We evaluated several other Best Management Practices (BMPs) to further attenuate peak rates of discharge to POA-1, including infiltration basins and infiltration trenches. However, site constraints and substantial additional excavation within the buffer associated with more substantial subsurface systems limited the sizing and affected the locations of these BMPs. Ultimately, in consideration of the temporary nature of the project, and to limit additional significant disturbances within the Riverfront Area and Buffer Zone, the Project does not propose these BMPs. Refer to the section below for a more detailed summary.

7.2.1 BMP Alternatives Analysis

As mentioned above, we evaluated several BMP options to further attenuate peak rates of discharge. We summarize the analysis for BMPs we considered below:

Vegetated Swale and Infiltration Basin: This alternative included a vegetated swale on the east side of the proposed substation which collected and conveyed stormwater to an infiltration basin. The infiltration basin was sized to attenuate peak flow rates up to the 100-year storm event. Siting constraints associated with this BMP included DEP recommended setback distances from slopes greater than 15% and surface waters. Additionally, site grading and drainage conveyance systems to the basin resulted in a bottom of basin elevation susceptible to the high

groundwater table. Due to the required size of the infiltration basin and the substation equipment, the basin needed to be located outside the temporary substation limits. This resulted in approximately 5,000 sf +/- of additional resource area impacts within the Riverfront Area.

Infiltration Trench: This option included an infiltration trench to the east of the temporary substation to collect and infiltrate runoff. Siting constraints related to the recommended distances from slopes greater than 5% ultimately led to the abandonment of this option. Accordingly, the proposed infiltration trench in proximity to the Powwow Riverbank presented an apparent embankment stability hazard with regard to seepage pressures.

Expanded Drywell: We evaluated sizing the proposed drywell within the temporary substation yard to attenuate peak flow rates beyond the 2-year storm event. However, constraints associated with substation equipment and associated underground utilities limited the footprint of the drywell within the contemplated area of disturbance. Sizing the drywell to attenuate flows for the 10-year or greater storm event significantly increased its overall footprint and significantly increased the excavation and earthwork within the resource area buffer. Additionally, relocating the drywell outside the limits of the temporary substation resulted in significant additional resource area impacts. In consideration of the temporary nature of the project, the proposed drywell balances these impacts.

7.3 Standard #3 – Recharge

The proposed stormwater management system is designed to recharge the required recharge volume. The proposed drywell provides approximately 800 cubic feet of storage in comparison the required recharge volume of approximately 280 cubic feet. The proposed drywell will exfiltrate the required recharge volume with an assumed exfiltration rate of 0.45 inches/hour in less than 72 hours, as shown in the hydrograph for the 2-year storm event (See Appendix E).

7.4 Standard #4 – Water Quality

The proposed stormwater management system provides 80% TSS removal for areas within the substation limits. In accordance with MassDEP Stormwater Management Standards, the proposed drywell provides 80% TSS removal for the water quality volume. A deep sump catch basin is also proposed to provide the required pre-treatment (25% TSS removal) for runoff collected and conveyed to the proposed drywell.

In consideration of the temporary nature of the project and limiting impacts within the Riverfront Area and Buffer zone, BMP measures are not proposed to provide TSS removal for areas outside the substation limits, which include the re-surfaced gravel access drive. Following construction of the temporary substation, the gravel access drive will be used only for maintenance access to the new temporary equipment, and therefore, presenting minimal risk for sedimentation after initial surface stabilization. The limits of the gravel access drive decrease under proposed conditions and National Grid anticipates minimal new material to provide a smooth surface. Additionally, the vegetated buffer between the gravel access drive and the resource area is increased from existing conditions and will remove sediments in a manner similar to existing conditions.

7.5 Standard #5 – Land Uses with Higher Potential Pollutant Loads (LUHPPLs)

The proposed use is not classified as a LUHPPL under MassDEP regulations. No storage or handling of hazardous materials or high-traffic vehicle operations will occur. Therefore, the project complies fully with Standard #5.

7.6 Standard #6 – Stormwater Discharges within Zone II or Interim Wellhead Protection Area and Stormwater Discharges Near/to Critical Areas

The site is not located within a Zone II, Interim Wellhead Protection Area, or any Critical Area as defined by MassDEP. Therefore, Standard #6 does not apply.

7.7 Standard #7 – Redevelopment

The proposed temporary substation project does not qualify as a redevelopment project, as defined by MassDEP, since it is not replacing an existing impervious development footprint. Portions of the project have been designed to the maximum extent practicable, given the temporary nature of the project and to minimize impacts within the Riverfront Area and Buffer Zone.

7.8 Standard #8 – Stormwater Pollution Prevention and Erosion and Sedimentation Control

Stormwater pollution prevention and erosion & sedimentation control will follow the measures indicated on the Permit Drawings.

7.9 Standard #9 – Operation and Maintenance Plan and Long-Term Pollution Prevention Plan

Maintenance of the proposed stormwater management system will be the responsibility of the Owner. A site-specific Operations and Maintenance Plan and Long-Term Pollution Prevention Plan is included in Appendix F.

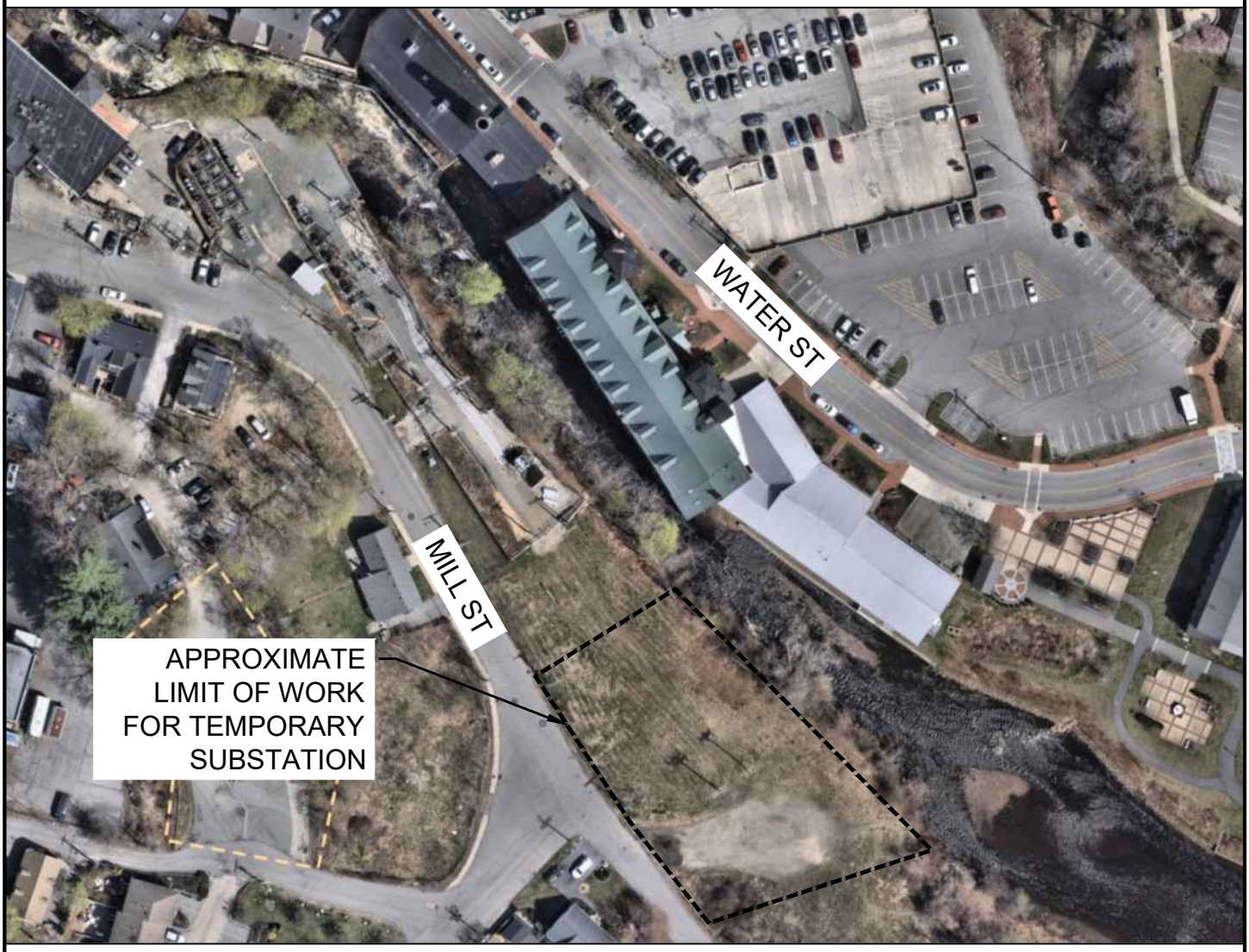
7.10 Standard #10 – Prohibition of Illicit Discharges

To the best of the Owner's and engineer's knowledge, no illicit discharges exist on the project site, and no illicit discharges will be added on site as part of the proposed Project.

8. CONCLUSION

The proposed Project and associated stormwater management improvements include provisions necessary for conformance with the Massachusetts Stormwater Management Standards as noted herein, in consideration of the temporary nature of the Project and to limit impacts within the Riverfront Area and Buffer Zone.

Figures



SOURCE: NEARMAP (2025); NOT TO SCALE

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Project: 0 & 14 MILL STREET, AMESBURY, MA				Drawing No.: FIGURE 1
Title: LOCATION MAP				Scale: N.T.S.
Drawn: BA	Checked: CAC	Approved: SPD	Project No.: 211340.01	Date: 09/09/2025

NORTH

NOTES:

1. EXISTING TOPOGRAPHIC AND SUBSURFACE UTILITY INFORMATION BASED UPON ELECTRONIC FILES, PREPARED BY BL COMPANIES IN OCTOBER 2021.

PRE DEVELOPMENT FLOW RATES

POINT OF ANALYSIS	PEAK FLOW (CFS) 2-YR	10-YR	25-YR	100-YR
POA-1	0.00	0.02	0.09	0.33
POA-2	0.10	0.46	0.73	1.21

LEGEND

- 100 FT WETLAND BUFFER
- PROPERTY LINE
- PROPERTY SETBACK
- TC OVERLAND SHEET FLOW PATH
- TC SHALLOW CONCENTRATED FLOW PATH
- WETLAND LIMITS
- LIMIT OF WORK
- (E) OVERHEAD POWER UTILITY LINES
- (E) CONTOUR
- (E) TREELINE
- WATERSHED SUBCATCHMENT BOUNDARY
- GRASSED AREAS
- GRAVEL AREAS

0 20 50 100

SCALE: 1" = 20'

THIS DRAWING MUST BE VIEWED IN COLOR

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Consultant

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No.	Date	Description	By
A	10/20/25	ISSUED FOR PERMIT	SPD

NATIONAL GRID TEMPORARY SUBSTATION
0 & 14 MILL STREET
AMESBURY, MA

Project

EXISTING CONDITIONS SWM PLAN

Drawing Title

Project No.	Checked	Date
211340.01	CAC	10/20/2025
Drawn	Approved	Scale
BA	SPD	AS SHOWN

COMMONWEALTH OF MASSACHUSETTS
SEAN P. DONLON
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PROFESSIONAL ENGINEER

Seal 10/20/2025

Drawing No.

SW-1

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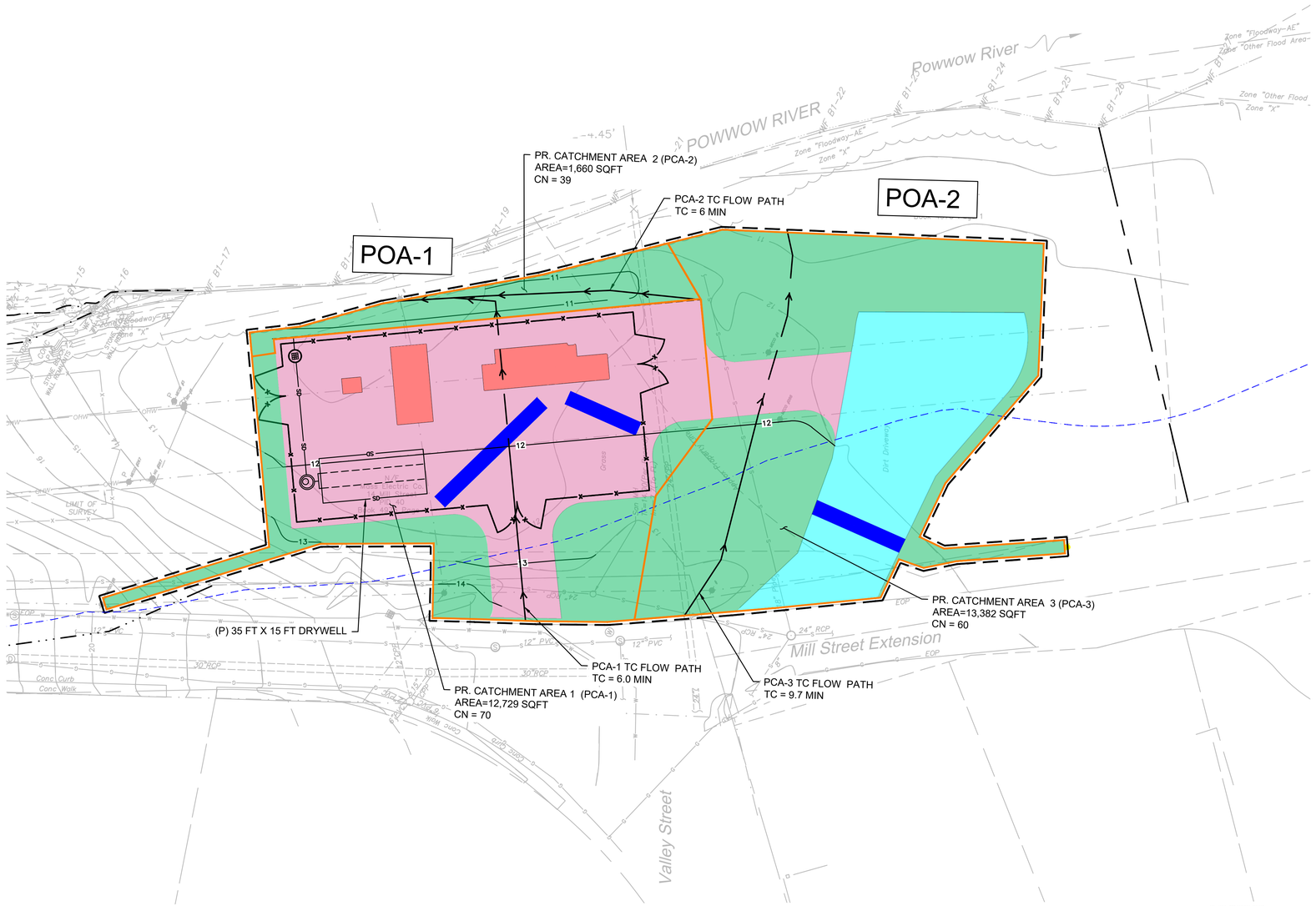
NORTH



NOTES:

1. EXISTING TOPOGRAPHIC AND SUBSURFACE UTILITY INFORMATION BASED UPON ELECTRONIC FILES, PREPARED BY BL COMPANIES IN OCTOBER 2021.

POST DEVELOPMENT FLOW RATES

POINT OF ANALYSIS	PEAK FLOW (CFS)			
	2-YR	10-YR	25-YR	100-YR
POA-1	0.00	0.19	1.38	1.64
POA-2	0.10	0.44	0.70	1.15

0 20 50 100

SCALE: 1" = 20'

LEGEND

- 100 FT WETLAND BUFFER
- PROPERTY LINE
- PROPERTY SETBACK
- TC OVERLAND SHEET FLOW PATH
- TC SHALLOW CONCENTRATED FLOW PATH
- WETLAND LIMITS
- LIMIT OF WORK
- (E) OVERHEAD POWER UTILITY LINES
- (E) CONTOUR
- (P) CONTOUR
- (E) TREELINE
- WATERSHED SUBCATCHMENT BOUNDARY
- GRASSED AREAS
- CRUSHED STONE AREAS
- STEEL COVER AREAS
- GRAVEL AREAS
- EQUIPMENT AND CONTAINMENT UNIT

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No.	Date	Description	By
A	10/20/25	ISSUED FOR PERMIT	SPD

NATIONAL GRID TEMPORARY SUBSTATION

0 & 14 MILL STREET
AMESBURY, MA

Project

PROPOSED CONDITIONS SWM PLAN

Drawing Title

Project No.	Checked	Date
211340.01	CAC	10/20/2025
Drawn	Approved	Scale
BA	SPD	AS SHOWN

COMMONWEALTH OF MASSACHUSETTS
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Seal 10/20/2025

Drawing No.

SW-2

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Appendix A
MA Stormwater Management Standards

Stormwater Management Standards

In 1996, the Massachusetts Department of Environmental Protection (the "Department" or "MassDEP") issued the Stormwater Policy that established Stormwater Management Standards aimed at encouraging recharge and preventing stormwater discharges from causing or contributing to the pollution of the surface waters and groundwaters of the Commonwealth. In 1997, MassDEP published the Massachusetts Stormwater Handbook as guidance on the Stormwater Policy. MassDEP has revised the Stormwater Management Standards and Massachusetts Stormwater Handbook to promote increased stormwater recharge, the treatment of more runoff from polluting land uses, low impact development (LID) techniques, pollution prevention, the removal of illicit discharges to stormwater management systems, and improved operation and maintenance of stormwater best management practices (BMPs). MassDEP applies the Stormwater Management Standards pursuant to its authority under the Wetlands Protection Act, M.G.L. c. 131, § 40, and the Massachusetts Clean Waters Act, M.G.L .c. 21, §§ 26-53. The revised Stormwater Management Standards have been incorporated in the Wetlands Protection Act Regulations, 310 CMR 10.05(6)(k) and the Water Quality Certification Regulations, 314 CMR 9.06(6)(a).

Stormwater runoff results from rainfall and snow melt and represents the single largest source responsible for water quality impairments in the Commonwealth's rivers, lakes, ponds, and marine waters. New and existing development typically adds impervious surfaces and, if not properly managed, may alter natural drainage features, increase peak discharge rates and volumes, reduce recharge to wetlands and streams, and increase the discharge of pollutants to wetlands and water bodies.

The Stormwater Management Standards address water quality (pollutants) and water quantity (flooding, low base flow and recharge) by establishing standards that require the implementation of a wide variety of stormwater management strategies. These strategies include environmentally sensitive site design and LID techniques to minimize impervious surface and land disturbance, source control and pollution prevention, structural BMPs, construction period erosion and sedimentation control, and the long-term operation and maintenance of stormwater management systems.

The Stormwater Management Standards

1. No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

2. Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

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

4. Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

    a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
    b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
    c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

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

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

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

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

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

10. All illicit discharges to the stormwater management system are prohibited.

Applicability

Except as expressly provided herein, stormwater runoff from all industrial, commercial, institutional, office, residential and transportation projects including site preparation, construction and redevelopment, and all point source stormwater discharges from said projects shall be managed according to the Stormwater Management Standards.

The Stormwater Management Standards shall not apply to:

(1) A single-family house;
(2) Housing development and redevelopment projects comprised of detached single-family dwellings on four or fewer lots provided that there are no stormwater discharges that may potentially affect a critical area;

(3) Multi-family housing development and redevelopment projects with four or fewer units, including condominiums, cooperatives, apartment buildings and townhouses, provided that there are no stormwater discharges that may potentially affect a critical area; and
(4) Emergency repairs to roads or their drainage systems.

The Stormwater Management Standards shall apply to the maximum extent practicable to the following:

(1) Housing development and redevelopment projects comprised of detached single-family dwellings on four or fewer lots that have a stormwater discharge that may potentially affect a critical area;
(2) Multi-family housing development and redevelopment projects, with four or fewer units, including condominiums, cooperatives, apartment buildings, and townhouses, that have a stormwater discharge that may potentially affect a critical area;
(3) Housing development and redevelopment projects comprised of detached single-family dwellings on five to nine lots, provided there is no stormwater discharge that may potentially affect a critical area;
(4) Multi-family housing development and redevelopment projects with five to nine units, including condominiums, cooperatives, apartment buildings, and townhouses, provided there is no stormwater discharge that may potentially affect a critical area;
(5) Marinas and boat yards, provided that the hull maintenance, painting and service areas are protected from exposure to rain, snow, snow melt, and stormwater runoff; and
(6) Footpaths, bikepaths and other paths for pedestrian and/or nonmotorized vehicle access.

Critical areas include Outstanding Resource Waters as designated in 314 CMR 4.00, Special Resource Waters as designated in 314 CMR 4.00, recharge areas for public water supplies as defined in 310 CMR 22.02 (Zone Is, Zone IIs and Interim Wellhead Protection Areas for groundwater sources and Zone As for surface water sources), bathing beaches as defined in 105 CMR 445.000, cold-water fisheries as defined in 310 CMR 10.04 and 314 CMR 9.02, and shellfish growing areas as defined in 310 CMR 10.04 and 314 CMR 9.02.

For phased projects, the determination of whether the Stormwater Management Standards apply is made on the entire project as a whole including all phases. When proposing a development or redevelopment project subject to the Stormwater Management Standards, proponents shall consider environmentally sensitive site design that incorporates low impact development techniques in addition to stormwater best management practices.

Project proponents seeking to demonstrate compliance with some or all of the Stormwater Management Standards to the maximum extent practicable shall demonstrate that:

(1) They have made all reasonable efforts to meet each of the Standards;
(2) They have made a complete evaluation of possible stormwater management measures, including environmentally sensitive site design, low impact development techniques that minimize land disturbance and impervious surfaces, structural stormwater best management practices, pollution prevention, erosion and sedimentation control, and proper operation and maintenance of stormwater best management practices; and
(3) If full compliance with the Standards cannot be achieved, they are implementing the highest practicable level of stormwater management.

The Stormwater Management Standards (Standards 4, 5, 6, 8, and 9) require project proponents to develop a construction-period erosion, sedimentation, and pollution prevention plan and long-term pollution prevention and operation and maintenance plans. The level of detail in these plans should reflect the complexity of the project and the nature and extent of the impacts that may arise both during and after construction. For small residential projects that are subject to jurisdiction under the Wetlands Protection Act and that are required to meet the Stormwater Management Standards only to the maximum extent practicable, the issuing authority has broad discretion to tailor this requirement to the specific stormwater

impacts of the project and require the construction period erosion and sedimentation control plan and the long-term pollution prevention and operation and maintenance plans only to the extent that they are necessary to address those impacts.

Even if the Stormwater Management Standards do not apply, a proponent still must implement erosion and sedimentation control if the project is located in a wetland resource area or associated Buffer Zone. See CMR 10.05(6). Although the Stormwater Management Standards do not apply, a person constructing a single-family house that extends into the Buffer Zone must control erosion and sedimentation within wetland resource areas and the Buffer Zone.

Environmentally Sensitive Site Design and Low Impact Development Techniques

The Wetlands Regulations, 310 CMR 10.04, and the Water Quality Certification Regulations, 314 CMR 9.02, define environmentally sensitive site design to mean design that incorporates low impact development techniques to prevent the generation of stormwater and non-point source pollution by reducing impervious surfaces, disconnecting flow paths, treating stormwater at its source, maximizing open space, minimizing disturbance, protecting natural features and processes, and/or enhancing wildlife habitat. The Wetlands Regulations, 310 CMR 10.04, and the Water Quality Certification Regulations, 314 CMR 9.02, define low impact development (LID) techniques to mean innovative stormwater management systems that are modeled after natural hydrologic features. Low impact development techniques manage rainfall at the source using uniformly distributed decentralized micro-scale controls. Low impact development techniques use small cost-effective landscape features located at the lot level.

Proponents of projects subject to the Stormwater Management Standards must consider environmentally sensitive site design and low impact development techniques to manage stormwater. Proponents shall consider decentralized systems that involve the placement of a number of small treatment and infiltration devices located close to the various impervious surfaces that generate stormwater runoff in place of a centralized system comprised of closed pipes that direct all the drainage from the entire site into one large dry detention basin.

MassDEP has established an "LID Site Design Credit" to encourage developers to incorporate LID techniques in their projects.[1] In exchange for directing runoff from roads and driveways to vegetated open areas, preserving open space with a conservation restriction, or directing rooftop runoff to landscaped or undisturbed areas, MassDEP allows developers to reduce or eliminate the traditional BMPs used to treat and infiltrate stormwater.

Incorporating environmentally sensitive design that uses the land to filter and recharge the water back into the ground and that reduces the amount of paved areas is a critical first step in creating sustainable development. Inspired by EEA's Smart Growth Toolkit, MassDEP believes that the LID Site Design Credit protects our natural resources, encourages cluster development, and reduces the environmental impacts of growth.[2] By using this credit, proponents can reduce the volume of stormwater subject to Standard 3 - the Recharge Standard, and Standard 4 - the Water Quality Standard.

Explanation of the Standards

Standard 1: No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

This standard allows the direct discharge of stormwater to waters and wetlands provided the discharge is adequately treated. The term "treated" refers to the implementation of stormwater management systems that are specifically designed to achieve sediment and contaminant removal rates that

[1] Information on the LID Site Design Credit is found in Volume 3 of the Massachusetts Stormwater Handbook.

[2] Smart Growth Toolkit - http://www.mass.gov/eea/grants-and-tech-assistance/guidance-technical-assistance/ma-smart-growth-smart-energy-toolkit.html

adequately protect groundwater, surface waters and wetlands in accordance with all applicable statutes, regulations, permits, and approvals, the other standards, and the technical specifications set forth in Volume 2 of the Massachusetts Stormwater Handbook. The level of treatment required by the other standards is based on whether the discharge impacts a critical area, is from a land use with a higher potential pollutant load, or to soils with a rapid infiltration rate.

The requirement that stormwater discharges must not cause erosion in wetlands or waters of the Commonwealth means that there must be no wearing away of the soil or land surface in excess of natural conditions. To prevent erosion and sedimentation, BMPs and associated pipes and other conveyances must be properly designed and installed in accordance with Volume 2 of the Massachusetts Stormwater Handbook. The use of level spreaders or other techniques at the point of discharge is required to minimize erosion. For projects subject to jurisdiction under the Wetlands Protection Act, the applicant shall demonstrate to the issuing authority that the discharge velocities will not cause erosion or scouring at the point of discharge or downstream. Discharge velocities from BMPs should take into account factors such as soils, slope and the type of receiving resource.

Standard 2: Stormwater management systems shall be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

To prevent storm damage and downstream and off-site flooding, Standard 2 requires that the post-development peak discharge rate is equal to or less than the pre-development rate from the 2-year and the 10-year 24-hour storms. BMPs that slow runoff rates through storage and gradual release, such as LID techniques, extended dry detention basins, and wet basins, must be provided to meet Standard 2. Where an area is within the 100-year coastal flood plain or land subject to coastal storm flowage, the control of peak discharge rates is usually unnecessary and may be waived.

For projects subject to jurisdiction under the Wetlands Protection Act, the issuing authority relies on TR 20 and 55[3], which are guides for estimating the effects of land use changes on runoff volume and peak rates of discharge published by Natural Resource Conservation Service (NRCS). Applicants must calculate runoff rates from pre-existing and post-development conditions. Measurement of peak discharge rates is calculated at a design point, typically the lowest point of discharge at the downgradient property boundary. The topography of the site may require evaluation at more than one design point, if flow leaves the property in more than one direction. An applicant may demonstrate that a feature beyond the property boundary (e.g. culvert) is more appropriate as a design point.

Proponents must also evaluate the impact of peak discharges from the 100-year 24-hour storm. If this evaluation shows that increased off-site flooding will result from peak discharges from the 100-year 24-hour storms, BMPs must also be provided to attenuate these discharges. [4]

Standard 3: Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

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[3] NRCS TR 20&55 - http://www.wsi.nrcs.usda.gov/products/W2Q/H&H/Tools_Models/tool_mod.html. See the Hydrology Handbook for Conservation Commissioners, http://www.mass.gov/eea/docs/dep/water/laws/a-thru-h/hydrol.pdf.

[4] The evaluation may show that retaining the 100-year 24-hour storm event is not needed. In some cases, retaining stormwater from the 100-year 24-hour storm event onsite may aggravate downstream impacts, because of the project's location within the watershed and the timing of the release of stormwater.

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

The NRCS classifies soils into four hydrologic groups, A thru D, indicative of the minimum infiltration obtained for a soil after prolonged wetting[5]. Group A soils have the lowest runoff potential and the highest infiltration rates, while Group D soils have the highest runoff potential and the lowest infiltration rates. The required recharge volume, the stormwater volume that must be infiltrated, shall be determined using existing site conditions and the infiltration rates set forth below.

Hydrologic Group Volume to Recharge (x Total Impervious Area)	
Hydrologic Group	Volume to Recharge x Total Impervious Area
A	0.60 inches of runoff
B	0.35 inches of runoff
C	0.25 inches of runoff
D	0.10 inches of runoff

For each NRCS Hydrologic Group on the site, the required recharge volume equals the recharge volume set forth above multiplied by the total area within that NRCS Hydrologic Group that is impervious. Infiltration of these volumes must be accomplished using appropriate BMPs. The following BMPs may be used to infiltrate stormwater in compliance with Standard 3: dry wells; infiltration basins; infiltration trenches; subsurface structures; leaching catch basins; exfiltrating bioretention areas[6] and porous pavement. Some proprietary BMPs can also be used to infiltrate stormwater in compliance with Standard 3. Proponents can reduce the volume of stormwater that they are required to recharge by using the LID Site Design Credit.

Infiltration BMPs must be designed, constructed, operated, and maintained in accordance with the specifications and procedures set forth in Volume 2 of the Massachusetts Stormwater Handbook. To size infiltration BMPs so that they infiltrate the required recharge volume, proponents may use the static method or one of the two dynamic methods specified in Volume 3.[7] The static method assumes that no infiltration occurs until the recharge device is filled to the elevation associated with the required recharge volume, is easy to calculate, and generally results in a larger recharge volume than the dynamic methods. The dynamic methods assume that that the recharge BMP is infiltrating as it fills and require certain technical calculations that take this recharge into account when sizing the infiltration BMP.

MassDEP recognizes that it may be difficult to infiltrate the required recharge volume on certain sites because of soil conditions[8]. For sites comprised solely of C and D soils and bedrock at the land

[5] Soil Groups – http://soils.usda.gov/education/

[6] Bioretention areas are an example of a BMP that may be designed to act as a filtering practice or an infiltration device. Bioretention areas that act solely as filters have an underdrain that captures runoff and conveys it to another BMP before it is discharged to a surface water, a wetland, or another BMP. These bioretention areas may be lined. Bioretention areas designed to infiltrate do not have those features. To distinguish the two types of bioretention areas, this Handbook will refer to bioretention areas designed to infiltrate as “exfiltrating bioretention areas” and other bioretention areas as “filtering bioretention areas".

[7] A detailed explanation of procedures that must be followed when applying the static method and the two dynamic methods is set forth in Volume 3.

[8] It may also be difficult for MassHighway to recharge the required recharge volume at every point along an add-a -lane project. For this reason, MassDEP allows MassHighway to use the macro approach, which allows MassHighway to recharge additional runoff at certain locations along a portion of the highway

surface, proponents are required to infiltrate the required recharge volume only to the maximum extent practicable. MassDEP also recognizes that on some sites, there is a risk that infiltrating the required recharge volume may cause or contribute to groundwater contamination. Consequently, MassDEP requires infiltration only to the maximum extent practicable on the following sites: sites where recharge is proposed at or adjacent to an area classified as contaminated, sites where contamination has been capped in place; sites that have an Activity and Use Limitation (AUL) that precludes inducing runoff to the groundwater, pursuant to MGL Chapter 21E and the Massachusetts Contingency Plan 310 CMR 40.0000; sites that are the location of a solid waste landfill as defined in 310 CMR 19.000; and sites where groundwater from the recharge location flows directly toward a solid waste landfill or 21E site.[9]

For purposes of Standard 3, "to the maximum extent practicable" means that:

(1) The applicant has made all reasonable efforts to meet the Standard;
(2) The applicant has made a complete evaluation of all possible applicable infiltration measures, including environmentally sensitive site design that minimizes land disturbance and impervious surfaces, low impact development techniques, and structural stormwater best management practices; and
(3) If the post-development recharge does not at least approximate the annual recharge from pre-development conditions, the applicant has demonstrated that s/he is implementing the highest practicable method for infiltrating stormwater.

To ensure the long-term operation of infiltration BMPs, pretreatment is required before discharge to an infiltration BMP. For infiltration of stormwater runoff from land uses with higher potential pollutant loads, discharges to the ground within an area with a rapid infiltration rate (greater than 2.4 inches per hour), a Zone II or Interim Wellhead Protection Area, and discharges to the ground near any of the following critical areas: Special Resource Waters, Outstanding Resource Waters, bathing beaches, shellfish growing areas, or cold-water fisheries, at least 44% of the total suspended solids must be removed prior to discharge to the infiltration structure. A discharge is near a critical area, if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors.

Runoff from non-metal roofs may be discharged to a dry well without any pretreatment. Runoff from metal roofs may be discharged to a dry well without pretreatment, only if the roof is located outside the Zone II or Interim Wellhead Protection Area of a public water supply and outside an industrial site. Infiltration of runoff from a metal roof that is located within the Zone II or Interim Wellhead Protection Area of a public water supply and/or at an industrial site requires pretreatment by means of a BMP capable of removing metals, such as a sand filter, organic filter, filtering bioretention area or equivalent. Metal roofs are galvanized steel or copper.

When designing infiltration BMPs, adequate subsurface information needs to be obtained[10]. Infiltration systems must be installed in soils capable of absorbing the recharge volume (i.e. not D soils). Infiltration structures must be able to drain fully within 72 hours. In addition, there must be at least a two-foot separation between the bottom of the infiltration structure and the seasonal high groundwater table.

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within a subwatershed to compensate for sections of the roadway in the same subwatershed where it may be difficult to recharge the entire required recharge volume. MassDEP and MassHighway intend to provide additional information on the macro approach in the MassHighway Stormwater Handbook for Highways and Bridges when it is revised to reflect the 2008 changes in the Stormwater Management Standards.

[9] A mounding analysis is needed if a site falls within this category. See Volume 3.

[10] The required minimum infiltration rate is 0.17 inches per hour. D soils have an infiltration rate that is below this minimum. To determine the infiltration rate, proponents must perform a soil evaluation using the methodologies set forth in Volume 3.

Table RR

Rules for Groundwater Recharge
All BMPs must be designed according to the specifications and procedures in Volumes 2 and 3 of the Massachusetts Stormwater Handbook. **Except as expressly provided herein, entire required recharge volume must be infiltrated.** **Required recharge volume must be infiltrated only to the maximum extent practicable, if:** **The site is comprised wholly of C and D soils and bedrock at the land surface; Recharge is proposed at or adjacent to a site that has:** ➢ **been classified as contaminated;** ➢ **contamination that has been capped in place;** ➢ **an Activity and Use Limitation (AUL) that precludes inducing runoff to the groundwater pursuant to MGL Chapter 21E and the Massachusetts Contingency Plan, 310 CMR 40.0000;** ➢ **has a solid waste landfill as defined in 310 CMR 19.000; or** ➢ **groundwater from the recharge area that flows directly toward a solid waste landfill or 21E site.** **Design Requirements:** **At least 44% of the TSS must be removed prior to discharge to the infiltration structure if the discharge is:** ➢ **within a Zone II or Interim Wellhead Protection Area;** ➢ **near an Outstanding Resource Water or Special Resource Water;** ➢ **near a shellfish growing area, cold-water fishery, or bathing beach;** ➢ **from a land use with higher potential pollutant loads; or** ➢ **within an area with a rapid infiltration rate (greater than 2.4 inches per hour).** **Except as set forth below, roof runoff from may be discharged to the ground via a dry well without pretreatment. The discharge of roof runoff to the ground requires pretreatment by means of a BMP capable of removing metals, such as a sand filter, organic filter or filtering biorention area, if the roof is a metal roof that is located in the Zone II or Interim Wellhead Protection Area of a public water supply and/or at an industrial site. Metal roofs are galvanized steel or copper.** **Depth to groundwater: At a minimum there should be a two-foot separation between bottom of structure and seasonal high groundwater.** **Minimum Infiltration Rate. 0.17 inches per hour.** **All infiltration structures must be able to drain fully within 72 hours.** **General Setback Requirements:** **Soil Absorption Systems for Title 5 System: 50 ft.** **Private wells: 100 ft.** **Public wells: Outside Zone I** **Public reservoir, surface water sources for public water systems and their tributaries: Outside Zone A** **Other surface waters: 50 ft.** **Property Line: 10 feet** **Building foundations (including slabs): >10 to 100 ft. depending on type of recharge BMP. See BMP description for exact minimum setback.** **Specific BMPs have additional setback requirements. See Volume 2, Chapter 2.**

Standard 4: Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:

a) Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
b) Structural stormwater best management practices are sized to capture the required water quality volume as determined in accordance with the Massachusetts Stormwater Handbook; and
c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

This standard applies after the site is stabilized.[11] Since removal efficiency may vary with each storm, 80% TSS removal is not required for each storm. It is the average removal over the year that is required to meet the standard. The required water quality volume, the runoff volume requiring TSS treatment, is calculated as follows:

The required water quality volume equals 1.0 inch of runoff times the total impervious area of the post-development project site for a discharge

- from a land use with a higher potential pollutant load;
- within an area with a rapid infiltration rate (greater than 2.4 inches per hour);
- within a Zone II or Interim Wellhead Protection Area;
- near or to the following critical areas:
  - Outstanding Resource Waters,
  - Special Resource Waters,
  - bathing beaches,
  - shellfish growing areas,
  - cold-water fisheries.

The required water quality volume equals 0.5 inches of runoff times the total impervious area of the post-development site for all other discharges.

Standard 4 requires the development and implementation of suitable practices for source control and pollution prevention. These measures must be identified in a long-term pollution prevention plan. The long-term pollution prevention plan shall include the proper procedures for the following:

- good housekeeping;
- storing materials and waste products inside or under cover;
- vehicle washing;
- routine inspections and maintenance of stormwater BMPs;
- spill prevention and response;
- maintenance of lawns, gardens, and other landscaped areas;
- storage and use of fertilizers, herbicides, and pesticides;
- pet waste management;
- operation and management of septic systems; and
- proper management of deicing chemicals and snow[12].

The long-term pollution prevention plan shall provide that sand piles be contained and stabilized to prevent the discharge of sand to wetlands or water bodies, and, where feasible, covered. If a Total Maximum Daily Load (TMDL)[13] has been developed that indicates that use of fertilizers containing nutrients must be reduced, the long-term pollution prevention plan shall also include a nutrient management

[11] Construction period requirements are found in Standard 8.
[12] Snow & Deicing Policies - http://www.mass.gov/eea/agencies/massdep/water/regulations/guidelines-on-deicing-chemical-road-salt-storage.html
[13] Information on TMDLs is set forth in Volume 1, Chapter 2.

plan. The long-term pollution prevention plan may be prepared as a separate document or combined with the Operation and Maintenance Plan required by Standard 9.[14]

BMPs must be selected so that a total of 80% TSS removal is provided by one or more BMPs.[15] Typically a stormwater management system will have several BMPs that will control flow rates and retain contaminants. In this BMP "process train", more than one BMP will be removing TSS. The goal is to ensure that the cumulative effect of the treatment train is the removal of at least 80% of the annual average TSS load. Where there is more than one outfall or treatment train, each outfall or treatment train shall achieve 80% TSS removal prior to discharge.[16]

BMPs must be designed, constructed, operated and maintained in accordance with the specifications and procedures set forth in Volumes 2 and 3 of the Massachusetts Stormwater Handbook. Standard 4 has been designed in a manner that makes it unnecessary for the permitting authority to verify a TSS load for the site in order to confirm removal rates. Assuming all BMPs are properly designed, the percentage of TSS removed by the entire system shall be calculated by applying the TSS removal rates set forth in Table TSS for each BMP in the order in which it is used in the stormwater management system.[17] Generally, monitoring is not required to confirm removal percentages. Nevertheless, monitoring or sampling may be appropriate to ensure protection of critical areas or to verify the effectiveness of alternative technologies that are not included in Table TSS or do not have a specified TSS removal rate and that have only limited data about their long-term performance.

The BMP design removal rates cannot be added directly to arrive at 80%. For example, if the first BMP in a system has a 60% removal rate, and the second BMP has a 20% removal rate, adding 60% and 20% will not achieve the desired 80% TSS removal rate; only 68 % of the TSS will be removed. The reason is that the second BMP removes only the percentage of TSS that is routed to it after an initial amount of TSS has been removed by the first BMP. In this example, after the stormwater was routed through the first BMP, 60% of the sediment was removed. The remaining 40% was routed to the second BMP that removed 20% of that 40% (not 20% of the entire load). The second BMP therefore removed an additional 8%, leaving 12% still to be removed (60%+8%=68%; 80%-68%=12%).

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[14] Proponents are required to prepare a Stormwater Report that includes both the long- term pollution prevention plan and the operation and maintenance plan Information on the Stormwater Report is set forth in Volume 3.

[15] If there is a Total Maximum Daily Load (TMDL) that indicates that stormwater BMPs are needed to reduce the concentration in stormwater runoff of pollutants other than TSS such as nitrogen and phosphorus, the BMPs selected must be consistent with the TMDL. See Volume 1, Chapter 2.

[16] 80% TSS removal is not required at an outfall with only a *de minimus* stormwater discharge. In that event, a proponent may demonstrate compliance with the 80% TSS removal requirement by using a weighted average. See Volume 3 for a description of the highly limited circumstances in which a discharge from a stormwater outfall will be considered *de minimus* and the procedures for applying a weighted average. Because of right-of-way constraints, MassDEP anticipates that MassHighway redevelopment projects and add-a-lane projects may in some circumstances have to rely on weighted averages to meet the TSS removal requirement. MassDEP and Mass Highway intend to provide additional information on this approach in the MassHighway Stormwater Handbook for Highways and Bridges, when it is revised to reflect 2008 changes to the Stormwater Management Standards.

[17] The following rules apply to Table TSS. If pretreatment is required, the total removal efficiency includes the terminal treatment BMP and the pretreatment BMP. For purposes of assessing compliance with the 44% TSS removal pretreatment requirement, a separate credit is awarded for the required pretreatment BMP. For example, for the leaching catch basin/deep sump catch basin combination, 80% is the total TSS removal credit for both BMPs. No additional TSS removal credit is given for the deep sump catch basin. However, the separate 25% TSS removal credit for the deep sump catch basin counts towards the 44% pretreatment requirement, if it is applicable.

Table TSS

TSS Removal Efficiencies for Best Management Practices	
Best Management Practice (BMP)	**TSS Removal Efficiency**
Non-Structural Pretreatment BMPs	
Street Sweeping	0-10%, See Volume 2, Chapter 1.
Structural Pretreatment BMPs	
Deep Sump Catch Basins	25% only if used for pretreatment and only if off-line
Oil Grit Separator	25% only if used for pretreatment and only if off-line
Proprietary Separators	Varies – see Volume 2, Chapter 4.
Sediment Forebays	25% if used for pretreatment
Vegetated filter strips	10% if at least 25 feet wide, 45% if at least 50 feet wide
Treatment BMPs	
Bioretention Areas including rain gardens	90% provided it is combined with adequate pretreatment
Constructed Stormwater Wetlands	80% provided it is combined with a sediment forebay
Extended Dry Detention Basins	50% provided it is combined with a sediment forebay
Gravel Wetlands	80% provided it is combined with a sediment forebay
Proprietary Media Filters	Varies – see Volume 2, Chapter 4
Sand/Organic Filters	80% provided it is combined with sediment forebay
Treebox filter	80% provided it is combined with adequate pretreatment
Wet Basins	80% provided it is combined with sediment forebay
Conveyance	
Drainage Channels	For conveyance only. No TSS Removal credit.
Grass Channels (formerly biofilter swales)	50% if combined with sediment forebay or equivalent
Water Quality Swale – wet & dry	70% provided it is combined with sediment forebay or equivalent
Infiltration BMPs	
Dry Wells	80% for runoff from non-metal roofs; may also be used for runoff from metal roofs but only if metal roof is not located within a Zone II, or IWPA or at an industrial site
Infiltration Basins & Infiltration Trenches	80% provided it is combined with adequate pretreatment (sediment forebay or vegetated filter strip, grass channel, water quality swale) prior to infiltration
Leaching Catch Basins	80% provided a deep sump catch basin is used for pretreatment
Subsurface Structure	80% provided they are combined with one or more pretreatment BMPs prior to infiltration.
Other BMPs	
Dry Detention Basins	For peak rate attenuation only. No TSS Removal credit.
Green Roofs	See Volume 2. Chapter 2. May reduce required water quality volume. No TSS Removal Credit.
Porous Pavement	80% if designed to prevent runon and with adequate storage capacity. Limited to uses identified in Volume 2, Chapter 2.
Rain Barrels and Cisterns	May reduce required water quality volume. No TSS Removal Credit.

Standard 5: For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If, through source control and/or pollution prevention, all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L.c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

Land uses with higher potential pollutant loads are defined in 310 CMR 10.04 and 314 CMR 9.02 to include the following: Land uses identified in 310 CMR 22.20B(2), 310 CMR 22.20C(2)(a)-(k) and (m), 310 CMR 22.21(2)(a)(1)-(8) and 310 CMR 22.21(2)(b)(1)-(6), areas within a site that are the location of activities that are subject to an individual National Pollutant Discharge Elimination System (NPDES) permit or the NPDES Multi-Sector General Permit[18]; auto fueling facilities (gas stations); exterior fleet storage areas; exterior vehicle service and equipment cleaning areas; marinas and boatyards; parking lots with high-intensity-use; confined disposal facilities and disposal sites.

Land uses with higher potential pollutant loads include the industrial sectors regulated by the NPDES Multi-Sector General Permit Program. These sectors include manufacturing: mineral, metal, oil and gas; hazardous waste treatment or disposal facilities; solid waste facilities; wastewater residual landfills; recycling facilities; steam electric plants; transportation facilities; treatment works; and light industrial activity. Land uses with higher potential pollutant loads also include any land uses that are regulated by an individual NPDES permit or that are subject to individual effluent limits established by EPA. Land uses with higher potential loads include land uses that the Department has determined are not suitable for Zone IIs and Zone As of public water supplies, including, without limitation,[19] the following: automobile junk yards; the removal of sand and gravel within four feet of the historical high water mark; the storage of hazardous materials, liquid petroleum, liquid propane, chemical fertilizers, pesticides, manures, septage, sludge, road-deicing materials or sanding materials; snow or ice that has been removed from roads and is contaminated with de-icing chemicals; cemeteries, mausoleums; bulk oil terminals; commercial washing of vehicles and car washes. In addition, land uses with higher potential pollutant loads include: exterior fleet storage areas; exterior vehicle service maintenance and cleaning areas; marinas and boatyards; and parking lots with high-intensity-uses (1000 vehicle trips per day or more). Shopping centers, malls, and large office parks typically have high-intensity-use parking lots. Finally, land uses with higher potential pollutant load include confined disposal facilities as defined in 314 CMR 9.02 and disposal sites as defined in M.G.L. c. 21E and 310 CMR 40.000.

For the purpose of Standard 5, stormwater discharges from land uses with higher potential pollutant loads require treatment by the specific structural BMPs determined to be suitable for treating runoff from such land uses. These BMPs are listed in Table LUHPPL. This requirement applies only to stormwater discharges that come into contact with the actual area or activity on the site that may generate the higher potential pollutant load. Runoff from other portions of the project site that does not come into contact with these specific areas or activities and does not mix with the runoff from these areas or activities does not require the structural BMPs that are determined to be suitable for treating runoff from land uses

[18] As of the date of publication of this Handbook, the NPDES Multi-Sector General Permit issued in 2000 has expired and has been administratively continued. To date, EPA has not issued a new permit. For purpose of the Stormwater Standards, the land uses subject to the 2000 NPDES Multi-Sector General Permit are land uses with higher potential pollutant loads. A full list of these land uses is set forth in the 2000 NPDES Multi-Sector General Permit. See http://cfpub1.epa.gov/npdes/stormwater/msgp.cfm#permit_factsheet.

[19] The complete text of the regulations that identify the land uses that are not suitable for Zone As and Zone IIs is set forth in 310 CMR 22.20B(2), 310 CMR 22.20C(2)(a) and 310 CMR 22.21(2)(a) and 310 CMR 22.21(b) i. See http://www.mass.gov/eea/agencies/massdep/water/regulations/310-cmr-22-00-massachusetts-drinking-water-regulations.html.

with higher potential pollutant loads. For example, on the site of a chemical manufacturing plant, runoff from any grassed open space or parking area without high-intensity use, which is separate from the chemical distribution, loading and storage areas, does not have to be treated with a BMP listed in Table LUHPPL.

A detailed source control and pollution prevention plan is crucial for sites with land uses that have higher potential pollutant loads. [20] To mitigate the potential impact of stormwater discharges from land uses with higher potential pollutant loads, the long-term pollution prevention plan shall include measures that eliminate or minimize any discharges that come into contact with the particular land uses that have the potential to generate high concentrations of pollutants. A proponent can fulfill this requirement by placing all industrial materials or activities in a storm-resistant shelter to prevent exposure to rain, snow, snow melt and runoff, or by placing all materials and wastes stored outside in sealed containers on impervious surfaces with adequate containment. The long-term pollution prevention plan shall also provide for the use of emergency shut-offs where appropriate to isolate the system in the event of an emergency spill or other unexpected event. Proponents of MassHighway projects can meet this requirement by implementing the containment procedures outlined in the MassHighway Stormwater Handbook [21].

Standard 5 expressly provides that a stormwater discharge from a land use with a higher potential pollutant load must comply with all applicable laws, regulations, permits and approvals, including 314 CMR 3.00, 314 CMR 4.00, and 314 CMR 5.00. Pursuant to 314 CMR 3.00 and 314 CMR 5.00, MassDEP has authority to require a discharge permit or other corrective action if it determines that a stormwater discharge is contaminated by contact with process wastes, raw materials, toxic pollutants or hazardous substances, oil and grease, or is a significant contributor of pollution to waters of the Commonwealth. To avoid additional requirements under 314 CMR 3.00, 314 CMR 5.00, and Standard 5, a project proponent should implement a pollution prevention plan that prevents stormwater runoff from coming into contact with significant pollutant sources.

As stated earlier, a stormwater discharge from a land use with a higher potential pollutant load also requires treatment by the specific structural BMPs determined by MassDEP to be suitable for treating discharges from such use.[22] Like all stormwater discharges, stormwater discharges from land uses with higher potential pollutant loads require the use of a treatment train that provides 80% TSS removal prior to discharge. As can be seen from Table LUHPPL, this treatment train shall provide for at least 44% TSS removal prior to discharge to the infiltration BMP and shall also be designed to treat 1.0 inch of runoff times the total impervious area at the post-development site. If the land use is one that has the potential to generate runoff with high concentrations of oil and grease such as a high-intensity-use parking lot, gas station, fleet storage area, or vehicle service and equipment cleaning area, the treatment train must include an oil grit separator, sand filter, filtering bioretention area or equivalent.[23] See Table LUHPPL.

[20] If the land use is also subject to the NPDES Multi-Sector General Permit, a Stormwater Pollution Prevention Plan (SWPPP) will also be required. To avoid duplication of effort, a project proponent may prepare one document that satisfies the SWPPP requirements of the NPDES Multi-Sector General Permit and the long-term pollution prevention plan requirements of Standards 4 and 5.

[21] Mass Highway Handbook - http://www.mhd.state.ma.us/default.asp?pgid=content/publicationmanuals&sid=about

[22] To make sure that proponents have the most up-to-date list of these BMPs, proponents should consult the MassDEP web site.

[23] Any BMP chosen to remove oil and grease including, without limitation, the oil grit separator, must be designed in accordance with the specifications set forth in Volume 2, Chapter 2.

Best Management Practices for Land Uses with Higher Potential Pollutant Loads (Standard 5) • Discharges from certain land uses with higher potential pollutant loads may be subject to additional requirements including the need to obtain an individual or general discharge permit pursuant to the MA Clean Waters Act or Federal Clean Water Act. • All proponents must implement source control and pollution prevention. • All BMPs shall be designed in accordance with specifications and sizing methodologies in the Massachusetts Stormwater Handbook Volumes 2 and 3. • The required water quality volume equals 1 inch times the total impervious area of the post-development site. • Many land uses have the potential to generate higher potential pollutant loads of oil and grease. These land uses include, without limitation, industrial machinery and equipment and railroad equipment maintenance, log storage and sorting yards, aircraft maintenance areas, railroad yards, fueling stations, vehicle maintenance and repair, construction businesses, paving, heavy equipment storage and/or maintenance, the storage of petroleum products, high-intensity-use parking lots, and fleet storage areas. To treat the runoff from such land uses, the following BMPs must be used to pretreat the runoff prior to discharge to an infiltration structure: an oil grit separator, a sand filter, organic filter, filtering bioretention area, or equivalent. • At least 44% TSS removal is required prior to discharge to an infiltration device. • Until they complete the STEP or TARP verification process outlined in Volume 2, proprietary BMPs may not be used as a terminal treatment device for runoff from land uses with higher potential pollutant loads. For purposes of this requirement, subsurface structures, even those that have a storage chamber that has been manufactured are not considered propriety BMPs, since the treatment occurs in the soil below the structure, not in the structure.	
Pretreatment	
	Deep Sump Catch Basin
	Oil Grit Separator
	Proprietary Separators: See Volume 2 Chapter 4
	Sediment Forebays
	Vegetated Filter Strip (*must be lined*)
Treatment	
Sand Filters, Organic Filters, Proprietary Media Filters, Wet Basins, Filtering Bioretention Areas, and Extended Dry Detention Basins must be lined and sealed unless at least 44% of TSS has been removed prior to discharge to the BMP.	Filtering Bioretention Areas including rain gardens
	Constructed Stormwater Wetlands
	Dry Water Quality Swales
	Extended Dry Detention Basins
	Gravel Wetlands
	Proprietary Media Filter. (*Does not include catch basin inserts) (Proprietary Media Filters may be used for terminal treatment for runoff from land uses with higher potential pollutant loads, only if verified for such use by the TARP or STEP process. See Volume 2.*)
	Sand /Organic Filters
	Wet Basins
Infiltration	
	Exfiltrating Bioretention Areas including rain garden
	Infiltration Basins
	Infiltration Trenches
	Leaching Catch Basins
	Subsurface Structures

Standard 6: Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1. or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. [24] Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of the public water supply.

Critical areas are Outstanding Resource Waters as designated in 314 CMR 4.00, Special Resource Waters as designated in 314 CMR 4.00, recharge areas for public water supplies as defined in 310 CMR 22.02 (Zone Is, Zone IIs and Interim Wellhead Protection Areas for groundwater sources and Zone As for surface water sources), bathing beaches as defined in 105 CMR 445.000, cold-water fisheries as defined in 314 CMR 9.02 and 310 CMR 10.04, and shellfish growing areas as defined in 314 CMR 9.02 and 310 CMR 10.04.

Cold-water fisheries are waters in which the mean of the maximum daily temperature over a seven-day period generally does not exceed 68°F (20°C) and, when other ecological factors are favorable (such as habitat), are capable of supporting a year-round population of cold-water stenothermal aquatic life. Waters designated as cold-water fisheries by the Department in 314 CMR 4.00, and waters designated as cold-water fishery resources by the Division of Fisheries and Wildlife, are cold-water fisheries. Waters where there is evidence based on a fish survey that a cold-water fish population and habitat exist are also cold-water fisheries.

A shellfish growing area is land under the ocean, tidal flats, rocky intertidal shores and marshes and land under salt ponds when any such land contains shellfish. Shellfish growing areas include land that has been identified and shown on a map published by the Division of Marine Fisheries as a shellfish growing area, including any area identified on such map as an area where shellfishing is prohibited. Shellfish growing areas shall also include land designated by the Department in 314 CMR 4.00 as suitable for shellfish harvesting with or without depuration. In addition, shellfish growing areas shall include shellfish growing areas designated by the local shellfish constable as suitable for shellfishing based on the density of shellfish, the size of the area, and the historical and current importance of the area for recreational and commercial shellfishing.

A list of Outstanding Resource Waters is published in the Surface Water Quality Standards, 314 CMR 4.00[25]. This list includes Class A public water supplies approved by MassDEP and their tributaries, active and inactive reservoirs approved by MassDEP, certain waters within Areas of Critical Environmental Concern, certified vernal pools, and wetlands bordering Class A waters. Wetlands bordering other Class B, SB, or SA ORWs are also Outstanding Resource Waters. Pursuant to the Surface Water Quality Standards, 314 CMR 4.00, MassDEP may designate as Special Resource Waters certain waters of exceptional significance such as waters in national or state parks and wildlife refuges.

Bathing beaches include public and semi-public bathing beaches as defined by the Massachusetts Department of Public Health in 105 CMR 445.000[26]. The Department of Public Health maintains an inventory of public and semi-public bathing beaches.

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[24] If an NPDES Construction General Permit or Multi-Sector General Permit is required for a discharge to an ORW, DEP must approve the Stormwater Pollution Prevention Plan (SWPPP).
[25] Surface Water Quality Standards – http://www.mass.gov/eea/agencies/massdep/water/regulations/314-cmr-4-00-mass-surface-water-quality-standards.html
[26] Standards for Bathing Beaches – http://www.mass.gov/eohhs/docs/dph/regs/105cmr445.pdf

Recharge areas for public water supplies are defined in the Drinking Water Regulations, 310 CMR 22.02[27], and include the Zone A for surface water supplies and the Zone II and Interim Wellhead Protection Areas for groundwater supplies. The Zone A means the land area between the surface water source and the upper boundary of the bank, the land area within a 400-foot lateral distance from the upper boundary of the bank of a Class A surface water source as defined in the Surface Water Quality Standards, 314 CMR 4.05(3), and the land area within a 200-foot lateral distance from the upper boundary of the bank of a tributary or associated surface water body. The Zone II means the area of an aquifer that contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated. The Interim Wellhead Protection Area is used for groundwater sources for public water supplies that lack a Zone II that has been approved by MassDEP.

Source control and pollution prevention are particularly important for critical areas. All projects that have the potential to impact critical areas shall implement a source control and pollution prevention program that includes proper management of snow and deicing chemicals. To protect critical areas, road salt must be properly stored within a Zone II or Interim Wellhead Protection Area or near an Outstanding Resource Water, Special Resource Water, shellfish growing area, bathing beach or cold-water fishery. The use of salt for the deicing of impervious surfaces must be minimized within water supply protection areas and any area near an Outstanding Resource Water, Special Resource Water, fresh water beach, or cold-water fishery. The long-term pollution prevention strategies for sites near critical areas must also incorporate designs that allow for shutdown and containment where appropriate to isolate the system in the event of an emergency spill or other unexpected event. Proponents of MassHighway projects may satisfy this requirement by implementing the containment procedures outlined in the Mass Highway Stormwater Handbook[28] .

A stormwater discharge within a Zone II or Interim Wellhead Protection Area or near or to an Outstanding Resource Water, a Special Resource Water, a bathing beach, shellfish growing area, or cold-water fishery requires the use of a treatment train that provides 80% TSS removal prior to discharge. This treatment train must use the structural BMPs determined by MassDEP to be suitable for such areas as set forth in Tables CA 1 through CA 4.[29] With the exception of runoff from a non-metal roof, and runoff from metal roofs located outside the Zone II or Interim Wellhead Protection Area of a public water supply or an industrial site, the treatment train shall provide for at least 44% TSS removal prior to discharge to the infiltration structure. For discharges within a Zone II or Interim Wellhead Protection Area or near or to an Outstanding Resource Water, a Special Resource Water, a shellfish growing area, a bathing beach, or a cold-water fishery, the treatment BMPs must be designed to treat the required water quality volume, a volume equal to one inch times the total impervious surfaces at the post-development site. All BMPs must be designed, constructed, operated and maintained in accordance with the specifications set forth in Volume 2 of the Massachusetts Stormwater Handbook.

[27] Recharge Areas – http://www.mass.gov/eea/docs/dep/water/ccdefreg.pdf
[28] Mass Highway Stormwater Handbook - http://www.mhd.state.ma.us/default.asp?pgid=content/publicationmanuals&sid=about
[29] To make sure that they have the most up-to-date list of these BMPs, proponents should consult the MassDEP web site.

Table CA 1 Standard 6

Stormwater BMPs for Discharges Near or To Shellfish Growing Areas and Bathing Beaches If applicable, proponent must comply with Coastal Wetlands Regulations[30]. All BMPs must be designed in accordance with specifications and sizing methodologies in Volumes 2 and 3 of the Massachusetts Stormwater Handbook. Required Water Quality Volume = 1.0 inch times impervious area. At least 44 % TSS removal must be provided prior to discharge to infiltration BMP. For discharges near or to shellfish growing areas or bathing beaches, proprietary BMPs may be used only for pretreatment, unless verified by TARP or STEP for other uses. For the purpose of this requirement, subsurface structures, even those that have a storage chamber that has been manufactured are not proprietary BMPs, since the pretreatment occurs in the soil below the structure, not in the structure itself.	
Pretreatment:	Deep Sump Catch Basin
	Oil Grit Separators
	Proprietary Separators See Volume 2.
	Sediment Forebays
	Vegetated Filter Strips
Treatment: Sand Filters, Organic Filters, Proprietary Media Filters, Filtering Bioretention Areas, and Wet Basins must be lined and sealed if at least 44% TSS has not been removed prior to discharge to the BMP.	
	Filtering Bioretention Areas including rain gardens
	Constructed Stormwater Wetlands *(highly recommended)*
	Gravel Wetlands
	Proprietary Filter Media (*Proprietary Media Filters may not be used as terminal treatment for discharges near or to critical areas unless they have been verified for such use through the TARP or STEP process. See Volume 2. Proprietary media filters do not include catch basin inserts.)*
	Sand /Organic Filters
	Wet Basins
Infiltration:	
	Exfiltrating Bioretention Areas including rain gardens
	Dry Wells *(runoff from non-metal roofs and runoff from metal roofs located outside of the Zone II or Interim Wellhead Protection Area of a public water supply and outside of an industrial site only.)*
	Infiltration Basins *(highly recommended)*
	Infiltration Trenches *(highly recommended)*
	Subsurface Structures

[30] Coastal Wetlands Regulations – http://www.mass.gov/eea/docs/dep/service/regulations/310cmr10a.pdf

Table CA 2: Standard 6

Stormwater Discharges Near or To Outstanding Resource Waters including Vernal Pools and Surface Water Sources for Public Water Systems	
1. Construction Sites of 1 acre or more must file a Notice of Intent (WM 09) with MassDEP requesting approval of the Stormwater Pollution Prevention Plan (SWPPP), if they discharge to an ORW. 2. Stormwater discharges to ORWs must be set back from the receiving water or wetland and receive the highest and best practical method of treatment. 3. Stormwater BMPs must be set back 100' from a certified vernal pool and comply with 310 CMR 10.60[31]. Proponents must perform a habitat evaluation and demonstrate that the stormwater BMPs meet the performance standard of having no adverse impact on the habitat functions of a certified vernal pool. 4. Unless essential to operation of a public water system, stormwater BMPs are prohibited within the Zone A. 5. BMPs must be designed according to the specifications and sizing methodologies in Volumes 2 and 3 of the Massachusetts Stormwater Handbook. 6. Required Water Quality Volume = 1.0 inch times impervious area. 7. At least 44% TSS must be removed prior to discharge to infiltration BMP. 8. For discharges near or to ORWs, proprietary BMPs may be used for pretreatment only unless verified by TARP or STEP for other uses. For the purpose of this requirement, subsurface structures, even those that have a storage chamber that has been manufactured are not proprietary BMPs, since the pretreatment occurs in the soil below the structure, not in the structure itself. See Volume 2.	
Pretreatment BMPS	Deep Sump Catch Basin Oil Grit Separator Proprietary Separators: See Volume 2 Sediment Forebay Vegetated Filter Strip
Treatment BMPs Sand Filters, Organic Filters, Proprietary Media Filters, Filtering Bioretention Areas, and Wet Basins must be lined and sealed unless at least 44% TSS has been removed prior to discharge to the BMP.	Filtering Bioretention areas including rain gardens Constructed Stormwater Wetlands *(do not use near certified vernal pool)* Gravel Wetlands (*do not use near certified vernal pool)* Proprietary Media Filter (*Proprietary Media Filters may not be used for terminal treatment for discharges near or to critical areas, unless the filter has been verified for such use through the TARP or STEP process. See Volume 2. Proprietary Media Filters do not include Catch Basin Inserts.)* Sand /Organic Filters Wet Basins (*do not use near certified vernal pool*)
Infiltration BMPs	Exfiltrating Bioretention areas including rain gardens Dry wells *(runoff from non-metal roofs and runoff from metal roofs located outside the Zone II or Interim Wellhead Protection Area of a public water supply or an industrial site only.)* Infiltration Basins *(highly recommended)* Infiltration Trenches *(highly recommended)* Subsurface Structures

For information on vernal pools, see MassDEP's Wildlife Habitat Guidance:
http://www.mass.gov/eea/docs/dep/water/laws/i-thru-z/wldhab.pdf

[31] Wildlife Habitat – http://www.mass.gov/eea/docs/dep/service/regulations/310cmr10a.pdf

Table CA 3 Standard 6

Stormwater Discharges within Zone Is, Zone IIs and Interim Wellhead Protection Areas	
Unless necessary to manage stormwater from essential drinking water facilities, no stormwater BMPs may be located within the Zone I. Proponents must comply with local source water protection ordinances, bylaws, and regulations. The Drinking Water Regulations, 310 CMR 22.21(2)(b)(7)[32], require the development of land use controls in the Zone II that prohibit land uses that result in rendering 15% or 2500 square feet of a lot impervious, whichever is larger, unless a system of artificial recharge that does not degrade groundwater quality is provided. Developers can comply with these land use controls by designing, constructing, operating and maintaining a stormwater management system in compliance with the Stormwater Management Standards. BMPs must be designed according to the specifications and sizing methodologies in Volumes 2 and 3 of the Massachusetts Stormwater Handbook. Required Water Quality Volume =1.0 inch times impervious area. At least 44% TSS must be removed prior to discharge to the infiltration structure. For discharges within the Zone I, Zone II or IWPA, proprietary BMPs may be used for pretreatment only, unless verified for other uses by TARP or STEP. For the purpose of this requirement, subsurface structures, even those that have a storage chamber that has been manufactured are not proprietary BMPs, since the pretreatment occurs in the soil below the structure, not in the structure itself. See Volume 2.	
Pretreatment BMPS	Deep Sump Catch Basin Oil Grit Separator Proprietary Separators: See Volume 2. Sediment Forebay Vegetated Filter Strip
Treatment BMPs Sand Filters, Organic Filters, Proprietary Media Filters, Filtering Bioretention Areas and Wet Basins must be lined and sealed unless 44% of TSS has been removed prior to discharge to the BMP.	Filtering Bioretention Areas including rain gardens Constructed Stormwater Wetlands Gravel Wetlands Proprietary Filter Media (*Proprietary Media Filter may not be used for terminal treatment for discharges near or to critical areas unless the filter has been verified by the TARP or STEP process. See Volume 2. Proprietary Media Filters do not include Catch Basin Inserts.)* Sand/Organic Filters Wet Basins
Infiltration BMPs	Exfiltrating Bioretention areas Dry wells (*runoff from non-metal roofs and runoff from metal roofs located outside the Interim Wellhead Protection Area or Zone II of a public water supply or an industrial site only)* Infiltration Basins *(highly recommended)* Infiltration Trenches *(highly recommended)* Subsurface Structures

[32] Drinking Water Regulations – http://www.mass.gov/eea/docs/dep/water/ccdefreg.pdf

Best Management Practices for Cold-Water Fisheries.	
All BMPs must be designed in accordance with specifications in Volume 2 of the Massachusetts Stormwater Handbook**.** Required Water Quality Volume = 1.0 times impervious area. At least 44% TSS removal required prior to discharge to infiltration structure. For discharges near or to cold-water fisheries, proprietary BMPs may be used for pretreatment only, unless verified for such other uses by STEP or TARP. For the purpose of this requirement, subsurface structures, even those that have a storage chamber that has been manufactured are not proprietary BMPs, since the pretreatment occurs in the soil below the structure, not in the structure itself. See Volume 2.	
Pretreatment:	Deep Sump Catch Basins
	Oil Grit Separator
	Proprietary Separators: See Volume 2
	Sediment Forebays
	Vegetated Filter Strips
Treatment: Sand Filters, Organic Filters, Proprietary Media Filters. Water Quality Swales, Grass Channels, and Filtering Bioretention Areas must be lined and sealed unless at least 44% TSS has been removed prior to discharge to the BMP.	Filtering Bioretention Areas including rain gardens with linings
	Dry Water Quality Swales
	Grass Channels
	Leaching Catch Basins
	Proprietary Media Filter (*Proprietary Media Filter may not be used for terminal treatment for discharges of stormwater runoff near or to a critical area unless verified through the TARP or STEP process. See Volume 2. Proprietary Media Filters do not include catch basin inserts).*
	Sand/Organic Filters
	Wet Water Quality Swales
Infiltration:	Infiltration Trenches
	Infiltration Basins
	Subsurface Structures
	Exfiltrating Bioretention Area including rain gardens
	Dry Wells *(runoff from non metal roofs and runoff from metal roofs located outside the Zone II or Interim Wellhead Protection Area of a public water supply or an industrial site only)*

Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

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

1. Maintenance and improvement of existing roadways, including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems, and repaving;
2. Development, rehabilitation, expansion and phased projects on previously developed sites, provided the redevelopment results in no net increase in impervious area; and

3. Remedial projects specifically designed to provide improved stormwater management, such as projects to separate storm drains and sanitary sewers and stormwater retrofit projects.

All redevelopment projects must fully comply with the provisions of the Stormwater Management Standards requiring the development and implementation of a construction period erosion and sedimentation control plan, a pollution prevention plan, an operation and maintenance plan, and the prohibition of illicit discharges. All redevelopment projects are also required to meet the following Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6[33] and improve existing conditions. Existing stormwater discharges are also required to comply with Standard 1 only to the maximum extent practicable.

For purpose of Standard 7, "To the maximum extent practicable" means that:

(1) Proponents of redevelopment projects have made all reasonable efforts to meet the applicable Standard;
(2) They have made a complete evaluation of possible stormwater management measures including environmentally sensitive site design that minimizes land disturbance and impervious surfaces, low impact development techniques, and stormwater BMPs; and,
(3) If not in full compliance with the applicable Standard, they are implementing the highest practicable level of stormwater management.

Generally, an alternative is practicable if it can be implemented within the site being redeveloped, taking into consideration cost, land area requirements, soils, and other site constraints. However, offsite alternatives may also be practicable. For example, pursuing an easement for locating stormwater controls on an adjacent lot where adequate capacity exists or can be provided may be a practicable alternative. Economic factors must be weighed as redevelopment projects attempt to meet the standards. The scope and effort to be undertaken to meet the standards should reflect the scale and impacts of the proposed project and the classification and sensitivity of the affected wetlands and water resources.

As stated earlier, all redevelopment projects must improve existing conditions. New stormwater controls (retrofitted or expanded) must be incorporated into the design and result in a reduction in annual stormwater pollutant loads from the site. Proponents of redevelopment projects shall make full use of all opportunities for controlling the sources of pollution and to incorporate environmentally sensitive site design and low impact development techniques. This is particularly important for constrained redevelopment sites where it is not possible to install BMPs that treat the entire water quality volume (i.e. 0.5 inch or 1.0 inch rule). All redevelopment projects shall also incorporate measures that will address water quantity issues by reducing the peak and total runoff from the site and by increasing recharge. Actions to improve existing conditions should be geared to addressing known water quality and water quantity problems such as documented failures to meet the Surface Water Quality Standards, low stream flow, or repeated flood events.

Volume 2 Chapter 3 contains a redevelopment checklist that both the issuing authority and the applicant can use to determinine whether the stormwater management system for a redevelopment project has been designed in accordance with all the requirements of Standard 7. For MassHighway projects involving less than a single lane, the Storm Water Handbook for Highway and Bridges may be used in lieu of the redevelopment checklist.

The portion of a property that is currently undeveloped is not a redevelopment and thus does not fall under Standard 7. To the extent a project includes development of previously undeveloped areas, the

[33] The maximum extent practicable standard applies to the 80% TSS removal requirement of Standards 4 through 6. For redevelopment projects, stormwater management system must be designed to remove 80% of TSS only to the maximum extent practicable. The maximum extent practicable standard also applies to redevelopment projects with existing stormwater discharges to Zone Is, Zone As, Outstanding Resource Waters, and Special Resource Waters subject to Standard 6.

project must comply fully with all the Stormwater Management Standards. The following example demonstrates how the Stormwater Management Standards apply to a site that includes both new development and redevelopment.

Suppose a 5-acre site with 2 acres of impervious surfaces including parking, a warehouse, and manufacturing plant, will be redeveloped into a mixed-use development with 3 acres of impervious surfaces. A pollution prevention plan, an erosion and sedimentation control plan and a long-term operation and maintenance plan must be prepared for the entire site in accordance with the applicable provisions of Standards 4 through 6, 8, and 9. All illicit discharges to the stormwater system must be eliminated in accordance with Standard 10. Because there is an additional acre of impervious surface, stormwater runoff from at least one acre of impervious surface must be directed to stormwater best management practices that are designed and constructed in accordance with all the Stormwater Management Standards. The remaining two acres of impervious surfaces included in the project may be treated as a redevelopment. Runoff from that portion of the project may be directed to structural stormwater best management practices that are designed and constructed to meet Standards 2 through 6 only to the maximum extent practicable. New stormwater outfalls must be designed in compliance with Standard 1. Existing outfalls are required to comply with Standard 1 only to the maximum extent practicable. The stormwater management system must also improve existing conditions. Because the site is located in a watershed where surface waters often experience low flow, the proponent can fulfill the requirement to improve existing conditions by maximizing opportunities for infiltration and by minimizing water use by installing a rain barrel or cistern.

Standard 8: A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

During land disturbance and construction activities, project proponents must implement controls that prevent erosion, control sediment movement, and stabilize exposed soils to prevent pollutants from moving offsite or entering wetlands or waters. Land disturbance activities include demolition, construction, clearing, excavation, grading, filling, and reconstruction.

For all projects subject to Wetlands jurisdiction, a construction period erosion, sedimentation, and pollution prevention plan that identifies the party or parties responsible for implementing the plan or any components thereof must be submitted.[34] The Order of Conditions should require the responsible party or parties to implement the plan as approved by the Conservation Commission, until the site is fully stabilized and the temporary erosion and sedimentation controls are removed.

Projects that disturb one acre of land or more are required to obtain coverage under the NPDES Construction General Permit issued by EPA and prepare a Stormwater Pollution Plan (SWPPP)[35]. To avoid duplication of effort, a project proponent can prepare a single document that satisfies the SWPPP requirements of the Construction General Permit and the construction period erosion, sedimentation and pollution prevention plan requirements of Standard 8. For all projects that are required to obtain coverage under the Construction General Permit, the issuing authority shall require submission of the SWPPP before land disturbance commences. If the proponent is not using the SWPPP as its construction period erosion,

[34] For projects subject to jurisdiction under the Wetlands Protection Act, the construction period pollution prevention and erosion and sedimentation control plan should ordinarily be included in the Stormwater Report submitted with the Notice of Intent. For highly complex projects, where the proponent demonstrates that submission with the Notice of Intent is not possible, the issuing authority has the discretion to issue an Order of Conditions authorizing a project prior to submission of the construction period pollution prevention and erosion and sedimentation control plan. However, any such Order must provide that no work including site preparation and land disturbance may commence unless and until a construction period pollution prevention and erosion and sedimentation control plan that meets the requirements of Standard 8 as further elaborated by the Massachusetts Stormwater Handbook has been approved by the issuing authority.

[35] EPA NPDES – http://cfpub.epa.gov/npdes/stormwater/cgp.cfm

sedimentation and pollution prevention plan, the issuing authority shall require implementation of any measures in the SWPPP that were not included in the plan.

The construction period erosion, sedimentation and pollution prevention plan must identify all stormwater management activities that are needed during land disturbance and construction, including source control and pollution prevention measures, BMPs to address erosion and sedimentation, stabilization measures, and procedures for operating and maintaining the BMPs, especially in response to wet weather events and frost. The plan shall include a schedule for sequencing construction and stormwater management activities that minimizes land disturbance by ensuring that vegetation is preserved to the extent practicable, and disturbed portions of the site are stabilized as quickly as possible.

The BMPs used during construction must be different from the BMPs that will be used to handle stormwater after construction is completed and the site is stabilized. Many stormwater technologies (infiltration technologies) are not designed to handle the high concentrations of sediments typically found in construction runoff, and thus must be protected from construction-related sediment loadings.

All construction period BMPs must be properly designed, and sediment traps must be sized to provide adequate capacity and retention time to allow for proper settling of fine-grained soils. Construction period BMPs must be properly operated and maintained. For more information on erosion and sediment control, see Volume 2 of the Massachusetts Stormwater Handbook and the Nonpoint Source Manual, and the Erosion and Sedimentation Control Guidelines: A Guide for Planners, Designers and Municipal Officials[36,37].

Standard 9: A Long -Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

The Long-Term Operation and Maintenance Plan shall at a minimum include:

1. Stormwater management system(s) owners;
2. The party or parties responsible for operation and maintenance, including how future property owners will be notified of the presence of the stormwater management system and the requirement for proper operation and maintenance;
3. The routine and non-routine maintenance tasks to be undertaken after construction is complete and a schedule for implementing those tasks;
4. A plan that is drawn to scale and shows the location of all stormwater BMPs in each treatment train along with the discharge point;
5. A description and delineation of public safety features; and
6. An estimated operations and maintenance budget.

The Operation and Maintenance Plan shall identify best management practices for implementing maintenance activities in a manner that minimizes impacts to wetland resource areas.[38]

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[36] MA Erosion & Sedimentation Control Guidelines - http://www.mass.gov/eea/agencies/massdep/water/watersheds/erosion-and-sedimentation-control-guidelines.html

[37] Nonpoint Source Manual (formally known as the MegaManual): http://projects.geosyntec.com/NPSManual/

[38] Some proponents may have developed an operation and maintenance plan for stormwater BMPs to meet the requirements of the National Pollutant Discharge System Elimination System (NPDES) Multi-Sector General Permit or the NPDES General Permit for Municipal Separate Storm Sewer Systems (MS4 Permit). To avoid duplication of effort, proponents may be able to prepare one plan for the operation and maintenance of stormwater BMPs that fulfills the requirements of Standard 8 and the applicable NPDES general stormwater permit. The Operation and Maintenance Plan must be included in the Stormwater Report. See Volume 3.

For projects subject to jurisdiction under the Wetlands Protection Act, the Conservation Commission and MassDEP will take the actions set forth below to ensure compliance with Standard 9. Unless and until another party accepts responsibility, the Conservation Commission and MassDEP shall presume that the owner of the BMP is the landowner of the property on which the BMP is located, unless there is a legally binding agreement with another entity that accepts responsibility for the operation and maintenance. If an applicant envisions that the municipality may accept responsibility for the operation and maintenance of a stormwater BMP, the applicant shall notify the Conservation Commission and make available to the municipal official responsible for stormwater management the design and operation and maintenance plan for the BMP in order that the municipal official may have an opportunity to review and provide comments to the Conservation Commission within a reasonable period of time prior to the issuance of the Final Order of Conditions. It is recommended that the Conservation Commission solicit comments from the responsible municipal official.

To ensure compliance with Standard 9, the Order of Conditions should include the continuing conditions set forth below.

(1) All stormwater BMPs shall be operated and maintained in accordance with the design plans and the Operation and Maintenance Plan approved by the issuing authority.

(2) The responsible party shall:
- (a) maintain an operation and maintenance log[39] for the last three years, including inspections, repairs, replacement and disposal (for disposal, the log shall indicate the type of material and the disposal location);
- (b) make this log available to MassDEP and the Conservation Commission upon request; and
- (c) allow members and agents of the MassDEP and the Conservation Commission to enter and inspect the premises to evaluate and ensure that the responsibility party complies with the Operation and Maintenance Plan requirements for each BMP.

These same continuing conditions should be included in the Certificate of Compliance.

The Order of Conditions should also include a condition requiring the responsible party to submit an O & M Compliance statement when requesting a Certificate of Compliance. The O & M Compliance Statement shall identify the party responsible for implementation of the Operation and Maintenance Plan and state that:

a. the site has been inspected for erosion and appropriate steps have been taken to permanently stabilize any eroded areas;
b. all aspects of the stormwater BMPs have been inspected for damage, wear and malfunction, and appropriate steps have been taken to repair or replace the system or portions of the system so that the stormwater at the site may be managed in accordance with the Stormwater Management Standards;
c. future responsible parties must be notified of their continuing legal responsibility to operate and maintain the structure; and
d. the Operation and Maintenance Plan for the stormwater BMPs is being implemented.

In the case of stormwater BMPs that are serving more than one lot, the applicant shall include with the Notice of Intent a mechanism for implementing and enforcing the Operation and Maintenance Plan. The applicant shall identify the lots or units that will be serviced by the proposed stormwater BMPs. The applicant shall also provide 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 stormwater BMPs. In the event that the stormwater BMPs will be operated and maintained by an entity, municipality, state agency or person other than the sole owner of the lot upon which the stormwater management facilities are placed, the applicant shall provide a plan and easement deed that provides a right

[39] This is a rolling log in which the responsible party records all operation and maintenance activities for the past three years.

of access for the legal entity to be able to perform said operation and maintenance functions. It is recommended that the Order of Conditions include a condition requiring that the responsible party provide a copy of the Order of Conditions and the legal instrument to each unit or lot owner at or before the purchase of each unit or lot to be serviced by the stormwater BMPs. When requesting the issuance of a Certificate of Compliance, the applicant shall identify to the Conservation Commission or MassDEP in writing the entity with legal responsibility for the operation and maintenance of the stormwater BMPs and provide a copy of the recorded instrument creating the responsible entity.

Prior to issuing a Certificate of Compliance, the Conservation Commission or MassDEP should inspect the site to determine whether the Stormwater BMPs are operating as designed so that the stormwater at the site may be managed in accordance with the Stormwater Management Standards. In conducting the inspection, the Conservation Commission or MassDEP should look for indicia that the stormwater BMPs are not functioning as designed. Evidence of problems with stormwater BMPs may include without limitation sand plumes at outfalls, excessive sands in catch basins, oil sheens, stressed vegetation, accumulated litter, and/or failure of the BMP to drain after 72 hours. No Certificate of Compliance should be issued unless and until the stormwater BMPs are functioning in accordance with the Final Order of Conditions and the Stormwater Management Standards.

Standard 10: All illicit discharges to the stormwater management system are prohibited.

Standard 10 prohibits illicit discharges to stormwater management systems. The stormwater management system is the system for conveying, treating, and infiltrating stormwater on-site, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

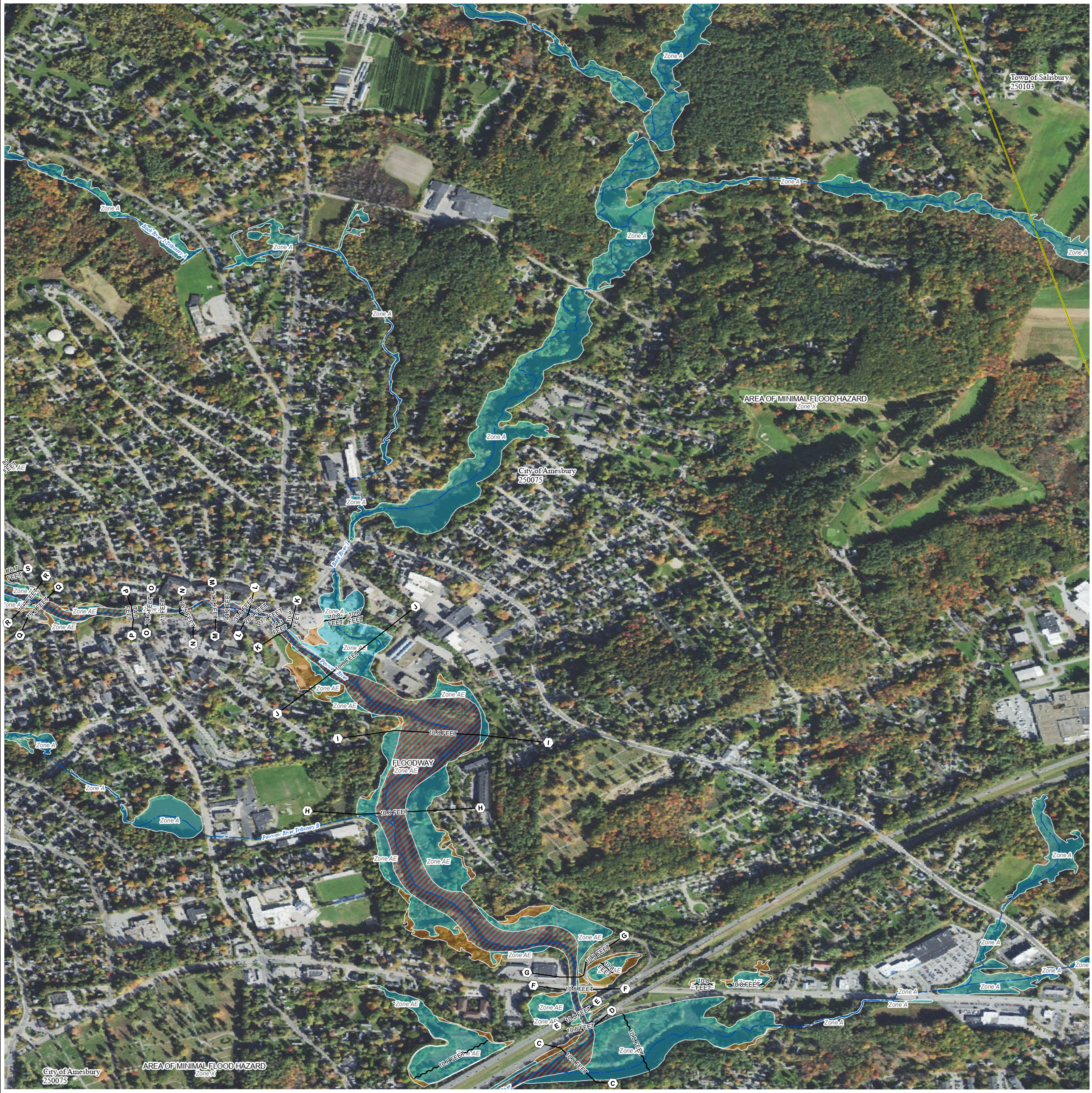
Proponents of projects within Wetlands jurisdiction must demonstrate compliance with this requirement by submitting to the issuing authority an Illicit Discharge Compliance Statement verifying that no illicit discharges exist on the site and by including in the pollution prevention plan measures to prevent illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease. The Illicit Discharge Compliance Statement may be filed with the Notice of Intent. If the Illicit Discharge Compliance Statement has not been filed, the Final Order of Conditions shall require the submission of an Illicit Discharge Compliance Statement prior to the discharge of stormwater runoff to the post-construction stormwater best management practices. The issuing authority should not issue a Certificate of Compliance until it has determined that the Illicit Discharge Compliance Statement has been submitted, has reviewed the Illicit Discharge Compliance Statement, and has verified that there are no illicit discharges at the site.

The Illicit Discharge Compliance Statement must be accompanied by a site map that is drawn to scale and that identifies the location of any systems for conveying stormwater on the site and shows that these systems do not allow the entry of any illicit discharges into the stormwater management system. The site map shall identify the location of any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater management systems and the location of any measures taken to prevent the entry of illicit discharges into the stormwater management system. For redevelopment projects, the Illicit Discharge Compliance Statement shall also document all actions taken to identify and remove illicit discharges, including, without limitation, visual screening, dye or smoke testing, and the removal of any sources of illicit discharges to the stormwater management system.

Many municipal and state agencies that own and operate roadways are also subject to coverage under the NPDES General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (the MS4 Permit). State agencies and municipalities covered by the MS4 Permit are required to have a stormwater management program that includes illicit discharge detection and elimination. For roadways covered by the MS4 Permit, the proponent may demonstrate compliance with Standard 10 by documenting the actions taken to identify and eliminate illicit discharges under the MS4 Permit. To prevent duplication of effort, the proponent may submit copies of reports prepared to satisfy the illicit discharge detection and elimination program requirements of the MS4 Permits as its Illicit Discharge Compliance Statement.

Appendix B
FEMA Flood Insurance Rate Map (FIRM)

70°56'15.43"W 42°52'36.67"N



70°54'22.07"W 42°50'31"N

FLOOD HAZARD INFORMATION

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

SPECIAL FLOOD HAZARD AREAS

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

OTHER AREAS OF FLOOD HAZARD

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

LINK> </CLR>for official maps and additional

OTHER AREAS

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

GENERAL STRUCTURES

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

OTHER FEATURES

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

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at https://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to the Flood Insurance Study Report for this jurisdiction.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on **8/11/2025 3:57 PM** and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at https://www.fema.gov/media-library/assets/documents/118418

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards. This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE

Map Projection:
GCS, Geodetic Reference System 1980;
Vertical Datum: NAVD88,
For information about the specific vertical datum for elevation features, datum conversions, or vertical monuments used to create this map, please see the Flood Insurance Study (FIS) Report for your community at https://msc.fema.gov

N

1 inch = 500 feet 1:6,000

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

0 50 100 200 300 400 Meters

FEMA
National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM

FLOOD INSURANCE RATE MAP

PANEL **106** OF **552**

Panel Contains:

COMMUNITY	NUMBER	PANEL
CITY OF AMESBURY	250075	0106
TOWN OF SALISBURY	250103	0106

MAP NUMBER
25009C0106G
EFFECTIVE DATE
July 08, 2025

Appendix C
NRCS Soil Survey

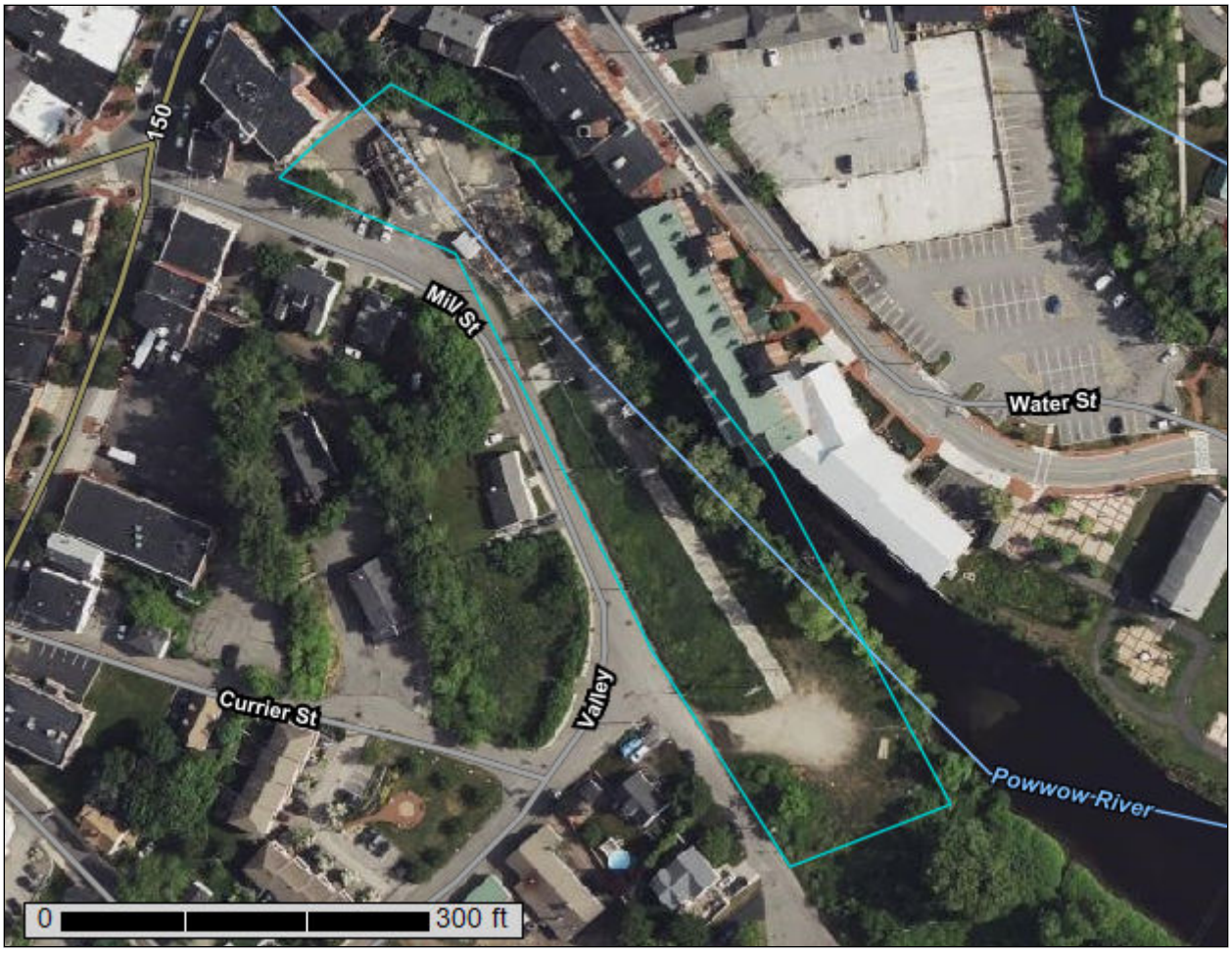
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Essex County, Massachusetts, Northern Part



August 18, 2025

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

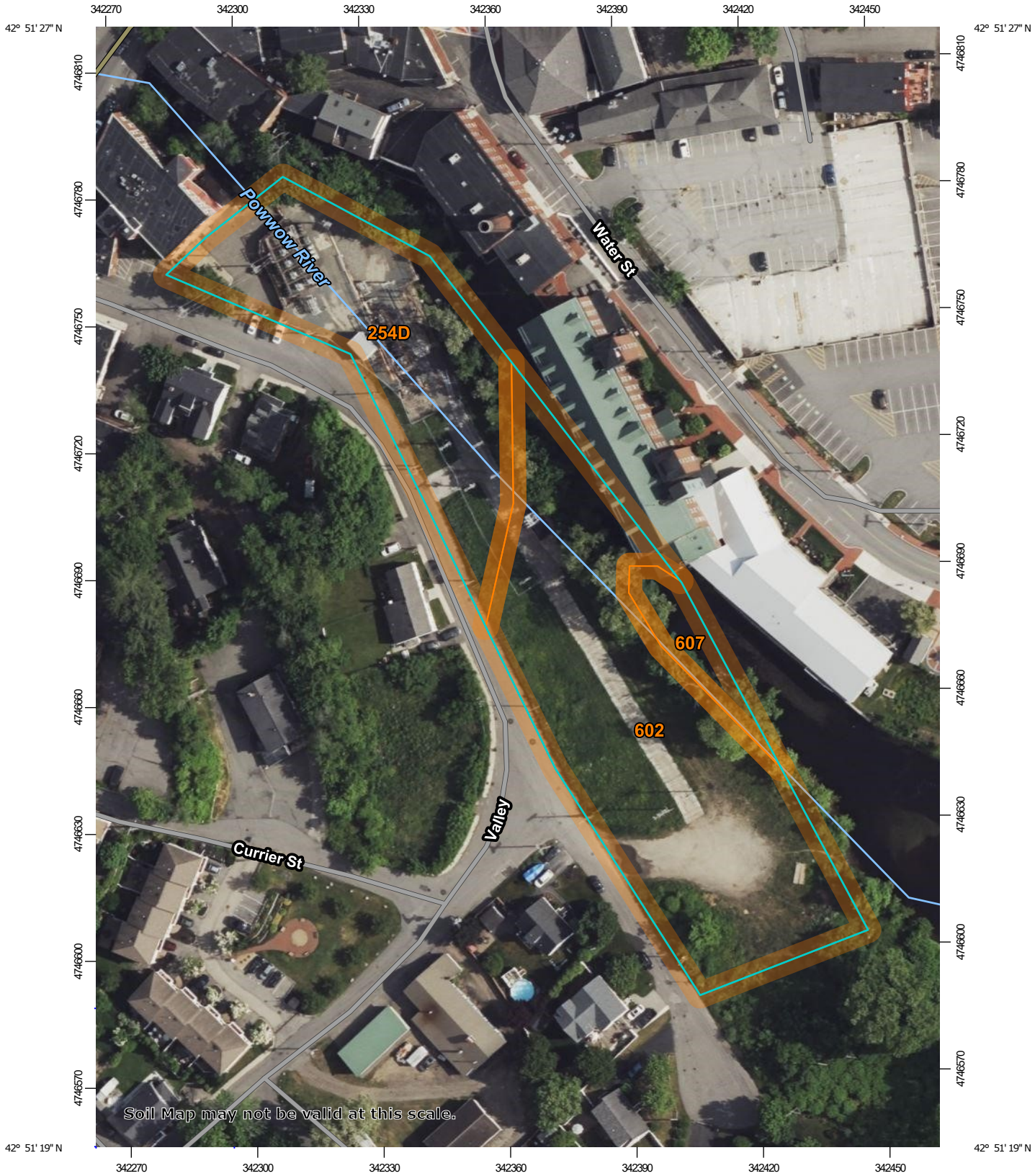
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,290 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

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

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

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

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 20, Aug 27, 2024

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
254D	Merrimac fine sandy loam, 15 to 25 percent slopes	0.8	35.4%
602	Urban land	1.3	59.8%
607	Water, saline	0.1	4.8%
Totals for Area of Interest		**2.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the

development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Essex County, Massachusetts, Northern Part

254D—Merrimac fine sandy loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2tyrg
Elevation: 0 to 1,890 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Merrimac

Setting

Landform: Outwash plains, outwash terraces, moraines, eskers, kames
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Ecological site: F145XY008MA - Dry Outwash

Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 10 percent
Landform: Deltas, kames, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Outwash terraces, dunes, outwash plains, deltas
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Agawam

Percent of map unit: 5 percent
Landform: Kame terraces, outwash plains, outwash terraces, moraines, kames
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Side slope, crest, riser, tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

602—Urban land

Map Unit Setting

National map unit symbol: vjx3
Frost-free period: 125 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Urban Land

Setting

Parent material: Excavated and filled land

Minor Components

Udorthents
Percent of map unit: 10 percent
Hydric soil rating: No

Merrimac
Percent of map unit: 2 percent
Hydric soil rating: No

Hinckley
Percent of map unit: 2 percent
Hydric soil rating: No

Windsor
Percent of map unit: 2 percent
Hydric soil rating: No

Charlton
Percent of map unit: 2 percent
Hydric soil rating: No

Paxton
Percent of map unit: 2 percent
Hydric soil rating: No

607—Water, saline

Map Unit Setting
National map unit symbol: vk29
Frost-free period: 120 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition
Water, saline: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Westbrook
Percent of map unit: 5 percent
Landform: Marshes
Hydric soil rating: Yes

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Appendix D
NOAA Precipitation Data

NOAA Atlas 14, Volume 10, Version 3
Location name: Amesbury, Massachusetts, USA*
Latitude: 42.8571°, Longitude: -70.9307°
Elevation: 55 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	**0.315** (0.252-0.395)	**0.377** (0.302-0.474)	**0.479** (0.382-0.602)	**0.563** (0.446-0.713)	**0.679** (0.518-0.894)	**0.767** (0.571-1.03)	**0.858** (0.617-1.19)	**0.960** (0.652-1.36)	**1.10** (0.718-1.62)	**1.22** (0.773-1.82)
10-min	**0.447** (0.358-0.560)	**0.535** (0.428-0.671)	**0.679** (0.541-0.854)	**0.798** (0.632-1.01)	**0.962** (0.734-1.27)	**1.09** (0.809-1.46)	**1.22** (0.875-1.69)	**1.36** (0.922-1.93)	**1.56** (1.02-2.29)	**1.73** (1.10-2.58)
15-min	**0.525** (0.421-0.659)	**0.629** (0.503-0.789)	**0.798** (0.636-1.01)	**0.939** (0.743-1.19)	**1.13** (0.863-1.49)	**1.28** (0.952-1.72)	**1.43** (1.03-1.98)	**1.60** (1.09-2.27)	**1.84** (1.20-2.69)	**2.04** (1.29-3.04)
30-min	**0.720** (0.577-0.903)	**0.863** (0.690-1.08)	**1.10** (0.872-1.38)	**1.29** (1.02-1.63)	**1.55** (1.18-2.04)	**1.75** (1.31-2.35)	**1.96** (1.41-2.72)	**2.19** (1.49-3.11)	**2.52** (1.64-3.70)	**2.79** (1.77-4.16)
60-min	**0.915** (0.733-1.15)	**1.10** (0.877-1.38)	**1.39** (1.11-1.75)	**1.64** (1.30-2.07)	**1.97** (1.50-2.60)	**2.23** (1.66-2.99)	**2.49** (1.79-3.46)	**2.79** (1.89-3.95)	**3.21** (2.08-4.70)	**3.55** (2.24-5.29)
2-hr	**1.20** (0.967-1.50)	**1.44** (1.16-1.80)	**1.84** (1.48-2.31)	**2.18** (1.74-2.74)	**2.63** (2.03-3.46)	**2.97** (2.24-3.99)	**3.34** (2.43-4.65)	**3.77** (2.57-5.32)	**4.42** (2.88-6.44)	**4.97** (3.16-7.37)
3-hr	**1.40** (1.14-1.74)	**1.69** (1.37-2.10)	**2.17** (1.75-2.71)	**2.57** (2.05-3.21)	**3.11** (2.40-4.08)	**3.51** (2.65-4.70)	**3.95** (2.90-5.50)	**4.48** (3.06-6.29)	**5.29** (3.46-7.67)	**5.99** (3.81-8.84)
6-hr	**1.82** (1.48-2.24)	**2.21** (1.79-2.72)	**2.84** (2.30-3.52)	**3.37** (2.71-4.19)	**4.09** (3.18-5.34)	**4.63** (3.52-6.17)	**5.21** (3.85-7.23)	**5.93** (4.06-8.28)	**7.04** (4.61-10.1)	**8.00** (5.10-11.7)
12-hr	**2.30** (1.89-2.82)	**2.81** (2.30-3.45)	**3.65** (2.97-4.49)	**4.34** (3.51-5.36)	**5.29** (4.13-6.85)	**5.99** (4.58-7.93)	**6.76** (5.01-9.31)	**7.69** (5.29-10.7)	**9.14** (6.00-13.1)	**10.4** (6.64-15.1)
24-hr	**2.73** (2.25-3.32)	**3.39** (2.79-4.13)	**4.47** (3.67-5.46)	**5.36** (4.37-6.58)	**6.59** (5.19-8.50)	**7.50** (5.77-9.89)	**8.49** (6.35-11.7)	**9.74** (6.72-13.4)	**11.7** (7.70-16.6)	**13.4** (8.58-19.3)
2-day	**3.04** (2.53-3.68)	**3.86** (3.20-4.67)	**5.20** (4.30-6.31)	**6.31** (5.18-7.70)	**7.84** (6.22-10.1)	**8.96** (6.96-11.8)	**10.2** (7.71-14.1)	**11.8** (8.18-16.2)	**14.4** (9.53-20.4)	**16.7** (10.8-24.1)
3-day	**3.31** (2.76-3.99)	**4.19** (3.49-5.05)	**5.63** (4.67-6.81)	**6.82** (5.62-8.29)	**8.46** (6.74-10.8)	**9.65** (7.53-12.7)	**11.0** (8.34-15.1)	**12.7** (8.83-17.4)	**15.6** (10.3-22.0)	**18.1** (11.7-25.9)
4-day	**3.58** (3.00-4.30)	**4.48** (3.75-5.39)	**5.96** (4.96-7.19)	**7.19** (5.94-8.71)	**8.88** (7.09-11.3)	**10.1** (7.90-13.2)	**11.5** (8.73-15.7)	**13.3** (9.23-18.1)	**16.2** (10.8-22.8)	**18.9** (12.2-26.9)
7-day	**4.33** (3.65-5.18)	**5.27** (4.42-6.30)	**6.79** (5.68-8.15)	**8.06** (6.69-9.72)	**9.80** (7.86-12.4)	**11.1** (8.69-14.4)	**12.5** (9.52-17.0)	**14.4** (10.0-19.4)	**17.4** (11.6-24.3)	**20.1** (13.0-28.5)
10-day	**5.03** (4.25-5.99)	**5.99** (5.05-7.13)	**7.55** (6.34-9.03)	**8.85** (7.38-10.6)	**10.6** (8.55-13.4)	**11.9** (9.38-15.4)	**13.4** (10.2-18.0)	**15.3** (10.7-20.6)	**18.2** (12.2-25.4)	**20.9** (13.5-29.5)
20-day	**7.04** (5.98-8.32)	**8.09** (6.87-9.57)	**9.81** (8.29-11.6)	**11.2** (9.43-13.4)	**13.2** (10.6-16.4)	**14.7** (11.5-18.6)	**16.2** (12.3-21.3)	**18.0** (12.7-24.1)	**20.7** (13.9-28.6)	**22.9** (14.9-32.2)
30-day	**8.71** (7.43-10.3)	**9.84** (8.39-11.6)	**11.7** (9.92-13.8)	**13.2** (11.1-15.7)	**15.3** (12.4-18.9)	**17.0** (13.3-21.3)	**18.6** (14.0-24.1)	**20.4** (14.4-27.1)	**22.8** (15.3-31.3)	**24.7** (16.1-34.6)
45-day	**10.8** (9.27-12.7)	**12.0** (10.3-14.1)	**14.0** (12.0-16.5)	**15.7** (13.3-18.6)	**18.0** (14.5-22.0)	**19.7** (15.5-24.5)	**21.5** (16.1-27.5)	**23.2** (16.5-30.7)	**25.4** (17.2-34.7)	**27.1** (17.7-37.7)
60-day	**12.6** (10.8-14.8)	**13.9** (11.9-16.3)	**16.0** (13.7-18.8)	**17.8** (15.1-21.0)	**20.2** (16.3-24.5)	**22.0** (17.3-27.3)	**23.9** (17.9-30.3)	**25.6** (18.2-33.7)	**27.7** (18.8-37.7)	**29.2** (19.1-40.6)

[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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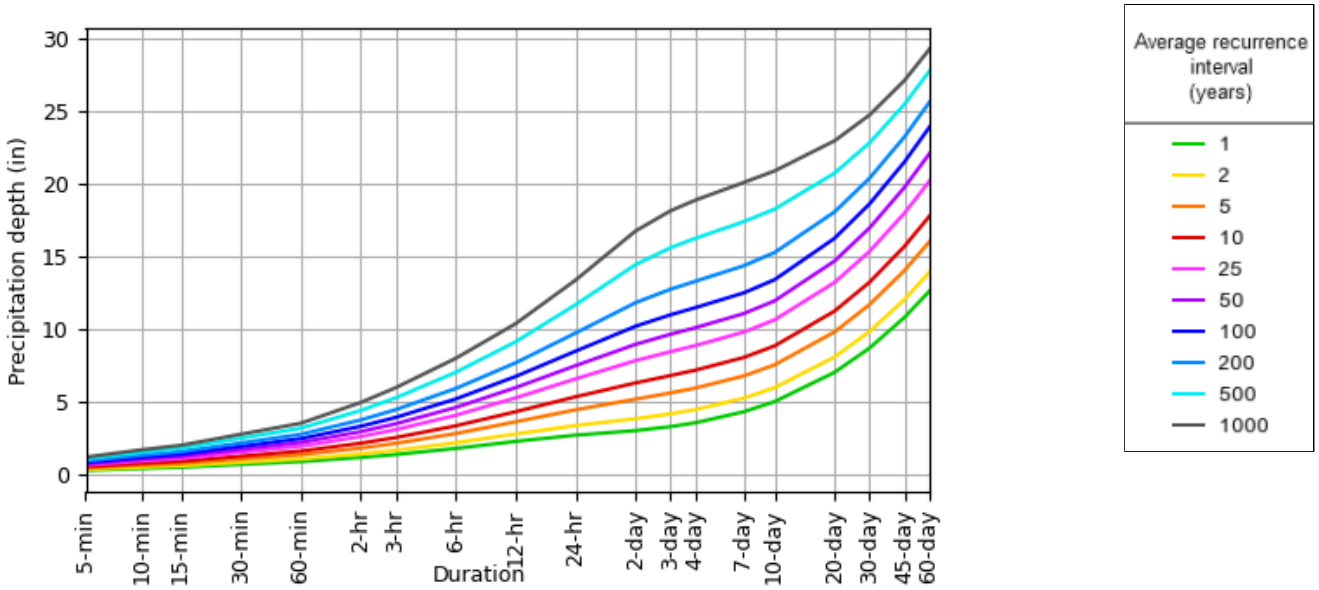
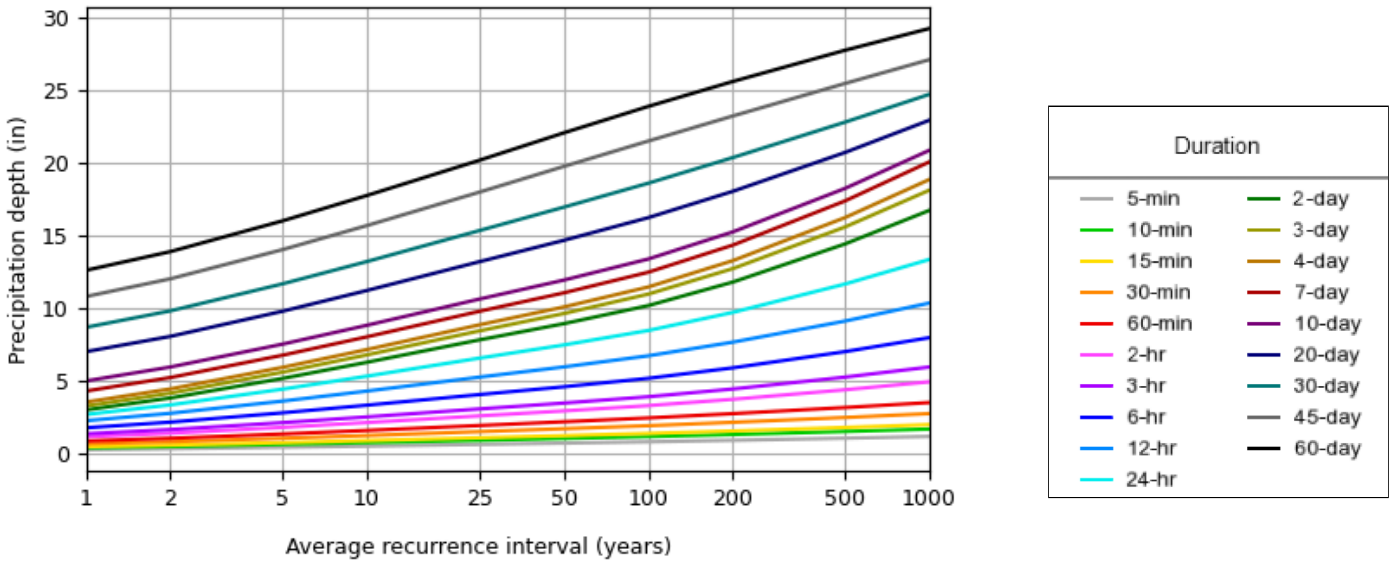
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 42.8571°, Longitude: -70.9307°





NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Tue Oct 14 19:22:19 2025

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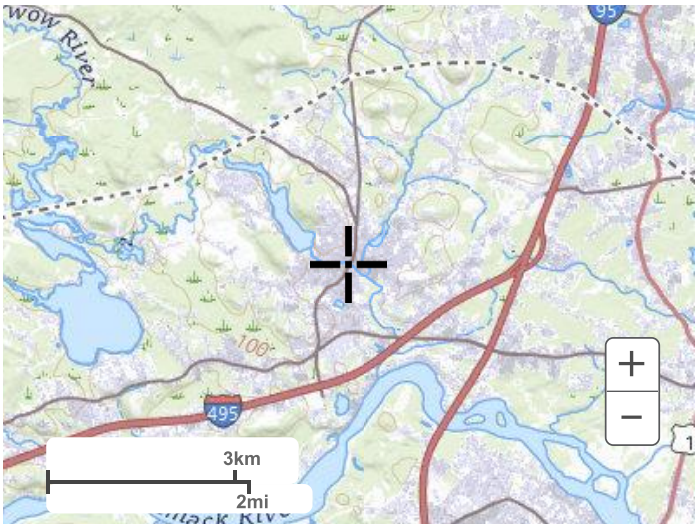
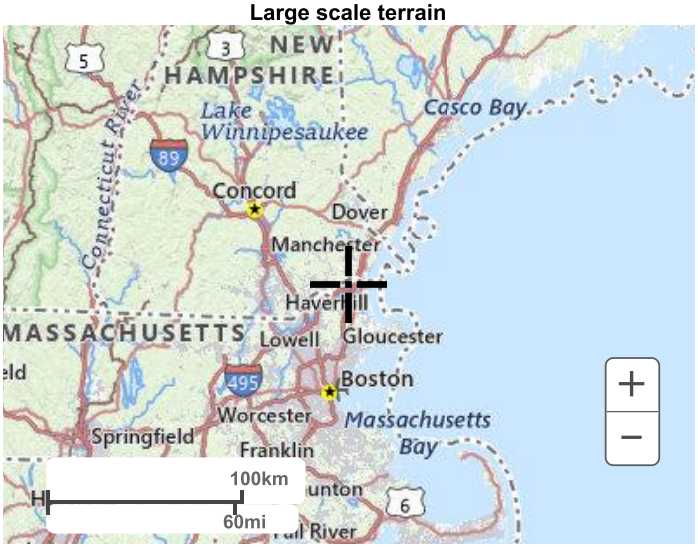
Maps & aerials

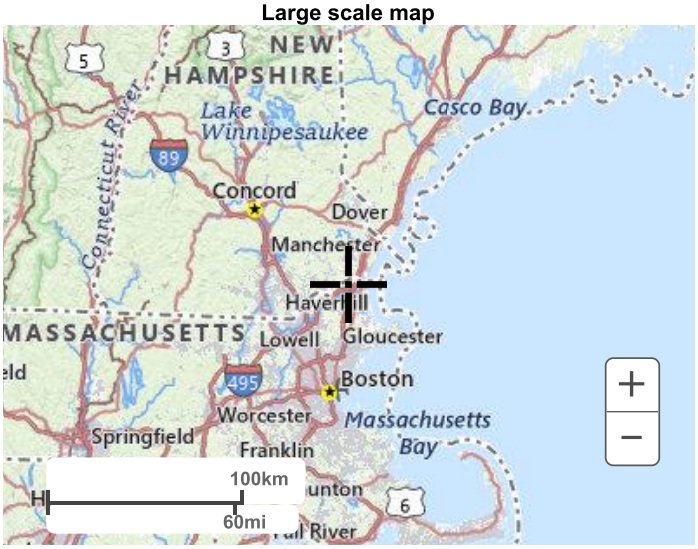
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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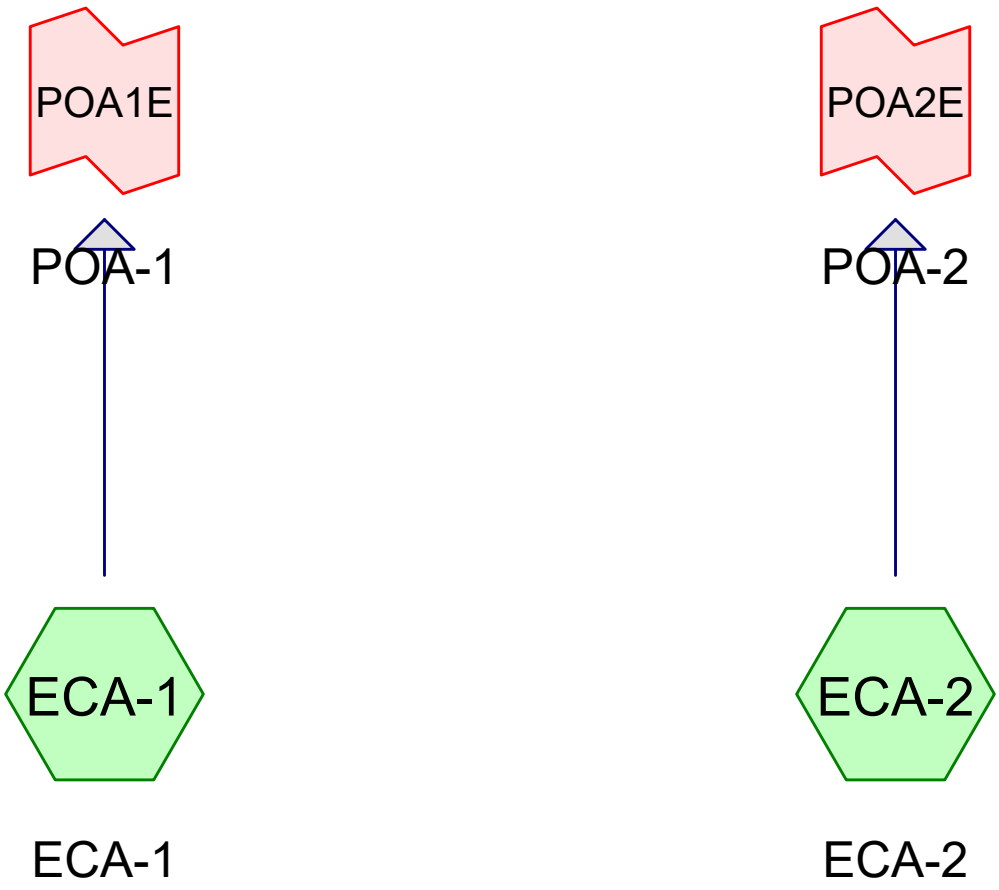
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Appendix E
HydroCAD Input/Output Data



Existing Conditions

Subcat Reach Pond Link

Routing Diagram for 2025-10-16_Temp Substation_Existing_Final
Prepared by Simpson, Gumpertz & Heger, Printed 10/20/2025

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-YEARS	Type III 24-hr		Default	24.00	1	3.39	2
2	10-YEARS	Type III 24-hr		Default	24.00	1	5.36	2
3	25-YEARS	Type III 24-hr		Default	24.00	1	6.59	2
4	100-YEARS	Type III 24-hr		Default	24.00	1	8.49	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
22,535	39	>75% Grass cover, Good, HSG A (ECA-1, ECA-2)
5,236	96	Gravel surface, HSG A (ECA-2)

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
22,535	0	0	0	0	22,535	>75% Grass cover, Good	
5,236	0	0	0	0	5,236	Gravel surface	

Time span=5.00-72.00 hrs, dt=0.05 hrs, 1341 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment ECA-1: ECA-1 Runoff Area=13,781 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=137' Tc=7.6 min CN=39 Runoff=0.00 cfs 5 cf

Subcatchment ECA-2: ECA-2 Runoff Area=13,990 sf 0.00% Impervious Runoff Depth=0.48"
Flow Length=136' Tc=9.5 min CN=60 Runoff=0.10 cfs 565 cf

Link POA1E: POA-1 Inflow=0.00 cfs 5 cf
Primary=0.00 cfs 5 cf

Link POA2E: POA-2 Inflow=0.10 cfs 565 cf
Primary=0.10 cfs 565 cf

Summary for Subcatchment ECA-1: ECA-1

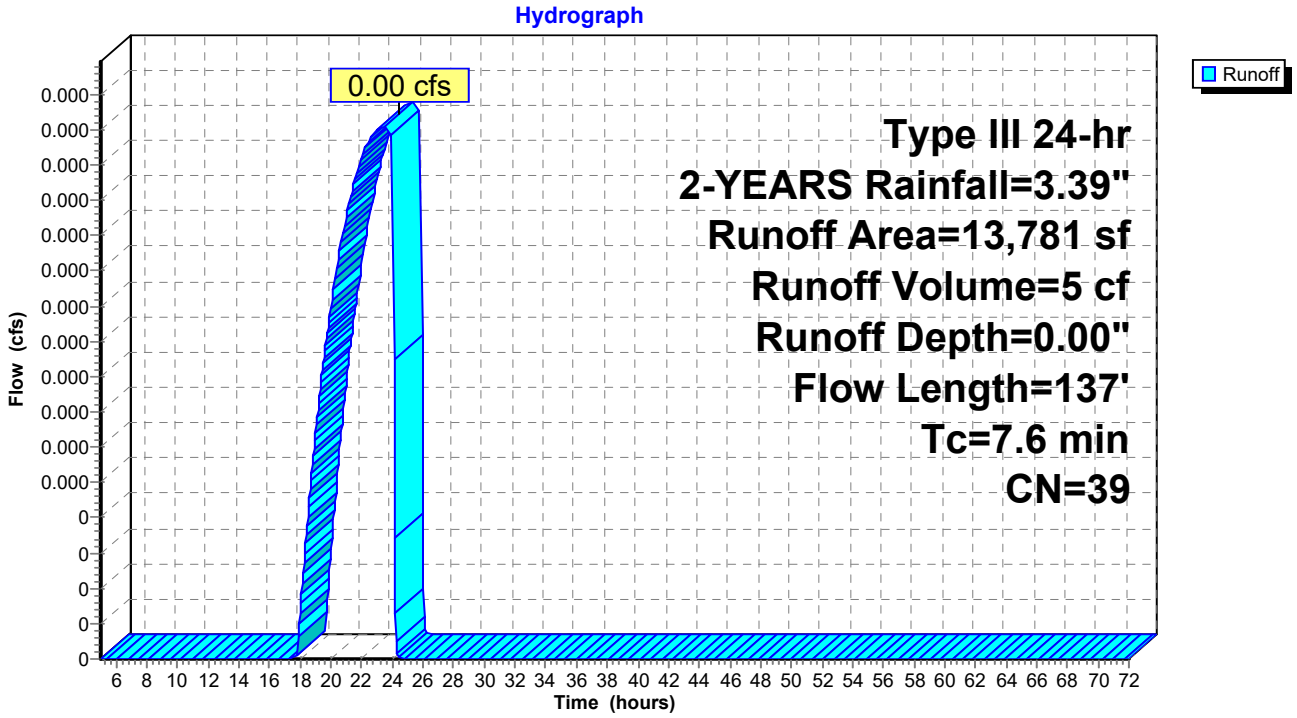
Runoff = 0.00 cfs @ 23.56 hrs, Volume= 5 cf, Depth= 0.00"
Routed to Link POA1E : POA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YEARS Rainfall=3.39"

Area (sf)	CN	Description
13,781	39	>75% Grass cover, Good, HSG A
13,781		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.0400	0.14		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
1.6	87	0.0172	0.92		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
7.6	137	Total			

Subcatchment ECA-1: ECA-1



Summary for Subcatchment ECA-2: ECA-2

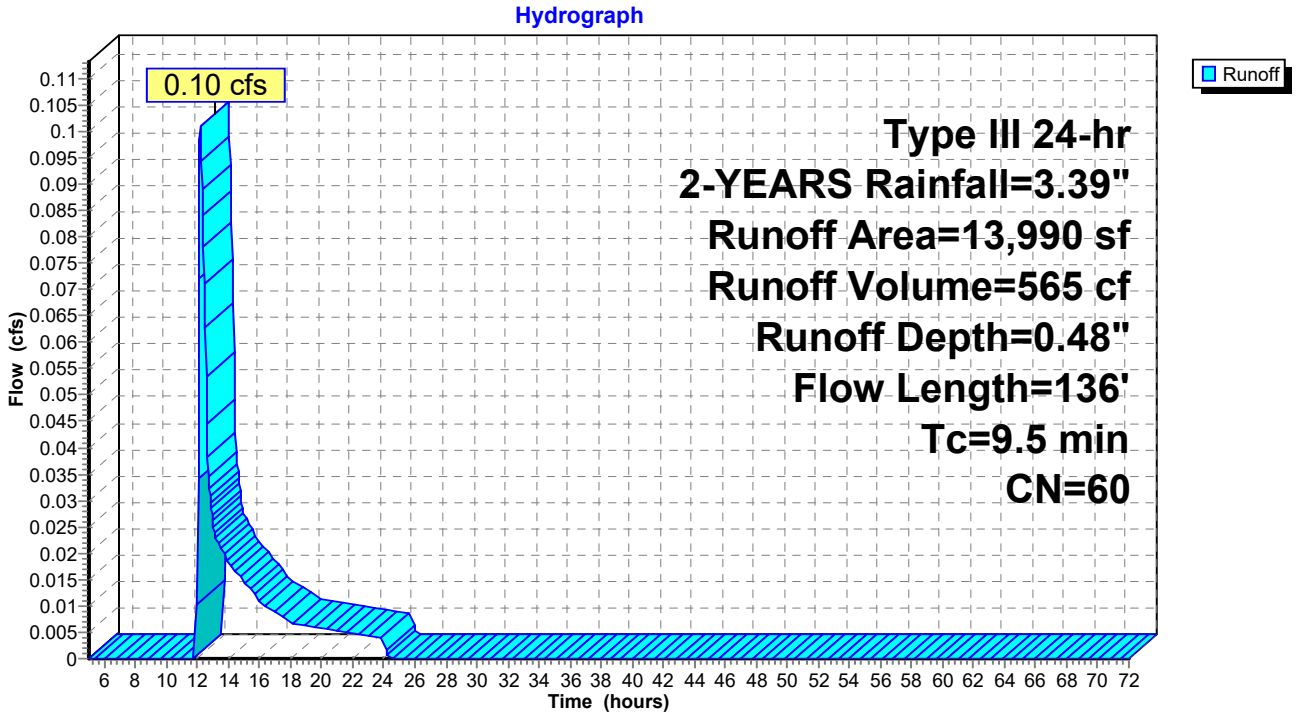
Runoff = 0.10 cfs @ 12.19 hrs, Volume= 565 cf, Depth= 0.48"
Routed to Link POA2E : POA-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YEARS Rainfall=3.39"

Area (sf)	CN	Description
8,754	39	>75% Grass cover, Good, HSG A
5,236	96	Gravel surface, HSG A
13,990	60	Weighted Average
13,990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0188	0.10		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
1.3	86	0.0263	1.14		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
9.5	136	Total			

Subcatchment ECA-2: ECA-2

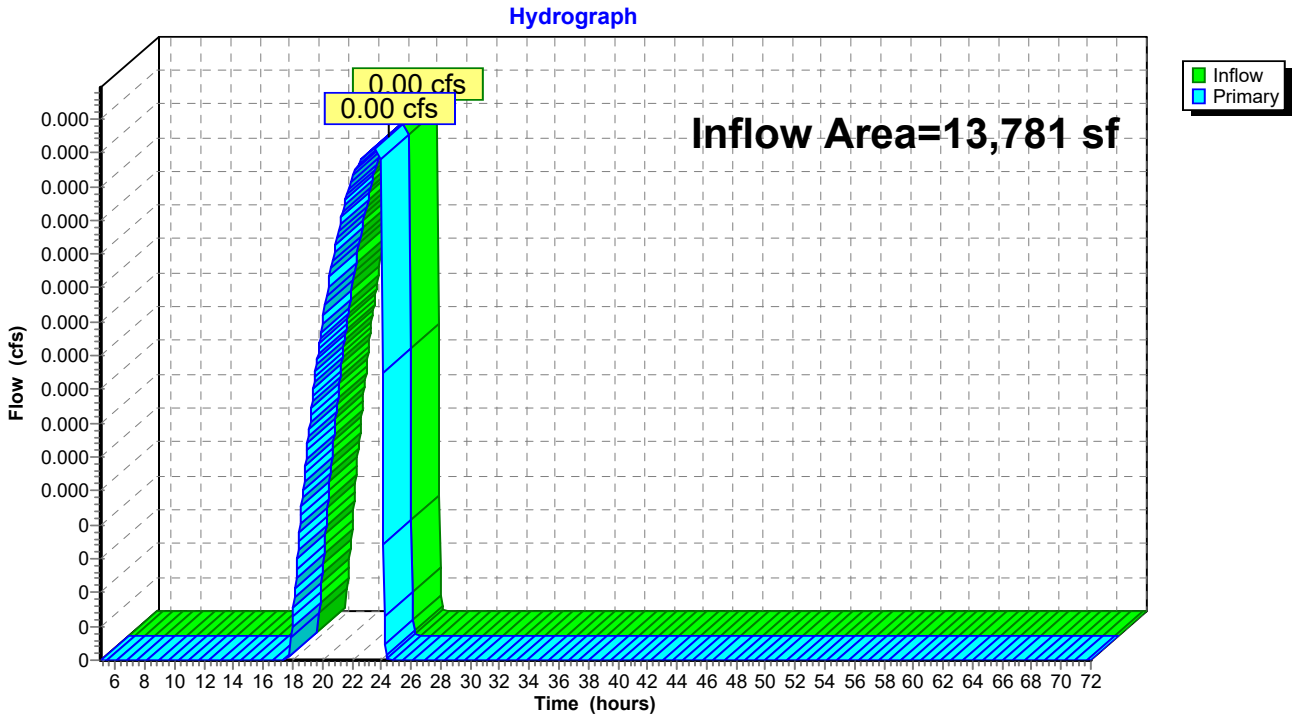


Summary for Link POA1E: POA-1

Inflow Area = 13,781 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2-YEARS event
Inflow = 0.00 cfs @ 23.56 hrs, Volume= 5 cf
Primary = 0.00 cfs @ 23.56 hrs, Volume= 5 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA1E: POA-1

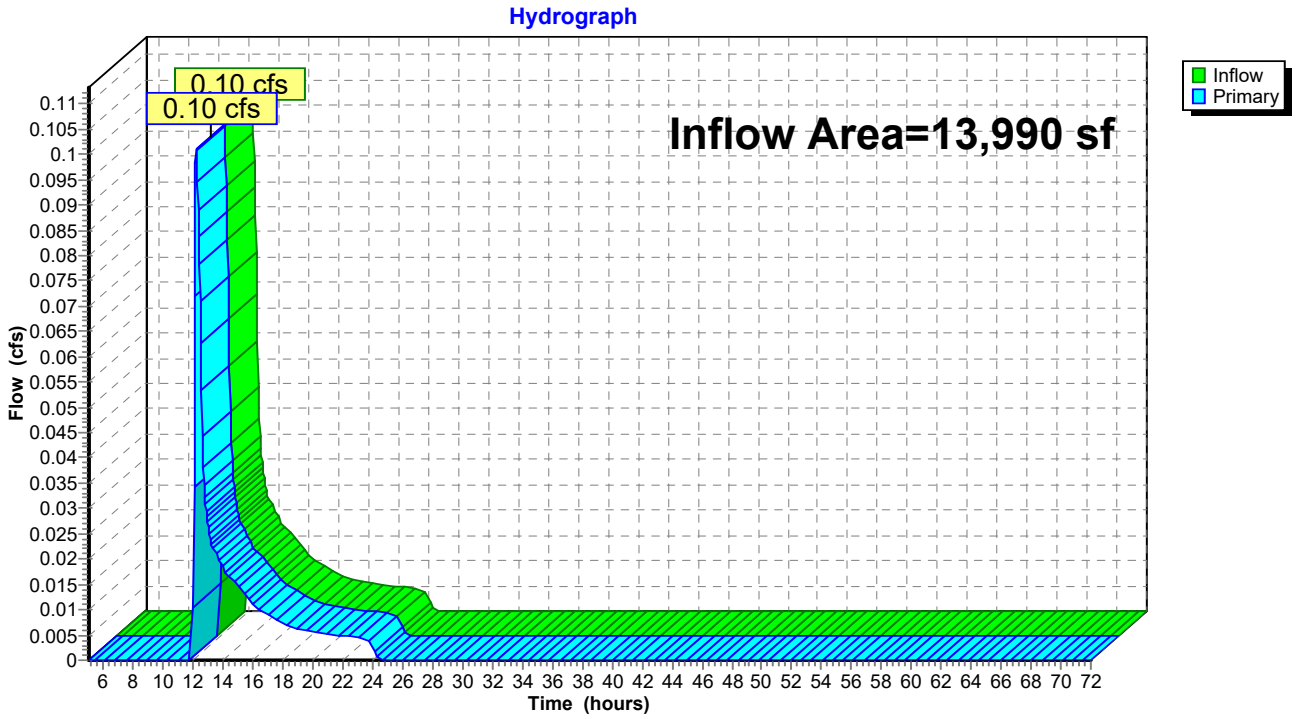


Summary for Link POA2E: POA-2

Inflow Area = 13,990 sf, 0.00% Impervious, Inflow Depth = 0.48" for 2-YEARS event
Inflow = 0.10 cfs @ 12.19 hrs, Volume= 565 cf
Primary = 0.10 cfs @ 12.19 hrs, Volume= 565 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA2E: POA-2



Time span=5.00-72.00 hrs, dt=0.05 hrs, 1341 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment ECA-1: ECA-1 Runoff Area=13,781 sf 0.00% Impervious Runoff Depth=0.28"
Flow Length=137' Tc=7.6 min CN=39 Runoff=0.02 cfs 320 cf

Subcatchment ECA-2: ECA-2 Runoff Area=13,990 sf 0.00% Impervious Runoff Depth=1.52"
Flow Length=136' Tc=9.5 min CN=60 Runoff=0.46 cfs 1,768 cf

Link POA1E: POA-1 Inflow=0.02 cfs 320 cf
Primary=0.02 cfs 320 cf

Link POA2E: POA-2 Inflow=0.46 cfs 1,768 cf
Primary=0.46 cfs 1,768 cf

Summary for Subcatchment ECA-1: ECA-1

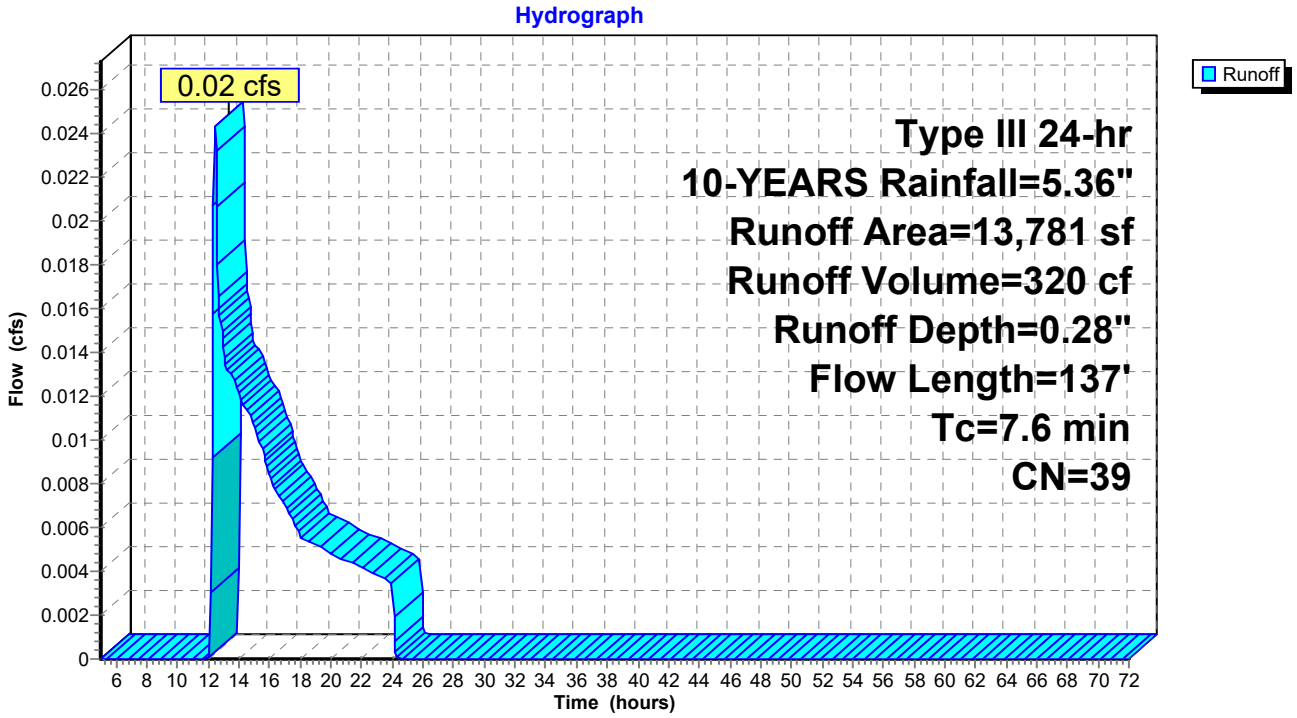
Runoff = 0.02 cfs @ 12.44 hrs, Volume= 320 cf, Depth= 0.28"
Routed to Link POA1E : POA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YEARS Rainfall=5.36"

Area (sf)	CN	Description
13,781	39	>75% Grass cover, Good, HSG A
13,781		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.0400	0.14		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
1.6	87	0.0172	0.92		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
7.6	137	Total			

Subcatchment ECA-1: ECA-1



Summary for Subcatchment ECA-2: ECA-2

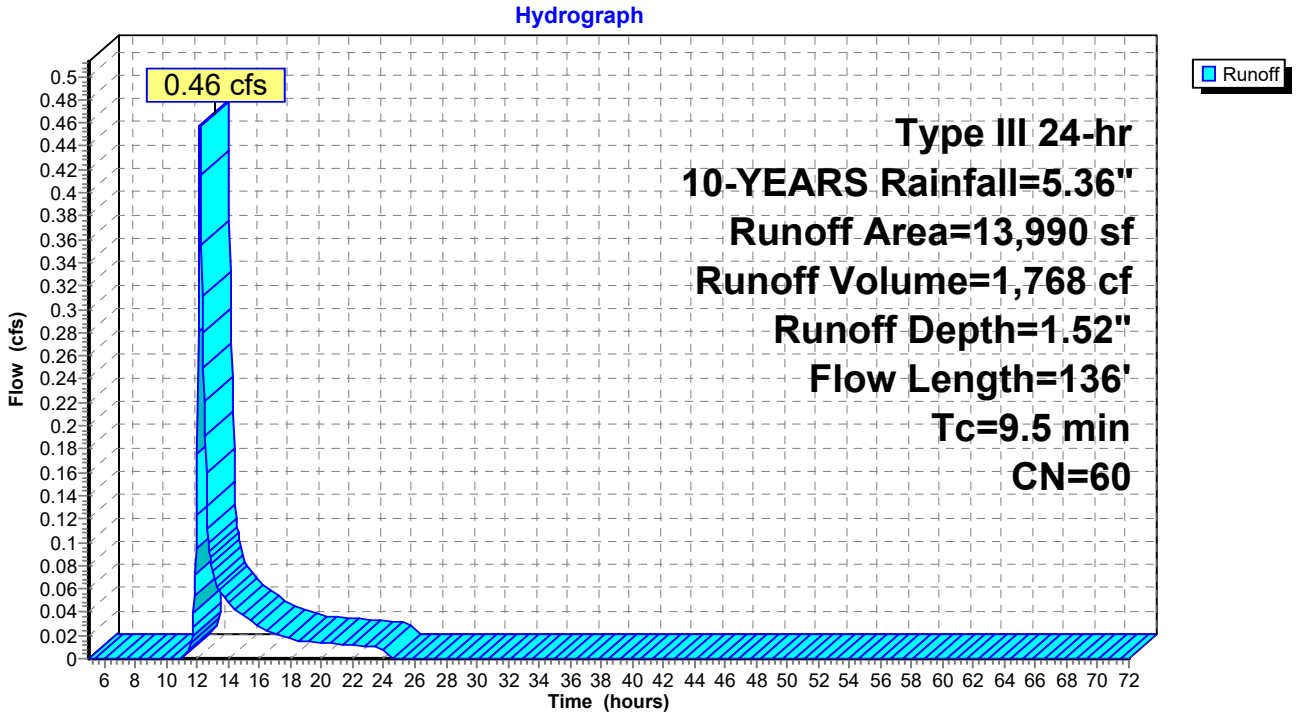
Runoff = 0.46 cfs @ 12.15 hrs, Volume= 1,768 cf, Depth= 1.52"
Routed to Link POA2E : POA-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YEARS Rainfall=5.36"

Area (sf)	CN	Description
8,754	39	>75% Grass cover, Good, HSG A
5,236	96	Gravel surface, HSG A
13,990	60	Weighted Average
13,990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0188	0.10		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
1.3	86	0.0263	1.14		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
9.5	136	Total			

Subcatchment ECA-2: ECA-2

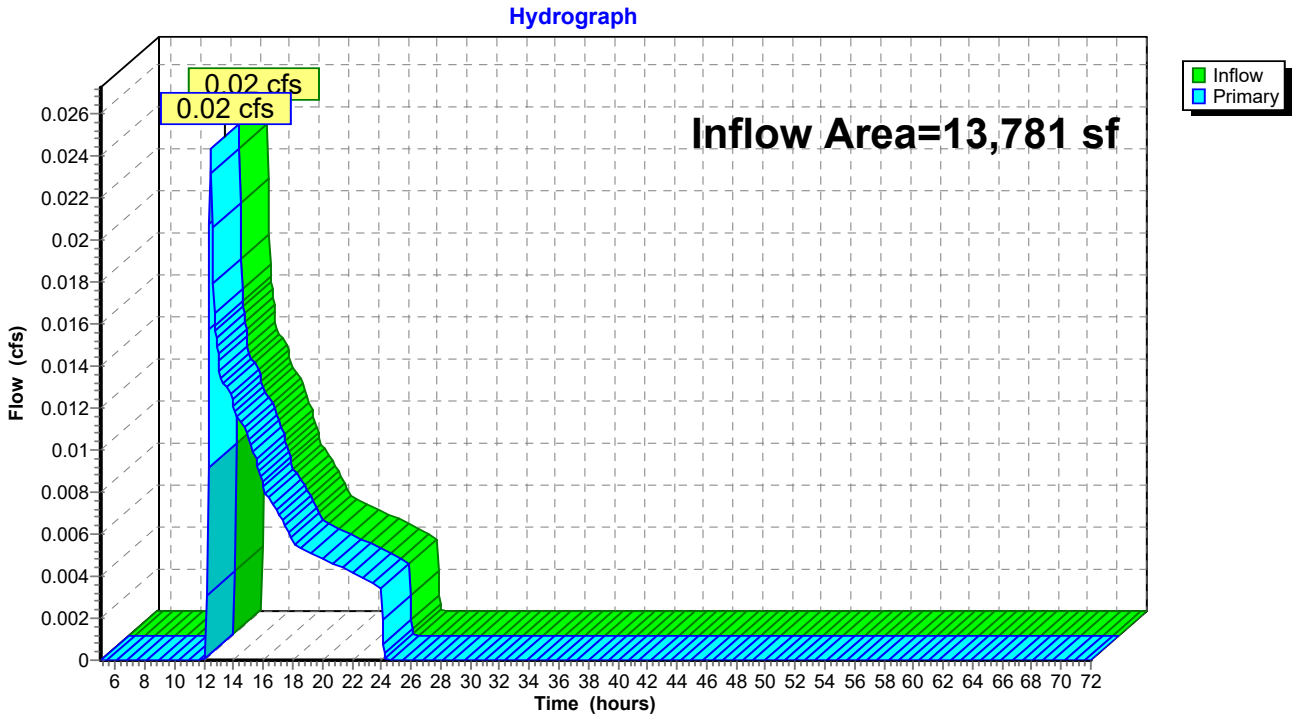


Summary for Link POA1E: POA-1

Inflow Area = 13,781 sf, 0.00% Impervious, Inflow Depth = 0.28" for 10-YEARS event
Inflow = 0.02 cfs @ 12.44 hrs, Volume= 320 cf
Primary = 0.02 cfs @ 12.44 hrs, Volume= 320 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA1E: POA-1

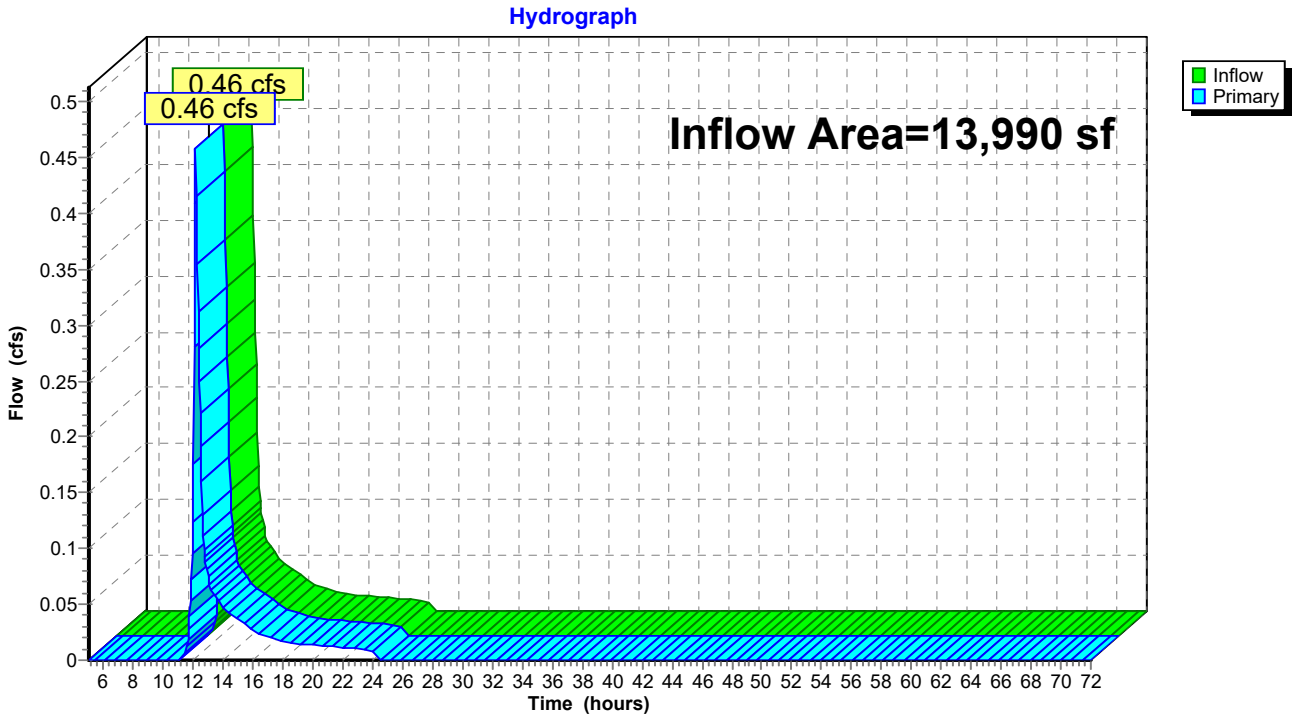


Summary for Link POA2E: POA-2

Inflow Area = 13,990 sf, 0.00% Impervious, Inflow Depth = 1.52" for 10-YEARS event
Inflow = 0.46 cfs @ 12.15 hrs, Volume= 1,768 cf
Primary = 0.46 cfs @ 12.15 hrs, Volume= 1,768 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA2E: POA-2



Time span=5.00-72.00 hrs, dt=0.05 hrs, 1341 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment ECA-1: ECA-1 Runoff Area=13,781 sf 0.00% Impervious Runoff Depth=0.63"
Flow Length=137' Tc=7.6 min CN=39 Runoff=0.09 cfs 720 cf

Subcatchment ECA-2: ECA-2 Runoff Area=13,990 sf 0.00% Impervious Runoff Depth=2.32"
Flow Length=136' Tc=9.5 min CN=60 Runoff=0.73 cfs 2,702 cf

Link POA1E: POA-1 Inflow=0.09 cfs 720 cf
Primary=0.09 cfs 720 cf

Link POA2E: POA-2 Inflow=0.73 cfs 2,702 cf
Primary=0.73 cfs 2,702 cf

Summary for Subcatchment ECA-1: ECA-1

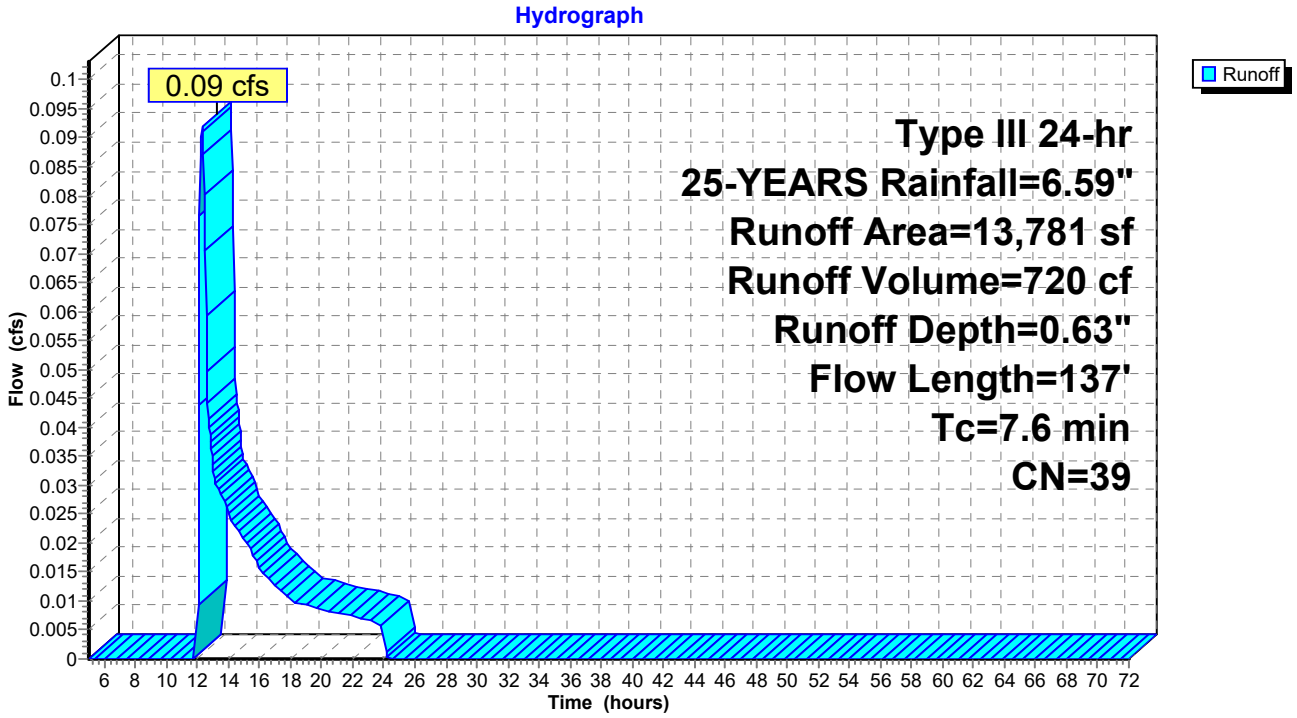
Runoff = 0.09 cfs @ 12.31 hrs, Volume= 720 cf, Depth= 0.63"
Routed to Link POA1E : POA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEARS Rainfall=6.59"

Area (sf)	CN	Description
13,781	39	>75% Grass cover, Good, HSG A
13,781		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.0400	0.14		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
1.6	87	0.0172	0.92		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
7.6	137	Total			

Subcatchment ECA-1: ECA-1



Summary for Subcatchment ECA-2: ECA-2

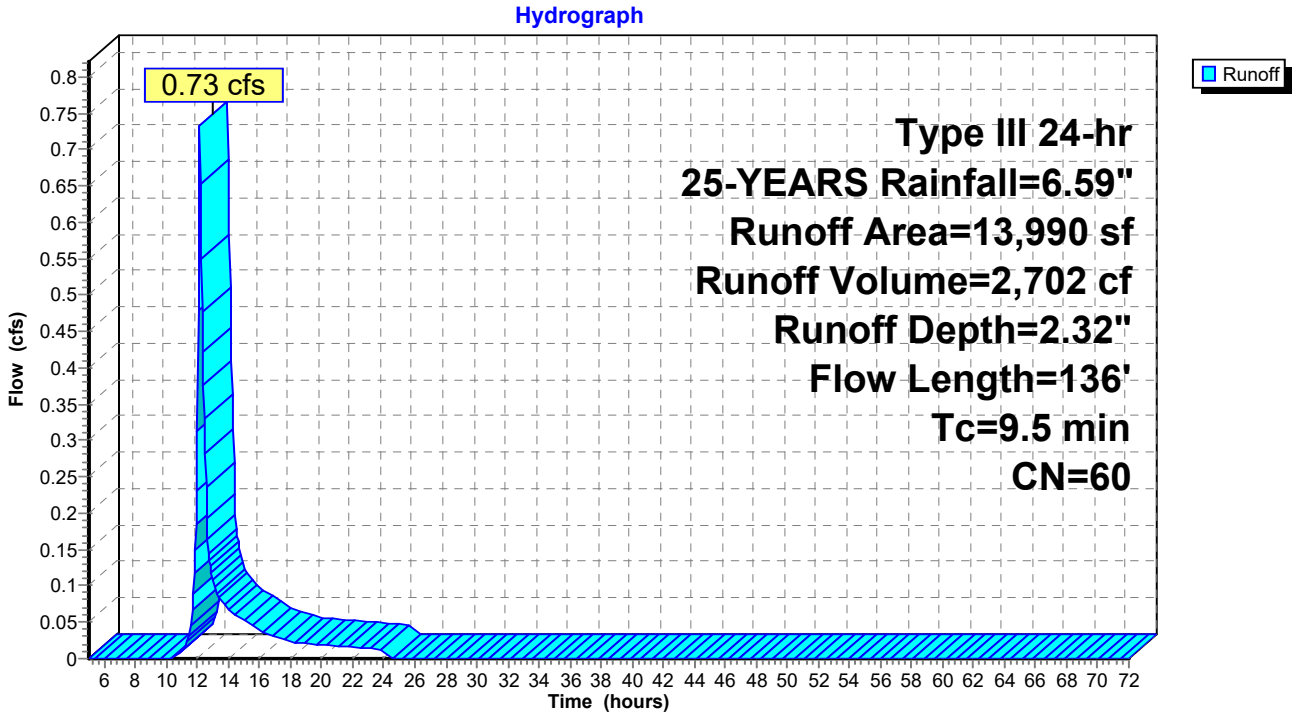
Runoff = 0.73 cfs @ 12.15 hrs, Volume= 2,702 cf, Depth= 2.32"
Routed to Link POA2E : POA-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEARS Rainfall=6.59"

Area (sf)	CN	Description
8,754	39	>75% Grass cover, Good, HSG A
5,236	96	Gravel surface, HSG A
13,990	60	Weighted Average
13,990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0188	0.10		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
1.3	86	0.0263	1.14		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
9.5	136	Total			

Subcatchment ECA-2: ECA-2

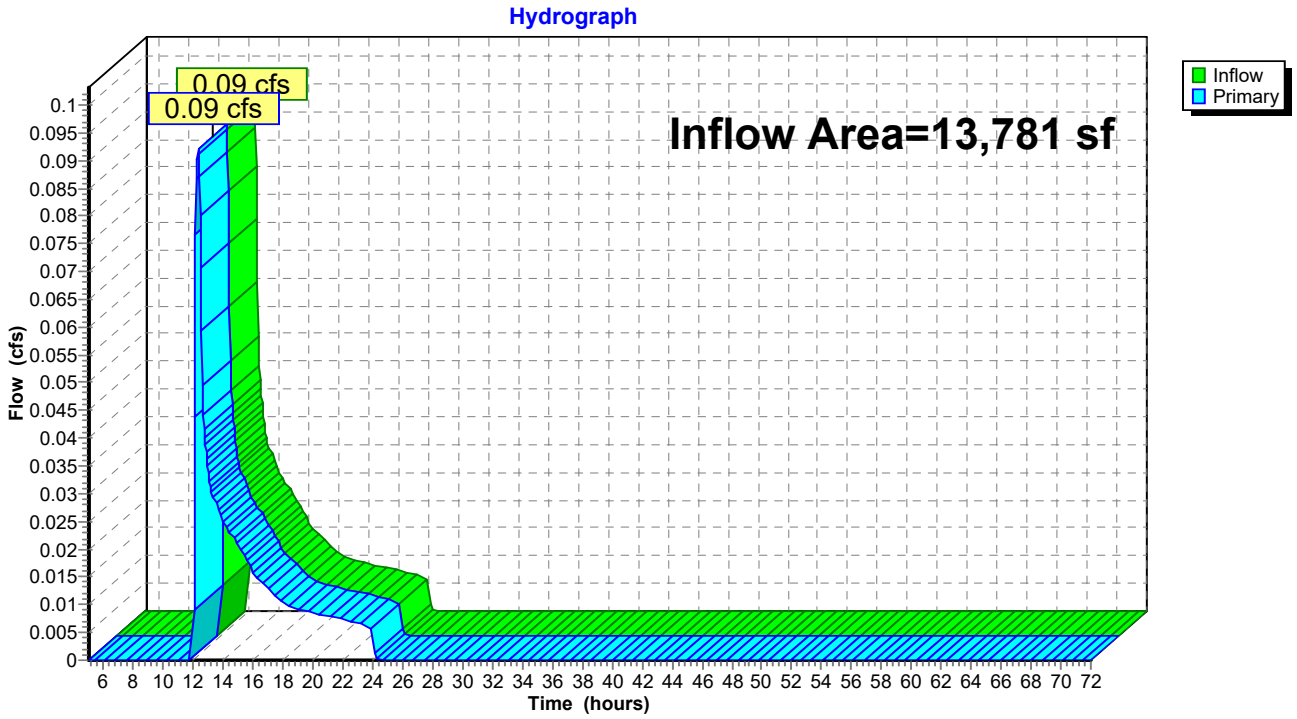


Summary for Link POA1E: POA-1

Inflow Area = 13,781 sf, 0.00% Impervious, Inflow Depth = 0.63" for 25-YEARS event
Inflow = 0.09 cfs @ 12.31 hrs, Volume= 720 cf
Primary = 0.09 cfs @ 12.31 hrs, Volume= 720 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA1E: POA-1

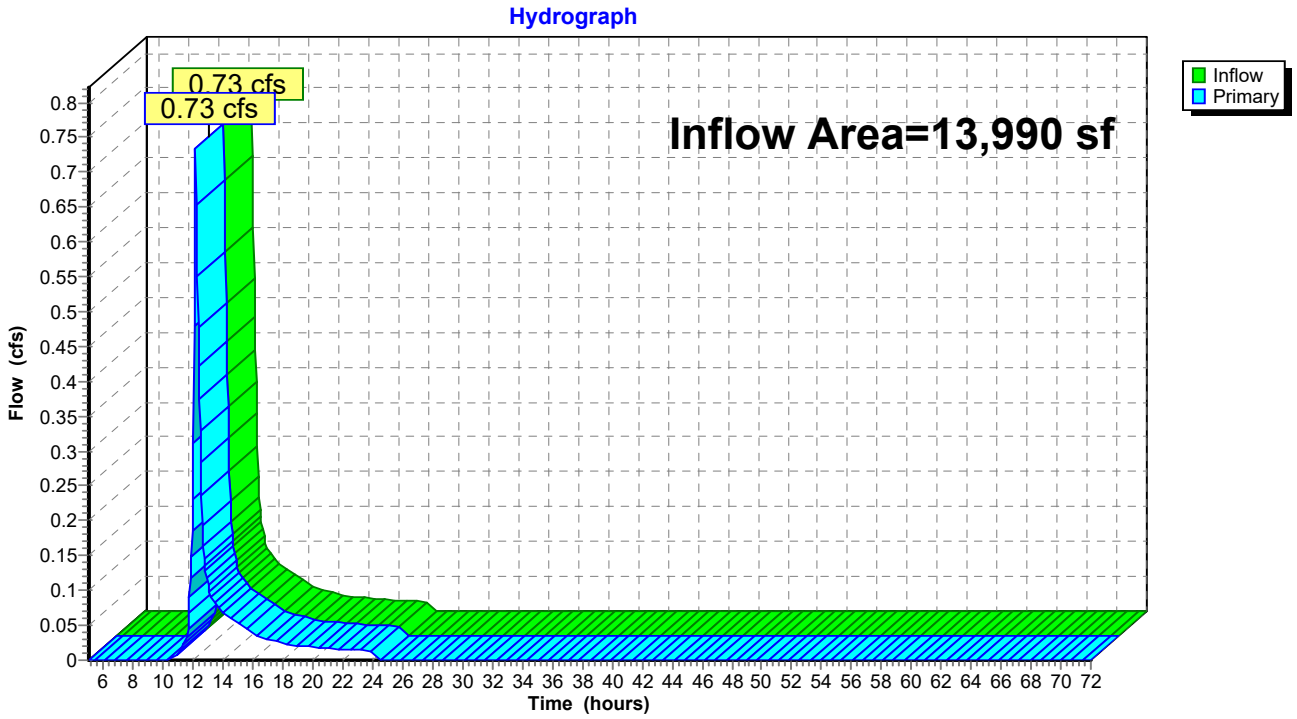


Summary for Link POA2E: POA-2

Inflow Area = 13,990 sf, 0.00% Impervious, Inflow Depth = 2.32" for 25-YEARS event
Inflow = 0.73 cfs @ 12.15 hrs, Volume= 2,702 cf
Primary = 0.73 cfs @ 12.15 hrs, Volume= 2,702 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA2E: POA-2



Time span=5.00-72.00 hrs, dt=0.05 hrs, 1341 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment ECA-1: ECA-1 Runoff Area=13,781 sf 0.00% Impervious Runoff Depth=1.37"
Flow Length=137' Tc=7.6 min CN=39 Runoff=0.33 cfs 1,572 cf

Subcatchment ECA-2: ECA-2 Runoff Area=13,990 sf 0.00% Impervious Runoff Depth=3.71"
Flow Length=136' Tc=9.5 min CN=60 Runoff=1.21 cfs 4,320 cf

Link POA1E: POA-1 Inflow=0.33 cfs 1,572 cf
Primary=0.33 cfs 1,572 cf

Link POA2E: POA-2 Inflow=1.21 cfs 4,320 cf
Primary=1.21 cfs 4,320 cf

Summary for Subcatchment ECA-1: ECA-1

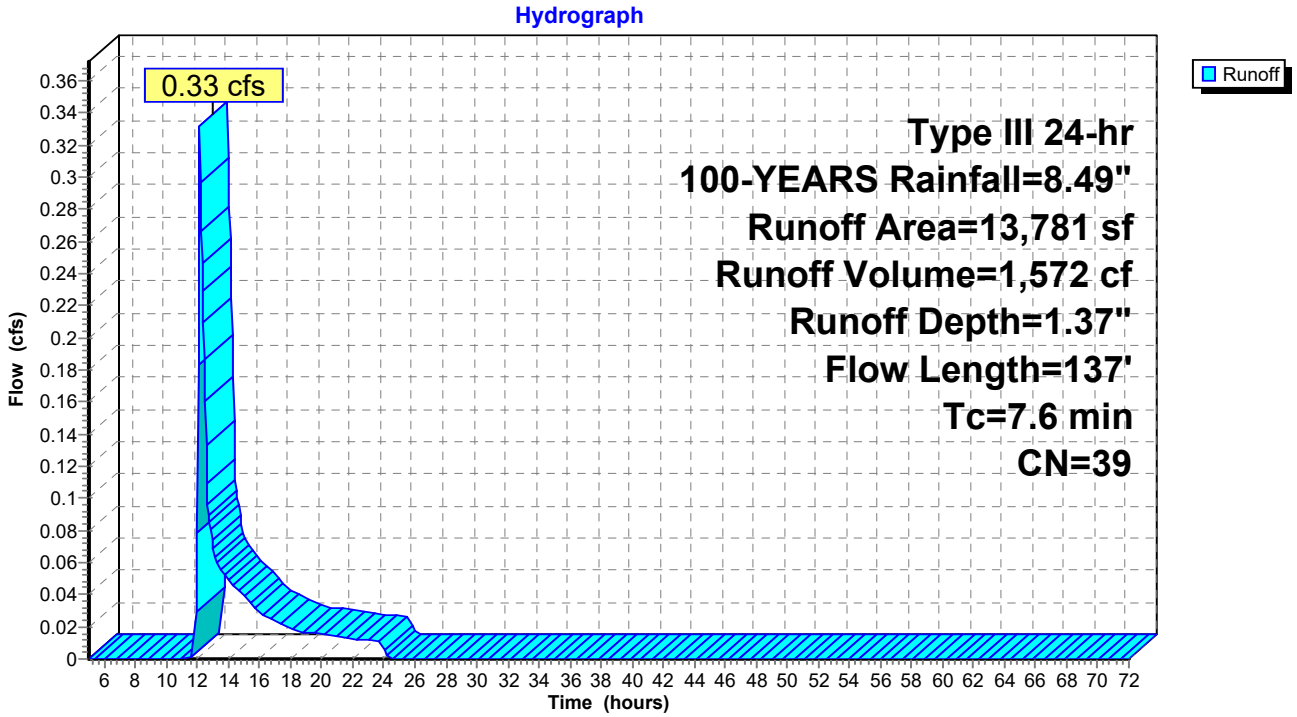
Runoff = 0.33 cfs @ 12.15 hrs, Volume= 1,572 cf, Depth= 1.37"
Routed to Link POA1E : POA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YEARS Rainfall=8.49"

Area (sf)	CN	Description
13,781	39	>75% Grass cover, Good, HSG A
13,781		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	50	0.0400	0.14		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
1.6	87	0.0172	0.92		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
7.6	137	Total			

Subcatchment ECA-1: ECA-1



Summary for Subcatchment ECA-2: ECA-2

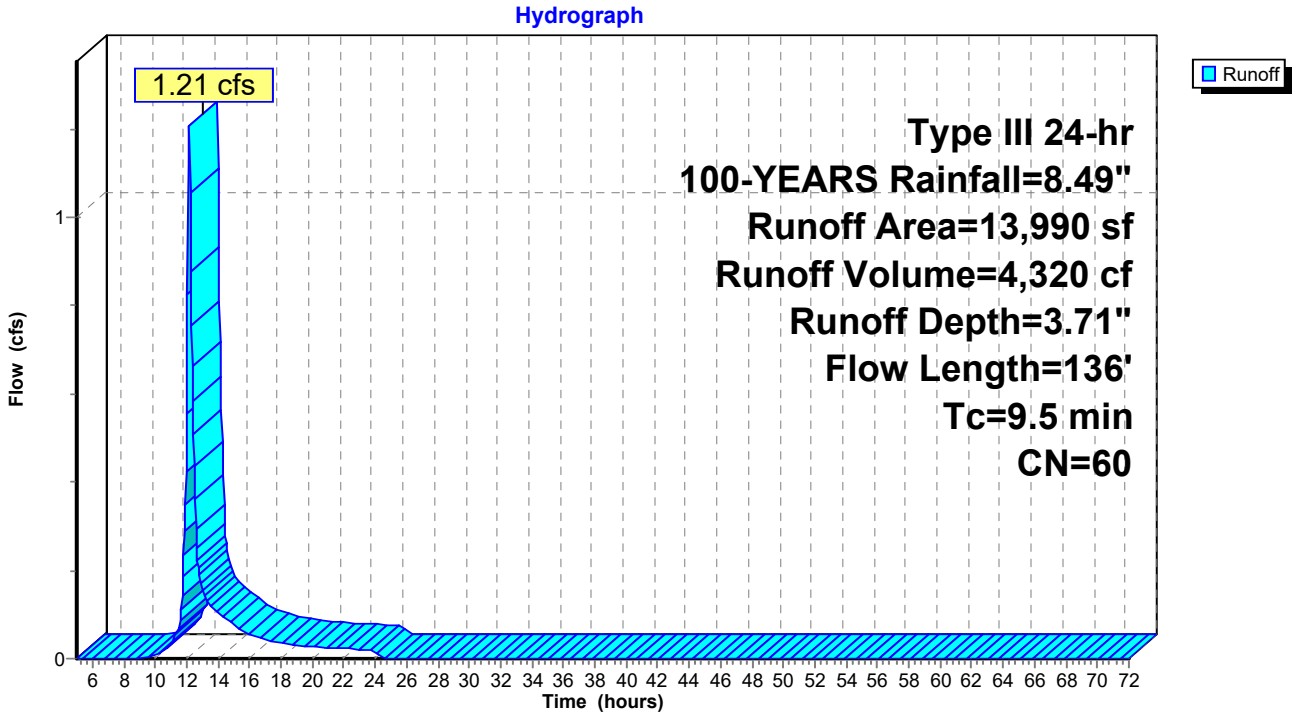
Runoff = 1.21 cfs @ 12.14 hrs, Volume= 4,320 cf, Depth= 3.71"
Routed to Link POA2E : POA-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YEARS Rainfall=8.49"

Area (sf)	CN	Description
8,754	39	>75% Grass cover, Good, HSG A
5,236	96	Gravel surface, HSG A
13,990	60	Weighted Average
13,990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0188	0.10		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
1.3	86	0.0263	1.14		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
9.5	136	Total			

Subcatchment ECA-2: ECA-2

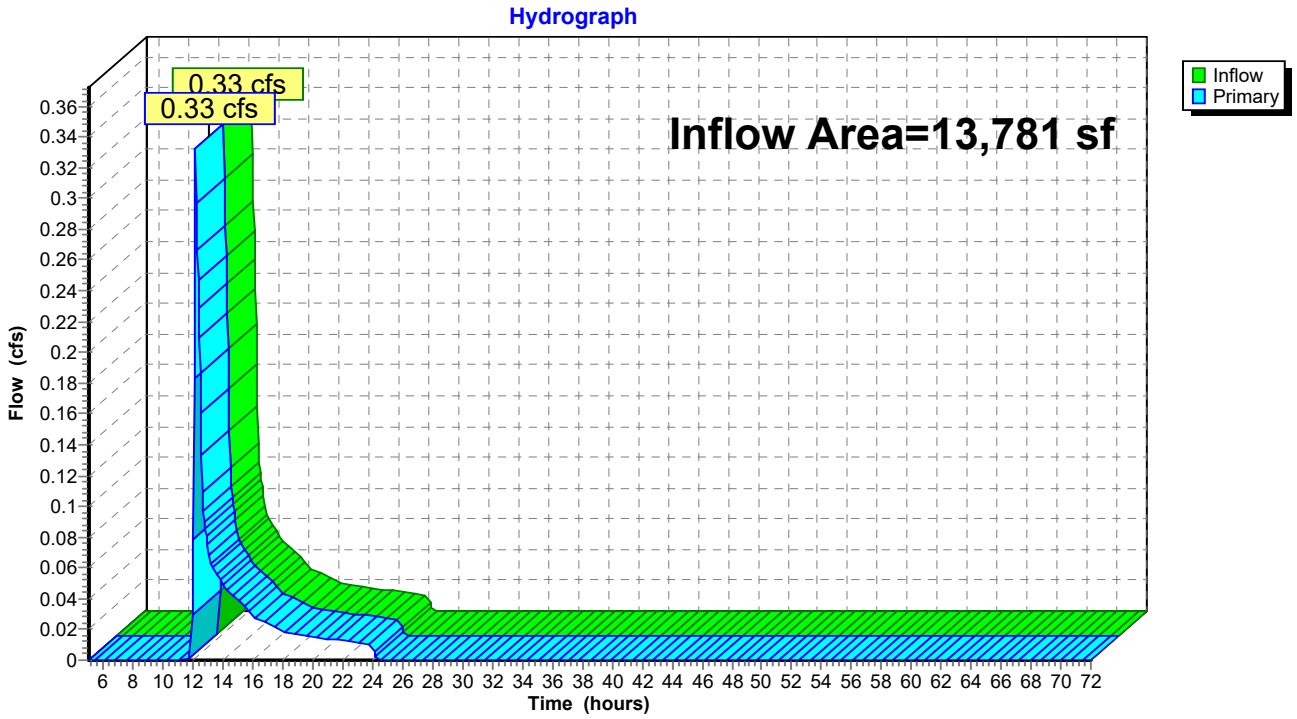


Summary for Link POA1E: POA-1

Inflow Area = 13,781 sf, 0.00% Impervious, Inflow Depth = 1.37" for 100-YEARS event
Inflow = 0.33 cfs @ 12.15 hrs, Volume= 1,572 cf
Primary = 0.33 cfs @ 12.15 hrs, Volume= 1,572 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA1E: POA-1

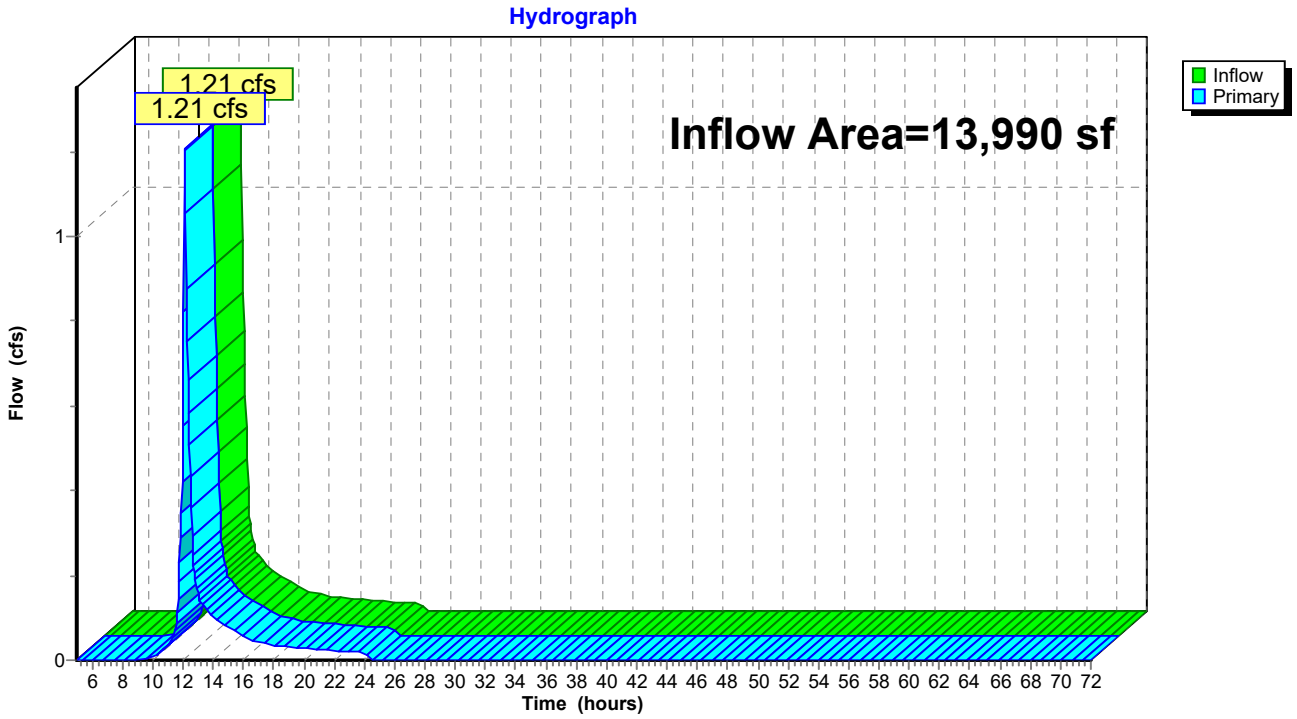


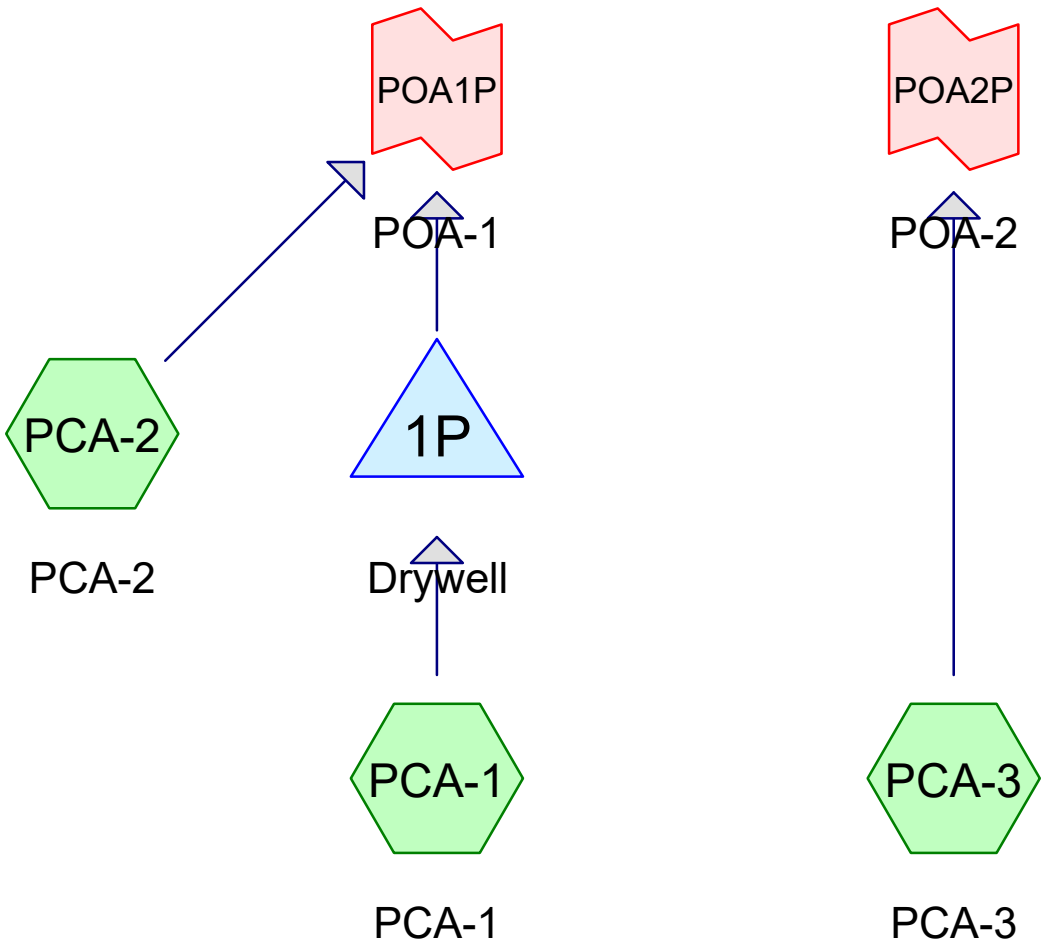
Summary for Link POA2E: POA-2

Inflow Area = 13,990 sf, 0.00% Impervious, Inflow Depth = 3.71" for 100-YEARS event
Inflow = 1.21 cfs @ 12.14 hrs, Volume= 4,320 cf
Primary = 1.21 cfs @ 12.14 hrs, Volume= 4,320 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA2E: POA-2





Proposed Conditions

Subcat Reach Pond Link

Routing Diagram for 2025-10-16_Temp Substation_Proposed_Final_REV
Prepared by Simpson, Gumpertz & Heger, Printed 10/20/2025

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-YEARS	Type III 24-hr		Default	24.00	1	3.39	2
2	10-YEARS	Type III 24-hr		Default	24.00	1	5.36	2
3	25-YEARS	Type III 24-hr		Default	24.00	1	6.59	2
4	100-YEARS	Type III 24-hr		Default	24.00	1	8.49	2

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
4,584	39	>75% Grass cover, Good, HSG A (PCA-1, PCA-2)
9,497	77	Crushed Stone, bare soil, HSG A (PCA-1, PCA-3)
830	98	Equipment and Containment, HSG A (PCA-1)
4,242	96	Gravel surface, HSG A (PCA-3)
8,097	39	Pasture/grassland/range, Good, HSG A (PCA-3)
521	98	Utility Covers, HSG A (PCA-1, PCA-3)

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
4,584	0	0	0	0	4,584	>75% Grass cover, Good
9,497	0	0	0	0	9,497	Crushed Stone, bare soil
830	0	0	0	0	830	Equipment and Containment
4,242	0	0	0	0	4,242	Gravel surface
8,097	0	0	0	0	8,097	Pasture/grassland/range, Good
521	0	0	0	0	521	Utility Covers

Time span=5.00-72.00 hrs, dt=0.05 hrs, 1341 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PCA-1: PCA-1 Runoff Area=12,729 sf 9.36% Impervious Runoff Depth=0.94"
Flow Length=100' Tc=6.0 min CN=70 Runoff=0.29 cfs 998 cf

Subcatchment PCA-2: PCA-2 Runoff Area=1,660 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=105' Tc=6.0 min CN=39 Runoff=0.00 cfs 1 cf

Subcatchment PCA-3: PCA-3 Runoff Area=13,382 sf 1.20% Impervious Runoff Depth=0.48"
Flow Length=134' Tc=9.7 min CN=60 Runoff=0.10 cfs 541 cf

Pond 1P: Drywell Peak Elev=11.16' Storage=763 cf Inflow=0.29 cfs 998 cf
Discarded=0.01 cfs 998 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 998 cf

Link POA1P: POA-1 Inflow=0.00 cfs 1 cf
Primary=0.00 cfs 1 cf

Link POA2P: POA-2 Inflow=0.10 cfs 541 cf
Primary=0.10 cfs 541 cf

Summary for Subcatchment PCA-1: PCA-1

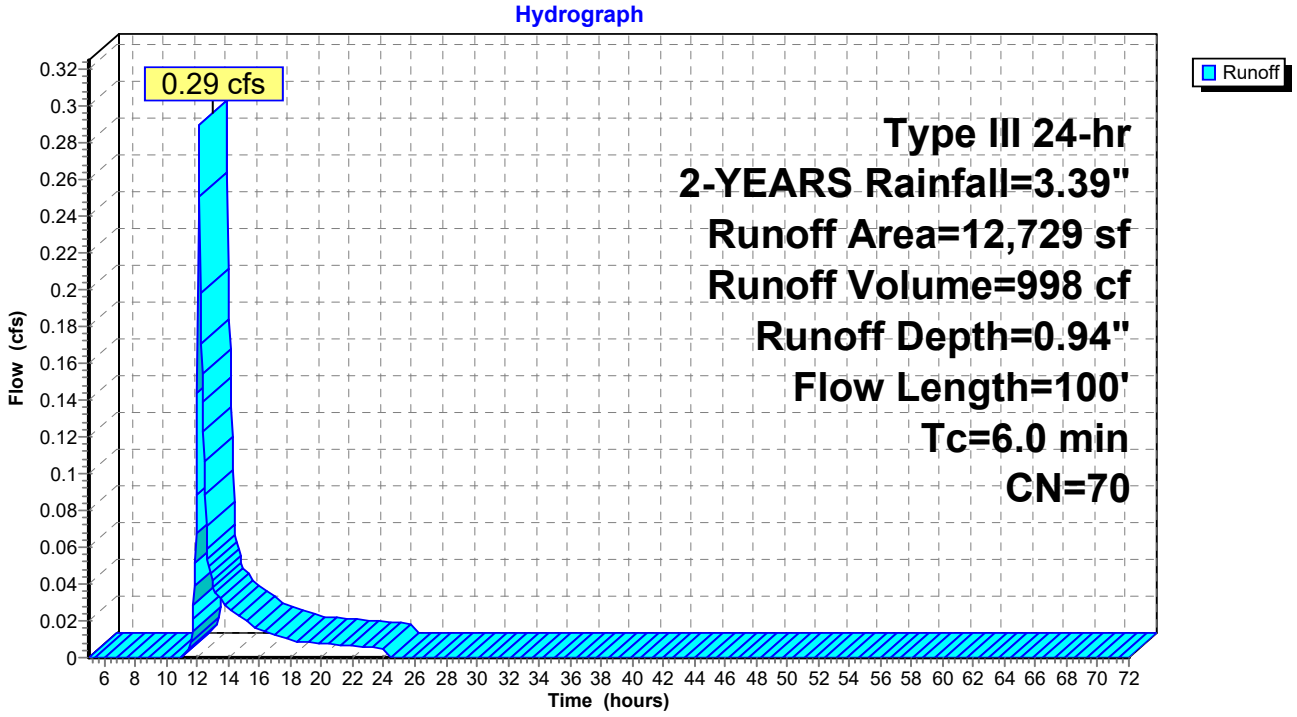
Runoff = 0.29 cfs @ 12.10 hrs, Volume= 998 cf, Depth= 0.94"
Routed to Pond 1P : Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YEARS Rainfall=3.39"

	Area (sf)	CN	Description
*	8,614	77	Crushed Stone, bare soil, HSG A
	2,924	39	>75% Grass cover, Good, HSG A
*	361	98	Utility Covers, HSG A
*	830	98	Equipment and Containment, HSG A
	12,729	70	Weighted Average
	11,538		90.64% Pervious Area
	1,191		9.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	50	0.0450	0.51		**Sheet Flow, SF** Fallow n= 0.050 P2= 3.39"
0.7	50	0.0150	1.22		**Shallow Concentrated Flow, CF** Nearly Bare & Untilled Kv= 10.0 fps
3.7					**Direct Entry, Direct**
6.0	100	Total			

Subcatchment PCA-1: PCA-1



Summary for Subcatchment PCA-2: PCA-2

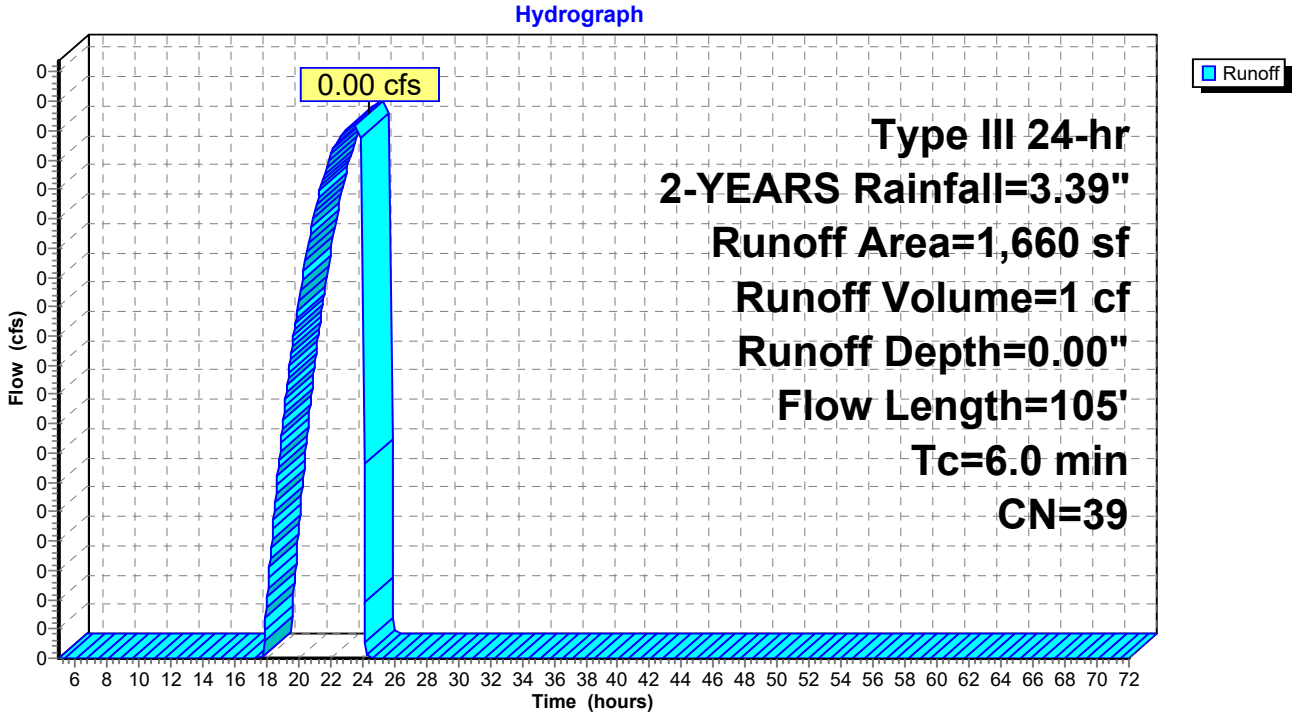
Runoff = 0.00 cfs @ 23.55 hrs, Volume= 1 cf, Depth= 0.00"
Routed to Link POA1P : POA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YEARS Rainfall=3.39"

Area (sf)	CN	Description
1,660	39	>75% Grass cover, Good, HSG A
1,660		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	10	0.0150	0.07		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
3.2	95	0.0050	0.49		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
0.3					**Direct Entry, Direct Entry**
6.0	105	Total			

Subcatchment PCA-2: PCA-2



Summary for Subcatchment PCA-3: PCA-3

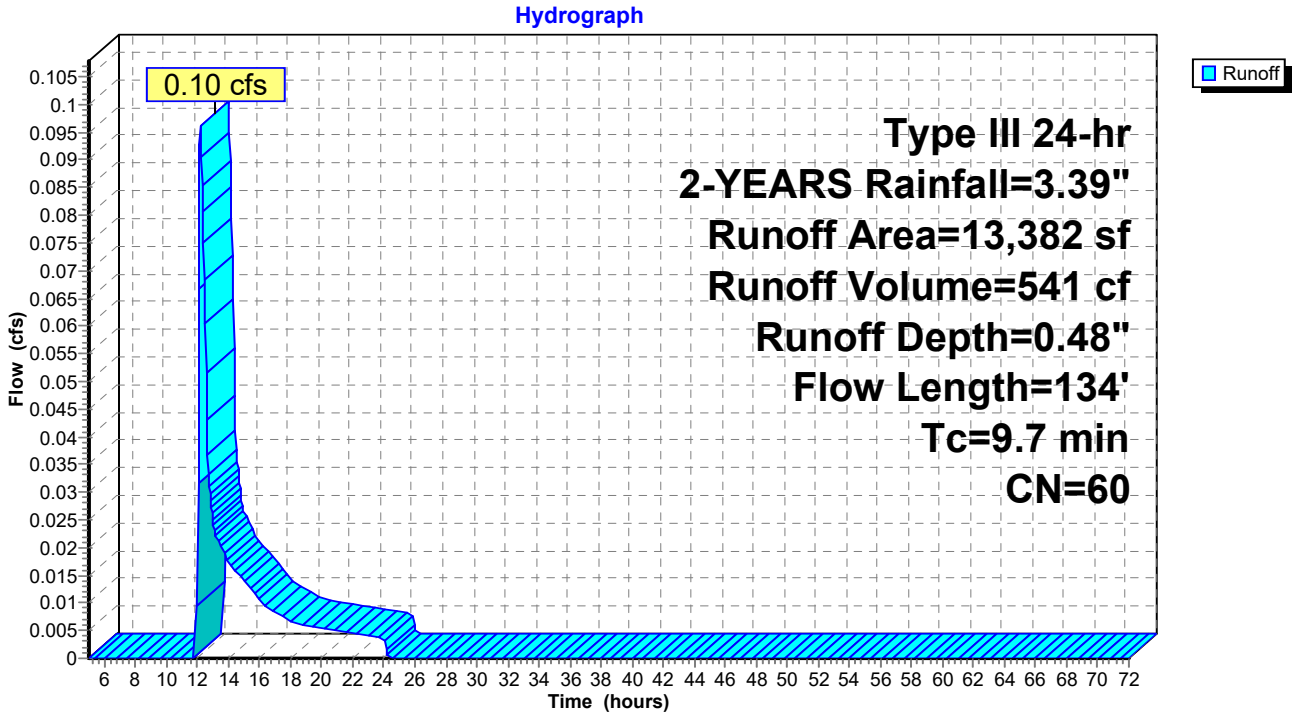
Runoff = 0.10 cfs @ 12.19 hrs, Volume= 541 cf, Depth= 0.48"
Routed to Link POA2P : POA-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YEARS Rainfall=3.39"

	Area (sf)	CN	Description
	4,242	96	Gravel surface, HSG A
*	160	98	Utility Covers, HSG A
*	883	77	Crushed Stone, bare soil, HSG A
	8,097	39	Pasture/grassland/range, Good, HSG A
	13,382	60	Weighted Average
	13,222		98.80% Pervious Area
	160		1.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0188	0.10		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
0.4	21	0.0188	0.96		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
0.3	20	0.0150	1.22		**Shallow Concentrated Flow, CF** Nearly Bare & Untilled Kv= 10.0 fps
0.8	43	0.0160	0.89		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
9.7	134	Total			

Subcatchment PCA-3: PCA-3



Summary for Pond 1P: Drywell

Inflow Area = 12,729 sf, 9.36% Impervious, Inflow Depth = 0.94" for 2-YEARS event
Inflow = 0.29 cfs @ 12.10 hrs, Volume= 998 cf
Outflow = 0.01 cfs @ 11.70 hrs, Volume= 998 cf, Atten= 98%, Lag= 0.0 min
Discarded = 0.01 cfs @ 11.70 hrs, Volume= 998 cf
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Routed to Link POA1P : POA-1

Routing by Stor-Ind method, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 11.16' @ 24.00 hrs Surf.Area= 500 sf Storage= 763 cf

Plug-Flow detention time= 1,416.9 min calculated for 997 cf (100% of inflow)
Center-of-Mass det. time= 1,417.7 min (2,289.2 - 871.5)

Volume	Invert	Avail.Storage	Storage Description
#1	7.35'	800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 2,000 cf Overall x 40.0% Voids

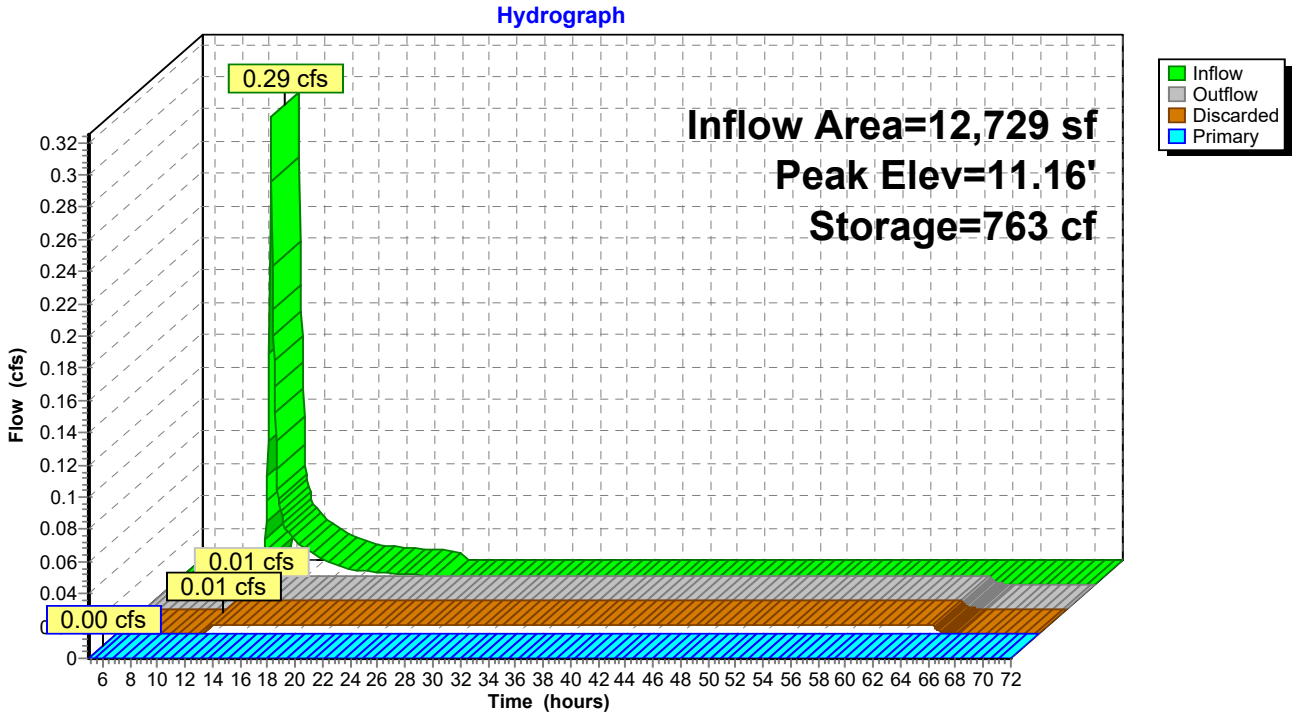
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.35	500	0	0
11.35	500	2,000	2,000

Device	Routing	Invert	Outlet Devices
#1	Primary	11.30'	**145.0' long + 0.3 '/' SideZ x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	7.35'	**0.450 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 11.70 hrs HW=7.39' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=7.35' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Drywell

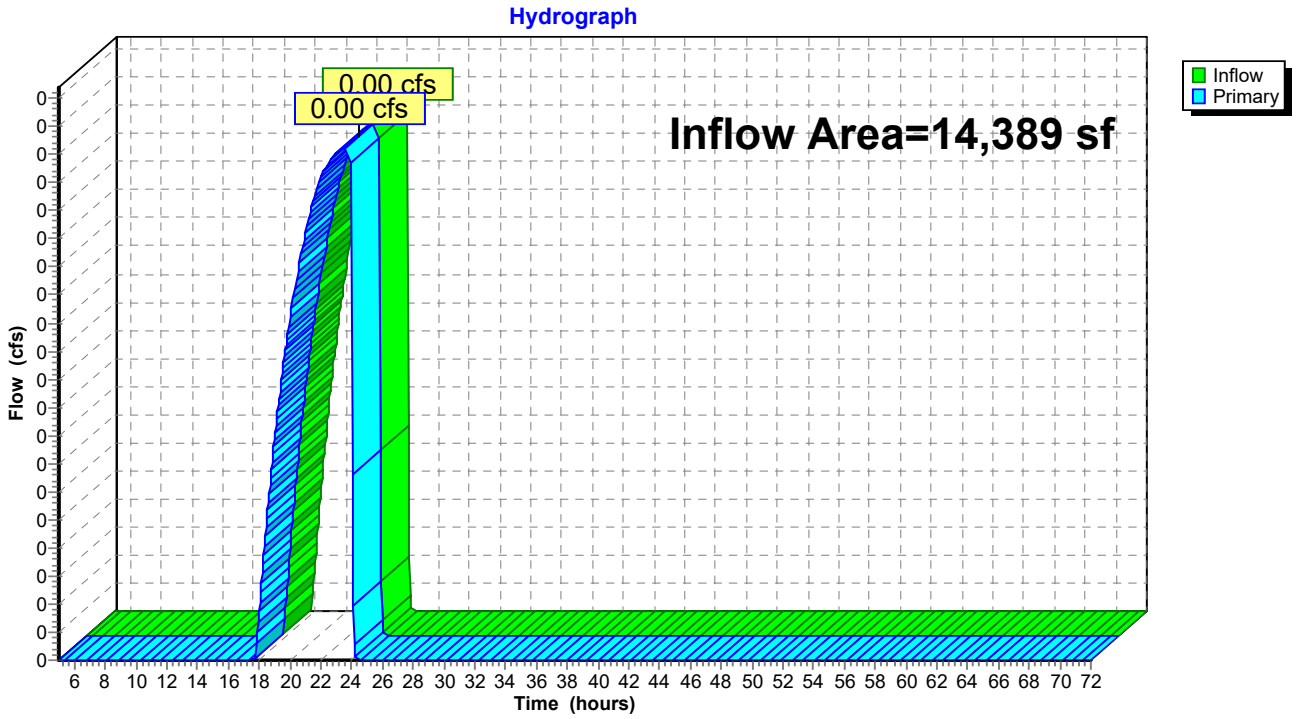


Summary for Link POA1P: POA-1

Inflow Area = 14,389 sf, 8.28% Impervious, Inflow Depth = 0.00" for 2-YEARS event
Inflow = 0.00 cfs @ 23.55 hrs, Volume= 1 cf
Primary = 0.00 cfs @ 23.55 hrs, Volume= 1 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA1P: POA-1

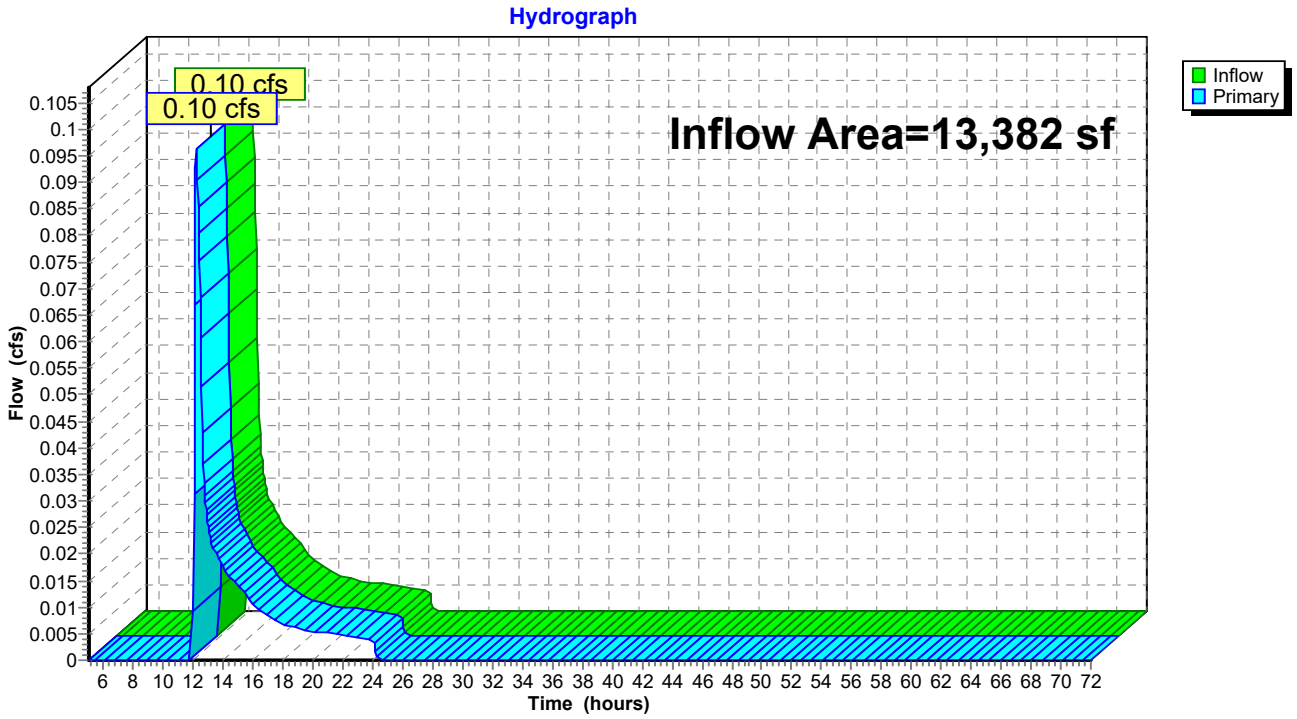


Summary for Link POA2P: POA-2

Inflow Area = 13,382 sf, 1.20% Impervious, Inflow Depth = 0.48" for 2-YEARS event
Inflow = 0.10 cfs @ 12.19 hrs, Volume= 541 cf
Primary = 0.10 cfs @ 12.19 hrs, Volume= 541 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA2P: POA-2



Time span=5.00-72.00 hrs, dt=0.05 hrs, 1341 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PCA-1: PCA-1 Runoff Area=12,729 sf 9.36% Impervious Runoff Depth=2.31"
Flow Length=100' Tc=6.0 min CN=70 Runoff=0.77 cfs 2,447 cf

Subcatchment PCA-2: PCA-2 Runoff Area=1,660 sf 0.00% Impervious Runoff Depth=0.28"
Flow Length=105' Tc=6.0 min CN=39 Runoff=0.00 cfs 39 cf

Subcatchment PCA-3: PCA-3 Runoff Area=13,382 sf 1.20% Impervious Runoff Depth=1.52"
Flow Length=134' Tc=9.7 min CN=60 Runoff=0.44 cfs 1,691 cf

Pond 1P: Drywell Peak Elev=11.31' Storage=791 cf Inflow=0.77 cfs 2,447 cf
Discarded=0.01 cfs 1,054 cf Primary=0.18 cfs 1,201 cf Outflow=0.19 cfs 2,255 cf

Link POA1P: POA-1 Inflow=0.19 cfs 1,240 cf
Primary=0.19 cfs 1,240 cf

Link POA2P: POA-2 Inflow=0.44 cfs 1,691 cf
Primary=0.44 cfs 1,691 cf

Summary for Subcatchment PCA-1: PCA-1

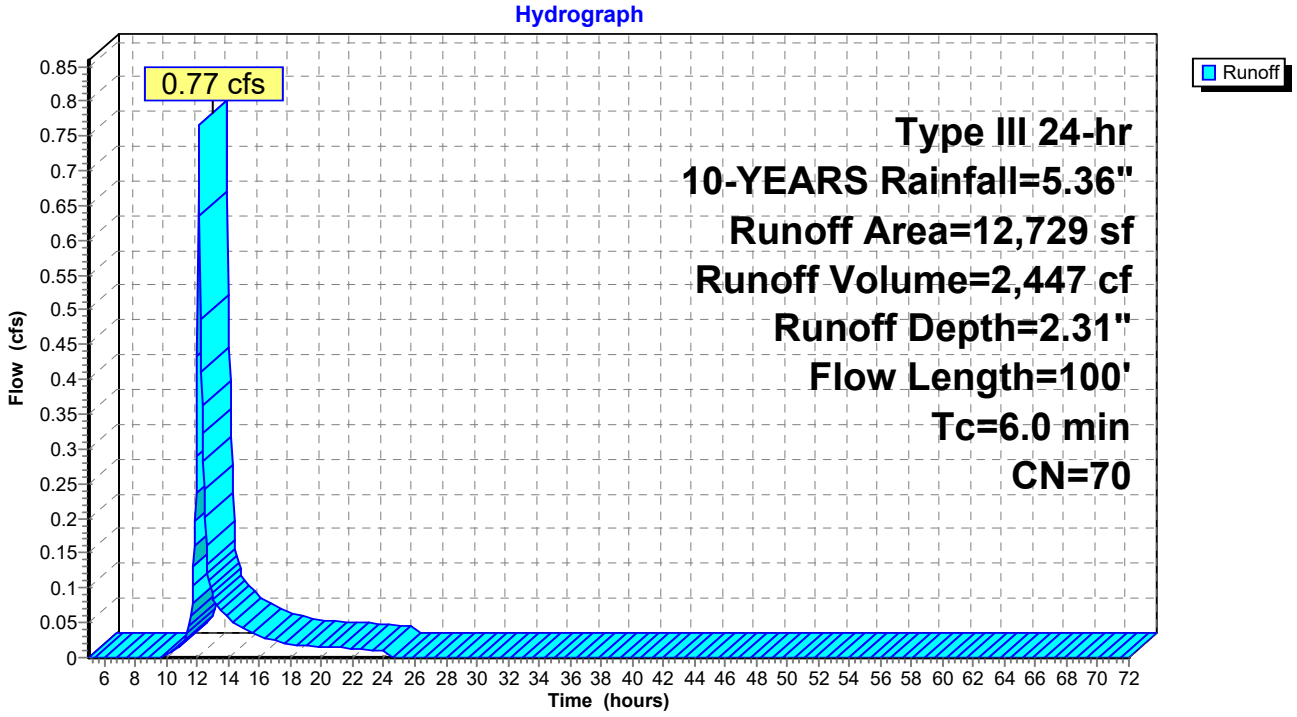
Runoff = 0.77 cfs @ 12.10 hrs, Volume= 2,447 cf, Depth= 2.31"
Routed to Pond 1P : Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YEARS Rainfall=5.36"

	Area (sf)	CN	Description
*	8,614	77	Crushed Stone, bare soil, HSG A
	2,924	39	>75% Grass cover, Good, HSG A
*	361	98	Utility Covers, HSG A
*	830	98	Equipment and Containment, HSG A
	12,729	70	Weighted Average
	11,538		90.64% Pervious Area
	1,191		9.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	50	0.0450	0.51		**Sheet Flow, SF** Fallow n= 0.050 P2= 3.39"
0.7	50	0.0150	1.22		**Shallow Concentrated Flow, CF** Nearly Bare & Untilled Kv= 10.0 fps
3.7					**Direct Entry, Direct**
6.0	100	Total			

Subcatchment PCA-1: PCA-1



Summary for Subcatchment PCA-2: PCA-2

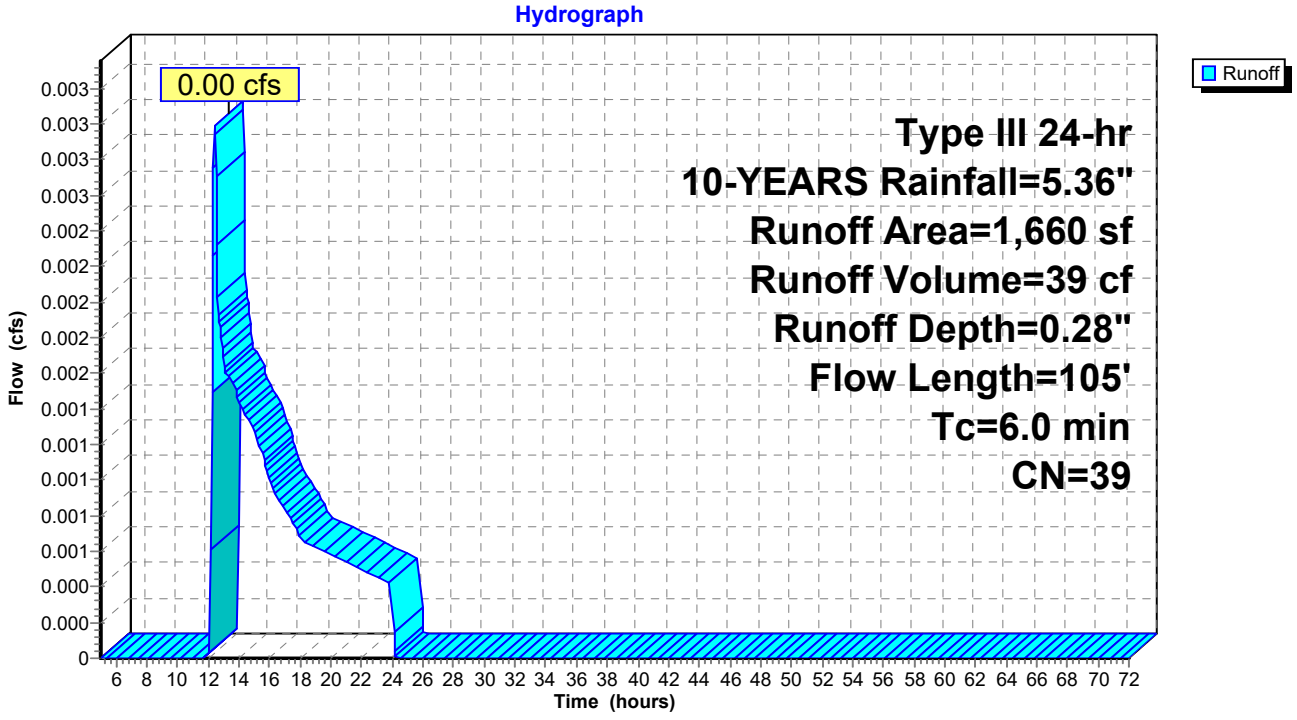
Runoff = 0.00 cfs @ 12.42 hrs, Volume= 39 cf, Depth= 0.28"
Routed to Link POA1P : POA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YEARS Rainfall=5.36"

Area (sf)	CN	Description
1,660	39	>75% Grass cover, Good, HSG A
1,660		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	10	0.0150	0.07		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
3.2	95	0.0050	0.49		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
0.3					**Direct Entry, Direct Entry**
6.0	105	Total			

Subcatchment PCA-2: PCA-2



Summary for Subcatchment PCA-3: PCA-3

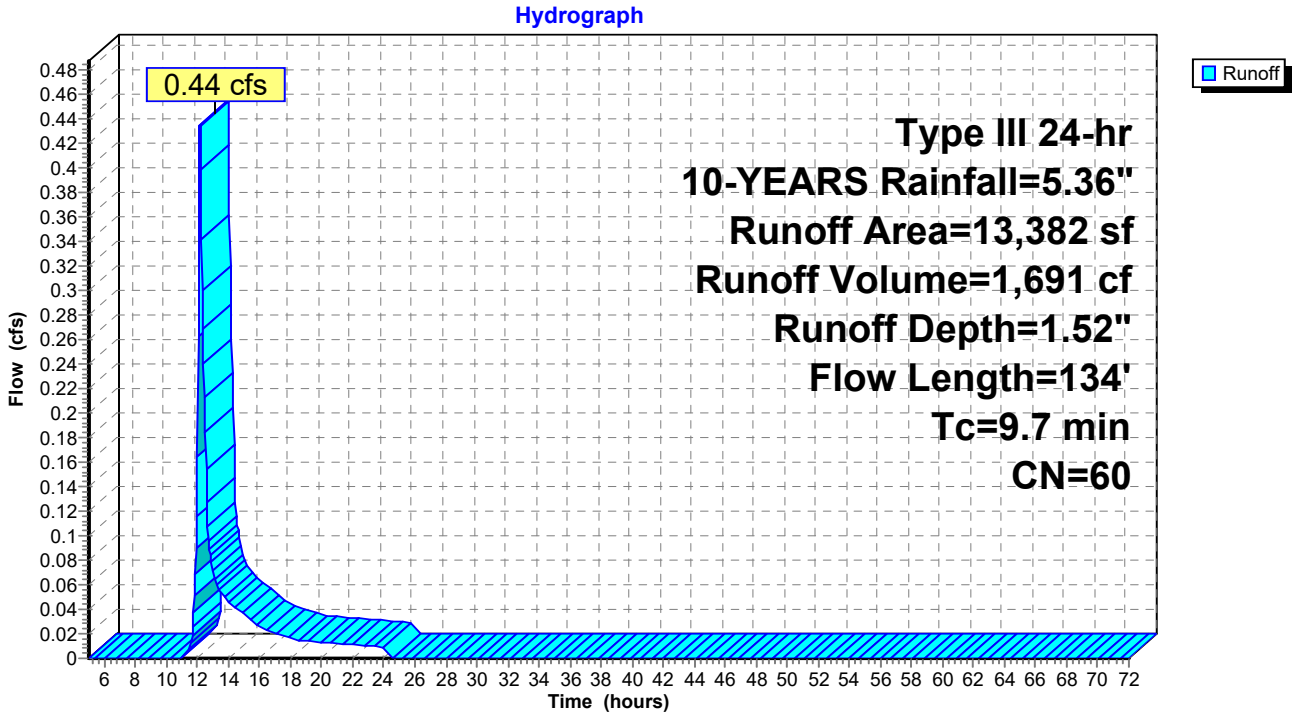
Runoff = 0.44 cfs @ 12.15 hrs, Volume= 1,691 cf, Depth= 1.52"
Routed to Link POA2P : POA-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YEARS Rainfall=5.36"

	Area (sf)	CN	Description
	4,242	96	Gravel surface, HSG A
*	160	98	Utility Covers, HSG A
*	883	77	Crushed Stone, bare soil, HSG A
	8,097	39	Pasture/grassland/range, Good, HSG A
	13,382	60	Weighted Average
	13,222		98.80% Pervious Area
	160		1.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0188	0.10		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
0.4	21	0.0188	0.96		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
0.3	20	0.0150	1.22		**Shallow Concentrated Flow, CF** Nearly Bare & Untilled Kv= 10.0 fps
0.8	43	0.0160	0.89		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
9.7	134	Total			

Subcatchment PCA-3: PCA-3



Summary for Pond 1P: Drywell

Inflow Area = 12,729 sf, 9.36% Impervious, Inflow Depth = 2.31" for 10-YEARS event
Inflow = 0.77 cfs @ 12.10 hrs, Volume= 2,447 cf
Outflow = 0.19 cfs @ 12.42 hrs, Volume= 2,255 cf, Atten= 75%, Lag= 19.6 min
Discarded = 0.01 cfs @ 10.45 hrs, Volume= 1,054 cf
Primary = 0.18 cfs @ 12.42 hrs, Volume= 1,201 cf
Routed to Link POA1P : POA-1

Routing by Stor-Ind method, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 11.31' @ 12.42 hrs Surf.Area= 500 sf Storage= 791 cf

Plug-Flow detention time= 747.2 min calculated for 2,253 cf (92% of inflow)
Center-of-Mass det. time= 708.7 min (1,552.7 - 844.0)

Volume	Invert	Avail.Storage	Storage Description
#1	7.35'	800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 2,000 cf Overall x 40.0% Voids

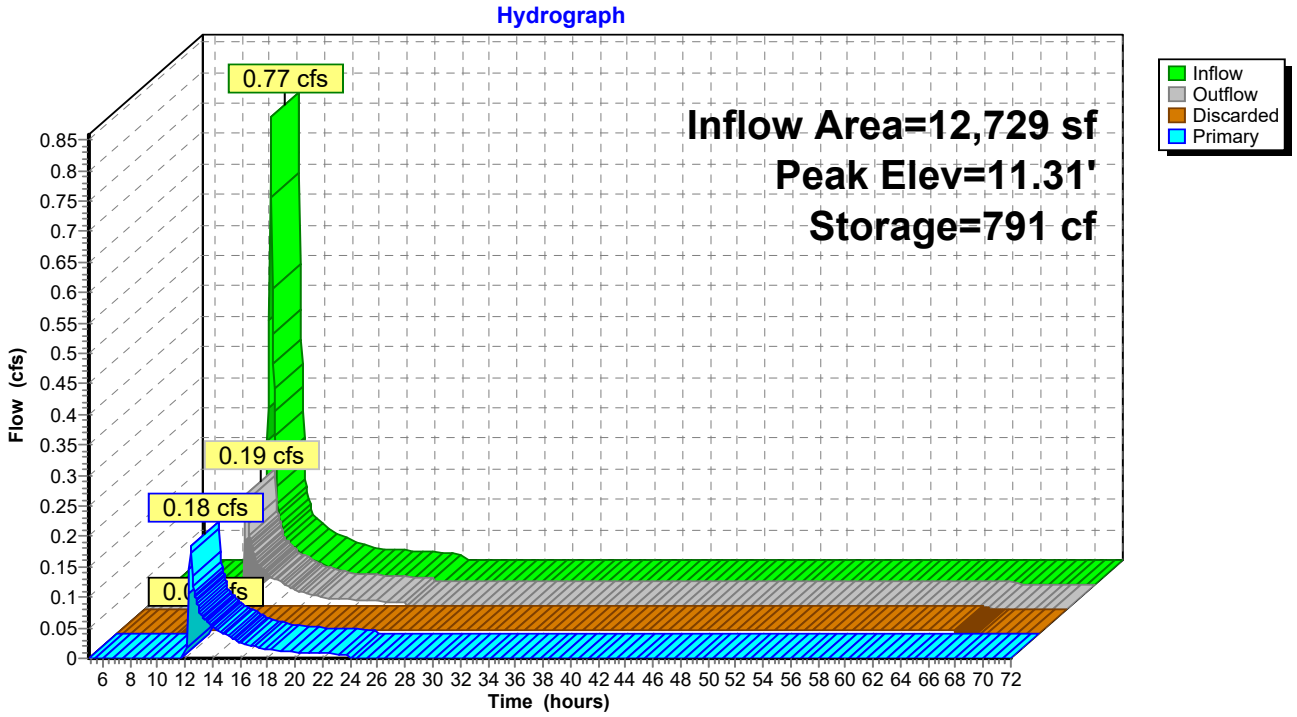
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.35	500	0	0
11.35	500	2,000	2,000

Device	Routing	Invert	Outlet Devices
#1	Primary	11.30'	**145.0' long + 0.3 '/' SideZ x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	7.35'	**0.450 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 10.45 hrs HW=7.39' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.13 cfs @ 12.42 hrs HW=11.31' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.13 cfs @ 0.17 fps)

Pond 1P: Drywell

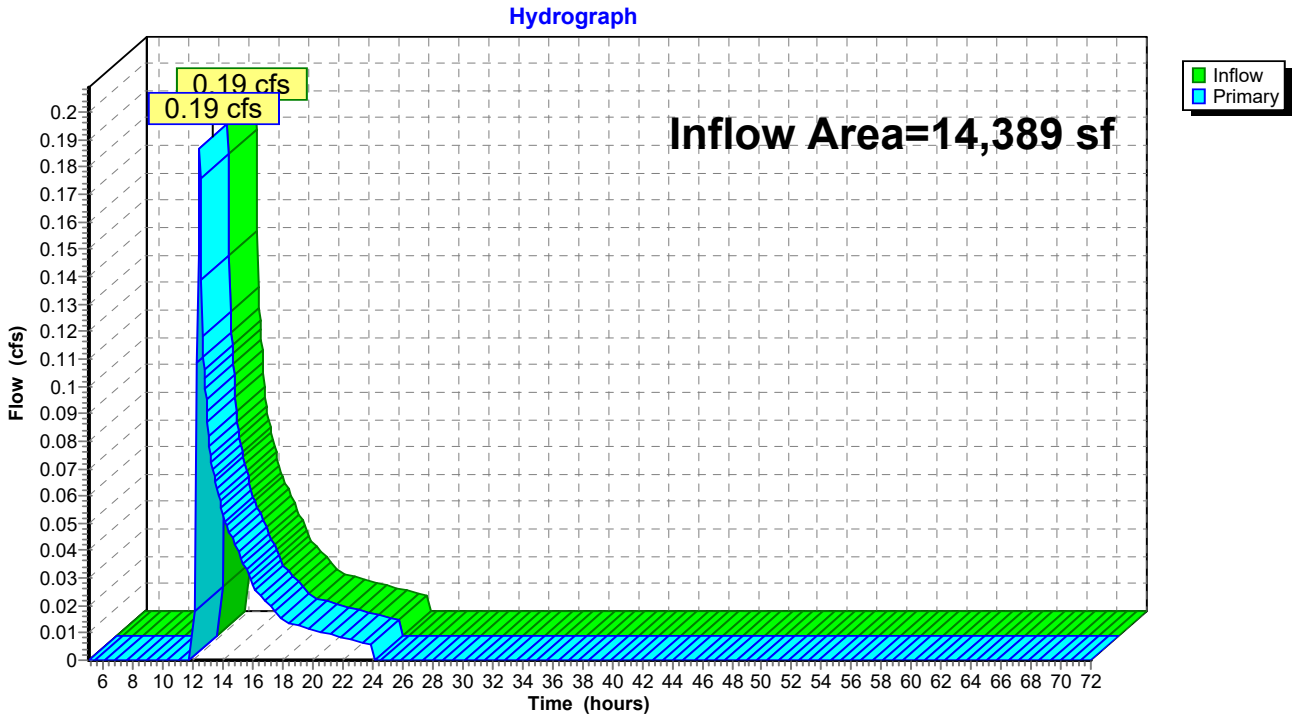


Summary for Link POA1P: POA-1

Inflow Area = 14,389 sf, 8.28% Impervious, Inflow Depth = 1.03" for 10-YEARS event
Inflow = 0.19 cfs @ 12.42 hrs, Volume= 1,240 cf
Primary = 0.19 cfs @ 12.42 hrs, Volume= 1,240 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA1P: POA-1

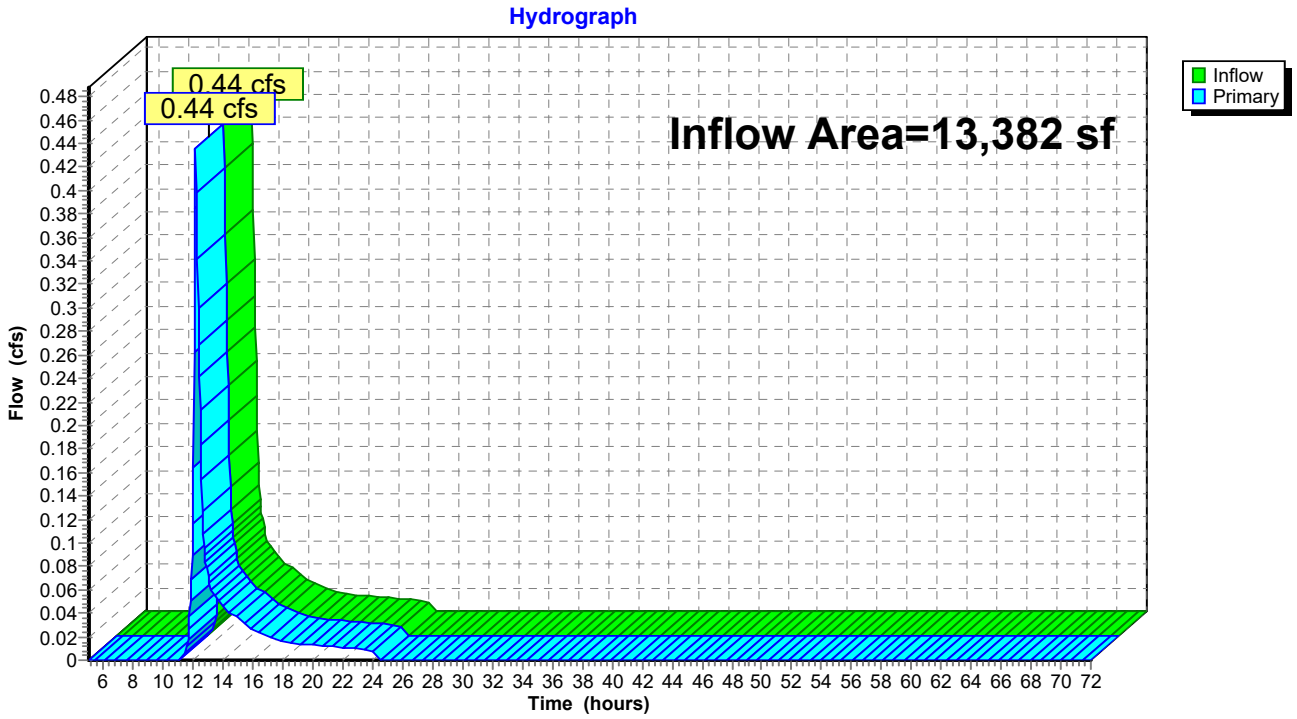


Summary for Link POA2P: POA-2

Inflow Area = 13,382 sf, 1.20% Impervious, Inflow Depth = 1.52" for 10-YEARS event
Inflow = 0.44 cfs @ 12.15 hrs, Volume= 1,691 cf
Primary = 0.44 cfs @ 12.15 hrs, Volume= 1,691 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA2P: POA-2



Time span=5.00-72.00 hrs, dt=0.05 hrs, 1341 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PCA-1: PCA-1 Runoff Area=12,729 sf 9.36% Impervious Runoff Depth=3.28"
Flow Length=100' Tc=6.0 min CN=70 Runoff=1.10 cfs 3,480 cf

Subcatchment PCA-2: PCA-2 Runoff Area=1,660 sf 0.00% Impervious Runoff Depth=0.63"
Flow Length=105' Tc=6.0 min CN=39 Runoff=0.01 cfs 87 cf

Subcatchment PCA-3: PCA-3 Runoff Area=13,382 sf 1.20% Impervious Runoff Depth=2.32"
Flow Length=134' Tc=9.7 min CN=60 Runoff=0.70 cfs 2,584 cf

Pond 1P: Drywell Peak Elev=11.32' Storage=794 cf Inflow=1.10 cfs 3,480 cf
Discarded=0.01 cfs 1,069 cf Primary=1.37 cfs 2,536 cf Outflow=1.38 cfs 3,604 cf

Link POA1P: POA-1 Inflow=1.38 cfs 2,622 cf
Primary=1.38 cfs 2,622 cf

Link POA2P: POA-2 Inflow=0.70 cfs 2,584 cf
Primary=0.70 cfs 2,584 cf

Summary for Subcatchment PCA-1: PCA-1

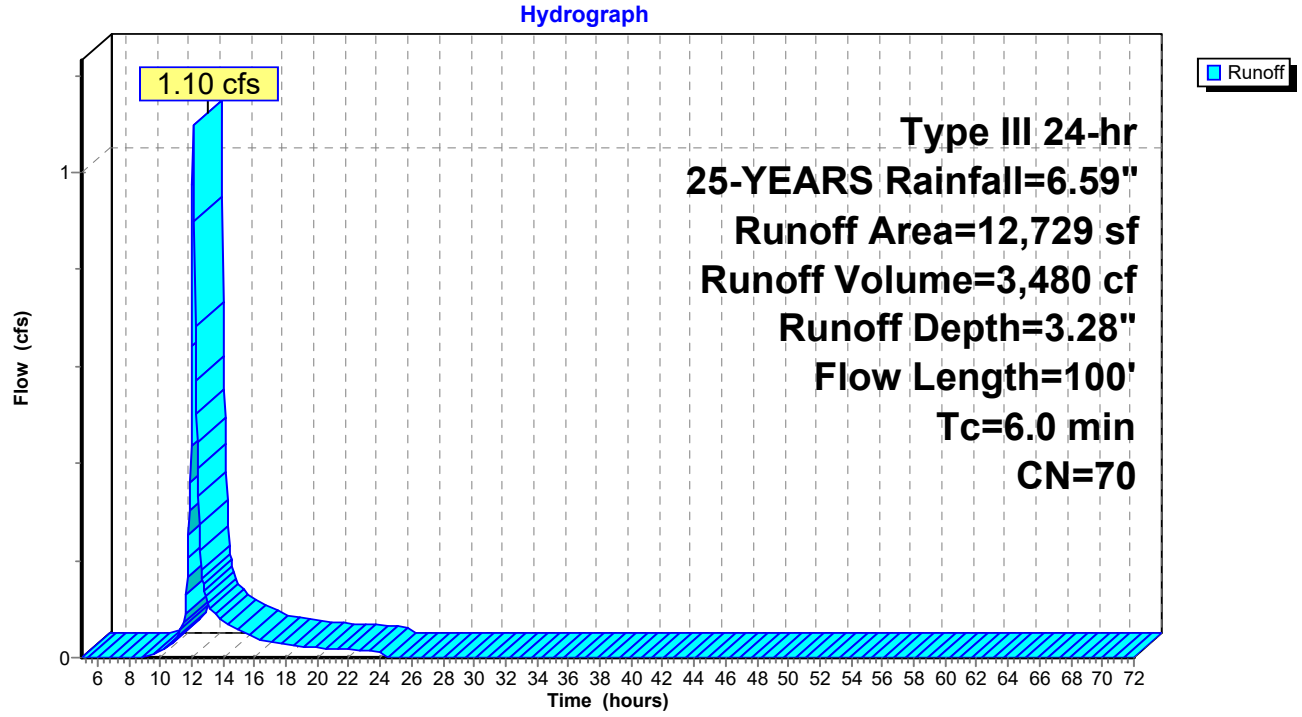
Runoff = 1.10 cfs @ 12.09 hrs, Volume= 3,480 cf, Depth= 3.28"
Routed to Pond 1P : Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEARS Rainfall=6.59"

	Area (sf)	CN	Description
*	8,614	77	Crushed Stone, bare soil, HSG A
	2,924	39	>75% Grass cover, Good, HSG A
*	361	98	Utility Covers, HSG A
*	830	98	Equipment and Containment, HSG A
	12,729	70	Weighted Average
	11,538		90.64% Pervious Area
	1,191		9.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	50	0.0450	0.51		**Sheet Flow, SF** Fallow n= 0.050 P2= 3.39"
0.7	50	0.0150	1.22		**Shallow Concentrated Flow, CF** Nearly Bare & Untilled Kv= 10.0 fps
3.7					**Direct Entry, Direct**
6.0	100	Total			

Subcatchment PCA-1: PCA-1



Summary for Subcatchment PCA-2: PCA-2

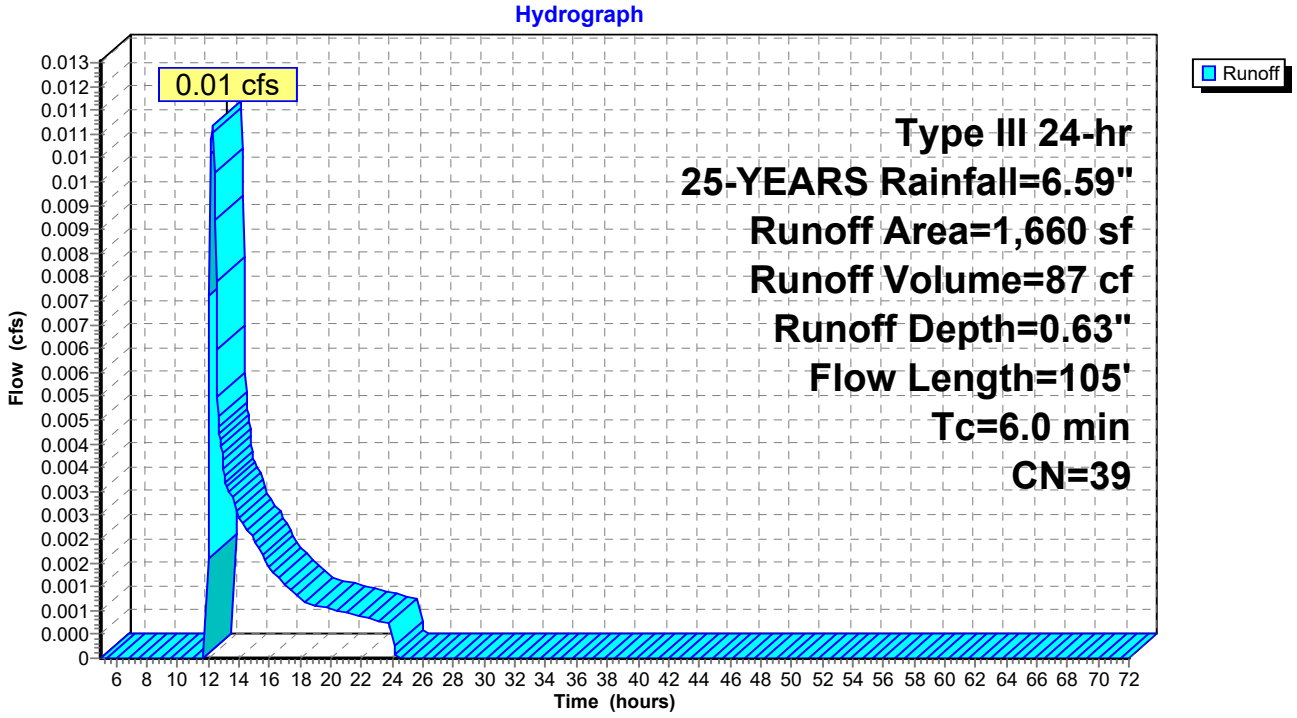
Runoff = 0.01 cfs @ 12.28 hrs, Volume= 87 cf, Depth= 0.63"
Routed to Link POA1P : POA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEARS Rainfall=6.59"

Area (sf)	CN	Description
1,660	39	>75% Grass cover, Good, HSG A
1,660		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	10	0.0150	0.07		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
3.2	95	0.0050	0.49		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
0.3					**Direct Entry, Direct Entry**
6.0	105	Total			

Subcatchment PCA-2: PCA-2



Summary for Subcatchment PCA-3: PCA-3

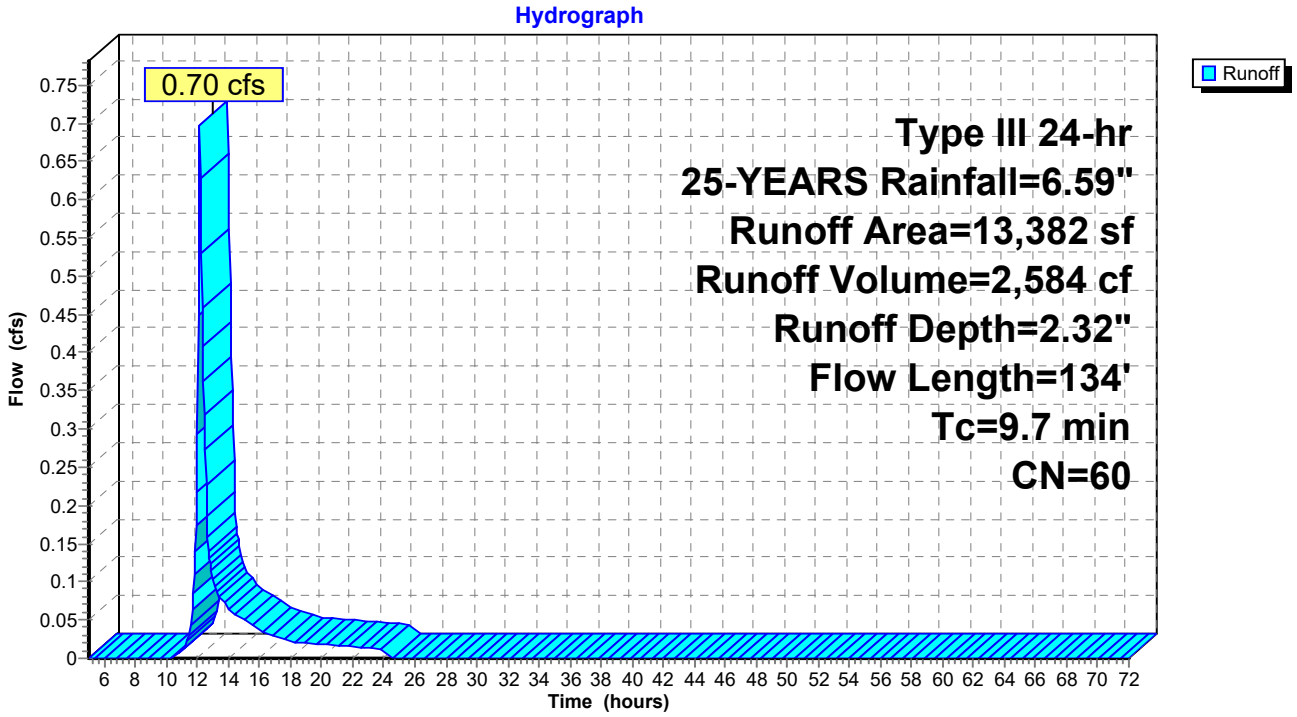
Runoff = 0.70 cfs @ 12.15 hrs, Volume= 2,584 cf, Depth= 2.32"
Routed to Link POA2P : POA-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEARS Rainfall=6.59"

	Area (sf)	CN	Description
	4,242	96	Gravel surface, HSG A
*	160	98	Utility Covers, HSG A
*	883	77	Crushed Stone, bare soil, HSG A
	8,097	39	Pasture/grassland/range, Good, HSG A
	13,382	60	Weighted Average
	13,222		98.80% Pervious Area
	160		1.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0188	0.10		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
0.4	21	0.0188	0.96		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
0.3	20	0.0150	1.22		**Shallow Concentrated Flow, CF** Nearly Bare & Untilled Kv= 10.0 fps
0.8	43	0.0160	0.89		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
9.7	134	Total			

Subcatchment PCA-3: PCA-3



Summary for Pond 1P: Drywell

Inflow Area = 12,729 sf, 9.36% Impervious, Inflow Depth = 3.28" for 25-YEARS event
Inflow = 1.10 cfs @ 12.09 hrs, Volume= 3,480 cf
Outflow = 1.38 cfs @ 12.12 hrs, Volume= 3,604 cf, Atten= 0%, Lag= 1.4 min
Discarded = 0.01 cfs @ 9.65 hrs, Volume= 1,069 cf
Primary = 1.37 cfs @ 12.12 hrs, Volume= 2,536 cf
Routed to Link POA1P : POA-1

Routing by Stor-Ind method, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 11.32' @ 12.10 hrs Surf.Area= 500 sf Storage= 794 cf

Plug-Flow detention time= 347.3 min calculated for 3,478 cf (100% of inflow)
Center-of-Mass det. time= 437.9 min (1,271.6 - 833.7)

Volume	Invert	Avail.Storage	Storage Description
#1	7.35'	800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 2,000 cf Overall x 40.0% Voids

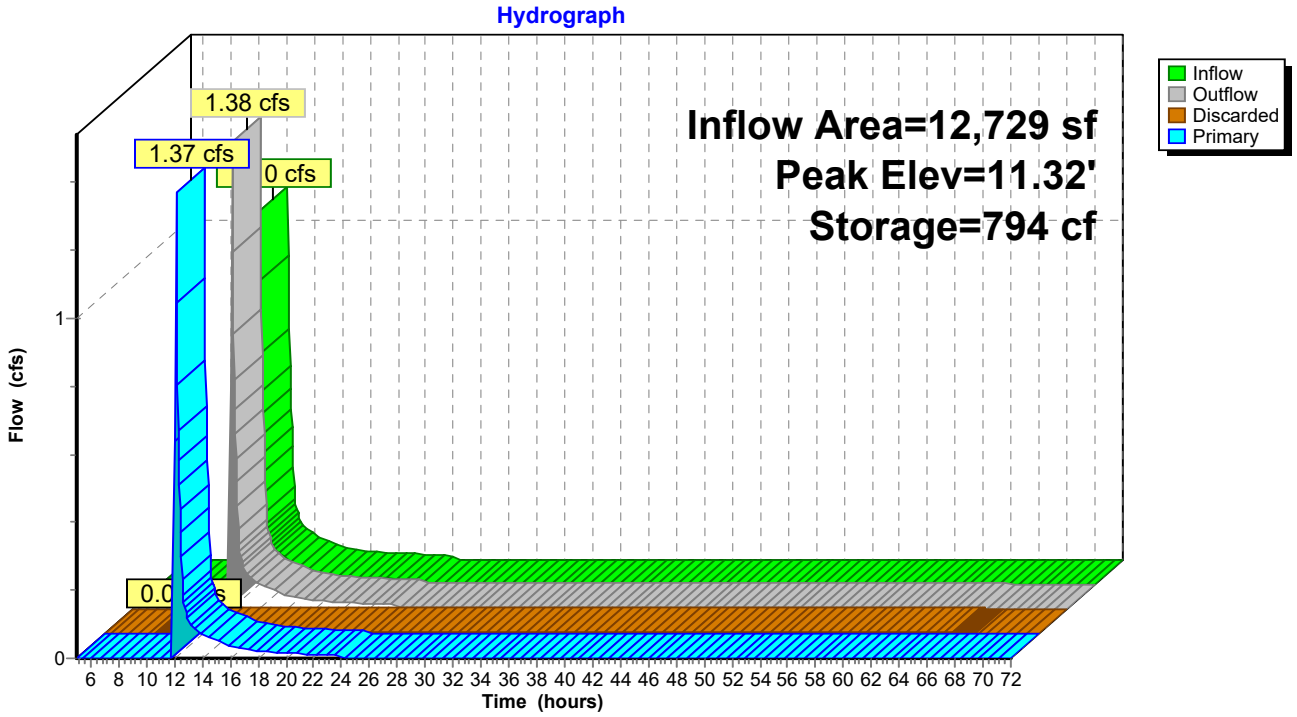
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.35	500	0	0
11.35	500	2,000	2,000

Device	Routing	Invert	Outlet Devices
#1	Primary	11.30'	**145.0' long + 0.3 '/' SideZ x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	7.35'	**0.450 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 9.65 hrs HW=7.39' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.96 cfs @ 12.12 hrs HW=11.32' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.96 cfs @ 0.33 fps)

Pond 1P: Drywell

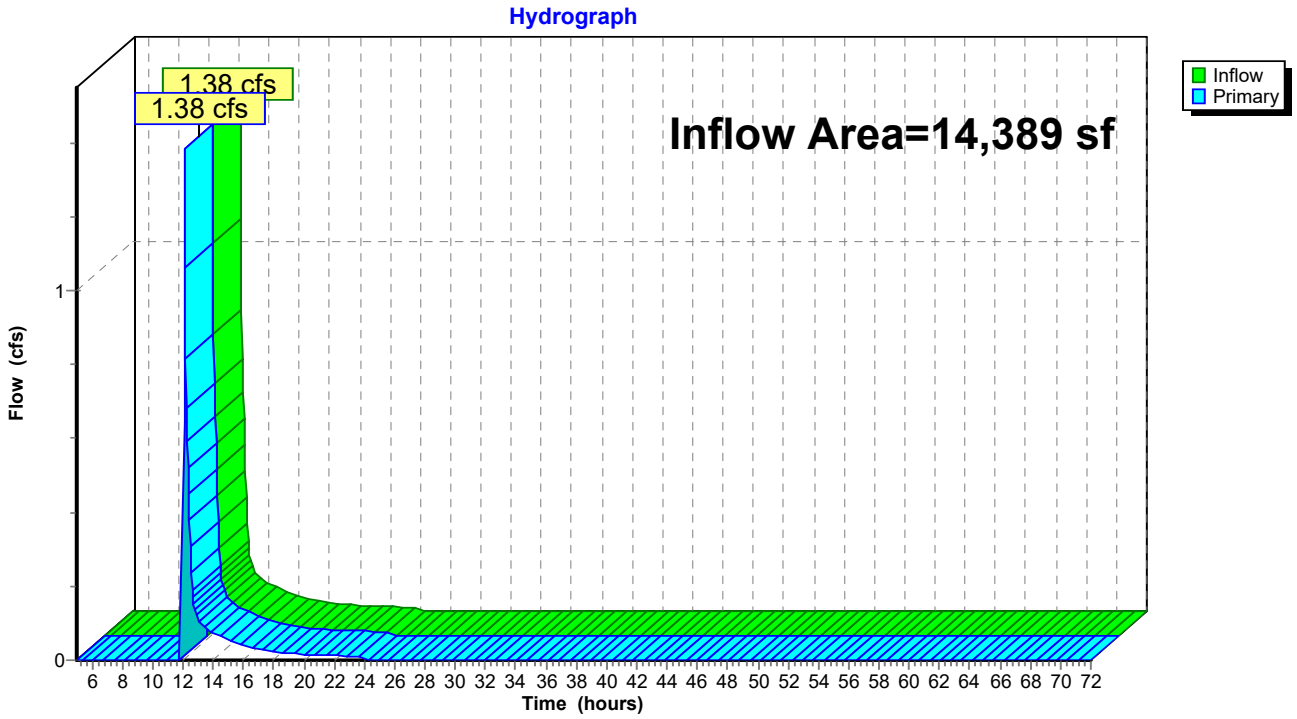


Summary for Link POA1P: POA-1

Inflow Area = 14,389 sf, 8.28% Impervious, Inflow Depth = 2.19" for 25-YEARS event
Inflow = 1.38 cfs @ 12.12 hrs, Volume= 2,622 cf
Primary = 1.38 cfs @ 12.12 hrs, Volume= 2,622 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA1P: POA-1

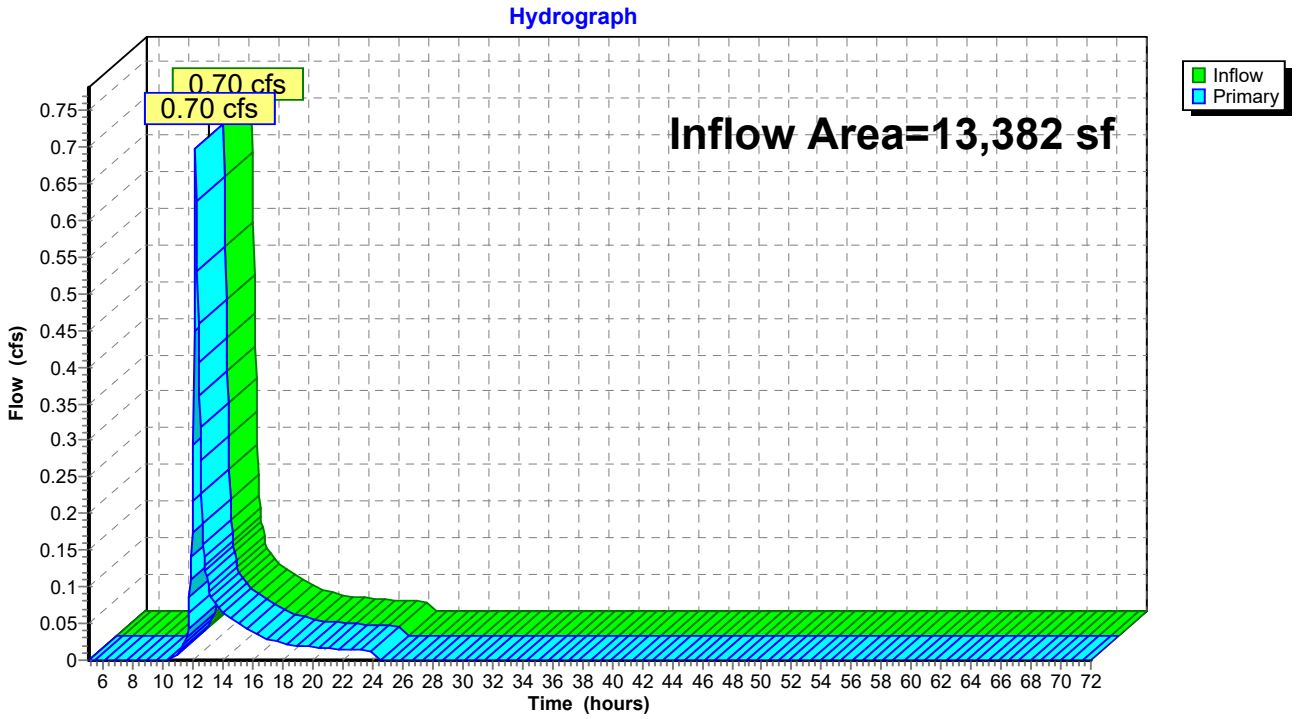


Summary for Link POA2P: POA-2

Inflow Area = 13,382 sf, 1.20% Impervious, Inflow Depth = 2.32" for 25-YEARS event
Inflow = 0.70 cfs @ 12.15 hrs, Volume= 2,584 cf
Primary = 0.70 cfs @ 12.15 hrs, Volume= 2,584 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA2P: POA-2



Time span=5.00-72.00 hrs, dt=0.05 hrs, 1341 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment PCA-1: PCA-1 Runoff Area=12,729 sf 9.36% Impervious Runoff Depth=4.89"
Flow Length=100' Tc=6.0 min CN=70 Runoff=1.64 cfs 5,185 cf

Subcatchment PCA-2: PCA-2 Runoff Area=1,660 sf 0.00% Impervious Runoff Depth=1.37"
Flow Length=105' Tc=6.0 min CN=39 Runoff=0.04 cfs 189 cf

Subcatchment PCA-3: PCA-3 Runoff Area=13,382 sf 1.20% Impervious Runoff Depth=3.71"
Flow Length=134' Tc=9.7 min CN=60 Runoff=1.15 cfs 4,132 cf

Pond 1P: Drywell Peak Elev=11.32' Storage=795 cf Inflow=1.64 cfs 5,185 cf
Discarded=0.01 cfs 1,088 cf Primary=1.60 cfs 4,053 cf Outflow=1.60 cfs 5,141 cf

Link POA1P: POA-1 Inflow=1.64 cfs 4,242 cf
Primary=1.64 cfs 4,242 cf

Link POA2P: POA-2 Inflow=1.15 cfs 4,132 cf
Primary=1.15 cfs 4,132 cf

Summary for Subcatchment PCA-1: PCA-1

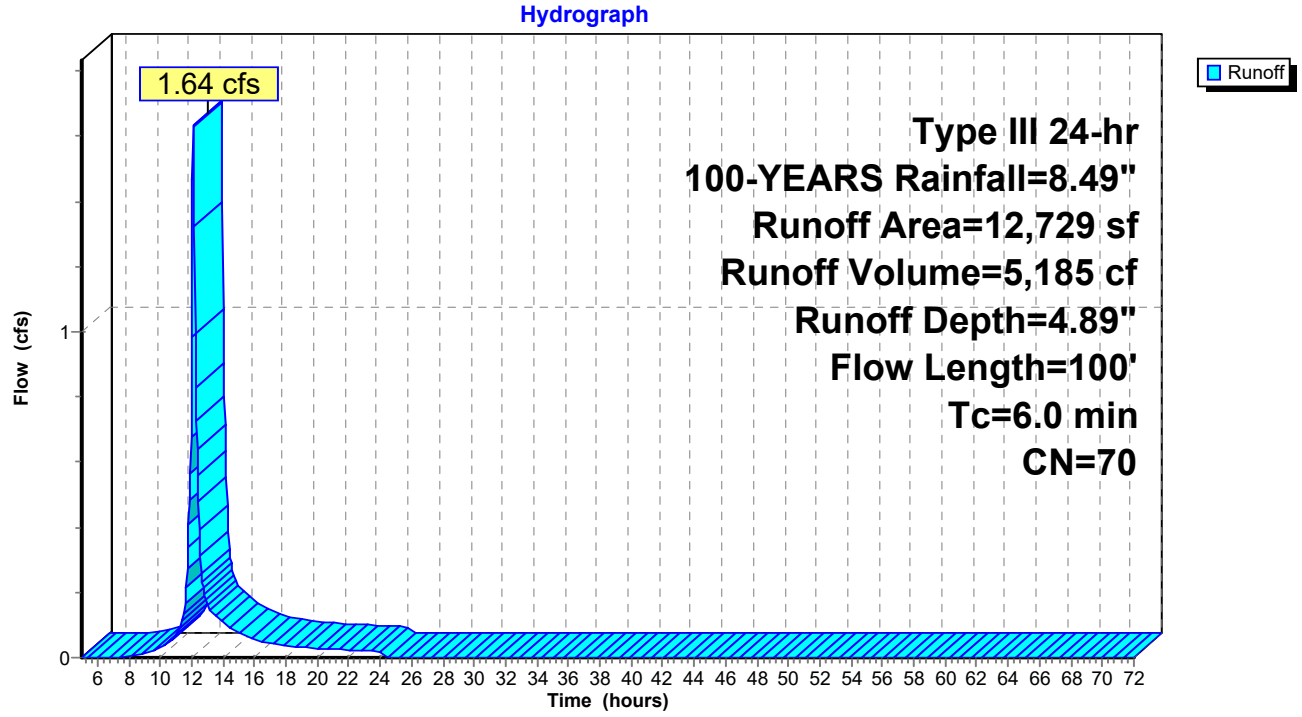
Runoff = 1.64 cfs @ 12.09 hrs, Volume= 5,185 cf, Depth= 4.89"
Routed to Pond 1P : Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YEARS Rainfall=8.49"

	Area (sf)	CN	Description
*	8,614	77	Crushed Stone, bare soil, HSG A
	2,924	39	>75% Grass cover, Good, HSG A
*	361	98	Utility Covers, HSG A
*	830	98	Equipment and Containment, HSG A
	12,729	70	Weighted Average
	11,538		90.64% Pervious Area
	1,191		9.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	50	0.0450	0.51		**Sheet Flow, SF** Fallow n= 0.050 P2= 3.39"
0.7	50	0.0150	1.22		**Shallow Concentrated Flow, CF** Nearly Bare & Untilled Kv= 10.0 fps
3.7					**Direct Entry, Direct**
6.0	100	Total			

Subcatchment PCA-1: PCA-1



Summary for Subcatchment PCA-2: PCA-2

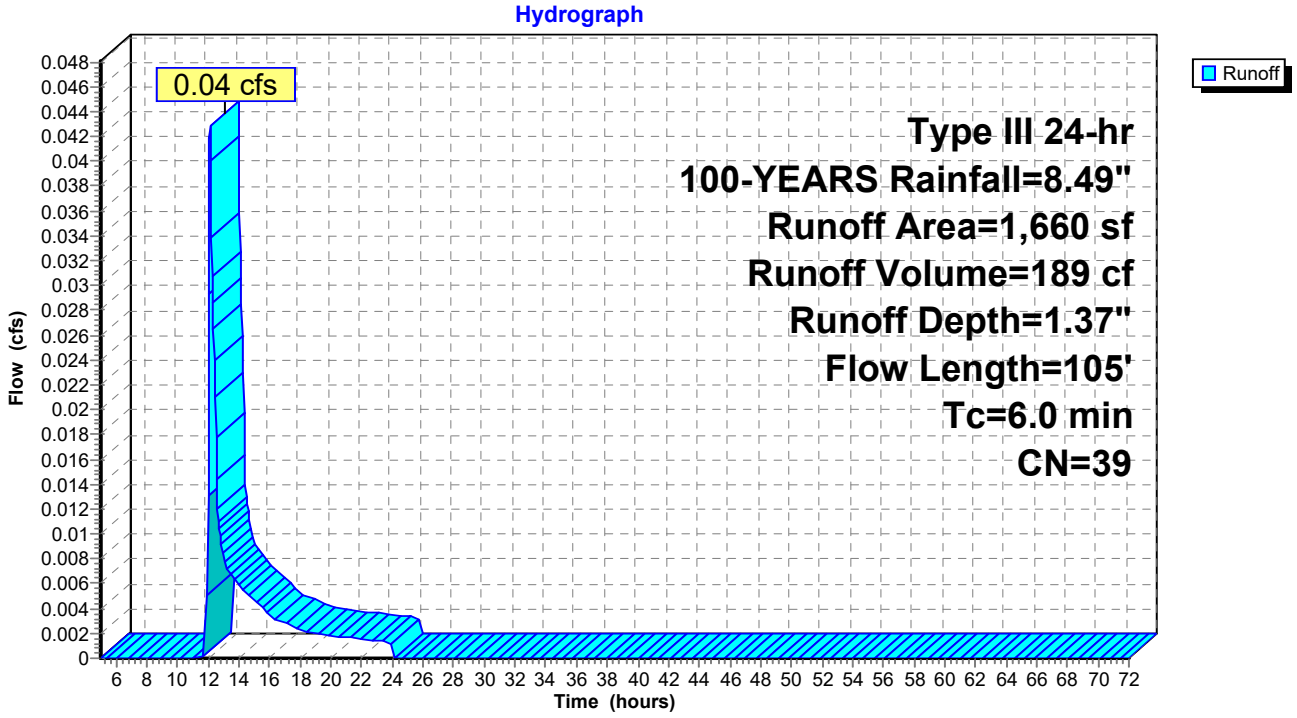
Runoff = 0.04 cfs @ 12.12 hrs, Volume= 189 cf, Depth= 1.37"
Routed to Link POA1P : POA-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YEARS Rainfall=8.49"

Area (sf)	CN	Description
1,660	39	>75% Grass cover, Good, HSG A
1,660		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	10	0.0150	0.07		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
3.2	95	0.0050	0.49		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
0.3					**Direct Entry, Direct Entry**
6.0	105	Total			

Subcatchment PCA-2: PCA-2



Summary for Subcatchment PCA-3: PCA-3

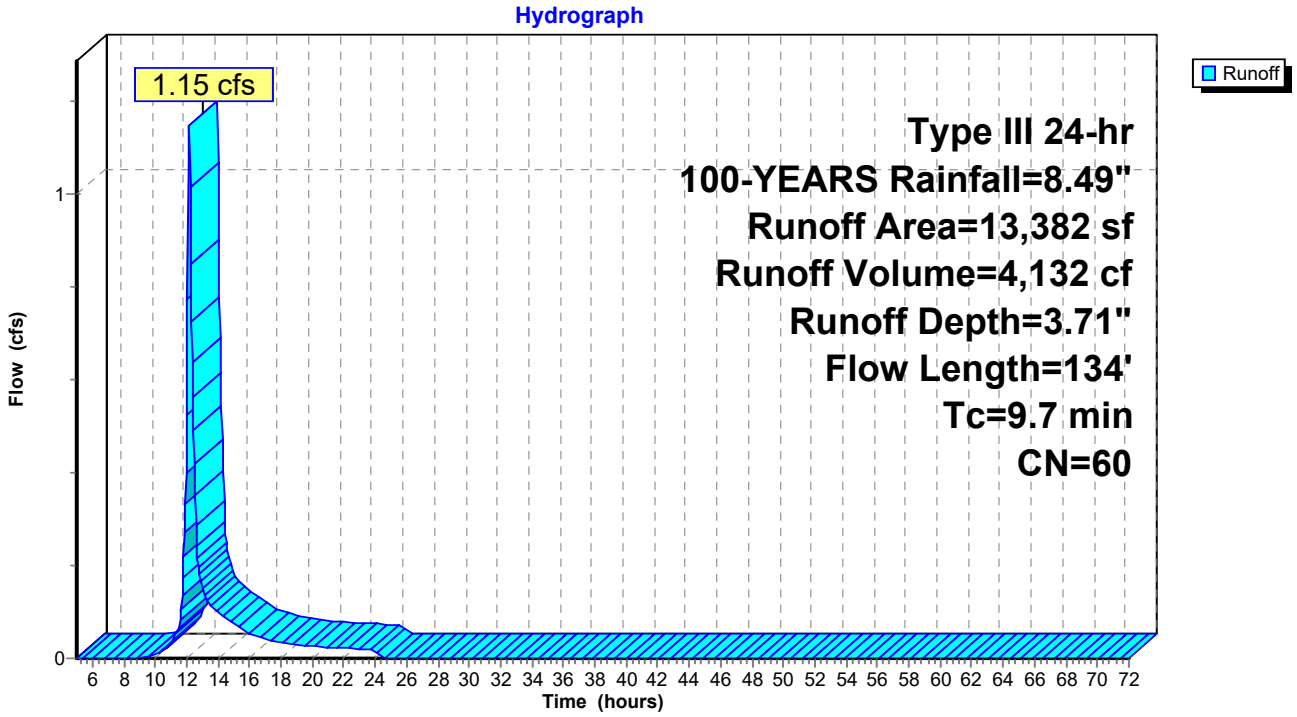
Runoff = 1.15 cfs @ 12.14 hrs, Volume= 4,132 cf, Depth= 3.71"
Routed to Link POA2P : POA-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YEARS Rainfall=8.49"

	Area (sf)	CN	Description
	4,242	96	Gravel surface, HSG A
*	160	98	Utility Covers, HSG A
*	883	77	Crushed Stone, bare soil, HSG A
	8,097	39	Pasture/grassland/range, Good, HSG A
	13,382	60	Weighted Average
	13,222		98.80% Pervious Area
	160		1.20% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	50	0.0188	0.10		**Sheet Flow, SF** Grass: Dense n= 0.240 P2= 3.39"
0.4	21	0.0188	0.96		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
0.3	20	0.0150	1.22		**Shallow Concentrated Flow, CF** Nearly Bare & Untilled Kv= 10.0 fps
0.8	43	0.0160	0.89		**Shallow Concentrated Flow, CF** Short Grass Pasture Kv= 7.0 fps
9.7	134	Total			

Subcatchment PCA-3: PCA-3



Summary for Pond 1P: Drywell

Inflow Area = 12,729 sf, 9.36% Impervious, Inflow Depth = 4.89" for 100-YEARS event
Inflow = 1.64 cfs @ 12.09 hrs, Volume= 5,185 cf
Outflow = 1.60 cfs @ 12.09 hrs, Volume= 5,141 cf, Atten= 2%, Lag= 0.0 min
Discarded = 0.01 cfs @ 8.70 hrs, Volume= 1,088 cf
Primary = 1.60 cfs @ 12.09 hrs, Volume= 4,053 cf
Routed to Link POA1P : POA-1

Routing by Stor-Ind method, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 11.32' @ 12.09 hrs Surf.Area= 500 sf Storage= 795 cf

Plug-Flow detention time= 320.0 min calculated for 5,141 cf (99% of inflow)
Center-of-Mass det. time= 314.6 min (1,136.8 - 822.2)

Volume	Invert	Avail.Storage	Storage Description
#1	7.35'	800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 2,000 cf Overall x 40.0% Voids

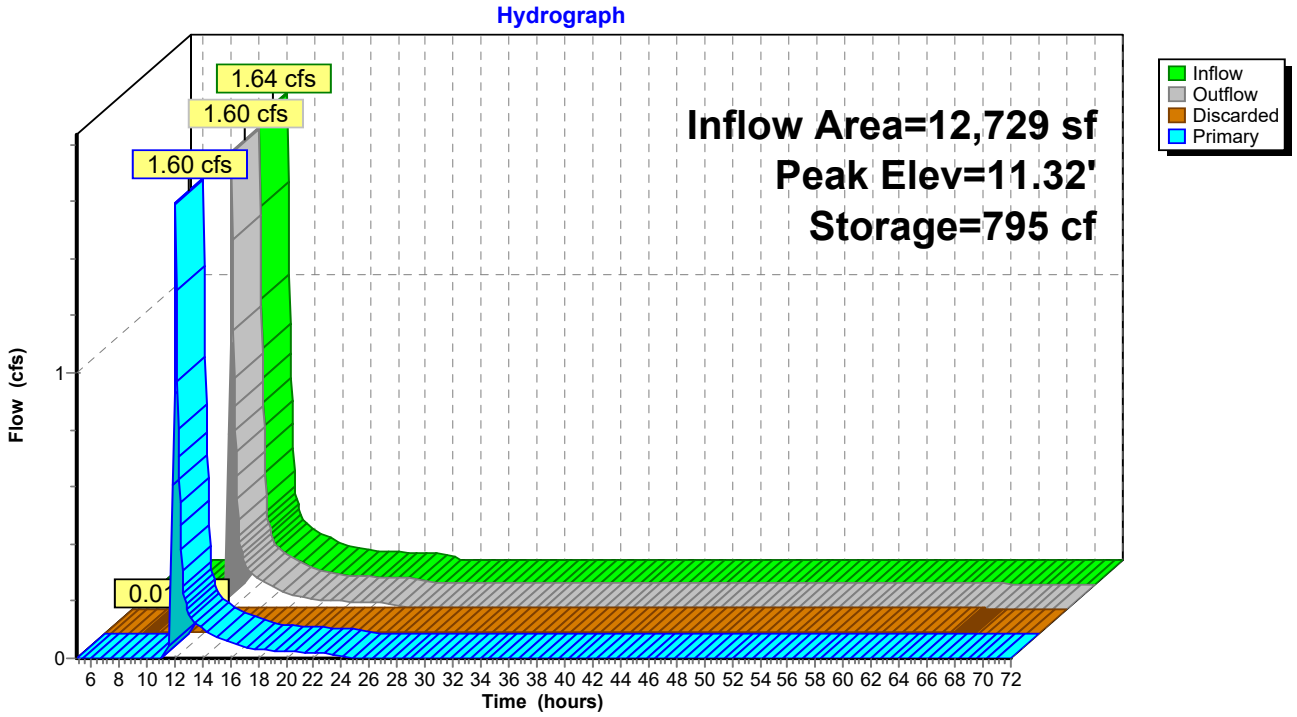
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
7.35	500	0	0
11.35	500	2,000	2,000

Device	Routing	Invert	Outlet Devices
#1	Primary	11.30'	**145.0' long + 0.3 '/' SideZ x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	7.35'	**0.450 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.01 cfs @ 8.70 hrs HW=7.39' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=1.28 cfs @ 12.09 hrs HW=11.32' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 1.28 cfs @ 0.36 fps)

Pond 1P: Drywell

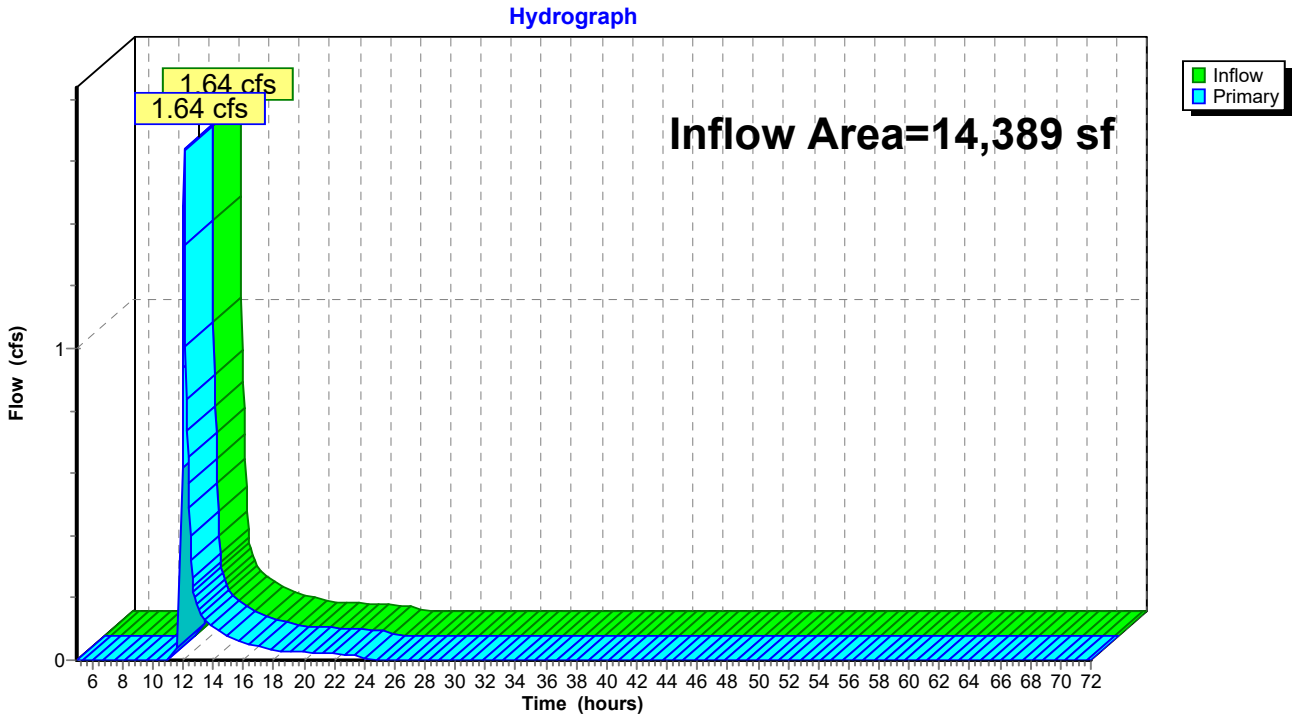


Summary for Link POA1P: POA-1

Inflow Area = 14,389 sf, 8.28% Impervious, Inflow Depth = 3.54" for 100-YEARS event
Inflow = 1.64 cfs @ 12.09 hrs, Volume= 4,242 cf
Primary = 1.64 cfs @ 12.09 hrs, Volume= 4,242 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA1P: POA-1

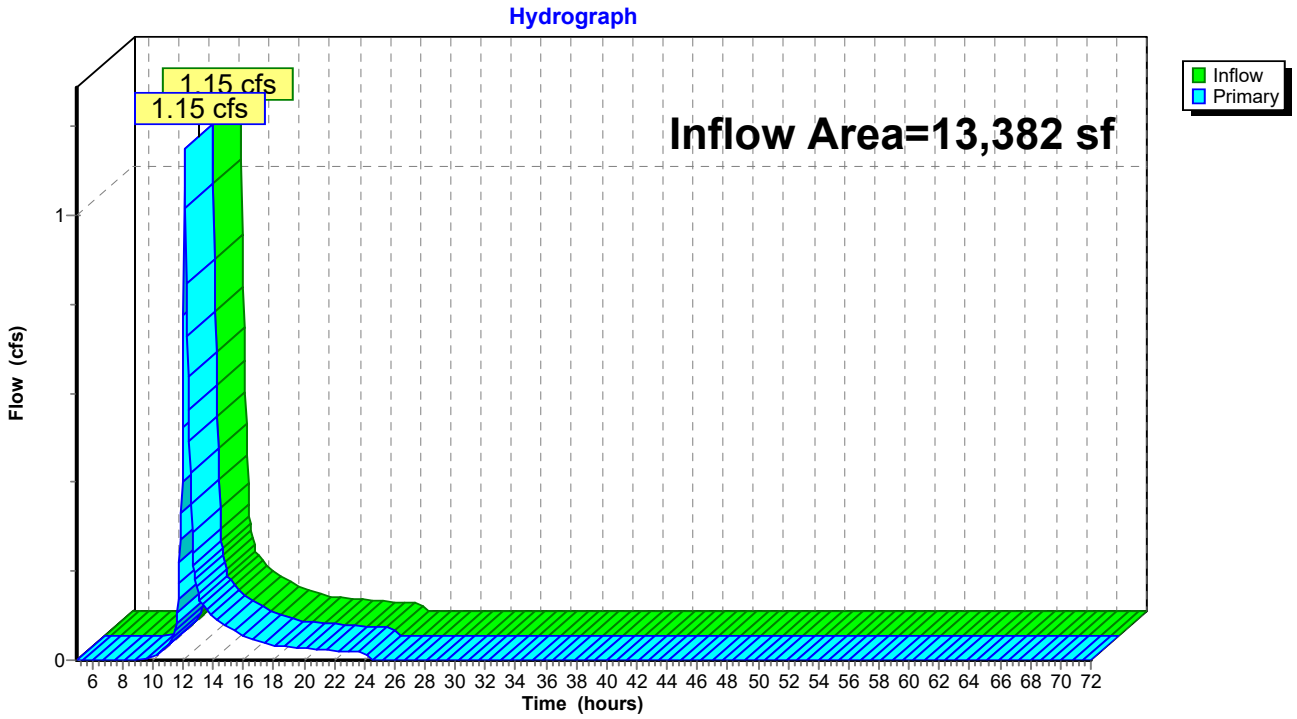


Summary for Link POA2P: POA-2

Inflow Area = 13,382 sf, 1.20% Impervious, Inflow Depth = 3.71" for 100-YEARS event
Inflow = 1.15 cfs @ 12.14 hrs, Volume= 4,132 cf
Primary = 1.15 cfs @ 12.14 hrs, Volume= 4,132 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-72.00 hrs, dt= 0.05 hrs

Link POA2P: POA-2



Appendix F
Operation and Maintenance &
Long-Term Pollution Prevention Plan

Operations and Maintenance
& Long-Term Pollution Prevention Plan
National Grid Temporary Substation
0 & 14 Mill Street
Amesbury, MA

October 20, 2025

Table of Contents

List of Attachments

1. INTRODUCTION

The Stormwater Management Systems Operations and Maintenance (O&M) Plan shall be implemented at the project site located at 0 & 14 Mill Street, Amesbury, Massachusetts to maintain the performance of the proposed stormwater management system. National Grid possesses the primary responsibility for overseeing and executing the O&M plan and assigning personnel who will be responsible for the proper operation and maintenance of the stormwater management system.

1.1 Responsibility

The purpose of the stormwater management O&M Plan is to require inspection of the system, removal of accumulated sediments, oils, and debris, and implementation of corrective action and record keeping activities. The below O&M activities will be performed by a registered Professional Engineer or other technical professional engaged by the National Grid, with expertise and experience with stormwater management facilities operation and maintenance.

The ongoing responsibility is the Owner, its successors, and assigns. Adequate maintenance is defined in this document as good working conditions. The Owner is responsible to develop and maintain an operation and maintenance budget suitable to implement the O&M plan described herein.

Contact information is provided below:

Owner:	National Grid
Contact:	Carli Gavin
Phone:	508.571.4029
Site Office Address:	0 & 14 Mill Street
City, State:	Amesbury, MA, 01913

2. MAINTENANCE PROGRAM

National Grid will be responsible for the implementation of the O&M Plan set forth in this document. The responsible party will ensure that inspections and record keeping are timely and accurate, and that cleaning and maintenance are performed in accordance with the recommended frequency.

2.1 Inspection and Maintenance Frequency and Corrective Measures

The following areas, facilities, and measures will be inspected by National Grid or assigned qualified personnel and maintained as specified below. Identified deficiencies will be corrected. Accumulated sediments and debris will be properly handled and disposed of offsite, in accordance with local, state, and federal guidelines and regulations.

2.1.1 Storm Management System Access

National Grid shall allow the City to enter the site and inspect the stormwater management system at their discretion upon coordination and approval with National Grid.

2.1.2 Deep Sump Catch Basins

The deep sump catch basins should be clear of any obstruction or debris to operate properly. Typical observations that would indicate that the catch basins are not functioning properly include: sediment or trash accumulation around the grates, vegetation growth within the structure, and puddles around the grates after a storm event. The deep sump catch basins will be inspected quarterly and cleaned when the depth of sediment is greater than half-full measured from the bottom of the sump to the invert of the outlet pipe. Adjust cleaning frequency as required based on sediment accumulation to ensure that the catch basins are working in their intended fashion and that they are free of debris. Deep sump catch basin outlets are designed with a hood to trap floatable materials, check to ensure watertight seal is working. Sediments and hydrocarbons will be properly handled and disposed of offsite in accordance with all applicable local, state, and federal guidelines and regulations.

2.1.3 Drainage Trench

The drainage trench should be clear of any obstruction or debris to operate properly. Typical observations that would indicate that the drainage trench is not functioning properly include: sediment or trash accumulation on top of the stone, vegetation growth, and puddles or standing water around the surface after a storm event. The drainage trench will be inspected quarterly and cleaned when water is present in the drain more than 72 hours following a storm event. Adjust cleaning frequency as required to ensure that the drainage trench is working in the intended fashion and that it is free of debris. Sediments will be properly handled and disposed of offsite in accordance with all applicable local, state, and federal guidelines and regulations.

2.1.4 Drain Manholes

The drain manholes should be clear of any obstruction or debris to operate properly. Typical observations that would indicate that the drain manholes are not functioning properly include: sediment or trash accumulation within the structure, or vegetation growth within the structure. The drain manholes will be inspected quarterly and cleaned when significant sediment present within the structure. Adjust cleaning frequency as required based on sediment accumulation to ensure that the drain manholes are working in their intended fashion and that they are free of debris. Sediments will be properly handled and disposed of offsite in accordance with all applicable local, state, and federal guidelines and regulations.

2.1.5 Storm Drain Piping

The storm drain piping will be inspected annually and cleaned as necessary. Typical observations that would indicate that the storm drain piping system is not functioning properly is stagnant water in or around drainage manholes or catch basins after a storm event. Sediments and hydrocarbons will be properly handled and disposed of offsite in accordance with all applicable local, state, and federal guidelines and regulations.

2.1.6 Drywell

The drywell shall be inspected after every major storm event (1" rainfall or greater) during the few months of operation after construction and annually thereafter to ensure proper function. Inspections shall check for sediment accumulation, clogging, standing water more than 72 hours after a storm, and structural integrity. An inspection port will be provided in the system to check for standing water. If standing water persists, the drywell shall be cleaned, rehabilitated, or replaced as needed. Maintenance activities and inspection results shall be documented and kept on file for review by MassDEP or the local approving authority. The property owner is responsible for the long-term operation and maintenance of the system.

3. LONG-TERM POLLUTION PREVENTION PLAN

3.1 Good Housekeeping Practices

Provisions for storing materials and waste products inside or under cover: All materials stored on site shall be stored in a neat and orderly fashion in their appropriate containers and under a roof or other secure enclosure. Waste products should be placed in secure receptacles until they are emptied by a licensed solid waste management company in Massachusetts.

3.1.1 Spill Prevention and Response Plans

Prevention: All materials stored on site shall be stored in a neat and orderly fashion in their appropriate containers and under a roof or other secure enclosure. Products will be kept in their original containers with the original manufacturer's label. Products should not be mixed with one another unless recommended by the manufacturer. If possible, all of the product should be used before disposing of the container. The manufacturer's recommendations for proper use and disposal should be followed.

Response: The manufacturer's recommended methods for cleanup shall be followed. Spills should be cleaned up immediately after discovery. The spill area shall be kept well-ventilated,

and personnel shall wear appropriate protective clothing to prevent injury from contact with a hazardous substance. Spills of toxic or hazardous material shall be reported to the appropriate local and/or State authority in accordance with local and/or State regulations.

3.1.2 Solid Waste Management

Waste products shall be carried away from the site. Site has no permanent personnel or any personal facilities, so any waste should be disposed of legally off site.

3.1.3 Snow Storage, Disposal, and Plowing

Snow disposal will be managed in accordance with the Department of Environmental Protection, Bureau of Resource Protection, Snow Disposal Guidelines, effective December 21, 2015. In general, snow will be plowed in accordance with standard operating procedures. During construction, snow will be plowed and stored in designated areas adjacent to the existing gravel access drive. Snow disposal in the Powwow River and stormwater management system is prohibited.

3.1.4 Landscape Maintenance

The Owner is responsible for maintenance of lawns or other landscaped areas. Requirements for storage and use of fertilizers, herbicides and pesticides will comply with all applied laws. Due to the temporary nature and utilitarian purpose of the facility fertilizers, herbicides and pesticides are unlikely to be used. If their use is necessary, the following requirements must be complied with:

Fertilizers: Fertilizers shall be applied in the minimum amounts recommended by the manufacturer. Once applied, fertilizers shall be worked into the soil to limit exposure to stormwater. Storage shall be under a roof or other secure enclosure. The contents of any partially-used bags of fertilizer shall be transferred to a sealable plastic bag or bin to avoid spills.

Herbicides and Pesticides: Store herbicides and pesticides in original containers that are closed and labeled, in a secure area out of reach of children and pets. Avoid storing in damp areas where containers may become moist or rusty. Herbicides and pesticides shall not be stored near food. Follow the label instructions strictly about where and how much to apply. Do not put herbicides and pesticides in the trash or down the drain. Use rubber gloves when handling and use an appropriate cartridge mask if using products extensively.

4. OPERATION AND MAINTENANCE BUDGET

Based on the inspections, maintenance frequencies, and procedures described herein and on current industry prices for lawn maintenance, snow plowing and trained personnel we estimate that the operation and maintenance costs associated with the proposed stormwater management system will be approximately $1,000/year. This estimate may vary due to major storm frequencies, actual site conditions, industry price escalation, and other factors.

5. SIGNATURE PAGE

The Stormwater Management Systems Operations and Maintenance (O&M) Plan shall be implemented at the project site located at 0 & 14 Mill Street, Amesbury, Massachusetts shall be the responsibility of:

Owner:	National Grid
Contact:	Carli Gavin
Phone:	508.571.4029
Site Office Address:	0 & 14 Mill Street
City, State:	Amesbury, MA, 01913

Signature: _____ Date: _____

Attachment A: SAMPLE OPERATION AND MAINTENANCE LOG

Property Manager / Contract Operator: _____Date: _____

- Routine
- Response to Rainfall Event (__inches)
- Other ____

BMP	Frequency	Structures Inspected	Date Performed	Comments
Deep Sump Catch Basins	Quarterly Inspection			Sump >50% full? (Yes/No) Approx. sediment depth_____
	Clean when sump is greater than 50% full			
Drainage Trench	Quarterly Inspection			Is standing water present in drainage trench (Yes/No) Approx. water depth _____
	Clean when standing water is present in stone trench more than 72 hours following a storm event			
Drain Manholes	Quarterly Inspection			
	Maintenance as necessary			
Storm Drain Piping	Annual Inspection			
	Maintenance as necessary			

Drywell	After major storm event (1″ or greater) for the first few months following construction. Annual Inspection thereafter.			Is standing water present in drywell (Yes/No) Approx. water depth _____
	Clean when standing water is present in stone trench more than 72 hours following a storm event			
Vegetated Areas	Annual Inspection			
	Maintenance as necessary			

Last significant storm event greater than 1 in. of rain in 24-hr period (date and amount):

ATTACHMENT B: SAMPLE INSPECTION FORMS

Attached are sample individual stormwater management system inspection forms to be filled out by the Owner, Property Manager, or Contractor.

DEEP SUMP AND HOODED CATCH BASIN

0 & 14 STREET, AMESUBRY, MA 01913

OWNER:

PROPERTY MANAGER:

INSPECTED BY:

DATE OF INSPECTION:

	Acceptable	Needs Work	Notes

DATE OF CLEANING: _____ BY WHOM: _____

DATE OF REPAIR: _____ BY WHOM: _____

NOTE ANY DISCREPANCIES AND SUGGESTED CORRECTIVE ACTIONS:

_____

_____

_____

_____

_____

DRAINAGE TRENCH

0 & 14 STREET, AMESUBRY, MA 01913

OWNER:

PROPERTY MANAGER:

INSPECTED BY:

DATE OF INSPECTION:

	Acceptable	Needs Work	Notes

DATE OF CLEANING: _____ BY WHOM: _____

DATE OF REPAIR: _____ BY WHOM: _____

NOTE ANY DISCREPANCIES AND SUGGESTED CORRECTIVE ACTIONS:

_____

_____

_____

_____

_____

DRAIN MANHOLE

0 & 14 STREET, AMESUBRY, MA 01913

OWNER:

PROPERTY MANAGER:

INSPECTED BY:

DATE OF INSPECTION:

	Acceptable	Needs Work	Notes

DATE OF CLEANING: _____ BY WHOM: _____

DATE OF REPAIR: _____ BY WHOM: _____

NOTE ANY DISCREPANCIES AND SUGGESTED CORRECTIVE ACTIONS:

_____

_____

_____

_____

_____

DRYWELL

0 & 14 STREET, AMESUBRY, MA 01913

OWNER:

PROPERTY MANAGER:

INSPECTED BY:

DATE OF INSPECTION:

	Acceptable	Needs Work	Notes

DATE OF CLEANING: _____ BY WHOM: _____

DATE OF REPAIR: _____ BY WHOM: _____

NOTE ANY DISCREPANCIES AND SUGGESTED CORRECTIVE ACTIONS:

_____

_____

_____

_____

_____