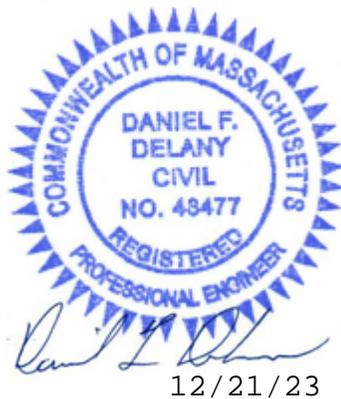


# Stormwater Management Report

Shutesbury Public Library

**Town of Shutesbury**  
Shutesbury, MA

December 21, 2023



1550 Main Street, Suite 400  
Springfield, MA 01089

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# 1 Executive Summary

The Town of Shutesbury is looking to construct an approximately 4,400-square-foot library located at 66 Leverett Road in Shutesbury, Massachusetts. Proposed development includes the building, a paved driveway, paved parking and drop-off area, stormwater management systems, site utilities, on-site septic, a potable water supply well, as well as other site amenities.

The proposed stormwater management system is designed to meet the guidelines of the Massachusetts Stormwater Handbook (Stormwater Handbook), the Wetlands Protection Act Regulations 310 CMR 10.00, and the Town of Shutesbury Wetland Protection Bylaw Regulations. Existing and proposed hydrologic conditions for the developed area were evaluated to ensure stormwater peak discharges are maintained or reduced as a result of the proposed development for the 2-, 10-, 25-, 50, and 100-year storm events. Maintenance or reduction in stormwater peak discharges was achieved through the utilization of stormwater detention basins. Stormwater treatment is provided by stormwater treatment structures (hydrodynamic separators).

## 2 Project Description

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### 2.1 Existing Conditions

The project is located within a 21.2-acre parcel of land located at 66 Leverett Road in Shutesbury, Massachusetts. There are no buildings currently present on the parcel. The northeast portion of the parcel has been regularly mowed and contains a gravel driveway accessed from Leverett Road. The remainder of the parcel is forested with mixed deciduous and coniferous species. A compacted, sandy access route generally aligned in a north-south direction provides access from the regularly maintained portion of the parcel to the interior of the parcel. The access route is approximately 12 feet wide, 1,300 feet long, and transitions into a narrower walking path at its southernmost extent. Additional access routes and walking paths are present within the parcel. Due to the past use of this site, there are multiple groundwater monitoring wells located primarily within the forested portion of the parcel. The approximate 2-acre project site is located in the northern portion of the project, along Leverett Road. The parcel is identified in *Figure 1* and the proposed site's existing conditions are shown on the Plan Sheets located in Appendix A.

The existing site does not contain any stormwater structures. Stormwater sheet flows to the east to the wetland located in the northeastern corner of the site, to the west to a small wetland and the western property line, and to the north into Leverett Road.

### 2.2 Proposed Conditions

The proposed limit of work for the project is primarily located within previously developed and degraded located within the northern portion of the parcel. The proposed project includes the construction of an approximately 4,400 square foot building, paved driveway, paved parking and drop-off area, stormwater management systems, site utilities, on-site septic, a potable water supply well, and

other site amenities. Proposed project site information and details are shown on the Site Plans located in *Appendix A*.

Proposed stormwater flow patterns generally follow existing conditions. Due to poor site soils and high groundwater, the stormwater systems have been designed to meet to the maximum extent practicable the requirements of the stormwater management standards outlined in the Stormwater Handbook. The proposed stormwater management systems have been designed to maintain or reduce peak flows and provide water quality of stormwater prior to entering a wetland or leaving the site. Mitigation of peak flows is achieved through stormwater storage provided by the proposed stormwater detention basins. Stormwater is treated by stormwater treatment structures that treat the stormwater prior to discharge into the stormwater detention basins.

### 3 Hydrologic Analysis

Peak flows for existing and proposed conditions were determined using the Natural Resources Conservation Service (NRCS) Technical Release 20 and Technical Release 55 (TR-55) hydrologic methods. The hydrologic analyses for existing and proposed conditions were completed using a computer software program, HydroCAD version 10.00-20, to determine peak runoff flow rates and total runoff volumes for each of the watersheds. Runoff curve numbers were developed based on a combination of land cover use and existing site soil types acquired from the NRCS website. The time of concentration runs was developed based on the methods in the NRCS TR55 manual.

Peak flows for the 2-, 10-, 25-, 50- and 100-year frequency storm events were determined by using a 24-hour type III storm, standard for the New England area. Rainfall depths were obtained from NOAA Atlas 14, Volume 10, Version 3 published rainfall records for Shutesbury, Massachusetts. Rainfall data can be found in *Appendix B*.

Three design points were developed for the project to evaluate pre- versus post-development hydrologic conditions. The location of the Design Points (DP) are shown in *Figure 2* and *Figure 3* and are described as follows:

- DP1 discharges to the western wetland and the western property line.
- DP2 discharges to the eastern wetland and the eastern property line.
- DP3 discharge to Leverett Road.

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#### 3.1 Site Soils

Soil mapping generated from the NRCS website is provided in *Appendix C*. The mapping shows site soils are comprised of Chichester fine sandy loam, having a hydrologic soil group (HSG) classification of A, Pillsbury fine sandy loam with an HSG classification of D, and Metacomet fine sandy loam with an HSG classification of B/D. For the purposes of the stormwater calculations, an HSG classification of D was used for the Metacomet fine sandy loam. This is a conservative approach using the saturated soil classification in the stormwater calculations.

Test pits and boring were completed by O'Reilly, Talbot & Okun on October 3, 2023. Soil conditions, including soil texture, color, horizon depths, and evidence of saturation were logged in the field. Soils observed on site were consistent with the NRCS classification. Evidence of seasonal high groundwater was observed to be between 2 to 4 feet below the existing grade depending on the location of the test pits. Test pit and boring information can be found in the Geotechnical Recommendation located in *Appendix D*.

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## 3.2 Existing Watershed Summary

Three subcatchment areas have been established for pre-development, existing conditions, and watershed modeling. *Figure 2* illustrates existing conditions, pre-development watershed areas, time of concentration (Tc) paths, and ground cover characteristics. A schematic watershed diagram showing the discharge point and the breakdown of the ground cover characteristics for each watershed area can be found in the pre-development hydrological analysis provided in *Appendix E*.

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## 3.3 Proposed Watershed Summary

The proposed development will maintain overall existing drainage patterns. The overall watershed boundary of the post-development, proposed conditions, and analysis are the same as the pre-development model, however, the subcatchments have been further delineated to the size of proposed stormwater detention basins. Eleven subcatchment areas have been established for the post-development watershed analysis. *Figure 3* illustrates proposed conditions, post-development watershed areas, Tc paths, and ground cover characteristics. A schematic watershed diagram showing discharge points and a breakdown of the ground cover characteristics for each watershed area can be found in the post-development hydrological analysis provided in *Appendix F*.

# 4 Soil Erosion and Sedimentation Control

Soil erosion and sedimentation control plans, including construction details and notes, are provided on the Site Plans located in *Appendix A*. Soil erosion and sedimentation control details and procedures are consistent with the “Massachusetts Erosion and Sediment Control Guideline for Urban and Suburban Areas,” and with state, local, and federal requirements.

Erosion and sedimentation controls used on the site during construction will include construction entrance, silt fence, straw bales, inlet protection, temporary sedimentation traps, erosion control blankets, temporary soil stockpiles, tree protection, and water for dust control. Additional erosion and sediment controls will be utilized as required. Silt fences and straw bales will be placed down-gradient of disturbed areas and up-gradient of wetlands. A construction entrance will be installed at the entrance of the site at Leverett Road. Water will be applied to exposed soils to provide dust control as needed.

Prior to the start of construction, a formal Stormwater Pollution Prevention Plan (SWPPP), further specifying the details of construction phasing, limits of soil disturbance, erosion, and sediment controls and other stabilization measures, stockpile locations, construction waste management procedures, and hazardous materials storage procedures during construction activities. Inspections pertaining to the operation and maintenance of E&S controls will be maintained as part of the SWPPP. The SWPPP will

also be updated regularly throughout construction to address site conditions and incorporate any changes made during construction.

## 5 Construction Sequence

An anticipated general construction sequencing for the project is as follows, although subject to change by the contractor due to weather conditions, scheduling, site constraints, and other construction factors.

- Conduct pre-construction meeting
- Install erosion and sedimentation control measures
- Clear trees and grub within the limit of work as shown on Site Plans
- Layout temporary stockpile locations
- Perform demolition activities as shown on the Site Plans
- Rough grade driveway, parking areas, sidewalks, and building areas
- Install site utilities and stormwater management systems
- Construction stormwater detention basins
- Construct building
- Place and grade base materials for driveways, parking areas, and sidewalks
- Install curb
- Place top course material for driveway and parking areas
- Place concrete for sidewalks
- Place topsoil in disturbed areas to be landscaped, grade, and seed
- Install plantings and other landscape elements
- Clean all on-site stormwater drainage management components of collected sediment, including the stormwater detention basins
- Obtain the owner's approval to remove erosion and sediment controls once the site is stabilized

The Contractor will be responsible for registration under the EPA NPDES General Permit for Discharge from Construction Activities. Upon construction award, any changes to the proposed construction sequencing plan by the Contractor will be reviewed and approved by the City and included in the final SWPPP.

## 6 Massachusetts Stormwater Handbook Standards

The following is a description of how the proposed project conforms to the Standards outlined in the Stormwater Handbook. The Stormwater Management Checklist is included in *Appendix G*.

### LID Measures

A reduction in the development scale of the project was reviewed as part of the development of this project. A previous design was developed, which included an approximately 7,220-square-foot building footprint and a longer driveway with more parking. The previous design required more tree clearing and disturbance of land. A copy of the previous design is provided in *Appendix H*. The current design proposes a reduction in the development scale which allows for a significant amount of the site to

remain undisturbed in its natural state and a reduction in the amount of proposed impervious by reducing the footprint of the building, the required length of the driveway, and the amount of parking.

#### **Standard 1: No Untreated Discharge or Erosion to Wetlands**

Perimeter erosion controls will be installed during construction to protect undisturbed wetland buffers and wetland resource areas from sedimentation until construction is completed and the site is stabilized.

There are no new untreated conveyances proposed. Proposed conveyances have been designed to ensure no erosion will occur to existing wetland buffers and wetland resource areas. Stormwater treatment will be provided by way of the proposed stormwater treatment structures.

#### **Standard 2: Peak Rate Attenuation**

Post-development discharge rates will not increase as a result of the proposed development. Stormwater Hydrologic Analyses that demonstrate the maintenance or reduction of peak discharge rates are provided in *Appendix E* and *Appendix F*. A summary of pre- versus post-development peak discharge rates is provided in Table 1, Table 2, Table 3, Table 4, and Table 5. Mitigation of peak flows is achieved through stormwater storage provided by the proposed stormwater detention basins.

#### **Standard 3: Stormwater Recharge**

Due to high seasonal groundwater and site soils having an HSG classification of D, providing infiltration BMPs sized to meet the required groundwater recharge and provide proper drawdown for the project is not feasible.

#### **Standard 4: Water Quality**

Due to high seasonal groundwater and site soils having an HSG classification of D, the project has been designed to provide the required water quality volume and 80% TSS removal to the maximum extent practicable. Proposed water quality measures include deep sump hooded catch basins and stormwater treatment structures. Stormwater collected will be treated by the stormwater treatment structures prior to discharge to each of the stormwater detention basins.

Each stormwater treatment structure has been designed to provide a volume equivalent to the 1-inch water quality volume for proposed impervious areas that contribute to each of the structures. Water quality calculations can be found in *Appendix I*.

TSS worksheets showing each treatment train provides a minimum of 80% TSS removal are located in *Appendix J*. TSS removal is provided by the stormwater treatment structures.

#### **Standard 5: Land Uses with Higher Potential Pollutant Loads**

The project is not classified as a LUHPP as defined by the Massachusetts Stormwater Handbook.

#### **Standard 6: Critical Areas**

This project does not contain any critical areas as defined by the Massachusetts Stormwater Handbook. Per the Town of Shutesbury General Wetland Protection Bylaw Regulations, the AURAs on site are considered critical areas. The stormwater treatment structures have been designed to provide a 1-inch water quality volume. The project does not propose any infiltration BMPs, therefore the 44%

pretreatment is not required. However, the deep sump hooded catch basins will provide 25% pretreatment prior to discharging into the stormwater treatment structures.

#### **Standard 7: Redevelopment**

This project is not classified as a redevelopment.

#### **Standard 8: Construction Period Controls**

It is anticipated that there will be no proposed pollution created during the construction of the proposed development. General erosion and sedimentation controls will be implemented and maintained in accordance with local, state, and federal requirements until construction is complete and disturbed areas have been stabilized. Details and notes for these erosion and sedimentation controls are provided on the Site Plan located in *Appendix A*. The contractor will be responsible for ensuring the correct implementation of the erosion and sedimentation controls.

The extent and schedule for the commencement or cessation of construction activities, grading, and soil stabilization measures will be recorded and maintained as part of the SWPPP. The SWPPP will be developed in accordance with the EPA NPDES General Permit for Discharge from Construction Activities. It will be completed and to be provided prior to the start of construction.

#### **Standard 9: Operation and Maintenance Plan**

A suggested Construction Operation and Maintenance (O&M) Plan has been developed for the development of the site and is included in *Appendix K*. The contractor shall be responsible for the construction operation and maintenance of the site.

A suggested Long-Term O&M Plan, which includes recommended maintenance activities and schedule of maintenance as outlined within the Stormwater Handbook, is included in *Appendix L*. The owner will be responsible for the long-term operation and maintenance of the site.

#### **Standard #10 Illicit Discharge to Drainage System**

The project does not include proposed illicit discharges to Stormwater Management Systems as defined in the Stormwater Handbook.

## **7 Town of Shutesbury – Design Requirements**

The project has been designed to meet the requirements of the stormwater standards outlined in Section 7.2.4 of the Wetland Protection Bylaw Regulations.

***7.2.4.1. Applicants for projects that generate stormwater runoff shall prioritize, to the maximum extent that is practicable, the use of Low Impact Design techniques as the primary approach in managing on-site stormwater.***

As previously described in this report, a reduction in the development scale of the project was reviewed as part of this project. The reduction in scale allowed for a reduction in site disturbance and tree clearing. It also allowed for a reduction in impervious areas by reducing the length of the driveway and the number of parking spaces.

***7.2.4.2. All stormwater management systems shall remove sediment, nutrients, hydrocarbons, and bacteria from stormwater flow to the maximum extent practicable.***

Stormwater treatment is provided by stormwater treatment structures designed to provide a 1-inch water quality volume.

***7.2.4.3. Applicants shall provide evidence that the proposed work or project shall not result in an exacerbation or creation of flooding conditions, including confirmation of no increase in the peak rate of stormwater runoff over existing conditions during storm events.***

Post-development discharge rates will not increase as a result of the proposed development. Stormwater Hydrologic Analyses that demonstrate the maintenance or reduction of peak discharge rates are provided in *Appendix E* and *Appendix F*. A summary of pre- versus post-development peak discharge rates is provided in Table 1, Table 2, Table 3, Table 4, and Table 5. Mitigation of peak flows is achieved through stormwater storage provided by the proposed stormwater detention basins.

***7.2.4.4. Rainfall amounts used for stormwater management design and analysis shall be based on NOAA Atlas 14, Volume 10 (or as it may be amended).***

Rainfall depths were obtained from NOAA Atlas 14, Volume 10, Version 3 published rainfall records for Shutesbury, Massachusetts. Rainfall data can be found in *Appendix B*.

***7.2.4.5. All stormwater management systems shall be designed and constructed to adequately control, contain, and recharge flow resulting from a 24-hour, 2-year, 10-year, and 100-year storm event. This requirement is designed to decrease the likelihood of downstream and off-site flooding, as well as to contribute to groundwater recharge.***

Post-development discharge rates will not increase as a result of the proposed development. Stormwater Hydrologic Analyses that demonstrate the maintenance or reduction of peak discharge rates are provided in *Appendix E* and *Appendix F*.

Due to high seasonal groundwater and site soils having an HSG classification of D, providing infiltration BMPs sized to meet the required groundwater recharge and provide proper drawdown for the project is not feasible.

***7.2.4.6. All footing drains and all stormwater outfalls must be, at a minimum, outside of the 50-foot Inner AURA and must be shown on all plans. See 310 CMR 10.03(4).***

Due to site constraints, it is not feasible to keep the pond outfalls outside the 50-foot inner aura.

## **8 Summary**

This Stormwater Management Report demonstrates the proposed project for the Shutesbury Public Library has been designed to meet the stormwater standards outlined in the Massachusetts Stormwater Handbook and the Town of Shutesbury Wetland Protection Bylaw Regulations.

## Tables

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**Table 1 - 2 Year Design Storm  
Peak Discharge Summary**

Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (%)
(1L)	1.1	0.8	-0.2	-23%
(2L)	2.0	2.0	0.0	0%
(3L)	0.3	0.3	0.0	-4%

**Table 2 - 10 Year Design Storm  
Peak Discharge Summary**

Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (%)
(1L)	2.1	1.6	-0.5	-24%
(2L)	3.9	3.7	-0.2	-5%
(3L)	0.5	0.5	0.0	-4%

**Table 3- 25 Year Design Storm  
Peak Discharge Summary**

Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (%)
(1L)	2.8	2.1	-0.7	-24%
(2L)	5.2	4.8	-0.4	-8%
(3L)	0.7	0.7	0.0	-4%

**Table 4 - 50 Year Design Storm  
Peak Discharge Summary**

Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (%)
(1L)	3.3	2.5	-0.8	-24%
(2L)	6.1	5.6	-0.5	-8%
(3L)	0.8	0.8	0.0	0%

**Table 5 - 100 Year Design Storm  
Peak Discharge Summary**

Design Point	Existing Flow (CFS)	Proposed Flow (CFS)	Net Change (CFS)	Net Change (%)
(1L)	3.8	2.9	-0.9	-24%
(2L)	7.1	6.8	-0.3	-4%
(3L)	0.9	0.9	0.0	-4%

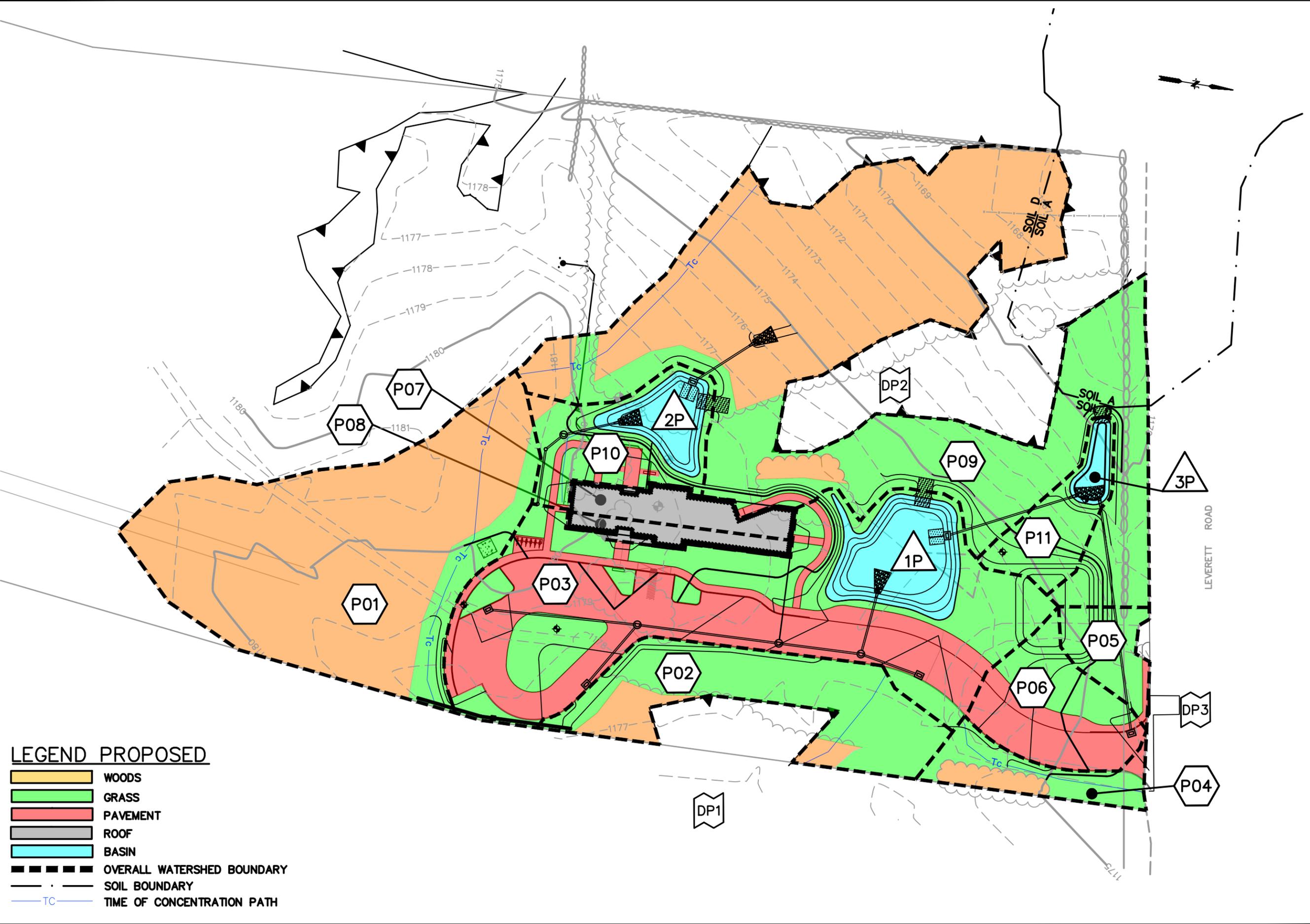
## Figures

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File: \\pvt\pvt\dfs\Cad\Proj\DWG\2022\110A10\Civil\Plan\2022\110A10\_DRA01.dwg Layout: FIG.3 Plotted: 2023-12-18 11:54 AM Saved: 2023-12-18 11:51 AM User: ABell  
 PC3: AUTOCAD PDF (GENERAL DOCUMENTATION).PC3 STB/CBT: FO STB  
 LAYER STATE: LAYER VIEW:



**LEGEND PROPOSED**

- WOODS
- GRASS
- PAVEMENT
- ROOF
- BASIN
- OVERALL WATERSHED BOUNDARY
- SOIL BOUNDARY
- TC TIME OF CONCENTRATION PATH

SCALE: - HORZ.: 1" = 60' VERT.: - DATUM: - HORZ.: - VERT.: - 0 30 60 GRAPHIC SCALE	<p><b>FUSS &amp; O'NEILL</b>          1550 MAIN STREET, SUITE 400          SPRINGFIELD, MA 01103          413.452.0445          www.fandob.com</p>	MASSACHUSETTS SHUTESBURY
TOWN OF SHUTESBURY POST DEVELOPMENT WATERSHED MAP SHUTESBURY PUBLIC LIBRARY		
PROJ. No.: 20221110.A10 DATE: 12/21/2023		
FIG. 3		

## **Appendix A**

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Site Plans  
(under separate attachment)

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## **Appendix B**

### Rain Fall Data



**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**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.324 (0.248-0.421)	0.382 (0.292-0.496)	0.476 (0.363-0.621)	0.554 (0.420-0.728)	0.662 (0.487-0.906)	0.743 (0.537-1.04)	0.828 (0.582-1.20)	0.922 (0.618-1.37)	1.06 (0.682-1.62)	1.16 (0.736-1.82)
10-min	0.459 (0.351-0.596)	0.541 (0.413-0.703)	0.675 (0.514-0.880)	0.785 (0.595-1.03)	0.938 (0.690-1.28)	1.05 (0.761-1.47)	1.17 (0.825-1.70)	1.31 (0.876-1.94)	1.50 (0.968-2.30)	1.65 (1.04-2.58)
15-min	0.540 (0.413-0.701)	0.636 (0.486-0.827)	0.793 (0.604-1.03)	0.924 (0.700-1.21)	1.10 (0.812-1.51)	1.24 (0.895-1.73)	1.38 (0.971-2.00)	1.54 (1.03-2.28)	1.76 (1.14-2.70)	1.94 (1.23-3.04)
30-min	0.745 (0.569-0.967)	0.877 (0.670-1.14)	1.09 (0.833-1.43)	1.28 (0.966-1.67)	1.52 (1.12-2.08)	1.71 (1.24-2.39)	1.90 (1.34-2.76)	2.12 (1.42-3.15)	2.43 (1.57-3.73)	2.68 (1.69-4.19)
60-min	0.949 (0.726-1.23)	1.12 (0.854-1.45)	1.40 (1.06-1.82)	1.62 (1.23-2.13)	1.94 (1.43-2.66)	2.18 (1.57-3.05)	2.43 (1.71-3.52)	2.71 (1.81-4.01)	3.10 (2.00-4.75)	3.41 (2.16-5.35)
2-hr	1.20 (0.927-1.56)	1.42 (1.09-1.83)	1.76 (1.35-2.28)	2.04 (1.56-2.66)	2.44 (1.80-3.32)	2.73 (1.99-3.80)	3.04 (2.16-4.40)	3.40 (2.28-5.01)	3.91 (2.54-5.98)	4.34 (2.75-6.77)
3-hr	1.37 (1.06-1.77)	1.62 (1.25-2.08)	2.02 (1.55-2.61)	2.35 (1.80-3.05)	2.81 (2.09-3.82)	3.15 (2.30-4.38)	3.51 (2.50-5.08)	3.94 (2.65-5.80)	4.57 (2.97-6.97)	5.10 (3.24-7.94)
6-hr	1.70 (1.32-2.17)	2.03 (1.58-2.60)	2.58 (2.00-3.31)	3.03 (2.33-3.90)	3.65 (2.73-4.94)	4.10 (3.02-5.70)	4.60 (3.32-6.68)	5.22 (3.52-7.65)	6.16 (4.02-9.36)	6.98 (4.45-10.8)
12-hr	2.07 (1.62-2.63)	2.53 (1.98-3.21)	3.28 (2.56-4.18)	3.90 (3.02-5.01)	4.76 (3.60-6.45)	5.39 (4.01-7.49)	6.09 (4.44-8.86)	6.98 (4.73-10.2)	8.40 (5.49-12.7)	9.64 (6.17-14.9)
24-hr	2.43 (1.92-3.07)	3.03 (2.38-3.82)	3.99 (3.13-5.06)	4.80 (3.74-6.11)	5.90 (4.49-7.96)	6.70 (5.02-9.30)	7.60 (5.59-11.1)	8.78 (5.97-12.8)	10.7 (7.00-16.1)	12.4 (7.94-19.0)
2-day	2.78 (2.21-3.48)	3.48 (2.76-4.36)	4.62 (3.65-5.82)	5.57 (4.37-7.05)	6.87 (5.26-9.22)	7.82 (5.89-10.8)	8.88 (6.57-12.9)	10.3 (7.02-14.9)	12.6 (8.26-18.8)	14.6 (9.38-22.3)
3-day	3.04 (2.42-3.79)	3.80 (3.02-4.74)	5.04 (3.99-6.32)	6.07 (4.78-7.66)	7.49 (5.76-10.0)	8.52 (6.44-11.7)	9.68 (7.19-14.0)	11.2 (7.67-16.2)	13.7 (9.03-20.5)	15.9 (10.3-24.3)
4-day	3.27 (2.61-4.07)	4.07 (3.25-5.08)	5.39 (4.28-6.74)	6.48 (5.12-8.16)	7.99 (6.16-10.7)	9.08 (6.88-12.5)	10.3 (7.67-14.9)	11.9 (8.18-17.2)	14.6 (9.62-21.8)	16.9 (10.9-25.8)
7-day	3.93 (3.15-4.86)	4.82 (3.87-5.98)	6.28 (5.02-7.82)	7.49 (5.95-9.38)	9.16 (7.08-12.1)	10.4 (7.89-14.1)	11.7 (8.74-16.8)	13.5 (9.29-19.4)	16.4 (10.8-24.3)	18.9 (12.2-28.7)
10-day	4.60 (3.70-5.67)	5.53 (4.45-6.83)	7.06 (5.66-8.76)	8.34 (6.64-10.4)	10.1 (7.81-13.3)	11.4 (8.65-15.4)	12.8 (9.51-18.2)	14.6 (10.1-20.9)	17.5 (11.6-25.9)	20.0 (13.0-30.3)
20-day	6.68 (5.42-8.18)	7.67 (6.21-9.41)	9.29 (7.49-11.4)	10.6 (8.53-13.2)	12.5 (9.69-16.2)	13.9 (10.5-18.5)	15.3 (11.3-21.3)	17.1 (11.9-24.2)	19.6 (13.1-29.0)	21.8 (14.2-32.9)
30-day	8.43 (6.86-10.3)	9.46 (7.69-11.6)	11.1 (9.02-13.7)	12.5 (10.1-15.5)	14.4 (11.2-18.6)	15.9 (12.1-20.9)	17.4 (12.8-23.8)	19.0 (13.3-26.9)	21.3 (14.3-31.3)	23.2 (15.1-34.8)
45-day	10.6 (8.68-12.9)	11.7 (9.55-14.2)	13.5 (10.9-16.4)	14.9 (12.1-18.4)	16.9 (13.2-21.7)	18.5 (14.1-24.2)	20.1 (14.7-27.1)	21.6 (15.1-30.4)	23.6 (15.9-34.6)	25.2 (16.4-37.7)
60-day	12.4 (10.2-15.1)	13.6 (11.1-16.5)	15.5 (12.6-18.8)	17.0 (13.8-20.8)	19.1 (14.9-24.4)	20.8 (15.8-27.0)	22.4 (16.4-30.1)	24.0 (16.8-33.6)	25.8 (17.4-37.7)	27.2 (17.8-40.7)

<sup>1</sup> 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.

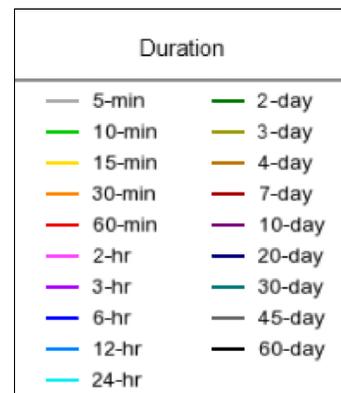
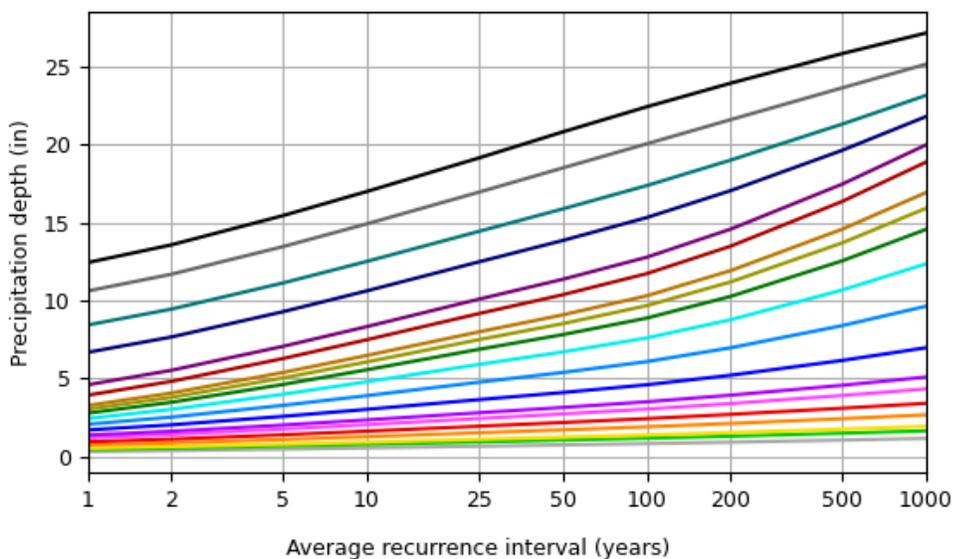
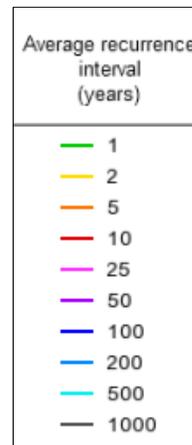
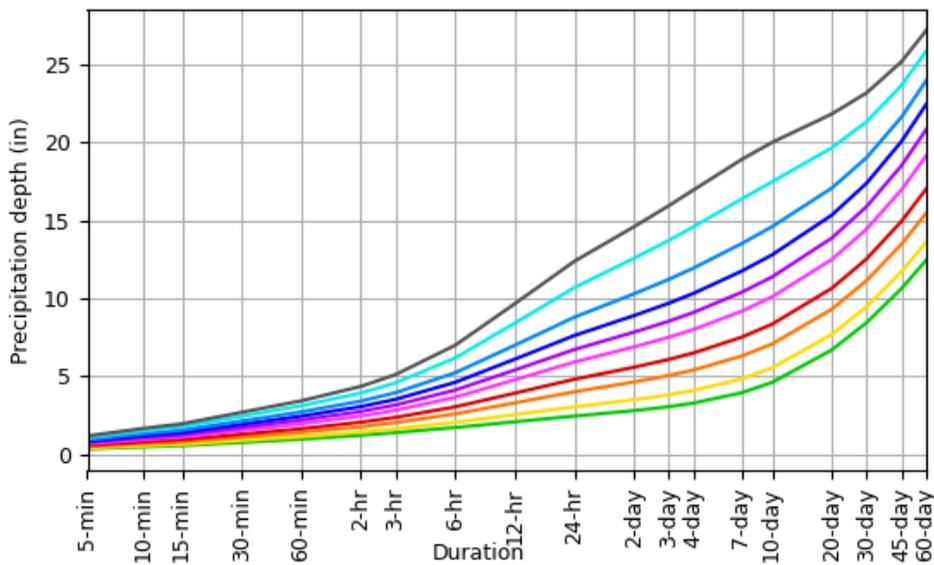
Please refer to NOAA Atlas 14 document for more information.

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**PF graphical**

PDS-based depth-duration-frequency (DDF) curves

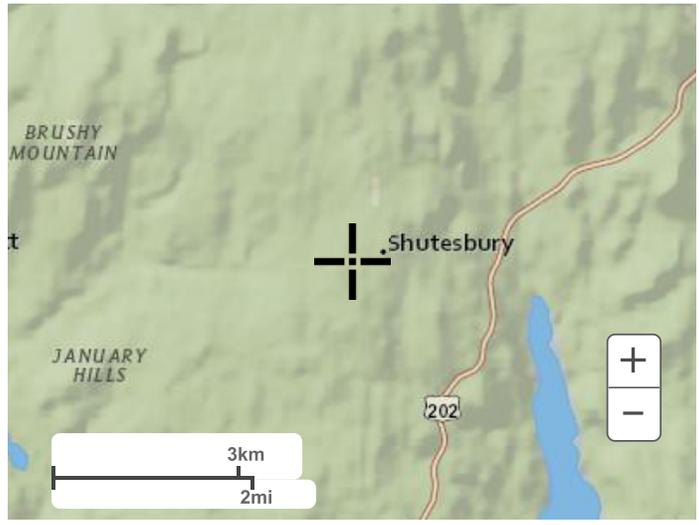
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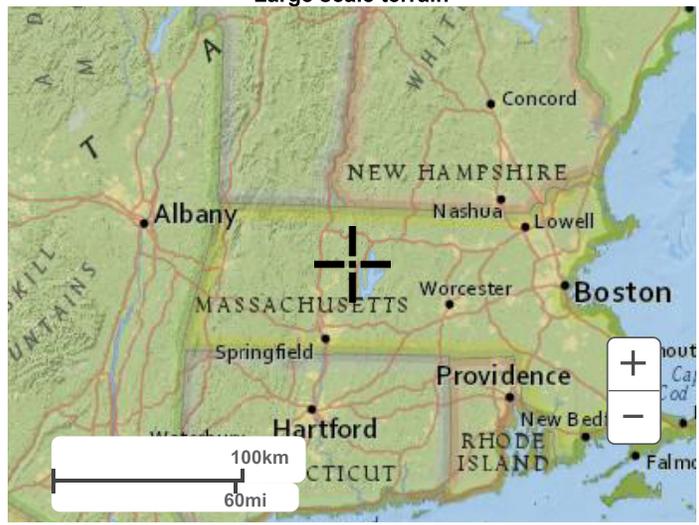
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**Maps & aerials**

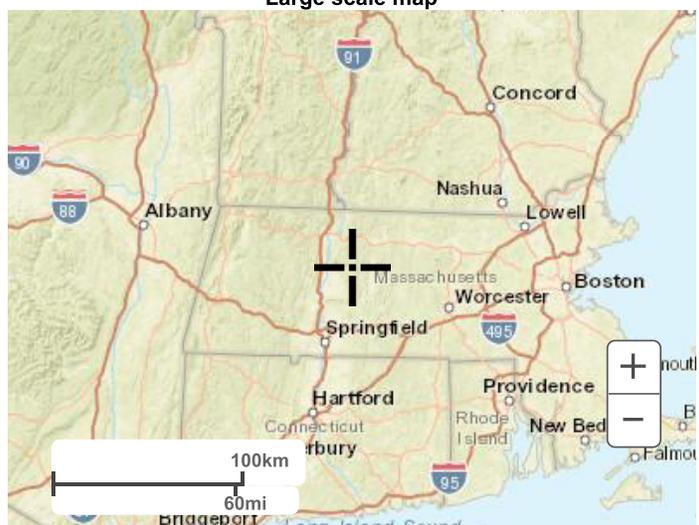
**Small scale terrain**



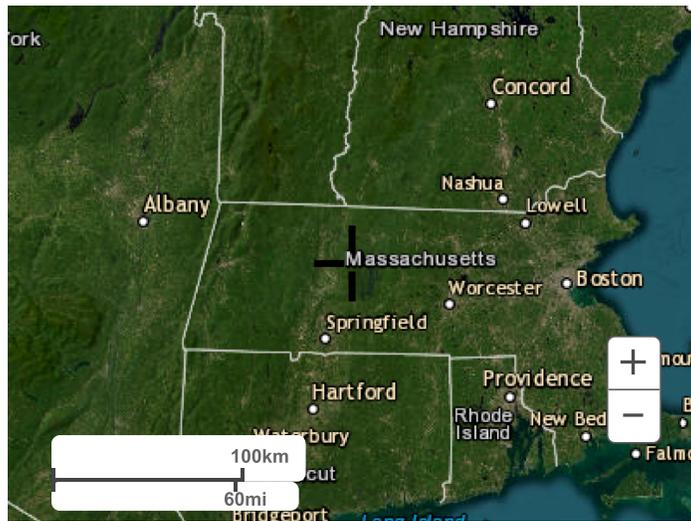
Large scale terrain



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](mailto:HDSC.Questions@noaa.gov)

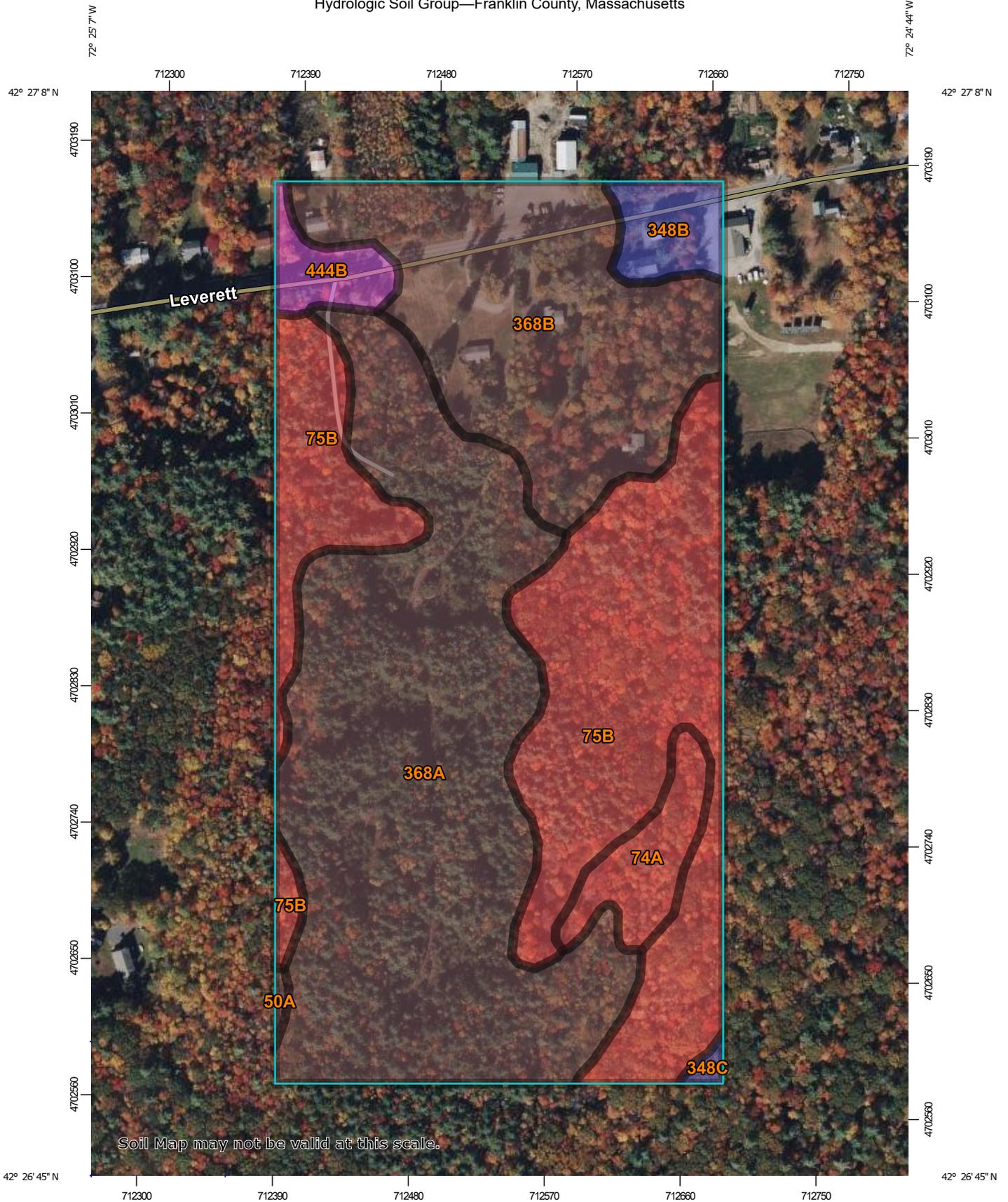
[Disclaimer](#)

## **Appendix C**

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### NRCS Web Soil Mapping

Hydrologic Soil Group—Franklin County, Massachusetts



Map Scale: 1:3,490 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84



## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

#### Soil Rating Polygons

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

#### Soil Rating Lines

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

#### Soil Rating Points

 A  
 A/D  
 B  
 B/D

 C  
 C/D  
 D  
 Not rated or not available

### Water Features

 Streams and Canals

### Transportation

 Rails  
 Interstate Highways  
 US Routes  
 Major Roads  
 Local Roads

### Background

 Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

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

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

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

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

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

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

Soil Survey Area: Franklin County, Massachusetts  
 Survey Area Data: Version 17, Sep 9, 2022

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

Date(s) aerial images were photographed: Oct 15, 2020—Oct 31, 2020

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

## Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
50A	Wonsqueak muck, 0 to 2 percent slopes	B/D	0.1	0.2%
74A	Peacham mucky peat, 0 to 8 percent slopes, very stony	D	1.5	3.5%
75B	Pillsbury fine sandy loam, 0 to 8 percent slopes, very stony	D	12.8	29.3%
348B	Henniker sandy loam, 3 to 8 percent slopes	B	1.1	2.6%
348C	Henniker sandy loam, 8 to 15 percent slopes	B	0.1	0.3%
368A	Metacomet fine sandy loam, 0 to 3 percent slopes	B/D	18.1	41.3%
368B	Metacomet fine sandy loam, 3 to 8 percent slopes	B/D	9.1	20.7%
444B	Chichester fine sandy loam, 3 to 8 percent slopes	A	1.0	2.2%
<b>Totals for Area of Interest</b>			<b>43.9</b>	<b>100.0%</b>

## Description

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

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

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

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

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

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

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

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

## **Appendix D**

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### Geotechnical Engineering Recommendations



J2060-03-01  
October 25, 2023

Ms. Mary Anne Antonellis, Director  
M.N. Spear Memorial Library  
10 Cooleyville Road  
PO Box 256  
Shutesbury, Massachusetts 01072

Re: Geotechnical Engineering Recommendations  
Shutesbury Public Library  
66 Leverett Road  
Shutesbury, Massachusetts

Dear Ms. Antonellis,

O'Reilly, Talbot & Okun Associates, Inc. (OTO) is pleased to provide this letter report summarizing our geotechnical engineering recommendations for the proposed new public library in Shutesbury, Massachusetts. A Site Locus is provided as Figure 1. A Site Plan is provided as Figure 2.

Our geotechnical recommendations are based upon the investigations performed during this study, as well as information gathered by OTO during both a preliminary geotechnical study in 2010 and a Limited Environmental Site Assessment (ESA) in 2021. In addition, OTO reviewed an Underground Injection Control (UIC) Closure Report prepared by Fuss & O'Neill (F&O) in 2022.

Our services consisted of a review of published geologic information and the previous studies, observation of the soil borings and test pits performed for this study, engineering analyses, and preparation of this report. This report is subject to the attached limitations.

## **PROJECT DESCRIPTION**

The project Site is located at 66 Leverett Road in Shutesbury, Massachusetts. The Site is bounded by a residential property to the east, Leverett Road followed by the Shutesbury Highway Department to the north, and wooded land to the west and south. The location of the Site is shown on Figure 1.

The Site currently consists of grass-covered areas with few trees. However, the western and southern portions of the Site are densely wooded. The ground surface of the grass-covered area slopes gently upward from approximate elevation 1,170 feet at Leverett Road to 1,180 feet near the southern tree line. We understand a former garage building (located to the northeast of the proposed building) with an approximate footprint of 1,500 square feet was demolished, and its slab removed, sometime in 2021. The floor drain and drain pipe components remained in place and were investigated under a UIC closure study by F&O in 2022. That study indicated that no further response actions regarding the UIC structure were warranted.

Project plans call for construction of an approximately 4,400 square foot (footprint) library building with associated parking areas and access roads. In addition, a stormwater detention basin will be constructed to the north of the proposed library building and a stormwater infiltration gallery to the southeast. The locations of the former garage and the proposed structures are shown on Figure 2.

We assume that the proposed library building will be a single-story, wood-framed structure. We understand that the building will be slab on grade with a finish floor elevation near the existing ground surface at approximate elevation 1,177 feet. Therefore, we anticipate cuts on the order of five feet or less will be required to construct the building.

We expect structural loads will be supported on both isolated column and continuous strip footings. Structural loads are unknown at this time. However, it is expected that maximum column loads will be less than 50 kips and that bearing walls will carry a load of five kips per linear foot, or less. We have assumed that floor loads may be relatively high in stack areas. The design team should confirm these assumptions.

## **SUBSURFACE EXPLORATIONS**

Geotechnical subsurface investigations consisted of four backhoe test pits and six soil borings. In addition, we reviewed soil borings that were performed as part of an environmental study in 2021. The conditions encountered in these borings (B-1 through B-10) were consistent with the geotechnical investigations. The location of each boring and test pit is shown on Figure 2. However, the environmental borings are not discussed in detail within this report. For additional details, please refer to our “Limited Subsurface Assessment” report, dated October 5, 2021.

### Soil Borings

The six geotechnical soil borings were performed by Seaboard Environmental Drilling of Chicopee, Massachusetts. Each boring was performed using a truck mounted drill rig and advanced using hollow stem auger drilling techniques. After drilling, bore holes were backfilled with soil cuttings. Boring logs are attached.

Soil borings SL-101 and SL-102 were performed within the proposed building footprint on October 3, 2023. The borings were extended to refusal at a depth of 16 feet below ground surface, corresponding to elevations between 1,163 and 1,162 feet. The proposed boring locations were adjusted in the field due to uneven terrain and landscaping, as areas of the Site were inaccessible with the truck mounted drill rig.

Borings SL-1 through SL-4. were performed to the northwest of the current proposed library building during a preliminary geotechnical study on June 23, 2010. The borings were extended to refusal at a depth of between 18 and 21.5 feet below ground surface, corresponding to elevations between 1,153.5 and 1,155.5 feet.

An OTO field representative observed and logged each boring. Soil samples were described according to a modified version of the Burmister Soil Classification System.

Soil samples were collected using a two-inch diameter split spoon sampler, driven 24 inches with a 140-pound safety hammer falling 30 inches (American Society for Testing and Materials Test Method D1586 “Standard Test Method for Penetration Test and Split-

Barrel Sampling of Soils”). The number of blows required to drive the sampler each six inches was recorded. The standard penetration resistance, or N-value, is the number of blows required to drive the sampler the middle 12 inches. Soil properties, such as strength and density, are related to the N-value. We note that the N-value collected in the field is corrected to account for differing hammer efficiencies, sampler type, borehole diameter, and depth. Typically, the field N-values are corrected to a standard 60% hammer efficiency, known as  $N_{60}$ . The N-values presented on the boring logs are field values, which are not adjusted for hammer efficiency. However, adjusted  $N_{60}$  values were used in our engineering calculations and analysis.

### Test Pits

Four test pits were performed on October 3, 2023 by the Shutesbury Department of Public Works. The test pits were performed using a CAT 420XE backhoe equipped with a 0.25 cubic yard bucket.

Test pits TP-1 and TP-2 were performed within or near the proposed stormwater infiltration gallery to the southeast of the proposed library. Test pits TP-3 and TP-4 were performed within or near the proposed stormwater detention basin to the north of the proposed library. The test pits were performed to observe the nature of near surface soils and examine historic groundwater levels. An OTO representative observed and logged each test pit. Test pit logs are attached.

## **SUBSURFACE CONDITIONS**

Subsurface conditions were interpreted based upon the explorations performed for this study and conditions documented in our 2010 preliminary geotechnical report. Subsurface conditions consisted of a surface layer of topsoil underlain by fine to medium sand and silt. Soil conditions are generally favorable for the proposed development.

### Soil Conditions

Approximately four to eight inches of topsoil was encountered at the ground surface in each of the borings and test pits. The topsoil consisted of brown, fine sand and silt with little medium sand, little organics (roots), and trace amounts of coarse sand and gravel.

Non-engineered fill was encountered in test pit TP-3 to an approximate depth of 6.5 feet below ground surface, corresponding to elevation 1,169.5 feet. The fill consisted of dark brown, fine to medium sand with trace amounts of gravel and little silt, coarse sand, and debris (brick, concrete, ash).

Sandy native soils were encountered immediately beneath the surficial topsoil and non-engineered fill layers. These soils generally consisted of medium dense to very dense, fine to medium sand with little silt and varying amounts of coarse sand and gravel.

Test pits TP-1 through TP-4 were terminated within this layer at a depth of 9.5 to 11 feet below ground surface, corresponding to approximate elevations 1169.5 to 1161.5 feet.

Borings SL-101 and SL-102 were terminated at a depth of 16 feet below ground surface, corresponding to approximate elevations 1,163 and 1,162 feet, respectively. Auger refusal

was encountered in borings SL-1 through SL-4 at a depth of between 18 and 21.5 feet below the ground surface, corresponding to approximate elevations 1,153.5 to 1,155.5 feet. Auger refusal was likely within the very dense soil layer.

### Groundwater Conditions

Saturated soils were encountered in each of the soil borings and test pits at a depth of 2 to 15 feet below ground surface, corresponding to approximate elevations 1,177 to 1,161 feet. It is unclear whether the saturated soils are indicative of groundwater or a result of limited vertical infiltration (perched water). Regardless, wet soils may be encountered during construction and the building should be designed to control groundwater and surface water infiltration.

## **SIGNIFICANT GEOTECHNICAL ISSUES**

The significant geotechnical issues for the proposed construction addressed in this report include the following: foundation bearing capacity and settlement; seismic design considerations; surface water and groundwater control; and the suitability of on-Site materials for use as engineered fill.

## **DESIGN RECOMMENDATIONS**

The following recommendations are provided for the construction assumed in this report. These recommendations may need to be revised if the building location and/or slab elevations change during design.

The recommendations in this report refer to the 9<sup>th</sup> Edition of the Massachusetts State Building Code (MSBC), which includes amendments to the 2015 International Building Code (IBC). We note that the 10<sup>th</sup> Edition of the MSBC is expected to become effective in 2024. However, the effective date and the concurrency period have not been announced. We recommend that information provided in this report be reviewed and updated if the final version of the new building code is published and becomes effective, and if this project falls outside of the concurrency period.

### Former Garage Building

We understand that the former garage building was removed in 2021 and that a remaining floor drain and drain pipe was investigated in 2022. Furthermore, we understand that no former utilities or structures were located with the footprint of the proposed building. However, we note that abandoned buried utilities containing asbestos (such as electrical conduit insulation or transite pipe) associated with the former garage building may be encountered during Site preparation and excavations. Furthermore, former structures (pipes, conduits, foundations walls) may contain or be covered with materials containing asbestos. Such materials should be handled in accordance with MassDEP's asbestos regulations (310 CMR 7.15). We recommend that suspect materials be managed appropriately and tested by a Department of Labor Standards (DLS) certified asbestos inspector prior to disturbances.

### Non-Engineered Fill

No significant amounts of non-engineered fill was observed within the two borings performed within or near the footprint of the new building. Non-engineered fill was encountered to a depth of 6.5 feet below ground surface in test pit TP-3, which was located within the proposed stormwater detention basin (to the north of the proposed building footprint). Furthermore, non-engineered fill within the footprint of the proposed building (if encountered) should be removed and replaced with engineered fill.

### Foundation Recommendations

The proposed building can be founded on normal spread footing foundations bearing on compacted native soils or engineered fill. Provided the recommendations presented in this section are followed, a maximum allowable bearing pressure of 4,500 pounds per square foot may be used for the design of exterior and isolated column footings. If wet soils are encountered at the footing level, the footing subgrade should be over-excavated by six inches and six inches of Crushed Stone should be placed to protect the footing subgrade from disturbance.

Any non-engineered fill, asphalt, and topsoil layers should be removed from beneath the building footprint. Any unsuitable soils should be replaced with compacted Sand and Gravel or Crushed Stone. In addition, we recommend that the entire building footprint be thoroughly proof compacted to treat any near surface loose areas. The Sand and Gravel fill beneath the footings should meet the grain size distribution characteristics outlined in Table 3.

We estimate that settlement of footings and slabs bearing on dense native soils or compacted engineered fill should be small and largely elastic in nature. Maximum settlements should be less than one half inch and should occur relatively quickly after load application (during construction).

Exterior footings should be embedded a minimum of 48 inches below the lowest adjacent grade for frost protection. Interior footings should bear at least two feet below the surrounding floor slab. Strip footings, beneath the load bearing walls, should be at least 18 inches wide. Isolated column footings should be at least 24 inches wide. All other applicable requirements of the Massachusetts State Building Code (MSBC) should be followed.

Footings should not be placed on frozen soils. Footing excavations should be free of loose or disturbed materials. Any boulders or cobbles larger than four inches in diameter should be removed from within one foot of the bottom of the footings and replaced with Sand and Gravel or Crushed Stone. The footing subgrades should be densified immediately prior to placement of footing concrete with at least three passes with a vibrating plate compactor. If loose materials are present in the excavations, they shall be recompacted to form a firm, dense bearing surface.

### Concrete Slabs

We recommend that concrete floor slabs bear on at least 12 inches of compacted Sand and Gravel or Crushed Stone to provide uniform support and a capillary moisture break.

The subgrade should also be free of large boulders or cobbles, if encountered. The Sand and Gravel or Crushed Stone fill beneath the concrete slabs should meet the grain size distribution characteristics outlined in Table 3.

The subgrade within the footprint of the proposed building should be stripped of topsoil and any asphalt or non-engineered fill. Prior to the placement of any engineered fill, we recommend that the building footprint be thoroughly densified to treat any loose areas that may be present. If non-engineered fill, soft, or disturbed areas are present, these materials should be removed and recompacted or replaced with compacted Sand and Gravel or Crushed Stone. Fill supporting slabs should be placed in accordance with the recommendations presented on Sheet 1.

### Groundwater and Surface Water Control

Wet soils were observed at a depth of 2 to 15 feet below ground surface, corresponding to approximate elevations 1,177 to 1,161 feet. Therefore, we recommend that the proposed building include perimeter drainage to control groundwater and surface water infiltration. The perimeter drainage system can consist of perforated PVC pipe installed in a Crushed Stone trench and wrapped in a non-woven geotextile fabric.

If wet soils are encountered during excavations for footings and utilities, it should be possible to dewater these excavations by trenching or using sump pumps. Furthermore, the contractor should establish and maintain proper drainage of soils during construction. The silty soils present at the Site are susceptible to moisture, due to the high percentage of fines within the soil mass. If these soils become wet during construction, they will become soft and easily disturbed.

### Seismic Considerations

Earthquake loadings must be considered under requirements in Section 1613 and 1806 of the 9<sup>th</sup> Edition (October 2017) of the Massachusetts State Building Code (MSBC), which is based upon the International Building Code 2015 (IBC) with Massachusetts amendments. Note that the IBC refers to ASCE-7 (2010), *Minimum Design Loads for Buildings and Other Structures*.

Section 1613 of the IBC covers lateral forces imposed on structures from earthquake shaking and requires that every structure be designed and constructed to resist the effects of earthquake motions in accordance with ASCE-7. Lateral forces are dependent on the type and properties of soils present beneath the Site, along with the geographic location. Per Table 1604.11, the maximum considered earthquake spectral response acceleration at short periods ( $S_s$ ) and at 1-sec ( $S_1$ ) was determined for Shutesbury, Massachusetts.

Soil properties are represented through Site Classification. Procedures for the Site-specific determination of Site Classification are provided in Chapter 20 of ASCE-7. We evaluated Site Classification using one of the parameters allowed, Standard Penetration Resistance (N-value), using values obtained from the 2010 and 2023 soil borings. Furthermore, the Site coefficients  $F_a$  and  $F_v$  were determined according to Tables 1613.3.3(1) and 1613.3.3(2) of the IBC (2015), using both the  $S_s$  and  $S_1$  values and the Site Class. Seismic design parameters are provided in Table 1.

**Table 1**  
**Seismic Design Parameters**

Parameter	Value
$S_s$	0.174
$S_1$	0.067
Site Class	C
$F_a$	1.2
$F_v$	1.7

Section 1806.4 relates to the liquefaction potential of the underlying soils. The liquefaction potential was evaluated for saturated Site soils. The liquefaction potential was evaluated for saturated Site soils, using Figure 1806.4b of the MSBC. Liquefiable layers were not identified in the soil borings. In addition, loose soil layers below the maximum depth explored are not anticipated.

#### Exterior Slabs and Pavements

This section provides recommendations for exterior entryways, slabs, and sidewalks, as well as flexible pavements.

#### Entryways and Sidewalks

Exterior concrete slabs, such as those at entryways and sidewalks adjacent to the building should be designed to mitigate differential frost movement between adjacent slabs, doorways, and pavements. To address this concern, we recommend that concrete slabs at entryways be underlain by four feet of non-frost susceptible Sand and Gravel fill. Where exterior slabs butt against hard surfaces, we recommend that for the area beyond the edges of the slab, the bottom of Sand and Gravel fill should transition gradually upward at a slope of 3H:1V or flatter (zone of influence). A typical detail (not for construction) showing an entryway fill area is shown on Sheet 2.

We recommend that concrete sidewalks that are outside the zone of influence of the building and entryways, as well as areas where differential frost movement would not cause a tripping hazard, bear on at least 12 inches of imported, compacted Sand and Gravel to provide uniform support and a capillary moisture break. Fill should be placed in accordance with the recommendations for compaction provided on Sheet 1. Subgrades should also be free of large boulders. We recommend that the entire subgrade of the sidewalk be proof compacted with a heavy vibrating roller to treat any loose areas. In addition, we recommend that the design team incorporate drainage into the sidewalk areas to remove water from the subgrade, in order to limit frost and the resulting vertical movement of sidewalks. The Sand and Gravel fill beneath the concrete slabs and sidewalks should meet the grain size distribution characteristics described in Table 3.

#### Flexible Pavement Design

We anticipate that the proposed pavements will likely experience loads from light passenger vehicles and occasional heavier vehicles. The proposed flexible asphalt design section is provided in Table 2.

**Table 2**  
**Pavement Design Sections**

<b>Layer</b>	<b>Thickness</b>
Asphalt Finish Course	1.5 inches
Asphalt Binder Course	1.5 inches
Gravel Base Course	12 inches

We recommend that the pavement subgrade be proof compacted to treat any loose areas. Table 3 presents recommendations for gradation requirements for the Gravel Base Course material. Please note that the Gravel Base Course matches the MassDOT Highway Division specification M1.03.1 for Processed Gravel for Subbase.

We note that the near surface silty soils present at the Site are poorly drained, are susceptible to disturbances during construction, and have the potential to cause frost heaves to occur in pavements. We recommend that pavements be pitched to promote surface water runoff. In addition, subsurface drainage should be provided to prevent water from accumulating on the surface during construction, and beneath pavement sections after installation.

#### Earthwork Considerations

We anticipate that earthwork for this project will include Site grading, excavations for footings; placement of compacted engineered fill beneath the building, floor slab, and pavements (as needed); and the treatment of the existing soils to address any localized loose areas that may be present.

#### Engineered Fill Recommendations

Four engineered fill types are recommended:

- Sand and Gravel for use immediately below slabs, pavements, and sidewalks
- Crushed Stone for use immediately below footings and slabs (if needed), in drainage systems, and as an alternative to Sand and Gravel
- Gravel Base Course for use beneath pavements
- Granular Fill for use in landscaped areas and as miscellaneous fill

Grain size distribution requirements are presented in Table 3. On-Site soils do not appear to meet requirements for reuse as engineered fill. If the contractor elects to use the on-Site material as fill, we recommend that representative samples be collected, and grain size distribution analyses be performed to obtain approval by the engineer.

Please note that the Sand and Gravel specification is approximately that for MassDOT Highway Division specification M1.03.0 for Type B Gravel Borrow.

**Table 3**  
**Grain Size Distribution Requirements**

Size	Sand and Gravel	Gravel Base Course	Granular Fill	Crushed Stone
	Percent Finer by Weight			
3 inch	100	100	100	---
1 ½ inch	---	70-100	---	---
1 inch	---	---	---	100
¾ inch	---	50-85	---	90-100
½ inch	50-85	---	---	10-50
⅜ inch	---	---	---	0-20
No. 4	40-75	30-60	---	0-5
No. 10	---	---	30-90	---
No. 40	10-35	---	10-70	---
No. 200	0-10	0-10	0-15	---

*Compaction Recommendations*

Fill, debris, and topsoil should be removed from beneath the building footprint and should not be reused as fill beneath structures. To avoid point loads, any cobbles or boulders larger than four inches in diameter encountered at the subgrade should also be removed. Prior to the placement of any engineered fill, we recommend that the entire building footprint be thoroughly proof compacted. Proof compaction should be accomplished by a minimum of six passes with a 6,000-pound vibratory roller. To facilitate compaction, the moisture content of the on-Site material should be maintained at or near the optimum moisture content as determined by ASTM D1557.

Compacted fill should be placed in lifts ranging in thickness between 6 and 12 inches depending on the size and type of equipment. Recommended degrees of compaction and compaction means and methods are presented on Sheet 1.

Compaction within five feet of foundation walls should be performed using a hand-operated roller or vibratory plate compactor. If the new walls are to be backfilled on both sides, placement and compaction of engineered fill should proceed on both sides of the wall so that the difference in top of fill on either side does not exceed two feet.

*Sloping and Earth Support*

We do not anticipate that significant shoring, underpinning, or sloping will be necessary to construct the proposed building. Any temporary earth support or underpinning should be the responsibility of the contractor. Prior to construction, we recommend that the contractor evaluate the need for temporary earth support systems. The unconsolidated native soils encountered at the Site are estimated to be Type C soils for slope stability purposes. The maximum allowable slope for excavations of Type C soils is 1H:1V (45°). All excavations should conform to current OSHA requirements.

## 6.0 FINAL DESIGN AND CONSTRUCTION PHASE SERVICES

It is recommended that O'Reilly, Talbot & Okun Associates, Inc. (OTO) be retained during final design to prepare and/or review appropriate specification sections and drawings, if necessary. During construction phases, we recommend that OTO be retained to provide engineering support, including documentation of subgrade conditions and preparation.

Environmental Assessments have been completed for this Site. Any environmental conditions reported as part of those assessments should be evaluated regarding potential impacts to the proposed construction and recommendations in this report. Any impacted soil and/or groundwater that is encountered during construction will need to be managed in accordance with the appropriate regulations.

We appreciated the opportunity to be of service on this project. If you have any questions, please do not hesitate to contact the undersigned.

Sincerely yours,  
O'Reilly, Talbot & Okun Associates, Inc.



Dustin A. Humphrey, P.E.  
Sr. Project Manager

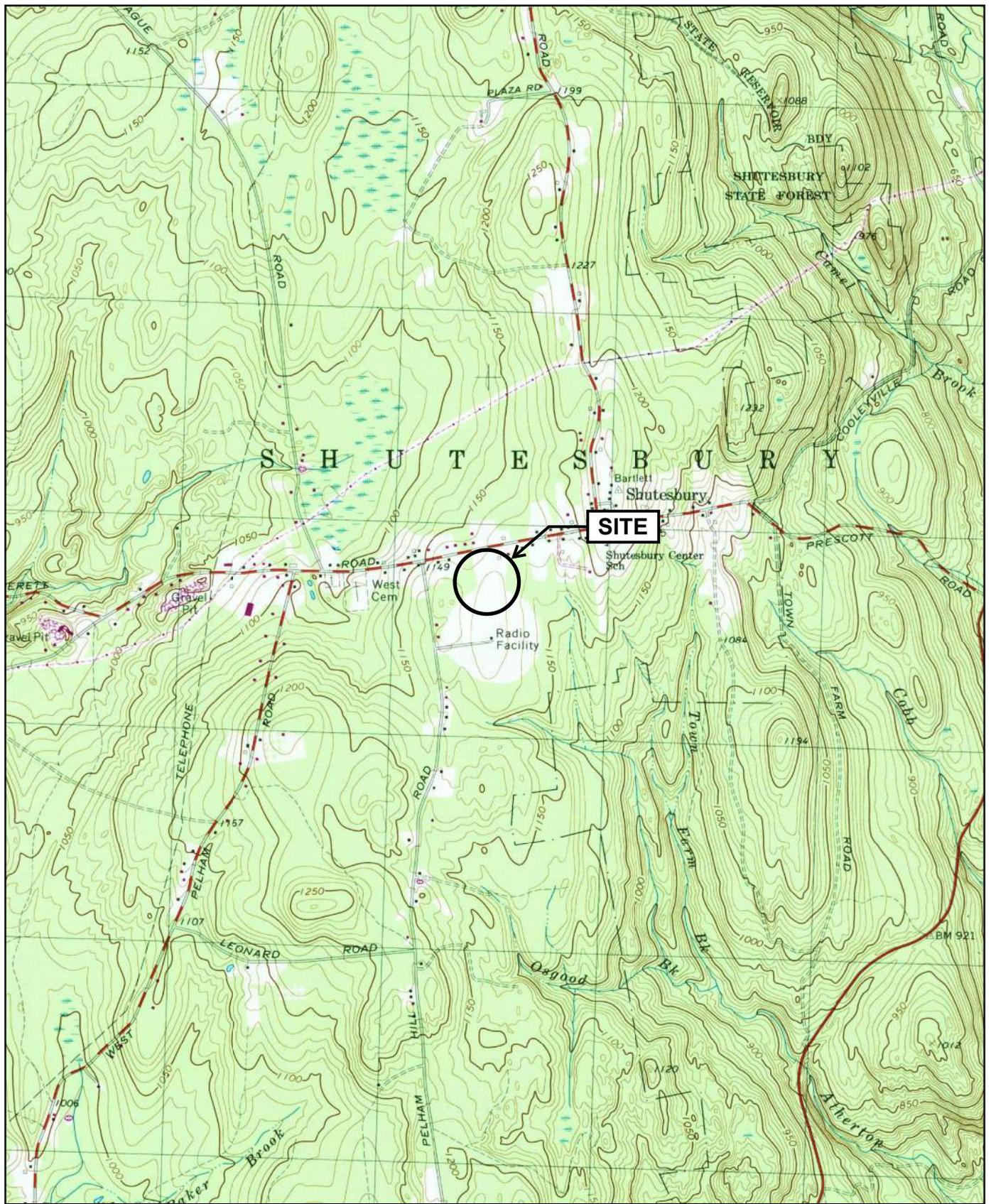


Ashley L. Sullivan, P.E.  
Principal

Attachments: Limitations  
Figure 1: Site Locus  
Figure 2: Site Plan  
Sheet 1: General Compaction Guidelines  
Sheet 2: Typical Foundation Section  
2023 Boring Logs  
2010 Boring Logs  
Test Pit Logs  
Test Pit Photographs

## LIMITATIONS

1. The observations presented in this report were made under the conditions described herein. The conclusions presented in this report were based solely upon the services described in the report and not on scientific tasks or procedures beyond the scope of the project or the time and budgetary constraints imposed by the client. The work described in this report was carried out in accordance with the Statement of Terms and Conditions attached to our proposal.
2. The analysis and recommendations submitted in this report are based in part upon the data obtained from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it may be necessary to reevaluate the recommendations of this report.
3. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.
4. In the event that any changes in the nature, design or location of the proposed structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by O'Reilly, Talbot & Okun Associates Inc. It is recommended that we be retained to provide a general review of final plans and specifications.
5. Our report was prepared for the exclusive benefit of our client. Reliance upon the report and its conclusions is not made to third parties or future property owners.



1:25,000 SCALE NATIONAL GEODETIC VERTICAL DATUM 1929 10 FOOT CONTOUR INTERVAL

C:\Users\20601\OneDrive\Shutesbury\03-01 New MN Spear Library\Leverett Rd Shutesbury, MA - Geotech\Report and Figures\Figure 1 - Site Locus.pdf

**O'Reilly, Talbot & Okun**  
ENGINEERING ASSOCIATES  
293 Bridge Street, Suite 500 Springfield, MA 01103 413.788.6222  
www.OTO-ENV.com

**SHUTESBURY PUBLIC LIBRARY**

66 LEVERETT ROAD  
SHUTESBURY, MASSACHUSETTS

**SITE LOCUS**

Topographic Map Quadrant:  
SHUTESBURY, MA  
Map Version: 1964  
Current As Of: 1979  
Date: SEPTEMBER 2023

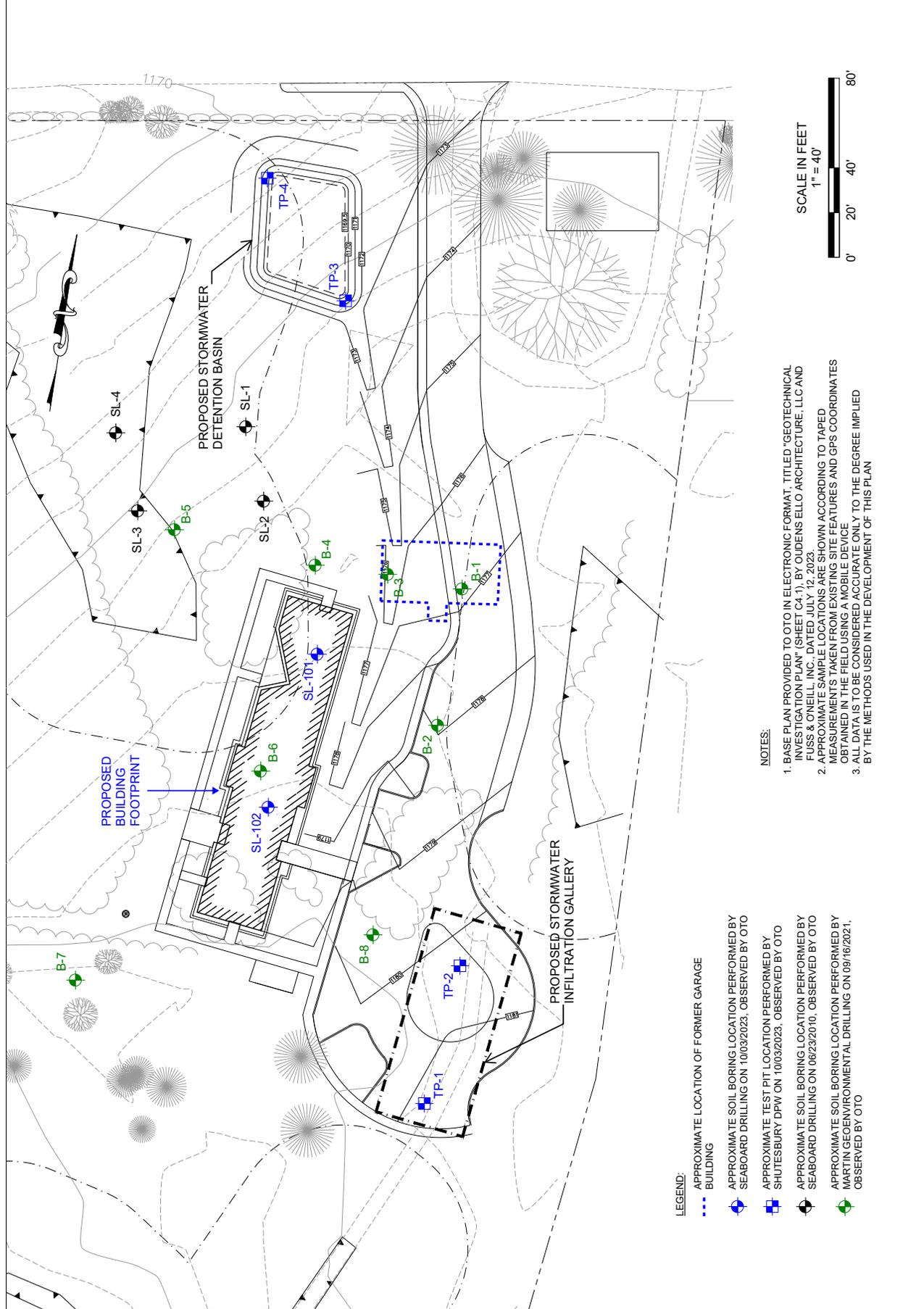
PROJECT No.  
**J2060-03-01**

FIGURE No.  
**1**

DESIGNED BY: PJC  
 DRAWN BY: SLR  
 CHECKED BY:  
 DATE: 10/06/2023  
 REV. DATE:

**SITE PLAN**  
 SHUTESBURY PUBLIC LIBRARY  
 66 LEVERETT ROAD  
 SHUTESBURY, MASSACHUSETTS

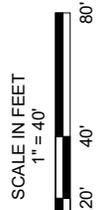
PROJECT NO. J2060-03-01  
 FIGURE NO. 2



**LEGEND:**

- APPROXIMATE LOCATION OF FORMER GARAGE
- BUILDING
- APPROXIMATE SOIL BORING LOCATION PERFORMED BY SEABOARD DRILLING ON 10/03/2023, OBSERVED BY OTO
- APPROXIMATE TEST PIT LOCATION PERFORMED BY SHUTESBURY DPW ON 10/03/2023, OBSERVED BY OTO
- APPROXIMATE SOIL BORING LOCATION PERFORMED BY SEABOARD DRILLING ON 06/23/2010, OBSERVED BY OTO
- APPROXIMATE SOIL BORING LOCATION PERFORMED BY MARTIN GEOTECHNICAL DRILLING ON 09/16/2021, OBSERVED BY OTO
- APPROXIMATE SOIL BORING LOCATION PERFORMED BY SEABOARD DRILLING ON 10/03/2023, OBSERVED BY OTO
- APPROXIMATE TEST PIT LOCATION PERFORMED BY SHUTESBURY DPW ON 10/03/2023, OBSERVED BY OTO
- APPROXIMATE SOIL BORING LOCATION PERFORMED BY SEABOARD DRILLING ON 06/23/2010, OBSERVED BY OTO
- APPROXIMATE SOIL BORING LOCATION PERFORMED BY MARTIN GEOTECHNICAL DRILLING ON 09/16/2021, OBSERVED BY OTO

- NOTES:**
1. BASE PLAN PROVIDED TO OTO IN ELECTRONIC FORMAT, TITLED "GEOTECHNICAL INVESTIGATION PLAN" (SHEET C4-1) BY OUDENS ELLO ARCHITECTURE, LLC AND FULS & ONEILL, INC., DATED JULY 12, 2023.
  2. APPROXIMATE SAMPLE LOCATIONS ARE SHOWN ACCORDING TO TAPED MEASUREMENTS TAKEN FROM EXISTING SITE FEATURES AND GPS COORDINATES OBTAINED IN THE FIELD USING A MOBILE DEVICE.
  3. ALL DATA IS TO BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHODS USED IN THE DEVELOPMENT OF THIS PLAN.



**Table 1-1  
Degree of Compaction Recommendations**

Location	Minimum Compaction
Below Structures (Foundations and Slabs)	95%
Below Pavements/Sidewalks/Exterior Slabs	95%
Against Basement Walls/Retaining Walls	92%
Utility Trenches	95%
General Landscaped Areas	90%
Notes. 1. Percentage of the maximum dry density as determined by Modified Proctor ASTM D1557, Method C. 2. When location falls into two or more categories, the engineer should be notified to determine appropriate compaction efforts and/or methods. 3. Crushed stone should be compacted in lifts of 12 inches to form a dense matrix using either traditional compaction methods (vibratory plate and/or roller) or tamping with an excavator bucket in deep excavations. It is generally not necessary to perform laboratory or field density testing on crushed stone.	

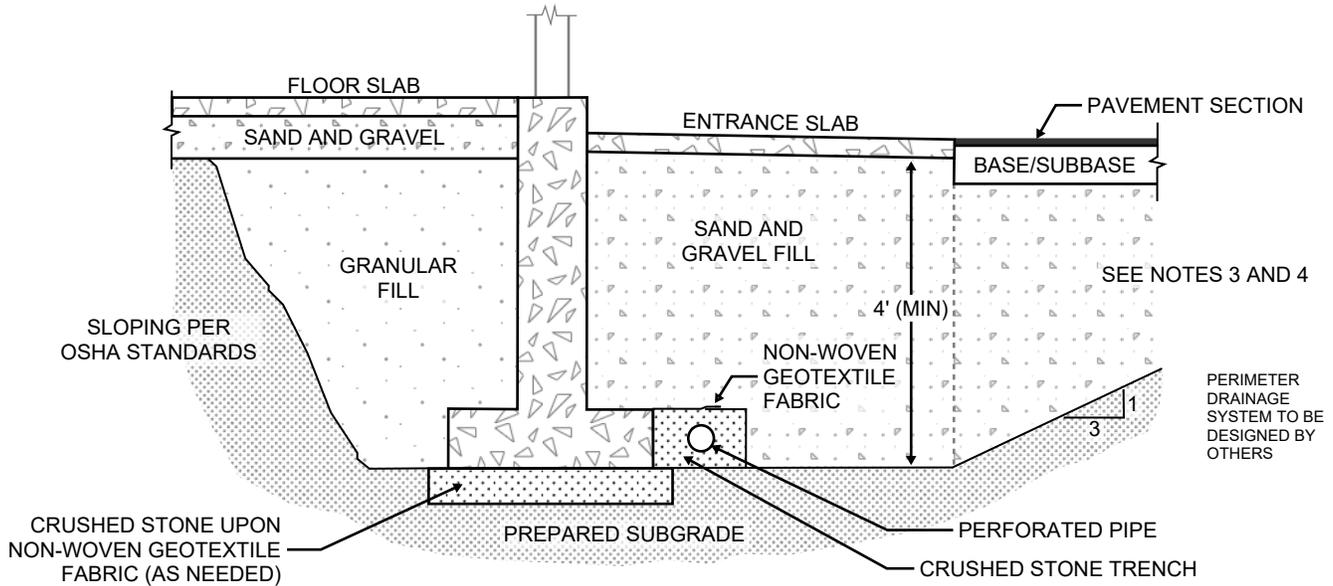
**Table 1-2  
General Guidelines for Compaction Means and Methods**

Compaction Method	Maximum Stone Size (Inches Diameter)	Maximum Lift Thickness (Inches)		Minimum Number of Passes	
		Below Structures & Pavement	Non-Critical Areas	Below Structures & Pavement	Non-Critical Areas
Hand-operated Vibratory Plate and confined spaces	3	6	8	6	4
Hand-operated vibratory drum roller (less than 1000 pounds)	3	6	8	6	4
Hand-operated vibratory drum roller (at least 1,000 pounds)	6	8	10	6	4
Light vibratory drum roller (minimum 3000 pounds)	6	10	14	6	4
Heavy vibratory drum roller (minimum 6000 pounds)	6	12	18	6	4
Note: The contractor should reduce or stop drum vibration if pumping of the subgrade is observed.					

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 <p>O'Reilly, Talbot &amp; Okun ENGINEERING ASSOCIATES 293 Bridge Street, Suite 500 Springfield, MA 01103 413.788.6222 www.OTO-ENV.com</p>	<p><b>SHUTESBURY PUBLIC LIBRARY</b> 66 LEVERETT ROAD SHUTESBURY, MASSACHUSETTS</p>	DESIGNED BY: ALS DRAWN BY: DAH CHECKED BY: MJT DATE: 11/09/2016 REV. DATE: 07/11/2022	PROJECT No. <b>J2060-03-01</b> SHEET No. <b>1</b>
	<p><b>GENERAL COMPACTION GUIDELINES</b></p>		

O:\2000\2060 Town of Shutesbury\03-01 New MN Spear Library\Leverett Rd Shutesbury, MA - Geotech\Field Work Sheet 2 - Foundations.pdf



**TYPICAL FOUNDATION SECTION  
SLAB ON GRADE FOOTING WITH ENTRANCE SLAB**

**NOTES:**

1. NOT FOR CONSTRUCTION, FOR ILLUSTRATION PURPOSES ONLY
2. FOR ADDITIONAL INFORMATION, REFER TO OTO'S GEOTECHNICAL REPORT DATED OCTOBER 2023
3. UNPAVED AREAS SHALL INCLUDE LOAM CAP AND SHOULD BE GRADED TO DIRECT SURFACE FLOW AWAY FROM BUILDING
4. PERMEABLE BACKFILL SHALL BE USED IN AREAS WITH UNDERDRAIN SYSTEMS

## BORING LOGS

### SUMMARY OF THE BURMISTER SOIL CLASSIFICATION SYSTEM (MODIFIED)

#### RELATIVE DENSITY (of non-plastic soils) OR CONSISTENCY (of plastic soils)

STANDARD PENETRATION TEST (SPT)
Method: Samples were collected in accordance with ASTM D1586, using a 2" diameter split spoon sampler driven 24 inches. If samples were collected using direct push methodology (Geoprobe), SPTs were not performed and relative density/consistency were not reported. N-Value: The number of blows with a 140 lb. hammer required to drive the sampler the middle 12 inches. WOR: Weight Of Rod (depth dependent) WOH: Weight Of Hammer (140 lbs.)

COHESIONLESS SOILS		COHESIVE SOILS	
BLOWS/FOOT (SPT N-Value)	RELATIVE DENSITY	BLOWS/FOOT (SPT N-Value)	CONSISTENCY
0-4	Very loose	<2	Very soft
4-10	Loose	2-4	Soft
10-30	Medium dense	4-8	Medium Stiff
30-50	Dense	8-15	Stiff
>50	Very dense	15-30	Very stiff
*Based upon uncorrected field N-values		>30	Hard

#### MATERIAL: (major constituent identified in CAPITAL letters)

COHESIONLESS SOILS		
MATERIAL	FRACTION	GRAIN SIZE RANGE
<b>GRAVEL</b>	Coarse	3/4" to 3"
	Fine	1/4" to 3/4"
<b>SAND</b>	Coarse	1/16" to 1/4"
	Medium	1/64" to 1/16"
	Fine	Finest visible & distinguishable particles
<b>SILT/CLAY</b>	see adjacent table	Cannot distinguish individual particles
<b>COBBLES</b>	3" to 6" in diameter	
<b>BOULDERS</b>	> 6" in diameter	

COHESIVE SOILS		
SMALLEST DIAMETER	PLASTICITY	IDENTITY
None	Non-plastic	<b>SILT</b>
1/4" (pencil)	Slight	<b>Clayey SILT</b>
1/8"	Low	<b>SILT &amp; CLAY</b>
1/16"	Medium	<b>CLAY &amp; SILT</b>
1/32"	High	<b>Silty CLAY</b>
1/64"	Very High	<b>CLAY</b>

Wetted sample is rolled in hands to smallest possible diameter before breaking.

**ORGANIC SILT:** Typically gray to dark gray, often has strong H<sub>2</sub>S odor. May contain shells or shell fragments. Light weight.

Fibrous PEAT: Light weight, spongy, mostly visible organic matter, water squeezed readily from sample. Typically near top of layer.

Fine grained PEAT: Light weight, spongy, little visible organic matter, water squeezed from sample. Typically below fibrous peat.

**DEBRIS:** Detailed contents described in parentheses (wood, glass, ash, crushed brick, metal, etc.)

**BEDROCK:** Underlying rock beneath loose soil, can be weathered (easily crushed) or competent (difficult to crush).

#### ADDITIONAL CONSTITUENTS

TERM	% OF TOTAL
and	35-50%
some	20-35%
little	10-20%
trace	1-10%

#### COMMON TERMS

Glacial till: Very dense/hard, heterogeneous mixture of sand, silt, clay, sub-angular gravel. Deposited at base of glaciers, which covered all of New England.

Varved clay: Fine-grained, post-glacial lake sediments characterized by alternating layers (or varves) of silt, sand and clay.

Fill: Material used to raise ground, can be engineered or non-engineered.

#### COMMON FIELD MEASUREMENTS

Torvane: Undrained shear strength is estimated using an E285 Pocket Torvane (TV). Values in tons/ft<sup>2</sup>.

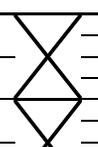
Penetrometer: Unconfined compressive strength is estimated using a Pocket Penetrometer (PP). Values in tons/ft<sup>2</sup>.

RQD: Rock Quality Designation is determined by measuring total length of pieces of core 4" or greater and dividing by the total length of the run, expressed as %. 100-90% excellent; 90-75% good; 75-50% fair; 50-25% poor; 25-0% very poor.

PID: Soil screened for volatile organic compounds (VOCs) using a photoionization detector (PID) referenced to benzene in air. Readings in parts per million by volume.

**LOG OF BORING SL-101**

PROJECT	Proposed Shutesbury Library			CONTRACTOR	Seaboard Environmental Drilling			
JOB NUMBER	2060-03-01	FINAL DEPTH (ft)	16.0	DRILLING EQUIPMENT	B-53 Truck Mounted Rig			
LOCATION	Shutesbury, MA	SURFACE ELEV (ft)	1179.0	FOREMAN	Mike	CASING		
START DATE	10/03/2023	DISTURBED SAMPLES	6	HELPER	Louie	CASE DIAMETER	N/A	
FINISH DATE	10/03/2023	UNDISTURBED SAMPLES	0	BIT TYPE	Hollow Stem Auger	HAMMER WGT	N/A	
ENGINEER/SCIENTIST	Shannon Raymond		WATER LEVEL	ROD TYPE	A (1 5/8" O.D.)	HAMMER DROP	N/A	
BORING LOCATION	Northern Portion of Proposed Building		FIRST (ft)	N/E	SAMPLER	2" O.D. Split Spoon	ROCK CORING INFORMATION	
			LAST (ft)	N/A	HAMMER TYPE	Safety	TYPE	N/A
			TIME (hr)	N/A	HAMMER WGT/DROP	140 lb / 30" Wire Line	SIZE	N/A

DEPTH (ft)/ SAMPLES	SAMPLES				SAMPLE DESCRIPTION (MODIFIED BURMISTER)	PROFILE		REMARKS	
	PENETR. RESIST. (bl / 6 in)	REC. (in)	TYPE/ NO.	FIELD TEST DATA		DEPTH (ft)	ELEV.		
	1/8/6	16/24	S-1 (0'-2')		Top 5" : Medium dense, dark brown, fine SAND, some silt, little medium sand, trace coarse sand, little organics (roots), moist (TOPSOIL) Middle 3" : Medium dense, dark brown, fine SAND, some to little silt, little medium sand, trace coarse sand, trace gravel, trace organics (roots), moist Bottom 8" : Medium dense, brown, fine to medium SAND, little to trace silt, trace coarse sand, trace gravel, moist (wet in bottom 2" ; trace rust staining throughout) Dense, light grey brown, fine to medium SAND, little to trace coarse sand, trace (+) silt, trace gravel, wet (trace rust staining throughout)			1. , 2.	
	10/16/30/46	18/24	S-2 (2'-4')			5.0	1174.0		3.
	16/18/20/17	15/24	S-3 (5'-7')		Dense, grey, fine to medium SAND, little silt, little to trace coarse sand, trace gravel, damp				5.
	50 for 3"	0/3	S-4 (10'-10.2')		No Recovery ; upon likely gravel			4.	
	14/50 for 5"	8/11	S-5 (12'-12.9')		Very dense, grey, fine to medium SAND, little silt, little to trace coarse sand, trace gravel, moist				
	31/50 for 5"	8/11	S-6 (15'-15.9')		Very dense, grey, fine to medium SAND, little silt, little to trace coarse sand, trace gravel, moist	16.0	1163.0	6. , 7.	
					End of Exploration at 16', upon dense soils				

Remarks: 1. Auger grinding between 2 and 5 feet below ground surface, upon likely gravel and cobbles. 2. Perched groundwater observed at 2 feet. 3. Auger significantly grinding between 4 and 4.5 feet, upon likely cobble or gravel. 4. Auger grinding between 9 and 10 feet, 10 and 15 feet, and 15 and 16 feet, upon likely gravel and dense soils. 5. Slow drilling occurred between 5 and 15 feet, due to dense soils. 6. Auger significantly grinding at 16 feet, upon likely dense soils. 7. Auger refusal at 16 feet, upon likely dense soils.	<b>PROJECT NO.</b> <b>2060-03-01</b>
	<b>LOG OF BORING</b> <b>SL-101</b>

**LOG OF BORING SL-102**

PROJECT				Proposed Shutesbury Library				CONTRACTOR		Seaboard Environmental Drilling					
JOB NUMBER		2060-03-01		FINAL DEPTH (ft)		16.0		DRILLING EQUIPMENT		B-53 Truck Mounted Rig					
LOCATION				Shutesbury, MA		SURFACE ELEV (ft)		1178.0		FOREMAN					
								Mike		CASING					
START DATE		10/03/2023		DISTURBED SAMPLES		6		HELPER		Louie					
FINISH DATE		10/03/2023		UNDISTURBED SAMPLES		0		BIT TYPE		Hollow Stem Auger					
ENGINEER/SCIENTIST				Shannon Raymond		WATER LEVEL		ROD TYPE		A (1 5/8" O.D.)					
BORING LOCATION		Southern Portion of Proposed Building				FIRST (ft)		N/E		SAMPLER		2" O.D. Split Spoon			
						LAST (ft)		N/A		HAMMER TYPE		Safety		ROCK CORING INFORMATION	
						TIME (hr)		N/A		HAMMER WGT/DROP		140 lb / 30" Wire Line		TYPE	
										HAMMER DROP		N/A			
										SIZE		N/A			

DEPTH (ft)/ SAMPLES	SAMPLES				SAMPLE DESCRIPTION (MODIFIED BURMISTER)	PROFILE		REMARKS
	PENETR. RESIST. (bl / 6 in)	REC. (in)	TYPE/ NO.	FIELD TEST DATA		DEPTH (ft)	ELEV.	
0' - 5'	1/3/4/11	15/24	S-1 (0'-2')		Top 4" : Loose, dark brown, fine SAND, some silt, little medium sand, trace coarse sand trace (-) gravel, little organics (roots), moist (TOPSOIL)	TOPSOIL		1. , 2.
	18/30/36/37	18/24	S-2 (2'-4')		Middle 4" : Loose, dark brown, fine to medium SAND, some to little silt, trace coarse sand, trace organics (roots), damp Bottom 7" : Loose, brown, fine to medium SAND, little to trace coarse sand, trace (+) silt, moist (wet in bottom 2" ; trace rust staining throughout)	FINE TO MEDIUM SAND		
5' - 10'	14/27/28/37	15/24	S-3 (5'-7')		Very dense, light grey brown, fine to medium SAND, little to trace coarse sand, trace silt, trace fine gravel, wet (little rust staining throughout)	5.0	1173.0	3. , 5.
10' - 15'	25/30/36/31	12/24	S-4 (8'-10')		Very dense, grey, fine to medium SAND, little silt, little coarse sand, trace (+) gravel, moist (trace rust staining throughout)	TILL		4.
15' - 20'	32/40/50 for 5"	14/17	S-5 (10'-11.4')		Very dense, grey, fine to medium SAND, little silt, little coarse sand, trace (+) gravel, moist			
20' - 25'	49/50 for 2"	8/8	S-6 (15'-15.7')		Very dense, grey, fine to medium SAND, little silt, little coarse sand, trace (+) gravel, moist	16.0	1162.0	6. , 7.
End of Exploration at 16', upon dense soils								

Remarks: 1. Auger grinding between 2 and 5 feet below ground surface, upon likely gravel and cobbles. 2. Perched groundwater observed at 2 feet. 3. Auger grinding between 5 and 8 feet, 8 and 15 feet, upon likely gravel and dense soils. 4. Auger significantly grinding at 8 feet, 9 feet, and between 14 and 14.5 feet, upon likely gravel and dense soils. 5. Slow drilling occurred between 5 and 15 feet, due to dense soils. 6. Auger significantly grinding at 16 feet, upon likely dense soils. 7. Auger refusal at 16 feet, upon likely dense soils.	<b>PROJECT NO.</b> <b>2060-03-01</b>
	<b>LOG OF BORING</b> <b>SL-102</b>

**O'REILLY, TALBOT & OKUN ASSOCIATES, INC.**  
 ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING CONSULTANTS

**LOG OF BORING SL-1**

PROJECT : M.N. Spear Library, Leverett Road		LOCATION: Shutesbury, MA		PROJECT NO. : 0762-02-01	
DRILLING CONTRACTOR Seaboard Environmental Drilling		FOREMAN Jeff HELPER Ronnie		DATE STARTED 06/23/2010	
DRILLING EQUIPMENT B-53 Truck Mounted Rig		COMPLETION DEPTH 20.5'		DATE FINISHED 06/23/2010	
TYPE BIT Hollow Stem Auger		SIZE & TYPE OF CORE BARREL		GROUND SURFACE ELEV. DATUM Approx. 1176 feet	
CASING		No. Samples 6		UNDIST.	
CASING HAMM.		TIME		FIRST	
WEIGHT		WATER LEVEL (FT.)		COMPL.	
DROPP		-		4 HR.	
SAMPLER: 2" O.D. Split Spoon		Rod A 1 5/8" O.D.		BORING	
SAMPLER Safety		WEIGHT 140 lbs.		DROPP 30" (Wire Line)	
HAMMER		LOCATION North of proposed building		ENGINEER/GEOLOGIST Sean Carr	

SAMPLES	DEPTH FT.	SAMPLES			DESCRIPTION	SOIL DESCRIPTION	REMARKS
		PENETR. RESIST. BL/6 IN.	REC. IN.	TYPE/ NO.			
X	0	1/1/2/3	12/24	S-1 (0'-2')	Top 6": Very loose, brown, SILT and fine SAND, little fibrous organics, trace gravel, moist (TOPSOIL) Bottom 6": Loose, light brown, SILT, some to little fine sand, trace gravel, moist	TOPSOIL FINE SAND	1.
		7/13/13/13	15/24	S-2 (2'-4')	Medium dense, white-brown, fine SAND, some to little silt, little to trace gravel, moist		
X	5	14/21/20/19	18/24	S-3 (5'-7')	Dense, light gray, fine SAND, little silt, little to trace medium to coarse sand, trace fine gravel, moist		2.
X	10	23/38/39/50 for 3"	20/24	S-4 (10'-12')	Very dense, light gray, fine SAND, some to little silt, trace (+) medium to coarse sand, trace (-) gravel, trace (-) cobbles, moist		
X	15	45/50 for 4"	6/12	S-5 (15'-15.5')	Very dense, light gray with rust mottling, fine SAND, some to little silt, trace (+) gravel, trace (-) medium sand, moist		
X	20	59/50 for 0"	4/12	S-6 (20'-21')	Very dense, light gray, fine SAND, little silt, trace (+) medium to coarse sand, trace (-) gravel, trace (-) cobbles, moist Auger Refusal at 20.5' End of Exploration		

Remarks:  
 1. Drill grinding at 4'  
 2. Cobble in spoon at approximately 11'

**O'REILLY, TALBOT & OKUN ASSOCIATES, INC.**  
 ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING CONSULTANTS

**LOG OF BORING SL-2**

PROJECT : M.N. Spear Library, Leverett Road		LOCATION: Shutesbury, MA		PROJECT NO. : 0762-02-01	
DRILLING CONTRACTOR Seaboard Environmental Drilling		FOREMAN Jeff HELPER Ronnie		DATE STARTED 06/23/2010	
DRILLING EQUIPMENT B-53 Truck Mounted Rig		COMPLETION DEPTH 21'		GROUND SURFACE ELEV. DATUM Approx. 1176 feet	
TYPE BIT Hollow Stem Auger		SIZE & TYPE OF CORE BARREL		No. Samples 6	
CASING		CASING HAMM. WEIGHT		DROP	
SAMPLER: 2" O.D. Split Spoon		Rod A 1 5/8" O.D.		WATER LEVEL (FT.) 15'	
SAMPLER Safety HAMMER		WEIGHT 140 lbs.		DROP 30" (Wire Line)	
				BORING LOCATION Northeast portion of proposed building	
				ENGINEER/GEOLOGIST Sean Carr	

SAMPLES	DEPTH FT.	SAMPLES			DESCRIPTION	SOIL DESCRIPTION	REMARKS
		PENETR. RESIST. BL/6 IN.	REC. IN.	TYPE/ NO.			
X	0	1/2/3/4	14/24	S-1 (0'-2')	Top 7": Very loose, brown, SILT and fine SAND, little fibrous organics, trace medium to coarse sand, trace (-) gravel, moist (TOPSOIL) Bottom 7": Loose, light brown, fine SAND, little silt, little medium to coarse sand, moist	TOPSOIL FINE SAND	
X	5	11/21/29/33	16/24	S-2 (2'-4')	Dense, light gray with rust mottling, fine SAND, little silt, little to trace subangular gravel, trace medium to coarse sand, moist		
X	10	20/30/19/20	19/24	S-3 (5'-7')	Dense, light gray with rust mottling, fine SAND, little silt, trace (+) gravel, trace (+) cobbles, trace (+) medium to coarse sand, moist		1.
X	15	22/15/30/30	12/24	S-4 (10'-12')	Dense, light gray, fine SAND, little silt, trace medium to coarse sand, trace sub-angular gravel, moist		
X	20	50 for 5"	2/6	S-5 (15'-15.5')	Very dense, dark brown, FRACTURED ROCK, appears wet at 15'	15' FRACTURED 16' ROCK	2.
X	25	25/ 50 for 1"	6/12	S-6 (20'-21')	Very dense, light gray, fine to medium SAND, little silt, little to trace fine gravel, wet	FINE SAND	
					Auger Refusal at 21' End of Exploration		

Remarks:  
 1. Drill grinding at approximately 6'  
 2. Drill grinding and bouncing at 15'

**O'REILLY, TALBOT & OKUN ASSOCIATES, INC.**  
 ENVIRONMENTAL AND GEOTECHNICAL ENGINEERING CONSULTANTS

**LOG OF BORING SL-3**

PROJECT : M.N. Spear Library, Leverett Road		LOCATION: Shutesbury, MA		PROJECT NO. : 0762-02-01	
DRILLING CONTRACTOR Seaboard Environmental Drilling		FOREMAN Jeff HELPER Ronnie		DATE STARTED 06/23/2010	
DRILLING EQUIPMENT B-53 Truck Mounted Rig		COMPLETION DEPTH 21.5'		GROUND SURFACE ELEV. DATUM Approx. 1175 feet	
TYPE BIT Hollow Stem Auger		SIZE & TYPE OF CORE BARREL		No. Samples 7	
CASING		TIME		FIRST 7'	
CASING HAMM. SAMPLER: 2" O.D. Split Spoon		WEIGHT Rod A 1 5/8" O.D.		COMPL. 2 HR.	
SAMPLER Safety HAMMER		DROP 30" (Wire Line)		UNDIST. 3	
		BORING LOCATION Northwest corner of proposed building		ENGINEER/GEOLOGIST Sean Carr	

SAMPLES	DEPTH FT.	SAMPLES			DESCRIPTION	SOIL DESCRIPTION	REMARKS
		PENETR. RESIST. BL/6 IN.	REC. IN.	TYPE/ NO.			
X	0	1/2/3/3	14/24	S-1 (0'-2')	Top 7": Very loose, brown, SILT and fine SAND, little fibrous organics, trace medium to coarse sand, trace (-) gravel, moist (TOPSOIL) Bottom 7": Loose, light brown, fine SAND, some to little silt, trace medium to coarse sand, moist	TOPSOIL FINE SAND	
X	5	8/14/16/19	15/24	S-2 (2'-4')	Dense, light gray, fine SAND, little silt, trace (+) medium to coarse sand, trace (+) sub-angular gravel, moist		
X	10	18/27/20/29	0/24	S-3 (5'-7')	No Recovery		
X	15	6/12/12/15	16/24	S-4 (7'-9')	Medium dense, light gray with rust mottling, fine SAND, little silt, trace medium to coarse sand, trace (-) sub-angular gravel, wet		
X	20	19/21/39/ 50 for 4"	14/24	S-5 (10'-12')	Very dense, light gray with rust mottling, fine SAND, little silt, little cobbles, trace medium to coarse sand, wet		1. 2.
X	25	29/33/ 50 for 5"	15/18	S-6 (15'-16.5')	Very dense, light gray, fine SAND, little silt, little to trace sub-angular gravel, trace cobbles, trace (-) medium to coarse sand, wet		3.
X	30	51/ 50 for 4"	6/12	S-7 (20'-21')	Very dense, light gray and brown, fine SAND, some fragmented rock, trace silt, trace gravel, moist		
					Auger Refusal at 21.5' End of Exploration		

Remarks:

1. Drill grinding at approximately 10'
2. Cobbles in spoon from 10.5-11'
3. Drill bouncing at approximately 14'





**LOG OF TEST PIT TP-1**

PROJECT	Proposed Shutesbury Library			CONTRACTOR	Shutesbury DPW
JOB NO.	2060-03-01	DATE	10/03/2023	OPERATOR	Dave
LOCATION	Shutesbury, MA.	WEATHER	Sunny, 50°F	BACKHOE	CAT 420XE
TEST PIT LOCATION	South Portion of Proposed Stormwater System in Southeastern Area of Site	START TIME	08:15	CAPACITY (cy)	1/4
		FINISH TIME	08:45	GS ELEV. (ft)	1179.0
		OTO STAFF	Shannon Raymond	FINAL DEPTH (ft)	9.5

DEPTH (ft)	SOIL DESCRIPTION	EXCAV. EFFORT	BOULDERS/ COBBLES		SAMPLE NO.	FIELD TEST DATA	REMARKS
			COUNT	CLASS			
1'	Forest Duff	E	3	C			
	Dark brown, fine SAND, some to little silt, little medium sand, trace coarse sand, some organics (roots, leaves), damp (TOPSOIL)						
2'	Orange brown, fine to medium SAND, little silt, little coarse sand, trace (-) gravel, trace organics (roots), moist (some rust staining throughout)	E					
3'	Light brown, fine to medium SAND, little to trace coarse sand, trace (-) silt, trace gravel, trace organics (roots), moist (little rust staining throughout)	M	5	C			1. 2.
4'	Light brown grey, fine to medium SAND, little to trace coarse sand, little to trace gravel, trace (+) silt, moist (trace rust staining throughout)	M	10	C	S-1 (5'-8')		
			4	S			
5'		D					
6'							
7'							
8'							
9'	Grey, fine to medium SAND, little silt, little to trace coarse sand, little to trace gravel, moist (trace rust staining throughout)	D	15	C			
			3	S			
10'	End of Exploration at 9.5'						
11'							

<b>TEST PIT PLAN</b> 	<b>EXCAVATION EFFORT</b> Easy .....E Moderate .....M Difficult .....D Very Difficult .....V	<b>BOULDER/COBBLE CLASS</b> <table border="0"> <tr> <td>Type</td> <td>Size</td> <td>Abbr.</td> </tr> <tr> <td>Cobble</td> <td>3" - 6"</td> <td>C</td> </tr> <tr> <td>Small</td> <td>6" - 18"</td> <td>S</td> </tr> <tr> <td>Medium</td> <td>18" - 36"</td> <td>M</td> </tr> <tr> <td>Large</td> <td>36" and Larger</td> <td>L</td> </tr> </table>	Type	Size	Abbr.	Cobble	3" - 6"	C	Small	6" - 18"	S	Medium	18" - 36"	M	Large	36" and Larger	L	<b>PROPORTIONS USED</b> <table border="0"> <tr> <td>Term</td> <td>Relative Quantity</td> </tr> <tr> <td>and</td> <td>35% - 50%</td> </tr> <tr> <td>some</td> <td>20% - 35%</td> </tr> <tr> <td>little</td> <td>10% - 20%</td> </tr> <tr> <td>trace</td> <td>10% or less</td> </tr> </table>	Term	Relative Quantity	and	35% - 50%	some	20% - 35%	little	10% - 20%	trace	10% or less	<b>GROUNDWATER CONDITIONS</b> GW Encountered?: N/E  GW Depth (ft): N/A GW Elevation (ft): N/A Elapsed Time (min): N/A
Type	Size	Abbr.																											
Cobble	3" - 6"	C																											
Small	6" - 18"	S																											
Medium	18" - 36"	M																											
Large	36" and Larger	L																											
Term	Relative Quantity																												
and	35% - 50%																												
some	20% - 35%																												
little	10% - 20%																												
trace	10% or less																												

Remarks: 1. Perched water observed at between 2 and 2.5 feet below ground surface. 2. Test pit walls began caving in at 2.5 feet.	<b>PROJECT NO.</b>
	<b>2060-03-01</b>
	<b>LOG OF TEST PIT</b>
	<b>TP-1</b>



**LOG OF TEST PIT TP-2**

PROJECT	Proposed Shutesbury Library			CONTRACTOR	Shutesbury DPW
JOB NO.	2060-03-01	DATE	10/03/2023	OPERATOR	Dave
LOCATION	Shutesbury, MA.	WEATHER	Sunny, 60°F	BACKHOE	CAT 420XE
TEST PIT LOCATION	North Portion of Proposed Stormwater System in Southeastern Area of Site	START TIME	09:20	CAPACITY (cy)	1/4
		FINISH TIME	10:00	GS ELEV. (ft)	1178.0
		OTO STAFF	Shannon Raymond	FINAL DEPTH (ft)	11.0

DEPTH (ft)	SOIL DESCRIPTION	EXCAV. EFFORT	BOULDERS/ COBBLES		SAMPLE NO.	FIELD TEST DATA	REMARKS
			COUNT	CLASS			
1'	Forest Duff	E					1.
	Dark brown, fine to medium SAND, some to little silt, trace coarse sand, little organics (roots, leaves), moist (TOPSOIL)						
	Orange brown, fine to medium SAND, little silt, little to trace coarse sand, trace gravel, trace organics (roots), moist (some rust staining throughout)	M	3	C			
2'	Light grey, fine to medium SAND, little coarse sand, little to trace silt, trace (+) gravel, trace organics (roots to 2 feet), moist (trace rust staining throughout)						
3'							
	Grey, fine to medium SAND, little coarse sand, little silt, trace (+) gravel, moist (trace rust staining throughout)						
4'		D	7	C			
			2	S			
5'			1	M			
6'							
7'							
		D	12	C			
8'			3	S			
			1	M			
9'							
10'							
11'	End of Exploration at 11'						

<b>TEST PIT PLAN</b> 	<b>EXCAVATION EFFORT</b> Easy .....E Moderate .....M Difficult .....D Very Difficult .....V	<b>BOULDER/COBBLE CLASS</b> <table border="0"> <tr> <td>Type</td> <td>Size</td> <td>Abbr.</td> </tr> <tr> <td>Cobble</td> <td>3" - 6"</td> <td>C</td> </tr> <tr> <td>Small</td> <td>6" - 18"</td> <td>S</td> </tr> <tr> <td>Medium</td> <td>18" - 36"</td> <td>M</td> </tr> <tr> <td>Large</td> <td>36" and Larger</td> <td>L</td> </tr> </table>	Type	Size	Abbr.	Cobble	3" - 6"	C	Small	6" - 18"	S	Medium	18" - 36"	M	Large	36" and Larger	L	<b>PROPORTIONS USED</b> <table border="0"> <tr> <td>Term</td> <td>Relative Quantity</td> </tr> <tr> <td>and</td> <td>35% - 50%</td> </tr> <tr> <td>some</td> <td>20% - 35%</td> </tr> <tr> <td>little</td> <td>10% - 20%</td> </tr> <tr> <td>trace</td> <td>10% or less</td> </tr> </table>	Term	Relative Quantity	and	35% - 50%	some	20% - 35%	little	10% - 20%	trace	10% or less	<b>GROUNDWATER CONDITIONS</b> GW Encountered?: N/E GW Depth (ft): N/A GW Elevation (ft): N/A Elapsed Time (min): N/A
Type	Size	Abbr.																											
Cobble	3" - 6"	C																											
Small	6" - 18"	S																											
Medium	18" - 36"	M																											
Large	36" and Larger	L																											
Term	Relative Quantity																												
and	35% - 50%																												
some	20% - 35%																												
little	10% - 20%																												
trace	10% or less																												

Remarks: 1. Perched water observed at ground surface, and at between 2 and 2.5 feet below ground surface.	<b>PROJECT NO.</b>  <b>2060-03-01</b>
	<b>LOG OF TEST PIT</b>  <b>TP-2</b>



**LOG OF TEST PIT TP-3**

PROJECT	Proposed Shutesbury Library			CONTRACTOR	Shutesbury DPW
JOB NO.	2060-03-01	DATE	10/03/2023	OPERATOR	Dave
LOCATION	Shutesbury, MA.	WEATHER	Sunny, 60°F	BACKHOE	CAT 420XE
TEST PIT LOCATION	Southeast Portion of Prop. Stormwater System in North Area of Site	START TIME	10:30	CAPACITY (cy)	1/4
		FINISH TIME	11:00	GS ELEV. (ft)	1176.0
		OTO STAFF	Shannon Raymond	FINAL DEPTH (ft)	9.5

DEPTH (ft)	← N		S →		EXCAV. EFFORT	BOULDERS/ COBBLES COUNT CLASS		SAMPLE NO.	FIELD TEST DATA	REMARKS
	SOIL DESCRIPTION									
1'	Dark brown, fine to medium SAND, little silt, little to trace coarse sand, trace (-) fine gravel, little organics (roots), damp (TOPSOIL)				E	5	C			
	Light brown, fine to medium SAND, little coarse sand, little to trace gravel, trace silt, trace organics (roots), damp					2	S			
2'	Dark brown to very dark brown, fine to medium SAND, little silt, little coarse sand, trace (+) gravel, little debris (brick, concrete, ash), damp		Dark brown, fine to medium SAND, little silt, little coarse sand, trace gravel, damp		M	20	C			
			Orange brown, fine to medium SAND, little silt, little to trace coarse sand, trace gravel, moist (some rust staining throughout)			3	S			
3'						2	M			
4'			Grey, fine to medium SAND, little coarse sand, little silt, little to trace gravel, moist (trace rust staining throughout)		D	5	C			1.
5'										
6'					D	7	C			
						2	S			
7'	End of Exploration at 6.5'									
8'										
9'										
10'										
11'	End of Exploration at 9.5'									
	End of Exploration at 11'									

<b>TEST PIT PLAN</b> 	<b>EXCAVATION EFFORT</b> Easy .....E Moderate .....M Difficult .....D Very Difficult .....V	<b>BOULDER/COBBLE CLASS</b> <table border="1"> <tr> <th>Type</th> <th>Size</th> <th>Abbr.</th> </tr> <tr> <td>Cobble</td> <td>3" - 6"</td> <td>C</td> </tr> <tr> <td>Small</td> <td>6" - 18"</td> <td>S</td> </tr> <tr> <td>Medium</td> <td>18" - 36"</td> <td>M</td> </tr> <tr> <td>Large</td> <td>36" and Larger</td> <td>L</td> </tr> </table>	Type	Size	Abbr.	Cobble	3" - 6"	C	Small	6" - 18"	S	Medium	18" - 36"	M	Large	36" and Larger	L	<b>PROPORTIONS USED</b> <table border="1"> <tr> <th>Term</th> <th>Relative Quantity</th> </tr> <tr> <td>and</td> <td>35% - 50%</td> </tr> <tr> <td>some</td> <td>20% - 35%</td> </tr> <tr> <td>little</td> <td>10% - 20%</td> </tr> <tr> <td>trace</td> <td>10% or less</td> </tr> </table>	Term	Relative Quantity	and	35% - 50%	some	20% - 35%	little	10% - 20%	trace	10% or less	<b>GROUNDWATER CONDITIONS</b> GW Encountered?: N/E  GW Depth (ft): N/A GW Elevation (ft): N/A Elapsed Time (min): N/A
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Term	Relative Quantity																												
and	35% - 50%																												
some	20% - 35%																												
little	10% - 20%																												
trace	10% or less																												

Remarks: 1. Perched water observed in north end of test pit at 4 feet below ground surface.	<b>PROJECT NO.</b>
	<b>2060-03-01</b>
	<b>LOG OF TEST PIT</b>
	<b>TP-3</b>



**LOG OF TEST PIT TP-4**

PROJECT	Proposed Shutesbury Library			CONTRACTOR	Shutesbury DPW
JOB NO.	2060-03-01	DATE	10/03/2023	OPERATOR	Dave
LOCATION	Shutesbury, MA.	WEATHER	Sunny, 70°F	BACKHOE	CAT 420XE
TEST PIT LOCATION	Southeast Portion of Prop. Stormwater System in North Area of Site	START TIME	11:30	CAPACITY (cy)	1/4
		FINISH TIME	12:10	GS ELEV. (ft)	1171.0
		OTO STAFF	Shannon Raymond	FINAL DEPTH (ft)	9.5

DEPTH (ft)	← W SOIL DESCRIPTION E →		EXCAV. EFFORT	BOULDERS/ COBBLES COUNT CLASS		SAMPLE NO.	FIELD TEST DATA	REMARKS
	1'	Dark brown, fine SAND, some to little silt, little medium sand, little coarse sand, trace (-) fine gravel, some organics (roots), moist		Dark brown, fine SAND, some to little silt, little medium sand, little coarse sand, some organics (roots), moist Brown, fine to medium SAND, little silt, little to trace coarse sand, trace (-) gravel, trace organics (roots), damp	E			
2'								
3'	Light brown grey, fine to medium SAND, little coarse sand, little to trace silt, trace (+) gravel, trace organics (roots to 3'), moist (trace rust staining in top 3')		M	10	C			1.
4'								
5'	Light grey, fine to medium SAND, little coarse sand, little to trace silt, trace (+) gravel, damp		D	5	C	S-1 (5'-9')		
6'								
7'			D					
8'								
9'								
10'	End of Exploration at 9.5'							
11'								

<b>TEST PIT PLAN</b> 	<b>EXCAVATION EFFORT</b> Easy .....E Moderate .....M Difficult .....D Very Difficult .....V	<b>BOULDER/COBBLE CLASS</b> <table border="1"> <tr> <th>Type</th> <th>Size</th> <th>Abbr.</th> </tr> <tr> <td>Cobble</td> <td>3" - 6"</td> <td>C</td> </tr> <tr> <td>Small</td> <td>6" - 18"</td> <td>S</td> </tr> <tr> <td>Medium</td> <td>18" - 36"</td> <td>M</td> </tr> <tr> <td>Large</td> <td>36" and Larger</td> <td>L</td> </tr> </table>	Type	Size	Abbr.	Cobble	3" - 6"	C	Small	6" - 18"	S	Medium	18" - 36"	M	Large	36" and Larger	L	<b>PROPORTIONS USED</b> <table border="1"> <tr> <th>Term</th> <th>Relative Quantity</th> </tr> <tr> <td>and</td> <td>35% - 50%</td> </tr> <tr> <td>some</td> <td>20% - 35%</td> </tr> <tr> <td>little</td> <td>10% - 20%</td> </tr> <tr> <td>trace</td> <td>10% or less</td> </tr> </table>	Term	Relative Quantity	and	35% - 50%	some	20% - 35%	little	10% - 20%	trace	10% or less	<b>GROUNDWATER CONDITIONS</b> GW Encountered?: N/E  GW Depth (ft): N/A GW Elevation (ft): N/A Elapsed Time (min): N/A
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Large	36" and Larger	L																											
Term	Relative Quantity																												
and	35% - 50%																												
some	20% - 35%																												
little	10% - 20%																												
trace	10% or less																												

Remarks: 1. Perched water observed at 3 feet below ground surface.	<b>PROJECT NO.</b>
	<b>2060-03-01</b>
	<b>LOG OF TEST PIT</b>
	<b>TP-4</b>



**Photograph 1 : TP-1**



**Photograph 2 : TP-1**



**Photograph 3 : TP-1**



**Photograph 4 : TP-1**



**Photograph 5 : TP-2**



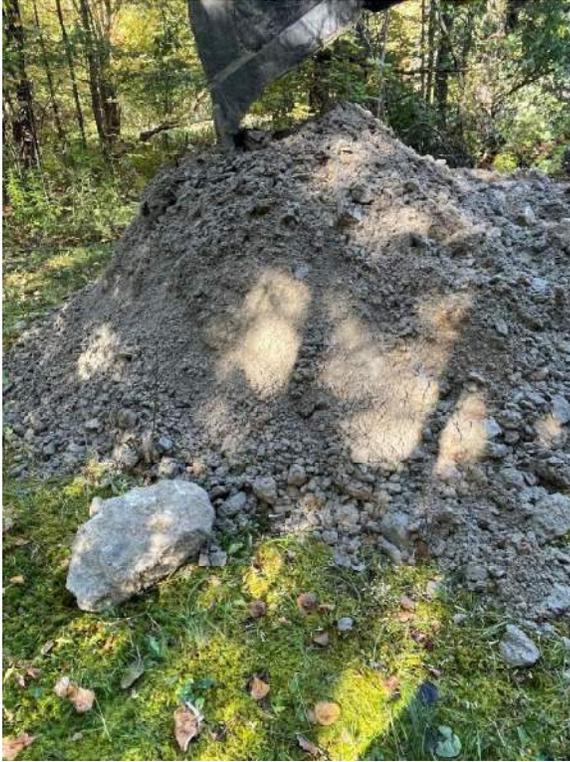
**Photograph 6 : TP-2**



**Photograph 7 : TP-2**



**Photograph 8 : TP-2**



**Photograph 9 : TP-2**



**Photograph 10 : TP-3**



**Photograph 11 : TP-3**



**Photograph 12 : TP-3**



**Photograph 13 : TP-3**



**Photograph 14 : TP-3**



**Photograph 15 : TP-3**



**Photograph 16 : TP-3**



**Photograph 17 : TP-4**

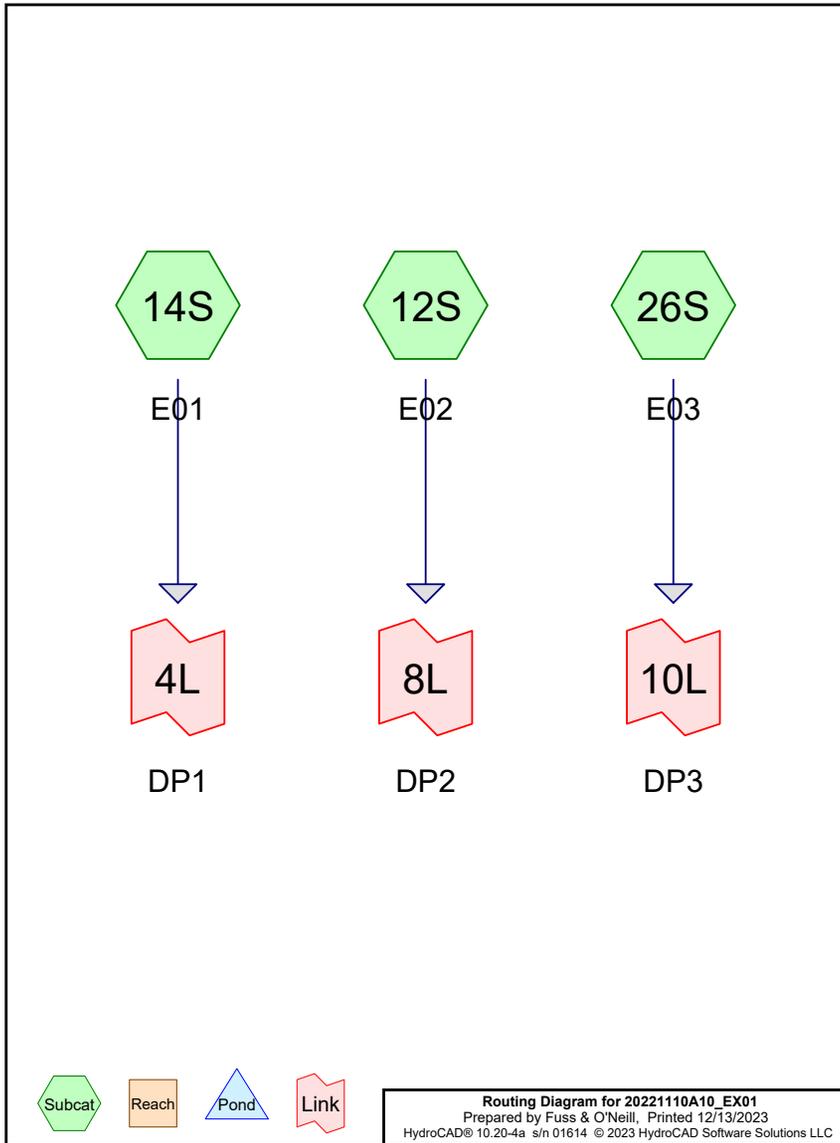


**Photograph 18 : TP-4**

## **Appendix E**

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### Pre-Development Hydrologic Analysis



**2022110A10\_EX01**

Prepared by Fuss & O'Neill

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Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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Time span=0.00-75.00 hrs, dt=0.05 hrs, 1501 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment12S: E02**

Runoff Area=93,475 sf 0.63% Impervious Runoff Depth=1.27"  
Flow Length=406' Tc=23.5 min CN=80 Runoff=1.95 cfs 9,913 cf

**Subcatchment14S: E01**

Runoff Area=60,711 sf 0.00% Impervious Runoff Depth=1.27"  
Flow Length=274' Tc=33.0 min CN=80 Runoff=1.05 cfs 6,438 cf

**Subcatchment26S: E03**

Runoff Area=14,271 sf 0.00% Impervious Runoff Depth=1.54"  
Flow Length=231' Tc=37.0 min CN=84 Runoff=0.28 cfs 1,833 cf

**Link 4L: DP1**

Inflow=1.05 cfs 6,438 cf  
Primary=1.05 cfs 6,438 cf

**Link 8L: DP2**

Inflow=1.95 cfs 9,913 cf  
Primary=1.95 cfs 9,913 cf

**Link 10L: DP3**

Inflow=0.28 cfs 1,833 cf  
Primary=0.28 cfs 1,833 cf

**Total Runoff Area = 168,457 sf Runoff Volume = 18,183 cf Average Runoff Depth = 1.30"**  
**99.65% Pervious = 167,867 sf 0.35% Impervious = 590 sf**

**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Summary for Subcatchment 12S: E02**

Runoff = 1.95 cfs @ 12.28 hrs, Volume= 9,913 cf, Depth= 1.27"  
Routed to Link 8L : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
3,802	49	50-75% Grass cover, Fair, HSG A
49,575	84	50-75% Grass cover, Fair, HSG D
590	98	Paved parking, HSG D
1,194	36	Woods, Fair, HSG A
38,314	79	Woods, Fair, HSG D
93,475	80	Weighted Average
92,885		99.37% Pervious Area
590		0.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	54	0.0200	0.07		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
4.8	40	0.0200	0.14		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.03"
0.7	43	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	269	0.0400	1.00		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
23.5	406				<b>Total</b>

**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

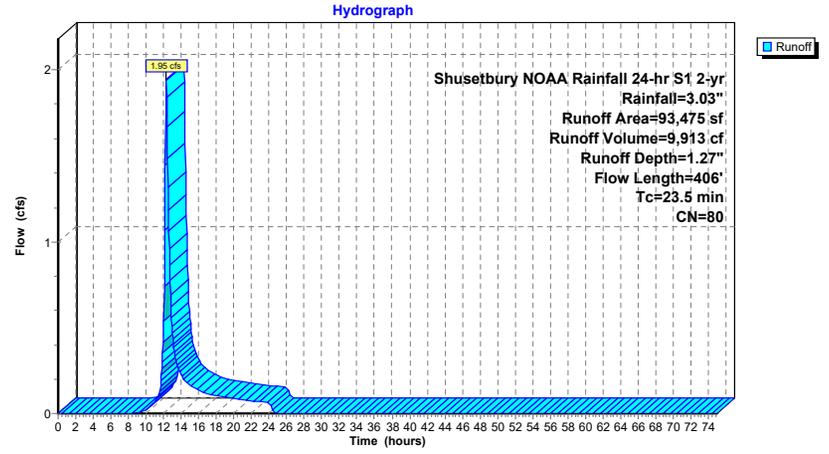
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**Subcatchment 12S: E02**



**2022110A10\_EX01**

Shussetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Summary for Subcatchment 14S: E01**

Runoff = 1.05 cfs @ 12.42 hrs, Volume= 6,438 cf, Depth= 1.27"  
Routed to Link 4L : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shussetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
13,580	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
47,131	79	Woods, Fair, HSG D
60,711	80	Weighted Average
60,711		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0100	0.06		<b>Sheet Flow, Woods</b> Woods: Light underbrush n= 0.400 P2= 3.03"
1.4	43	0.0100	0.50		<b>Shallow Concentrated Flow, Woods</b> Woodland Kv= 5.0 fps
0.3	19	0.0250	1.11		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
1.4	67	0.0250	0.79		<b>Shallow Concentrated Flow, Woods</b> Woodland Kv= 5.0 fps
0.8	45	0.0170	0.91		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
33.0	274	Total			

**2022110A10\_EX01**

Shussetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Prepared by Fuss & O'Neill

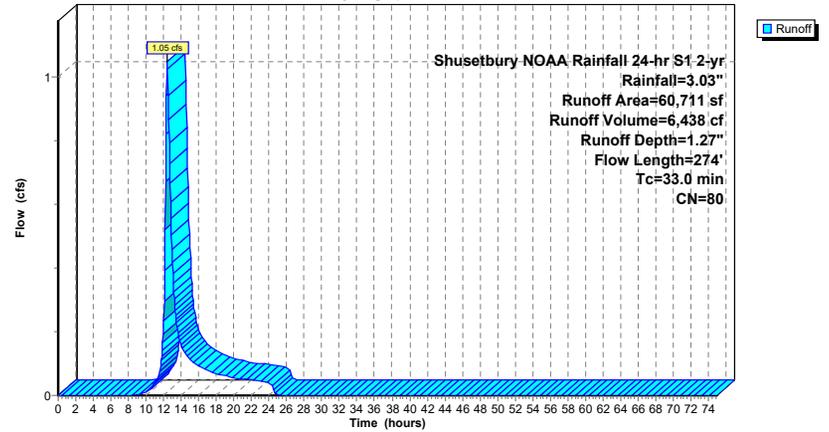
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**Subcatchment 14S: E01**

Hydrograph



**2022110A10\_EX01**

Shusettbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Summary for Subcatchment 26S: E03**

Runoff = 0.28 cfs @ 12.46 hrs, Volume= 1,833 cf, Depth= 1.54"  
Routed to Link 10L : DP3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shusettbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
13,269	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
1,002	79	Woods, Fair, HSG D
14,271	84	Weighted Average
14,271		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.9	70	0.0014	0.05		<b>Sheet Flow, Grass</b> Grass: Short n= 0.150 P2= 3.03"
12.8	30	0.0070	0.04		<b>Sheet Flow, Woods</b> Woods: Light underbrush n= 0.400 P2= 3.03"
0.7	47	0.0255	1.12		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
1.4	69	0.0145	0.84		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
0.2	15	0.0333	1.28		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
37.0	231				Total

**2022110A10\_EX01**

Shusettbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

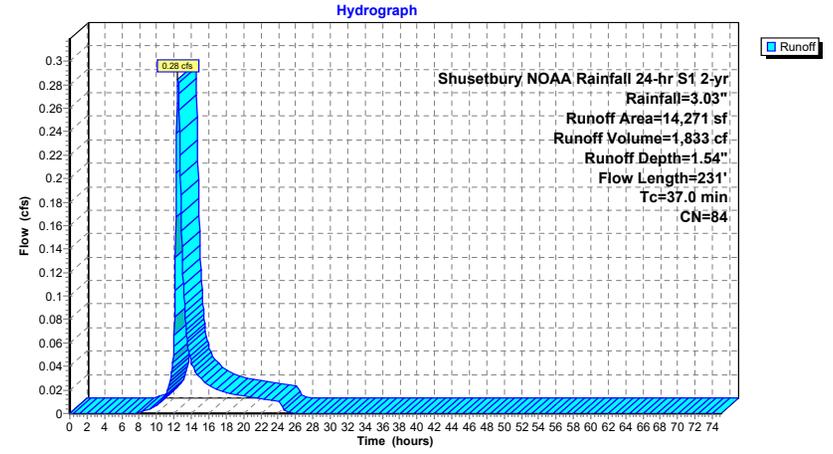
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**Subcatchment 26S: E03**



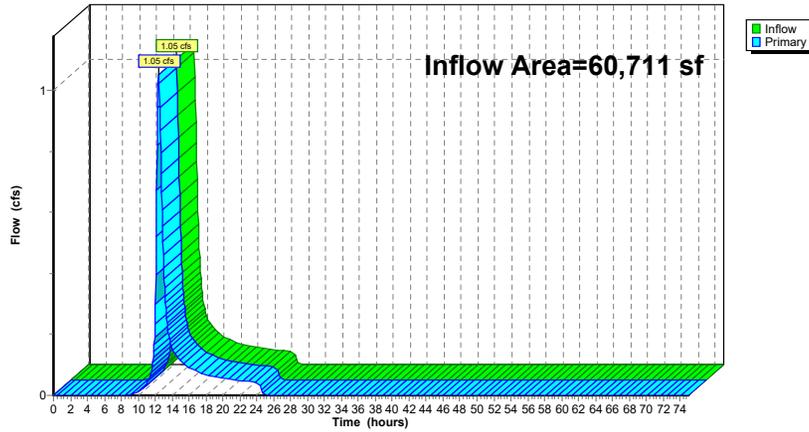
Summary for Link 4L: DP1

Inflow Area = 60,711 sf, 0.00% Impervious, Inflow Depth = 1.27" for 2-yr event  
 Inflow = 1.05 cfs @ 12.42 hrs, Volume= 6,438 cf  
 Primary = 1.05 cfs @ 12.42 hrs, Volume= 6,438 cf, Atten=0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

Link 4L: DP1

Hydrograph



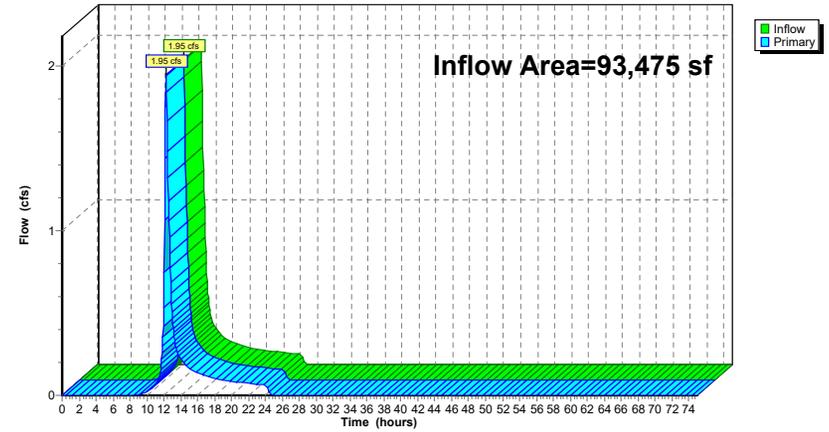
Summary for Link 8L: DP2

Inflow Area = 93,475 sf, 0.63% Impervious, Inflow Depth = 1.27" for 2-yr event  
 Inflow = 1.95 cfs @ 12.28 hrs, Volume= 9,913 cf  
 Primary = 1.95 cfs @ 12.28 hrs, Volume= 9,913 cf, Atten=0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

Link 8L: DP2

Hydrograph



**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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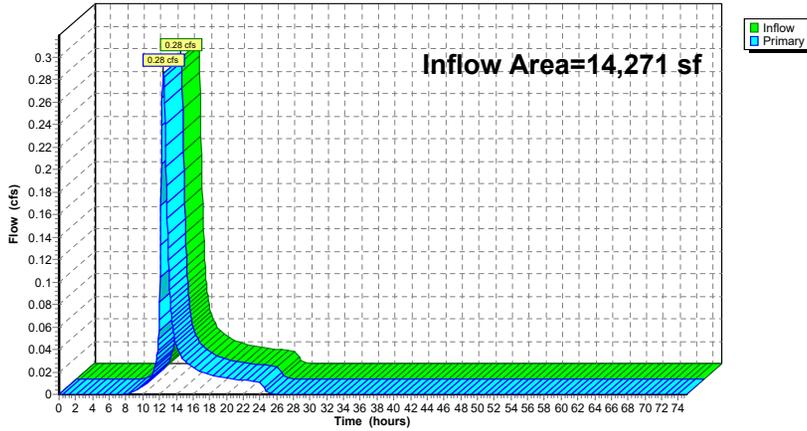
**Summary for Link 10L: DP3**

Inflow Area = 14,271 sf, 0.00% Impervious, Inflow Depth = 1.54" for 2-yr event  
 Inflow = 0.28 cfs @ 12.46 hrs, Volume= 1,833 cf  
 Primary = 0.28 cfs @ 12.46 hrs, Volume= 1,833 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

**Link 10L: DP3**

Hydrograph



**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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Time span=0.00-75.00 hrs, dt=0.05 hrs, 1501 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment12S: E02**

Runoff Area=93,475 sf 0.63% Impervious Runoff Depth=2.72"  
 Flow Length=406' Tc=23.5 min CN=80 Runoff=3.92 cfs 21,181 cf

**Subcatchment14S: E01**

Runoff Area=60,711 sf 0.00% Impervious Runoff Depth=2.72"  
 Flow Length=274' Tc=33.0 min CN=80 Runoff=2.11 cfs 13,757 cf

**Subcatchment26S: E03**

Runoff Area=14,271 sf 0.00% Impervious Runoff Depth=3.09"  
 Flow Length=231' Tc=37.0 min CN=84 Runoff=0.53 cfs 3,672 cf

**Link 4L: DP1**

Inflow=2.11 cfs 13,757 cf  
 Primary=2.11 cfs 13,757 cf

**Link 8L: DP2**

Inflow=3.92 cfs 21,181 cf  
 Primary=3.92 cfs 21,181 cf

**Link 10L: DP3**

Inflow=0.53 cfs 3,672 cf  
 Primary=0.53 cfs 3,672 cf

**Total Runoff Area = 168,457 sf Runoff Volume = 38,610 cf Average Runoff Depth = 2.75"**  
**99.65% Pervious = 167,867 sf 0.35% Impervious = 590 sf**

**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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**Summary for Subcatchment 12S: E02**

Runoff = 3.92 cfs @ 12.27 hrs, Volume= 21,181 cf, Depth= 2.72"  
Routed to Link 8L : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

Area (sf)	CN	Description
3,802	49	50-75% Grass cover, Fair, HSG A
49,575	84	50-75% Grass cover, Fair, HSG D
590	98	Paved parking, HSG D
1,194	36	Woods, Fair, HSG A
38,314	79	Woods, Fair, HSG D
93,475	80	Weighted Average
92,885		99.37% Pervious Area
590		0.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	54	0.0200	0.07		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
4.8	40	0.0200	0.14		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.03"
0.7	43	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	269	0.0400	1.00		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
23.5	406	Total			

**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

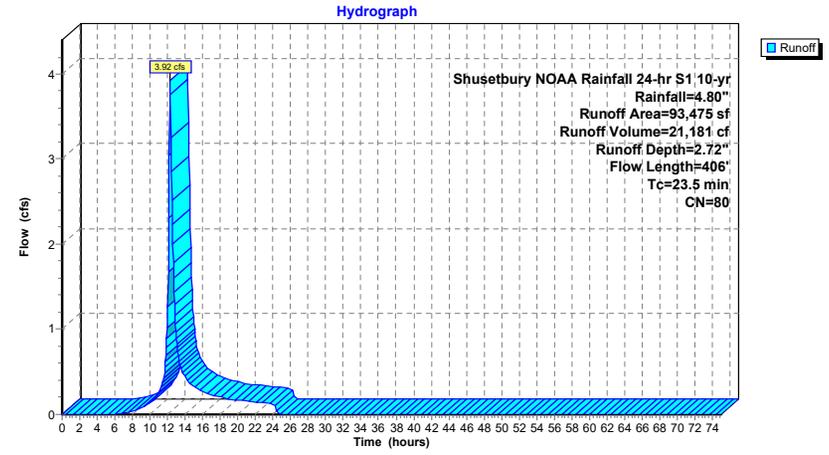
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**Subcatchment 12S: E02**



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Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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**Summary for Subcatchment 14S: E01**

Runoff = 2.11 cfs @ 12.40 hrs, Volume= 13,757 cf, Depth= 2.72"  
Routed to Link 4L : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
13,580	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
47,131	79	Woods, Fair, HSG D
60,711	80	Weighted Average
60,711		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0100	0.06		<b>Sheet Flow, Woods</b> Woods: Light underbrush n= 0.400 P2= 3.03"
1.4	43	0.0100	0.50		<b>Shallow Concentrated Flow, Woods</b> Woodland Kv= 5.0 fps
0.3	19	0.0250	1.11		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
1.4	67	0.0250	0.79		<b>Shallow Concentrated Flow, Woods</b> Woodland Kv= 5.0 fps
0.8	45	0.0170	0.91		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
33.0	274				<b>Total</b>

**2022110A10\_EX01**

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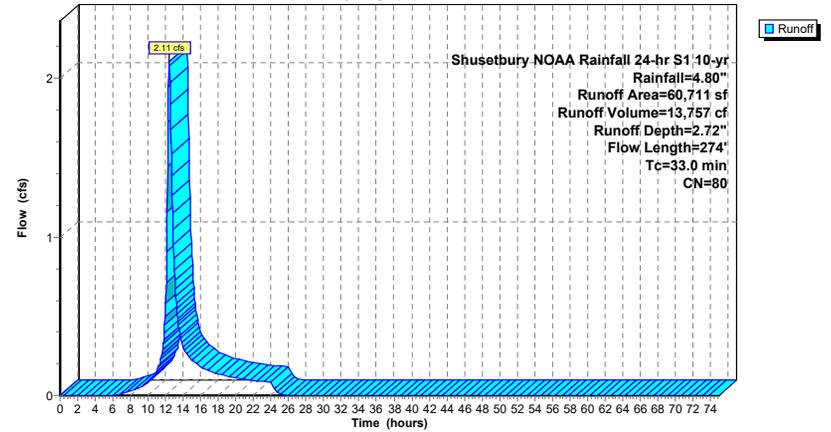
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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**Subcatchment 14S: E01**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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**Summary for Subcatchment 26S: E03**

Runoff = 0.53 cfs @ 12.45 hrs, Volume= 3,672 cf, Depth= 3.09"  
Routed to Link 10L : DP3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
13,269	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
1,002	79	Woods, Fair, HSG D
14,271	84	Weighted Average
14,271		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.9	70	0.0014	0.05		<b>Sheet Flow, Grass</b> Grass: Short n= 0.150 P2= 3.03"
12.8	30	0.0070	0.04		<b>Sheet Flow, Woods</b> Woods: Light underbrush n= 0.400 P2= 3.03"
0.7	47	0.0255	1.12		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
1.4	69	0.0145	0.84		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
0.2	15	0.0333	1.28		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
37.0	231				<b>Total</b>

**20221110A10\_EX01**

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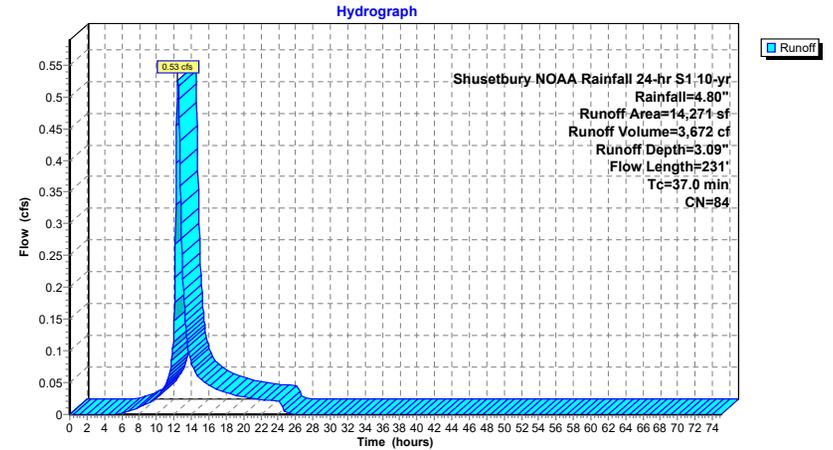
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Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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**Subcatchment 26S: E03**



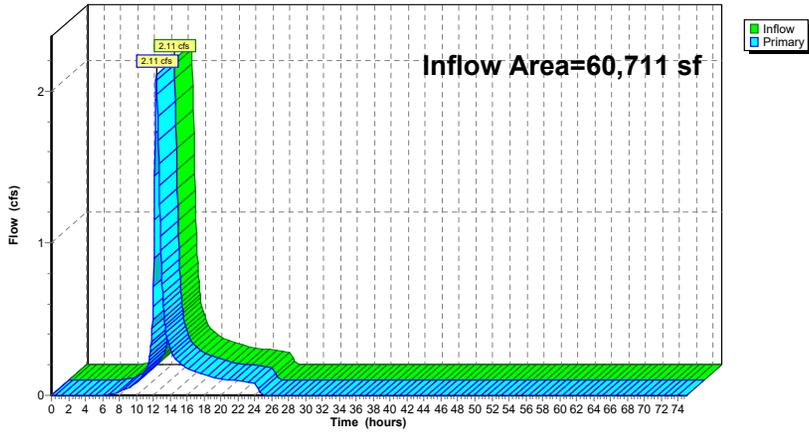
Summary for Link 4L: DP1

Inflow Area = 60,711 sf, 0.00% Impervious, Inflow Depth = 2.72" for 10-yr event  
 Inflow = 2.11 cfs @ 12.40 hrs, Volume= 13,757 cf  
 Primary = 2.11 cfs @ 12.40 hrs, Volume= 13,757 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

Link 4L: DP1

Hydrograph



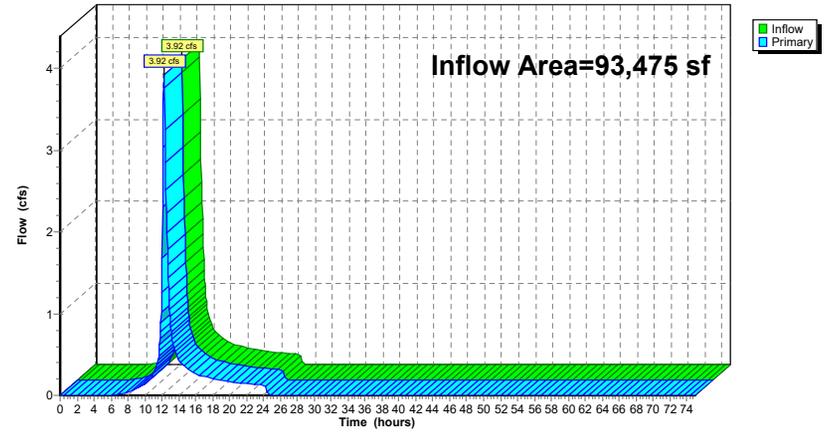
Summary for Link 8L: DP2

Inflow Area = 93,475 sf, 0.63% Impervious, Inflow Depth = 2.72" for 10-yr event  
 Inflow = 3.92 cfs @ 12.27 hrs, Volume= 21,181 cf  
 Primary = 3.92 cfs @ 12.27 hrs, Volume= 21,181 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

Link 8L: DP2

Hydrograph



**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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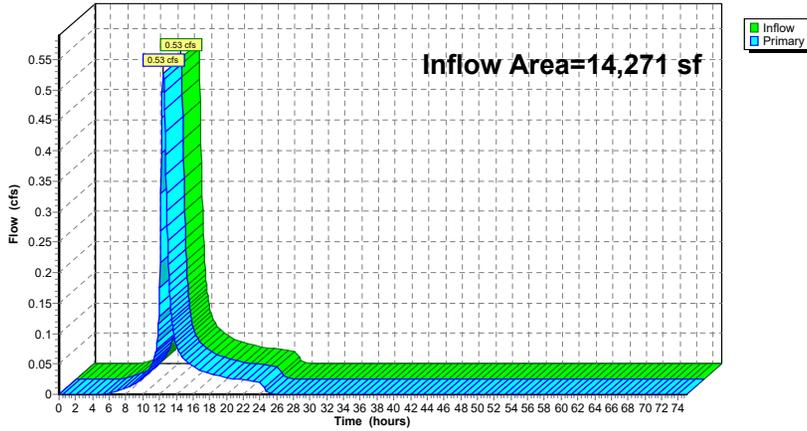
**Summary for Link 10L: DP3**

Inflow Area = 14,271 sf, 0.00% Impervious, Inflow Depth = 3.09" for 10-yr event  
 Inflow = 0.53 cfs @ 12.45 hrs, Volume= 3,672 cf  
 Primary = 0.53 cfs @ 12.45 hrs, Volume= 3,672 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

**Link 10L: DP3**

Hydrograph



**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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Time span=0.00-75.00 hrs, dt=0.05 hrs, 1501 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment12S: E02**

Runoff Area=93,475 sf 0.63% Impervious Runoff Depth=3.69"  
 Flow Length=406' Tc=23.5 min CN=80 Runoff=5.18 cfs 28,752 cf

**Subcatchment14S: E01**

Runoff Area=60,711 sf 0.00% Impervious Runoff Depth=3.69"  
 Flow Length=274' Tc=33.0 min CN=80 Runoff=2.79 cfs 18,674 cf

**Subcatchment26S: E03**

Runoff Area=14,271 sf 0.00% Impervious Runoff Depth=4.10"  
 Flow Length=231' Tc=37.0 min CN=84 Runoff=0.68 cfs 4,879 cf

**Link 4L: DP1**

Inflow=2.79 cfs 18,674 cf  
 Primary=2.79 cfs 18,674 cf

**Link 8L: DP2**

Inflow=5.18 cfs 28,752 cf  
 Primary=5.18 cfs 28,752 cf

**Link 10L: DP3**

Inflow=0.68 cfs 4,879 cf  
 Primary=0.68 cfs 4,879 cf

**Total Runoff Area = 168,457 sf Runoff Volume = 52,306 cf Average Runoff Depth = 3.73"**  
**99.65% Pervious = 167,867 sf 0.35% Impervious = 590 sf**

**20221110A10\_EX01**

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Shusbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Summary for Subcatchment 12S: E02**

Runoff = 5.18 cfs @ 12.27 hrs, Volume= 28,752 cf, Depth= 3.69"  
 Routed to Link 8L : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
 Shusbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
3,802	49	50-75% Grass cover, Fair, HSG A
49,575	84	50-75% Grass cover, Fair, HSG D
590	98	Paved parking, HSG D
1,194	36	Woods, Fair, HSG A
38,314	79	Woods, Fair, HSG D
93,475	80	Weighted Average
92,885		99.37% Pervious Area
590		0.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	54	0.0200	0.07		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
4.8	40	0.0200	0.14		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.03"
0.7	43	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	269	0.0400	1.00		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
23.5	406	Total			

**20221110A10\_EX01**

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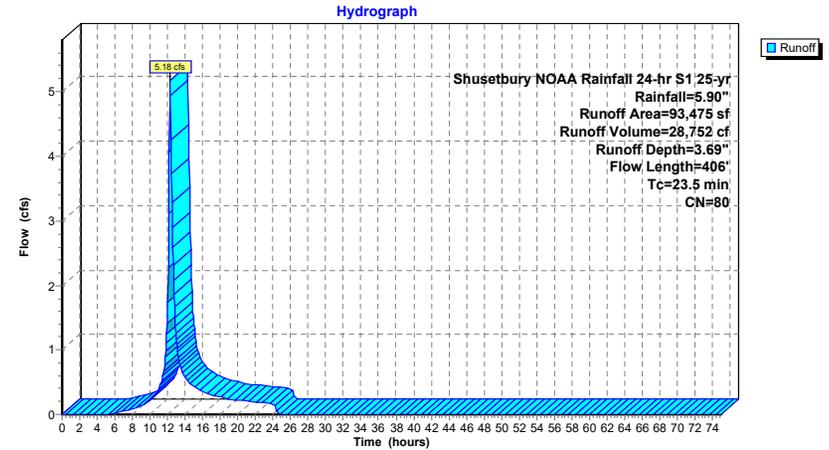
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Shusbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Subcatchment 12S: E02**



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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Summary for Subcatchment 14S: E01**

Runoff = 2.79 cfs @ 12.40 hrs, Volume= 18,674 cf, Depth= 3.69"  
Routed to Link 4L : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
13,580	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
47,131	79	Woods, Fair, HSG D
60,711	80	Weighted Average
60,711		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0100	0.06		<b>Sheet Flow, Woods</b> Woods: Light underbrush n= 0.400 P2= 3.03"
1.4	43	0.0100	0.50		<b>Shallow Concentrated Flow, Woods</b> Woodland Kv= 5.0 fps
0.3	19	0.0250	1.11		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
1.4	67	0.0250	0.79		<b>Shallow Concentrated Flow, Woods</b> Woodland Kv= 5.0 fps
0.8	45	0.0170	0.91		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
33.0	274				Total

**20221110A10\_EX01**

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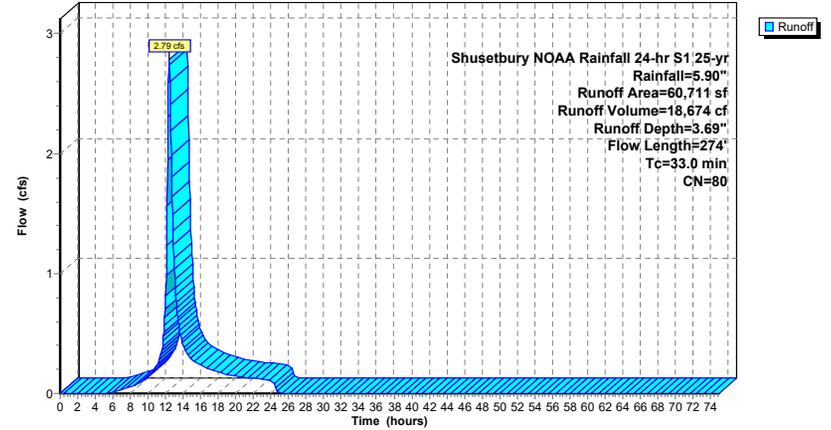
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Subcatchment 14S: E01**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Summary for Subcatchment 26S: E03**

Runoff = 0.68 cfs @ 12.44 hrs, Volume= 4,879 cf, Depth= 4.10"  
Routed to Link 10L : DP3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
13,269	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
1,002	79	Woods, Fair, HSG D
14,271	84	Weighted Average
14,271		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.9	70	0.0014	0.05		<b>Sheet Flow, Grass</b> Grass: Short n= 0.150 P2= 3.03"
12.8	30	0.0070	0.04		<b>Sheet Flow, Woods</b> Woods: Light underbrush n= 0.400 P2= 3.03"
0.7	47	0.0255	1.12		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
1.4	69	0.0145	0.84		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
0.2	15	0.0333	1.28		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
37.0	231				<b>Total</b>

**20221110A10\_EX01**

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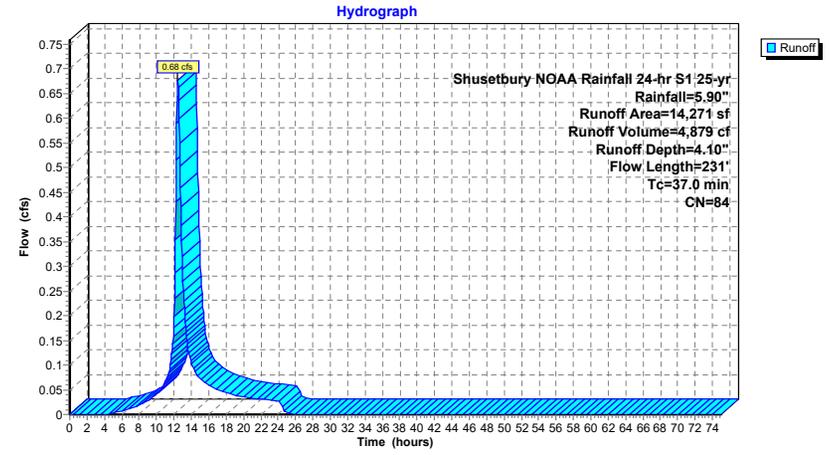
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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Subcatchment 26S: E03**



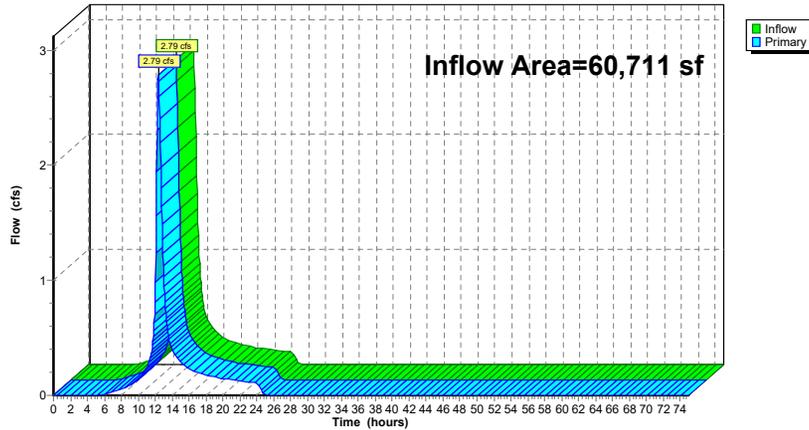
Summary for Link 4L: DP1

Inflow Area = 60,711 sf, 0.00% Impervious, Inflow Depth = 3.69" for 25-yr event  
 Inflow = 2.79 cfs @ 12.40 hrs, Volume= 18,674 cf  
 Primary = 2.79 cfs @ 12.40 hrs, Volume= 18,674 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

Link 4L: DP1

Hydrograph



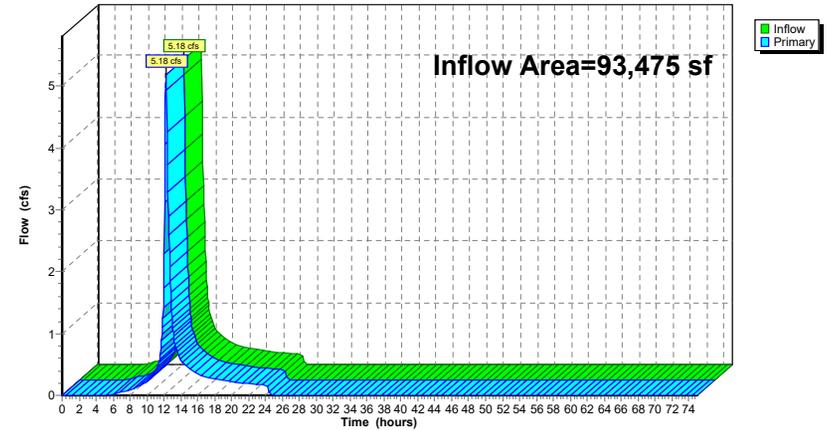
Summary for Link 8L: DP2

Inflow Area = 93,475 sf, 0.63% Impervious, Inflow Depth = 3.69" for 25-yr event  
 Inflow = 5.18 cfs @ 12.27 hrs, Volume= 28,752 cf  
 Primary = 5.18 cfs @ 12.27 hrs, Volume= 28,752 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

Link 8L: DP2

Hydrograph



**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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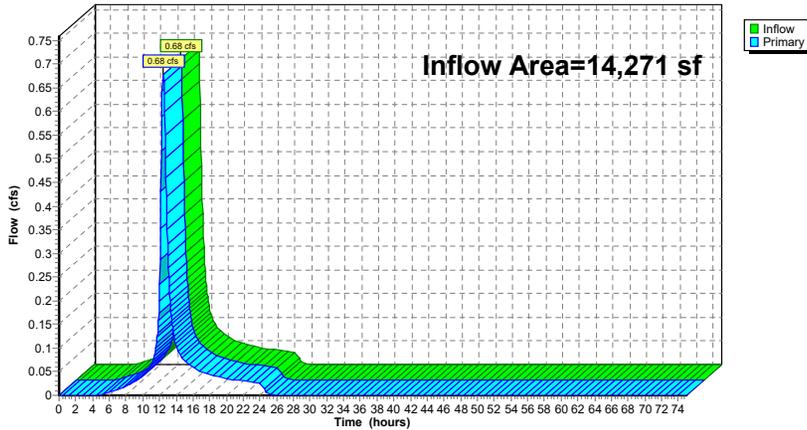
**Summary for Link 10L: DP3**

Inflow Area = 14,271 sf, 0.00% Impervious, Inflow Depth = 4.10" for 25-yr event  
 Inflow = 0.68 cfs @ 12.44 hrs, Volume= 4,879 cf  
 Primary = 0.68 cfs @ 12.44 hrs, Volume= 4,879 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

**Link 10L: DP3**

Hydrograph



**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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Time span=0.00-75.00 hrs, dt=0.05 hrs, 1501 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment12S: E02**

Runoff Area=93,475 sf 0.63% Impervious Runoff Depth=4.42"  
 Flow Length=406' Tc=23.5 min CN=80 Runoff=6.12 cfs 34,417 cf

**Subcatchment14S: E01**

Runoff Area=60,711 sf 0.00% Impervious Runoff Depth=4.42"  
 Flow Length=274' Tc=33.0 min CN=80 Runoff=3.29 cfs 22,354 cf

**Subcatchment26S: E03**

Runoff Area=14,271 sf 0.00% Impervious Runoff Depth=4.86"  
 Flow Length=231' Tc=37.0 min CN=84 Runoff=0.79 cfs 5,774 cf

**Link 4L: DP1**

Inflow=3.29 cfs 22,354 cf  
 Primary=3.29 cfs 22,354 cf

**Link 8L: DP2**

Inflow=6.12 cfs 34,417 cf  
 Primary=6.12 cfs 34,417 cf

**Link 10L: DP3**

Inflow=0.79 cfs 5,774 cf  
 Primary=0.79 cfs 5,774 cf

**Total Runoff Area = 168,457 sf Runoff Volume = 62,546 cf Average Runoff Depth = 4.46"**  
**99.65% Pervious = 167,867 sf 0.35% Impervious = 590 sf**

**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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**Summary for Subcatchment 12S: E02**

Runoff = 6.12 cfs @ 12.27 hrs, Volume= 34,417 cf, Depth= 4.42"  
Routed to Link 8L : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
3,802	49	50-75% Grass cover, Fair, HSG A
49,575	84	50-75% Grass cover, Fair, HSG D
590	98	Paved parking, HSG D
1,194	36	Woods, Fair, HSG A
38,314	79	Woods, Fair, HSG D
93,475	80	Weighted Average
92,885		99.37% Pervious Area
590		0.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	54	0.0200	0.07		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
4.8	40	0.0200	0.14		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.03"
0.7	43	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	269	0.0400	1.00		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
23.5	406				<b>Total</b>

**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Prepared by Fuss & O'Neill

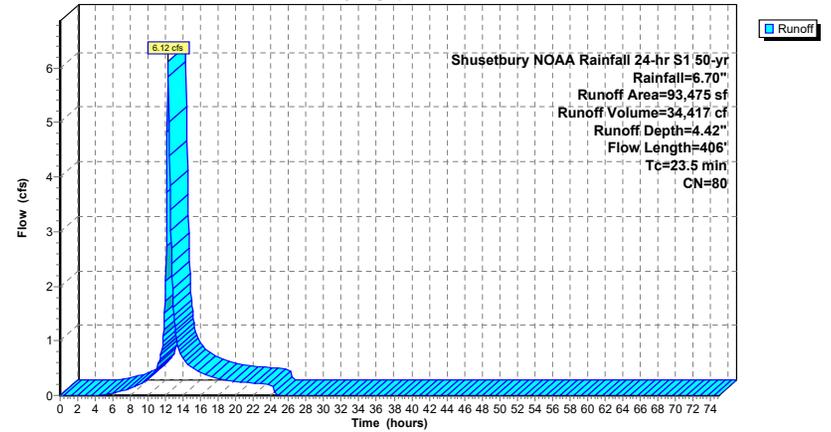
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**Subcatchment 12S: E02**

Hydrograph



**2022110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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**Summary for Subcatchment 14S: E01**

Runoff = 3.29 cfs @ 12.39 hrs, Volume= 22,354 cf, Depth= 4.42"  
Routed to Link 4L : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
13,580	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
47,131	79	Woods, Fair, HSG D
60,711	80	Weighted Average
60,711		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0100	0.06		<b>Sheet Flow, Woods</b> Woods: Light underbrush n= 0.400 P2= 3.03"
1.4	43	0.0100	0.50		<b>Shallow Concentrated Flow, Woods</b> Woodland Kv= 5.0 fps
0.3	19	0.0250	1.11		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
1.4	67	0.0250	0.79		<b>Shallow Concentrated Flow, Woods</b> Woodland Kv= 5.0 fps
0.8	45	0.0170	0.91		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
33.0	274				Total

**2022110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

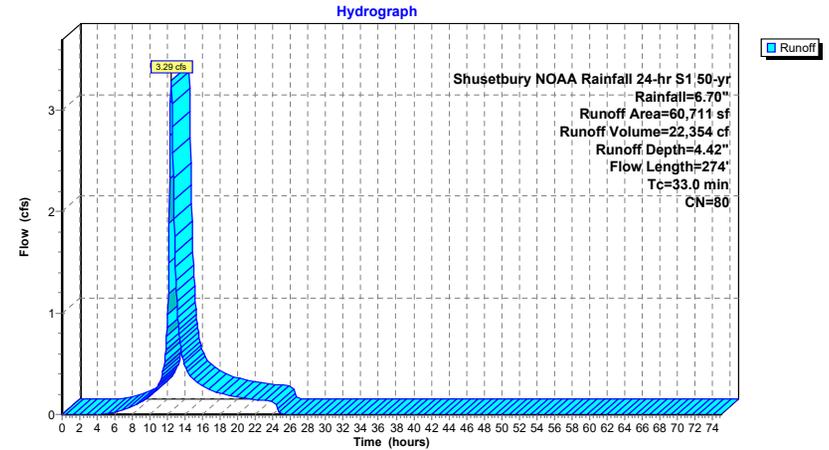
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**Subcatchment 14S: E01**



**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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**Summary for Subcatchment 26S: E03**

Runoff = 0.79 cfs @ 12.44 hrs, Volume= 5,774 cf, Depth= 4.86"  
 Routed to Link 10L : DP3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
 Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
13,269	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
1,002	79	Woods, Fair, HSG D
14,271	84	Weighted Average
14,271		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.9	70	0.0014	0.05		<b>Sheet Flow, Grass</b> Grass: Short n= 0.150 P2= 3.03"
12.8	30	0.0070	0.04		<b>Sheet Flow, Woods</b> Woods: Light underbrush n= 0.400 P2= 3.03"
0.7	47	0.0255	1.12		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
1.4	69	0.0145	0.84		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
0.2	15	0.0333	1.28		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
37.0	231				<b>Total</b>

**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

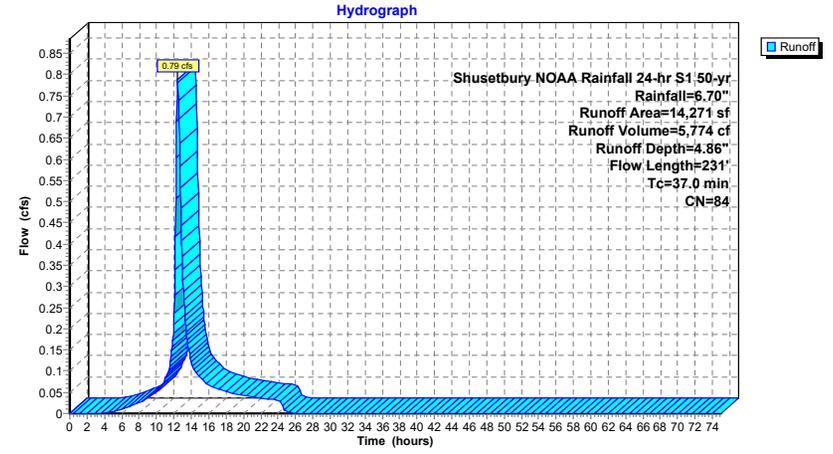
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**Subcatchment 26S: E03**



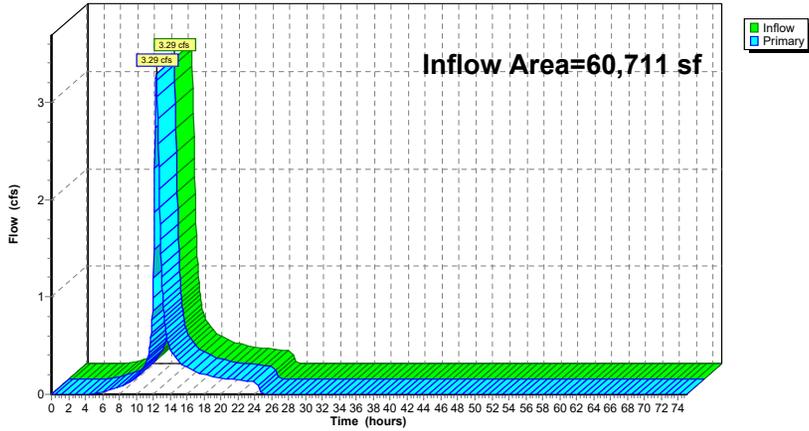
Summary for Link 4L: DP1

Inflow Area = 60,711 sf, 0.00% Impervious, Inflow Depth = 4.42" for 50-yr event  
 Inflow = 3.29 cfs @ 12.39 hrs, Volume= 22,354 cf  
 Primary = 3.29 cfs @ 12.39 hrs, Volume= 22,354 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

Link 4L: DP1

Hydrograph



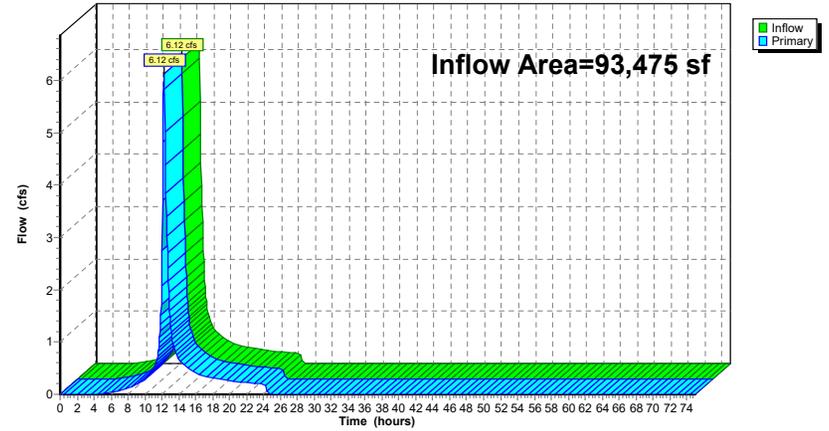
Summary for Link 8L: DP2

Inflow Area = 93,475 sf, 0.63% Impervious, Inflow Depth = 4.42" for 50-yr event  
 Inflow = 6.12 cfs @ 12.27 hrs, Volume= 34,417 cf  
 Primary = 6.12 cfs @ 12.27 hrs, Volume= 34,417 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

Link 8L: DP2

Hydrograph



**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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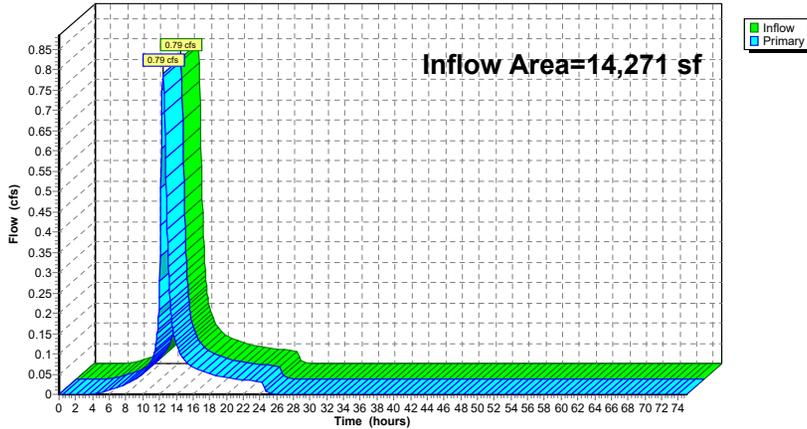
**Summary for Link 10L: DP3**

Inflow Area = 14,271 sf, 0.00% Impervious, Inflow Depth = 4.86" for 50-yr event  
 Inflow = 0.79 cfs @ 12.44 hrs, Volume= 5,774 cf  
 Primary = 0.79 cfs @ 12.44 hrs, Volume= 5,774 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

**Link 10L: DP3**

Hydrograph



**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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Time span=0.00-75.00 hrs, dt=0.05 hrs, 1501 points  
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment12S: E02**

Runoff Area=93,475 sf 0.63% Impervious Runoff Depth=5.25"  
 Flow Length=406' Tc=23.5 min CN=80 Runoff=7.12 cfs 40,903 cf

**Subcatchment14S: E01**

Runoff Area=60,711 sf 0.00% Impervious Runoff Depth=5.25"  
 Flow Length=274' Tc=33.0 min CN=80 Runoff=3.83 cfs 26,566 cf

**Subcatchment26S: E03**

Runoff Area=14,271 sf 0.00% Impervious Runoff Depth=5.71"  
 Flow Length=231' Tc=37.0 min CN=84 Runoff=0.91 cfs 6,793 cf

**Link 4L: DP1**

Inflow=3.83 cfs 26,566 cf  
 Primary=3.83 cfs 26,566 cf

**Link 8L: DP2**

Inflow=7.12 cfs 40,903 cf  
 Primary=7.12 cfs 40,903 cf

**Link 10L: DP3**

Inflow=0.91 cfs 6,793 cf  
 Primary=0.91 cfs 6,793 cf

**Total Runoff Area = 168,457 sf Runoff Volume = 74,263 cf Average Runoff Depth = 5.29"**  
**99.65% Pervious = 167,867 sf 0.35% Impervious = 590 sf**

**20221110A10\_EX01**

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Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 12S: E02**

Runoff = 7.12 cfs @ 12.27 hrs, Volume= 40,903 cf, Depth= 5.25"  
Routed to Link 8L : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
3,802	49	50-75% Grass cover, Fair, HSG A
49,575	84	50-75% Grass cover, Fair, HSG D
590	98	Paved parking, HSG D
1,194	36	Woods, Fair, HSG A
38,314	79	Woods, Fair, HSG D
93,475	80	Weighted Average
92,885		99.37% Pervious Area
590		0.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.5	54	0.0200	0.07		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
4.8	40	0.0200	0.14		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.03"
0.7	43	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
4.5	269	0.0400	1.00		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
23.5	406	Total			

**20221110A10\_EX01**

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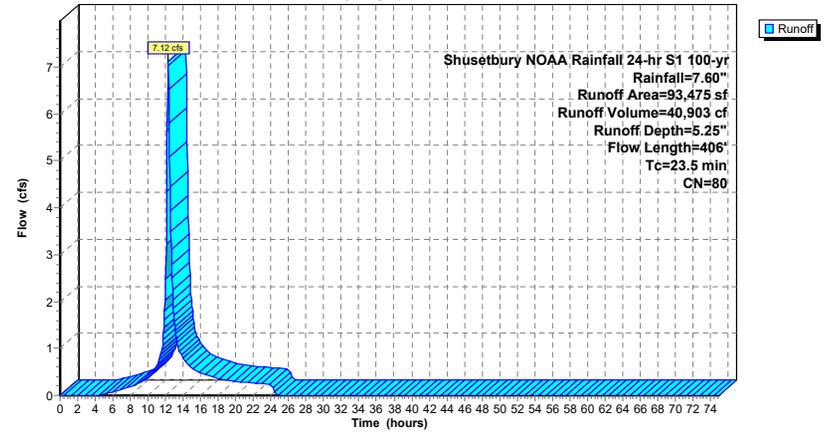
Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Subcatchment 12S: E02**

Hydrograph



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Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 14S: E01**

Runoff = 3.83 cfs @ 12.39 hrs, Volume= 26,566 cf, Depth= 5.25"  
 Routed to Link 4L : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
 Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
13,580	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
47,131	79	Woods, Fair, HSG D
60,711	80	Weighted Average
60,711		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0100	0.06		<b>Sheet Flow, Woods</b> Woods: Light underbrush n= 0.400 P2= 3.03"
1.4	43	0.0100	0.50		<b>Shallow Concentrated Flow, Woods</b> Woodland Kv= 5.0 fps
0.3	19	0.0250	1.11		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
1.4	67	0.0250	0.79		<b>Shallow Concentrated Flow, Woods</b> Woodland Kv= 5.0 fps
0.8	45	0.0170	0.91		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
33.0	274	Total			

**2022110A10\_EX01**

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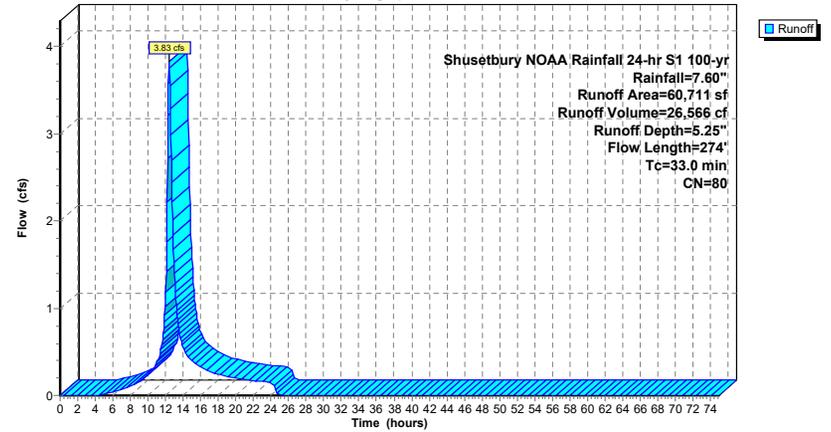
Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Subcatchment 14S: E01**

Hydrograph



**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 26S: E03**

Runoff = 0.91 cfs @ 12.44 hrs, Volume= 6,793 cf, Depth= 5.71"  
Routed to Link 10L : DP3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs  
Shusetbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
13,269	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
1,002	79	Woods, Fair, HSG D
14,271	84	Weighted Average
14,271		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.9	70	0.0014	0.05		<b>Sheet Flow, Grass</b> Grass: Short n= 0.150 P2= 3.03"
12.8	30	0.0070	0.04		<b>Sheet Flow, Woods</b> Woods: Light underbrush n= 0.400 P2= 3.03"
0.7	47	0.0255	1.12		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
1.4	69	0.0145	0.84		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
0.2	15	0.0333	1.28		<b>Shallow Concentrated Flow, Grass</b> Short Grass Pasture Kv= 7.0 fps
37.0	231				Total

**20221110A10\_EX01**

Shusetbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

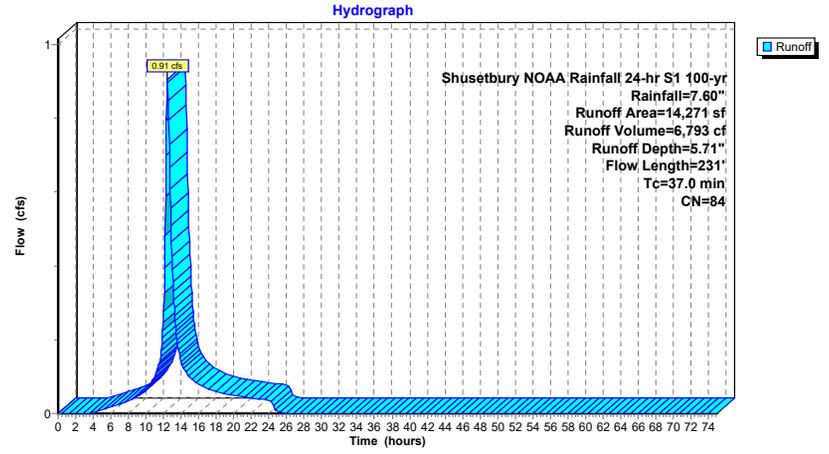
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**Subcatchment 26S: E03**



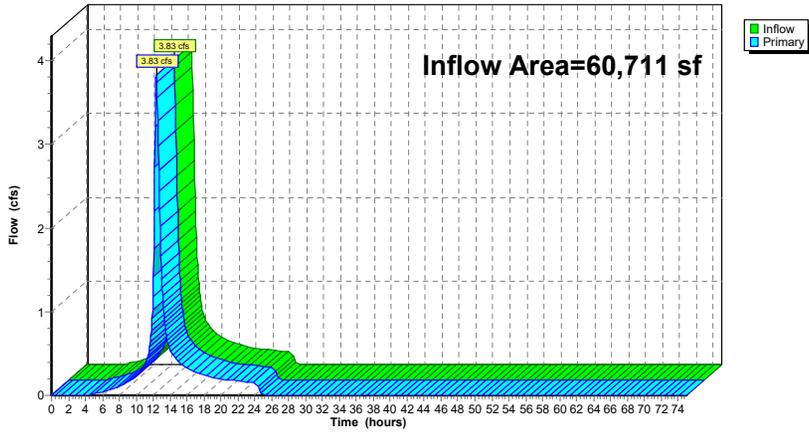
Summary for Link 4L: DP1

Inflow Area = 60,711 sf, 0.00% Impervious, Inflow Depth = 5.25" for 100-yr event  
 Inflow = 3.83 cfs @ 12.39 hrs, Volume= 26,566 cf  
 Primary = 3.83 cfs @ 12.39 hrs, Volume= 26,566 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

Link 4L: DP1

Hydrograph



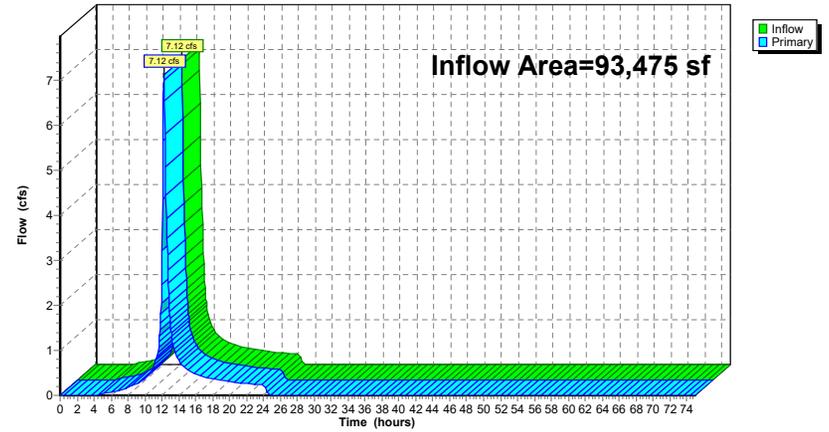
Summary for Link 8L: DP2

Inflow Area = 93,475 sf, 0.63% Impervious, Inflow Depth = 5.25" for 100-yr event  
 Inflow = 7.12 cfs @ 12.27 hrs, Volume= 40,903 cf  
 Primary = 7.12 cfs @ 12.27 hrs, Volume= 40,903 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

Link 8L: DP2

Hydrograph



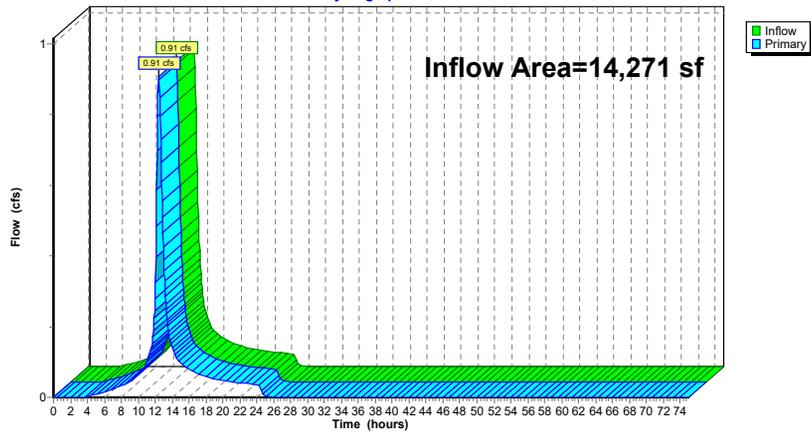
**Summary for Link 10L: DP3**

Inflow Area = 14,271 sf, 0.00% Impervious, Inflow Depth = 5.71" for 100-yr event  
Inflow = 0.91 cfs @ 12.44 hrs, Volume= 6,793 cf  
Primary = 0.91 cfs @ 12.44 hrs, Volume= 6,793 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-75.00 hrs, dt= 0.05 hrs

**Link 10L: DP3**

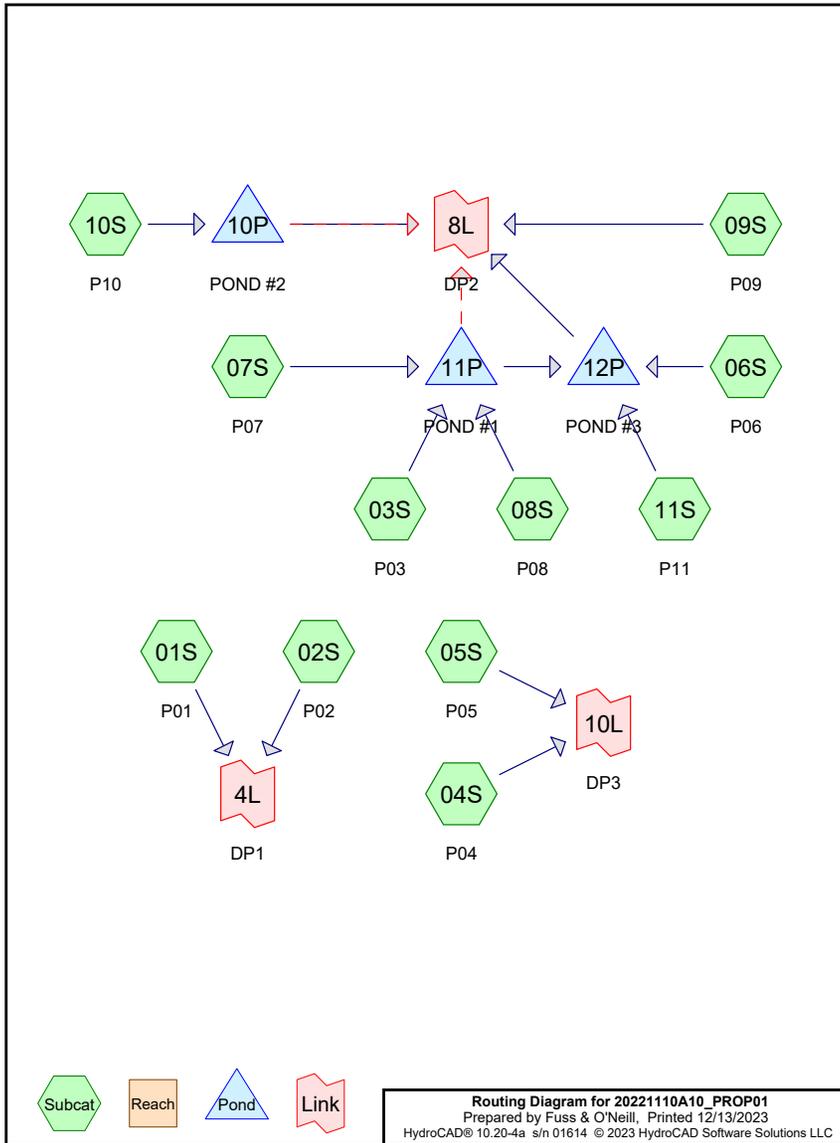
Hydrograph



## **Appendix F**

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### Post-Development Hydrologic Analysis



**2022110A10\_PROP01**

Prepared by Fuss & O'Neill

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Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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Time span=0.00-100.00 hrs, dt=0.03 hrs, 3334 points x 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment01S: P01</b>	Runoff Area=32,249 sf 0.00% Impervious Runoff Depth=1.27" Flow Length=222' Tc=31.2 min CN=80 Runoff=0.57 cfs 3,420 cf
<b>Subcatchment02S: P02</b>	Runoff Area=11,918 sf 0.00% Impervious Runoff Depth=1.47" Flow Length=85' Slope=0.0130 '/' Tc=17.6 min CN=83 Runoff=0.34 cfs 1,461 cf
<b>Subcatchment03S: P03</b>	Runoff Area=37,348 sf 47.60% Impervious Runoff Depth=2.28" Tc=6.0 min CN=93 Runoff=2.65 cfs 7,105 cf
<b>Subcatchment04S: P04</b>	Runoff Area=3,986 sf 5.27% Impervious Runoff Depth=1.47" Flow Length=137' Slope=0.0200 '/' Tc=10.7 min CN=83 Runoff=0.15 cfs 489 cf
<b>Subcatchment05S: P05</b>	Runoff Area=2,992 sf 6.28% Impervious Runoff Depth=1.61" Tc=6.0 min CN=85 Runoff=0.15 cfs 402 cf
<b>Subcatchment06S: P06</b>	Runoff Area=7,053 sf 57.88% Impervious Runoff Depth=2.19" Tc=6.0 min CN=92 Runoff=0.48 cfs 1,287 cf
<b>Subcatchment07S: P07</b>	Runoff Area=3,147 sf 100.00% Impervious Runoff Depth=2.80" Tc=6.0 min CN=98 Runoff=0.25 cfs 734 cf
<b>Subcatchment08S: P08</b>	Runoff Area=1,869 sf 100.00% Impervious Runoff Depth=2.80" Tc=6.0 min CN=98 Runoff=0.15 cfs 436 cf
<b>Subcatchment09S: P09</b>	Runoff Area=55,682 sf 0.50% Impervious Runoff Depth=1.15" Flow Length=209' Tc=20.6 min CN=78 Runoff=1.11 cfs 5,337 cf
<b>Subcatchment10S: P10</b>	Runoff Area=7,808 sf 11.68% Impervious Runoff Depth=2.01" Flow Length=74' Slope=0.0500 '/' Tc=6.0 min CN=90 Runoff=0.50 cfs 1,309 cf
<b>Subcatchment11S: P11</b>	Runoff Area=4,381 sf 0.00% Impervious Runoff Depth=1.77" Tc=6.0 min CN=87 Runoff=0.25 cfs 644 cf
<b>Pond 10P: POND #2</b>	Peak Elev=1,176.59' Storage=911 cf Inflow=0.50 cfs 1,309 cf Primary=0.02 cfs 542 cf Secondary=0.00 cfs 0 cf Outflow=0.02 cfs 542 cf
<b>Pond 11P: POND #1</b>	Peak Elev=1,175.08' Storage=3,370 cf Inflow=3.05 cfs 8,274 cf Primary=0.69 cfs 7,424 cf Secondary=0.00 cfs 0 cf Outflow=0.69 cfs 7,424 cf
<b>Pond 12P: POND #3</b>	Peak Elev=1,170.64' Storage=445 cf Inflow=1.25 cfs 9,355 cf Outflow=1.23 cfs 9,021 cf
<b>Link 4L: DP1</b>	Inflow=0.81 cfs 4,881 cf Primary=0.81 cfs 4,881 cf
<b>Link 8L: DP2</b>	Inflow=2.03 cfs 14,901 cf Primary=2.03 cfs 14,901 cf

**20221110A10\_PROP01**

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Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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Link 10L: DP3

Inflow=0.27 cfs 891 cf  
Primary=0.27 cfs 891 cf

Total Runoff Area = 168,433 sf Runoff Volume = 22,623 cf Average Runoff Depth = 1.61"  
83.10% Pervious = 139,970 sf 16.90% Impervious = 28,463 sf

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Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Summary for Subcatchment 01S: P01**

Runoff = 0.57 cfs @ 12.39 hrs, Volume= 3,420 cf, Depth= 1.27"  
Routed to Link 4L : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

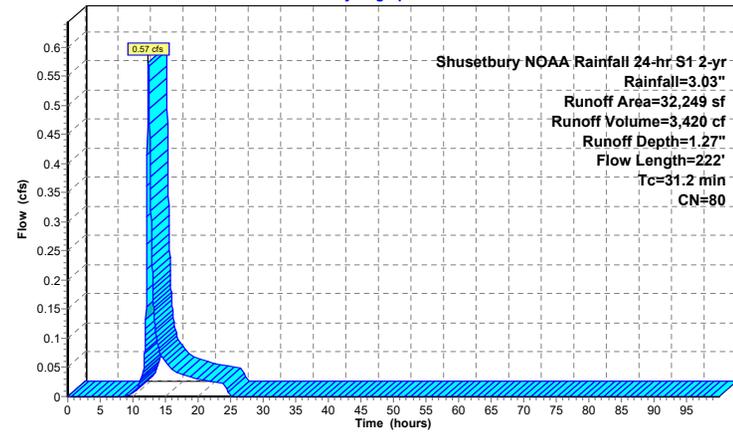
Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,462	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
28,787	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
32,249	80	Weighted Average
32,249		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0100	0.06		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.03"
2.1	122	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
31.2	222	Total			

**Subcatchment 01S: P01**

Hydrograph



**20221110A10\_PROP01**

Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Summary for Subcatchment 02S: P02**

Runoff = 0.34 cfs @ 12.20 hrs, Volume= 1,461 cf, Depth= 1.47"  
Routed to Link 4L : DP1

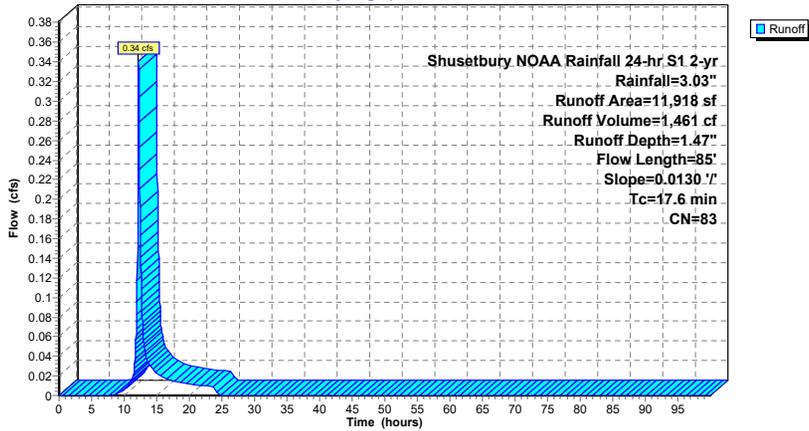
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
9,878	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
2,040	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
11,918	83	Weighted Average
11,918		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	54	0.0130	0.12		Sheet Flow, Grass: Short n= 0.150 P2= 3.03"
10.3	31	0.0130	0.05		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.03"
17.6	85				Total

**Subcatchment 02S: P02**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Summary for Subcatchment 03S: P03**

Runoff = 2.65 cfs @ 12.04 hrs, Volume= 7,105 cf, Depth= 2.28"  
Routed to Pond 11P : POND #1

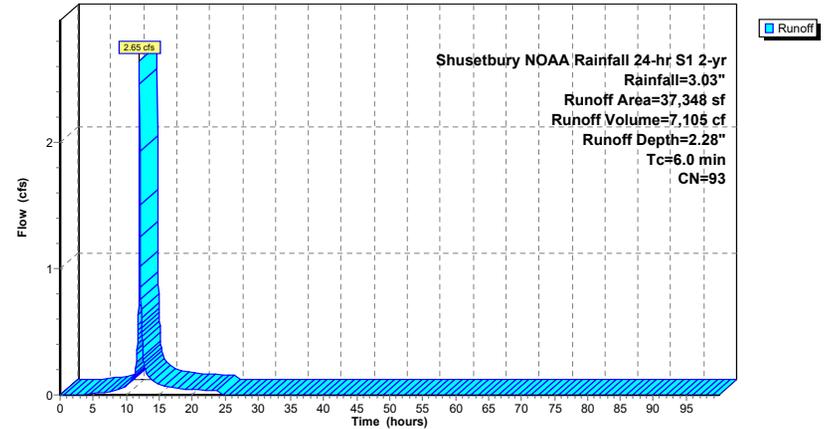
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
14,179	84	50-75% Grass cover, Fair, HSG D
17,778	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
5,391	98	Water Surface, 0% imp, HSG D
37,348	93	Weighted Average
19,570		52.40% Pervious Area
17,778		47.60% Impervious Area

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

**Subcatchment 03S: P03**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Summary for Subcatchment 04S: P04**

Runoff = 0.15 cfs @ 12.10 hrs, Volume= 489 cf, Depth= 1.47"  
Routed to Link 10L : DP3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,774	84	50-75% Grass cover, Fair, HSG D
210	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
1,002	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
3,986	83	Weighted Average
3,776		94.73% Pervious Area
210		5.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	100	0.0200	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.03"
0.6	37	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
10.7	137	Total			

**2022110A10\_PROP01**

Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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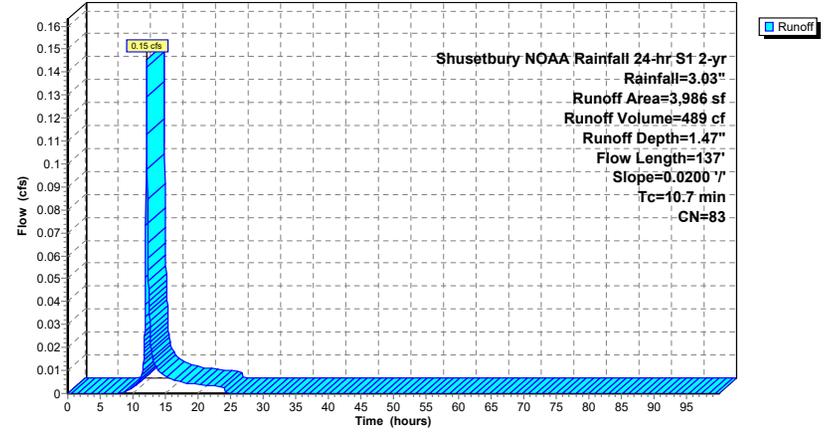
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**Subcatchment 04S: P04**

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**Summary for Subcatchment 05S: P05**

Runoff = 0.15 cfs @ 12.04 hrs, Volume= 402 cf, Depth= 1.61"  
Routed to Link 10L : DP3

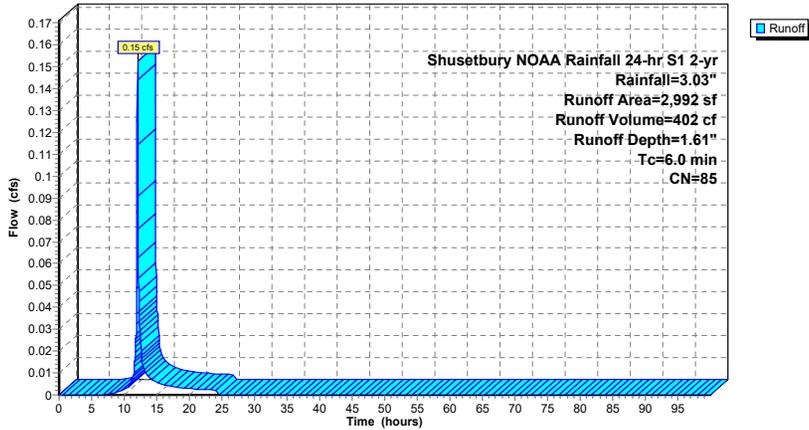
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,804	84	50-75% Grass cover, Fair, HSG D
188	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
2,992	85	Weighted Average
2,804		93.72% Pervious Area
188		6.28% Impervious Area

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

**Subcatchment 05S: P05**

Hydrograph



**20221110A10\_PROP01**

Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Summary for Subcatchment 06S: P06**

Runoff = 0.48 cfs @ 12.04 hrs, Volume= 1,287 cf, Depth= 2.19"  
Routed to Pond 12P : POND #3

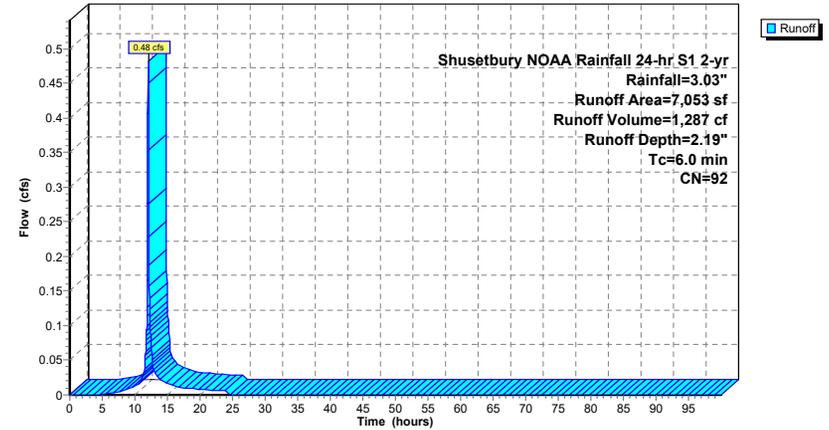
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,971	84	50-75% Grass cover, Fair, HSG D
4,082	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
7,053	92	Weighted Average
2,971		42.12% Pervious Area
4,082		57.88% Impervious Area

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

**Subcatchment 06S: P06**

Hydrograph



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**Summary for Subcatchment 07S: P07**

Runoff = 0.25 cfs @ 12.03 hrs, Volume= 734 cf, Depth= 2.80"  
Routed to Pond 11P : POND #1

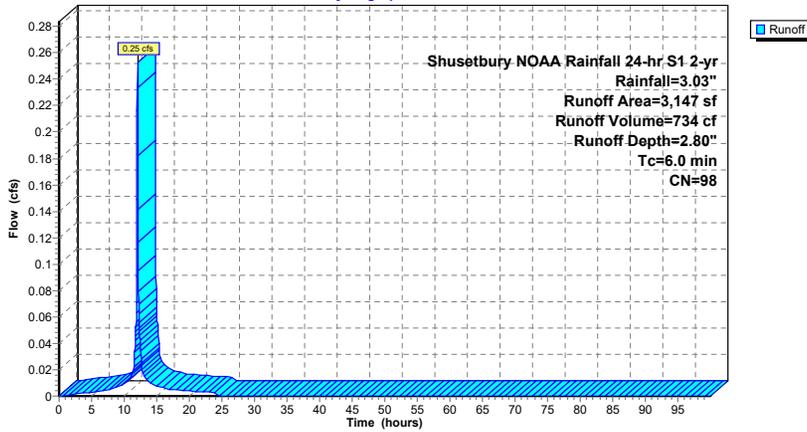
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
0	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
3,147	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
3,147	98	Weighted Average
3,147		100.00% Impervious Area

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

**Subcatchment 07S: P07**

Hydrograph



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**Summary for Subcatchment 08S: P08**

Runoff = 0.15 cfs @ 12.03 hrs, Volume= 436 cf, Depth= 2.80"  
Routed to Pond 11P : POND #1

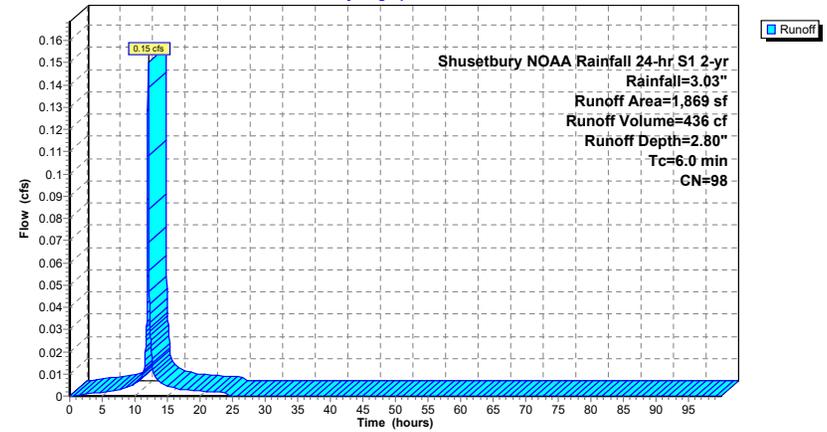
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
0	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
1,869	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
1,869	98	Weighted Average
1,869		100.00% Impervious Area

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

**Subcatchment 08S: P08**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Summary for Subcatchment 09S: P09**

Runoff = 1.11 cfs @ 12.24 hrs, Volume= 5,337 cf, Depth= 1.15"  
 Routed to Link 8L : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
 Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
3,802	49	50-75% Grass cover, Fair, HSG A
19,931	84	50-75% Grass cover, Fair, HSG D
277	98	Paved parking, HSG D
1,194	36	Woods, Fair, HSG A
30,478	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
55,682	78	Weighted Average
55,405		99.50% Pervious Area
277		0.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	100	0.0300	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
1.8	109	0.0430	1.04		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
20.6	209	Total			

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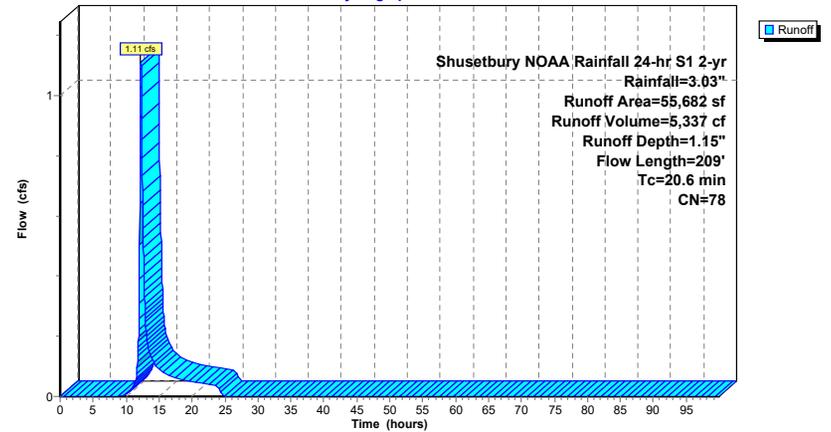
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Subcatchment 09S: P09**

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**Summary for Subcatchment 10S: P10**

Runoff = 0.50 cfs @ 12.04 hrs, Volume= 1,309 cf, Depth= 2.01"  
 Routed to Pond 10P : POND #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
 Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,994	84	50-75% Grass cover, Fair, HSG D
912	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
210	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
2,692	98	Water Surface, 0% imp, HSG D
7,808	90	Weighted Average
6,896		88.32% Pervious Area
912		11.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	23	0.0500	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
0.5	51	0.0500	1.57		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
5.2	74				Total, Increased to minimum Tc = 6.0 min

**2022110A10\_PROP01**

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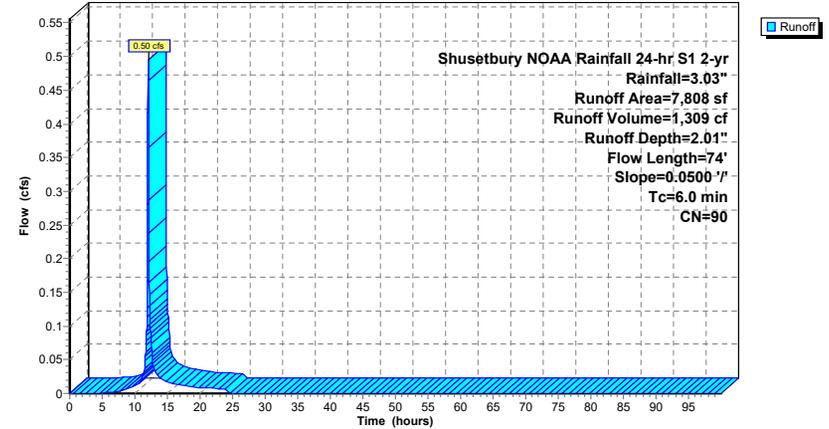
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Subcatchment 10S: P10**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Summary for Subcatchment 11S: P11**

Runoff = 0.25 cfs @ 12.04 hrs, Volume= 644 cf, Depth= 1.77"  
Routed to Pond 12P : POND #3

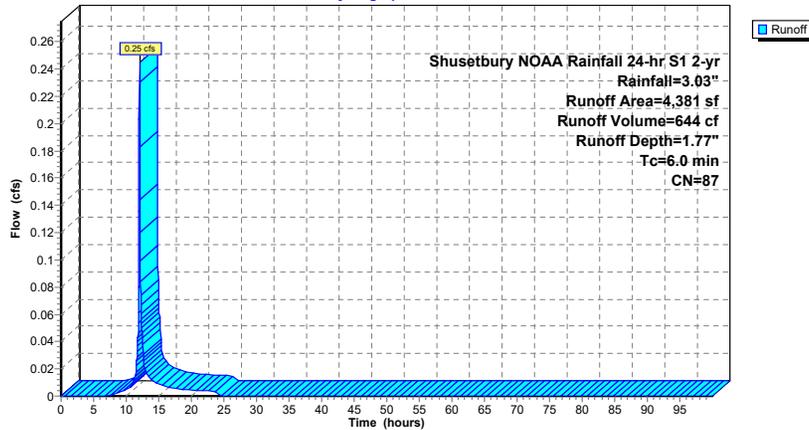
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,414	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
967	98	Water Surface, 0% imp, HSG D
4,381	87	Weighted Average
4,381		100.00% Pervious Area

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

**Subcatchment 11S: P11**

Hydrograph



**20221110A10\_PROP01**

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Shusetbury NOAA Rainfall 24-hr S1 2-yr Rainfall=3.03"

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**Summary for Pond 10P: POND #2**

Inflow Area = 7,808 sf, 11.68% Impervious, Inflow Depth = 2.01" for 2-yr event  
Inflow = 0.50 cfs @ 12.04 hrs, Volume= 1,309 cf  
Outflow = 0.02 cfs @ 15.39 hrs, Volume= 542 cf, Atten= 97%, Lag= 201.3 min  
Primary = 0.02 cfs @ 15.39 hrs, Volume= 542 cf  
Routed to Link 8L : DP2  
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf  
Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
Peak Elev= 1,176.59' @ 15.39 hrs Surf.Area= 1,729 sf Storage= 911 cf

Plug-Flow detention time= 560.2 min calculated for 542 cf (41% of inflow)  
Center-of-Mass det. time= 414.4 min ( 1,236.4 - 822.0 )

Volume #1	Invert	Avail.Storage	Storage Description
	1,176.00'	4,012 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,176.00	1,373	0	0
1,177.00	1,979	1,676	1,676
1,178.00	2,692	2,336	4,012

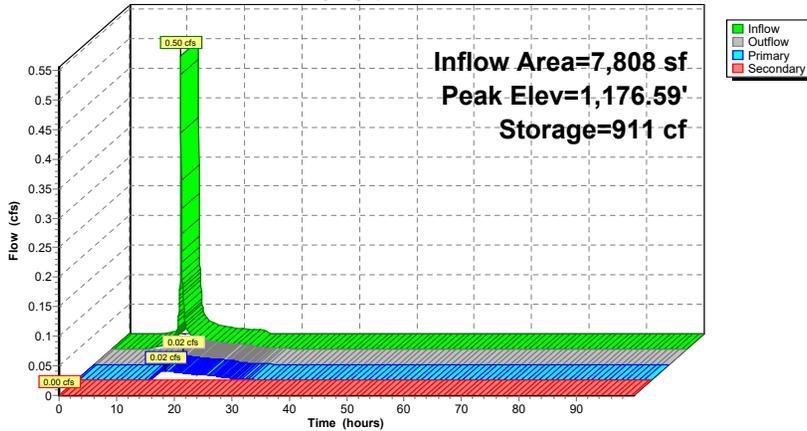
Device	Routing	Invert	Outlet Devices
#1	Primary	1,175.23'	<b>12.0" Round Culvert</b> L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,175.23' / 1,175.00' S= 0.0052' S= 0.0052' n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	1,177.00'	<b>24.0" x 24.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,176.50'	<b>3.0" Vert. Orifice</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,177.50'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.02 cfs @ 15.39 hrs HW=1,176.59' TW=0.00' (Dynamic Tailwater)  
1=Culvert (Passes 0.02 cfs of 2.85 cfs potential flow)  
2=Grate ( Controls 0.00 cfs)  
3=Orifice (Orifice Controls 0.02 cfs @ 1.01 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,176.00' TW=0.00' (Dynamic Tailwater)  
4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Pond 10P: POND #2**

Hydrograph



**Summary for Pond 11P: POND #1**

Inflow Area = 42,364 sf, 53.81% Impervious, Inflow Depth = 2.34" for 2-yr event  
 Inflow = 3.05 cfs @ 12.04 hrs, Volume= 8,274 cf  
 Outflow = 0.69 cfs @ 12.31 hrs, Volume= 7,424 cf, Atten= 78%, Lag= 16.4 min  
 Primary = 0.69 cfs @ 12.31 hrs, Volume= 7,424 cf  
 Routed to Pond 12P : POND #3  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,175.08' @ 12.31 hrs Surf.Area= 3,587 sf Storage= 3,370 cf

Plug-Flow detention time= 181.3 min calculated for 7,424 cf (90% of inflow)  
 Center-of-Mass det. time= 126.5 min ( 924.5 - 798.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,174.00'	11,904 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,174.00	2,675	0	0
1,175.00	3,524	3,100	3,100
1,176.00	4,347	3,936	7,035
1,177.00	5,391	4,869	11,904

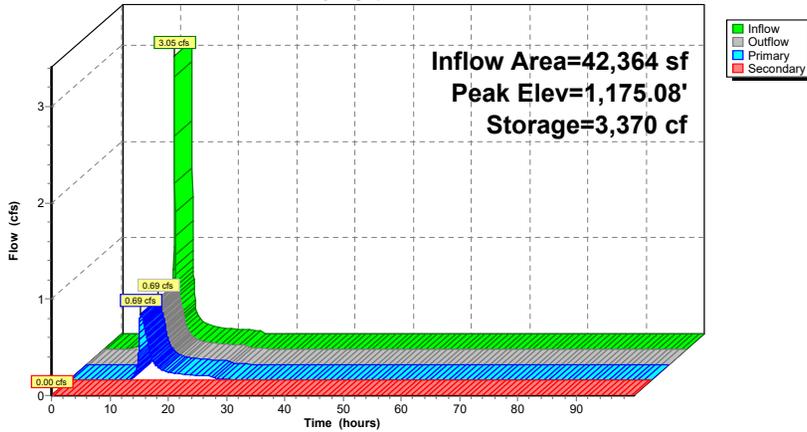
Device	Routing	Invert	Outlet Devices
#1	Primary	1,173.50'	<b>12.0" Round Culvert</b> L= 83.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,173.50' / 1,170.00' S= 0.0422'/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	1,176.00'	<b>24.0" x 24.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,174.30'	<b>6.0" Vert. Orifice</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,176.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.69 cfs @ 12.31 hrs HW=1,175.08' TW=1,170.61' (Dynamic Tailwater)  
 1=Culvert (Passes 0.69 cfs of 3.92 cfs potential flow)  
 2=Grate ( Controls 0.00 cfs)  
 3=Orifice (Orifice Controls 0.69 cfs @ 3.49 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,174.00' TW=0.00' (Dynamic Tailwater)  
 4=Broad-Crested Rectangular Weir( Controls 0.00 cfs)

**Pond 11P: POND #1**

Hydrograph



**Summary for Pond 12P: POND #3**

Inflow Area = 53,798 sf, 49.96% Impervious, Inflow Depth = 2.09" for 2-yr event  
 Inflow = 1.25 cfs @ 12.05 hrs, Volume= 9,355 cf  
 Outflow = 1.23 cfs @ 12.07 hrs, Volume= 9,021 cf, Atten= 2%, Lag= 1.2 min  
 Primary = 1.23 cfs @ 12.07 hrs, Volume= 9,021 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,170.64' @ 12.07 hrs Surf.Area= 823 sf Storage= 445 cf

Plug-Flow detention time= 46.2 min calculated for 9,019 cf (96% of inflow)  
 Center-of-Mass det. time= 14.0 min ( 916.7 - 902.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,170.00'	768 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

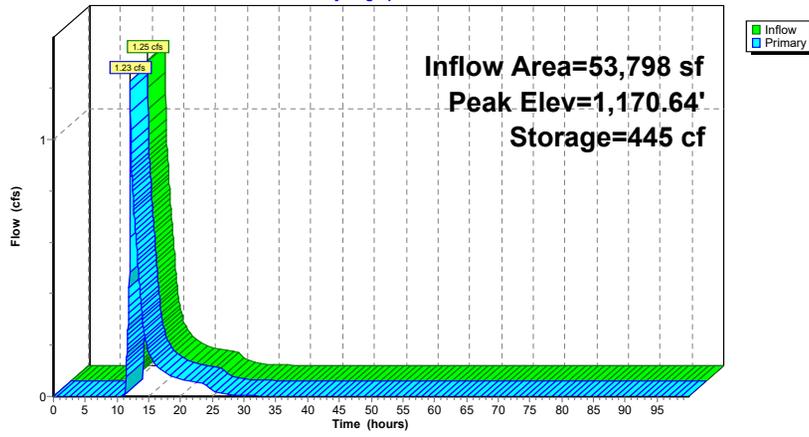
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,170.00	568	0	0
1,171.00	967	768	768

Device	Routing	Invert	Outlet Devices
#1	Primary	1,170.50'	<b>10.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> 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

**Primary OutFlow** Max=1.21 cfs @ 12.07 hrs HW=1,170.64' TW=0.00' (Dynamic Tailwater)  
 ↳=Broad-Crested Rectangular Weir(Weir Controls 1.21 cfs @ 0.87 fps)

**Pond 12P: POND #3**

Hydrograph



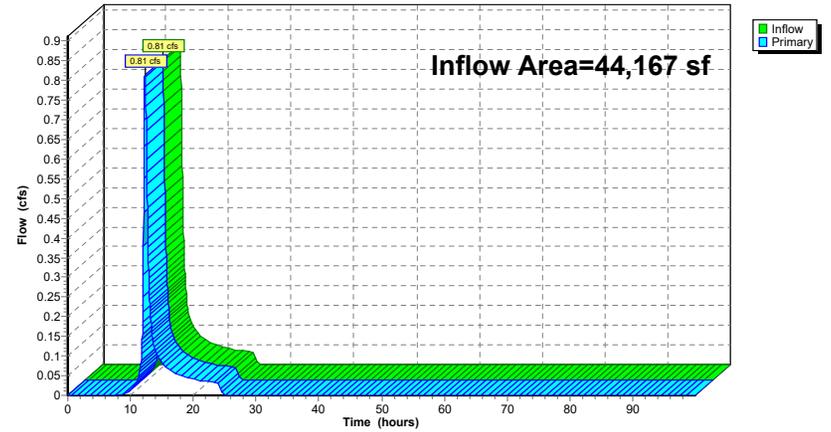
**Summary for Link 4L: DP1**

Inflow Area = 44,167 sf, 0.00% Impervious, Inflow Depth = 1.33" for 2-yr event  
Inflow = 0.81 cfs @ 12.30 hrs, Volume= 4,881 cf  
Primary = 0.81 cfs @ 12.30 hrs, Volume= 4,881 cf, Atten=0%, Lag=0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

**Link 4L: DP1**

Hydrograph



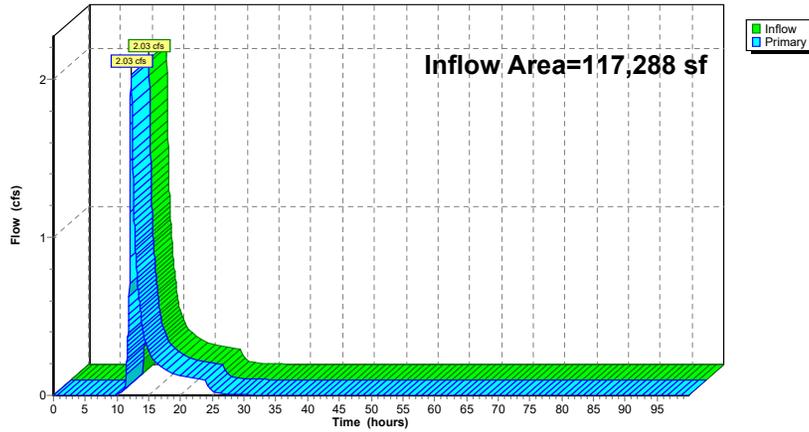
Summary for Link 8L: DP2

Inflow Area = 117,288 sf, 23.93% Impervious, Inflow Depth = 1.52" for 2-yr event  
 Inflow = 2.03 cfs @ 12.21 hrs, Volume= 14,901 cf  
 Primary = 2.03 cfs @ 12.21 hrs, Volume= 14,901 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

Link 8L: DP2

Hydrograph



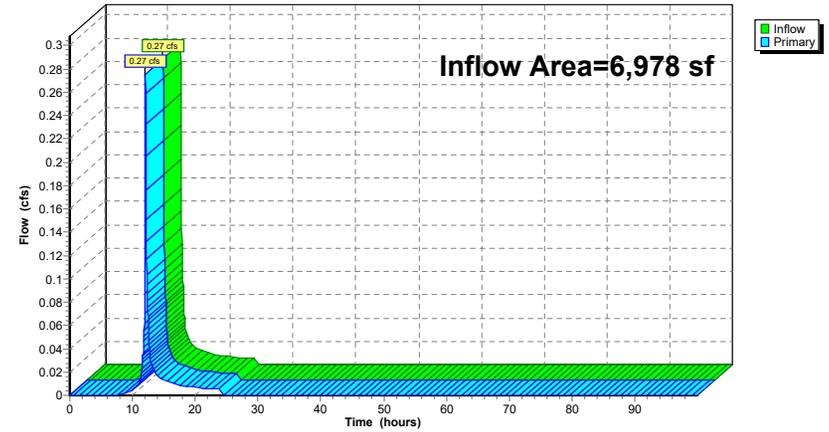
Summary for Link 10L: DP3

Inflow Area = 6,978 sf, 5.70% Impervious, Inflow Depth = 1.53" for 2-yr event  
 Inflow = 0.27 cfs @ 12.06 hrs, Volume= 891 cf  
 Primary = 0.27 cfs @ 12.06 hrs, Volume= 891 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

Link 10L: DP3

Hydrograph



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Time span=0.00-100.00 hrs, dt=0.03 hrs, 3334 points x 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment01S: P01** Runoff Area=32,249 sf 0.00% Impervious Runoff Depth=2.72"  
Flow Length=222' Tc=31.2 min CN=80 Runoff=1.15 cfs 7,307 cf

**Subcatchment02S: P02** Runoff Area=11,918 sf 0.00% Impervious Runoff Depth=2.99"  
Flow Length=85' Slope=0.0130 '/' Tc=17.6 min CN=83 Runoff=0.64 cfs 2,973 cf

**Subcatchment03S: P03** Runoff Area=37,348 sf 47.60% Impervious Runoff Depth=4.00"  
Tc=6.0 min CN=93 Runoff=4.13 cfs 12,454 cf

**Subcatchment04S: P04** Runoff Area=3,986 sf 5.27% Impervious Runoff Depth=2.99"  
Flow Length=137' Slope=0.0200 '/' Tc=10.7 min CN=83 Runoff=0.27 cfs 994 cf

**Subcatchment05S: P05** Runoff Area=2,992 sf 6.28% Impervious Runoff Depth=3.18"  
Tc=6.0 min CN=85 Runoff=0.28 cfs 794 cf

**Subcatchment06S: P06** Runoff Area=7,053 sf 57.88% Impervious Runoff Depth=3.89"  
Tc=6.0 min CN=92 Runoff=0.77 cfs 2,289 cf

**Subcatchment07S: P07** Runoff Area=3,147 sf 100.00% Impervious Runoff Depth=4.56"  
Tc=6.0 min CN=98 Runoff=0.37 cfs 1,197 cf

**Subcatchment08S: P08** Runoff Area=1,869 sf 100.00% Impervious Runoff Depth=4.56"  
Tc=6.0 min CN=98 Runoff=0.22 cfs 711 cf

**Subcatchment09S: P09** Runoff Area=55,682 sf 0.50% Impervious Runoff Depth=2.54"  
Flow Length=209' Tc=20.6 min CN=78 Runoff=2.34 cfs 11,799 cf

**Subcatchment10S: P10** Runoff Area=7,808 sf 11.68% Impervious Runoff Depth=3.68"  
Flow Length=74' Slope=0.0500 '/' Tc=6.0 min CN=90 Runoff=0.81 cfs 2,397 cf

**Subcatchment11S: P11** Runoff Area=4,381 sf 0.00% Impervious Runoff Depth=3.38"  
Tc=6.0 min CN=87 Runoff=0.43 cfs 1,234 cf

**Pond 10P: POND #2** Peak Elev=1,176.79' Storage=1,265 cf Inflow=0.81 cfs 2,397 cf  
Primary=0.09 cfs 1,630 cf Secondary=0.00 cfs 0 cf Outflow=0.09 cfs 1,630 cf

**Pond 11P: POND #1** Peak Elev=1,175.50' Storage=4,945 cf Inflow=4.72 cfs 14,362 cf  
Primary=0.92 cfs 13,512 cf Secondary=0.00 cfs 0 cf Outflow=0.92 cfs 13,512 cf

**Pond 12P: POND #3** Peak Elev=1,170.69' Storage=484 cf Inflow=1.92 cfs 17,034 cf  
Outflow=1.88 cfs 16,700 cf

**Link 4L: DP1** Inflow=1.61 cfs 10,281 cf  
Primary=1.61 cfs 10,281 cf

**Link 8L: DP2** Inflow=3.72 cfs 30,129 cf  
Primary=3.72 cfs 30,129 cf

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**Link 10L: DP3**

Inflow=0.51 cfs 1,788 cf

Primary=0.51 cfs 1,788 cf

**Total Runoff Area = 168,433 sf Runoff Volume = 44,149 cf Average Runoff Depth = 3.15"**  
**83.10% Pervious = 139,970 sf 16.90% Impervious = 28,463 sf**

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**Summary for Subcatchment 01S: P01**

Runoff = 1.15 cfs @ 12.37 hrs, Volume= 7,307 cf, Depth= 2.72"  
Routed to Link 4L : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

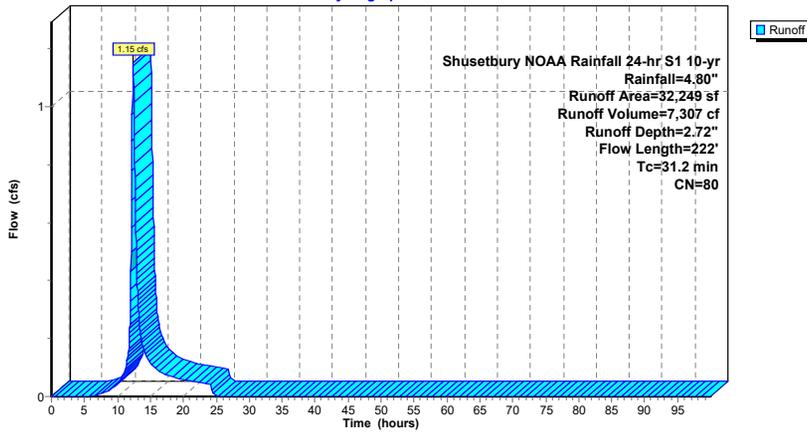
Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,462	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
28,787	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
32,249	80	Weighted Average
32,249		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0100	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
2.1	122	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
31.2	222	Total			

**Subcatchment 01S: P01**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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**Summary for Subcatchment 02S: P02**

Runoff = 0.64 cfs @ 12.19 hrs, Volume= 2,973 cf, Depth= 2.99"  
Routed to Link 4L : DP1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

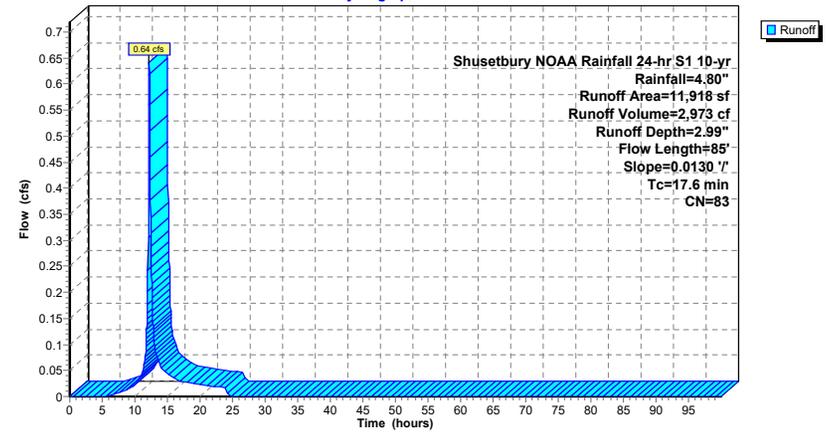
Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
9,878	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
2,040	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
11,918	83	Weighted Average
11,918		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	54	0.0130	0.12		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.03"
10.3	31	0.0130	0.05		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
17.6	85	Total			

**Subcatchment 02S: P02**

Hydrograph



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**Summary for Subcatchment 03S: P03**

Runoff = 4.13 cfs @ 12.04 hrs, Volume= 12,454 cf, Depth= 4.00"  
Routed to Pond 11P : POND #1

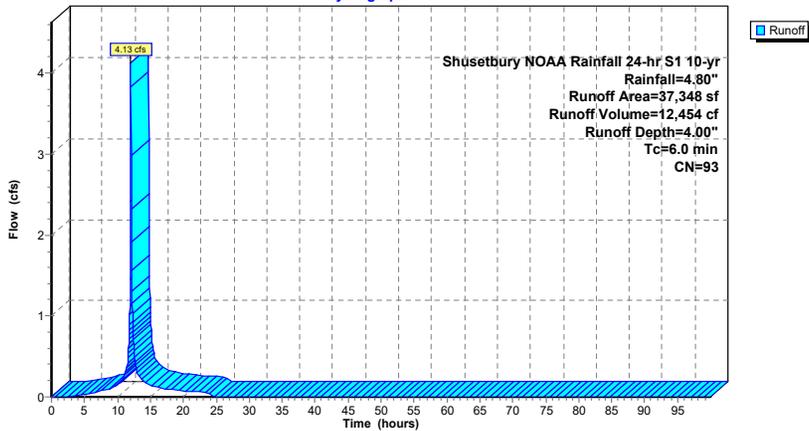
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
14,179	84	50-75% Grass cover, Fair, HSG D
17,778	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
5,391	98	Water Surface, 0% imp, HSG D
37,348	93	Weighted Average
19,570		52.40% Pervious Area
17,778		47.60% Impervious Area

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

**Subcatchment 03S: P03**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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**Summary for Subcatchment 04S: P04**

Runoff = 0.27 cfs @ 12.10 hrs, Volume= 994 cf, Depth= 2.99"  
Routed to Link 10L : DP3

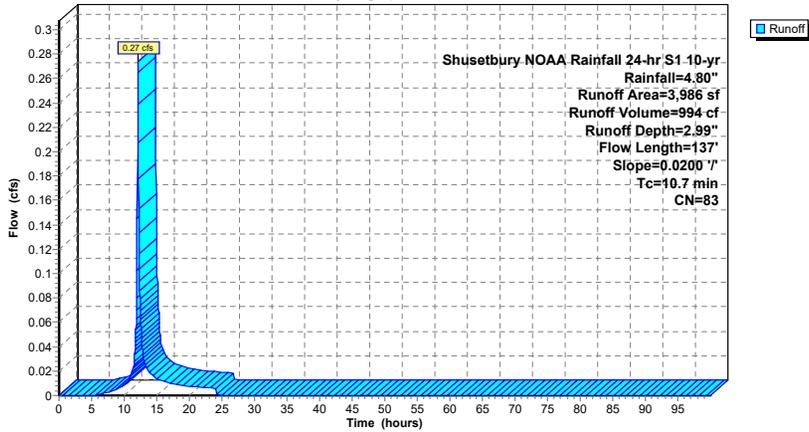
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,774	84	50-75% Grass cover, Fair, HSG D
210	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
1,002	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
3,986	83	Weighted Average
3,776		94.73% Pervious Area
210		5.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	100	0.0200	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.03"
0.6	37	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
10.7	137				Total

**Subcatchment 04S: P04**

Hydrograph



**Summary for Subcatchment 05S: P05**

Runoff = 0.28 cfs @ 12.04 hrs, Volume= 794 cf, Depth= 3.18"  
 Routed to Link 10L : DP3

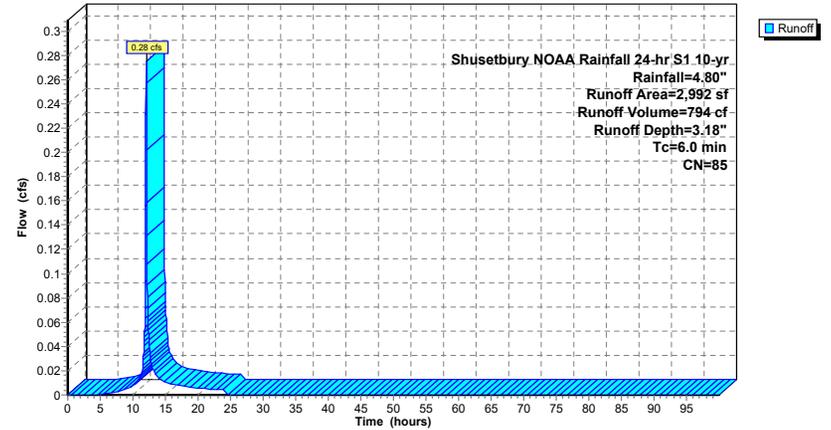
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
 Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,804	84	50-75% Grass cover, Fair, HSG D
188	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
2,992	85	Weighted Average
2,804		93.72% Pervious Area
188		6.28% Impervious Area

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

**Subcatchment 05S: P05**

Hydrograph



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**Summary for Subcatchment 06S: P06**

Runoff = 0.77 cfs @ 12.04 hrs, Volume= 2,289 cf, Depth= 3.89"  
Routed to Pond 12P : POND #3

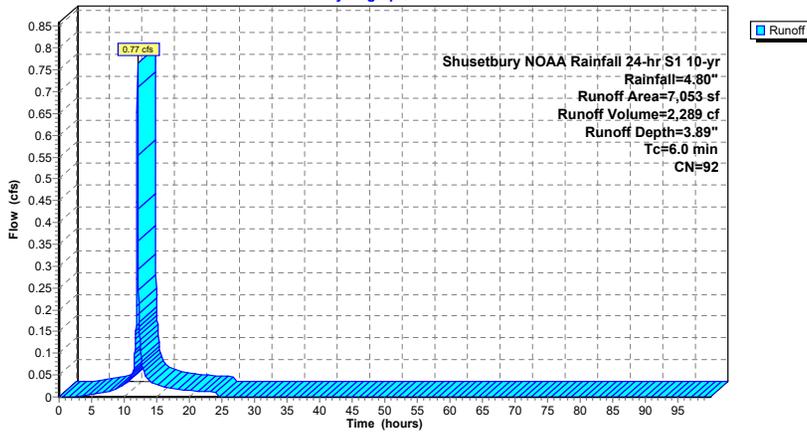
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,971	84	50-75% Grass cover, Fair, HSG D
4,082	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
7,053	92	Weighted Average
2,971		42.12% Pervious Area
4,082		57.88% Impervious Area

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

**Subcatchment 06S: P06**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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**Summary for Subcatchment 07S: P07**

Runoff = 0.37 cfs @ 12.03 hrs, Volume= 1,197 cf, Depth= 4.56"  
Routed to Pond 11P : POND #1

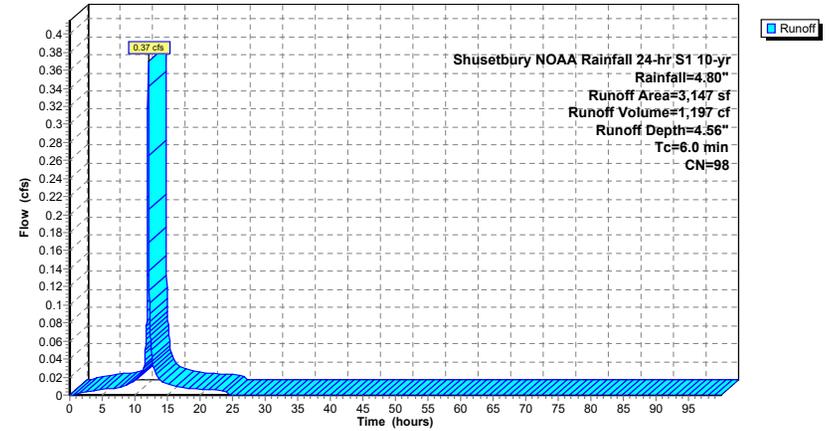
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
0	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
3,147	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
3,147	98	Weighted Average
3,147		100.00% Impervious Area

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

**Subcatchment 07S: P07**

Hydrograph



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**Summary for Subcatchment 08S: P08**

Runoff = 0.22 cfs @ 12.03 hrs, Volume= 711 cf, Depth= 4.56"  
Routed to Pond 11P : POND #1

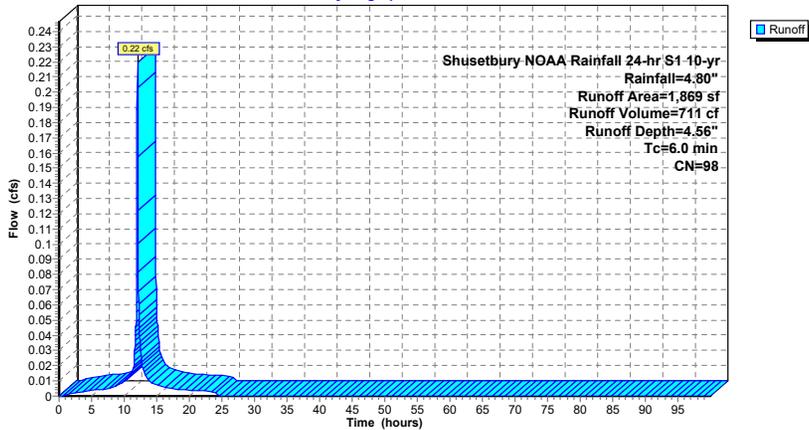
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
0	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
1,869	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
1,869	98	Weighted Average
1,869		100.00% Impervious Area

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

**Subcatchment 08S: P08**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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**Summary for Subcatchment 09S: P09**

Runoff = 2.34 cfs @ 12.23 hrs, Volume= 11,799 cf, Depth= 2.54"  
Routed to Link 8L : DP2

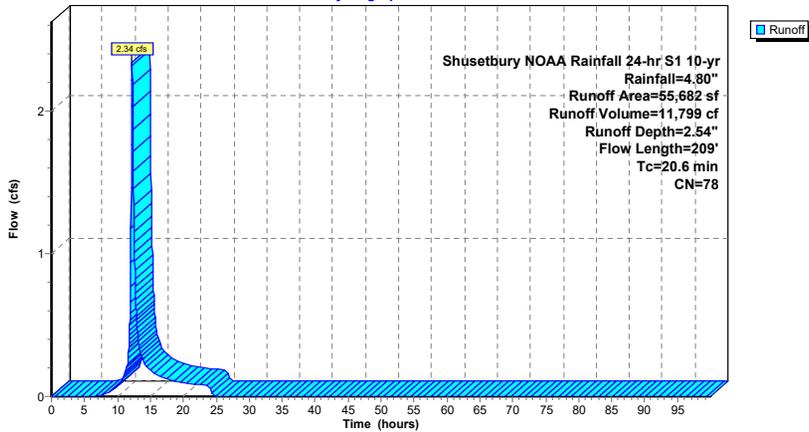
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

Area (sf)	CN	Description
3,802	49	50-75% Grass cover, Fair, HSG A
19,931	84	50-75% Grass cover, Fair, HSG D
277	98	Paved parking, HSG D
1,194	36	Woods, Fair, HSG A
30,478	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
55,682	78	Weighted Average
55,405		99.50% Pervious Area
277		0.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	100	0.0300	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.03"
1.8	109	0.0430	1.04		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
20.6	209				Total

**Subcatchment 09S: P09**

Hydrograph



**Summary for Subcatchment 10S: P10**

Runoff = 0.81 cfs @ 12.04 hrs, Volume= 2,397 cf, Depth= 3.68"  
 Routed to Pond 10P : POND #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
 Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

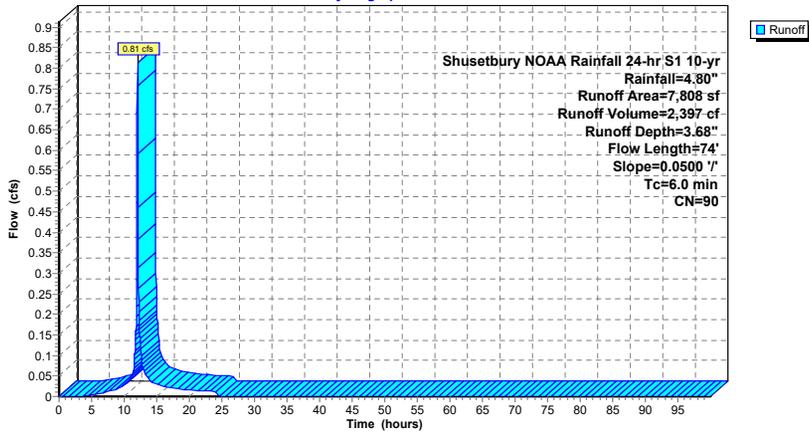
Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,994	84	50-75% Grass cover, Fair, HSG D
912	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
210	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
2,692	98	Water Surface, 0% imp, HSG D
7,808	90	Weighted Average
6,896		88.32% Pervious Area
912		11.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	23	0.0500	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
0.5	51	0.0500	1.57		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
5.2	74				Total, Increased to minimum Tc = 6.0 min

**Subcatchment 10S: P10**

Hydrograph



**Summary for Subcatchment 11S: P11**

Runoff = 0.43 cfs @ 12.04 hrs, Volume= 1,234 cf, Depth= 3.38"  
 Routed to Pond 12P : POND #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
 Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

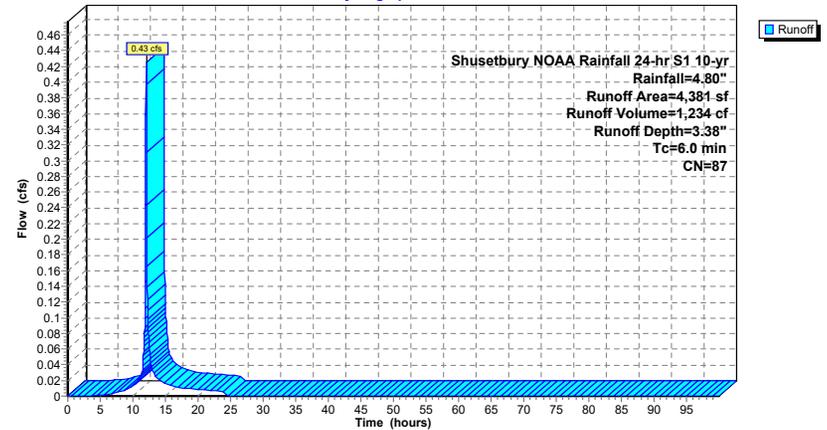
Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,414	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
967	98	Water Surface, 0% imp, HSG D

4,381	87	Weighted Average
4,381		100.00% Pervious Area

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

**Subcatchment 11S: P11**

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**Summary for Pond 10P: POND #2**

Inflow Area = 7,808 sf, 11.68% Impervious, Inflow Depth = 3.68" for 10-yr event  
 Inflow = 0.81 cfs @ 12.04 hrs, Volume= 2,397 cf  
 Outflow = 0.09 cfs @ 12.61 hrs, Volume= 1,630 cf, Atten= 88%, Lag= 34.7 min  
 Primary = 0.09 cfs @ 12.61 hrs, Volume= 1,630 cf  
 Routed to Link 8L : DP2  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,176.79' @ 12.61 hrs Surf.Area= 1,849 sf Storage= 1,265 cf

Plug-Flow detention time= 340.5 min calculated for 1,630 cf (68% of inflow)  
 Center-of-Mass det. time= 221.3 min ( 1,025.9 - 804.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,176.00'	4,012 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,176.00	1,373	0	0
1,177.00	1,979	1,676	1,676
1,178.00	2,692	2,336	4,012

Device	Routing	Invert	Outlet Devices
#1	Primary	1,175.23'	<b>12.0" Round Culvert</b> L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,175.23' / 1,175.00' S= 0.0052'/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	1,177.00'	<b>24.0" x 24.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,176.50'	<b>3.0" Vert. Orifice</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,177.50'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.09 cfs @ 12.61 hrs HW=1,176.79' TW=0.00' (Dynamic Tailwater)  
 1=Culvert (Passes 0.09 cfs of 3.29 cfs potential flow)  
 2=Grate ( Controls 0.00 cfs)  
 3=Orifice (Orifice Controls 0.09 cfs @ 1.93 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,176.00' TW=0.00' (Dynamic Tailwater)  
 4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

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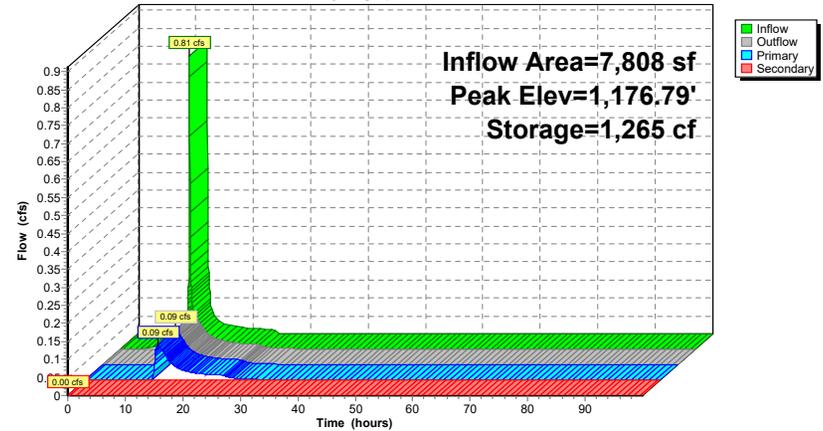
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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**Pond 10P: POND #2**

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**Summary for Pond 11P: POND #1**

Inflow Area = 42,364 sf, 53.81% Impervious, Inflow Depth = 4.07" for 10-yr event  
 Inflow = 4.72 cfs @ 12.04 hrs, Volume= 14,362 cf  
 Outflow = 0.92 cfs @ 12.36 hrs, Volume= 13,512 cf, Atten= 81%, Lag= 19.5 min  
 Primary = 0.92 cfs @ 12.36 hrs, Volume= 13,512 cf  
 Routed to Pond 12P : POND #3  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,175.50' @ 12.36 hrs Surf.Area= 3,931 sf Storage= 4,945 cf

Plug-Flow detention time= 144.2 min calculated for 13,512 cf (94% of inflow)  
 Center-of-Mass det. time= 108.8 min ( 892.0 - 783.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,174.00'	11,904 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,174.00	2,675	0	0
1,175.00	3,524	3,100	3,100
1,176.00	4,347	3,936	7,035
1,177.00	5,391	4,869	11,904

Device	Routing	Invert	Outlet Devices
#1	Primary	1,173.50'	<b>12.0" Round Culvert</b> L= 83.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,173.50' / 1,170.00' S= 0.0422 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	1,176.00'	<b>24.0" x 24.0" Horiz. Gate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,174.30'	<b>6.0" Vert. Orifice</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,176.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.92 cfs @ 12.36 hrs HW=1,175.50' TW=1,170.64' (Dynamic Tailwater)  
 1=Culvert (Passes 0.92 cfs of 4.62 cfs potential flow)  
 2=Grate ( Controls 0.00 cfs)  
 3=Orifice (Orifice Controls 0.92 cfs @ 4.68 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,174.00' TW=0.00' (Dynamic Tailwater)  
 4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

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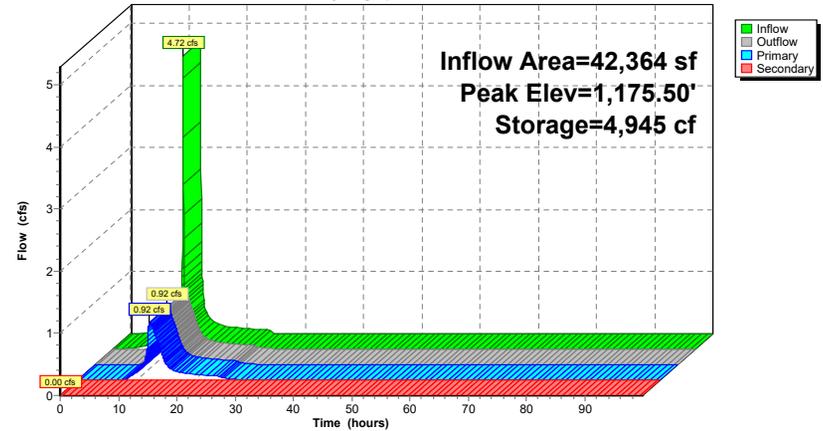
Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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**Pond 11P: POND #1**

Hydrograph



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**Summary for Pond 12P: POND #3**

Inflow Area = 53,798 sf, 49.96% Impervious, Inflow Depth = 3.80" for 10-yr event  
 Inflow = 1.92 cfs @ 12.04 hrs, Volume= 17,034 cf  
 Outflow = 1.88 cfs @ 12.06 hrs, Volume= 16,700 cf, Atten= 2%, Lag= 1.1 min  
 Primary = 1.88 cfs @ 12.06 hrs, Volume= 16,700 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,170.69' @ 12.06 hrs Surf.Area= 842 sf Storage= 484 cf

Plug-Flow detention time= 29.2 min calculated for 16,695 cf (98% of inflow)  
 Center-of-Mass det. time= 11.0 min ( 884.5 - 873.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,170.00'	768 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,170.00	568	0	0
1,171.00	967	768	768

Device	Routing	Invert	Outlet Devices
#1	Primary	1,170.50'	<b>10.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> 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

**Primary OutFlow** Max=1.88 cfs @ 12.06 hrs HW=1,170.69' TW=0.00' (Dynamic Tailwater)  
 ↑=Broad-Crested Rectangular Weir(Weir Controls 1.88 cfs @ 1.01 fps)

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Shusetbury NOAA Rainfall 24-hr S1 10-yr Rainfall=4.80"

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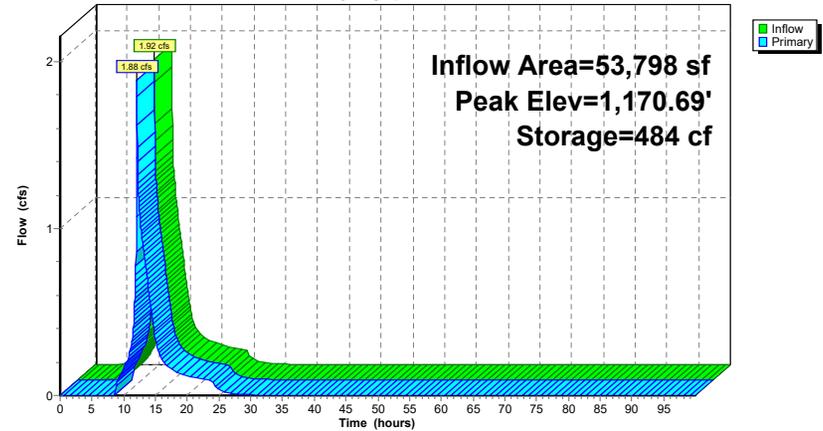
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**Pond 12P: POND #3**

Hydrograph



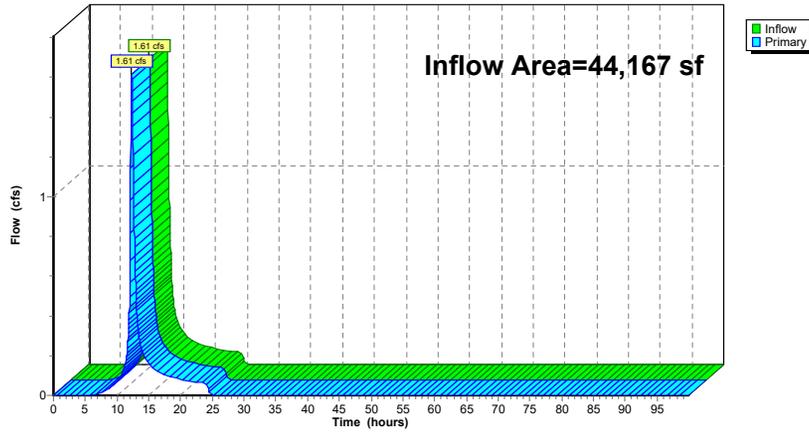
Summary for Link 4L: DP1

Inflow Area = 44,167 sf, 0.00% Impervious, Inflow Depth = 2.79" for 10-yr event  
Inflow = 1.61 cfs @ 12.29 hrs, Volume= 10,281 cf  
Primary = 1.61 cfs @ 12.29 hrs, Volume= 10,281 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

Link 4L: DP1

Hydrograph



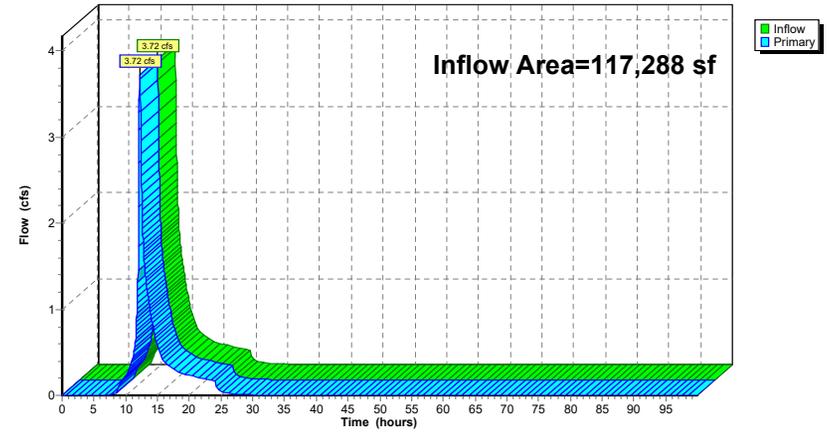
Summary for Link 8L: DP2

Inflow Area = 117,288 sf, 23.93% Impervious, Inflow Depth = 3.08" for 10-yr event  
Inflow = 3.72 cfs @ 12.21 hrs, Volume= 30,129 cf  
Primary = 3.72 cfs @ 12.21 hrs, Volume= 30,129 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

Link 8L: DP2

Hydrograph



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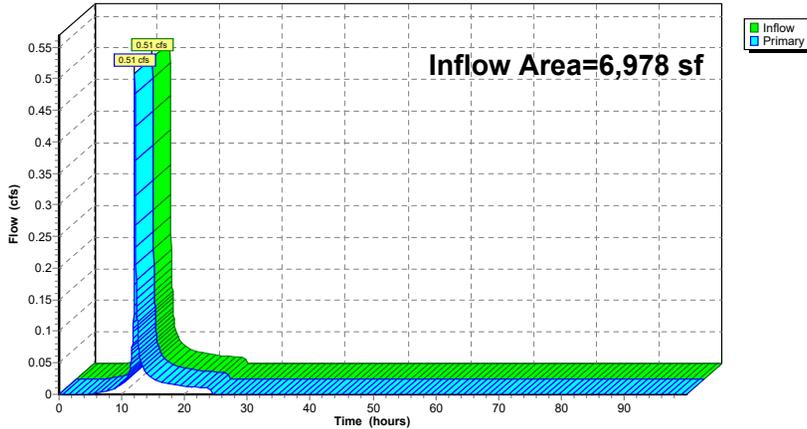
**Summary for Link 10L: DP3**

Inflow Area = 6,978 sf, 5.70% Impervious, Inflow Depth = 3.08" for 10-yr event  
 Inflow = 0.51 cfs @ 12.06 hrs, Volume= 1,788 cf  
 Primary = 0.51 cfs @ 12.06 hrs, Volume= 1,788 cf, Atten=0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

**Link 10L: DP3**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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Time span=0.00-100.00 hrs, dt=0.03 hrs, 3334 points x 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

<b>Subcatchment01S: P01</b>	Runoff Area=32,249 sf 0.00% Impervious Runoff Depth=3.69" Flow Length=222' Tc=31.2 min CN=80 Runoff=1.53 cfs 9,920 cf
<b>Subcatchment02S: P02</b>	Runoff Area=11,918 sf 0.00% Impervious Runoff Depth=4.00" Flow Length=85' Slope=0.0130 1/1' Tc=17.6 min CN=83 Runoff=0.83 cfs 3,971 cf
<b>Subcatchment03S: P03</b>	Runoff Area=37,348 sf 47.60% Impervious Runoff Depth=5.08" Tc=6.0 min CN=93 Runoff=5.04 cfs 15,823 cf
<b>Subcatchment04S: P04</b>	Runoff Area=3,986 sf 5.27% Impervious Runoff Depth=4.00" Flow Length=137' Slope=0.0200 1/1' Tc=10.7 min CN=83 Runoff=0.35 cfs 1,328 cf
<b>Subcatchment05S: P05</b>	Runoff Area=2,992 sf 6.28% Impervious Runoff Depth=4.21" Tc=6.0 min CN=85 Runoff=0.35 cfs 1,049 cf
<b>Subcatchment06S: P06</b>	Runoff Area=7,053 sf 57.88% Impervious Runoff Depth=4.97" Tc=6.0 min CN=92 Runoff=0.94 cfs 2,922 cf
<b>Subcatchment07S: P07</b>	Runoff Area=3,147 sf 100.00% Impervious Runoff Depth=5.66" Tc=6.0 min CN=98 Runoff=0.44 cfs 1,485 cf
<b>Subcatchment08S: P08</b>	Runoff Area=1,869 sf 100.00% Impervious Runoff Depth=5.66" Tc=6.0 min CN=98 Runoff=0.26 cfs 882 cf
<b>Subcatchment09S: P09</b>	Runoff Area=55,682 sf 0.50% Impervious Runoff Depth=3.49" Flow Length=209' Tc=20.6 min CN=78 Runoff=3.14 cfs 16,198 cf
<b>Subcatchment10S: P10</b>	Runoff Area=7,808 sf 11.68% Impervious Runoff Depth=4.75" Flow Length=74' Slope=0.0500 1/1' Tc=6.0 min CN=90 Runoff=1.01 cfs 3,090 cf
<b>Subcatchment11S: P11</b>	Runoff Area=4,381 sf 0.00% Impervious Runoff Depth=4.42" Tc=6.0 min CN=87 Runoff=0.54 cfs 1,614 cf
<b>Pond 10P: POND #2</b>	Peak Elev=1,176.95' Storage=1,583 cf Inflow=1.01 cfs 3,090 cf Primary=0.14 cfs 2,323 cf Secondary=0.00 cfs 0 cf Outflow=0.14 cfs 2,323 cf
<b>Pond 11P: POND #1</b>	Peak Elev=1,175.74' Storage=5,950 cf Inflow=5.75 cfs 18,190 cf Primary=1.03 cfs 17,339 cf Secondary=0.00 cfs 0 cf Outflow=1.03 cfs 17,339 cf
<b>Pond 12P: POND #3</b>	Peak Elev=1,170.71' Storage=504 cf Inflow=2.30 cfs 21,875 cf Outflow=2.26 cfs 21,541 cf
<b>Link 4L: DP1</b>	Inflow=2.12 cfs 13,891 cf Primary=2.12 cfs 13,891 cf
<b>Link 8L: DP2</b>	Inflow=4.77 cfs 40,062 cf Primary=4.77 cfs 40,062 cf

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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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Link 10L: DP3

Inflow=0.65 cfs 2,377 cf  
Primary=0.65 cfs 2,377 cf

Total Runoff Area = 168,433 sf Runoff Volume = 58,281 cf Average Runoff Depth = 4.15"  
83.10% Pervious = 139,970 sf 16.90% Impervious = 28,463 sf

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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Summary for Subcatchment 01S: P01**

Runoff = 1.53 cfs @ 12.37 hrs, Volume= 9,920 cf, Depth= 3.69"  
Routed to Link 4L : DP1

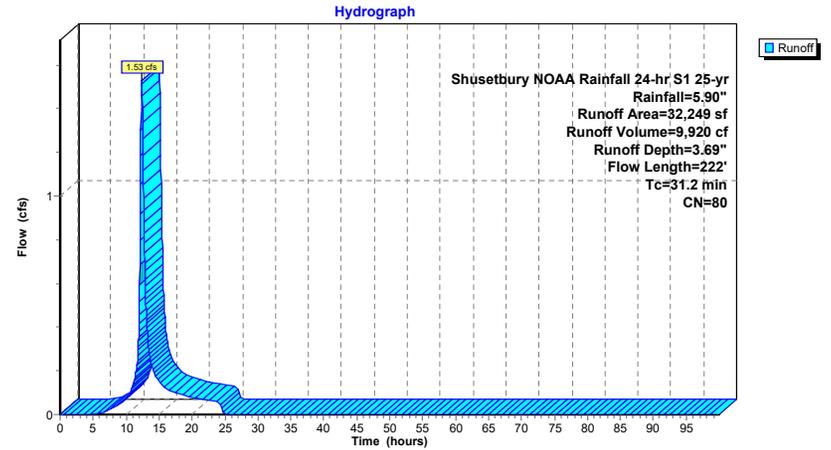
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,462	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
28,787	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
32,249	80	Weighted Average
32,249		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0100	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
2.1	122	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
31.2	222	Total			

**Subcatchment 01S: P01**



**20221110A10\_PROP01**

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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Summary for Subcatchment 02S: P02**

Runoff = 0.83 cfs @ 12.19 hrs, Volume= 3,971 cf, Depth= 4.00"  
Routed to Link 4L : DP1

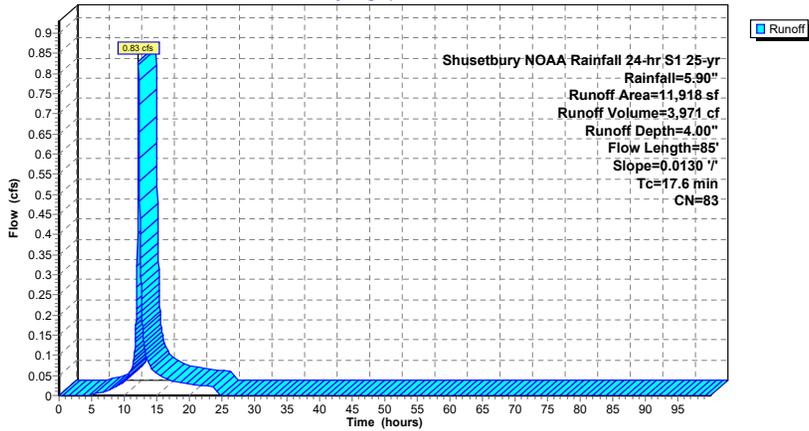
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
9,878	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
2,040	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
11,918	83	Weighted Average
11,918		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	54	0.0130	0.12		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.03"
10.3	31	0.0130	0.05		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
17.6	85				Total

**Subcatchment 02S: P02**

Hydrograph



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**Summary for Subcatchment 03S: P03**

Runoff = 5.04 cfs @ 12.04 hrs, Volume= 15,823 cf, Depth= 5.08"  
Routed to Pond 11P : POND #1

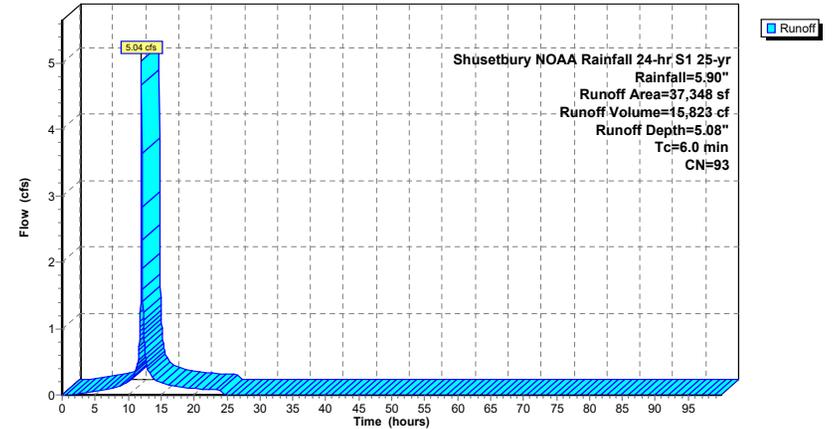
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
14,179	84	50-75% Grass cover, Fair, HSG D
17,778	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
5,391	98	Water Surface, 0% imp, HSG D
37,348	93	Weighted Average
19,570		52.40% Pervious Area
17,778		47.60% Impervious Area

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

**Subcatchment 03S: P03**

Hydrograph



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**Summary for Subcatchment 04S: P04**

Runoff = 0.35 cfs @ 12.10 hrs, Volume= 1,328 cf, Depth= 4.00"  
Routed to Link 10L : DP3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,774	84	50-75% Grass cover, Fair, HSG D
210	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
1,002	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
3,986	83	Weighted Average
3,776		94.73% Pervious Area
210		5.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	100	0.0200	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.03"
0.6	37	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
10.7	137	Total			

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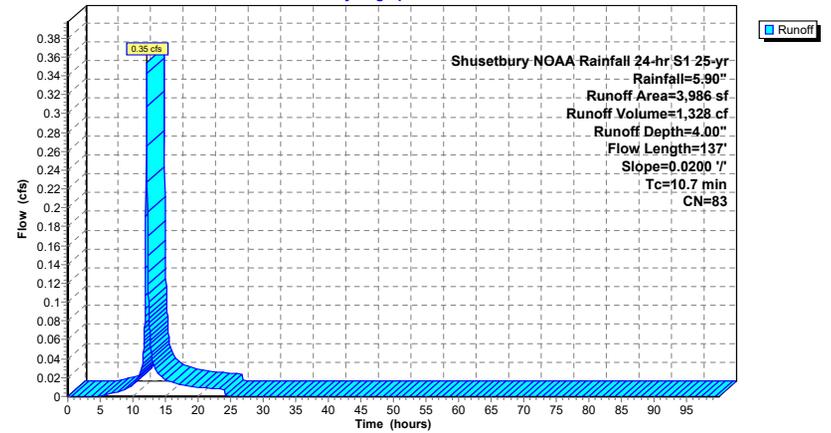
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Subcatchment 04S: P04**

Hydrograph



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**Summary for Subcatchment 05S: P05**

Runoff = 0.35 cfs @ 12.04 hrs, Volume= 1,049 cf, Depth= 4.21"  
Routed to Link 10L : DP3

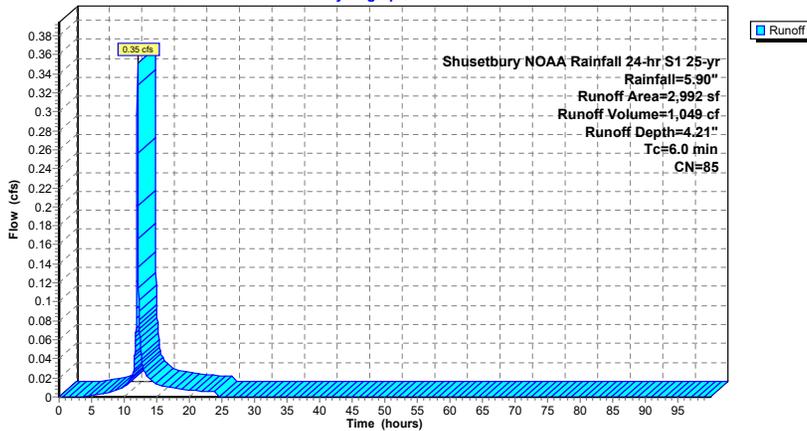
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,804	84	50-75% Grass cover, Fair, HSG D
188	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
2,992	85	Weighted Average
2,804		93.72% Pervious Area
188		6.28% Impervious Area

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

**Subcatchment 05S: P05**

Hydrograph



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**Summary for Subcatchment 06S: P06**

Runoff = 0.94 cfs @ 12.04 hrs, Volume= 2,922 cf, Depth= 4.97"  
Routed to Pond 12P : POND #3

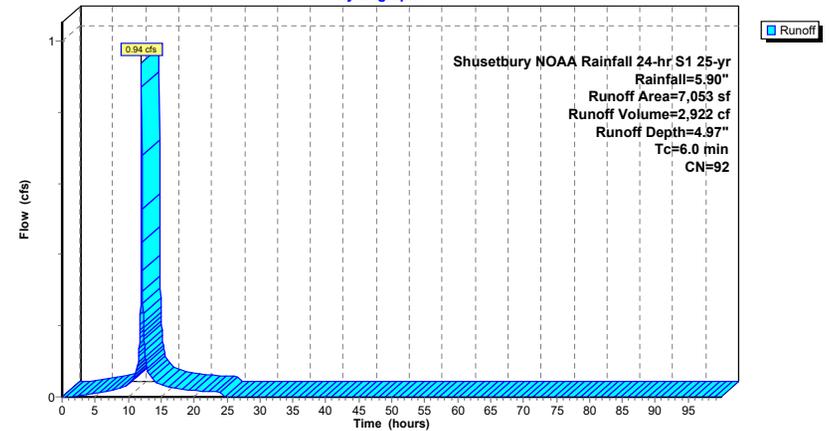
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,971	84	50-75% Grass cover, Fair, HSG D
4,082	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
7,053	92	Weighted Average
2,971		42.12% Pervious Area
4,082		57.88% Impervious Area

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

**Subcatchment 06S: P06**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Summary for Subcatchment 07S: P07**

Runoff = 0.44 cfs @ 12.03 hrs, Volume= 1,485 cf, Depth= 5.66"  
Routed to Pond 11P : POND #1

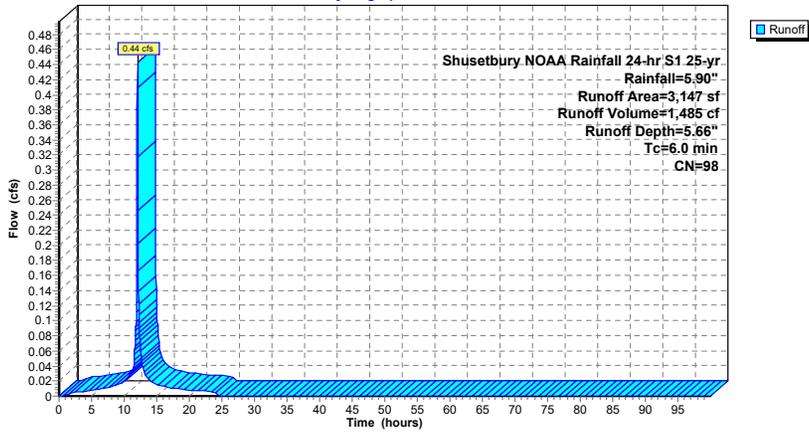
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
0	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
3,147	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
3,147	98	Weighted Average
3,147		100.00% Impervious Area

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

**Subcatchment 07S: P07**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Summary for Subcatchment 08S: P08**

Runoff = 0.26 cfs @ 12.03 hrs, Volume= 882 cf, Depth= 5.66"  
Routed to Pond 11P : POND #1

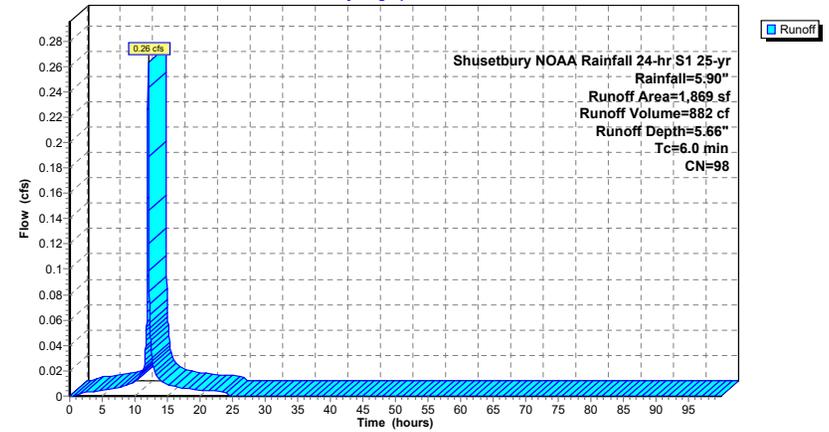
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
0	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
1,869	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
1,869	98	Weighted Average
1,869		100.00% Impervious Area

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

**Subcatchment 08S: P08**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Summary for Subcatchment 09S: P09**

Runoff = 3.14 cfs @ 12.23 hrs, Volume= 16,198 cf, Depth= 3.49"  
Routed to Link 8L : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
3,802	49	50-75% Grass cover, Fair, HSG A
19,931	84	50-75% Grass cover, Fair, HSG D
277	98	Paved parking, HSG D
1,194	36	Woods, Fair, HSG A
30,478	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
55,682	78	Weighted Average
55,405		99.50% Pervious Area
277		0.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	100	0.0300	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
1.8	109	0.0430	1.04		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
20.6	209	Total			

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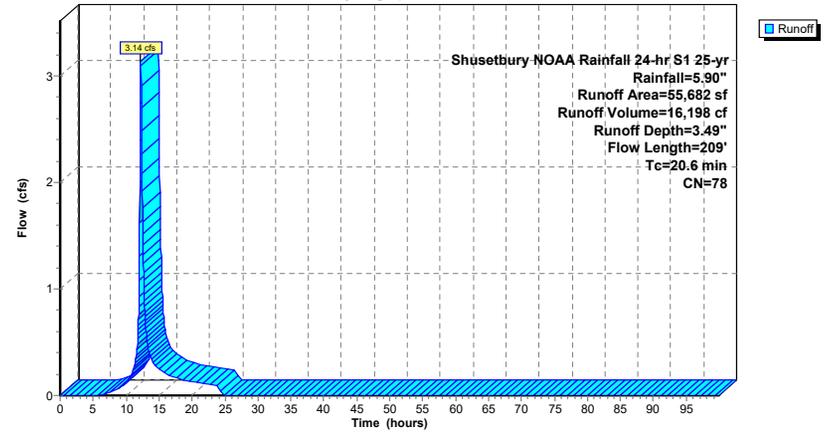
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Subcatchment 09S: P09**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Summary for Subcatchment 10S: P10**

Runoff = 1.01 cfs @ 12.04 hrs, Volume= 3,090 cf, Depth= 4.75"  
 Routed to Pond 10P : POND #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
 Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,994	84	50-75% Grass cover, Fair, HSG D
912	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
210	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
2,692	98	Water Surface, 0% imp, HSG D
7,808	90	Weighted Average
6,896		88.32% Pervious Area
912		11.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	23	0.0500	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
0.5	51	0.0500	1.57		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
5.2	74				Total, Increased to minimum Tc = 6.0 min

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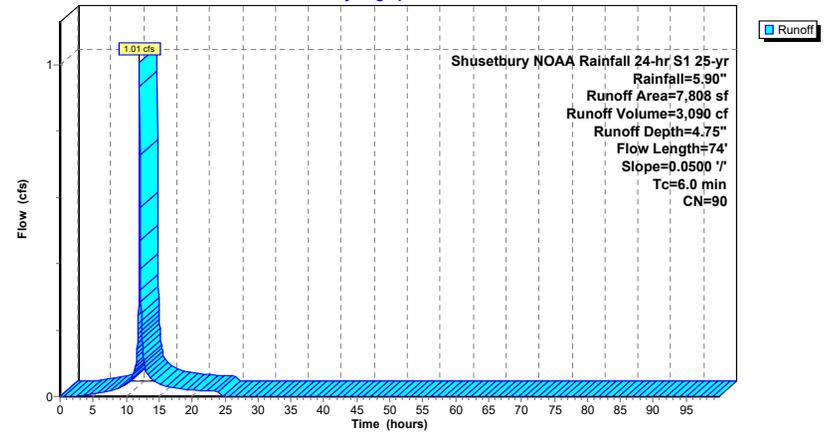
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Subcatchment 10S: P10**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Summary for Subcatchment 11S: P11**

Runoff = 0.54 cfs @ 12.04 hrs, Volume= 1,614 cf, Depth= 4.42"  
Routed to Pond 12P : POND #3

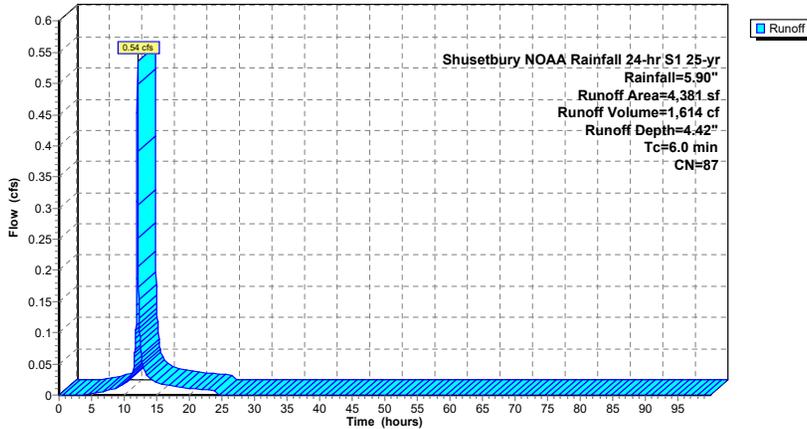
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,414	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
967	98	Water Surface, 0% imp, HSG D
4,381	87	Weighted Average
4,381		100.00% Pervious Area

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

**Subcatchment 11S: P11**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 25-yr Rainfall=5.90"

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**Summary for Pond 10P: POND #2**

Inflow Area = 7,808 sf, 11.68% Impervious, Inflow Depth = 4.75" for 25-yr event  
Inflow = 1.01 cfs @ 12.04 hrs, Volume= 3,090 cf  
Outflow = 0.14 cfs @ 12.57 hrs, Volume= 2,323 cf, Atten= 87%, Lag= 32.0 min  
Primary = 0.14 cfs @ 12.57 hrs, Volume= 2,323 cf  
Routed to Link 8L : DP2  
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf  
Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
Peak Elev= 1,176.95' @ 12.57 hrs Surf.Area= 1,950 sf Storage= 1,583 cf

Plug-Flow detention time= 304.5 min calculated for 2,323 cf (75% of inflow)  
Center-of-Mass det. time= 197.8 min ( 994.2 - 796.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,176.00'	4,012 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,176.00	1,373	0	0
1,177.00	1,979	1,676	1,676
1,178.00	2,692	2,336	4,012

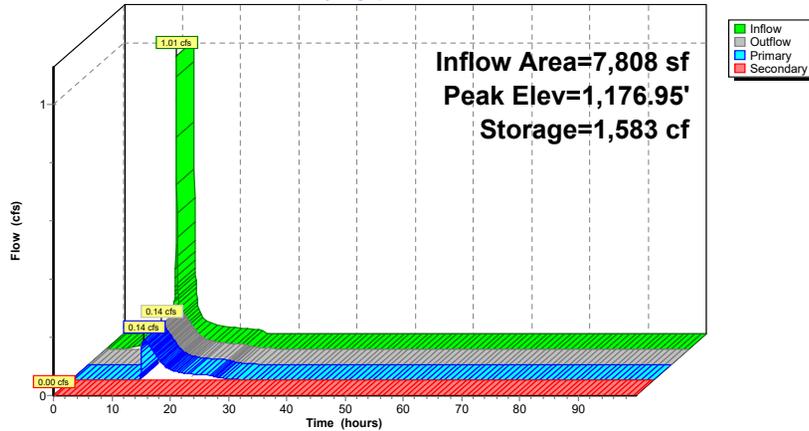
Device	Routing	Invert	Outlet Devices
#1	Primary	1,175.23'	<b>12.0" Round Culvert</b> L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,175.23' / 1,175.00' S= 0.0052' S= 0.0052' n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	1,177.00'	<b>24.0" x 24.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,176.50'	<b>3.0" Vert. Orifice</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,177.50'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.14 cfs @ 12.57 hrs HW=1,176.95' TW=0.00' (Dynamic Tailwater)  
 1=Culvert (Passes 0.14 cfs of 3.62 cfs potential flow)  
 2=Grate ( Controls 0.00 cfs)  
 3=Orifice (Orifice Controls 0.14 cfs @ 2.76 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,176.00' TW=0.00' (Dynamic Tailwater)  
 4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Pond 10P: POND #2**

Hydrograph



**Summary for Pond 11P: POND #1**

Inflow Area = 42,364 sf, 53.81% Impervious, Inflow Depth = 5.15" for 25-yr event  
 Inflow = 5.75 cfs @ 12.03 hrs, Volume= 18,190 cf  
 Outflow = 1.03 cfs @ 12.40 hrs, Volume= 17,339 cf, Atten= 82%, Lag= 21.7 min  
 Primary = 1.03 cfs @ 12.40 hrs, Volume= 17,339 cf  
 Routed to Pond 12P : POND #3  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,175.74' @ 12.40 hrs Surf.Area= 4,136 sf Storage= 5,950 cf

Plug-Flow detention time= 130.8 min calculated for 17,334 cf (95% of inflow)  
 Center-of-Mass det. time= 103.1 min ( 879.6 - 776.5 )

Volume #1	Invert	Avail.Storage	Storage Description
	1,174.00'	11,904 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,174.00	2,675	0	0
1,175.00	3,524	3,100	3,100
1,176.00	4,347	3,936	7,035
1,177.00	5,391	4,869	11,904

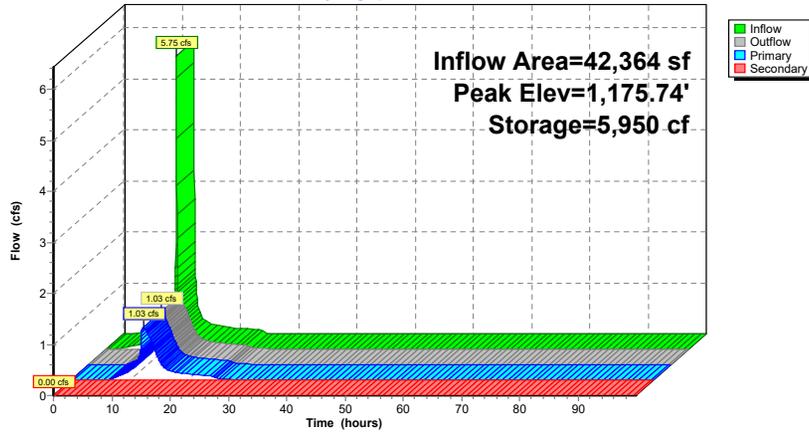
Device	Routing	Invert	Outlet Devices
#1	Primary	1,173.50'	<b>12.0" Round Culvert</b> L= 83.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,173.50' / 1,170.00' S= 0.0422'/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	1,176.00'	<b>24.0" x 24.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,174.30'	<b>6.0" Vert. Orifice</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,176.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=1.03 cfs @ 12.40 hrs HW=1,175.74' TW=1,170.65' (Dynamic Tailwater)  
 1=Culvert (Passes 1.03 cfs of 4.99 cfs potential flow)  
 2=Grate ( Controls 0.00 cfs)  
 3=Orifice (Orifice Controls 1.03 cfs @ 5.26 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,174.00' TW=0.00' (Dynamic Tailwater)  
 4=Broad-Crested Rectangular Weir( Controls 0.00 cfs)

**Pond 11P: POND #1**

Hydrograph



**Summary for Pond 12P: POND #3**

Inflow Area = 53,798 sf, 49.96% Impervious, Inflow Depth = 4.88" for 25-yr event  
 Inflow = 2.30 cfs @ 12.04 hrs, Volume= 21,875 cf  
 Outflow = 2.26 cfs @ 12.06 hrs, Volume= 21,541 cf, Atten= 2%, Lag= 1.0 min  
 Primary = 2.26 cfs @ 12.06 hrs, Volume= 21,541 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,170.71' @ 12.06 hrs Surf.Area= 851 sf Storage= 504 cf

Plug-Flow detention time= 24.1 min calculated for 21,535 cf (98% of inflow)  
 Center-of-Mass det. time= 9.7 min ( 871.7 - 862.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,170.00'	768 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

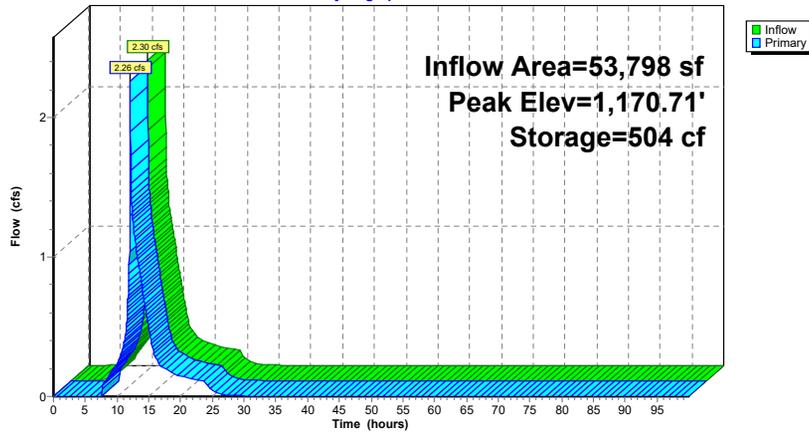
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,170.00	568	0	0
1,171.00	967	768	768

Device	Routing	Invert	Outlet Devices
#1	Primary	1,170.50'	<b>10.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> 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

**Primary OutFlow** Max=2.26 cfs @ 12.06 hrs HW=1,170.71' TW=0.00' (Dynamic Tailwater)  
 ↳=Broad-Crested Rectangular Weir(Weir Controls 2.26 cfs @ 1.08 fps)

**Pond 12P: POND #3**

Hydrograph



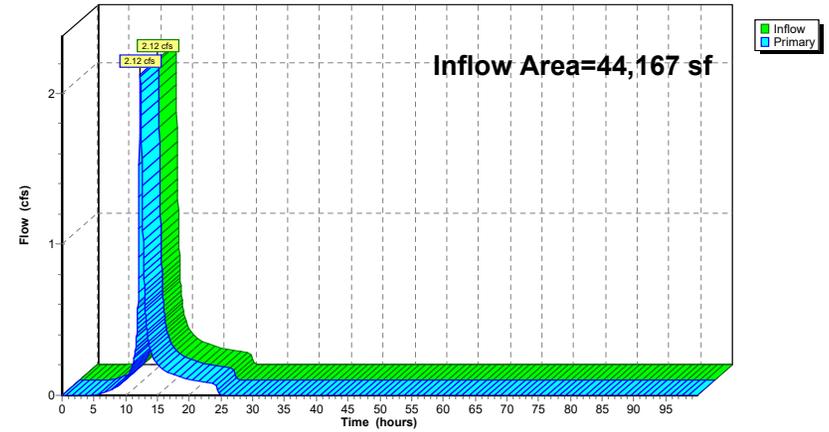
**Summary for Link 4L: DP1**

Inflow Area = 44,167 sf, 0.00% Impervious, Inflow Depth = 3.77" for 25-yr event  
Inflow = 2.12 cfs @ 12.29 hrs, Volume= 13,891 cf  
Primary = 2.12 cfs @ 12.29 hrs, Volume= 13,891 cf, Atten=0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

**Link 4L: DP1**

Hydrograph



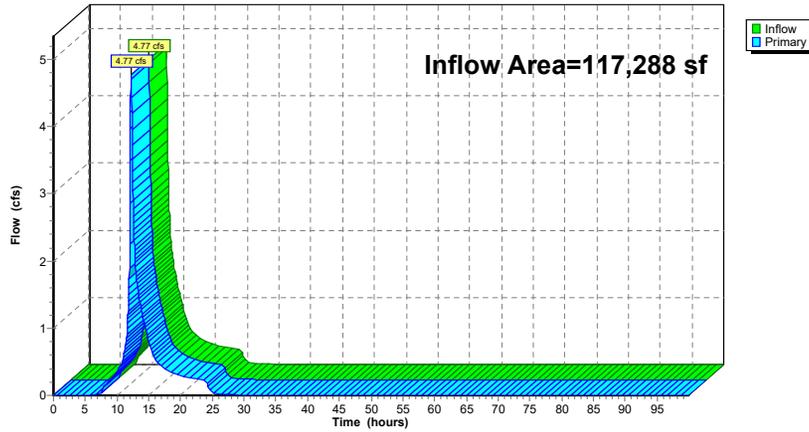
Summary for Link 8L: DP2

Inflow Area = 117,288 sf, 23.93% Impervious, Inflow Depth = 4.10" for 25-yr event  
 Inflow = 4.77 cfs @ 12.21 hrs, Volume= 40,062 cf  
 Primary = 4.77 cfs @ 12.21 hrs, Volume= 40,062 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

Link 8L: DP2

Hydrograph



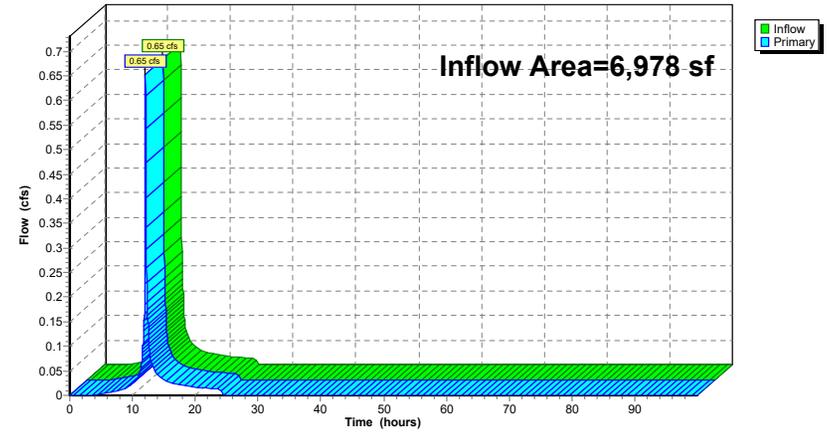
Summary for Link 10L: DP3

Inflow Area = 6,978 sf, 5.70% Impervious, Inflow Depth = 4.09" for 25-yr event  
 Inflow = 0.65 cfs @ 12.06 hrs, Volume= 2,377 cf  
 Primary = 0.65 cfs @ 12.06 hrs, Volume= 2,377 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

Link 10L: DP3

Hydrograph



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Time span=0.00-100.00 hrs, dt=0.03 hrs, 3334 points x 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment01S: P01** Runoff Area=32,249 sf 0.00% Impervious Runoff Depth=4.42"  
Flow Length=222' Tc=31.2 min CN=80 Runoff=1.80 cfs 11,874 cf

**Subcatchment02S: P02** Runoff Area=11,918 sf 0.00% Impervious Runoff Depth=4.75"  
Flow Length=85' Slope=0.0130 '/' Tc=17.6 min CN=83 Runoff=0.97 cfs 4,713 cf

**Subcatchment03S: P03** Runoff Area=37,348 sf 47.60% Impervious Runoff Depth=5.87"  
Tc=6.0 min CN=93 Runoff=5.71 cfs 18,283 cf

**Subcatchment04S: P04** Runoff Area=3,986 sf 5.27% Impervious Runoff Depth=4.75"  
Flow Length=137' Slope=0.0200 '/' Tc=10.7 min CN=83 Runoff=0.41 cfs 1,576 cf

**Subcatchment05S: P05** Runoff Area=2,992 sf 6.28% Impervious Runoff Depth=4.97"  
Tc=6.0 min CN=85 Runoff=0.41 cfs 1,238 cf

**Subcatchment06S: P06** Runoff Area=7,053 sf 57.88% Impervious Runoff Depth=5.76"  
Tc=6.0 min CN=92 Runoff=1.07 cfs 3,385 cf

**Subcatchment07S: P07** Runoff Area=3,147 sf 100.00% Impervious Runoff Depth=6.46"  
Tc=6.0 min CN=98 Runoff=0.50 cfs 1,694 cf

**Subcatchment08S: P08** Runoff Area=1,869 sf 100.00% Impervious Runoff Depth=6.46"  
Tc=6.0 min CN=98 Runoff=0.30 cfs 1,006 cf

**Subcatchment09S: P09** Runoff Area=55,682 sf 0.50% Impervious Runoff Depth=4.20"  
Flow Length=209' Tc=20.6 min CN=78 Runoff=3.74 cfs 19,505 cf

**Subcatchment10S: P10** Runoff Area=7,808 sf 11.68% Impervious Runoff Depth=5.53"  
Flow Length=74' Slope=0.0500 '/' Tc=6.0 min CN=90 Runoff=1.15 cfs 3,598 cf

**Subcatchment11S: P11** Runoff Area=4,381 sf 0.00% Impervious Runoff Depth=5.19"  
Tc=6.0 min CN=87 Runoff=0.62 cfs 1,895 cf

**Pond 10P: POND #2** Peak Elev=1,177.03' Storage=1,731 cf Inflow=1.15 cfs 3,598 cf  
Primary=0.27 cfs 2,831 cf Secondary=0.00 cfs 0 cf Outflow=0.27 cfs 2,831 cf

**Pond 11P: POND #1** Peak Elev=1,175.93' Storage=6,723 cf Inflow=6.51 cfs 20,984 cf  
Primary=1.11 cfs 20,133 cf Secondary=0.00 cfs 0 cf Outflow=1.11 cfs 20,133 cf

**Pond 12P: POND #3** Peak Elev=1,170.73' Storage=517 cf Inflow=2.57 cfs 25,413 cf  
Outflow=2.53 cfs 25,079 cf

**Link 4L: DP1** Inflow=2.50 cfs 16,587 cf  
Primary=2.50 cfs 16,587 cf

**Link 8L: DP2** Inflow=5.60 cfs 47,415 cf  
Primary=5.60 cfs 47,415 cf

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Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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**Link 10L: DP3**

Inflow=0.76 cfs 2,814 cf

Primary=0.76 cfs 2,814 cf

**Total Runoff Area = 168,433 sf Runoff Volume = 68,768 cf Average Runoff Depth = 4.90"**  
**83.10% Pervious = 139,970 sf 16.90% Impervious = 28,463 sf**

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**Summary for Subcatchment 01S: P01**

Runoff = 1.80 cfs @ 12.37 hrs, Volume= 11,874 cf, Depth= 4.42"  
Routed to Link 4L : DP1

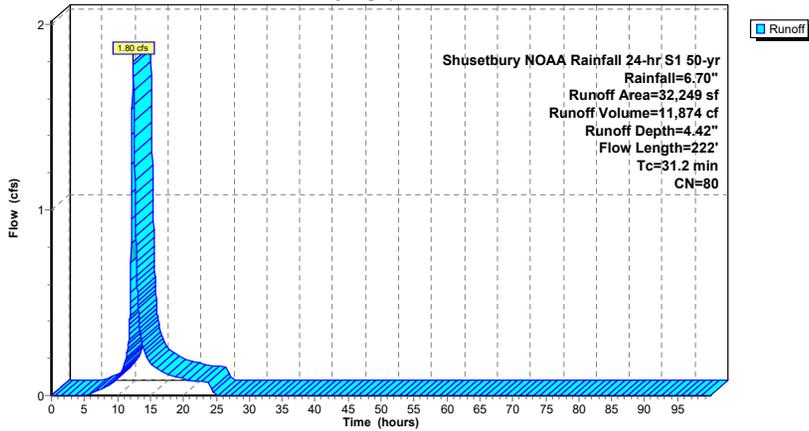
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,462	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
28,787	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
32,249	80	Weighted Average
32,249		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0100	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
2.1	122	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
31.2	222	Total			

**Subcatchment 01S: P01**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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**Summary for Subcatchment 02S: P02**

Runoff = 0.97 cfs @ 12.19 hrs, Volume= 4,713 cf, Depth= 4.75"  
Routed to Link 4L : DP1

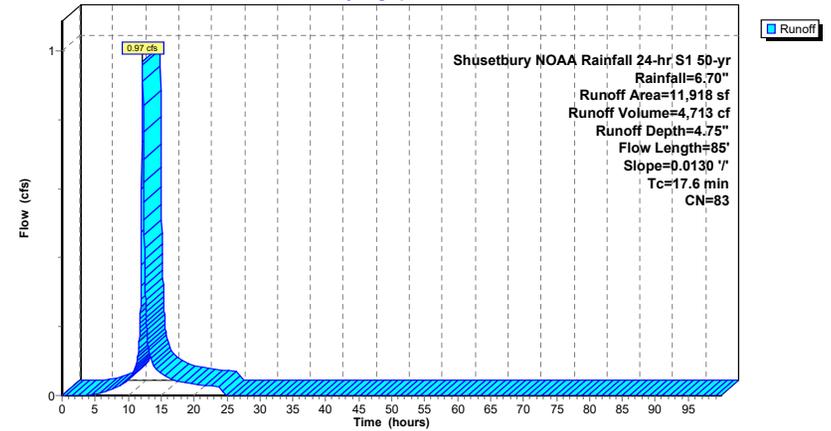
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
9,878	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
2,040	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
11,918	83	Weighted Average
11,918		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	54	0.0130	0.12		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.03"
10.3	31	0.0130	0.05		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
17.6	85	Total			

**Subcatchment 02S: P02**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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**Summary for Subcatchment 03S: P03**

Runoff = 5.71 cfs @ 12.03 hrs, Volume= 18,283 cf, Depth= 5.87"  
Routed to Pond 11P : POND #1

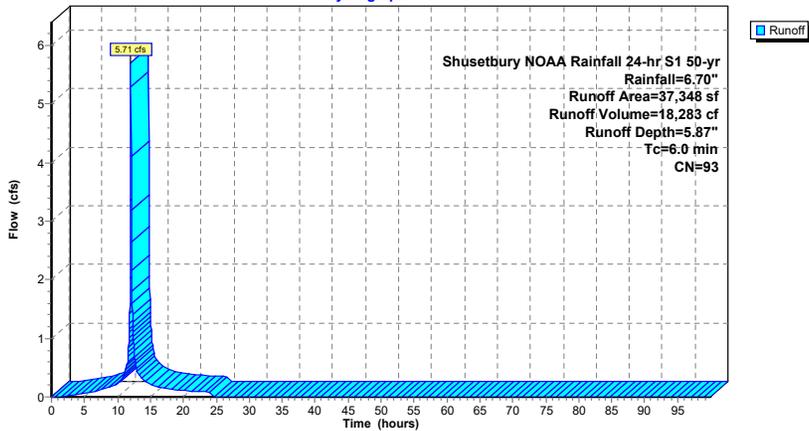
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
14,179	84	50-75% Grass cover, Fair, HSG D
17,778	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
5,391	98	Water Surface, 0% imp, HSG D
37,348	93	Weighted Average
19,570		52.40% Pervious Area
17,778		47.60% Impervious Area

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

**Subcatchment 03S: P03**

Hydrograph



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**Summary for Subcatchment 04S: P04**

Runoff = 0.41 cfs @ 12.10 hrs, Volume= 1,576 cf, Depth= 4.75"  
Routed to Link 10L : DP3

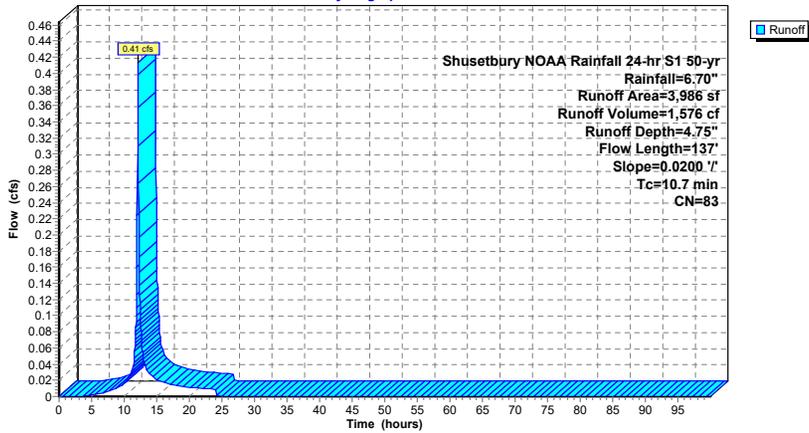
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,774	84	50-75% Grass cover, Fair, HSG D
210	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
1,002	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
3,986	83	Weighted Average
3,776		94.73% Pervious Area
210		5.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	100	0.0200	0.17		Sheet Flow, Grass: Short n= 0.150 P2= 3.03"
0.6	37	0.0200	0.99		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
10.7	137				Total

**Subcatchment 04S: P04**

Hydrograph



**Summary for Subcatchment 05S: P05**

Runoff = 0.41 cfs @ 12.04 hrs, Volume= 1,238 cf, Depth= 4.97"  
 Routed to Link 10L : DP3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
 Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

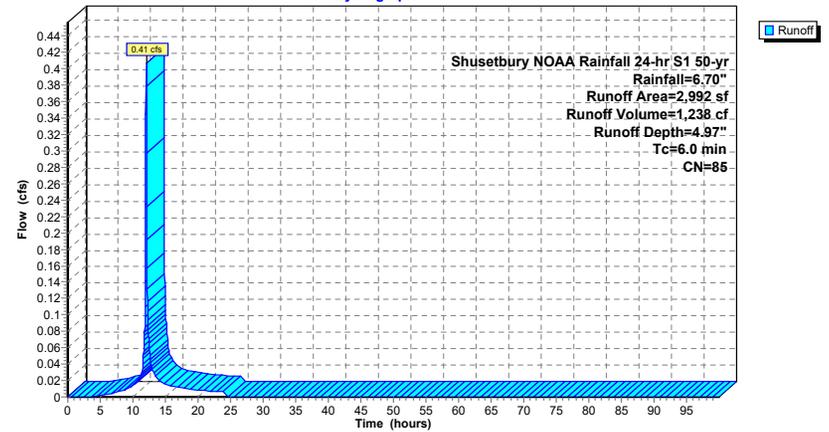
Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,804	84	50-75% Grass cover, Fair, HSG D
188	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D

2,992	85	Weighted Average
2,804		93.72% Pervious Area
188		6.28% Impervious Area

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

**Subcatchment 05S: P05**

Hydrograph



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**Summary for Subcatchment 06S: P06**

Runoff = 1.07 cfs @ 12.04 hrs, Volume= 3,385 cf, Depth= 5.76"  
Routed to Pond 12P : POND #3

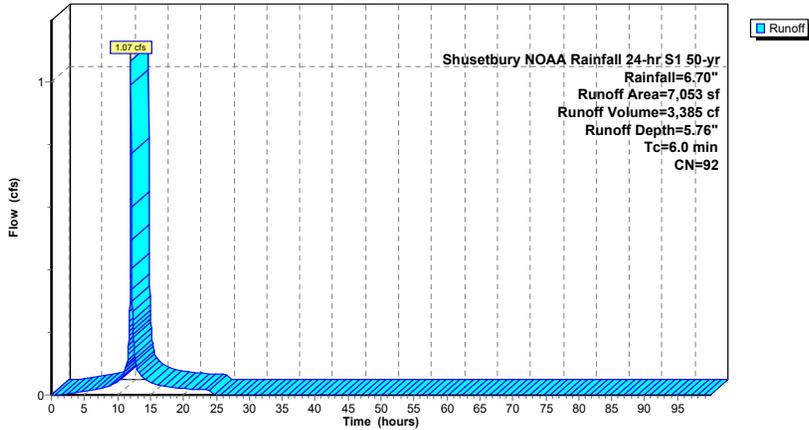
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,971	84	50-75% Grass cover, Fair, HSG D
4,082	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
7,053	92	Weighted Average
2,971		42.12% Pervious Area
4,082		57.88% Impervious Area

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

**Subcatchment 06S: P06**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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**Summary for Subcatchment 07S: P07**

Runoff = 0.50 cfs @ 12.03 hrs, Volume= 1,694 cf, Depth= 6.46"  
Routed to Pond 11P : POND #1

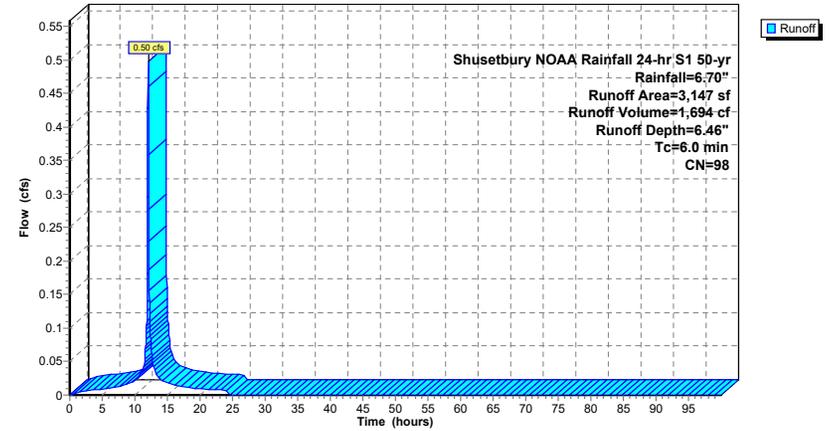
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
0	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
3,147	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
3,147	98	Weighted Average
3,147		100.00% Impervious Area

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

**Subcatchment 07S: P07**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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**Summary for Subcatchment 08S: P08**

Runoff = 0.30 cfs @ 12.03 hrs, Volume= 1,006 cf, Depth= 6.46"  
Routed to Pond 11P : POND #1

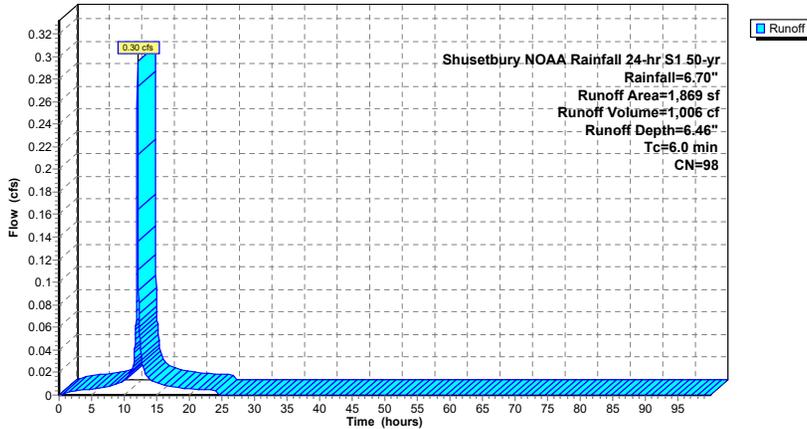
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
0	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
1,869	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
1,869	98	Weighted Average
1,869		100.00% Impervious Area

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

**Subcatchment 08S: P08**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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**Summary for Subcatchment 09S: P09**

Runoff = 3.74 cfs @ 12.23 hrs, Volume= 19,505 cf, Depth= 4.20"  
Routed to Link 8L : DP2

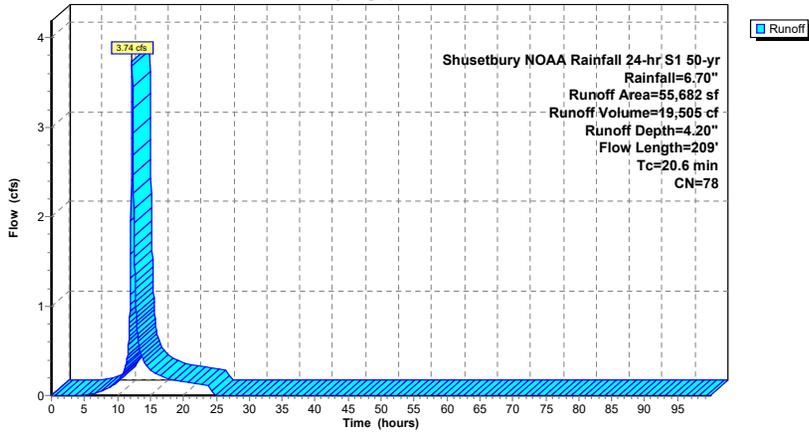
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
3,802	49	50-75% Grass cover, Fair, HSG A
19,931	84	50-75% Grass cover, Fair, HSG D
277	98	Paved parking, HSG D
1,194	36	Woods, Fair, HSG A
30,478	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
55,682	78	Weighted Average
55,405		99.50% Pervious Area
277		0.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	100	0.0300	0.09		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.03"
1.8	109	0.0430	1.04		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
20.6	209				Total

**Subcatchment 09S: P09**

Hydrograph



**Summary for Subcatchment 10S: P10**

Runoff = 1.15 cfs @ 12.04 hrs, Volume= 3,598 cf, Depth= 5.53"  
 Routed to Pond 10P : POND #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
 Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

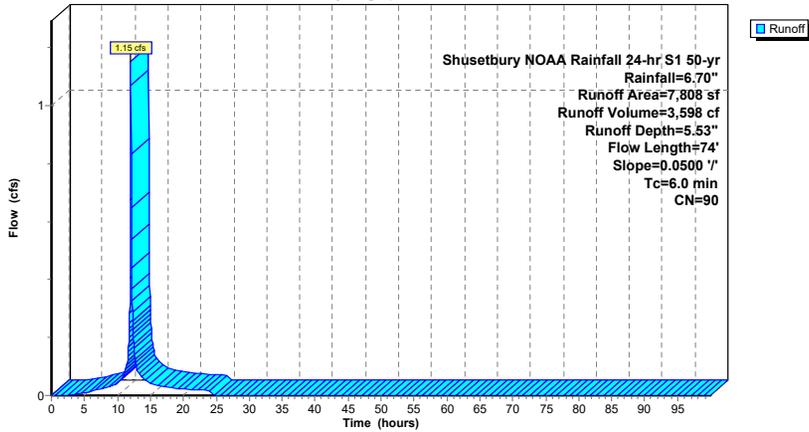
Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,994	84	50-75% Grass cover, Fair, HSG D
912	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
210	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
2,692	98	Water Surface, 0% imp, HSG D
7,808	90	Weighted Average
6,896		88.32% Pervious Area
912		11.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	23	0.0500	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
0.5	51	0.0500	1.57		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
5.2	74				Total, Increased to minimum Tc = 6.0 min

**Subcatchment 10S: P10**

Hydrograph



**Summary for Subcatchment 11S: P11**

Runoff = 0.62 cfs @ 12.04 hrs, Volume= 1,895 cf, Depth= 5.19"  
 Routed to Pond 12P : POND #3

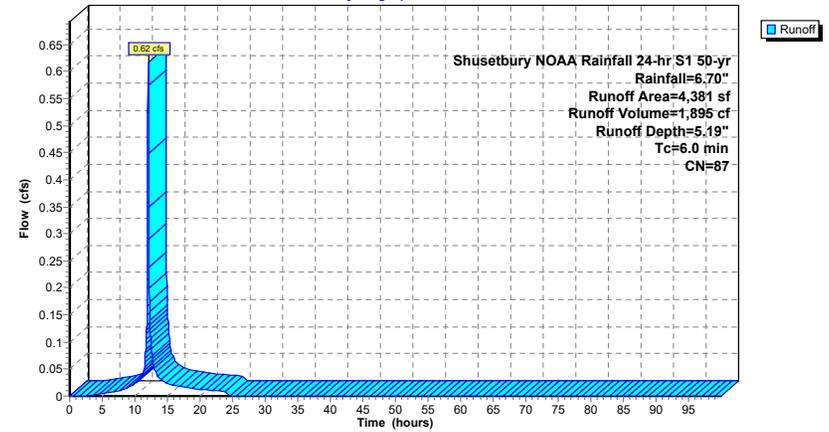
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
 Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,414	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
967	98	Water Surface, 0% imp, HSG D
4,381	87	Weighted Average
4,381		100.00% Pervious Area

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

**Subcatchment 11S: P11**

Hydrograph



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**Summary for Pond 10P: POND #2**

Inflow Area = 7,808 sf, 11.68% Impervious, Inflow Depth = 5.53" for 50-yr event  
 Inflow = 1.15 cfs @ 12.04 hrs, Volume= 3,598 cf  
 Outflow = 0.27 cfs @ 12.29 hrs, Volume= 2,831 cf, Atten= 77%, Lag= 15.4 min  
 Primary = 0.27 cfs @ 12.29 hrs, Volume= 2,831 cf  
 Routed to Link 8L : DP2  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,177.03' @ 12.29 hrs Surf.Area= 1,999 sf Storage= 1,731 cf

Plug-Flow detention time= 282.4 min calculated for 2,831 cf (79% of inflow)  
 Center-of-Mass det. time= 184.6 min ( 976.0 - 791.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,176.00'	4,012 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,176.00	1,373	0	0
1,177.00	1,979	1,676	1,676
1,178.00	2,692	2,336	4,012

Device	Routing	Invert	Outlet Devices
#1	Primary	1,175.23'	<b>12.0" Round Culvert</b> L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,175.23' / 1,175.00' S= 0.0052'/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	1,177.00'	<b>24.0" x 24.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,176.50'	<b>3.0" Vert. Orifice</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,177.50'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.27 cfs @ 12.29 hrs HW=1,177.03' TW=0.00' (Dynamic Tailwater)  
 1=Culvert (Passes 0.27 cfs of 3.76 cfs potential flow)  
 2=Grate (Weir Controls 0.12 cfs @ 0.54 fps)  
 3=Orifice (Orifice Controls 0.15 cfs @ 3.05 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,176.00' TW=0.00' (Dynamic Tailwater)  
 4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

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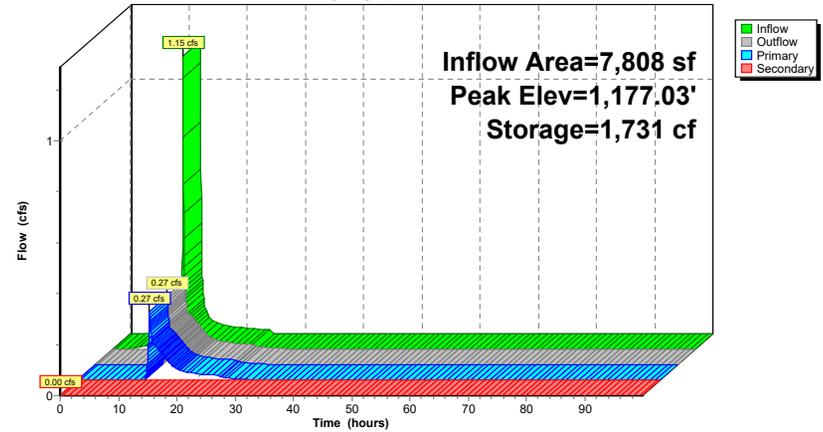
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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**Pond 10P: POND #2**

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**Summary for Pond 11P: POND #1**

Inflow Area = 42,364 sf, 53.81% Impervious, Inflow Depth = 5.94" for 50-yr event  
 Inflow = 6.51 cfs @ 12.03 hrs, Volume= 20,984 cf  
 Outflow = 1.11 cfs @ 12.43 hrs, Volume= 20,133 cf, Atten= 83%, Lag= 23.5 min  
 Primary = 1.11 cfs @ 12.43 hrs, Volume= 20,133 cf  
 Routed to Pond 12P : POND #3  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,175.93' @ 12.43 hrs Surf.Area= 4,287 sf Storage= 6,723 cf

Plug-Flow detention time= 126.0 min calculated for 20,133 cf (96% of inflow)  
 Center-of-Mass det. time= 100.5 min ( 873.0 - 772.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,174.00'	11,904 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,174.00	2,675	0	0
1,175.00	3,524	3,100	3,100
1,176.00	4,347	3,936	7,035
1,177.00	5,391	4,869	11,904

Device	Routing	Invert	Outlet Devices
#1	Primary	1,173.50'	<b>12.0" Round Culvert</b> L= 83.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,173.50' / 1,170.00' S= 0.0422 ' / Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	1,176.00'	<b>24.0" x 24.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,174.30'	<b>6.0" Vert. Orifice</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,176.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=1.11 cfs @ 12.43 hrs HW=1,175.93' TW=1,170.65' (Dynamic Tailwater)  
 1=Culvert (Passes 1.11 cfs of 5.25 cfs potential flow)  
 2=Grate ( Controls 0.00 cfs)  
 3=Orifice (Orifice Controls 1.11 cfs @ 5.65 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,174.00' TW=0.00' (Dynamic Tailwater)  
 4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

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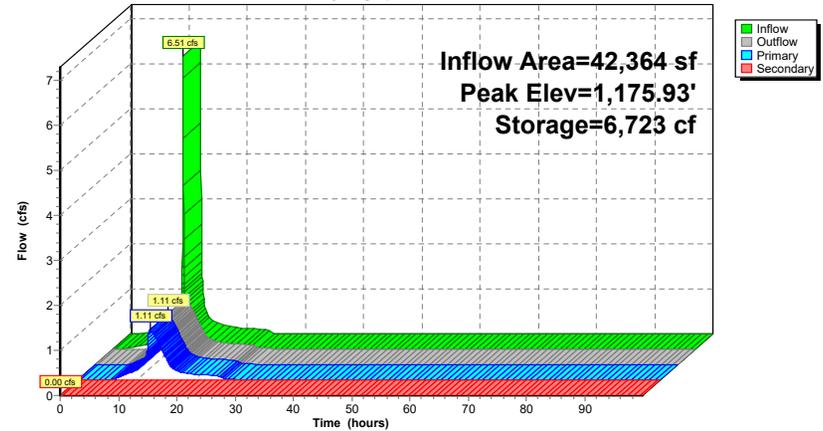
Shusetbury NOAA Rainfall 24-hr S1 50-yr Rainfall=6.70"

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**Pond 11P: POND #1**

Hydrograph



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**Summary for Pond 12P: POND #3**

Inflow Area = 53,798 sf, 49.96% Impervious, Inflow Depth = 5.67" for 50-yr event  
 Inflow = 2.57 cfs @ 12.04 hrs, Volume= 25,413 cf  
 Outflow = 2.53 cfs @ 12.06 hrs, Volume= 25,079 cf, Atten= 2%, Lag= 1.0 min  
 Primary = 2.53 cfs @ 12.06 hrs, Volume= 25,079 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,170.73' @ 12.06 hrs Surf.Area= 857 sf Storage= 517 cf

Plug-Flow detention time= 21.4 min calculated for 25,071 cf (99% of inflow)  
 Center-of-Mass det. time= 9.0 min ( 864.7 - 855.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,170.00'	768 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,170.00	568	0	0
1,171.00	967	768	768

Device	Routing	Invert	Outlet Devices
#1	Primary	1,170.50'	<b>10.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> 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

**Primary OutFlow** Max=2.52 cfs @ 12.06 hrs HW=1,170.72' TW=0.00' (Dynamic Tailwater)  
 ↑1=Broad-Crested Rectangular Weir(Weir Controls 2.52 cfs @ 1.12 fps)

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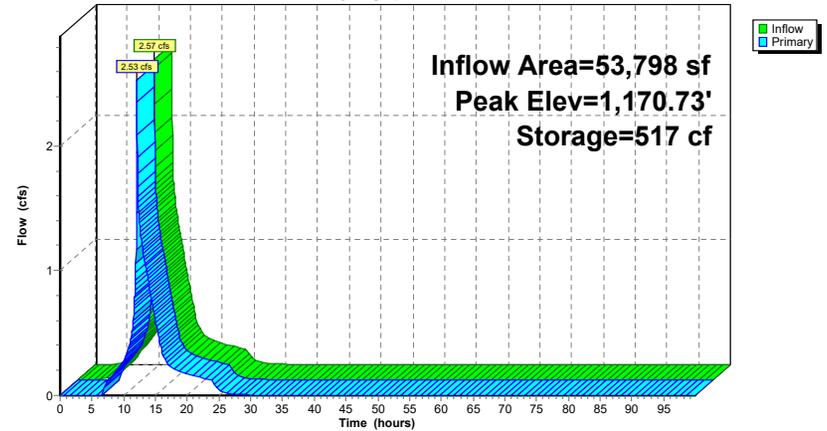
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**Pond 12P: POND #3**

Hydrograph



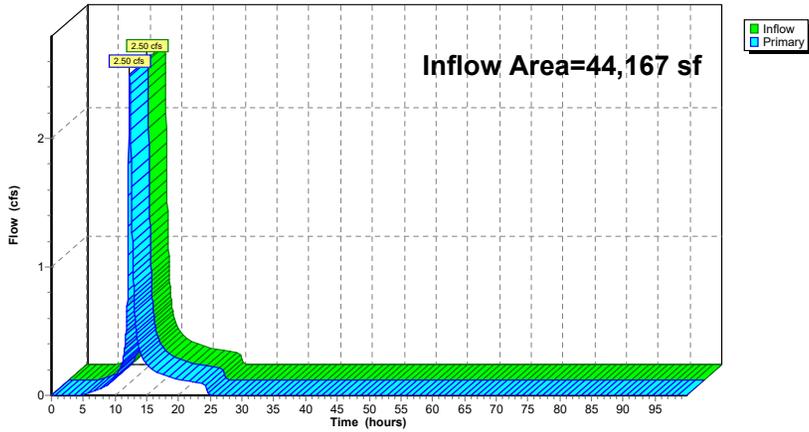
Summary for Link 4L: DP1

Inflow Area = 44,167 sf, 0.00% Impervious, Inflow Depth = 4.51" for 50-yr event  
 Inflow = 2.50 cfs @ 12.29 hrs, Volume= 16,587 cf  
 Primary = 2.50 cfs @ 12.29 hrs, Volume= 16,587 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

Link 4L: DP1

Hydrograph



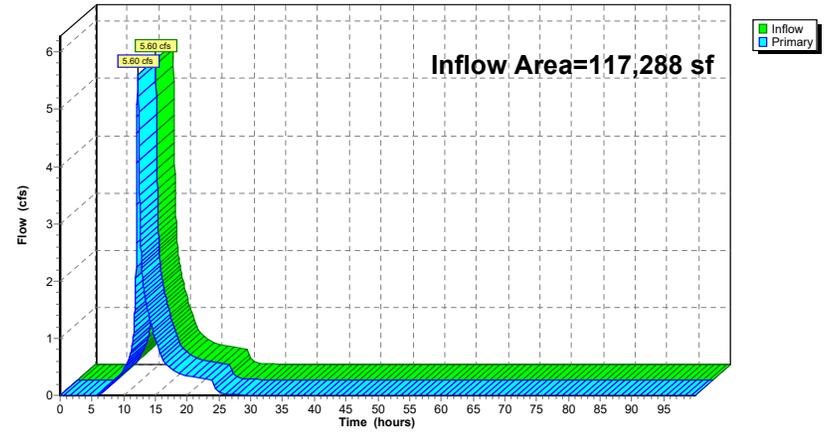
Summary for Link 8L: DP2

Inflow Area = 117,288 sf, 23.93% Impervious, Inflow Depth = 4.85" for 50-yr event  
 Inflow = 5.60 cfs @ 12.22 hrs, Volume= 47,415 cf  
 Primary = 5.60 cfs @ 12.22 hrs, Volume= 47,415 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

Link 8L: DP2

Hydrograph



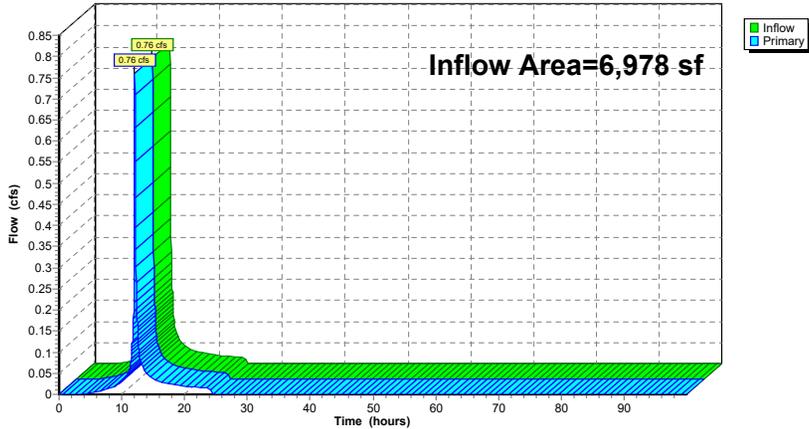
**Summary for Link 10L: DP3**

Inflow Area = 6,978 sf, 5.70% Impervious, Inflow Depth = 4.84" for 50-yr event  
 Inflow = 0.76 cfs @ 12.06 hrs, Volume= 2,814 cf  
 Primary = 0.76 cfs @ 12.06 hrs, Volume= 2,814 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

**Link 10L: DP3**

Hydrograph



Time span=0.00-100.00 hrs, dt=0.03 hrs, 3334 points x 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

- Subcatchment01S: P01** Runoff Area=32,249 sf 0.00% Impervious Runoff Depth=5.25"  
Flow Length=222' Tc=31.2 min CN=80 Runoff=2.10 cfs 14,112 cf
- Subcatchment02S: P02** Runoff Area=11,918 sf 0.00% Impervious Runoff Depth=5.60"  
Flow Length=85' Slope=0.0130 '/' Tc=17.6 min CN=83 Runoff=1.12 cfs 5,558 cf
- Subcatchment03S: P03** Runoff Area=37,348 sf 47.60% Impervious Runoff Depth=6.77"  
Tc=6.0 min CN=93 Runoff=6.41 cfs 21,058 cf
- Subcatchment04S: P04** Runoff Area=3,986 sf 5.27% Impervious Runoff Depth=5.60"  
Flow Length=137' Slope=0.0200 '/' Tc=10.7 min CN=83 Runoff=0.48 cfs 1,859 cf
- Subcatchment05S: P05** Runoff Area=2,992 sf 6.28% Impervious Runoff Depth=5.83"  
Tc=6.0 min CN=85 Runoff=0.47 cfs 1,453 cf
- Subcatchment06S: P06** Runoff Area=7,053 sf 57.88% Impervious Runoff Depth=6.65"  
Tc=6.0 min CN=92 Runoff=1.20 cfs 3,907 cf
- Subcatchment07S: P07** Runoff Area=3,147 sf 100.00% Impervious Runoff Depth=7.36"  
Tc=6.0 min CN=98 Runoff=0.56 cfs 1,930 cf
- Subcatchment08S: P08** Runoff Area=1,869 sf 100.00% Impervious Runoff Depth=7.36"  
Tc=6.0 min CN=98 Runoff=0.33 cfs 1,146 cf
- Subcatchment09S: P09** Runoff Area=55,682 sf 0.50% Impervious Runoff Depth=5.02"  
Flow Length=209' Tc=20.6 min CN=78 Runoff=4.38 cfs 23,305 cf
- Subcatchment10S: P10** Runoff Area=7,808 sf 11.68% Impervious Runoff Depth=6.41"  
Flow Length=74' Slope=0.0500 '/' Tc=6.0 min CN=90 Runoff=1.30 cfs 4,172 cf
- Subcatchment11S: P11** Runoff Area=4,381 sf 0.00% Impervious Runoff Depth=6.06"  
Tc=6.0 min CN=87 Runoff=0.70 cfs 2,213 cf
- Pond 10P: POND #2** Peak Elev=1,177.06' Storage=1,800 cf Inflow=1.30 cfs 4,172 cf  
Primary=0.56 cfs 3,405 cf Secondary=0.00 cfs 0 cf Outflow=0.56 cfs 3,405 cf
- Pond 11P: POND #1** Peak Elev=1,176.07' Storage=7,330 cf Inflow=7.30 cfs 24,134 cf  
Primary=1.62 cfs 23,284 cf Secondary=0.00 cfs 0 cf Outflow=1.62 cfs 23,284 cf
- Pond 12P: POND #3** Peak Elev=1,170.74' Storage=530 cf Inflow=2.85 cfs 29,404 cf  
Outflow=2.80 cfs 29,070 cf
- Link 4L: DP1** Inflow=2.90 cfs 19,670 cf  
Primary=2.90 cfs 19,670 cf
- Link 8L: DP2** Inflow=6.83 cfs 55,780 cf  
Primary=6.83 cfs 55,780 cf

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Shusetbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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Link 10L: DP3

Inflow=0.87 cfs 3,312 cf  
Primary=0.87 cfs 3,312 cf

Total Runoff Area = 168,433 sf Runoff Volume = 80,713 cf Average Runoff Depth = 5.75"  
83.10% Pervious = 139,970 sf 16.90% Impervious = 28,463 sf

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**Summary for Subcatchment 01S: P01**

Runoff = 2.10 cfs @ 12.37 hrs, Volume= 14,112 cf, Depth= 5.25"  
Routed to Link 4L : DP1

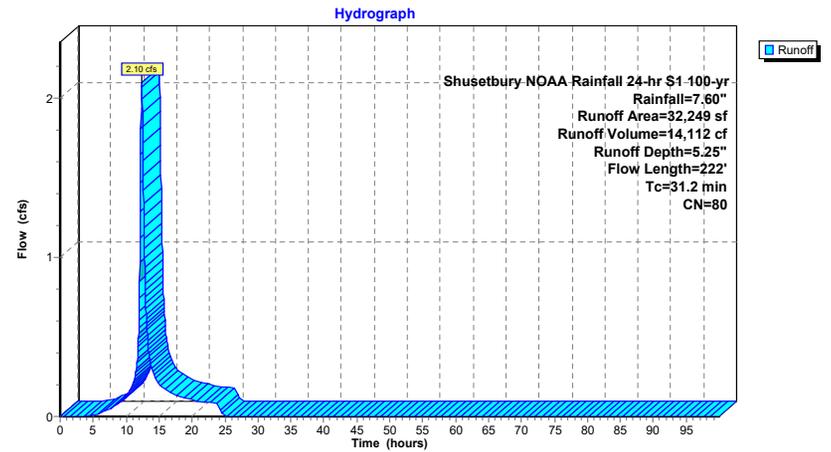
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,462	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
28,787	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
32,249	80	Weighted Average
32,249		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0100	0.06		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
2.1	122	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
31.2	222	Total			

**Subcatchment 01S: P01**



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Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 02S: P02**

Runoff = 1.12 cfs @ 12.19 hrs, Volume= 5,558 cf, Depth= 5.60"  
Routed to Link 4L : DP1

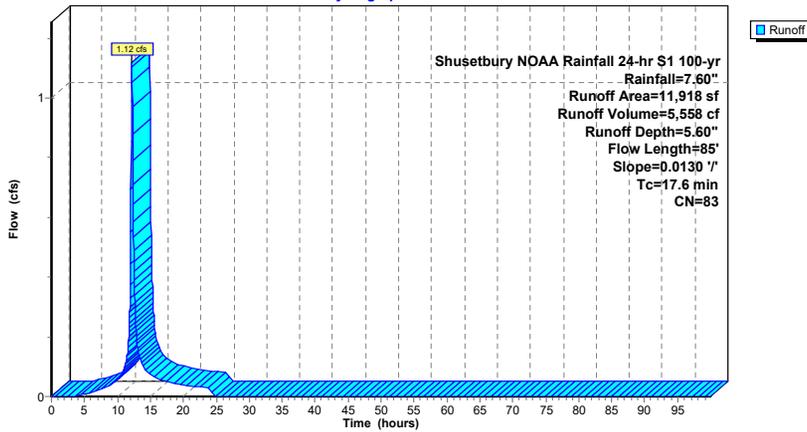
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
9,878	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
2,040	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
11,918	83	Weighted Average
11,918		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	54	0.0130	0.12		<b>Sheet Flow</b> , Grass: Short n= 0.150 P2= 3.03"
10.3	31	0.0130	0.05		<b>Sheet Flow</b> , Woods: Light underbrush n= 0.400 P2= 3.03"
17.6	85				Total

**Subcatchment 02S: P02**

Hydrograph



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Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 03S: P03**

Runoff = 6.41 cfs @ 12.03 hrs, Volume= 21,058 cf, Depth= 6.77"  
Routed to Pond 11P : POND #1

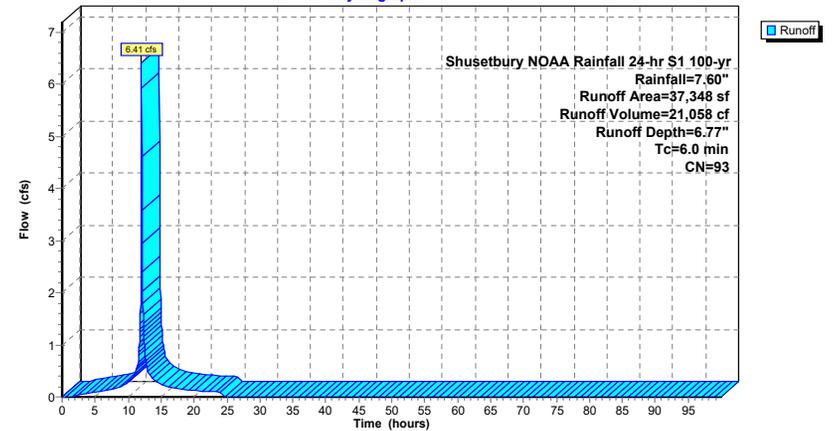
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
14,179	84	50-75% Grass cover, Fair, HSG D
17,778	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
5,391	98	Water Surface, 0% imp, HSG D
37,348	93	Weighted Average
19,570		52.40% Pervious Area
17,778		47.60% Impervious Area

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

**Subcatchment 03S: P03**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 04S: P04**

Runoff = 0.48 cfs @ 12.10 hrs, Volume= 1,859 cf, Depth= 5.60"  
Routed to Link 10L : DP3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusetbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,774	84	50-75% Grass cover, Fair, HSG D
210	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
1,002	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
3,986	83	Weighted Average
3,776		94.73% Pervious Area
210		5.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	100	0.0200	0.17		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 3.03"
0.6	37	0.0200	0.99		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
10.7	137				<b>Total</b>

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Shusetbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

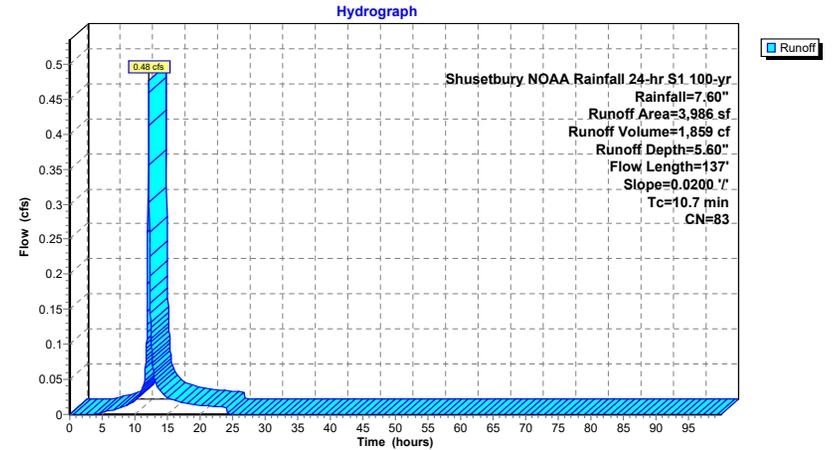
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**Subcatchment 04S: P04**



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Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 05S: P05**

Runoff = 0.47 cfs @ 12.04 hrs, Volume= 1,453 cf, Depth= 5.83"  
Routed to Link 10L : DP3

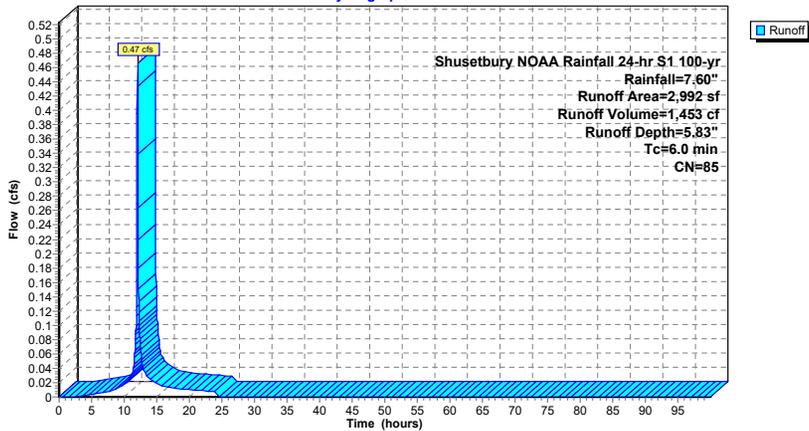
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,804	84	50-75% Grass cover, Fair, HSG D
188	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
2,992	85	Weighted Average
2,804		93.72% Pervious Area
188		6.28% Impervious Area

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

**Subcatchment 05S: P05**

Hydrograph



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Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 06S: P06**

Runoff = 1.20 cfs @ 12.03 hrs, Volume= 3,907 cf, Depth= 6.65"  
Routed to Pond 12P : POND #3

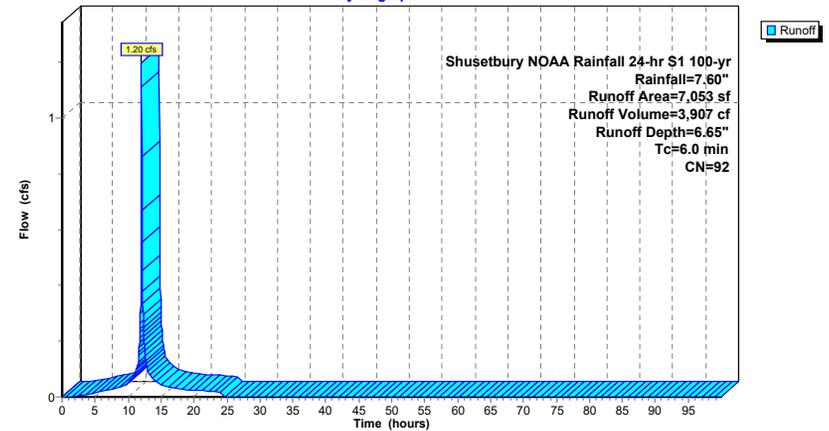
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
2,971	84	50-75% Grass cover, Fair, HSG D
4,082	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
7,053	92	Weighted Average
2,971		42.12% Pervious Area
4,082		57.88% Impervious Area

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

**Subcatchment 06S: P06**

Hydrograph



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**Summary for Subcatchment 07S: P07**

Runoff = 0.56 cfs @ 12.03 hrs, Volume= 1,930 cf, Depth= 7.36"  
Routed to Pond 11P : POND #1

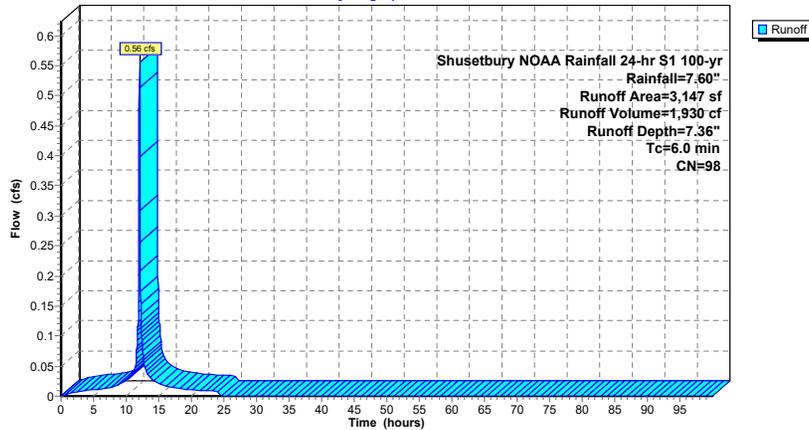
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
0	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
3,147	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
3,147	98	Weighted Average
3,147		100.00% Impervious Area

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

**Subcatchment 07S: P07**

Hydrograph



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Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 08S: P08**

Runoff = 0.33 cfs @ 12.03 hrs, Volume= 1,146 cf, Depth= 7.36"  
Routed to Pond 11P : POND #1

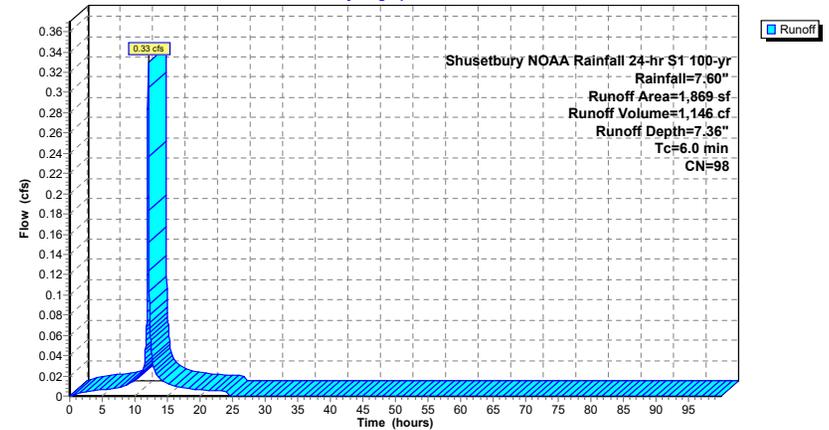
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusettbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
0	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
1,869	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
1,869	98	Weighted Average
1,869		100.00% Impervious Area

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

**Subcatchment 08S: P08**

Hydrograph



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Shusbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 09S: P09**

Runoff = 4.38 cfs @ 12.23 hrs, Volume= 23,305 cf, Depth= 5.02"  
 Routed to Link 8L : DP2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
 Shusbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
3,802	49	50-75% Grass cover, Fair, HSG A
19,931	84	50-75% Grass cover, Fair, HSG D
277	98	Paved parking, HSG D
1,194	36	Woods, Fair, HSG A
30,478	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
0	98	Water Surface, 0% imp, HSG D
55,682	78	Weighted Average
55,405		99.50% Pervious Area
277		0.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	100	0.0300	0.09		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
1.8	109	0.0430	1.04		<b>Shallow Concentrated Flow,</b> Woodland Kv= 5.0 fps
20.6	209	Total			

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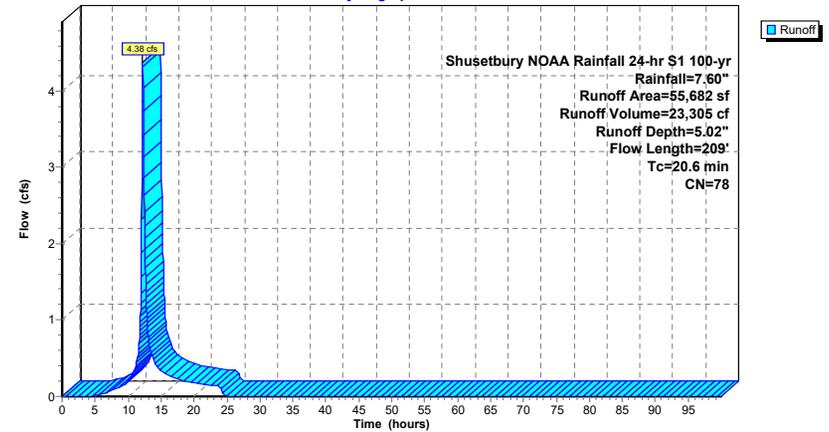
Shusbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Subcatchment 09S: P09**

Hydrograph



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Shusbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 10S: P10**

Runoff = 1.30 cfs @ 12.04 hrs, Volume= 4,172 cf, Depth= 6.41"  
 Routed to Pond 10P : POND #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
 Shusbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,994	84	50-75% Grass cover, Fair, HSG D
912	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
210	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
2,692	98	Water Surface, 0% imp, HSG D
7,808	90	Weighted Average
6,896		88.32% Pervious Area
912		11.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	23	0.0500	0.08		<b>Sheet Flow,</b> Woods: Light underbrush n= 0.400 P2= 3.03"
0.5	51	0.0500	1.57		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
5.2	74				Total, Increased to minimum Tc = 6.0 min

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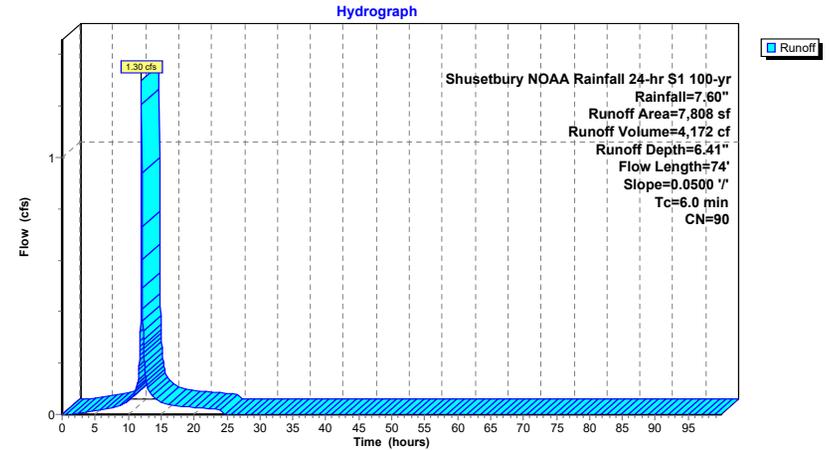
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Shusbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Subcatchment 10S: P10**



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Shusbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Subcatchment 11S: P11**

Runoff = 0.70 cfs @ 12.04 hrs, Volume= 2,213 cf, Depth= 6.06"  
Routed to Pond 12P : POND #3

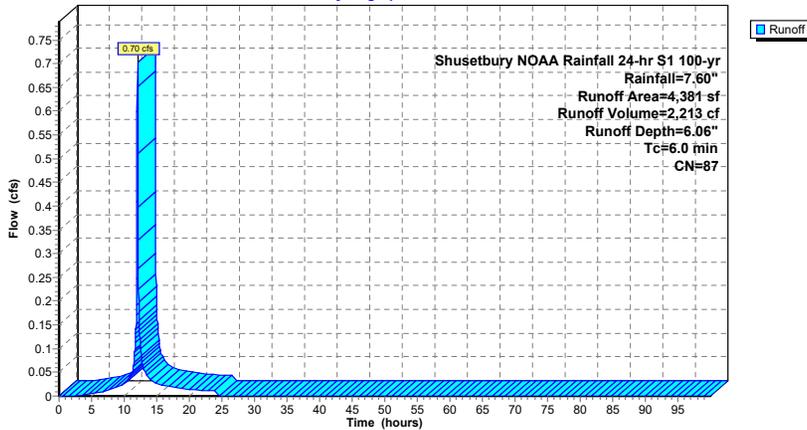
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs  
Shusbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

Area (sf)	CN	Description
0	49	50-75% Grass cover, Fair, HSG A
3,414	84	50-75% Grass cover, Fair, HSG D
0	98	Paved parking, HSG D
0	36	Woods, Fair, HSG A
0	79	Woods, Fair, HSG D
0	98	Roofs, HSG D
967	98	Water Surface, 0% imp, HSG D
4,381	87	Weighted Average
4,381		100.00% Pervious Area

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

**Subcatchment 11S: P11**

Hydrograph



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Shusbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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**Summary for Pond 10P: POND #2**

Inflow Area = 7,808 sf, 11.68% Impervious, Inflow Depth = 6.41" for 100-yr event  
Inflow = 1.30 cfs @ 12.04 hrs, Volume= 4,172 cf  
Outflow = 0.56 cfs @ 12.16 hrs, Volume= 3,405 cf, Atten= 57%, Lag= 7.8 min  
Primary = 0.56 cfs @ 12.16 hrs, Volume= 3,405 cf  
Routed to Link 8L : DP2  
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf  
Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
Peak Elev= 1,177.06' @ 12.16 hrs Surf.Area= 2,023 sf Storage= 1,800 cf

Plug-Flow detention time= 259.4 min calculated for 3,405 cf (82% of inflow)  
Center-of-Mass det. time= 170.0 min ( 956.7 - 786.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,176.00'	4,012 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,176.00	1,373	0	0
1,177.00	1,979	1,676	1,676
1,178.00	2,692	2,336	4,012

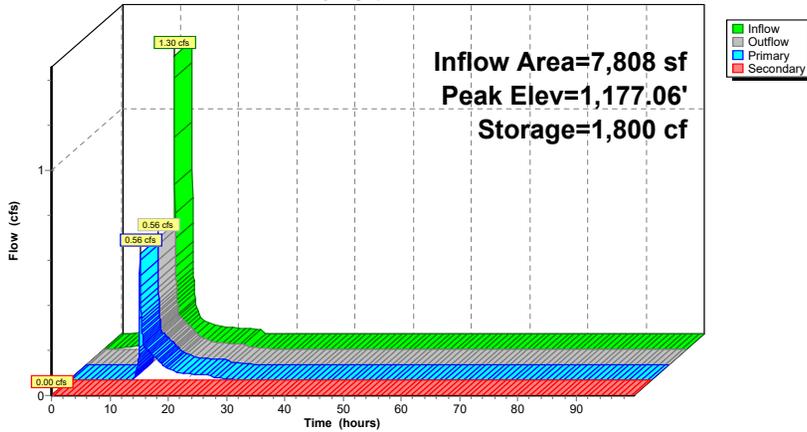
Device	Routing	Invert	Outlet Devices
#1	Primary	1,175.23'	<b>12.0" Round Culvert</b> L= 44.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,175.23' / 1,175.00' S= 0.0052' S= 0.0052' n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	1,177.00'	<b>24.0" x 24.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,176.50'	<b>3.0" Vert. Orifice</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,177.50'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=0.55 cfs @ 12.16 hrs HW=1,177.06' TW=0.00' (Dynamic Tailwater)  
 1=Culvert (Passes 0.55 cfs of 3.82 cfs potential flow)  
 2=Grate (Weir Controls 0.39 cfs @ 0.81 fps)  
 3=Orifice (Orifice Controls 0.16 cfs @ 3.18 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,176.00' TW=0.00' (Dynamic Tailwater)  
 4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Pond 10P: POND #2**

Hydrograph



**Summary for Pond 11P: POND #1**

Inflow Area = 42,364 sf, 53.81% Impervious, Inflow Depth = 6.84" for 100-yr event  
 Inflow = 7.30 cfs @ 12.03 hrs, Volume= 24,134 cf  
 Outflow = 1.62 cfs @ 12.30 hrs, Volume= 23,284 cf, Atten= 78%, Lag= 16.2 min  
 Primary = 1.62 cfs @ 12.30 hrs, Volume= 23,284 cf  
 Routed to Pond 12P : POND #3  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,176.07' @ 12.30 hrs Surf.Area= 4,417 sf Storage= 7,330 cf

Plug-Flow detention time= 117.8 min calculated for 23,277 cf (96% of inflow)  
 Center-of-Mass det. time= 96.4 min ( 865.2 - 768.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,174.00'	11,904 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,174.00	2,675	0	0
1,175.00	3,524	3,100	3,100
1,176.00	4,347	3,936	7,035
1,177.00	5,391	4,869	11,904

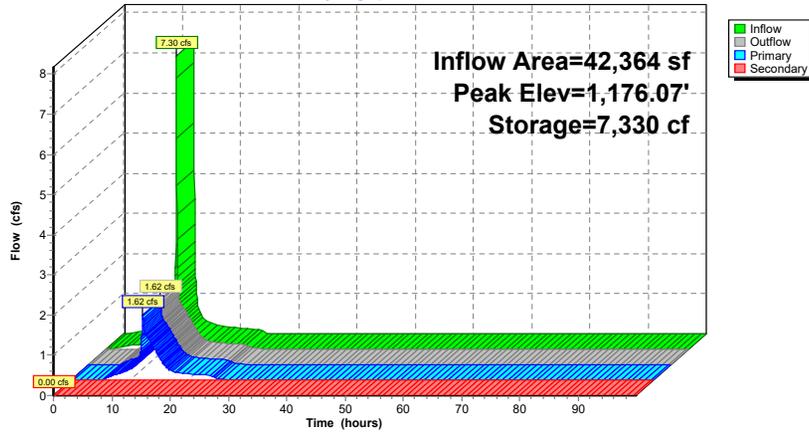
Device	Routing	Invert	Outlet Devices
#1	Primary	1,173.50'	<b>12.0" Round Culvert</b> L= 83.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,173.50' / 1,170.00' S= 0.0422'/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	1,176.00'	<b>24.0" x 24.0" Horiz. Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Device 1	1,174.30'	<b>6.0" Vert. Orifice</b> C= 0.600 Limited to weir flow at low heads
#4	Secondary	1,176.25'	<b>10.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

**Primary OutFlow** Max=1.62 cfs @ 12.30 hrs HW=1,176.07' TW=1,170.70' (Dynamic Tailwater)  
 1=Culvert (Passes 1.62 cfs of 5.44 cfs potential flow)  
 2=Grate (Weir Controls 0.46 cfs @ 0.85 fps)  
 3=Orifice (Orifice Controls 1.16 cfs @ 5.93 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=1,174.00' TW=0.00' (Dynamic Tailwater)  
 4=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Pond 11P: POND #1**

Hydrograph



**Summary for Pond 12P: POND #3**

Inflow Area = 53,798 sf, 49.96% Impervious, Inflow Depth = 6.56" for 100-yr event  
 Inflow = 2.85 cfs @ 12.04 hrs, Volume= 29,404 cf  
 Outflow = 2.80 cfs @ 12.06 hrs, Volume= 29,070 cf, Atten= 2%, Lag= 1.0 min  
 Primary = 2.80 cfs @ 12.06 hrs, Volume= 29,070 cf  
 Routed to Link 8L : DP2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs / 2  
 Peak Elev= 1,170.74' @ 12.06 hrs Surf.Area= 864 sf Storage= 530 cf

Plug-Flow detention time= 20.1 min calculated for 29,070 cf (99% of inflow)  
 Center-of-Mass det. time= 8.3 min ( 856.9 - 848.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	1,170.00'	768 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

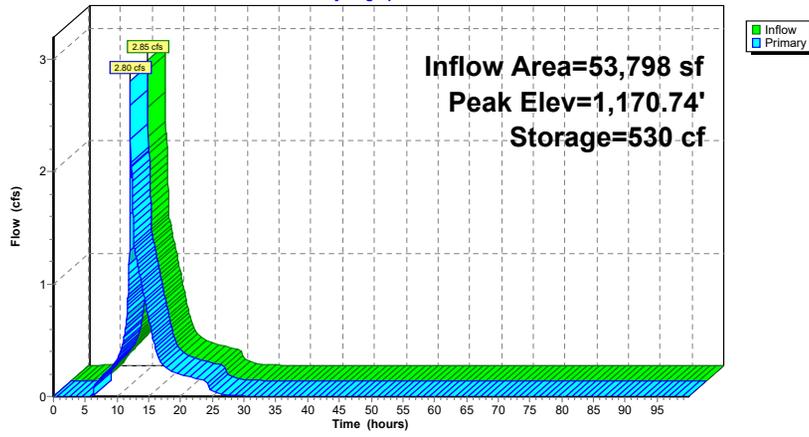
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,170.00	568	0	0
1,171.00	967	768	768

Device	Routing	Invert	Outlet Devices
#1	Primary	1,170.50'	<b>10.0' long x 5.0' breadth Broad-Crested Rectangular Weir</b> 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

**Primary OutFlow** Max=2.79 cfs @ 12.06 hrs HW=1,170.74' TW=0.00' (Dynamic Tailwater)  
 ↳=Broad-Crested Rectangular Weir(Weir Controls 2.79 cfs @ 1.16 fps)

**Pond 12P: POND #3**

Hydrograph



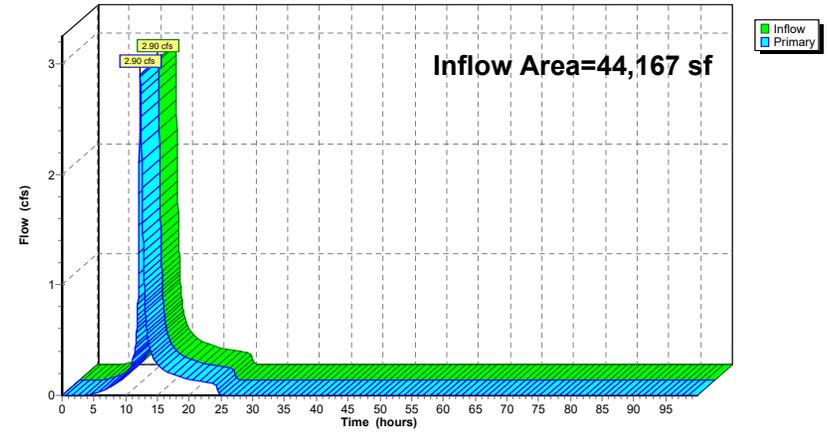
**Summary for Link 4L: DP1**

Inflow Area = 44,167 sf, 0.00% Impervious, Inflow Depth = 5.34" for 100-yr event  
 Inflow = 2.90 cfs @ 12.29 hrs, Volume= 19,670 cf  
 Primary = 2.90 cfs @ 12.29 hrs, Volume= 19,670 cf, Atten=0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

**Link 4L: DP1**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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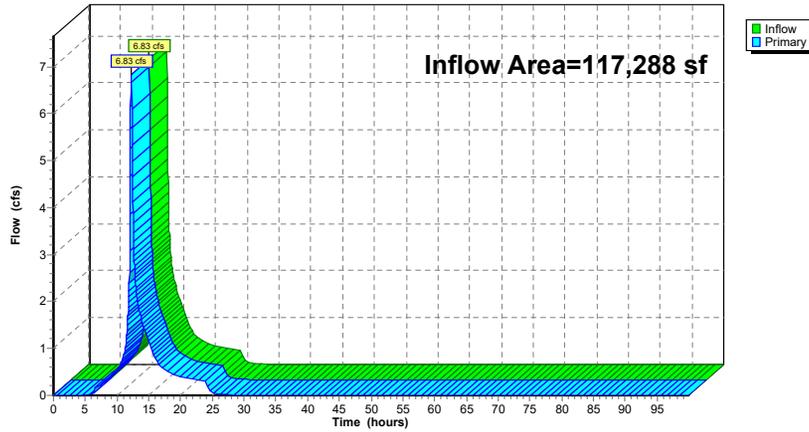
**Summary for Link 8L: DP2**

Inflow Area = 117,288 sf, 23.93% Impervious, Inflow Depth = 5.71" for 100-yr event  
Inflow = 6.83 cfs @ 12.23 hrs, Volume= 55,780 cf  
Primary = 6.83 cfs @ 12.23 hrs, Volume= 55,780 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

**Link 8L: DP2**

Hydrograph



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Shusetbury NOAA Rainfall 24-hr S1 100-yr Rainfall=7.60"

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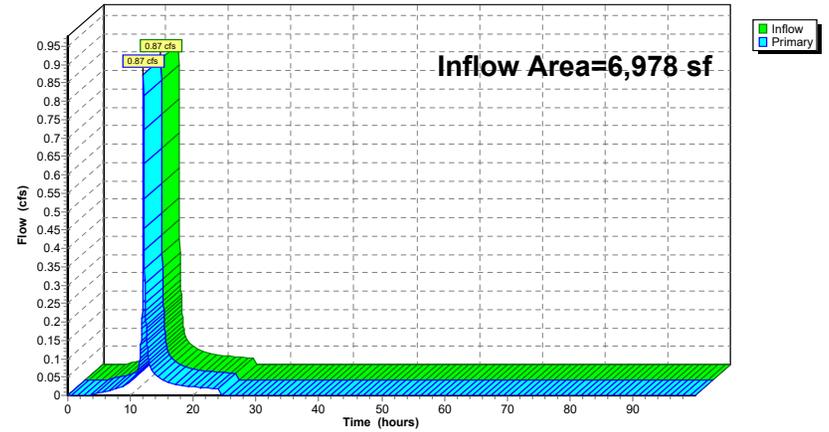
**Summary for Link 10L: DP3**

Inflow Area = 6,978 sf, 5.70% Impervious, Inflow Depth = 5.70" for 100-yr event  
Inflow = 0.87 cfs @ 12.06 hrs, Volume= 3,312 cf  
Primary = 0.87 cfs @ 12.06 hrs, Volume= 3,312 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-99.99 hrs, dt= 0.03 hrs

**Link 10L: DP3**

Hydrograph



## **Appendix G**

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### Stormwater Management Checklist



# Checklist for Stormwater Report

## A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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



# Checklist for Stormwater Report

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## B. Stormwater Checklist and Certification

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

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

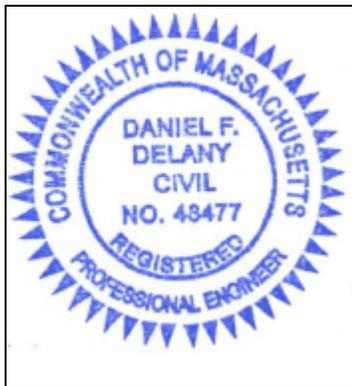
A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

---

### Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



12/21/23

Signature and Date

---

## Checklist

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

- New development
- Redevelopment
- Mix of New Development and Redevelopment



# Checklist for Stormwater Report

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## Checklist (continued)

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

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

### Standard 1: No New Untreated Discharges

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



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

### Standard 3: Recharge

- Soil Analysis provided.
- Required Recharge Volume calculation provided.
- Required Recharge volume reduced through use of the LID site Design Credits.
- Sizing the infiltration, BMPs is based on the following method: Check the method used.
  - Static
  - Simple Dynamic
  - Dynamic Field<sup>1</sup>
- Runoff from all impervious areas at the site discharging to the infiltration BMP.
- Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
  - Site is comprised solely of C and D soils and/or bedrock at the land surface
  - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
  - Solid Waste Landfill pursuant to 310 CMR 19.000
  - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

---

<sup>1</sup> 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 3: Recharge (continued)

- The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

### Standard 4: Water Quality

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

- Good housekeeping practices;
  - Provisions for storing materials and waste products inside or under cover;
  - Vehicle washing controls;
  - Requirements for routine inspections and maintenance of stormwater BMPs;
  - Spill prevention and response plans;
  - Provisions for maintenance of lawns, gardens, and other landscaped areas;
  - Requirements for storage and use of fertilizers, herbicides, and pesticides;
  - Pet waste management provisions;
  - Provisions for operation and management of septic systems;
  - Provisions for solid waste management;
  - Snow disposal and plowing plans relative to Wetland Resource Areas;
  - Winter Road Salt and/or Sand Use and Storage restrictions;
  - Street sweeping schedules;
  - Provisions for prevention of illicit discharges to the stormwater management system;
  - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
  - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
  - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
  - Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
    - is within the Zone II or Interim Wellhead Protection Area
    - is near or to other critical areas
    - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
    - involves runoff from land uses with higher potential pollutant loads.
  - The Required Water Quality Volume is reduced through use of the LID site Design Credits.
  - Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



# Checklist for Stormwater Report

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## Checklist (continued)

### Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
  - The ½" or 1" Water Quality Volume or
  - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does **not** cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

### Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



# Checklist for Stormwater Report

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## Checklist (continued)

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

- The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
  - Limited Project
  - Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
  - Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
  - Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
  - Bike Path and/or Foot Path
  - Redevelopment Project
  - Redevelopment portion of mix of new and redevelopment.
- Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

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

- Narrative;
  - Construction Period Operation and Maintenance Plan;
  - Names of Persons or Entity Responsible for Plan Compliance;
  - Construction Period Pollution Prevention Measures;
  - Erosion and Sedimentation Control Plan Drawings;
  - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
  - Vegetation Planning;
  - Site Development Plan;
  - Construction Sequencing Plan;
  - Sequencing of Erosion and Sedimentation Controls;
  - Operation and Maintenance of Erosion and Sedimentation Controls;
  - Inspection Schedule;
  - Maintenance Schedule;
  - Inspection and Maintenance Log Form.
- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



# Checklist for Stormwater Report

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## Checklist (continued)

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

- The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- The project is **not** covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

### Standard 9: Operation and Maintenance Plan

- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
  - Name of the stormwater management system owners;
  - Party responsible for operation and maintenance;
  - Schedule for implementation of routine and non-routine maintenance tasks;
  - Plan showing the location of all stormwater BMPs maintenance access areas;
  - Description and delineation of public safety features;
  - Estimated operation and maintenance budget; and
  - Operation and Maintenance Log Form.
- The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
  - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
  - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

### Standard 10: Prohibition of Illicit Discharges

- The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- An Illicit Discharge Compliance Statement is attached;
- NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

## **Appendix H**

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### Previous Project Design

**LEGEND & ABBREVIATIONS**

- PROPERTY LINE
- BORDERING VEGETATED WETLANDS
- 100' WETLAND BUFFER
- 50' WETLAND BUFFER
- BUILDING OUTLINE
- ASPHALT
- CONCRETE SIDEWALK



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BALA Consulting Engineers  
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 Structural  
 Lighting  
 Cost Estimator

LAM Partners  
 AM Fogarty & Associates

**SHUTESBURY PUBLIC LIBRARY**  
 66 Leverett Road  
 Shutesbury, MA 01462

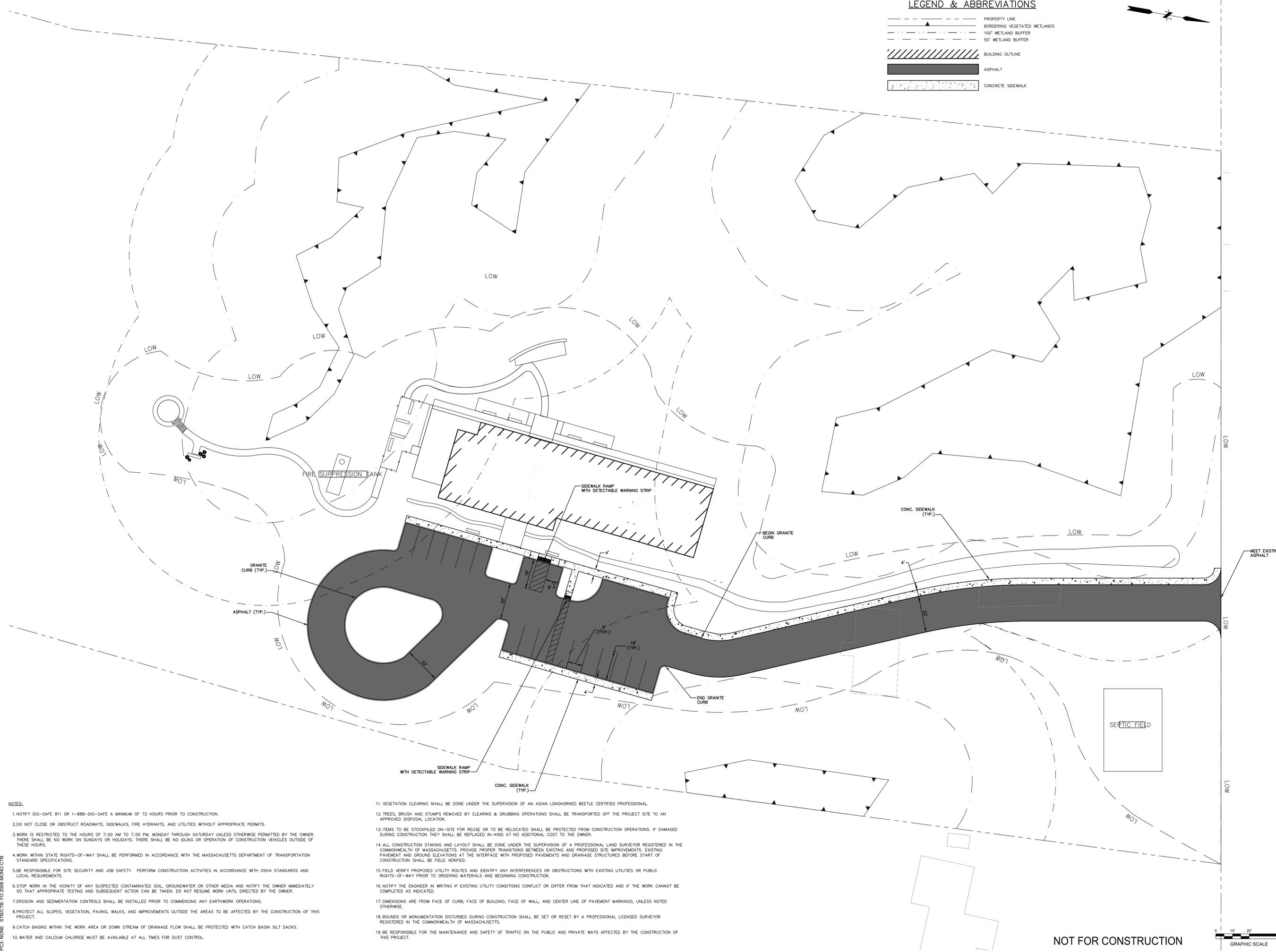
Oudens Elio Architecture, LLC  
 82 Main Street, Suite 4A, Boston, MA  
 617.422.0880, F. 617.422.0881

Revision	Date
SD 04	04.28.2023

Sheet Title:  
**SITE LAYOUT PLAN**

Date: 05/03/2023  
 Scale: 1"=20'  
 Drawn: ATB  
 Checked: [Signature]  
 Project No: 2022110.A10

Sheet No.: **C3.0**

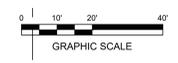


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 PCD NONE, STR:CTB: FO 2008 MONO.CTB

- NOTES:**
1. NOTIFY DIG-SAFE 811 OR 1-888-DIG-SAFE A MINIMUM OF 72 HOURS PRIOR TO CONSTRUCTION.
  2. DO NOT CLOSE OR OBSTRUCT ROADWAYS, SIDEWALKS, FIRE HYDRANTS, AND UTILITIES WITHOUT APPROPRIATE PERMITS.
  3. WORK IS RESTRICTED TO THE HOURS OF 7:00 AM TO 7:00 PM, MONDAY THROUGH SATURDAY UNLESS OTHERWISE PERMITTED BY THE OWNER. THERE SHALL BE NO WORK ON SUNDAYS OR HOLIDAYS. THERE SHALL BE NO IDLING OR OPERATION OF CONSTRUCTION VEHICLES OUTSIDE OF THESE HOURS.
  4. WORK WITHIN STATE RIGHTS-OF-WAY SHALL BE PERFORMED IN ACCORDANCE WITH THE MASSACHUSETTS DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS.
  5. BE RESPONSIBLE FOR SITE SECURITY AND JOB SAFETY. PERFORM CONSTRUCTION ACTIVITIES IN ACCORDANCE WITH OSHA STANDARDS AND LOCAL REQUIREMENTS.
  6. STOP WORK IN THE VICINITY OF ANY SUSPECTED CONTAMINATED SOIL, GROUNDWATER OR OTHER MEDIA AND NOTIFY THE OWNER IMMEDIATELY SO THAT APPROPRIATE TESTING AND SUBSEQUENT ACTION CAN BE TAKEN. DO NOT RESUME WORK UNTIL DIRECTED BY THE OWNER.
  7. EROSION AND SEDIMENTATION CONTROLS SHALL BE INSTALLED PRIOR TO COMMENCING ANY EARTHWORK OPERATIONS.
  8. PROTECT ALL SLOPES, VEGETATION, PAVING, WALKS, AND IMPROVEMENTS OUTSIDE THE AREAS TO BE AFFECTED BY THE CONSTRUCTION OF THIS PROJECT.
  9. CATCH BASINS WITHIN THE WORK AREA OR DOWN STREAM OF DRAINAGE FLOW SHALL BE PROTECTED WITH CATCH BASIN SILT SACKS.
  10. WATER AND CALCIUM CHLORIDE MUST BE AVAILABLE AT ALL TIMES FOR DUST CONTROL.

11. VEGETATION CLEARING SHALL BE DONE UNDER THE SUPERVISION OF AN ASIAN LONGHORNED BEETLE CERTIFIED PROFESSIONAL.
12. TREES, BRUSH AND STUMPS REMOVED BY CLEARING & GRUBBING OPERATIONS SHALL BE TRANSPORTED OFF THE PROJECT SITE TO AN APPROVED DISPOSAL LOCATION.
13. ITEMS TO BE STOCKPILED ON-SITE FOR REUSE OR TO BE RELOCATED SHALL BE PROTECTED FROM CONSTRUCTION OPERATIONS. IF DAMAGED DURING CONSTRUCTION THEY SHALL BE REPLACED IN-KIND AT NO ADDITIONAL COST TO THE OWNER.
14. ALL CONSTRUCTION STAKING AND LAYOUT SHALL BE DONE UNDER THE SUPERVISION OF A PROFESSIONAL LAND SURVEYOR REGISTERED IN THE COMMONWEALTH OF MASSACHUSETTS. PROVIDE PROPER TRANSITIONS BETWEEN EXISTING AND PROPOSED SITE IMPROVEMENTS. EXISTING PAVEMENT AND GROUND ELEVATIONS AT THE INTERFACE WITH PROPOSED PAVEMENTS AND DRAINAGE STRUCTURES BEFORE START OF CONSTRUCTION SHALL BE FIELD VERIFIED.
15. FIELD VERIFY PROPOSED UTILITY ROUTES AND IDENTIFY ANY INTERFERENCES OR OBSTRUCTIONS WITH EXISTING UTILITIES OR PUBLIC RIGHTS-OF-WAY PRIOR TO ORDERING MATERIALS AND BEGINNING CONSTRUCTION.
16. NOTIFY THE ENGINEER IN WRITING IF EXISTING UTILITY CONDITIONS CONFLICT OR DIFFER FROM THAT INDICATED AND IF THE WORK CANNOT BE COMPLETED AS INDICATED.
17. DIMENSIONS ARE FROM FACE OF CURB, FACE OF BUILDING, FACE OF WALL, AND CENTER LINE OF PAVEMENT MARKINGS, UNLESS NOTED OTHERWISE.
18. BOUNDS OR MONUMENTATION DISTURBED DURING CONSTRUCTION SHALL BE SET OR RESET BY A PROFESSIONAL LICENSED SURVEYOR REGISTERED IN THE COMMONWEALTH OF MASSACHUSETTS.
19. BE RESPONSIBLE FOR THE MAINTENANCE AND SAFETY OF TRAFFIC ON THE PUBLIC AND PRIVATE WAYS AFFECTED BY THE CONSTRUCTION OF THIS PROJECT.

**NOT FOR CONSTRUCTION**



## **Appendix I**

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### Water Quality Volume Stormwater Treatment Structure

**Sizing VortSentryHS - STS #13  
Water Quality Volume to Discharge Rate**

---

$$Q_1 = (qu)(A)(WQV)$$

$Q_1$  = flow rate associated with first 1-inch of runoff

qu = the unit peak discharge, in csm/in

A = impervious surface drainage area (in square miles)

WQV = water quality volume in watershed inches (1/2 or 1 inch)

Flow Rate		
Equations		
CN		98
WQV	inch	1.0
Area	sq ft	22,793
	acres	0.52
	sq miles	0.00
Tc	min.	6
Tc	hours	0.1
qu	csm/in	774
$Q_1$	cfs	0.63

from Figure 4 of the Mass DEP Q Rate - Sept. 10, 2013

Per Contech Specification a Cascade CS-3

**Sizing VortSentryHS - STS #18  
Water Quality Volume to Discharge Rate**

---

$$Q_1 = (qu)(A)(WQV)$$

$Q_1$  = flow rate associated with first 1-inch of runoff

qu = the unit peak discharge, in csm/in

A = impervious surface drainage area (in square miles)

WQV = water quality volume in watershed inches (1/2 or 1 inch)

Flow Rate		
Equations		
CN		98
WQV	inch	1.0
Area	sq ft	912
	acres	0.02
	sq miles	0.00
Tc	min.	6
Tc	hours	0.1
qu	csm/in	774
$Q_1$	cfs	0.03

from Figure 4 of the Mass DEP Q Rate - Sept. 10, 2013

Per Contech Specification a Cascade CS-3

**Sizing VortSentryHS - STS #20  
Water Quality Volume to Discharge Rate**

---

$$Q_1 = (qu)(A)(WQV)$$

$Q_1$  = flow rate associated with first 1-inch of runoff

$qu$  = the unit peak discharge, in csm/in

$A$  = impervious surface drainage area (in square miles)

$WQV$  = water quality volume in watershed inches (1/2 or 1 inch)

Flow Rate		
Equations		
CN		98
WQV	inch	1.0
Area	sq ft	4,082
	acres	0.09
	sq miles	0.00
Tc	min.	6
Tc	hours	0.1
qu	csm/in	774
$Q_1$	cfs	0.11

from Figure 4 of the Mass DEP Q Rate - Sept. 10, 2013

Per Contech Specification a Cascade CS-3

## Appendix J

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### TSS Treatment Worksheets

**Project:** Shutesbury Public Library  
66 Leverette  
Road

**Prepared By:** ATB

**Site Location:** Shutesbury, M

**Date:** 12/21/2023

**Outfall Location:** DP1

<b>BMP</b>	<b>TSS Removal Efficiency</b>	<b>Starting TSS Load</b>	<b>TSS Removed</b>	<b>TSS Remaining</b>
Stormwater Treatment Structures	80%	1.00	0.80	0.20
		0.20	0.00	0.20
		0.20	0.00	0.20
		0.20	0.00	0.20

**Total TSS Removal Efficiency= 80%**

**Project:** Shutesbury Public Library  
66 Leverette  
Road

**Prepared By:** ATB

**Site Location:** Shutesbury, M

**Date:** 12/21/2023

**Outfall Location:** DP2

<b>BMP</b>	<b>TSS Removal Efficiency</b>	<b>Starting TSS Load</b>	<b>TSS Removed</b>	<b>TSS Remaining</b>
Stormwater Treatment Structures	80%	1.00	0.80	0.20
		0.20	0.00	0.20
		0.20	0.00	0.20
		0.20	0.00	0.20

**Total TSS Removal Efficiency= 80%**

**Project:** Shutesbury Public Library  
66 Leverette  
Road

**Prepared By:** ATB

**Site Location:** Shutesbury, M

**Date:** 12/21/2023

**Outfall Location:** DP3

<b>BMP</b>	<b>TSS Removal Efficiency</b>	<b>Starting TSS Load</b>	<b>TSS Removed</b>	<b>TSS Remaining</b>
Stormwater Treatment Structures	80%	1.00	0.80	0.20
		0.20	0.00	0.20
		0.20	0.00	0.20
		0.20	0.00	0.20

**Total TSS Removal Efficiency= 80%**

## Appendix K

---

### Construction Operation and Maintenance Plan

# MEMORANDUM

**TO:** Town of Shutesbury

**FROM:** Fuss & O'Neill, Inc.

**DATE:** December 21, 2023

**RE:** Construction Operation and Maintenance Plan  
Shutesbury Public Library

---

This suggested Construction Operation and Maintenance Plan (O&M) is for the construction of a the Shutesbury Public Library located at 66 Leverette Road in Shutesbury, Massachusetts. Construction includes an approximately XXX square foot building with associated paved parking, gravel parking, paved driveway, pedestrian sidewalks, stormwater management system, site utilities, on-site septic system, on-site well, and other site amenities. This O&M Plan has been prepared in accordance with the Massachusetts Stormwater Handbook and the Town of Shutesbury Wetland Protection Bylaw Regulations. This O&M plan will be in conjunction with the requirements of the Construction General Permit and Stormwater Pollution Prevention Plan (SWPPP). The SWPPP will provide additional details and be completed prior to the start of construction.

**Property Owner:** Town of Shutesbury  
P.O. Box 276  
1 Cooleyville Road  
Shutesbury, MA 01072

**Responsible Party:** Site Contractor

The contractor shall be responsible for the operation and maintenance of the site during construction. A suggested operation and maintenance activities plan and proposed schedule for during construction are as follows:

1. No earthwork activities shall commence until silt fence has been installed. Silt fence and compost filter tubes (or straw bales) shall be installed as shown on the drawings.
2. No earthwork activities shall commence until catch basin inlet protection have been installed. Catch basin protection to be installed in all catch basins located on site.
3. Areas left exposed to erosion for more than seven days shall be rough graded and temporarily stabilized. Areas disturbed but inactive for more than thirty days shall be temporarily seeded.
4. Erosion and sedimentation controls shall be maintained until successful establishment of ground cover.

5. No staging of materials or lay down areas shall be located within the resource areas or the 25-foot wetland buffer area.
6. Paved areas shall be kept free of sediment and shall be cleaned periodically as required by construction activities.
7. Catch basins shall be periodically inspected for the accumulation of sediment. Catch basins within the project shall be cleaned at the end of the project.
8. Temporary soil stockpiles shall be located within the project limit of work and outside of the 25-foot wetland buffer area. Stockpiles will be moved as necessary to accommodate ongoing work.
9. Sediment stockpiles shall have a side slope of no greater than 2:1. Stockpiles shall be rough graded or maintain a roughened surface to prevent erosion. Stockpiles that are not to be used within 7 days shall be seeded after formation of stockpile as to prevent erosion. Compost filter tube barrier and silt fence shall be installed around stockpile area approximately 10 feet from toe of slope.
10. The contractor is responsible for inspecting and repairing erosion and sedimentation control measures as required to prevent damage or sedimentation.
11. Upon completion of construction and establishment of permanent ground cover, remove and dispose of temporary erosion control measures. Clean sediment and debris from temporary measures and from permanent storm drain and sanitary sewer systems.

Inspections shall be completed a minimum of every seven (7) calendar days and within 24 hours of the end of a storm event of 0.25 inches or greater. Attached is an example Construction Inspection and Maintenance Report Form.

## CONSTRUCTION INSPECTION AND MAINTENANCE REPORT FORM

**Shutesbury Public Library  
Shutesbury, MA**

*To be completed every 7 calendar days and within 24 hours of the end of a storm event of  
0.25 inches or greater*

Inspector: \_\_\_\_\_ Date: \_\_\_\_\_

Inspector's Title and Qualifications: \_\_\_\_\_  
\_\_\_\_\_

### Summary of Previous 7-day Rainfall:

Date	Friday Date	Saturday Date	Sunday Date	Monday Date	Tuesday Date	Wednesday Date	Thursday Date
<b>Total Daily Rainfall (in.)</b>							

### Stabilization Measures:

Area	Disturbed (Yes/No)	Stabilized (Yes/No)	Stabilized With	Condition
<b>Paved Parking and Driveway</b>				
<b>Stormwater Detention Basin #1</b>				
<b>Stormwater Detention Basin #2</b>				
<b>Stormwater Detention Basin #3</b>				

### Construction Site & Adjacent Areas:

General condition: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Maintenance Required for Silt Fence: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Is sediment being tracked on to road? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Maintenance required? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**CONSTRUCTION INSPECTION AND MAINTENANCE REPORT FORM**

**Shutesbury Public Library  
Shutesbury, MA**

**Changes Required to the Pollution Prevention Plan:**

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**Reasons for Changes:**

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**Certification:**

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

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## **Appendix L**

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### Long-Term Operation and Maintenance Plan

## MEMORANDUM

**TO:** Town of Shutesbury

**FROM:** Fuss & O'Neill, Inc.

**DATE:** December 21, 2023

**RE:** Long Term Operation and Maintenance Plan  
Shutesbury Public Library

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This Long-Term Operation and Maintenance Plan (O&M) is for the long-term operation of the Public Library located at 66 Leverette Road in Shutesbury, Massachusetts. This Long-Term O&M Plan has been prepared in accordance with the Massachusetts Stormwater Handbook and the Town of Shutesbury Wetland Protection Bylaw Regulations.

**Property Owner and Responsible Party:**

Town of Shutesbury  
P.O. Box 276  
1 Cooleyville Road  
Shutesbury, MA 01072

It will be the responsibility of the Owner to comply with this Long-Term Operation and Maintenance Plan. The owner is responsible for all financing, maintenance and emergency repairs. Should the property or any portion of the property be transferred to another owner, that new owner must be notified of the presence of this Long-Term Operation and Maintenance Plan and be held responsible for the implementation of this plan and financing as it pertains to their property.

**Operation and Maintenance Plan**

The long-term construction operation and maintenance plan outlined hereafter provides recommendations for periodic inspection and maintenance activities for the stormwater management system. This Long-Term Operation and Maintenance Plan will ensure that the stormwater management system functions as designed throughout the life of the system.

- The stormwater collection systems will be inspected a minimum of four (4) times per year to maintain proper operation. Sediment and debris shall be removed from structures and pipes. Sedimentation will be removed from each deep sump catch basin a minimum of four (4) times a year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe. Deep sump catch basins shall be cleaned at the end of the foliage and snow removal seasons.
- Paved surfaces will be swept twice annually, April and October, to remove sand and debris.
- Stone drip edge around building shall be inspected twice a year. This will include checking for signs of riling and gullyng. Also, this will include checking for the accumulation of sediments, pollutants, and

vegetation. The stone drip edge shall be maintained in good shape, free of vegetation, and cleaned twice a year.

- At least twice per year, during the spring (April) and fall (November), outlet structures will be examined and cleaned, and all floatables and solids trapped will be removed.
- Stormwater Treatments System shall be inspected in accordance with the manufacturer's recommendations. The manufacturer recommended O&M Plan is attached.
- Stormwater detention basin shall be inspected after every major storm event for the first three months and a minimum twice a year thereafter. Basin shall be inspected for, but not limited to, evidence of differential settlement, cracking, erosion, leakage in the embankments, tree growth on the embankments, condition of riprap, and sediment accumulation and the health of the vegetation. All upper-stage, side slopes, embankments, and emergency spillways shall be mowed at least twice a year. Trash and debris shall be removed at least twice a year and accumulated sediment shall be removed at least twice a year from the basin.

#### **Snow Removal and Storage**

Snow removal and storage shall be performed when needed as follows:

- Snow shall be plowed to snow storage areas located off the perimeter of the parking areas. No snow shall be stored within wetland resource areas or within the stormwater detention basins.
- De-icing chemicals may only be used on pedestrian surfaces. All other paved surfaces may have sand applied.
- Excess snow shall be removed from site or stockpiled only within the paved areas on the site.

#### **Location and Access of Stormwater Management System**

All components of the stormwater management system are located within project site area. Access to the components will be from Leveret Road. The attached Figure A, provides the location of stormwater features and access for the stormwater management system.

#### **Records of Maintenance and Repair Activities**

The responsible parties shall keep records of installation, maintenance and repairs of the stormwater management facilities. These records shall be retained for the most recent five years on site and be provided to the Conservation Commission annually and upon request. An example Operation and Maintenance Log Form is attached.

#### **Attachments:**

O&M Log Form

Figure A – Stormwater Location Plan

Stormwater Treatment System manufacturer recommended O&M Plan.

## Operation and Maintenance Log Form

Project/Location: Gardner Rear Main Street Site Improvements

“As Built” Plans Available? \_\_\_\_\_

Date/Time: \_\_\_\_\_

Days since Previous Rainfall and Rainfall Amount: \_\_\_\_\_

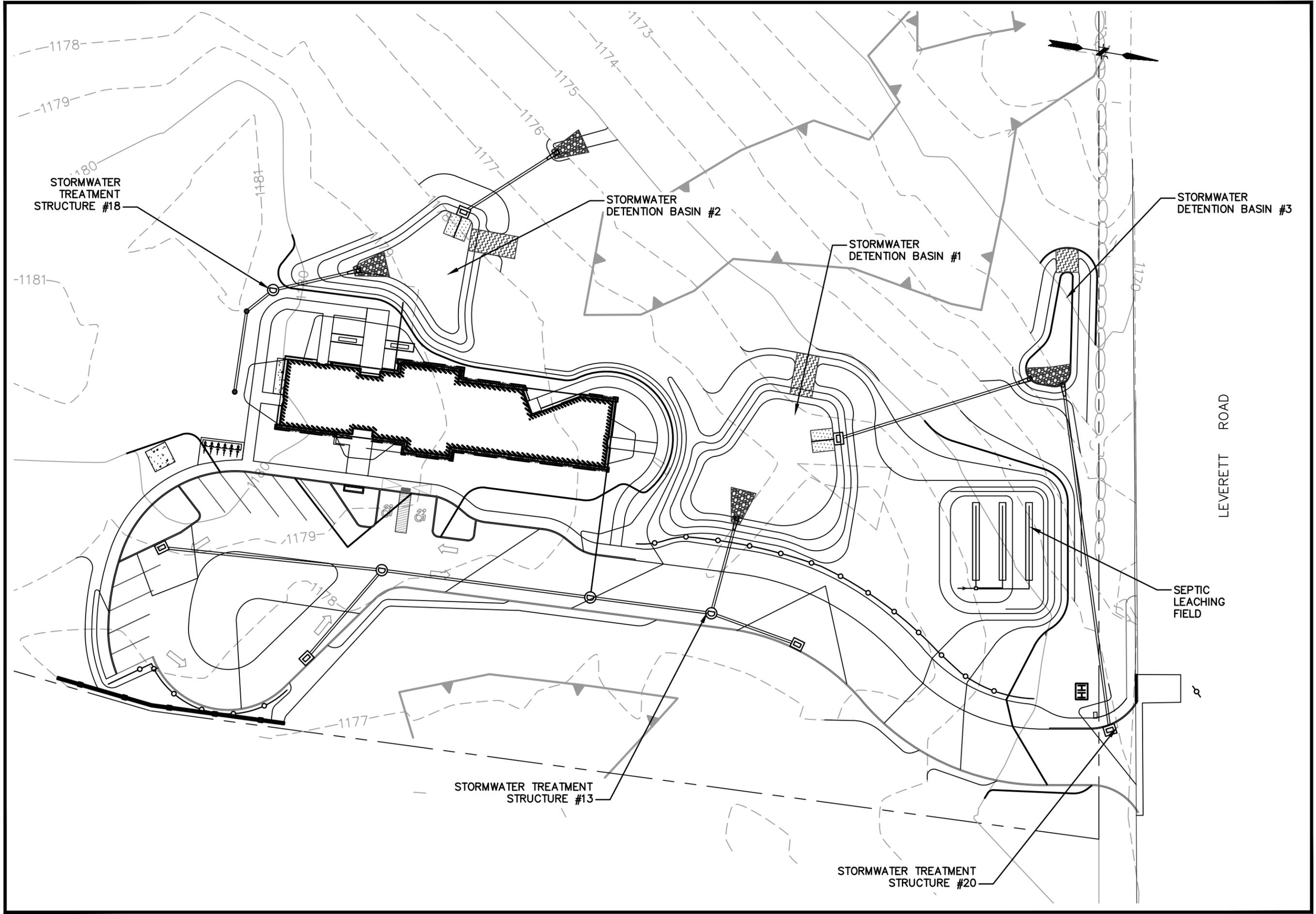
Inspector: \_\_\_\_\_

Maintenance Item	Satisfactory	Unsatisfactory	Comments
<b>1. Asphalt Road &amp; Sidewalk Sweeping</b>			
<ul style="list-style-type: none"> <li>• Evidence of erosion</li> </ul>			
<b>Action to be Taken:</b>			
<b>Date to be Completed by:</b>			
<b>2. Deep Sump Catch Basins</b>			
<ul style="list-style-type: none"> <li>• Sump clean of sedimentation</li> <li>• Structure is free of debris, litter and waste</li> <li>• Concrete surfaces are structurally sound and have negligible spalling and cracking.</li> </ul>			
<b>Action to be Taken:</b>			
<b>Date to be Completed by:</b>			
<b>3. Stone Drip Edge</b>			
<ul style="list-style-type: none"> <li>• free of debris, litter and waste.</li> <li>• In good condition.</li> <li>• Free of vegetation</li> </ul>			
<b>Action to be Taken:</b>			
<b>Date to be Completed by:</b>			
<b>5. Stormwater Detention Basin</b>			
<ul style="list-style-type: none"> <li>• Vegetation coverage adequate</li> <li>• Undesirable vegetative growth</li> <li>• Undesirable woody vegetation</li> <li>• Mowing performed as necessary</li> <li>• Embankment in good repair</li> <li>• No evidence of erosion</li> <li>• Standing water or wet spots</li> <li>• Sediment and/or trash accumulation</li> </ul>			

Maintenance Item	Satisfactory	Unsatisfactory	Comments
<ul style="list-style-type: none"> <li>Outlet Control Structure Good Condition</li> </ul>			
<ul style="list-style-type: none"> <li>Other (specify)</li> </ul>			
<b>Action to be Taken:</b>			
<b>Date to be Completed by:</b>			
<b>7. Stormwater Treatment Systems</b>			
<ul style="list-style-type: none"> <li>Meet requirements of the Manufacture's O&amp;M Guidelines</li> </ul>			
<ul style="list-style-type: none"> <li>Other (specify)</li> </ul>			
<b>Action to be Taken:</b>			
<b>Date to be Completed by:</b>			

Source: Adapted from Watershed Management Institute, Inc. 1997. *Operation, Maintenance, and Management of Stormwater Management Systems*. In cooperation with U.S. Environmental Protection Agency, Office of Water. Washington, D.C.

File: I:\projects\DFS\Cad\Proj\DWG\20221110A10\Civil\Plan\20221110A10\_FIG.A.dwg Layout: FIG.A\_PlotSet: 2023-12-18 11:53 AM Saved: 2023-12-18 11:51 AM User: ABell  
PC3: AUTOCAD PDF (GENERAL DOCUMENTATION).PC3 STB/CTB: FO STB  
LAYER STATE:



SCALE:	HORZ.: 1"=40'
	VERT.: 1"=20'
DATUM:	
	HORZ.: 1"=40'
	VERT.: 1"=20'
	GRAPHIC SCALE
	0 20 40

**FUSS & O'NEILL**  
1550 MAIN STREET, SUITE 400  
SPRINGFIELD, MA 01103  
413.452.0445  
www.fandob.com

TOWN OF SHUTESBURY  
STORMWATER LOCATION PLAN  
SHUTESBURY PUBLIC LIBRARY  
SHUTESBURY  
MASSACHUSETTS

PROJ. No.: 20221110.A10  
DATE: 12/21/2023

FIG. A

## Cascade Separator<sup>®</sup> Inspection and Maintenance Guide



## Maintenance

The Cascade Separator® system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects sediment and debris will depend upon on-site activities and site pollutant characteristics. For example, unstable soils or heavy winter sanding will cause the sediment storage sump to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

## Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall). However, more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment wash-down areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

A visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet chamber, flumes or outlet channel. The inspection should also quantify the accumulation of hydrocarbons, trash and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided in this Inspection and Maintenance Guide.

Access to the Cascade Separator unit is typically achieved through one manhole access cover. The opening allows for inspection and cleanout of the center chamber (cylinder) and sediment storage sump, as well as inspection of the inlet chamber and slanted skirt. For large units, multiple manhole covers allow access to the chambers and sump.

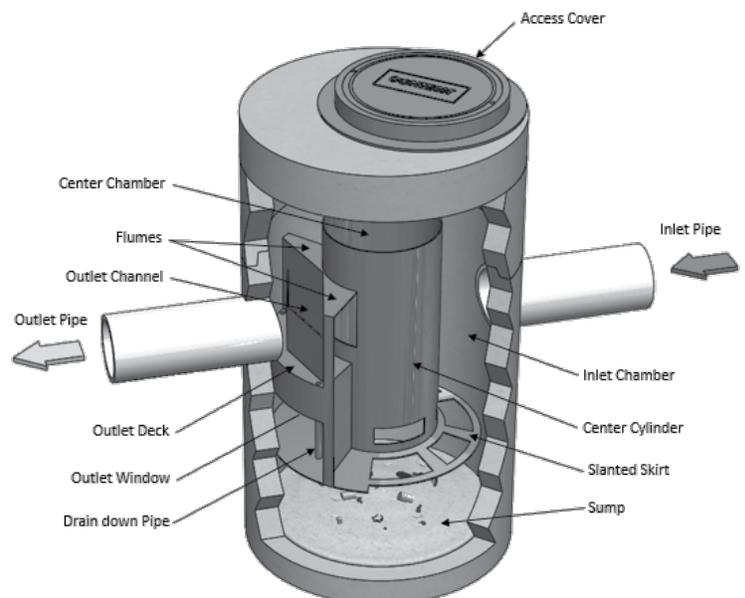
The Cascade Separator system should be cleaned before the level of sediment in the sump reaches the maximum sediment depth and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it must be replaced when significant discoloration has occurred. Performance may be impacted when maximum sediment storage capacity is exceeded. Contech recommends maintaining the system when sediment level reaches 50% of maximum storage volume. The level of sediment is easily determined by measuring the distance from the system outlet invert (standing water level) to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the chart in this document to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage.

## Cleaning

Cleaning of a Cascade Separator system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole cover and insert the vacuum tube down through the center chamber and into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The areas outside the center chamber and the slanted skirt should also be washed off if pollutant build-up exists in these areas.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. Then the system should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and to ensure proper safety precautions. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the Cascade Separator system must be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal. If any components are damaged, replacement parts can be ordered from the manufacturer.



## Cascade Separator® Maintenance Indicators and Sediment Storage Capacities

Model Number	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y <sup>3</sup>	m <sup>3</sup>
CS-3	3	0.9	1.5	0.5	0.4	0.3
CS-4	4	1.2	2.5	0.8	0.7	0.5
CS-5	5	1.3	3	0.9	1.1	0.8
CS-6	6	1.8	3.5	1	1.6	1.2
CS-8	8	2.4	4.8	1.4	2.8	2.1
CS-10	10	3.0	6.2	1.9	4.4	3.3
CS-12	12	3.6	7.5	2.3	6.3	4.8

Note: The information in the chart is for standard units. Units may have been designed with non-standard sediment storage depth.



A Cascade Separator unit can be easily cleaned in less than 30 minutes.



A vacuum truck excavates pollutants from the systems.

