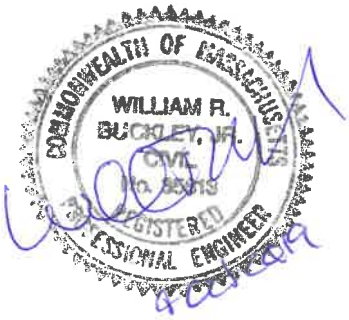
Bay Colony Group, Inc.
Professional Civil Engineers & Land Surveyors

4 School Street, PO Box 9136
Foxborough, Massachusetts 02035
Telephone (508) 543-3939 • Fax (508) 543-8866
E-mail: mailbox@baycolonygroup.com

# Storm Water Analysis and Management Plan
# 40 School Street/21 Market Street
# Foxborough, MA

**October, 2019**




Prepared for:

Douglas A. King Builders, Inc.
115 Main Street, Suite 1D
North Easton, MA 02356

**Table of Contents:**

## 1.0 Introduction

The project involves the redevelopment of the property listed as 40 School Street and 21 Market Street in Foxborough, MA. The site currently contains an abandoned fire station and funeral home. The project involves the redevelopment of the fire station into a brew pub w/ residences on the second floor. The funeral home will be torn down and a 4 story 15 residence building will be constructed. An 11 car parking lot will be constructed in the rear of the fire station where vehicle bays are currently located. The property is bordered by residences to the south on the opposite side of Market Street, a church to the west, and a commercial building to the east. The surface hydrology of the land has all drainage flowing from the site through a combination of roof drains and overland flow to drains at the intersection of Market Street and Rockhill Street. That point is the study point for the project.

Bay Colony Group, Inc. conducted a study of flood control and storm water management to ensure that the proposed project meet the ten MA DEP Stormwater Management Standards, the storm water standards outlined in the Town of Foxborough Zoning Bylaws, and standard engineering practice. The scope of this study includes:

- Determining existing flood conditions and storm water quality calculations and analysis;
- Developing proposed flood conditions and storm water quality calculations and analysis;
- Designing a storm water management system.

## 2.0 Existing Conditions

The project area lies on a hillside that slopes from northeast to the southwest. All runoff goes into a drain system that eventually ends up in 2 catch basins and a drain manhole at the Market Street/Rockhill Street intersection. The roof runoff from the flat roof of the fire station appears to connect to a drain manhole in Rockhill Street near the intersection of School Street and the remainder of the site sheet flows to either School Street or Rockhill Street or Market Street which all end up in the 2 catch basins or drain manhole at the Rockhill Street/Market Street intersection The high point is at School Street at about elevation 307' and the low point is at the Market Street/Rockhill Street intersection at about elevation 291'. The NRCS has logged the soils as Urban Land. Because the site is covered by buildings we are unable to do soil testing to determine the actual soil classification. Therefore, we have assumed no infiltration on the site. Soil borings were done in February 2017 when the new sewer main was installed on Rockhill Street and we have used that data to assume that the ground water is about 8.5' below grade **Appendix D.** There is very little vegetation on the site, mostly grass, and that has not been maintained for years. The impervious lot coverage is currently 82%.

## 3.0 Flood Condition Analyses and Flood Control

The storm water management system will consist of roof drainage, driveway and parking lot drainage (runoff collection, pretreatment, and conveyance) and flood control and treatment. This report will concentrate on the storm water basin design, the ten DEP stormwater management standards and the Town of Foxborough performance standards. Because this is a redevelopment project Standard 7 Redevelopment Projects of the DEP Stormwater Standards requires following standards to be met to the maximum extent practical: Standard 2, Standard 3, and the pretreatment and structural stormwater BMPs of Standards 4, 5, and 6. It shall comply with all other requirements and improve existing conditions.

The current land uses are buildings, parking lots, and landscaping and the proposed land uses are the same. The land uses for existing and proposed conditions are summarized in **Tables 1a** and **1b**. All of the existing flow is modeled as sheet flow with one subarea since all runoff ends up in the DMH a the intersection of Market Street/Rockhill Street. There is no flow on to the property from off the property so only on-site activities are modeled. Because the site is so small a Tc of 10 minutes is assumed for all conditions **Sheets 2 & 3 Civil Drawings.**

**Table 1a – Summary of Existing Land Uses**

| Subarea | Total Area (acres) | Land use | Area (acres) |
|---|---|---|---|
| EA | 0.45 | Roofs, HSG C | 0.19 |
| | | Paved parking, HSG C | 0.18 |
| | | 50-75% Grass cover, fair, HSG C | 0.08 |
| Total: | 0.45 | Total: | 0.45 |

For proposed conditions the watershed is broken into 2 subareas since a subsurface basin will be used to capture and detain roof runoff from all of the brew pub, about 2/3 of the residences building, and the surface parking lot. No infiltration will be assumed in the basin for the inflow/outflow analysis since we are unable to determine the soil conditions at this time and this is a conservative assumption. For the basin empty time analysis we are assuming a class C soil SILT LOAM and an infiltration rate of 0.27 in/hour which, based on my knowledge of the area, is a conservative assumption since the land to the west is largely a SANDY LOAM.

**Table 1b – Summary of Proposed Land Uses**

| Subarea | Total Area (acres) | Land use | Area (acres) |
|---|---|---|---|
| Roof/ Parking | 0.29 | Roofs, HSG C | 0.19 |
| | | Paved parking, HSG C | 0.10 |
| | | | |
| A | 0.16 | Roofs, HSG C | 0.05 |
| | | Paved parking, HSG C | 0.04 |
| | | >75% Grass cover, good, HSG C | 0.08 |
| Total: | 0.45 | Total: | 0.45 |

The flood conditions based on the land uses in **Tables 1a** and **1b** are summarized in **Table 2** and detailed calculations can be found in **APPENDIX A**. The CN is slightly lower for the developed condition. The roof runoff from the fire station and about 2/3 of the residence building are piped directly into the subsurface basin under the parking lot. The runoff from the parking lot will go through a catch basin with a Stormceptor 450i unit that will clean the runoff to better than 80% before discharge into the basin. The basin will have an overflow into the existing storm drain on Rockhill Street that drains to the Market Street/Rockhill Street study point. Sheet flow from the remaining 1/3 of the roof and driveway of the residence building as well as the Brewpub patio will sheet flow to the street and eventually into the catch basins at Market Street/Rockhill Street. Those catch basins will be rebuilt into deep sump catch basins with water quality hoods.

**Table 2: Summary of Peak Runoff (cfs) at the Study Point**

| Condition | | 2-year (cfs) | 10-year (cfs) | 100-year (cfs) |
|---|---|---|---|---|
| Existing Conditions | Market St/Rockhill St Intersection | 1.1 | 1.7 | 2.5 |
| Proposed Conditions | Market St/Rockhill St Intersection | 0.9 | 1.3 | 2.4 |

The detailed flood routing calculations are attached in **APPENDIX A**.

## 4.0 Stormwater Management

The site is not located in a groundwater recharge zone (Zone I, II, III), nor are there private drinking water wells around the project site. There are no other critical areas downgradient of the project site based on 314 CMR 4.00 (Massachusetts Surface Water Quality Standards). There are no certified vernal pools on the site. The DEP Stormwater Standards apply to this proposed project under the Town regulations and the project design is based on the latest edition of these documents.

***DEP STORMWATER MANAGEMENT STANDARDS***

***Standard #1: NO UNTREATED DISCHARGE OR EROSION TO WETLANDS***

The existing discharge currently discharges untreated storm water to the trunk drain on Rockhill Street. The new treatment train will achieve a TSS removal rate of 96%, with about 78% of the impervious area being treated by the treatment train which exceeds the DEP standard of 65%. This is an improvement over the existing condition which is the standard for redevelopment.

***Standard #2: PEAK RATE ATTENUATION***

Stormwater controls have been designed for 2, 10, and 100-year storms according to both state and local regulations. The post-development peak discharge rates with flood control do not exceed pre-development rates on the site at the downgradient discharge point. See **Table 2** for details.

***Standard #3: STORMWATER RECHARGE***

1) The proposed project is located on a plot with an unknown hydrologic class, but the soils in the area are rated as C soils by the NRCS and I agree based on my knowledge of the area. The target depth factor for a C soil is 0.25 inches and the RAWLs rate for a C soil SILT LOAM is 0.27 inches/hour which will be used in the drawdown calculation. The calculations for the recharge volume are located in **Appendix B**.

2) The infiltration BMPs that will be used will be the below-ground infiltration basin which will include a direct piping from the roofs to the maximum extent possible to the basins so that the water is "clean" once it gets there. The calculations for the recharge volume are located in **Appendix B**.

3) Using the RAWLS rate for SiL of 0.27 inches/hour reveals a drawdown time of 36 hours, which meets the required 72 hours dewatering standard **APPENDIX B**.

4) Capture area adjustment is necessary since not all of the infiltration will take place within the drainage basins. The access driveway to the residential building and the roof runoff from about 1/3 of that building will not have any infiltration. Those areas include about 22% of the impervious area on the site, which means that 78% of the site will be directed to the infiltration structure, which meets the 65% requirement.

5) A mounding analysis is not necessary because no infiltration is assumed under the system to attenuate the 10-year or higher storm event.

***Standard # 4: WATER QUALITY***

1) The required water quality volume is based on 0.37 acres of impervious area and 0.5 inch water quality depth, which yields a water quality volume of 672 cubic feet or 0.0153 acre-feet.
2) The BMPs used for the proposed project to enhance water quality include: deep sump catch basins, Stormceptors, and the subsurface basin. Runoff from the most of the roofs will be infiltrated through direct discharge to the subsurface basin. The estimated overall TSS removal will be greater than 85% - **see Table 3.**

**Table 3: Summary of TSS Removal**

| | | | | |
|---|---|---|---|---|
| **Impervious Area =** | | 0.37 acres | | |
| **Runoff depth to be treated =** | | 0.50 inches | | |
| **Runoff volume to be treated =** | | 0.0153 ac-ft | | |
| *BMP* | *TSS Removal Rate* | *Starting TSS Load* | *Amount Removed* | *Remaining Load* |
| Stormcepter STC450i | 0.8 | 1.00 | 0.8 | 0.20 |
| Infiltration Basin | 0.8 | 0.20 | 0.16 | 0.04 |
| **TOTAL TSS REMOVED =** | | | | **96 %** |

3) Because the subsurface basin is being used to fulfill the requirements of Standards 3 and 4 it must handle the larger of the water quality volumes. The basin has a Water Quality Volume of 0.0153 ac-ft and a storage volume 0.016 ac-ft. Therefore the standard is met. **APPENDIX B**

***Standard # 5: LAND USES WITH HIGHER POTENTIAL POLLUTION LOADS***

The site will consist of a typical commercial building and residential building use which is not considered to have a high potential pollutant load. The site will be compatible with the surrounding environment, which is a commercial zone and a residential area abutting a commercial zone.

***Standard #6: CRITICAL AREAS***

According to 314 CMR 14.400 and MASS GIS the project site does not contain any critical resource areas.

***Standard #7: REDEVELOPMENT***

Because this is a redevelopment project Standard 7 Redevelopment Projects of the DEP Stormwater Standards requires following standards to be met to the maximum extent practical: Standard 2, Standard 3, and the pretreatment and structural stormwater BMPs of Standards 4, 5, and 6. It shall comply with all other requirements and improve existing conditions. The project meets that criteria.

***Standard #8: CONSTRUCTION PERIOD CONTROLS***

Silt sock barriers will be installed in areas where runoff is expected to exit the site. A stone pad shall be spread at the entrance from Market Street to the project site to prevent mud from escaping the site during construction of the residential building. Erosion from the fire station site is expected to be minimal. Because of the size of the site it does not fall under the EPA Construction General Permit regulations or the Town's Stormwater Regulations. A SWPPP has been prepared for the project **Sheet 7.**

***Standard #9: OPERATION AND MAINTENANCE PLAN***

See **Appendix C** for details.

***Standard # 10: ILLICIT DISCHARGES TO DRAINAGE SYSTEM***

I certify to the best of my professional knowledge, information and belief that there are no illicit discharges to the stormwater management system, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease. The proposed systems as shown on the referenced plans do not allow entry of any illicit discharges into the system and there are no connections between the stormwater and wastewater management systems.

To be signed prior to construction
Douglas A. King

Date

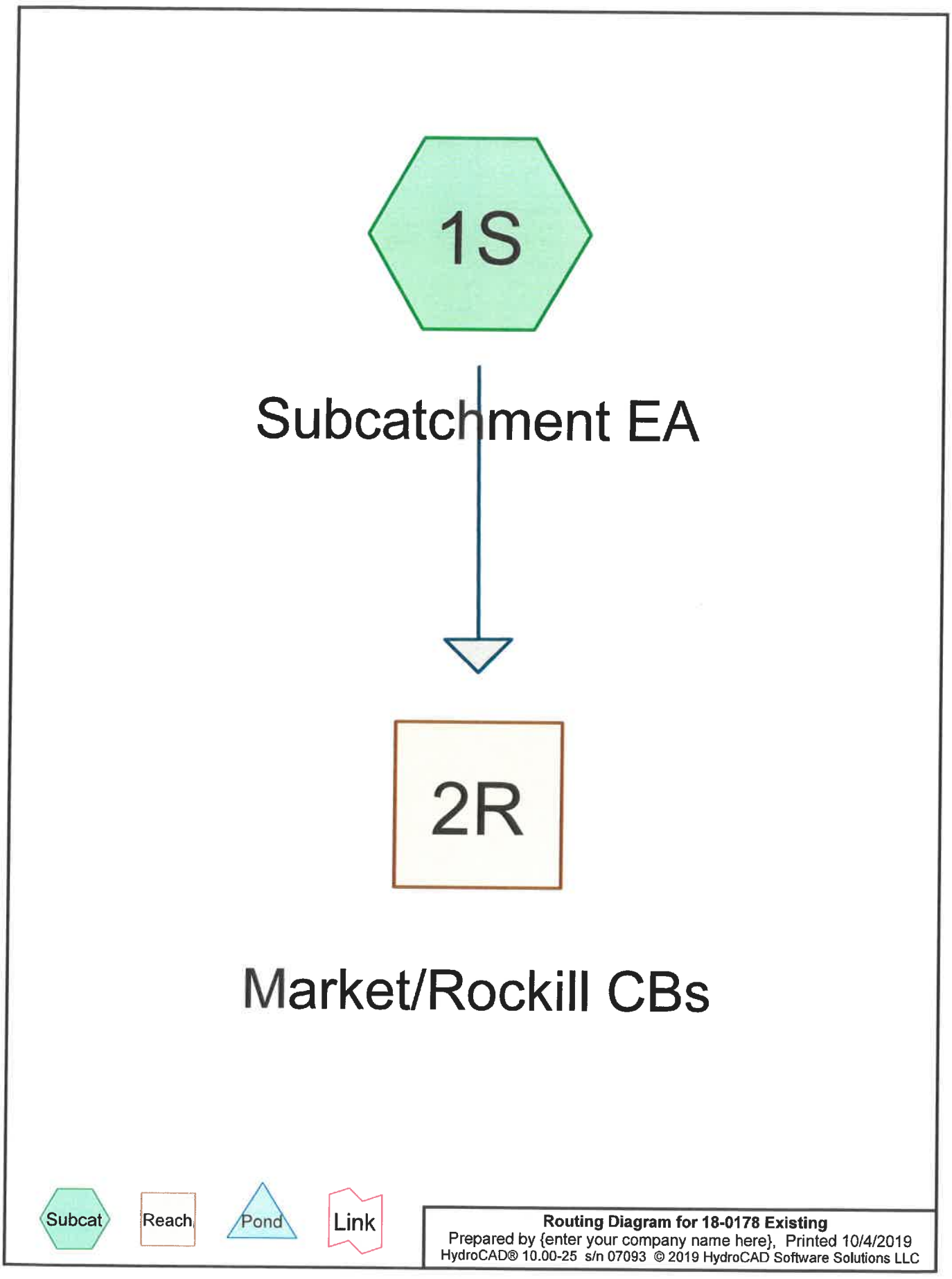
## 5.0 Town of Foxborough Performance Standards

**6.5.11.1 – Utilize Low Impact Development Methods** – The proposed drain system separately discharges roof runoff to a subsurface infiltration basin.

**6.5.11.2 – Detailed Drainage Design** – A detailed drainage design has been prepared in accordance with the DEP Stormwater Standards and a discussion on each of the required elements is provided within the report. The system has been designed to handle the 100-year storm event.

**6.5.11.3 – Post Development Drainage Rate Shall not Exceed Pre Development Rate** – The drain system utilizes an infiltration basin and grading design in order to ensure that the rate of runoff from the site is not increased due to the development **Table 2.**

# APPENDIX A – Pre- and Post-DEVELOPMENT ANALYSIS AND STORM WATER POND DESIGNS


1S
Subcatchment EA
2R
Market/Rockill CBs
Subcat
Reach
Pond
Link
Routing Diagram for 18-0178 Existing
Prepared by {enter your company name here}, Printed 10/4/2019
HydroCAD® 10.00-25 s/n 07093 © 2019 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 0.079 | 79 | 50-75% Grass cover, Fair, HSG C (1S) |
| 0.177 | 98 | Paved parking, HSG C (1S) |
| 0.190 | 98 | Roofs, HSG C (1S) |
| **0.446** | **95** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 0.446 | HSG C | 1S |
| 0.000 | HSG D | |
| 0.000 | Other | |
| **0.446** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.079 | 0.000 | 0.000 | 0.079 | 50-75% Grass cover, Fair | 1S |
| 0.000 | 0.000 | 0.177 | 0.000 | 0.000 | 0.177 | Paved parking | 1S |
| 0.000 | 0.000 | 0.190 | 0.000 | 0.000 | 0.190 | Roofs | 1S |
| **0.000** | **0.000** | **0.446** | **0.000** | **0.000** | **0.446** | **TOTAL AREA** | |

## Summary for Subcatchment 1S: Subcatchment EA

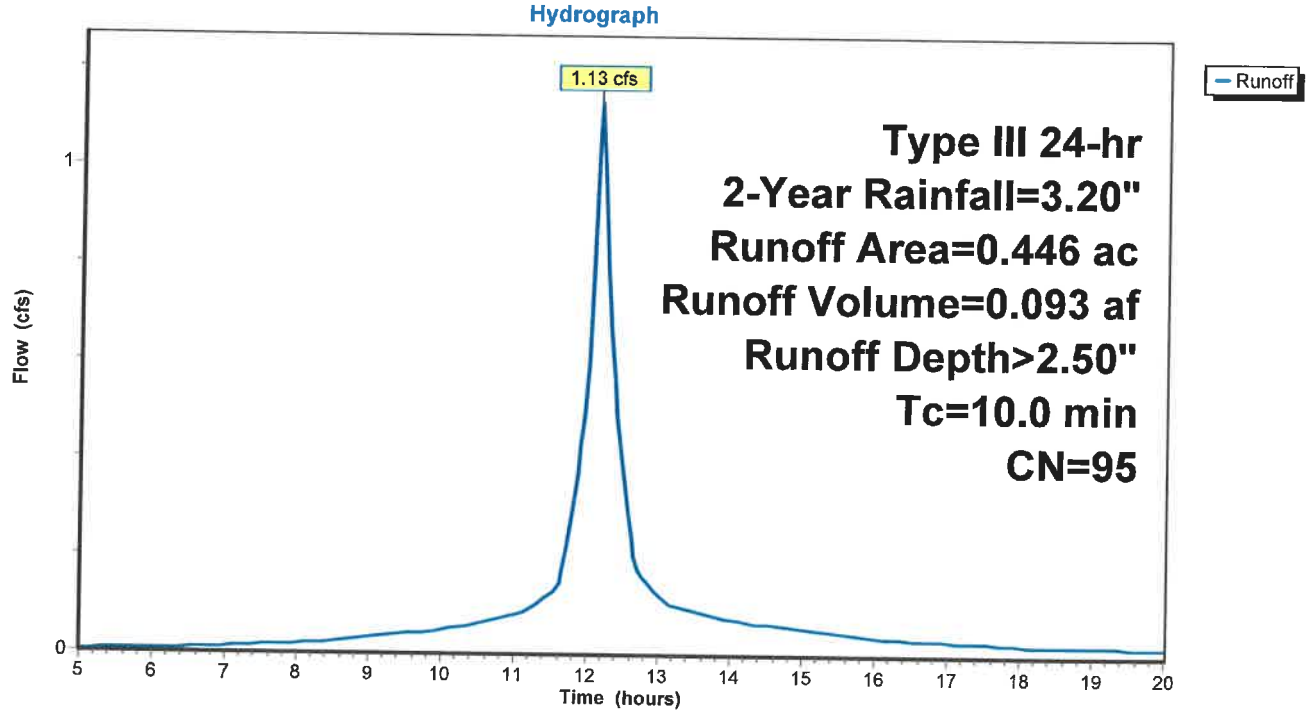
Runoff = 1.13 cfs @ 12.14 hrs, Volume= 0.093 af, Depth> 2.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

| Area (ac) | CN | Description |
|---|---|---|
| 0.190 | 98 | Roofs, HSG C |
| 0.177 | 98 | Paved parking, HSG C |
| 0.079 | 79 | 50-75% Grass cover, Fair, HSG C |
| 0.446 | 95 | Weighted Average |
| 0.079 | | 17.71% Pervious Area |
| 0.367 | | 82.29% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | Direct Entry, |

## Subcatchment 1S: Subcatchment EA



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Subcatchment EA** Runoff Area=0.446 ac 82.29% Impervious Runoff Depth>2.50"
Tc=10.0 min CN=95 Runoff=1.13 cfs 0.093 af

**Reach 2R: Market/Rockill CBs** Inflow=1.13 cfs 0.093 af
Outflow=1.13 cfs 0.093 af

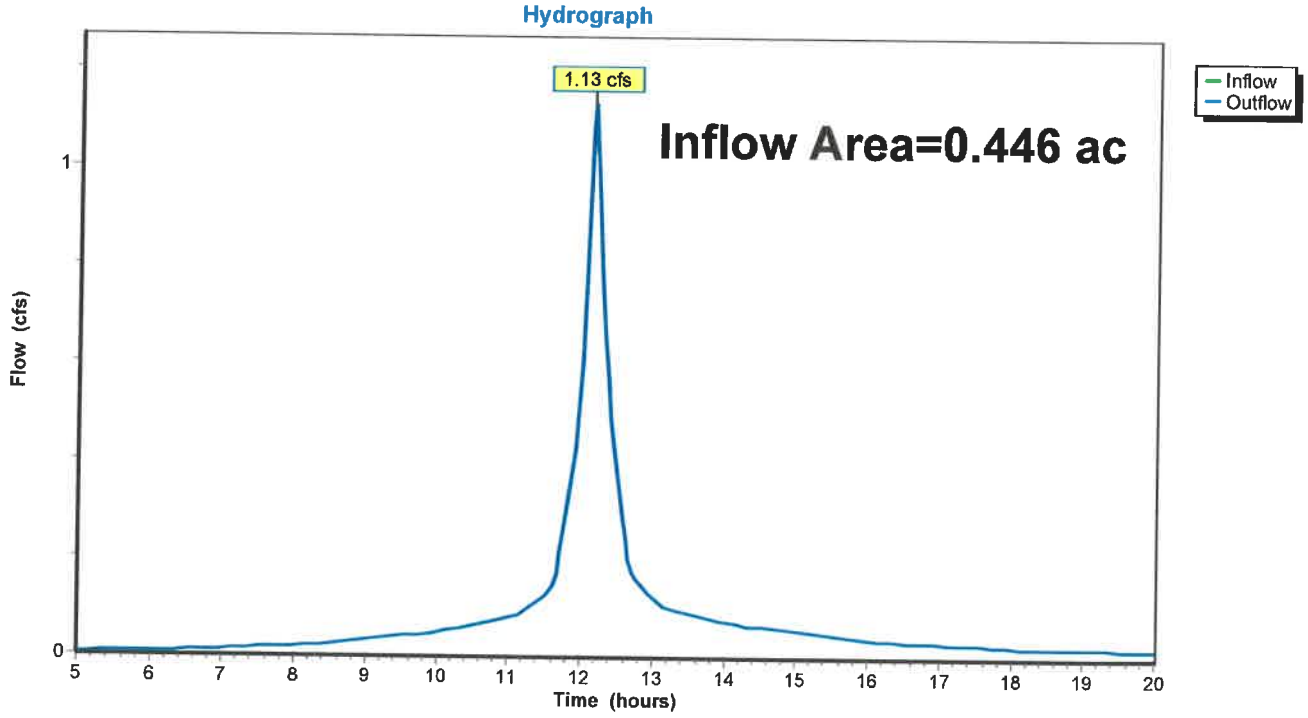
**Total Runoff Area = 0.446 ac Runoff Volume = 0.093 af Average Runoff Depth = 2.50"**
**17.71% Pervious = 0.079 ac 82.29% Impervious = 0.367 ac**

## Summary for Reach 2R: Market/Rockill CBs

Inflow Area = 0.446 ac, 82.29% Impervious, Inflow Depth > 2.50" for 2-Year event
Inflow = 1.13 cfs @ 12.14 hrs, Volume= 0.093 af
Outflow = 1.13 cfs @ 12.14 hrs, Volume= 0.093 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

## Reach 2R: Market/Rockill CBs



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Subcatchment EA** Runoff Area=0.446 ac 82.29% Impervious Runoff Depth>3.88"
Tc=10.0 min CN=95 Runoff=1.72 cfs 0.144 af

**Reach 2R: Market/Rockill CBs** Inflow=1.72 cfs 0.144 af
Outflow=1.72 cfs 0.144 af

**Total Runoff Area = 0.446 ac Runoff Volume = 0.144 af Average Runoff Depth = 3.88"**
**17.71% Pervious = 0.079 ac 82.29% Impervious = 0.367 ac**

## Summary for Subcatchment 1S: Subcatchment EA

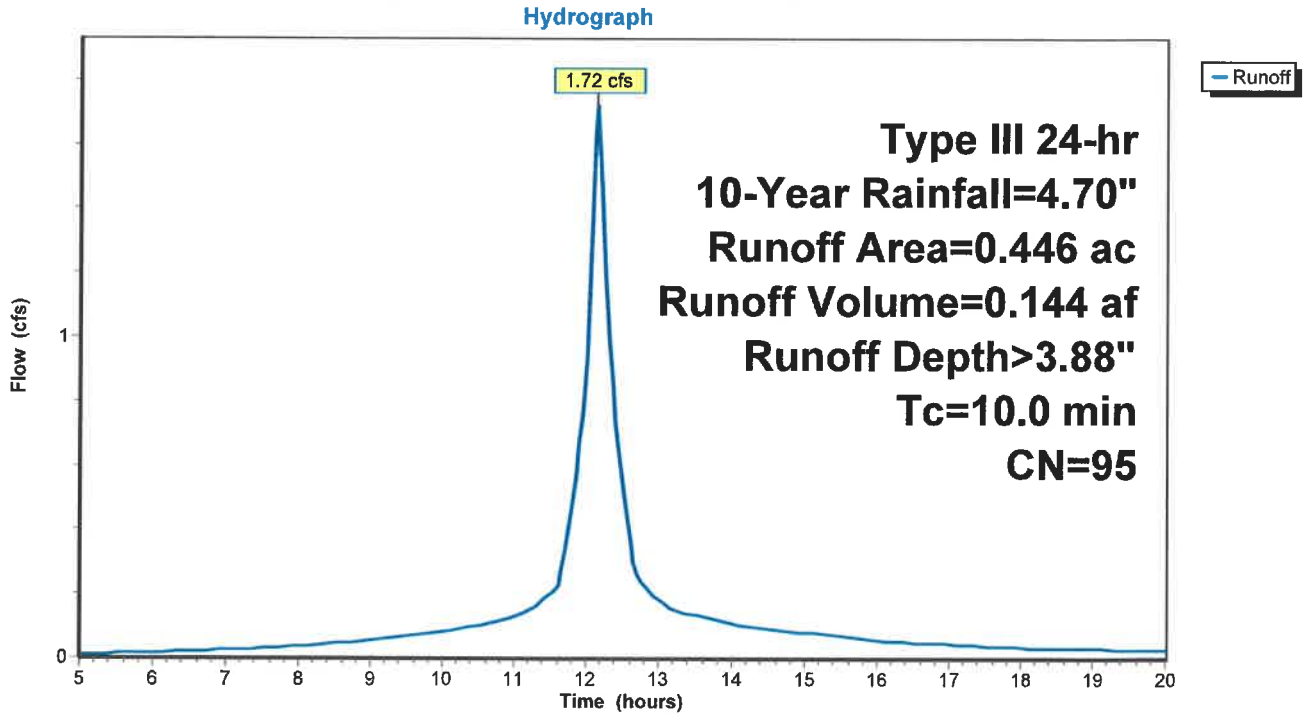
Runoff = 1.72 cfs @ 12.14 hrs, Volume= 0.144 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.70"

| Area (ac) | CN | Description |
|---|---|---|
| 0.190 | 98 | Roofs, HSG C |
| 0.177 | 98 | Paved parking, HSG C |
| 0.079 | 79 | 50-75% Grass cover, Fair, HSG C |
| 0.446 | 95 | Weighted Average |
| 0.079 | | 17.71% Pervious Area |
| 0.367 | | 82.29% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment 1S: Subcatchment EA

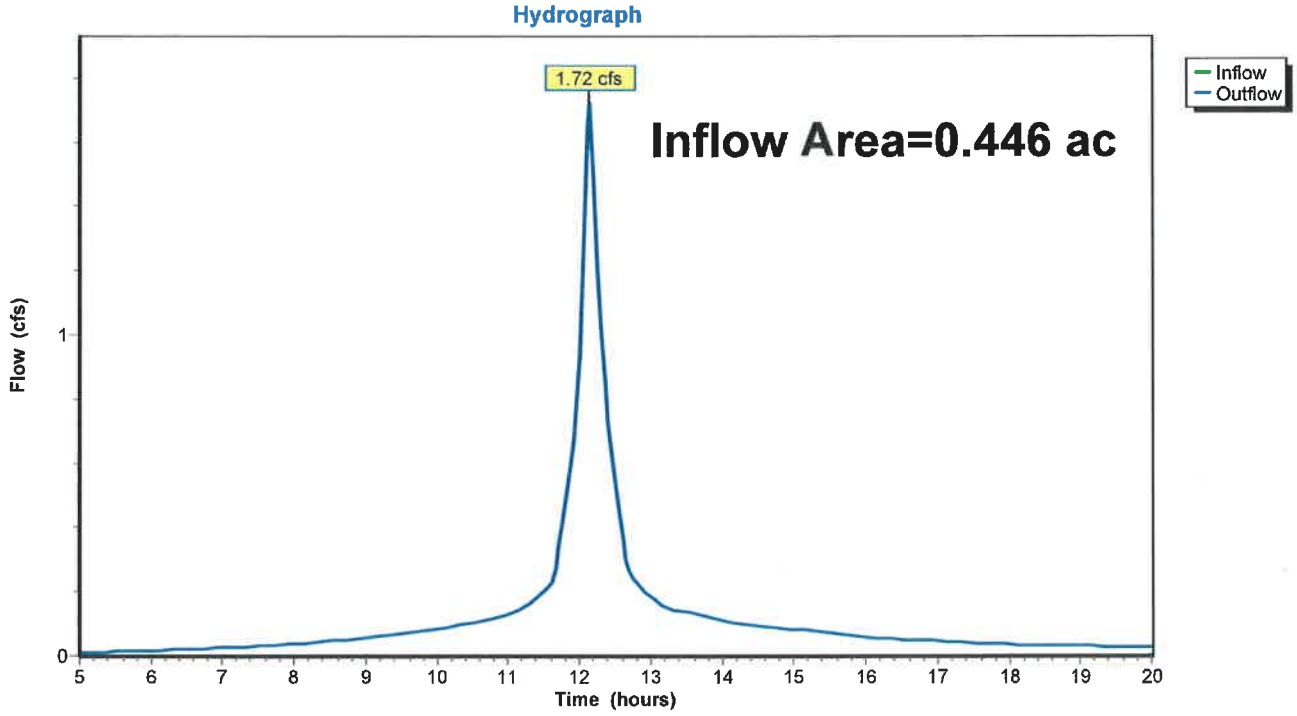


## Summary for Reach 2R: Market/Rockill CBs

Inflow Area = 0.446 ac, 82.29% Impervious, Inflow Depth > 3.88" for 10-Year event
Inflow = 1.72 cfs @ 12.14 hrs, Volume= 0.144 af
Outflow = 1.72 cfs @ 12.14 hrs, Volume= 0.144 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

## Reach 2R: Market/Rockill CBs



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Subcatchment EA** Runoff Area=0.446 ac 82.29% Impervious Runoff Depth>5.72"
Tc=10.0 min CN=95 Runoff=2.49 cfs 0.213 af

**Reach 2R: Market/Rockill CBs** Inflow=2.49 cfs 0.213 af
Outflow=2.49 cfs 0.213 af

**Total Runoff Area = 0.446 ac Runoff Volume = 0.213 af Average Runoff Depth = 5.72"**
**17.71% Pervious = 0.079 ac 82.29% Impervious = 0.367 ac**

## Summary for Subcatchment 1S: Subcatchment EA

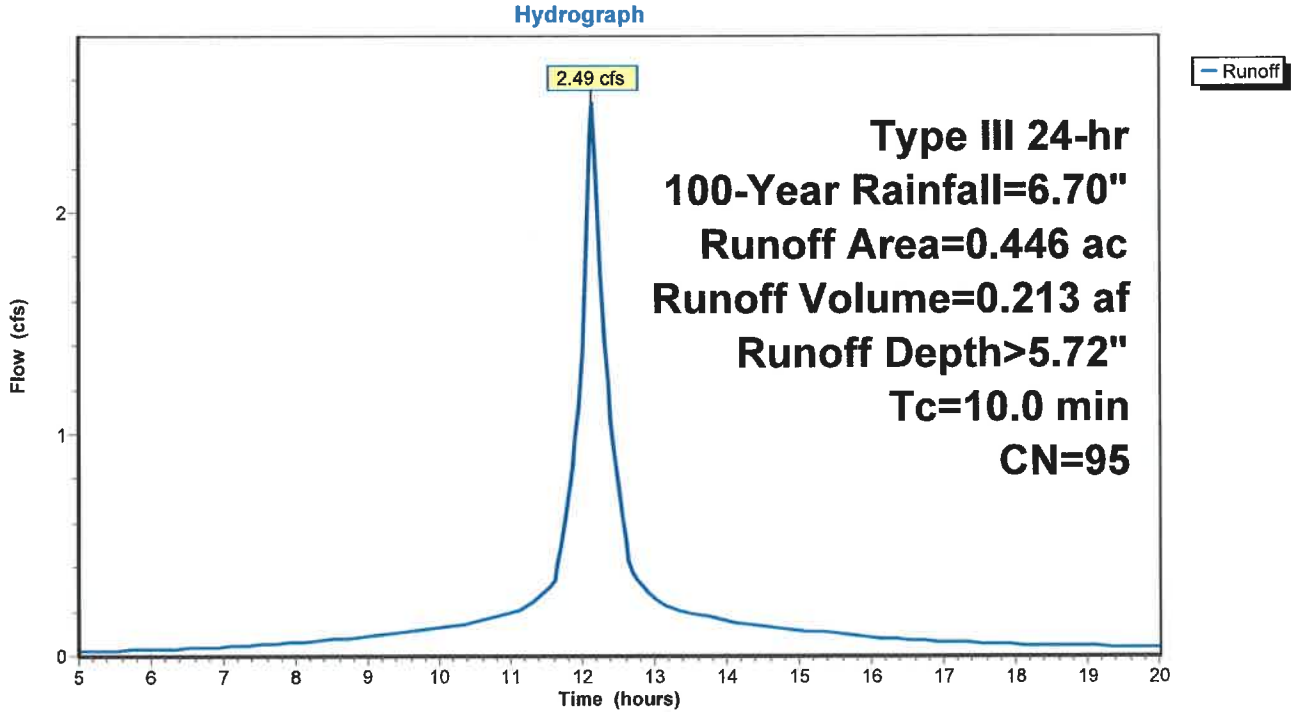
Runoff = 2.49 cfs @ 12.14 hrs, Volume= 0.213 af, Depth> 5.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.70"

| Area (ac) | CN | Description |
|---|---|---|
| 0.190 | 98 | Roofs, HSG C |
| 0.177 | 98 | Paved parking, HSG C |
| 0.079 | 79 | 50-75% Grass cover, Fair, HSG C |
| 0.446 | 95 | Weighted Average |
| 0.079 | | 17.71% Pervious Area |
| 0.367 | | 82.29% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment 1S: Subcatchment EA

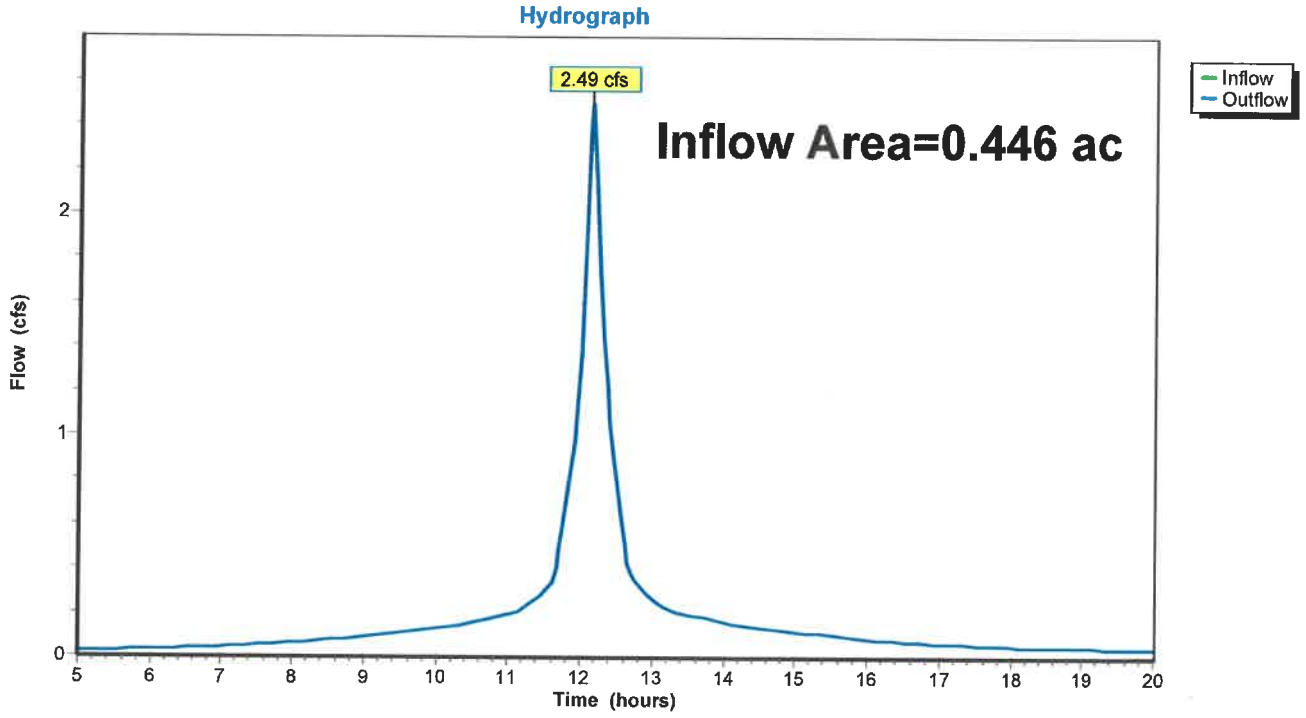


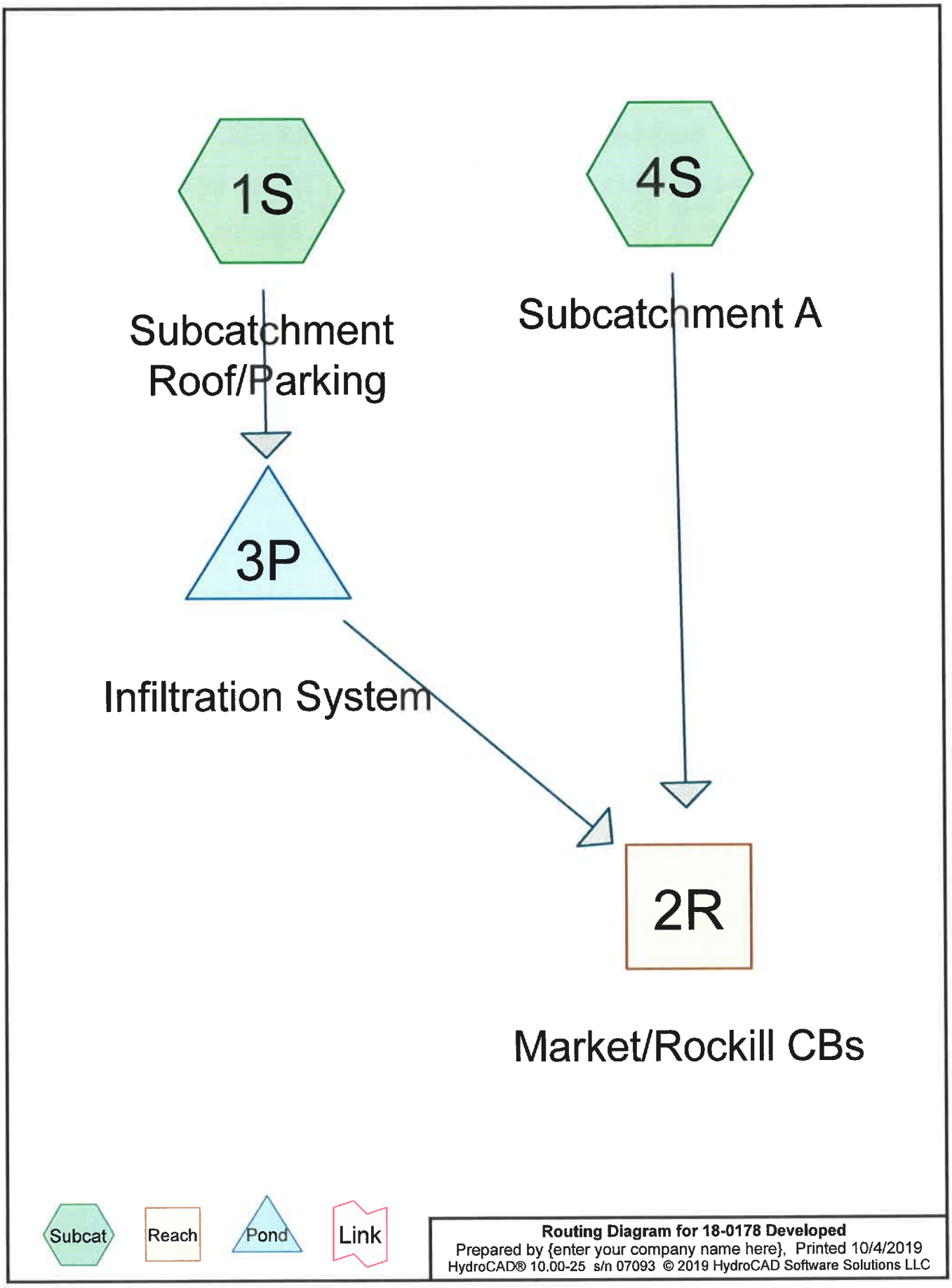
## Summary for Reach 2R: Market/Rockill CBs

Inflow Area = 0.446 ac, 82.29% Impervious, Inflow Depth > 5.72" for 100-Year event
Inflow = 2.49 cfs @ 12.14 hrs, Volume= 0.213 af
Outflow = 2.49 cfs @ 12.14 hrs, Volume= 0.213 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

## Reach 2R: Market/Rockill CBs




1S
4S
Subcatchment
Roof/Parking
Subcatchment A
3P
Infiltration System
2R
Market/Rockill CBs
Subcat
Reach
Pond
Link
Routing Diagram for 18-0178 Developed
Prepared by {enter your company name here}, Printed 10/4/2019
HydroCAD® 10.00-25 s/n 07093 © 2019 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 0.079 | 74 | >75% Grass cover, Good, HSG C (4S) |
| 0.135 | 98 | Paved parking, HSG C (1S, 4S) |
| 0.232 | 98 | Roofs, HSG C (1S, 4S) |
| **0.446** | **94** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 0.446 | HSG C | 1S, 4S |
| 0.000 | HSG D | |
| 0.000 | Other | |
| **0.446** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 0.079 | 0.000 | 0.000 | 0.079 | >75% Grass cover, Good | 4S |
| 0.000 | 0.000 | 0.135 | 0.000 | 0.000 | 0.135 | Paved parking | 1S, 4S |
| 0.000 | 0.000 | 0.232 | 0.000 | 0.000 | 0.232 | Roofs | 1S, 4S |
| **0.000** | **0.000** | **0.446** | **0.000** | **0.000** | **0.446** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3P | 295.50 | 292.80 | 31.0 | 0.0871 | 0.013 | 6.0 | 0.0 | 0.0 |

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Subcatchment** Runoff Area=0.285 ac 100.00% Impervious Runoff Depth>2.77"
Tc=10.0 min CN=98 Runoff=0.77 cfs 0.066 af

**Subcatchment4S: SubcatchmentA** Runoff Area=0.161 ac 50.93% Impervious Runoff Depth>1.71"
Tc=10.0 min CN=86 Runoff=0.30 cfs 0.023 af

**Reach 2R: Market/Rockill CBs** Inflow=0.89 cfs 0.084 af
Outflow=0.89 cfs 0.084 af

**Pond 3P: Infiltration System** Peak Elev=296.31' Storage=0.010 af Inflow=0.77 cfs 0.066 af
6.0" Round Culvert n=0.013 L=31.0' S=0.0871 '/' Outflow=0.62 cfs 0.061 af

**Total Runoff Area = 0.446 ac Runoff Volume = 0.089 af Average Runoff Depth = 2.39"**
**17.71% Pervious = 0.079 ac 82.29% Impervious = 0.367 ac**

## Summary for Subcatchment 1S: Subcatchment Roof/Parking

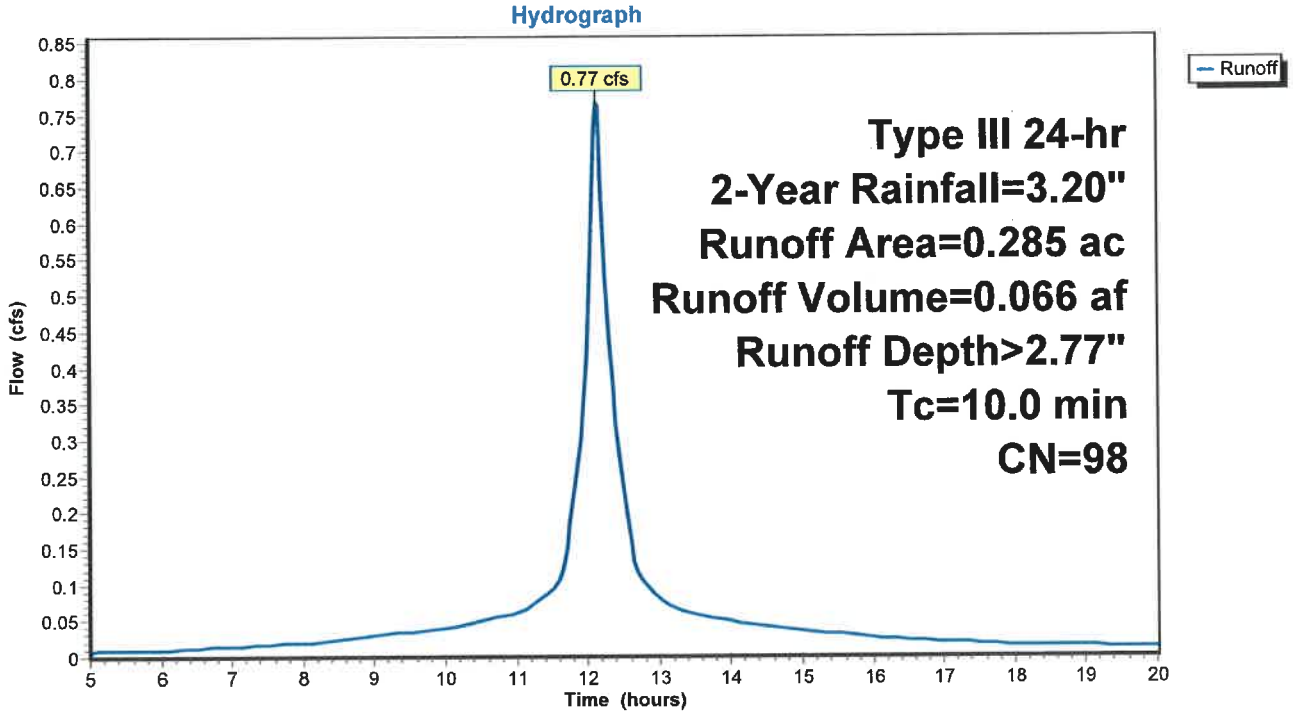
Runoff = 0.77 cfs @ 12.14 hrs, Volume= 0.066 af, Depth> 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

| Area (ac) | CN | Description |
|---|---|---|
| 0.187 | 98 | Roofs, HSG C |
| 0.098 | 98 | Paved parking, HSG C |
| 0.285 | 98 | Weighted Average |
| 0.285 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment 1S: Subcatchment Roof/Parking



## Summary for Subcatchment 4S: Subcatchment A

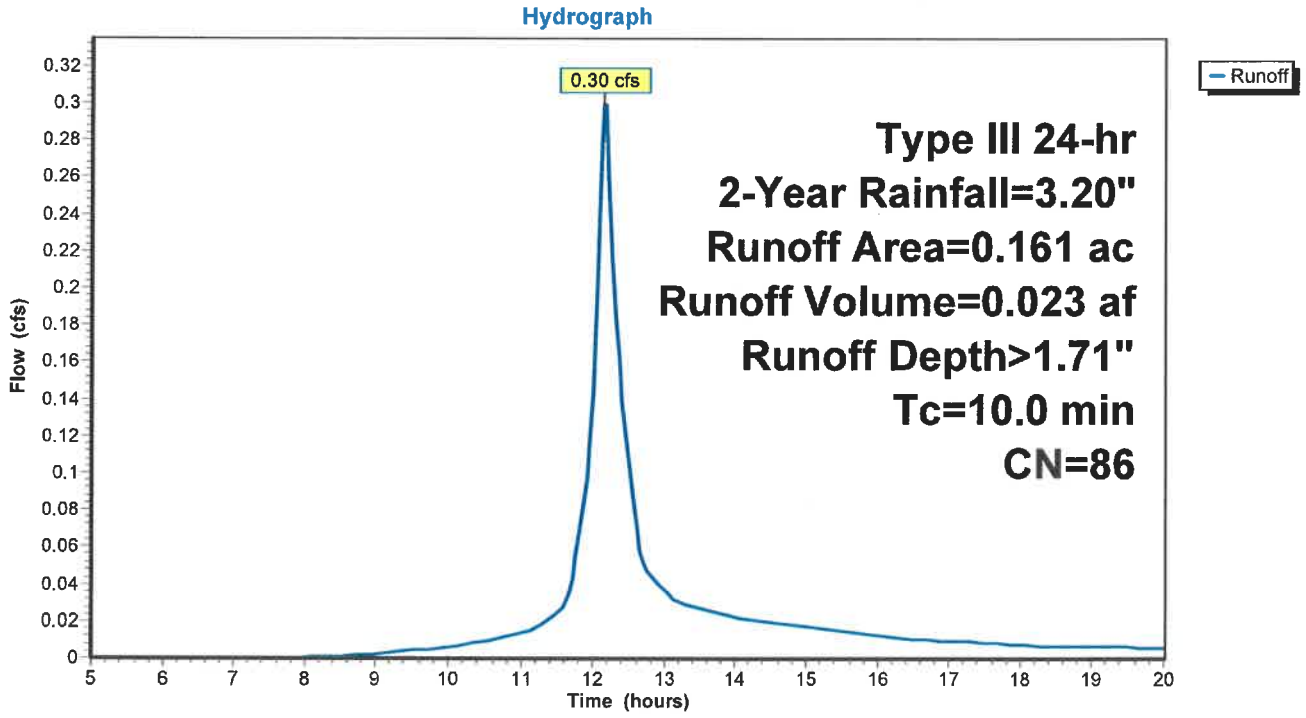
Runoff = 0.30 cfs @ 12.14 hrs, Volume= 0.023 af, Depth> 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

| Area (ac) | CN | Description |
|---|---|---|
| 0.045 | 98 | Roofs, HSG C |
| 0.037 | 98 | Paved parking, HSG C |
| 0.079 | 74 | >75% Grass cover, Good, HSG C |
| 0.161 | 86 | Weighted Average |
| 0.079 | | 49.07% Pervious Area |
| 0.082 | | 50.93% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment 4S: Subcatchment A

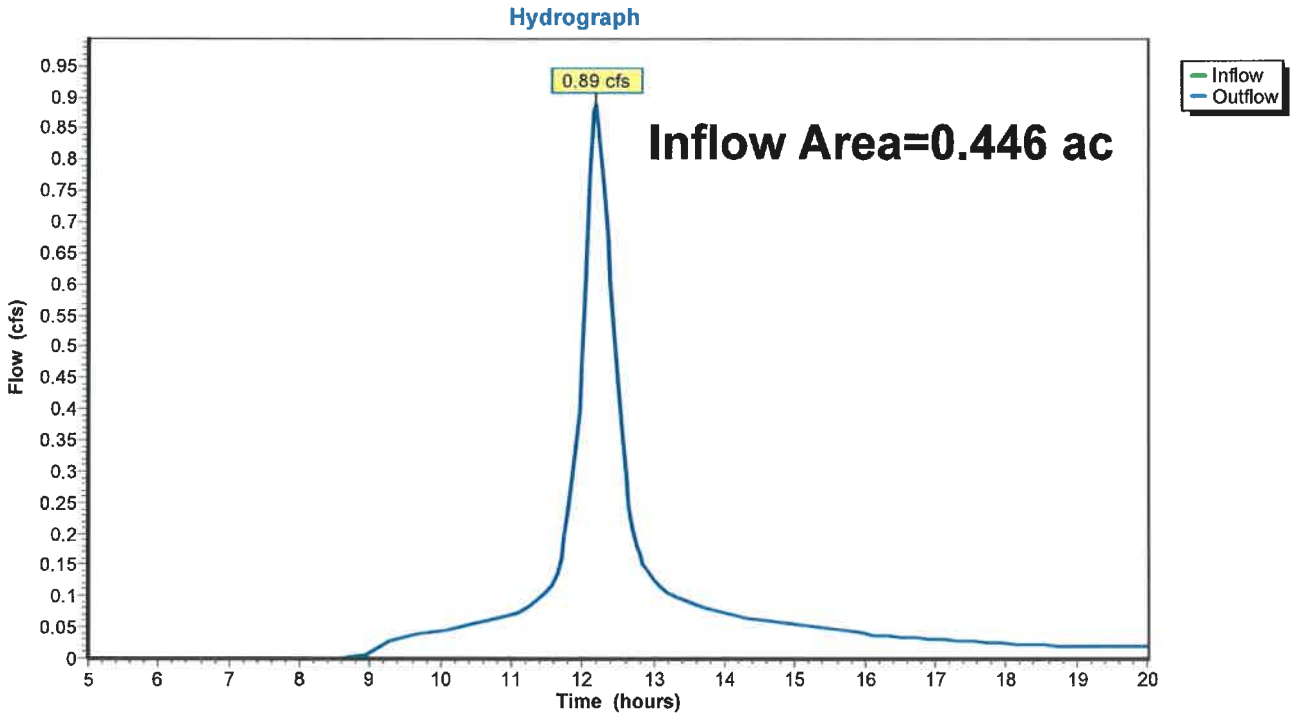


## Summary for Reach 2R: Market/Rockill CBs

Inflow Area = 0.446 ac, 82.29% Impervious, Inflow Depth > 2.25" for 2-Year event
Inflow = 0.89 cfs @ 12.18 hrs, Volume= 0.084 af
Outflow = 0.89 cfs @ 12.18 hrs, Volume= 0.084 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

## Reach 2R: Market/Rockill CBs



## Summary for Pond 3P: Infiltration System

Inflow Area = 0.285 ac,100.00% Impervious, Inflow Depth > 2.77" for 2-Year event
Inflow = 0.77 cfs @ 12.14 hrs, Volume= 0.066 af
Outflow = 0.62 cfs @ 12.22 hrs, Volume= 0.061 af, Atten= 19%, Lag= 4.8 min
Primary = 0.62 cfs @ 12.22 hrs, Volume= 0.061 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 296.31' @ 12.22 hrs Surf.Area= 0.009 ac Storage= 0.010 af

Plug-Flow detention time= 60.1 min calculated for 0.060 af (92% of inflow)
Center-of-Mass det. time= 31.9 min ( 773.5 - 741.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 294.53' | 0.008 af | **18.33'W x 22.32'L x 2.88'H Field A**<br>0.027 af Overall - 0.008 af Embedded = 0.019 af x 40.0% Voids |
| #2A | 295.20' | 0.008 af | **Cultec R-180** x 15 Inside #1<br>Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf<br>Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap<br>Row Length Adjustment= +1.00' x 3.44 sf x 5 rows |
| #3 | 295.38' | 0.000 af | **0.50'D x 4.60'H Vertical Cone/Cylinder** |
| | | 0.016 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 295.50' | **6.0" Round Culvert**<br>L= 31.0' CPP, mitered to conform to fill, Ke= 0.700<br>Inlet / Outlet Invert= 295.50' / 292.80' S= 0.0871 '/' Cc= 0.900<br>n= 0.013, Flow Area= 0.20 sf |

**Primary OutFlow** Max=0.62 cfs @ 12.22 hrs HW=296.30' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.62 cfs @ 3.14 fps)

## Pond 3P: Infiltration System - Chamber Wizard Field A

**Chamber Model = Cultec R-180 (Cultec Recharger® 180HD)**
Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf
Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 3.44 sf x 5 rows

36.0" Wide + 3.0" Spacing = 39.0" C-C Row Spacing

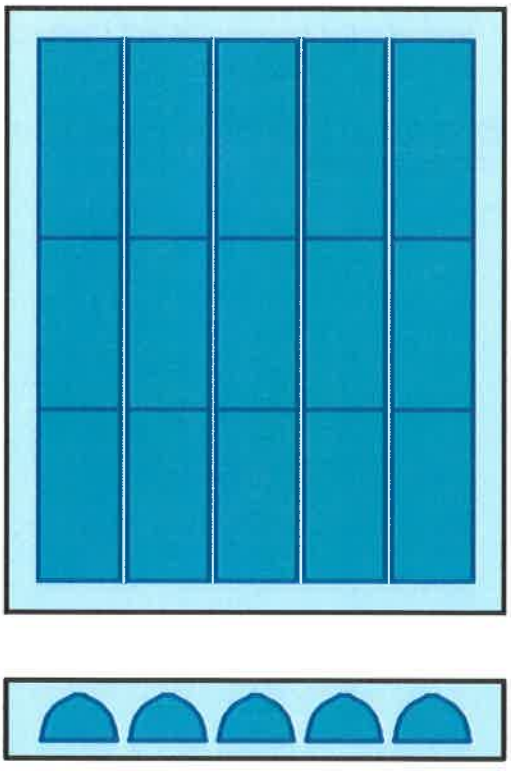
3 Chambers/Row x 6.33' Long +1.00' Row Adjustment = 19.99' Row Length +14.0" End Stone x 2 = 22.32' Base Length
5 Rows x 36.0" Wide + 3.0" Spacing x 4 + 14.0" Side Stone x 2 = 18.33' Base Width
8.0" Base + 20.5" Chamber Height + 6.0" Cover = 2.88' Field Height

15 Chambers x 21.8 cf +1.00' Row Adjustment x 3.44 sf x 5 Rows = 343.8 cf Chamber Storage

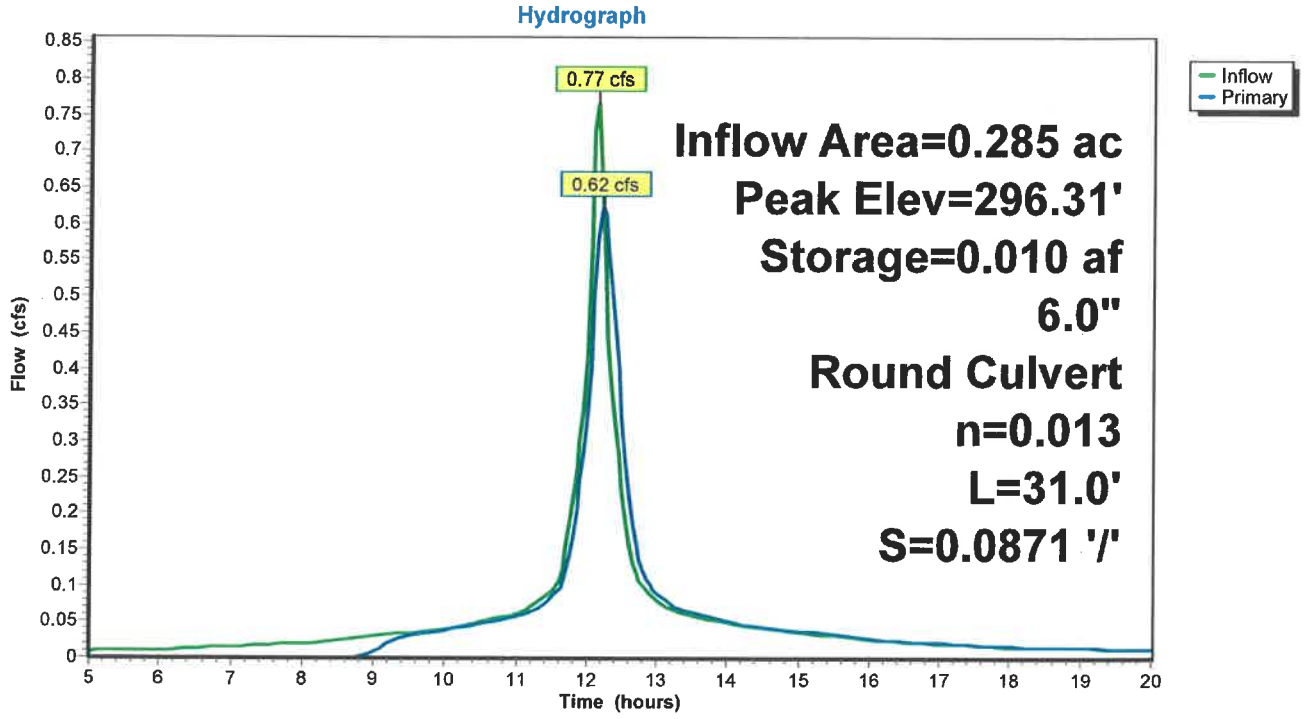
1,176.6 cf Field - 343.8 cf Chambers = 832.8 cf Stone x 40.0% Voids = 333.1 cf Stone Storage

Chamber Storage + Stone Storage = 676.9 cf = 0.016 af
Overall Storage Efficiency = 57.5%
Overall System Size = 22.32' x 18.33' x 2.88'

15 Chambers
43.6 cy Field
30.8 cy Stone



## Pond 3P: Infiltration System



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Subcatchment** Runoff Area=0.285 ac 100.00% Impervious Runoff Depth>4.14"
Tc=10.0 min CN=98 Runoff=1.13 cfs 0.098 af

**Subcatchment4S: SubcatchmentA** Runoff Area=0.161 ac 50.93% Impervious Runoff Depth>2.99"
Tc=10.0 min CN=86 Runoff=0.51 cfs 0.040 af

**Reach 2R: Market/Rockill CBs** Inflow=1.33 cfs 0.133 af
Outflow=1.33 cfs 0.133 af

**Pond 3P: Infiltration System** Peak Elev=296.88' Storage=0.014 af Inflow=1.13 cfs 0.098 af
6.0" Round Culvert n=0.013 L=31.0' S=0.0871 '/' Outflow=0.89 cfs 0.093 af

**Total Runoff Area = 0.446 ac Runoff Volume = 0.139 af Average Runoff Depth = 3.73"**
**17.71% Pervious = 0.079 ac 82.29% Impervious = 0.367 ac**

## Summary for Subcatchment 1S: Subcatchment Roof/Parking

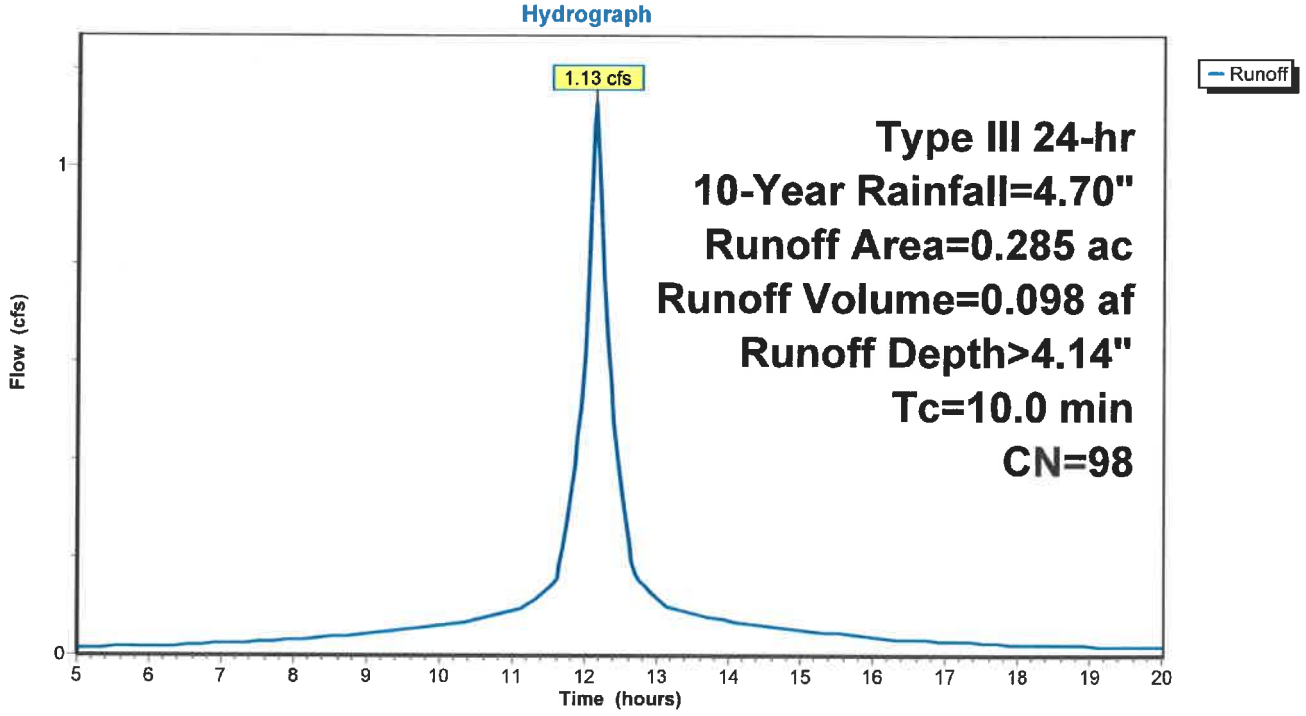
Runoff = 1.13 cfs @ 12.14 hrs, Volume= 0.098 af, Depth> 4.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.70"

| Area (ac) | CN | Description |
|---|---|---|
| 0.187 | 98 | Roofs, HSG C |
| 0.098 | 98 | Paved parking, HSG C |
| 0.285 | 98 | Weighted Average |
| 0.285 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment 1S: Subcatchment Roof/Parking



## Summary for Subcatchment 4S: Subcatchment A

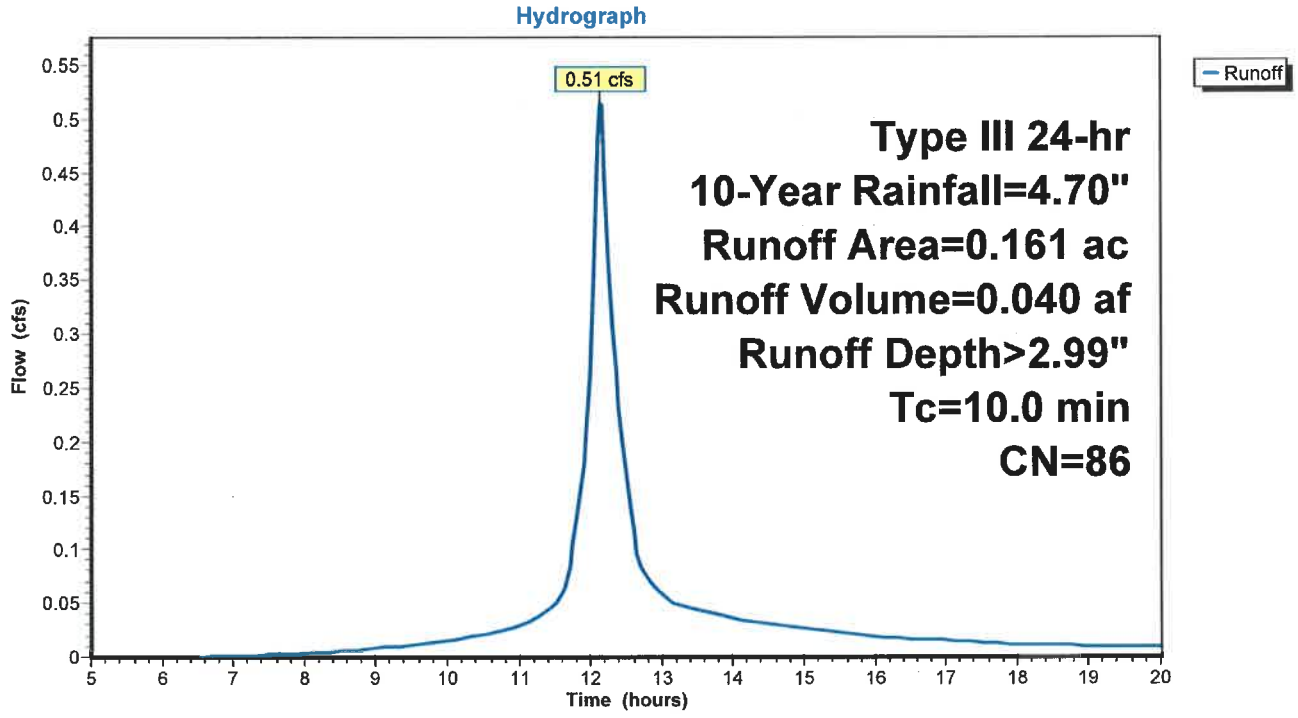
Runoff = 0.51 cfs @ 12.14 hrs, Volume= 0.040 af, Depth> 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.70"

| Area (ac) | CN | Description |
|---|---|---|
| 0.045 | 98 | Roofs, HSG C |
| 0.037 | 98 | Paved parking, HSG C |
| 0.079 | 74 | >75% Grass cover, Good, HSG C |
| 0.161 | 86 | Weighted Average |
| 0.079 | | 49.07% Pervious Area |
| 0.082 | | 50.93% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment 4S: Subcatchment A

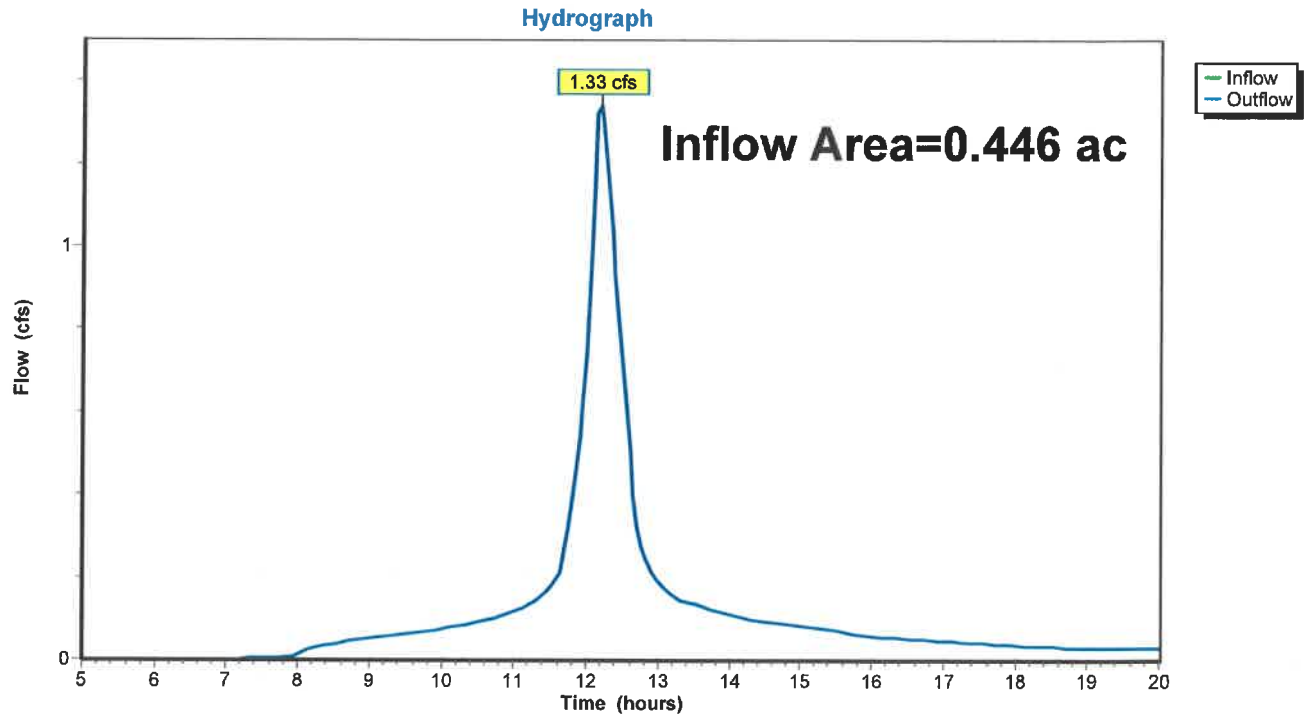


## Summary for Reach 2R: Market/Rockill CBs

Inflow Area = 0.446 ac, 82.29% Impervious, Inflow Depth > 3.58" for 10-Year event
Inflow = 1.33 cfs @ 12.18 hrs, Volume= 0.133 af
Outflow = 1.33 cfs @ 12.18 hrs, Volume= 0.133 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

## Reach 2R: Market/Rockill CBs



## Summary for Pond 3P: Infiltration System

Inflow Area = 0.285 ac,100.00% Impervious, Inflow Depth > 4.14" for 10-Year event
Inflow = 1.13 cfs @ 12.14 hrs, Volume= 0.098 af
Outflow = 0.89 cfs @ 12.22 hrs, Volume= 0.093 af, Atten= 22%, Lag= 5.3 min
Primary = 0.89 cfs @ 12.22 hrs, Volume= 0.093 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 296.88' @ 12.22 hrs Surf.Area= 0.009 ac Storage= 0.014 af

Plug-Flow detention time= 46.6 min calculated for 0.093 af (95% of inflow)
Center-of-Mass det. time= 25.2 min ( 763.7 - 738.4 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 294.53' | 0.008 af | **18.33'W x 22.32'L x 2.88'H Field A**<br>0.027 af Overall - 0.008 af Embedded = 0.019 af x 40.0% Voids |
| #2A | 295.20' | 0.008 af | **Cultec R-180** x 15 Inside #1<br>Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf<br>Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap<br>Row Length Adjustment= +1.00' x 3.44 sf x 5 rows |
| #3 | 295.38' | 0.000 af | **0.50'D x 4.60'H Vertical Cone/Cylinder** |
| | | 0.016 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 295.50' | **6.0" Round Culvert**<br>L= 31.0' CPP, mitered to conform to fill, Ke= 0.700<br>Inlet / Outlet Invert= 295.50' / 292.80' S= 0.0871 '/' Cc= 0.900<br>n= 0.013, Flow Area= 0.20 sf |

**Primary OutFlow** Max=0.88 cfs @ 12.22 hrs HW=296.86' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.88 cfs @ 4.48 fps)

## Pond 3P: Infiltration System - Chamber Wizard Field A

**Chamber Model = Cultec R-180 (Cultec Recharger®180HD)**
Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf
Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 3.44 sf x 5 rows

36.0" Wide + 3.0" Spacing = 39.0" C-C Row Spacing

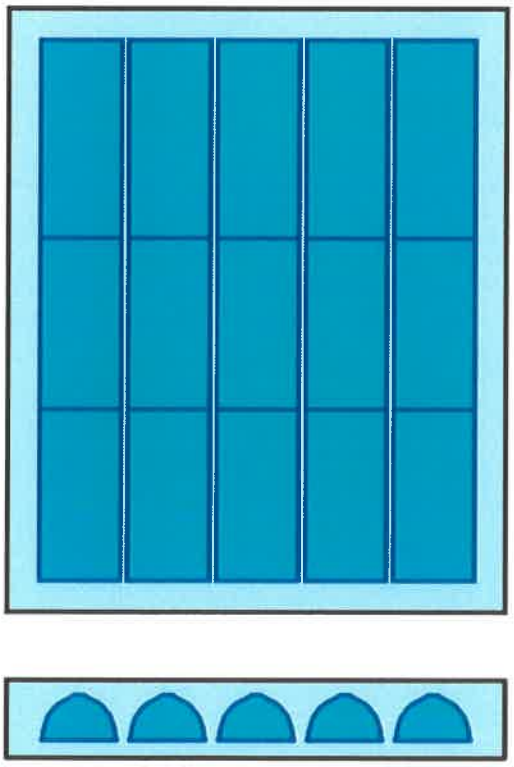
3 Chambers/Row x 6.33' Long +1.00' Row Adjustment = 19.99' Row Length +14.0" End Stone x 2 = 22.32' Base Length
5 Rows x 36.0" Wide + 3.0" Spacing x 4 + 14.0" Side Stone x 2 = 18.33' Base Width
8.0" Base + 20.5" Chamber Height + 6.0" Cover = 2.88' Field Height

15 Chambers x 21.8 cf +1.00' Row Adjustment x 3.44 sf x 5 Rows = 343.8 cf Chamber Storage

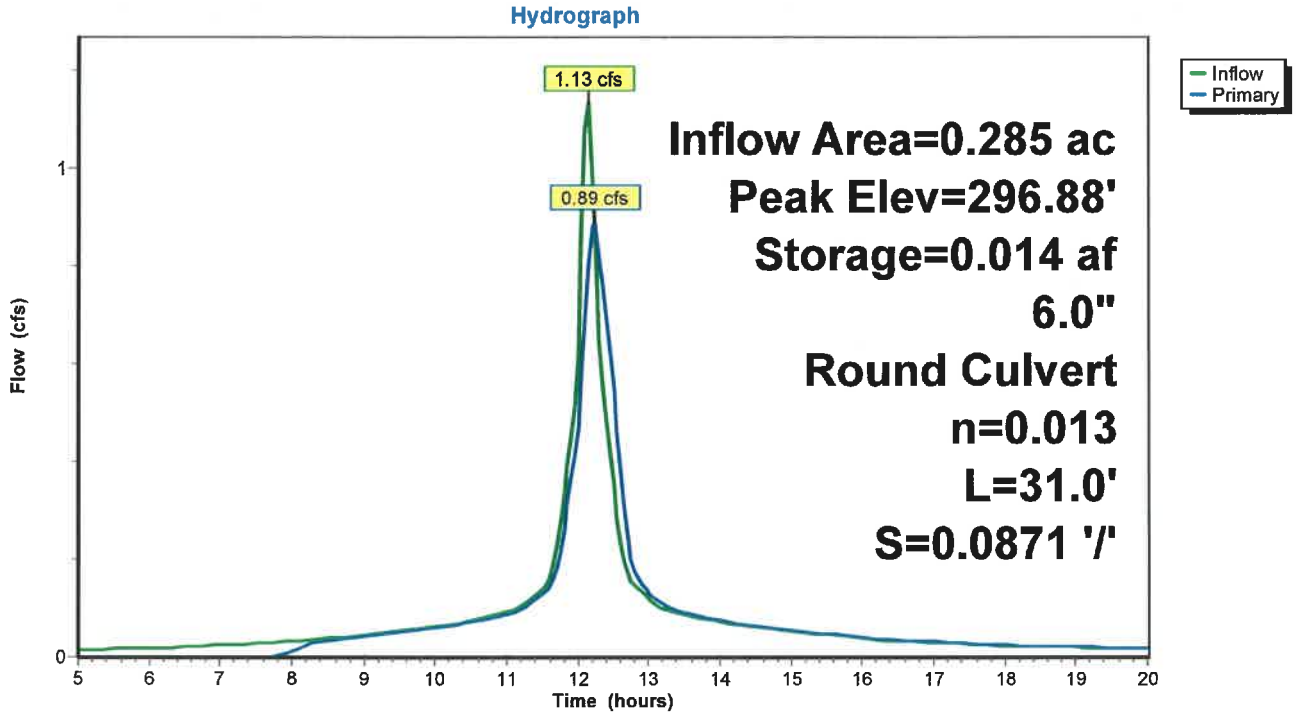
1,176.6 cf Field - 343.8 cf Chambers = 832.8 cf Stone x 40.0% Voids = 333.1 cf Stone Storage

Chamber Storage + Stone Storage = 676.9 cf = 0.016 af
Overall Storage Efficiency = 57.5%
Overall System Size = 22.32' x 18.33' x 2.88'

15 Chambers
43.6 cy Field
30.8 cy Stone



## Pond 3P: Infiltration System



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Subcatchment** Runoff Area=0.285 ac 100.00% Impervious Runoff Depth>5.96"
Tc=10.0 min CN=98 Runoff=1.62 cfs 0.142 af

**Subcatchment4S: SubcatchmentA** Runoff Area=0.161 ac 50.93% Impervious Runoff Depth>4.79"
Tc=10.0 min CN=86 Runoff=0.80 cfs 0.064 af

**Reach 2R: Market/Rockill CBs** Inflow=2.39 cfs 0.200 af
Outflow=2.39 cfs 0.200 af

**Pond 3P: Infiltration System** Peak Elev=299.38' Storage=0.016 af Inflow=1.62 cfs 0.142 af
6.0" Round Culvert n=0.013 L=31.0' S=0.0871 '/' Outflow=1.60 cfs 0.136 af

**Total Runoff Area = 0.446 ac Runoff Volume = 0.206 af Average Runoff Depth = 5.54"**
**17.71% Pervious = 0.079 ac 82.29% Impervious = 0.367 ac**

## Summary for Subcatchment 1S: Subcatchment Roof/Parking

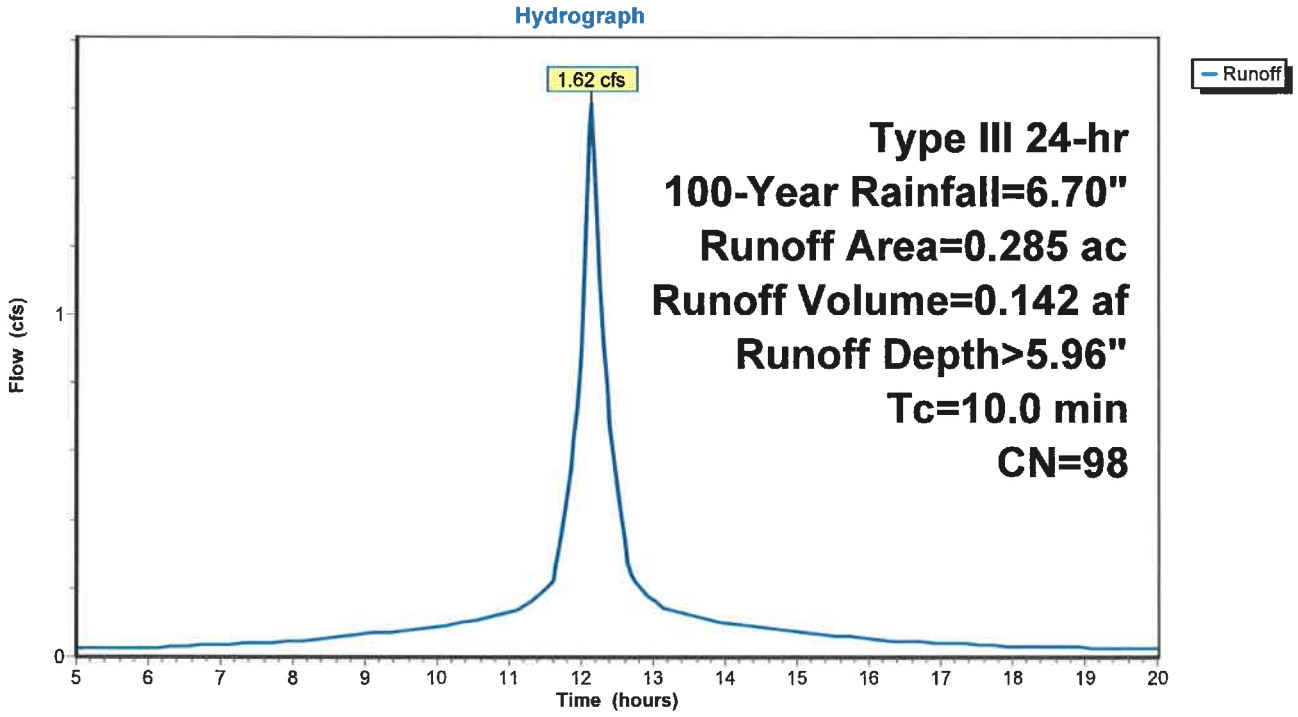
Runoff = 1.62 cfs @ 12.14 hrs, Volume= 0.142 af, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.70"

| Area (ac) | CN | Description |
|---|---|---|
| 0.187 | 98 | Roofs, HSG C |
| 0.098 | 98 | Paved parking, HSG C |
| 0.285 | 98 | Weighted Average |
| 0.285 | | 100.00% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment 1S: Subcatchment Roof/Parking



## Summary for Subcatchment 4S: Subcatchment A

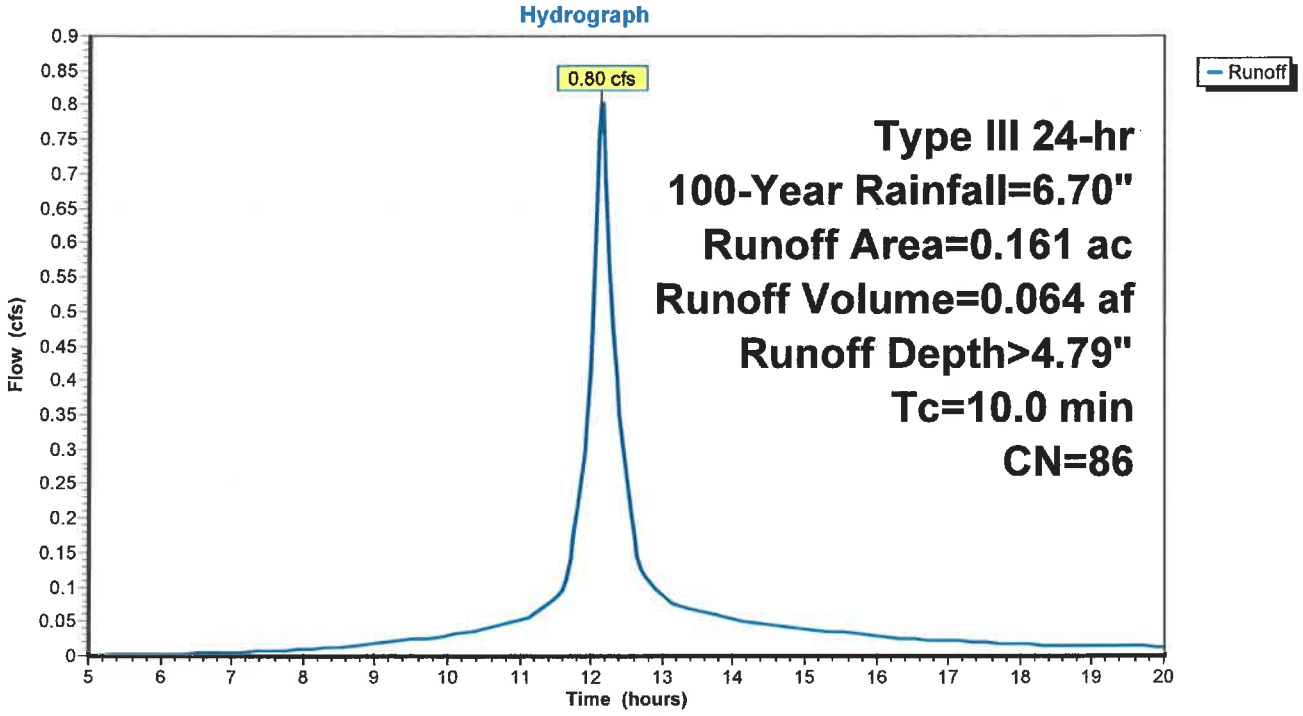
Runoff = 0.80 cfs @ 12.14 hrs, Volume= 0.064 af, Depth> 4.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.70"

| Area (ac) | CN | Description |
|---|---|---|
| 0.045 | 98 | Roofs, HSG C |
| 0.037 | 98 | Paved parking, HSG C |
| 0.079 | 74 | >75% Grass cover, Good, HSG C |
| 0.161 | 86 | Weighted Average |
| 0.079 | | 49.07% Pervious Area |
| 0.082 | | 50.93% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | | | | | **Direct Entry,** |

## Subcatchment 4S: Subcatchment A

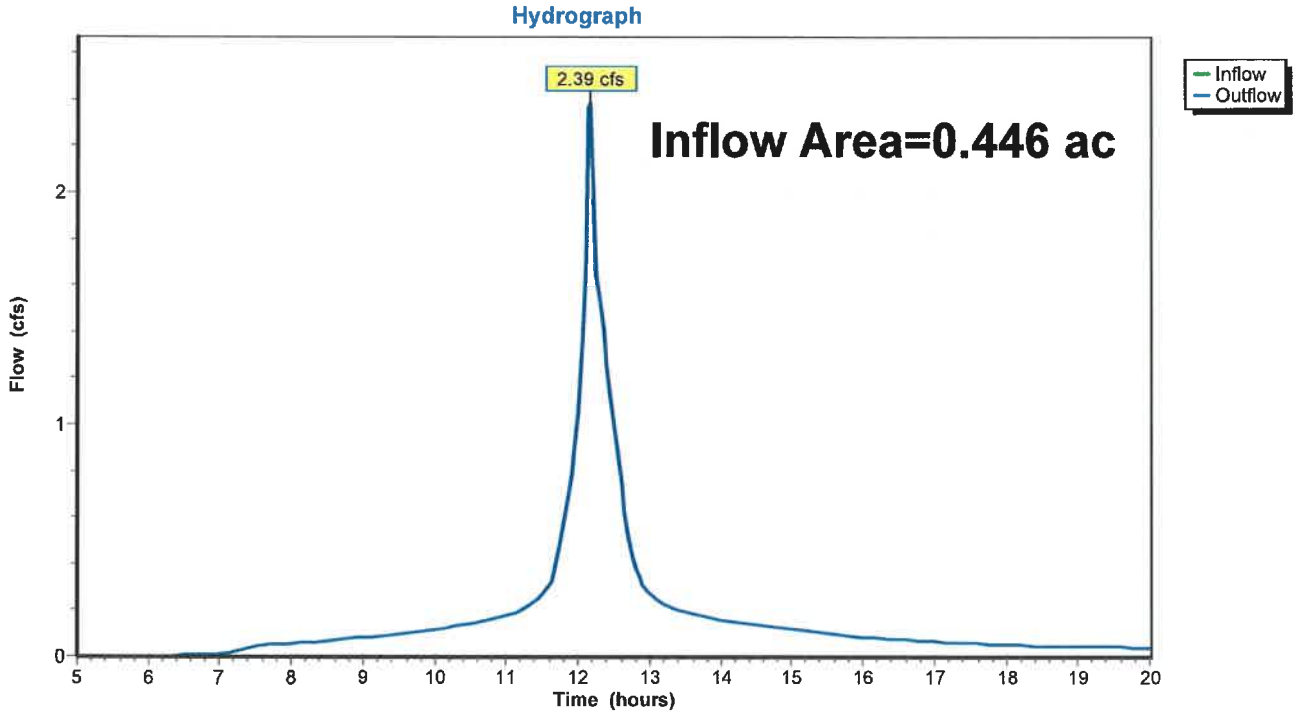


## Summary for Reach 2R: Market/Rockill CBs

Inflow Area = 0.446 ac, 82.29% Impervious, Inflow Depth > 5.39" for 100-Year event
Inflow = 2.39 cfs @ 12.16 hrs, Volume= 0.200 af
Outflow = 2.39 cfs @ 12.16 hrs, Volume= 0.200 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

## Reach 2R: Market/Rockill CBs



## Summary for Pond 3P: Infiltration System

Inflow Area = 0.285 ac,100.00% Impervious, Inflow Depth > 5.96" for 100-Year event
Inflow = 1.62 cfs @ 12.14 hrs, Volume= 0.142 af
Outflow = 1.60 cfs @ 12.17 hrs, Volume= 0.136 af, Atten= 1%, Lag= 1.8 min
Primary = 1.60 cfs @ 12.17 hrs, Volume= 0.136 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 299.38' @ 12.17 hrs Surf.Area= 0.009 ac Storage= 0.016 af

Plug-Flow detention time= 36.1 min calculated for 0.136 af (96% of inflow)
Center-of-Mass det. time= 20.0 min ( 756.6 - 736.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 294.53' | 0.008 af | **18.33'W x 22.32'L x 2.88'H Field A**<br>0.027 af Overall - 0.008 af Embedded = 0.019 af x 40.0% Voids |
| #2A | 295.20' | 0.008 af | **Cultec R-180** x 15 Inside #1<br>Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf<br>Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap<br>Row Length Adjustment= +1.00' x 3.44 sf x 5 rows |
| #3 | 295.38' | 0.000 af | **0.50'D x 4.60'H Vertical Cone/Cylinder** |
| | | 0.016 af | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 295.50' | **6.0" Round Culvert**<br>L= 31.0' CPP, mitered to conform to fill, Ke= 0.700<br>Inlet / Outlet Invert= 295.50' / 292.80' S= 0.0871 '/' Cc= 0.900<br>n= 0.013, Flow Area= 0.20 sf |

**Primary OutFlow** Max=1.52 cfs @ 12.17 hrs HW=299.07' (Free Discharge)
↑**1=Culvert** (Inlet Controls 1.52 cfs @ 7.74 fps)

## Pond 3P: Infiltration System - Chamber Wizard Field A

**Chamber Model = Cultec R-180 (Cultec Recharger® 180HD)**
Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf
Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 3.44 sf x 5 rows

36.0" Wide + 3.0" Spacing = 39.0" C-C Row Spacing

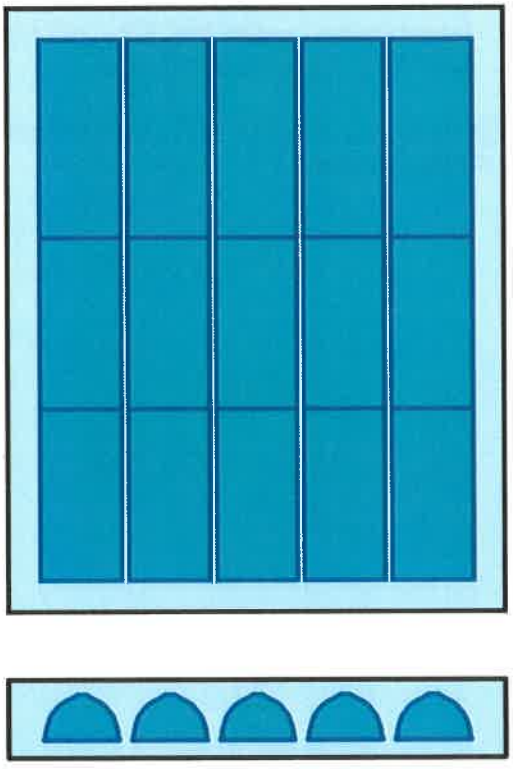
3 Chambers/Row x 6.33' Long +1.00' Row Adjustment = 19.99' Row Length +14.0" End Stone x 2 = 22.32' Base Length
5 Rows x 36.0" Wide + 3.0" Spacing x 4 + 14.0" Side Stone x 2 = 18.33' Base Width
8.0" Base + 20.5" Chamber Height + 6.0" Cover = 2.88' Field Height

15 Chambers x 21.8 cf +1.00' Row Adjustment x 3.44 sf x 5 Rows = 343.8 cf Chamber Storage

1,176.6 cf Field - 343.8 cf Chambers = 832.8 cf Stone x 40.0% Voids = 333.1 cf Stone Storage

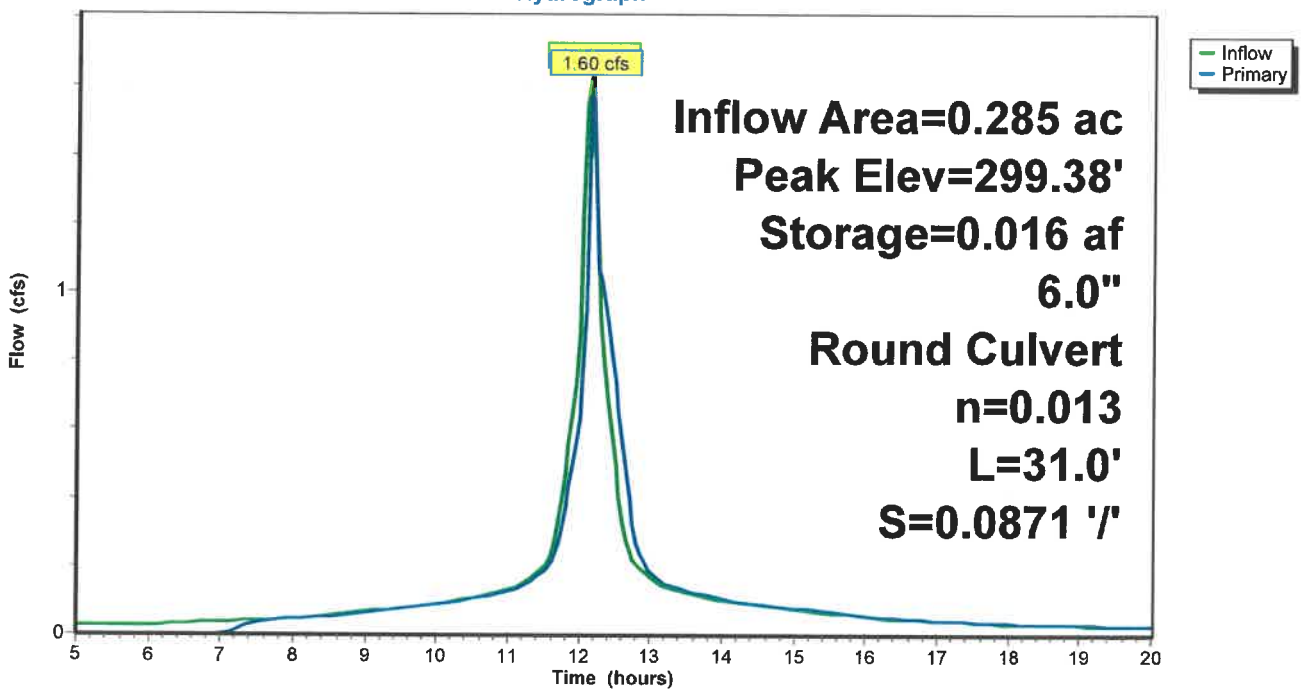
Chamber Storage + Stone Storage = 676.9 cf = 0.016 af
Overall Storage Efficiency = 57.5%
Overall System Size = 22.32' x 18.33' x 2.88'

15 Chambers
43.6 cy Field
30.8 cy Stone



## Pond 3P: Infiltration System

Hydrograph



## APPENDIX B – STORM WATER WORKSHEETS

Required Recharge Volume and Drawdown Worksheet
TSS Removal Worksheet
Convert WQV to Discharge Rate for Proprietary Stormwater Treatment Practices
Stormcepter Cut Sheet
Stormceptor MASTEP Technology Review

# Required Recharge Volume Worksheet

**PROJECT LOCATION:** **40 School Street/21 Market Street Foxborough**
**DATE:** 3-Oct-19
**PROJECT NUMBER:** 11-0155

| *SCS Soil Type Hydrologic Group* | *Target Depth Factor (in)* | *Total Impervious Area (acre)* | *Required Volume to Recharge (ac-ft)* |
|---|---|---|---|
| HSG C - Roofs & Pavement | 0.25 | 0.37 | 0.0076 |
| | | **TOTAL:** | **0.0076** |

| | |
|---|---|
| **SITE TOTAL Rv:** | **0.0076** |

**Subsurface Basin**

| **Volume Recharged** | |
|---|---|
| Volume of pond between bottom and outlet | 0.016 ac-ft |

| **Drawdown Within 72 hours** | |
|---|---|
| Soil Type: | Silt Loam |
| RAWLS Rate (in/hr): | 0.27 |
| Infiltration Area (sf): | 409 |
| Drawdown Time (hours): | 36.2 |

# TSS Removal Worksheet

**PROJECT LOCATION:** 40 School Street/21 Market Street Foxborough
**DATE:** 3-Oct-19
**PROJECT NUMBER:** 11-0155

**Subsurface Basin**

| | | | | |
|---|---|---|---|---|
| **Impervious Area =** | 0.37 | acres | | |
| **Runoff depth to be treated =** | 0.50 | inches | | |
| **Runoff volume to be treated =** | 0.0153 | ac-ft | | |
| *BMP* | *TSS Removal Rate* | *Starting TSS Load* | *Amount Removed* | *Remaining Load* |
| Stormcepter STC450i | 0.8 | 1.00 | 0.8 | 0.20 |
| Infiltration Basin | 0.8 | 0.20 | 0.16 | 0.04 |
| **TOTAL TSS REMOVED =** | | | | **96 %** |

- 0.082 acres does not receive pretreatment, which is 22% of impervious area on site, which meets max of 35% capture area adjustment standard

## Convert WQV to Discharge Rate for Propiertary Stormwater Treatment Practices

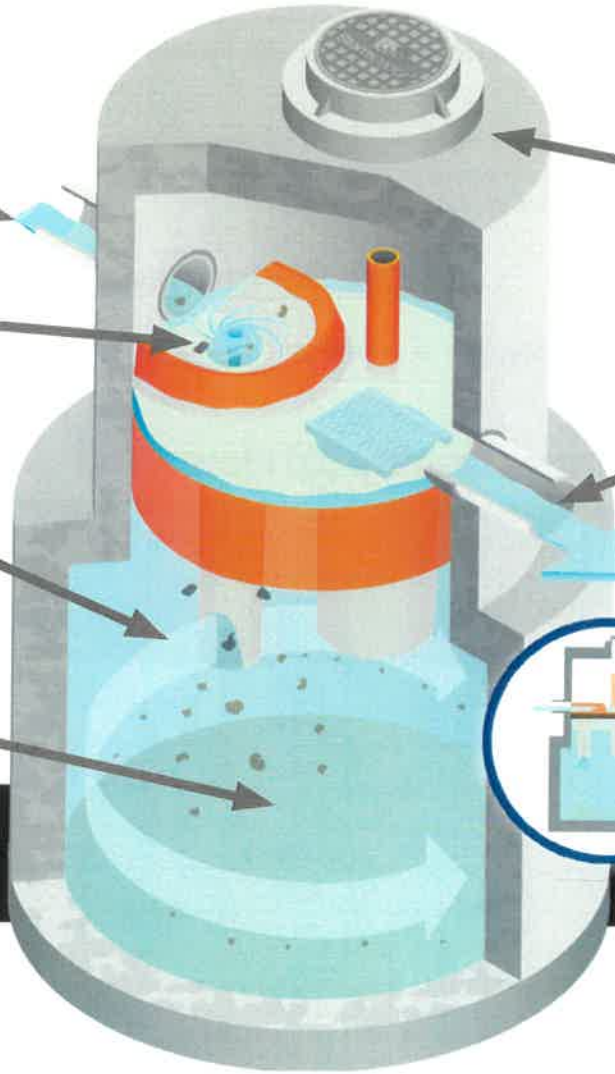
| | |
|---|---|
| **PROJECT LOCATION:** | Lawson Farm |
| **DATE:** | 05/27/16 |
| **PROJECT NUMBER:** | 15-0143 |

| | | | |
|---|---|---|---|
| **Structure Location:** | CB#1 | | |
| **Within or Near a Critical Area:** | No | | |
| **WQV:** | 0.5 | inch | |
| **Impervious Area =** | 0.000153 | square miles | |
| **Runoff Curve Number - CN =** | 98 | | |
| **Time of Concentration - Tc =** | 10.0 | min | |
| **Unit Peak Discharge - qu =** | 677 | csm/inch | see Table in Figure 2 |
| **Computed Flow Rate (0.5" of Runoff) $Q_{0.5}$ =** | 0.05 | cfs | **STC 450i** |

# Stormceptor®

## Stormwater Treatment Made Simple!

*TSS & Oil Removal* ■ *Scour Prevention* ■ *Small Footprint*




***Design Flexibility***

***Proven Performance***

*Environmentally Engineered Stormwater Solutions...*
*that exceed your client's needs!*


www.rinkerstormceptor.com
Phone: (413) 562-3647


Rinker MATERIALS

# Stormceptor® STC

Stormceptor® is an underground stormwater quality treatment device that is unparalleled in its effectiveness for pollutant capture and retention. With thousands of systems operating worldwide, Stormceptor delivers protection every day in every storm.

With patented technology, optimal treatment occurs by allowing free oil to rise and sediment to settle. The Stormceptor design prohibits scour and release of previously captured pollutants, ensuring superior treatment and protection during even the most extreme storm events.

Stormceptor is very easy to design and provides flexibility under varying site constraints such as tight right-of-ways, zero lot lines and retrofit projects. Design flexibility allows for a cost-effective approach to stormwater treatment. Stormceptor has proven performance backed by the longest record of lab and field verification in the industry.

## Tested Performance

- Fine particle capture
- Prevents scour or release
- 95%+ Oil removal

## Massachusetts – Water Quality (Q) Flow Rate

| Stormceptor STC Model | Inside Diameter (ft) | Typical Depth Below Inlet Pipe Invert [1] (in) | Water Quality Flow Rate Q [2] (cfs) | Peak Conveyance Flow Rate [3] (cfs) | Hydrocarbon Capacity [4] (Gallons) | Maximum Sediment Capacity [4] ($ft^3$) |
|---|---|---|---|---|---|---|
| STC 450i | 4 | 68 | 0.40 | 5.5 | 86 | 46 |
| STC 900 | 6 | 63 | 0.89 | 22 | 251 | 89 |
| STC 2400 | 8 | 104 | 1.58 | 22 | 840 | 205 |
| STC 4800 | 10 | 140 | 2.47 | 22 | 909 | 543 |
| STC 7200 | 12 | 148 | 3.56 | 22 | 1,059 | 839 |
| STC 11000 | 2 x 10 | 142 | 4.94 | 48 | 2,792 | 1,086 |
| STC 16000 | 2 x 12 | 148 | 7.12 | 48 | 3,055 | 1,677 |

[1] Depth Below Pipe Inlet Invert to the Bottom of Base Slab, and Maximum Sediment Capacity can vary to accommodate specific site designs and pollutant loads. Depths can vary to accommodate special designs or site conditions. Contact your local representative for assistance.
[2] Water Quality Flow Rate (Q) is based on 80% annual average TSS removal of the OK110 particle size distribution.
[3] Peak Conveyance Flow Rate is based upon ideal velocity of 3 feet per second and outlet pipe diameters of 18-inch, 36-inch, and 54-inch diameters.
[4] Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.

Stormceptor®
www.stormceptor.com

Rinker MATERIALS™
www.rinkerstormceptor.com
Manufacturing Plant: Westfield, MA
Phone: (413) 562-3647
11-22-13-R13-802 MDEP

UNIVERSITY OF MASSACHUSETTS
AT AMHERST
Water Resources Research Center
Blaisdell House, UMass
310 Hicks Way
Amherst, MA 01003

**Massachusetts Stormwater Evaluation Project**

(413) 545-5532
(413) 545-2304 FAX
**www.mastep.net**

# MASTEP Technology Review

**Technology Name:** Stormceptor

**Studies Reviewed:** Final NJCAT Technology Verification Stormceptor STC900 September 2004; Coventry University Study, 1996; Technology Assessment, University of Massachusetts, 1997; SeaTac Stormceptor Performance report 2001; SWAMP report Ontario 2004; Phoenix Group Edmonton report 1995; Stormceptor 1200 Field Evaluation report 2004; Applied Hydrology Associates Denver report 2003; Rinker Materials Como Park St. Paul MN report 2002; VA DOT / UVA "Testing of Ultra-Urban Stormwater Best Management Practices" report 2001.
Hydrodynamic Separator Sediment Retention Testing, Mohseni, 2010.

**Date:** September 17, 2013

**Reviewer:** Jerry Schoen

**Rating:** 2

**Brief rationale for rating:** This rating is primarily based on the 2005 NJCAT Technology Verification study. In general, this was a well-conducted test, which in large part followed NJDEP test guidelines for laboratory studies, which MASTEP considers as the laboratory equivalent of TARP field protocols. Issues of concern: the study measured suspended sediment concentration (SSC) rather than total suspended solids (TSS). Although SSC is considered by many scientists to be the preferred method, it is at odds with Massachusetts stormwater regulations, which are based on TSS treatment. Comparing SSC and TSS results is considered an inexact science. The test was conducted with higher influent sediment concentrations than is preferred, but results were fairly consistent across all ranges studied. The particle size distribution also appears to be slightly higher than the target test range. There are additional field studies that in general support the results obtained in this laboratory studies. These studies do not satisfy TARP protocols, but they do not contradict results obtained in the NJCAT study.

**TARP Requirements Not Met*:**

- Measurements in TSS.
- Influent sediment concentration is 100 – 300 mg/l: actual was 153-460.
- No documentation of a Quality Assurance Project Plan
- Third party studies are preferred. This was conducted by Stormceptor personnel, with sample analyses conducted by an external laboratory.

**Other Comments:**
* The 2010 Mohseni study evaluates the susceptibility of the Stormceptor to scouring, or washout of collected sediments. Report concluded that the unit does not scour at high flows as long as sediment depth does not exceed maintenance level.

* Criteria also based on NJDEP laboratory testing guidelines.

# APPENDIX C - OPERATION AND MAINTENANCE PLAN FOR STORM WATER BMPS

## Appendix C: LONG TERM OPERATION AND MAINTENANCE PLAN FOR STORMWATER BMPs
## 40 School Street/21 Market Street Foxborough, MA

| | During Construction | Post-construction |
|---|---|---|
| *BMP Owner:* | **Owner** | **Owner** |
| *Party of Plan Responsibility:* | **Owner** | **Owner** |

**References:**

- Site Development Plan of #40 School Street/21 Market Street Foxborough, MA dated October 4, 2019
- Storm Water Report "41 School Street/21 Market Street Foxborough, MA" dated October, 2019

**Operation and Maintenance**

Catch Basins: The catch basins shall be inspected three times a year: once after leaf fall, once before the arrival of hurricane season, and the third in the early or mid-spring after the snow melt and road sweeping. Any debris in catch basins shall be cleaned out. If there is less than 2' of space below the outlet and the top of the silt then the structure shall be cleaned out.

Stormceptor: The Stormceptor shall be inspected in accordance with the manufacturer's latest recommendations which can be found at http://www.imbriumsystems.com/stormwater-treatment-solutions/stormceptor-systems.

Parking areas: The parking areas will be swept twice a year: once before hurricane season, the other in the spring after snow melt.

Infiltration Basin: Once the infiltration system is in use, inspect it after every major storm (3.2 inches in 24 hours) for the first few months to ensure it is functioning properly and if necessary take corrective action. Note how long water remains standing in the basin after a storm; standing water within the basin 48 to 72 hours after a storm indicates that there is an issue. If the ponding is due to clogging, immediately address the reasons for the clogging (such as upland sediment erosion). Thereafter, inspect the infiltration basin at least twice per year to ensure that it is dry.

**Estimated Operations and Maintenance Budget**

The following is an estimate of the O&M Budget, post construction.
Inspections (3 times per year): $200
Cleaning catch basins (yearly): $200

**CONSTRUCTION PERIOD MAINTENANCE PLAN**
**FOR STORMWATER BMPs**
**40 School Street/21 Market Street Foxborough, MA**

**References:**

- Site Development Plan of #40 School Street/21 Market Street Foxborough, MA dated October 4, 2019
- Storm Water Report "41 School Street/21 Market Street Foxborough, MA" dated October, 2019

**Operation and Maintenance**

Item 1: During construction, **weekly** inspection of the crushed stone construction entrance pad and erosion control silt socks shall be conducted by a qualified staff member of the responsible party or an independent sediment and erosion control expert hired by the responsible party. Any displaced barriers shall be restored or repaired immediately.

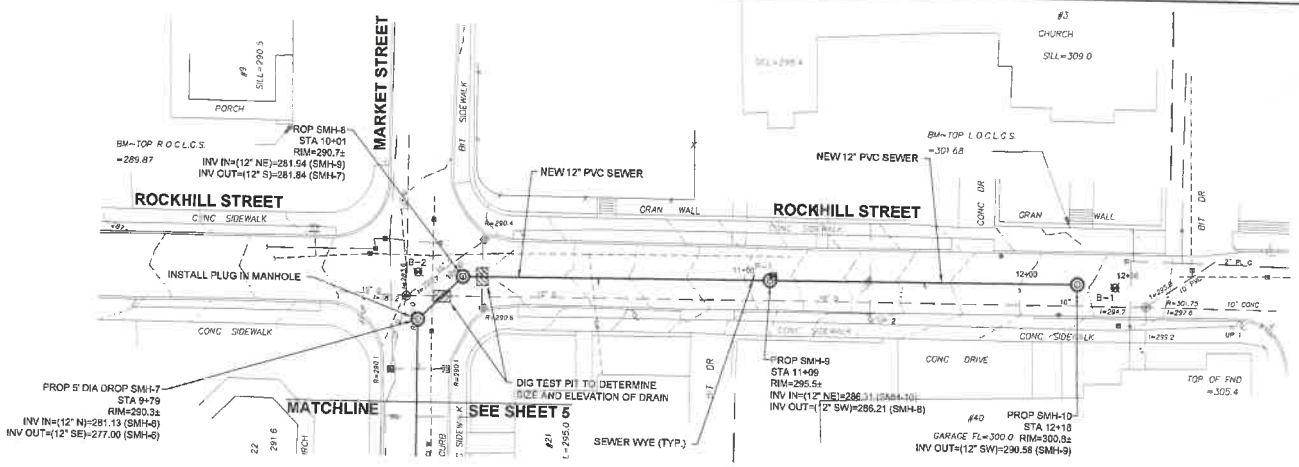
Item 2: The catch basins in the **parking area and on Rockhill Street/Market Street** shall be inspected **before** and **after** rain storms, if they are filled with sediment to half of their depth they shall be cleaned out with an orange peel bucket or some other means. Silt sacks shall be installed inside the catch basins. The infiltration system and catch basins shall be inspected three times a year: once after leaf fall, once before the arrival of hurricane season, the third in the early or mid-spring after the snow melt and road sweeping. Any debris should be cleaned out. The parking lot shall be swept as necessary, but no less than twice a year: once before hurricane season, the once in the spring after snow melt.

Item 4: During construction every effort will be made to ensure that silt does not enter the stormwater basin. Additional silt socks shall be used as necessary. If silt does enter the basin, then contractor shall be responsible for its removal through the inspection ports.

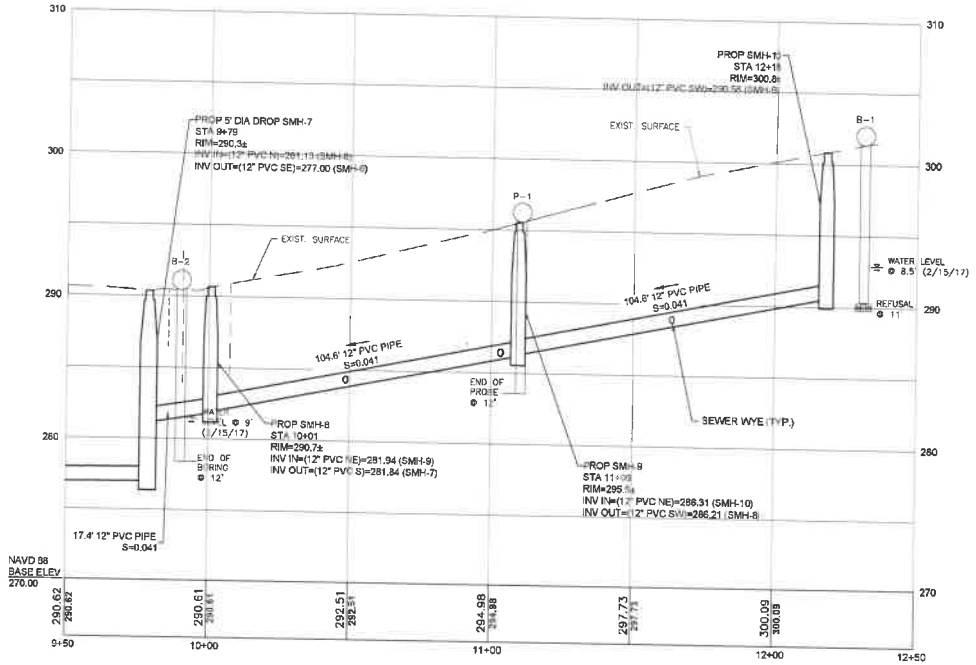
Item 5: During construction, the stone pad at the entrance to the project shall be inspected **weekly** and replenished if siltation is impeding the cleaning of truck tires. Any materials tracked into the roadway shall be swept up within a day.

## APPENDIX D: SOILS DATA

NRCS Soil Resource Report
BETA Soil System Profile




## SEWER SYSTEM EXTENSION
## STA 9+50 TO STA 12+50.00




NOTES:
1. CHIMNEY AND WYE LOCATIONS ARE APPROXIMATE. CONTRACTOR SHALL COORDINATE EXACT LOCATION OF CHIMNEYS AND WYES IN FIELD.

PREPARED BY
BETA
www.BETA-Inc.com

REGISTERED PROFESSIONAL
ANDREW J. DEWEERT CIVIL No. 49478 Registered
6/27/17

SUBCONSULTANT

PROJECT
**Sewer System Extension**
**Foxborough, MA**

TITLE
ROCKHILL STREET

| NO. | REVISIONS | DATE |
|---|---|---|

DRAWN BY: KHM
DESIGNED BY: KHM
CHECKED BY: AJD
ISSUE DATE: 6/27/2017
BETA JOB NO.: 5910

NORTH ARROW
**AS SHOWN**

SCALE
HOR. SCALE IN FEET: 1"=20'
VER. SCALE IN FEET: 1"=4'

SHEET NO.
6

5/8/2017 10:54 AM K:\FOXBOROUGH\5910 - SEWER SYSTEM EXTENSION\DRAWINGS\FILES\PLAN SHEET\DESIGN.DWG

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

# Custom Soil Resource Report for Norfolk and Suffolk Counties, Massachusetts

## 40 School Street/21 Market Street Foxborough, MA


October 3, 2019

# Preface

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

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

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

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

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

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

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

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

# Contents

# How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

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

# Soil Map

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

# Custom Soil Resource Report
## Soil Map

## MAP LEGEND

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

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

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

**Water Features**
- Streams and Canals

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

**Background**
- Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 15, Sep 12, 2019

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

Date(s) aerial images were photographed: Aug 26, 2014—Sep 4, 2014

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

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| 602 | Urban land, 0 to 15 percent slopes | 0.4 | 100.0% |
| **Totals for Area of Interest** | | **0.4** | **100.0%** |

# Map Unit Descriptions

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

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

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

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

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

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

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

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

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

# Norfolk and Suffolk Counties, Massachusetts

## 602—Urban land, 0 to 15 percent slopes

### Map Unit Setting

*National map unit symbol:* vkyj
*Mean annual precipitation:* 32 to 50 inches
*Mean annual air temperature:* 45 to 50 degrees F
*Frost-free period:* 120 to 200 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Urban land:* 99 percent
*Minor components:* 1 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Urban Land

#### Setting

*Parent material:* Excavated and filled land

### Minor Components

#### Rock outcrops

*Percent of map unit:* 1 percent
*Hydric soil rating:* Unranked

# References

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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