Stormwater Management Report



Project Address:

464-466 County Street & NW William and Eighth Streets New Bedford, MA

Date:

August 11th, 2016

Prepared For:

South Coast Real Estate Holdings LLC 200 Mill Road Suite 100 Fairhaven, MA 02719

Prepared by:



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First Citizens' Federal Credit Union – New Bedford, Massachusetts

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INTRODUCTION

This analysis summarizes pre- and post-development stormwater impacts associated with the reconstruction of parking areas located at 464-466 County Street and 178 Eighth Street in New Bedford, Massachusetts. The subject property is comprised of two lots:

- Lot 1: 464-466 County Street
- Lot 2: 178 Eighth Street

Total area of the combined lots is approximately 24,731 sf. The property is bounded by residential uses to the north, Williams Street to the south, Eighth Street to the east and County Street to the west. It is located within the Mixed Use Business Zoning District.

The property is currently developed consisting of an existing building, two paved parking lots (upper and lower), and a paved driveway. The existing building is equipped with a gutter and downspout roof drain system. Two of the downspouts located on the north side of the building discharge directly onto the paved surface of the upper parking lot, the remaining downspouts are directed below the surface. The majority of the runoff generated in the upper parking lot flows east, southeast down the paved driveway and out to Eighth Street uncontrolled. Runoff from a small portion of the upper parking lot, the front portion of the roof and a lawn area with paved walkways flows west out to County Street uncontrolled. The majority of the runoff generated from the lower parking lot flows overland, southeast to an existing onsite catch basin. Under current conditions, runoff generated onsite received no pre-treatment prior to leaving the site.

Work associated with the site improvements includes:

- Installation of erosion control devices, demolition of pavement, curb removal, and removal of vegetation and topsoil.
- Removal of existing catch basin on the southeast corner of the lower parking lot.
- Installation of new curb as indicated on site plan.
- Installation of new sidewalks and wheelchair access ramp.
- Installation of underground roof drains/drywells.
- Installation of two new deep sump hooded catch basins, one new drain manhole, HDPE Drain pipe
 of various sizes, and FocalPoint High Performance Modular Biofiltration System (HPMBS) for
 stormwater management with connection to off-site catch basin.

For detailed information regarding existing site conditions and proposed development, refer to the plans entitled, "FIRST CITIZENS' FEDERAL CREDIT UNION", dated August 11, 2016 prepared by Highpoint Engineering, Inc.



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METHODOLOGY

The hydrologic analysis models the pre- and post-development stormwater characteristics for the site, and compares changes in peak rate of runoff and water quality associated with the proposed development. Where increases to peak rate of runoff or reductions in water quality are identified, Stormwater Best Management Practices (BMP's) and Low Impact Development (LID) techniques are considered. The analysis shall prove that post-development hydrologic conditions generally mimic predevelopment hydrologic conditions, and any potential impacts to downstream properties, infrastructure, or environmentally sensitive areas are mitigated.

The pre-development hydrologic model establishes the limits of the study area and down-gradient Points of Analysis (POA's), which is dependent on topographic and environmental conditions. The model quantifies watershed stormwater runoff characteristics related to topography, land use/cover types and soil conditions, computing peak runoff rates for specific design storm frequencies under pre-development conditions at the POA's.

The post-development hydrologic model analyzes the same study area, and accounts for changes in the watershed area topography, and land use/cover types associated with the proposed development. The model computes the changes to the peak runoff rates at the same POAs, and BMP's are implemented to mitigate stormwater impacts due to development. In addition, BMP's are also implemented to improve water quality and reduce Total Suspended Solid (TSS) pollutant concentrations to the maximum extent practicable.

For this analysis three (3) POA's have been established including:

- POA-A (Off-Site): Catch basin at Eighth Street.
- POA-B (Off-Site): County Street at driveway entry.
- POA-S (Off-Site): City Drainage System (combined).

The hydrologic model, analysis, and proposed mitigation measures have been developed using the following resources:

- Hydrologic modeling techniques and methods established in NRCS Technical Releases No. 20 and No. 55 (TR-20 and TR-55) using proprietary HydroCAD® stormwater modeling software.
- Massachusetts Department of Environmental Protection Stormwater Handbook Volumes #1 and #2 (as amended).

Rainfall Data

Peak stormwater discharges are determined for total rainfall estimated for the 2, 10, 25 and 100-year storm event recurrence intervals. For this analysis, the values to be used for the 24-hour rainfall calculations were taken from Appendix 1, Table A1.1, "Massachusetts rainfall data by town and county [inches]" of the Engineering Field Handbook – Chapter 2, March 2013 and are outlined in Table 1 below:

Table 1 – Summary of Rainfall Data

| Rainfall Recurrence Interval | 24 Hour Rainfall Depth |
|------------------------------|------------------------|
| 2 Year Storm | 3.30 inches |
| 10 Year Storm | 4.88 inches |
| 25 Year Storm | 6.10 inches |
| 100 Year Storm | 8.56 inches |

Soils Data

Based upon the USDA – NRCS Soil Conservation Service (SCS) Web Soil Survey for Bristol County, soils underlying the site are classified as follows:

Table 2. - Summary of USDA Soil Classification

| Soil Classification | Hydrologic Soil Group (HSG) |
|---------------------|-----------------------------|
| Urban Land | Unclassified (Assumed D) |

PRE-DEVELOPMENT CONDITIONS

The existing site is divided into three (3) watershed areas as described below, and analyzed at the three (3) POA's described in the "Methodology" section of this report. Existing watershed areas include:

- <u>Ex-WS A</u> Consists of the majority of the upper parking lot off of County Street, the driveway that connects the upper parking lot to Eighth Street, landscape areas, and a portion of the roof area. Runoff flows overland and uncontrolled to Eighth Street.
- <u>EX-WS B</u> Consists of the lower parking lot on Eighth Street and landscape areas. The runoff flows overland to the existing catch basin in the southeast corner of the parking lot and is conveyed to an existing catch basin in Eighth Street.
- <u>Ex-WS C</u> Consists of a very small section of the upper parking lot on County Street, the landscape areas on the east side of the building with concrete walks, and part of the east half of the roof area. The runoff flows overland and uncontrolled to County Street.

Refer to Figures - <u>Pre-Development Watershed Map</u> for information and limits of the existing watershed areas.

For the pre-development watershed analysis, Table 3 presents a comparison of watershed areas, the weighted TR-55 runoff curve numbers (CN – based on ground cover types), and Time of Concentrations $\{T_c\}$ for the existing Watershed Areas:

Table 3. – Pre-Development Watershed Area and Runoff Curve Number

| | EX-WS A | EX-WS B | EX-WS C |
|------------|-----------|-----------|----------|
| Area (ft²) | 10,292 sf | 12,614 sf | 1,826 sf |
| CN | 96 | 94 | 92 |
| Тс | 5.0 min | 5.0 min | 5.0 min |

POST-DEVELOPMENT CONDITIONS

The project proposes to maintain the existing building, reconstruct both the existing upper and lower parking lot, add a new stormwater conveyance system and a focal point for stormwater mitigation.

The developed site is divided into four (4) watershed areas as described below. The three (3) POA's remain unchanged.

- Pr-WS A Consists of the majority of the upper parking lot off of County Street, the driveway that connects the upper parking lot to Eighth Street, landscape areas and a portion of the roof area. Runoff flows east overland to one of the two new catch basins located in the driveway. From the catch basins, the runoff will be conveyed via a 12"-HDPE drain pipe to the new drain manhole in the southeast corner of the new lower parking lot. From the manhole, it will travel through another 12"-HDPE pipe to the existing catch basin located off-site in Eighth Street.
- <u>Pr-Ws B</u> Consists of the lower parking lot on Eighth Street and landscape areas. The runoff flows southeast overland to the new FocalPoint High Performance Modular Biofiltration System (HPMBS). Once the FocalPoint receives the first one-inch of stormwater, additional runoff will fill the FocalPoint until it overflows out of a beehive grate. The overflow runoff will enter a 12"-HPDE pipe and travel to the existing catch basin off-site in Eighth Street.
- <u>Pr-Ws C</u> Consists of a very small section of the upper parking lot on County Street, the landscape areas on the east side of the building with concrete walks, and part of the east half of the roof area.
 The runoff flows overland and uncontrolled to County Street.
- <u>Pr-WS D</u> Consists a small area of the eastern portion of the driveway, and landscape areas. The runoff flows overland and uncontrolled to Eighth Street.

Refer to Figures - <u>Post-Development Watershed Map</u> for information and limits of the proposed watershed areas.

Table 4 presents a comparison of watershed area, the weighted TR-55 runoff curve number (CN - based on ground cover types), and Time of Concentration (T_c) for the proposed watersheds:

Table 4. – Post-Development Watershed Areas and Runoff Curve Numbers

| | Pr-WS A | Pr-WS B | Pr-WS C | Pr WS D | |
|------------|----------|----------|----------|----------|--|
| Area (ft²) | 9,290 | 11,748 | 3,052 | 644 | |
| CN | 95 | 93 | 93 | 96 | |
| Tc | 5.0 min. | 5.0 min. | 5.0 min. | 5.0 min. | |

The overall project will result in a decrease of approximately 1,314± sf of impervious cover associated with the redevelopment. The new stormwater management system is designed to direct most of the generated stormwater runoff to the new stormwater collection system or the FocalPoint system for Watershed Areas A and B, where they will receive some pre-treatment prior to discharge to POA A in Eighth Street. The stormwater improvements were designed to provide pretreatment for the 1.0" water quality depth of runoff generated within Watershed Area B.

STORMWATER MITIGATION

The proposed stormwater management facilities are designed to improve water quality, and mitigate the stormwater associated with the redevelopment.

The following is a summary of the drainage infrastructure and BMPs selected for the project:

- Two deep-sump hooded catch basins, one drain manhole, and HDPE pipe collection system throughout the parking areas and access driveways.
- FocalPoint High Performance Modular Biofiltration System (HPMBS) for filtration of stormwater, utilizes physical, chemical and biological mechanisms of soil, plant and microbe complex to remove pollutants typically found in urban stormwater runoff

The following tables summarize the pre- and post-development peak rates of runoff and total runoff volumes for the project after implementation of the selected stormwater BMPs at the POA's:

Table 5. – Summary of Pre- and Post-Development Peak Rates of Runoff

| Design Storm | POA-A (Eighth Street) | | | | | | | | |
|-----------------|-----------------------|----------|-----------|--|--|--|--|--|--|
| | Pre-Dev | Post-Dev | Change | | | | | | |
| 2 Year | 1.60 cfs | 1.48 cfs | -0.12 cfs | | | | | | |
| 10 Year | 2.45 cfs | 2.29 cfs | -0.16 cfs | | | | | | |
| 25 Year | 3.10 cfs | 2.90 cfs | -0.20 cfs | | | | | | |
| 100 Year | 4.40 cfs | 4.14 cfd | -0.26 cfs | | | | | | |

| Design Storm | POA-B (County Street) | | | | | | | | |
|-----------------|-----------------------|----------|-----------|--|--|--|--|--|--|
| | Pre-Dev | Post-Dev | Change | | | | | | |
| 2 Year | 0.12 cfs | 0.20 cfs | +0.08 cfs | | | | | | |
| 10 Year | 0.19 cfs | 0.32 cfs | +0.13 cfs | | | | | | |
| 25 Year | 0.24 cfs | 0.40 cfs | +0.16 cfs | | | | | | |
| 100 Year | 0.34 cfs | 0.58 cfs | +0.24 cfs | | | | | | |

| Design Storm | POA-S (City System - Combined) | | | | | | | |
|-----------------|--------------------------------|----------|-----------|--|--|--|--|--|
| | Pre-Dev | Post-Dev | Change | | | | | |
| 2 Year | 1.72 cfs | 1.68 cfs | -0.04 cfs | | | | | |
| 10 Year | 2.64 cfs | 2.60 cfs | -0.04 cfs | | | | | |
| 25 Year | 3.34 cfs | 3.31 cfs | -0.03 cfs | | | | | |
| 100 Year | 4.74 cfs | 4.72 cfs | -0.02 cfs | | | | | |



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TSS Removal calculations has been completed and can be found in Appendix B – Hydraulic Calculations.

Construction Phase and Long-Term Stormwater Maintenance and Operation Plans (O&M Plans) have been included in Appendix C – Supporting Information of this report and include information on the responsible party for the O&M plan implementation, a project overview, and the structural and non-structural BMPs to be utilized on site.

CONCLUSION

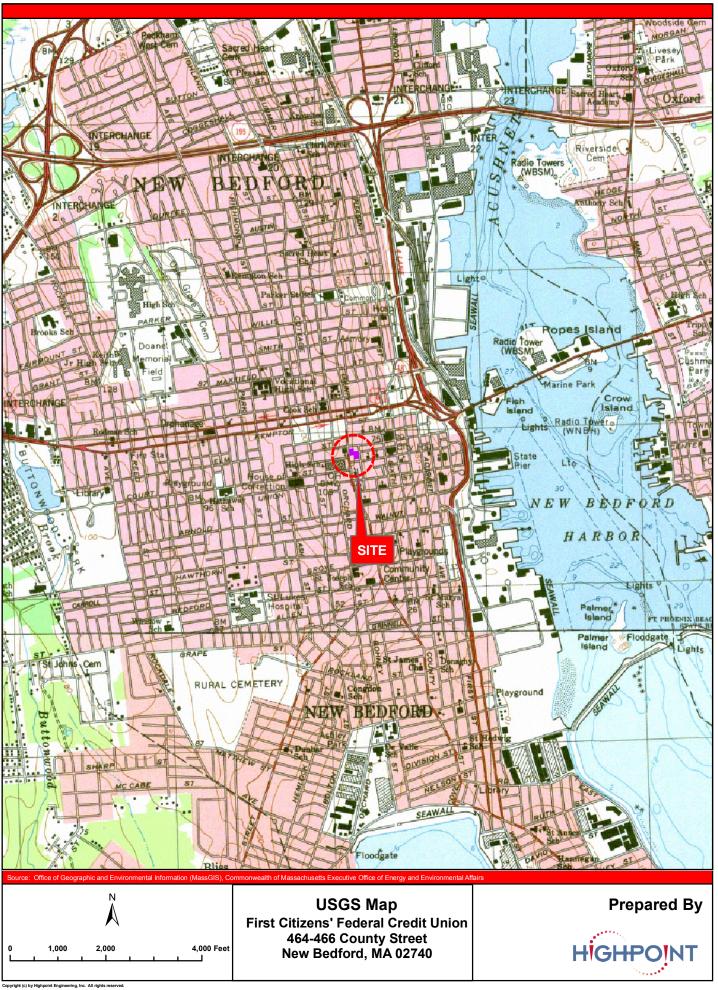
The proposed project will preserve the existing runoff patterns of the site and off-site discharge locations. Potential stormwater impacts associated with the redevelopment will be mitigated to the maximum extent practicable as required by State and Municipal Regulations.

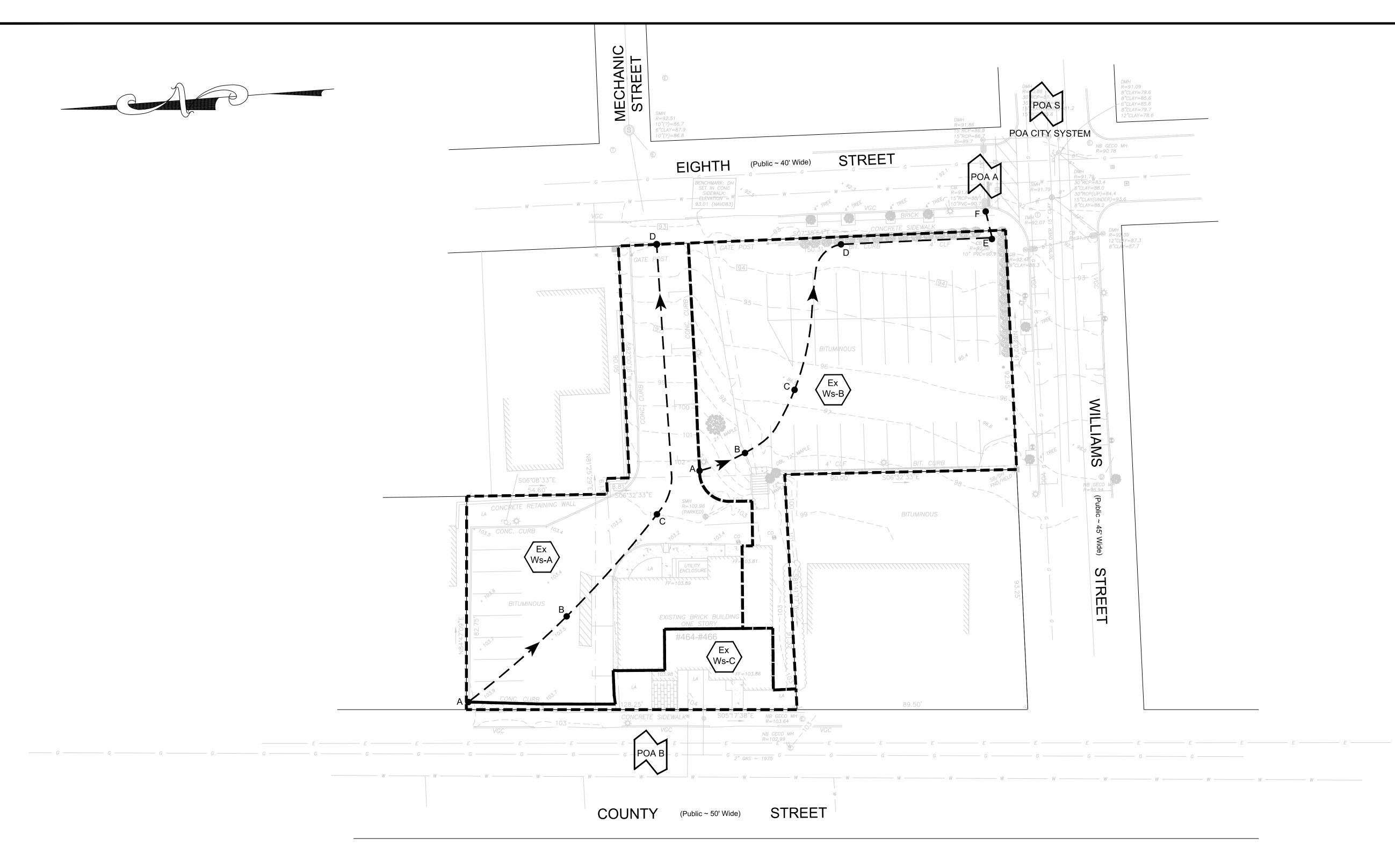


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FIGURES







PRE-DEVELOPMENT WATERSHED SUMMARY

WATERSHED AREA: Ex Ws-C

• TOTAL AREA = 1,826 S.F

ROOF AREA = 857 S.F

OPEN SPACE = 658 S.F

• CURVE NUMBER (CN) = 92

IMPERVIOUS AREA = 311 S.F

WATERSHED AREA: Ex Ws-A

• TOTAL AREA = 10,292 S.F

IMPERVIOUS AREA = 7,907 S.F

• ROOF AREA = 1,363 S.F

OPEN SPACE = 1,022 S.F

• CURVE NUMBER (CN) = 96

• TIME OF CONCENTRÁTION (TC) =5 MIN. • TIME OF CONCENTRÁTION (TC) = 5 MIN.

WATERSHED AREA: Ex Ws-B TOTAL AREA = 12,614 S.F

 IMPERVIOUS AREA = 9,618 S.F ROOF AREA = 373 S.F

• OPEN SPACE = 2,623 S.F

• CURVE NUMBER (CN) = 94 • TIME OF CONCENTRATION (TC) = 5 MIN.

SYMBOL LEGEND WATERSHED BOUNDARY TIME OF CONCENTRATION TIME OF CONCENTRATION FLOW POINT OF ANALYSIS DESIGNATION WATERSHED DESIGNATION ****Ws-A

POINT OF ANALYSIS SUMMARY OFF SITE. CATCH BASIN AT EIGHT STREET OFF SITE. COUNTY STREET AT

DRIVEWAY ENTRY

SOIL CLASSIFICATION SYMBOL 602 85% URBAN FILL 15% UDORTHENTS



ISSUE TYPE:

ISSUE DATE:

16022

SHEET TITLE:

PRE

FOR PERMIT

08/11/2016

PROJECT NUMBER:

DRAWN BY: SD

CHECKED BY: SD

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DEVELOPMENT

PRE

WATERSHED

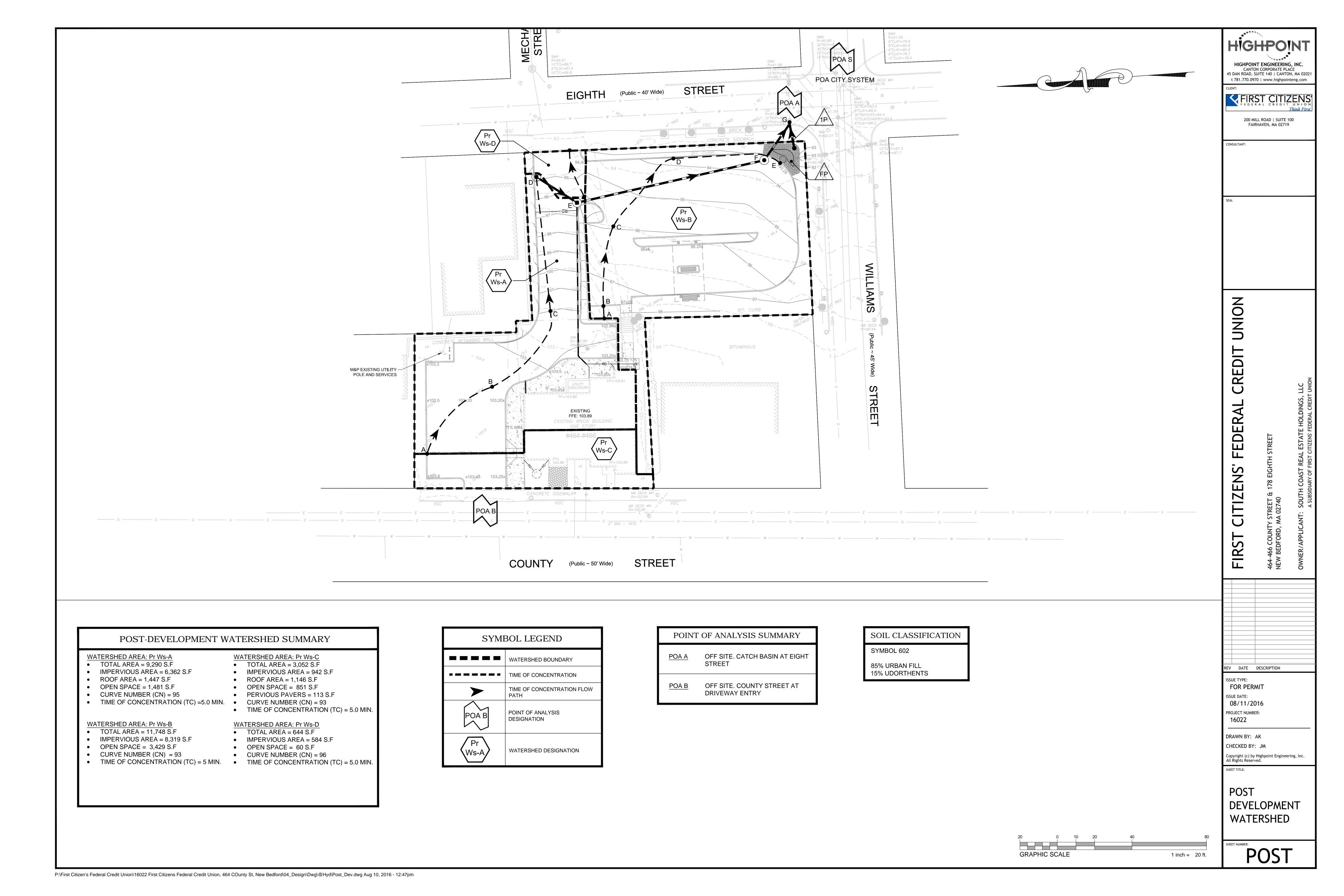
HIGHPOINT ENGINEERING, INC.
CANTON CORPORATE PLACE
45 DAN ROAD, SUITE 140 | CANTON, MA 0202

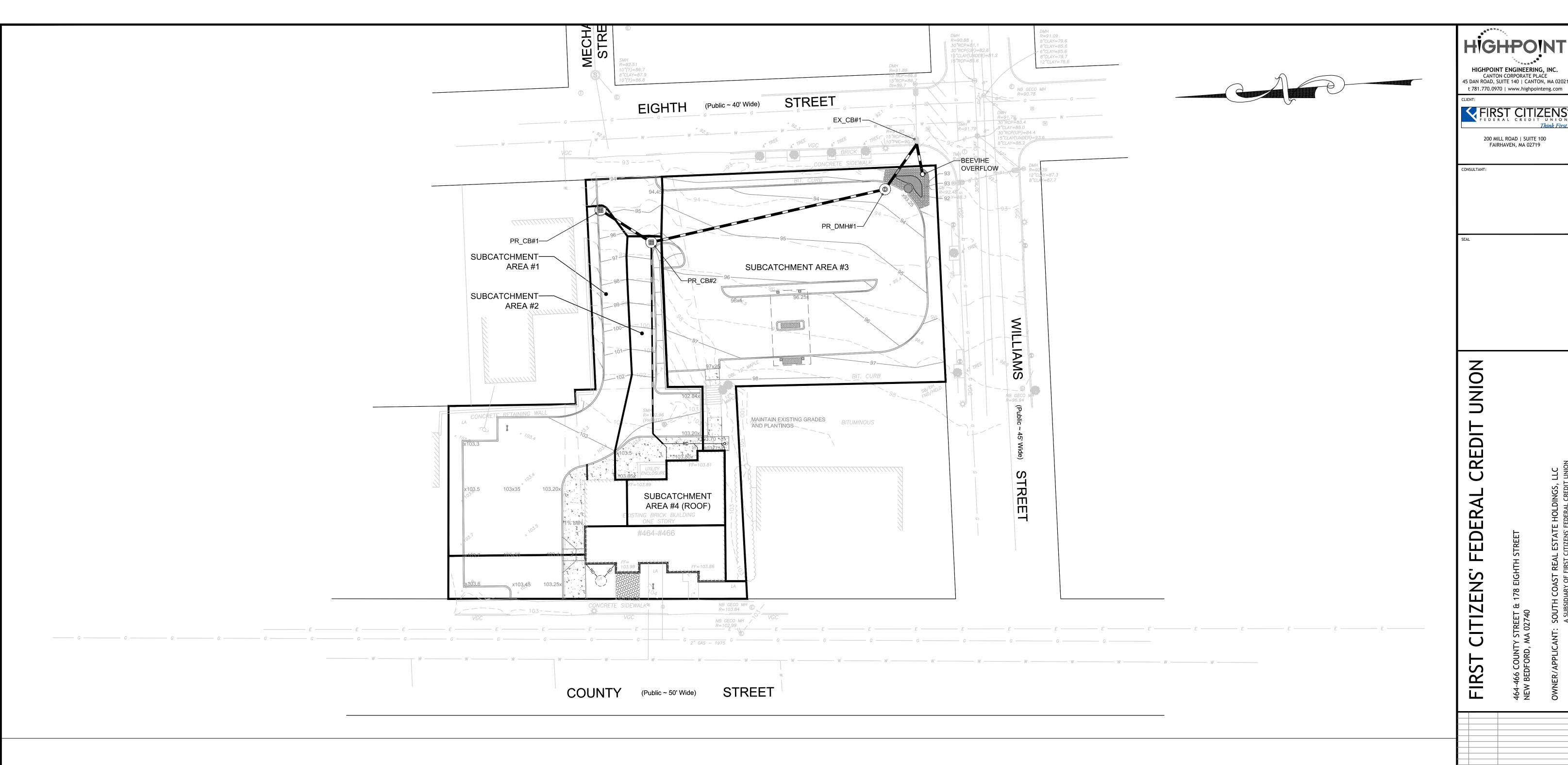
t 781.770.0970 | www.highpointeng.com

200 MILL ROAD | SUITE 100

FAIRHAVEN, MA 02719

GRAPHIC SCALE 1 inch = 20 ft.





SUBCATCHMENT AREA SUMMARY

SUBCATCHMENT AREA #1

• TOTAL AREA = 5,946 S.F

IMPERVIOUS AREA = 4,674 S.F

OPEN SPACE = 1,272 S.F

ROOF AREA = 0 S.F

SUBCATCHMENT AREA #3 • TOTAL AREA = 11,748 S.F • IMPERVIOUS AREA = 8,319 S.F

> ROOF AREA = 0 SF • OPEN SPACE = 3,429 S.F

SUBCATCHMENT AREA #2

• TOTAL AREA = 2,267 S.F IMPERVIOUS AREA = 2,058 S.F

 ROOF AREA = 0 SF • OPEN SPACE = 209 S.F SUBCATCHMENT AREA #4 (ROOF) • TOTAL AREA = 1,086 S.F

• IMPERVIOUS AREA = 0 S.F

 ROOF AREA = 1,086 OPEN SPACE = 0 S.F

> GRAPHIC SCALE 1 inch = 20 ft.

UNION CREDIT CITIZENS ST FIR

REV DATE DESCRIPTION

ISSUE TYPE: FOR PERMIT

ISSUE DATE: 08/11/2016 PROJECT NUMBER: 16022

DRAWN BY: AK

SHEET TITLE:

AREA

CHECKED BY: JM

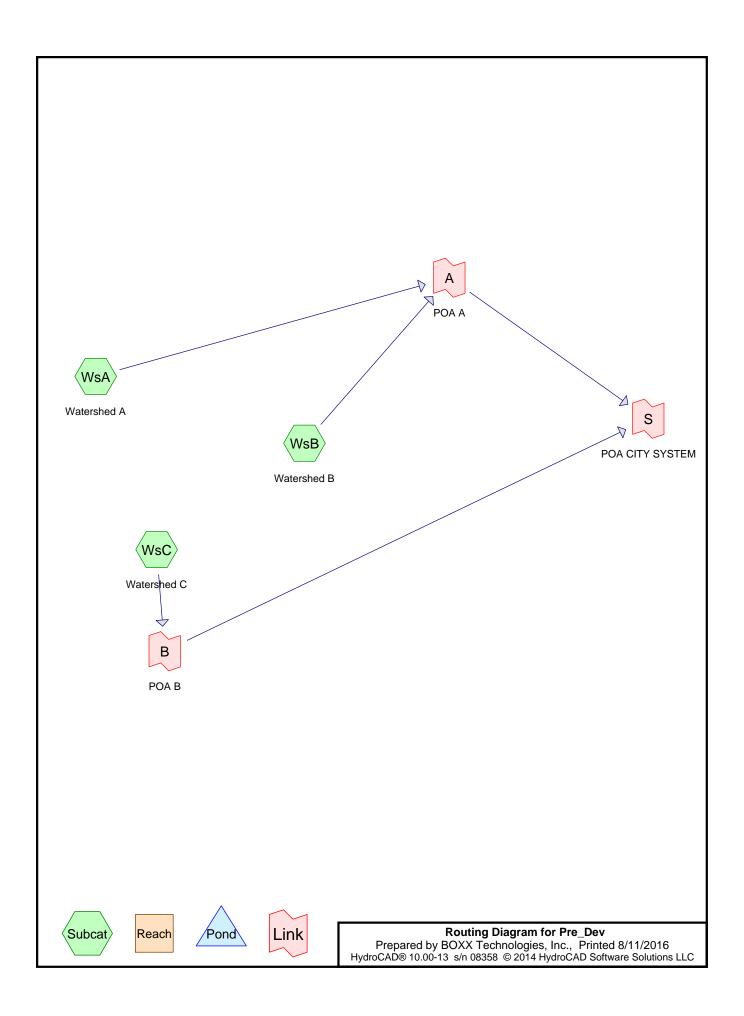
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SUBCATCHMENT

200 MILL ROAD | SUITE 100 FAIRHAVEN, MA 02719



APPENDIX A – HYDROLOGIC CALCULATIONS



Pre_Dev

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Area Listing (all nodes)

| Area | CN | Description |
|---------|----|---|
| (acres) | | (subcatchment-numbers) |
| 0.099 | 80 | >75% Grass cover, Good, HSG D (WsA, WsB, WsC) |
| 0.409 | 98 | Paved parking, HSG D (WsA, WsB, WsC) |
| 0.060 | 98 | Roofs, HSG D (WsA, WsB, WsC) |
| 0.568 | 95 | TOTAL AREA |

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Soil Listing (all nodes)

| Area | Soil | Subcatchment |
|---------|-------|-------------------|
| (acres) | Group | Numbers |
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 0.000 | HSG C | |
| 0.568 | HSG D | WsA, WsB, WsC |
| 0.000 | Other | |
| 0.568 | | TOTAL AREA |

Pre_Dev

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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 | 0.000 | 0.099 | 0.000 | 0.099 | >75% Grass cover, Good | WsA, WsB, |
| 0.000 | 0.000 | 0.000 | 0.409 | 0.000 | 0.409 | Paved parking | WsC WsA, |
| 0.000 | 0.000 | 0.000 | 0.060 | 0.000 | 0.060 | Roofs | WsB, WsC WsA, |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | Roois | WsB, WsC |
| 0.000 | 0.000 | 0.000 | 0.568 | 0.000 | 0.568 | TOTAL AREA | |

Pre_Dev

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Pipe Listing (all nodes)

| Line# | Node | In-Invert | Out-Invert | Length | Slope | n | Diam/Width | Height | Inside-Fill |
|-------|--------|-----------|------------|--------|---------|-------|------------|----------|-------------|
| | Number | (feet) | (feet) | (feet) | (ft/ft) | | (inches) | (inches) | (inches) |
| 1 | WsB | 0.00 | 0.00 | 10.0 | 0.0200 | 0.010 | 10.0 | 0.0 | 0.0 |

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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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 WsA: Watershed A Runoff Area=10,292 sf 90.07% Impervious Runoff Depth=2.85"

Flow Length=209' Tc=5.0 min CN=96 Runoff=0.74 cfs 0.056 af

Subcatchment WsB: Watershed B Runoff Area=12,614 sf 79.21% Impervious Runoff Depth=2.64"

Flow Length=180' Tc=5.0 min CN=94 Runoff=0.86 cfs 0.064 af

Subcatchment WsC: Watershed C Runoff Area=1,826 sf 63.96% Impervious Runoff Depth=2.45"

Tc=5.0 min CN=92 Runoff=0.12 cfs 0.009 af

Link A: POA A Inflow=1.60 cfs 0.120 af

Primary=1.60 cfs 0.120 af

Link B: POA B Inflow=0.12 cfs 0.009 af

Primary=0.12 cfs 0.009 af

Link S: POA CITY SYSTEM Inflow=1.72 cfs 0.128 af

Primary=1.72 cfs 0.128 af

Total Runoff Area = 0.568 ac Runoff Volume = 0.128 af Average Runoff Depth = 2.71" 17.40% Pervious = 0.099 ac 82.60% Impervious = 0.469 ac

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Summary for Subcatchment WsA: Watershed A

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.74 cfs @ 12.07 hrs, Volume= 0.056 af, Depth= 2.85"

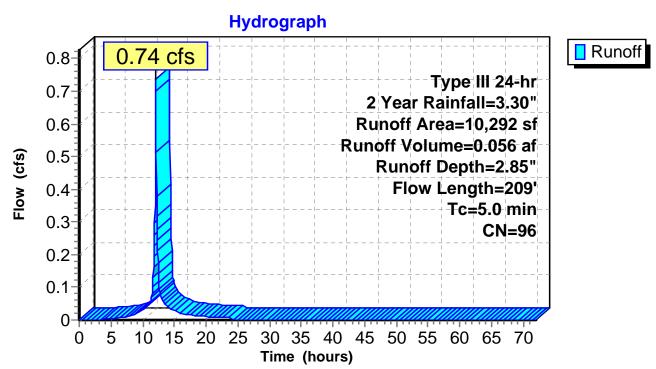
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2 Year Rainfall=3.30"

| A | rea (sf) | CN D | escription | | | | | | |
|-------|----------|-------------------------|------------|------------|------------------------------------|--|--|--|--|
| | 7,907 | 98 Paved parking, HSG D | | | | | | | |
| | 1,022 | 80 > | · • | | | | | | |
| | 1,363 | 98 F | , , | | | | | | |
| • | 10,292 | 96 V | Veighted A | verage | | | | | |
| | 1,022 | 9 | .93% Perv | ious Area | | | | | |
| | 9,270 | 9 | 0.07% lmp | ervious Ar | ea | | | | |
| | | | | | | | | | |
| Tc | Length | Slope | Velocity | Capacity | Description | | | | |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | |
| 0.9 | 50 | 0.0100 | 0.92 | | Sheet Flow, A-B | | | | |
| | | | | | Smooth surfaces n= 0.011 P2= 3.30" | | | | |
| 0.5 | 53 | 0.0090 | 1.93 | | Shallow Concentrated Flow, B-C | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | |
| 0.3 | 106 | 0.0850 | 5.92 | | Shallow Concentrated Flow, C-D | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | |
| 3.3 | | | | | Direct Entry, DIRECT | | | | |
| 5.0 | 209 | Total | | | | | | | |

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Subcatchment WsA: Watershed A



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Summary for Subcatchment WsB: Watershed B

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.86 cfs @ 12.07 hrs, Volume= 0.064 af, Depth= 2.64"

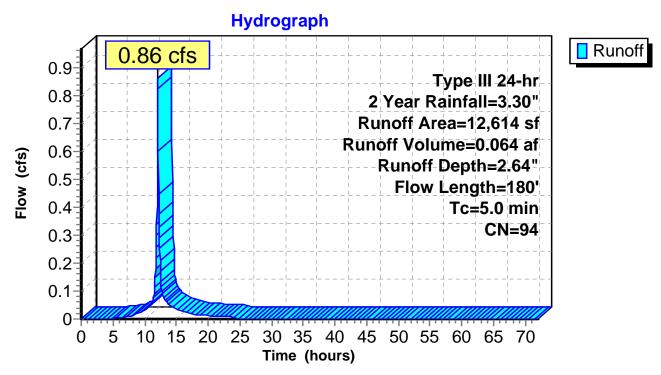
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2 Year Rainfall=3.30"

| | Area (sf) | CN D | escription | | | | | |
|-------|-----------|---------|------------------------|------------|---|--|--|--|
| | 9,618 | 98 P | aved park | ing, HSG D | | | | |
| | 2,623 | | | • | ood, HSG D | | | |
| | 373 | 98 R | loofs, HSG | 6 D | | | | |
| | 12,614 | | Veighted A | • | | | | |
| | 2,623 | | 20.79% Pervious Area | | | | | |
| | 9,991 | 7 | 79.21% Impervious Area | | | | | |
| Tc | Length | Slope | Velocity | Capacity | Description | | | |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | Description | | | |
| 1.0 | | 0.1850 | 0.30 | (0.0) | Sheet Flow, A-B | | | |
| 1.0 | 10 | 0.1000 | 0.00 | | Grass: Short n= 0.150 P2= 3.30" | | | |
| 0.3 | 31 | 0.0800 | 1.92 | | Sheet Flow, B-C | | | |
| | | | | | Smooth surfaces n= 0.011 P2= 3.30" | | | |
| 0.3 | 62 | 0.0350 | 3.80 | | Shallow Concentrated Flow, C-D | | | |
| | | | | | Paved Kv= 20.3 fps | | | |
| 0.3 | 58 | 0.0330 | 3.69 | | Shallow Concentrated Flow, D-E | | | |
| | 4.0 | | = 00 | 4.00 | Paved Kv= 20.3 fps | | | |
| 0.0 | 10 | 0.0200 | 7.39 | 4.03 | Pipe Channel, E-F | | | |
| | | | | | 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' | | | |
| 3.1 | | | | | n= 0.010 PVC, smooth interior Direct Entry, DIRECT | | | |
| | 100 | Total | | | Direct Entry, DIRECT | | | |
| 5.0 | 180 | Total | | | | | | |

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Subcatchment WsB: Watershed B



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Summary for Subcatchment WsC: Watershed C

[49] Hint: Tc<2dt may require smaller dt

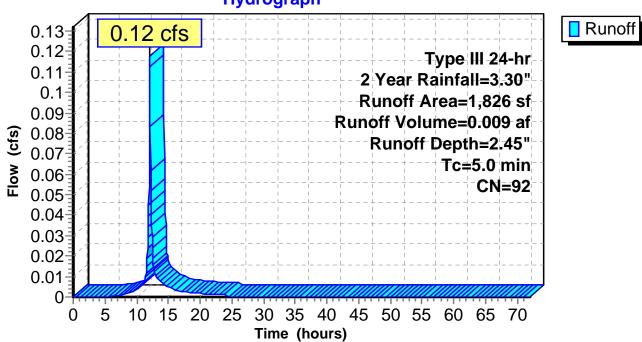
0.12 cfs @ 12.07 hrs, Volume= 0.009 af, Depth= 2.45" Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2 Year Rainfall=3.30"

| _ | Α | rea (sf) | CN | Description | | | | | | | | |
|---|-------|--------------|--------|--|----------|----------------------|--|--|--|--|--|--|
| | | 311 | 98 | Paved parking, HSG D | | | | | | | | |
| | | 658 | 80 | >75% Grass cover, Good, HSG D | | | | | | | | |
| _ | | 857 | 98 | Roofs, HSG D | | | | | | | | |
| | | 1,826 658 | | Weighted Average 36.04% Pervious Area | | | | | | | | |
| | | 1,168 | | 63.96% Impervious Area | | | | | | | | |
| | Tc | Length | Slope | , | Capacity | · | | | | | | |
| _ | (min) | (feet) | (ft/ft |) (ft/sec) | (cfs) | | | | | | | |
| | 5.0 | | | | | Direct Entry, DIRECT | | | | | | |

Subcatchment WsC: Watershed C

Hydrograph



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Summary for Link A: POA A

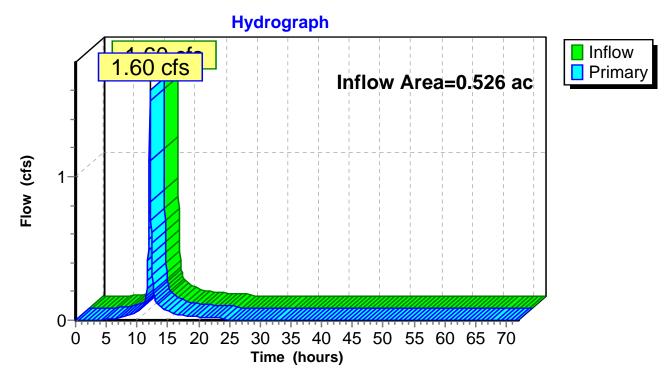
Inflow Area = 0.526 ac, 84.09% Impervious, Inflow Depth = 2.73" for 2 Year event

Inflow = 1.60 cfs @ 12.07 hrs, Volume= 0.120 af

Primary = 1.60 cfs @ 12.07 hrs, Volume= 0.120 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link A: POA A



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Summary for Link B: POA B

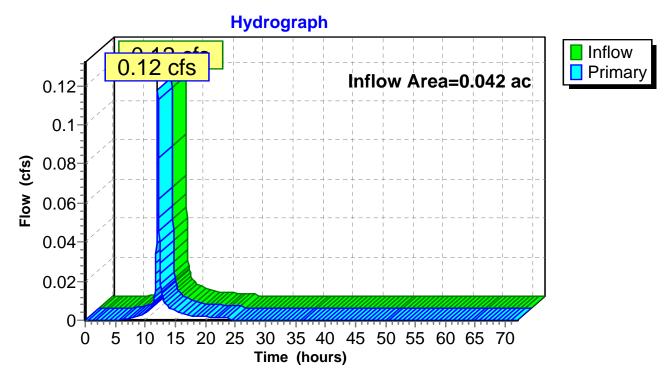
Inflow Area = 0.042 ac, 63.96% Impervious, Inflow Depth = 2.45" for 2 Year event

Inflow = 0.12 cfs @ 12.07 hrs, Volume= 0.009 af

Primary = 0.12 cfs @ 12.07 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link B: POA B



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Summary for Link S: POA CITY SYSTEM

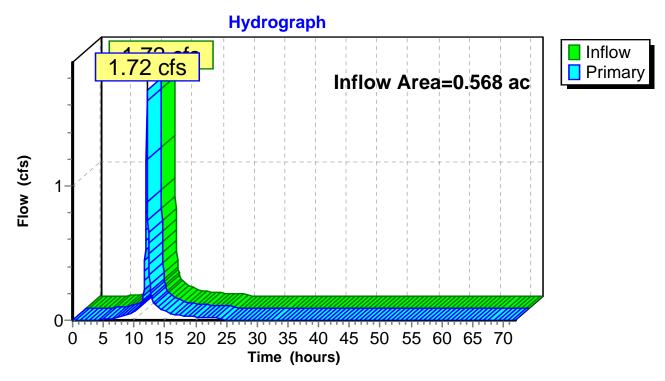
Inflow Area = 0.568 ac, 82.60% Impervious, Inflow Depth = 2.71" for 2 Year event

Inflow = 1.72 cfs @ 12.07 hrs, Volume= 0.128 af

Primary = 1.72 cfs @ 12.07 hrs, Volume= 0.128 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link S: POA CITY SYSTEM



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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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 WsA: Watershed A Runoff Area=10,292 sf 90.07% Impervious Runoff Depth=4.41"

Flow Length=209' Tc=5.0 min CN=96 Runoff=1.12 cfs 0.087 af

Subcatchment WsB: Watershed B Runoff Area=12,614 sf 79.21% Impervious Runoff Depth=4.19"

Flow Length=180' Tc=5.0 min CN=94 Runoff=1.33 cfs 0.101 af

Subcatchment WsC: Watershed C Runoff Area=1,826 sf 63.96% Impervious Runoff Depth=3.97"

Tc=5.0 min CN=92 Runoff=0.19 cfs 0.014 af

Link A: POA A Inflow=2.45 cfs 0.188 af

Primary=2.45 cfs 0.188 af

Link B: POA B Inflow=0.19 cfs 0.014 af

Primary=0.19 cfs 0.014 af

Link S: POA CITY SYSTEM Inflow=2.64 cfs 0.202 af

Primary=2.64 cfs 0.202 af

Total Runoff Area = 0.568 ac Runoff Volume = 0.202 af Average Runoff Depth = 4.27" 17.40% Pervious = 0.099 ac 82.60% Impervious = 0.469 ac HydroCAD® 10.00-13 s/n 08358 © 2014 HydroCAD Software Solutions LLC

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Summary for Subcatchment WsA: Watershed A

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.12 cfs @ 12.07 hrs, Volume= 0.087 af, Depth= 4.41"

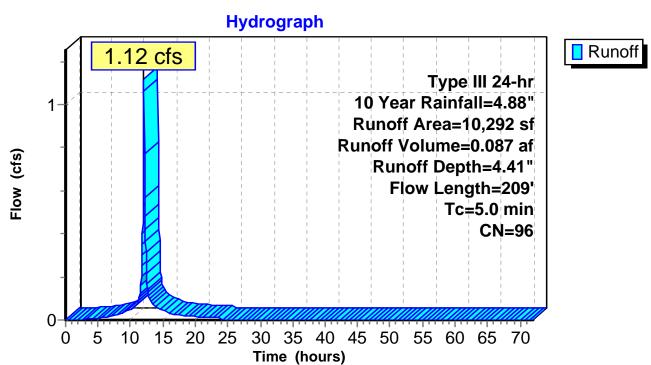
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10 Year Rainfall=4.88"

| _ | Α | rea (sf) | CN E | Description | | | | | | |
|---|-------|----------|-------------------------|----------------------------------|-------------|------------------------------------|--|--|--|--|
| | | 7,907 | 98 Paved parking, HSG D | | | | | | | |
| | | 1,022 | 80 > | 80 >75% Grass cover, Good, HSG D | | | | | | |
| _ | | 1,363 | 98 F | 98 Roofs, HSG D | | | | | | |
| | | 10,292 | 96 V | Veighted A | verage | | | | | |
| | | 1,022 | 9 | .93% Perv | ious Area | | | | | |
| | | 9,270 | 9 | 0.07% Imp | pervious Ar | ea | | | | |
| | | | | | | | | | | |
| | Tc | Length | Slope | Velocity | Capacity | Description | | | | |
| _ | (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | |
| | 0.9 | 50 | 0.0100 | 0.92 | | Sheet Flow, A-B | | | | |
| | | | | | | Smooth surfaces n= 0.011 P2= 3.30" | | | | |
| | 0.5 | 53 | 0.0090 | 1.93 | | Shallow Concentrated Flow, B-C | | | | |
| | | | | | | Paved Kv= 20.3 fps | | | | |
| | 0.3 | 106 | 0.0850 | 5.92 | | Shallow Concentrated Flow, C-D | | | | |
| | | | | | | Paved Kv= 20.3 fps | | | | |
| _ | 3.3 | | | | | Direct Entry, DIRECT | | | | |
| | 5.0 | 209 | Total | | | | | | | |

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Subcatchment WsA: Watershed A



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Summary for Subcatchment WsB: Watershed B

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.33 cfs @ 12.07 hrs, Volume= 0.101 af, Depth= 4.19"

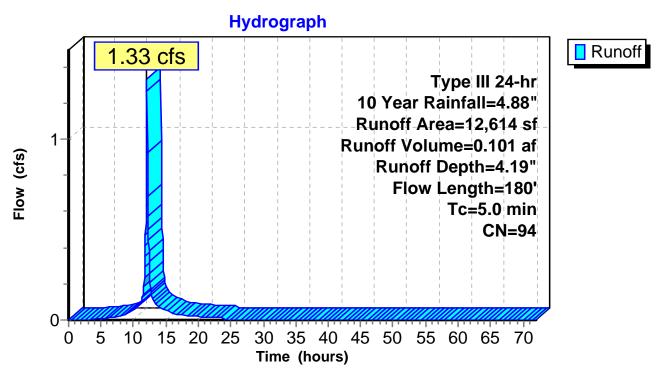
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10 Year Rainfall=4.88"

| A | rea (sf) | CN D | escription | | |
|---|---|---------|----------------|-------------|---|
| 9,618 98 Paved parking, HSG D 2,623 80 >75% Grass cover, God | | | | | |
| | iou, 1100 D | | | | |
| | 12,614 | | /eighted A | - | |
| | 2,623 20.79% Pervious Area 9,991 79.21% Impervious Are | | | | |
| | 3,331 | , | J.2 1 /0 IIIIp | CIVIOUS AIR | 54 |
| Tc | Length | Slope | Velocity | Capacity | Description |
| <u>(min)</u> | (feet) | (ft/ft) | (ft/sec) | (cfs) | |
| 1.0 | 19 | 0.1850 | 0.30 | | Sheet Flow, A-B |
| | | | | | Grass: Short n= 0.150 P2= 3.30" |
| 0.3 | 31 | 0.0800 | 1.92 | | Sheet Flow, B-C |
| | | | | | Smooth surfaces n= 0.011 P2= 3.30" |
| 0.3 | 62 | 0.0350 | 3.80 | | Shallow Concentrated Flow, C-D |
| | | | | | Paved Kv= 20.3 fps |
| 0.3 | 58 | 0.0330 | 3.69 | | Shallow Concentrated Flow, D-E |
| | | | | | Paved Kv= 20.3 fps |
| 0.0 | 10 | 0.0200 | 7.39 | 4.03 | Pipe Channel, E-F |
| | | | | | 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' |
| | | | | | n= 0.010 PVC, smooth interior |
| 3.1 | | | | | Direct Entry, DIRECT |
| 5.0 | 180 | Total | | | |

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Subcatchment WsB: Watershed B



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Summary for Subcatchment WsC: Watershed C

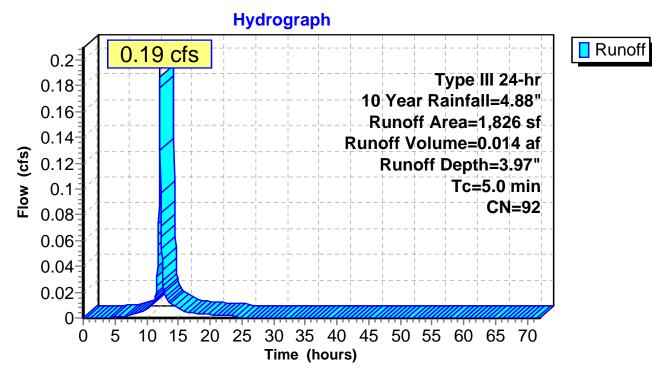
[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.19 cfs @ 12.07 hrs, Volume= 0.014 af, Depth= 3.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10 Year Rainfall=4.88"

| A | rea (sf) | CN | Description | | | | | | | |
|-------|----------|--------|-------------------------------|----------|----------------------|--|--|--|--|--|
| | 311 | 98 | Paved parking, HSG D | | | | | | | |
| | 658 | 80 | >75% Grass cover, Good, HSG D | | | | | | | |
| | 857 | 98 | Roofs, HSG D | | | | | | | |
| | 1,826 | 92 | Weighted Average | | | | | | | |
| | 658 | | 36.04% Pervious Area | | | | | | | |
| | 1,168 | | 63.96% Impervious Area | | | | | | | |
| _ | | | | | | | | | | |
| Tc | Length | Slope | , | Capacity | · | | | | | |
| (min) | (feet) | (ft/ft | (ft/sec) | (cfs) | | | | | | |
| 5.0 | | | | | Direct Entry, DIRECT | | | | | |

Subcatchment WsC: Watershed C



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Summary for Link A: POA A

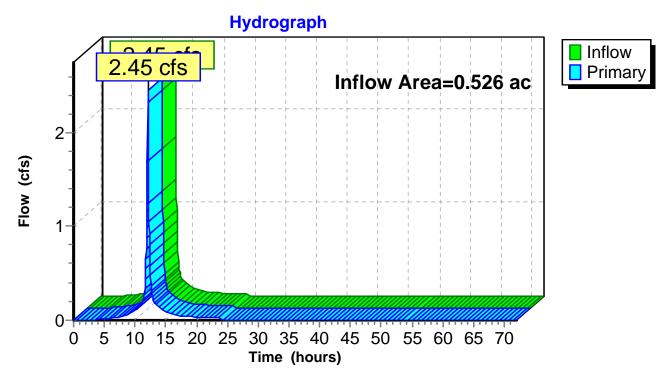
0.526 ac, 84.09% Impervious, Inflow Depth = 4.29" for 10 Year event Inflow Area =

Inflow 2.45 cfs @ 12.07 hrs, Volume= 0.188 af

2.45 cfs @ 12.07 hrs, Volume= 0.188 af, Atten= 0%, Lag= 0.0 min Primary

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link A: POA A



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Summary for Link B: POA B

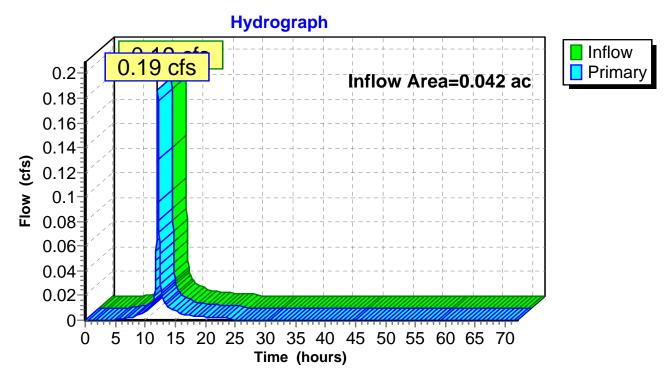
Inflow Area = 0.042 ac, 63.96% Impervious, Inflow Depth = 3.97" for 10 Year event

Inflow = 0.19 cfs @ 12.07 hrs, Volume= 0.014 af

Primary = 0.19 cfs @ 12.07 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link B: POA B



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Summary for Link S: POA CITY SYSTEM

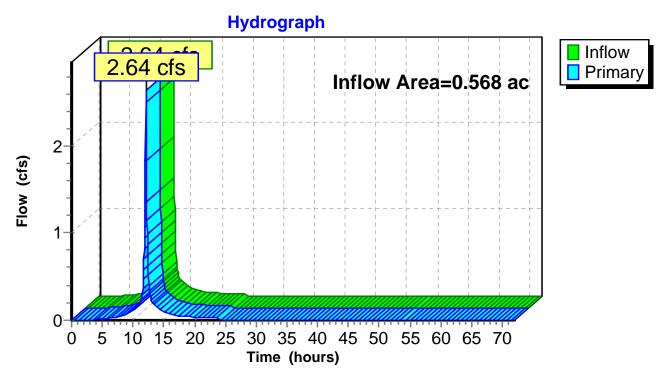
Inflow Area = 0.568 ac, 82.60% Impervious, Inflow Depth = 4.27" for 10 Year event

Inflow = 2.64 cfs @ 12.07 hrs, Volume= 0.202 af

Primary = 2.64 cfs @ 12.07 hrs, Volume= 0.202 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link S: POA CITY SYSTEM



Type III 24-hr 25 Year Rainfall=6.10"

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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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 WsA: Watershed A Runoff Area=10,292 sf 90.07% Impervious Runoff Depth=5.63"

Flow Length=209' Tc=5.0 min CN=96 Runoff=1.41 cfs 0.111 af

Subcatchment WsB: Watershed B Runoff Area=12,614 sf 79.21% Impervious Runoff Depth=5.40"

Flow Length=180' Tc=5.0 min CN=94 Runoff=1.69 cfs 0.130 af

Subcatchment WsC: Watershed C Runoff Area=1,826 sf 63.96% Impervious Runoff Depth=5.17"

Tc=5.0 min CN=92 Runoff=0.24 cfs 0.018 af

Link A: POA A Inflow=3.10 cfs 0.241 af

Primary=3.10 cfs 0.241 af

Link B: POA B Inflow=0.24 cfs 0.018 af

Primary=0.24 cfs 0.018 af

Link S: POA CITY SYSTEM Inflow=3.34 cfs 0.259 af

Primary=3.34 cfs 0.259 af

Total Runoff Area = 0.568 ac Runoff Volume = 0.259 af Average Runoff Depth = 5.48" 17.40% Pervious = 0.099 ac 82.60% Impervious = 0.469 ac

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Summary for Subcatchment WsA: Watershed A

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.41 cfs @ 12.07 hrs, Volume= 0.111 af, Depth= 5.63"

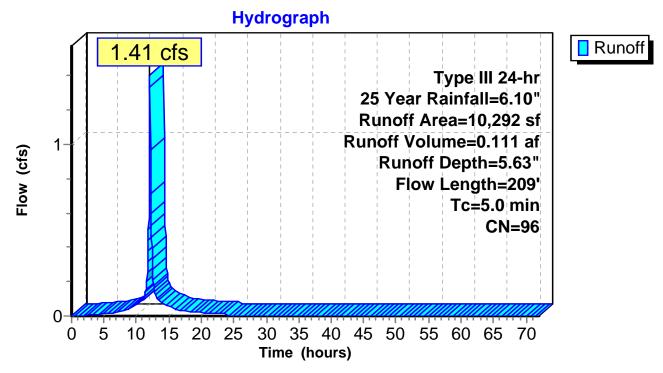
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25 Year Rainfall=6.10"

| A | rea (sf) | CN D | escription | | | | | | | |
|--------|----------|---------|----------------------|-------------|------------------------------------|--|--|--|--|--|
| | 7,907 | 98 F | Paved parking, HSG D | | | | | | | |
| | 1,022 | 80 > | 75% Gras | s cover, Go | ood, HSG D | | | | | |
| | 1,363 | 98 F | Roofs, HSG | D D | | | | | | |
| | 10,292 | 96 V | Veighted A | verage | | | | | | |
| | 1,022 | 9 | .93% Perv | ious Area | | | | | | |
| | 9,270 | 9 | 0.07% lmp | ervious Ar | ea | | | | | |
| _ | | | | | | | | | | |
| Tc | Length | Slope | Velocity | Capacity | Description | | | | | |
| (min)_ | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | | |
| 0.9 | 50 | 0.0100 | 0.92 | | Sheet Flow, A-B | | | | | |
| | | | | | Smooth surfaces n= 0.011 P2= 3.30" | | | | | |
| 0.5 | 53 | 0.0090 | 1.93 | | Shallow Concentrated Flow, B-C | | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | | |
| 0.3 | 106 | 0.0850 | 5.92 | | Shallow Concentrated Flow, C-D | | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | | |
| 3.3 | | | | | Direct Entry, DIRECT | | | | | |
| 5.0 | 209 | Total | | | | | | | | |

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Summary for Subcatchment WsB: Watershed B

[49] Hint: Tc<2dt may require smaller dt

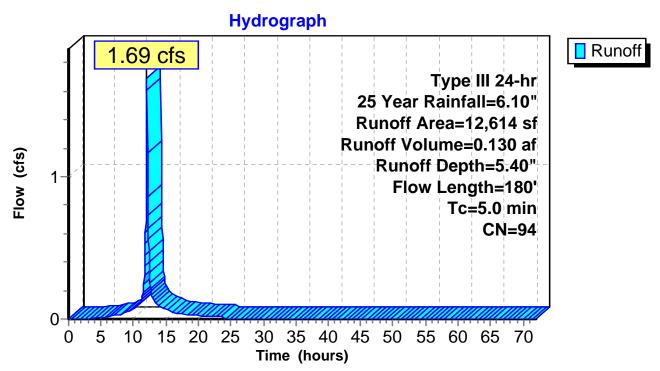
Runoff = 1.69 cfs @ 12.07 hrs, Volume= 0.130 af, Depth= 5.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25 Year Rainfall=6.10"

| A | rea (sf) | CN D | escription | | | | | | |
|--------------|----------------|---------|------------|----------------------------|---|--|--|--|--|
| | 9,618 | | 1 0, | | | | | | |
| | 2,623 373 | | oofs, HSC | • | , nsg D | | | | |
| | 12,614 | | Veighted A | • | | | | | |
| | 2,623 9,991 | | | vious Area pervious Are | | | | | |
| Тс | Length | Slope | Velocity | Capacity | Description | | | | |
| <u>(min)</u> | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | |
| 1.0 | 19 | 0.1850 | 0.30 | | Sheet Flow, A-B | | | | |
| | | | | | Grass: Short n= 0.150 P2= 3.30" | | | | |
| 0.3 | 31 | 0.0800 | 1.92 | | Sheet Flow, B-C | | | | |
| | | | | | Smooth surfaces n= 0.011 P2= 3.30" | | | | |
| 0.3 | 62 | 0.0350 | 3.80 | | Shallow Concentrated Flow, C-D | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | |
| 0.3 | 58 | 0.0330 | 3.69 | | Shallow Concentrated Flow, D-E | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | |
| 0.0 | 10 | 0.0200 | 7.39 | 4.03 | · · · · · · · · · · · · · · · · · · · | | | | |
| | | | | | 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' | | | | |
| | | | | | n= 0.010 PVC, smooth interior | | | | |
| 3.1 | | | | | Direct Entry, DIRECT | | | | |
| 5.0 | 180 | Total | | | | | | | |

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Subcatchment WsB: Watershed B



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Runoff

Summary for Subcatchment WsC: Watershed C

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.24 cfs @ 12.07 hrs, Volume= 0.018 af, Depth= 5.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25 Year Rainfall=6.10"

| | rea (sf) | CN | Description | | | | | | | |
|--------------|----------|--------|----------------------|-------------|----------------------|--|--|--|--|--|
| | 311 | 98 | Paved park | ing, HSG D | D | | | | | |
| | 658 | 80 | >75% Gras | s cover, Go | lood, HSG D | | | | | |
| | 857 | 98 | Roofs, HSG | B D | | | | | | |
| | 1,826 | 92 | Weighted Average | | | | | | | |
| | 658 | | 36.04% Pervious Area | | | | | | | |
| | 1,168 | | 63.96% lmp | pervious Ar | rea | | | | | |
| | | | | | | | | | | |
| Tc | - 3 | Slope | , | Capacity | • | | | | | |
| <u>(min)</u> | (feet) | (ft/ft | (ft/sec) | (cfs) | | | | | | |
| 5.0 | | | | | Direct Entry, DIRECT | | | | | |

Subcatchment WsC: Watershed C

Hydrograph 0.24 cfs 0.26 -0.24-Type III 24-hr 0.22 -25 Year Rainfall=6.10" 0.2^{-1} Runoff Area=1,826 sf 0.18 Runoff Volume=0.018 af 0.16-Runoff Depth=5.17" 0.14Tc=5.0 min 0.12-CN=92 0.1^{-} 0.08^{-1} 0.06- 0.04^{-3} 0.02 -0 30 35 40 45 50 55 60 65 70 10 15 20 25 Time (hours)

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Summary for Link A: POA A

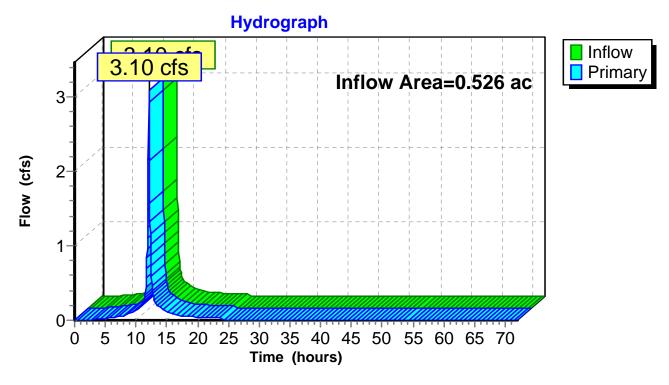
Inflow Area = 0.526 ac, 84.09% Impervious, Inflow Depth = 5.50" for 25 Year event

Inflow = 3.10 cfs @ 12.07 hrs, Volume= 0.241 af

Primary = 3.10 cfs @ 12.07 hrs, Volume= 0.241 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link A: POA A



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Summary for Link B: POA B

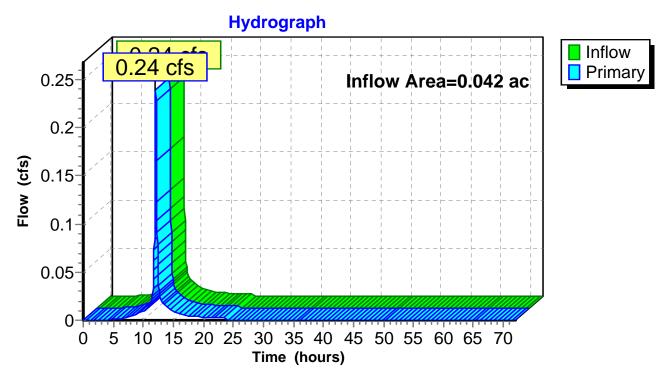
Inflow Area = 0.042 ac, 63.96% Impervious, Inflow Depth = 5.17" for 25 Year event

Inflow = 0.24 cfs @ 12.07 hrs, Volume= 0.018 af

Primary = 0.24 cfs @ 12.07 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link B: POA B



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Summary for Link S: POA CITY SYSTEM

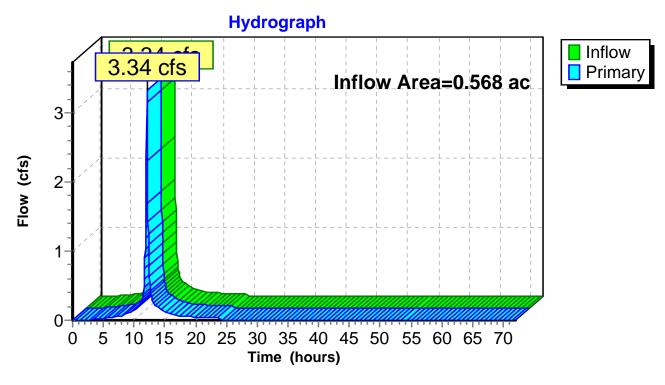
Inflow Area = 0.568 ac, 82.60% Impervious, Inflow Depth = 5.48" for 25 Year event

Inflow = 3.34 cfs @ 12.07 hrs, Volume= 0.259 af

Primary = 3.34 cfs @ 12.07 hrs, Volume= 0.259 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link S: POA CITY SYSTEM



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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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 WsA: Watershed A Runoff Area=10,292 sf 90.07% Impervious Runoff Depth=8.08"

Flow Length=209' Tc=5.0 min CN=96 Runoff=1.99 cfs 0.159 af

Subcatchment WsB: Watershed B Runoff Area=12,614 sf 79.21% Impervious Runoff Depth=7.84"

Flow Length=180' Tc=5.0 min CN=94 Runoff=2.41 cfs 0.189 af

Subcatchment WsC: Watershed C Runoff Area=1,826 sf 63.96% Impervious Runoff Depth=7.60"

Tc=5.0 min CN=92 Runoff=0.34 cfs 0.027 af

Link A: POA A Inflow=4.40 cfs 0.348 af

Primary=4.40 cfs 0.348 af

Link B: POA B Inflow=0.34 cfs 0.027 af

Primary=0.34 cfs 0.027 af

Link S: POA CITY SYSTEM Inflow=4.74 cfs 0.375 af

Primary=4.74 cfs 0.375 af

Total Runoff Area = 0.568 ac Runoff Volume = 0.375 af Average Runoff Depth = 7.92" 17.40% Pervious = 0.099 ac 82.60% Impervious = 0.469 ac

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Summary for Subcatchment WsA: Watershed A

[49] Hint: Tc<2dt may require smaller dt

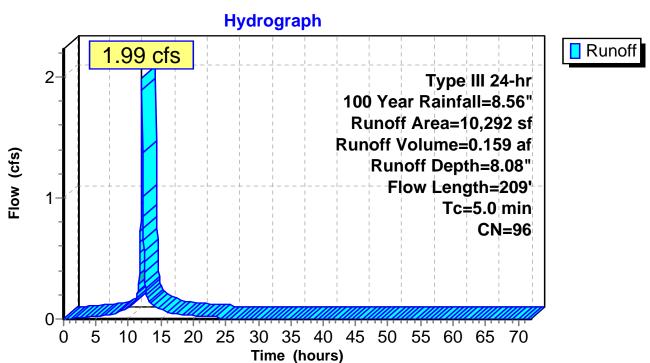
Runoff = 1.99 cfs @ 12.07 hrs, Volume= 0.159 af, Depth= 8.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100 Year Rainfall=8.56"

| | rea (sf) | CN D | escription | | | | | | | |
|-------|----------|---------|----------------------|-------------|------------------------------------|--|--|--|--|--|
| | 7,907 | 98 P | Paved parking, HSG D | | | | | | | |
| | 1,022 | 80 > | 75% Grass | s cover, Go | ood, HSG D | | | | | |
| | 1,363 | 98 R | Roofs, HSG | i D | | | | | | |
| | 10,292 | 96 V | Veighted A | verage | | | | | | |
| | 1,022 | 9 | .93% Perv | ious Area | | | | | | |
| | 9,270 | 9 | 0.07% Imp | ervious Ar | ea | | | | | |
| | | | | | | | | | | |
| Tc | Length | Slope | Velocity | Capacity | Description | | | | | |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | | |
| 0.9 | 50 | 0.0100 | 0.92 | | Sheet Flow, A-B | | | | | |
| | | | | | Smooth surfaces n= 0.011 P2= 3.30" | | | | | |
| 0.5 | 53 | 0.0090 | 1.93 | | Shallow Concentrated Flow, B-C | | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | | |
| 0.3 | 106 | 0.0850 | 5.92 | | Shallow Concentrated Flow, C-D | | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | | |
| 3.3 | | | | | Direct Entry, DIRECT | | | | | |
| 5.0 | 209 | Total | | | | | | | | |

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Subcatchment WsA: Watershed A



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Summary for Subcatchment WsB: Watershed B

[49] Hint: Tc<2dt may require smaller dt

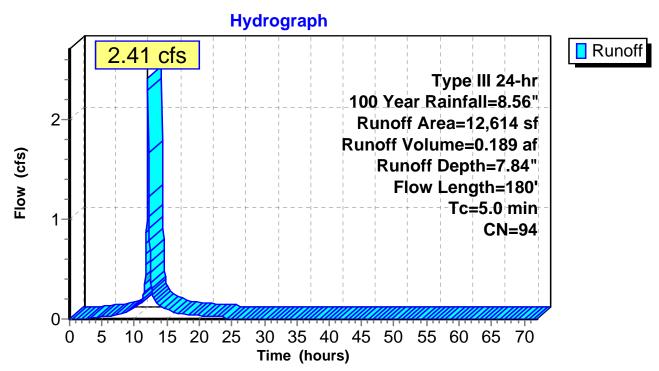
Runoff 2.41 cfs @ 12.07 hrs, Volume= 0.189 af, Depth= 7.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100 Year Rainfall=8.56"

| | Α | rea (sf) | CN D | escription | | | | | | | |
|----|-----|--------------|---------|------------------------|--------------|--|--|--|--|--|--|
| | | 9,618 | | 1 0, | | | | | | | |
| | | 2,623 373 | | 75% Gras .oofs, HSC | | ood, HSG D | | | | | |
| | | 12,614 | | /eighted A | | | | | | | |
| | | 2,623 | | • | vious Area | | | | | | |
| | | 9,991 | 7 | 9.21% lmp | pervious Are | ea | | | | | |
| | Тс | Length | Slope | Velocity | Capacity | Description | | | | | |
| (m | in) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | | |
| | 1.0 | 19 | 0.1850 | 0.30 | | Sheet Flow, A-B | | | | | |
| | | | | | | Grass: Short n= 0.150 P2= 3.30" | | | | | |
| (| 0.3 | 31 | 0.0800 | 1.92 | | Sheet Flow, B-C | | | | | |
| (| 0.3 | 62 | 0.0350 | 3.80 | | Smooth surfaces n= 0.011 P2= 3.30" Shallow Concentrated Flow, C-D | | | | | |
| , | 0.0 | 02 | 0.0000 | 0.00 | | Paved Kv= 20.3 fps | | | | | |
| (| 0.3 | 58 | 0.0330 | 3.69 | | Shallow Concentrated Flow, D-E | | | | | |
| | | 4.0 | | = 00 | 4.00 | Paved Kv= 20.3 fps | | | | | |
| (| 0.0 | 10 | 0.0200 | 7.39 | 4.03 | Pipe Channel, E-F 10.0" Round Area= 0.5 sf Perim= 2.6' r= 0.21' | | | | | |
| | | | | | | n= 0.010 PVC, smooth interior | | | | | |
| ; | 3.1 | | | | | Direct Entry, DIRECT | | | | | |
| | 5.0 | 180 | Total | | | | | | | | |

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Subcatchment WsB: Watershed B



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Summary for Subcatchment WsC: Watershed C

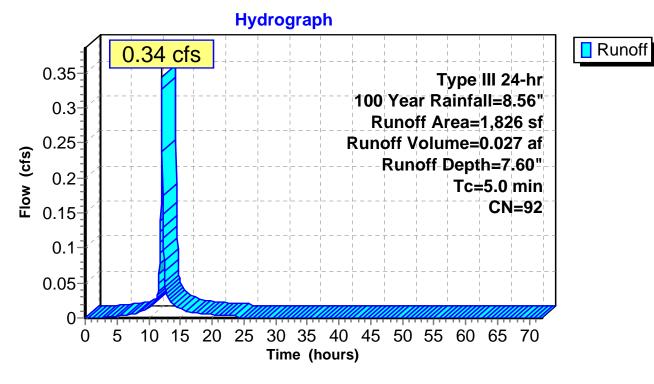
[49] Hint: Tc<2dt may require smaller dt

0.34 cfs @ 12.07 hrs, Volume= 0.027 af, Depth= 7.60" Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100 Year Rainfall=8.56"

| | rea (sf) | CN | Description | | | | | | | |
|--------------|----------|---------|------------------|-------------|----------------------|--|--|--|--|--|
| | 311 | 98 | Paved park | ing, HSG D | | | | | | |
| | 658 | 80 | >75% Gras | s cover, Go | ood, HSG D | | | | | |
| | 857 | 98 | Roofs, HSC | D D | | | | | | |
| | 1,826 | 92 | Weighted Average | | | | | | | |
| | 658 | | 36.04% Pei | vious Area | A | | | | | |
| | 1,168 | | 63.96% lmp | pervious Ar | rea | | | | | |
| | | | | | | | | | | |
| Tc | - 3 | Slope | , | Capacity | Description | | | | | |
| <u>(min)</u> | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | | |
| 5.0 | | | | | Direct Entry, DIRECT | | | | | |

Subcatchment WsC: Watershed C



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Summary for Link A: POA A

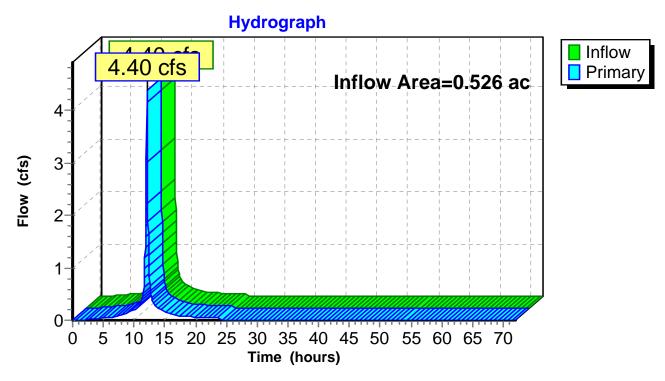
Inflow Area = 0.526 ac, 84.09% Impervious, Inflow Depth = 7.95" for 100 Year event

Inflow = 4.40 cfs @ 12.07 hrs, Volume= 0.348 af

Primary = 4.40 cfs @ 12.07 hrs, Volume= 0.348 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link A: POA A



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Summary for Link B: POA B

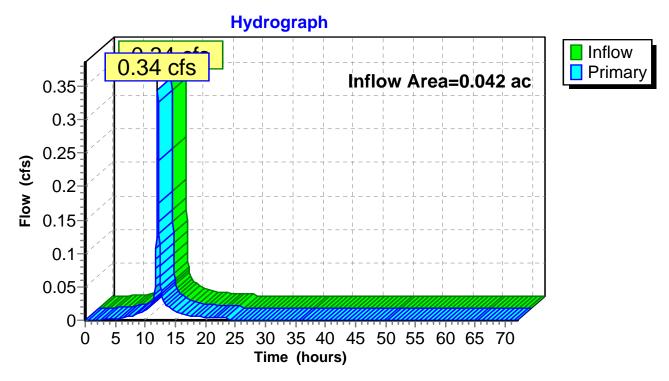
Inflow Area = 0.042 ac, 63.96% Impervious, Inflow Depth = 7.60" for 100 Year event

Inflow = 0.34 cfs @ 12.07 hrs, Volume= 0.027 af

Primary = 0.34 cfs @ 12.07 hrs, Volume= 0.027 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link B: POA B



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Summary for Link S: POA CITY SYSTEM

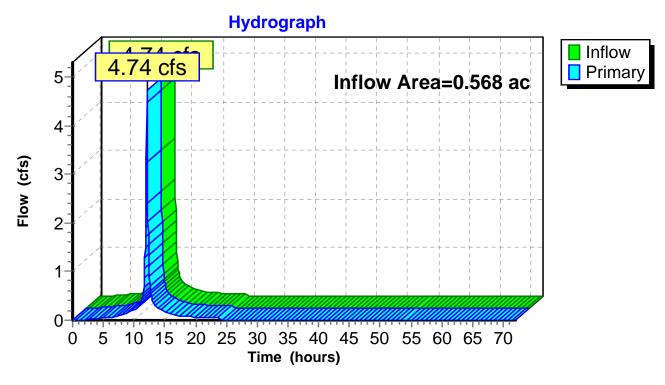
Inflow Area = 0.568 ac, 82.60% Impervious, Inflow Depth = 7.92" for 100 Year event

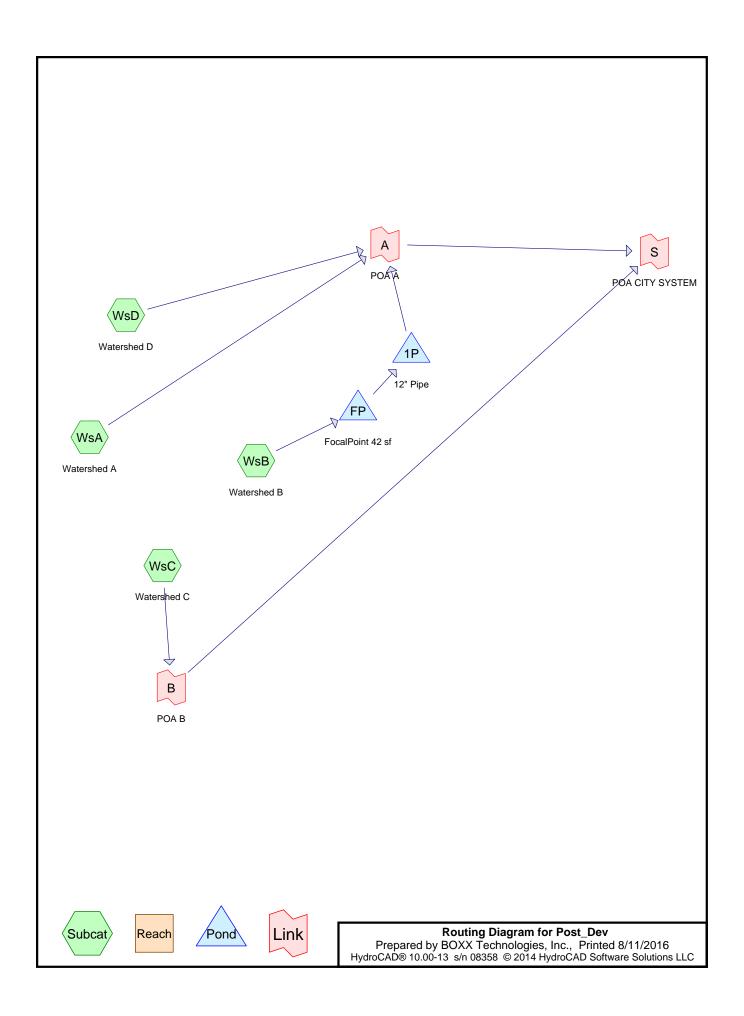
Inflow = 4.74 cfs @ 12.07 hrs, Volume= 0.375 af

Primary = 4.74 cfs @ 12.07 hrs, Volume= 0.375 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link S: POA CITY SYSTEM





Post_Dev

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Area Listing (all nodes)

| Area | CN | Description |
|---------|----|--|
| (acres) | | (subcatchment-numbers) |
| 0.134 | 80 | >75% Grass cover, Good, HSG D (WsA, WsB, WsC, WsD) |
| 0.372 | 98 | Paved parking, HSG D (WsA, WsB, WsC, WsD) |
| 0.003 | 90 | Pervious Pavers (WsC) |
| 0.060 | 98 | Unconnected roofs, HSG D (WsA, WsC) |
| 0.568 | 94 | TOTAL AREA |

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Soil Listing (all nodes)

| Area | Soil | Subcatchment |
|---------|-------|--------------------|
| (acres) | Group | Numbers |
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 0.000 | HSG C | |
| 0.565 | HSG D | WsA, WsB, WsC, WsD |
| 0.003 | Other | WsC |
| 0.568 | | TOTAL AREA |

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Ground Covers (all nodes)

| HSG- (acres | | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|----------------|-------|------------------|------------------|---------------|---------------|------------------------|-------------------------|
| 0.00 | 0.000 | 0.000 | 0.134 | 0.000 | 0.134 | >75% Grass cover, Good | WsA, |
| | | | | | | | WsB, |
| | | | | | | | WsC, |
| | | | | | | | WsD |
| 0.00 | 0.000 | 0.000 | 0.372 | 0.000 | 0.372 | Paved parking | WsA, |
| | | | | | | | WsB, |
| | | | | | | | WsC, |
| | | | | | | | WsD |
| 0.00 | 0.000 | 0.000 | 0.000 | 0.003 | 0.003 | Pervious Pavers | WsC |
| 0.00 | 0.000 | 0.000 | 0.060 | 0.000 | 0.060 | Unconnected roofs | WsA, |
| | | | | | | | WsC |
| 0.00 | 0.000 | 0.000 | 0.565 | 0.003 | 0.568 | TOTAL AREA | |

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Pipe Listing (all nodes)

| Line# | Node | In-Invert | Out-Invert | Length | Slope | n | Diam/Width | Height | Inside-Fill |
|-------|--------|-----------|------------|--------|---------|-------|------------|----------|-------------|
| | Number | (feet) | (feet) | (feet) | (ft/ft) | | (inches) | (inches) | (inches) |
| 1 | WsA | 0.00 | 0.00 | 21.0 | 0.0120 | 0.013 | 12.0 | 0.0 | 0.0 |
| 2 | WsA | 0.00 | 0.00 | 98.0 | 0.0100 | 0.013 | 12.0 | 0.0 | 0.0 |
| 3 | WsA | 0.00 | 0.00 | 21.0 | 0.0120 | 0.013 | 12.0 | 0.0 | 0.0 |

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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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 WsA: Watershed A Runoff Area=9,290 sf 84.06% Impervious Runoff Depth=2.74"

Flow Length=316' Tc=5.0 min CN=95 Runoff=0.65 cfs 0.049 af

Subcatchment WsB: Watershed B Runoff Area=11,748 sf 70.81% Impervious Runoff Depth=2.54"

Tc=5.0 min CN=93 Runoff=0.78 cfs 0.057 af

Subcatchment WsC: Watershed C Runoff Area=3,052 sf 68.41% Impervious Runoff Depth=2.54"

Tc=5.0 min CN=93 Runoff=0.20 cfs 0.015 af

Subcatchment WsD: Watershed D Runoff Area=644 sf 90.68% Impervious Runoff Depth=2.85"

Tc=5.0 min CN=96 Runoff=0.05 cfs 0.004 af

Pond 1P: 12" Pipe Peak Elev=89.05' Storage=0.000 af Inflow=0.79 cfs 0.055 af

Outflow=0.78 cfs 0.055 af

Pond FP: FocalPoint 42 sf Peak Elev=92.61' Storage=73 cf Inflow=0.78 cfs 0.057 af

Outflow=0.79 cfs 0.055 af

Link A: POA A Inflow=1.48 cfs 0.108 af

Primary=1.48 cfs 0.108 af

Link B: POA B Inflow=0.20 cfs 0.015 af

Primary=0.20 cfs 0.015 af

Link S: POA CITY SYSTEM Inflow=1.68 cfs 0.123 af

Primary=1.68 cfs 0.123 af

Total Runoff Area = 0.568 ac Runoff Volume = 0.124 af Average Runoff Depth = 2.63" 23.99% Pervious = 0.136 ac 76.01% Impervious = 0.432 ac

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Summary for Subcatchment WsA: Watershed A

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.65 cfs @ 12.07 hrs, Volume= 0.049 af, Depth= 2.74"

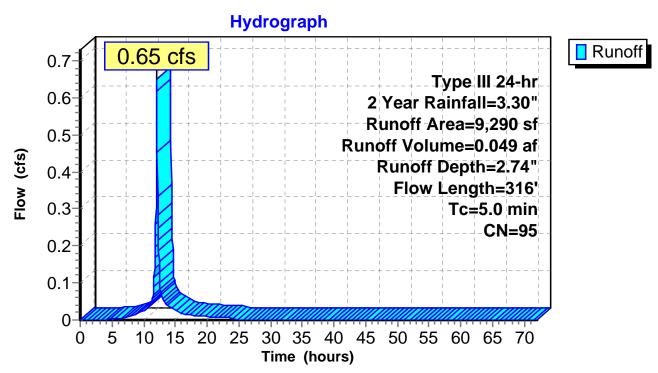
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2 Year Rainfall=3.30"

| A | rea (sf) | CN D | escription | | | | | | |
|-------|----------|---------|-------------------------------|--------------|---|--|--|--|--|
| | 6,362 | 98 F | Paved parking, HSG D | | | | | | |
| | 1,481 | | >75% Grass cover, Good, HSG D | | | | | | |
| | 1,447 | 98 L | <u>Inconnecte</u> | ed roofs, HS | SG D | | | | |
| | 9,290 | 95 V | Veighted A | verage | | | | | |
| | 1,481 | 1 | 5.94% Per | vious Area | | | | | |
| | 7,809 | | | pervious Ar | ea | | | | |
| | 1,447 | 1 | 8.53% Un | connected | | | | | |
| Tc | Length | Slope | Velocity | Capacity | Description | | | | |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | |
| 0.8 | 50 | 0.0120 | 0.99 | , | Sheet Flow, A-B | | | | |
| | | | | | Smooth surfaces n= 0.011 P2= 3.30" | | | | |
| 0.3 | 54 | 0.0200 | 2.87 | | Shallow Concentrated Flow, B-C | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | |
| 0.2 | 72 | 0.1000 | 6.42 | | Shallow Concentrated Flow, C-D | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | |
| 0.1 | 21 | 0.0120 | 4.97 | 3.90 | 1 | | | | |
| | | | | | 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | | |
| 0.4 | 00 | 0.0400 | 4 5 4 | 2.50 | n= 0.013 Corrugated PE, smooth interior | | | | |
| 0.4 | 98 | 0.0100 | 4.54 | 3.56 | Pipe Channel, E-F 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | | |
| | | | | | n= 0.013 Corrugated PE, smooth interior | | | | |
| 0.1 | 21 | 0.0120 | 4.97 | 3.90 | Pipe Channel, F-G | | | | |
| 0.1 | 21 | 0.0120 | 4.57 | 0.50 | 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | | |
| | | | | | n= 0.013 Corrugated PE, smooth interior | | | | |
| 3.1 | | | | | Direct Entry, DIRECT | | | | |
| 5.0 | 316 | Total | | | | | | | |

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Subcatchment WsA: Watershed A



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Summary for Subcatchment WsB: Watershed B

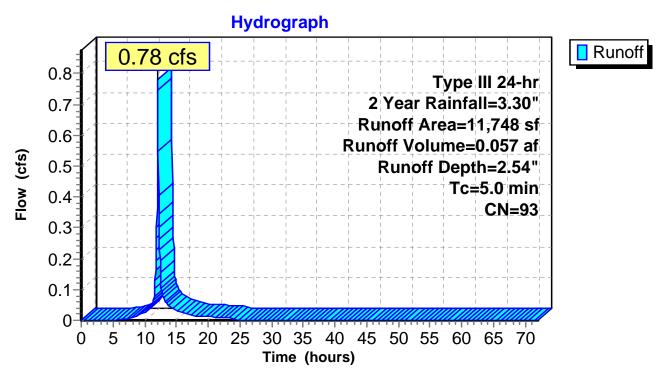
[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.78 cfs @ 12.07 hrs, Volume= 0.057 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2 Year Rainfall=3.30"

| Ar | ea (sf) | CN | Description | | | | | | |
|-------------|------------------|------------------|----------------------|-------------------|-------------------|--|--|--|--|
| | 8,319 | 98 | Paved park | ing, HSG D |) | | | | |
| | 3,429 | 80 | >75% Gras | s cover, Go | ood, HSG D | | | | |
| | 11,748 | 93 | Weighted Average | | | | | | |
| | 3,429 | | 29.19% Pervious Area | | | | | | |
| | 8,319 | | 70.81% lmp | ervious Are | ea | | | | |
| Tc (min) | Length (feet) | Slope (ft/ft) | , | Capacity (cfs) | Description | | | | |
| 5.0 | | | | | Direct Entry, Min | | | | |

Subcatchment WsB: Watershed B



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Summary for Subcatchment WsC: Watershed C

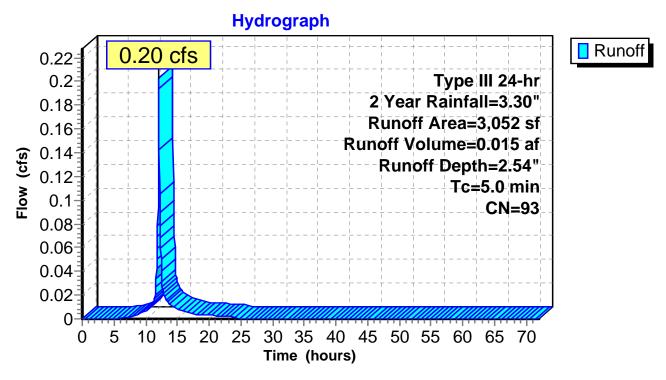
[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.20 cfs @ 12.07 hrs, Volume= 0.015 af, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2 Year Rainfall=3.30"

| | Area (sf) | CN | Description | | | |
|-------|-----------|--------|-------------------------------|----------|----------------------|--|
| | 942 | 98 | Paved parking, HSG D | | | |
| * | 113 | 90 | Pervious Pavers | | | |
| | 851 | 80 | >75% Grass cover, Good, HSG D | | | |
| | 1,146 | 98 | Unconnected roofs, HSG D | | | |
| | 3,052 | 93 | 93 Weighted Average | | | |
| | 964 | | 31.59% Pervious Area | | | |
| | 2,088 | | 68.41% Impervious Area | | | |
| | 1,146 | | 54.89% Unconnected | | | |
| | | | | | | |
| Tc | - 3 | Slope | | Capacity | • | |
| (min) | (feet) | (ft/ft |) (ft/sec) | (cfs) | | |
| 5.0 | | | | | Direct Entry, Direct | |

Subcatchment WsC: Watershed C



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Summary for Subcatchment WsD: Watershed D

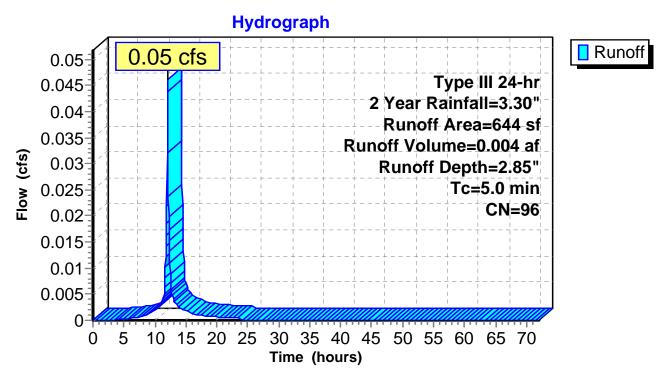
[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.05 cfs @ 12.07 hrs, Volume= 0.004 af, Depth= 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 2 Year Rainfall=3.30"

| A | rea (sf) | CN | Description | | | |
|-------------|------------------|------------------|-------------------------------|-------------------|----------------------|--|
| | 584 | 98 | Paved parking, HSG D | | | |
| | 60 | 80 | >75% Grass cover, Good, HSG D | | | |
| | 644 | 96 | Weighted Average | | | |
| | 60 | | 9.32% Pervious Area | | | |
| | 584 | | 90.68% Impervious Area | | | |
| Tc (min) | Length (feet) | Slope (ft/ft) | , | Capacity (cfs) | Description | |
| 5.0 | | | | | Direct Entry, DIRECT | |

Subcatchment WsD: Watershed D



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Summary for Pond 1P: 12" Pipe

Inflow Area = 0.270 ac, 70.81% Impervious, Inflow Depth = 2.47" for 2 Year event

Inflow = 0.79 cfs @ 12.07 hrs. Volume= 0.055 af

Outflow = 0.78 cfs @ 12.07 hrs, Volume= 0.055 af, Atten= 1%, Lag= 0.2 min

Primary = 0.78 cfs @ 12.07 hrs, Volume= 0.055 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 89.05' @ 12.07 hrs Surf.Area= 0.000 ac Storage= 0.000 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)

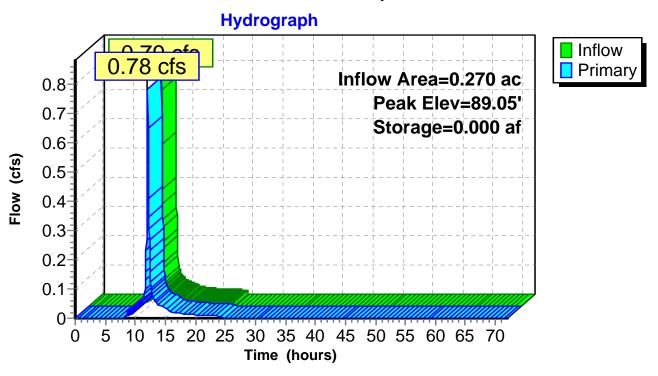
Center-of-Mass det. time= 0.2 min (801.6 - 801.4)

| <u>Volume</u> | Invert | Avail.Storage | Storage Description |
|---------------|---------|---------------|---|
| #1 | 88.60' | 0.000 af | 10.0" Round Pipe Storage L= 12.0' S= 0.0170 '/' |
| | | | L= 12.0 |
| Device | Routing | Invert Ou | itlet Devices |

#1 Primary 88.60' **12.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.75 cfs @ 12.07 hrs HW=89.04' (Free Discharge) 1=Orifice/Grate (Orifice Controls 0.75 cfs @ 2.26 fps)

Pond 1P: 12" Pipe



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Summary for Pond FP: FocalPoint 42 sf

[93] Warning: Storage range exceeded by 0.11'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=142)

Inflow Area = 0.270 ac, 70.81% Impervious, Inflow Depth = 2.54" for 2 Year event

Inflow = 0.78 cfs @ 12.07 hrs, Volume= 0.057 af

Outflow = 0.79 cfs @ 12.07 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.0 min

Primary = 0.79 cfs @ 12.07 hrs, Volume= 0.055 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 92.61' @ 12.07 hrs Surf.Area= 162 sf Storage= 73 cf

Plug-Flow detention time= 27.9 min calculated for 0.055 af (97% of inflow)

Center-of-Mass det. time= 10.7 min (801.4 - 790.7)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 89.75' | 19 cf | 6.00'W x 7.00'L x 2.25'H FocalPoint |
| | | | 95 cf Overall x 20.0% Voids |
| #2 | 92.00' | 54 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

73 cf Total Available Storage

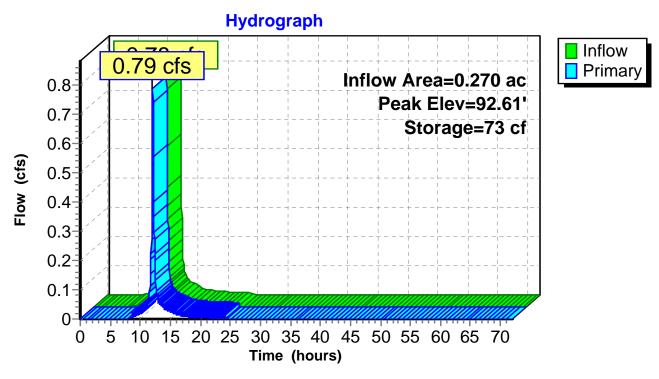
| Elevation | Surf.Area | Inc.Store | Cum.Store |
|-----------|-----------|--------------|--------------|
| (feet) | (sq-ft) | (cubic-feet) | (cubic-feet) |
| 92.00 | 96 | 0 | 0 |
| 92.50 | 120 | 54 | 54 |

| Device | Routing | Invert | Outlet Devices |
|--------|---------|--------|--|
| #1 | Primary | 92.50' | 24.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads |

Primary OutFlow Max=0.75 cfs @ 12.07 hrs HW=92.61' (Free Discharge) 1=Orifice/Grate (Weir Controls 0.75 cfs @ 1.09 fps)

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Pond FP: FocalPoint 42 sf



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Summary for Link A: POA A

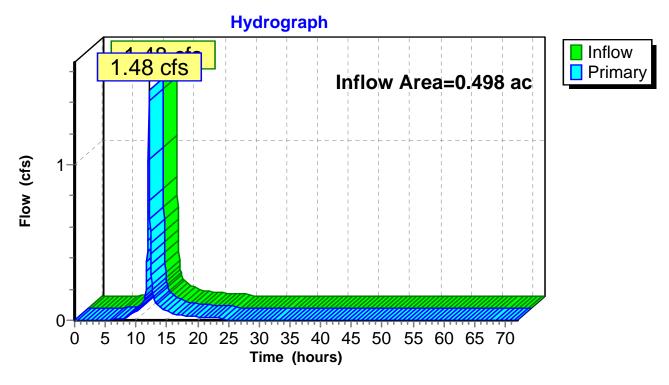
Inflow Area = 0.498 ac, 77.08% Impervious, Inflow Depth = 2.60" for 2 Year event

Inflow = 1.48 cfs @ 12.07 hrs, Volume= 0.108 af

Primary = 1.48 cfs @ 12.07 hrs, Volume= 0.108 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link A: POA A



Summary for Link B: POA B

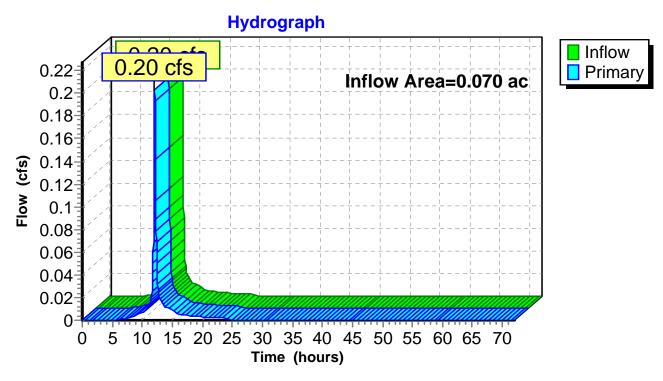
Inflow Area = 0.070 ac, 68.41% Impervious, Inflow Depth = 2.54" for 2 Year event

Inflow = 0.20 cfs @ 12.07 hrs, Volume= 0.015 af

Primary = 0.20 cfs @ 12.07 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link B: POA B



Summary for Link S: POA CITY SYSTEM

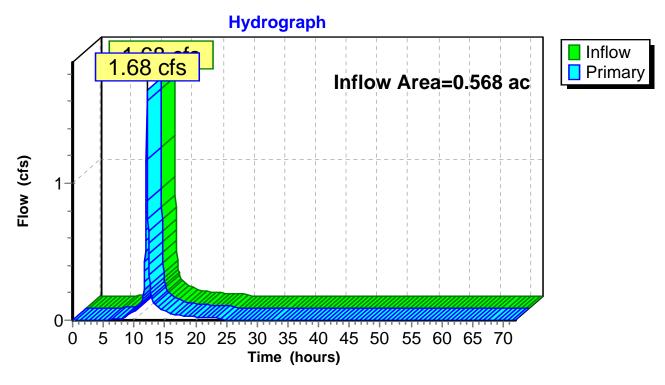
Inflow Area = 0.568 ac, 76.01% Impervious, Inflow Depth = 2.59" for 2 Year event

Inflow = 1.68 cfs @ 12.07 hrs, Volume= 0.123 af

Primary = 1.68 cfs @ 12.07 hrs, Volume= 0.123 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link S: POA CITY SYSTEM



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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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 WsA: Watershed A Runoff Area=9,290 sf 84.06% Impervious Runoff Depth=4.30"

Flow Length=316' Tc=5.0 min CN=95 Runoff=1.00 cfs 0.076 af

Subcatchment WsB: Watershed B Runoff Area=11,748 sf 70.81% Impervious Runoff Depth=4.08"

Tc=5.0 min CN=93 Runoff=1.22 cfs 0.092 af

Subcatchment WsC: Watershed C Runoff Area=3,052 sf 68.41% Impervious Runoff Depth=4.08"

Tc=5.0 min CN=93 Runoff=0.32 cfs 0.024 af

Subcatchment WsD: Watershed D Runoff Area=644 sf 90.68% Impervious Runoff Depth=4.41"

Tc=5.0 min CN=96 Runoff=0.07 cfs 0.005 af

Pond 1P: 12" Pipe Peak Elev=89.18' Storage=0.000 af Inflow=1.22 cfs 0.090 af

Outflow=1.22 cfs 0.090 af

Pond FP: FocalPoint 42 sf Peak Elev=92.65' Storage=73 cf Inflow=1.22 cfs 0.092 af

Outflow=1.22 cfs 0.090 af

Link A: POA A Inflow=2.29 cfs 0.172 af

Primary=2.29 cfs 0.172 af

Link B: POA B Inflow=0.32 cfs 0.024 af

Primary=0.32 cfs 0.024 af

Link S: POA CITY SYSTEM Inflow=2.60 cfs 0.196 af

Primary=2.60 cfs 0.196 af

Total Runoff Area = 0.568 ac Runoff Volume = 0.197 af Average Runoff Depth = 4.17" 23.99% Pervious = 0.136 ac 76.01% Impervious = 0.432 ac

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[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.00 cfs @ 12.07 hrs, Volume=

0.076 af, Depth= 4.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10 Year Rainfall=4.88"

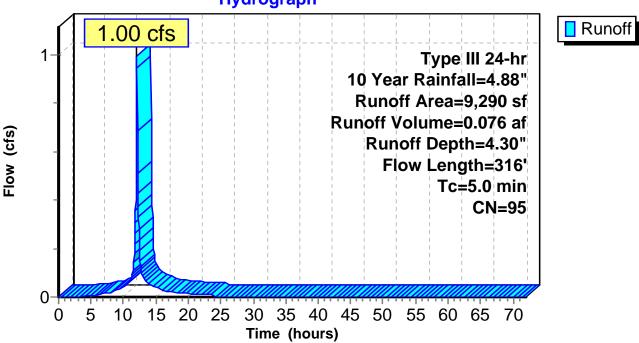
Summary for Subcatchment WsA: Watershed A

| A | rea (sf) | CN D | Description | | | | | | |
|-------|----------|---------|----------------------|--------------|---|--|--|--|--|
| | 6,362 | 98 F | Paved parking, HSG D | | | | | | |
| | 1,481 | | | | | | | | |
| | 1,447 | 98 L | <u>Inconnecte</u> | ed roofs, HS | SG D | | | | |
| | 9,290 | 95 V | Veighted A | verage | | | | | |
| | 1,481 | 1 | 5.94% Per | vious Area | | | | | |
| | 7,809 | | | pervious Ar | ea | | | | |
| | 1,447 | 1 | 8.53% Un | connected | | | | | |
| Tc | Length | Slope | Velocity | Capacity | Description | | | | |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | |
| 0.8 | 50 | 0.0120 | 0.99 | , | Sheet Flow, A-B | | | | |
| | | | | | Smooth surfaces n= 0.011 P2= 3.30" | | | | |
| 0.3 | 54 | 0.0200 | 2.87 | | Shallow Concentrated Flow, B-C | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | |
| 0.2 | 72 | 0.1000 | 6.42 | | Shallow Concentrated Flow, C-D | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | |
| 0.1 | 21 | 0.0120 | 4.97 | 3.90 | 1 | | | | |
| | | | | | 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | | |
| 0.4 | 00 | 0.0400 | 4 5 4 | 2.50 | n= 0.013 Corrugated PE, smooth interior | | | | |
| 0.4 | 98 | 0.0100 | 4.54 | 3.56 | Pipe Channel, E-F 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | | |
| | | | | | n= 0.013 Corrugated PE, smooth interior | | | | |
| 0.1 | 21 | 0.0120 | 4.97 | 3.90 | Pipe Channel, F-G | | | | |
| 0.1 | 21 | 0.0120 | 4.57 | 0.50 | 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | | |
| | | | | | n= 0.013 Corrugated PE, smooth interior | | | | |
| 3.1 | | | | | Direct Entry, DIRECT | | | | |
| 5.0 | 316 | Total | | | | | | | |

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Subcatchment WsA: Watershed A





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Summary for Subcatchment WsB: Watershed B

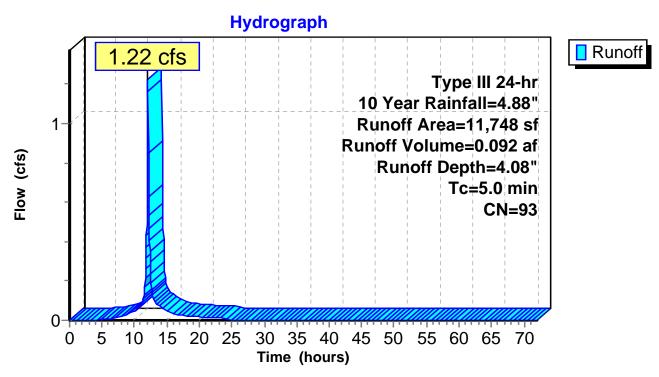
[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.22 cfs @ 12.07 hrs, Volume= 0.092 af, Depth= 4.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10 Year Rainfall=4.88"

| A | rea (sf) | CN | Description | | | | | | |
|-------------|------------------|------------------|----------------------|-------------------|-------------------|--|--|--|--|
| | 8,319 | 98 | Paved park | ing, HSG D |) | | | | |
| | 3,429 | 80 | >75% Gras | s cover, Go | ood, HSG D | | | | |
| | 11,748 | 93 | Weighted Average | | | | | | |
| | 3,429 | | 29.19% Pervious Area | | | | | | |
| | 8,319 | • | 70.81% lmp | pervious Ar | ea | | | | |
| Tc (min) | Length (feet) | Slope (ft/ft) | , | Capacity (cfs) | Description | | | | |
| 5.0 | | | | | Direct Entry, Min | | | | |

Subcatchment WsB: Watershed B



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Summary for Subcatchment WsC: Watershed C

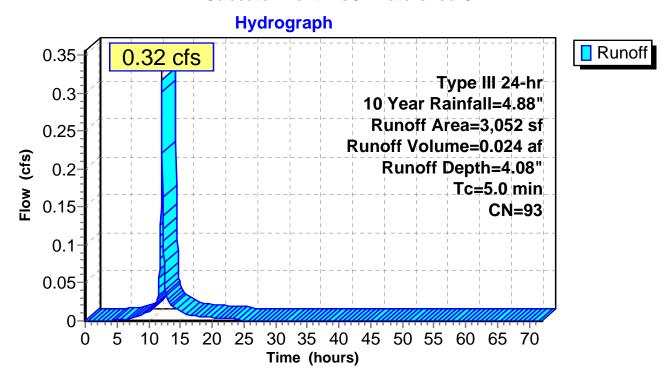
[49] Hint: Tc<2dt may require smaller dt

0.32 cfs @ 12.07 hrs, Volume= 0.024 af, Depth= 4.08" Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10 Year Rainfall=4.88"

| | Area (sf) | CN | Description | | | | | | | |
|-------------|-----------|-------|--------------------|-------------|--------------|--------|--|--|--|--|
| | 942 | 98 | Paved park | ing, HSG D |) | | | | | |
| * | 113 | 90 | Pervious Pa | avers | | | | | | |
| | 851 | 80 | >75% Gras | s cover, Go | ood, HSG D | | | | | |
| | 1,146 | 98 | Unconnecte | ed roofs, H | SG D | | | | | |
| | 3,052 | 93 | Weighted Average | | | | | | | |
| | 964 | | 31.59% Per | vious Area | 1 | | | | | |
| | 2,088 | | 68.41% Imp | ervious Ar | ea | | | | | |
| | 1,146 | | 54.89% Unconnected | | | | | | | |
| _ | | 01 | | | | | | | | |
| | c Length | | , | Capacity | Description | | | | | |
| <u>(mir</u> | n) (feet) | (ft/f | t) (ft/sec) | (cfs) | | | | | | |
| 5 | 0 | | | | Direct Entry | Direct | | | | |

Subcatchment WsC: Watershed C



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Summary for Subcatchment WsD: Watershed D

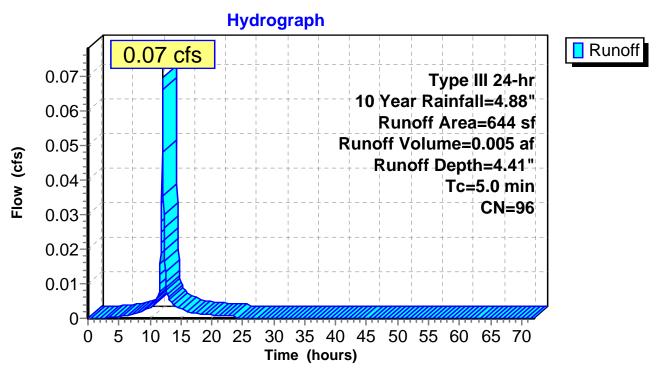
[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.07 cfs @ 12.07 hrs, Volume= 0.005 af, Depth= 4.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 10 Year Rainfall=4.88"

| A | rea (sf) | CN | Description | | | | | | |
|-------|----------|--------|----------------------|------------------|----------------------|--|--|--|--|
| | 584 | 98 | Paved parking, HSG D | | | | | | |
| | 60 | 80 | >75% Gras | s cover, Go | ood, HSG D | | | | |
| | 644 | 96 | Weighted A | Weighted Average | | | | | |
| | 60 | | 9.32% Pervious Area | | | | | | |
| | 584 | | 90.68% lmp | pervious Ar | ea | | | | |
| Tc | Length | Slope | e Velocity | Capacity | Description | | | | |
| (min) | (feet) | (ft/ft | , | (cfs) | Description | | | | |
| 5.0 | • | • | | , , | Direct Entry, DIRECT | | | | |

Subcatchment WsD: Watershed D



Summary for Pond 1P: 12" Pipe

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.270 ac, 70.81% Impervious, Inflow Depth = 4.01" for 10 Year event

Inflow = 1.22 cfs @ 12.07 hrs, Volume= 0.090 af

Outflow = 1.22 cfs @ 12.07 hrs, Volume= 0.090 af, Atten= 0%, Lag= 0.0 min

Primary = 1.22 cfs @ 12.07 hrs, Volume= 0.090 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 89.18' @ 12.07 hrs Surf.Area= 0.000 ac Storage= 0.000 af

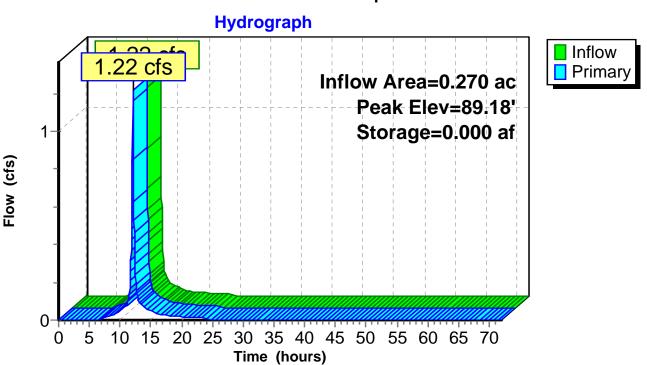
Plug-Flow detention time= (not calculated: outflow precedes inflow)

Center-of-Mass det. time= 0.1 min (786.4 - 786.2)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|---------|--------------------|----------------------------------|
| #1 | 88.60' | 0.000 af | 10.0" Round Pipe Storage |
| | | | L= 12.0' S= 0.0170 '/' |
| | | | |
| Device | Routing | Invert Ou | itlet Devices |
| #1 | Primary | 88.60' 12 . | .0" Vert. Orifice/Grate C= 0.600 |

Primary OutFlow Max=1.18 cfs @ 12.07 hrs HW=89.17' (Free Discharge) 1=Orifice/Grate (Orifice Controls 1.18 cfs @ 2.56 fps)

Pond 1P: 12" Pipe



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Summary for Pond FP: FocalPoint 42 sf

[93] Warning: Storage range exceeded by 0.15'

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=149)

0.270 ac, 70.81% Impervious, Inflow Depth = 4.08" for 10 Year event Inflow Area =

1.22 cfs @ 12.07 hrs, Volume= Inflow 0.092 af

Outflow 1.22 cfs @ 12.07 hrs, Volume= 0.090 af, Atten= 0%, Lag= 0.1 min =

1.22 cfs @ 12.07 hrs, Volume= Primary 0.090 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 92.65' @ 12.07 hrs Surf.Area= 162 sf Storage= 73 cf

Plug-Flow detention time= 19.5 min calculated for 0.090 af (98% of inflow)

Center-of-Mass det. time= 8.2 min (786.2 - 778.1)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 89.75' | 19 cf | 6.00'W x 7.00'L x 2.25'H FocalPoint |
| | | | 95 cf Overall x 20.0% Voids |
| #2 | 92.00' | 54 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

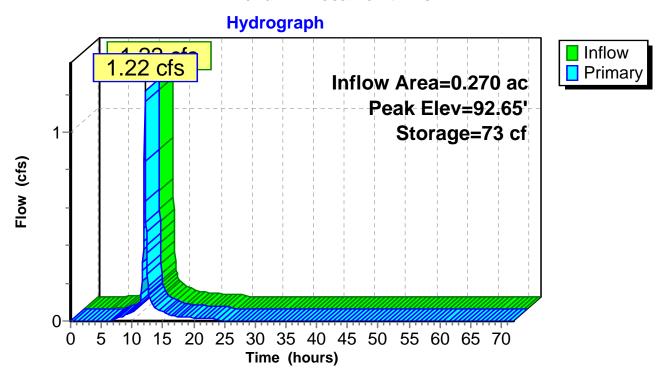
73 cf Total Available Storage

| Elevation | Surf.Area | Inc.Store | Cum.Store |
|-----------|-----------|--------------|--------------|
| (feet) | (sq-ft) | (cubic-feet) | (cubic-feet) |
| 92.00 | 96 | 0 | 0 |
| 92.50 | 120 | 54 | 54 |

| Device | Routing | Invert | Outlet Devices |
|--------|---------|--------|--|
| #1 | Primary | 92.50' | 24.0" Horiz. Orifice/Grate C= 0.600 |
| | - | | Limited to weir flow at low heads |

Primary OutFlow Max=1.17 cfs @ 12.07 hrs HW=92.65' (Free Discharge) 1=Orifice/Grate (Weir Controls 1.17 cfs @ 1.26 fps)

Pond FP: FocalPoint 42 sf



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Summary for Link A: POA A

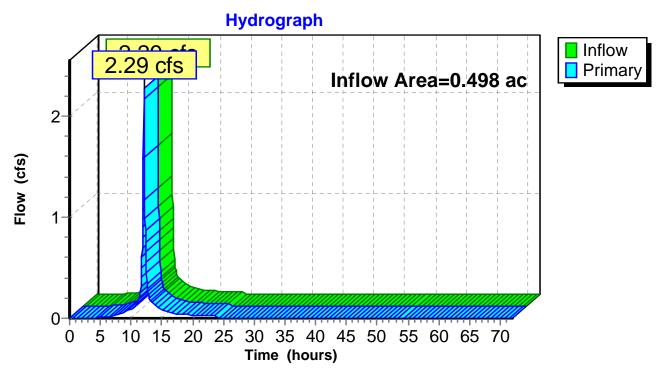
Inflow Area = 0.498 ac, 77.08% Impervious, Inflow Depth = 4.14" for 10 Year event

Inflow = 2.29 cfs @ 12.07 hrs, Volume= 0.172 af

Primary = 2.29 cfs @ 12.07 hrs, Volume= 0.172 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link A: POA A



Summary for Link B: POA B

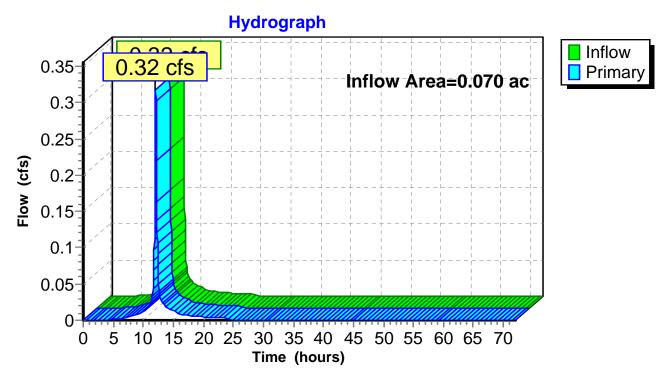
Inflow Area = 0.070 ac, 68.41% Impervious, Inflow Depth = 4.08" for 10 Year event

Inflow = 0.32 cfs @ 12.07 hrs, Volume= 0.024 af

Primary = 0.32 cfs @ 12.07 hrs, Volume= 0.024 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link B: POA B



Summary for Link S: POA CITY SYSTEM

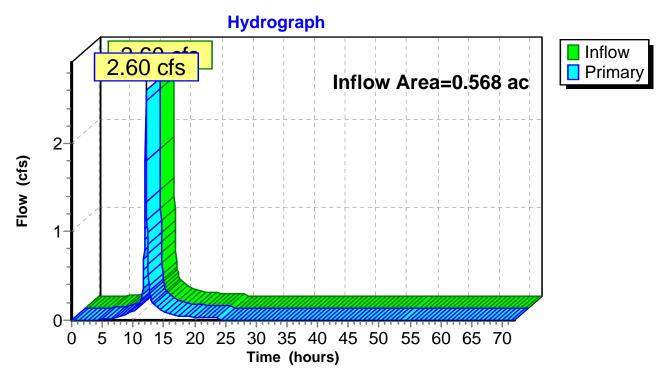
Inflow Area = 0.568 ac, 76.01% Impervious, Inflow Depth = 4.14" for 10 Year event

Inflow = 2.60 cfs @ 12.07 hrs, Volume= 0.196 af

Primary = 2.60 cfs @ 12.07 hrs, Volume= 0.196 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link S: POA CITY SYSTEM



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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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 WsA: Watershed A Runoff Area=9,290 sf 84.06% Impervious Runoff Depth=5.51"

Flow Length=316' Tc=5.0 min CN=95 Runoff=1.26 cfs 0.098 af

Subcatchment WsB: Watershed B Runoff Area=11,748 sf 70.81% Impervious Runoff Depth=5.28"

Tc=5.0 min CN=93 Runoff=1.56 cfs 0.119 af

Subcatchment WsC: Watershed C Runoff Area=3,052 sf 68.41% Impervious Runoff Depth=5.28"

Tc=5.0 min CN=93 Runoff=0.40 cfs 0.031 af

Subcatchment WsD: Watershed D Runoff Area=644 sf 90.68% Impervious Runoff Depth=5.63"

Tc=5.0 min CN=96 Runoff=0.09 cfs 0.007 af

Pond 1P: 12" Pipe Peak Elev=89.27' Storage=0.000 af Inflow=1.55 cfs 0.117 af

Outflow=1.56 cfs 0.117 af

Pond FP: FocalPoint 42 sf Peak Elev=92.68' Storage=73 cf Inflow=1.56 cfs 0.119 af

Outflow=1.55 cfs 0.117 af

Link A: POA A Inflow=2.90 cfs 0.222 af

Primary=2.90 cfs 0.222 af

Link B: POA B Inflow=0.40 cfs 0.031 af

Primary=0.40 cfs 0.031 af

Link S: POA CITY SYSTEM Inflow=3.31 cfs 0.253 af

Primary=3.31 cfs 0.253 af

Total Runoff Area = 0.568 ac Runoff Volume = 0.254 af Average Runoff Depth = 5.38" 23.99% Pervious = 0.136 ac 76.01% Impervious = 0.432 ac

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Summary for Subcatchment WsA: Watershed A

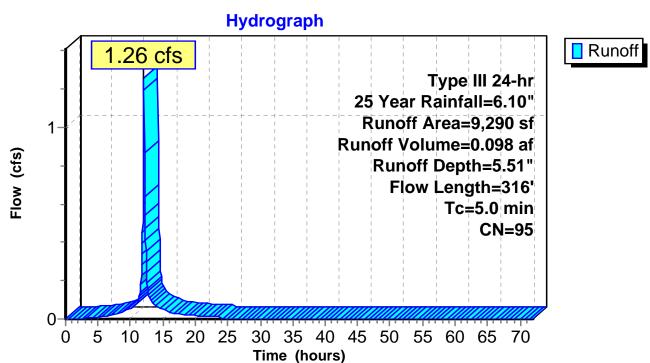
[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.26 cfs @ 12.07 hrs, Volume= 0.098 af, Depth= 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25 Year Rainfall=6.10"

| A | rea (sf) | CN D | Description | | | | | | |
|-------|----------|---------|----------------------|--------------|---|--|--|--|--|
| | 6,362 | 98 F | Paved parking, HSG D | | | | | | |
| | 1,481 | | | | | | | | |
| | 1,447 | 98 L | <u>Inconnecte</u> | ed roofs, HS | SG D | | | | |
| | 9,290 | 95 V | Veighted A | verage | | | | | |
| | 1,481 | 1 | 5.94% Per | vious Area | | | | | |
| | 7,809 | | | pervious Ar | ea | | | | |
| | 1,447 | 1 | 8.53% Un | connected | | | | | |
| Tc | Length | Slope | Velocity | Capacity | Description | | | | |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | | |
| 0.8 | 50 | 0.0120 | 0.99 | , | Sheet Flow, A-B | | | | |
| | | | | | Smooth surfaces n= 0.011 P2= 3.30" | | | | |
| 0.3 | 54 | 0.0200 | 2.87 | | Shallow Concentrated Flow, B-C | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | |
| 0.2 | 72 | 0.1000 | 6.42 | | Shallow Concentrated Flow, C-D | | | | |
| | | | | | Paved Kv= 20.3 fps | | | | |
| 0.1 | 21 | 0.0120 | 4.97 | 3.90 | 1 | | | | |
| | | | | | 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | | |
| 0.4 | 00 | 0.0400 | 4 5 4 | 2.50 | n= 0.013 Corrugated PE, smooth interior | | | | |
| 0.4 | 98 | 0.0100 | 4.54 | 3.56 | Pipe Channel, E-F 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | | |
| | | | | | n= 0.013 Corrugated PE, smooth interior | | | | |
| 0.1 | 21 | 0.0120 | 4.97 | 3.90 | Pipe Channel, F-G | | | | |
| 0.1 | 21 | 0.0120 | 4.57 | 0.50 | 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | | |
| | | | | | n= 0.013 Corrugated PE, smooth interior | | | | |
| 3.1 | | | | | Direct Entry, DIRECT | | | | |
| 5.0 | 316 | Total | | | | | | | |

Subcatchment WsA: Watershed A



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Summary for Subcatchment WsB: Watershed B

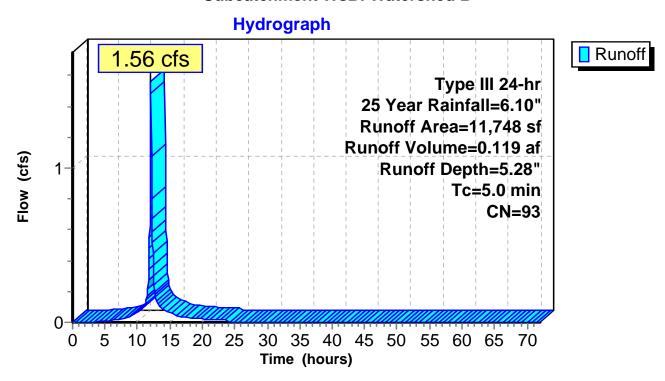
[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.56 cfs @ 12.07 hrs, Volume= 0.119 af, Depth= 5.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25 Year Rainfall=6.10"

| Are | ea (sf) | CN | Description | | | | | | |
|-------|---------|--------|----------------------|--------------|-------------------|---|--|--|--|
| | 8,319 | 98 | Paved park | ing, HSG D |) | | | | |
| | 3,429 | 80 | >75% Gras | s cover, Go | ood, HSG D | | | | |
| 1 | 1,748 | 93 | Weighted Average | | | | | | |
| | 3,429 | | 29.19% Pervious Area | | | | | | |
| | 8,319 | | 70.81% lmp | pervious Are | ea | | | | |
| Tc | Length | Slope | e Velocity | Capacity | Description | | | | |
| (min) | (feet) | (ft/ft | | | | | | | |
| 5.0 | • | | | | Direct Entry, Min | _ | | | |

Subcatchment WsB: Watershed B



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Summary for Subcatchment WsC: Watershed C

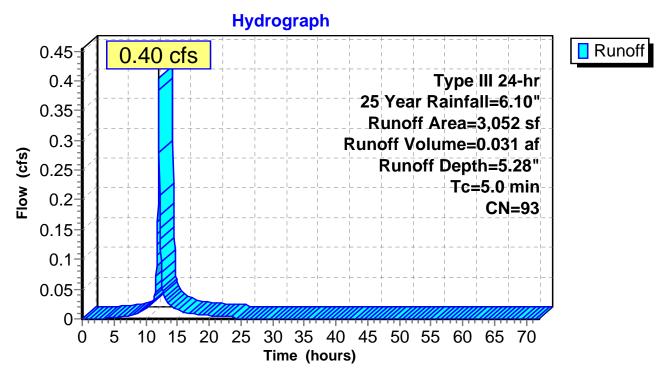
[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.40 cfs @ 12.07 hrs, Volume= 0.031 af, Depth= 5.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25 Year Rainfall=6.10"

| | Area (sf) | CN | Description | | | | | | | |
|-------|-----------|--------|----------------------|-------------|----------------------|--|--|--|--|--|
| | 942 | 98 | Paved park | ing, HSG D | D | | | | | |
| * | 113 | 90 | Pervious Pa | avers | | | | | | |
| | 851 | 80 | >75% Gras | s cover, Go | ood, HSG D | | | | | |
| | 1,146 | 98 | Unconnecte | ed roofs, H | ISG D | | | | | |
| | 3,052 | 93 | Weighted Average | | | | | | | |
| | 964 | | 31.59% Pervious Area | | | | | | | |
| | 2,088 | | 68.41% Imp | pervious Ar | rea | | | | | |
| | 1,146 | | 54.89% Un | connected | | | | | | |
| | | | | | | | | | | |
| Tc | - 3 | Slope | | Capacity | • | | | | | |
| (min) | (feet) | (ft/ft |) (ft/sec) | (cfs) | | | | | | |
| 5.0 | | | | | Direct Entry, Direct | | | | | |

Subcatchment WsC: Watershed C



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Summary for Subcatchment WsD: Watershed D

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.09 cfs @ 12.07 hrs, Volume= 0.007 af, Depth= 5.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 25 Year Rainfall=6.10"

| A | rea (sf) | CN | Description | | | | | |
|-------------|------------------|------------------|---------------------|-------------------|----------------------|--|--|--|
| | 584 | 98 | Paved park | ing, HSG D |) | | | |
| | 60 | 80 | >75% Gras | s cover, Go | ood, HSG D | | | |
| | 644 | 96 | Weighted Average | | | | | |
| | 60 | | 9.32% Pervious Area | | | | | |
| | 584 | | 90.68% lmp | ervious Ar | ea | | | |
| Tc (min) | Length (feet) | Slope (ft/ft) | , | Capacity (cfs) | Description | | | |
| 5.0 | | | | | Direct Entry, DIRECT | | | |

Subcatchment WsD: Watershed D

Hydrograph Runoff 0.09 cfs 0.09 Type III 24-hr 0.08 - 325 Year Rainfall=6.10" Runoff Area=644 sf 0.07 Runoff Volume=0.007 af 0.06 Runoff Depth=5.63" 0.05 Tc=5.0 min CN=96 0.04- 0.03^{-} 0.02 -0.01-0 10 15 20 25 30 35 40 45 50 55 60 65 70 Time (hours)

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Summary for Pond 1P: 12" Pipe

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.270 ac, 70.81% Impervious, Inflow Depth = 5.21" for 25 Year event

Inflow = 1.55 cfs @ 12.07 hrs, Volume= 0.117 af

Outflow = 1.56 cfs @ 12.07 hrs, Volume= 0.117 af, Atten= 0%, Lag= 0.0 min

Primary = 1.56 cfs @ 12.07 hrs, Volume= 0.117 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 89.27' @ 12.07 hrs Surf.Area= 0.000 ac Storage= 0.000 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)

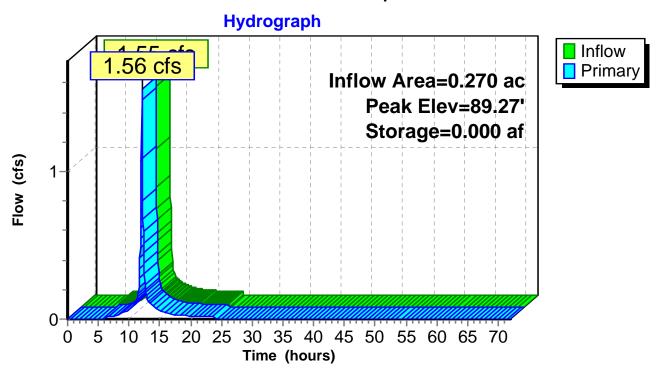
Center-of-Mass det. time= 0.2 min (778.8 - 778.6)

| Volume | Invert | Avail.Storage | Storage Description | |
|--------|---------|---------------|---|--|
| #1 | 88.60' | 0.000 af | 10.0" Round Pipe Storage L= 12.0' S= 0.0170 '/' | |
| Device | Routing | Invert Ou | tlet Devices | |

#1 Primary 88.60' **12.0" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=1.50 cfs @ 12.07 hrs HW=89.25' (Free Discharge) 1=Orifice/Grate (Orifice Controls 1.50 cfs @ 2.75 fps)

Pond 1P: 12" Pipe



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Summary for Pond FP: FocalPoint 42 sf

[93] Warning: Storage range exceeded by 0.18'

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=168)

0.270 ac, 70.81% Impervious, Inflow Depth = 5.28" for 25 Year event Inflow Area =

1.56 cfs @ 12.07 hrs, Volume= Inflow = 0.119 af

Outflow 1.55 cfs @ 12.07 hrs, Volume= 0.117 af, Atten= 0%, Lag= 0.1 min =

1.55 cfs @ 12.07 hrs, Volume= Primary = 0.117 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 92.68' @ 12.07 hrs Surf.Area= 162 sf Storage= 73 cf

Plug-Flow detention time= 15.9 min calculated for 0.117 af (99% of inflow)

Center-of-Mass det. time= 7.0 min (778.6 - 771.6)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 89.75' | 19 cf | 6.00'W x 7.00'L x 2.25'H FocalPoint |
| | | | 95 cf Overall x 20.0% Voids |
| #2 | 92.00' | 54 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

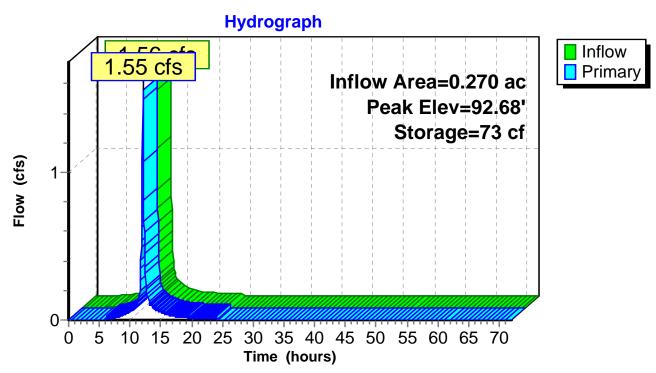
73 cf Total Available Storage

| Cum.Store | Inc.Store | Surf.Area | Elevation |
|--------------|--------------|-----------|-----------|
| (cubic-feet) | (cubic-feet) | (sq-ft) | (feet) |
| 0 | 0 | 96 | 92.00 |
| 54 | 54 | 120 | 92.50 |

| Device | Routing | Invert | Outlet Devices |
|--------|---------|--------|--|
| #1 | Primary | 92.50' | 24.0" Horiz. Orifice/Grate C= 0.600 |
| | - | | Limited to weir flow at low heads |

Primary OutFlow Max=1.50 cfs @ 12.07 hrs HW=92.67' (Free Discharge) 1=Orifice/Grate (Weir Controls 1.50 cfs @ 1.37 fps)

Pond FP: FocalPoint 42 sf



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Summary for Link A: POA A

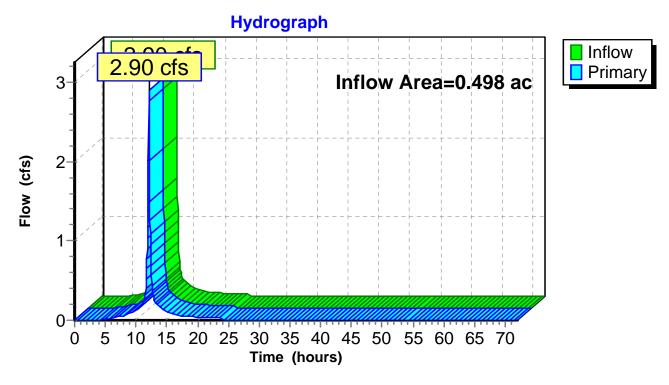
Inflow Area = 0.498 ac, 77.08% Impervious, Inflow Depth = 5.35" for 25 Year event

Inflow = 2.90 cfs @ 12.07 hrs, Volume= 0.222 af

Primary = 2.90 cfs @ 12.07 hrs, Volume= 0.222 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link A: POA A



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Summary for Link B: POA B

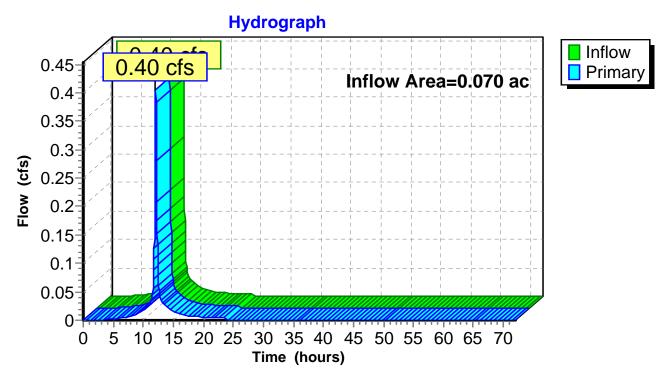
Inflow Area = 0.070 ac, 68.41% Impervious, Inflow Depth = 5.28" for 25 Year event

Inflow = 0.40 cfs @ 12.07 hrs, Volume= 0.031 af

Primary = 0.40 cfs @ 12.07 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link B: POA B



Summary for Link S: POA CITY SYSTEM

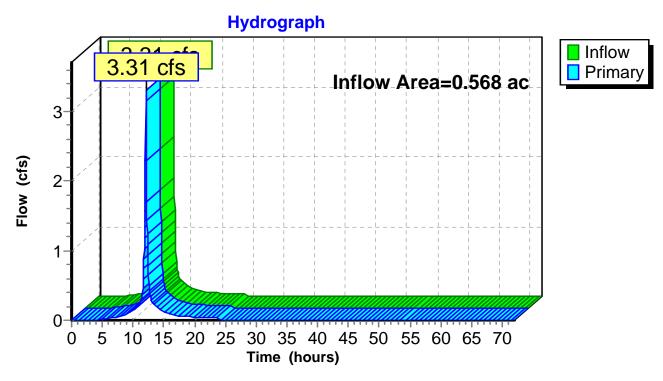
Inflow Area = 0.568 ac, 76.01% Impervious, Inflow Depth = 5.34" for 25 Year event

Inflow = 3.31 cfs @ 12.07 hrs, Volume= 0.253 af

Primary = 3.31 cfs @ 12.07 hrs, Volume= 0.253 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link S: POA CITY SYSTEM



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Time span=0.00-72.00 hrs, dt=0.05 hrs, 1441 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 WsA: Watershed A Runoff Area=9,290 sf 84.06% Impervious Runoff Depth=7.96"

Flow Length=316' Tc=5.0 min CN=95 Runoff=1.79 cfs 0.141 af

Subcatchment WsB: Watershed B Runoff Area=11,748 sf 70.81% Impervious Runoff Depth=7.72"

Tc=5.0 min CN=93 Runoff=2.23 cfs 0.173 af

Subcatchment WsC: Watershed C Runoff Area=3,052 sf 68.41% Impervious Runoff Depth=7.72"

Tc=5.0 min CN=93 Runoff=0.58 cfs 0.045 af

Subcatchment WsD: Watershed D Runoff Area=644 sf 90.68% Impervious Runoff Depth=8.08"

Tc=5.0 min CN=96 Runoff=0.12 cfs 0.010 af

Pond 1P: 12" Pipe Peak Elev=89.45' Storage=0.000 af Inflow=2.24 cfs 0.172 af

Outflow=2.23 cfs 0.172 af

Pond FP: FocalPoint 42 sf Peak Elev=92.73' Storage=73 cf Inflow=2.23 cfs 0.173 af

Outflow=2.24 cfs 0.172 af

Link A: POA A Inflow=4.14 cfs 0.323 af

Primary=4.14 cfs 0.323 af

Link B: POA B Inflow=0.58 cfs 0.045 af

Primary=0.58 cfs 0.045 af

Link S: POA CITY SYSTEM Inflow=4.72 cfs 0.368 af

Primary=4.72 cfs 0.368 af

Total Runoff Area = 0.568 ac Runoff Volume = 0.370 af Average Runoff Depth = 7.82" 23.99% Pervious = 0.136 ac 76.01% Impervious = 0.432 ac

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Summary for Subcatchment WsA: Watershed A

[49] Hint: Tc<2dt may require smaller dt

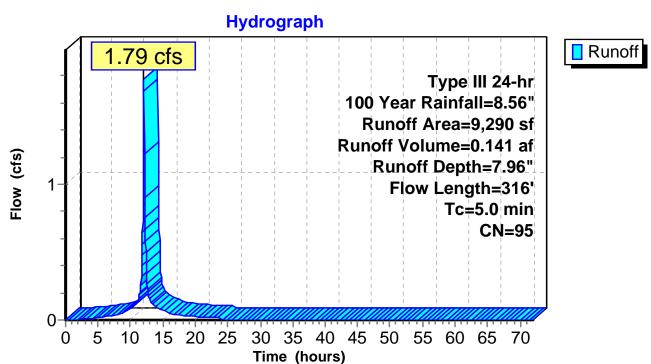
Runoff = 1.79 cfs @ 12.07 hrs, Volume= 0.141 af, Depth= 7.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100 Year Rainfall=8.56"

| A | rea (sf) | CN D | Description | | | | | |
|-------|----------|---------|--------------------|-------------|---|--|--|--|
| | 6,362 | 98 F | aved park | ing, HSG D |) | | | |
| | 1,481 | 80 > | 75% Gras | s cover, Go | ood, HSG D | | | |
| | 1,447 | 98 L | | | | | | |
| | 9,290 | 95 V | Veighted A | verage | | | | |
| | 1,481 | 1 | 5.94% Per | rvious Area | | | | |
| | 7,809 | 8 | 4.06% lmp | pervious Ar | ea | | | |
| | 1,447 | 1 | 8.53% Un | connected | | | | |
| Tc | Length | Slope | Velocity | Capacity | Description | | | |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | |
| 0.8 | 50 | 0.0120 | 0.99 | ` ' | Sheet Flow, A-B | | | |
| | | | | | Smooth surfaces n= 0.011 P2= 3.30" | | | |
| 0.3 | 54 | 0.0200 | 2.87 | | Shallow Concentrated Flow, B-C | | | |
| | | | | | Paved Kv= 20.3 fps | | | |
| 0.2 | 72 | 0.1000 | 6.42 | | Shallow Concentrated Flow, C-D | | | |
| | | | | | Paved Kv= 20.3 fps | | | |
| 0.1 | 21 | 0.0120 | 4.97 | 3.90 | · · · · · · · · · · · · · · · · · · · | | | |
| | | | | | 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | |
| 0.4 | 00 | 0.0400 | 4.5.4 | 0.50 | n= 0.013 Corrugated PE, smooth interior | | | |
| 0.4 | 98 | 0.0100 | 4.54 | 3.56 | | | | |
| | | | | | 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | |
| 0.1 | 21 | 0.0120 | 4.07 | 2.00 | n= 0.013 Corrugated PE, smooth interior | | | |
| 0.1 | ۷۱ | 0.0120 | 4.97 | 3.90 | Pipe Channel, F-G 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' | | | |
| | | | | | n= 0.013 Corrugated PE, smooth interior | | | |
| 3.1 | | | | | Direct Entry, DIRECT | | | |
| 5.0 | 316 | Total | | | Direct Entry, Direct | | | |
| 5.0 | 510 | i Olai | | | | | | |

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Subcatchment WsA: Watershed A



Post Dev

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Summary for Subcatchment WsB: Watershed B

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.23 cfs @ 12.07 hrs, Volume= 0.173 af, Depth= 7.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100 Year Rainfall=8.56"

| Ar | ea (sf) | CN I | Description | | | | | |
|-------|---------|---------|-------------------------------|------------|-------------------|--|--|--|
| | 8,319 | 98 I | Paved park | ing, HSG D |) | | | |
| | 3,429 | 80 : | >75% Grass cover, Good, HSG D | | | | | |
| | 11,748 | 93 \ | Weighted Average | | | | | |
| | 3,429 | 2 | 29.19% Pervious Area | | | | | |
| | 8,319 | - | 70.81% Impervious Area | | | | | |
| _ | | | | | | | | |
| Tc | Length | Slope | , | Capacity | Description | | | |
| (min) | (feet) | (ft/ft) | (ft/sec) | (cfs) | | | | |
| 5.0 | | | | | Direct Entry, Min | | | |

Subcatchment WsB: Watershed B

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Summary for Subcatchment WsC: Watershed C

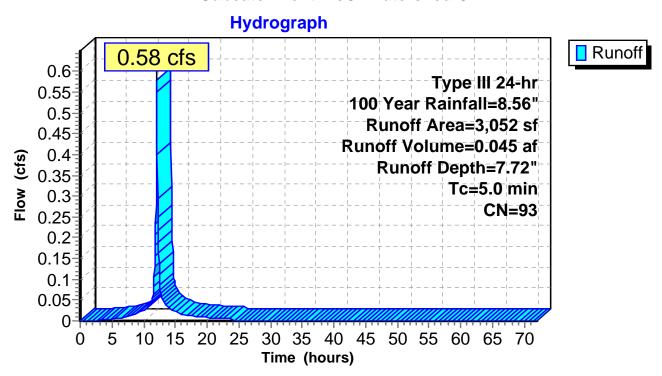
[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.58 cfs @ 12.07 hrs, Volume= 0.045 af, Depth= 7.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100 Year Rainfall=8.56"

| | Area (sf) | CN | Description | | | | | |
|-------------|-----------|-------|------------------------|-------------|--------------|--------|--|--|
| | 942 | 98 | Paved park | ing, HSG D |) | | | |
| * | 113 | 90 | Pervious Pa | avers | | | | |
| | 851 | 80 | >75% Gras | s cover, Go | ood, HSG D | | | |
| | 1,146 | 98 | Unconnecte | ed roofs, H | SG D | | | |
| | 3,052 | 93 | 93 Weighted Average | | | | | |
| | 964 | | 31.59% Pervious Area | | | | | |
| | 2,088 | | 68.41% Impervious Area | | | | | |
| | 1,146 | | 54.89% Unconnected | | | | | |
| _ | | 01 | | | | | | |
| | c Length | | , | Capacity | Description | | | |
| <u>(mir</u> | n) (feet) | (ft/f | t) (ft/sec) | (cfs) | | | | |
| 5 | 0 | | | | Direct Entry | Direct | | |

Subcatchment WsC: Watershed C



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Summary for Subcatchment WsD: Watershed D

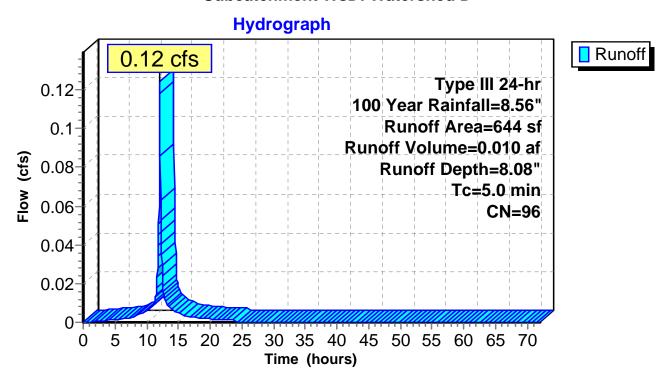
[49] Hint: Tc<2dt may require smaller dt

0.12 cfs @ 12.07 hrs, Volume= 0.010 af, Depth= 8.08" Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Type III 24-hr 100 Year Rainfall=8.56"

| A | rea (sf) | CN | Description | Description | | | | | |
|-------------|------------------|-----------------|-------------------------------|----------------------|----------------------|--|--|--|--|
| | 584 | 98 | Paved park | Paved parking, HSG D | | | | | |
| | 60 | 80 | >75% Grass cover, Good, HSG D | | | | | | |
| | 644 | 96 | 96 Weighted Average | | | | | | |
| | 60 | | 9.32% Pervious Area | | | | | | |
| | 584 | | 90.68% Impervious Area | | | | | | |
| Tc (min) | Length (feet) | Slope (ft/ft | , | Capacity (cfs) | Description | | | | |
| 5.0 | | | | | Direct Entry, DIRECT | | | | |

Subcatchment WsD: Watershed D



Post Dev

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Summary for Pond 1P: 12" Pipe

Inflow Area = 0.270 ac, 70.81% Impervious, Inflow Depth = 7.65" for 100 Year event

Inflow = 2.24 cfs @ 12.07 hrs, Volume= 0.172 af

Outflow = 2.23 cfs @ 12.07 hrs, Volume= 0.172 af, Atten= 0%, Lag= 0.1 min

Primary = 2.23 cfs @ 12.07 hrs, Volume= 0.172 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 89.45' @ 12.07 hrs Surf.Area= 0.000 ac Storage= 0.000 af

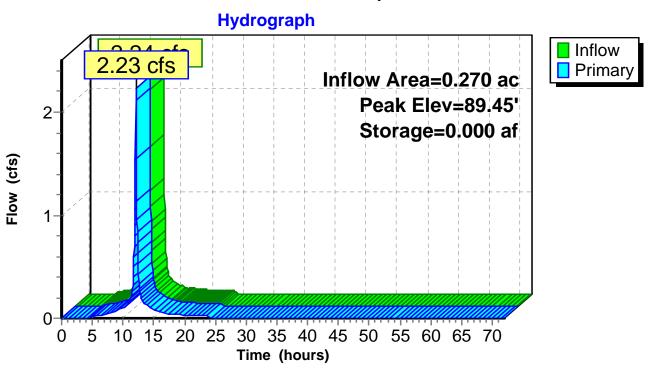
Plug-Flow detention time= (not calculated: outflow precedes inflow)

Center-of-Mass det. time= 0.1 min (768.3 - 768.1)

| <u>Volume</u> | Invert | Avail.Storage | Storage Description |
|---------------|---------|---------------|----------------------------------|
| #1 | 88.60' | 0.000 af | 10.0" Round Pipe Storage |
| | | | L= 12.0' S= 0.0170 '/' |
| Device | Routina | Invert Ou | itlet Devices |
| #1 | Primary | | .0" Vert. Orifice/Grate C= 0.600 |

Primary OutFlow Max=2.15 cfs @ 12.07 hrs HW=89.43' (Free Discharge) 1=Orifice/Grate (Orifice Controls 2.15 cfs @ 3.09 fps)

Pond 1P: 12" Pipe



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Summary for Pond FP: FocalPoint 42 sf

[93] Warning: Storage range exceeded by 0.23'

[88] Warning: Qout>Qin may require smaller dt or Finer Routing

[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=181)

Inflow Area = 0.270 ac, 70.81% Impervious, Inflow Depth = 7.72" for 100 Year event

Inflow = 2.23 cfs @ 12.07 hrs, Volume= 0.173 af

Outflow = 2.24 cfs @ 12.07 hrs, Volume= 0.172 af, Atten= 0%, Lag= 0.0 min

Primary = 2.24 cfs @ 12.07 hrs, Volume= 0.172 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs Peak Elev= 92.73' @ 12.07 hrs Surf.Area= 162 sf Storage= 73 cf

Plug-Flow detention time= 11.6 min calculated for 0.172 af (99% of inflow)

Center-of-Mass det. time= 5.4 min (768.1 - 762.8)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 89.75' | 19 cf | 6.00'W x 7.00'L x 2.25'H FocalPoint |
| | | | 95 cf Overall x 20.0% Voids |
| #2 | 92.00' | 54 cf | Custom Stage Data (Prismatic)Listed below (Recalc) |

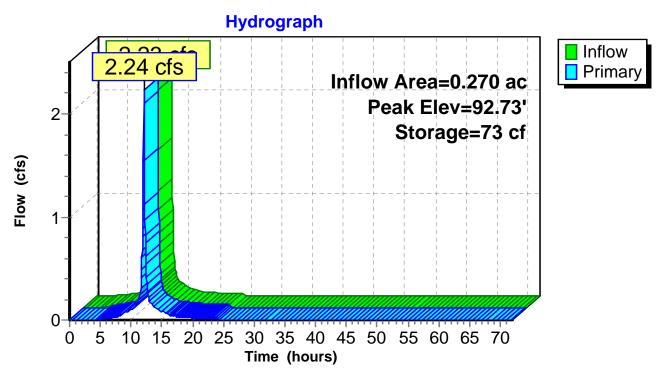
73 cf Total Available Storage

| Cum.Store | Inc.Store | Surf.Area | Elevation |
|--------------|--------------|-----------|-----------|
| (cubic-feet) | (cubic-feet) | (sq-ft) | (feet) |
| 0 | 0 | 96 | 92.00 |
| 54 | 54 | 120 | 92.50 |

| Device | Routing | Invert | Outlet Devices | | |
|--------|---------|--------|-----------------------------------|----------|--|
| #1 | Primary | 92.50' | 24.0" Horiz. Orifice/Grate | C= 0.600 | |
| | | | Limited to weir flow at low heads | | |

Primary OutFlow Max=2.15 cfs @ 12.07 hrs HW=92.72' (Free Discharge) 1=Orifice/Grate (Weir Controls 2.15 cfs @ 1.54 fps)

Pond FP: FocalPoint 42 sf



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Summary for Link A: POA A

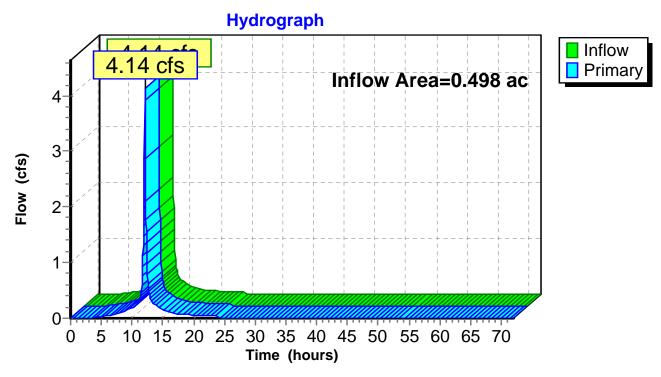
Inflow Area = 0.498 ac, 77.08% Impervious, Inflow Depth = 7.79" for 100 Year event

Inflow = 4.14 cfs @ 12.07 hrs, Volume= 0.323 af

Primary = 4.14 cfs @ 12.07 hrs, Volume= 0.323 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link A: POA A



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Summary for Link B: POA B

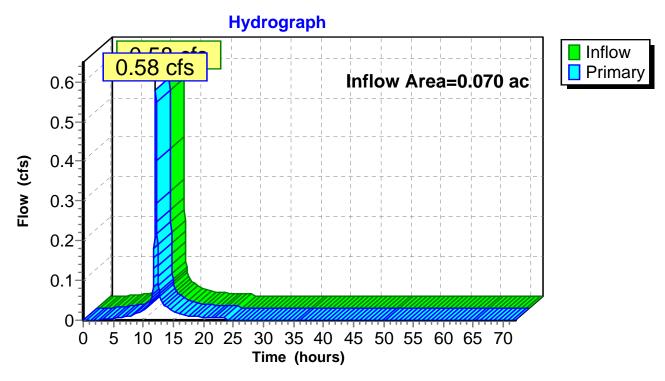
Inflow Area = 0.070 ac, 68.41% Impervious, Inflow Depth = 7.72" for 100 Year event

Inflow = 0.58 cfs @ 12.07 hrs, Volume= 0.045 af

Primary = 0.58 cfs @ 12.07 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link B: POA B



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Summary for Link S: POA CITY SYSTEM

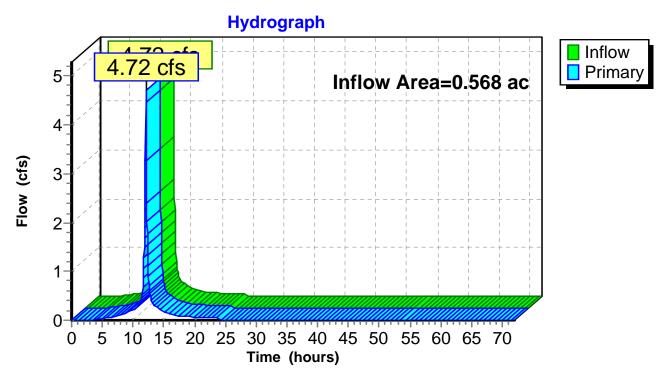
Inflow Area = 0.568 ac, 76.01% Impervious, Inflow Depth = 7.78" for 100 Year event

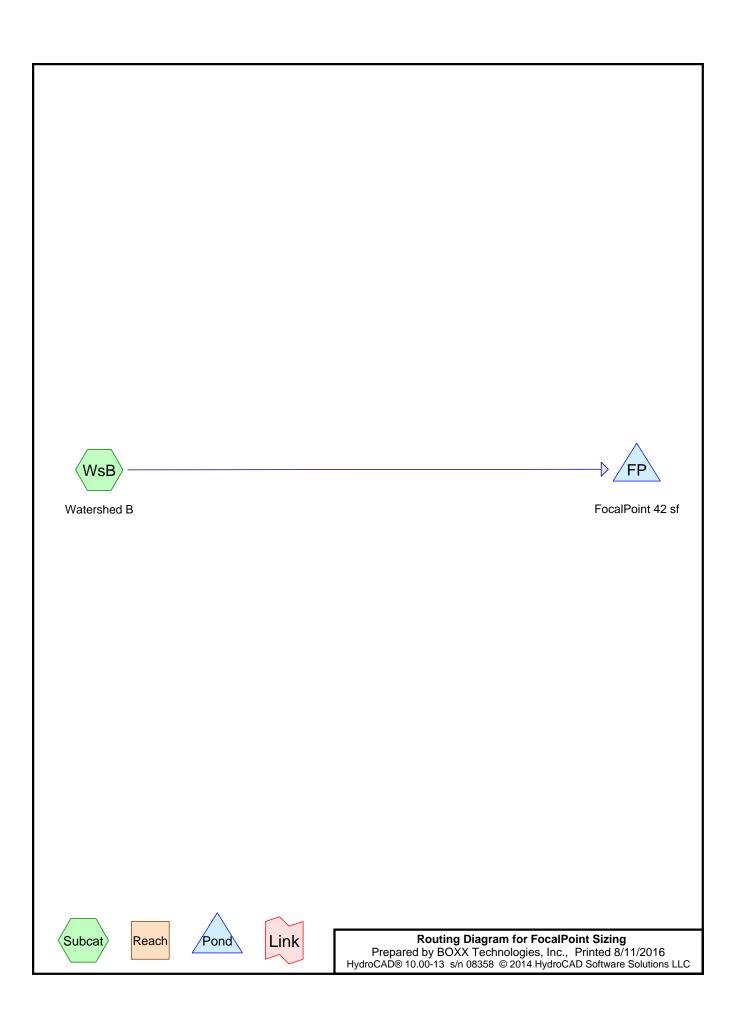
Inflow = 4.72 cfs @ 12.07 hrs, Volume= 0.368 af

Primary = 4.72 cfs @ 12.07 hrs, Volume= 0.368 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Link S: POA CITY SYSTEM





FocalPoint Sizing
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Area Listing (all nodes)

| Area | CN | Description |
|-------------|----|-------------------------------------|
| (sq-ft) | | (subcatchment-numbers) |
| 3,429 | 80 | >75% Grass cover, Good, HSG D (WsB) |
| 8,319 | 98 | Paved parking, HSG D (WsB) |
| 11,748 | 93 | TOTAL AREA |

FocalPoint Sizing
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Soil Listing (all nodes)

| Area | Soil | Subcatchment |
|---------|-------|-------------------|
| (sq-ft) | Group | Numbers |
| 0 | HSG A | |
| 0 | HSG B | |
| 0 | HSG C | |
| 11,748 | HSG D | WsB |
| 0 | Other | |
| 11,748 | | TOTAL AREA |

FocalPoint Sizing
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Sub Nun

Ground Covers (all nodes)

| HSG-A | HSG-B | HSG-C | HSG-D | Other | Total | Ground |
|---------|---------|---------|---------|---------|---------|---------------|
| (sq-ft) | (sq-ft) | (sq-ft) | (sq-ft) | (sq-ft) | (sq-ft) | Cover |
| 0 | 0 | 0 | 3,429 | 0 | 3,429 | >75% Grass |
| | | | | | | cover, Good |
| 0 | 0 | 0 | 8,319 | 0 | 8,319 | Paved parking |
| 0 | 0 | 0 | 11,748 | 0 | 11,748 | TOTAL AREA |

FocalPoint Sizing

Type III 24-hr 1.22inch Rainfall=1.22"

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Time span=1.00-48.00 hrs, dt=0.02 hrs, 2351 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment WsB: Watershed B Runoff Area=11,748 sf 70.81% Impervious Runoff Depth=0.63"

Tc=5.0 min CN=93 Runoff=0.21 cfs 615 cf

Pond FP: FocalPoint 42 sf Peak Elev=92.32' Storage=52 cf Inflow=0.21 cfs 615 cf

Outflow=0.10 cfs 615 cf

Total Runoff Area = 11,748 sf Runoff Volume = 615 cf Average Runoff Depth = 0.63" 29.19% Pervious = 3,429 sf 70.81% Impervious = 8,319 sf HydroCAD® 10.00-13 s/n 08358 © 2014 HydroCAD Software Solutions LLC

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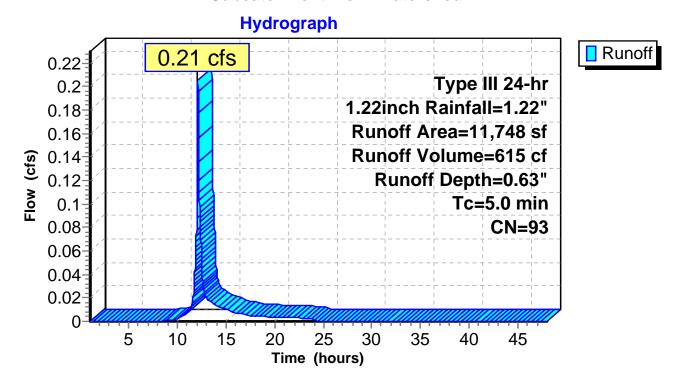
Summary for Subcatchment WsB: Watershed B

Runoff = 0.21 cfs @ 12.08 hrs, Volume= 615 cf, Depth= 0.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-48.00 hrs, dt= 0.02 hrs Type III 24-hr 1.22inch Rainfall=1.22"

| A | rea (sf) | CN | Description | | | | | | | |
|-------|----------|--------|-------------|----------------------|---|--|--|--|--|--|
| | 8,319 | 98 | Paved park | ing, HSG D | | | | | | |
| | 3,429 | 80 | >75% Gras | s cover, Go | od, HSG D | | | | | |
| | 11,748 | 93 | Weighted A | /eighted Average | | | | | | |
| | 3,429 | | 29.19% Per | 29.19% Pervious Area | | | | | | |
| | 8,319 | | 70.81% Imp | ervious Ar | ea | | | | | |
| Tc | Length | Slope | e Velocity | Capacity | Description | | | | | |
| (min) | (feet) | (ft/ft | , | (cfs) | 2 3 3 3 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 | | | | | |
| 5.0 | | | | | Direct Entry, Min | | | | | |

Subcatchment WsB: Watershed B



Prepared by BOXX Technologies, Inc.

Printed 8/11/2016

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Page 7

Summary for Pond FP: FocalPoint 42 sf

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=2)

Inflow Area = 11,748 sf, 70.81% Impervious, Inflow Depth = 0.63" for 1.22inch event

Inflow = 0.21 cfs @ 12.08 hrs, Volume= 615 cf

Outflow = 0.10 cfs @ 11.98 hrs, Volume= 615 cf, Atten= 53%, Lag= 0.0 min

Primary = 0.10 cfs @ 11.98 hrs, Volume= 615 cf

Routing by Dyn-Stor-Ind method, Time Span= 1.00-48.00 hrs, dt= 0.02 hrs

Peak Elev= 92.32' @ 12.24 hrs Surf.Area= 42 sf Storage= 52 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)

Center-of-Mass det. time= 2.1 min (832.4 - 830.3)

| Volume | Invert | Avail.Storage | Storage Description |
|--------|--------|---------------|--|
| #1 | 89.75' | 19 cf | 6.00'W x 7.00'L x 2.25'H FocalPoint |
| | | | 95 cf Overall x 20.0% Voids |
| #2 | 92.00' | 54 cf | Custom Stage Data (Prismatic)Listed below (Recalc) -Impervious |

73 cf Total Available Storage

| Elevation | Surf.Area | Inc.Store | Cum.Store |
|-----------|-----------|--------------|--------------|
| (feet) | (sq-ft) | (cubic-feet) | (cubic-feet) |
| 92.00 | 96 | 0 | 0 |
| 92.50 | 120 | 54 | 54 |

| Device | Routing | Invert | Outlet Devices | |
|--------|---------|--------|--|-----------------|
| #1 | Primary | 89.75' | 100.000 in/hr Exfiltration over Surface area | Phase-In= 0.10' |
| #2 | Primary | 92.50' | 24.0" Horiz. Orifice/Grate C= 0.600 | |
| | | | Limited to weir flow at low heads | |

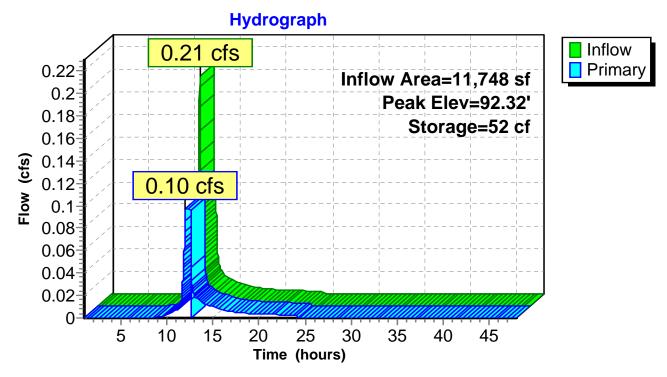
Primary OutFlow Max=0.10 cfs @ 11.98 hrs HW=89.88' (Free Discharge)

1=Exfiltration (Exfiltration Controls 0.10 cfs)

-2=Orifice/Grate (Controls 0.00 cfs)

114 Hydrocad Sollware Solutions LLC

Pond FP: FocalPoint 42 sf





First Citizens' Federal Credit Union – New Bedford, Massachusetts

APPENDIX B – HYDRAULIC CALCULATIONS



Location: 464-466 County Street, New Bedford MA

Development:

Project No.: 16020

16020

Storm Frequency: 10 Year Storm, From the New Bedford Design Standards

| Run: | 1 | Ru |
|------|---|----|
|------|---|----|

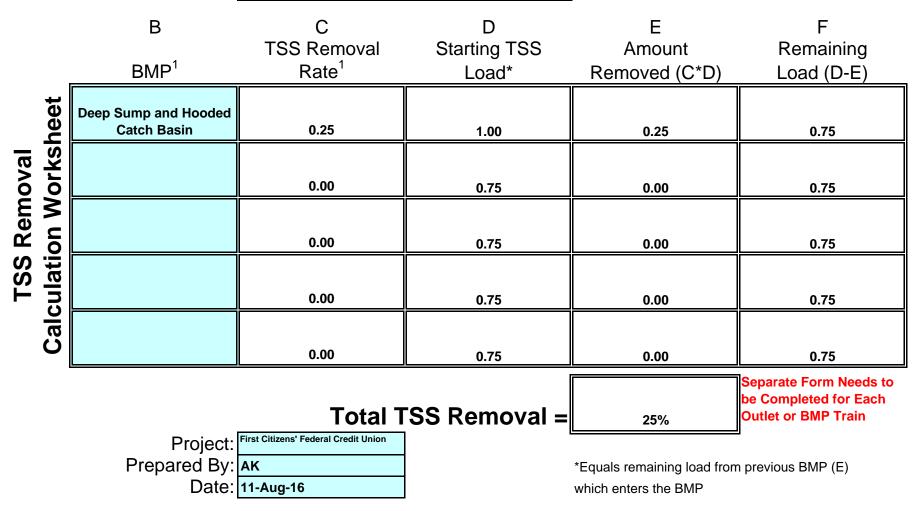
| Drainage | | | age 1 | | Drainage | | | | | Flow from | | Min. | | | | | | | | | | | Hydraulic | | |
|---------------------------|---------------------|----------------|--------------|------------------|----------|------|--------------------|-----------------|------------------|------------------|------------------|-----------|--------------------|-------------------|-------------------|-----------------------|-----------------|----------|----------------|-------------------|-------|---------------|-------------------|--|--|
| From | То | Area (s.f.) | С | C x A (acres) | | | Q = (CIA) (cfs) | others (cfs) | Total Q (cfs) | Slope (ft/ft) | Pipe Material | Manning's | Dia (in) | Q (full) (cfs) | V (full) (fps) | Q/Q(full) < 1? | INV. IN (ft) | INV. OUT | Length (ft) | Pipe Rad. (ft) | | Area (ft2) | Perimeter (ft) | | |
| RUN #1 | | , , | | | | | | , , | • • | , , | | | | • | | | | | , , | | | | · · · · · | | |
| · <u></u> | | | | | | | | | | | | | | | | | | | | | | | | | |
| Subcatchment #1 | CB #1 | 0 | 0.20 | | | | | | | | | | | | | | | | | | | | | | |
| | | 1272 4674 | 0.30 0.90 | | | | | | | | | | | | | | | | | | | | | | |
| | | | | 0.11 | 5 | 4.88 | 0.51 | 0.00 | 0.51 | | | | | | | | | | | | | | | | |
| CB #1 | CB #2 | 0 | 0.20 | | | | | | | | | | | | | | | | | | | | | | |
| | | 0 0 | 0.30 0.90 | | | | | | | | | | | | | | | | | | | | | | |
| | | | | 0.00 | 5 | 4.88 | 0.00 | 0.51 | 0.51 | 0.012 | HDPE | 0.011 | 12 | 4.61 | 5.87 | 0.11 | 89.65 | 89.9 | 21 | 0.5 | 0.25 | 0.785 | 3.142 | | |
| Subcatchment #2 | CB #2 | 0 | 0.20 | | | | | | | | | | | | | | | | | | | | | | |
| | | 209 | 0.30 | | | | | | | | | | | | | | | | | | | | | | |
| | | 2058 | 0.90 | 0.04 | 5 | 4.88 | 0.21 | 0.00 | 0.21 | | | | | | | | | | | | | | | | |
| | | | | 0.04 | 3 | 4.00 | 0.21 | 0.00 | 0.21 | | | | | | | | | | | | | | | | |
| Subcatchment #4 (Roof) | 6" HDPE Pipe | 0 | 0.20 | | | | | | | | | | | | | | | | | | | | | | |
| (/ | | 0 1086 | 0.30 | | | | | | | | | | | | | | | | | | | | | | |
| | | 1000 | 0.50 | 0.02 | 5 | 4.88 | 0.11 | 0.00 | 0.11 | | | | | | | | | | | | | | | | |
| 6" HDPE Pipe | CB #2 | 0 | 0.20 | | | | | | | | | | | | | | | | | | | | | | |
| | | 0 0 | 0.30 0.90 | | | | | | | | | | | | | | _ | | | | | | | | |
| | | | | 0.00 | 5 | 4.88 | 0.00 | 0.11 | 0.11 | 0.035 | HDPE | 0.011 | 6 | 1.24 | 6.32 | 0.09 | 91 | 94 | 86 | 0.25 | 0.125 | 0.196 | 1.571 | | |
| CB #2 | DMH #1 | 0 | 0.20 0.30 | | | | | | | | | | | | | | | | | | | | | | |
| | | 0 | 0.90 | | | | | | | | | | | - 100 | | | | | | | | | | | |
| | | | | 0.00 | 5 | 4.88 | 0.00 | 0.84 | 0.84 | 0.010 | HDPE | 0.011 | 12 | 4.26 | 5.43 | 0.20 | 88.55 | 89.55 | 98 | 0.5 | 0.25 | 0.785 | 3.142 | | |
| DMH #1 | EX_CB #1 | 0 | 0.20 0.30 | | | | | | | | | | | | | | | | | | | | | | |
| | | 0 | 0.90 | 0.00 | 5 | 4.88 | 0.00 | 0.73 | 0.73 | 0.012 | HDPE | 0.011 | 12 | 4.61 | 5.87 | 0.16 | 88.2 | 88.45 | 21 | 0.5 | 0.25 | 0.785 | 3.142 | | |
| | | | | 0.00 | 3 | 4.00 | 0.00 | 0.73 | 0.73 | 0.012 | TIDEL | 0.011 | 12 | 4.01 | 3.01 | 0.10 | 00.2 | 00.43 | 21 | 0.5 | 0.23 | 0.765 | 3.142 | | |
| Subcatchment #3 | Beehive Overflow | 0 | 0.20 | | | | | | | | | | | | | | | | | | | | | | |
| | | 3429 | 0.30 | | | | | | | | | | | | | | | | | | | | | | |
| | | 8319 | 0.90 | 0.20 | 5 | 4.88 | 0.95 | 0.00 | 0.95 | | | | | | | | | | | | | | | | |
| | | | | 0.20 | 3 | 4.00 | 0.33 | 0.00 | 0.95 | | | | | | | | | | | | | | | | |
| Beehive Overflow | EX_CB #1 | 0 | 0.20 | | | | | | | | | | | | | | | | | | | | | | |
| | | 0 | 0.30 0.90 | | | | | | | | | | | | | | | | | | | | | | |
| | | Ü | 0.00 | 0.00 | 5 | 4.88 | 0.00 | 0.95 | 0.95 | 0.017 | HDPE | 0.011 | 12 | 5.45 | 6.94 | 0.18 | 88.6 | 88.8 | 12 | 0.5 | 0.25 | 0.785 | 3.142 | | |

INSTRUCTIONS:

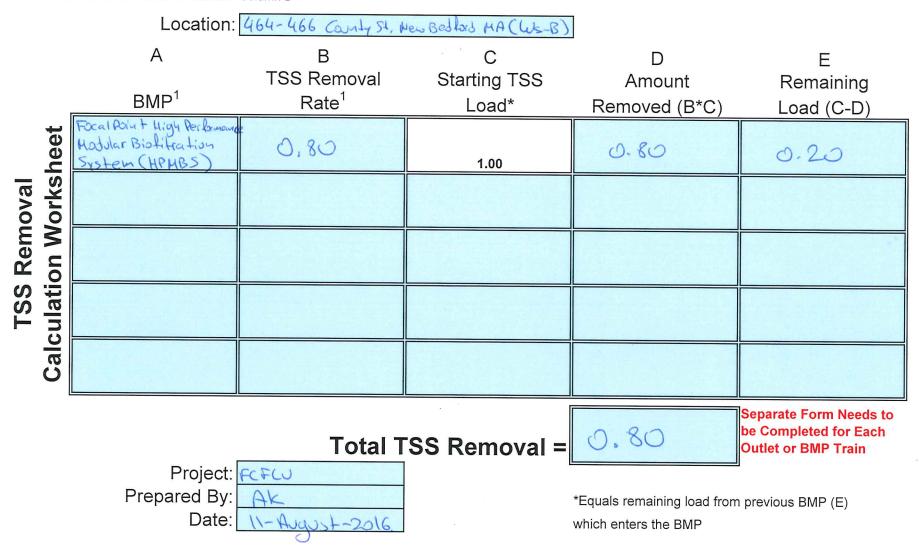
Version 1, Automated: Mar. 4, 2008

- 1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
- 2. Select BMP from Drop Down Menu
- 3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: 464-466 County Street, New Bedford, MA (Pr_WsA)



- 1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
- 2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
- 3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
- 4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
- 5. Total TSS Removal = Sum All Values in Column D



FOCALPOINT

HIGH PERFORMANCE MODULAR BIOFILTRATION SYSTEM

MA DEP PROPRIETARY TECHNOLOGY COMPLIANCE

ACF Environmental has prepared this guidance document for engineers designing projects in Massachusetts with the FocalPoint high performance modular biofiltration system. This information is based on the guidance provide in Chapter 4 of the Massachusetts Stormwater Handbook titled "Process to Approve or Deny the Use of Proprietary Stormwater Technology". Each evaluation criteria is provided below followed by a response from ACF in **bold face blue** text to address the criteria. It is anticipated that this document would be provided as an attachment to a permit application with local MA conservation commission groups and local reviewing authorities.

Process To Approve or Deny the Use of Proprietary Stormwater Technology

There are only two ways to evaluate a proposed use of a proprietary BMP in Massachusetts:

1. The Commonwealth has evaluated the performance of the technology and assigned a TSS removal efficiency.

This does not apply to FocalPoint-HPMBS, please proceed to Item 2.

2. The issuing authority has evaluated the proposed use of a particular proprietary BMP at a specific site and assigned a TSS removal efficiency based upon its own case-by-case review of the effectiveness and intended use of the proprietary BMP.

MassDEP strongly recommends that the issuing authority evaluate proposed BMPs using studies reviewed by the University of Massachusetts and posted on its stormwater database website (www.mastep.net). That database includes information on the relative quality of the studies, and should be used as the basis for a local agency's evaluation of the effectiveness of a proprietary system. Based on this information, the issuing authority may decide to approve or deny the use of any proprietary technology. The issuing authority may not unreasonably deny the use of a proposed technology.

Per the MassDEP The Massachusetts Strategic Envirotechnology Partnership (MassSTEP) was defunded by the Commonwealth and thereafter sunset by the Massachusetts Executive Office of Energy and Environmental Affairs (MassEEA) on January 11, 2011. As such, it is not effective for regulatory purposes pursuant to the Massachusetts Wetlands Protection (310 CMR 10.00) or any other regulations of the Commonwealth. Similarly, the Massachusetts Stormwater Technology Evaluation Project (MASTEP) is no longer funded by the Massachusetts Department of Environmental Protection (MassDEP) and is not effective for regulatory purposes pursuant to the Massachusetts Wetlands Protection (310 CMR 10.00) or any other regulations of the Commonwealth.

In regards to the Technology and Reciprocity Partnership (TARP), MassDEP has not granted written reciprocity to any of the reviews conducted by the New Jersey Corporation for Advanced Technology (NJCAT) through the New Jersey DEP. As such, any documents represented as being TARP compliant verifications are not effective for regulatory purposes pursuant to the Massachusetts Wetlands Protection (310 CMR 10.00) or any other regulations of the Commonwealth.

If the operating parameters and performance claims of a proprietary technology have not been fully verified by STEP or TARP and a MassDEP removal efficiency rating has not been assigned, the technology vendor must submit evaluative information to the local agency regarding the technology's effectiveness.

On October 28, 2014, ACF Environmental of East Norriton, Pennsylvania authorized Civil & Environmental Consultants, Inc. (CEC) to perform a 3rd party, full-scale test to assess the water quality performance of the FocalPoint High Performance Modular Biofiltration System (HPMBS). The field-based assessment was performed in accordance with a protocol which produces the same quality and quantity of data as the protocols established by the University of New Hampshire Stormwater Center, the Technology Acceptance and Reciprocity Partnership, or the Washington State Department of Ecology Technology Assessment Protocol (TAPE). Specifically, TAPE protocols were followed for this study and are indicated in the Table 1. Table 2 provides a summary of removal efficiencies based on even mean concentrations. A full technical evaluation report that includes a complete breakdown of individual event data, statistical analysis, analytical sheets and conclusions is available upon request.

Table 1. TAPE versus TARP Protocols

| STANDARD | TAPE | TARP | | |
|------------------------------------|-----------------------|---------------|--|--|
| Number of test sites | 1 | None | | |
| Number of Storms | 12-35 | 15-20 | | |
| Storm Depth (inches) | ≥ 0.15 | ≥ 0.10 | | |
| Antecedent Dry Period (hrs) | 6 with less than 0.04 | 6 | | |
| | inches | | | |
| Storm Duration (hr) | 1 | None | | |
| Average Storm Intensity | None | None | | |
| Sampling Methods | Automated | Automated | | |
| Type of Samples | Flow weighted | Flow weighted | | |
| | composite | composite | | |
| Minimum # of Aliquots | 10 | 10 | | |

| Volume Coverage (covering X% of each storms total runoff volume) | 75 | 70 |
|--|---|--|
| Pollutant Analyzed | TSS pH Metals (Zn, Cu, Cd) Oils and Grease TPH TP TKN (none) SSC (optional) | TSS |
| Performance Criteria for all three protocols | Influent Range 20-100 mg/L TSS, 100-200 mg/L TSS ≥ 200 mg/L TSS | Effluent Criteria ≤ 20 mg/L 80% removal 80% removal |

Table 2. Summary of removal efficiencies for primary constituents of concern – Suspended Sediment (TSS), Total Phosphorus (TP), Total Nitrogen (TN)

| Study | Constituents | % Removal | % Removal | Bootstrap | Bootstrap | % |
|--------|-------------------------------|----------------|------------|---------------|-------------------|--------------------|
| Method | | Concentration | Mass | 95% CI for | 95% CI for | Removal, |
| | | Based, for the | Based, for | mean [LCL, | mean [LCL, | Lab Based |
| | | event mean A | the event | UCL], | UCL] | Column |
| | | | mean | Concentration | Mass Based | Study ^B |
| | | | | Based | | |
| TAPE | Suspended | 86 | 88 | [65.1, 85.7] | [82.1, 91.3] | 91.2 |
| | Sediment (TSS) | (n=12) | (n=11) | | | |
| TAPE | Total | 52 | 59 | [30.6, 57.9] | [45.7, 62.9] | 66 |
| | Phosphorus (TP) | (n=7 | (n=7) | | | |
| TAPE | Total | 95 | 97 | [59.7, 86.6] | [67.5, 89.6] | 48.5 |
| | Nitrogen (TN) ^c | (n=6) | (n=6) | | | |

A Automated flow-weighted composites were collected and composite sample concentrations are defined as the volume weighted average of all the individual samples. Therefore, the event mean concentration (EMC) for the flow-weighted sample is the concentration of the composite.

^B CEC Assessment of suspended solids and nutrient attenuation by the Virginia mixture of FocalPoint Biofiltration System via column testing, October 2014.

^c For this study period there were no measureable removals of nitrates. The reduction in TN is derived from the attenuation of the Kjeldahl Nitrogen portion of the influent concentrations.

As indicated in the table above, a TAPE minimum of 12 storm events have been sampled to date. All 12 events are classified as qualifying storm events, as defined by TAPE for this research (i.e., qualifying storm event of 0.15-inch or greater rainfall total). From these 12 storm events, there has been an average 31% reduction in runoff volume through the FocalPoint HPMBS system for the given storms.

of the 12 qualifying storm events, 12 events qualified for assessing suspended solids removal efficiencies. Relative to TSS, the influent concentrations measured from the test site range from 4.9 to 238 mg/L. For the 20-100 mg/L influent range, the measured effluent TSS does meet the TAPE-required upper 95% confidence limit about the mean effluent concentration of less than or equal to 20 mg/L (data calculations from the study produced a 16.8 mg/L upper confidence limit concentration via bootstrapping. For influent TSS in the range of 100-200 mg/L, three events to date, the TAPE minimum 80% removal efficiency requirement is met with a mass loading-based 95% lower confidence limit of 90.5%, as calculated via bootstrapping. There as one event with an influent TSS concentration above 200 mg/L (238 mg/L from December 14, 2015) for which 80% TSS removal was achieved on a single event concentration and mass load basis.

Please note that Proprietary BMPs are NOT required to be evaluated by MassDEP to be used in Massachusetts. Only a small number of proprietary BMPs have been evaluated by the Commonwealth, and those evaluations are limited to the specific conditions that were reviewed. In most case in Massachusetts, a proposed use of a particular proprietary BMP at a specific site will be reviewed by the local agency on a case–by-case basis.

FocalPoint HPMBS will be reviewed by the local agency on a case-by-case basis.

How to Evaluate the Effectiveness of Proprietary BMPs that Do Not Have a MassDEP TSS Removal Efficiency Rating: MassDEP recognizes that the process of reviewing a proposed use of a particular proprietary BMP at a specific site may be daunting. MassDEP has prepared guidance for conducting this review.

Step One: Information that should be submitted as part of the Wetlands NOI.

As more fully set out below, issuing authorities require sufficient information to evaluate proposed uses of proprietary BMPs. If sufficient information is not submitted with the NOI, the Conservation Commission should request additional information as part of the review process. Specific information that a Conservation Commission may want to request prior to a hearing include:

A complete description of the proprietary technology or product including a discussion of the advantages of the technology when compared to conventional stormwater treatment systems and LID practices, including:

FocalPoint HPMBS is a modular, high performance biofiltration system that often works in tandem with other integrated management practices (IMP). Contaminated stormwater runoff enters the biofiltration bed through a conveyance swale, planter box, or directly through a curb cut or false inlet. Energy is dissipated by a rock or vegetative dissipation device and is

absorbed by a 3-inch layer of aged, double shredded hardwood mulch, with fines removed, on the surface of the biofiltration media.

The FocalPoint HPMBS design describes a mostly permeable profile or boxless system that is identical to that of a traditional bioretention system (i.e., 2-3 inches of mulch layer, 18-24 inch media depth, \geq 6" underdrain and 24 to 48 hr for complete drain down time) and substitutes high performance, high-flow rate engineered media for traditional slow-flow rate media and incorporates a matching high performance, highly permeable, modular underdrain for typical perforated pipe. The performance difference between these two systems is dramatic in terms of their ability to receive water. The modular underdrain also may be expanded to include integrated subsurface storage options for extended detention, infiltration, and/or reuse. These options are integral to the FocalPoint HPMBS design and they are almost infinitely scalable in length width and depth. Outfall from these underdrain structures may be restricted to meet any design need, either by pipe, pump (for harvesting) or subsurface infiltration.

As the water passes through the mulch layer, most of the larger sediment particles and heavy metals are removed through sedimentation and chemical reactions with the organic material in the mulch. Water passes through the biofiltration media where the finer particles are removed and numerous chemical reactions take place to immobilize and capture pollutants in the soil media.

The cleansed water passes into the underdrain/storage system and remaining flows are directed to a stormwater conveyance system or other appropriate discharge point. Once the pollutants are in the media, bacteria begin to break down and metabolize the materials and the plants begin to uptake and metabolize the pollutants. Some pollutants such as heavy metals, which are chemically bound to organic particles in the mulch, are released over time as the organic matter decomposes to release the metals to the feeder roots of the plants and the cells of the bacteria in the media where they remain and are recycled. Other pollutants such as phosphorus are chemically bound to the soil particles and released slowly back to the plants and bacteria and used in their metabolic processes. Nitrogen goes through a variety of very complex biochemical processes where it can ultimately end up in the plant/bacteria biomass, turned to nitrogen gas or dissolves back into the water column as nitrates depending on soil temperature, pH and the availability of oxygen. The pollutants ultimately are retained in the mulch, media and biomass with some passing out of the system into the air or back into the water.

The System is comprised of the following elements and depicted in Figure 1.

Open Cell Underdrain: A modular, high infiltration rate 'flat pipe' underdrain/storage system which is designed to directly infiltrate or exfiltrate water through its surface. The modular underdrain overcomes the limited collection capacity of traditional stone and pipe underdrains. A 90% open surface area collects water significantly faster and can be extended below for additional volume.

Separation Layer: A wide aperture mesh layer is utilized to prevent bridging stone from entering the underdrain system. The separation layer utilizes the concept of 'bridging' to separate the biofiltration media from the underdrain without the use of geotextile fabrics.

The use of geotextile fabrics within an infiltration device can lead to clogging; by eliminating the need for a geotextile fabric, the potential for clogging is greatly reduced.

High Flow Media: The advanced high flow rate engineered media utilizes physical, chemical and biological mechanisms of the soil, plant and microbe complex to remove pollutants found in stormwater runoff. Infiltration rates at 100 inches per hour overcome the challenges of clogging and flooding while minimizing space requirements.

Mulch: Shredded hardwood mulch acts as a pre-treatment mechanism by preventing trash, sediments and particles from entering the system. Removal and replacement of mulch is necessary only every 6-12 months and is the only maintenance requirement for the entire system. Maintenance cycles may be extended with the implementation of upstream pretreatment.

Plants: Native Plants are best suited as they adjust well to periodic droughts and temperature extremes. The media contains 10% by volume peat moss. Over the years the decaying mulch, roots, fungi, bacteria and organic inputs from stormwater runoff add to the organic mix as it evolves as more natural soil strata. Soil moisture is maintained through the use of peat moss and mulch.

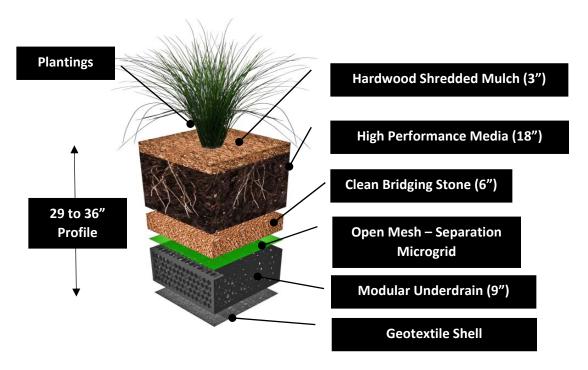


Figure 1. Cross section of a FocalPoint-HPMBS

While the most remarkable effect of the high-flow media in a FocalPoint HPMBS design is that it allows for a dramatically smaller footprint of the biofilter media bed, the surface storage option inherent in a conventional bioretention remains a design option. In this case the smaller biofilter bed is located within a simple, vegetated recession or swale without necessity for excavation, underdrain, special plantings or special maintenance beyond the small biofilter. Although the infiltration flow rate of the media bed is 100 inches per hour, the time frame associated with draining the surface pond, if this approach is utilized, is dependent

not on the infiltration rate of subsurface soils as it would be with a conventional system, but on the size of the FocalPoint HPMBS biofilter, which can be adjusted according to allowable drain down time and factor of safety. These characteristics are the key to the economics, maintainability and design flexibility of FocalPoint HPMBS and are not likely accomplished if the media is enclosed in a precast shell.

- Size: What volume is it designed to hold and/or treat? How is the system sized to meet the performance standards in order to handle the required water quality volume, rate of runoff, and types of storms? Standard 4 requires treatment for a required water quality volume, not for a specified design flow rate.
 - The FocalPoint HPMBS is sized to treat the water quality volume (WQv) as determined by a qualified project engineer or local jurisdiction.
 - o FocalPoint HPMBS sizing is iterative and site specific based on the available space above the unit for temporary storage of the water quality volume prior to overflow. For example, on a site with little available space for the water quality volume above the unit, the FocalPoint HPMBS may need to be increased in size to utilize the 100 inch/hr. infiltration rate to ensure the entire water quality volume passes through the unit. On the other hand, if a great wealth of space was available for the water quality volume to temporarily pond over the unit, the FocalPoint HPMBS could be incrementally reduced in size. A key design parameter is having the system draw down within 24-48 hours from the commencement of the storm.
 - O ACF Environmental has developed a sizing calculator/tool (ACF FP and RT Calculator) to assist engineers and designers with the optimal sizing of the unit in all configurations and locations. The tool is a dynamic model that distributes the water quality volume and design storm with an SCS 24-hour rainfall event. The tool demonstrates how much volume is treated by the FocalPoint HPMBS and at what point in the storm the overflow device is activated. The system size can also be modeled and verified in a program such as HydroCAD or other model.
 - At a minimum, the filter bed area to impervious runoff area should be 0.40% (44 sq. ft of filter bed area to 10,890 s.q ft of impervious area) and the ponding volume above the practice equal to 20% of the WQV.
- Technical description, schematic and process flow diagram: How does it work? What are the technical configurations of the unit? Are there any pretreatment requirements? How does it fit in combination with other treatment systems?
 - o Figure 1 below provides schematic and process flow diagram.
 - The system works according to the fundamentals of media bed\infitration bed
 design and is best described by the Darcy Equation which the area of the filter
 bed as a function of (WQv, filter bed depth, coefficient of permeability, average
 height of the water above the filter bed and drain down time of the filter bed).
 - The configuration is typically square or rectangular in shape. The minimum size FocalPoint HPMBS from a constructability standpoint is 20 SF and the minimum width should be 2 ft.
 - The system has a vertical profile of 3 ft (typical) from top of mulch to bottom of underdrain.

- The ponding zone above the mulch can take on many different geometric shapes, the most common being trapezoidal bowl with a ponding depth of 6 to 18 inches.
- O Pretreatment of runoff entering a FocalPoint HPMBS is recommended to trap coarse sediment particles before they reach and prematurely close the filter bed. Pretreatment measures must be designed to dissipate velocities and spread water out over a 2 to 4 ft width. Many pretreatment options are available and include manufactured systems like the Rain Guardian or non-propriety systems like stone aprons\diaphragms, grass filter stripes and level lip spreaders.
- The system integrates into Low Impact Development objectives and seeks to decentralize the management of stormwater. Conversely, and may also be used in a more centralized or end of pipe application if site condition dictate.
- The system can be configured either off-line or on-line and be used in combination with other treatment systems if required to meet the project specific treatment goals.

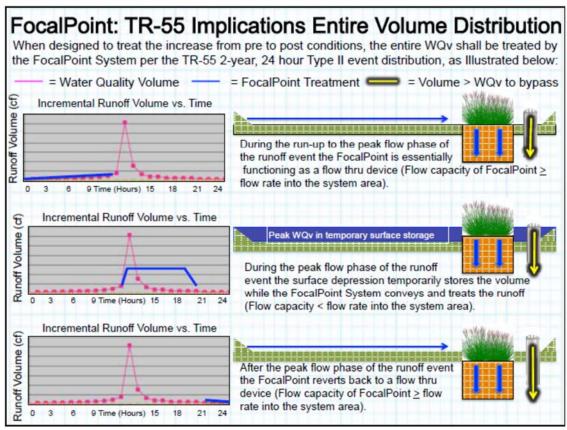


Figure 2. Cross section of a FocalPoint-HPMBS

• Capital costs and installation process and costs: What does this size system cost? Are there any consumable materials that need to be replaced and if so, how often and how much do they cost? How will the system be installed and who will supervise the installation to ensure that it is done properly? What mistakes can happen during installation? Is any special handling, installation techniques or equipment required?

- o Capital costs are market driven and typically range from \$125 to \$185/SF of filter bed area. Installation cost range from \$30 to \$60/SF of filter bed area.
- o The system is installed with common utility\landscape equipment and labor.
- A jobsite superintendent or foreman is qualified to supervise installation as this is not different than a planter bed, bioretention or landscape feature.
- ACF Environmental has certified installers and is qualified to site supervise.
 We offer these services as part of our contract with the customer.
- o No special handling is required.
- o No special equipment is required
- Potential disadvantages at this site: Any physical constraints? Weight or buoyancy issues? Durability issues? Energy requirements?
 - The system should be separated from the water table to ensure that groundwater does not inundate the filter bed. A separation distance of 2 feet is recommended between bottom of excavated FocalPoint HPMBS area and the seasonally high ground water table.
- Operation and maintenance (0&M) requirements and costs: New technologies will not have long-term data on 0&M requirements, so it is particularly important that an applicant provide all available information for evaluation.
 - We have installed over 1,000 systems across the United States and sufficient experience with 0&M to feel confident our recommendation on maintenance frequency are sound.
 - All stormwater treatment systems require maintenance for effective operation.
 This necessity is often incorporated in your property's permitting process as a legally binding operation and maintenance agreement. Other reasons for maintenance include:
 - Avoid legal challenges from your jurisdiction's maintenance enforcement program.
 - Prolong the lifespan of your FocalPoint HPMBS.
 - Avoid costly repairs.
 - Help reduce pollutant loads leaving your property.
 - Simple maintenance of the FocalPoint HPMBS is required to continue effective pollutant removal from stormwater runoff before any discharge into downstream waters. This procedure will also extend the longevity of the living biofiltration system. The unit will recycle and accumulate pollutants within the biomass, but may also be subjected to other materials entering the surface of the system. This may include trash, silt and leaves etc. which will be contained above the mulch and/or biofiltration media layer. Too much silt may inhibit the FocalPoint's HPMBS flowrate, which is a primary reason for system maintenance. Removal of accumulated silt/sediment and/or replacement of the mulch layer (when specified), is an important activity that prevents over accumulation of such silt/sediment.
 - Convergent Water Technologies and/or its Value-Added Reseller (VAR) include
 a 1-year maintenance plan with each system purchased. Annual included
 maintenance consists of two (2) scheduled maintenance visits. Additional
 maintenance may be necessary depending on sediment and trash loading (by

- Owner or at additional cost). The start of the maintenance plan begins when the system is activated for full operation. Full operation is defined as when the site is appropriately stabilized, the unit is installed and activated (by VAR), i.e., when mulch (if specified) and plantings are added.
- Activation should be avoided until the site is fully stabilized (full landscaping, grass cover, final paving and street sweeping completed). Maintenance visits are scheduled seasonally; the spring visit aims to clean up after winter loads including salts and sands. The fall visit helps the system by removing excessive leaf litter.
- It has been found that in regions which receive between 30-50 inches of annual rainfall, (2) two visits are generally required. Regions with less rainfall often only require (1) one visit per annum. Varying land uses can affect maintenance frequency.
- o Some sites may be subjected to extreme sediment or trash loads, requiring more frequent maintenance visits. This is the reason for detailed notes of maintenance actions per unit, helping the VAR/Maintenance contractor and Owner predict future maintenance frequencies, reflecting individual site conditions. Owners must promptly notify the VAR/Maintenance contractor of any damage to the plant(s), which constitute(s) an integral part of the biofiltration technology. Owners should also advise other landscape or maintenance contractors to leave all maintenance of the FocalPoint HPMBS to the VAR/Maintenance contractor (i.e. no pruning or fertilizing).
- B. Data on how well the alternative technology works:
- Flow proportional sampling from laboratory testing and full-scale operations that is representative of the potential range of rainfall events (for example, a sufficient number of storms is generally at least 15) and located at sites similar to the conditions of the installation under review.
 - A full scale FocalPoint HPMBS has been field monitoring to TAPE protocols as described Table 1 above and include flow weighted composite sample.
 - The system was installed in July of 2015 and has experienced 57 days with measurable precipitation. The total rainfall depth for the study period to date is 18.24 inches. Of the 57 wet weather events, there have been 12 qualified events as defined by TAPE.
- Calculation of TSS removal rate should be presented. If there is a removal rating for a similar technology and use posted at http://www.mass.gov/dep/, and the proponent makes a claim for a higher TSS removal rate than for the similar system posted, the applicant must provide sufficient data to support the claim. Removal rates should show removal of various particle sizes across the full range of operating conditions including maximum, minimum and optimal conditions for reliable performance.
 - Removal rates from the TAPE level field study are based in event mean concentrations, which characterize the operating rate conditions, influent\effluent TSS concentrations and particle sizes from the start to the end of the rainfall event.
 - Total Suspended Solids (TSS) removal of 86% as defined as the change in average event mean concentration (EMC) between the influent runoff and

- effluent runoff was observed. TSS influent EMCs ranges from 4.9 to 238 mg/L from the field test site. Hydraulic operating conditions for each storm event ranged from 7 to 157% of design capacity; thereby demonstrating performance across the full range of operating conditions.
- O Per TAPE protocol, particle size distribution (PSD) shall be determined by Method ASTM D3977. We have run this method for two events and determined the majority of material in the runoff are clays and silts (Method B) with the remainder being fine to coarse sand (below 250 microns). The corresponding influent TSS concentration for the 9/30/15 event was 26.6 mg/L and the portion associated with silts and clays (Method B) measured at 16 mg/L or mg/kg, for a percentage of 60%. The influent TSS concentration for the 10/9/15 event was 197 mg/L and the portion associated with silts and clays (Method B) was 161 mg/L or mg/kg, for a percentage of 82%.
- The MassSDEP requires 80% TSS removal for most permitted projects and the results from the TAPE field study confirm the we are able to meet and exceed this removal rate.
- A copy of the site's operation and maintenance plan including operational details on any
 full-scale installations: e.g., locations, length of time in operation, maintenance logs (logs
 should record the dates of inspections and cleaning, actions performed, quantities of solids
 removed, and time required for work).
 - o Not applicable at this time.
- Information on any system failures, what those failures were, and how were they corrected.
 - The mechanisms of failure inherent with bioswales, bioretention, rain gardens are the same for FocalPoint.
 - The system includes a 1-yr guarantee on media infiltration rate along with the first year of maintenance as part of the upfront capital cost.
- Copies of any articles from peer-reviewed, scientific or engineering journals.
 - Land and Water Magazine, Jan\Feb 2016 Issue, Lessons Learned from LID Based Roadway, Anthony Kendrick, Env SP.
- Any approvals or permits from other authorities. (See below)

RECENT REGUALATORY APPROVALS:

New Hampshire Department of Environmental Protection (NHDES) Alteration of Terrain Bureau (AOT) has approved the FocalPoint\HPMBS system for stand-alone 80% treatment on the basis of our TAPE field testing data.

Maine Department of Environmental Protection (MEDEP) has approved the FocalPoint\HPMBS system for stand-alone treatment of TSS and Phosphorus.

VA DEQ - BMP Clearinghouse Approval for 50% Phosphorus (maximum allowable removal)

Virginia Department of Transportation (VDOT) Tree Box Filter Specification

• The filtration media shall achieve a flow rate equal to a minimum of 100 inches per hour and verified via a third part report

- The unit shall remove 80% TSS using Sil-Co-Sill 106 typical particle size distribution in the laboratory. Field results should show at least 80% TSS removal following either TAPE or TARP testing protocols.
- The unit shall belocated to esnnure that high flow events shall bypass the filter media preventing erosion and resuspension of pollutants.

Florida Department of Environmental Protection (FLDEP) included on the Accepted Technology List

Pennsylvania Department of Environmental Protection – approved as a stand alone treatment BMP for TP, TSS and TN.

District of Columbia – Department of Energy and Environment (DDOEE) - approved as a standalone bioretention practice consistent with Chapter 3.5 BMP Manual.

Missouri Department of Transportation - approved as an acceptable bioretention practice

Harris County, TX - Office of Public Infrastructure – approved as a stand alone BMP and is acceptabke fir LID method for green roadway, green street and green infrastructure. Generic FocalPoint-HPMBS details and specicaitons are available for download at the Harris County

• References along with contact information from other installations.

Town of Falmouth
Department of Public Works
271 Falmouth Rd
Falmouth, ME 04105
Mr. Jay Reynolds
207-699-5374

City of Houston Engineering Services Section 611 Walker St Houston, TX 77002 Ms. Kathlie Jeng-Bullock, P.E. 832-395-2511

Town of Kittery Code Enforcement 200 Rogers Road Kittery, ME 03904 Jessa Kellogg 207-475-1321 Harris County Government Engineering Department 1001 Preston, 7th Floor Houston, TX 77002 Mr. John Blount, P.E. 713-755-6888

Sebago Technics City of South Portland Engineer 75 John Roberts Rd, Suite 1A South Portland, ME 04106 Mr. Dan Riley, P.E. 207-200-2100

C. Operation and Maintenance (O&M) Plan:

• To ensure that the system will function as designed, all stormwater management systems must have a written operation and maintenance plan in accordance with Stormwater

Management Standard 9. MassDEP stresses the importance of routine maintenance for all stormwater control technologies. A number of alternative technologies perform very well, but only if they are installed and maintained as specified by the manufacturer. For example, some alternative wet vaults may be able to achieve a high TSS removal rate, but only if they are cleaned often enough to prevent re-entrainment of previously trapped sediment.

The O & M Plan shall (see attached)

- 1. Identify access points to all components of the stormwater system;
- 2. Specify equipment, personnel, and training needed to inspect and maintain system;
- 3. Include a list of any safety equipment and safety training required for personnel;
- 4. Set forth a suggested frequency of inspection and cleaning; and
- 5. Provide a sample inspection checklist and maintenance log.

Please refer to Standard 9 in the Stormwater Technical Handbook (Volume 1, Chapter 1 and Volume 2, Chapter 1) for further guidance about 0&M.



First Citizens' Federal Credit Union – New Bedford, Massachusetts

APPENDIX C – SUPPORTING INFORMATION



CONSTRUCTION PHASE STORMWATER OPERATION AND MAINTENANCE PLAN

First Citizens' Federal Credit Union 464-466 County Street & 178 Eighth Street New Bedford, Massachusetts 02740

I. OWNER:

South Coast Real Estate Holdings, LLC A Subsidiary of First Citizens' Federal Credit Union 200 Mill Road, Suite 100 Fairhaven, MA 02719

II. RESPONSIBLE PARTY:

South Coast Real Estate Holdings, LLC A Subsidiary of First Citizens' Federal Credit Union 200 Mill Road, Suite 100 Fairhaven, MA 02719 Attn: Shawn McDonough (774) 628-7851

III. PROJECT OVERVIEW:

Prevention of offsite flooding and improvement to water quality to the maximum extent practicable are the main priorities of the project with respect to stormwater management. The project will improve water quality within the property by installing Best Management Practices (BMPs). Water quality BMPs to mitigate the runoff generated by the site improvements during construction include deep-sump catch basins with hooded outlets, straw wattles, temporary SiltSack® catch basin inserts (or similar product), and periodic sweeping to remove sand and sediment.

It is the intent of the stormwater management design to achieve the maximum Total Suspended Solids (TSS) removal efficiency possible for the redevelopment as outlined in the DEP Massachusetts Stormwater Management Handbook prior to stormwater discharging into the City's system. In addition to the water quality BMPs, the drainage conveyance system will consist of traditional stormwater design components such as high density polyethylene (HDPE) smooth interior wall pipe.

The BMPs used in this design were chosen for their effectiveness and ease of maintenance with respect to developed site conditions. Providing for maintenance requirements that are practical is essential to achieve the desired result of improved water quality of on-site stormwater runoff



generated by the proposed improvements. This plan will be provided to the property owner, property manager, and general contractor to educate them on the recommendations of this plan and the DEP Stormwater Management Guidelines.

The protection of resource areas and BMP's installed during construction is essential to both short and long term operation and use of the facility.

IV. CONSTRUCTION PERIOD – NON STRUCTURAL BEST MANAGEMENT PRACTICES:

a) MONITORING

During clearing, grading and pavement rehabilitation operations, the stormwater management system and roadways will be inspected at least once every seven (7) calendar days, or once every fourteen (14) calendar days and within twenty-four (24) hours after a storm event of one quarter inch (0.25") or greater. Sediment accumulation shall be removed once a depth of one-third the height of the erosion control device is achieved unless otherwise stated. Damaged erosion controls shall be replaced immediately.

b) WASTE DISPOSAL

Metal dumpster type waste disposal receptacles will be located on-site. The project site will be policed daily by a person appointed by the general contractor to be kept free of construction debris.

c) DUST MONITORING PLAN

A dust monitoring plan will be established prior to the start of construction to be kept on site at all times. This will reduce the amount of particulates in the air and reduce impacts to the surrounding area and to wetland resource areas adjacent to the site. Recommended methods for controlling dust include:

- Provide a vegetative cover to disturbed areas at the end of earth disturbing activities as soon as practical, but no longer than 14 days.
- Apply a mulch layer to disturbed areas at the end of earth disturbing activities as soon as practical, but no longer than 14 days.
- Cover stockpiles unused for a maximum of 7 days with poly sheeting or tarps.
- Water surface materials and soil stockpiles.
- Use covered trucks.
- Minimize spoils stockpiled on site.
- Monitor construction practices to minimize unnecessary disturbance and transfer of soil materials.
- Conduct periodic street cleaning along the site frontage during excavation and hauling of materials.
- Pave driveways and parking surfaces (where applicable and feasible).



- Assign a person to remove windblown debris daily.
- Limit the idling of engines or stopped vehicles (with the exception of asphalt and cement concrete mixing trucks and equipment) to five minutes.

d) STATE & LOCAL SANITARY LAWS

Portable sanitary units will be placed on-site during construction and will be serviced weekly.

V. CONSTRUCTION PERIOD - STRUCTURAL BEST MANAGEMENT PRACTICES

Structural BMPs are those physical facilities that are designed to manage both stormwater quantity and quality. Proper maintenance of the proposed structural BMPs will ensure design performance, promote longevity, and decrease operator maintenance costs. The structural BMPs selected for the proposed site development include: straw wattles, deep sump hooded catch basins, Silt Sack® temporary catch basin inserts.

a) **STRAW WATTLES**

Straw wattles shall be installed as specified on the "Site Preparation, Demolition and Erosion Control Plan", Sheet C200 dated August 11, 2016, prior to commencing construction activities. The straw wattles shall be inspected daily and maintained throughout construction. Any damage to the straw wattle shall be repaired/replaced immediately. Wattles to remain in place for the duration of construction until disturbed areas are permanently stabilized.

b) **DEEP SUMP HOODED CATCH BASINS**

The two proposed catch basins are to be a minimum of four feet in diameter and equipped with four foot deep-sumps to trap sediments and any debris/trash. The pipe outlets shall be hooded to prevent floating debris and oils from entering the subsurface drainage conveyance system. The actual removal of sediments, trash, and associated pollutants only occurs when the deep sumps are cleaned out; therefore, frequent maintenance is required. The more frequent the cleaning, the less likely sediments will be re-suspended and subsequently discharged. In addition, frequent cleaning also results in more sediment storage volume available for future storms and enhances overall performance.

Upon completion of the work, contractor is responsible for inspection and cleaning of units to ensure delivery of clean units to owner prior to completion of project.

c) SILTSACK® CATCH BASIN INSERTS

SiltSack® catch basin inserts shall be placed under the grate of all existing/proposed catch basins prior to commencing construction activities and as specified on the "Site Preparation, Demolition and Erosion Control Plan", Sheet C200 dated August 11, 2016. SiltSacks® shall



remain in place until construction is complete and the site is stabilized. During construction all catch basins and SiltSacks® shall be inspected every fourteen (14) calendar days and after a storm of a quarter inch (0.25") or greater. Sediment accumulation shall be removed once a depth of six-inches (6") is accumulated in the sack. Damaged SiltSacks® shall be repaired/replaced immediately. Disposal of accumulated sediment and trash is to be in accordance with applicable local, state and federal guidelines and regulations.

d) FOCALPOINT HIGH PERFORMANCE MODULAR BIOFILTRATION SYSTEM (HPMBS)

A FocalPoint High Performance Modular Biofiltration System (HPMBS is proposed to be constructed in the south west corner of the site. The FocalPoint High Performance Modular Biofiltration System (HPMBS is designed to receive the first one inch incoming stormwater runoff and use its biofiltration system to remove suspended solids.

FocalPoint High Performance Modular Biofiltration System (HPMBS is a post-construction BMP only. The contractor is responsible to protect the FocalPoint and prevent sediments from entering during construction. The contractor shall coordinate any necessary temporary diversion and/or retention measures of stormwater runoff to prevent undesirable materials from entering the FocalPoint. Contractor shall stake the limits of the FocalPoint during construction to keep construction equipment away from the area. Once floor and side slopes of the Focal Point have been stabilized, it may be used as part of the stormwater runoff treatment train.

End



LONG TERM OPERATION & MAITENANCE PLAN

First Citizens' Federal Credit Union 464-466 County Street & 178 Eighth Street New Bedford, Massachusetts 02740

I. OWNER:

South Coast Real Estate Holdings, LLC A Subsidiary of First Citizens' Federal Credit Union 200 Mill Road, Suite 100 Fairhaven, MA 02719

II. RESPONSIBLE PARTY:

South Coast Real Estate Holdings, LLC A Subsidiary of First Citizens' Federal Credit Union 200 Mill Road, Suite 100 Fairhaven, MA 02719 Attn: Shawn McDonough (774) 628-7851

III. PROJECT OVERVIEW:

Prevention of offsite flooding and improvement to water quality to the maximum extent practicable are the main priorities of the project with respect to stormwater management. The project will improve water quality within the property by installing Best Management Practices (BMPs). Long term water quality BMPs that will address the runoff generated by the existing and proposed paved areas include deep-sump catch basins with hooded outlets, FocalPoint High Performance Modular Biofiltration System (HPMBS), and periodic sweeping to remove sand and sediment from paved surfaces.

It is the intent of the stormwater management design to achieve the maximum Total Suspended Solids (TSS) removal efficiency possible for the redevelopment as outlined in the DEP Stormwater Management Handbook prior to stormwater discharging into the City's system. In addition to the water quality BMPs, the drainage conveyance system will consist of traditional stormwater design components such as high density polyethylene (HDPE) smooth interior wall pipe.

The BMPs used in this design were chosen for their effectiveness and ease of maintenance with respect to developed site conditions. Providing for maintenance requirements that are practical is essential to achieve the desired result of improved water quality of on-site stormwater runoff generated by the impervious area. This plan will be provided to the property owner or property manager to educate them on the recommendations of this plan and the DEP Stormwater Management Guidelines.



IV. POST CONSTRUCTION | BEST MANAGEMENT PRACTICES

a) NON-STRUCTURAL BEST MANAGEMENT PRACTICES

Implementing source controls can aid in reducing the types and concentrations of contaminants in stormwater runoff, which in turn can result in improved water quality. This principle for pollution prevention and non-structural controls, or BMPs, is to minimize the volume of runoff and to minimize contact of stormwater with potential pollutants. Measures such as street sweeping, managing snow removal, and educating the owner/operator of good maintenance practices are examples of non-structural BMPs.

i. PUBLIC AWARENESS

The responsible party shall issue periodic reminders to the building tenants to avoid dumping or releasing pollutants into the storm drains and onto the ground.

ii. STREET SWEEPING

Driveway and parking lot sweeping is an integral part of the storm water management plan as a fundamental component of source reduction efforts. Typically, parking lot and driveway sweeping activities will begin around April 1. However, sweeping should be done in cases of winter thaw and the onset of early spring. It is critical to remove the accumulated sediment in the parking areas from the winter months as soon as possible before heavy and frequent spring precipitation.

Parking lot sweeping shall be performed a minimum of two (2) times annually (April 1st and September 1st).

iii. SNOW AND SNOWMELT MANAGEMENT

It is suggested that during minor snowfall events resulting in accumulations of up to six (6) inches of snow, the snow be stockpiled in a designated area onsite determined by the property manager.

During high snowfall events resulting in accumulations in excess of six (6) inches, it is suggested that additional snow be stockpiled in a second area to be designated by the property manager. The removal contractor shall not stockpile snow directly on top of catch basin grates, or on top of the FocalPoint system. Stockpiled snow shall not extend more than 6 feet from the edge of pavement to allow normal vehicular travel.

It is the responsibility of the owner/manager to make sure the snow removal contractor utilizes the designated areas according to the procedures described herein. The owner/manager shall remove sediment from snow storage areas every spring.

It is suggested that no de-icing compounds, such as calcium chloride (CaCl₂), calcium magnesium acetate (CMA) or the like be used on the site. The snow removal contractor shall store all sand off-site. No quantities of sand compounds shall be stored on site.



iv. PUBLIC SAFETY FEATURES

The project has been designed with consideration for public safety and does not require any specific features as part of the stormwater management system.

b) NON-STRUCTURAL BEST MANAGEMENT PRACTICES

Structural BMPs are those physical facilities that are designed to manage both stormwater quantity and quality. Proper maintenance of the proposed structural BMPs will ensure design performance and promote longevity of the structure and may decrease operator maintenance costs. The structural BMPs selected for the proposed site development include: deep sump catch basins with hooded outlets, and FocalPoint High Performance Modular Biofiltration System (HPMBS)

i. DEEP SUMP HOODED CATCH BASINS

All proposed catch basins are to be a minimum of four feet in diameter and equipped with four-foot-deep sumps to trap sediments and any debris/trash. The pipe outlets shall be hooded to prevent floating debris and oils from entering the subsurface drainage conveyance system. The actual removal of sediments, trash, and associated pollutants only occurs when the deep sumps are cleaned out; therefore, frequent maintenance is required. The more frequent the cleaning, the less likely sediments will be re-suspended and subsequently discharged. In addition, frequent cleaning also results in more volume available for storage from future storms and enhances overall performance.

In areas of high sediment loading, basin sumps shall be inspected and cleaned as necessary. It is recommended that deep sump catch basins be inspected at least four times per year and at the end of the foliage and snow-removal seasons cleaning should take place two (2) to three (3) times per year and whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the lowest invert to the bottom of the SWMP. Disposal of accumulated sediment and trash is to be in accordance with applicable local, state and federal guidelines and regulations.

ii. FOCALPOINT HIGH PERFORMANCE MODULAR BIOFILTRATION SYSTEM (HPMBS)

See attached Operations & Maintenance Plan provided by ACF Environmental.



SPILL PREVENTION AND RESPONSE PLANS

Business activities for the Project will necessitate the use of vehicles and tractor trailers to transport goods and materials. Potential drips and residue from vehicle engines, or transported materials that might be dropped could result in a spill.

Equipment and materials necessary to clean spills or leaks shall be stored on site in an area clearly marked and easily accessed for immediate use. Materials shall consist of the following:

- Safety goggles;
- Chemically resistant gloves and overshoe boots;
- Water and chemical fire extinguishers;
- Shovels;
- Absorbent materials;
- Containers suitable for storage of site specific materials.
- First aid kits.

Spills and leaks shall be treated according to the type, volume, and location of the released material. Generally, mitigation shall consist of the following:

- Prevention of additional material spill
- Containment of spilled material;
- Safe, thorough and environmentally sound removal of spilled material; and
- Remediation of potential environmental damage.

The following describes specific preventative methods to be employed for materials to be used on site.

Fuels, Antifreeze, and Coolant for Tractor Trailer Usage:

In the case of a fuel spill on a pervious surface, the spill shall be contained and treated with absorbent polymer material immediately and the affected soil shall be excavated and stored in an impervious, bermed area for removal by a professional hazardous material removal company. In the case of a fuel spill on an impervious surface, the spill shall be contained to prevent runoff and treated with absorbent material.

Emergency Contact Information in Case of a Spill:

Town of Franklin Emergency Contacts are as Follows:

- Emergency Management: (888) 304-1133 (MassDEP 24-Hour Spill Reporting)
- Police Department: 911
- Fire Department: (508) 991-6501 (Main Number)



For spills of less than five (5) gallons of material, mitigation shall consist of source control, containment and clean-up with absorbent materials, unless an imminent hazard necessitates that a local professional hazardous material removal company become involved to mitigate the spill.

For spills greater than five (5) gallons of material, the incident shall be reported immediately to the MassDEP Hazardous Waste Incident Response Group at (617)-792-7653 and a professional emergency response contractor. Information that shall be provided to the said contractor is as follows:

- Type of material spilled;
- Quantity of material spilled;
- Location of the spill; and
- Time of the spill.

The building manager appointed by the property owner shall then employ measures to prevent further spillage, contain and/or clean up the spill.

If a Reportable Quantity (RQ) of material is spilled, the National Response Center (NRC) shall be notified immediately at (800) 424-8802. Reportable Quantities of hazardous material are available in 310 CMR 40: Massachusetts Contingency Plan Subpart P: Massachusetts Oil and Hazardous Material List. Within 14 days a report shall be submitted to the EPA New England Regional Office describing the following:

- Type of material released;
- Date and circumstances of the release; and
- Measures taken to prevent future releases.

• PROVISIONS FOR MAINTENANCE OF LAWNS, GARDENS, AND OTHER LANDSCAPE AREAS

All maintenance for the lawns, gardens and other landscape areas will be performed by a licensed landscape contractor appointed by the Property Manager.

REQUIREMENTS FOR STORAGE AND USE OF FERTILIZERS, HEBICIDES, AND PESTICIDES

No fertilizers, herbicides, and pesticides will be stored on site. The landscape contractor appointed by the Property Manager will be responsible for the storage and mixing of materials at their own facilities.

When fertilizers are scheduled to be used on site to promote vegetative stabilization, the landscape contractor will monitor the application to verify that the fertilizer is being applied per the manufacturers recommended rate and quantity. The application of fertilizer should only take place during the regular growing season, April 15 – October 15. Fertilizers should never be applied before a heavy rain event or on frozen ground.



• PROVISIONS FOR SOLID WASTE MANAGEMENT

All solid waste generated by the site will be stored in closed dumpsters located in specific areas as depicted on the Project Plans. The Property Manager will be responsible to ensure that all solid waste remains in the closed dumpsters, and the dumpster are emptied regularly.

• PROVISIONS FOR PREVENTION OF ILLICIT DISCHARGES TO THE STORMWATER MANAGEMENT SYSTEM

Illicit discharges to the stormwater management system are strictly prohibited. The Property Manager will promote tenant employee training sessions to inform employees of the prohibition of and detrimental effects associated with an illicit discharge. In the unlikely event of an illicit discharge, the building manager will use the procedures noted on the Spill Prevention and Response Plan.

The building manager will keep a copy of this Long Term Pollution Prevention Plan at the premises at all times, and will periodically train new or refresh existing employees on Spill Response Action Plans and Illicit Discharge prohibitions.

Employees involved with the implementation of this Long Term Pollution and Prevention Plan will be trained as specified above, and they will all have a copy of this plan.



FocalPoint

BIOFILTRATION SYSTEMS

HIGH PERFORMANCE MODULAR BIOFILTRATION SYSTEM (HPMBS)
Operations & Maintenance





GENERAL DESCRIPTION

The following general specifications describe the general operations and maintenance requirements for the FocalPoint® High Performance Modular Biofiltration System (HPMBS). The system utilizes physical, chemical and biological mechanisms of a soil, plant and microbe complex to remove pollutants typically found in urban stormwater runoff. The treatment system is a fully equipped, modular, constructed in place system designed to treat contaminated runoff.

Stormwater enters the FocalPoint® HPMBS, is filtered by the High Flow Biofiltration Media and passes through to the underdrain/storage system where the treated water is detained, retained or infiltrated to sub-soils, prior to discharge to the storm sewer system of any remaining flow.

Higher flows bypass the FocalPoint® HPMBS via a downstream inlet or other overflow conveyance. Maintenance is a simple, inexpensive and safe operation that does not require confined space entry, pumping or vacuum equipment, or specialized tools. Properly trained landscape personnel can effectively maintain FocalPoint® HPMBS by following instructions in this manual.



BASIC OPERATIONS

FocalPoint® is a modular, high performance biofiltration system that often works in tandem with other integrated management practices (IMP). Contaminated stormwater runoff enters the biofiltration bed through a conveyance swale, planter box, or directly through a curb cut or false inlet. Energy is dissipated by a rock or vegetative dissipation device and is absorbed by a 3-inch layer of aged, double shredded hardwood mulch, with fines removed, (when specified) on the surface of the biofiltration media.

As the water passes through the mulch layer, most of the larger sediment particles and heavy metals are removed through sedimentation and chemical reactions with the organic material in the mulch. Water passes through the biofiltration media where the finer particles are removed and numerous chemical reactions take place to immobilize and capture pollutants in the soil media.

The cleansed water passes into the underdrain/storage system and remaining flows are directed to a storm sewer system or other appropriate discharge point. Once the pollutants are in the soil, bacteria begin to break down and metabolize the materials and the plants begin to uptake and metabolize the pollutants. Some pollutants such as heavy metals, which are chemically bound to organic particles in the mulch, are released over time as the organic matter decomposes to release the metals to the feeder roots of the plants and the cells of the bacteria in the soil where they remain and are recycled. Other pollutants such as phosphorus are chemically bound to the soil particles and released slowly back to the plants and bacteria and used in their metabolic processes. Nitrogen goes through a variety of very complex biochemical processes where it can ultimately end up in the plant/bacteria biomass, turned to nitrogen gas or dissolves back into the water column as nitrates depending on soil temperature, pH and the availability of oxygen. The pollutants ultimately are retained in the mulch, soil and biomass with some passing out of the system into the air or back into the water.

DESIGN AND INSTALLATION

Each project presents different scopes for the use of FocalPoint® HPMBS. To ensure the safe and specified function of this stormwater BMP, Convergent Water Technologies and/or its Value Added Resellers (VAR) review each application before supply. Information and design assistance is available to the design engineer during the planning process. Correct FocalPoint® sizing is essential to optimum performance. The engineer shall submit calculations for approval by the local jurisdiction when required. The contractor and/or VAR is responsible for the correct installation of FocalPoint® HPMBS units as described in approved plans. A comprehensive installation manual is available at www.convergentwater.com.







MAINTENANCE

Why Maintain?

All stormwater treatment systems require maintenance for effective operation. This necessity is often incorporated in your property's permitting process as a legally binding BMP maintenance agreement. Other reasons for maintenance include:

- Avoid legal challenges from your jurisdiction's maintenance enforcement program.
- Prolong the lifespan of your FocalPoint® HPMBS.
- Avoid costly repairs.
- Help reduce pollutant loads leaving your property.

Simple maintenance of the FocalPoint® HPMBS is required to continue effective pollutant removal from stormwater runoff before any discharge into downstream waters. This procedure will also extend the longevity of the living biofiltration system. The unit will recycle and accumulate pollutants within the biomass, but may also subjected to other materials entering the surface of the system. This may include trash, silt and leaves etc. which will be contained above the mulch and/or biofiltration media layer. Too much silt may inhibit the FocalPoint's® HPMBS flow rate, which is a primary reason for system maintenance. Removal of accumulated silt/sediment and/or replacement of the mulch layer (when specified), is an important activity that prevents over accumulation of such silt/sediment.

When to Maintain?

Convergent Water Technologies and/or its VAR includes a 1-year maintenance plan with each system purchased. Annual included maintenance consists of two (2) scheduled maintenance visits. Additional maintenance may be necessary depending on sediment and trash loading (by Owner or at additional cost). The start of the maintenance plan begins when the system is activated for full operation. Full operation is defined as when the site is appropriately stabilized, the unit is installed and activated (by VAR), i.e., when mulch (if specified) and plantings are added.

Activation should be avoided until the site is fully stabilized (full landscaping, grass cover, final paving and street sweeping completed). Maintenance visits are scheduled seasonally; the spring visit aims to clean up after winter loads including salts and sands. The fall visit helps the system by removing excessive leaf litter.

A first inspection to determine if maintenance is necessary should be performed at least twice annually after storm events of greater than (1) one inch total depth (subject to regional climate). Please refer to the maintenance checklist for specific conditions that indicate if maintenance is necessary.

It has been found that in regions which receive between 30-50 inches of annual rainfall, (2) two visits are generally required. Regions with less rainfall often only require (1) one visit per annum. Varying land uses can affect maintenance frequency.





Some sites may be subjected to extreme sediment or trash loads, requiring more frequent maintenance visits. This is the reason for detailed notes of maintenance actions per unit, helping the VAR/Maintenance contractor and Owner predict future maintenance frequencies, reflecting individual site conditions.

Owners must promptly notify the VAR/Maintenance contractor of any damage to the plant(s), which constitute(s) an integral part of the biofiltration technology. Owners should also advise other landscape or maintenance contractors to leave all maintenance of the FocalPoint® HPMBS to the VAR/Maintenance contractor (i.e. no pruning or fertilizing).

EXCLUSION OF SERVICES

It is the responsibility of the owner to provide adequate irrigation when necessary to the plant(s) in the FocalPoint® HPMRS.

Clean up due to major contamination such as oils, chemicals, toxic spills, etc. will result in additional costs and are not covered under the VAR/Maintenance contractor maintenance contract. Should a major contamination event occur, the Owner must block off the outlet pipe of the FocalPoint® (where the cleaned runoff drains to, such as drop-inlet) and block off the point where water enters of the FocalPoint® HPMBS. The VAR/Maintenance contractor should be informed immediately.

MAINTENANCE VISIT SUMMARY

Each maintenance visit consists of the following simple tasks (detailed instructions below).

- 1. Inspection of FocalPoint® HPMBS and surrounding area
- 2. Removal of debris, trash and mulch
- 3. Mulch replacement
- 4. Plant health evaluation (including measurements) and pruning or replacement as necessary
- 5. Clean area around FocalPoint® HPMBS
- 6. Complete paperwork, including date stamped photos of the tasks listed above.

MAINTENANCE TOOLS, SAFETY EQUIPMENT AND SUPPLIES

Ideal tools include: camera, bucket, shovel, broom, pruners, hoe/rake, and tape measure. Appropriate Personal Protective Equipment (PPE) should be used in accordance with local or company procedures. This may include impervious gloves where the type of trash is unknown, high visibility clothing and barricades when working in close proximity to traffic and also safety hats and shoes.



MAINTENANCE VISIT PROCEDURE



| Inspection of FocalPoint® HPMBS and surrounding area | | | | | |
|---|---|--------------------------------|--|--|--|
| Record individual unit before maintenance with photograph (numbered). Record on Maintenance Report (see example in this document) the following: | | | | | |
| Standing Water yes n | 9 | yes no | | | |
| ——— Is Bypass Inlet Clear? yes n | to Overflow conveyance | yes no | | | |
| Removal of Silt / Sediment / Clay | | | | | |
| Dig out silt (if any) and mulch and remove trash & foreign items. | | | | | |
| Silt / Clay Found? yes n Cups / Bags Found? yes n | | yes no (volume or weight) | | | |
| Removal of debris, trash and mulch | | | | | |
| After removal of mulch and debris, measure distance from the top of the FocalPoint® HPMBS engineered media soil to the flow line elevation of the adjacent overflow conveyance. If this distance is greater than that specified on the plans (typ. 6" - 12"), add media (not top soil or other) to recharge to the distance specified. Distance to media surface to flow line of overflow conveyance (inches) # of Buckets of Media Added | | | | | |
| Mulch Replacement | | | | | |
| Most maintenance visits require only replacement mulch (if utilized) which must be, aged, double shredded hardwood mulch with fines removed. For smaller projects, one cubic foot of mulch will cover four square feet of biofiltration bed, and for larger projects, one cubic yard of mulch will cover 108 square feet of biofiltration bed. Some visits may require additional FocalPoint® HPMBS engineered soil media available from the VAR/Contractor. Add double shredded, aged hardwood mulch which has been screened to remove fines, evenly across the entire biofiltration media bed to a depth of 3". Clean accumulated sediment from energy dissipation system at the inlet to the FocalPoint® HPMBS to allow for entry of trash during a storm event. | | | | | |
| | ** ** · · · · · · · · · · · · · · · · · | | | | |
| Plant health evaluation and pruning or replacement as necessary Examine the plant's health and replace if dead or dying. | | | | | |
| Prune as necessary to encourage growth in the correct directions | | | | | |
| Height above Grate (feet) Width at Widest point (feet) | Health Damage to Plant | alive dead yes no | | | |
| Clean area around FocalPoint® HPMBS | | | | | |
| Clean area around unit and remove all refuse to be disposed of appropriately. | | | | | |
| Complete paperwork | | | | | |
| Deliver Maintenance Report and photographs as appropriate. Some jurisdictions may require submission of maintenance reports in accordance with approvals. It is the responsibility of the Owner to comply with local regulations. | | | | | |



FocalPoint Warranty

Seller warrants goods sold hereunder against defects in materials and workmanship only, for a period of (1) year from date the Seller activates the system into service. Seller makes no other warranties, express or implied.

Seller's liability hereunder shall be conditioned upon the Buyer's installation, maintenance, and service of the goods in strict compliance with the written instructions and specifications provided by the Seller. Any deviation from Seller's instructions and specifications or any abuse or neglect shall void warranties.

In the event of any claim upon Seller's warranty, the burden shall be upon the Buyer to prove strict compliance with all instructions and specifications provided by the Seller.

Seller's liability hereunder shall be limited only to the cost or replacement of the goods. Buyer agrees that Seller shall not be liable for any consequential losses arising from the purchase, installation, and/or use of the goods.



Maintenance Checklist

| Element | Problem | What To Check | Should Exist | Action |
|----------------|--|--|--|--|
| Inlet | Excessive sediment or trash accumulation | Accumulation of sediment or trash impair free flow of water into FocalPoint | Inlet free of obstructions allowing free flow into FocalPoint System | Sediments or trash should be removed |
| Mulch Cover | Trash and floatable debris accumulation | Excessive trash or debris accumulation. | Minimal trash or other debris on mulch cover | Trash and debris should be removed and mulch cover raked level. Ensure that bark nugget |
| Mulch Cover | Ponding of water on mulch cover | Ponding in unit could be indicative of clogging due to excessive fine sediment accumulation or spill of petroleum oils | Stormwater should drain freely and evenly over mulch cover. | Contact VAR for advice. |
| Plants | Plants not growing, or in poor condition | Soil/mulch too wet, evidence of spill. Pest infestation. Vandalism to plants. | Plants should be healthy and pest free. | Contact VAR for advice. |
| Plants | Plant growth excessive | Plants should be appropriate to the species and location of FocalPoint | | Trim/prune plants in accordance with typical landscaping and |

