STORMWATER CALCULATIONS

FOR

Truax Drive Industrial Development
Mill Creek Corporate Center
Salem, OR

Prepared For:

PacTrust
15350 SW Sequoia Parkway
Portland, OR 97224

Prepared By:

PRELIMINARY

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Section A. Project Overview

The Truax Drive Industrial Development is a phased project located in Mill Creek Corporate Center (MCCC). MCCC is located within the City of Salem and has its own set of design standards that are included in the MCCC Covenants, Conditions, and Restrictions. Therefore, the stormwater design of this facility utilized the MCCC Stormwater Management Plan (MCSMP) prepared by OTAK dated, October 16, 2006 as the stormwater design standards. Per the MCSMP new water quality facilities shall be designed to meet the following:

- Water quality treatment must be provided based on a storm equal to 0.83 inches distributed over 24 hours and should be sized to remove 70% of TSS per BES and Portland SMM standards.
- SBUH method should be used with a Type IA storm distribution over 24 hours.
- Landscaping is required per the CCR's (not covered in this report)
- Operation and Maintenance Plan

The entire project site (Phases 1-2) is approximately 24.59 acres with 20.41 impervious acres and 4.18 pervious acres making the overall site 83% impervious. This exceeds the MCSMP impervious area of 80%, to mitigate this, we have added detention for the 3% of excess impervious area.

For analysis, Phases 1 and 2 of the site were divided into 10 basins (Phase 1 = Basins 1-7, Phase 2 = Basins A-B). Stormwater runoff from each basin will drain to separate bioswales except for Basin 2. Stormwater runoff from Basin 2 will drain to an 8'x16' Perkfilter Vault.

The following discussion describes how the proposed stormwater design meets the water quality criteria described above and in the MCSMP. This document is intended to be viewed while looking at the civil drawings.

Section B. Analysis and Design

(1). Hydrologic Parameters and Developed Conditions

The site was divided into ten drainage basins as illustrated in Appendix I.3. Basins are labeled according to location and phase. Stormwater runoff from the ten basins (Basins 1-7, and Basins A-C) will require water quality treatment. Runoff from Basins 2-7 and A-C is proposed to be routed to one of nine bioswales for treatment, then to the common wetland area for detention. Stormwater runoff from Basin 1 will be treated via proprietary treatment prior to discharge to the common wetland area.

In accordance with the water quality requirements of the MCSMP the storm events used in this method included the water quality storm (0.83 inches per 24 hours) and the 100-year conveyance storm (4.40 inches per 24-hours). The storm depth for the 100-year, 24-hour storm event is per the City of Salem Department of Public Works Administrative Rules Design Standards (City of Salem Design Standards). The water quality storm event was determined to be 0.83 inches per the MCSMP.

Please refer to Table B-1 below for the basin names, areas, time of concentrations (T_c), and curve numbers (CN) for each basin.

Time of concentrations for the Central Basins are set to the minimum time allowed by the HydroCAD model's time-step. Refer to the HydroCAD Analysis in Appendix II for more details.

Curve Numbers were determined in accordance with Division 004 Appendix D of the City of Salem Design Standards. The developed impervious and pervious areas were assigned curve numbers of 98 and 80, respectively. Impervious areas were assigned a curve number of 98 which corresponds to paved parking. Pervious areas were assigned a curve number of 80 which corresponds to amended soil cover with group D soils per Division 004 Appendix D of the City of Salem Department of Public works Administrative Rules Design Standards.

Table B-1| Hydrologic Parameters

BASIN	Total Area (AC)	Developed Tc (Min.)	Weighted Curve Number
1	10.37	5	97
2	3.93	5	95
3	0.95	5	95
4	0.42	5	92
5	0.96	5	93
6	0.35	5	94
7	0.82	5	93
A	0.54	5	92
B	5.25	5	97
C	1.00	5	94

(2). Hydrologic Analysis

The hydrologic analysis as previously mentioned was completed using HydroCAD modeling software which was used to size the stormwater facilities. The Santa Barbara Unit Hydrograph Type 1A storm was used to model the required water quality and conveyance storms. Refer to Appendix I for HydroCAD outputs for the runoff calculations, and hydrographs for each developed storm event. A summary of the peak runoff for the design storms for each basin is provided in Table B-2 below.

Table B-2| Calculated Developed Peak Flows

Basin	Water Quality (cfs)	100 yr, 24-hour (cfs)
1	1.48	9.9
2	0.48	3.5
3	0.1	0.82
4	0.04	0.34
5	0.1	0.81
6	0.04	0.3
7	0.8	0.68
A	0.06	0.45
B	0.67	4.77
C	0.09	0.81

Section C. Water Quality Design

The site utilizes four bioswales and proprietary treatment to meet the stormwater quality standard.

(1). Bioswale Design Criteria

Bioswales are utilized to treat (remove TSS and other pollution) the stormwater runoff from Basins 2-7 and Basins A-C prior to discharge. One bioswale is used per basin and the bioswale ID coincides with the basin it treats. A summary of bioswale design criteria used in the design and the design characteristics of the proposed bioswales is provided in Table C-1. As illustrated in Table C-1, the bioswale designs meet or exceed the bioswale design criteria as described in the MCSMP. For the purpose of this stormwater report, these swales are theoretical and not included in the plans.

Table C-1| Bioswale Design Criteria (Per MCSMP)

Bioswale Criteria		Bioswale Design								
		S2	S3	S4	S5	S6	S7	SA	SB	SC
Min. Length (ft)	100	150	100	100	100	100	100	100	200	100
Min. Bottom Width (ft) (B)	N/A	3	2	2	2	2	2	2	2	2
Side Slopes (X:1)	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1	3:1
Min. Constructed Depth (ft)	3	3	3	3	3	3	3	3	3	3
Water Quality Flowrate (cfs)	N/A	0.48	0.10	0.04	0.10	0.04	0.08	0.06	0.67	0.09
Max Water Quality Flow Depth (ft)	1	0.55	0.29	0.17	0.28	0.17	0.26	0.20	0.74	0.28
Max. Water Quality Velocity (ft/s)	1	0.18	0.12	0.09	0.12	0.09	0.11	0.10	0.20	0.11
Manning's Roughness Coefficient[1]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Max. Longitudinal Slope	1%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%	0.3%
Min Hydraulic Residence Time (min.)	9	13.9	13.9	18.5	13.9	18.5	15.2	16.7	16.7	15.2
Max Tributary Area (AC)	20	3.93	0.95	0.42	0.96	0.35	0.82	0.54	5.25	1.00
Conveyance Flowrate (cfs)	N/A	3.56	0.83	0.34	0.82	0.30	0.69	0.46	5.01	0.85
Max. Conveyance Design Flow Depth[1] (ft)	2	1.53	0.86	0.55	0.85	0.52	0.79	0.64	1.88	0.85

[1] The MCSMP differentiates the roughness coefficient for the water quality storm and conveyance storm. To provide a conservative depth calculation the design engineer chose to use the higher roughness coefficient for all storm events evaluated.

Refer the civil drawings for the grading & drainage plans. Operation and maintenance of the bioswales shall be carried out in accordance with the MCSMP by the Owner of the property per the CCR's (See Appendix II for details).

(2). Proprietary Treatment Design Criteria

Stormwater runoff from Basin 1 is treated via proprietary treatment prior to discharge to the common wetland area. An 8'x16' PerkFilter vault will be used to treat the runoff from Basin 1. The proprietary facility is sized to treat runoff from Basin 2 during the water quality event. See Table B-1 above for times of concentration and water quality flows for each basin.

For purposes of this report, it was assumed that (24) 12"+18" stacked Oldcastle PerkFilter cartridges would be used. Each stacked PerkFilter cartridge can treat up to 0.067 cfs, for a total vault treatment of 1.61 cfs with 24 cartridges. For construction, Oldcastle PerkFilter cartridges or an approved equal shall be allowed ensuring a minimum treatment of 1.56 cfs and approval by Washington Department of Ecology for basic treatment per MCSMP.

Table C-2| Proprietary Treatment Design Criteria

Required Treatment (cfs)	Treatment Provided (cfs)
1.56	1.61

Operation and maintenance of the Oldcastle PerkFilter cartridges shall be carried out in accordance with the PerkFilter Inspection and Maintenance Guide (See Appendix II for details).

The Oldcastle PerkFilter vault has a hydraulic capacity of 20.5 cfs which exceeds the 100-year storm event peak of 10.39 cfs and thus does not require a bypass for high flows. Refer to the civil drawings for further detail.

(3). Flow Control Design

The entire project site (Phases 1-2) is approximately 24.59 acres with 20.41 impervious acres and 4.18 pervious acres making the overall site 83% impervious. This exceeds the MCSMP impervious area of 80%, to mitigate this, we have added detention for the 3% of excess impervious area.

The site was analyzed as 80% impervious compared to the proposed 83% impervious. A Type III Flow Control Catch Basin is proposed to reduce the 83% impervious runoff to the 80% impervious runoff rate.

The total allowable release rates for the design storms are listed in Table C-3 along with the total developed release rates after detention.

Table C-3 | Allowable Release Rates

Site Condition/Basin	Design Storm (cfs)		
	2 Year	10 Year	100 Year
Total Developed Release	9.96	15.38	22.04
Total Allowable	9.96	15.39	22.04

Stormwater is released from the detention facility to a public storm drain via a flow-control structure with two orifices and a rim to control the 2-year, 10-year, and 100-year events. See Table C-4 for a summary of the flow control design.

Runoff from events exceeding 100-year storm will overflow a weir located on the top of the Type III flow control catch basin. Refer to the Basin Map in Appendix C and the Civil Drawings for more details.

Table C-4 | Summary of Flow Control Design

Storm Event	Orifice Size (in)	Orifice Elevation (ft)	Peak WSE[1] (ft)	Release Rate[2] (cfs)
2-year	16.8	227.50	228.43	3.56
10-year	20.0	228.40	228.68	5.56
100-year	24.0[3]	228.75	228.91	8.03

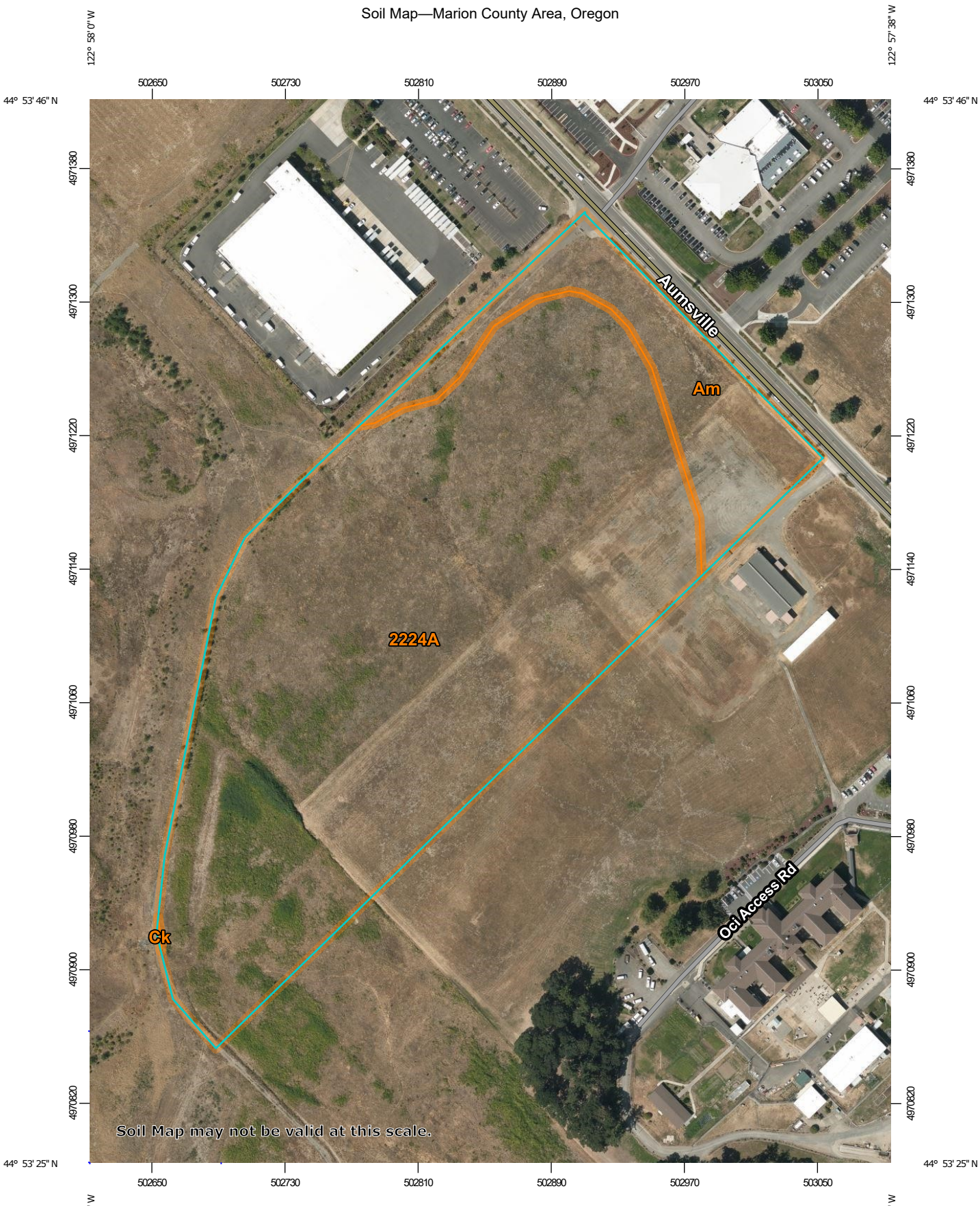
[1] WSE = Water Surface Elevation
[2] Release rates are shown as the release from the Type III Flow Control Catch Basin.
[3] Type III flow control catch basin weir opening.

APPENDIX I

Basin Runoff Calculations

SOIL MAPS

Soil Map—Marion County Area, Oregon



Map Scale: 1:3,100 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 17, Jun 11, 2020

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

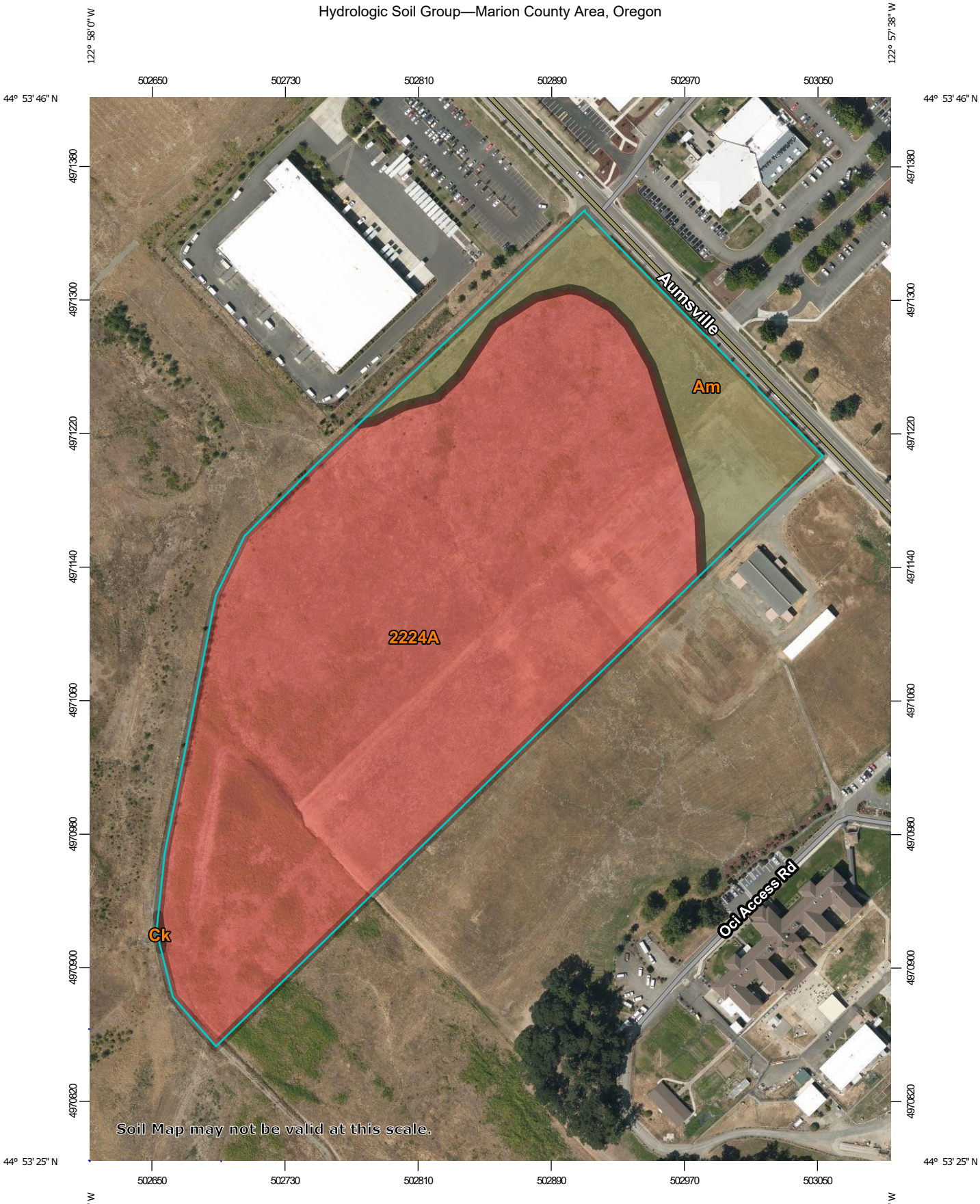
Date(s) aerial images were photographed: Aug 1, 2018—Aug 31, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2224A	Courtney gravelly silty clay loam, 0 to 3 percent slopes	19.1	85.9%
Am	Amity silt loam	3.1	14.1%
Ck	Clackamas gravelly loam	0.0	0.0%
Totals for Area of Interest		**22.3**	**100.0%**

Hydrologic Soil Group—Marion County Area, Oregon



Map Scale: 1:3,100 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2224A	Courtney gravelly silty clay loam, 0 to 3 percent slopes	D	19.1	85.9%
Am	Amity silt loam	C/D	3.1	14.1%
Ck	Clackamas gravelly loam	C/D	0.0	0.0%
Totals for Area of Interest			**22.3**	**100.0%**

Description

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

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

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

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

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

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

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

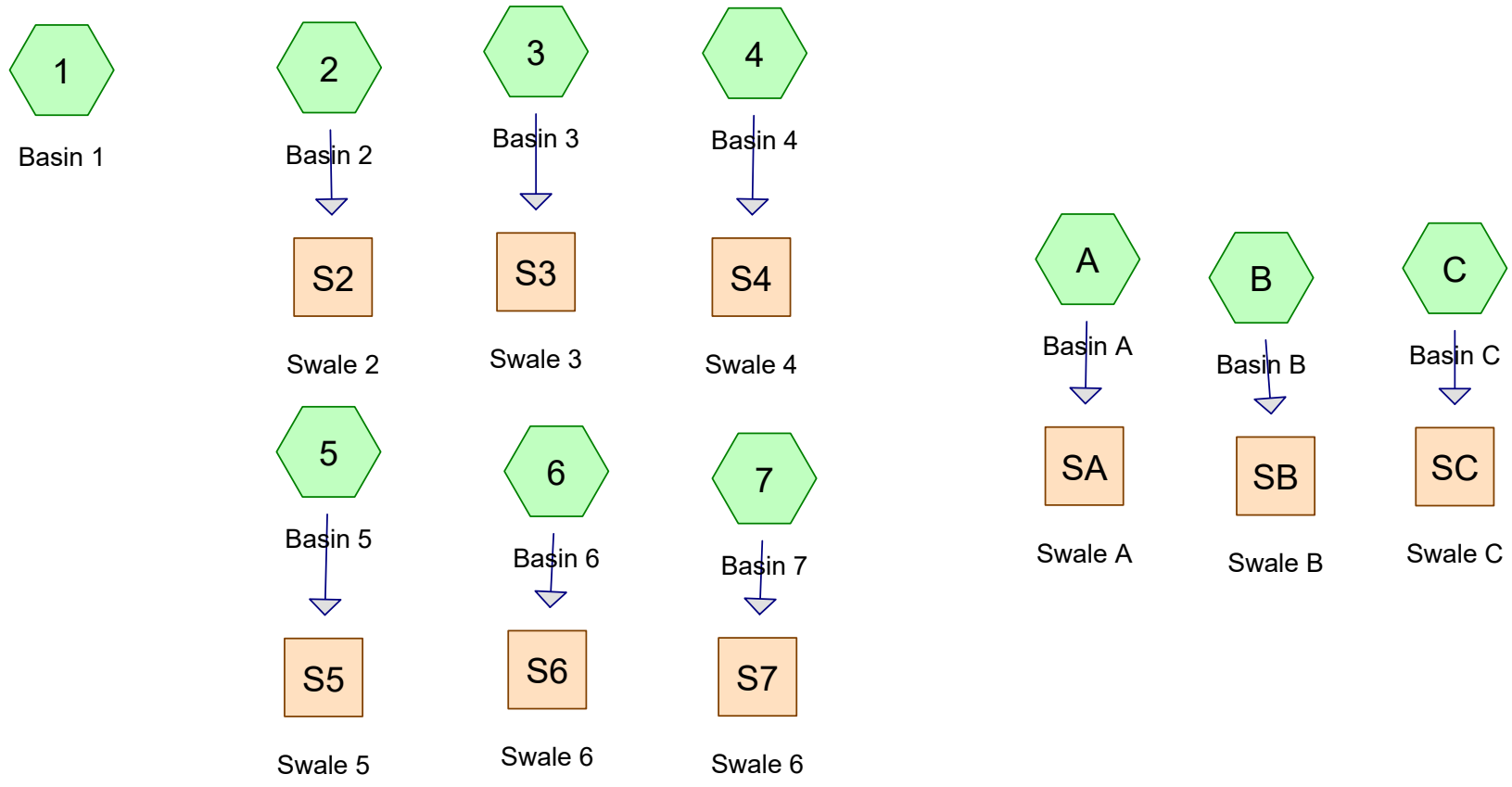
Rating Options

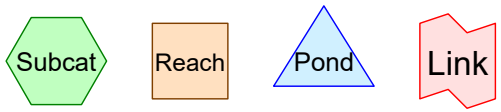
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

HYDROCAD MODELING DATA
(WATER QUALITY AND 100-YR)





Routing Diagram for Truax
Prepared by Westech Engineering, Inc.

Summary for Subcatchment 1: Basin 1

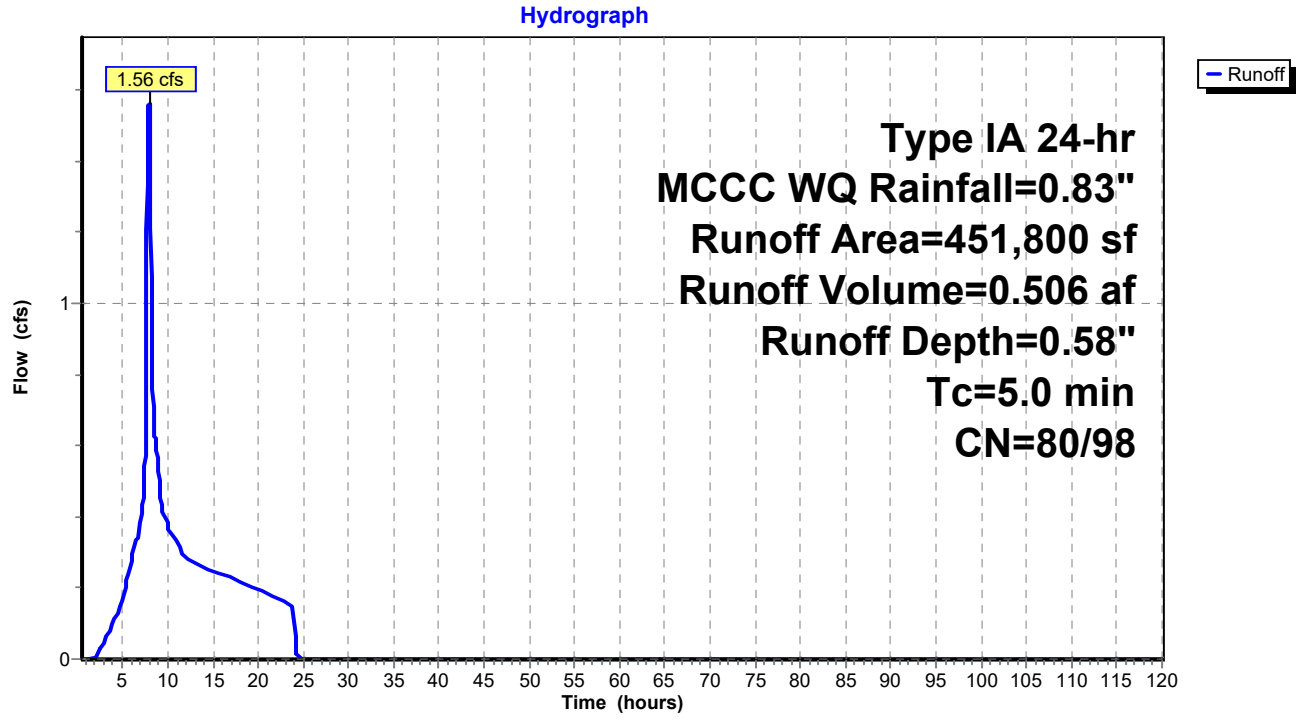
Runoff = 1.56 cfs @ 7.93 hrs, Volume= 0.506 af, Depth= 0.58"
Routed to nonexistent node 1L

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC WQ Rainfall=0.83"

Area (sf)	CN	Description
419,500	98	Paved parking, HSG D
32,300	80	>75% Grass cover, Good, HSG D
451,800	97	Weighted Average
32,300		7.15% Pervious Area
419,500		92.85% Impervious Area

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

Subcatchment 1: Basin 1



Summary for Subcatchment 1: Basin 1

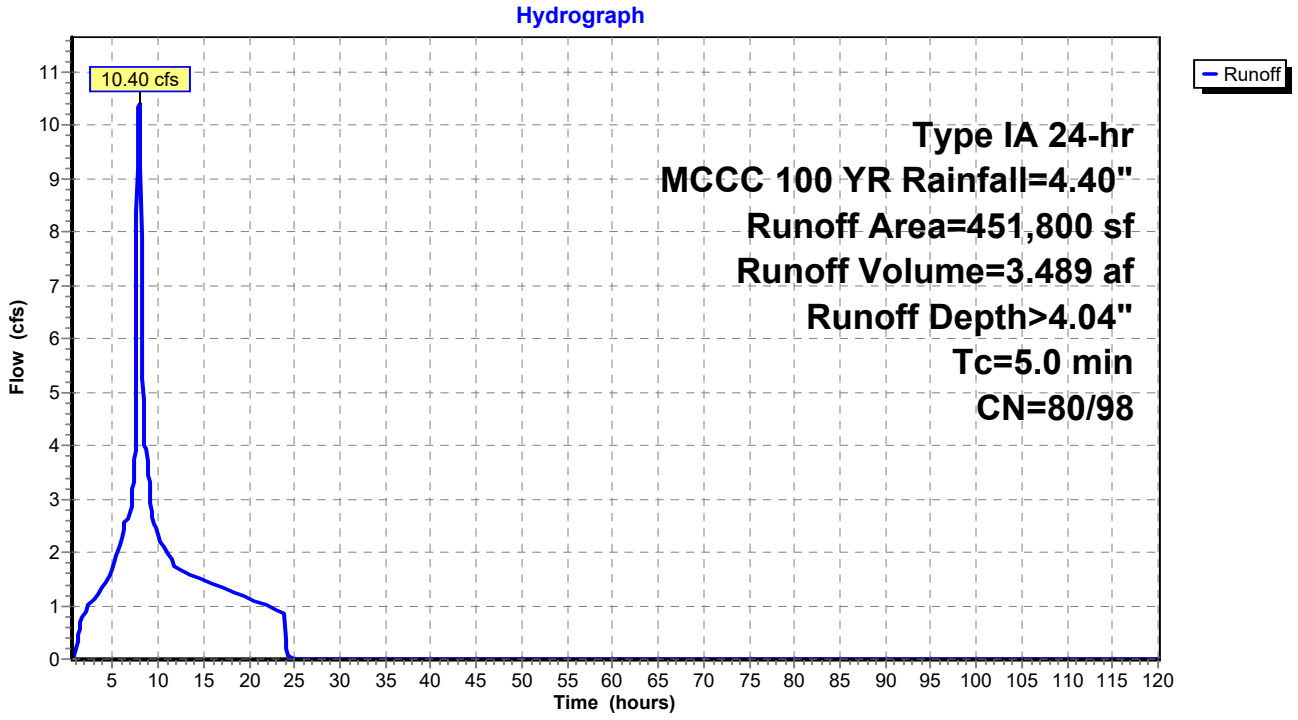
Runoff = 10.40 cfs @ 7.90 hrs, Volume= 3.489 af, Depth> 4.04"
Routed to nonexistent node 1L

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 100 YR Rainfall=4.40"

Area (sf)	CN	Description
419,500	98	Paved parking, HSG D
32,300	80	>75% Grass cover, Good, HSG D
451,800	97	Weighted Average
32,300		7.15% Pervious Area
419,500		92.85% Impervious Area

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

Subcatchment 1: Basin 1



Summary for Subcatchment 2: Basin 2

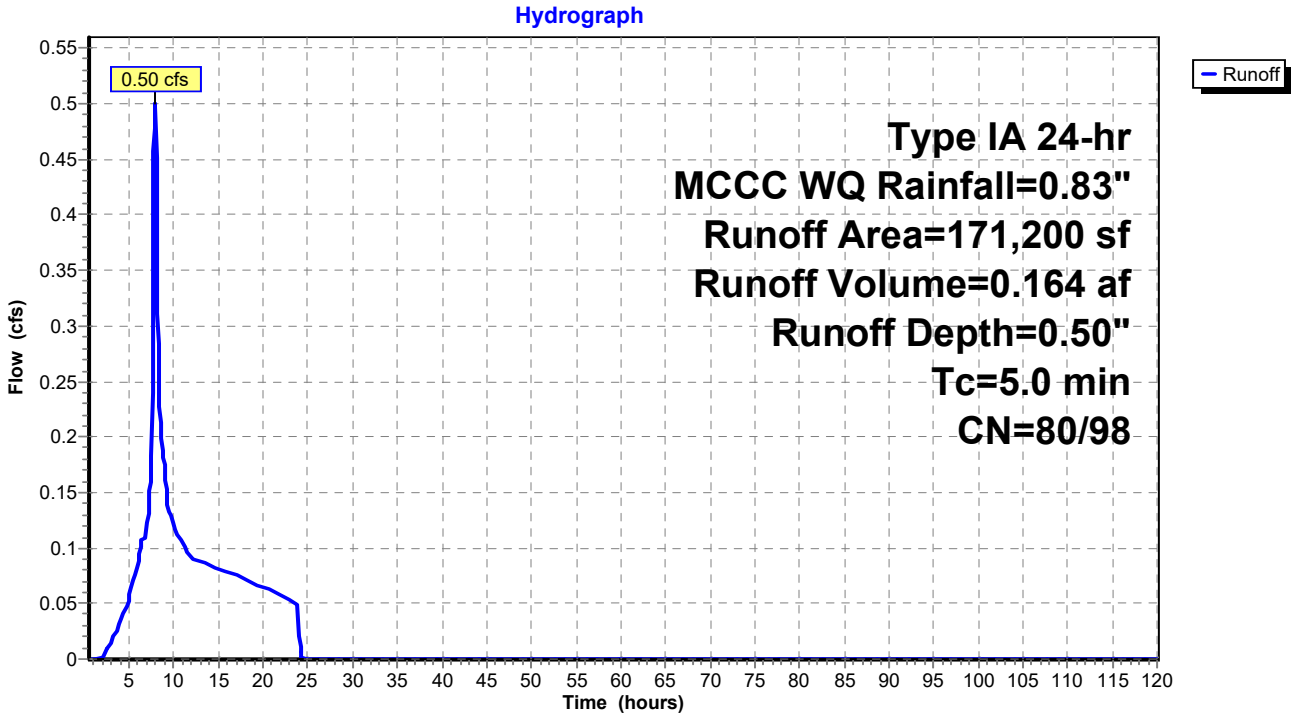
Runoff = 0.50 cfs @ 7.93 hrs, Volume= 0.164 af, Depth= 0.50"
Routed to Reach S2 : Swale 2

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC WQ Rainfall=0.83"

Area (sf)	CN	Description
134,500	98	Paved parking, HSG D
36,700	80	>75% Grass cover, Good, HSG D
171,200	94	Weighted Average
36,700		21.44% Pervious Area
134,500		78.56% Impervious Area

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

Subcatchment 2: Basin 2



Summary for Reach S2: Swale 2

Inflow Area = 3.930 ac, 78.56% Impervious, Inflow Depth = 0.50" for MCCC WQ event
Inflow = 0.50 cfs @ 7.93 hrs, Volume= 0.164 af
Outflow = 0.45 cfs @ 8.05 hrs, Volume= 0.164 af, Atten= 9%, Lag= 7.1 min

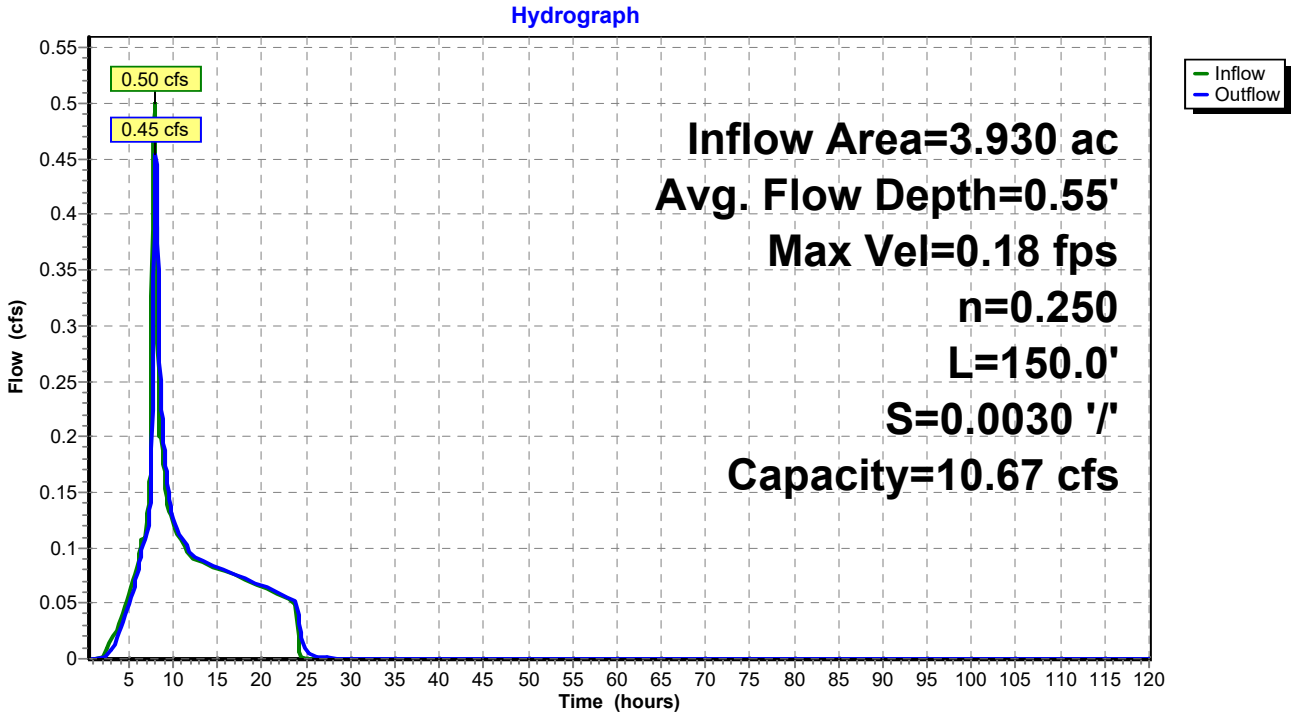
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.18 fps, Min. Travel Time= 14.2 min
Avg. Velocity = 0.08 fps, Avg. Travel Time= 32.9 min

Peak Storage= 387 cf @ 8.05 hrs
Average Depth at Peak Storage= 0.55' , Surface Width= 6.32'
Bank-Full Depth= 2.50' Flow Area= 26.3 sf, Capacity= 10.67 cfs

3.00' x 2.50' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 18.00'
Length= 150.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.45'

‡

Reach S2: Swale 2



Summary for Subcatchment 2: Basin 2

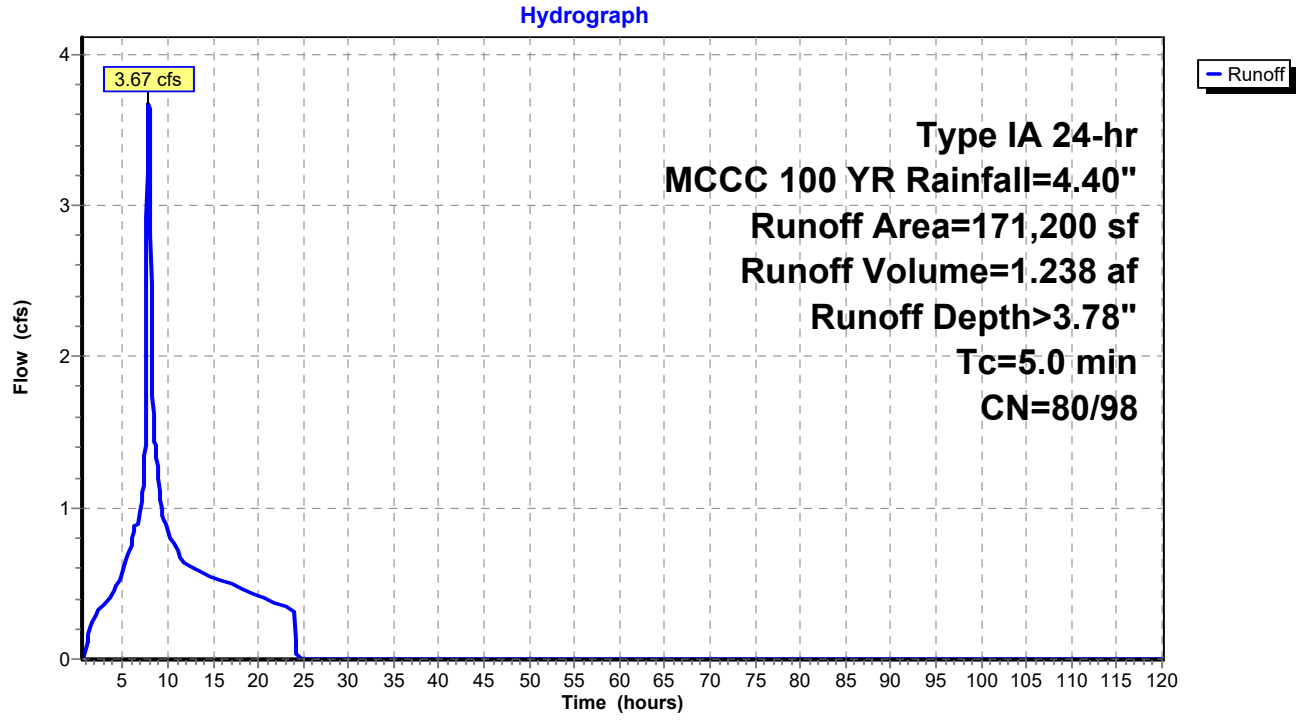
Runoff = 3.67 cfs @ 7.91 hrs, Volume= 1.238 af, Depth> 3.78"
Routed to Reach S2 : Swale 2

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 100 YR Rainfall=4.40"

Area (sf)	CN	Description
134,500	98	Paved parking, HSG D
36,700	80	>75% Grass cover, Good, HSG D
171,200	94	Weighted Average
36,700		21.44% Pervious Area
134,500		78.56% Impervious Area

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

Subcatchment 2: Basin 2



Summary for Reach S2: Swale 2

Inflow Area = 3.930 ac, 78.56% Impervious, Inflow Depth > 3.78" for MCCC 100 YR event
Inflow = 3.67 cfs @ 7.91 hrs, Volume= 1.238 af
Outflow = 3.56 cfs @ 8.00 hrs, Volume= 1.238 af, Atten= 3%, Lag= 5.5 min

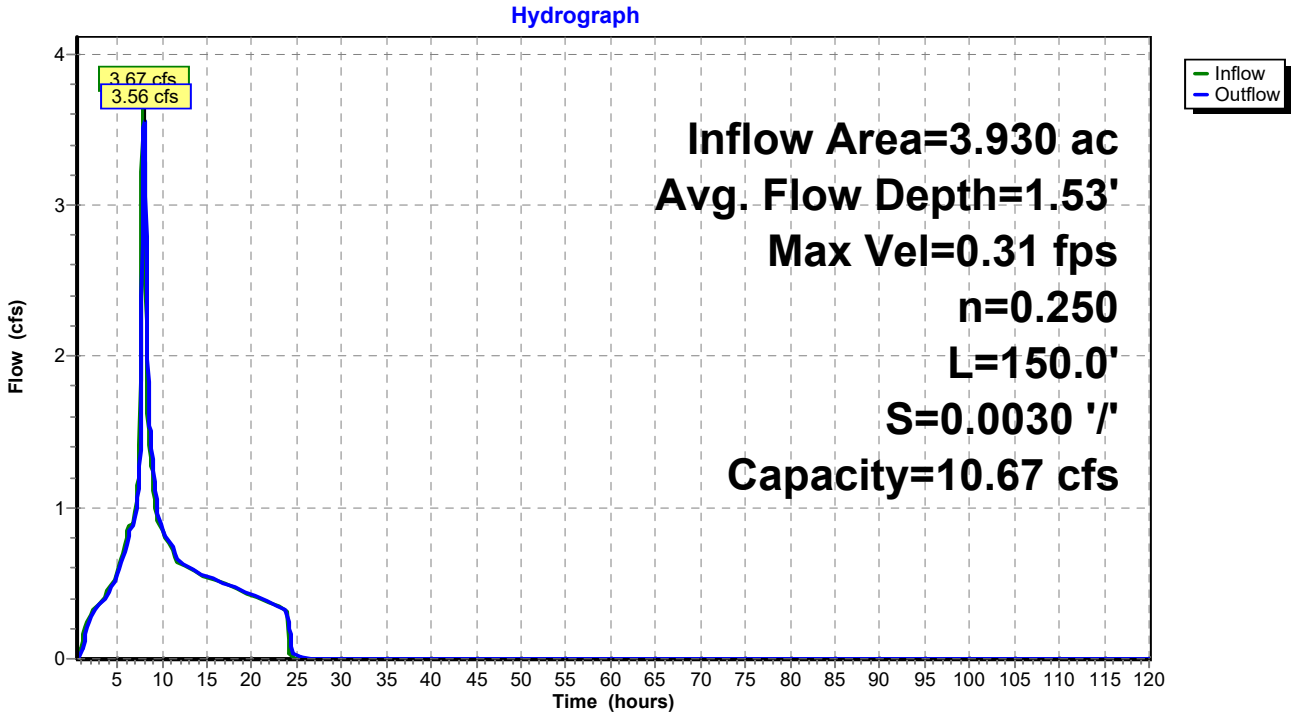
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.31 fps, Min. Travel Time= 8.1 min
Avg. Velocity = 0.13 fps, Avg. Travel Time= 18.9 min

Peak Storage= 1,739 cf @ 8.00 hrs
Average Depth at Peak Storage= 1.53' , Surface Width= 12.17'
Bank-Full Depth= 2.50' Flow Area= 26.3 sf, Capacity= 10.67 cfs

3.00' x 2.50' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 18.00'
Length= 150.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.45'

‡

Reach S2: Swale 2



Summary for Subcatchment 3: Basin 3

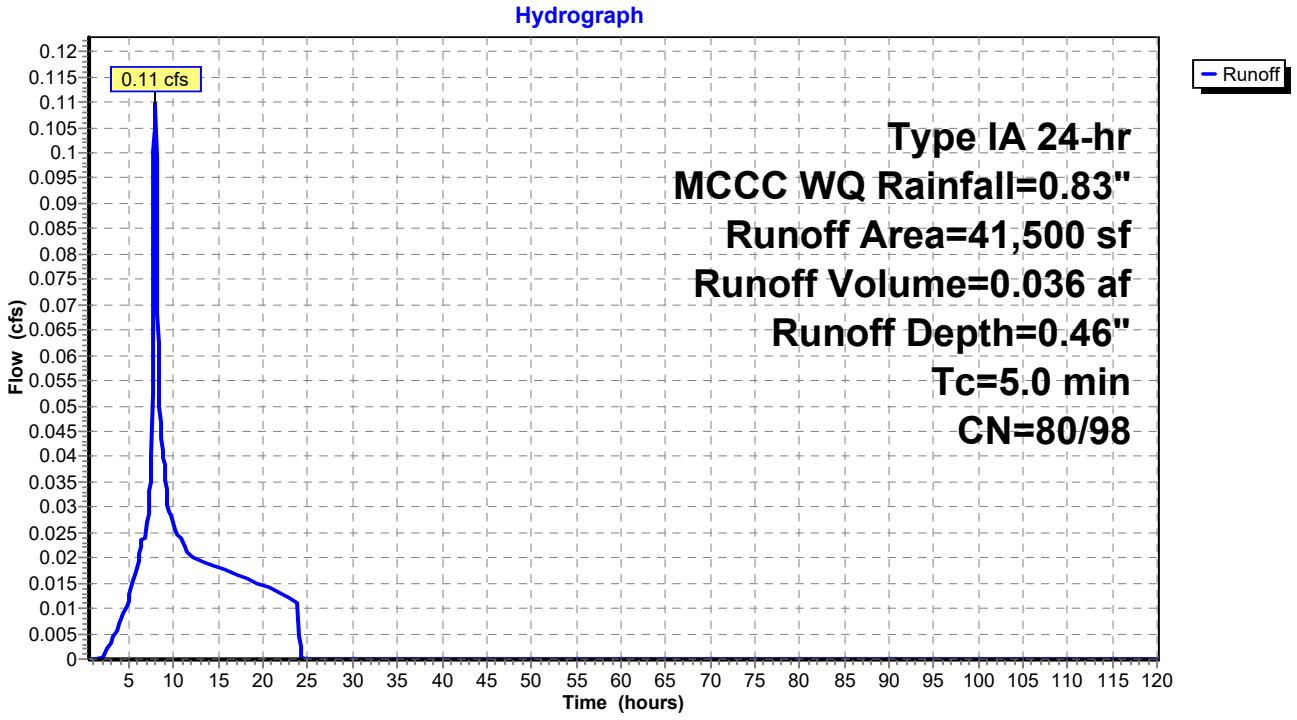
Runoff = 0.11 cfs @ 7.93 hrs, Volume= 0.036 af, Depth= 0.46"
Routed to Reach S3 : Swale 3

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC WQ Rainfall=0.83"

Area (sf)	CN	Description
29,500	98	Paved parking, HSG D
12,000	80	>75% Grass cover, Good, HSG D
41,500	93	Weighted Average
12,000		28.92% Pervious Area
29,500		71.08% Impervious Area

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

Subcatchment 3: Basin 3



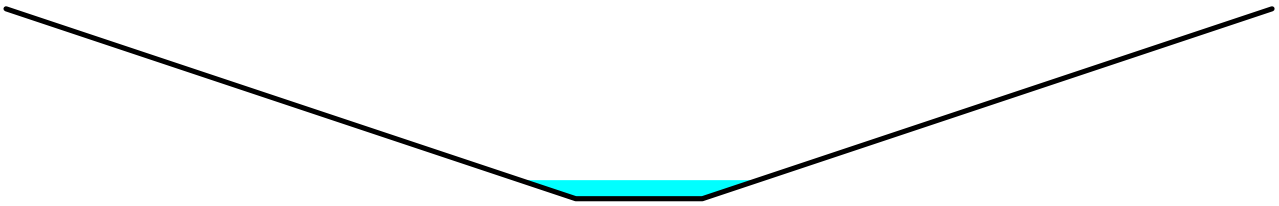
Summary for Reach S3: Swale 3

Inflow Area = 0.953 ac, 71.08% Impervious, Inflow Depth = 0.46" for MCCC WQ event
Inflow = 0.11 cfs @ 7.93 hrs, Volume= 0.036 af
Outflow = 0.10 cfs @ 8.04 hrs, Volume= 0.036 af, Atten= 9%, Lag= 7.0 min

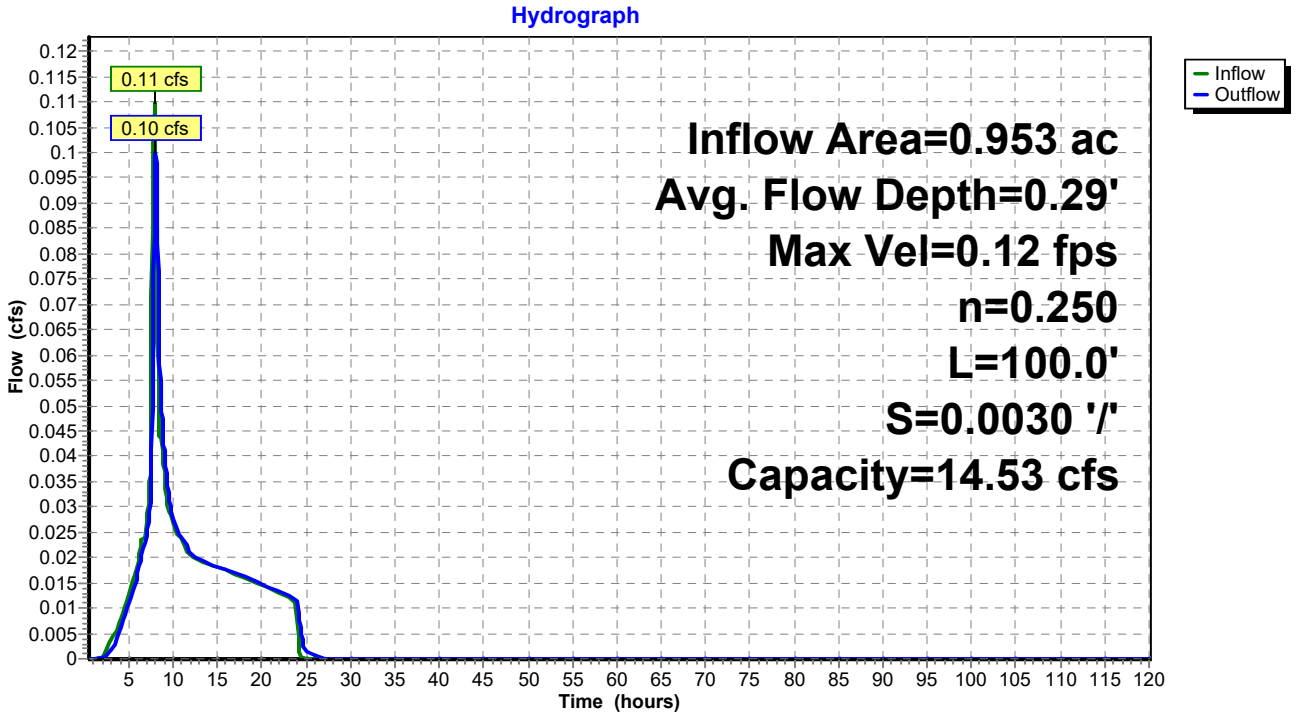
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.12 fps, Min. Travel Time= 14.1 min
Avg. Velocity = 0.06 fps, Avg. Travel Time= 28.2 min

Peak Storage= 84 cf @ 8.04 hrs
Average Depth at Peak Storage= 0.29' , Surface Width= 3.76'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach S3: Swale 3



Summary for Subcatchment 3: Basin 3

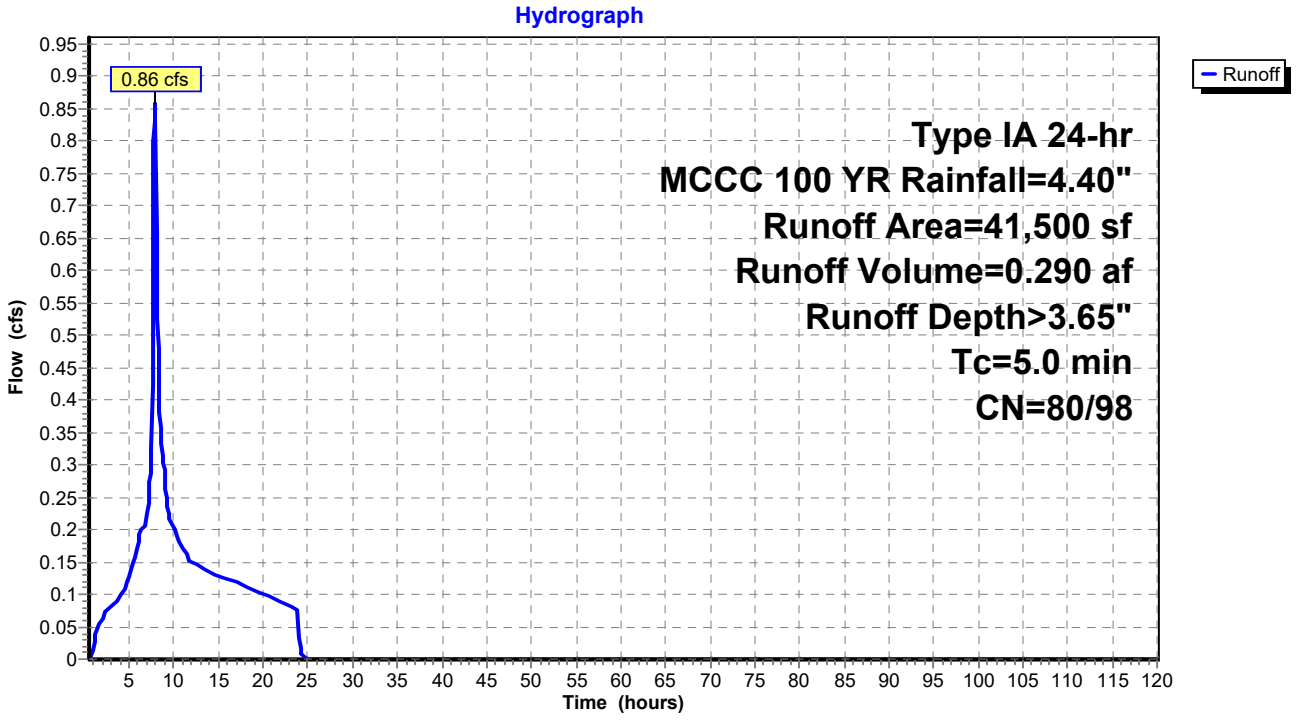
Runoff = 0.86 cfs @ 7.91 hrs, Volume= 0.290 af, Depth> 3.65"
Routed to Reach S3 : Swale 3

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 100 YR Rainfall=4.40"

Area (sf)	CN	Description
29,500	98	Paved parking, HSG D
12,000	80	>75% Grass cover, Good, HSG D
41,500	93	Weighted Average
12,000		28.92% Pervious Area
29,500		71.08% Impervious Area

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

Subcatchment 3: Basin 3



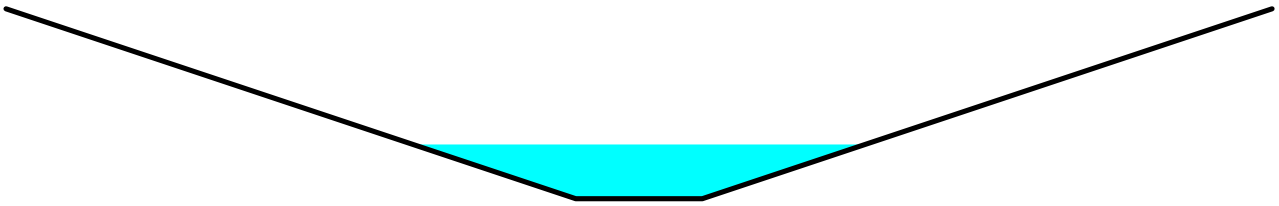
Summary for Reach S3: Swale 3

Inflow Area = 0.953 ac, 71.08% Impervious, Inflow Depth > 3.65" for MCCC 100 YR event
Inflow = 0.86 cfs @ 7.91 hrs, Volume= 0.290 af
Outflow = 0.83 cfs @ 8.00 hrs, Volume= 0.290 af, Atten= 3%, Lag= 5.2 min

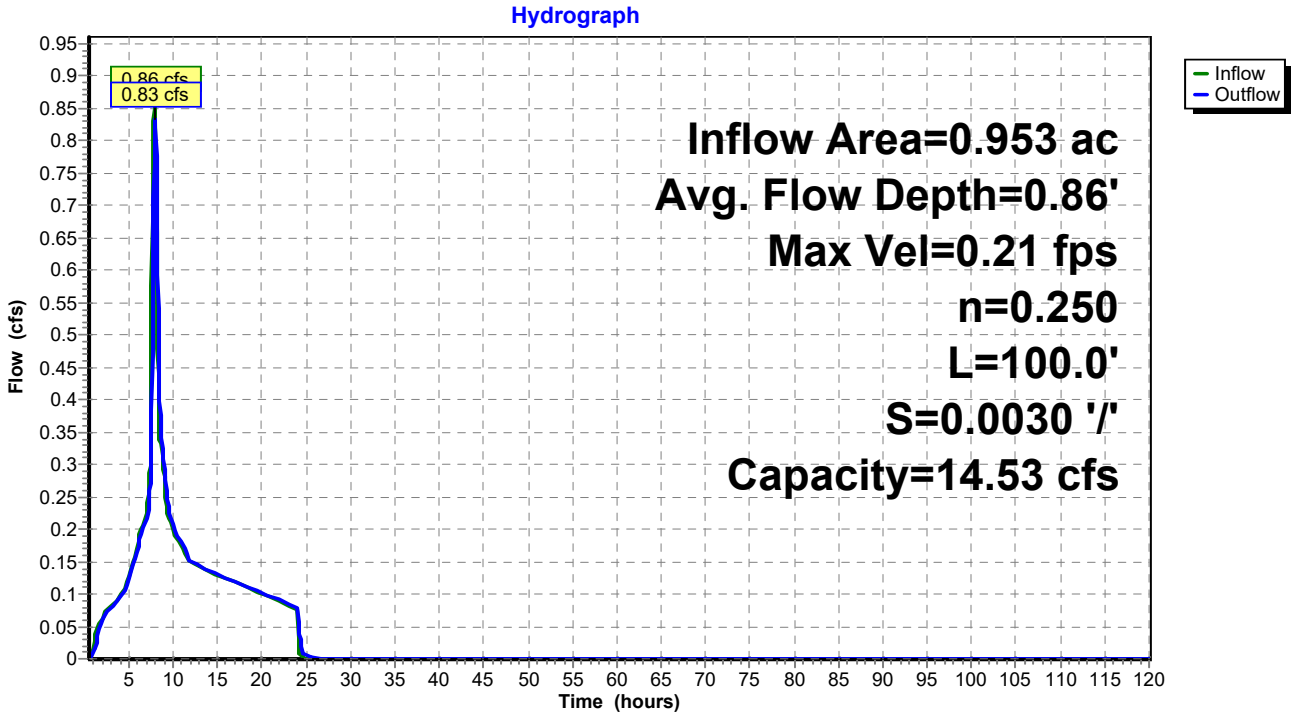
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.21 fps, Min. Travel Time= 7.8 min
Avg. Velocity = 0.11 fps, Avg. Travel Time= 15.9 min

Peak Storage= 391 cf @ 8.00 hrs
Average Depth at Peak Storage= 0.86' , Surface Width= 7.14'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach S3: Swale 3



Summary for Subcatchment 4: Basin 4

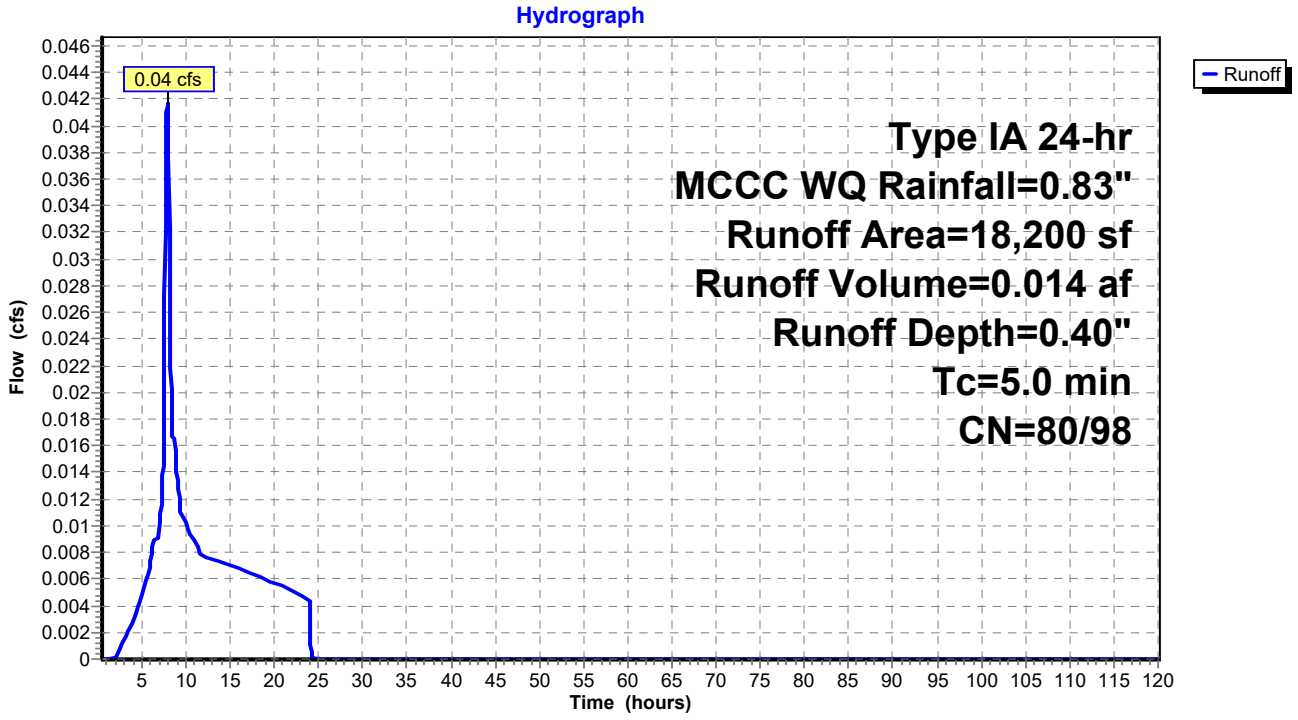
Runoff = 0.04 cfs @ 7.93 hrs, Volume= 0.014 af, Depth= 0.40"
Routed to Reach S4 : Swale 4

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC WQ Rainfall=0.83"

Area (sf)	CN	Description
11,200	98	Paved parking, HSG D
7,000	80	>75% Grass cover, Good, HSG D
18,200	91	Weighted Average
7,000		38.46% Pervious Area
11,200		61.54% Impervious Area

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

Subcatchment 4: Basin 4



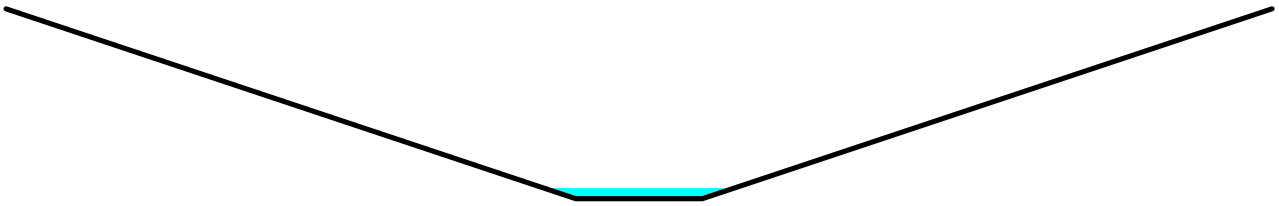
Summary for Reach S4: Swale 4

Inflow Area = 0.418 ac, 61.54% Impervious, Inflow Depth = 0.40" for MCCC WQ event
Inflow = 0.04 cfs @ 7.93 hrs, Volume= 0.014 af
Outflow = 0.04 cfs @ 8.07 hrs, Volume= 0.014 af, Atten= 14%, Lag= 8.4 min

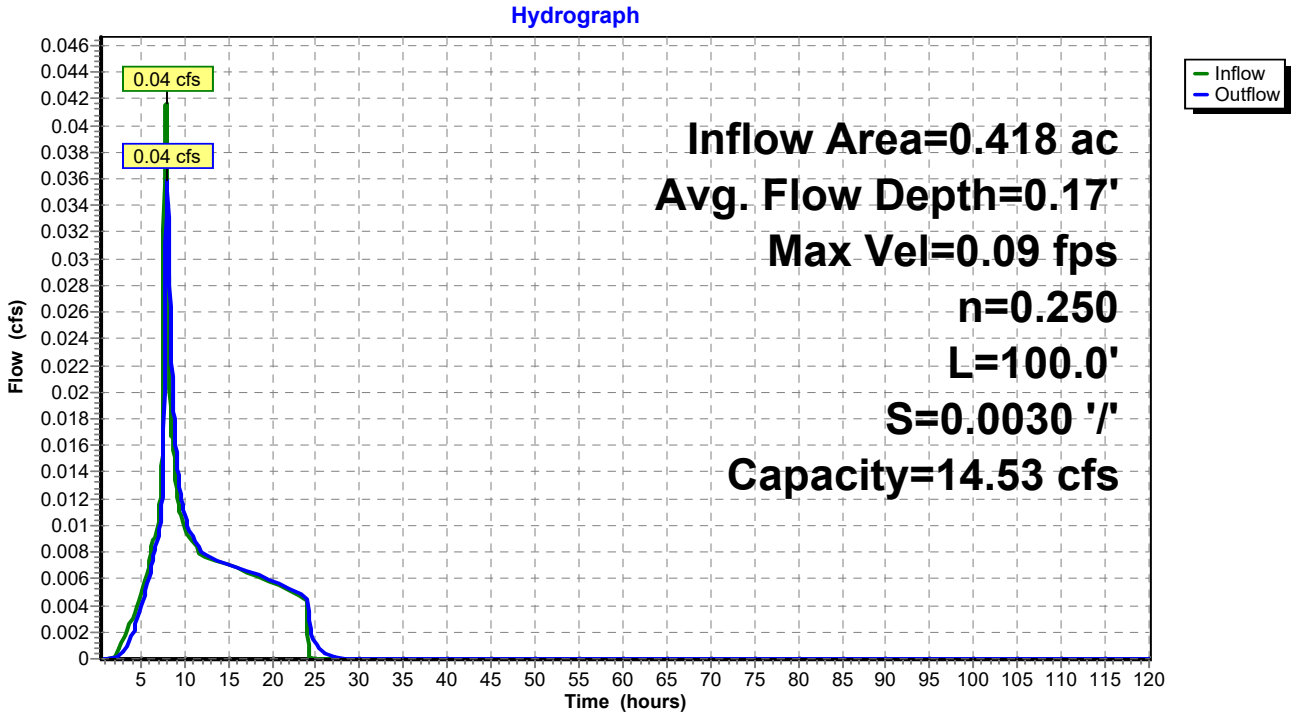
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.09 fps, Min. Travel Time= 19.3 min
Avg. Velocity = 0.05 fps, Avg. Travel Time= 37.0 min

Peak Storage= 42 cf @ 8.07 hrs
Average Depth at Peak Storage= 0.17' , Surface Width= 3.00'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach S4: Swale 4



Summary for Subcatchment 4: Basin 4

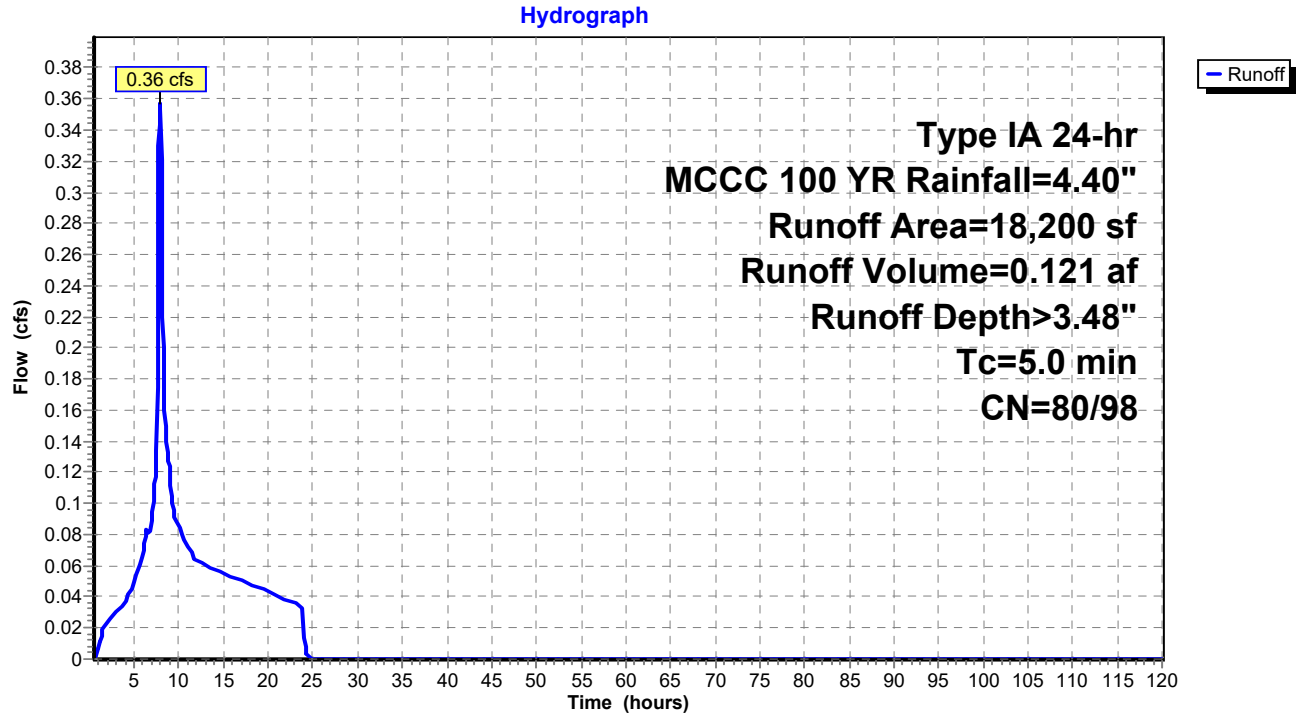
Runoff = 0.36 cfs @ 7.92 hrs, Volume= 0.121 af, Depth> 3.48"
Routed to Reach S4 : Swale 4

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 100 YR Rainfall=4.40"

Area (sf)	CN	Description
11,200	98	Paved parking, HSG D
7,000	80	>75% Grass cover, Good, HSG D
18,200	91	Weighted Average
7,000		38.46% Pervious Area
11,200		61.54% Impervious Area

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

Subcatchment 4: Basin 4



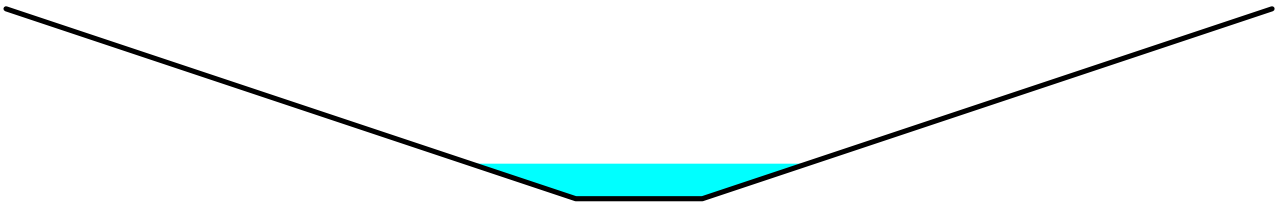
Summary for Reach S4: Swale 4

Inflow Area = 0.418 ac, 61.54% Impervious, Inflow Depth > 3.48" for MCCC 100 YR event
Inflow = 0.36 cfs @ 7.92 hrs, Volume= 0.121 af
Outflow = 0.34 cfs @ 8.02 hrs, Volume= 0.121 af, Atten= 5%, Lag= 6.0 min

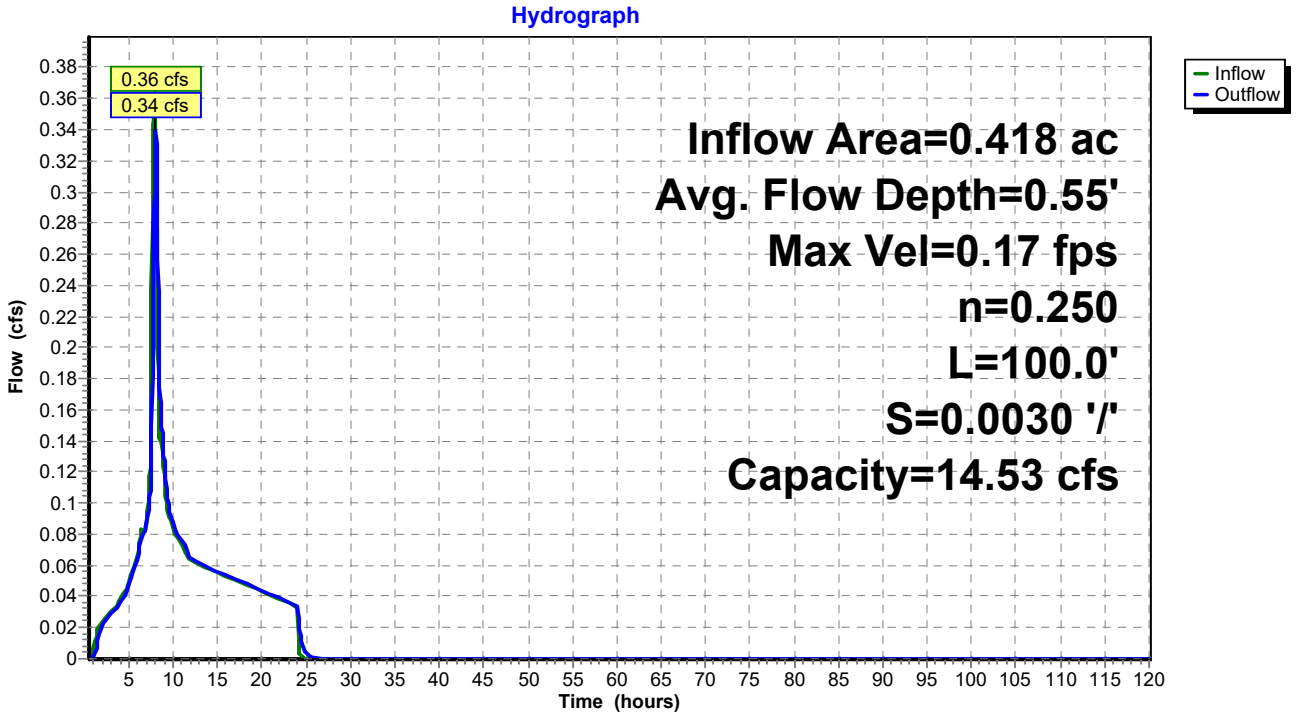
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.17 fps, Min. Travel Time= 10.0 min
Avg. Velocity = 0.08 fps, Avg. Travel Time= 20.2 min

Peak Storage= 203 cf @ 8.02 hrs
Average Depth at Peak Storage= 0.55' , Surface Width= 5.32'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach S4: Swale 4



Summary for Subcatchment 5: Basin 5

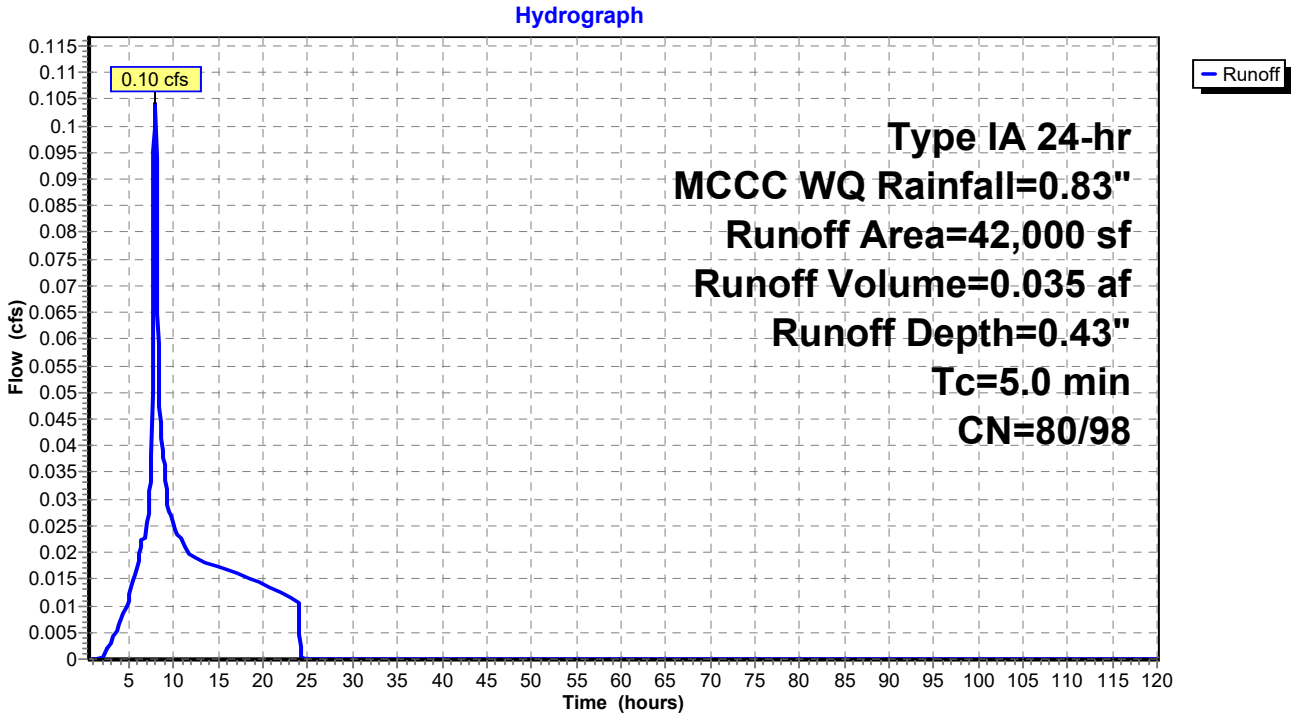
Runoff = 0.10 cfs @ 7.93 hrs, Volume= 0.035 af, Depth= 0.43"
Routed to Reach S5 : Swale 5

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC WQ Rainfall=0.83"

Area (sf)	CN	Description
28,000	98	Paved parking, HSG D
14,000	80	>75% Grass cover, Good, HSG D
42,000	92	Weighted Average
14,000		33.33% Pervious Area
28,000		66.67% Impervious Area

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

Subcatchment 5: Basin 5



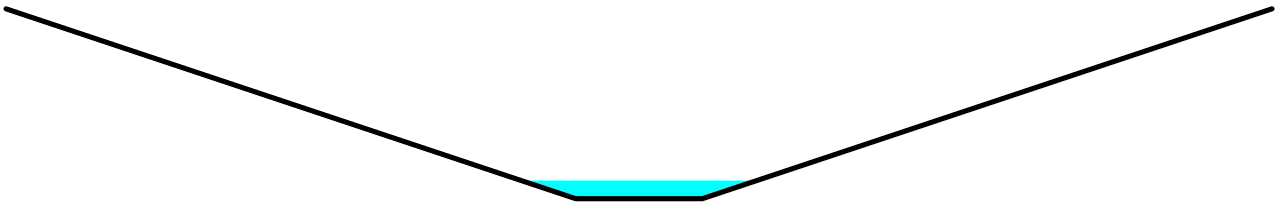
Summary for Reach S5: Swale 5

Inflow Area = 0.964 ac, 66.67% Impervious, Inflow Depth = 0.43" for MCCC WQ event
Inflow = 0.10 cfs @ 7.93 hrs, Volume= 0.035 af
Outflow = 0.09 cfs @ 8.04 hrs, Volume= 0.035 af, Atten= 9%, Lag= 7.1 min

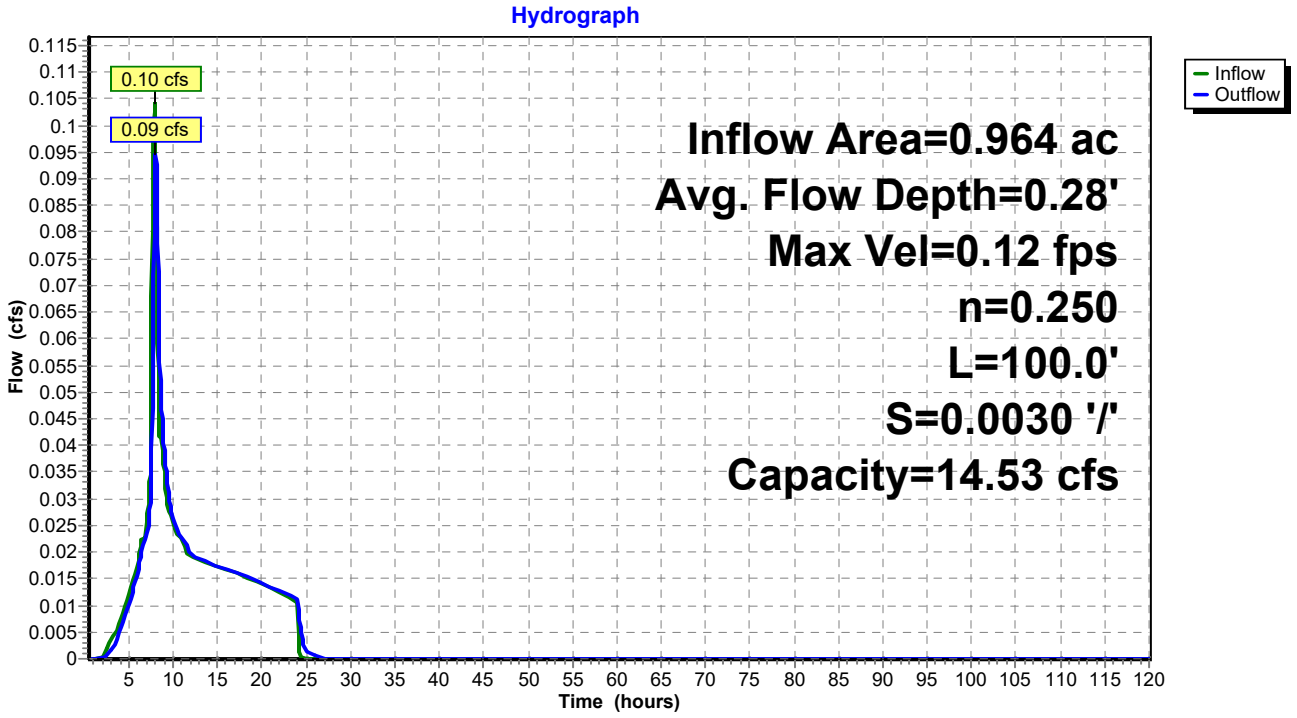
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.12 fps, Min. Travel Time= 14.3 min
Avg. Velocity = 0.06 fps, Avg. Travel Time= 28.6 min

Peak Storage= 81 cf @ 8.04 hrs
Average Depth at Peak Storage= 0.28' , Surface Width= 3.71'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach S5: Swale 5



Summary for Subcatchment 5: Basin 5

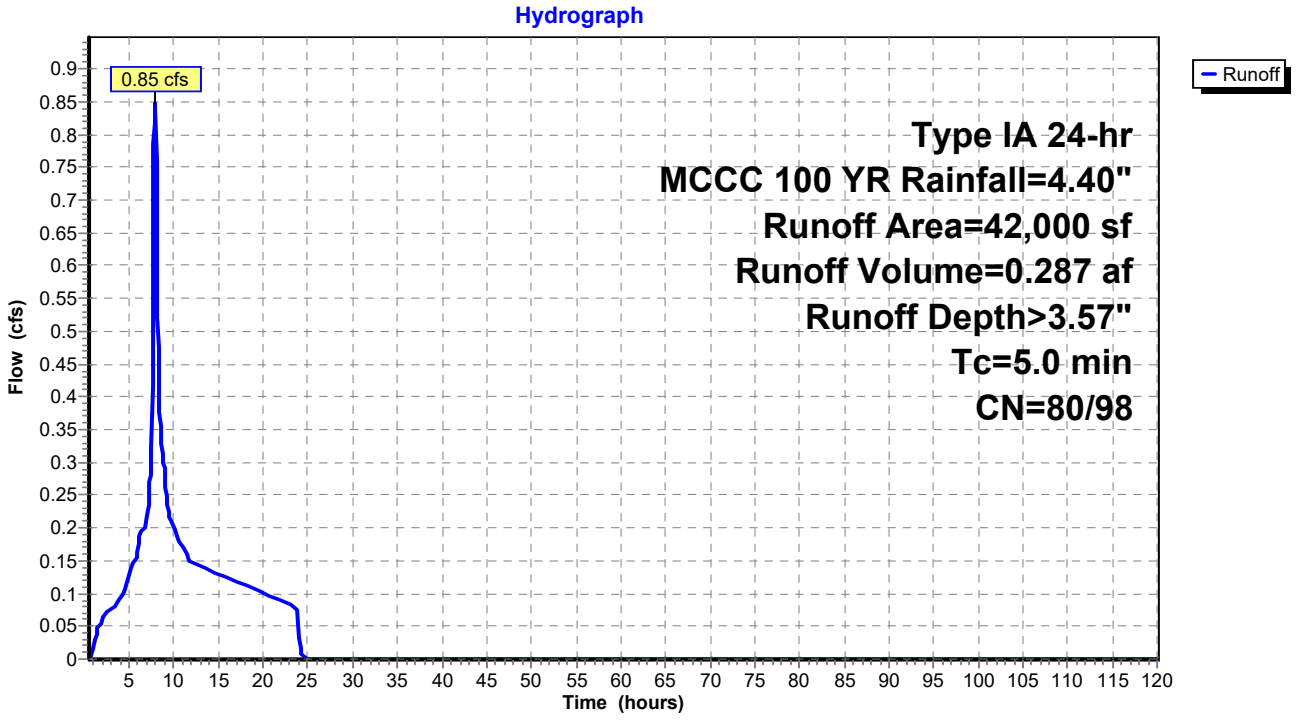
Runoff = 0.85 cfs @ 7.91 hrs, Volume= 0.287 af, Depth> 3.57"
Routed to Reach S5 : Swale 5

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 100 YR Rainfall=4.40"

Area (sf)	CN	Description
28,000	98	Paved parking, HSG D
14,000	80	>75% Grass cover, Good, HSG D
42,000	92	Weighted Average
14,000		33.33% Pervious Area
28,000		66.67% Impervious Area

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

Subcatchment 5: Basin 5



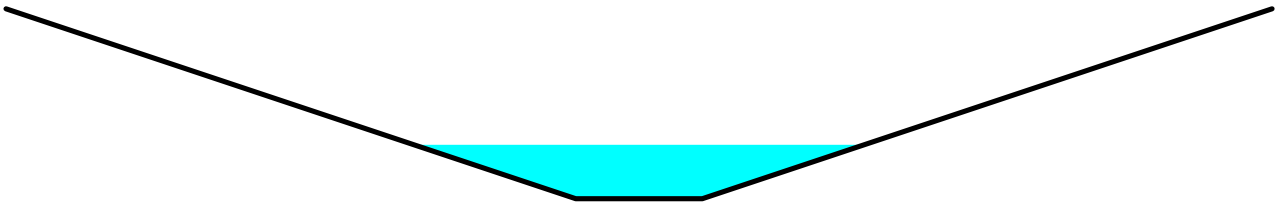
Summary for Reach S5: Swale 5

Inflow Area = 0.964 ac, 66.67% Impervious, Inflow Depth > 3.57" for MCCC 100 YR event
Inflow = 0.85 cfs @ 7.91 hrs, Volume= 0.287 af
Outflow = 0.82 cfs @ 8.00 hrs, Volume= 0.287 af, Atten= 3%, Lag= 5.1 min

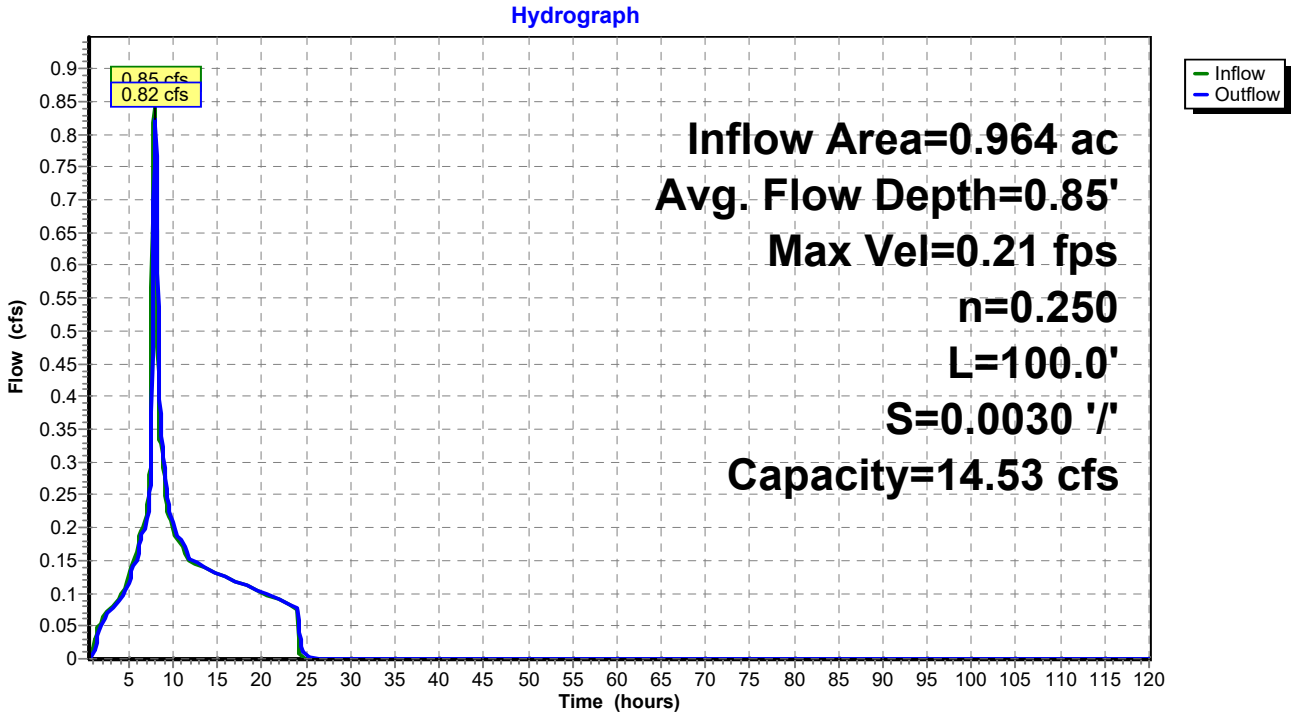
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.21 fps, Min. Travel Time= 7.9 min
Avg. Velocity = 0.10 fps, Avg. Travel Time= 15.9 min

Peak Storage= 388 cf @ 8.00 hrs
Average Depth at Peak Storage= 0.85' , Surface Width= 7.11'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach S5: Swale 5



Summary for Subcatchment 6: Basin 6

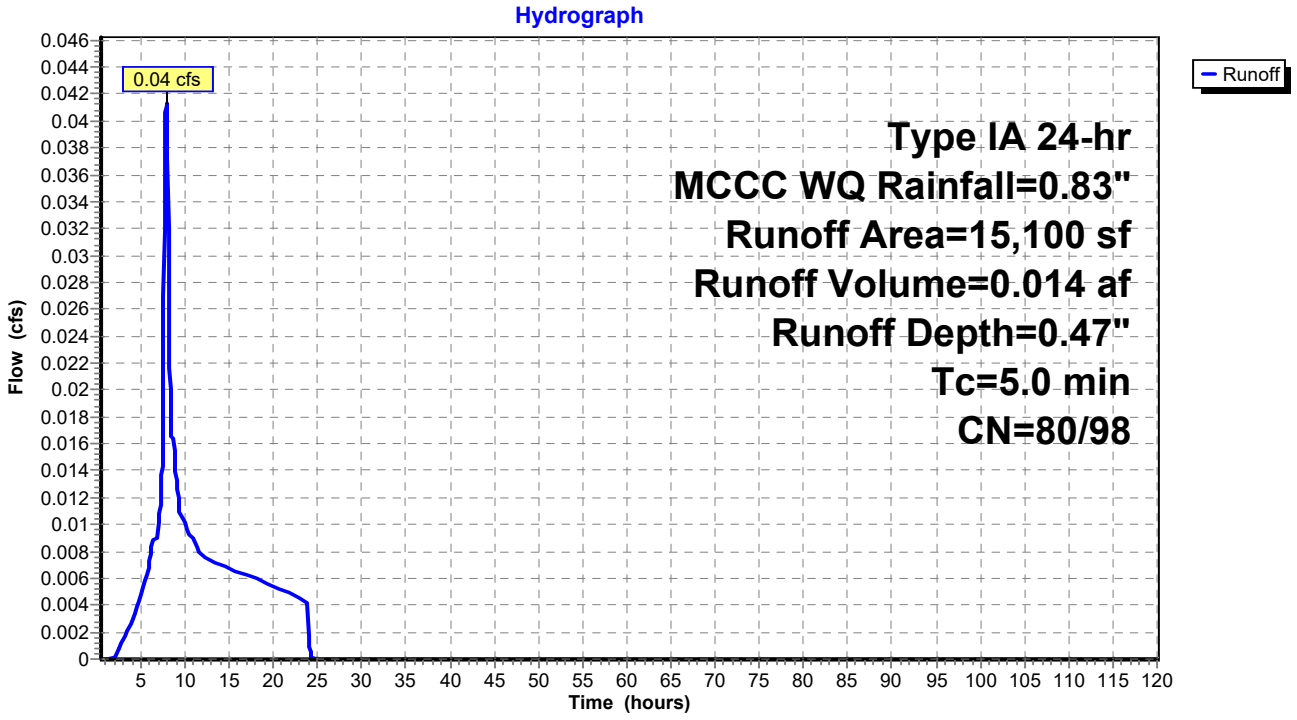
Runoff = 0.04 cfs @ 7.93 hrs, Volume= 0.014 af, Depth= 0.47"
Routed to Reach S6 : Swale 6

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC WQ Rainfall=0.83"

Area (sf)	CN	Description
11,100	98	Paved parking, HSG D
4,000	80	>75% Grass cover, Good, HSG D
15,100	93	Weighted Average
4,000		26.49% Pervious Area
11,100		73.51% Impervious Area

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

Subcatchment 6: Basin 6



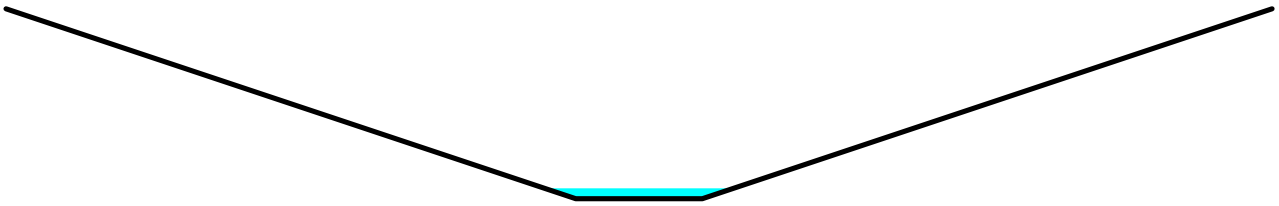
Summary for Reach S6: Swale 6

Inflow Area = 0.347 ac, 73.51% Impervious, Inflow Depth = 0.47" for MCCC WQ event
Inflow = 0.04 cfs @ 7.93 hrs, Volume= 0.014 af
Outflow = 0.04 cfs @ 8.07 hrs, Volume= 0.014 af, Atten= 14%, Lag= 8.4 min

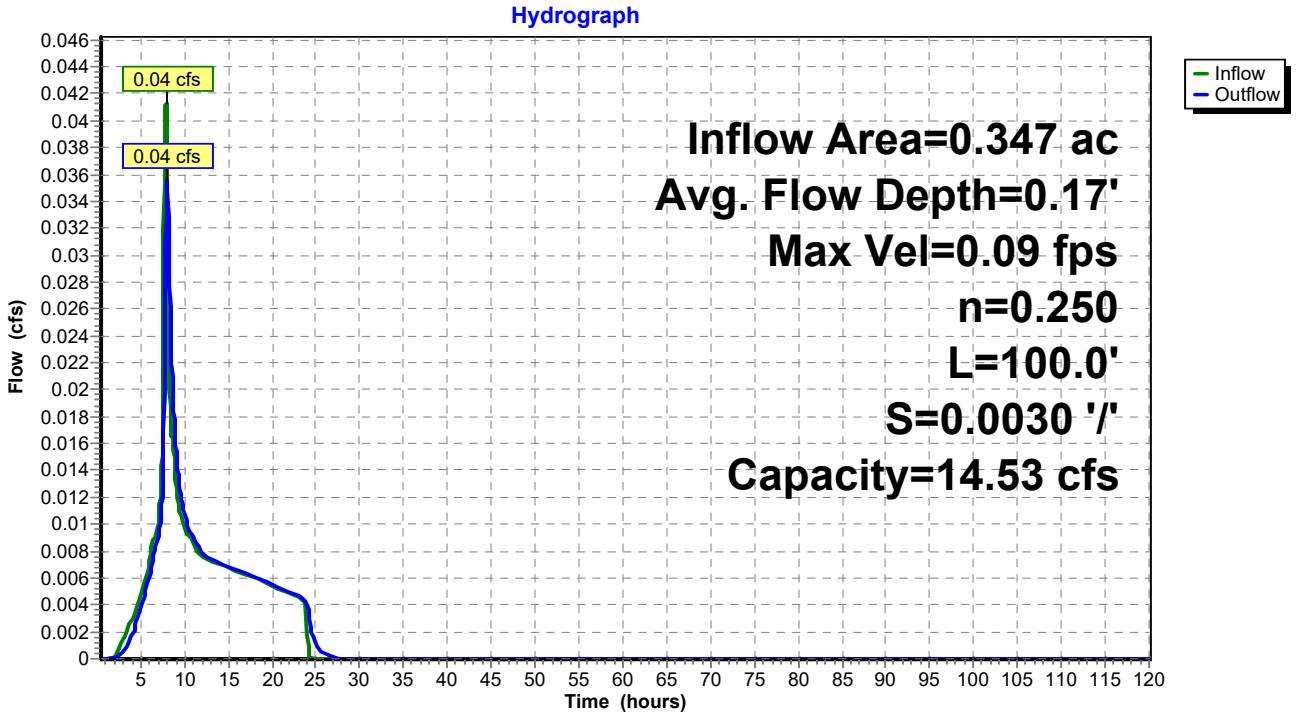
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.09 fps, Min. Travel Time= 19.3 min
Avg. Velocity = 0.04 fps, Avg. Travel Time= 37.3 min

Peak Storage= 41 cf @ 8.07 hrs
Average Depth at Peak Storage= 0.17' , Surface Width= 2.99'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach S6: Swale 6



Summary for Subcatchment 6: Basin 6

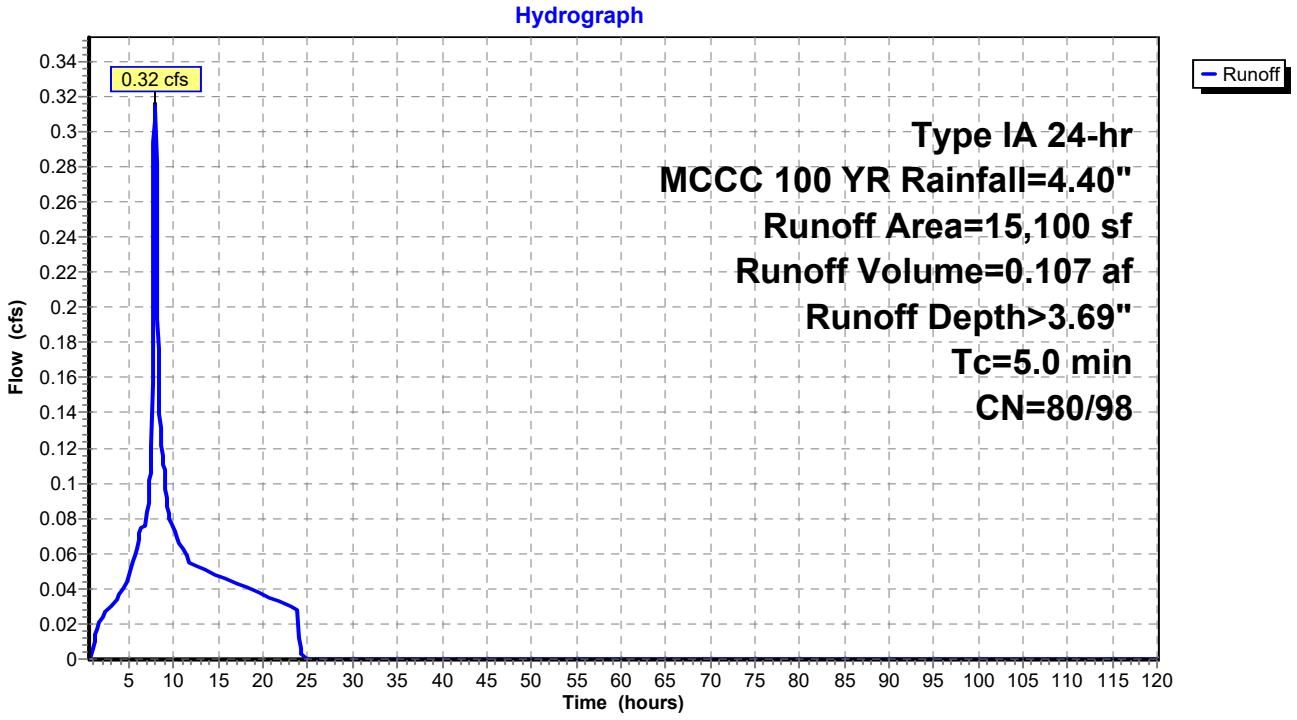
Runoff = 0.32 cfs @ 7.91 hrs, Volume= 0.107 af, Depth> 3.69"
Routed to Reach S6 : Swale 6

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 100 YR Rainfall=4.40"

Area (sf)	CN	Description
11,100	98	Paved parking, HSG D
4,000	80	>75% Grass cover, Good, HSG D
15,100	93	Weighted Average
4,000		26.49% Pervious Area
11,100		73.51% Impervious Area

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

Subcatchment 6: Basin 6



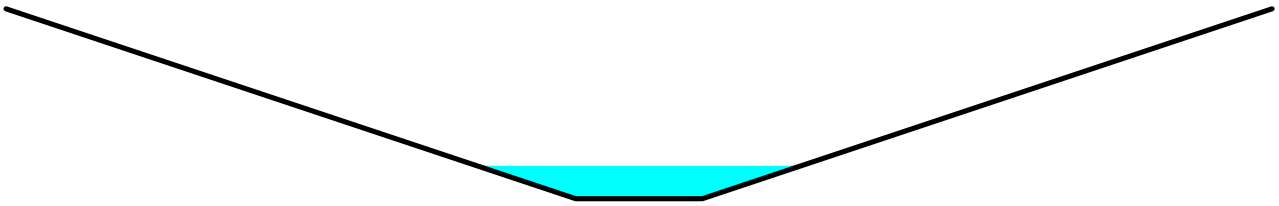
Summary for Reach S6: Swale 6

Inflow Area = 0.347 ac, 73.51% Impervious, Inflow Depth > 3.69" for MCCC 100 YR event
Inflow = 0.32 cfs @ 7.91 hrs, Volume= 0.107 af
Outflow = 0.30 cfs @ 8.02 hrs, Volume= 0.107 af, Atten= 5%, Lag= 6.4 min

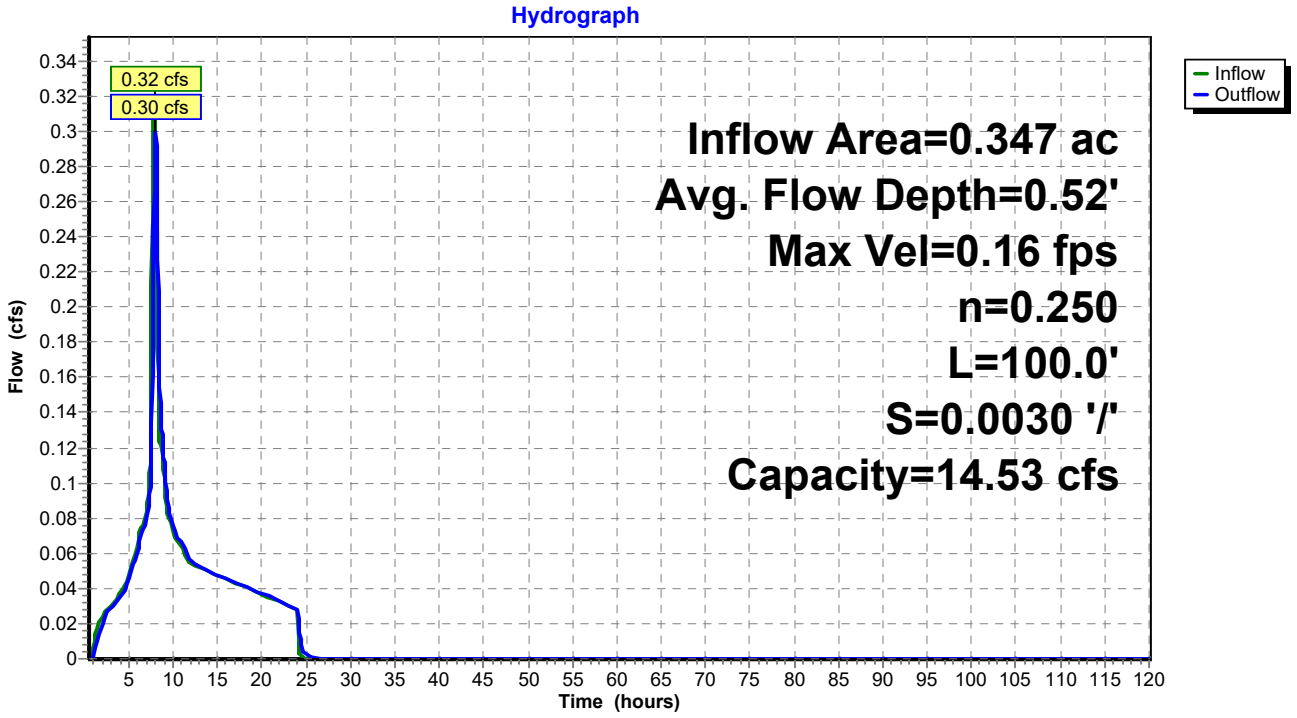
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.16 fps, Min. Travel Time= 10.3 min
Avg. Velocity = 0.08 fps, Avg. Travel Time= 20.9 min

Peak Storage= 185 cf @ 8.02 hrs
Average Depth at Peak Storage= 0.52' , Surface Width= 5.12'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach S6: Swale 6



Summary for Subcatchment 7: Basin 7

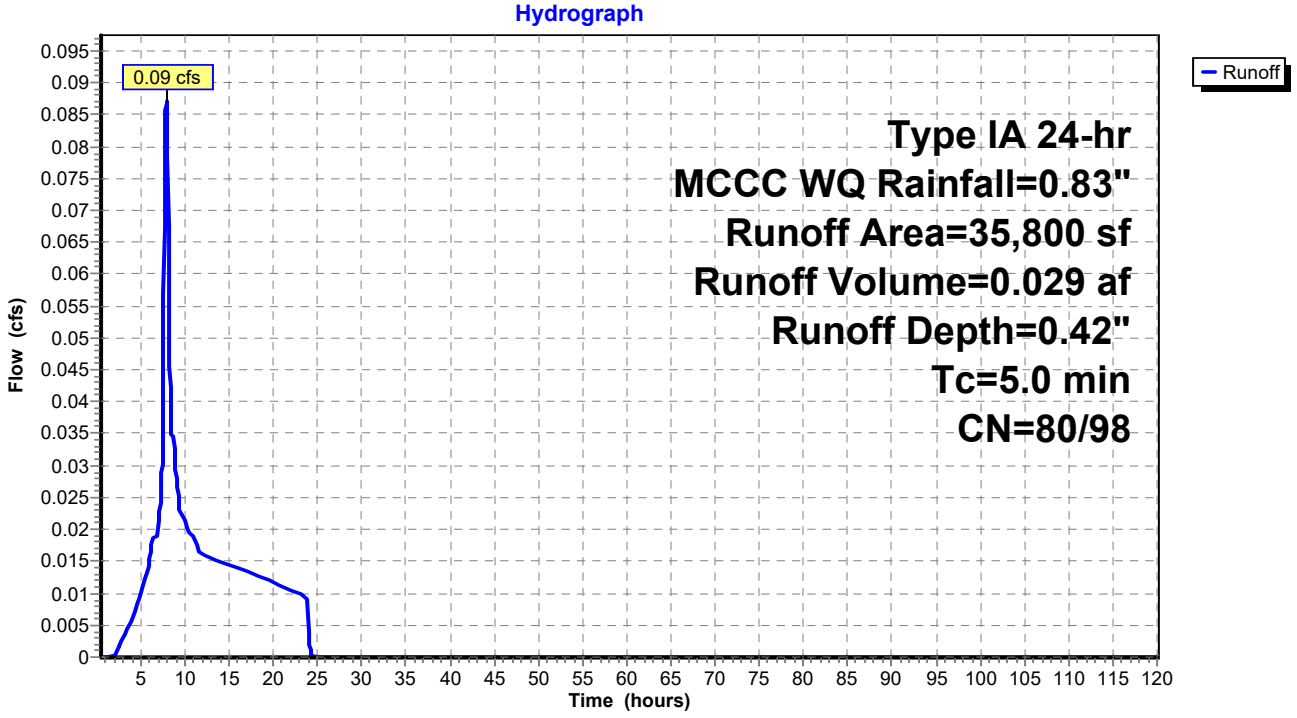
Runoff = 0.09 cfs @ 7.93 hrs, Volume= 0.029 af, Depth= 0.42"
Routed to Reach S7 : Swale 7

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC WQ Rainfall=0.83"

Area (sf)	CN	Description
23,400	98	Paved parking, HSG D
12,400	80	>75% Grass cover, Good, HSG D
35,800	92	Weighted Average
12,400		34.64% Pervious Area
23,400		65.36% Impervious Area

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

Subcatchment 7: Basin 7



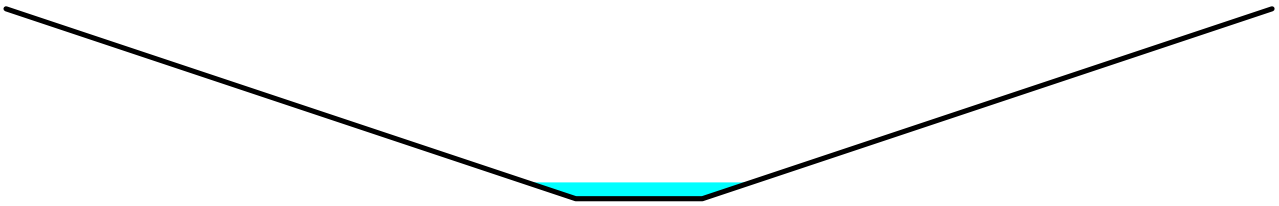
Summary for Reach S7: Swale 7

Inflow Area = 0.822 ac, 65.36% Impervious, Inflow Depth = 0.42" for MCCC WQ event
Inflow = 0.09 cfs @ 7.93 hrs, Volume= 0.029 af
Outflow = 0.08 cfs @ 8.05 hrs, Volume= 0.029 af, Atten= 10%, Lag= 7.3 min

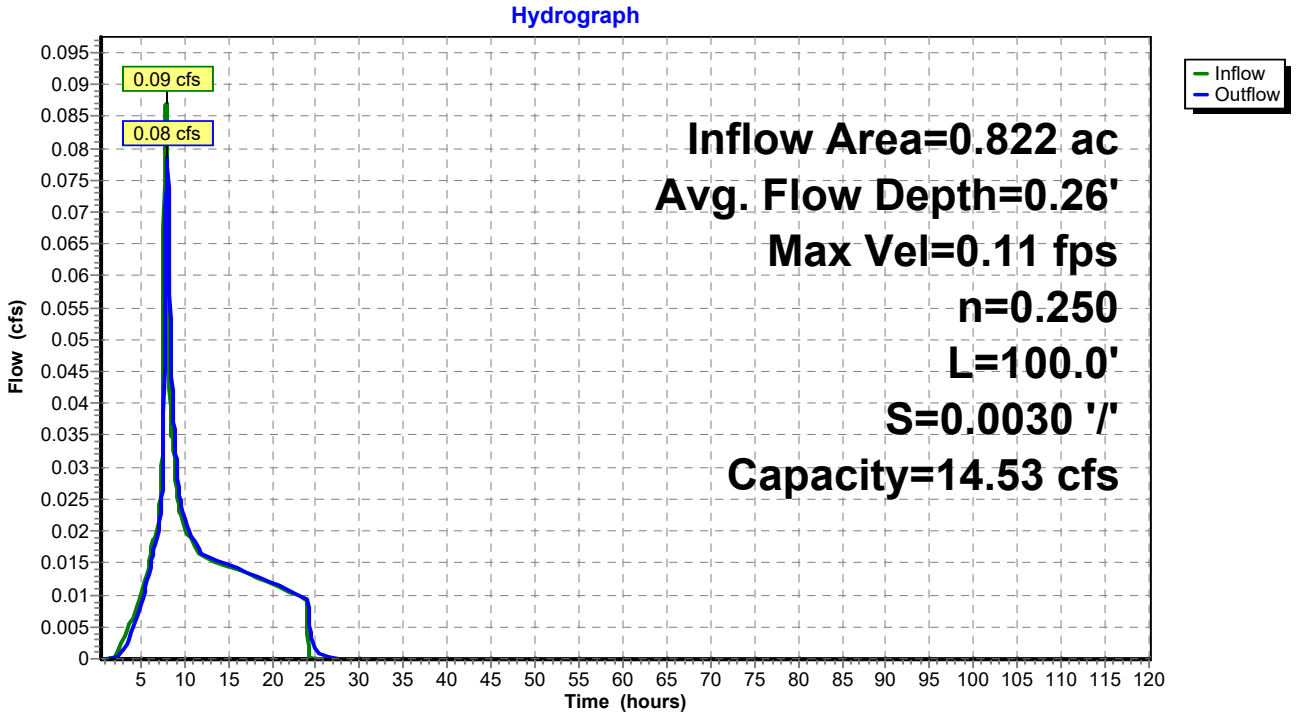
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.11 fps, Min. Travel Time= 15.1 min
Avg. Velocity = 0.06 fps, Avg. Travel Time= 30.0 min

Peak Storage= 71 cf @ 8.05 hrs
Average Depth at Peak Storage= 0.26' , Surface Width= 3.54'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach S7: Swale 7



Summary for Subcatchment 7: Basin 7

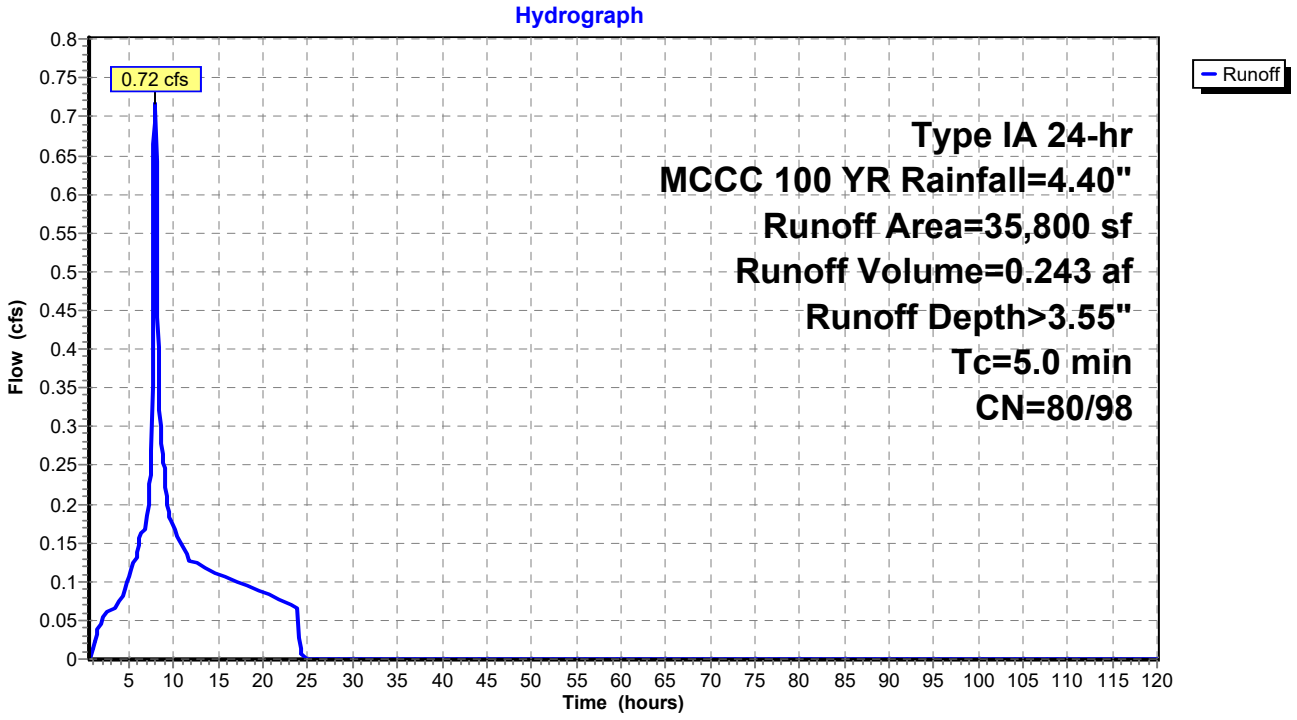
Runoff = 0.72 cfs @ 7.92 hrs, Volume= 0.243 af, Depth> 3.55"
Routed to Reach S7 : Swale 7

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 100 YR Rainfall=4.40"

Area (sf)	CN	Description
23,400	98	Paved parking, HSG D
12,400	80	>75% Grass cover, Good, HSG D
35,800	92	Weighted Average
12,400		34.64% Pervious Area
23,400		65.36% Impervious Area

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

Subcatchment 7: Basin 7



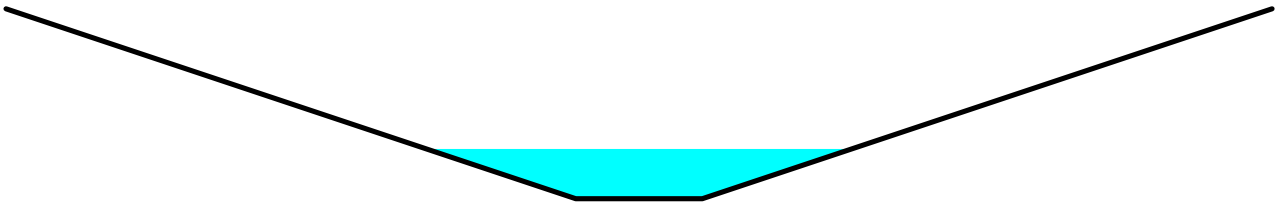
Summary for Reach S7: Swale 7

Inflow Area = 0.822 ac, 65.36% Impervious, Inflow Depth > 3.55" for MCCC 100 YR event
Inflow = 0.72 cfs @ 7.92 hrs, Volume= 0.243 af
Outflow = 0.69 cfs @ 8.00 hrs, Volume= 0.243 af, Atten= 3%, Lag= 5.2 min

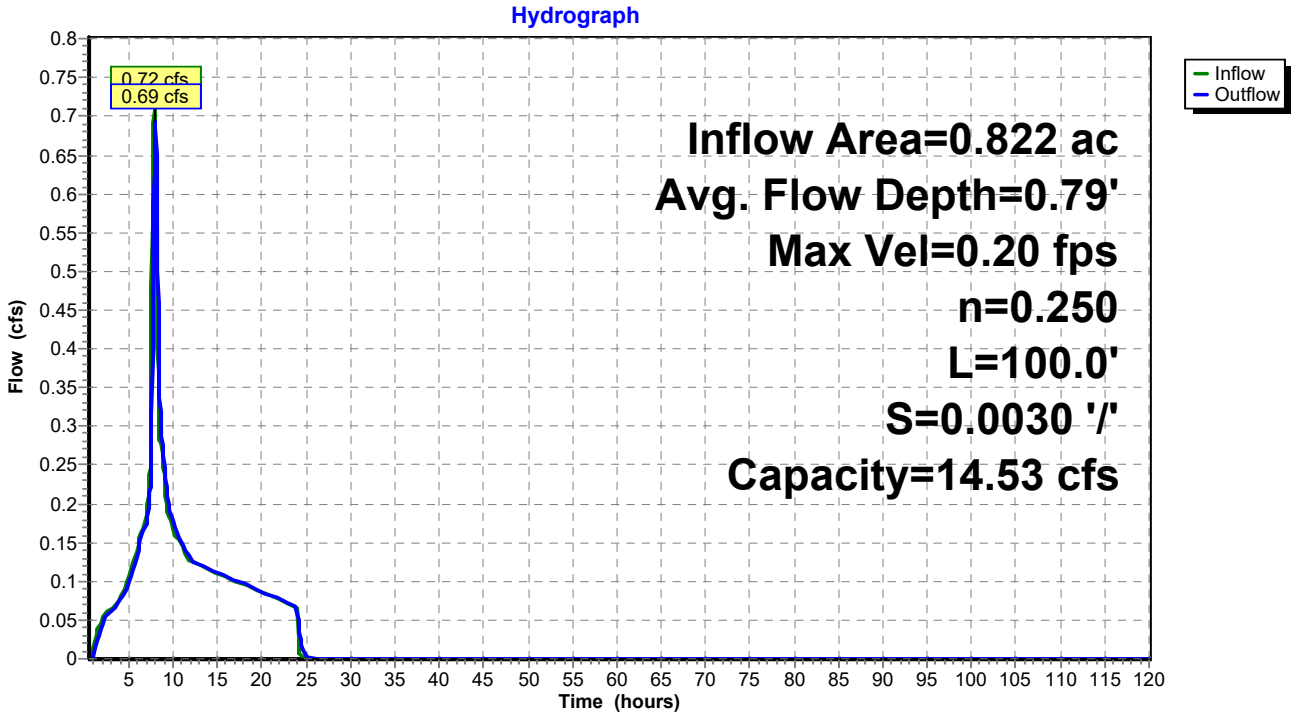
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.20 fps, Min. Travel Time= 8.2 min
Avg. Velocity = 0.10 fps, Avg. Travel Time= 16.6 min

Peak Storage= 342 cf @ 8.00 hrs
Average Depth at Peak Storage= 0.79' , Surface Width= 6.71'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach S7: Swale 7



Summary for Subcatchment A: Basin A

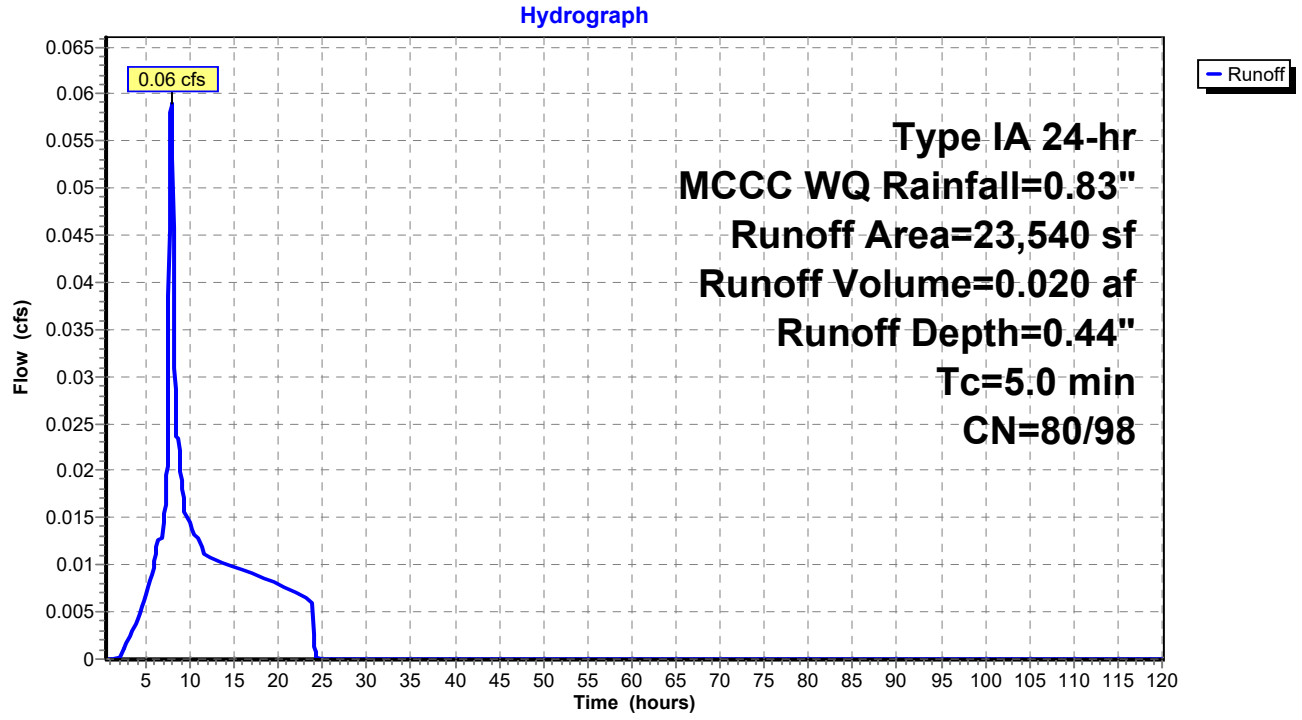
Runoff = 0.06 cfs @ 7.93 hrs, Volume= 0.020 af, Depth= 0.44"
Routed to Reach SA : Swale A

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC WQ Rainfall=0.83"

Area (sf)	CN	Description
15,860	98	Paved parking, HSG D
7,680	80	>75% Grass cover, Good, HSG D
23,540	92	Weighted Average
7,680		32.63% Pervious Area
15,860		67.37% Impervious Area

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

Subcatchment A: Basin A



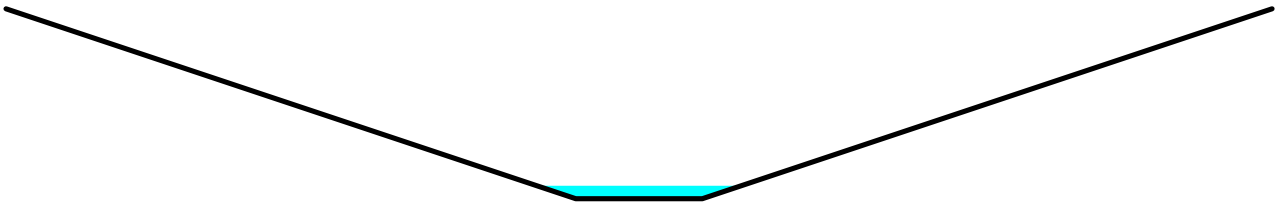
Summary for Reach SA: Swale A

Inflow Area = 0.540 ac, 67.37% Impervious, Inflow Depth = 0.44" for MCCC WQ event
Inflow = 0.06 cfs @ 7.93 hrs, Volume= 0.020 af
Outflow = 0.05 cfs @ 8.06 hrs, Volume= 0.020 af, Atten= 12%, Lag= 7.8 min

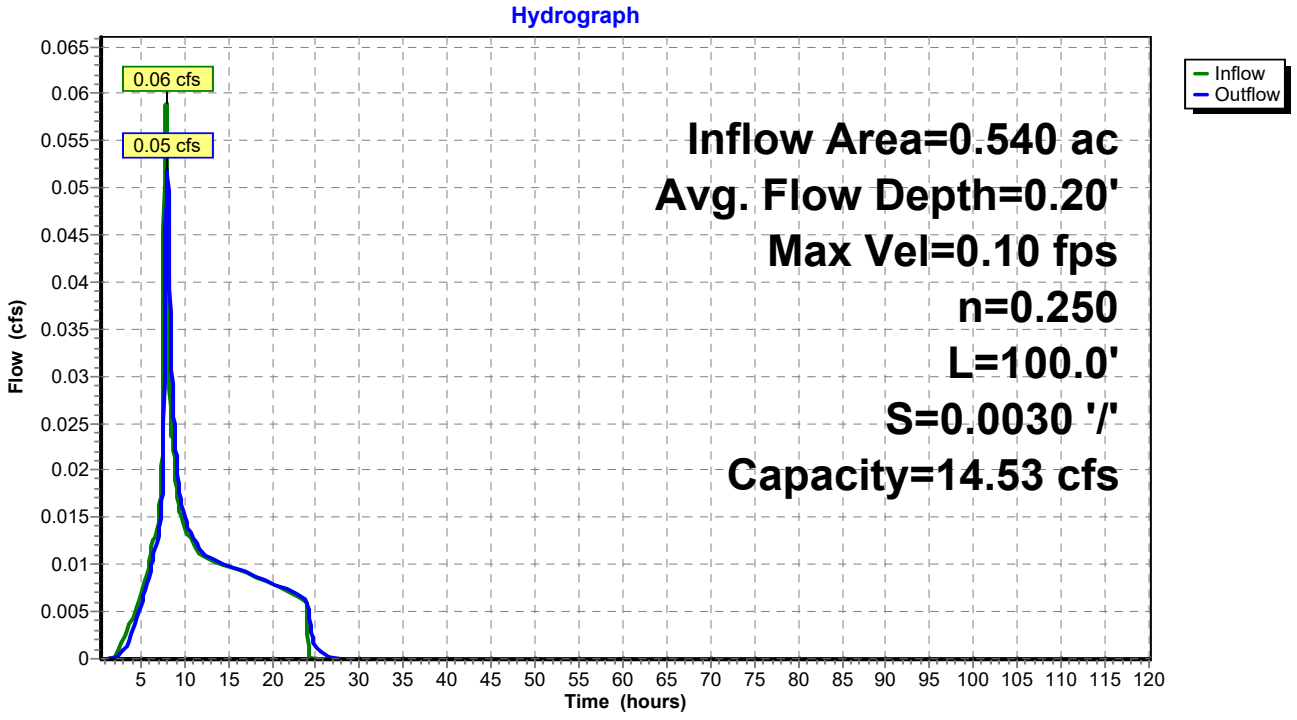
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.10 fps, Min. Travel Time= 17.2 min
Avg. Velocity = 0.05 fps, Avg. Travel Time= 33.6 min

Peak Storage= 54 cf @ 8.06 hrs
Average Depth at Peak Storage= 0.20' , Surface Width= 3.23'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach SA: Swale A



Summary for Subcatchment A: Basin A

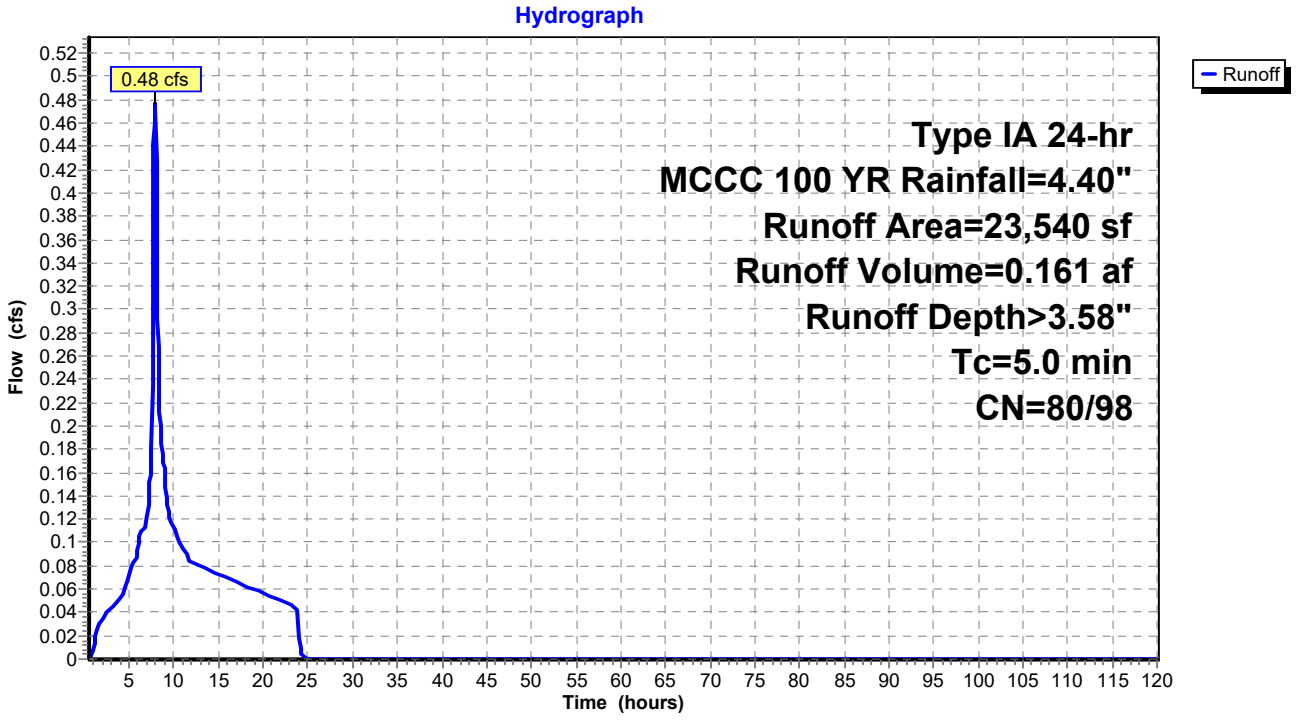
Runoff = 0.48 cfs @ 7.91 hrs, Volume= 0.161 af, Depth> 3.58"
Routed to Reach SA : Swale A

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 100 YR Rainfall=4.40"

Area (sf)	CN	Description
15,860	98	Paved parking, HSG D
7,680	80	>75% Grass cover, Good, HSG D
23,540	92	Weighted Average
7,680		32.63% Pervious Area
15,860		67.37% Impervious Area

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

Subcatchment A: Basin A



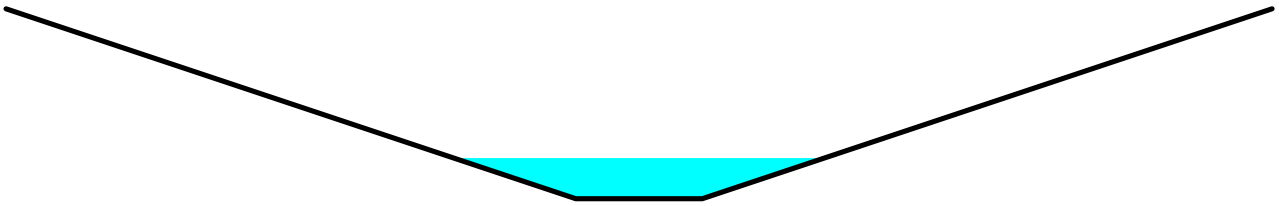
Summary for Reach SA: Swale A

Inflow Area = 0.540 ac, 67.37% Impervious, Inflow Depth > 3.58" for MCCC 100 YR event
Inflow = 0.48 cfs @ 7.91 hrs, Volume= 0.161 af
Outflow = 0.46 cfs @ 8.01 hrs, Volume= 0.161 af, Atten= 4%, Lag= 5.7 min

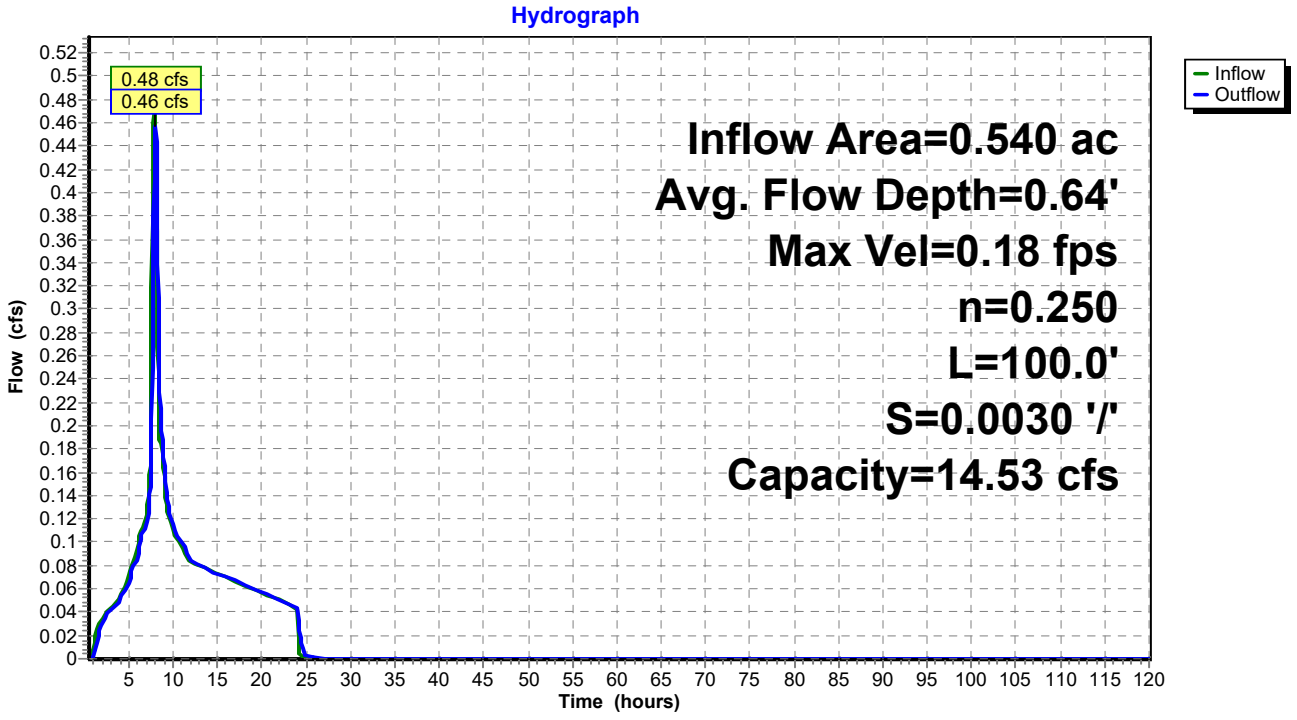
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.18 fps, Min. Travel Time= 9.2 min
Avg. Velocity = 0.09 fps, Avg. Travel Time= 18.6 min

Peak Storage= 252 cf @ 8.01 hrs
Average Depth at Peak Storage= 0.64' , Surface Width= 5.85'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach SA: Swale A



Summary for Subcatchment B: Basin B

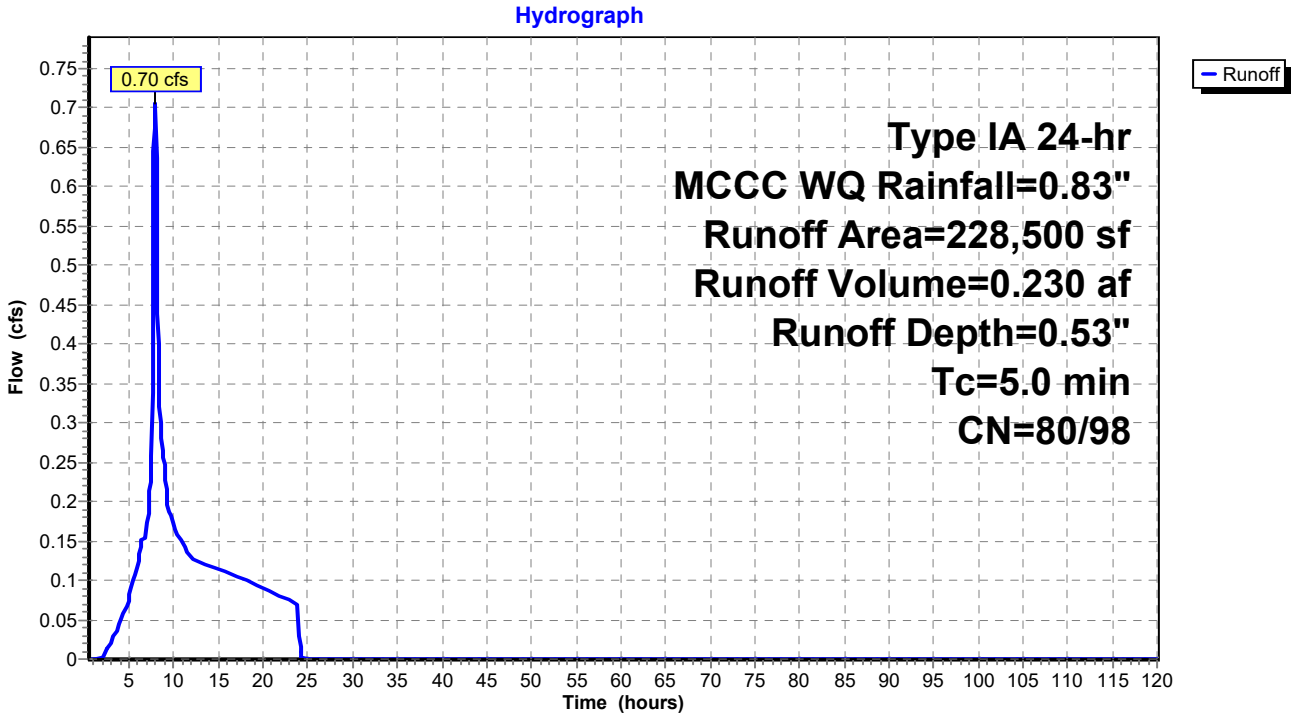
Runoff = 0.70 cfs @ 7.93 hrs, Volume= 0.230 af, Depth= 0.53"
Routed to Reach SB : Swale B

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC WQ Rainfall=0.83"

Area (sf)	CN	Description
189,500	98	Paved parking, HSG D
39,000	80	>75% Grass cover, Good, HSG D
228,500	95	Weighted Average
39,000		17.07% Pervious Area
189,500		82.93% Impervious Area

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

Subcatchment B: Basin B



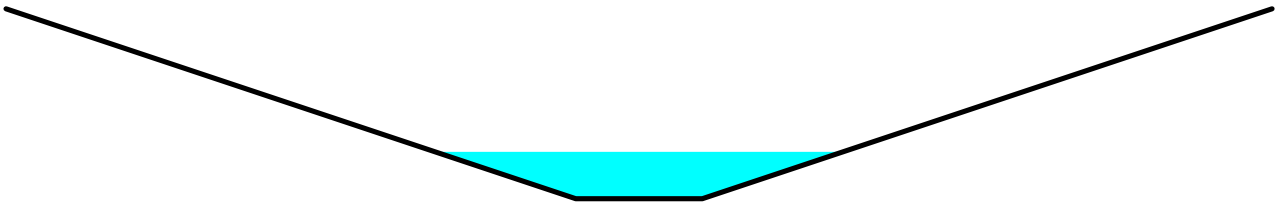
Summary for Reach SB: Swale B

Inflow Area = 5.246 ac, 82.93% Impervious, Inflow Depth = 0.53" for MCCC WQ event
Inflow = 0.70 cfs @ 7.93 hrs, Volume= 0.230 af
Outflow = 0.62 cfs @ 8.06 hrs, Volume= 0.230 af, Atten= 13%, Lag= 8.1 min

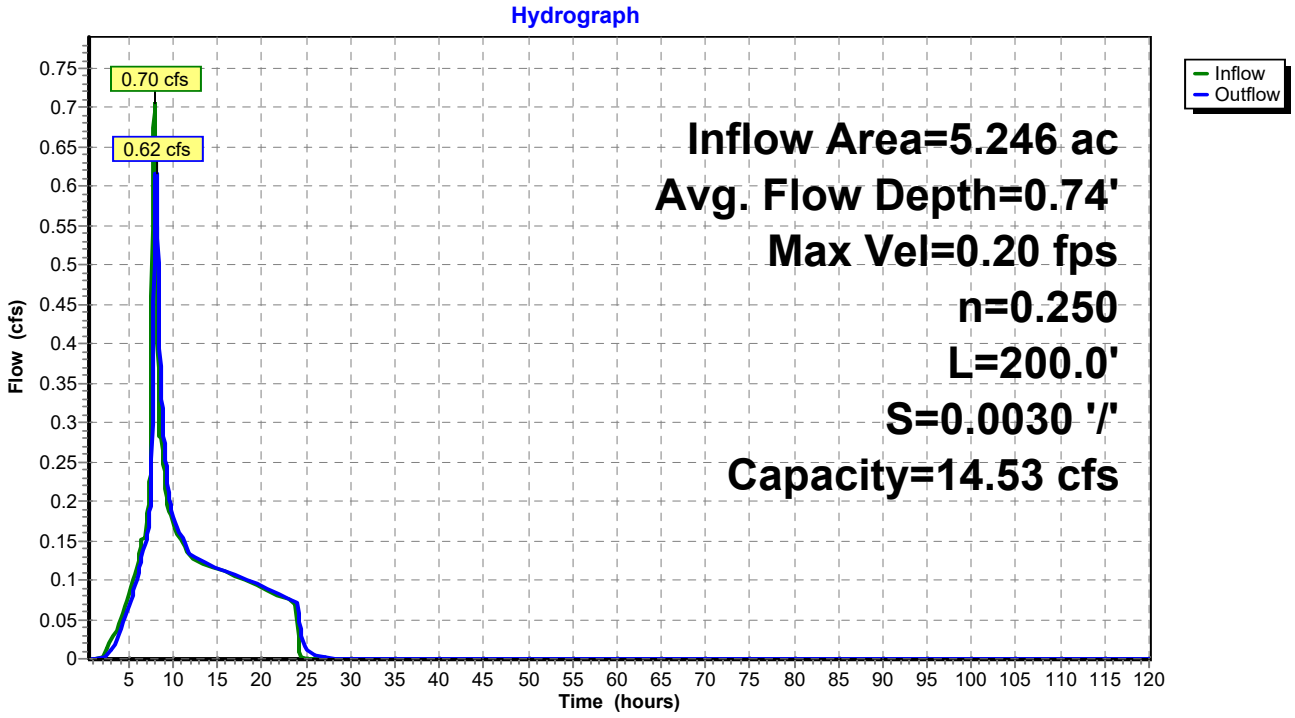
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.20 fps, Min. Travel Time= 17.0 min
Avg. Velocity = 0.09 fps, Avg. Travel Time= 38.7 min

Peak Storage= 627 cf @ 8.06 hrs
Average Depth at Peak Storage= 0.74' , Surface Width= 6.45'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 200.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.60'



Reach SB: Swale B



Summary for Subcatchment B: Basin B

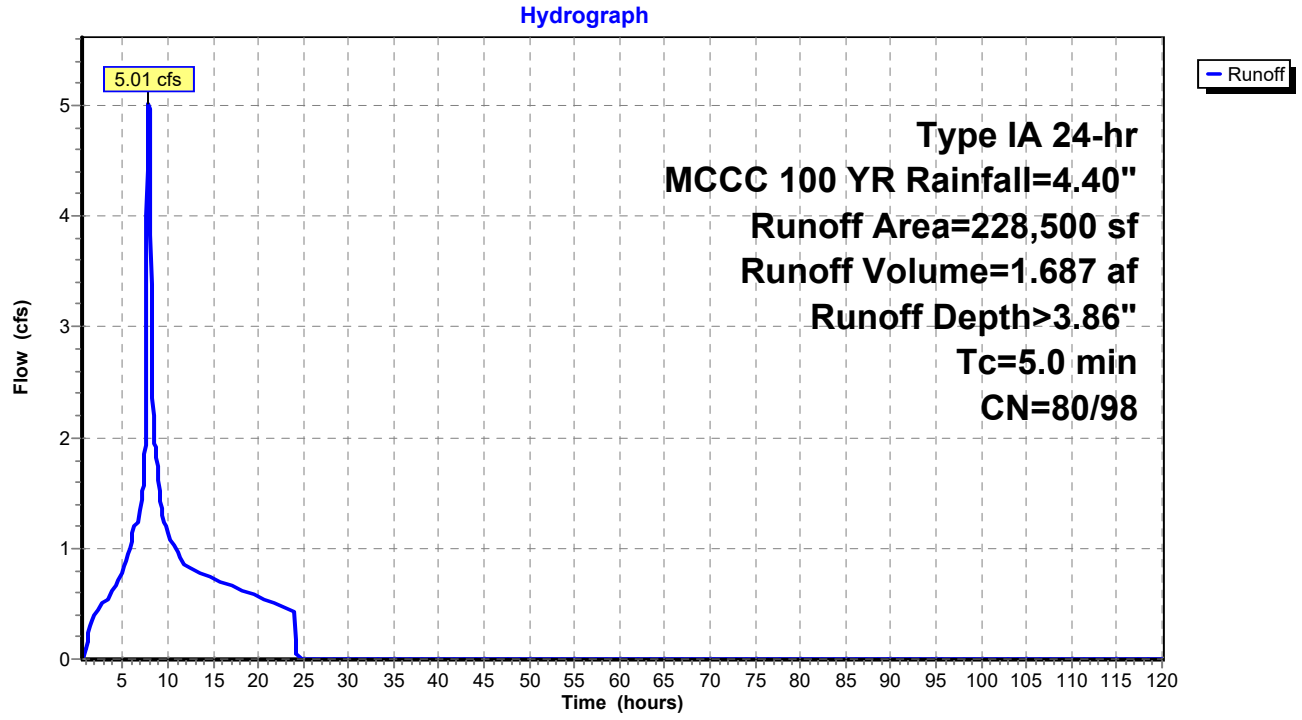
Runoff = 5.01 cfs @ 7.90 hrs, Volume= 1.687 af, Depth> 3.86"
Routed to Reach SB : Swale B

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 100 YR Rainfall=4.40"

Area (sf)	CN	Description
189,500	98	Paved parking, HSG D
39,000	80	>75% Grass cover, Good, HSG D
228,500	95	Weighted Average
39,000		17.07% Pervious Area
189,500		82.93% Impervious Area

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

Subcatchment B: Basin B



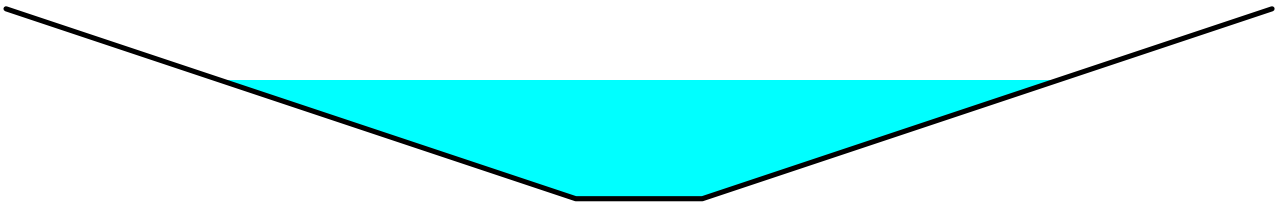
Summary for Reach SB: Swale B

Inflow Area = 5.246 ac, 82.93% Impervious, Inflow Depth > 3.86" for MCCC 100 YR event
Inflow = 5.01 cfs @ 7.90 hrs, Volume= 1.687 af
Outflow = 4.76 cfs @ 8.01 hrs, Volume= 1.687 af, Atten= 5%, Lag= 6.6 min

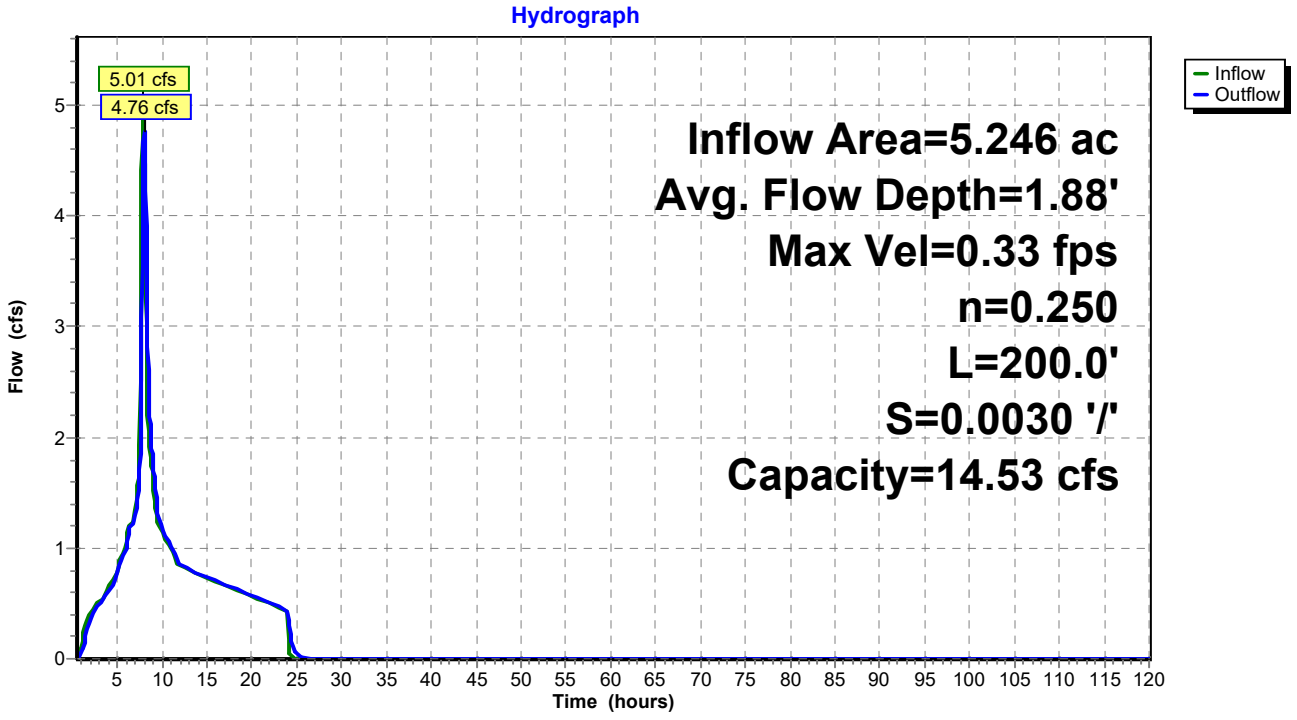
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.33 fps, Min. Travel Time= 10.0 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 23.6 min

Peak Storage= 2,863 cf @ 8.01 hrs
Average Depth at Peak Storage= 1.88' , Surface Width= 13.26'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 200.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.60'



Reach SB: Swale B



Summary for Subcatchment C: Basin C

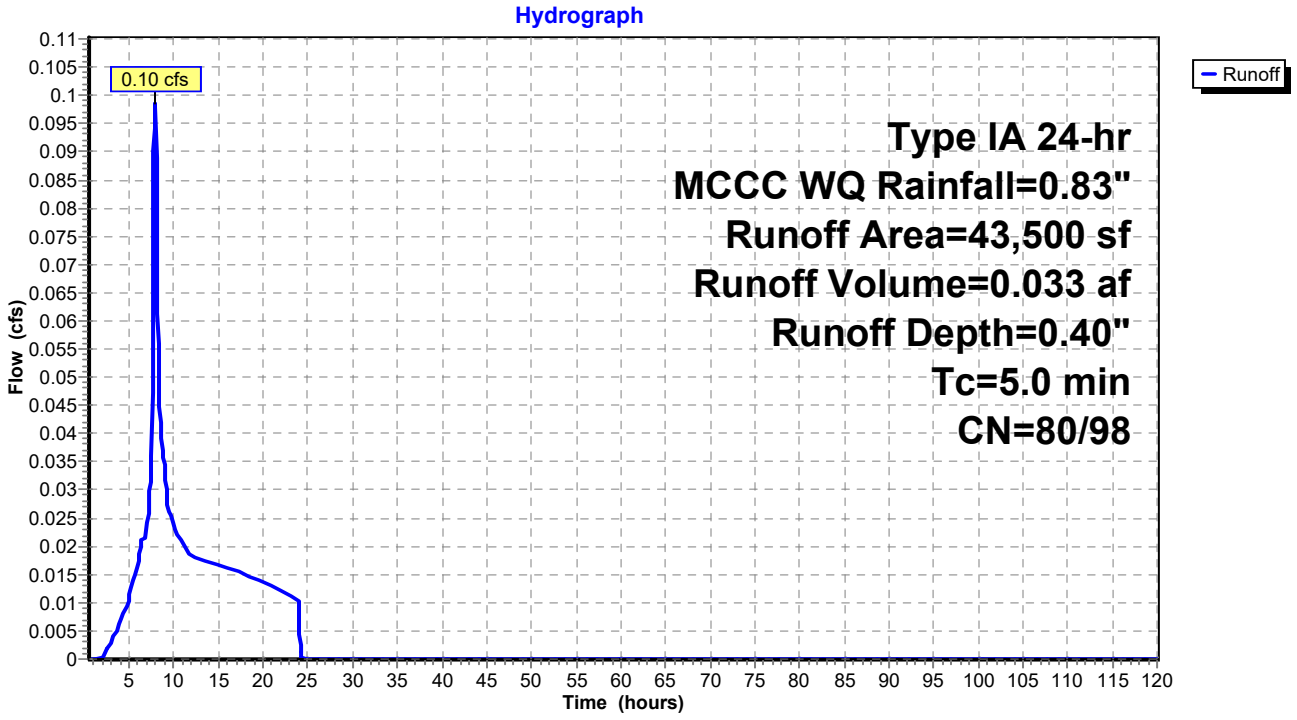
Runoff = 0.10 cfs @ 7.93 hrs, Volume= 0.033 af, Depth= 0.40"
Routed to Reach SC : Swale C

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC WQ Rainfall=0.83"

Area (sf)	CN	Description
26,500	98	Paved parking, HSG D
17,000	80	>75% Grass cover, Good, HSG D
43,500	91	Weighted Average
17,000		39.08% Pervious Area
26,500		60.92% Impervious Area

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

Subcatchment C: Basin C



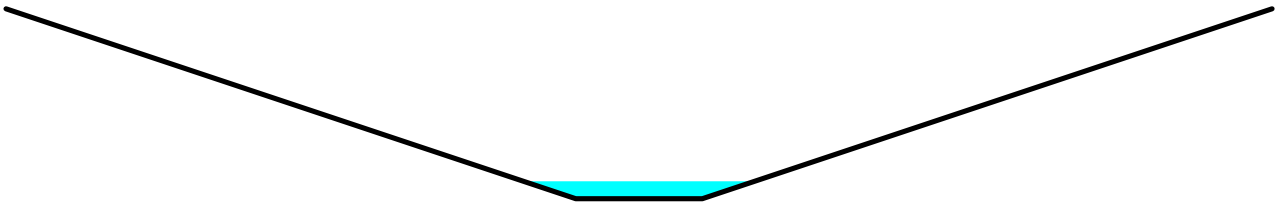
Summary for Reach SC: Swale C

Inflow Area = 0.999 ac, 60.92% Impervious, Inflow Depth = 0.40" for MCCC WQ event
Inflow = 0.10 cfs @ 7.93 hrs, Volume= 0.033 af
Outflow = 0.09 cfs @ 8.05 hrs, Volume= 0.033 af, Atten= 9%, Lag= 7.1 min

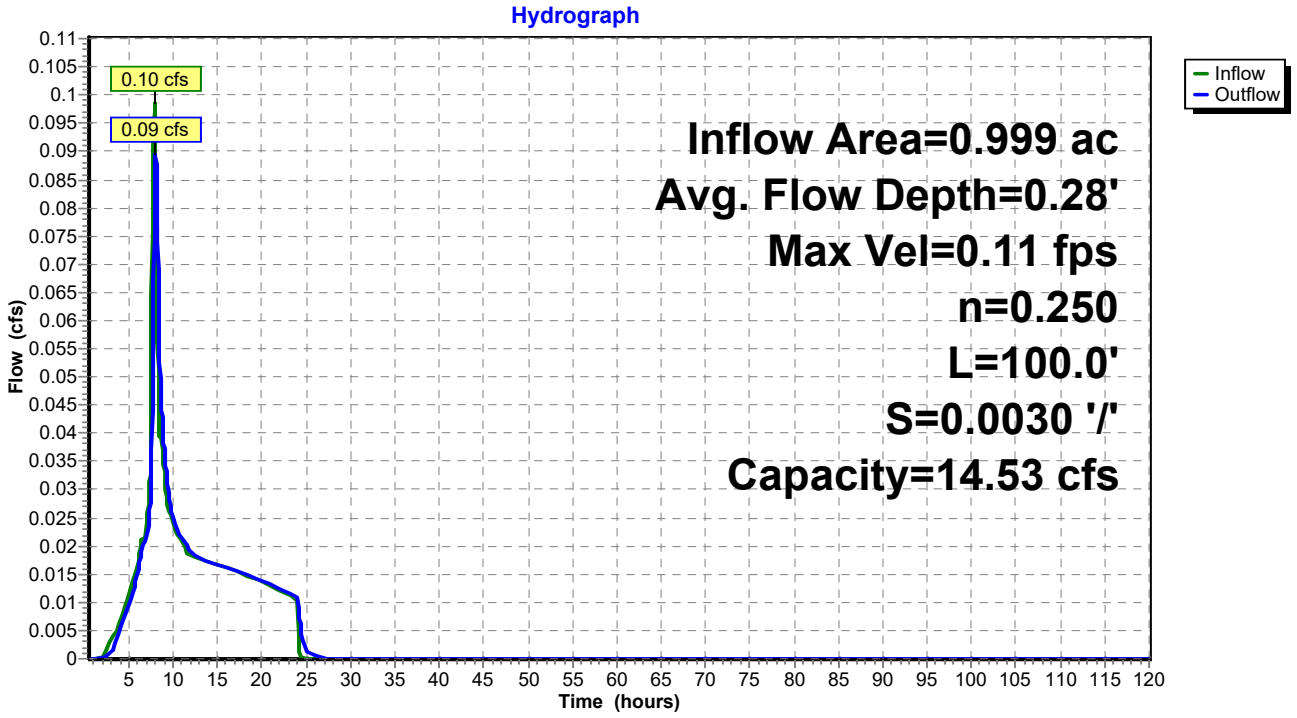
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.11 fps, Min. Travel Time= 14.6 min
Avg. Velocity = 0.06 fps, Avg. Travel Time= 28.9 min

Peak Storage= 78 cf @ 8.05 hrs
Average Depth at Peak Storage= 0.28' , Surface Width= 3.66'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach SC: Swale C



Summary for Subcatchment C: Basin C

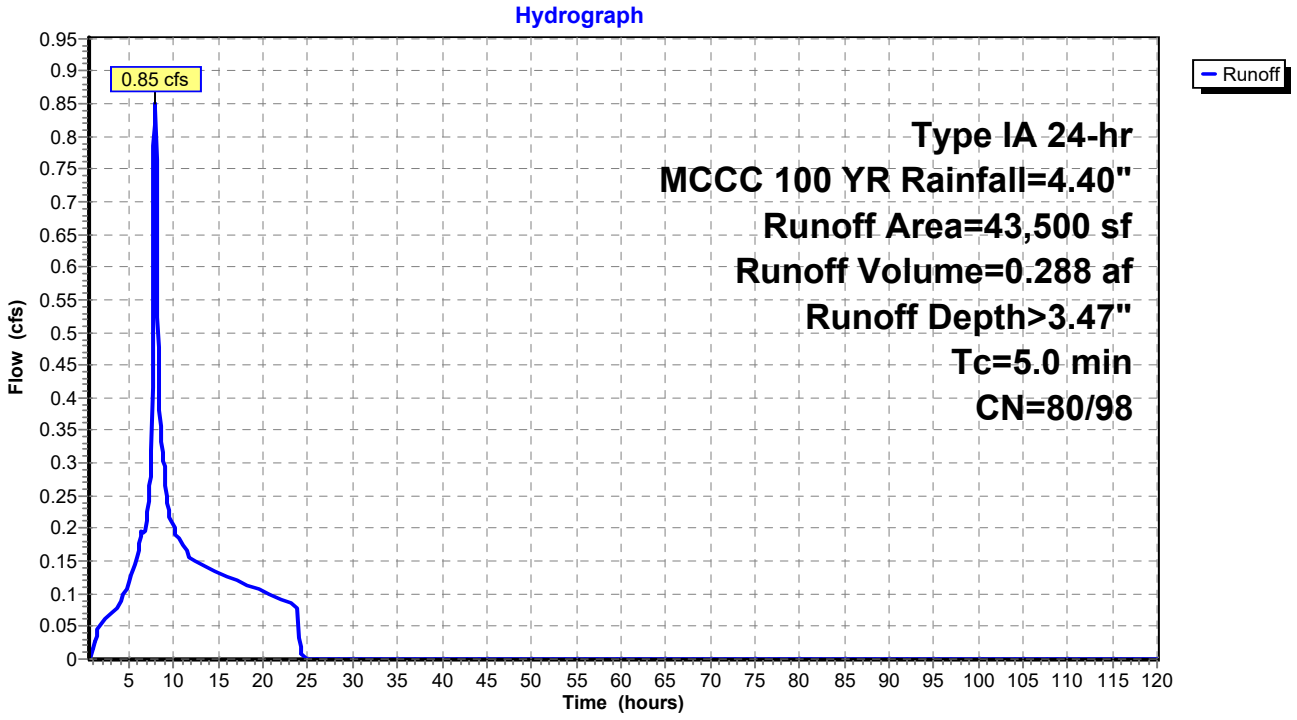
Runoff = 0.85 cfs @ 7.92 hrs, Volume= 0.288 af, Depth> 3.47"
Routed to Reach SC : Swale C

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 100 YR Rainfall=4.40"

Area (sf)	CN	Description
26,500	98	Paved parking, HSG D
17,000	80	>75% Grass cover, Good, HSG D
43,500	91	Weighted Average
17,000		39.08% Pervious Area
26,500		60.92% Impervious Area

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

Subcatchment C: Basin C



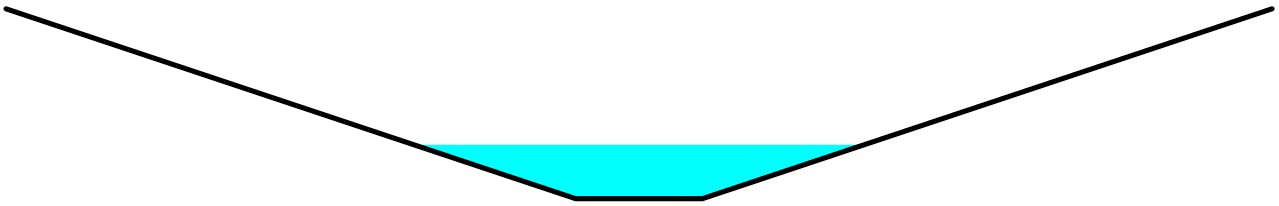
Summary for Reach SC: Swale C

Inflow Area = 0.999 ac, 60.92% Impervious, Inflow Depth > 3.47" for MCCC 100 YR event
Inflow = 0.85 cfs @ 7.92 hrs, Volume= 0.288 af
Outflow = 0.83 cfs @ 8.00 hrs, Volume= 0.288 af, Atten= 3%, Lag= 5.0 min

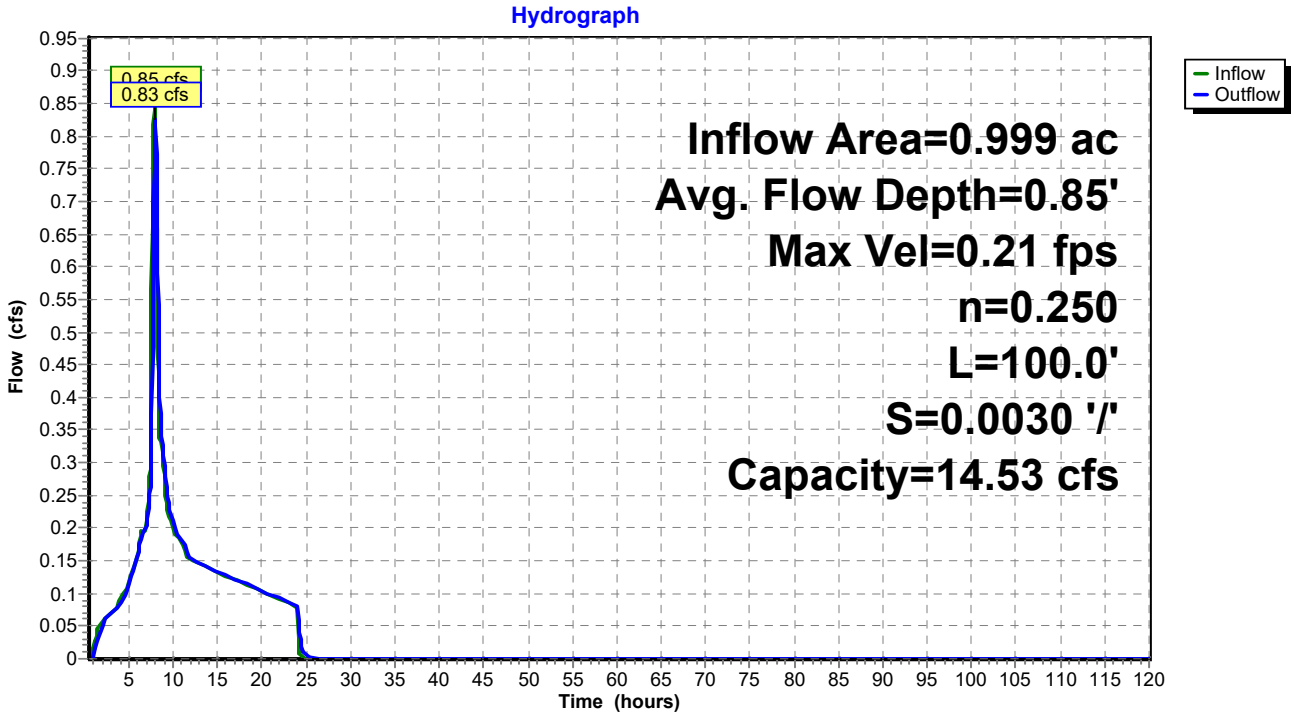
Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.21 fps, Min. Travel Time= 7.9 min
Avg. Velocity = 0.10 fps, Avg. Travel Time= 15.9 min

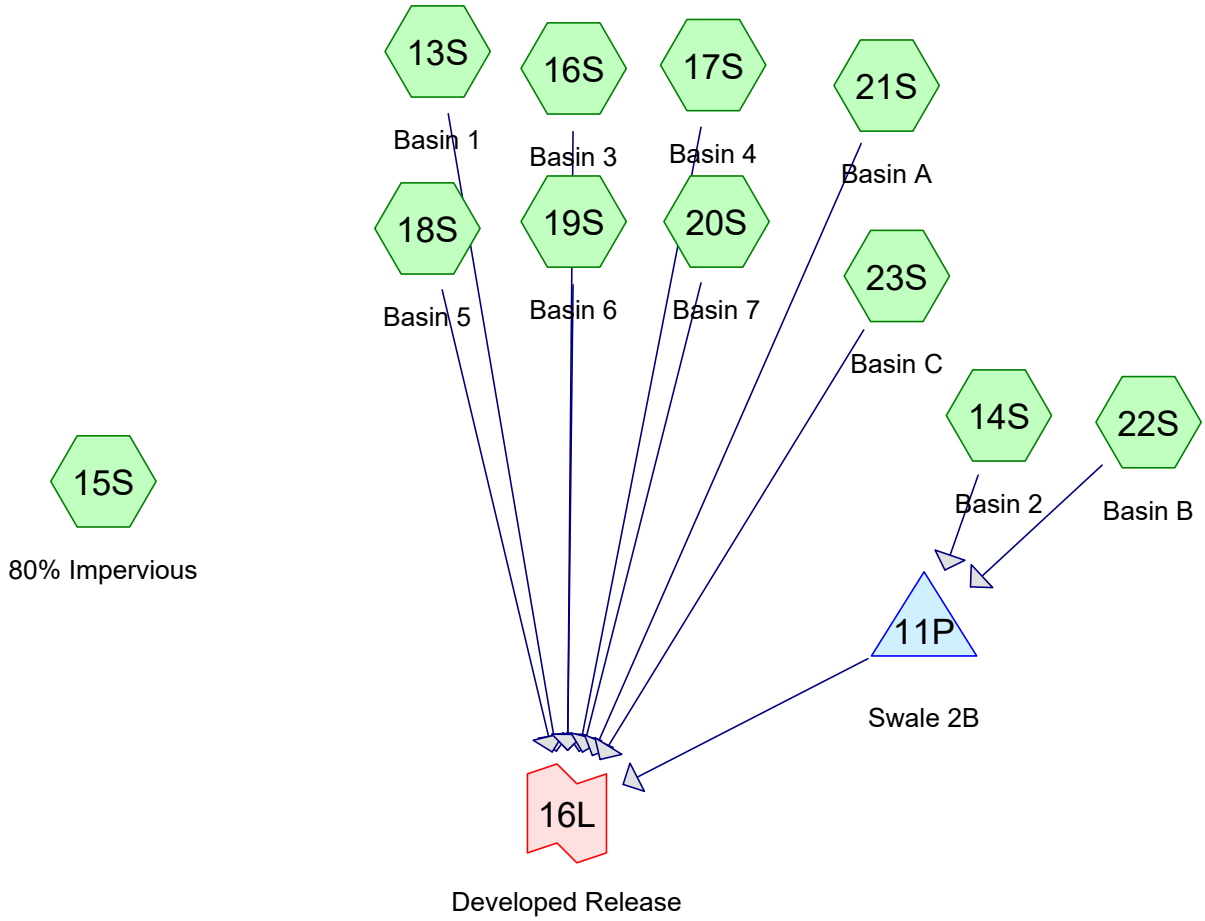
Peak Storage= 389 cf @ 8.00 hrs
Average Depth at Peak Storage= 0.85' , Surface Width= 7.12'
Bank-Full Depth= 3.00' Flow Area= 33.0 sf, Capacity= 14.53 cfs

2.00' x 3.00' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 20.00'
Length= 100.0' Slope= 0.0030 '/'
Inlet Invert= 0.00', Outlet Invert= -0.30'



Reach SC: Swale C





Subcat Reach Pond Link

Routing Diagram for Truax
Prepared by Westech Engineering, Inc.

Summary for Subcatchment 15S: 80% Impervious

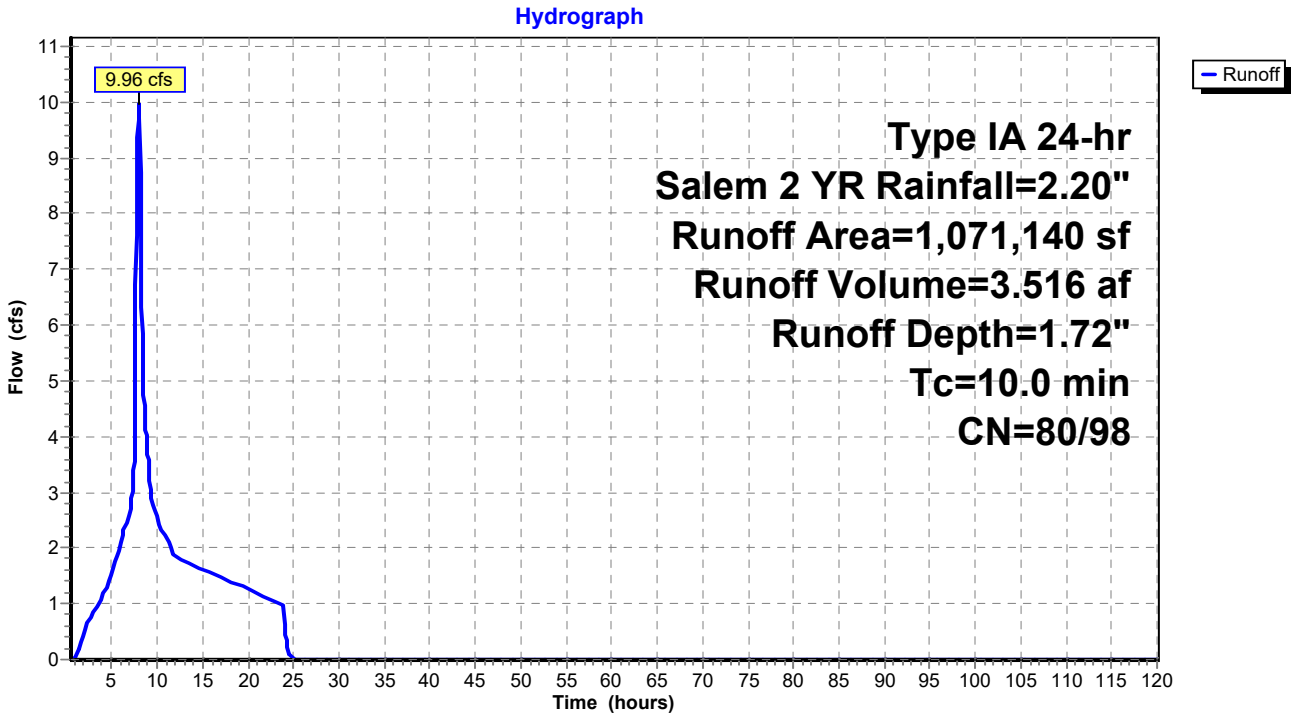
Runoff = 9.96 cfs @ 7.98 hrs, Volume= 3.516 af, Depth= 1.72"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 2 YR Rainfall=2.20"

Area (sf)	CN	Description
856,912	98	Paved parking, HSG D
214,228	80	>75% Grass cover, Good, HSG D
1,071,140	94	Weighted Average
214,228		20.00% Pervious Area
856,912		80.00% Impervious Area

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

Subcatchment 15S: 80% Impervious



Summary for Subcatchment 15S: 80% Impervious

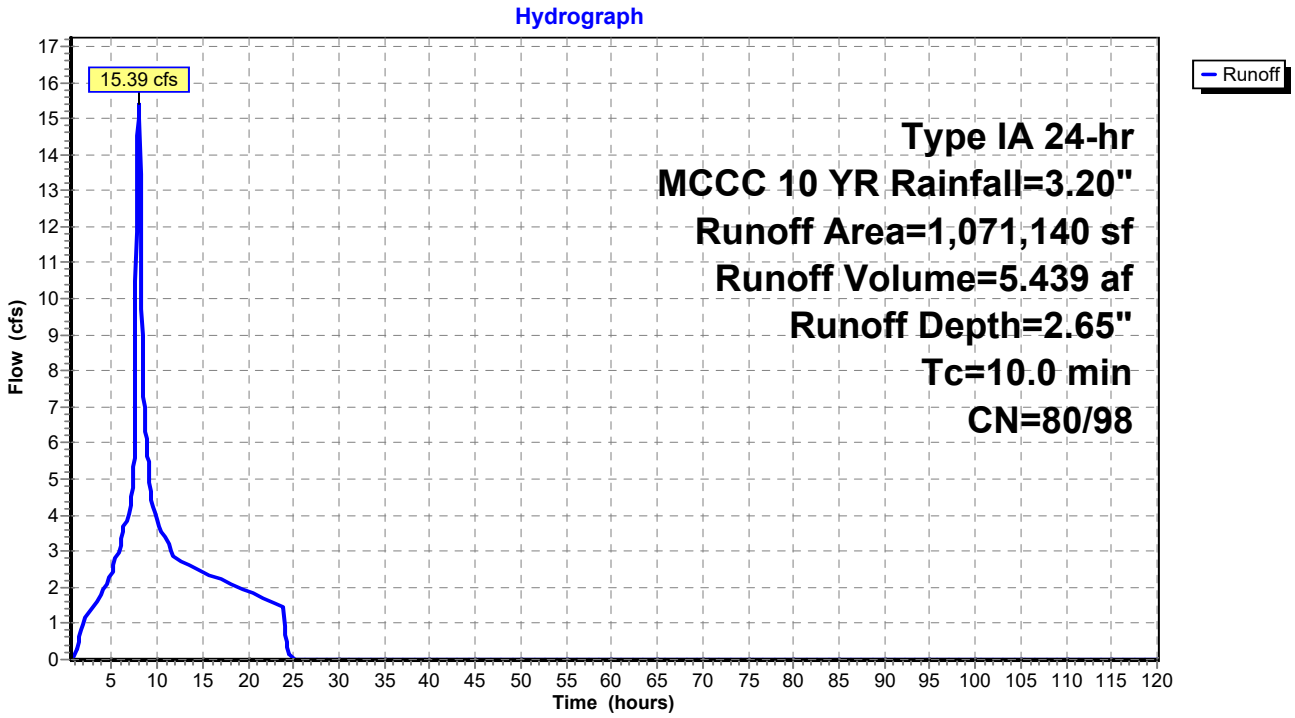
Runoff = 15.39 cfs @ 7.98 hrs, Volume= 5.439 af, Depth= 2.65"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 10 YR Rainfall=3.20"

Area (sf)	CN	Description
856,912	98	Paved parking, HSG D
214,228	80	>75% Grass cover, Good, HSG D
1,071,140	94	Weighted Average
214,228		20.00% Pervious Area
856,912		80.00% Impervious Area

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

Subcatchment 15S: 80% Impervious



Summary for Subcatchment 15S: 80% Impervious

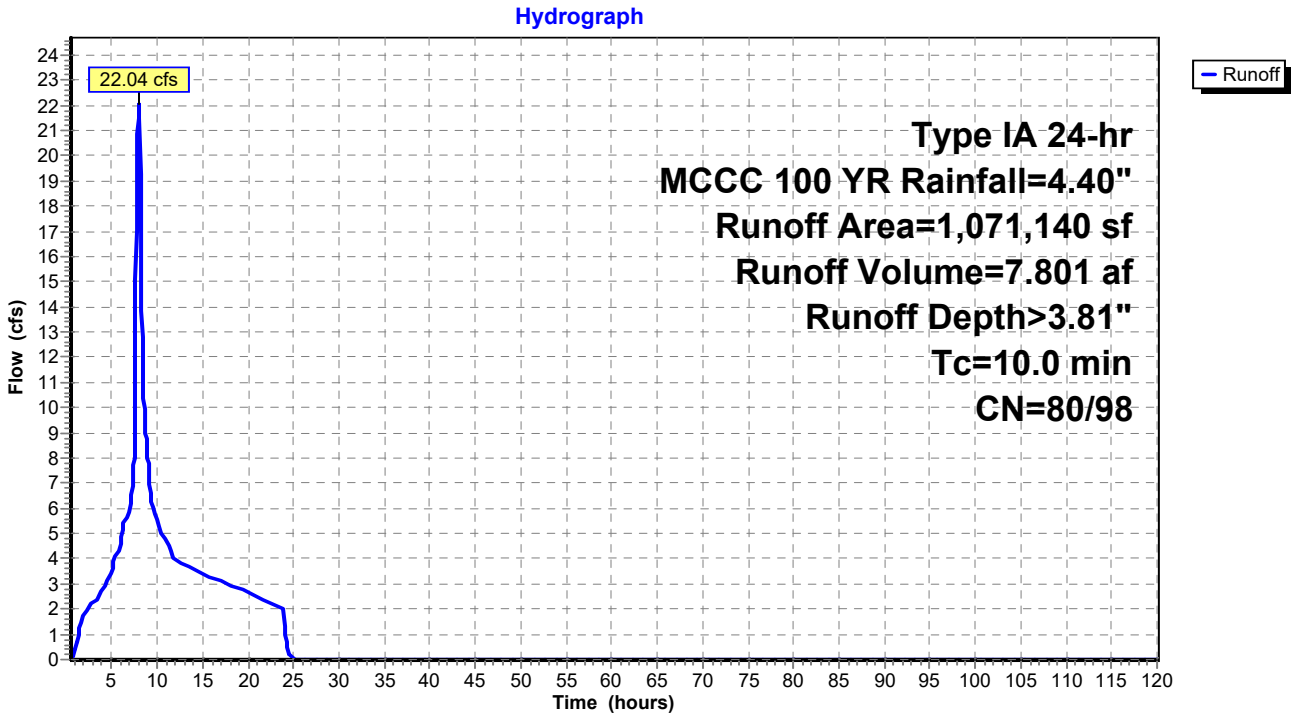
Runoff = 22.04 cfs @ 7.98 hrs, Volume= 7.801 af, Depth> 3.81"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr MCCC 100 YR Rainfall=4.40"

Area (sf)	CN	Description
856,912	98	Paved parking, HSG D
214,228	80	>75% Grass cover, Good, HSG D
1,071,140	94	Weighted Average
214,228		20.00% Pervious Area
856,912		80.00% Impervious Area

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

Subcatchment 15S: 80% Impervious



Summary for Pond 11P: Swale 2B

Inflow Area = 9.176 ac, 81.06% Impervious, Inflow Depth = 1.73" for Salem 2 YR event
Inflow = 3.75 cfs @ 7.98 hrs, Volume= 1.322 af
Outflow = 3.56 cfs @ 8.05 hrs, Volume= 1.322 af, Atten= 5%, Lag= 4.3 min
Primary = 3.56 cfs @ 8.05 hrs, Volume= 1.322 af
Routed to Link 16L : Developed Release

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 228.43' @ 8.05 hrs Surf.Area= 2,648 sf Storage= 1,715 cf

Plug-Flow detention time= 12.5 min calculated for 1.322 af (100% of inflow)
Center-of-Mass det. time= 11.9 min (709.5 - 697.5)

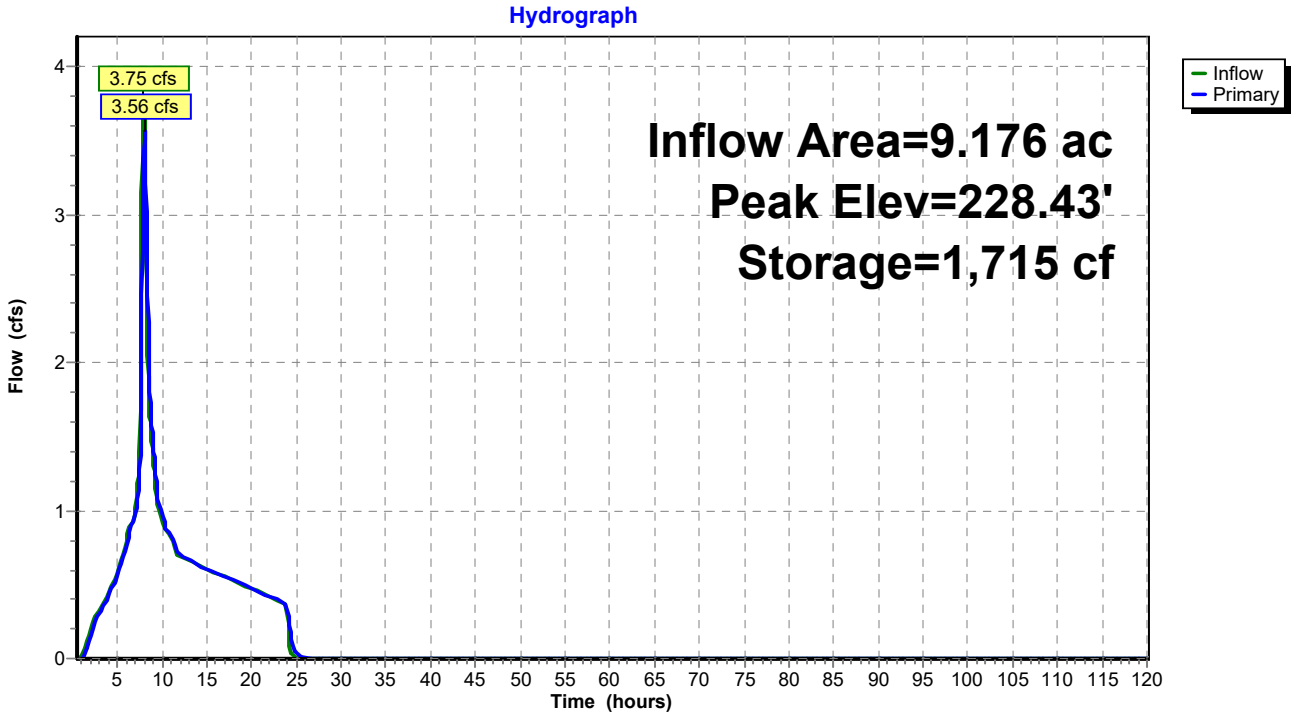
Volume	Invert	Avail.Storage	Storage Description
#1	226.00'	34,516 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
226.00	980	0.0	0	0
227.49	980	0.1	1	1
227.50	980	100.0	10	11
228.00	1,920	100.0	725	736
229.00	3,620	100.0	2,770	3,506
230.00	5,550	100.0	4,585	8,091
231.00	7,620	100.0	6,585	14,676
232.00	9,940	100.0	8,780	23,456
233.00	12,180	100.0	11,060	34,516

Device	Routing	Invert	Outlet Devices
#1	Primary	227.50'	**16.8" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	228.40'	**20.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	228.75'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=3.56 cfs @ 8.05 hrs HW=228.43' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 3.55 cfs @ 3.28 fps)
- **2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.57 fps)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 11P: Swale 2B



Summary for Pond 11P: Swale 2B

Inflow Area = 9.176 ac, 81.06% Impervious, Inflow Depth = 2.67" for MCCC 10 YR event
Inflow = 5.78 cfs @ 7.98 hrs, Volume= 2.042 af
Outflow = 5.56 cfs @ 8.04 hrs, Volume= 2.042 af, Atten= 4%, Lag= 3.7 min
Primary = 5.56 cfs @ 8.04 hrs, Volume= 2.042 af
Routed to Link 16L : Developed Release

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 228.68' @ 8.04 hrs Surf.Area= 3,076 sf Storage= 2,434 cf

Plug-Flow detention time= 10.5 min calculated for 2.041 af (100% of inflow)
Center-of-Mass det. time= 10.4 min (697.3 - 686.9)

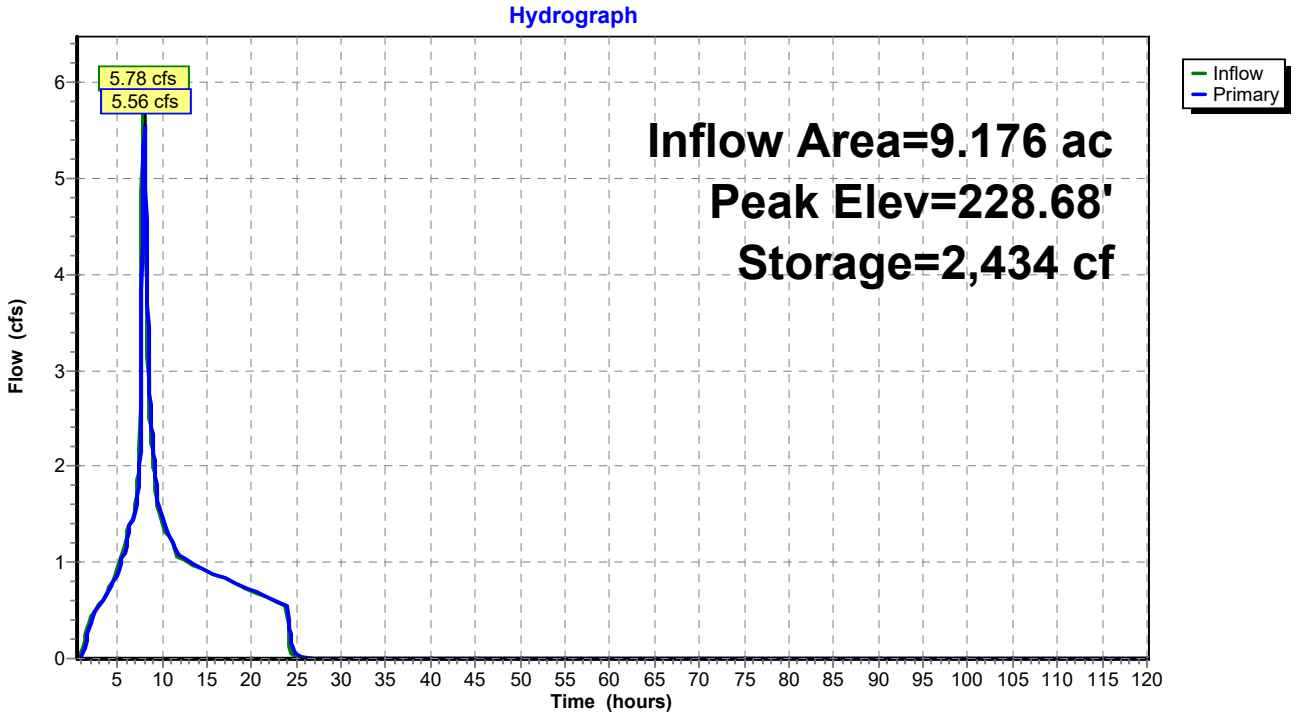
Volume	Invert	Avail.Storage	Storage Description
#1	226.00'	34,516 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
226.00	980	0.0	0	0
227.49	980	0.1	1	1
227.50	980	100.0	10	11
228.00	1,920	100.0	725	736
229.00	3,620	100.0	2,770	3,506
230.00	5,550	100.0	4,585	8,091
231.00	7,620	100.0	6,585	14,676
232.00	9,940	100.0	8,780	23,456
233.00	12,180	100.0	11,060	34,516

Device	Routing	Invert	Outlet Devices
#1	Primary	227.50'	**16.8" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	228.40'	**20.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	228.75'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=5.54 cfs @ 8.04 hrs HW=228.68' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 5.11 cfs @ 3.70 fps)
- **2=Orifice/Grate** (Orifice Controls 0.43 cfs @ 1.80 fps)
- **3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 11P: Swale 2B



Summary for Pond 11P: Swale 2B

Inflow Area = 9.176 ac, 81.06% Impervious, Inflow Depth > 3.83" for MCCC 100 YR event
Inflow = 8.27 cfs @ 7.98 hrs, Volume= 2.925 af
Outflow = 8.03 cfs @ 8.03 hrs, Volume= 2.925 af, Atten= 3%, Lag= 3.2 min
Primary = 8.03 cfs @ 8.03 hrs, Volume= 2.925 af
Routed to Link 16L : Developed Release

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 228.91' @ 8.03 hrs Surf.Area= 3,471 sf Storage= 3,195 cf

Plug-Flow detention time= 9.5 min calculated for 2.924 af (100% of inflow)
Center-of-Mass det. time= 9.5 min (688.4 - 679.0)

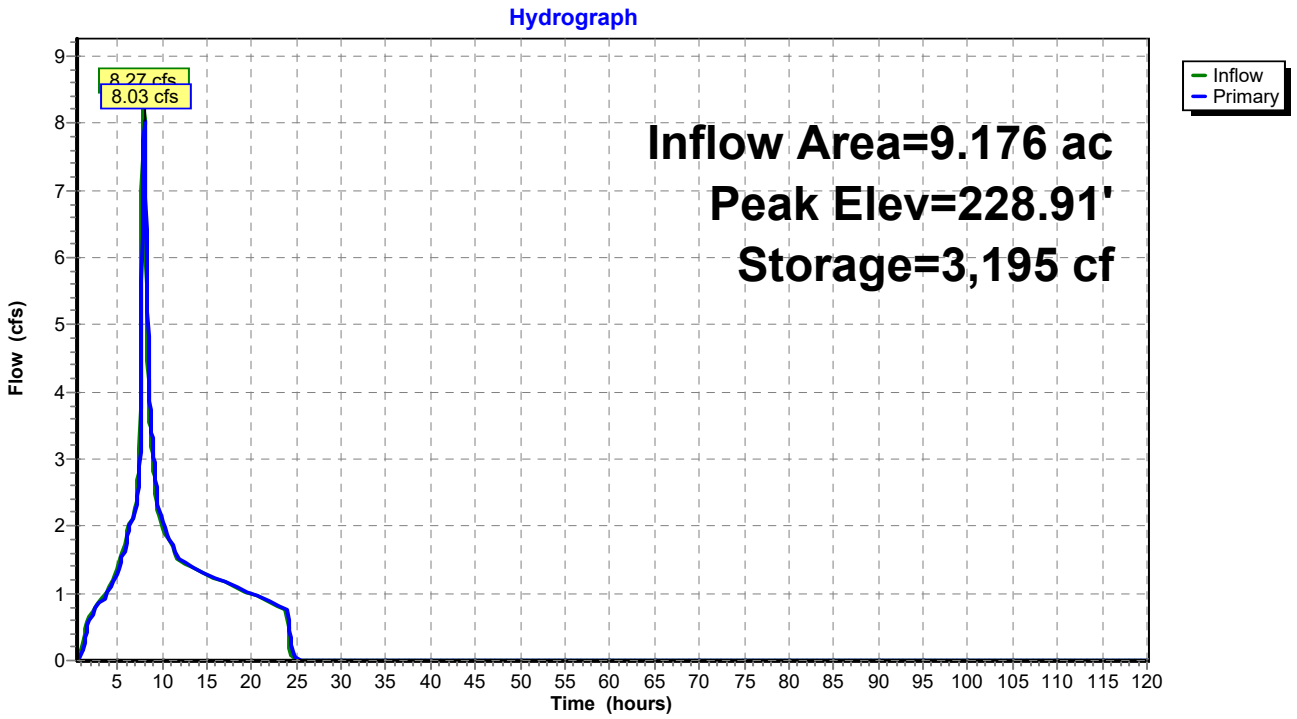
Volume	Invert	Avail.Storage	Storage Description
#1	226.00'	34,516 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
226.00	980	0.0	0	0
227.49	980	0.1	1	1
227.50	980	100.0	10	11
228.00	1,920	100.0	725	736
229.00	3,620	100.0	2,770	3,506
230.00	5,550	100.0	4,585	8,091
231.00	7,620	100.0	6,585	14,676
232.00	9,940	100.0	8,780	23,456
233.00	12,180	100.0	11,060	34,516

Device	Routing	Invert	Outlet Devices
#1	Primary	227.50'	**16.8" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#2	Primary	228.40'	**20.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	228.75'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=7.98 cfs @ 8.03 hrs HW=228.91' (Free Discharge)
- **1=Orifice/Grate** (Orifice Controls 6.24 cfs @ 4.06 fps)
- **2=Orifice/Grate** (Orifice Controls 1.37 cfs @ 2.43 fps)
- **3=Broad-Crested Rectangular Weir** (Weir Controls 0.36 cfs @ 1.12 fps)

Pond 11P: Swale 2B

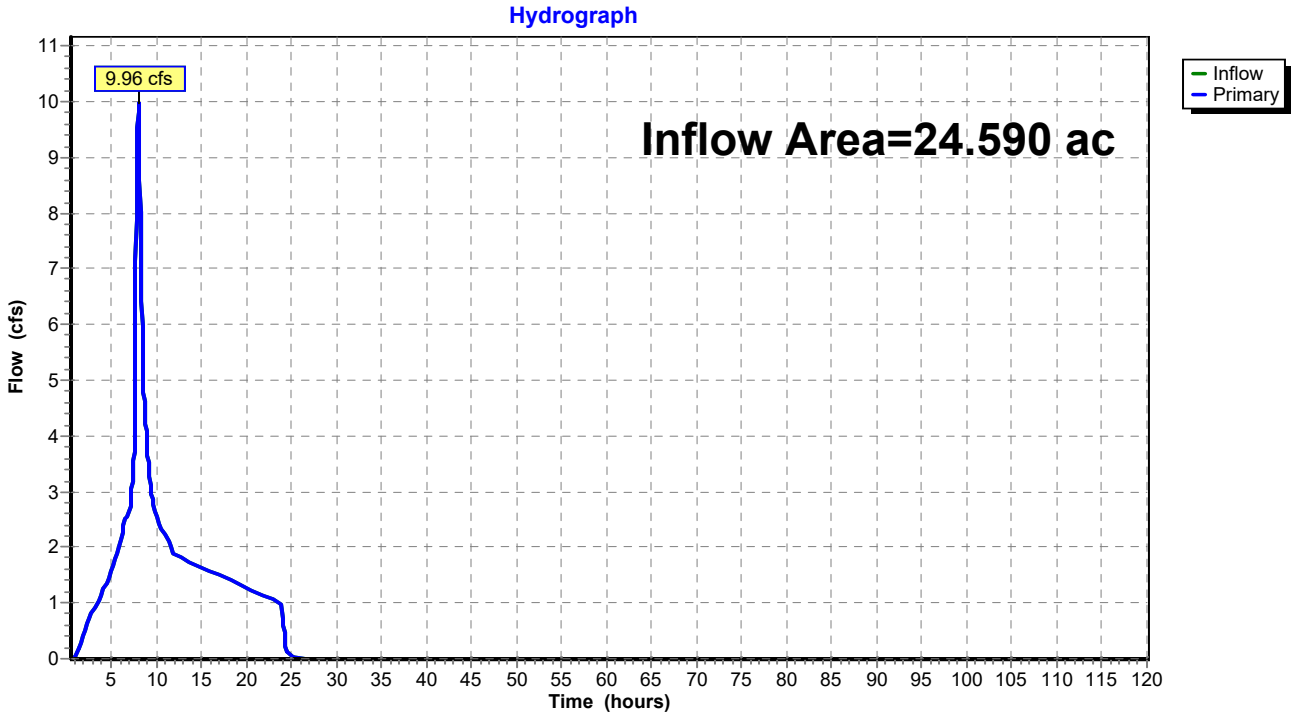


Summary for Link 16L: Developed Release

Inflow Area = 24.590 ac, 83.00% Impervious, Inflow Depth = 1.75" for Salem 2 YR event
Inflow = 9.96 cfs @ 8.00 hrs, Volume= 3.595 af
Primary = 9.96 cfs @ 8.00 hrs, Volume= 3.595 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs

Link 16L: Developed Release

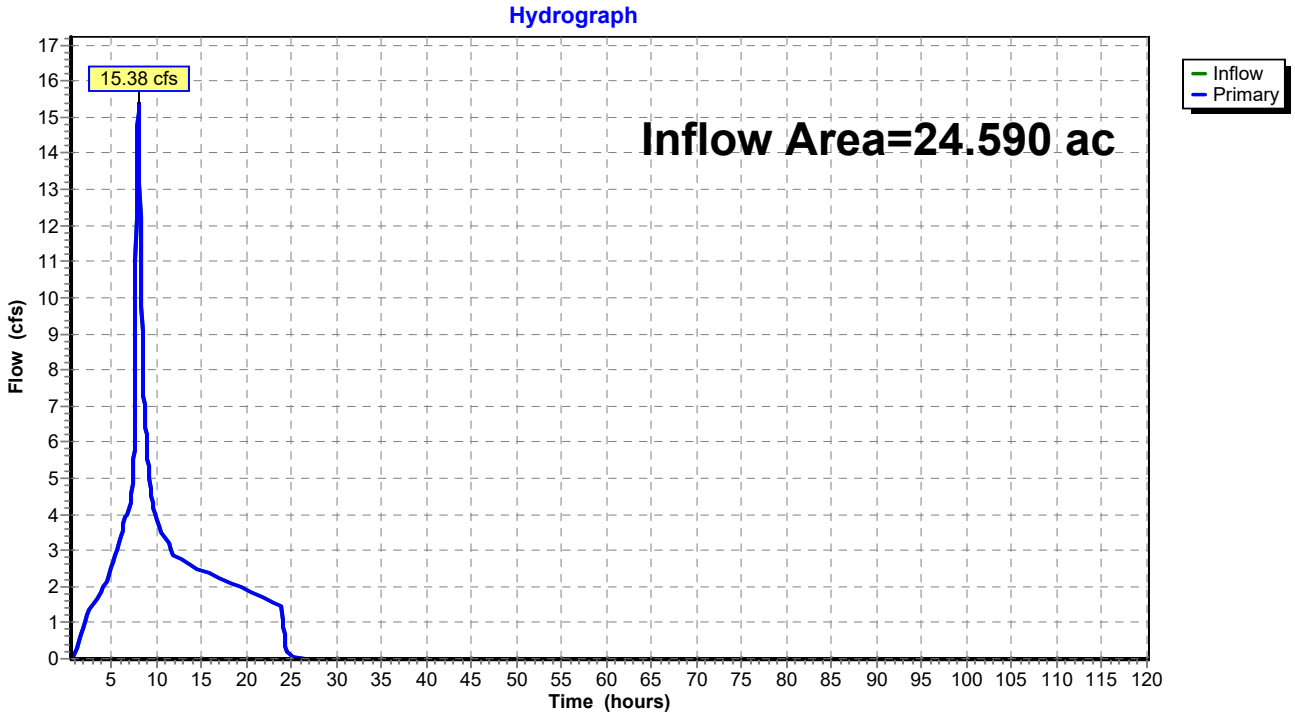


Summary for Link 16L: Developed Release

Inflow Area = 24.590 ac, 83.00% Impervious, Inflow Depth = 2.70" for MCCC 10 YR event
Inflow = 15.38 cfs @ 7.99 hrs, Volume= 5.535 af
Primary = 15.38 cfs @ 7.99 hrs, Volume= 5.535 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs

Link 16L: Developed Release

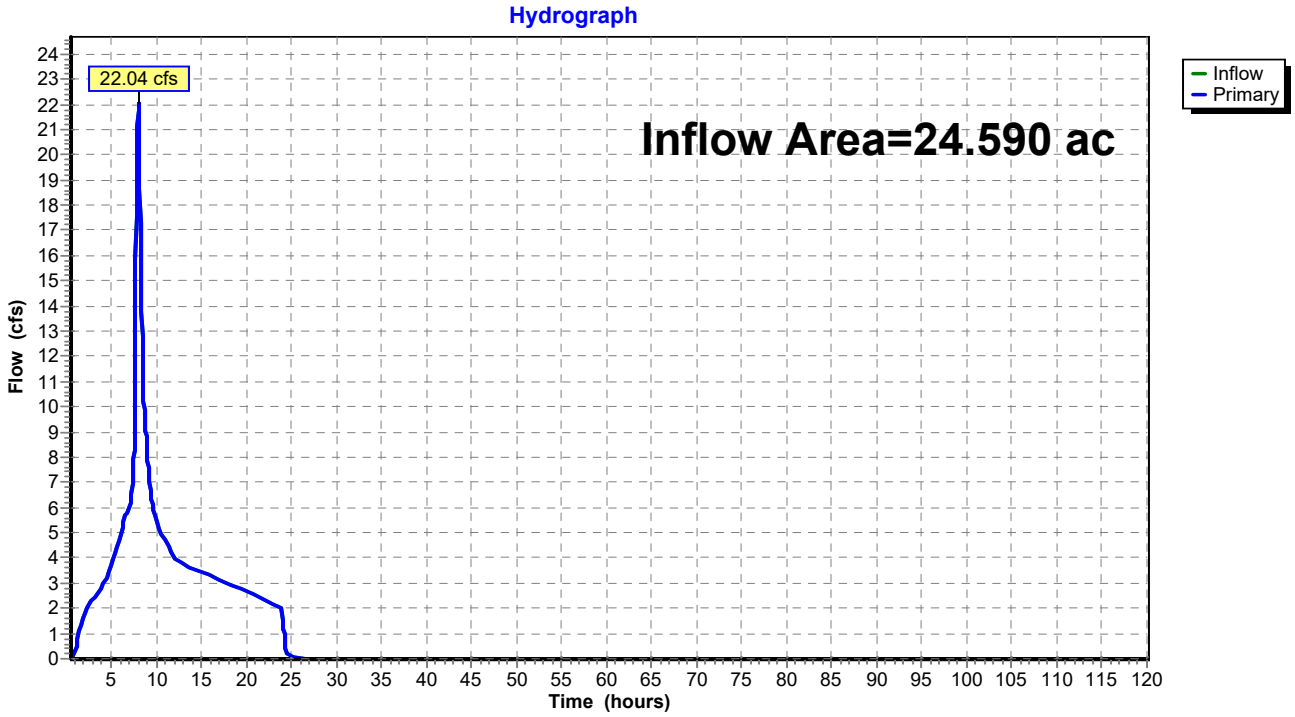


Summary for Link 16L: Developed Release

Inflow Area = 24.590 ac, 83.00% Impervious, Inflow Depth > 3.86" for MCCC 100 YR event
Inflow = 22.04 cfs @ 7.99 hrs, Volume= 7.910 af
Primary = 22.04 cfs @ 7.99 hrs, Volume= 7.910 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs

Link 16L: Developed Release



STORMWATER MANAGEMENT MAP

WQ Sizing									
ID #	Length	Bottom Width (ft)	Slope (%)	Res. Time (min	Max WQ Vel. (fps)	WQ Flow Depth (ft)	100 YR Flow Depth (ft)	WQ Q (cfs)	100 YR Q (cfs)
1	8' x 16' vault			12" + 18" Cartridges		24 Cartridges		1.48	9.9
2	150	3	0.3	13.9	0.18	0.55	1.53	0.48	3.5
3	100	2	0.3	13.9	0.12	0.29	0.86	0.1	0.82
4	100	2	0.3	18.5	0.09	0.17	0.55	0.04	0.34
5	100	2	0.3	13.9	0.12	0.28	0.85	0.1	0.81
6	100	2	0.3	18.5	0.09	0.17	0.52	0.04	0.3
7	100	2	0.3	15.2	0.11	0.26	0.79	0.08	0.68
A	100	2	0.3	16.7	0.1	0.2	0.64	0.06	0.45
B	200	2	0.3	16.7	0.2	0.74	1.88	0.67	4.77
C	100	2	0.3	15.2	0.11	0.28	0.85	0.09	0.81
2B*	250	5	0.3	19.8	0.21	0.69	1.99	1.13	7.98

*Combined Swale for basins 2 and B

Basin Treatment Method and Release Rate				
Basin	Treatment	WQ ID#	WQ Q (cfs)	100 YR Q (cfs)
1	PerkFilter Vault	1	1.48	9.9
2	Swale	2	0.48	3.5
3	Swale	3	0.1	0.82
4	Swale	4	0.04	0.34
5	Swale	5	0.1	0.81
6	Swale	6	0.04	0.3
7	Swale	7	0.8	0.68
A	Swale	A	0.06	0.45
B	Swale	B	0.67	4.77
C	Swale	C	0.09	0.81

PROJECT NORTH

TRUE NORTH

0 30 60 120
(feet)

Total Area = 35,800 SF
Impervious = 23,400 SF
Pervious = 12,400 SF

Q (cfs):
WQ = 0.08
100 YR = 0.68

Total Area = 15,100 SF
Impervious = 11,100 SF
Pervious = 4,000 SF

Q (cfs):
WQ = 0.04
100 YR = 0.30

Total Area = 42,000 SF
Impervious = 28,000 SF
Pervious = 14,000 SF

Q (cfs):
WQ = 0.1
100 YR = 0.81

Q (cfs):
WQ = 0.04
100 YR = 0.34

Total Area = 18,200 SF
Impervious = 11,200 SF
Pervious = 7,000 SF

Total Area = 43,500 SF
Impervious = 26,500 SF
Pervious = 17,000 SF

Q (cfs):
WQ = 0.09
100 YR = 0.81

Total Area = 228,500 SF
Impervious = 189,500 SF
Pervious = 39,000 SF

Q (cfs):
WQ = 0.67
100 YR = 4.77

Total Area = 23,540 SF
Impervious = 15,860 SF
Pervious = 7,680 SF

Q (cfs):
WQ = 0.06
100 YR = 0.45

Total Area = 451,800 SF
Impervious = 419,500 SF
Pervious = 32,300 SF

Q (cfs):
WQ = 1.48
100 YR = 9.90

Total Area = 41,500 SF
Impervious = 29,500 SF
Pervious = 12,000 SF

Q (cfs):
WQ = 0.10
100 YR = 0.82

Total Area = 171,200 SF
Impervious = 134,500 SF
Pervious = 36,700 SF

Q (cfs):
WQ = 0.48
100 YR = 3.50

NEW PROPERTY LINE

PHASE LINE

PHASE LINE &
NEW PROPERTY LINE

BLDG. 223
(BLDG. PAD ONLY)

BLDG. 222

BLDG. 221

BLDG. 221

BY	DESCRIPTION	NO.	DATE
	REVISIONS	1	

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH, ADJUST SCALES ACCORDINGLY

DSN. JW
DRN. TN
CKD. JW
DATE: JAN. 2022

PROFESSIONAL ENGINEER
OREGON
JANUARY 12, 2009
WILLIAM J. WELLS
RENEWS: 6/30/2022

REVIEW

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

PACTRUST – MCCC TRUAX PROPERTY

TRUAX DRIVE ONSITE DEVELOPMENT PLANS

OVERALL STORMWATER MANAGEMENT PLAN

DRAWING
C3.7

JOB NUMBER
3073.0000.0

1/14/2022 1:02:00 PM
C:_Westech\DWG\PacTrust\Truax Drive-Onsite\Civil\Plots\C3.7 OA Stormwater Management Plan.dwg, (C3.7 tab)

APPENDIX II

Water Quality Calculations

OPERATION & MAINTENANCE REQUIREMENTS

Until the monitoring period has ended and the mitigation wetlands in the open space areas are established, the Oregon Department of Administrative Services (DAS), as the 404 permit applicant, will be responsible for maintenance of the open space areas. After establishment, the open space areas will be transferred to the City of Salem. The Salem Parks Department will then become responsible for maintenance of the open space areas. The open space areas provide much of the flow attenuation required for the site.

The City's Public Works Department inspectors will visit MCIP stormwater facilities annually to evaluate their operating condition and request maintenance actions be taken if problems are observed.

The City of Salem Public Works Department also employs maintenance crews to maintain roadways and public conveyance systems located within public right-of-ways.

Stormwater facility types allowed by this MCIP Stormwater Management Plan include; vegetated swales, sand filters, detention ponds for flow control, various pre-treatment technologies, and proprietary devices. Recommended operation and maintenance of the approved facility types are shown in Tables 7.1, 7.2, 7.3, and 7.4.

Operation and maintenance of proprietary stormwater devices shall follow the manufacturer's recommendations.

Responsibility for maintenance of stormwater management facilities throughout the MCIP is defined in the "Stormwater Management Agreement".

Table 7.1 Recommended Operations and Maintenance for Vegetated Swales

Vegetated Swales are planted open channels that trap pollutants by filtering and slowing flows, allowing particles to settle out. All facility components, vegetation, and source controls shall be inspected for proper operations and structural stability, at a minimum, quarterly for the first 2 years from the date of installation, 2 times per year thereafter, and within 72 hours after each major flood event. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

Swale Inlet (such as curb cuts or pipes) shall maintain a calm flow of water entering the swale.

- Source of erosion shall be identified and controlled when native soil is exposed or erosion channels are forming.
- Sediment accumulation shall be hand-removed with minimum damage to vegetation using proper erosion control measures. Sediment shall be removed if it is more than 4" thick or so thick as to damage or kill vegetation.
- Inlet shall be cleared when conveyance capacity is plugged. Sources of sediment and debris shall be identified and corrected.
- Rock splash pads shall be replenished to prevent erosion.

Side Slopes shall be maintained to prevent erosion that introduces sediment into the swale.

- Slopes shall be stabilized and planted using appropriate erosion control measures when native soil is exposed or erosion channels are forming.

Swale Media shall allow stormwater to percolate uniformly through the landscape swale.

- Debris in quantities that inhibit operation shall be removed upon discovery.

Swale Outlet shall maintain sheet flow of water exiting swale unless a collection drain is used. Source of erosion damage shall be identified and controlled when native soil is exposed or erosion channels are forming.

- Outlets such as drains and overland flow paths shall be cleared when 50% of the conveyance capacity is plugged.
- Sources of sediment and debris shall be identified and corrected.

Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion. Mulch shall be replenished as needed to ensure survival of vegetation.

- Vegetation, large shrubs or trees that interfere with landscape swale operation shall be pruned or removed.
- Fallen leaves and debris from deciduous plant foliage shall be removed if necessary.
- Nuisance and prohibited vegetation from the Pre-Approved Plant List (such as blackberries and English Ivy) shall be removed when discovered. Invasive vegetation contributing up to 25% of vegetation of all species shall be removed and replaced.
- Dead vegetation and woody material shall be removed to maintain less than 10% of area coverage or when swale function is impaired. Vegetation shall be replaced within 3 months, or immediately if required to maintain cover density and control erosion where soils are exposed.

Spill Prevention measures shall be exercised when handling substances that contaminate stormwater. Releases of pollutants shall be corrected as soon as identified.

Training and/or written guidance information for operating and maintaining swales shall be provided to all property owners and tenants within the Mill Creek Industrial Park. A copy of the O&M Plan shall be provided to all property owners and tenants.

Access to the swale shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable.

- Obstacles preventing maintenance personnel and/or equipment access to the swale shall be removed.
- Gravel or ground cover shall be added if erosion occurs, e.g., due to vehicular or pedestrian traffic.

Insects & Rodents shall not be harbored in the sand filter. Pest control measures shall be taken when insects/rodents are found to be present.

- If sprays are considered, then a mosquito larvicide, such as Bacillus thurendensis can be applied only if absolutely necessary, and only by a licensed individual or contractor.
- Holes in the ground located in and around the sand filter shall be filled.

Check Dams shall control and distribute flow.

- Causes for altered water flow shall be identified, and obstructions cleared upon discovery.
- Causes for channelization shall be identified and repaired.

Oldcastle Infrastructure™
A CRH COMPANY

PERKFILTER™

Inspection and Maintenance Guide

Water

PerkFilter™ Media Filtration System

Description

The PerkFilter is a stormwater treatment device used to remove pollutants from urban runoff. Impervious surfaces and other urban and suburban landscapes generate a variety of contaminants that can enter stormwater and pollute downstream receiving waters. The PerkFilter is a media-filled cartridge filtration device designed to capture and retain sediment, gross solids, metals, nutrients, hydrocarbons, and trash and debris. As with any stormwater treatment system, the PerkFilter requires periodic maintenance to sustain optimum system performance.

Function

The PerkFilter is a water quality treatment system consisting of three chambers: an inlet chamber, a filter cartridge treatment chamber, and an outlet chamber (Figure 1). Stormwater runoff enters the inlet chamber through an inlet pipe, curb opening, or grated inlet. Gross solids are settled out, and floating trash and debris are trapped in the inlet chamber. Pretreated flow is then directed to the treatment chamber through an opening in the baffle wall between the inlet chamber and treatment chamber. The treatment chamber contains media-filled filter cartridges (Figure 2) that use physical and chemical processes to remove pollutants. During a storm event, runoff pools in the treatment chamber before passing radially through the cylindrical cartridges from the outside surface, through the media for treatment, and into the center of the cartridge. At the center of the cartridge is a center tube assembly designed to distribute the hydraulic load evenly across the surface of the filter cartridge and control the treatment flow rate. The center tube assembly discharges treated flow through the false floor and into the outlet chamber. A draindown feature built into each cartridge allows the treatment chamber to dewater between storm events.

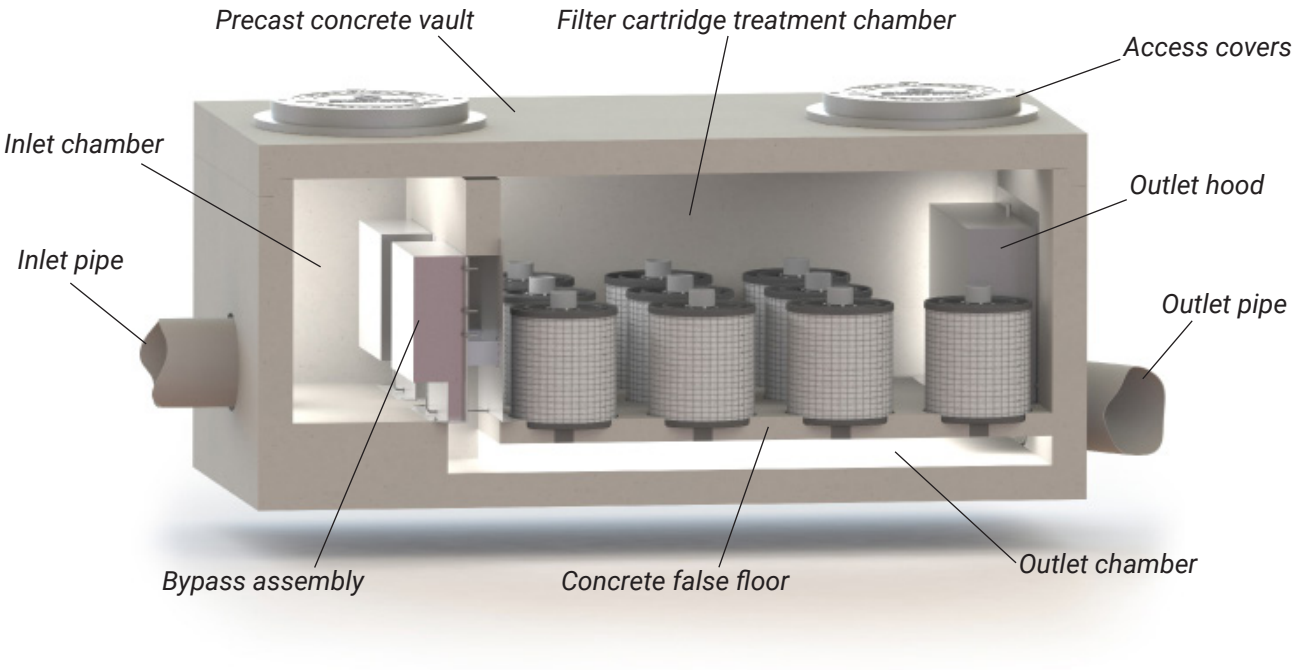


Figure 1. Schematic of the PerkFilter system.

All PerkFilter systems include a high-flow bypass assembly to divert flow exceeding the treatment capacity of the filter cartridges around the treatment chamber. The bypass assembly routes peak flow from the inlet chamber directly to the outlet chamber, bypassing the treatment chamber to prevent sediment and other captured pollutants from being scoured and re-entrained by high flow. Treated flow and bypass flow merge in the outlet chamber for discharge by a single outlet pipe.

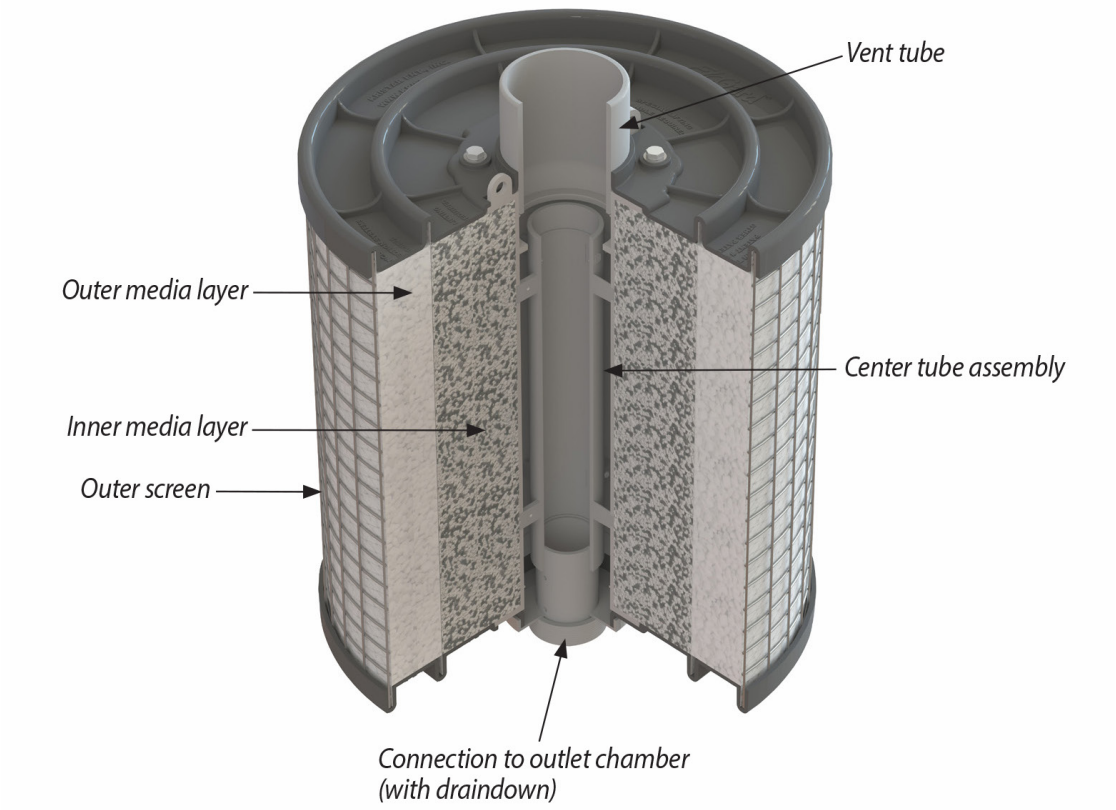


Figure 2. Schematic of PerkFilter cartridge.

Configuration

The PerkFilter structure may consist of a vault, manhole, or catch basin configuration. Catch basin units may be fabricated from concrete or steel. Internal components including the PerkFilter cartridges are manufactured from durable plastic and stainless steel components and hardware. All cartridges are 18 inches in diameter and are available in two heights: 12-inch and 18-inch. Cartridges may be used alone or may be stacked (Figure 3) to provide 24-inch and 30-inch combinations. The capacity of each cartridge or cartridge combination is dictated by the allowable operating rate of the media and the outer surface area of the cartridge. Thus, taller cartridges have greater treatment capacity than shorter cartridges, but they also require more hydraulic drop across the system. Cartridges may be filled with a wide variety of media but the standard mix is composed of zeolite, perlite and carbon (ZPC).

Access to an installed PerkFilter system is typically provided by ductile iron castings or hatch covers. The location and number of access appurtenances is dependent on the size and configuration of the system.

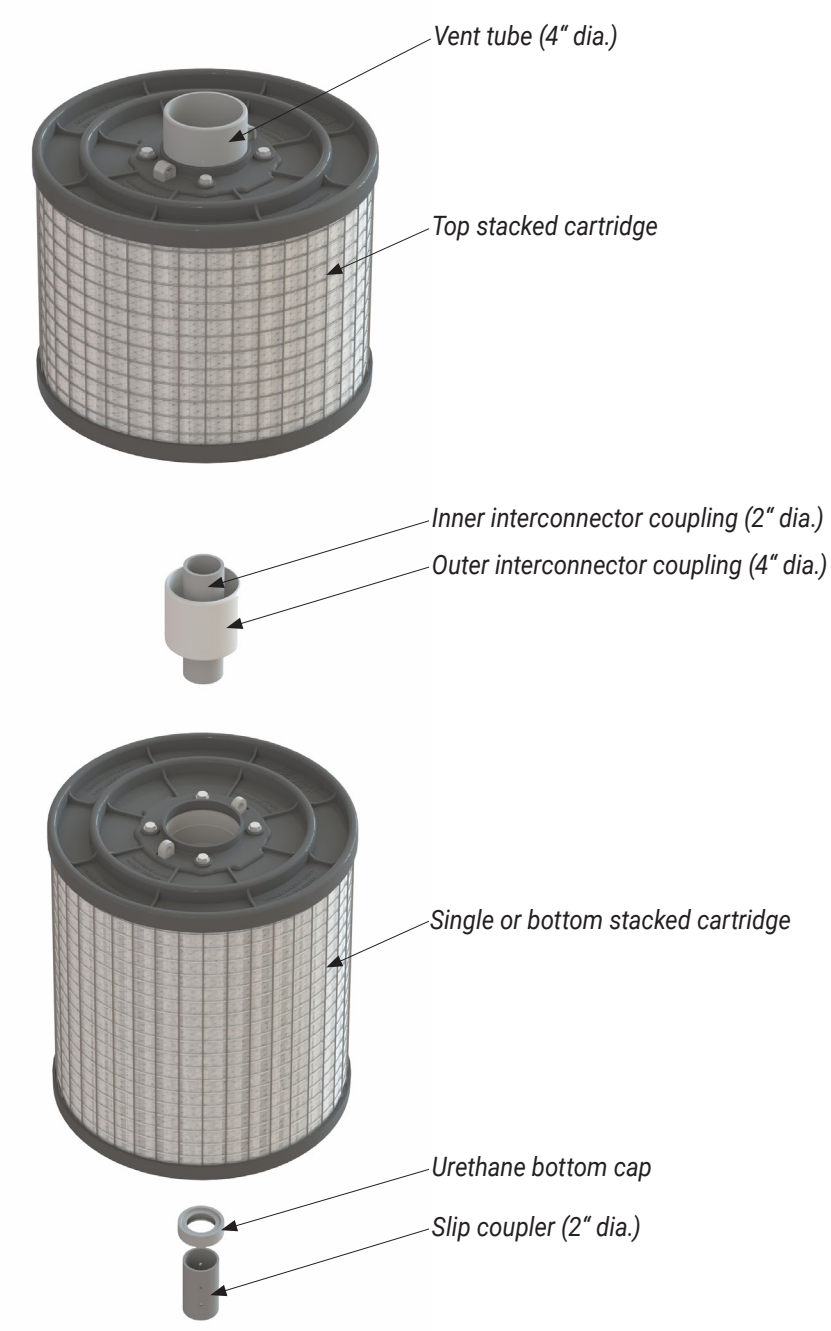


Figure 3. Schematic of stacked cartridges and connector components.

Maintenance Overview

State and local regulations require all stormwater management systems to be inspected on a periodic basis and maintained as necessary to ensure performance and protect downstream receiving waters. Maintenance prevents excessive pollutant buildup that can limit system performance by reducing the operating capacity and increasing the potential for scouring of pollutants during periods of high flow.

Inspection and Maintenance Frequency

The PerkFilter should be inspected on a periodic basis, typically twice per year, and maintained as required. Initially, inspections of a new system should be conducted more frequently to help establish an appropriate site-specific inspection frequency. The maintenance frequency will be driven by the amount of runoff and pollutant loading encountered by a given system. In most cases, the optimum maintenance interval will be one to three years. Inspection and maintenance activities should be performed only during dry weather periods.

Inspection Equipment

The following equipment is helpful when conducting PerkFilter inspections:

- Recording device (pen and paper form, voice recorder, iPad, etc.)
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Socket and wrench for bolt-down access covers
- Manhole hook or pry bar
- Flashlight
- Tape measure
- Measuring stick or sludge sampler
- Long-handled net (optional)

Inspection Procedures

PerkFilter inspections are visual and may be conducted from the ground surface without entering the unit. To complete an inspection, safety measures including traffic control should be deployed before the access covers are removed. Once the covers have been removed, the following items should be checked and recorded (see form provided at the end of this document) to determine whether maintenance is required:

- Inspect the internal components and note whether there are any broken or missing parts. In the unlikely event that internal parts are broken or missing, contact Oldcastle Infrastructure at (800) 579-8819 to determine appropriate corrective action.
- Note whether the inlet pipe is blocked or obstructed. The outlet pipe is covered by a removable outlet hood and cannot be observed without entering the unit.
- Observe, quantify and record the accumulation of floating trash and debris in the inlet chamber. The significance of accumulated floating trash and debris is a matter of judgment. A long-handled net may be used to retrieve the bulk of trash and debris at the time of inspection if full maintenance due to accumulation of floating oils or settled sediment is not yet warranted.

- Observe, quantify and record the accumulation of oils in the inlet chamber. The significance of accumulated floating oils is a matter of judgment. However, if there is evidence of an oil or fuel spill, immediate maintenance by appropriate certified personnel is warranted.
- Observe, quantify and record the average accumulation of sediment in the inlet chamber and treatment chamber. A calibrated dipstick, tape measure, or sludge sampler may be used to determine the amount of accumulated sediment in each chamber. The depth of sediment may be determined by calculating the difference between the measurement from the rim of the PerkFilter to the top of the accumulated sediment, and the measurement from the rim of the PerkFilter to the bottom of the PerkFilter structure. Finding the top of the accumulated sediment below standing water takes some practice and a light touch, but increased resistance as the measuring device is lowered toward the bottom of the unit indicates the top of the accumulated sediment.
- Finally, observe, quantify and record the amount of standing water in the treatment chamber around the cartridges. If standing water is present, do not include the depth of sediment that may have settled out below the standing water in the measurement.

Maintenance Triggers

Maintenance should be scheduled if any of the following conditions are identified during the inspection:

- Internal components are broken or missing.
- Inlet piping is obstructed.
- The accumulation of floating trash and debris that cannot be retrieved with a net and/or oil in the inlet chamber is significant.
- There is more than 6” of accumulated sediment in the inlet chamber.
- There is more than 4” of accumulated sediment in the treatment chamber.
- There is more than 4” of standing water in the treatment chamber more than 24 hours after end of rain event.
- A hazardous material release (e.g. automotive fluids) is observed or reported.
- The system has not been maintained for 3 years (wet climates) to 5 years (dry climates).

Maintenance Equipment

The following equipment is helpful when conducting PerkFilter maintenance:

- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Socket and wrench for bolt-down access covers
- Manhole hook or pry bar
- Confined space entry equipment, if needed
- Flashlight
- Tape measure
- 9/16” socket and wrench to remove hold-down struts and filter cartridge tops
- Replacement filter cartridges
- Vacuum truck with water supply and water jet

Contact Oldcastle Infrastructure at (800) 579-8819 for replacement filter cartridges. A lead time of four weeks is recommended.

Maintenance Procedures

Maintenance should be conducted during dry weather when no flow is entering the system. Confined space entry is necessary to maintain vault and manhole PerkFilter configurations. Only personnel that are OSHA Confined Space Entry trained and certified may enter underground structures. Confined space entry is not required for catch basin PerkFilter configurations. Once safety measures such as traffic control are deployed, the access covers may be removed and the following activities may be conducted to complete maintenance:

- Remove floating trash, debris and oils from the water surface in the inlet chamber using the extension nozzle on the end of the boom hose of the vacuum truck. Continue using the vacuum truck to completely dewater the inlet chamber and evacuate all accumulated sediment from the inlet chamber. Some jetting may be required to fully remove sediment. The inlet chamber does not need to be refilled with water after maintenance is complete. The system will fill with water when the next storm event occurs.
- Remove the hold-down strut from each row of filter cartridges and then remove the top of each cartridge (the top is held on by four 9/16" bolts) and use the vacuum truck to evacuate the spent media. When empty, the spent cartridges may be easily lifted off their slip couplers and removed from the vault. The couplers may be left inserted into couplings cast into the false floor to prevent sediment and debris from being washed into the outlet chamber during washdown.
- Once all the spent cartridges have been removed from the structure, the vacuum truck may be used to evacuate all accumulated sediment from the treatment chamber. Some jetting may be required to fully remove sediment. Take care not to wash sediment and debris through the openings in the false floor and into the outlet chamber. All material removed from the PerkFilter during maintenance including the spent media must be disposed of in accordance with local, state, and/or federal regulations. In most cases, the material may be handled in the same manner as disposal of material removed from sumped catch basins or manholes.
- Place a fresh cartridge in each cartridge position using the existing slip couplers and urethane bottom caps. If the vault is equipped with stacked cartridges, the existing outer and inner interconnector couplers must be used between the stacked cartridges to provide hydraulic connection. Transfer the existing vent tubes from the spent cartridges to the fresh cartridges. Finally, refit the struts to hold the fresh cartridges in place.
- Securely replace access covers, as appropriate.
- Make arrangements to return the empty spent cartridges to Oldcastle Infrastructure.

PerkFilter
Inspection and Maintenance Log

Location_____

Structure Configuration and Size:

Inspection Date_____

☐ Vault _____feet x _____feet
☐ Manhole _____feet diameter
☐ Catch Basin _____feet x _____feet

Number and Height of Cartridge Stacks:

Count____each ☐12" ☐ 18" ☐ 24" ☐ 30"

Media Type:

☐ ZPC ☐ Perlite ☐ Other_____

Condition of Internal Components ☐ Good ☐ Damaged ☐ Missing	Notes:
Inlet or Outlet Blockage or Obstruction ☐ Yes ☐ No	Notes:
Floating Trash and Debris ☐ Significant ☐ Not Significant	Notes:
Floating Oils ☐ Significant ☐ Not Significant ☐ Spill	Notes:
Sediment Depth in Inlet Chamber ☐ Inches of Sediment:_____	Notes:
Sediment Depth in Treatment Chamber ☐ Inches of Sediment:_____	Notes:
Standing Water in Treatment Chamber ☐ Inches of Standing Water:_____	Notes:

Maintenance Required

☐ **Yes - Schedule Maintenance** ☐ **No - Inspect Again in _____ Months**

PERKFILTER™

OUR MARKETS

BUILDING STRUCTURES

COMMUNICATIONS

WATER

ENERGY

TRANSPORTATION