STORMWATER MANAGEMENT PLAN

MANDEL DEVELOPMENT

City of Waukesha, Waukesha County, Wisconsin

PEG Project Number: 1687.00-WI

September 30, 2020

PINNACLE ENGINEERING GROUP
15850 W. Bluemound Road | Suite 210 | Brookfield, WI 53005
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INTRODUCTION

The proposed project is a high end multifamily development located on the east side of St. PAUl Avenue. The site is approximately 1.8 acres in size. A location map illustrates the tract of land included in **Appendix 1**. The site will trigger DNR and City stormwater regulations. Pinnacle Engineering has completed plan to meet these requirements.

DESIGN CRITERIA

City of Waukesha:.....Stormwater Submittal Standards

Wisconsin Department of Natural Resources: ..... NR 216 & NR 151

Water Quantity: *City of Waukesha Stormwater Submittal Standards, Retention/Detention Requirements* – Peak Discharge. To minimize downstream bank erosion and the failure of downstream conveyance systems, the calculated post-development peak storm water discharge rate shall not exceed the calculated pre-development discharge rates for the 1-year, 2-year, 10-year, and 100-year, 24-hour design storms.

Water Quality: *WDNR NR 151.122* – While the site was part of a railyard in the past, there has been no recent development and much of the site was still pervious. Therefore, this site will be considered new development instead of re-development. A 80% reduction of total suspended solids from parking areas and roads.

Infiltration: *WDNR NR 151.124* – BMPs shall be designed, installed, and maintained to infiltrate runoff in accordance with the following or to the maximum extent practicable.

Protective Areas: *WDNR NR 151.125* – Protective areas shall be provided from hard surfaces draining directly to wetlands.

PRE-DEVELOPMENT CONDITIONS

The existing site was part of a former railyard which has long since been removed. The site slopes generally towards the Fox River thought there are some stockpiles that force some of the water to the storm sewer in St. Paul, which drains to the river as well. Soils on the have likely been disturbed over the years and are classified as loamy lands on the USDA soil survey. Group C soil is being used in modeling seeing how this site has since been previously developed.

POST-DEVELOPMENT CONDITIONS

The proposed development consists of a new building which will cover the majority of the site. The building will incorporate green roof and controlled flow roof drains in select areas. Bioretention will provide additional stormwater to meet the goals for the project. All of the runoff will be conveyed to the river. This will actually reduce the flows to the storm sewer in St. Paul Avenue.

ANALYSIS METHODS

HydroCAD® (Version 10.00) software has been used to analyze stormwater characteristics for this stormwater management plan. HydroCAD uses the accepted TR-55 methodology for determining peak discharge runoff rates. Rainfall depths for the 1, 2, 10 and 100-year storm events are 2.40, 2.70, 3.81 and 6.18 inches in accordance with NOAA Atlas 14, Volume 8, Version 2, Appendix 1.

TSS reduction characteristics for the proposed water quality facilities were determined using WinSLAMM® (Version 10.4.0) Source Loading and Management Model.

Note that a portion of the site along the river which is the bank of the river which will not be disturbed and is not included in the modeling for that reason. The remaining 1.5 acres of land is modeled.

Note that the roof plan has not yet been finalized. It is assumed for purposes of this model, that 70% of the roof area will be available for detention to a maximum depth of 6" during the 100-year event. It is assumed that approximately 10 drains will be controlled flow. The final details and configuration will need to be done at a later date once the roof plan is finalized.

SUMMARY OF RESULTS

Existing Flows

Area	Area (ac)	CN	1-year (cfs)	2-year (cfs)	10-year (cfs)	100-year (cfs)
EXISTING SITE	1.5	72	**1.1**	**1.6**	**3.5**	**8.4**

Proposed Flows

Area	Area (ac)	CN	Tc (min)	1-year (cfs)	2-year (cfs)	10-year (cfs)	100-year (cfs)
CONTROLLED FLOW ROOF AREA	1.2	95	6.0*	3.8	4.3	6.3	10.5
AREA TO BIORETENTION	0.2	74	6.0*	0.2	0.3	0.5	1.2
UNDETAINED AREA	0.1	86	6.0*	0.2	0.3	0.4	0.8
PROPOSED SITE DISCHARGE	1.5	---	---	**0.9**	**1.0**	**1.1**	**2.4**

**A Tc of 6.0 min is used as the actual computed Tc is less than the minimum of 6 min per TR 55.*

Bioretention Basin Data

Bottom Elev	Peak W.S. Elev. 1-year	Peak W.S. Elev. 2-year	Peak W.S. Elev. 10-year	Peak W.S. Elev. 100-year	Spillway Elev.
22.0	22.8	23.0	23.8	24.1	25.0

The modeling indicates that the stormwater ponds will detain the peak flows to meet the City ordinance.

Water Quality SLAMM Model Summary

Area/Pond	Pounds of TSS Generated	Pounds of TSS Remaining	Percent Removal
Bioretention	235	29	88%
Undetained	22	22	0%
Site Total	257	51	80%

The modeling indicates that the stormwater ponds will provide TSS removal to meet the City ordinance.

Infiltration

Based on the clay soils on the site, the site is exempt from infiltration per DNR NR 151.

Protective Areas

Protective areas are required along all wetlands in order to minimize impacts of pollutants from untreated impervious sources. On this project, there are no wetlands and all of the hard surface is being captured and treated. Therefore the protective areas do not apply.

CONCLUSION

The stormwater management features for the development have been designed to comply with the City of Waukesha ordinance and WDNR technical standards NR216/151. All proposed runoff from the north parking area will be routed to the pond. Storm water runoff from all new parking areas and roads will be treated to remove at least 80% total suspended solids. Protective areas are not required under the proposed drainage pattern. Maintenance is expected to occur on a regular basis. An agreement with the City of Waukesha will be executed to ensure this occurs.

APPENDIX 1
MAPS

LAND INFORMATION SYSTEMS DIVISION

Waukesha County GIS Map

Legend

- Parcels (Click for details)
- Plats (Click for details)
- Retired Parcels (Click for detai
- Retired Plats (Click for details)

0 70.73 Feet

Notes

Map Scale: 1:1,000 if printed on A landscape (11" x 8.5") sheet.

N

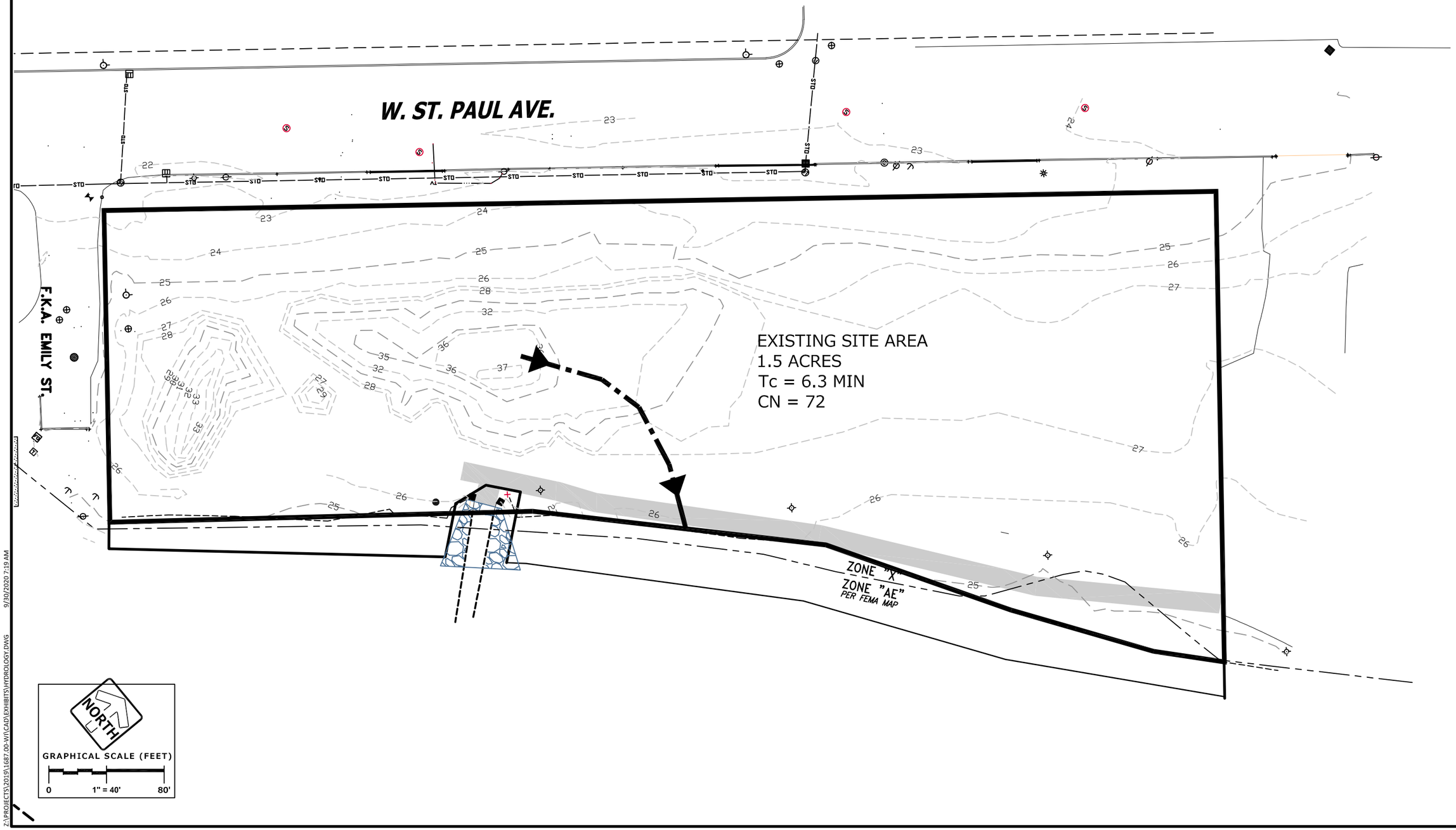
Meters: 0 10 20 40 60

Feet: 0 45 90 180 270

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Lu	Loamy land	1.6	100.0%
Totals for Area of Interest		**1.6**	**100.0%**

APPENDIX 2
PRE DEVELOPMENT CONDITIONS



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HYDROLOGY EXHIBIT - EXISTING

9-30-20

PINNACLE ENGINEERING GROUP
20725 WATERTOWN ROAD | SUITE 100 | BROOKFIELD, WI 53186 | WWW.PINNACLE-ENGR.COM |

PLAN | DESIGN | DELIVER **PEG JOB#** 1687.00

Summary for Subcatchment ES: EXISTING SITE

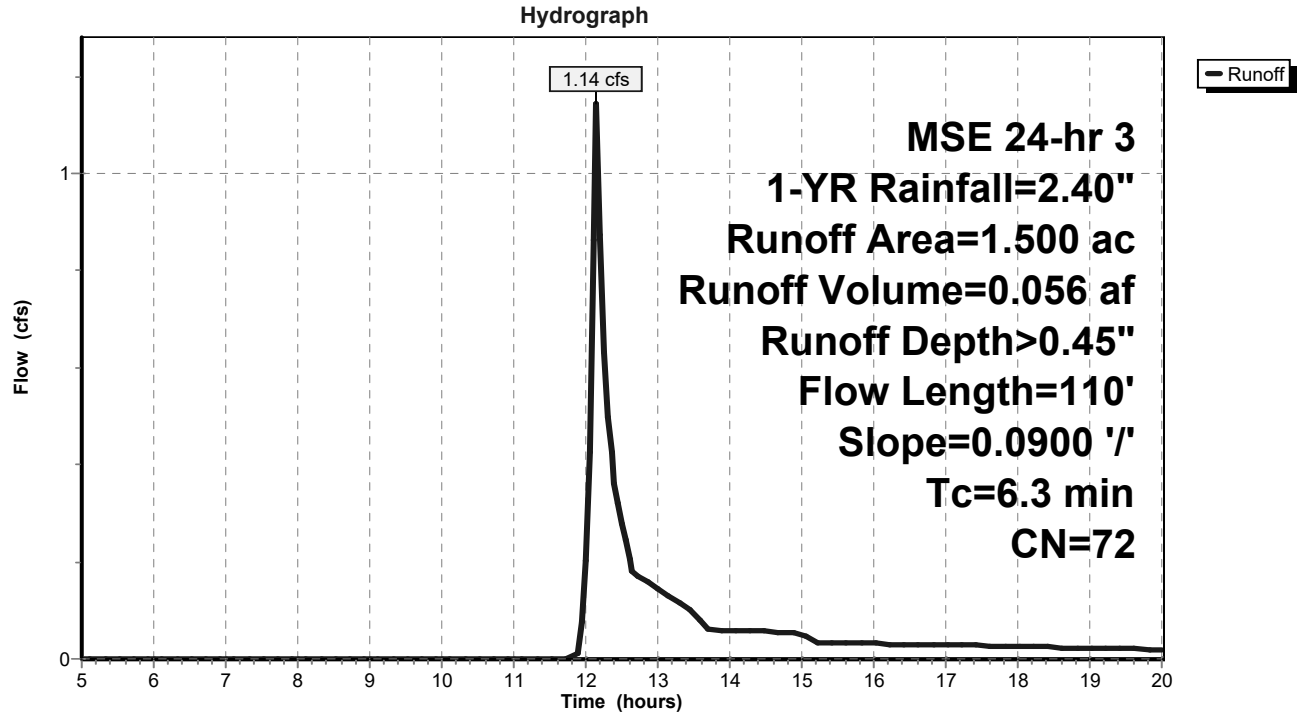
Runoff = 1.14 cfs @ 12.15 hrs, Volume= 0.056 af, Depth> 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-YR Rainfall=2.40"

Area (ac)	CN	Description
1.500	72	Woods/grass comb., Good, HSG C
1.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	110	0.0900	0.29		**Sheet Flow, SHEET** Grass: Short n= 0.150 P2= 2.70"

Subcatchment ES: EXISTING SITE



Summary for Subcatchment ES: EXISTING SITE

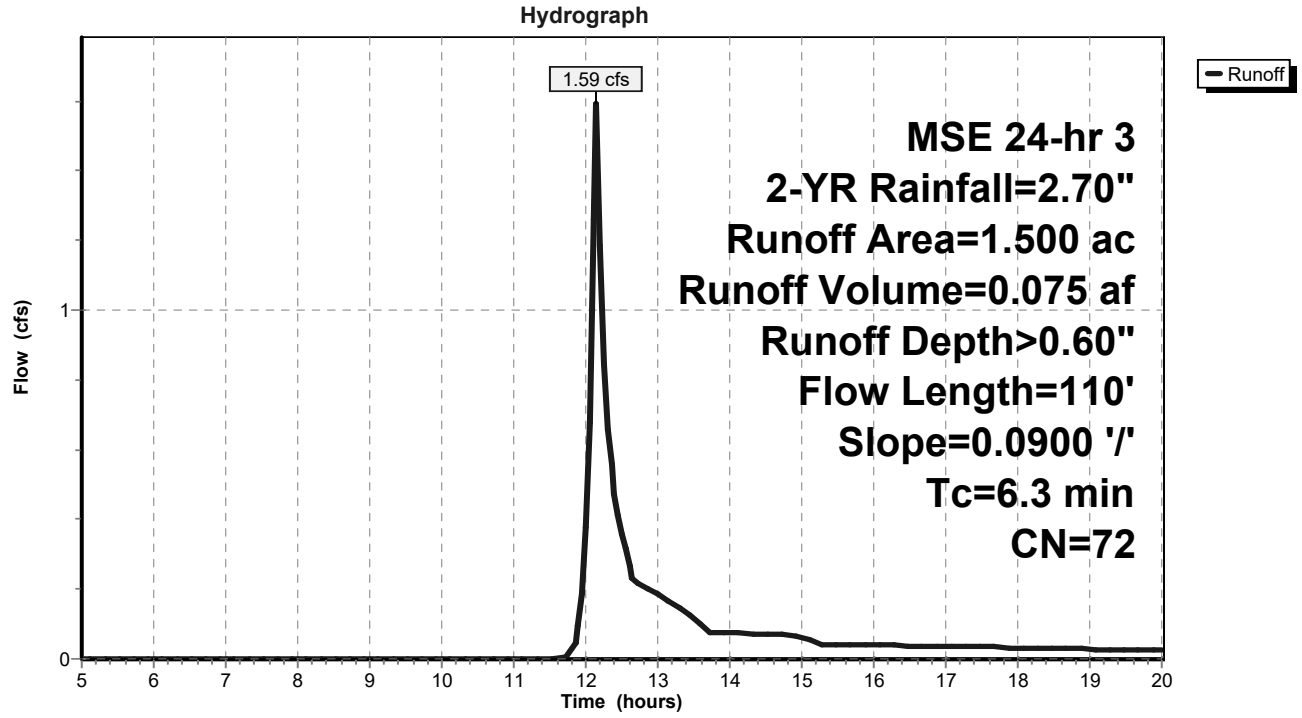
Runoff = 1.59 cfs @ 12.15 hrs, Volume= 0.075 af, Depth> 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-YR Rainfall=2.70"

Area (ac)	CN	Description
1.500	72	Woods/grass comb., Good, HSG C
1.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	110	0.0900	0.29		**Sheet Flow, SHEET** Grass: Short n= 0.150 P2= 2.70"

Subcatchment ES: EXISTING SITE



Summary for Subcatchment ES: EXISTING SITE

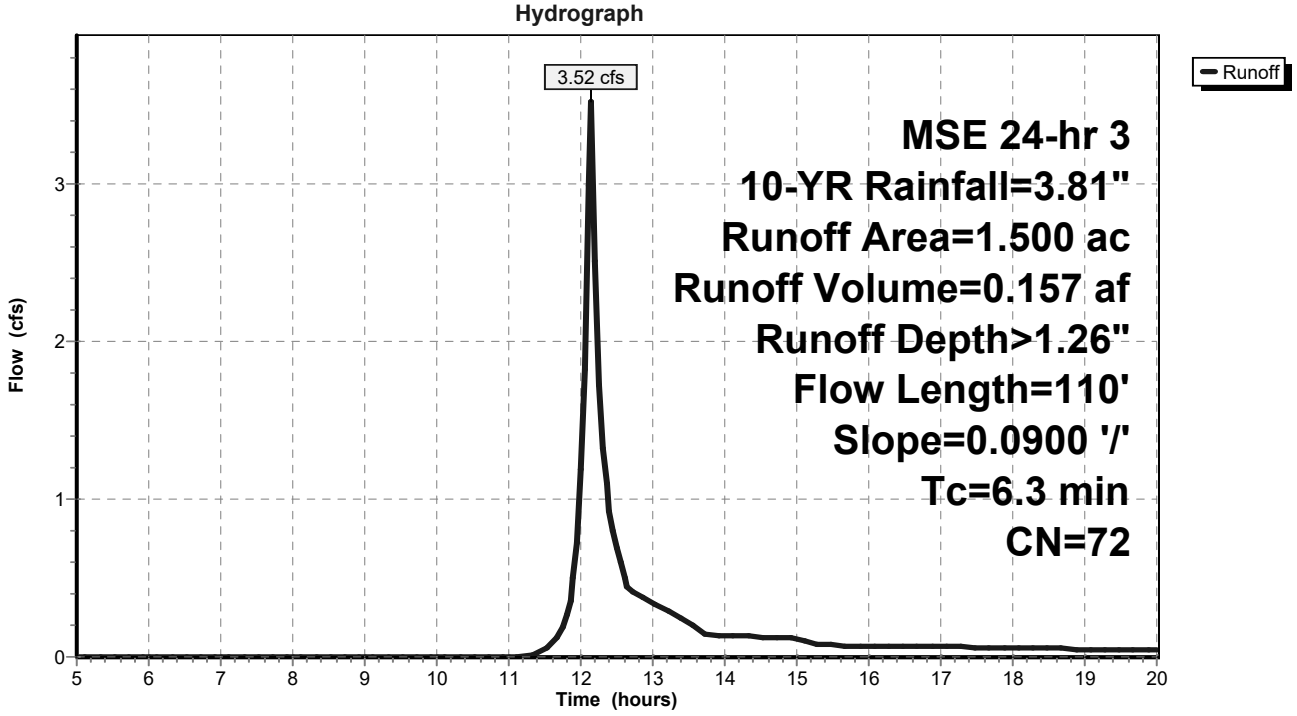
Runoff = 3.52 cfs @ 12.14 hrs, Volume= 0.157 af, Depth> 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-YR Rainfall=3.81"

Area (ac)	CN	Description
1.500	72	Woods/grass comb., Good, HSG C
1.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	110	0.0900	0.29		**Sheet Flow, SHEET** Grass: Short n= 0.150 P2= 2.70"

Subcatchment ES: EXISTING SITE



Summary for Subcatchment ES: EXISTING SITE

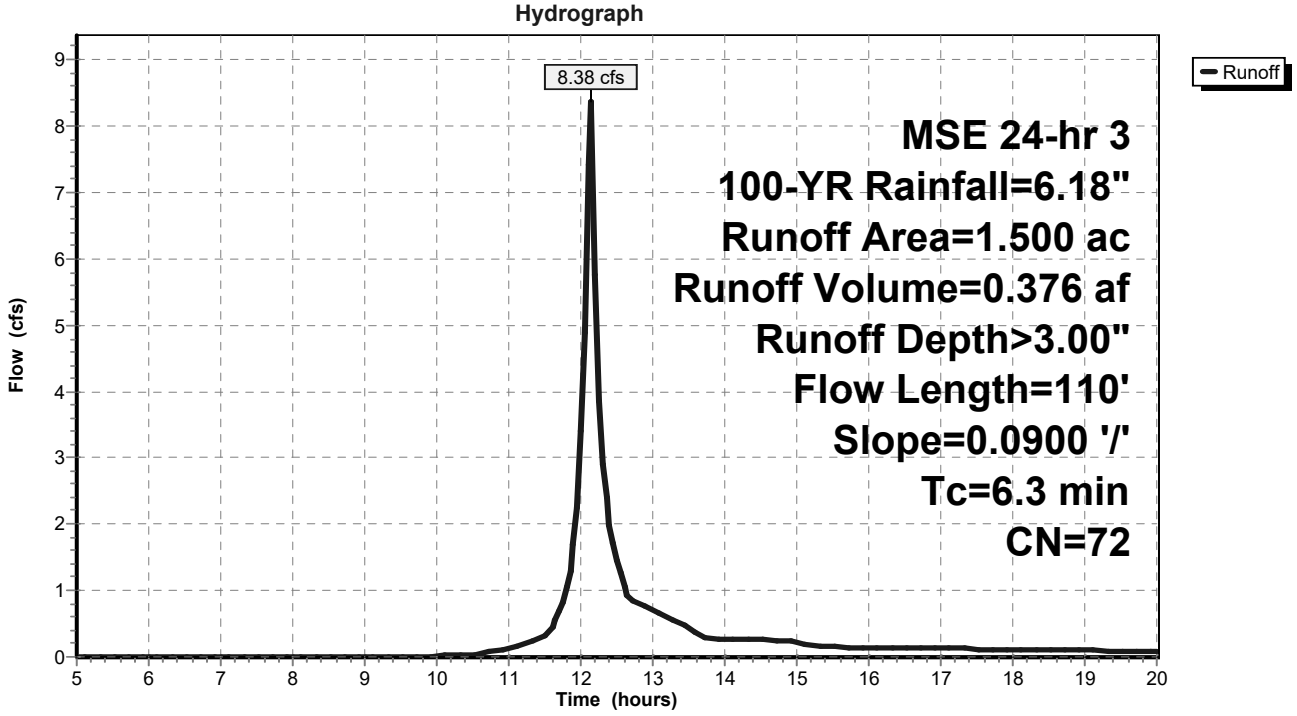
Runoff = 8.38 cfs @ 12.14 hrs, Volume= 0.376 af, Depth> 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-YR Rainfall=6.18"

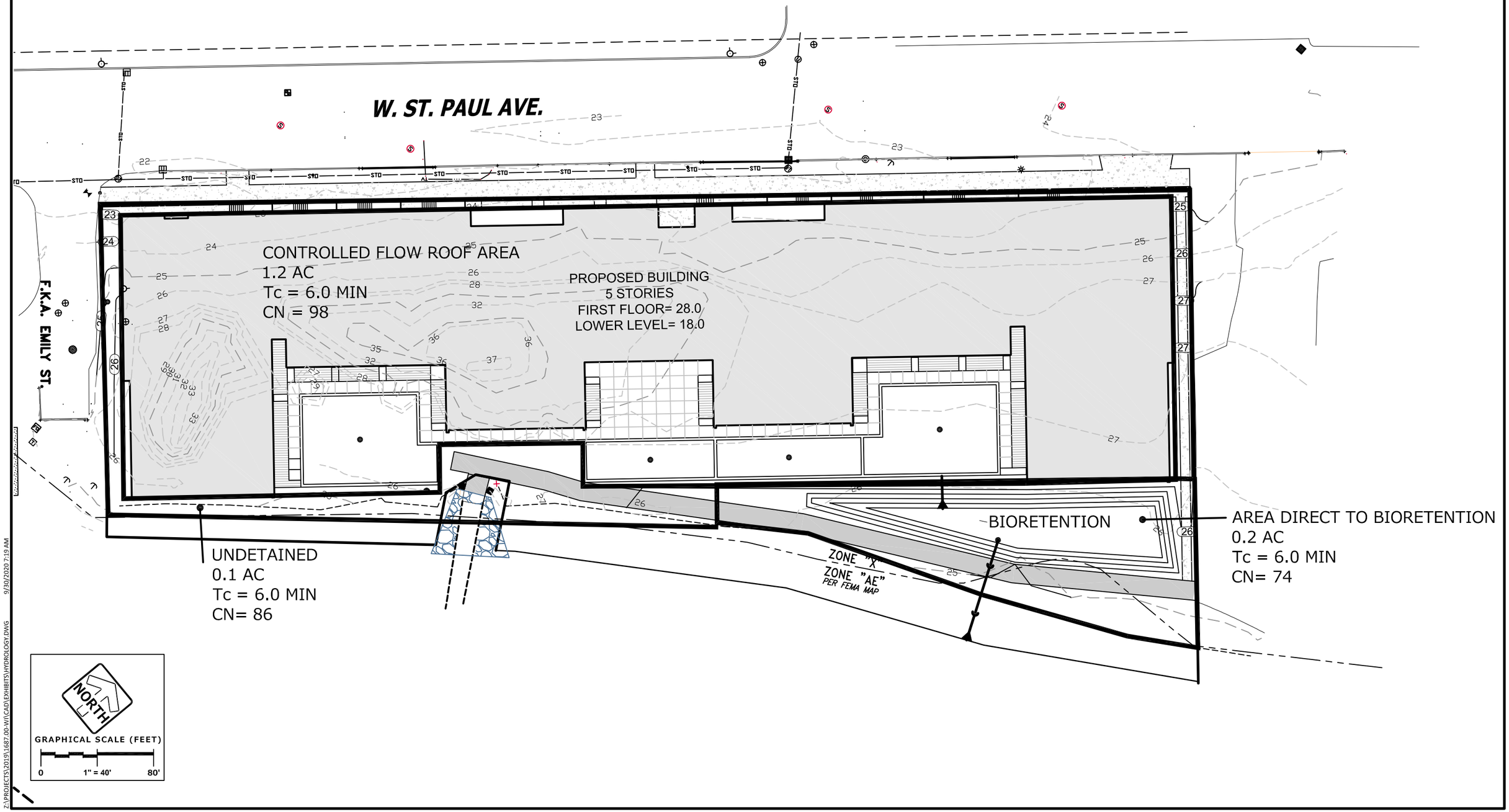
Area (ac)	CN	Description
1.500	72	Woods/grass comb., Good, HSG C
1.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	110	0.0900	0.29		**Sheet Flow, SHEET** Grass: Short n= 0.150 P2= 2.70"

Subcatchment ES: EXISTING SITE



APPENDIX 3
POST DEVELOPMENT CONDITIONS RATE ATTENUATION



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HYDROLOGY EXHIBIT - PROPOSED

9-30-20

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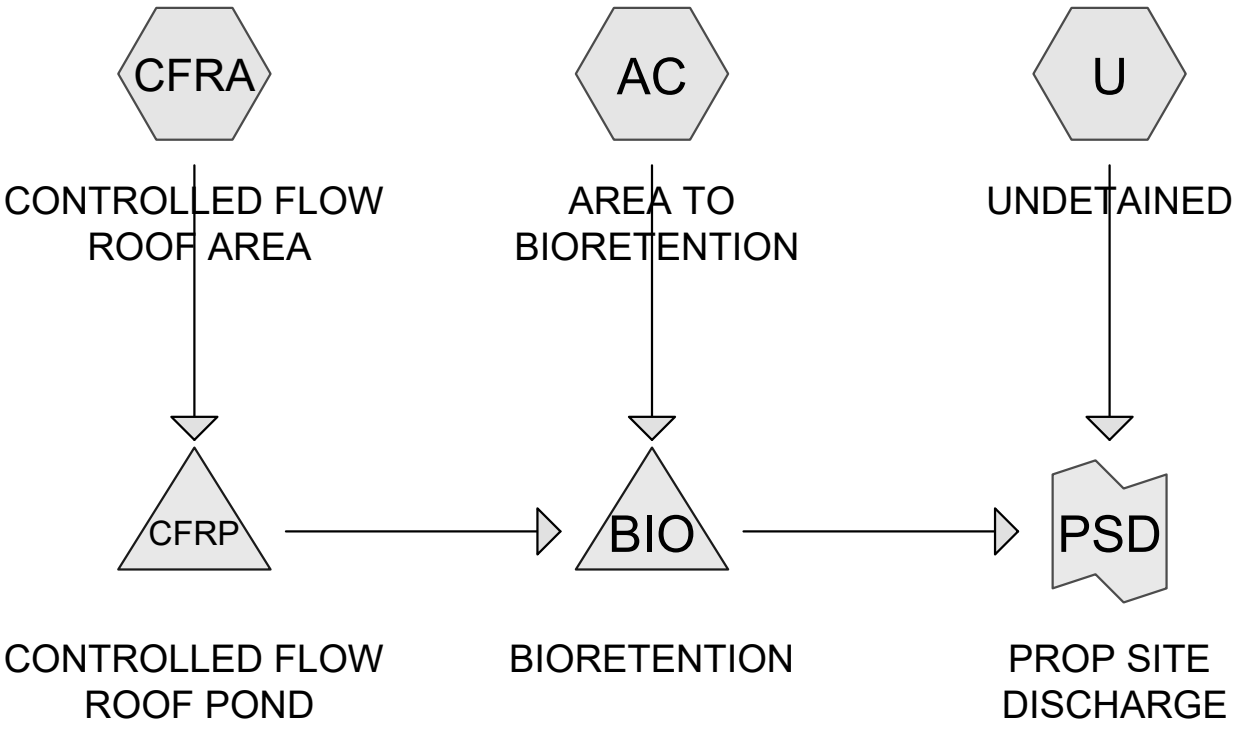
20725 WATERTOWN ROAD | SUITE 100 | BROOKFIELD, WI 53186 | WWW.PINNACLE-ENGR.COM |

PLAN | DESIGN | DELIVER **PEG JOB#** 1687.00



Subcat Reach Pond Link

Routing Diagram for MANDEL WAUKESHA
Prepared by Microsoft, Printed 9/30/2020

Summary for Subcatchment AC: AREA TO BIORETENTION

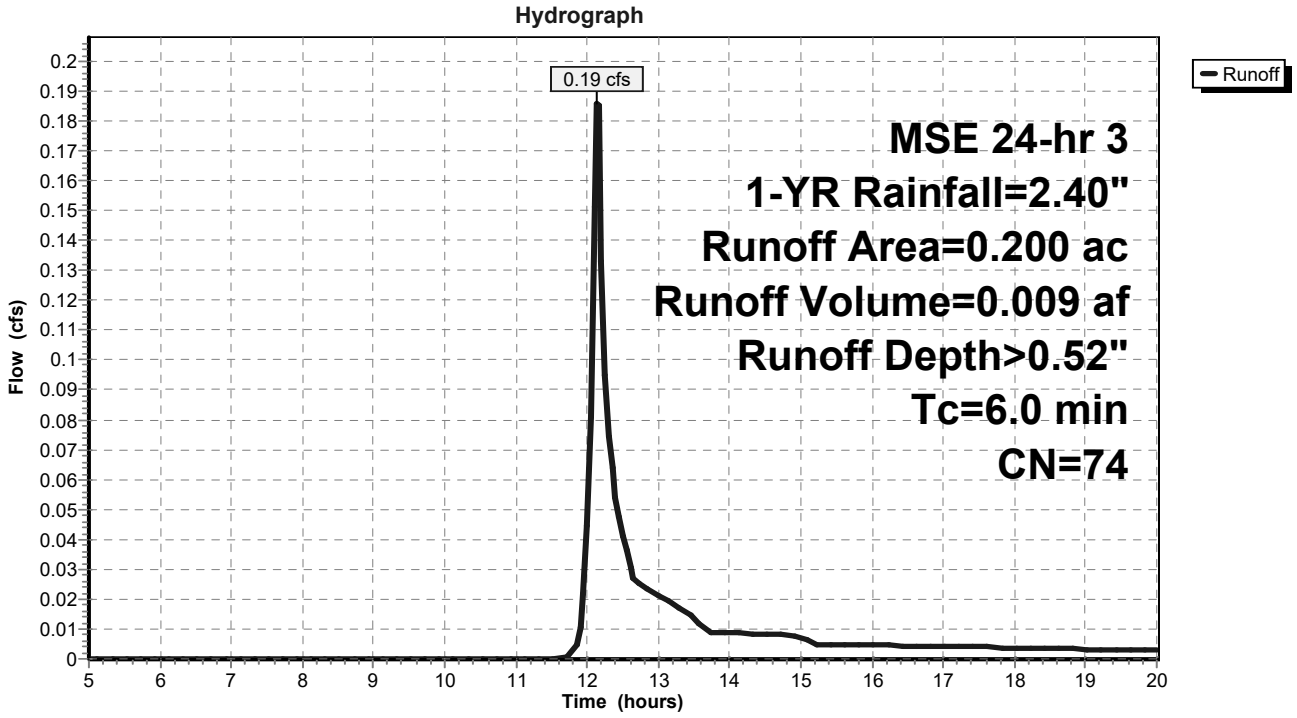
Runoff = 0.19 cfs @ 12.14 hrs, Volume= 0.009 af, Depth> 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-YR Rainfall=2.40"

	Area (ac)	CN	Description
*	0.200	74	GRASS
	0.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment AC: AREA TO BIORETENTION



Summary for Subcatchment CFRA: CONTROLLED FLOW ROOF AREA

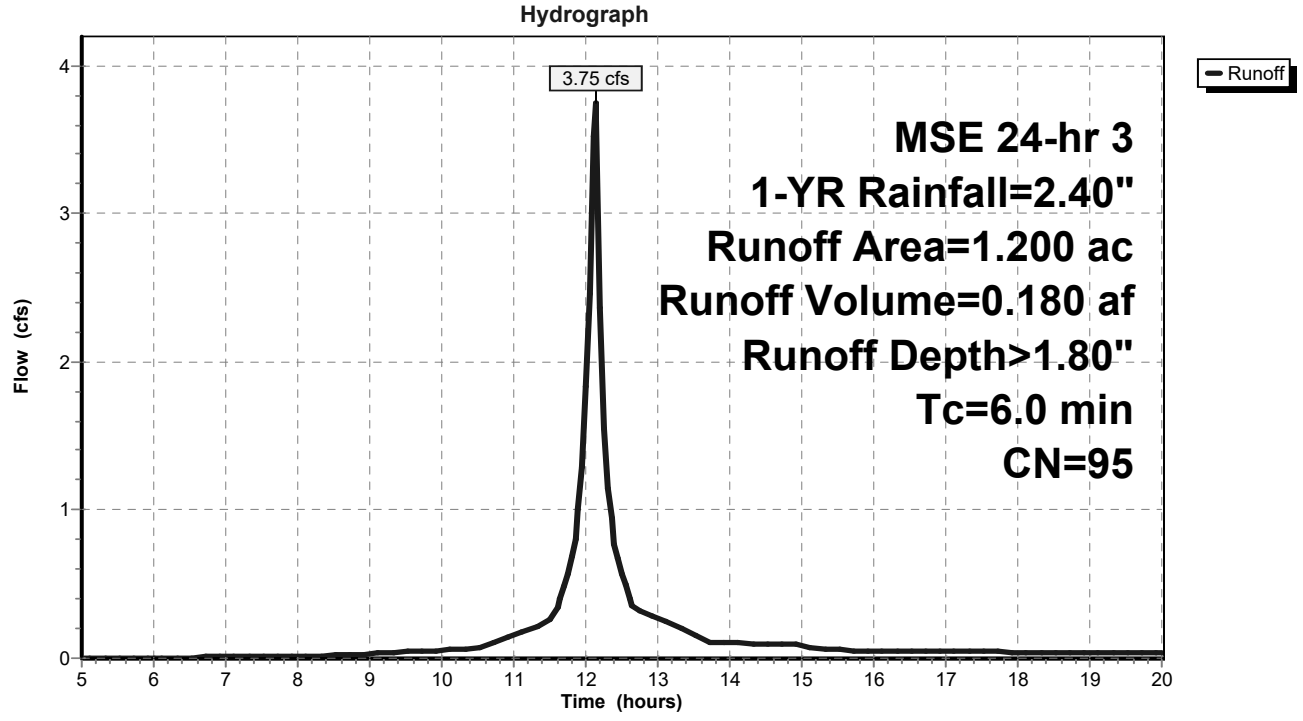
Runoff = 3.75 cfs @ 12.13 hrs, Volume= 0.180 af, Depth> 1.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-YR Rainfall=2.40"

	Area (ac)	CN	Description
*	1.050	98	ROOF
*	0.150	74	GREEN ROOF
	1.200	95	Weighted Average
	0.150		12.50% Pervious Area
	1.050		87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment CFRA: CONTROLLED FLOW ROOF AREA



Summary for Subcatchment U: UNDETAINED

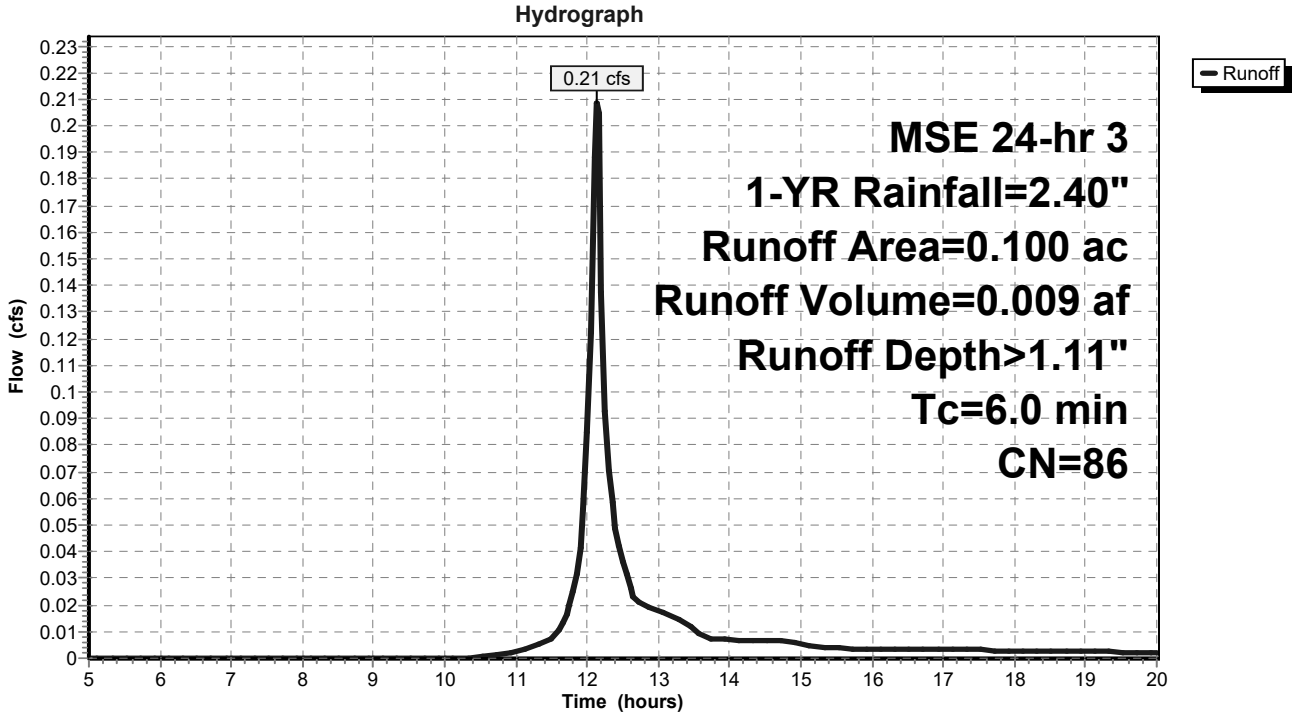
Runoff = 0.21 cfs @ 12.13 hrs, Volume= 0.009 af, Depth> 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-YR Rainfall=2.40"

	Area (ac)	CN	Description
*	0.050	98	WALK
*	0.050	74	GRASS
	0.100	86	Weighted Average
	0.050		50.00% Pervious Area
	0.050		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment U: UNDETAINED



Summary for Pond BIO: BIORETENTION

Inflow Area = 1.400 ac, 75.00% Impervious, Inflow Depth > 1.62" for 1-YR event
Inflow = 1.37 cfs @ 12.22 hrs, Volume= 0.189 af
Outflow = 0.77 cfs @ 13.01 hrs, Volume= 0.189 af, Atten= 44%, Lag= 47.1 min
Primary = 0.77 cfs @ 13.01 hrs, Volume= 0.189 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 20.00' Surf.Area= 0 sf Storage= 0 cf
Peak Elev= 22.76' @ 13.01 hrs Surf.Area= 2,104 sf Storage= 1,399 cf

Plug-Flow detention time= 13.7 min calculated for 0.188 af (100% of inflow)
Center-of-Mass det. time= 13.5 min (789.5 - 775.9)

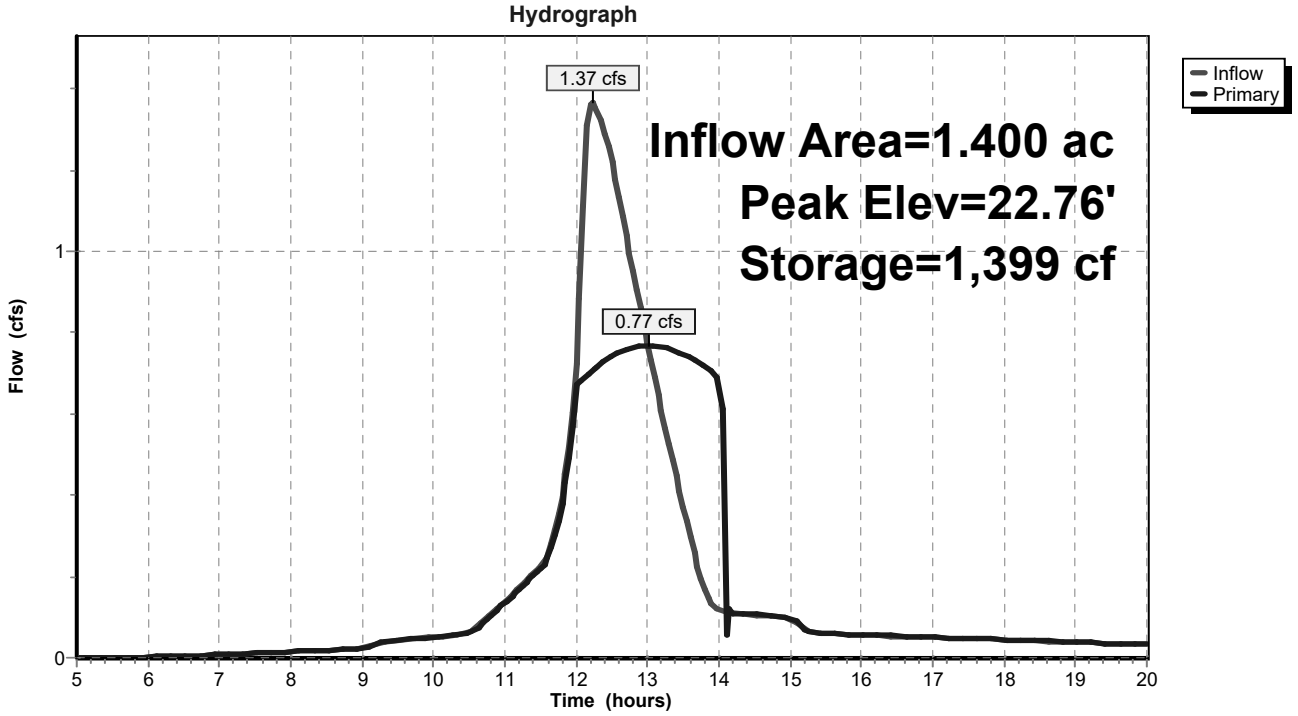
Volume	Invert	Avail.Storage	Storage Description
#1	22.00'	7,800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
22.00	1,600	0	0
25.00	3,600	7,800	7,800

Device	Routing	Invert	Outlet Devices
#1	Primary	19.25'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	24.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.77 cfs @ 13.01 hrs HW=22.76' (Free Discharge)
↑ **1=Orifice/Grate** (Orifice Controls 0.77 cfs @ 8.80 fps)
└ **2=Orifice/Grate** (Controls 0.00 cfs)

Pond BIO: BIORETENTION



Summary for Pond CFRP: CONTROLLED FLOW ROOF POND

Inflow Area = 1.200 ac, 87.50% Impervious, Inflow Depth > 1.80" for 1-YR event
Inflow = 3.75 cfs @ 12.13 hrs, Volume= 0.180 af
Outflow = 1.27 cfs @ 12.29 hrs, Volume= 0.180 af, Atten= 66%, Lag= 9.6 min
Primary = 1.27 cfs @ 12.29 hrs, Volume= 0.180 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 100.24' @ 12.29 hrs Surf.Area= 17,883 sf Storage= 2,184 cf

Plug-Flow detention time= 14.9 min calculated for 0.180 af (100% of inflow)
Center-of-Mass det. time= 14.8 min (774.1 - 759.3)

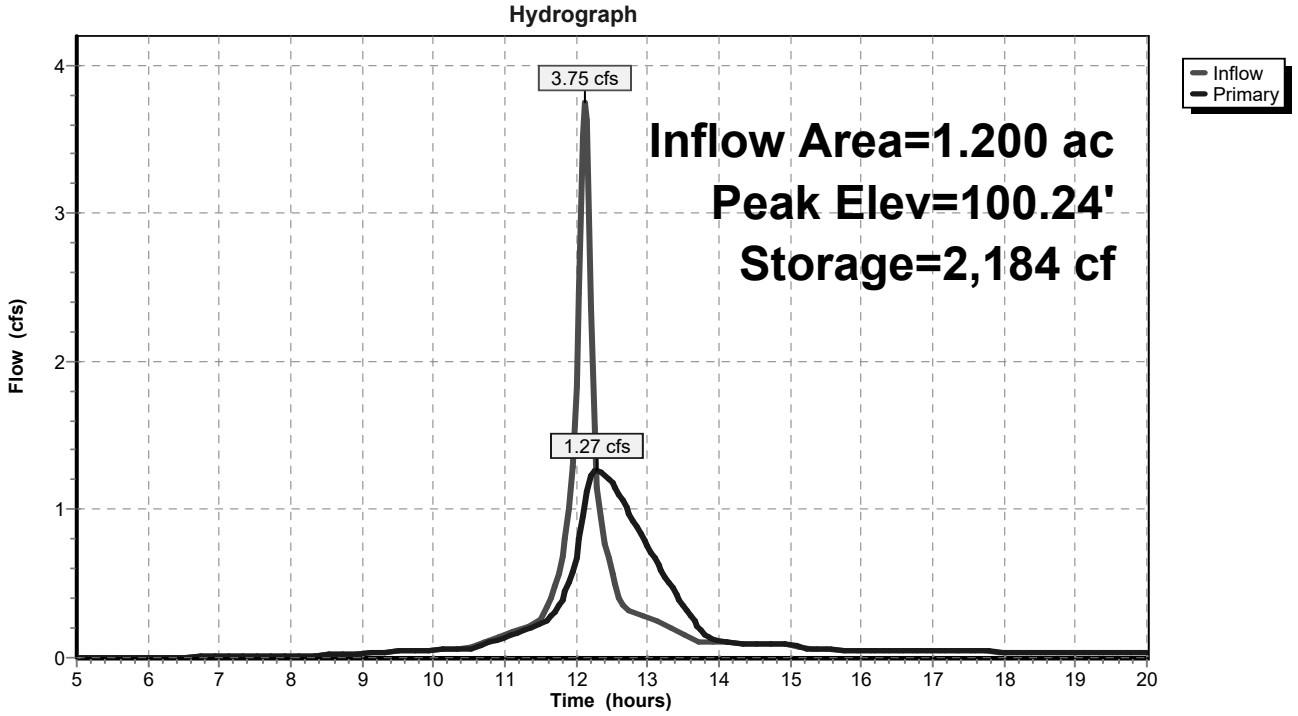
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	9,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 10

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
100.00	0	0	0
100.50	3,660	915	915

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**2 - 10gpm notch per fixture X 10.00** Head (feet) 0.00 0.50 Disch. (cfs) 0.000 0.260

Primary OutFlow Max=1.27 cfs @ 12.29 hrs HW=100.24' (Free Discharge)
↑—**1=2 - 10gpm notch per fixture** (Custom Controls 1.27 cfs)

Pond CFRP: CONTROLLED FLOW ROOF POND

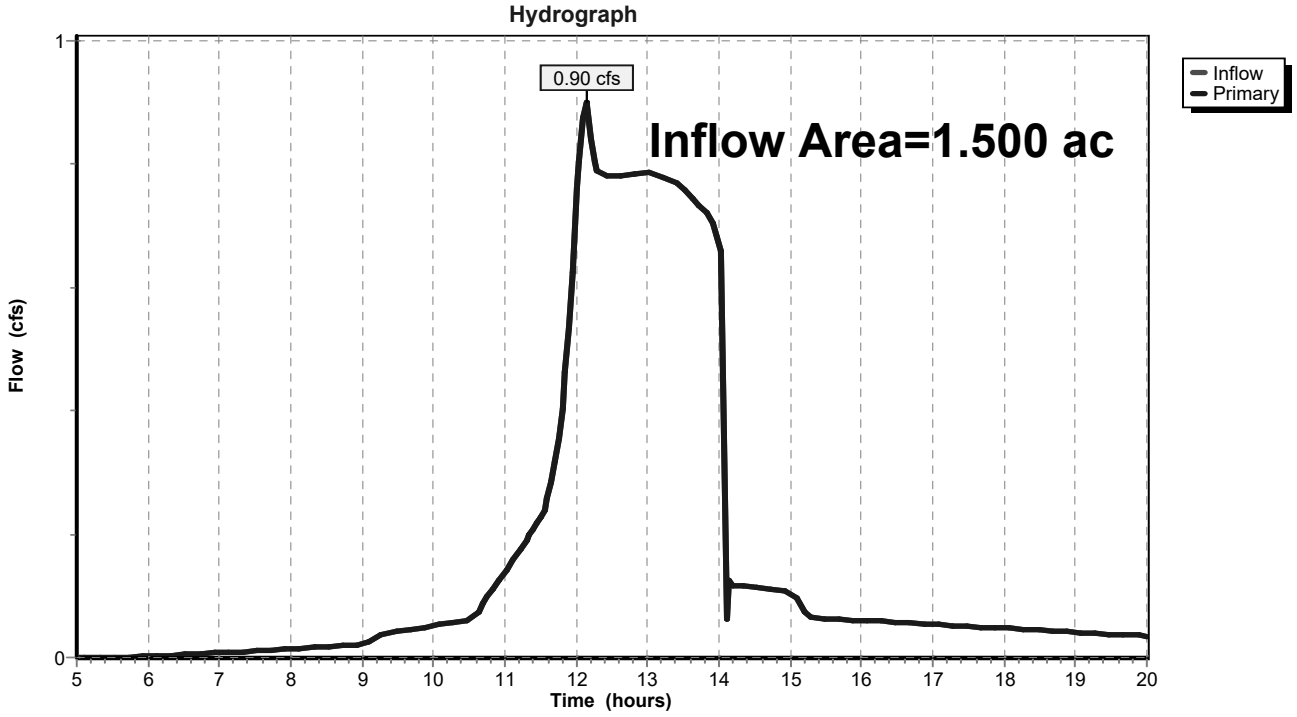


Summary for Link PSD: PROP SITE DISCHARGE

Inflow Area = 1.500 ac, 73.33% Impervious, Inflow Depth > 1.59" for 1-YR event
Inflow = 0.90 cfs @ 12.14 hrs, Volume= 0.198 af
Primary = 0.90 cfs @ 12.14 hrs, Volume= 0.198 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link PSD: PROP SITE DISCHARGE



Summary for Subcatchment AC: AREA TO BIORETENTION

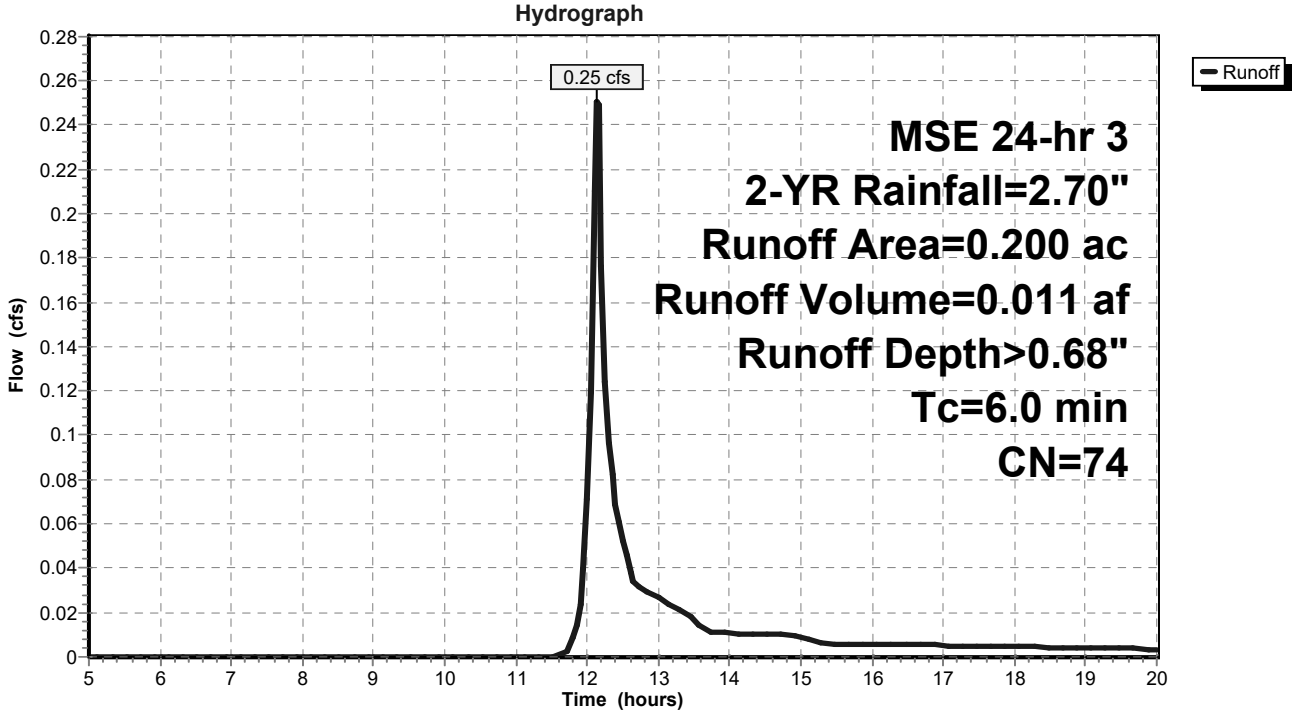
Runoff = 0.25 cfs @ 12.14 hrs, Volume= 0.011 af, Depth> 0.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-YR Rainfall=2.70"

	Area (ac)	CN	Description
*	0.200	74	GRASS
	0.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment AC: AREA TO BIORETENTION



Summary for Subcatchment CFRA: CONTROLLED FLOW ROOF AREA

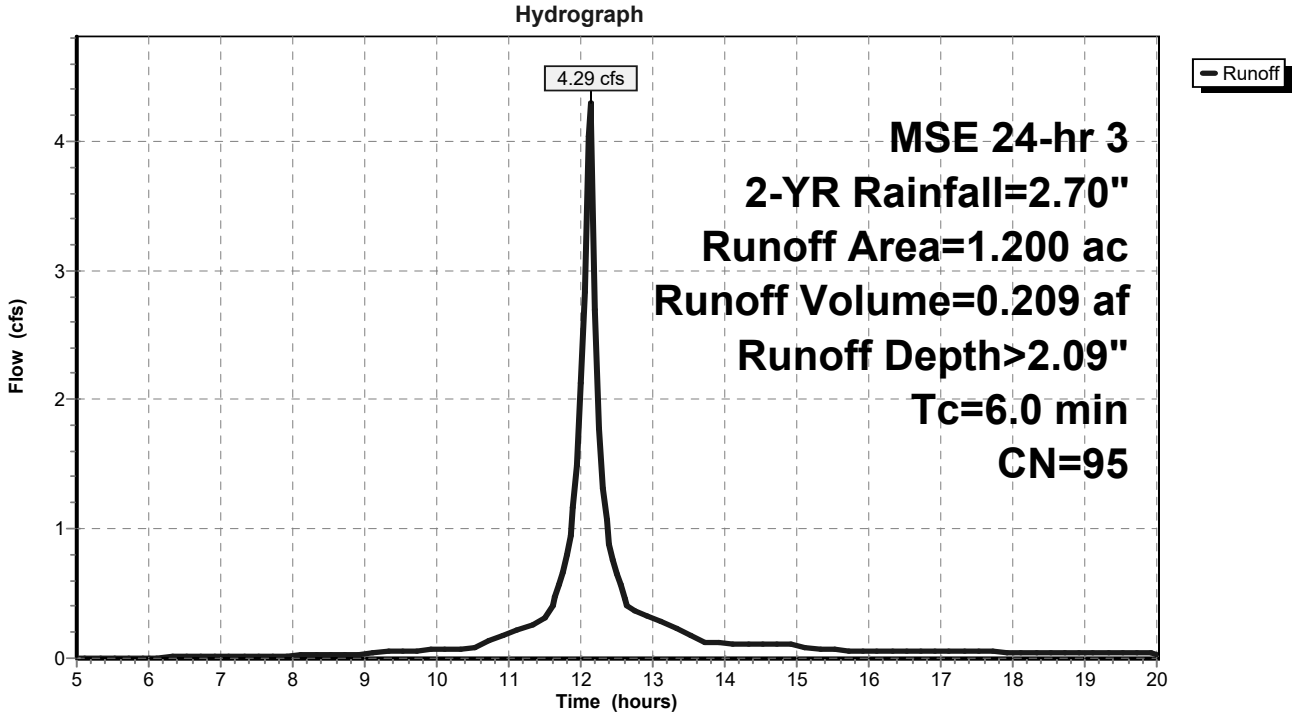
Runoff = 4.29 cfs @ 12.13 hrs, Volume= 0.209 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-YR Rainfall=2.70"

	Area (ac)	CN	Description
*	1.050	98	ROOF
*	0.150	74	GREEN ROOF
	1.200	95	Weighted Average
	0.150		12.50% Pervious Area
	1.050		87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment CFRA: CONTROLLED FLOW ROOF AREA



Summary for Subcatchment U: UNDETAINED

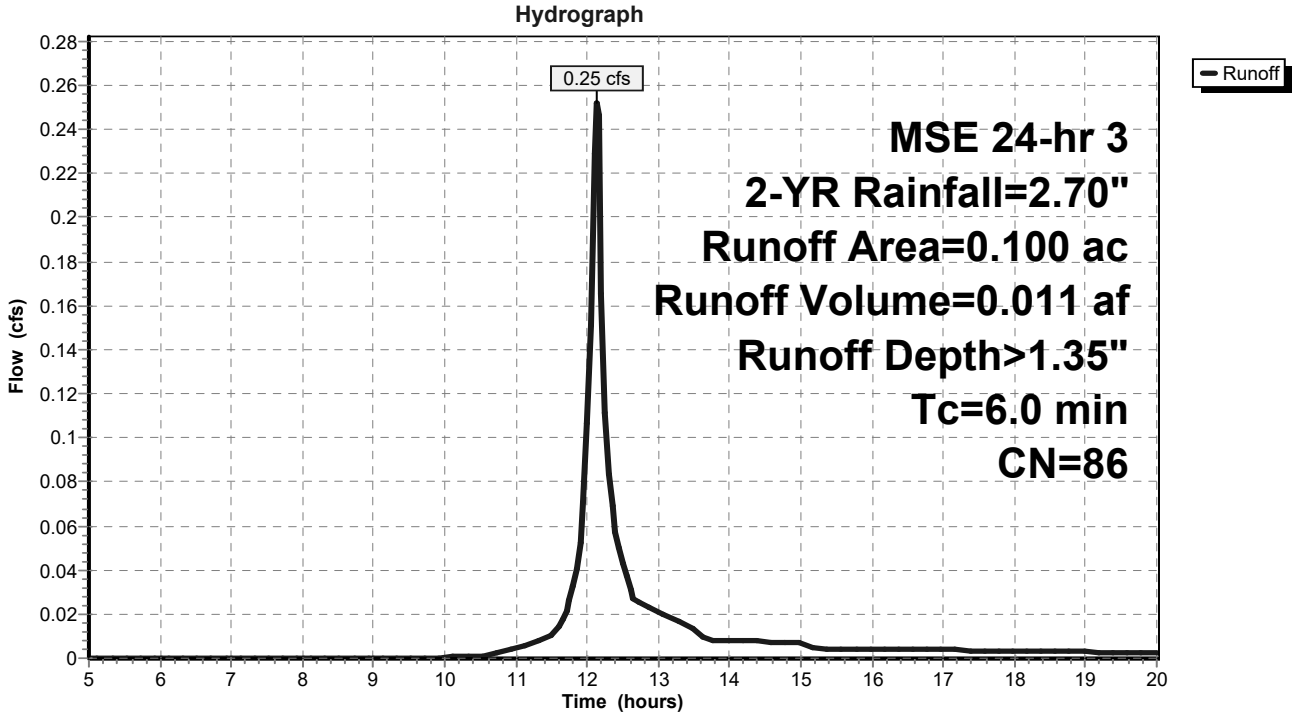
Runoff = 0.25 cfs @ 12.13 hrs, Volume= 0.011 af, Depth> 1.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-YR Rainfall=2.70"

	Area (ac)	CN	Description
*	0.050	98	WALK
*	0.050	74	GRASS
	0.100	86	Weighted Average
	0.050		50.00% Pervious Area
	0.050		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment U: UNDETAINED



Summary for Pond BIO: BIORETENTION

Inflow Area = 1.400 ac, 75.00% Impervious, Inflow Depth > 1.89" for 2-YR event
Inflow = 1.52 cfs @ 12.22 hrs, Volume= 0.220 af
Outflow = 0.79 cfs @ 13.13 hrs, Volume= 0.220 af, Atten= 48%, Lag= 54.9 min
Primary = 0.79 cfs @ 13.13 hrs, Volume= 0.220 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 20.00' Surf.Area= 0 sf Storage= 0 cf
Peak Elev= 22.98' @ 13.13 hrs Surf.Area= 2,252 sf Storage= 1,883 cf

Plug-Flow detention time= 18.2 min calculated for 0.219 af (100% of inflow)
Center-of-Mass det. time= 18.0 min (792.9 - 774.9)

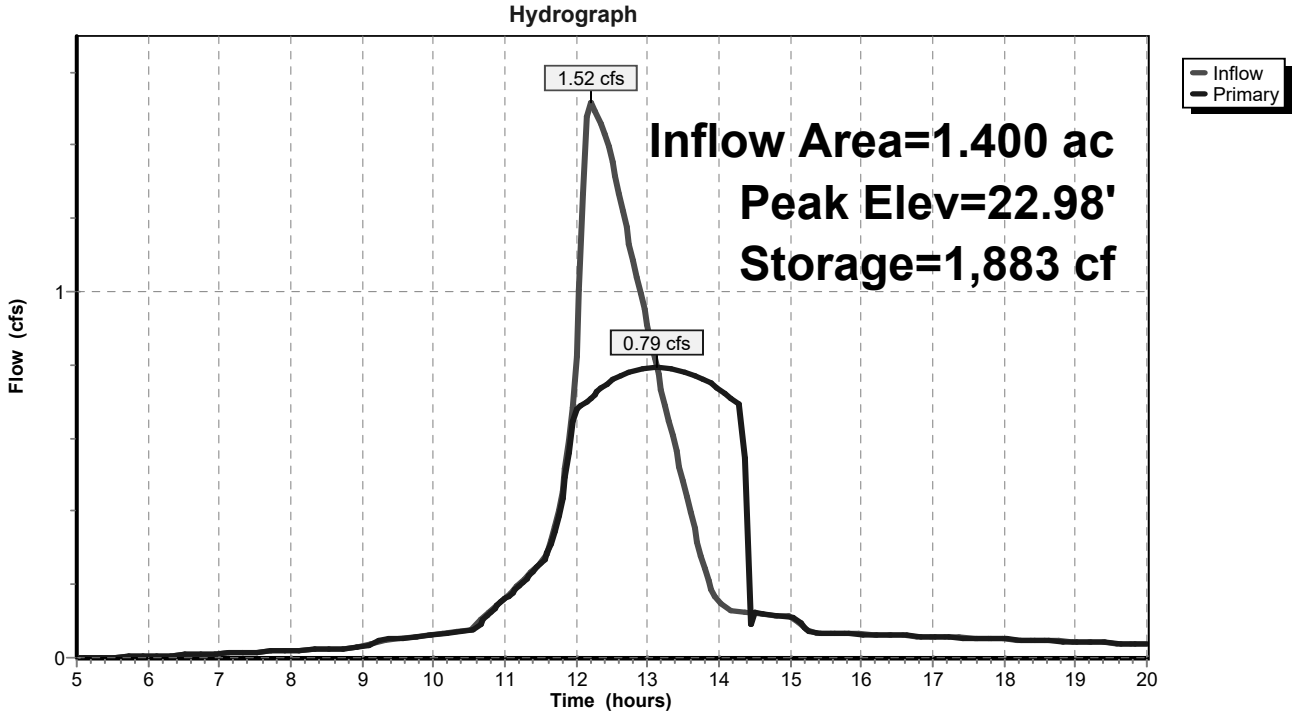
Volume	Invert	Avail.Storage	Storage Description
#1	22.00'	7,800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
22.00	1,600	0	0
25.00	3,600	7,800	7,800

Device	Routing	Invert	Outlet Devices
#1	Primary	19.25'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	24.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.79 cfs @ 13.13 hrs HW=22.98' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.79 cfs @ 9.09 fps)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Pond BIO: BIORETENTION



Summary for Pond CFRP: CONTROLLED FLOW ROOF POND

Inflow Area = 1.200 ac, 87.50% Impervious, Inflow Depth > 2.09" for 2-YR event
Inflow = 4.29 cfs @ 12.13 hrs, Volume= 0.209 af
Outflow = 1.39 cfs @ 12.30 hrs, Volume= 0.209 af, Atten= 68%, Lag= 10.1 min
Primary = 1.39 cfs @ 12.30 hrs, Volume= 0.209 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 100.27' @ 12.30 hrs Surf.Area= 19,548 sf Storage= 2,610 cf

Plug-Flow detention time= 16.5 min calculated for 0.208 af (100% of inflow)
Center-of-Mass det. time= 16.3 min (773.1 - 756.7)

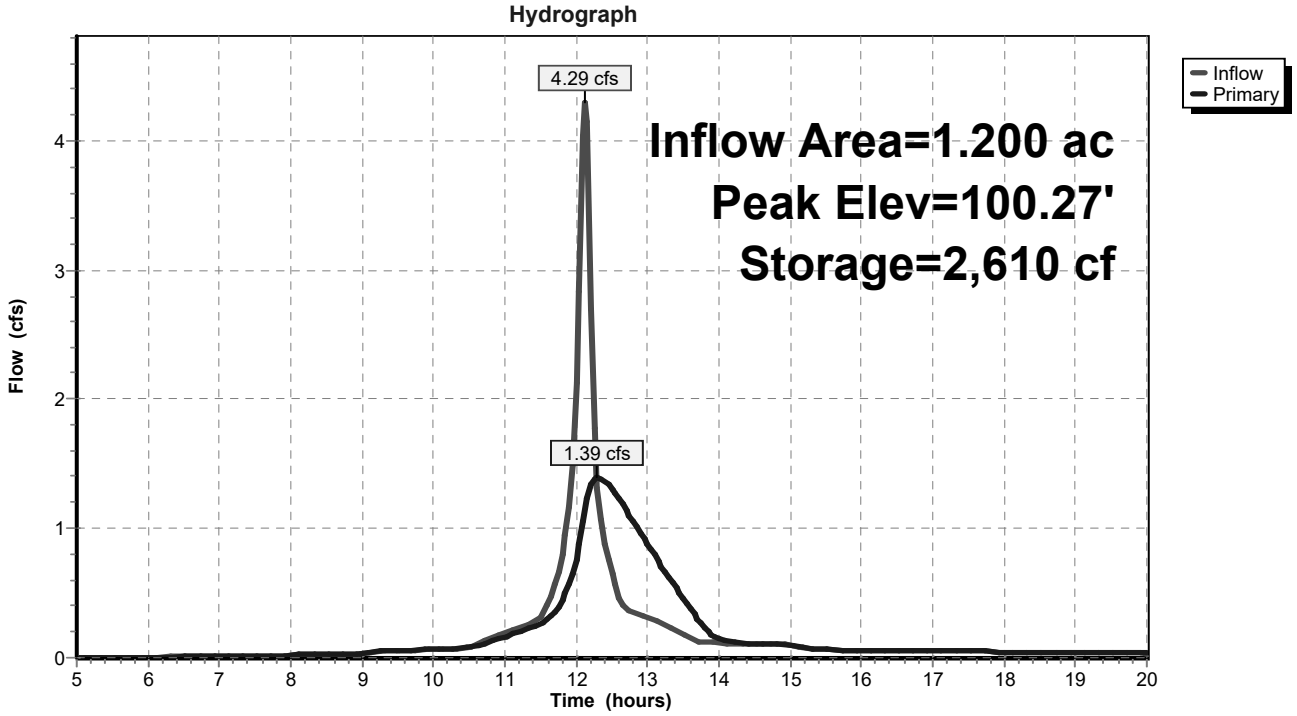
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	9,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 10

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
100.00	0	0	0
100.50	3,660	915	915

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**2 - 10gpm notch per fixture X 10.00** Head (feet) 0.00 0.50 Disch. (cfs) 0.000 0.260

Primary OutFlow Max=1.39 cfs @ 12.30 hrs HW=100.27' (Free Discharge)
↑—**1=2 - 10gpm notch per fixture** (Custom Controls 1.39 cfs)

Pond CFRP: CONTROLLED FLOW ROOF POND

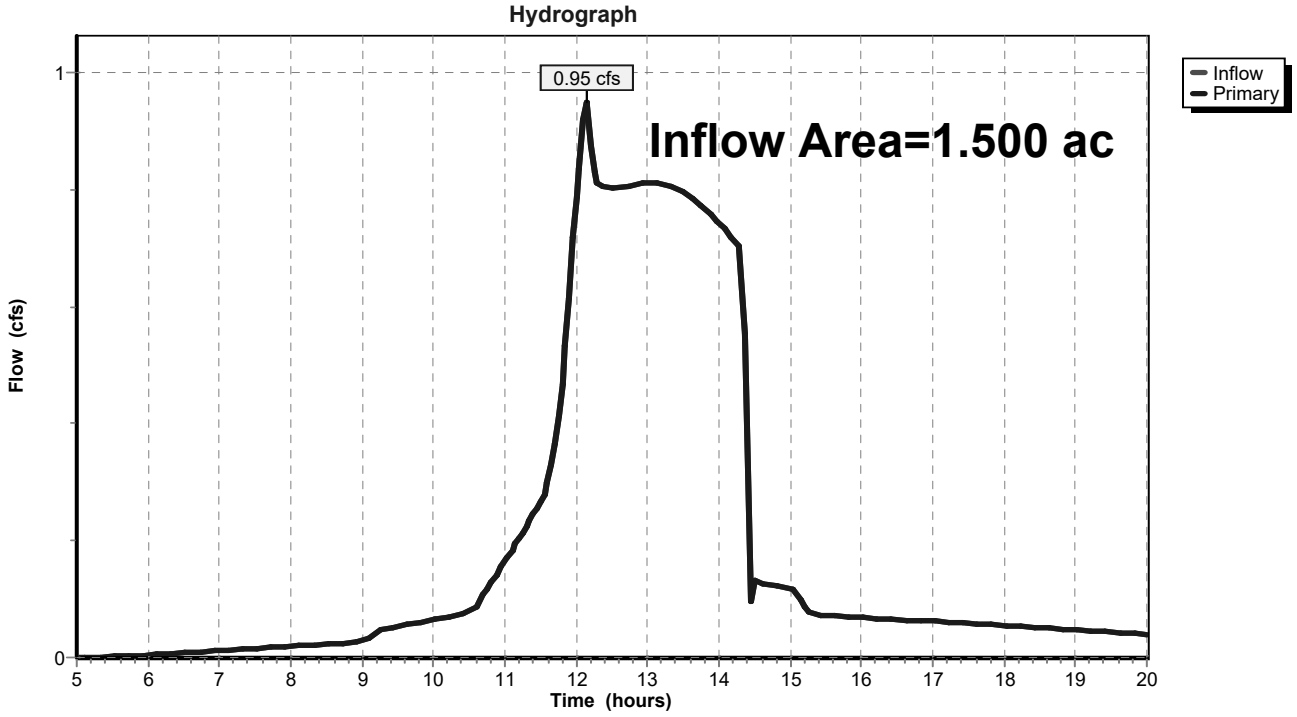


Summary for Link PSD: PROP SITE DISCHARGE

Inflow Area = 1.500 ac, 73.33% Impervious, Inflow Depth > 1.85" for 2-YR event
Inflow = 0.95 cfs @ 12.14 hrs, Volume= 0.231 af
Primary = 0.95 cfs @ 12.14 hrs, Volume= 0.231 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link PSD: PROP SITE DISCHARGE



Summary for Subcatchment AC: AREA TO BIORETENTION

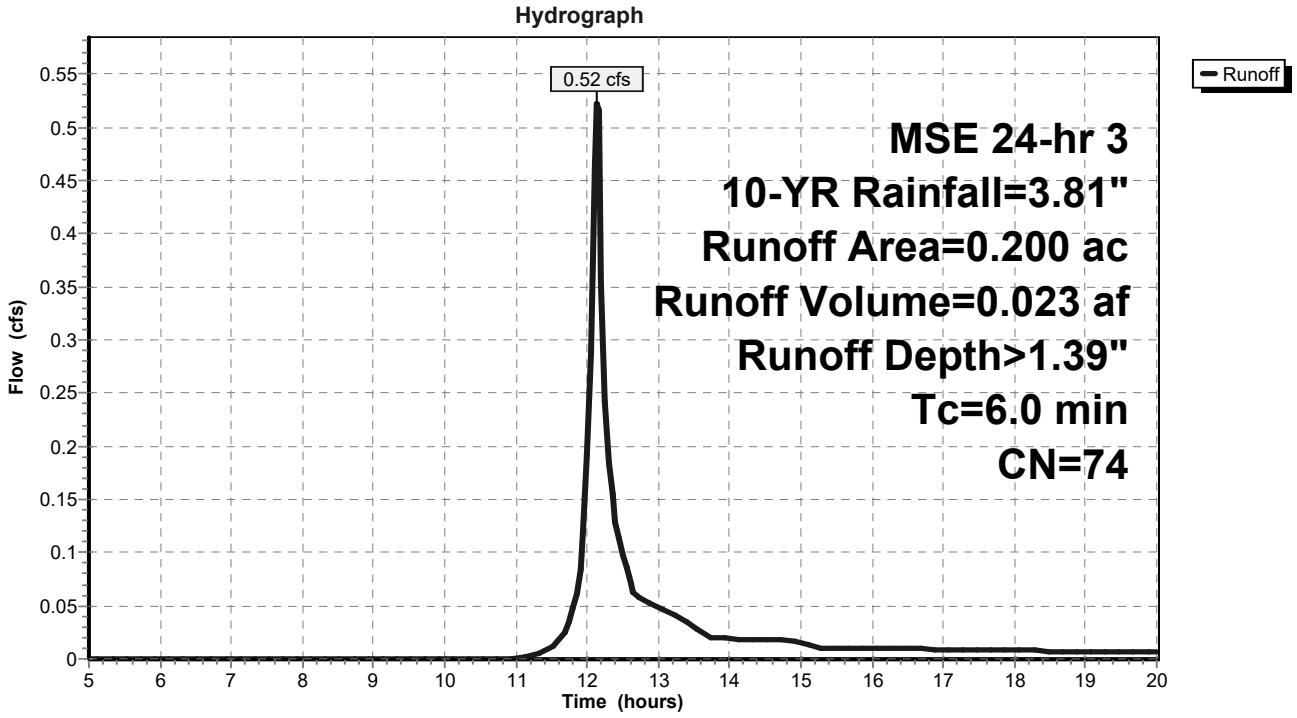
Runoff = 0.52 cfs @ 12.14 hrs, Volume= 0.023 af, Depth> 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-YR Rainfall=3.81"

	Area (ac)	CN	Description
*	0.200	74	GRASS
	0.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment AC: AREA TO BIORETENTION



Summary for Subcatchment CFRA: CONTROLLED FLOW ROOF AREA

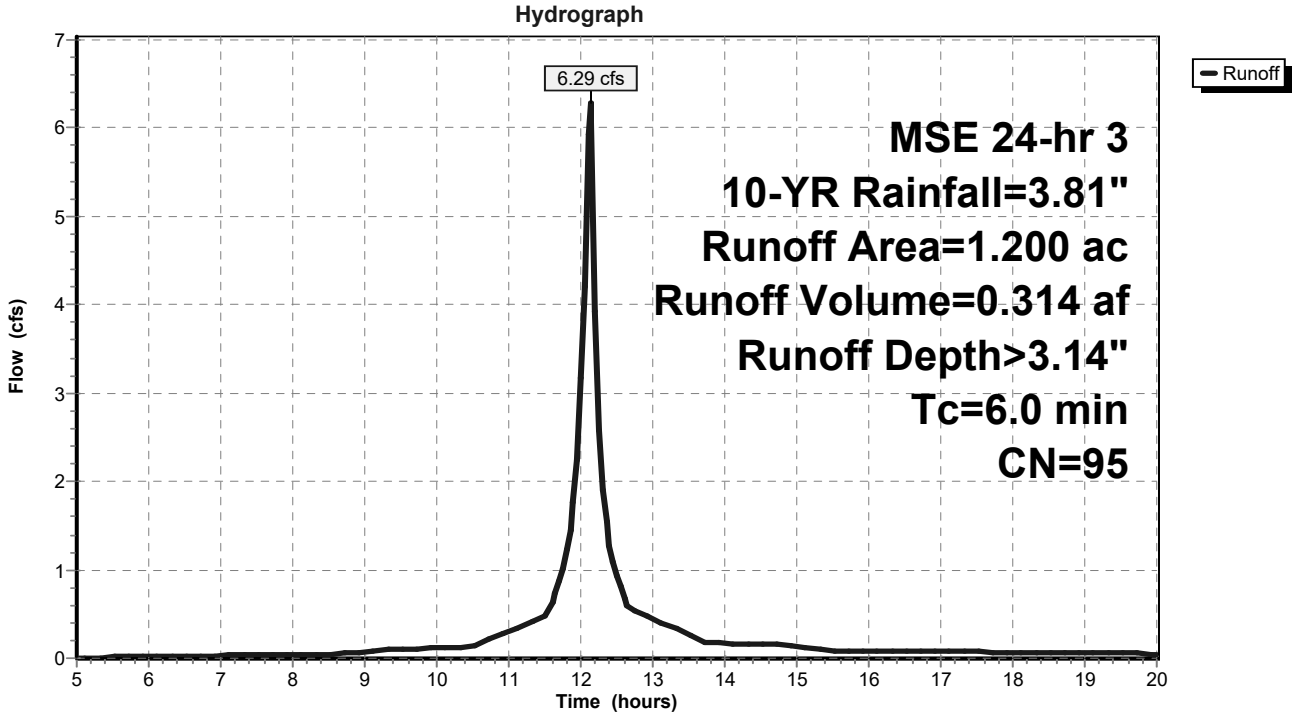
Runoff = 6.29 cfs @ 12.13 hrs, Volume= 0.314 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-YR Rainfall=3.81"

	Area (ac)	CN	Description
*	1.050	98	ROOF
*	0.150	74	GREEN ROOF
	1.200	95	Weighted Average
	0.150		12.50% Pervious Area
	1.050		87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment CFRA: CONTROLLED FLOW ROOF AREA



Summary for Subcatchment U: UNDETAINED

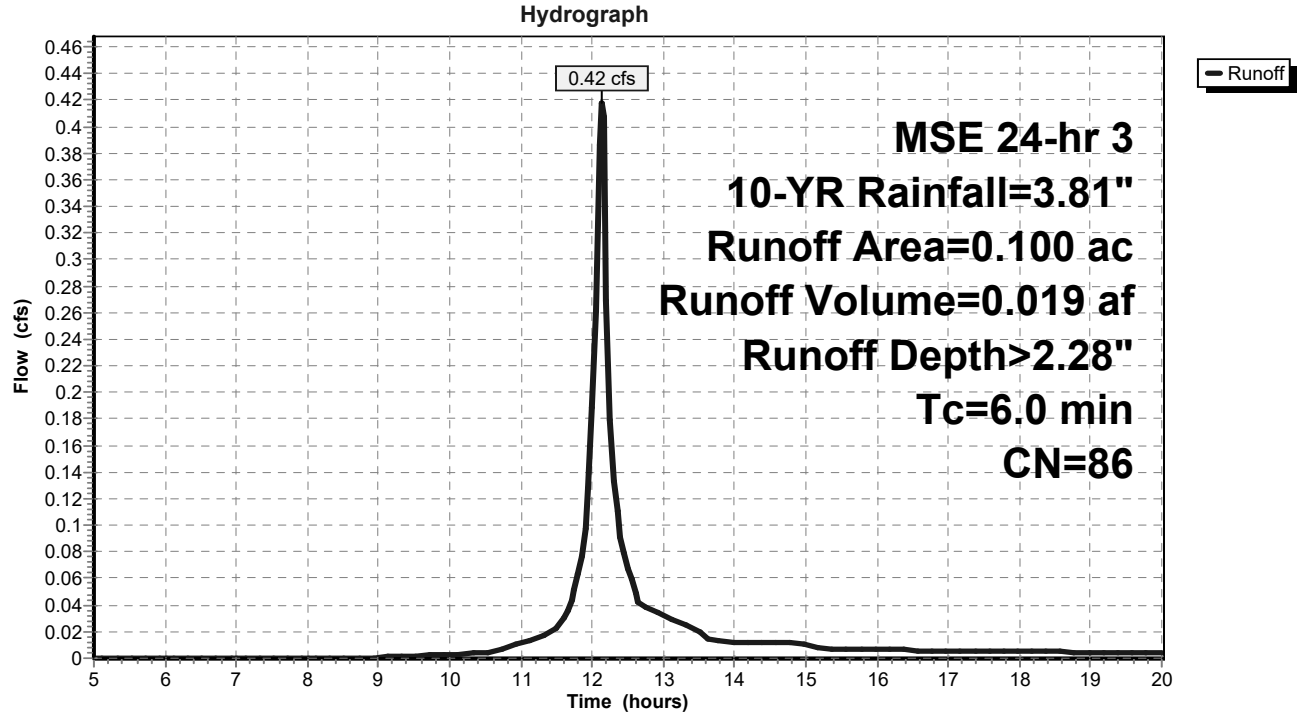
Runoff = 0.42 cfs @ 12.13 hrs, Volume= 0.019 af, Depth> 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-YR Rainfall=3.81"

	Area (ac)	CN	Description
*	0.050	98	WALK
*	0.050	74	GRASS
	0.100	86	Weighted Average
	0.050		50.00% Pervious Area
	0.050		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment U: UNDETAINED



Summary for Pond BIO: BIORETENTION

Inflow Area = 1.400 ac, 75.00% Impervious, Inflow Depth > 2.89" for 10-YR event
Inflow = 2.10 cfs @ 12.17 hrs, Volume= 0.337 af
Outflow = 0.88 cfs @ 13.51 hrs, Volume= 0.337 af, Atten= 58%, Lag= 80.2 min
Primary = 0.88 cfs @ 13.51 hrs, Volume= 0.337 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 20.00' Surf.Area= 0 sf Storage= 0 cf
Peak Elev= 23.79' @ 13.51 hrs Surf.Area= 2,796 sf Storage= 3,942 cf

Plug-Flow detention time= 36.3 min calculated for 0.336 af (100% of inflow)
Center-of-Mass det. time= 36.1 min (808.9 - 772.9)

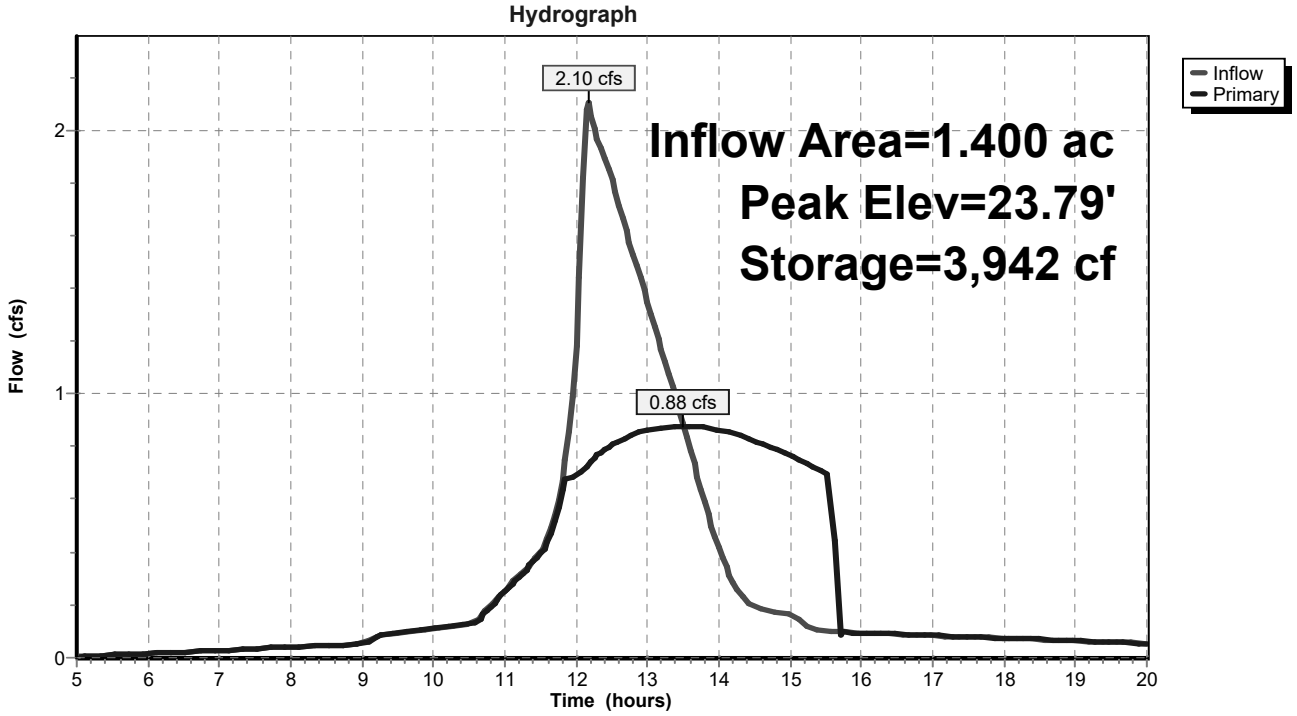
Volume	Invert	Avail.Storage	Storage Description
#1	22.00'	7,800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
22.00	1,600	0	0
25.00	3,600	7,800	7,800

Device	Routing	Invert	Outlet Devices
#1	Primary	19.25'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	24.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.88 cfs @ 13.51 hrs HW=23.79' (Free Discharge)
↑ **1=Orifice/Grate** (Orifice Controls 0.88 cfs @ 10.07 fps)
2=Orifice/Grate (Controls 0.00 cfs)

Pond BIO: BIORETENTION



Summary for Pond CFRP: CONTROLLED FLOW ROOF POND

Inflow Area = 1.200 ac, 87.50% Impervious, Inflow Depth > 3.14" for 10-YR event
Inflow = 6.29 cfs @ 12.13 hrs, Volume= 0.314 af
Outflow = 1.78 cfs @ 12.32 hrs, Volume= 0.314 af, Atten= 72%, Lag= 11.6 min
Primary = 1.78 cfs @ 12.32 hrs, Volume= 0.314 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 100.34' @ 12.32 hrs Surf.Area= 25,032 sf Storage= 4,280 cf

Plug-Flow detention time= 21.5 min calculated for 0.314 af (100% of inflow)
Center-of-Mass det. time= 21.3 min (771.2 - 749.9)

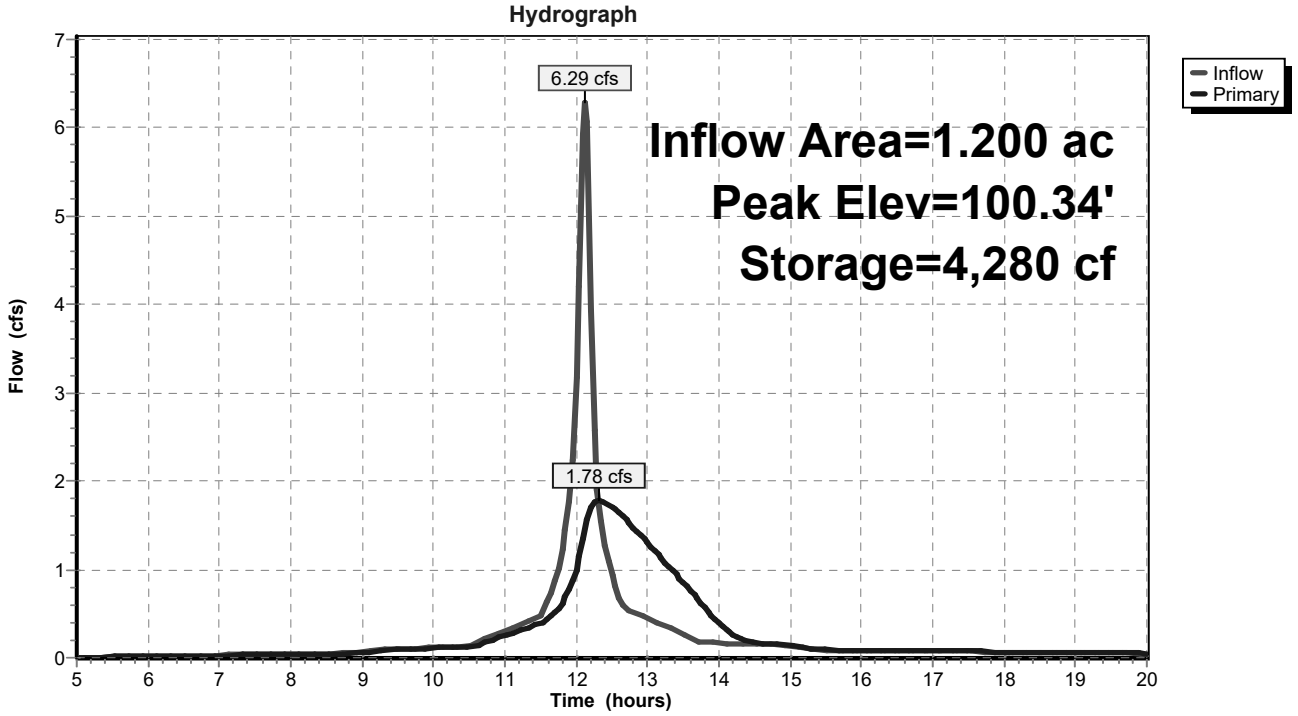
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	9,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 10

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
100.00	0	0	0
100.50	3,660	915	915

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**2 - 10gpm notch per fixture X 10.00** Head (feet) 0.00 0.50 Disch. (cfs) 0.000 0.260

Primary OutFlow Max=1.78 cfs @ 12.32 hrs HW=100.34' (Free Discharge)
↑—**1=2 - 10gpm notch per fixture** (Custom Controls 1.78 cfs)

Pond CFRP: CONTROLLED FLOW ROOF POND

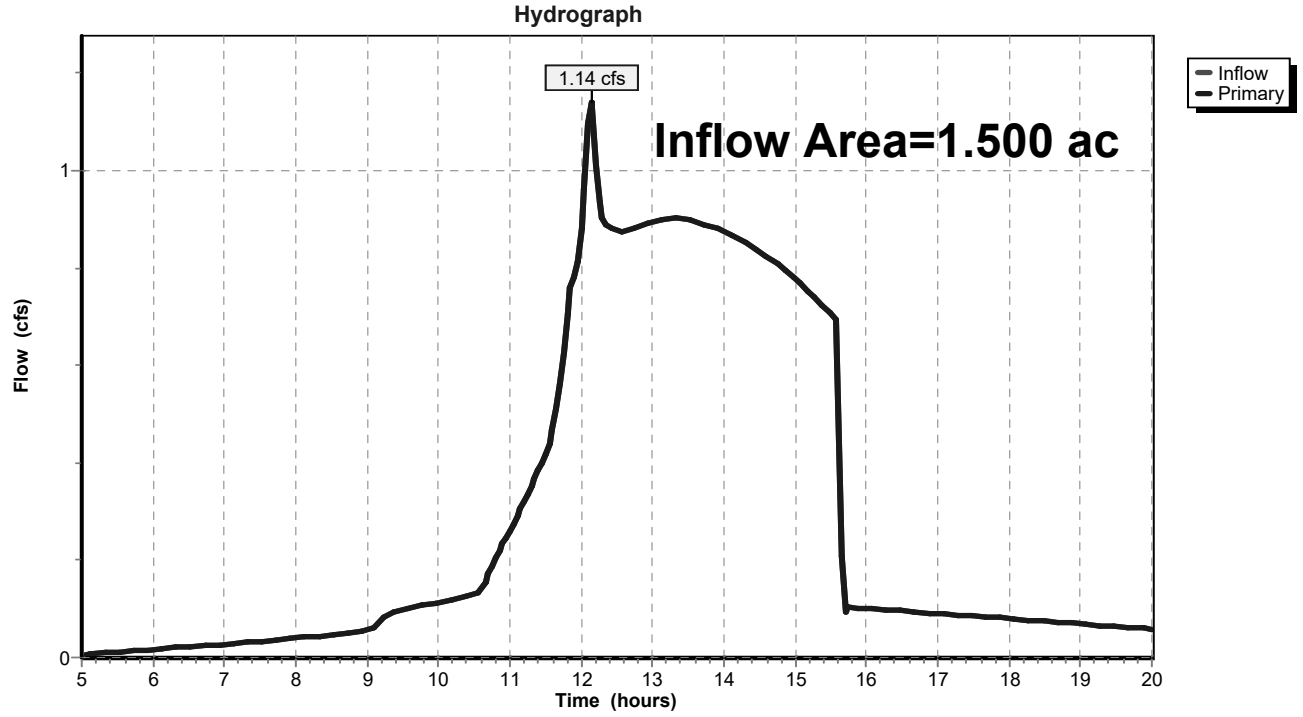


Summary for Link PSD: PROP SITE DISCHARGE

Inflow Area = 1.500 ac, 73.33% Impervious, Inflow Depth > 2.85" for 10-YR event
Inflow = 1.14 cfs @ 12.14 hrs, Volume= 0.356 af
Primary = 1.14 cfs @ 12.14 hrs, Volume= 0.356 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link PSD: PROP SITE DISCHARGE



Summary for Subcatchment AC: AREA TO BIORETENTION

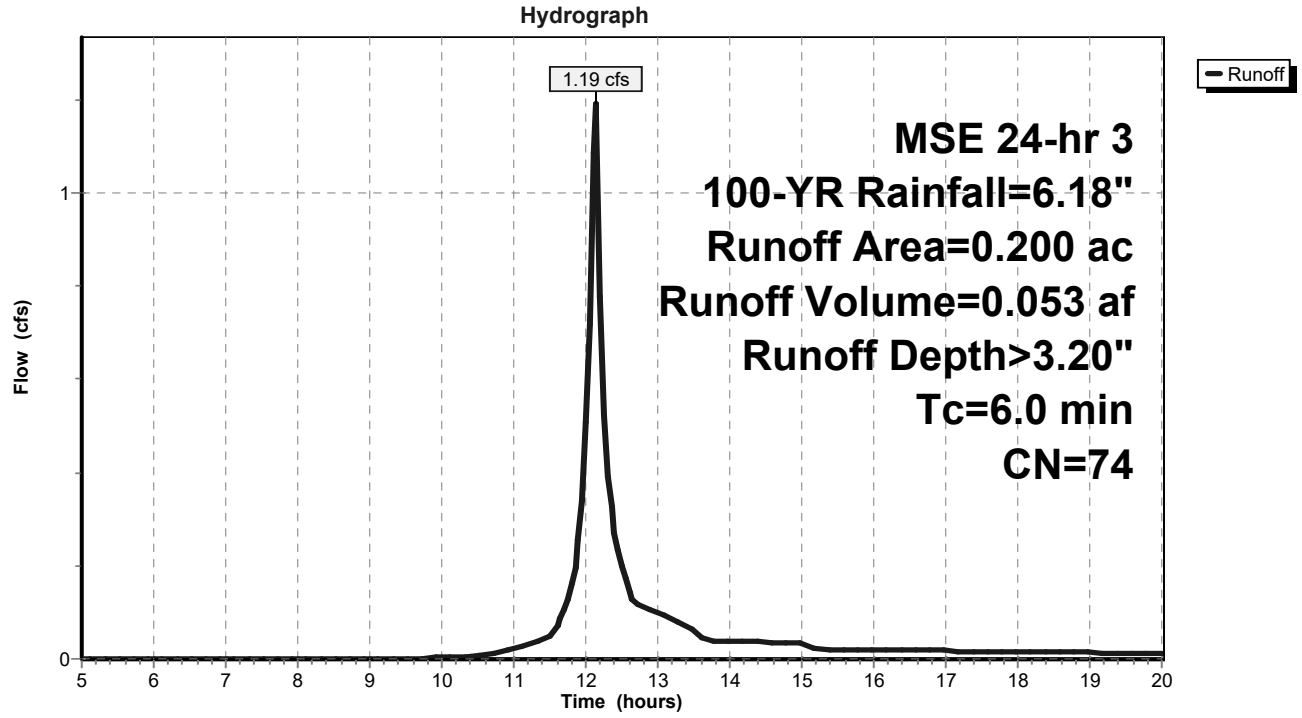
Runoff = 1.19 cfs @ 12.13 hrs, Volume= 0.053 af, Depth> 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-YR Rainfall=6.18"

	Area (ac)	CN	Description
*	0.200	74	GRASS
	0.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment AC: AREA TO BIORETENTION



Summary for Subcatchment CFRA: CONTROLLED FLOW ROOF AREA

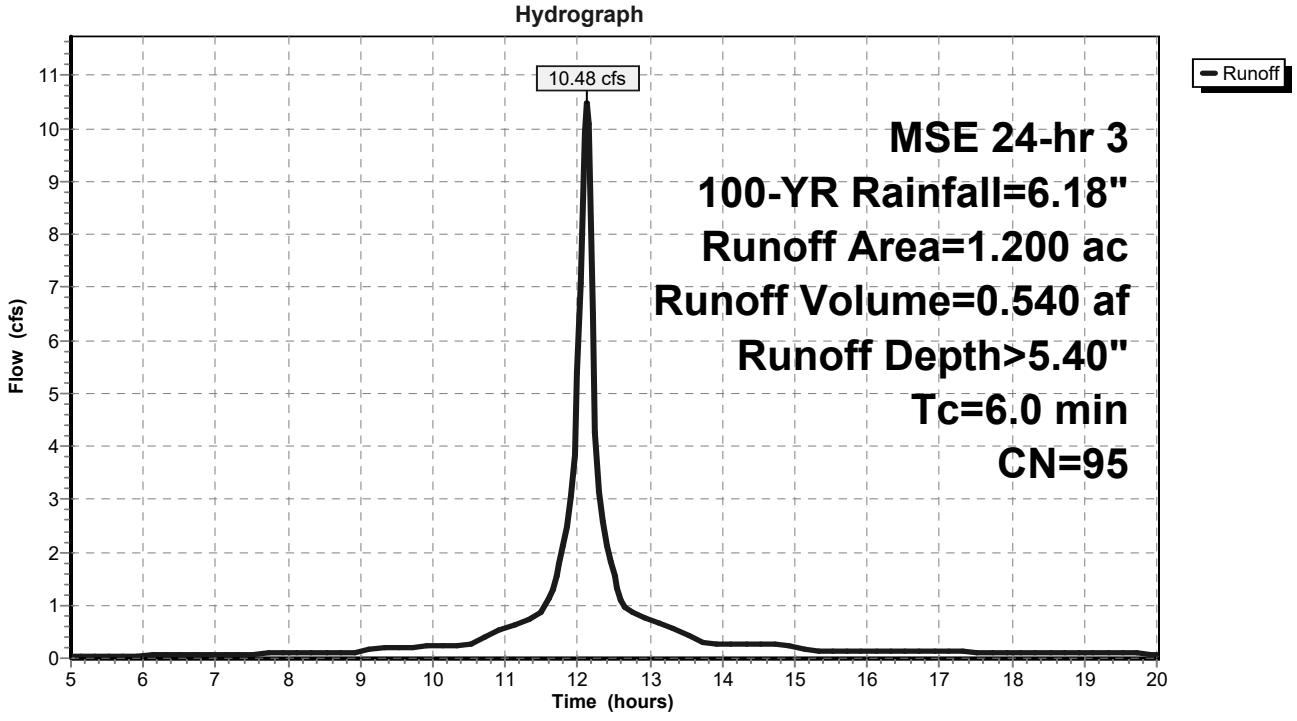
Runoff = 10.48 cfs @ 12.13 hrs, Volume= 0.540 af, Depth> 5.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-YR Rainfall=6.18"

	Area (ac)	CN	Description
*	1.050	98	ROOF
*	0.150	74	GREEN ROOF
	1.200	95	Weighted Average
	0.150		12.50% Pervious Area
	1.050		87.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment CFRA: CONTROLLED FLOW ROOF AREA



Summary for Subcatchment U: UNDETAINED

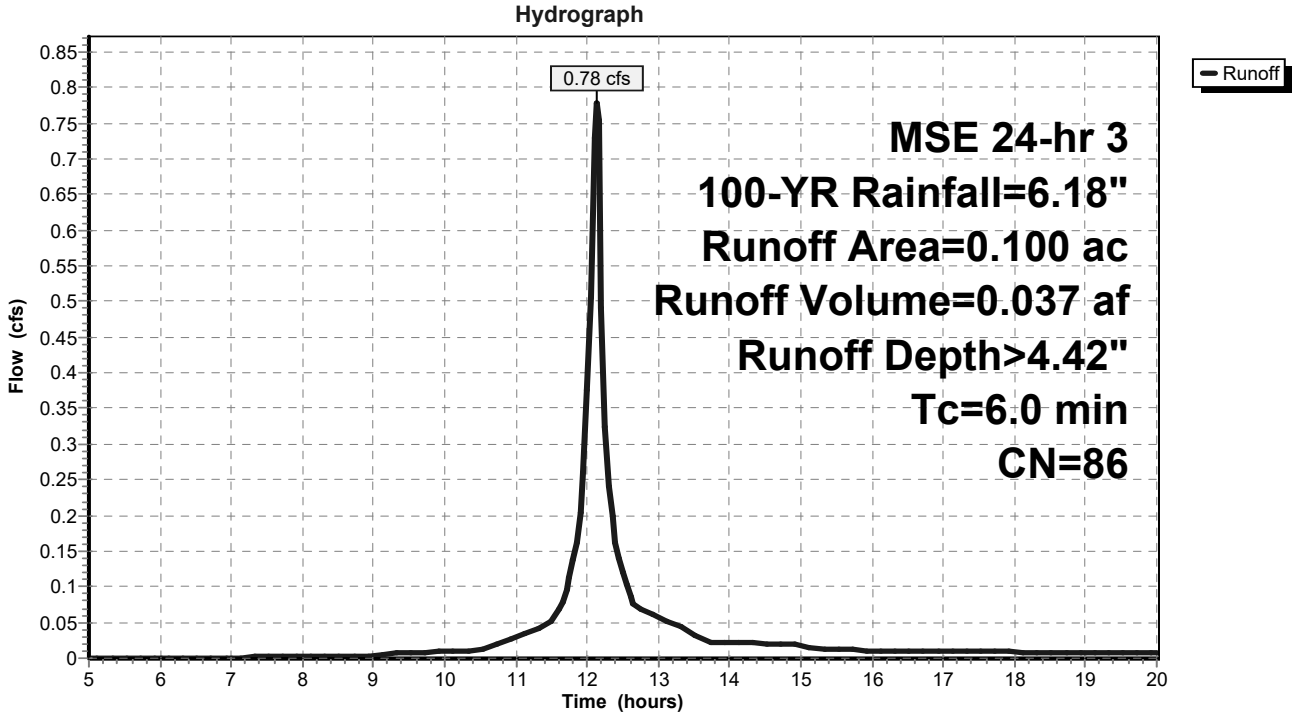
Runoff = 0.78 cfs @ 12.13 hrs, Volume= 0.037 af, Depth> 4.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-YR Rainfall=6.18"

	Area (ac)	CN	Description
*	0.050	98	WALK
*	0.050	74	GRASS
	0.100	86	Weighted Average
	0.050		50.00% Pervious Area
	0.050		50.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN PER TR55**

Subcatchment U: UNDETAINED



Summary for Pond BIO: BIORETENTION

Inflow Area = 1.400 ac, 75.00% Impervious, Inflow Depth > 5.09" for 100-YR event
Inflow = 3.31 cfs @ 12.16 hrs, Volume= 0.594 af
Outflow = 2.37 cfs @ 12.75 hrs, Volume= 0.593 af, Atten= 28%, Lag= 35.6 min
Primary = 2.37 cfs @ 12.75 hrs, Volume= 0.593 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Starting Elev= 20.00' Surf.Area= 0 sf Storage= 0 cf
Peak Elev= 24.13' @ 12.75 hrs Surf.Area= 3,021 sf Storage= 4,923 cf

Plug-Flow detention time= 37.9 min calculated for 0.591 af (100% of inflow)
Center-of-Mass det. time= 37.6 min (811.1 - 773.5)

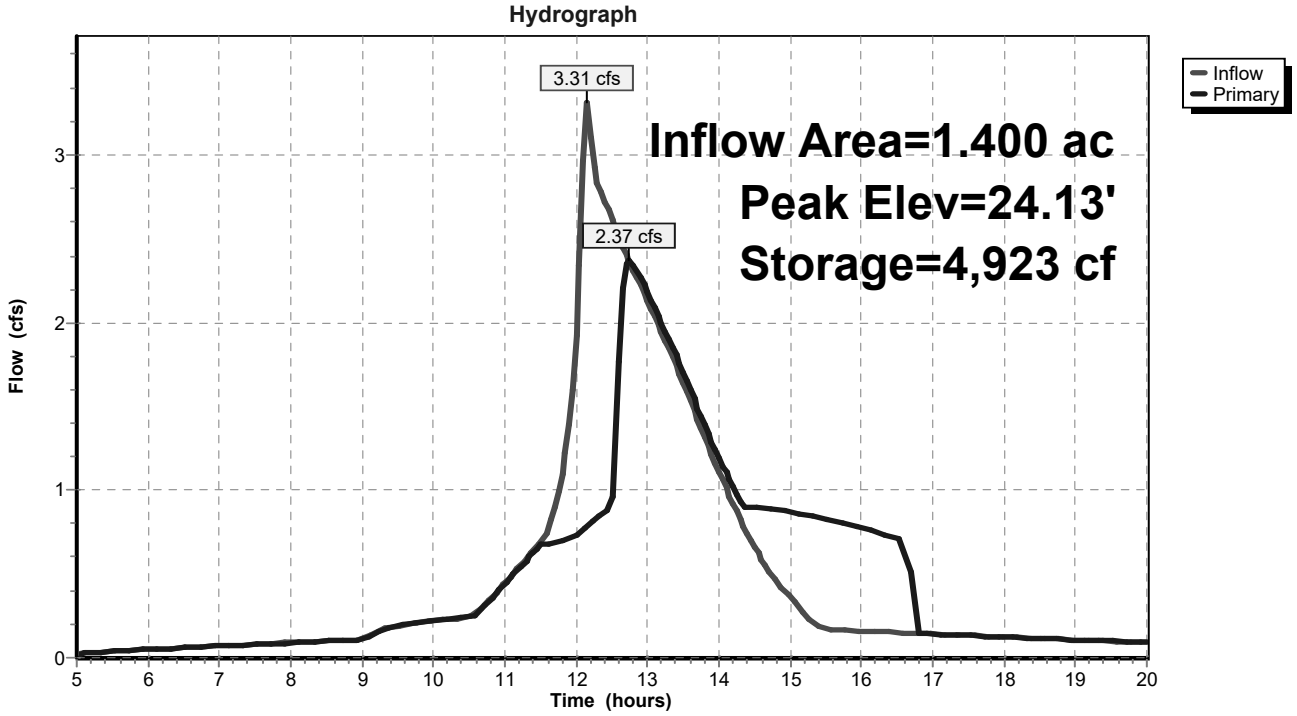
Volume	Invert	Avail.Storage	Storage Description
#1	22.00'	7,800 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
22.00	1,600	0	0
25.00	3,600	7,800	7,800

Device	Routing	Invert	Outlet Devices
#1	Primary	19.25'	**4.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	24.00'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.37 cfs @ 12.75 hrs HW=24.13' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.91 cfs @ 10.45 fps)
└**2=Orifice/Grate** (Weir Controls 1.46 cfs @ 1.18 fps)

Pond BIO: BIORETENTION



Summary for Pond CFRP: CONTROLLED FLOW ROOF POND

Inflow Area = 1.200 ac, 87.50% Impervious, Inflow Depth > 5.40" for 100-YR event
Inflow = 10.48 cfs @ 12.13 hrs, Volume= 0.540 af
Outflow = 2.46 cfs @ 12.36 hrs, Volume= 0.540 af, Atten= 77%, Lag= 14.2 min
Primary = 2.46 cfs @ 12.36 hrs, Volume= 0.540 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 100.47' @ 12.36 hrs Surf.Area= 34,579 sf Storage= 8,168 cf

Plug-Flow detention time= 30.6 min calculated for 0.540 af (100% of inflow)
Center-of-Mass det. time= 30.4 min (772.7 - 742.4)

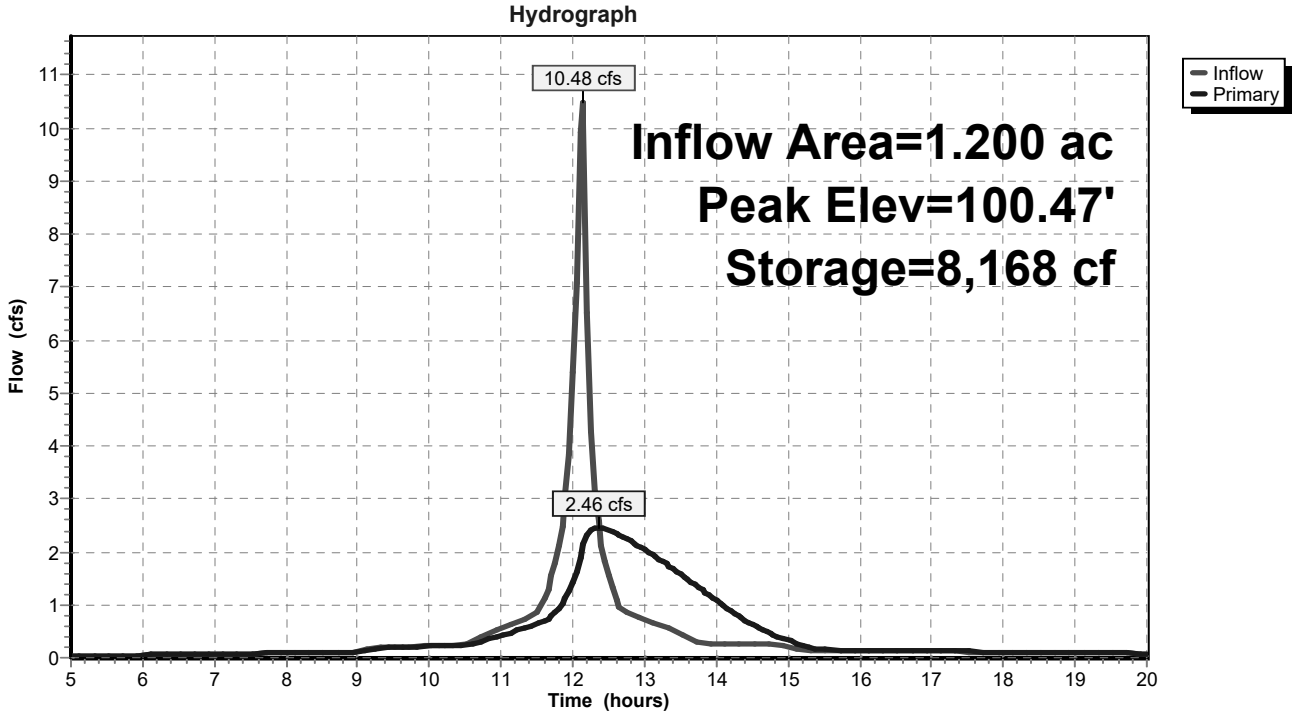
Volume	Invert	Avail.Storage	Storage Description
#1	100.00'	9,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) x 10

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
100.00	0	0	0
100.50	3,660	915	915

Device	Routing	Invert	Outlet Devices
#1	Primary	100.00'	**2 - 10gpm notch per fixture X 10.00** Head (feet) 0.00 0.50 Disch. (cfs) 0.000 0.260

Primary OutFlow Max=2.46 cfs @ 12.36 hrs HW=100.47' (Free Discharge)
↑—**1=2 - 10gpm notch per fixture** (Custom Controls 2.46 cfs)

Pond CFRP: CONTROLLED FLOW ROOF POND

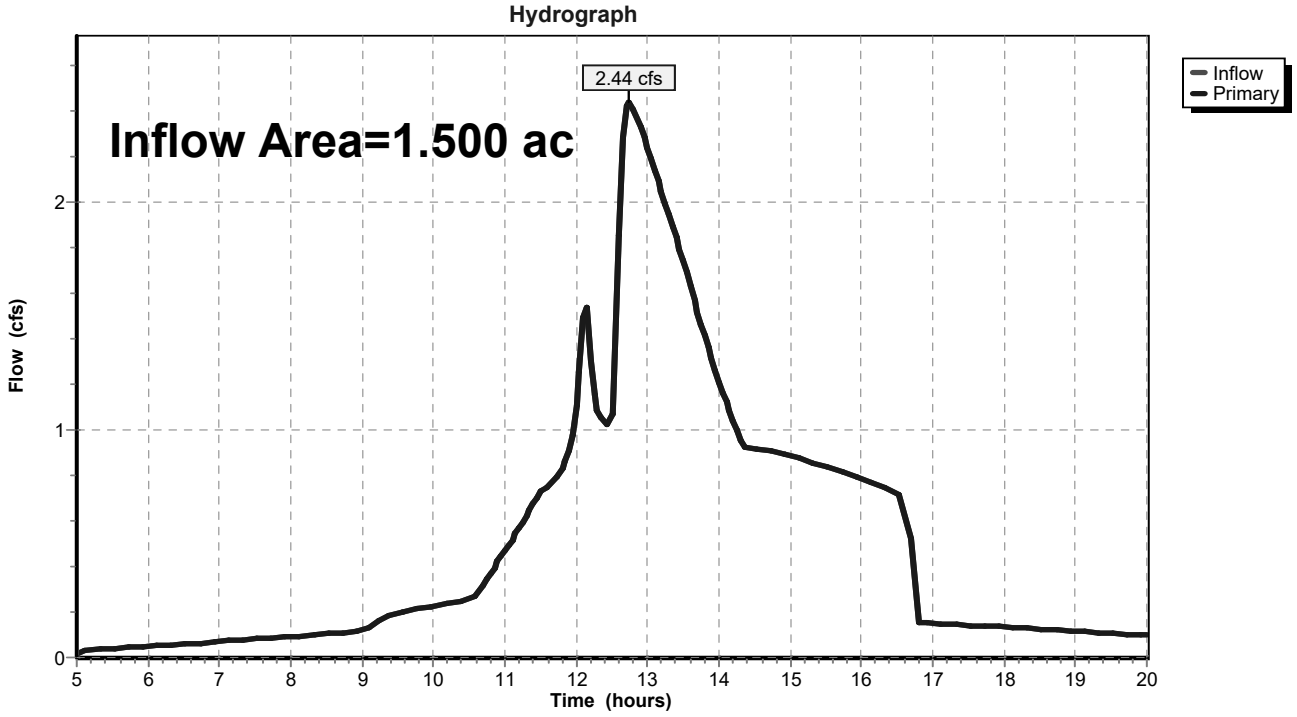


Summary for Link PSD: PROP SITE DISCHARGE

Inflow Area = 1.500 ac, 73.33% Impervious, Inflow Depth > 5.04" for 100-YR event
Inflow = 2.44 cfs @ 12.75 hrs, Volume= 0.630 af
Primary = 2.44 cfs @ 12.75 hrs, Volume= 0.630 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link PSD: PROP SITE DISCHARGE



APPENDIX 4
POST DEVELOPMENT CONDITIONS WATER QUALITY

Data file name: Z:\Projects\2019\1687.00-WI\DESIGN\SWMP\SLAMM\PRELIM.mdb
WinSLAMM Version 10.4.0
Rain file name: C:\WinSLAMM Files\Rain Files\WI Milwaukee 69.RAN
Particulate Solids Concentration file name: C:\WinSLAMM Files\v10.1 WI_AVG01.pscx
Runoff Coefficient file name: C:\WinSLAMM Files\WI_SL06 Dec06.rsvx
Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std
Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance: False
Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI_GEO03.ppdx
Source Area PSD and Peak to Average Flow Ratio File: C:\WinSLAMM Files\NURP Source Area PSD Files.csv
Cost Data file name:
If Other Device Pollutant Load Reduction Values = 1, Off-site Pollutant Loads are Removed from Pollutant Load % Reduction calculations
Seed for random number generator: -42
Study period starting date: 01/05/69 Study period ending date: 12/31/69
Start of Winter Season: 12/05 End of Winter Season: 03/28
Date: 09-30-2020 Time: 10:25:39
Site information:

LU# 1 - Residential: AREA TO BIORETENTION Total area (ac): 1.400
  1 - Roofs 1: 1.050 ac. Flat Connected Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
  51 - Small Landscaped Areas 1: 0.350 ac. Normal Clayey Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
LU# 2 - Residential: UNDETAINED Total area (ac): 0.100
  31 - Sidewalks 1: 0.050 ac. Connected Source Area PSD File: C:\WinSLAMM Files\NURP.cpz
  51 - Small Landscaped Areas 1: 0.050 ac. Normal Silty Source Area PSD File: C:\WinSLAMM Files\NURP.cpz

Control Practice 1: Biofilter CP# 1 (DS) - DS Biofilters # 1
1. Top area (square feet) = 3600
2. Bottom aea (square feet) = 1600
3. Depth (ft): 6
4. Biofilter width (ft) - for Cost Purposes Only: 10
5. Infiltration rate (in/hr) = 0.5
6. Random infiltration rate generation? No
7. Infiltration rate fraction (side): 0.01
8. Infiltration rate fraction (bottom): 1
9. Depth of biofilter that is rock filled (ft) 1
10. Porosity of rock filled volume = 0.35
11. Engineered soil infiltration rate: 3.6
12. Engineered soil depth (ft) = 2
13. Engineered soil porosity = 0.25

14. Percent solids reduction due to flow through engineered soil = 80
15. Biofilter peak to average flow ratio = 3.8
16. Number of biofiltration control devices = 1
17. Particle size distribution file: Not needed - calculated by program
18. Initial water surface elevation (ft): 0

Soil Data — Soil Type Fraction in Eng. Soil

User-Defined Soil Type — 1.000

Biofilter Outlet/Discharge Characteristics:

Outlet type: Broad Crested Weir

1. Weir crest length (ft): 0.1
2. Weir crest width (ft): 0.1
3. Height of datum to bottom of weir opening: 5.99

Outlet type: Vertical Stand Pipe

1. Stand pipe diameter (ft): 3
2. Stand pipe height above datum (ft): 5

Outlet type: Drain Tile/Underdrain

1. Underdrain outlet diameter (ft): 0.33
2. Invert elevation above datum (ft): 0.25
3. Number of underdrain outlets: 1

SLAMM for Windows Version 10.4.0

Data file name: Z:\Projects\2019\1687.00-WI\DESIGN\SWMP\SLAMM\PRELIM.mdb
Data file description:
Rain file name: C:\WinSLAMM Files\Rain Files\WI Milwaukee 69.RAN
Particulate Solids Concentration file name: C:\WinSLAMM Files\v10.1 WI_AVG01.pscx
Runoff Coefficient file name: C:\WinSLAMM Files\WI_SL06 Dec06.rsvx
Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std
Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std
Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std
Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI_GEO03.ppdx
Start of Winter Season: 12/05 End of Winter Season: 03/28
Model Run Start Date: 01/05/69 Model Run End Date: 12/31/69
Date of run: 09-30-2020 Time of run: 10:25:58
Total Area Modeled (acres): 1.500
Years in Model Run: 0.99

	Runoff Volume (cu ft)	Percent Runoff Volume Reduction	Particulate Solids Conc. (mg/L)	Particulate Solids Yield (lbs)	Percent Particulate Solids Reduction
Total of all Land Uses without Controls:	92257	-	44.55	256.6	-
Outfall Total with Controls:	57288	37.90%	14.16	50.64	80.27%
Annualized Total After Outfall Controls:	58084			51.35	