

Stormwater Management Report

Front Street Place
Mankato, Minnesota

February 24th, 2026

Project No. 25-33587



Architecture
Engineering
Environmental
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REPORT FOR:
City of Mankato
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SIGNATURE SHEET

I HEREBY CERTIFY THAT THESE CALCULATIONS WERE PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.



Nathan J. Hermer, **P.E.**
Project Engineer
Reg. No. 54848

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Mankato, MN 56001

Front Street Place
Mankato, MN

Engineer's Project Number: 25-33587

Dated this 24th day of February 2026

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INTRODUCTION

This stormwater management report was prepared for the redevelopment of the city block contained within South Front Street, Warren Street, West Liberty Street, and South Riverfront Drive in Mankato, MN. The property area is 2.61 acres. The proposed development will include new mixed use development including apartments, office space, restaurants, retail and a parking garage. The improvements will include grading, underground utility installation, curb and gutter, underground stormwater management, and pavement surfacing.

In concurrence with the production of site plans, hydrologic and hydraulic models were developed to generate the data presented within this report. Given that the project will disturb more than one acre of land, an NPDES Construction Stormwater Permit will be required. This project is also subject to the City of Mankato's stormwater rate control and water quality requirements.

DRAINAGE CONDITIONS

Existing Site

The project property has historically been the site of local businesses, a Walgreens, and one residential house. The site drains in two different directions. The first direction is to the north, towards the corner of Riverfront Drive and Warren Street. The North drainage area is approximately 1.53 acres in size and accepts water from portions of the historical Walgreens and the parking lot associated with it. The second direction is to the west, towards the corner of West Liberty Street and S Riverfront Drive. The West drainage area is approximately 1.08 acres in size, and accepts water from the local businesses, the residential house, and the final portions of the Walgreens. More information on the existing drainage areas can be found on the Existing Conditions Drainage Map in Appendix A.

Table 1. Existing Drainage Areas

Drainage Area	Total Area [ac]	Impervious Area [ac]	Pervious Area [ac]	Discharge Point
North	1.53	1.53	0	S Riverfront Dr & Warren St Corner
West	1.08	1.08	0	W Liberty St & S Riverfront Dr Corner
Total	2.61	2.61	0	-

Proposed Site

The proposed project will provide a multitude of different spaces for offices, residential, and businesses alike. These spaces are not increasing any impervious area to the site, as the exiting site is entirely impervious. Additionally, there are no wetlands on site, and the proposed project will not have any increased impact on any downstream waters.

The proposed site is to be captured in one drainage area that is approximately 2.61 acres in size. This drainage area will outlet into the existing storm sewer on Warren Street, in-line with the alleyway to the City Center parking ramp.

Table 2. Proposed Drainage Areas

Drainage Area	Total Area [ac]	Impervious Area [ac]	Pervious Area [ac]	Discharge Point
Total	2.61	2.61	0	Warren Street

Soil Conditions

The USDA's Web Soil Survey (WSS) was used to review the existing soils. Based on the findings from WSS, the soil type on site is to be modeled using Hydraulic Soil Group (HSG) D soils.

STORMWATER MANAGEMENT

Stormwater Regulations

The location of the project involves two agencies with stormwater management requirements: the Minnesota Pollution Control Agency (MPCA NPDES Construction Stormwater Permit) and the City of Mankato. The project exceeds all agencies' disturbance thresholds, and as such, must meet all applicable stormwater rate control and water quality requirements. The City of Mankato standards are more stringent than the MPCA requirements; thus, meeting the City of Mankato's requirements indicates that the site inherently complies with MPCA regulations.

Stormwater System Overview

Hydrologic and hydraulic calculations were performed for the existing and proposed drainage conditions using the rainfalls depths obtained for the City of Mankato and the MSE-3 24-hour rainfall distribution curve. The stormwater management system consists of two drainage areas and one storage basin that were modeled in HydroCAD to ensure the site meets rate control and water quality standards. Given the poor soils, infiltration was deemed infeasible for the site. Given the limitation on drained soils and lack of available space, the Engineer opted to pursue underground storage.

The underground basin discharge point is shown on the Proposed Drainage Map in Appendix A. Final design elevations and discharge rates for each storm event will be provided with the final design.

Stormwater Rate Control

The City of Mankato requires that the proposed peak discharge rate does not exceed the existing peak discharge rates for the 2-, 10-, and 100-year 24-hour rainfall. In addition to these storm events, the City of Mankato also requires that peak discharge rates do not exceed the existing peak discharge rates for two back-to-back 10-year 24-hour storm events. An overall summary of the existing and proposed peak discharge rates is available in Table 3. The peak discharge rates decrease from existing conditions for each storm event.

Table 3. Peak Discharge Rates

Storm Event	Existing [cfs]	Proposed [cfs]
2-year	9.25	7.88
10-year	13.92	12.19
10-year Back-to-Back	14.01	12.28
100-year	23.50	19.56

Water Quality

WATER QUALITY VOLUME

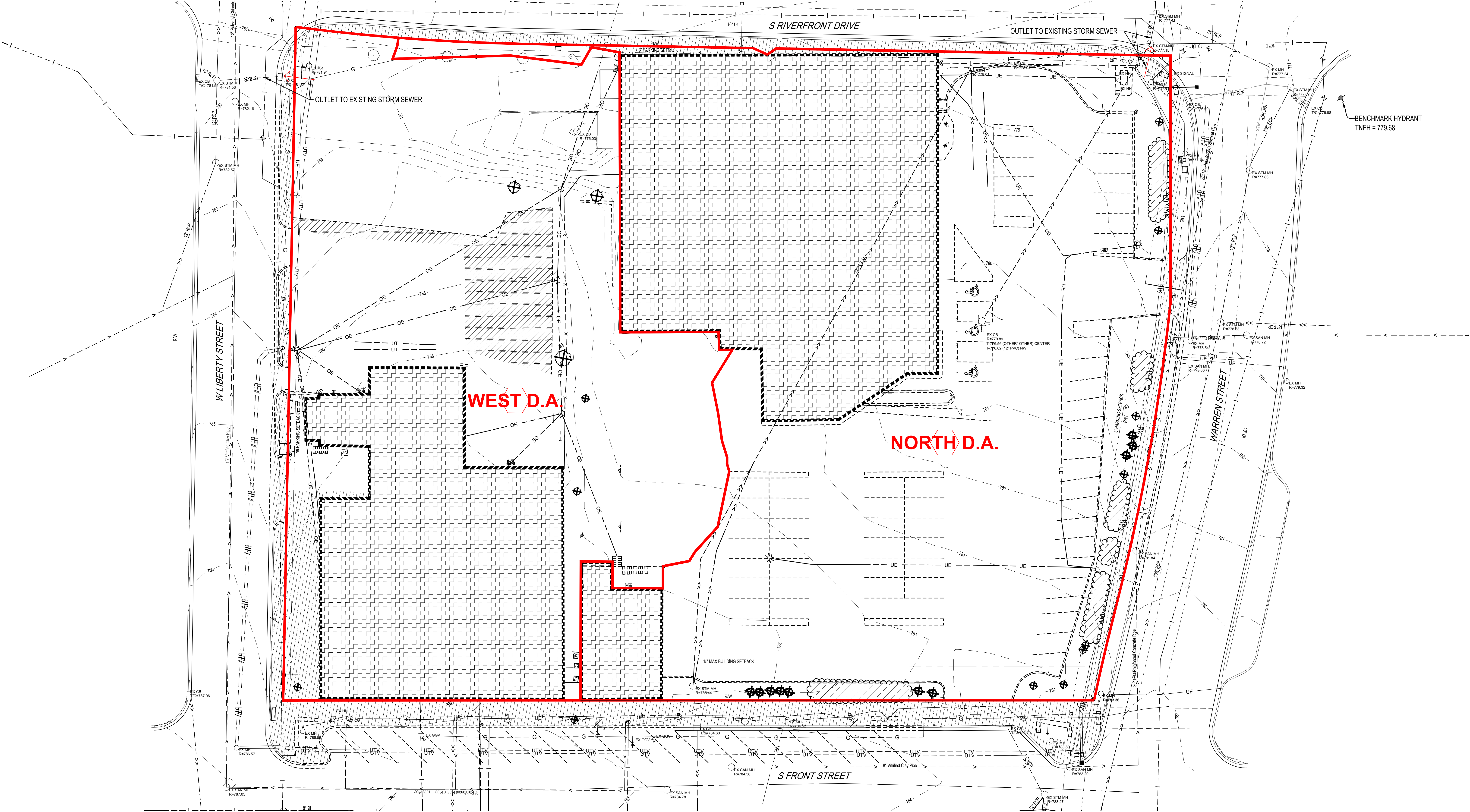
The City of Mankato requires that 1.1 inches of runoff across new and reconstructed impervious surfaces be retained as the water quality volume. If the volume requirement is met, then Total Suspended Solids (TSS) and Total Phosphorus (TP) requirements shall be considered met.

Due to the predominately clay soil and lack of space on the site, underground storage basins are proposed to meet the water quality requirements. Appendix B shows the calculations of water quality discharge rate for the underground storage basin.

CONCLUSION

The proposed project provides a stormwater management system that meets all MPCA NPDES and City of Mankato requirements. The NPDES Construction Stormwater Permit will be applied for prior to construction and available as soon as the permit is obtained. The proposed project as designed provides rate control, water quality volume, and detention requirements.

Appendix A: Existing + Proposed Condition Drainage Maps

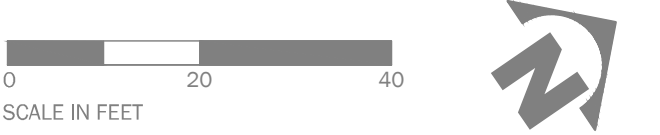


EXISTING DRAINAGE MAP

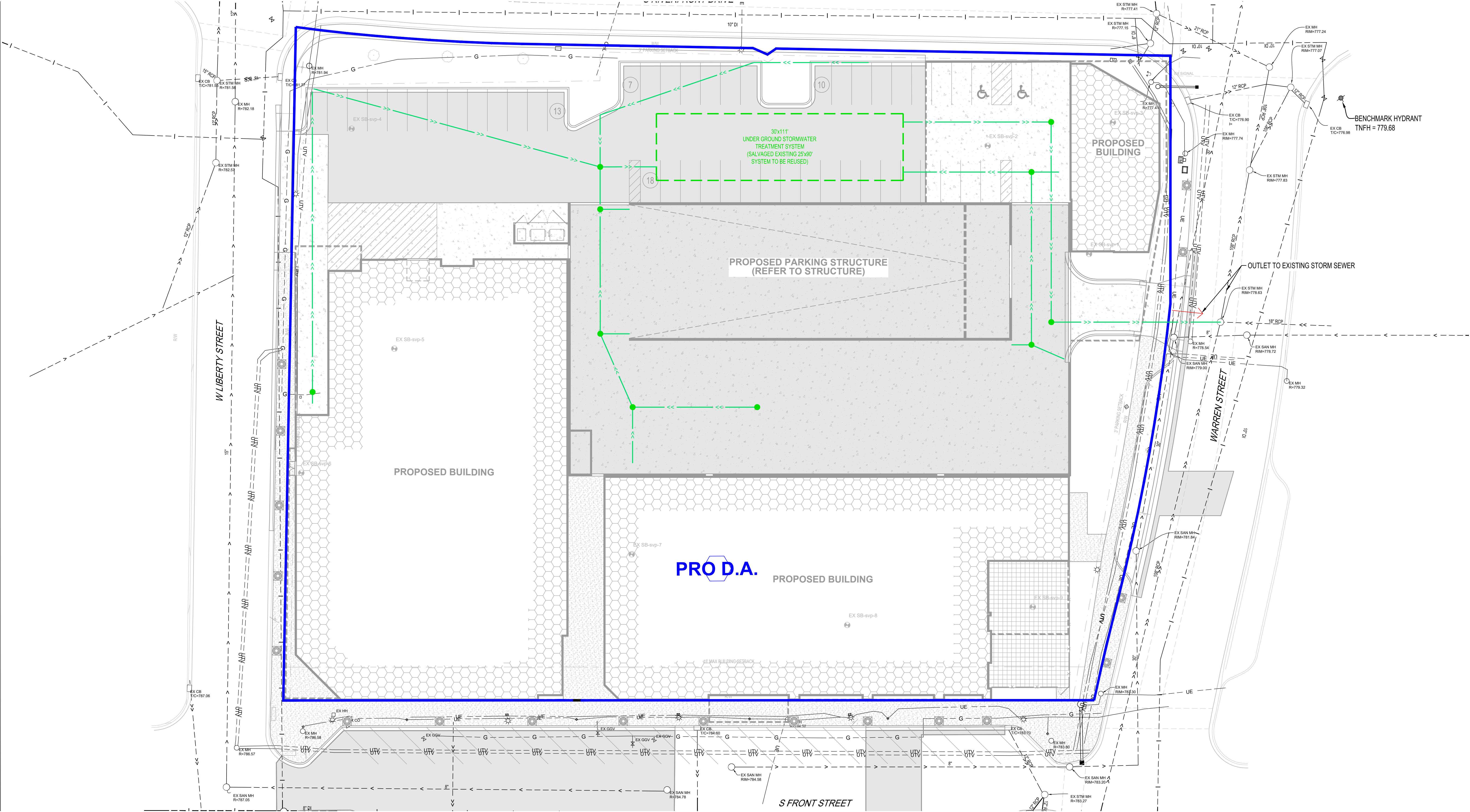


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FRONT STREET REDEVELOPMENT
MANKATO, MINNESOTA - 02/24/2026
ISG PROJECT NO. 25-33587



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PROPOSED DRAINAGE MAP

Appendix B: Storage Calculations



Storage Calculations

Project No.	33587
Date	2/18/26
By	Ian Moran

Project Name: Front Street
Pond ID: Underground Detention

INFILTRATION BASIN

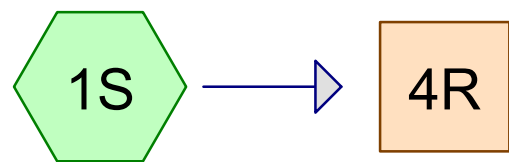
Total Drainage Area to Basin Acres

New Impervious Area to Basin Acres

New Impervious Area to Basin 113692 Square Feet

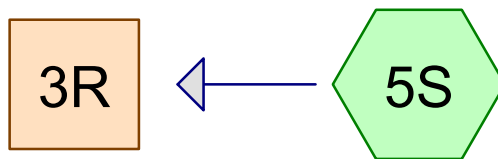
Required Water Quality Volume 0.24 Acre-Feet

Required Water Quality Volume 10421.73 Cubic Feet



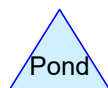
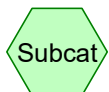
Riverfront

12-in Outlet Pipe



15-in Outlet Pipe

Liberty Street



Routing Diagram for 33587 Front Street Existing

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33587 Front Street Existing

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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	MSE 24-hr	3	Default	24.00	1	2.87	2
2	10-yr	MSE 24-hr	3	Default	24.00	1	4.28	2
3	10-yrb2b	MSE 24-hr	3	Default	24.00	2	4.28	2
4	100-yr	MSE 24-hr	3	Default	24.00	1	7.19	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.613	98	Paved parking, HSG D (1S, 5S)
2.613	98	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
2.613	HSG D	1S, 5S
0.000	Other	
2.613		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	2.613	0.000	2.613	Paved parking	1S, 5S
0.000	0.000	0.000	2.613	0.000	2.613	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	3R	772.21	772.10	27.5	0.0040	0.013	0.0	15.0	0.0	
2	4R	773.11	771.98	14.5	0.0779	0.013	0.0	12.0	0.0	

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MSE 24-hr 3 2-yr Rainfall=2.87"

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Time span=0.00-108.00 hrs, dt=0.05 hrs, 2161 points

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

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

Subcatchment1S: Riverfront

Runoff Area=1.527 ac 100.00% Impervious Runoff Depth=2.64"

Tc=10.0 min CN=98 Runoff=5.41 cfs 0.336 af

Subcatchment5S: Liberty Street

Runoff Area=1.086 ac 100.00% Impervious Runoff Depth=2.64"

Tc=10.0 min CN=98 Runoff=3.85 cfs 0.239 af

Reach 3R: 15-in Outlet Pipe

Avg. Flow Depth=0.96' Max Vel=3.78 fps Inflow=3.85 cfs 0.239 af

15.0" Round Pipe n=0.013 L=27.5' S=0.0040 '/' Capacity=4.09 cfs Outflow=3.82 cfs 0.239 af

Reach 4R: 12-in Outlet Pipe

Avg. Flow Depth=0.53' Max Vel=12.87 fps Inflow=5.41 cfs 0.336 af

12.0" Round Pipe n=0.013 L=14.5' S=0.0779 '/' Capacity=9.95 cfs Outflow=5.40 cfs 0.336 af

Total Runoff Area = 2.613 ac Runoff Volume = 0.575 af Average Runoff Depth = 2.64"
0.00% Pervious = 0.000 ac 100.00% Impervious = 2.613 ac

33587 Front Street Existing

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MSE 24-hr 3 2-yr Rainfall=2.87"

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Summary for Subcatchment 1S: Riverfront

Runoff = 5.41 cfs @ 12.17 hrs, Volume= 0.336 af, Depth= 2.64"
Routed to Reach 4R : 12-in Outlet Pipe

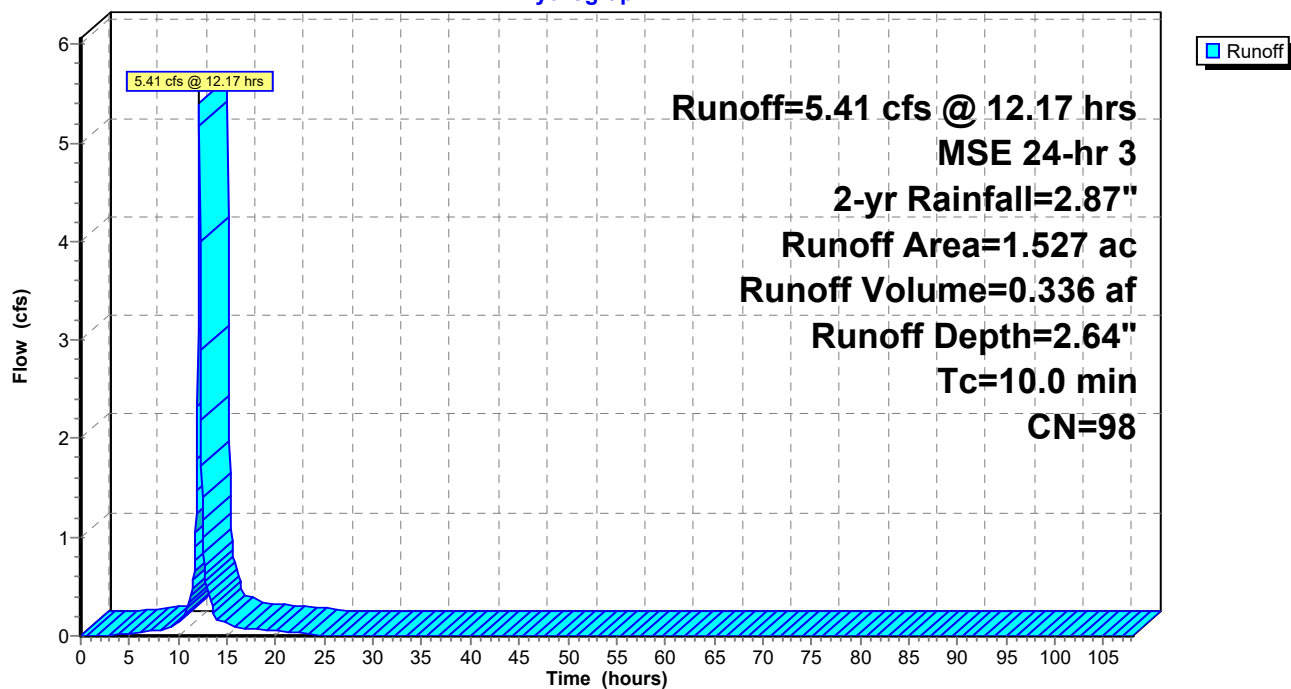
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-yr Rainfall=2.87"

Area (ac)	CN	Description
1.527	98	Paved parking, HSG D
1.527		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 Minute Minimum

Subcatchment 1S: Riverfront

Hydrograph



33587 Front Street Existing

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MSE 24-hr 3 2-yr Rainfall=2.87"

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Summary for Subcatchment 5S: Liberty Street

Runoff = 3.85 cfs @ 12.17 hrs, Volume= 0.239 af, Depth= 2.64"
Routed to Reach 3R : 15-in Outlet Pipe

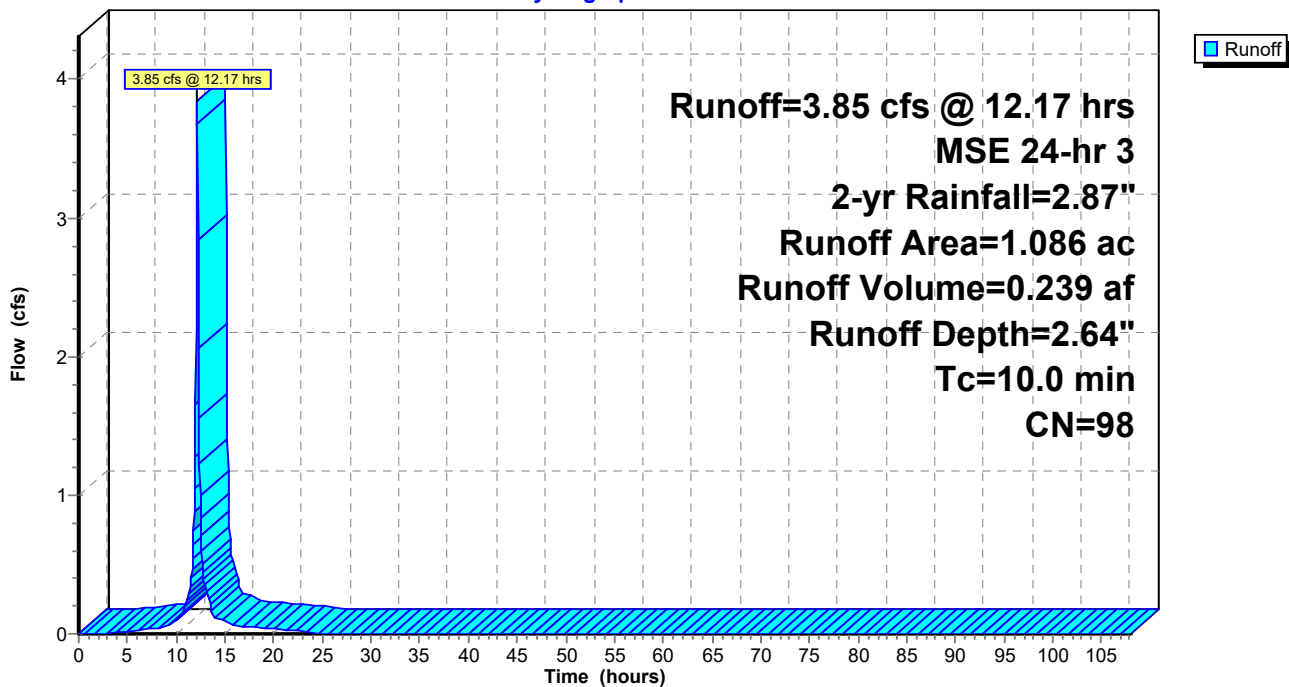
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-yr Rainfall=2.87"

Area (ac)	CN	Description
1.086	98	Paved parking, HSG D
1.086		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 min Minimum

Subcatchment 5S: Liberty Street

Hydrograph



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MSE 24-hr 3 2-yr Rainfall=2.87"

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Summary for Reach 3R: 15-in Outlet Pipe

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.086 ac, 100.00% Impervious, Inflow Depth = 2.64" for 2-yr event
Inflow = 3.85 cfs @ 12.17 hrs, Volume= 0.239 af
Outflow = 3.82 cfs @ 12.17 hrs, Volume= 0.239 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 3.78 fps, Min. Travel Time= 0.1 min

Avg. Velocity= 1.18 fps, Avg. Travel Time= 0.4 min

Peak Storage= 28 cf @ 12.17 hrs

Average Depth at Peak Storage= 0.96' , Surface Width= 1.05'

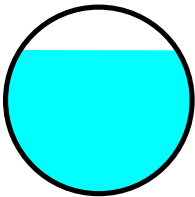
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 4.09 cfs

15.0" Round Pipe

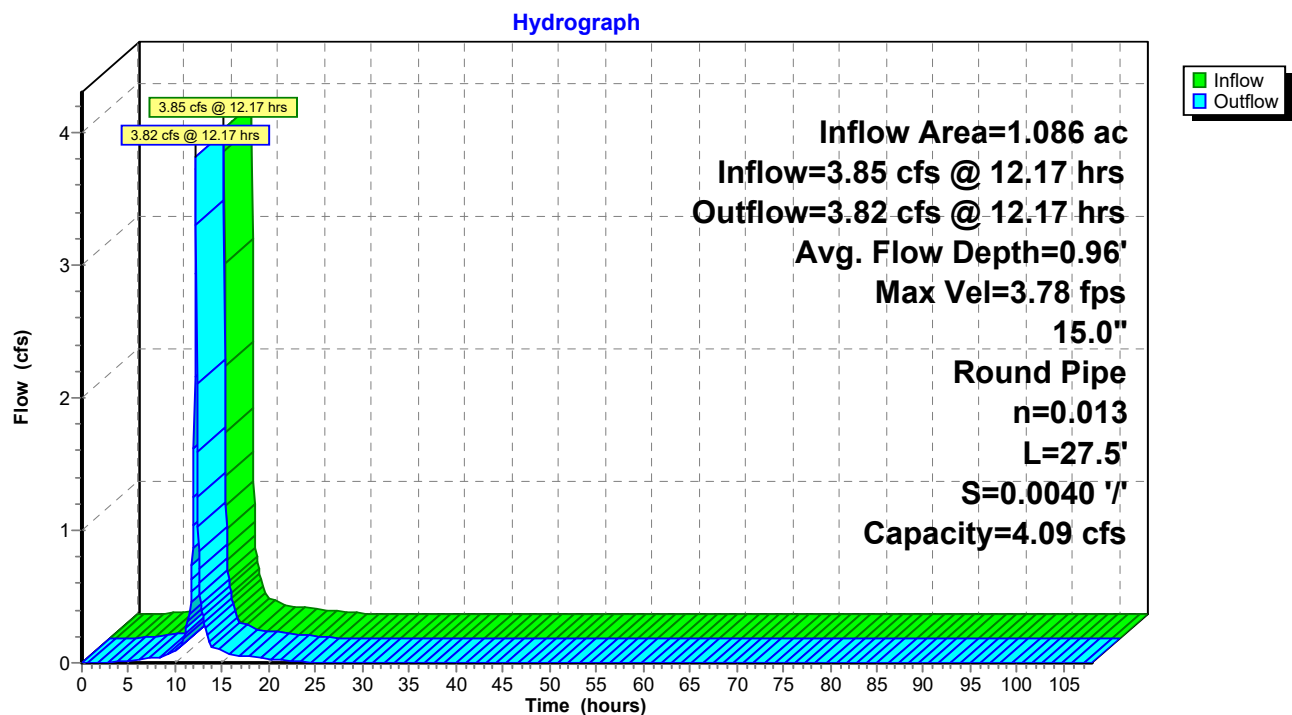
n= 0.013 Concrete pipe, bends & connections

Length= 27.5' Slope= 0.0040 '/'

Inlet Invert= 772.21', Outlet Invert= 772.10'



Reach 3R: 15-in Outlet Pipe



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MSE 24-hr 3 2-yr Rainfall=2.87"

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Summary for Reach 4R: 12-in Outlet Pipe

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.527 ac, 100.00% Impervious, Inflow Depth = 2.64" for 2-yr event
Inflow = 5.41 cfs @ 12.17 hrs, Volume= 0.336 af
Outflow = 5.40 cfs @ 12.17 hrs, Volume= 0.336 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 12.87 fps, Min. Travel Time= 0.0 min

Avg. Velocity = 3.82 fps, Avg. Travel Time= 0.1 min

Peak Storage= 6 cf @ 12.17 hrs

Average Depth at Peak Storage= 0.53' , Surface Width= 1.00'

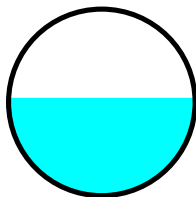
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 9.95 cfs

12.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

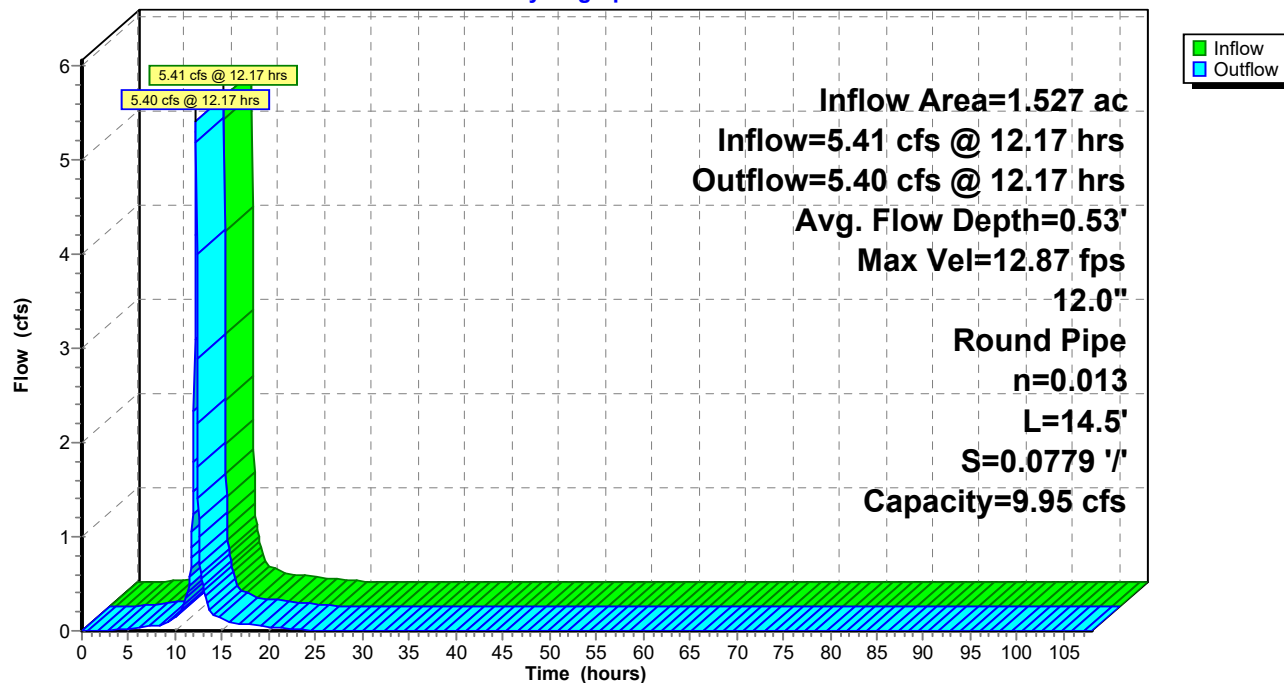
Length= 14.5' Slope= 0.0779 '/'

Inlet Invert= 773.11', Outlet Invert= 771.98'



Reach 4R: 12-in Outlet Pipe

Hydrograph



33587 Front Street Existing

MSE 24-hr 3 10-yr Rainfall=4.28"

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Time span=0.00-108.00 hrs, dt=0.05 hrs, 2161 points

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

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

Subcatchment1S: Riverfront

Runoff Area=1.527 ac 100.00% Impervious Runoff Depth=4.04"

Tc=10.0 min CN=98 Runoff=8.13 cfs 0.515 af

Subcatchment5S: Liberty Street

Runoff Area=1.086 ac 100.00% Impervious Runoff Depth=4.04"

Tc=10.0 min CN=98 Runoff=5.78 cfs 0.366 af

Reach 3R: 15-in Outlet Pipe

Avg. Flow Depth=1.25' Max Vel=3.71 fps Inflow=5.78 cfs 0.366 af

15.0" Round Pipe n=0.013 L=27.5' S=0.0040 '/' Capacity=4.09 cfs Outflow=4.09 cfs 0.366 af

Reach 4R: 12-in Outlet Pipe

Avg. Flow Depth=0.69' Max Vel=14.08 fps Inflow=8.13 cfs 0.515 af

12.0" Round Pipe n=0.013 L=14.5' S=0.0779 '/' Capacity=9.95 cfs Outflow=8.13 cfs 0.515 af

Total Runoff Area = 2.613 ac Runoff Volume = 0.881 af Average Runoff Depth = 4.04"
0.00% Pervious = 0.000 ac 100.00% Impervious = 2.613 ac

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MSE 24-hr 3 10-yr Rainfall=4.28"

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Summary for Subcatchment 1S: Riverfront

Runoff = 8.13 cfs @ 12.17 hrs, Volume= 0.515 af, Depth= 4.04"
Routed to Reach 4R : 12-in Outlet Pipe

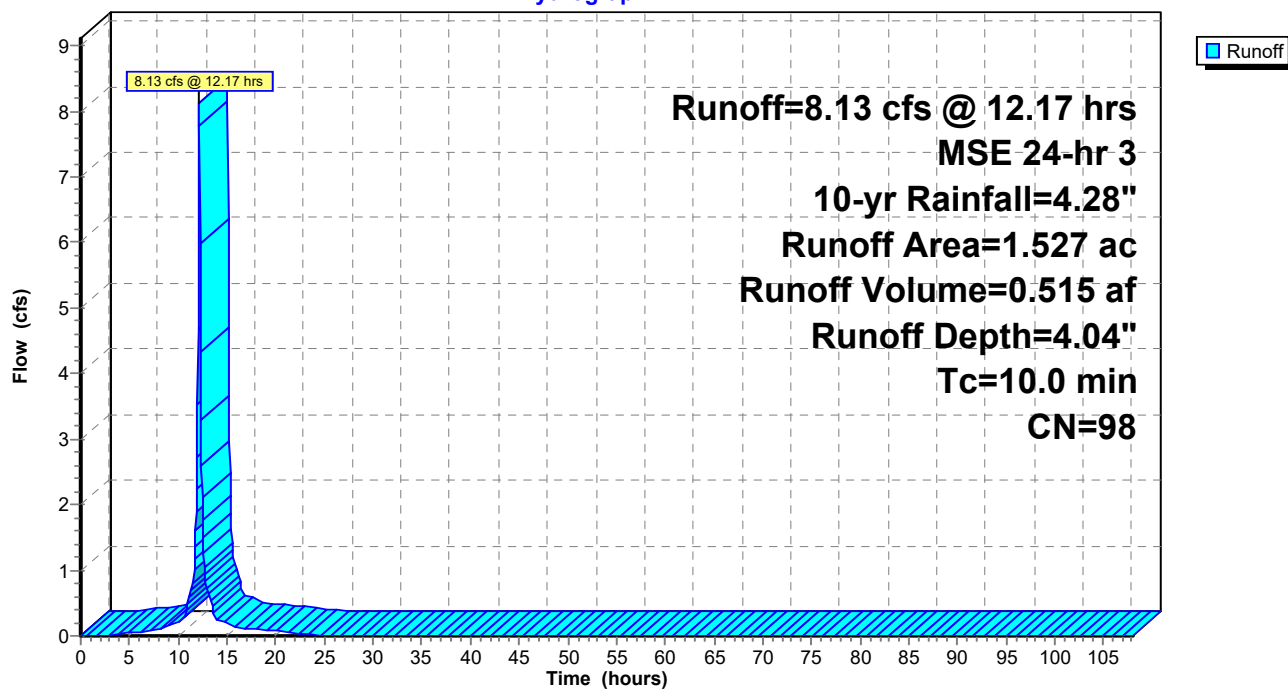
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-yr Rainfall=4.28"

Area (ac)	CN	Description
1.527	98	Paved parking, HSG D
1.527		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 Minute Minimum

Subcatchment 1S: Riverfront

Hydrograph



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MSE 24-hr 3 10-yr Rainfall=4.28"

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Summary for Subcatchment 5S: Liberty Street

Runoff = 5.78 cfs @ 12.17 hrs, Volume= 0.366 af, Depth= 4.04"
Routed to Reach 3R : 15-in Outlet Pipe

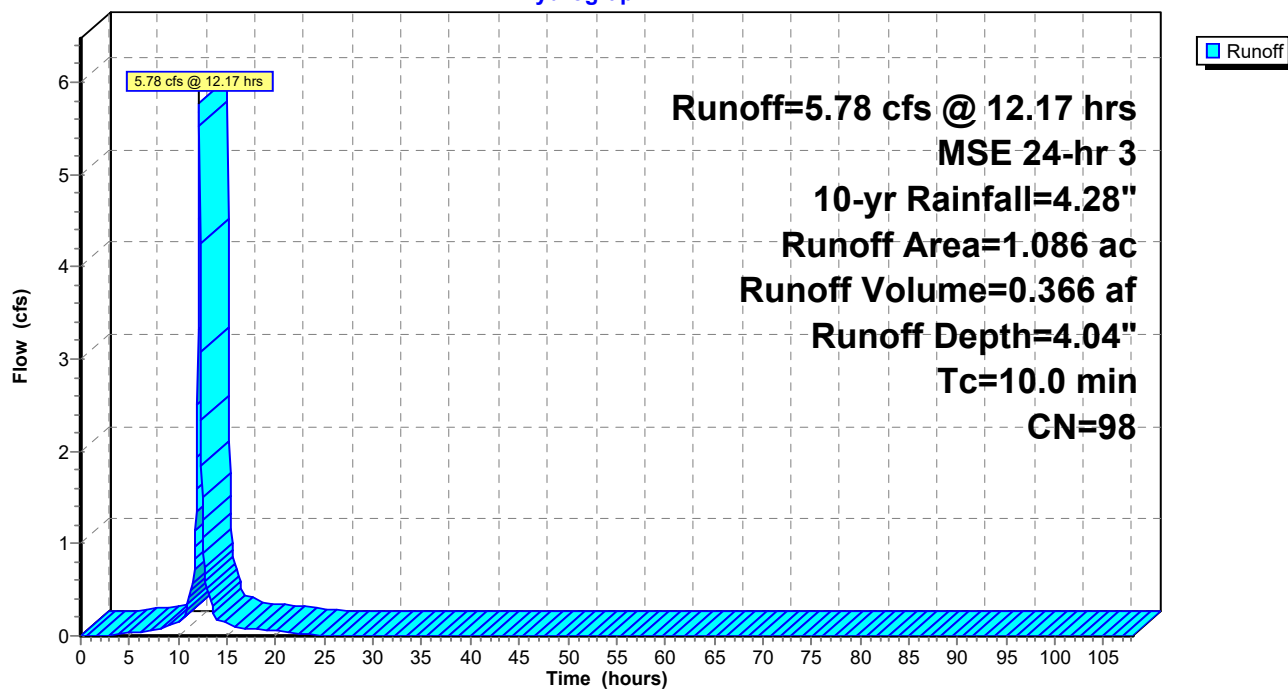
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-yr Rainfall=4.28"

Area (ac)	CN	Description
1.086	98	Paved parking, HSG D
1.086		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 min Minimum

Subcatchment 5S: Liberty Street

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MSE 24-hr 3 10-yr Rainfall=4.28"

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Summary for Reach 3R: 15-in Outlet Pipe

[52] Hint: Inlet/Outlet conditions not evaluated

[55] Hint: Peak inflow is 142% of Manning's capacity

[76] Warning: Detained 0.015 af (Pond w/culvert advised)

Inflow Area = 1.086 ac, 100.00% Impervious, Inflow Depth = 4.04" for 10-yr event
Inflow = 5.78 cfs @ 12.17 hrs, Volume= 0.366 af
Outflow = 4.09 cfs @ 12.15 hrs, Volume= 0.366 af, Atten= 29%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 3.71 fps, Min. Travel Time= 0.1 min

Avg. Velocity= 1.32 fps, Avg. Travel Time= 0.3 min

Peak Storage= 34 cf @ 12.10 hrs

Average Depth at Peak Storage= 1.25'

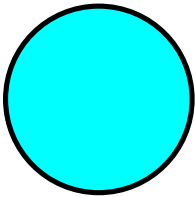
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 4.09 cfs

15.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

Length= 27.5' Slope= 0.0040 '/'

Inlet Invert= 772.21', Outlet Invert= 772.10'



33587 Front Street Existing

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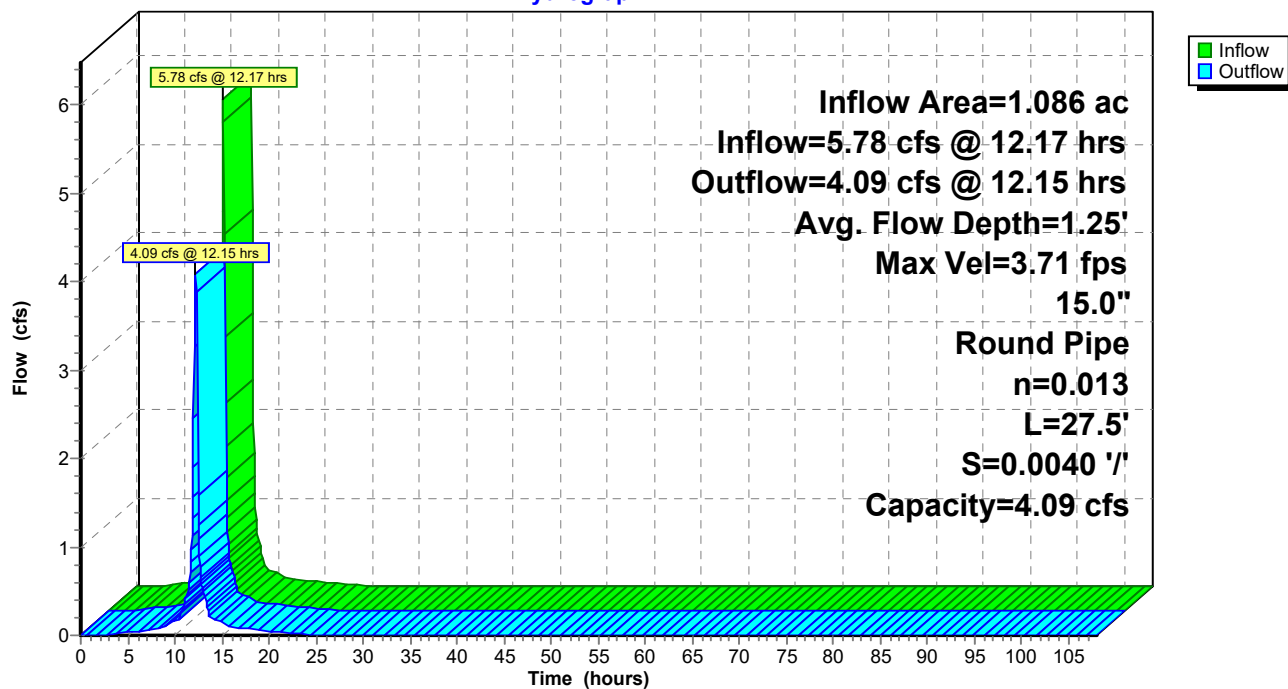
MSE 24-hr 3 10-yr Rainfall=4.28"

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Reach 3R: 15-in Outlet Pipe

Hydrograph



33587 Front Street Existing

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MSE 24-hr 3 10-yr Rainfall=4.28"

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Summary for Reach 4R: 12-in Outlet Pipe

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.527 ac, 100.00% Impervious, Inflow Depth = 4.04" for 10-yr event
Inflow = 8.13 cfs @ 12.17 hrs, Volume= 0.515 af
Outflow = 8.13 cfs @ 12.17 hrs, Volume= 0.515 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 14.08 fps, Min. Travel Time= 0.0 min

Avg. Velocity= 4.33 fps, Avg. Travel Time= 0.1 min

Peak Storage= 8 cf @ 12.17 hrs

Average Depth at Peak Storage= 0.69' , Surface Width= 0.93'

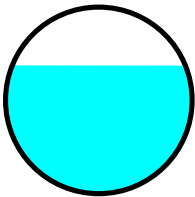
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 9.95 cfs

12.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

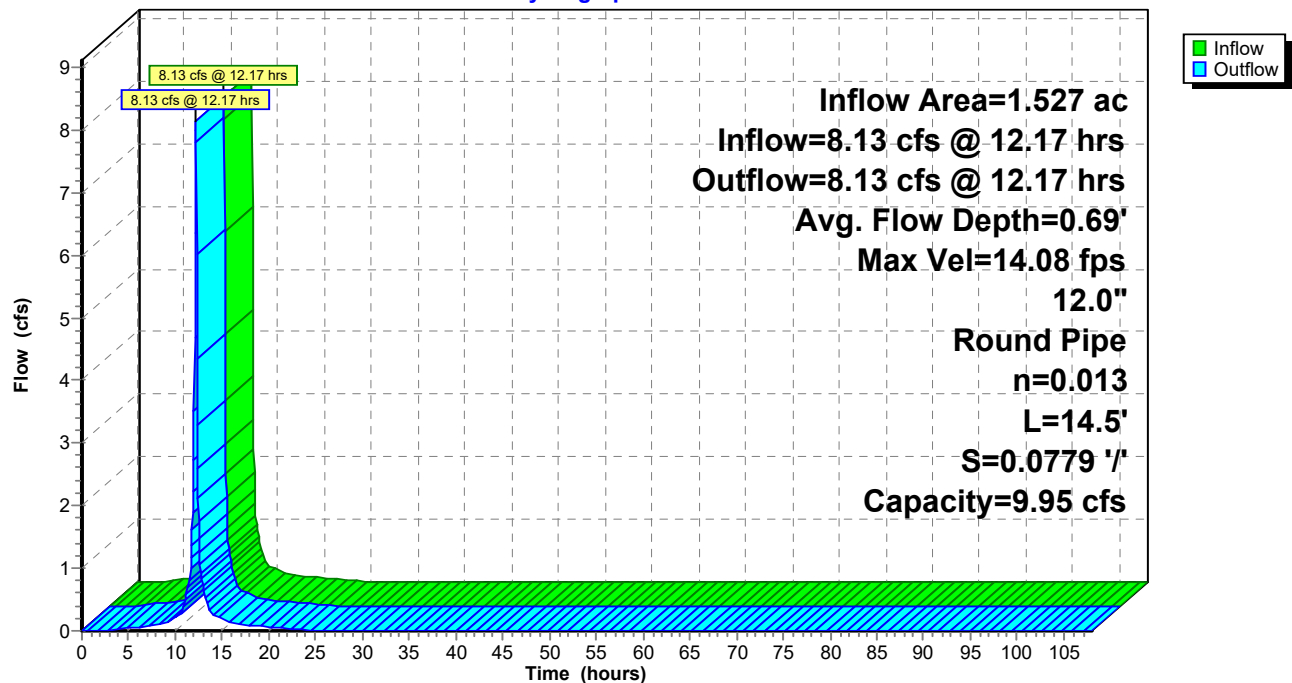
Length= 14.5' Slope= 0.0779 '/'

Inlet Invert= 773.11', Outlet Invert= 771.98'



Reach 4R: 12-in Outlet Pipe

Hydrograph



33587 Front Street Existing*MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2*

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Time span=0.00-108.00 hrs, dt=0.05 hrs, 2161 points

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

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

Subcatchment1S: Riverfront

Runoff Area=1.527 ac 100.00% Impervious Runoff Depth=8.32"

Tc=10.0 min CN=98 Runoff=8.19 cfs 1.059 af

Subcatchment5S: Liberty Street

Runoff Area=1.086 ac 100.00% Impervious Runoff Depth=8.32"

Tc=10.0 min CN=98 Runoff=5.82 cfs 0.753 af

Reach 3R: 15-in Outlet Pipe

Avg. Flow Depth=1.25' Max Vel=3.71 fps Inflow=5.82 cfs 0.753 af

15.0" Round Pipe n=0.013 L=27.5' S=0.0040 '/' Capacity=4.09 cfs Outflow=4.09 cfs 0.753 af

Reach 4R: 12-in Outlet Pipe

Avg. Flow Depth=0.69' Max Vel=14.10 fps Inflow=8.19 cfs 1.059 af

12.0" Round Pipe n=0.013 L=14.5' S=0.0779 '/' Capacity=9.95 cfs Outflow=8.18 cfs 1.059 af

Total Runoff Area = 2.613 ac Runoff Volume = 1.812 af Average Runoff Depth = 8.32"
0.00% Pervious = 0.000 ac 100.00% Impervious = 2.613 ac

33587 Front Street Existing

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MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

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Summary for Subcatchment 1S: Riverfront

Runoff = 8.19 cfs @ 36.17 hrs, Volume= 1.059 af, Depth= 8.32"
Routed to Reach 4R : 12-in Outlet Pipe

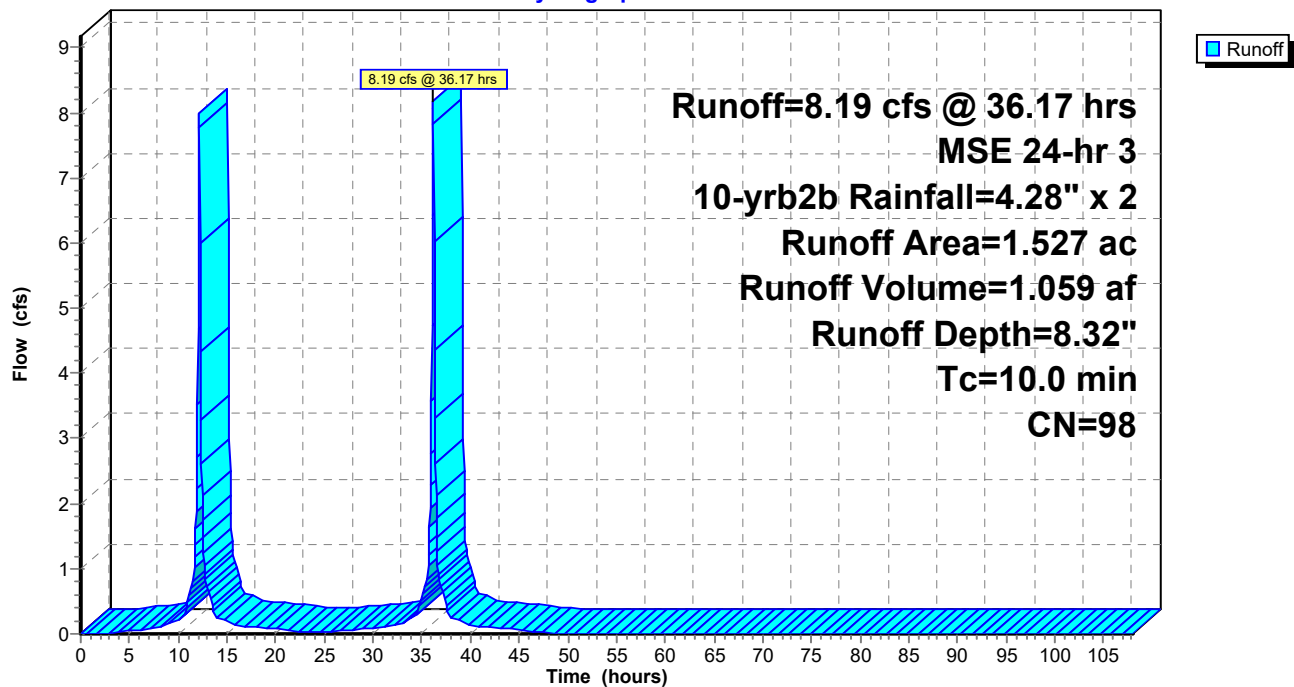
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

Area (ac)	CN	Description
1.527	98	Paved parking, HSG D
1.527		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 Minute Minimum

Subcatchment 1S: Riverfront

Hydrograph



33587 Front Street Existing

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MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

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Summary for Subcatchment 5S: Liberty Street

Runoff = 5.82 cfs @ 36.17 hrs, Volume= 0.753 af, Depth= 8.32"
Routed to Reach 3R : 15-in Outlet Pipe

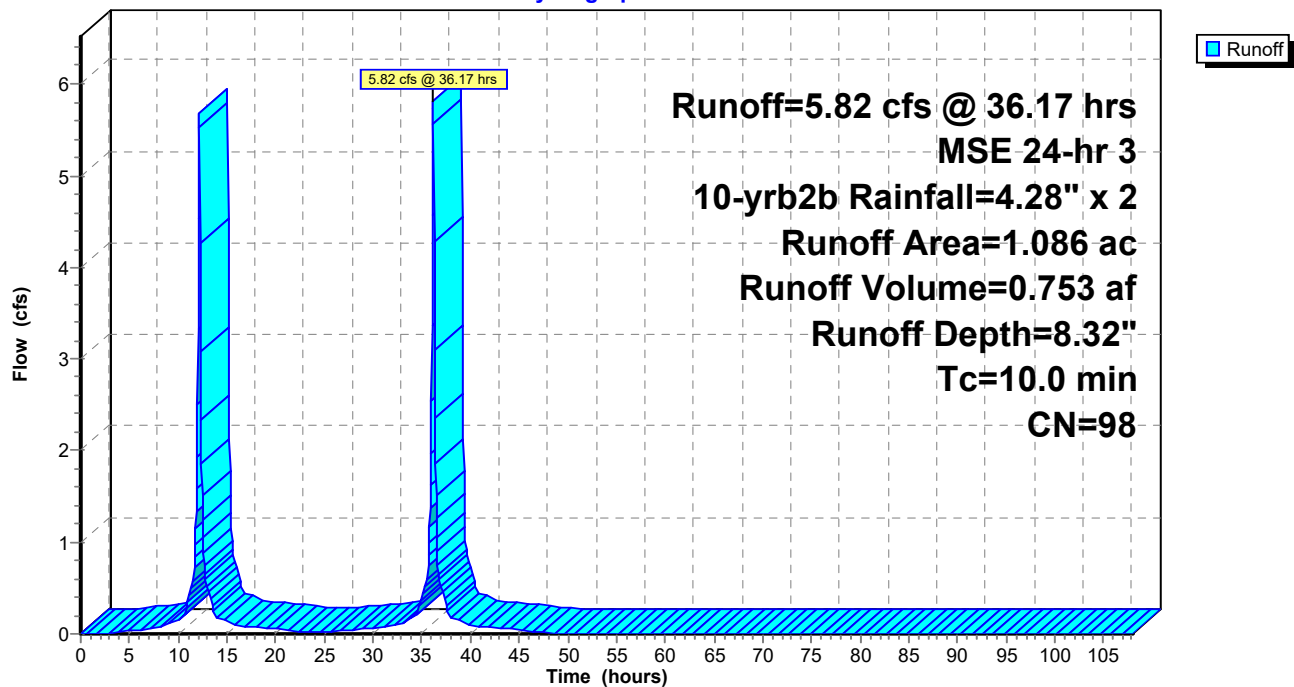
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

Area (ac)	CN	Description
1.086	98	Paved parking, HSG D
1.086		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 min Minimum

Subcatchment 5S: Liberty Street

Hydrograph



Summary for Reach 3R: 15-in Outlet Pipe

[52] Hint: Inlet/Outlet conditions not evaluated

[55] Hint: Peak inflow is 143% of Manning's capacity

[76] Warning: Detained 0.016 af (Pond w/culvert advised)

Inflow Area = 1.086 ac, 100.00% Impervious, Inflow Depth = 8.32" for 10-yrb2b event
Inflow = 5.82 cfs @ 36.17 hrs, Volume= 0.753 af
Outflow = 4.09 cfs @ 12.15 hrs, Volume= 0.753 af, Atten= 30%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 3.71 fps, Min. Travel Time= 0.1 min

Avg. Velocity= 1.35 fps, Avg. Travel Time= 0.3 min

Peak Storage= 34 cf @ 12.10 hrs

Average Depth at Peak Storage= 1.25'

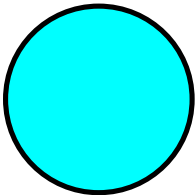
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 4.09 cfs

15.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

Length= 27.5' Slope= 0.0040 '/'

Inlet Invert= 772.21', Outlet Invert= 772.10'



33587 Front Street Existing

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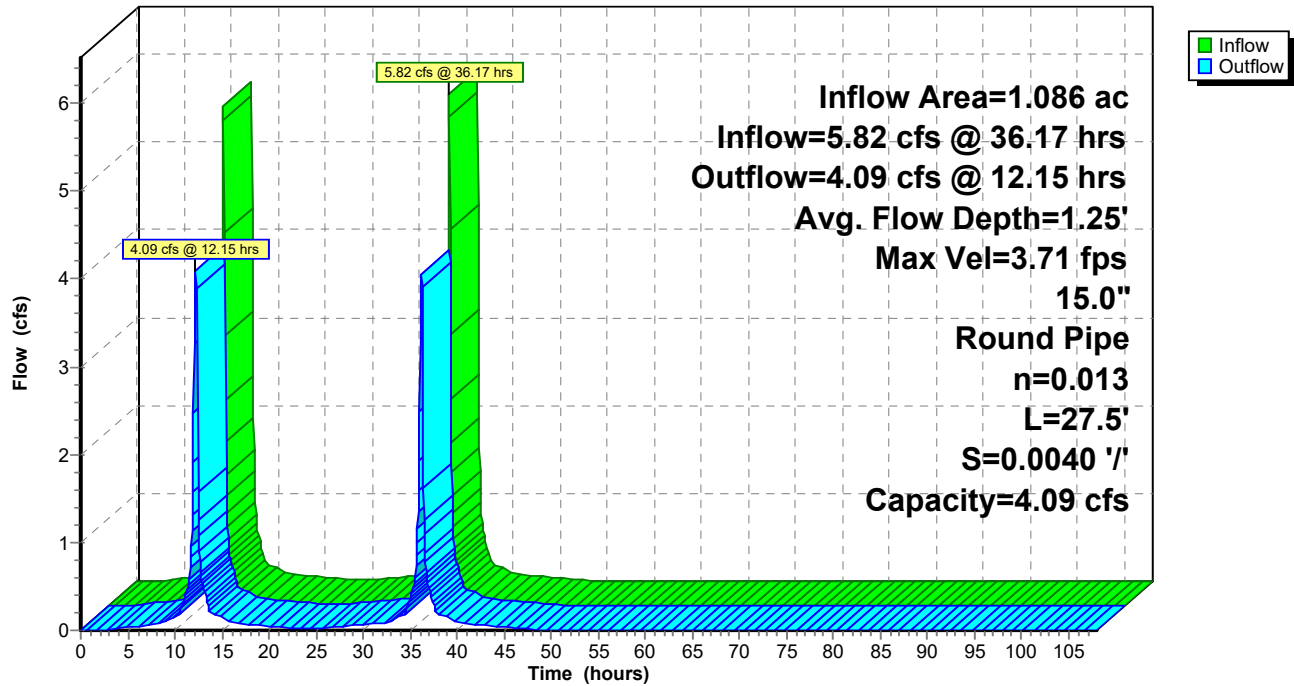
MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

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Reach 3R: 15-in Outlet Pipe

Hydrograph



33587 Front Street Existing

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MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

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Summary for Reach 4R: 12-in Outlet Pipe

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 1.527 ac, 100.00% Impervious, Inflow Depth = 8.32" for 10-yrb2b event
Inflow = 8.19 cfs @ 36.17 hrs, Volume= 1.059 af
Outflow = 8.18 cfs @ 36.17 hrs, Volume= 1.059 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 14.10 fps, Min. Travel Time= 0.0 min

Avg. Velocity= 4.38 fps, Avg. Travel Time= 0.1 min

Peak Storage= 8 cf @ 36.17 hrs

Average Depth at Peak Storage= 0.69' , Surface Width= 0.92'

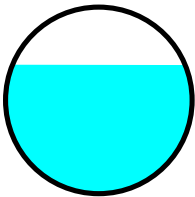
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 9.95 cfs

12.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

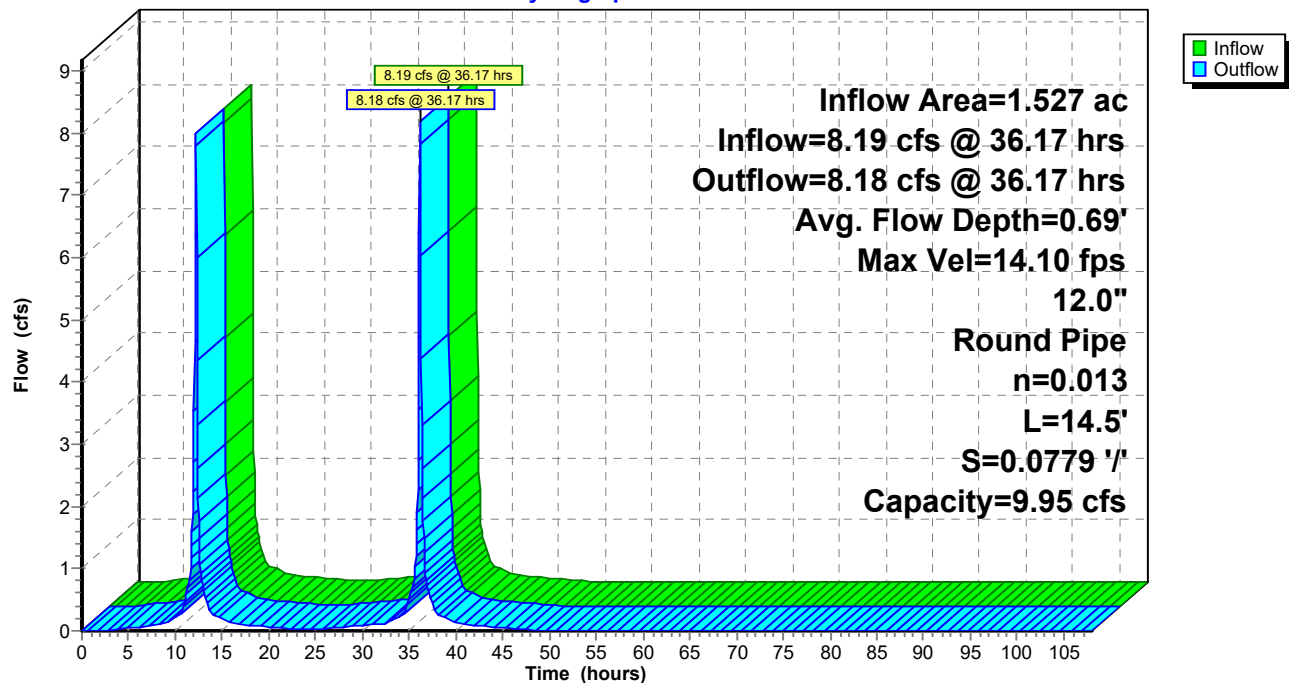
Length= 14.5' Slope= 0.0779 '/'

Inlet Invert= 773.11', Outlet Invert= 771.98'



Reach 4R: 12-in Outlet Pipe

Hydrograph



33587 Front Street Existing*MSE 24-hr 3 100-yr Rainfall=7.19"*

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Time span=0.00-108.00 hrs, dt=0.05 hrs, 2161 points

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

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

Subcatchment1S: Riverfront

Runoff Area=1.527 ac 100.00% Impervious Runoff Depth=6.95"

Tc=10.0 min CN=98 Runoff=13.73 cfs 0.884 af

Subcatchment5S: Liberty Street

Runoff Area=1.086 ac 100.00% Impervious Runoff Depth=6.95"

Tc=10.0 min CN=98 Runoff=9.77 cfs 0.629 af

Reach 3R: 15-in Outlet Pipe

Avg. Flow Depth=1.25' Max Vel=3.79 fps Inflow=9.77 cfs 0.629 af

15.0" Round Pipe n=0.013 L=27.5' S=0.0040 '/' Capacity=4.09 cfs Outflow=4.26 cfs 0.629 af

Reach 4R: 12-in Outlet Pipe

Avg. Flow Depth=1.00' Max Vel=14.22 fps Inflow=13.73 cfs 0.884 af

12.0" Round Pipe n=0.013 L=14.5' S=0.0779 '/' Capacity=9.95 cfs Outflow=11.17 cfs 0.884 af

Total Runoff Area = 2.613 ac Runoff Volume = 1.514 af Average Runoff Depth = 6.95"
0.00% Pervious = 0.000 ac 100.00% Impervious = 2.613 ac

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MSE 24-hr 3 100-yr Rainfall=7.19"

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Summary for Subcatchment 1S: Riverfront

Runoff = 13.73 cfs @ 12.17 hrs, Volume= 0.884 af, Depth= 6.95"
Routed to Reach 4R : 12-in Outlet Pipe

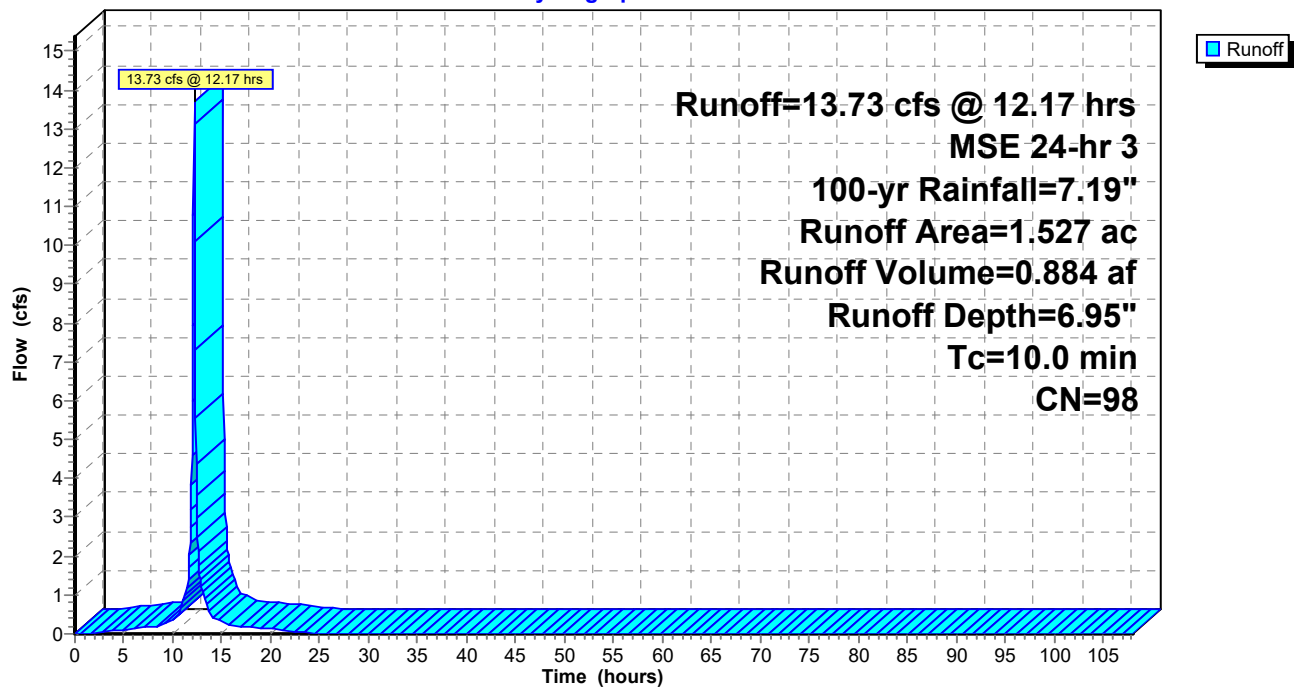
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-yr Rainfall=7.19"

Area (ac)	CN	Description
1.527	98	Paved parking, HSG D
1.527		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 Minute Minimum

Subcatchment 1S: Riverfront

Hydrograph



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MSE 24-hr 3 100-yr Rainfall=7.19"

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Summary for Subcatchment 5S: Liberty Street

Runoff = 9.77 cfs @ 12.17 hrs, Volume= 0.629 af, Depth= 6.95"
Routed to Reach 3R : 15-in Outlet Pipe

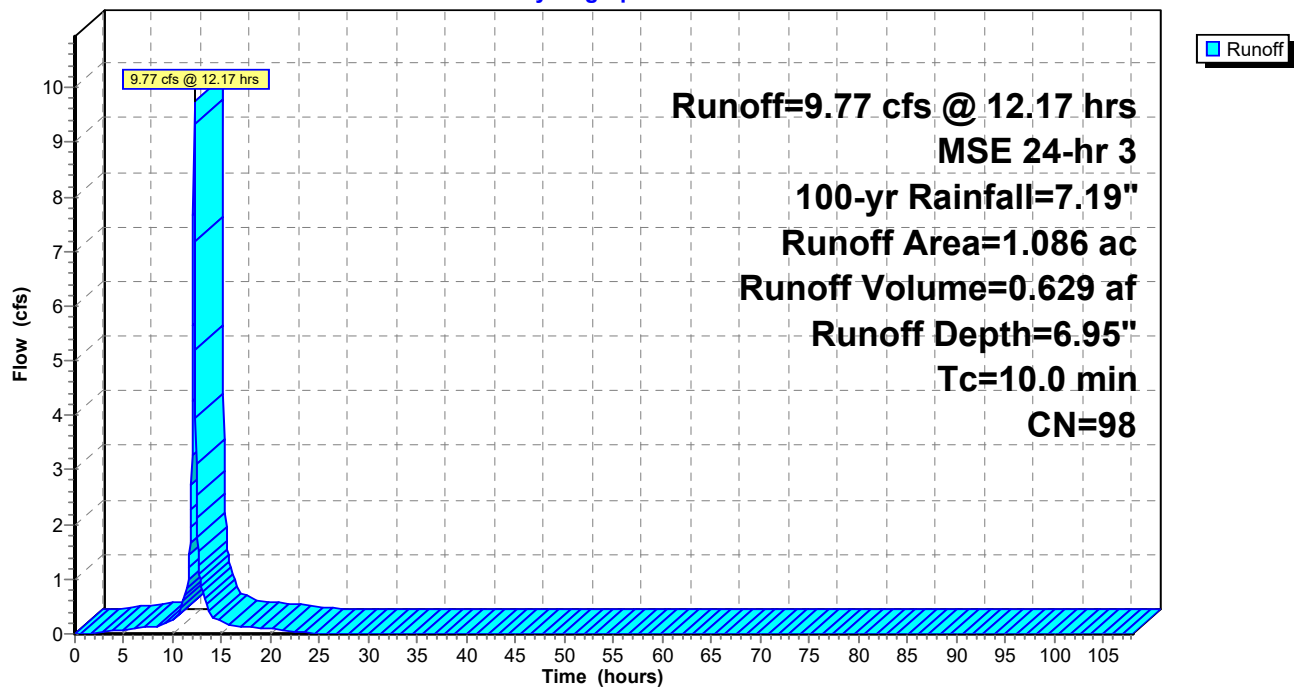
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-yr Rainfall=7.19"

Area (ac)	CN	Description
1.086	98	Paved parking, HSG D
1.086		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 min Minimum

Subcatchment 5S: Liberty Street

Hydrograph



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MSE 24-hr 3 100-yr Rainfall=7.19"

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Summary for Reach 3R: 15-in Outlet Pipe

[52] Hint: Inlet/Outlet conditions not evaluated

[55] Hint: Peak inflow is 239% of Manning's capacity

[76] Warning: Detained 0.083 af (Pond w/culvert advised)

Inflow Area = 1.086 ac, 100.00% Impervious, Inflow Depth = 6.95" for 100-yr event
Inflow = 9.77 cfs @ 12.17 hrs, Volume= 0.629 af
Outflow = 4.26 cfs @ 12.02 hrs, Volume= 0.629 af, Atten= 56%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 3.79 fps, Min. Travel Time= 0.1 min

Avg. Velocity= 1.55 fps, Avg. Travel Time= 0.3 min

Peak Storage= 34 cf @ 12.05 hrs

Average Depth at Peak Storage= 1.25'

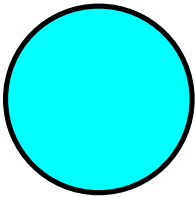
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 4.09 cfs

15.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

Length= 27.5' Slope= 0.0040 '/'

Inlet Invert= 772.21', Outlet Invert= 772.10'



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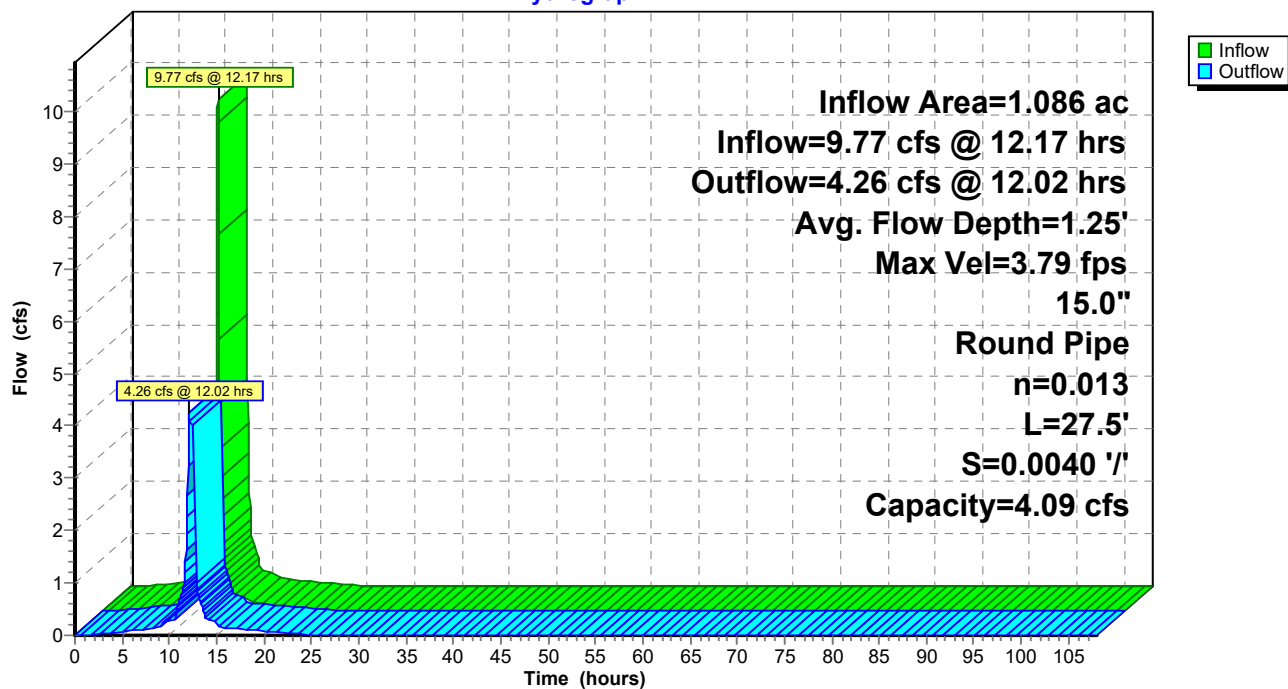
MSE 24-hr 3 100-yr Rainfall=7.19"

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Reach 3R: 15-in Outlet Pipe

Hydrograph



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MSE 24-hr 3 100-yr Rainfall=7.19"

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Summary for Reach 4R: 12-in Outlet Pipe

[52] Hint: Inlet/Outlet conditions not evaluated

[55] Hint: Peak inflow is 138% of Manning's capacity

[76] Warning: Detained 0.032 af (Pond w/culvert advised)

Inflow Area = 1.527 ac, 100.00% Impervious, Inflow Depth = 6.95" for 100-yr event

Inflow = 13.73 cfs @ 12.17 hrs, Volume= 0.884 af

Outflow = 11.17 cfs @ 12.33 hrs, Volume= 0.884 af, Atten= 19%, Lag= 9.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 14.22 fps, Min. Travel Time= 0.0 min

Avg. Velocity= 5.03 fps, Avg. Travel Time= 0.0 min

Peak Storage= 11 cf @ 12.10 hrs

Average Depth at Peak Storage= 1.00'

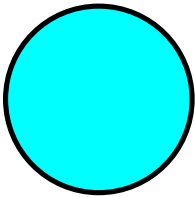
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 9.95 cfs

12.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

Length= 14.5' Slope= 0.0779 '/'

Inlet Invert= 773.11', Outlet Invert= 771.98'



33587 Front Street Existing

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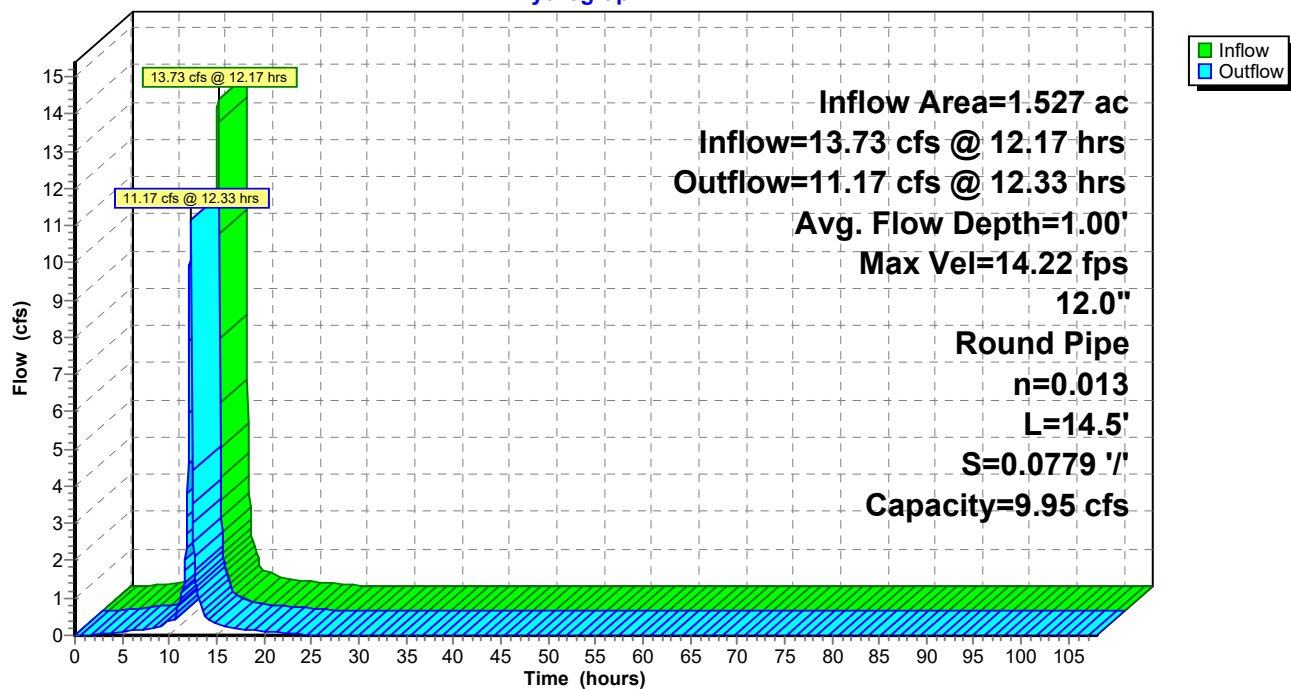
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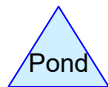
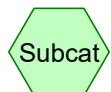
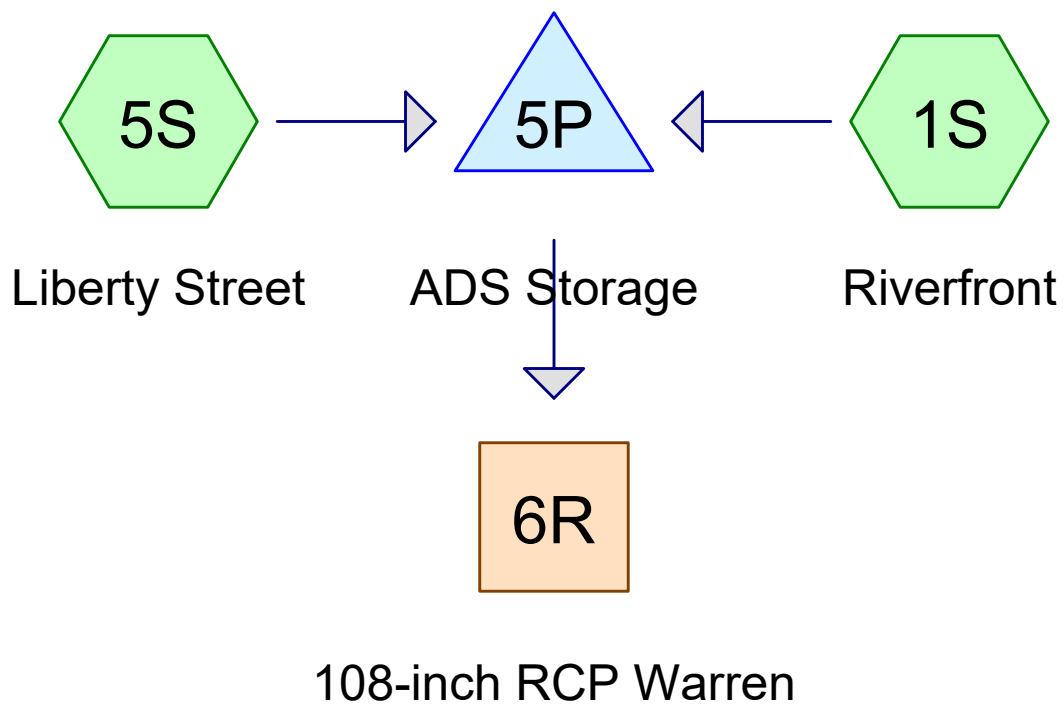
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Reach 4R: 12-in Outlet Pipe

Hydrograph





Routing Diagram for 33587 Front Street Proposed

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33587 Front Street Proposed

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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	MSE 24-hr	3	Default	24.00	1	2.87	2
2	10-yr	MSE 24-hr	3	Default	24.00	1	4.28	2
3	10-yrb2b	MSE 24-hr	3	Default	24.00	2	4.28	2
4	100-yr	MSE 24-hr	3	Default	24.00	1	7.19	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.613	98	Paved parking, HSG D (1S, 5S)
2.613	98	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
2.613	HSG D	1S, 5S
0.000	Other	
2.613		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	2.613	0.000	2.613	Paved parking	1S, 5S
0.000	0.000	0.000	2.613	0.000	2.613	TOTAL AREA	

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Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	6R	762.62	761.37	66.0	0.0189	0.013	0.0	108.0	0.0	
2	5P	771.19	770.12	215.0	0.0050	0.013	0.0	24.0	0.0	

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MSE 24-hr 3 2-yr Rainfall=2.87"

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Time span=0.00-108.00 hrs, dt=0.05 hrs, 2161 points

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

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

Subcatchment1S: Riverfront

Runoff Area=1.527 ac 100.00% Impervious Runoff Depth=2.64"

Tc=10.0 min CN=98 Runoff=5.41 cfs 0.336 af

Subcatchment5S: Liberty Street

Runoff Area=1.086 ac 100.00% Impervious Runoff Depth=2.64"

Tc=10.0 min CN=98 Runoff=3.85 cfs 0.239 af

Reach 6R: 108-inch RCP Warren

Avg. Flow Depth=0.44' Max Vel=6.84 fps Inflow=7.88 cfs 0.575 af

108.0" Round Pipe n=0.013 L=66.0' S=0.0189 '/' Capacity=1,718.39 cfs Outflow=7.86 cfs 0.575 af

Pond 5P: ADS Storage

Peak Elev=772.59' Storage=0.080 af Inflow=9.25 cfs 0.575 af

24.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=7.88 cfs 0.575 af

Total Runoff Area = 2.613 ac Runoff Volume = 0.575 af Average Runoff Depth = 2.64"
0.00% Pervious = 0.000 ac 100.00% Impervious = 2.613 ac

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MSE 24-hr 3 2-yr Rainfall=2.87"

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Summary for Subcatchment 1S: Riverfront

Runoff = 5.41 cfs @ 12.17 hrs, Volume= 0.336 af, Depth= 2.64"
Routed to Pond 5P : ADS Storage

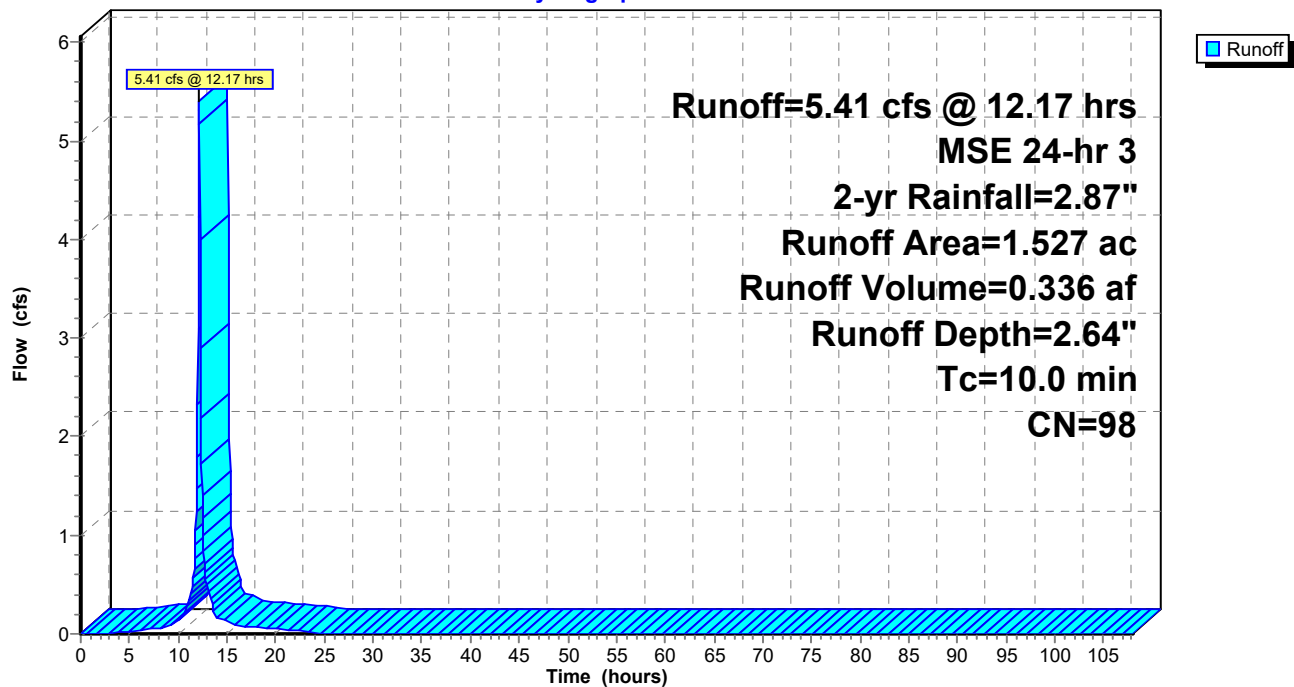
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-yr Rainfall=2.87"

Area (ac)	CN	Description
1.527	98	Paved parking, HSG D
1.527		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 Minute Minimum

Subcatchment 1S: Riverfront

Hydrograph



33587 Front Street Proposed

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MSE 24-hr 3 2-yr Rainfall=2.87"

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Summary for Subcatchment 5S: Liberty Street

Runoff = 3.85 cfs @ 12.17 hrs, Volume= 0.239 af, Depth= 2.64"
Routed to Pond 5P : ADS Storage

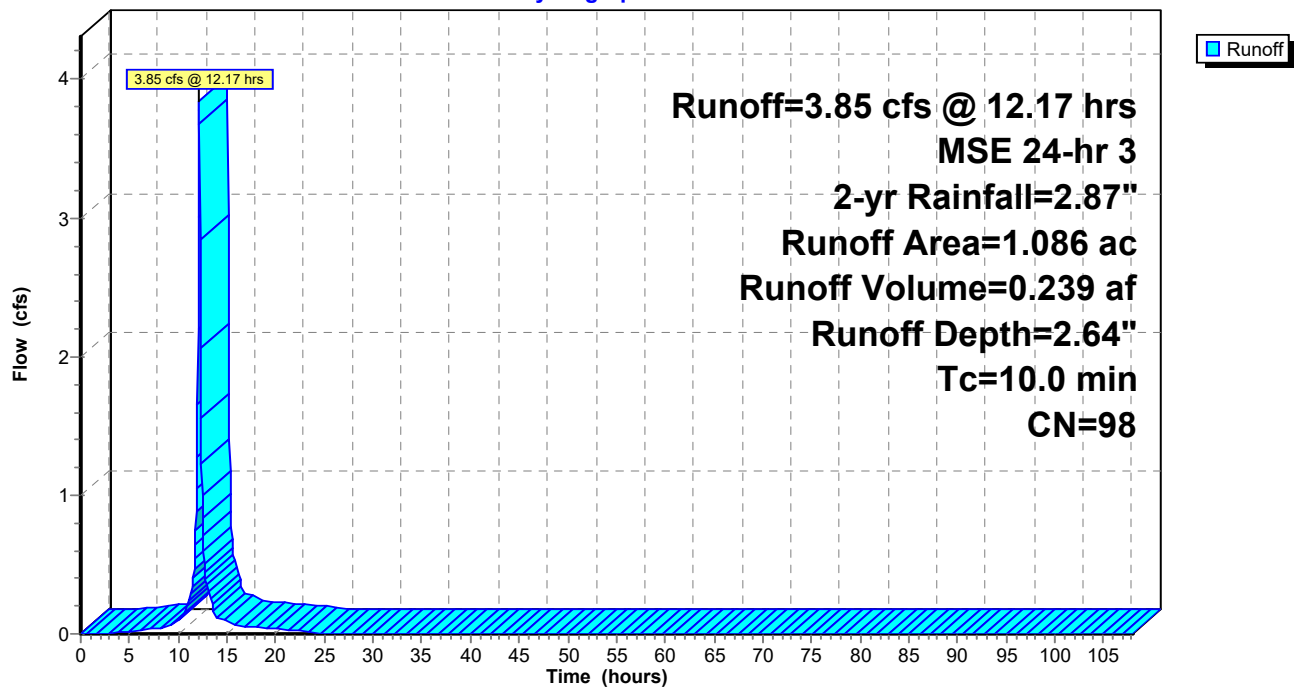
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2-yr Rainfall=2.87"

Area (ac)	CN	Description
1.086	98	Paved parking, HSG D
1.086		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 min Minimum

Subcatchment 5S: Liberty Street

Hydrograph



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MSE 24-hr 3 2-yr Rainfall=2.87"

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Summary for Reach 6R: 108-inch RCP Warren

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 2.613 ac, 100.00% Impervious, Inflow Depth = 2.64" for 2-yr event
Inflow = 7.88 cfs @ 12.23 hrs, Volume= 0.575 af
Outflow = 7.86 cfs @ 12.23 hrs, Volume= 0.575 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 6.84 fps, Min. Travel Time= 0.2 min

Avg. Velocity = 2.55 fps, Avg. Travel Time= 0.4 min

Peak Storage= 76 cf @ 12.23 hrs

Average Depth at Peak Storage= 0.44' , Surface Width= 3.88'

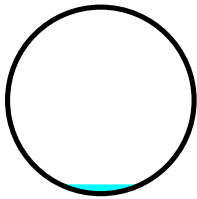
Bank-Full Depth= 9.00' Flow Area= 63.6 sf, Capacity= 1,718.39 cfs

108.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

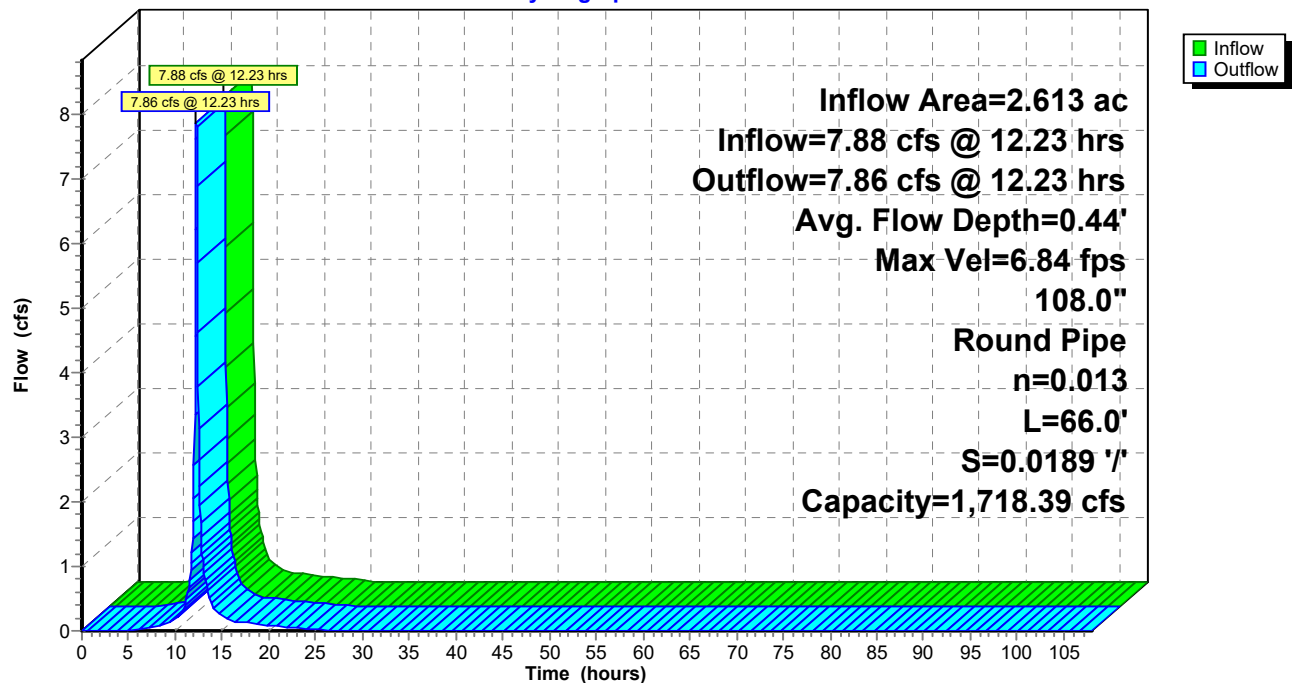
Length= 66.0' Slope= 0.0189 '/'

Inlet Invert= 762.62', Outlet Invert= 761.37'



Reach 6R: 108-inch RCP Warren

Hydrograph



33587 Front Street Proposed

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MSE 24-hr 3 2-yr Rainfall=2.87"

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Summary for Pond 5P: ADS Storage

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 2.613 ac, 100.00% Impervious, Inflow Depth = 2.64" for 2-yr event
Inflow = 9.25 cfs @ 12.17 hrs, Volume= 0.575 af
Outflow = 7.88 cfs @ 12.23 hrs, Volume= 0.575 af, Atten= 15%, Lag= 3.5 min
Primary = 7.88 cfs @ 12.23 hrs, Volume= 0.575 af
Routed to Reach 6R : 108-inch RCP Warren

Routing by Stor-Ind method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
Peak Elev= 772.59' @ 12.23 hrs Surf.Area= 0.053 ac Storage= 0.080 af

Plug-Flow detention time= 25.8 min calculated for 0.574 af (100% of inflow)
Center-of-Mass det. time= 26.1 min (783.5 - 757.4)

Volume	Invert	Avail.Storage	Storage Description
#1	771.20'	0.159 af	ADS_StormTech MC-3500 d +Cap @ 111.00' Lx 4 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 111.00'L = 1,702.2 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 4 Chambers in 4 Rows Cap Storage= 14.9 cf x 2 x 4 rows = 119.2 cf

Device	Routing	Invert	Outlet Devices
#1	Primary	771.19'	24.0" Round Culvert L= 215.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 771.19' / 770.12' S= 0.0050 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf

Primary OutFlow Max=7.75 cfs @ 12.23 hrs HW=772.57' (Free Discharge)
↑**1=Culvert** (Barrel Controls 7.75 cfs @ 4.72 fps)

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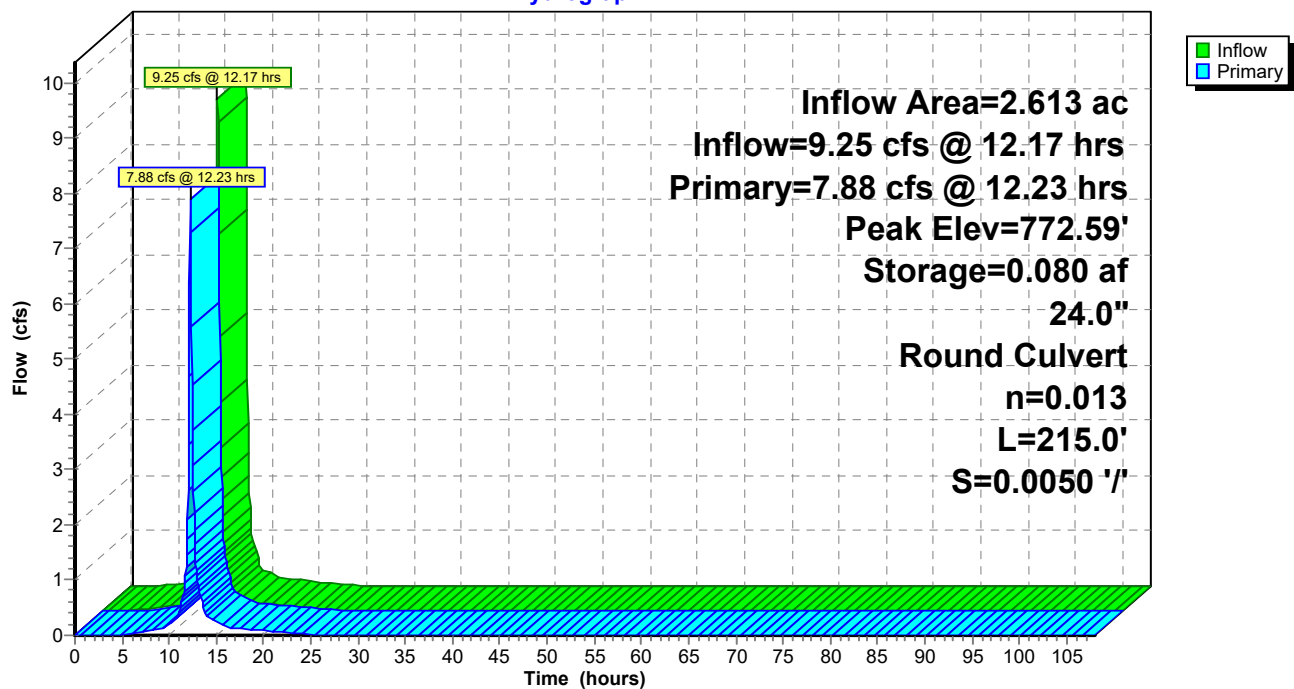
MSE 24-hr 3 2-yr Rainfall=2.87"

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Pond 5P: ADS Storage

Hydrograph



33587 Front Street Proposed

MSE 24-hr 3 10-yr Rainfall=4.28"

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Time span=0.00-108.00 hrs, dt=0.05 hrs, 2161 points

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

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

Subcatchment1S: Riverfront

Runoff Area=1.527 ac 100.00% Impervious Runoff Depth=4.04"

Tc=10.0 min CN=98 Runoff=8.13 cfs 0.515 af

Subcatchment5S: Liberty Street

Runoff Area=1.086 ac 100.00% Impervious Runoff Depth=4.04"

Tc=10.0 min CN=98 Runoff=5.78 cfs 0.366 af

Reach 6R: 108-inch RCP Warren

Avg. Flow Depth=0.54' Max Vel=7.77 fps Inflow=12.19 cfs 0.881 af

108.0" Round Pipe n=0.013 L=66.0' S=0.0189 '/' Capacity=1,718.39 cfs Outflow=12.09 cfs 0.881 af

Pond 5P: ADS Storage

Peak Elev=773.05' Storage=0.103 af Inflow=13.92 cfs 0.881 af

24.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=12.19 cfs 0.881 af

Total Runoff Area = 2.613 ac Runoff Volume = 0.881 af Average Runoff Depth = 4.04"
0.00% Pervious = 0.000 ac 100.00% Impervious = 2.613 ac

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MSE 24-hr 3 10-yr Rainfall=4.28"

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Summary for Subcatchment 1S: Riverfront

Runoff = 8.13 cfs @ 12.17 hrs, Volume= 0.515 af, Depth= 4.04"
Routed to Pond 5P : ADS Storage

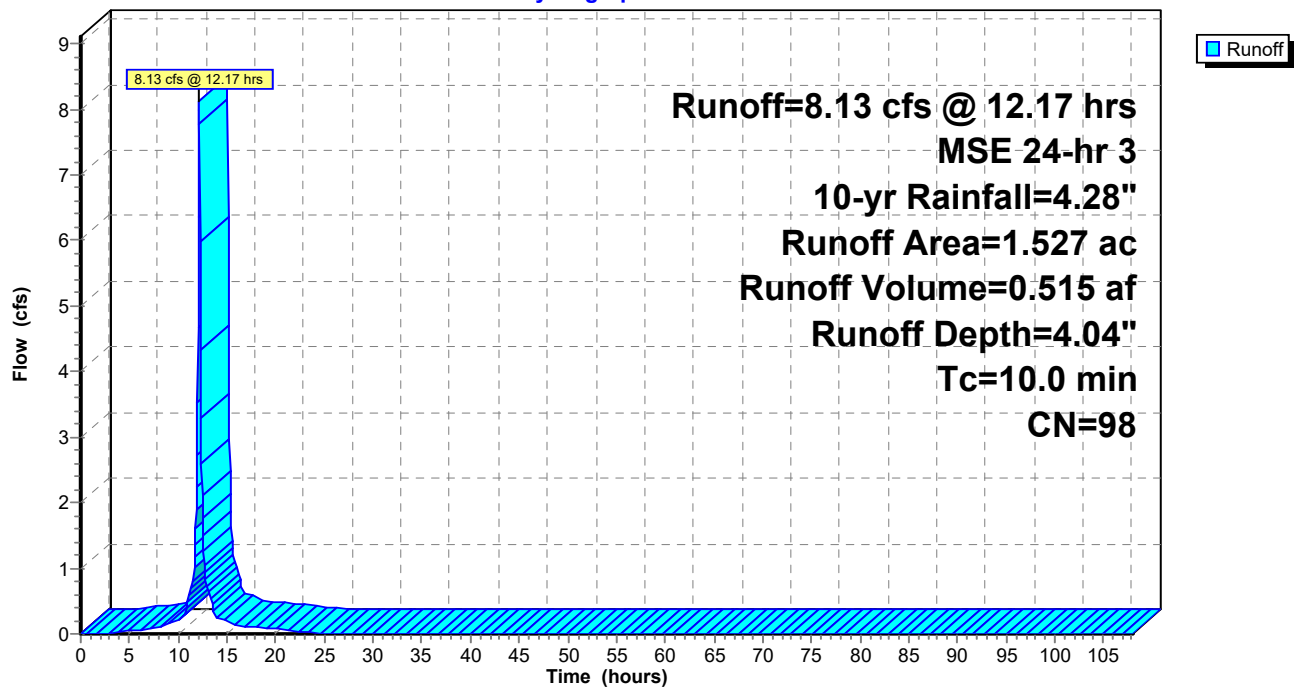
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-yr Rainfall=4.28"

Area (ac)	CN	Description
1.527	98	Paved parking, HSG D
1.527		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 Minute Minimum

Subcatchment 1S: Riverfront

Hydrograph



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MSE 24-hr 3 10-yr Rainfall=4.28"

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Summary for Subcatchment 5S: Liberty Street

Runoff = 5.78 cfs @ 12.17 hrs, Volume= 0.366 af, Depth= 4.04"
Routed to Pond 5P : ADS Storage

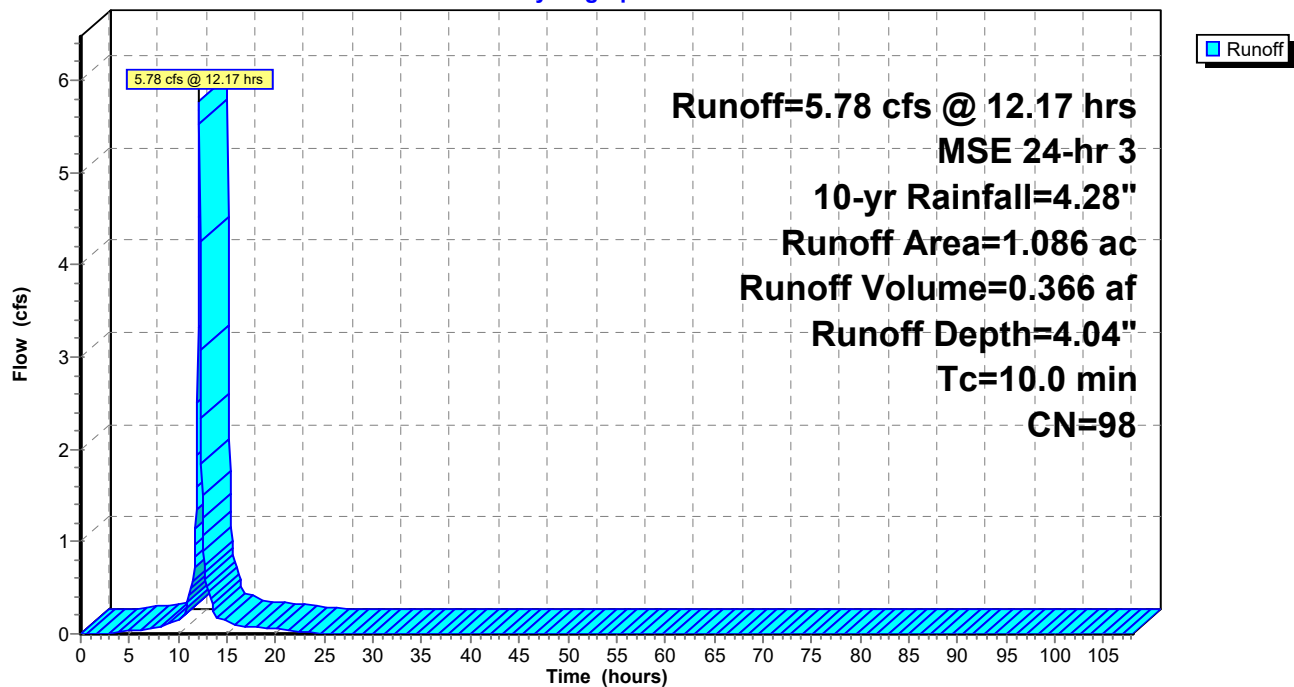
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-yr Rainfall=4.28"

Area (ac)	CN	Description
1.086	98	Paved parking, HSG D
1.086		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 min Minimum

Subcatchment 5S: Liberty Street

Hydrograph



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MSE 24-hr 3 10-yr Rainfall=4.28"

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Summary for Reach 6R: 108-inch RCP Warren

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 2.613 ac, 100.00% Impervious, Inflow Depth = 4.04" for 10-yr event
Inflow = 12.19 cfs @ 12.22 hrs, Volume= 0.881 af
Outflow = 12.09 cfs @ 12.23 hrs, Volume= 0.881 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 7.77 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 2.62 fps, Avg. Travel Time= 0.4 min

Peak Storage= 103 cf @ 12.22 hrs

Average Depth at Peak Storage= 0.54' , Surface Width= 4.28'

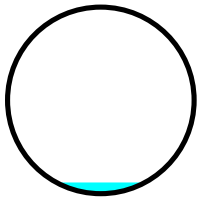
Bank-Full Depth= 9.00' Flow Area= 63.6 sf, Capacity= 1,718.39 cfs

108.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

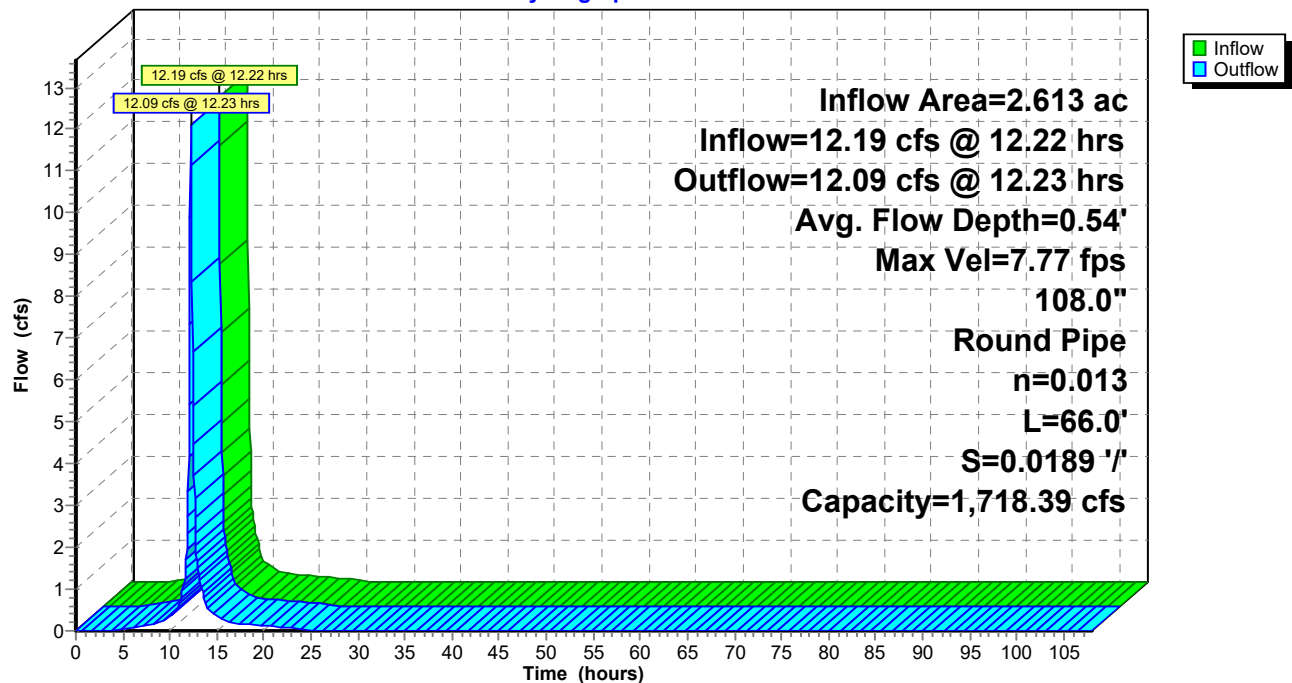
Length= 66.0' Slope= 0.0189 '/'

Inlet Invert= 762.62', Outlet Invert= 761.37'



Reach 6R: 108-inch RCP Warren

Hydrograph



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MSE 24-hr 3 10-yr Rainfall=4.28"

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Summary for Pond 5P: ADS Storage

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 2.613 ac, 100.00% Impervious, Inflow Depth = 4.04" for 10-yr event
Inflow = 13.92 cfs @ 12.17 hrs, Volume= 0.881 af
Outflow = 12.19 cfs @ 12.22 hrs, Volume= 0.881 af, Atten= 12%, Lag= 3.2 min
Primary = 12.19 cfs @ 12.22 hrs, Volume= 0.881 af
Routed to Reach 6R : 108-inch RCP Warren

Routing by Stor-Ind method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
Peak Elev= 773.05' @ 12.22 hrs Surf.Area= 0.048 ac Storage= 0.103 af

Plug-Flow detention time= 21.3 min calculated for 0.880 af (100% of inflow)
Center-of-Mass det. time= 21.6 min (772.6 - 751.1)

Volume	Invert	Avail.Storage	Storage Description
#1	771.20'	0.159 af	ADS_StormTech MC-3500 d +Cap @ 111.00' Lx 4 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 111.00'L = 1,702.2 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 4 Chambers in 4 Rows Cap Storage= 14.9 cf x 2 x 4 rows = 119.2 cf

Device	Routing	Invert	Outlet Devices
#1	Primary	771.19'	24.0" Round Culvert L= 215.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 771.19' / 770.12' S= 0.0050 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf

Primary OutFlow Max=11.94 cfs @ 12.22 hrs HW=773.02' (Free Discharge)

↑**1=Culvert** (Barrel Controls 11.94 cfs @ 5.19 fps)

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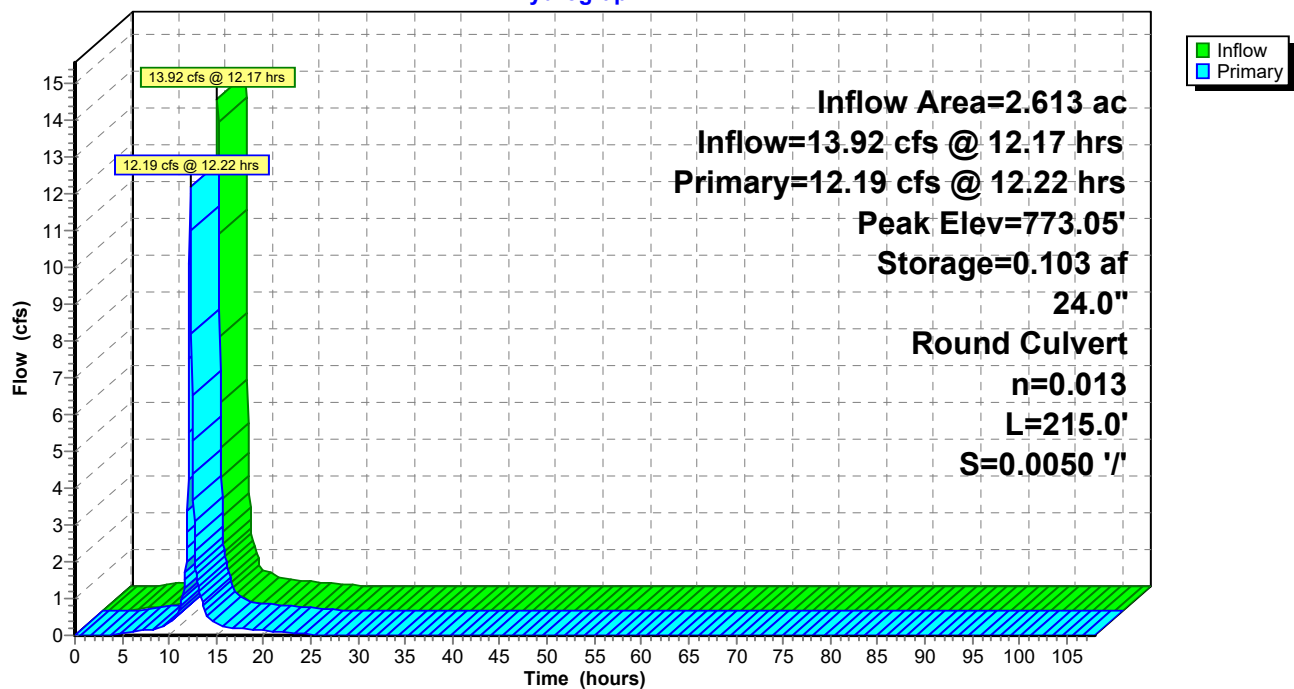
MSE 24-hr 3 10-yr Rainfall=4.28"

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Pond 5P: ADS Storage

Hydrograph



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MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

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Time span=0.00-108.00 hrs, dt=0.05 hrs, 2161 points

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

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

Subcatchment1S: Riverfront

Runoff Area=1.527 ac 100.00% Impervious Runoff Depth=8.32"

Tc=10.0 min CN=98 Runoff=8.19 cfs 1.059 af

Subcatchment5S: Liberty Street

Runoff Area=1.086 ac 100.00% Impervious Runoff Depth=8.32"

Tc=10.0 min CN=98 Runoff=5.82 cfs 0.753 af

Reach 6R: 108-inch RCP Warren

Avg. Flow Depth=0.54' Max Vel=7.79 fps Inflow=12.28 cfs 1.812 af

108.0" Round Pipe n=0.013 L=66.0' S=0.0189 '/' Capacity=1,718.39 cfs Outflow=12.19 cfs 1.812 af

Pond 5P: ADS Storage

Peak Elev=773.06' Storage=0.104 af Inflow=14.01 cfs 1.812 af

24.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=12.28 cfs 1.812 af

Total Runoff Area = 2.613 ac Runoff Volume = 1.812 af Average Runoff Depth = 8.32"
0.00% Pervious = 0.000 ac 100.00% Impervious = 2.613 ac

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MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

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Summary for Subcatchment 1S: Riverfront

Runoff = 8.19 cfs @ 36.17 hrs, Volume= 1.059 af, Depth= 8.32"
Routed to Pond 5P : ADS Storage

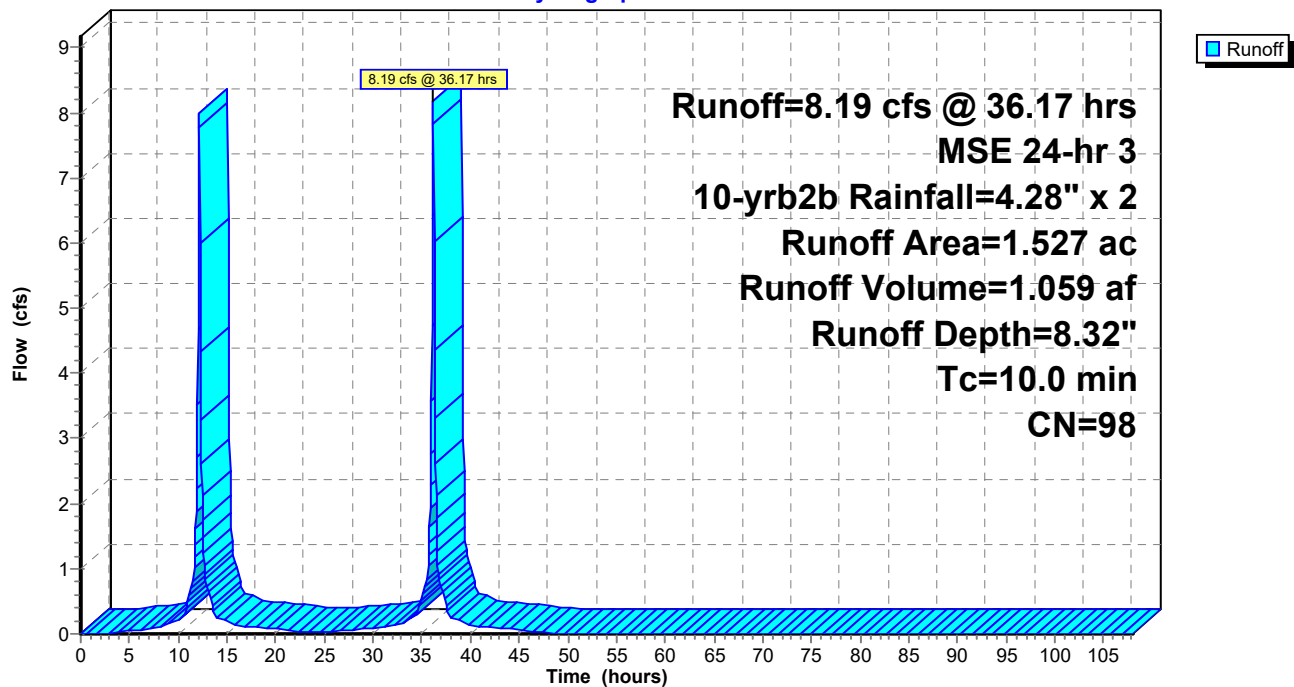
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

Area (ac)	CN	Description
1.527	98	Paved parking, HSG D
1.527		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 Minute Minimum

Subcatchment 1S: Riverfront

Hydrograph



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MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

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Summary for Subcatchment 5S: Liberty Street

Runoff = 5.82 cfs @ 36.17 hrs, Volume= 0.753 af, Depth= 8.32"
Routed to Pond 5P : ADS Storage

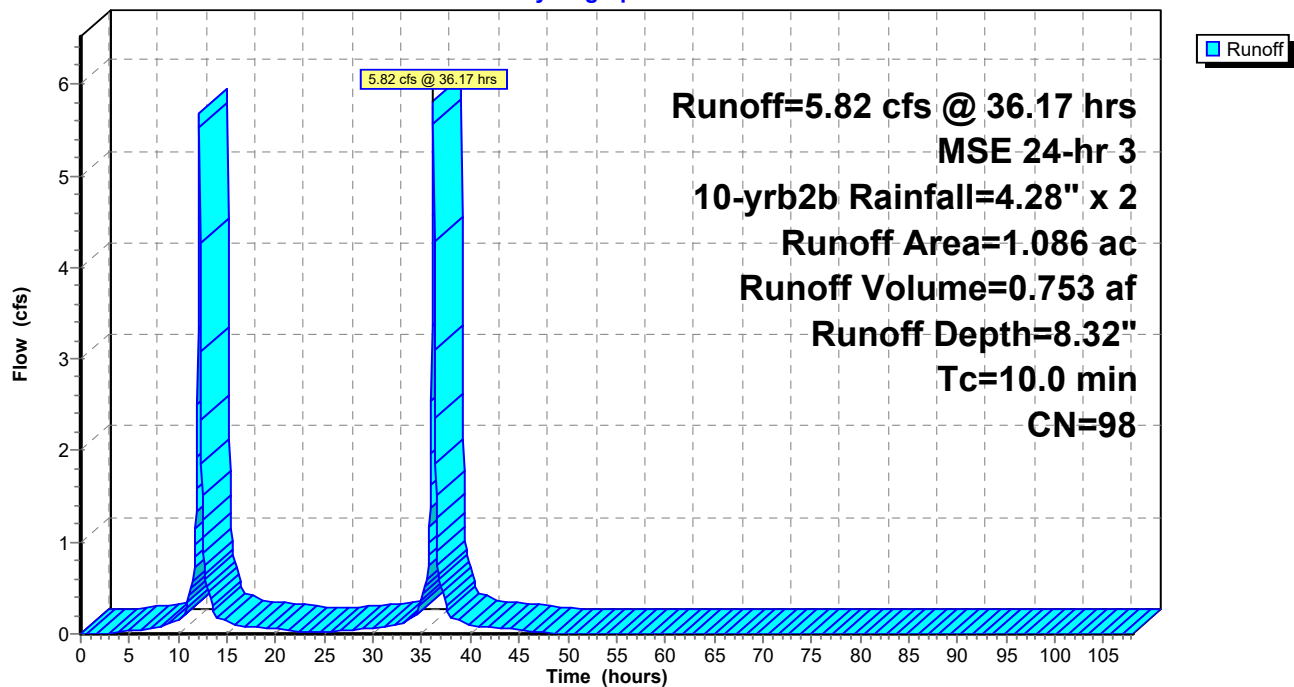
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

Area (ac)	CN	Description
1.086	98	Paved parking, HSG D
1.086		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 min Minimum

Subcatchment 5S: Liberty Street

Hydrograph



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MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

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Summary for Reach 6R: 108-inch RCP Warren

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 2.613 ac, 100.00% Impervious, Inflow Depth = 8.32" for 10-yrb2b event
Inflow = 12.28 cfs @ 36.22 hrs, Volume= 1.812 af
Outflow = 12.19 cfs @ 36.23 hrs, Volume= 1.812 af, Atten= 1%, Lag= 0.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 7.79 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 2.66 fps, Avg. Travel Time= 0.4 min

Peak Storage= 103 cf @ 36.22 hrs

Average Depth at Peak Storage= 0.54' , Surface Width= 4.28'

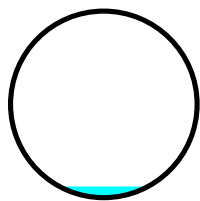
Bank-Full Depth= 9.00' Flow Area= 63.6 sf, Capacity= 1,718.39 cfs

108.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

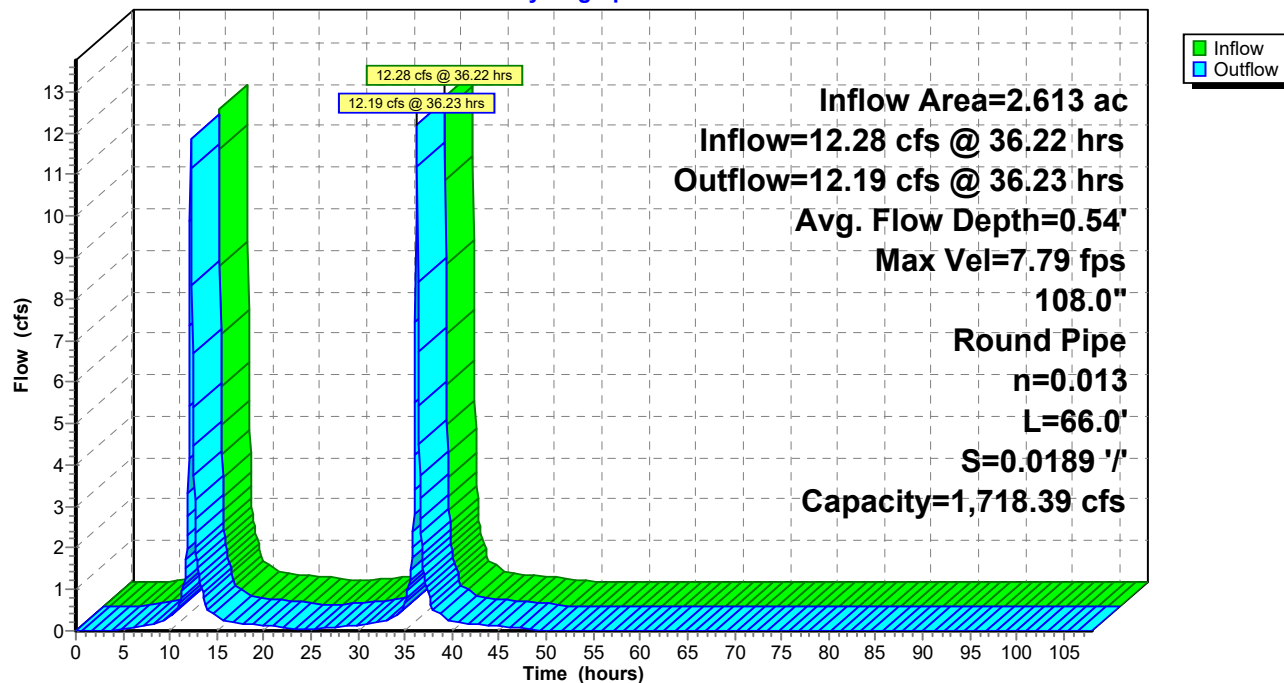
Length= 66.0' Slope= 0.0189 '/'

Inlet Invert= 762.62', Outlet Invert= 761.37'



Reach 6R: 108-inch RCP Warren

Hydrograph



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MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

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Summary for Pond 5P: ADS Storage

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 2.613 ac, 100.00% Impervious, Inflow Depth = 8.32" for 10-yrb2b event
Inflow = 14.01 cfs @ 36.17 hrs, Volume= 1.812 af
Outflow = 12.28 cfs @ 36.22 hrs, Volume= 1.812 af, Atten= 12%, Lag= 3.2 min
Primary = 12.28 cfs @ 36.22 hrs, Volume= 1.812 af
Routed to Reach 6R : 108-inch RCP Warren

Routing by Stor-Ind method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
Peak Elev= 773.06' @ 36.22 hrs Surf.Area= 0.048 ac Storage= 0.104 af

Plug-Flow detention time= 22.4 min calculated for 1.812 af (100% of inflow)
Center-of-Mass det. time= 21.8 min (1,501.8 - 1,480.0)

Volume	Invert	Avail.Storage	Storage Description
#1	771.20'	0.159 af	ADS_StormTech MC-3500 d +Cap @ 111.00' Lx 4 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 111.00'L = 1,702.2 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 4 Chambers in 4 Rows Cap Storage= 14.9 cf x 2 x 4 rows = 119.2 cf

Device	Routing	Invert	Outlet Devices
#1	Primary	771.19'	24.0" Round Culvert L= 215.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 771.19' / 770.12' S= 0.0050 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf

Primary OutFlow Max=12.03 cfs @ 36.22 hrs HW=773.03' (Free Discharge)
↑**1=Culvert** (Barrel Controls 12.03 cfs @ 5.20 fps)

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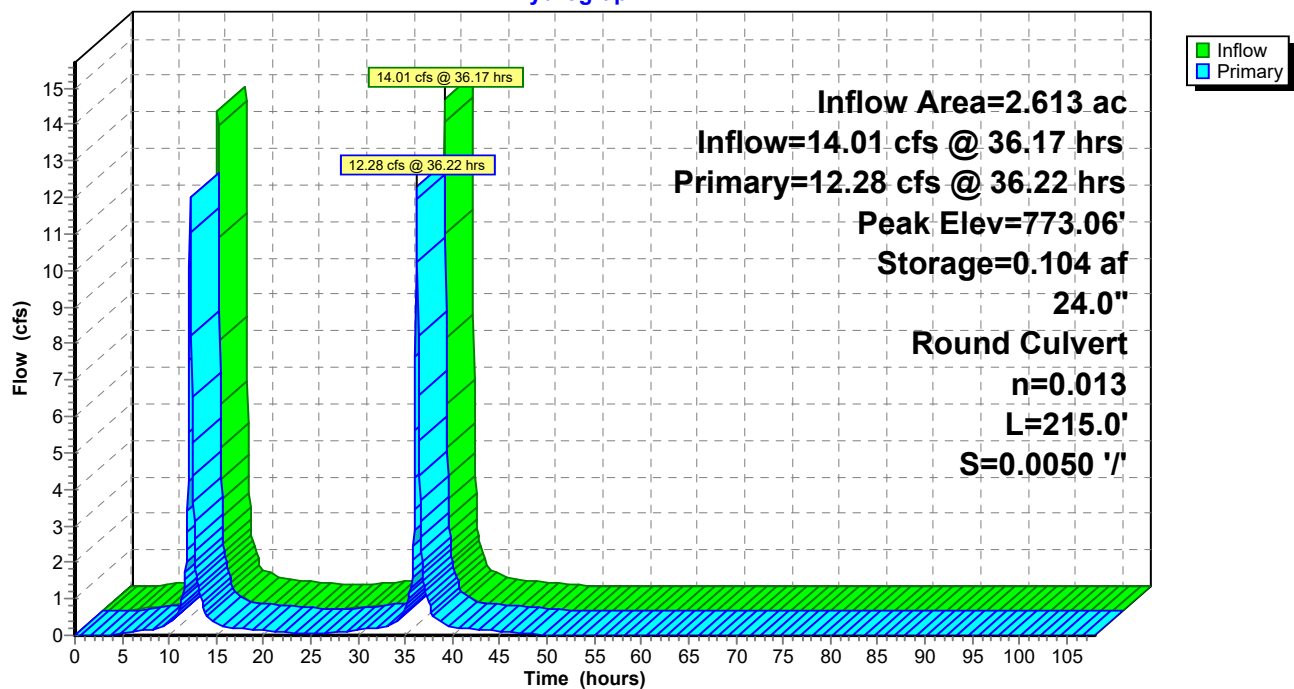
MSE 24-hr 3 10-yrb2b Rainfall=4.28" x 2

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Pond 5P: ADS Storage

Hydrograph



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MSE 24-hr 3 100-yr Rainfall=7.19"

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Time span=0.00-108.00 hrs, dt=0.05 hrs, 2161 points

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

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

Subcatchment1S: Riverfront

Runoff Area=1.527 ac 100.00% Impervious Runoff Depth=6.95"

Tc=10.0 min CN=98 Runoff=13.73 cfs 0.884 af

Subcatchment5S: Liberty Street

Runoff Area=1.086 ac 100.00% Impervious Runoff Depth=6.95"

Tc=10.0 min CN=98 Runoff=9.77 cfs 0.629 af

Reach 6R: 108-inch RCP Warren

Avg. Flow Depth=0.67' Max Vel=9.02 fps Inflow=19.56 cfs 1.514 af

108.0" Round Pipe n=0.013 L=66.0' S=0.0189 '/' Capacity=1,718.39 cfs Outflow=19.47 cfs 1.514 af

Pond 5P: ADS Storage

Peak Elev=774.63' Storage=0.158 af Inflow=23.50 cfs 1.514 af

24.0" Round Culvert n=0.013 L=215.0' S=0.0050 '/' Outflow=19.56 cfs 1.514 af

Total Runoff Area = 2.613 ac Runoff Volume = 1.514 af Average Runoff Depth = 6.95"
0.00% Pervious = 0.000 ac 100.00% Impervious = 2.613 ac

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MSE 24-hr 3 100-yr Rainfall=7.19"

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Summary for Subcatchment 1S: Riverfront

Runoff = 13.73 cfs @ 12.17 hrs, Volume= 0.884 af, Depth= 6.95"
Routed to Pond 5P : ADS Storage

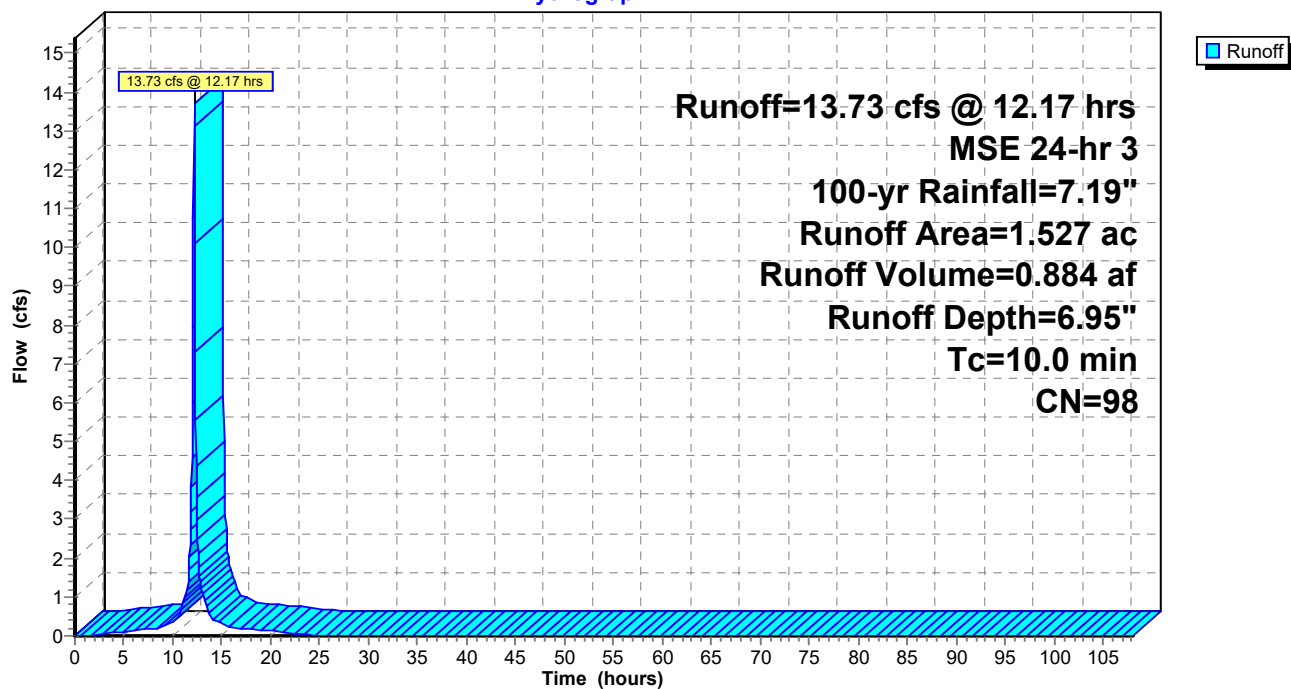
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-yr Rainfall=7.19"

Area (ac)	CN	Description
1.527	98	Paved parking, HSG D
1.527		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 Minute Minimum

Subcatchment 1S: Riverfront

Hydrograph



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MSE 24-hr 3 100-yr Rainfall=7.19"

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Summary for Subcatchment 5S: Liberty Street

Runoff = 9.77 cfs @ 12.17 hrs, Volume= 0.629 af, Depth= 6.95"
Routed to Pond 5P : ADS Storage

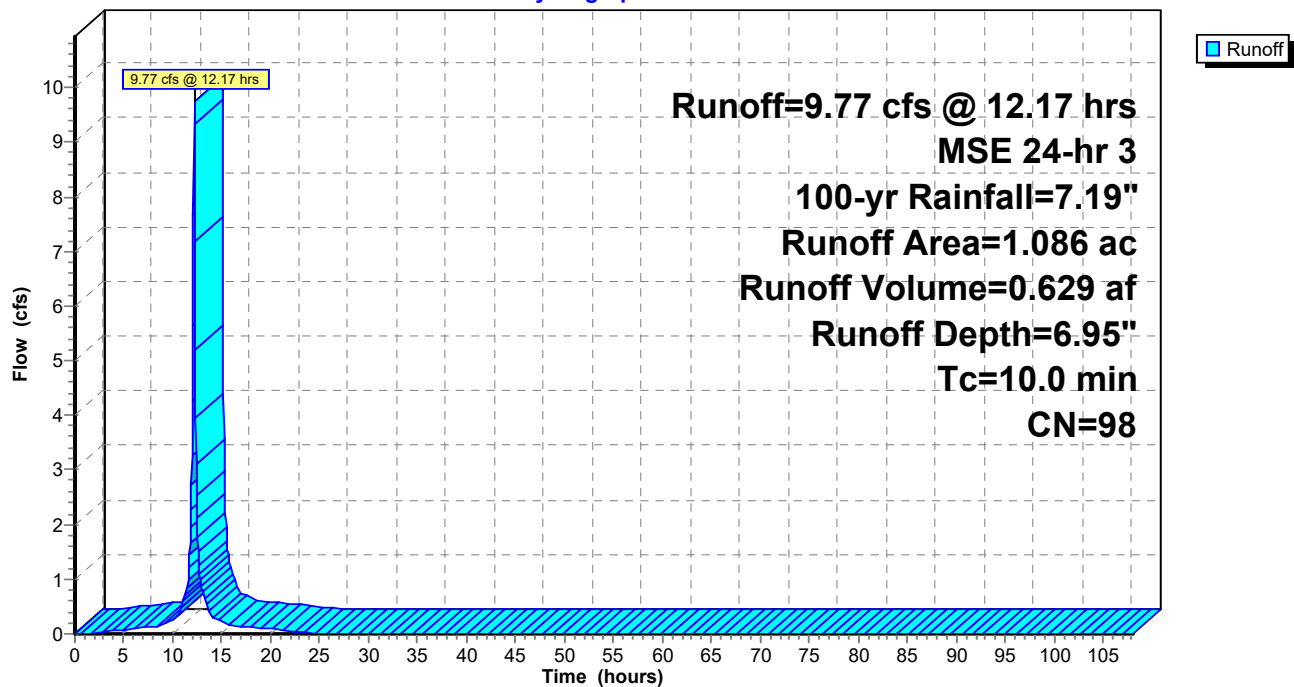
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-yr Rainfall=7.19"

Area (ac)	CN	Description
1.086	98	Paved parking, HSG D
1.086		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, 10 min Minimum

Subcatchment 5S: Liberty Street

Hydrograph



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MSE 24-hr 3 100-yr Rainfall=7.19"

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Summary for Reach 6R: 108-inch RCP Warren

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 2.613 ac, 100.00% Impervious, Inflow Depth = 6.95" for 100-yr event
Inflow = 19.56 cfs @ 12.24 hrs, Volume= 1.514 af
Outflow = 19.47 cfs @ 12.24 hrs, Volume= 1.514 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs

Max. Velocity= 9.02 fps, Min. Travel Time= 0.1 min

Avg. Velocity = 2.75 fps, Avg. Travel Time= 0.4 min

Peak Storage= 143 cf @ 12.24 hrs

Average Depth at Peak Storage= 0.67' , Surface Width= 4.73'

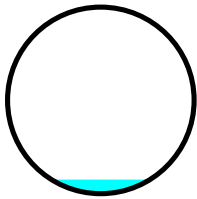
Bank-Full Depth= 9.00' Flow Area= 63.6 sf, Capacity= 1,718.39 cfs

108.0" Round Pipe

n= 0.013 Concrete pipe, bends & connections

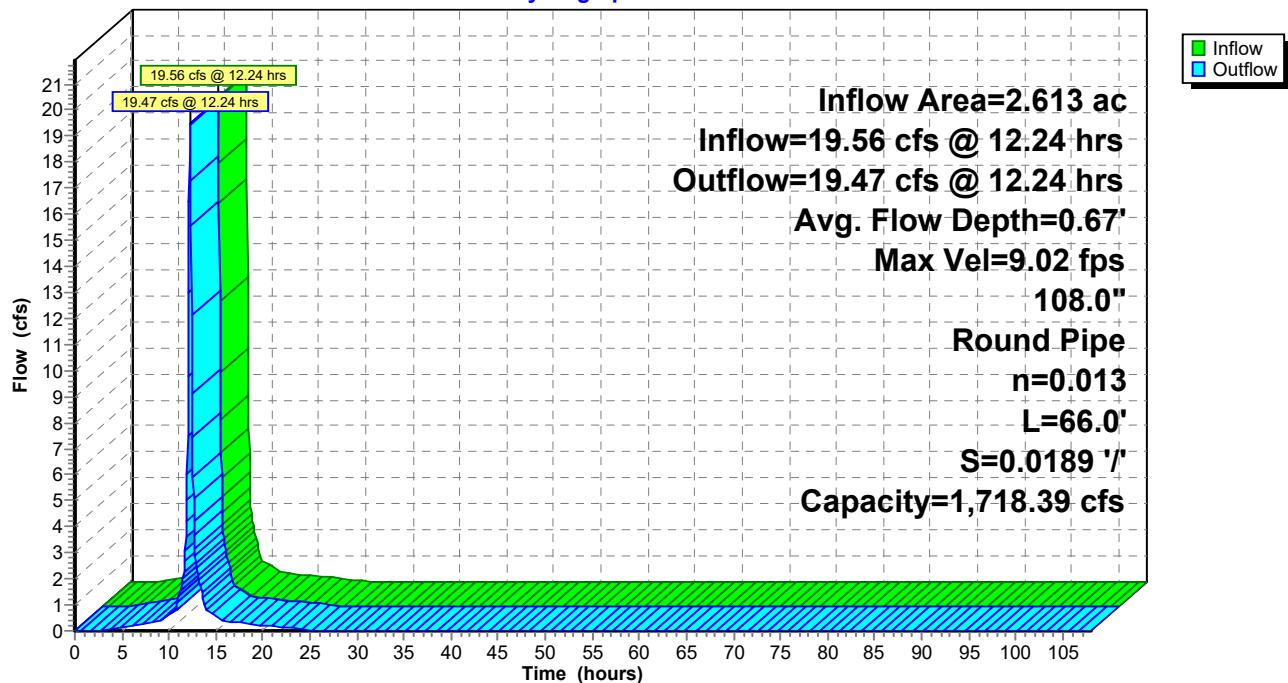
Length= 66.0' Slope= 0.0189 '/'

Inlet Invert= 762.62', Outlet Invert= 761.37'



Reach 6R: 108-inch RCP Warren

Hydrograph



33587 Front Street Proposed

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MSE 24-hr 3 100-yr Rainfall=7.19"

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Summary for Pond 5P: ADS Storage

[44] Hint: Outlet device #1 is below defined storage

Inflow Area = 2.613 ac, 100.00% Impervious, Inflow Depth = 6.95" for 100-yr event
Inflow = 23.50 cfs @ 12.17 hrs, Volume= 1.514 af
Outflow = 19.56 cfs @ 12.24 hrs, Volume= 1.514 af, Atten= 17%, Lag= 4.1 min
Primary = 19.56 cfs @ 12.24 hrs, Volume= 1.514 af
Routed to Reach 6R : 108-inch RCP Warren

Routing by Stor-Ind method, Time Span= 0.00-108.00 hrs, dt= 0.05 hrs
Peak Elev= 774.63' @ 12.24 hrs Surf.Area= 0.009 ac Storage= 0.158 af

Plug-Flow detention time= 16.8 min calculated for 1.513 af (100% of inflow)
Center-of-Mass det. time= 17.0 min (761.5 - 744.5)

Volume	Invert	Avail.Storage	Storage Description
#1	771.20'	0.159 af	ADS_StormTech MC-3500 d +Cap @ 111.00' Lx 4 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 111.00'L = 1,702.2 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 4 Chambers in 4 Rows Cap Storage= 14.9 cf x 2 x 4 rows = 119.2 cf

Device	Routing	Invert	Outlet Devices
#1	Primary	771.19'	24.0" Round Culvert L= 215.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 771.19' / 770.12' S= 0.0050 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.14 sf

Primary OutFlow Max=19.26 cfs @ 12.24 hrs HW=774.56' (Free Discharge)

↑**1=Culvert** (Barrel Controls 19.26 cfs @ 6.13 fps)

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Pond 5P: ADS Storage

Hydrograph

