



To: City of Waukesha
From: Matthew A. Carey, P.E., LEED AP
Date: July 25, 2025
Subject: Bridge Church Expansion – Stormwater Memorandum

The following is a short summary detailing the stormwater management design intent for the Bridge Church Building Expansion.

EXISTING CONDITIONS SUMMARY

The project site is located on the west side of Grand Avenue and just north of W. Sunset Drive within the City of Waukesha, Waukesha County, WI. In the area where proposed improvements will occur the site drains to an existing catch basin within Grand Avenue which connects to a 27" storm sewer main. Two offsite areas also contribute to the existing 27" storm sewer as shown in the **Attached EX-1**. This area is located within an internally drained watershed area as shown in **EX-1** and currently the overland flow path is between the existing church building and parsonage. The current overtop elevation for the overland flow path is 855.60. The existing church building finished floor elevation is at an elevation of 855.70. It should be noted that the church has not noted any issues with flooding in this area with heavy rain events in recent years.

PROPOSED CONDITIONS SUMMARY

The proposed development will construct an approximately 24,000 sf expansion to the existing church building with a proposed finished floor elevation of 855.70. The proposed addition will further reduce the existing overland flow capability. To offset this, a swale will be graded to provide drainage between the proposed expansion and existing Bridge Church offices and will discharge to a proposed storm sewer with flared end section. This will connect into the existing catch basin and the storm sewer outflow from the catch basin will be upsized and connected to the existing 27" storm sewer within Grand Avenue with a new manhole structure. A portion of the new building roof and existing office building roof will drain at grade into the proposed swale. The **Attached EX-2** shows the proposed drainage area conditions.

The intent of the proposed swale is to provide drainage between existing and proposed buildings along with overland flow relief, in the situation that a larger storm event creates surface ponding at this location. There is a sidewalk that will connect over this swale, however there will be an opening in the sidewalk with an open grate to allow for drainage from the existing parking lot to the west and for overland relief to the east. In the event of overland flow relief routing the water will push back into the drainage swale to the west, through the sidewalk opening, and overtop at a proposed elevation of 854.60 within the parking lot. This area will then continue to the southeast into an existing depressional area which will ultimately drain into the storm sewer within W. Sunset Avenue.

STORMWATER MANAGEMENT

A stormwater analysis was completed utilizing TR-55 and Rational methodology to determine water surface elevation during the 1, 2, 10 and 100-year storm events. The storage area in Grand Avenue was modeled with the existing 27" storm sewer as a primary outlet and the 854.60 overtop point modeled as a secondary weir. The 27" existing storm sewer was utilized as the primary outlet because it is the controlling factor in the stormwater analysis. For the TR-55 analysis, the area draining in the proposed condition to the depressional area within Grand Avenue was modeled with a curve number of 83 and is a total of 23.463-acres. Rainfall totals utilized in the analysis were based on City of Waukesha stormwater code and are 2.40", 2.70", 3.81", & 6.18" for the 1, 2, 10, and 100-year storms respectively. The rational analysis was modeled with an overall C value of 0.69 and is an area of 23.463-acres. Rainfall totals utilized were for a 10-minute intensity in the analysis are 3.00", 3.60", 5.28", & 7.86" for the 1, 2, 10, and 100-year storms respectively.

These two analyses were completed to compare water surface elevation values, in both analyses the water surface elevation is below the proposed finished floor of 855.70. A comparison of each analysis is provided on the table below:

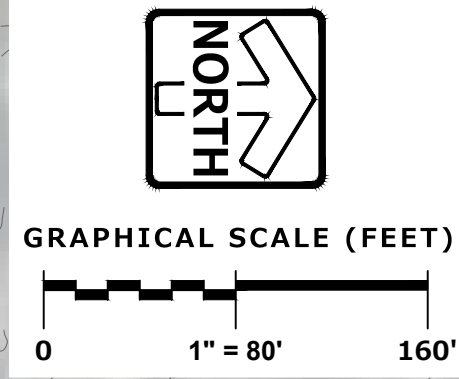
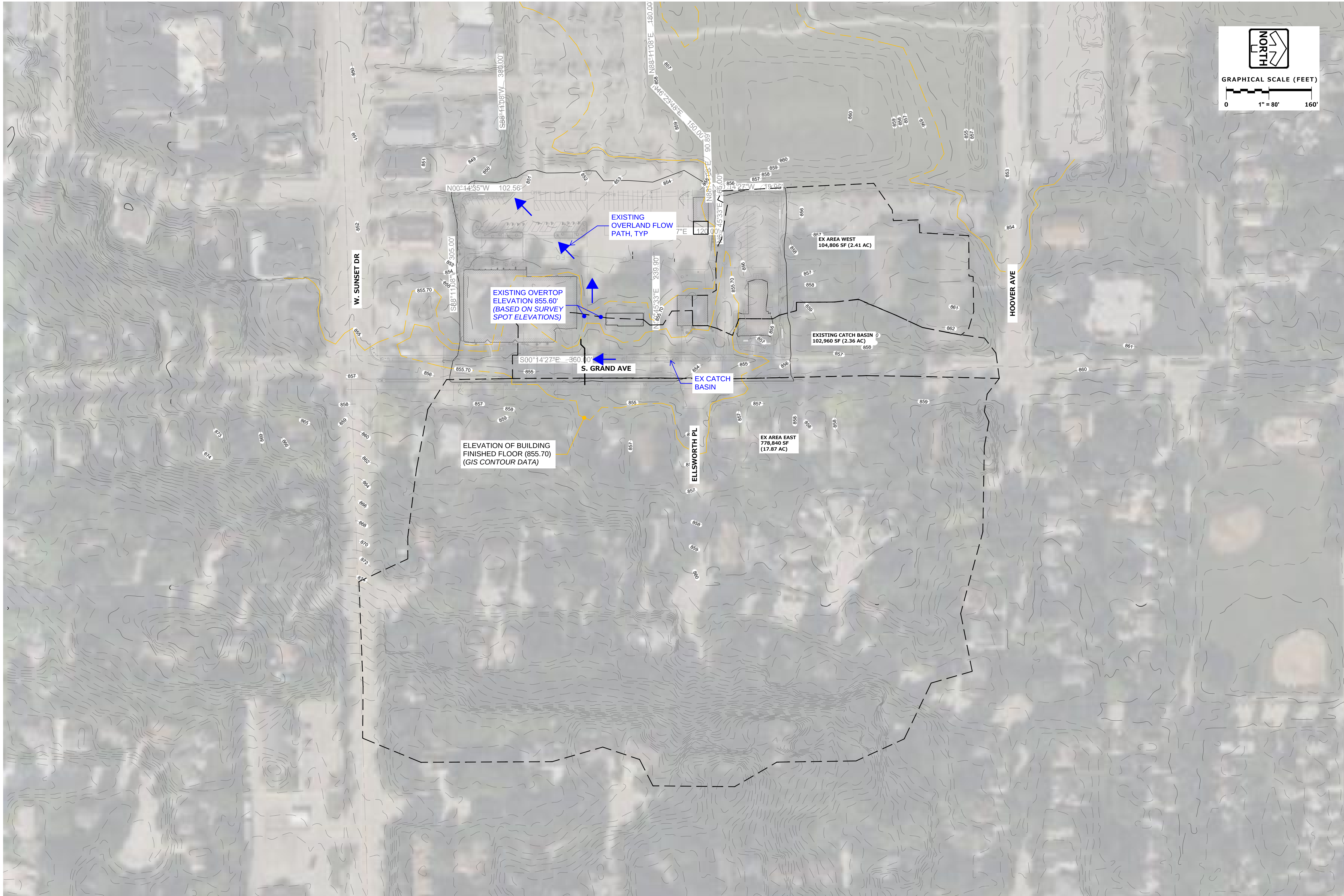
TR-55 & RATIONAL ANALYSIS COMPARISON

	1-year	2-year	10-year	100-year
	TR-55 Analysis			
Inflow (cfs)	28.86	35.80	63.06	126.44
Outflow (cfs)	25.35	27.20	35.60	87.50
Peak Water Elevation (ft)	853.37	853.83	854.79	855.42
	Rational Analysis			
Inflow (cfs)	48.12	57.74	84.68	126.06
Discharge (cfs)	27.75	28.74	32.87	56.40
Peak Water Elevation (ft)	853.98	854.24	854.72	855.10

Based on the two analyses completed the peak water elevation will remain between 3-6" below the finished floor elevation of the proposed addition and the existing Bridge Church offices adjacent to the proposed swale during the 100-year storm event.

LIST OF ATTACHMENTS

1. Existing Drainage Map
2. Proposed Drainage Map
3. TR-55 HydroCAD Analysis
4. Rational HydroCAD Analysis
5. Proposed Storm Sewer Design





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PROJECT

BRIDGE CHURCH

ADDITION AND
RENOVATION

1314 S GRAND
AVE
WAUKESHA, WI
53186

ISSUE

PROGRESS
DOCUMENTS

These documents reflect progress and intent and may be subject to change, including additional detail. These are not final construction documents and should not be used for final bidding or construction-related purposes.

PROJECT INFO

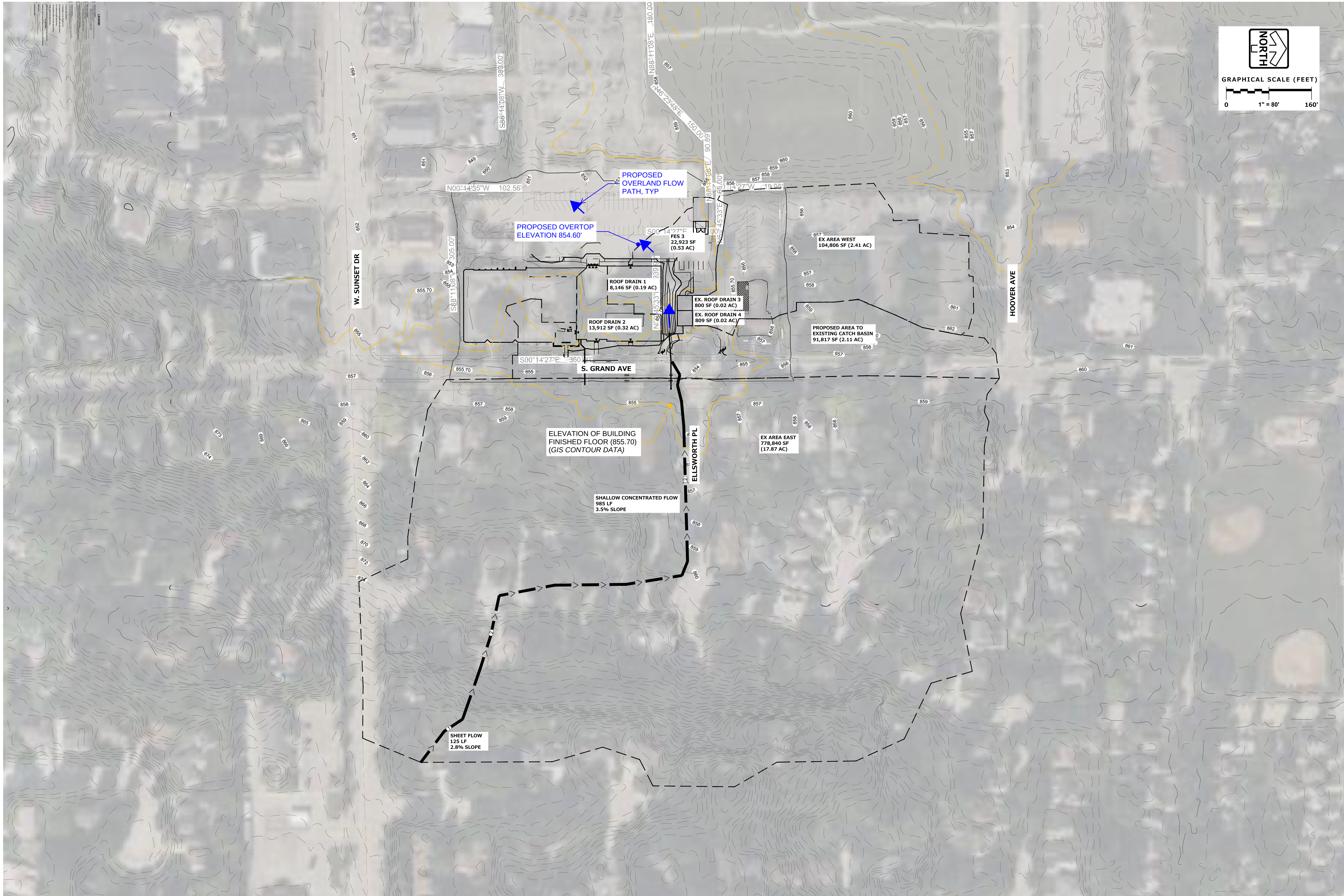
Date
07/25/2025
Project No.
6112.00-WI

SHEET TITLE

EXISTING DRAINAGE
EXHIBIT

EX-1

PLAN COMMISSION SET



N58 W6181 COLUMBIA RD.
P.O. BOX 332
CEDARBURG, WISCONSIN 53012
PH. (262) 377-8001
FX. (262) 377-8003

PROJECT

BRIDGE CHURCH

ADDITION AND RENOVATION

1314 S GRAND AVE
WAUKESHA, WI
53186

ISSUE

PROGRESS DOCUMENTS

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PROJECT INFO

Date

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Project No.

6112.00-WI

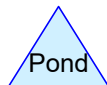
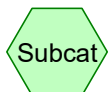
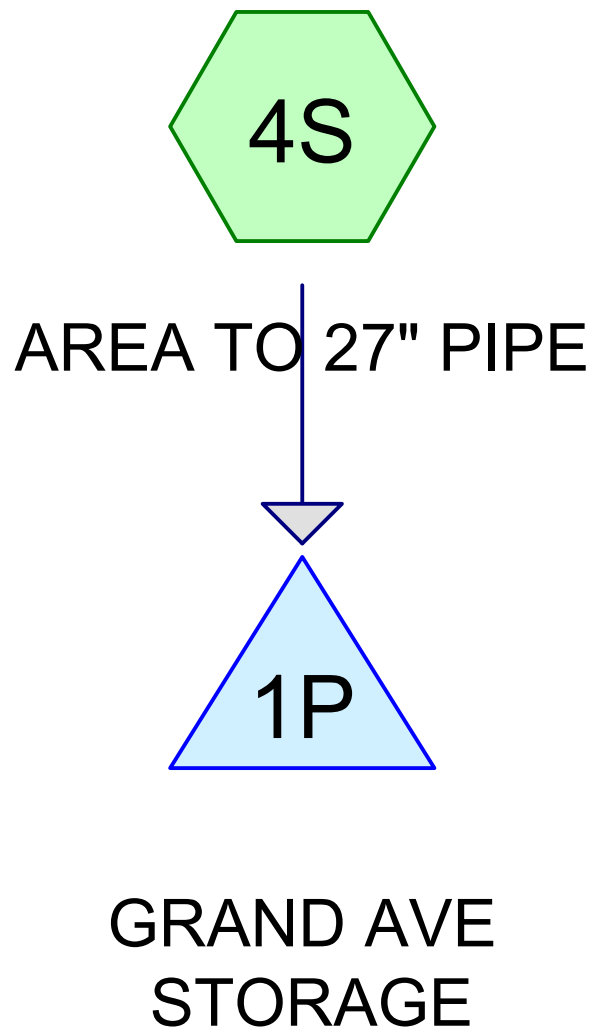
SHEET TITLE

PROPOSED DRAINAGE
AREA EXHIBIT

EX-2

PLAN COMMISSION SET

TR-55 ANALYSIS



6112.00-WI BRIDGE CHURCH - TR-55

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Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-YR	MSE 24-hr	3	Default	24.00	1	2.40	2
2	2-YR	MSE 24-hr	3	Default	24.00	1	2.70	2
3	10-YR	MSE 24-hr	3	Default	24.00	1	3.81	2
4	100-YR	MSE 24-hr	3	Default	24.00	1	6.18	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
23.463	83	1/4 acre lots, 38% imp, HSG C (4S)
23.463	83	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
23.463	HSG C	4S
0.000	HSG D	
0.000	Other	
23.463		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	23.463	0.000	0.000	23.463	1/4 acre lots, 38% imp	4S
0.000	0.000	23.463	0.000	0.000	23.463	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	1P	849.26	848.07	312.9	0.0038	0.013	0.0	27.0	0.0	

6112.00-WI BRIDGE CHURCH - TR-55*MSE 24-hr 3 1-YR Rainfall=2.40"*

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points

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

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment4S: AREA TO 27" PIPE Runoff Area=23.463 ac 38.00% Impervious Runoff Depth>0.98"
Flow Length=1,110' Tc=15.4 min CN=83 Runoff=28.86 cfs 1.916 af

Pond 1P: GRAND AVE STORAGE Peak Elev=853.37' Storage=1,777 cf Inflow=28.86 cfs 1.916 af
Primary=25.35 cfs 1.917 af Secondary=0.00 cfs 0.000 af Outflow=25.35 cfs 1.917 af

Total Runoff Area = 23.463 ac Runoff Volume = 1.916 af Average Runoff Depth = 0.98"
62.00% Pervious = 14.547 ac 38.00% Impervious = 8.916 ac

6112.00-WI BRIDGE CHURCH - TR-55

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MSE 24-hr 3 1-YR Rainfall=2.40"

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Summary for Subcatchment 4S: AREA TO 27" PIPE

Runoff = 28.86 cfs @ 12.25 hrs, Volume= 1.916 af, Depth> 0.98"
Routed to Pond 1P : GRAND AVE STORAGE

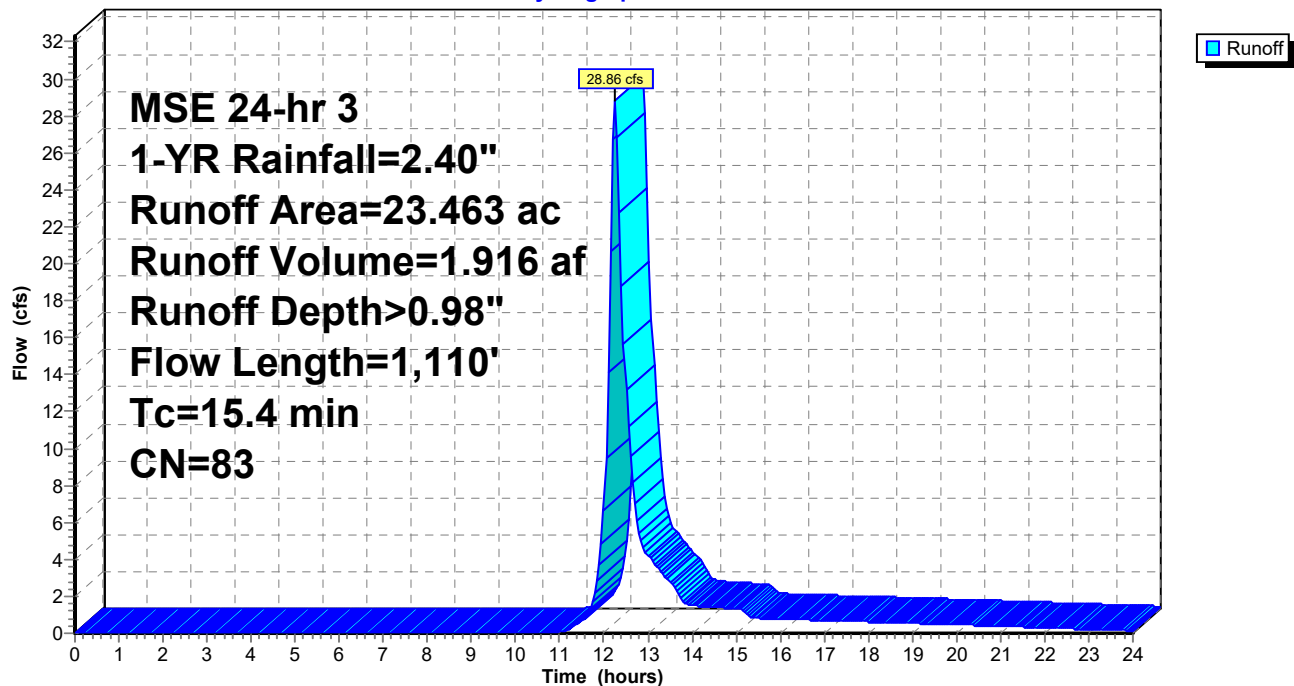
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 1-YR Rainfall=2.40"

Area (ac)	CN	Description
23.463	83	1/4 acre lots, 38% imp, HSG C
14.547		62.00% Pervious Area
8.916		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.1	125	0.0280	0.19		Sheet Flow, Sheet Grass: Short n= 0.150 P2= 2.70"
4.3	985	0.0350	3.80		Shallow Concentrated Flow, Paved Kv= 20.3 fps
15.4	1,110	Total			

Subcatchment 4S: AREA TO 27" PIPE

Hydrograph



Summary for Pond 1P: GRAND AVE STORAGE

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=74)

Inflow Area = 23.463 ac, 38.00% Impervious, Inflow Depth > 0.98" for 1-YR event
 Inflow = 28.86 cfs @ 12.25 hrs, Volume= 1.916 af
 Outflow = 25.35 cfs @ 12.32 hrs, Volume= 1.917 af, Atten= 12%, Lag= 4.1 min
 Primary = 25.35 cfs @ 12.32 hrs, Volume= 1.917 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 853.37' @ 12.32 hrs Surf.Area= 4,912 sf Storage= 1,777 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 0.2 min (825.9 - 825.7)

Volume	Invert	Avail.Storage	Storage Description
#1	849.20'	78,705 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
849.20	4	0	0
851.00	4	7	7
852.00	210	107	114
853.00	942	576	690
854.00	11,636	6,289	6,979
855.00	42,538	27,087	34,066
855.70	85,000	44,638	78,705

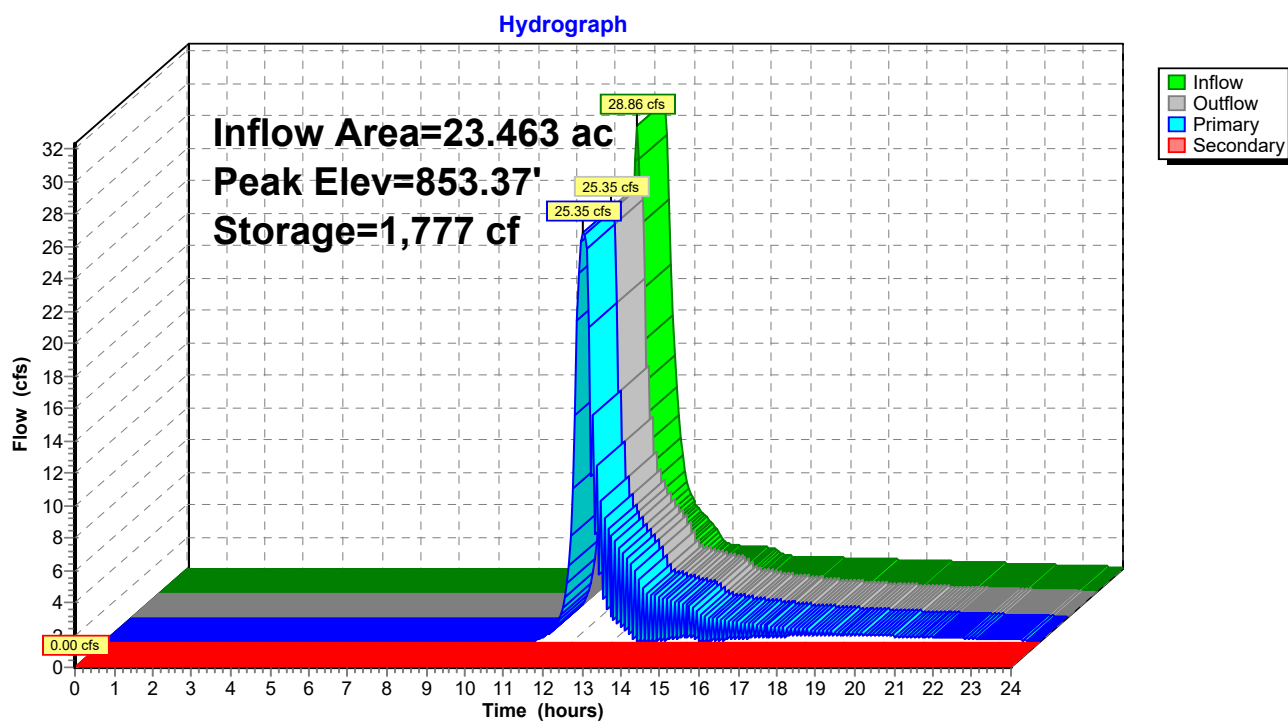
Device	Routing	Invert	Outlet Devices
#1	Primary	849.26'	27.0" Round Culvert L= 312.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 849.26' / 848.07' S= 0.0038 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.98 sf
#2	Secondary	854.60'	25.0' long + 4.0 ' SideZ x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=25.29 cfs @ 12.32 hrs HW=853.35' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 25.29 cfs @ 6.36 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=849.20' (Free Discharge)

↑ **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: GRAND AVE STORAGE

6112.00-WI BRIDGE CHURCH - TR-55*MSE 24-hr 3 2-YR Rainfall=2.70"*

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment4S: AREATO 27" PIPE Runoff Area=23.463 ac 38.00% Impervious Runoff Depth>1.21"
Flow Length=1,110' Tc=15.4 min CN=83 Runoff=35.80 cfs 2.362 af

Pond 1P: GRAND AVE STORAGE Peak Elev=853.83' Storage=5,176 cf Inflow=35.80 cfs 2.362 af
Primary=27.20 cfs 2.363 af Secondary=0.00 cfs 0.000 af Outflow=27.20 cfs 2.363 af

Total Runoff Area = 23.463 ac Runoff Volume = 2.362 af Average Runoff Depth = 1.21"
62.00% Pervious = 14.547 ac 38.00% Impervious = 8.916 ac

6112.00-WI BRIDGE CHURCH - TR-55

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MSE 24-hr 3 2-YR Rainfall=2.70"

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Summary for Subcatchment 4S: AREA TO 27" PIPE

Runoff = 35.80 cfs @ 12.25 hrs, Volume= 2.362 af, Depth> 1.21"
 Routed to Pond 1P : GRAND AVE STORAGE

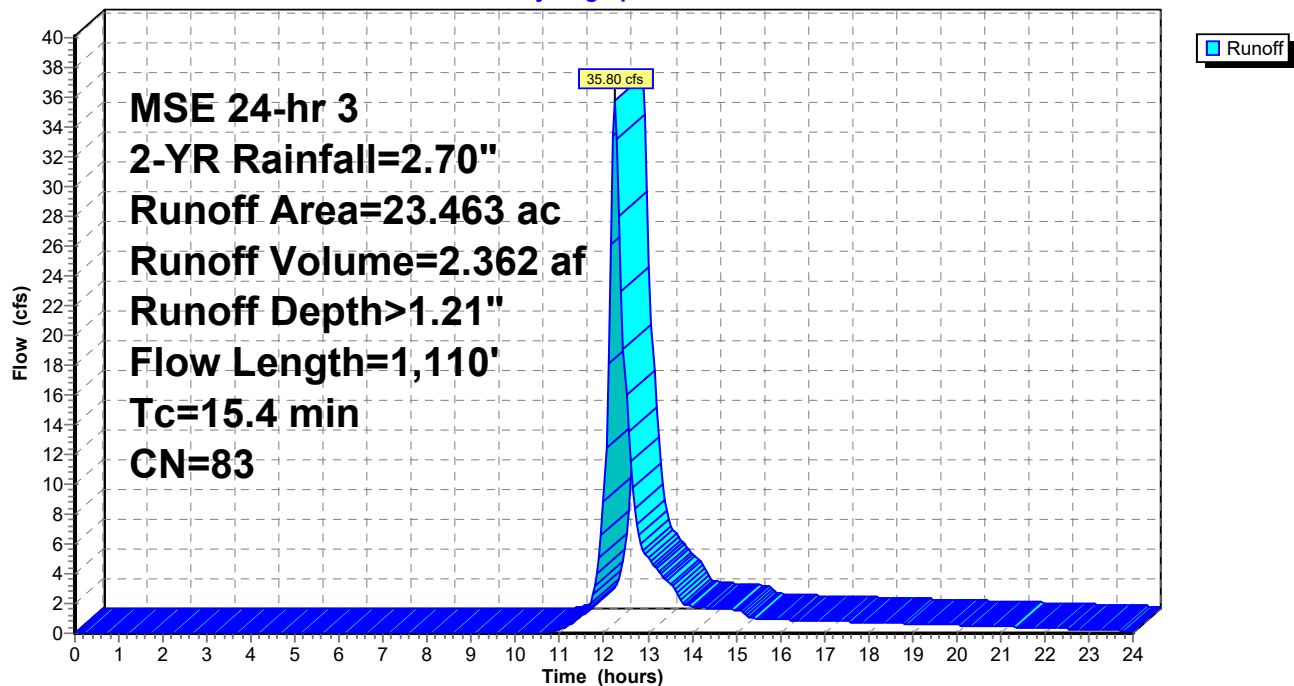
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 MSE 24-hr 3 2-YR Rainfall=2.70"

Area (ac)	CN	Description
23.463	83	1/4 acre lots, 38% imp, HSG C
14.547		62.00% Pervious Area
8.916		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.1	125	0.0280	0.19		Sheet Flow, Sheet
					Grass: Short n= 0.150 P2= 2.70"
4.3	985	0.0350	3.80		Shallow Concentrated Flow,
					Paved Kv= 20.3 fps
15.4	1,110	Total			

Subcatchment 4S: AREA TO 27" PIPE

Hydrograph



Summary for Pond 1P: GRAND AVE STORAGE

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=78)

Inflow Area = 23.463 ac, 38.00% Impervious, Inflow Depth > 1.21" for 2-YR event
 Inflow = 35.80 cfs @ 12.25 hrs, Volume= 2.362 af
 Outflow = 27.20 cfs @ 12.36 hrs, Volume= 2.363 af, Atten= 24%, Lag= 6.6 min
 Primary = 27.20 cfs @ 12.36 hrs, Volume= 2.363 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 853.83' @ 12.36 hrs Surf.Area= 9,840 sf Storage= 5,176 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 0.8 min (822.1 - 821.3)

Volume	Invert	Avail.Storage	Storage Description
#1	849.20'	78,705 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
849.20	4	0	0
851.00	4	7	7
852.00	210	107	114
853.00	942	576	690
854.00	11,636	6,289	6,979
855.00	42,538	27,087	34,066
855.70	85,000	44,638	78,705

Device	Routing	Invert	Outlet Devices
#1	Primary	849.26'	27.0" Round Culvert L= 312.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 849.26' / 848.07' S= 0.0038 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.98 sf
#2	Secondary	854.60'	25.0' long + 4.0 ' SideZ x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

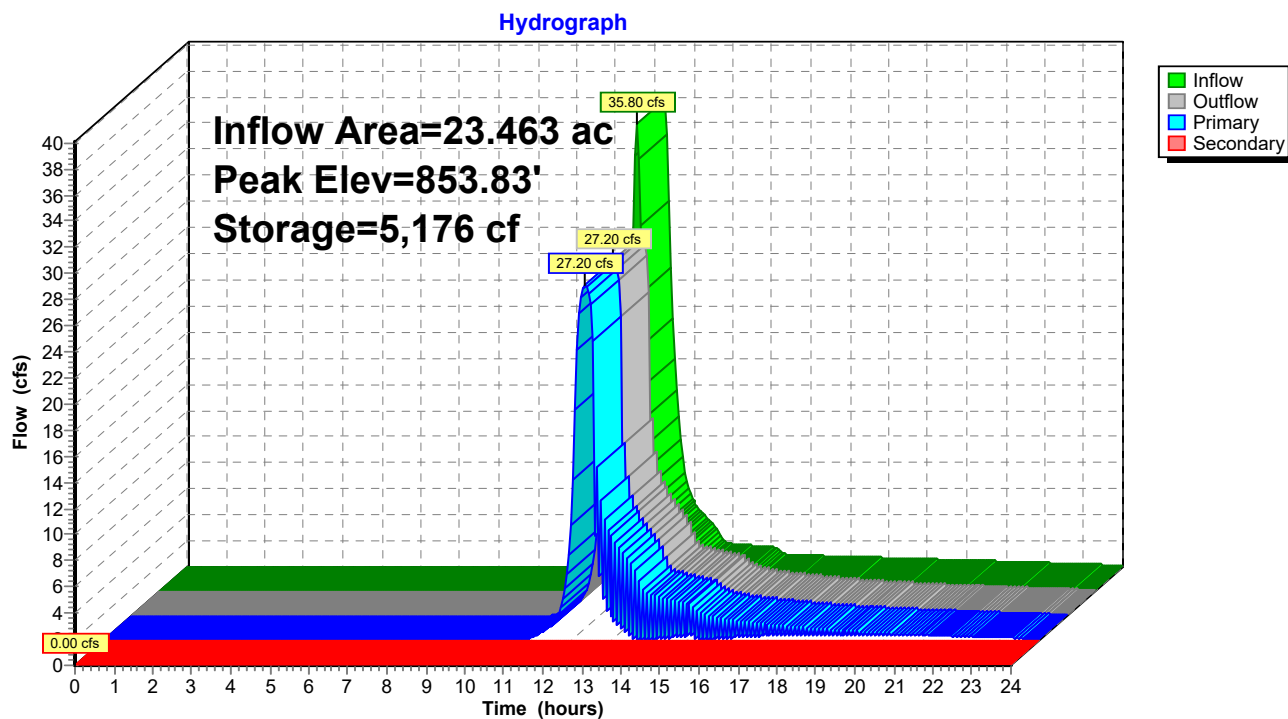
Primary OutFlow Max=27.17 cfs @ 12.36 hrs HW=853.82' (Free Discharge)

↑ **1=Culvert** (Barrel Controls 27.17 cfs @ 6.83 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=849.20' (Free Discharge)

↑ **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: GRAND AVE STORAGE



6112.00-WI BRIDGE CHURCH - TR-55*MSE 24-hr 3 10-YR Rainfall=3.81"*

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment4S: AREA TO 27" PIPE Runoff Area=23.463 ac 38.00% Impervious Runoff Depth>2.12"
Flow Length=1,110' Tc=15.4 min CN=83 Runoff=63.06 cfs 4.145 af

Pond 1P: GRAND AVE STORAGE Peak Elev=854.79' Storage=25,775 cf Inflow=63.06 cfs 4.145 af
Primary=30.68 cfs 4.071 af Secondary=4.91 cfs 0.081 af Outflow=35.60 cfs 4.152 af

Total Runoff Area = 23.463 ac Runoff Volume = 4.145 af Average Runoff Depth = 2.12"
62.00% Pervious = 14.547 ac 38.00% Impervious = 8.916 ac

6112.00-WI BRIDGE CHURCH - TR-55

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MSE 24-hr 3 10-YR Rainfall=3.81"

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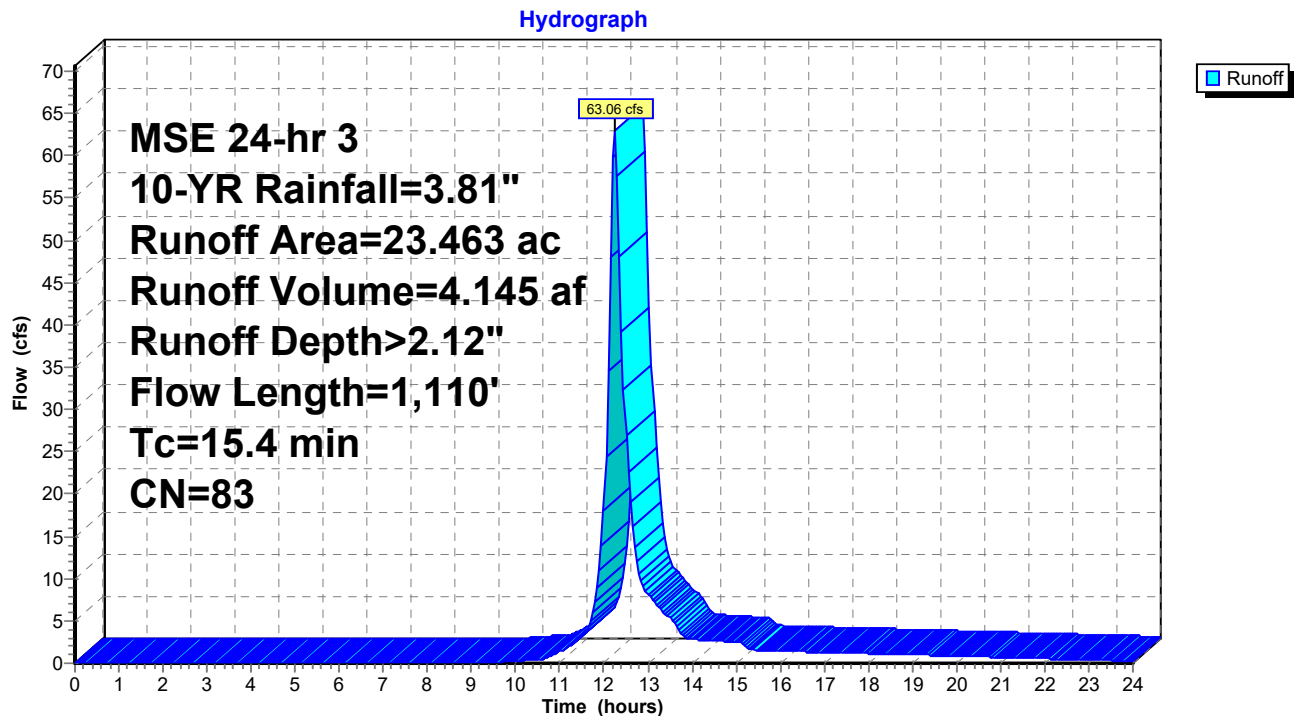
Summary for Subcatchment 4S: AREA TO 27" PIPE

Runoff = 63.06 cfs @ 12.24 hrs, Volume= 4.145 af, Depth> 2.12"
Routed to Pond 1P : GRAND AVE STORAGE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10-YR Rainfall=3.81"

Area (ac)	CN	Description
23.463	83	1/4 acre lots, 38% imp, HSG C
14.547		62.00% Pervious Area
8.916		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.1	125	0.0280	0.19		Sheet Flow, Sheet Grass: Short n= 0.150 P2= 2.70"
4.3	985	0.0350	3.80		Shallow Concentrated Flow, Paved Kv= 20.3 fps
15.4	1,110	Total			

Subcatchment 4S: AREA TO 27" PIPE

Summary for Pond 1P: GRAND AVE STORAGE

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=88)

Inflow Area = 23.463 ac, 38.00% Impervious, Inflow Depth > 2.12" for 10-YR event
 Inflow = 63.06 cfs @ 12.24 hrs, Volume= 4.145 af
 Outflow = 35.60 cfs @ 12.43 hrs, Volume= 4.152 af, Atten= 44%, Lag= 11.0 min
 Primary = 30.68 cfs @ 12.43 hrs, Volume= 4.071 af
 Secondary = 4.91 cfs @ 12.43 hrs, Volume= 0.081 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 854.79' @ 12.43 hrs Surf.Area= 36,015 sf Storage= 25,775 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 4.4 min (814.2 - 809.8)

Volume	Invert	Avail.Storage	Storage Description
#1	849.20'	78,705 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
849.20	4	0	0
851.00	4	7	7
852.00	210	107	114
853.00	942	576	690
854.00	11,636	6,289	6,979
855.00	42,538	27,087	34,066
855.70	85,000	44,638	78,705

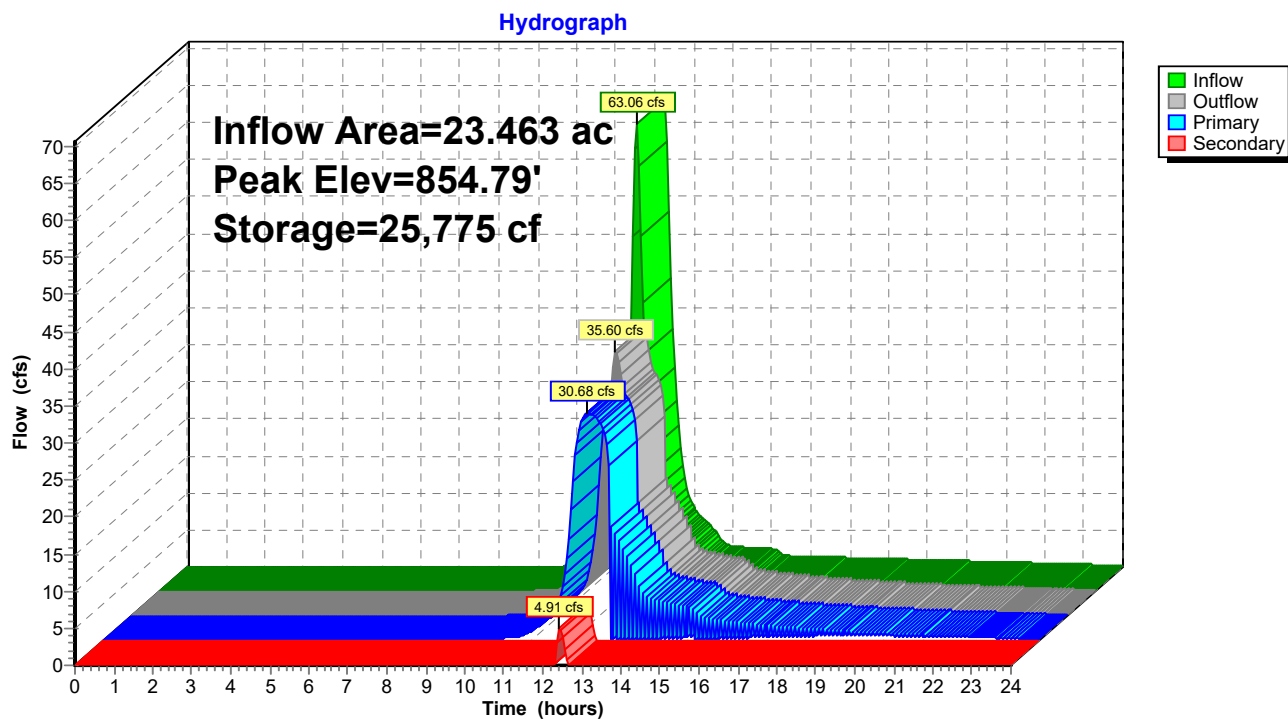
Device	Routing	Invert	Outlet Devices
#1	Primary	849.26'	27.0" Round Culvert L= 312.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 849.26' / 848.07' S= 0.0038 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.98 sf
#2	Secondary	854.60'	25.0' long + 4.0 ' SideZ x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=30.67 cfs @ 12.43 hrs HW=854.79' (Free Discharge)

↑1=Culvert (Barrel Controls 30.67 cfs @ 7.71 fps)

Secondary OutFlow Max=4.78 cfs @ 12.43 hrs HW=854.79' (Free Discharge)

↑2=Broad-Crested Rectangular Weir (Weir Controls 4.78 cfs @ 1.00 fps)

Pond 1P: GRAND AVE STORAGE

6112.00-WI BRIDGE CHURCH - TR-55*MSE 24-hr 3 100-YR Rainfall=6.18"*

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points

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

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment4S: AREATO 27" PIPERunoff Area=23.463 ac 38.00% Impervious Runoff Depth>4.26"
Flow Length=1,110' Tc=15.4 min CN=83 Runoff=124.44 cfs 8.320 af**Pond 1P: GRAND AVE STORAGE**Peak Elev=855.42' Storage=57,139 cf Inflow=124.44 cfs 8.320 af
Primary=32.77 cfs 6.582 af Secondary=54.73 cfs 1.740 af Outflow=87.50 cfs 8.322 af**Total Runoff Area = 23.463 ac Runoff Volume = 8.320 af Average Runoff Depth = 4.26"**
62.00% Pervious = 14.547 ac 38.00% Impervious = 8.916 ac

6112.00-WI BRIDGE CHURCH - TR-55

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MSE 24-hr 3 100-YR Rainfall=6.18"

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Summary for Subcatchment 4S: AREA TO 27" PIPE

Runoff = 124.44 cfs @ 12.24 hrs, Volume= 8.320 af, Depth> 4.26"
Routed to Pond 1P : GRAND AVE STORAGE

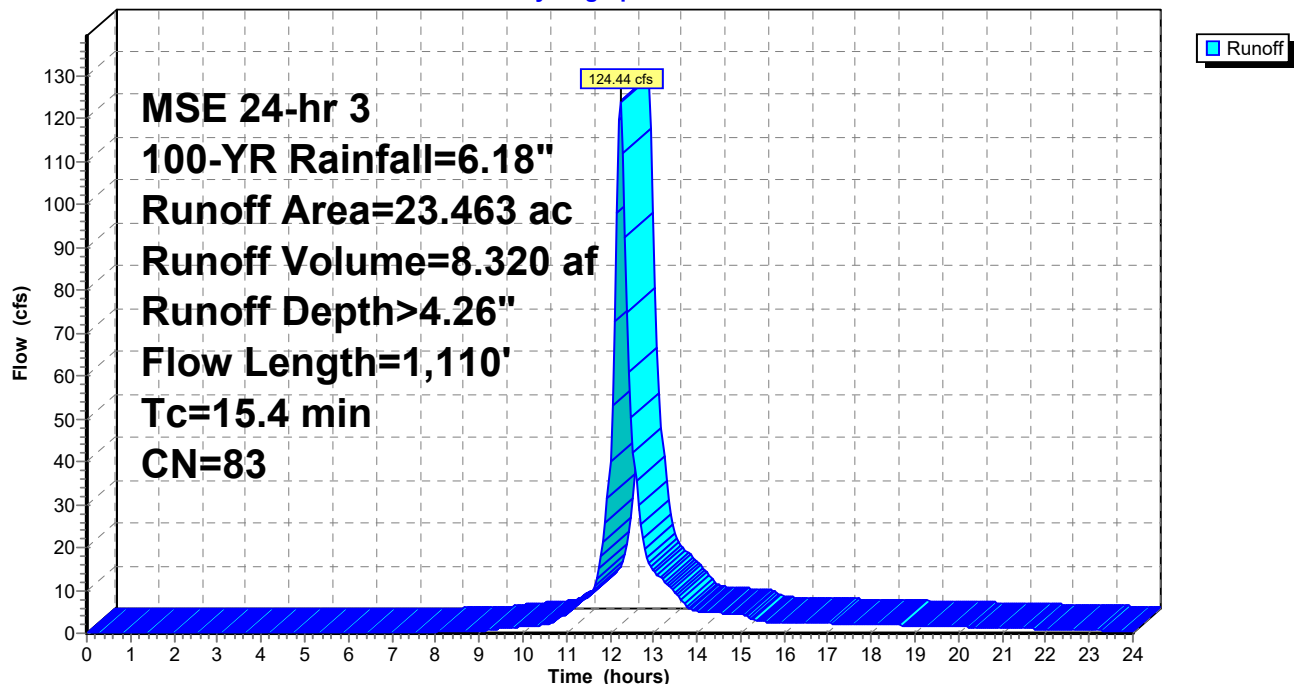
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100-YR Rainfall=6.18"

Area (ac)	CN	Description
23.463	83	1/4 acre lots, 38% imp, HSG C
14.547		62.00% Pervious Area
8.916		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.1	125	0.0280	0.19		Sheet Flow, Sheet Grass: Short n= 0.150 P2= 2.70"
4.3	985	0.0350	3.80		Shallow Concentrated Flow, Paved Kv= 20.3 fps
15.4	1,110	Total			

Subcatchment 4S: AREA TO 27" PIPE

Hydrograph



Summary for Pond 1P: GRAND AVE STORAGE

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=91)

Inflow Area = 23.463 ac, 38.00% Impervious, Inflow Depth > 4.26" for 100-YR event
 Inflow = 124.44 cfs @ 12.24 hrs, Volume= 8.320 af
 Outflow = 87.50 cfs @ 12.37 hrs, Volume= 8.322 af, Atten= 30%, Lag= 7.7 min
 Primary = 32.77 cfs @ 12.37 hrs, Volume= 6.582 af
 Secondary = 54.73 cfs @ 12.37 hrs, Volume= 1.740 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 855.42' @ 12.37 hrs Surf.Area= 67,887 sf Storage= 57,139 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 6.0 min (802.0 - 796.0)

Volume	Invert	Avail.Storage	Storage Description
#1	849.20'	78,705 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
849.20	4	0	0
851.00	4	7	7
852.00	210	107	114
853.00	942	576	690
854.00	11,636	6,289	6,979
855.00	42,538	27,087	34,066
855.70	85,000	44,638	78,705

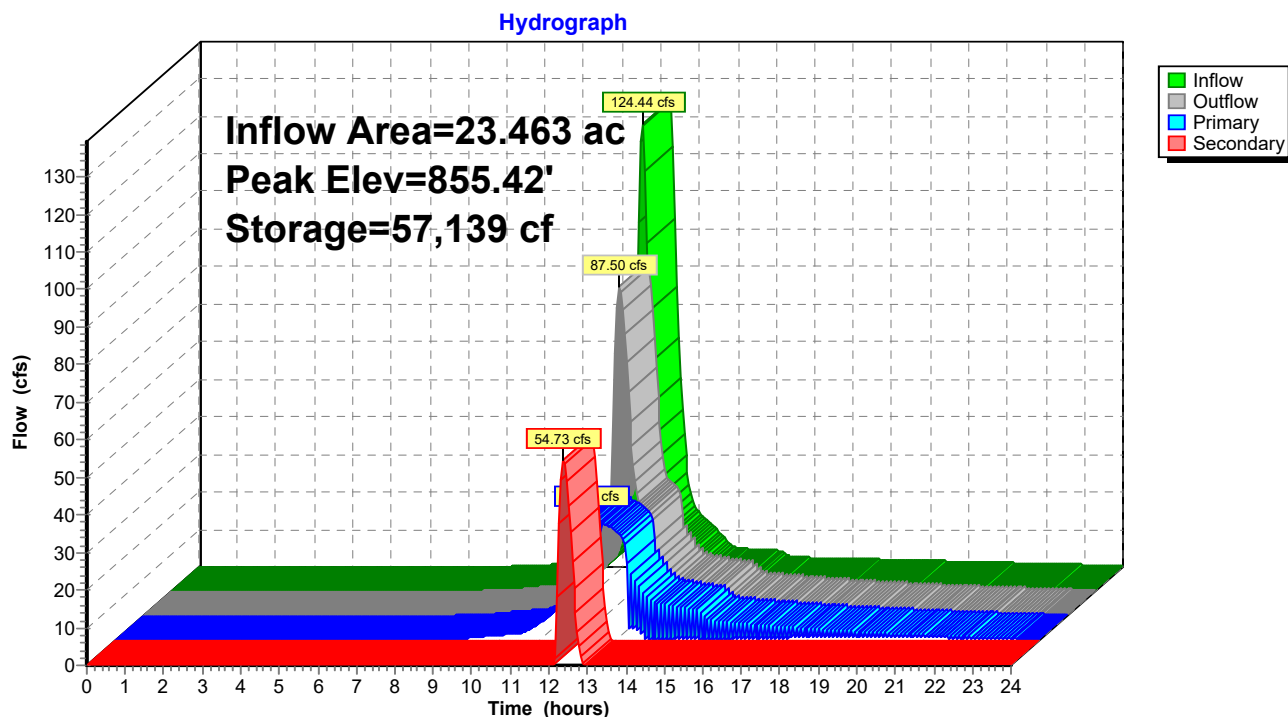
Device	Routing	Invert	Outlet Devices
#1	Primary	849.26'	27.0" Round Culvert L= 312.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 849.26' / 848.07' S= 0.0038 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.98 sf
#2	Secondary	854.60'	25.0' long + 4.0 ' SideZ x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=32.75 cfs @ 12.37 hrs HW=855.41' (Free Discharge)

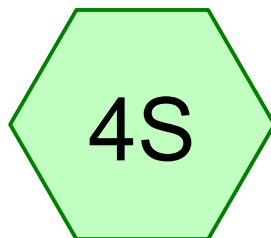
↑1=Culvert (Barrel Controls 32.75 cfs @ 8.24 fps)

Secondary OutFlow Max=54.07 cfs @ 12.37 hrs HW=855.41' (Free Discharge)

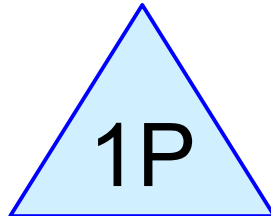
↑2=Broad-Crested Rectangular Weir (Weir Controls 54.07 cfs @ 2.36 fps)

Pond 1P: GRAND AVE STORAGE

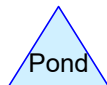
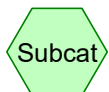
1-YR RATIONAL



AREA TO 27" PIPE



GRAND AVE
STORAGE



Routing Diagram for 6112.00-WI BRIDGE CHURCH - 1 YR RATIONAL

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6112.00-WI BRIDGE CHURCH - 1 YR RATIONAL

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Area Listing (all nodes)

Area (acres)	C	Description (subcatchment-numbers)
0.543	0.90	(4S)
0.526	0.65	(4S)
2.108	0.62	(4S)
20.286	0.69	(4S)
23.463	0.69	TOTAL AREA

6112.00-WI BRIDGE CHURCH - 1 YR RATIONAL

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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	
0.000	HSG D	
23.463	Other	4S
23.463		TOTAL AREA

6112.00-WI BRIDGE CHURCH - 1 YR RATIONAL

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	23.463	23.463		4S
0.000	0.000	0.000	0.000	23.463	23.463	TOTAL AREA	

6112.00-WI BRIDGE CHURCH - 1 YR RATIONAL

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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	1P	849.26	848.07	312.9	0.0038	0.013	0.0	27.0	0.0	

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment4S: AREA TO 27" PIPE Runoff Area=23.463 ac 0.00% Impervious Runoff Depth=0.34"
Tc=10.0 min C=0.69 Runoff=48.12 cfs 0.674 af

Pond 1P: GRAND AVE STORAGE Peak Elev=853.98' Storage=6,696 cf Inflow=48.12 cfs 0.674 af
Primary=27.75 cfs 0.680 af Secondary=0.00 cfs 0.000 af Outflow=27.75 cfs 0.680 af

Total Runoff Area = 23.463 ac Runoff Volume = 0.674 af Average Runoff Depth = 0.34"
100.00% Pervious = 23.463 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 4S: AREA TO 27" PIPE

Runoff = 48.12 cfs @ 0.17 hrs, Volume= 0.674 af, Depth= 0.34"
 Routed to Pond 1P : GRAND AVE STORAGE

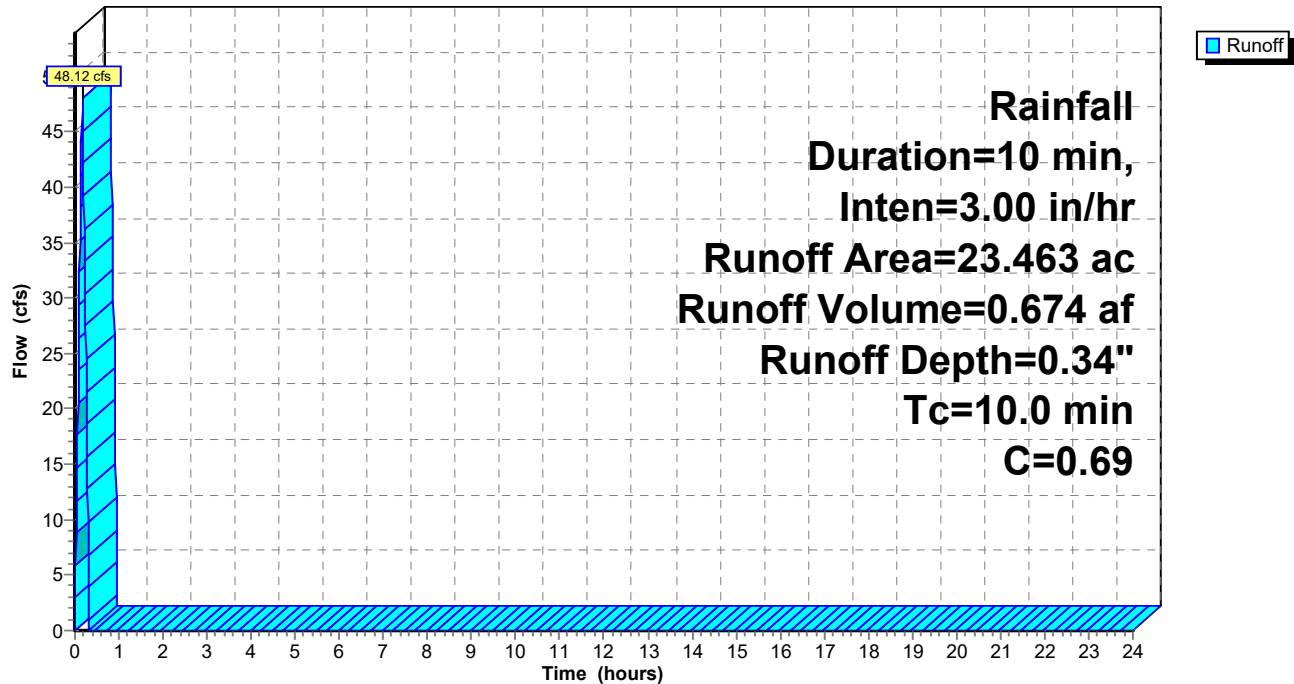
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Rainfall Duration=10 min, Inten=3.00 in/hr

Area (ac)	C	Description
0.187	0.90	
0.319	0.90	
0.018	0.90	
0.019	0.90	
0.526	0.65	
2.108	0.62	
2.406	0.69	
17.880	0.69	
23.463	0.69	Weighted Average
23.463		100.00% Pervious Area

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

Subcatchment 4S: AREA TO 27" PIPE

Hydrograph



Summary for Pond 1P: GRAND AVE STORAGE

Inflow Area = 23.463 ac, 0.00% Impervious, Inflow Depth = 0.34"
 Inflow = 48.12 cfs @ 0.17 hrs, Volume= 0.674 af
 Outflow = 27.75 cfs @ 0.24 hrs, Volume= 0.680 af, Atten= 42%, Lag= 4.3 min
 Primary = 27.75 cfs @ 0.24 hrs, Volume= 0.680 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 853.98' @ 0.24 hrs Surf.Area= 11,373 sf Storage= 6,696 cf

Plug-Flow detention time= 2.2 min calculated for 0.674 af (100% of inflow)
 Center-of-Mass det. time= 2.3 min (12.3 - 10.0)

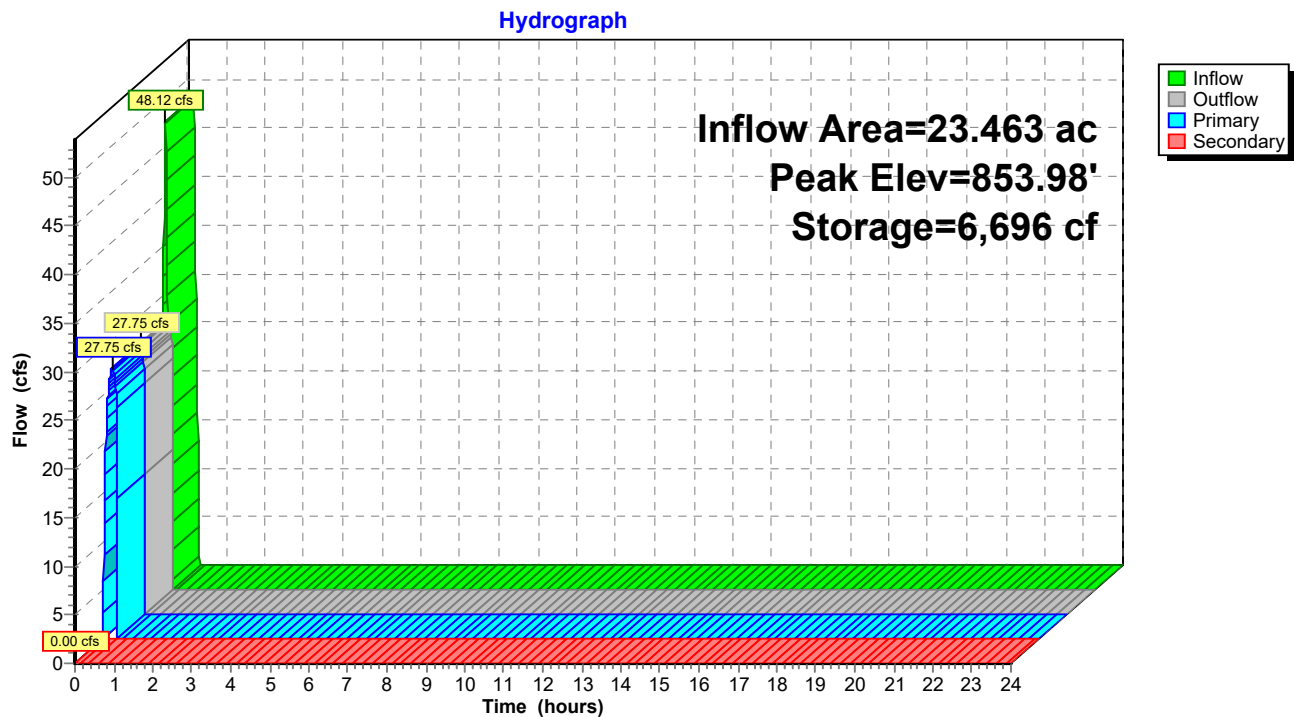
Volume	Invert	Avail.Storage	Storage Description
#1	849.20'	78,705 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
849.20	4	0	0
851.00	4	7	7
852.00	210	107	114
853.00	942	576	690
854.00	11,636	6,289	6,979
855.00	42,538	27,087	34,066
855.70	85,000	44,638	78,705

Device	Routing	Invert	Outlet Devices
#1	Primary	849.26'	27.0" Round Culvert L= 312.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 849.26' / 848.07' S= 0.0038 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.98 sf
#2	Secondary	854.60'	25.0' long + 4.0 ' SideZ x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

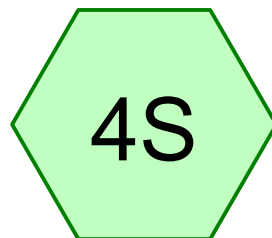
Primary OutFlow Max=27.75 cfs @ 0.24 hrs HW=853.97' (Free Discharge)
 ↑1=Culvert (Barrel Controls 27.75 cfs @ 6.98 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=849.20' (Free Discharge)
 ↑2=Broad-Crested Rectangular Weir(Controls 0.00 cfs)

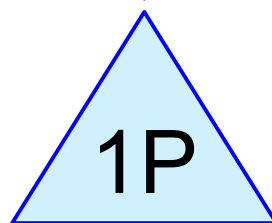
Pond 1P: GRAND AVE STORAGE



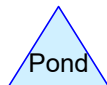
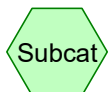
2-YR RATIONAL



AREA TO 27" PIPE



GRAND AVE
STORAGE



Routing Diagram for 6112.00-WI BRIDGE CHURCH - 2 YR RATIONAL

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6112.00-WI BRIDGE CHURCH - 2 YR RATIONAL

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Area Listing (all nodes)

Area (acres)	C	Description (subcatchment-numbers)
0.543	0.90	(4S)
0.526	0.65	(4S)
2.108	0.62	(4S)
20.286	0.69	(4S)
23.463	0.69	TOTAL AREA

6112.00-WI BRIDGE CHURCH - 2 YR RATIONAL

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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	
0.000	HSG D	
23.463	Other	4S
23.463		TOTAL AREA

6112.00-WI BRIDGE CHURCH - 2 YR RATIONAL

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	23.463	23.463		4S
0.000	0.000	0.000	0.000	23.463	23.463	TOTAL AREA	

6112.00-WI BRIDGE CHURCH - 2 YR RATIONAL

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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	1P	849.26	848.07	312.9	0.0038	0.013	0.0	27.0	0.0	

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment4S: AREA TO 27" PIPE Runoff Area=23.463 ac 0.00% Impervious Runoff Depth=0.41"
Tc=10.0 min C=0.69 Runoff=57.74 cfs 0.809 af

Pond 1P: GRAND AVE STORAGE Peak Elev=854.24' Storage=10,685 cf Inflow=57.74 cfs 0.809 af
Primary=28.74 cfs 0.810 af Secondary=0.00 cfs 0.000 af Outflow=28.74 cfs 0.810 af

Total Runoff Area = 23.463 ac Runoff Volume = 0.809 af Average Runoff Depth = 0.41"
100.00% Pervious = 23.463 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 4S: AREA TO 27" PIPE

Runoff = 57.74 cfs @ 0.17 hrs, Volume= 0.809 af, Depth= 0.41"
 Routed to Pond 1P : GRAND AVE STORAGE

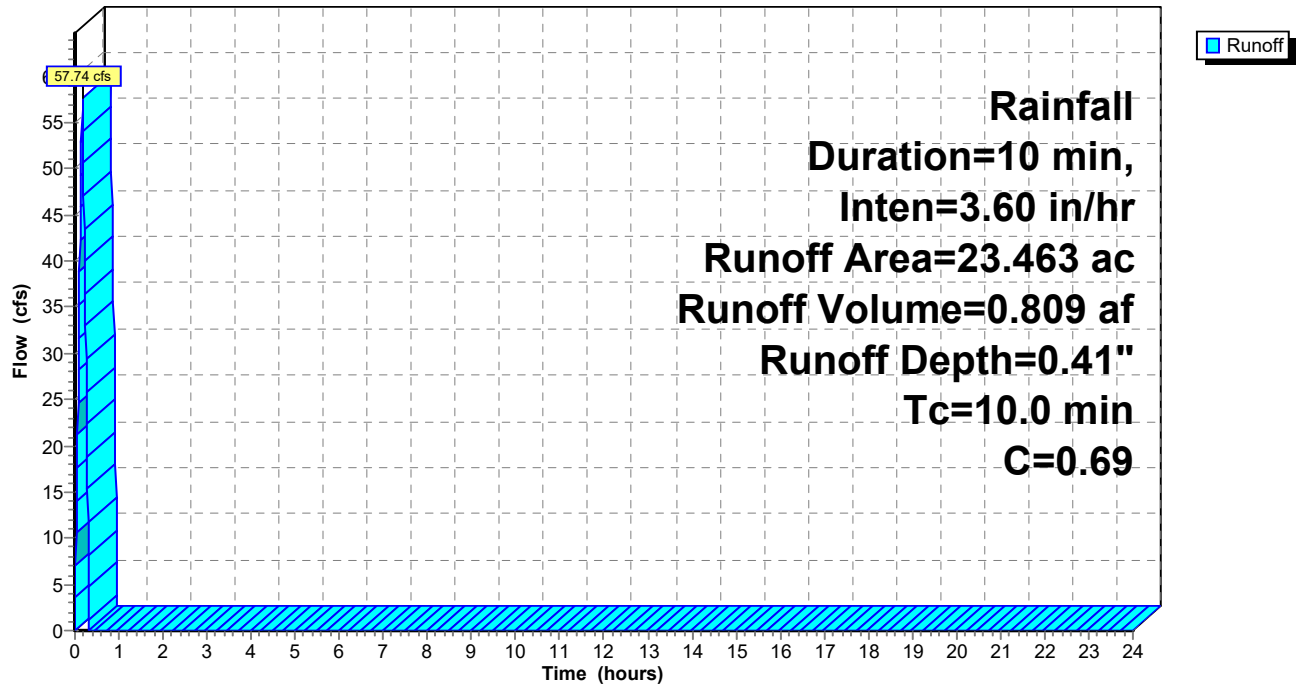
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Rainfall Duration=10 min, Inten=3.60 in/hr

Area (ac)	C	Description
0.187	0.90	
0.319	0.90	
0.018	0.90	
0.019	0.90	
0.526	0.65	
2.108	0.62	
2.406	0.69	
17.880	0.69	
23.463	0.69	Weighted Average
23.463		100.00% Pervious Area

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

Subcatchment 4S: AREA TO 27" PIPE

Hydrograph



Summary for Pond 1P: GRAND AVE STORAGE

Inflow Area = 23.463 ac, 0.00% Impervious, Inflow Depth = 0.41"
 Inflow = 57.74 cfs @ 0.17 hrs, Volume= 0.809 af
 Outflow = 28.74 cfs @ 0.25 hrs, Volume= 0.810 af, Atten= 50%, Lag= 5.1 min
 Primary = 28.74 cfs @ 0.25 hrs, Volume= 0.810 af
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 854.24' @ 0.25 hrs Surf.Area= 19,090 sf Storage= 10,685 cf

Plug-Flow detention time= 3.4 min calculated for 0.809 af (100% of inflow)
 Center-of-Mass det. time= 3.4 min (13.4 - 10.0)

Volume	Invert	Avail.Storage	Storage Description
#1	849.20'	78,705 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

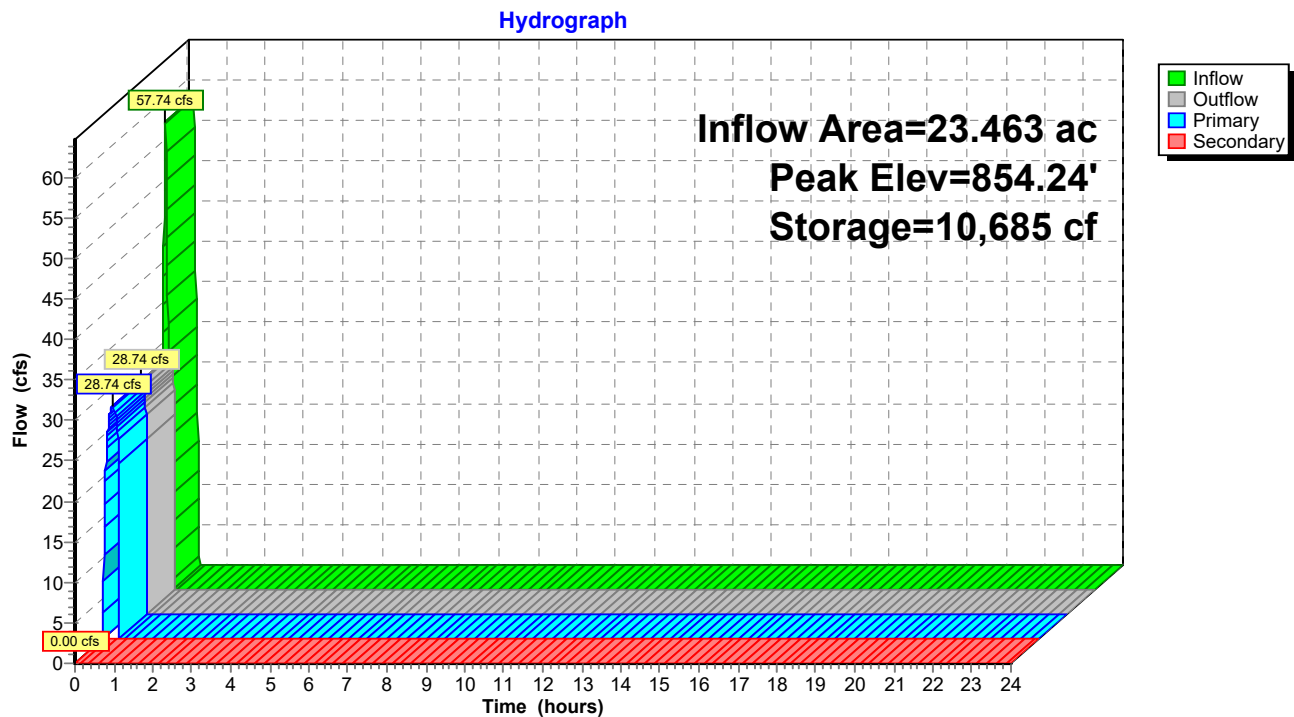
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
849.20	4	0	0
851.00	4	7	7
852.00	210	107	114
853.00	942	576	690
854.00	11,636	6,289	6,979
855.00	42,538	27,087	34,066
855.70	85,000	44,638	78,705

Device	Routing	Invert	Outlet Devices
#1	Primary	849.26'	27.0" Round Culvert L= 312.9' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 849.26' / 848.07' S= 0.0038 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 3.98 sf
#2	Secondary	854.60'	25.0' long + 4.0 ' SideZ x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=28.74 cfs @ 0.25 hrs HW=854.24' (Free Discharge)
 ↑ **1=Culvert** (Barrel Controls 28.74 cfs @ 7.23 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=849.20' (Free Discharge)
 ↑ **2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: GRAND AVE STORAGE



Summary for Subcatchment 4S: AREA TO 27" PIPE

Runoff = 84.68 cfs @ 0.17 hrs, Volume= 1.187 af, Depth= 0.61"
 Routed to Pond 1P : GRAND AVE STORAGE

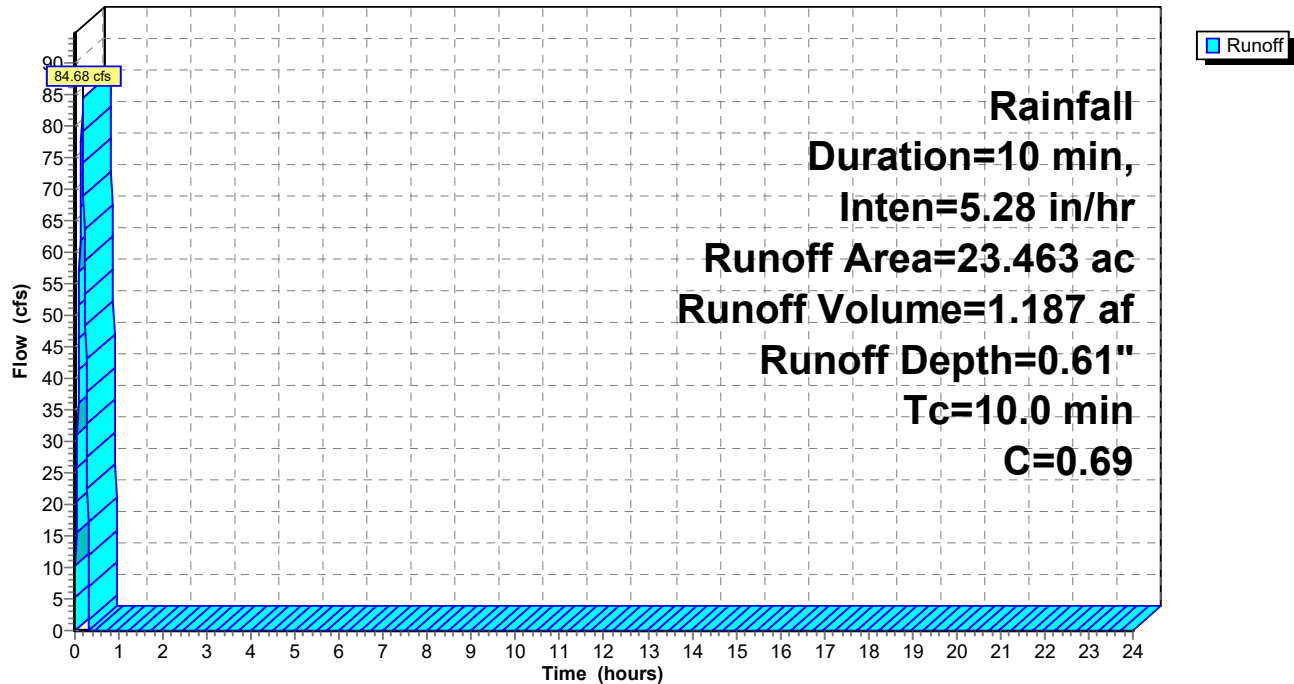
Runoff by Rational method, Rise/Fall=1.0/1.0 xTc, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Rainfall Duration=10 min, Inten=5.28 in/hr

Area (ac)	C	Description
0.187	0.90	
0.319	0.90	
0.018	0.90	
0.019	0.90	
0.526	0.65	
2.108	0.62	
2.406	0.69	
17.880	0.69	
23.463	0.69	Weighted Average
23.463		100.00% Pervious Area

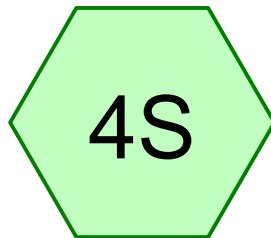
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry,

Subcatchment 4S: AREA TO 27" PIPE

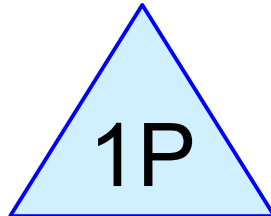
Hydrograph



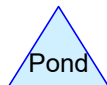
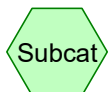
100-YR RATIONAL



AREA TO 27" PIPE



GRAND AVE
STORAGE



Routing Diagram for 6112.00-WI BRIDGE CHURCH - 100 YR RATIONAL

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STORM NOTES:

STRUCTURE DATA			DRAINAGE AREA AND FLOW DATA					PIPE DATA				PIPE CAPACITY INFORMATION					ELEVATIONS		
			FLOW IS DETERMINED BY RATIONAL METHOD Q = CIA									PIPE CAPACITY IS DETERMINED BY MANNING'S EQUATION Q = 1.486/N AR ^{2/3} S ^{1/2}							
NOTES	UPSTREAM STRUCTURE	DOWNSTREAM STRUCTURE	INDIVIDUAL ACRES A <i>26</i>	INDIVIDUAL COEFFICIENT C <i>27</i>	STORM EVENT <i>28</i>	INDIVIDUAL FLOW Q (CFS) <i>29</i>	CUMULATIVE FLOW (CFS) <i>31</i>	LENGTH (FT) <i>32</i>	DIAMETER (IN) <i>33</i>	SLOPE (%) <i>34</i>	MANNING COEFFICIENT <i>35</i>	REQUIRED DROP (FT) <i>36</i>	ACTUAL DROP (FT) <i>37</i>	PERCENT FULL (%) <i>38</i>	ACTUAL VELOCITY (FPS) <i>39</i>	MAX. CAPACITY (CFS) <i>40</i>	RIM/TOC UP <i>41</i>	INVERT UP <i>42</i>	INVERT DOWN <i>43</i>
	RD 1	FES 3	0.19	0.95	10-YR	0.94	0.94	12.5	8	1.04	0.011	0.05	0.13	61%	4.43	1.57			
	RD 2	FES 3	0.32	0.95	10-YR	1.60	1.60	12.5	8	2.08	0.011	0.16	0.26	70%	6.52	2.22			
	EX RD 3	FES 3	0.02	0.95	10-YR	0.09	0.09	18.0	4	1.04	0.011	0.03	0.19	42%	2.48	0.25			
	EX RD 4	FES 3	0.02	0.95	10-YR	0.09	0.09	18.0	4	1.04	0.011	0.03	0.19	43%	2.49	0.25			
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	FES 3	EX CB	0.53	0.7	10-YR	1.94	4.67	48.5	12	1.75	0.013	0.83	0.85	87%	6.84	5.07	853.79	850.81	849.96
	EX CB	PR RCP	2.11	0.67	10-YR	7.46	12.13	53.6	21	1.00	0.013	0.31	0.54	69%	7.26	17.04	852.92	849.96	849.42
INCLUDES 72.65 CFS FROM EAST/WEST OFFSITE	PR RCP	EX STM MH SOUTH		---	10-YR	---	84.78	290.3	27	0.37	0.013	21.75	1.07	SURCHARGE	---	20.26	854.30	849.14	848.07
				---		---	---					-	-						
														SURCHARGE					
														SURCHARGE					