PRELIMINARY STORMWATER REPORT
FOR
Lee's Summit Joint Operations Campus

Project Location:

10 NE Tudor Road, Lee's Summit, MO 64086

BHC Project # 041470.00.01

7/25/2024

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7/25/2024

CIVIL ENGINEERING / SURVEYING / UTILITIES

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1.0 Introduction

This Preliminary Stormwater Management Study is prepared for the expansion of the existing Lee's Summit Joint Operations Campus located at 10 NE Tudor Road, Lee's Summit, Missouri. The purpose of this study is to evaluate the existing on-site detention pond and the impacts of the expanded development on the existing detention pond and surrounding area. The project will result in the construction of a new Fire Administration building and associated Parking.

Governing design criteria is based on the APWA 5600's Extreme Event Control Strategies.

Figure 1: Project Location Aerial

1. 1 Methodology

The unit hydrograph modeling for this report was conducted using TR-55 methodologies within HydroCAD.

Runoff for this report was determined using a SCS Type II 24-Hour rainfall event.

The design storms used for this report were the 2-year (50%), 10-year (10%), and 100-year (1%) events. Rainfall depths for these events were determined from NOAA Atlas 14. The table below contains these rainfall depths.

Table I: Report Design Storms

Report Design Storms	
Storm Event	**Rainfall Depth (in)**
2-Year	3.70
10-Year	5.66
100-Year	9.23

The following documents were used as the design criteria for this report:

- Kansas City Metropolitan Chapter of APWA Standards, Specification and Design Criteria, Section 5600 (2011)

2.0 Existing Conditions

2.1 Project Site

The existing project site is currently occupied by the existing Lee's Summit Municipal Court Facility basin on the site grading, the project site has 9.92 acres tributary to the detention pond, of the 9.92 acres, 4.6 acres are impervious surface.

2.2 Hydrology

A majority of the project site drains towards the existing detention pond. This drainage area is summarized below in Table II.

Table II: Existing Drainage Areas

EXISTING DRAINAGE AREAS									
Basin ID	AREA		PERVIOUS		IMPERVIOUS		CN-Value	C-VALUE	Tc (min)
EX 01	432115.20 SF	9.92	200376.00 SF	4.60	231739.20 SF	5.32	89.65	0.62	10.00

The drainage area was analyzed in HydroCAD, using TR-55 methodologies to calculate the peak runoff from the existing site in the 2-, 10-, and 100-year storm events to the existing detention pond. These calculations are found in Appendix A1. Table III below summarizes these quantities.

Table III: Existing Site Generated Runoff

Existing Site Generated Runoff (cfs)		
2-Year	**10-Year**	**100-Year**
38.38	63.82	109.45

3.3 Existing Detention

The existing detention pond was evaluated in the all runoff events. The storm events are attenuated through the pond by two existing 30" CMP culvert pipes.

This results in the following pond peak release rates:

Existing Detention Pond		
Storm Event	**Peak Release (cfs)**	**Stage Storage Elevation**
2-year	27.56	1001.39
10-year	43.77	1002.08
100-year	63.96	1003.39

3.0 Proposed Condition

3.1 Project Site

The project will result in the construction of a Fire Administration building, associated parking and site grading changes. This will result in an increase of the tributary area to the detention pond from 9.92 acres to 10.18 acres and an increase in impervious area from 4.61 acres to 6.67 acres.

3.2 Hydrology

A majority of the project site drains towards the existing detention pond. This drainage area is summarized below in Table IV.

Table IV: Proposed Drainage Areas

PROPOSED DRAINAGE AREAS									
Basin ID	AREA		PERVIOUS		IMPERVIOUS		CN-Value	C-VALUE	Tc
DA 01	443,441 SF	(10.18 ac)	152,896 SF	(3.51 ac)	290545.20 SF	(6.67 ac)	91.79	0.69	10.00

The drainage area was analyzed in HydroCAD, using TR-55 methodologies to calculate the peak runoff from the existing site in the 2-, 10-, and 100-year storm events. These calculations are found in Appendix A1. Table V below summarizes these quantities.

Table V: Proposed Site Generated Runoff

Proposed Site Generated Runoff (cfs)		
2-Year	**10-Year**	**100-Year**
41.56	67.47	113.91

The proposed development of the site results in an increase in peak runoff rates in all analyzed storm events. To manage runoff to pre-development levels the existing detention pond will need to be expanded.

3.3 Proposed Detention

Detention will be provided by modification of the existing dry detention pond. Presently, the outlet of the pond includes two 30” CMP outlet pipes, the proposed solutions considers replacing the existing CMP structures with two new 24” HDPE outlet pipes. The pond has been increased in size to manage the additional runoff created by the expanded tributary area and the additional impervious. This increased pond area results in the following release rates and stage storage volume. The current top of berm elevation is 1004.

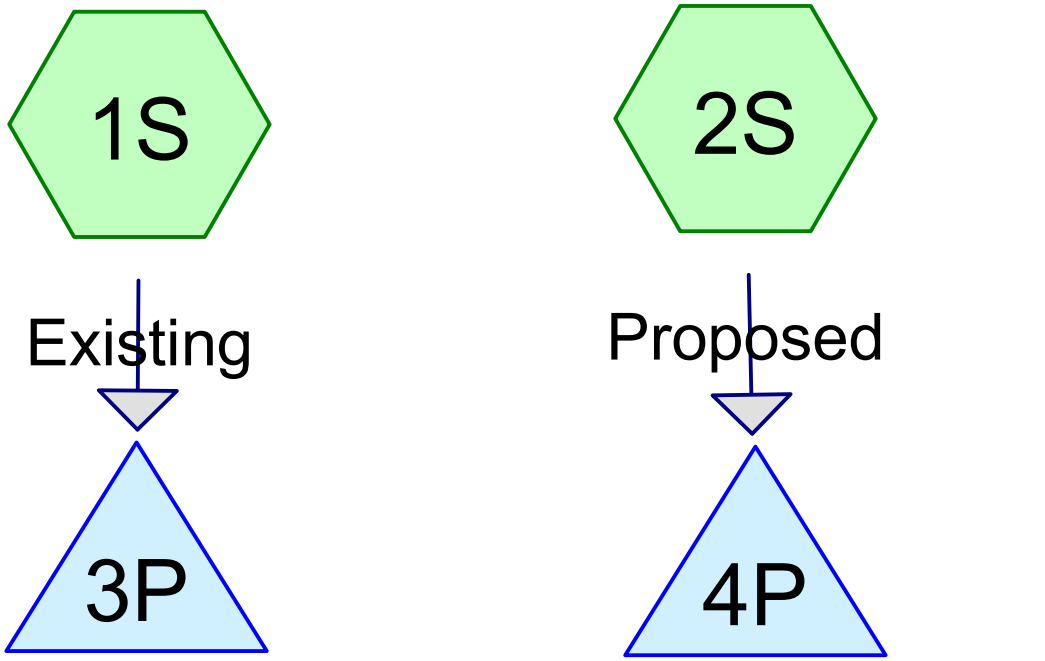
Proposed Detention Pond		
Storm Event	**Peak Release (cfs)**	**Stage Storage Elevation**
2-year	32.92	1001.18
10-year	43.59	1002.08
100-year	56.99	1003.55

6.0 Conclusion

The existing site manages runoff through the detention pond located in northwest corner of the project site. Evaluation of the current pond indicates it manages all storm events with a stage storage beneath the top of berm. The proposed detention pond expands the volume and incorporates smaller outlet pipes to reduce runoff created by the expanded tributary area and additional impervious. The pond reduces the peak release rates and from the 10-year and 100-year events and meets the extreme event control requirements of APWA 5600, this minimizes flooding potential to downstream drainageways.

Appendix A – Reference Documents

A1 – HyrdoCAD Output Summary



Existing Detention

Proposed Detention

Subcat Reach Pond Link

Routing Diagram for LS Joint Ops

Prepared by {enter your company name here}, Printed 7/25/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
9.920	90	(1S)
10.180	92	(2S)
20.100	**91**	**TOTAL AREA**

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	
20.100	Other	1S, 2S
20.100		**TOTAL AREA**

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	20.100	20.100		1S, 2S
0.000	**0.000**	**0.000**	**0.000**	**20.100**	**20.100**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	3P	999.50	999.00	40.0	0.0125	0.025	30.0	0.0	0.0
2	4P	999.00	998.50	40.0	0.0125	0.012	24.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Runoff Area=9.920 ac 0.00% Impervious Runoff Depth>2.46"
Tc=10.0 min CN=90 Runoff=38.38 cfs 2.036 af

Subcatchment 2S: Proposed Runoff Area=10.180 ac 0.00% Impervious Runoff Depth>2.65"
Tc=10.0 min CN=92 Runoff=41.56 cfs 2.248 af

Pond 3P: Existing Detention Peak Elev=1,001.39' Storage=13,738 cf Inflow=38.38 cfs 2.036 af
30.0" Round Culvert x 2.00 n=0.025 L=40.0' S=0.0125 '/' Outflow=27.56 cfs 2.020 af

Pond 4P: Proposed Detention Peak Elev=1,001.18' Storage=8,158 cf Inflow=41.56 cfs 2.248 af
24.0" Round Culvert x 2.00 n=0.012 L=40.0' S=0.0125 '/' Outflow=32.92 cfs 2.247 af

Total Runoff Area = 20.100 ac Runoff Volume = 4.284 af Average Runoff Depth = 2.56"
100.00% Pervious = 20.100 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Existing

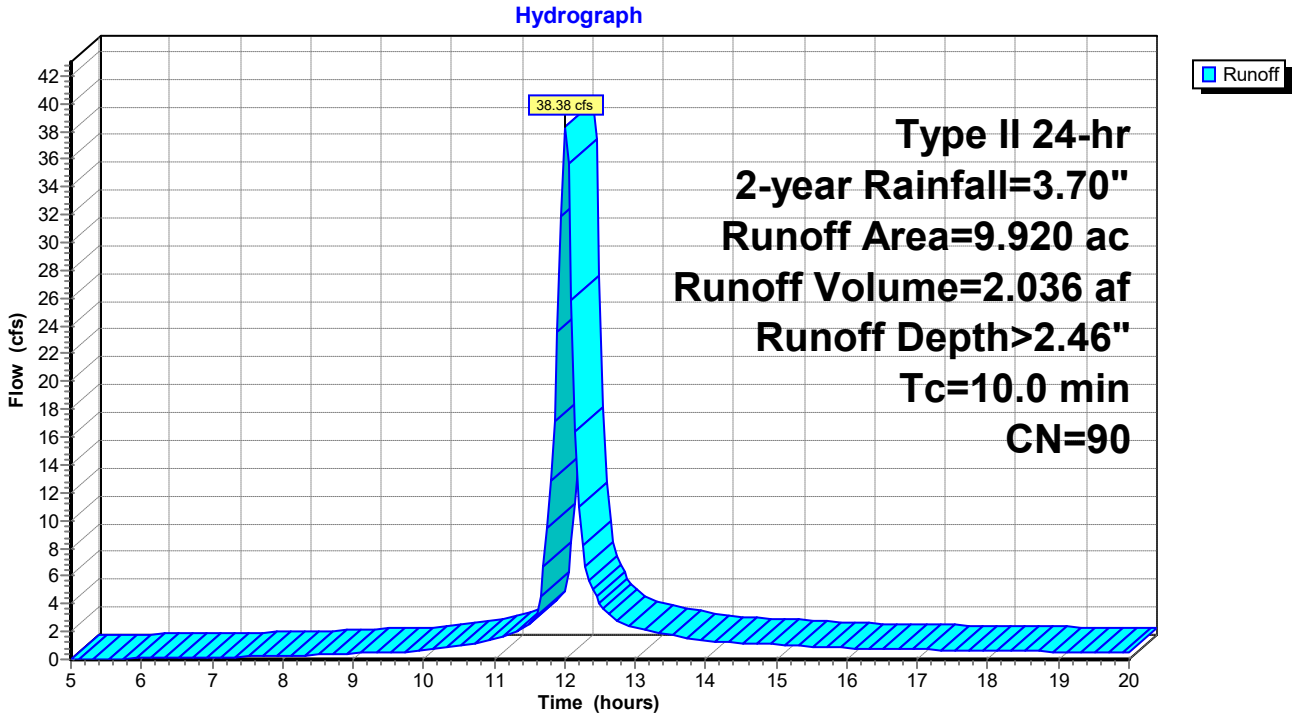
Runoff = 38.38 cfs @ 12.01 hrs, Volume= 2.036 af, Depth> 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.70"

	Area (ac)	CN	Description
*	9.920	90	
	9.920		100.00% Pervious Area

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

Subcatchment 1S: Existing



Summary for Subcatchment 2S: Proposed

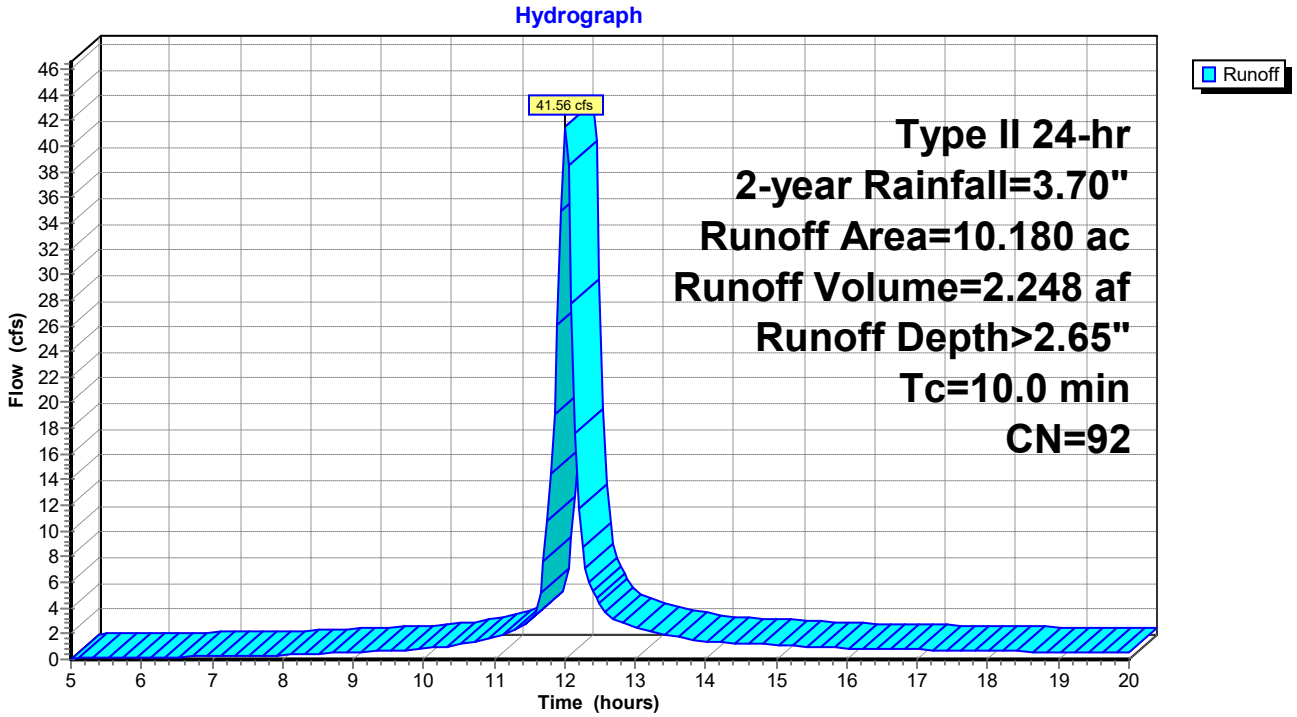
Runoff = 41.56 cfs @ 12.01 hrs, Volume= 2.248 af, Depth> 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-year Rainfall=3.70"

	Area (ac)	CN	Description
*	10.180	92	
	10.180		100.00% Pervious Area

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

Subcatchment 2S: Proposed



Summary for Pond 3P: Existing Detention

Inflow Area = 9.920 ac, 0.00% Impervious, Inflow Depth > 2.46" for 2-year event
Inflow = 38.38 cfs @ 12.01 hrs, Volume= 2.036 af
Outflow = 27.56 cfs @ 12.10 hrs, Volume= 2.020 af, Atten= 28%, Lag= 5.1 min
Primary = 27.56 cfs @ 12.10 hrs, Volume= 2.020 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,001.39' @ 12.10 hrs Surf.Area= 14,040 sf Storage= 13,738 cf

Plug-Flow detention time= 11.4 min calculated for 2.013 af (99% of inflow)
Center-of-Mass det. time= 8.0 min (773.5 - 765.5)

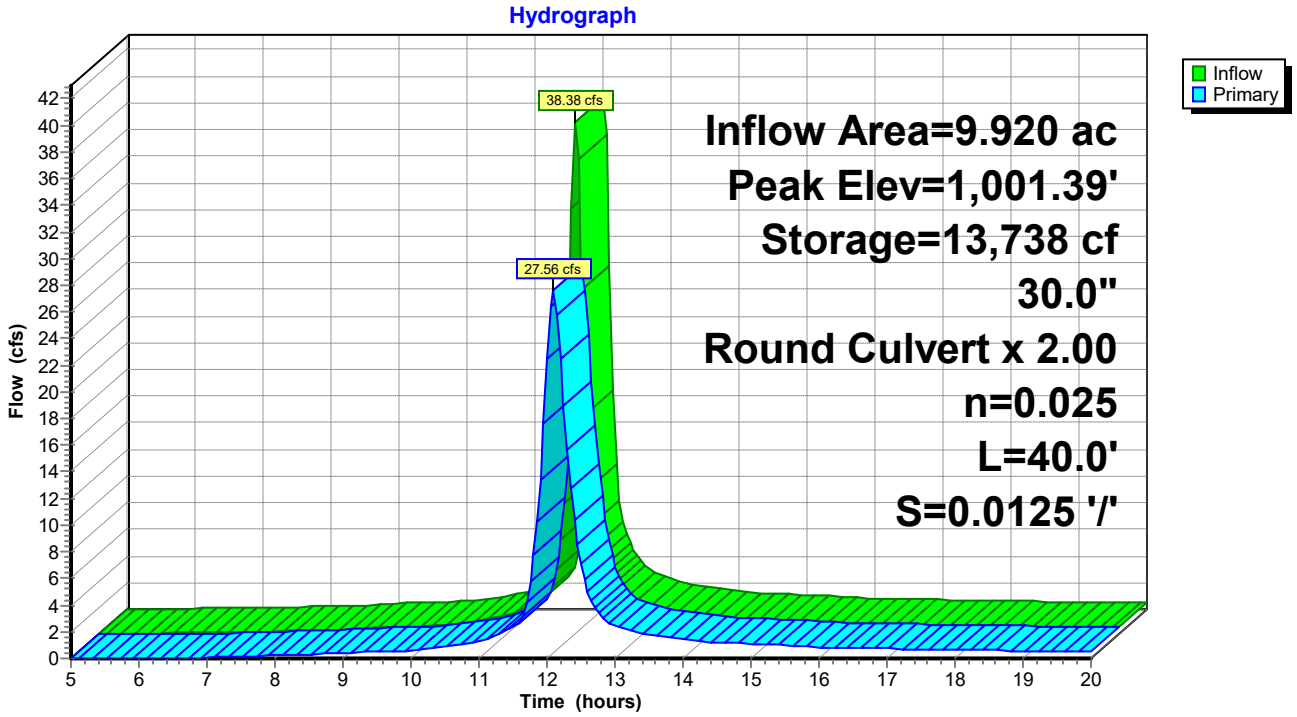
Volume	Invert	Avail.Storage	Storage Description
#1	999.00'	88,385 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
999.00	10	0	0
1,000.00	2,580	1,295	1,295
1,001.00	12,035	7,308	8,603
1,002.00	17,125	14,580	23,183
1,003.00	19,500	18,313	41,495
1,004.00	22,140	20,820	62,315
1,005.00	30,000	26,070	88,385

Device	Routing	Invert	Outlet Devices
#1	Primary	999.50'	**30.0" Round CMP_Round 30" X 2.00** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 999.50' / 999.00' S= 0.0125 '/' Cc= 0.900 n= 0.025, Flow Area= 4.91 sf

Primary OutFlow Max=27.43 cfs @ 12.10 hrs HW=1,001.39' (Free Discharge)
↑—**1=CMP_Round 30"** (Barrel Controls 27.43 cfs @ 4.78 fps)

Pond 3P: Existing Detention



Summary for Pond 4P: Proposed Detention

[82] Warning: Early inflow requires earlier time span

Inflow Area = 10.180 ac, 0.00% Impervious, Inflow Depth > 2.65" for 2-year event
Inflow = 41.56 cfs @ 12.01 hrs, Volume= 2.248 af
Outflow = 32.92 cfs @ 12.08 hrs, Volume= 2.247 af, Atten= 21%, Lag= 4.1 min
Primary = 32.92 cfs @ 12.08 hrs, Volume= 2.247 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,001.18' @ 12.08 hrs Surf.Area= 10,113 sf Storage= 8,158 cf

Plug-Flow detention time= 2.2 min calculated for 2.247 af (100% of inflow)
Center-of-Mass det. time= 2.0 min (760.5 - 758.4)

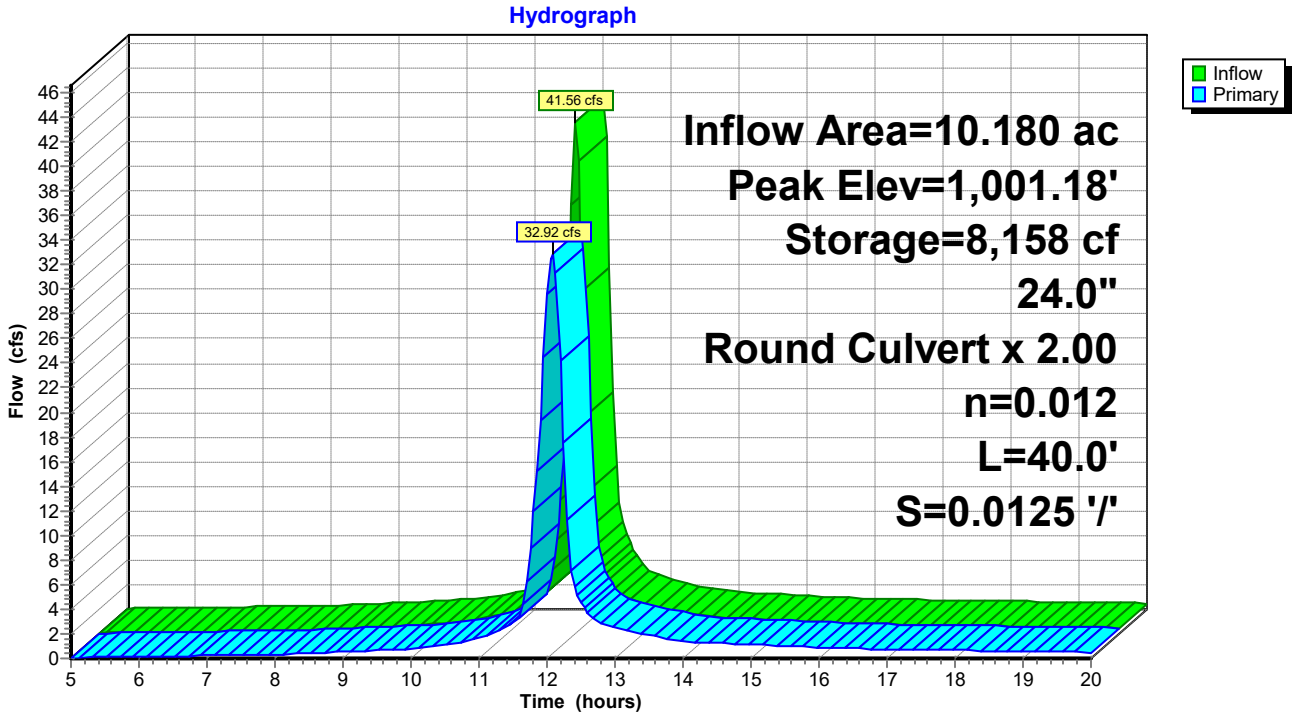
Volume	Invert	Avail.Storage	Storage Description
#1	999.00'	60,550 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
999.00	10	0	0
1,000.00	2,050	1,030	1,030
1,001.00	8,785	5,418	6,448
1,002.00	16,120	12,453	18,900
1,003.00	21,150	18,635	37,535
1,004.00	24,880	23,015	60,550

Device	Routing	Invert	Outlet Devices
#1	Primary	999.00'	**24.0" Round Culvert X 2.00** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 999.00' / 998.50' S= 0.0125 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=32.57 cfs @ 12.08 hrs HW=1,001.16' (Free Discharge)
1=Culvert (Inlet Controls 32.57 cfs @ 5.18 fps)

Pond 4P: Proposed Detention



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Runoff Area=9.920 ac 0.00% Impervious Runoff Depth>4.23"
Tc=10.0 min CN=90 Runoff=63.82 cfs 3.498 af

Subcatchment 2S: Proposed Runoff Area=10.180 ac 0.00% Impervious Runoff Depth>4.43"
Tc=10.0 min CN=92 Runoff=67.47 cfs 3.761 af

Pond 3P: Existing Detention Peak Elev=1,002.08' Storage=24,563 cf Inflow=63.82 cfs 3.498 af
30.0" Round Culvert x 2.00 n=0.025 L=40.0' S=0.0125 '/' Outflow=43.77 cfs 3.479 af

Pond 4P: Proposed Detention Peak Elev=1,002.08' Storage=20,135 cf Inflow=67.47 cfs 3.761 af
24.0" Round Culvert x 2.00 n=0.012 L=40.0' S=0.0125 '/' Outflow=43.59 cfs 3.759 af

Total Runoff Area = 20.100 ac Runoff Volume = 7.258 af Average Runoff Depth = 4.33"
100.00% Pervious = 20.100 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Existing

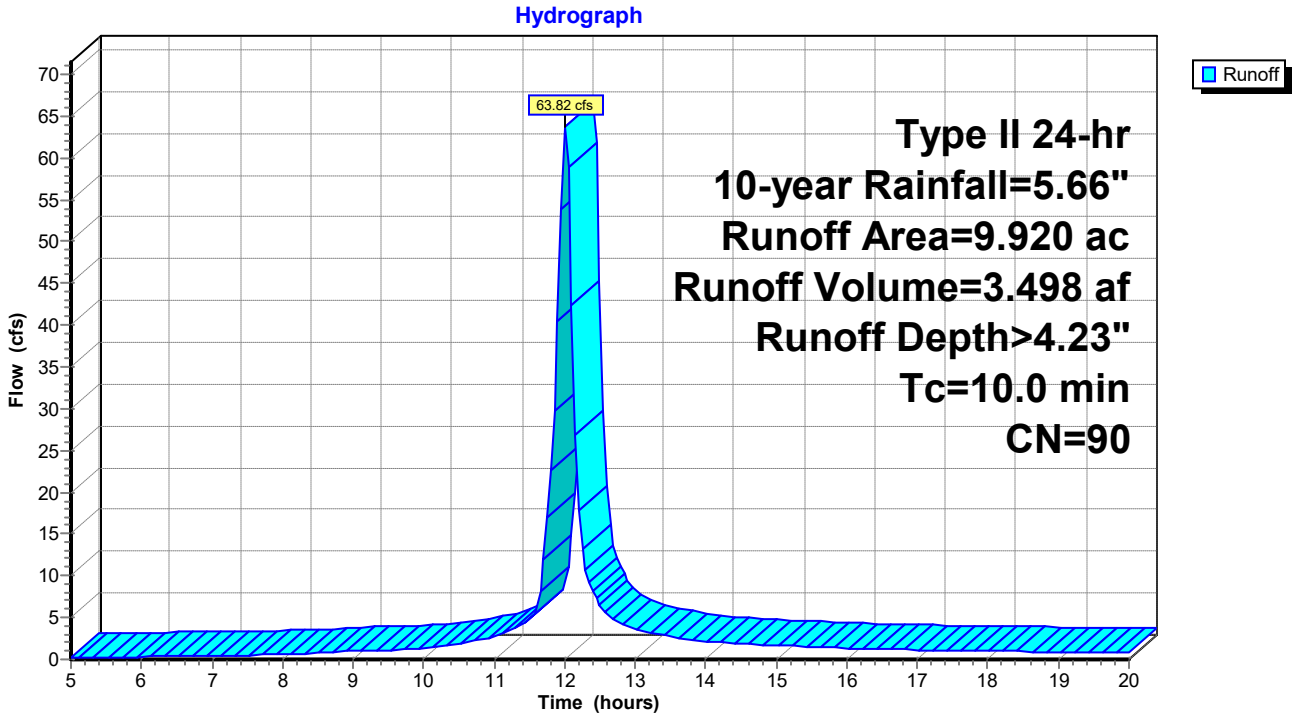
Runoff = 63.82 cfs @ 12.01 hrs, Volume= 3.498 af, Depth> 4.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-year Rainfall=5.66"

	Area (ac)	CN	Description
*	9.920	90	
	9.920		100.00% Pervious Area

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

Subcatchment 1S: Existing



Summary for Subcatchment 2S: Proposed

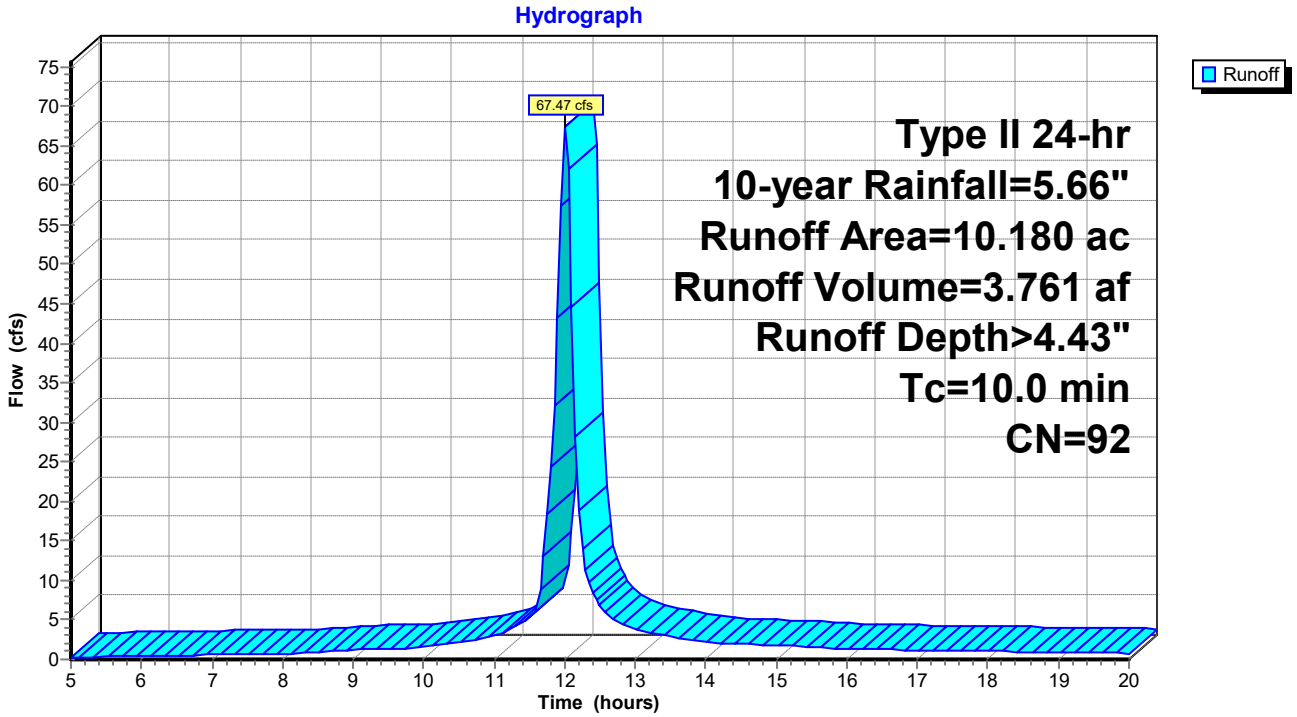
Runoff = 67.47 cfs @ 12.01 hrs, Volume= 3.761 af, Depth> 4.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-year Rainfall=5.66"

	Area (ac)	CN	Description
*	10.180	92	
	10.180		100.00% Pervious Area

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

Subcatchment 2S: Proposed



Summary for Pond 3P: Existing Detention

[82] Warning: Early inflow requires earlier time span

Inflow Area = 9.920 ac, 0.00% Impervious, Inflow Depth > 4.23" for 10-year event
Inflow = 63.82 cfs @ 12.01 hrs, Volume= 3.498 af
Outflow = 43.77 cfs @ 12.10 hrs, Volume= 3.479 af, Atten= 31%, Lag= 5.4 min
Primary = 43.77 cfs @ 12.10 hrs, Volume= 3.479 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,002.08' @ 12.10 hrs Surf.Area= 17,315 sf Storage= 24,563 cf

Plug-Flow detention time= 10.1 min calculated for 3.479 af (99% of inflow)
Center-of-Mass det. time= 7.7 min (761.6 - 753.9)

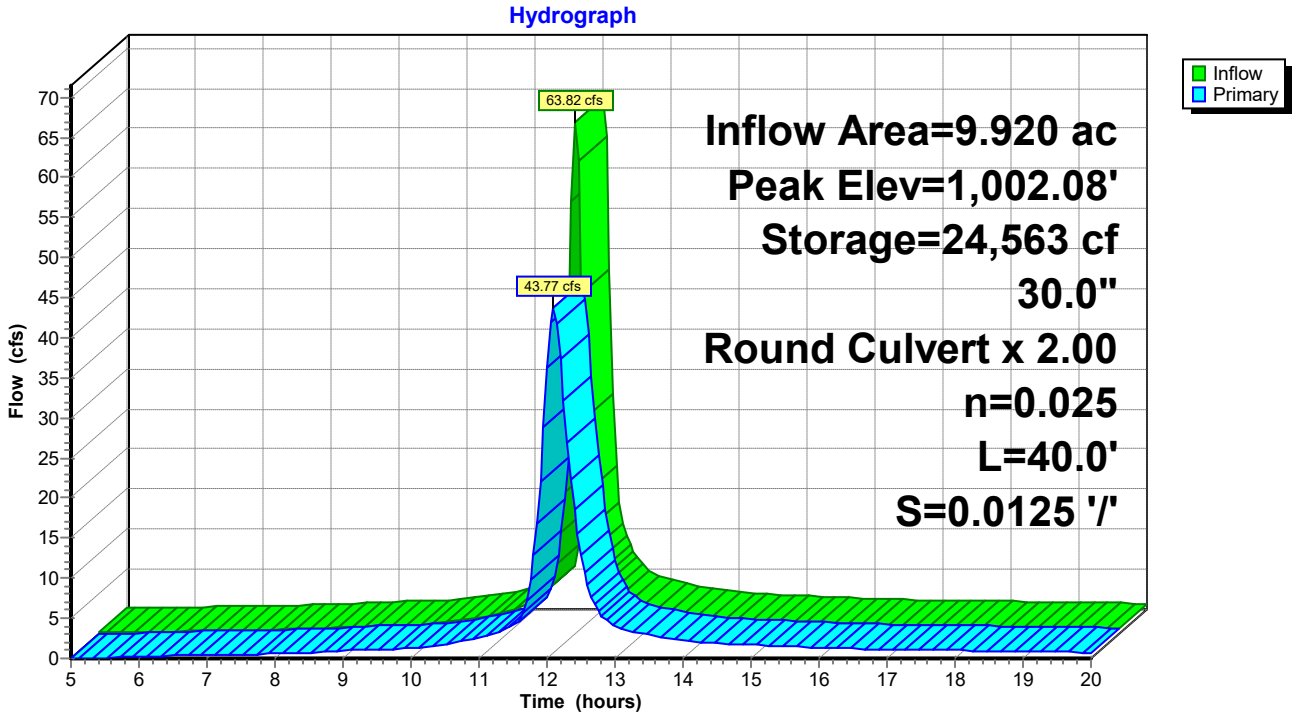
Volume	Invert	Avail.Storage	Storage Description
#1	999.00'	88,385 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
999.00	10	0	0
1,000.00	2,580	1,295	1,295
1,001.00	12,035	7,308	8,603
1,002.00	17,125	14,580	23,183
1,003.00	19,500	18,313	41,495
1,004.00	22,140	20,820	62,315
1,005.00	30,000	26,070	88,385

Device	Routing	Invert	Outlet Devices
#1	Primary	999.50'	**30.0" Round CMP_Round 30" X 2.00** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 999.50' / 999.00' S= 0.0125 '/' Cc= 0.900 n= 0.025, Flow Area= 4.91 sf

Primary OutFlow Max=43.76 cfs @ 12.10 hrs HW=1,002.08' (Free Discharge)
↑—**1=CMP_Round 30"** (Barrel Controls 43.76 cfs @ 5.37 fps)

Pond 3P: Existing Detention



Summary for Pond 4P: Proposed Detention

[82] Warning: Early inflow requires earlier time span

Inflow Area = 10.180 ac, 0.00% Impervious, Inflow Depth > 4.43" for 10-year event
Inflow = 67.47 cfs @ 12.01 hrs, Volume= 3.761 af
Outflow = 43.59 cfs @ 12.11 hrs, Volume= 3.759 af, Atten= 35%, Lag= 5.8 min
Primary = 43.59 cfs @ 12.11 hrs, Volume= 3.759 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,002.08' @ 12.11 hrs Surf.Area= 16,501 sf Storage= 20,135 cf

Plug-Flow detention time= 3.3 min calculated for 3.759 af (100% of inflow)
Center-of-Mass det. time= 3.1 min (751.7 - 748.6)

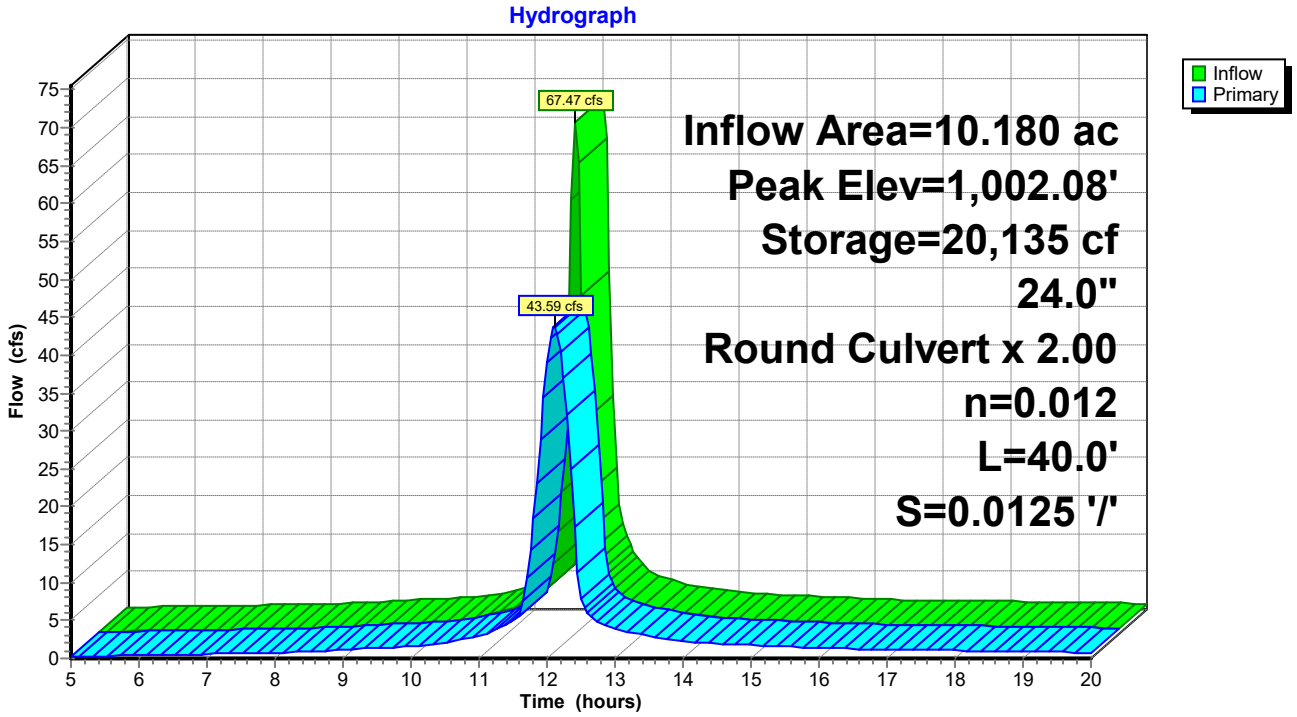
Volume	Invert	Avail.Storage	Storage Description
#1	999.00'	60,550 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
999.00	10	0	0
1,000.00	2,050	1,030	1,030
1,001.00	8,785	5,418	6,448
1,002.00	16,120	12,453	18,900
1,003.00	21,150	18,635	37,535
1,004.00	24,880	23,015	60,550

Device	Routing	Invert	Outlet Devices
#1	Primary	999.00'	**24.0" Round Culvert X 2.00** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 999.00' / 998.50' S= 0.0125 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=43.49 cfs @ 12.11 hrs HW=1,002.07' (Free Discharge)
1=Culvert (Inlet Controls 43.49 cfs @ 6.92 fps)

Pond 4P: Proposed Detention



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Existing Runoff Area=9.920 ac 0.00% Impervious Runoff Depth>7.49"
Tc=10.0 min CN=90 Runoff=109.45 cfs 6.191 af

Subcatchment 2S: Proposed Runoff Area=10.180 ac 0.00% Impervious Runoff Depth>7.69"
Tc=10.0 min CN=92 Runoff=113.91 cfs 6.525 af

Pond 3P: Existing Detention Peak Elev=1,003.39' Storage=49,303 cf Inflow=109.45 cfs 6.191 af
30.0" Round Culvert x 2.00 n=0.025 L=40.0' S=0.0125 '/' Outflow=63.96 cfs 6.168 af

Pond 4P: Proposed Detention Peak Elev=1,003.55' Storage=49,705 cf Inflow=113.91 cfs 6.525 af
24.0" Round Culvert x 2.00 n=0.012 L=40.0' S=0.0125 '/' Outflow=56.99 cfs 6.522 af

Total Runoff Area = 20.100 ac Runoff Volume = 12.715 af Average Runoff Depth = 7.59"
100.00% Pervious = 20.100 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Existing

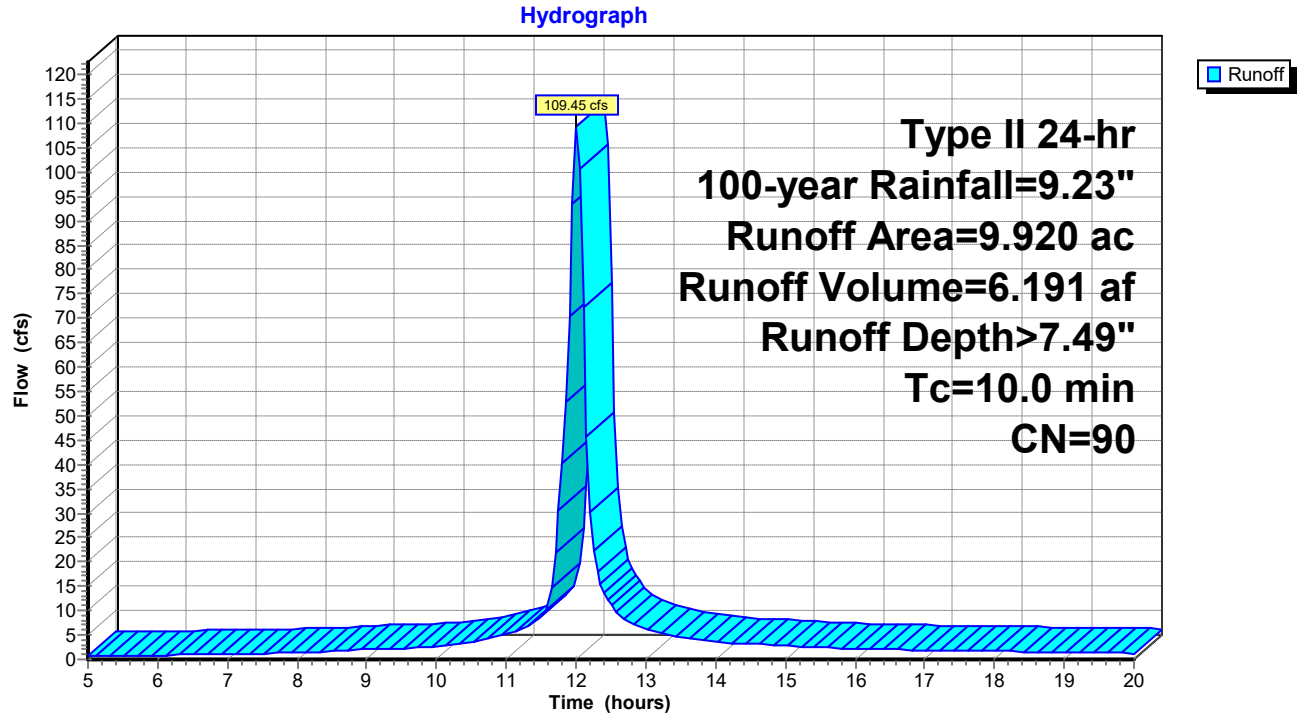
Runoff = 109.45 cfs @ 12.01 hrs, Volume= 6.191 af, Depth> 7.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-year Rainfall=9.23"

	Area (ac)	CN	Description
*	9.920	90	
	9.920		100.00% Pervious Area

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

Subcatchment 1S: Existing



Summary for Subcatchment 2S: Proposed

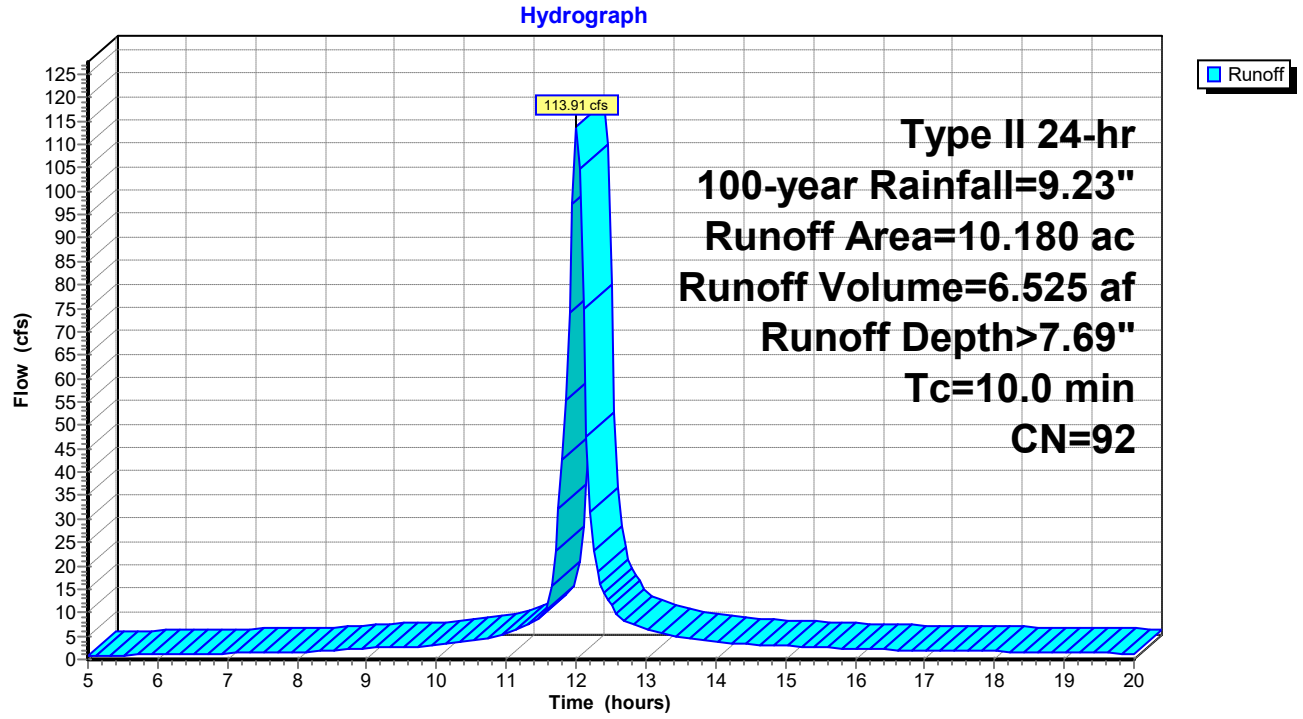
Runoff = 113.91 cfs @ 12.01 hrs, Volume= 6.525 af, Depth> 7.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-year Rainfall=9.23"

	Area (ac)	CN	Description
*	10.180	92	
	10.180		100.00% Pervious Area

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

Subcatchment 2S: Proposed



Summary for Pond 3P: Existing Detention

[82] Warning: Early inflow requires earlier time span

Inflow Area = 9.920 ac, 0.00% Impervious, Inflow Depth > 7.49" for 100-year event
Inflow = 109.45 cfs @ 12.01 hrs, Volume= 6.191 af
Outflow = 63.96 cfs @ 12.12 hrs, Volume= 6.168 af, Atten= 42%, Lag= 6.6 min
Primary = 63.96 cfs @ 12.12 hrs, Volume= 6.168 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,003.39' @ 12.12 hrs Surf.Area= 20,530 sf Storage= 49,303 cf

Plug-Flow detention time= 10.0 min calculated for 6.146 af (99% of inflow)
Center-of-Mass det. time= 8.2 min (752.3 - 744.1)

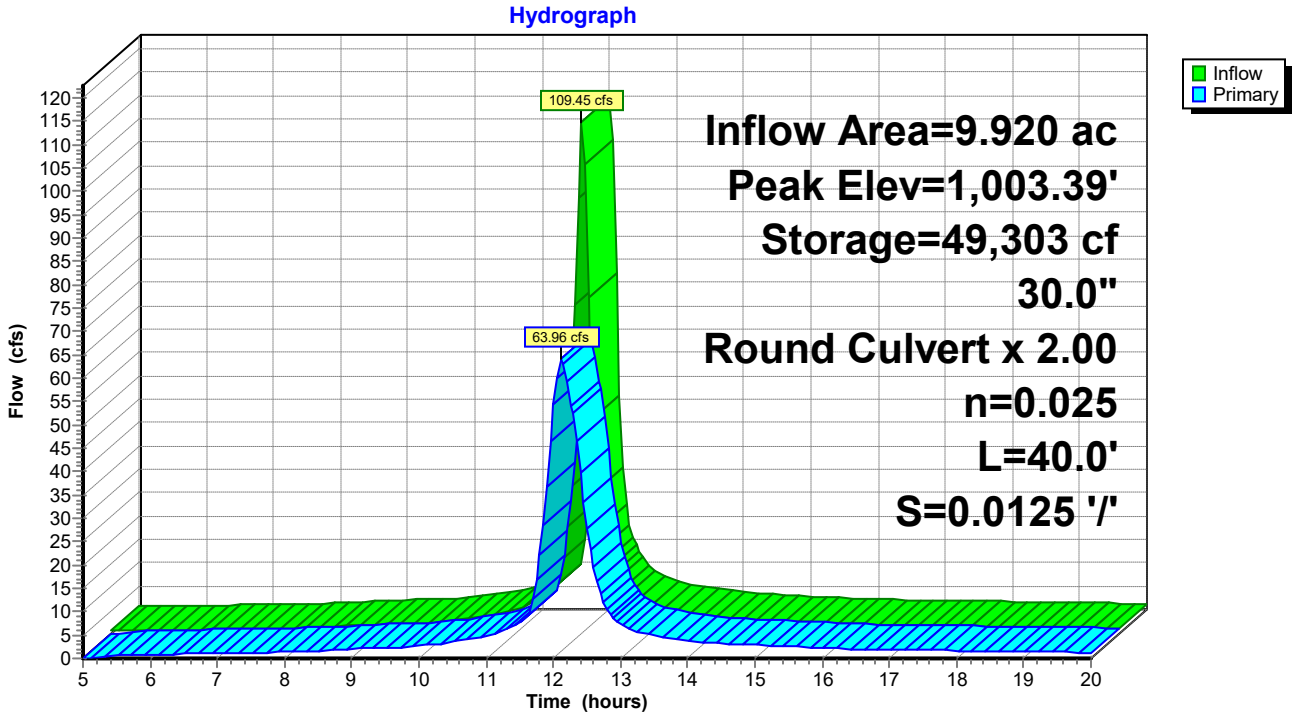
Volume	Invert	Avail.Storage	Storage Description
#1	999.00'	88,385 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
999.00	10	0	0
1,000.00	2,580	1,295	1,295
1,001.00	12,035	7,308	8,603
1,002.00	17,125	14,580	23,183
1,003.00	19,500	18,313	41,495
1,004.00	22,140	20,820	62,315
1,005.00	30,000	26,070	88,385

Device	Routing	Invert	Outlet Devices
#1	Primary	999.50'	**30.0" Round CMP_Round 30" X 2.00** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 999.50' / 999.00' S= 0.0125 '/' Cc= 0.900 n= 0.025, Flow Area= 4.91 sf

Primary OutFlow Max=63.44 cfs @ 12.12 hrs HW=1,003.36' (Free Discharge)
↑—**1=CMP_Round 30"** (Barrel Controls 63.44 cfs @ 6.46 fps)

Pond 3P: Existing Detention



Summary for Pond 4P: Proposed Detention

[82] Warning: Early inflow requires earlier time span

Inflow Area = 10.180 ac, 0.00% Impervious, Inflow Depth > 7.69" for 100-year event
Inflow = 113.91 cfs @ 12.01 hrs, Volume= 6.525 af
Outflow = 56.99 cfs @ 12.13 hrs, Volume= 6.522 af, Atten= 50%, Lag= 7.7 min
Primary = 56.99 cfs @ 12.13 hrs, Volume= 6.522 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1,003.55' @ 12.14 hrs Surf.Area= 23,197 sf Storage= 49,705 cf

Plug-Flow detention time= 5.6 min calculated for 6.521 af (100% of inflow)
Center-of-Mass det. time= 5.4 min (745.8 - 740.5)

Volume	Invert	Avail.Storage	Storage Description
#1	999.00'	60,550 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
999.00	10	0	0
1,000.00	2,050	1,030	1,030
1,001.00	8,785	5,418	6,448
1,002.00	16,120	12,453	18,900
1,003.00	21,150	18,635	37,535
1,004.00	24,880	23,015	60,550

Device	Routing	Invert	Outlet Devices
#1	Primary	999.00'	**24.0" Round Culvert X 2.00** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 999.00' / 998.50' S= 0.0125 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf

Primary OutFlow Max=56.85 cfs @ 12.13 hrs HW=1,003.53' (Free Discharge)
1=Culvert (Inlet Controls 56.85 cfs @ 9.05 fps)

Pond 4P: Proposed Detention