

January 3, 2023

City of Columbus, Division of Sewerage & Drainage  
Attn: Mr. Greg Fedner, P.E.  
Private Development Section Manager  
910 Dublin Road  
Columbus, Ohio 43215

Subject: Dixon House CC18727  
Type II Variance from Stormwater Drainage Manual

Dear Greg,

On behalf of Metro Development, Advanced Civil Design, Inc. is applying for a Type II variance from the 2021 Columbus Stormwater Drainage Manual (SWDM) for the Dixon House multi-family project, (CC-18727), located north at the southwest corner of the intersection of Galloway and Hall Roads, Columbus, Ohio 43230.

The project utilizes a central extended wet detention basin for stormwater quantity and quality control. A Type II variance is requested for the acceptance of a retaining wall that was constructed along a portion of the pond perimeter within the detention storage zone where a 4:1 slope is required (SWDM Section 3.4.1).

The following information is provided in support of the application:

-Project Name: Dixon House  
-Address, PID, Site Disturbance  
and Total Site Area:  
Address: 950 Brushfield Dr, Columbus, OH 43119  
PID: Multiple Owners; Dixon House Investment Condominiums  
Site Disturbance: 9.93 acres  
Total Site Area: 9.37 acres  
-Date Property Acquired: N/A  
-Primary (Owner) Contact: Metro Development  
Attn: Mr. Joe Thomas, Jr., Director of Development  
470 Olde Worthington Road  
Worthington, OH 43082  
(614) 540-2400; jthomasjr@villagecommunities.com

Additional information pertaining to the requested variance is included in the enclosed application document. Please contact me with any questions you may have at (614) 329-5474, or by email at [dstorck@advancedcivildesign.com](mailto:dstorck@advancedcivildesign.com).

Sincerely,



David Storck- Project Manager

**DIXON HOUSE  
STORM CC18727  
GALLOWAY ROAD  
COLUMBUS, OHIO**

**STORMWATER DRAINAGE MANUAL  
TYPE II VARIANCE APPLICATION**

Prepared By:



**ADVANCED**  
CIVIL DESIGN

ENGINEERS & SURVEYORS  
781 SCIENCE BOULEVARD – SUITE 100  
GAHANNA, OHIO 43230  
Ph: 614-428-7750  
Fax: 614-428-7755

Date:

**January 3, 2023**



## **INTRODUCTION**

The following report provides information pertaining to a requested variance from the City of Columbus Stormwater Drainage Manual for the Dixon House multi-family development project (CC-18727). The project is a 9.37-acre site that was constructed in 2020-2021 with six apartment buildings, clubhouse, garages, sidewalks, parking lots and access drives. Stormwater management for the site is controlled by a central wet detention basin and single outlet control structure to meet the required water quantity and quality volumes.

The variance request involves a field modification to a portion of the detention pond perimeter where a retaining wall was installed partially within the detention storage zone and within the required 4:1 side slope. An exhibit drawing is provided in the Appendix that depicts the as-built conditions and provides reference to the mentioned building locations and design parameters in the following text.

As such, the applicant is seeking a Type II variance to Section 3.4.1(5) of the City of Columbus SWDM and allow a minor modification of the detention basin storage zone side slope.

## **TYPE II VARIANCE REQUEST**

### **SITE CONDITIONS**

The grading design on the east side of the building 5, which is adjacent to the wet basin, was designed as an extension of the 4:1 wet detention basin side slope up to the edge of building. To facilitate construction of building number 5, the grade east of the building was benched out approximately 18-20 feet to provide construction access around the building. Once the building was completed, the developer regraded the area between building 5 and the wet basin per the approved storm and grading plan.

Shortly after project completion, the developer's property management team took over the site and began updating landscape features and site amenities to help promote and market the newly opened project to potential residents and buyers of the units. It was during this time the wall was installed. While it is not completely clear on how the position of the wall was established, it was noted that the water level of the pond was not yet up to the final normal pool level and that the wall may have been placed based on the horizontal distance from the edge of water at the time. The intent of the wall was to ease the grade between the building and basin embankment for maintenance access and not to cause any issues with the wet basin.

### **PROPOSED STORMWATER BMP'S**

The project utilizes a central extended wet detention basin that provides post-construction stormwater quantity control meeting the requirements of the City of Columbus Stormwater Manual. The retaining wall that was installed is within the 4:1 embankment and detention storage zone which slightly reduces the overall storage volume. As noted on the Variance Exhibit in the Appendix and Section A-A, the calculated storage loss is 2,256 cubic feet. However, based on the as-built survey of the overall as-built basin limits and volumes, the pond is slightly larger than the plan limits as is depicted by the blue edge of water line, which represents the location per plan, versus the red edge of water line, which represents the as-built edge of water line.

### **IMPACTS TO STORMWATER DETENTION AND WATER QUALITY**

In reference to the as-built basin survey, the as-built volume of 111,388 c.f. is more than the required plan volume of 108,465 c.f. Based on the increased capacity, the installation of the retaining wall has zero impact on the overall post-construction design release rates, detention storage volume or water quality treatment volume.

## **SITE DEVELOPMENT ALTERNATIVES**

### **FULL COMPLIANCE**

Under full compliance the retaining wall would be removed, and the proposed wet pond slopes established per the approved storm and grading plan CC18727. Under this option the pond would need partially drained and sediment control installed at the outlet structure for the duration of the regrading work. The results of this alternative are financially detrimental due to the loss involved with the cost for the wall installation and subsequent removal. Additionally, the desired post-construction access for building maintenance would no longer be available. Please refer to the full compliance exhibit in the appendix.

### **MINIMAL IMPACT**

Based on the situation involved with the variance request and allowing an as-built wall encroachment into the storage zone and side slope of the wet basin, there is not a viable alternative that meets the middle ground from full compliance versus the requested preferred alternative. As stated in the Variance Request section, there is zero impact to the functional volume and release requirements of the wet basin in the as-built condition and preferred development alternative.

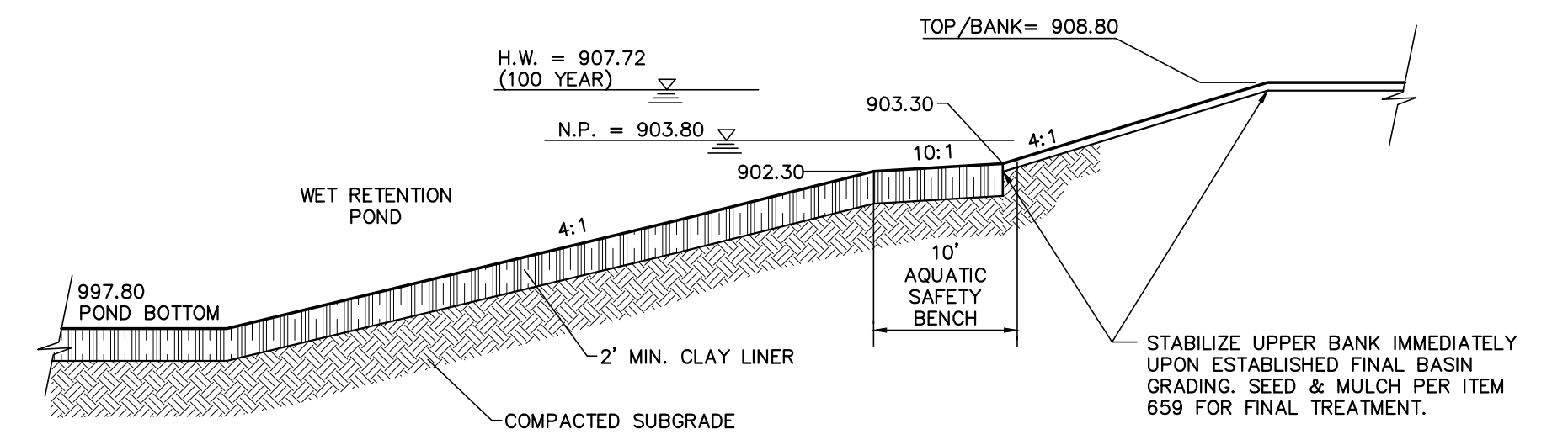
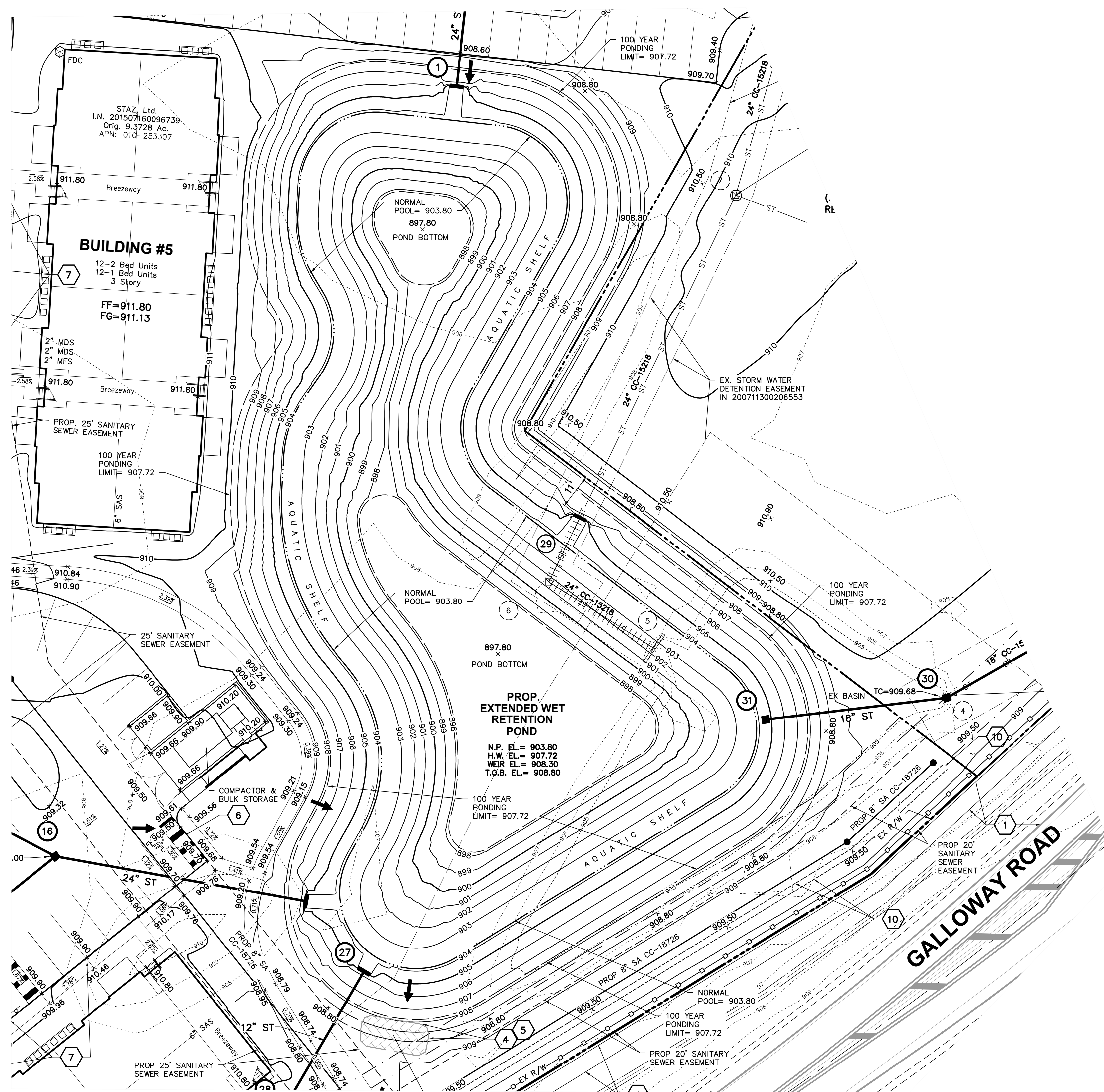
### **PREFERRED DEVELOPMENT ALTERNATIVE**

The preferred alternative is to allow the as-built wet basin with the retaining wall to remain. While the Stormwater Manual prescribes a 4:1 maximum slope for the basin storage zone, there is not explicit language prohibiting a wall in lieu of the slope requirement. Further, the project was approved before the 2021 SWDM and this preferred alternate would now provide the SCP access path required around the wet basin. In addition to the wall, a few areas of the basin slope within the storage zone are built steeper and flatter than the required 4:1 slope. The southern and southwestern banks have a few as-built slopes slightly under the required 4:1 slope, while the eastern bank has as-built slopes flatter than the required 4:1 slopes. Per the Preferred Development Alternative exhibit in the Appendix, the design storage volumes are maintained in the as-built condition. The wall and any maintenance thereof would be the responsibility of the current Owner and considered part of the basin design.

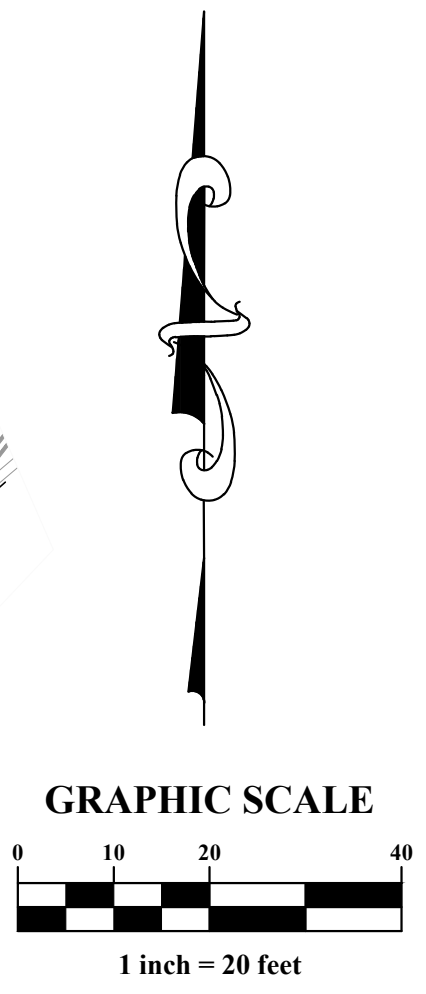
## **CONCLUSIONS**

The Applicant is seeking approval of the Preferred Development Alternative as a Type II variance for the Dixon House multi-family project. The variance would allow an approximate 188 foot length of the 770 foot as-built edge of water perimeter length (or 24% of the overall perimeter) to be modified from a 4:1 side slope to a retaining wall. The variance would also allow an approximate 130 foot length (or 17% of the overall perimeter) of as-built slopes built slightly steeper than the required 4:1 slope (3.4:1 max). The Applicant respectfully submits for City approval of this variance request.

**APPENDIX A  
FULL COMPLIANCE  
STORMWATER BASIN EXHIBIT**



PROP. EXTENDED WET RETENTION POND TYPICAL SECTION  
(NO SCALE)



Z:\18-071-128\PRODUCTION DRAWINGS\EXHIBIT\POND ASBULT\DIXON POND FULL.dwg GRADING (2) Jan 30, 2023 - 1:47:31pm DStorck

EASEMENT REFERENCE			REVISIONS		
CITY NO.	COUNTY RECORDER	GRANTOR	NO.	DESCRIPTION	APPROVAL/DATE

PLAN PREPARED BY:

**ADVANCED CIVIL DESIGN**  
ENGINEERS SURVEYORS

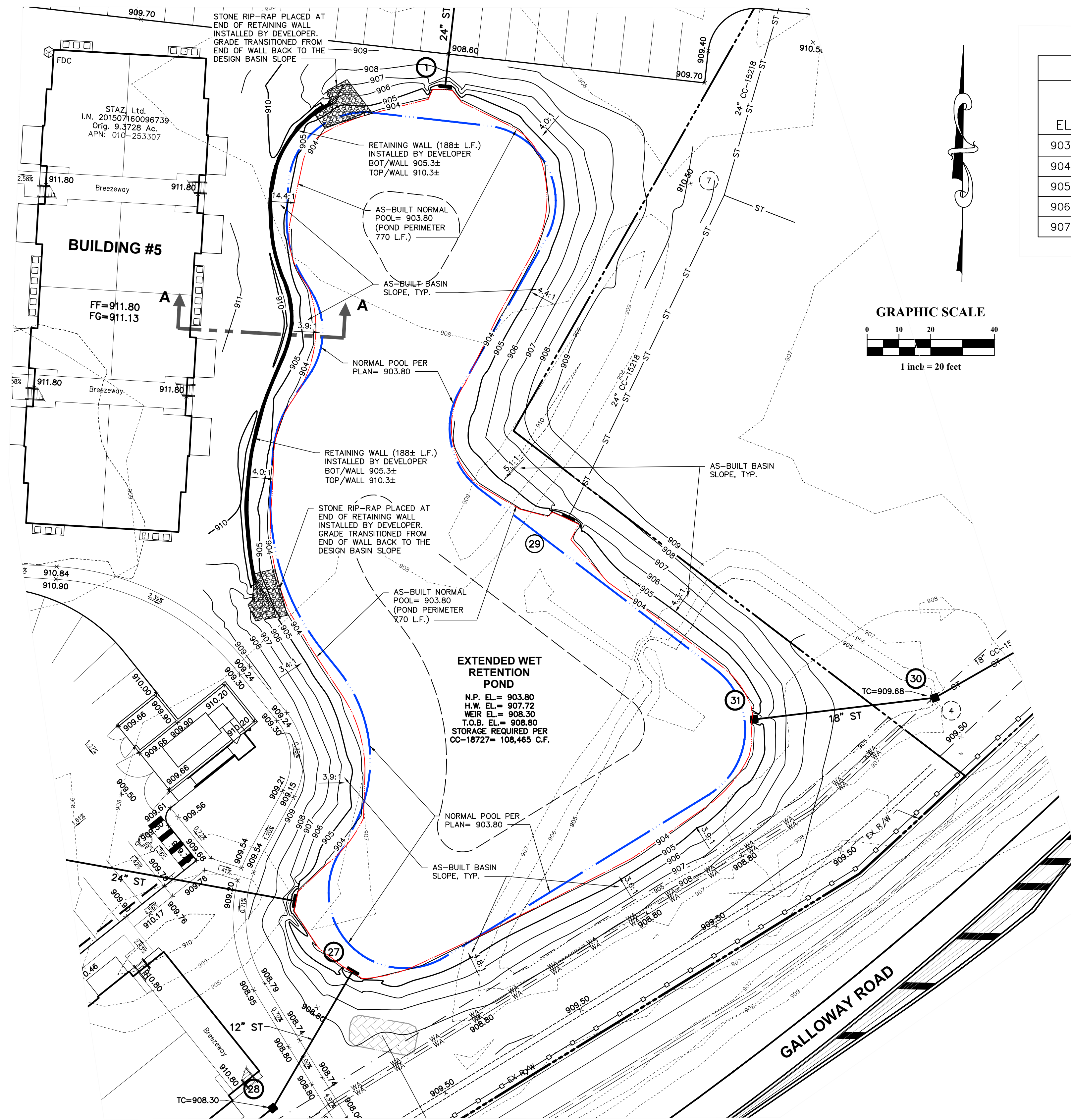
422 Beecher Road  
Gahanna, Ohio 43230  
ph 614.428.7750  
fax 614.428.7755

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PROJECT TITLE: DETENTION BASIN VARIANCE FOR DIXON HOUSE FULL COMPLIANCE					
DIVISION USE ONLY			OWNER		
			CONTRACTOR		
			INSPECTOR		
AGREEMENT		COMPLETED			
RPD	CKD	CID	CON.DR.		
INDEX DETAIL			RECORD FILE		

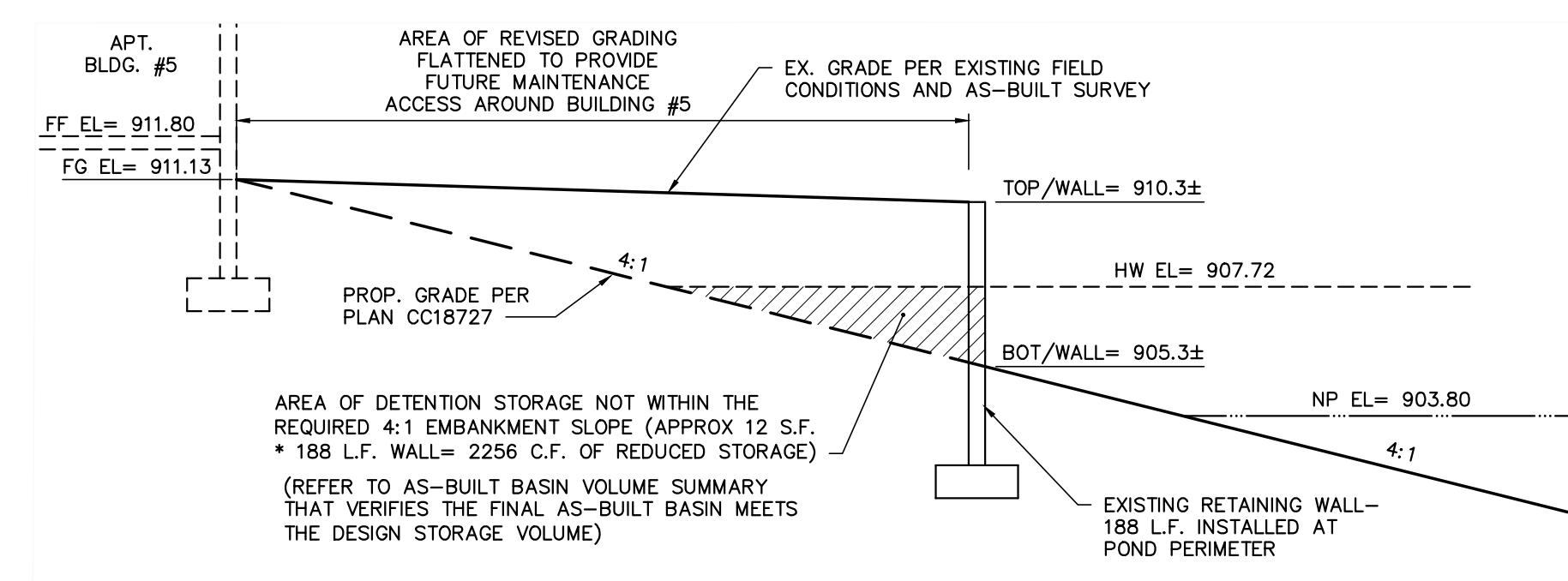
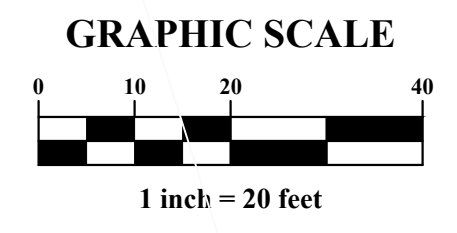
CITY OF COLUMBUS, OHIO DEPARTMENT OF PUBLIC UTILITIES DIVISION OF SEWERAGE AND DRAINAGE	
DIVISION USE ONLY	
SCALE: 1" = 20'	SHEET 1 / 1
CONTRACT DRAWING NO. CC-18727	RECORD PLAN NO.

**APPENDIX B**  
**PREFERRED DEVELOPMENT ALTERNATIVE**  
**AS-BUILT STORMWATER BASIN EXHIBIT**  
**AS-BUILT HYDRAULIC CALCULATIONS**



ELEV	AREA (sq. ft.)	DEPT H (ft)	AVG END INC. VOL. (cu. ft.)	AVG END TOTAL VOL. (cu. ft.)	CONIC INC. VOL. (cu. ft.)	CONIC TOTAL VOL. (cu. ft.)
903.800	22,654.40	N/A	N/A	0.00	N/A	0.00
904.800	25,095.40	1.000	23874.90	23874.90	23864.50	23864.50
905.800	28,012.23	1.000	26553.82	50428.72	26540.46	50404.95
906.800	30,311.52	1.000	29161.88	79590.60	29154.32	79559.28
907.800	33,370.00	1.000	31840.76	111431.36	31828.51	111387.79

STORAGE REQUIRED PER CC-18727= 108,465 C.F.



SECTION A-A  
TYPICAL AS-BUILT WET BASIN SECTION AT EXISTING RETAINING WALL  
NO SCALE

**EXTENDED WET RETENTION POND**  
 N.P. EL= 903.80  
 H.W. EL= 907.72  
 WEIR EL= 908.30  
 T.O.B. EL= 908.80  
 STORAGE REQUIRED PER CC-18727= 108,465 C.F.

EASEMENT REFERENCE		
CITY NO.	COUNTY RECORDER	GRANTOR

REVISIONS		
NO.	DESCRIPTION	APPROVAL/DATE
1	ADDED SHEET 9A: A RETAINING WALL AND AREAS OF RIP-RAP WERE ADDED AND NOT PART OF THE APPROVED PLAN FOR THE POND. AS-BUILT SURVEY VERIFIES THE REQUIRED DETENTION STORAGE VOLUME IS MAINTAINED; NO OUTLET DESIGN CHANGES ARE REQUIRED.	

PLAN PREPARED BY:

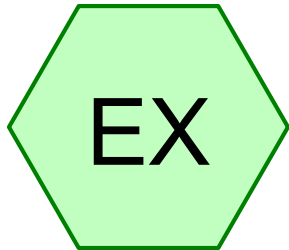


422 Beecher Road  
 Gahanna, Ohio 43230  
 ph 614.428.7750  
 fax 614.428.7755

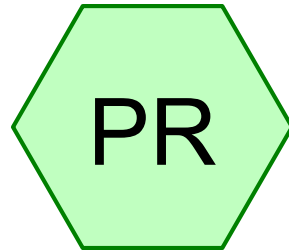
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DETENTION BASIN VARIANCE FOR DIXON HOUSE PREFERRED DEVELOPMENT ALTERNATIVE			
DIVISION USE ONLY		OWNER	
		CONTRACTOR	
		INSPECTOR	
AGREEMENT	COMPLETED		
RPD	CKD	CID	CON.DR.
INDEX DETAIL	RECORD FILE		

CITY OF COLUMBUS, OHIO DEPARTMENT OF PUBLIC UTILITIES DIVISION OF SEWERAGE AND DRAINAGE	
DIVISION USE ONLY	
SCALE: 1" = 20'	SHEET 1 / 1
CONTRACT DRAWING NO. CC-18727	RECORD PLAN NO.

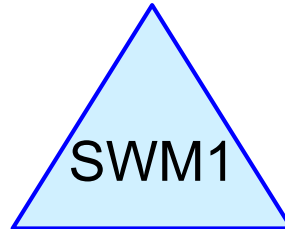
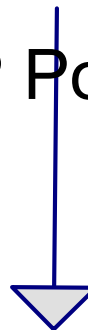




EX Pre-Dev

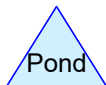
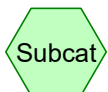


PROP Post-Dev



SWM Ret Pond

REVISED CALCULATIONS PER  
AS-BUILT SURVEY 09/21/21 BY  
ADVANCED CIVIL DESIGN, INC.



**Routing Diagram for HYDROCAD Dixon ASB**  
Prepared by Advanced Civil Design, Inc., Printed 1/2/2023  
HydroCAD® 10.00-12 s/n 02822 © 2014 HydroCAD Software Solutions LLC

**HYDROCAD Dixon ASB**

Prepared by Advanced Civil Design, Inc.

HydroCAD® 10.00-12 s/n 02822 © 2014 HydroCAD Software Solutions LLC

Type II 24-hr 1-yr COL Rainfall=2.20"

Printed 1/2/2023

Page 2

**Summary for Subcatchment EX: EX Pre-Dev**

Runoff = 4.20 cfs @ 12.34 hrs, Volume= 0.502 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 1-yr COL Rainfall=2.20"

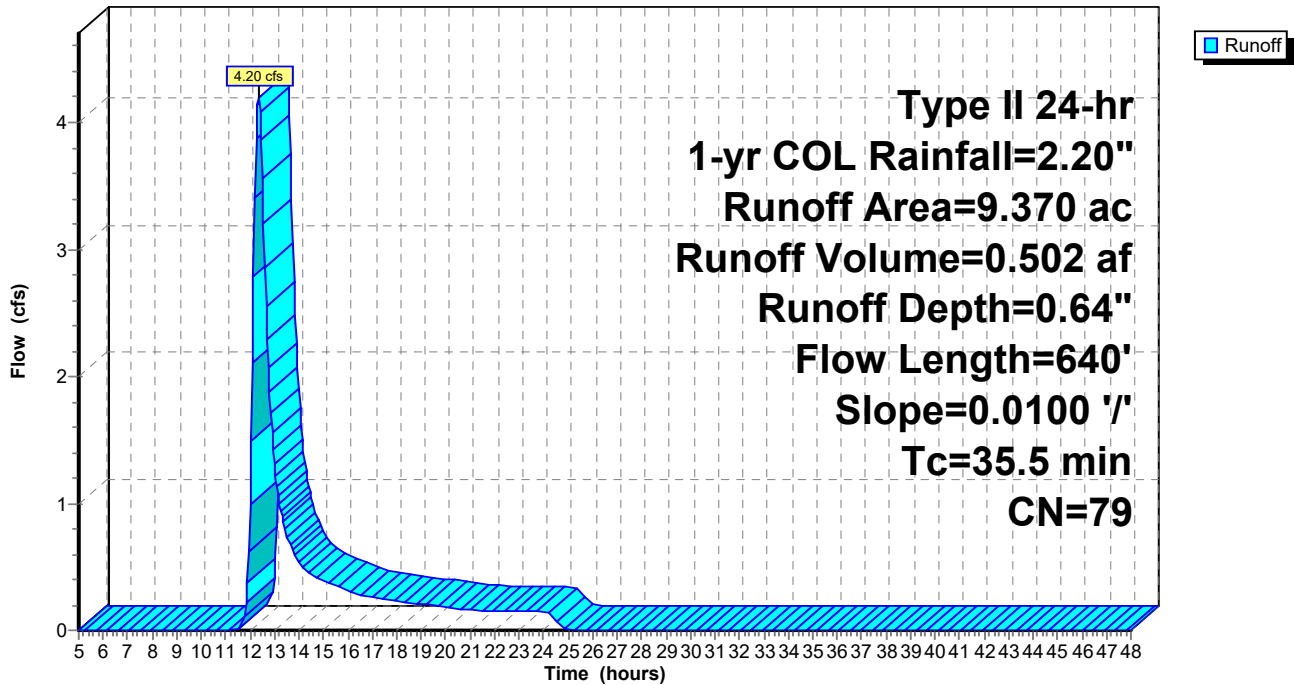
Area (ac)	CN	Description
9.370	79	Pasture/grassland/range, Fair, HSG C
9.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	200	0.0100	0.13		<b>Sheet Flow, SHEET</b> Grass: Short n= 0.150 P2= 2.60"
10.5	440	0.0100	0.70		<b>Shallow Concentrated Flow, SHALLOW CONCENTRATED</b> Short Grass Pasture Kv= 7.0 fps
35.5	640	Total			

**Subcatchment EX: EX Pre-Dev**

Hydrograph



**Summary for Subcatchment PR: PROP Post-Dev**

Runoff = 20.79 cfs @ 12.01 hrs, Volume= 1.170 af, Depth= 1.50"

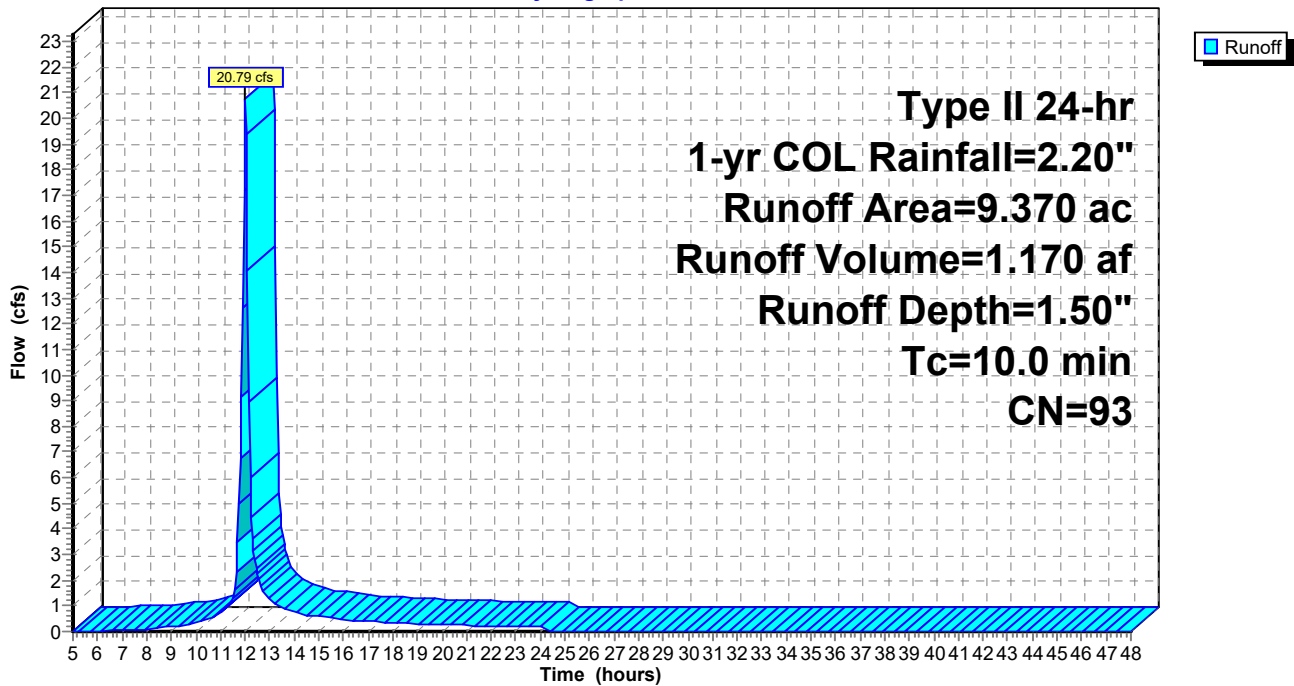
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 1-yr COL Rainfall=2.20"

Area (ac)	CN	Description
5.620	98	Paved parking, HSG C
3.750	86	<50% Grass cover, Poor, HSG C
9.370	93	Weighted Average
3.750		40.02% Pervious Area
5.620		59.98% Impervious Area

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

**Subcatchment PR: PROP Post-Dev**

Hydrograph



**Summary for Pond SWM1: SWM Ret Pond**

Inflow Area = 9.370 ac, 59.98% Impervious, Inflow Depth = 1.50" for 1-yr COL event  
 Inflow = 20.79 cfs @ 12.01 hrs, Volume= 1.170 af  
 Outflow = 0.36 cfs @ 17.87 hrs, Volume= 0.891 af, Atten= 98%, Lag= 351.6 min  
 Primary = 0.36 cfs @ 17.87 hrs, Volume= 0.891 af  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 905.32' @ 17.87 hrs Surf.Area= 26,617 sf Storage= 37,369 cf

Plug-Flow detention time= 962.1 min calculated for 0.891 af (76% of inflow)  
 Center-of-Mass det. time= 873.1 min ( 1,680.1 - 807.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	903.80'	111,430 cf	<b>Wet Retention Pond (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
903.80	22,654	0	0
904.80	25,095	23,875	23,875
905.80	28,012	26,554	50,428
906.80	30,311	29,162	79,590
907.80	33,370	31,841	111,430

Device	Routing	Invert	Outlet Devices
#1	Primary	903.80'	<b>18.0" Round Culvert</b> L= 147.4' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 903.80' / 903.44' S= 0.0024 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	903.80'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 2	903.80'	<b>3.4" Vert. WQ</b> C= 0.600
#4	Device 2	907.50'	<b>24.0" x 24.0" Horiz. Top Casting</b> C= 0.600 Limited to weir flow at low heads
#5	Secondary	908.30'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=0.36 cfs @ 17.87 hrs HW=905.32' (Free Discharge)

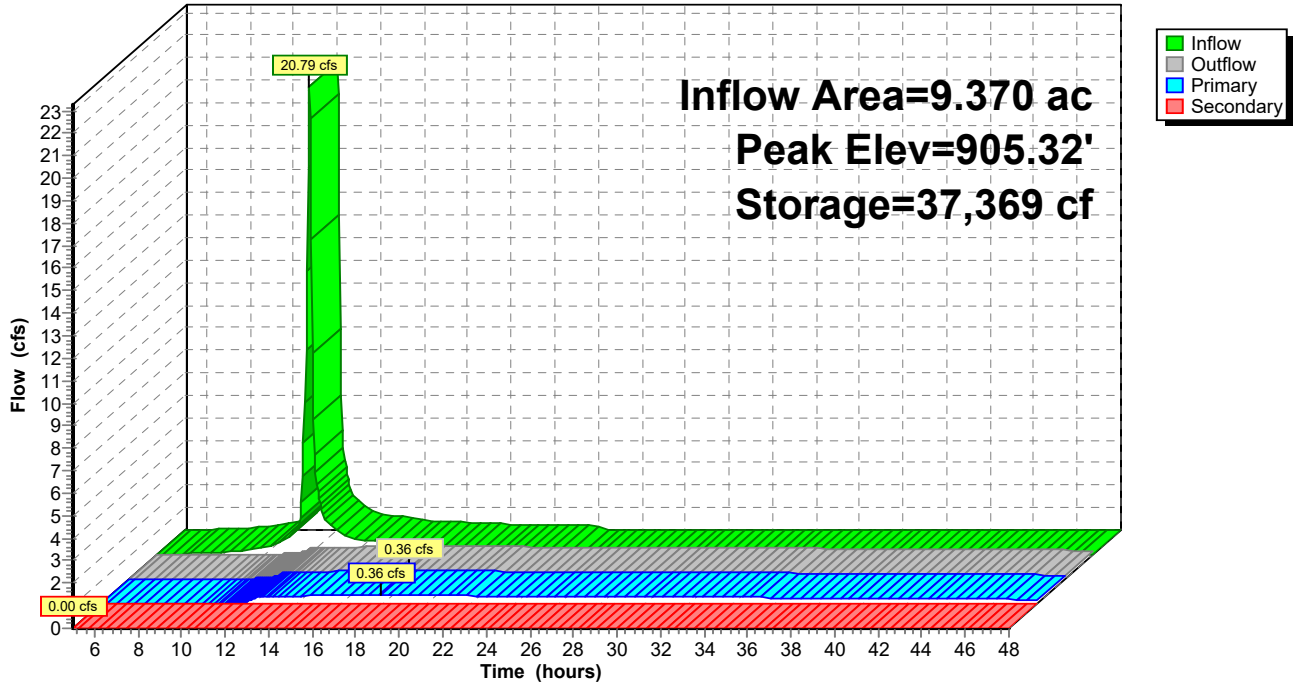
- ↑ **1=Culvert** (Passes 0.36 cfs of 5.26 cfs potential flow)
- ↑ **2=Orifice/Grate** (Passes 0.36 cfs of 1.83 cfs potential flow)
- ↑ **3=WQ** (Orifice Controls 0.36 cfs @ 5.66 fps)
- ↑ **4=Top Casting** ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=903.80' (Free Discharge)

- ↑ **5=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

Pond SWM1: SWM Ret Pond

Hydrograph



**HYDROCAD Dixon ASB**

Prepared by Advanced Civil Design, Inc.

HydroCAD® 10.00-12 s/n 02822 © 2014 HydroCAD Software Solutions LLC

Type II 24-hr 2-yr COL Rainfall=2.63"

Printed 1/2/2023

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**Summary for Subcatchment EX: EX Pre-Dev**

Runoff = 6.34 cfs @ 12.33 hrs, Volume= 0.723 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 2-yr COL Rainfall=2.63"

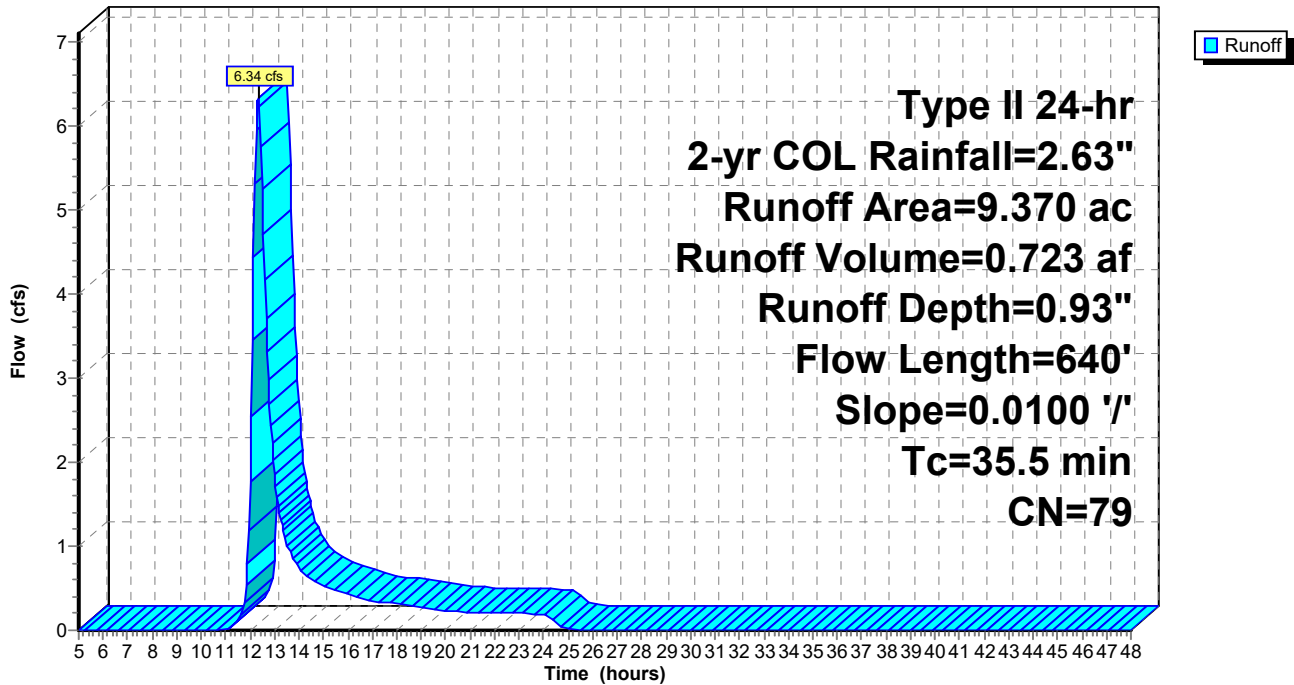
Area (ac)	CN	Description
9.370	79	Pasture/grassland/range, Fair, HSG C
9.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	200	0.0100	0.13		<b>Sheet Flow, SHEET</b> Grass: Short n= 0.150 P2= 2.60"
10.5	440	0.0100	0.70		<b>Shallow Concentrated Flow, SHALLOW CONCENTRATED</b> Short Grass Pasture Kv= 7.0 fps
35.5	640	Total			

**Subcatchment EX: EX Pre-Dev**

Hydrograph



**Summary for Subcatchment PR: PROP Post-Dev**

Runoff = 26.08 cfs @ 12.01 hrs, Volume= 1.485 af, Depth> 1.90"

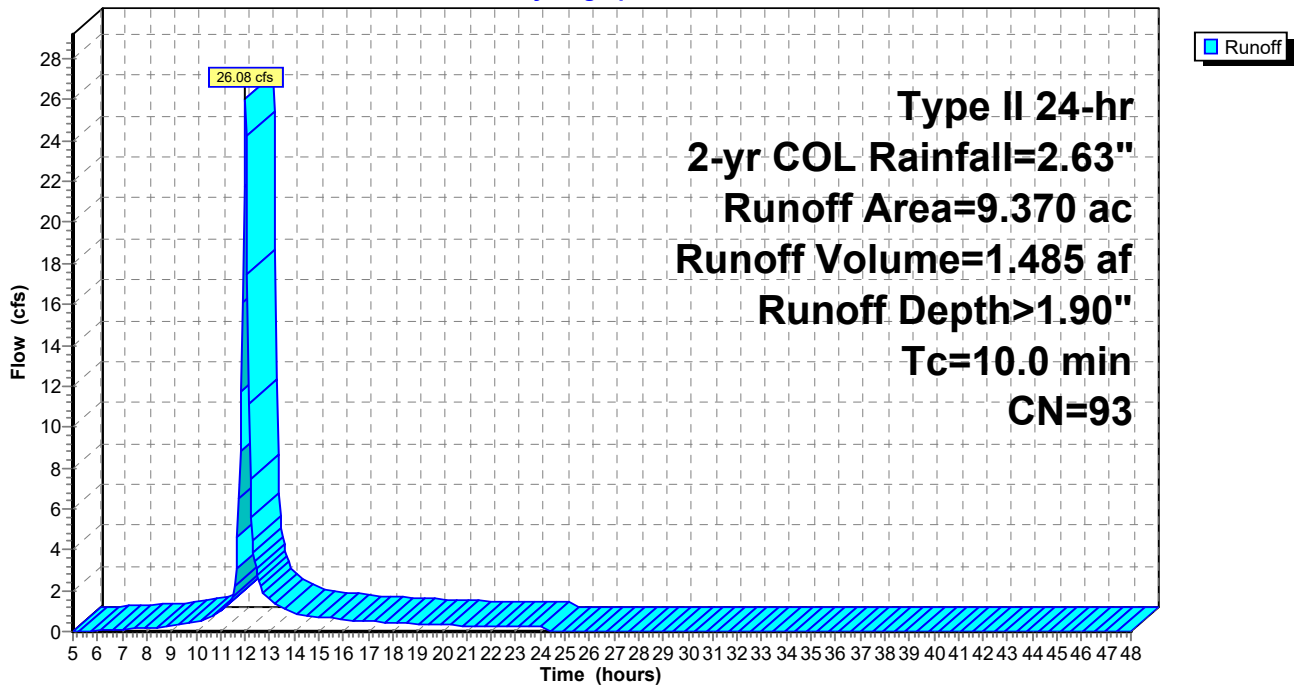
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 2-yr COL Rainfall=2.63"

Area (ac)	CN	Description
5.620	98	Paved parking, HSG C
3.750	86	<50% Grass cover, Poor, HSG C
9.370	93	Weighted Average
3.750		40.02% Pervious Area
5.620		59.98% Impervious Area

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

**Subcatchment PR: PROP Post-Dev**

Hydrograph



**Summary for Pond SWM1: SWM Ret Pond**

Inflow Area = 9.370 ac, 59.98% Impervious, Inflow Depth > 1.90" for 2-yr COL event  
 Inflow = 26.08 cfs @ 12.01 hrs, Volume= 1.485 af  
 Outflow = 0.41 cfs @ 18.39 hrs, Volume= 1.056 af, Atten= 98%, Lag= 382.7 min  
 Primary = 0.41 cfs @ 18.39 hrs, Volume= 1.056 af  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 905.73' @ 18.39 hrs Surf.Area= 27,810 sf Storage= 48,493 cf

Plug-Flow detention time= 990.3 min calculated for 1.054 af (71% of inflow)  
 Center-of-Mass det. time= 895.9 min ( 1,696.1 - 800.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	903.80'	111,430 cf	<b>Wet Retention Pond (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
903.80	22,654	0	0
904.80	25,095	23,875	23,875
905.80	28,012	26,554	50,428
906.80	30,311	29,162	79,590
907.80	33,370	31,841	111,430

Device	Routing	Invert	Outlet Devices
#1	Primary	903.80'	<b>18.0" Round Culvert</b> L= 147.4' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 903.80' / 903.44' S= 0.0024 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	903.80'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 2	903.80'	<b>3.4" Vert. WQ</b> C= 0.600
#4	Device 2	907.50'	<b>24.0" x 24.0" Horiz. Top Casting</b> C= 0.600 Limited to weir flow at low heads
#5	Secondary	908.30'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=0.41 cfs @ 18.39 hrs HW=905.73' (Free Discharge)

- ↑ **1=Culvert** (Passes 0.41 cfs of 6.60 cfs potential flow)
- ↑ **2=Orifice/Grate** (Passes 0.41 cfs of 2.12 cfs potential flow)
- ↑ **3=WQ** (Orifice Controls 0.41 cfs @ 6.44 fps)
- ↑ **4=Top Casting** ( Controls 0.00 cfs)

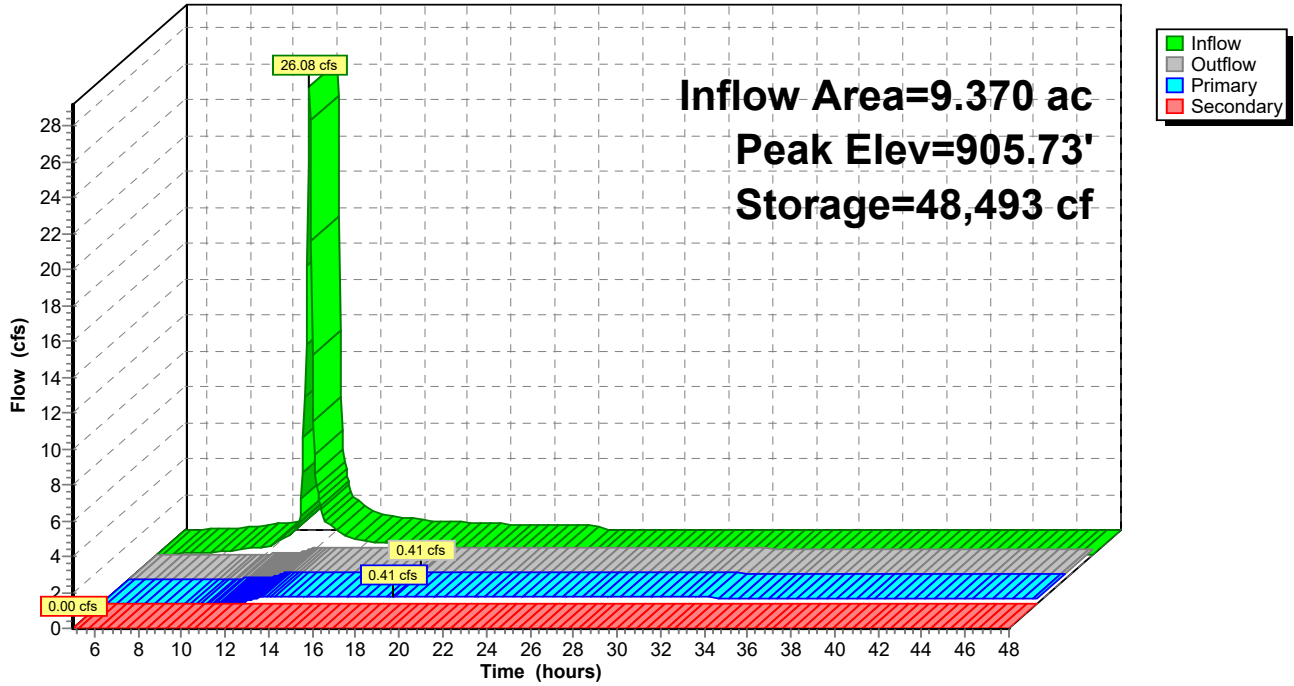
**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=903.80' (Free Discharge)

- ↑ **5=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)



**Pond SWM1: SWM Ret Pond**

Hydrograph



**HYDROCAD Dixon ASB**

Prepared by Advanced Civil Design, Inc.

HydroCAD® 10.00-12 s/n 02822 © 2014 HydroCAD Software Solutions LLC

Type II 24-hr 5-yr COL Rainfall=3.24"

Printed 1/2/2023

Page 10

**Summary for Subcatchment EX: EX Pre-Dev**

Runoff = 9.66 cfs @ 12.32 hrs, Volume= 1.067 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 5-yr COL Rainfall=3.24"

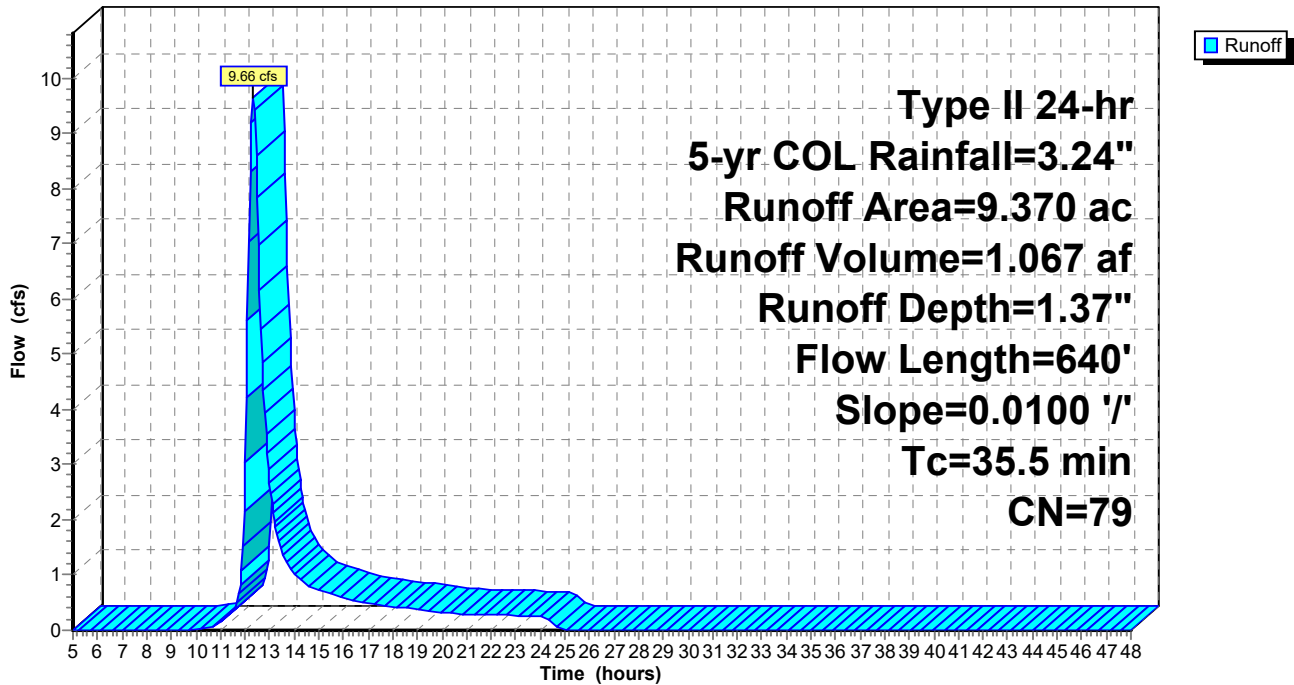
Area (ac)	CN	Description
9.370	79	Pasture/grassland/range, Fair, HSG C
9.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	200	0.0100	0.13		<b>Sheet Flow, SHEET</b> Grass: Short n= 0.150 P2= 2.60"
10.5	440	0.0100	0.70		<b>Shallow Concentrated Flow, SHALLOW CONCENTRATED</b> Short Grass Pasture Kv= 7.0 fps
35.5	640	Total			

**Subcatchment EX: EX Pre-Dev**

Hydrograph



**Summary for Subcatchment PR: PROP Post-Dev**

Runoff = 33.57 cfs @ 12.01 hrs, Volume= 1.938 af, Depth> 2.48"

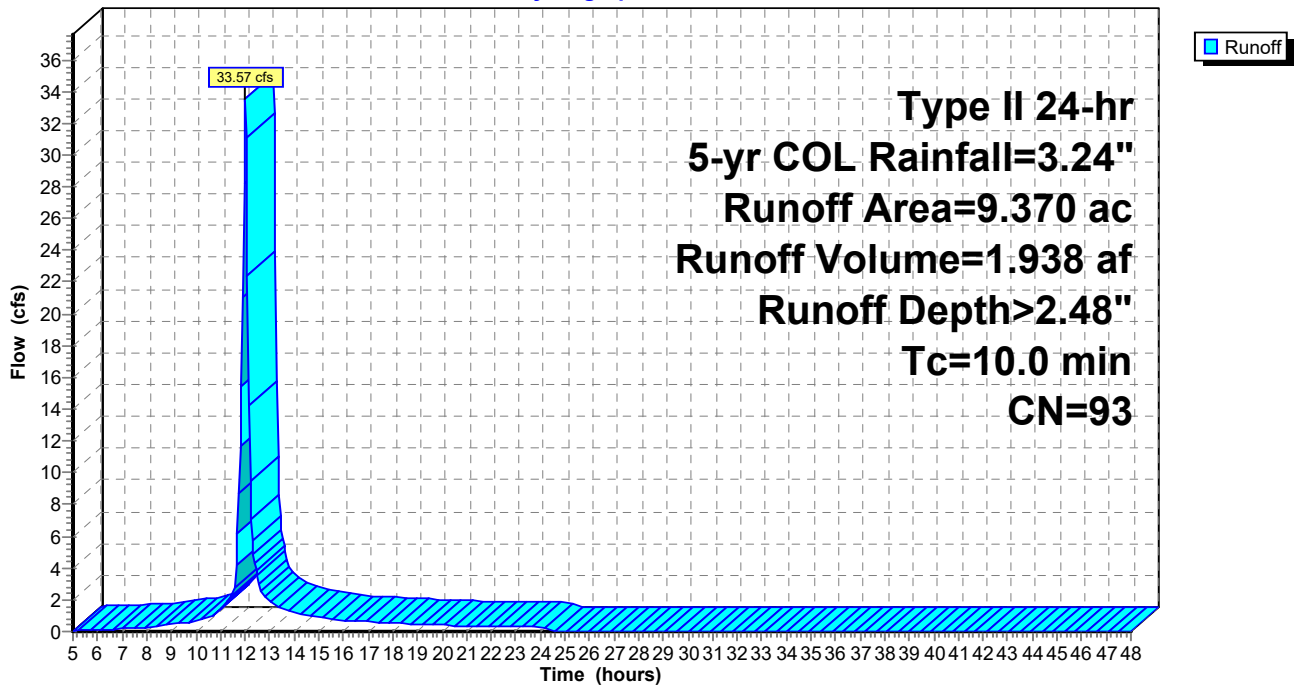
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 5-yr COL Rainfall=3.24"

Area (ac)	CN	Description
5.620	98	Paved parking, HSG C
3.750	86	<50% Grass cover, Poor, HSG C
9.370	93	Weighted Average
3.750		40.02% Pervious Area
5.620		59.98% Impervious Area

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

**Subcatchment PR: PROP Post-Dev**

Hydrograph



**Summary for Pond SWM1: SWM Ret Pond**

Inflow Area = 9.370 ac, 59.98% Impervious, Inflow Depth > 2.48" for 5-yr COL event  
 Inflow = 33.57 cfs @ 12.01 hrs, Volume= 1.938 af  
 Outflow = 0.47 cfs @ 18.98 hrs, Volume= 1.259 af, Atten= 99%, Lag= 418.5 min  
 Primary = 0.47 cfs @ 18.98 hrs, Volume= 1.259 af  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 906.30' @ 18.98 hrs Surf.Area= 29,169 sf Storage= 64,813 cf

Plug-Flow detention time= 1,015.9 min calculated for 1.259 af (65% of inflow)  
 Center-of-Mass det. time= 914.8 min ( 1,708.0 - 793.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	903.80'	111,430 cf	<b>Wet Retention Pond (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
903.80	22,654	0	0
904.80	25,095	23,875	23,875
905.80	28,012	26,554	50,428
906.80	30,311	29,162	79,590
907.80	33,370	31,841	111,430

Device	Routing	Invert	Outlet Devices
#1	Primary	903.80'	<b>18.0" Round Culvert</b> L= 147.4' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 903.80' / 903.44' S= 0.0024 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	903.80'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 2	903.80'	<b>3.4" Vert. WQ</b> C= 0.600
#4	Device 2	907.50'	<b>24.0" x 24.0" Horiz. Top Casting</b> C= 0.600 Limited to weir flow at low heads
#5	Secondary	908.30'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=0.47 cfs @ 18.98 hrs HW=906.30' (Free Discharge)

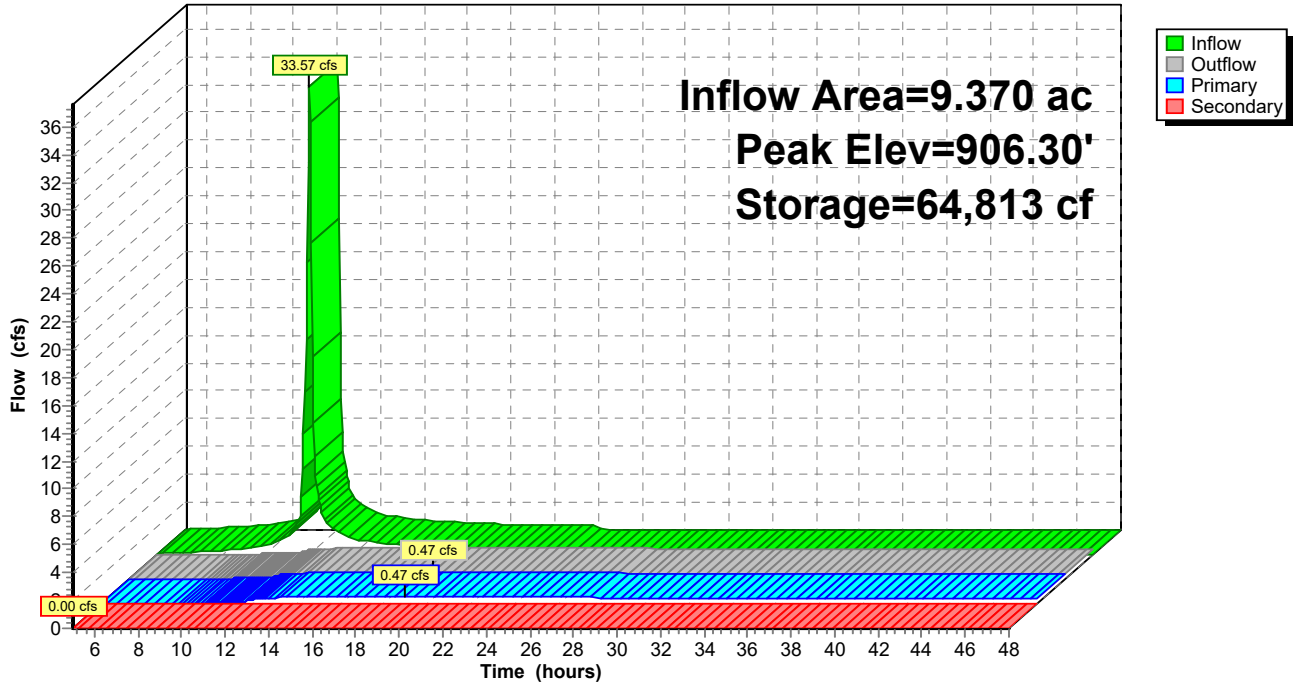
- ↑ **1=Culvert** (Passes 0.47 cfs of 8.08 cfs potential flow)
- ↑ **2=Orifice/Grate** (Passes 0.47 cfs of 2.48 cfs potential flow)
- ↑ **3=WQ** (Orifice Controls 0.47 cfs @ 7.40 fps)
- ↑ **4=Top Casting** ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=903.80' (Free Discharge)

- ↑ **5=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Pond SWM1: SWM Ret Pond**

Hydrograph



**HYDROCAD Dixon ASB**

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Type II 24-hr 10-yr COL Rainfall=3.74"

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**Summary for Subcatchment EX: EX Pre-Dev**

Runoff = 12.56 cfs @ 12.32 hrs, Volume= 1.370 af, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 10-yr COL Rainfall=3.74"

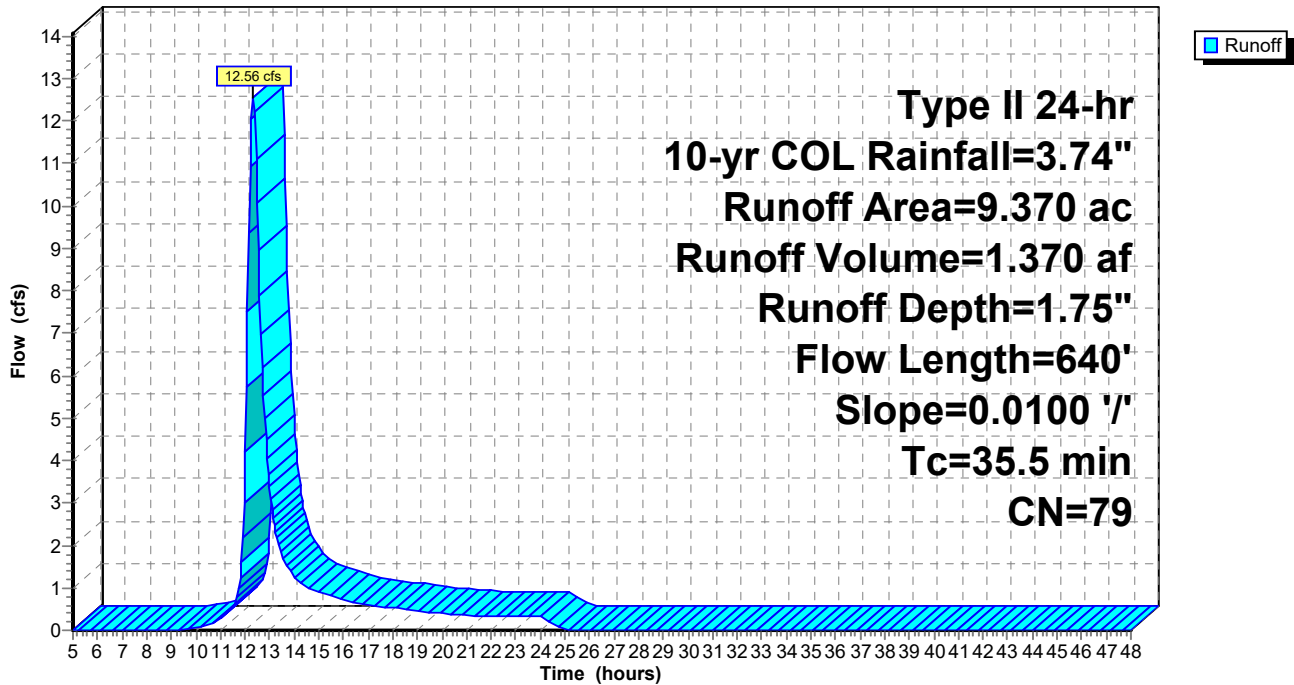
Area (ac)	CN	Description
9.370	79	Pasture/grassland/range, Fair, HSG C
9.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	200	0.0100	0.13		<b>Sheet Flow, SHEET</b> Grass: Short n= 0.150 P2= 2.60"
10.5	440	0.0100	0.70		<b>Shallow Concentrated Flow, SHALLOW CONCENTRATED</b> Short Grass Pasture Kv= 7.0 fps
35.5	640	Total			

**Subcatchment EX: EX Pre-Dev**

Hydrograph



**Summary for Subcatchment PR: PROP Post-Dev**

Runoff = 39.68 cfs @ 12.01 hrs, Volume= 2.312 af, Depth> 2.96"

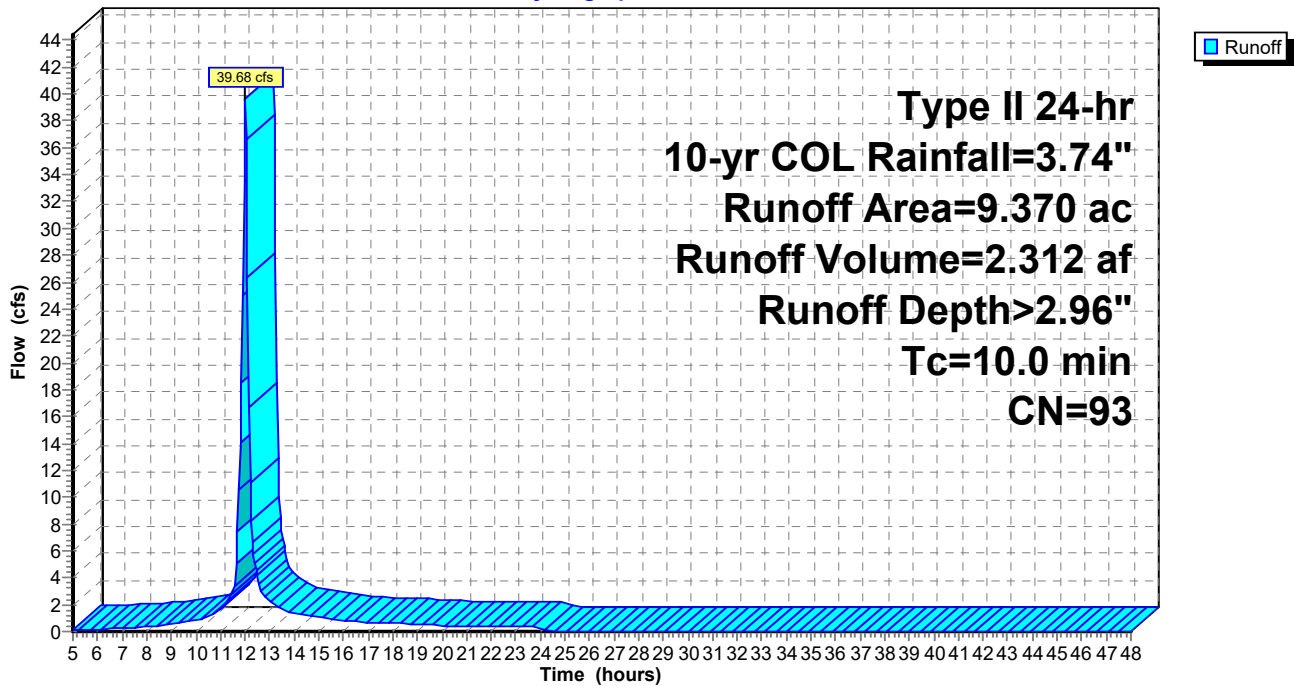
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 10-yr COL Rainfall=3.74"

Area (ac)	CN	Description
5.620	98	Paved parking, HSG C
3.750	86	<50% Grass cover, Poor, HSG C
9.370	93	Weighted Average
3.750		40.02% Pervious Area
5.620		59.98% Impervious Area

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

**Subcatchment PR: PROP Post-Dev**

Hydrograph



**HYDROCAD Dixon ASB**

Type II 24-hr 10-yr COL Rainfall=3.74"

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**Summary for Pond SWM1: SWM Ret Pond**

Inflow Area = 9.370 ac, 59.98% Impervious, Inflow Depth > 2.96" for 10-yr COL event  
 Inflow = 39.68 cfs @ 12.01 hrs, Volume= 2.312 af  
 Outflow = 0.51 cfs @ 19.38 hrs, Volume= 1.406 af, Atten= 99%, Lag= 442.3 min  
 Primary = 0.51 cfs @ 19.38 hrs, Volume= 1.406 af  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 906.76' @ 19.38 hrs Surf.Area= 30,230 sf Storage= 78,519 cf

Plug-Flow detention time= 1,027.0 min calculated for 1.404 af (61% of inflow)  
 Center-of-Mass det. time= 924.2 min ( 1,713.2 - 789.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	903.80'	111,430 cf	<b>Wet Retention Pond (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
903.80	22,654	0	0
904.80	25,095	23,875	23,875
905.80	28,012	26,554	50,428
906.80	30,311	29,162	79,590
907.80	33,370	31,841	111,430

Device	Routing	Invert	Outlet Devices
#1	Primary	903.80'	<b>18.0" Round Culvert</b> L= 147.4' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 903.80' / 903.44' S= 0.0024 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	903.80'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 2	903.80'	<b>3.4" Vert. WQ</b> C= 0.600
#4	Device 2	907.50'	<b>24.0" x 24.0" Horiz. Top Casting</b> C= 0.600 Limited to weir flow at low heads
#5	Secondary	908.30'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=0.51 cfs @ 19.38 hrs HW=906.76' (Free Discharge)

↑ **1=Culvert** (Passes 0.51 cfs of 9.35 cfs potential flow)  
 ↑ **2=Orifice/Grate** (Passes 0.51 cfs of 2.73 cfs potential flow)  
 ↑ **3=WQ** (Orifice Controls 0.51 cfs @ 8.09 fps)  
 ↑ **4=Top Casting** ( Controls 0.00 cfs)

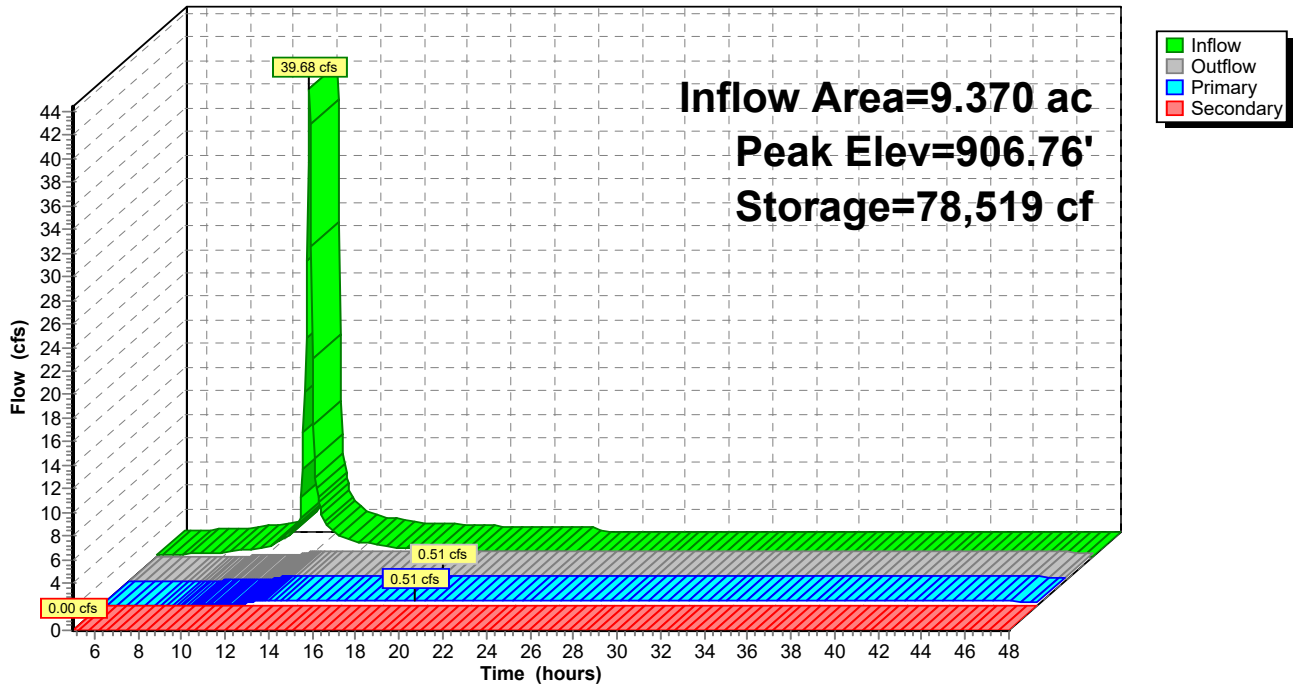
**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=903.80' (Free Discharge)

↑ **5=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)



Pond SWM1: SWM Ret Pond

Hydrograph



**HYDROCAD Dixon ASB**

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Type II 24-hr 25-yr COL Rainfall=4.44"

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**Summary for Subcatchment EX: EX Pre-Dev**

Runoff = 16.81 cfs @ 12.31 hrs, Volume= 1.816 af, Depth= 2.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 25-yr COL Rainfall=4.44"

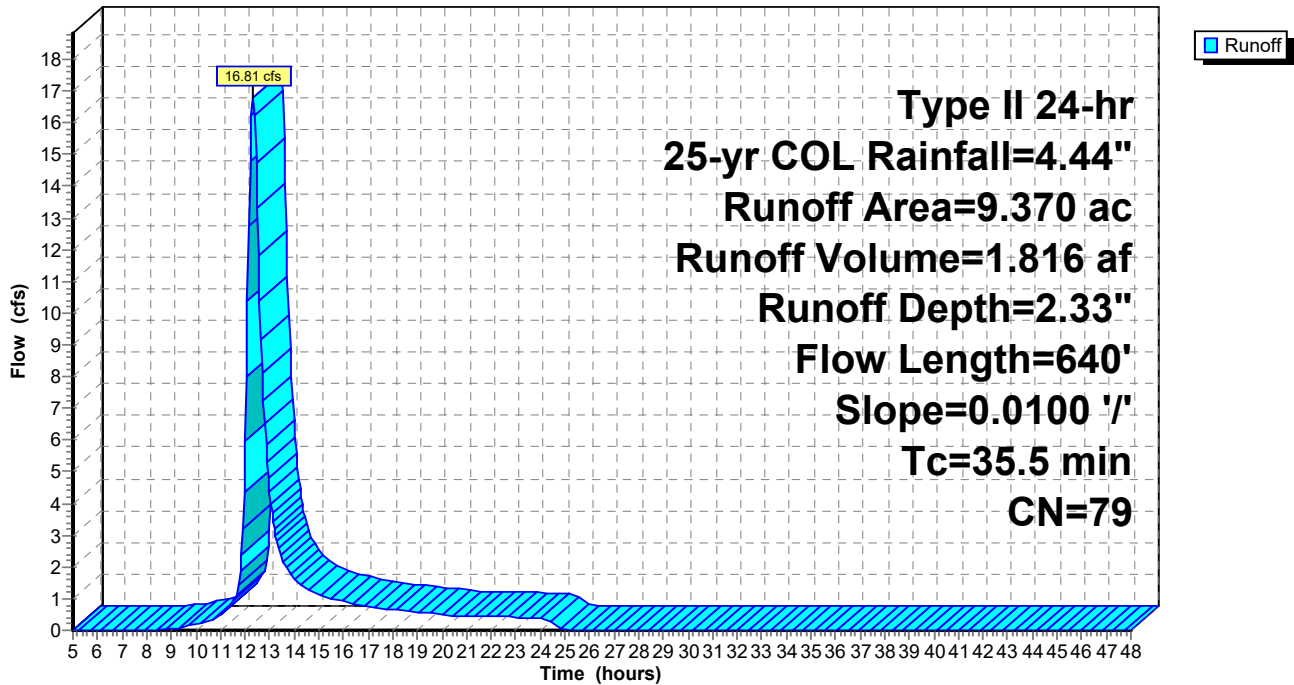
Area (ac)	CN	Description
9.370	79	Pasture/grassland/range, Fair, HSG C
9.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	200	0.0100	0.13		<b>Sheet Flow, SHEET</b> Grass: Short n= 0.150 P2= 2.60"
10.5	440	0.0100	0.70		<b>Shallow Concentrated Flow, SHALLOW CONCENTRATED</b> Short Grass Pasture Kv= 7.0 fps
35.5	640	Total			

**Subcatchment EX: EX Pre-Dev**

Hydrograph



**Summary for Subcatchment PR: PROP Post-Dev**

Runoff = 48.20 cfs @ 12.01 hrs, Volume= 2.837 af, Depth> 3.63"

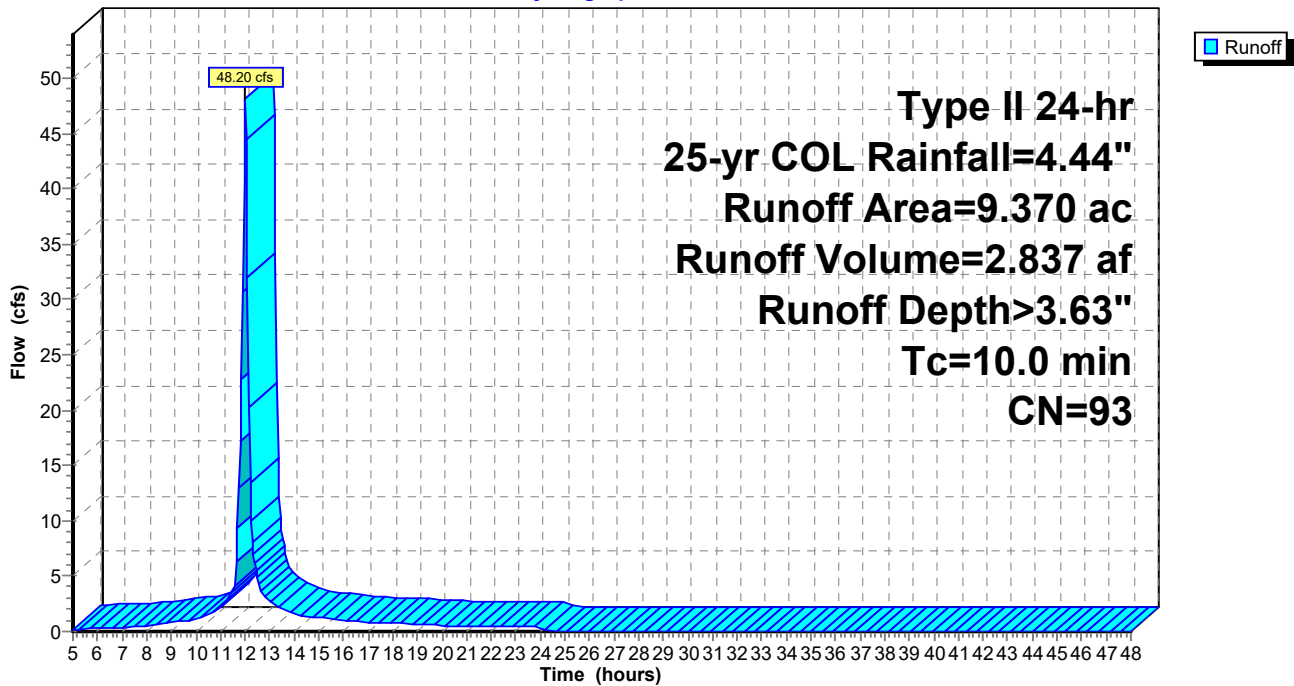
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 25-yr COL Rainfall=4.44"

Area (ac)	CN	Description
5.620	98	Paved parking, HSG C
3.750	86	<50% Grass cover, Poor, HSG C
9.370	93	Weighted Average
3.750		40.02% Pervious Area
5.620		59.98% Impervious Area

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

**Subcatchment PR: PROP Post-Dev**

Hydrograph



**HYDROCAD Dixon ASB**

Type II 24-hr 25-yr COL Rainfall=4.44"

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**Summary for Pond SWM1: SWM Ret Pond**

Inflow Area = 9.370 ac, 59.98% Impervious, Inflow Depth > 3.63" for 25-yr COL event  
 Inflow = 48.20 cfs @ 12.01 hrs, Volume= 2.837 af  
 Outflow = 0.56 cfs @ 19.84 hrs, Volume= 1.589 af, Atten= 99%, Lag= 470.0 min  
 Primary = 0.56 cfs @ 19.84 hrs, Volume= 1.589 af  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 907.39' @ 19.84 hrs Surf.Area= 32,123 sf Storage= 98,078 cf

Plug-Flow detention time= 1,040.9 min calculated for 1.589 af (56% of inflow)  
 Center-of-Mass det. time= 932.8 min ( 1,717.4 - 784.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	903.80'	111,430 cf	<b>Wet Retention Pond (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
903.80	22,654	0	0
904.80	25,095	23,875	23,875
905.80	28,012	26,554	50,428
906.80	30,311	29,162	79,590
907.80	33,370	31,841	111,430

Device	Routing	Invert	Outlet Devices
#1	Primary	903.80'	<b>18.0" Round Culvert</b> L= 147.4' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 903.80' / 903.44' S= 0.0024 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	903.80'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 2	903.80'	<b>3.4" Vert. WQ</b> C= 0.600
#4	Device 2	907.50'	<b>24.0" x 24.0" Horiz. Top Casting</b> C= 0.600 Limited to weir flow at low heads
#5	Secondary	908.30'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=0.56 cfs @ 19.84 hrs HW=907.39' (Free Discharge)

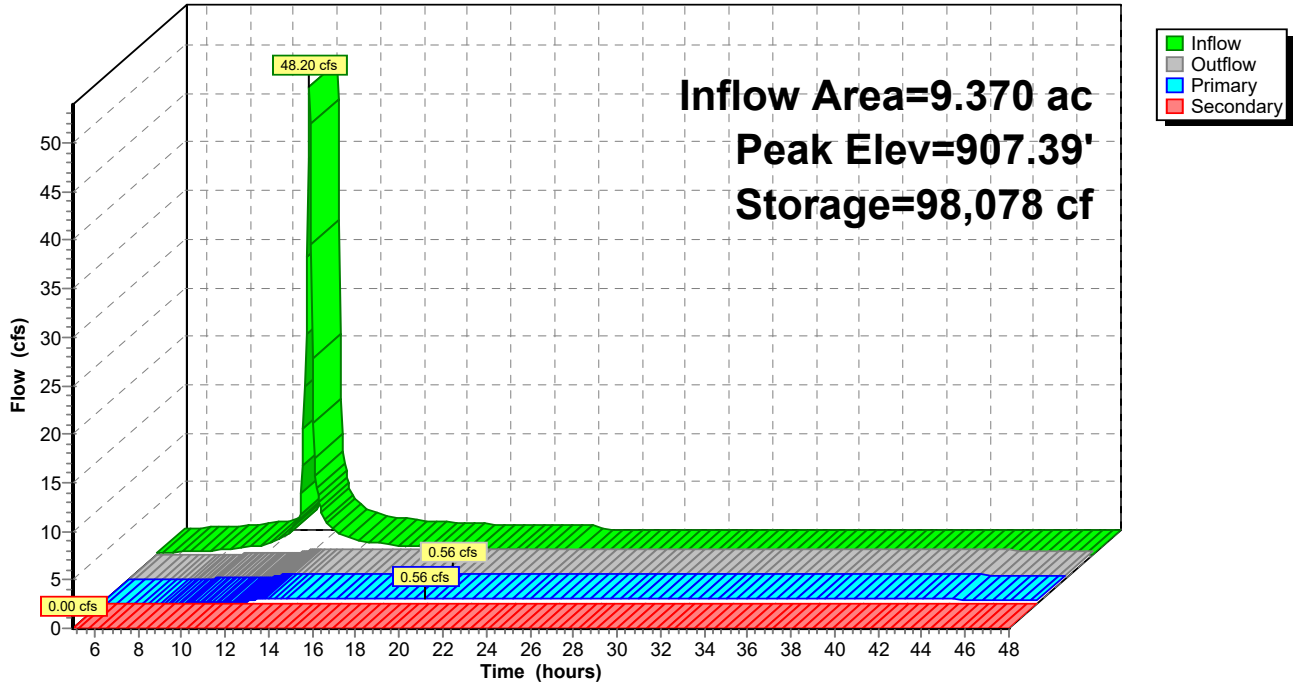
↑ **1=Culvert** (Passes 0.56 cfs of 10.84 cfs potential flow)  
 ↑ **2=Orifice/Grate** (Passes 0.56 cfs of 3.03 cfs potential flow)  
 ↑ **3=WQ** (Orifice Controls 0.56 cfs @ 8.94 fps)  
 ↑ **4=Top Casting** ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=903.80' (Free Discharge)

↑ **5=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

Pond SWM1: SWM Ret Pond

Hydrograph



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Type II 24-hr 50-yr COL Rainfall=5.02"

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**Summary for Subcatchment EX: EX Pre-Dev**

Runoff = 20.44 cfs @ 12.31 hrs, Volume= 2.201 af, Depth= 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 50-yr COL Rainfall=5.02"

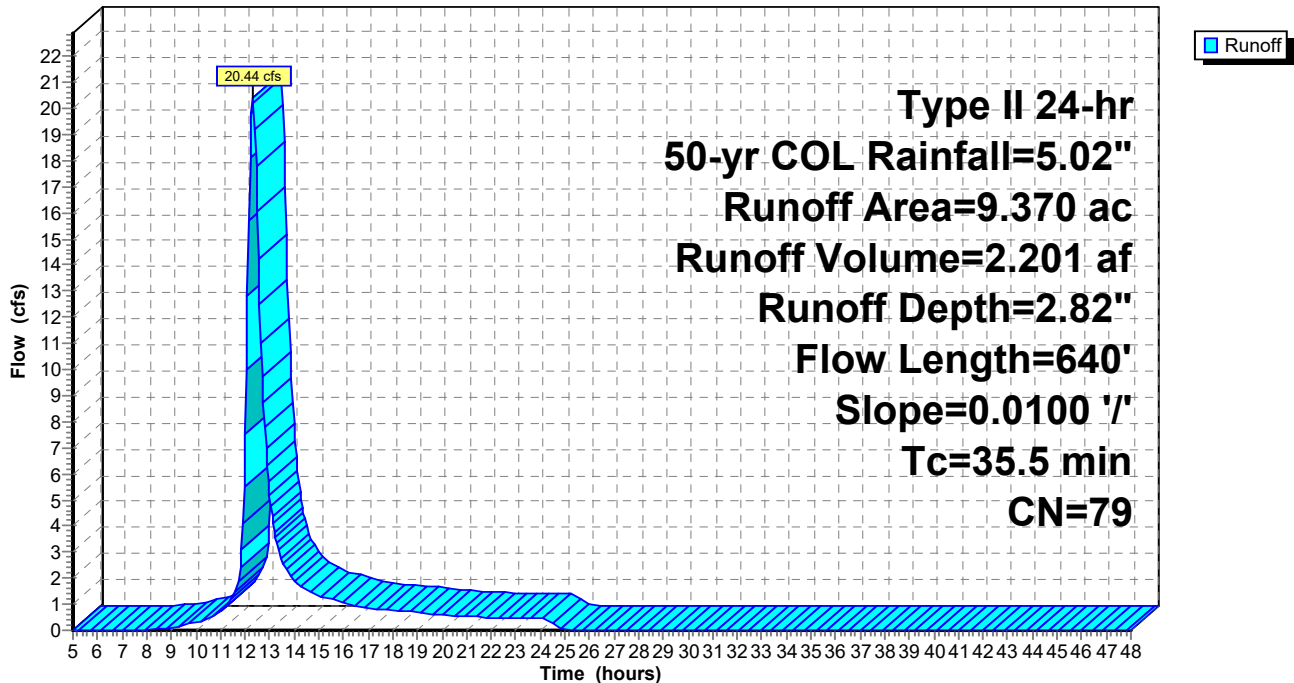
Area (ac)	CN	Description
9.370	79	Pasture/grassland/range, Fair, HSG C
9.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	200	0.0100	0.13		<b>Sheet Flow, SHEET</b> Grass: Short n= 0.150 P2= 2.60"
10.5	440	0.0100	0.70		<b>Shallow Concentrated Flow, SHALLOW CONCENTRATED</b> Short Grass Pasture Kv= 7.0 fps
35.5	640	Total			

**Subcatchment EX: EX Pre-Dev**

Hydrograph



**Summary for Subcatchment PR: PROP Post-Dev**

Runoff = 55.21 cfs @ 12.01 hrs, Volume= 3.273 af, Depth> 4.19"

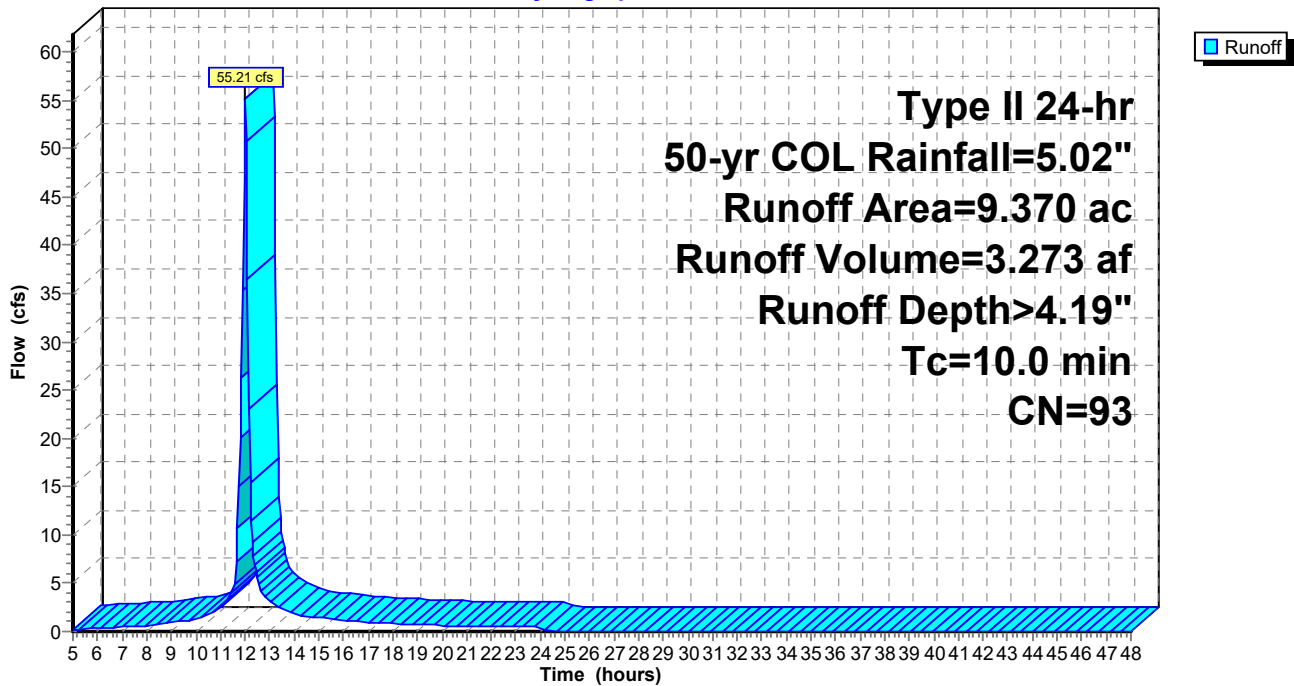
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 50-yr COL Rainfall=5.02"

Area (ac)	CN	Description
5.620	98	Paved parking, HSG C
3.750	86	<50% Grass cover, Poor, HSG C
9.370	93	Weighted Average
3.750		40.02% Pervious Area
5.620		59.98% Impervious Area

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

**Subcatchment PR: PROP Post-Dev**

Hydrograph



**Summary for Pond SWM1: SWM Ret Pond**

Inflow Area = 9.370 ac, 59.98% Impervious, Inflow Depth > 4.19" for 50-yr COL event  
 Inflow = 55.21 cfs @ 12.01 hrs, Volume= 3.273 af  
 Outflow = 1.46 cfs @ 14.92 hrs, Volume= 1.945 af, Atten= 97%, Lag= 174.9 min  
 Primary = 1.46 cfs @ 14.92 hrs, Volume= 1.945 af  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 907.60' @ 14.92 hrs Surf.Area= 32,772 sf Storage= 104,963 cf

Plug-Flow detention time= 919.0 min calculated for 1.942 af (59% of inflow)  
 Center-of-Mass det. time= 815.5 min ( 1,597.1 - 781.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	903.80'	111,430 cf	<b>Wet Retention Pond (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
903.80	22,654	0	0
904.80	25,095	23,875	23,875
905.80	28,012	26,554	50,428
906.80	30,311	29,162	79,590
907.80	33,370	31,841	111,430

Device	Routing	Invert	Outlet Devices
#1	Primary	903.80'	<b>18.0" Round Culvert</b> L= 147.4' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 903.80' / 903.44' S= 0.0024 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	903.80'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 2	903.80'	<b>3.4" Vert. WQ</b> C= 0.600
#4	Device 2	907.50'	<b>24.0" x 24.0" Horiz. Top Casting</b> C= 0.600 Limited to weir flow at low heads
#5	Secondary	908.30'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=1.46 cfs @ 14.92 hrs HW=907.60' (Free Discharge)

- ↑ **1=Culvert** (Passes 1.46 cfs of 11.30 cfs potential flow)
- ↑ **2=Orifice/Grate** (Passes 1.46 cfs of 3.13 cfs potential flow)
- ↑ **3=WQ** (Orifice Controls 0.58 cfs @ 9.22 fps)
- ↑ **4=Top Casting** (Weir Controls 0.88 cfs @ 1.06 fps)

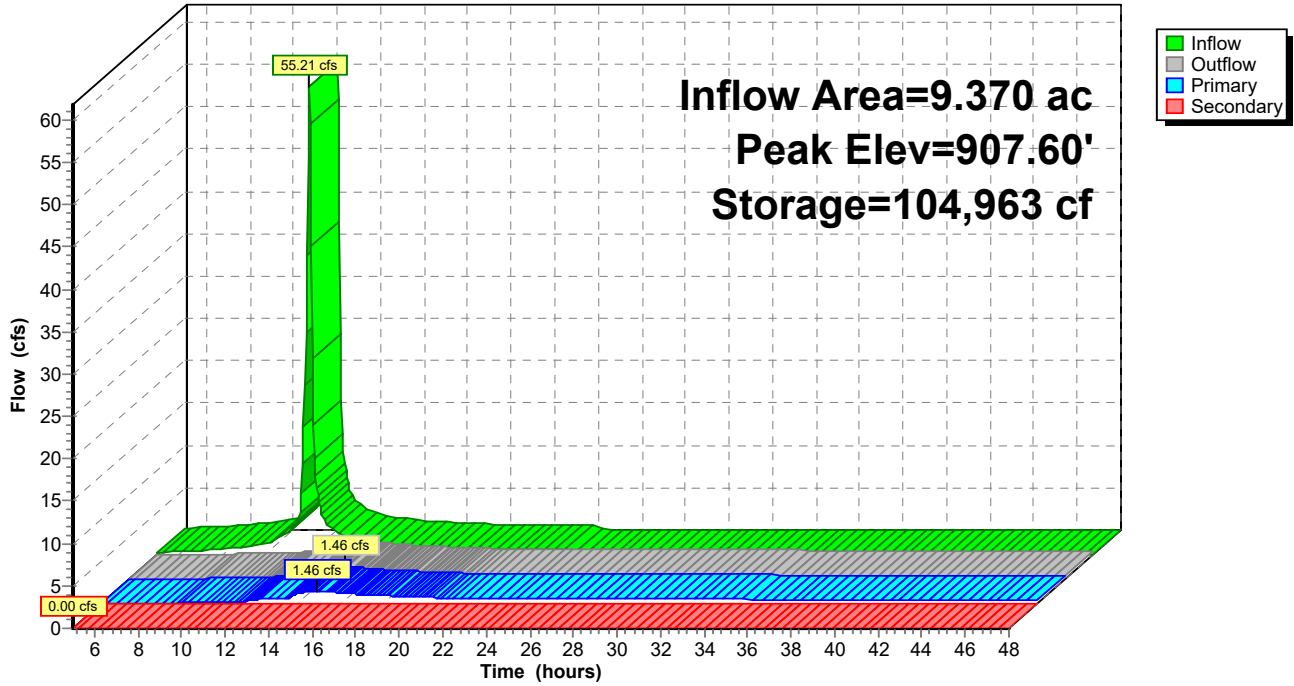
**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=903.80' (Free Discharge)

- ↑ **5=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)



**Pond SWM1: SWM Ret Pond**

Hydrograph



**HYDROCAD Dixon ASB**

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Type II 24-hr 100-yr COL Rainfall=5.63"

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**Summary for Subcatchment EX: EX Pre-Dev**

Runoff = 24.33 cfs @ 12.31 hrs, Volume= 2.617 af, Depth= 3.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 100-yr COL Rainfall=5.63"

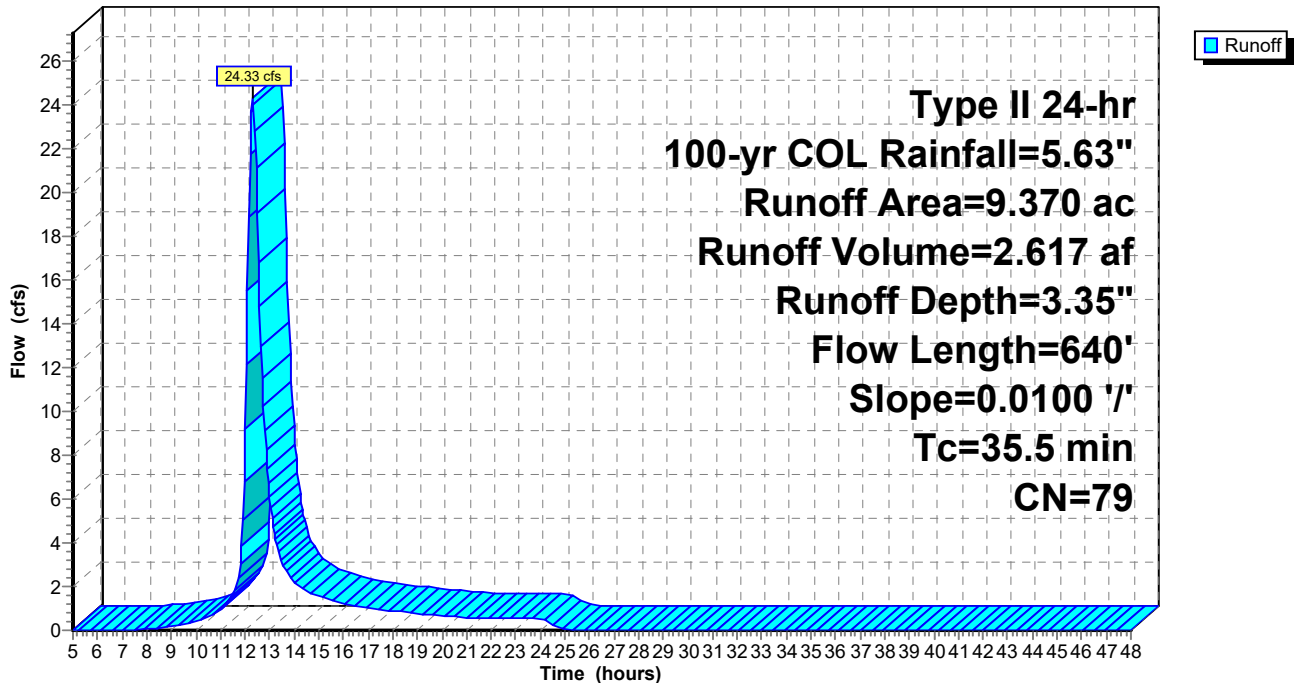
Area (ac)	CN	Description
9.370	79	Pasture/grassland/range, Fair, HSG C
9.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	200	0.0100	0.13		<b>Sheet Flow, SHEET</b> Grass: Short n= 0.150 P2= 2.60"
10.5	440	0.0100	0.70		<b>Shallow Concentrated Flow, SHALLOW CONCENTRATED</b> Short Grass Pasture Kv= 7.0 fps
35.5	640	Total			

**Subcatchment EX: EX Pre-Dev**

Hydrograph



**Summary for Subcatchment PR: PROP Post-Dev**

Runoff = 62.56 cfs @ 12.01 hrs, Volume= 3.732 af, Depth> 4.78"

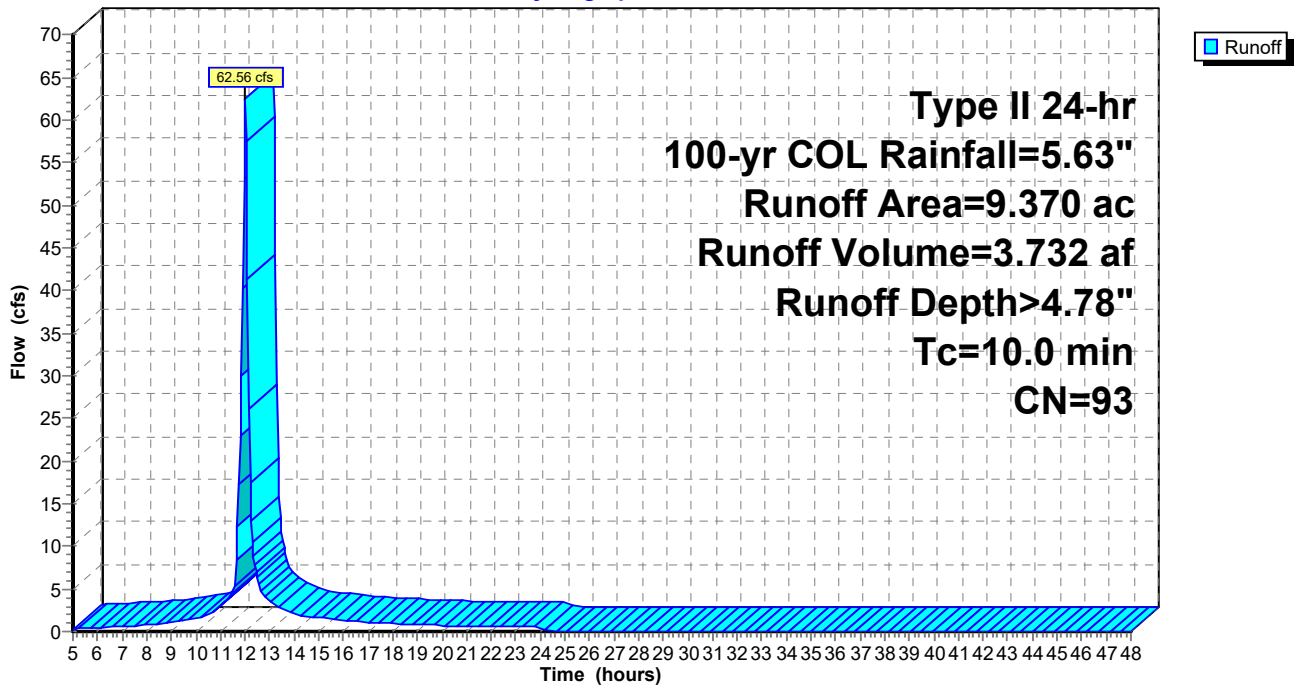
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 100-yr COL Rainfall=5.63"

Area (ac)	CN	Description
5.620	98	Paved parking, HSG C
3.750	86	<50% Grass cover, Poor, HSG C
9.370	93	Weighted Average
3.750		40.02% Pervious Area
5.620		59.98% Impervious Area

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

**Subcatchment PR: PROP Post-Dev**

Hydrograph



**Summary for Pond SWM1: SWM Ret Pond**

Inflow Area = 9.370 ac, 59.98% Impervious, Inflow Depth > 4.78" for 100-yr COL event  
 Inflow = 62.56 cfs @ 12.01 hrs, Volume= 3.732 af  
 Outflow = 3.18 cfs @ 13.17 hrs, Volume= 2.396 af, Atten= 95%, Lag= 69.6 min  
 Primary = 3.18 cfs @ 13.17 hrs, Volume= 2.396 af  
 Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-48.00 hrs, dt= 0.05 hrs  
 Peak Elev= 907.72' @ 13.17 hrs Surf.Area= 33,121 sf Storage= 108,726 cf

Plug-Flow detention time= 778.6 min calculated for 2.393 af (64% of inflow)  
 Center-of-Mass det. time= 679.7 min ( 1,458.9 - 779.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	903.80'	111,430 cf	<b>Wet Retention Pond (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
903.80	22,654	0	0
904.80	25,095	23,875	23,875
905.80	28,012	26,554	50,428
906.80	30,311	29,162	79,590
907.80	33,370	31,841	111,430

Device	Routing	Invert	Outlet Devices
#1	Primary	903.80'	<b>18.0" Round Culvert</b> L= 147.4' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 903.80' / 903.44' S= 0.0024 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	903.80'	<b>8.0" Vert. Orifice/Grate</b> C= 0.600
#3	Device 2	903.80'	<b>3.4" Vert. WQ</b> C= 0.600
#4	Device 2	907.50'	<b>24.0" x 24.0" Horiz. Top Casting</b> C= 0.600 Limited to weir flow at low heads
#5	Secondary	908.30'	<b>4.0' long Sharp-Crested Rectangular Weir</b> 2 End Contraction(s)

**Primary OutFlow** Max=3.18 cfs @ 13.17 hrs HW=907.72' (Free Discharge)

- ↑ **1=Culvert** (Passes 3.18 cfs of 11.54 cfs potential flow)
- ↑ **2=Orifice/Grate** (Orifice Controls 3.18 cfs @ 9.12 fps)
- ↑ **3=WQ** (Passes < 0.59 cfs potential flow)
- ↑ **4=Top Casting** (Passes < 2.67 cfs potential flow)

**Secondary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=903.80' (Free Discharge)

- ↑ **5=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Pond SWM1: SWM Ret Pond**

Hydrograph

