

DRAINAGE REPORT



**FOR THE CASALINI WAREHOUSE BUILDING
AT E. HENDRI DE TONTI BLVD.
TONTITOWN, ARKANSAS**

CDE Project No. 1124

April, 2019

LARGE SCALE DEVELOPMENT SUBMITTAL

REVISION 0

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FOR THE CASALINI WAREHOUSE BUILDING
AT HENRI DE TONTI BLVD.
TONTITOWN, ARKANSAS**

CDE Project No. 1124

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**DRAINAGE STUDY
FOR THE CASALINI WAREHOUSE BUILDING
AT E. HENRI DE TONTI BLVD.
TONTITOWN, AR**

INTRODUCTION

The Casalini Warehouse Building is on approximately 0.75 acres behind the existing Casalini Commercial Building. located along the north side of E. Henri De Tonti Blvd (US Highway 412) near the Maestri Road (US 112) intersection. Appendix 1 contains a Vicinity Map.

SITE DESCRIPTION

The site previously consisted of vegetative cover and is generally sloped to drain towards the north. Approximately 1.5-feet of topsoil was previously removed on the property. This will be backfilled with acceptable import material, as part of the proposed grading required for this project.

No portion of the site is located within any regulatory flood plain, as indicated on the Flood Insurance Rate Map for Washington County Number 05143C0065F, effective May 16, 2008. Appendix 3 contains the Flood Insurance Map, and indicates the location of the site.

PRE AND POST-DEVELOPED RUNOFF CONTROL

A regional detention pond was previously constructed to provide drainage control for both properties. This Drainage Study will compare the undeveloped total area to it being developed, since the previous Drainage Studies does not appear to account for the north portion of the site in developed condition.

The following results are based on the current two developments:

DRAINAGE SUMMARY STUDY POINT 1							
Storm Event	Pre-Developed			Post-Developed			Difference at Study Point 1 (cfs)
	Area (AC)	Rational Runoff Coeff	Peak Flow (cfs)	Site Area (AC)	Rational Runoff Coeff	Study Point 1 Peak Flow (cfs)	
2-Year	4.94	0.4	9.6	4.94	0.86	6.36	-3.27
5-Year	4.94	0.4	12.9	4.94	0.86	9.59	-3.30
25-year	4.94	0.4	14.9	4.94	0.86	11.39	-3.52
50-Year	4.94	0.4	16.5	4.94	0.86	12.89	-3.60
100-Year	4.94	0.4	18.1	4.94	0.86	14.40	-3.67

The pond performance is summarized in the following table:

DETENTION POND 1 SUMMARY				
Storm Event	Pond Inflow (cfs)	Pond Outflow (cfs)	Pond Elevation (ft)	Pond Volume (ac-ft)
2-Year	10.78	6.36	1286.54	0.33
10-Year	13.35	9.59	1287.03	0.45
25-Year	15.69	11.39	1287.27	0.51
50-Year	15.56	12.89	1287.47	0.56
100-Year	20.47	14.40	1287.66	0.61

CONCLUSION

As indicated in this report, the post-developed runoff from the site will increase due to the addition of impervious area. However, appropriate drainage structures and improvements will be constructed to control the flow to prevent any downstream or upstream adverse impact from the developed site.

Storm event data as used in this report has been based on the following 24-hour rainfall amounts (inches):

	2-Year	10-Year	25-Year	50-Year	100-Year
24-Hr Precip	4.08	6.00	6.96	7.92	8.64

CERTIFICATION

I, Ferdinand Fourie, Registered Professional Engineer No. 12538 in the State of Arkansas, hereby certify that the drainage studies, reports, calculations, designs, and specifications contained in this report have been prepared in accordance with the requirements of the City of Tontitown. Further, I hereby acknowledge that the review of the drainage studies, reports, calculations, designs, and specifications by the City of Tontitown or its representatives cannot and does not relieve me from any professional responsibility or liability.



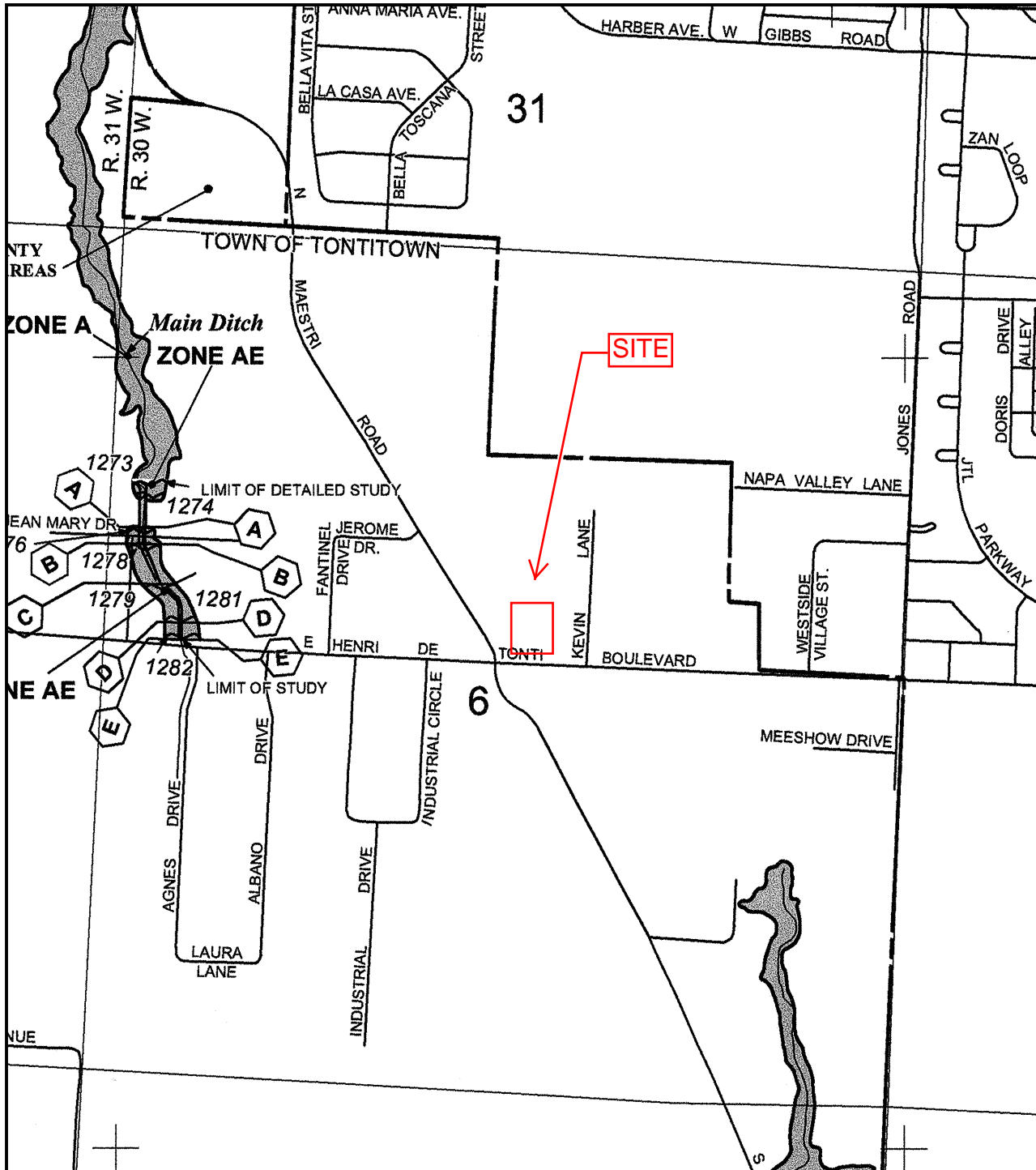
04-02-2019

Signed & Sealed

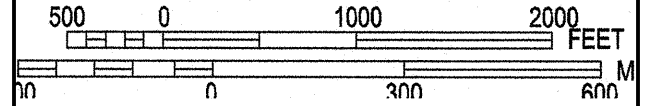
APPENDIX 1 VICINITY MAP

APPENDIX 2

FLOOD INSURANCE RATE MAP



MAP SCALE 1" = 1000'



PANEL 0065F

FIRM
FLOOD INSURANCE RATE MAP
WASHINGTON COUNTY,
ARKANSAS
AND INCORPORATED AREAS

PANEL 65 OF 575
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
WASHINGTON COUNTY	050212	0065	F
JOHNSON, CITY OF	050218	0065	F
SPRINGDALE, CITY OF	050219	0065	F
TONTITOWN, TOWN OF	050293	0065	F

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



MAP NUMBER
 05143C0065F
 MAP REVISED
 MAY 16, 2008

Federal Emergency Management Agency

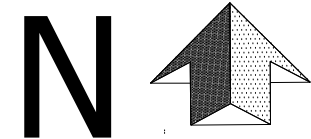
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

NATIONAL FLOOD INSURANCE PROGRAM

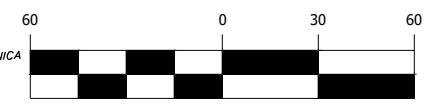
APPENDIX 3

DRAINAGE MAPS

**PRE-DEVELOPMENT
POST-DEVELOPMENT**



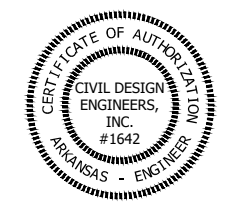
GRAPHIC SCALE



(IN FEET)
1 INCH = 60 FEET

SEAL:

DATE: _____



CASALINI WAREHOUSE BUILDING

TONTITOWN, AR

PRE-DEVELOPED DRAINAGE MAP

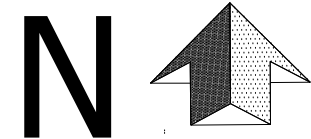
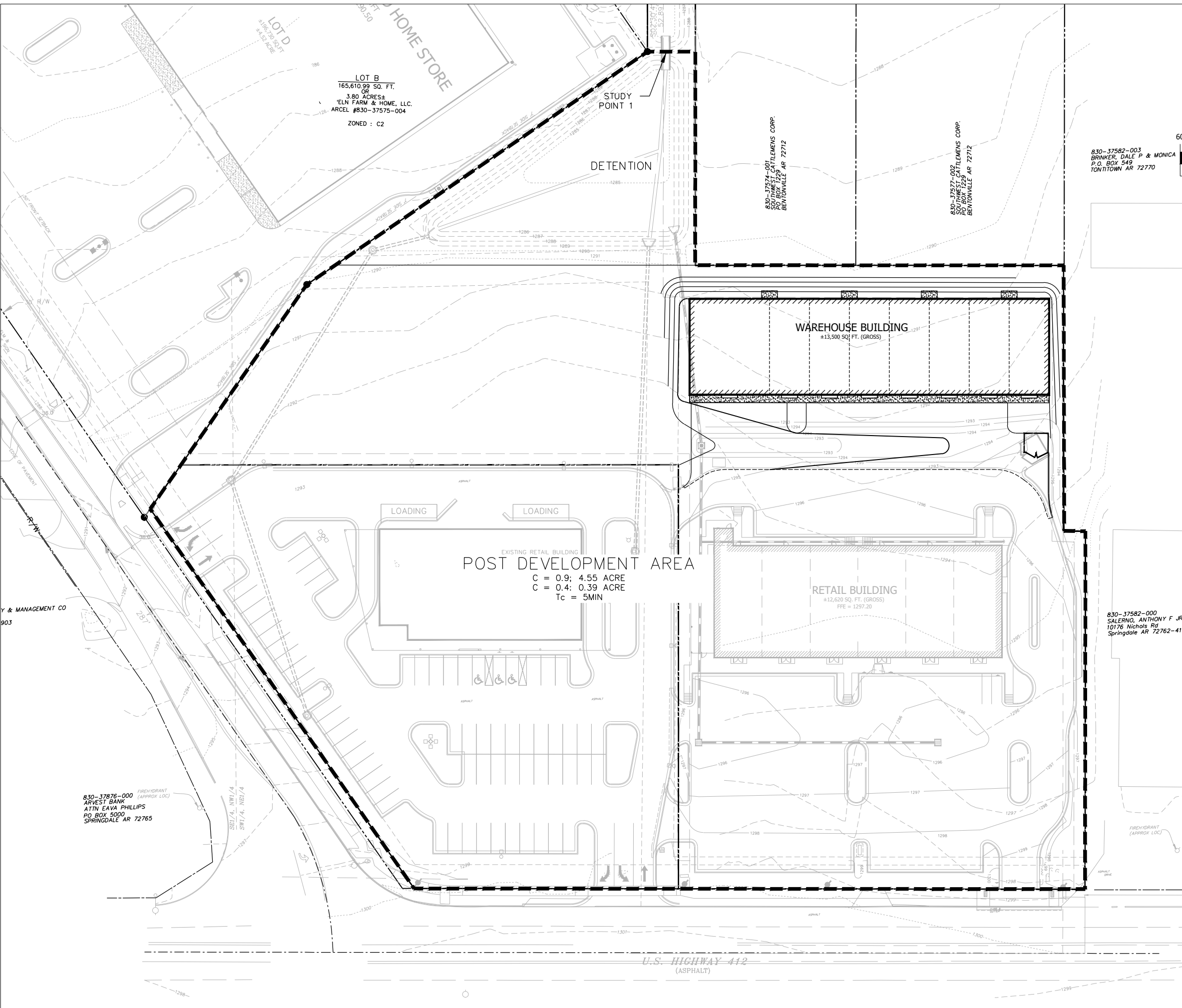


CIVIL DESIGN ENGINEERS, INC.

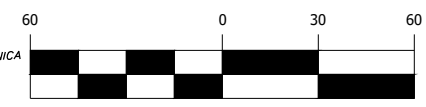
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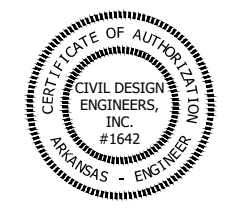
GRAPHIC SCALE



(IN FEET)
1 INCH = 60 FEET

SEAL:

DATE: _____



CASALINI WAREHOUSE BUILDING

TONTITOWN, AR

POST-DEVELOPED DRAINAGE MAP

SHEET:



CIVIL DESIGN ENGINEERS, INC.

SHEET NUMBER:

1

APPENDIX 4

PRE-DEVELOPMENT DRAINAGE CALCULATIONS

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

<u>Hyd.</u>	<u>Origin</u>	<u>Description</u>
1	Rational	PRE DEV

Hydrograph Return Period Recap

Hydroflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Rational	-----	-----	9.629	-----	-----	12.89	14.91	16.49	18.07	PRE DEV

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	Rational	9.629	1	8	0.106	-----	-----	-----	PRE DEV
PreDevR0.gpw					Return Period: 2 Year			Monday, 04 / 1 / 2019	

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 04 / 1 / 2019

Hyd. No. 1

PRE DEV

Hydrograph type	= Rational	Peak discharge	= 9.629 cfs
Storm frequency	= 2 yrs	Time to peak	= 8 min
Time interval	= 1 min	Hyd. volume	= 0.106 acft
Drainage area	= 4.940 ac	Runoff coeff.	= 0.4
Intensity	= 4.873 in/hr	Tc by TR55	= 8.00 min
IDF Curve	= NWA.IDF	Asc/Rec limb fact	= 1/1



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No. 1

PRE DEV

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.050	0.011	0.011	
Flow length (ft)	= 150.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 4.08	0.00	0.00	
Land slope (%)	= 2.00	0.00	0.00	
Travel Time (min)	= 4.98	+ 0.00	+ 0.00	= 4.98
Shallow Concentrated Flow				
Flow length (ft)	= 370.00	0.00	0.00	
Watercourse slope (%)	= 2.00	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=2.28	0.00	0.00	
Travel Time (min)	= 2.70	+ 0.00	+ 0.00	= 2.70
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=0.00	0.00	0.00	
Flow length (ft)	({0})0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				8.00 min

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	Rational	12.89	1	8	0.142	-----	-----	-----	PRE DEV
PreDevR0.gpw					Return Period: 10 Year			Monday, 04 / 1 / 2019	

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 04 / 1 / 2019

Hyd. No. 1

PRE DEV

Hydrograph type	= Rational	Peak discharge	= 12.89 cfs
Storm frequency	= 10 yrs	Time to peak	= 8 min
Time interval	= 1 min	Hyd. volume	= 0.142 acft
Drainage area	= 4.940 ac	Runoff coeff.	= 0.4
Intensity	= 6.521 in/hr	Tc by TR55	= 8.00 min
IDF Curve	= NWA.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	Rational	14.91	1	8	0.164	-----	-----	-----	PRE DEV
PreDevR0.gpw					Return Period: 25 Year			Monday, 04 / 1 / 2019	

Hydrograph Report

Hyd. No. 1

PRE DEV

Hydrograph type	= Rational	Peak discharge	= 14.91 cfs
Storm frequency	= 25 yrs	Time to peak	= 8 min
Time interval	= 1 min	Hyd. volume	= 0.164 acft
Drainage area	= 4.940 ac	Runoff coeff.	= 0.4
Intensity	= 7.545 in/hr	Tc by TR55	= 8.00 min
IDF Curve	= NWA.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	Rational	16.49	1	8	0.182	-----	-----	-----	PRE DEV
PreDevR0.gpw					Return Period: 50 Year			Monday, 04 / 1 / 2019	

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 04 / 1 / 2019

Hyd. No. 1

PRE DEV

Hydrograph type	= Rational	Peak discharge	= 16.49 cfs
Storm frequency	= 50 yrs	Time to peak	= 8 min
Time interval	= 1 min	Hyd. volume	= 0.182 acft
Drainage area	= 4.940 ac	Runoff coeff.	= 0.4
Intensity	= 8.347 in/hr	Tc by TR55	= 8.00 min
IDF Curve	= NWA.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	Rational	18.07	1	8	0.199	-----	-----	-----	PRE DEV
PreDevR0.gpw					Return Period: 100 Year		Monday, 04 / 1 / 2019		

Hydrograph Report

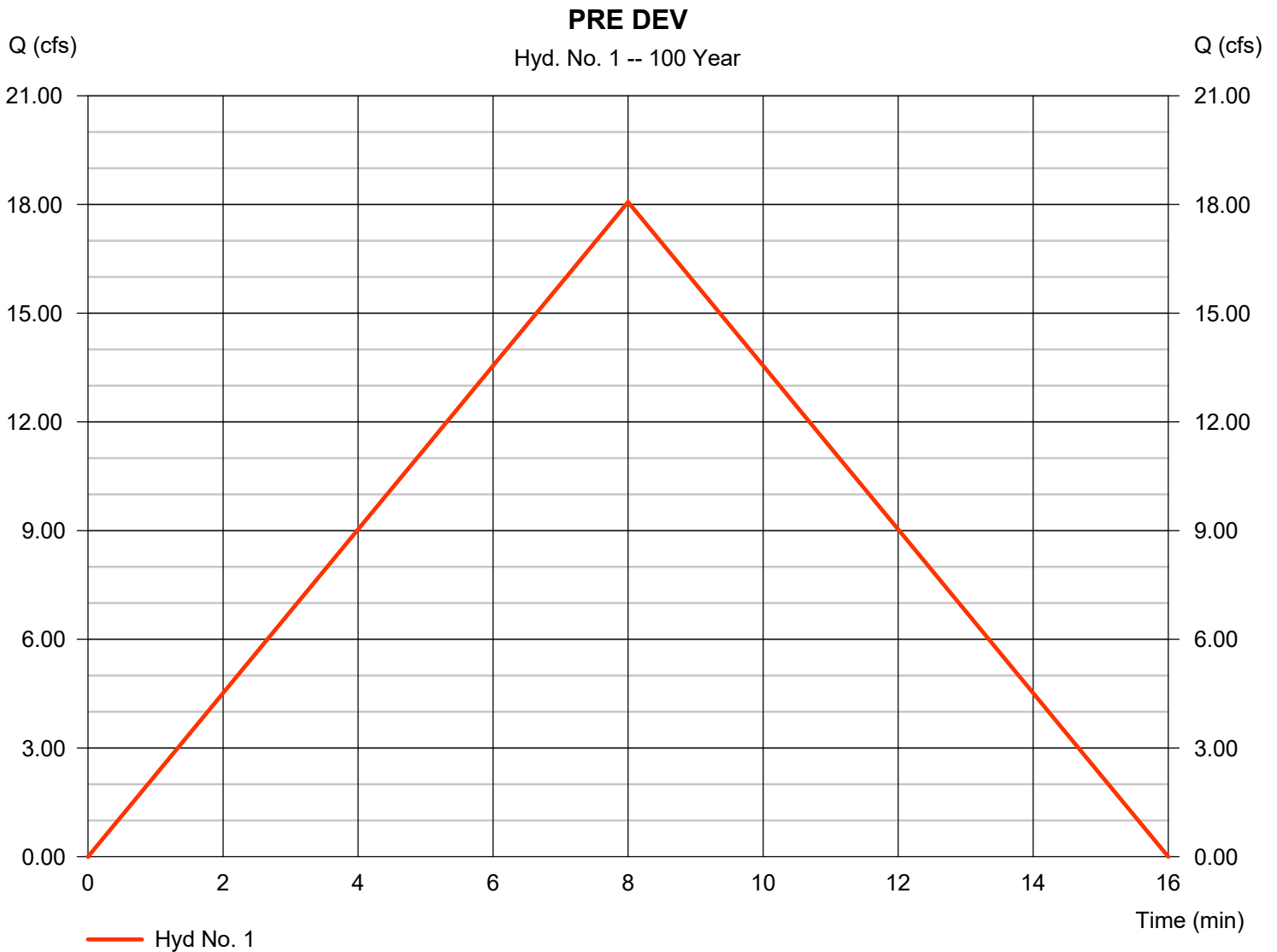
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 04 / 1 / 2019

Hyd. No. 1

PRE DEV

Hydrograph type	= Rational	Peak discharge	= 18.07 cfs
Storm frequency	= 100 yrs	Time to peak	= 8 min
Time interval	= 1 min	Hyd. volume	= 0.199 acft
Drainage area	= 4.940 ac	Runoff coeff.	= 0.4
Intensity	= 9.143 in/hr	Tc by TR55	= 8.00 min
IDF Curve	= NWA.IDF	Asc/Rec limb fact	= 1/1



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APPENDIX 5

POST-DEVELOPMENT DRAINAGE CALCULATIONS

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12



Legend

<u>Hyd.</u>	<u>Origin</u>	<u>Description</u>
1	Mod. Rational	POST DEV
2	Reservoir	POND

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Mod. Rational	-----	-----	10.78	-----	-----	13.35	15.69	18.56	20.47	POST DEV
2	Reservoir	1	-----	6.363	-----	-----	9.587	11.39	12.89	14.40	POND

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	Mod. Rational	10.78	1	5	21,354	-----	-----	-----	POST DEV	
2	Reservoir	6.363	1	35	21,345	1	1286.54	14,381	POND	
PostDevR0.gpw					Return Period: 2 Year			Wednesday, 04 / 17 / 2019		

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

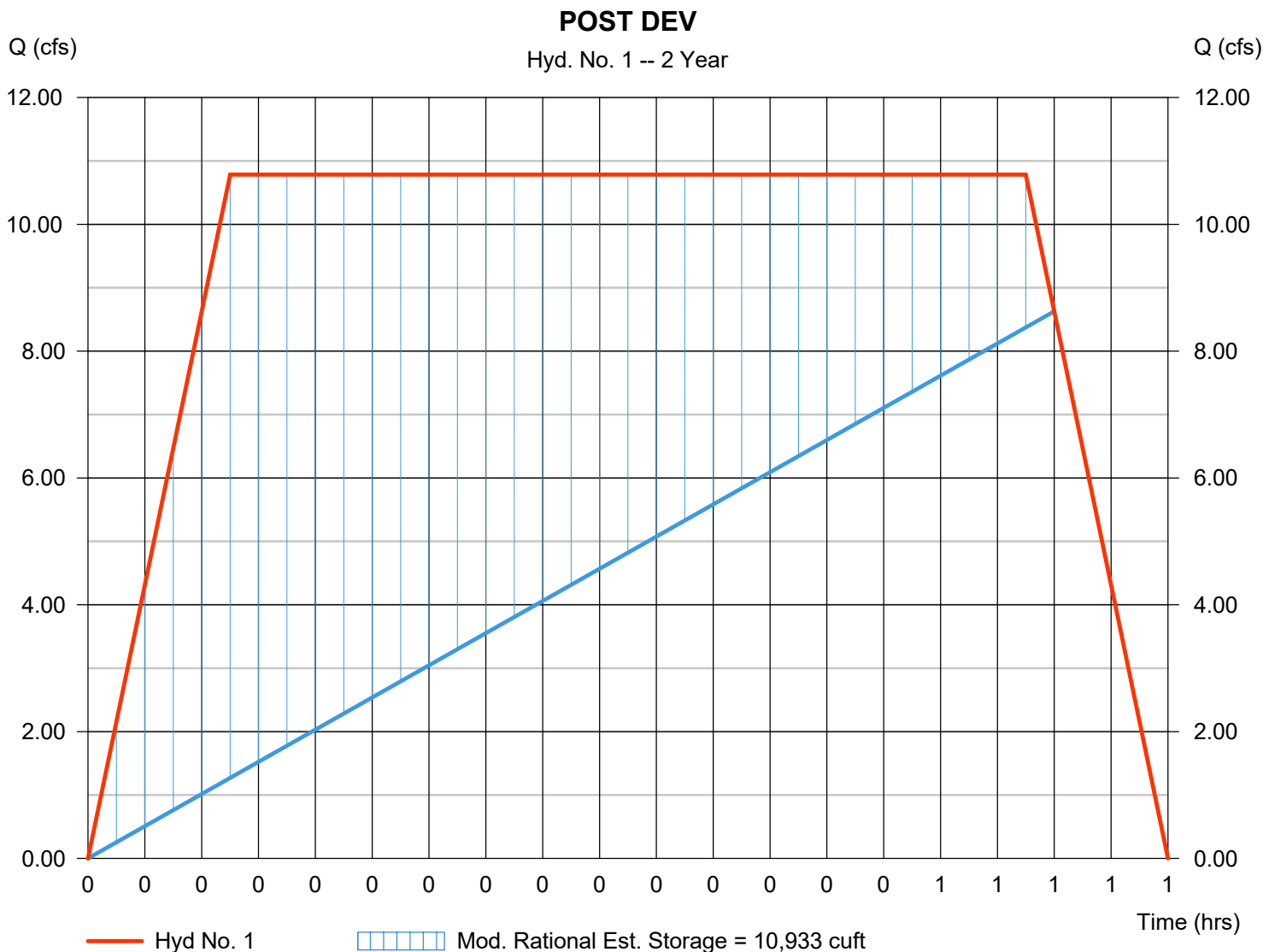
Wednesday, 04 / 17 / 2019

Hyd. No. 1

POST DEV

Hydrograph type	= Mod. Rational	Peak discharge	= 10.78 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 21,354 cuft
Drainage area	= 4.940 ac	Runoff coeff.	= 0.86*
Intensity	= 2.539 in/hr	Tc by User	= 5.00 min
IDF Curve	= NWA.IDF	Storm duration	= 6.6 x Tc
Target Q	=9.000 cfs	Est. Req'd Storage	=10,933 cuft

* Composite (Area/C) = [(4.550 x 0.90) + (0.390 x 0.40)] / 4.940



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

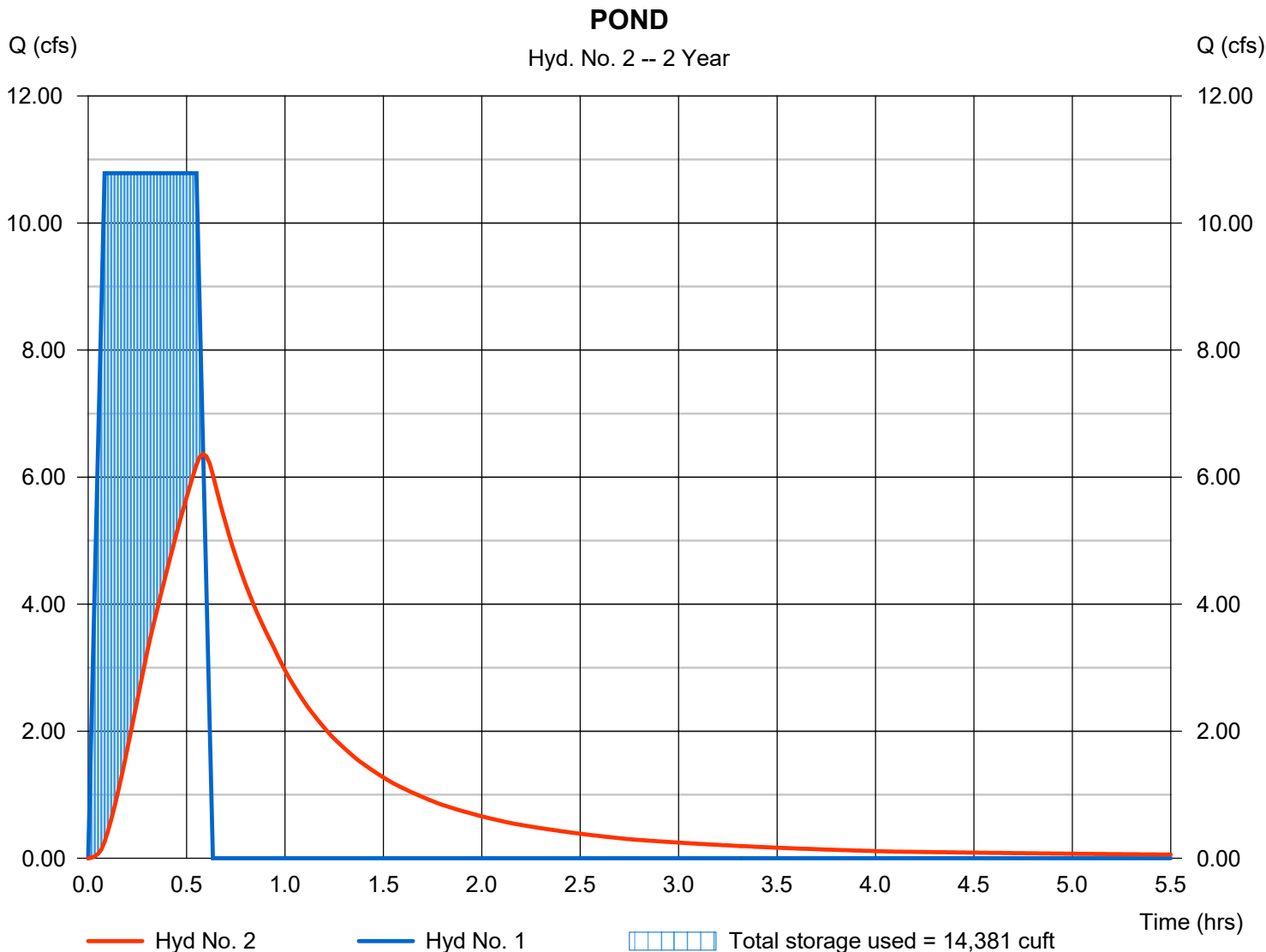
Wednesday, 04 / 17 / 2019

Hyd. No. 2

POND

Hydrograph type	= Reservoir	Peak discharge	= 6.363 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.58 hrs
Time interval	= 1 min	Hyd. volume	= 21,345 cuft
Inflow hyd. No.	= 1 - POST DEV	Max. Elevation	= 1286.54 ft
Reservoir name	= CASALINIPOND	Max. Storage	= 14,381 cuft

Storage Indication method used.



Pond No. 1 - CASALINIPOND

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1285.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1285.00	8,177	0	0
1.00	1286.00	9,548	8,853	8,853
2.00	1287.00	10,966	10,248	19,101
3.00	1288.00	12,494	11,721	30,821
4.00	1289.00	14,102	13,289	44,110

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 1.00	0.00	0.00	0.00
Crest El. (ft)	= 1285.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.000 (by Contour)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1285.00	---	---	---	---	0.00	---	---	---	---	---	0.000
0.10	885	1285.10	---	---	---	---	0.11	---	---	---	---	---	0.105
0.20	1,771	1285.20	---	---	---	---	0.30	---	---	---	---	---	0.298
0.30	2,656	1285.30	---	---	---	---	0.55	---	---	---	---	---	0.547
0.40	3,541	1285.40	---	---	---	---	0.84	---	---	---	---	---	0.843
0.50	4,426	1285.50	---	---	---	---	1.18	---	---	---	---	---	1.177
0.60	5,312	1285.60	---	---	---	---	1.55	---	---	---	---	---	1.548
0.70	6,197	1285.70	---	---	---	---	1.95	---	---	---	---	---	1.950
0.80	7,082	1285.80	---	---	---	---	2.38	---	---	---	---	---	2.383
0.90	7,967	1285.90	---	---	---	---	2.84	---	---	---	---	---	2.843
1.00	8,853	1286.00	---	---	---	---	3.33	---	---	---	---	---	3.330
1.10	9,878	1286.10	---	---	---	---	3.84	---	---	---	---	---	3.842
1.20	10,902	1286.20	---	---	---	---	4.38	---	---	---	---	---	4.377
1.30	11,927	1286.30	---	---	---	---	4.94	---	---	---	---	---	4.936
1.40	12,952	1286.40	---	---	---	---	5.52	---	---	---	---	---	5.516
1.50	13,977	1286.50	---	---	---	---	6.12	---	---	---	---	---	6.118
1.60	15,001	1286.60	---	---	---	---	6.74	---	---	---	---	---	6.739
1.70	16,026	1286.70	---	---	---	---	7.38	---	---	---	---	---	7.381
1.80	17,051	1286.80	---	---	---	---	8.04	---	---	---	---	---	8.042
1.90	18,076	1286.90	---	---	---	---	8.72	---	---	---	---	---	8.721
2.00	19,101	1287.00	---	---	---	---	9.42	---	---	---	---	---	9.419
2.10	20,273	1287.10	---	---	---	---	10.13	---	---	---	---	---	10.13
2.20	21,445	1287.20	---	---	---	---	10.87	---	---	---	---	---	10.87
2.30	22,617	1287.30	---	---	---	---	11.62	---	---	---	---	---	11.62
2.40	23,789	1287.40	---	---	---	---	12.38	---	---	---	---	---	12.38
2.50	24,961	1287.50	---	---	---	---	13.16	---	---	---	---	---	13.16
2.60	26,133	1287.60	---	---	---	---	13.96	---	---	---	---	---	13.96
2.70	27,305	1287.70	---	---	---	---	14.77	---	---	---	---	---	14.77
2.80	28,477	1287.80	---	---	---	---	15.60	---	---	---	---	---	15.60
2.90	29,649	1287.90	---	---	---	---	16.45	---	---	---	---	---	16.45
3.00	30,821	1288.00	---	---	---	---	17.30	---	---	---	---	---	17.30
3.10	32,150	1288.10	---	---	---	---	18.18	---	---	---	---	---	18.18
3.20	33,479	1288.20	---	---	---	---	19.06	---	---	---	---	---	19.06
3.30	34,808	1288.30	---	---	---	---	19.96	---	---	---	---	---	19.96
3.40	36,137	1288.40	---	---	---	---	20.88	---	---	---	---	---	20.88
3.50	37,465	1288.50	---	---	---	---	21.80	---	---	---	---	---	21.80
3.60	38,794	1288.60	---	---	---	---	22.75	---	---	---	---	---	22.75
3.70	40,123	1288.70	---	---	---	---	23.70	---	---	---	---	---	23.70

Continues on next page...

CASALINIPOND

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.80	41,452	1288.80	---	---	---	---	24.67	---	---	---	---	---	24.67
3.90	42,781	1288.90	---	---	---	---	25.65	---	---	---	---	---	25.65
4.00	44,110	1289.00	---	---	---	---	26.64	---	---	---	---	---	26.64

...End

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Mod. Rational	13.35	1	5	32,852	-----	-----	-----	POST DEV
2	Reservoir	9.587	1	42	32,843	1	1287.03	19,377	POND
PostDevR0.gpw					Return Period: 10 Year			Wednesday, 04 / 17 / 2019	

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

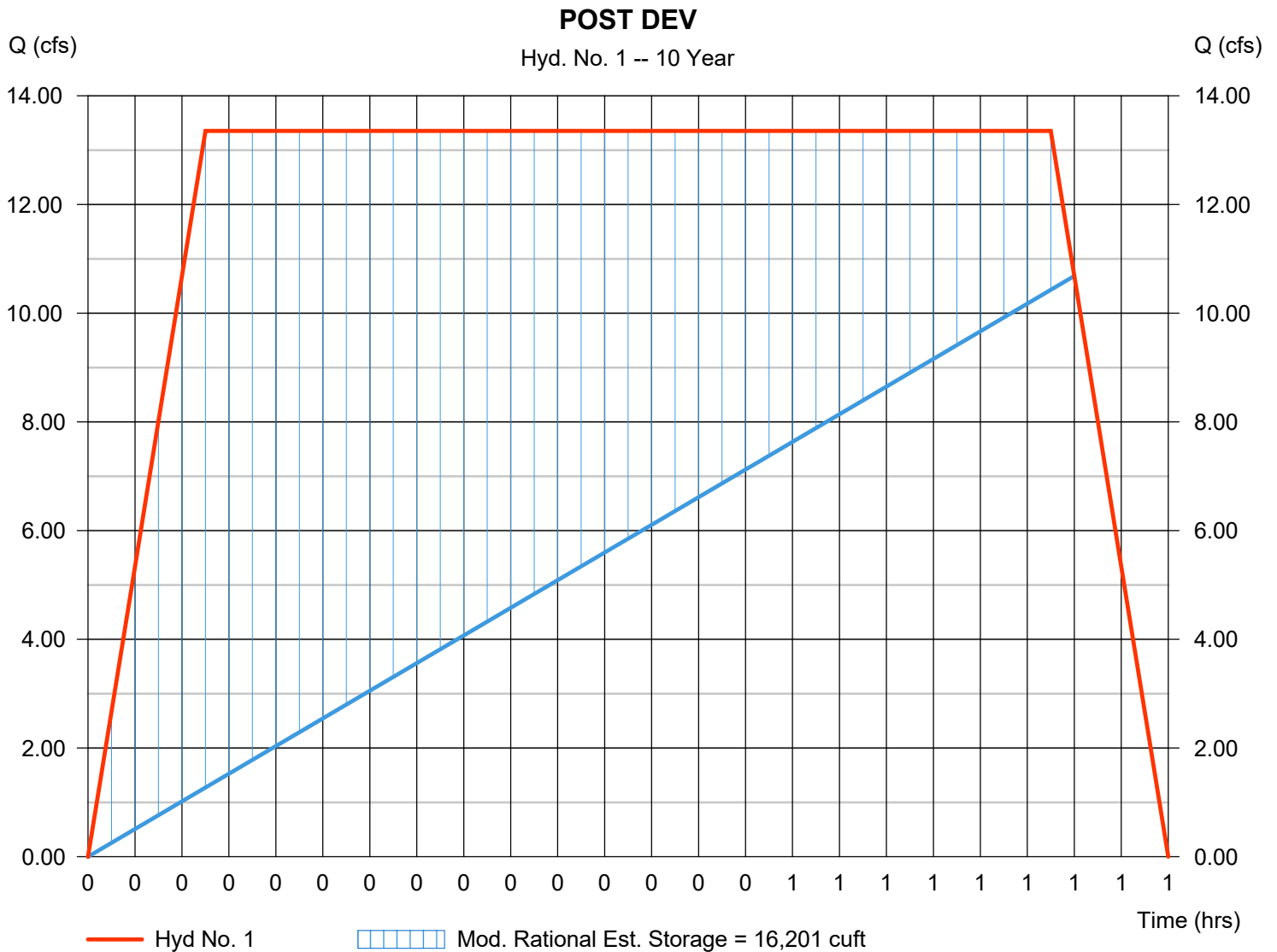
Wednesday, 04 / 17 / 2019

Hyd. No. 1

POST DEV

Hydrograph type	= Mod. Rational	Peak discharge	= 13.35 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 32,852 cuft
Drainage area	= 4.940 ac	Runoff coeff.	= 0.86*
Intensity	= 3.143 in/hr	Tc by User	= 5.00 min
IDF Curve	= NWA.IDF	Storm duration	= 8.2 x Tc
Target Q	=12.00 cfs	Est. Req'd Storage	=16,201 cuft

* Composite (Area/C) = [(4.550 x 0.90) + (0.390 x 0.40)] / 4.940



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

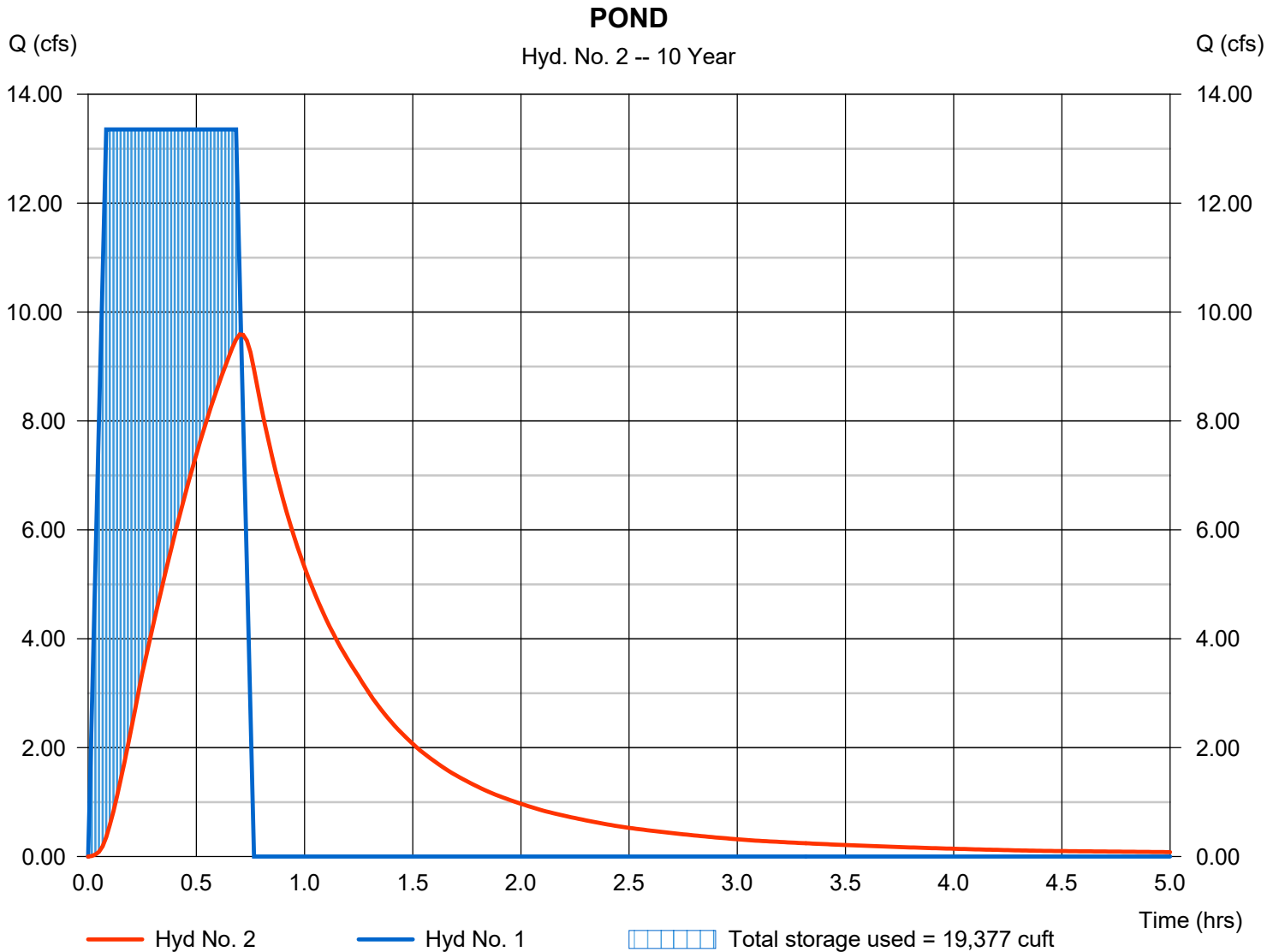
Wednesday, 04 / 17 / 2019

Hyd. No. 2

POND

Hydrograph type	= Reservoir	Peak discharge	= 9.587 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.70 hrs
Time interval	= 1 min	Hyd. volume	= 32,843 cuft
Inflow hyd. No.	= 1 - POST DEV	Max. Elevation	= 1287.03 ft
Reservoir name	= CASALINIPOND	Max. Storage	= 19,377 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Mod. Rational	15.69	1	5	38,590	-----	-----	-----	POST DEV
2	Reservoir	11.39	1	42	38,582	1	1287.27	22,271	POND
PostDevR0.gpw					Return Period: 25 Year		Wednesday, 04 / 17 / 2019		

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

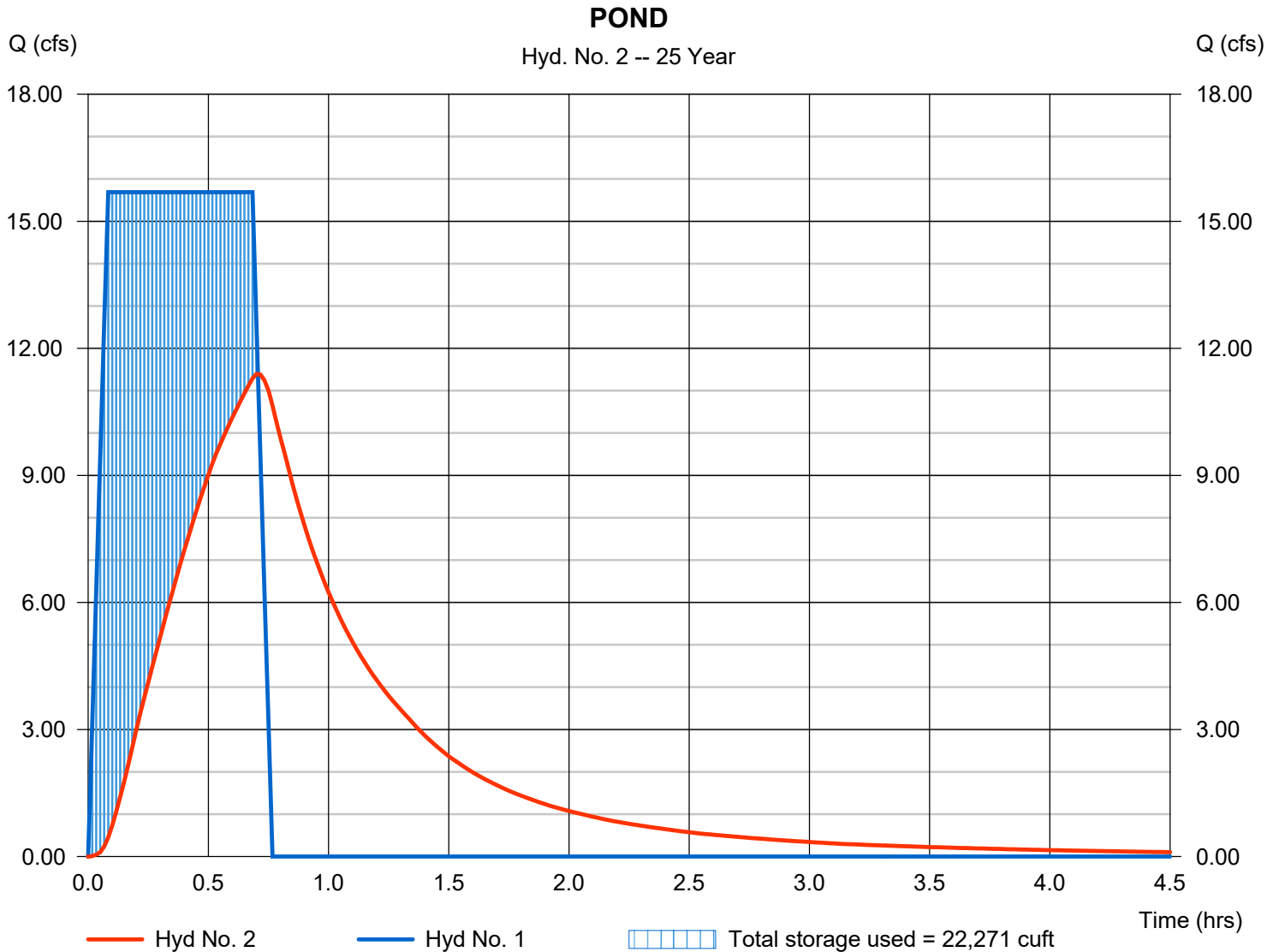
Wednesday, 04 / 17 / 2019

Hyd. No. 2

POND

Hydrograph type	= Reservoir	Peak discharge	= 11.39 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.70 hrs
Time interval	= 1 min	Hyd. volume	= 38,582 cuft
Inflow hyd. No.	= 1 - POST DEV	Max. Elevation	= 1287.27 ft
Reservoir name	= CASALINIPOND	Max. Storage	= 22,271 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Mod. Rational	18.56	1	5	41,198	-----	-----	-----	POST DEV
2	Reservoir	12.89	1	39	41,189	1	1287.47	24,555	POND
PostDevR0.gpw					Return Period: 50 Year			Wednesday, 04 / 17 / 2019	

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

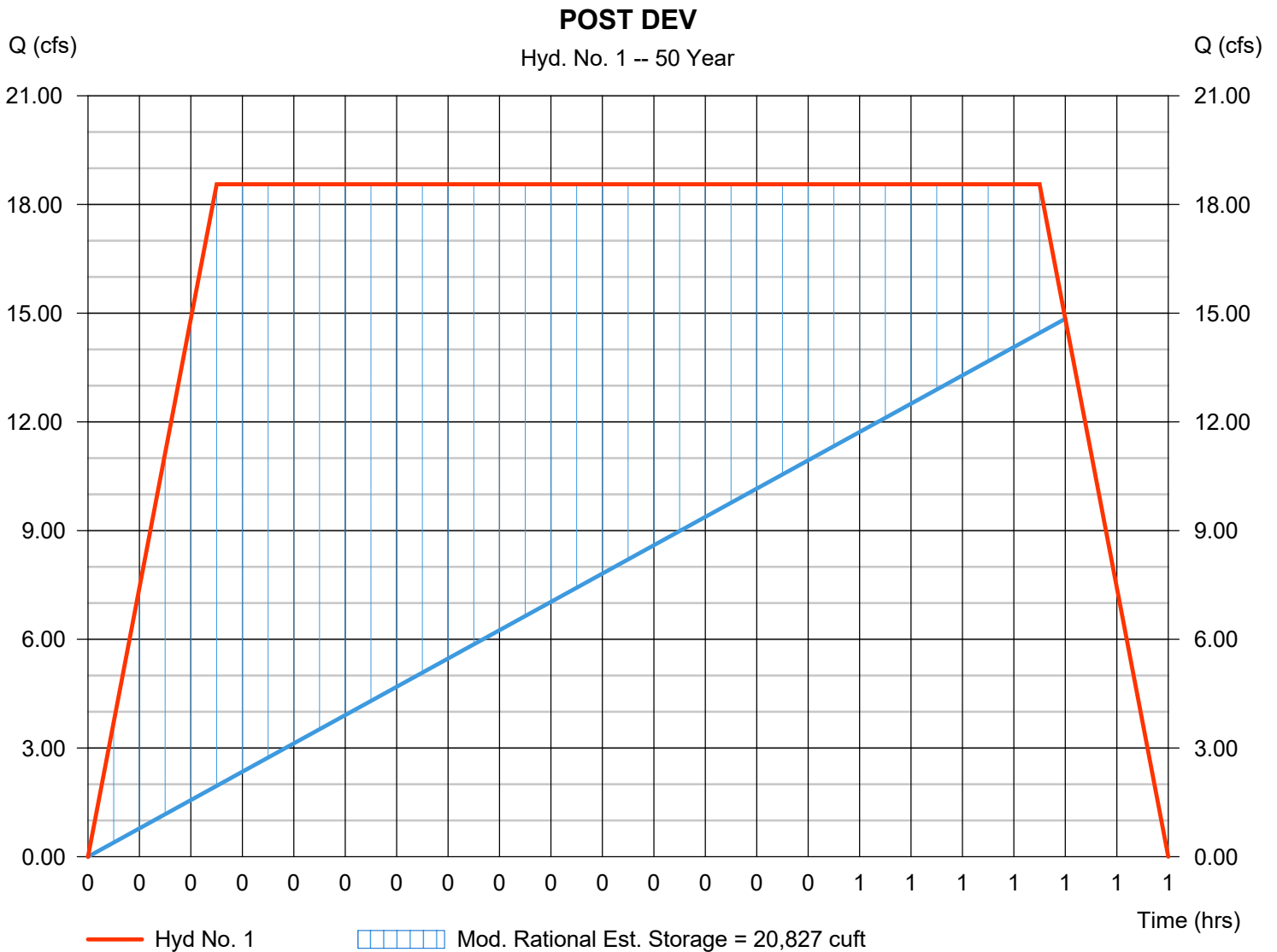
Wednesday, 04 / 17 / 2019

Hyd. No. 1

POST DEV

Hydrograph type	= Mod. Rational	Peak discharge	= 18.56 cfs
Storm frequency	= 50 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 41,198 cuft
Drainage area	= 4.940 ac	Runoff coeff.	= 0.86*
Intensity	= 4.368 in/hr	Tc by User	= 5.00 min
IDF Curve	= NWA.IDF	Storm duration	= 7.4 x Tc
Target Q	=16.00 cfs	Est. Req'd Storage	=20,827 cuft

* Composite (Area/C) = [(4.550 x 0.90) + (0.390 x 0.40)] / 4.940



Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

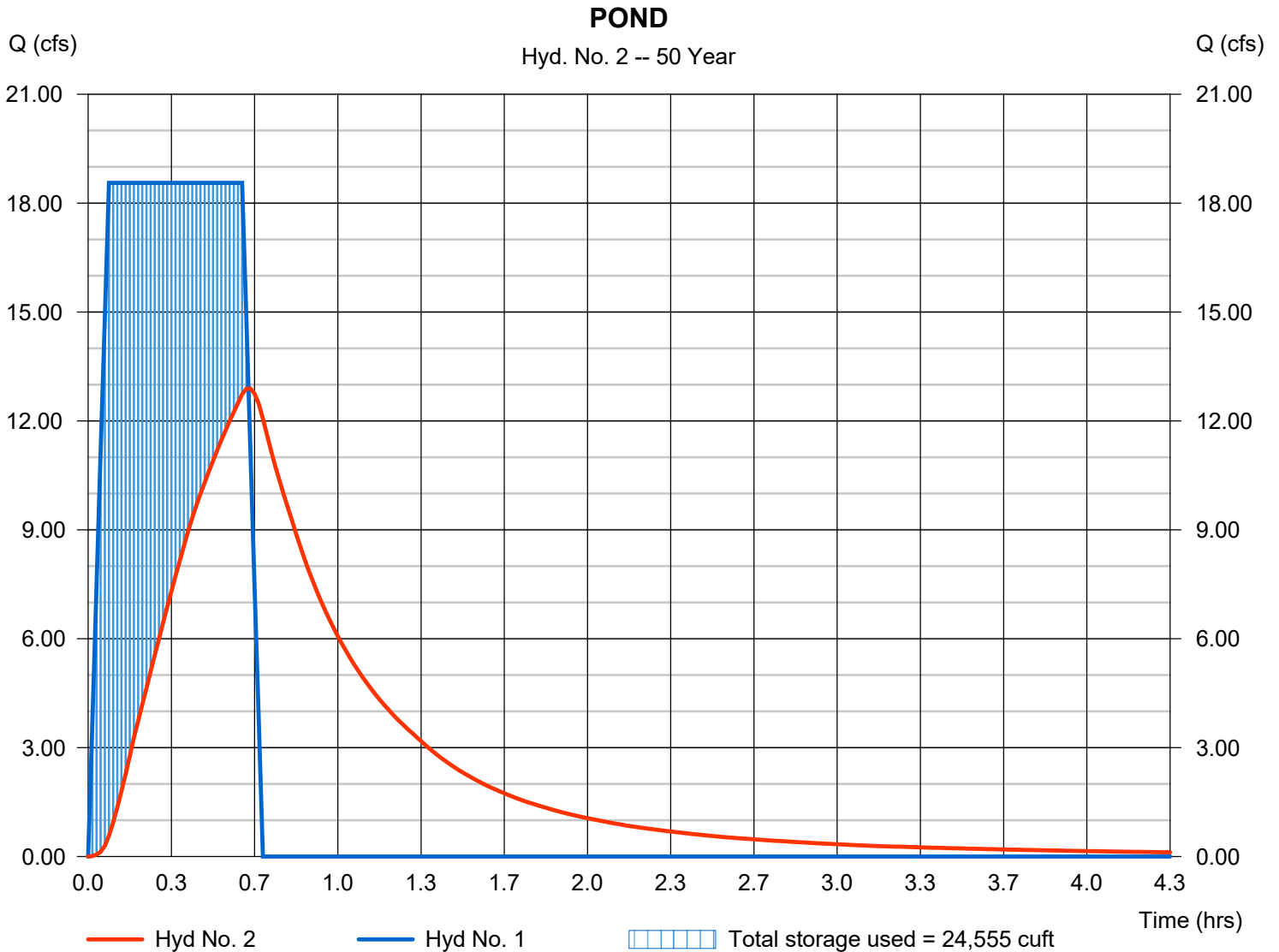
Wednesday, 04 / 17 / 2019

Hyd. No. 2

POND

Hydrograph type	= Reservoir	Peak discharge	= 12.89 cfs
Storm frequency	= 50 yrs	Time to peak	= 0.65 hrs
Time interval	= 1 min	Hyd. volume	= 41,189 cuft
Inflow hyd. No.	= 1 - POST DEV	Max. Elevation	= 1287.47 ft
Reservoir name	= CASALINIPOND	Max. Storage	= 24,555 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	Mod. Rational	20.47	1	5	45,433	-----	-----	-----	POST DEV	
2	Reservoir	14.40	1	38	45,425	1	1287.66	26,761	POND	
PostDevR0.gpw					Return Period: 100 Year			Wednesday, 04 / 17 / 2019		

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

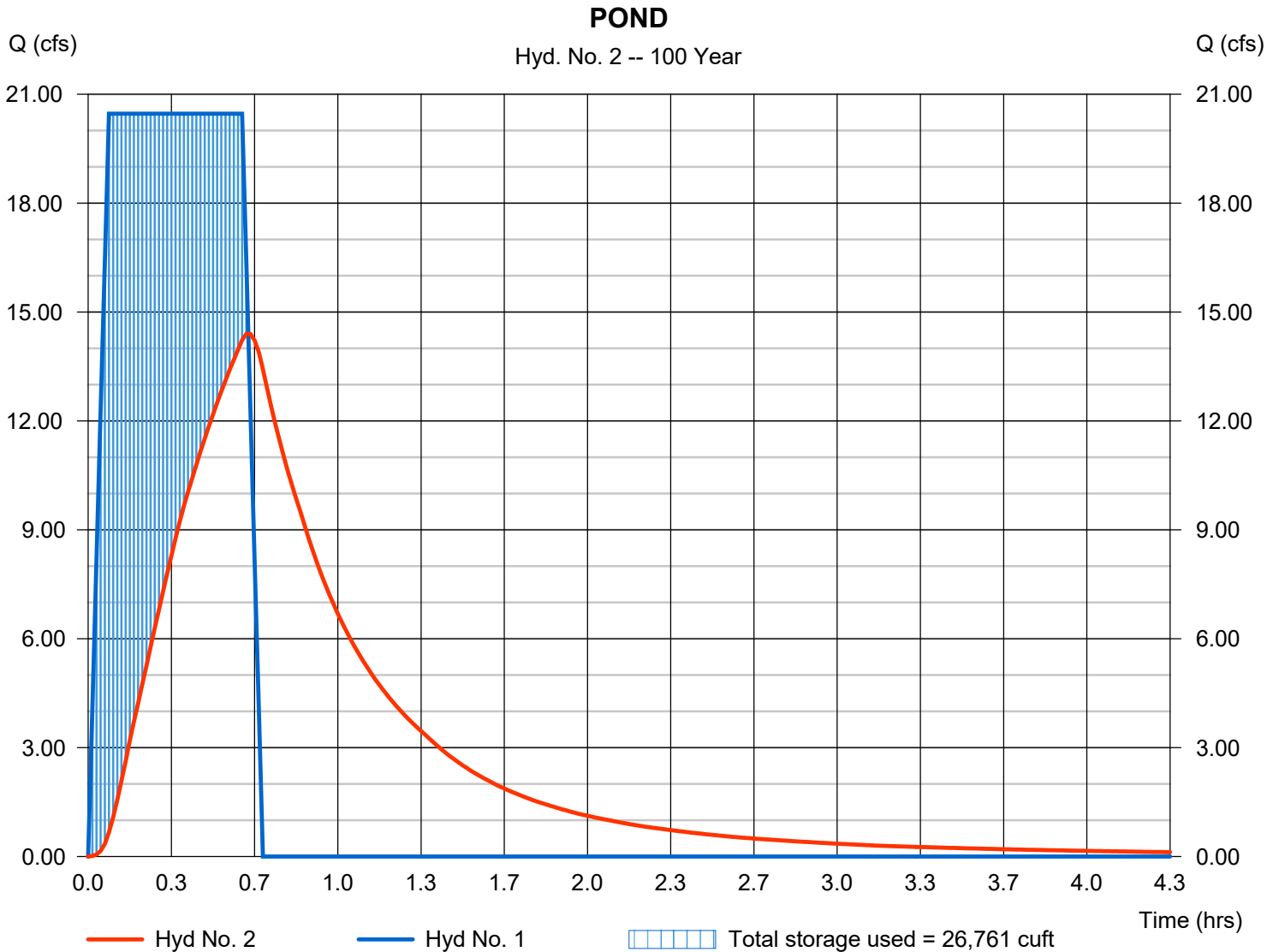
Wednesday, 04 / 17 / 2019

Hyd. No. 2

POND

Hydrograph type	= Reservoir	Peak discharge	= 14.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.63 hrs
Time interval	= 1 min	Hyd. volume	= 45,425 cuft
Inflow hyd. No.	= 1 - POST DEV	Max. Elevation	= 1287.66 ft
Reservoir name	= CASALINIPOND	Max. Storage	= 26,761 cuft

Storage Indication method used.



Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v12

Wednesday, 04 / 17 / 2019

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	-----
2	60.5368	12.9000	0.8289	-----
3	0.0000	0.0000	0.0000	-----
5	68.2780	13.5000	0.8023	-----
10	74.8044	13.8000	0.7917	-----
25	84.9758	14.1000	0.7822	-----
50	93.2428	14.3000	0.7773	-----
100	101.7395	14.5000	0.7739	-----

File name: NWA.IDF

$$\text{Intensity} = B / (T_c + D)^E$$

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.54	4.52	3.84	3.35	2.98	2.68	2.45	2.26	2.09	1.96	1.83	1.73
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.42	4.65	4.08	3.65	3.31	3.03	2.80	2.61	2.44	2.30	2.17
10	7.33	6.08	5.23	4.61	4.13	3.75	3.45	3.19	2.97	2.79	2.63	2.48
25	8.46	7.05	6.08	5.37	4.83	4.40	4.04	3.75	3.50	3.28	3.09	2.93
50	9.34	7.81	6.75	5.97	5.37	4.90	4.51	4.18	3.90	3.66	3.46	3.28
100	10.21	8.56	7.41	6.57	5.91	5.39	4.97	4.61	4.31	4.05	3.82	3.62

Tc = time in minutes. Values may exceed 60.

Precip. file name: Fayetteville.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	4.08	0.00	3.30	6.00	6.96	7.92	8.64
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

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APPENDIX 6

REFERENCE INFORMATION

DETERMINATION OF STORM WATER RUNOFF

DRAINAGE METHODS

Watershed Size Applicability for Peak Runoff Calculations

Watershed Size (acres)	Applicable Drainage Method
0 to 30	Rational Method
30 to 2000	SCS Method
2000 +	Computer models (such as HEC-HMS, TR-20, or equivalent)

Rational Method

- Refer to [Section 2.0](#) for more detailed information/explanation
- Rational Method Formula: $Q = k_i * C * I * A$
- Refer to [Table RO-2](#), [Table RO-3](#), and [Table RO-4](#) for more detailed information

Runoff Coefficient, *C*, for Specific Rogers Zoning

Rogers Zoning	Description	Runoff Coefficient, <i>C</i>
A-1	Agricultural	0.40
R-E	Residential Estate	0.45
R-SF	Residential Single Family	0.55
R-AF	Residential Affordable Housing	0.60
R-DP	Residential Duplex and Patio Home	0.65
R-MF	Residential MultiFamily	0.75
N-R	Neighborhood Residential	0.60
R-MHC	Manufactured Home Community	0.70
R-RVP	Recreational Vehicle	0.70
R-O	Residential Office	0.80
O	Office	0.90
C-1	Central Business District	0.90
C-2	Highway Commercial	0.90
C-3	Neighborhood Commercial	0.80
C-4	Open Display Commercial	0.90
W-O	Warehouse Office	0.90
I-1	Light Industrial	0.90
I-2	Heavy Industrial	0.95
CU	Condominium Unit	0.80
	Church	0.80
	School	0.80
	Park	0.40
	Cemetery	0.40

Slope	Land Use	Soil Classification			
		Sand or Sandy Loam Soils (Pervious)		High Clay Soils (Impervious)	
		Min.	Max.	Min.	Max.
Flat (0 to 1%)	Cultivated	0.25	0.35	0.30	0.40
	Woodlands	0.15	0.20	0.10	0.15
	Pasture	0.20	0.25	0.30	0.40
	Residential	0.50	0.60	0.50	0.60
	Commercial/Industrial	0.60	0.90	0.60	0.90
	Paved	0.90	0.90	0.90	0.90
Rolling (1 to 3.5%)	Cultivated	0.45	0.65	0.50	0.70
	Woodlands	0.15	0.20	0.18	0.25
	Pasture	0.30	0.40	0.35	0.45
	Residential	0.50	0.60	0.50	0.60
	Commercial/Industrial	0.60	0.90	0.60	0.90
	Paved	0.90	0.90	0.90	0.90
Hilly (3.5 to 5.5%)	Cultivated	0.60	0.75	0.70	0.85
	Woodlands	0.20	0.25	0.25	0.30
	Pasture	0.35	0.45	0.45	0.55
	Residential	0.50	0.60	0.50	0.60
	Commercial/Industrial	0.60	0.90	0.60	0.90
	Paved	0.90	0.90	0.90	0.90
Mountainous (over 5.5%)	Woodlands			0.70	0.80
	Bare			0.80	0.90
Grassed ROW slopes		0.70	0.70	0.70	0.70

NOTE: The maximum value for High Clay Soils shall be used unless approved by City Staff.

SOURCE:

City of Springdale Arkansas	RUNOFF COEFFICIENT VALUES	Table 2.1
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