

Drainage Plan Report

FOR

Watergap Wellness Storage & Golf Cart Building

Watergap Acquisitions Partners, LLC
Smithfield Township
Monroe County, PA

Date: September 1, 2023
Project #: 1022419.003



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DRAINAGE PLAN NARRATIVE

FOR

Watergap Wellness Storage & Golf Cart Building

Smithfield Township
Monroe County, Pennsylvania

INTRODUCTION

The proposed project is located on a 105.71-acre property at 288 Mountain Road, Delaware Water Gap, Pennsylvania 18327. The project area currently exists as open lawn with small areas of gravel.

The proposed project includes the construction of a new 5,000 SF golf cart building that will be primarily utilized for golf cart storage. Additional site improvements include a small amount of grading around the proposed building and a subsurface infiltration system.

PRE-DEVELOPMENT ANALYSIS

The site exists as open lawn area with small areas of gravel. Runoff from the site drains overland to the Northwest and eventually drains into the Cherry Creek (Defined specifically in the PA Chapter 93 code as Cherry Creek -- Basin, LR 45010 Bridge to Mouth – CWF, MF).

For more information of pre-development runoff calculations, refer to Appendix B of this report.

POST-DEVELOPMENT ANALYSIS

The increase in stormwater runoff from the proposed development will be controlled through the use of a subsurface infiltration basin located on the western side of the site. The infiltration system will capture the roof of the proposed golf cart building and the remaining undetained lawn areas will sheet flow off site just as they did in the pre-development condition. The runoff released from the proposed subsurface infiltration system will discharge to grade to the northwest of the project site and flow to the Cherry Creek.

For more information of post-development runoff calculations, refer to Appendix C of this report.

STORMWATER RUNOFF COMPUTATIONS

The Rational Method was used to compute the pre- and post-development peak flow rates for the 2-, 5-, 10-, 25-, 50-, and 100-year storm frequencies to meet Smithfield Township requirements. The post-development rates could not exceed the pre-development 1-, 2-, 5-, 10-, 25-, 50-, and 100-year storms respectively. Post-development stage-storage volume, inflow hydrographs, basin routing, and outflow hydrographs for the infiltration system were produced with Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2018.

GROUNDWATER RECHARGE

The Groundwater Recharge requirements have been managed through the use of a subsurface infiltration system in accordance with Chapter 26 Part 2 Subsection 224 of the Smithfield Township Subdivision and Land Development Ordinance. Additionally, equations 224.1 and 224.2 have been utilized for the calculation and the subsurface system has been sized to exceed the calculated required capacity.

For more information on Groundwater Recharge calculations, refer to Appendix D of this report.

WATER QUALITY AND STREAMBANK EROSION

A pre- to post-development analysis was conducted utilizing SCS Type II distribution to prove that the proposed development will not negatively impact the receiving watercourse and the rate of runoff is reduced through the use of the subsurface infiltration system.

For more information of the water quality and streambank erosion analysis calculations, refer to Appendix E of this report.

CONCLUSIONS

The overall stormwater management concept for the project has been designed in accordance to Chapter 26 Part 2 Subsection 222 of the Smithfield Township code. Groundwater Recharge requirements are met by providing the required capacity within the subsurface infiltration system. The proposed stormwater management facilities will reduce the rate below pre-development levels.

Appendix A – Site Information

Soil Report
Stormwater Infiltration Testing

Appendix B – Predevelopment Analysis

Pre-development Rational Coefficient Calculations
Pre-development Rational Hydrograph Calculations

Appendix C – Post Development Analysis

Post-development Rational Coefficient Calculations
Post-development Rational Hydrograph Calculations - Bypass
Post-development Rational Hydrograph Calculations - Capture
Peak Flow Summary
Hydraflow Report Summary
Hydraflow Report Full
Underground Pipe Infiltration System – Storage Calculations

Appendix D – Groundwater Recharge

Recharge Calculations

Appendix E – Water Quality and Streambank Erosion

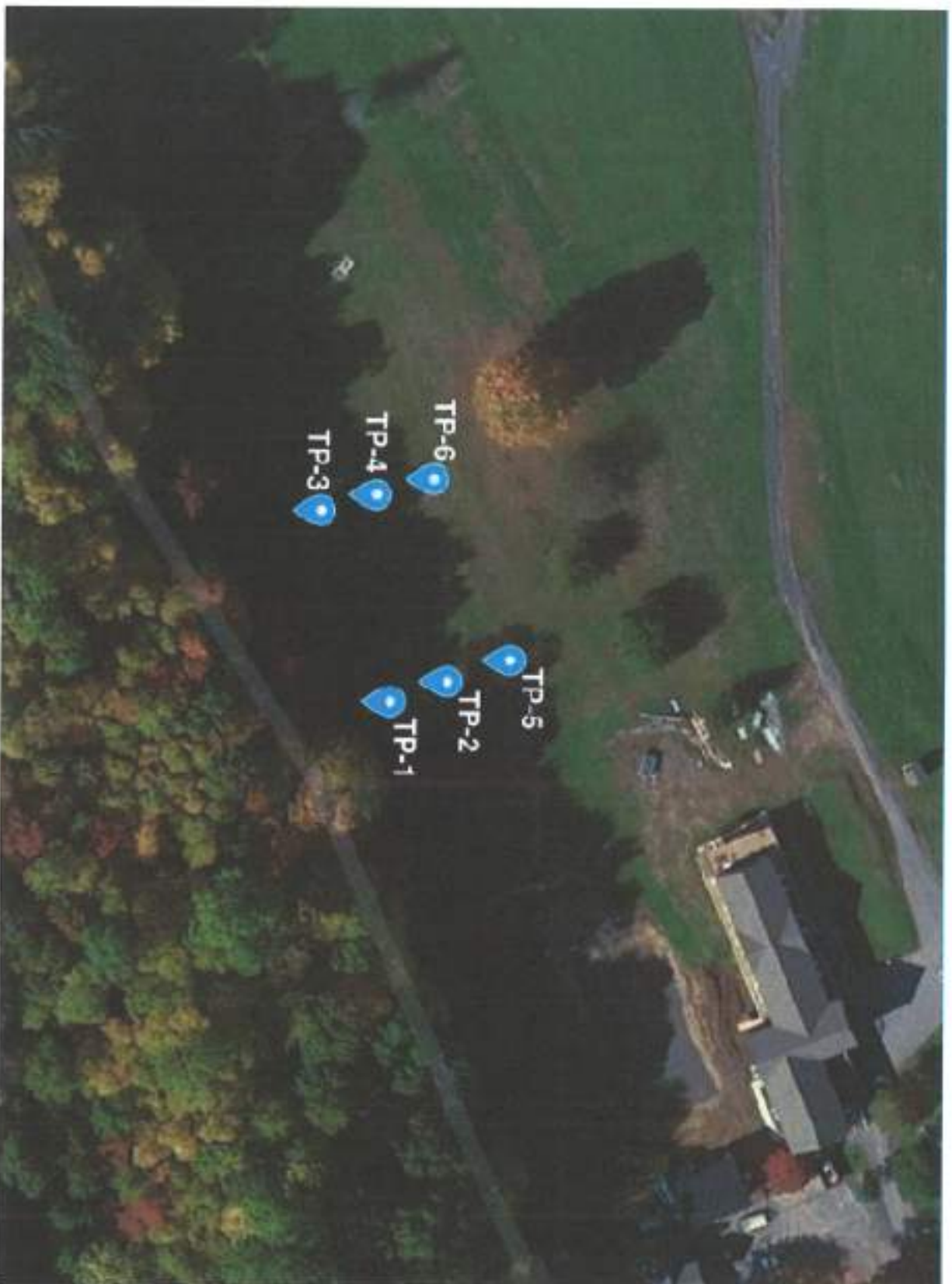
Rip-rap Apron Calculations
E&S Rip-Rap Figure 9.3

Appendix F – Reference Information

NOAA Atlas Rainfall Depth
NOAA Atlas Rainfall Intensity



Appendix A – Site Information



Test Location Plan
Water Gap Wellness – Proposed Cart Building
Smithfield Township, Monroe County, Pennsylvania



Not to Scale



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Date: June 28, 2023
Project: Water Gap Wellness - Proposed Cart Building
Location: Smithfield Township, Monroe County, Pennsylvania

Soil Log # TP-1 Stormwater Limiting Zone: Not Encountered Condition: N/A Lat/Long: 40.97354, -75.14916

Horizon	Depth	Color	Texture		Grade	Structure		Consistence	Redox Features	Boundary (Dist/Topo)
			C.F.	Class		Size	Type			
Ap	0-10	10YR 4/3	cl	sil	2	med	gr	fr	...	abs
Bw1	10-28	10YR 5/6	ch	sil	1	med	slk	fr	...	cbw
Bw2	28-44	10YR 4/3	vch	l	1	med	slk	fr	old	grw
C	44-96	2.5YR 5/4	vch	l	0	...	m	fr	...	...
...
...
...

Qualified Soil Scientist: Phillip R. Schiebel, SEO (PA SEO No. 039751)

Soil Series: Bath

Drainage Class Moderately Well Drained
 Course Fragments (C.F.) 15-35%
 Textural Class cs - coarse sand

Structure Size
 f - fine
 med - medium
 co - coarse
 Type
 sq - single grain
 gr - granular
 pl - platy
 pr - prismatic
 cm - columnar
 abk - angular blocky
 sbk - subangular blocky
 m - massive
 Consistence
 l - loose
 vr - very friable
 fr - friable
 fl - firm
 wh - very firm
 exfl - extremely firm

gr - gravelly
 ch - clay very
 cb - cobbly
 fl - flaggy
 st - stony
 35-65%
 vgr - very gravelly
 vch - very clayey
 vcb - very cobbly
 vfl - very flaggy
 vsl - very stony
 >65%
 exgr - extremely gravelly
 exch - extremely clayey
 excb - extremely cobbly
 exfl - extremely flaggy
 uxst - extremely stony

Structure Size
 f - fine
 med - medium
 co - coarse
 Type
 sq - single grain
 gr - granular
 pl - platy
 pr - prismatic
 cm - columnar
 abk - angular blocky
 sbk - subangular blocky
 m - massive
 Consistence
 l - loose
 vr - very friable
 fr - friable
 fl - firm
 wh - very firm
 exfl - extremely firm

Redox Features Abundance
 f few <2%
 c - common 2-20%
 m many >20%
 Redox Features
 f - faint
 d - distinct
 p - prominent
 Boundary
 Distinctness
 a - abrupt < 1" thick
 c - clear 1-2.5"
 g - gradual 2.5-5"
 d - diffuse > 5"
 Topography
 s - smooth
 w - wavy
 l - irregular
 b - broken



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Date: June 28, 2023
Project: Water Gap Wellness - Proposed Cart Building
Location: Smithfield Township
Monroe County Pennsylvania

Soil Log # TP-2 Stormwater Limiting Zone: 60"

Condition: Bedrock Lat/Long: 40.97362, -75.14920

Horizon	Depth	Color	Texture			Structure	Type	Consistence	Redox Features	Boundary (Dist/Topo)
			C.F.	Class	Grade					
Ap	0-8	10YR 4/3	ch	silt	2	fine	gr	fr	...	Dis
Bw1	8-19	10YR 5/6	ch	sh	1	fine	sbk	fr	...	Dis
Bw2	19-28	10YR 4/3	vch	l	1	fine	sbk	fr	cid	g/w
C	28-50	2.5YR 5/4	vch	l	0	...	m	fr	...	...
R	60+	...	...	...	...	...	...	...	...	...

Qualified Soil Scientist: Philip R. Schedel, SEQ (PA SEQ No. 03975)

Soil Series: Bath

Drainage Class: Somewhat Poorly Drained

Coarse Fragments (C.F.) 15-35%

Textural Class: ss - coarse sand

Structure: s - sand

Redox Features: f - few

gr - gravelly
ch - channery
cb - cobbly
f - flaggy
sl - silty
35-65%
vgr - very gravelly
vch - very channery
vcb - very cobbly
vfl - very flaggy
vsl - very silty
>65%
exgr - extremely gravelly
exch - extremely channery
excb - extremely cobbly
exfl - extremely flaggy
exsl - extremely silty

ss - coarse sand
fs - fine sand
ls - loamy sand
sl - sandy loam
l - loam
sil - silt
silt - silty
scl - sandy clay loam
cl - clay loam
scl - silty clay loam
sc - sandy clay
silt - silty clay
c - clay

fs - fine
med - medium
co - coarse
Type
sg - single grain
gr - granular
sl - platy
pr - prismatic
cm - columnar
ahk - angular blocky
sbk - subangular blocky
m - massive

Abundance: c - common 2-20%
m - many >20%
Redox Features: f - faint
c - distinct
p - prominent
Boundary: a - sand, p - < 1" thick
Distinctness: c - clear 1-2.5"
g - gradual 2.5-5"
d - diffuse > 5"
Topography: s - smooth
w - wavy
l - irregular
b - broken

Structure: 0 - structureless
Grade: 1 - weak
2 - moderate
3 - strong

Consistence: vfr - very friable
fr - friable
fi - firm
vfr - very firm
exf - extremely firm

Consistence: 1 - loose
vfr - very friable
fr - friable
fi - firm
vfr - very firm
exf - extremely firm



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Date: June 28, 2023
 Project: Water Gap Wellness - Proposed Car Building
 Location: Smithfield Township
Montco County, Pennsylvania

Soil Log # TP-3 Stormwater Limiting Zone: Not Encountered Condition: N/A Lat/Long: 40.97344, -75.14952

Horizon	Depth	Color	Texture		Grade	Structure		Consistence	Redox Features	Boundary (Dist/Topo)
			C.F.	Class		Size	Type			
A ₀	0-10	10YR 4/3	chl	sll	2	med	gr	fr		a/s
Bw1	10-19	10YR 5/6	ch	sll	1	med	sbk	fr		c/w
Bw2	19-32	10YR 4/3	vch		1	med	sbk	fr	c/d	g/w
C	32-96	2.5YR 5/4	vch		0		m	fr		

Qualified Soil Scientist: **Philip R. Schiebel, SEO (PA SEO No. 03975)** Soil Series: **Bath**

Drainage Class: **Superficial Poorly Drained**

Coarse Fragments (C.F.): **15-35%**

gr - gravelly
 ch - channery
 cb - cobbley
 fl - flaggy
 st - stony
35-65%
 vgr - very gravelly
 vch - very channery
 vcb - very cobbley
 vfl - very flaggy
 vst - very stony
>65%
 vxgr - extremely gravelly
 vxch - extremely channery
 vxcb - extremely cobbley
 vxfl - extremely flaggy
 vxst - extremely stony

Textural Class: **cs - coarse sand**

s - sand
 fs - fine sand
 ls - loamy sand
 sl - sandy loam
 l - loam
 sll - silt loam
 sil - silt
 scl - sandy clay loam
 cl - clay loam
 silcl - silty clay loam
 scl - sandy clay
 sic - silty clay
 c - clay
Structure
 0 - structureless
 1 - weak
 2 - moderate
 3 - strong

Structure Size: **f - fine**

f - fine
 med - medium
 co - coarse
Type
 sq - single grain
 gr - granular
 pl - platy
 pr - prismatic
 cm - columnar
 abk - angular blocky
 subk - subangular blocky
 m - massive
Consistence
 l - loose
 vfr - very friable
 fr - friable
 fi - firm
 vfr - very firm
 exfr - extremely firm

Redox Features Abundance: **l - low <2%**

c - common 2-20%
 m - many >20%
Redox Features Contrast
 f - faint
 d - distinct
 p - prominent
Boundary Distinctness
 a - abrupt < 1" thick
 c - clear 1-2.5"
 g - gradual 2.5-5"
 d - diffuse > 5"
Topography
 s - smooth
 w - wavy
 i - irregular
 b - broken



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Date: June 28, 2023
 Project: Water Gap Wellness - Proposed Cart Building
 Location: Smithfield Township
 Monroe County, Pennsylvania

Lat/Long: 40.97352, -75.14955

Soil Log # TP-4 Stormwater Limiting Zone: Not Encountered Condition: N/A

Horizon	Depth	Color	Texture			Structure	Consistence	Redox Features	Boundary (Disc/Topol)
			C.F.	Class	Grade				
Ap	0-10	10YR 4/3	ch	sll	2	med	gr	fr	abs
Bw1	10-16	10YR 5/6	ch	sll		med	slk	fr	slw
Bw2	16-26	10YR 4/3	vch	l	1	med	sbk	fr	glw
C	26-96	2.5YR 5/4	vch	l	0		ns	fr	

Qualified Soil Scientist: Philip R. Schiebel, SEQ (PA SEQ No. 03975)

Soil Series: Bath

Drainage Class Somewhat Poorly Drained	Coarse Fragments (C.F.) 15-35%	Textural Class cs - coarse sand	Structure fi - fine	Consistence l - loose	Redox Features Abundance f - few <2% c - common 2-20% m - many >20%
gr - gravelly	gr - gravelly	s - sand	med - medium	vr - very friable	
ch - channerly	ch - channerly	fs - fine sand	co - coarse	fr - friable	
cb - cobbly	cb - cobbly	ls - loamy sand	co - coarse	fl - firm	
fl - flaggy	fl - flaggy	sl - sandy loam	Type	vf - very firm	
st - stony	st - stony	l loam	sq - single gran	axfl - extremely firm	
35-65%	35-65%	sil - silt loam	gr - granular		
vgr - very gravelly	vgr - very gravelly	si - silt	pl - platy		
vch - very channerly	vch - very channerly	scl - sandy clay loam	pr - prismatic		
vcb - very cobbly	vcb - very cobbly	cl - clay loam	cm - columnar		
wfl - very flaggy	wfl - very flaggy	sicl - silty clay loam	blk - angular blocky		
vst - very stony	vst - very stony	sc - sandy clay	shk - subangular blocky		
255%	255%	sic - silty clay	m - massive		
exgr - extremely gravelly	exgr - extremely gravelly	uc - clay	Consistence		
exch - extremely channerly	exch - extremely channerly	Structure	l - loose		
excb - extremely cobbly	excb - extremely cobbly	Grade	vr - very friable		
oxfl - extremely flaggy	oxfl - extremely flaggy	n - structureless	fr - friable		
axst - extremely stony	axst - extremely stony	1 - weak	fl - firm		
		2 - moderate	vf - very firm		
		3 - strong	axfl - extremely firm		



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Date: June 28, 2023
Project: Water Gap Wellcross - Pro-Crossed Carl Builing
Location: Smithfield Township
Merone County Pennsylvania

Soil Log # TP-5 Stormwater Limiting Zone, 20'

Condition: Bedrock Lat Long: 40.97371, -75.14924

Horizon	Depth	Color	Texture		Grade	Structure		Type	Consistence	Redox Features	Boundary (Dist/Topo)
			C.F.	Class		Size					
Ap	0-9	10YR 4/3	ch	sil	2	med		gr	fr		abs
Bw	9-20	10YR 5/6	ch	sil	1	med		sub	fr		glw
R	20+										

Qualified Soil Scientist: Phillip R. Schiebel, SEO (PA SEO No. 03975)

Soil Series: Bath

Drainage Class: Moderate Well Drained
Coarse Fragments (C.F.): 15-35%
Textural Class: CS - coarse sand

Structure: fi - fine
Size: mod - medium
Type: co - coarse
Consistence: loose

gr - gravelly
ch - channerly
cb - cobbly
fl - flaggy
st - stony
35-65%

Structure: fi - fine
Size: mod - medium
Type: co - coarse
Consistence: loose

vgr - very gravelly
vch - very channerly
vcb - very cobbly
vfl - very flaggy
vst - very stony
>65%

Structure: fi - fine
Size: mod - medium
Type: co - coarse
Consistence: loose

exch - extremely channerly
excb - extremely cobbly
exfl - extremely flaggy
exst - extremely stony

Structure: fi - fine
Size: mod - medium
Type: co - coarse
Consistence: loose

exgr - extremely gravelly
exch - extremely channerly
excb - extremely cobbly
exfl - extremely flaggy
exst - extremely stony

Structure: fi - fine
Size: mod - medium
Type: co - coarse
Consistence: loose

exgr - extremely gravelly
exch - extremely channerly
excb - extremely cobbly
exfl - extremely flaggy
exst - extremely stony

Structure: fi - fine
Size: mod - medium
Type: co - coarse
Consistence: loose

exgr - extremely gravelly
exch - extremely channerly
excb - extremely cobbly
exfl - extremely flaggy
exst - extremely stony

Structure: fi - fine
Size: mod - medium
Type: co - coarse
Consistence: loose

exgr - extremely gravelly
exch - extremely channerly
excb - extremely cobbly
exfl - extremely flaggy
exst - extremely stony

Structure: fi - fine
Size: mod - medium
Type: co - coarse
Consistence: loose

exgr - extremely gravelly
exch - extremely channerly
excb - extremely cobbly
exfl - extremely flaggy
exst - extremely stony

Structure: fi - fine
Size: mod - medium
Type: co - coarse
Consistence: loose

exgr - extremely gravelly
exch - extremely channerly
excb - extremely cobbly
exfl - extremely flaggy
exst - extremely stony

Structure: fi - fine
Size: mod - medium
Type: co - coarse
Consistence: loose

**DOUBLE RING INFILTROMETER TESTING FIELD READINGS
FOR STORMWATER INFILTRATION**

Project: Water Gap Wellness - Proposed Cart Building
Smithfield Township
Monroe County, Pennsylvania
Test Date: June 28, 2023

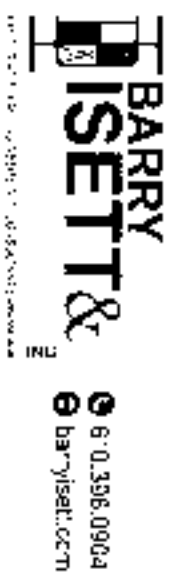


Table 1. Double Ring Infiltrometer Test Results

Test No.	Test Depth (in.)	Surface Elev. (ft.)	Test Elev. (ft.)	Hole Dia. (in.)	Reading Interval (min.)	Readings (in.)								Stabilized or Final Drop (in.)	Infiltration Rate (in/hr.)	Design Inf. Rate (in/hr.)	
						1	2	3	4	5	6	7	8				
TP-1A	60	543.90	544.00	6.00	30.00	0.00	1.00	1.00	1.00	...	...	...	...	...	1.30	2.00	1.00
TP-1B	36			6.00	30.00	0.50	0.50	0.50	0.50	...	...	...	...	...	0.50	1.00	0.50
TP-2A	36	547.00	544.00	6.00	30.00	0.50	0.50	0.50	0.50	...	...	...	...	...	0.50	1.00	0.50
TP-2B	36			6.00	30.00	0.50	0.50	0.50	0.50	...	...	...	...	...	0.50	1.00	0.50
TP-3A	36	545.50	544.00	6.00	30.00	1.00	1.00	1.00	1.00	1.30	...	...	...	...	1.30	2.00	1.00
TP-3B	36			6.00	30.00	1.00	1.00	1.00	1.00	1.30	...	...	...	...	1.30	2.00	1.00
TP-4A	36	543.90	543.00	6.00	30.00	0.50	0.75	0.75	0.75	...	...	...	...	...	0.75	1.50	0.75
TP-4B	36			6.00	30.00	0.75	0.75	0.75	0.75	...	...	...	...	...	0.75	1.50	0.75

Notes:
 1) A stabilized value of drop is indicated by a "...", which means either the highest and lowest drop in four (4) consecutive readings.
 2) The time that elapses in the meter and during the final portion expressed as minutes per hour should represent the infiltration rate for that test location.
 3) The design infiltration rate values are safety factor of two (2).
 C = Empty



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Date: June 26, 2023
Project: Water Gap Wellness - Proposed Car Building
Location: Smithfield Township
Monroe County, Pennsylvania

Soil Log # TP-6 Stormwater Limiting Zone: 27'

Condition: Bedrock Lat/Long: 40.97360, -75.14958

Horizon	Depth	Color	Texture		Grade	Structure		Consistence	Redox Features	Boundary (Dist/Topo)
			C.F.	Class		Size	Type			
Ap	0-9	10YR 4/3	ch	sll	2	med	gr	fr	..	avg
Bw	9-21	10YR 5/6	ch	sll	1	med	sbk	fr	old	crw
C	21-27	2.5YR 5/4	wch	l	0	...	m	fr	..	slw
R	2/+	...	...	...	...	...	...	...	...	...
...
...
...

Qualified Soil Scientist: Philip R. Schiebel, SEO (PA SEO No. 03975)

Soil Series: Bath

Drainage Class
Poorly Drained

Coarse Fragments (C.F.)
15-35%

Textural Class
cs - coarse sand

Structure
Size

Redox Features
Abundance

- gr - gravelly
- ch - channely
- ch - cobbly
- R - fraggy
- st - stony
- 35-65%
- vgr - very gravelly
- vch - very channely
- wch - very cobbly
- wf - very fraggy
- vsl - very stony
- >65%
- exgr - extremely gravelly
- exch - extremely channely
- exch - extremely cobbly
- exst - extremely stony
- ext - extremely stony

- cs - coarse sand
- s - sand
- fs - fine sand
- ls - loamy sand
- sl - sandy loam
- l - loam
- sll - silt loam
- sl - silt
- scl - sandy clay loam
- cl - clay loam
- sicl - silty clay loam
- sc - sandy clay
- sic - silty clay
- c - clay

- f - fine
- med - medium
- co - coarse

- 1 - few <2%
- c - common 2-20%
- m - many >20%

- 0 - structureless
- 1 - weak
- 2 - moderate
- 3 - strong

- fr - very friable
- fr - friable
- fl - firm
- vf - very firm
- ext - extremely firm

- 1 - loose
- fr - very friable
- fr - friable
- fl - firm
- vf - very firm
- ext - extremely firm

- Structure
- Grade

- Structure
- Consistence

- Boundary
- Distinctness
- Topography

Appendix B – Pre-development Analysis



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RATIONAL COEFFICIENT CALCULATION SHEET

Pre-Development

POINT OF INTEREST	DRAINAGE AREA	LAND COVER/USE		AREA		RUNOFF COEFFICIENT		
		LAND COVER/USE	HSL (SLOPE)	SF	AC	< 25 YR	≥ 25 YR	
1	Pre Dev Overall	Meadow	C (6%+)	20,909	0.48	0.32	0.39	
		Gravel	C (6%+)	2,613	0.06	0.43	0.50	
						23,522	0.54	0.33



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UNIVERSAL RATIONAL HYDROGRAPH METHOD

Pre-Development

Watershed Parameters	
T_c	5.00
$C (<25Yr)$	0.33
$C (\geq 25Yr)$	0.40
Area (A)	0.54

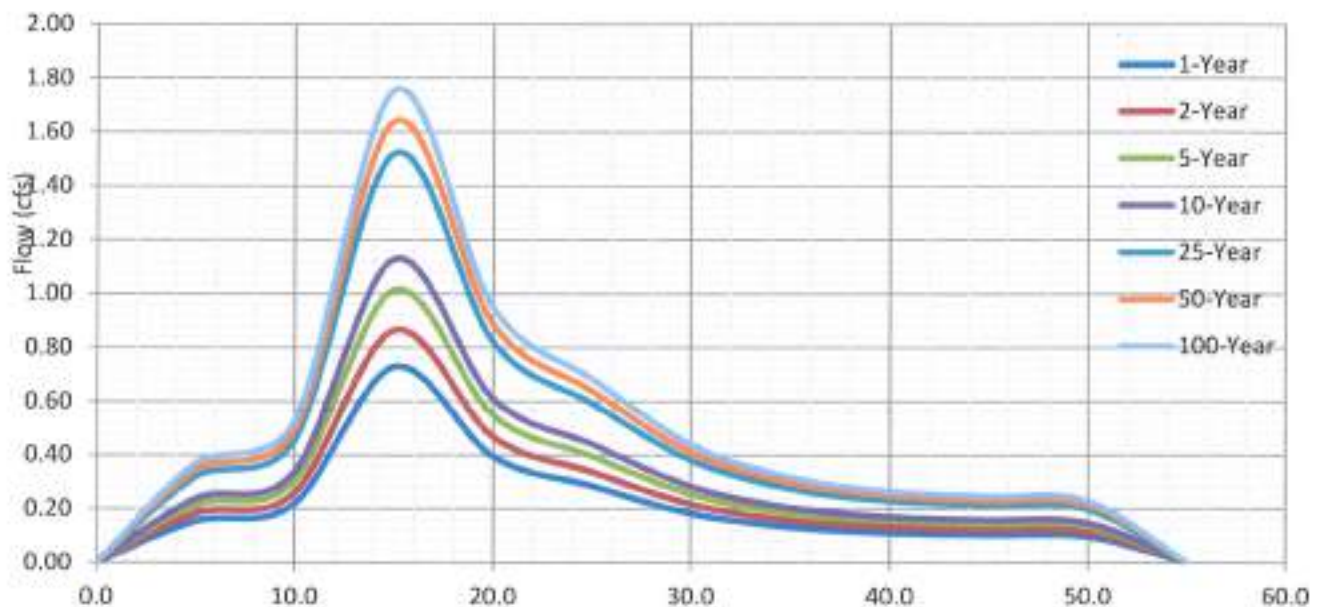
1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Runoff Coefficient C						
0.33	0.33	0.33	0.33	0.40	0.40	0.40

Precipitation Intensity I (in/hr)						
4.06	4.82	5.65	6.29	7.00	7.55	8.08

12 Point Universal Hydrograph

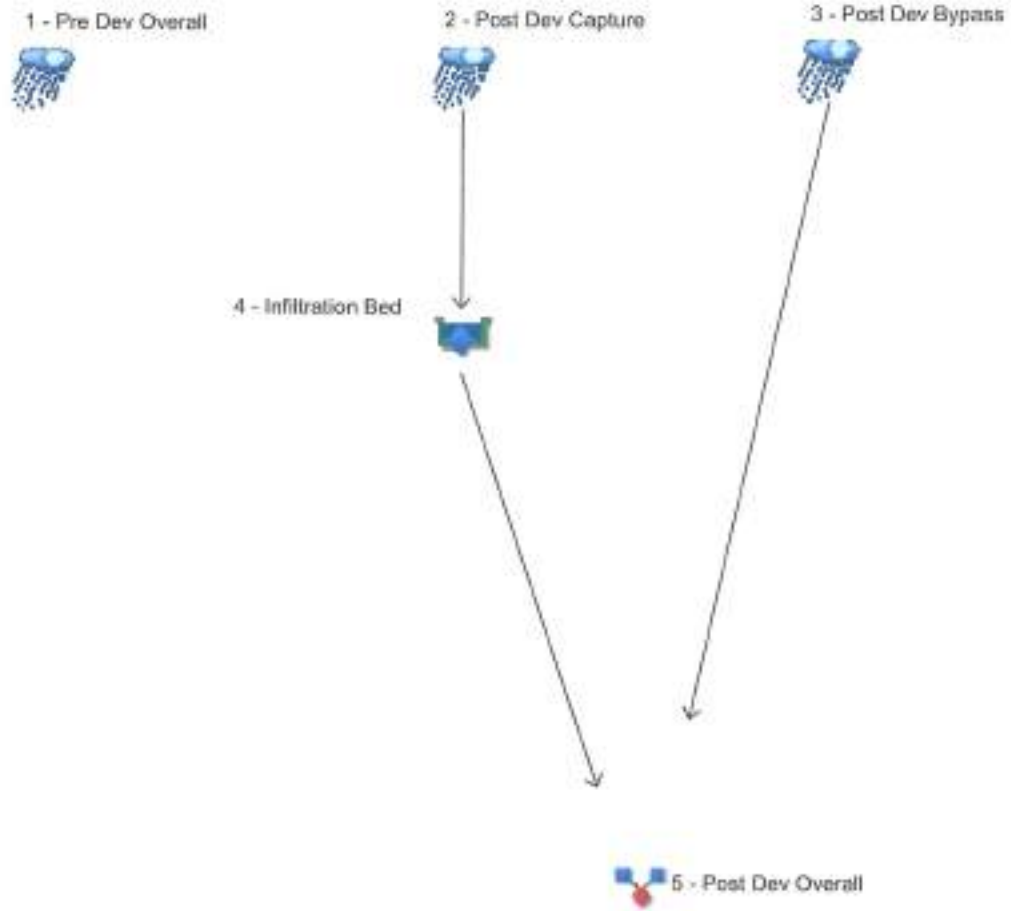
Time (min)	Flow Q (cfs)						
0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.0	0.15	0.18	0.21	0.24	0.32	0.34	0.37
10.0	0.22	0.26	0.30	0.34	0.46	0.49	0.53
15.0	0.73	0.86	1.01	1.13	1.52	1.64	1.75
20.0	0.39	0.47	0.55	0.61	0.82	0.89	0.95
25.0	0.28	0.34	0.40	0.44	0.59	0.64	0.68
30.0	0.18	0.22	0.25	0.28	0.38	0.41	0.44
35.0	0.13	0.16	0.18	0.20	0.27	0.30	0.32
40.0	0.11	0.13	0.15	0.17	0.23	0.25	0.26
45.0	0.10	0.12	0.14	0.16	0.21	0.23	0.25
50.0	0.09	0.11	0.13	0.15	0.20	0.21	0.23
55.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Volume (cf)	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
	719	853	1,000	1,114	1,501	1,619	1,732



Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

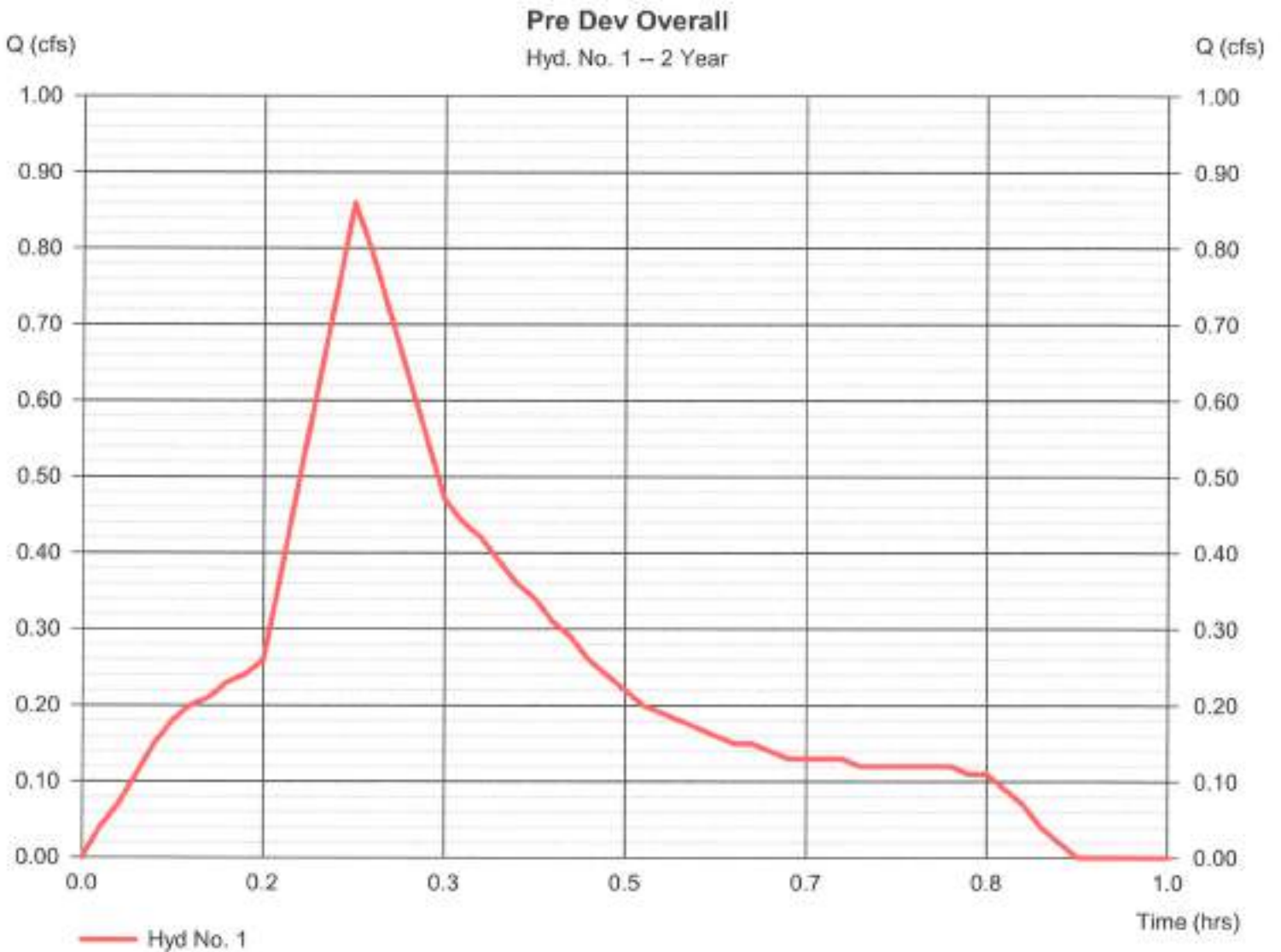


Hydrograph Report

Hyd. No. 1

Pre Dev Overall

Hydrograph type	= Manual	Peak discharge	= 0.860 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 854 cuft

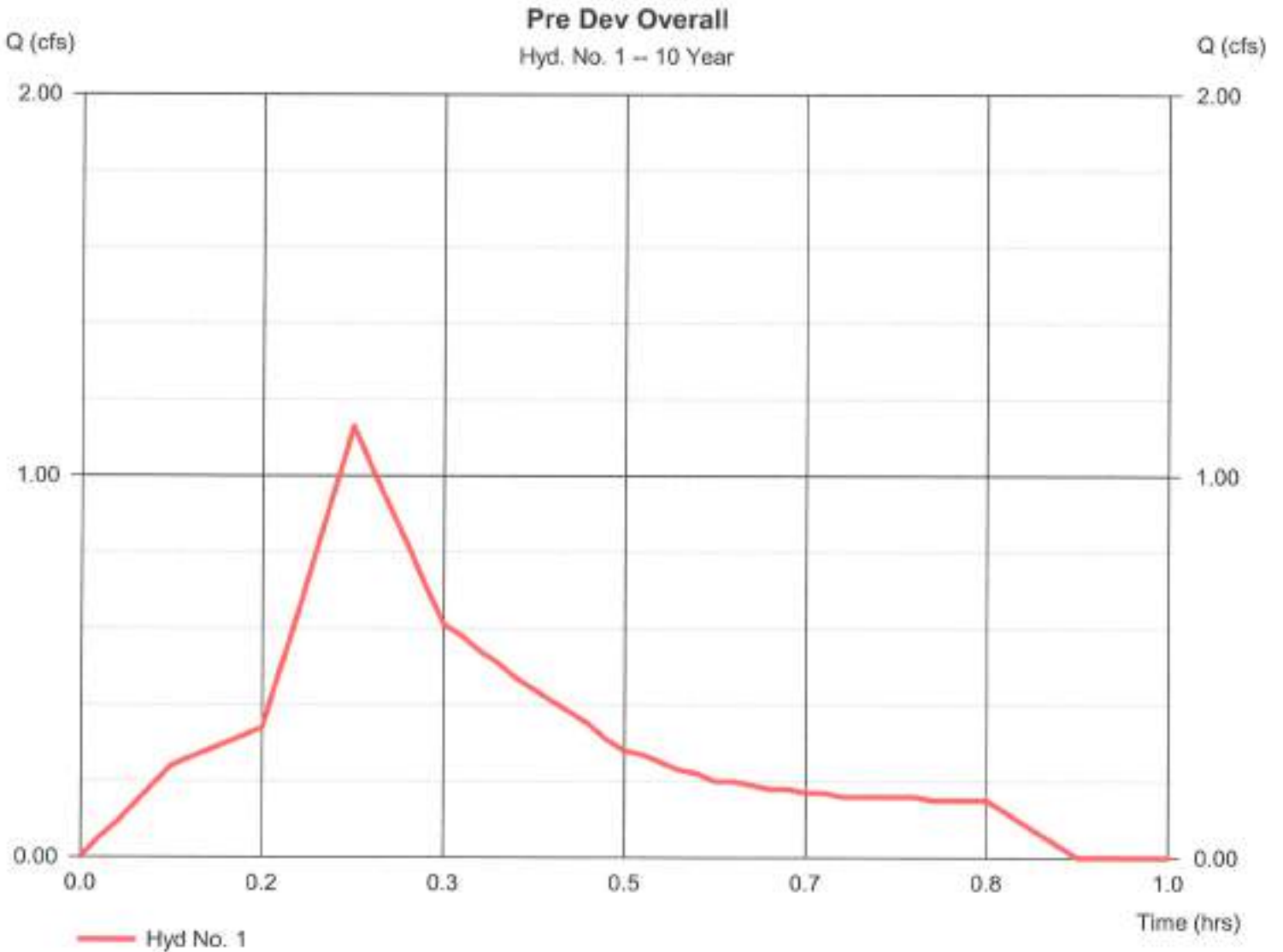


Hydrograph Report

Hyd. No. 1

Pre Dev Overall

Hydrograph type	= Manual	Peak discharge	= 1.130 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 1,115 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Tuesday, 09 / 5 / 2023

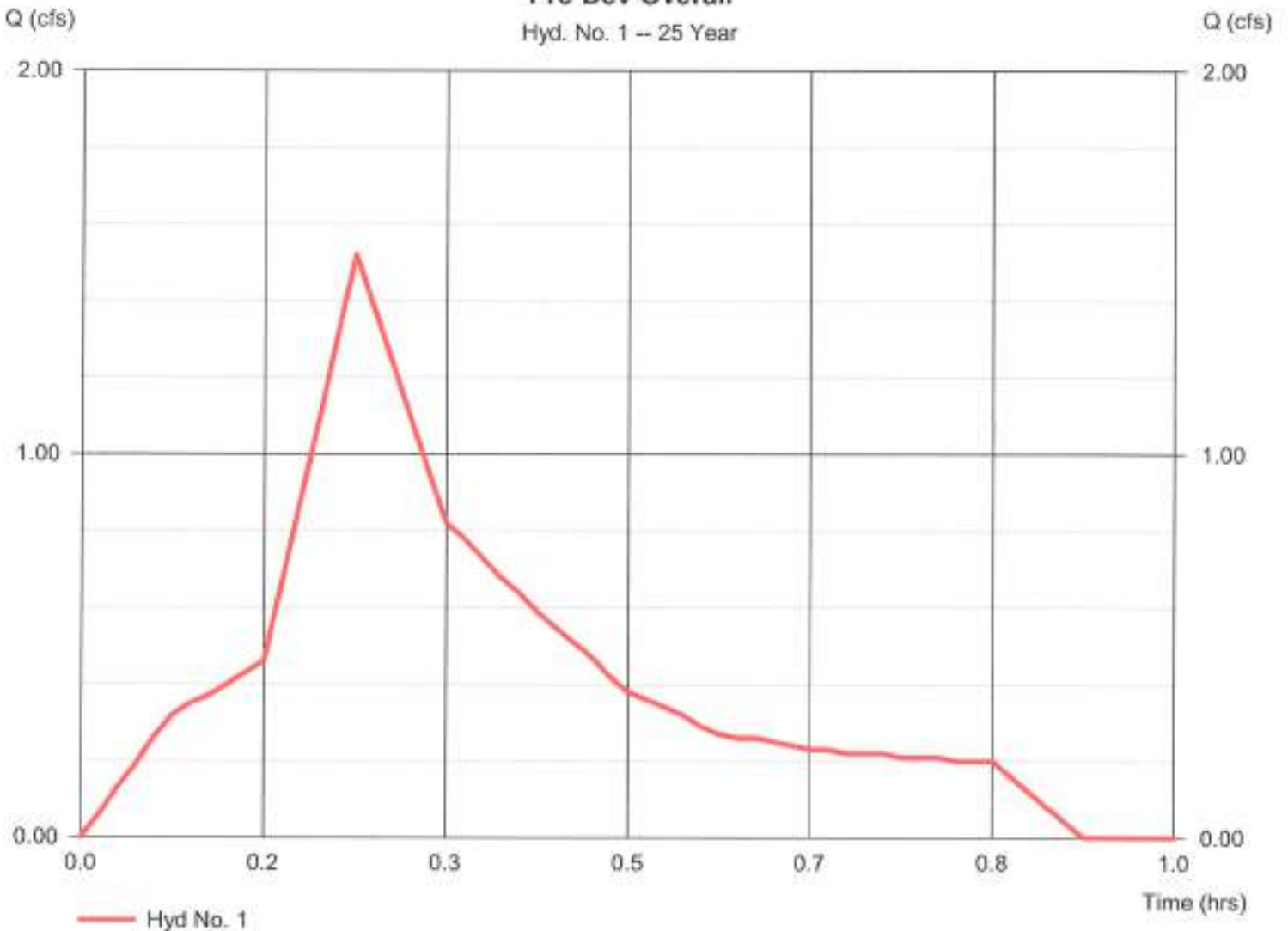
Hyd. No. 1

Pre Dev Overall

Hydrograph type	= Manual	Peak discharge	= 1,520 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 1,502 cuft

Pre Dev Overall

Hyd. No. 1 -- 25 Year



Hydrograph Report

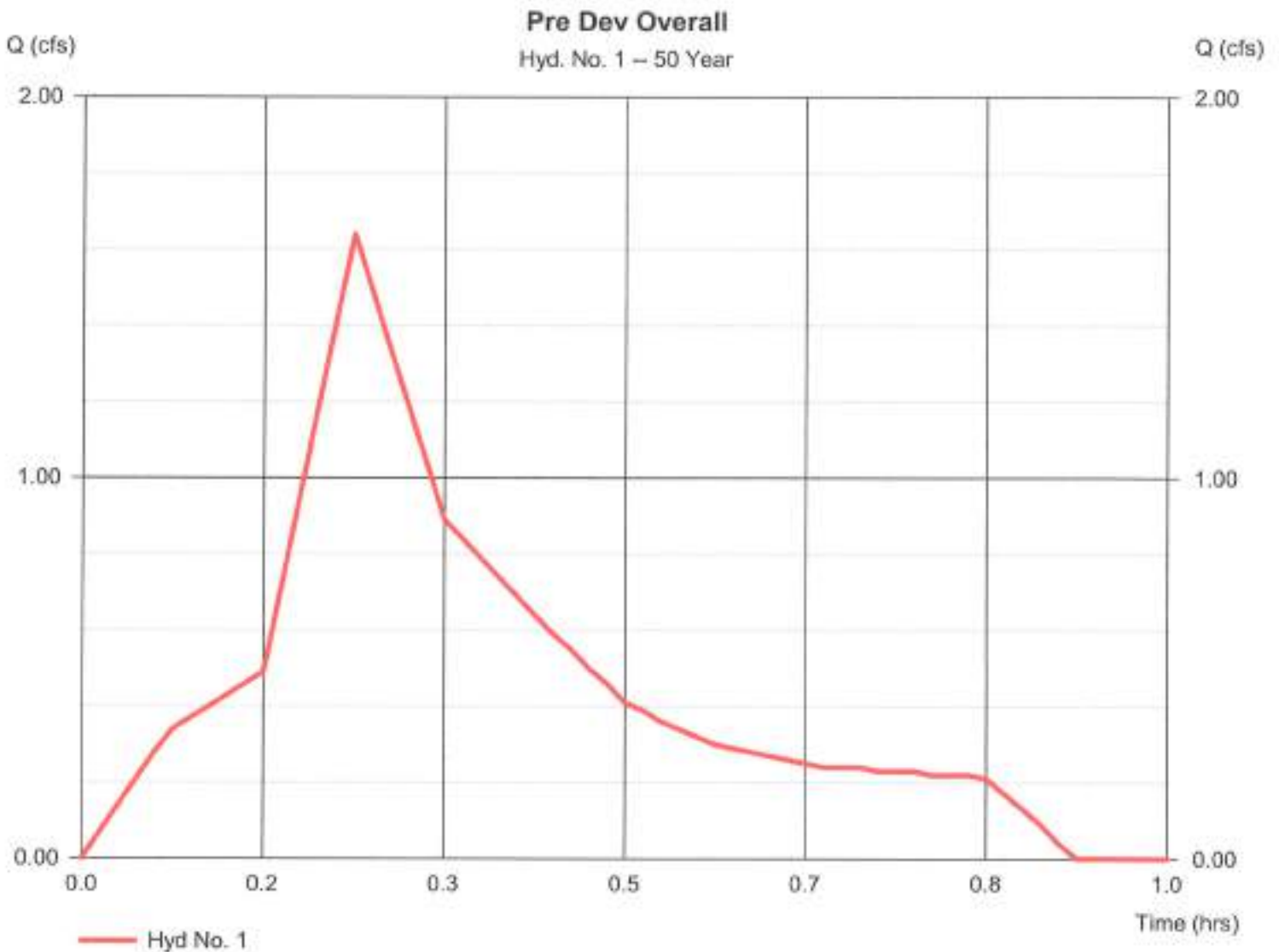
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Tuesday, 09/15/2023

Hyd. No. 1

Pre Dev Overall

Hydrograph type	= Manual	Peak discharge	= 1,640 cfs
Storm frequency	= 50 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 1,621 cuft



Hydrograph Report

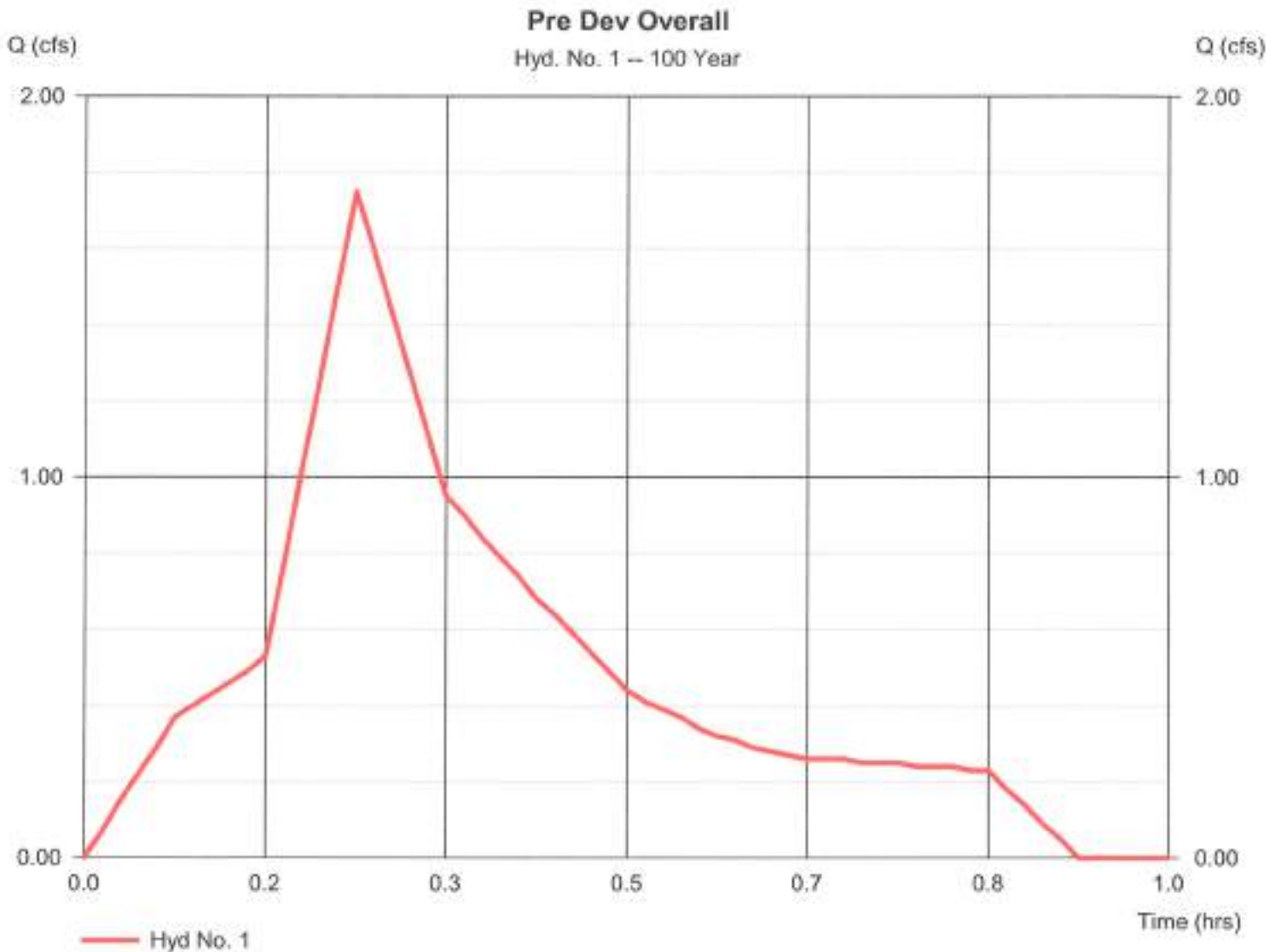
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Tuesday, 09 / 5 / 2023

Hyd. No. 1

Pre Dev Overall

Hydrograph type	= Manual	Peak discharge	= 1,750 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 1,732 cuft



Appendix C – Post-Development Analysis



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RATIONAL COEFFICIENT CALCULATION SHEET

Post-Development

POINT OF INTEREST	DRAINAGE AREA	LAND COVER/USE		AREA		RUNOFF COEFFICIENT	
		LAND COVER/USE	HSL (SLOPE)	SF	AC	< 25 YR.	≥ 25 YR.
1	Post Capture	Parking, Other Impervious	C (0-2%)	4,980	0.11	0.72	0.84
					4,980	0.11	0.72	0.84
1	Post Bypass	Gravel	C (6%+)	10,890	0.25	0.43	0.50
		Lawn	C (6%+)	7,652	0.18	0.32	0.39
					18,542	0.43	0.38



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UNIVERSAL RATIONAL HYDROGRAPH METHOD

Post-Development Capture

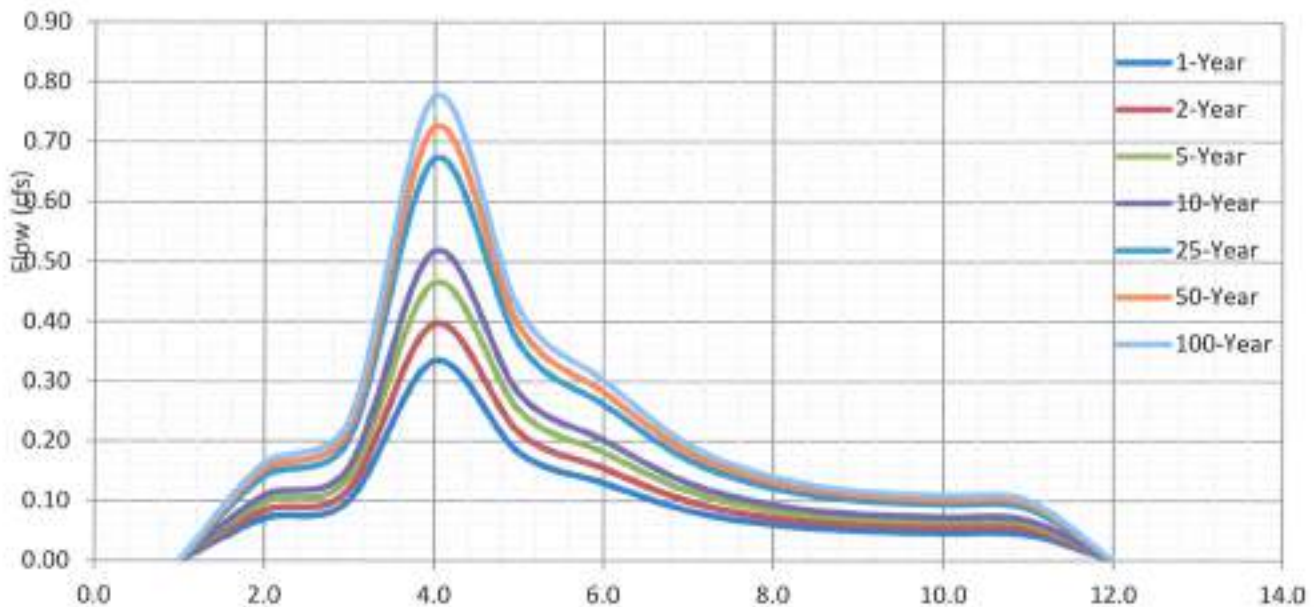
Watershed Parameters	
T_c	5.00
$C (<25Yr)$	0.72
$C (\geq 25Yr)$	0.84
Area (A)	0.11

1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Runoff Coefficient C						
0.72	0.72	0.72	0.72	0.84	0.84	0.84
Precipitation Intensity I (in/hr)						
4.06	4.82	5.65	6.29	7.00	7.55	8.08

12 Point Universal Hydrograph

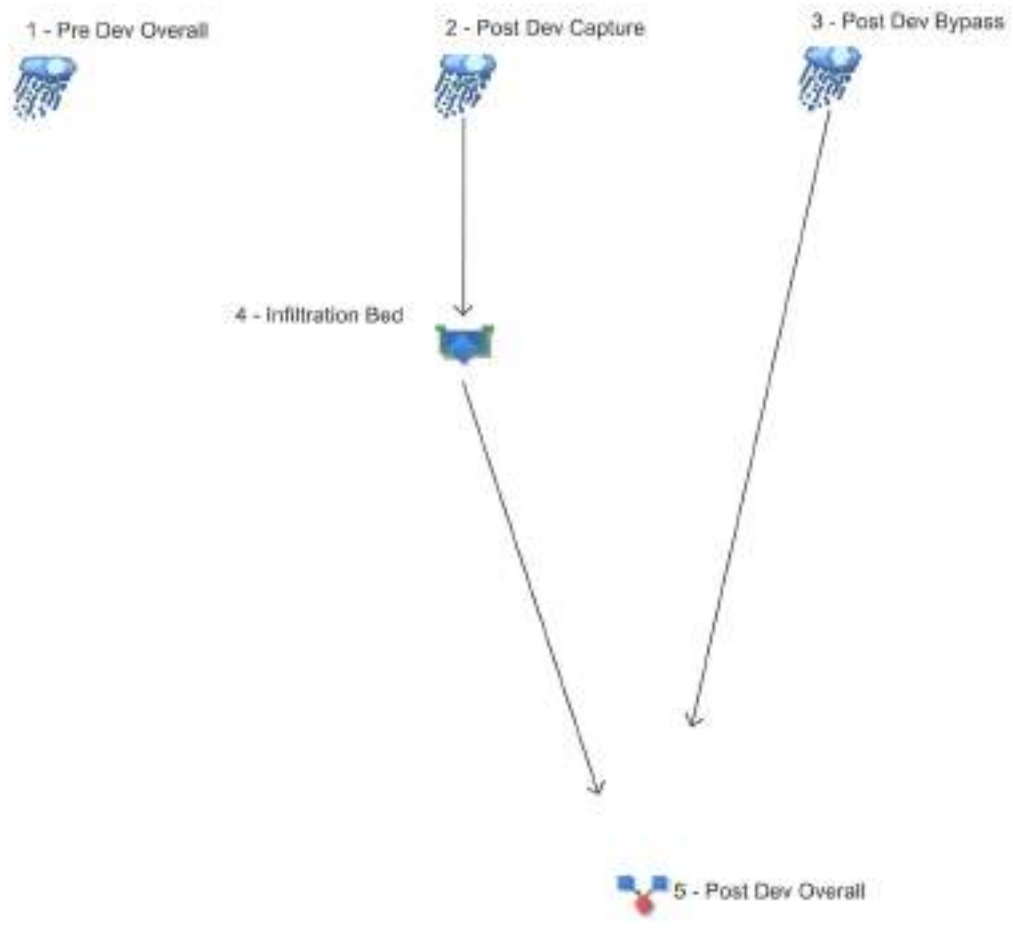
Time (min)	Flow Q (cfs)						
0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.0	0.07	0.08	0.10	0.11	0.14	0.15	0.16
10.0	0.10	0.12	0.14	0.16	0.20	0.22	0.23
15.0	0.33	0.40	0.47	0.52	0.67	0.73	0.78
20.0	0.18	0.21	0.25	0.28	0.36	0.39	0.42
25.0	0.13	0.15	0.18	0.20	0.26	0.28	0.30
30.0	0.08	0.10	0.12	0.13	0.17	0.18	0.19
35.0	0.06	0.07	0.08	0.09	0.12	0.13	0.14
40.0	0.05	0.06	0.07	0.08	0.10	0.11	0.12
45.0	0.05	0.06	0.07	0.07	0.09	0.10	0.11
50.0	0.04	0.05	0.06	0.07	0.09	0.09	0.10
55.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Volume (cf)	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
	330	392	459	511	663	716	766



Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

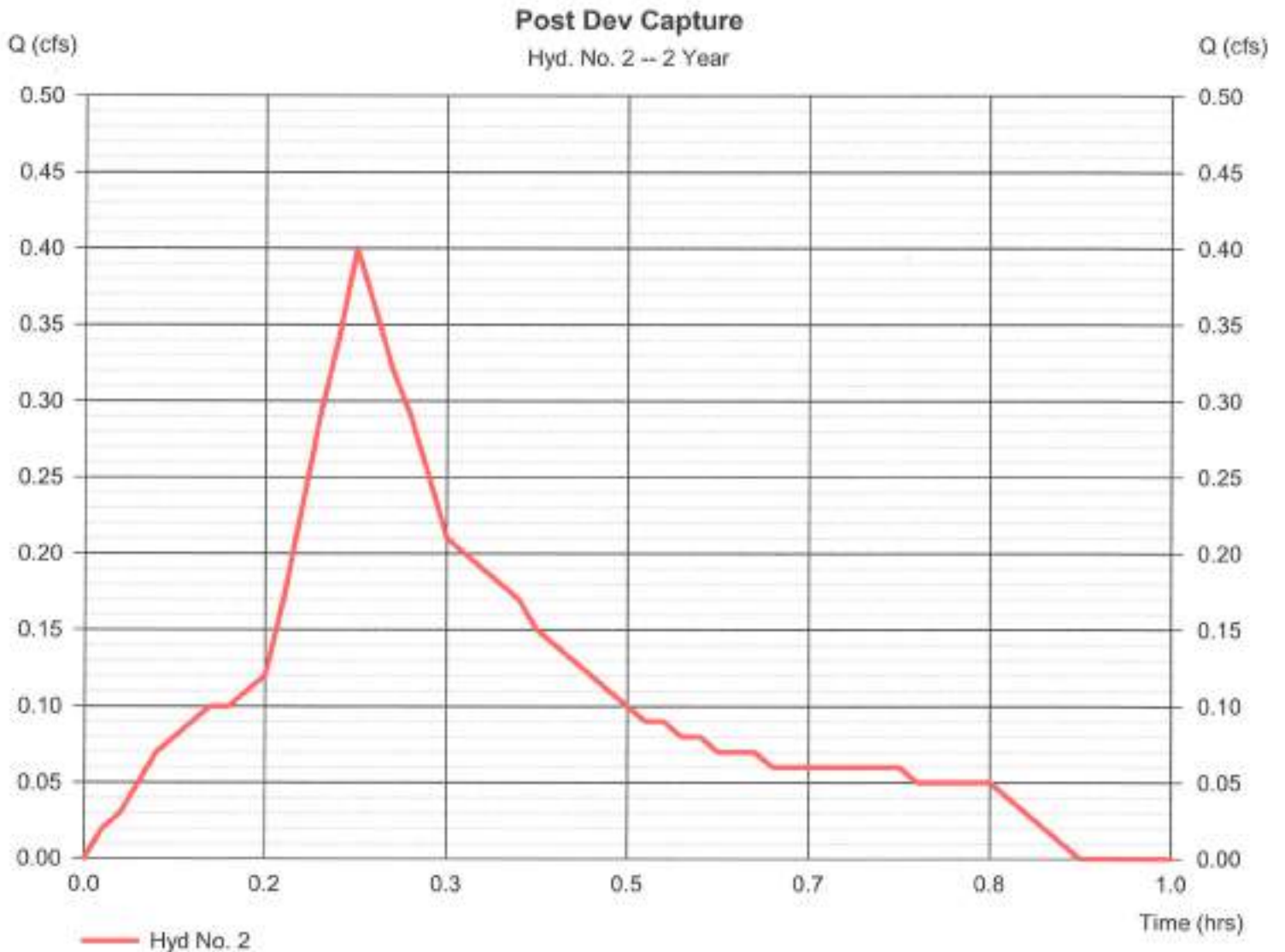


Hydrograph Report

Hyd. No. 2

Post Dev Capture

Hydrograph type	= Manual	Peak discharge	= 0.400 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 390 cuft

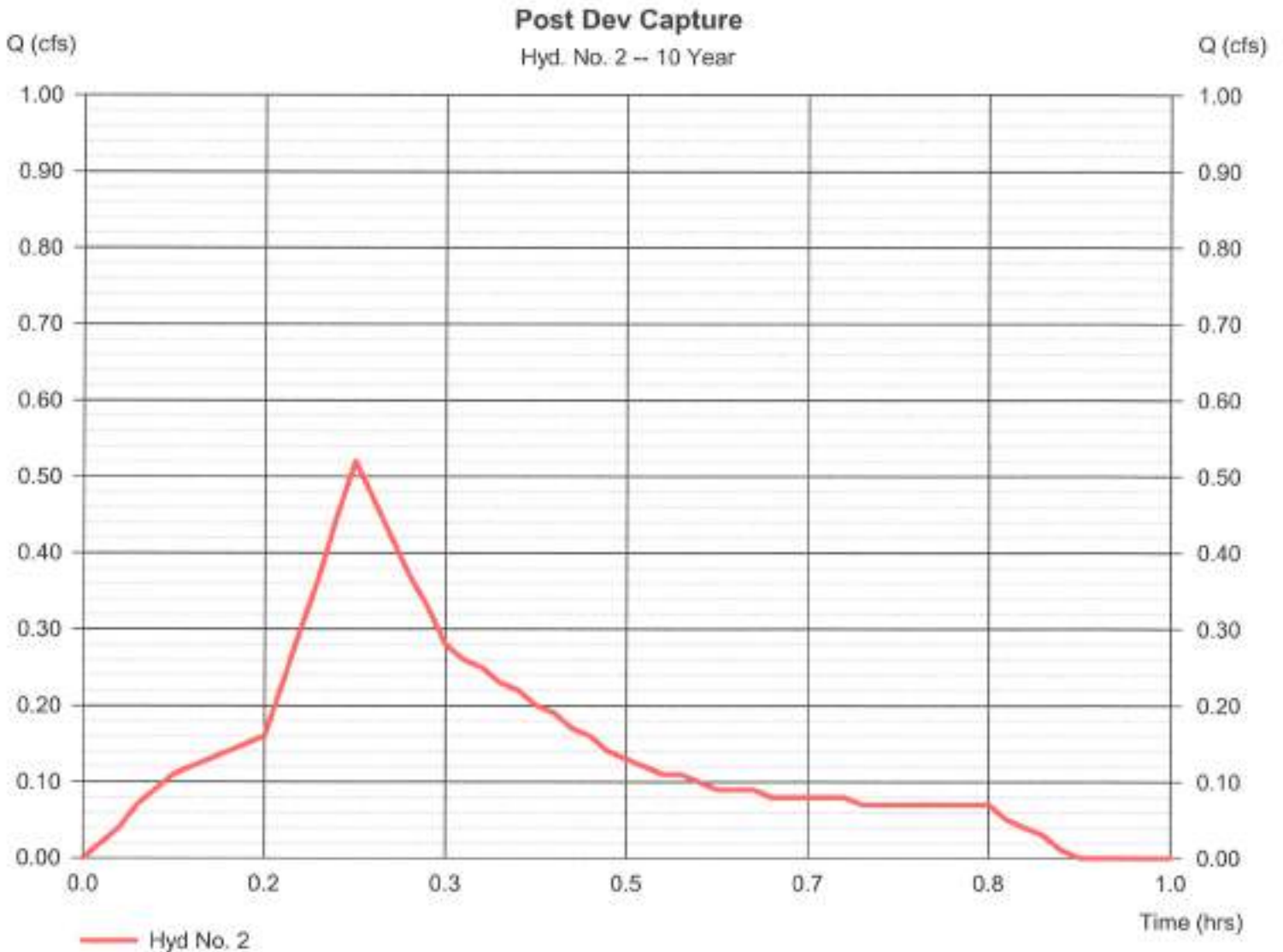


Hydrograph Report

Hyd. No. 2

Post Dev Capture

Hydrograph type	= Manual	Peak discharge	= 0.520 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 511 cuft



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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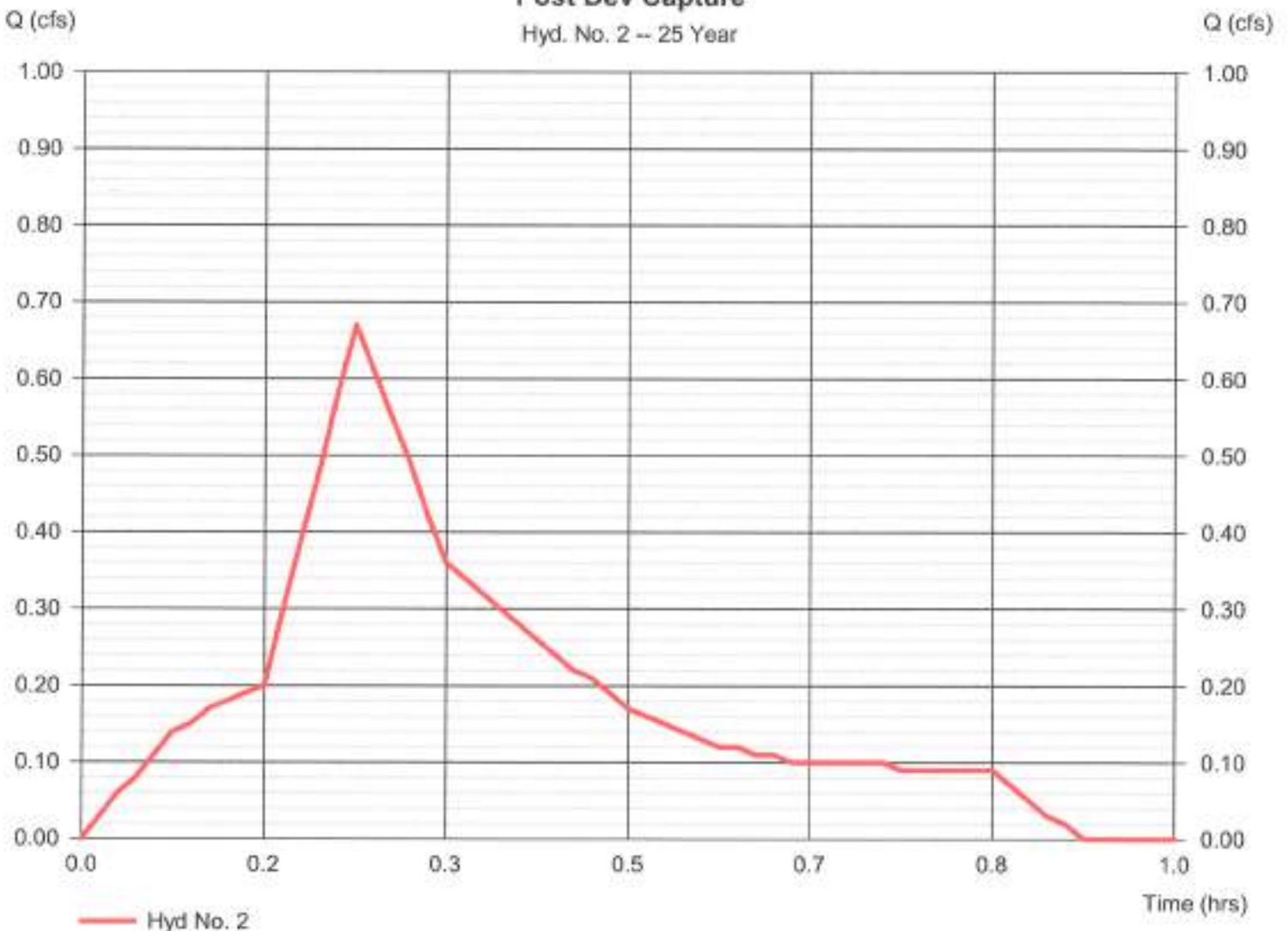
Hyd. No. 2

Post Dev Capture

Hydrograph type	= Manual	Peak discharge	= 0.670 cfs
Storm frequency	= 25 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 662 cuft

Post Dev Capture

Hyd. No. 2 -- 25 Year



Hydrograph Report

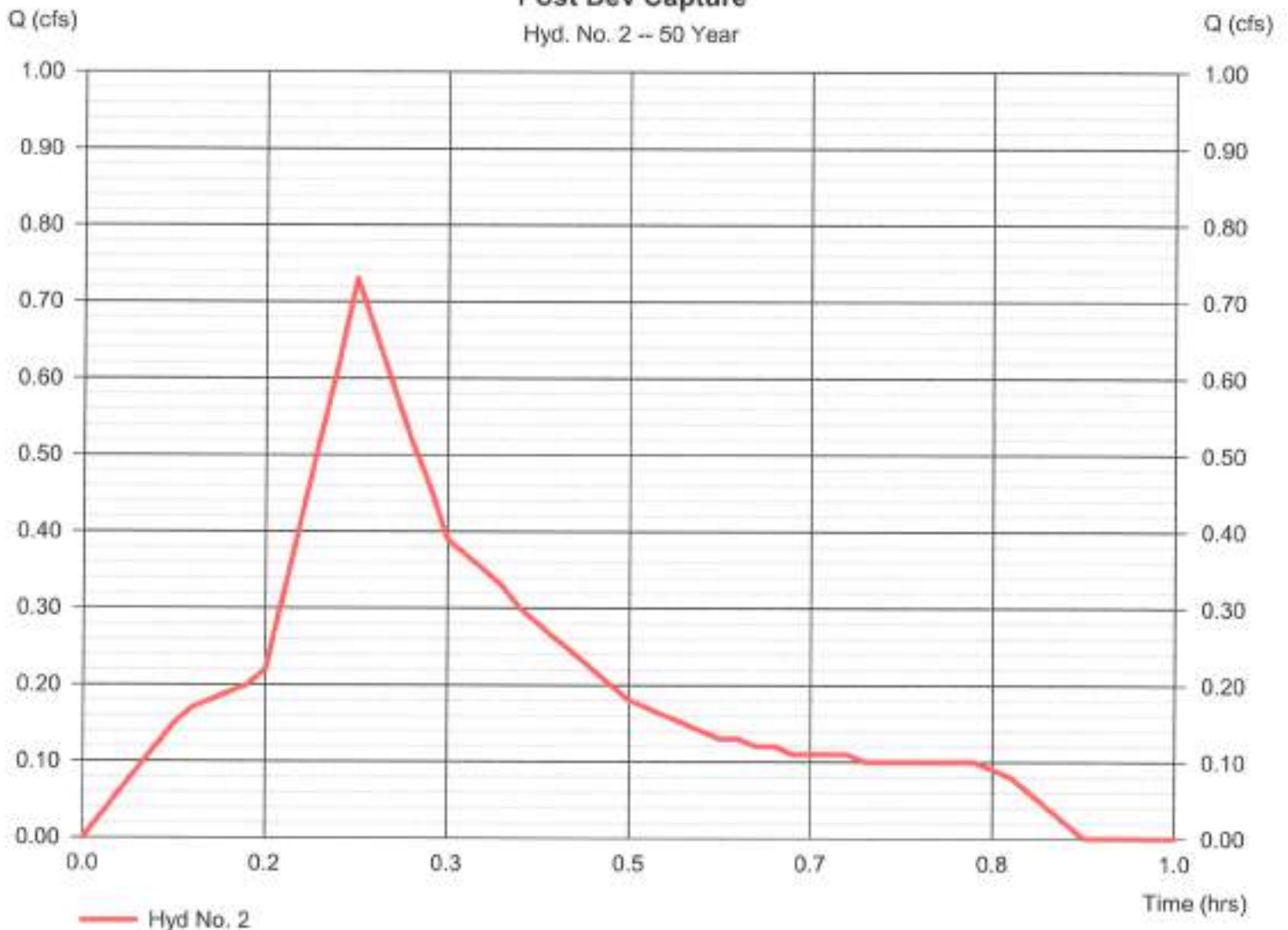
Hyd. No. 2

Post Dev Capture

Hydrograph type	= Manual	Peak discharge	= 0.730 cfs
Storm frequency	= 50 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 715 cuft

Post Dev Capture

Hyd. No. 2 -- 50 Year



Hydrograph Report

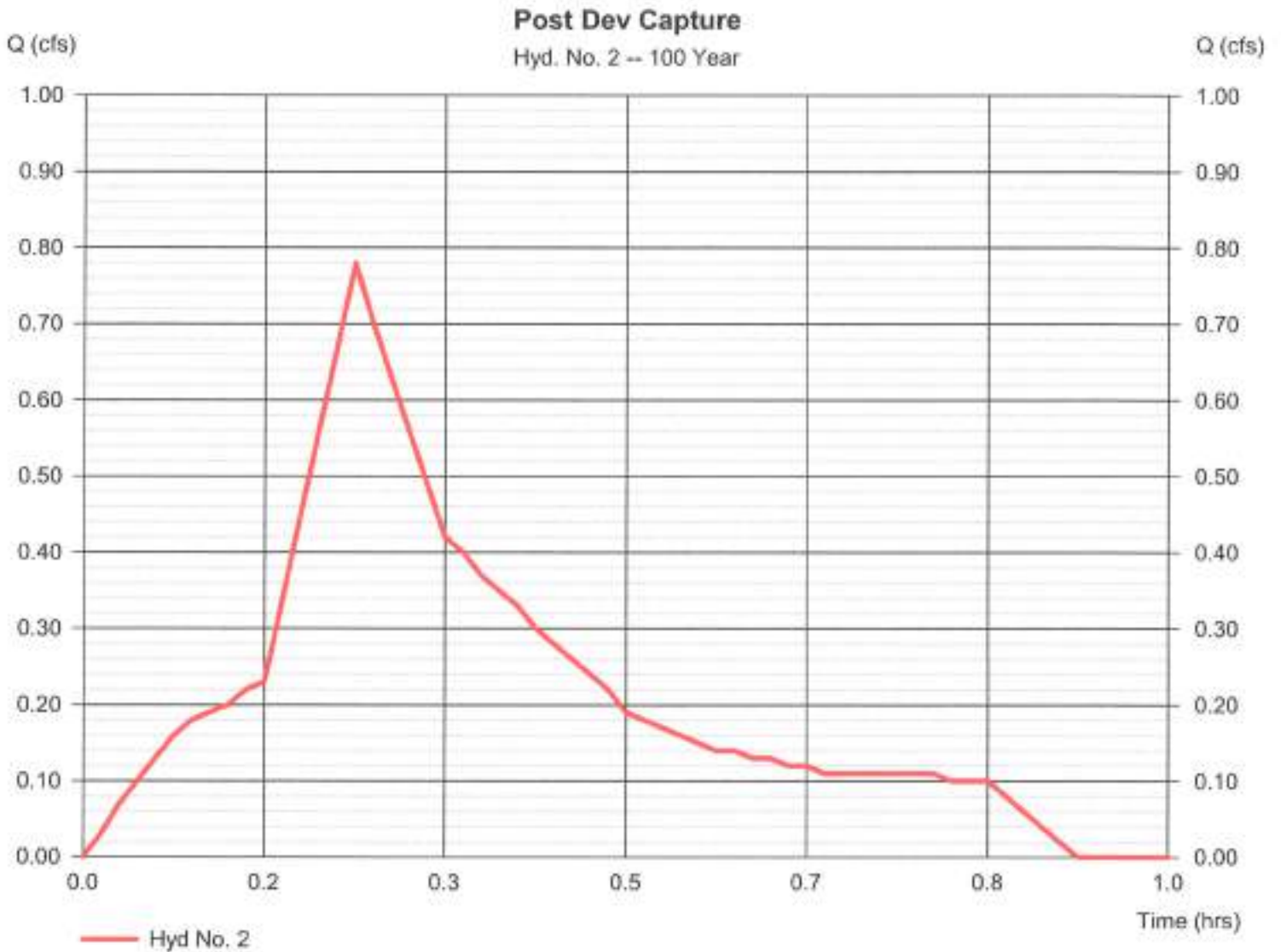
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Tuesday, 09 / 5 / 2023

Hyd. No. 2

Post Dev Capture

Hydrograph type	= Manual	Peak discharge	= 0.780 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 766 cuft





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UNIVERSAL RATIONAL HYDROGRAPH METHOD

Post-Development Bypass

Watershed Parameters	
T_c	5.00
$C (<25Yr)$	0.34
$C (\geq 25Yr)$	0.41
Area (A)	0.43

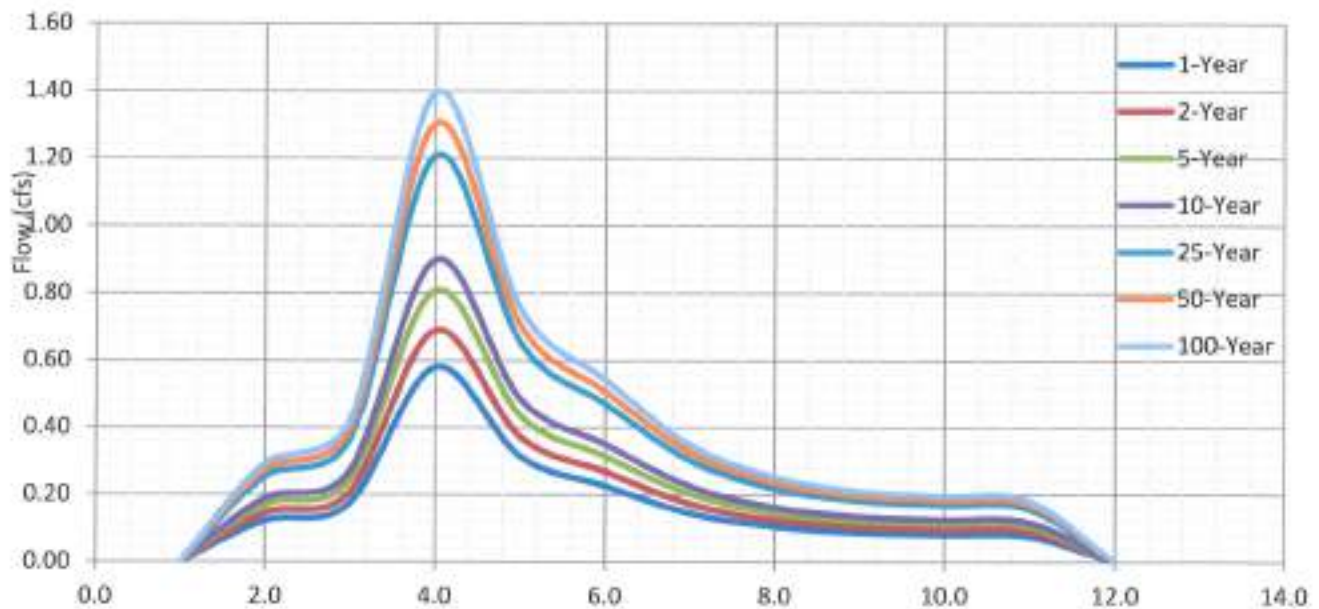
1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Runoff Coefficient C						
0.34	0.34	0.34	0.34	0.41	0.41	0.41

1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Precipitation intensity I (in/hr)						
4.06	4.82	5.65	6.29	7.00	7.55	8.08

12 Point Universal Hydrograph

Time (min)	Flow Q (cfs)						
	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.0	0.12	0.14	0.17	0.19	0.25	0.27	0.29
10.0	0.17	0.21	0.24	0.27	0.36	0.39	0.42
15.0	0.58	0.69	0.81	0.90	1.21	1.30	1.39
20.0	0.31	0.37	0.44	0.49	0.65	0.70	0.75
25.0	0.23	0.27	0.31	0.35	0.47	0.51	0.54
30.0	0.14	0.17	0.20	0.22	0.30	0.33	0.35
35.0	0.10	0.12	0.15	0.16	0.22	0.23	0.25
40.0	0.09	0.10	0.12	0.13	0.18	0.20	0.21
45.0	0.08	0.10	0.11	0.13	0.17	0.18	0.20
50.0	0.08	0.09	0.10	0.12	0.16	0.17	0.18
55.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Volume (cf)	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
	572	679	796	887	1,193	1,286	1,377

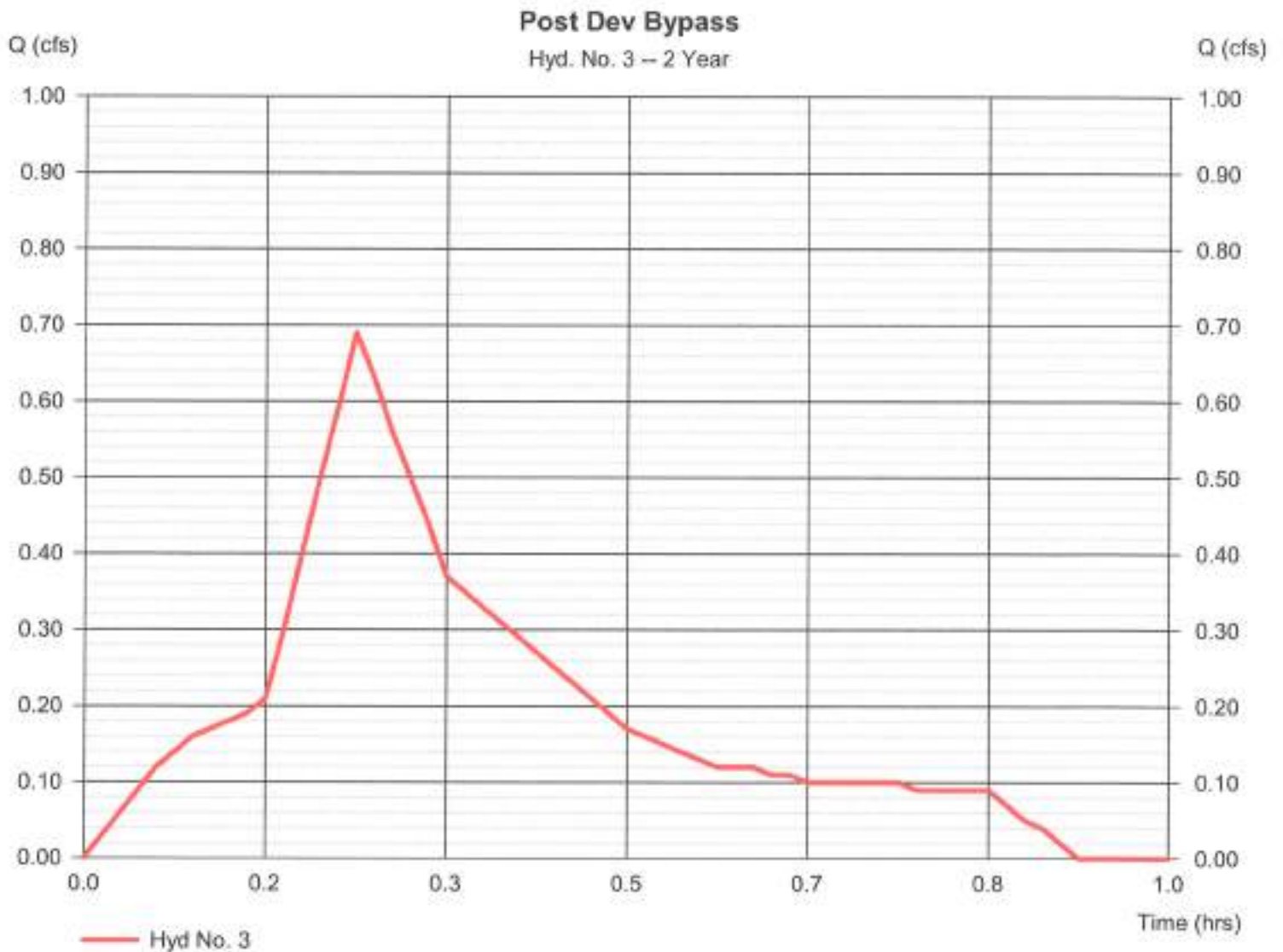


Hydrograph Report

Hyd. No. 3

Post Dev Bypass

Hydrograph type	= Manual	Peak discharge	= 0.690 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 679 cuft



Hydrograph Report

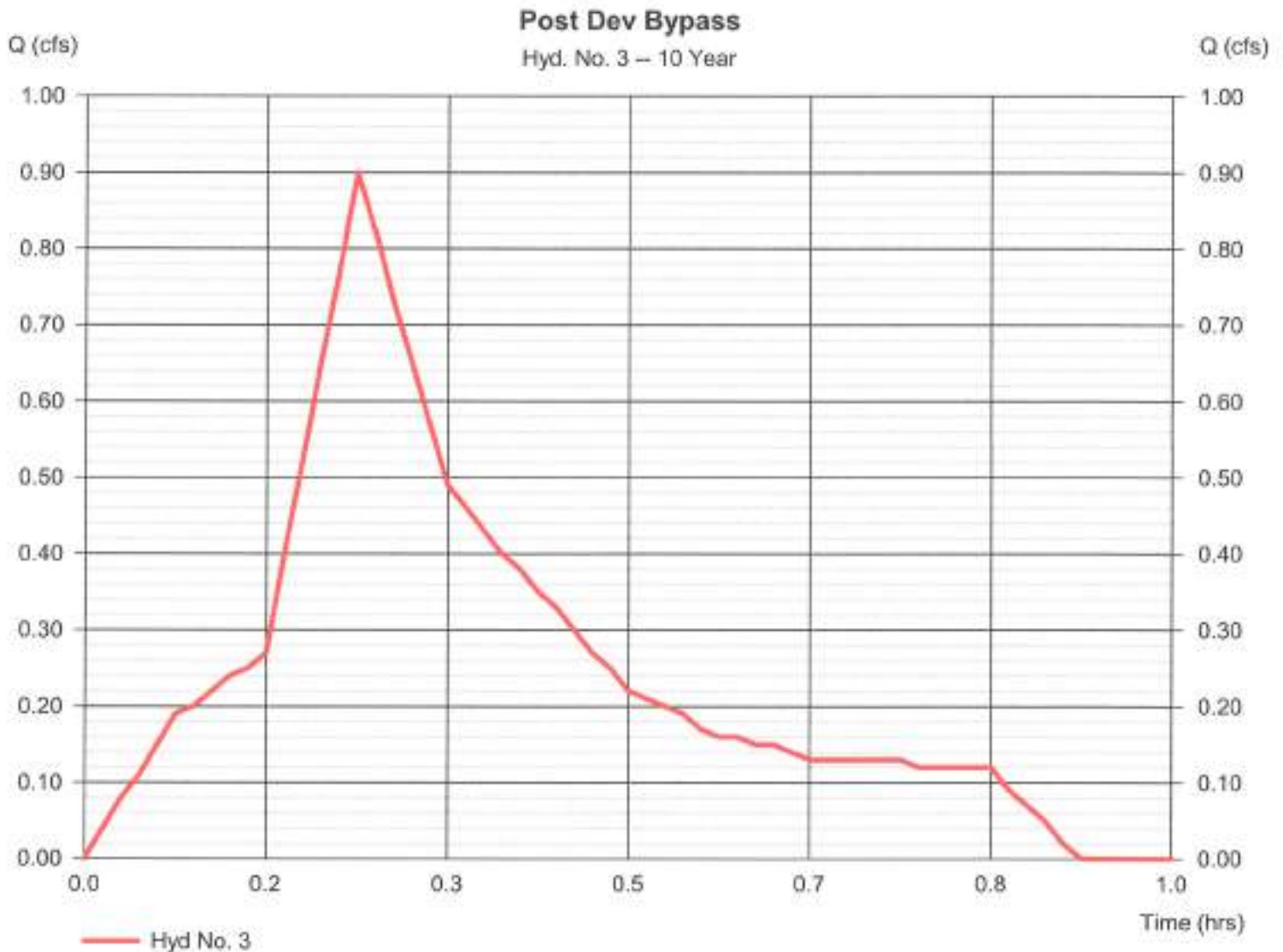
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Tuesday, 09 / 5 / 2023

Hyd. No. 3

Post Dev Bypass

Hydrograph type	= Manual	Peak discharge	= 0.900 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 887 cuft



Hydrograph Report

Hyd. No. 3

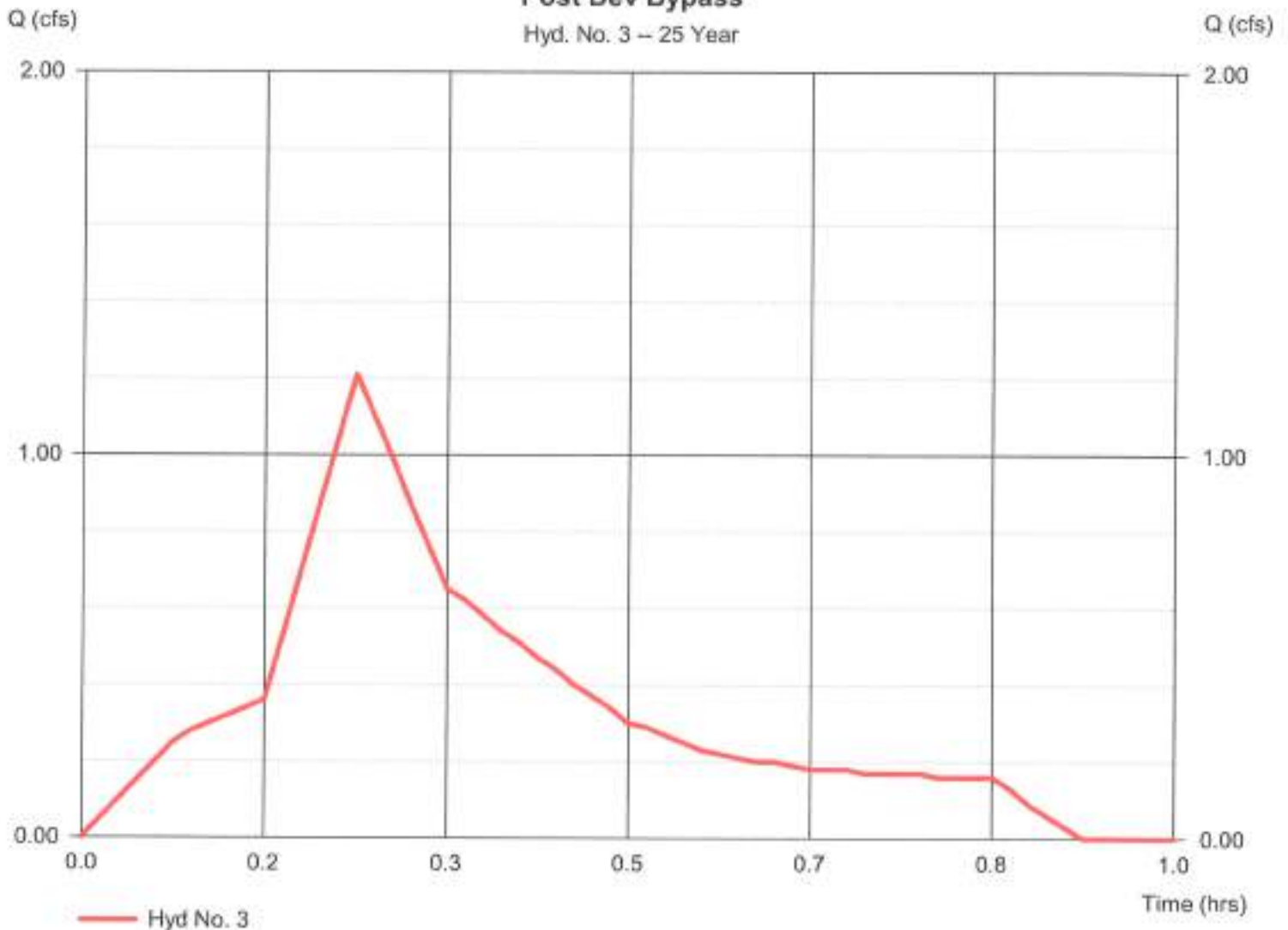
Post Dev Bypass

Hydrograph type = Manual
Storm frequency = 25 yrs
Time interval = 1 min

Peak discharge = 1,210 cfs
Time to peak = 0.25 hrs
Hyd. volume = 1,192 cuft

Post Dev Bypass

Hyd. No. 3 – 25 Year

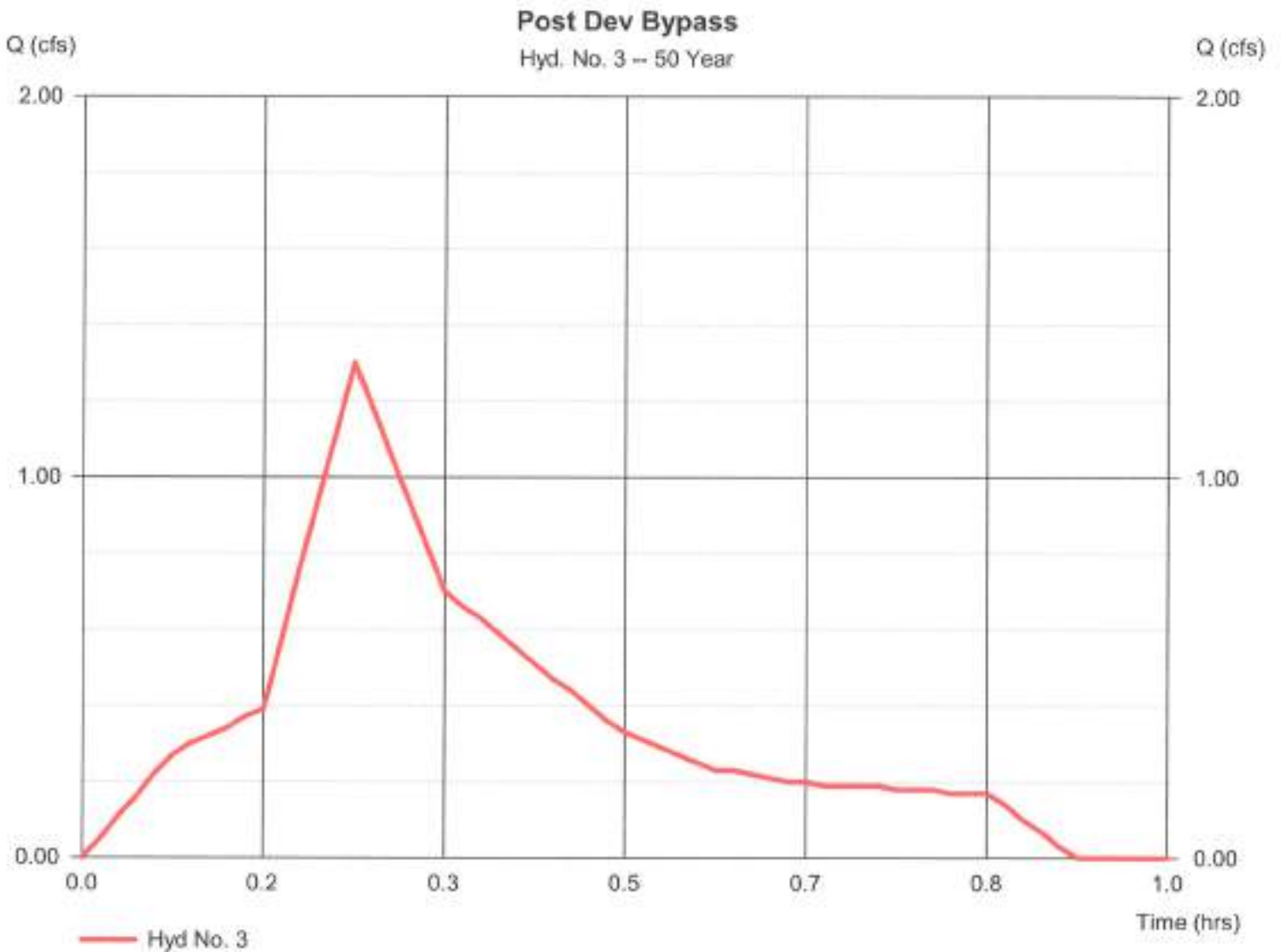


Hydrograph Report

Hyd. No. 3

Post Dev Bypass

Hydrograph type	= Manual	Peak discharge	= 1,300 cfs
Storm frequency	= 50 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 1,285 cuft

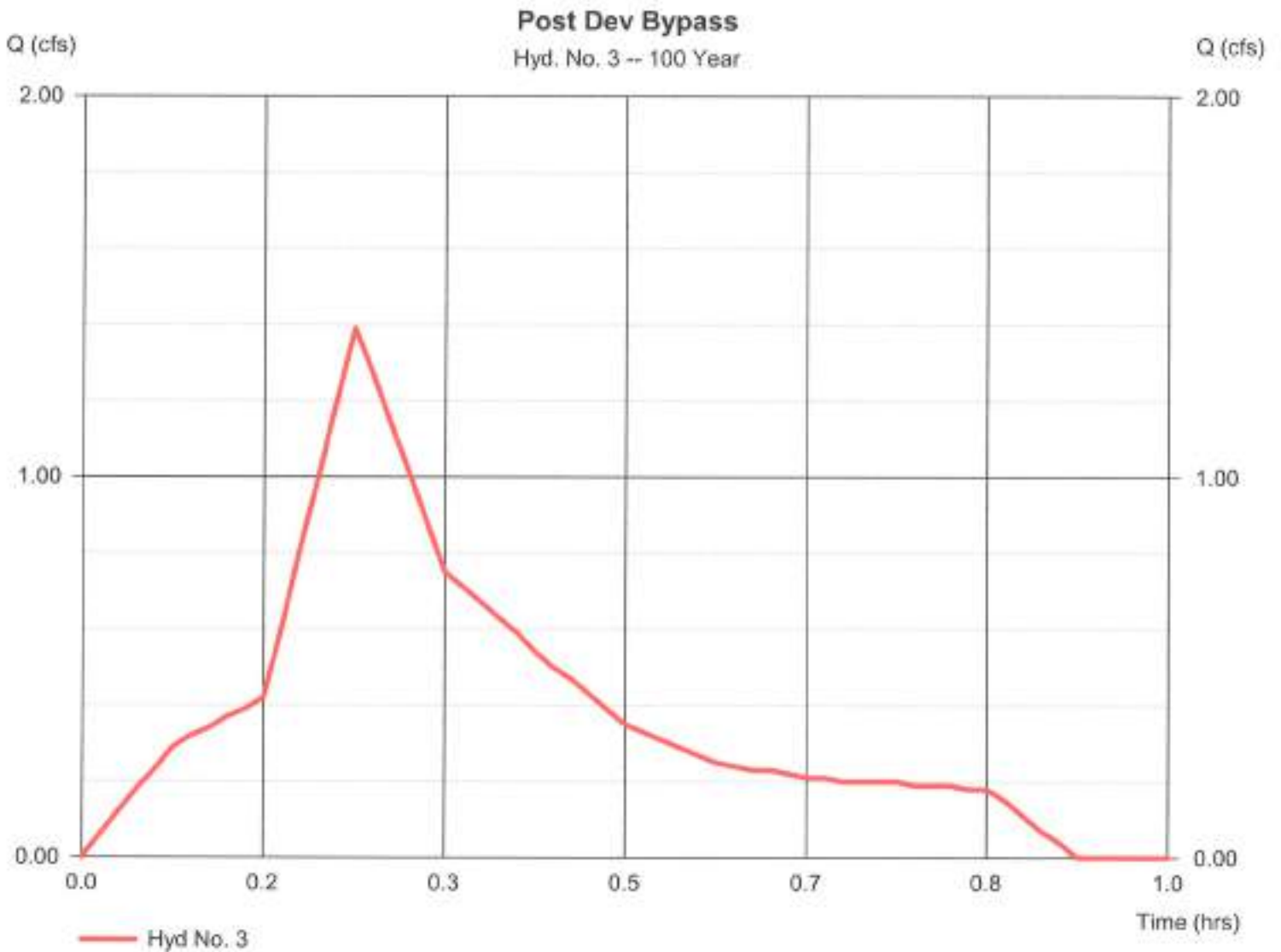


Hydrograph Report

Hyd. No. 3

Post Dev Bypass

Hydrograph type	= Manual	Peak discharge	= 1,390 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 1,377 cuft



Pond Report

Pond No. 1 - Infiltration Bed

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	540.00	n/a	0	0
0.25	540.25	n/a	31	31
0.50	540.50	n/a	67	122
0.75	540.75	n/a	67	204
1.00	541.00	n/a	95	299
1.25	541.25	n/a	102	401
1.50	541.50	n/a	105	506
1.75	541.75	n/a	105	611
2.00	542.00	n/a	102	713
2.25	542.25	n/a	35	804
2.50	542.50	n/a	91	891
2.75	542.75	n/a	87	951
3.00	543.00	n/a	51	1,012

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (ft)	= 12.00	5.00	inactive	inactive
Span (ft)	= 12.00	24.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 540.00	542.75	0.00	0.00
Length (ft)	= 40.00	0.00	0.00	0.00
Slope (%)	= 1.50	0.00	0.00	n/a
N-Value	= 112	612	.015	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 3.00	inactive	inactive	inactive
Crest El. (ft)	= 543.00	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)	= 1.500 (by Weir area)			
FW Elev. (ft)	= 0.50			

Note: Culverts and weirs are analyzed using either the full flow or the weir flow method. The flow method is used when the flow is full.

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Civ A cfs	Civ B cfs	Civ 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	540.00	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
0.25	31	540.25	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
0.50	122	540.50	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
0.75	204	540.75	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
1.00	299	541.00	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
1.25	401	541.25	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
1.50	506	541.50	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
1.75	611	541.75	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
2.00	713	542.00	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
2.25	804	542.25	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
2.50	891	542.50	0.85 ic	0.85 ic	---	---	0.00	---	---	---	0.000	---	0.851
2.75	951	542.75	2.19 ic	2.17 ic	---	---	0.00	---	---	---	0.000	---	2.167
3.00	1,012	543.00	2.95 ic	2.90 ic	---	---	0.00	---	---	---	0.000	---	2.953

Hydrograph Report

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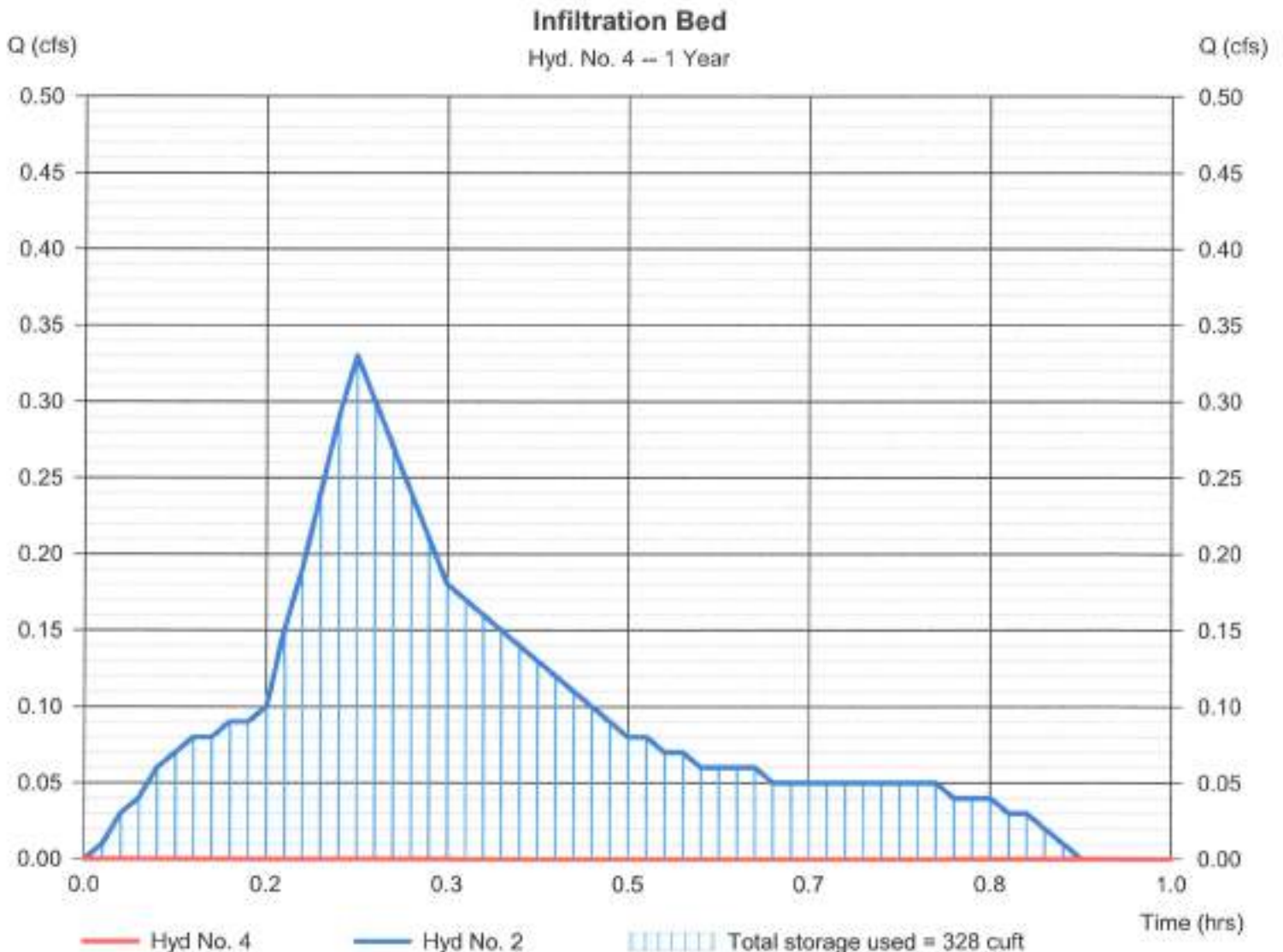
Tuesday, 09 / 5 / 2023

Hyd. No. 4

Infiltration Bed

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 1 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 2 - Post Dev Capture	Max. Elevation	= 541.07 ft
Reservoir name	= Infiltration Bed	Max. Storage	= 328 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Tuesday, 09 / 5 / 2023

Hyd. No. 4

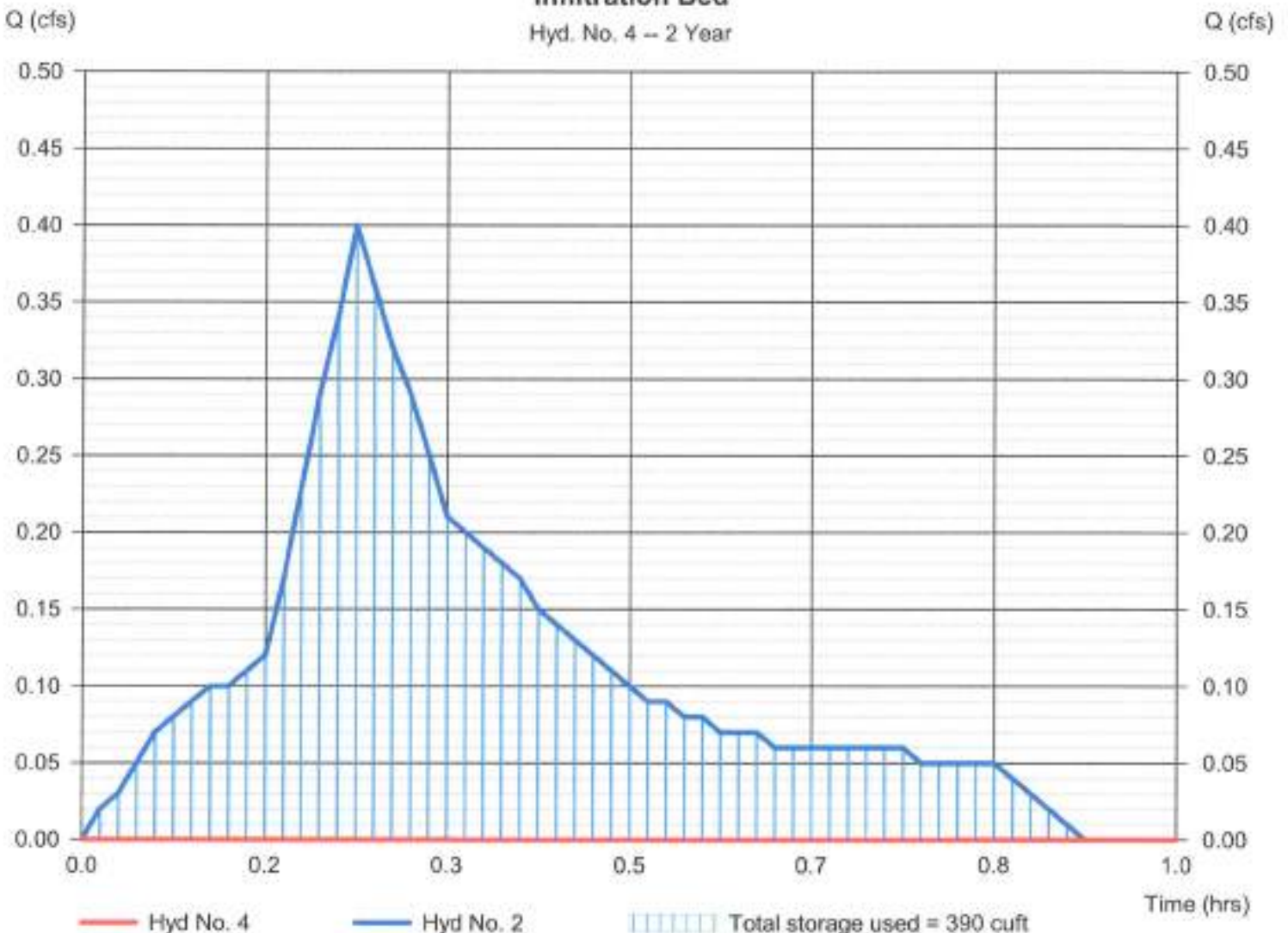
Infiltration Bed

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 2 - Post Dev Capture	Max. Elevation	= 541.22 ft
Reservoir name	= Infiltration Bed	Max. Storage	= 390 cuft

Storage Indication method used: Exfiltration extracted from Outflow.

Infiltration Bed

Hyd. No. 4 -- 2 Year



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

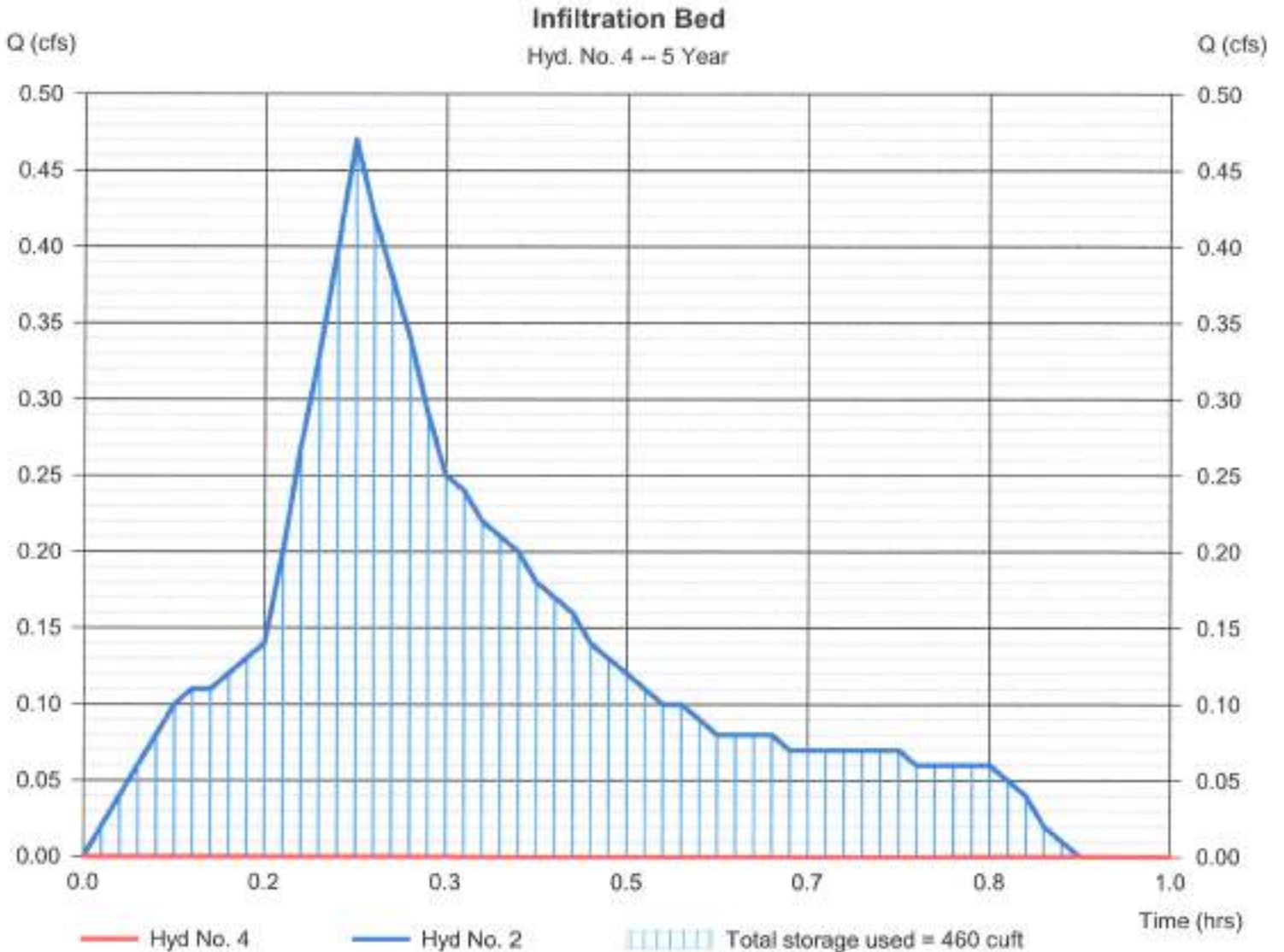
Tuesday, 09 / 5 / 2023

Hyd. No. 4

Infiltration Bed

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 5 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 2 - Post Dev Capture	Max. Elevation	= 541.39 ft
Reservoir name	= Infiltration Bed	Max. Storage	= 460 cuft

Storage Indication method used, Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

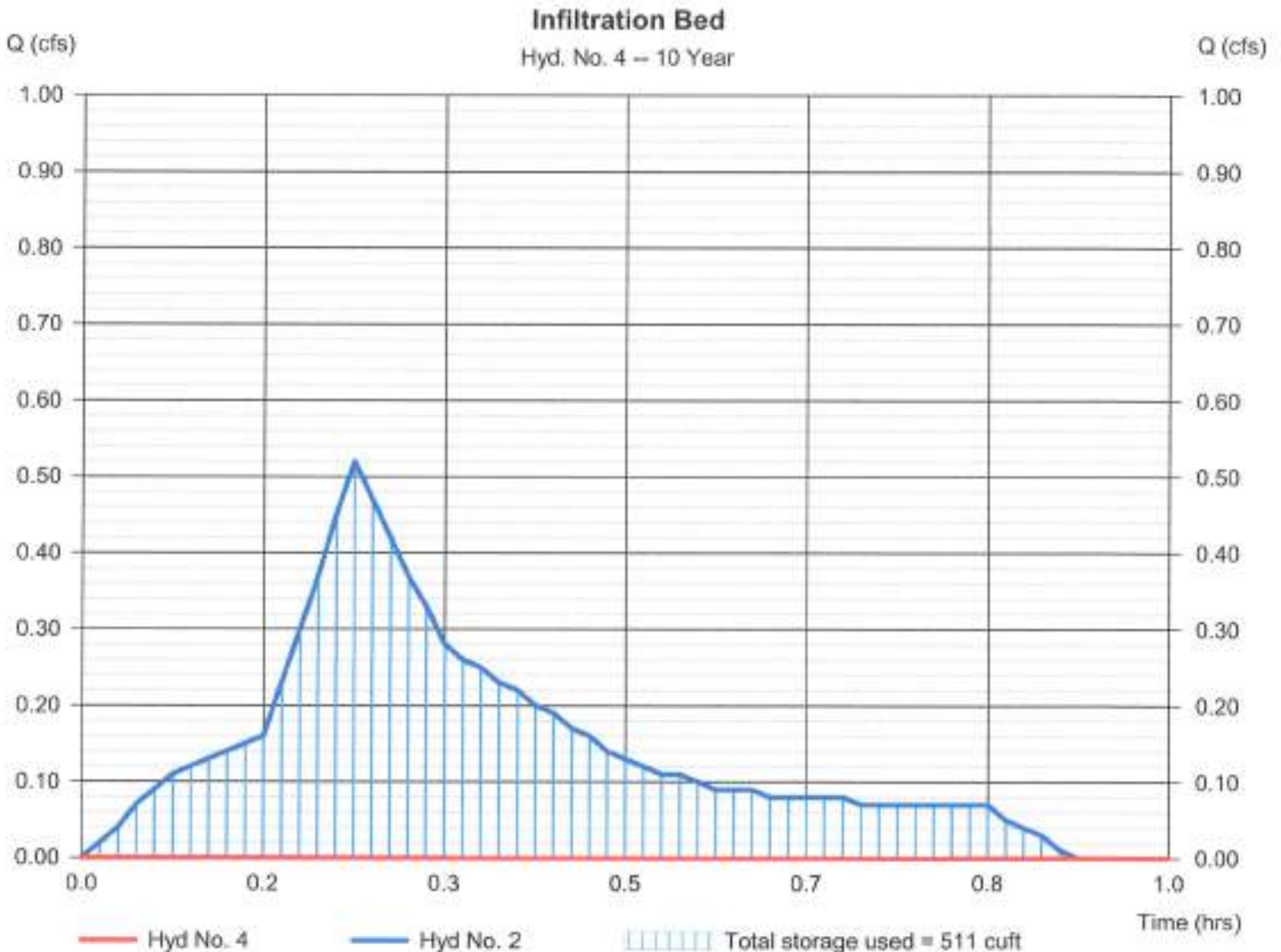
Tuesday, 09 / 5 / 2023

Hyd. No. 4

Infiltration Bed

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 2 - Post Dev Capture	Max. Elevation	= 541.51 ft
Reservoir name	= Infiltration Bed	Max. Storage	= 511 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydrflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

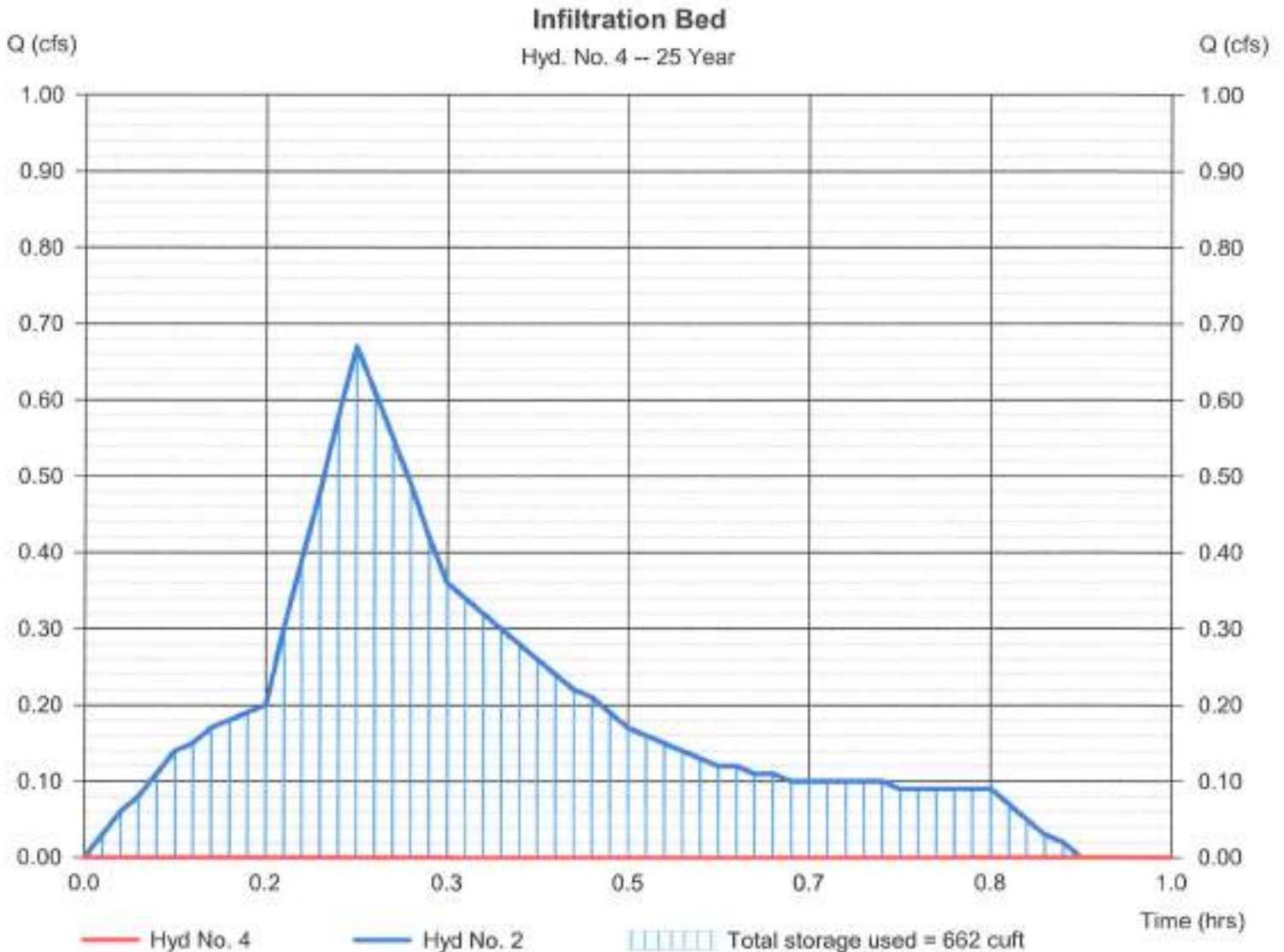
Tuesday, 09 / 5 / 2023

Hyd. No. 4

Infiltration Bed

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 25 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 2 - Post Dev Capture	Max. Elevation	= 541.88 ft
Reservoir name	= Infiltration Bed	Max. Storage	= 662 cuft

Storage indication method used: Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

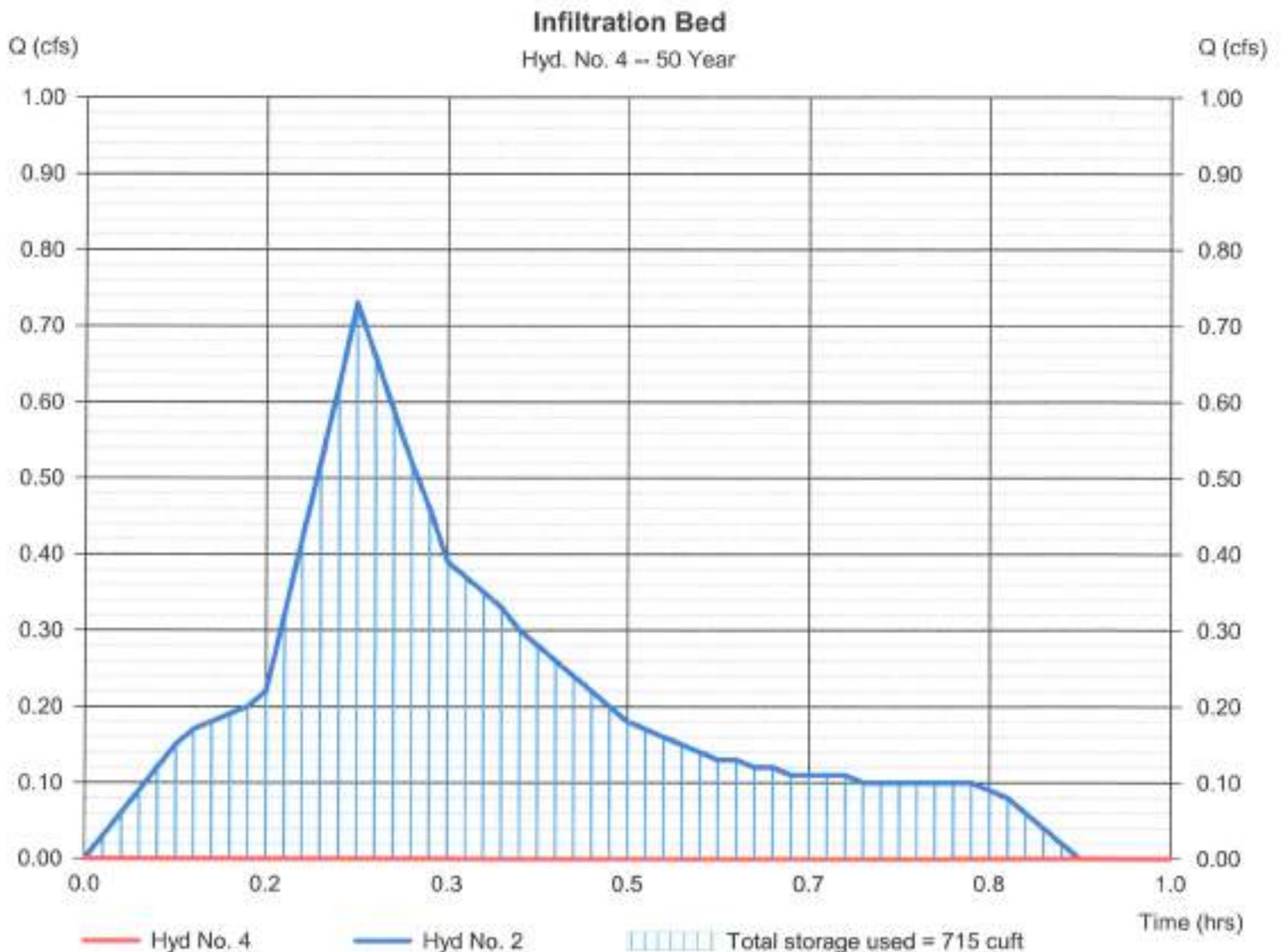
Tuesday, 09 / 5 / 2023

Hyd. No. 4

Infiltration Bed

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 50 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 2 - Post Dev Capture	Max. Elevation	= 542.01 ft
Reservoir name	= Infiltration Bed	Max. Storage	= 715 cuft

Storage indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

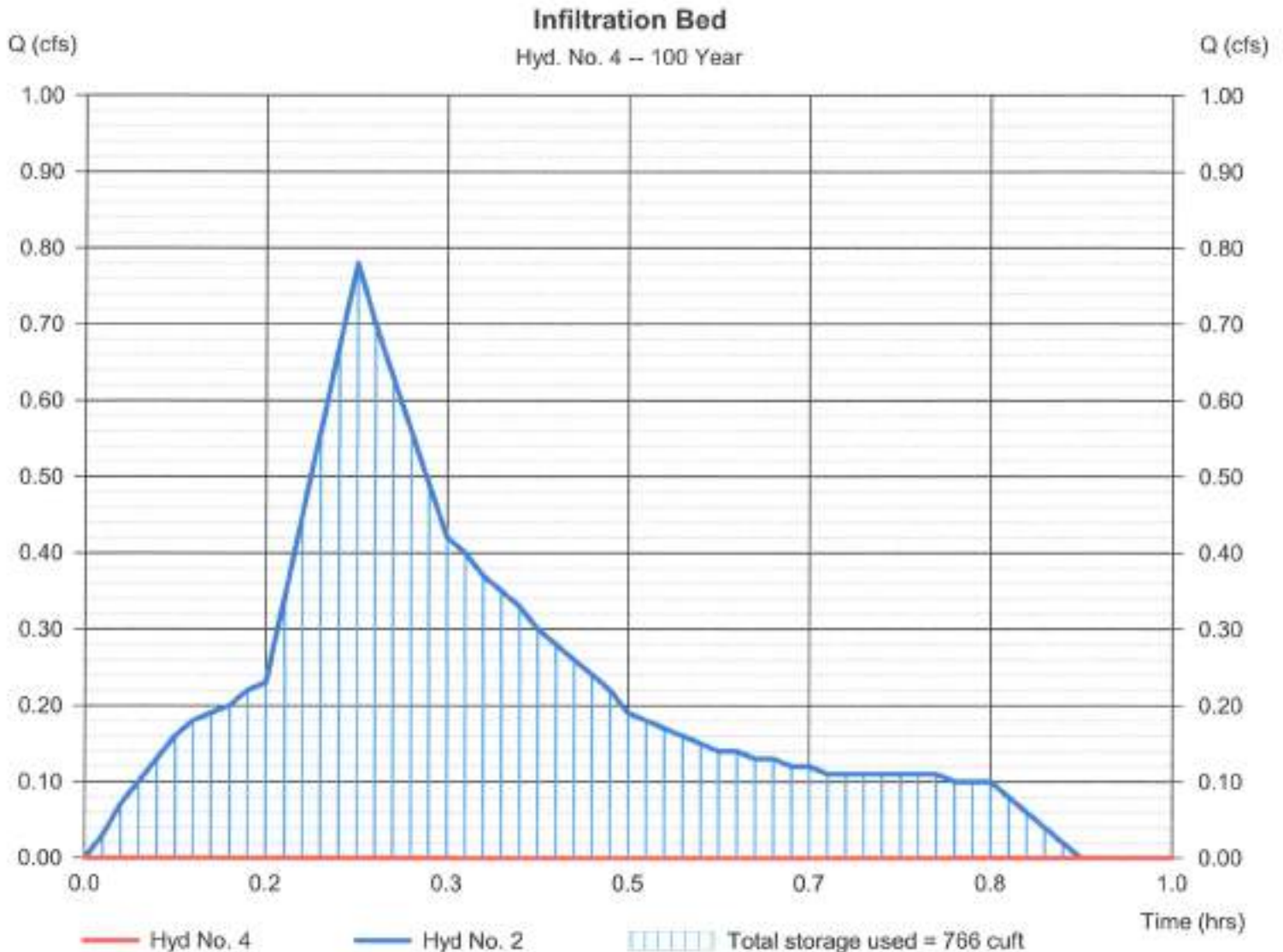
Tuesday, 09 / 5 / 2023

Hyd. No. 4

Infiltration Bed

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= n/a
Time interval	= 1 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 2 - Post Dev Capture	Max. Elevation	= 542.14 ft
Reservoir name	= Infiltration Bed	Max. Storage	= 766 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



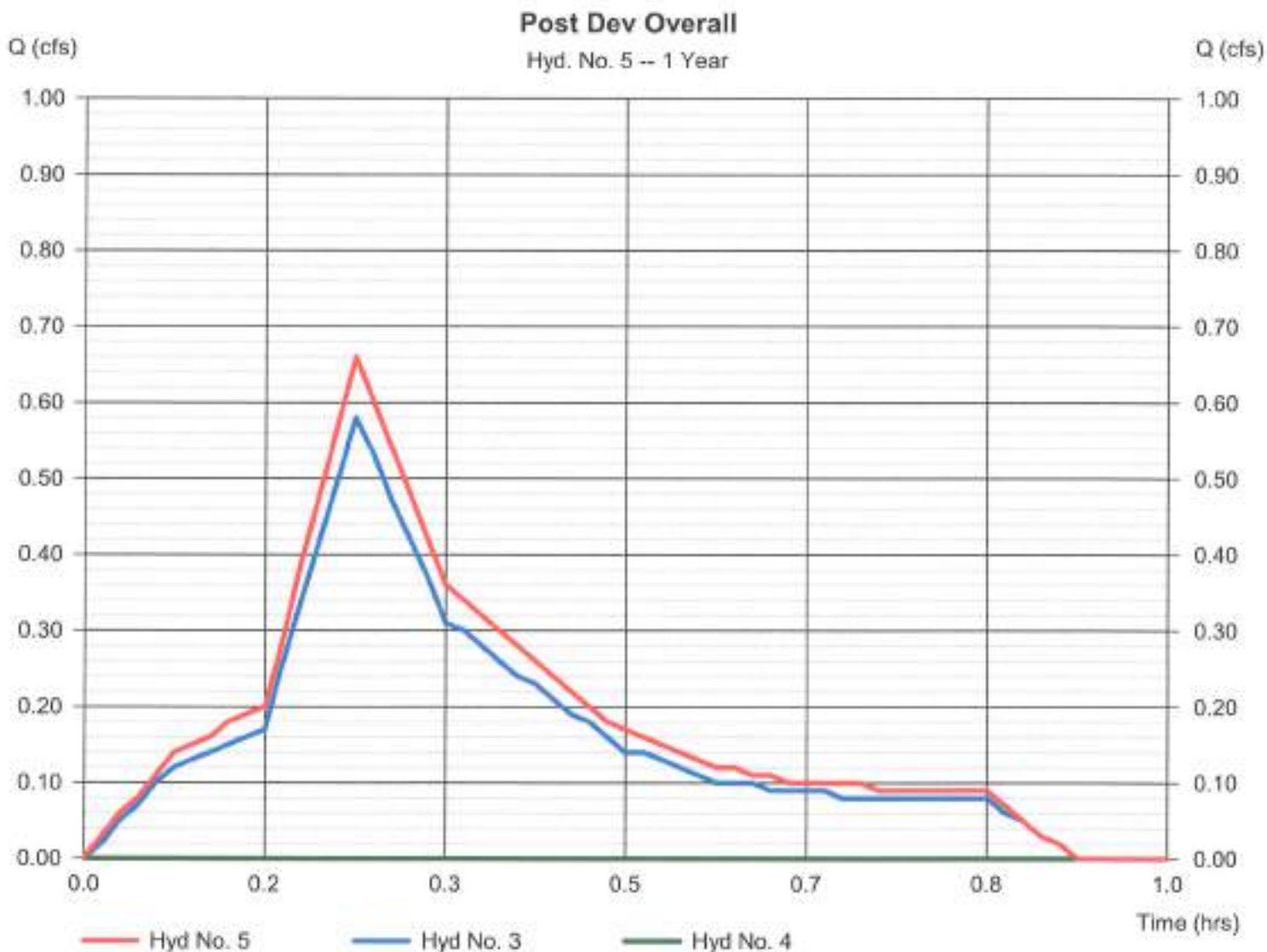
Hydrograph Report

Hyd. No. 5

Post Dev Overall

Hydrograph type = Combine
Storm frequency = 1 yrs
Time interval = 1 min
Inflow hyds. = 3, 4

Peak discharge = 0.660 cfs
Time to peak = 0.25 hrs
Hyd. volume = 656 cuft
Contrib. drain. area = 0.000 ac



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Tuesday, 09 / 5 / 2023

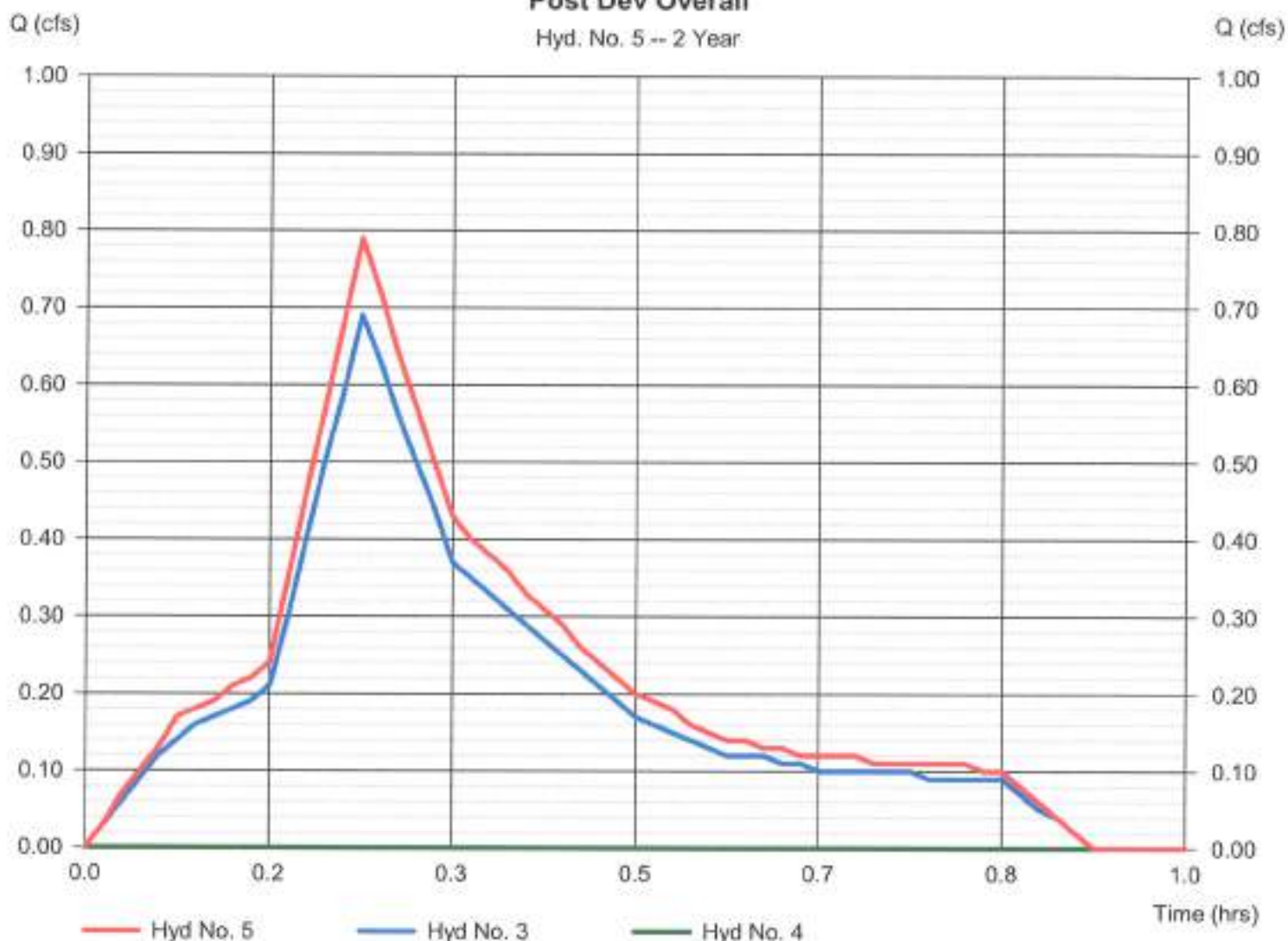
Hyd. No. 5

Post Dev Overall

Hydrograph type	= Combine	Peak discharge	= 0.790 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 780 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.000 ac

Post Dev Overall

Hyd. No. 5 -- 2 Year



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Tuesday, 09 / 5 / 2023

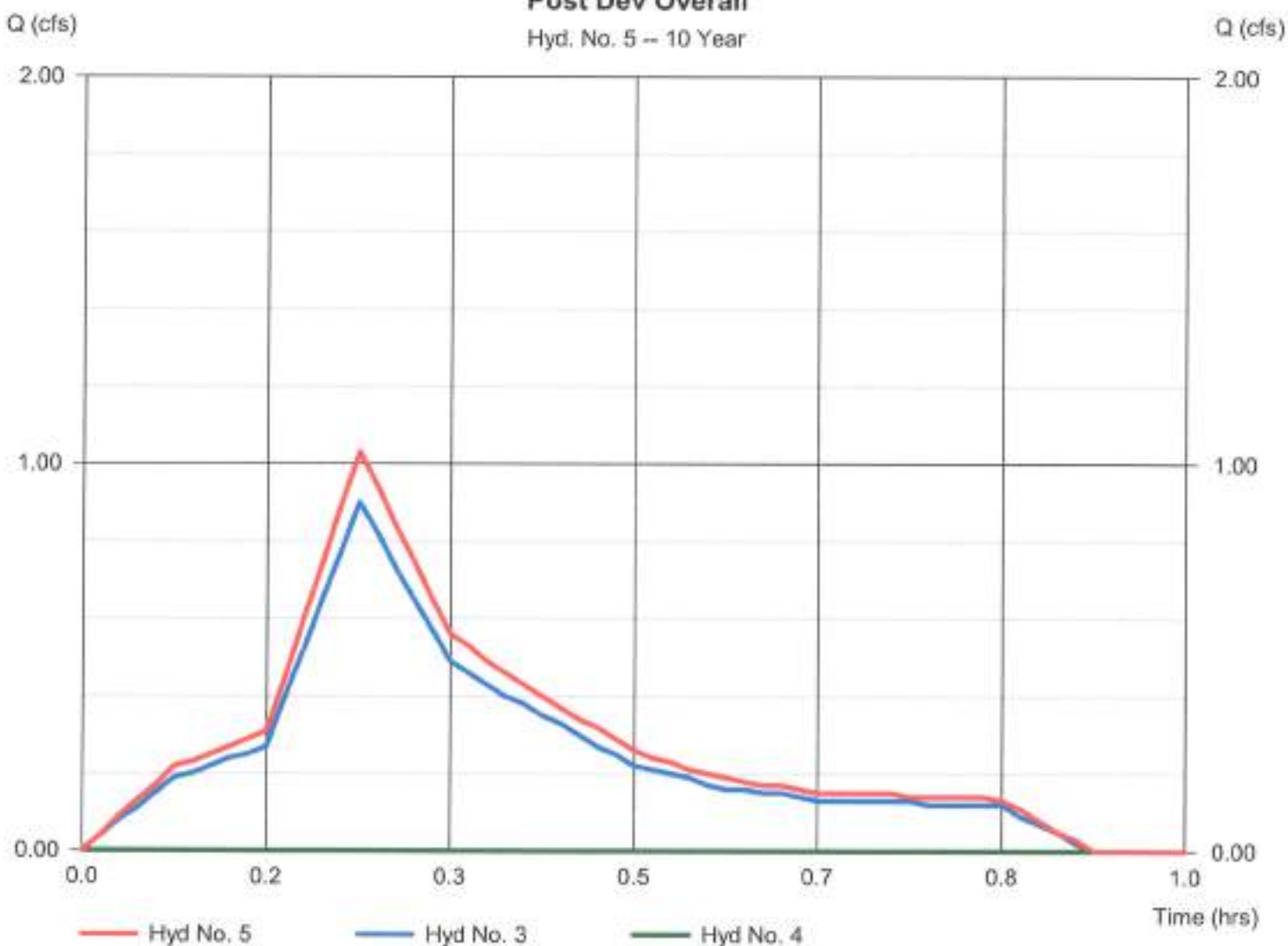
Hyd. No. 5

Post Dev Overall

Hydrograph type	= Combine	Peak discharge	= 1.030 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 1,016 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.000 ac

Post Dev Overall

Hyd. No. 5 -- 10 Year



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Tuesday, 09 / 5 / 2023

Hyd. No. 5

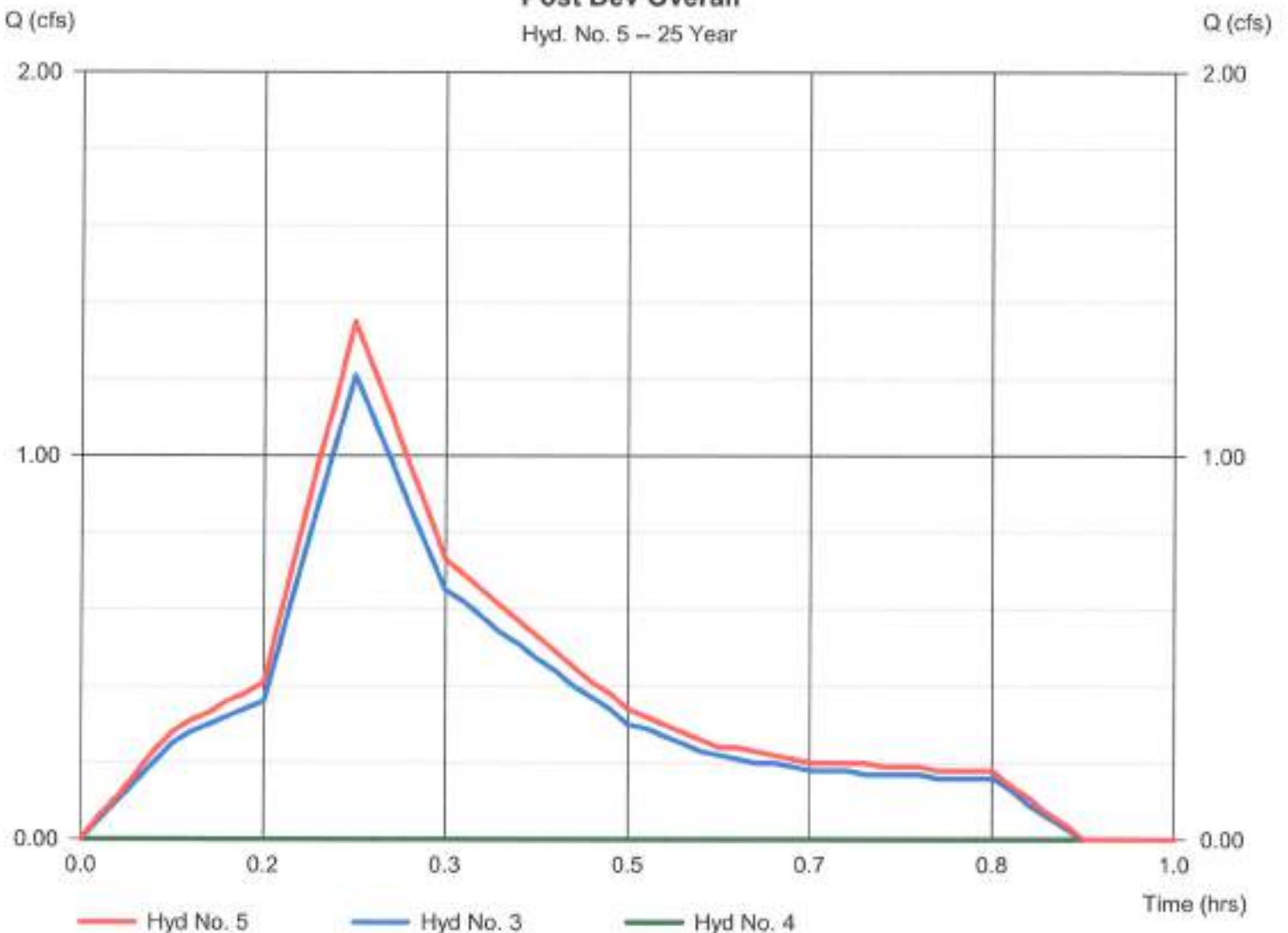
Post Dev Overall

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyds. = 3, 4

Peak discharge = 1.350 cfs
Time to peak = 0.25 hrs
Hyd. volume = 1,338 cuft
Contrib. drain. area = 0.000 ac

Post Dev Overall

Hyd. No. 5 -- 25 Year



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

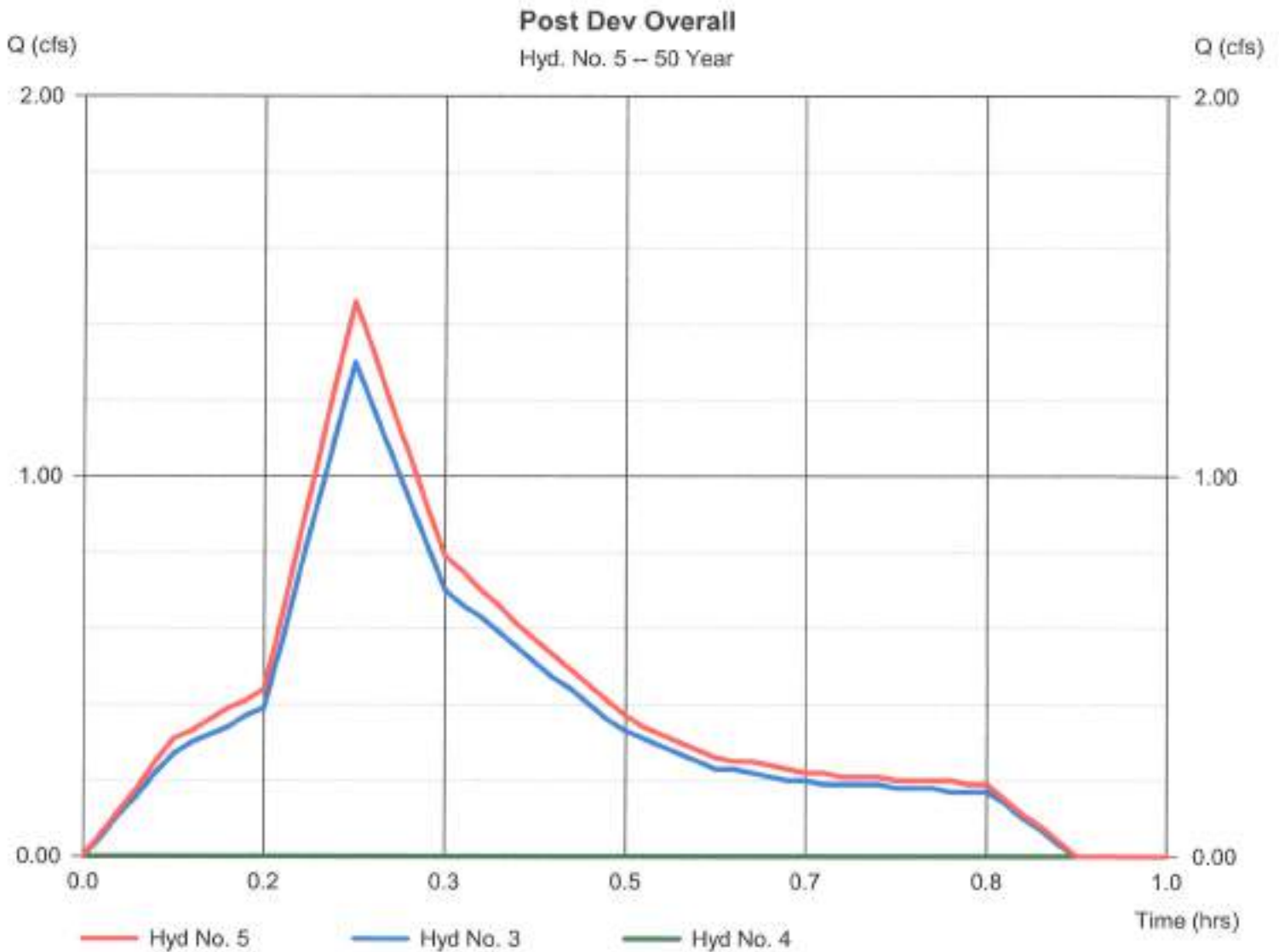
Tuesday, 09 / 5 / 2023

Hyd. No. 5

Post Dev Overall

Hydrograph type = Combine
 Storm frequency = 50 yrs
 Time interval = 1 min
 Inflow hyds. = 3, 4

Peak discharge = 1,460 cfs
 Time to peak = 0.25 hrs
 Hyd. volume = 1,442 cuft
 Contrib. drain. area = 0.000 ac



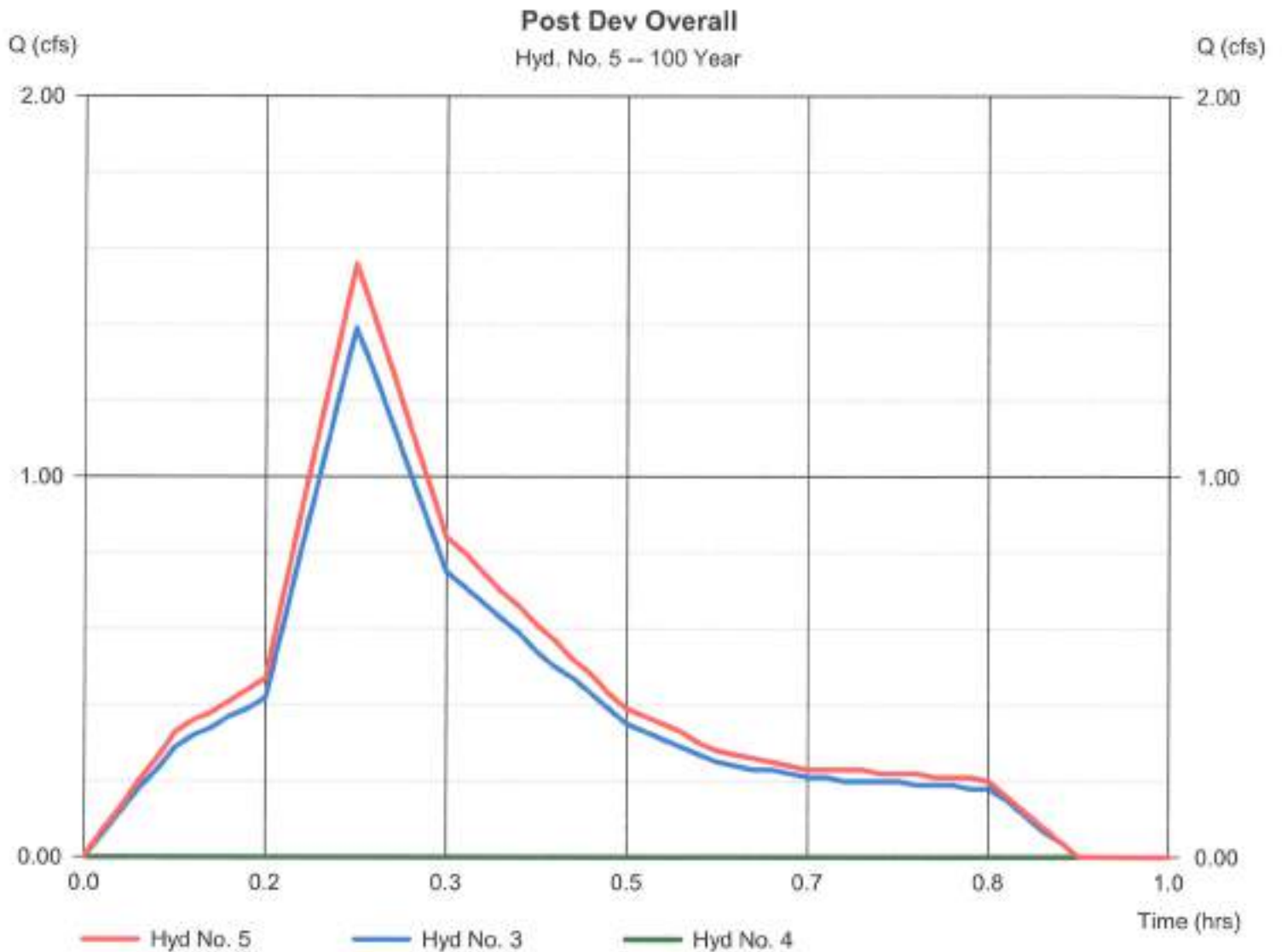
Hydrograph Report

Hyd. No. 5

Post Dev Overall

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 1 min
Inflow hyds. = 3, 4

Peak discharge = 1.560 cfs
Time to peak = 0.25 hrs
Hyd. volume = 1,543 cuft
Contrib. drain. area = 0.000 ac





BARRY ISETT & ASSOCIATES, INC.

Multidiscipline Engineers & Consultants

www.barryisett.com

SUMMARY OF PEAK FLOWS

Rational Method

Peak Flow Rate (CFS)

Pre-Development	1-Yr	2-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<i>Pre-Development Total</i>	0.73	0.86	1.13	1.52	1.64	1.75
<i>Release Rate Requirements</i>	-	100%	100%	100%	100%	100%
<i>Pre-Development Allowable Flows</i>	0.73	0.86	1.13	1.52	1.64	1.75

Post-Development	1-Yr	2-Yr	10-Yr	25-Yr	50-Yr	100-Yr
<i>Inf. Basin Capture</i>	0.33	0.40	0.52	0.67	0.73	0.78
<i>Inf. Basin Release</i>	0.00	0.00	0.00	0.00	0.00	0.00
<i>Bypass</i>	0.58	0.69	0.90	1.21	1.30	1.39
<i>Inf. Basin Release and Bypass Combination</i>	0.66	0.69	0.90	1.21	1.30	1.39
<i>Post-Development Total</i>	0.66	0.69	0.90	1.21	1.30	1.39
<i>Net Change</i>	-0.07	-0.18	-0.23	-0.31	-0.34	-0.36

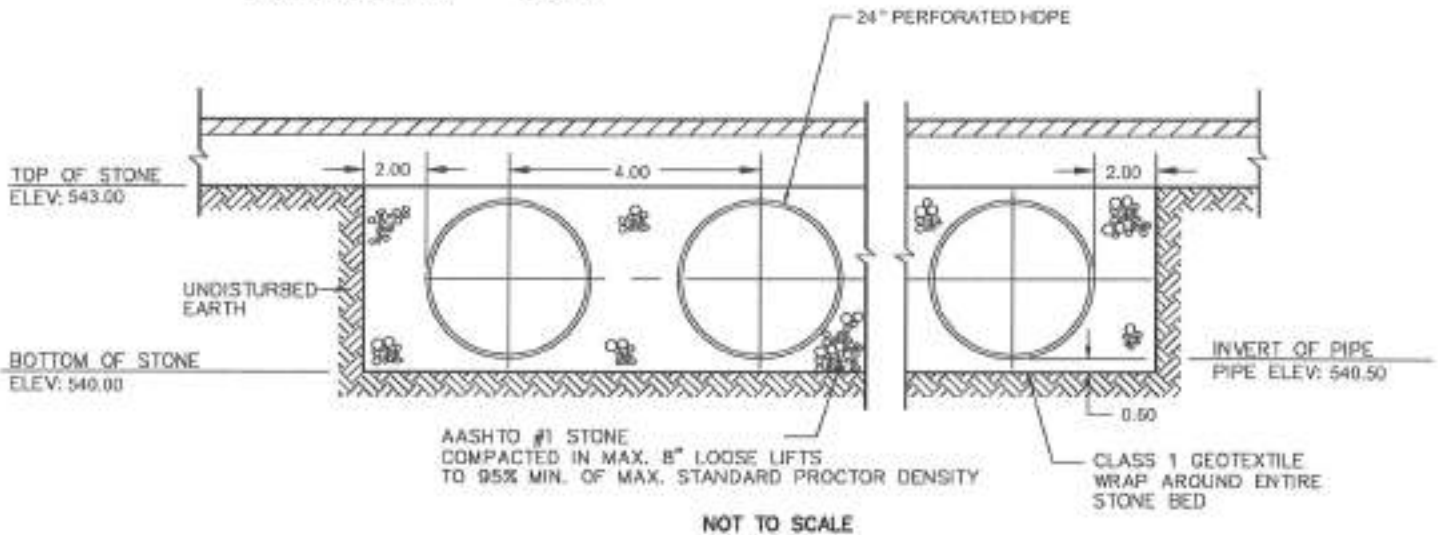


DART BELL & ASSOCIATES, INC.
 Consulting Engineers & Surveyors
 85 S. Route 100
 Allentown, PA 18106

PROJECT: Watergap Wellness Storage & Golf Cart Building
LOCATION: Smithfield Twp.
COUNTY: Monroe

**PROPOSED SUBSURFACE INFILTRATION SYSTEM
 24-INCH PERFORATED PIPE W/STONE BED**

Pipe Diameter	24 in	System Dimensions	
Total Length	30 ft		
Pipe Storage	462 ft ³	Bed Footprint	612 sf
Total Storage (ft³)	1,257 ft ³	Height	3.00 ft



STORAGE - ELEVATION

Elevation	Volume	Stone		Pipe	Total Storage	
		Volume	Void Space		ft ³	acre*ft
540.00	0	0	0	0	0	0.000
540.25	153	153	61	0	61	0.001
540.50	306	306	122	0	122	0.003
540.75	459	426	170	33	204	0.005
541.00	612	522	209	90	299	0.007
541.25	765	607	243	158	401	0.009
541.50	918	687	275	231	506	0.012
541.75	1,071	767	307	304	611	0.014
542.00	1,224	852	341	372	713	0.016
542.25	1,377	948	379	429	808	0.019
542.50	1,530	1,068	427	462	889	0.020
542.75	1,683	1,221	488	462	951	0.022
543.00	1,836	1,374	550	462	1,012	0.023



Appendix D – Groundwater Recharge



BARRY ISETT & ASSOCIATES, INC.

Multidiscipline Engineers & Consultants

www.barryissett.com

PROJECT: Watergap Wellness Storage

CALCULATED BY: DHC

CHECKED BY: _____

SHEET: 1 OF 1

CREATED/LAST REVISED: _____

§224. Ground Water Recharge Calculations (Infiltration)

$$Recharge Volume (Re_v) = \frac{\left(\frac{200}{CN} - 2\right) (Impervious Area (SF))}{12 \frac{in}{ft}} \quad [Eqn. 305.2]$$

$CN = 73$ (Existing Conditions nearly all Meadow, HSG C)

$A_{imp} = 10,000 sf$

$$Re_v = \frac{\left(\frac{200}{73} - 2\right)(4,980)}{12} = 306.99 cf$$

Check: 1,285 cf treated in BMP, OK

Watergap Wellness Center Cart Building

Project #: 11/27/18 0003
 Smithfield Township, Monroe County
 Machine No. UTM, Date: 2/12/2023
 File Name: 57, Date: _____



CONVEYANCE RUNOFF CALCULATIONS

Design Storm: 25-Year Storm

Structure	Total Drainage	Cover Conditions (Acres)							Runoff (Q)	TOC (ft/min)	Rainfall Intensity (1.50)	Runoff Q (cfs)	Combine of Runoff (cfs)	Contributing Area
		Type A	Type B	Type C	Type D	Type E	Type F	Type G						
A	0.11	0.11						0.07	3		0.6	0.6		

Runoff Coefficients for Cover Conditions

Type	Description	Coefficient
Type A	In pervious 6% Slopes	0.87
Type B	Meadowland (50% Gr. 60% Slopes)	0.39
Type C	Meadowland (20% Gr. 40% Slopes)	0.43
Type D	Gravel (1-5% Gr. 1%+ Slopes)	0.50
Type E	Gravel (5-10% Gr. 6%+ Slopes)	0.61
Type F	Forest/Woods (1-5% Gr. 6%+ Slopes)	0.30
Type G		

NOTES:

- * Station Coordinates were taken from Paave W. J. S. Wang and R. J. McQueen, 1981, "Comparison of Urban Flood Frequency Procedures", Pennsylvania Dept. of Transportation.
- ** Rainfall intensities were taken from NOAA Atlas 14, Muscovy, PA.
- *** 100-year 25-Year rule only for design.
- **** All of Final Development 5/24/18 assumed to flow to Inlet 5 to be conservative for capacity analysis.

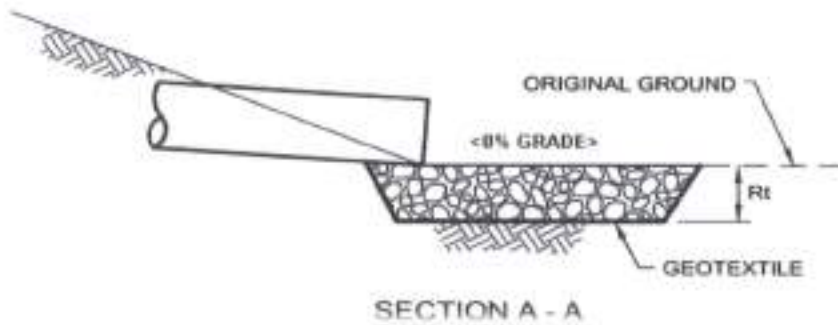
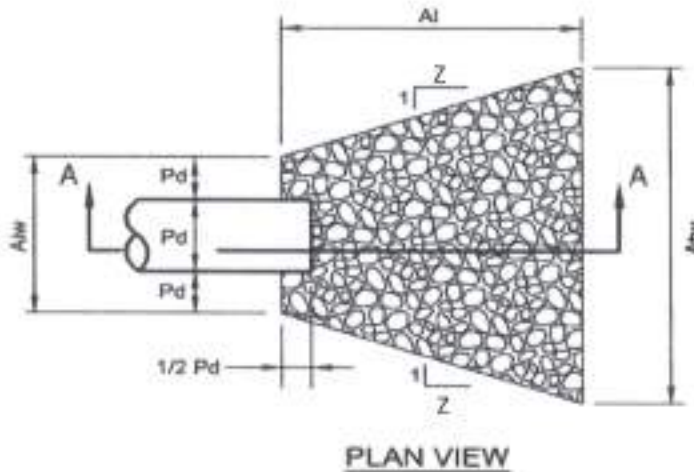
*Appendix E – Water Quality and
Streambank Erosion*

STANDARD E and S WORKSHEET #20

RipRap Apron Outlet Protection



Project Name: Rice Twp. Park Multipurpose Field
 Project #: 140802.005
 Calculated By: DHC
 Checked By: _____
 Date: _____

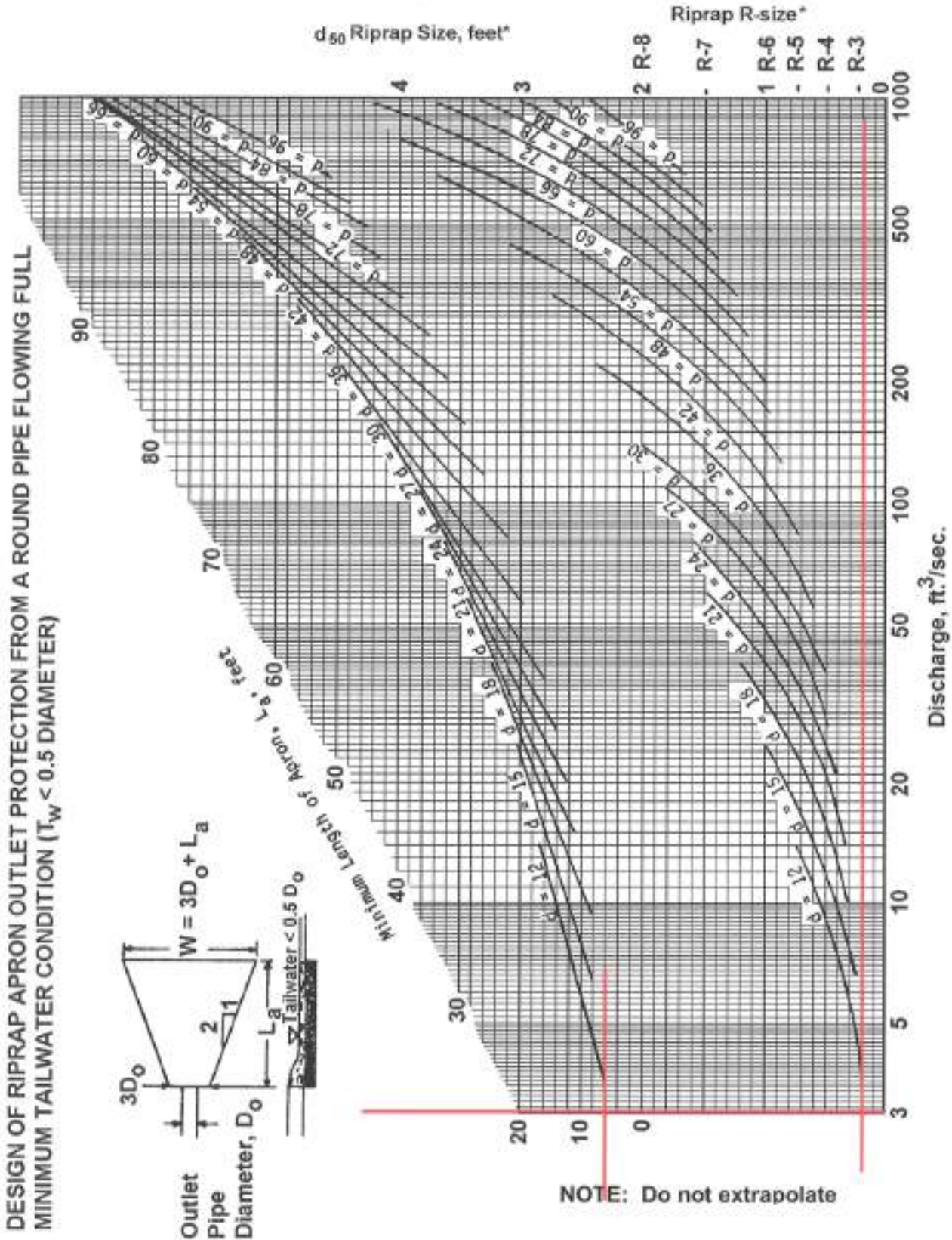


NO.	PIPE DIA. D_o (IN)	TAIL WATER COND. (Max or Min)	MAN. "n" FOR PIPE	PIPE SLOPE (FT/FT)	Q (CFS)	V* (FPS)	RIPRAP Size	Al (FT)	Rt (IN)	Alw (FT)	Z**	Atw** (FT)
RA-1	12	MIN	0.015	0.013	1.20	4.10	R-3	6	9	3	2	9

*: The anticipated velocity (V) should not exceed the maximum permissible shown in Table 6.6 for the proposed riprap protection. Adjust for less than full pipe flow. Use Manning's equation to calculate velocity for pipe slopes ≥ 0.05 ft/ft.

** : Atw calculated using appropriate Z-value and formula from figure 9.3 or 9.4.

FIGURE 9.3
Riprap Apron Design, Minimum Tailwater Condition



* For discharge velocities exceeding Maximum Allowable for Riprap indicated, increase d_{50} stone size and/or provide velocity reduction device.

Adapted from USDA - NRCS

Not to be used for Box Culverts

Appendix F – Reference Information



NOAA Atlas 14, Volume 2, Version 3
Location name: Stroudsburg, Pennsylvania, USA*
Latitude: 40.9757°, Longitude: -75.1457°
Elevation: 512 ft**
* source: ESRI Maps
** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonn, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aeriels](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.326 (0.291-0.365)	0.390 (0.348-0.437)	0.469 (0.416-0.525)	0.534 (0.472-0.596)	0.620 (0.544-0.692)	0.695 (0.605-0.776)	0.779 (0.671-0.870)	0.867 (0.738-0.972)	1.01 (0.843-1.14)	1.12 (0.926-1.28)
10-min	0.514 (0.459-0.576)	0.617 (0.551-0.692)	0.741 (0.657-0.829)	0.840 (0.743-0.938)	0.972 (0.852-1.08)	1.08 (0.944-1.21)	1.21 (1.04-1.35)	1.34 (1.14-1.50)	1.54 (1.29-1.73)	1.71 (1.41-1.94)
15-min	0.638 (0.569-0.714)	0.766 (0.684-0.860)	0.926 (0.821-1.04)	1.05 (0.928-1.17)	1.22 (1.07-1.36)	1.38 (1.18-1.52)	1.51 (1.30-1.69)	1.68 (1.43-1.88)	1.93 (1.62-2.18)	2.14 (1.76-2.43)
30-min	0.862 (0.769-0.964)	1.04 (0.932-1.17)	1.30 (1.15-1.45)	1.49 (1.32-1.67)	1.77 (1.55-1.97)	2.01 (1.74-2.24)	2.26 (1.95-2.53)	2.55 (2.17-2.86)	2.98 (2.50-3.36)	3.36 (2.77-3.82)
60-min	1.06 (0.950-1.19)	1.30 (1.16-1.46)	1.65 (1.46-1.84)	1.93 (1.70-2.15)	2.33 (2.04-2.60)	2.68 (2.34-3.00)	3.08 (2.65-3.44)	3.53 (3.00-3.95)	4.21 (3.53-4.75)	4.82 (3.98-5.48)
2-hr	1.29 (1.16-1.43)	1.57 (1.41-1.75)	1.98 (1.78-2.21)	2.33 (2.08-2.59)	2.85 (2.53-3.17)	3.33 (2.93-3.70)	3.88 (3.38-4.31)	4.52 (3.90-5.04)	5.53 (4.69-6.23)	6.47 (5.40-7.33)
3-hr	1.44 (1.30-1.59)	1.74 (1.57-1.93)	2.17 (1.96-2.41)	2.53 (2.28-2.80)	3.09 (2.76-3.42)	3.59 (3.18-3.97)	4.17 (3.65-4.62)	4.85 (4.19-5.40)	5.92 (5.02-6.64)	6.91 (5.77-7.80)
6-hr	1.86 (1.69-2.06)	2.23 (2.03-2.48)	2.75 (2.49-3.05)	3.20 (2.89-3.54)	3.90 (3.49-4.32)	4.54 (4.02-5.04)	5.29 (4.63-5.88)	6.18 (5.34-6.88)	7.60 (6.44-8.52)	8.92 (7.42-10.1)
12-hr	2.32 (2.11-2.58)	2.80 (2.54-3.11)	3.47 (3.14-3.85)	4.06 (3.65-4.50)	4.98 (4.43-5.51)	5.83 (5.13-6.46)	6.83 (5.94-7.58)	8.02 (6.88-8.93)	9.92 (8.35-11.1)	11.7 (9.65-13.2)
24-hr	2.77 (2.56-3.03)	3.33 (3.08-3.64)	4.14 (3.82-4.52)	4.85 (4.45-5.28)	5.95 (5.42-6.45)	6.94 (6.28-7.51)	8.11 (7.26-8.75)	9.47 (8.39-10.2)	11.7 (10.2-12.5)	13.7 (11.7-14.6)
2-day	3.26 (3.01-3.56)	3.91 (3.63-4.28)	4.86 (4.49-5.30)	5.67 (5.22-6.17)	6.94 (6.34-7.53)	8.08 (7.32-8.75)	9.40 (8.45-10.2)	10.9 (9.73-11.8)	13.4 (11.7-14.4)	15.7 (13.5-16.9)
3-day	3.42 (3.17-3.72)	4.10 (3.81-4.46)	5.07 (4.70-5.51)	5.91 (5.46-6.41)	7.21 (6.61-7.79)	8.38 (7.63-9.04)	9.73 (8.78-10.5)	11.3 (10.1-12.2)	13.8 (12.2-14.8)	16.1 (14.0-17.3)
4-day	3.58 (3.33-3.88)	4.29 (3.99-4.66)	5.29 (4.91-5.73)	6.15 (5.70-6.64)	7.48 (6.85-8.05)	8.68 (7.93-9.33)	10.1 (9.12-10.8)	11.7 (10.5-12.5)	14.3 (12.6-15.2)	16.6 (14.5-17.8)
7-day	4.24 (3.94-4.59)	5.07 (4.71-5.49)	6.19 (5.75-6.70)	7.16 (6.63-7.74)	8.66 (7.97-9.32)	9.99 (9.15-10.7)	11.5 (10.5-12.4)	13.3 (12.0-14.2)	16.1 (14.3-17.2)	18.6 (16.3-19.9)
10-day	4.90 (4.57-5.28)	5.83 (5.44-6.28)	7.04 (6.58-7.58)	8.06 (7.49-8.67)	9.61 (8.99-10.3)	11.0 (10.1-11.8)	12.5 (11.4-13.4)	14.3 (12.9-15.2)	16.9 (15.2-18.1)	19.3 (17.2-20.6)
20-day	6.62 (6.23-7.06)	7.81 (7.36-8.34)	9.19 (8.68-9.80)	10.3 (9.72-11.0)	12.0 (11.2-12.8)	13.5 (12.5-14.3)	15.1 (14.0-16.0)	16.8 (15.5-17.9)	19.5 (17.8-20.7)	21.7 (19.7-23.1)
30-day	8.23 (7.78-8.74)	9.68 (9.14-10.3)	11.2 (10.6-11.8)	12.4 (11.7-13.2)	14.2 (13.3-15.0)	15.7 (14.7-16.6)	17.3 (16.2-18.3)	19.1 (17.7-20.2)	21.7 (20.0-22.9)	23.9 (21.9-25.3)
45-day	10.5 (9.96-11.1)	12.2 (11.6-12.9)	13.9 (13.2-14.7)	15.3 (14.5-16.1)	17.2 (16.3-18.2)	18.8 (17.8-19.9)	20.5 (19.3-21.6)	22.3 (20.9-23.6)	24.9 (23.2-26.3)	27.0 (25.1-28.6)
60-day	12.6 (12.0-13.2)	14.7 (14.0-15.4)	16.6 (15.8-17.4)	18.1 (17.2-19.0)	20.3 (19.2-21.3)	22.0 (20.9-23.1)	23.9 (22.6-25.1)	25.8 (24.3-27.1)	28.6 (26.8-30.1)	30.9 (28.8-32.5)

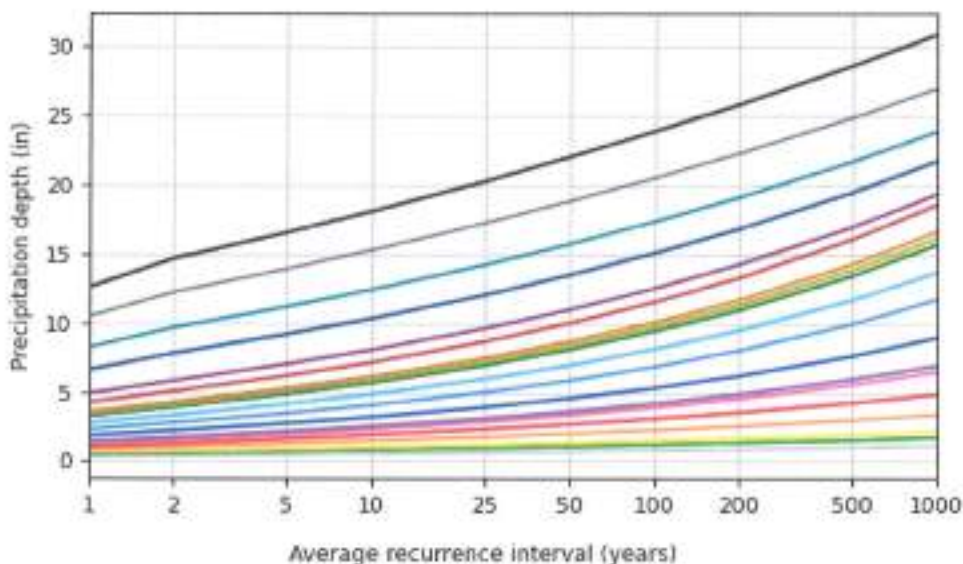
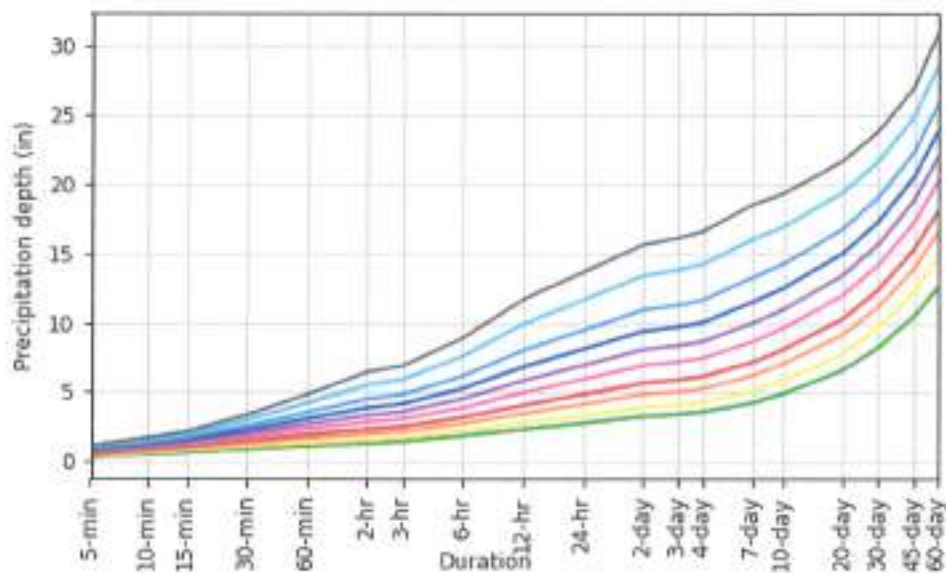
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based depth-duration-frequency (DDF) curves

Latitude: 40.9757°, Longitude: -75.1457°



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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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NOAA Atlas 14, Volume 2, Version 3
 Location name: Stroudsburg, Pennsylvania, USA*
 Latitude: 40.9757°, Longitude: -75.1457°
 Elevation: 512 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Porzybok, M. Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aeriels](#)

PF tabular

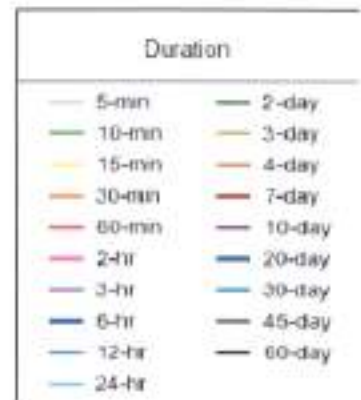
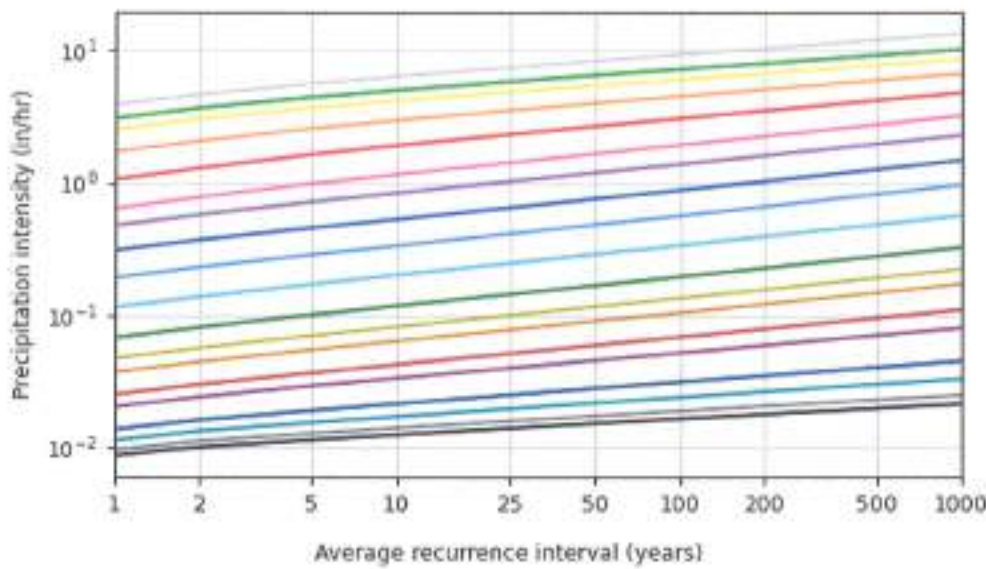
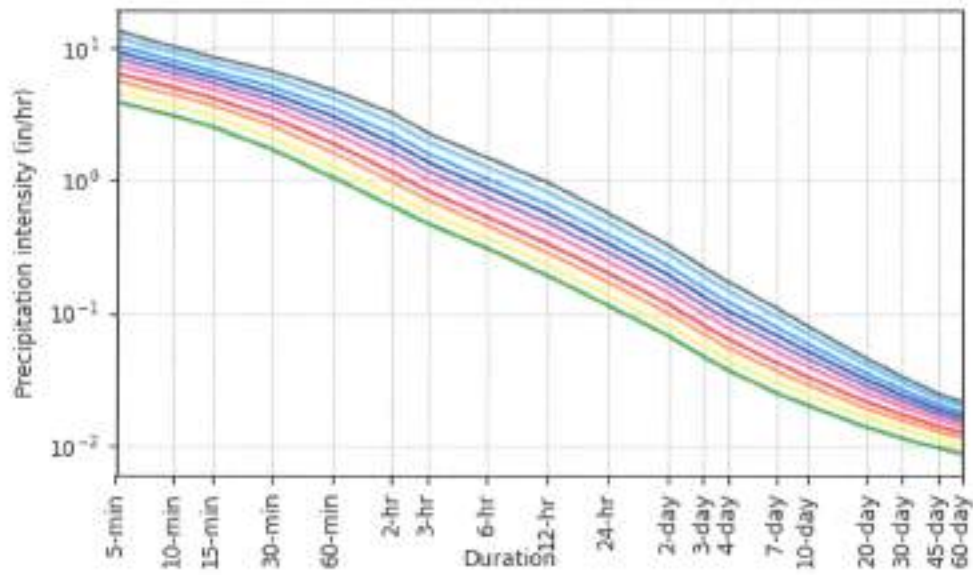
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	3.91 (3.49-4.38)	4.68 (4.18-5.24)	5.63 (4.99-6.30)	6.41 (5.66-7.15)	7.44 (6.53-8.30)	8.34 (7.26-9.31)	9.35 (8.05-10.4)	10.4 (8.86-11.7)	12.1 (10.1-13.6)	13.5 (11.1-15.3)
10-min	3.08 (2.75-3.46)	3.70 (3.31-4.15)	4.45 (3.94-4.97)	5.04 (4.46-5.63)	5.83 (5.11-6.50)	6.51 (5.66-7.26)	7.24 (6.24-8.09)	8.04 (6.84-9.01)	9.22 (7.72-10.4)	10.2 (8.45-11.6)
15-min	2.55 (2.28-2.86)	3.06 (2.74-3.44)	3.70 (3.28-4.14)	4.20 (3.72-4.69)	4.88 (4.28-5.44)	5.44 (4.74-6.07)	6.06 (5.22-6.77)	6.73 (5.72-7.54)	7.71 (6.46-8.70)	8.57 (7.06-9.74)
30-min	1.72 (1.54-1.93)	2.09 (1.86-2.34)	2.59 (2.30-2.90)	2.99 (2.64-3.33)	3.54 (3.10-3.95)	4.01 (3.49-4.47)	4.52 (3.90-5.06)	5.10 (4.34-5.71)	5.96 (4.99-6.73)	6.72 (5.53-7.63)
60-min	1.06 (0.950-1.19)	1.30 (1.16-1.46)	1.65 (1.46-1.84)	1.93 (1.70-2.15)	2.33 (2.04-2.60)	2.68 (2.34-3.00)	3.08 (2.65-3.44)	3.53 (3.00-3.95)	4.21 (3.53-4.75)	4.82 (3.98-5.48)
2-hr	0.643 (0.579-0.717)	0.784 (0.706-0.874)	0.992 (0.891-1.10)	1.16 (1.04-1.29)	1.43 (1.27-1.58)	1.66 (1.47-1.85)	1.94 (1.69-2.16)	2.26 (1.95-2.52)	2.77 (2.35-3.11)	3.23 (2.70-3.66)
3-hr	0.478 (0.432-0.530)	0.578 (0.523-0.642)	0.722 (0.652-0.801)	0.843 (0.757-0.932)	1.03 (0.917-1.14)	1.20 (1.06-1.32)	1.39 (1.21-1.54)	1.61 (1.39-1.80)	1.97 (1.67-2.21)	2.30 (1.92-2.60)
6-hr	0.310 (0.282-0.344)	0.372 (0.339-0.413)	0.459 (0.416-0.509)	0.533 (0.482-0.591)	0.651 (0.582-0.720)	0.758 (0.671-0.840)	0.884 (0.773-0.981)	1.03 (0.891-1.15)	1.27 (1.07-1.42)	1.49 (1.24-1.68)
12-hr	0.192 (0.174-0.214)	0.232 (0.210-0.258)	0.287 (0.260-0.319)	0.336 (0.302-0.373)	0.413 (0.367-0.457)	0.484 (0.426-0.536)	0.567 (0.493-0.629)	0.665 (0.571-0.741)	0.823 (0.693-0.923)	0.971 (0.801-1.10)
24-hr	0.115 (0.105-0.128)	0.138 (0.128-0.151)	0.172 (0.159-0.188)	0.202 (0.185-0.218)	0.247 (0.223-0.268)	0.289 (0.261-0.313)	0.337 (0.302-0.364)	0.394 (0.349-0.424)	0.485 (0.423-0.521)	0.569 (0.489-0.609)
2-day	0.067 (0.062-0.074)	0.081 (0.075-0.089)	0.101 (0.093-0.110)	0.118 (0.108-0.128)	0.144 (0.132-0.156)	0.168 (0.152-0.182)	0.195 (0.175-0.211)	0.228 (0.202-0.245)	0.279 (0.244-0.300)	0.326 (0.281-0.351)
3-day	0.047 (0.044-0.051)	0.056 (0.052-0.062)	0.070 (0.065-0.076)	0.082 (0.075-0.088)	0.100 (0.091-0.108)	0.116 (0.105-0.125)	0.135 (0.121-0.145)	0.157 (0.140-0.168)	0.192 (0.169-0.206)	0.224 (0.194-0.240)
4-day	0.037 (0.034-0.040)	0.044 (0.041-0.048)	0.055 (0.051-0.059)	0.064 (0.059-0.069)	0.077 (0.071-0.083)	0.090 (0.082-0.097)	0.104 (0.094-0.112)	0.121 (0.109-0.130)	0.148 (0.131-0.158)	0.173 (0.151-0.184)
7-day	0.025 (0.023-0.027)	0.030 (0.028-0.032)	0.036 (0.034-0.039)	0.042 (0.039-0.046)	0.051 (0.047-0.055)	0.059 (0.054-0.063)	0.068 (0.062-0.073)	0.079 (0.071-0.084)	0.095 (0.084-0.102)	0.110 (0.097-0.118)
10-day	0.020 (0.019-0.021)	0.024 (0.022-0.026)	0.029 (0.027-0.031)	0.033 (0.031-0.036)	0.040 (0.037-0.042)	0.045 (0.042-0.048)	0.052 (0.047-0.055)	0.059 (0.053-0.063)	0.070 (0.063-0.075)	0.080 (0.071-0.086)
20-day	0.013 (0.012-0.014)	0.016 (0.015-0.017)	0.019 (0.018-0.020)	0.021 (0.020-0.022)	0.025 (0.023-0.026)	0.028 (0.026-0.029)	0.031 (0.029-0.033)	0.035 (0.032-0.037)	0.040 (0.037-0.043)	0.045 (0.041-0.048)
30-day	0.011 (0.010-0.012)	0.013 (0.012-0.014)	0.015 (0.014-0.016)	0.017 (0.016-0.018)	0.019 (0.018-0.020)	0.021 (0.020-0.023)	0.024 (0.022-0.025)	0.026 (0.024-0.028)	0.030 (0.027-0.031)	0.033 (0.030-0.035)
45-day	0.009 (0.009-0.010)	0.011 (0.010-0.011)	0.012 (0.012-0.013)	0.014 (0.013-0.014)	0.015 (0.015-0.016)	0.017 (0.016-0.018)	0.018 (0.017-0.020)	0.020 (0.019-0.021)	0.023 (0.021-0.024)	0.024 (0.023-0.026)
60-day	0.008 (0.008-0.009)	0.010 (0.009-0.010)	0.011 (0.010-0.012)	0.012 (0.011-0.013)	0.014 (0.013-0.014)	0.015 (0.014-0.016)	0.016 (0.015-0.017)	0.017 (0.016-0.018)	0.019 (0.018-0.020)	0.021 (0.020-0.022)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based intensity-duration-frequency (IDF) curves
Latitude: 40.9757°, Longitude: -75.1457°



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Maps & aerials

Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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