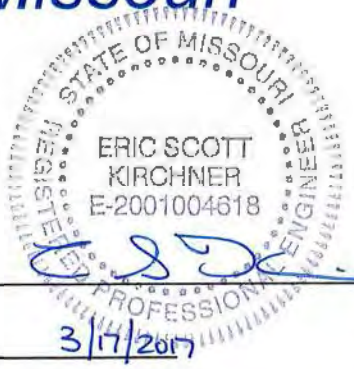
Drainage & Detention Calculations

Site Improvement Plans
For
C Bennett Premium Building Supplies
O'fallon, Missouri



3/17/2017
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Cochran Project No. M16-7229A

Table of Contents
Drainage and Detention Calculations
Site Improvement Plans – C Bennett Premium Building Supplies

DETENTION CALCULATIONS
FOR BMP #1
FOR
C BENNETT PREMIUM BUILDING SUPLIES
O'FALLON, MISSOURI
FEBRUARY 14, 2017
PROJECT NO. M16-7229A

The following detention calculations have been performed for final design for C Bennett Premium Building Supplies in O'fallon, Missouri. Said calculations were performed in accordance with the City of O'fallon Standards. All calculations and design was performed with the aid of AutoCAD Civil 3D Software. Existing, proposed, and routed hydrographs for the 2-year, 15-year, 25-year, 100-year storms are attached.

BMP #1 CALCULATIONS SUMMARY:
A summary of the detention calculations is shown below. All detention calculations, including release rates and volumes, are included in this report. A drainage area map is also included at the end of this report.

Year of Storm Frequency	Existing Peak Runoff (cfs) [A]	Proposed Peak Runoff (cfs) [B]	**Required Detention (cfs) [B] – [A]**	Tributary/Runoff to Basin (cfs) [C]	Basin Peak Release Rate (cfs) [D]	**Actual Detention (cfs) [C] – [D]**
2	7.93	9.76	**1.83**	6.82	**0.037**	**6.78**
15	10.84	13.35	**2.51**	9.35	**0.040**	**9.31**
25	12.04	14.83	**2.79**	10.39	**0.041**	**10.35**
100	14.45	17.80	**3.35**	12.46	**0.043**	**12.42**

The 100-year storm reaches a peak elevation of 559.09 (with low flow blocked) in the basin; the basin berm elevation is 560.50 providing 1.41' freeboard.

Storm Water Handling for C Bennett Premium Building Supplies will be provided in BMP #1 at the western portion of the property. The detention basin was designed so that the existing flow off of the south of the site would not be exceeded by the proposed condition and increased drainage area. All necessary calculations are attached.

2-YEAR STORM

Existing Runoff (2-year storm**)**

Total Development = 2.67 acres
Existing Runoff (cfs) = 7.93 cfs

Proposed On-Site Runoff (2-year storm)

Total Development = 2.67 acres
Proposed Runoff (cfs) = 9.76 cfs

Tributary Runoff to Basin (2-year storm)

Total On-Site Development = 2.67 acres
Proposed "C" Factor= Tributary area is made of subareas which each have separate runoff coefficients, see subarea hydrograph for specific runoff coefficient.
Proposed ToC = Tributary area is made of subareas which each have separate time of concentrations, see subarea hydrograph for specific time of concentrations.
Proposed Runoff (cfs) = 6.82 cfs

Required Detention (2-year storm)

Required Detained Runoff = Developed Runoff – Undeveloped Runoff
Required Detained Runoff = **1.83 cfs**

Actual Detained Run-off = Tributary run-off to basin – Peak detention basin release rate
Actual Detained Run-off = 6.82 cfs – 0.037 cfs = 6.78 cfs
Actual High Water Elevation = 557.05 ft

Total Stored Volume = 1,440 ft^3

Detention Basin Volume = 9,489 ft^3 (To elevation 560.00, not including 1 ft of freeboard)

15-YEAR STORM

Existing Runoff (15-year storm**)**

Total Development = 2.67 acres
Existing Runoff (cfs) = 10.84 cfs

Proposed On-Site Runoff (15-year storm)

Total Development = 2.67 acres
Proposed Runoff (cfs) = 13.35 cfs

Tributary Runoff to Basin (15-year storm)

Total On-Site Development = 2.67 acres
Proposed "C" Factor= Tributary area is made of subareas which each have separate runoff coefficients, see subarea hydrograph for specific runoff coefficient.
Proposed ToC = Tributary area is made of subareas which each have separate time of concentrations, see subarea hydrograph for specific time of concentrations.
Proposed Runoff (cfs) = 9.35 cfs

Required Detention (15-year storm)

Required Detained Runoff = Developed Runoff – Undeveloped Runoff
Required Detained Runoff = **2.51 cfs**

Actual Detained Run-off = Tributary run-off to basin – Peak detention basin release rate
Actual Detained Run-off = 9.35 cfs – 0.040 cfs = 9.31 cfs
Actual High Water Elevation = 557.36 ft

Total Stored Volume = 1,991 ft^3

Detention Basin Volume = 9,489 ft^3 (To elevation 560.00, not including 1 ft of freeboard)

25-YEAR STORM

Existing Runoff (25-year storm**)**

Total Development = 2.67 acres
Existing Runoff (cfs) = 12.04 cfs

Proposed Runoff (25-year storm)

Total Development = 2.67 acres
Proposed Runoff (cfs) = 14.83 cfs

Tributary Runoff to Basin (25-year storm)

Total On-Site Development = 2.67 acres
Proposed "C" Factor= Tributary area is made of subareas which each have separate runoff coefficients, see subarea hydrograph for specific runoff coefficient.
Proposed ToC = Tributary area is made of subareas which each have separate time of concentrations, see subarea hydrograph for specific time of concentrations.
Proposed Runoff (cfs) = 10.39 cfs

Required Detention (25-year storm)

Required Detained Runoff = Developed Runoff – Undeveloped Runoff
Required Detained Runoff = 2.79 **cfs**

Actual Detained Run-off = Tributary run-off to basin – Peak detention basin release rate
Actual Detained Run-off = 10.39 cfs – 0.041 cfs = 10.35 cfs
Actual High Water Elevation = 557.49 ft

Total Stored Volume = 2,216 ft^3

Detention Basin Volume = 9,489 ft^3 (To elevation 560.00, not including 1 ft of freeboard)

100-YEAR STORM

Existing Runoff (100-year storm)

Total Development = 2.67 acres
Existing Runoff (cfs) = 14.45 cfs

Proposed Runoff (100-year storm)

Total Development = 2.67 acres
Proposed Runoff (cfs) = 17.80 cfs

Tributary Runoff to Basin (100-year storm)

Total On-Site Development = 2.67 acres
Proposed "C" Factor= Tributary area is made of subareas which each have separate runoff coefficients, see subarea hydrograph for specific runoff coefficient.
Proposed ToC = Tributary area is made of subareas which each have separate time of concentrations, see subarea hydrograph for specific time of concentrations.
Proposed Runoff (cfs) = 12.46 cfs

Required Detention (100-year storm)

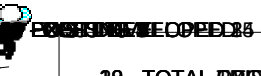
Required Detained Runoff = Developed Runoff – Undeveloped Runoff
Required Detained Runoff = **3.35 cfs**

Actual Detained Run-off = Tributary run-off to basin – Peak detention basin release rate
Actual Detained Run-off = 12.46 cfs – 0.043 cfs = 12.42 cfs
Actual High Water Elevation = 557.73 ft

Total Stored Volume = 2,655 ft^3

Detention Basin Volume = 9,489 ft^3 (To elevation 560.00, not including 1 ft of freeboard)

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	Rational	EXISTING 1
2	Rational	EXISTING 2
3	Rational	EXISTING 3
4	Rational	EXISTING 4
5	Rational	EXISTING 5
7	Rational	POST DEVELOPED 1
8	Rational	POST DEVELOPED 2
9	Rational	POST DEVELOPED 3
10	Rational	POST DEVELOPED 4
11	Rational	POST DEVELOPED 5
13	Rational	OFFSITE 1
14	Rational	OFFSITE 2
15	Rational	OFFSITE 3
16	Rational	OFFSITE 4
18	Combine	TOTAL EXISTING
19	Combine	TOTAL TRIBUTARY TO BASIN
20	Combine	TOTAL OFFSITE
22	Reservoir	DETENTION BASIN
23	Combine	TOTAL PROPOSED

Hydrograph Return Period Recap

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	------	-------	4.555	-------	-------	6.262	6.963	-------	8.343	EXISTING 1
2	Rational	------	-------	2.734	-------	-------	3.728	4.139	-------	4.973	EXISTING 2
3	Rational	------	-------	1.886	-------	-------	2.571	2.855	-------	3.430	EXISTING 3
4	Rational	------	-------	1.005	-------	-------	1.371	1.522	-------	1.828	EXISTING 4
5	Rational	------	-------	0.029	-------	-------	0.040	0.045	-------	0.053	EXISTING 5
7	Rational	------	-------	3.208	-------	-------	4.443	4.948	-------	5.917	POST DEVELOPED 1
8	Rational	------	-------	3.296	-------	-------	4.494	4.990	-------	5.994	POST DEVELOPED 2
9	Rational	------	-------	1.065	-------	-------	1.464	1.628	-------	1.951	POST DEVELOPED 3
10	Rational	------	-------	0.843	-------	-------	1.150	1.277	-------	1.534	POST DEVELOPED 4
11	Rational	------	-------	2.830	-------	-------	3.945	4.398	-------	5.252	POST DEVELOPED 5
13	Rational	------	-------	1.269	-------	-------	1.729	1.920	-------	2.307	OFFSITE 1
14	Rational	------	-------	1.402	-------	-------	1.911	2.122	-------	2.549	OFFSITE 2
15	Rational	------	-------	0.296	-------	-------	0.403	0.448	-------	0.538	OFFSITE 3
16	Rational	------	-------	0.091	-------	-------	0.124	0.138	-------	0.165	OFFSITE 4
18	Combine	1, 2, 3, 4, 5,	-------	7.933	-------	-------	10.84	12.04	-------	14.46	TOTAL EXISTING
19	Combine	7, 8, 9, 10, 11,	-------	6.449	-------	-------	8.843	9.829	-------	11.79	TOTAL TRIBUTARY TO BASIN
20	Combine	13, 14, 15, 16,	-------	3.057	-------	-------	4.168	4.628	-------	5.559	TOTAL OFFSITE
22	Reservoir	19	-------	0.038	-------	-------	0.041	0.042	-------	0.044	DETENTION BASIN
23	Combine	20, 22	-------	3.076	-------	-------	4.190	4.651	-------	5.585	TOTAL PROPOSED

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

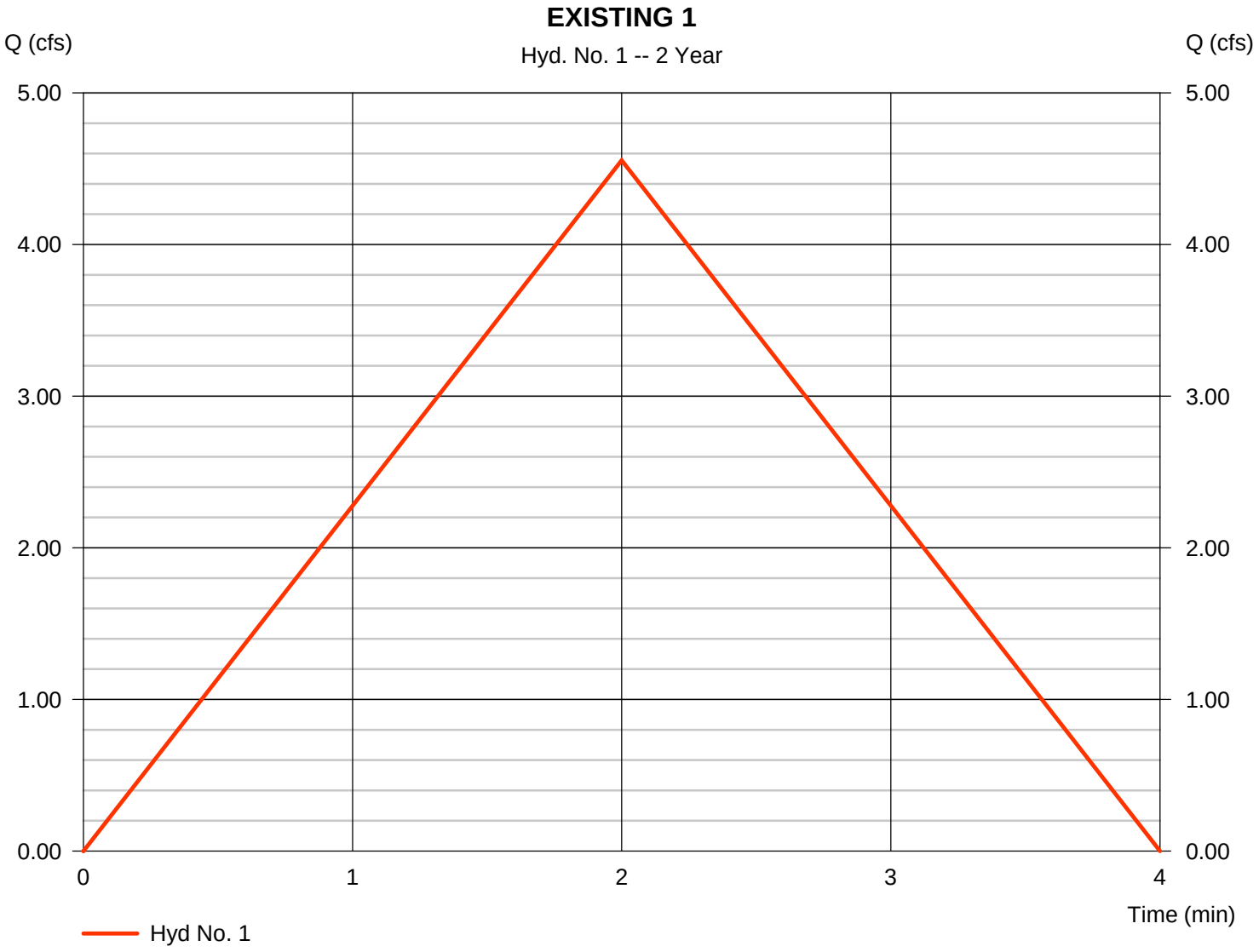
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	4.555	1	2	547	------	------	------	EXISTING 1
2	Rational	2.734	1	1	164	------	------	------	EXISTING 2
3	Rational	1.886	1	1	113	------	------	------	EXISTING 3
4	Rational	1.005	1	1	60	------	------	------	EXISTING 4
5	Rational	0.029	1	1	2	------	------	------	EXISTING 5
7	Rational	3.208	1	3	578	------	------	------	POST DEVELOPED 1
8	Rational	3.296	1	1	198	------	------	------	POST DEVELOPED 2
9	Rational	1.065	1	2	128	------	------	------	POST DEVELOPED 3
10	Rational	0.843	1	1	51	------	------	------	POST DEVELOPED 4
11	Rational	2.830	1	4	679	------	------	------	POST DEVELOPED 5
13	Rational	1.269	1	1	76	------	------	------	OFFSITE 1
14	Rational	1.402	1	1	84	------	------	------	OFFSITE 2
15	Rational	0.296	1	1	18	------	------	------	OFFSITE 3
16	Rational	0.091	1	1	5	------	------	------	OFFSITE 4
18	Combine	7.933	1	1	886	1, 2, 3, 4, 5,	------	------	TOTAL EXISTING
19	Combine	6.449	1	1	1,633	7, 8, 9, 10, 11,	------	------	TOTAL TRIBUTARY TO BASIN
20	Combine	3.057	1	1	183	13, 14, 15, 16,	------	------	TOTAL OFFSITE
22	Reservoir	0.038	1	8	1,627	19	557.15	1,618	DETENTION BASIN
23	Combine	3.076	1	1	1,810	20, 22	------	------	TOTAL PROPOSED

Hydrograph Report

Hyd. No. 1

EXISTING 1

Hydrograph type	=	Rational	Peak discharge	=	4.555 cfs
Storm frequency	=	2 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	547 cuft
Drainage area	=	1.910 ac	Runoff coeff.	=	0.38
Intensity	=	6.276 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

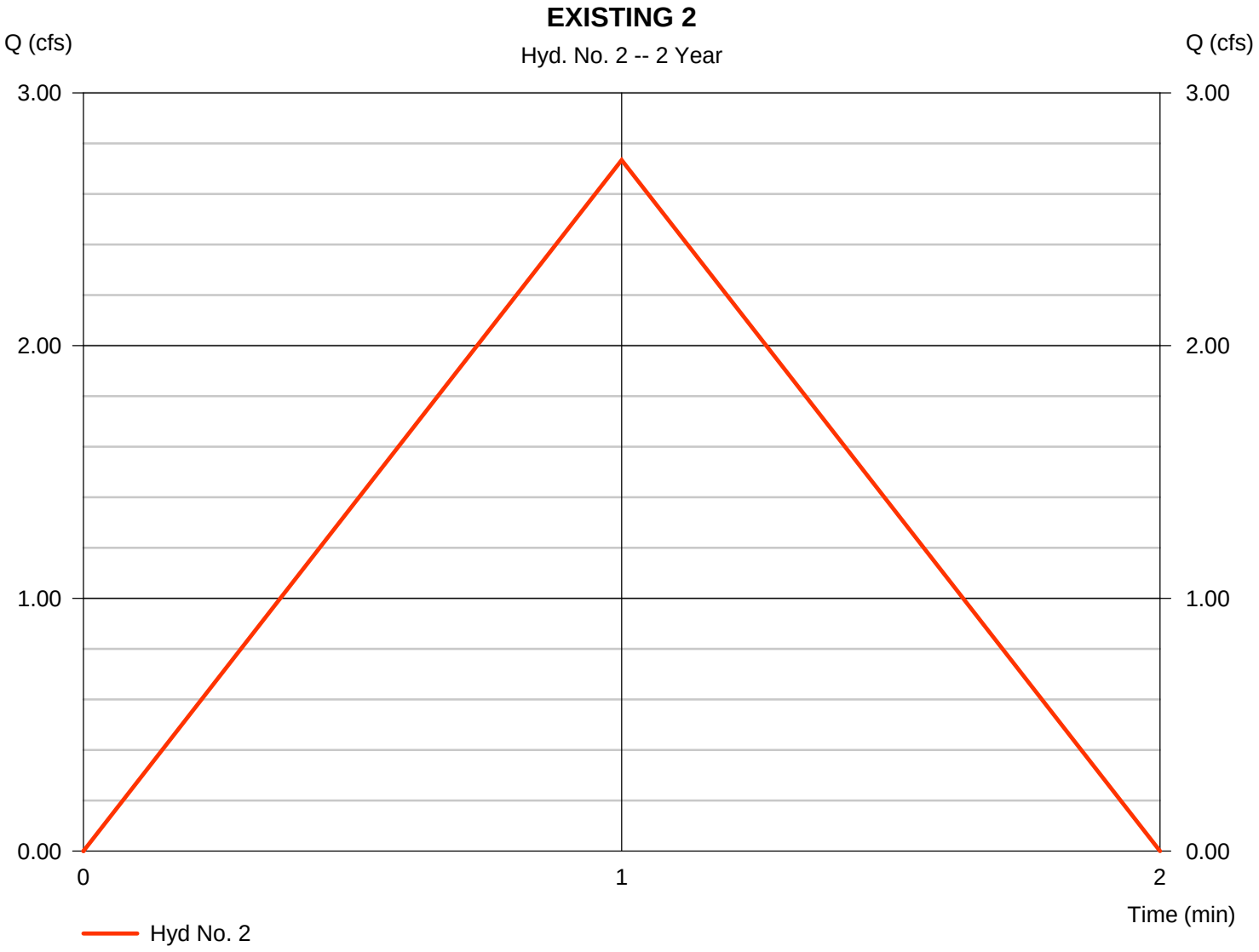


Hydrograph Report

Hyd. No. 2

EXISTING 2

Hydrograph type	=	Rational	Peak discharge	=	2.734 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	164 cuft
Drainage area	=	0.802 ac	Runoff coeff.	=	0.51
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

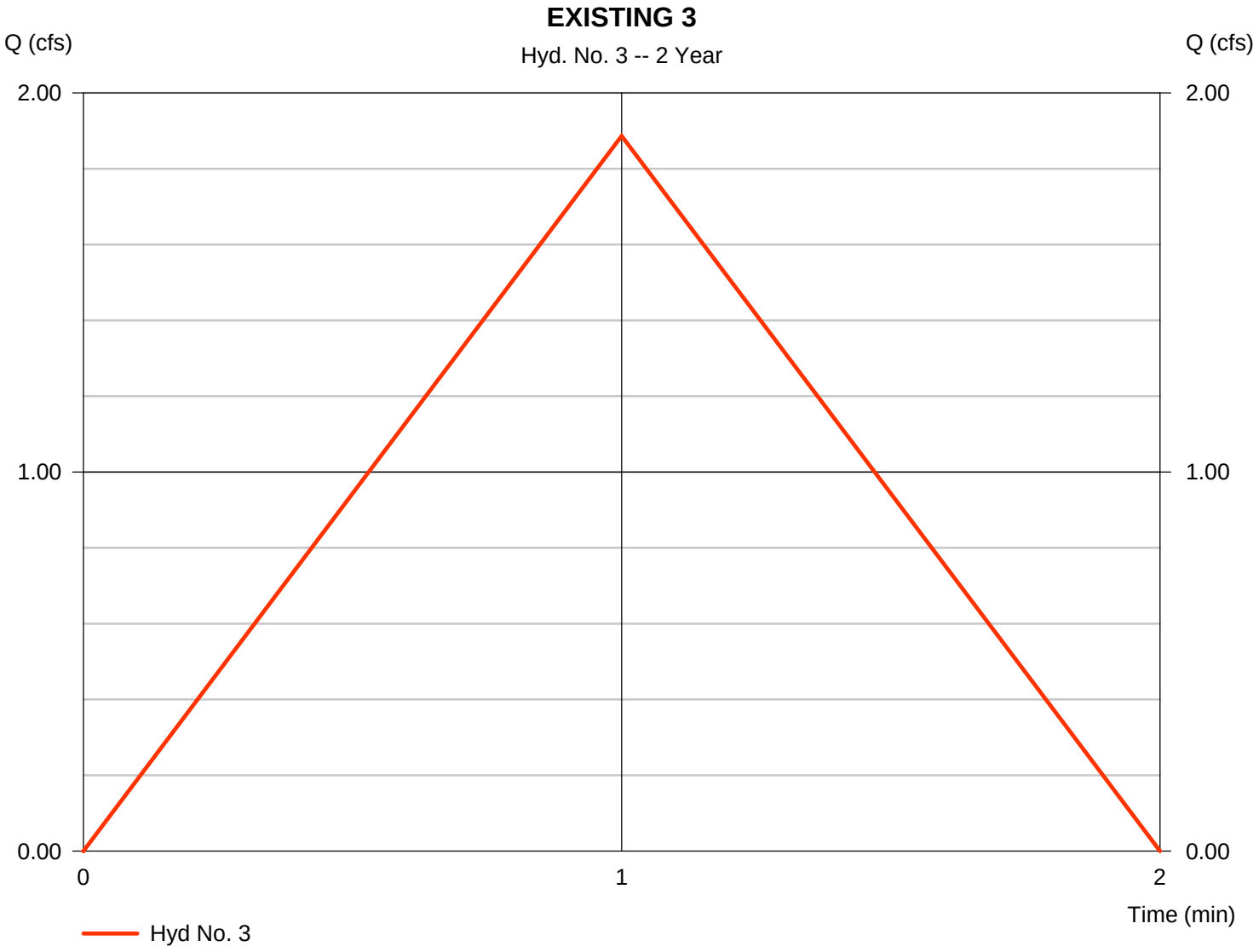


Hydrograph Report

Hyd. No. 3

EXISTING 3

Hydrograph type	=	Rational	Peak discharge	=	1.886 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	113 cuft
Drainage area	=	0.495 ac	Runoff coeff.	=	0.57
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 4

EXISTING 4

Hydrograph type	=	Rational	Peak discharge	=	1.005 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	60 cuft
Drainage area	=	0.376 ac	Runoff coeff.	=	0.4
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
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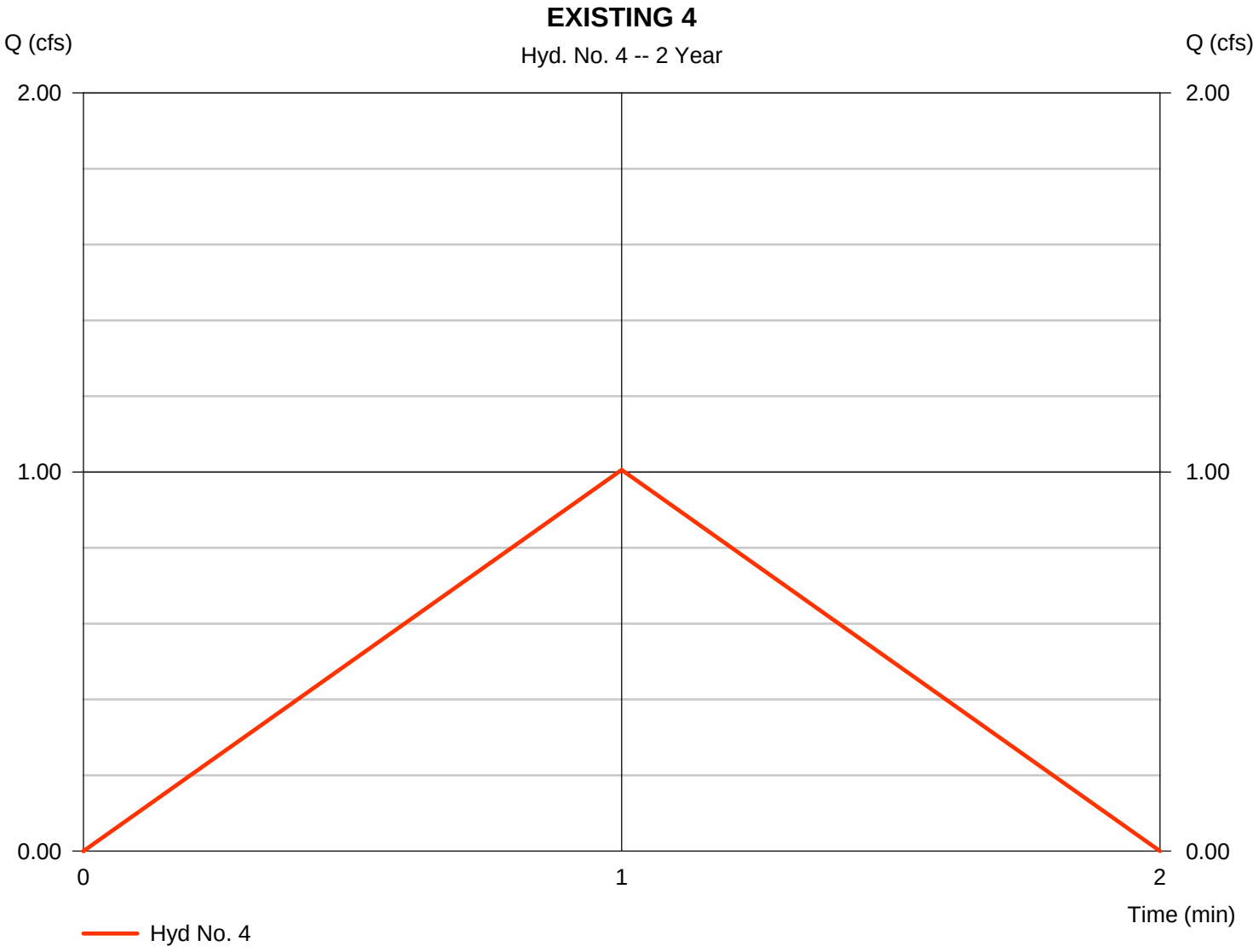
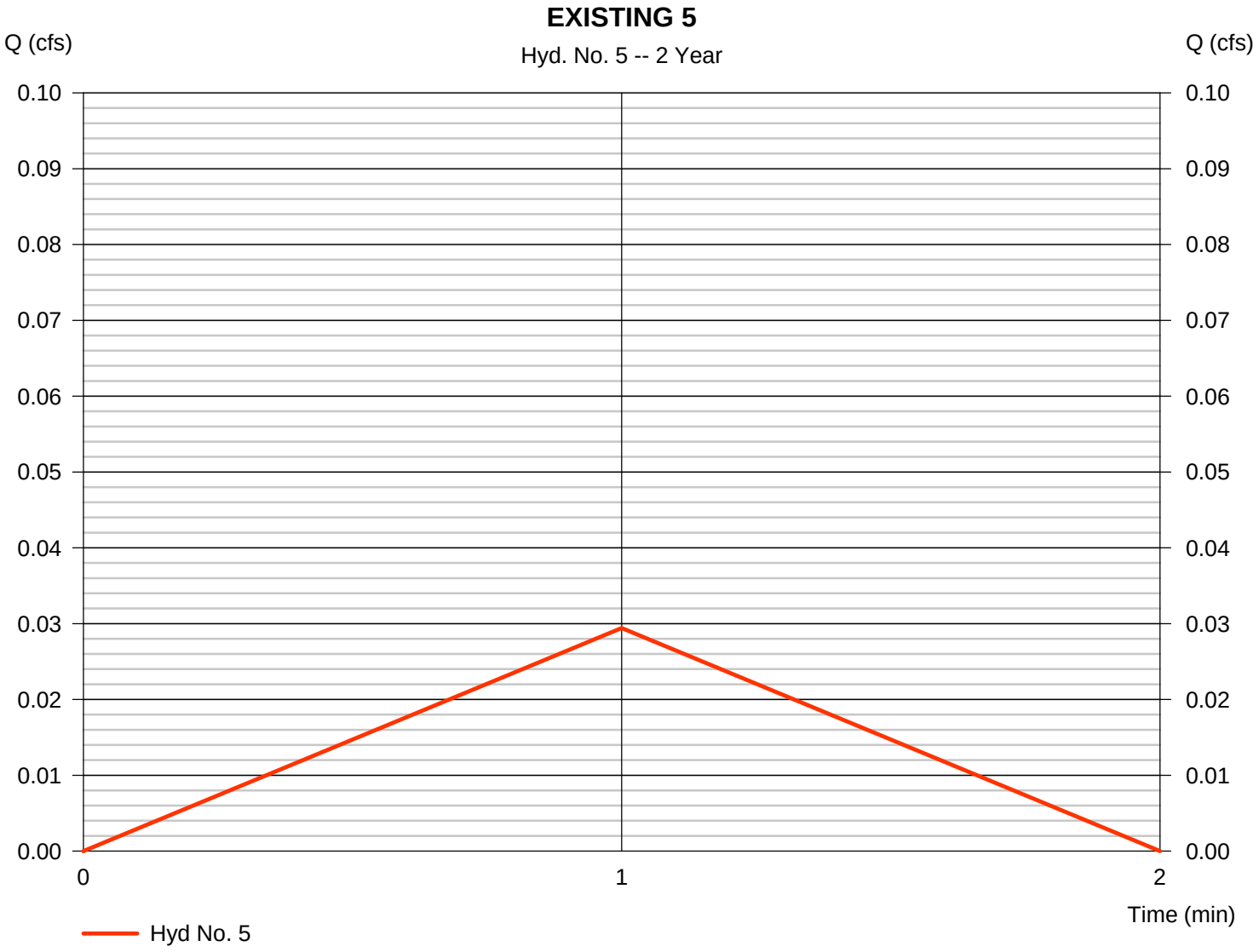


Hydrograph Report

Hyd. No. 5

EXISTING 5

Hydrograph type	=	Rational	Peak discharge	=	0.029 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	2 cuft
Drainage area	=	0.022 ac	Runoff coeff.	=	0.2
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

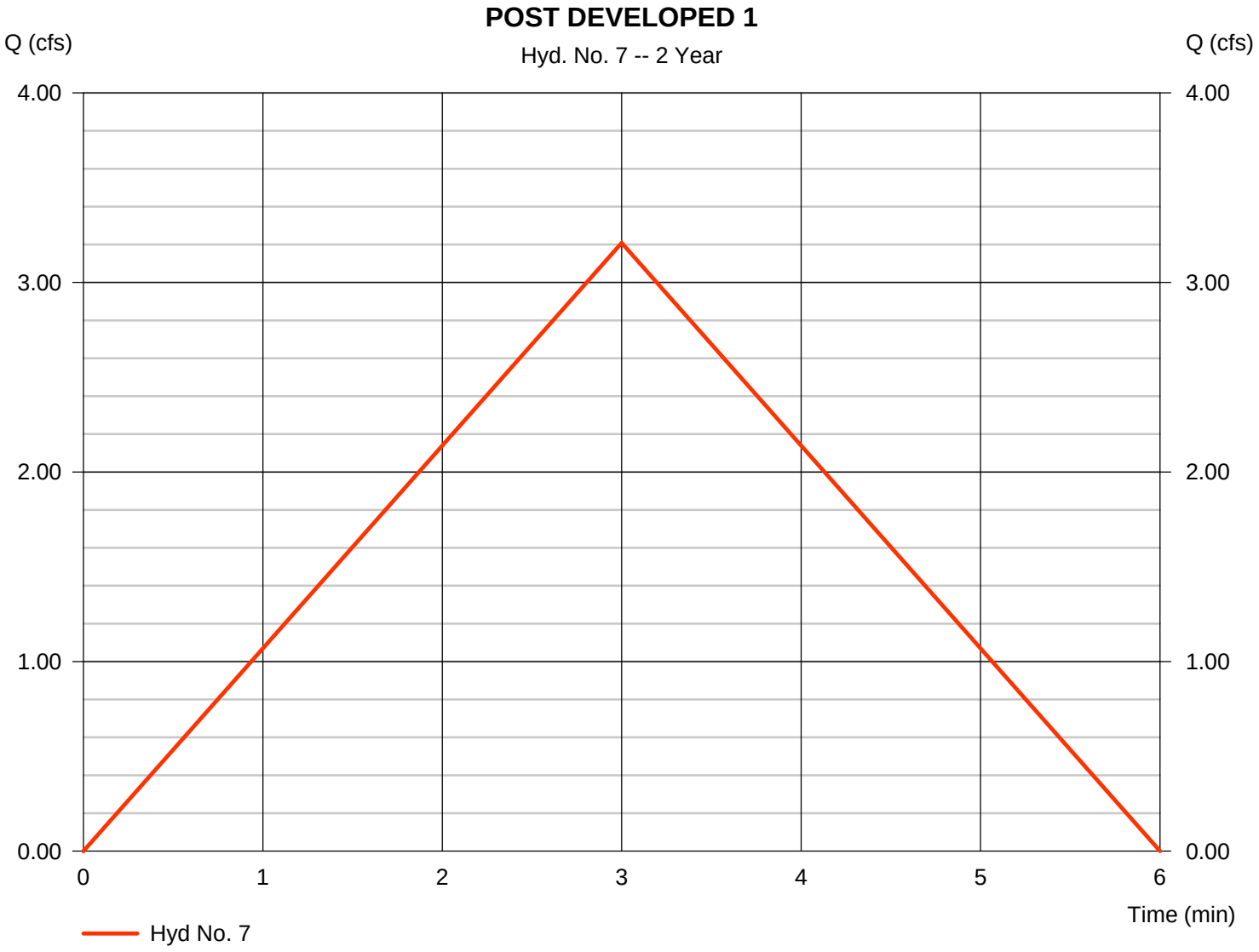


Hydrograph Report

Hyd. No. 7

POST DEVELOPED 1

Hydrograph type	=	Rational	Peak discharge	=	3.208 cfs
Storm frequency	=	2 yrs	Time to peak	=	3 min
Time interval	=	1 min	Hyd. volume	=	578 cuft
Drainage area	=	1.004 ac	Runoff coeff.	=	0.54
Intensity	=	5.918 in/hr	Tc by User	=	3.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 8

POST DEVELOPED 2

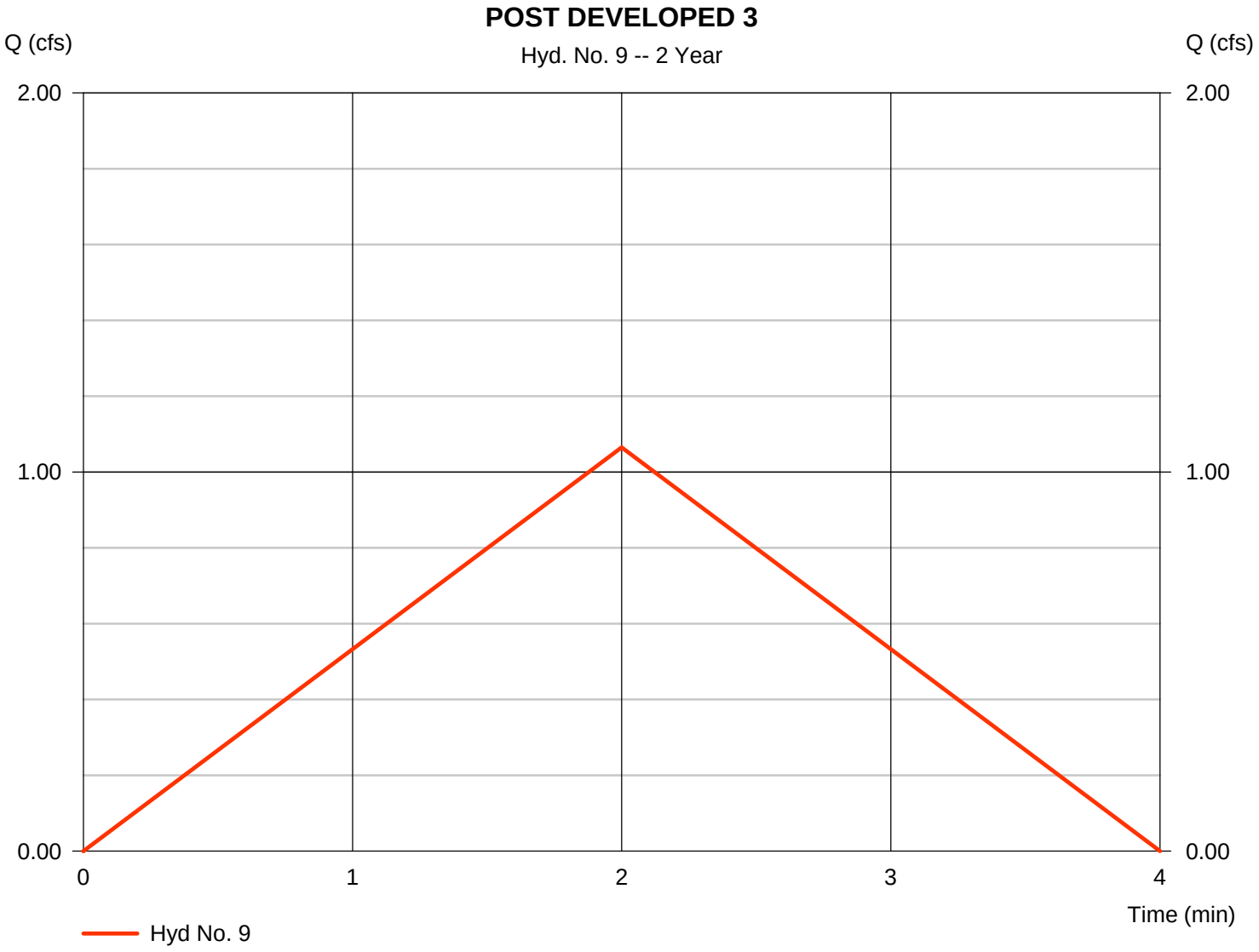
Hydrograph type	=	Rational	Peak discharge	=	3.296 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	198 cuft
Drainage area	=	0.554 ac	Runoff coeff.	=	0.89
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 9

POST DEVELOPED 3

Hydrograph type	=	Rational	Peak discharge	=	1.065 cfs
Storm frequency	=	2 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	128 cuft
Drainage area	=	0.239 ac	Runoff coeff.	=	0.71
Intensity	=	6.276 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

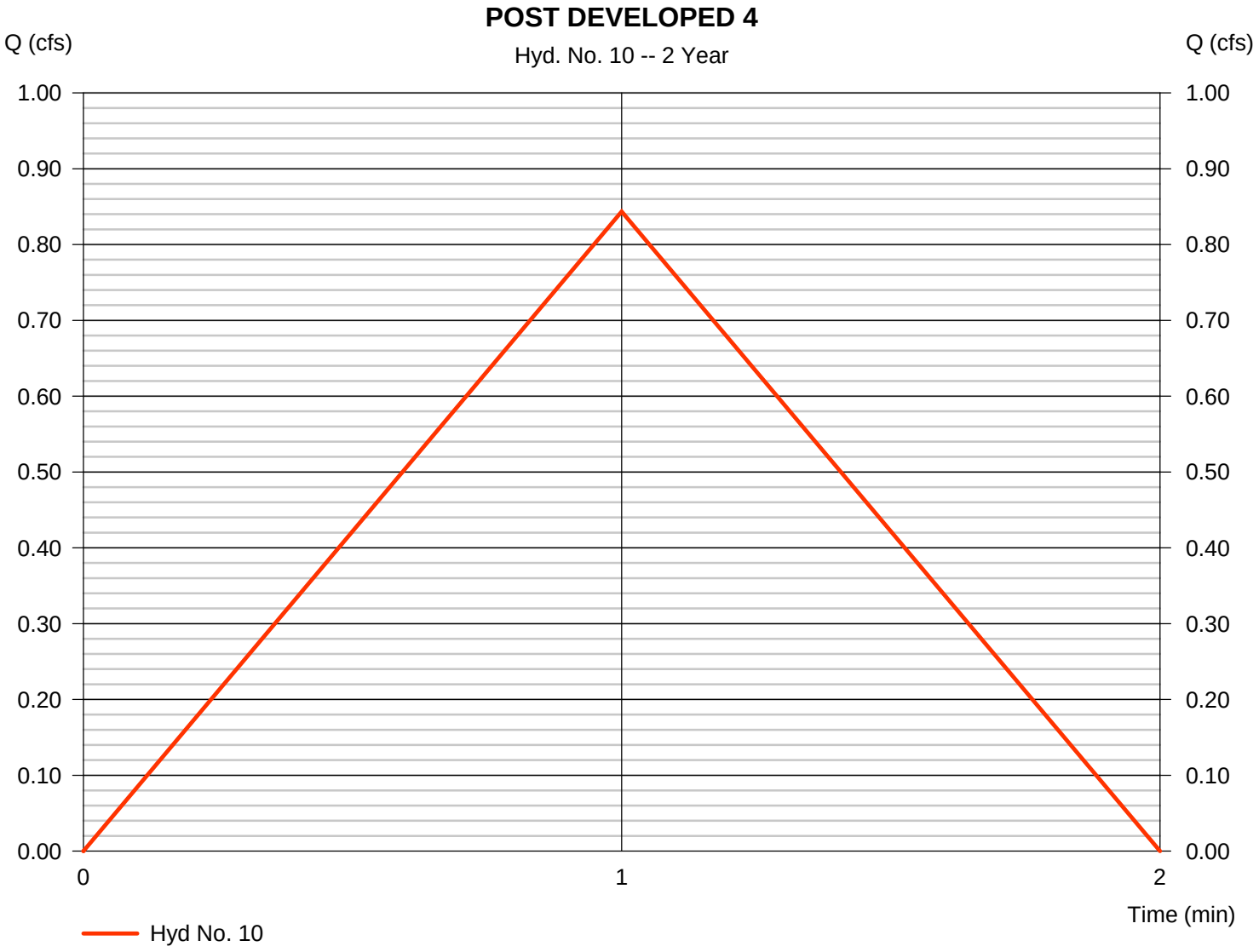


Hydrograph Report

Hyd. No. 10

POST DEVELOPED 4

Hydrograph type	=	Rational	Peak discharge	=	0.843 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	51 cuft
Drainage area	=	0.166 ac	Runoff coeff.	=	0.76
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

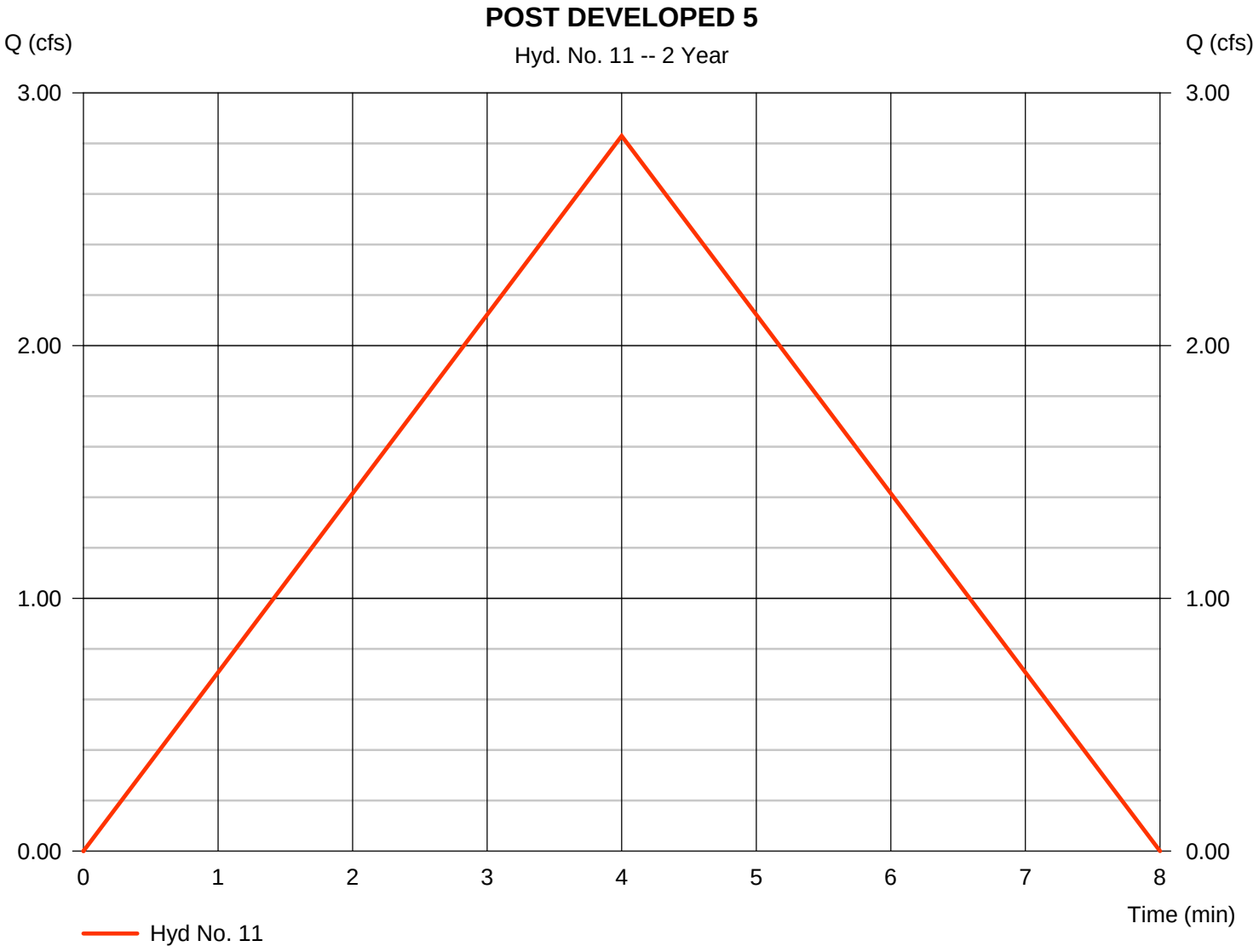


Hydrograph Report

Hyd. No. 11

POST DEVELOPED 5

Hydrograph type	=	Rational	Peak discharge	=	2.830 cfs
Storm frequency	=	2 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	679 cuft
Drainage area	=	0.692 ac	Runoff coeff.	=	0.73
Intensity	=	5.602 in/hr	Tc by User	=	4.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

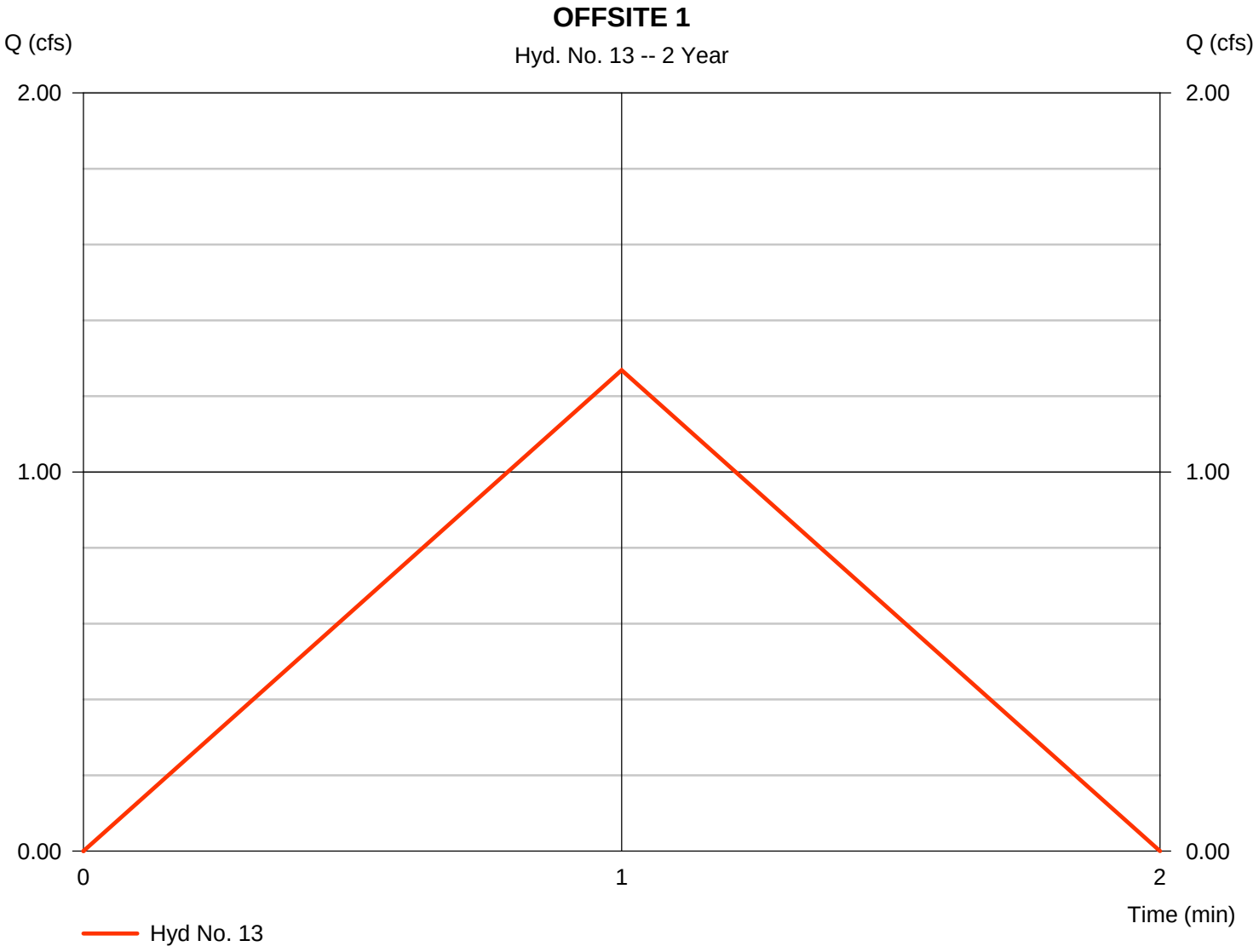


Hydrograph Report

Hyd. No. 13

OFFSITE 1

Hydrograph type	=	Rational	Peak discharge	=	1.269 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	76 cuft
Drainage area	=	0.593 ac	Runoff coeff.	=	0.32
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

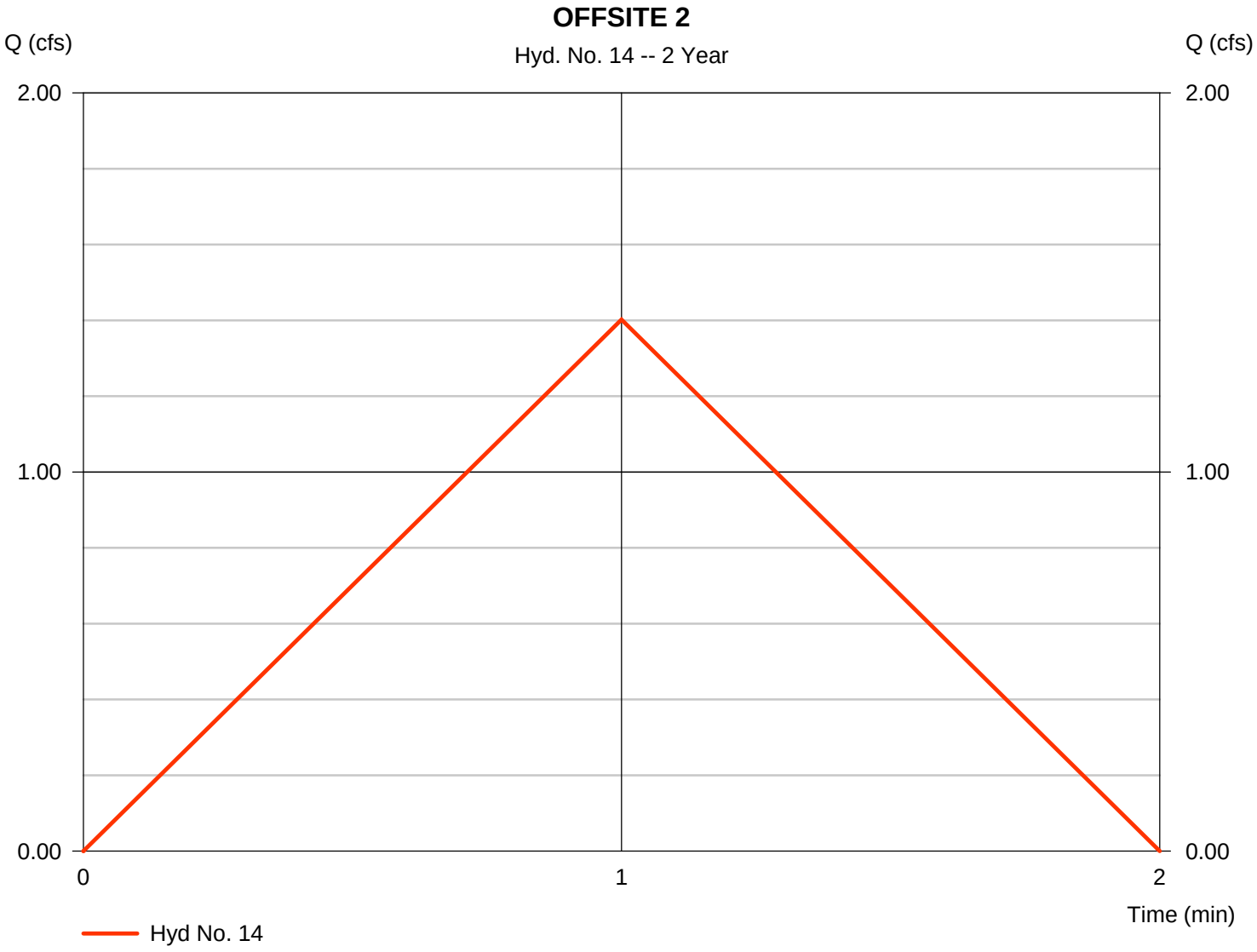


Hydrograph Report

Hyd. No. 14

OFFSITE 2

Hydrograph type	=	Rational	Peak discharge	=	1.402 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	84 cuft
Drainage area	=	0.233 ac	Runoff coeff.	=	0.9
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

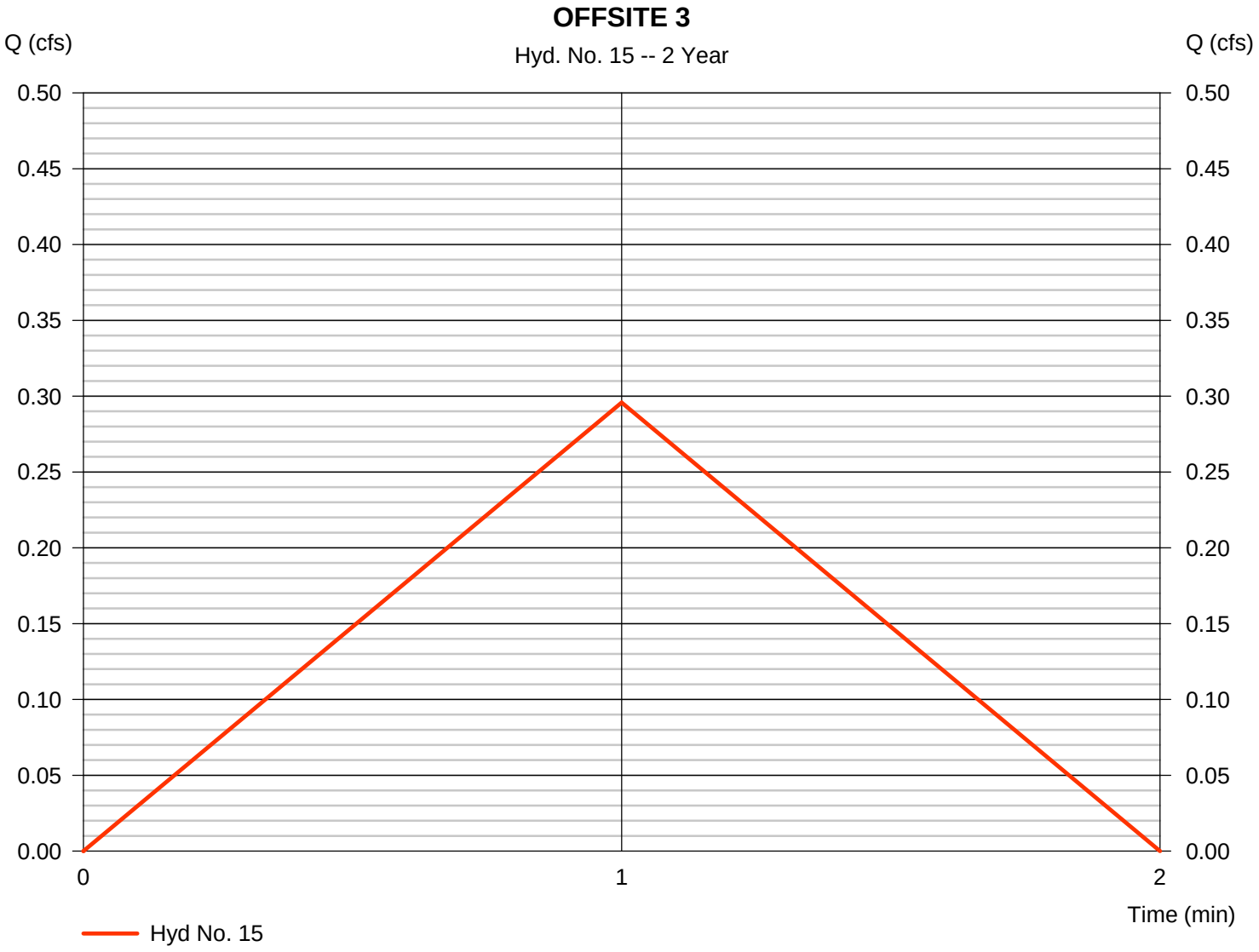


Hydrograph Report

Hyd. No. 15

OFFSITE 3

Hydrograph type	=	Rational	Peak discharge	=	0.296 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	18 cuft
Drainage area	=	0.056 ac	Runoff coeff.	=	0.79
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

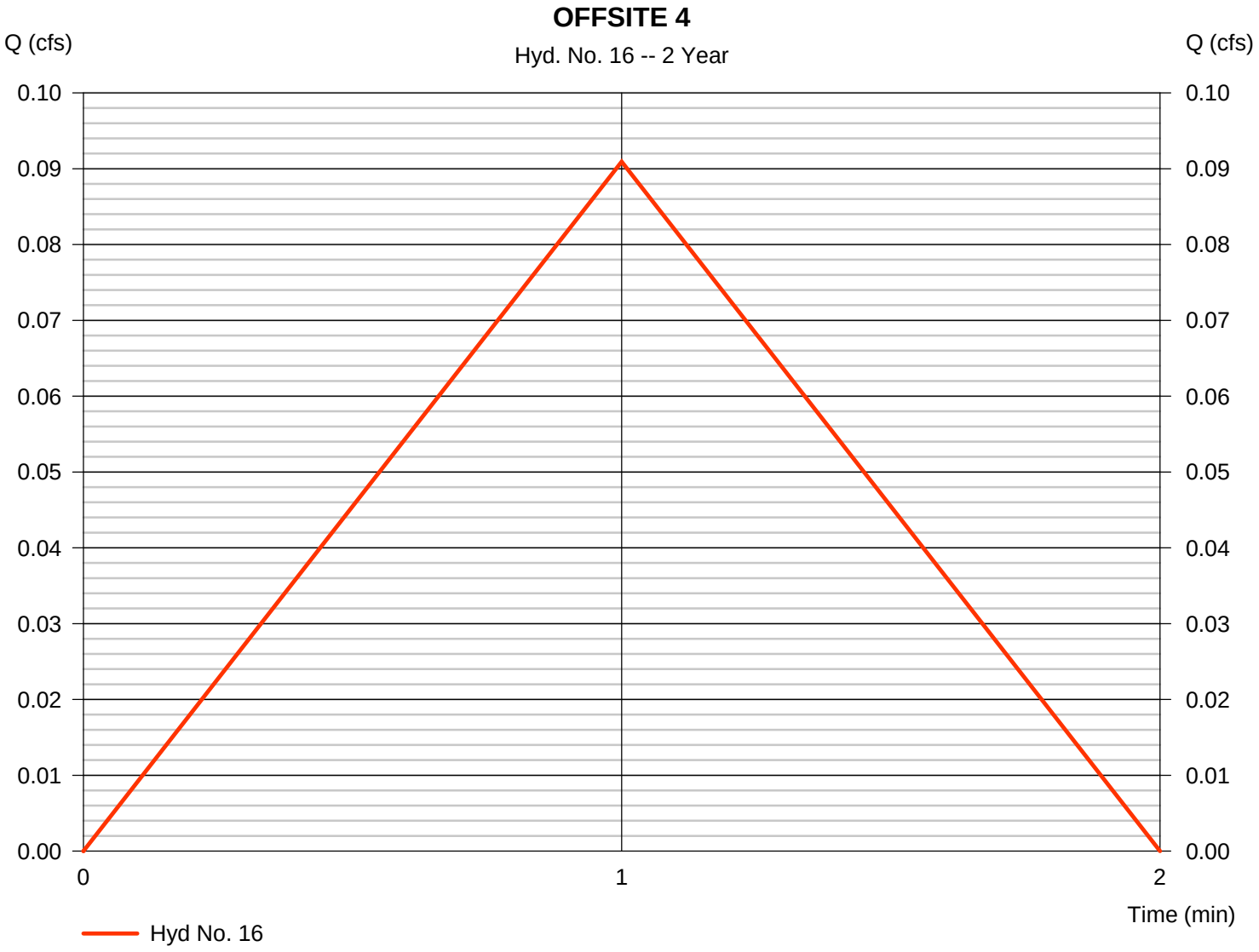


Hydrograph Report

Hyd. No. 16

OFFSITE 4

Hydrograph type	=	Rational	Peak discharge	=	0.091 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	5 cuft
Drainage area	=	0.068 ac	Runoff coeff.	=	0.2
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

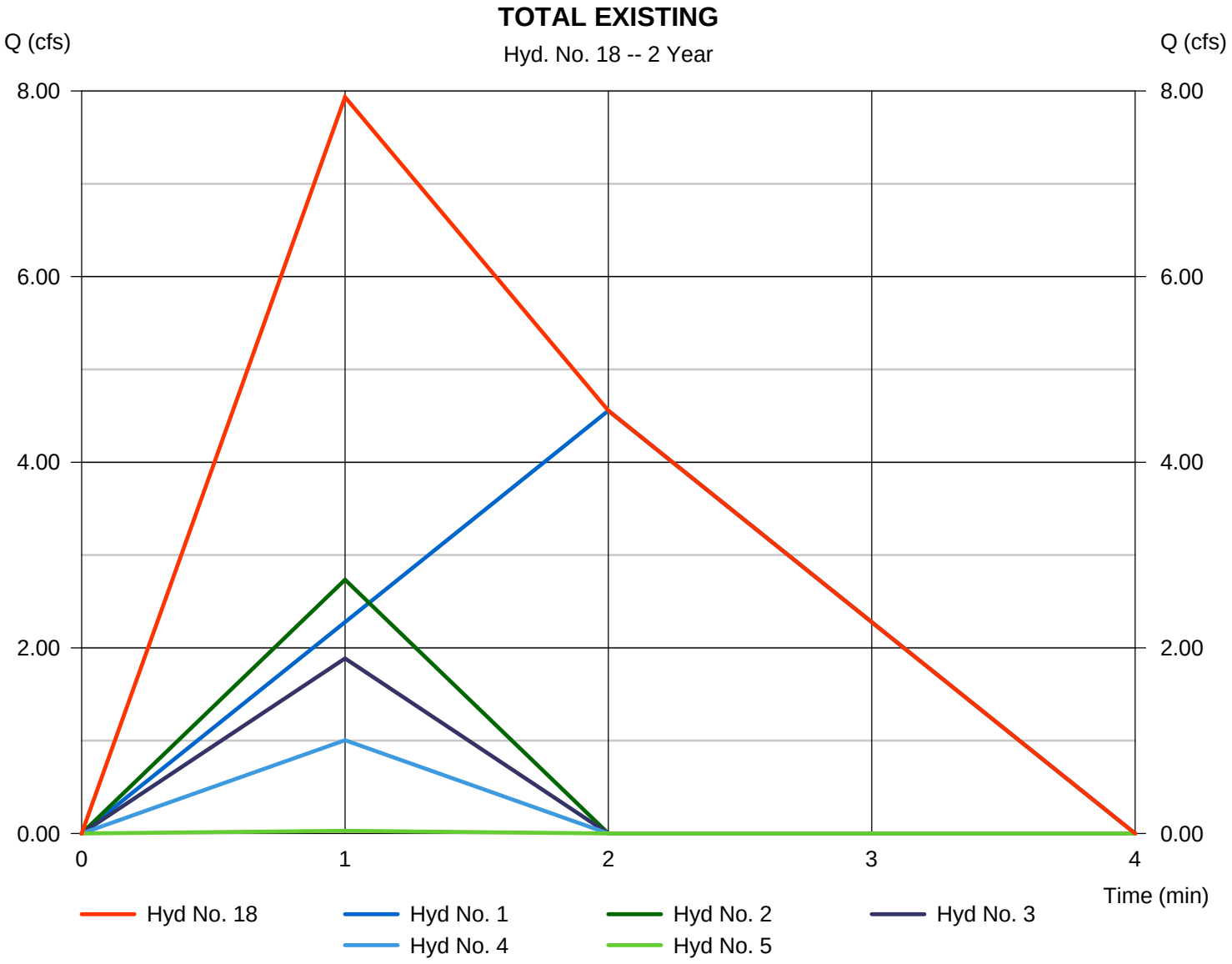


Hydrograph Report

Hyd. No. 18

TOTAL EXISTING

Hydrograph type	= Combine	Peak discharge	= 7.933 cfs
Storm frequency	= 2 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 886 cuft
Inflow hyds.	= 1, 2, 3, 4, 5	Contrib. drain. area	= 3.605 ac

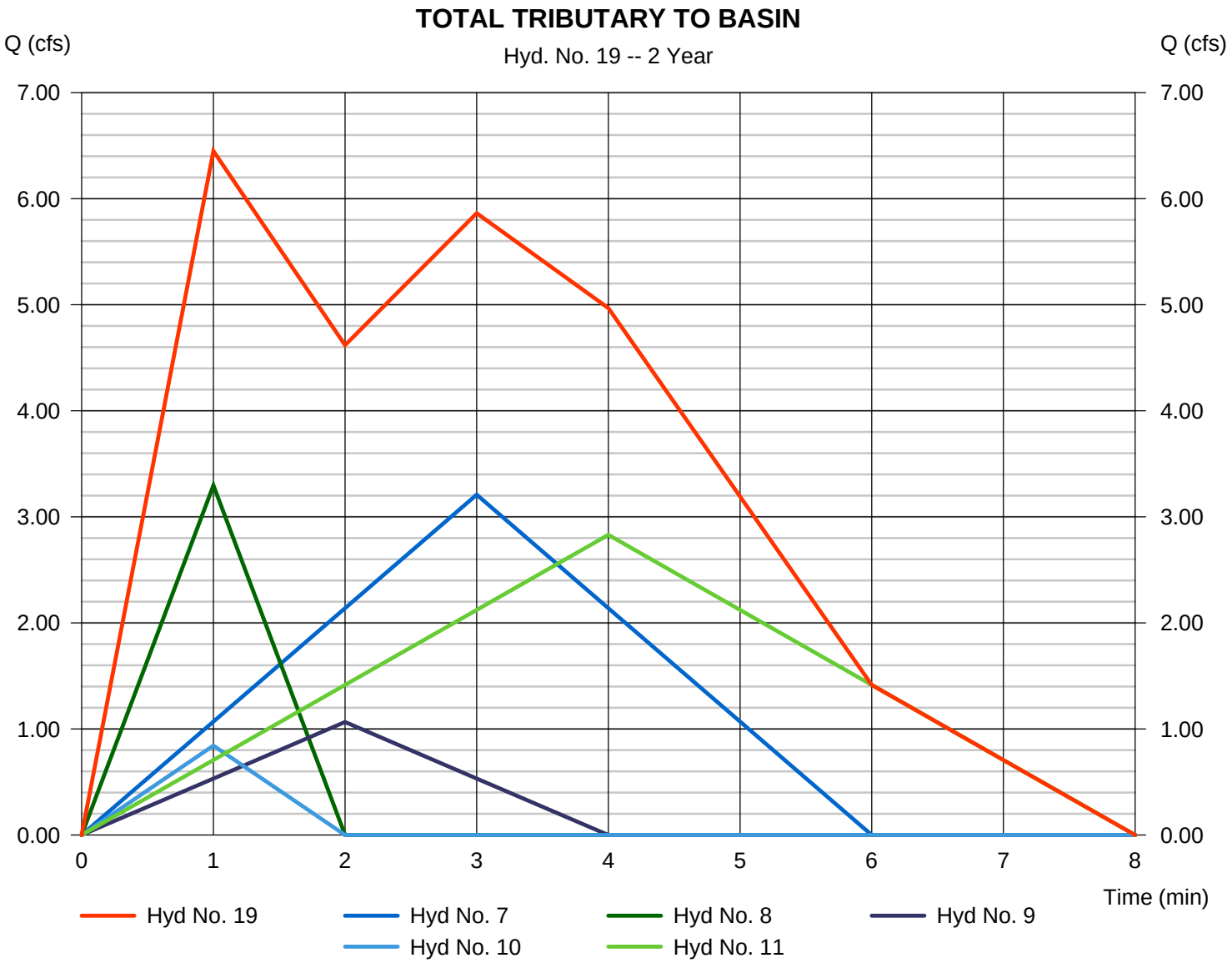


Hydrograph Report

Hyd. No. 19

TOTAL TRIBUTARY TO BASIN

Hydrograph type	= Combine	Peak discharge	= 6.449 cfs
Storm frequency	= 2 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 1,633 cuft
Inflow hyds.	= 7, 8, 9, 10, 11	Contrib. drain. area	= 2.655 ac

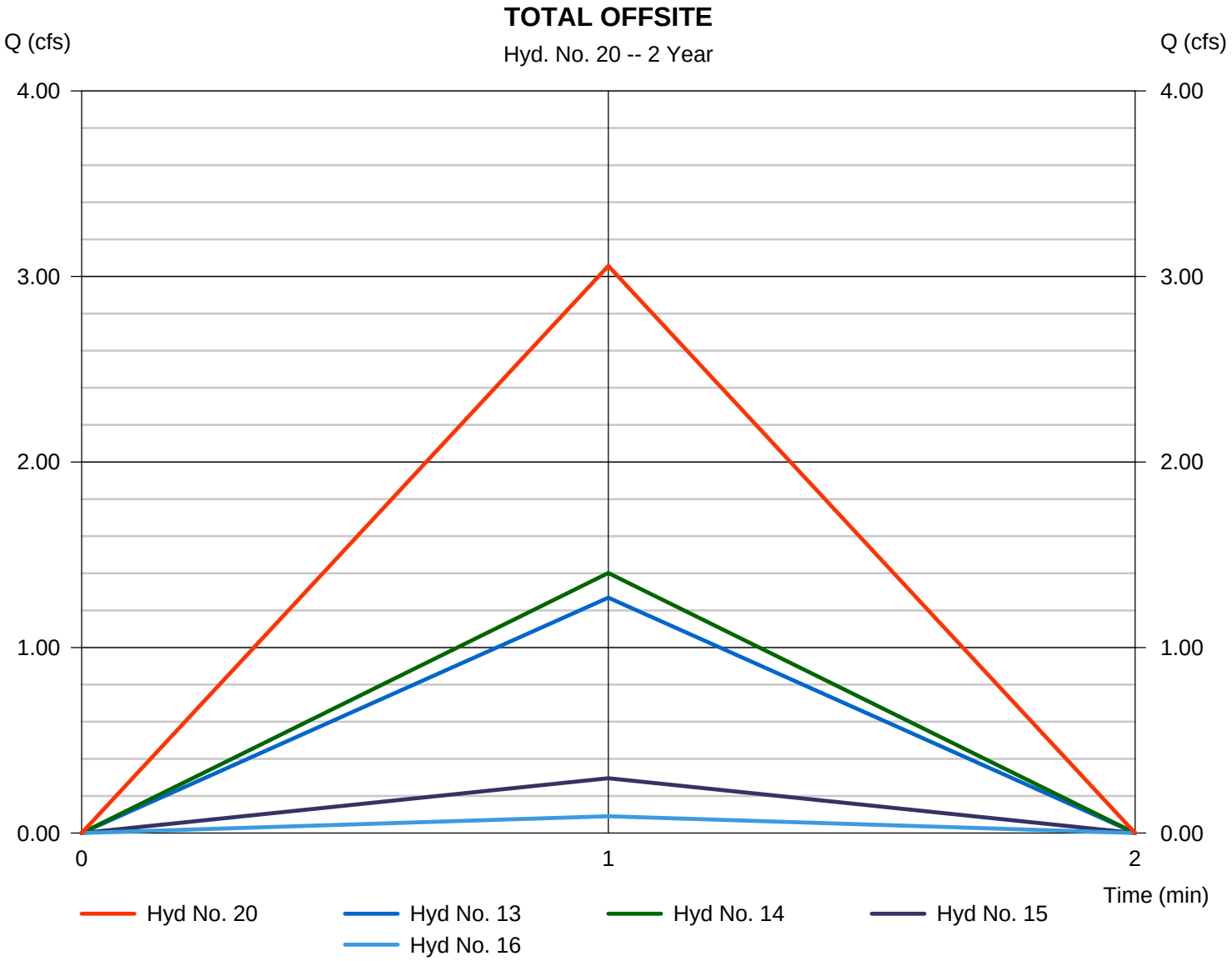


Hydrograph Report

Hyd. No. 20

TOTAL OFFSITE

Hydrograph type	= Combine	Peak discharge	= 3.057 cfs
Storm frequency	= 2 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 183 cuft
Inflow hyds.	= 13, 14, 15, 16	Contrib. drain. area	= 0.950 ac



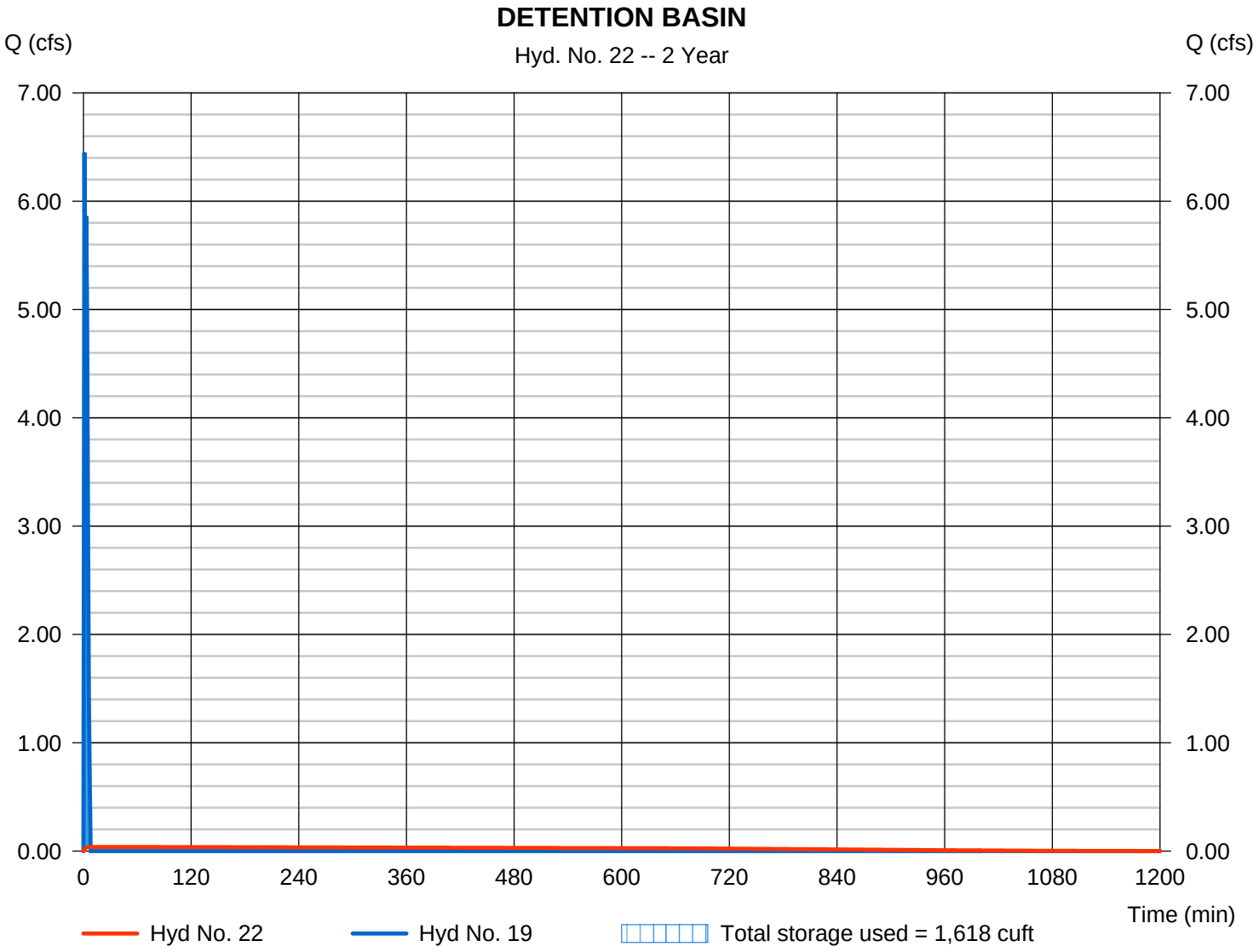
Hydrograph Report

Hyd. No. 22

DETENTION BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	0.038 cfs
Storm frequency	=	2 yrs	Time to peak	=	8 min
Time interval	=	1 min	Hyd. volume	=	1,627 cuft
Inflow hyd. No.	=	19 - TOTAL TRIBUTARY TO BASIN	Max. Elevation	=	557.15 ft
Reservoir name	=	DETENTION	Max. Storage	=	1,618 cuft

Storage Indication method used.



Pond No. 1 - DETENTION

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 555.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	555.00	112	0	0
1.00	556.00	657	347	347
2.00	557.00	1,380	997	1,344
3.00	558.00	2,239	1,792	3,136
4.00	559.00	3,170	2,691	5,827
5.00	560.00	4,178	3,662	9,489

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	1.00	6.00	0.00
Span (in)	= 12.00	1.00	8.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 553.80	555.01	558.40	0.00
Length (ft)	= 33.94	0.00	0.00	0.00
Slope (%)	= 5.30	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)	= 16.00	Inactive	0.00	0.00
Crest El. (ft)	= 558.90	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.11	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	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	555.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.10	35	555.10	3.16 ic	0.01 ic	0.00	---	0.00	---	---	---	---	---	0.006
0.20	69	555.20	3.16 ic	0.01 ic	0.00	---	0.00	---	---	---	---	---	0.010
0.30	104	555.30	3.16 ic	0.01 ic	0.00	---	0.00	---	---	---	---	---	0.013
0.40	139	555.40	3.16 ic	0.02 ic	0.00	---	0.00	---	---	---	---	---	0.015
0.50	173	555.50	3.16 ic	0.02 ic	0.00	---	0.00	---	---	---	---	---	0.018
0.60	208	555.60	3.16 ic	0.02 ic	0.00	---	0.00	---	---	---	---	---	0.019
0.70	243	555.70	3.16 ic	0.02 ic	0.00	---	0.00	---	---	---	---	---	0.021
0.80	278	555.80	3.16 ic	0.02 ic	0.00	---	0.00	---	---	---	---	---	0.023
0.90	312	555.90	3.16 ic	0.02 ic	0.00	---	0.00	---	---	---	---	---	0.024
1.00	347	556.00	3.16 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.026
1.10	447	556.10	3.16 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.027
1.20	546	556.20	3.16 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.028
1.30	646	556.30	3.16 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.029
1.40	746	556.40	3.16 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.030
1.50	845	556.50	3.16 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.032
1.60	945	556.60	3.16 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.033
1.70	1,045	556.70	3.16 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.034
1.80	1,144	556.80	3.16 ic	0.03 ic	0.00	---	0.00	---	---	---	---	---	0.035
1.90	1,244	556.90	3.16 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.036
2.00	1,344	557.00	3.16 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.037
2.10	1,523	557.10	3.16 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.038
2.20	1,702	557.20	3.16 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.038
2.30	1,881	557.30	3.16 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.039
2.40	2,061	557.40	3.16 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.040
2.50	2,240	557.50	3.16 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.041
2.60	2,419	557.60	3.16 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.042
2.70	2,598	557.70	3.16 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.043
2.80	2,777	557.80	3.16 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.044
2.90	2,957	557.90	3.16 ic	0.04 ic	0.00	---	0.00	---	---	---	---	---	0.044
3.00	3,136	558.00	3.16 ic	0.05 ic	0.00	---	0.00	---	---	---	---	---	0.045
3.10	3,405	558.10	3.16 ic	0.05 ic	0.00	---	0.00	---	---	---	---	---	0.046
3.20	3,674	558.20	3.16 ic	0.05 ic	0.00	---	0.00	---	---	---	---	---	0.047
3.30	3,943	558.30	3.16 ic	0.05 ic	0.00	---	0.00	---	---	---	---	---	0.047
3.40	4,212	558.40	3.16 ic	0.05 ic	0.00	---	0.00	---	---	---	---	---	0.048
3.50	4,481	558.50	3.16 ic	0.05 ic	0.07 ic	---	0.00	---	---	---	---	---	0.120
3.60	4,750	558.60	3.16 ic	0.05 ic	0.20 ic	---	0.00	---	---	---	---	---	0.252

Continues on next page...

DETENTION

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
3.70	5,020	558.70	3.16 ic	0.05 ic	0.37 ic	---	0.00	---	---	---	---	---	0.423
3.80	5,289	558.80	3.16 ic	0.05 ic	0.57 ic	---	0.00	---	---	---	---	---	0.625
3.90	5,558	558.90	3.16 ic	0.05 ic	0.80 ic	---	0.00	---	---	---	---	---	0.853
4.00	5,827	559.00	3.16 ic	0.05 ic	0.95 ic	---	1.68	---	---	---	---	---	2.686
4.10	6,193	559.10	4.76 ic	0.05 ic	1.08 ic	---	4.76	---	---	---	---	---	5.893
4.20	6,559	559.20	8.19 ic	0.05 ic	1.19 ic	---	8.19 s	---	---	---	---	---	9.430
4.30	6,926	559.30	8.39 ic	0.05 ic	1.29 ic	---	8.38 s	---	---	---	---	---	9.732
4.40	7,292	559.40	8.50 ic	0.05 ic	1.39 ic	---	8.50 s	---	---	---	---	---	9.940
4.50	7,658	559.50	8.60 ic	0.06 ic	1.48 ic	---	8.59 s	---	---	---	---	---	10.13
4.60	8,024	559.60	8.69 ic	0.06 ic	1.56 ic	---	8.67 s	---	---	---	---	---	10.29
4.70	8,391	559.70	8.78 ic	0.06 ic	1.64 ic	---	8.75 s	---	---	---	---	---	10.45
4.80	8,757	559.80	8.86 ic	0.06 ic	1.72 ic	---	8.84 s	---	---	---	---	---	10.62
4.90	9,123	559.90	8.94 ic	0.06 ic	1.79 ic	---	8.91 s	---	---	---	---	---	10.76
5.00	9,489	560.00	9.02 ic	0.06 ic	1.86 ic	---	8.97 s	---	---	---	---	---	10.89

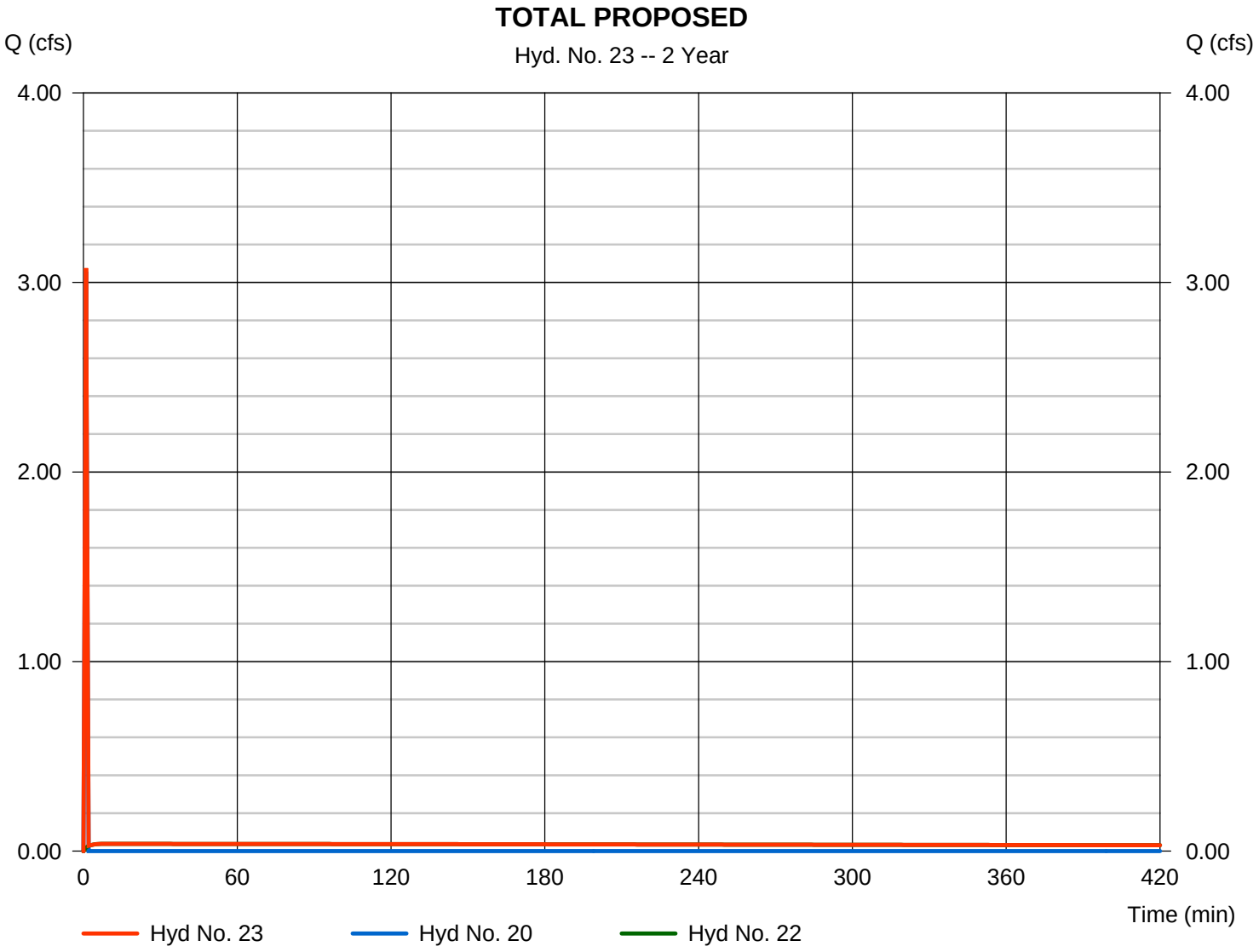
...End

Hydrograph Report

Hyd. No. 23

TOTAL PROPOSED

Hydrograph type	= Combine	Peak discharge	= 3.076 cfs
Storm frequency	= 2 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 1,810 cuft
Inflow hyds.	= 20, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

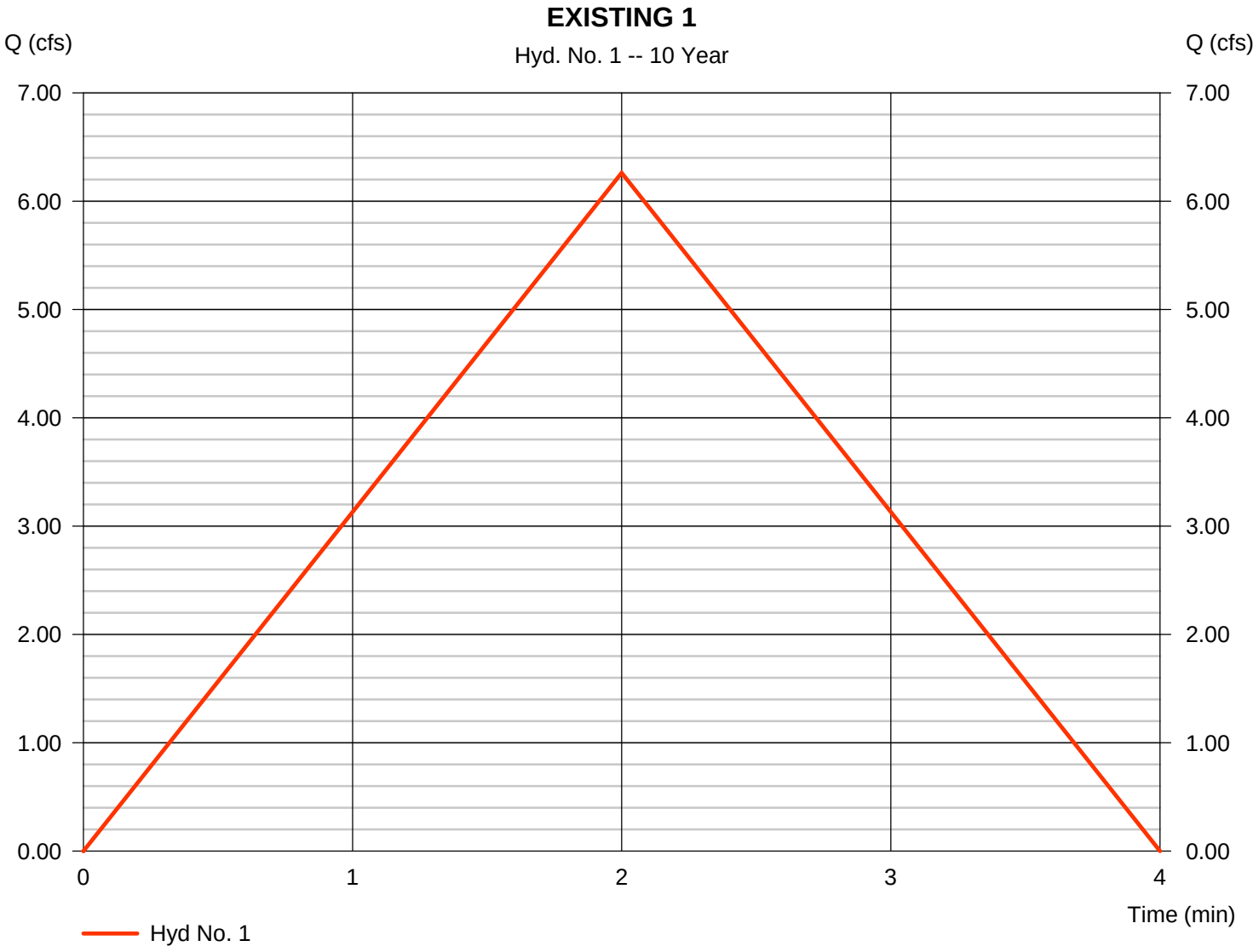
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	6.262	1	2	751	------	------	------	EXISTING 1
2	Rational	3.728	1	1	224	------	------	------	EXISTING 2
3	Rational	2.571	1	1	154	------	------	------	EXISTING 3
4	Rational	1.371	1	1	82	------	------	------	EXISTING 4
5	Rational	0.040	1	1	2	------	------	------	EXISTING 5
7	Rational	4.443	1	3	800	------	------	------	POST DEVELOPED 1
8	Rational	4.494	1	1	270	------	------	------	POST DEVELOPED 2
9	Rational	1.464	1	2	176	------	------	------	POST DEVELOPED 3
10	Rational	1.150	1	1	69	------	------	------	POST DEVELOPED 4
11	Rational	3.945	1	4	947	------	------	------	POST DEVELOPED 5
13	Rational	1.729	1	1	104	------	------	------	OFFSITE 1
14	Rational	1.911	1	1	115	------	------	------	OFFSITE 2
15	Rational	0.403	1	1	24	------	------	------	OFFSITE 3
16	Rational	0.124	1	1	7	------	------	------	OFFSITE 4
18	Combine	10.84	1	1	1,214	1, 2, 3, 4, 5,	------	------	TOTAL EXISTING
19	Combine	8.843	1	1	2,261	7, 8, 9, 10, 11,	------	------	TOTAL TRIBUTARY TO BASIN
20	Combine	4.168	1	1	250	13, 14, 15, 16,	------	------	TOTAL OFFSITE
22	Reservoir	0.041	1	8	2,255	19	557.50	2,245	DETENTION BASIN
23	Combine	4.190	1	1	2,505	20, 22	------	------	TOTAL PROPOSED

Hydrograph Report

Hyd. No. 1

EXISTING 1

Hydrograph type	=	Rational	Peak discharge	=	6.262 cfs
Storm frequency	=	10 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	751 cuft
Drainage area	=	1.910 ac	Runoff coeff.	=	0.38
Intensity	=	8.628 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

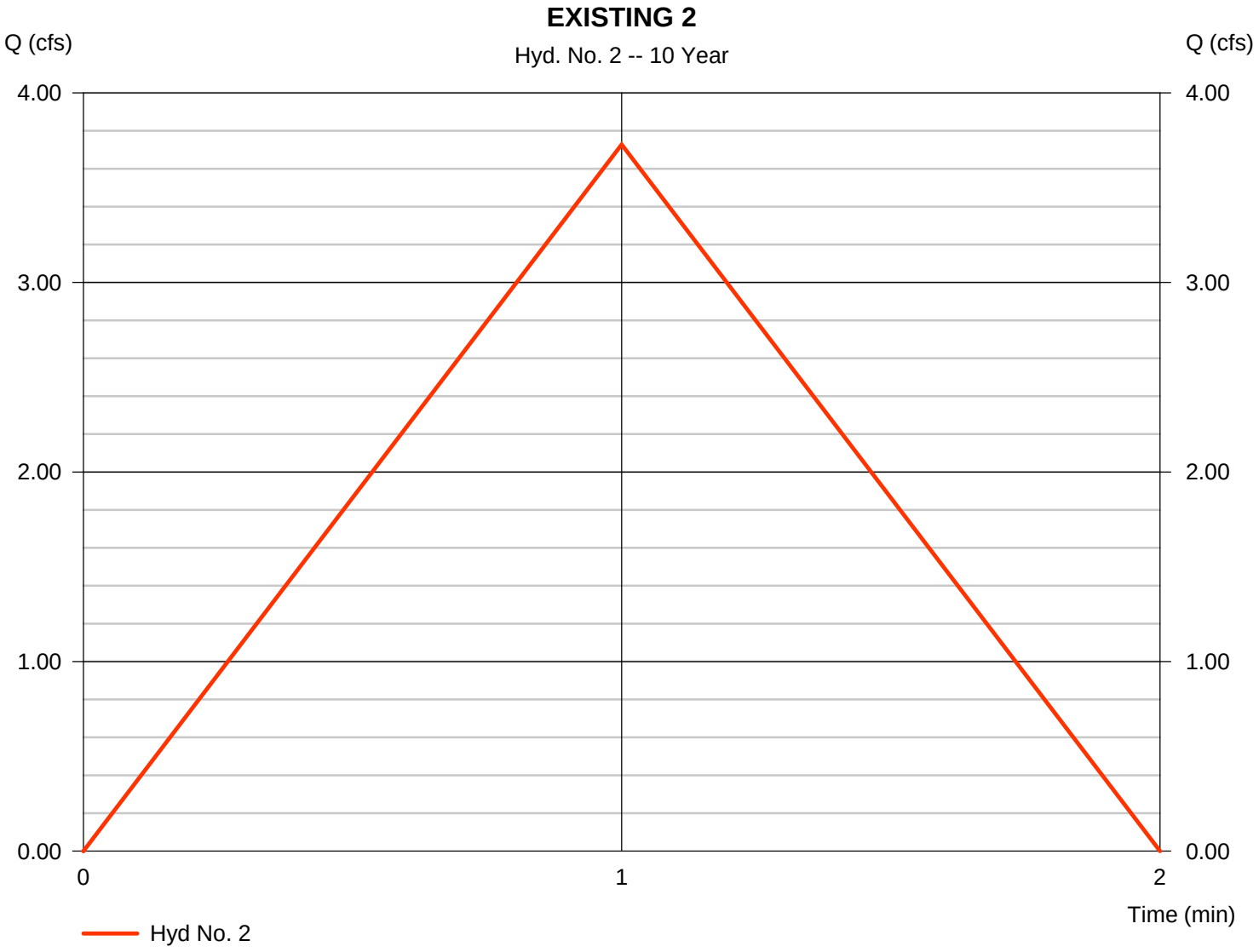


Hydrograph Report

Hyd. No. 2

EXISTING 2

Hydrograph type	=	Rational	Peak discharge	=	3.728 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	224 cuft
Drainage area	=	0.802 ac	Runoff coeff.	=	0.51
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

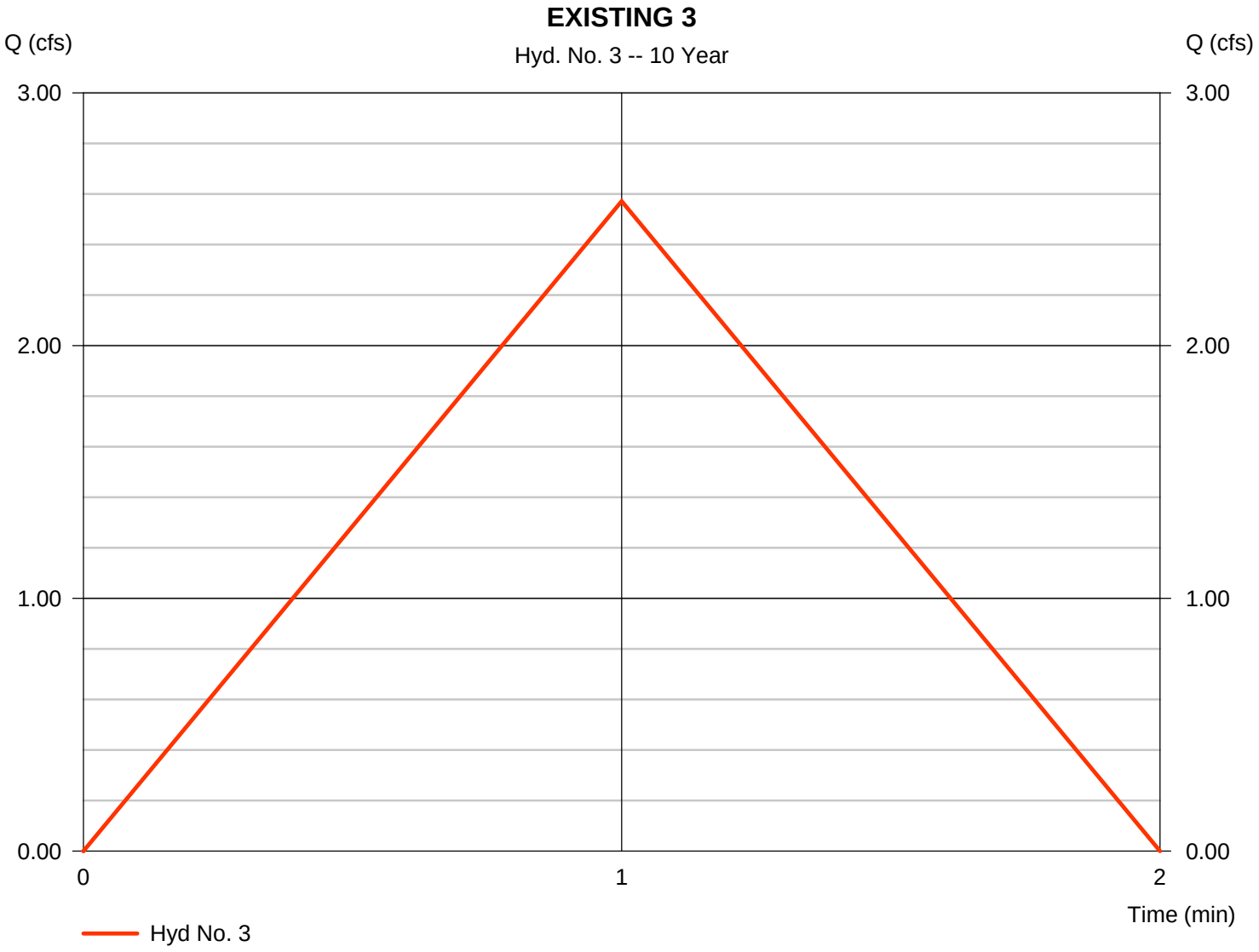


Hydrograph Report

Hyd. No. 3

EXISTING 3

Hydrograph type	=	Rational	Peak discharge	=	2.571 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	154 cuft
Drainage area	=	0.495 ac	Runoff coeff.	=	0.57
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

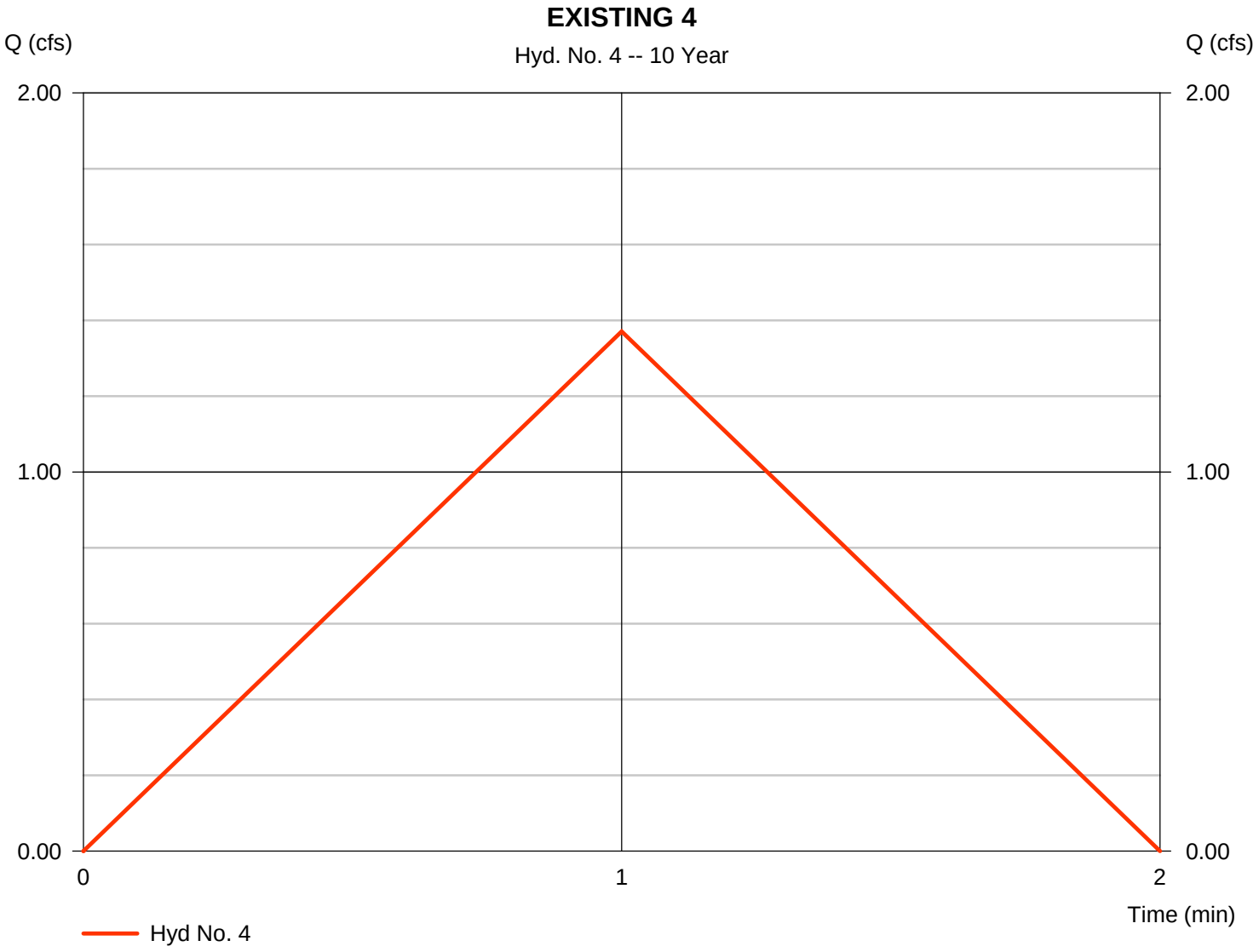


Hydrograph Report

Hyd. No. 4

EXISTING 4

Hydrograph type	=	Rational	Peak discharge	=	1.371 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	82 cuft
Drainage area	=	0.376 ac	Runoff coeff.	=	0.4
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

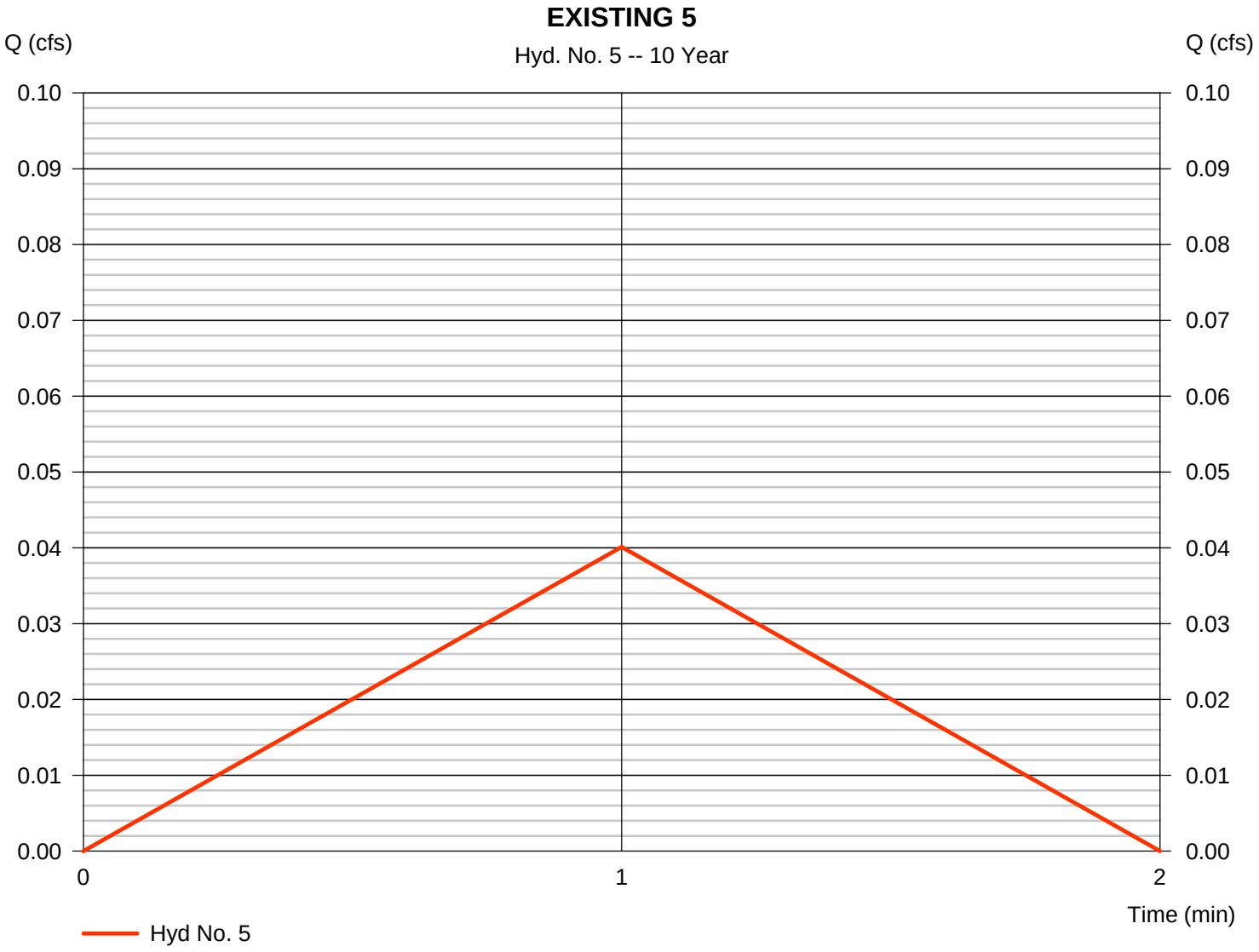


Hydrograph Report

Hyd. No. 5

EXISTING 5

Hydrograph type	=	Rational	Peak discharge	=	0.040 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	2 cuft
Drainage area	=	0.022 ac	Runoff coeff.	=	0.2
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

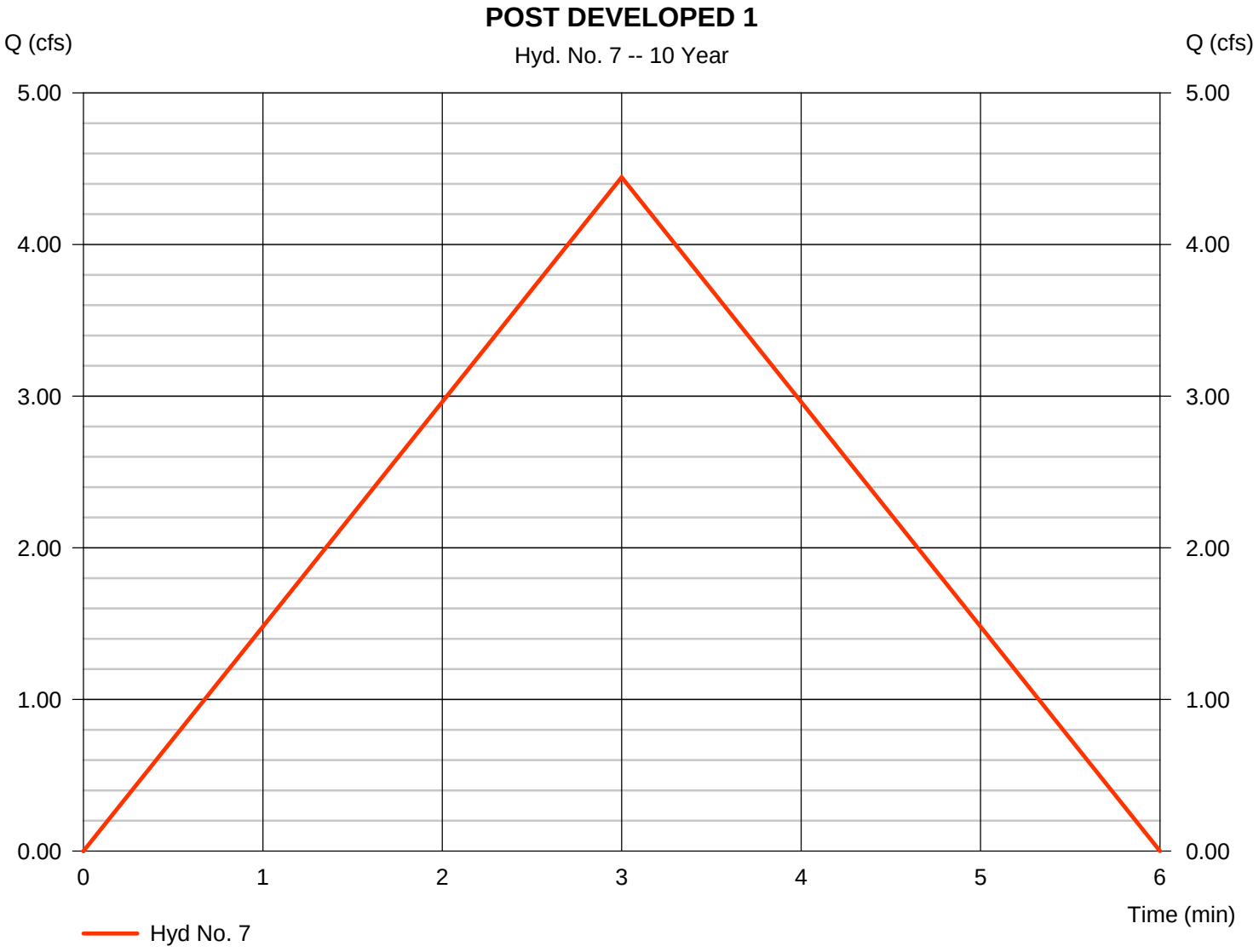


Hydrograph Report

Hyd. No. 7

POST DEVELOPED 1

Hydrograph type	=	Rational	Peak discharge	=	4.443 cfs
Storm frequency	=	10 yrs	Time to peak	=	3 min
Time interval	=	1 min	Hyd. volume	=	800 cuft
Drainage area	=	1.004 ac	Runoff coeff.	=	0.54
Intensity	=	8.196 in/hr	Tc by User	=	3.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

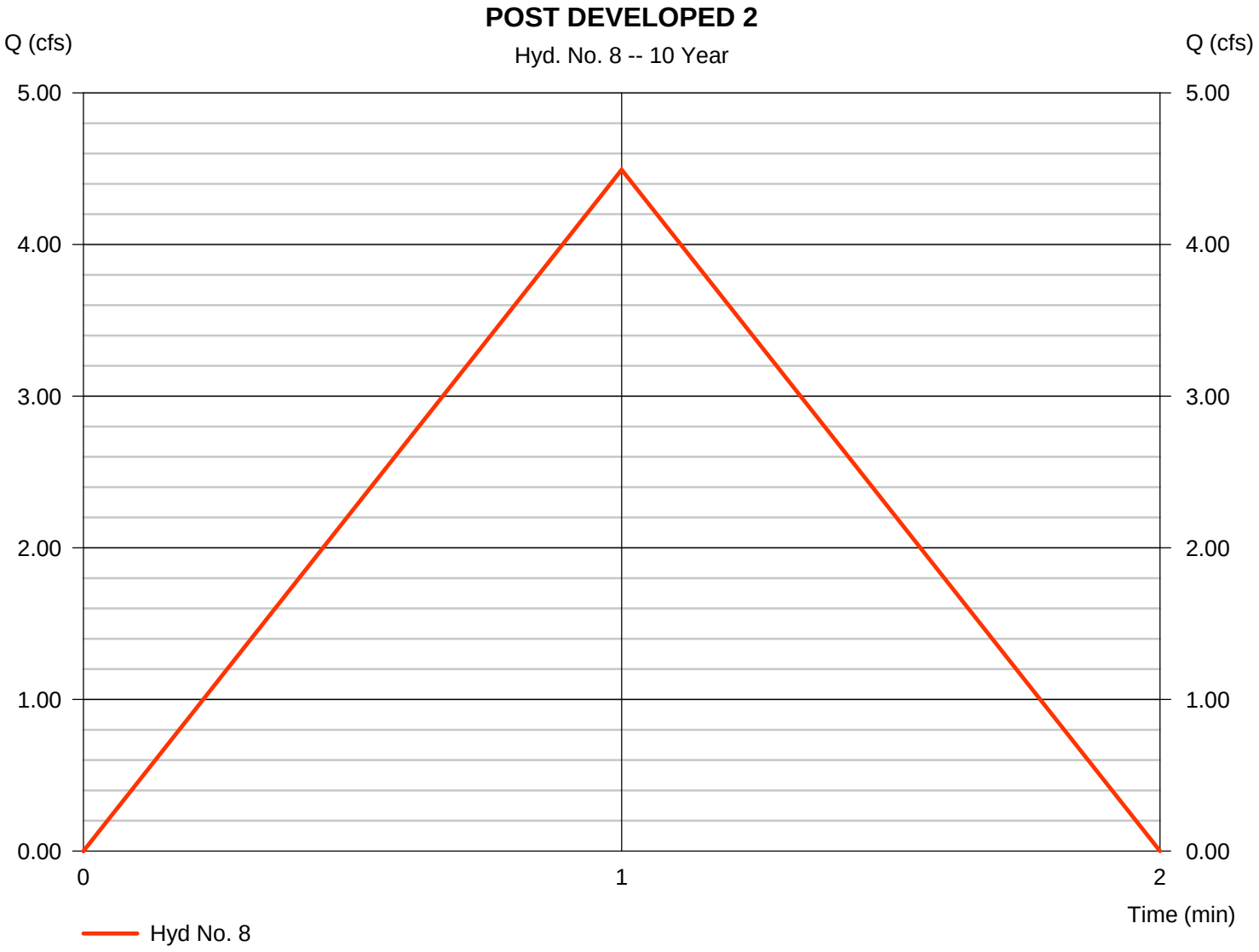


Hydrograph Report

Hyd. No. 8

POST DEVELOPED 2

Hydrograph type	=	Rational	Peak discharge	=	4.494 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	270 cuft
Drainage area	=	0.554 ac	Runoff coeff.	=	0.89
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

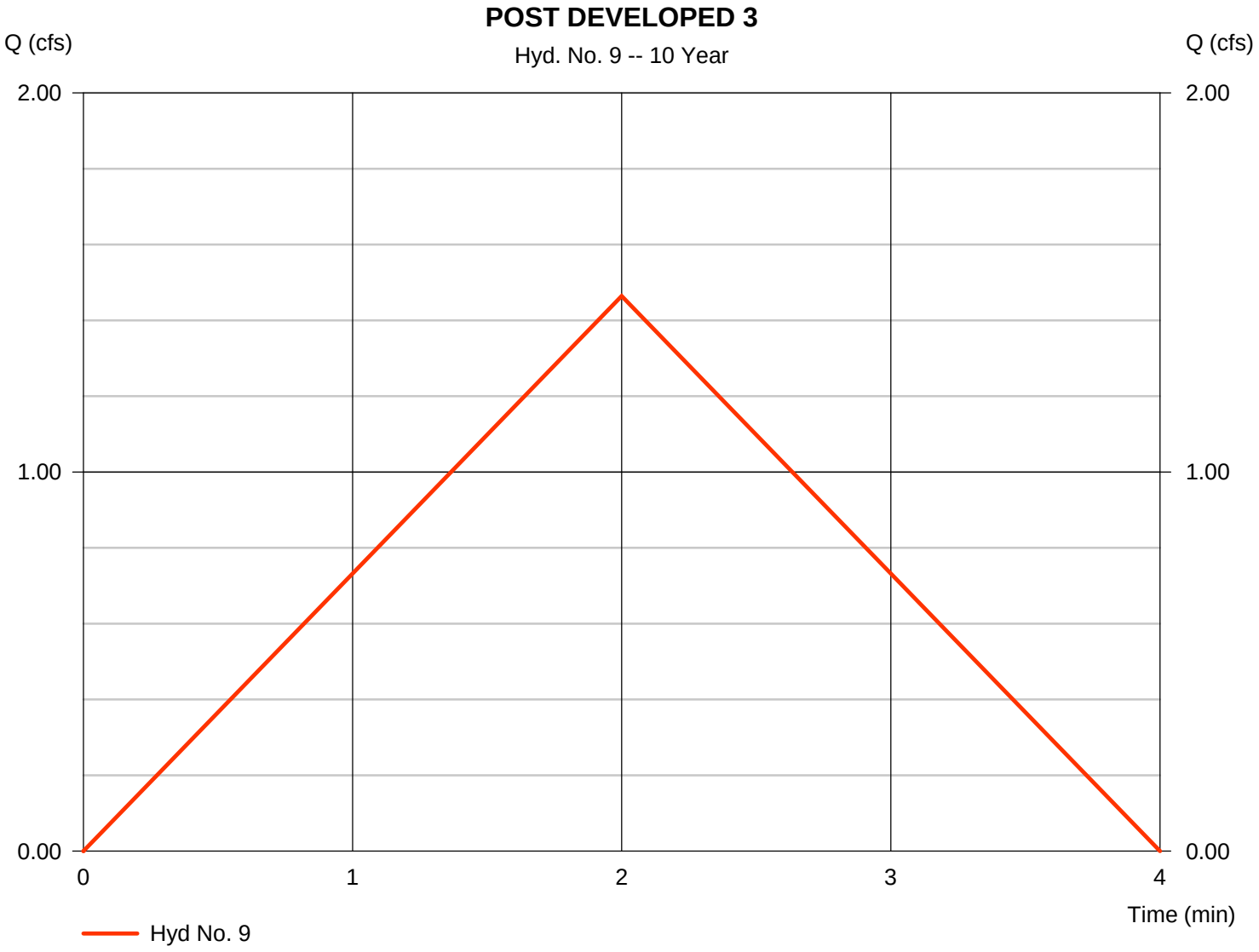


Hydrograph Report

Hyd. No. 9

POST DEVELOPED 3

Hydrograph type	=	Rational	Peak discharge	=	1.464 cfs
Storm frequency	=	10 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	176 cuft
Drainage area	=	0.239 ac	Runoff coeff.	=	0.71
Intensity	=	8.628 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

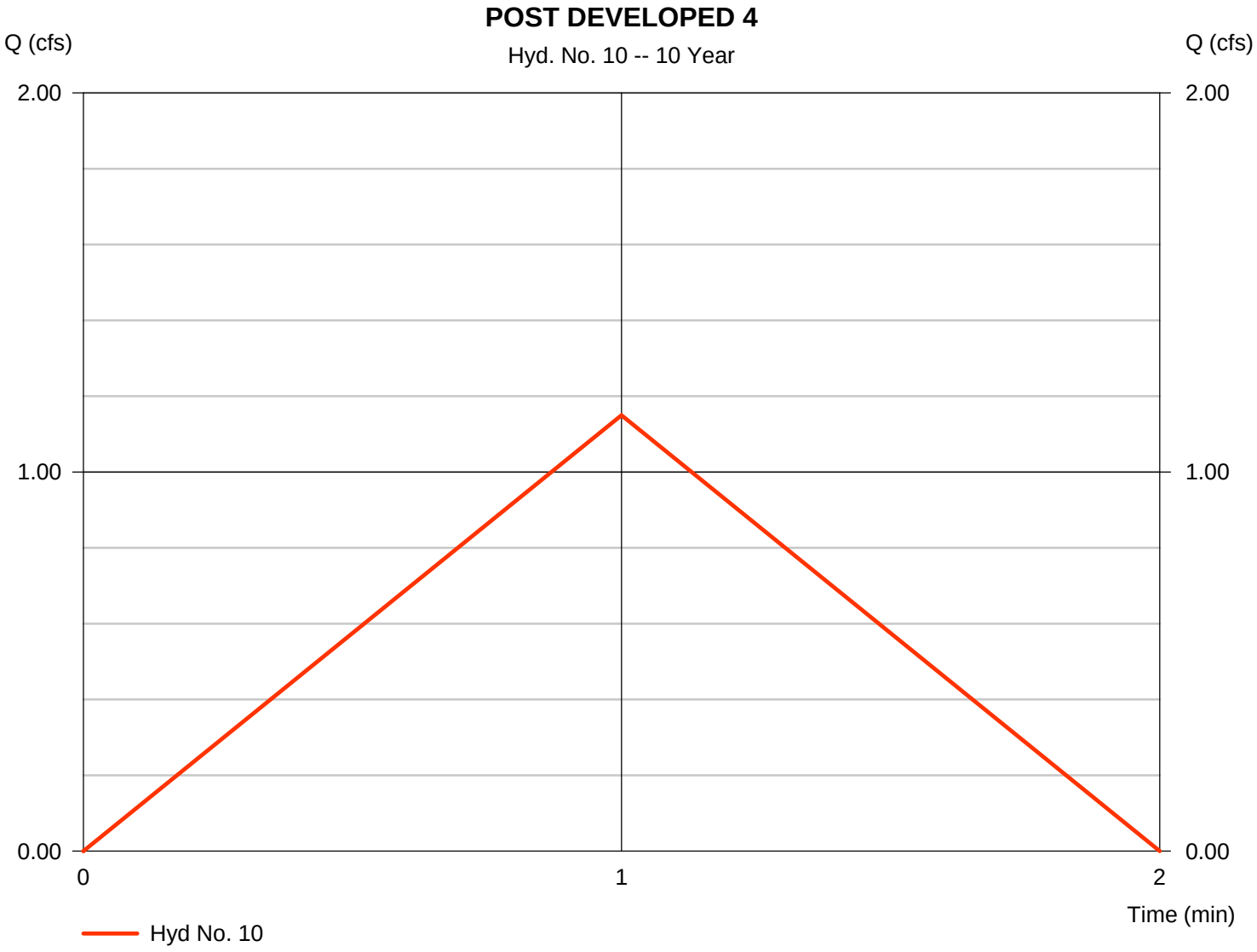


Hydrograph Report

Hyd. No. 10

POST DEVELOPED 4

Hydrograph type	=	Rational	Peak discharge	=	1.150 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	69 cuft
Drainage area	=	0.166 ac	Runoff coeff.	=	0.76
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

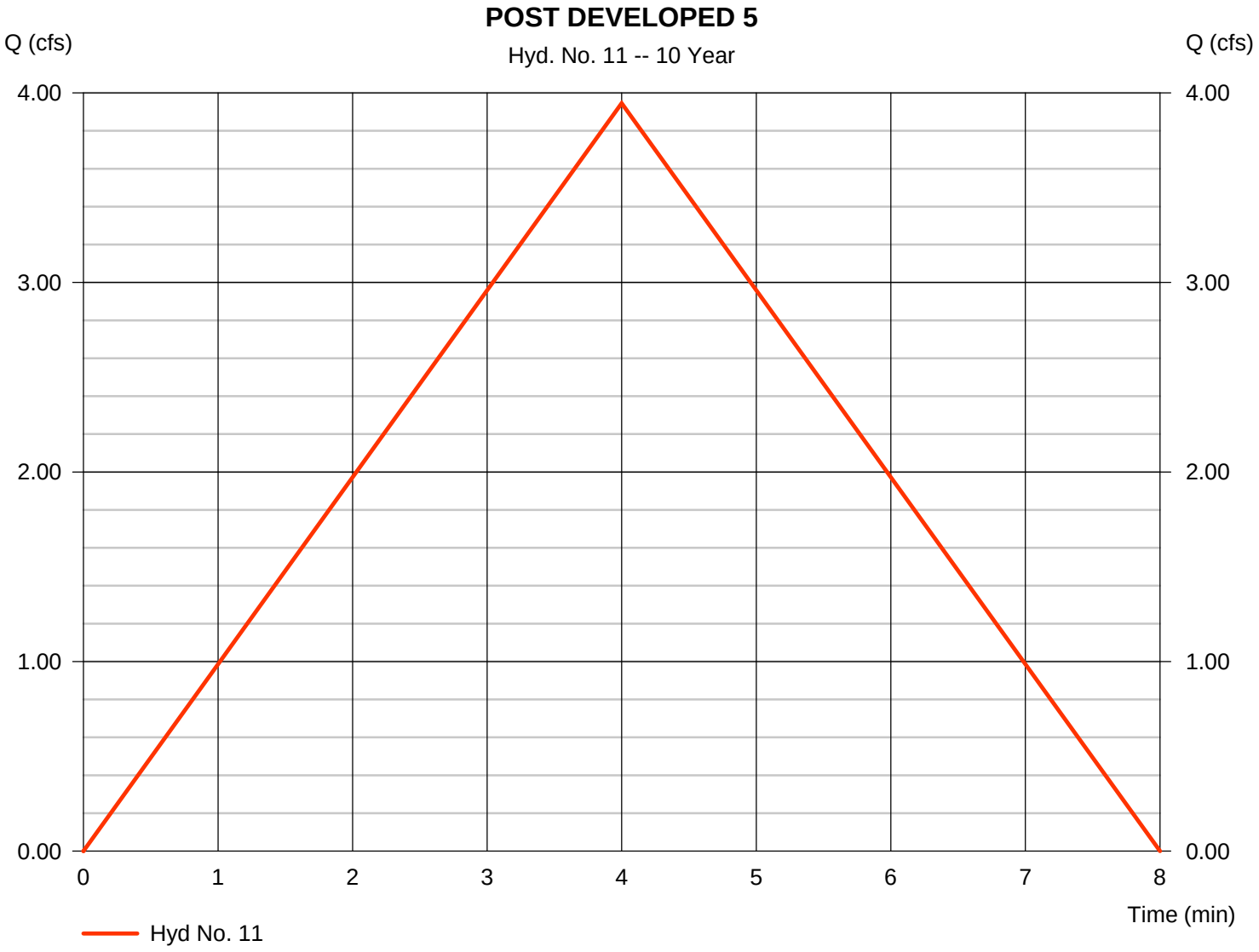


Hydrograph Report

Hyd. No. 11

POST DEVELOPED 5

Hydrograph type	=	Rational	Peak discharge	=	3.945 cfs
Storm frequency	=	10 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	947 cuft
Drainage area	=	0.692 ac	Runoff coeff.	=	0.73
Intensity	=	7.810 in/hr	Tc by User	=	4.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

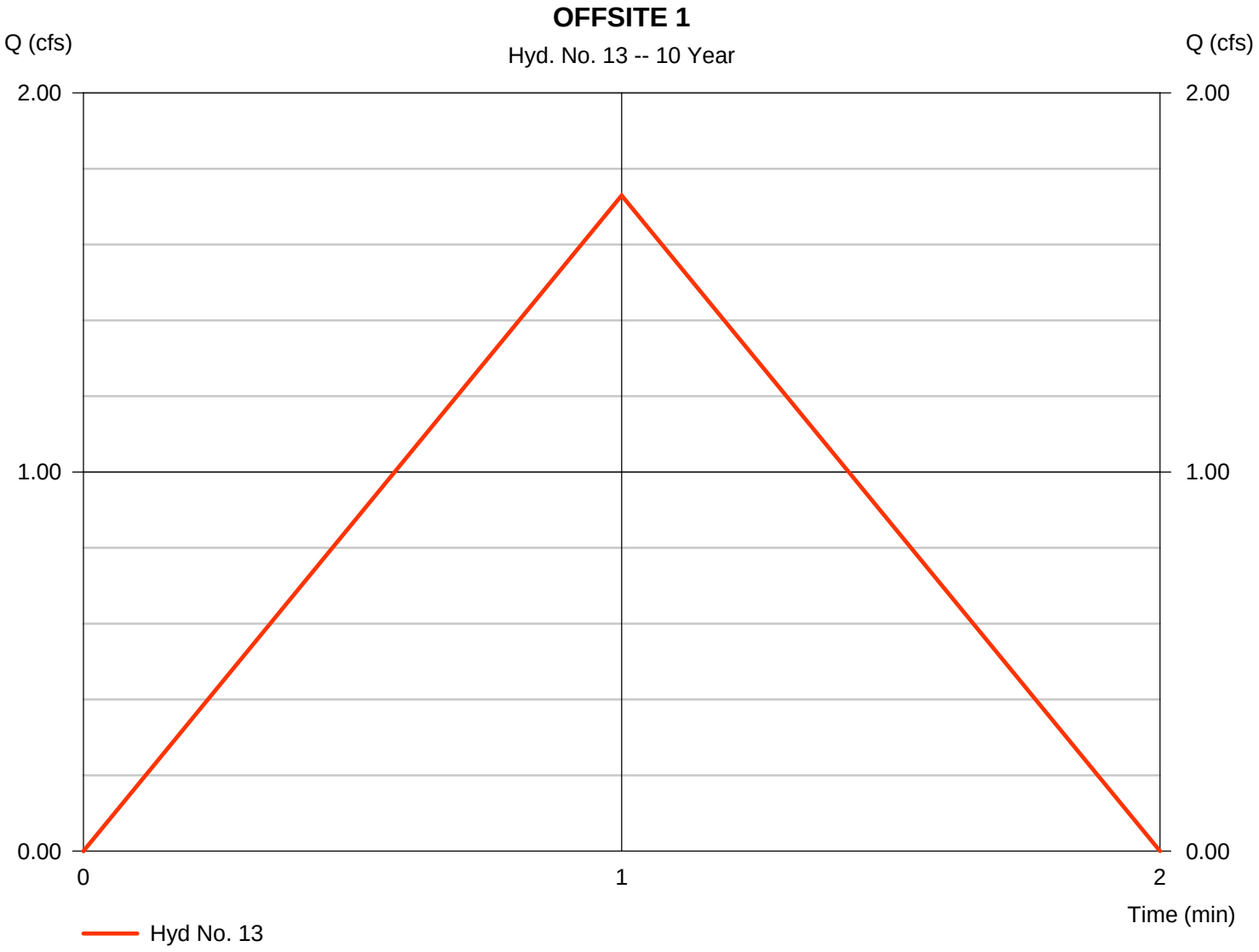


Hydrograph Report

Hyd. No. 13

OFFSITE 1

Hydrograph type	=	Rational	Peak discharge	=	1.729 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	104 cuft
Drainage area	=	0.593 ac	Runoff coeff.	=	0.32
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

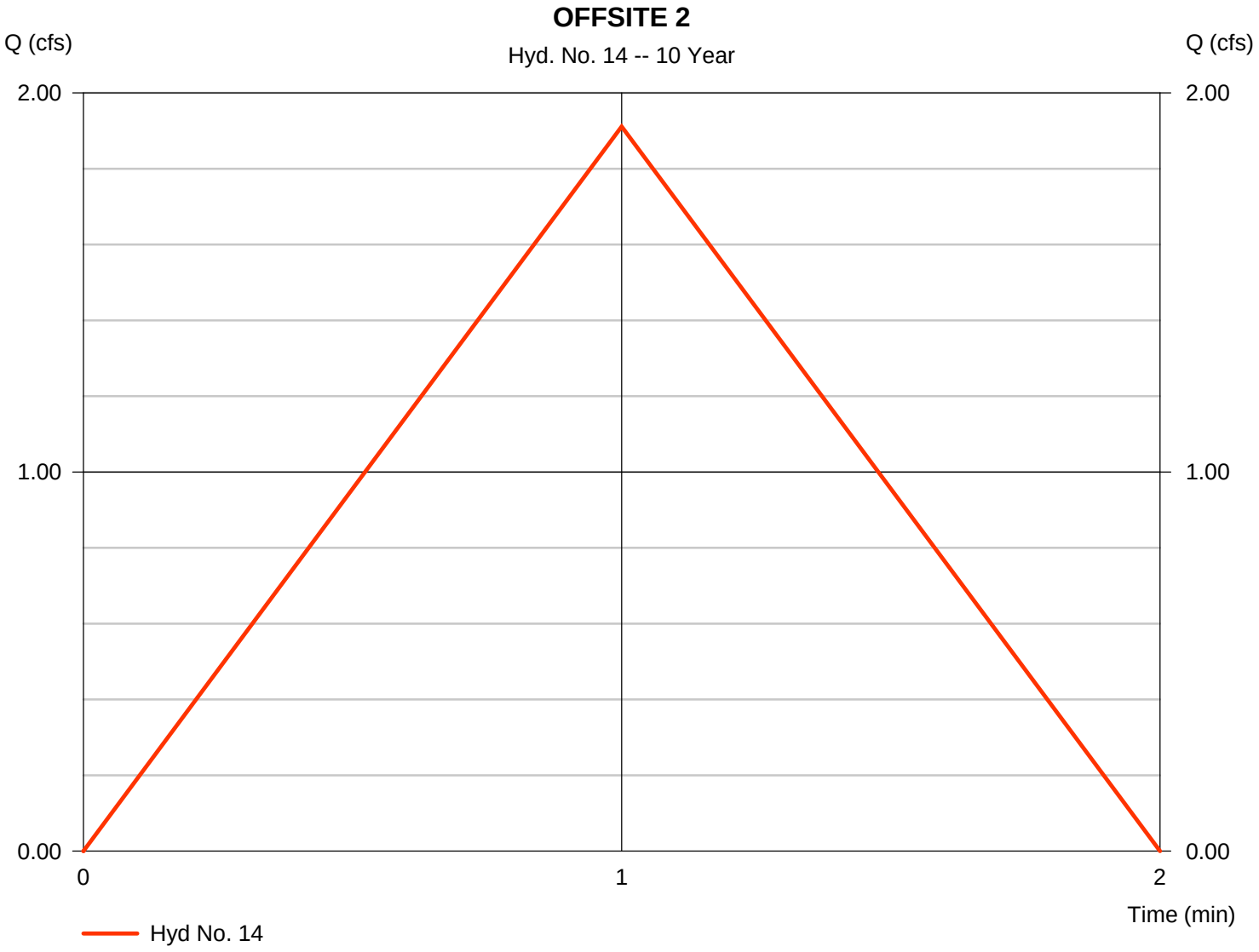


Hydrograph Report

Hyd. No. 14

OFFSITE 2

Hydrograph type	=	Rational	Peak discharge	=	1.911 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	115 cuft
Drainage area	=	0.233 ac	Runoff coeff.	=	0.9
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

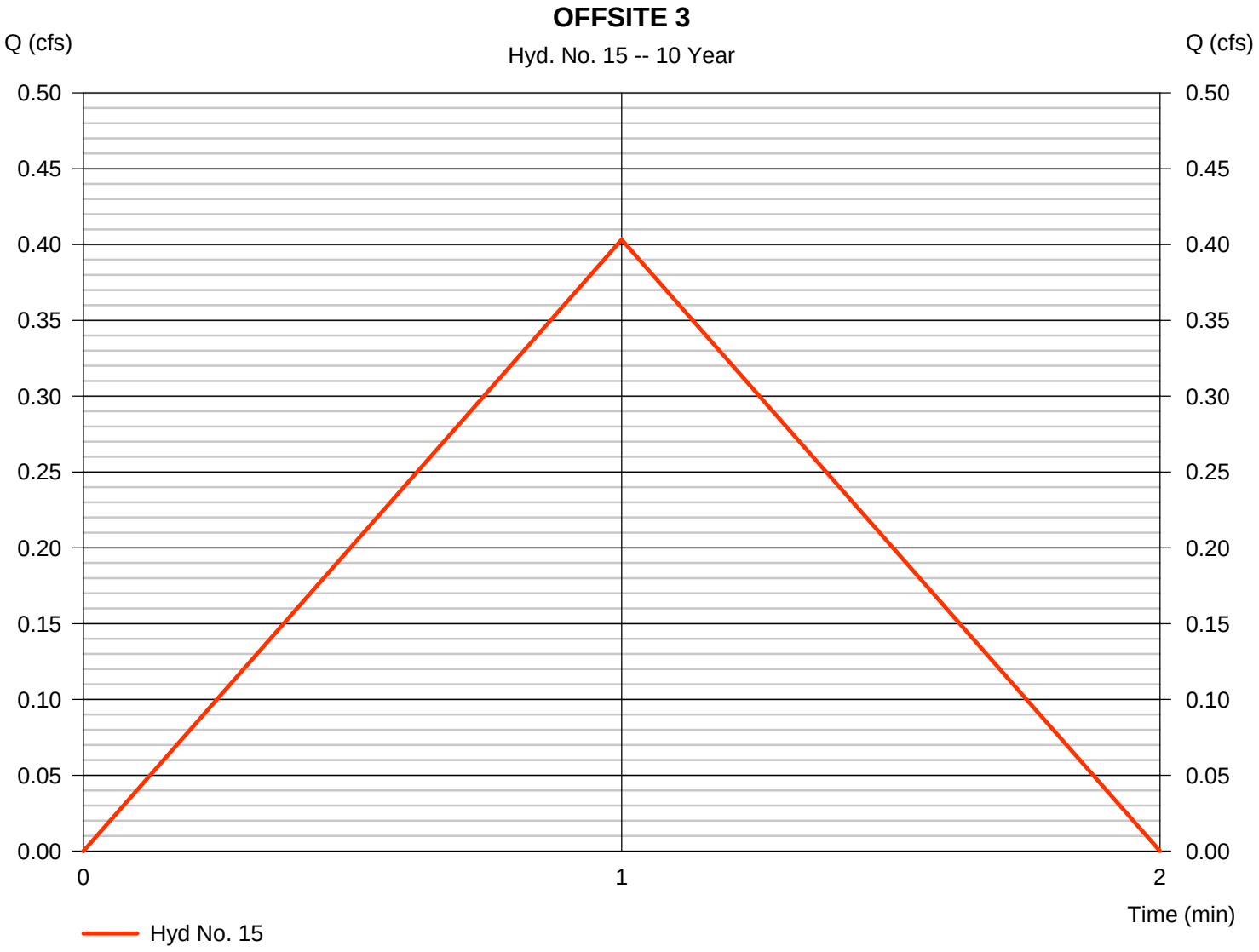


Hydrograph Report

Hyd. No. 15

OFFSITE 3

Hydrograph type	=	Rational	Peak discharge	=	0.403 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	24 cuft
Drainage area	=	0.056 ac	Runoff coeff.	=	0.79
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

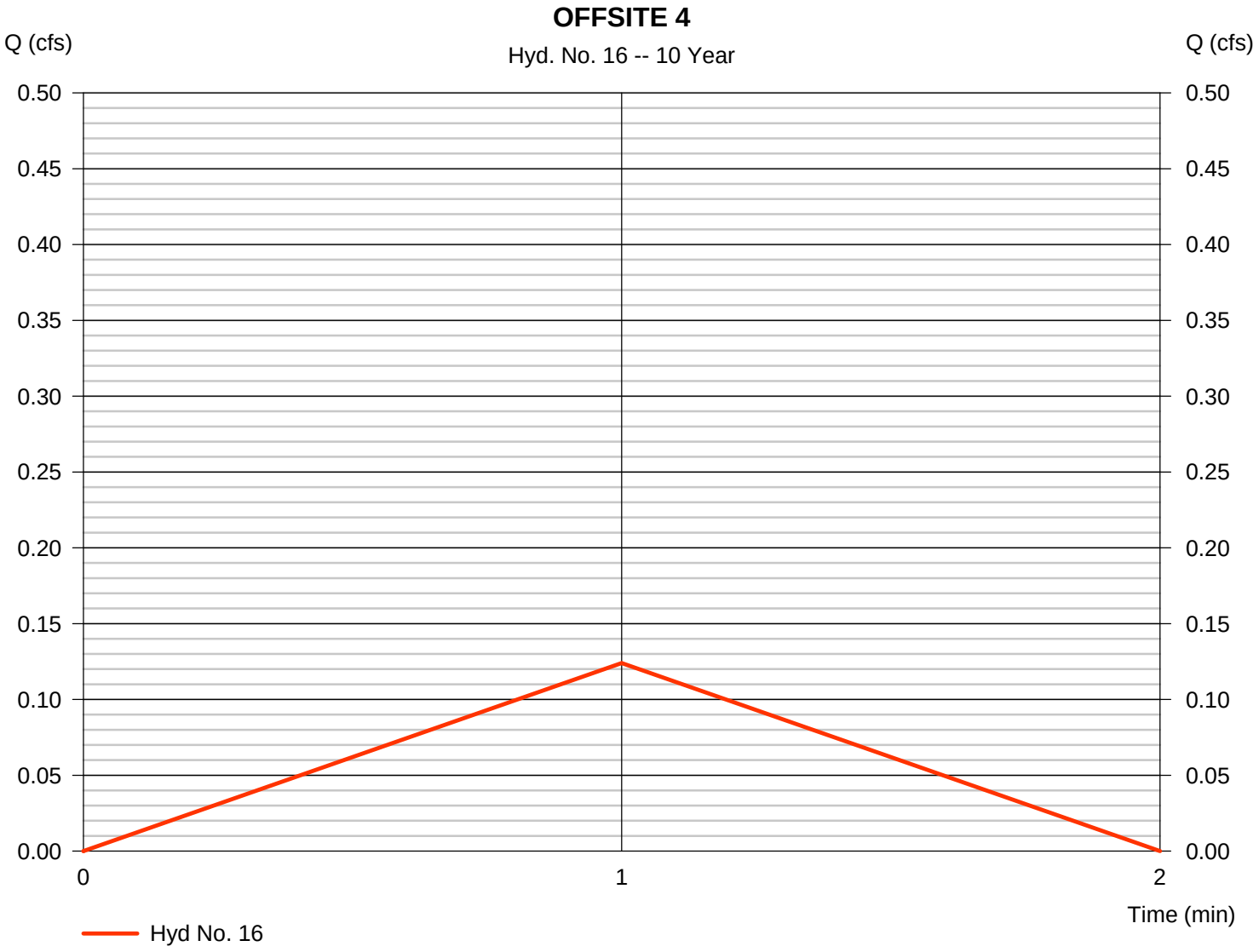


Hydrograph Report

Hyd. No. 16

OFFSITE 4

Hydrograph type	=	Rational	Peak discharge	=	0.124 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	7 cuft
Drainage area	=	0.068 ac	Runoff coeff.	=	0.2
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

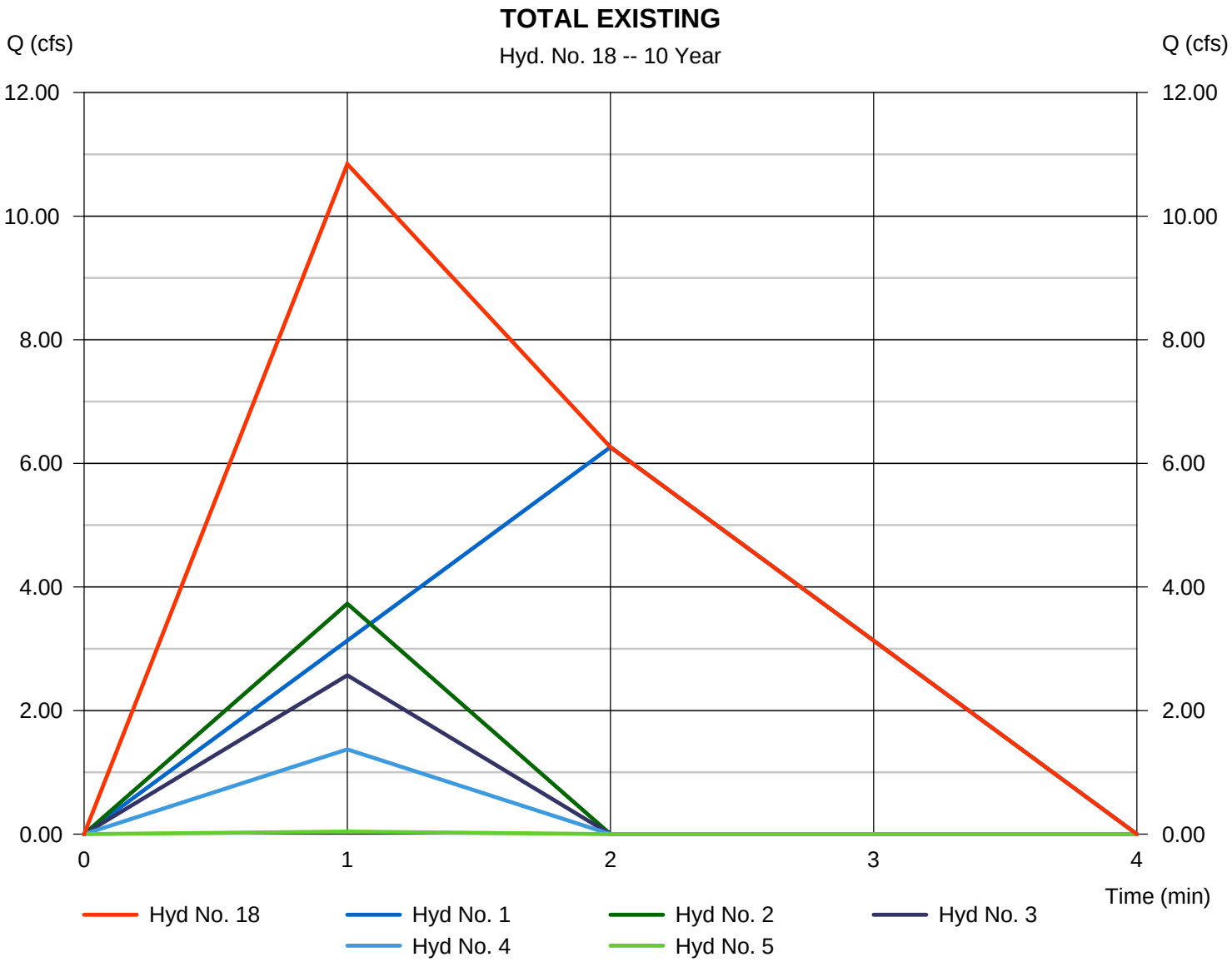


Hydrograph Report

Hyd. No. 18

TOTAL EXISTING

Hydrograph type	=	Combine	Peak discharge	=	10.84 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	1,214 cuft
Inflow hyds.	=	1, 2, 3, 4, 5	Contrib. drain. area	=	3.605 ac

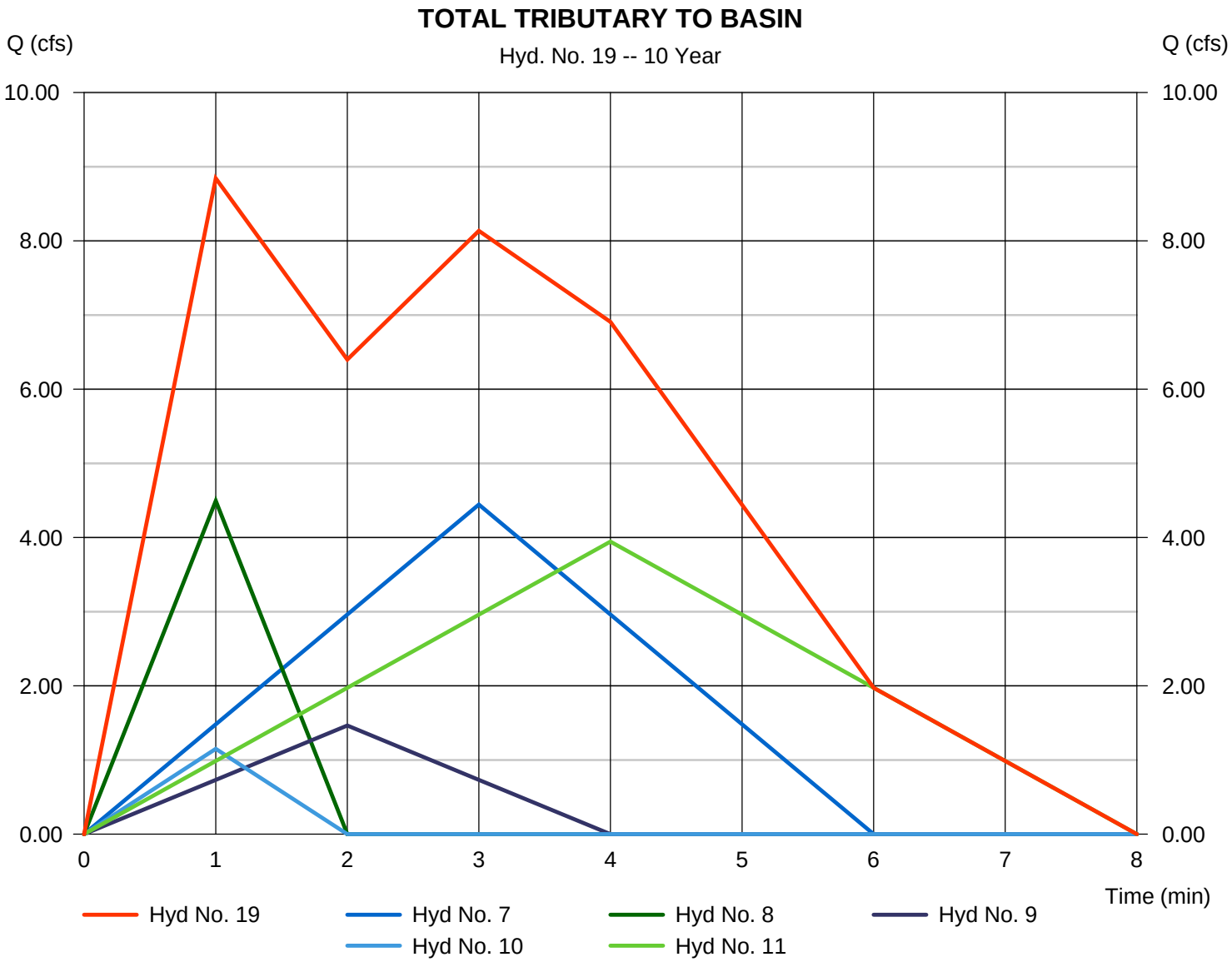


Hydrograph Report

Hyd. No. 19

TOTAL TRIBUTARY TO BASIN

Hydrograph type	= Combine	Peak discharge	= 8.843 cfs
Storm frequency	= 10 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 2,261 cuft
Inflow hyds.	= 7, 8, 9, 10, 11	Contrib. drain. area	= 2.655 ac

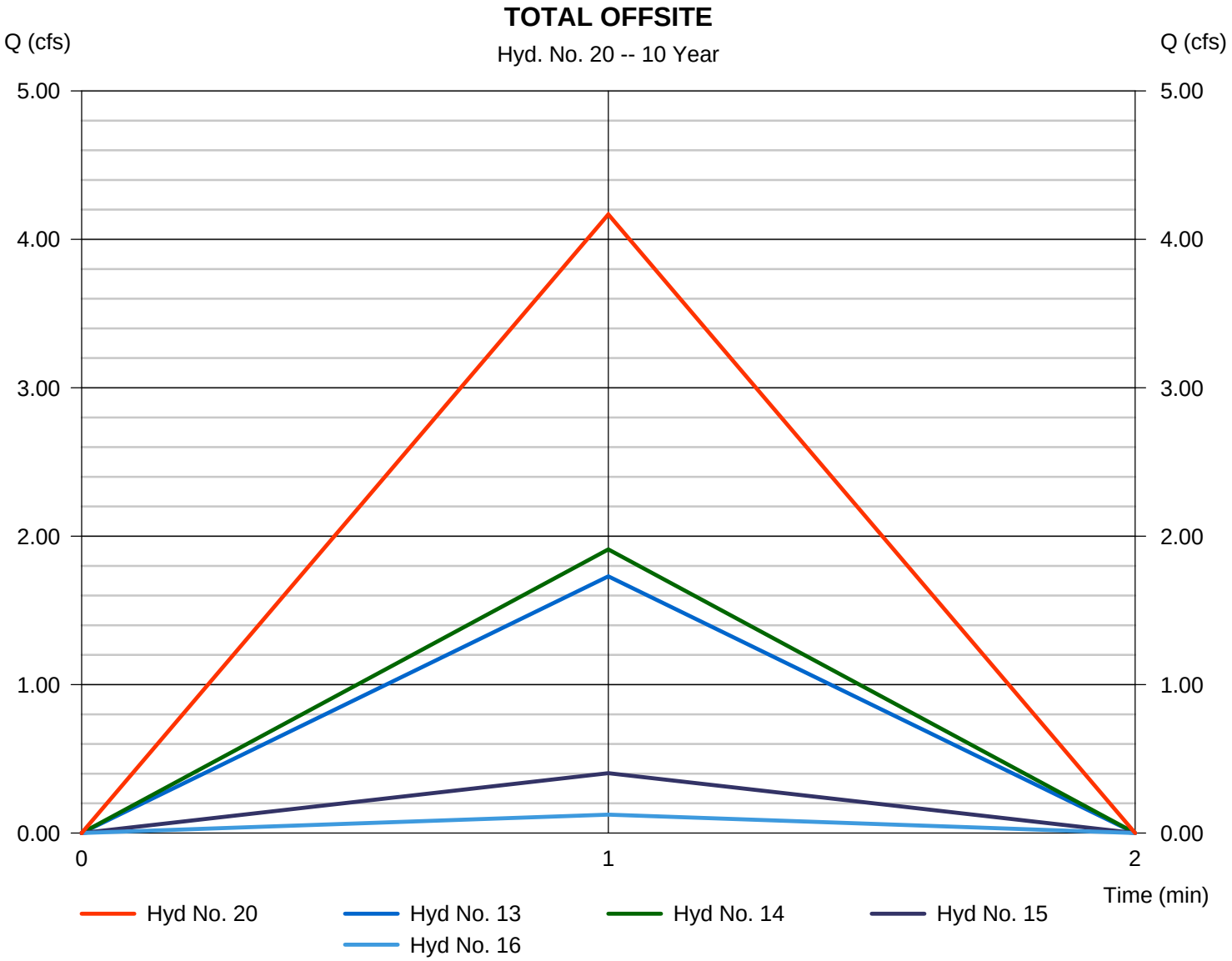


Hydrograph Report

Hyd. No. 20

TOTAL OFFSITE

Hydrograph type	= Combine	Peak discharge	= 4.168 cfs
Storm frequency	= 10 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 250 cuft
Inflow hyds.	= 13, 14, 15, 16	Contrib. drain. area	= 0.950 ac



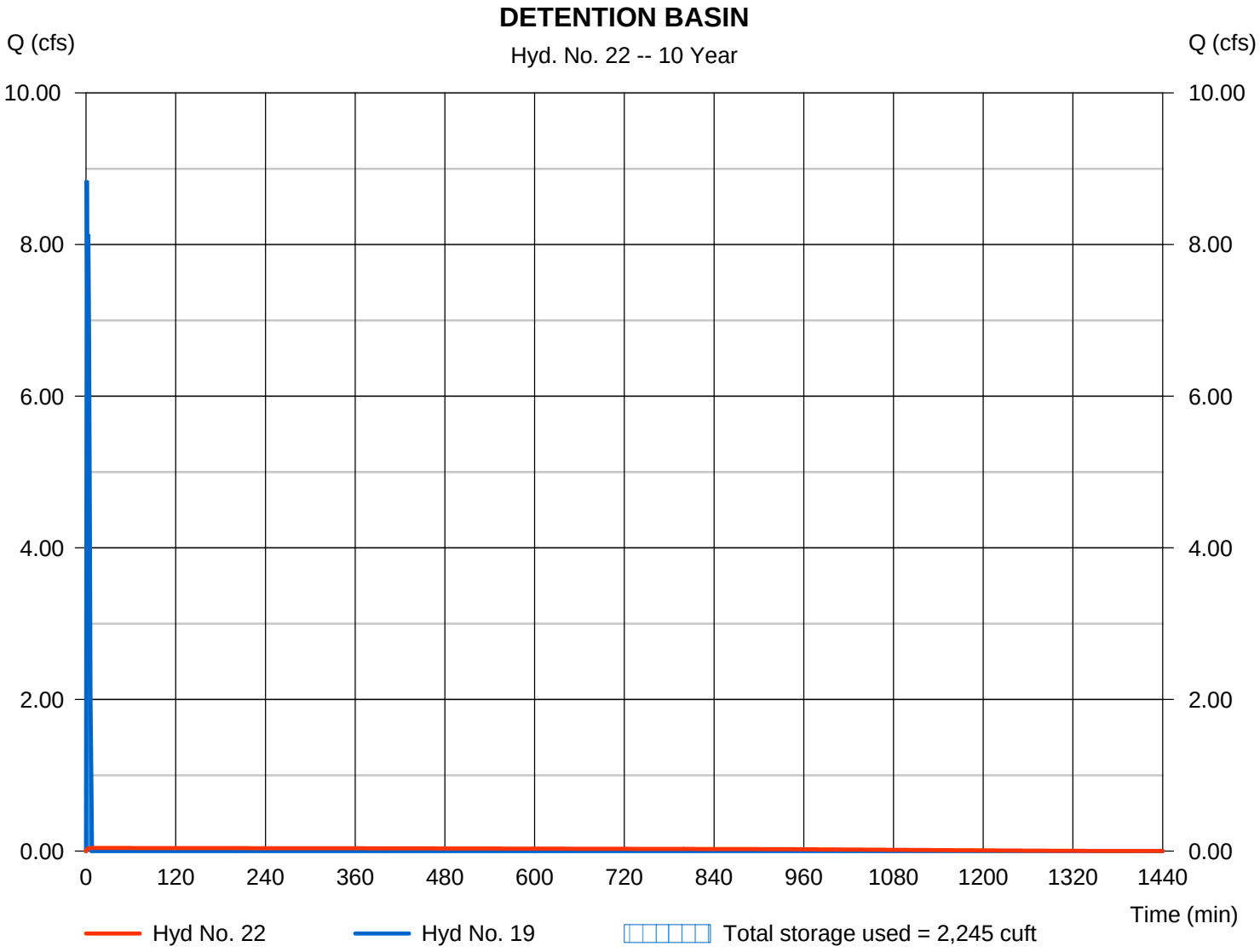
Hydrograph Report

Hyd. No. 22

DETENTION BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	0.041 cfs
Storm frequency	=	10 yrs	Time to peak	=	8 min
Time interval	=	1 min	Hyd. volume	=	2,255 cuft
Inflow hyd. No.	=	19 - TOTAL TRIBUTARY TO BASIN	Max. Elevation	=	557.50 ft
Reservoir name	=	DETENTION	Max. Storage	=	2,245 cuft

Storage Indication method used.

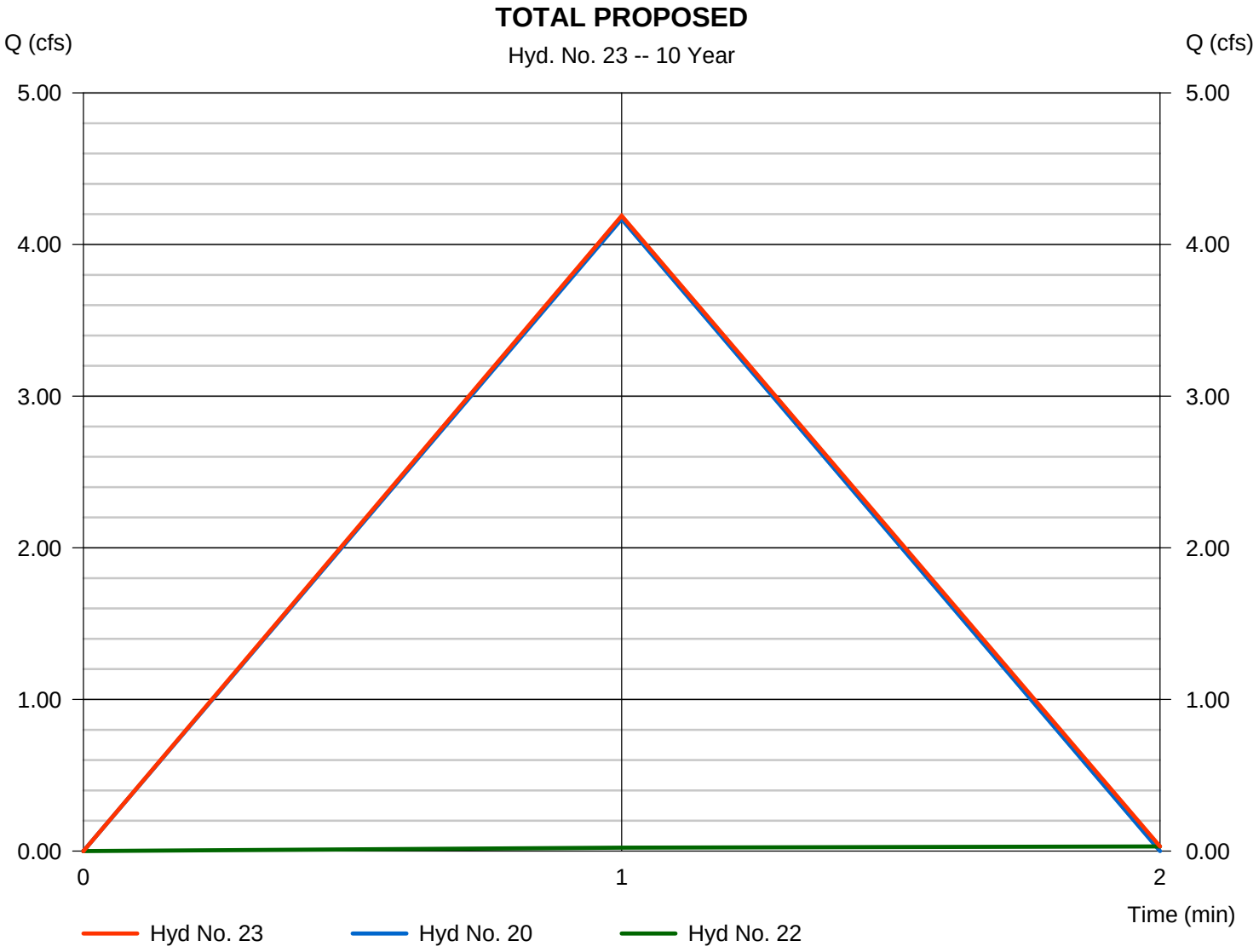


Hydrograph Report

Hyd. No. 23

TOTAL PROPOSED

Hydrograph type	= Combine	Peak discharge	= 4.190 cfs
Storm frequency	= 10 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 2,505 cuft
Inflow hyds.	= 20, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

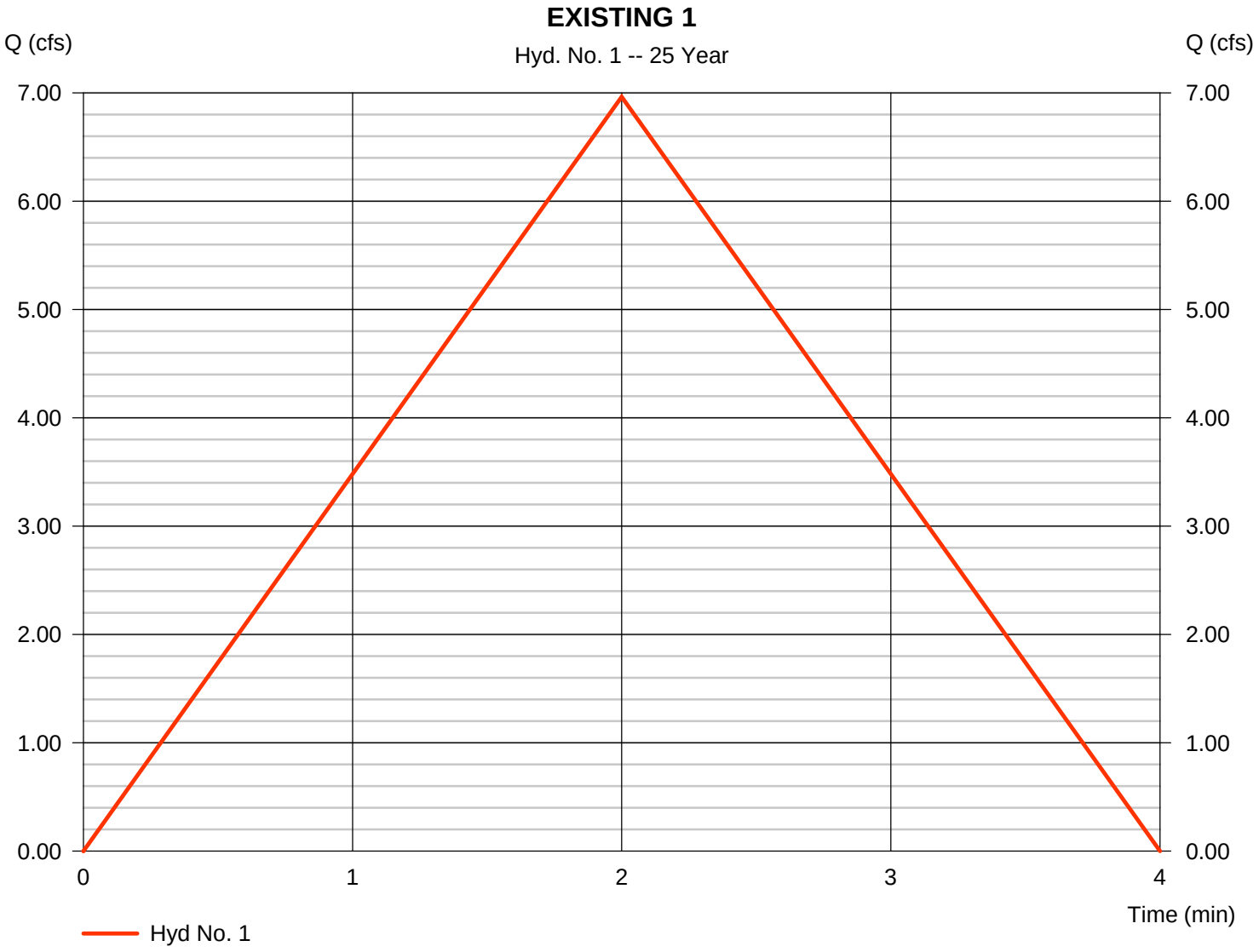
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	6.963	1	2	836	------	------	------	EXISTING 1
2	Rational	4.139	1	1	248	------	------	------	EXISTING 2
3	Rational	2.855	1	1	171	------	------	------	EXISTING 3
4	Rational	1.522	1	1	91	------	------	------	EXISTING 4
5	Rational	0.045	1	1	3	------	------	------	EXISTING 5
7	Rational	4.948	1	3	891	------	------	------	POST DEVELOPED 1
8	Rational	4.990	1	1	299	------	------	------	POST DEVELOPED 2
9	Rational	1.628	1	2	195	------	------	------	POST DEVELOPED 3
10	Rational	1.277	1	1	77	------	------	------	POST DEVELOPED 4
11	Rational	4.398	1	4	1,055	------	------	------	POST DEVELOPED 5
13	Rational	1.920	1	1	115	------	------	------	OFFSITE 1
14	Rational	2.122	1	1	127	------	------	------	OFFSITE 2
15	Rational	0.448	1	1	27	------	------	------	OFFSITE 3
16	Rational	0.138	1	1	8	------	------	------	OFFSITE 4
18	Combine	12.04	1	1	1,349	1, 2, 3, 4, 5,	------	------	TOTAL EXISTING
19	Combine	9.829	1	1	2,517	7, 8, 9, 10, 11,	------	------	TOTAL TRIBUTARY TO BASIN
20	Combine	4.628	1	1	278	13, 14, 15, 16,	------	------	TOTAL OFFSITE
22	Reservoir	0.042	1	8	2,511	19	557.65	2,501	DETENTION BASIN
23	Combine	4.651	1	1	2,789	20, 22	------	------	TOTAL PROPOSED

Hydrograph Report

Hyd. No. 1

EXISTING 1

Hydrograph type	=	Rational	Peak discharge	=	6.963 cfs
Storm frequency	=	25 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	836 cuft
Drainage area	=	1.910 ac	Runoff coeff.	=	0.38
Intensity	=	9.594 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

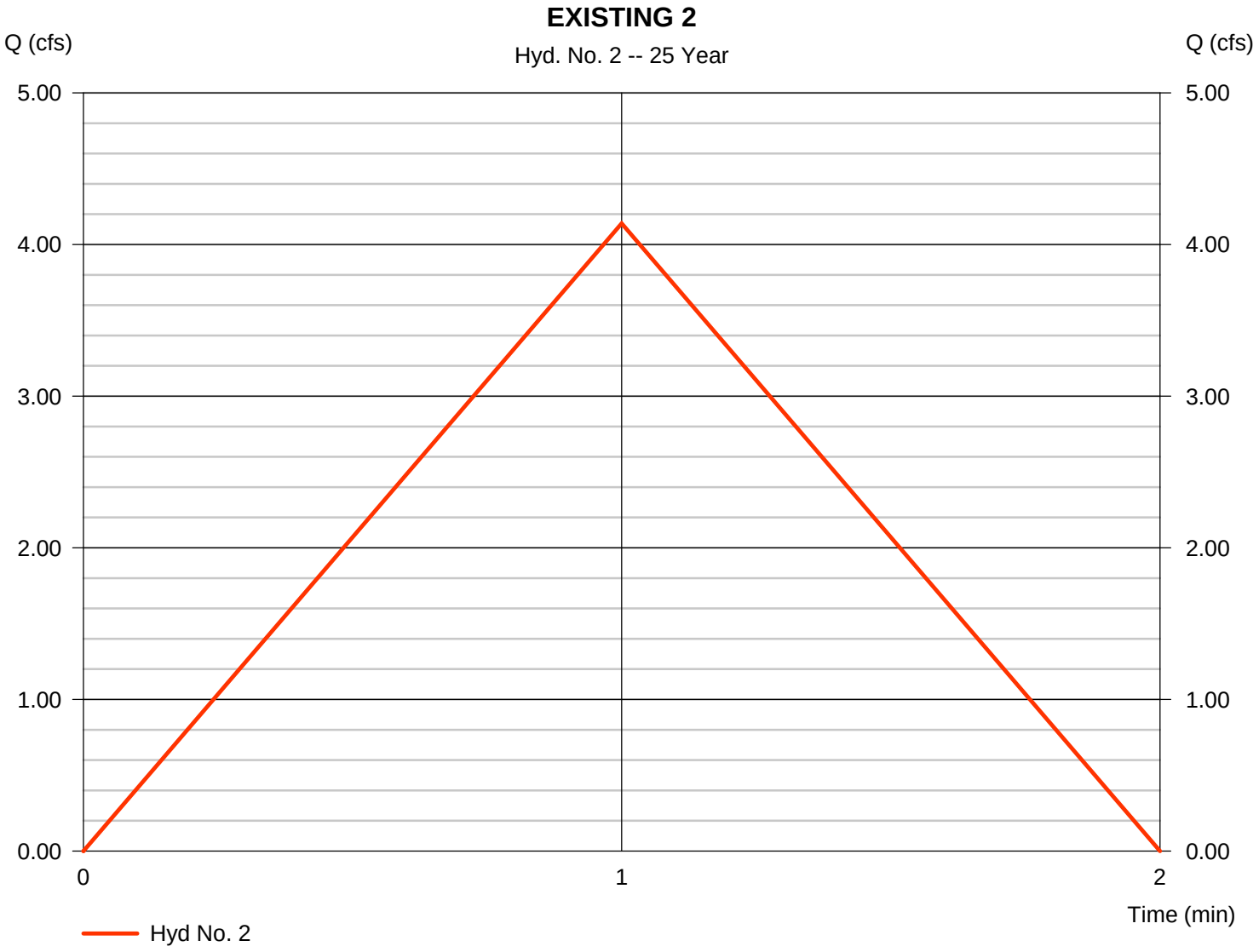


Hydrograph Report

Hyd. No. 2

EXISTING 2

Hydrograph type	=	Rational	Peak discharge	=	4.139 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	248 cuft
Drainage area	=	0.802 ac	Runoff coeff.	=	0.51
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

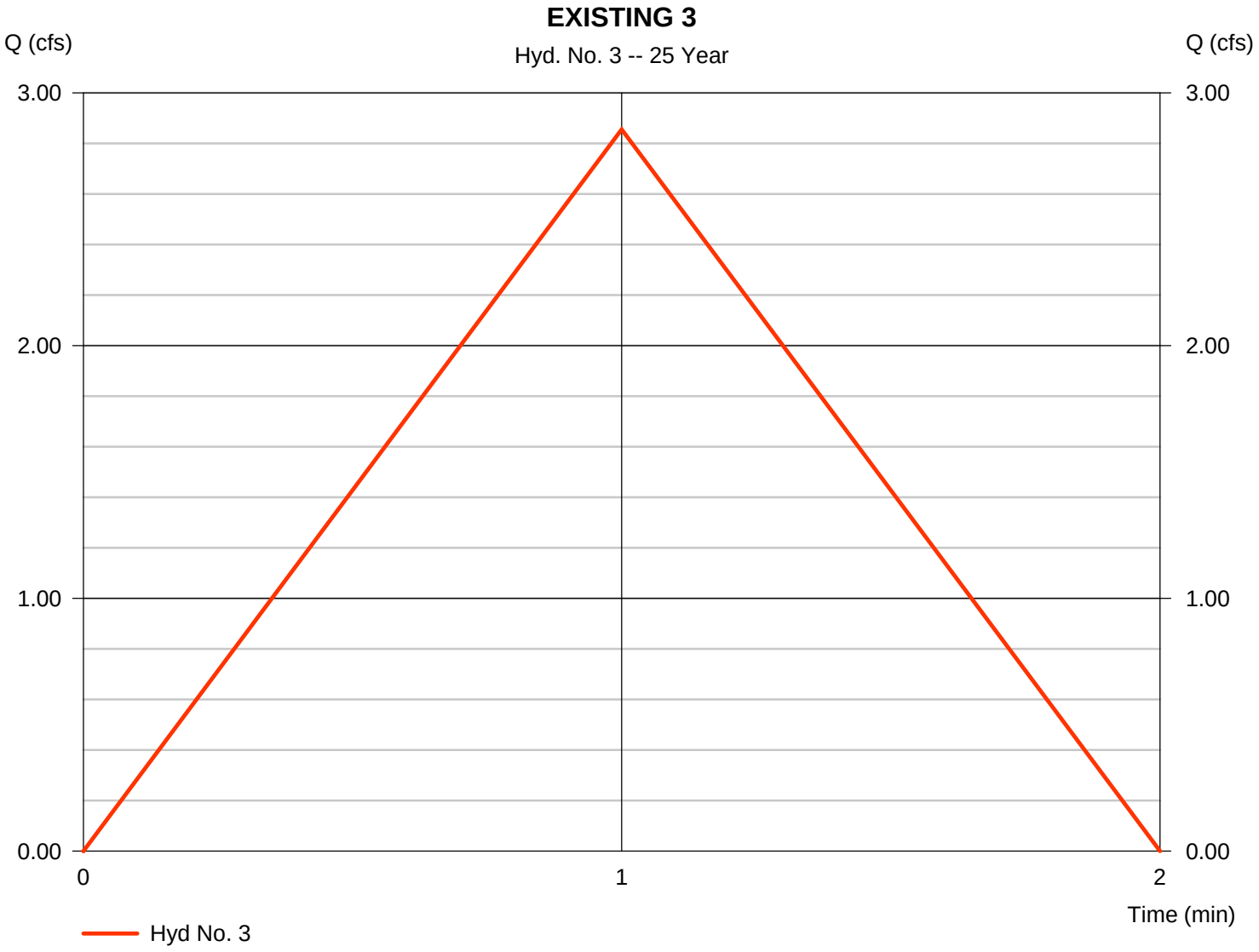


Hydrograph Report

Hyd. No. 3

EXISTING 3

Hydrograph type	=	Rational	Peak discharge	=	2.855 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	171 cuft
Drainage area	=	0.495 ac	Runoff coeff.	=	0.57
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

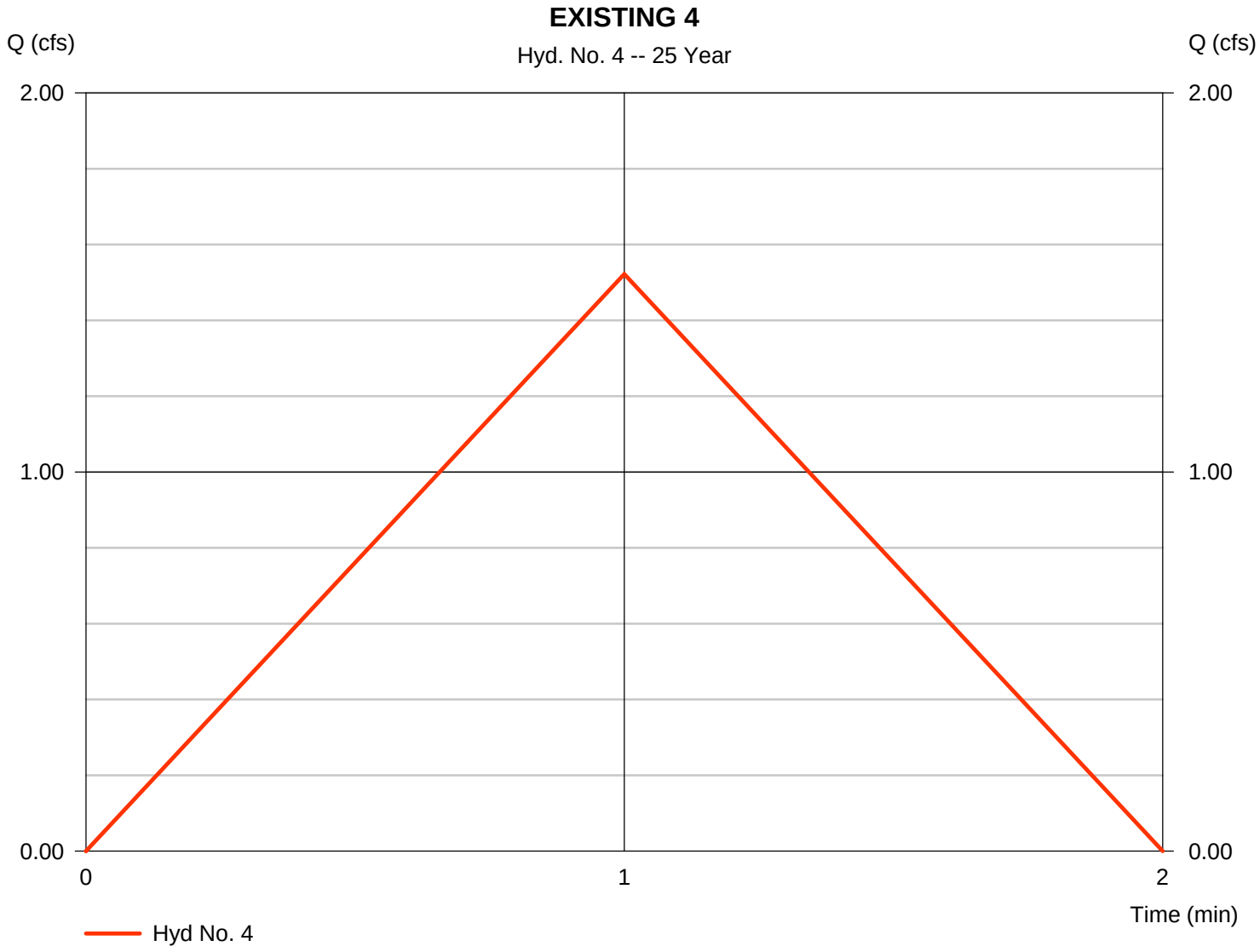


Hydrograph Report

Hyd. No. 4

EXISTING 4

Hydrograph type	=	Rational	Peak discharge	=	1.522 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	91 cuft
Drainage area	=	0.376 ac	Runoff coeff.	=	0.4
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

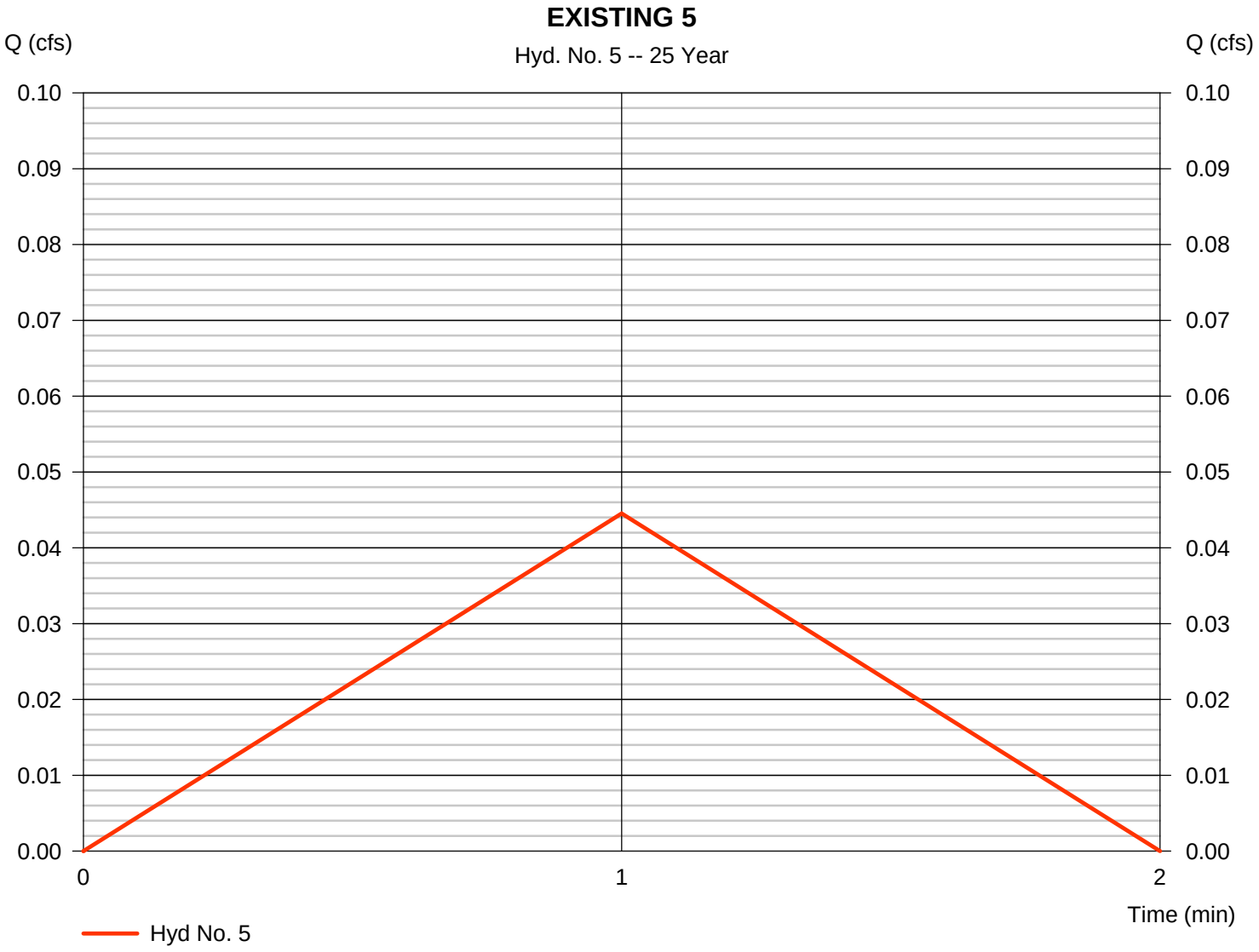


Hydrograph Report

Hyd. No. 5

EXISTING 5

Hydrograph type	=	Rational	Peak discharge	=	0.045 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	3 cuft
Drainage area	=	0.022 ac	Runoff coeff.	=	0.2
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

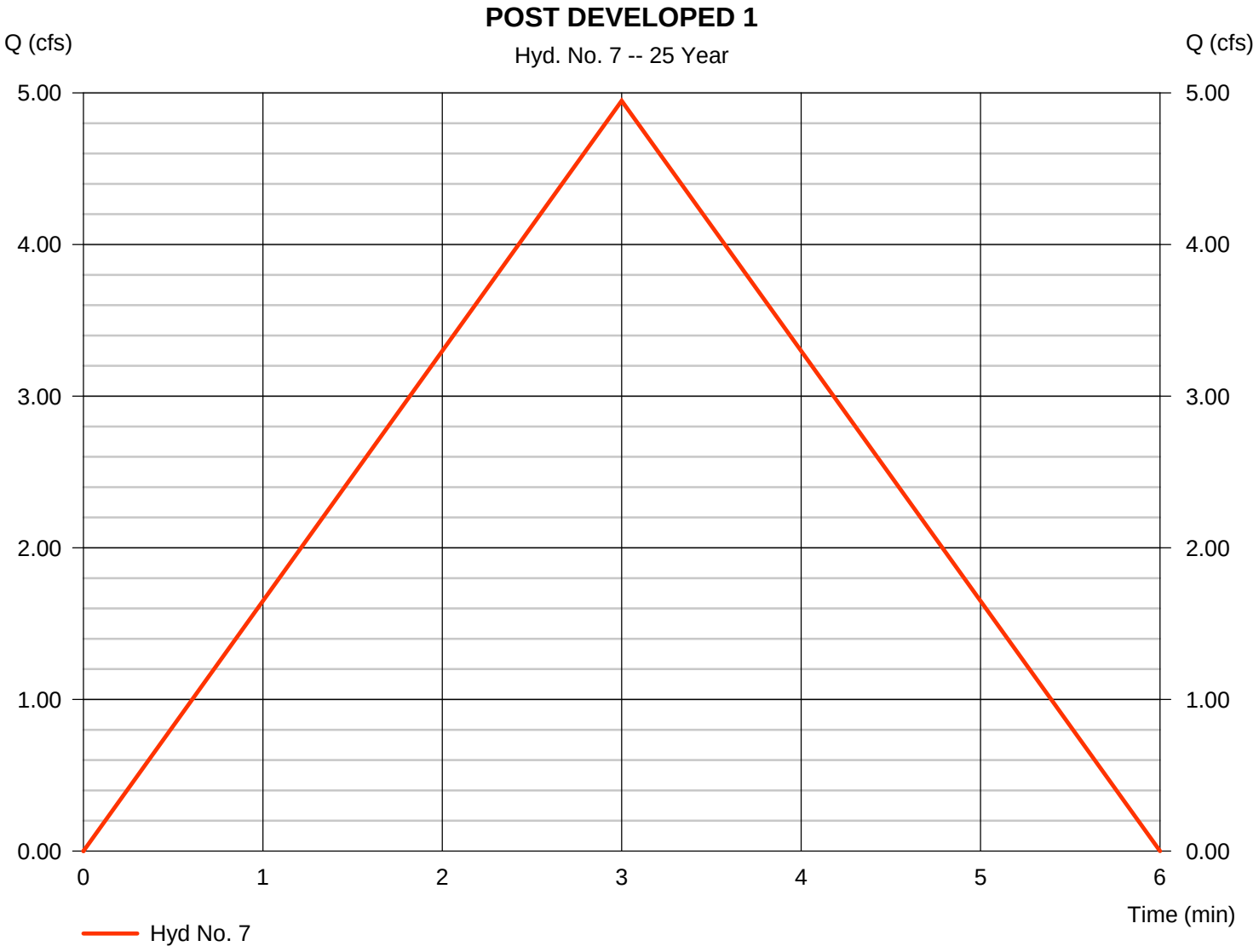


Hydrograph Report

Hyd. No. 7

POST DEVELOPED 1

Hydrograph type	=	Rational	Peak discharge	=	4.948 cfs
Storm frequency	=	25 yrs	Time to peak	=	3 min
Time interval	=	1 min	Hyd. volume	=	891 cuft
Drainage area	=	1.004 ac	Runoff coeff.	=	0.54
Intensity	=	9.126 in/hr	Tc by User	=	3.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

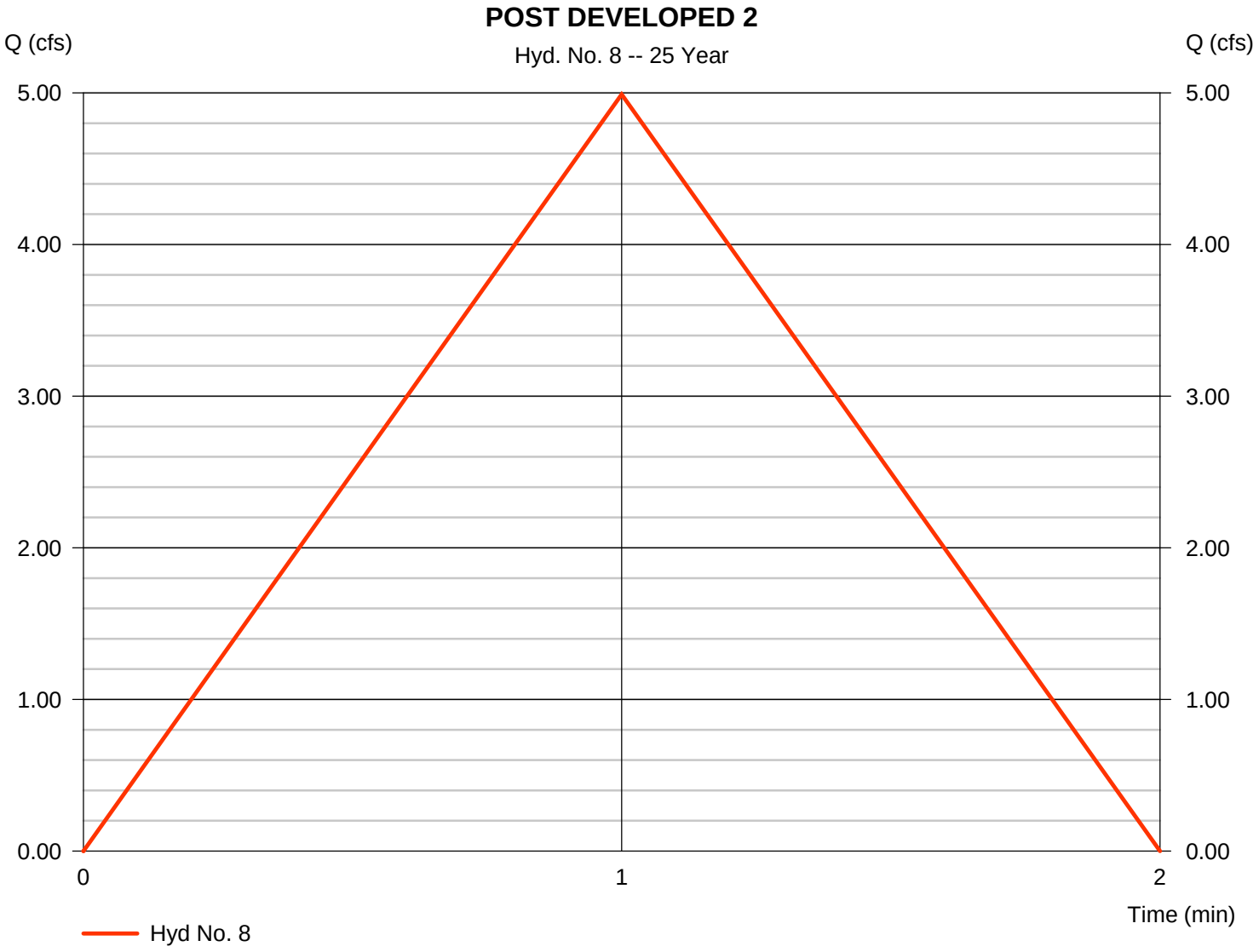


Hydrograph Report

Hyd. No. 8

POST DEVELOPED 2

Hydrograph type	=	Rational	Peak discharge	=	4.990 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	299 cuft
Drainage area	=	0.554 ac	Runoff coeff.	=	0.89
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

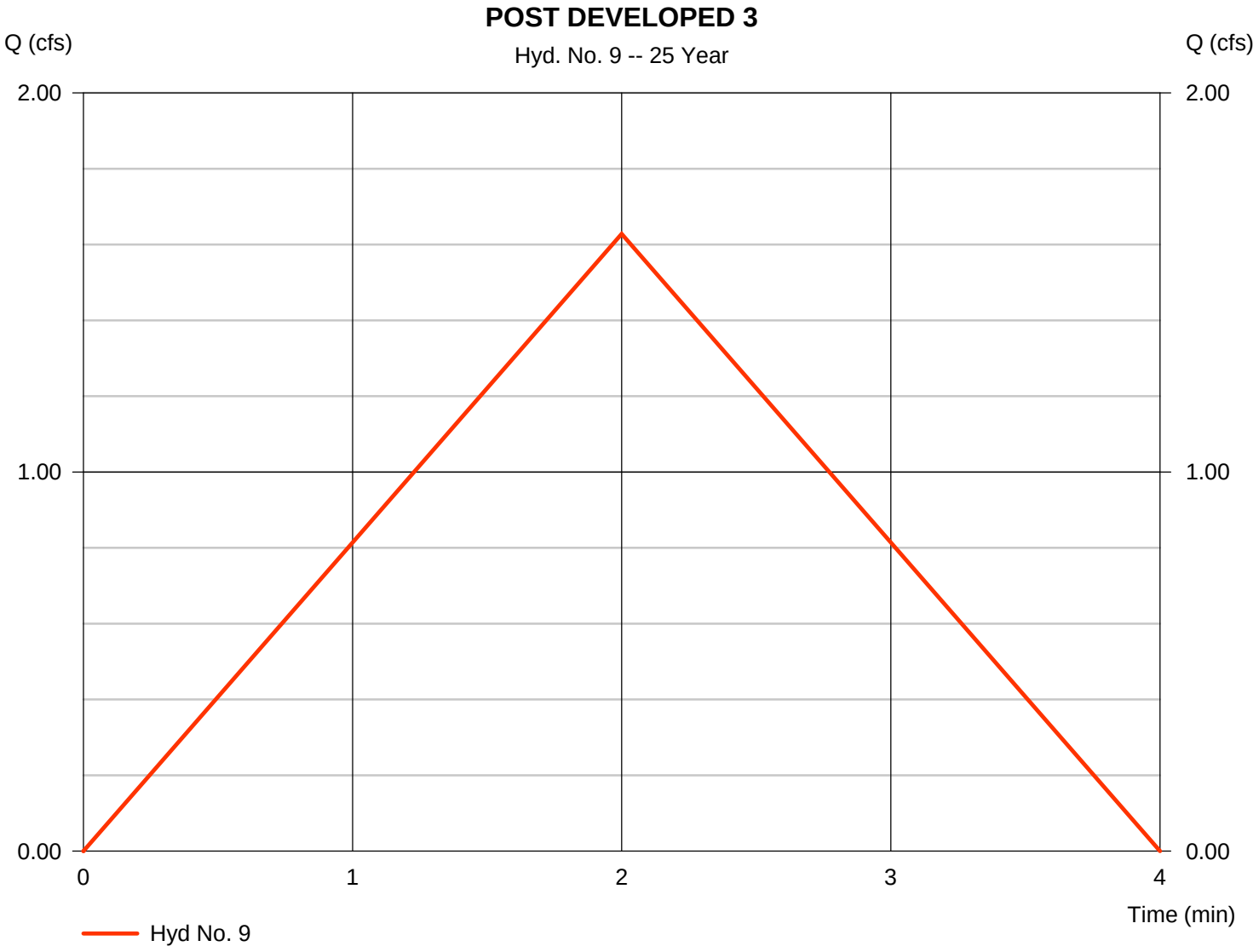


Hydrograph Report

Hyd. No. 9

POST DEVELOPED 3

Hydrograph type	=	Rational	Peak discharge	=	1.628 cfs
Storm frequency	=	25 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	195 cuft
Drainage area	=	0.239 ac	Runoff coeff.	=	0.71
Intensity	=	9.594 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

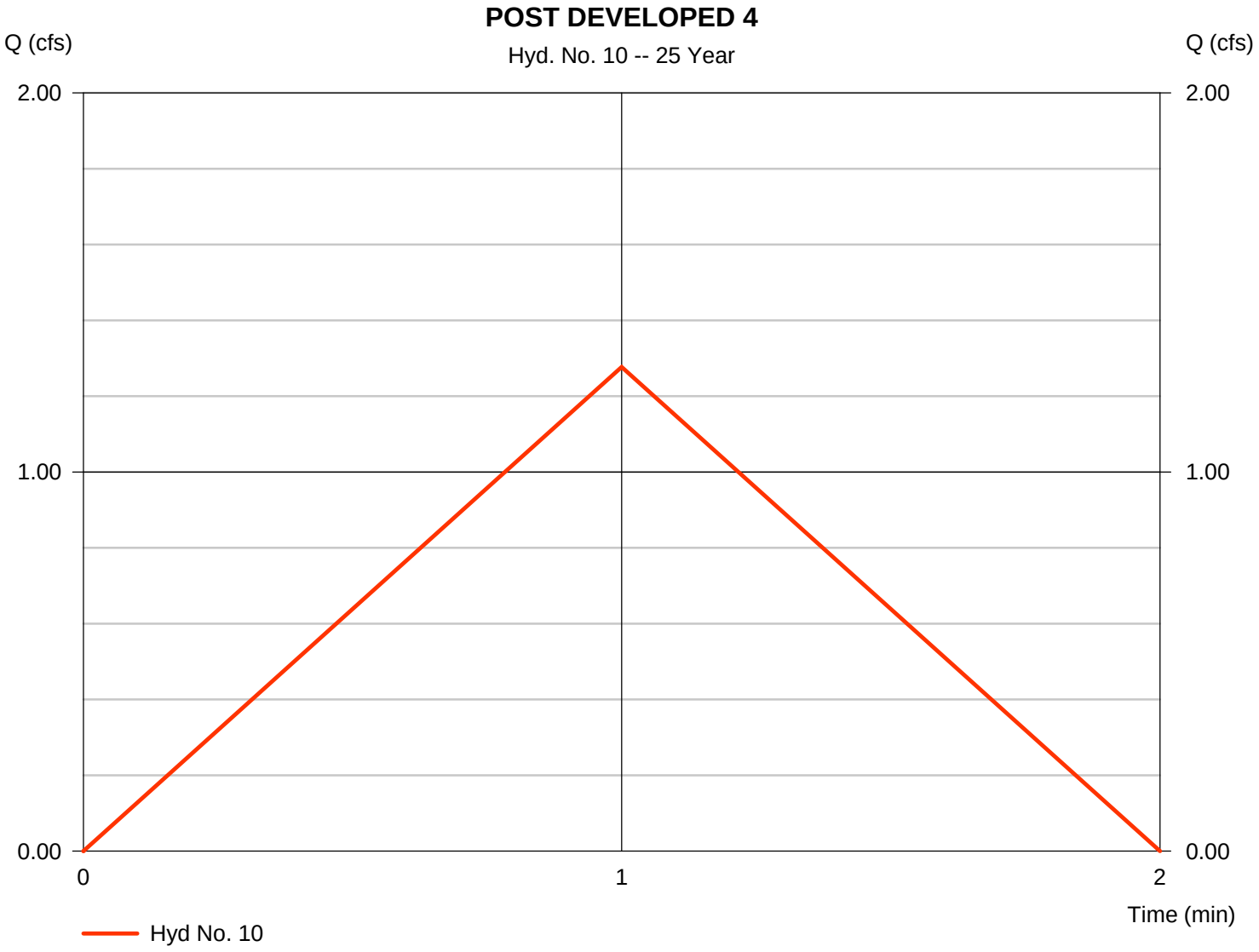


Hydrograph Report

Hyd. No. 10

POST DEVELOPED 4

Hydrograph type	=	Rational	Peak discharge	=	1.277 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	77 cuft
Drainage area	=	0.166 ac	Runoff coeff.	=	0.76
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

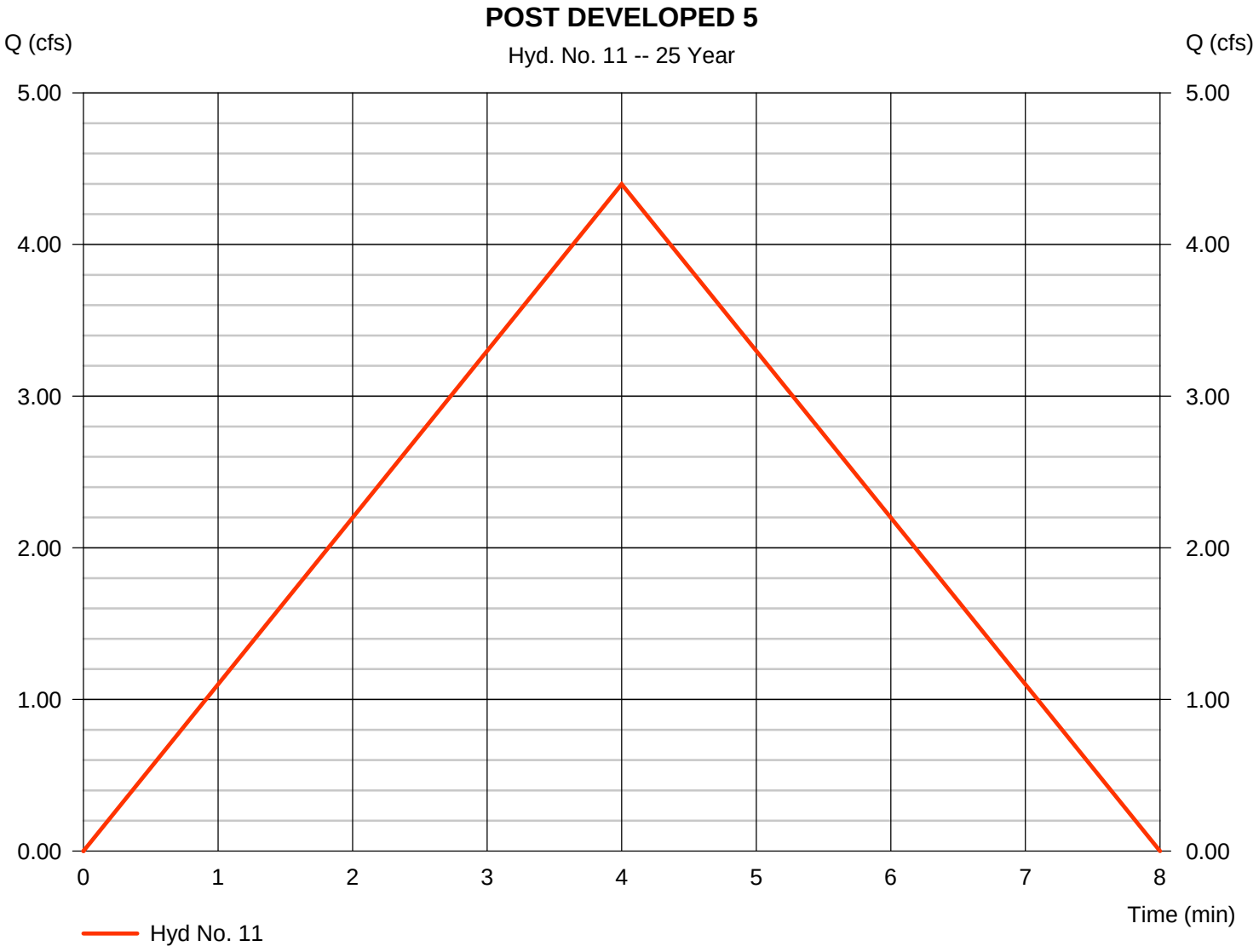


Hydrograph Report

Hyd. No. 11

POST DEVELOPED 5

Hydrograph type	=	Rational	Peak discharge	=	4.398 cfs
Storm frequency	=	25 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	1,055 cuft
Drainage area	=	0.692 ac	Runoff coeff.	=	0.73
Intensity	=	8.706 in/hr	Tc by User	=	4.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

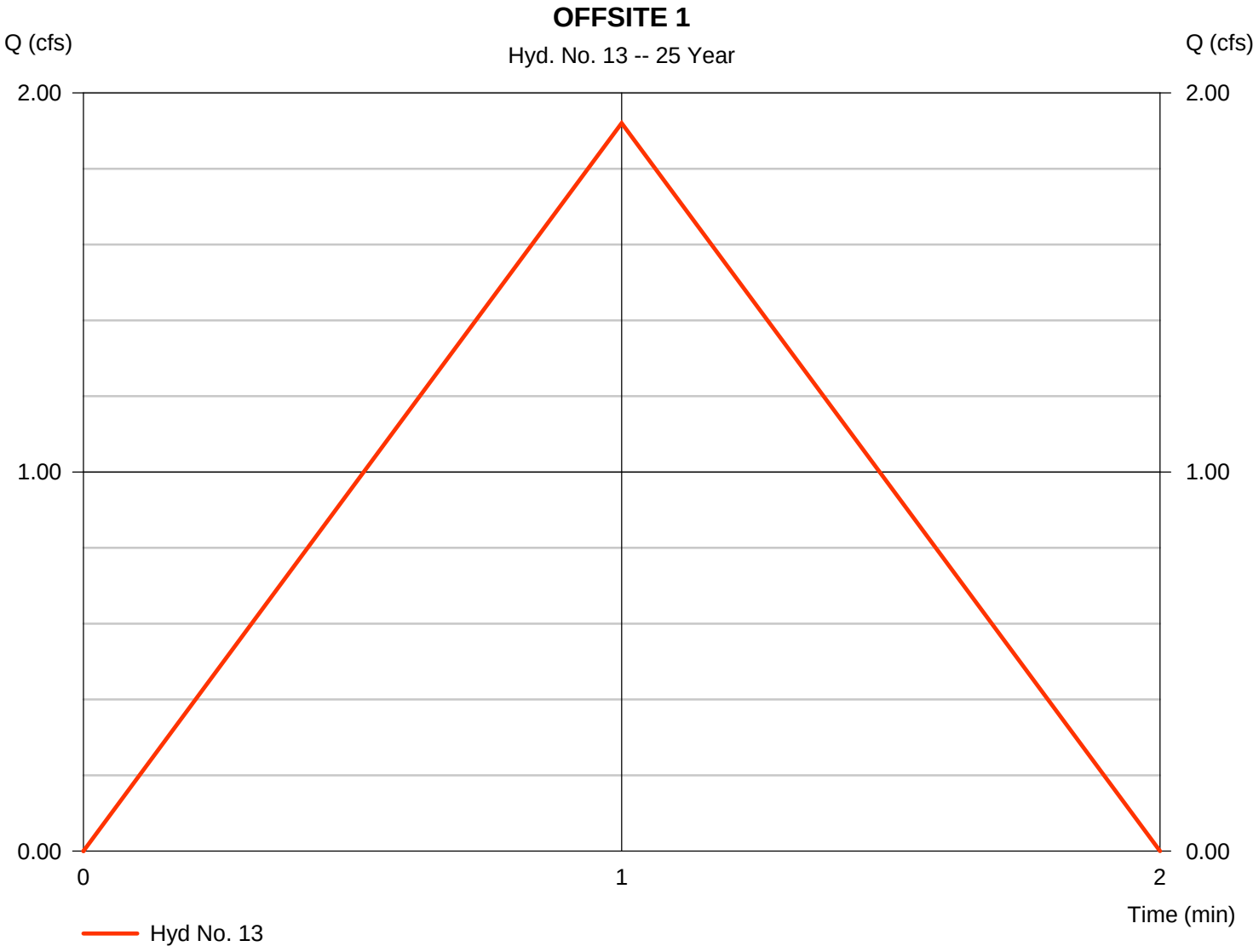


Hydrograph Report

Hyd. No. 13

OFFSITE 1

Hydrograph type	=	Rational	Peak discharge	=	1.920 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	115 cuft
Drainage area	=	0.593 ac	Runoff coeff.	=	0.32
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

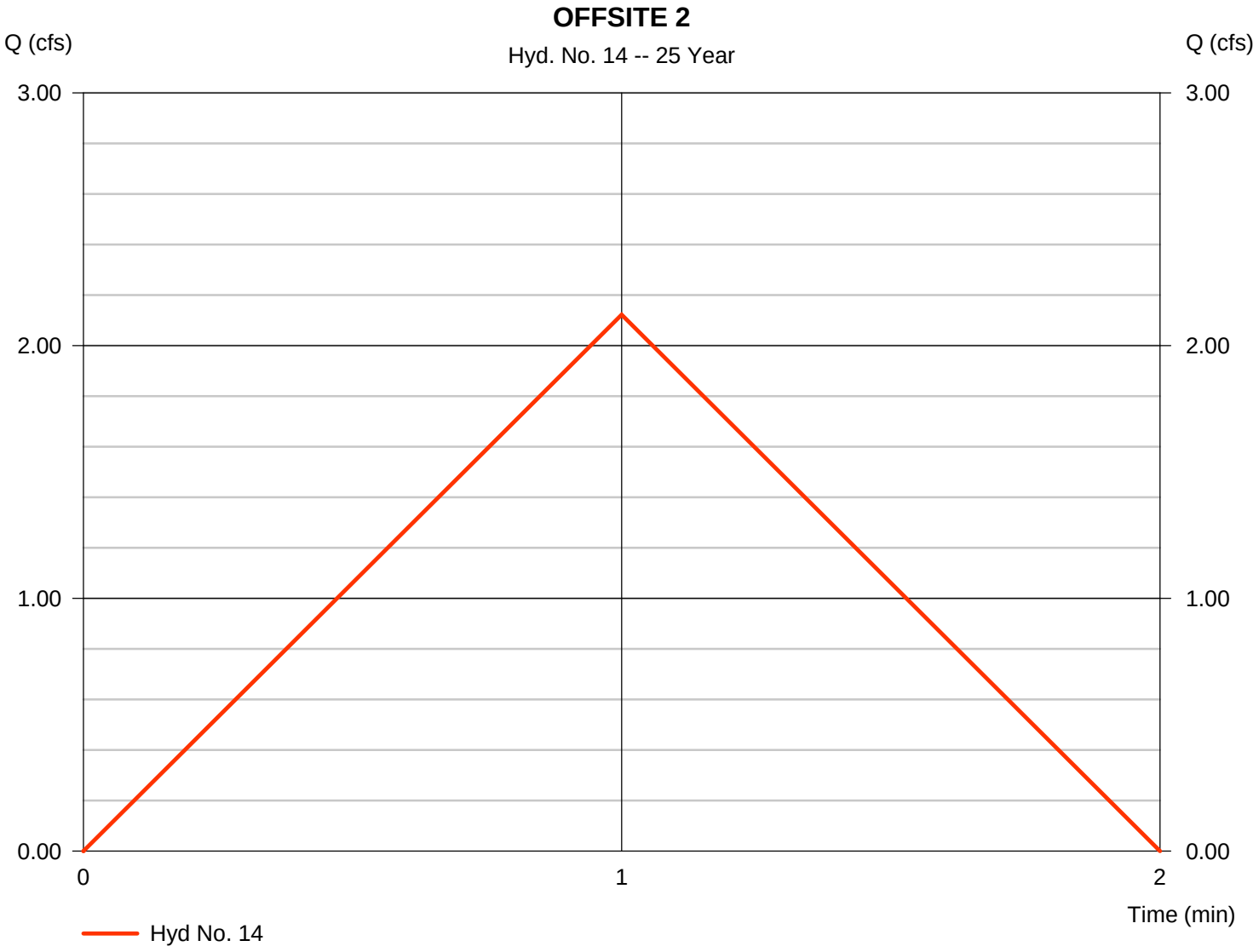


Hydrograph Report

Hyd. No. 14

OFFSITE 2

Hydrograph type	=	Rational	Peak discharge	=	2.122 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	127 cuft
Drainage area	=	0.233 ac	Runoff coeff.	=	0.9
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

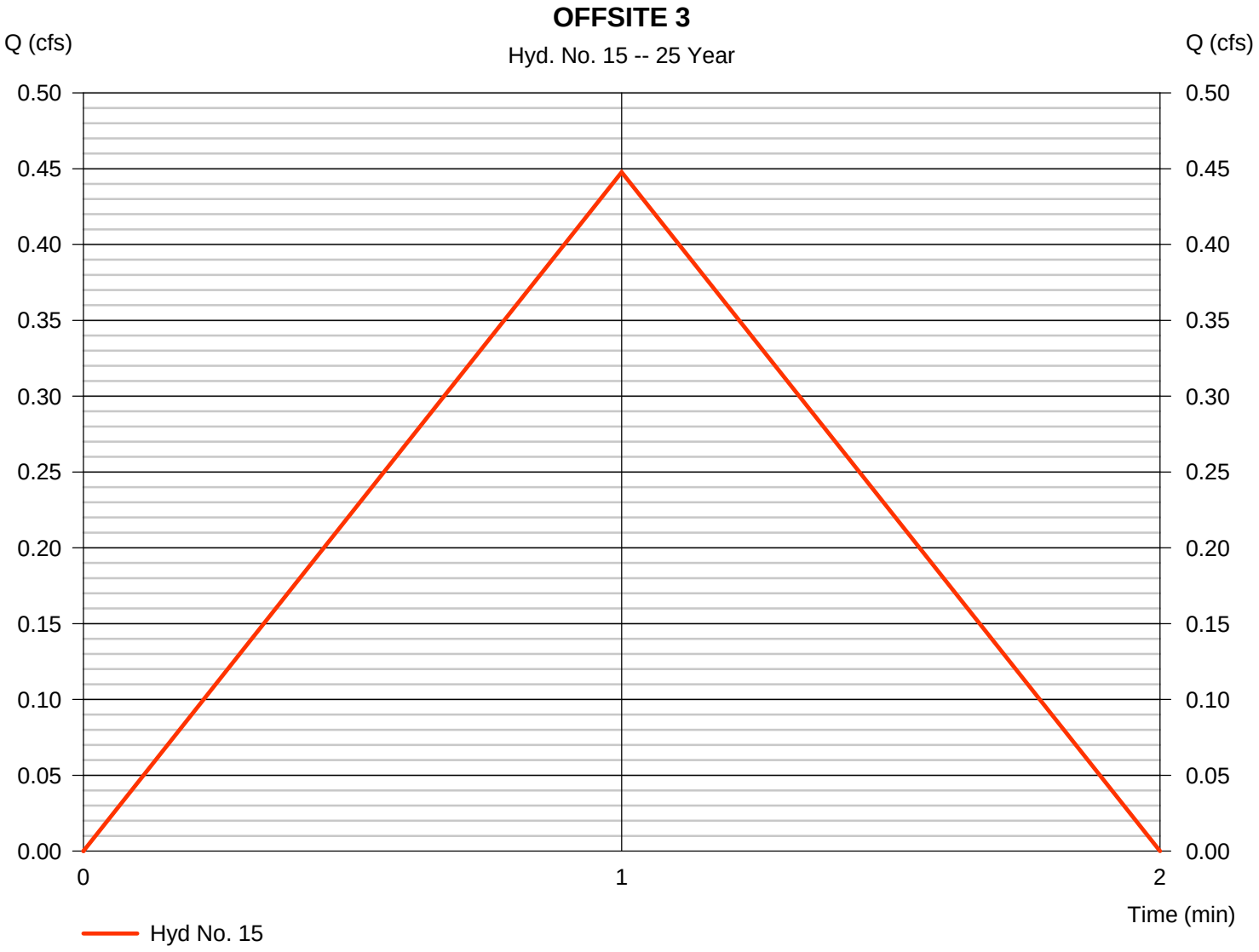


Hydrograph Report

Hyd. No. 15

OFFSITE 3

Hydrograph type	=	Rational	Peak discharge	=	0.448 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	27 cuft
Drainage area	=	0.056 ac	Runoff coeff.	=	0.79
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

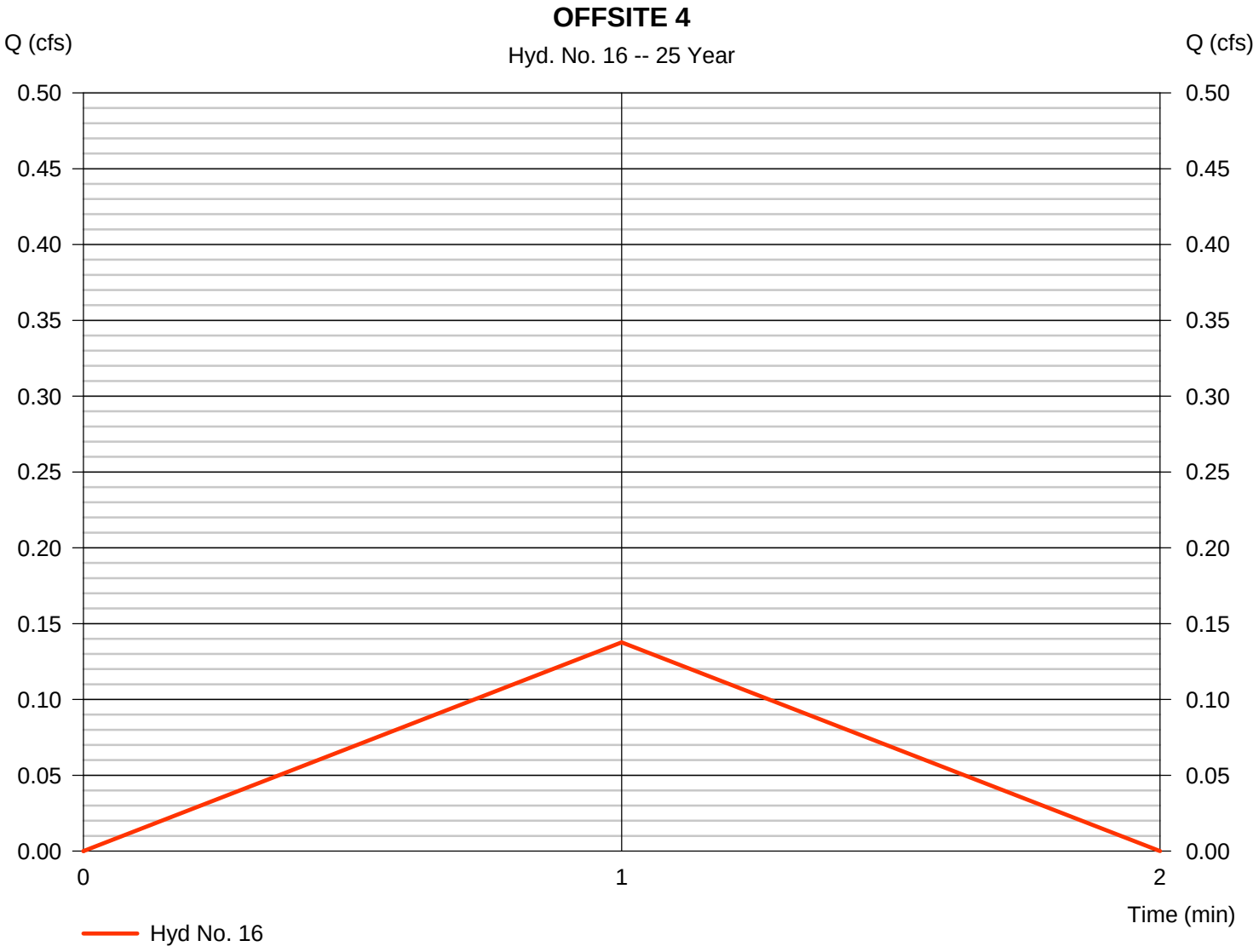


Hydrograph Report

Hyd. No. 16

OFFSITE 4

Hydrograph type	=	Rational	Peak discharge	=	0.138 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	8 cuft
Drainage area	=	0.068 ac	Runoff coeff.	=	0.2
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

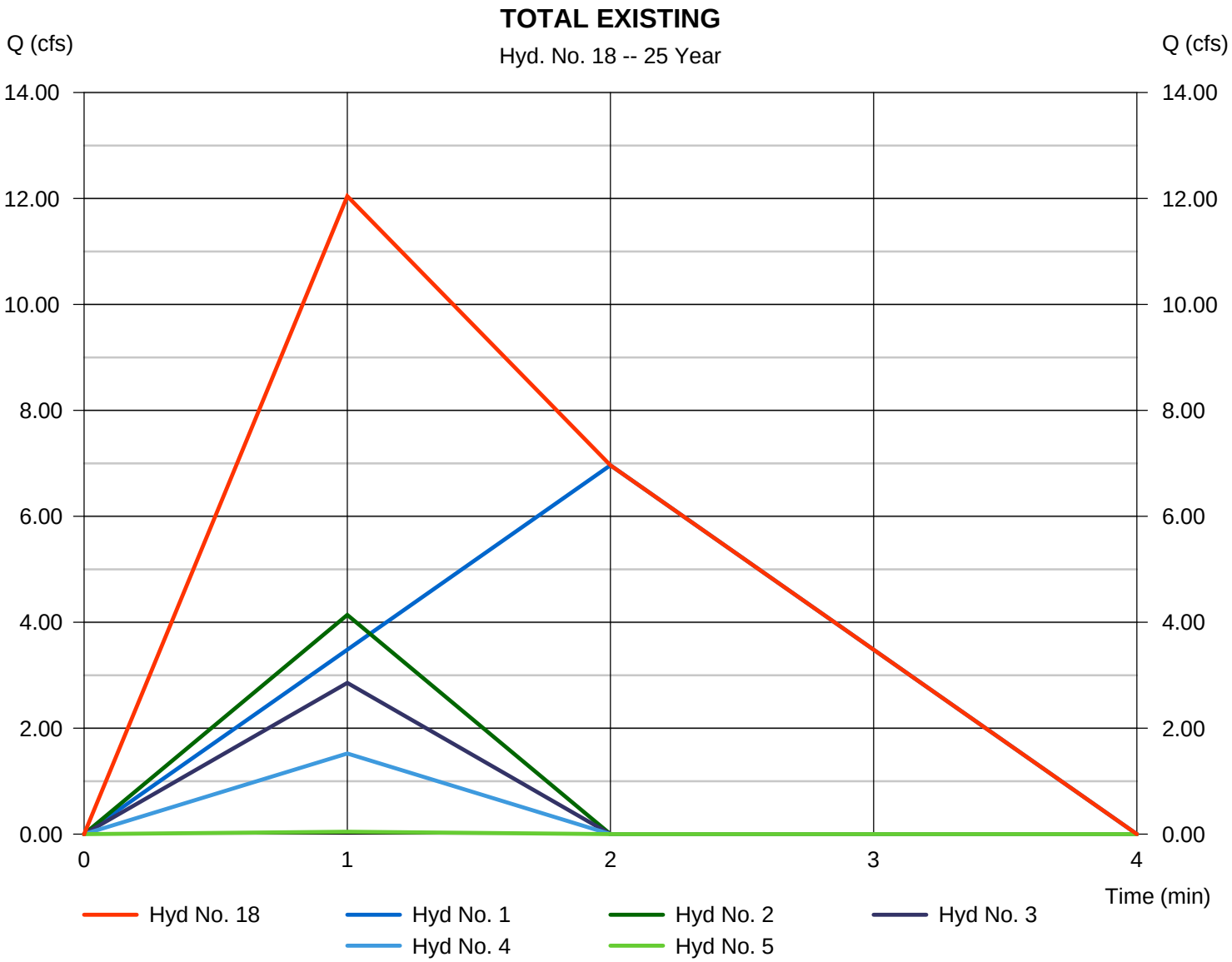


Hydrograph Report

Hyd. No. 18

TOTAL EXISTING

Hydrograph type	=	Combine	Peak discharge	=	12.04 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	1,349 cuft
Inflow hyds.	=	1, 2, 3, 4, 5	Contrib. drain. area	=	3.605 ac

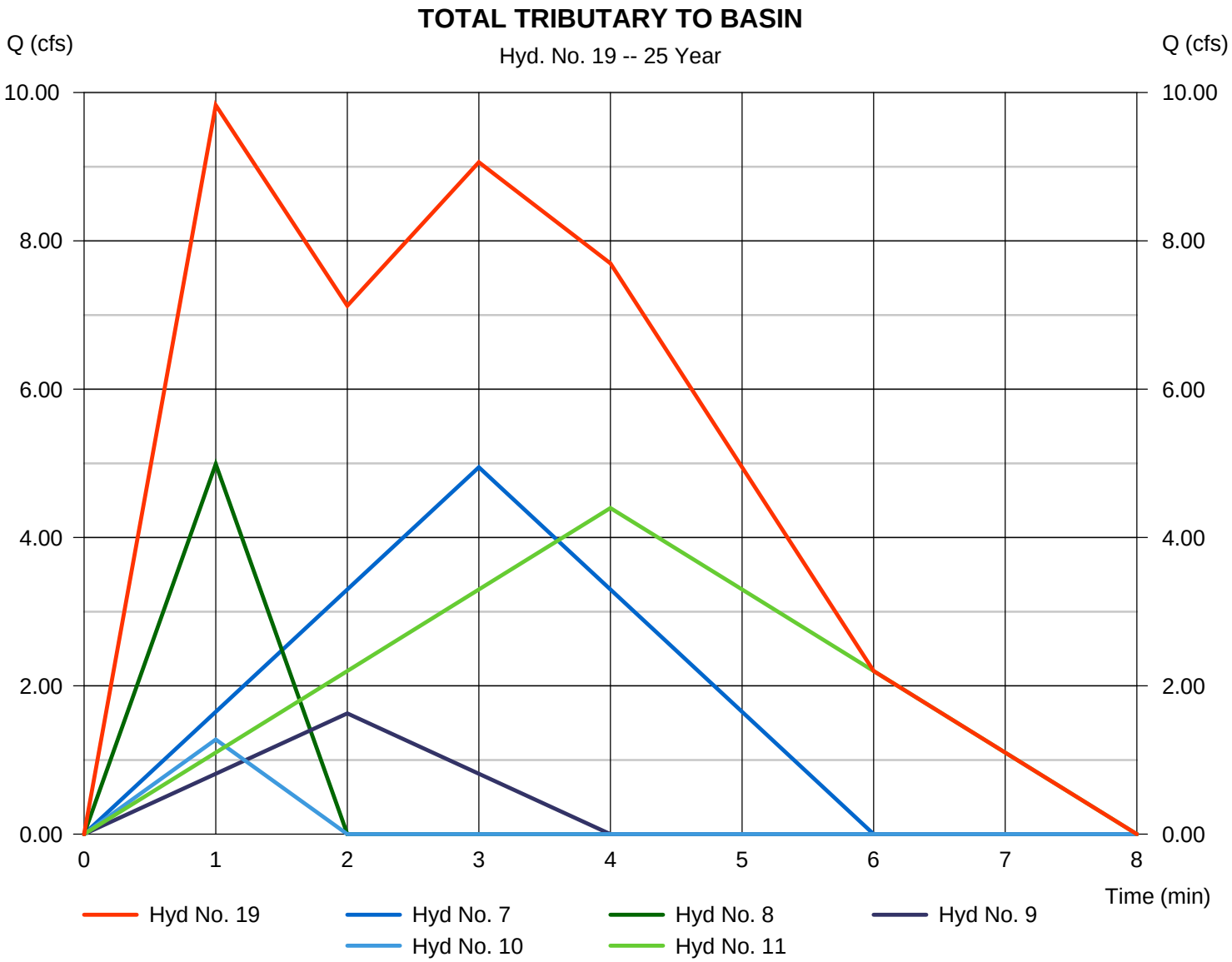


Hydrograph Report

Hyd. No. 19

TOTAL TRIBUTARY TO BASIN

Hydrograph type	= Combine	Peak discharge	= 9.829 cfs
Storm frequency	= 25 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 2,517 cuft
Inflow hyds.	= 7, 8, 9, 10, 11	Contrib. drain. area	= 2.655 ac

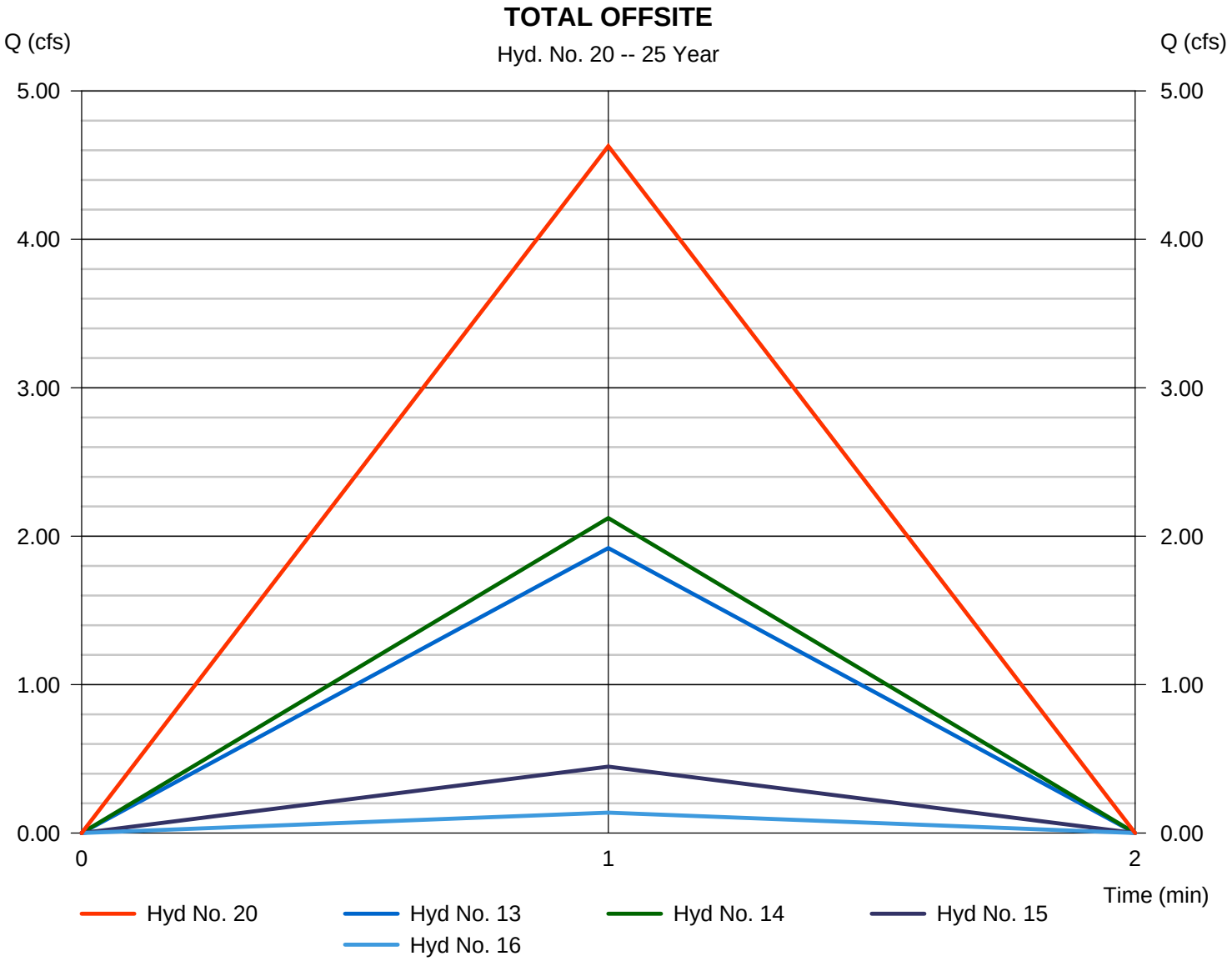


Hydrograph Report

Hyd. No. 20

TOTAL OFFSITE

Hydrograph type	=	Combine	Peak discharge	=	4.628 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	278 cuft
Inflow hyds.	=	13, 14, 15, 16	Contrib. drain. area	=	0.950 ac



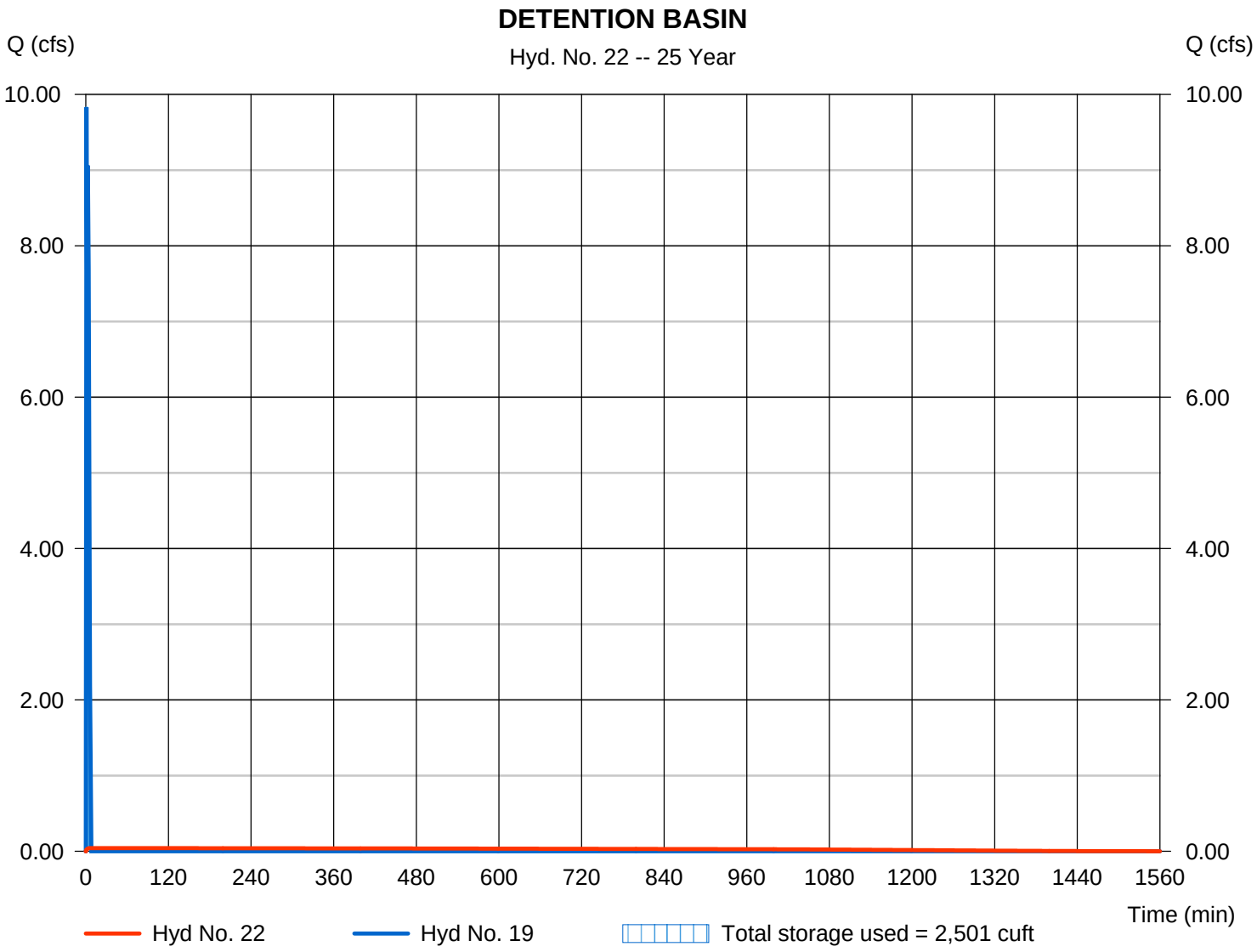
Hydrograph Report

Hyd. No. 22

DETENTION BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	0.042 cfs
Storm frequency	=	25 yrs	Time to peak	=	8 min
Time interval	=	1 min	Hyd. volume	=	2,511 cuft
Inflow hyd. No.	=	19 - TOTAL TRIBUTARY TO BASIN	Max. Elevation	=	557.65 ft
Reservoir name	=	DETENTION	Max. Storage	=	2,501 cuft

Storage Indication method used.

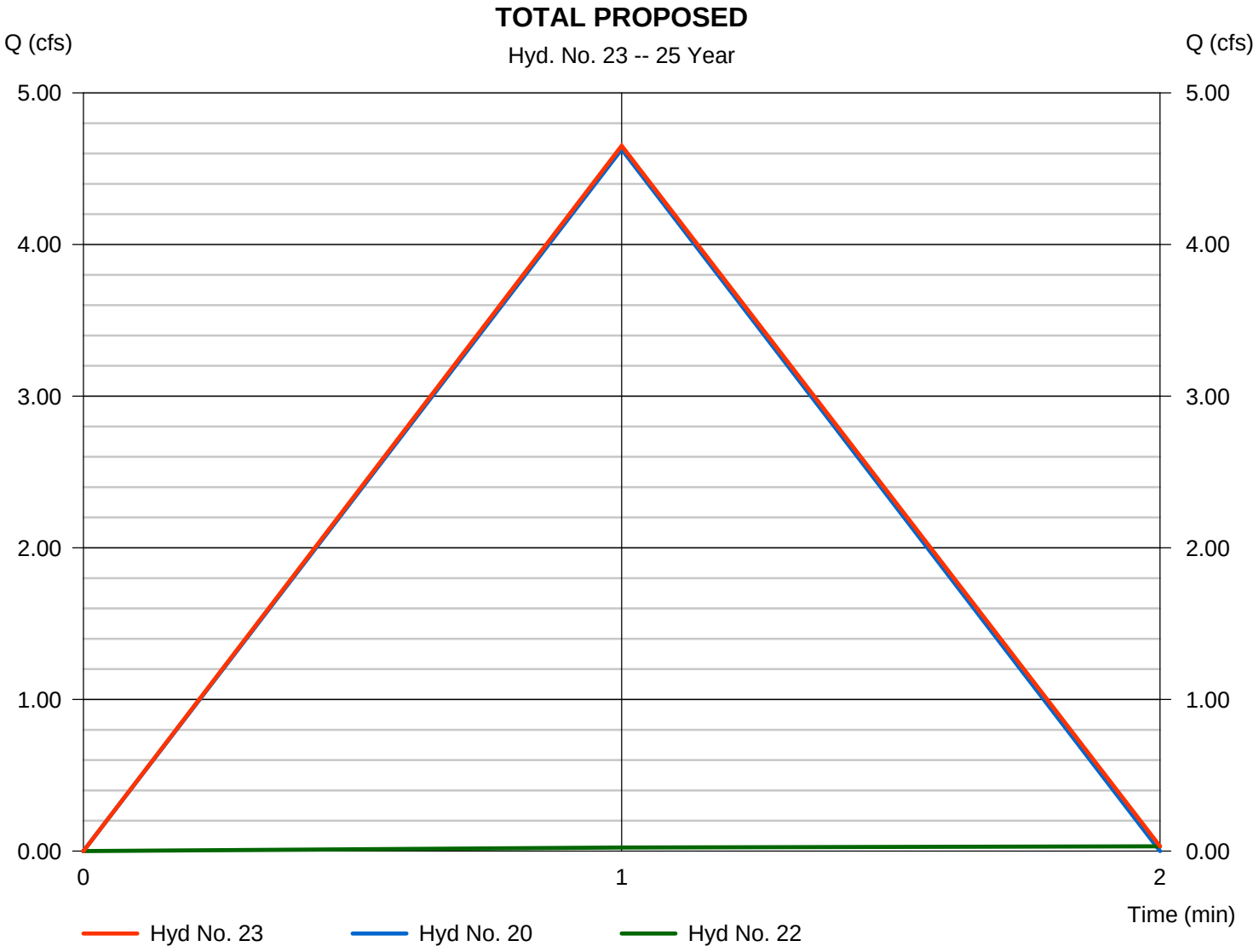


Hydrograph Report

Hyd. No. 23

TOTAL PROPOSED

Hydrograph type	= Combine	Peak discharge	= 4.651 cfs
Storm frequency	= 25 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 2,789 cuft
Inflow hyds.	= 20, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

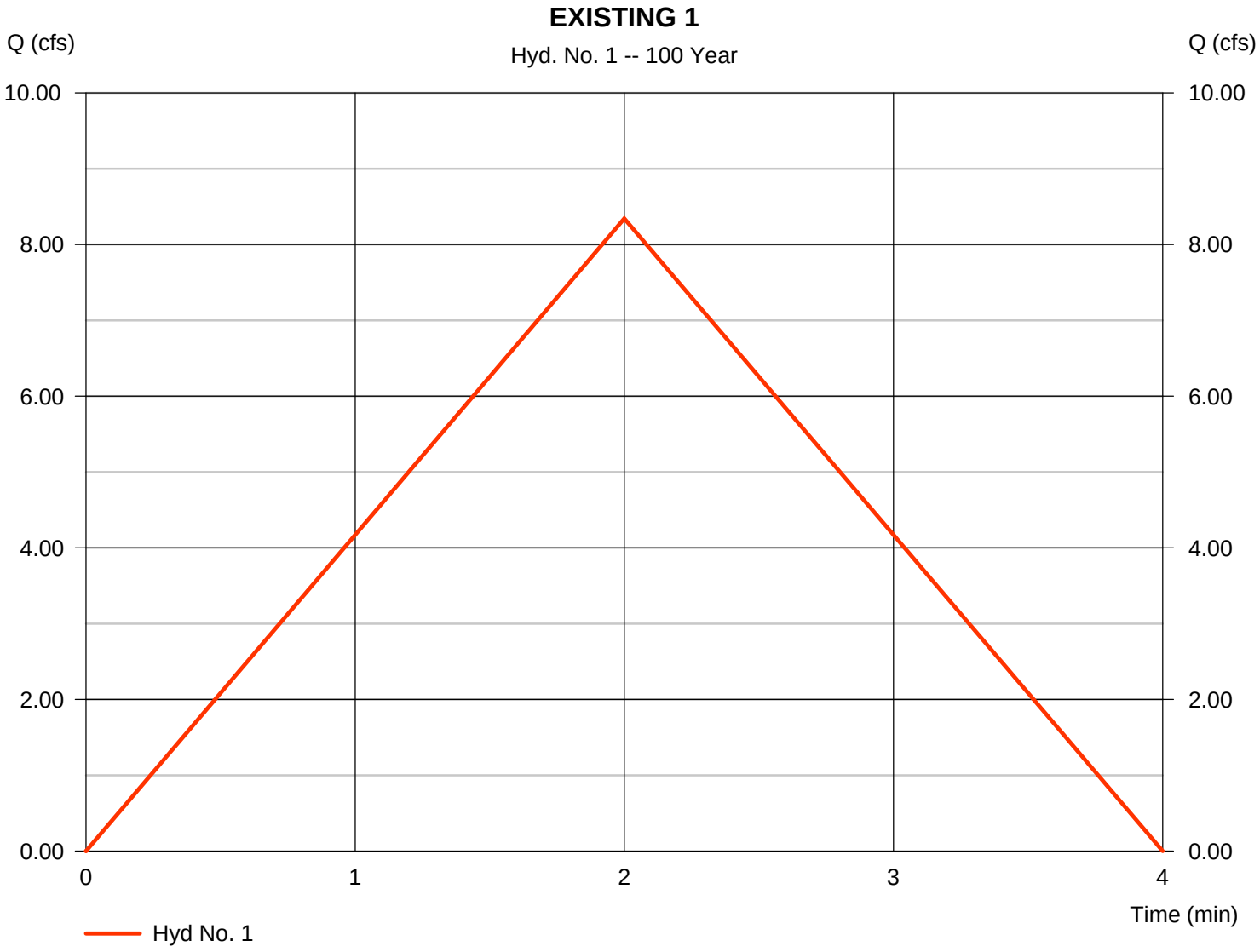
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	8.343	1	2	1,001	------	------	------	EXISTING 1
2	Rational	4.973	1	1	298	------	------	------	EXISTING 2
3	Rational	3.430	1	1	206	------	------	------	EXISTING 3
4	Rational	1.828	1	1	110	------	------	------	EXISTING 4
5	Rational	0.053	1	1	3	------	------	------	EXISTING 5
7	Rational	5.917	1	3	1,065	------	------	------	POST DEVELOPED 1
8	Rational	5.994	1	1	360	------	------	------	POST DEVELOPED 2
9	Rational	1.951	1	2	234	------	------	------	POST DEVELOPED 3
10	Rational	1.534	1	1	92	------	------	------	POST DEVELOPED 4
11	Rational	5.252	1	4	1,261	------	------	------	POST DEVELOPED 5
13	Rational	2.307	1	1	138	------	------	------	OFFSITE 1
14	Rational	2.549	1	1	153	------	------	------	OFFSITE 2
15	Rational	0.538	1	1	32	------	------	------	OFFSITE 3
16	Rational	0.165	1	1	10	------	------	------	OFFSITE 4
18	Combine	14.46	1	1	1,618	1, 2, 3, 4, 5,	------	------	TOTAL EXISTING
19	Combine	11.79	1	1	3,011	7, 8, 9, 10, 11,	------	------	TOTAL TRIBUTARY TO BASIN
20	Combine	5.559	1	1	334	13, 14, 15, 16,	------	------	TOTAL OFFSITE
22	Reservoir	0.044	1	8	3,005	19	557.92	2,994	DETENTION BASIN
23	Combine	5.585	1	1	3,339	20, 22	------	------	TOTAL PROPOSED

Hydrograph Report

Hyd. No. 1

EXISTING 1

Hydrograph type	=	Rational	Peak discharge	=	8.343 cfs
Storm frequency	=	100 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	1,001 cuft
Drainage area	=	1.910 ac	Runoff coeff.	=	0.38
Intensity	=	11.495 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

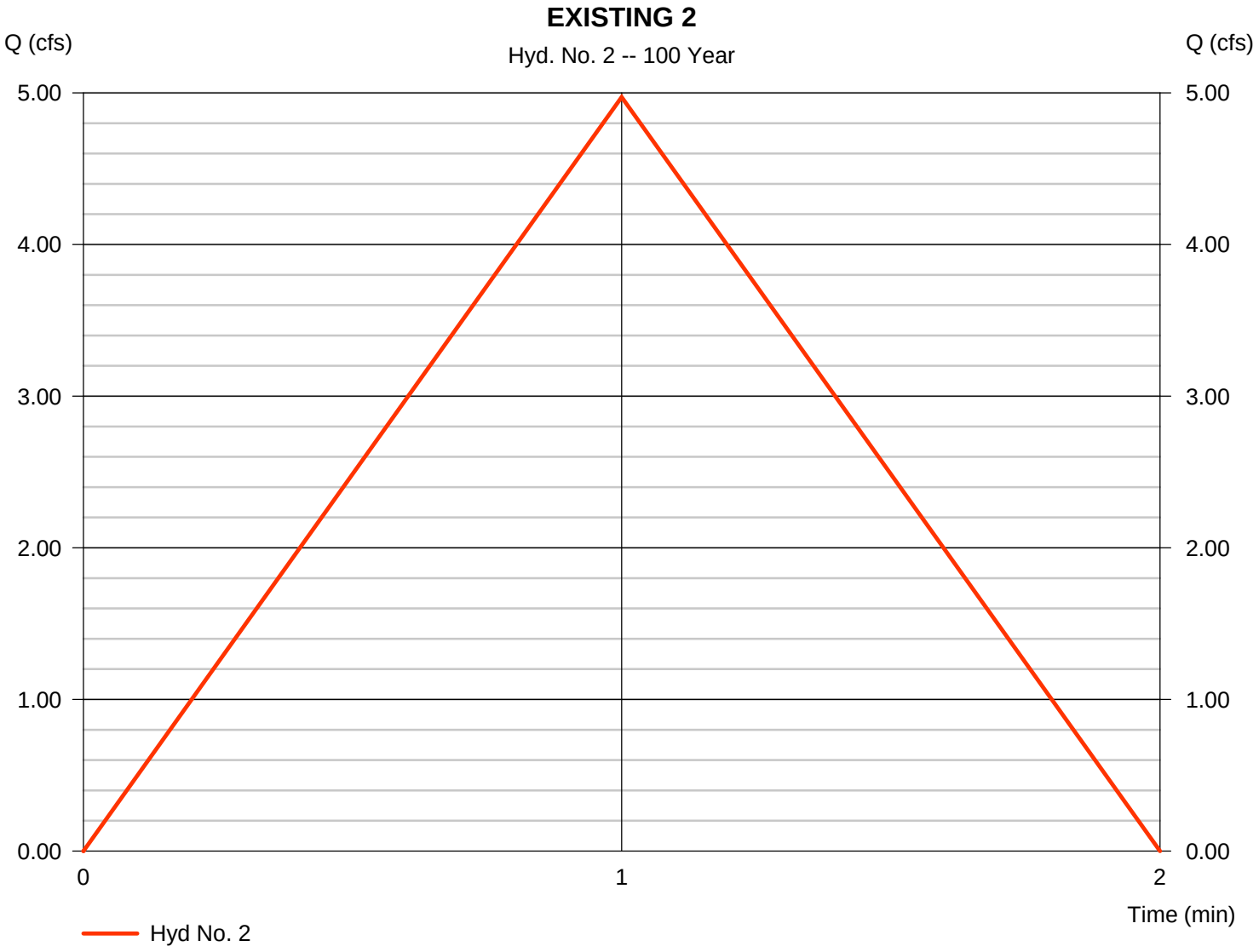


Hydrograph Report

Hyd. No. 2

EXISTING 2

Hydrograph type	=	Rational	Peak discharge	=	4.973 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	298 cuft
Drainage area	=	0.802 ac	Runoff coeff.	=	0.51
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

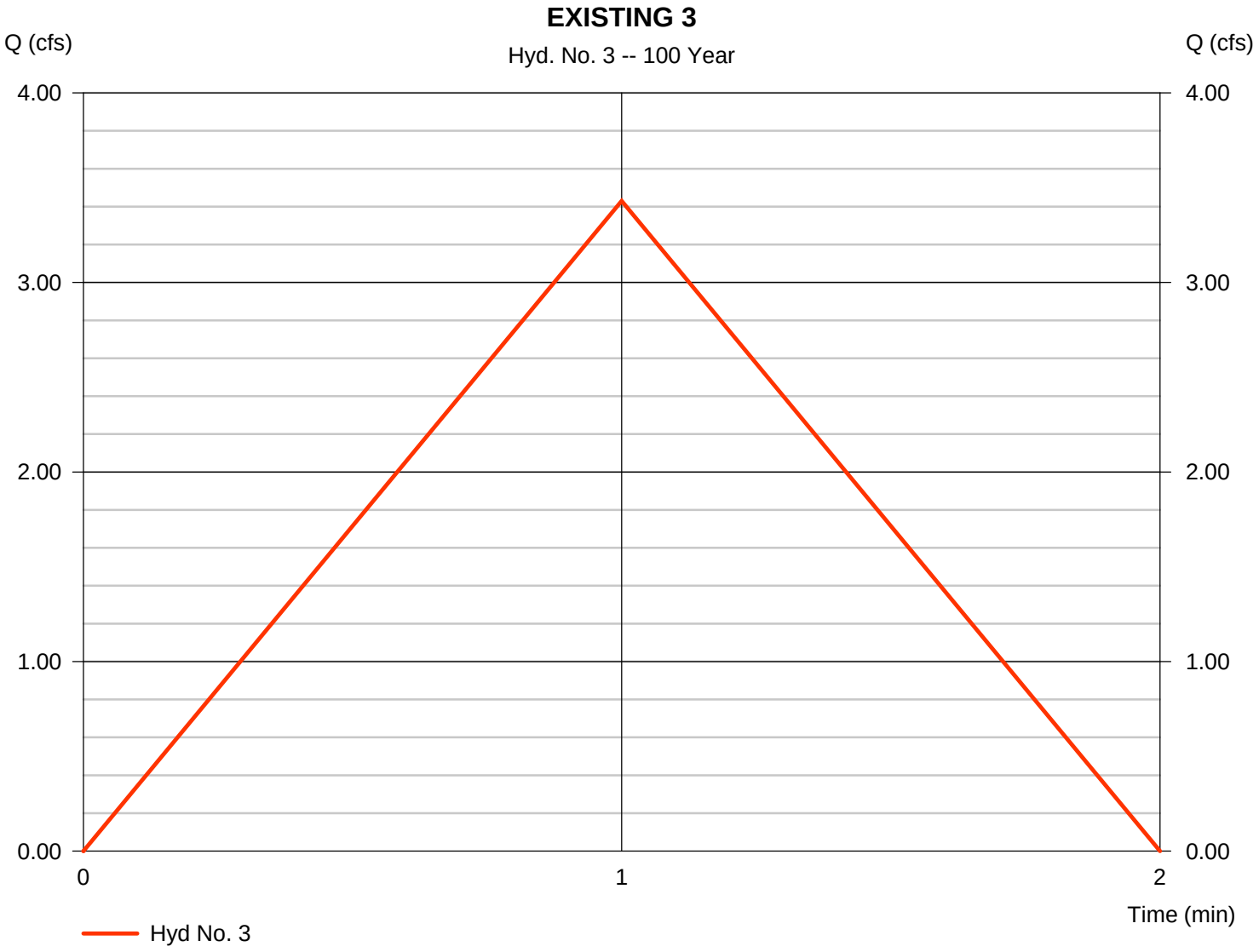


Hydrograph Report

Hyd. No. 3

EXISTING 3

Hydrograph type	=	Rational	Peak discharge	=	3.430 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	206 cuft
Drainage area	=	0.495 ac	Runoff coeff.	=	0.57
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

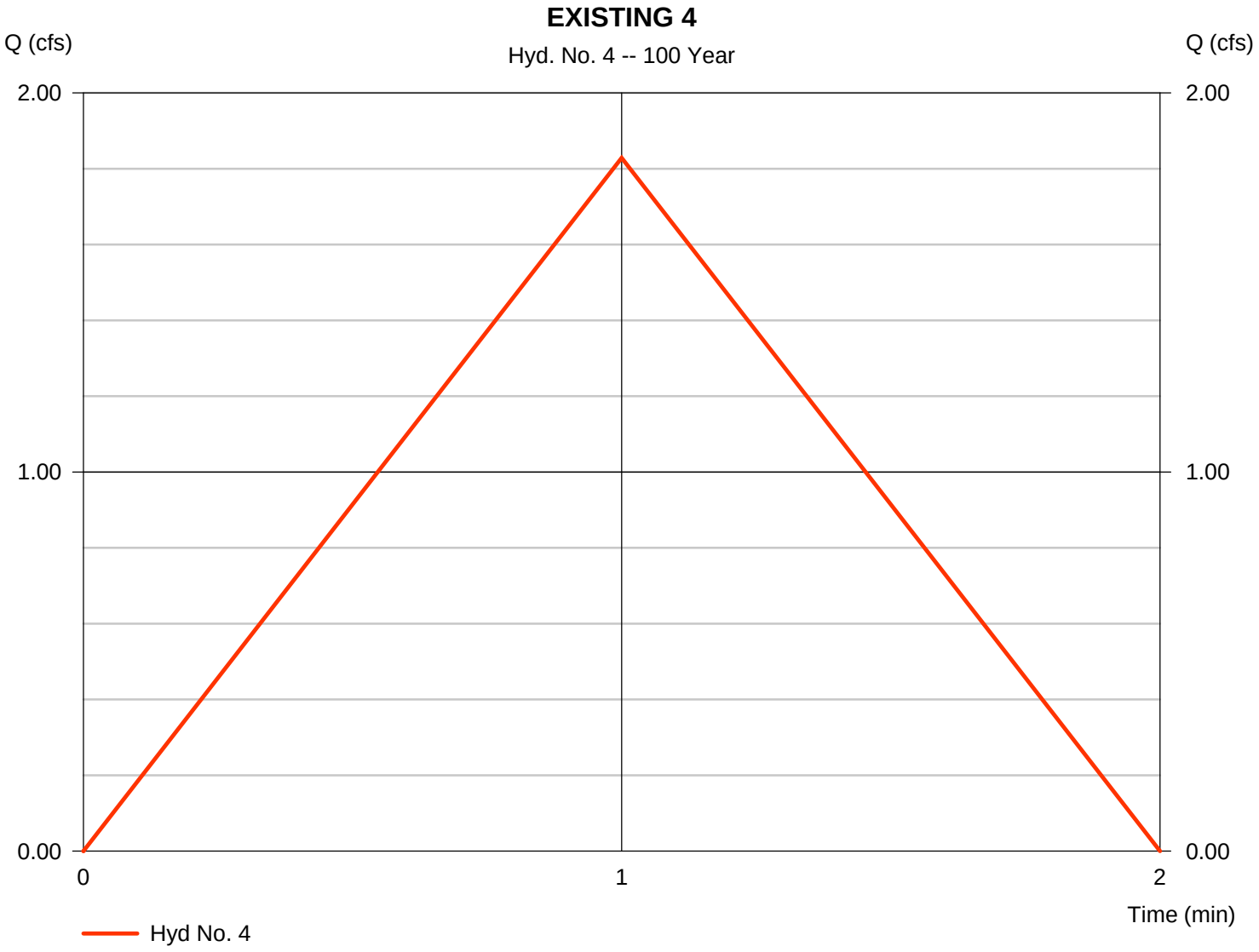


Hydrograph Report

Hyd. No. 4

EXISTING 4

Hydrograph type	=	Rational	Peak discharge	=	1.828 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	110 cuft
Drainage area	=	0.376 ac	Runoff coeff.	=	0.4
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

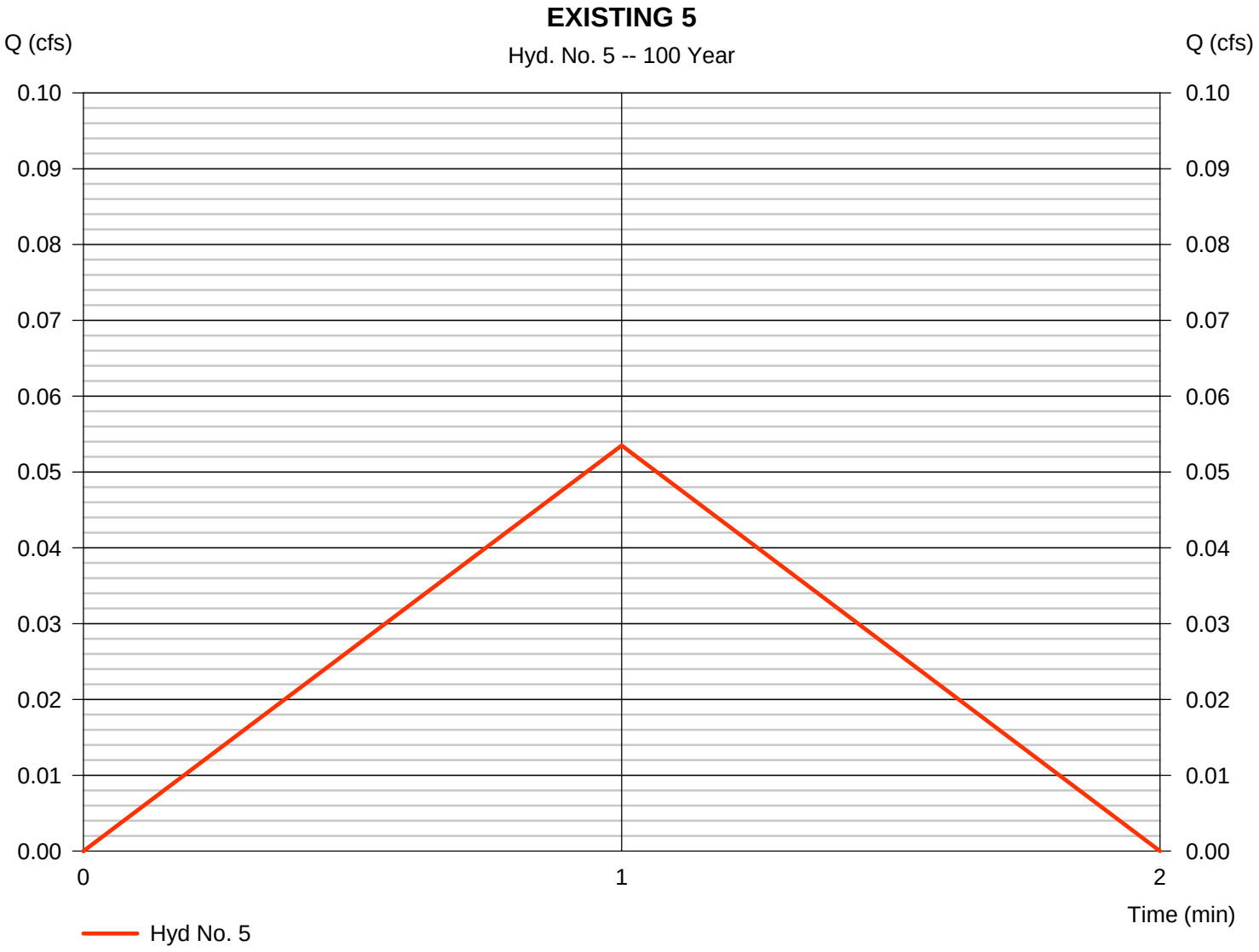


Hydrograph Report

Hyd. No. 5

EXISTING 5

Hydrograph type	=	Rational	Peak discharge	=	0.053 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	3 cuft
Drainage area	=	0.022 ac	Runoff coeff.	=	0.2
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

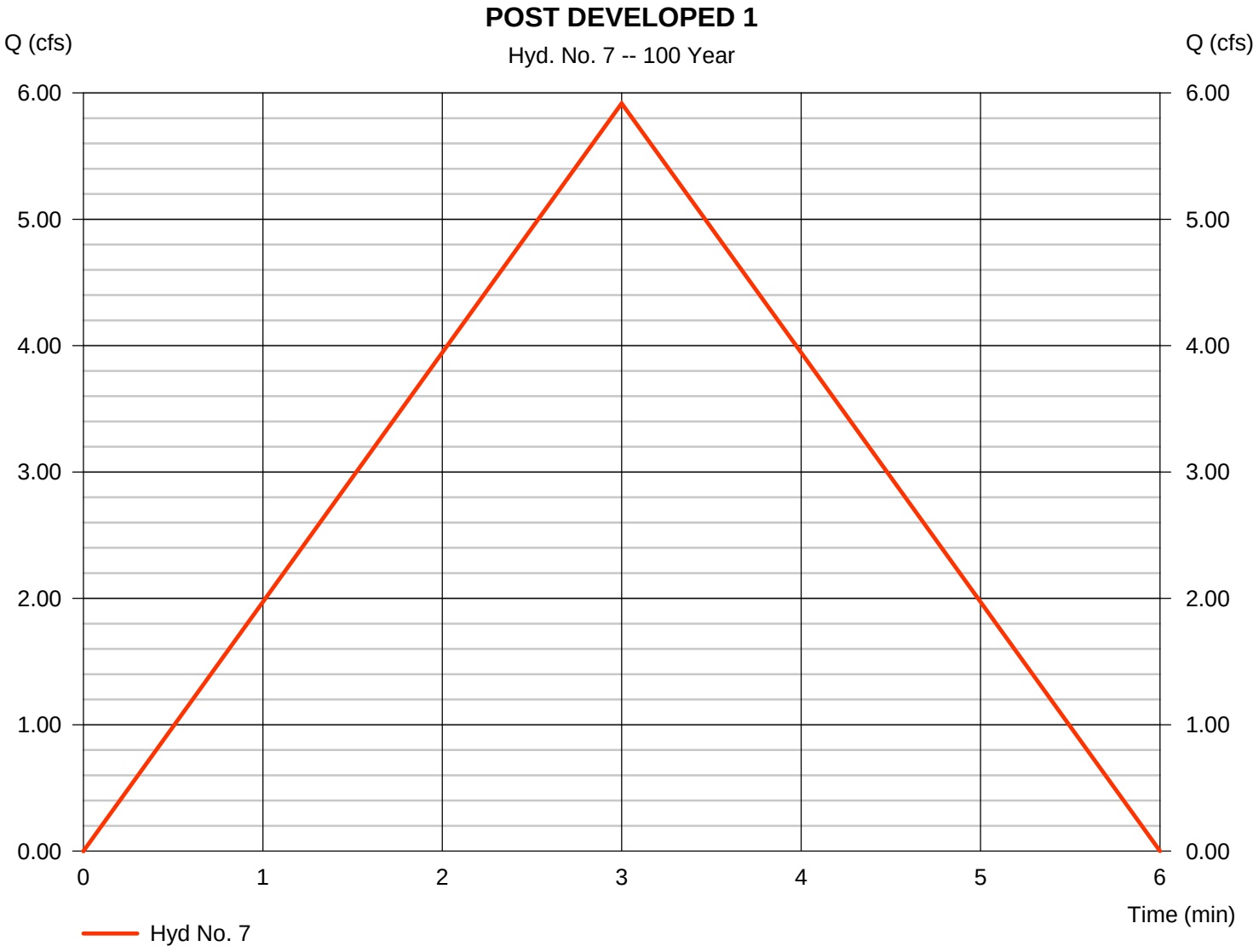


Hydrograph Report

Hyd. No. 7

POST DEVELOPED 1

Hydrograph type	=	Rational	Peak discharge	=	5.917 cfs
Storm frequency	=	100 yrs	Time to peak	=	3 min
Time interval	=	1 min	Hyd. volume	=	1,065 cuft
Drainage area	=	1.004 ac	Runoff coeff.	=	0.54
Intensity	=	10.914 in/hr	Tc by User	=	3.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

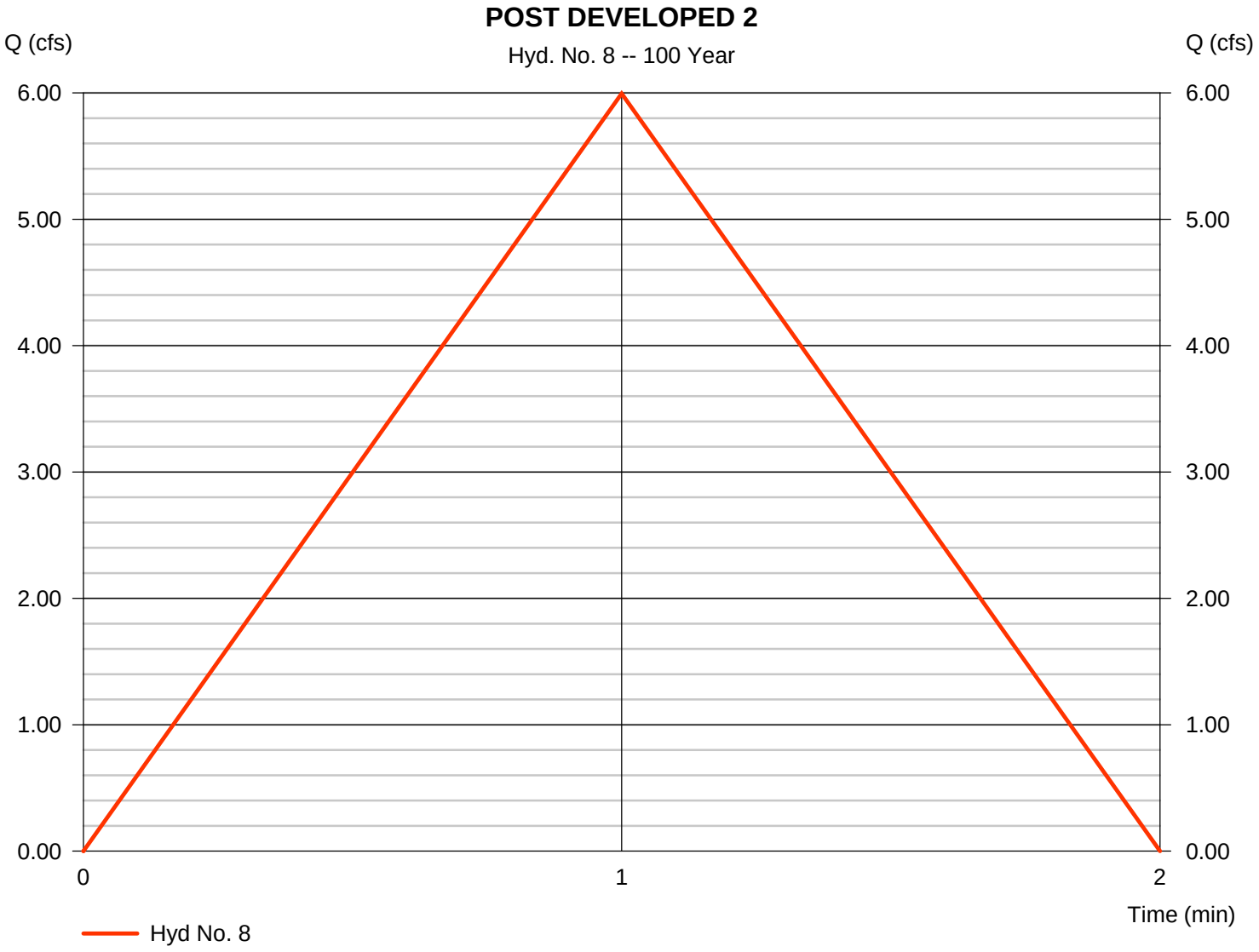


Hydrograph Report

Hyd. No. 8

POST DEVELOPED 2

Hydrograph type	=	Rational	Peak discharge	=	5.994 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	360 cuft
Drainage area	=	0.554 ac	Runoff coeff.	=	0.89
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

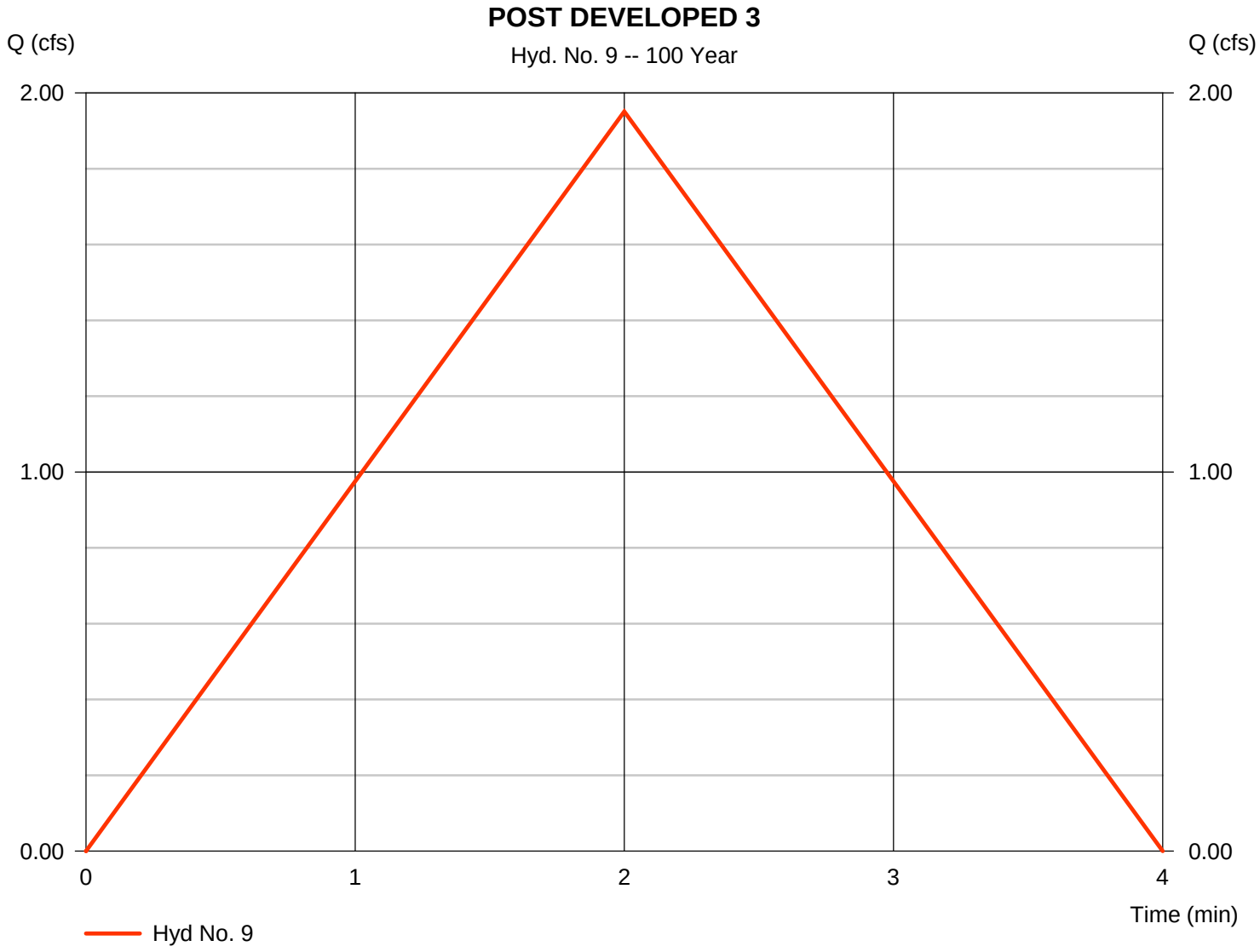


Hydrograph Report

Hyd. No. 9

POST DEVELOPED 3

Hydrograph type	=	Rational	Peak discharge	=	1.951 cfs
Storm frequency	=	100 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	234 cuft
Drainage area	=	0.239 ac	Runoff coeff.	=	0.71
Intensity	=	11.495 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

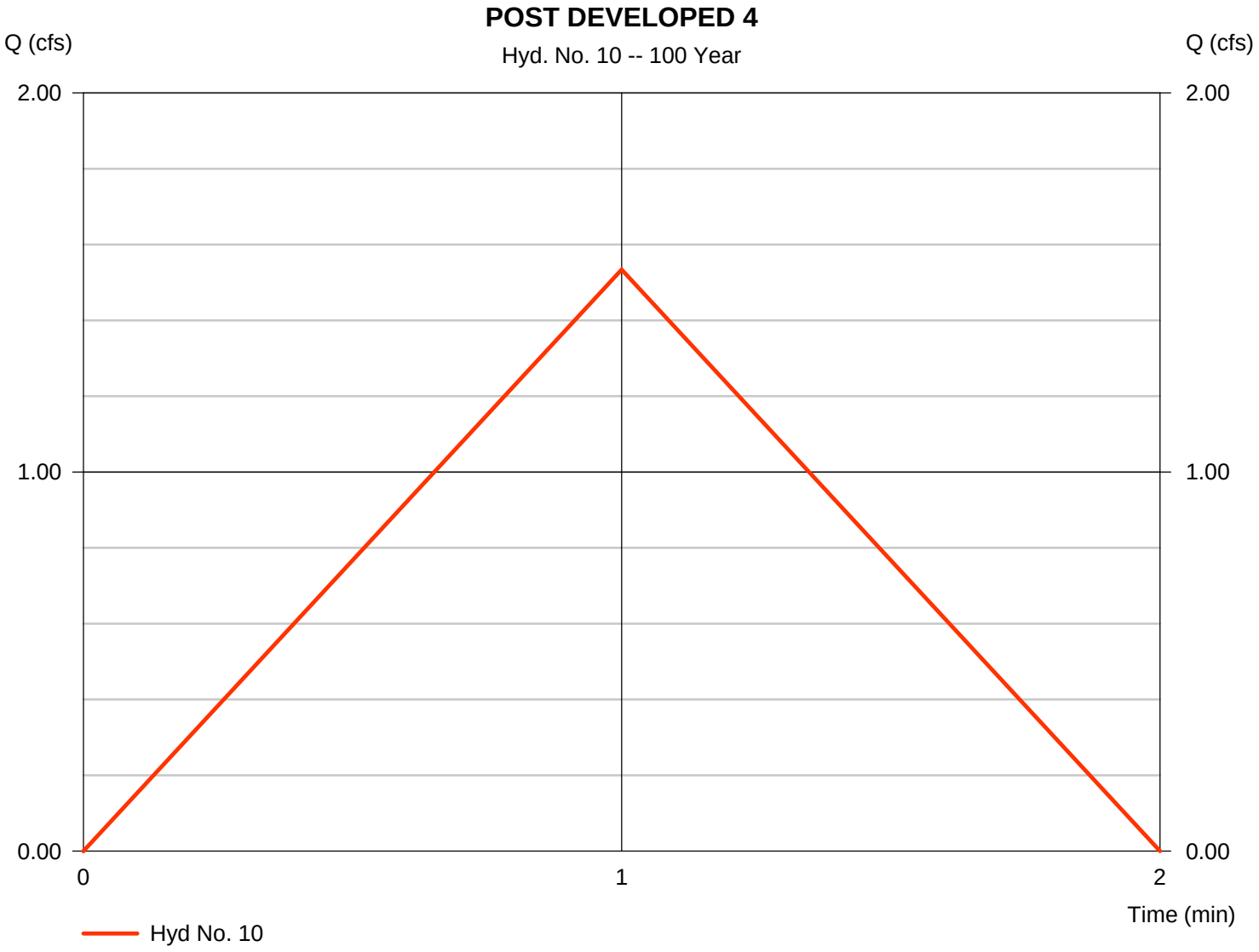


Hydrograph Report

Hyd. No. 10

POST DEVELOPED 4

Hydrograph type	=	Rational	Peak discharge	=	1.534 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	92 cuft
Drainage area	=	0.166 ac	Runoff coeff.	=	0.76
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

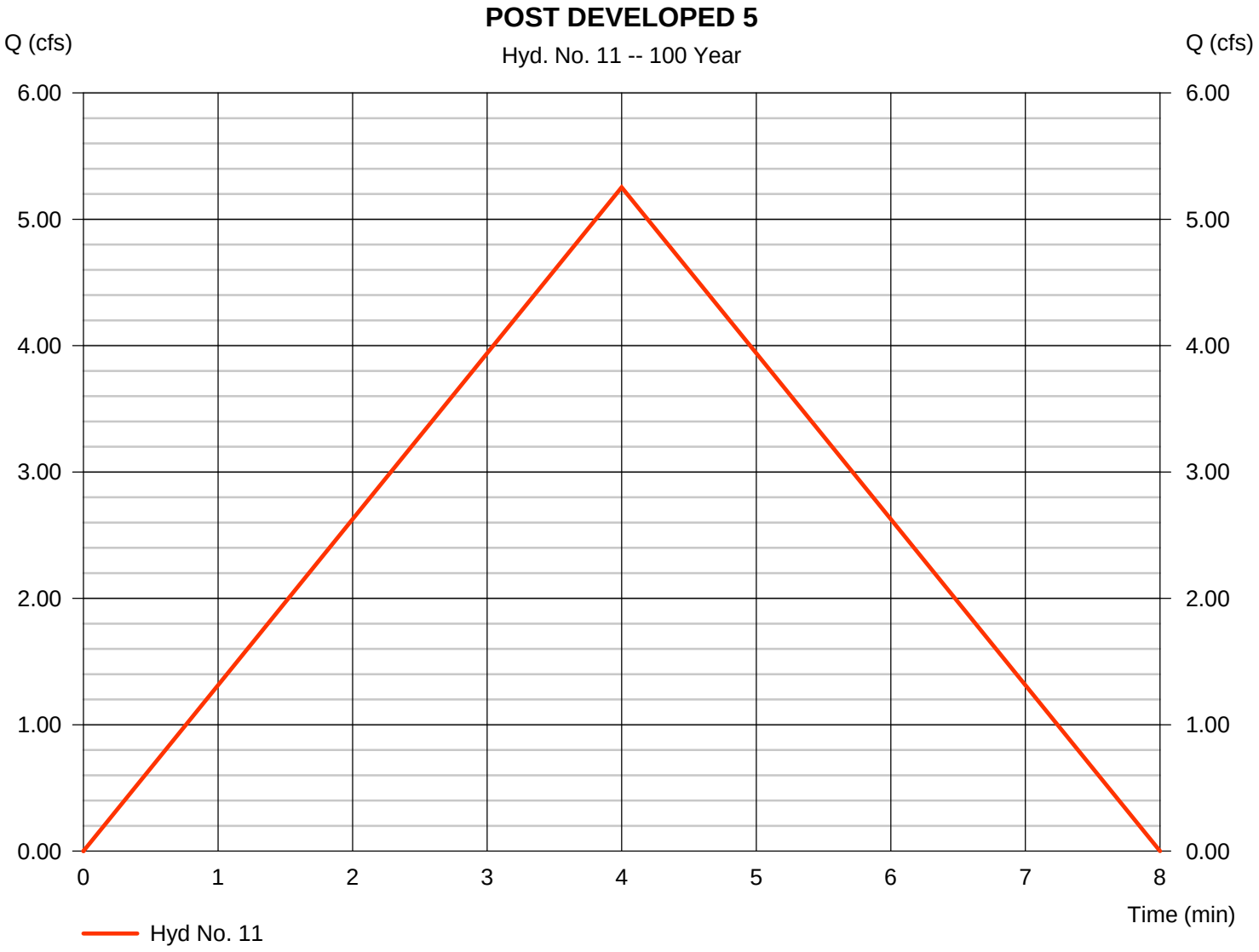


Hydrograph Report

Hyd. No. 11

POST DEVELOPED 5

Hydrograph type	=	Rational	Peak discharge	=	5.252 cfs
Storm frequency	=	100 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	1,261 cuft
Drainage area	=	0.692 ac	Runoff coeff.	=	0.73
Intensity	=	10.398 in/hr	Tc by User	=	4.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

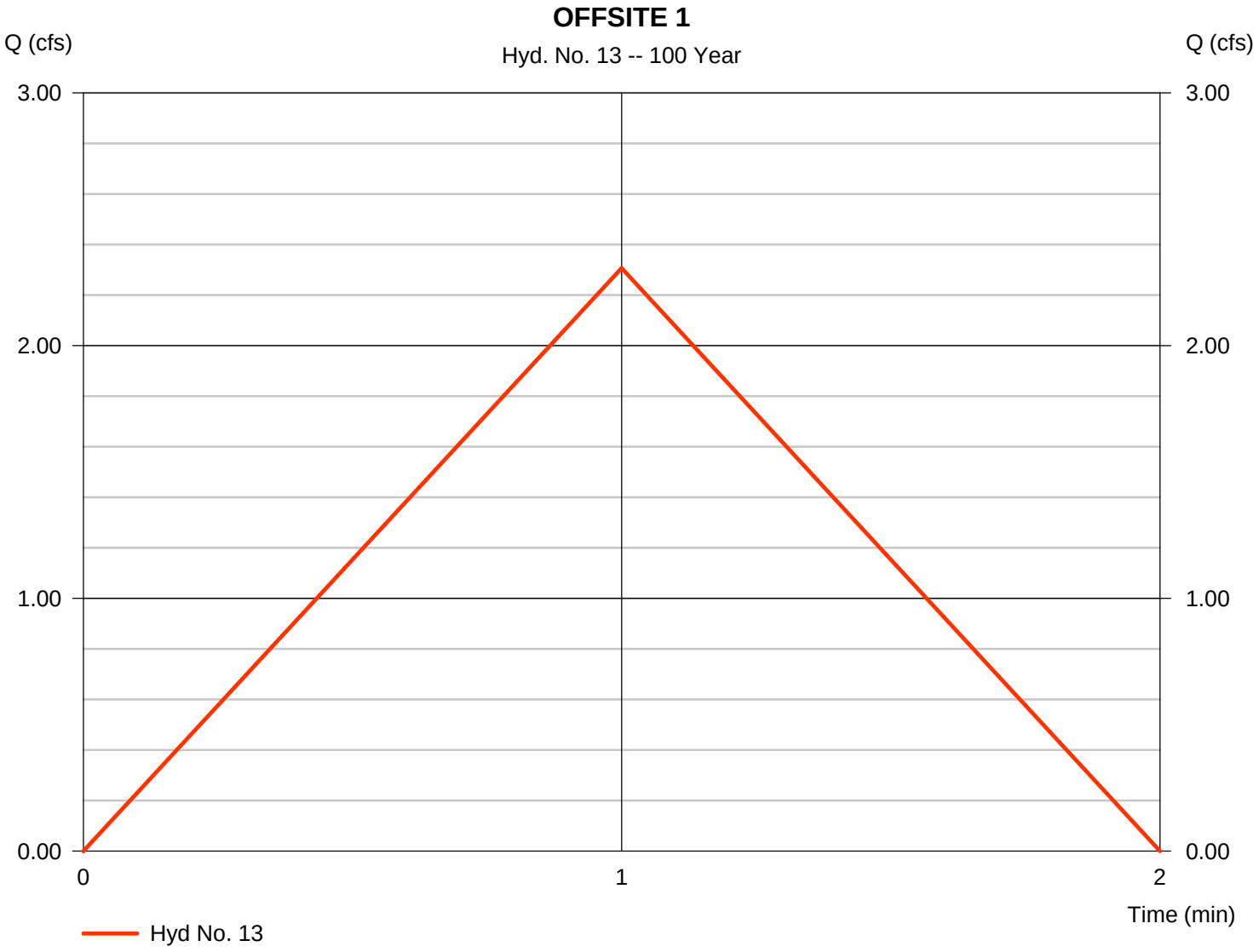


Hydrograph Report

Hyd. No. 13

OFFSITE 1

Hydrograph type	=	Rational	Peak discharge	=	2.307 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	138 cuft
Drainage area	=	0.593 ac	Runoff coeff.	=	0.32
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

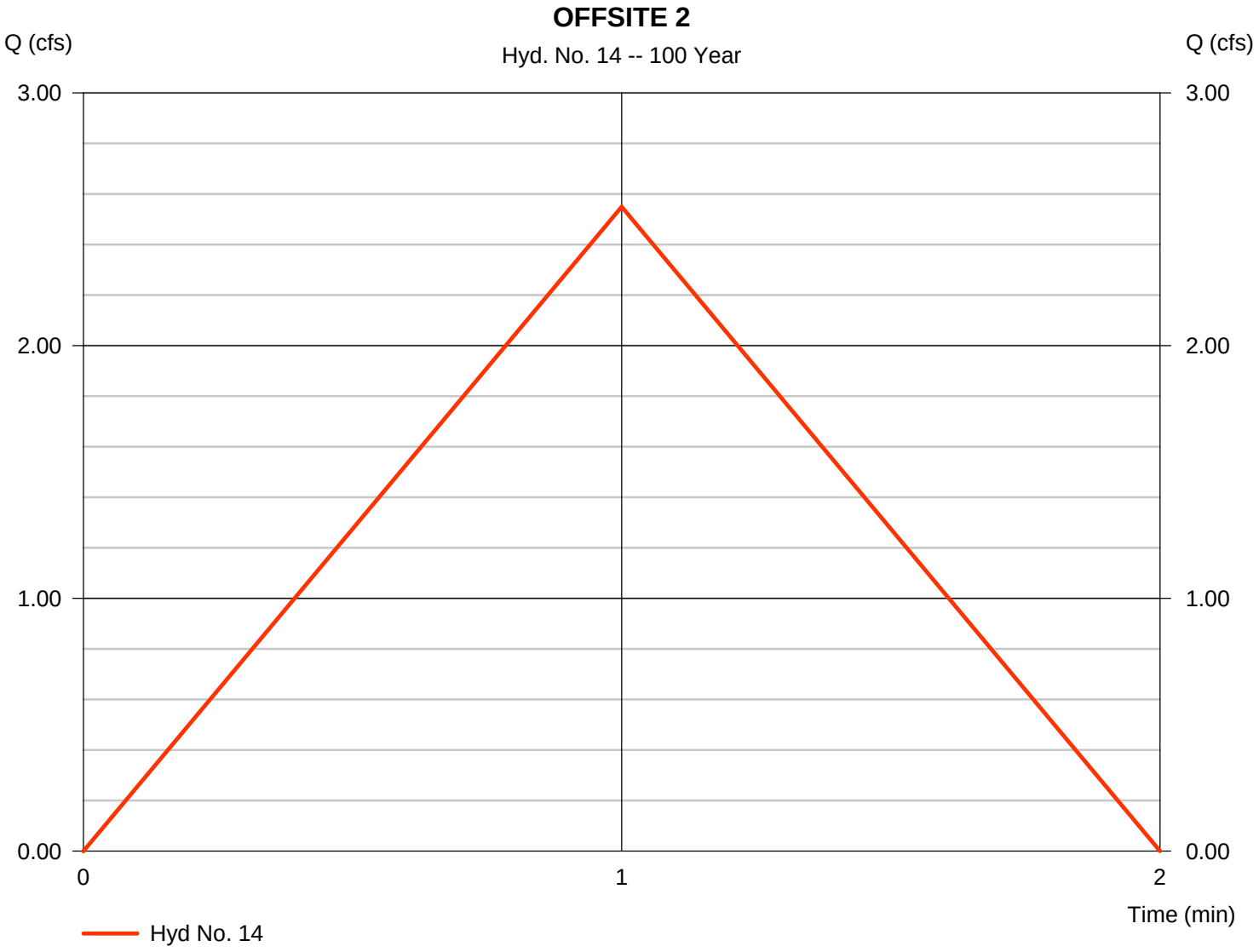


Hydrograph Report

Hyd. No. 14

OFFSITE 2

Hydrograph type	=	Rational	Peak discharge	=	2.549 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	153 cuft
Drainage area	=	0.233 ac	Runoff coeff.	=	0.9
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

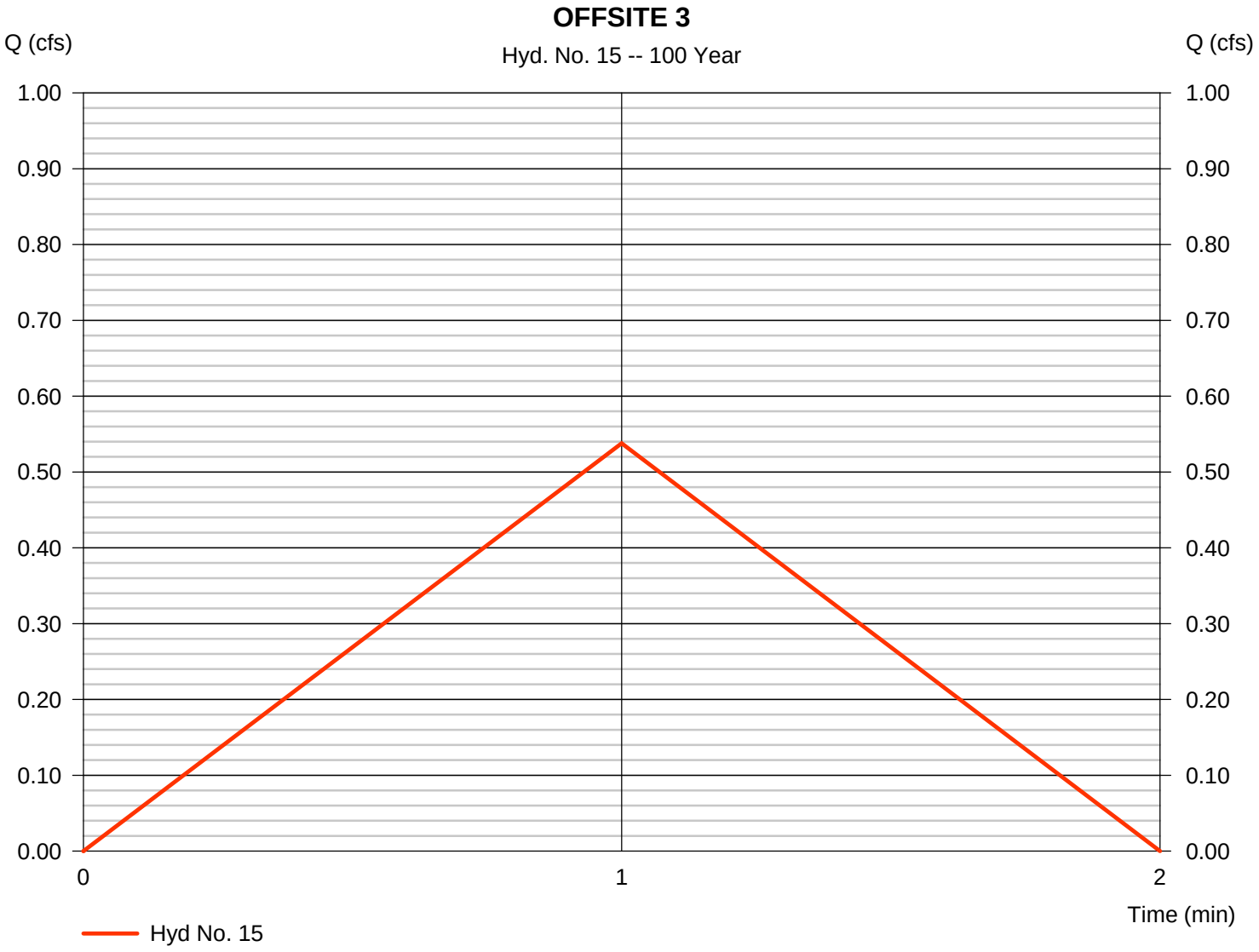


Hydrograph Report

Hyd. No. 15

OFFSITE 3

Hydrograph type	=	Rational	Peak discharge	=	0.538 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	32 cuft
Drainage area	=	0.056 ac	Runoff coeff.	=	0.79
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

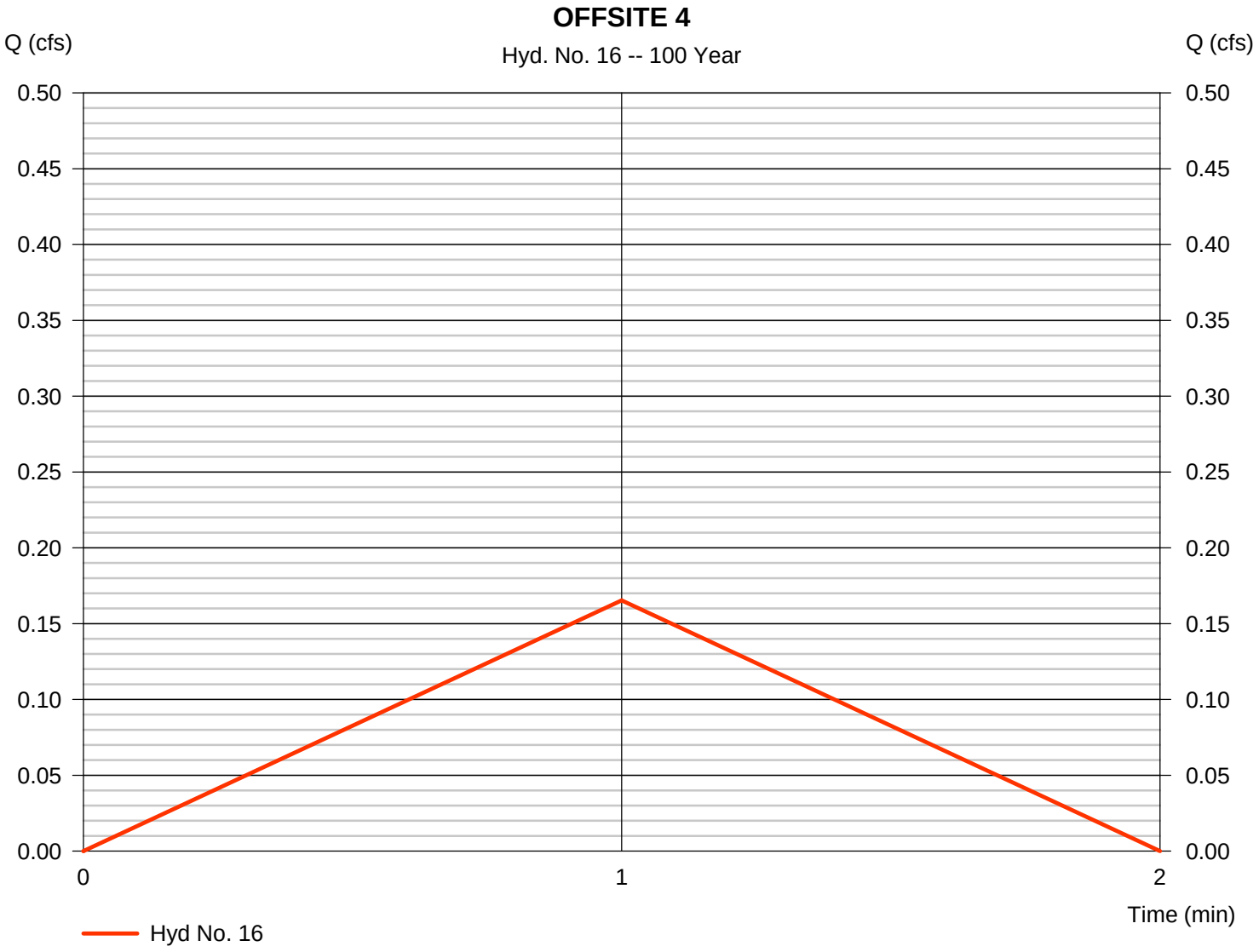


Hydrograph Report

Hyd. No. 16

OFFSITE 4

Hydrograph type	=	Rational	Peak discharge	=	0.165 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	10 cuft
Drainage area	=	0.068 ac	Runoff coeff.	=	0.2
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

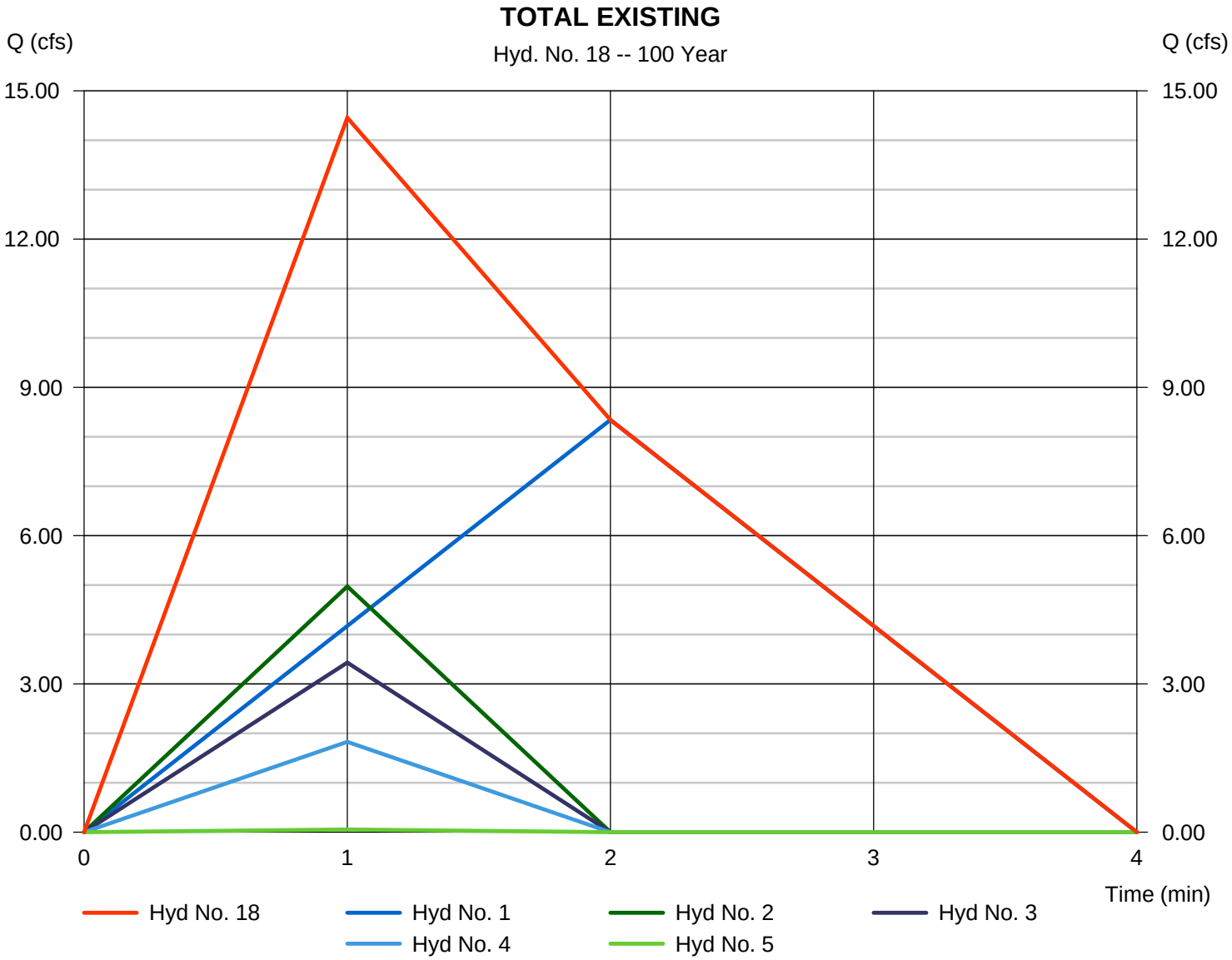


Hydrograph Report

Hyd. No. 18

TOTAL EXISTING

Hydrograph type	=	Combine	Peak discharge	=	14.46 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	1,618 cuft
Inflow hyds.	=	1, 2, 3, 4, 5	Contrib. drain. area	=	3.605 ac

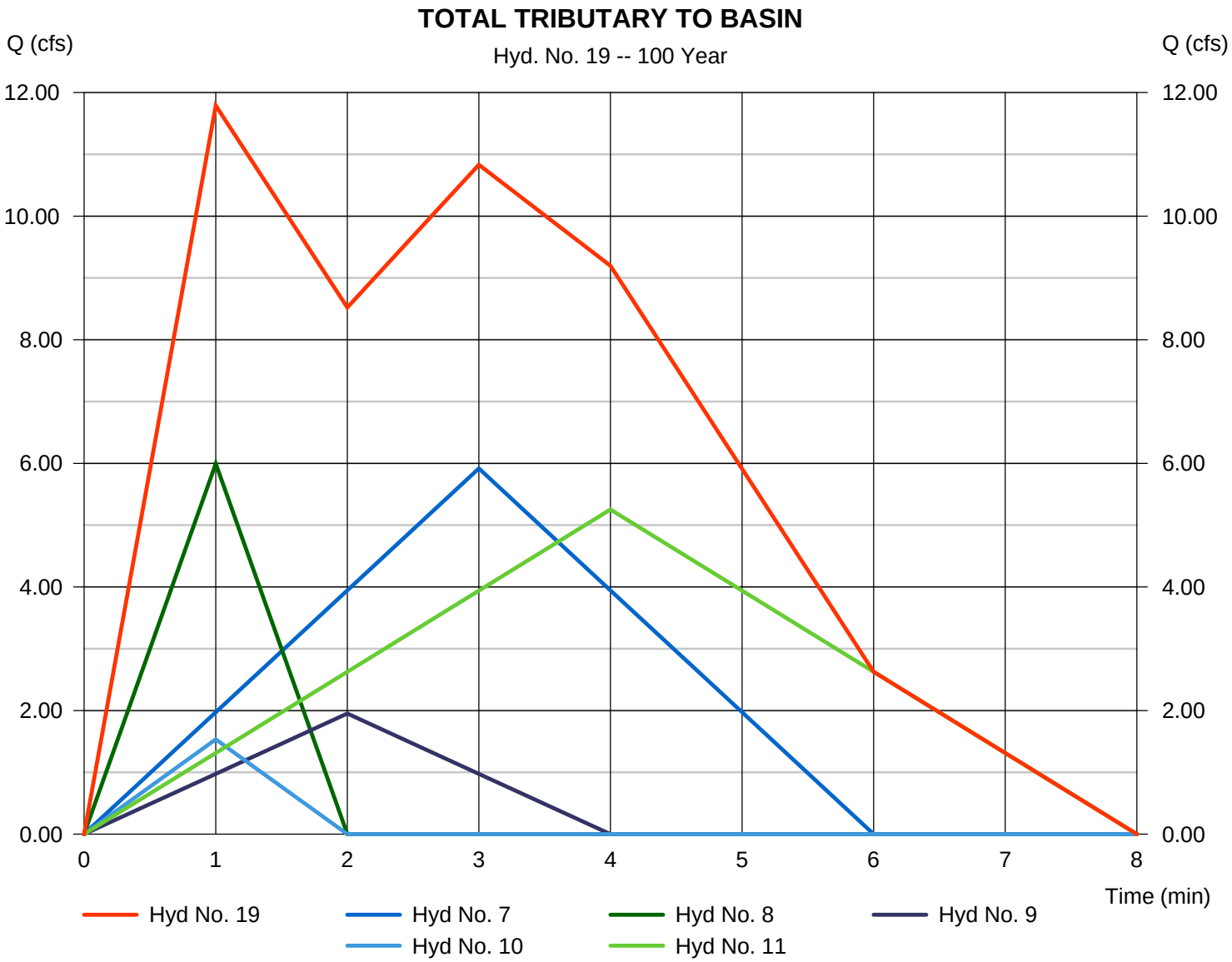


Hydrograph Report

Hyd. No. 19

TOTAL TRIBUTARY TO BASIN

Hydrograph type	= Combine	Peak discharge	= 11.79 cfs
Storm frequency	= 100 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 3,011 cuft
Inflow hyds.	= 7, 8, 9, 10, 11	Contrib. drain. area	= 2.655 ac

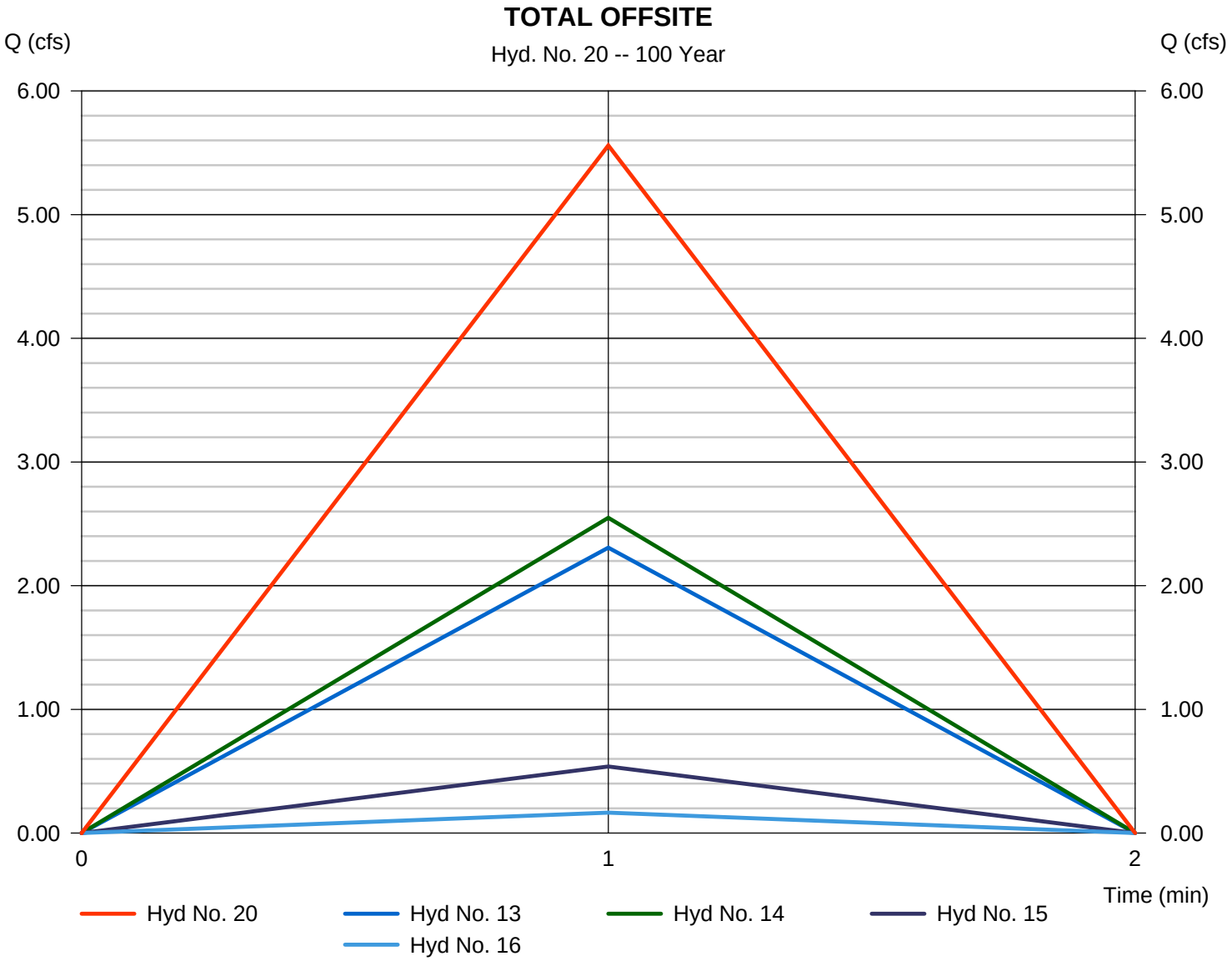


Hydrograph Report

Hyd. No. 20

TOTAL OFFSITE

Hydrograph type	=	Combine	Peak discharge	=	5.559 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	334 cuft
Inflow hyds.	=	13, 14, 15, 16	Contrib. drain. area	=	0.950 ac



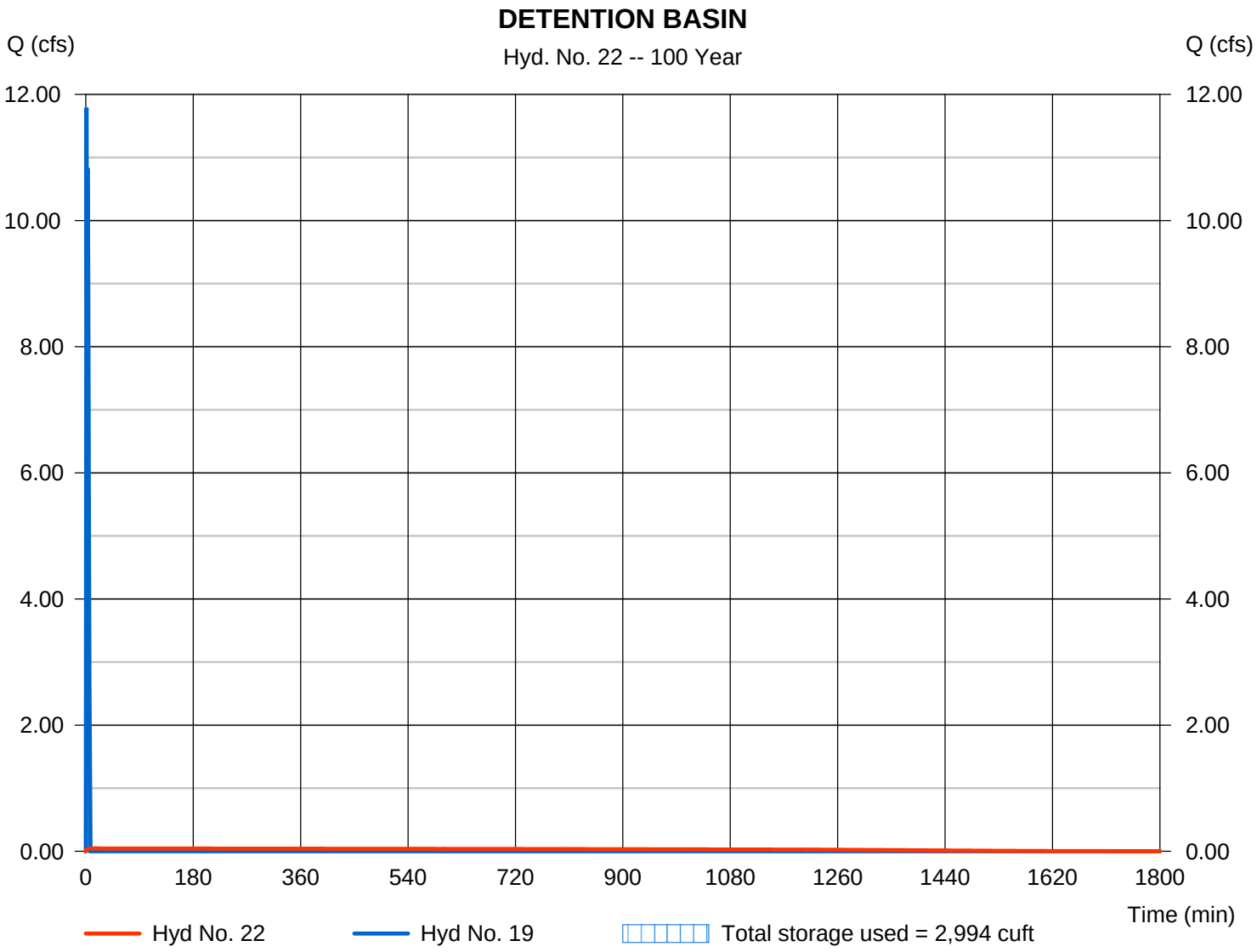
Hydrograph Report

Hyd. No. 22

DETENTION BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	0.044 cfs
Storm frequency	=	100 yrs	Time to peak	=	8 min
Time interval	=	1 min	Hyd. volume	=	3,005 cuft
Inflow hyd. No.	=	19 - TOTAL TRIBUTARY TO BASIN	Max. Elevation	=	557.92 ft
Reservoir name	=	DETENTION	Max. Storage	=	2,994 cuft

Storage Indication method used.

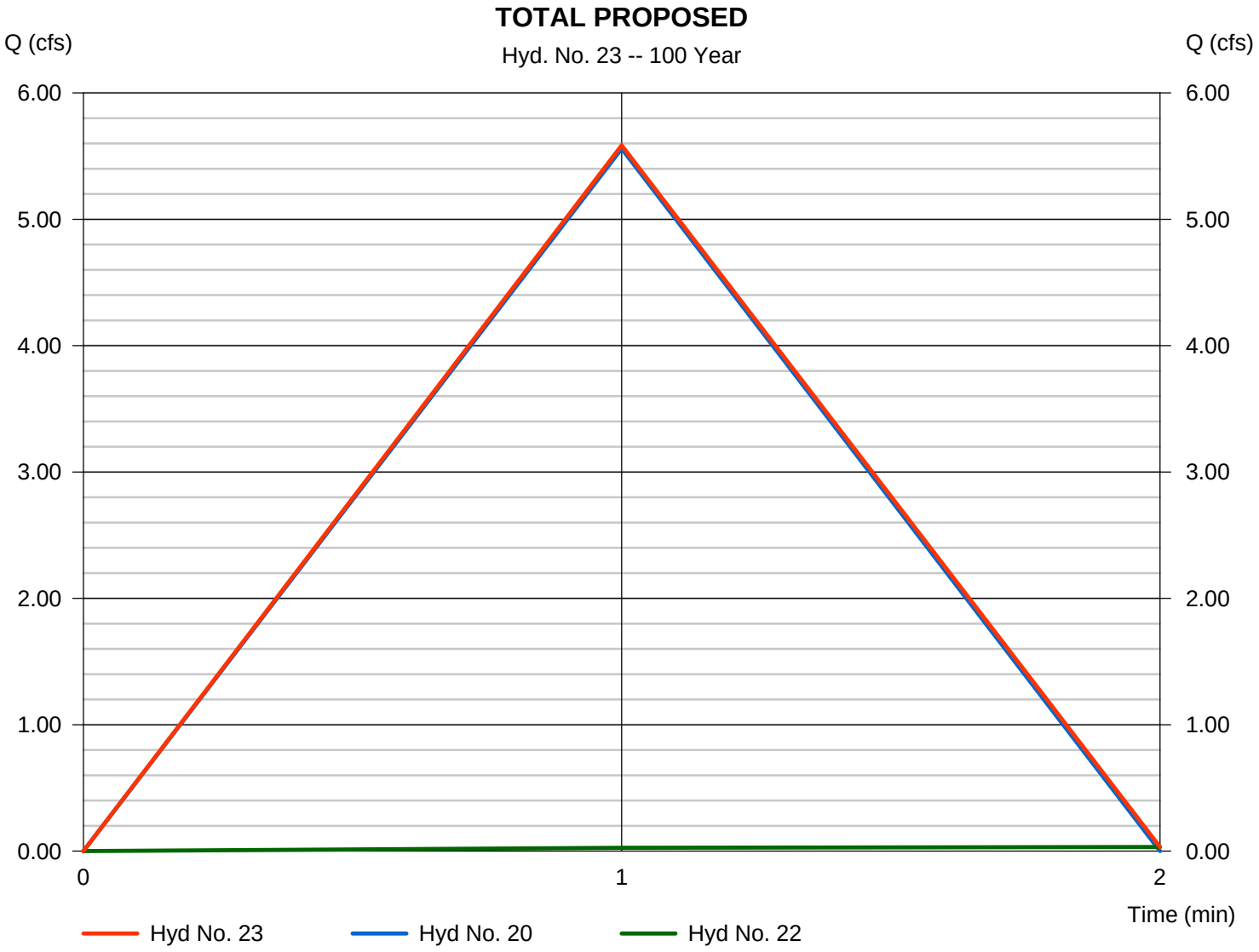


Hydrograph Report

Hyd. No. 23

TOTAL PROPOSED

Hydrograph type	= Combine	Peak discharge	= 5.585 cfs
Storm frequency	= 100 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 3,339 cuft
Inflow hyds.	= 20, 22	Contrib. drain. area	= 0.000 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	56.9100	11.8000	0.8400	--------
3	0.0000	0.0000	0.0000	--------
5	23.9590	3.4000	0.6210	--------
10	78.5300	13.2800	0.8100	--------
25	85.9100	13.4900	0.8000	--------
50	33.5240	2.8000	0.5900	--------
100	74.3600	11.3700	0.7200	--------

File name: MoDOT St. Louis IDF Curve.IDF

Intensity = B / (Tc + 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	5.32	4.27	3.59	3.11	2.75	2.47	2.25	2.07	1.91	1.78	1.67	1.57
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	6.39	4.78	3.93	3.38	3.00	2.71	2.49	2.30	2.15	2.03	1.92	1.82
10	7.46	6.13	5.24	4.59	4.10	3.71	3.40	3.14	2.92	2.73	2.57	2.42
25	8.33	6.88	5.89	5.18	4.63	4.20	3.85	3.56	3.31	3.10	2.92	2.76
50	9.98	7.45	6.13	5.30	4.71	4.28	3.93	3.65	3.42	3.23	3.06	2.91
100	9.94	8.20	7.05	6.22	5.59	5.10	4.70	4.36	4.08	3.84	3.63	3.44

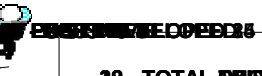
Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.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	2.50	3.10	0.00	3.30	4.64	5.60	6.80	7.21
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	2.75	0.00	0.00	6.50	0.00
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	2.80	0.00	0.00	6.00	0.00

Hydraflow Table of Contents

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	Rational	EXISTING 1
2	Rational	EXISTING 2
3	Rational	EXISTING 3
4	Rational	EXISTING 4
5	Rational	EXISTING 5
7	Rational	POST DEVELOPED 1
8	Rational	POST DEVELOPED 2
9	Rational	POST DEVELOPED 3
10	Rational	POST DEVELOPED 4
11	Rational	POST DEVELOPED 5
13	Rational	OFFSITE 1
14	Rational	OFFSITE 2
15	Rational	OFFSITE 3
16	Rational	OFFSITE 4
18	Combine	TOTAL EXISTING
19	Combine	TOTAL TRIBUTARY TO BASIN
20	Combine	TOTAL OFFSITE
22	Reservoir	DETENTION BASIN
23	Combine	TOTAL PROPOSED

Hydrograph Return Period Recap

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	------	-------	4.555	-------	-------	6.262	6.963	-------	8.343	EXISTING 1
2	Rational	------	-------	2.734	-------	-------	3.728	4.139	-------	4.973	EXISTING 2
3	Rational	------	-------	1.886	-------	-------	2.571	2.855	-------	3.430	EXISTING 3
4	Rational	------	-------	1.005	-------	-------	1.371	1.522	-------	1.828	EXISTING 4
5	Rational	------	-------	0.029	-------	-------	0.040	0.045	-------	0.053	EXISTING 5
7	Rational	------	-------	3.208	-------	-------	4.443	4.948	-------	5.917	POST DEVELOPED 1
8	Rational	------	-------	3.296	-------	-------	4.494	4.990	-------	5.994	POST DEVELOPED 2
9	Rational	------	-------	1.065	-------	-------	1.464	1.628	-------	1.951	POST DEVELOPED 3
10	Rational	------	-------	0.843	-------	-------	1.150	1.277	-------	1.534	POST DEVELOPED 4
11	Rational	------	-------	2.830	-------	-------	3.945	4.398	-------	5.252	POST DEVELOPED 5
13	Rational	------	-------	1.269	-------	-------	1.729	1.920	-------	2.307	OFFSITE 1
14	Rational	------	-------	1.402	-------	-------	1.911	2.122	-------	2.549	OFFSITE 2
15	Rational	------	-------	0.296	-------	-------	0.403	0.448	-------	0.538	OFFSITE 3
16	Rational	------	-------	0.091	-------	-------	0.124	0.138	-------	0.165	OFFSITE 4
18	Combine	1, 2, 3, 4, 5,	-------	7.933	-------	-------	10.84	12.04	-------	14.46	TOTAL EXISTING
19	Combine	7, 8, 9, 10, 11,	-------	6.449	-------	-------	8.843	9.829	-------	11.79	TOTAL TRIBUTARY TO BASIN
20	Combine	13, 14, 15, 16,	-------	3.057	-------	-------	4.168	4.628	-------	5.559	TOTAL OFFSITE
22	Reservoir	19	-------	4.390	-------	-------	6.245	7.000	-------	8.204	DETENTION BASIN
23	Combine	20, 22	-------	4.390	-------	-------	6.245	7.000	-------	8.204	TOTAL PROPOSED

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

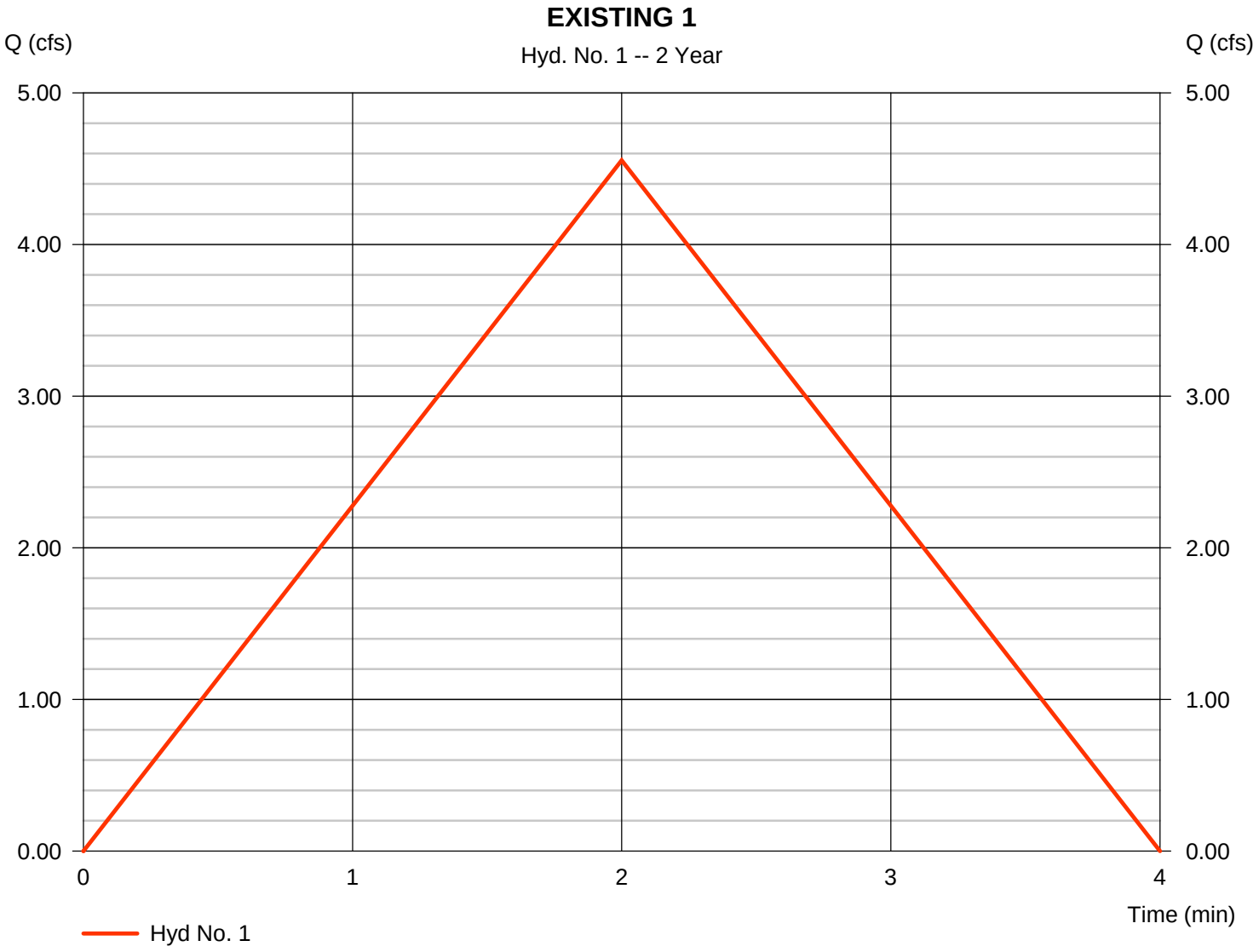
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	4.555	1	2	547	------	------	------	EXISTING 1
2	Rational	2.734	1	1	164	------	------	------	EXISTING 2
3	Rational	1.886	1	1	113	------	------	------	EXISTING 3
4	Rational	1.005	1	1	60	------	------	------	EXISTING 4
5	Rational	0.029	1	1	2	------	------	------	EXISTING 5
7	Rational	3.208	1	3	578	------	------	------	POST DEVELOPED 1
8	Rational	3.296	1	1	198	------	------	------	POST DEVELOPED 2
9	Rational	1.065	1	2	128	------	------	------	POST DEVELOPED 3
10	Rational	0.843	1	1	51	------	------	------	POST DEVELOPED 4
11	Rational	2.830	1	4	679	------	------	------	POST DEVELOPED 5
13	Rational	1.269	1	1	76	------	------	------	OFFSITE 1
14	Rational	1.402	1	1	84	------	------	------	OFFSITE 2
15	Rational	0.296	1	1	18	------	------	------	OFFSITE 3
16	Rational	0.091	1	1	5	------	------	------	OFFSITE 4
18	Combine	7.933	1	1	886	1, 2, 3, 4, 5,	------	------	TOTAL EXISTING
19	Combine	6.449	1	1	1,633	7, 8, 9, 10, 11,	------	------	TOTAL TRIBUTARY TO BASIN
20	Combine	3.057	1	1	183	13, 14, 15, 16,	------	------	TOTAL OFFSITE
22	Reservoir	4.390	1	4	1,633	19	559.09	6,149	DETENTION BASIN
23	Combine	4.390	1	4	1,816	20, 22	------	------	TOTAL PROPOSED

Hydrograph Report

Hyd. No. 1

EXISTING 1

Hydrograph type	=	Rational	Peak discharge	=	4.555 cfs
Storm frequency	=	2 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	547 cuft
Drainage area	=	1.910 ac	Runoff coeff.	=	0.38
Intensity	=	6.276 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

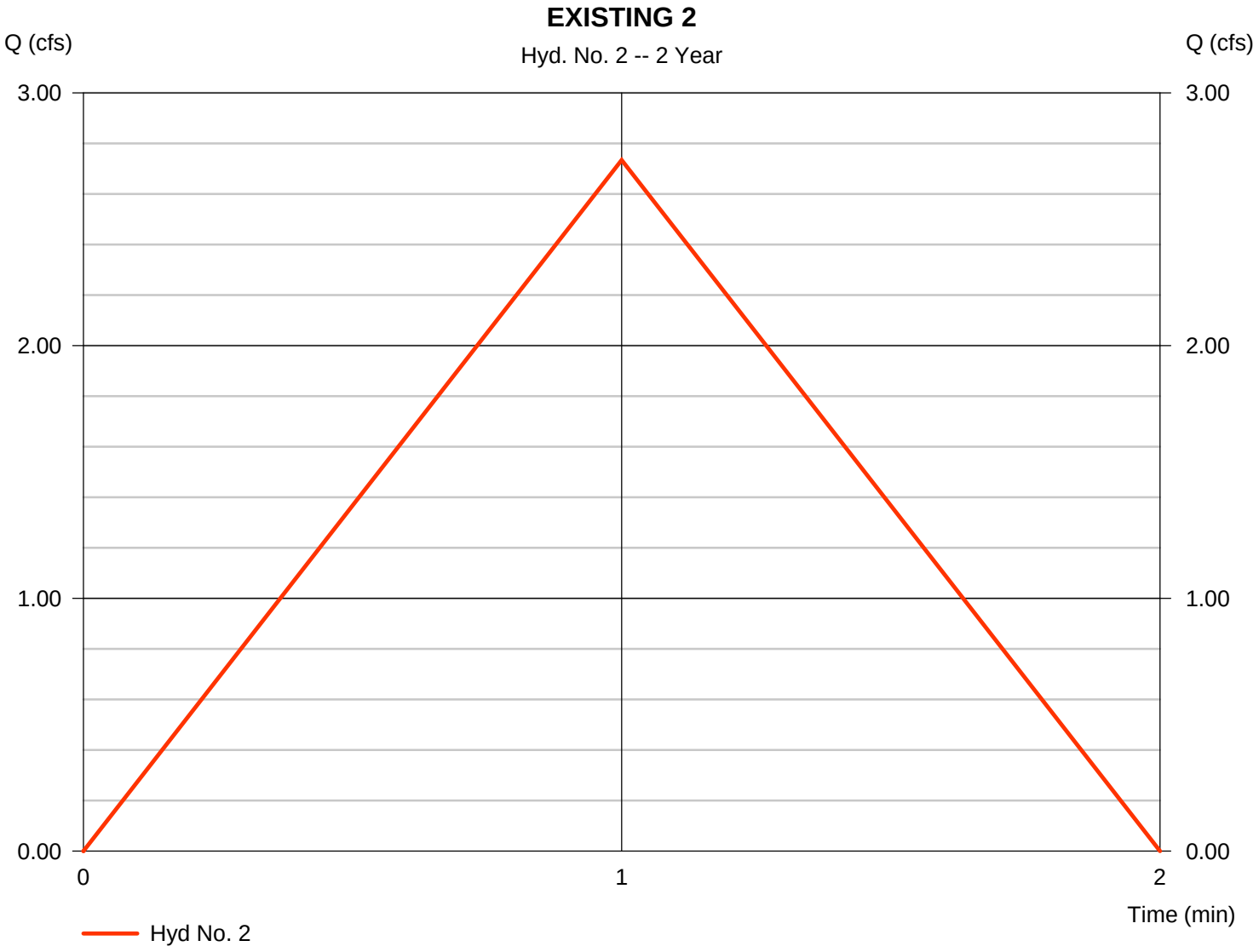


Hydrograph Report

Hyd. No. 2

EXISTING 2

Hydrograph type	=	Rational	Peak discharge	=	2.734 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	164 cuft
Drainage area	=	0.802 ac	Runoff coeff.	=	0.51
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

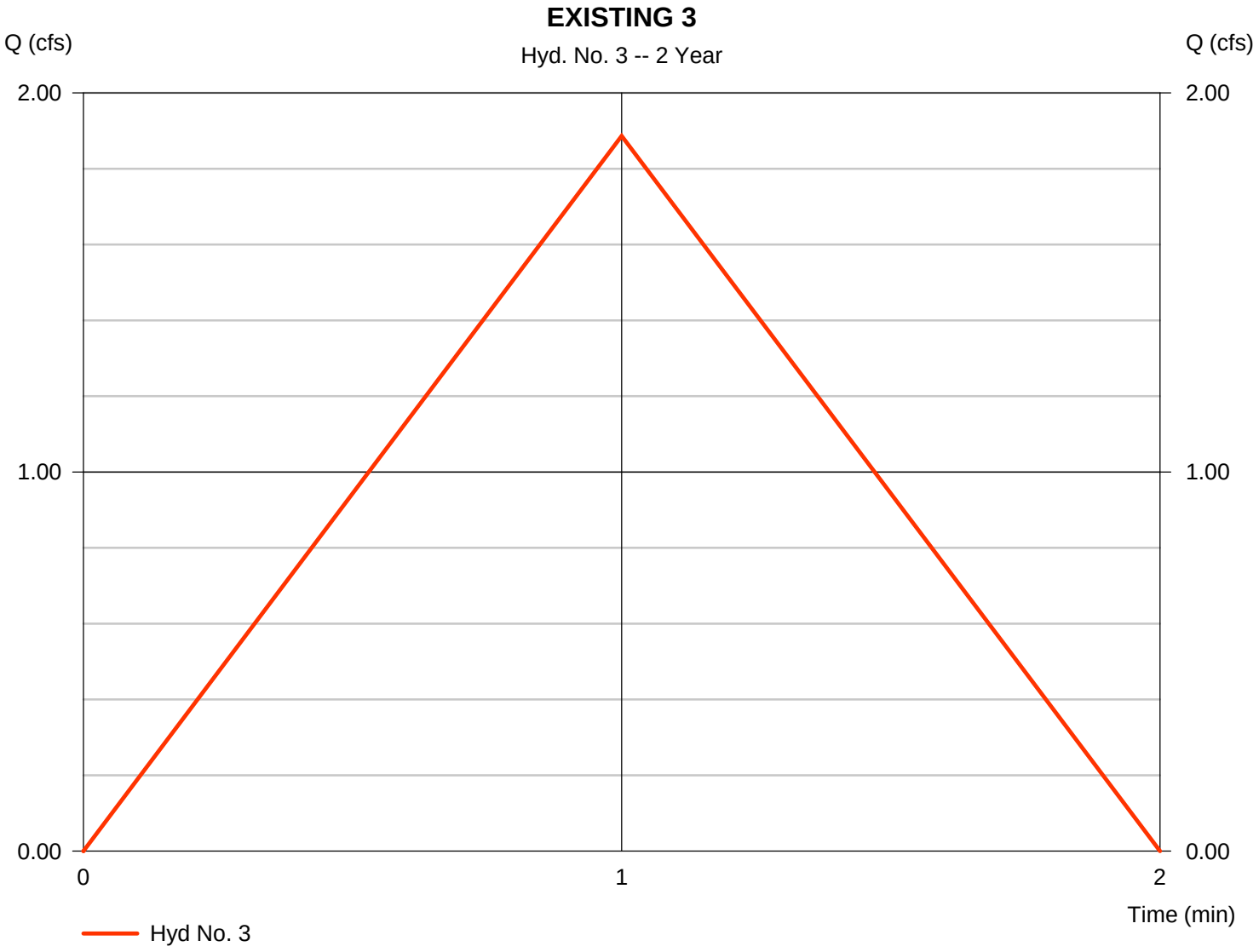


Hydrograph Report

Hyd. No. 3

EXISTING 3

Hydrograph type	=	Rational	Peak discharge	=	1.886 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	113 cuft
Drainage area	=	0.495 ac	Runoff coeff.	=	0.57
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

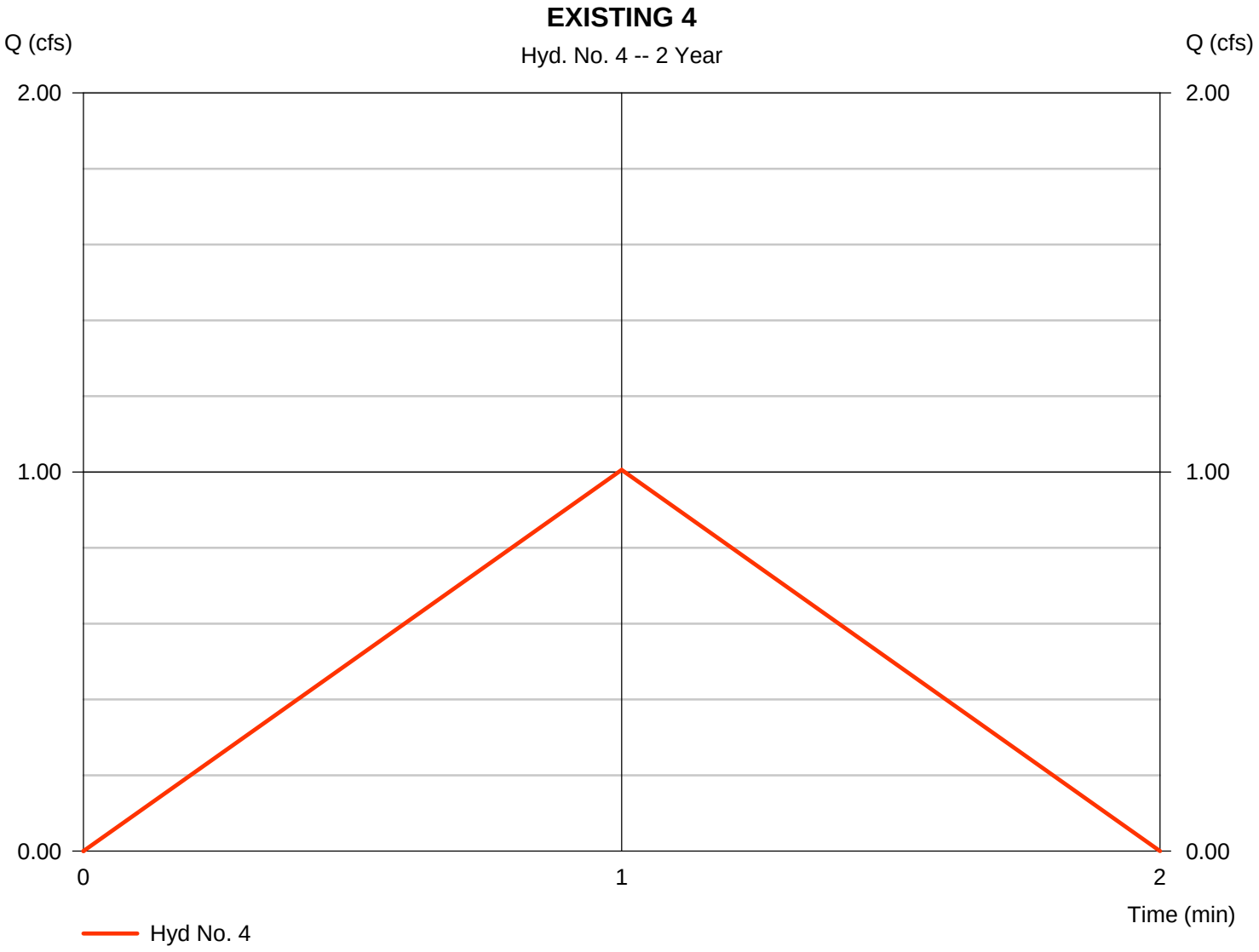


Hydrograph Report

Hyd. No. 4

EXISTING 4

Hydrograph type	=	Rational	Peak discharge	=	1.005 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	60 cuft
Drainage area	=	0.376 ac	Runoff coeff.	=	0.4
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

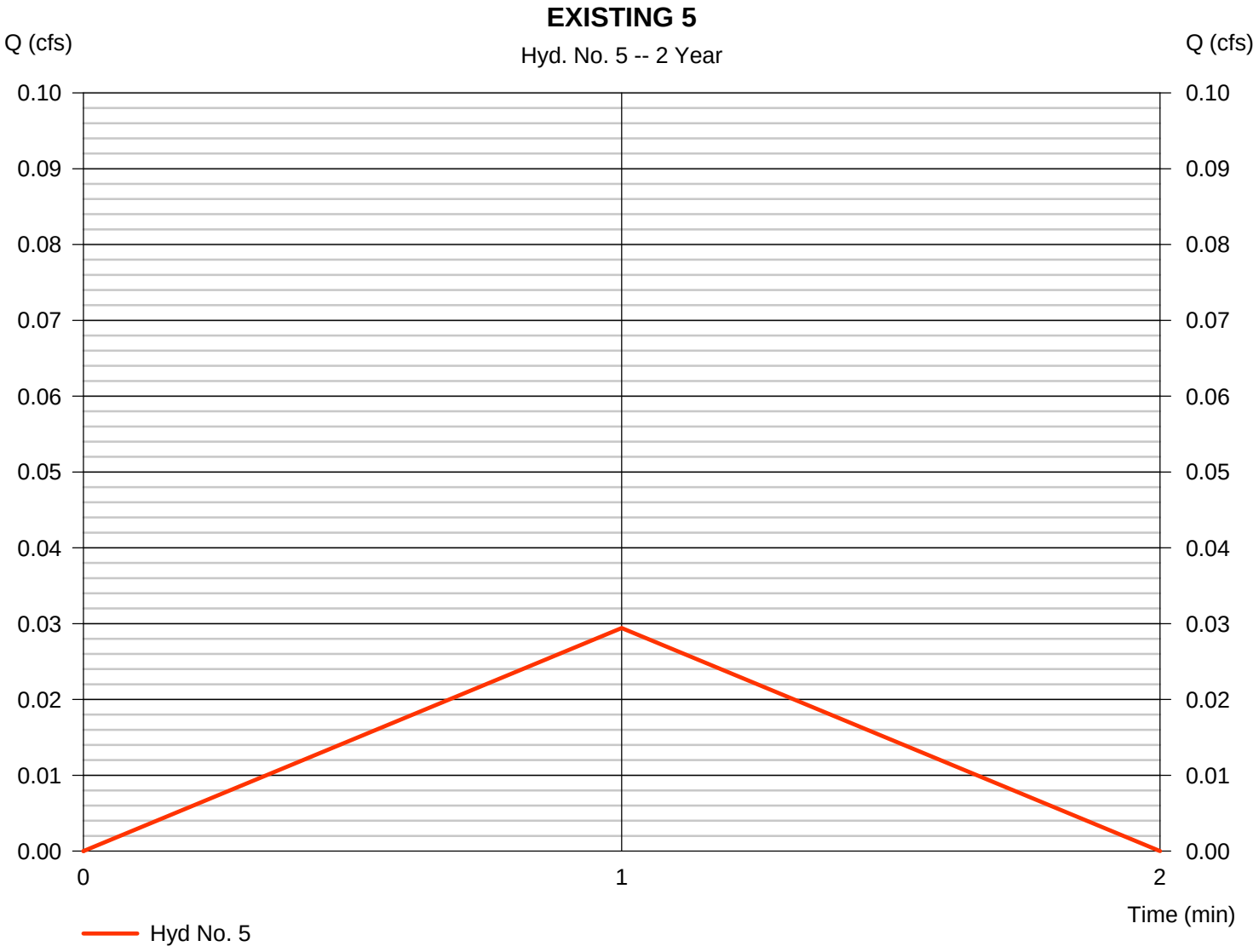


Hydrograph Report

Hyd. No. 5

EXISTING 5

Hydrograph type	=	Rational	Peak discharge	=	0.029 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	2 cuft
Drainage area	=	0.022 ac	Runoff coeff.	=	0.2
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

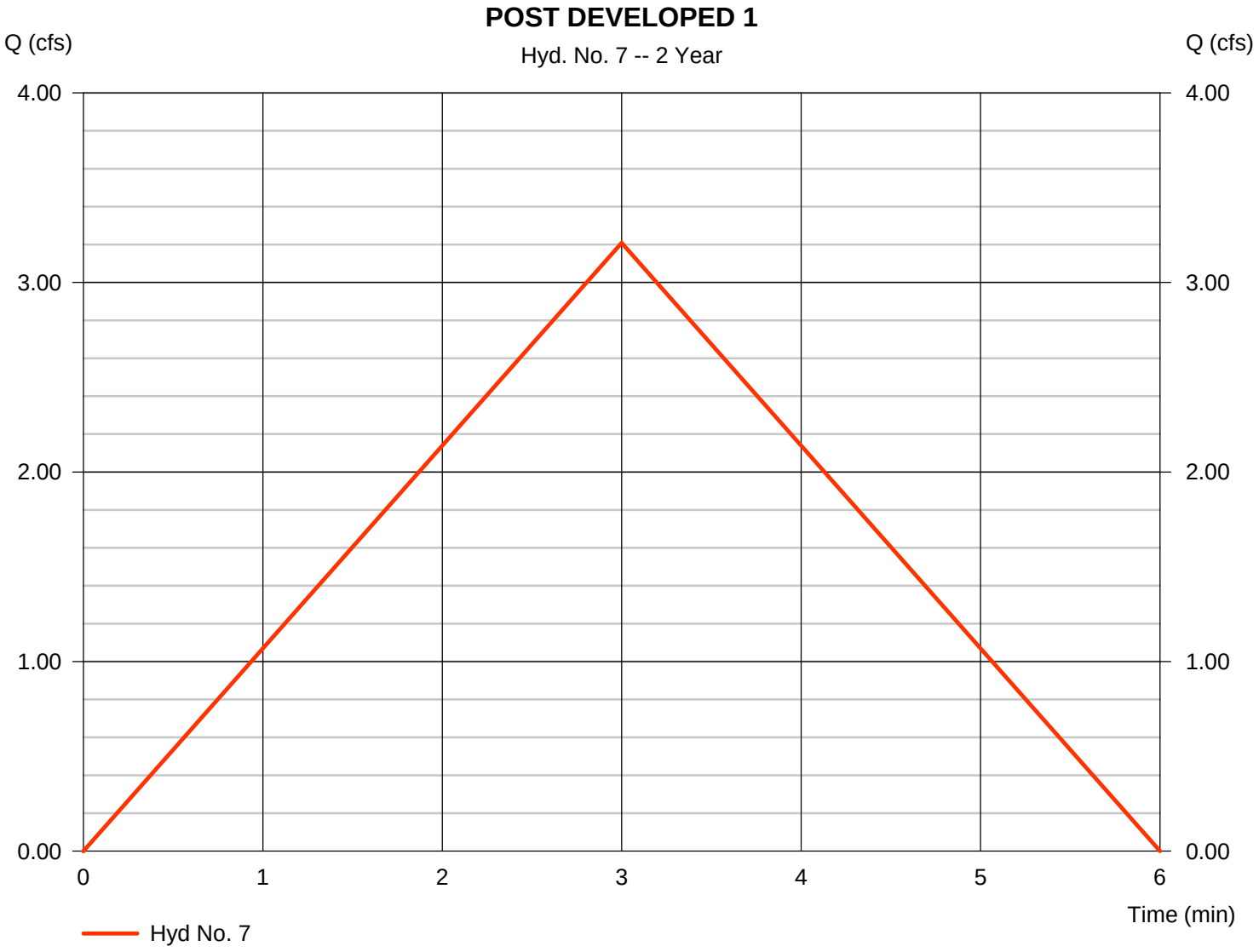


Hydrograph Report

Hyd. No. 7

POST DEVELOPED 1

Hydrograph type	=	Rational	Peak discharge	=	3.208 cfs
Storm frequency	=	2 yrs	Time to peak	=	3 min
Time interval	=	1 min	Hyd. volume	=	578 cuft
Drainage area	=	1.004 ac	Runoff coeff.	=	0.54
Intensity	=	5.918 in/hr	Tc by User	=	3.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 8

POST DEVELOPED 2

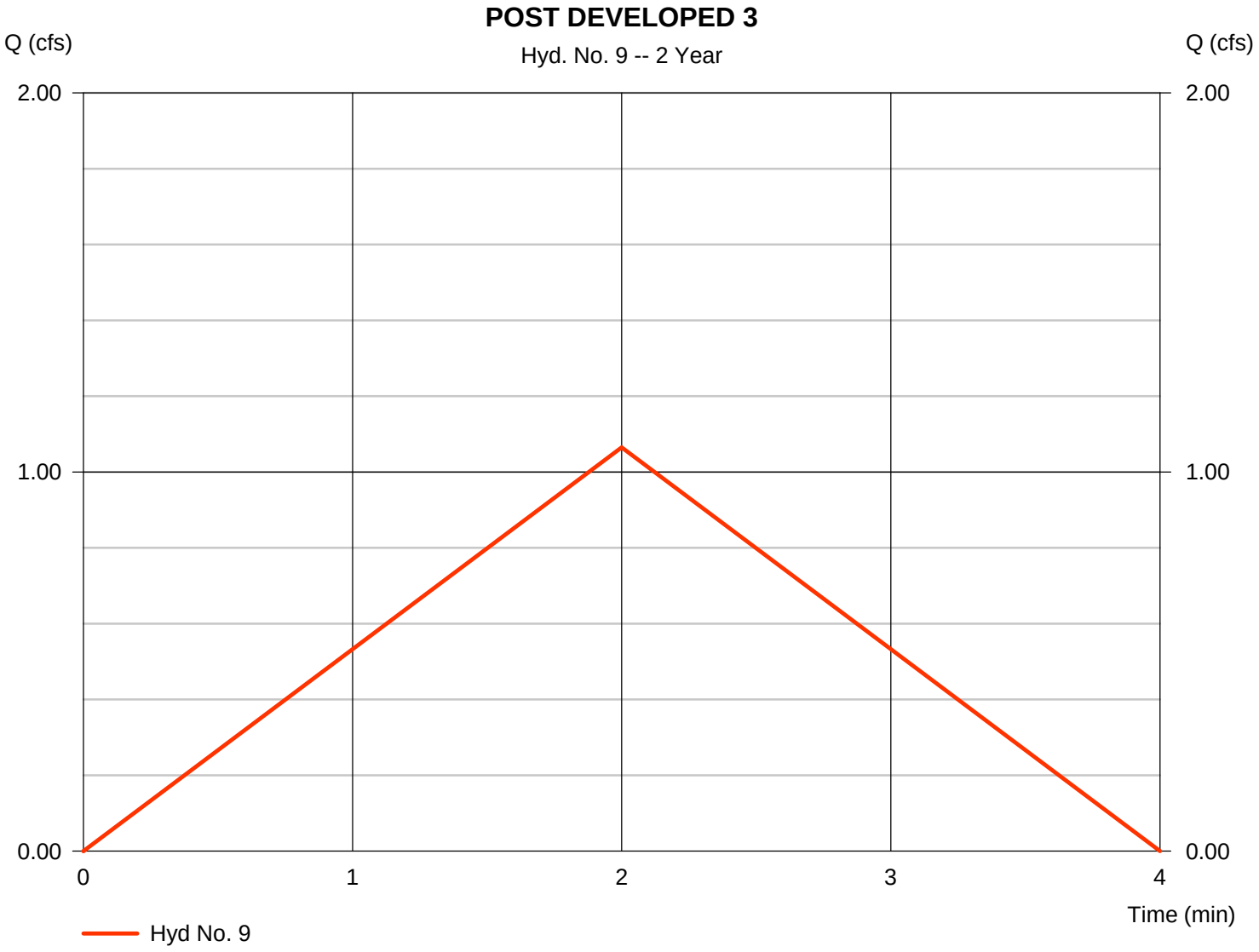
Hydrograph type	=	Rational	Peak discharge	=	3.296 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	198 cuft
Drainage area	=	0.554 ac	Runoff coeff.	=	0.89
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 9

POST DEVELOPED 3

Hydrograph type	=	Rational	Peak discharge	=	1.065 cfs
Storm frequency	=	2 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	128 cuft
Drainage area	=	0.239 ac	Runoff coeff.	=	0.71
Intensity	=	6.276 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

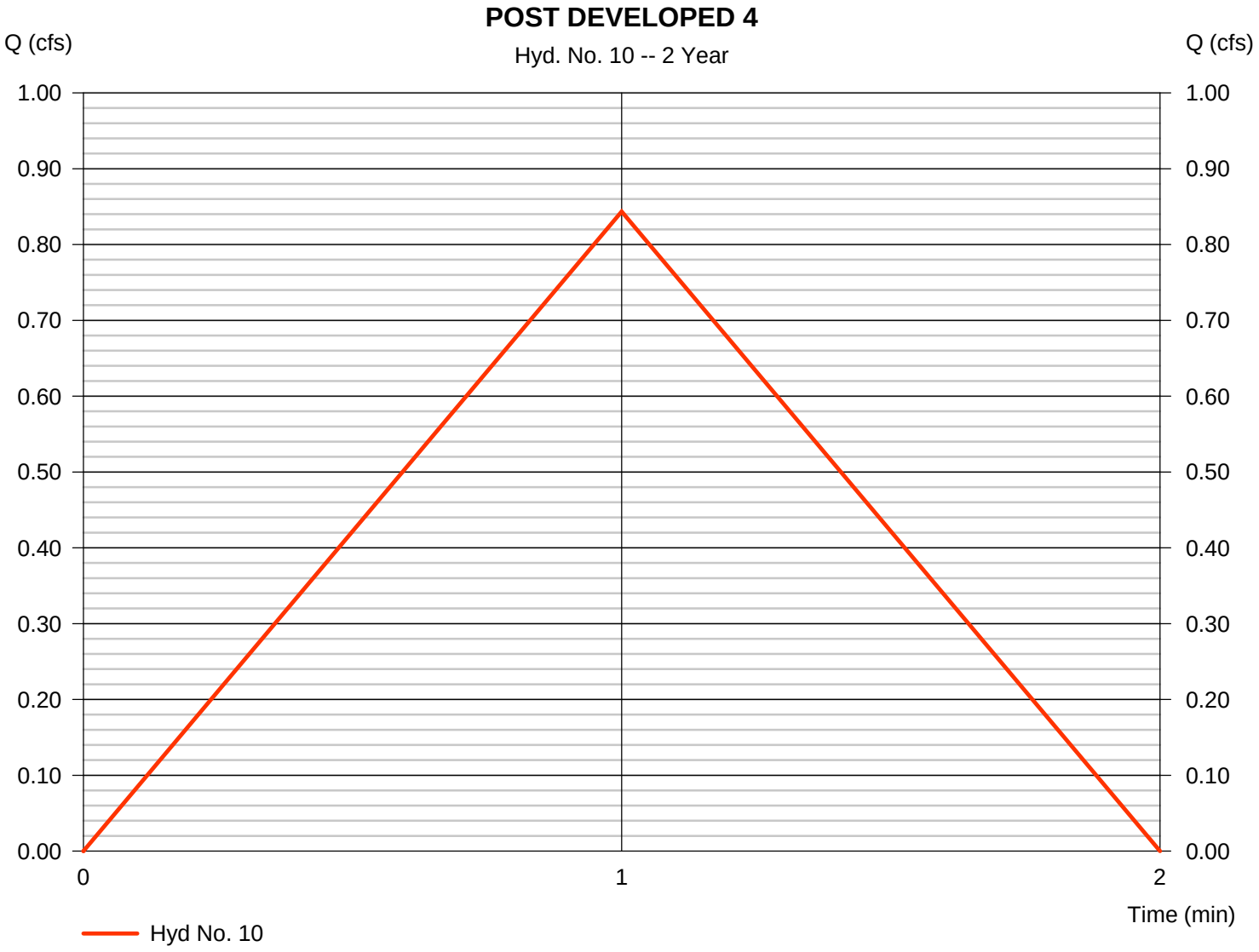


Hydrograph Report

Hyd. No. 10

POST DEVELOPED 4

Hydrograph type	=	Rational	Peak discharge	=	0.843 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	51 cuft
Drainage area	=	0.166 ac	Runoff coeff.	=	0.76
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

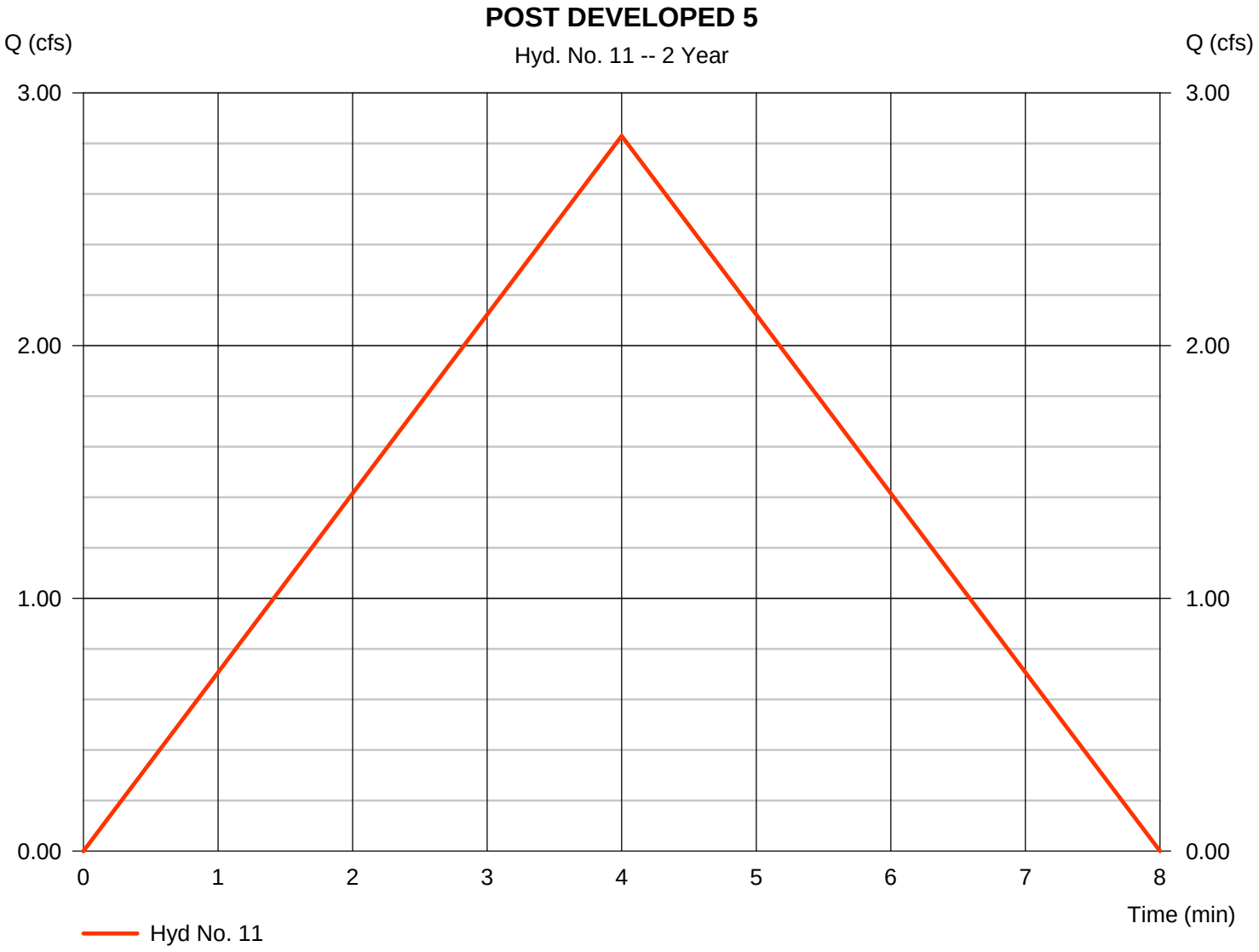


Hydrograph Report

Hyd. No. 11

POST DEVELOPED 5

Hydrograph type	=	Rational	Peak discharge	=	2.830 cfs
Storm frequency	=	2 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	679 cuft
Drainage area	=	0.692 ac	Runoff coeff.	=	0.73
Intensity	=	5.602 in/hr	Tc by User	=	4.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

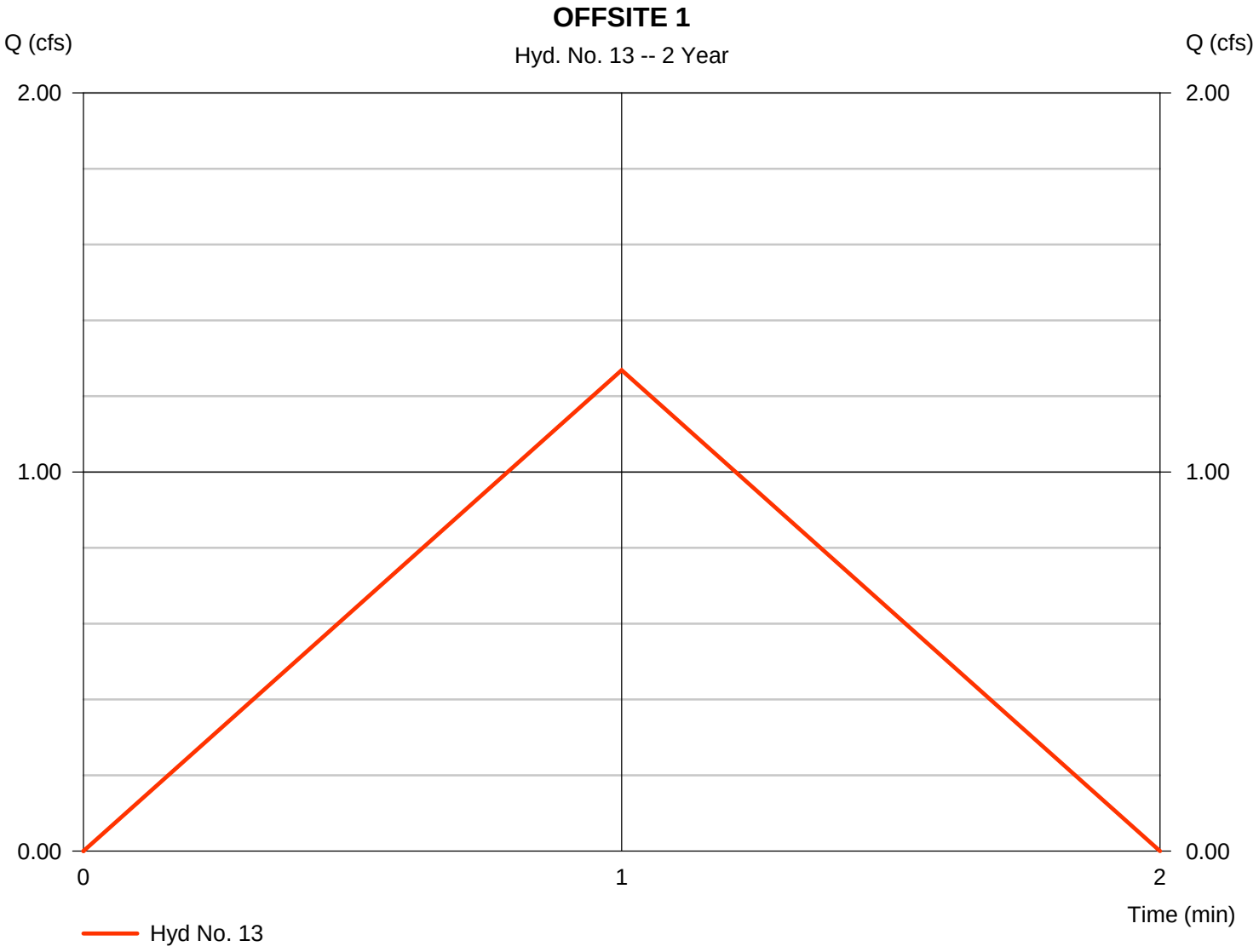


Hydrograph Report

Hyd. No. 13

OFFSITE 1

Hydrograph type	=	Rational	Peak discharge	=	1.269 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	76 cuft
Drainage area	=	0.593 ac	Runoff coeff.	=	0.32
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

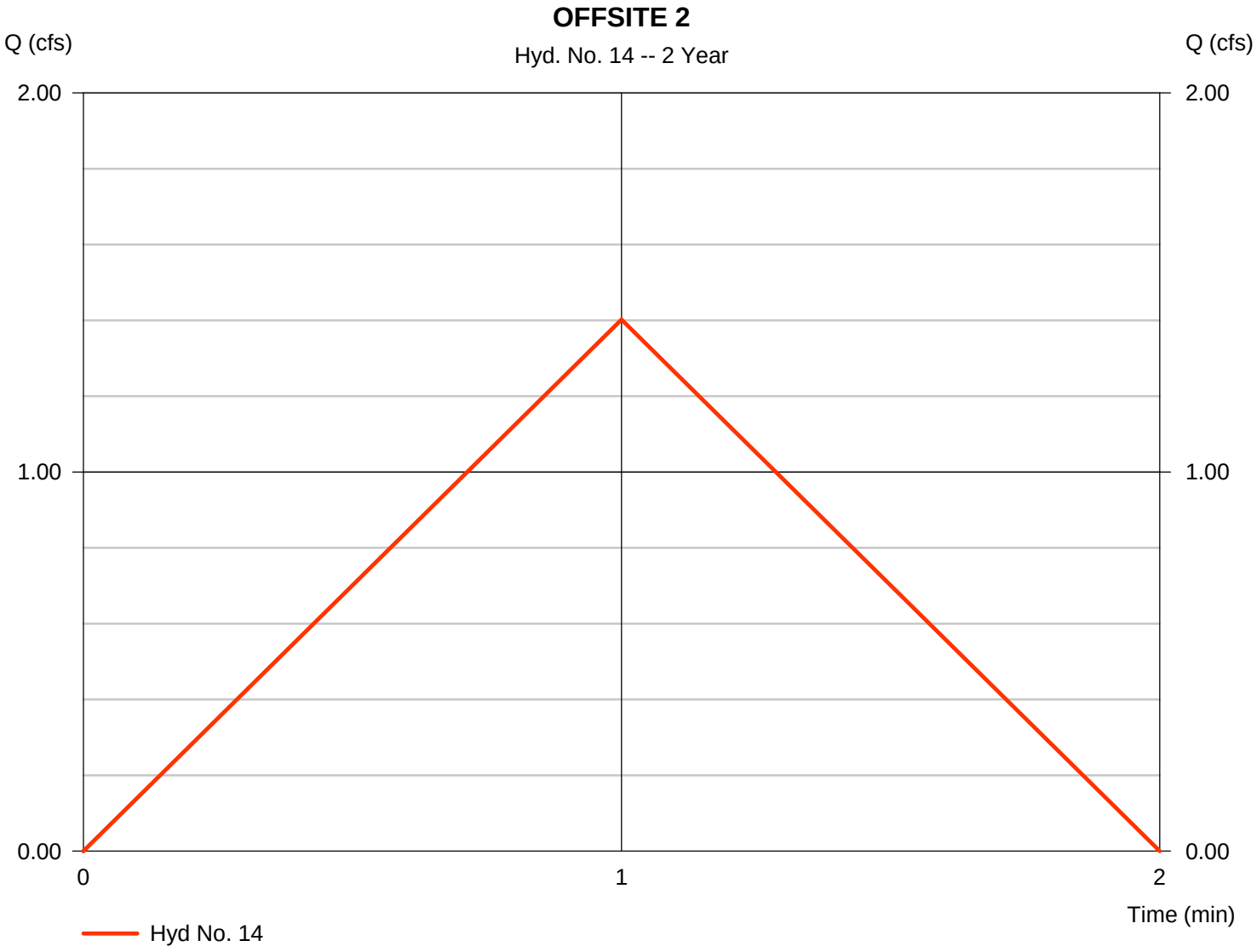


Hydrograph Report

Hyd. No. 14

OFFSITE 2

Hydrograph type	=	Rational	Peak discharge	=	1.402 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	84 cuft
Drainage area	=	0.233 ac	Runoff coeff.	=	0.9
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

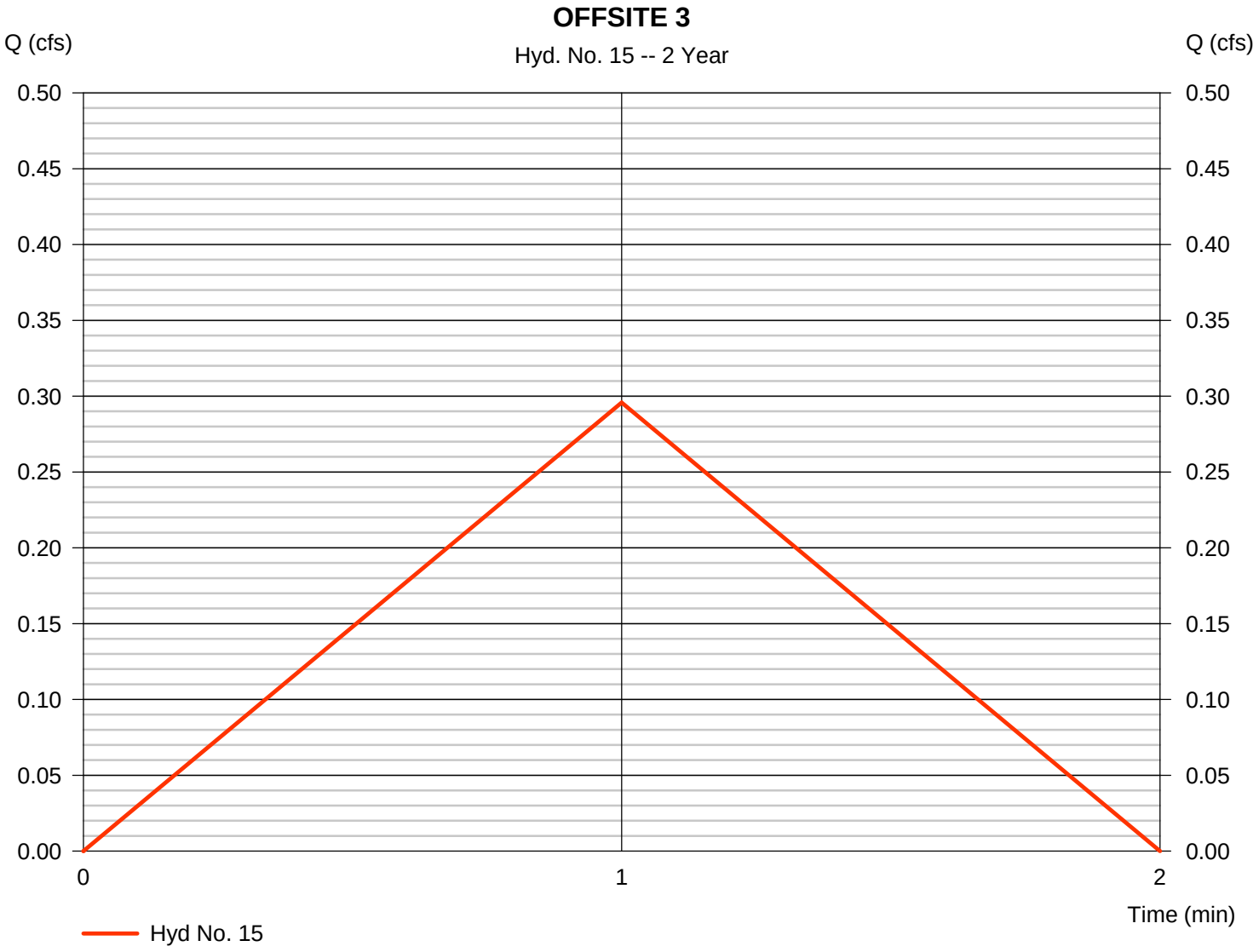


Hydrograph Report

Hyd. No. 15

OFFSITE 3

Hydrograph type	=	Rational	Peak discharge	=	0.296 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	18 cuft
Drainage area	=	0.056 ac	Runoff coeff.	=	0.79
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

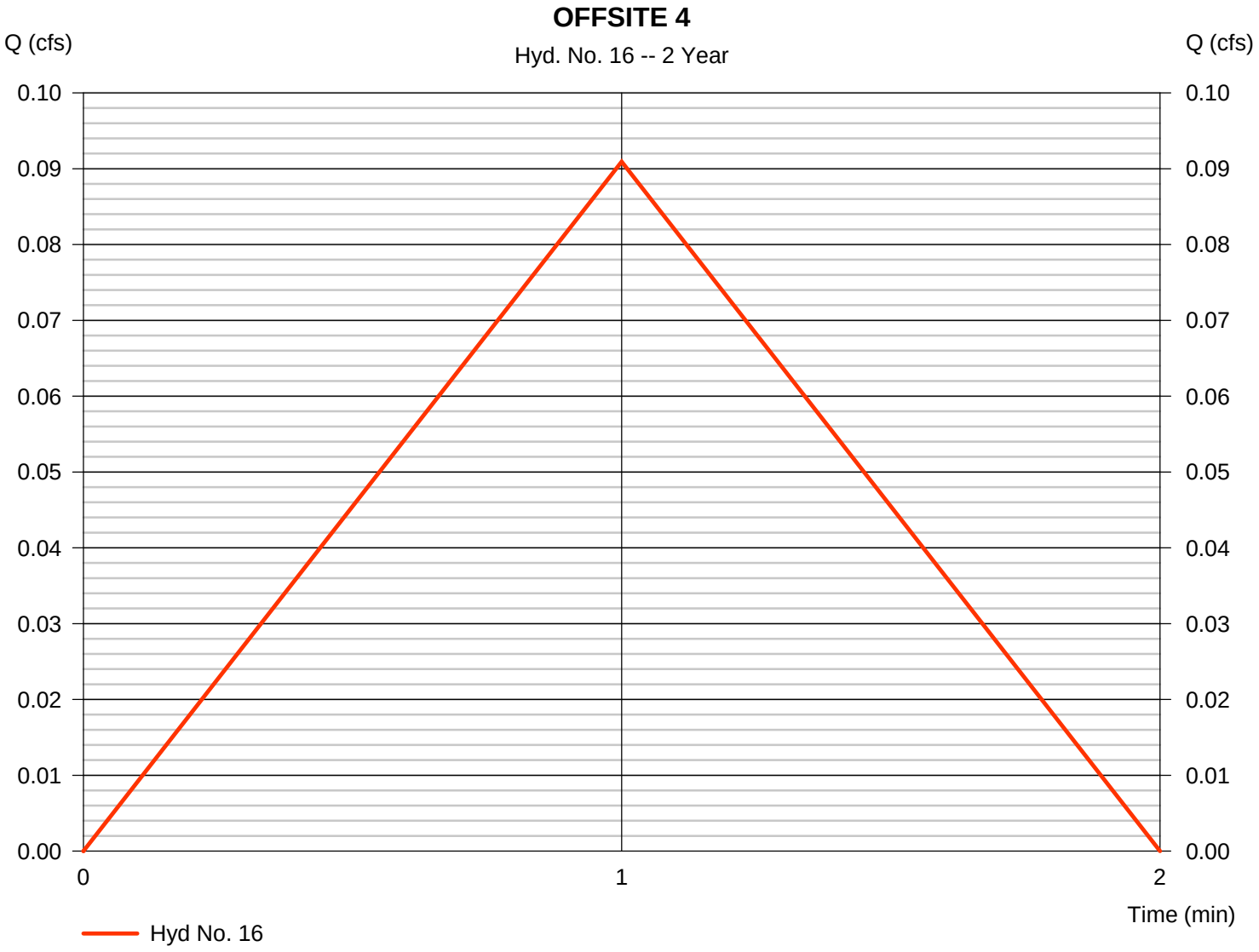


Hydrograph Report

Hyd. No. 16

OFFSITE 4

Hydrograph type	=	Rational	Peak discharge	=	0.091 cfs
Storm frequency	=	2 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	5 cuft
Drainage area	=	0.068 ac	Runoff coeff.	=	0.2
Intensity	=	6.685 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

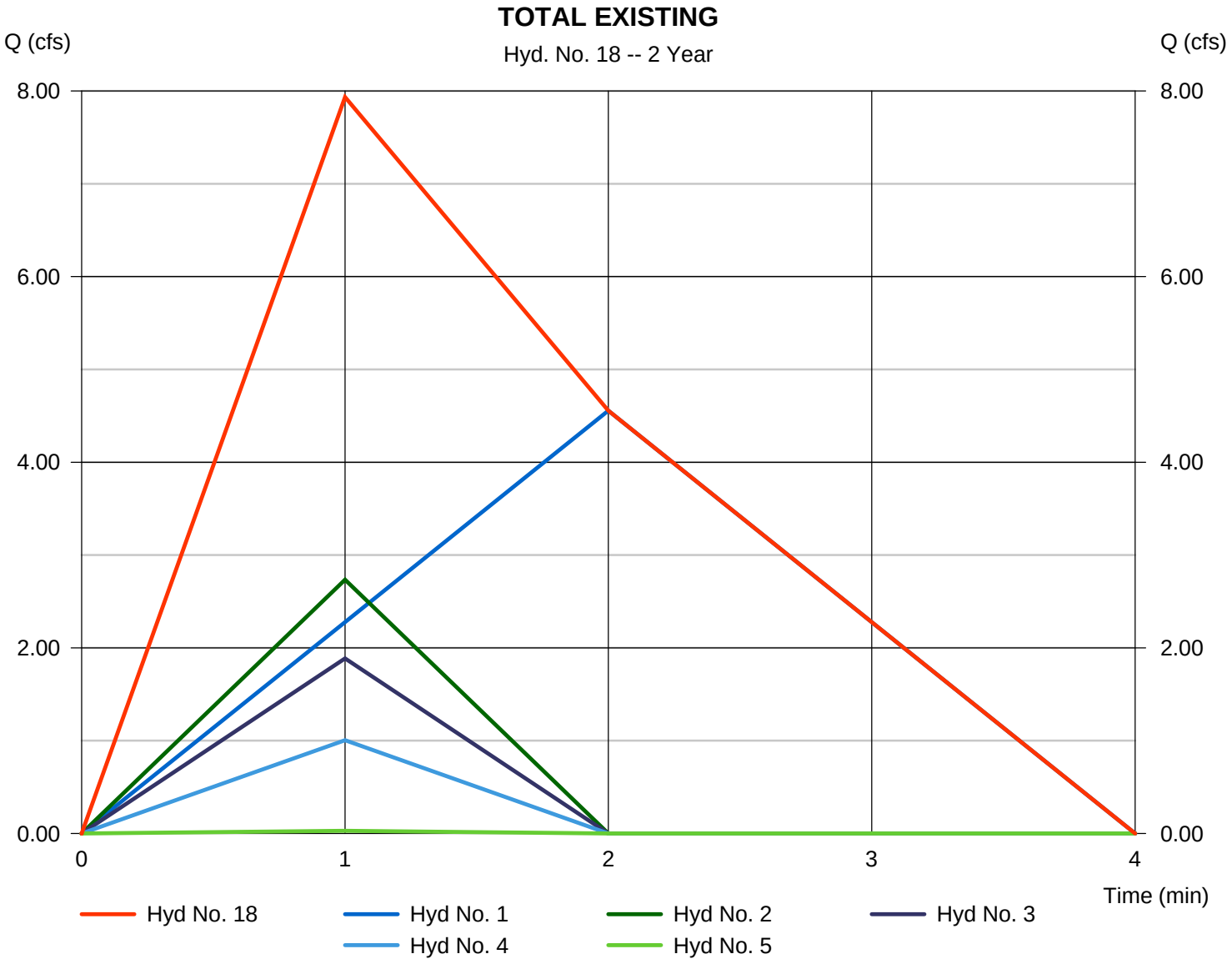


Hydrograph Report

Hyd. No. 18

TOTAL EXISTING

Hydrograph type	= Combine	Peak discharge	= 7.933 cfs
Storm frequency	= 2 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 886 cuft
Inflow hyds.	= 1, 2, 3, 4, 5	Contrib. drain. area	= 3.605 ac

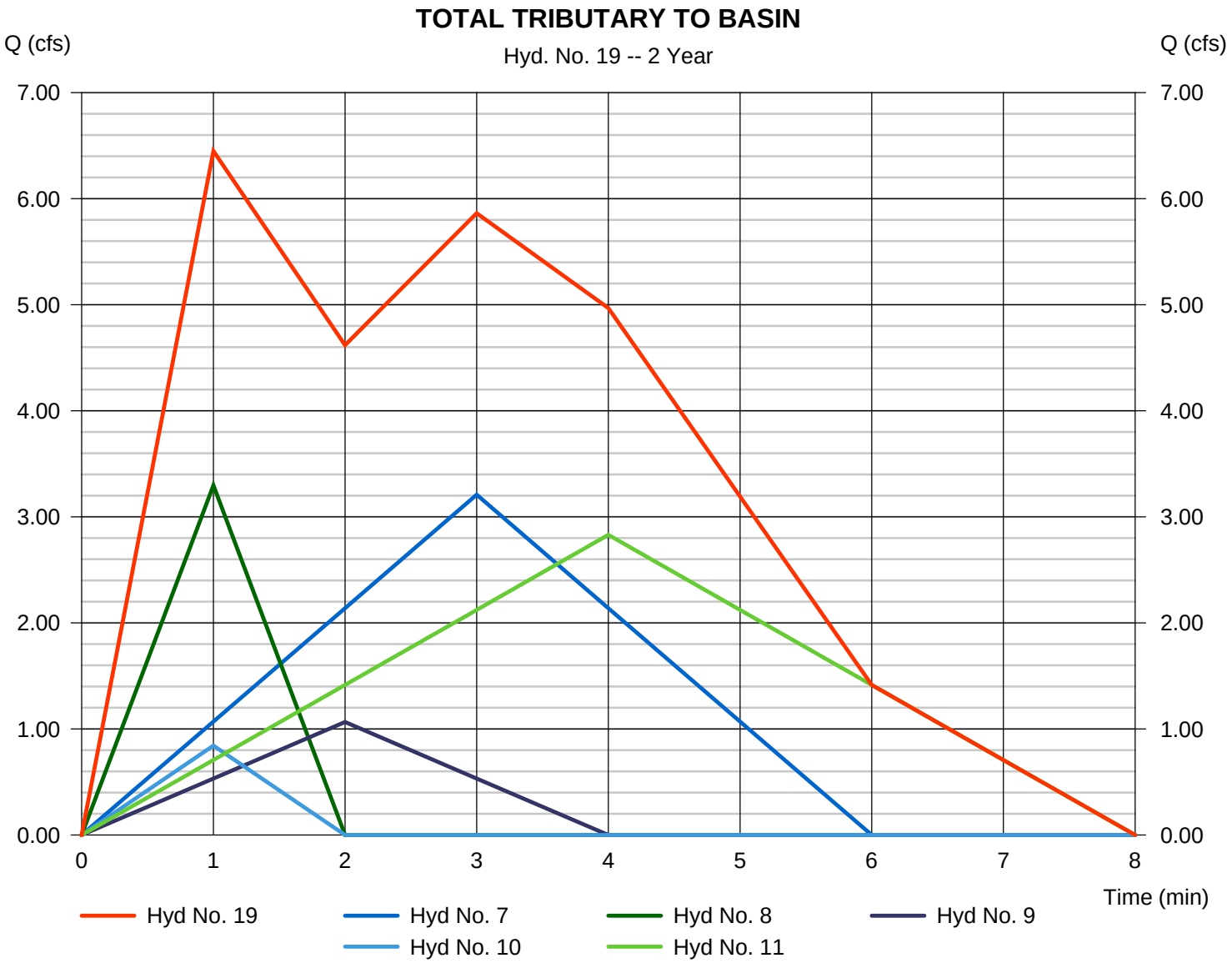


Hydrograph Report

Hyd. No. 19

TOTAL TRIBUTARY TO BASIN

Hydrograph type	= Combine	Peak discharge	= 6.449 cfs
Storm frequency	= 2 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 1,633 cuft
Inflow hyds.	= 7, 8, 9, 10, 11	Contrib. drain. area	= 2.655 ac

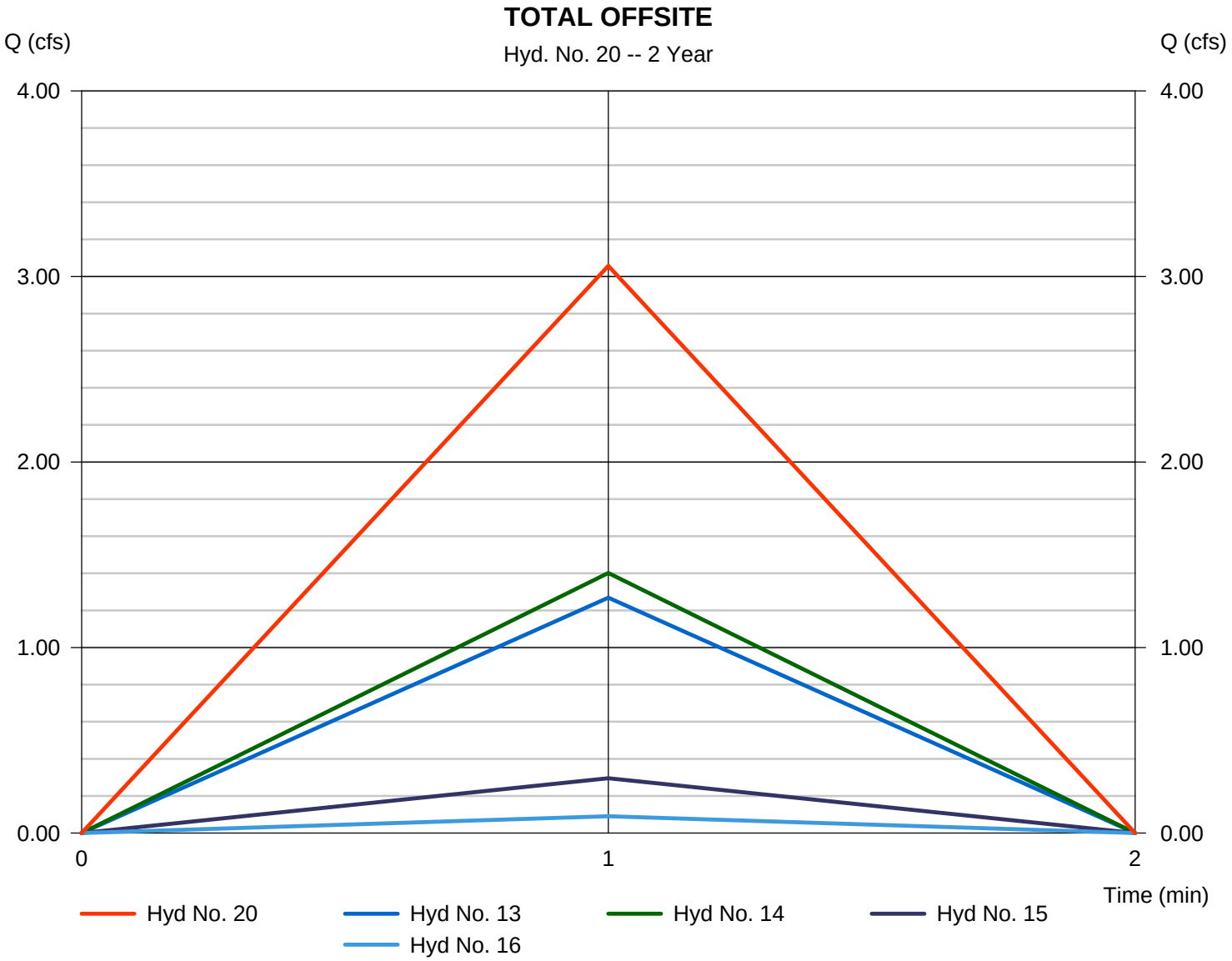


Hydrograph Report

Hyd. No. 20

TOTAL OFFSITE

Hydrograph type	= Combine	Peak discharge	= 3.057 cfs
Storm frequency	= 2 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 183 cuft
Inflow hyds.	= 13, 14, 15, 16	Contrib. drain. area	= 0.950 ac



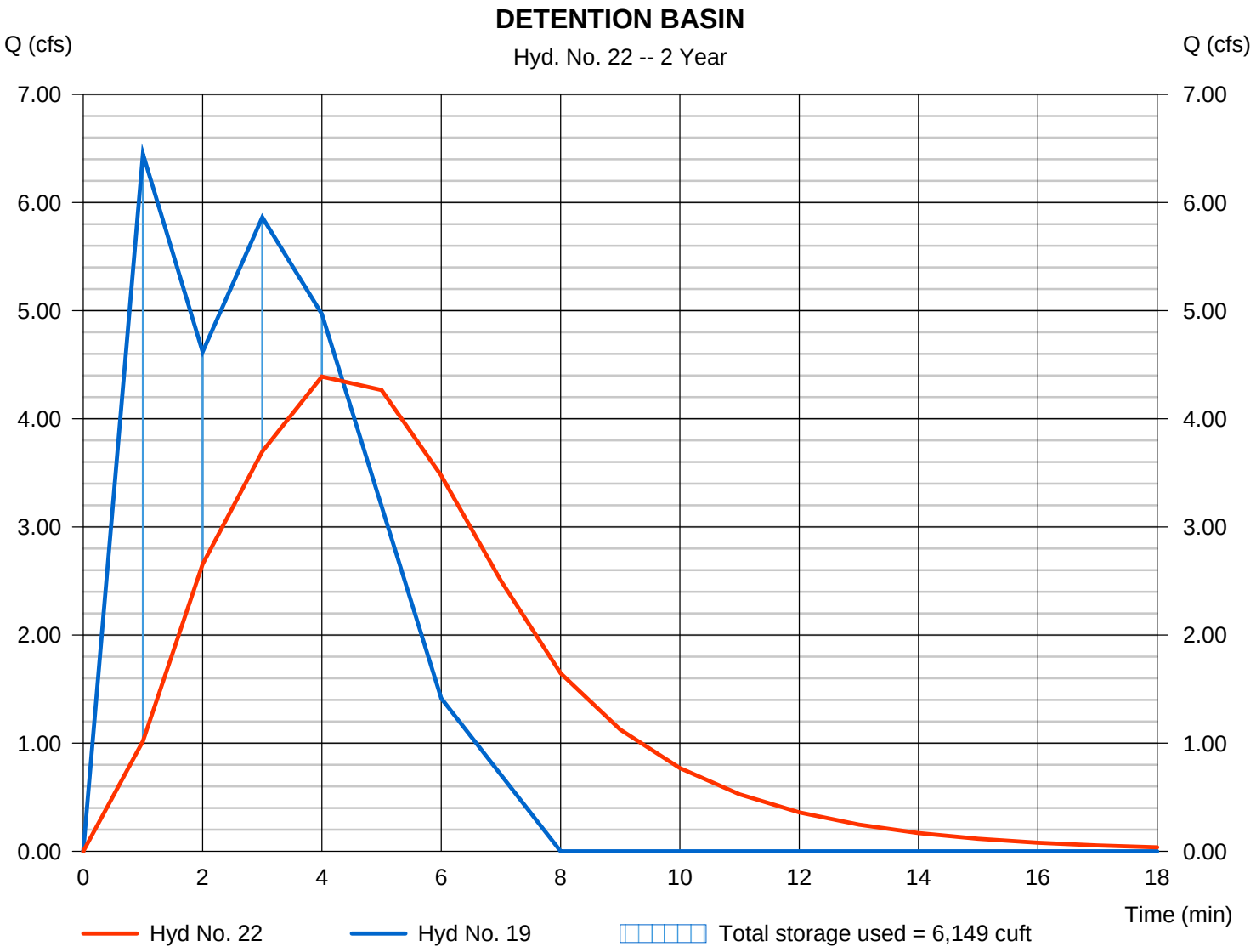
Hydrograph Report

Hyd. No. 22

DETENTION BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	4.390 cfs
Storm frequency	=	2 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	1,633 cuft
Inflow hyd. No.	=	19 - TOTAL TRIBUTARY TO BASIN	Max. Elevation	=	559.09 ft
Reservoir name	=	DETENTION	Max. Storage	=	6,149 cuft

Storage Indication method used. Wet pond routing start elevation = 558.90 ft.



Pond No. 1 - DETENTION

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 555.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	555.00	112	0	0
1.00	556.00	657	347	347
2.00	557.00	1,380	997	1,344
3.00	558.00	2,239	1,792	3,136
4.00	559.00	3,170	2,691	5,827
5.00	560.00	4,178	3,662	9,489

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	Inactive	Inactive	0.00
Span (in)	= 12.00	1.00	8.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 553.80	555.01	558.40	0.00
Length (ft)	= 33.94	0.00	0.00	0.00
Slope (%)	= 5.30	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)	= 16.00	Inactive	0.00	0.00
Crest El. (ft)	= 558.90	0.00	0.00	0.00
Weir Coeff.	= 3.33	0.11	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	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	555.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.10	35	555.10	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.20	69	555.20	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.30	104	555.30	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.40	139	555.40	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.50	173	555.50	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.60	208	555.60	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.70	243	555.70	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.80	278	555.80	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.90	312	555.90	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.00	347	556.00	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.10	447	556.10	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.20	546	556.20	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.30	646	556.30	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.40	746	556.40	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.50	845	556.50	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.60	945	556.60	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.70	1,045	556.70	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.80	1,144	556.80	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
1.90	1,244	556.90	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.00	1,344	557.00	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.10	1,523	557.10	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.20	1,702	557.20	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.30	1,881	557.30	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.40	2,061	557.40	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.50	2,240	557.50	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.60	2,419	557.60	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.70	2,598	557.70	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.80	2,777	557.80	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
2.90	2,957	557.90	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.00	3,136	558.00	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.10	3,405	558.10	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.20	3,674	558.20	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.30	3,943	558.30	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.40	4,212	558.40	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.50	4,481	558.50	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.60	4,750	558.60	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000

Continues on next page...

DETENTION

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
3.70	5,020	558.70	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.80	5,289	558.80	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
3.90	5,558	558.90	3.16 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
4.00	5,827	559.00	3.16 ic	0.00	0.00	---	1.68	---	---	---	---	---	1.684
4.10	6,193	559.10	4.76 ic	0.00	0.00	---	4.76	---	---	---	---	---	4.764
4.20	6,559	559.20	8.19 ic	0.00	0.00	---	8.19 s	---	---	---	---	---	8.187
4.30	6,926	559.30	8.39 ic	0.00	0.00	---	8.38 s	---	---	---	---	---	8.384
4.40	7,292	559.40	8.50 ic	0.00	0.00	---	8.50 s	---	---	---	---	---	8.496
4.50	7,658	559.50	8.60 ic	0.00	0.00	---	8.59 s	---	---	---	---	---	8.594
4.60	8,024	559.60	8.69 ic	0.00	0.00	---	8.67 s	---	---	---	---	---	8.673
4.70	8,391	559.70	8.78 ic	0.00	0.00	---	8.75 s	---	---	---	---	---	8.753
4.80	8,757	559.80	8.86 ic	0.00	0.00	---	8.84 s	---	---	---	---	---	8.837
4.90	9,123	559.90	8.94 ic	0.00	0.00	---	8.91 s	---	---	---	---	---	8.909
5.00	9,489	560.00	9.02 ic	0.00	0.00	---	8.97 s	---	---	---	---	---	8.968

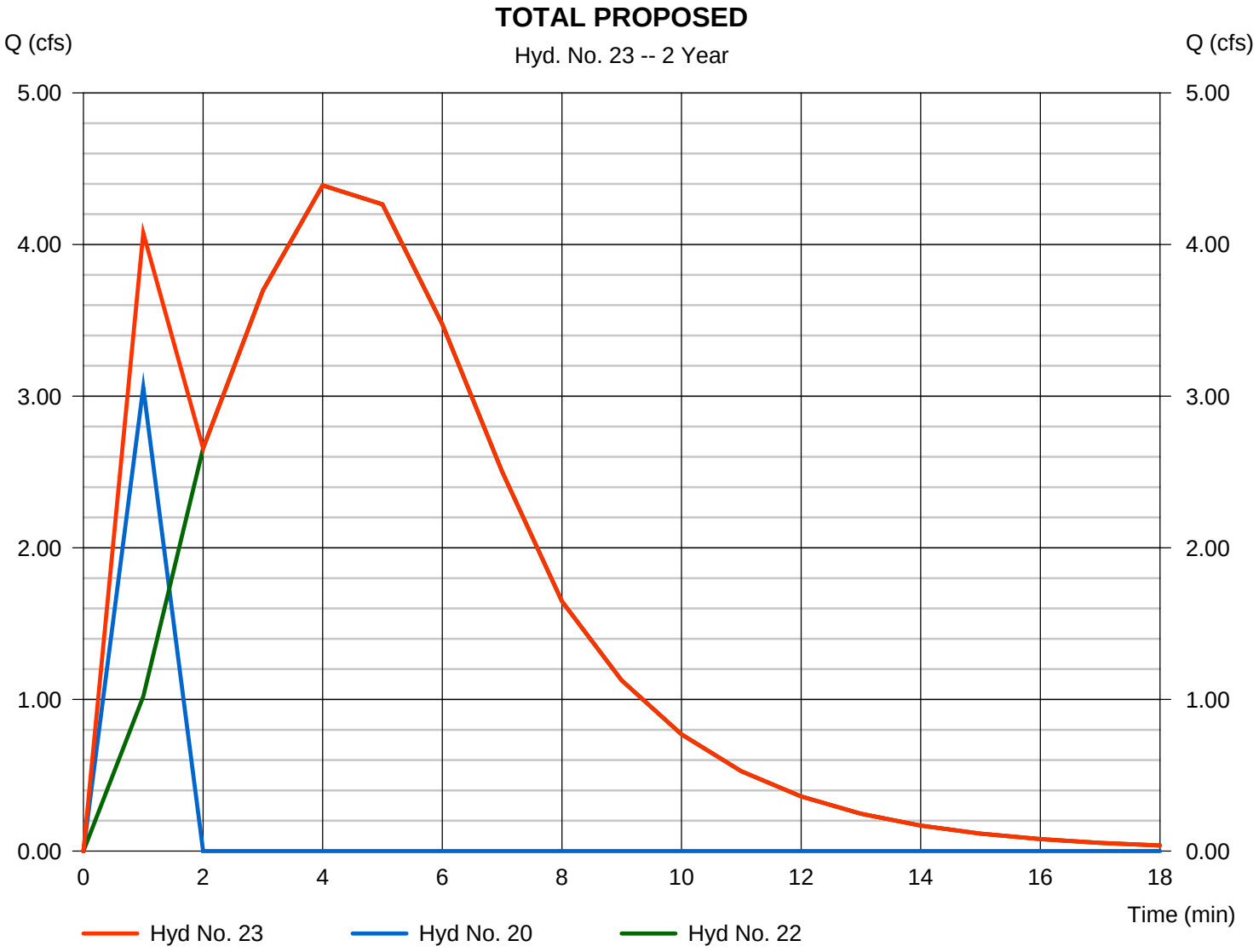
...End

Hydrograph Report

Hyd. No. 23

TOTAL PROPOSED

Hydrograph type	= Combine	Peak discharge	= 4.390 cfs
Storm frequency	= 2 yrs	Time to peak	= 4 min
Time interval	= 1 min	Hyd. volume	= 1,816 cuft
Inflow hyds.	= 20, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

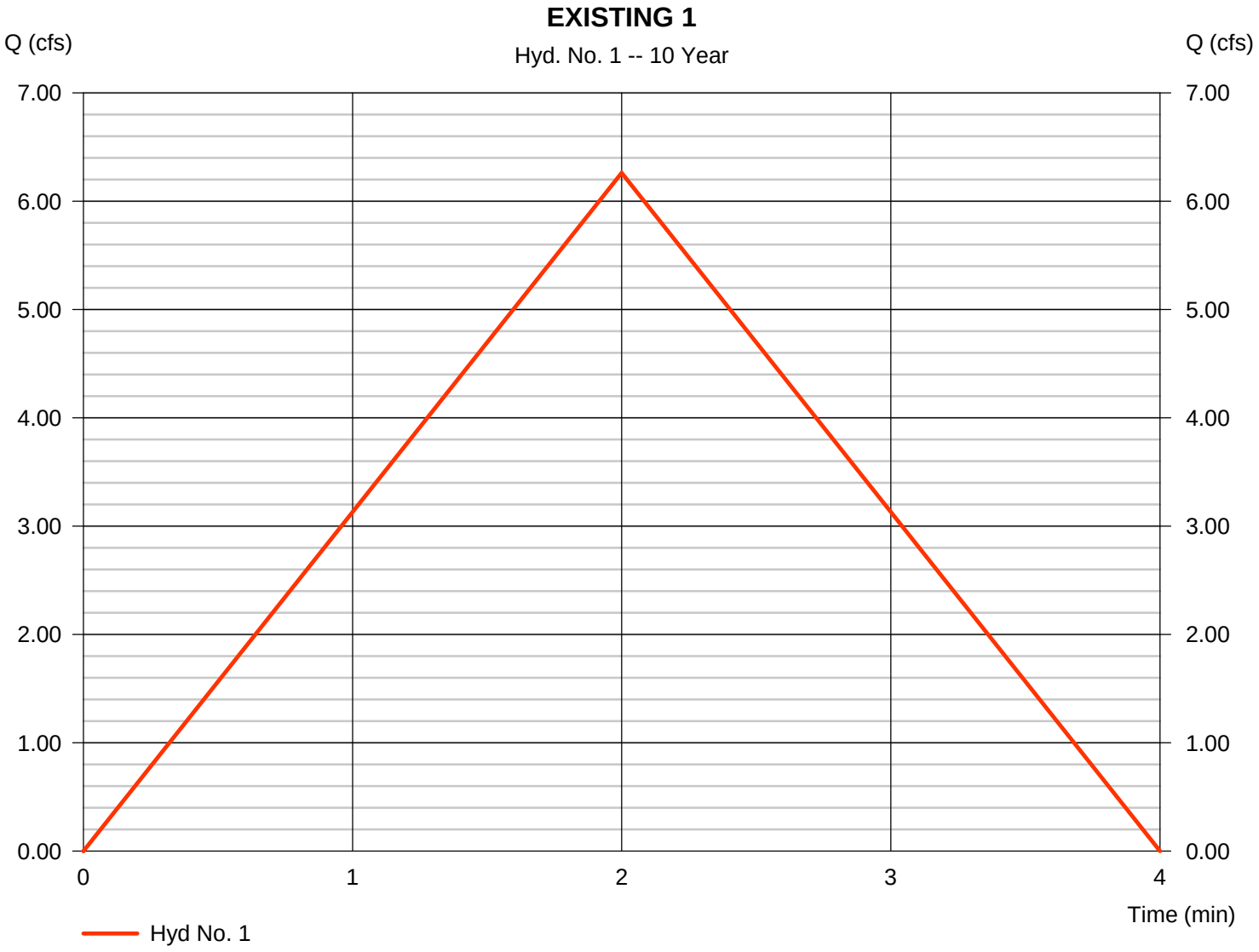
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	6.262	1	2	751	------	------	------	EXISTING 1
2	Rational	3.728	1	1	224	------	------	------	EXISTING 2
3	Rational	2.571	1	1	154	------	------	------	EXISTING 3
4	Rational	1.371	1	1	82	------	------	------	EXISTING 4
5	Rational	0.040	1	1	2	------	------	------	EXISTING 5
7	Rational	4.443	1	3	800	------	------	------	POST DEVELOPED 1
8	Rational	4.494	1	1	270	------	------	------	POST DEVELOPED 2
9	Rational	1.464	1	2	176	------	------	------	POST DEVELOPED 3
10	Rational	1.150	1	1	69	------	------	------	POST DEVELOPED 4
11	Rational	3.945	1	4	947	------	------	------	POST DEVELOPED 5
13	Rational	1.729	1	1	104	------	------	------	OFFSITE 1
14	Rational	1.911	1	1	115	------	------	------	OFFSITE 2
15	Rational	0.403	1	1	24	------	------	------	OFFSITE 3
16	Rational	0.124	1	1	7	------	------	------	OFFSITE 4
18	Combine	10.84	1	1	1,214	1, 2, 3, 4, 5,	------	------	TOTAL EXISTING
19	Combine	8.843	1	1	2,261	7, 8, 9, 10, 11,	------	------	TOTAL TRIBUTARY TO BASIN
20	Combine	4.168	1	1	250	13, 14, 15, 16,	------	------	TOTAL OFFSITE
22	Reservoir	6.245	1	4	2,261	19	559.15	6,352	DETENTION BASIN
23	Combine	6.245	1	4	2,511	20, 22	------	------	TOTAL PROPOSED

Hydrograph Report

Hyd. No. 1

EXISTING 1

Hydrograph type	=	Rational	Peak discharge	=	6.262 cfs
Storm frequency	=	10 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	751 cuft
Drainage area	=	1.910 ac	Runoff coeff.	=	0.38
Intensity	=	8.628 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

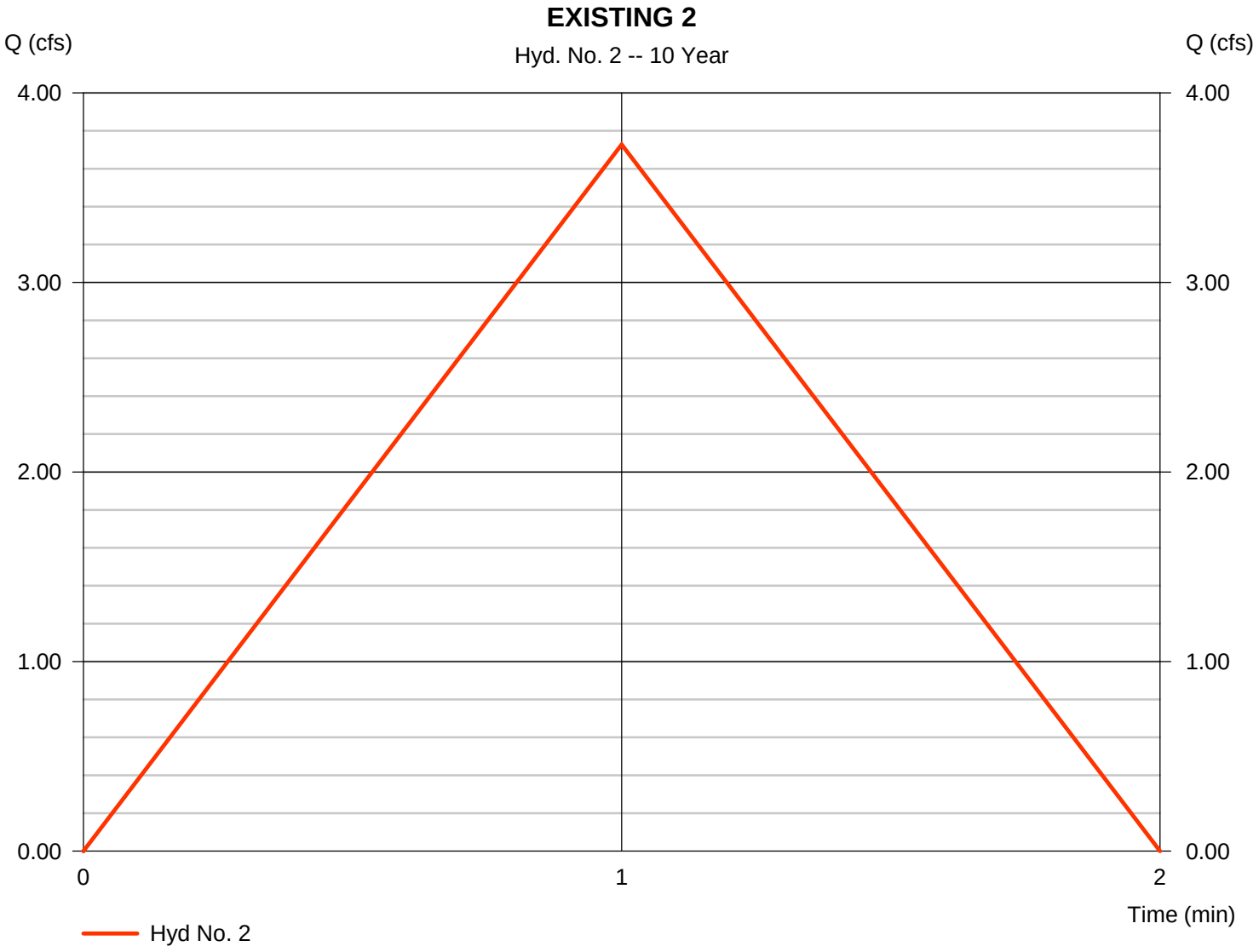


Hydrograph Report

Hyd. No. 2

EXISTING 2

Hydrograph type	=	Rational	Peak discharge	=	3.728 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	224 cuft
Drainage area	=	0.802 ac	Runoff coeff.	=	0.51
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

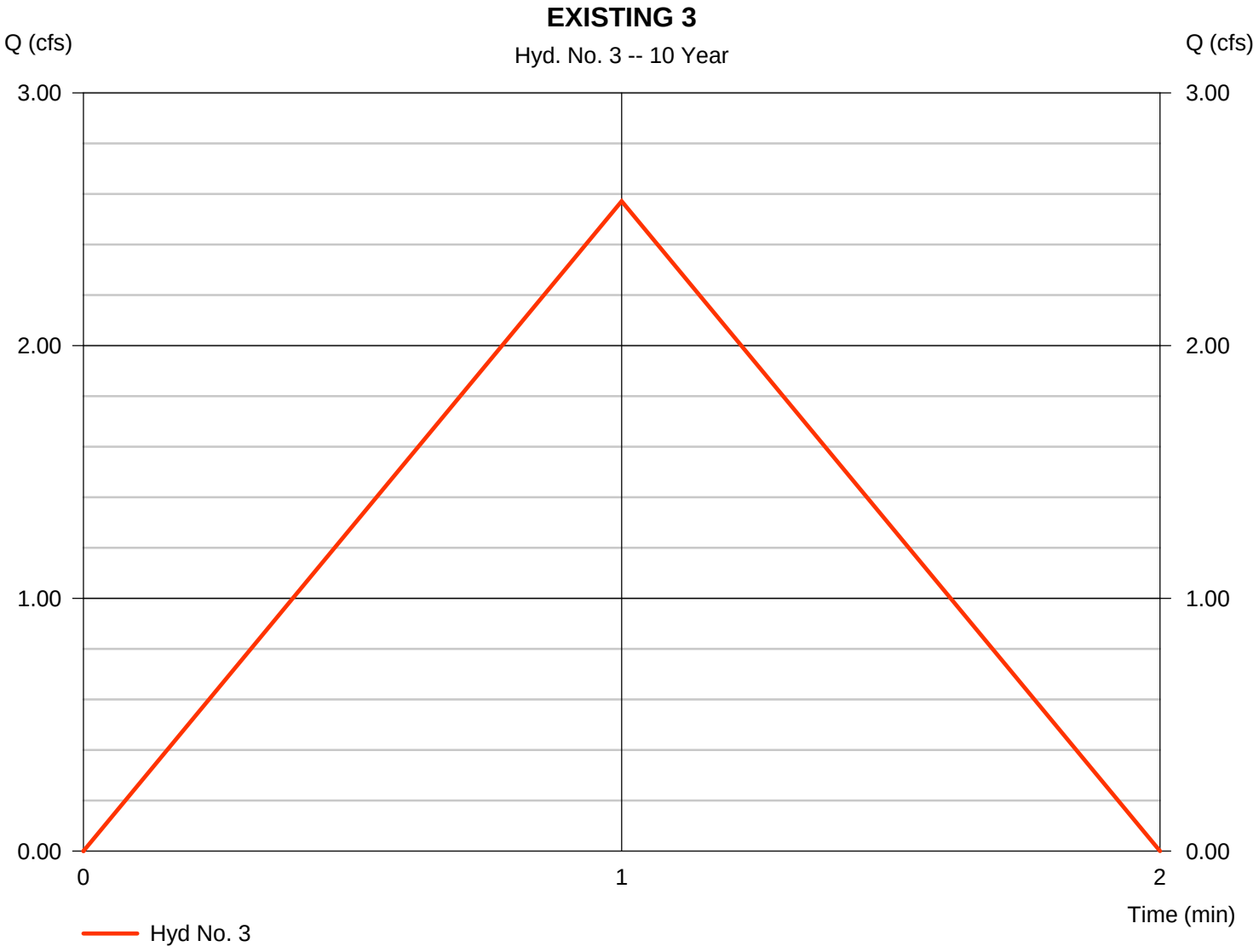


Hydrograph Report

Hyd. No. 3

EXISTING 3

Hydrograph type	=	Rational	Peak discharge	=	2.571 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	154 cuft
Drainage area	=	0.495 ac	Runoff coeff.	=	0.57
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

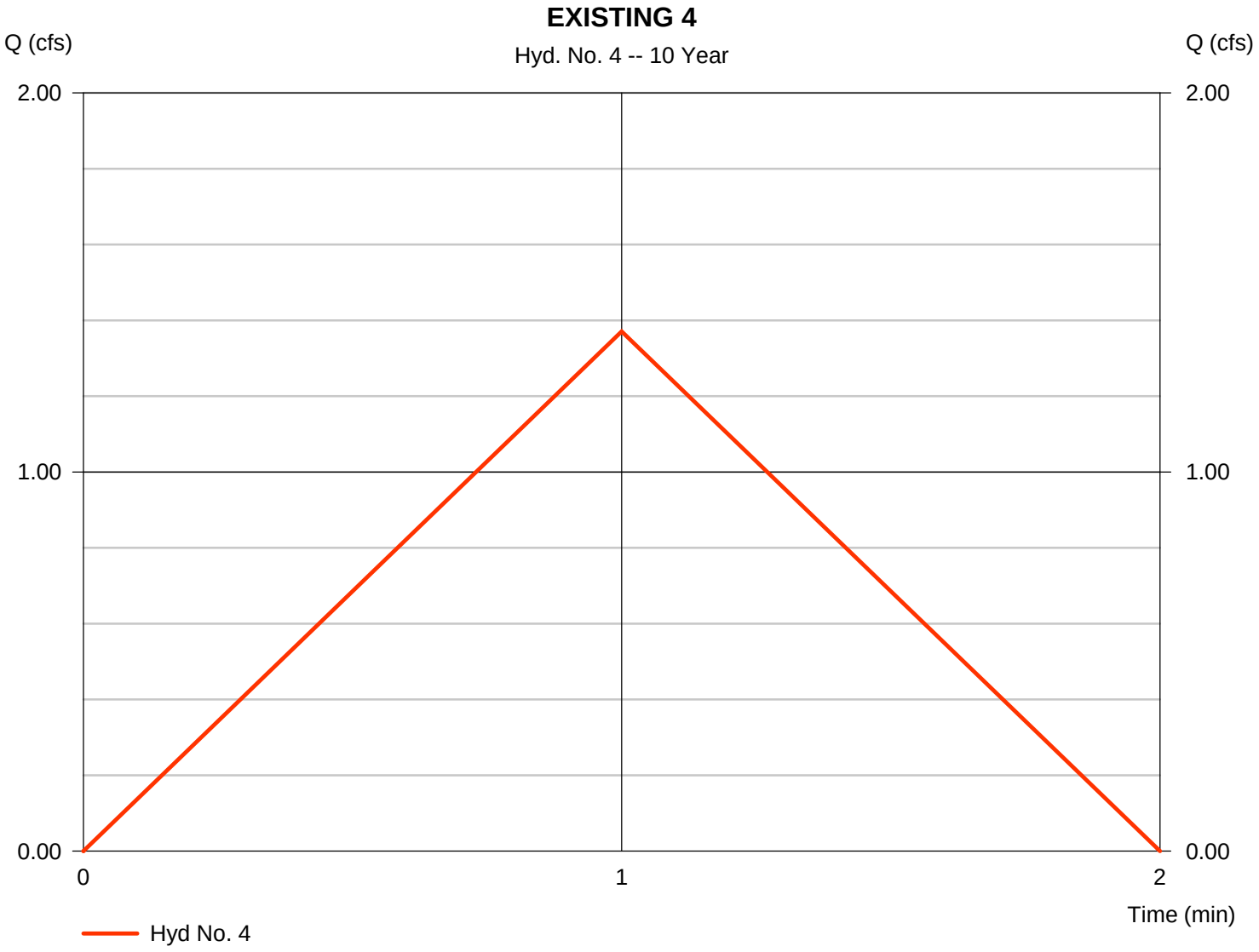


Hydrograph Report

Hyd. No. 4

EXISTING 4

Hydrograph type	=	Rational	Peak discharge	=	1.371 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	82 cuft
Drainage area	=	0.376 ac	Runoff coeff.	=	0.4
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

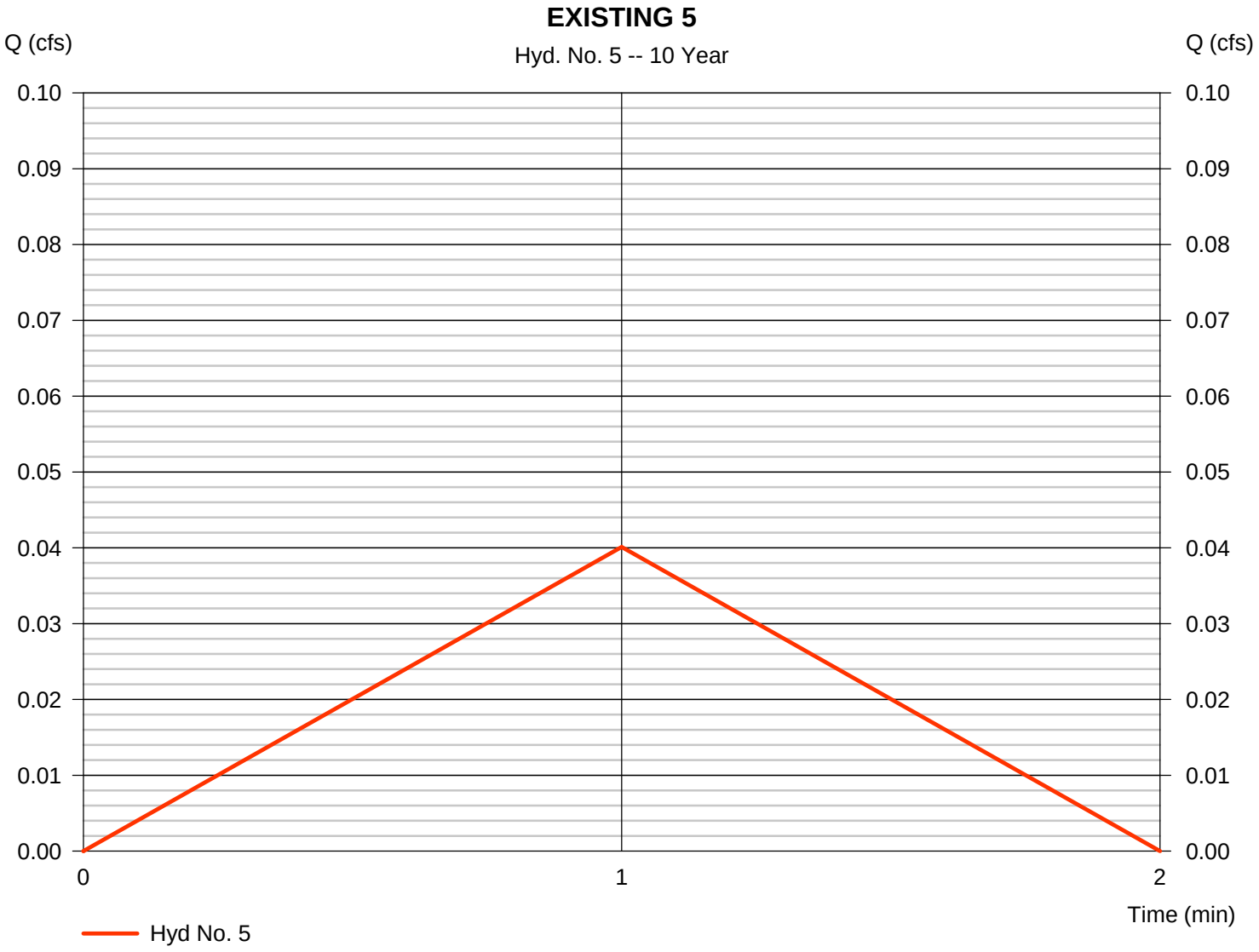


Hydrograph Report

Hyd. No. 5

EXISTING 5

Hydrograph type	=	Rational	Peak discharge	=	0.040 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	2 cuft
Drainage area	=	0.022 ac	Runoff coeff.	=	0.2
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

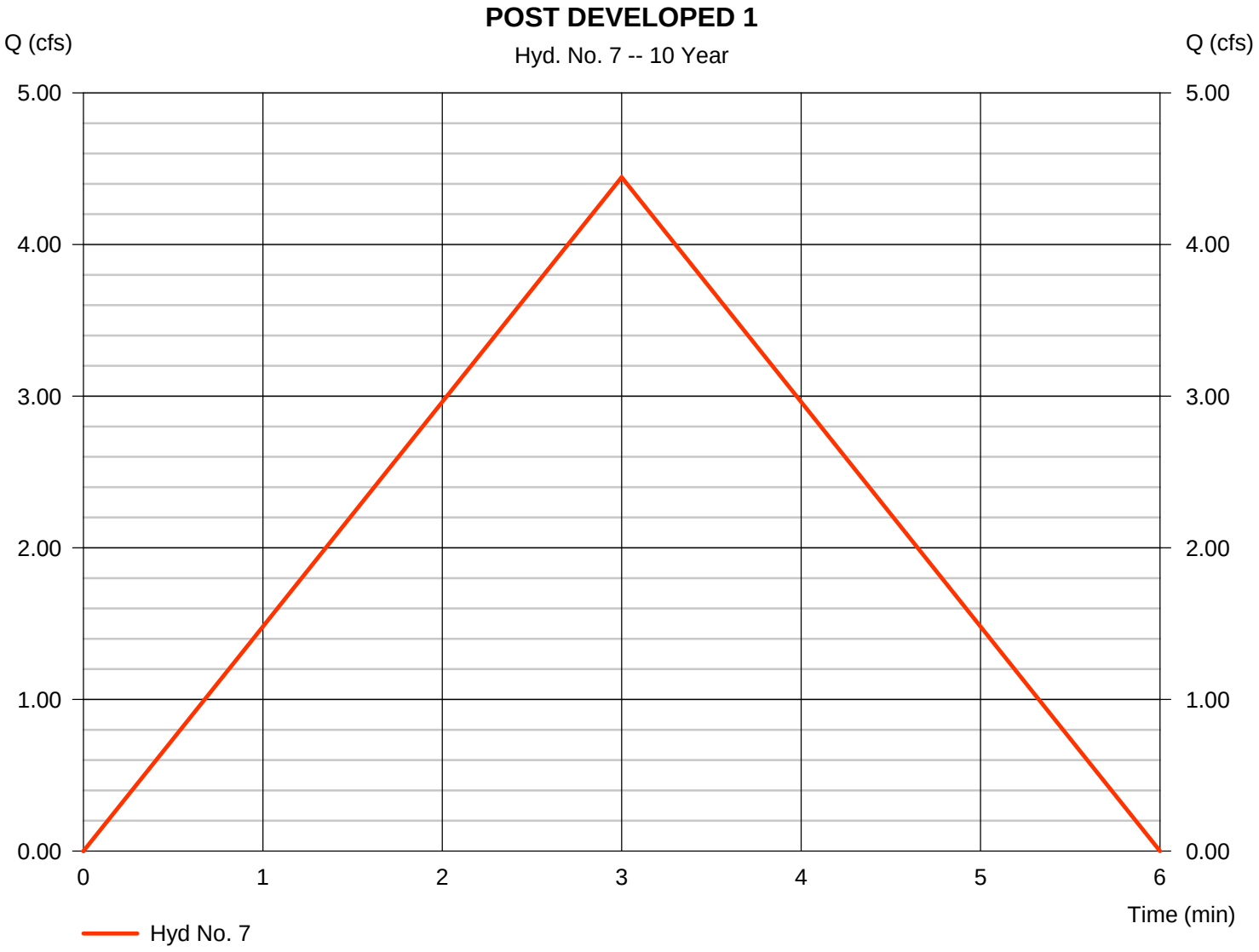


Hydrograph Report

Hyd. No. 7

POST DEVELOPED 1

Hydrograph type	=	Rational	Peak discharge	=	4.443 cfs
Storm frequency	=	10 yrs	Time to peak	=	3 min
Time interval	=	1 min	Hyd. volume	=	800 cuft
Drainage area	=	1.004 ac	Runoff coeff.	=	0.54
Intensity	=	8.196 in/hr	Tc by User	=	3.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

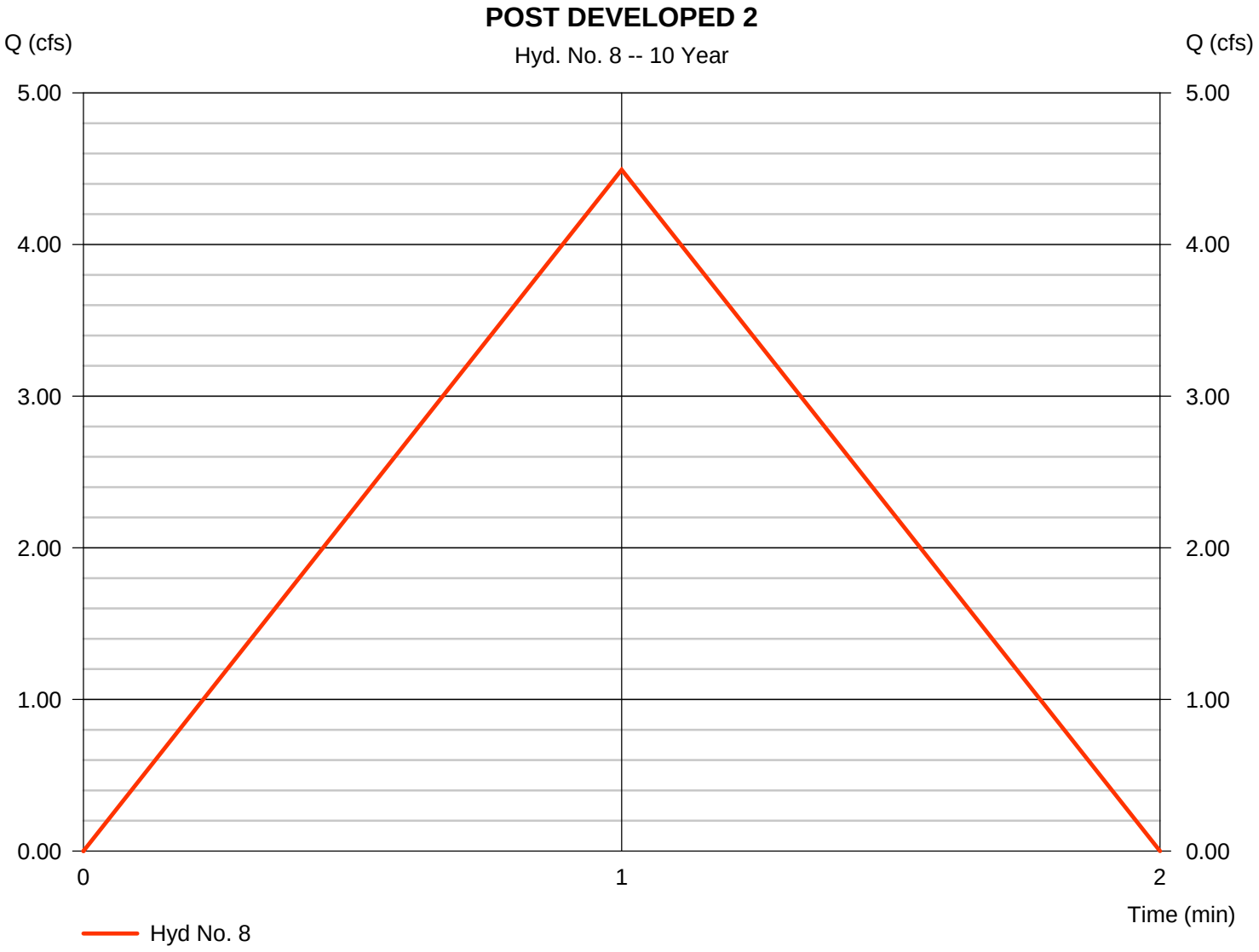


Hydrograph Report

Hyd. No. 8

POST DEVELOPED 2

Hydrograph type	=	Rational	Peak discharge	=	4.494 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	270 cuft
Drainage area	=	0.554 ac	Runoff coeff.	=	0.89
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

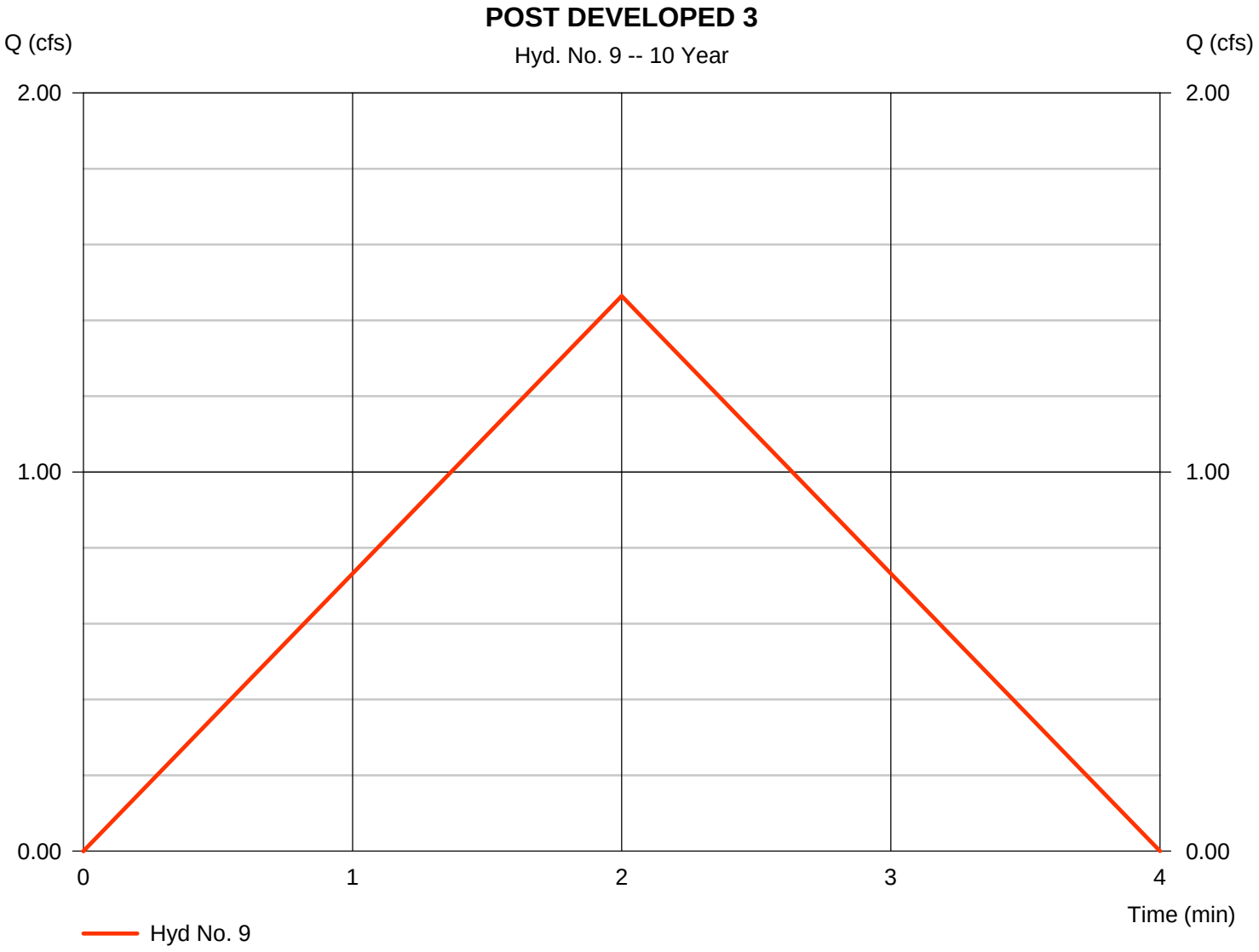


Hydrograph Report

Hyd. No. 9

POST DEVELOPED 3

Hydrograph type	=	Rational	Peak discharge	=	1.464 cfs
Storm frequency	=	10 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	176 cuft
Drainage area	=	0.239 ac	Runoff coeff.	=	0.71
Intensity	=	8.628 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

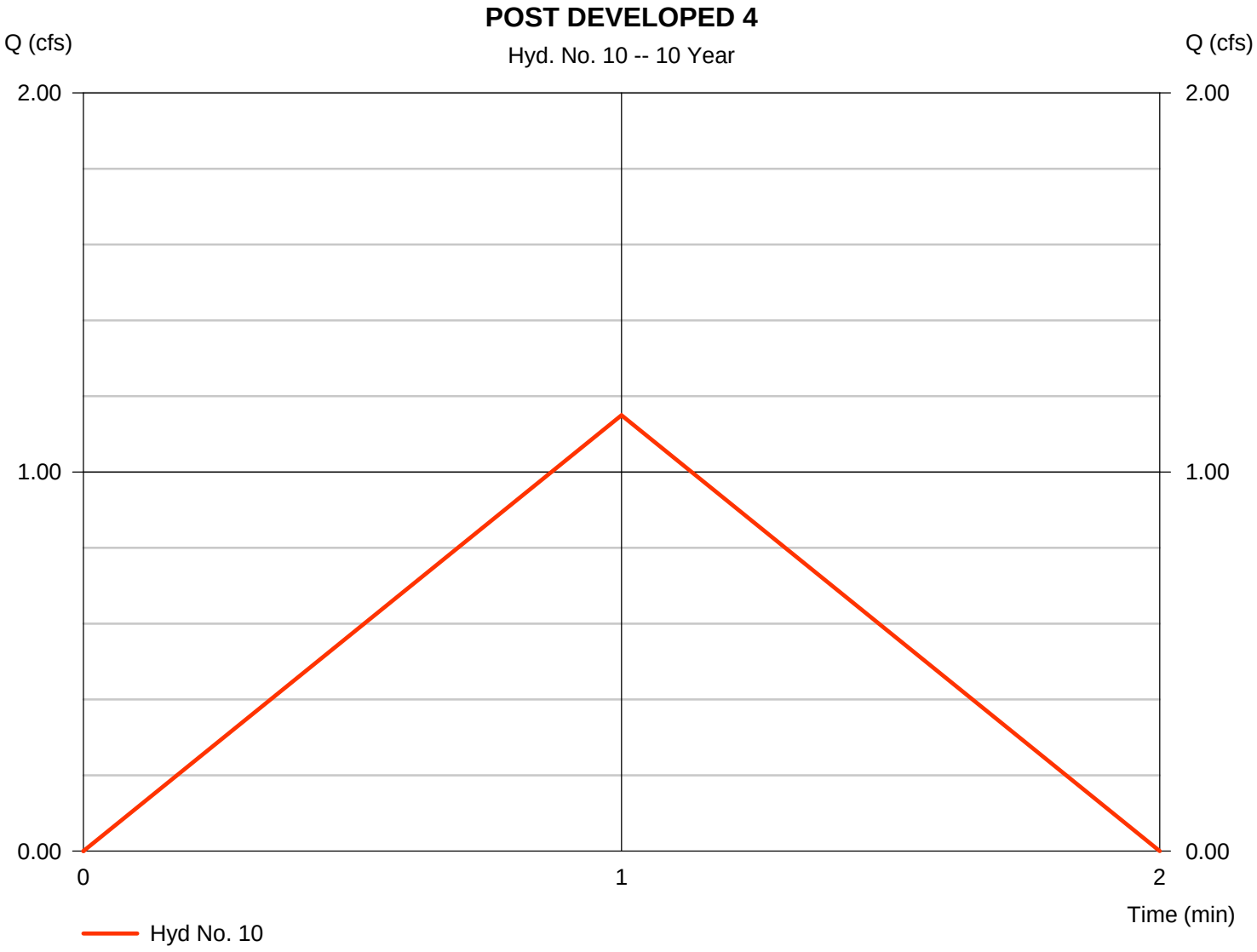


Hydrograph Report

Hyd. No. 10

POST DEVELOPED 4

Hydrograph type	=	Rational	Peak discharge	=	1.150 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	69 cuft
Drainage area	=	0.166 ac	Runoff coeff.	=	0.76
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

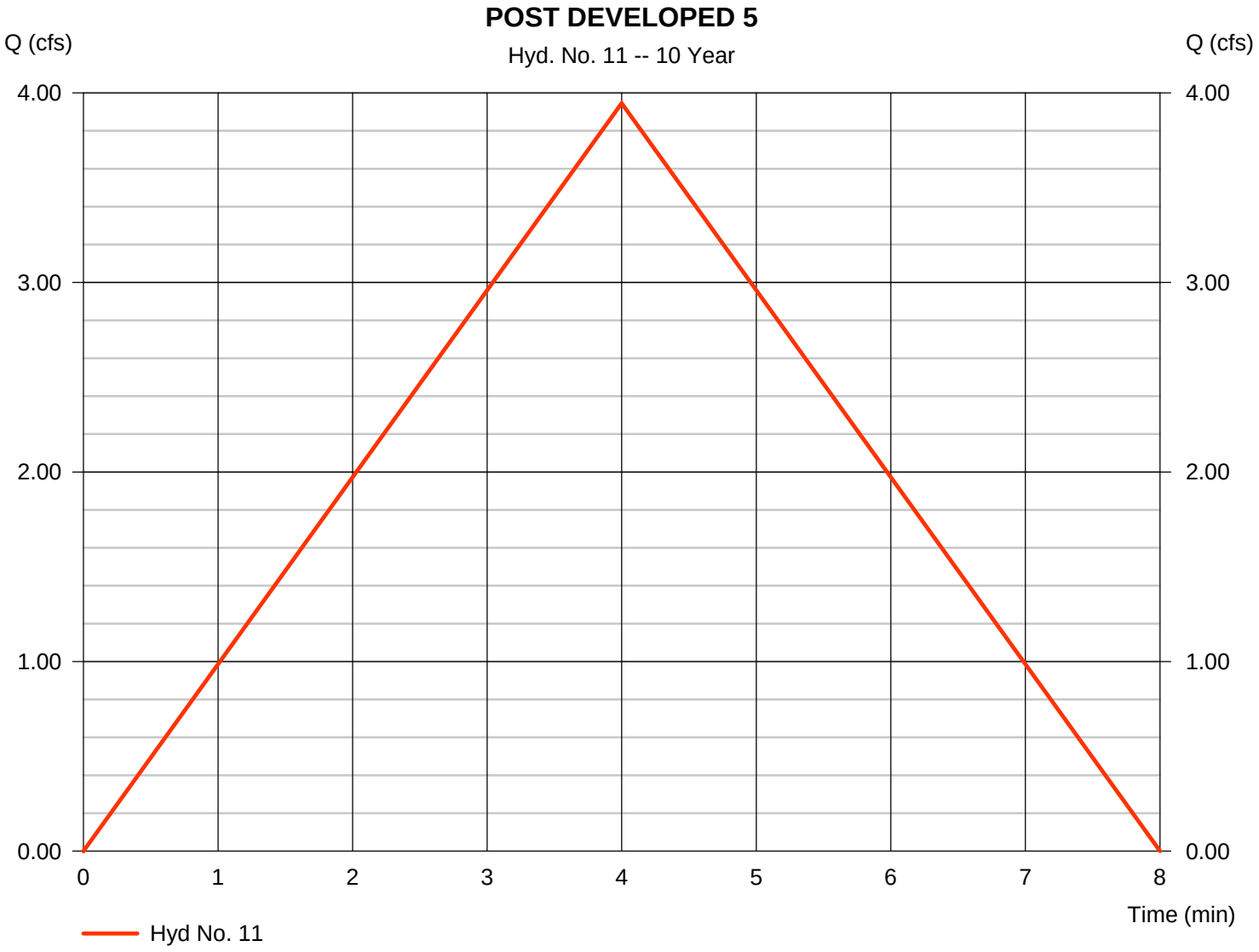


Hydrograph Report

Hyd. No. 11

POST DEVELOPED 5

Hydrograph type	=	Rational	Peak discharge	=	3.945 cfs
Storm frequency	=	10 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	947 cuft
Drainage area	=	0.692 ac	Runoff coeff.	=	0.73
Intensity	=	7.810 in/hr	Tc by User	=	4.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

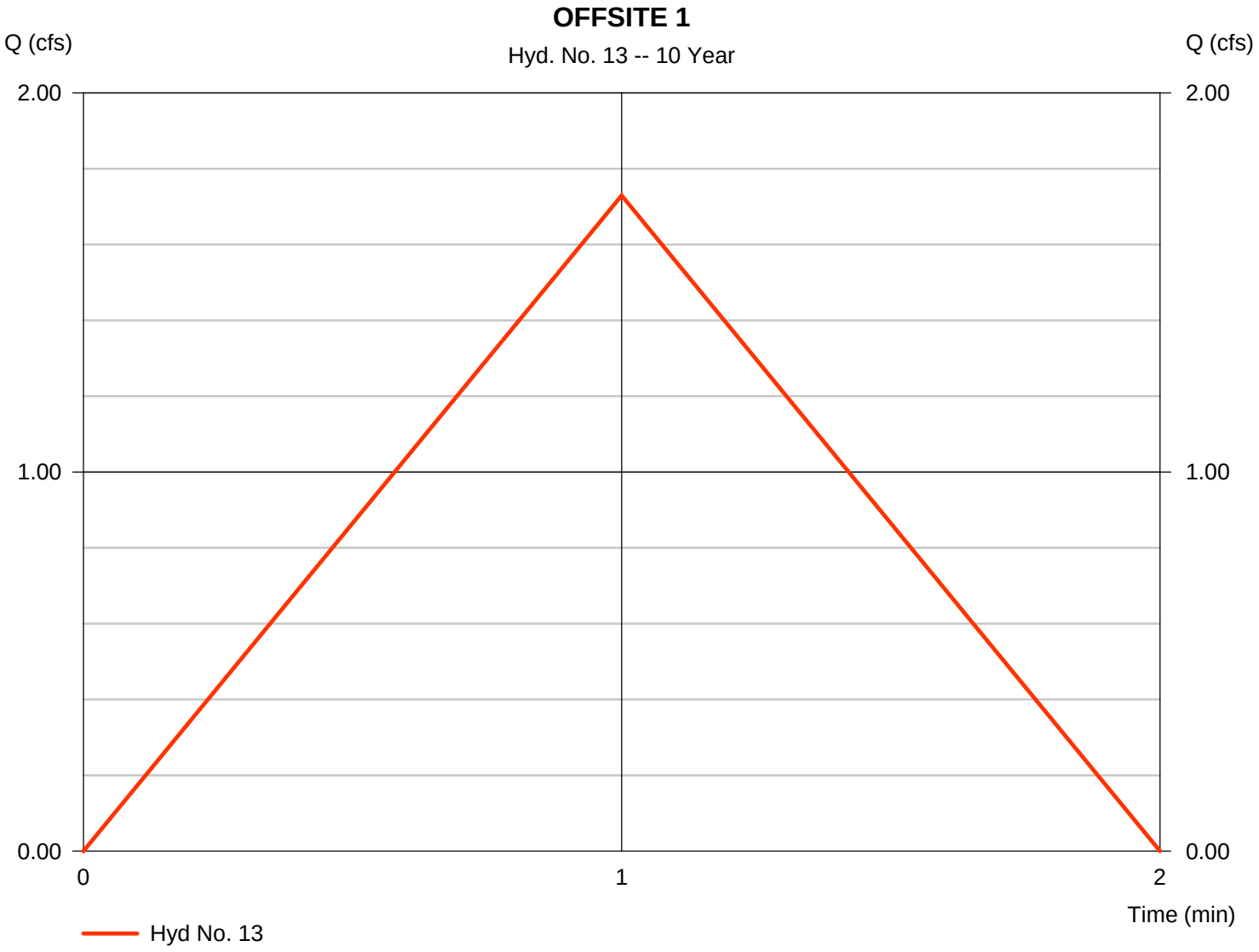


Hydrograph Report

Hyd. No. 13

OFFSITE 1

Hydrograph type	=	Rational	Peak discharge	=	1.729 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	104 cuft
Drainage area	=	0.593 ac	Runoff coeff.	=	0.32
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

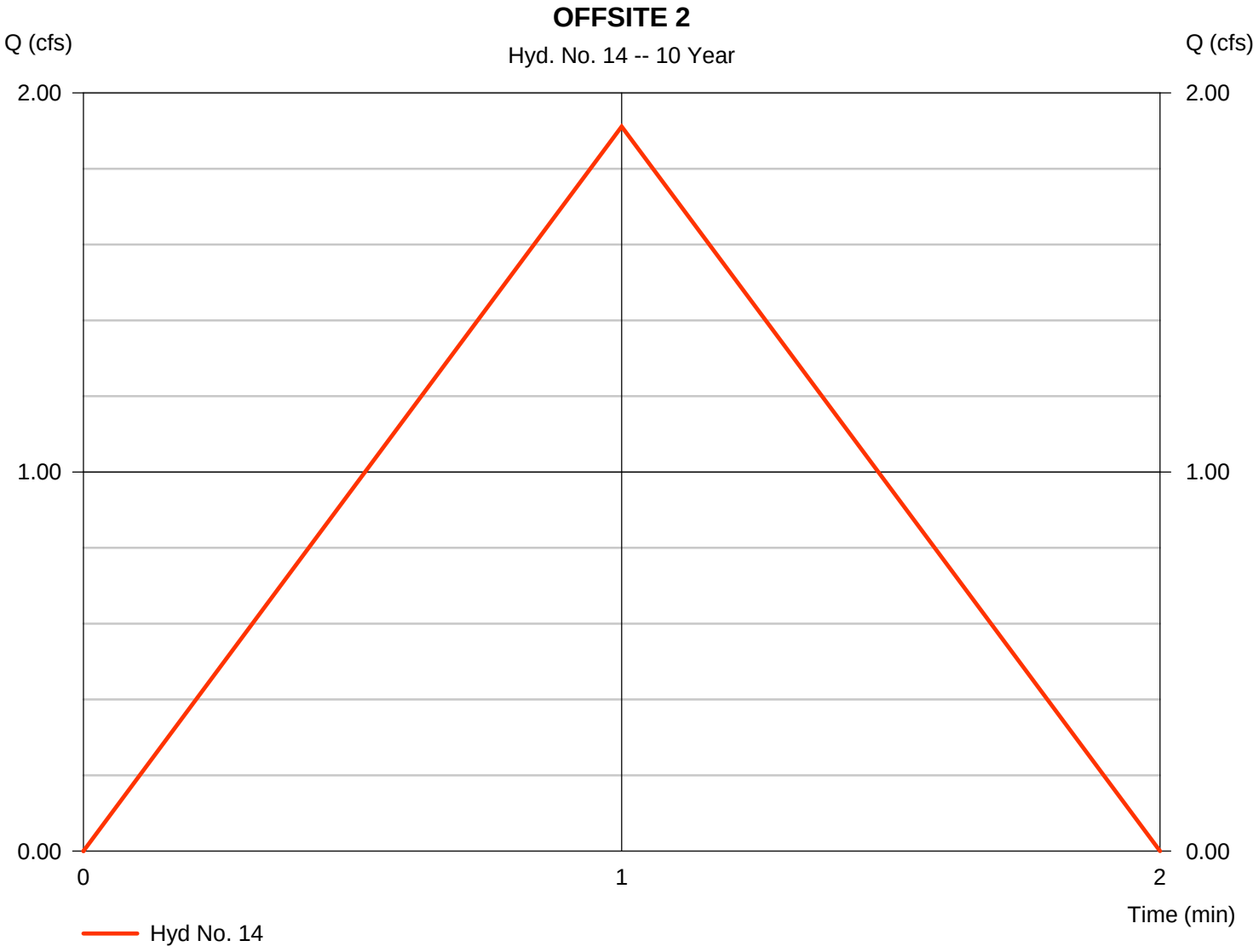


Hydrograph Report

Hyd. No. 14

OFFSITE 2

Hydrograph type	=	Rational	Peak discharge	=	1.911 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	115 cuft
Drainage area	=	0.233 ac	Runoff coeff.	=	0.9
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

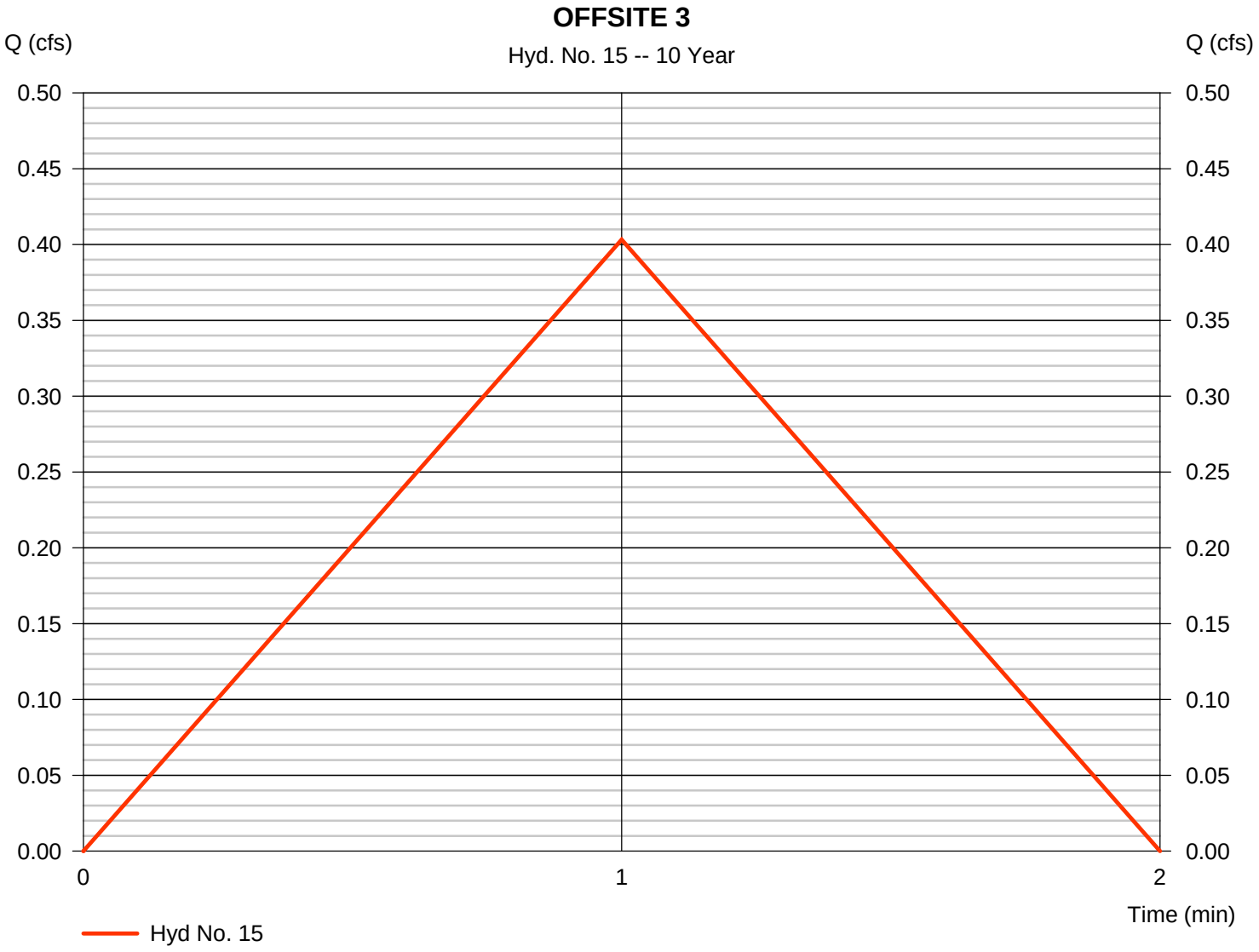


Hydrograph Report

Hyd. No. 15

OFFSITE 3

Hydrograph type	=	Rational	Peak discharge	=	0.403 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	24 cuft
Drainage area	=	0.056 ac	Runoff coeff.	=	0.79
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

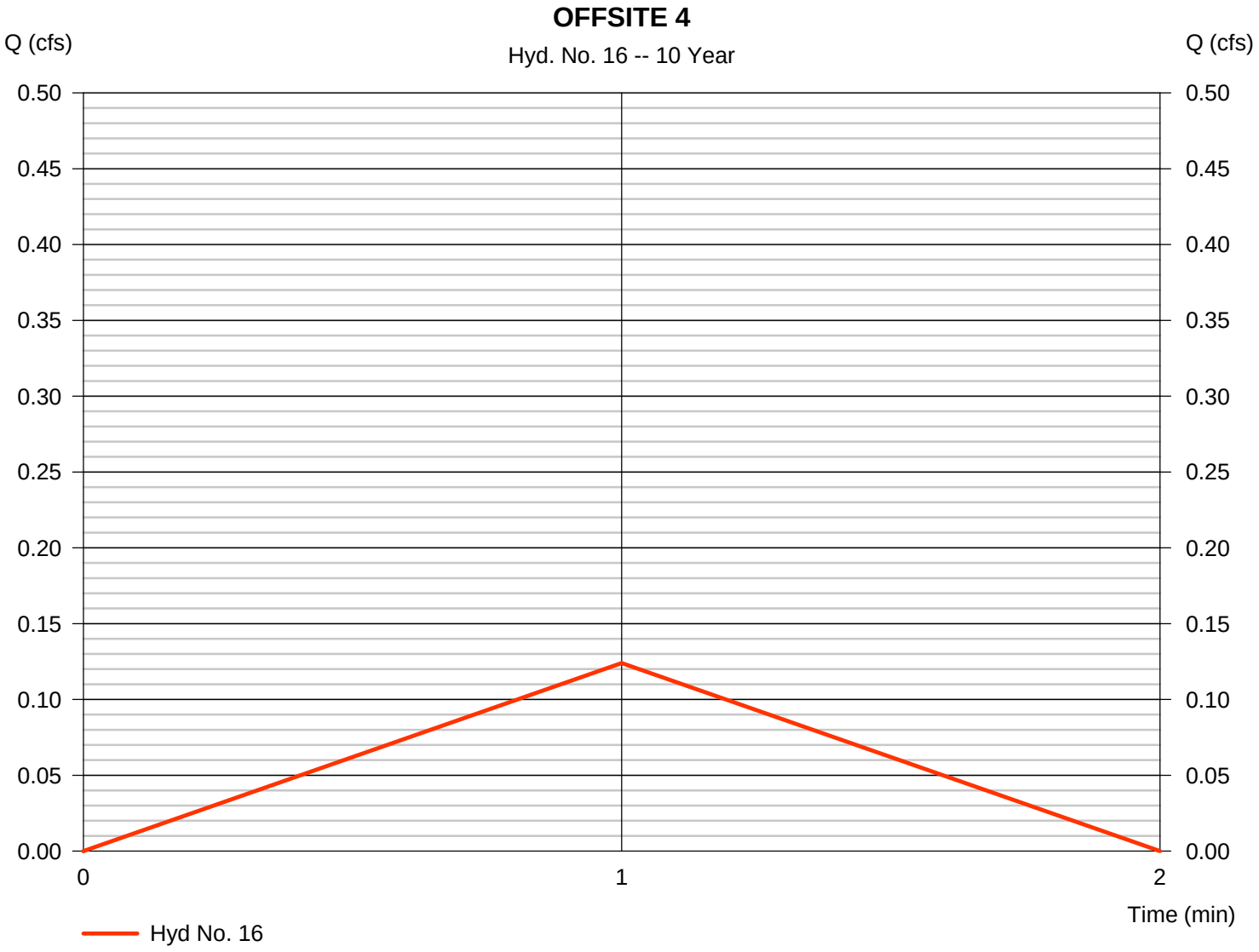


Hydrograph Report

Hyd. No. 16

OFFSITE 4

Hydrograph type	=	Rational	Peak discharge	=	0.124 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	7 cuft
Drainage area	=	0.068 ac	Runoff coeff.	=	0.2
Intensity	=	9.114 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

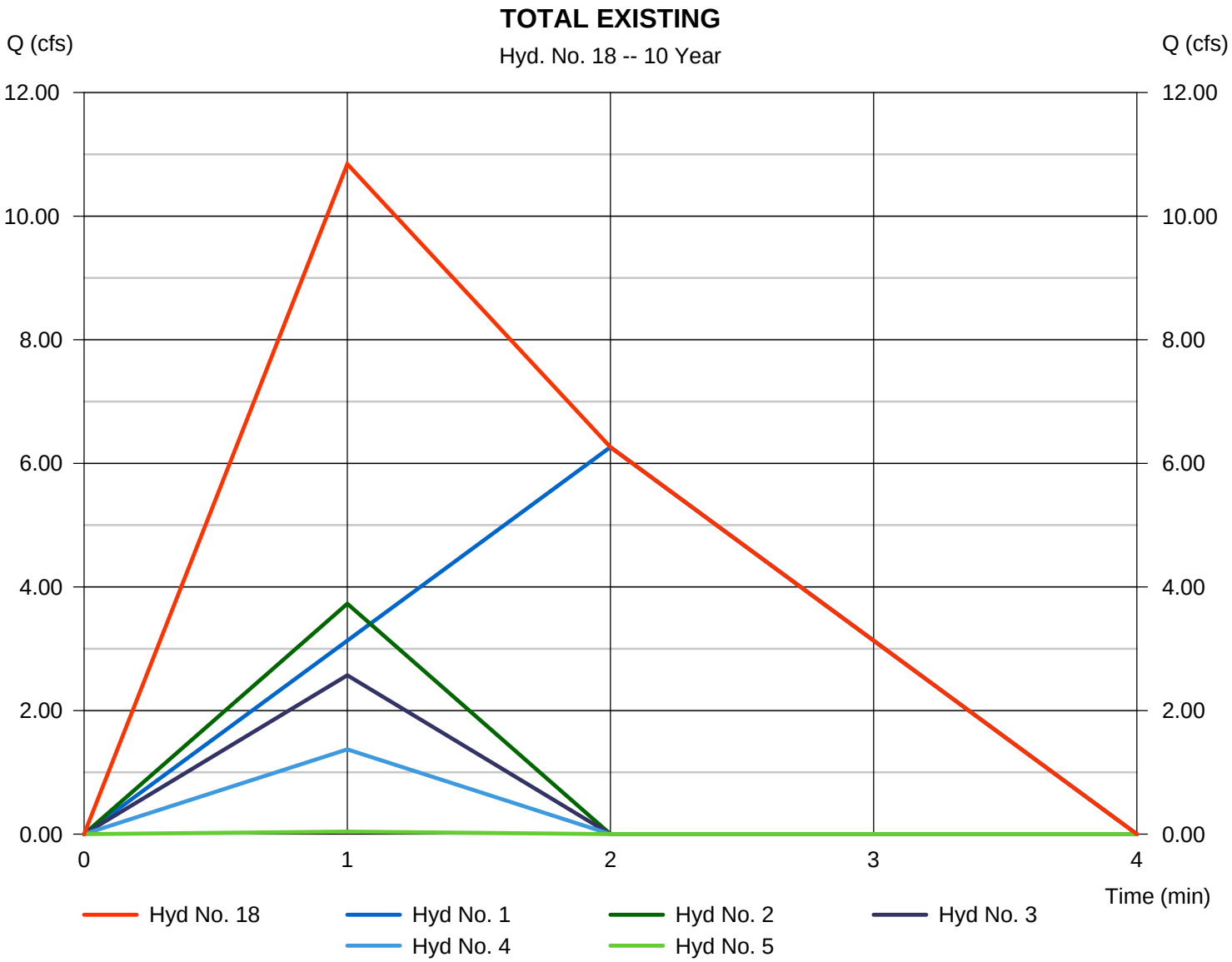


Hydrograph Report

Hyd. No. 18

TOTAL EXISTING

Hydrograph type	=	Combine	Peak discharge	=	10.84 cfs
Storm frequency	=	10 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	1,214 cuft
Inflow hyds.	=	1, 2, 3, 4, 5	Contrib. drain. area	=	3.605 ac

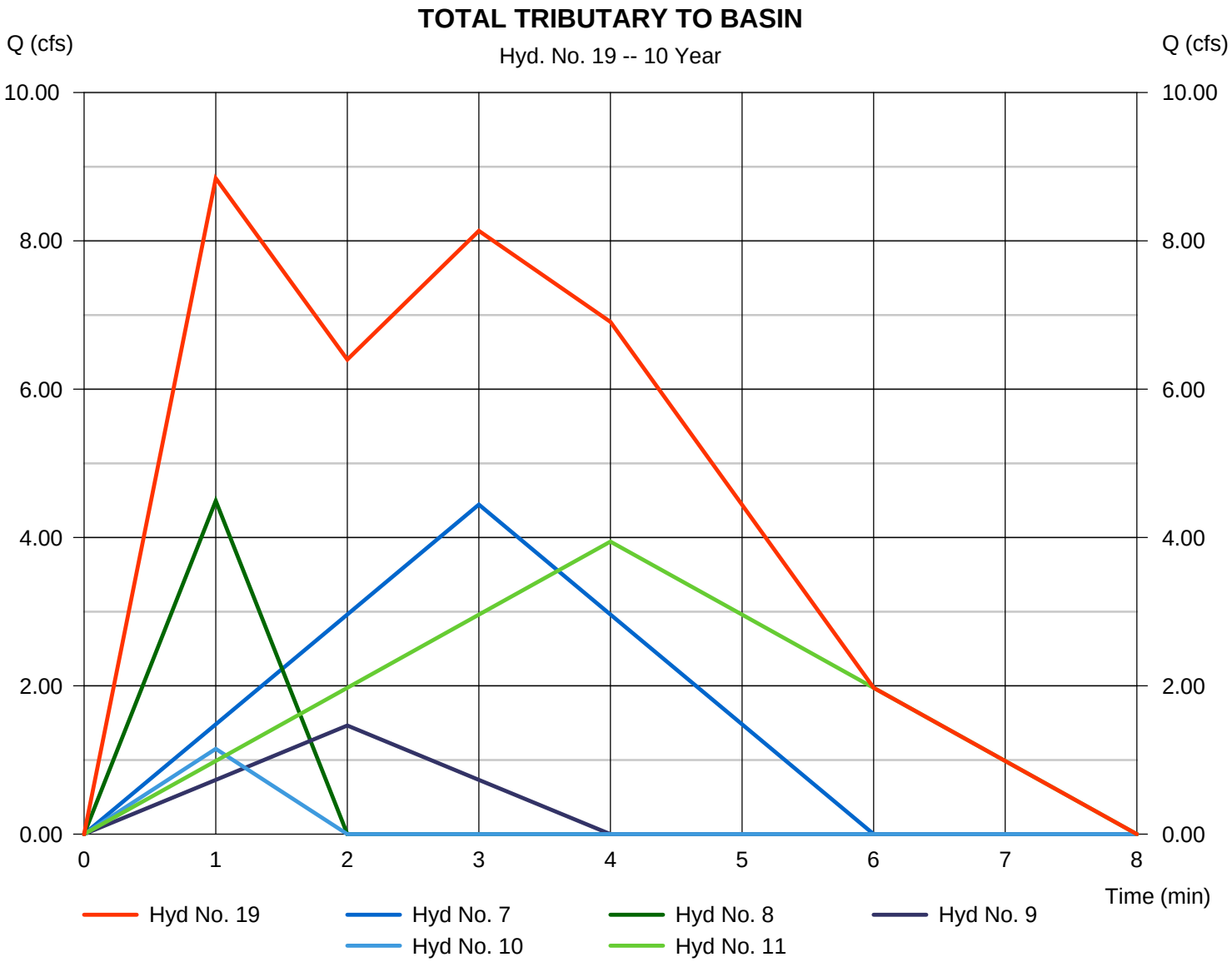


Hydrograph Report

Hyd. No. 19

TOTAL TRIBUTARY TO BASIN

Hydrograph type	= Combine	Peak discharge	= 8.843 cfs
Storm frequency	= 10 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 2,261 cuft
Inflow hyds.	= 7, 8, 9, 10, 11	Contrib. drain. area	= 2.655 ac

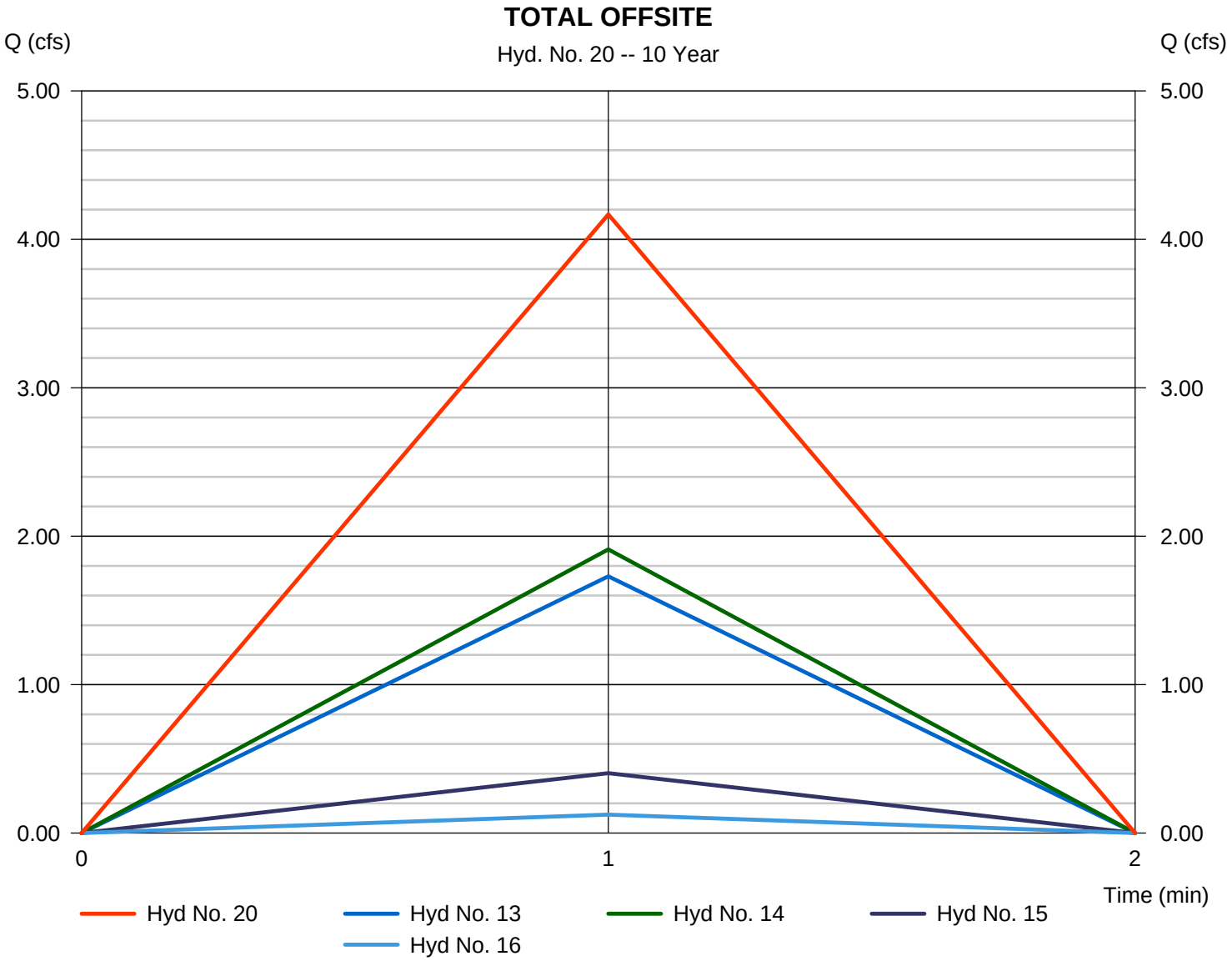


Hydrograph Report

Hyd. No. 20

TOTAL OFFSITE

Hydrograph type	= Combine	Peak discharge	= 4.168 cfs
Storm frequency	= 10 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 250 cuft
Inflow hyds.	= 13, 14, 15, 16	Contrib. drain. area	= 0.950 ac



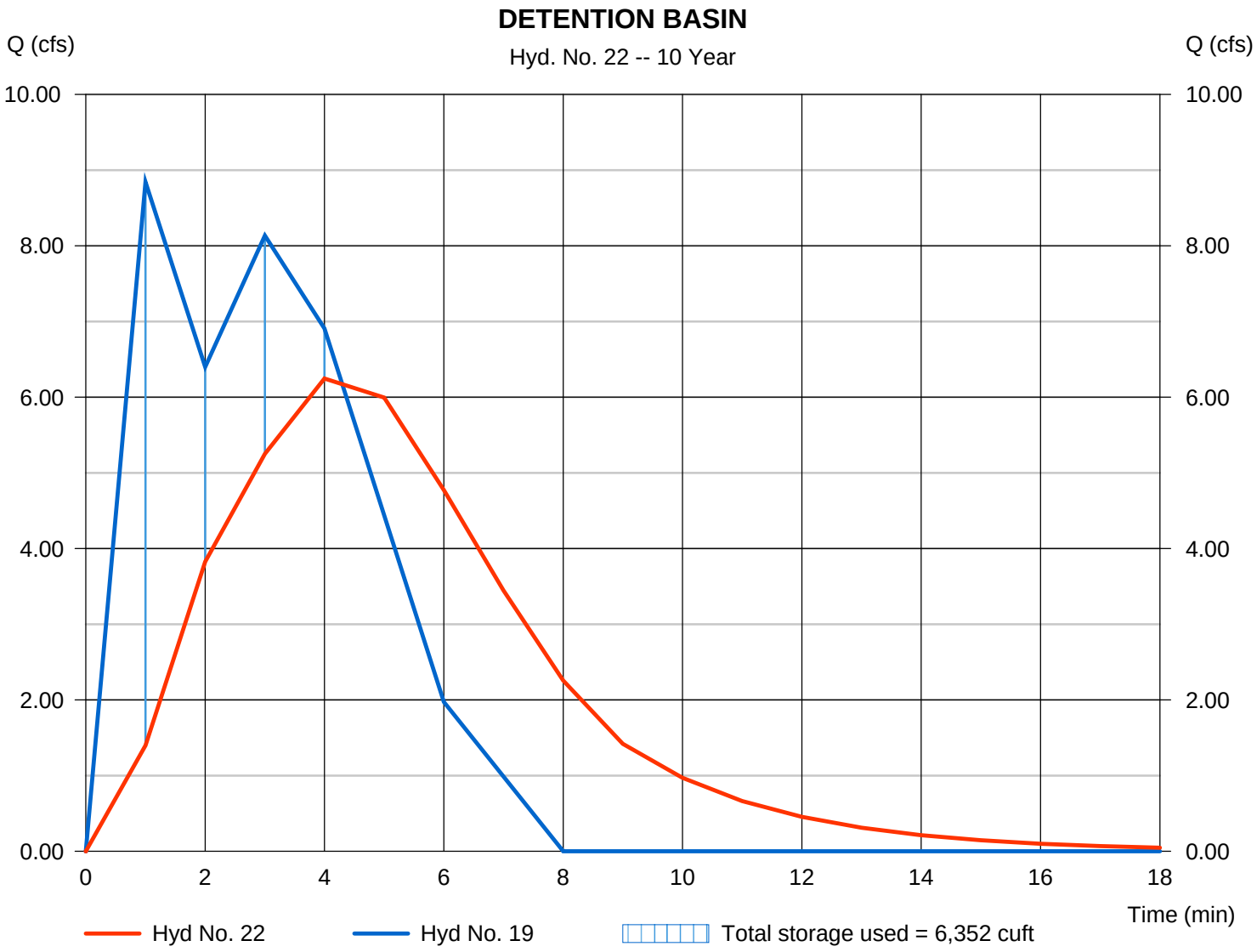
Hydrograph Report

Hyd. No. 22

DETENTION BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	6.245 cfs
Storm frequency	=	10 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	2,261 cuft
Inflow hyd. No.	=	19 - TOTAL TRIBUTARY TO BASIN	Max. Elevation	=	559.15 ft
Reservoir name	=	DETENTION	Max. Storage	=	6,352 cuft

Storage Indication method used. Wet pond routing start elevation = 558.90 ft.

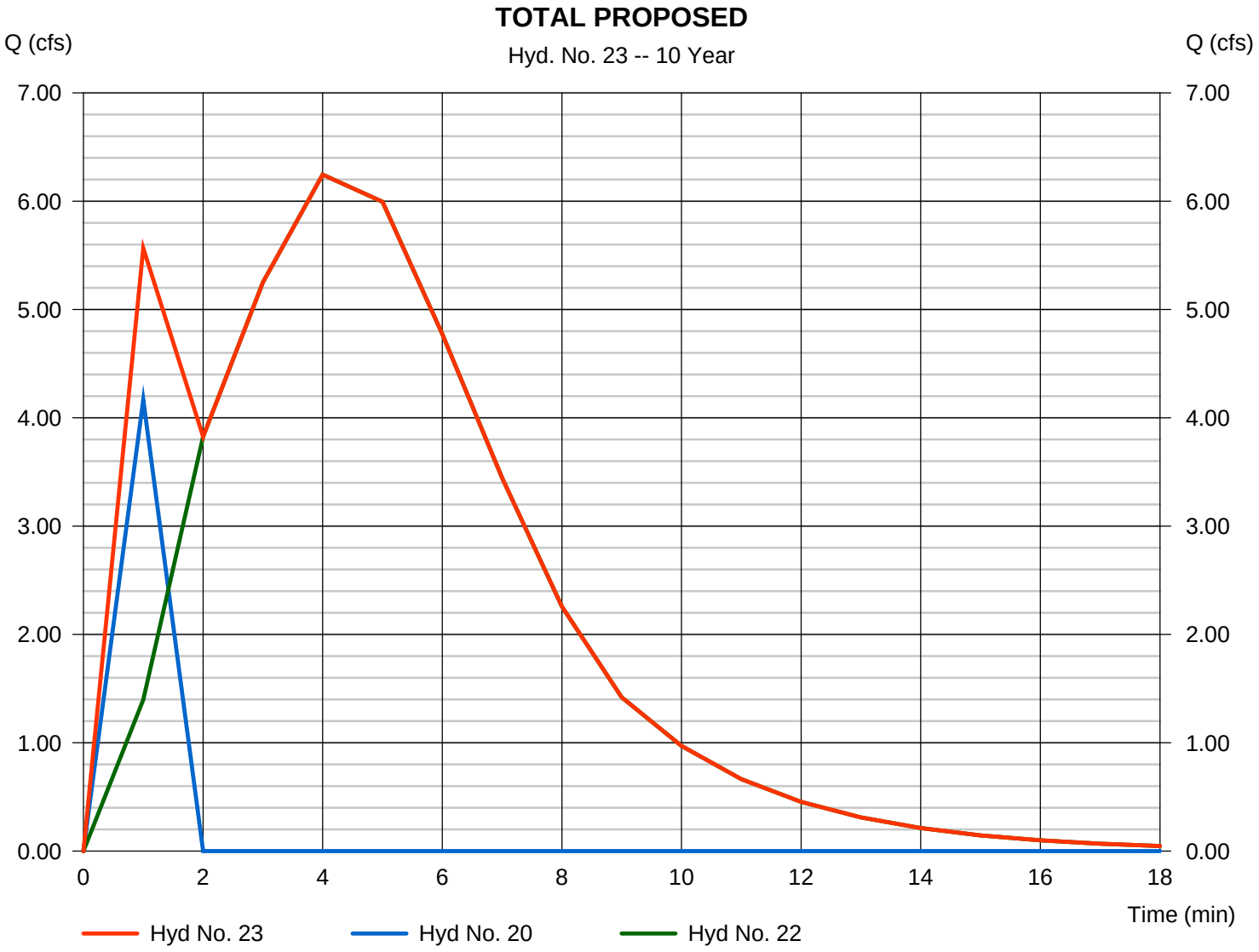


Hydrograph Report

Hyd. No. 23

TOTAL PROPOSED

Hydrograph type	= Combine	Peak discharge	= 6.245 cfs
Storm frequency	= 10 yrs	Time to peak	= 4 min
Time interval	= 1 min	Hyd. volume	= 2,511 cuft
Inflow hyds.	= 20, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

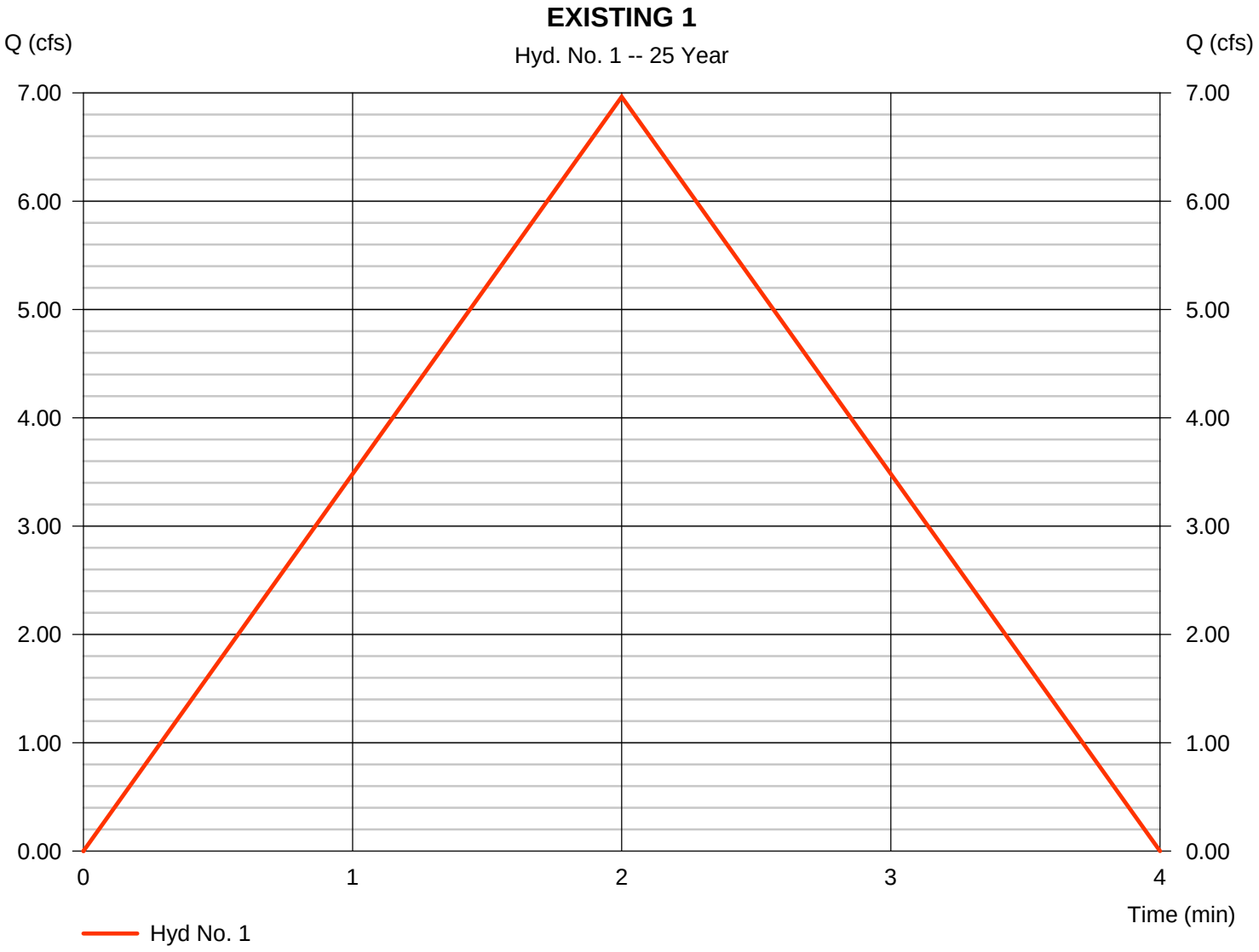
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	6.963	1	2	836	------	------	------	EXISTING 1
2	Rational	4.139	1	1	248	------	------	------	EXISTING 2
3	Rational	2.855	1	1	171	------	------	------	EXISTING 3
4	Rational	1.522	1	1	91	------	------	------	EXISTING 4
5	Rational	0.045	1	1	3	------	------	------	EXISTING 5
7	Rational	4.948	1	3	891	------	------	------	POST DEVELOPED 1
8	Rational	4.990	1	1	299	------	------	------	POST DEVELOPED 2
9	Rational	1.628	1	2	195	------	------	------	POST DEVELOPED 3
10	Rational	1.277	1	1	77	------	------	------	POST DEVELOPED 4
11	Rational	4.398	1	4	1,055	------	------	------	POST DEVELOPED 5
13	Rational	1.920	1	1	115	------	------	------	OFFSITE 1
14	Rational	2.122	1	1	127	------	------	------	OFFSITE 2
15	Rational	0.448	1	1	27	------	------	------	OFFSITE 3
16	Rational	0.138	1	1	8	------	------	------	OFFSITE 4
18	Combine	12.04	1	1	1,349	1, 2, 3, 4, 5,	------	------	TOTAL EXISTING
19	Combine	9.829	1	1	2,517	7, 8, 9, 10, 11,	------	------	TOTAL TRIBUTARY TO BASIN
20	Combine	4.628	1	1	278	13, 14, 15, 16,	------	------	TOTAL OFFSITE
22	Reservoir	7.000	1	4	2,517	19	559.17	6,432	DETENTION BASIN
23	Combine	7.000	1	4	2,795	20, 22	------	------	TOTAL PROPOSED

Hydrograph Report

Hyd. No. 1

EXISTING 1

Hydrograph type	=	Rational	Peak discharge	=	6.963 cfs
Storm frequency	=	25 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	836 cuft
Drainage area	=	1.910 ac	Runoff coeff.	=	0.38
Intensity	=	9.594 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

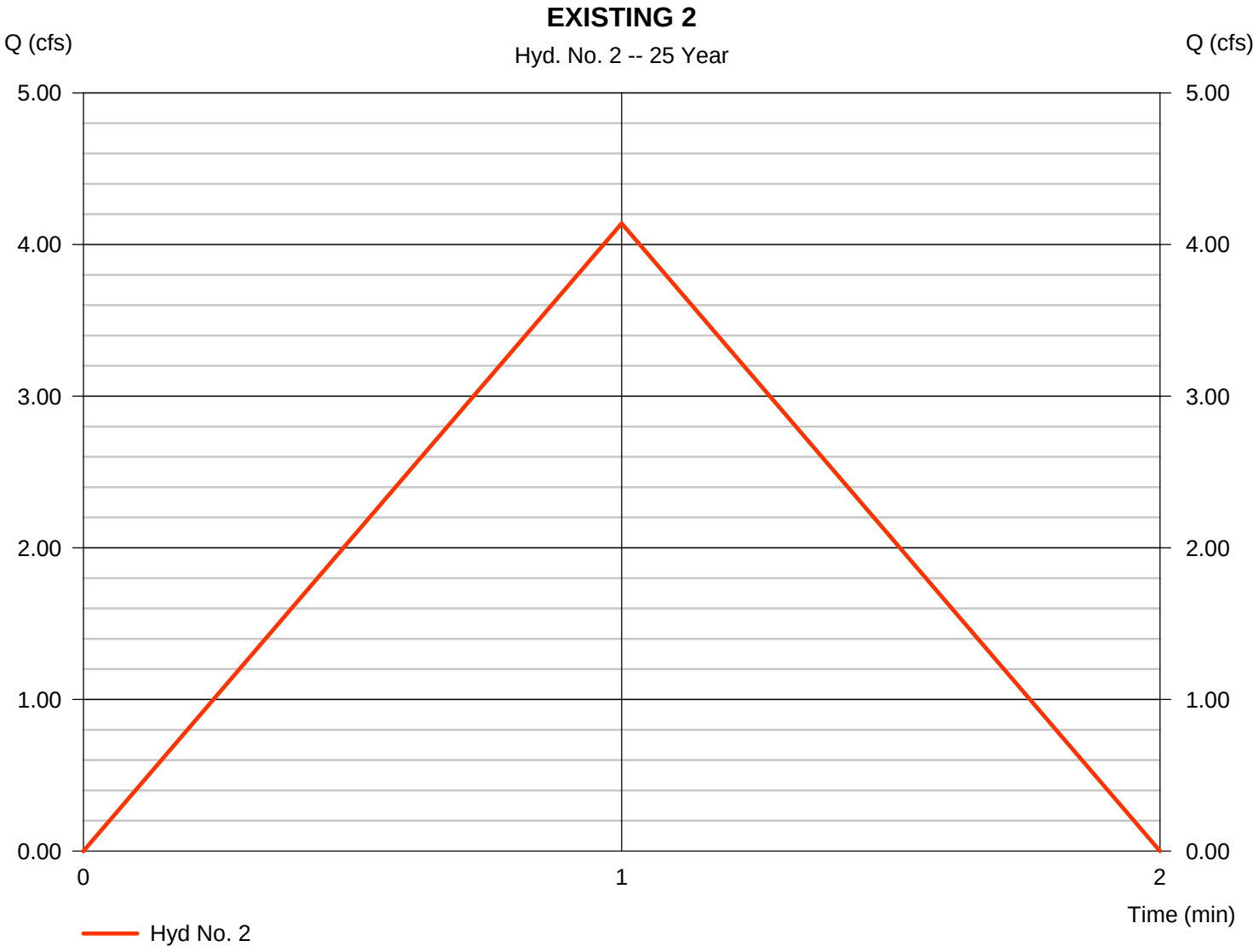


Hydrograph Report

Hyd. No. 2

EXISTING 2

Hydrograph type	=	Rational	Peak discharge	=	4.139 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	248 cuft
Drainage area	=	0.802 ac	Runoff coeff.	=	0.51
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

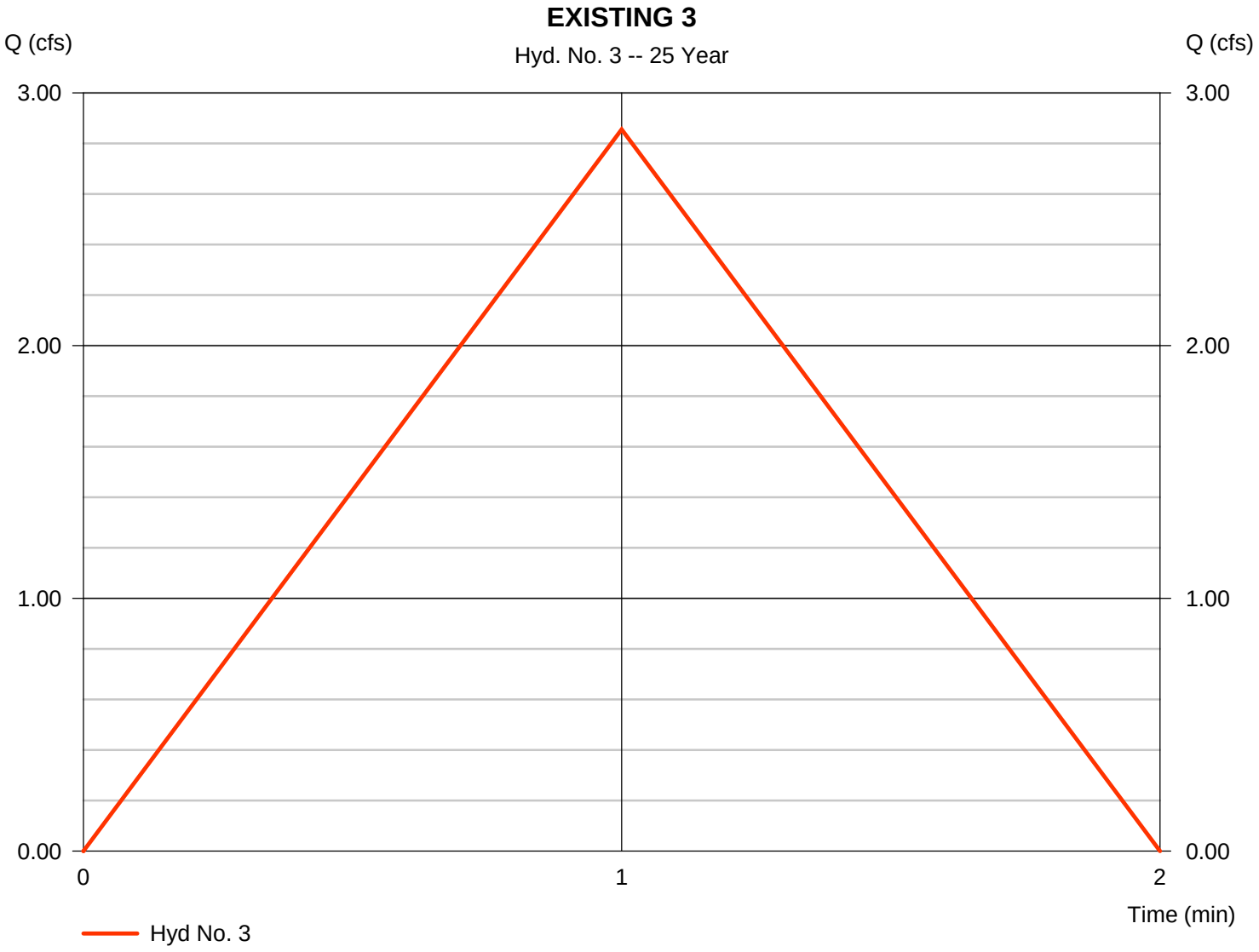


Hydrograph Report

Hyd. No. 3

EXISTING 3

Hydrograph type	=	Rational	Peak discharge	=	2.855 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	171 cuft
Drainage area	=	0.495 ac	Runoff coeff.	=	0.57
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

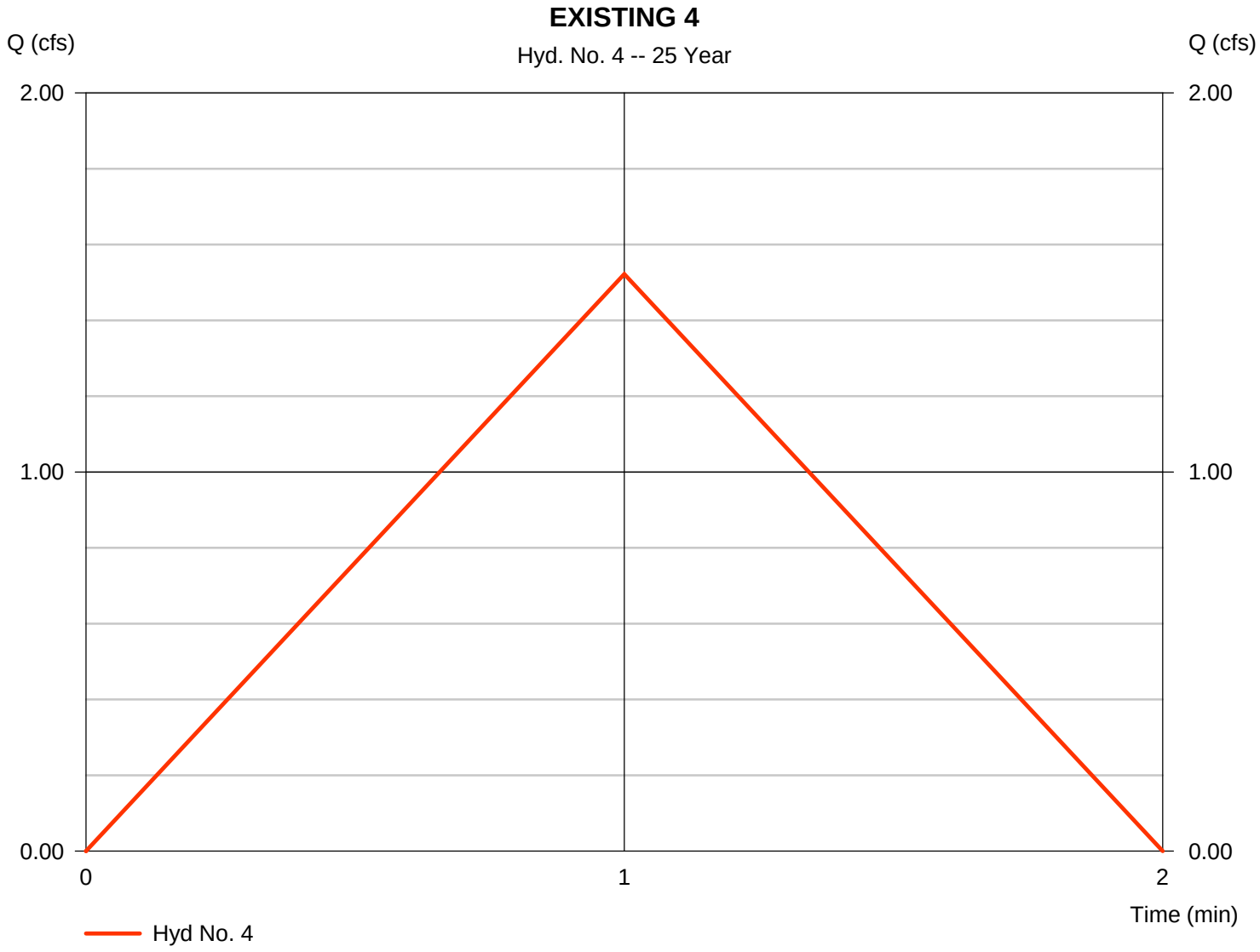


Hydrograph Report

Hyd. No. 4

EXISTING 4

Hydrograph type	=	Rational	Peak discharge	=	1.522 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	91 cuft
Drainage area	=	0.376 ac	Runoff coeff.	=	0.4
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

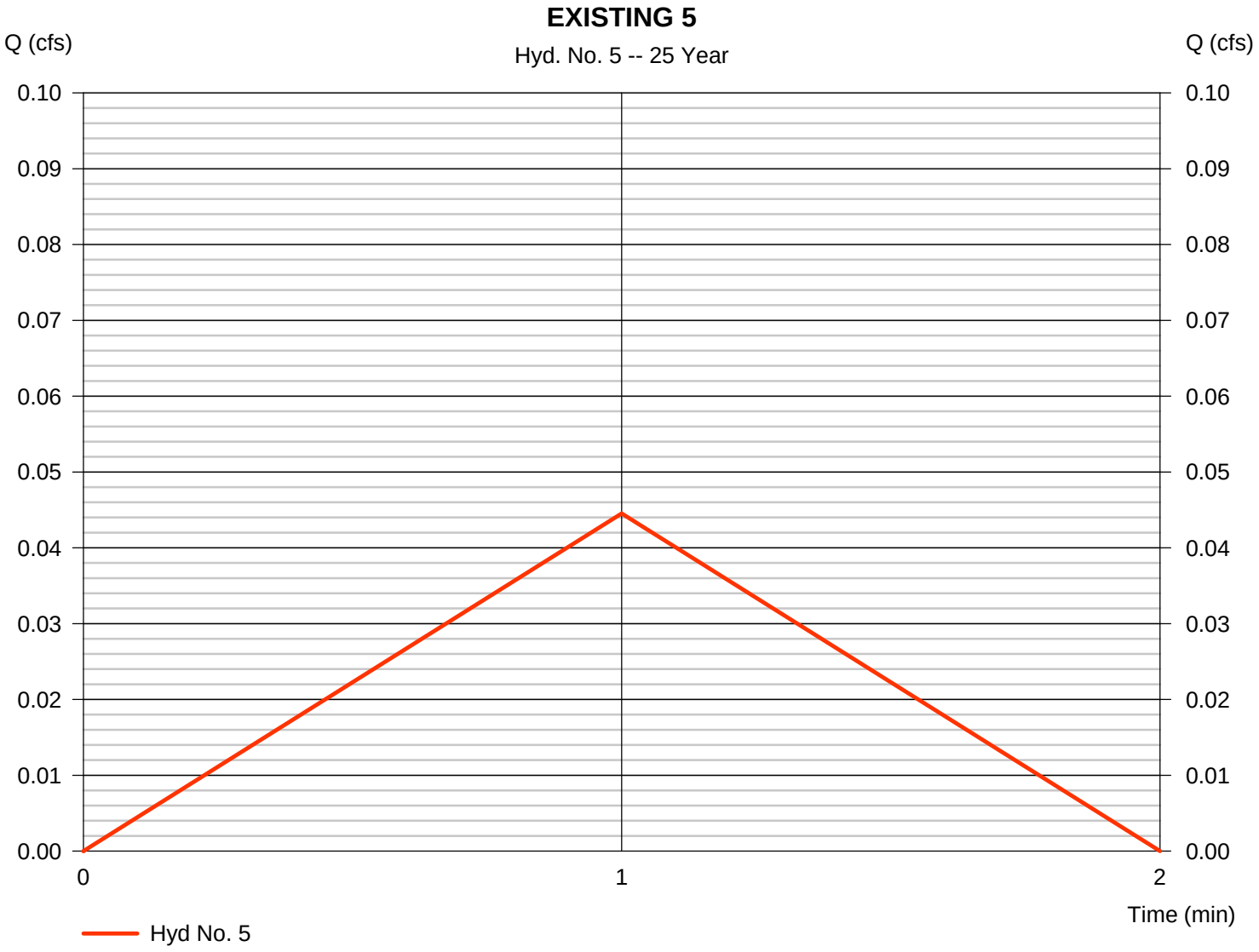


Hydrograph Report

Hyd. No. 5

EXISTING 5

Hydrograph type	=	Rational	Peak discharge	=	0.045 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	3 cuft
Drainage area	=	0.022 ac	Runoff coeff.	=	0.2
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

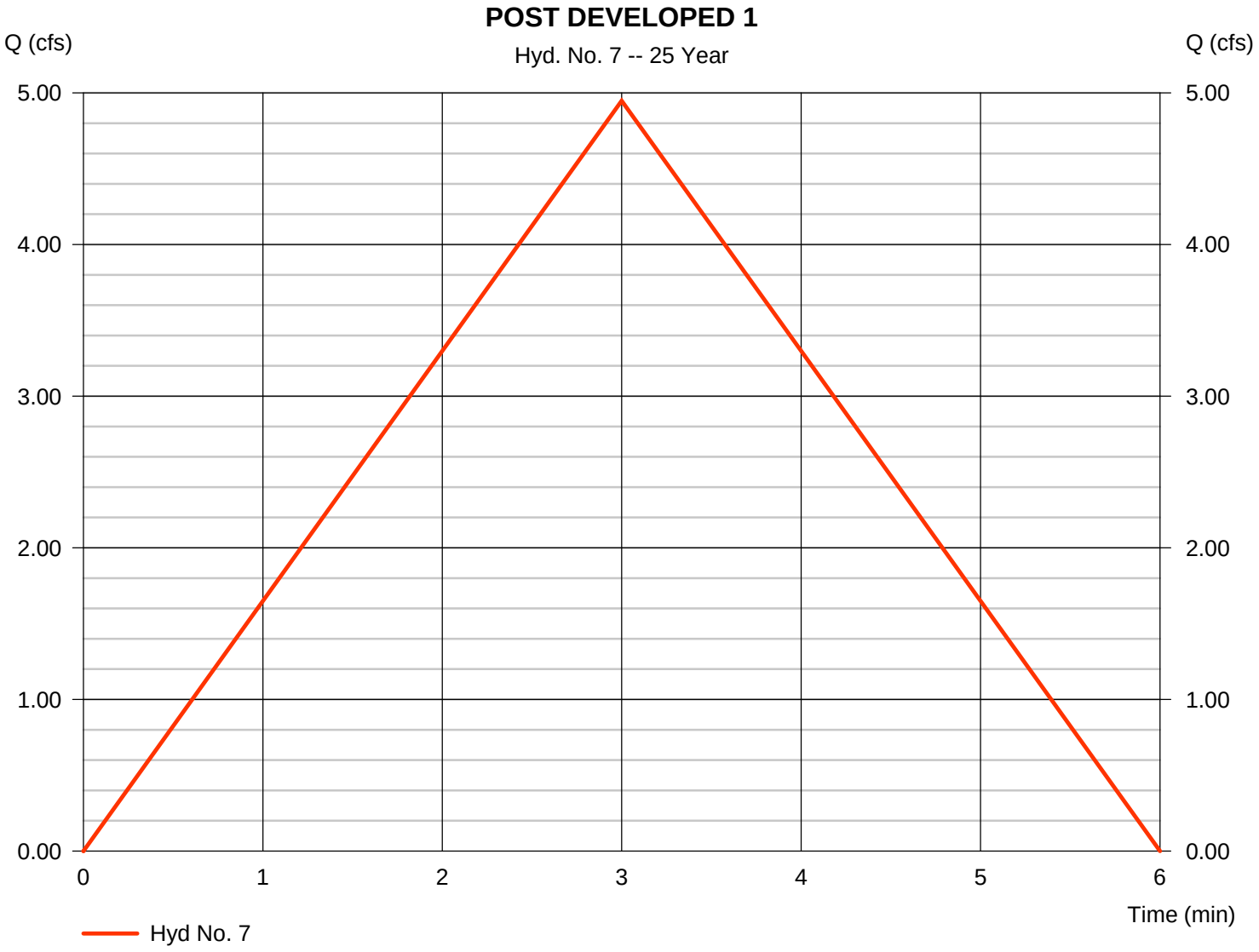


Hydrograph Report

Hyd. No. 7

POST DEVELOPED 1

Hydrograph type	=	Rational	Peak discharge	=	4.948 cfs
Storm frequency	=	25 yrs	Time to peak	=	3 min
Time interval	=	1 min	Hyd. volume	=	891 cuft
Drainage area	=	1.004 ac	Runoff coeff.	=	0.54
Intensity	=	9.126 in/hr	Tc by User	=	3.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

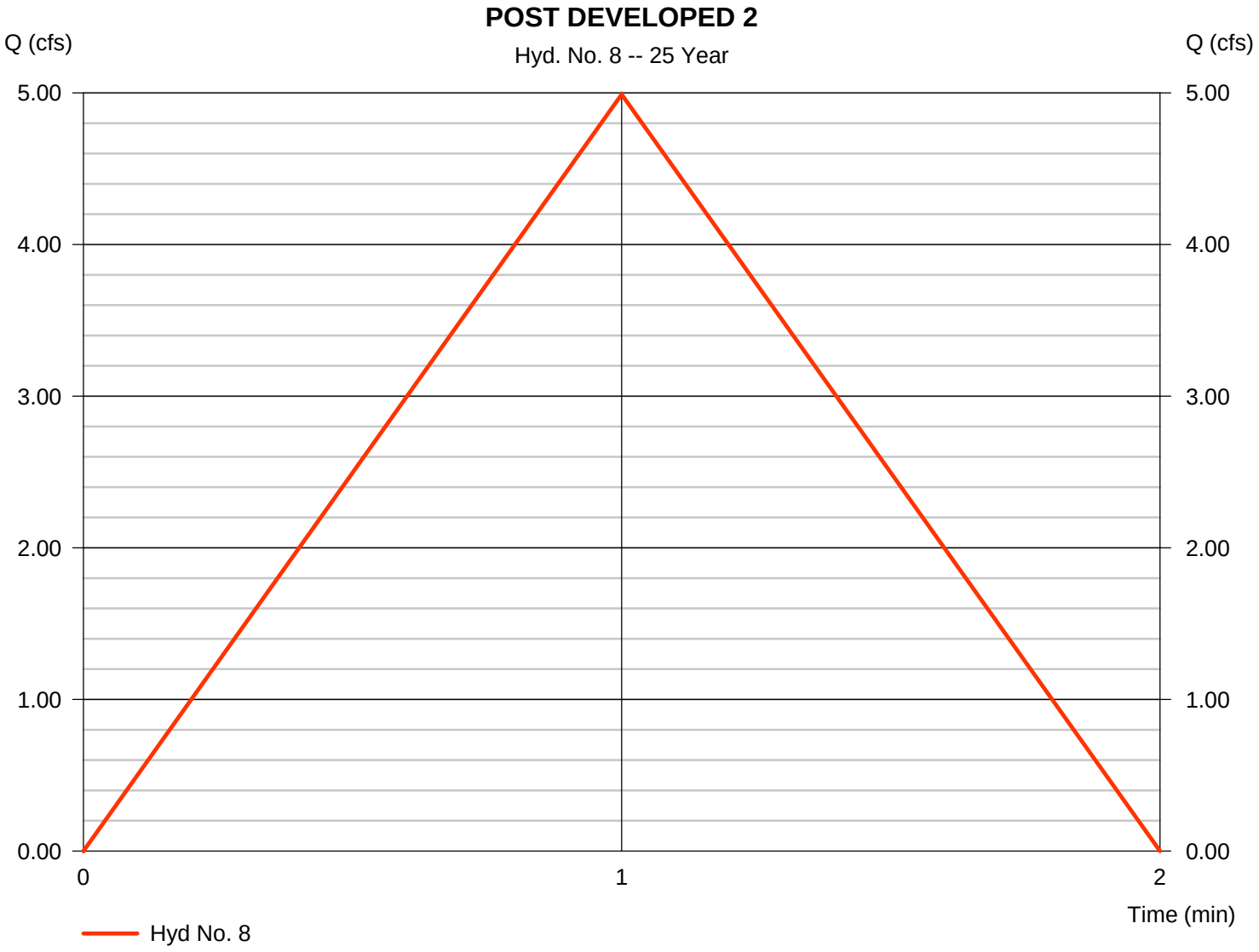


Hydrograph Report

Hyd. No. 8

POST DEVELOPED 2

Hydrograph type	=	Rational	Peak discharge	=	4.990 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	299 cuft
Drainage area	=	0.554 ac	Runoff coeff.	=	0.89
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

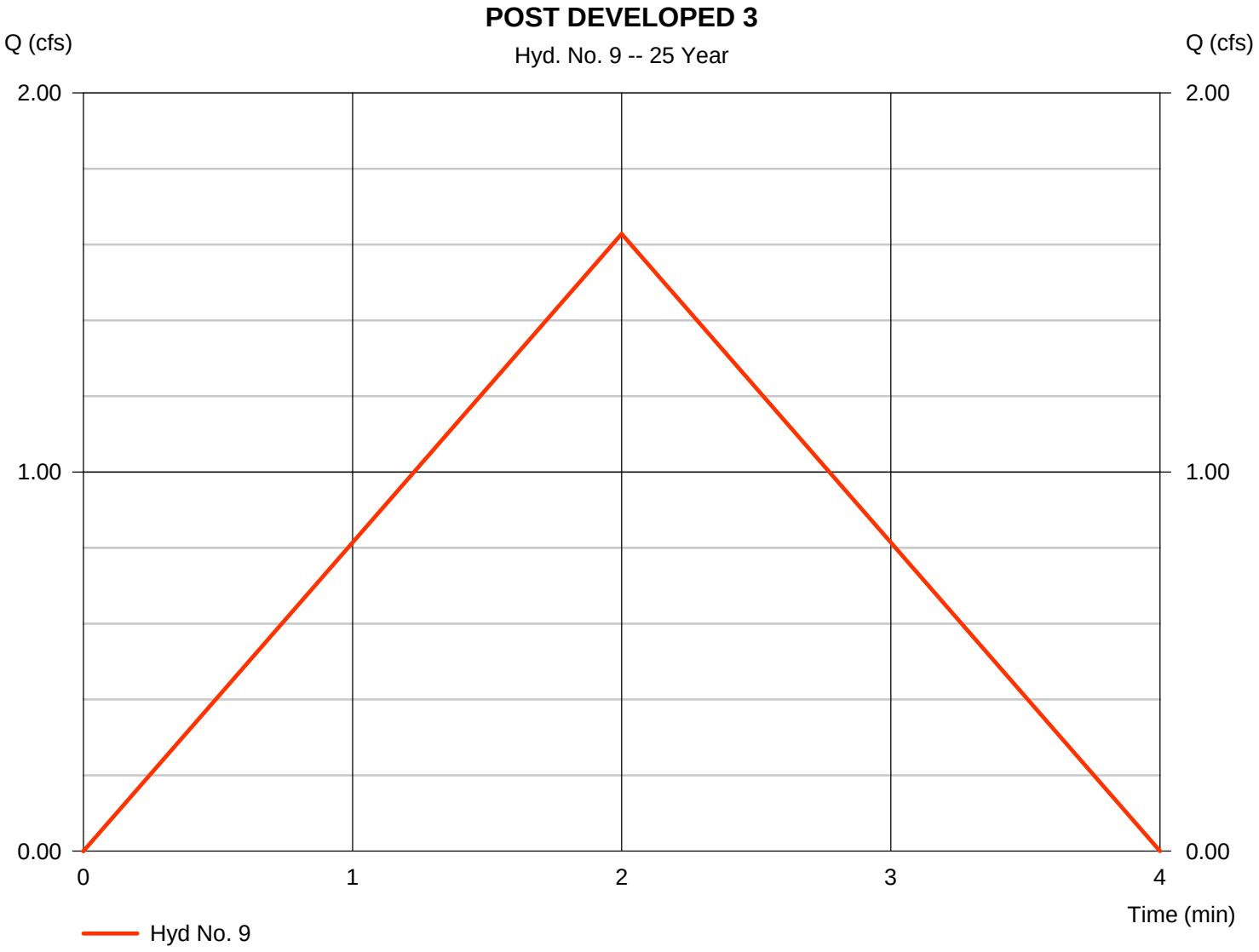


Hydrograph Report

Hyd. No. 9

POST DEVELOPED 3

Hydrograph type	=	Rational	Peak discharge	=	1.628 cfs
Storm frequency	=	25 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	195 cuft
Drainage area	=	0.239 ac	Runoff coeff.	=	0.71
Intensity	=	9.594 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

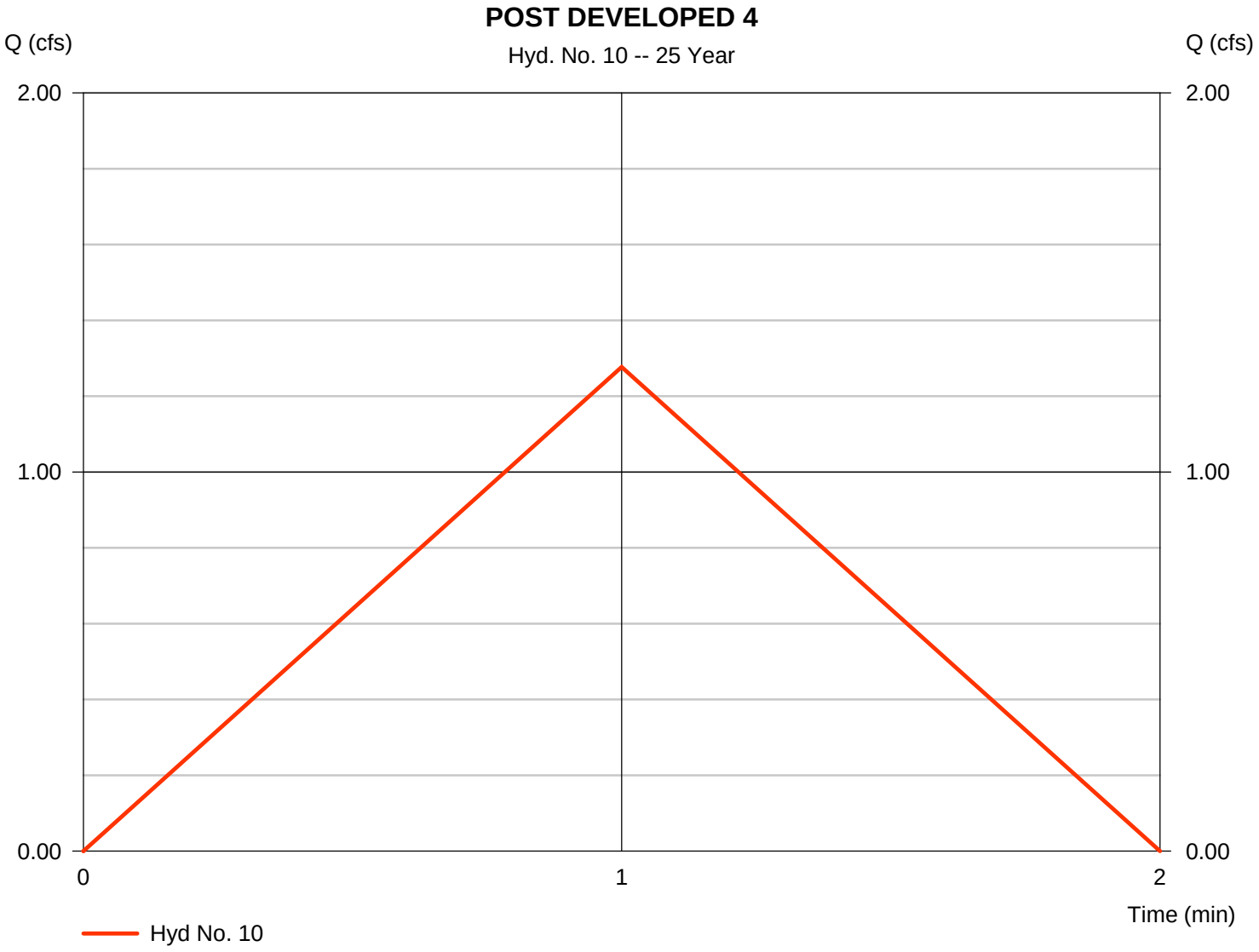


Hydrograph Report

Hyd. No. 10

POST DEVELOPED 4

Hydrograph type	=	Rational	Peak discharge	=	1.277 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	77 cuft
Drainage area	=	0.166 ac	Runoff coeff.	=	0.76
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

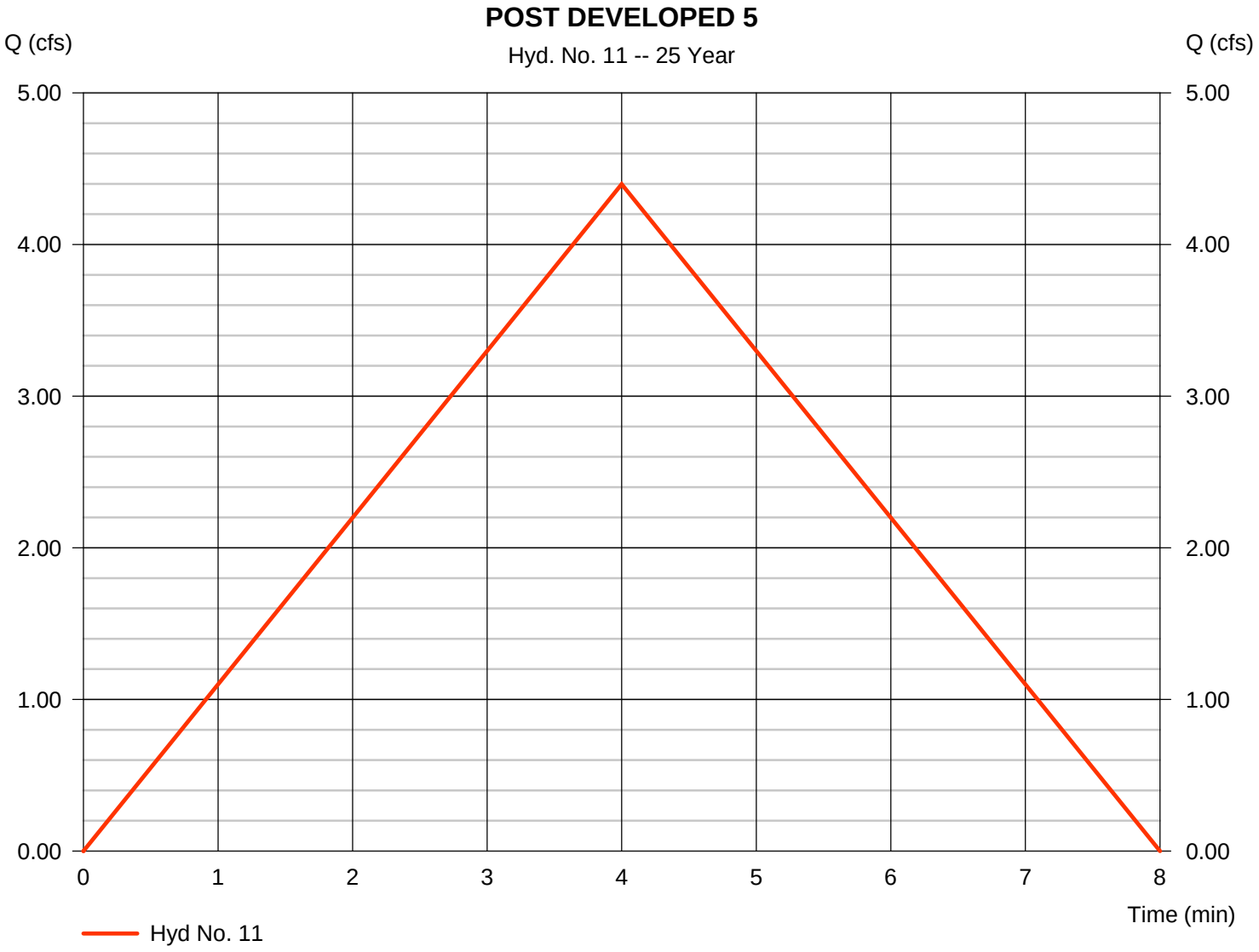


Hydrograph Report

Hyd. No. 11

POST DEVELOPED 5

Hydrograph type	=	Rational	Peak discharge	=	4.398 cfs
Storm frequency	=	25 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	1,055 cuft
Drainage area	=	0.692 ac	Runoff coeff.	=	0.73
Intensity	=	8.706 in/hr	Tc by User	=	4.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

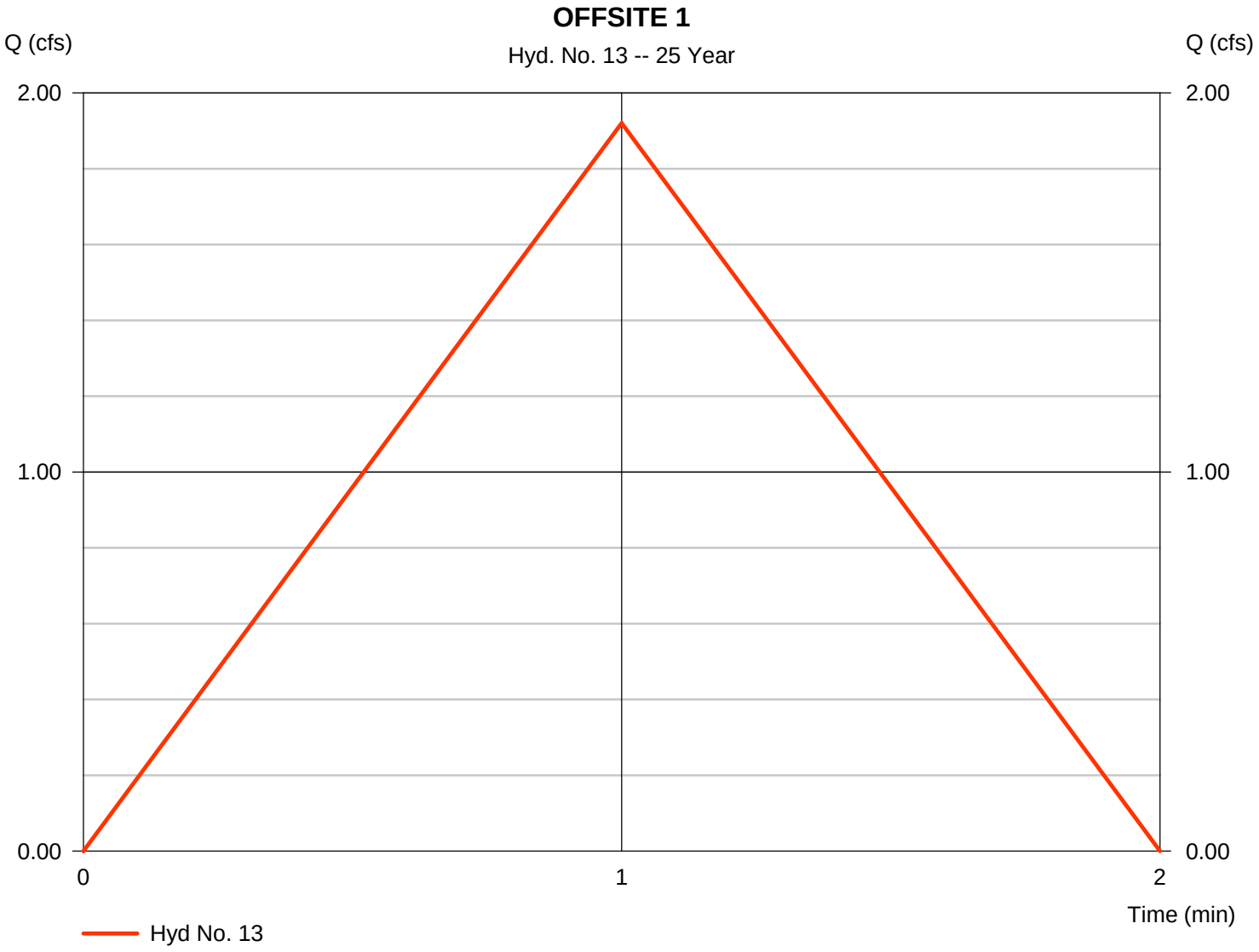


Hydrograph Report

Hyd. No. 13

OFFSITE 1

Hydrograph type	=	Rational	Peak discharge	=	1.920 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	115 cuft
Drainage area	=	0.593 ac	Runoff coeff.	=	0.32
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

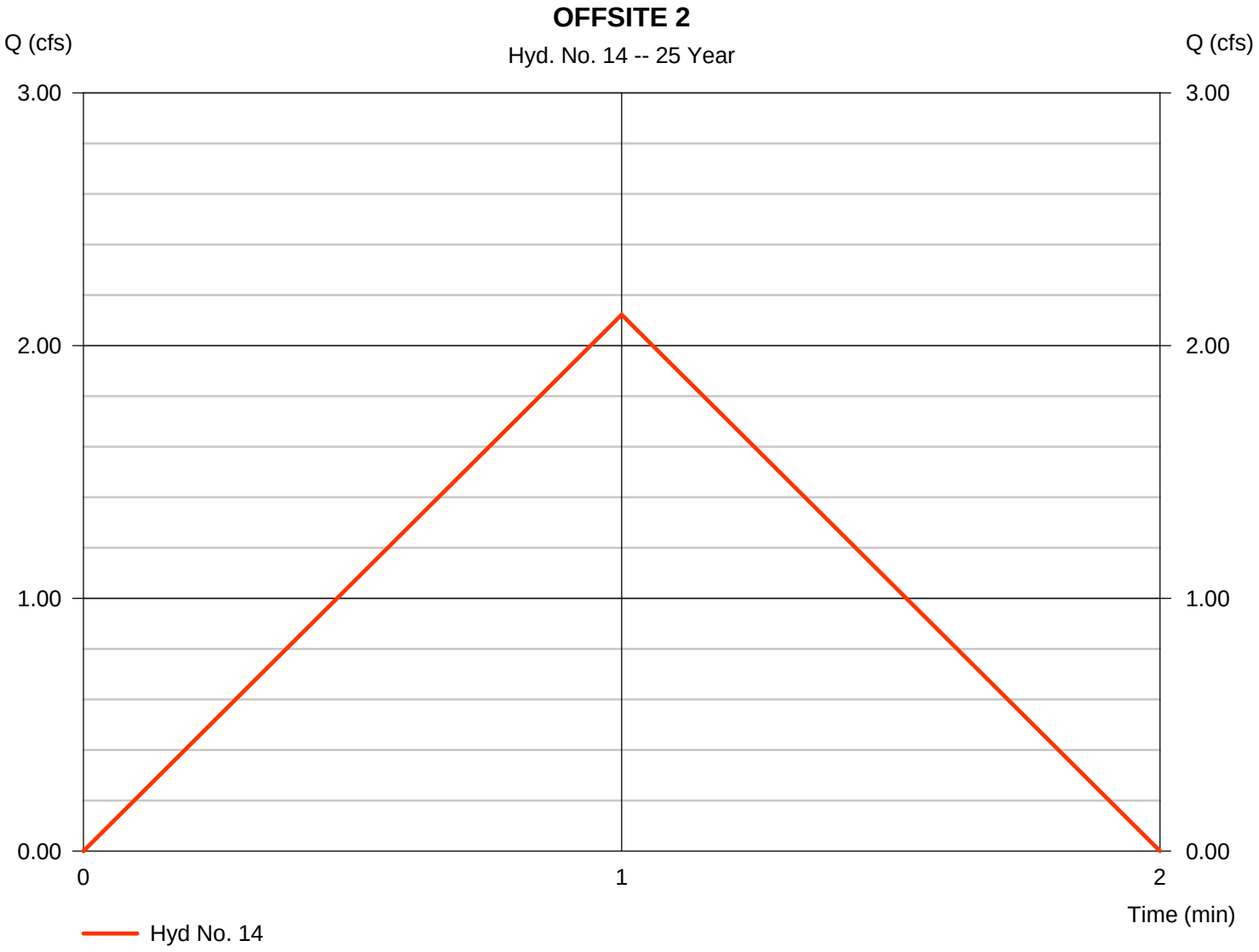


Hydrograph Report

Hyd. No. 14

OFFSITE 2

Hydrograph type	=	Rational	Peak discharge	=	2.122 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	127 cuft
Drainage area	=	0.233 ac	Runoff coeff.	=	0.9
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

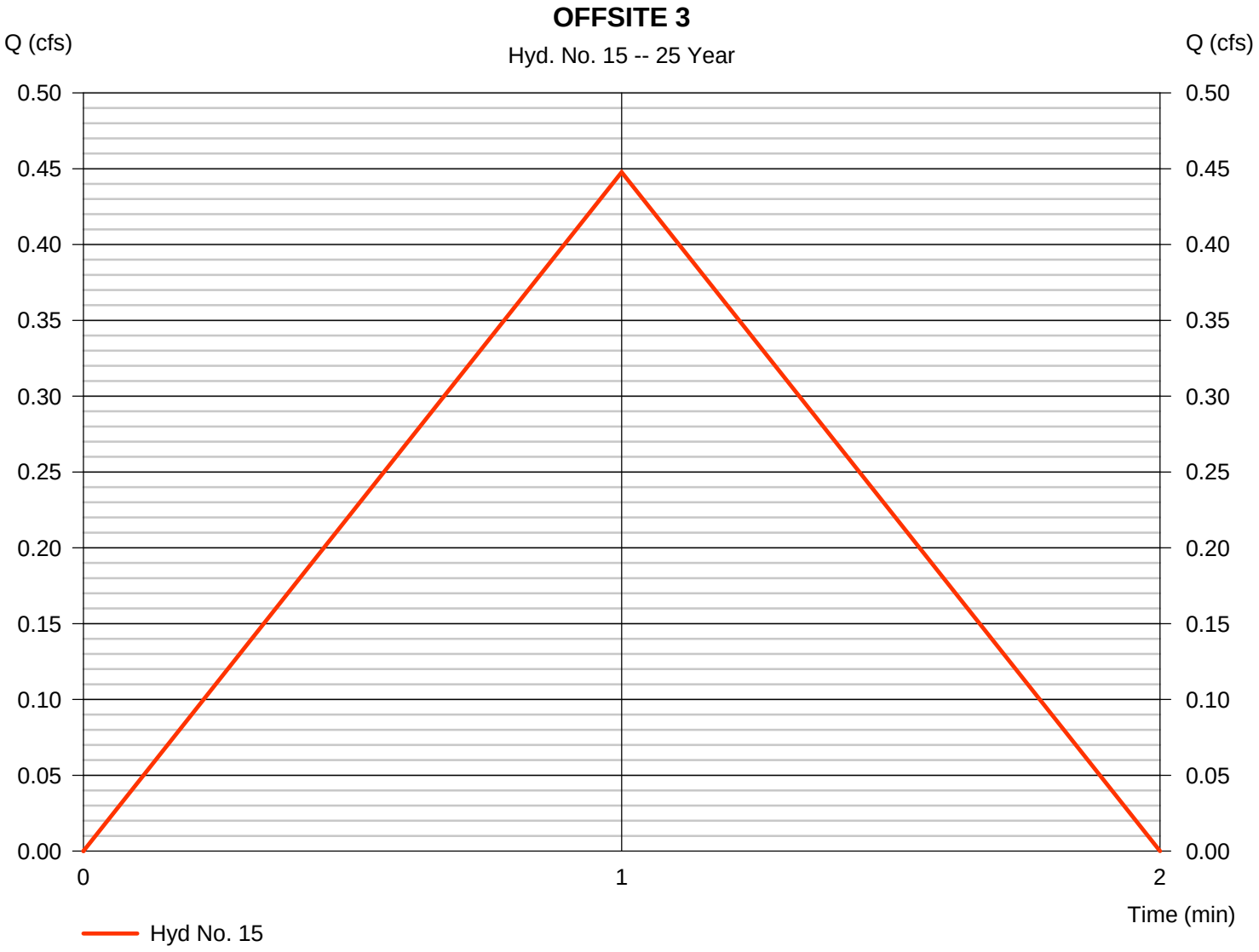


Hydrograph Report

Hyd. No. 15

OFFSITE 3

Hydrograph type	=	Rational	Peak discharge	=	0.448 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	27 cuft
Drainage area	=	0.056 ac	Runoff coeff.	=	0.79
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

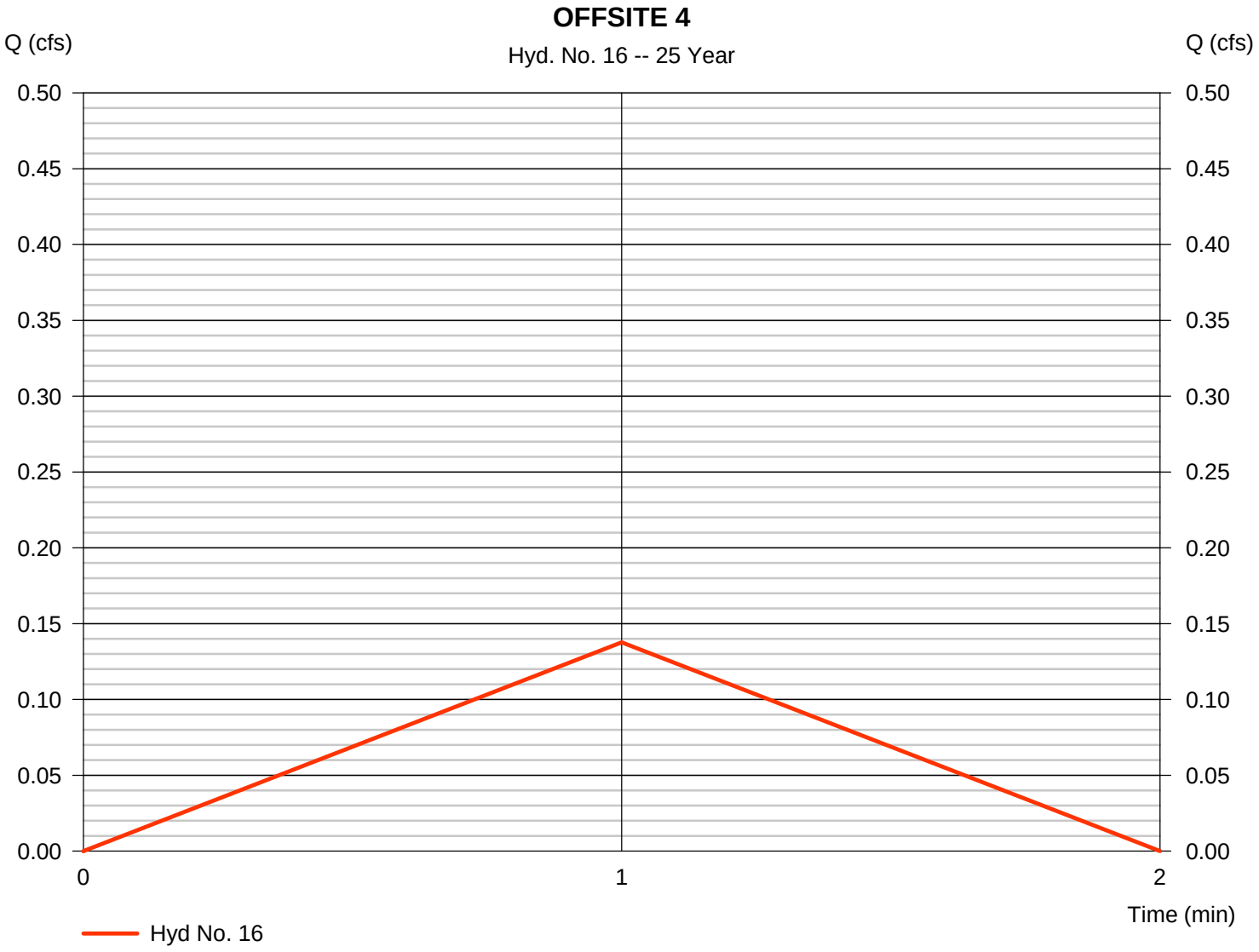


Hydrograph Report

Hyd. No. 16

OFFSITE 4

Hydrograph type	=	Rational	Peak discharge	=	0.138 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	8 cuft
Drainage area	=	0.068 ac	Runoff coeff.	=	0.2
Intensity	=	10.120 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

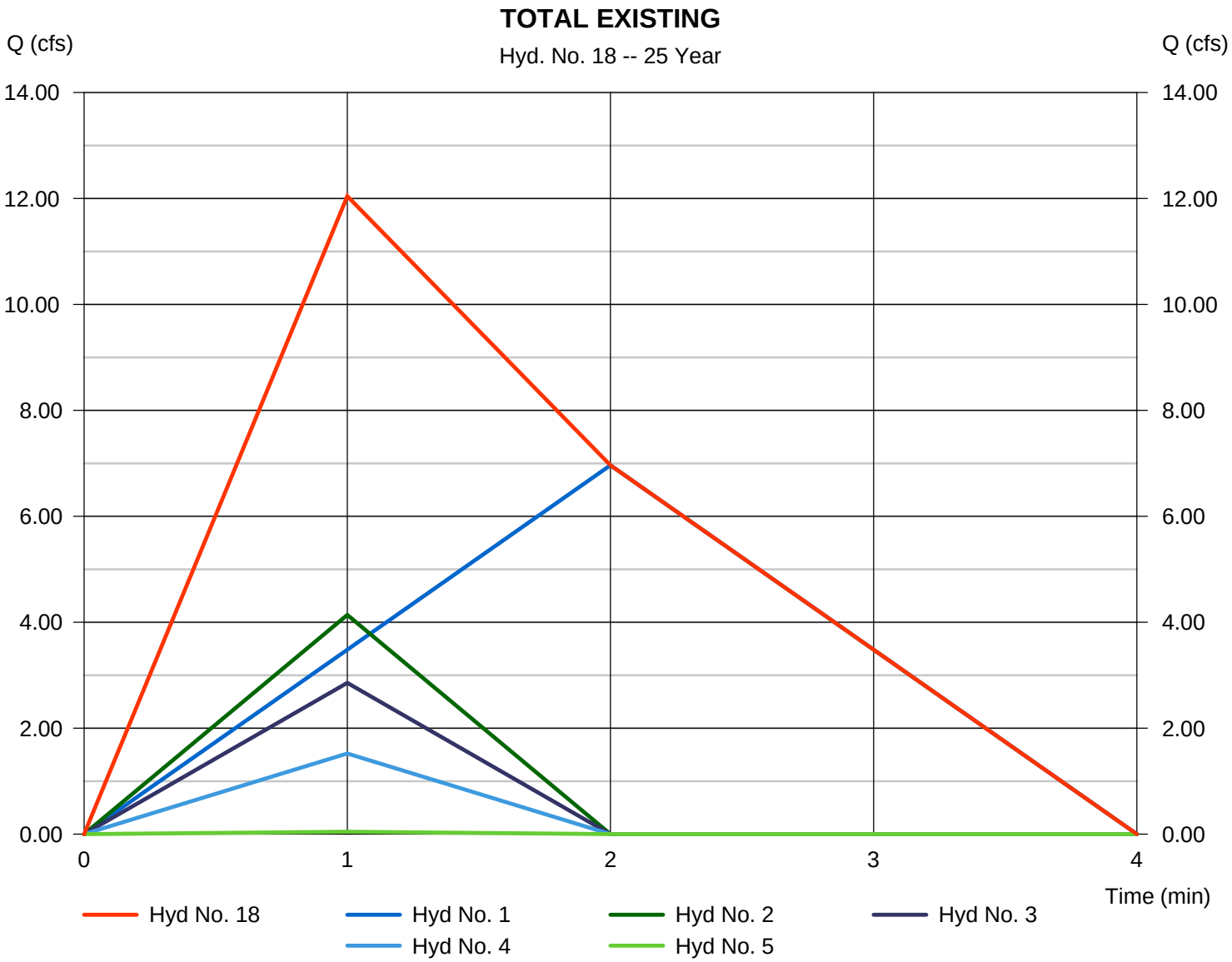


Hydrograph Report

Hyd. No. 18

TOTAL EXISTING

Hydrograph type	=	Combine	Peak discharge	=	12.04 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	1,349 cuft
Inflow hyds.	=	1, 2, 3, 4, 5	Contrib. drain. area	=	3.605 ac

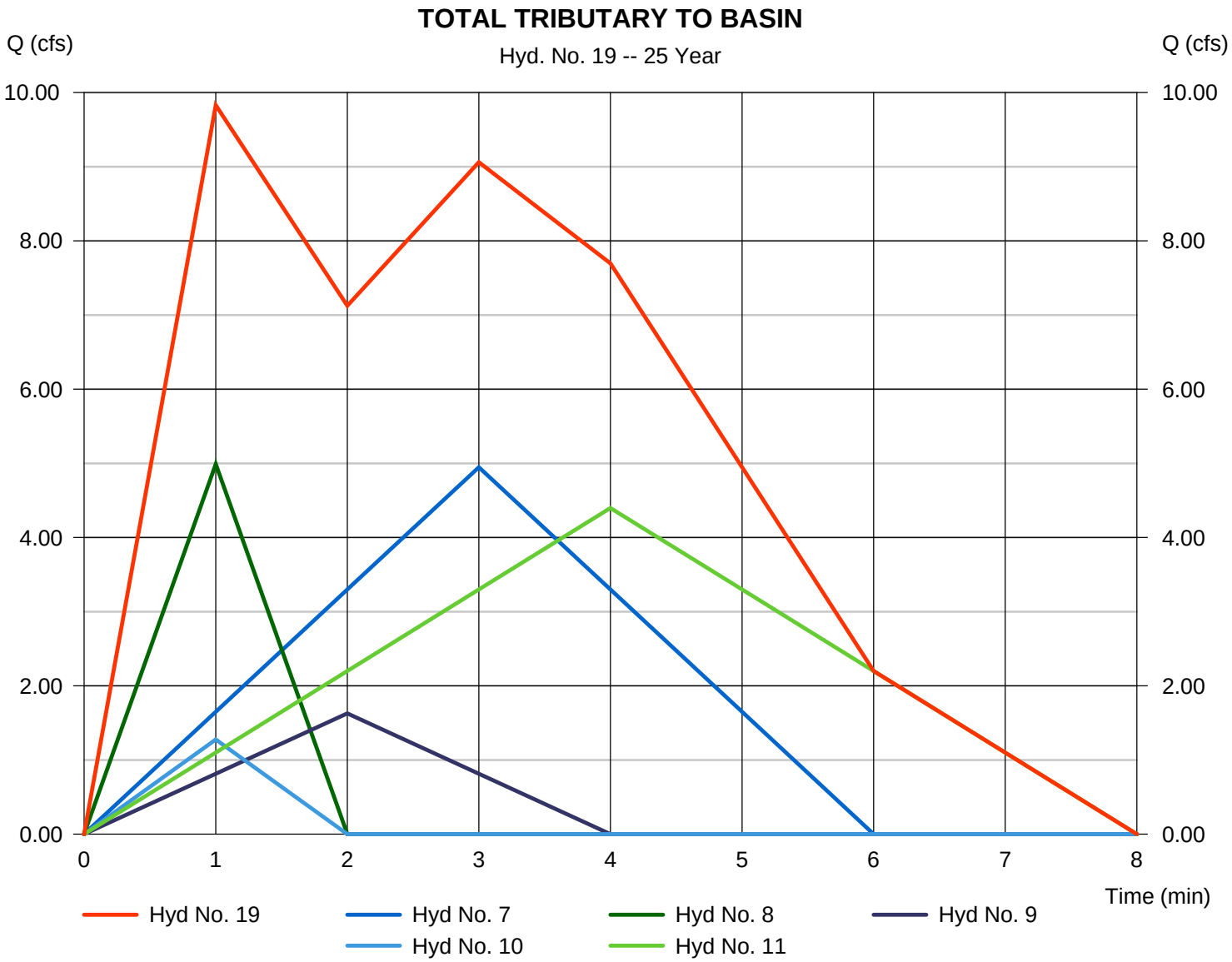


Hydrograph Report

Hyd. No. 19

TOTAL TRIBUTARY TO BASIN

Hydrograph type	= Combine	Peak discharge	= 9.829 cfs
Storm frequency	= 25 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 2,517 cuft
Inflow hyds.	= 7, 8, 9, 10, 11	Contrib. drain. area	= 2.655 ac

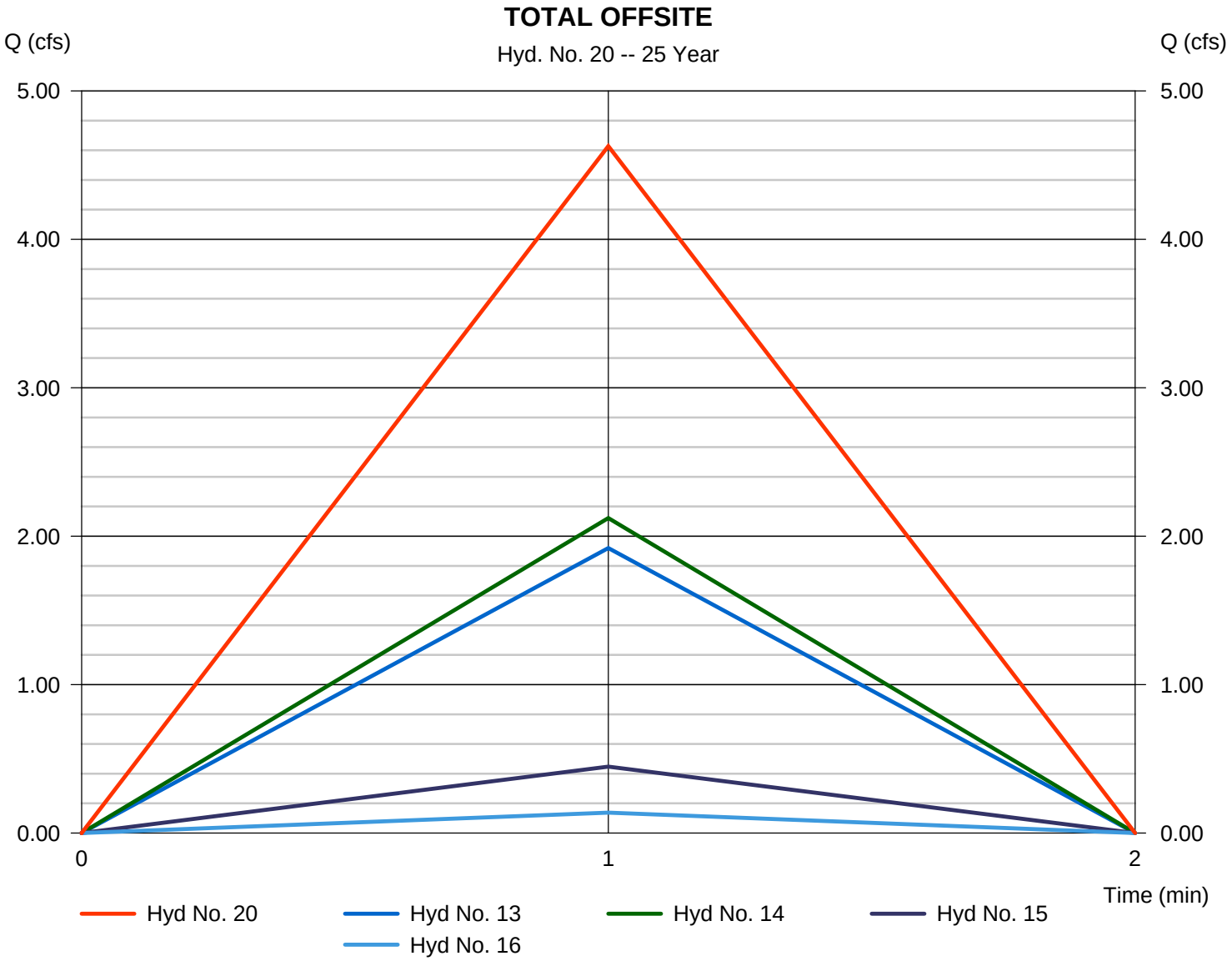


Hydrograph Report

Hyd. No. 20

TOTAL OFFSITE

Hydrograph type	=	Combine	Peak discharge	=	4.628 cfs
Storm frequency	=	25 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	278 cuft
Inflow hyds.	=	13, 14, 15, 16	Contrib. drain. area	=	0.950 ac



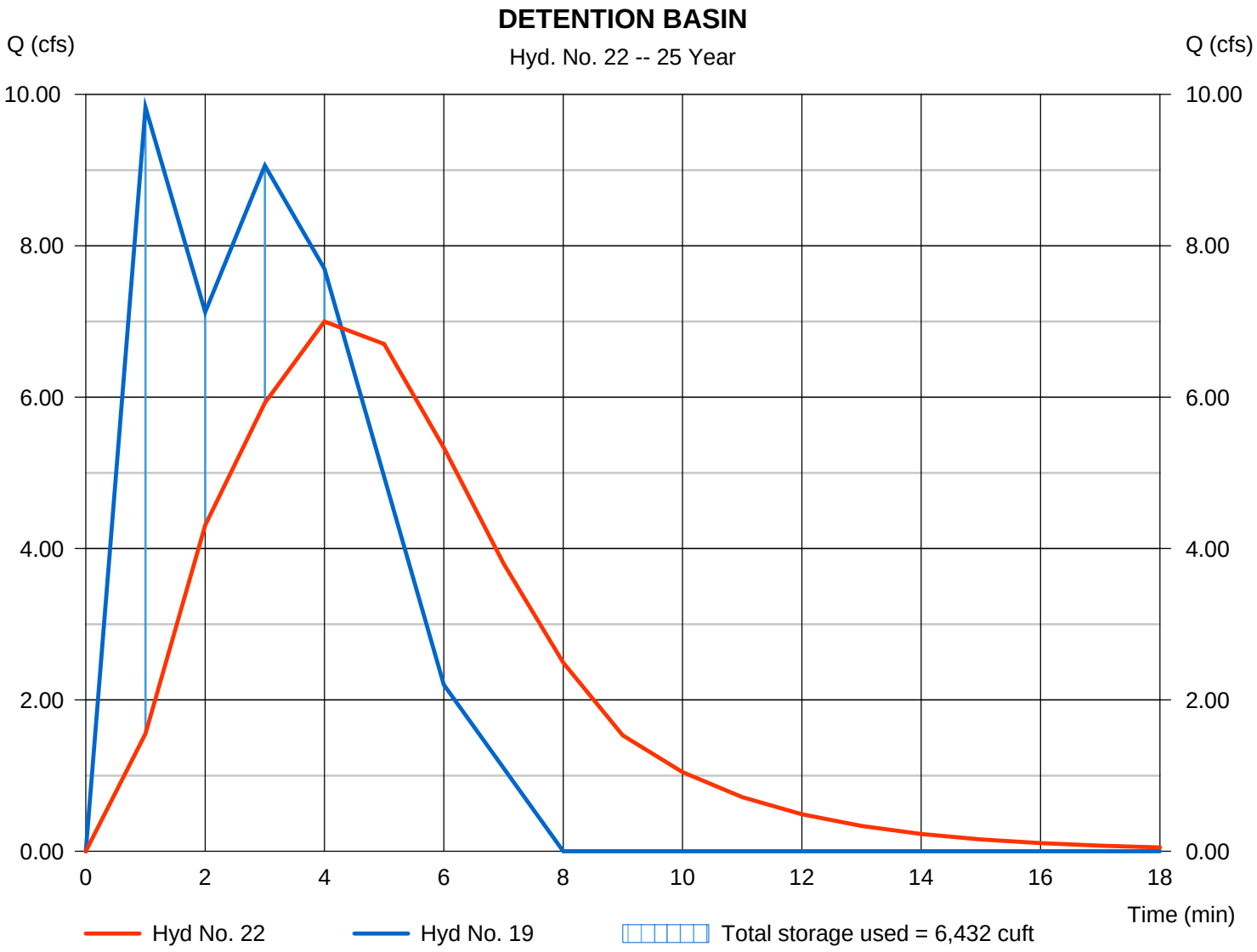
Hydrograph Report

Hyd. No. 22

DETENTION BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	7.000 cfs
Storm frequency	=	25 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	2,517 cuft
Inflow hyd. No.	=	19 - TOTAL TRIBUTARY TO BASIN	Max. Elevation	=	559.17 ft
Reservoir name	=	DETENTION	Max. Storage	=	6,432 cuft

Storage Indication method used. Wet pond routing start elevation = 558.90 ft.

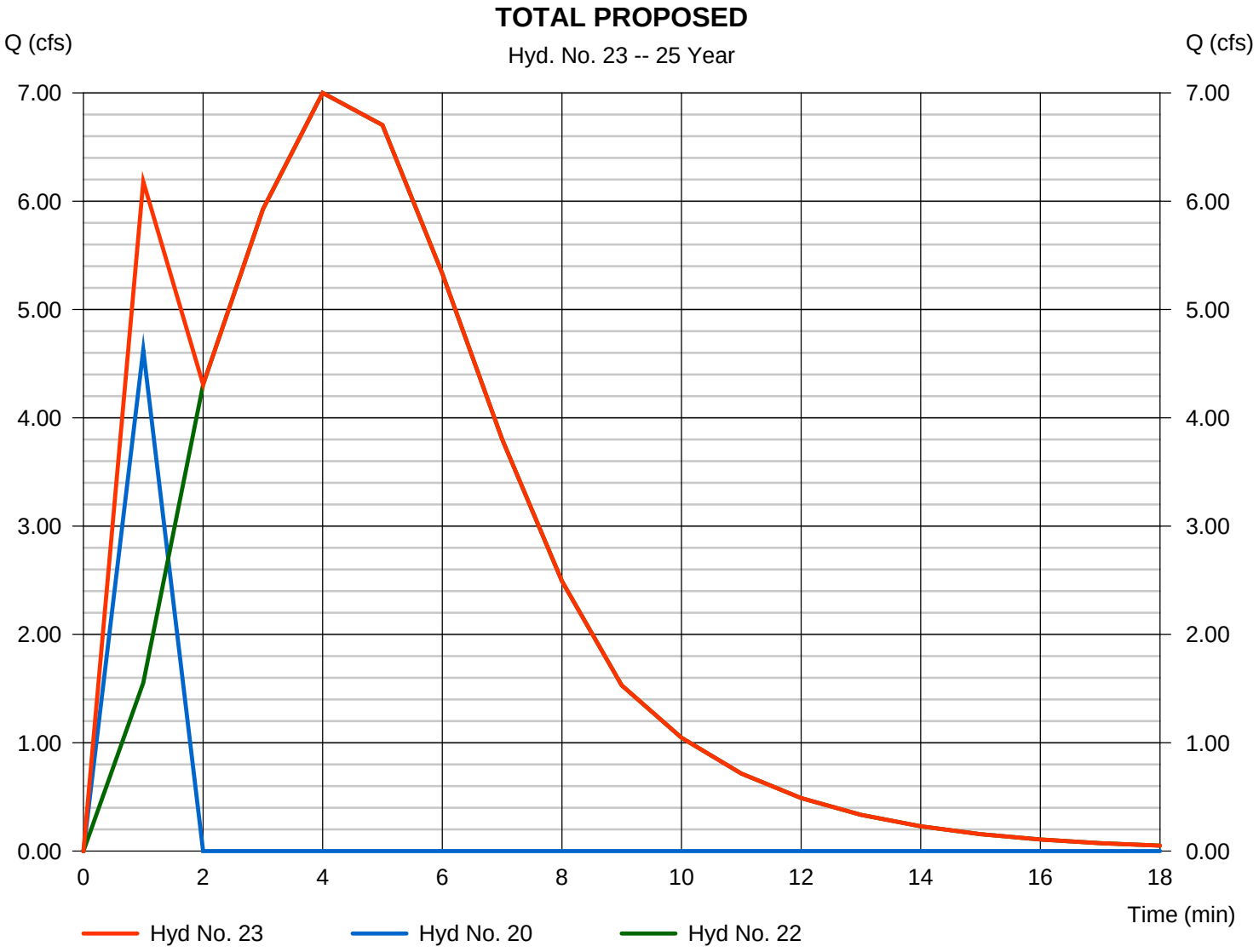


Hydrograph Report

Hyd. No. 23

TOTAL PROPOSED

Hydrograph type	= Combine	Peak discharge	= 7.000 cfs
Storm frequency	= 25 yrs	Time to peak	= 4 min
Time interval	= 1 min	Hyd. volume	= 2,795 cuft
Inflow hyds.	= 20, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

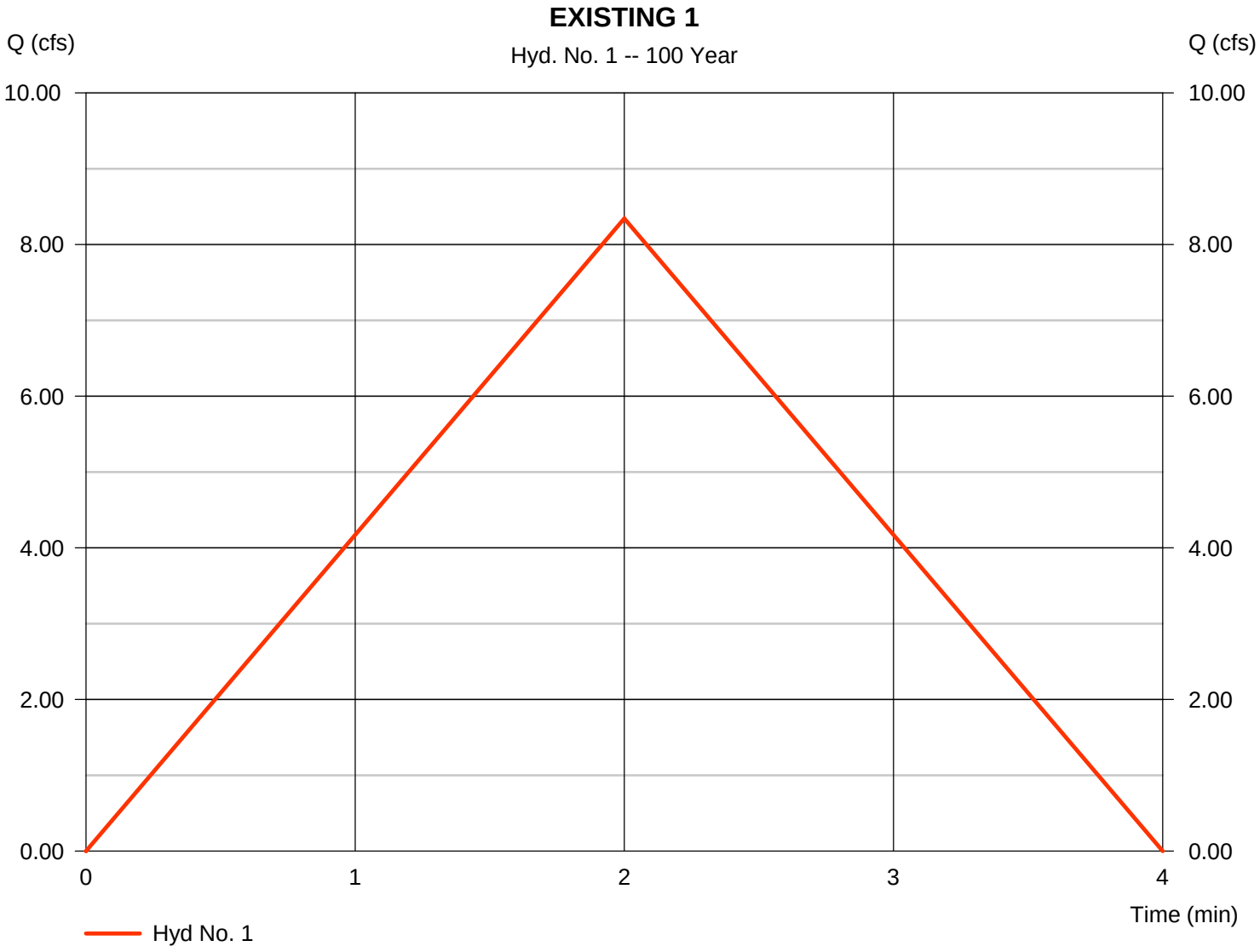
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	8.343	1	2	1,001	------	------	------	EXISTING 1
2	Rational	4.973	1	1	298	------	------	------	EXISTING 2
3	Rational	3.430	1	1	206	------	------	------	EXISTING 3
4	Rational	1.828	1	1	110	------	------	------	EXISTING 4
5	Rational	0.053	1	1	3	------	------	------	EXISTING 5
7	Rational	5.917	1	3	1,065	------	------	------	POST DEVELOPED 1
8	Rational	5.994	1	1	360	------	------	------	POST DEVELOPED 2
9	Rational	1.951	1	2	234	------	------	------	POST DEVELOPED 3
10	Rational	1.534	1	1	92	------	------	------	POST DEVELOPED 4
11	Rational	5.252	1	4	1,261	------	------	------	POST DEVELOPED 5
13	Rational	2.307	1	1	138	------	------	------	OFFSITE 1
14	Rational	2.549	1	1	153	------	------	------	OFFSITE 2
15	Rational	0.538	1	1	32	------	------	------	OFFSITE 3
16	Rational	0.165	1	1	10	------	------	------	OFFSITE 4
18	Combine	14.46	1	1	1,618	1, 2, 3, 4, 5,	------	------	TOTAL EXISTING
19	Combine	11.79	1	1	3,011	7, 8, 9, 10, 11,	------	------	TOTAL TRIBUTARY TO BASIN
20	Combine	5.559	1	1	334	13, 14, 15, 16,	------	------	TOTAL OFFSITE
22	Reservoir	8.204	1	4	3,011	19	559.22	6,593	DETENTION BASIN
23	Combine	8.204	1	4	3,345	20, 22	------	------	TOTAL PROPOSED

Hydrograph Report

Hyd. No. 1

EXISTING 1

Hydrograph type	=	Rational	Peak discharge	=	8.343 cfs
Storm frequency	=	100 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	1,001 cuft
Drainage area	=	1.910 ac	Runoff coeff.	=	0.38
Intensity	=	11.495 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

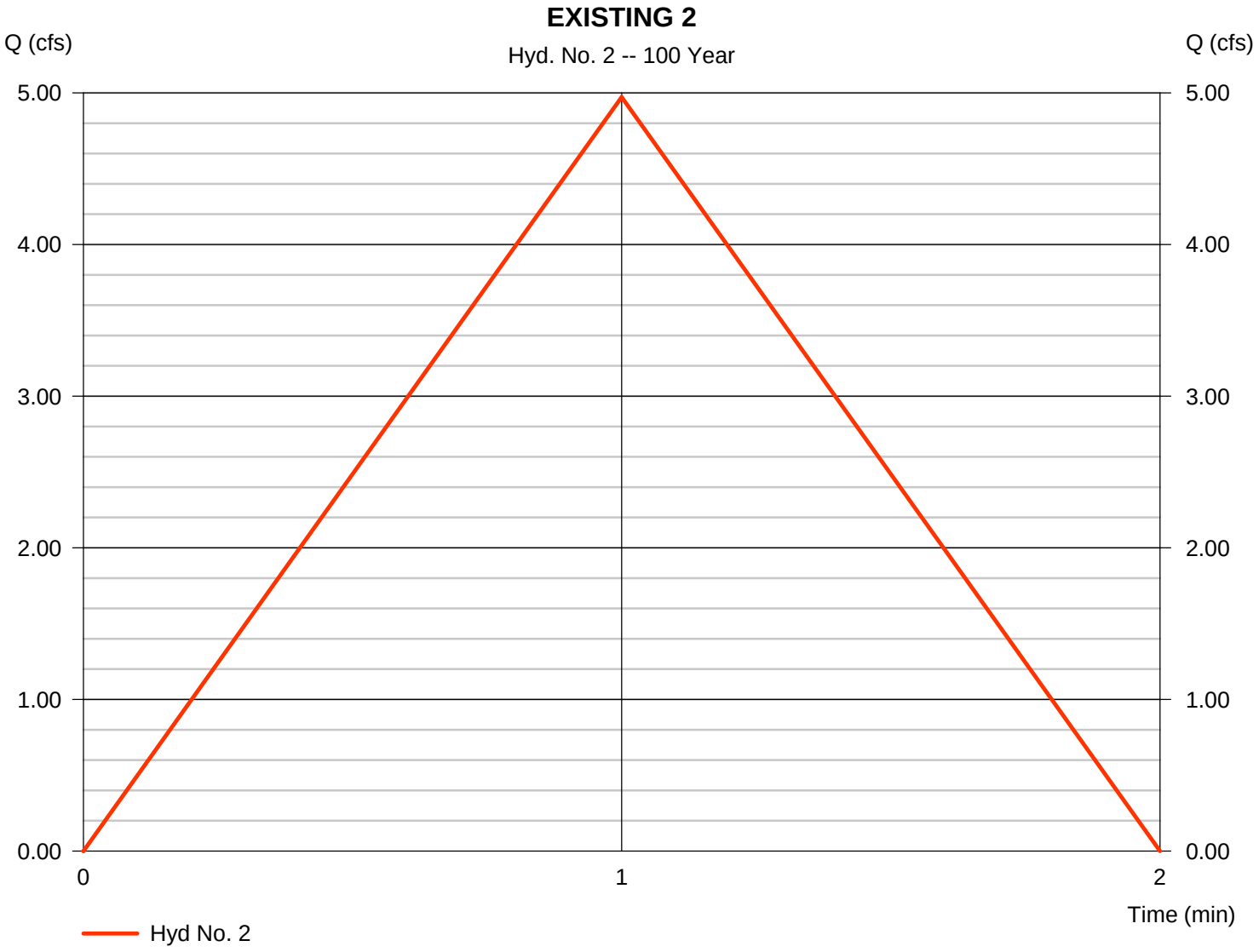


Hydrograph Report

Hyd. No. 2

EXISTING 2

Hydrograph type	=	Rational	Peak discharge	=	4.973 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	298 cuft
Drainage area	=	0.802 ac	Runoff coeff.	=	0.51
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

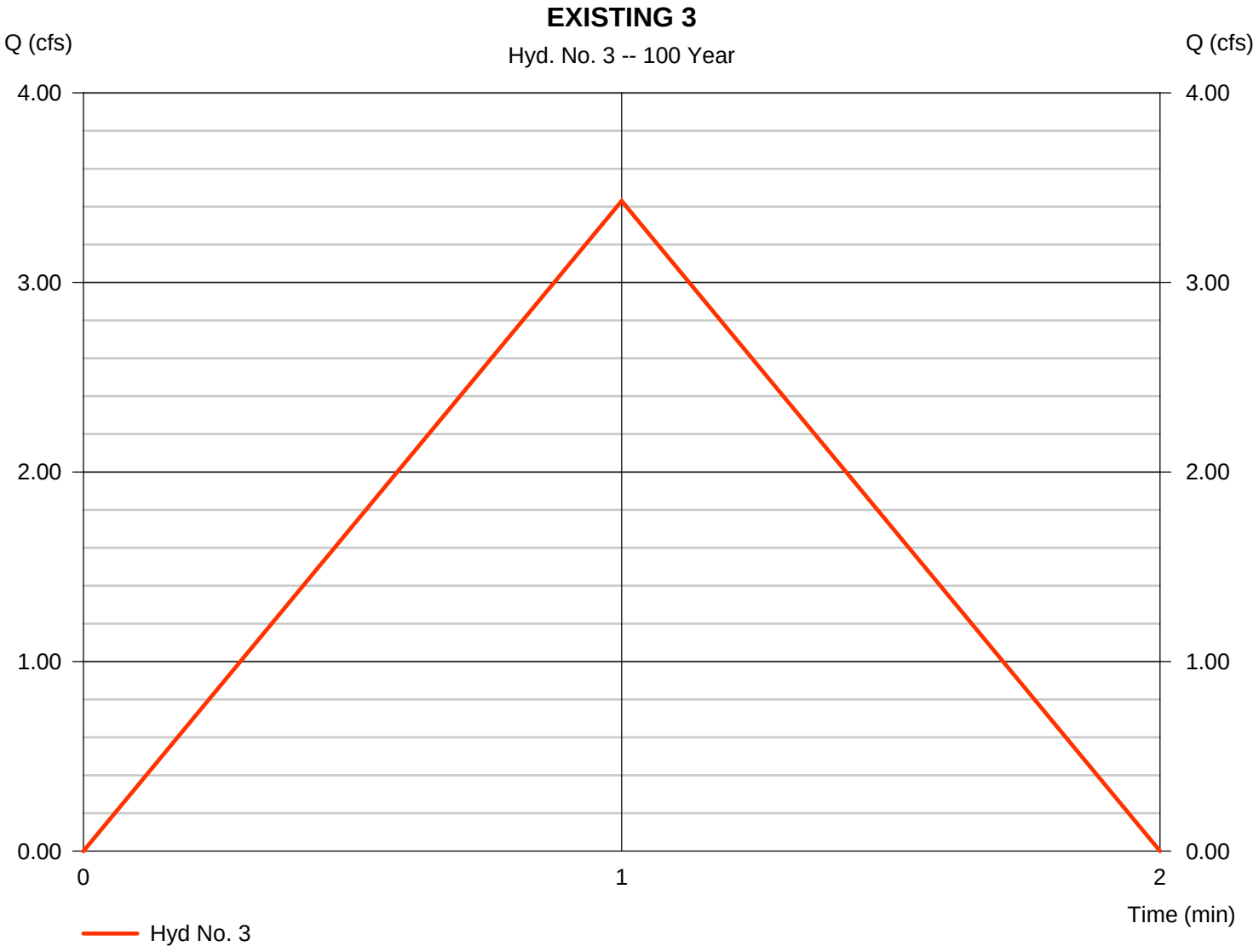


Hydrograph Report

Hyd. No. 3

EXISTING 3

Hydrograph type	=	Rational	Peak discharge	=	3.430 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	206 cuft
Drainage area	=	0.495 ac	Runoff coeff.	=	0.57
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

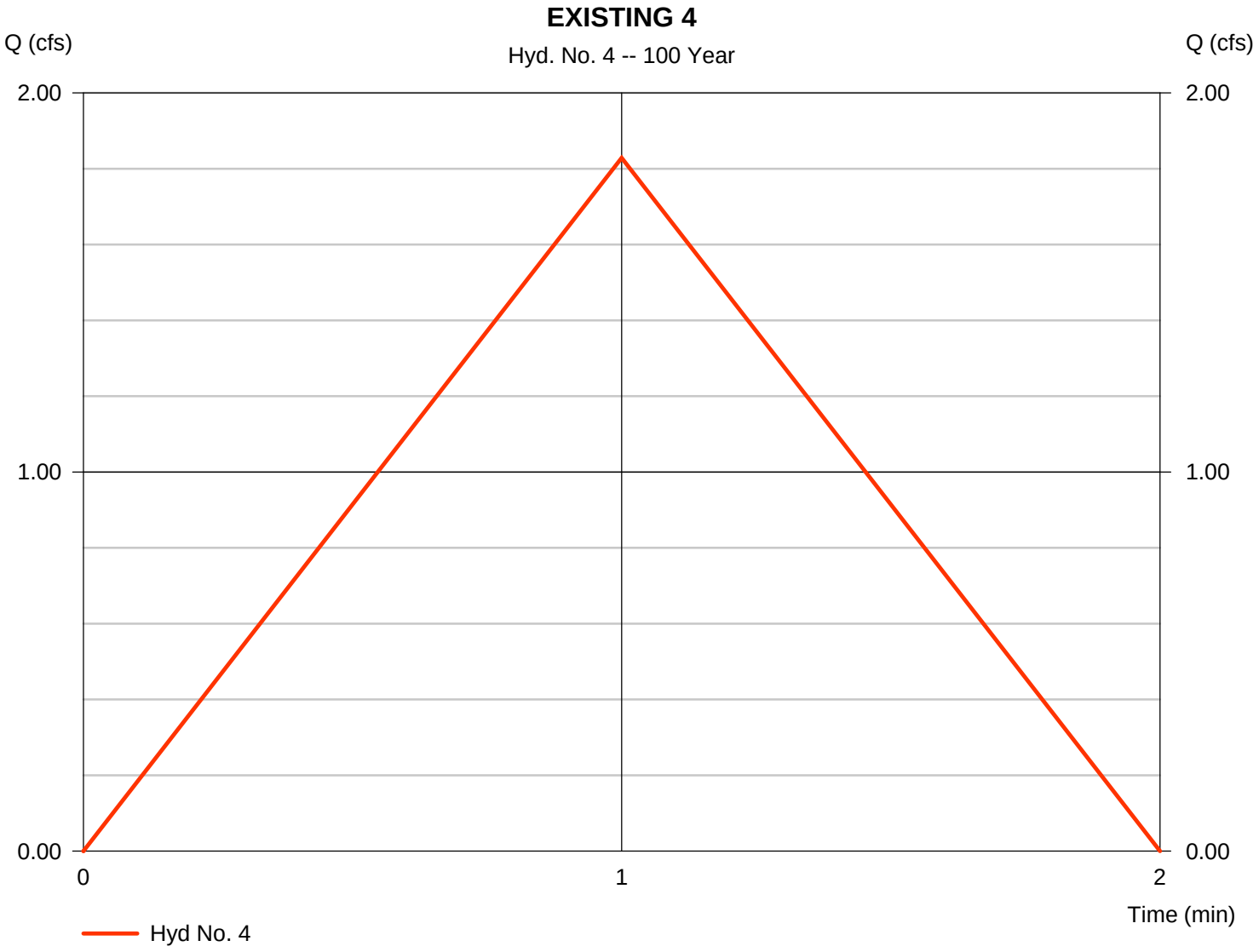


Hydrograph Report

Hyd. No. 4

EXISTING 4

Hydrograph type	=	Rational	Peak discharge	=	1.828 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	110 cuft
Drainage area	=	0.376 ac	Runoff coeff.	=	0.4
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

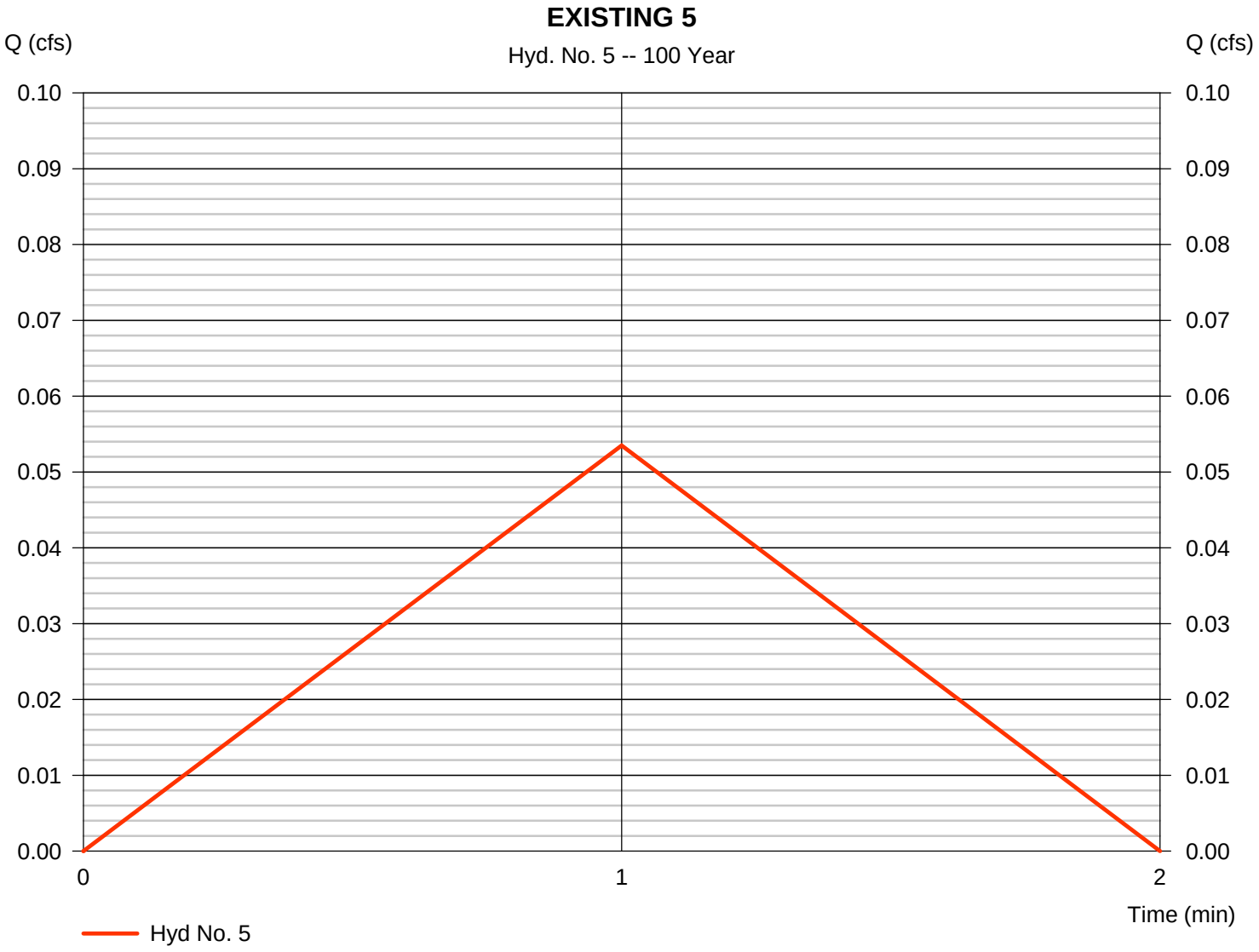


Hydrograph Report

Hyd. No. 5

EXISTING 5

Hydrograph type	=	Rational	Peak discharge	=	0.053 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	3 cuft
Drainage area	=	0.022 ac	Runoff coeff.	=	0.2
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

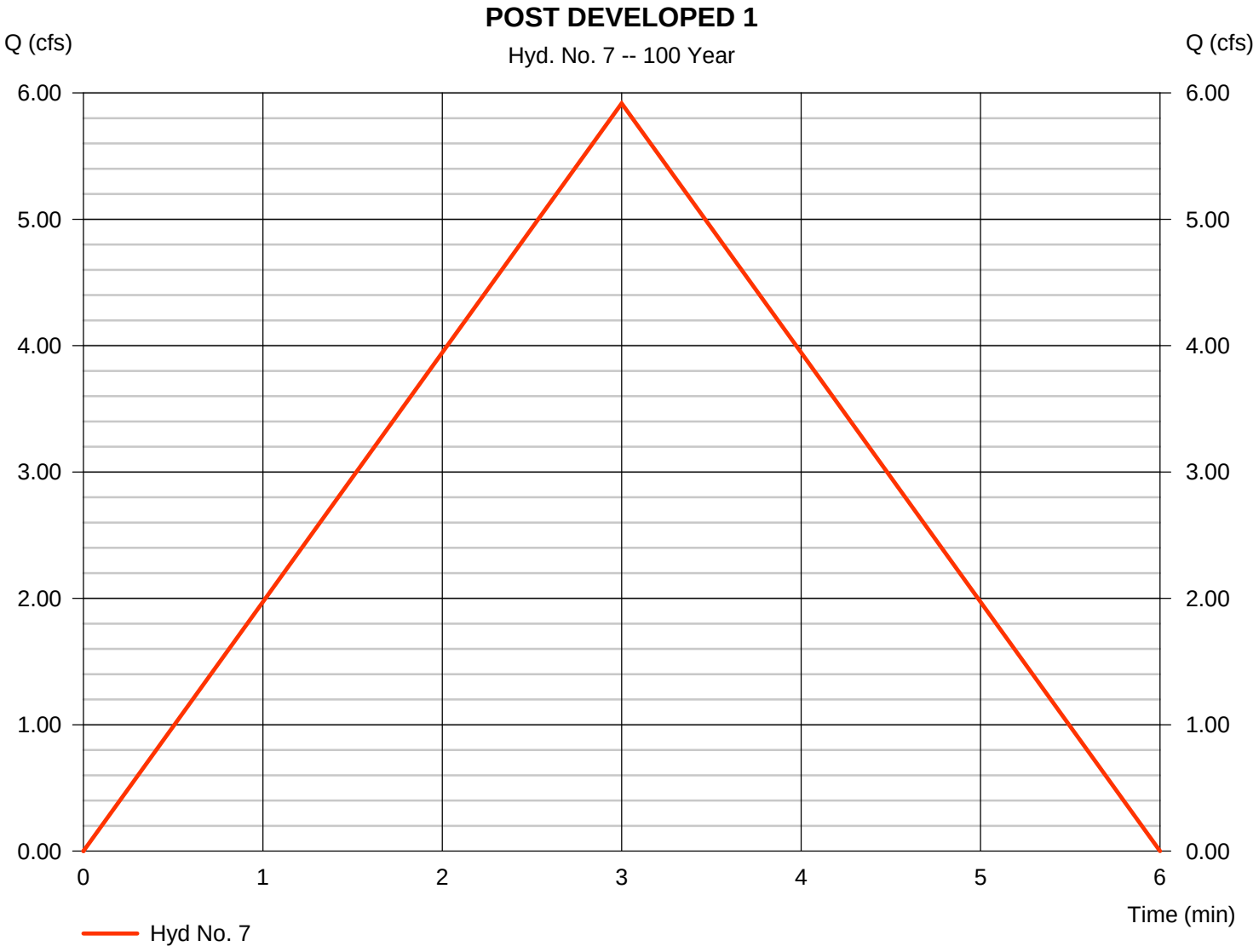


Hydrograph Report

Hyd. No. 7

POST DEVELOPED 1

Hydrograph type	=	Rational	Peak discharge	=	5.917 cfs
Storm frequency	=	100 yrs	Time to peak	=	3 min
Time interval	=	1 min	Hyd. volume	=	1,065 cuft
Drainage area	=	1.004 ac	Runoff coeff.	=	0.54
Intensity	=	10.914 in/hr	Tc by User	=	3.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

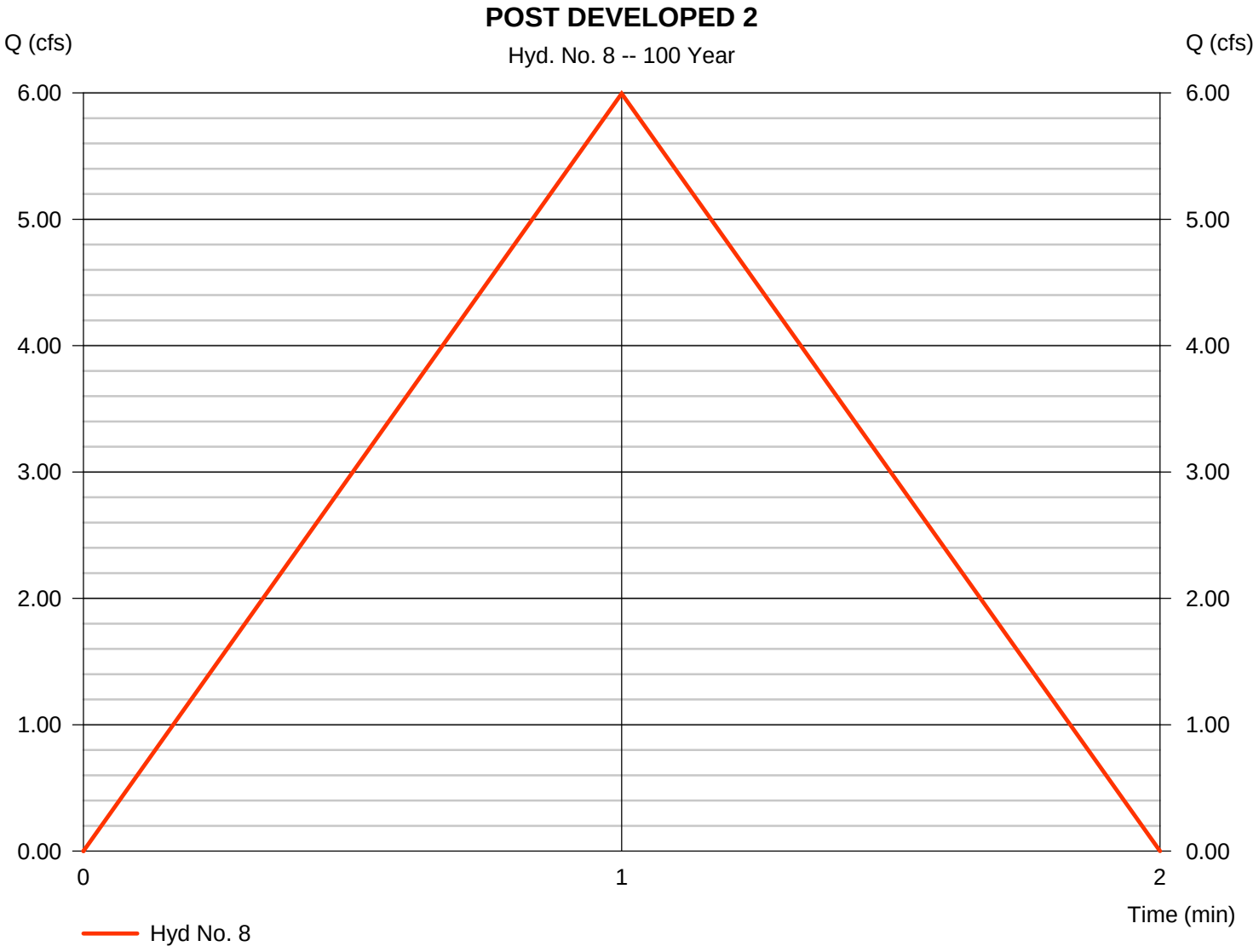


Hydrograph Report

Hyd. No. 8

POST DEVELOPED 2

Hydrograph type	=	Rational	Peak discharge	=	5.994 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	360 cuft
Drainage area	=	0.554 ac	Runoff coeff.	=	0.89
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

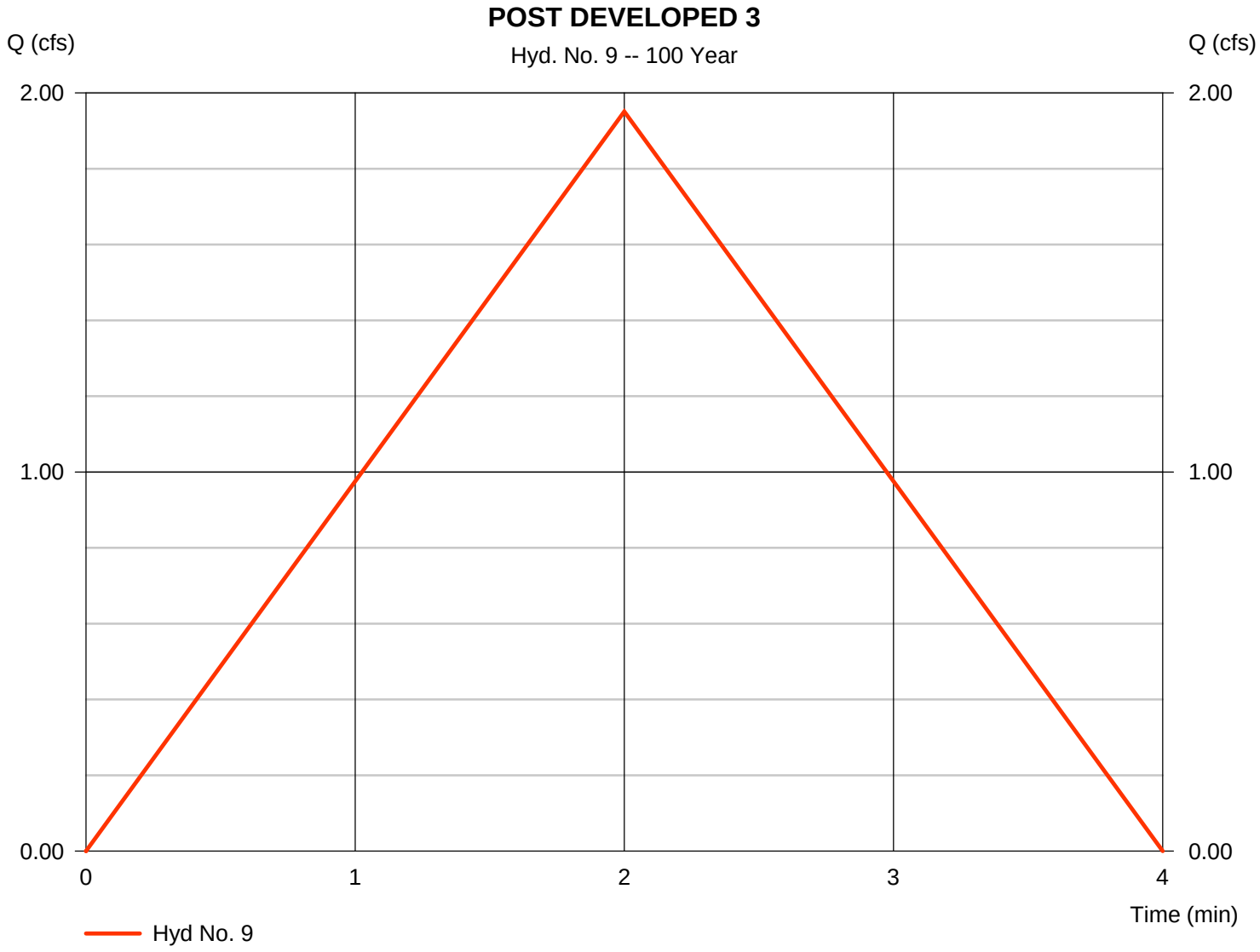


Hydrograph Report

Hyd. No. 9

POST DEVELOPED 3

Hydrograph type	=	Rational	Peak discharge	=	1.951 cfs
Storm frequency	=	100 yrs	Time to peak	=	2 min
Time interval	=	1 min	Hyd. volume	=	234 cuft
Drainage area	=	0.239 ac	Runoff coeff.	=	0.71
Intensity	=	11.495 in/hr	Tc by User	=	2.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

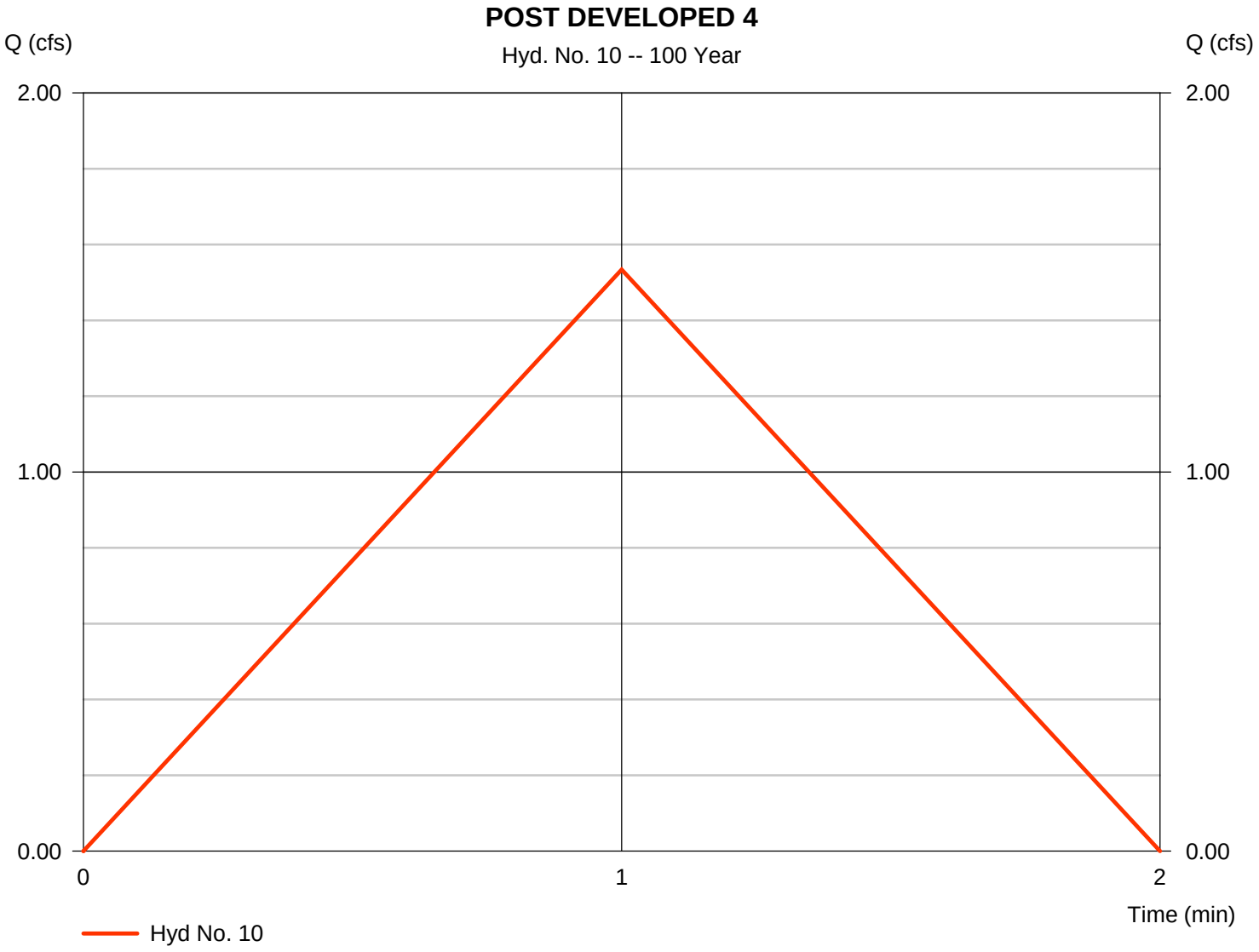


Hydrograph Report

Hyd. No. 10

POST DEVELOPED 4

Hydrograph type	=	Rational	Peak discharge	=	1.534 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	92 cuft
Drainage area	=	0.166 ac	Runoff coeff.	=	0.76
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

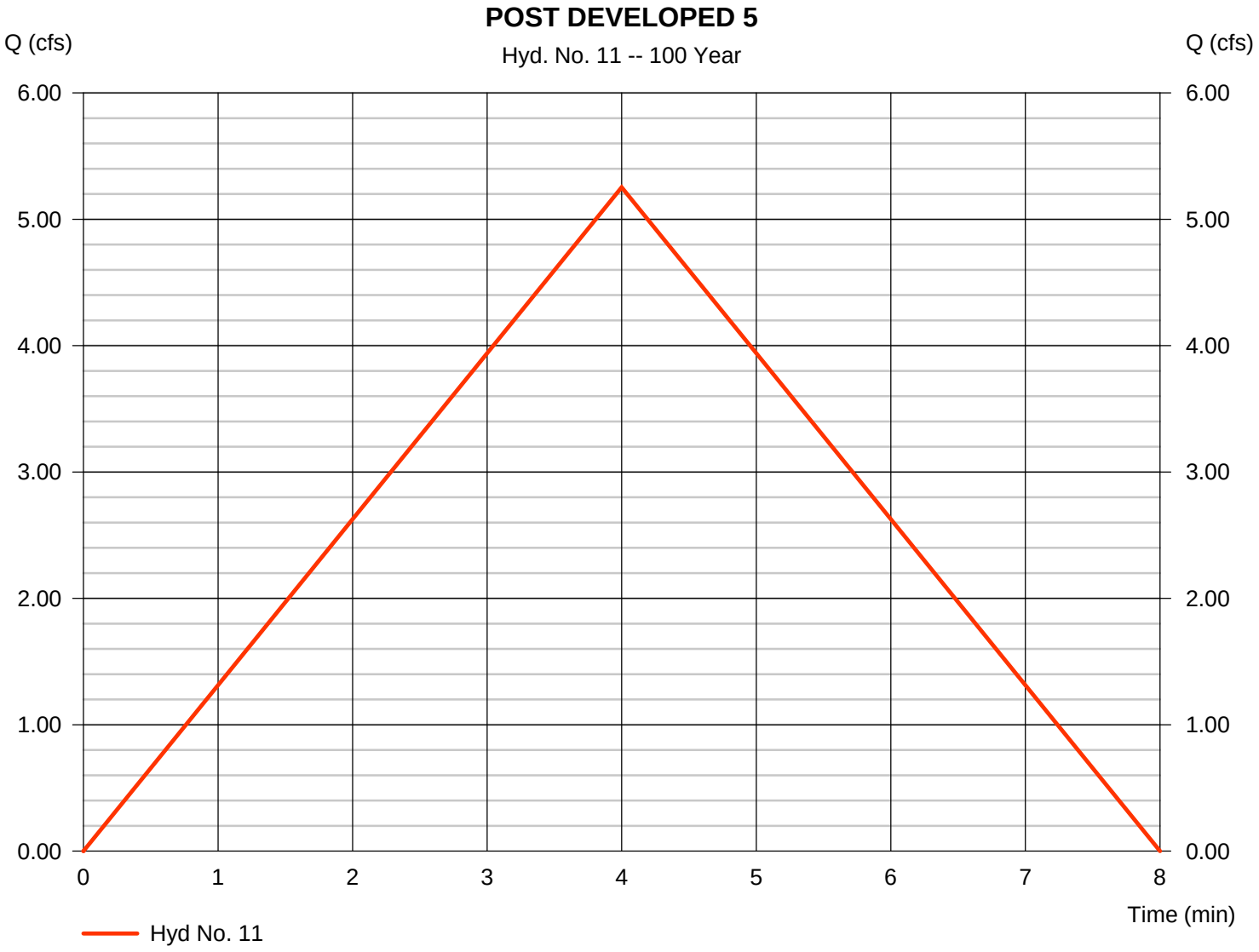


Hydrograph Report

Hyd. No. 11

POST DEVELOPED 5

Hydrograph type	=	Rational	Peak discharge	=	5.252 cfs
Storm frequency	=	100 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	1,261 cuft
Drainage area	=	0.692 ac	Runoff coeff.	=	0.73
Intensity	=	10.398 in/hr	Tc by User	=	4.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

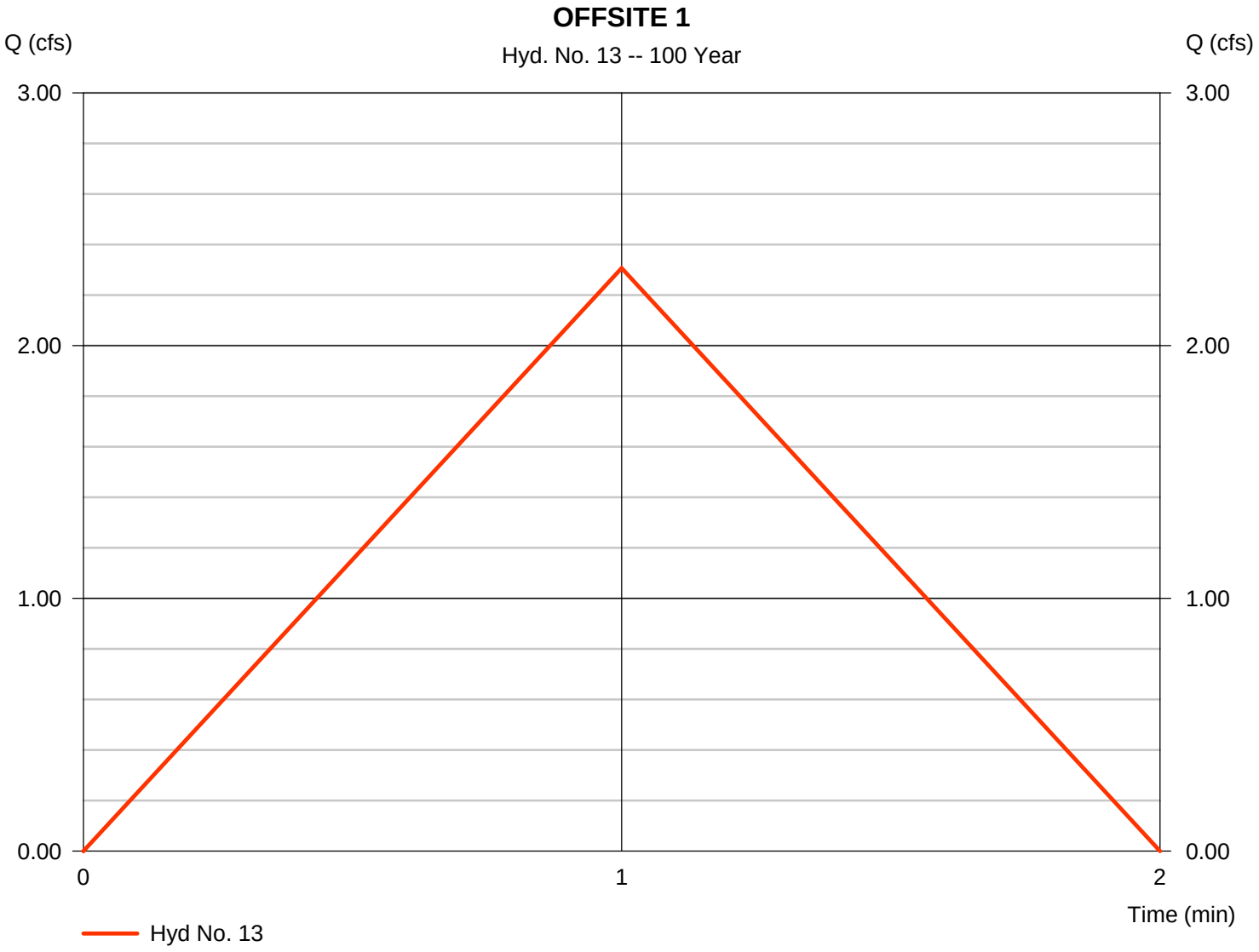


Hydrograph Report

Hyd. No. 13

OFFSITE 1

Hydrograph type	=	Rational	Peak discharge	=	2.307 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	138 cuft
Drainage area	=	0.593 ac	Runoff coeff.	=	0.32
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

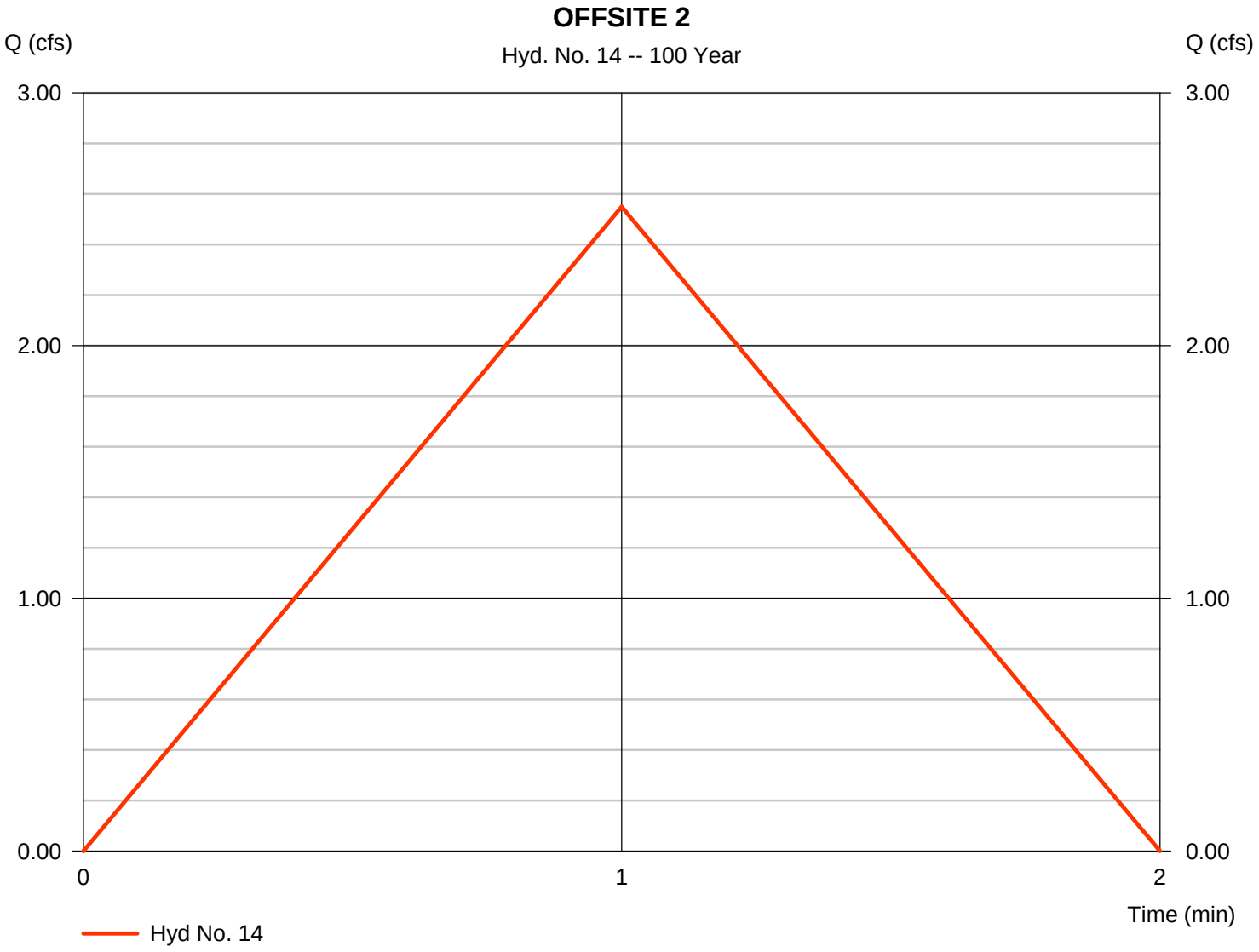


Hydrograph Report

Hyd. No. 14

OFFSITE 2

Hydrograph type	=	Rational	Peak discharge	=	2.549 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	153 cuft
Drainage area	=	0.233 ac	Runoff coeff.	=	0.9
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

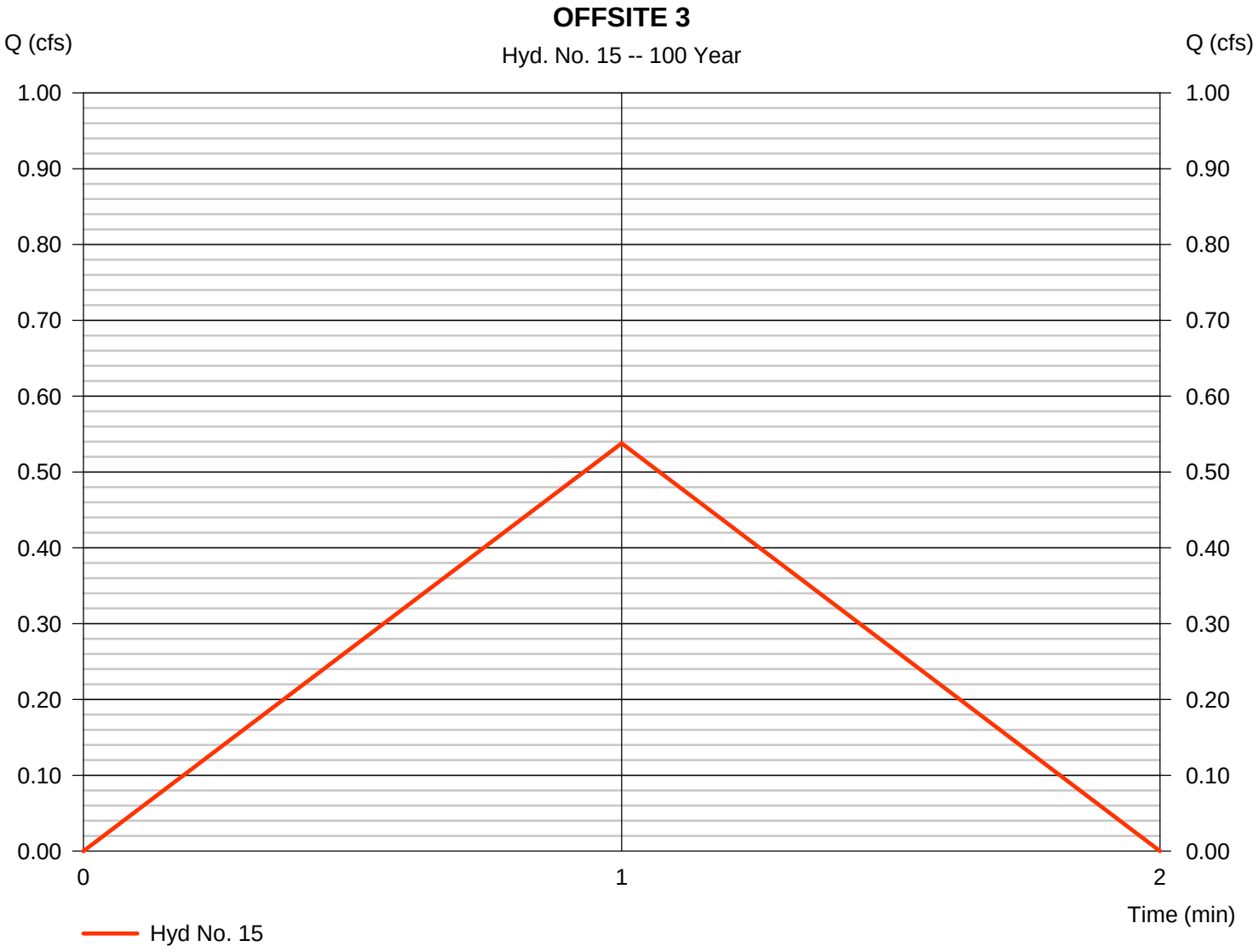


Hydrograph Report

Hyd. No. 15

OFFSITE 3

Hydrograph type	=	Rational	Peak discharge	=	0.538 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	32 cuft
Drainage area	=	0.056 ac	Runoff coeff.	=	0.79
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

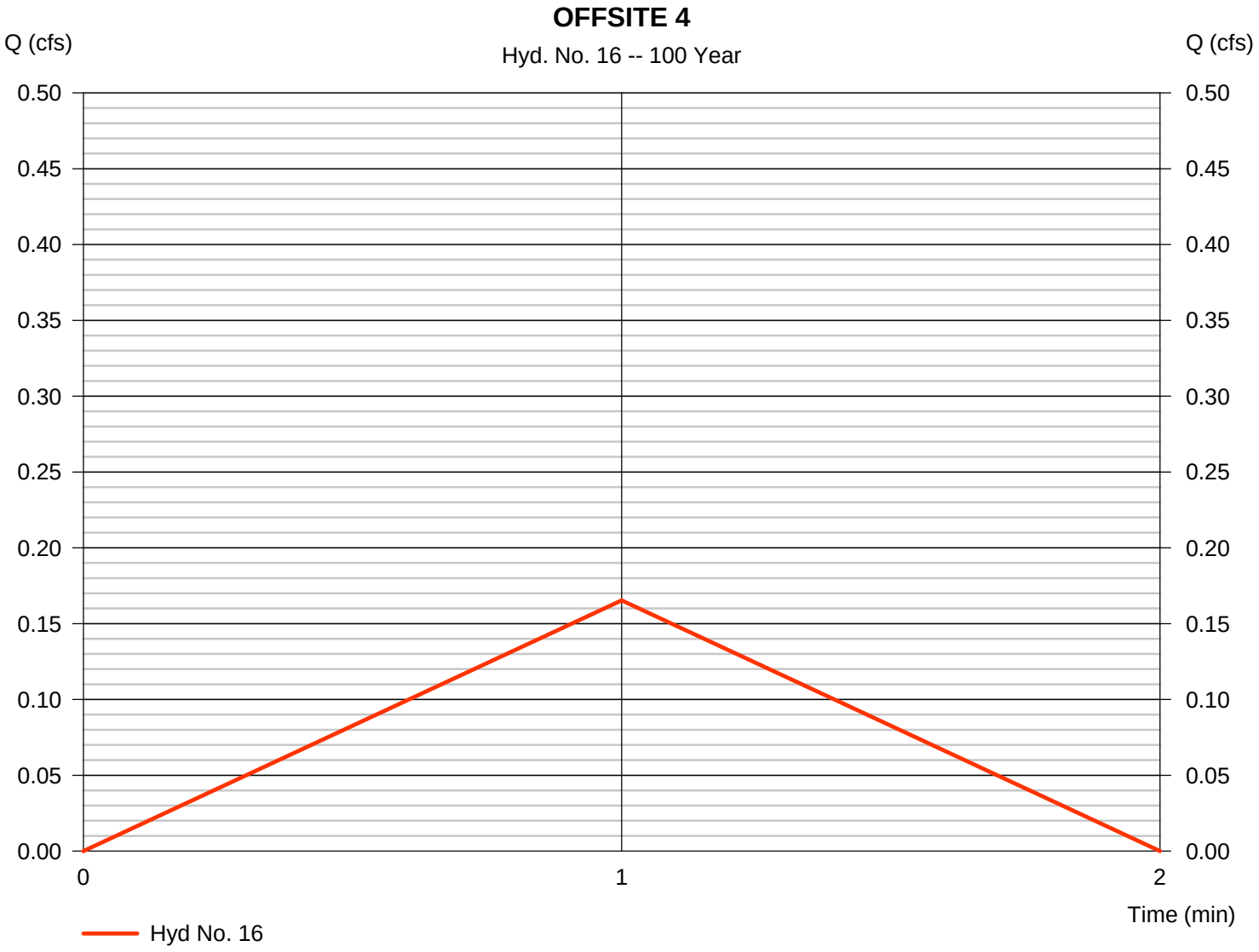


Hydrograph Report

Hyd. No. 16

OFFSITE 4

Hydrograph type	=	Rational	Peak discharge	=	0.165 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	10 cuft
Drainage area	=	0.068 ac	Runoff coeff.	=	0.2
Intensity	=	12.157 in/hr	Tc by User	=	1.00 min
IDF Curve	=	MoDOT St. Louis IDF Curve.IDF	Asc/Rec limb fact	=	1/1

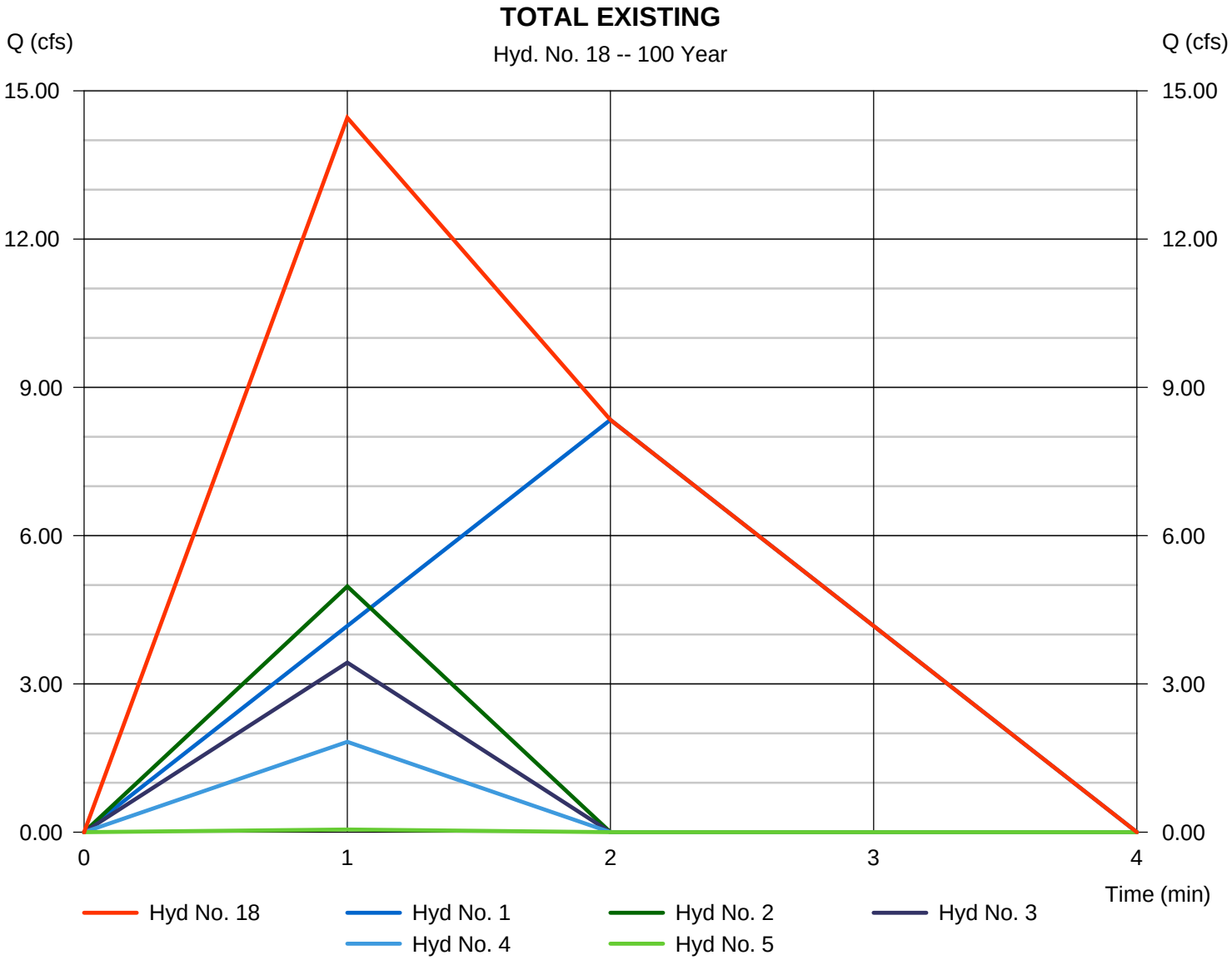


Hydrograph Report

Hyd. No. 18

TOTAL EXISTING

Hydrograph type	=	Combine	Peak discharge	=	14.46 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	1,618 cuft
Inflow hyds.	=	1, 2, 3, 4, 5	Contrib. drain. area	=	3.605 ac

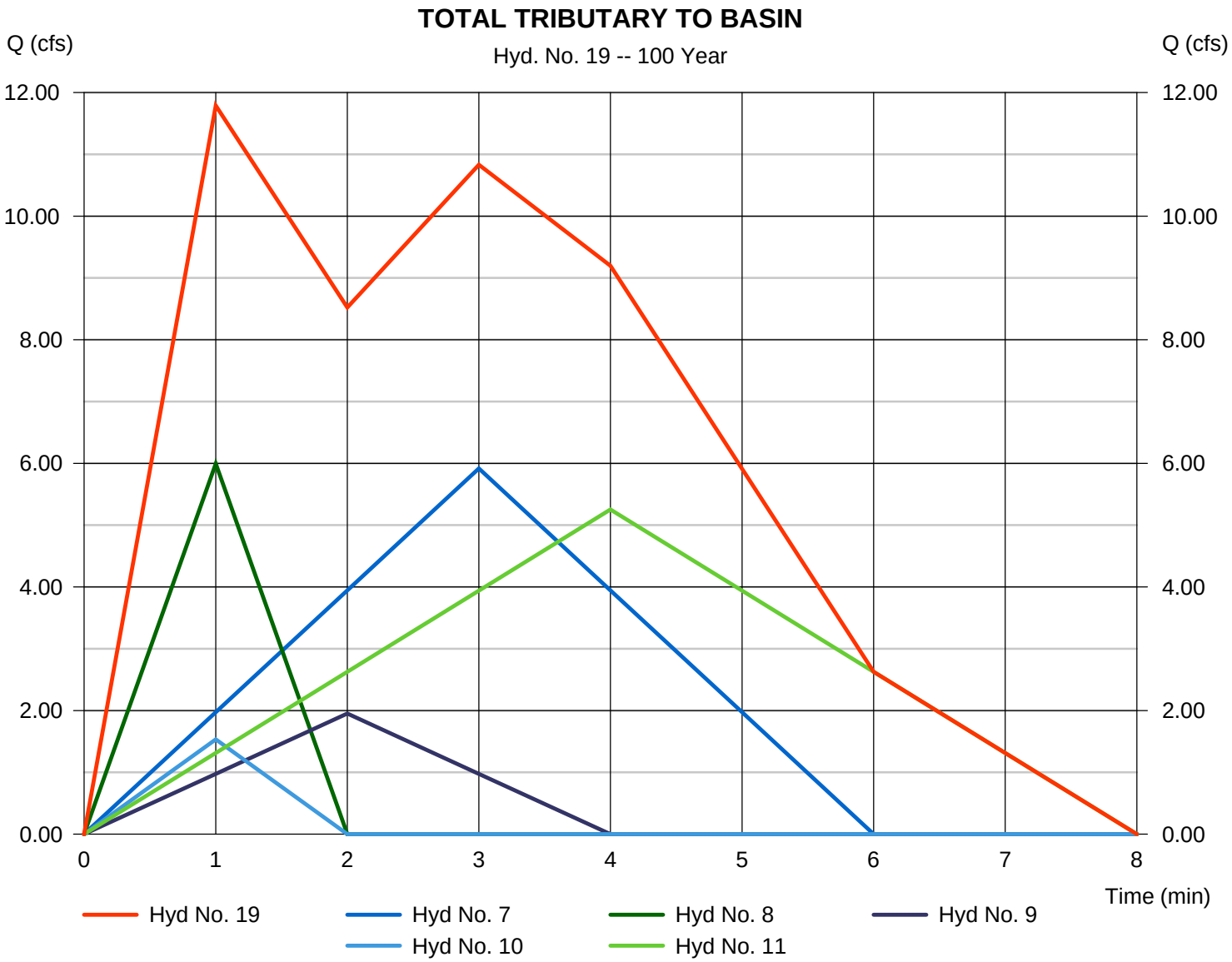


Hydrograph Report

Hyd. No. 19

TOTAL TRIBUTARY TO BASIN

Hydrograph type	= Combine	Peak discharge	= 11.79 cfs
Storm frequency	= 100 yrs	Time to peak	= 1 min
Time interval	= 1 min	Hyd. volume	= 3,011 cuft
Inflow hyds.	= 7, 8, 9, 10, 11	Contrib. drain. area	= 2.655 ac

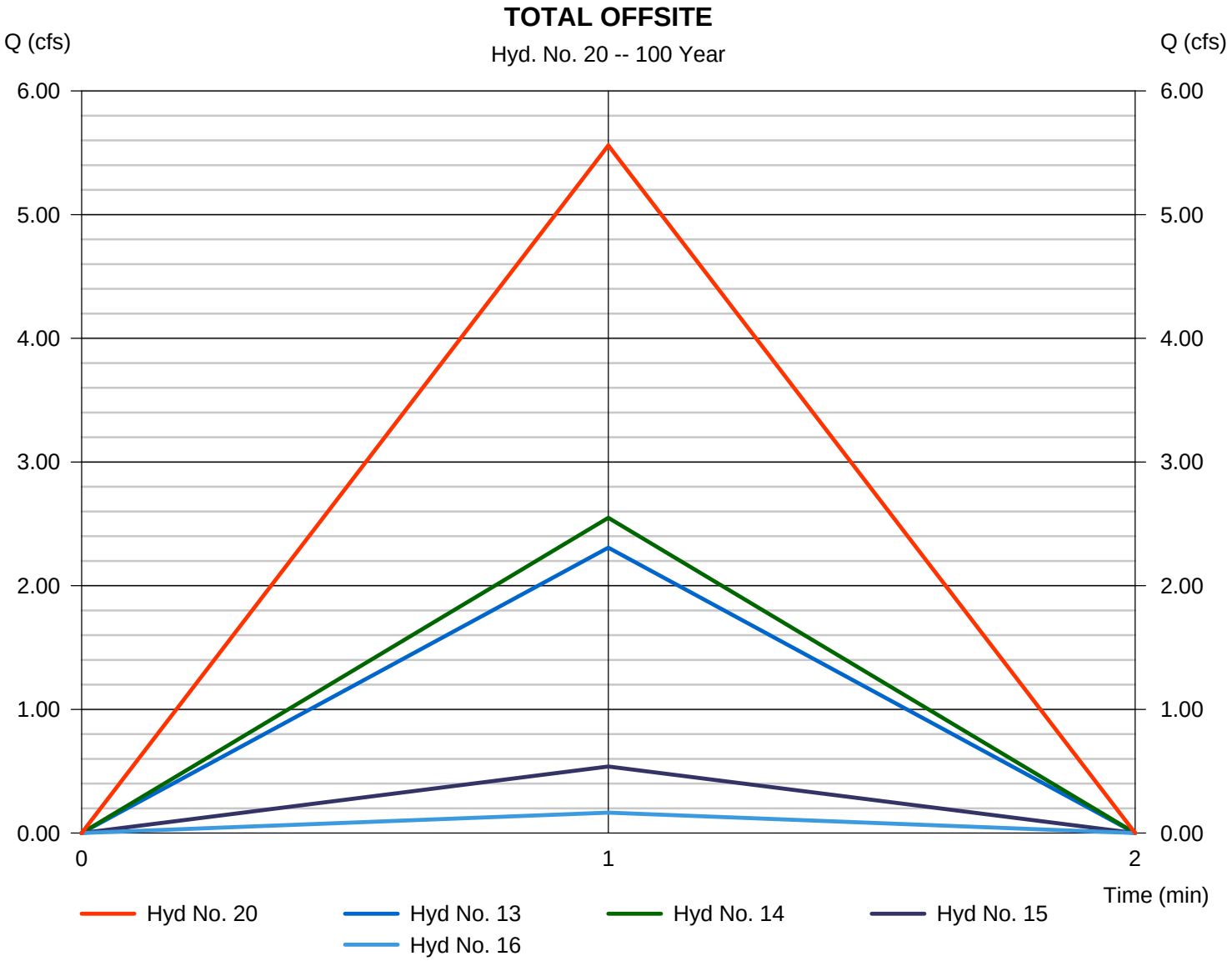


Hydrograph Report

Hyd. No. 20

TOTAL OFFSITE

Hydrograph type	=	Combine	Peak discharge	=	5.559 cfs
Storm frequency	=	100 yrs	Time to peak	=	1 min
Time interval	=	1 min	Hyd. volume	=	334 cuft
Inflow hyds.	=	13, 14, 15, 16	Contrib. drain. area	=	0.950 ac



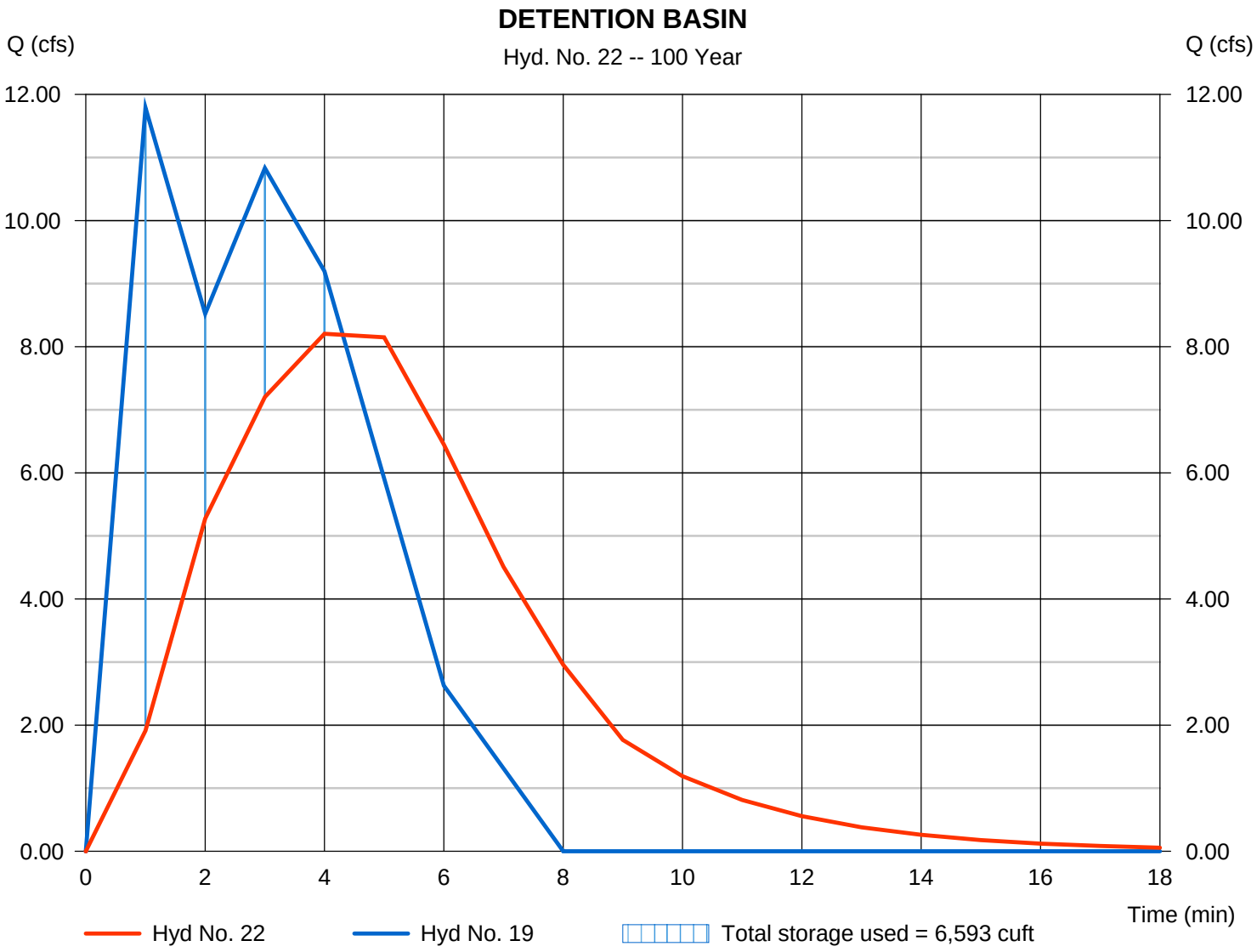
Hydrograph Report

Hyd. No. 22

DETENTION BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	8.204 cfs
Storm frequency	=	100 yrs	Time to peak	=	4 min
Time interval	=	1 min	Hyd. volume	=	3,011 cuft
Inflow hyd. No.	=	19 - TOTAL TRIBUTARY TO BASIN	Max. Elevation	=	559.22 ft
Reservoir name	=	DETENTION	Max. Storage	=	6,593 cuft

Storage Indication method used. Wet pond routing start elevation = 558.90 ft.

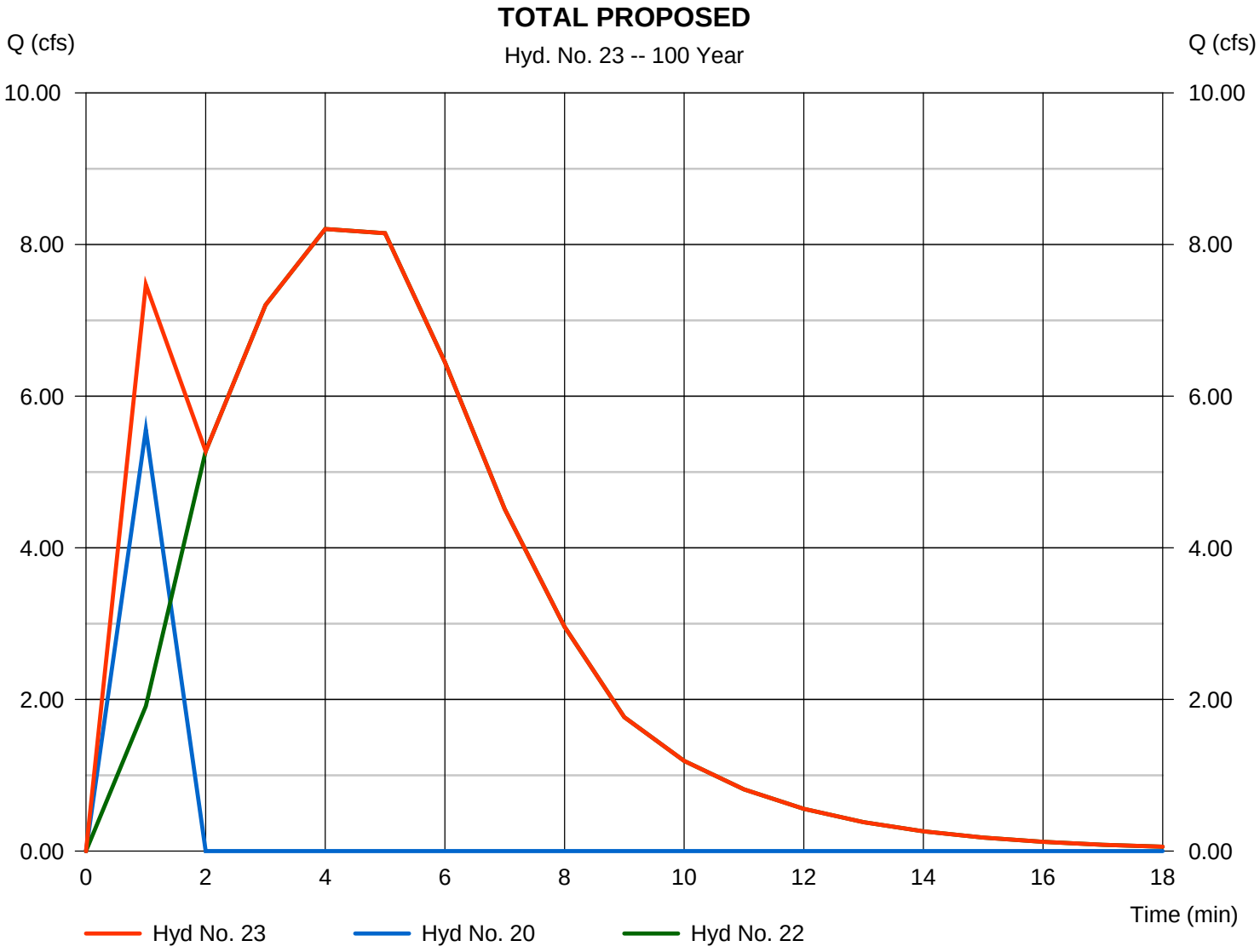


Hydrograph Report

Hyd. No. 23

TOTAL PROPOSED

Hydrograph type	= Combine	Peak discharge	= 8.204 cfs
Storm frequency	= 100 yrs	Time to peak	= 4 min
Time interval	= 1 min	Hyd. volume	= 3,345 cuft
Inflow hyds.	= 20, 22	Contrib. drain. area	= 0.000 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	56.9100	11.8000	0.8400	--------
3	0.0000	0.0000	0.0000	--------
5	23.9590	3.4000	0.6210	--------
10	78.5300	13.2800	0.8100	--------
25	85.9100	13.4900	0.8000	--------
50	33.5240	2.8000	0.5900	--------
100	74.3600	11.3700	0.7200	--------

File name: MoDOT St. Louis IDF Curve.IDF

Intensity = B / (Tc + 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	5.32	4.27	3.59	3.11	2.75	2.47	2.25	2.07	1.91	1.78	1.67	1.57
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	6.39	4.78	3.93	3.38	3.00	2.71	2.49	2.30	2.15	2.03	1.92	1.82
10	7.46	6.13	5.24	4.59	4.10	3.71	3.40	3.14	2.92	2.73	2.57	2.42
25	8.33	6.88	5.89	5.18	4.63	4.20	3.85	3.56	3.31	3.10	2.92	2.76
50	9.98	7.45	6.13	5.30	4.71	4.28	3.93	3.65	3.42	3.23	3.06	2.91
100	9.94	8.20	7.05	6.22	5.59	5.10	4.70	4.36	4.08	3.84	3.63	3.44

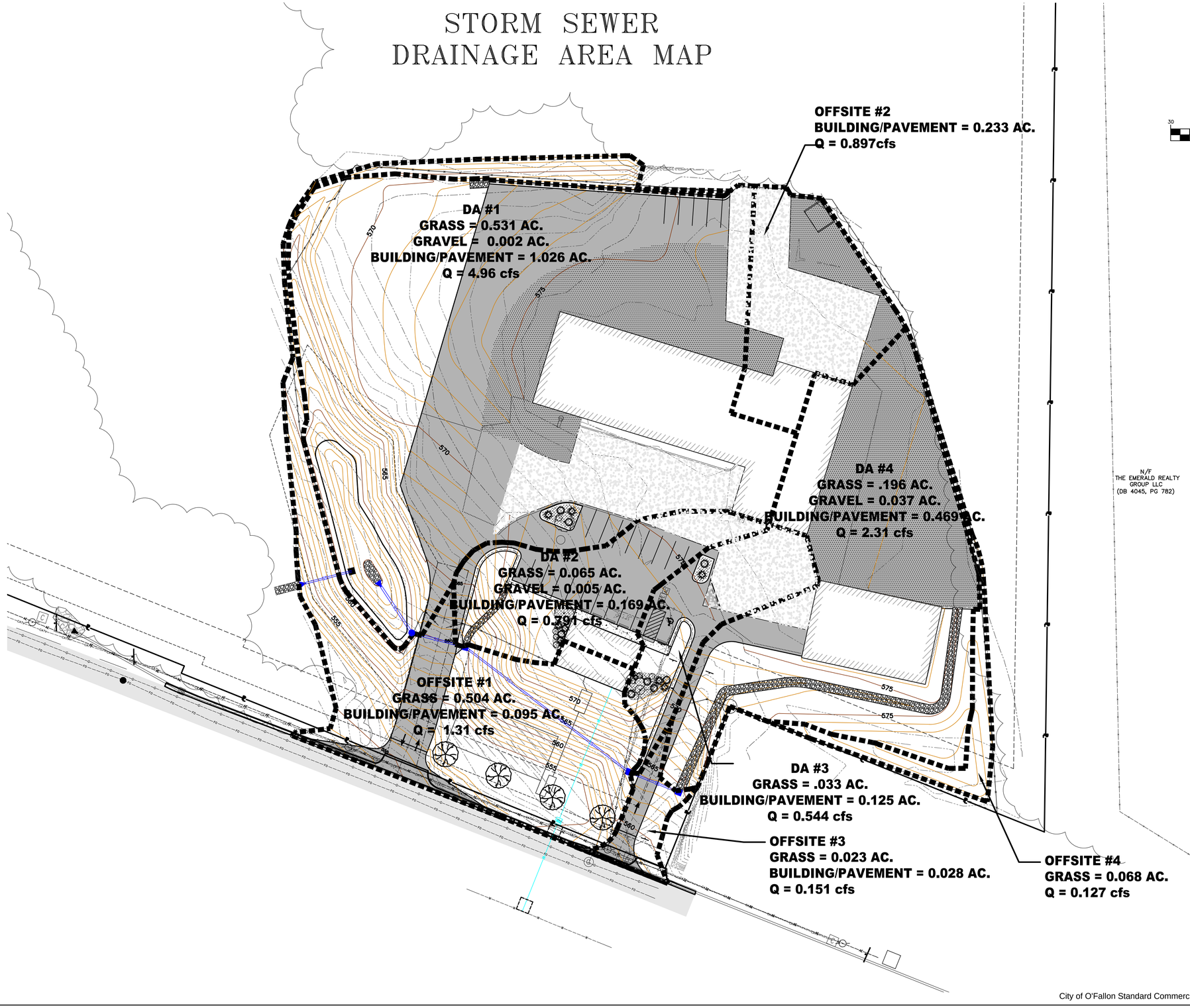
Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.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	2.50	3.10	0.00	3.30	4.64	5.60	6.80	7.21
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	2.75	0.00	0.00	6.50	0.00
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	2.80	0.00	0.00	6.00	0.00

Hydraflow Table of Contents

STORM SEWER
DRAINAGE AREA MAP



North Office
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wentzmail@cochraneng.com
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• Architecture
• Site Development
• General Consulting
• Master Planning
COCHRAN

STATE OF MISSOURI
ERIC SCOTT KIRCHNER
E-2001004618
REGISTERED PROFESSIONAL ENGINEER
2/16/2017
DATE

Eric S. Kirchner No. E-2001004618
Registered Professional Engineer
State of Missouri
for Cochran Engineering & Surveying

Developer / Owner Information:
C Bennett Premium Building Supplies
1285 W. Terra Lane
O'Fallon, MO 63366

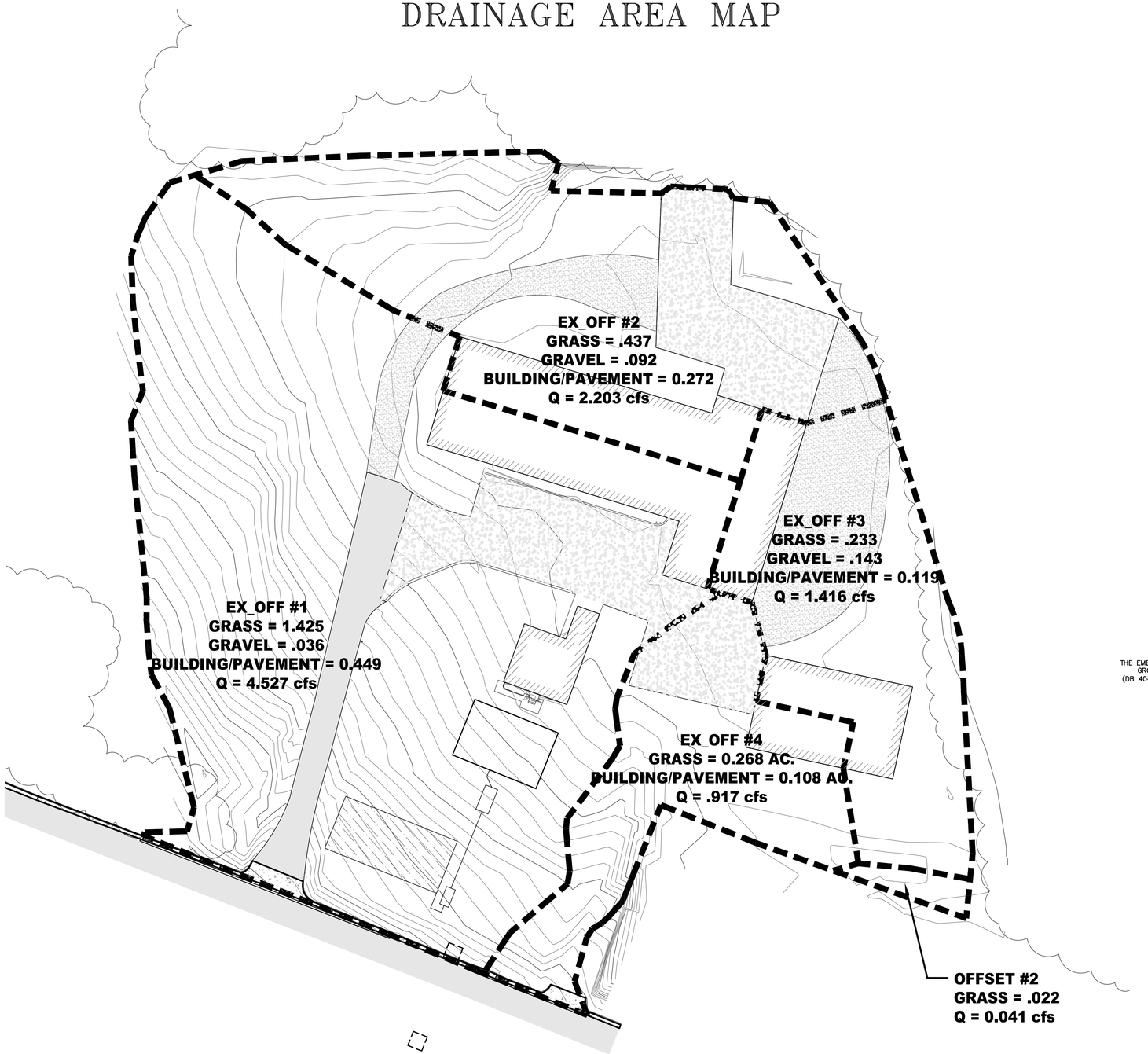
City of O'Fallon Standard Sheet

P+Z No.
Approval Date: 9/1/16

City No.

Page No.
C4

PRE-DEVELOPED
DRAINAGE AREA MAP



30 0 15 30 60

SCALE: 1"=30'
NOVEMBER 2016

North Office
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Wentzville, Missouri 63385
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• Land Surveying
• Architecture
• Site Development
• General Consulting
• Master Planning

STATE OF MISSOURI
ERIC SCOTT KIRCHNER
E-2001004618
PROFESSIONAL ENGINEER

DATE

Eric S. Kirchner No. E-2001004618
Registered Professional Engineer
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O'Fallon, MO 63366

City of O'Fallon Standard Sheet

P+Z No.
Approval Date: 9/1/16

City No.

Page No.
C5

POST-DEVELOPED TRIBUTARY DRAINAGE AREA MAP

30 0 15 30 60

SCALE: 1"=30'

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STATE OF MISSOURI
ERIC SCOTT KIRCHNER
E-2001004618
REGISTERED PROFESSIONAL ENGINEER

11/16/2016

DATE

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Registered Professional Engineer
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City of O'Fallon Standard Sheet

P+Z No.

Approval Date: 9/1/16

City No.

Page No.

C6

HGL CALCS

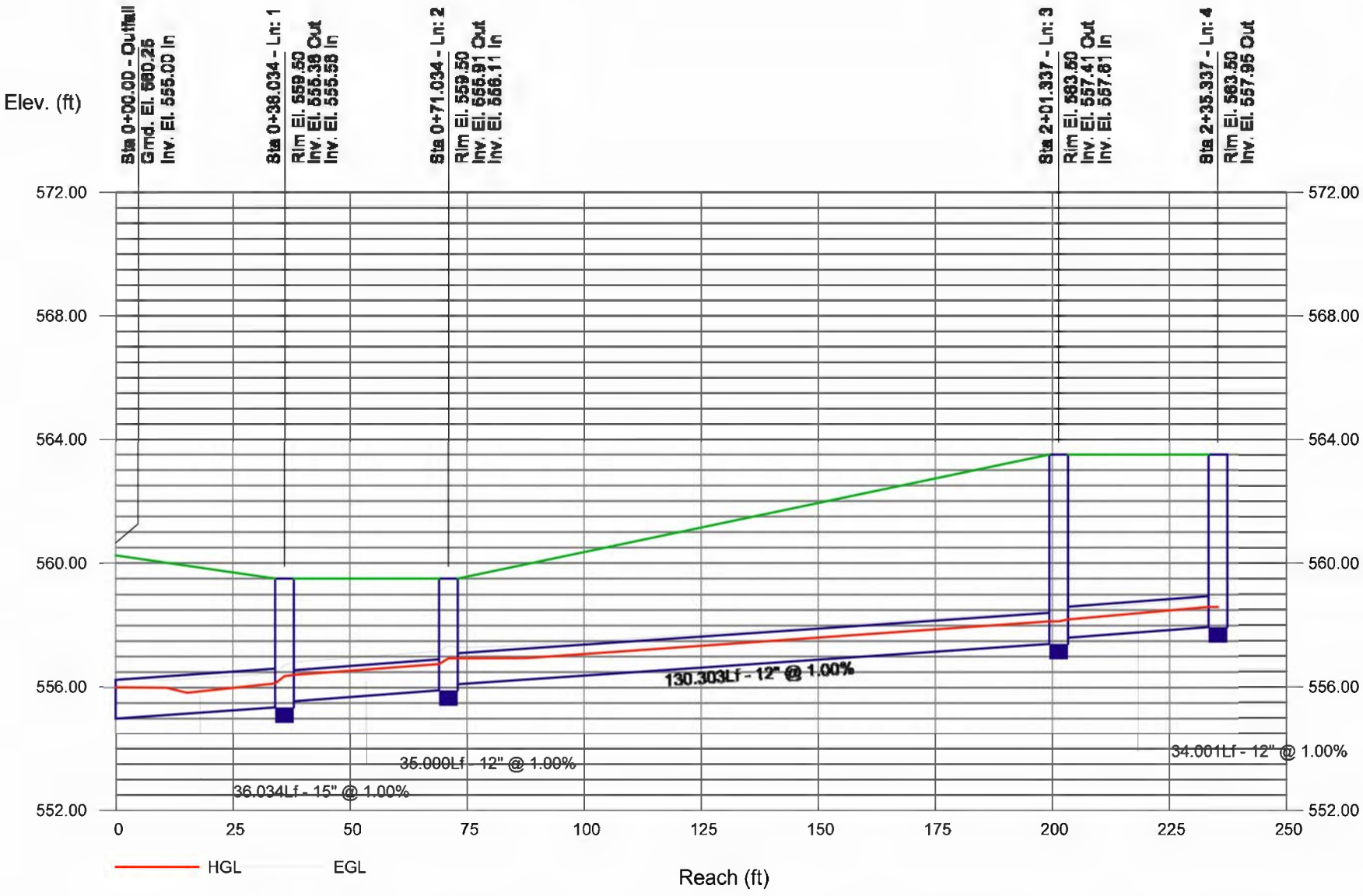
Line No.	Inlet ID	DnStm Ln No	Invert Dn (ft)	Invert Up (ft)	Line Length (ft)	Line Slope (%)	Line Size (in)	Capac Full (cfs)	Known Q (cfs)	Flow Rate (cfs)	Depth Dn (ft)	Depth Up (ft)	HGL Dn (ft)	HGL Up (ft)	Vel Ave (ft/s)	Vel Dn (ft/s)	
1	MH2	Outfall	555.00	555.36	36.034	1.00	15	6.45	0.00	3.67	1.01	0.77**	556.01	556.13 j	4.03	3.45	
2	CI3	1	555.56	555.91	35.000	1.00	12	3.56	0.79	3.67	0.85	0.85	556.41	556.76	5.16	5.16	
3	CI4	2	556.11	557.41	130.303	1.00	12	3.56	0.57	2.88	0.83	0.73**	556.94	558.14 j	4.42	4.12	
4	CI5	3	557.61	557.95	34.001	1.00	12	3.56	2.31	2.31	0.59	0.65**	558.20	558.60	4.55	4.82	

Project File: 15 YR.stm | Number of lines: 4 | Date: 2/13/2017

NOTES: ** Critical depth

Storm Sewer Profile

Proj. file: 15 YR.stm



HGL CALCS

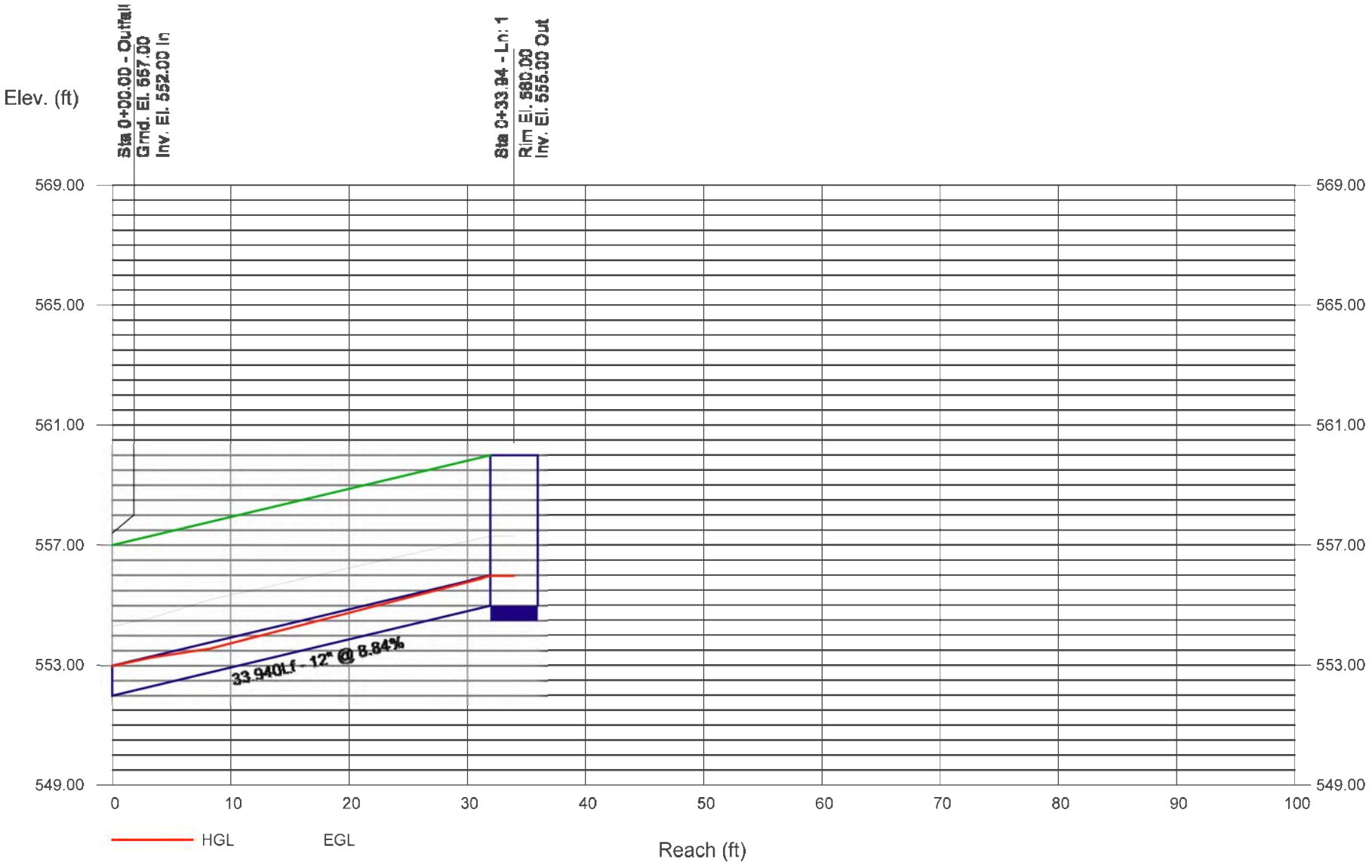
Line No.	Inlet ID	DnStm Ln No	Invert Dn (ft)	Invert Up (ft)	Line Length (ft)	Line Slope (%)	Line Size (in)	Capac Full (cfs)	Known Q (cfs)	Flow Rate (cfs)	Depth Dn (ft)	Depth Up (ft)	HGL Dn (ft)	HGL Up (ft)	Vel Ave (ft/s)	Vel Dn (ft/s)	
1	Structure - (48)	Outfall	552.00	555.00	33.940	8.84	12	10.59	7.20	7.20	0.99	0.98**	552.99	555.98 j	9.21	9.19	

Project File: OUTFALL 11-21-16.stm | Number of lines: 1 | Date: 2/13/2017

NOTES: ** Critical depth

Storm Sewer Profile

Proj. file: OUTFALL 11-21-16.stm



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Feb 13 2017

SOUTH EAST SWALE, 15 YEAR 20 MINUTE

Triangular

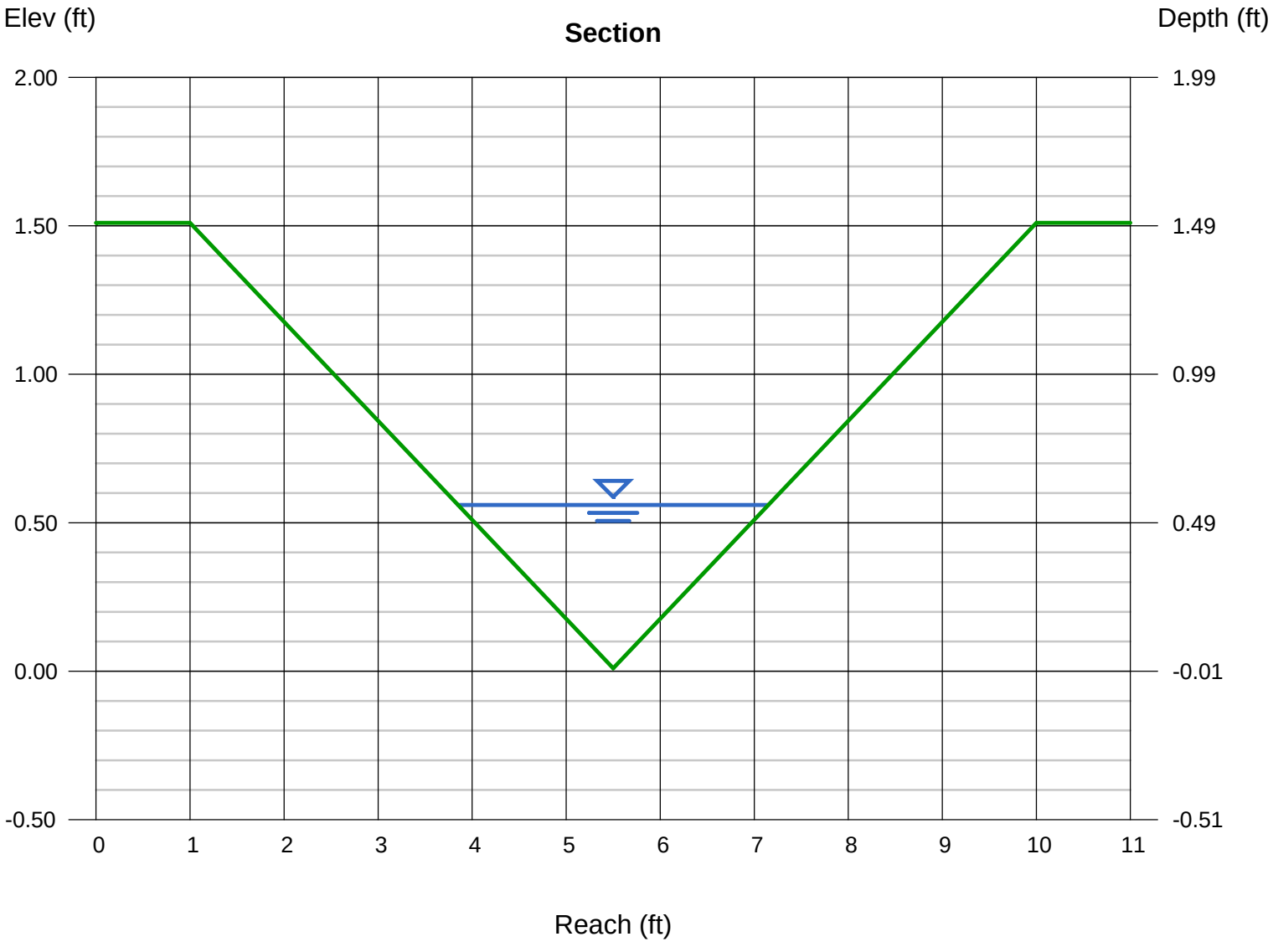
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 0.01
Slope (%)	= 2.00
N-Value	= 0.033

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.31

Highlighted

Depth (ft)	= 0.55
Q (cfs)	= 2.310
Area (sqft)	= 0.91
Velocity (ft/s)	= 2.55
Wetted Perim (ft)	= 3.48
Crit Depth, Yc (ft)	= 0.52
Top Width (ft)	= 3.30
EGL (ft)	= 0.65



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Feb 13 2017

SOUTH WEST SWALE, 15 YEAR 20 MINUTE

Triangular

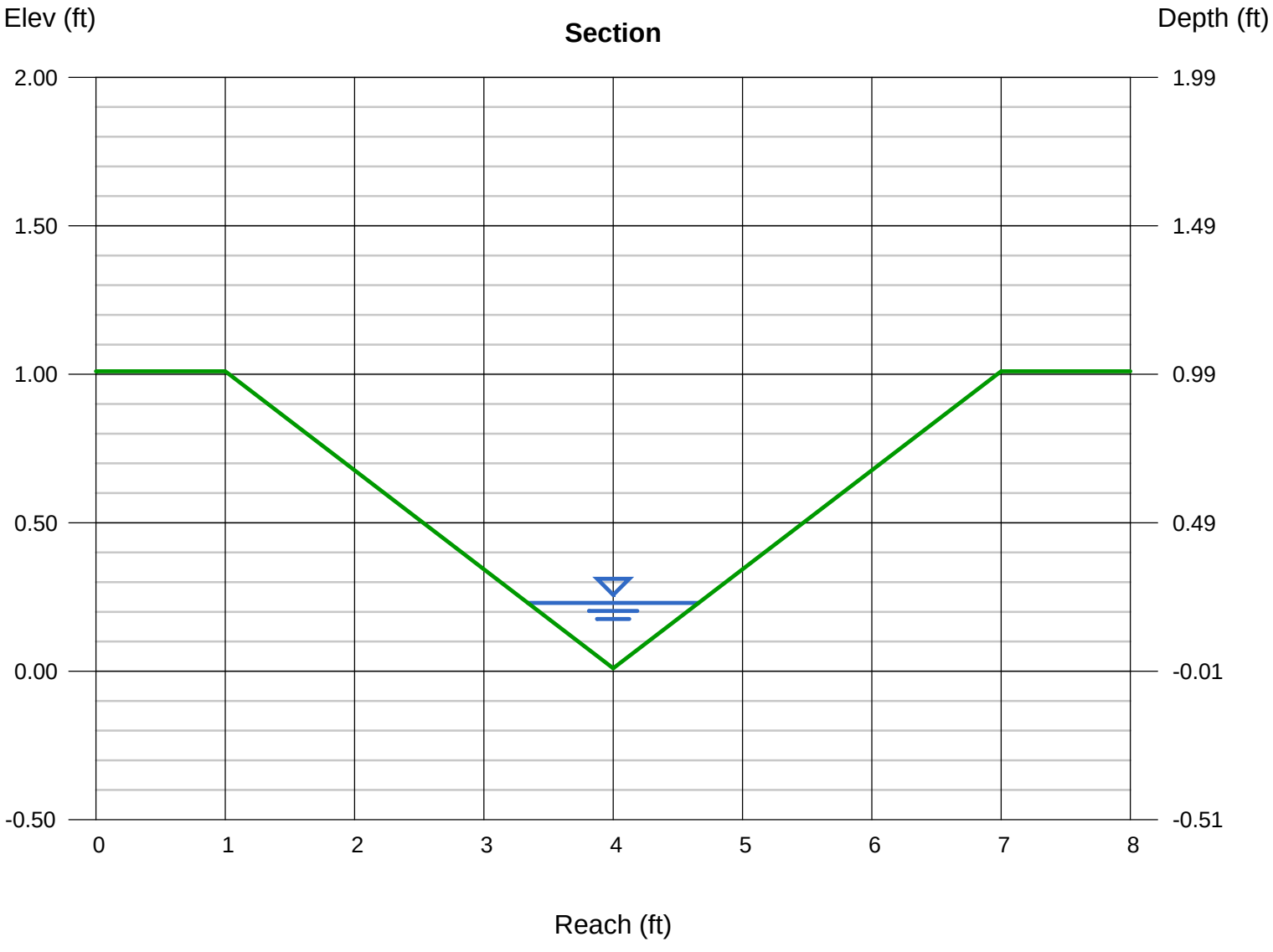
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 0.01
Slope (%)	= 33.00
N-Value	= 0.033

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.79

Highlighted

Depth (ft)	= 0.22
Q (cfs)	= 0.790
Area (sqft)	= 0.15
Velocity (ft/s)	= 5.44
Wetted Perim (ft)	= 1.39
Crit Depth, Yc (ft)	= 0.34
Top Width (ft)	= 1.32
EGL (ft)	= 0.68



Rip-Rap Calculations

Rip-Rap Calculations for BMP into basin

$D_{50} = 0.001V_a^3/(d_{avg}^{0.5}K_1^{1.5})^a = (0.001)(3.45\text{ ft./s})^3/(1.01\text{ ft.})^{0.5}(1.0)^{1.5} = 0.04$ ft., 0.5 in.

$V_a = 3.45$ ft./s

$D_{avg.} = 1.01$ ft.

$K_1 = [1-(\sin^2\theta/\sin^2\varphi)]^{0.5\ b} = 1.0^c$

$\theta^d = 1.14° = 0.02$ ft./ft.

$\varphi^e = 42.3°$

Rip-Rap specific gravity = 2.65^f

Stability factor = 1.5

$C = 1.48^g$

$C_{P/A} = 1^h$, (no piers)

$D'_{50} = CC_{P/A}D_{50}{}^i = (1.48)(1)(0.04) = 0.059$ ft. = 0.7 in.

Thickness $(T)^j = 2D'_{50} = (2)(0.059) = 0.12$ ft., use T = 1.00 ft.

Conclusion: Use MoDOT Type 1 Rock Ditch Liner[k]

Type 1 rock ditch liner shall consist of material with a predominant rock size of 3 inches, a maximum rock size of 6 inches and a gradation such that no more than 15 percent will be less than one inch.

---

[a] Per HEC-11, 4.1.1.1, Eq. 6
[b] Per HEC-11, 4.1.1.1, Eq. 7
[c] Per Hec-11, Chart 3, Attached
[d] Per Site Plan, Sheet C2
[e] Per HEC-11, Chart 4, Attached, Assumed 12"= D_{50}
[f] Per HEC-11, Table 3, Footnote 1
[g] Per HEC-11, Chart 2, Attached
[h] Per HEC-11, Form 1, Footnote 12
[i] Per HEC-11, 5.2, Step 7, Part D
[j] Per HEC-11, 4.3, Bullet note 1
[k] Per Missouri Standards Specifications for Highway Construction Sec. 609.60.2.1

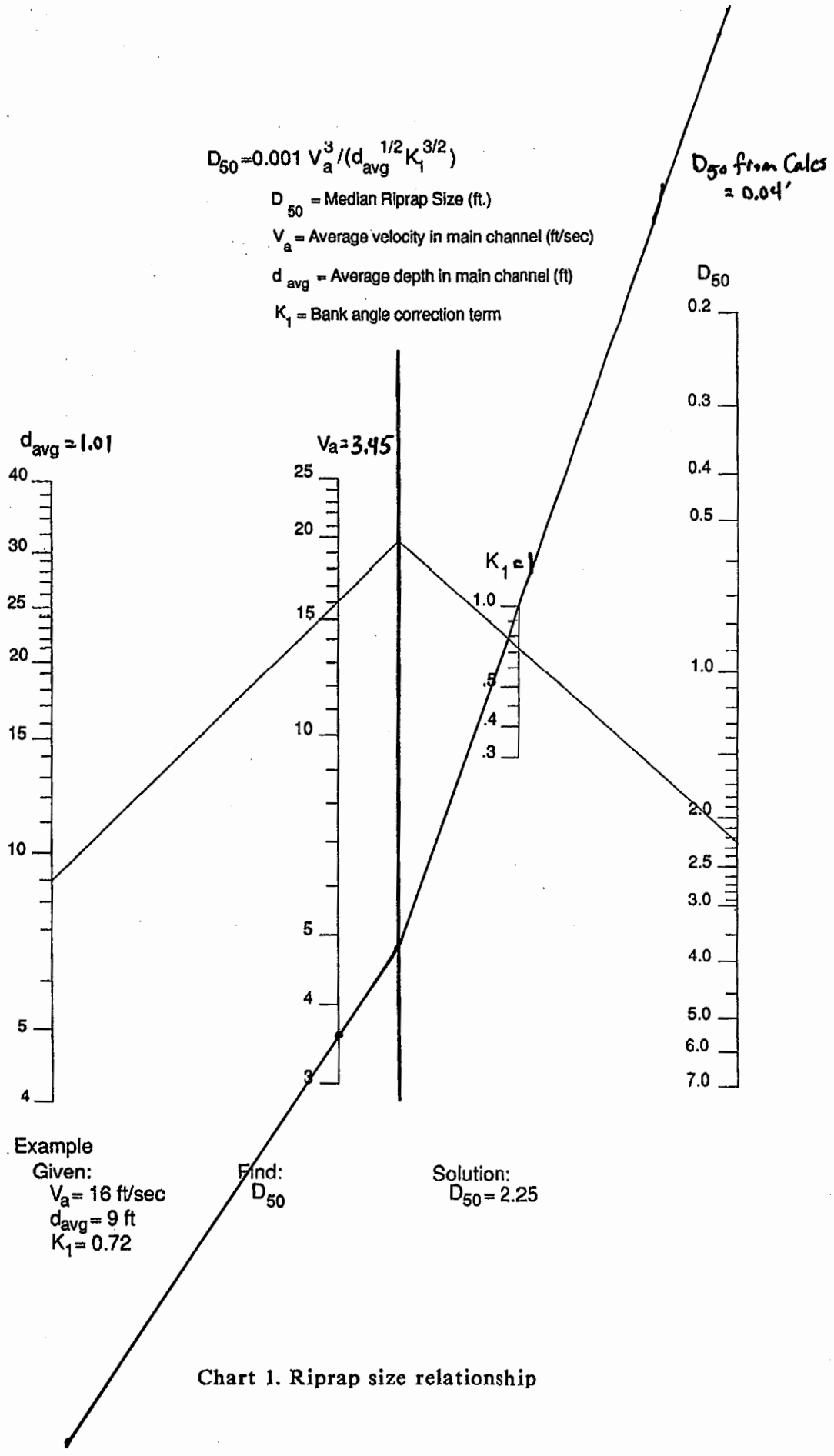
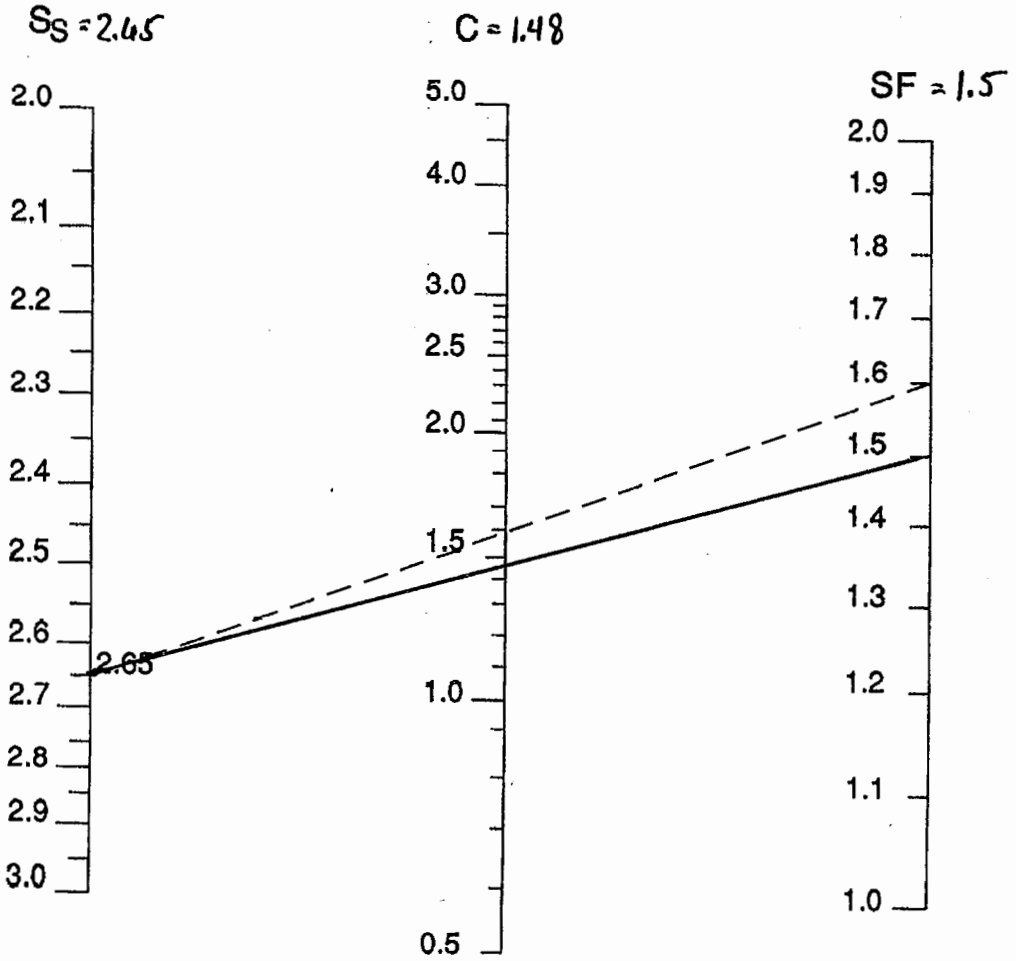


Chart 1. Riprap size relationship

$$C=1.61SF^{1.5}/(S_S-1)^{1.5}$$

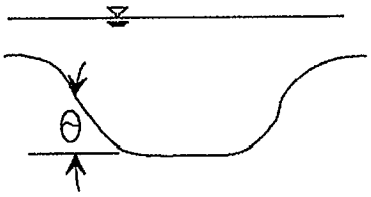
CORR=D_{50}CORRECTION FACTOR
SF = STABILITY FACTOR
S_S= SPECIFIC GRAVITY OF ROCK



Example:

Given:	Find:	Solution:
S_S=2.75	C	C=1.59
SF= 1.60		

Chart 2. Correction factor for riprap size



$$K_1 = \left[1 - \frac{\sin^2\theta}{\sin^2\Phi}\right]^{0.5}$$

θ = Bank angle with horizontal

Φ = Material angle of repose
(See chart 4)

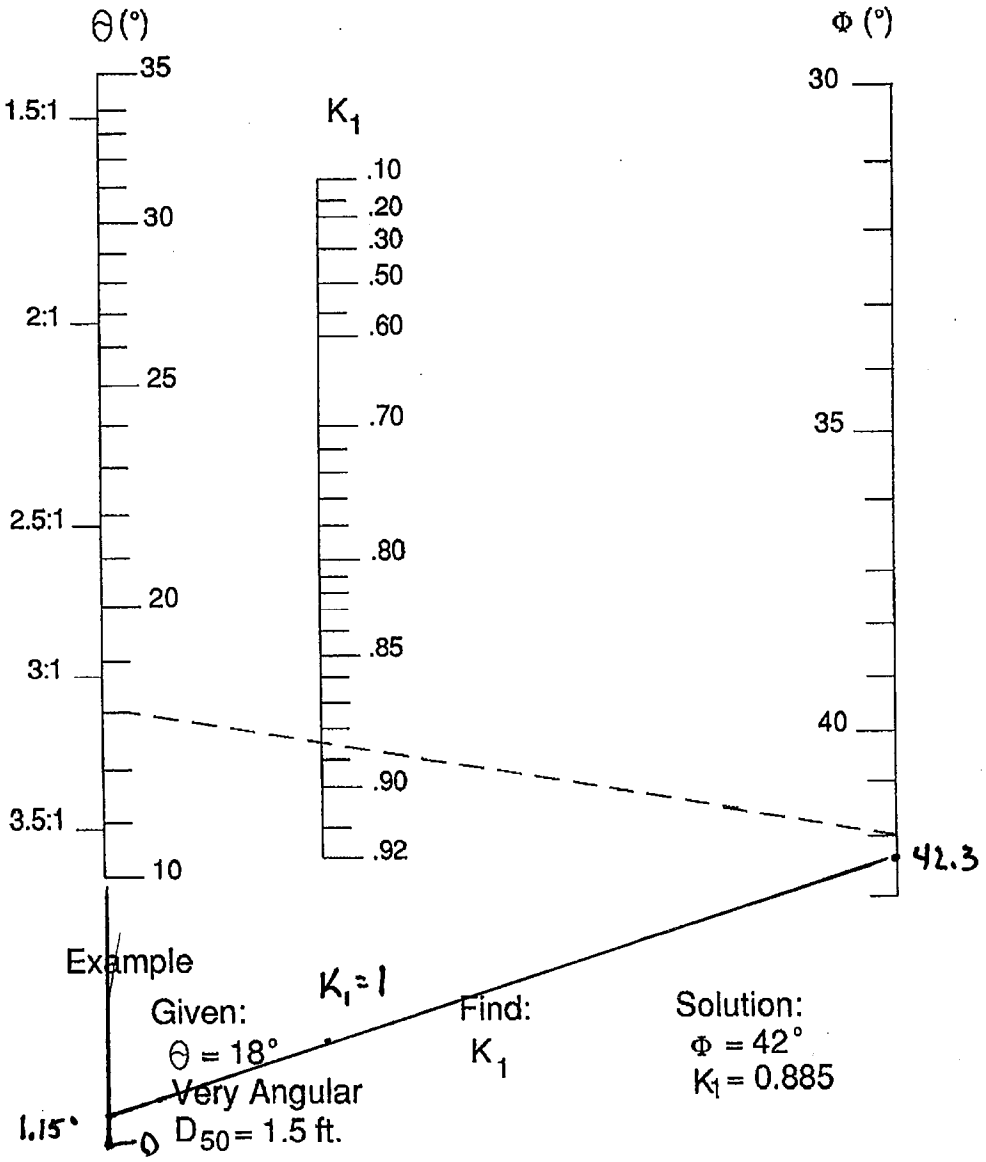


Chart 3. Bank angle correction factor (K_1) nomograph

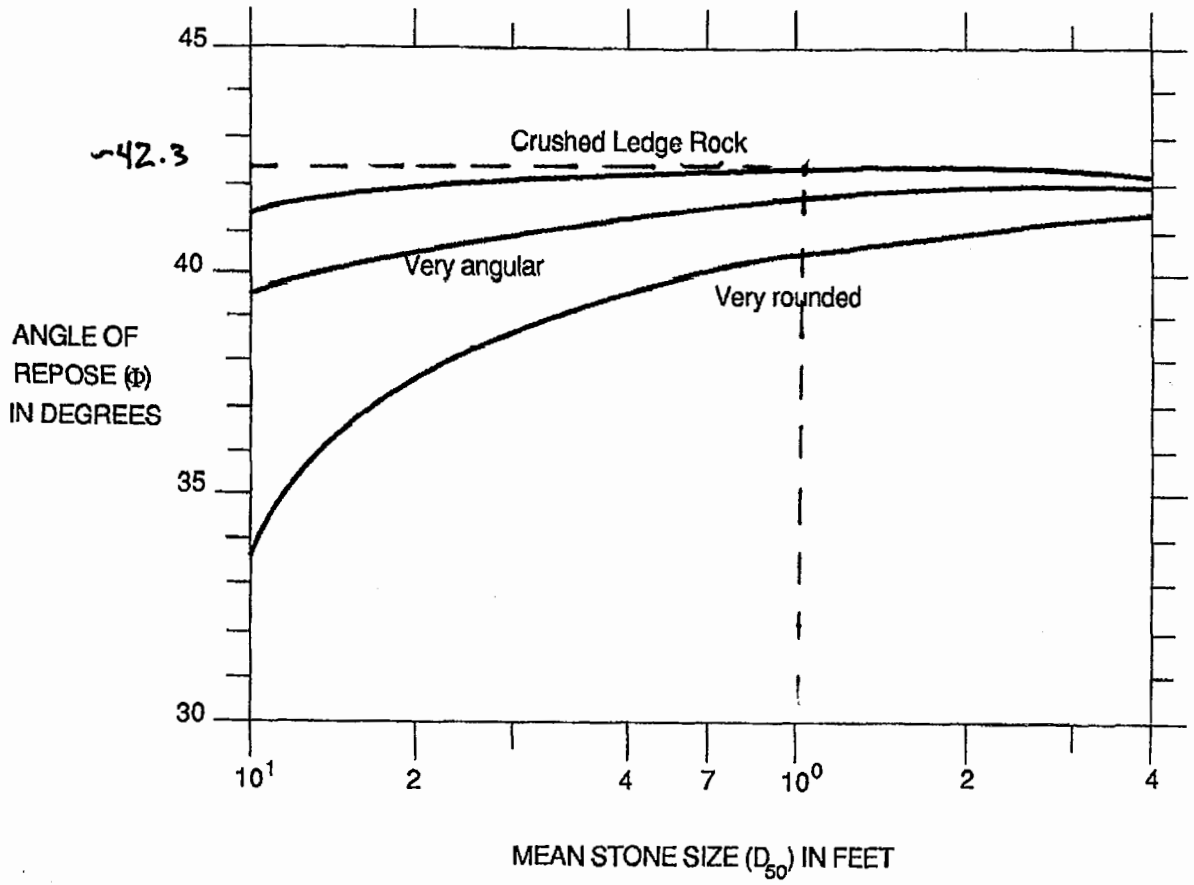


Chart 4. Angle of repose of riprap in terms of mean size and shape of stone.

Rip-Rap Calculations

Rip-Rap Calculations for South West Swale

$D_{50} = 0.001V_a^3/(d_{avg}^{0.5}K_1^{1.5})^a = (0.001)(5.44\text{ ft./s})^3/(0.22\text{ ft.})^{0.5}(0.883)^{1.5} = 0.41$ ft., 5.0 in.

$V_a = 5.44$ ft./s

$D_{avg.} = 0.22$ ft.

$K_1 = [1-(\sin^2\theta/\sin^2\varphi)]^{0.5}$ [b] $= 0.883$[c]

θ[d] $= 18.4° = 0.33$ ft./ft.

φ[e] $= 42.2°$

Rip-Rap specific gravity = 2.65[f]

Stability factor = 1.5

$C = 1.48$[g]

$C_{P/A} = 1$[h], (no piers)

$D'_{50} = CC_{P/A}D_{50}$ [i] $= (1.48)(1)(0.41) = 0.82$ ft. $= 9.84$ in.

Thickness (T)[j] $= 2D'_{50} = (2)(0.82) = 1.64$ ft., use T = 1.75 ft.

Conclusion: Use MoDOT Type 3 Rock Ditch Liner[k]

Type 3 rock ditch liner shall consist of material with a predominant rock size of 12 inches, a maximum rock size of 20 inches and a gradation such that no more than 15 percent will be less than 4 inches.

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[a] Per HEC-11, 4.1.1.1, Eq. 6
[b] Per HEC-11, 4.1.1.1, Eq. 7
[c] Per Hec-11, Chart 3, Attached
[d] Per Site Plan, Sheet C2
[e] Per HEC-11, Chart 4, Attached, Assumed 12"= D_{50}
[f] Per HEC-11, Table 3, Footnote 1
[g] Per HEC-11, Chart 2, Attached
[h] Per HEC-11, Form 1, Footnote 12
[i] Per HEC-11, 5.2, Step 7, Part D
[j] Per HEC-11, 4.3, Bullet note 1
[k] Per MSD Standard Construction Specifications for Sewers and Drainage Facilities, Section K

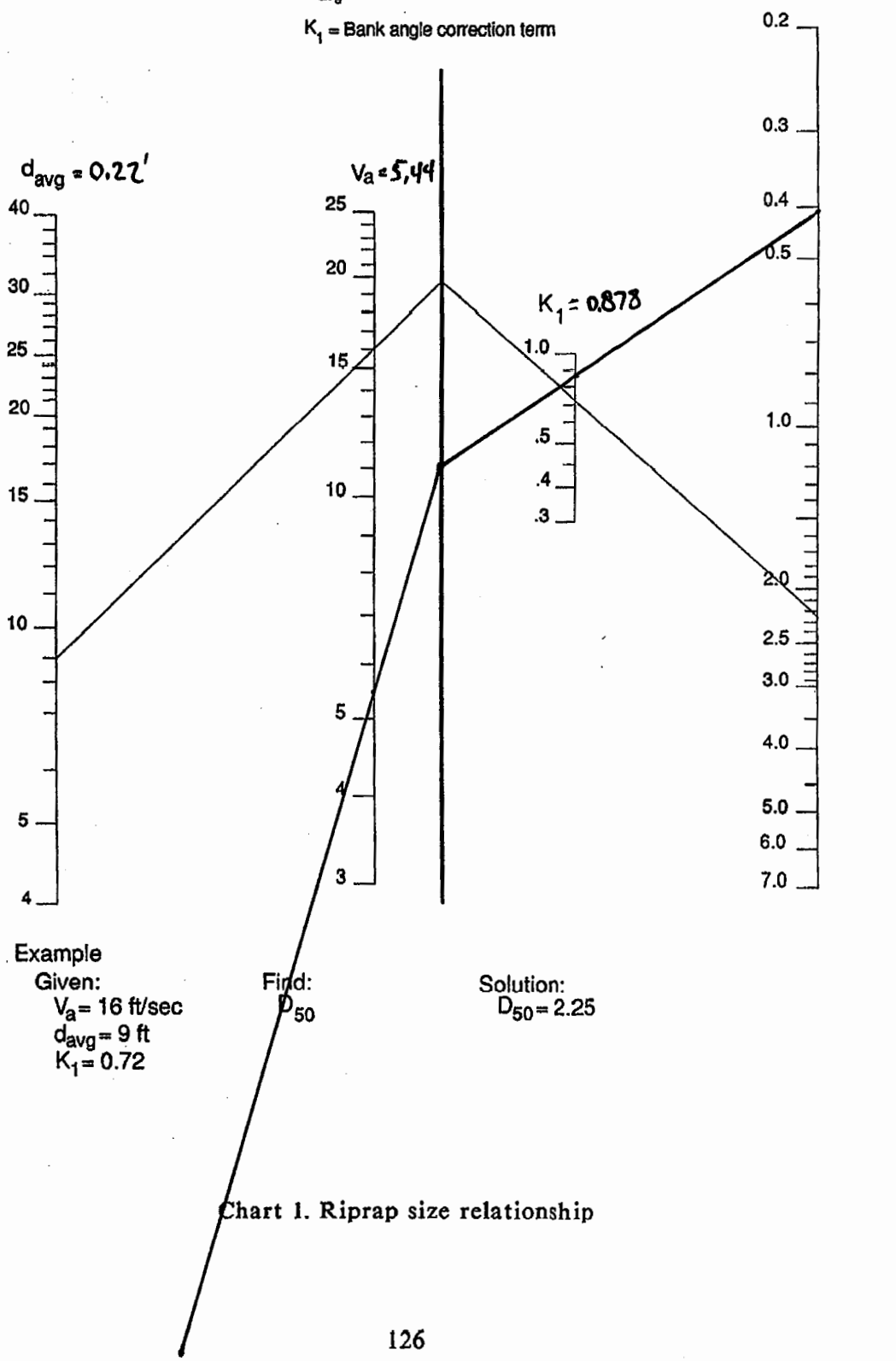
$$D_{50}=0.001\ V_a^3/(d_{avg}^{1/2}K_1^{3/2})$$

D_{50} = Median Riprap Size (ft.)

V_a = Average velocity in main channel (ft/sec)

d_{avg} = Average depth in main channel (ft)

K_1 = Bank angle correction term



Example

Given:
V_a = 16 ft/sec
d_{avg} = 9 ft
K_1 = 0.72

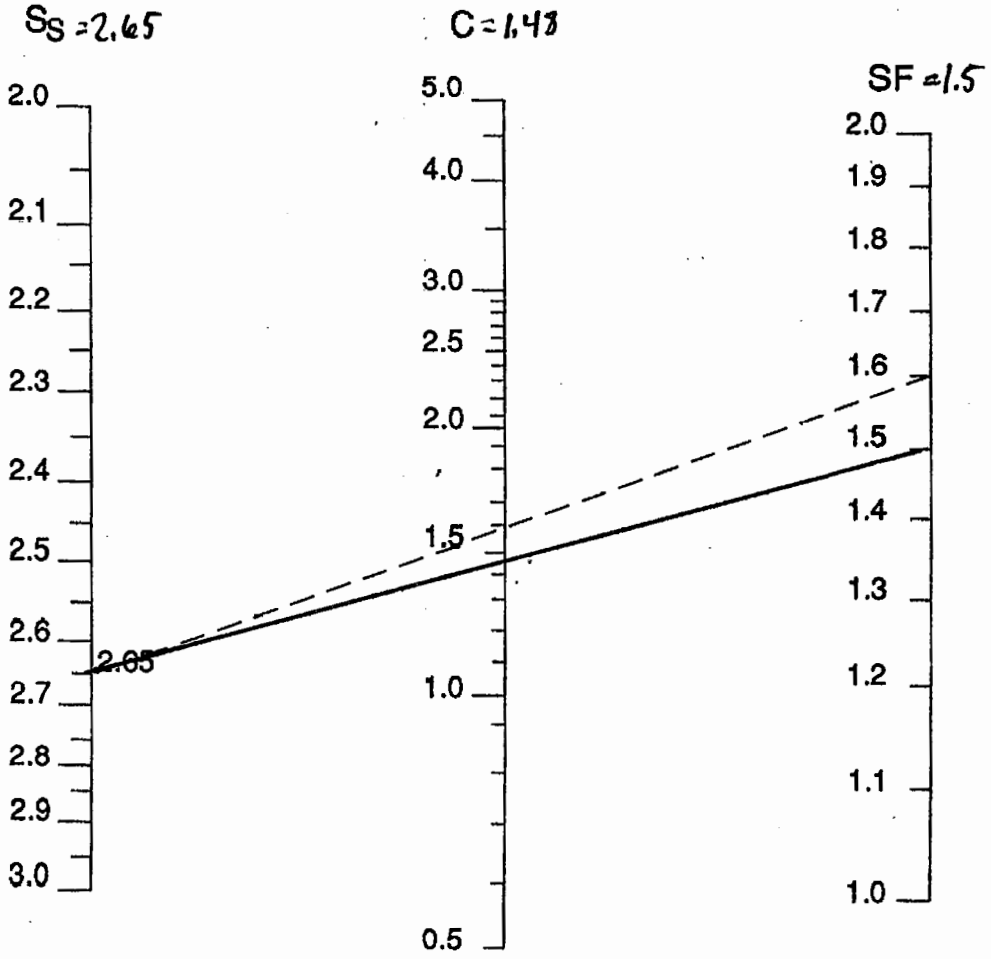
Find:
D_{50}

Solution:
D_{50} = 2.25

Chart 1. Riprap size relationship

$$C=1.61SF^{1.5}/(S_S-1)^{1.5}$$

CORR=D_{50}CORRECTION FACTOR
SF = STABILITY FACTOR
S_S= SPECIFIC GRAVITY OF ROCK



Example:

Given:	Find:	Solution:
S_S=2.75	C	C=1.59
SF= 1.60		

Chart 2. Correction factor for riprap size

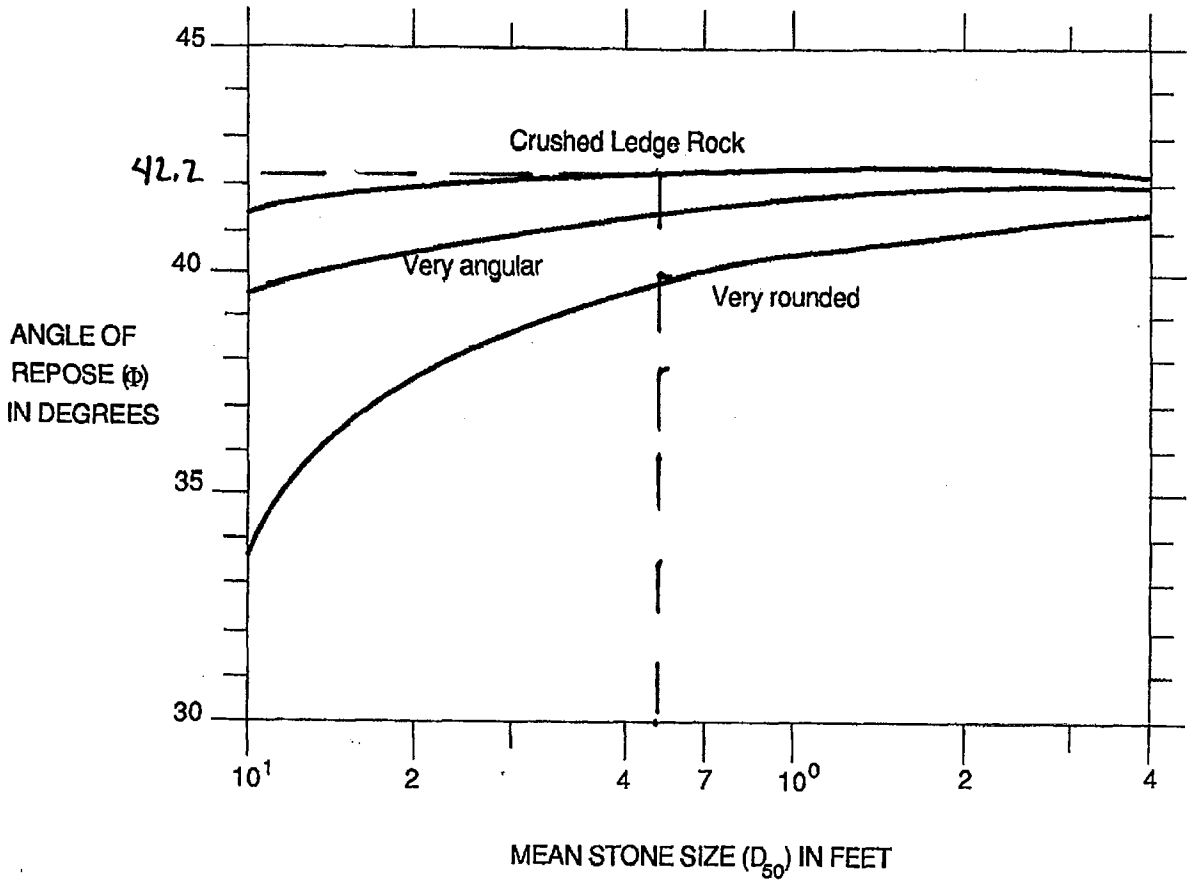


Chart 4. Angle of repose of riprap in terms of mean size and shape of stone.

Rip-Rap Calculations

Rip-Rap Calculations for South East Swale

$D_{50} = 0.001V_a^3/(d_{avg}^{0.5}K_1^{1.5})^a = (0.001)(2.55\text{ ft./s})^3/(0.55\text{ ft.})^{0.5}(0.883)^{1.5} = 0.03$ ft., 0.32 in.

$V_a = 2.55$ ft./s

$D_{avg.} = 0.55$ ft.

$K_1 = [1-(\sin^2\theta/\sin^2\varphi)]^{0.5\ b} = 0.883^c$

$\theta^d = 18.4° = 0.33$ ft./ft.

$\varphi^e = 42.2°$

Rip-Rap specific gravity = 2.65[f]

Stability factor = 1.5

$C = 1.48^g$

$C_{P/A} = 1^h$, (no piers)

$D'_{50} = CC_{P/A}D_{50}{}^i = (1.48)(1)(0.03) = 0.04$ ft. = 0.5 in.

Thickness $(T)^j = 2D'_{50} = (2)(0.04) = 0.09$ ft., use T = 1.0 ft.

Conclusion: Use MoDOT Type 1 Rock Ditch Liner[k]

Type 3 rock ditch liner shall consist of material with a predominant rock size of 3 inches, a maximum rock size of 6 inches and a gradation such that no more than 15 percent will be less than 1 inches.

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[a] Per HEC-11, 4.1.1.1, Eq. 6
[b] Per HEC-11, 4.1.1.1, Eq. 7
[c] Per Hec-11, Chart 3, Attached
[d] Per Site Plan, Sheet C2
[e] Per HEC-11, Chart 4, Attached, Assumed 12"= D_{50}
[f] Per HEC-11, Table 3, Footnote 1
[g] Per HEC-11, Chart 2, Attached
[h] Per HEC-11, Form 1, Footnote 12
[i] Per HEC-11, 5.2, Step 7, Part D
[j] Per HEC-11, 4.3, Bullet note 1
[k] Per MSD Standard Construction Specifications for Sewers and Drainage Facilities, Section K

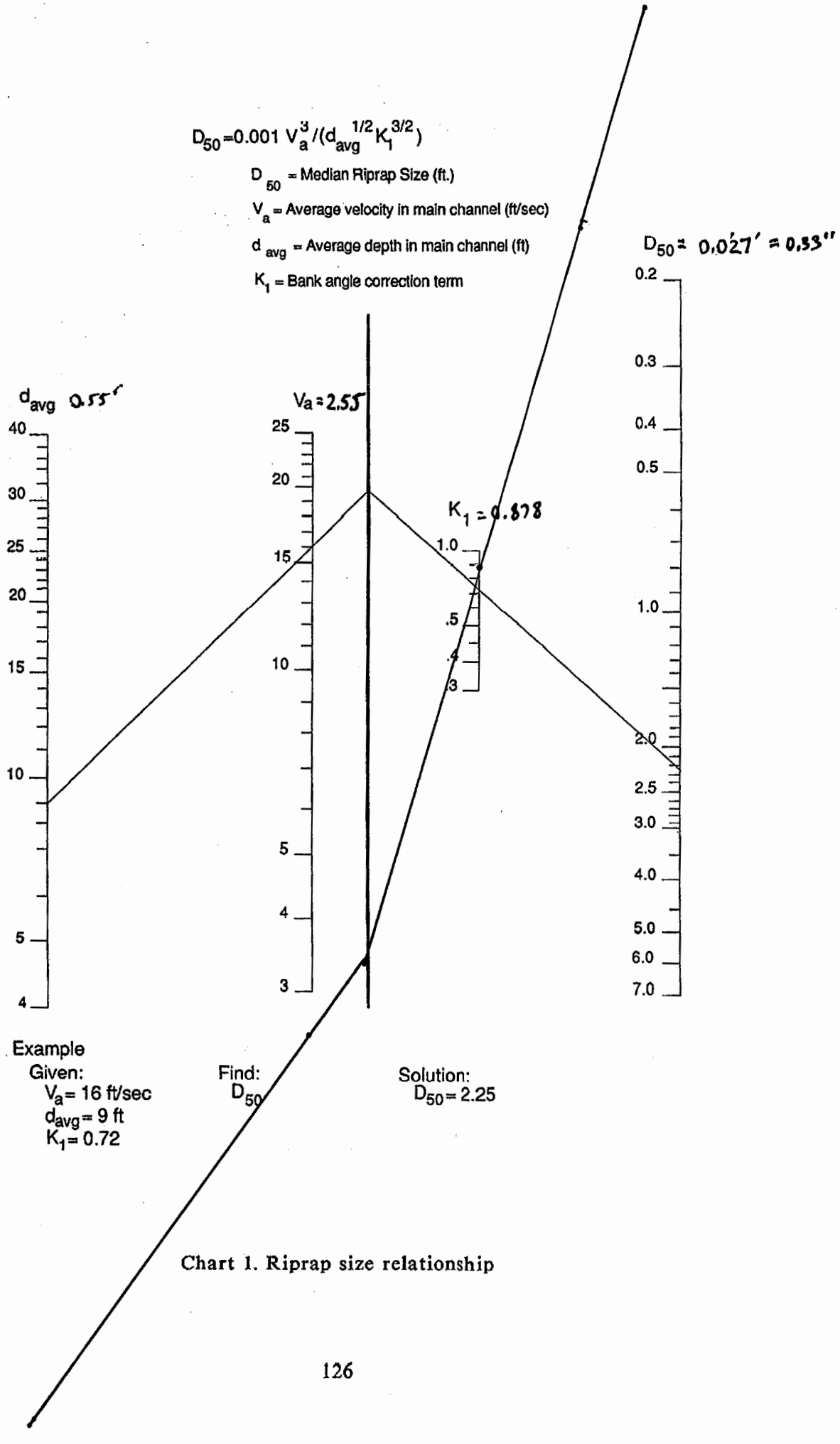
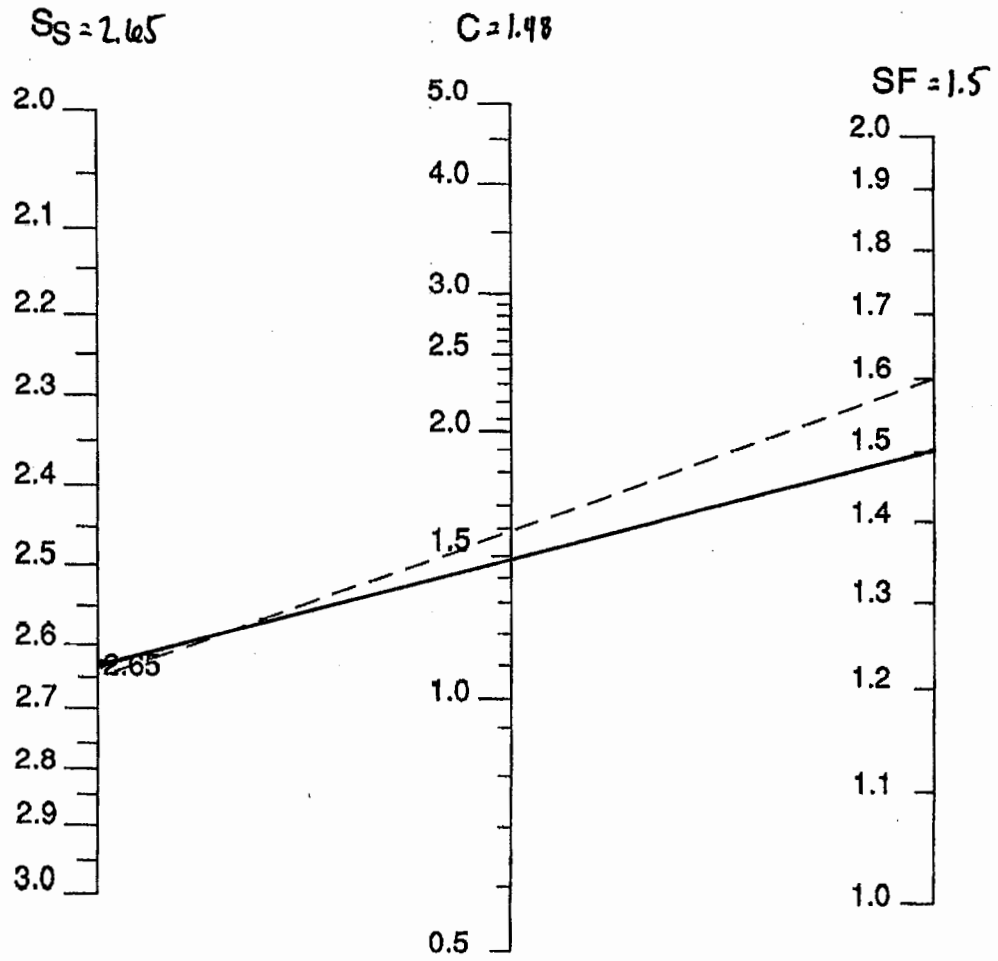


Chart 1. Riprap size relationship

$$C=1.61SF^{1.5}/(S_S-1)^{1.5}$$

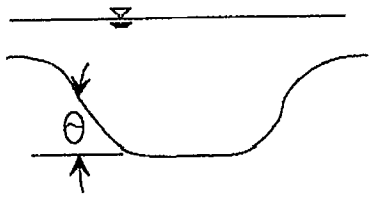
CORR=D_{50}CORRECTION FACTOR
SF = STABILITY FACTOR
S_S= SPECIFIC GRAVITY OF ROCK



Example:

Given:	Find:	Solution:
S_S=2.75	C	C=1.59
SF= 1.60		

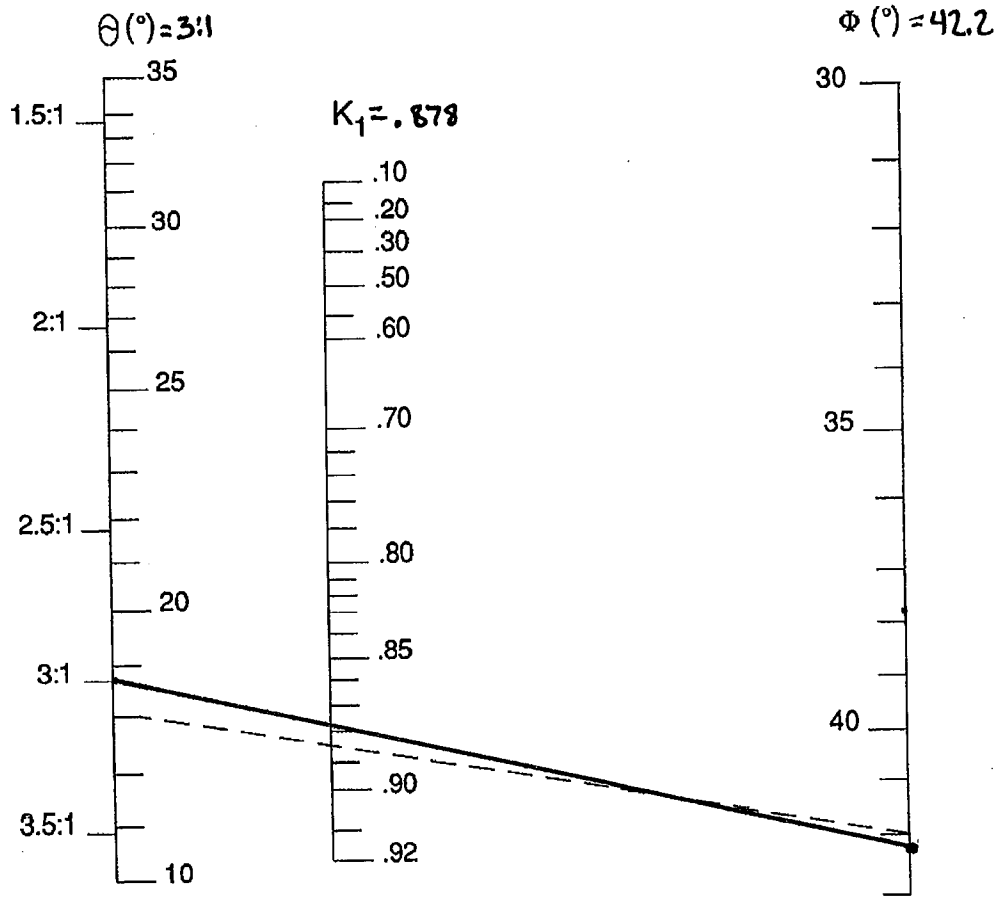
Chart 2. Correction factor for riprap size



$$K_1 = \left[1 - \frac{\sin^2\theta}{\sin^2\Phi}\right]^{0.5}$$

θ = Bank angle with horizontal

Φ = Material angle of repose
(See chart 4)



Example

Given:
$\theta = 18°$
Very Angular
$D_{50} = 1.5$ ft.

Find:
K_1

Solution:
$\Phi = 42°$
$K_1 = 0.885$

Chart 3. Bank angle correction factor (K_1) nomograph

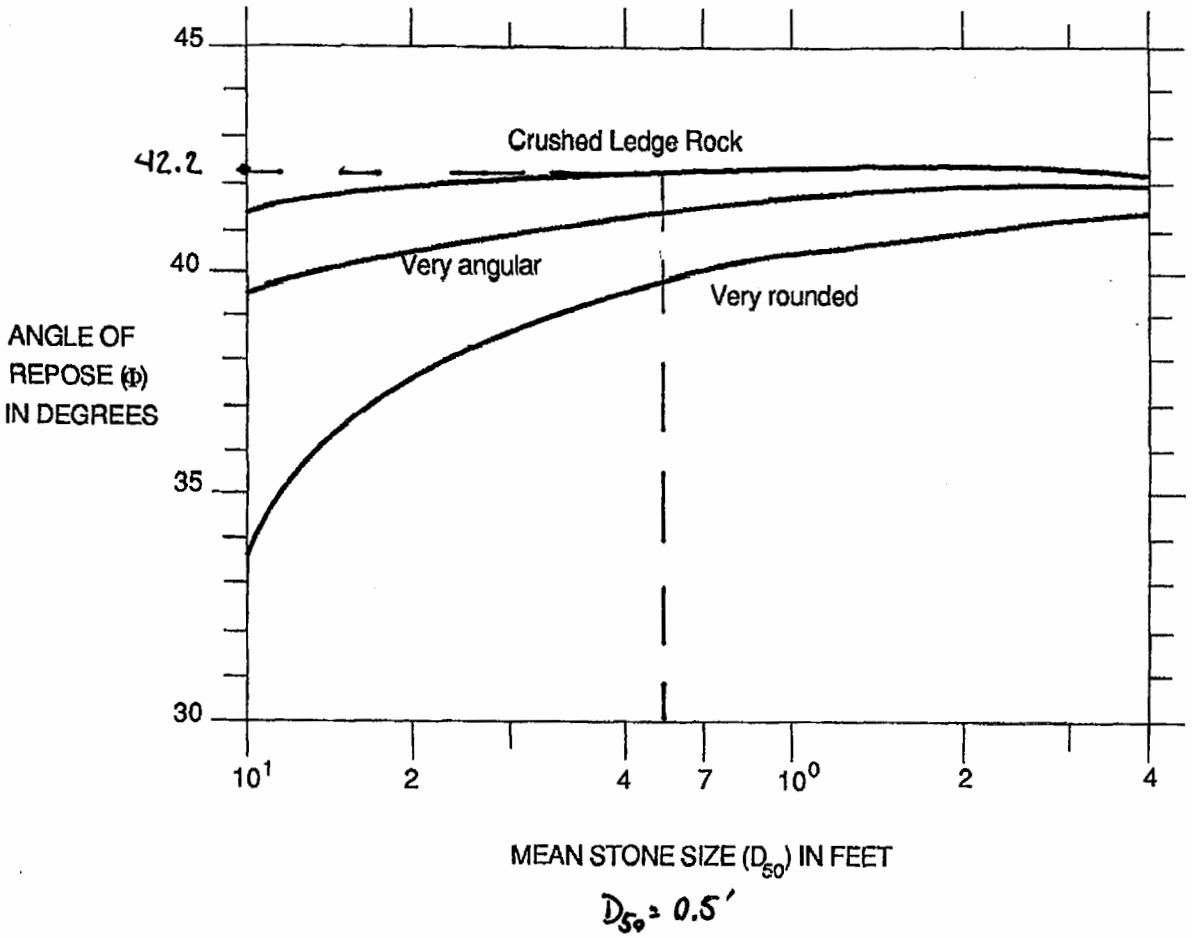


Chart 4. Angle of repose of riprap in terms of mean size and shape of stone.

Rip-Rap Calculations

Rip-Rap Calculations for BMP basin outfall

$D_{50} = 0.001V_a^3/(d_{avg}^{0.5}K_1^{1.5})^a = (0.001)(9.19\text{ ft./s})^3/(0.99\text{ ft.})^{0.5}(0.883)^{1.5} = 0.94$ ft., 11.3 in.

$V_a = 9.19$ ft./s

$D_{avg.} = 0.99$ ft.

$K_1 = [1-(\sin^2\theta/\sin^2\varphi)]^{0.5}$ [b] $= 0.883$[c]

θ[d] $= 18.4° = 0.33$ ft./ft.

φ[e] $= 42.3°$

Rip-Rap specific gravity = 2.65[f]

Stability factor = 1.5

$C = 1.48$[g]

$C_{P/A} = 1$[h], (no piers)

$D'_{50} = CC_{P/A}D_{50}$ [i] $= (1.48)(1)(0.94) = 1.39$ ft. $= 16.7$ in.

Thickness (T)[j] $= 2D'_{50} = (2)(1.39) = 2.78$ ft., use T = 3.0 ft.

Conclusion: Use MSD-8 Heavy Limestone Revetment[k]

Heavy limestone revetment rock shall be at least 12 inches in size and all stones shall weigh not less than 50 pounds, and at least 60 percent shall weigh not less than 100 pounds.

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[a] Per HEC-11, 4.1.1.1, Eq. 6
[b] Per HEC-11, 4.1.1.1, Eq. 7
[c] Per Hec-11, Chart 3, Attached
[d] Per Site Plan, Sheet C2
[e] Per HEC-11, Chart 4, Attached, Assumed 12"= D_{50}
[f] Per HEC-11, Table 3, Footnote 1
[g] Per HEC-11, Chart 2, Attached
[h] Per HEC-11, Form 1, Footnote 12
[i] Per HEC-11, 5.2, Step 7, Part D
[j] Per HEC-11, 4.3, Bullet note 1
[k] Per MSD Standard Construction Specifications for Sewers and Drainage Facilities, Section K

$$D_{50} = 0.001\, V_a^3 / (d_{avg}^{1/2} K_1^{3/2})$$

D_{50} = Median Riprap Size (ft.)

V_a = Average velocity in main channel (ft/sec)

d_{avg} = Average depth in main channel (ft)

K_1 = Bank angle correction term

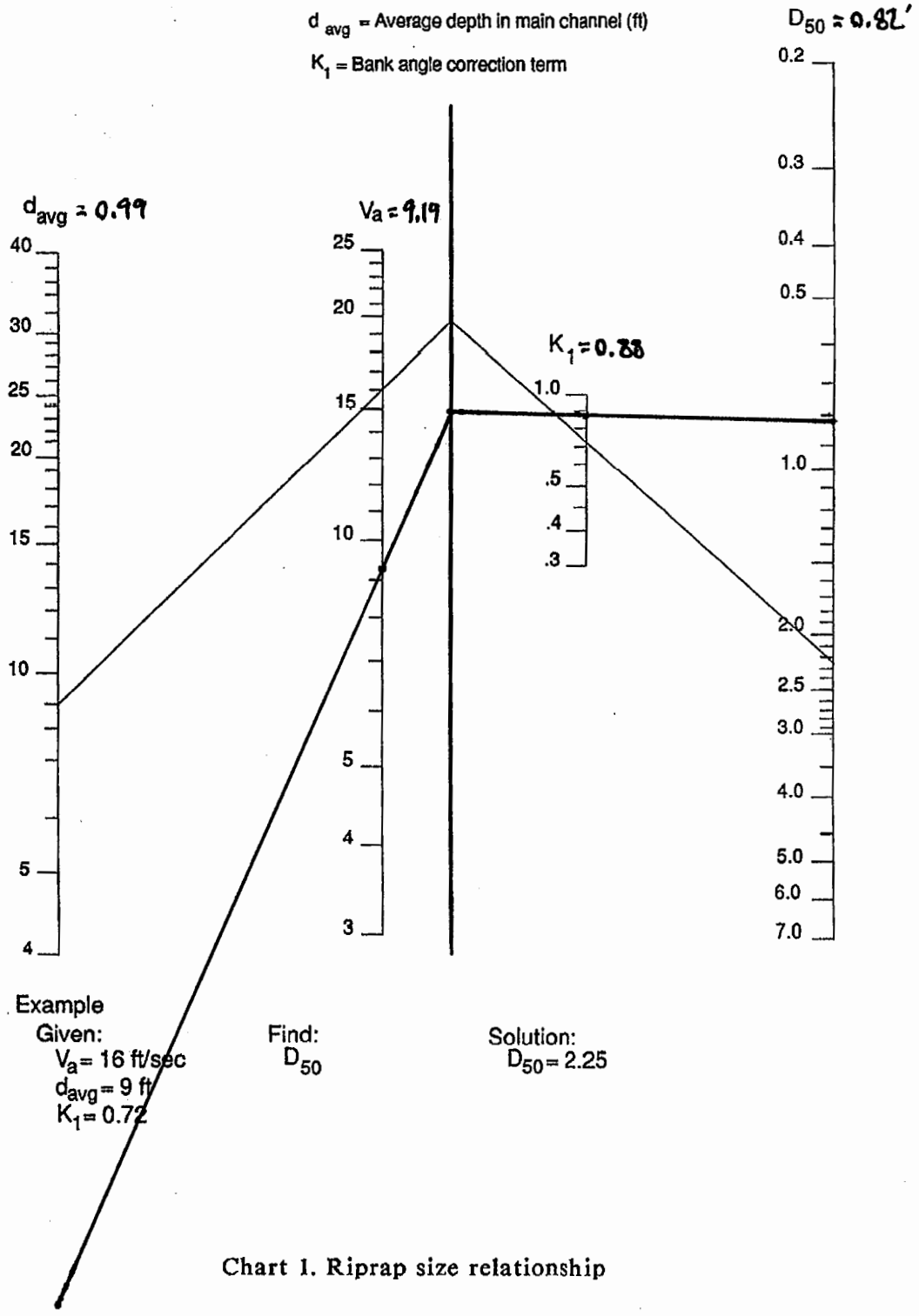
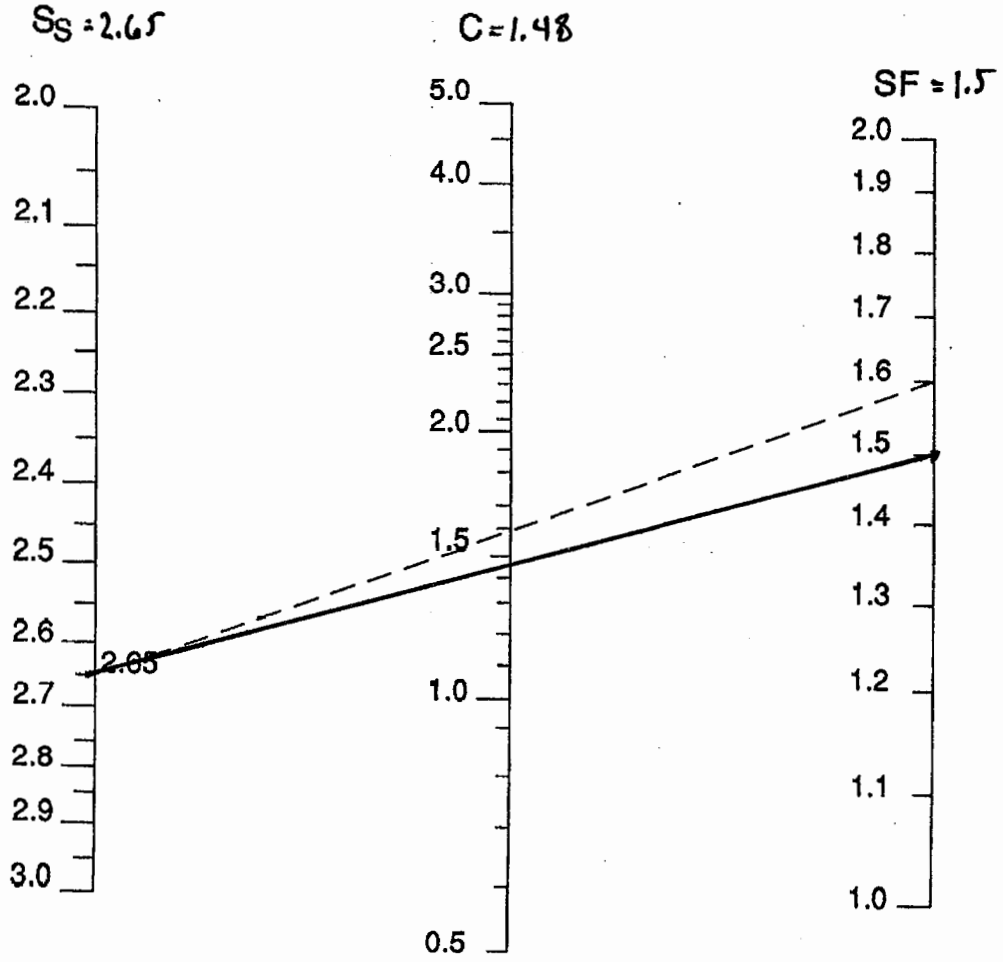


Chart 1. Riprap size relationship

$$C=1.61SF^{1.5}/(S_S-1)^{1.5}$$

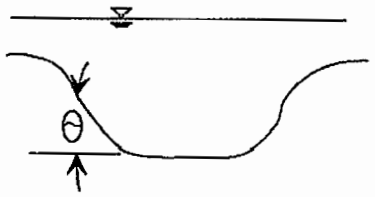
CORR=D_{50}CORRECTION FACTOR
SF = STABILITY FACTOR
S_S= SPECIFIC GRAVITY OF ROCK



Example:

Given:	Find:	Solution:
S_S=2.75	C	C=1.59
SF= 1.60		

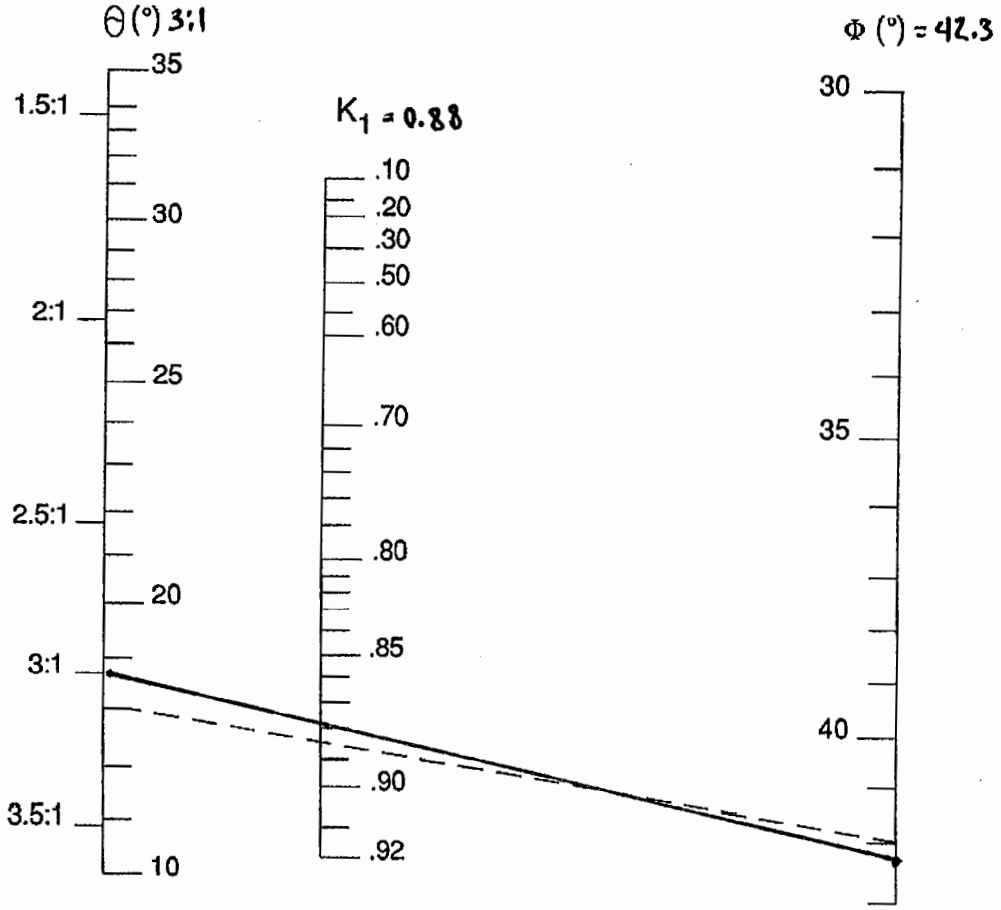
Chart 2. Correction factor for riprap size



$$K_1 = \left[1 - \frac{\sin^2\theta}{\sin^2\Phi} \right]^{0.5}$$

θ = Bank angle with horizontal

Φ = Material angle of repose
(See chart 4)



Example

Given:	Find:	Solution:
$\theta = 18°$	K_1	$\Phi = 42°$
Very Angular		$K_1 = 0.885$
$D_{50} = 1.5$ ft.		

Chart 3. Bank angle correction factor (K_1) nomograph

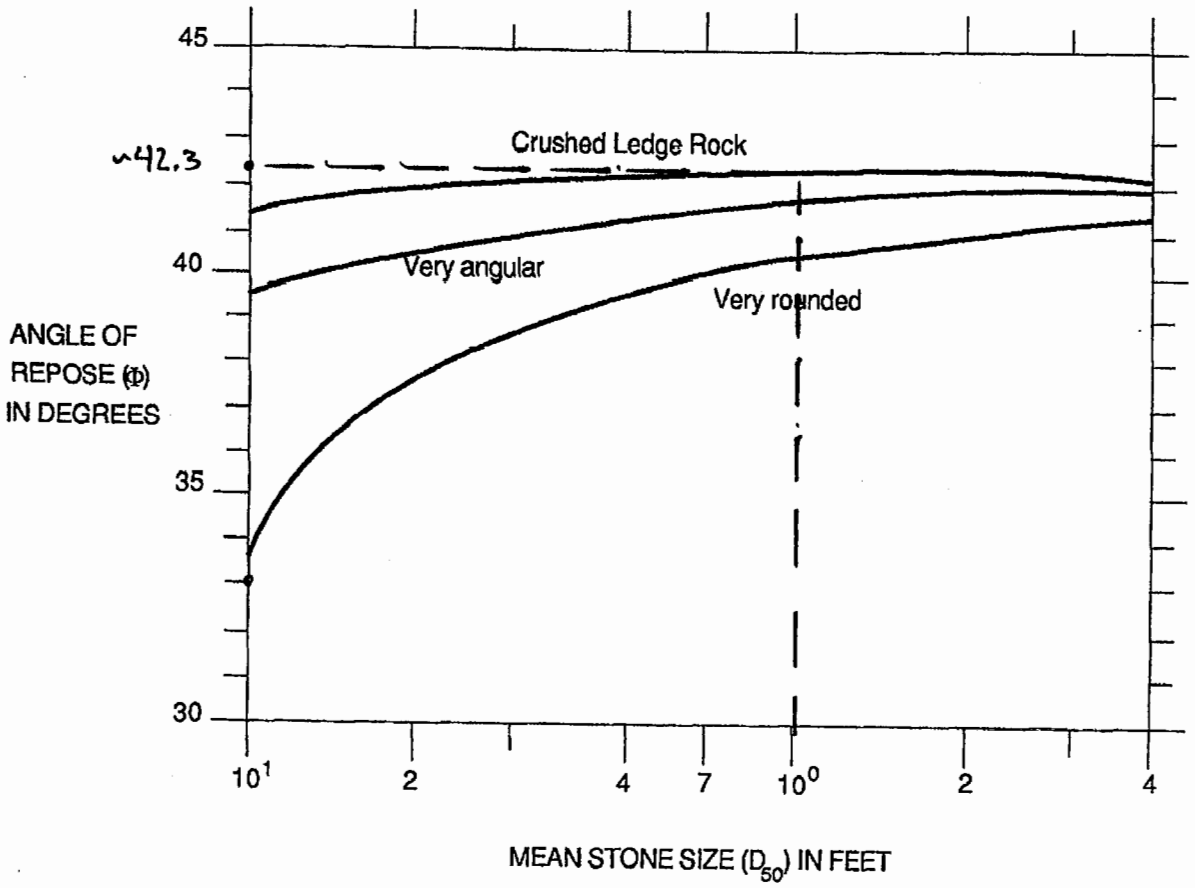


Chart 4. Angle of repose of riprap in terms of mean size and shape of stone.