TETRA TECH, INC.

By: RH Date: 11/11/2016 Subject: Raystown Road
Checked By: JB Date: 11/18/2016 PCSM Design and Evaluation

PURPOSE:

The purpose of these calculations is to design a Post-Construction Stormwater Management (PCSM) Plan for the Raystown Road block valve site as part of the Sunoco Pipeline L.P. Pennsylvania Pipeline Project. The site is located within Penn Township, Huntingdon County, Pennsylvania. Permanent stormwater controls will be developed to satisfy PADEP requirements.

PCSM DESIGN REQUIREMENTS:

The PCSM design for this project follows the PA Department of Environmental Protection's (PADEP) Pennsylvania Stormwater Best Management Practices Manual (BMP Manual), December 2006; and the standard design criteria from PA Title 25, Chapter 102.8.(g)(2) and (3). The design criteria evaluated for the site are summarized below.

Act 167 Consistency

Huntingdon County does not have an approved Act 167 Stormwater Management Plan, therefore, the county has adopted the PADEP Chapter 102 regulations as their county-wide stormwater guidance.

Recommended Volume Control Guideline

Use of Control Guideline 1 is recommended where site conditions offer the opportunity to reduce the increase in runoff volume as follows:

- Do not increase the post-development total runoff volume for all storms equal to or less than the two-year/24-hour event;
- Existing (pre-development) non-forested pervious areas must be considered meadow (good condition) or its equivalent; and
- 20 percent of existing impervious area, when present, shall be considered meadow (good condition) or its equivalent.

This site will utilize an infiltration trench and an infiltration berm to manage the two-year/24-hour volume increase.

Recommended Peak Rate Control Guideline

The recommended control guideline for peak rate control is:

- Do not increase the peak rate of discharge for the 2-year through 100-year events (at minimum); as necessary, provide additional peak rate control as required by applicable and approved Act 167 plan.
- There are no additional peak rate control required under the Act 167 Plan.

This site will utilize an infiltration trench and an infiltration berm to manage the two-year through 100-year peak rate increases. These BMPs will also help to increase the time of concentration for the drainage area encompassing the block valve.

Recommended Water Quality Control Guideline

Control Guideline 1 will provide water quality control and stream channel protection as well as flood control protection.

Infiltration

Infiltration rates for the PCSM BMPs have been determined from site infiltration testing conducted in accordance of the PA BMP Manual. Documentation for infiltration testing and design infiltration rates can be found in Attachment 5 of the Site Restoration/Post Construction Stormwater Management Plan. Infiltration test locations and recommended design rates are also labeled on the PCSM Plan Drawings in Attachment 6.

During the onsite infiltration tests, the depth to seasonal high groundwater and shallow bedrock or another confining layer were evaluated. An infiltration berm is proposed where seasonal high groundwater and shallow bedrock are not apparent. Due to the presence of shallow groundwater at one of the test locations, it is not possible to maintain 2 feet of separation between a volume-reducing BMP and groundwater. Therefore, a shallow infiltration trench has been proposed. The trench is proposed to have a 1 foot depth to maintain the required separation between the trench bottom and seasonal high groundwater. Although the infiltration test was performed at a depth of 2 feet, based on infiltration test results at both the surface and deep depths, infiltration is still feasible at this location.

Due to site constraints, the proposed infiltration berm is located over the proposed pipeline. To ensure that infiltration will occur, post-construction infiltration tests will be performed in the area of the proposed berm. Tilling and scarifying of the soil will be performed if the post-construction infiltration rate is deemed too low. Soil amendments can also be added post-construction. This method will ensure that any compaction that does occur during construction will be remedied, thus ensuring that the infiltration berm will work as designed.

The post-construction stormwater management design will utilize onsite infiltration to meet Volume Control Guideline 1.

Loading Ratio

Loading ratios have been considered for the design of infiltration BMPs. In general, the following Loading Ratio guidelines are recommended:

- Maximum Impervious Loading Ratio of 5:1 relating impervious drainage area to infiltration area.
- Maximum Drainage Area Loading Ratio of 8:1 relating total drainage area to infiltration area.

The maximum impervious loading ratio of 5:1 has been met. The impervious loading ratio for the site is 5:1.

The maximum drainage area loading ratio of 8:1 has not been met. The drainage area loading ratio for the site is 20.9:1. However, runoff from the site and upslope drainage area will be dispersed to an infiltration berm and an infiltration trench. These BMPs have been placed to maximize the loading ratio to the

maximum extent practicable, and other infiltration design parameters from the PA Stormwater BMP Manual have been met.

Disturbed Area

To meet Standard Worksheet 10 guidelines, 90% of the disturbed area is contained by the proposed PCSM BMPs.

Karst Topography

The Raystown Road block valve is not located in an area of karst terrain.

Special Protection Watershed

The Raystown Road block valve site is not located within a special protection watershed, so antidegradation requirements do not apply.

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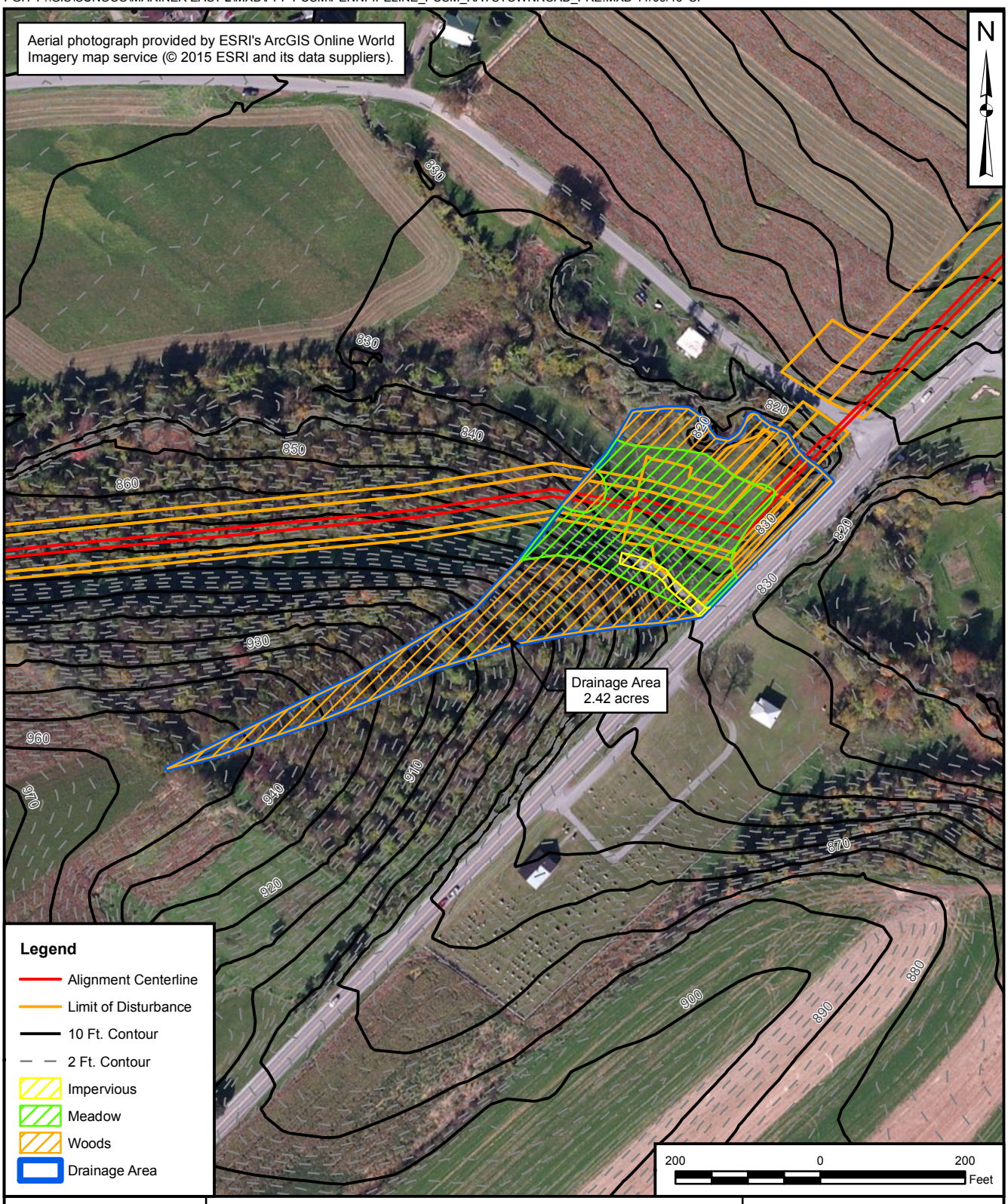

TETRA TECH

PRE-DEVELOPMENT DRAINAGE AREA MAP
RAYSTOWN ROAD
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
HUNTINGDON COUNTY, PENNSYLVANIA

DRAWN BY: S. PAXTON 05/20/16
CHECKED BY: J. BRODY 11/09/16

APPROVED BY:

CONTRACT NUMBER: 112IC05958

FIGURE NUMBER	REV
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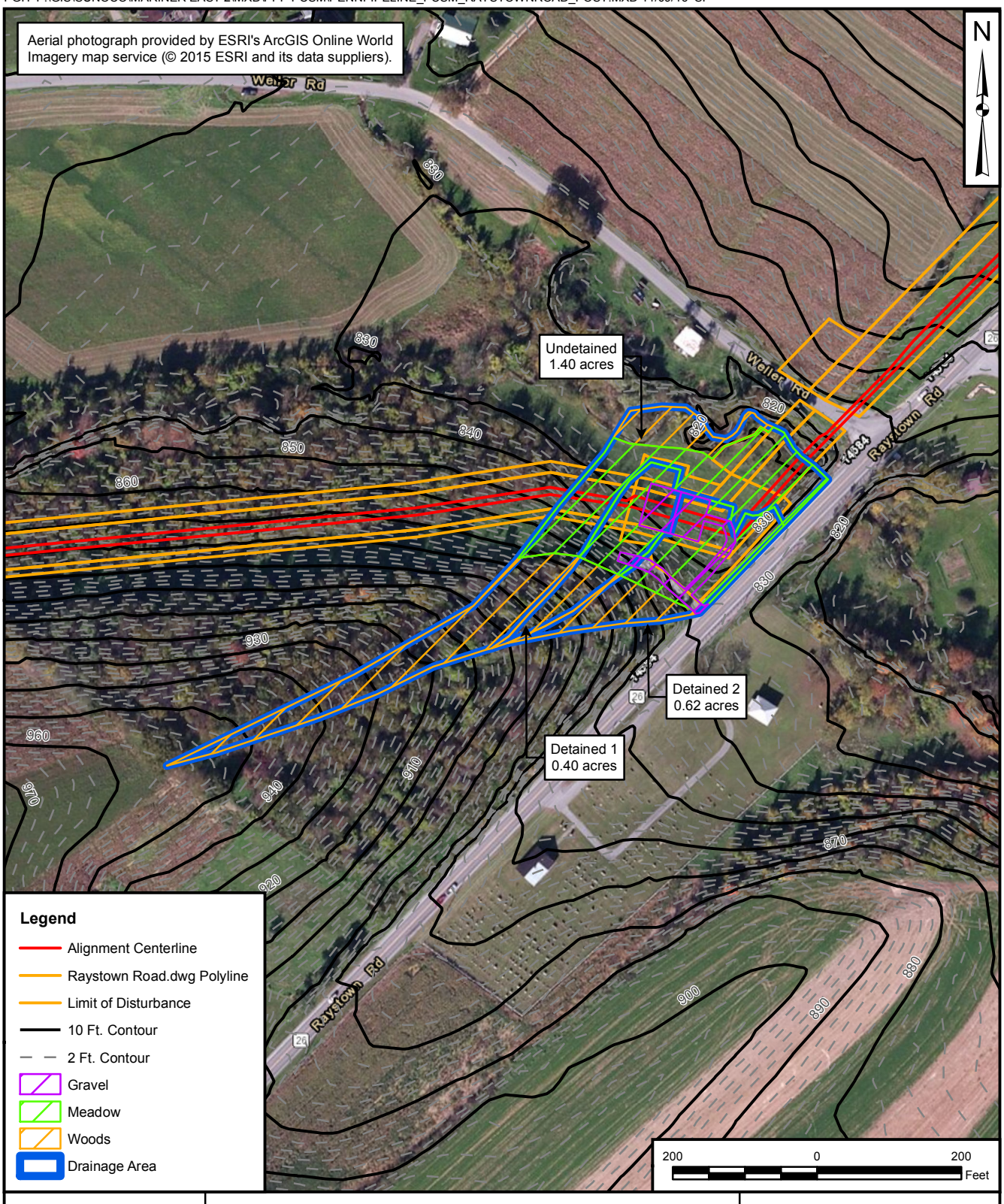


TETRA TECH

POST-DEVELOPMENT DRAINAGE AREA MAP
RAYSTOWN ROAD
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
HUNTINGDON COUNTY, PENNSYLVANIA

DRAWN BY: S. PAXTON 05/20/16
CHECKED BY: J. BRODY 11/09/16

APPROVED BY:

CONTRACT NUMBER: 112IC05958

FIGURE NUMBER	REV
2	0

NOAA Atlas 14, Volume 2, Version 3
Location name: Penn Twp, Pennsylvania, USA*
Latitude: 40.3968°, Longitude: -78.1502°
Elevation: 825.56 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.314** (0.280-0.353)	**0.376** (0.336-0.421)	**0.458** (0.408-0.512)	**0.522** (0.464-0.583)	**0.607** (0.536-0.677)	**0.674** (0.593-0.750)	**0.742** (0.648-0.824)	**0.812** (0.705-0.901)	**0.911** (0.782-1.01)	**0.987** (0.839-1.09)
10-min	**0.488** (0.436-0.548)	**0.587** (0.525-0.657)	**0.711** (0.634-0.796)	**0.805** (0.716-0.900)	**0.929** (0.820-1.03)	**1.02** (0.898-1.14)	**1.12** (0.975-1.24)	**1.21** (1.05-1.34)	**1.34** (1.15-1.48)	**1.44** (1.22-1.59)
15-min	**0.599** (0.534-0.672)	**0.717** (0.642-0.804)	**0.873** (0.779-0.977)	**0.991** (0.881-1.11)	**1.15** (1.01-1.28)	**1.26** (1.11-1.41)	**1.39** (1.21-1.54)	**1.51** (1.31-1.67)	**1.67** (1.44-1.85)	**1.80** (1.53-1.99)
30-min	**0.792** (0.707-0.889)	**0.960** (0.859-1.08)	**1.20** (1.07-1.34)	**1.38** (1.22-1.54)	**1.62** (1.43-1.81)	**1.81** (1.59-2.01)	**2.00** (1.75-2.22)	**2.20** (1.91-2.44)	**2.48** (2.13-2.74)	**2.69** (2.29-2.98)
60-min	**0.967** (0.863-1.09)	**1.18** (1.05-1.32)	**1.50** (1.34-1.68)	**1.75** (1.56-1.96)	**2.10** (1.86-2.34)	**2.38** (2.09-2.65)	**2.68** (2.34-2.97)	**2.99** (2.59-3.31)	**3.43** (2.94-3.79)	**3.78** (3.21-4.18)
2-hr	**1.11** (0.981-1.26)	**1.35** (1.19-1.53)	**1.72** (1.51-1.95)	**2.01** (1.77-2.28)	**2.43** (2.12-2.74)	**2.77** (2.41-3.13)	**3.15** (2.71-3.54)	**3.54** (3.03-3.97)	**4.12** (3.48-4.61)	**4.59** (3.85-5.14)
3-hr	**1.20** (1.07-1.36)	**1.45** (1.29-1.65)	**1.83** (1.63-2.08)	**2.14** (1.90-2.43)	**2.59** (2.28-2.92)	**2.96** (2.58-3.32)	**3.36** (2.91-3.77)	**3.79** (3.26-4.24)	**4.42** (3.75-4.93)	**4.94** (4.15-5.50)
6-hr	**1.50** (1.35-1.69)	**1.81** (1.62-2.04)	**2.25** (2.02-2.54)	**2.62** (2.34-2.95)	**3.16** (2.80-3.53)	**3.60** (3.17-4.01)	**4.07** (3.56-4.53)	**4.58** (3.97-5.09)	**5.33** (4.56-5.91)	**5.95** (5.04-6.59)
12-hr	**1.86** (1.67-2.10)	**2.23** (2.00-2.52)	**2.77** (2.48-3.12)	**3.23** (2.87-3.62)	**3.89** (3.43-4.35)	**4.45** (3.90-4.96)	**5.06** (4.39-5.62)	**5.72** (4.92-6.34)	**6.70** (5.68-7.41)	**7.53** (6.31-8.32)
24-hr	**2.23** (2.04-2.45)	**2.67** (2.44-2.94)	**3.32** (3.04-3.65)	**3.86** (3.52-4.24)	**4.64** (4.21-5.08)	**5.30** (4.78-5.79)	**5.99** (5.38-6.55)	**6.75** (6.01-7.37)	**7.84** (6.90-8.56)	**8.75** (7.63-9.55)
2-day	**2.57** (2.36-2.82)	**3.08** (2.83-3.38)	**3.83** (3.51-4.20)	**4.46** (4.07-4.88)	**5.36** (4.86-5.85)	**6.11** (5.51-6.67)	**6.93** (6.21-7.55)	**7.81** (6.94-8.51)	**9.09** (7.98-9.92)	**10.2** (8.81-11.1)
3-day	**2.74** (2.52-3.00)	**3.28** (3.03-3.59)	**4.07** (3.74-4.45)	**4.72** (4.33-5.15)	**5.66** (5.17-6.16)	**6.44** (5.85-7.01)	**7.28** (6.57-7.92)	**8.19** (7.33-8.91)	**9.49** (8.39-10.3)	**10.6** (9.24-11.5)
4-day	**2.91** (2.69-3.17)	**3.48** (3.23-3.80)	**4.30** (3.98-4.69)	**4.98** (4.60-5.42)	**5.96** (5.47-6.47)	**6.77** (6.18-7.34)	**7.63** (6.93-8.28)	**8.56** (7.71-9.30)	**9.89** (8.80-10.8)	**11.0** (9.67-12.0)
7-day	**3.41** (3.17-3.69)	**4.08** (3.79-4.40)	**4.98** (4.63-5.37)	**5.70** (5.29-6.14)	**6.71** (6.20-7.22)	**7.51** (6.91-8.08)	**8.35** (7.64-8.99)	**9.22** (8.38-9.94)	**10.4** (9.39-11.3)	**11.4** (10.2-12.3)
10-day	**3.93** (3.67-4.22)	**4.67** (4.36-5.02)	**5.62** (5.24-6.02)	**6.37** (5.93-6.83)	**7.41** (6.88-7.94)	**8.24** (7.62-8.83)	**9.09** (8.36-9.75)	**9.97** (9.10-10.7)	**11.2** (10.1-12.0)	**12.1** (10.9-13.0)
20-day	**5.38** (5.08-5.70)	**6.33** (5.99-6.72)	**7.41** (6.99-7.85)	**8.23** (7.76-8.71)	**9.30** (8.75-9.85)	**10.1** (9.50-10.7)	**10.9** (10.2-11.6)	**11.7** (10.9-12.4)	**12.7** (11.8-13.5)	**13.4** (12.4-14.3)
30-day	**6.70** (6.34-7.06)	**7.85** (7.43-8.28)	**9.02** (8.54-9.51)	**9.91** (9.38-10.4)	**11.1** (10.4-11.6)	**11.9** (11.2-12.5)	**12.7** (12.0-13.4)	**13.5** (12.6-14.2)	**14.4** (13.5-15.3)	**15.1** (14.1-16.1)
45-day	**8.47** (8.04-8.91)	**9.91** (9.40-10.4)	**11.2** (10.7-11.8)	**12.2** (11.6-12.9)	**13.4** (12.7-14.1)	**14.3** (13.5-15.0)	**15.1** (14.3-15.8)	**15.8** (14.9-16.6)	**16.6** (15.7-17.5)	**17.2** (16.2-18.2)
60-day	**10.2** (9.71-10.7)	**11.9** (11.3-12.5)	**13.3** (12.7-14.0)	**14.4** (13.7-15.1)	**15.6** (14.9-16.4)	**16.5** (15.7-17.3)	**17.3** (16.4-18.1)	**18.0** (17.1-18.9)	**18.8** (17.8-19.7)	**19.3** (18.3-20.3)

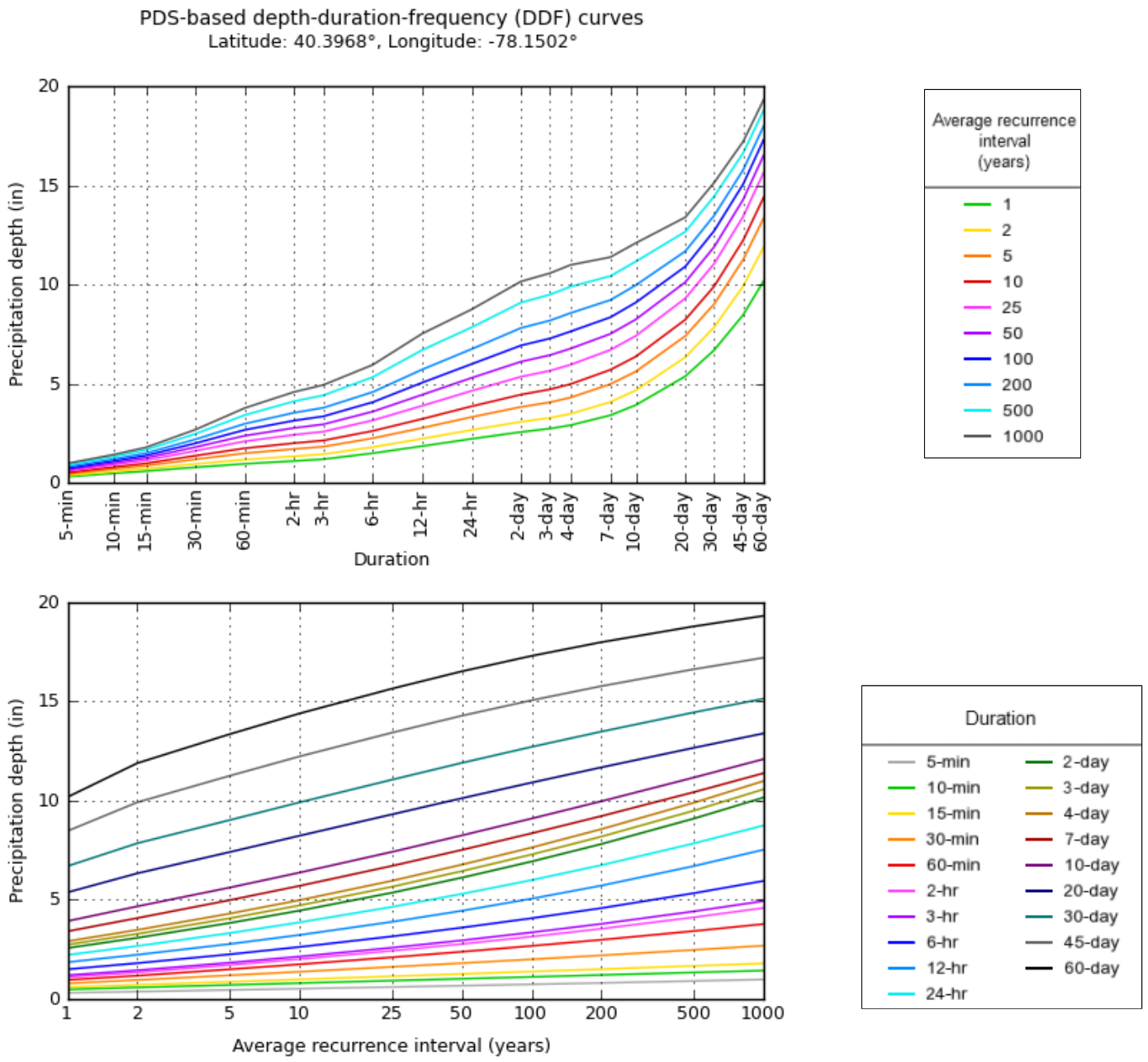
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



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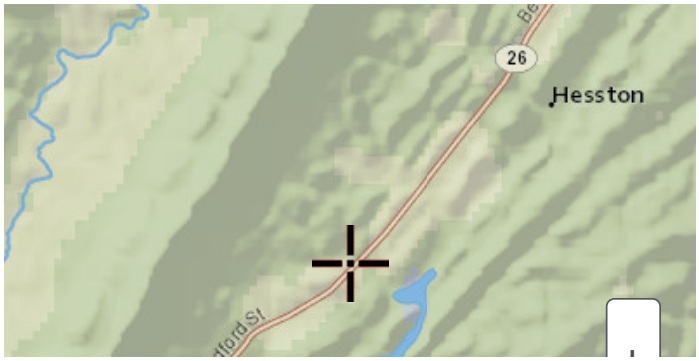
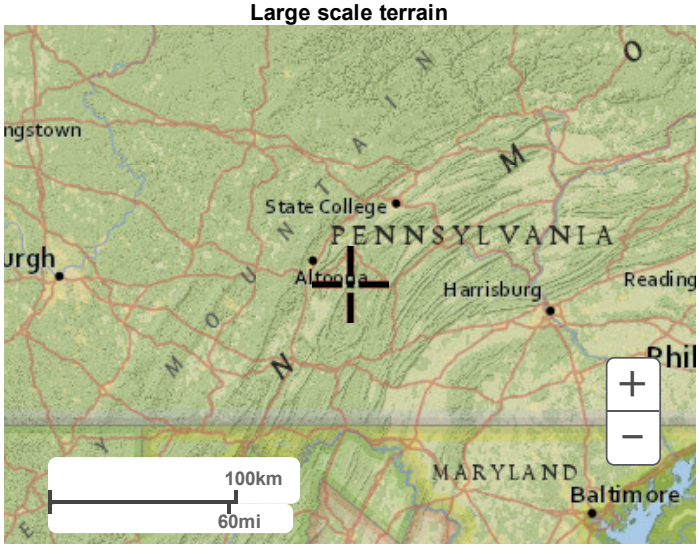
Back to Top

Maps & aerials

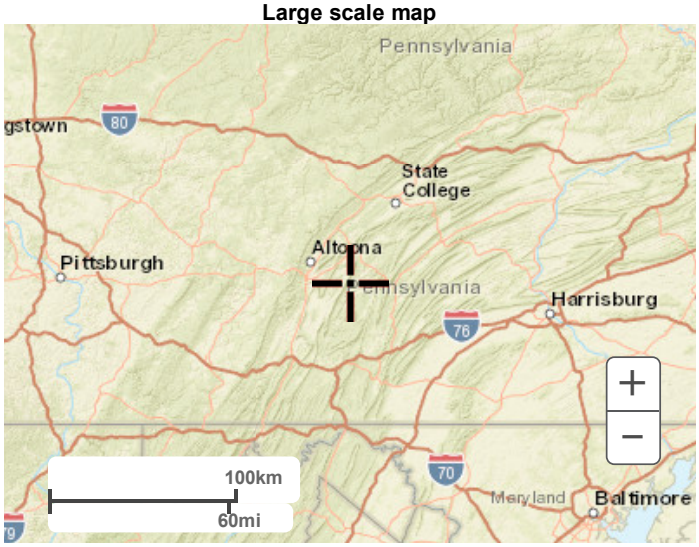
Small scale terrain



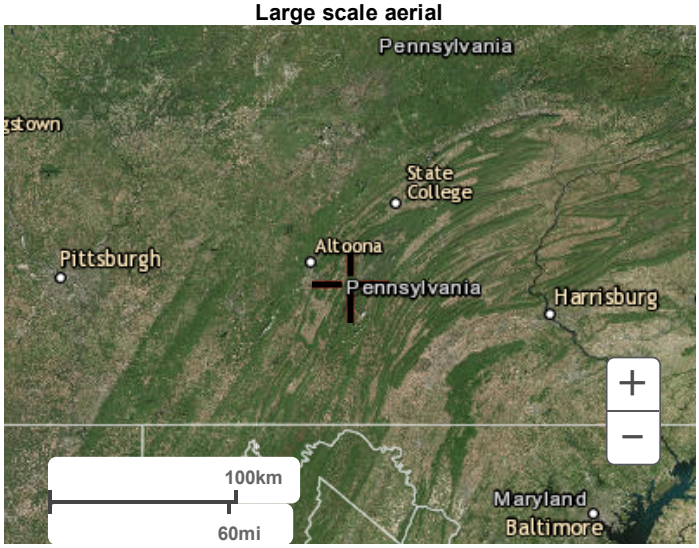
Large scale terrain



Large scale map



Large scale aerial



Back to Top

WORKSHEET 1. GENERAL SITE INFORMATION

Date: November 11, 2016

Project Name: Raystown Road

Municipality: Penn

County: Huntingdon

Total Area (acres): 2.42

Major River Basin: Susquehanna River

Watershed: Raystown Branch - Juniata River

Sub Basin: James Creek

Nearest Surface Water to Receive Runoff: Tributary #13451 to James Creek

Chapter 93 - Designated Water Use: Warm Water Fishes (WWF)

Impaired according to Chapter 303(d) list?	YES	
List Causes of Impairment:	NO	X

Is Project Subject to, or Part of:

Municipal Separate Storm Sewer System (MS4) Requirements	YES	
	NO	X
Existing or Planned drinking water supply?	YES	
	NO	X
If yes, distance from proposed discharge (miles):		
Approved Act 167 Plan?	YES	
	NO	X
Existing River Conservation Plan?	YES	X
	NO	

Worksheet 2. Sensitive Natural Resources

INSTRUCTIONS

1. Provide Sensitive Resources Map according to non-structural BMP 5.4.1 in Chapter 5. This map should identify wetlands, woodlands, natural drainage ways, steep slopes, and other sensitive natural areas.

   See pre-development drainage area map

2. Summarize the existing extent of each sensitive resource in the Existing Sensitive Resources Table (below, using Acres). If none present, insert 0.

   Woodlands - 0.28 acres

3. Summarize Total Protected Area as defined under BMPs in Chapter 5.

   0.00 acres

4. Do not count any area twice. For example, an area that is both a floodplain and a wetland may only be considered once.

EXISTING NATURAL SENSITIVE RESOURCE	MAPPED? Yes/no/n/a	TOTAL AREA (Ac.)	PROTECTED AREA (Ac.)
Waterbodies	N/A		
Floodplains	N/A		
Riparian Areas	N/A		
Wetlands	N/A		
Woodlands	Yes	0.28	
Natural Drainage Ways	N/A		
Steep Slopes, 15% - 25%	N/A		
Steep Slopes, over 25%	N/A		
Other:			
Other:			
TOTAL EXISTING:		**0.28**	**0.00**

Worksheet 3. Nonstructural BMP Credits

PROTECTED AREA

1.1 Area of Protected Sensitive/Special Value Features (see WS 2) 0.00 **Ac.**

1.2 Area of Riparian Forest Buffer Protection 0.00 **Ac.**

3.1 Area of Minimum Disturbance/Reduced Grading 0.00 **Ac**

TOTAL 0.00 **Ac**

Site Area	Minus	Protected Area	=	Stormwater Management Area
0.91	-	0	=	0.91

This is the area that requires stormwater management

VOLUME CREDITS

3.1 Minimum Soil Compaction (See Chapter 8, page 22 – SW BMP Manual)

Lawn _____ ft^2 x 1/4" x 1/12 = _____ ft^3

Meadow _____ ft^2 x 1/3" x 1/12 = _____ ft^3

3.3 Protect Existing Trees (See Chapter 8, page 23 – SW BMP Manual)

For Trees within 100 feet of impervious area:

Tree Canopy _____ ft^2 x 1/2" x 1/12 = _____ ft^3

5.1 Disconnect Roof Leaders to Vegetated Areas (See Chapter 8 page 25 – SW BMP Manual)

For runoff directed to areas protected under 5.8.1 and 5.8.2

Roof Area _____ ft^2 x 1/3" x 1/12 = _____ ft^3

For all other disconnected roof areas

Roof Area _____ ft^2 x 1/4" x 1/12 = _____ ft^3

5.2 Disconnect Non-Roof impervious to Vegetated Areas (See Chapter 8, page 26 – SW BMP Manual)

For Runoff directed to areas protected under 5.8.1 and 5.8.2

Impervious Area _____ ft^2 x 1/3" x 1/12 = _____ ft^3

For all other disconnected roof areas

Impervious Area _____ ft^2 x 1/4" x 1/12 = _____ ft^3

TOTAL NON-STRUCTURAL VOLUME CREDIT* _____ ft^3

**For use on Worksheet 5*

WORKSHEET 4. CHANGE IN RUNOFF VOLUME FOR 2-YR STORM EVENT

PROJECT: Raystown Road
Drainage Area: 2.42 acres
2-Year Rainfall: 2.67 in

Total Site Area: 0.92 acres
Protected Site Area: N/A acres
Managed Site Area: 0.92 acres

Existing Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[3] (ft^3)
Meadow	B	13,939	0.32	58	7.24	1.45	0.18	205
Meadow	D	13,939	0.32	78	2.82	0.56	0.90	1,046
Woods	B	6,098	0.14	55	8.18	1.64	0.12	59
Woods	D	6,098	0.14	77	2.99	0.60	0.85	431
TOTAL:		**40,075**	**0.92**					**1,741**

Developed Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	Ia (0.2*S)	Q Runoff[1] (in)	Runoff Volume[3] (ft^3)
Impervious-Gravel	B	3,485	0.08	85	1.76	0.35	1.32	382
Impervious-Gravel	D	3,485	0.08	91	0.99	0.20	1.77	513
Meadow	B	16,553	0.38	58	7.24	1.45	0.18	243
Meadow	D	16,553	0.38	78	2.82	0.56	0.90	1,242
TOTAL:		**40,075**	**0.92**					**2,380**

2-Year Volume Increase (ft^3):	**639**

2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume

1. Runoff (in) = Q = (P - 0.2S)2 / (P+ 0.8S) where
   P = 2-Year Rainfall (in)
   S = (1000/CN)-10

2. Runoff Volume (CF) = Q x Area x 1/12
   Q = Runoff (in)
   Area = Land use area (sq. ft.)

Note: Runoff Volume must be calculated for EACH land use type/condition and HSGI.
The use of a weighted CN value for volume calculations is not acceptable.

Worksheet 5. Structural BMP Volume Credits

PROJECT: Raystown Road
SUB-BASIN:

Required Control Volume (ft^3) - *from Worksheet 4:* 639

Non-structural Volume Credit (ft^3) - *from Worksheet 3:* N/A
(maximum is 25% of required volume)

Structural Volume Reqmt (ft^3): 639
(Required Control Volume minus Non-structural Credit)

Proposed BMPs from PA Stormwater Best Management Practices Manual Chapter 6		Area (ft^2)	Volume Reduction Permanently Removed (ft^3)
6.4.1	Porous Pavement		
6.4.2	Infiltration Basin		
6.4.3	Infiltration Bed		
6.4.4	Infiltration Trench	126	53
6.4.5	Rain Garden/Bioretention		
6.4.6	Dry Well/Seepage Pit		
6.4.7	Constructed Filter		
6.4.8	Vegetated Swale		
6.4.9	Vegetated Filter Strip		
6.4.10	Berm	1,877	1,627
6.5.1	Vegetated Roof		
6.5.2	Capture and Re-Use		
6.6.1	Constructed Wetlands		
6.6.2	Wet Pond/Retention Basin		
6.7.1	Riparian Buffer/Riparian Forest Buffer Restoration		
6.7.2	Landscape Restoration/Reforestation		
6.7.3	Soil Amendment		
6.8.1	Level Spreader		
6.8.2	Special Storage Areas		
Other:	Slow Release Concept		
		Total Structural Volume (ft^3):	**1,680**
		Structural Volume Requirement (ft^3):	**639**
		DIFFERENCE:	**-1,041**

VOLUME CREDIT DETERMINATION DETAINED 1

1 Detained area runoff volume from Hydraflow = 734 cf

2 Storage volume of the BMP = 893 cf

3 Infiltrated volume within 72 hours after the 2-yr/24-hr event
(Infiltration Rate/12) x Infiltration Area x 72 hrs = 734 cf

VOLUME CREDIT DETERMINATION DETAINED 2

1 Detained area runoff volume from Hydraflow = 1,687 cf

2 Storage volume of the BMP = 946 cf

3 Infiltrated volume within 72 hours after the 2-yr/24-hr event
(Infiltration Rate/12) x Infiltration Area x 72 hrs = 946 cf

WORKSHEET 10. WATER QUALITY COMPLIANCE FOR NITRATE

Does the site design incorporate the following BMPs to address nitrate pollution? A summary "yes" rating is achieved if at least 2 Primary BMPs for nitrate are provided across the site or 4 secondary BMPs for nitrate are provided across the site (or the

PRIMARY BMPs FOR NITRATE:

	YES	NO
NS BMP 5.4.2 - Protect / Conserve / Enhance Riparian Buffers		
NS BMP 5.5.4 - Cluster Uses at Each Site		
NS BMP 5.6.1 - Minimize Total Disturbed Area	X	
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native Species)	X	
NS BMP 5.9.1 - Street Sweeping / Vacuuming		
Structural BMP 6.7.1 - Riparian Buffer Restoration		
Structural BMP 6.7.2 - Landscape Restoration		

SECONDARY BMPs FOR NITRATE:

NS BMP 5.4.1 - Protect Sensitive / Special Value Features		
NS BMP 5.4.3 - Protect / Utilize Natural Drainage Features		
NS BMP 5.6.2 - Minimize Soil Compaction	X	
Structural BMP 6.4.5 - Rain Garden / Bioretention		
Structural BMP 6.4.8 - Vegetated Swale		
Structural BMP 6.4.9 - Vegetated Filter Strip		
Structural BMP 6.6.1 - Constructed Wetland		
Structural BMP 6.7.1 - Riparian Buffer Restoration		
Structural BMP 6.7.2 - Landscape Restoration		
Structural BMP 6.7.3 - Soils Amendment/Restoration	X	

TIME OF CONCENTRATION ADJUSTMENT

POST CONSTRUCTION TC TO BMP (DETAINED TC) BEFORE ADJUSTMENT 4.2 MIN

STRUCTURAL VOLUME PROVIDED BY BMP 734 CF FOR 2-YR/24-HR STORM EVENT
893 CF FOR ALL REMANING STORM EVENTS

RATES OF RUNOFF TO THE BMP (FROM HYDRAFLOW REPORT)

Storm Event	Q (CFS)
2 YR/24 HR	0.345
10 YR/24 HR	0.84
50 YR/24 HR	1.534
100 YR/24 HR	1.888

ADDITIONAL RESIDENCE TIME (MIN) = (STRUCTURAL VOLUME PROVIDED BY BMP / RATE OF RUNOFF TO BMP) / 60

Storm Event	Q (CFS)	Additional Residence Time (min.)
2 YR/24 HR	0.345	35.459
10 YR/24 HR	0.840	17.718
50 YR/24 HR	1.534	9.702
100 YR/24 HR	1.888	7.883

ADJUSTED TC = POST CONSTRUCTION TC TO BMP BEFORE ADJUSTMENT + ADDITIONAL RESIDENCE TIME

Storm Event	Q (CFS)	Additional Residence Time (min.)	Adjusted Time of Concentration (min.)
2 YR/24 HR	0.345	35.459	39.659
10 YR/24 HR	0.840	17.718	21.918
50 YR/24 HR	1.534	9.702	13.902
100 YR/24 HR	1.888	7.883	12.083

TIME OF CONCENTRATION ADJUSTMENT

POST CONSTRUCTION TC TO BMP (DETAINED TC) BEFORE ADJUSTMENT 4.7 MIN

STRUCTURAL VOLUME PROVIDED BY BMP 946 CF

RATES OF RUNOFF TO THE BMP (FROM HYDRAFLOW REPORT)

Storm Event	Q (CFS)
2 YR/24 HR	0.838
10 YR/24 HR	1.717
50 YR/24 HR	2.905
100 YR/24 HR	3.504

ADDITIONAL RESIDENCE TIME (MIN) = (STRUCTURAL VOLUME PROVIDED BY BMP / RATE OF RUNOFF TO BMP) / 60

Storm Event	Q (CFS)	Additional Residence Time (min.)
2 YR/24 HR	0.838	18.815
10 YR/24 HR	1.717	9.183
50 YR/24 HR	2.905	5.427
100 YR/24 HR	3.504	4.500

ADJUSTED TC = POST CONSTRUCTION TC TO BMP BEFORE ADJUSTMENT + ADDITIONAL RESIDENCE TIME

Storm Event	Q (CFS)	Additional Residence Time (min.)	Adjusted Time of Concentration (min.)
2 YR/24 HR	0.838	18.815	23.515
10 YR/24 HR	1.717	9.183	13.883
50 YR/24 HR	2.905	5.427	10.127
100 YR/24 HR	3.504	4.500	9.200

INFILTRATION BERM A DEWATERING CALCULATION SITE NAME: Raystown Road

STORAGE VOLUME	734	CF	
DESIGN INFILTRATION RATE	1.8	IN/HR	BASED ON IT- AND IT-2
INFILTRATION AREA	930	SF	

DEWATERING TIME = STORAGE VOLUME / ((DESIGN INFILTRATION RATE /12) * INFILTRATION AREA)

DEWATERING TIME = 5.3 HOURS

INFILTRATION BERM B DEWATERING CALCULATION SITE NAME: Raystown Road

STORAGE VOLUME	1,772	CF	
DESIGN INFILTRATION RATE	0.7	IN/HR	BASED ON IT-C AND IT-D
INFILTRATION AREA	946	SF	

DEWATERING TIME = STORAGE VOLUME / ((DESIGN INFILTRATION RATE /12) * INFILTRATION AREA)

DEWATERING TIME = 32.1 HOURS

INFILTRATION TRENCH - VOLUME CALCULATION

LENGTH	42	FT
WIDTH	3	FT
DEPTH	1	FT
PIPE DIAMETER	0.334	FT
NUMBER OF PIPES	1	
VOID RATIO OF GRAVEL	0.4	
X-SECTIONAL AREA OF VOIDS IN TRENCH	1.16	SF
AREA OF PIPE(S)	0.09	SF
COMBINED X-SECTIONAL AREA	1.25	SF

STORAGE IN TRENCH	**52.61**	**CF**

Worksheet for Circular Pipe - 1

Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.05500	ft/ft
Normal Depth	0.25	ft
Diameter	0.25	ft
Discharge	0.22	ft³/s

Results

Discharge	0.22	ft³/s
Normal Depth	0.25	ft
Flow Area	0.05	ft²
Wetted Perimeter	0.79	ft
Hydraulic Radius	0.06	ft
Top Width	0.00	ft
Critical Depth	0.24	ft
Percent Full	100.0	%
Critical Slope	0.04896	ft/ft
Velocity	4.57	ft/s
Velocity Head	0.33	ft
Specific Energy	0.58	ft
Froude Number	0.00	
Maximum Discharge	0.24	ft³/s
Discharge Full	0.22	ft³/s
Slope Full	0.05500	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%

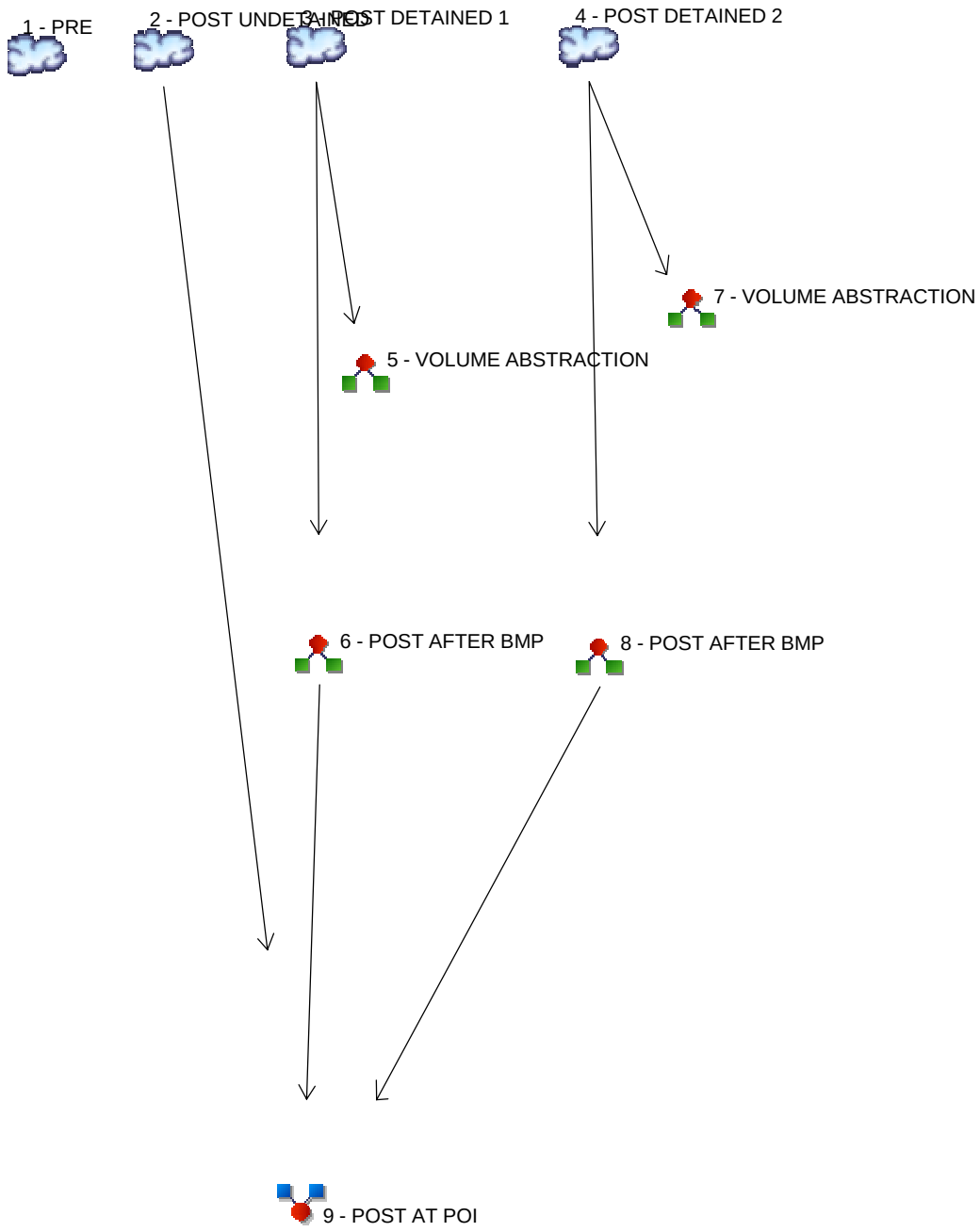
Worksheet for Circular Pipe - 1

GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.25	ft
Critical Depth	0.24	ft
Channel Slope	0.05500	ft/ft
Critical Slope	0.04896	ft/ft

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE
2	SCS Runoff	POST UNDETAINED
3	SCS Runoff	POST DETAINED 1
4	SCS Runoff	POST DETAINED 2
5	Diversion1	VOLUME ABSTRACTION
6	Diversion2	POST AFTER BMP
7	Diversion1	VOLUME ABSTRACTION
8	Diversion2	POST AFTER BMP
9	Combine	POST AT POI

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	SCS Runoff	------	-------	1.963	-------	-------	4.662	-------	8.458	10.42	PRE
2	SCS Runoff	------	-------	1.062	-------	-------	2.455	-------	4.436	5.443	POST UNDETAINED
3	SCS Runoff	------	-------	0.345	-------	-------	0.840	-------	1.534	1.888	POST DETAINED 1
4	SCS Runoff	------	-------	0.838	-------	-------	1.717	-------	2.905	3.504	POST DETAINED 2
5	Diversion1	3	-------	0.345	-------	-------	0.840	-------	1.521	1.591	VOLUME ABSTRACTION
6	Diversion2	3	-------	0.000	-------	-------	0.060	-------	1.534	1.888	POST AFTER BMP
7	Diversion1	4	-------	0.838	-------	-------	1.701	-------	1.164	0.970	VOLUME ABSTRACTION
8	Diversion2	4	-------	0.049	-------	-------	1.717	-------	2.905	3.504	POST AFTER BMP
9	Combine	2, 6, 8	-------	1.062	-------	-------	3.707	-------	8.137	9.956	POST AT POI

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	SCS Runoff	1.963	2	722	5,611	------	------	------	PRE
2	SCS Runoff	1.062	2	724	3,280	------	------	------	POST UNDETAINED
3	SCS Runoff	0.345	2	718	734	------	------	------	POST DETAINED 1
4	SCS Runoff	0.838	2	718	1,687	------	------	------	POST DETAINED 2
5	Diversion1	0.345	2	718	734	3	------	------	VOLUME ABSTRACTION
6	Diversion2	0.000	2	n/a	0	3	------	------	POST AFTER BMP
7	Diversion1	0.838	2	718	950	4	------	------	VOLUME ABSTRACTION
8	Diversion2	0.049	2	788	737	4	------	------	POST AFTER BMP
9	Combine	1.062	2	724	4,017	2, 6, 8	------	------	POST AT POI

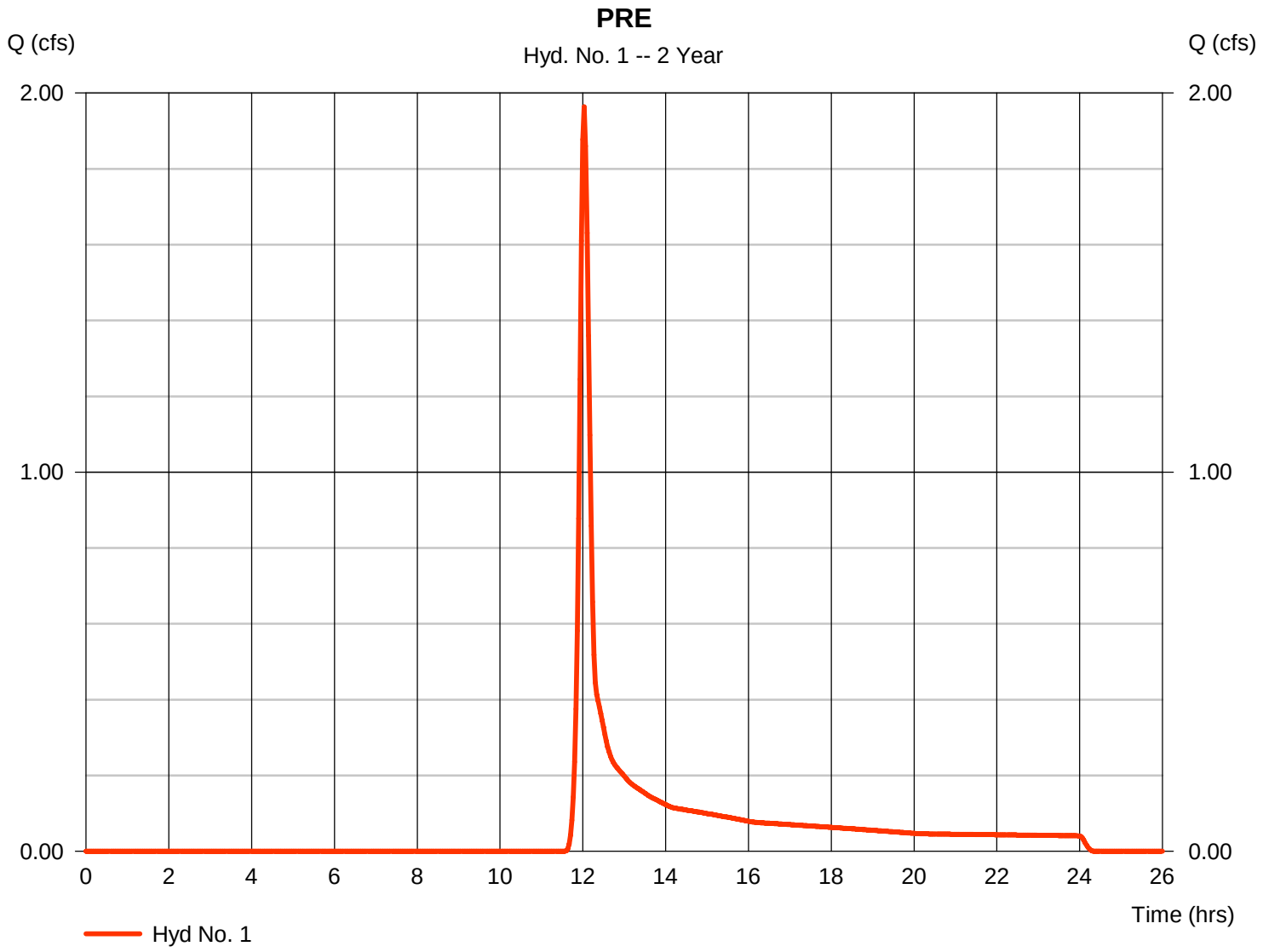
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.963 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	5,611 cuft
Drainage area	=	2.420 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	2.67 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.040 x 98) + (0.130 x 58) + (0.840 x 78) + (0.850 x 77) + (0.560 x 55)] / 2.420



TR55 Tc Worksheet

Hyd. No. 1

PRE

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 3.46		0.00		0.00		
Travel Time (min)	**= 7.21**	**+**	**0.00**	**+**	**0.00**	**=**	**7.21**
Shallow Concentrated Flow							
Flow length (ft)	= 896.00		0.00		0.00		
Watercourse slope (%)	= 5.12		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.65		0.00		0.00		
Travel Time (min)	**= 4.09**	**+**	**0.00**	**+**	**0.00**	**=**	**4.09**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 1.35		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=7.93						
			0.00				
					0.00		
Flow length (ft)	({0})93.0		0.0		0.0		
Travel Time (min)	**= 0.20**	**+**	**0.00**	**+**	**0.00**	**=**	**0.20**

Total Travel Time, Tc ..... 11.50 min

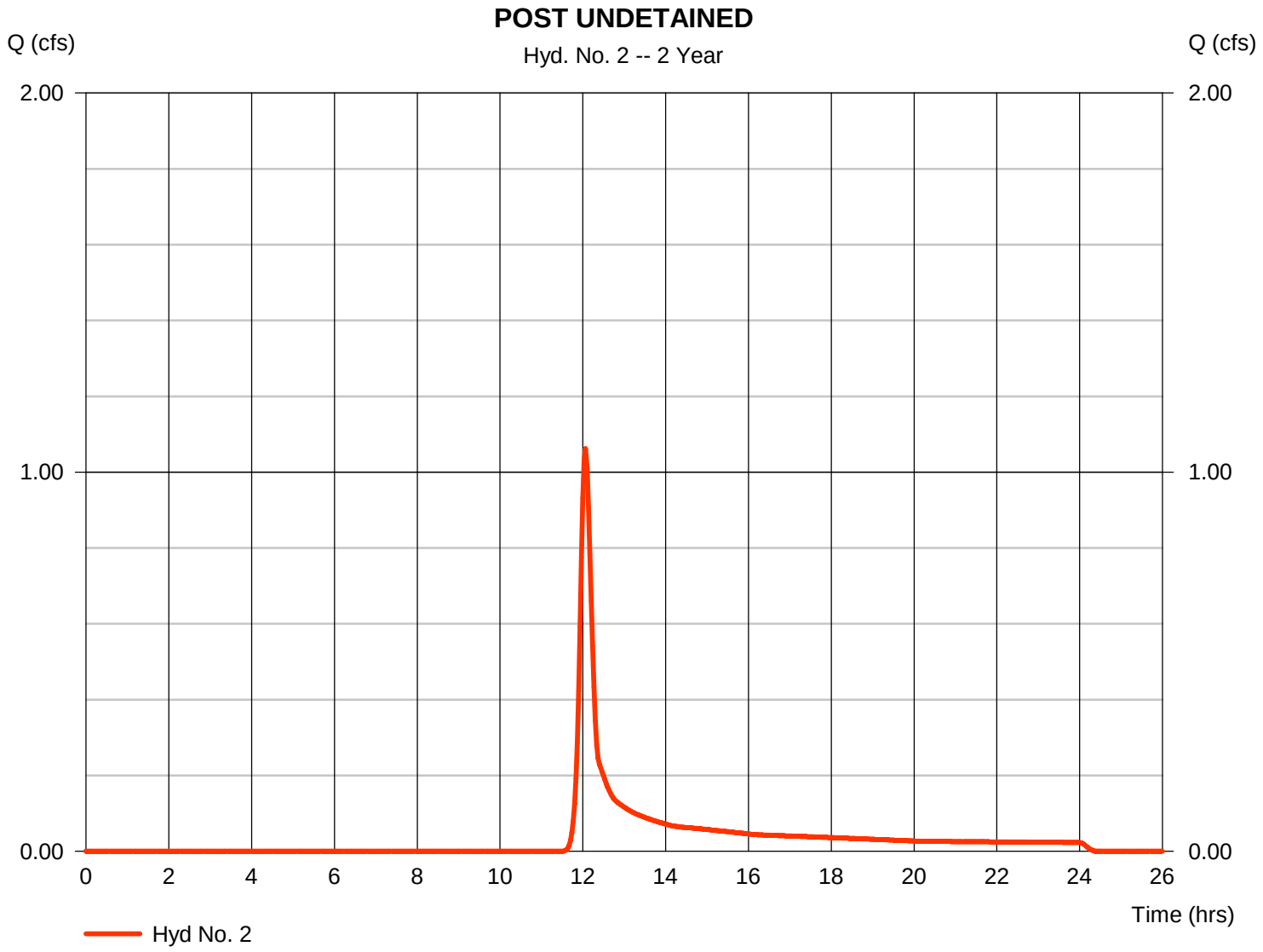
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.062 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	3,280 cuft
Drainage area	=	1.400 ac	Curve number	=	73*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.60 min
Total precip.	=	2.67 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = + (0.060 x 58) + (0.540 x 78) + (0.550 x 77) + (0.250 x 55)] / 1.400



TR55 Tc Worksheet

Hyd. No. 2

POST UNDETAINED

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 3.46		0.00		0.00		
Travel Time (min)	**= 12.55**	**+**	**0.00**	**+**	**0.00**	**=**	**12.55**
Shallow Concentrated Flow							
Flow length (ft)	= 846.00		0.00		0.00		
Watercourse slope (%)	= 5.12		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.65		0.00		0.00		
Travel Time (min)	**= 3.86**	**+**	**0.00**	**+**	**0.00**	**=**	**3.86**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 1.35		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=7.93						
			0.00				
					0.00		
Flow length (ft)	({0})93.0		0.0		0.0		
Travel Time (min)	**= 0.20**	**+**	**0.00**	**+**	**0.00**	**=**	**0.20**

Total Travel Time, Tc ..... 16.60 min

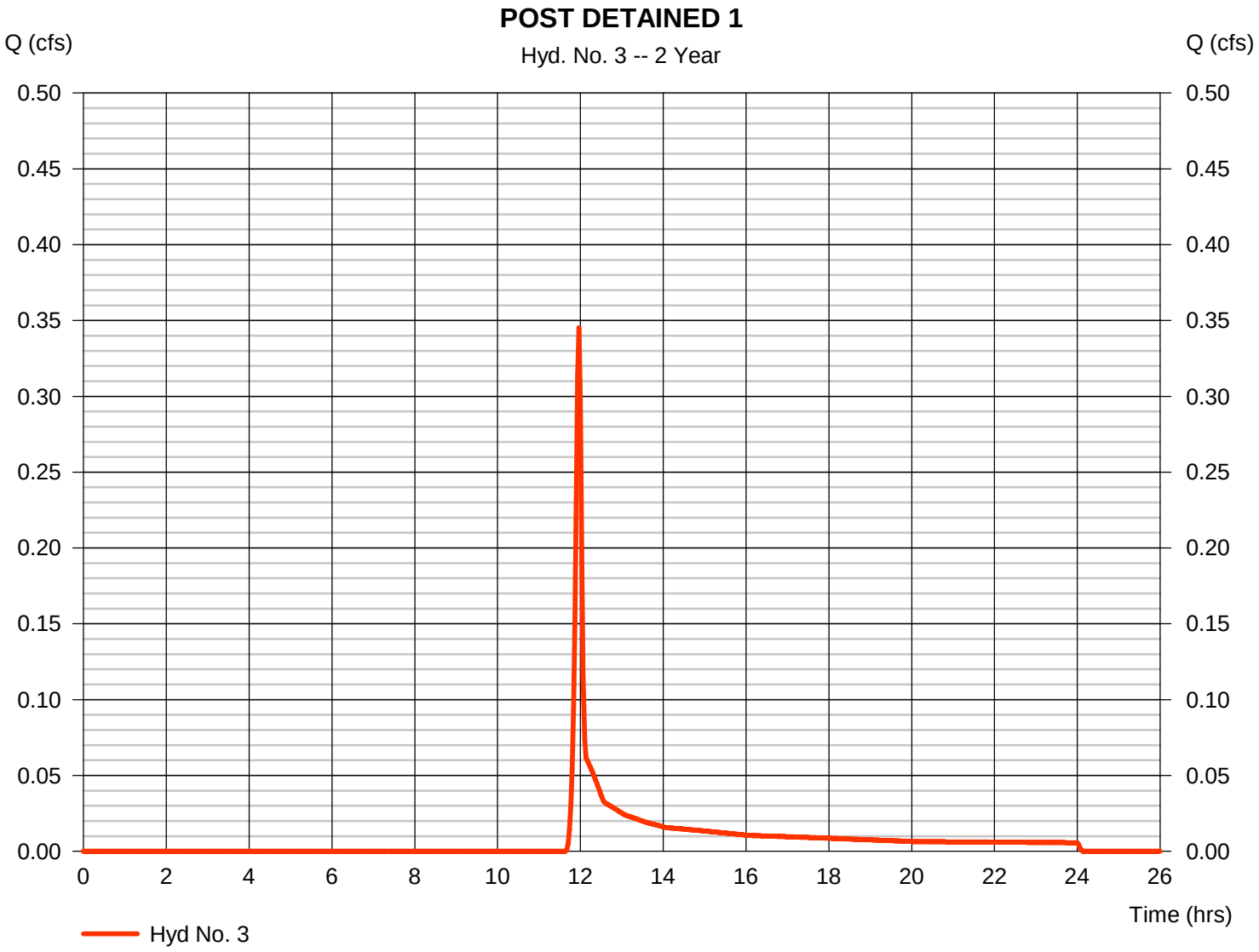
Hydrograph Report

Hyd. No. 3

POST DETAINED 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.345 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 734 cuft
Drainage area	= 0.400 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 4.20 min
Total precip.	= 2.67 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.010 x 85) + (0.050 x 58) + (0.150 x 78) + (0.060 x 91) + (0.130 x 55)] / 0.400



TR55 Tc Worksheet

Hyd. No. 3

POST DETAINED 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 20.00		0.00		0.00		
Travel Time (min)	**= 3.57**	**+**	**0.00**	**+**	**0.00**	**=**	**3.57**
Shallow Concentrated Flow							
Flow length (ft)	= 277.00		0.00		0.00		
Watercourse slope (%)	= 25.30		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=8.12		0.00		0.00		
Travel Time (min)	**= 0.57**	**+**	**0.00**	**+**	**0.00**	**=**	**0.57**
Channel Flow							
X sectional flow area (sqft)	= 0.35		0.00		0.00		
Wetted perimeter (ft)	= 1.05		0.00		0.00		
Channel slope (%)	= 8.70		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=14.01						
			0.00				
					0.00		
Flow length (ft)	({0})23.0		0.0		0.0		
Travel Time (min)	**= 0.03**	**+**	**0.00**	**+**	**0.00**	**=**	**0.03**

Total Travel Time, Tc ..... 4.20 min

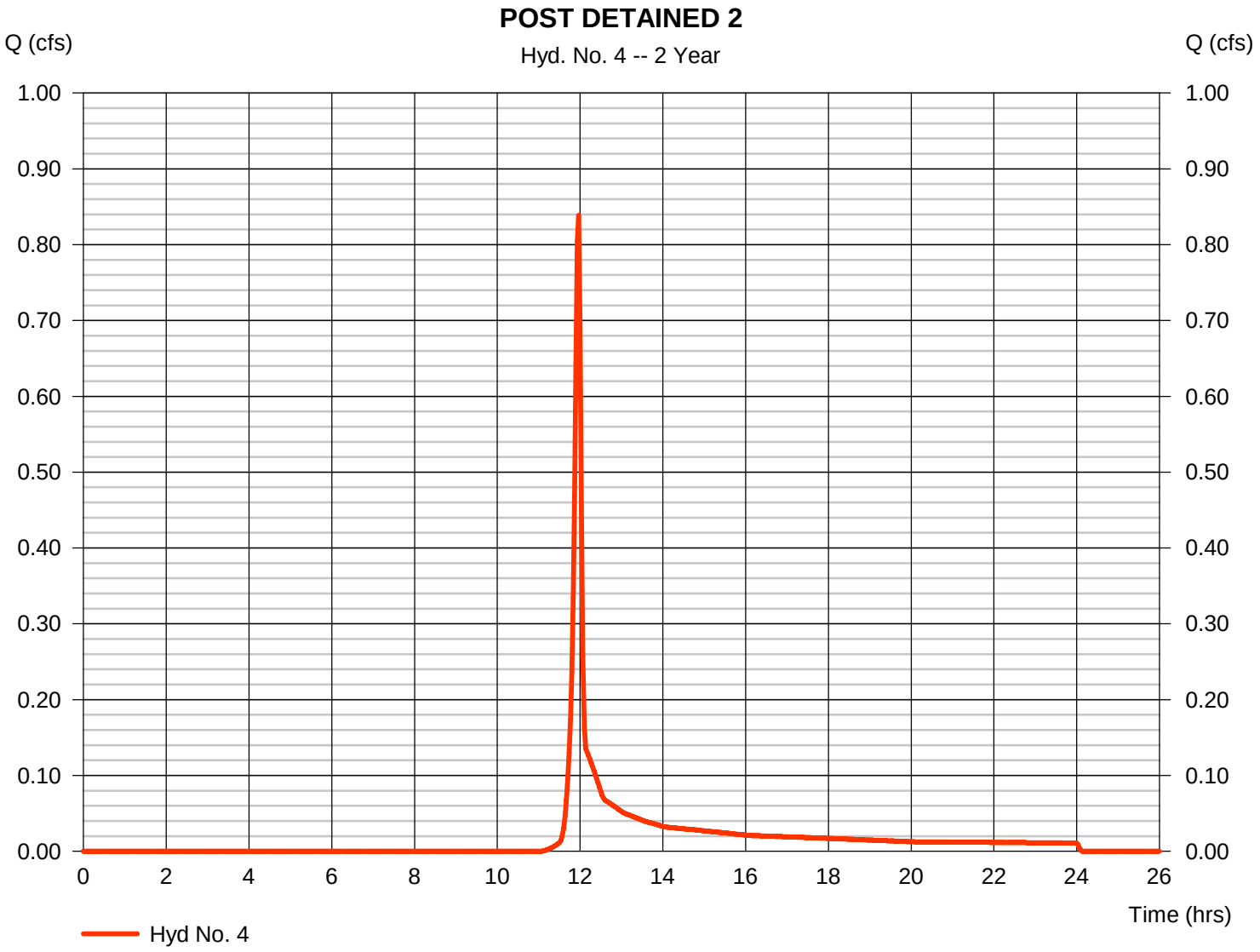
Hydrograph Report

Hyd. No. 4

POST DETAINED 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.838 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 1,687 cuft
Drainage area	= 0.620 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 4.70 min
Total precip.	= 2.67 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.010 x 85) + (0.030 x 58) + (0.270 x 78) + (0.170 x 91) + (0.130 x 55) + (0.010 x 77)] / 0.620



TR55 Tc Worksheet

Hyd. No. 4

POST DETAINED 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 16.00		0.00		0.00		
Travel Time (min)	**= 3.91**	**+**	**0.00**	**+**	**0.00**	**=**	**3.91**
Shallow Concentrated Flow							
Flow length (ft)	= 360.00		0.00		0.00		
Watercourse slope (%)	= 19.40		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=7.11		0.00		0.00		
Travel Time (min)	**= 0.84**	**+**	**0.00**	**+**	**0.00**	**=**	**0.84**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

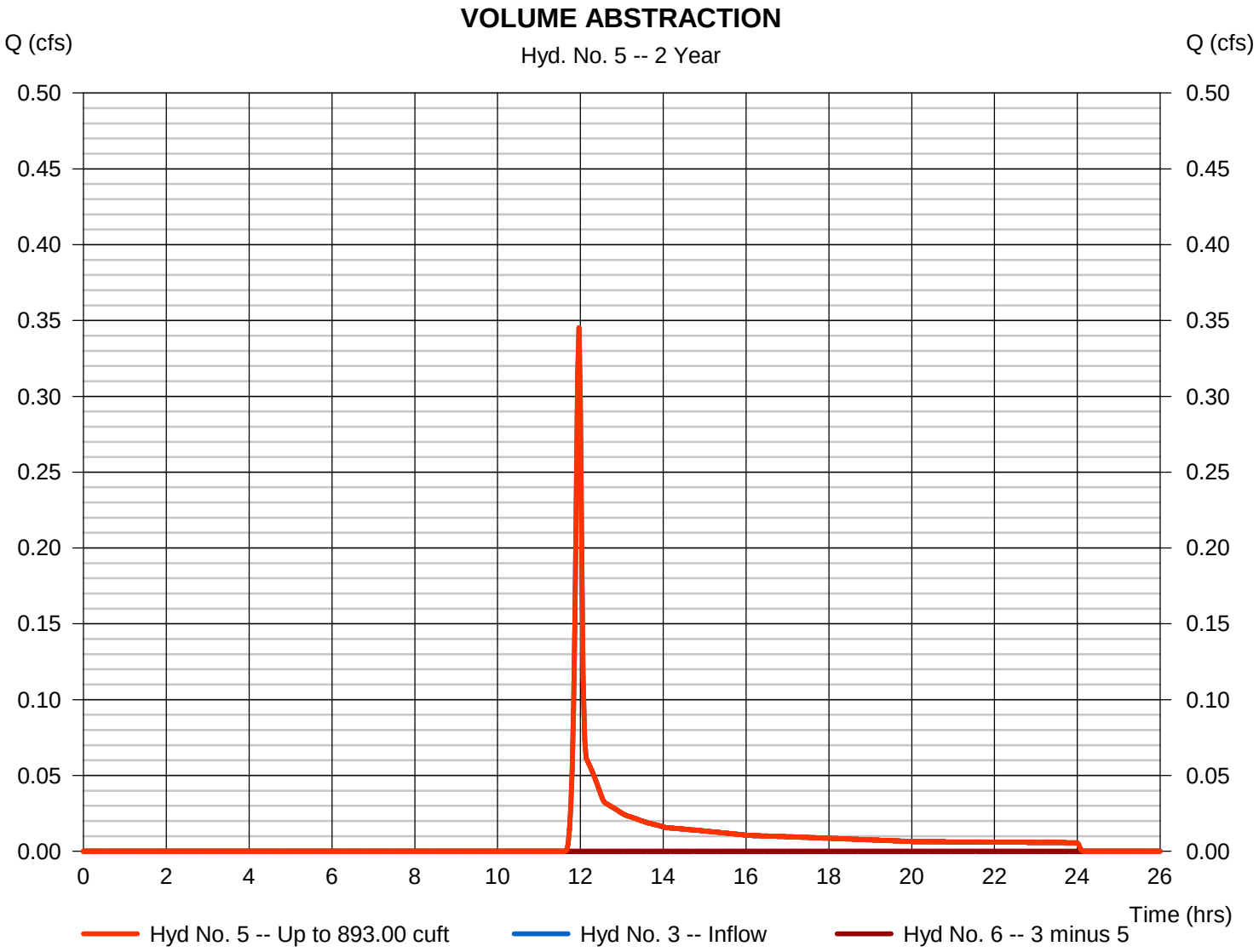
Total Travel Time, Tc ..... 4.70 min

Hydrograph Report

Hyd. No. 5

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.345 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 734 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 6
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

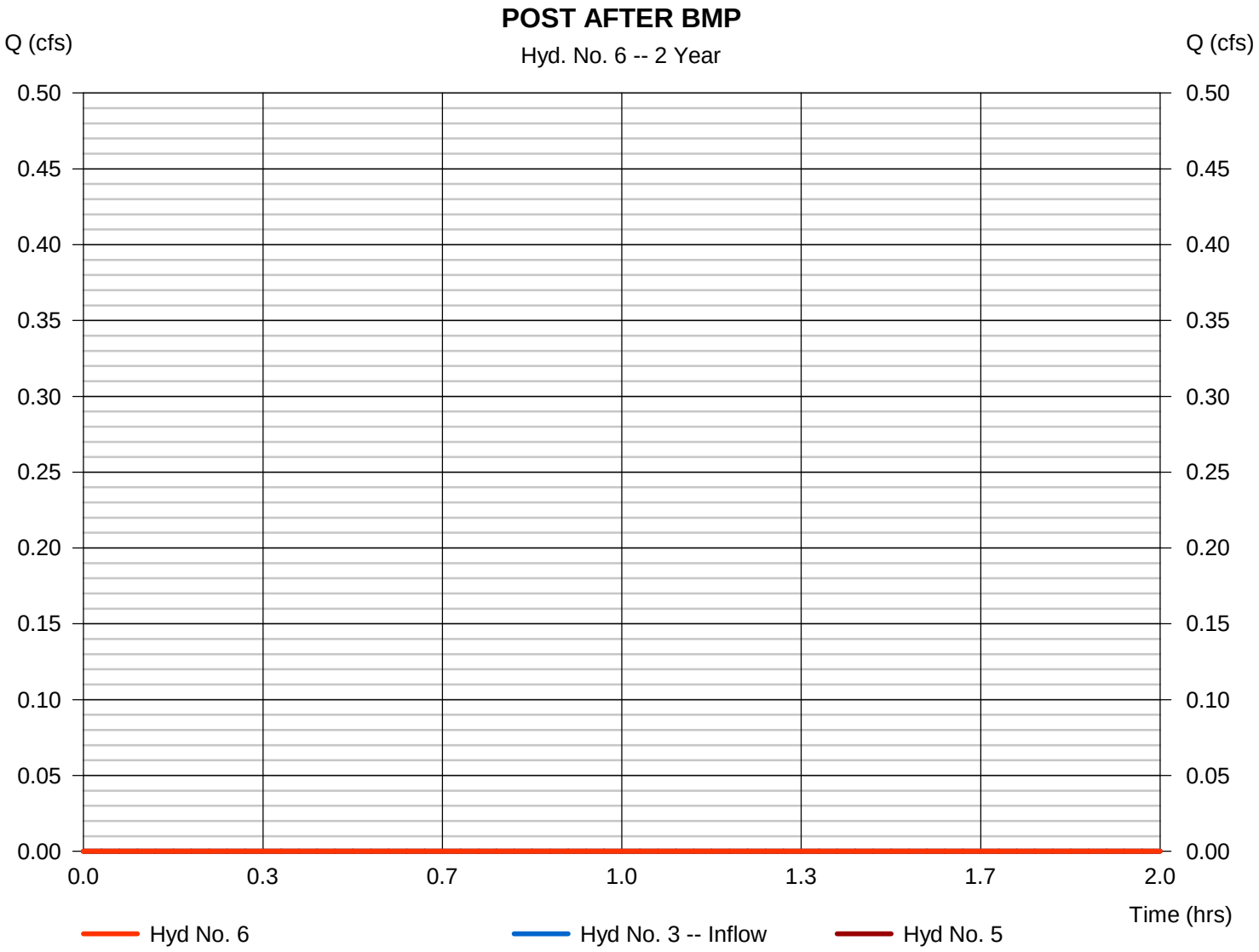


Hydrograph Report

Hyd. No. 6

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

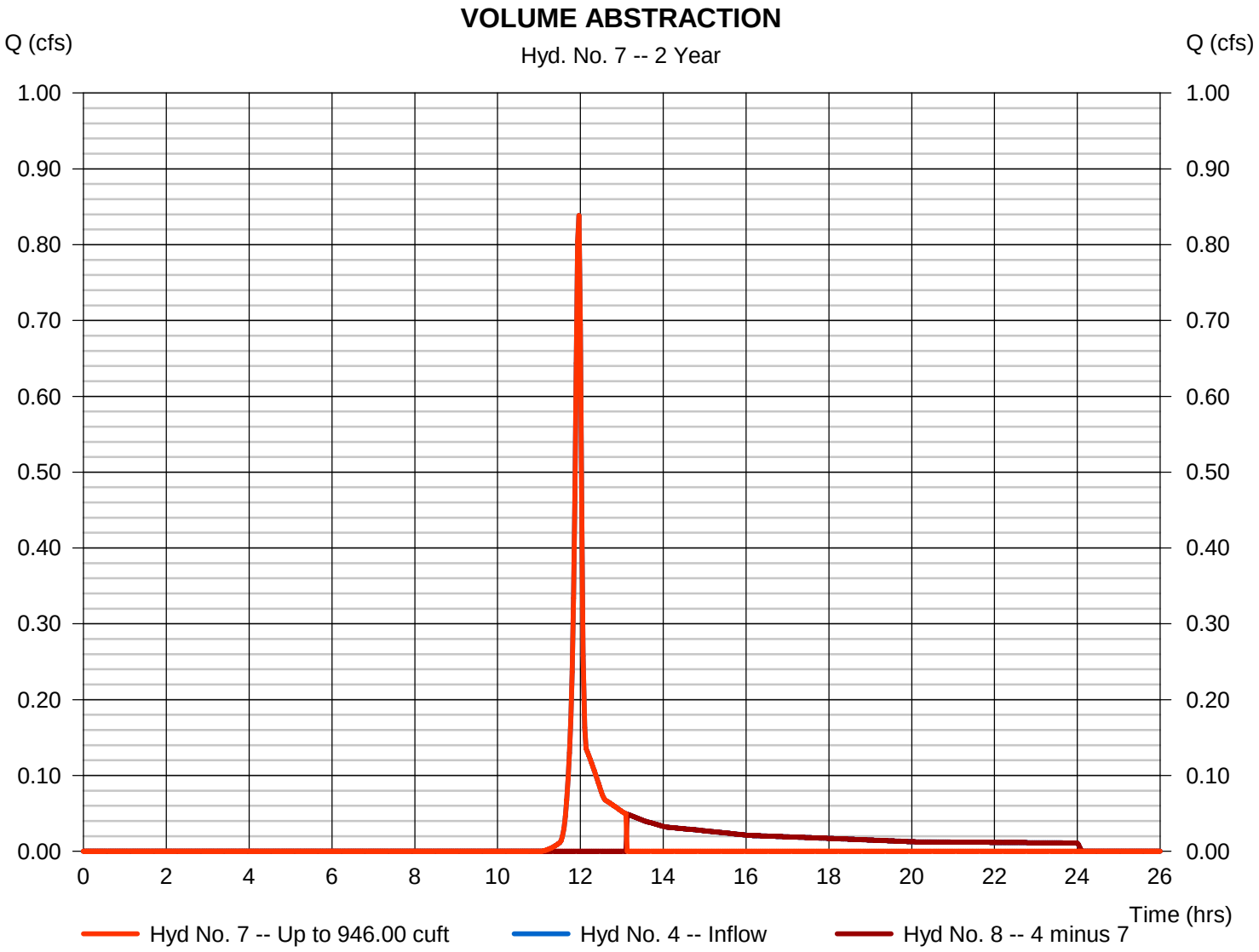


Hydrograph Report

Hyd. No. 7

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.838 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 950 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 8
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

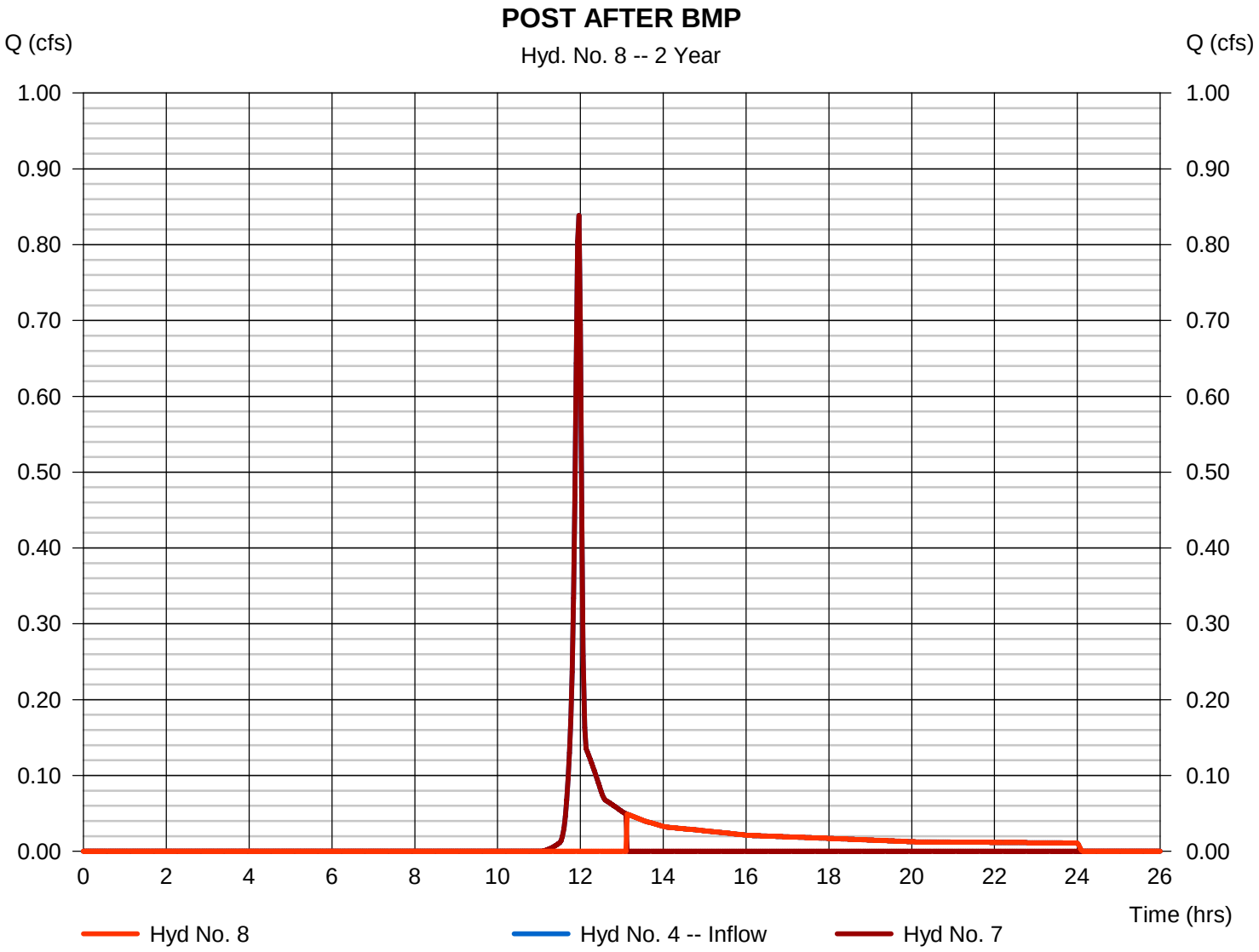


Hydrograph Report

Hyd. No. 8

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.049 cfs
Storm frequency	= 2 yrs	Time to peak	= 13.13 hrs
Time interval	= 2 min	Hyd. volume	= 737 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 7
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

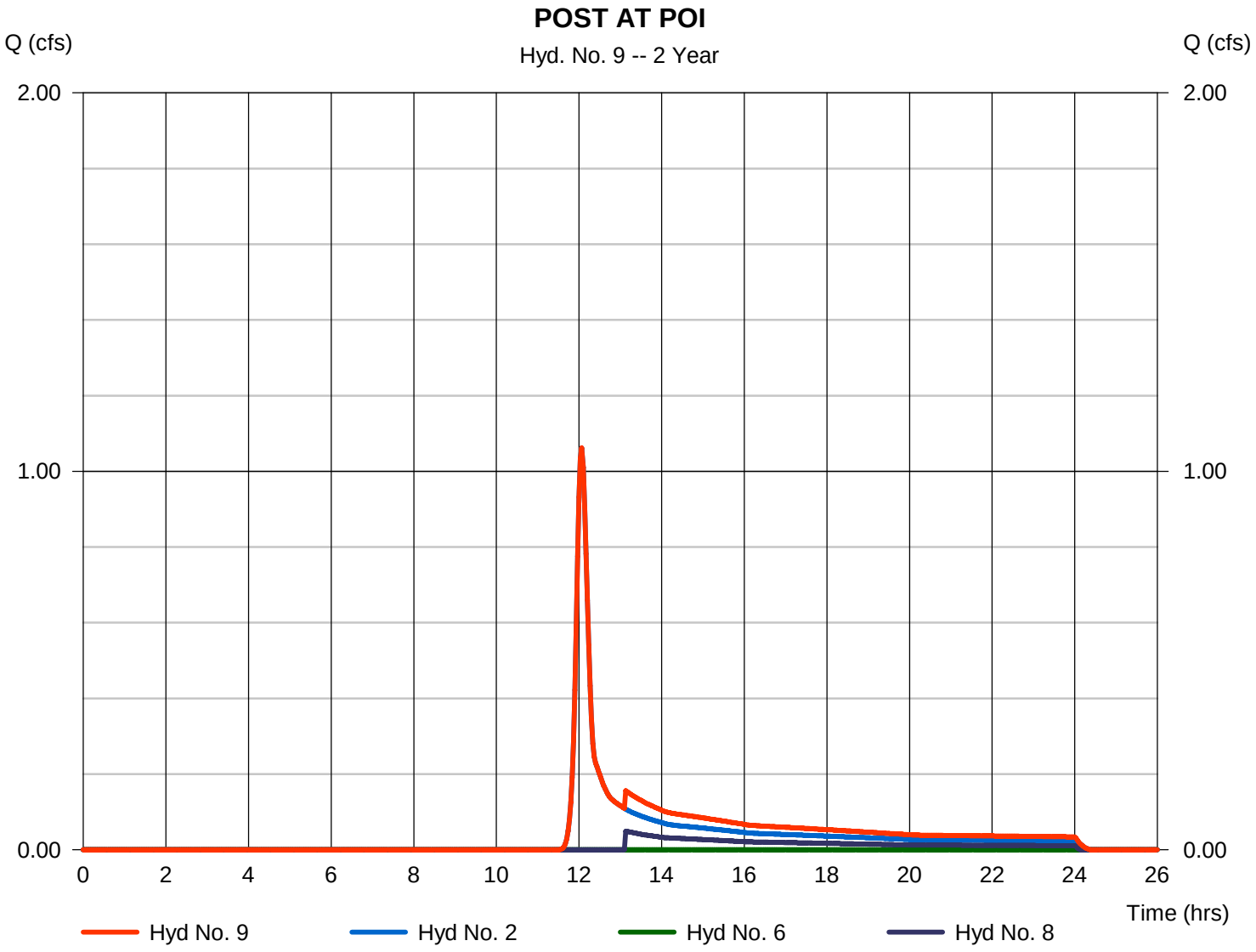


Hydrograph Report

Hyd. No. 9

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 1.062 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 4,017 cuft
Inflow hyds.	= 2, 6, 8	Contrib. drain. area	= 1.400 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	SCS Runoff	4.662	2	722	12,346	------	------	------	PRE
2	SCS Runoff	2.455	2	722	7,075	------	------	------	POST UNDETAINED
3	SCS Runoff	0.840	2	718	1,684	------	------	------	POST DETAINED 1
4	SCS Runoff	1.717	2	718	3,443	------	------	------	POST DETAINED 2
5	Diversion1	0.840	2	718	895	3	------	------	VOLUME ABSTRACTION
6	Diversion2	0.060	2	766	789	3	------	------	POST AFTER BMP
7	Diversion1	1.701	2	716	1,017	4	------	------	VOLUME ABSTRACTION
8	Diversion2	1.717	2	718	2,426	4	------	------	POST AFTER BMP
9	Combine	3.707	2	718	10,290	2, 6, 8	------	------	POST AT POI

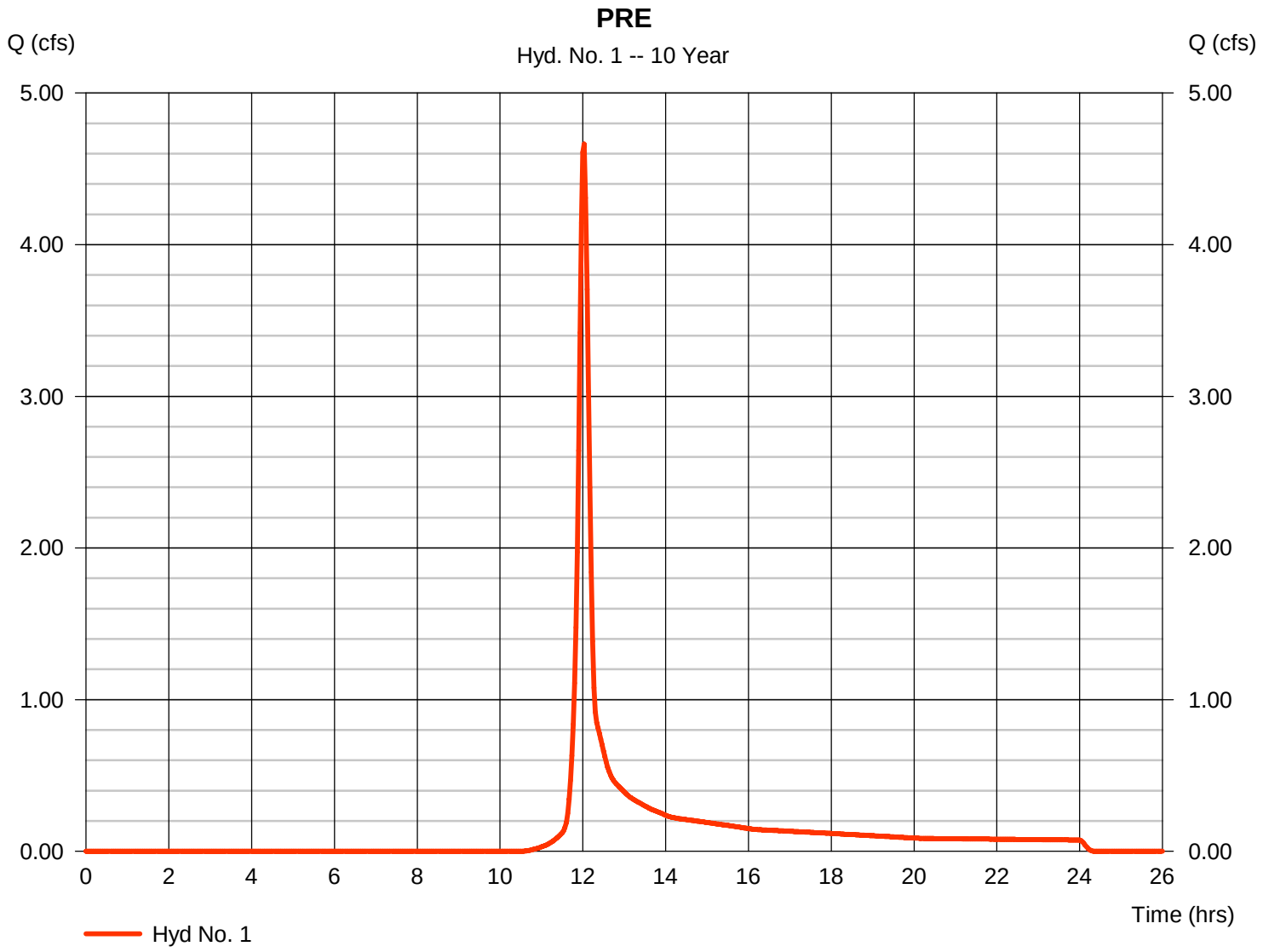
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.662 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	12,346 cuft
Drainage area	=	2.420 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	3.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.040 x 98) + (0.130 x 58) + (0.840 x 78) + (0.850 x 77) + (0.560 x 55)] / 2.420



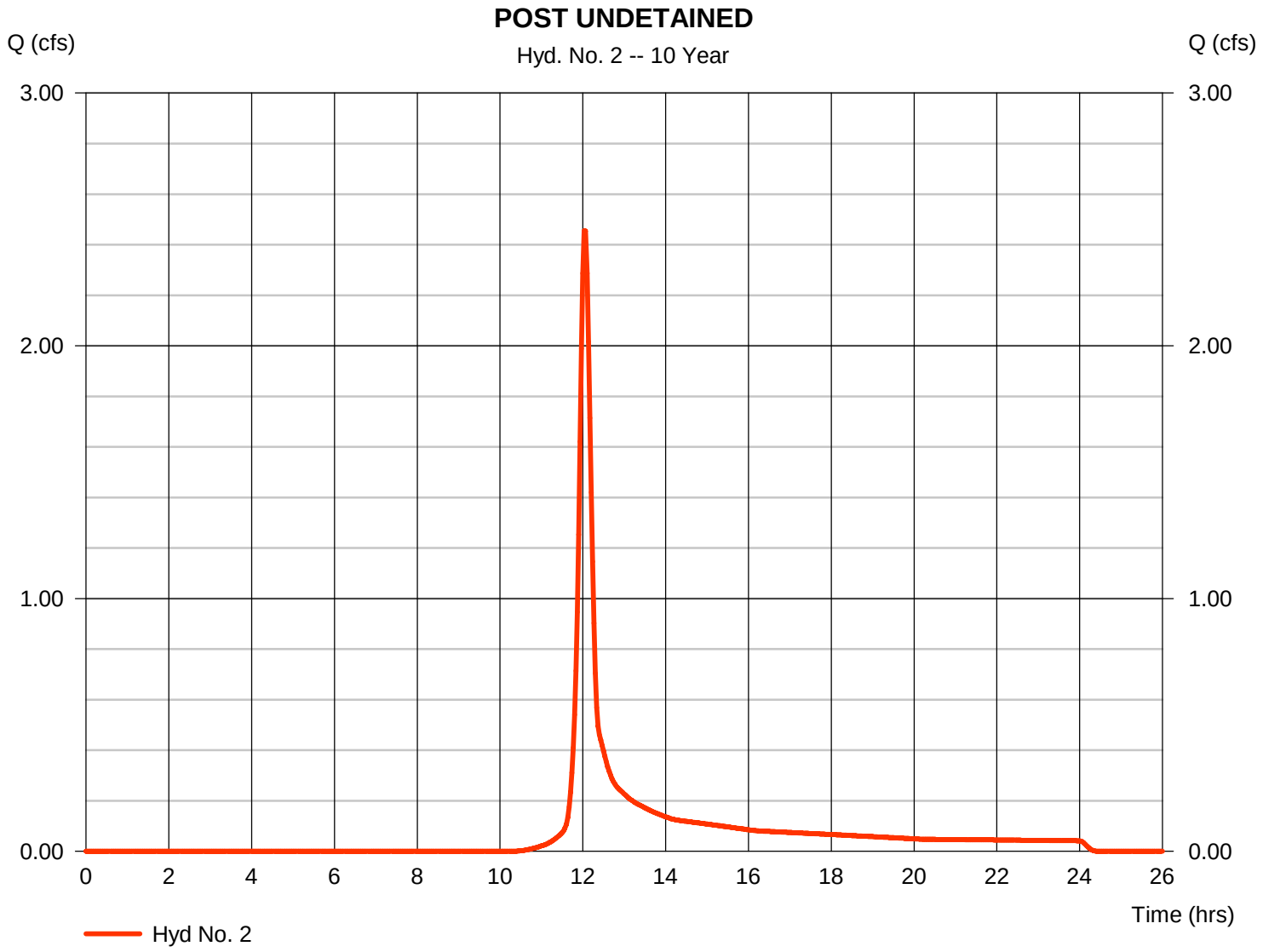
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.455 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	7,075 cuft
Drainage area	=	1.400 ac	Curve number	=	73*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.60 min
Total precip.	=	3.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = + (0.060 x 58) + (0.540 x 78) + (0.550 x 77) + (0.250 x 55)] / 1.400



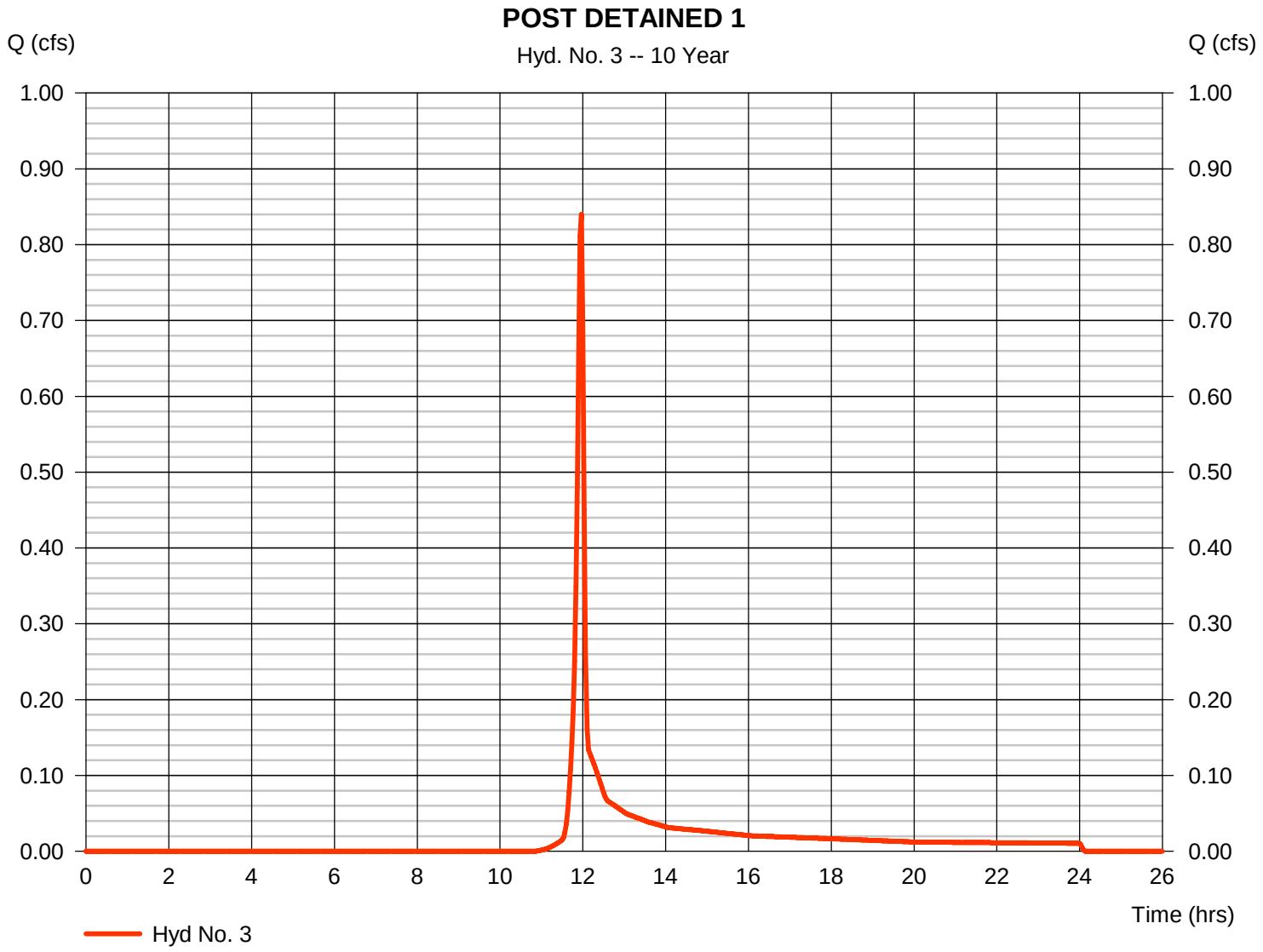
Hydrograph Report

Hyd. No. 3

POST DETAINED 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.840 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	1,684 cuft
Drainage area	=	0.400 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	4.20 min
Total precip.	=	3.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (0.050 x 58) + (0.150 x 78) + (0.060 x 91) + (0.130 x 55)] / 0.400



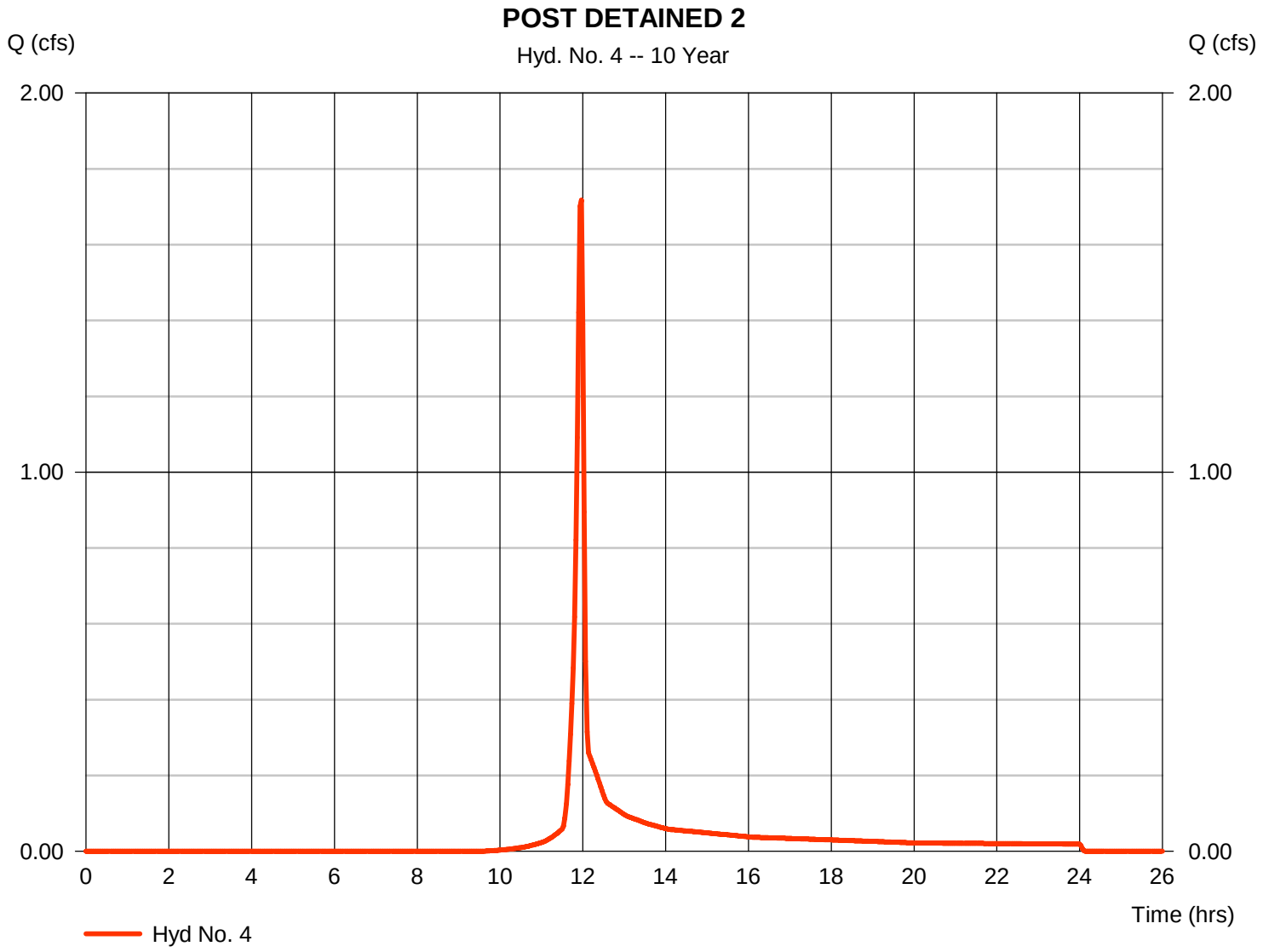
Hydrograph Report

Hyd. No. 4

POST DETAINED 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.717 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	3,443 cuft
Drainage area	=	0.620 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	4.70 min
Total precip.	=	3.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (0.030 x 58) + (0.270 x 78) + (0.170 x 91) + (0.130 x 55) + (0.010 x 77)] / 0.620

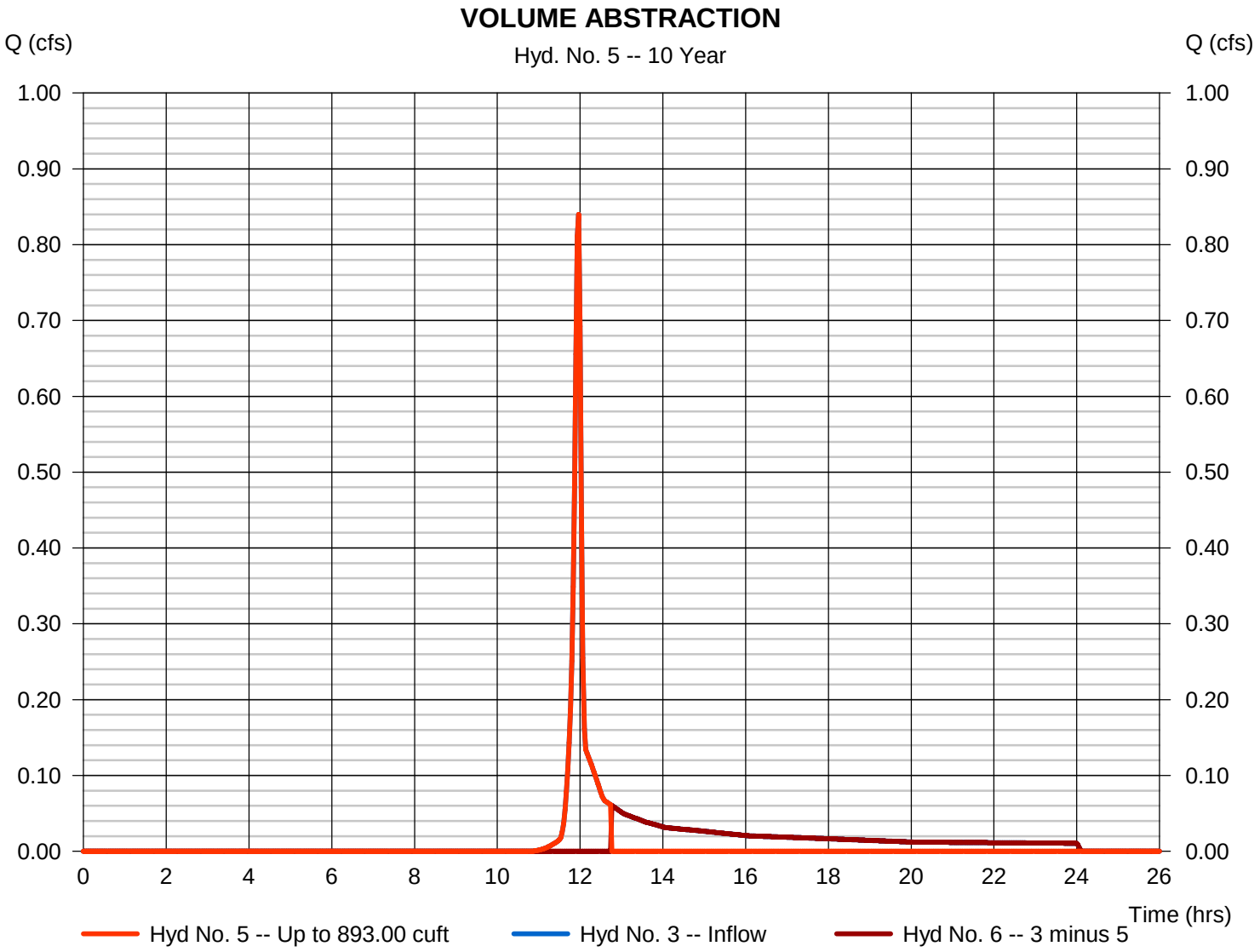


Hydrograph Report

Hyd. No. 5

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.840 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 895 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 6
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

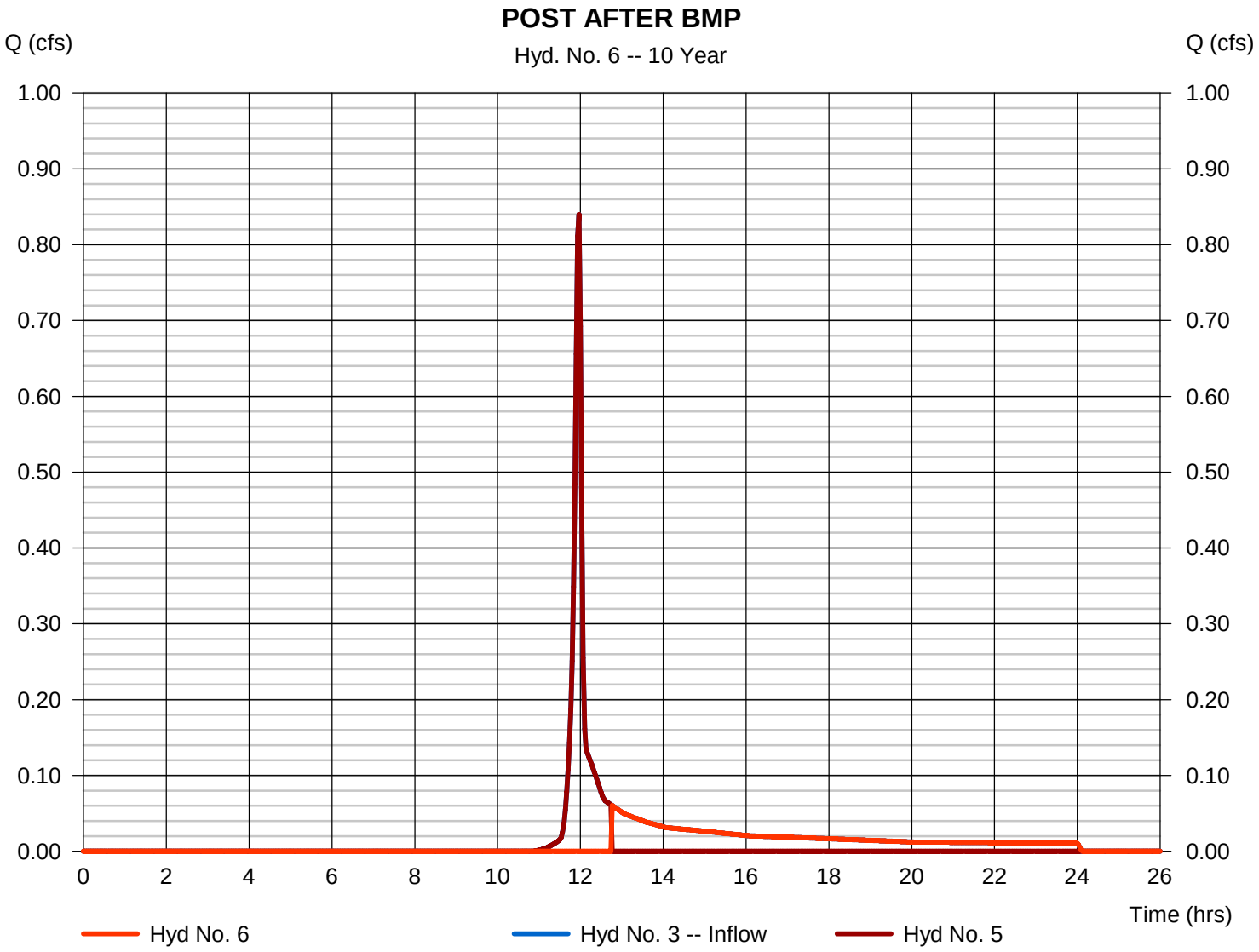


Hydrograph Report

Hyd. No. 6

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.060 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.77 hrs
Time interval	= 2 min	Hyd. volume	= 789 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

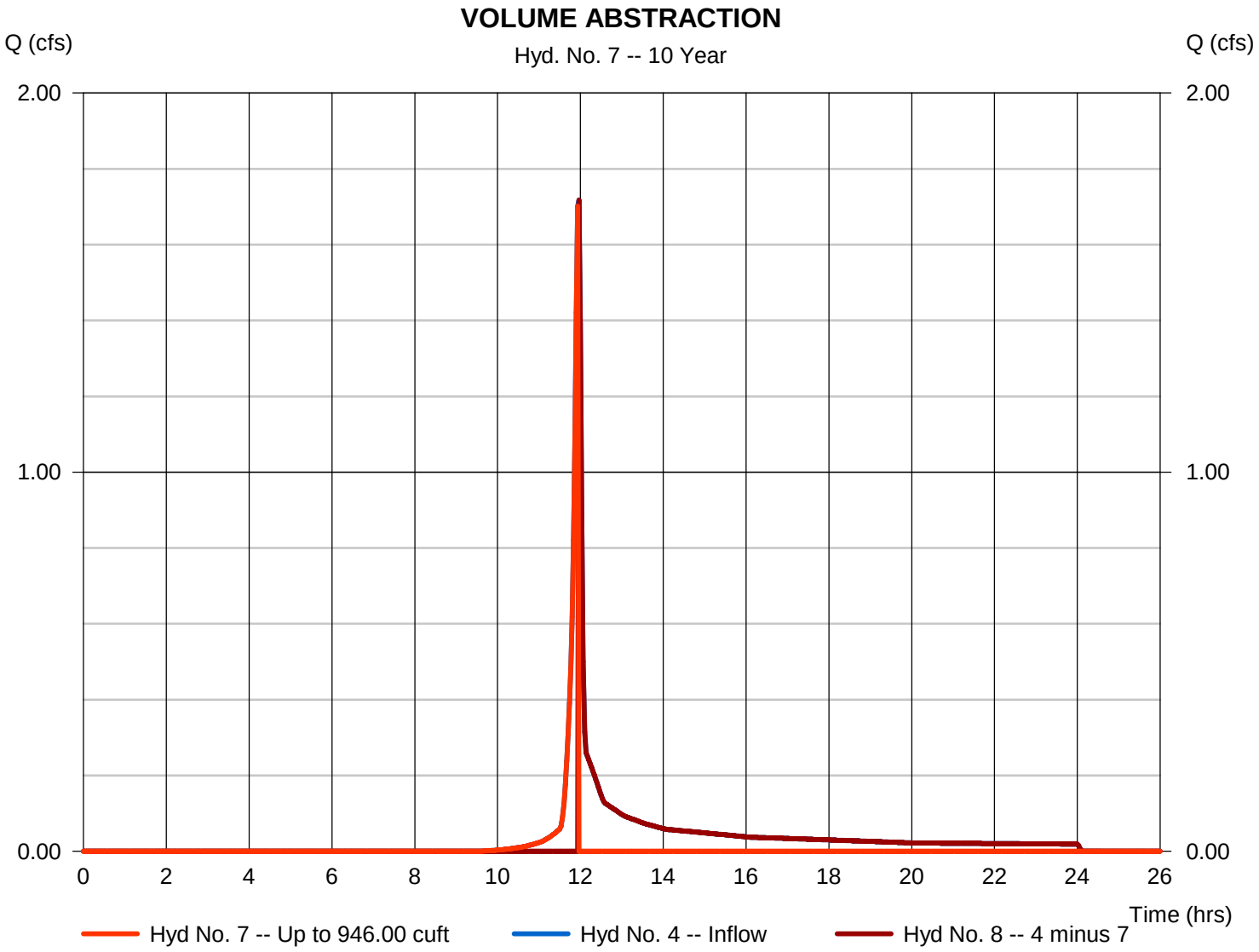


Hydrograph Report

Hyd. No. 7

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.701 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 1,017 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 8
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

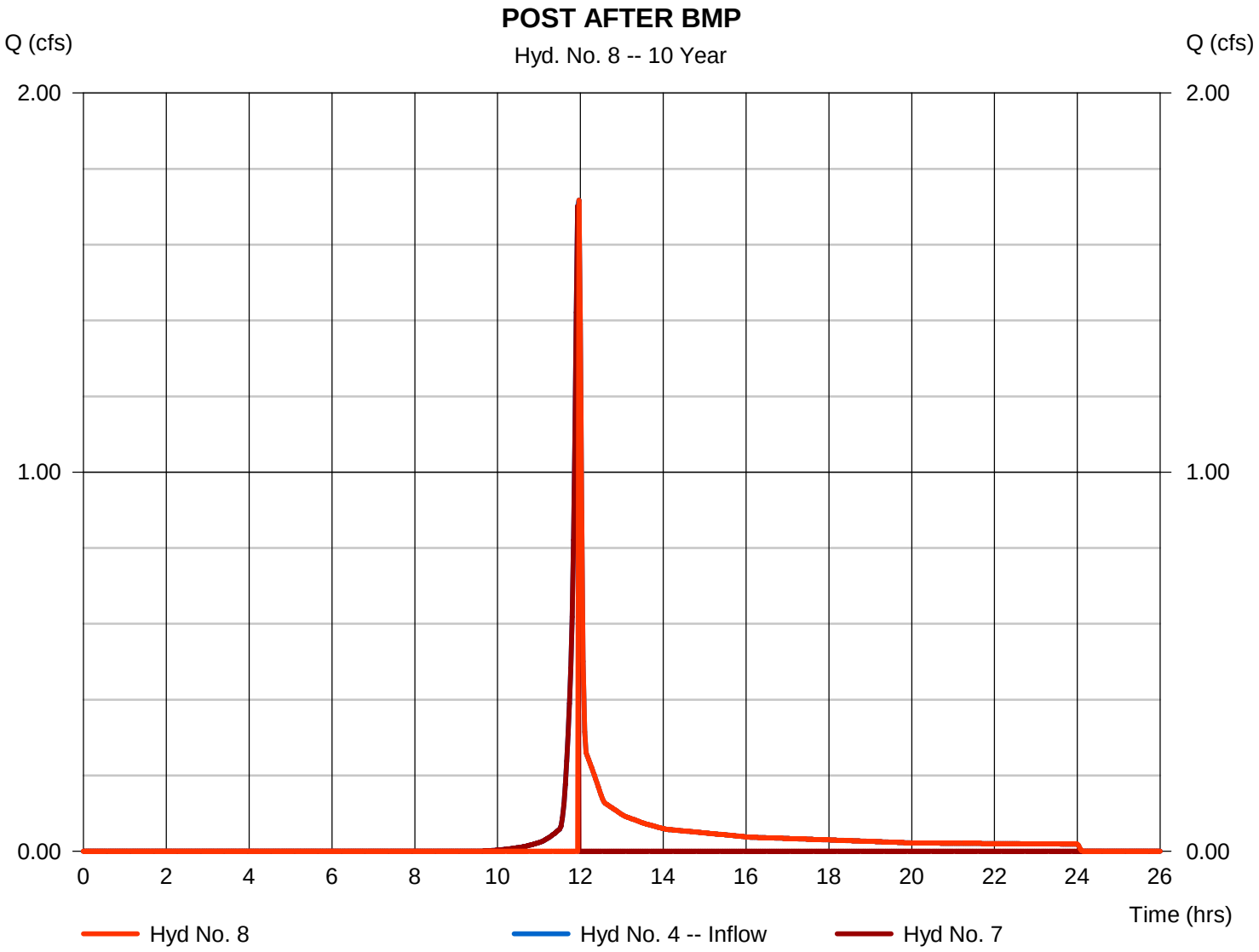


Hydrograph Report

Hyd. No. 8

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 1.717 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 2,426 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 7
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

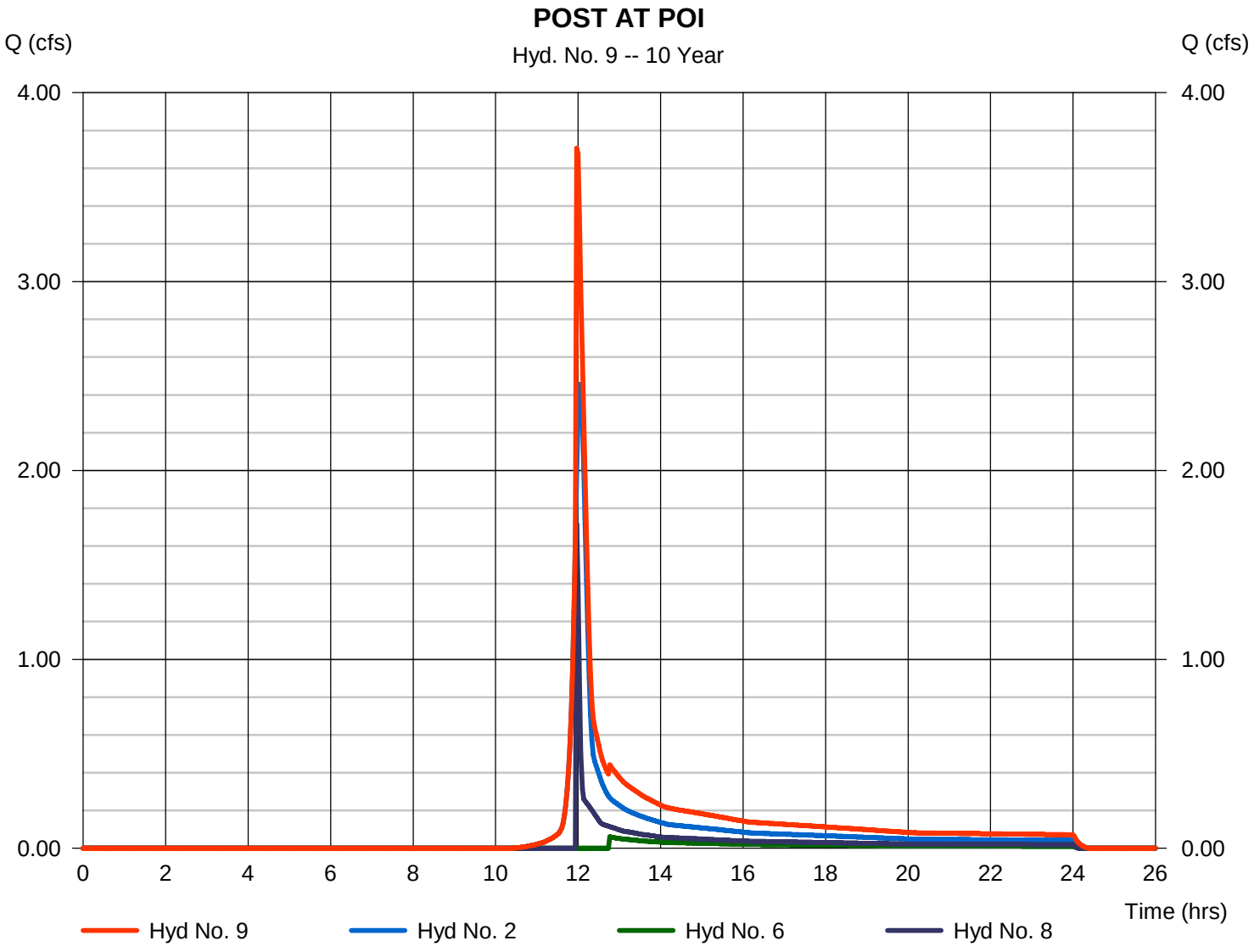


Hydrograph Report

Hyd. No. 9

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 3.707 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 10,290 cuft
Inflow hyds.	= 2, 6, 8	Contrib. drain. area	= 1.400 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	SCS Runoff	8.458	2	720	22,026	------	------	------	PRE
2	SCS Runoff	4.436	2	722	12,477	------	------	------	POST UNDETAINED
3	SCS Runoff	1.534	2	718	3,078	------	------	------	POST DETAINED 1
4	SCS Runoff	2.905	2	716	5,876	------	------	------	POST DETAINED 2
5	Diversion1	1.521	2	716	916	3	------	------	VOLUME ABSTRACTION
6	Diversion2	1.534	2	718	2,163	3	------	------	POST AFTER BMP
7	Diversion1	1.164	2	708	970	4	------	------	VOLUME ABSTRACTION
8	Diversion2	2.905	2	716	4,906	4	------	------	POST AFTER BMP
9	Combine	8.137	2	718	19,545	2, 6, 8	------	------	POST AT POI

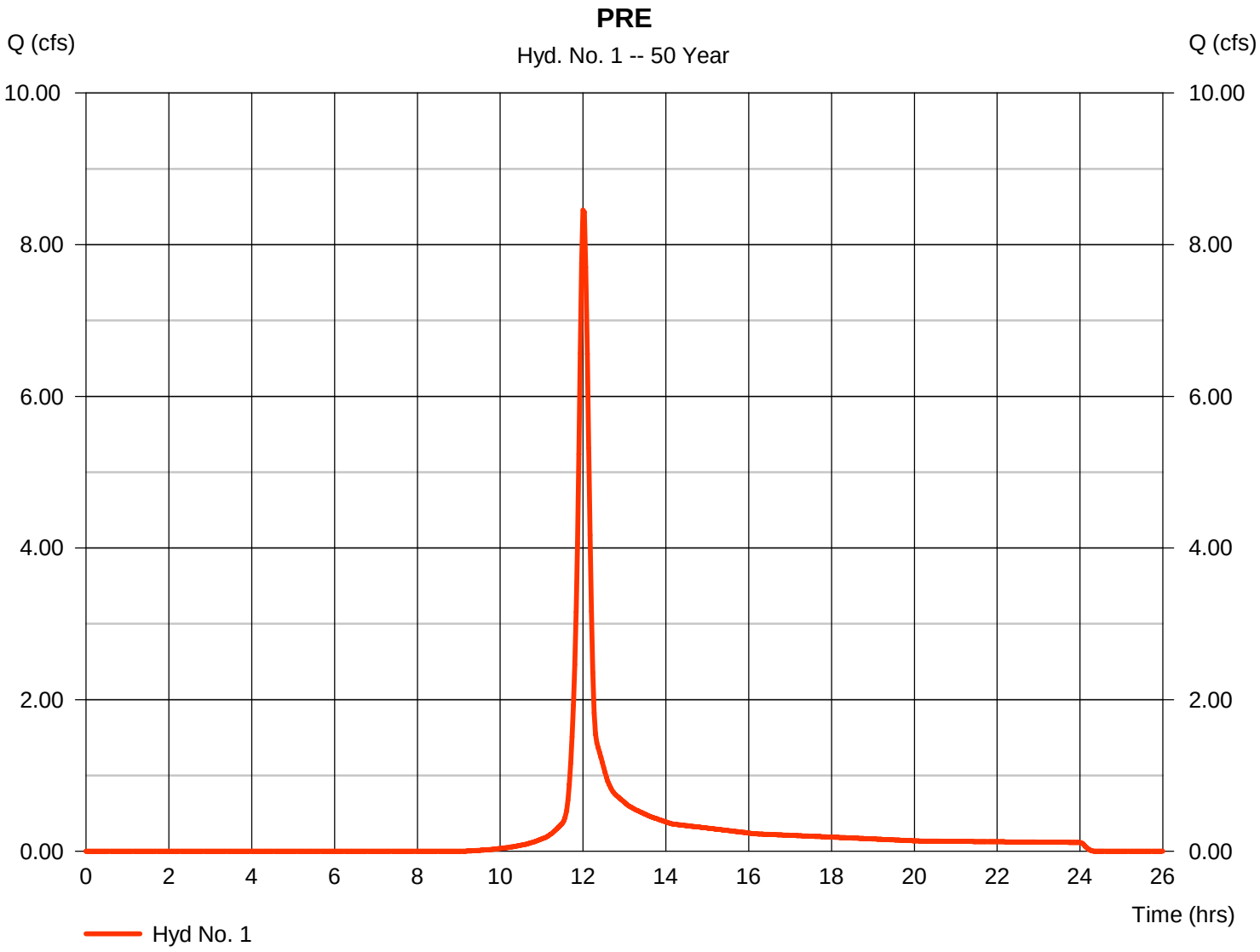
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.458 cfs
Storm frequency	=	50 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	22,026 cuft
Drainage area	=	2.420 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.040 x 98) + (0.130 x 58) + (0.840 x 78) + (0.850 x 77) + (0.560 x 55)] / 2.420



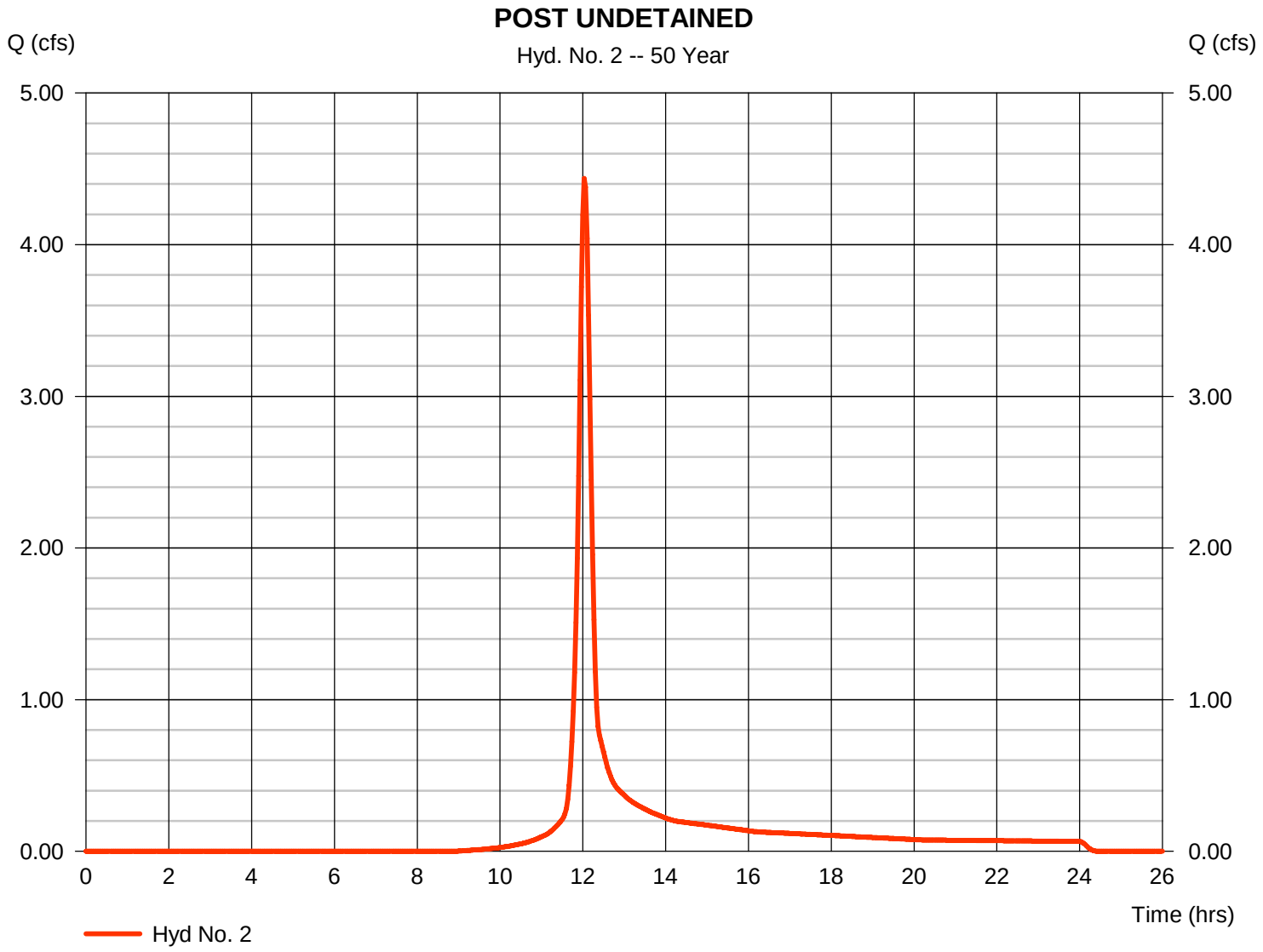
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.436 cfs
Storm frequency	=	50 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	12,477 cuft
Drainage area	=	1.400 ac	Curve number	=	73*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.60 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = + (0.060 x 58) + (0.540 x 78) + (0.550 x 77) + (0.250 x 55)] / 1.400



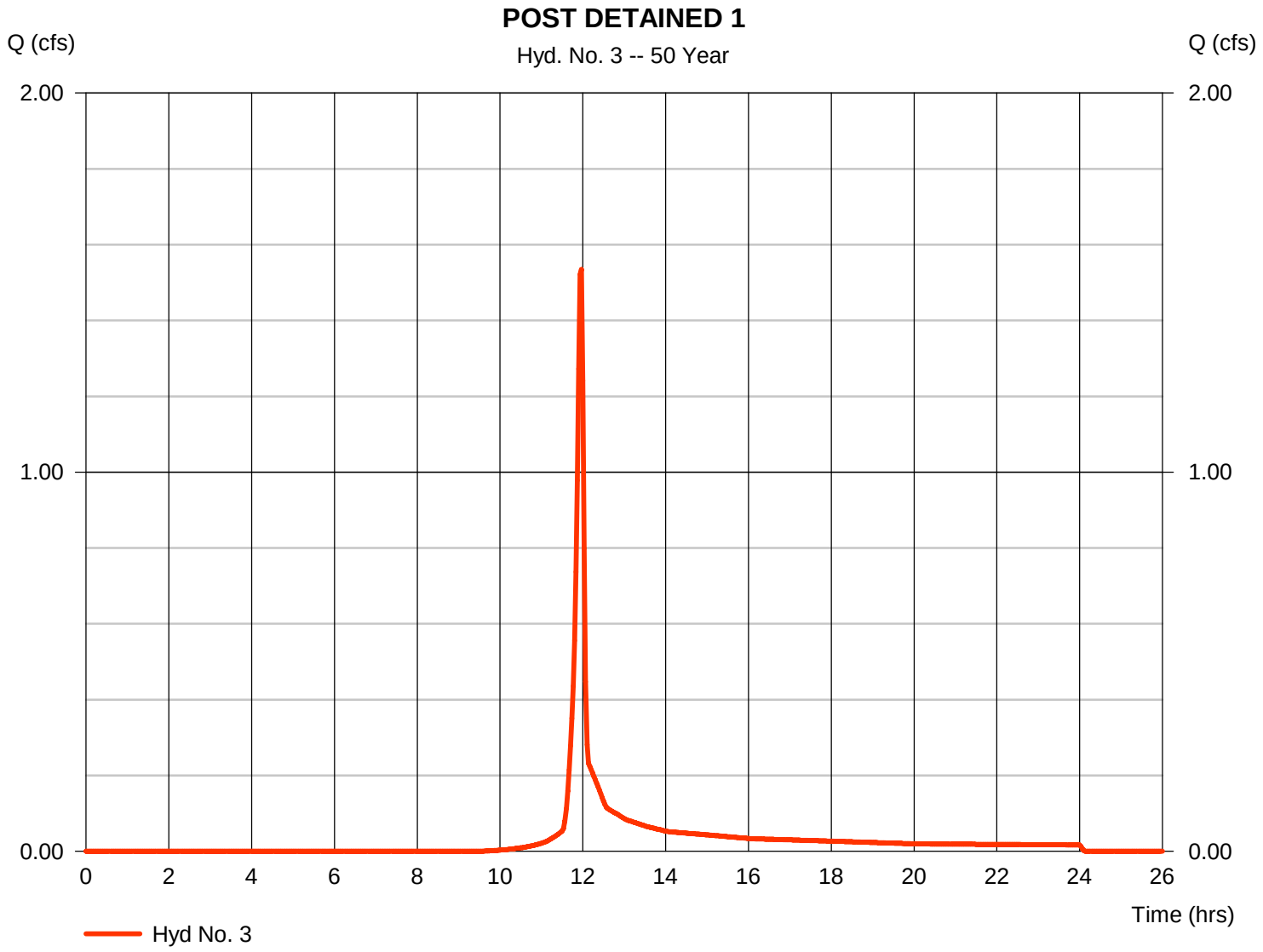
Hydrograph Report

Hyd. No. 3

POST DETAINED 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.534 cfs
Storm frequency	=	50 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	3,078 cuft
Drainage area	=	0.400 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	4.20 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (0.050 x 58) + (0.150 x 78) + (0.060 x 91) + (0.130 x 55)] / 0.400



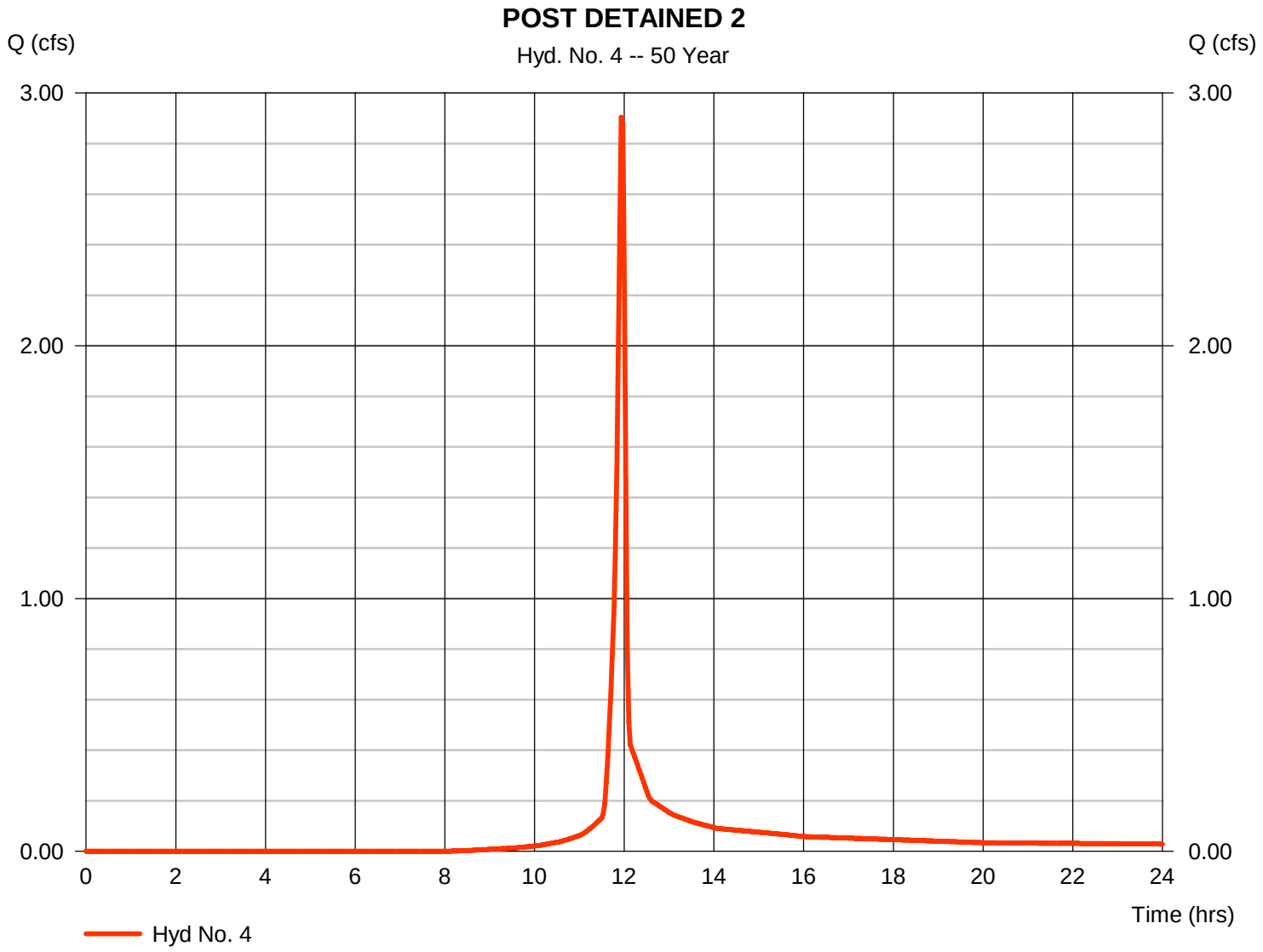
Hydrograph Report

Hyd. No. 4

POST DETAINED 2

Hydrograph type	= SCS Runoff	Peak discharge	= 2.905 cfs
Storm frequency	= 50 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 5,876 cuft
Drainage area	= 0.620 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 4.70 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.010 x 85) + (0.030 x 58) + (0.270 x 78) + (0.170 x 91) + (0.130 x 55) + (0.010 x 77)] / 0.620

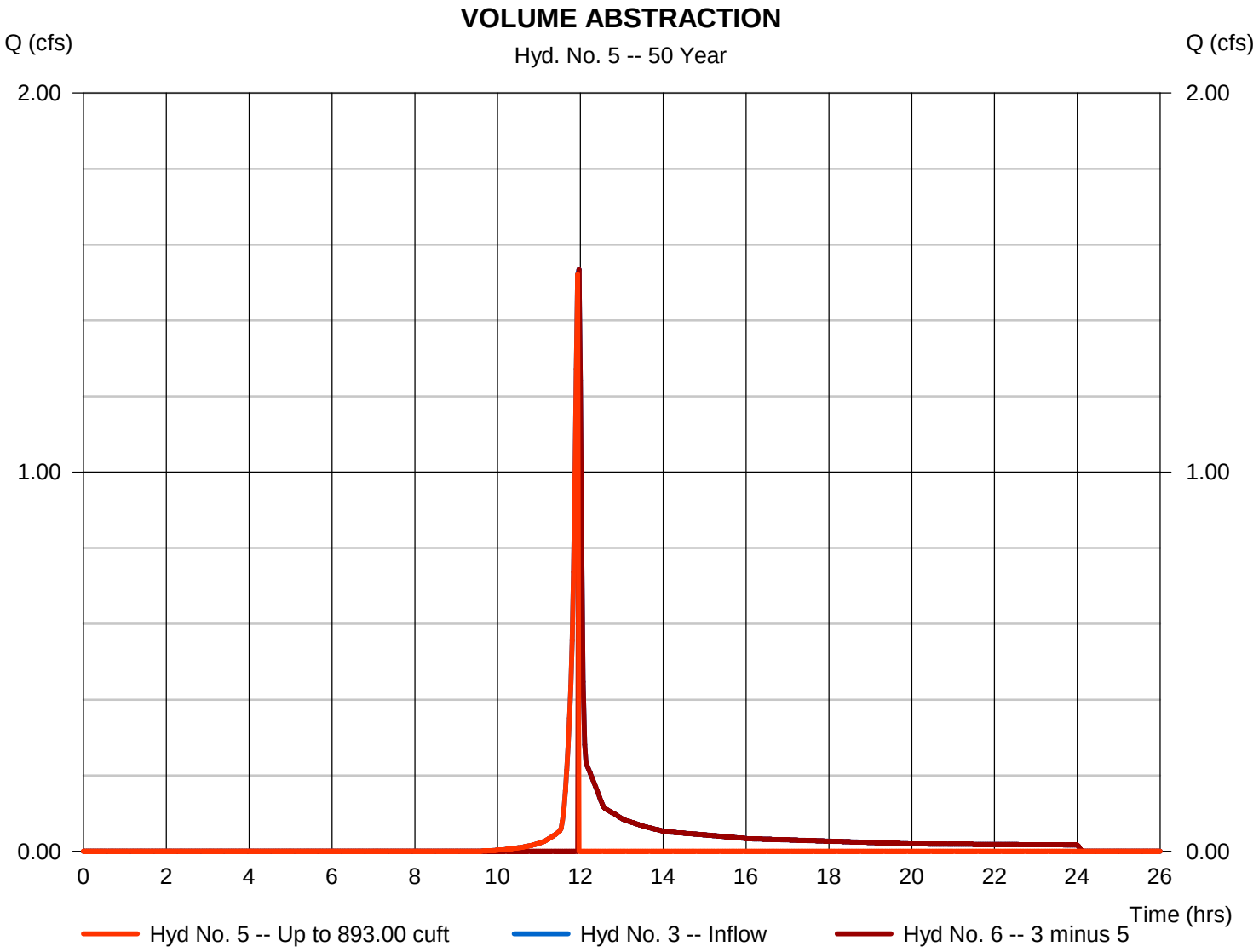


Hydrograph Report

Hyd. No. 5

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.521 cfs
Storm frequency	= 50 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 916 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 6
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

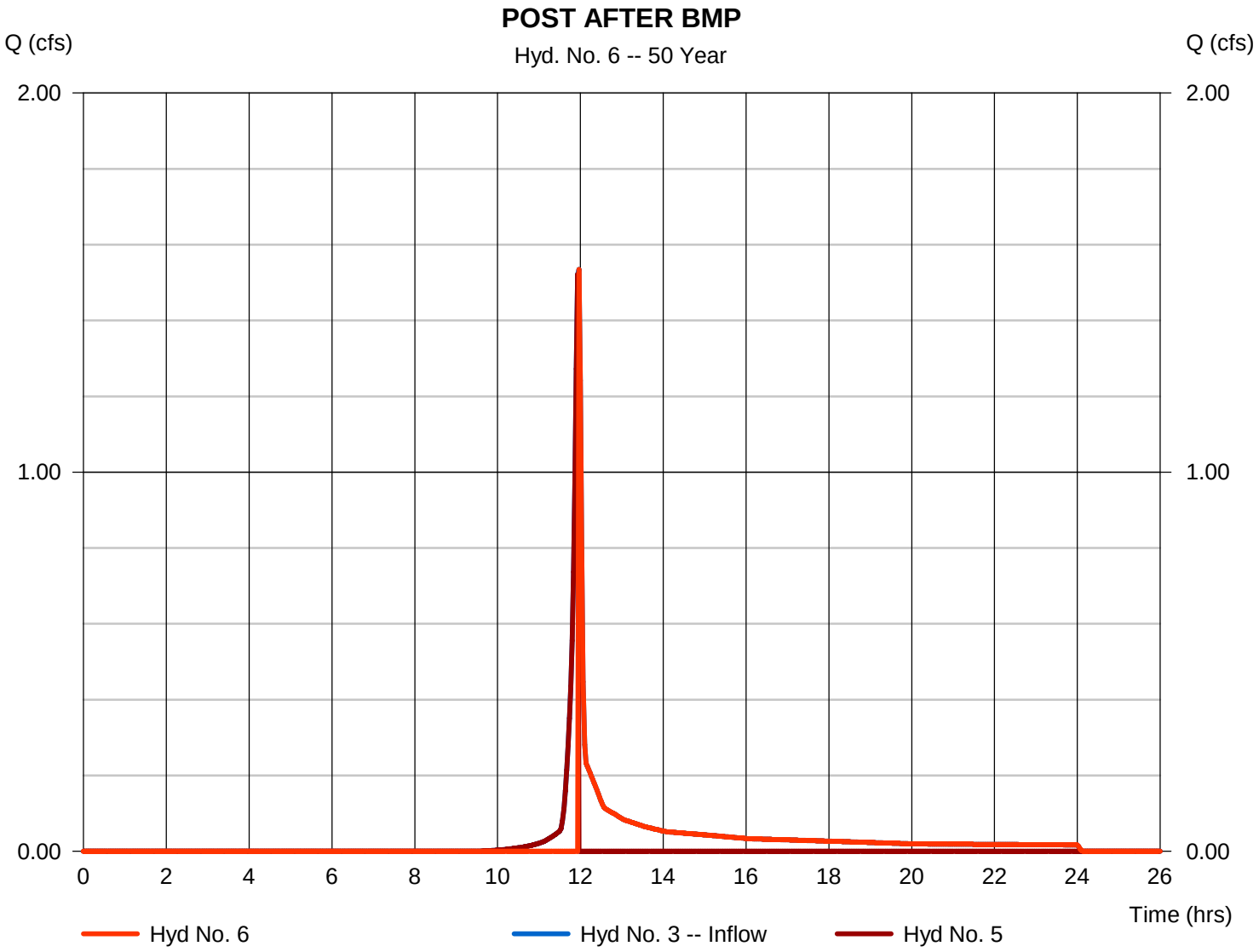


Hydrograph Report

Hyd. No. 6

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 1.534 cfs
Storm frequency	= 50 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 2,163 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

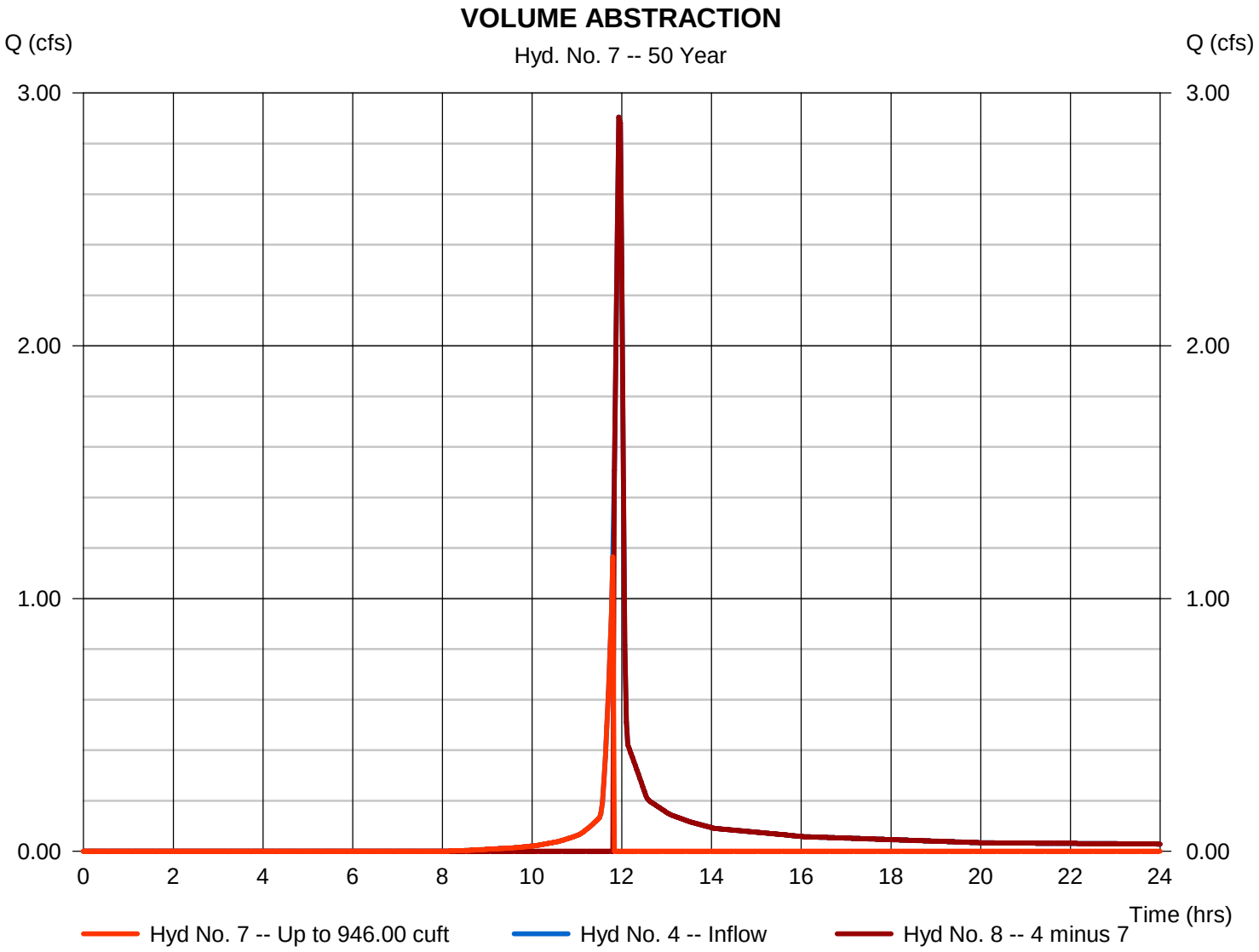


Hydrograph Report

Hyd. No. 7

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.164 cfs
Storm frequency	= 50 yrs	Time to peak	= 11.80 hrs
Time interval	= 2 min	Hyd. volume	= 970 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 8
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

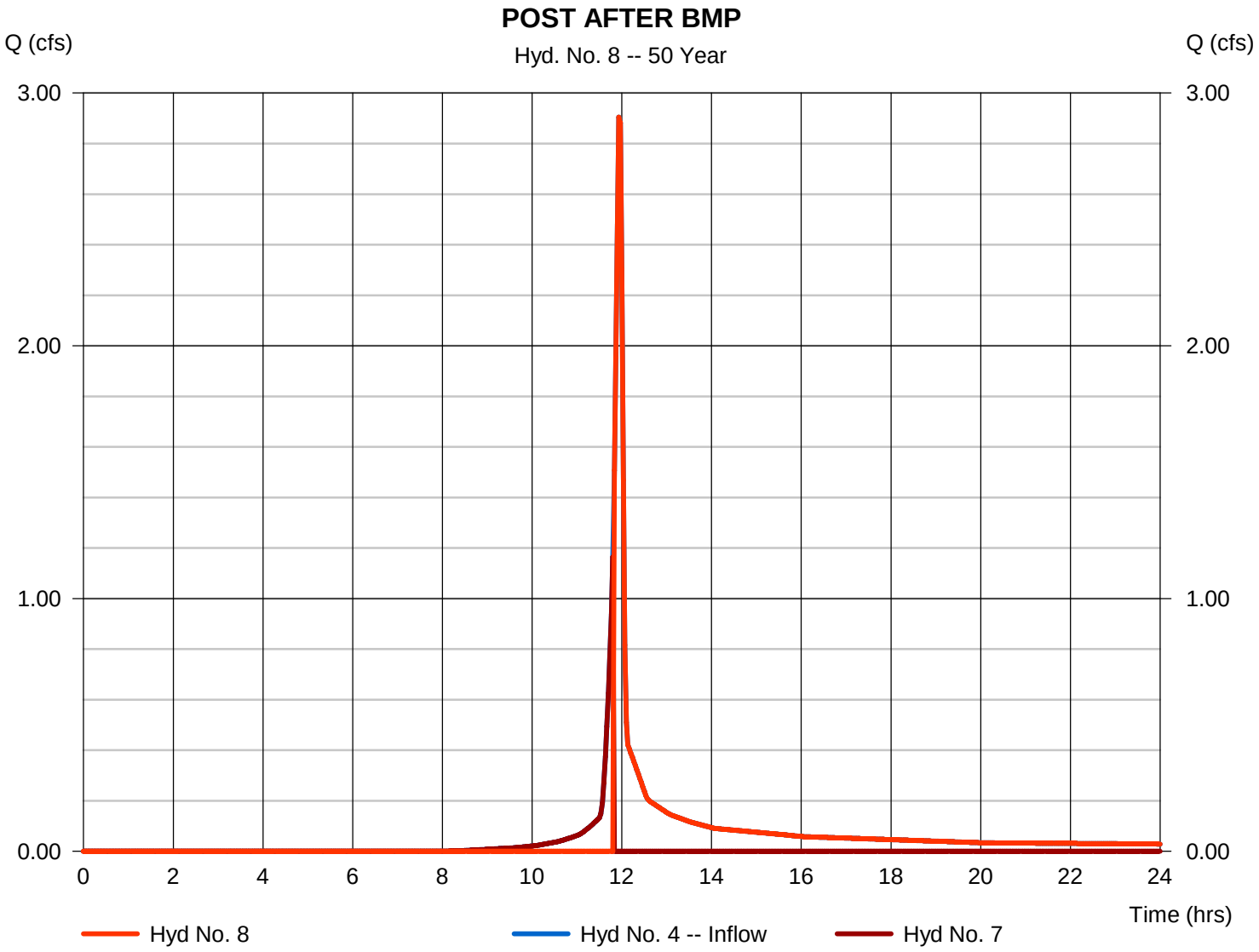


Hydrograph Report

Hyd. No. 8

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 2.905 cfs
Storm frequency	= 50 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 4,906 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 7
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

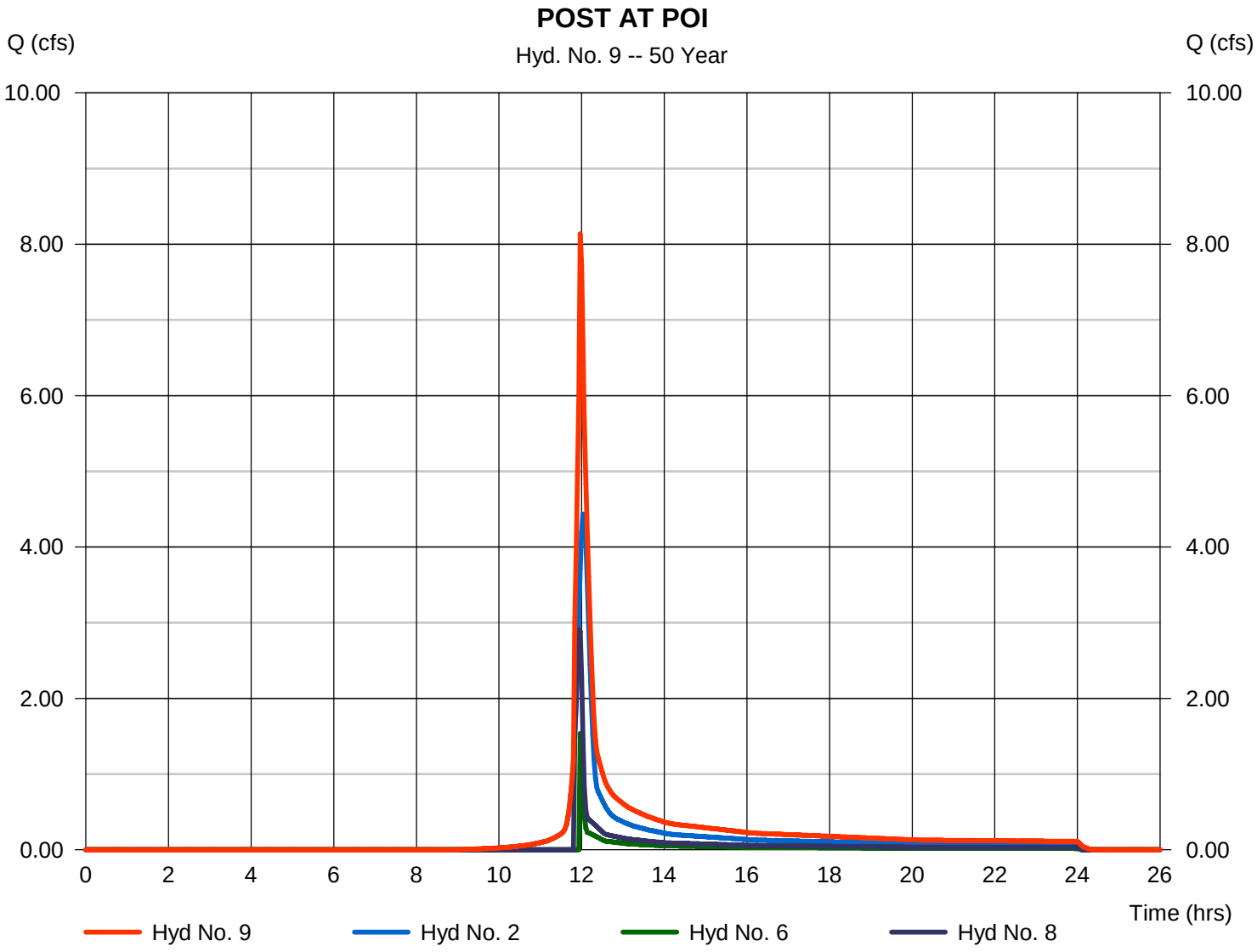


Hydrograph Report

Hyd. No. 9

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 8.137 cfs
Storm frequency	= 50 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 19,545 cuft
Inflow hyds.	= 2, 6, 8	Contrib. drain. area	= 1.400 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	SCS Runoff	10.42	2	720	27,042	------	------	------	PRE
2	SCS Runoff	5.443	2	722	15,263	------	------	------	POST UNDETAINED
3	SCS Runoff	1.888	2	718	3,808	------	------	------	POST DETAINED 1
4	SCS Runoff	3.504	2	716	7,114	------	------	------	POST DETAINED 2
5	Diversion1	1.591	2	714	984	3	------	------	VOLUME ABSTRACTION
6	Diversion2	1.888	2	718	2,824	3	------	------	POST AFTER BMP
7	Diversion1	0.970	2	704	976	4	------	------	VOLUME ABSTRACTION
8	Diversion2	3.504	2	716	6,138	4	------	------	POST AFTER BMP
9	Combine	9.956	2	718	24,224	2, 6, 8	------	------	POST AT POI

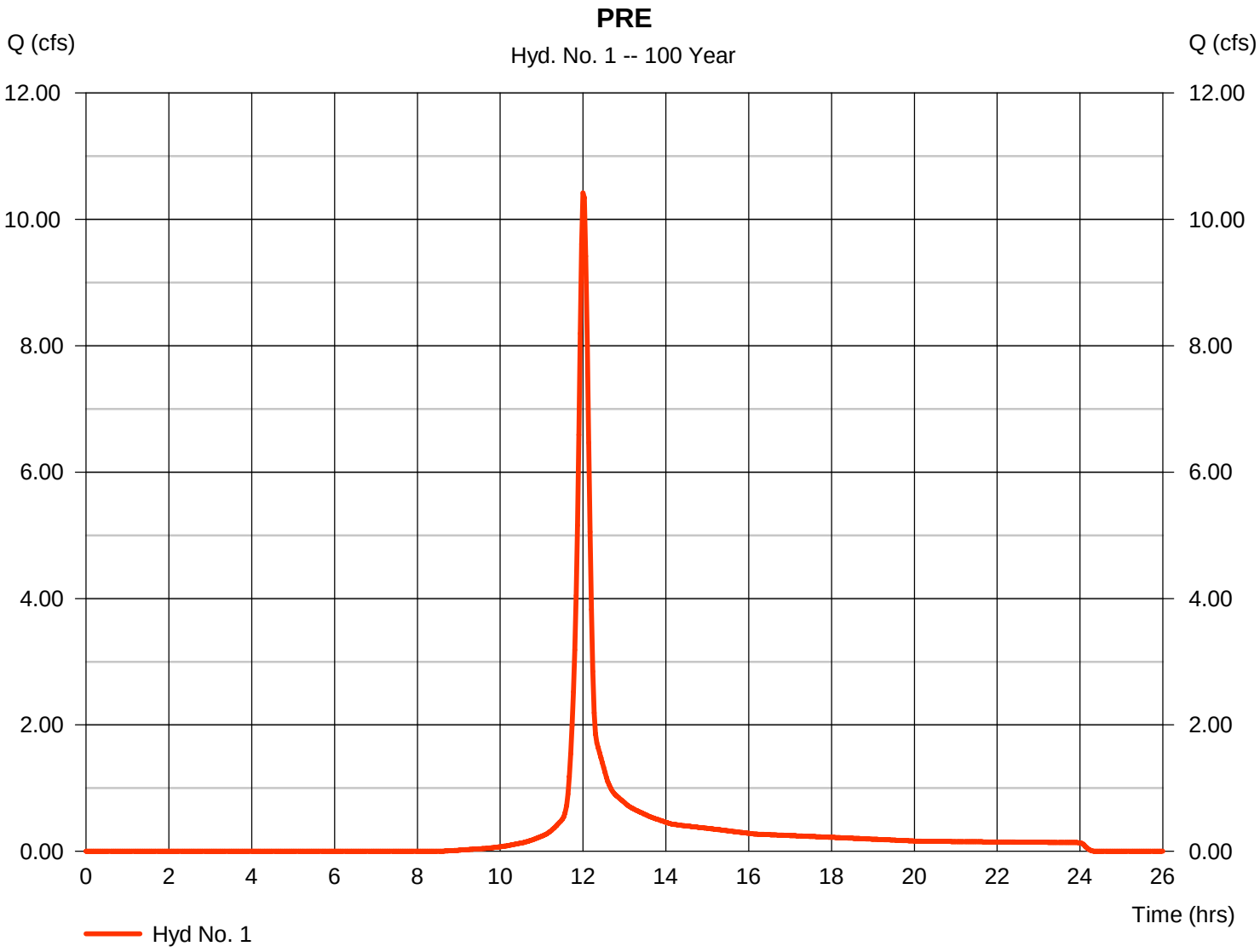
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.42 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	27,042 cuft
Drainage area	=	2.420 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.040 x 98) + (0.130 x 58) + (0.840 x 78) + (0.850 x 77) + (0.560 x 55)] / 2.420



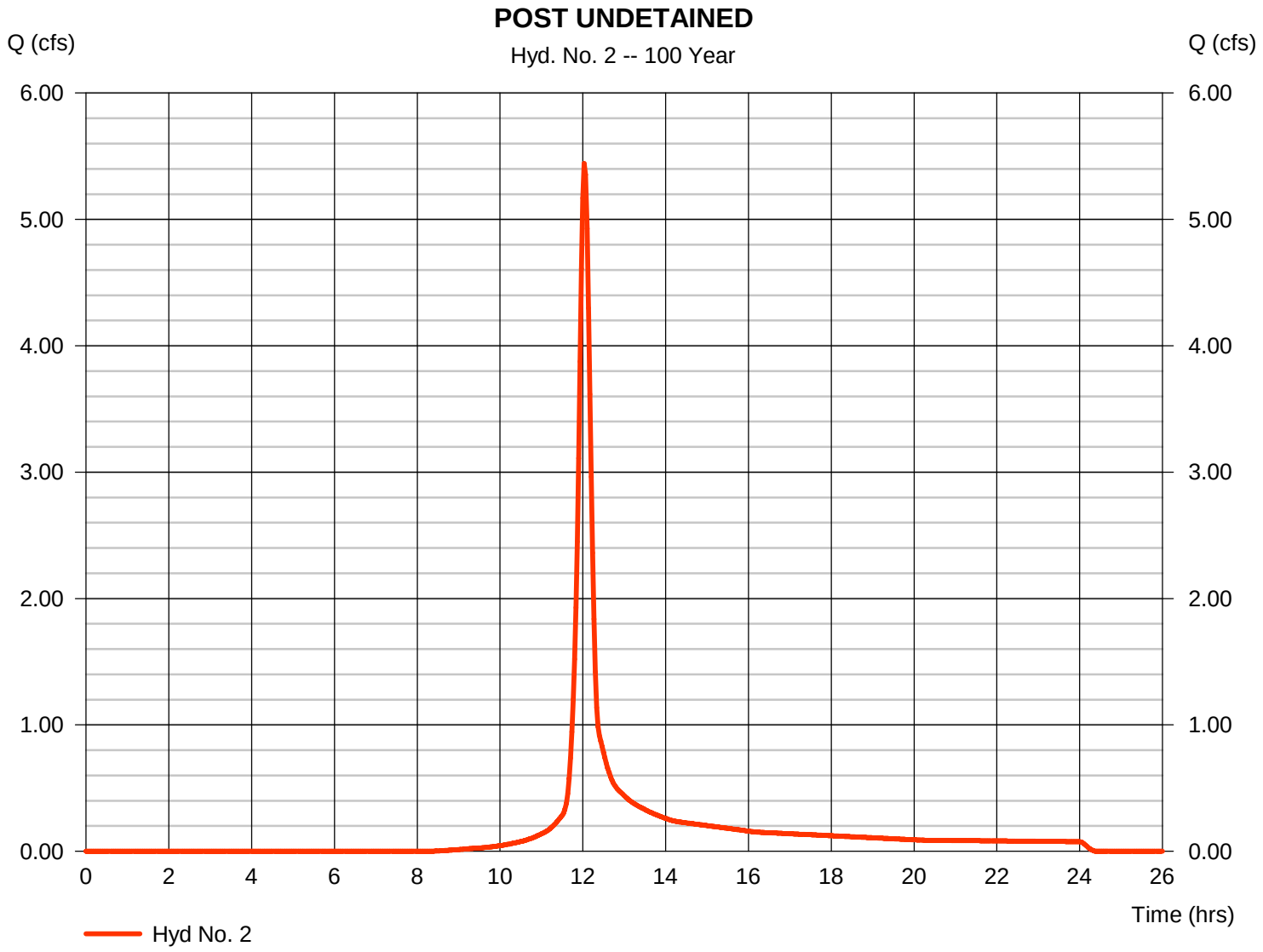
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.443 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	15,263 cuft
Drainage area	=	1.400 ac	Curve number	=	73*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.60 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = + (0.060 x 58) + (0.540 x 78) + (0.550 x 77) + (0.250 x 55)] / 1.400



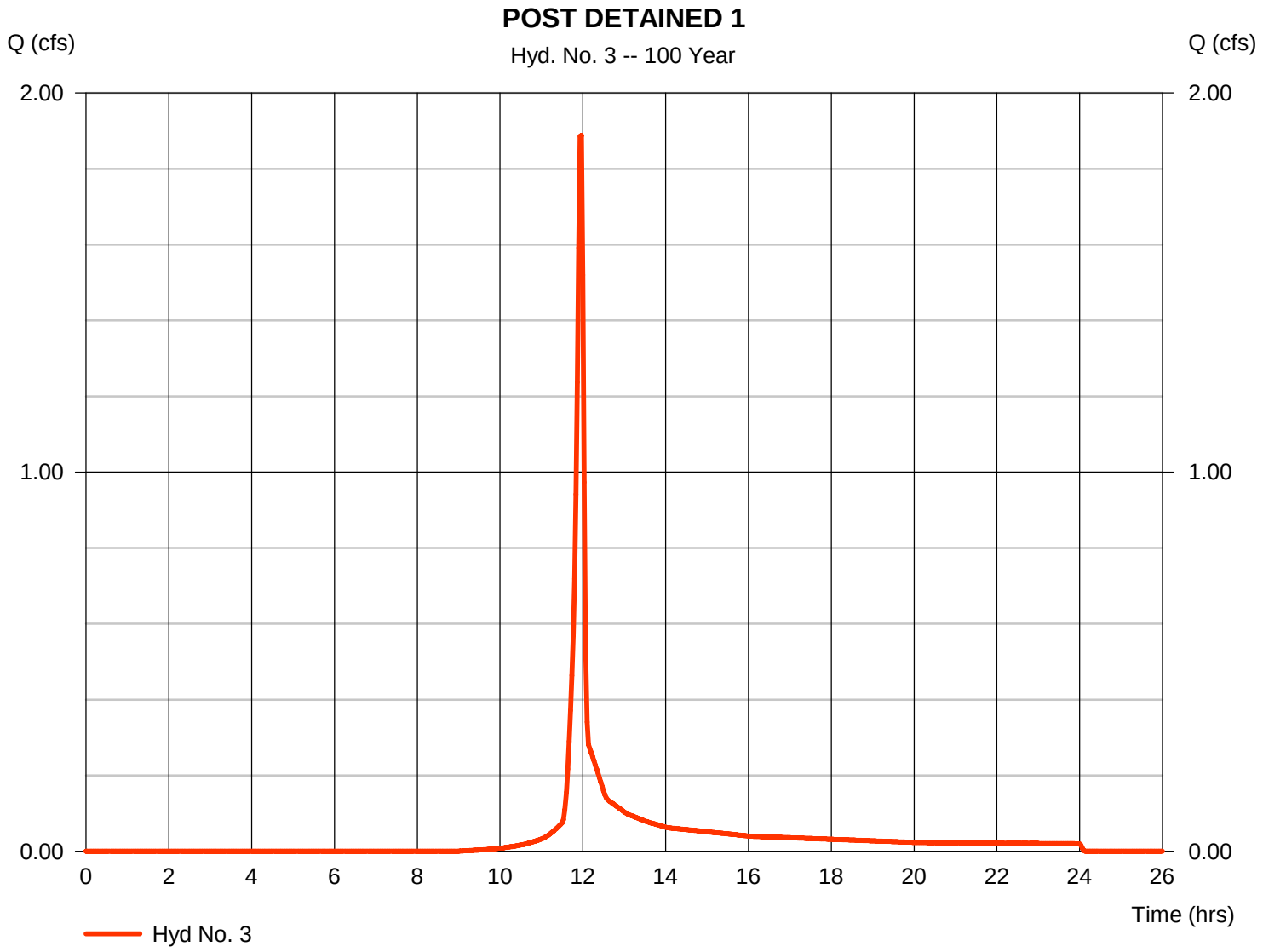
Hydrograph Report

Hyd. No. 3

POST DETAINED 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.888 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	3,808 cuft
Drainage area	=	0.400 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	4.20 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (0.050 x 58) + (0.150 x 78) + (0.060 x 91) + (0.130 x 55)] / 0.400



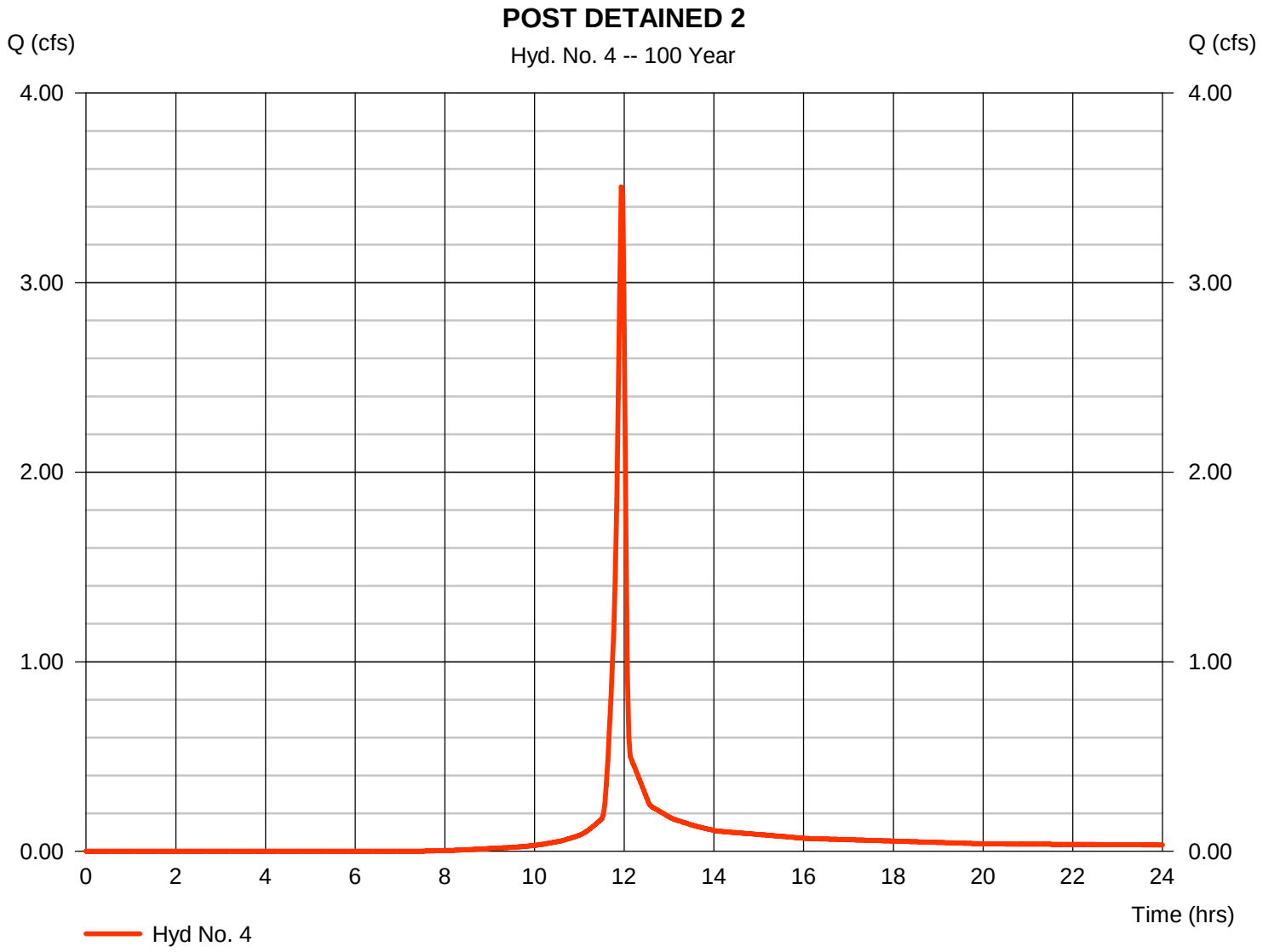
Hydrograph Report

Hyd. No. 4

POST DETAINED 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.504 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	7,114 cuft
Drainage area	=	0.620 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	4.70 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (0.030 x 58) + (0.270 x 78) + (0.170 x 91) + (0.130 x 55) + (0.010 x 77)] / 0.620

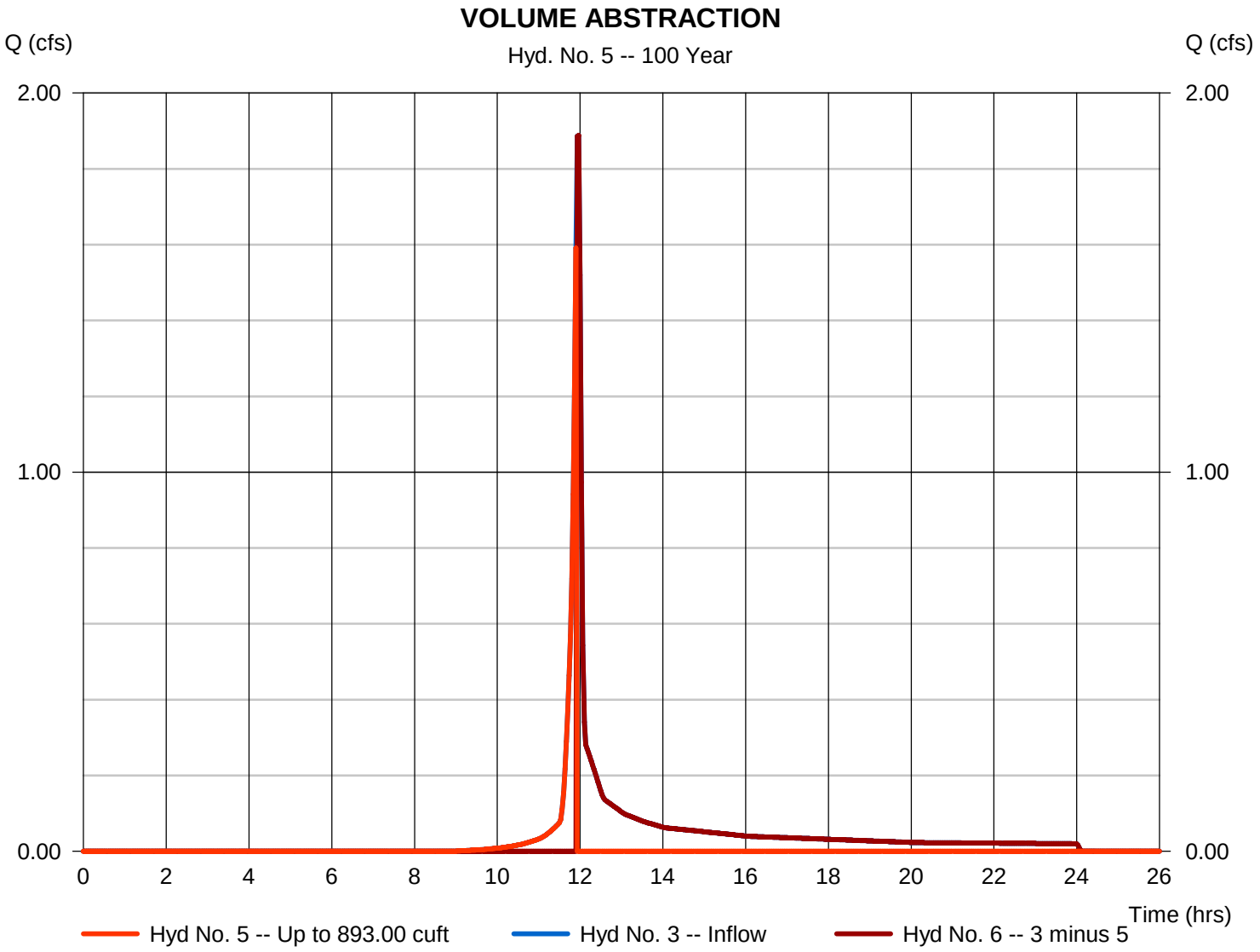


Hydrograph Report

Hyd. No. 5

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.591 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.90 hrs
Time interval	= 2 min	Hyd. volume	= 984 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 6
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

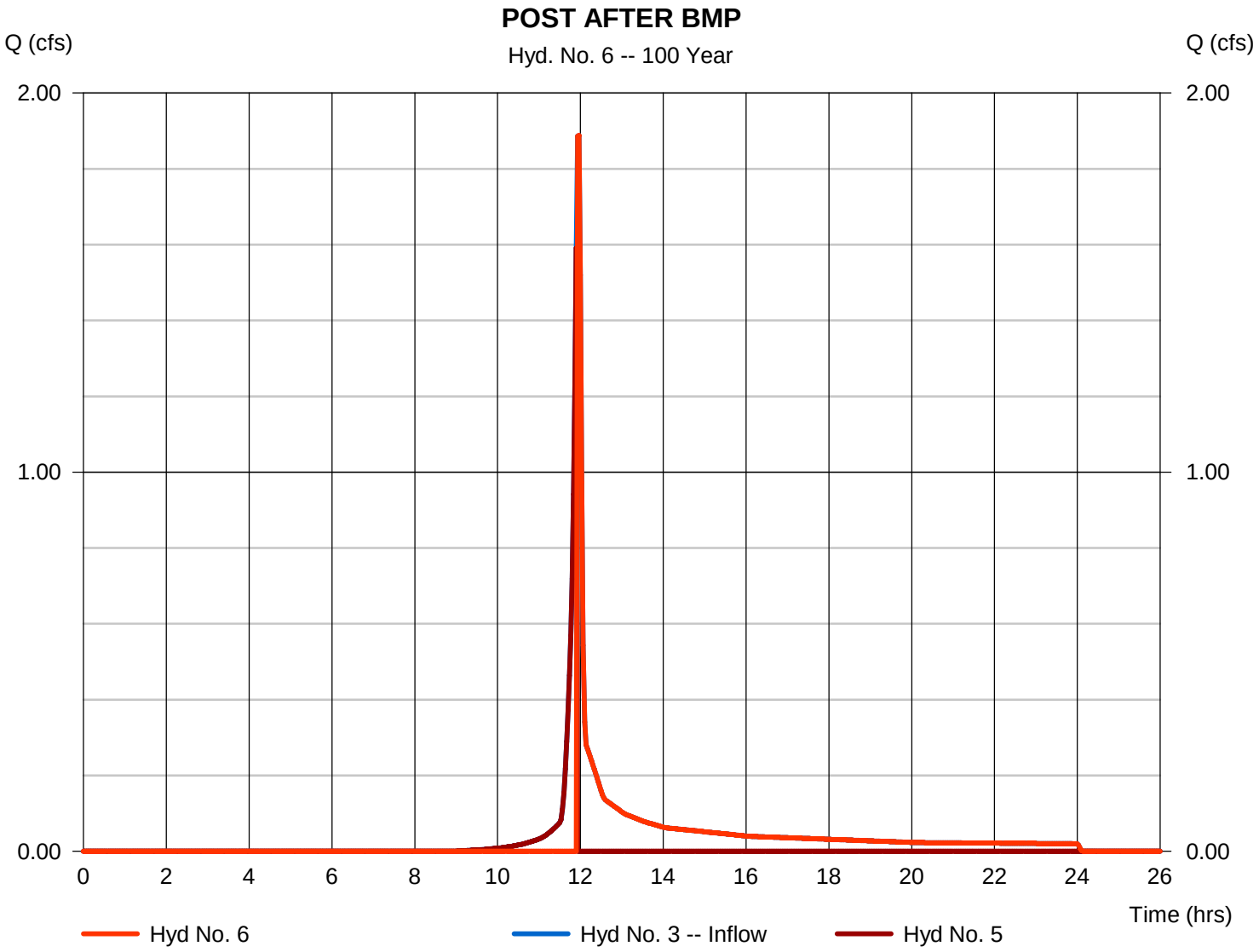


Hydrograph Report

Hyd. No. 6

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 1.888 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 2,824 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

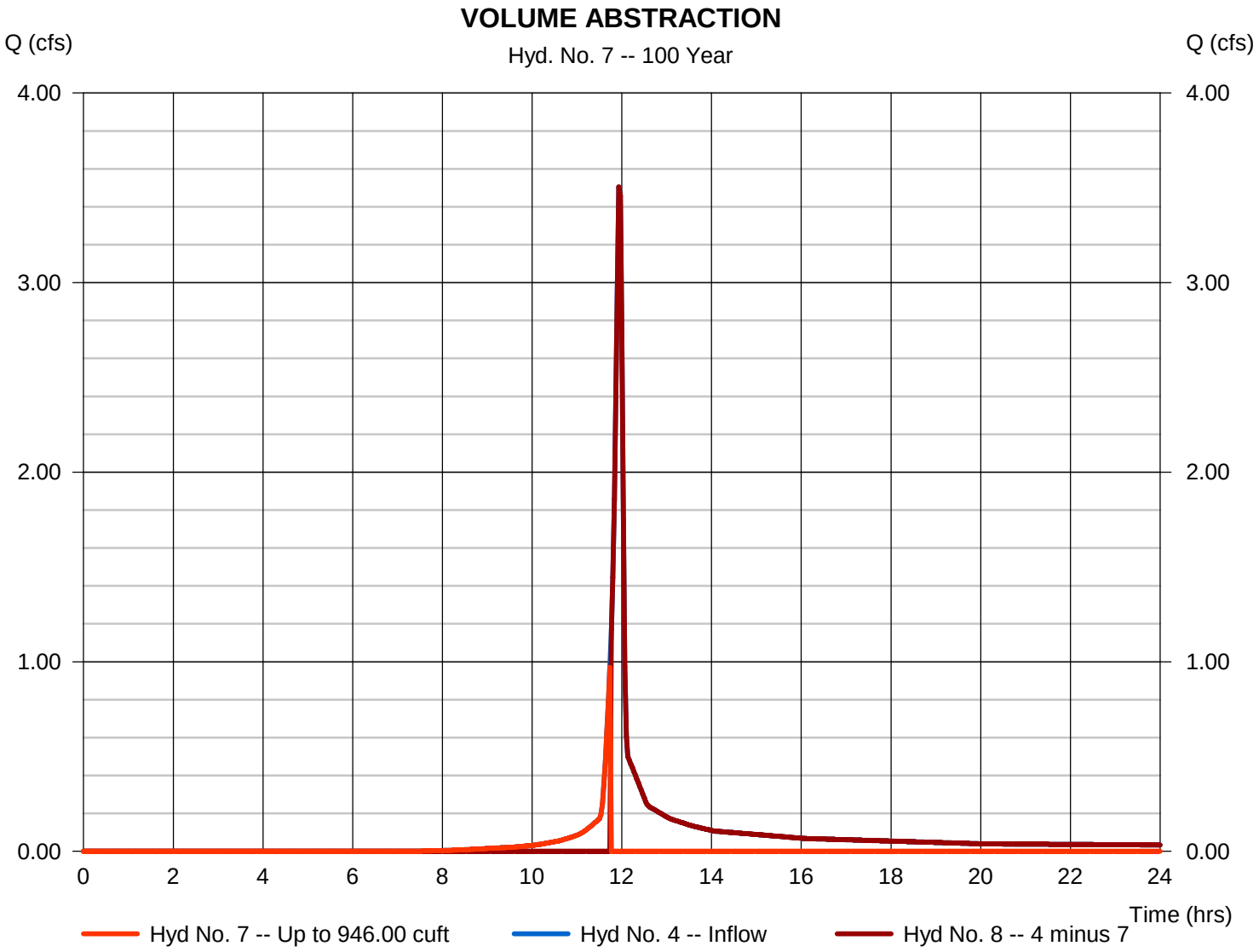


Hydrograph Report

Hyd. No. 7

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.970 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.73 hrs
Time interval	= 2 min	Hyd. volume	= 976 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 8
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

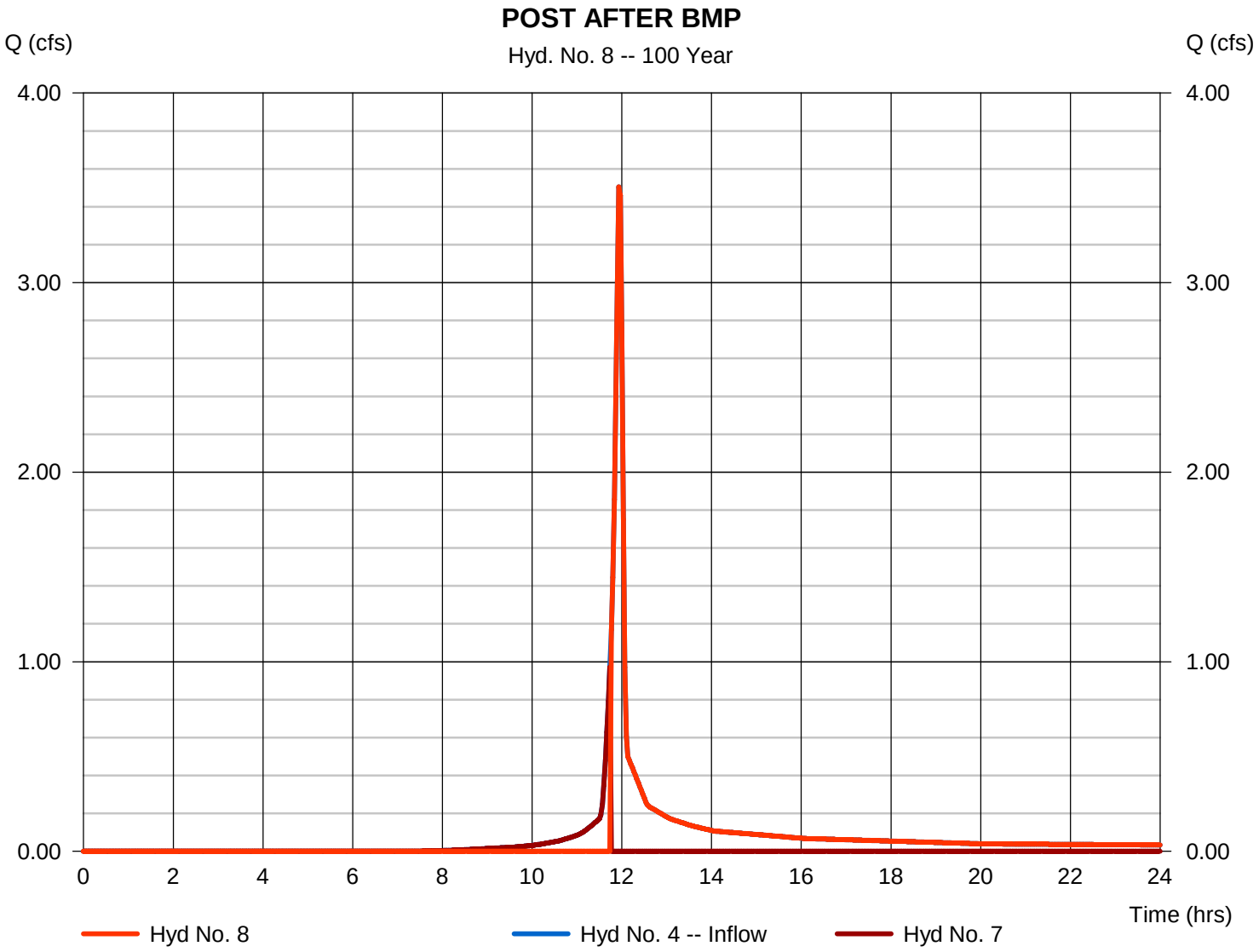


Hydrograph Report

Hyd. No. 8

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 3.504 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 6,138 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 7
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

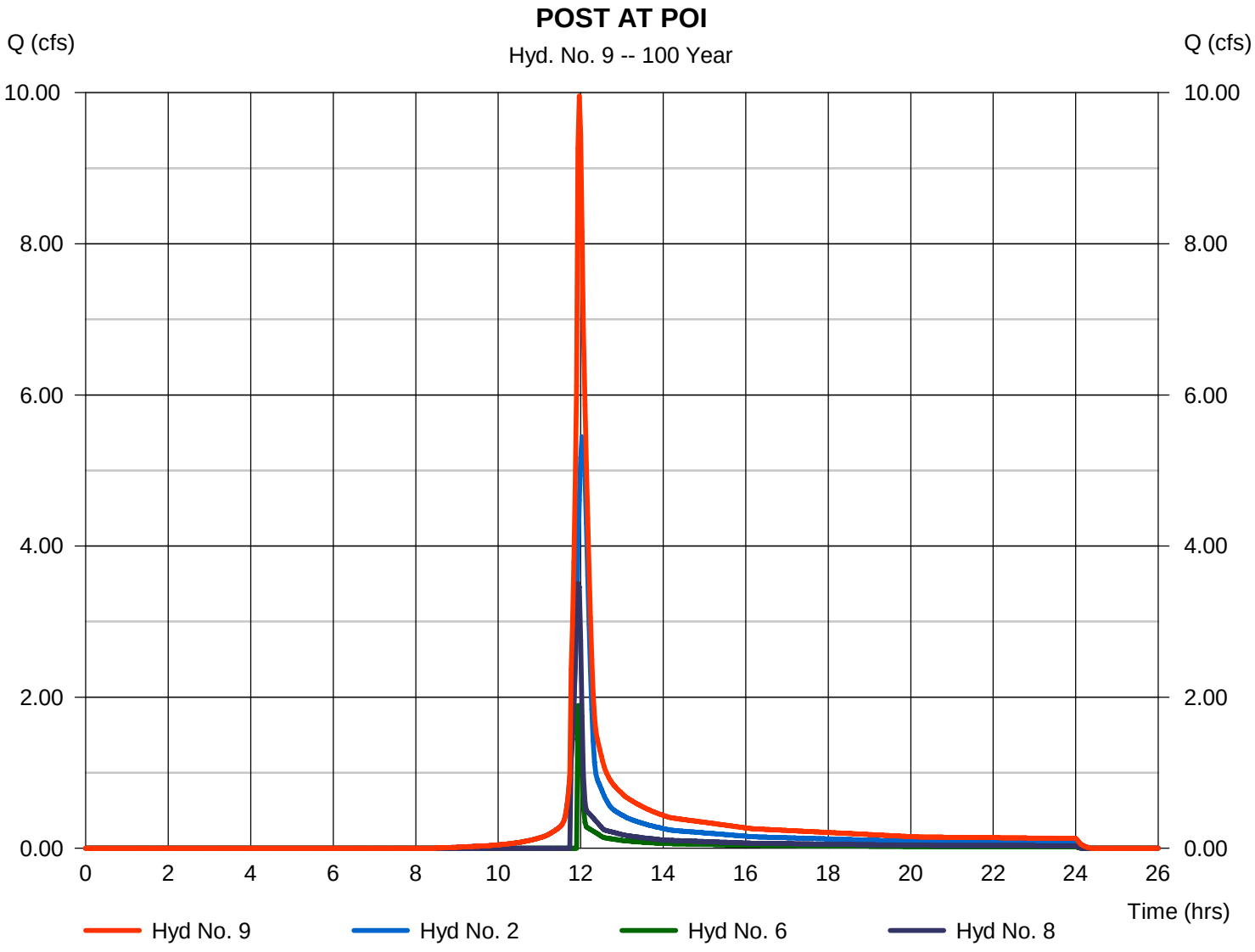


Hydrograph Report

Hyd. No. 9

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 9.956 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 24,224 cuft
Inflow hyds.	= 2, 6, 8	Contrib. drain. area	= 1.400 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	40.9797	10.0000	0.8819	--------
2	47.5266	10.0000	0.8699	--------
3	0.0000	0.0000	0.0000	--------
5	52.3308	9.8000	0.8367	--------
10	51.4601	9.0000	0.7986	--------
25	47.3122	7.6000	0.7392	--------
50	45.3993	6.7000	0.7020	--------
100	40.9920	5.4000	0.6524	--------

File name: Raystown IDF.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	3.76	2.92	2.40	2.04	1.78	1.58	1.43	1.30	1.20	1.11	1.03	0.97
2	4.51	3.51	2.89	2.47	2.16	1.92	1.73	1.58	1.46	1.35	1.26	1.18
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	5.49	4.30	3.57	3.06	2.69	2.40	2.17	1.99	1.84	1.71	1.60	1.50
10	6.25	4.90	4.07	3.50	3.08	2.76	2.51	2.30	2.13	1.98	1.86	1.75
25	7.27	5.68	4.72	4.07	3.60	3.24	2.95	2.72	2.53	2.36	2.22	2.10
50	8.08	6.29	5.23	4.53	4.01	3.62	3.31	3.06	2.85	2.67	2.51	2.38
100	8.89	6.89	5.73	4.97	4.42	4.00	3.67	3.40	3.18	2.99	2.82	2.68

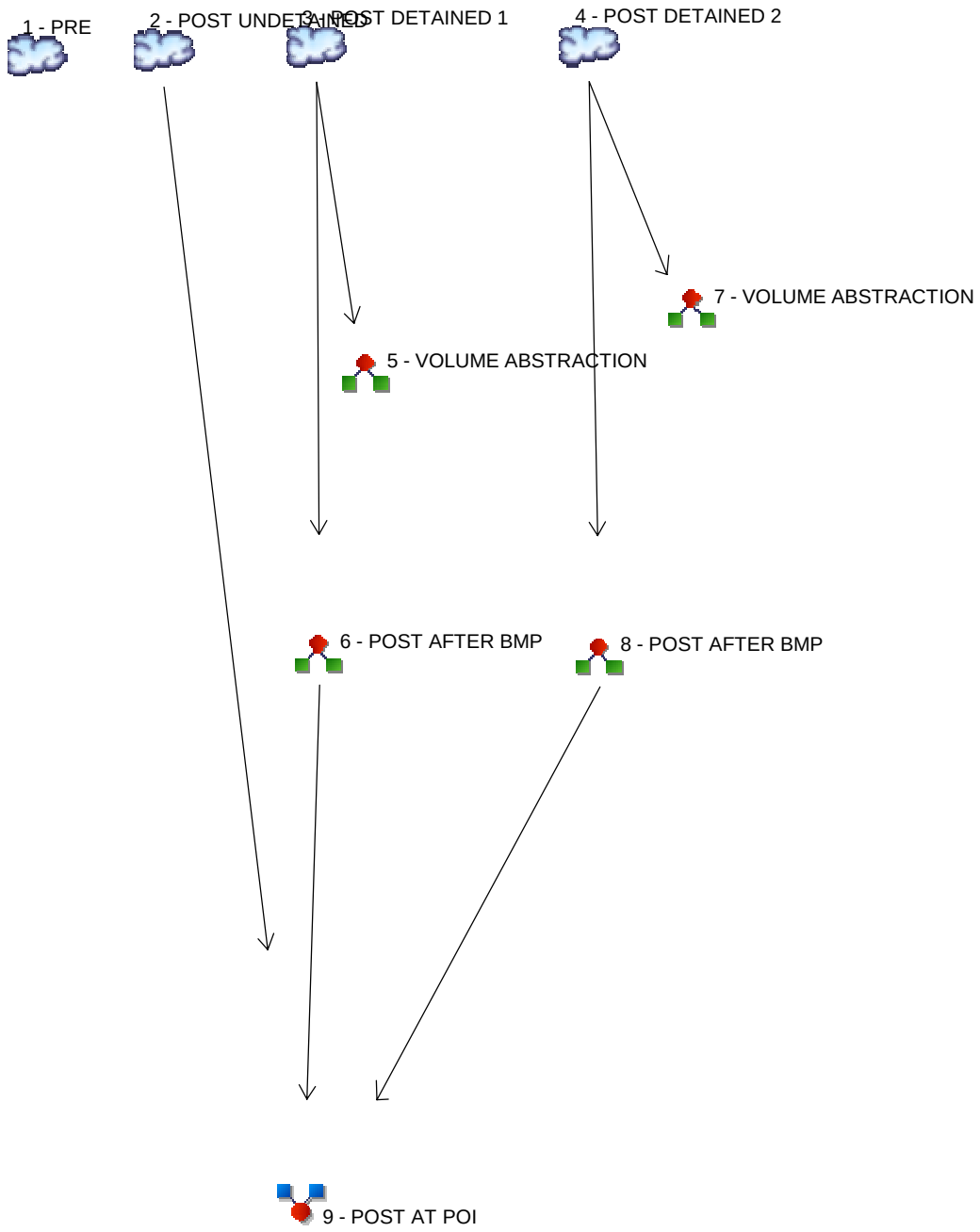
Tc = time in minutes. Values may exceed 60.

P-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Raystown Rd (SR26)\Hydraflow Rev 1\Raystown Precip.p

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	2.23	2.67	0.00	3.32	3.86	4.64	5.30	5.99
SCS 6-Hr	1.50	1.81	0.00	2.25	2.62	3.16	3.60	4.07
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE
2	SCS Runoff	POST UNDETAINED
3	SCS Runoff	POST DETAINED 1
4	SCS Runoff	POST DETAINED 2
5	Diversion1	VOLUME ABSTRACTION
6	Diversion2	POST AFTER BMP
7	Diversion1	VOLUME ABSTRACTION
8	Diversion2	POST AFTER BMP
9	Combine	POST AT POI

Hydrograph Return Period Recap

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

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	SCS Runoff	------	-------	1.963	-------	-------	-------	-------	-------	-------	PRE
2	SCS Runoff	------	-------	1.062	-------	-------	-------	-------	-------	-------	POST UNDETAINED
3	SCS Runoff	------	-------	0.126	-------	-------	-------	-------	-------	-------	POST DETAINED 1
4	SCS Runoff	------	-------	0.446	-------	-------	-------	-------	-------	-------	POST DETAINED 2
5	Diversion1	3	-------	0.126	-------	-------	-------	-------	-------	-------	VOLUME ABSTRACTION
6	Diversion2	3	-------	0.000	-------	-------	-------	-------	-------	-------	POST AFTER BMP
7	Diversion1	4	-------	0.446	-------	-------	-------	-------	-------	-------	VOLUME ABSTRACTION
8	Diversion2	4	-------	0.060	-------	-------	-------	-------	-------	-------	POST AFTER BMP
9	Combine	2, 6, 8	-------	1.062	-------	-------	-------	-------	-------	-------	POST AT POI

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	SCS Runoff	1.963	2	722	5,611	------	------	------	PRE
2	SCS Runoff	1.062	2	724	3,280	------	------	------	POST UNDETAINED
3	SCS Runoff	0.126	2	740	782	------	------	------	POST DETAINED 1
4	SCS Runoff	0.446	2	730	1,772	------	------	------	POST DETAINED 2
5	Diversion1	0.126	2	740	782	3	------	------	VOLUME ABSTRACTION
6	Diversion2	0.000	2	n/a	0	3	------	------	POST AFTER BMP
7	Diversion1	0.446	2	730	947	4	------	------	VOLUME ABSTRACTION
8	Diversion2	0.060	2	788	824	4	------	------	POST AFTER BMP
9	Combine	1.062	2	724	4,104	2, 6, 8	------	------	POST AT POI

Hydrograph Report

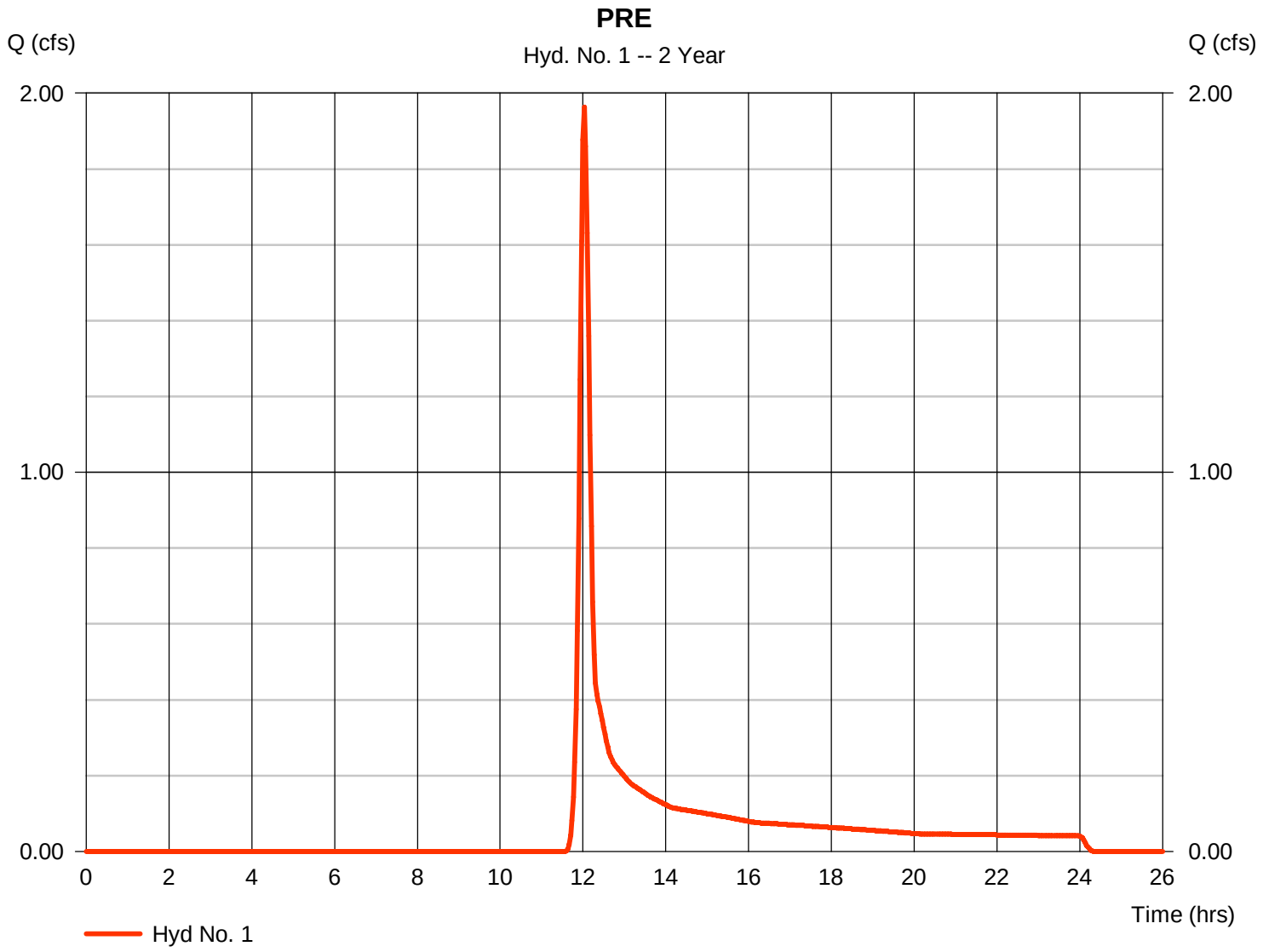
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 Tuesday, 11 / 8 / 2016

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.963 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	5,611 cuft
Drainage area	=	2.420 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	2.67 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.040 x 98) + (0.130 x 58) + (0.840 x 78) + (0.850 x 77) + (0.560 x 55)] / 2.420



TR55 Tc Worksheet

Hyd. No. 1

PRE

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 3.46		0.00		0.00		
Travel Time (min)	**= 7.21**	**+**	**0.00**	**+**	**0.00**	**=**	**7.21**
Shallow Concentrated Flow							
Flow length (ft)	= 896.00		0.00		0.00		
Watercourse slope (%)	= 5.12		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.65		0.00		0.00		
Travel Time (min)	**= 4.09**	**+**	**0.00**	**+**	**0.00**	**=**	**4.09**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 1.35		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=7.93						
			0.00				
					0.00		
Flow length (ft)	({0})93.0		0.0		0.0		
Travel Time (min)	**= 0.20**	**+**	**0.00**	**+**	**0.00**	**=**	**0.20**

Total Travel Time, Tc ..... 11.50 min

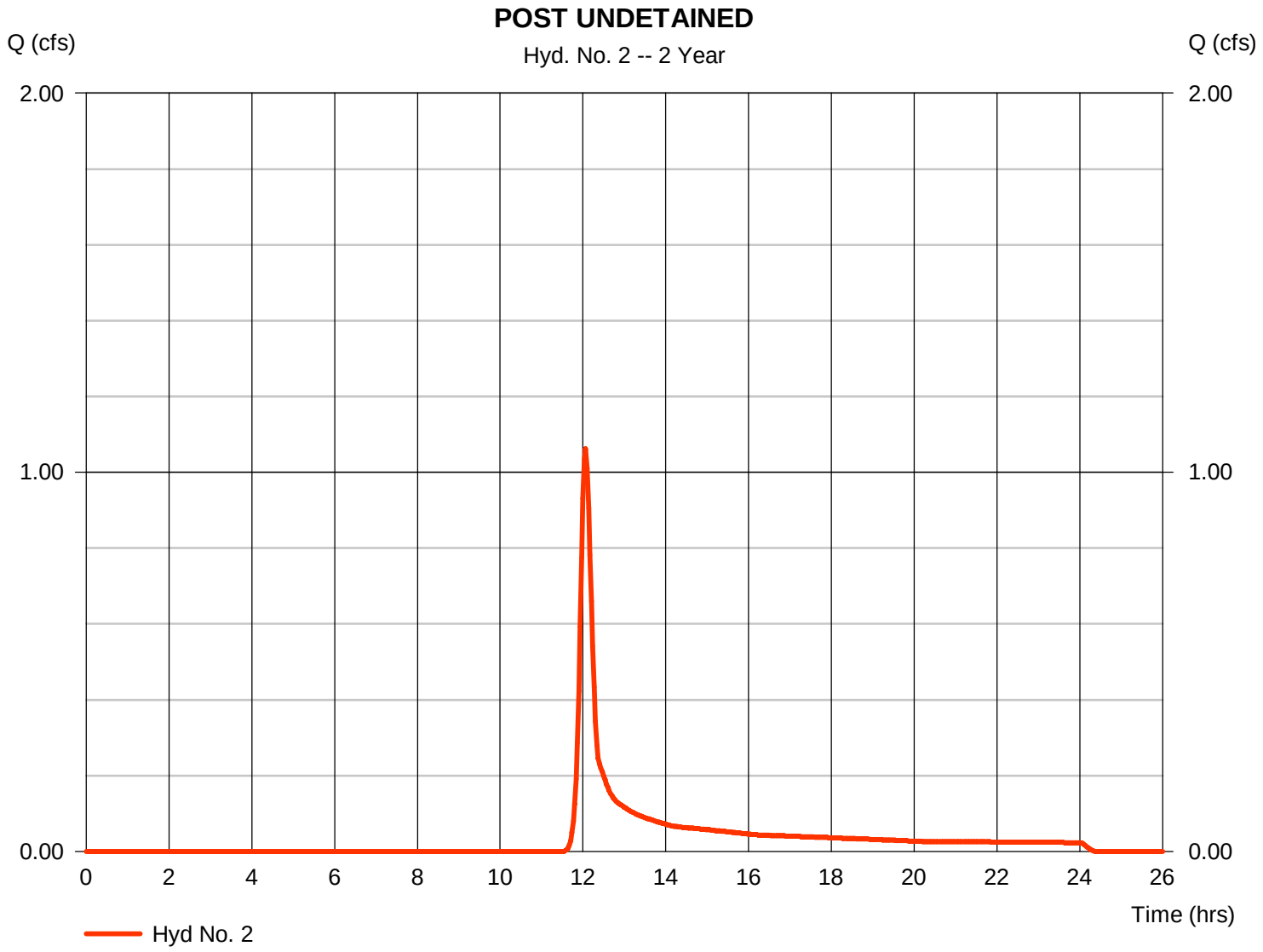
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.062 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 3,280 cuft
Drainage area	= 1.400 ac	Curve number	= 73*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 16.60 min
Total precip.	= 2.67 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = + (0.060 x 58) + (0.540 x 78) + (0.550 x 77) + (0.250 x 55)] / 1.400



TR55 Tc Worksheet

Hyd. No. 2

POST UNDETAINED

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 3.46		0.00		0.00		
Travel Time (min)	**= 12.55**	**+**	**0.00**	**+**	**0.00**	**=**	**12.55**
Shallow Concentrated Flow							
Flow length (ft)	= 846.00		0.00		0.00		
Watercourse slope (%)	= 5.12		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.65		0.00		0.00		
Travel Time (min)	**= 3.86**	**+**	**0.00**	**+**	**0.00**	**=**	**3.86**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 1.35		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=7.93						
			0.00				
					0.00		
Flow length (ft)	({0})93.0		0.0		0.0		
Travel Time (min)	**= 0.20**	**+**	**0.00**	**+**	**0.00**	**=**	**0.20**

Total Travel Time, Tc ..... 16.60 min

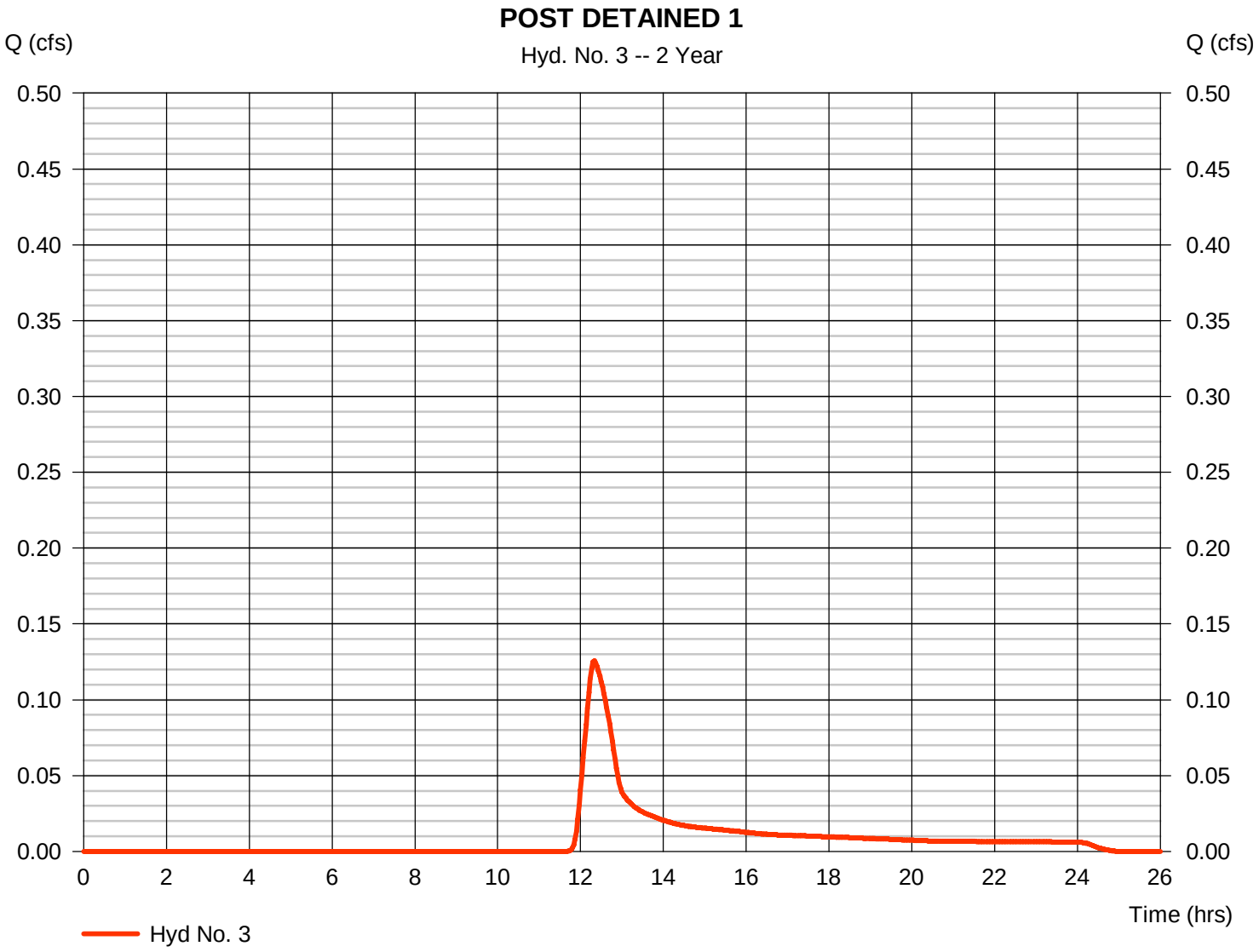
Hydrograph Report

Hyd. No. 3

POST DETAINED 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.126 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.33 hrs
Time interval	= 2 min	Hyd. volume	= 782 cuft
Drainage area	= 0.400 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 39.70 min
Total precip.	= 2.67 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.010 x 85) + (0.050 x 58) + (0.150 x 78) + (0.060 x 91) + (0.130 x 55)] / 0.400



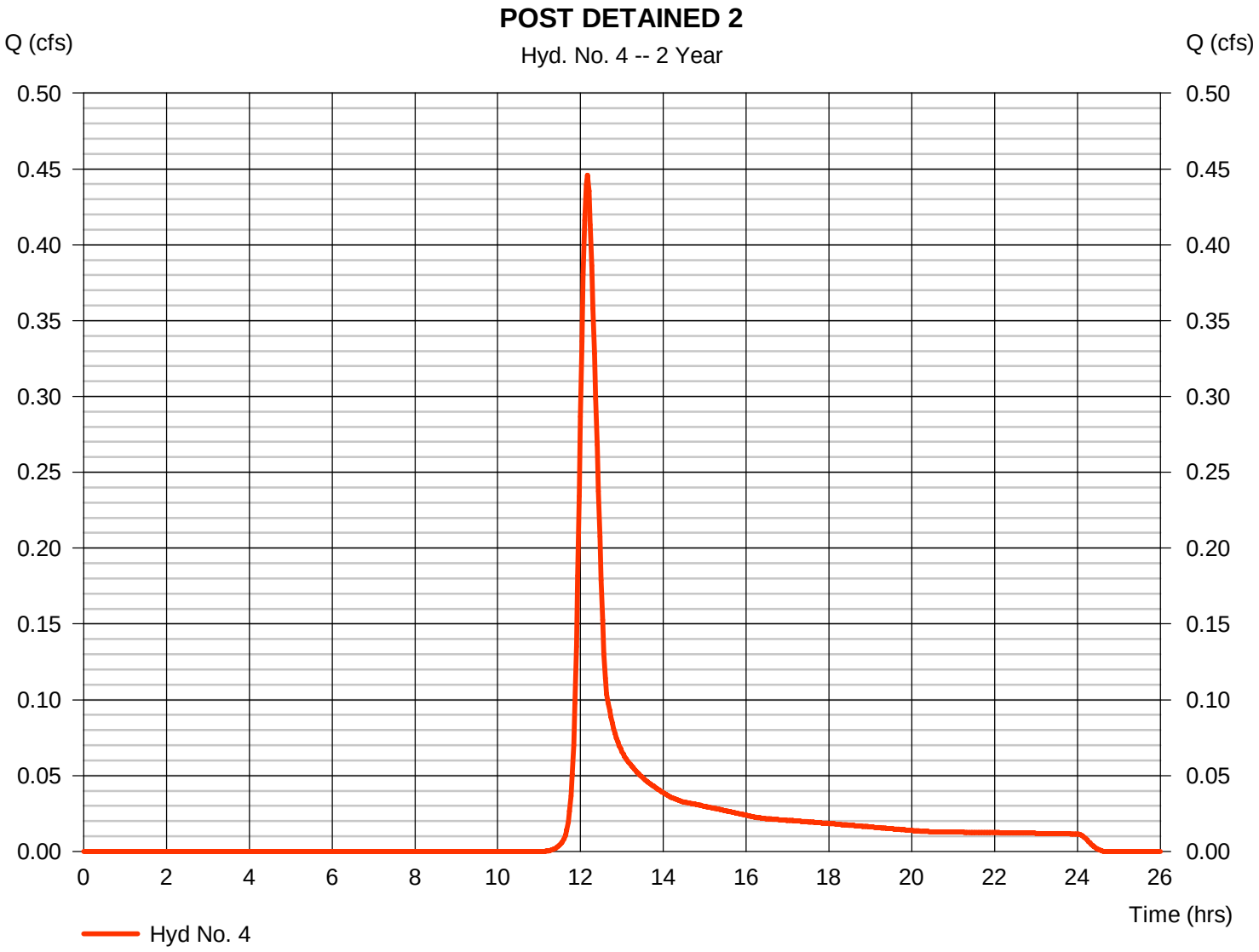
Hydrograph Report

Hyd. No. 4

POST DETAINED 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.446 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 1,772 cuft
Drainage area	= 0.620 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 23.50 min
Total precip.	= 2.67 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.010 x 85) + (0.030 x 58) + (0.270 x 78) + (0.170 x 91) + (0.130 x 55) + (0.010 x 77)] / 0.620

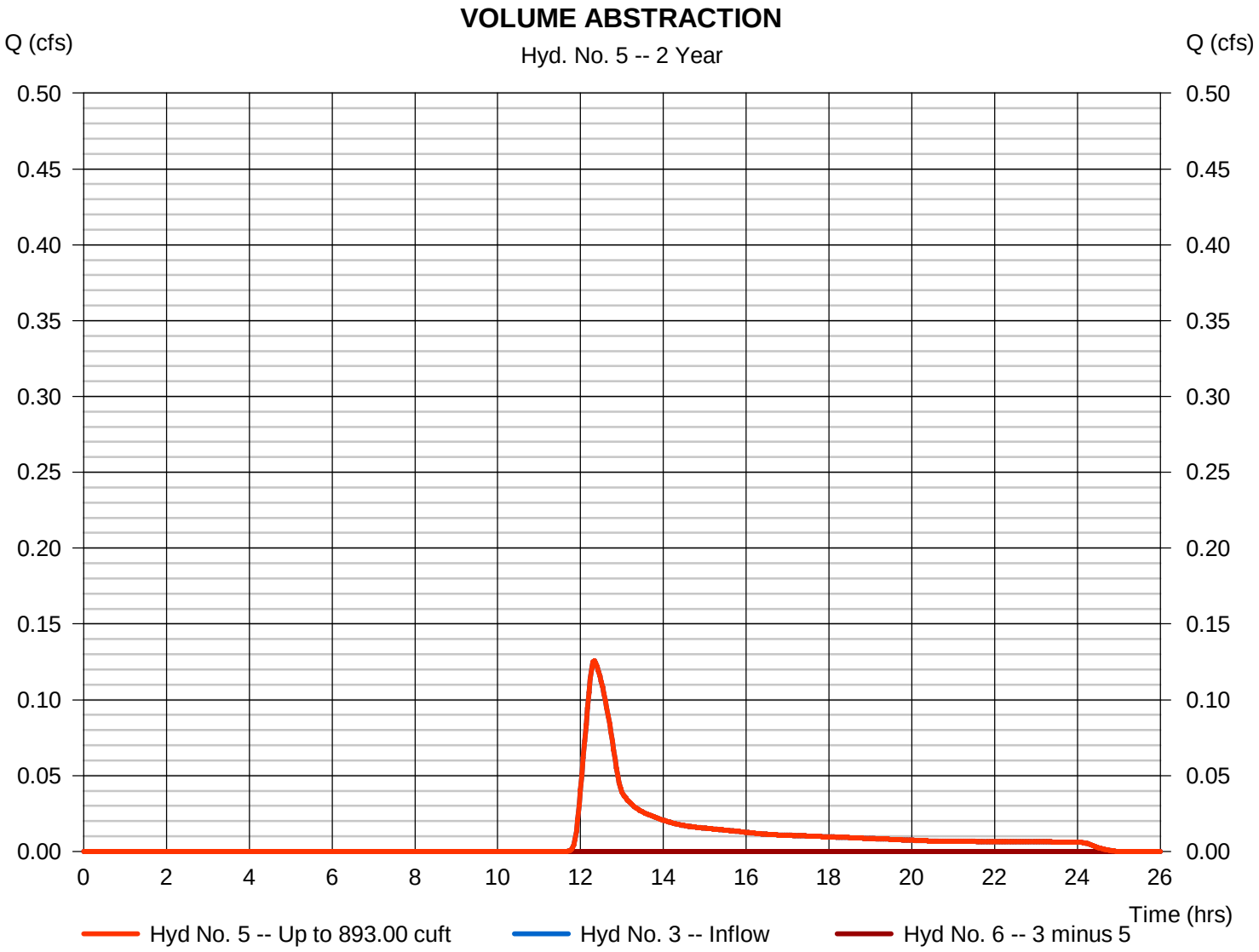


Hydrograph Report

Hyd. No. 5

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.126 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.33 hrs
Time interval	= 2 min	Hyd. volume	= 782 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 6
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

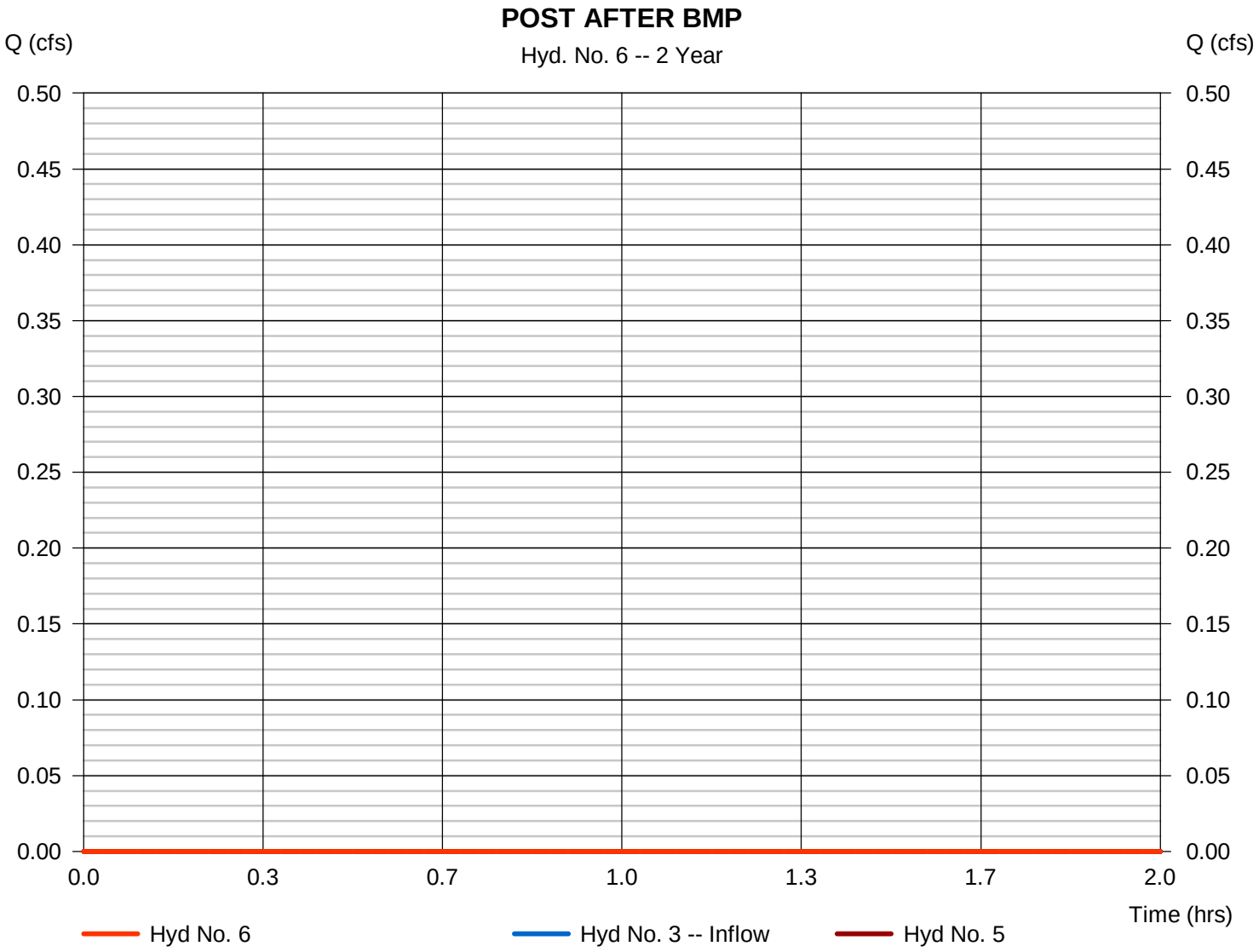


Hydrograph Report

Hyd. No. 6

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

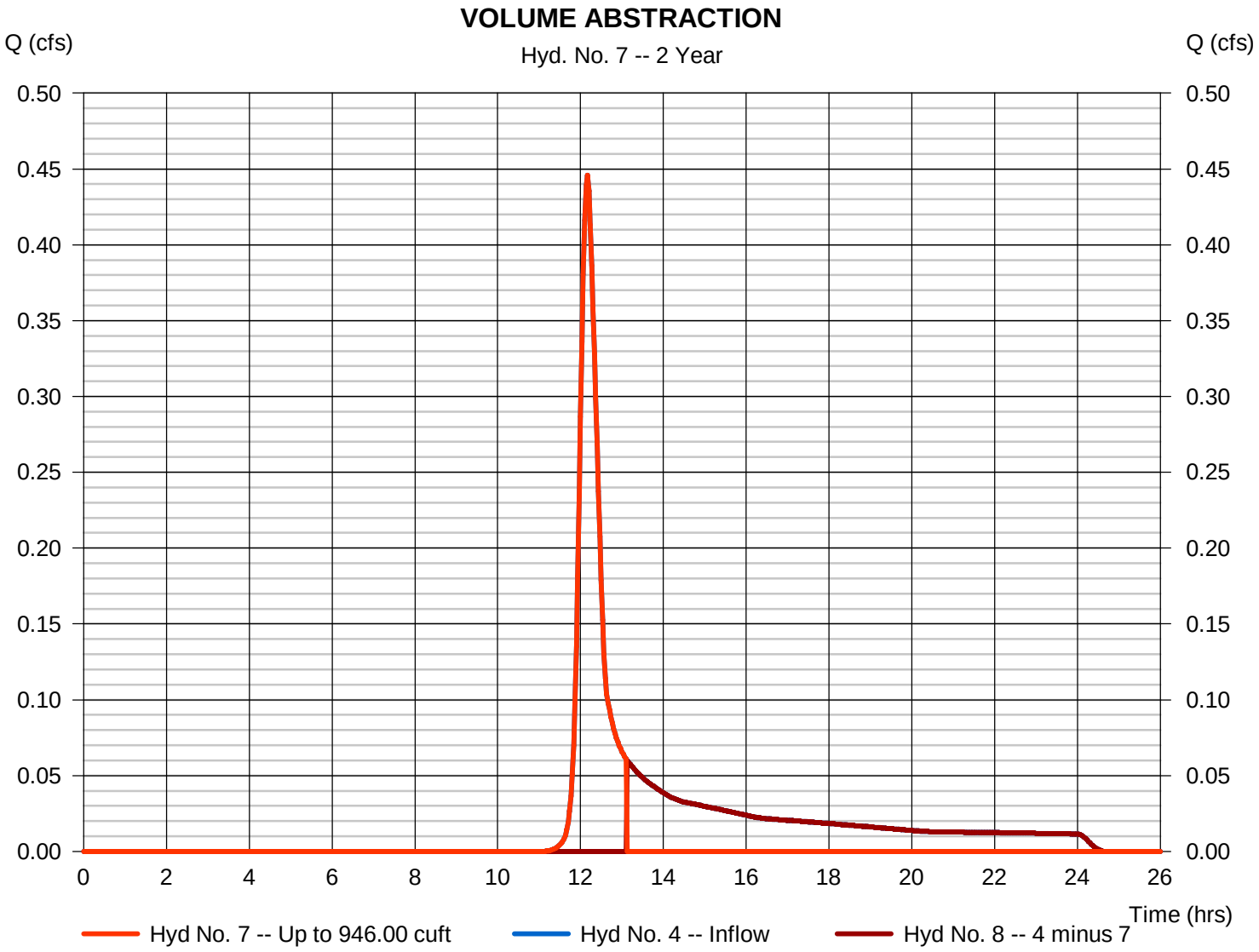


Hydrograph Report

Hyd. No. 7

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.446 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 947 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 8
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

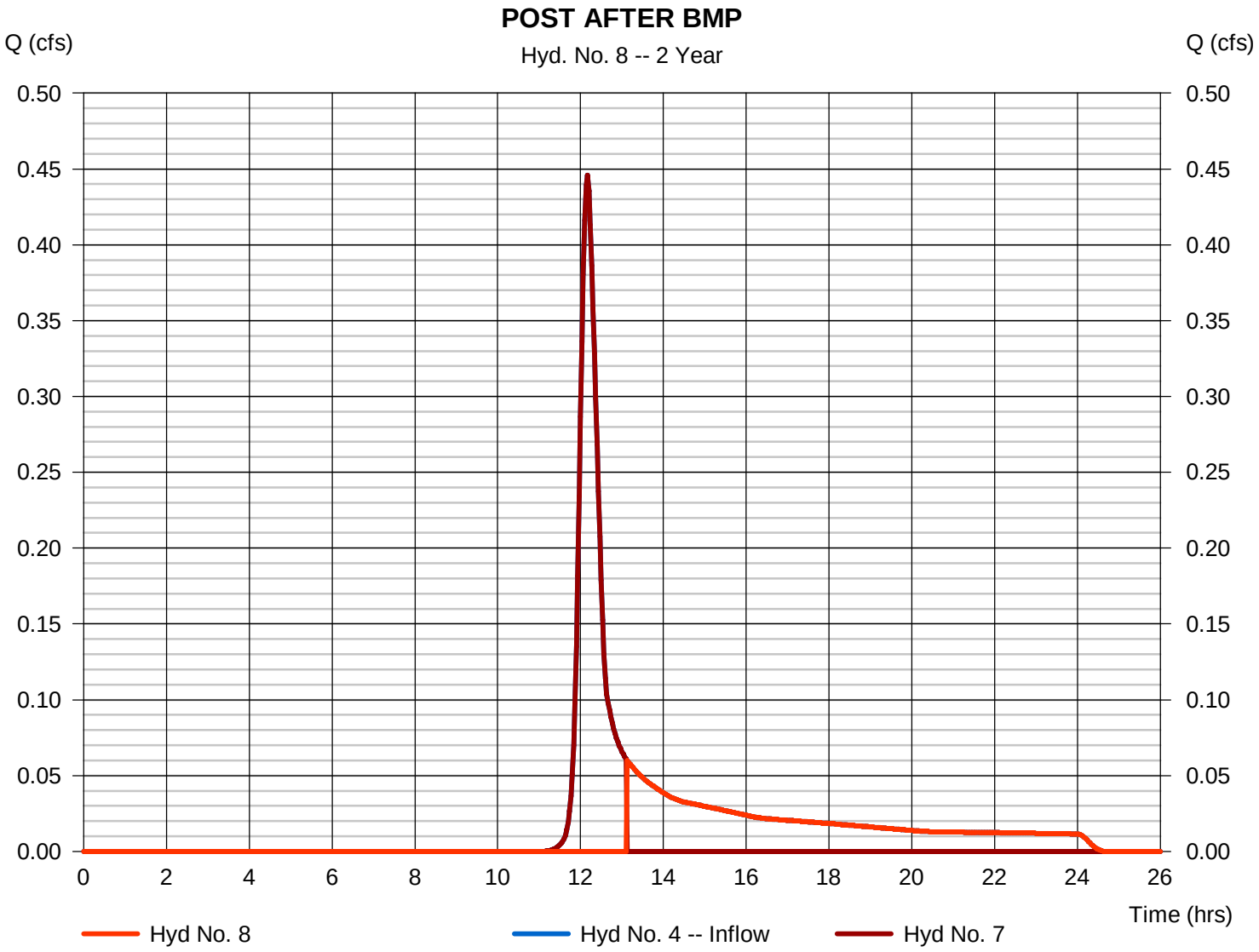


Hydrograph Report

Hyd. No. 8

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.060 cfs
Storm frequency	= 2 yrs	Time to peak	= 13.13 hrs
Time interval	= 2 min	Hyd. volume	= 824 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 7
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

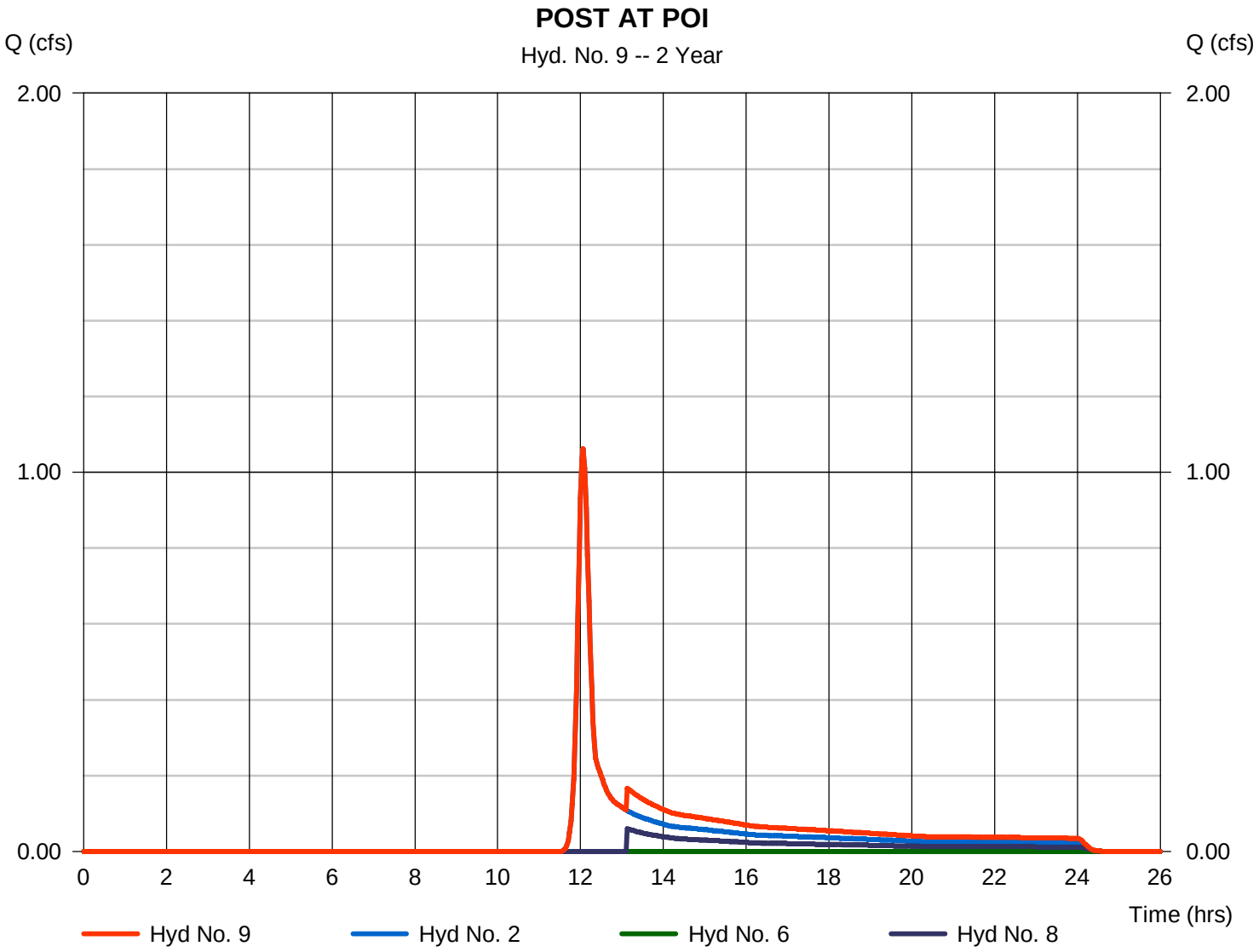


Hydrograph Report

Hyd. No. 9

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 1.062 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 4,104 cuft
Inflow hyds.	= 2, 6, 8	Contrib. drain. area	= 1.400 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	40.9797	10.0000	0.8819	--------
2	47.5266	10.0000	0.8699	--------
3	0.0000	0.0000	0.0000	--------
5	52.3308	9.8000	0.8367	--------
10	51.4601	9.0000	0.7986	--------
25	47.3122	7.6000	0.7392	--------
50	45.3993	6.7000	0.7020	--------
100	40.9920	5.4000	0.6524	--------

File name: Raystown IDF.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	3.76	2.92	2.40	2.04	1.78	1.58	1.43	1.30	1.20	1.11	1.03	0.97
2	4.51	3.51	2.89	2.47	2.16	1.92	1.73	1.58	1.46	1.35	1.26	1.18
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	5.49	4.30	3.57	3.06	2.69	2.40	2.17	1.99	1.84	1.71	1.60	1.50
10	6.25	4.90	4.07	3.50	3.08	2.76	2.51	2.30	2.13	1.98	1.86	1.75
25	7.27	5.68	4.72	4.07	3.60	3.24	2.95	2.72	2.53	2.36	2.22	2.10
50	8.08	6.29	5.23	4.53	4.01	3.62	3.31	3.06	2.85	2.67	2.51	2.38
100	8.89	6.89	5.73	4.97	4.42	4.00	3.67	3.40	3.18	2.99	2.82	2.68

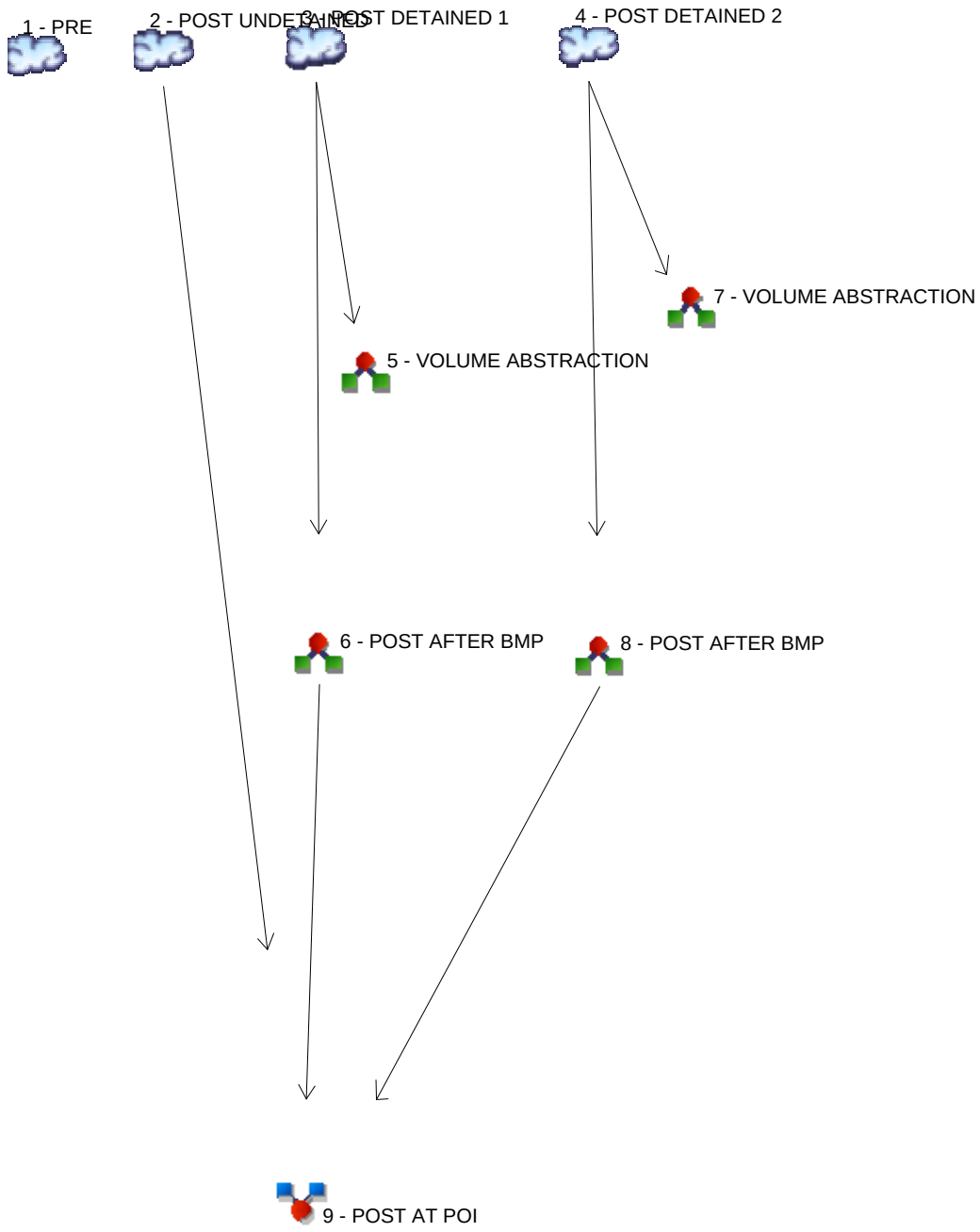
Tc = time in minutes. Values may exceed 60.

P-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Raystown Rd (SR26)\Hydraflow Rev 1\Raystown Precip.pc

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	2.23	2.67	0.00	3.32	3.86	4.64	5.30	5.99
SCS 6-Hr	1.50	1.81	0.00	2.25	2.62	3.16	3.60	4.07
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE
2	SCS Runoff	POST UNDETAINED
3	SCS Runoff	POST DETAINED 1
4	SCS Runoff	POST DETAINED 2
5	Diversion1	VOLUME ABSTRACTION
6	Diversion2	POST AFTER BMP
7	Diversion1	VOLUME ABSTRACTION
8	Diversion2	POST AFTER BMP
9	Combine	POST AT POI

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	SCS Runoff	------	-------	-------	-------	-------	4.662	-------	-------	-------	PRE
2	SCS Runoff	------	-------	-------	-------	-------	2.455	-------	-------	-------	POST UNDETAINED
3	SCS Runoff	------	-------	-------	-------	-------	0.499	-------	-------	-------	POST DETAINED 1
4	SCS Runoff	------	-------	-------	-------	-------	1.263	-------	-------	-------	POST DETAINED 2
5	Diversion1	3	-------	-------	-------	-------	0.499	-------	-------	-------	VOLUME ABSTRACTION
6	Diversion2	3	-------	-------	-------	-------	0.089	-------	-------	-------	POST AFTER BMP
7	Diversion1	4	-------	-------	-------	-------	1.263	-------	-------	-------	VOLUME ABSTRACTION
8	Diversion2	4	-------	-------	-------	-------	1.253	-------	-------	-------	POST AFTER BMP
9	Combine	2, 6, 8	-------	-------	-------	-------	3.707	-------	-------	-------	POST AT POI

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	SCS Runoff	4.662	2	722	12,346	------	------	------	PRE
2	SCS Runoff	2.455	2	722	7,075	------	------	------	POST UNDETAINED
3	SCS Runoff	0.499	2	728	1,828	------	------	------	POST DETAINED 1
4	SCS Runoff	1.263	2	722	3,581	------	------	------	POST DETAINED 2
5	Diversion1	0.499	2	728	894	3	------	------	VOLUME ABSTRACTION
6	Diversion2	0.089	2	762	935	3	------	------	POST AFTER BMP
7	Diversion1	1.263	2	722	959	4	------	------	VOLUME ABSTRACTION
8	Diversion2	1.253	2	724	2,622	4	------	------	POST AFTER BMP
9	Combine	3.707	2	724	10,631	2, 6, 8	------	------	POST AT POI

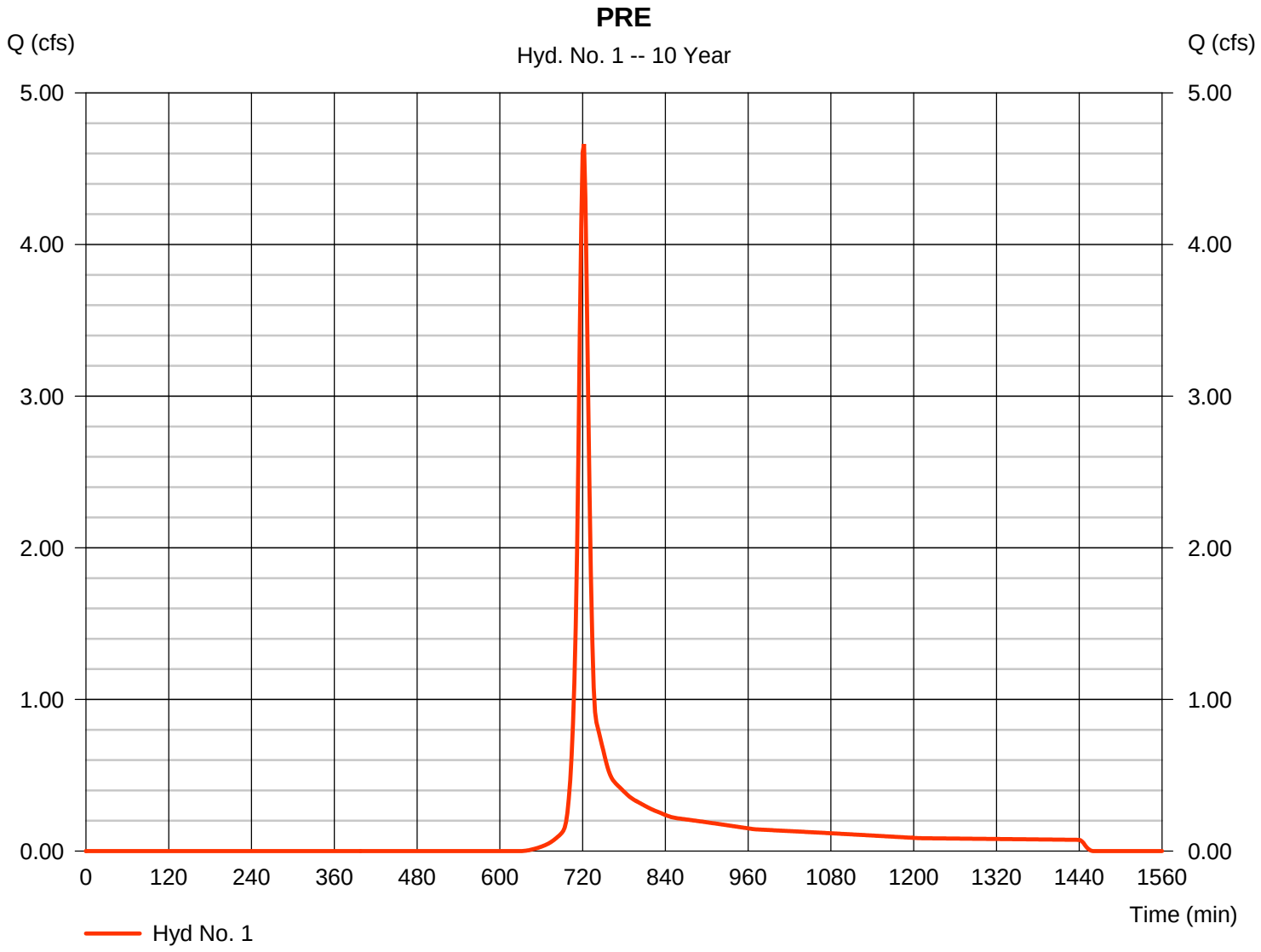
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.662 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	12,346 cuft
Drainage area	=	2.420 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	3.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.040 x 98) + (0.130 x 58) + (0.840 x 78) + (0.850 x 77) + (0.560 x 55)] / 2.420



TR55 Tc Worksheet

Hyd. No. 1

PRE

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 3.46		0.00		0.00		
Travel Time (min)	**= 7.21**	**+**	**0.00**	**+**	**0.00**	**=**	**7.21**
Shallow Concentrated Flow							
Flow length (ft)	= 896.00		0.00		0.00		
Watercourse slope (%)	= 5.12		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.65		0.00		0.00		
Travel Time (min)	**= 4.09**	**+**	**0.00**	**+**	**0.00**	**=**	**4.09**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 1.35		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=7.93						
			0.00				
					0.00		
Flow length (ft)	({0})93.0		0.0		0.0		
Travel Time (min)	**= 0.20**	**+**	**0.00**	**+**	**0.00**	**=**	**0.20**

Total Travel Time, Tc ..... 11.50 min

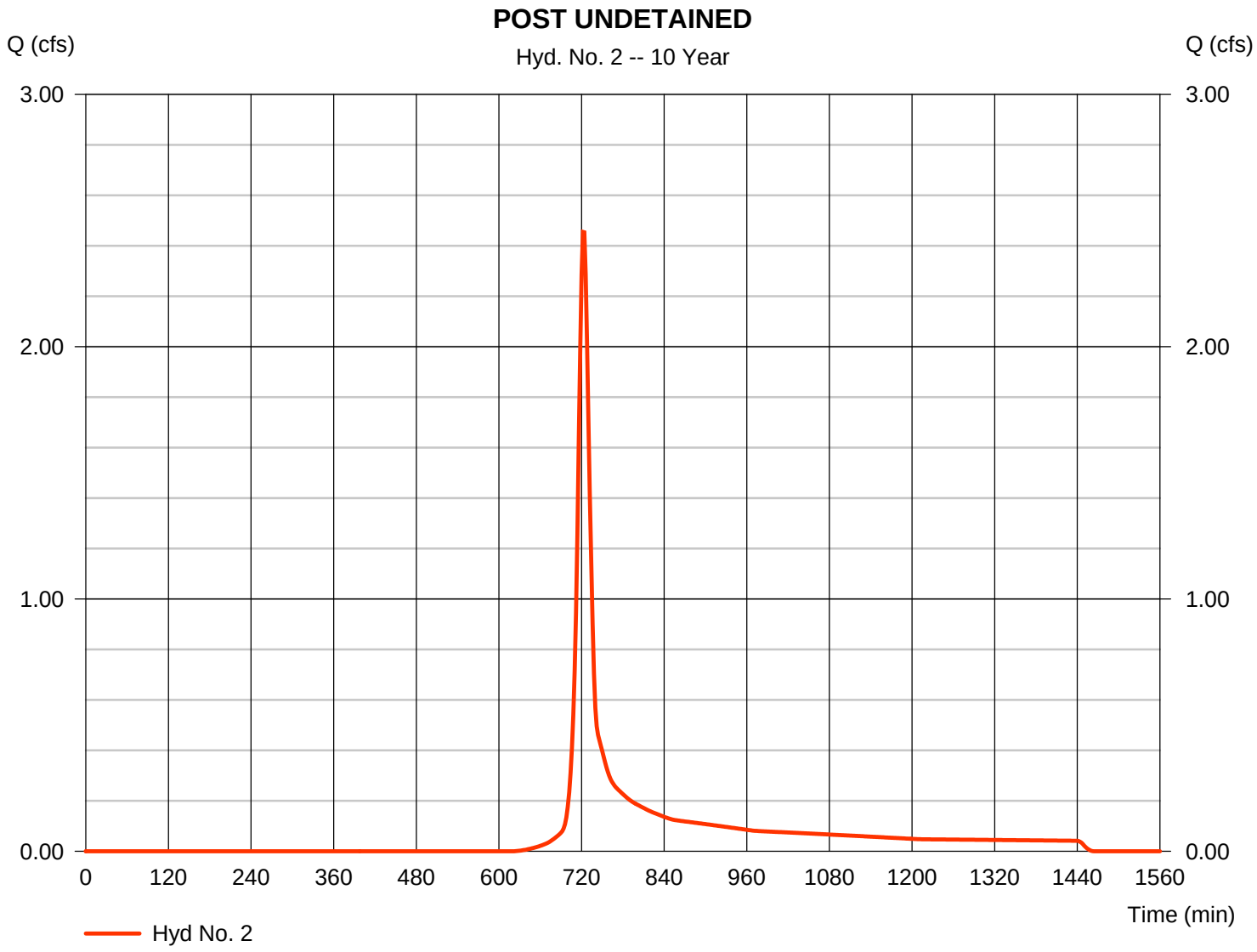
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.455 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	7,075 cuft
Drainage area	=	1.400 ac	Curve number	=	73*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.60 min
Total precip.	=	3.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = + (0.060 x 58) + (0.540 x 78) + (0.550 x 77) + (0.250 x 55)] / 1.400



TR55 Tc Worksheet

Hyd. No. 2

POST UNDETAINED

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 3.46		0.00		0.00		
Travel Time (min)	**= 12.55**	**+**	**0.00**	**+**	**0.00**	**=**	**12.55**
Shallow Concentrated Flow							
Flow length (ft)	= 846.00		0.00		0.00		
Watercourse slope (%)	= 5.12		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.65		0.00		0.00		
Travel Time (min)	**= 3.86**	**+**	**0.00**	**+**	**0.00**	**=**	**3.86**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 1.35		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=7.93						
			0.00				
					0.00		
Flow length (ft)	({0})93.0		0.0		0.0		
Travel Time (min)	**= 0.20**	**+**	**0.00**	**+**	**0.00**	**=**	**0.20**

Total Travel Time, Tc ..... 16.60 min

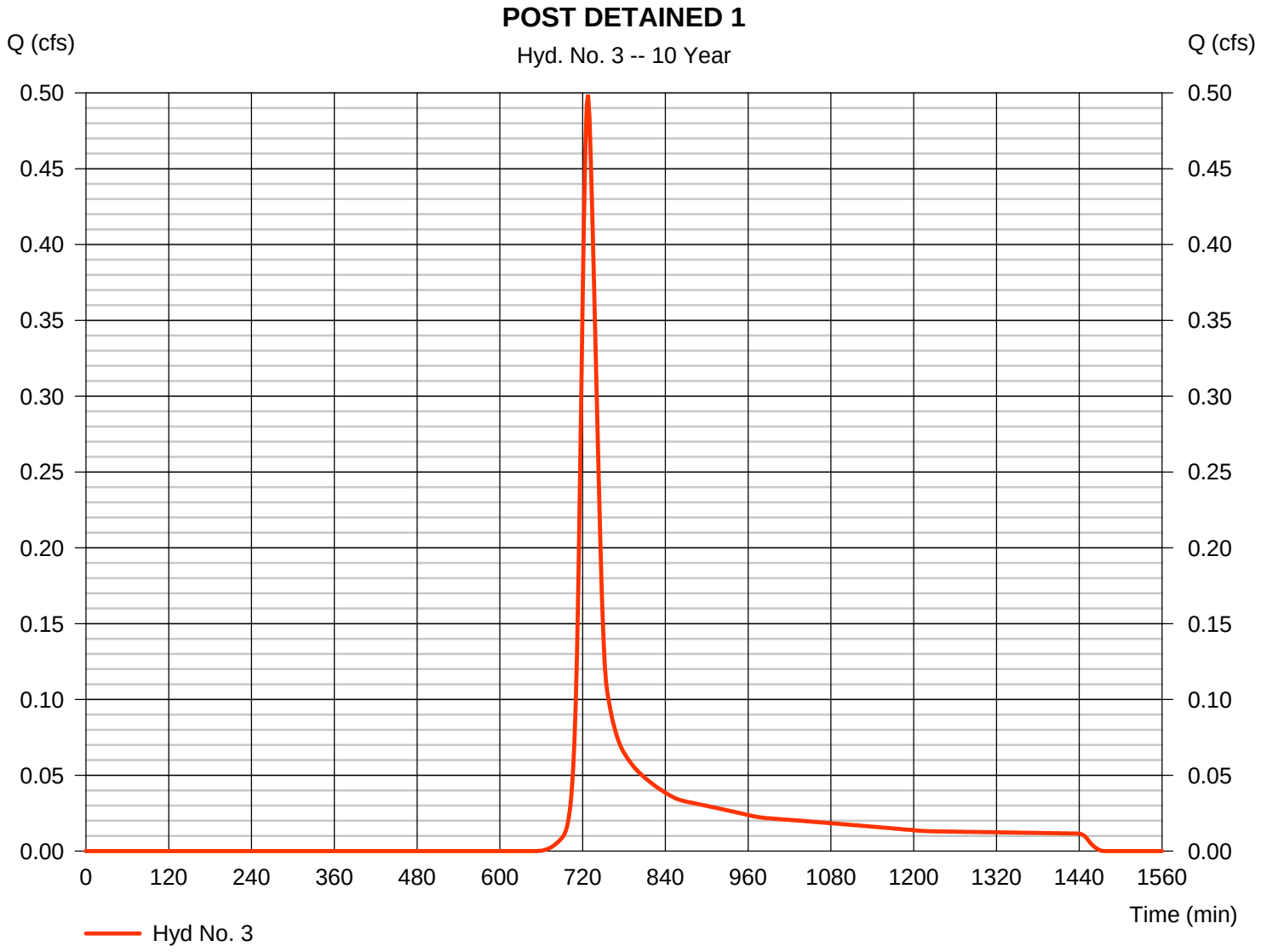
Hydrograph Report

Hyd. No. 3

POST DETAINED 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.499 cfs
Storm frequency	=	10 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	1,828 cuft
Drainage area	=	0.400 ac	Curve number	=	70*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	21.90 min
Total precip.	=	3.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (0.050 x 58) + (0.150 x 78) + (0.060 x 91) + (0.130 x 55)] / 0.400



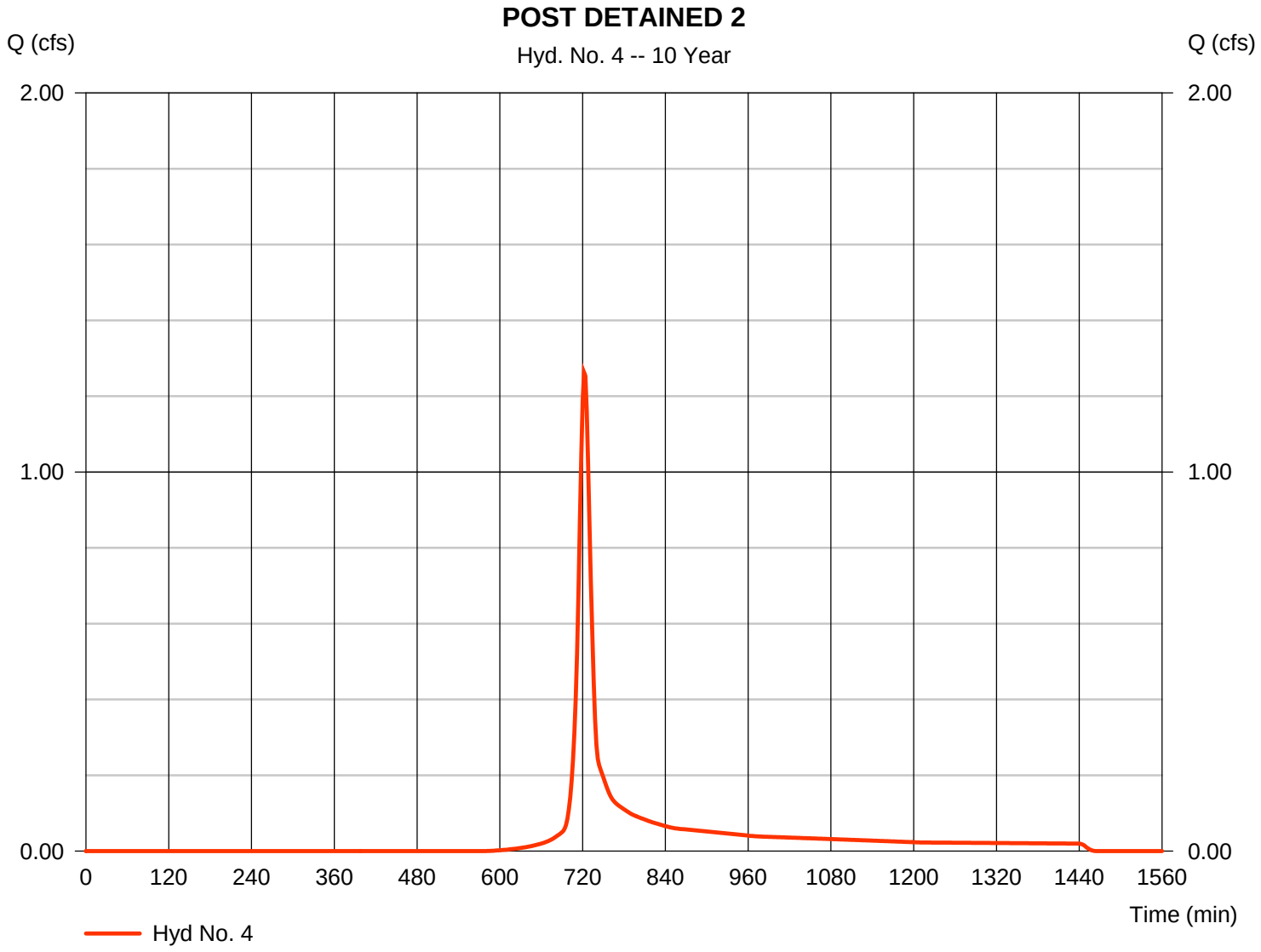
Hydrograph Report

Hyd. No. 4

POST DETAINED 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.263 cfs
Storm frequency	=	10 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	3,581 cuft
Drainage area	=	0.620 ac	Curve number	=	76*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.90 min
Total precip.	=	3.86 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (0.030 x 58) + (0.270 x 78) + (0.170 x 91) + (0.130 x 55) + (0.010 x 77)] / 0.620

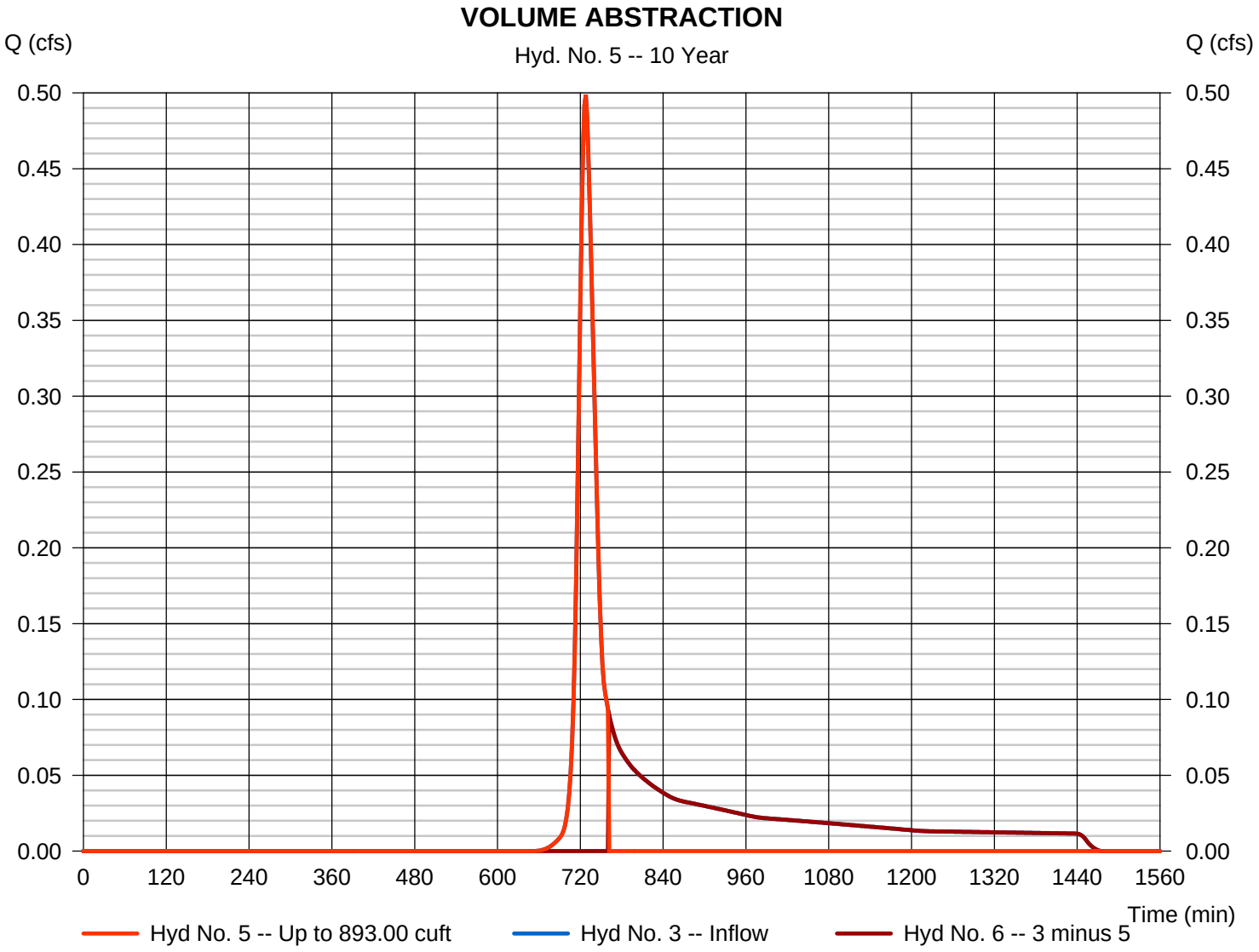


Hydrograph Report

Hyd. No. 5

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.499 cfs
Storm frequency	= 10 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 894 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 6
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

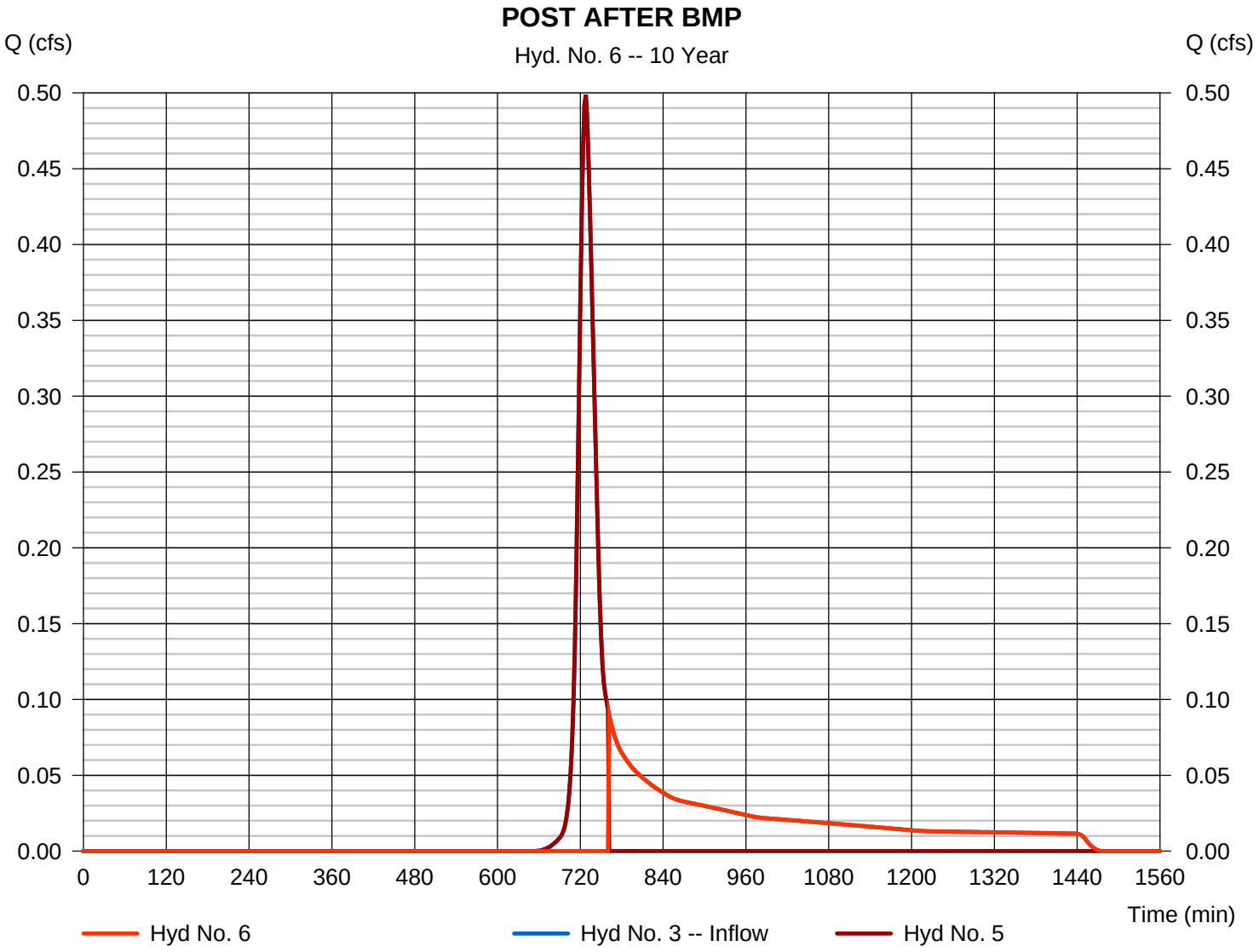


Hydrograph Report

Hyd. No. 6

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.089 cfs
Storm frequency	= 10 yrs	Time to peak	= 762 min
Time interval	= 2 min	Hyd. volume	= 935 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

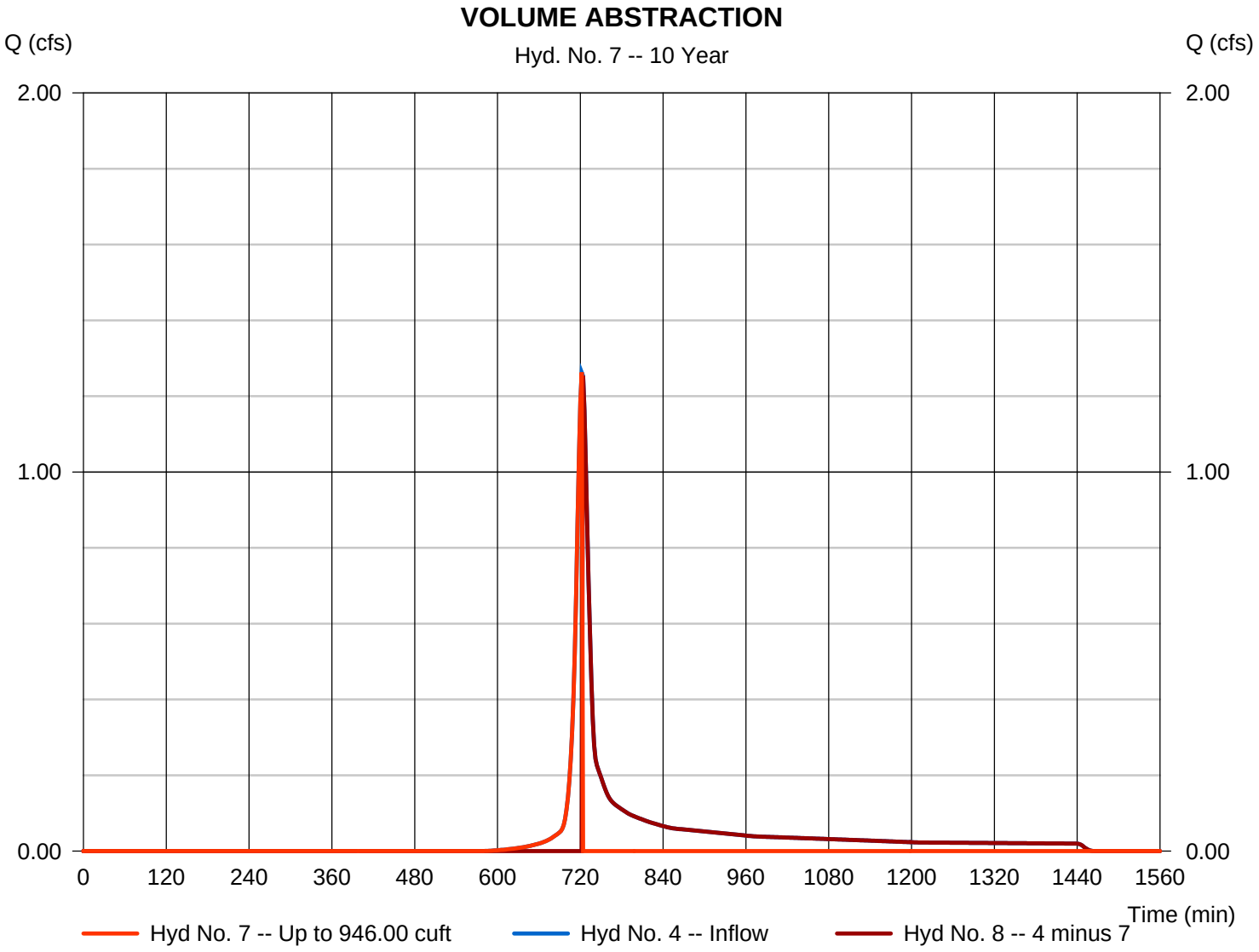


Hydrograph Report

Hyd. No. 7

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.263 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 959 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 8
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

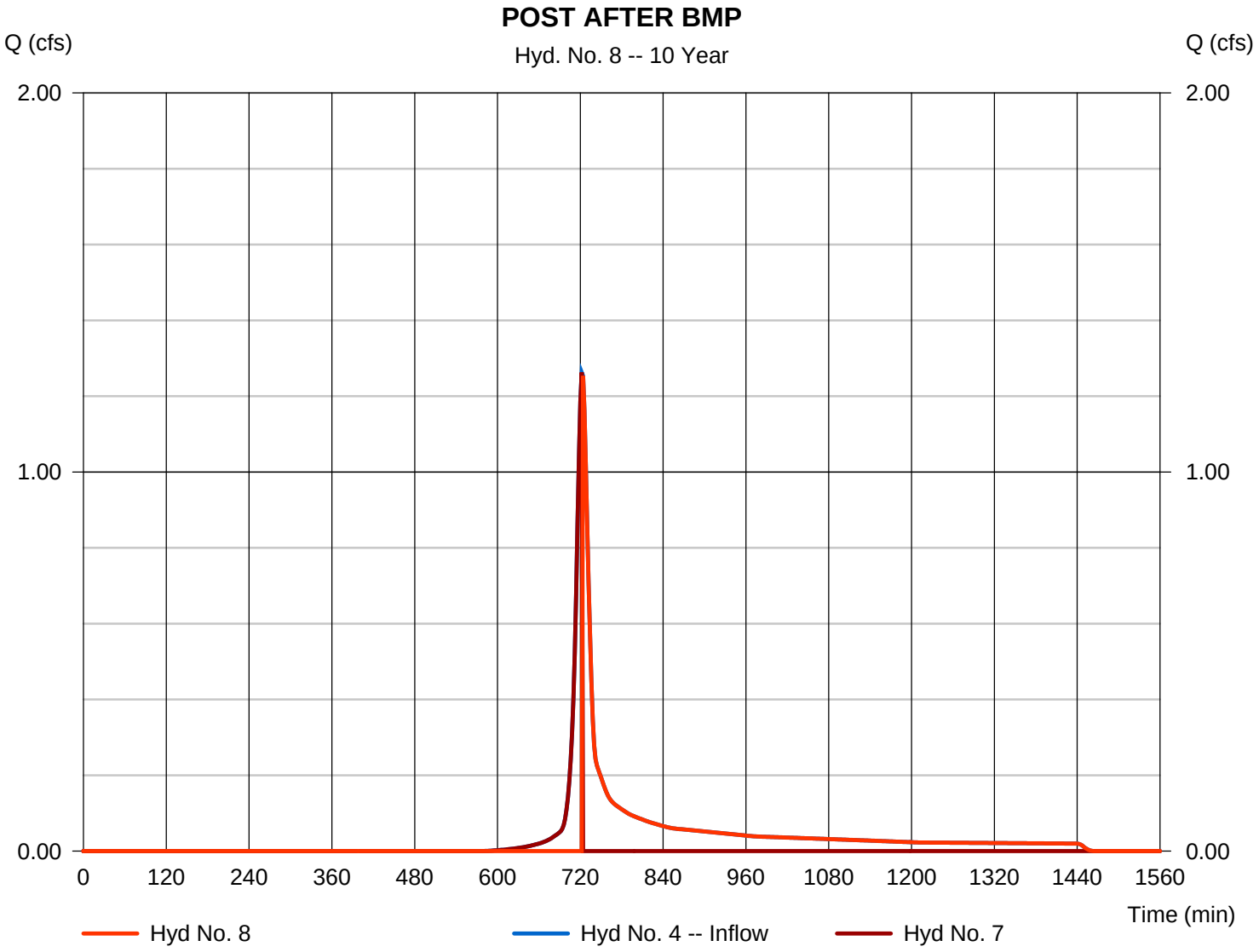


Hydrograph Report

Hyd. No. 8

POST AFTER BMP

Hydrograph type	=	Diversion2	Peak discharge	=	1.253 cfs
Storm frequency	=	10 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	2,622 cuft
Inflow hydrograph	=	4 - POST DETAINED 2	2nd diverted hyd.	=	7
Diversion method	=	First Flush Volume	Volume Up To	=	946.00 cuft

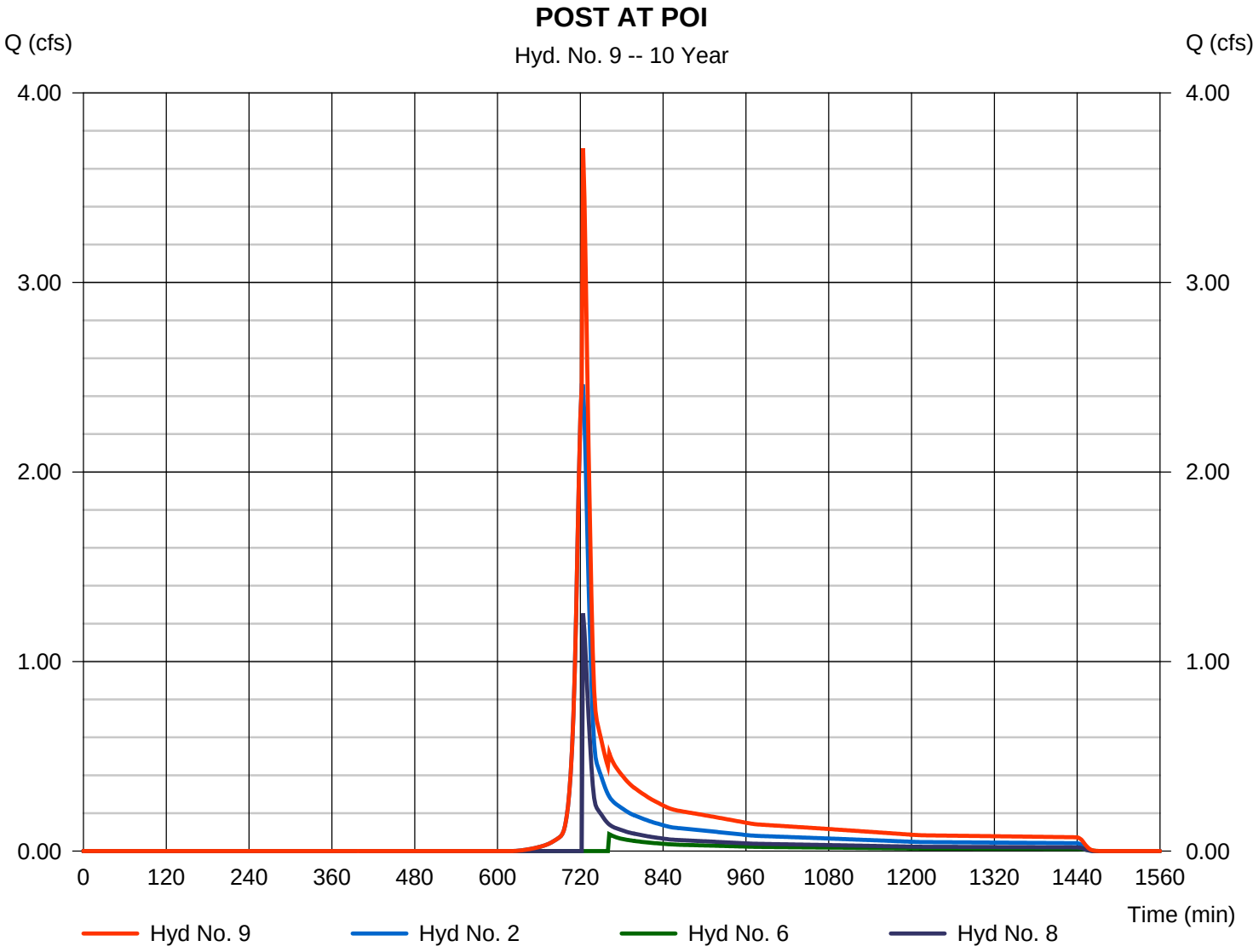


Hydrograph Report

Hyd. No. 9

POST AT POI

Hydrograph type	=	Combine	Peak discharge	=	3.707 cfs
Storm frequency	=	10 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	10,631 cuft
Inflow hyds.	=	2, 6, 8	Contrib. drain. area	=	1.400 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	40.9797	10.0000	0.8819	--------
2	47.5266	10.0000	0.8699	--------
3	0.0000	0.0000	0.0000	--------
5	52.3308	9.8000	0.8367	--------
10	51.4601	9.0000	0.7986	--------
25	47.3122	7.6000	0.7392	--------
50	45.3993	6.7000	0.7020	--------
100	40.9920	5.4000	0.6524	--------

File name: Raystown IDF.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	3.76	2.92	2.40	2.04	1.78	1.58	1.43	1.30	1.20	1.11	1.03	0.97
2	4.51	3.51	2.89	2.47	2.16	1.92	1.73	1.58	1.46	1.35	1.26	1.18
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	5.49	4.30	3.57	3.06	2.69	2.40	2.17	1.99	1.84	1.71	1.60	1.50
10	6.25	4.90	4.07	3.50	3.08	2.76	2.51	2.30	2.13	1.98	1.86	1.75
25	7.27	5.68	4.72	4.07	3.60	3.24	2.95	2.72	2.53	2.36	2.22	2.10
50	8.08	6.29	5.23	4.53	4.01	3.62	3.31	3.06	2.85	2.67	2.51	2.38
100	8.89	6.89	5.73	4.97	4.42	4.00	3.67	3.40	3.18	2.99	2.82	2.68

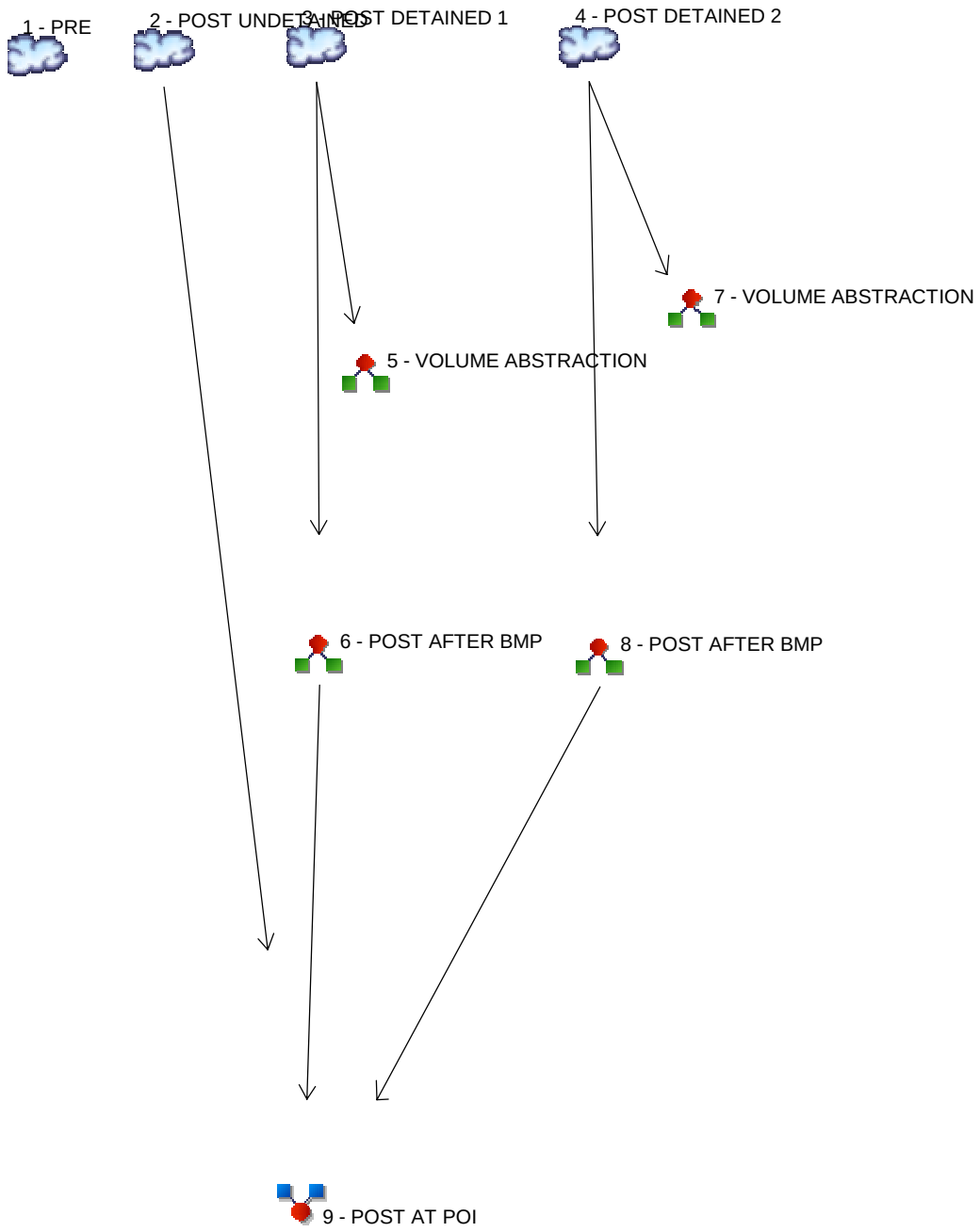
Tc = time in minutes. Values may exceed 60.

GP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Raystown Rd (SR26)\Hydraflow Rev 1\Raystown Precip.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	2.23	2.67	0.00	3.32	3.86	4.64	5.30	5.99
SCS 6-Hr	1.50	1.81	0.00	2.25	2.62	3.16	3.60	4.07
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE
2	SCS Runoff	POST UNDETAINED
3	SCS Runoff	POST DETAINED 1
4	SCS Runoff	POST DETAINED 2
5	Diversion1	VOLUME ABSTRACTION
6	Diversion2	POST AFTER BMP
7	Diversion1	VOLUME ABSTRACTION
8	Diversion2	POST AFTER BMP
9	Combine	POST AT POI

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	SCS Runoff	------	-------	-------	-------	-------	-------	-------	8.458	-------	PRE
2	SCS Runoff	------	-------	-------	-------	-------	-------	-------	4.436	-------	POST UNDETAINED
3	SCS Runoff	------	-------	-------	-------	-------	-------	-------	1.130	-------	POST DETAINED 1
4	SCS Runoff	------	-------	-------	-------	-------	-------	-------	2.493	-------	POST DETAINED 2
5	Diversion1	3	-------	-------	-------	-------	-------	-------	1.130	-------	VOLUME ABSTRACTION
6	Diversion2	3	-------	-------	-------	-------	-------	-------	1.039	-------	POST AFTER BMP
7	Diversion1	4	-------	-------	-------	-------	-------	-------	1.257	-------	VOLUME ABSTRACTION
8	Diversion2	4	-------	-------	-------	-------	-------	-------	2.493	-------	POST AFTER BMP
9	Combine	2, 6, 8	-------	-------	-------	-------	-------	-------	6.982	-------	POST AT POI

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	SCS Runoff	8.458	2	720	22,026	------	------	------	PRE
2	SCS Runoff	4.436	2	722	12,477	------	------	------	POST UNDETAINED
3	SCS Runoff	1.130	2	722	3,201	------	------	------	POST DETAINED 1
4	SCS Runoff	2.493	2	720	6,463	------	------	------	POST DETAINED 2
5	Diversion1	1.130	2	722	998	3	------	------	VOLUME ABSTRACTION
6	Diversion2	1.039	2	726	2,203	3	------	------	POST AFTER BMP
7	Diversion1	1.257	2	712	1,032	4	------	------	VOLUME ABSTRACTION
8	Diversion2	2.493	2	720	5,432	4	------	------	POST AFTER BMP
9	Combine	6.982	2	726	20,111	2, 6, 8	------	------	POST AT POI

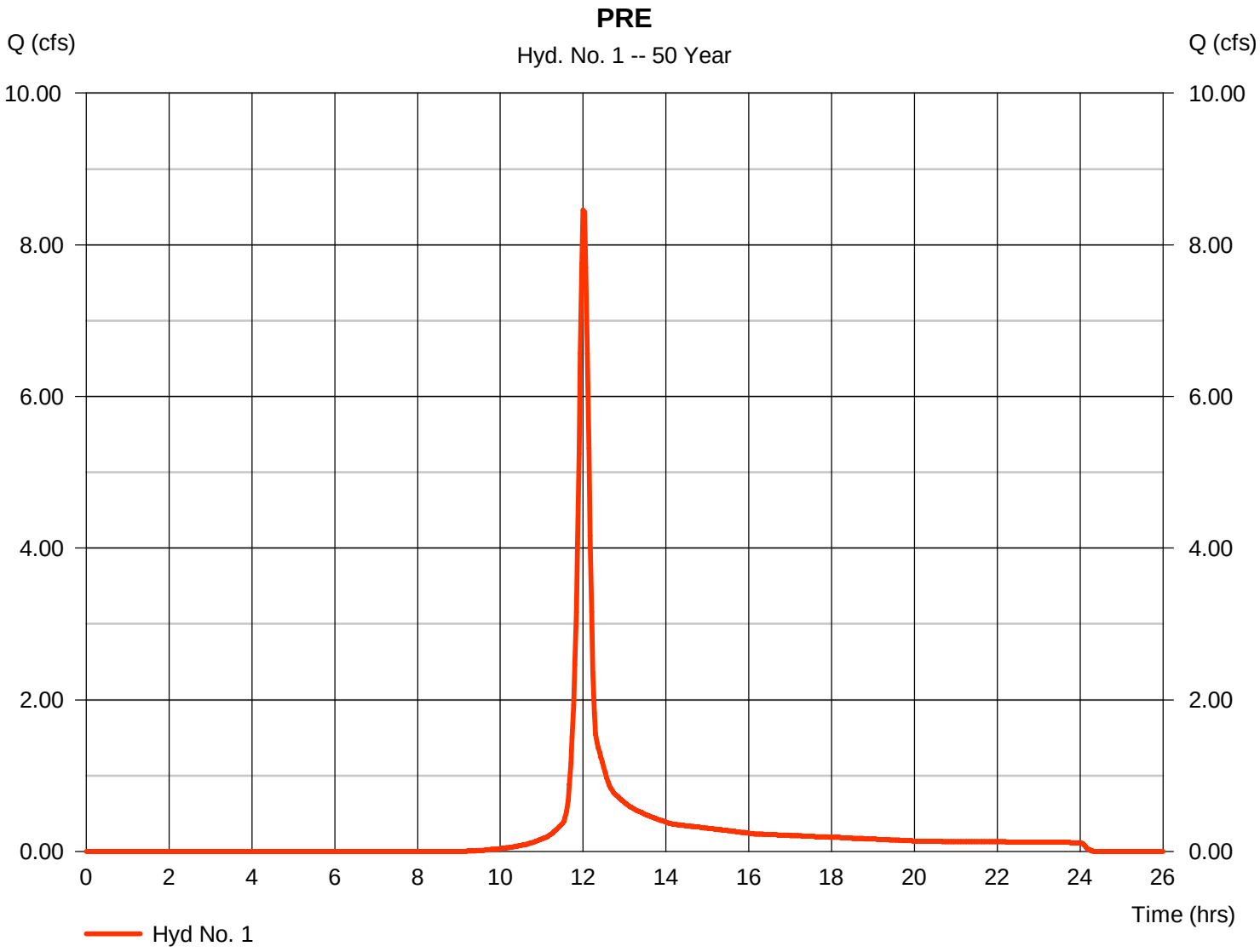
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.458 cfs
Storm frequency	=	50 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	22,026 cuft
Drainage area	=	2.420 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.040 x 98) + (0.130 x 58) + (0.840 x 78) + (0.850 x 77) + (0.560 x 55)] / 2.420



TR55 Tc Worksheet

Hyd. No. 1

PRE

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 3.46		0.00		0.00		
Travel Time (min)	**= 7.21**	**+**	**0.00**	**+**	**0.00**	**=**	**7.21**
Shallow Concentrated Flow							
Flow length (ft)	= 896.00		0.00		0.00		
Watercourse slope (%)	= 5.12		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.65		0.00		0.00		
Travel Time (min)	**= 4.09**	**+**	**0.00**	**+**	**0.00**	**=**	**4.09**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 1.35		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=7.93						
			0.00				
					0.00		
Flow length (ft)	({0})93.0		0.0		0.0		
Travel Time (min)	**= 0.20**	**+**	**0.00**	**+**	**0.00**	**=**	**0.20**

Total Travel Time, Tc ..... 11.50 min

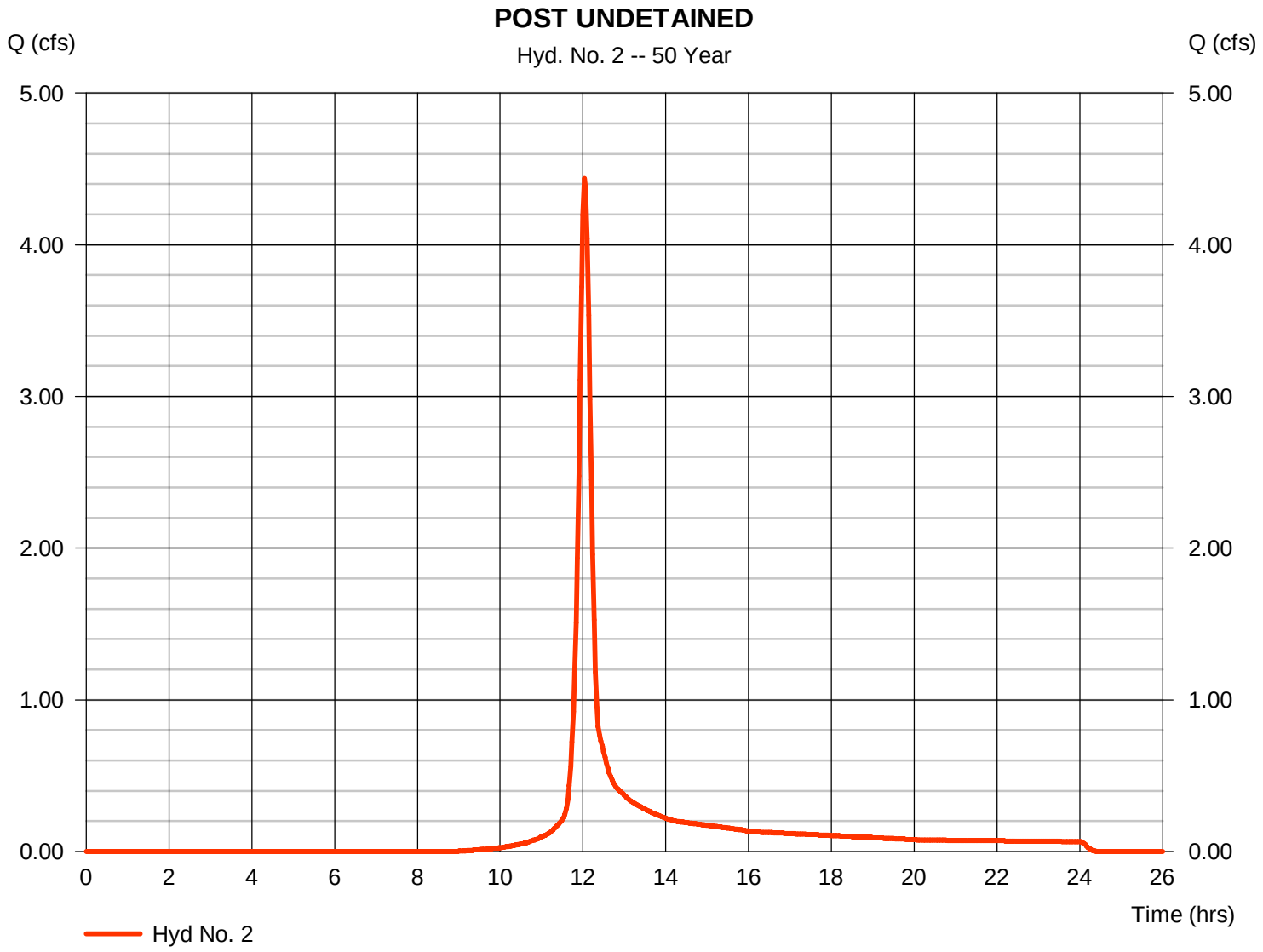
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.436 cfs
Storm frequency	=	50 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	12,477 cuft
Drainage area	=	1.400 ac	Curve number	=	73*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.60 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = + (0.060 x 58) + (0.540 x 78) + (0.550 x 77) + (0.250 x 55)] / 1.400



TR55 Tc Worksheet

Hyd. No. 2

POST UNDETAINED

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 3.46		0.00		0.00		
Travel Time (min)	**= 12.55**	**+**	**0.00**	**+**	**0.00**	**=**	**12.55**
Shallow Concentrated Flow							
Flow length (ft)	= 846.00		0.00		0.00		
Watercourse slope (%)	= 5.12		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.65		0.00		0.00		
Travel Time (min)	**= 3.86**	**+**	**0.00**	**+**	**0.00**	**=**	**3.86**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 1.35		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=7.93						
			0.00				
					0.00		
Flow length (ft)	({0})93.0		0.0		0.0		
Travel Time (min)	**= 0.20**	**+**	**0.00**	**+**	**0.00**	**=**	**0.20**

Total Travel Time, Tc ..... 16.60 min

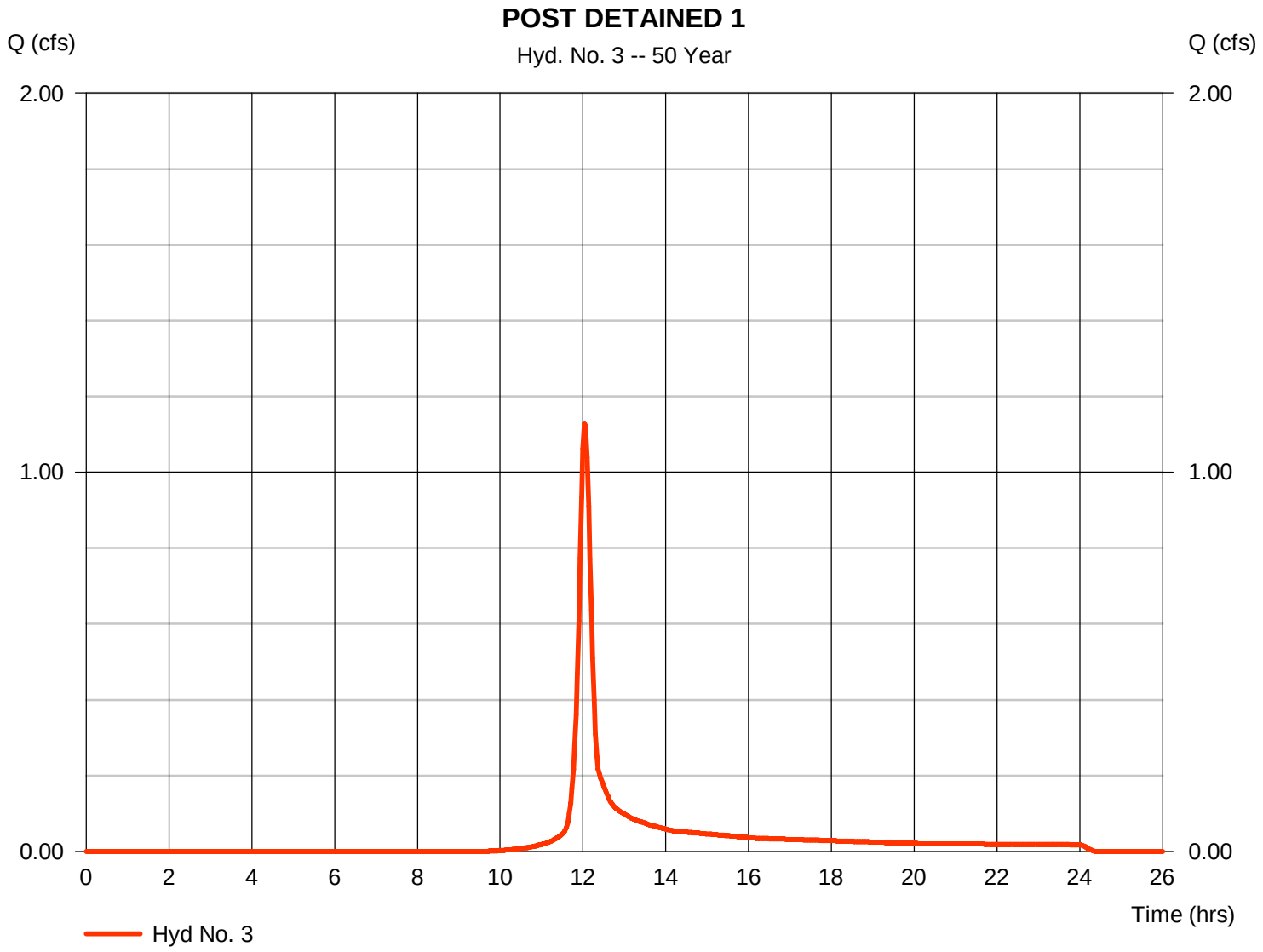
Hydrograph Report

Hyd. No. 3

POST DETAINED 1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.130 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 3,201 cuft
Drainage area	= 0.400 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 13.90 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.010 x 85) + (0.050 x 58) + (0.150 x 78) + (0.060 x 91) + (0.130 x 55)] / 0.400



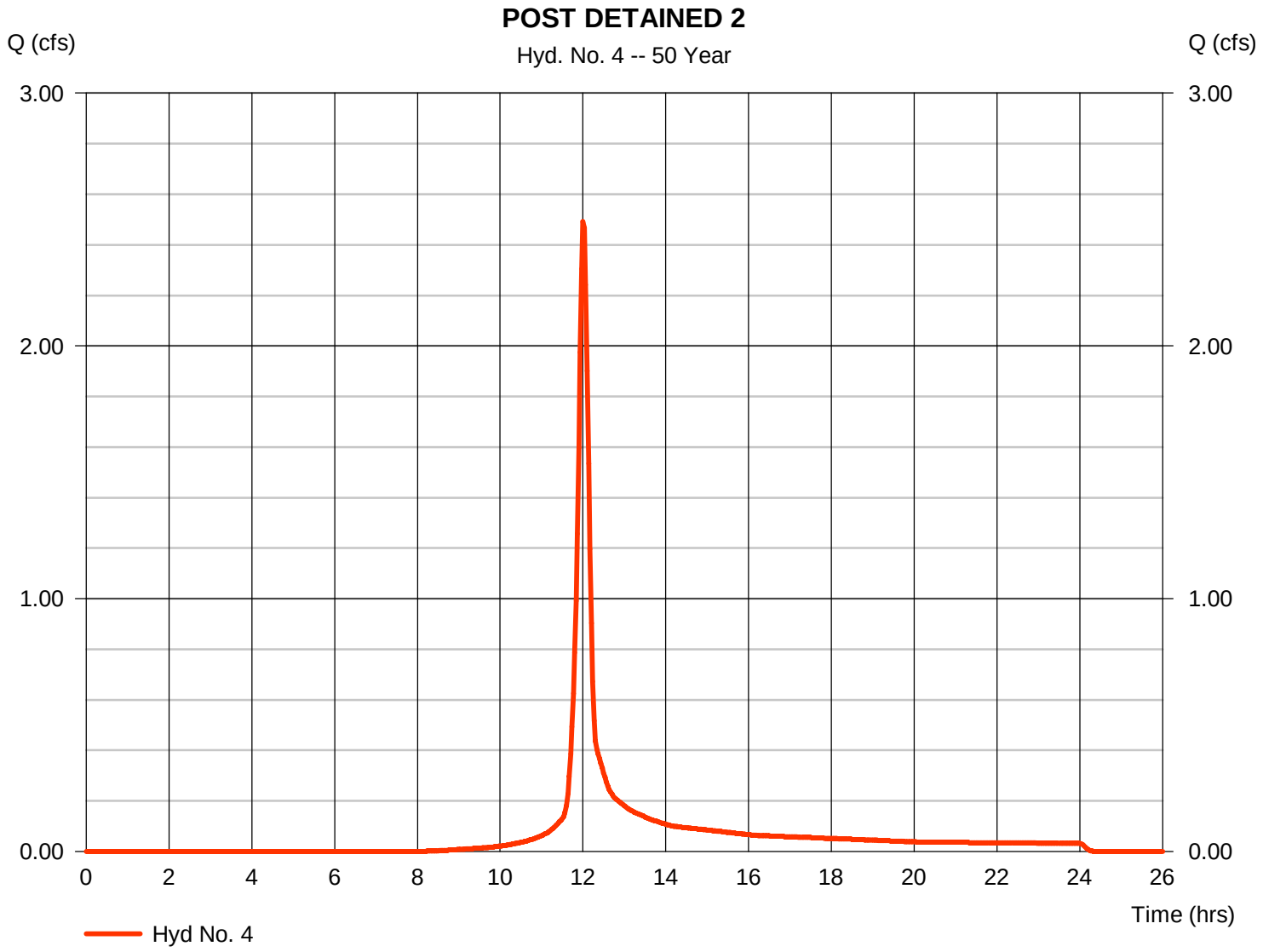
Hydrograph Report

Hyd. No. 4

POST DETAINED 2

Hydrograph type	= SCS Runoff	Peak discharge	= 2.493 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 6,463 cuft
Drainage area	= 0.620 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.13 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.010 x 85) + (0.030 x 58) + (0.270 x 78) + (0.170 x 91) + (0.130 x 55) + (0.010 x 77)] / 0.620

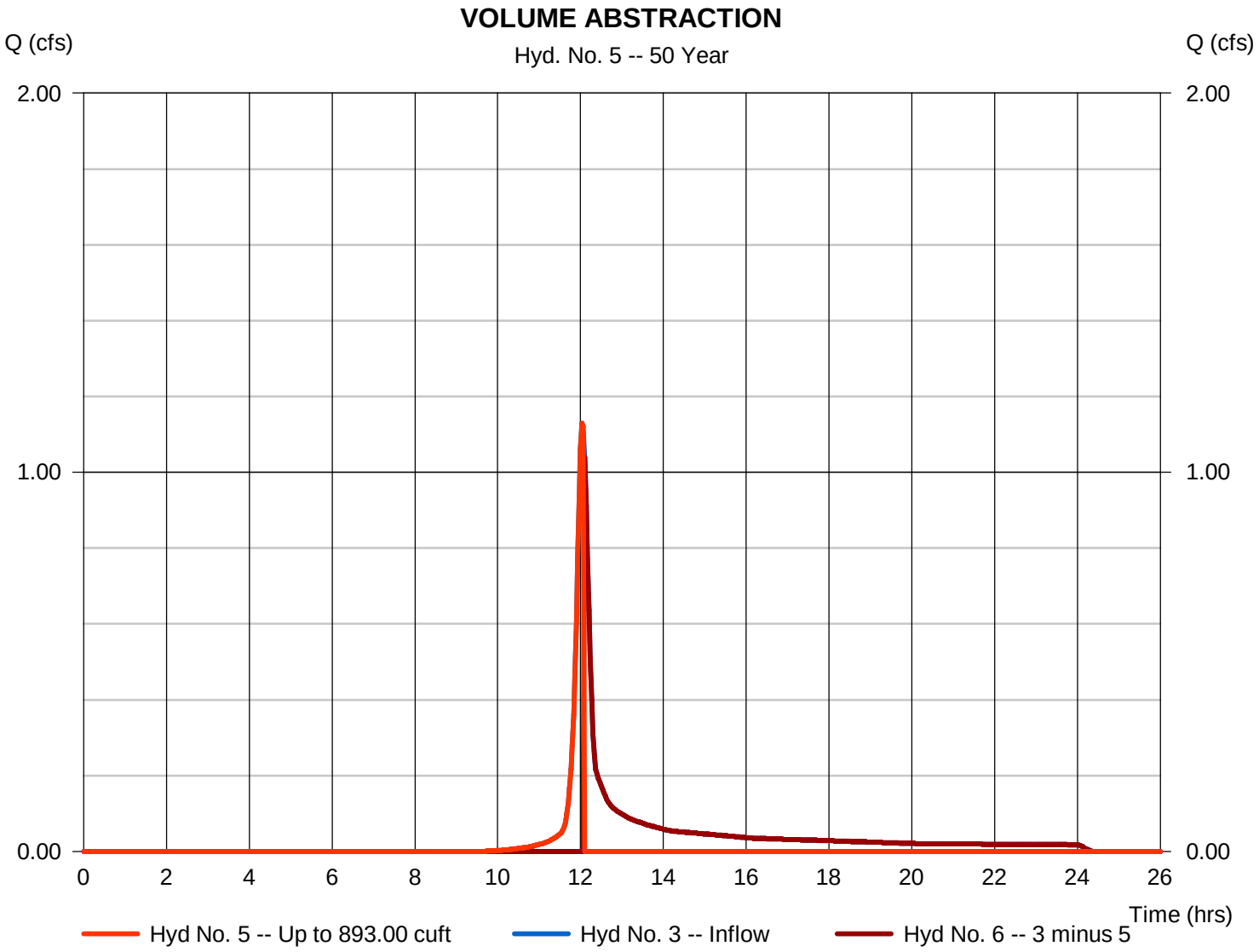


Hydrograph Report

Hyd. No. 5

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.130 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 998 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 6
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

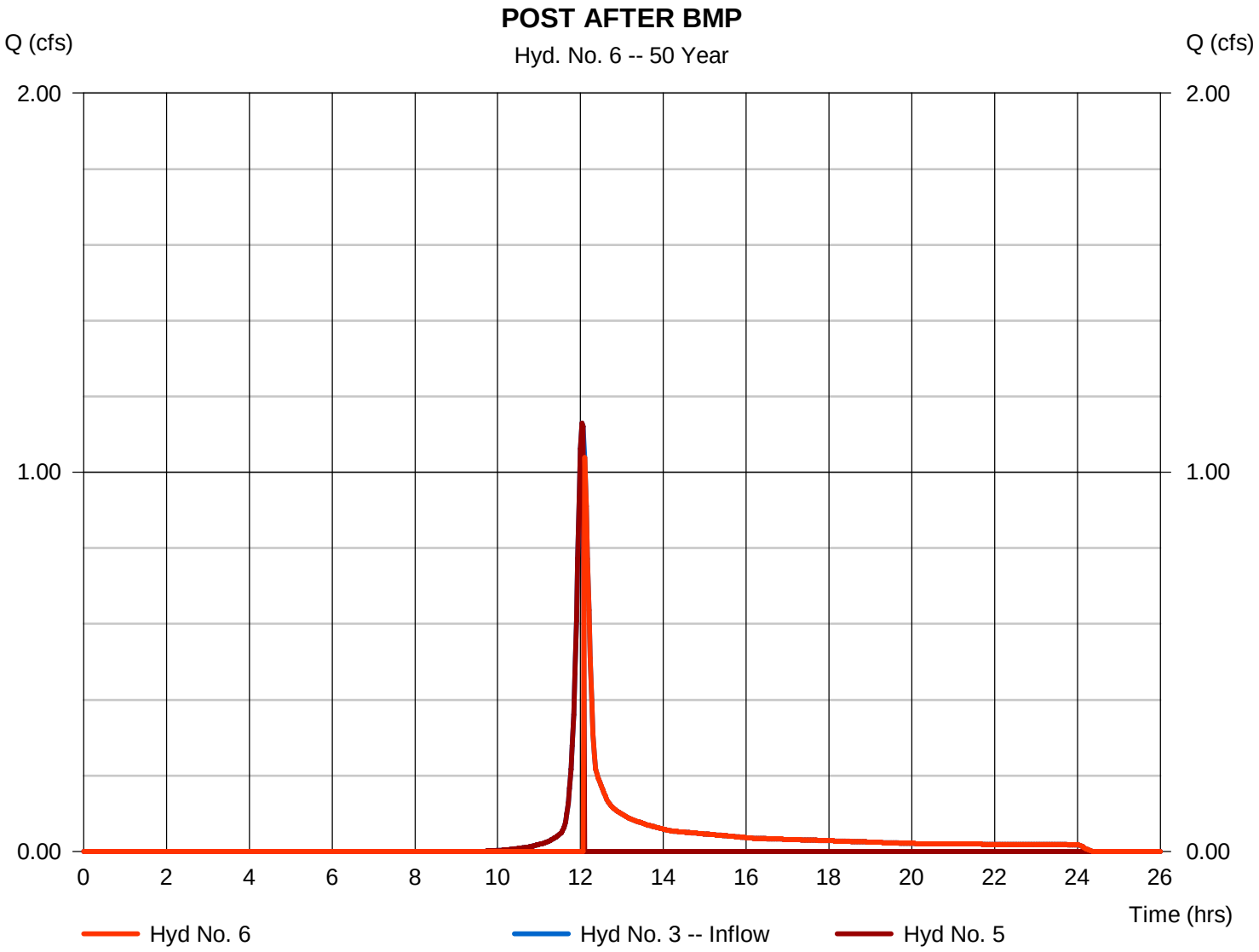


Hydrograph Report

Hyd. No. 6

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 1.039 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 2,203 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

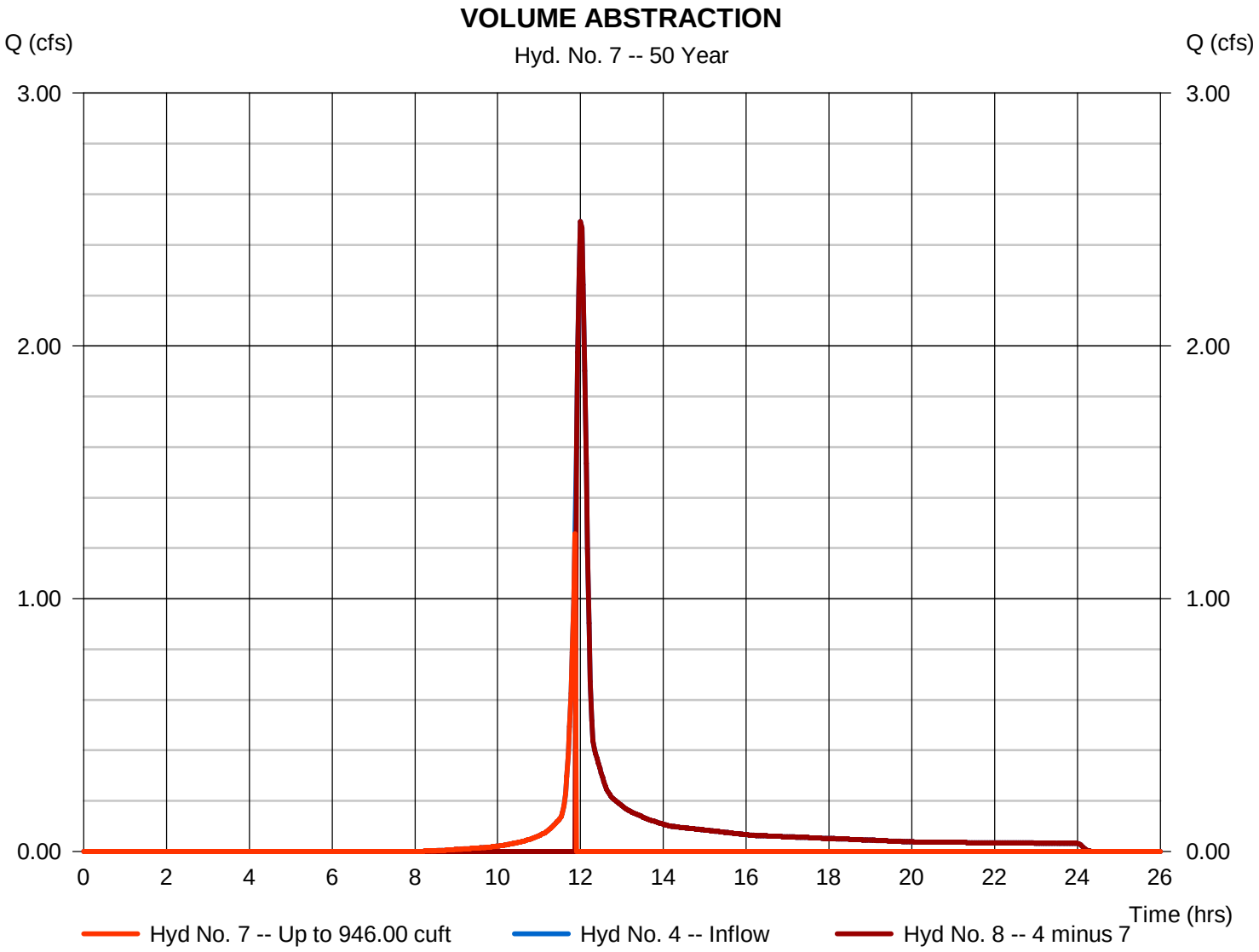


Hydrograph Report

Hyd. No. 7

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.257 cfs
Storm frequency	= 50 yrs	Time to peak	= 11.87 hrs
Time interval	= 2 min	Hyd. volume	= 1,032 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 8
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

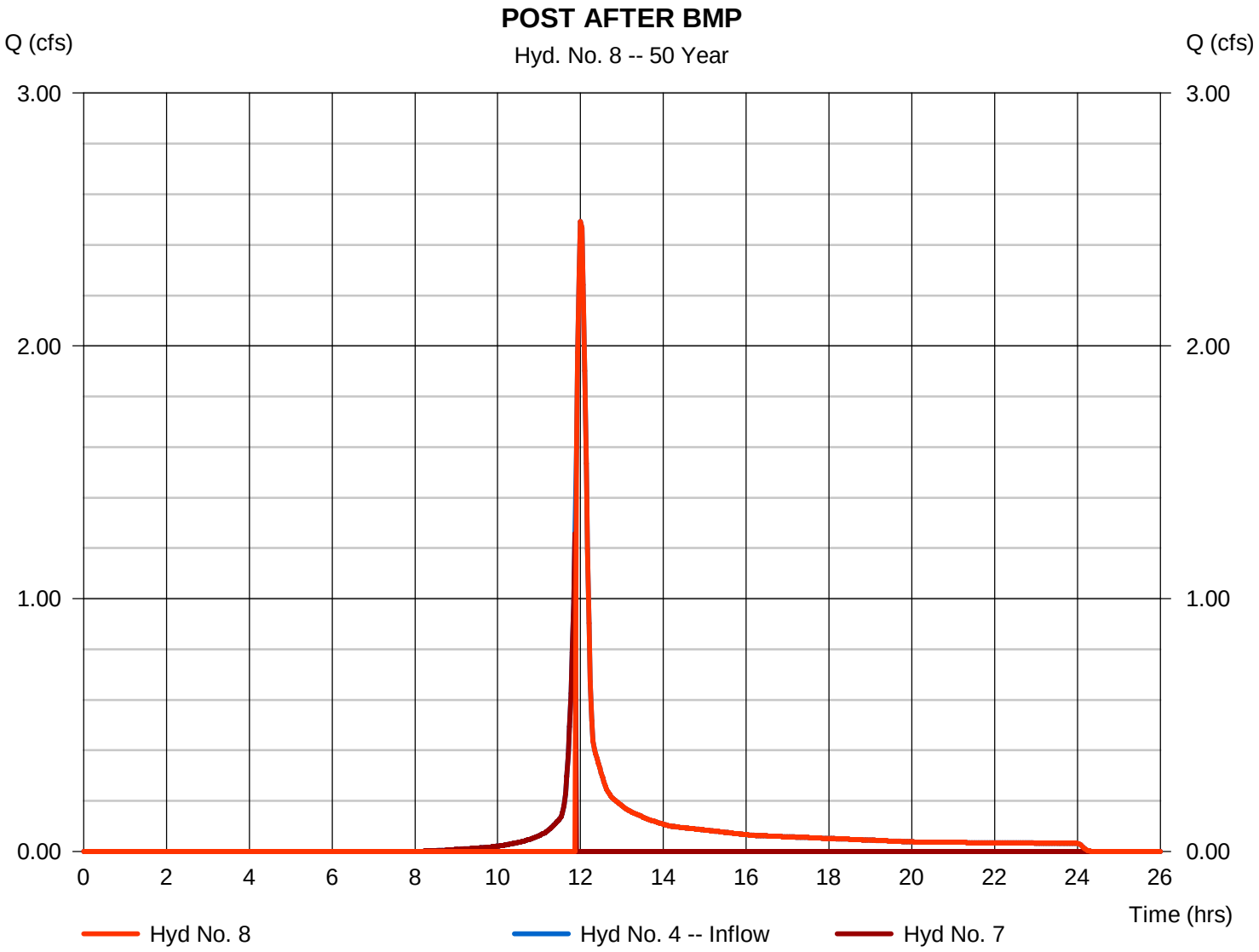


Hydrograph Report

Hyd. No. 8

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 2.493 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 5,432 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 7
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

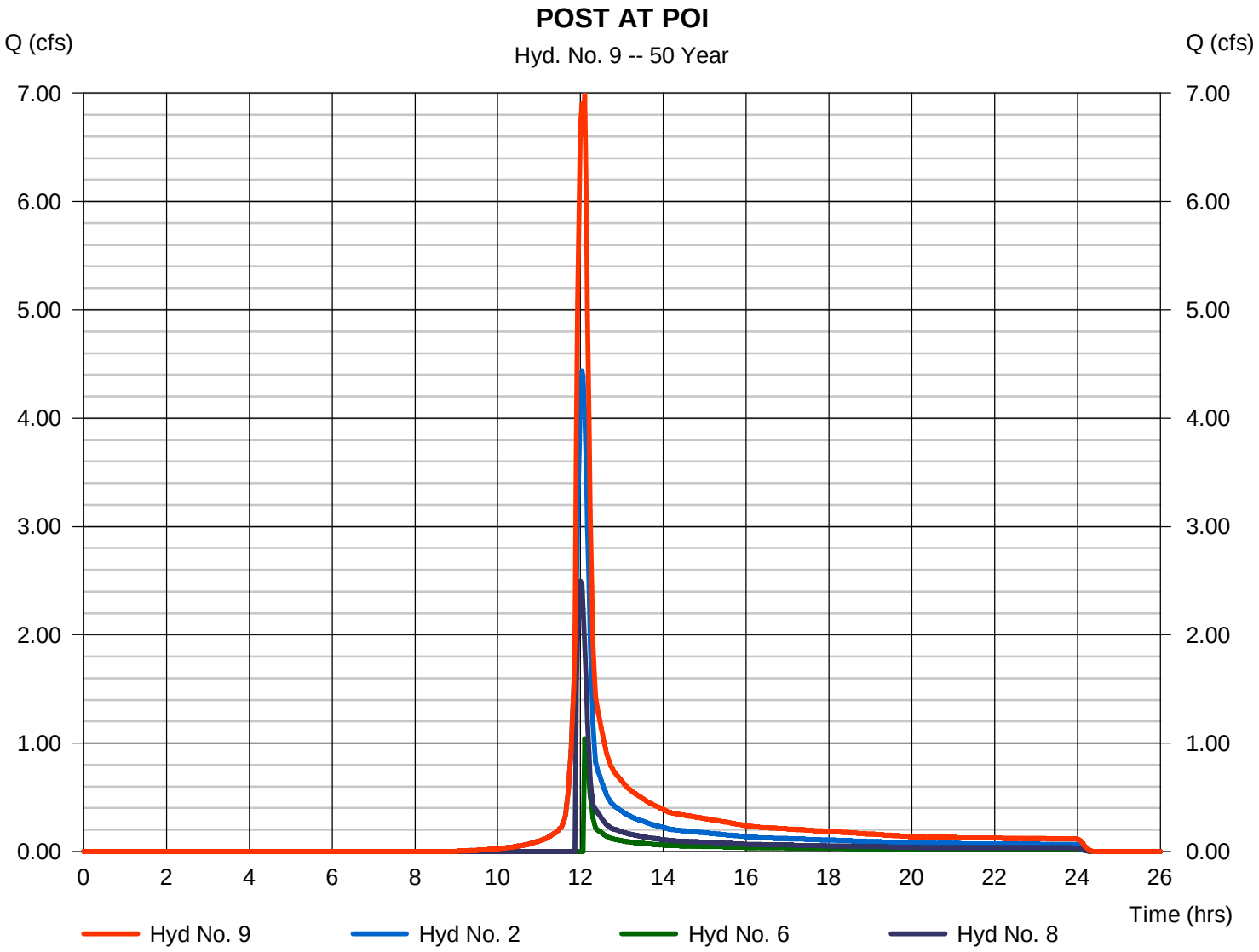


Hydrograph Report

Hyd. No. 9

POST AT POI

Hydrograph type	=	Combine	Peak discharge	=	6.982 cfs
Storm frequency	=	50 yrs	Time to peak	=	12.10 hrs
Time interval	=	2 min	Hyd. volume	=	20,111 cuft
Inflow hyds.	=	2, 6, 8	Contrib. drain. area	=	1.400 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	40.9797	10.0000	0.8819	--------
2	47.5266	10.0000	0.8699	--------
3	0.0000	0.0000	0.0000	--------
5	52.3308	9.8000	0.8367	--------
10	51.4601	9.0000	0.7986	--------
25	47.3122	7.6000	0.7392	--------
50	45.3993	6.7000	0.7020	--------
100	40.9920	5.4000	0.6524	--------

File name: Raystown IDF.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	3.76	2.92	2.40	2.04	1.78	1.58	1.43	1.30	1.20	1.11	1.03	0.97
2	4.51	3.51	2.89	2.47	2.16	1.92	1.73	1.58	1.46	1.35	1.26	1.18
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	5.49	4.30	3.57	3.06	2.69	2.40	2.17	1.99	1.84	1.71	1.60	1.50
10	6.25	4.90	4.07	3.50	3.08	2.76	2.51	2.30	2.13	1.98	1.86	1.75
25	7.27	5.68	4.72	4.07	3.60	3.24	2.95	2.72	2.53	2.36	2.22	2.10
50	8.08	6.29	5.23	4.53	4.01	3.62	3.31	3.06	2.85	2.67	2.51	2.38
100	8.89	6.89	5.73	4.97	4.42	4.00	3.67	3.40	3.18	2.99	2.82	2.68

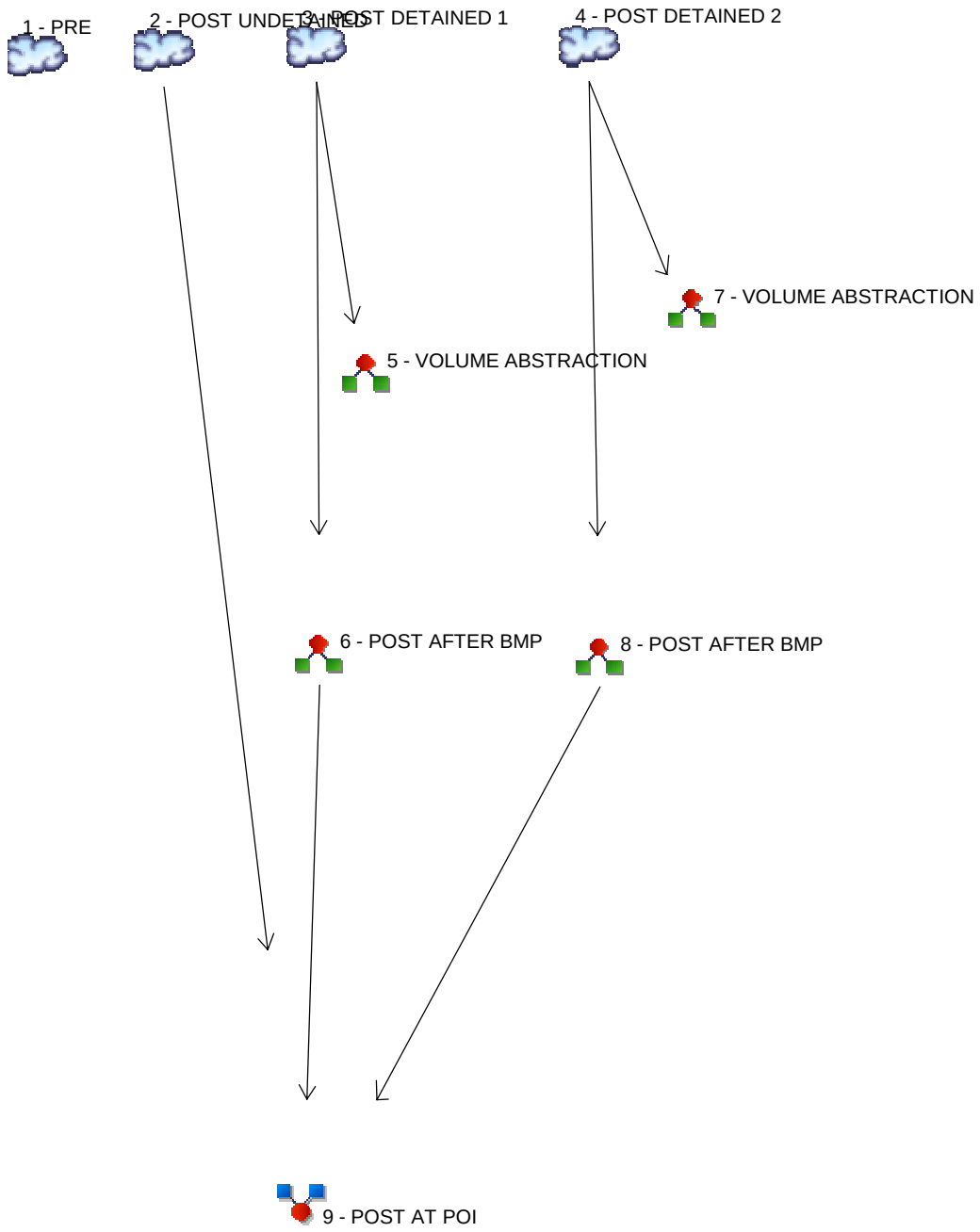
Tc = time in minutes. Values may exceed 60.

P-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Raystown Rd (SR26)\Hydraflow Rev 1\Raystown Precip.pc

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	2.23	2.67	0.00	3.32	3.86	4.64	5.30	5.99
SCS 6-Hr	1.50	1.81	0.00	2.25	2.62	3.16	3.60	4.07
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	0.00	0.00	0.00	0.00	0.00

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE
2	SCS Runoff	POST UNDETAINED
3	SCS Runoff	POST DETAINED 1
4	SCS Runoff	POST DETAINED 2
5	Diversion1	VOLUME ABSTRACTION
6	Diversion2	POST AFTER BMP
7	Diversion1	VOLUME ABSTRACTION
8	Diversion2	POST AFTER BMP
9	Combine	POST AT POI

Hydrograph Return Period Recap

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

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	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	10.42	PRE
2	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	5.443	POST UNDETAINED
3	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	1.610	POST DETAINED 1
4	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	3.309	POST DETAINED 2
5	Diversion1	3	-------	-------	-------	-------	-------	-------	-------	1.477	VOLUME ABSTRACTION
6	Diversion2	3	-------	-------	-------	-------	-------	-------	-------	1.610	POST AFTER BMP
7	Diversion1	4	-------	-------	-------	-------	-------	-------	-------	0.986	VOLUME ABSTRACTION
8	Diversion2	4	-------	-------	-------	-------	-------	-------	-------	3.309	POST AFTER BMP
9	Combine	2, 6, 8	-------	-------	-------	-------	-------	-------	-------	10.05	POST AT POI

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	SCS Runoff	10.42	2	720	27,042	------	------	------	PRE
2	SCS Runoff	5.443	2	722	15,263	------	------	------	POST UNDETAINED
3	SCS Runoff	1.610	2	720	4,189	------	------	------	POST DETAINED 1
4	SCS Runoff	3.309	2	718	7,588	------	------	------	POST DETAINED 2
5	Diversion1	1.477	2	718	1,013	3	------	------	VOLUME ABSTRACTION
6	Diversion2	1.610	2	720	3,175	3	------	------	POST AFTER BMP
7	Diversion1	0.986	2	706	1,017	4	------	------	VOLUME ABSTRACTION
8	Diversion2	3.309	2	718	6,571	4	------	------	POST AFTER BMP
9	Combine	10.05	2	720	25,009	2, 6, 8	------	------	POST AT POI

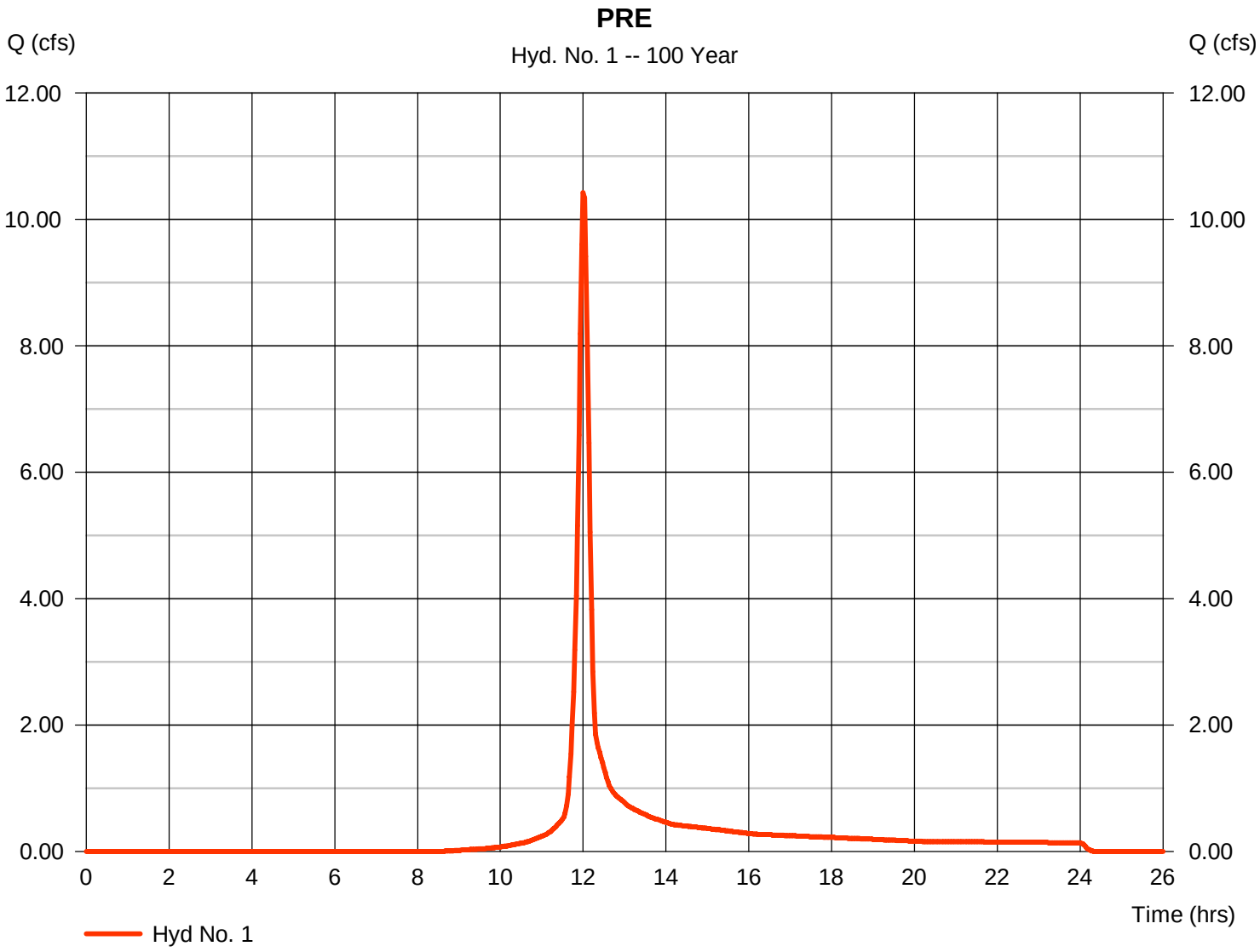
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.42 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	27,042 cuft
Drainage area	=	2.420 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	11.50 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.040 x 98) + (0.130 x 58) + (0.840 x 78) + (0.850 x 77) + (0.560 x 55)] / 2.420



TR55 Tc Worksheet

Hyd. No. 1

PRE

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 3.46		0.00		0.00		
Travel Time (min)	**= 7.21**	**+**	**0.00**	**+**	**0.00**	**=**	**7.21**
Shallow Concentrated Flow							
Flow length (ft)	= 896.00		0.00		0.00		
Watercourse slope (%)	= 5.12		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.65		0.00		0.00		
Travel Time (min)	**= 4.09**	**+**	**0.00**	**+**	**0.00**	**=**	**4.09**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 1.35		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=7.93						
			0.00				
					0.00		
Flow length (ft)	({0})93.0		0.0		0.0		
Travel Time (min)	**= 0.20**	**+**	**0.00**	**+**	**0.00**	**=**	**0.20**

Total Travel Time, Tc ..... 11.50 min

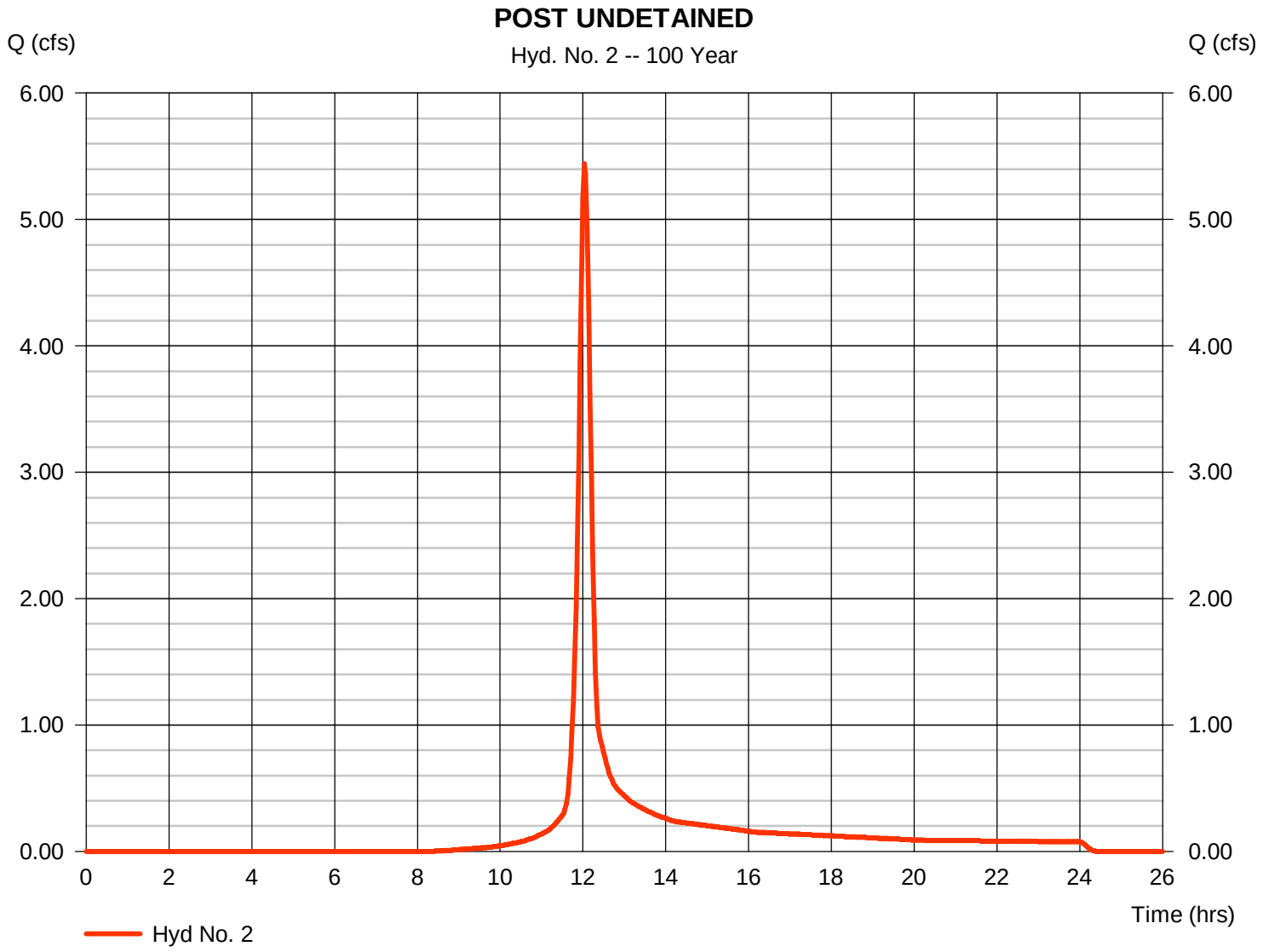
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.443 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	15,263 cuft
Drainage area	=	1.400 ac	Curve number	=	73*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.60 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = + (0.060 x 58) + (0.540 x 78) + (0.550 x 77) + (0.250 x 55)] / 1.400



TR55 Tc Worksheet

Hyd. No. 2

POST UNDETAINED

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.67		0.00		0.00		
Land slope (%)	= 3.46		0.00		0.00		
Travel Time (min)	**= 12.55**	**+**	**0.00**	**+**	**0.00**	**=**	**12.55**
Shallow Concentrated Flow							
Flow length (ft)	= 846.00		0.00		0.00		
Watercourse slope (%)	= 5.12		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.65		0.00		0.00		
Travel Time (min)	**= 3.86**	**+**	**0.00**	**+**	**0.00**	**=**	**3.86**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 1.35		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=7.93						
			0.00				
					0.00		
Flow length (ft)	({0})93.0		0.0		0.0		
Travel Time (min)	**= 0.20**	**+**	**0.00**	**+**	**0.00**	**=**	**0.20**

Total Travel Time, Tc ..... 16.60 min

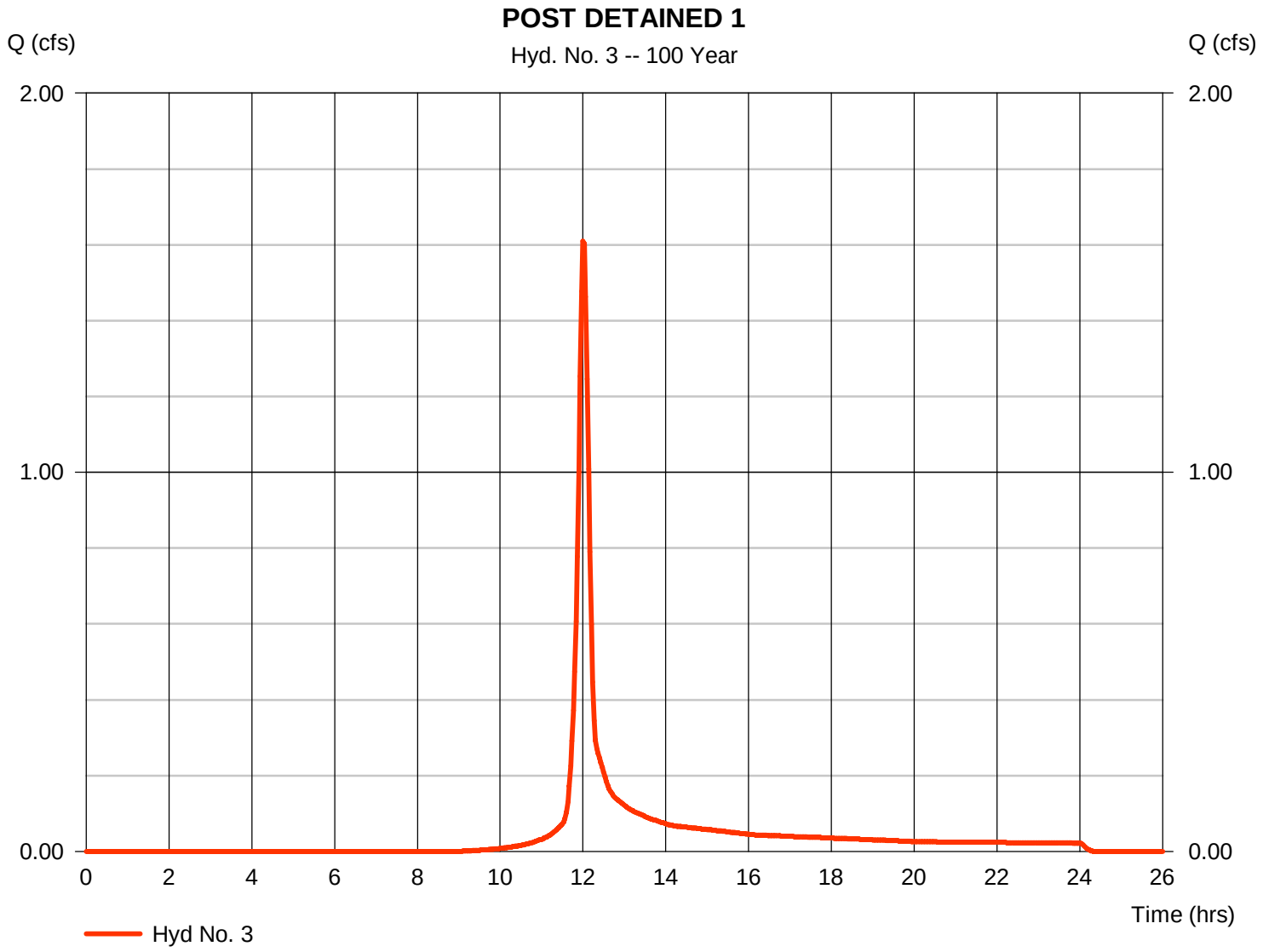
Hydrograph Report

Hyd. No. 3

POST DETAINED 1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.610 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 4,189 cuft
Drainage area	= 0.400 ac	Curve number	= 70*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 12.10 min
Total precip.	= 5.99 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.010 x 85) + (0.050 x 58) + (0.150 x 78) + (0.060 x 91) + (0.130 x 55)] / 0.400



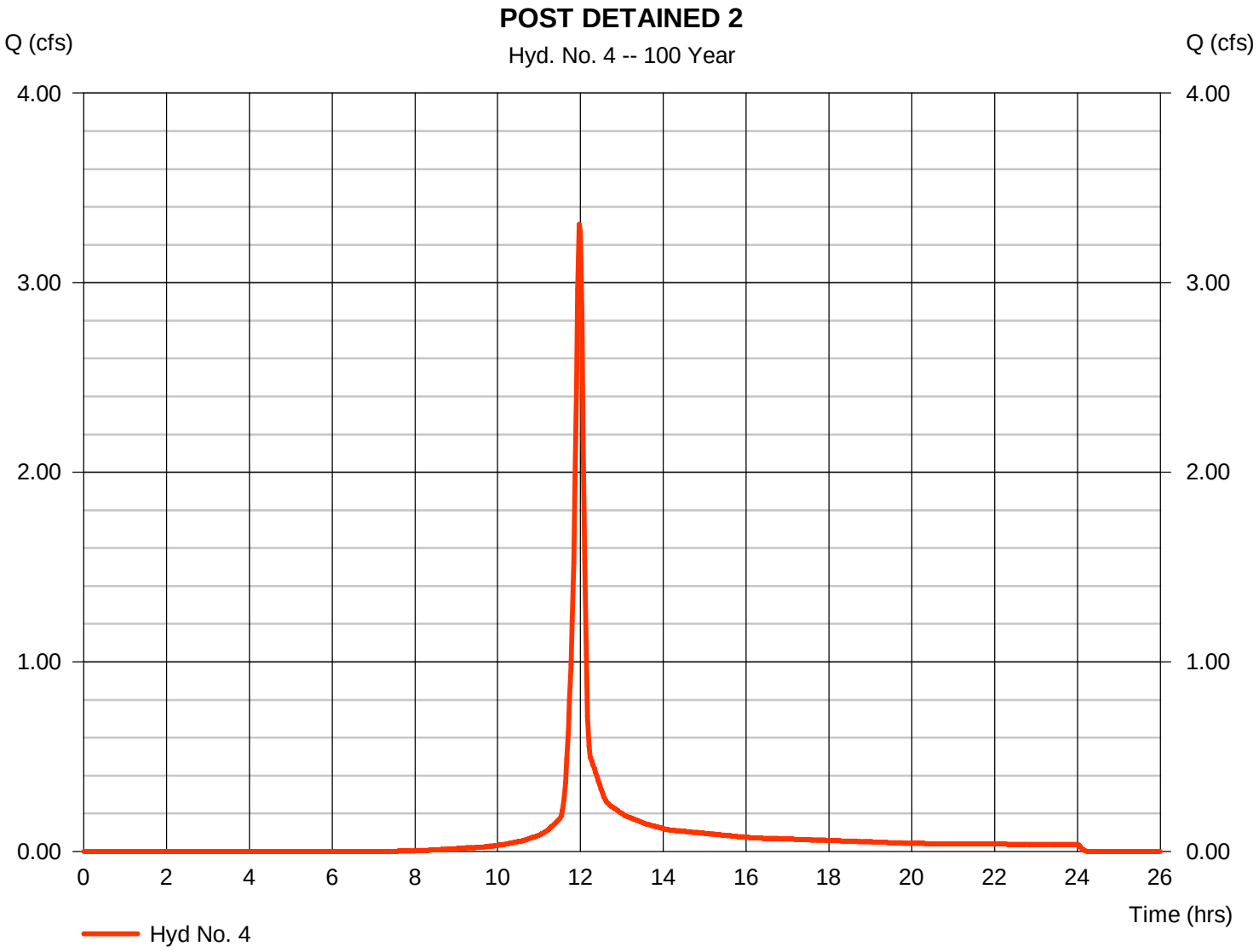
Hydrograph Report

Hyd. No. 4

POST DETAINED 2

Hydrograph type	= SCS Runoff	Peak discharge	= 3.309 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 7,588 cuft
Drainage area	= 0.620 ac	Curve number	= 76*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.20 min
Total precip.	= 5.99 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.010 x 85) + (0.030 x 58) + (0.270 x 78) + (0.170 x 91) + (0.130 x 55) + (0.010 x 77)] / 0.620

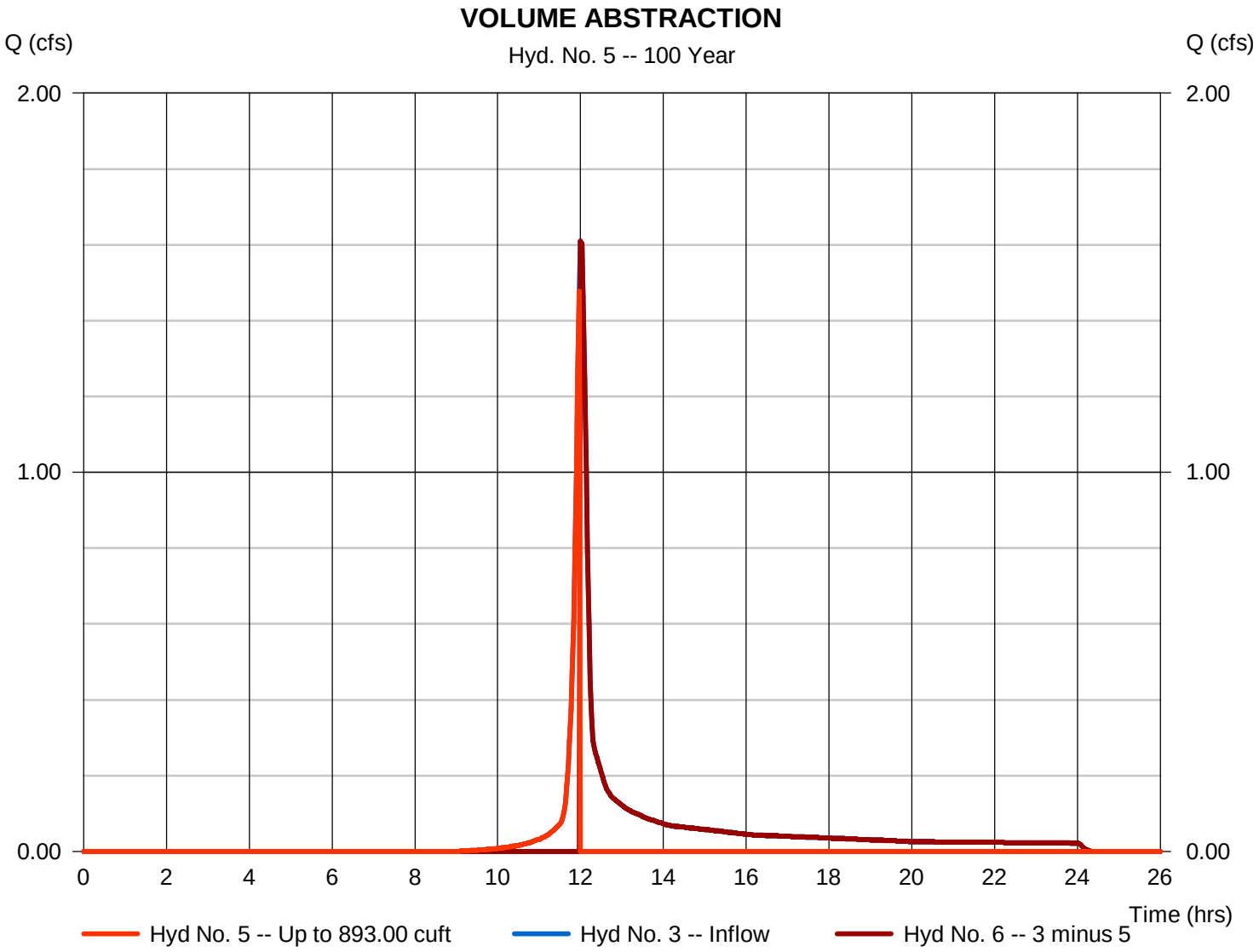


Hydrograph Report

Hyd. No. 5

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.477 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 1,013 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 6
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

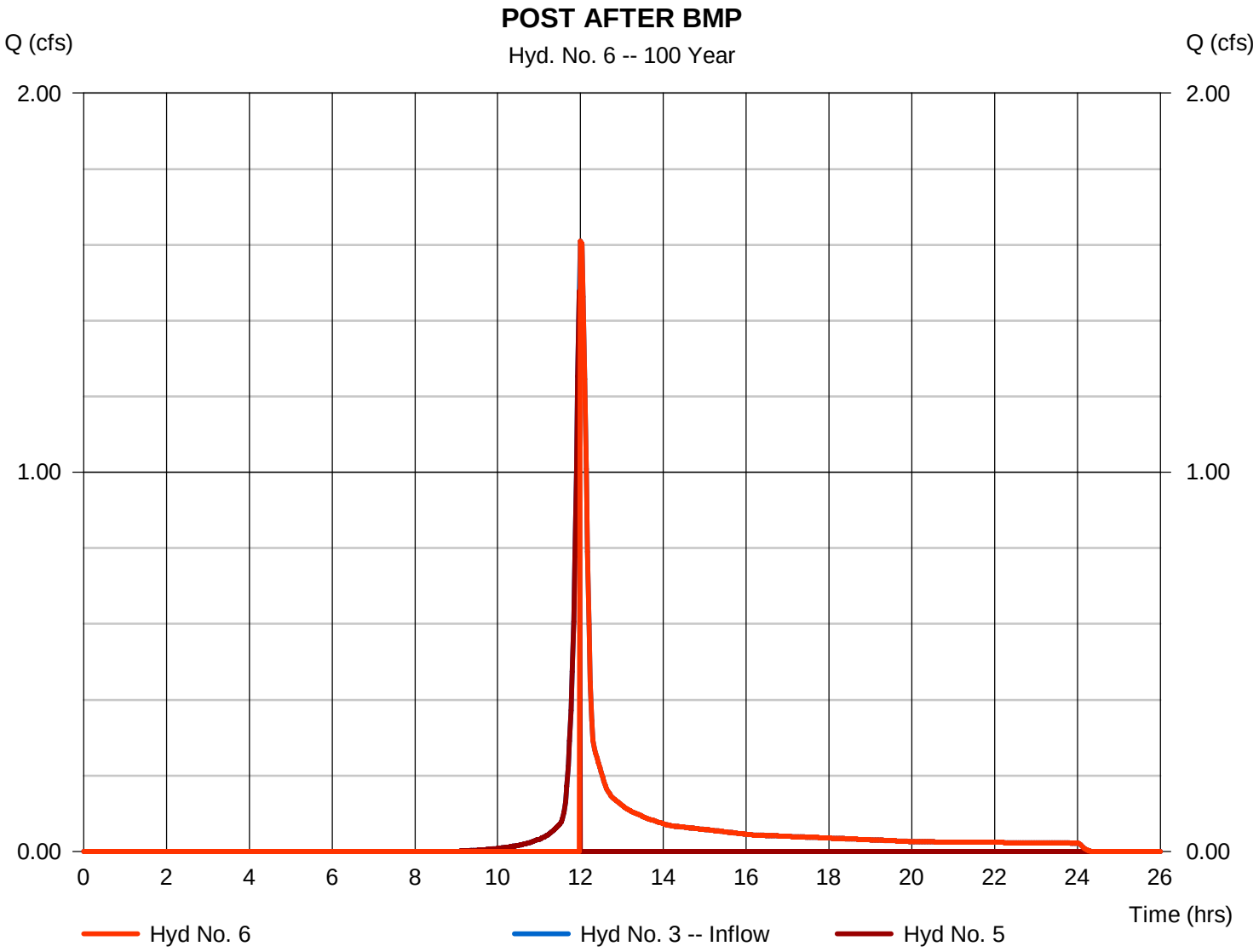


Hydrograph Report

Hyd. No. 6

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 1.610 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 3,175 cuft
Inflow hydrograph	= 3 - POST DETAINED 1	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 893.00 cuft

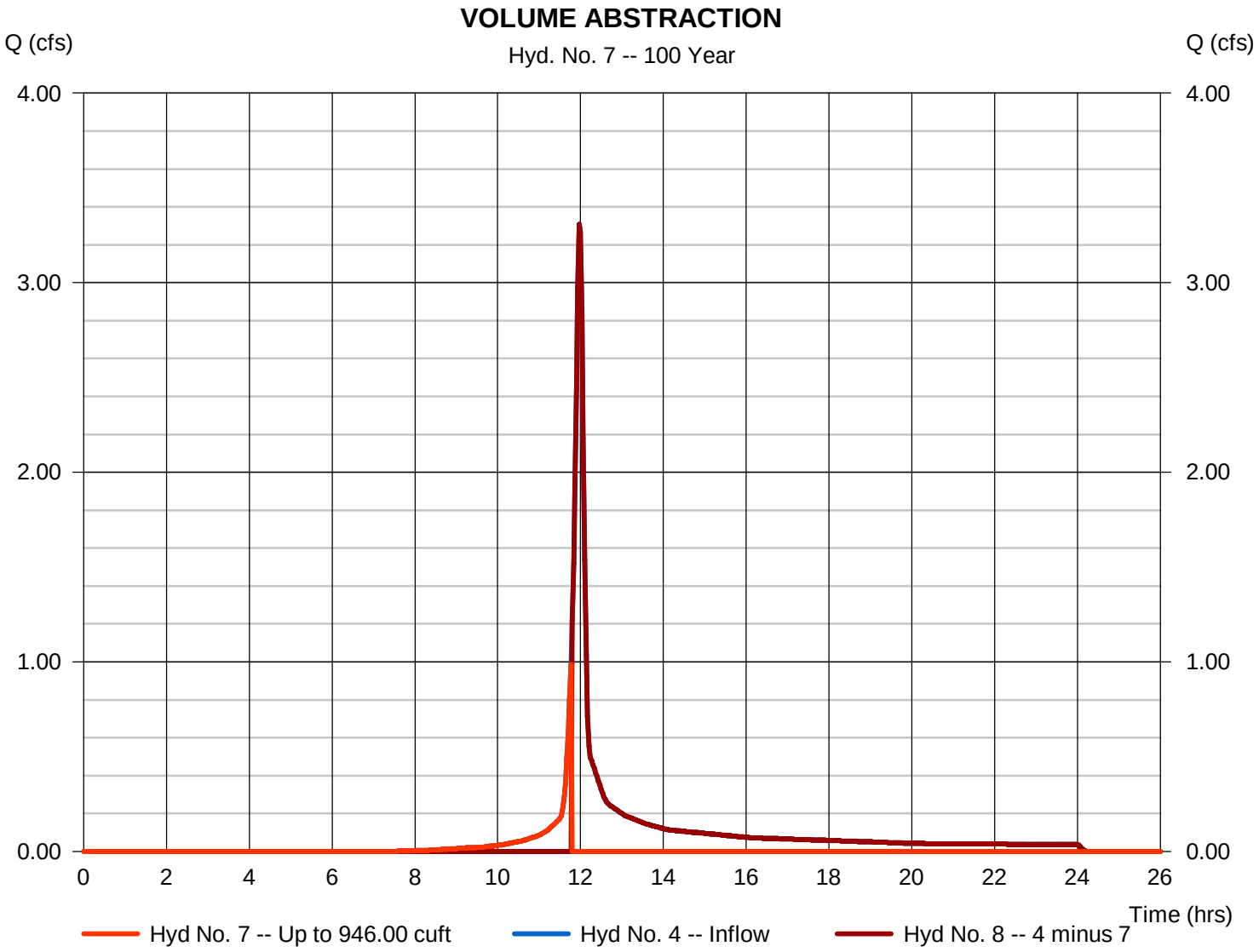


Hydrograph Report

Hyd. No. 7

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.986 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.77 hrs
Time interval	= 2 min	Hyd. volume	= 1,017 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 8
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

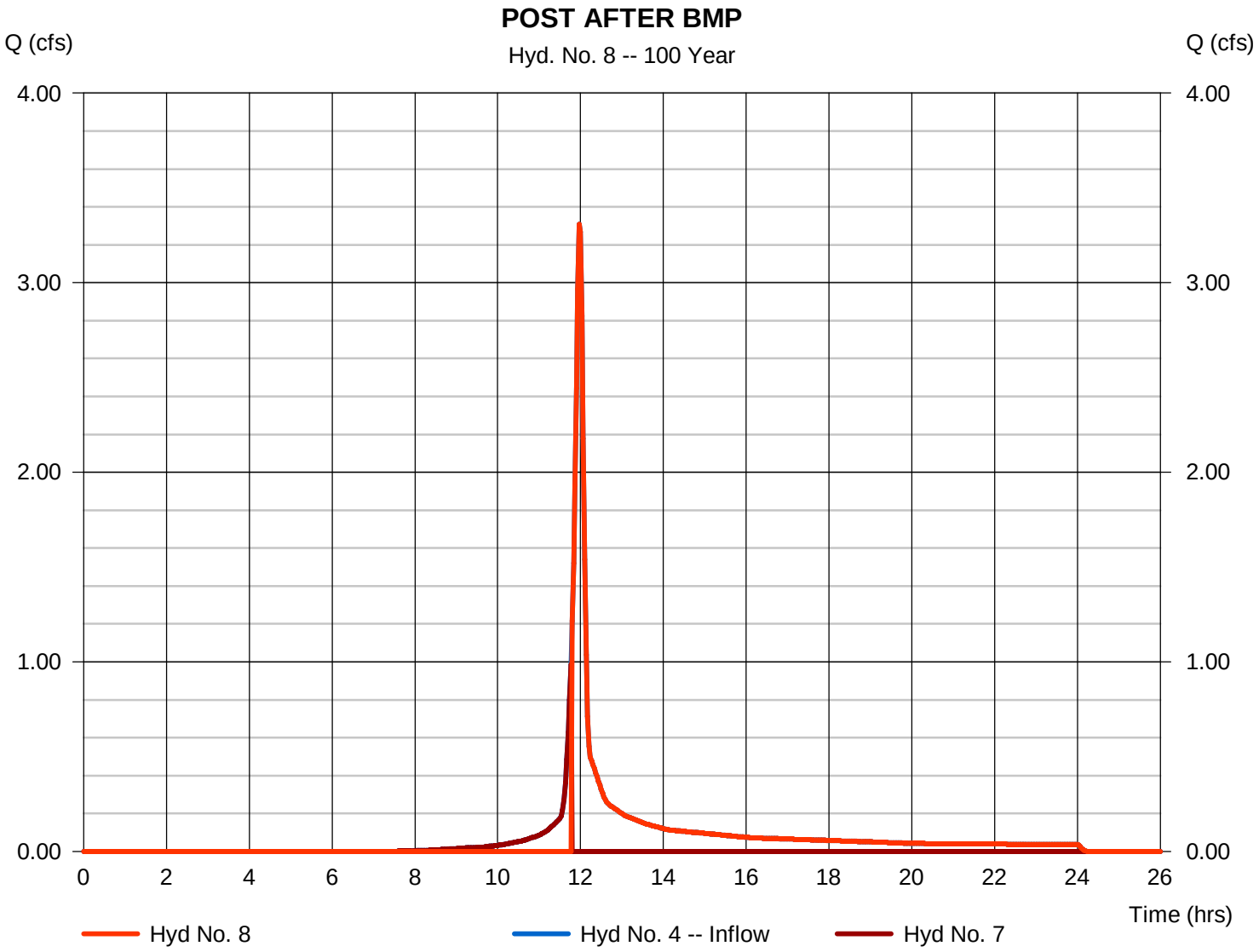


Hydrograph Report

Hyd. No. 8

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 3.309 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 6,571 cuft
Inflow hydrograph	= 4 - POST DETAINED 2	2nd diverted hyd.	= 7
Diversion method	= First Flush Volume	Volume Up To	= 946.00 cuft

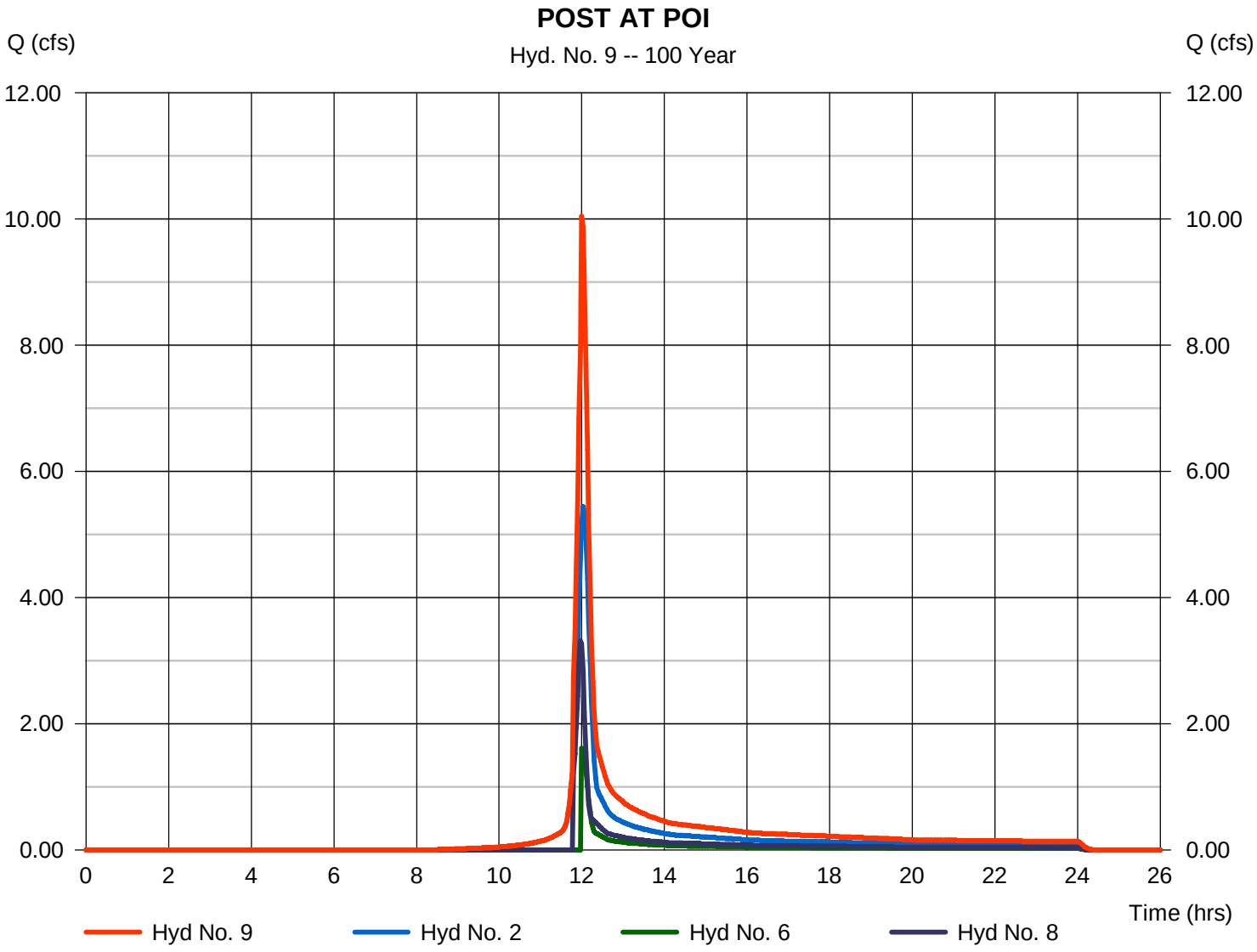


Hydrograph Report

Hyd. No. 9

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 10.05 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 25,009 cuft
Inflow hyds.	= 2, 6, 8	Contrib. drain. area	= 1.400 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	40.9797	10.0000	0.8819	--------
2	47.5266	10.0000	0.8699	--------
3	0.0000	0.0000	0.0000	--------
5	52.3308	9.8000	0.8367	--------
10	51.4601	9.0000	0.7986	--------
25	47.3122	7.6000	0.7392	--------
50	45.3993	6.7000	0.7020	--------
100	40.9920	5.4000	0.6524	--------

File name: Raystown IDF.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	3.76	2.92	2.40	2.04	1.78	1.58	1.43	1.30	1.20	1.11	1.03	0.97
2	4.51	3.51	2.89	2.47	2.16	1.92	1.73	1.58	1.46	1.35	1.26	1.18
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	5.49	4.30	3.57	3.06	2.69	2.40	2.17	1.99	1.84	1.71	1.60	1.50
10	6.25	4.90	4.07	3.50	3.08	2.76	2.51	2.30	2.13	1.98	1.86	1.75
25	7.27	5.68	4.72	4.07	3.60	3.24	2.95	2.72	2.53	2.36	2.22	2.10
50	8.08	6.29	5.23	4.53	4.01	3.62	3.31	3.06	2.85	2.67	2.51	2.38
100	8.89	6.89	5.73	4.97	4.42	4.00	3.67	3.40	3.18	2.99	2.82	2.68

Tc = time in minutes. Values may exceed 60.

P-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Raystown Rd (SR26)\Hydraflow Rev 1\Raystown Precip.pc

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	2.23	2.67	0.00	3.32	3.86	4.64	5.30	5.99
SCS 6-Hr	1.50	1.81	0.00	2.25	2.62	3.16	3.60	4.07
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	0.00	0.00	0.00	0.00	0.00