Valley Forge

TETRA TECH, INC.

By: RH Date: 11/18/2016 Subject: Valley Forge Road
Checked By: JB Date: 11/23/2016 PCSM Design and Evaluation

PURPOSE:

The purpose of these calculations is to design a Post-Construction Stormwater Management (PCSM) Plan for the Valley Forge Road block valve site as part of the Sunoco Pipeline L.P. Pennsylvania Pipeline Project. The site is located within Juniata Township, Blair County, Pennsylvania. Permanent stormwater controls will be developed to satisfy PADEP and Juniata Township's approved Act 167 Plan.

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

The Valley Forge Road block valve site is located in Blair County, which does not have a county-wide Act 167 plan adopted. However, Juniata Township has enacted the Beaverdam Branch Watershed Act 167 Stormwater Management Plan. This plan requires that the post-development runoff rate be less than or equal to the pre-development rate. The PCSM design at the Valley Forge Road block valve has been designed for consistency with Juniata Township's approved Act 167 Plan.

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 three infiltration berms 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 the applicable and approved Act 167 plan.
- The Juniata Township Act 167 rate requirements mirror PADEP's requirements. Therefore, no additional peak rate control is required under the Act 167 Plan.

This site will utilize three infiltration berms to manage the 2-year through 100-year peak rate increases. The infiltration berms will increase the post-construction time of concentration for the detained 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. The post-construction stormwater management facility for the site has been designed to maintain 2 feet of separation between the ponding elevation of the facility and the seasonal high water table and bedrock.

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 4.9:1.

The drainage area loading ratio for the site is 20:1. However, runoff from the site and upslope drainage area will be dispersed to three infiltration berms. Berms have been placed to maximum 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 detained by the proposed PCSM BMPs.

Karst Topography

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

Special Protection Watershed

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

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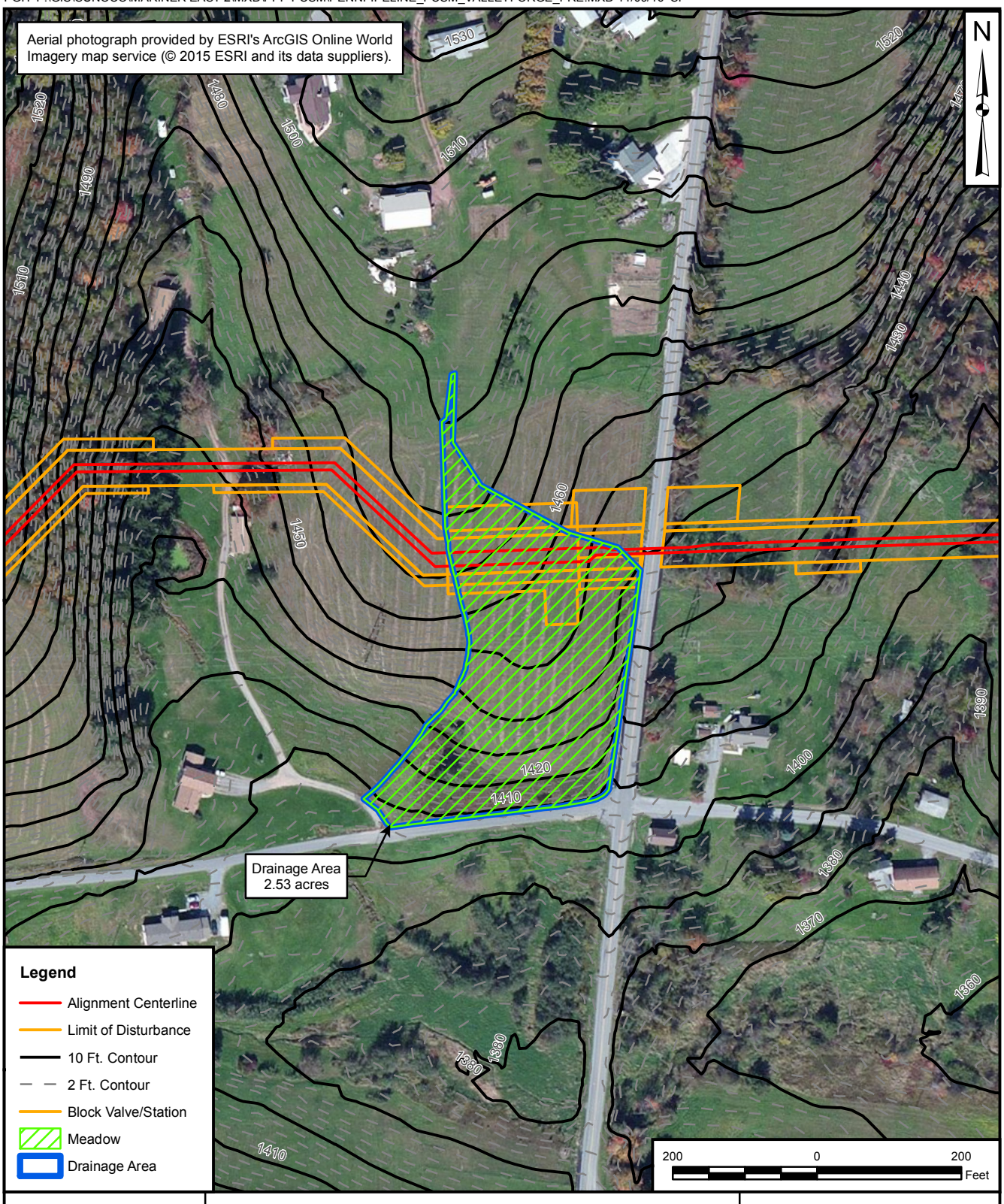

TETRA TECH

PRE-DEVELOPMENT DRAINAGE AREA MAP
VALLEY FORGE ROAD
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
BLAIR 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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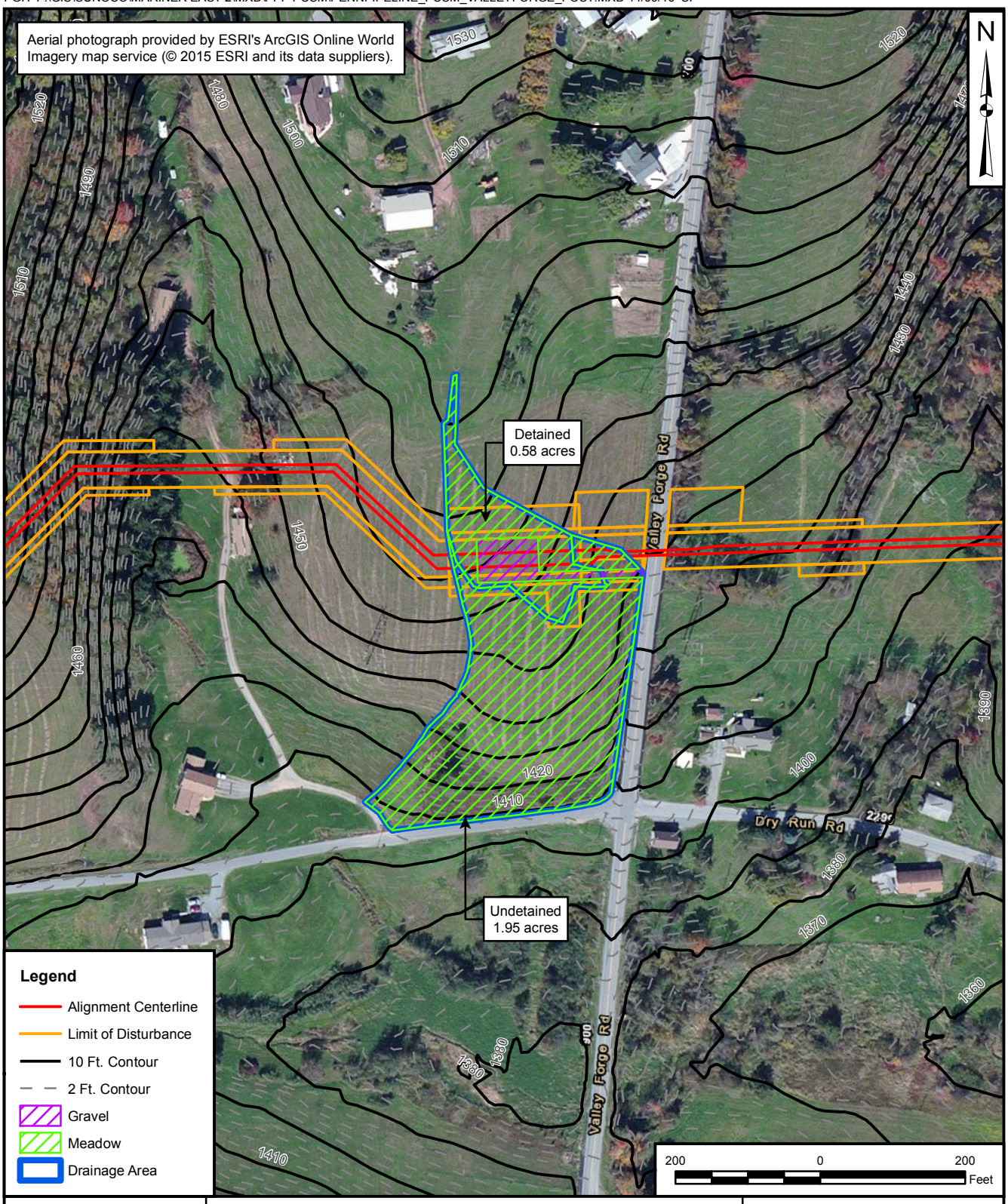

TETRA TECH

POST-DEVELOPMENT DRAINAGE AREA MAP
VALLEY FORGE ROAD
PENNSYLVANIA PIPELINE PROJECT
SUNOCO LOGISTICS, L.P.
BLAIR 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: Juniata Twp, Pennsylvania, USA*
Latitude: 40.4047°, Longitude: -78.4935°
Elevation: 1439.28 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	**0.309** (0.279-0.344)	**0.369** (0.334-0.411)	**0.450** (0.405-0.499)	**0.513** (0.460-0.569)	**0.596** (0.531-0.659)	**0.663** (0.587-0.731)	**0.729** (0.642-0.803)	**0.798** (0.698-0.878)	**0.894** (0.776-0.982)	**0.967** (0.831-1.06)
10-min	**0.480** (0.433-0.534)	**0.577** (0.521-0.641)	**0.699** (0.629-0.776)	**0.792** (0.710-0.878)	**0.912** (0.813-1.01)	**1.00** (0.890-1.11)	**1.10** (0.967-1.21)	**1.19** (1.04-1.31)	**1.31** (1.14-1.44)	**1.41** (1.21-1.54)
15-min	**0.588** (0.531-0.655)	**0.705** (0.637-0.784)	**0.858** (0.773-0.953)	**0.975** (0.874-1.08)	**1.13** (1.00-1.25)	**1.24** (1.10-1.37)	**1.36** (1.20-1.50)	**1.48** (1.30-1.63)	**1.64** (1.42-1.80)	**1.76** (1.51-1.93)
30-min	**0.778** (0.703-0.867)	**0.944** (0.852-1.05)	**1.18** (1.06-1.30)	**1.35** (1.21-1.50)	**1.59** (1.42-1.76)	**1.78** (1.57-1.96)	**1.97** (1.73-2.17)	**2.16** (1.89-2.38)	**2.43** (2.11-2.67)	**2.64** (2.27-2.89)
60-min	**0.950** (0.858-1.06)	**1.16** (1.05-1.29)	**1.48** (1.33-1.64)	**1.72** (1.54-1.91)	**2.06** (1.84-2.28)	**2.34** (2.08-2.58)	**2.63** (2.32-2.90)	**2.93** (2.57-3.23)	**3.36** (2.92-3.69)	**3.71** (3.18-4.06)
2-hr	**1.10** (0.989-1.23)	**1.33** (1.20-1.49)	**1.70** (1.52-1.90)	**2.00** (1.78-2.22)	**2.42** (2.14-2.68)	**2.76** (2.42-3.05)	**3.13** (2.73-3.45)	**3.52** (3.05-3.88)	**4.09** (3.50-4.50)	**4.55** (3.86-5.02)
3-hr	**1.19** (1.07-1.33)	**1.44** (1.30-1.60)	**1.82** (1.64-2.02)	**2.13** (1.91-2.36)	**2.57** (2.29-2.85)	**2.94** (2.60-3.24)	**3.34** (2.93-3.68)	**3.77** (3.28-4.14)	**4.39** (3.77-4.81)	**4.90** (4.17-5.36)
6-hr	**1.48** (1.34-1.65)	**1.78** (1.61-1.99)	**2.23** (2.01-2.48)	**2.59** (2.32-2.88)	**3.12** (2.78-3.46)	**3.56** (3.15-3.93)	**4.03** (3.53-4.44)	**4.54** (3.94-4.99)	**5.28** (4.53-5.79)	**5.89** (5.00-6.45)
12-hr	**1.84** (1.67-2.07)	**2.22** (2.01-2.48)	**2.75** (2.49-3.08)	**3.21** (2.88-3.57)	**3.87** (3.45-4.29)	**4.42** (3.92-4.90)	**5.04** (4.42-5.56)	**5.70** (4.95-6.29)	**6.67** (5.72-7.35)	**7.50** (6.35-8.24)
24-hr	**2.24** (2.06-2.45)	**2.69** (2.47-2.94)	**3.34** (3.06-3.65)	**3.88** (3.54-4.23)	**4.65** (4.23-5.06)	**5.30** (4.79-5.75)	**5.99** (5.38-6.49)	**6.73** (6.01-7.30)	**7.82** (6.90-8.46)	**8.71** (7.61-9.44)
2-day	**2.55** (2.35-2.78)	**3.05** (2.81-3.33)	**3.77** (3.47-4.11)	**4.37** (4.01-4.76)	**5.23** (4.78-5.69)	**5.95** (5.40-6.46)	**6.73** (6.06-7.30)	**7.55** (6.75-8.20)	**8.75** (7.73-9.49)	**9.73** (8.51-10.6)
3-day	**2.71** (2.51-2.95)	**3.25** (3.00-3.53)	**4.00** (3.69-4.35)	**4.62** (4.26-5.02)	**5.52** (5.06-5.98)	**6.26** (5.71-6.78)	**7.05** (6.38-7.63)	**7.90** (7.10-8.55)	**9.11** (8.09-9.88)	**10.1** (8.88-11.0)
4-day	**2.88** (2.67-3.13)	**3.44** (3.20-3.74)	**4.23** (3.92-4.58)	**4.88** (4.51-5.27)	**5.80** (5.34-6.27)	**6.57** (6.01-7.09)	**7.38** (6.71-7.97)	**8.24** (7.44-8.91)	**9.47** (8.45-10.3)	**10.5** (9.25-11.4)
7-day	**3.40** (3.18-3.66)	**4.06** (3.79-4.36)	**4.92** (4.59-5.29)	**5.61** (5.23-6.02)	**6.57** (6.10-7.05)	**7.33** (6.78-7.86)	**8.12** (7.48-8.71)	**8.94** (8.18-9.60)	**10.1** (9.12-10.8)	**10.9** (9.84-11.8)
10-day	**3.97** (3.72-4.25)	**4.70** (4.41-5.03)	**5.62** (5.27-6.02)	**6.36** (5.96-6.80)	**7.37** (6.88-7.88)	**8.17** (7.60-8.73)	**8.98** (8.32-9.60)	**9.81** (9.03-10.5)	**10.9** (9.99-11.7)	**11.8** (10.7-12.7)
20-day	**5.46** (5.18-5.77)	**6.43** (6.10-6.80)	**7.50** (7.11-7.93)	**8.32** (7.87-8.79)	**9.40** (8.87-9.93)	**10.2** (9.62-10.8)	**11.0** (10.3-11.6)	**11.8** (11.0-12.5)	**12.8** (11.9-13.5)	**13.5** (12.5-14.3)
30-day	**6.85** (6.50-7.20)	**8.02** (7.61-8.44)	**9.19** (8.73-9.67)	**10.1** (9.59-10.6)	**11.3** (10.7-11.8)	**12.1** (11.5-12.8)	**13.0** (12.2-13.6)	**13.7** (12.9-14.5)	**14.7** (13.8-15.5)	**15.4** (14.4-16.3)
45-day	**8.69** (8.28-9.12)	**10.2** (9.68-10.7)	**11.5** (11.0-12.1)	**12.5** (11.9-13.1)	**13.7** (13.1-14.4)	**14.6** (13.9-15.4)	**15.5** (14.7-16.2)	**16.2** (15.4-17.0)	**17.1** (16.2-18.0)	**17.7** (16.7-18.7)
60-day	**10.5** (10.0-10.9)	**12.2** (11.7-12.7)	**13.7** (13.1-14.3)	**14.8** (14.2-15.4)	**16.1** (15.4-16.8)	**17.0** (16.3-17.7)	**17.8** (17.0-18.6)	**18.5** (17.7-19.4)	**19.4** (18.5-20.3)	**20.0** (19.0-20.9)

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

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

Please refer to NOAA Atlas 14 document for more information.

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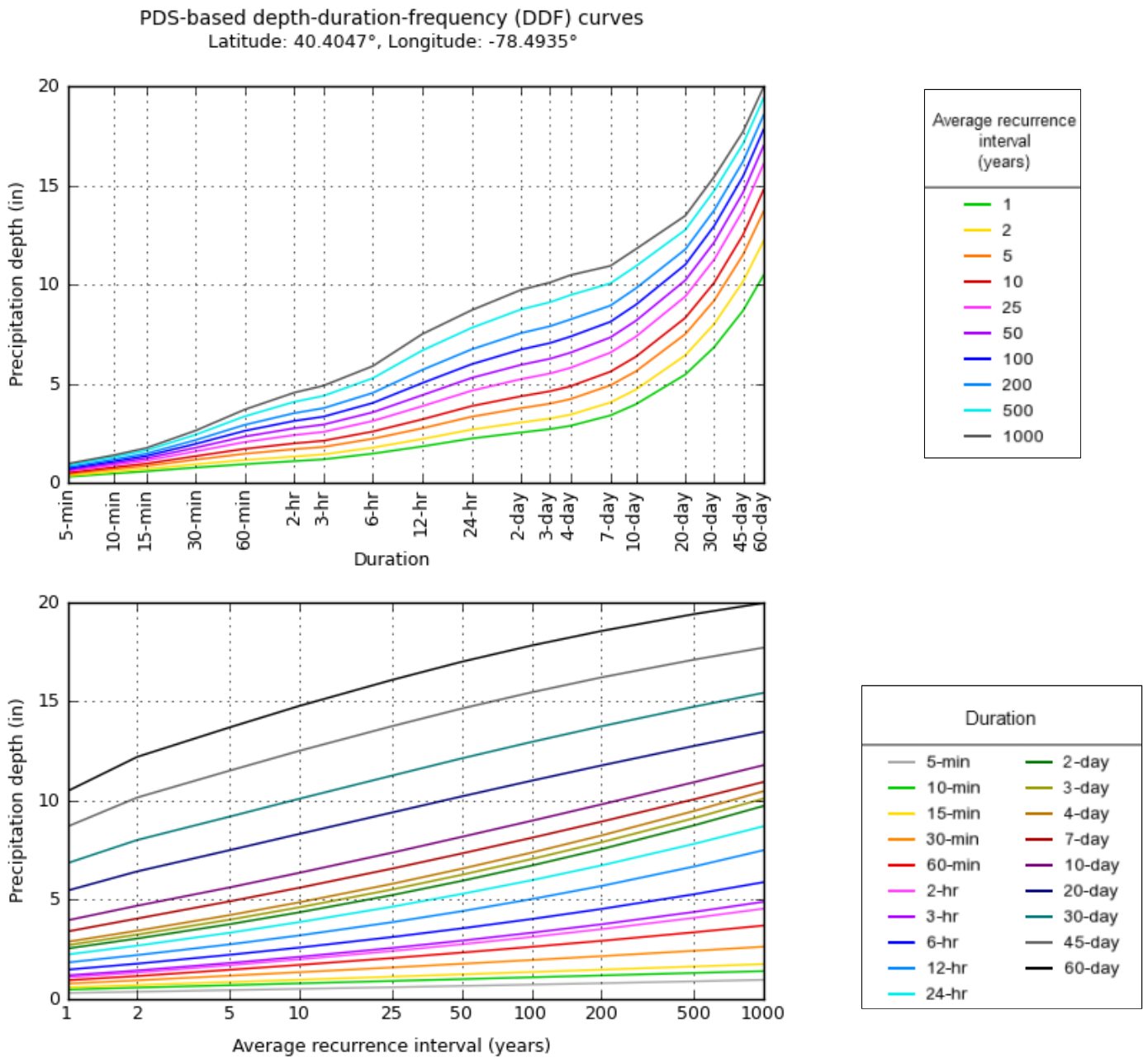
PF graphical



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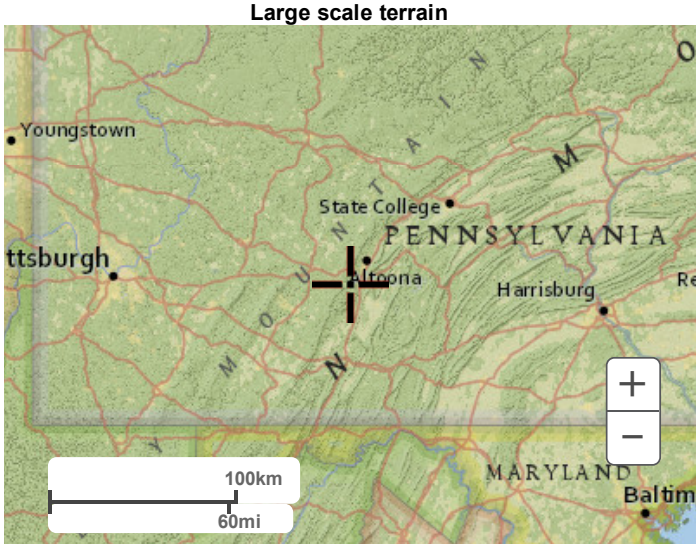
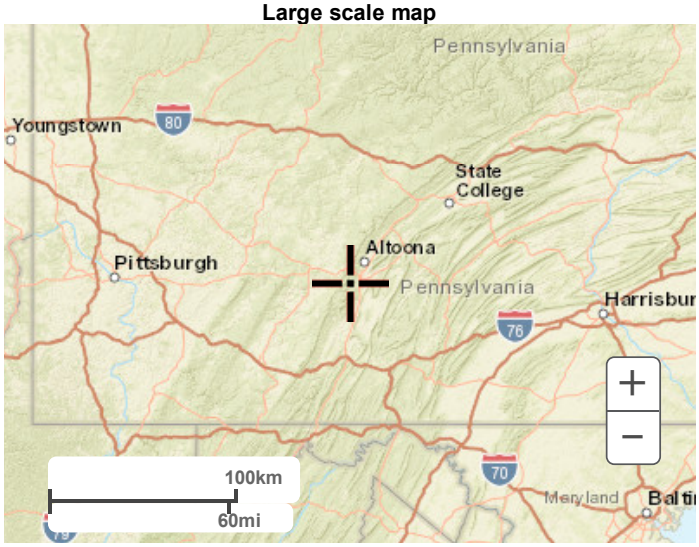
Maps & aerials

Small scale terrain

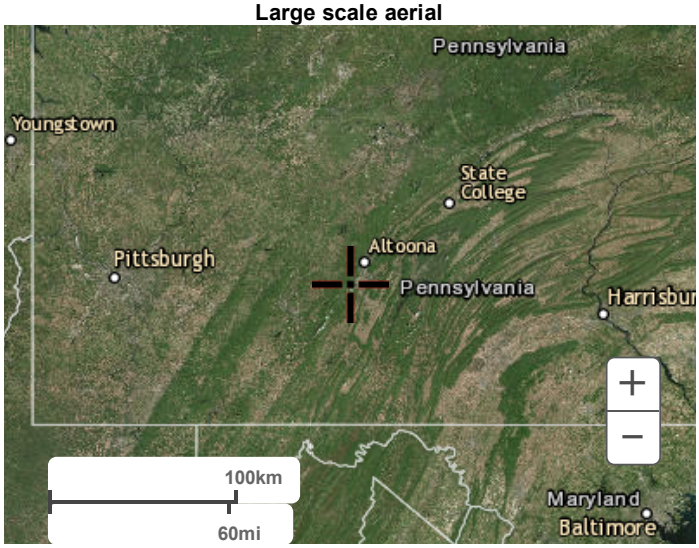
Large scale terrain



Large scale map



Large scale aerial



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WORKSHEET 1. GENERAL SITE INFORMATION

Date: November 11, 2016

Project Name: Valley Forge Road

Municipality: Juniata

County: Blair

Total Area (acres): 2.53

Major River Basin: Susquehanna River

Watershed: Frankstown Branch Juniata River

Sub Basin: Little Juniata River

Nearest Surface Water to Receive Runoff: Tributary #16353 to Dry Run

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

Impaired according to Chapter 303(d) list?	YES	X
	NO	

List Causes of Impairment:

Metals; pH; Organic Enrichment/Low D.O.

Is Project Subject to, or Part of:

Municipal Separate Storm Sewer System (MS4) Requirements	YES	X
	NO	
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	
	NO	X

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.

   0.00 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	N/A		
Natural Drainage Ways	N/A		
Steep Slopes, 15% - 25%	N/A		
Steep Slopes, over 25%	N/A		
Other:			
Other:			
TOTAL EXISTING:		**0.00**	**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
0.60	-	0	=	0.60

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: Valley Forge Road
Drainage Area: 2.53 acres
2-Year Rainfall: 2.69 in

Total Site Area: 0.60 acres
Protected Site Area: N/A acres
Managed Site Area: 0.60 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	26,136	0.60	58	7.24	1.45	0.18	396
TOTAL:		**26,136**	**0.60**					**396**

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	6,098	0.14	85	1.76	0.35	1.33	677
Meadow	B	20,038	0.46	58	7.24	1.45	0.18	304
TOTAL:		**26,136**	**0.60**					**980**

2-Year Volume Increase (ft^3):	**584**

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: Valley Forge Road
SUB-BASIN:

Required Control Volume (ft^3) - *from Worksheet 4:* 584

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

Structural Volume Reqmt (ft^3): 584
(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		
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	707	734
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 ForestBuffer Restoration		
6.7.2	Landscape Restoration/Reforestation		
6.7.3	Soil Amendment		
6.8.1	Level Spreader		
6.8.2	Special Storage Areas		
Other:			
		Total Structural Volume (ft^3):	**734**
		Structural Volume Requirement (ft^3):	**584**
		DIFFERENCE:	**-150**

VOLUME CREDIT DETERMINATION

1 Detained area runoff volume from Hydraflow = 734 cf

2 Storage volume of the BMPs = 970 cf

3 Infiltrated volume within 72 hours after the 2-yr/24-hr event
(Infiltration Rate/12) x Infiltration Area x 72 hrs = 848 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	

INFILTRATION BERM DEWATERING CALCULATION SITE NAME: Valley Forge

STORAGE VOLUME	734	CF	
DESIGN INFILTRATION RATE	0.20	IN/HR	BASED ON IT-01 AND IT-02
INFILTRATION AREA	707	SF	

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

DEWATERING TIME = 62.3 HOURS

TIME OF CONCENTRATION ADJUSTMENT

POST CONSTRUCTION TC TO BMP (DETAINED TC) BEFORE ADJUSTMENT 6.1 MIN

STRUCTURAL VOLUME PROVIDED BY BMP 734 CF - 2 YEAR/24-HR STORM ONLY
970 CF - FOR ALL OTHER REMAINING STORM EVENTS

RATES OF RUNOFF TO THE BMP (FROM HYDRAFLOW REPORT)

Storm Event	Q (CFS)
2 YR/24 HR	0.301
10 YR/24 HR	0.924
50 YR/24 HR	1.832
100 YR/24 HR	2.312

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

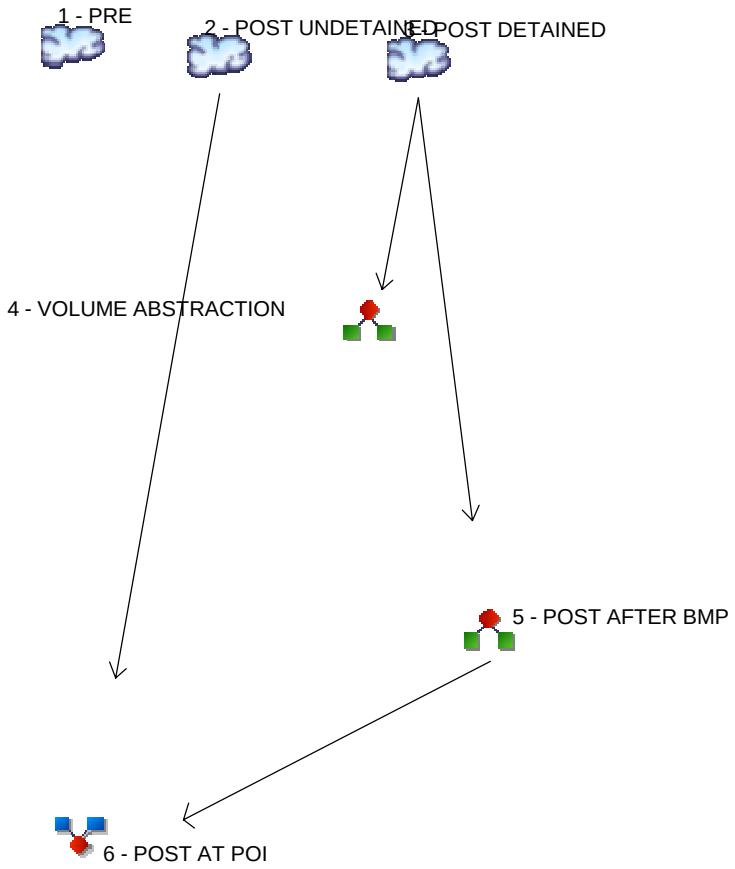
Storm Event	Q (CFS)	Additional Residence Time (min.)
2 YR/24 HR	0.301	40.642
10 YR/24 HR	0.924	17.496
50 YR/24 HR	1.832	8.825
100 YR/24 HR	2.312	6.993

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	0.301	40.642	46.742
10 YR/24 HR	0.924	17.496	23.596
50 YR/24 HR	1.832	8.825	14.925
100 YR/24 HR	2.312	6.993	13.093

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
4	Diversion1	VOLUME ABSTRACTION
5	Diversion2	POST AFTER BMP
6	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	------	-------	0.276	-------	-------	2.141	-------	5.441	7.280	PRE
2	SCS Runoff	------	-------	0.185	-------	-------	1.546	-------	3.956	5.297	POST UNDETAINED
3	SCS Runoff	------	-------	0.301	-------	-------	0.924	-------	1.832	2.312	POST DETAINED
4	Diversion1	3	-------	0.301	-------	-------	0.924	-------	1.832	1.885	VOLUME ABSTRACTION
5	Diversion2	3	-------	0.000	-------	-------	0.062	-------	1.501	2.312	POST AFTER BMP
6	Combine	2, 5	-------	0.185	-------	-------	1.546	-------	5.457	7.433	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	0.276	1	722	1,627	------	------	------	PRE
2	SCS Runoff	0.185	2	722	1,283	------	------	------	POST UNDETAINED
3	SCS Runoff	0.301	2	718	734	------	------	------	POST DETAINED
4	Diversion1	0.301	2	718	734	3	------	------	VOLUME ABSTRACTION
5	Diversion2	0.000	2	n/a	0	3	------	------	POST AFTER BMP
6	Combine	0.185	2	722	1,283	2, 5	------	------	POST AT POI

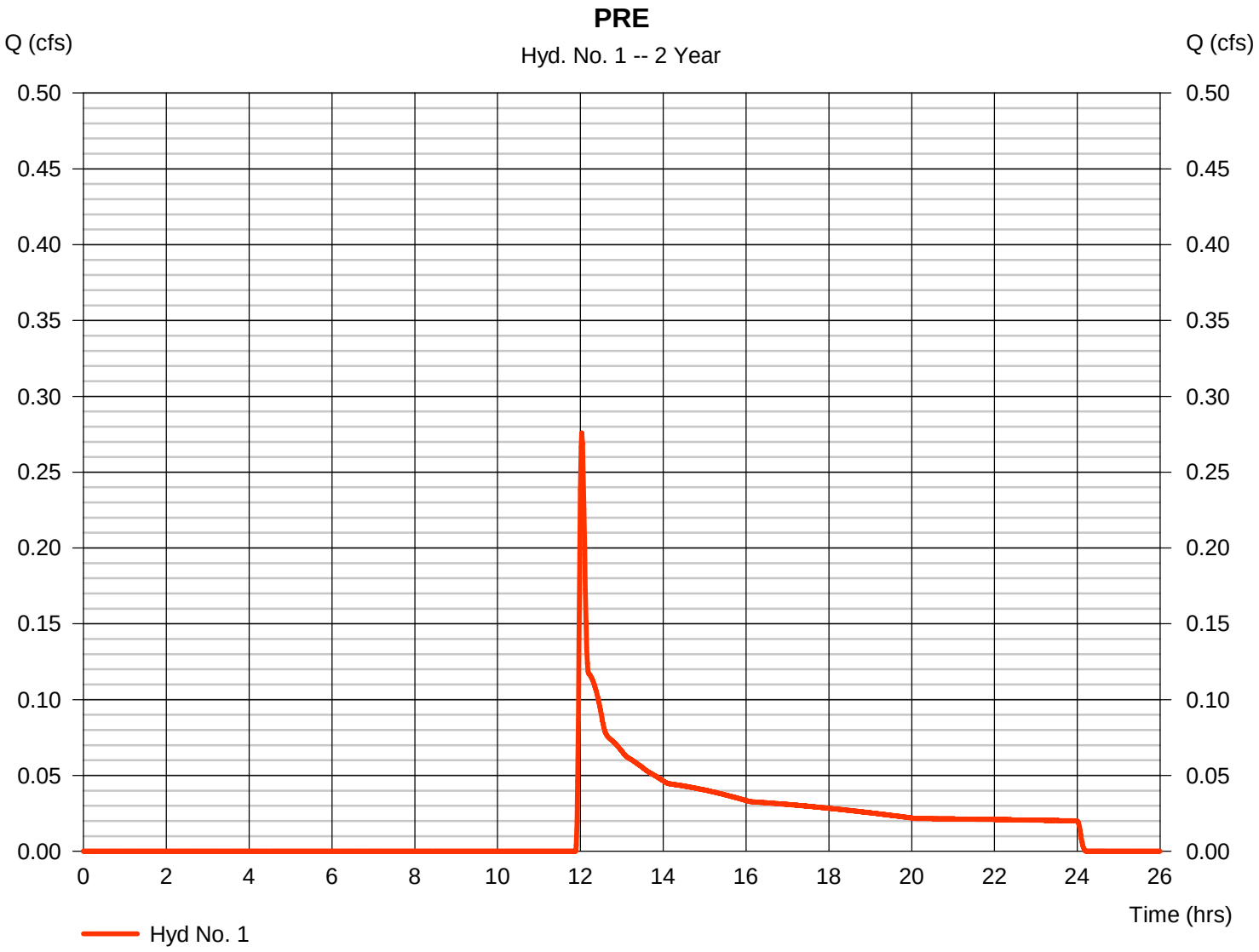
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.276 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.03 hrs
Time interval	=	1 min	Hyd. volume	=	1,627 cuft
Drainage area	=	2.530 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.10 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.530 x 58)] / 2.530



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)	= 2.69		0.00		0.00		
Land slope (%)	= 5.79		0.00		0.00		
Travel Time (min)	**= 5.84**	**+**	**0.00**	**+**	**0.00**	**=**	**5.84**
Shallow Concentrated Flow							
Flow length (ft)	= 671.00		0.00		0.00		
Watercourse slope (%)	= 15.66		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=6.38		0.00		0.00		
Travel Time (min)	**= 1.75**	**+**	**0.00**	**+**	**0.00**	**=**	**1.75**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 0.56		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=5.11						
			0.00				
					0.00		
Flow length (ft)	({0})140.0		0.0		0.0		
Travel Time (min)	**= 0.46**	**+**	**0.00**	**+**	**0.00**	**=**	**0.46**

Total Travel Time, Tc ..... 8.10 min

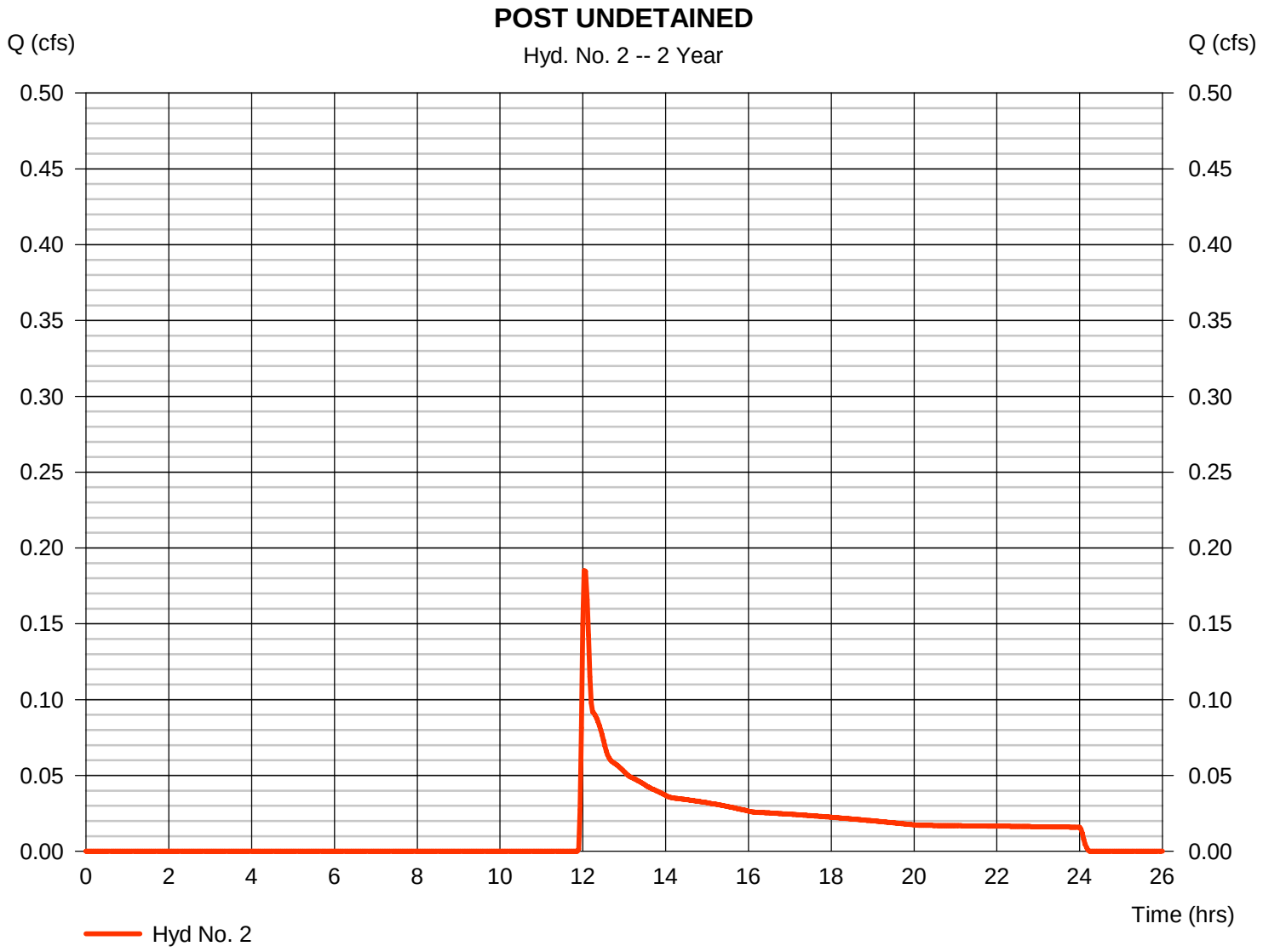
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.185 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	1,283 cuft
Drainage area	=	1.950 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.60 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



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)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.69		0.00		0.00		
Land slope (%)	= 7.00		0.00		0.00		
Travel Time (min)	**= 5.42**	**+**	**0.00**	**+**	**0.00**	**=**	**5.42**
Shallow Concentrated Flow							
Flow length (ft)	= 422.00		43.00		0.00		
Watercourse slope (%)	= 16.00		9.30		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=6.45		6.20		0.00		
Travel Time (min)	**= 1.09**	**+**	**0.12**	**+**	**0.00**	**=**	**1.21**
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 ..... 6.60 min

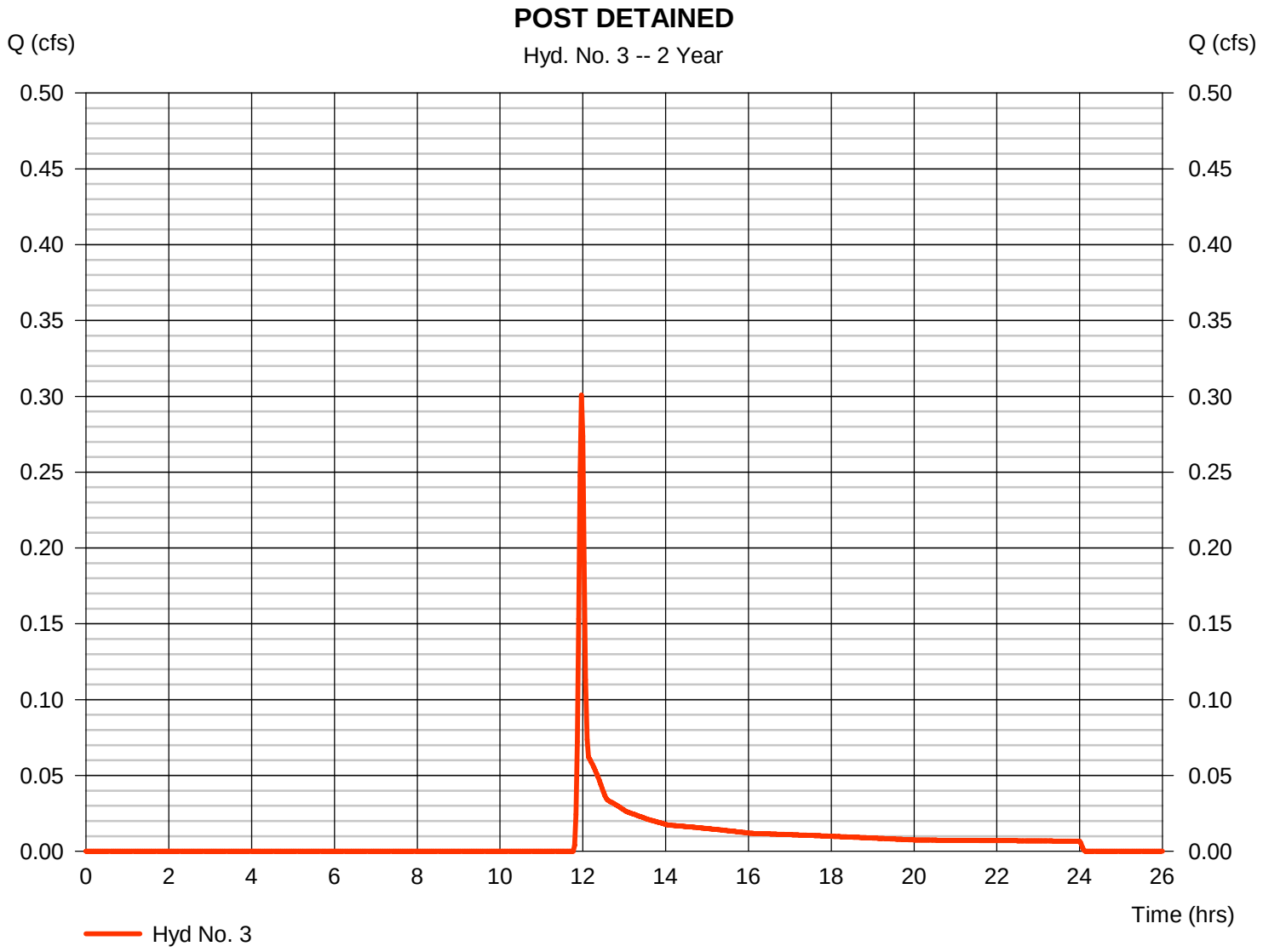
Hydrograph Report

Hyd. No. 3

POST DETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.301 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	734 cuft
Drainage area	=	0.580 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.10 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580



TR55 Tc Worksheet

Hyd. No. 3

POST DETAINED

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)	= 2.69		0.00		0.00		
Land slope (%)	= 7.00		0.00		0.00		
Travel Time (min)	**= 5.42**	**+**	**0.00**	**+**	**0.00**	**=**	**5.42**
Shallow Concentrated Flow							
Flow length (ft)	= 43.00		105.00		52.00		
Watercourse slope (%)	= 39.50		4.30		9.60		
Surface description	= Unpaved		Paved		Unpaved		
Average velocity (ft/s)	=10.14		4.22		5.00		
Travel Time (min)	**= 0.07**	**+**	**0.42**	**+**	**0.17**	**=**	**0.66**
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**

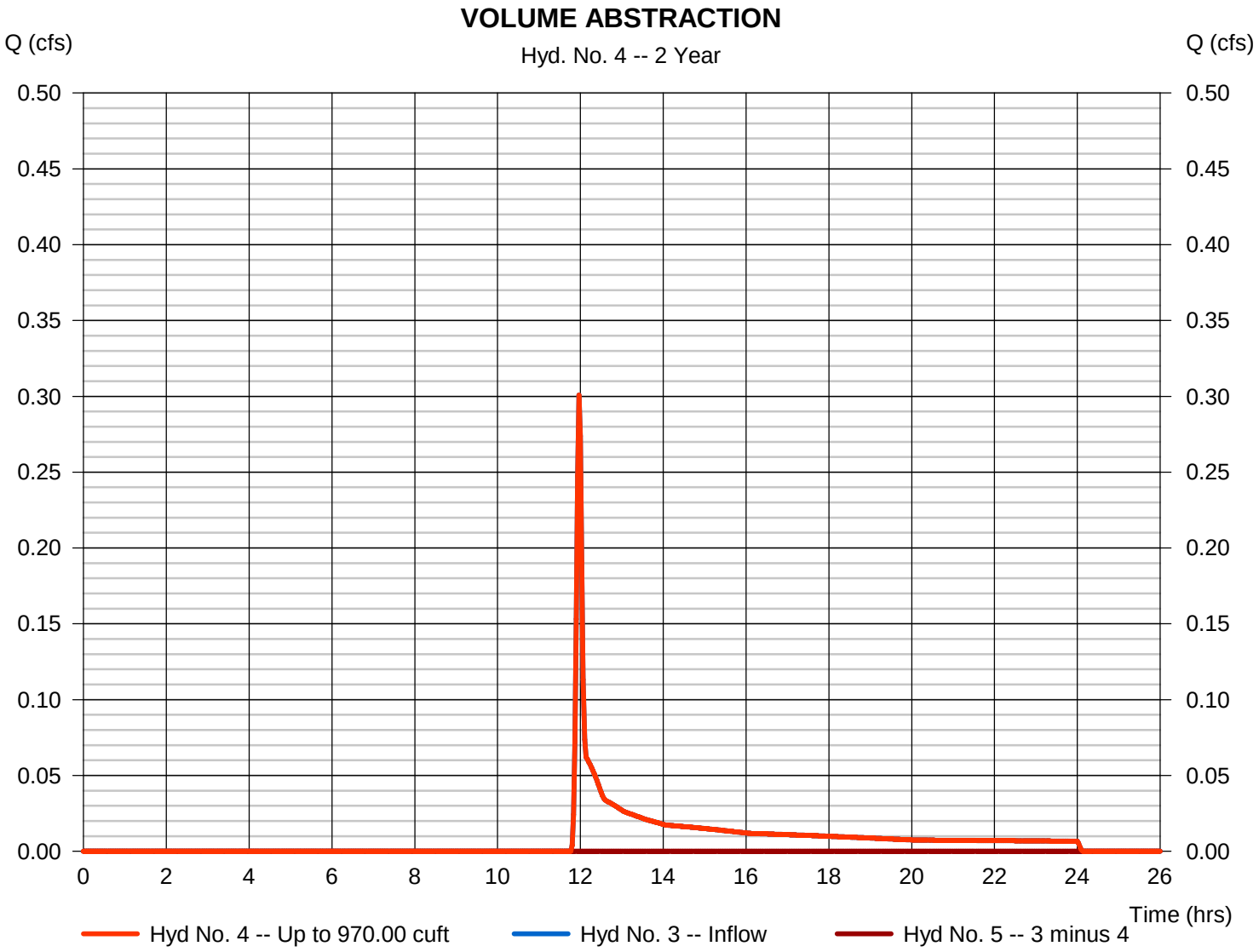
Total Travel Time, Tc ..... 6.10 min

Hydrograph Report

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.301 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 734 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

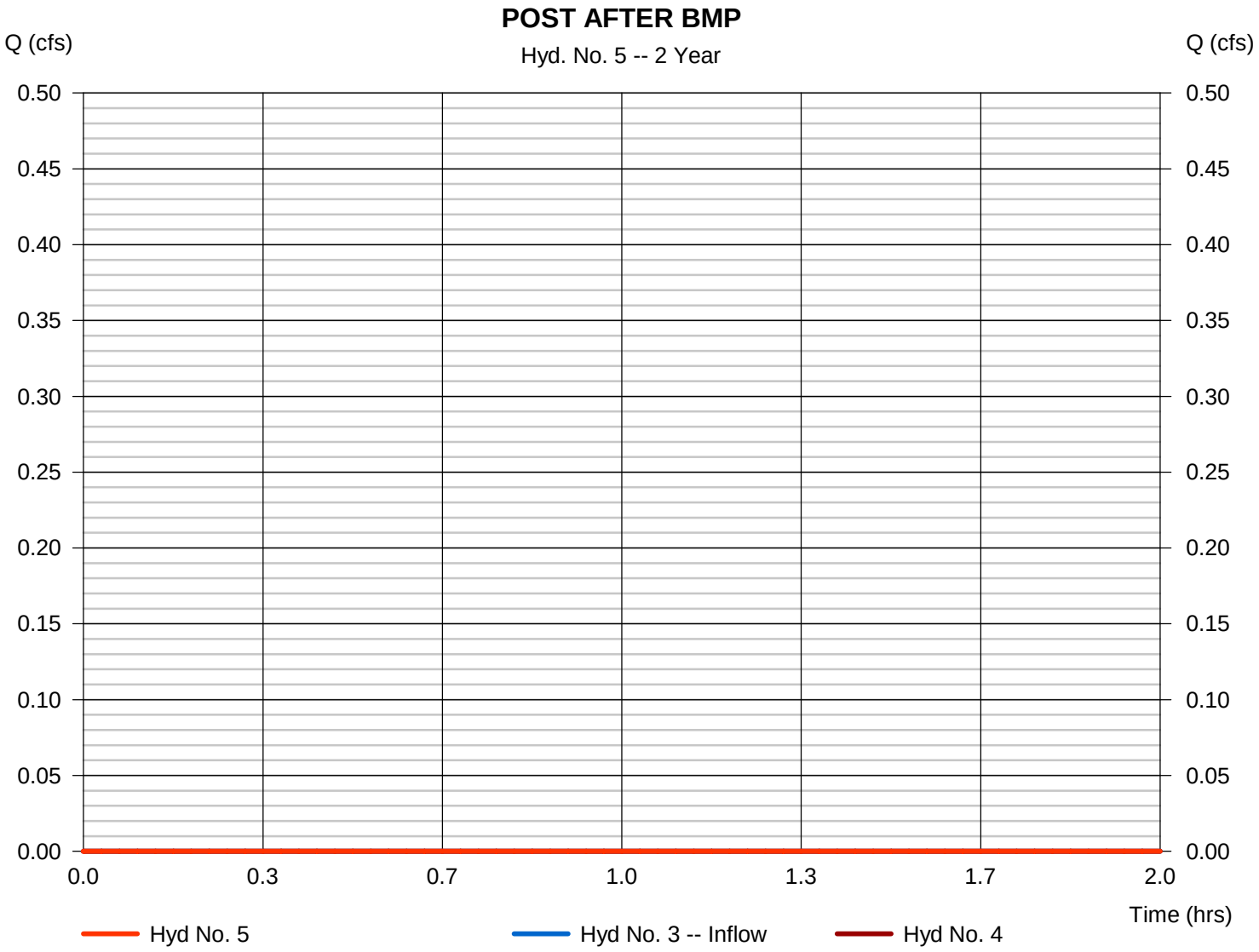


Hydrograph Report

Hyd. No. 5

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	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

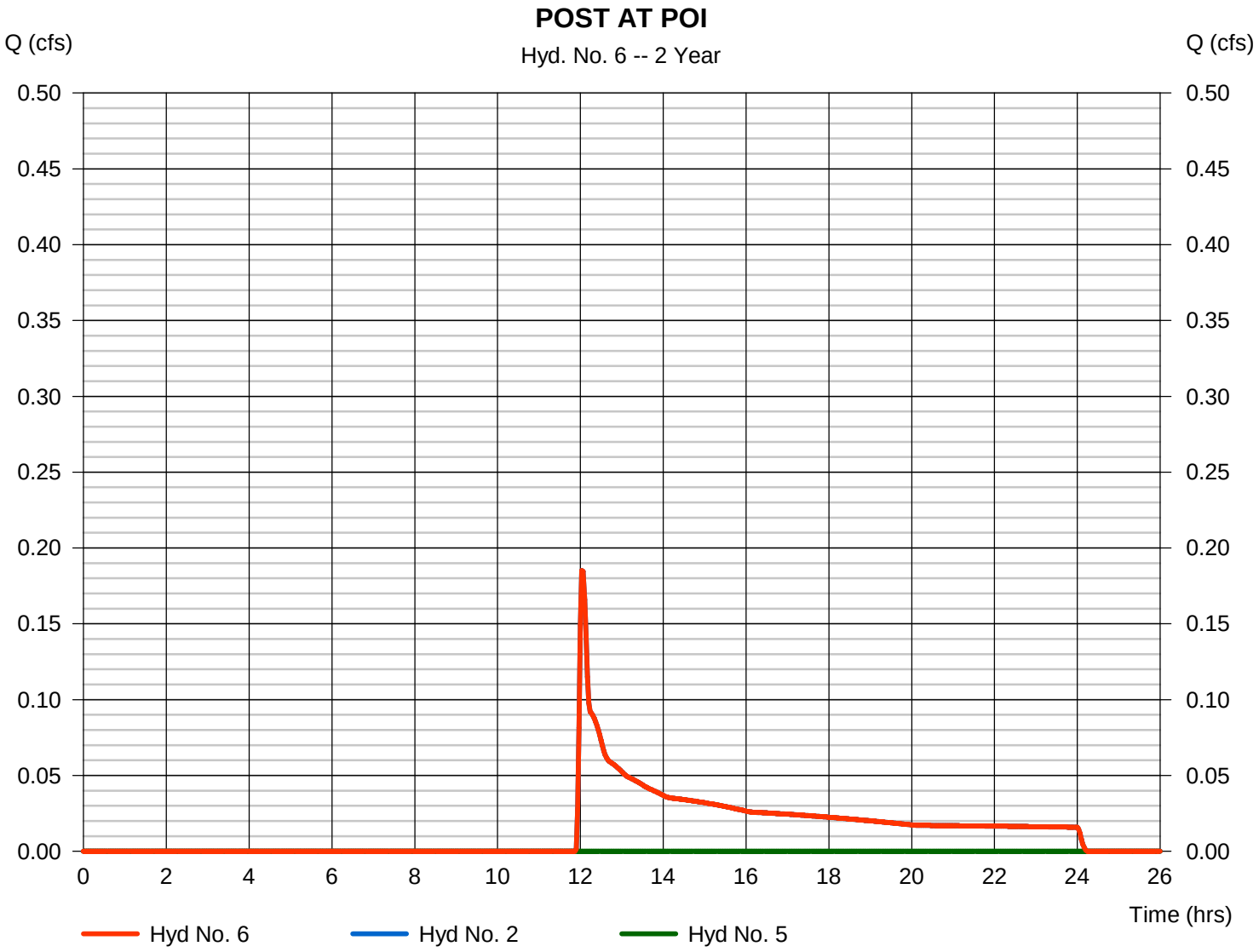


Hydrograph Report

Hyd. No. 6

POST AT POI

Hydrograph type	=	Combine	Peak discharge	=	0.185 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	1,283 cuft
Inflow hyds.	=	2, 5	Contrib. drain. area	=	1.950 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	2.141	1	720	5,474	------	------	------	PRE
2	SCS Runoff	1.546	2	720	4,327	------	------	------	POST UNDETAINED
3	SCS Runoff	0.924	2	718	1,894	------	------	------	POST DETAINED
4	Diversion1	0.924	2	718	978	3	------	------	VOLUME ABSTRACTION
5	Diversion2	0.062	2	780	917	3	------	------	POST AFTER BMP
6	Combine	1.546	2	720	5,244	2, 5	------	------	POST AT POI

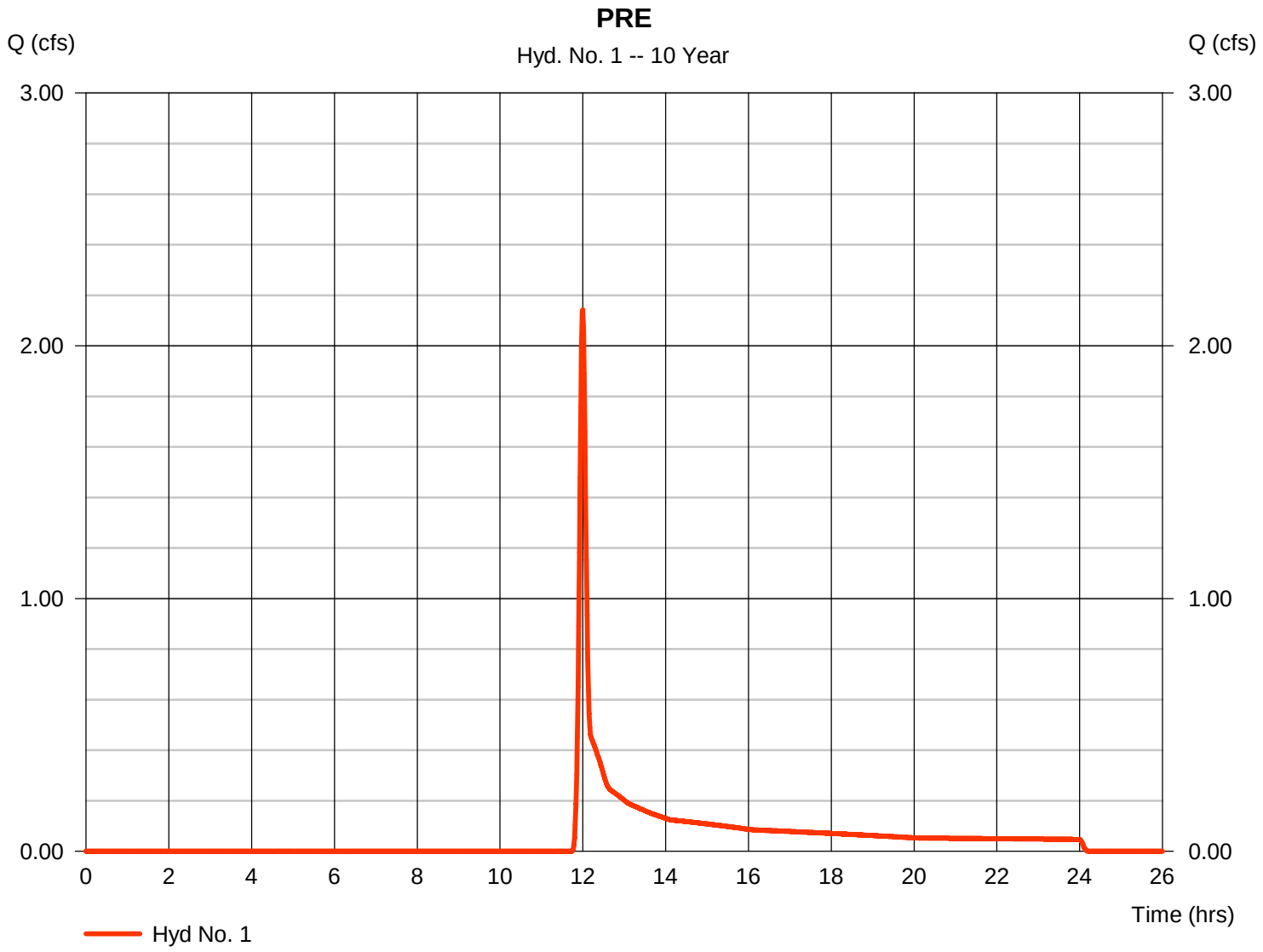
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.141 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.00 hrs
Time interval	=	1 min	Hyd. volume	=	5,474 cuft
Drainage area	=	2.530 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.10 min
Total precip.	=	3.88 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.530 x 58)] / 2.530



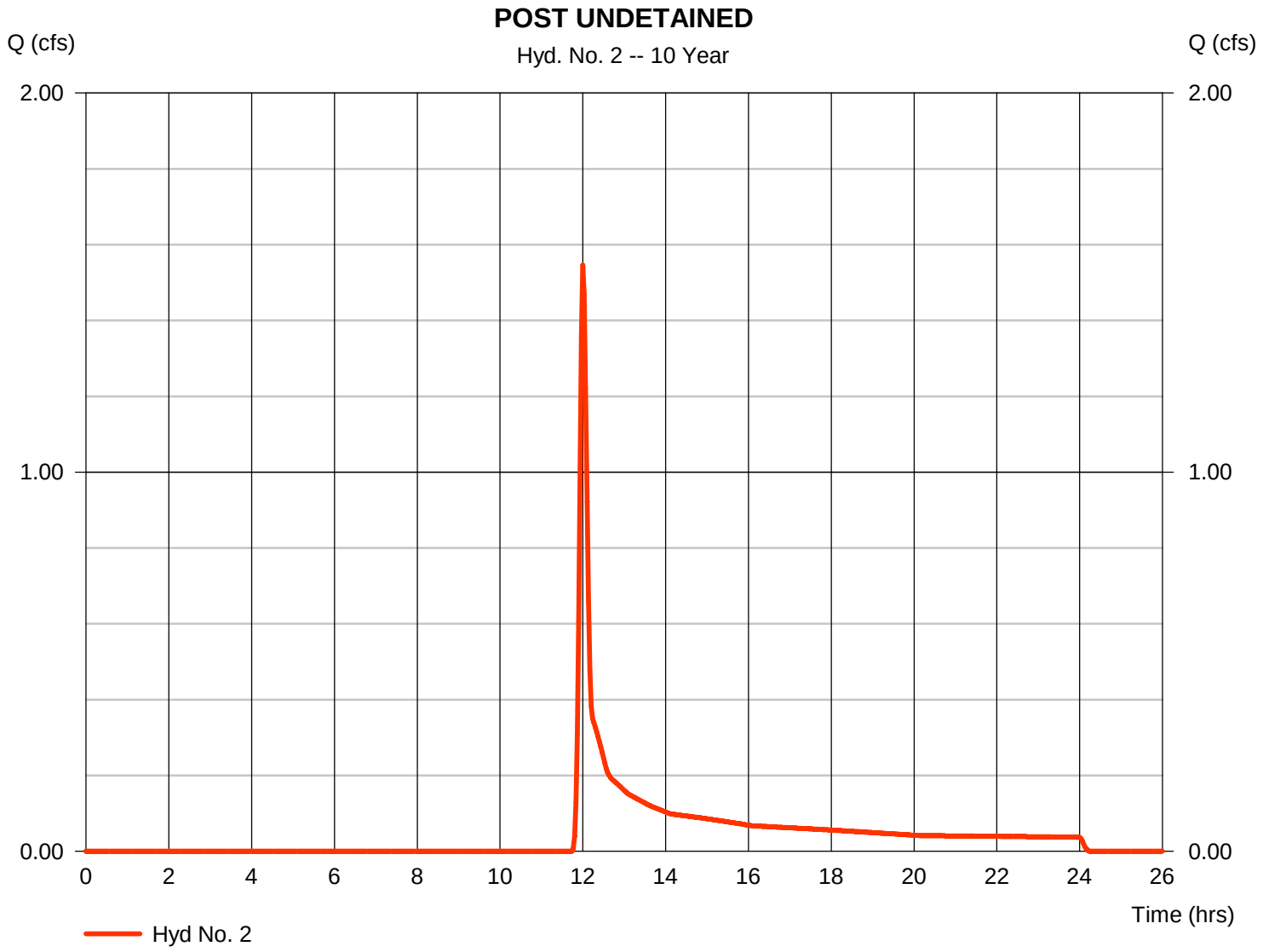
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.546 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	4,327 cuft
Drainage area	=	1.950 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.60 min
Total precip.	=	3.88 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



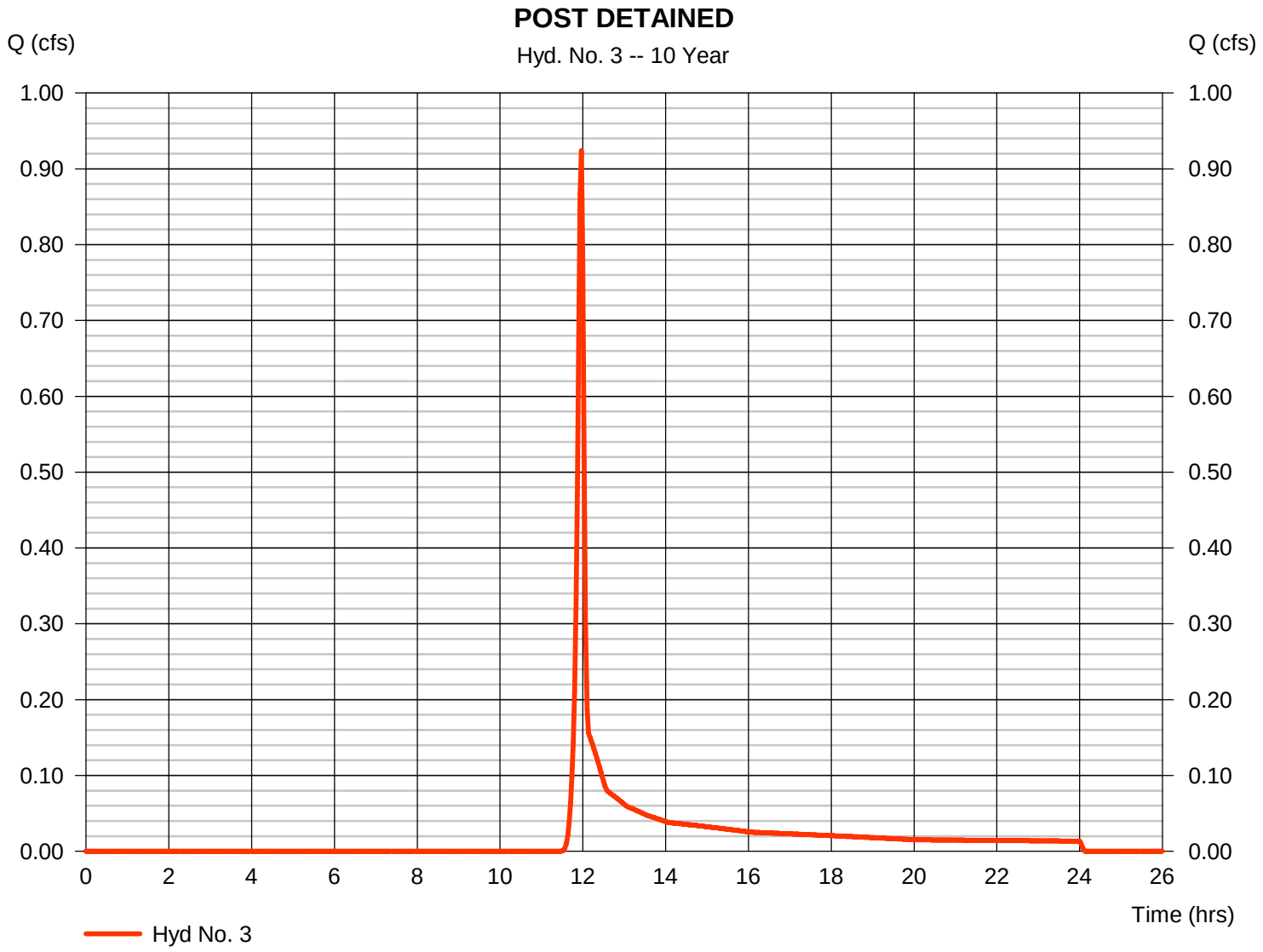
Hydrograph Report

Hyd. No. 3

POST DETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.924 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	1,894 cuft
Drainage area	=	0.580 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.10 min
Total precip.	=	3.88 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580

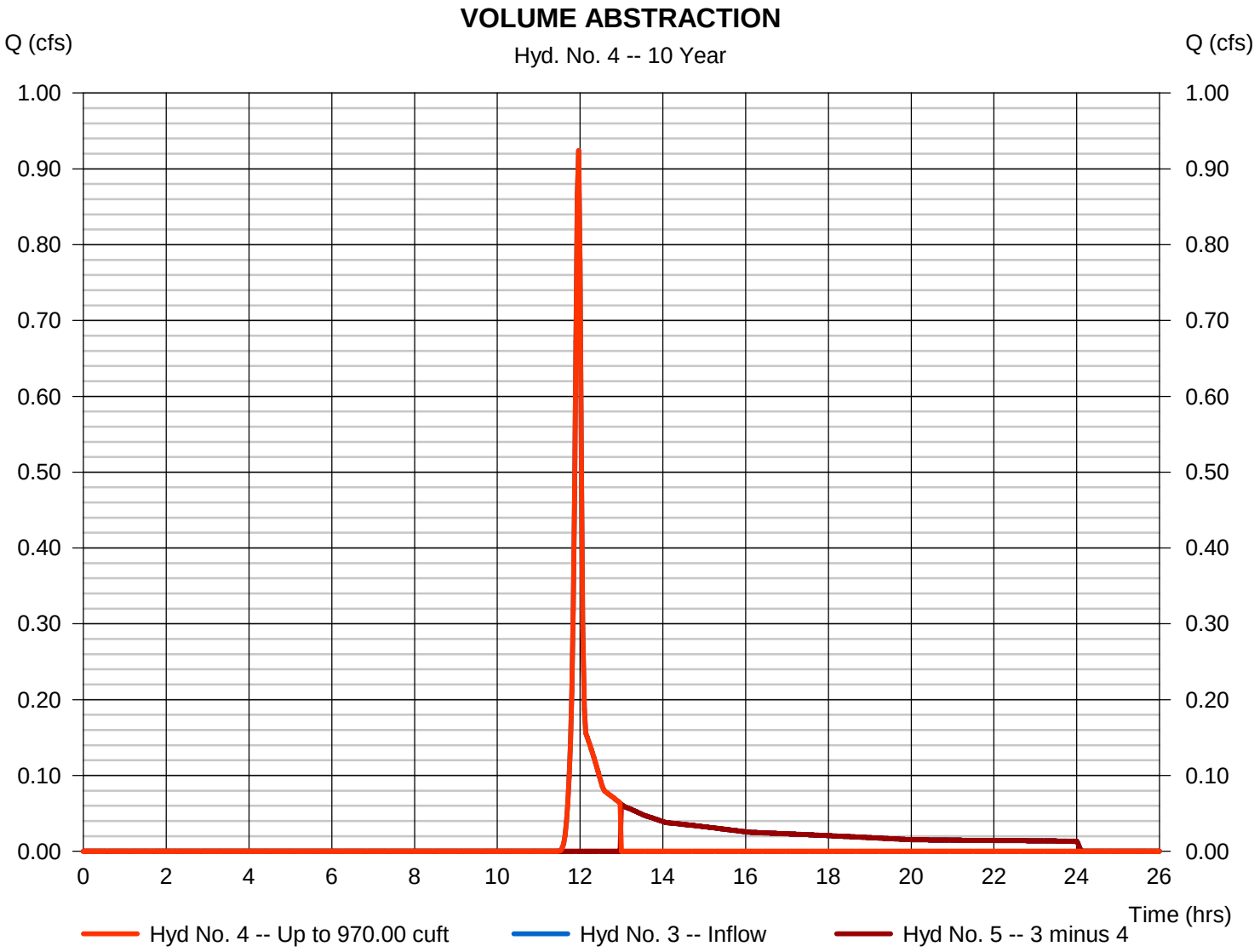


Hydrograph Report

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.924 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 978 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

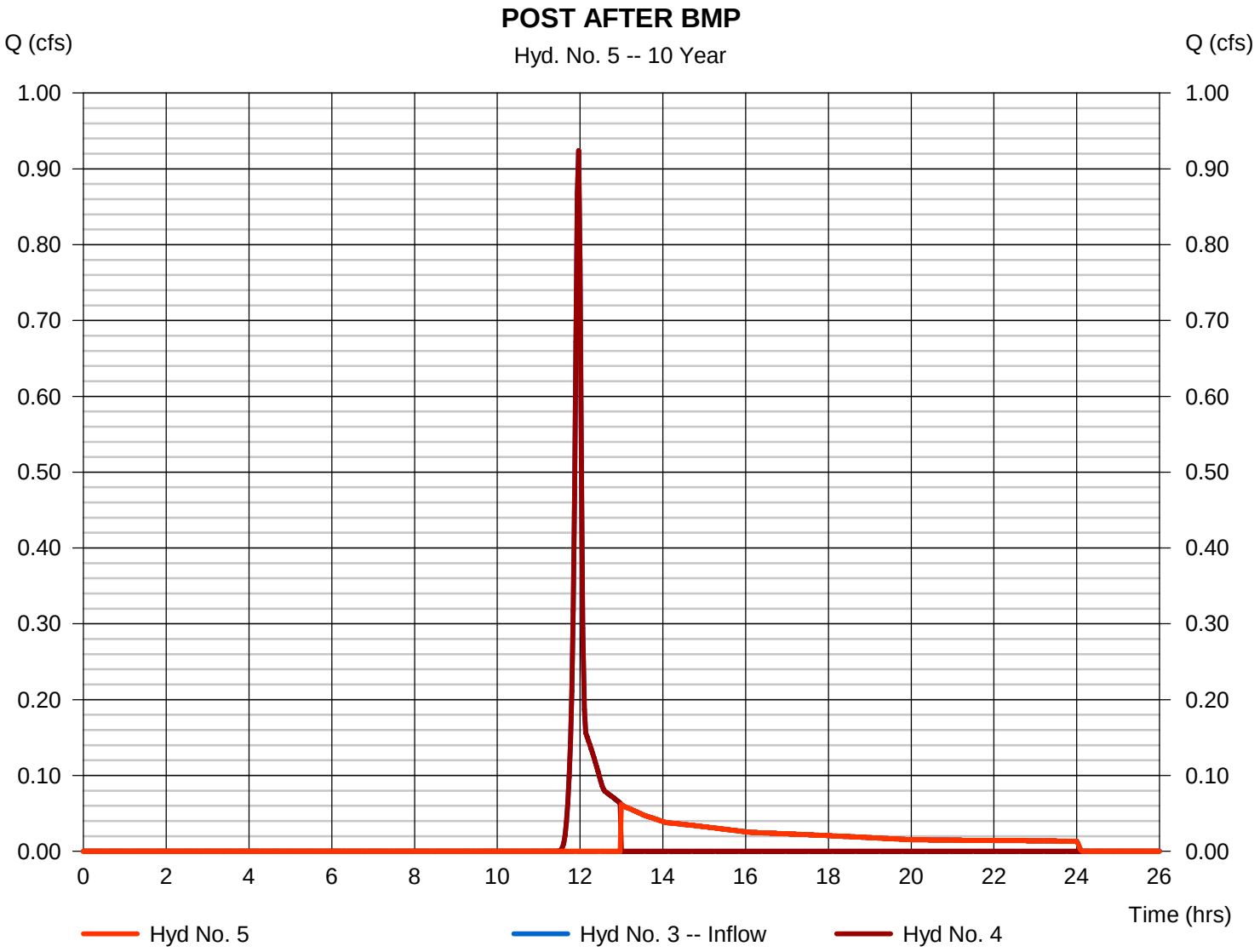


Hydrograph Report

Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.062 cfs
Storm frequency	= 10 yrs	Time to peak	= 13.00 hrs
Time interval	= 2 min	Hyd. volume	= 917 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

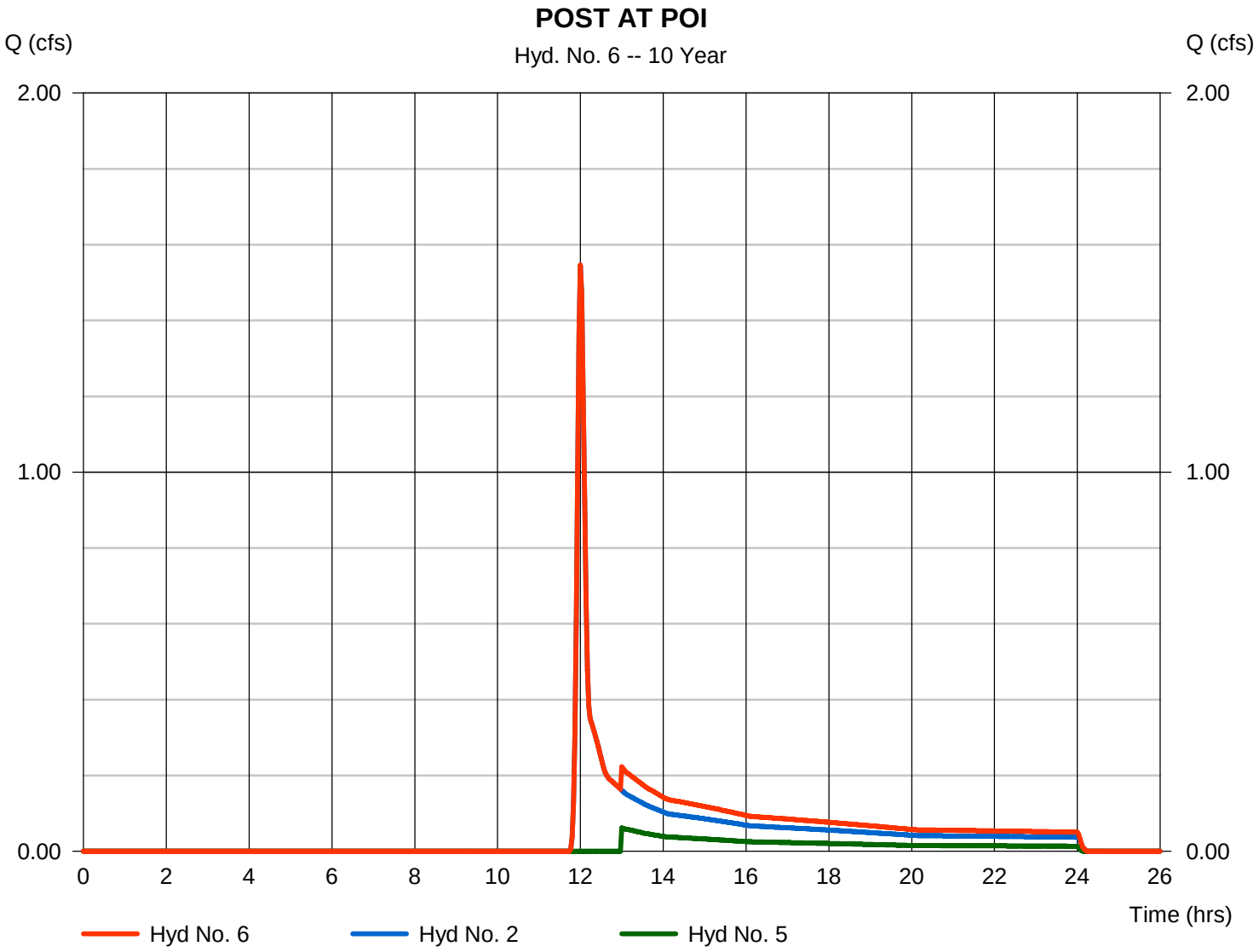


Hydrograph Report

Hyd. No. 6

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 1.546 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 5,244 cuft
Inflow hyds.	= 2, 5	Contrib. drain. area	= 1.950 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	5.441	1	719	11,975	------	------	------	PRE
2	SCS Runoff	3.956	2	720	9,467	------	------	------	POST UNDETAINED
3	SCS Runoff	1.832	2	718	3,664	------	------	------	POST DETAINED
4	Diversion1	1.832	2	718	1,153	3	------	------	VOLUME ABSTRACTION
5	Diversion2	1.501	2	720	2,510	3	------	------	POST AFTER BMP
6	Combine	5.457	2	720	11,977	2, 5	------	------	POST AT POI

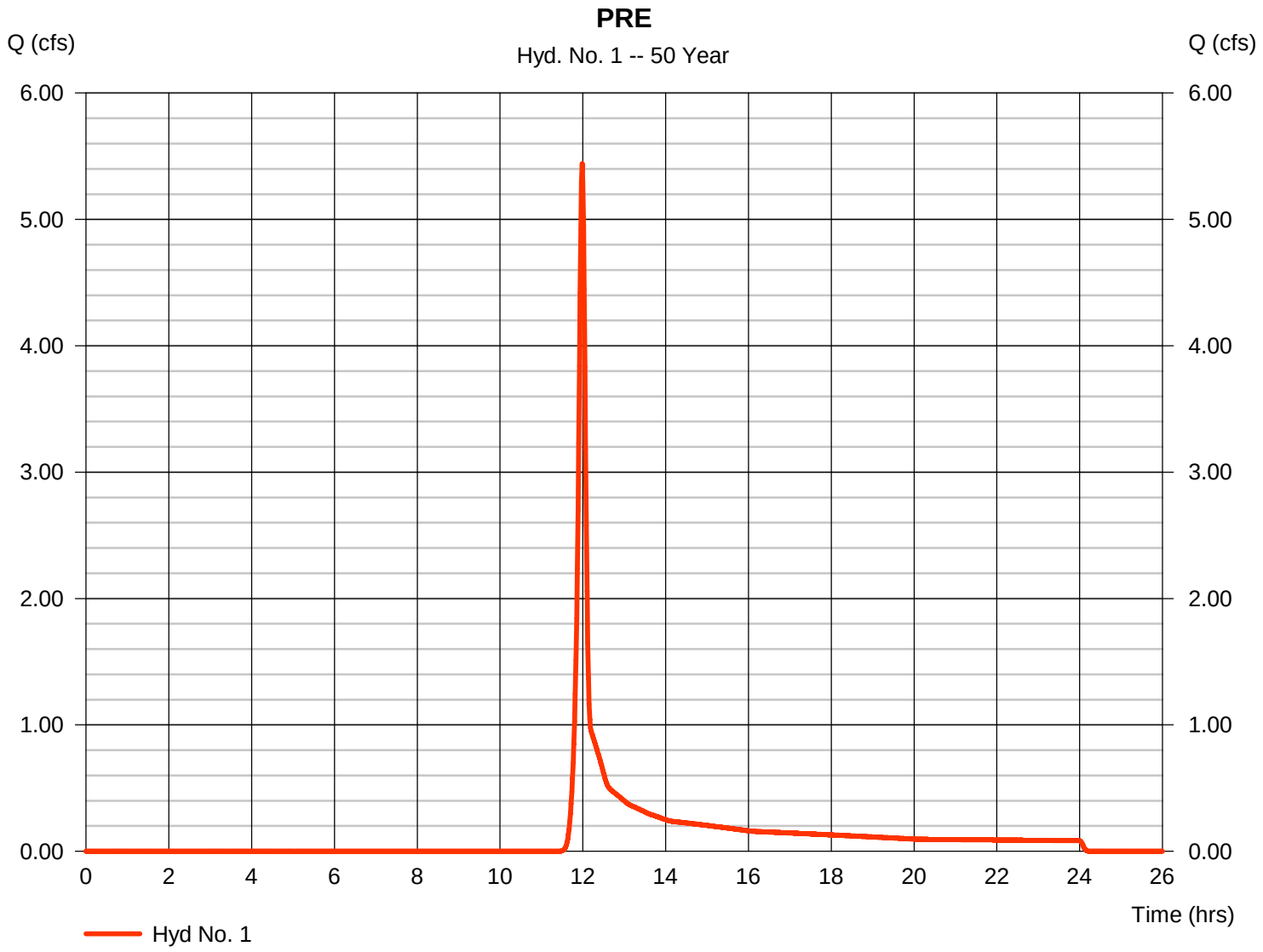
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.441 cfs
Storm frequency	=	50 yrs	Time to peak	=	11.98 hrs
Time interval	=	1 min	Hyd. volume	=	11,975 cuft
Drainage area	=	2.530 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.10 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.530 x 58)] / 2.530



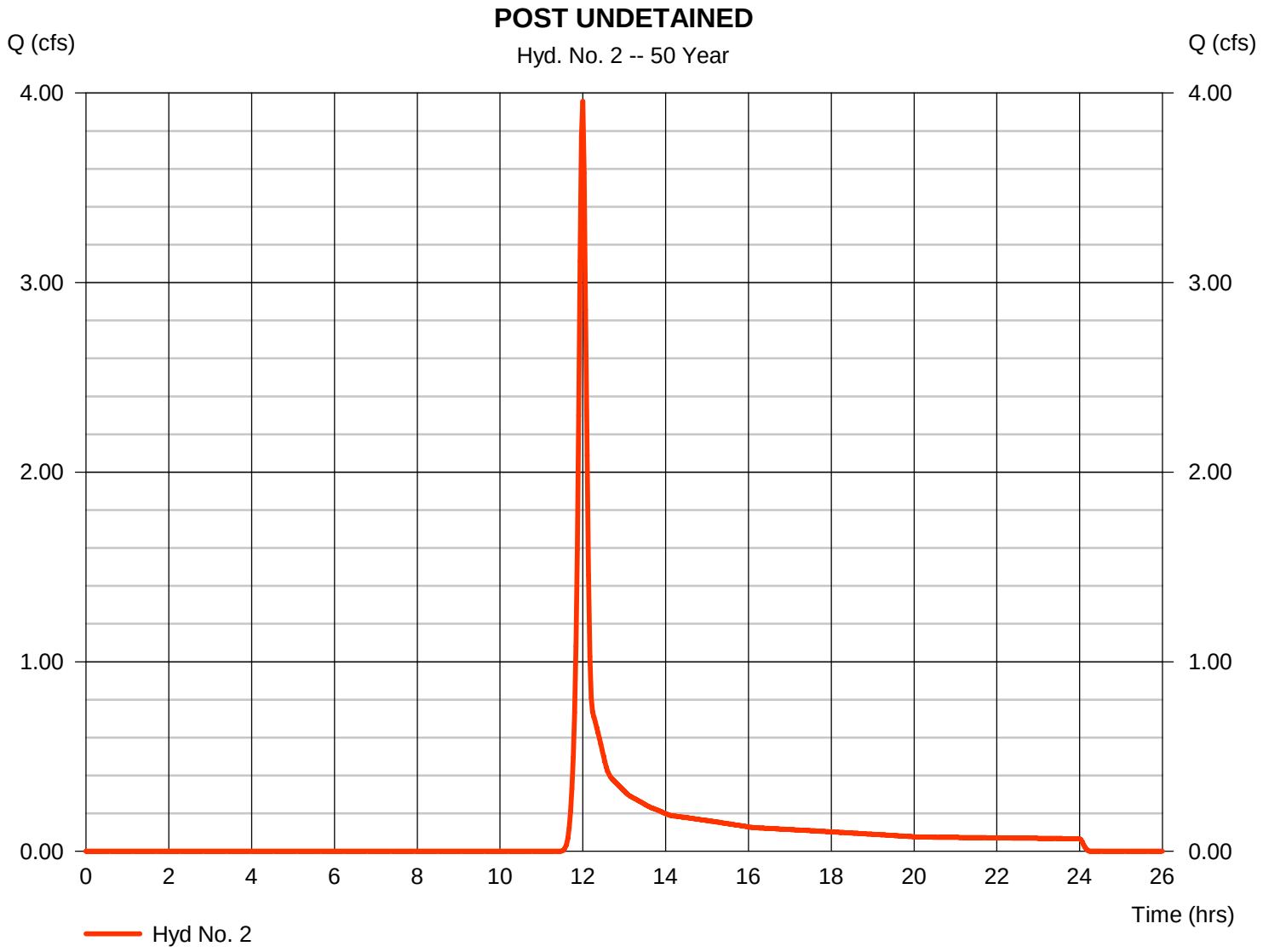
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.956 cfs
Storm frequency	=	50 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	9,467 cuft
Drainage area	=	1.950 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.60 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



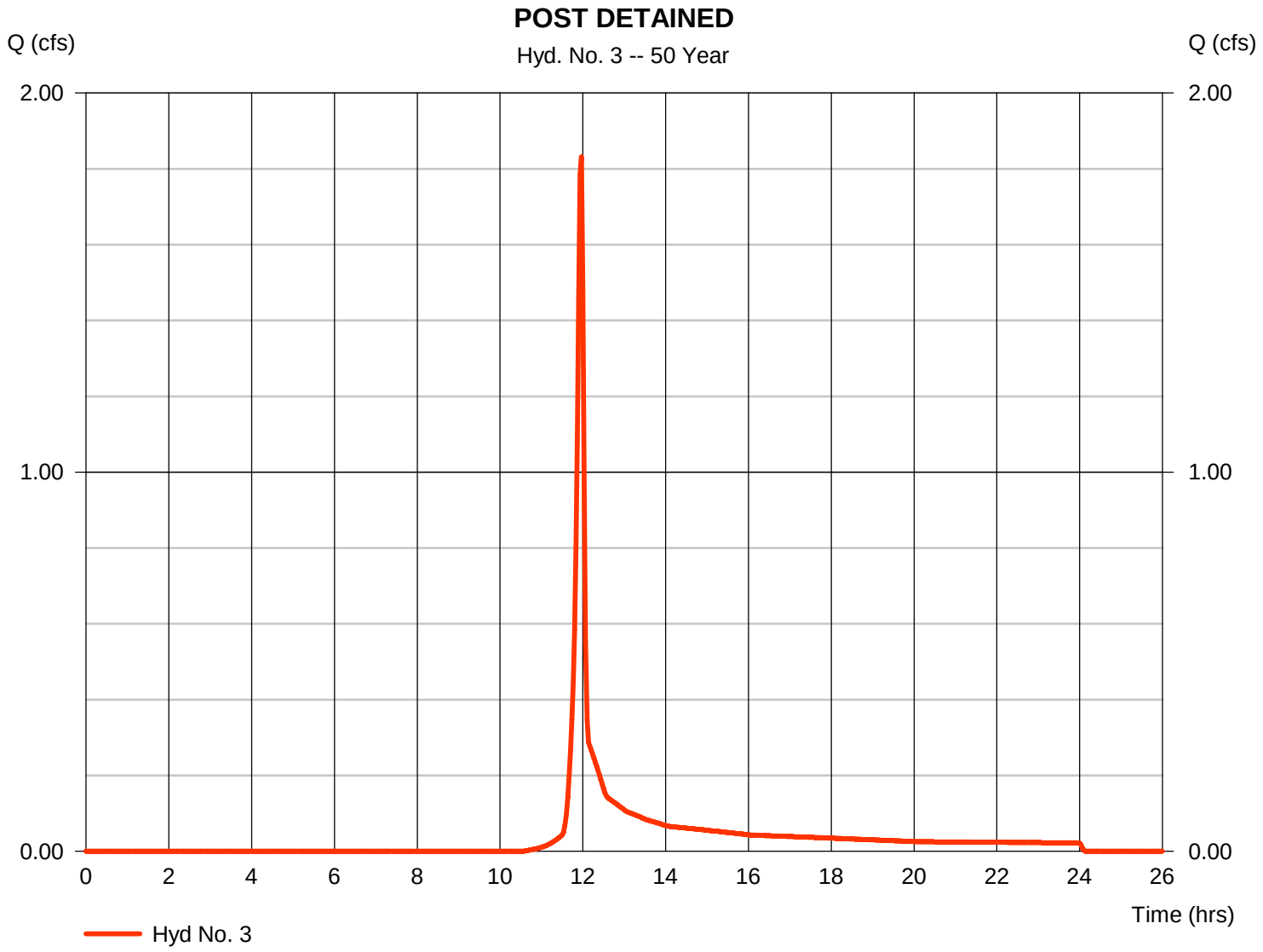
Hydrograph Report

Hyd. No. 3

POST DETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.832 cfs
Storm frequency	=	50 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	3,664 cuft
Drainage area	=	0.580 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.10 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580

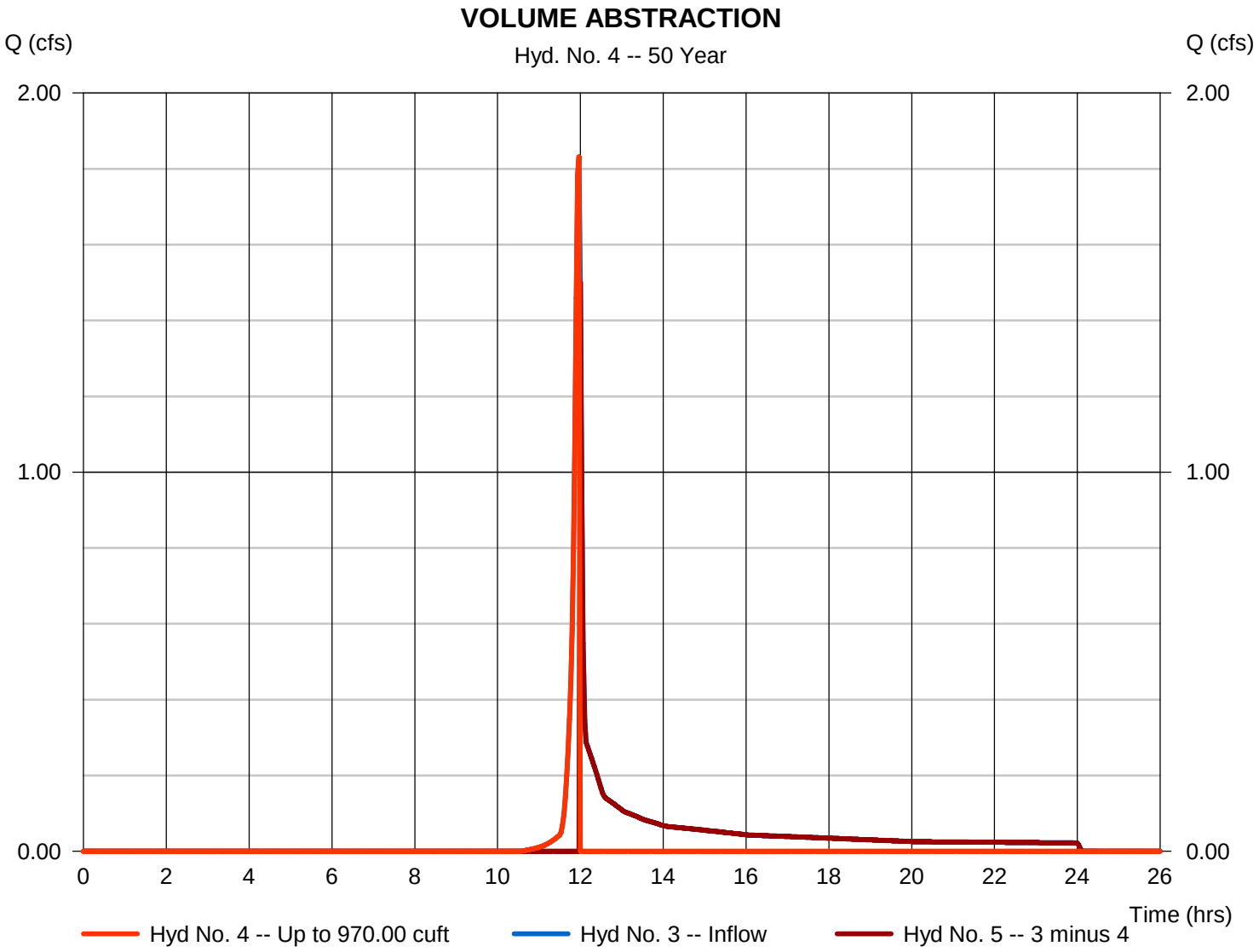


Hydrograph Report

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.832 cfs
Storm frequency	= 50 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 1,153 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

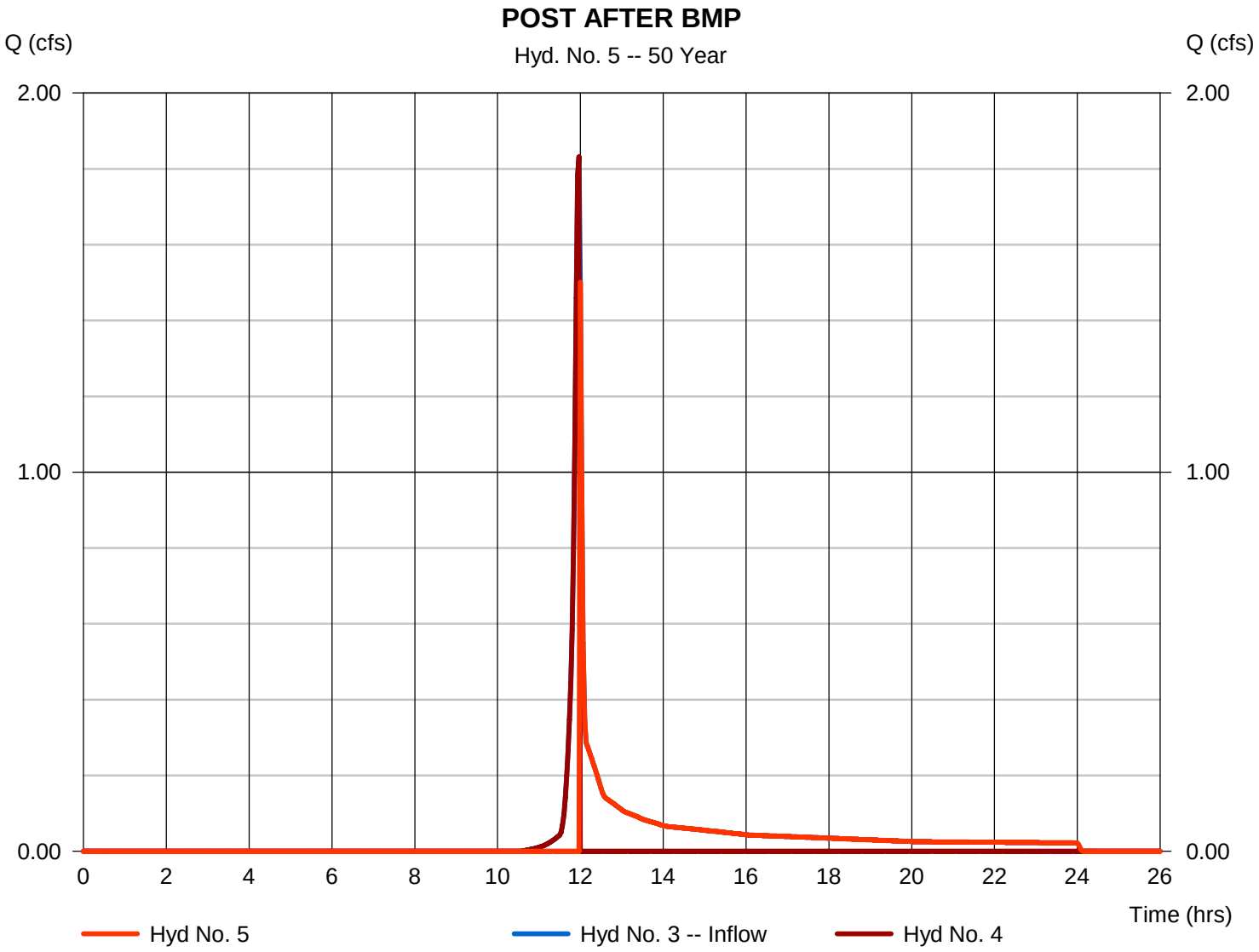


Hydrograph Report

Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 1.501 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 2,510 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

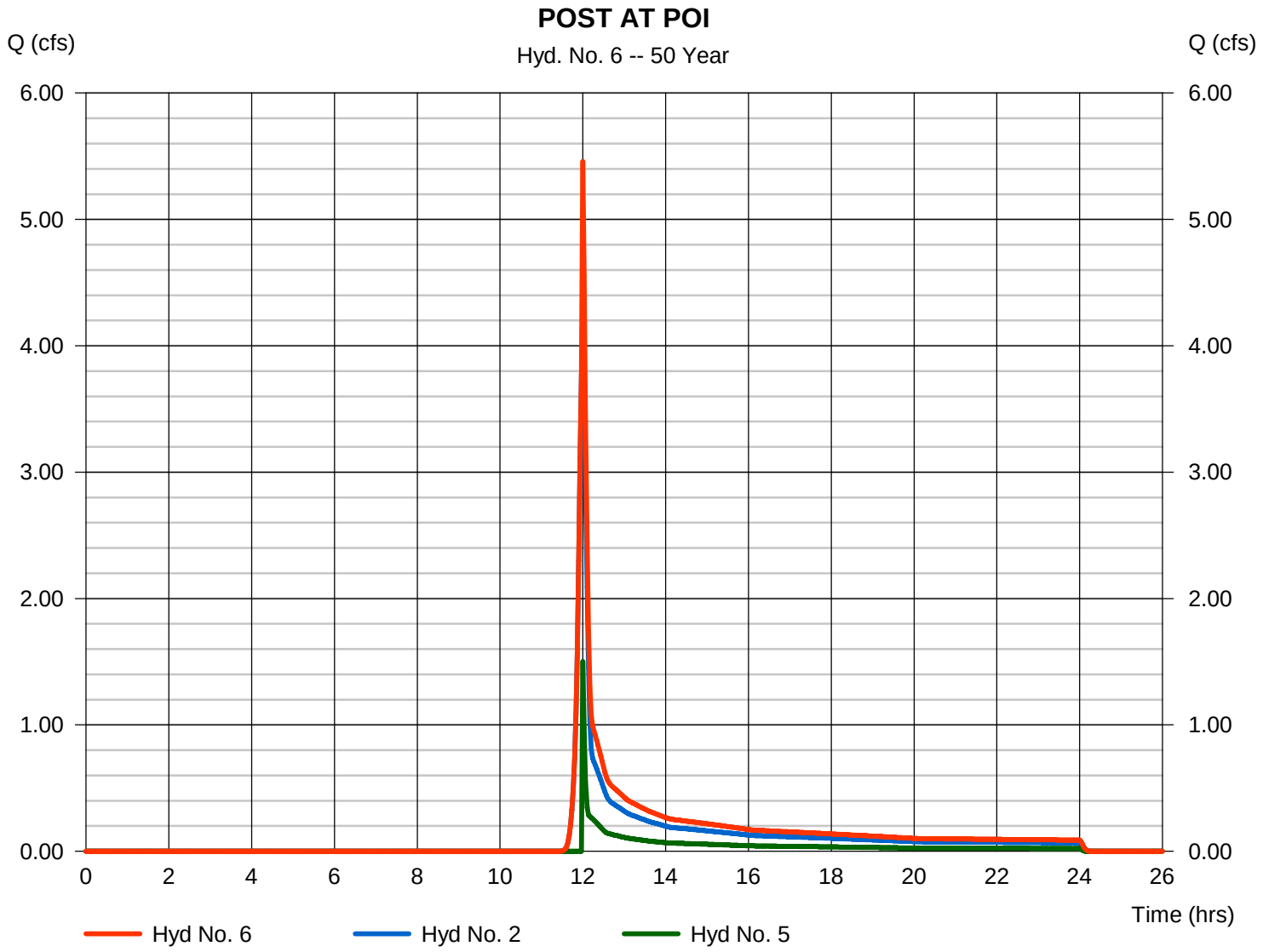


Hydrograph Report

Hyd. No. 6

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 5.457 cfs
Storm frequency	= 50 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 11,977 cuft
Inflow hyds.	= 2, 5	Contrib. drain. area	= 1.950 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	7.280	1	719	15,675	------	------	------	PRE
2	SCS Runoff	5.297	2	720	12,391	------	------	------	POST UNDETAINED
3	SCS Runoff	2.312	2	718	4,627	------	------	------	POST DETAINED
4	Diversion1	1.885	2	714	1,015	3	------	------	VOLUME ABSTRACTION
5	Diversion2	2.312	2	718	3,611	3	------	------	POST AFTER BMP
6	Combine	7.433	2	718	16,003	2, 5	------	------	POST AT POI

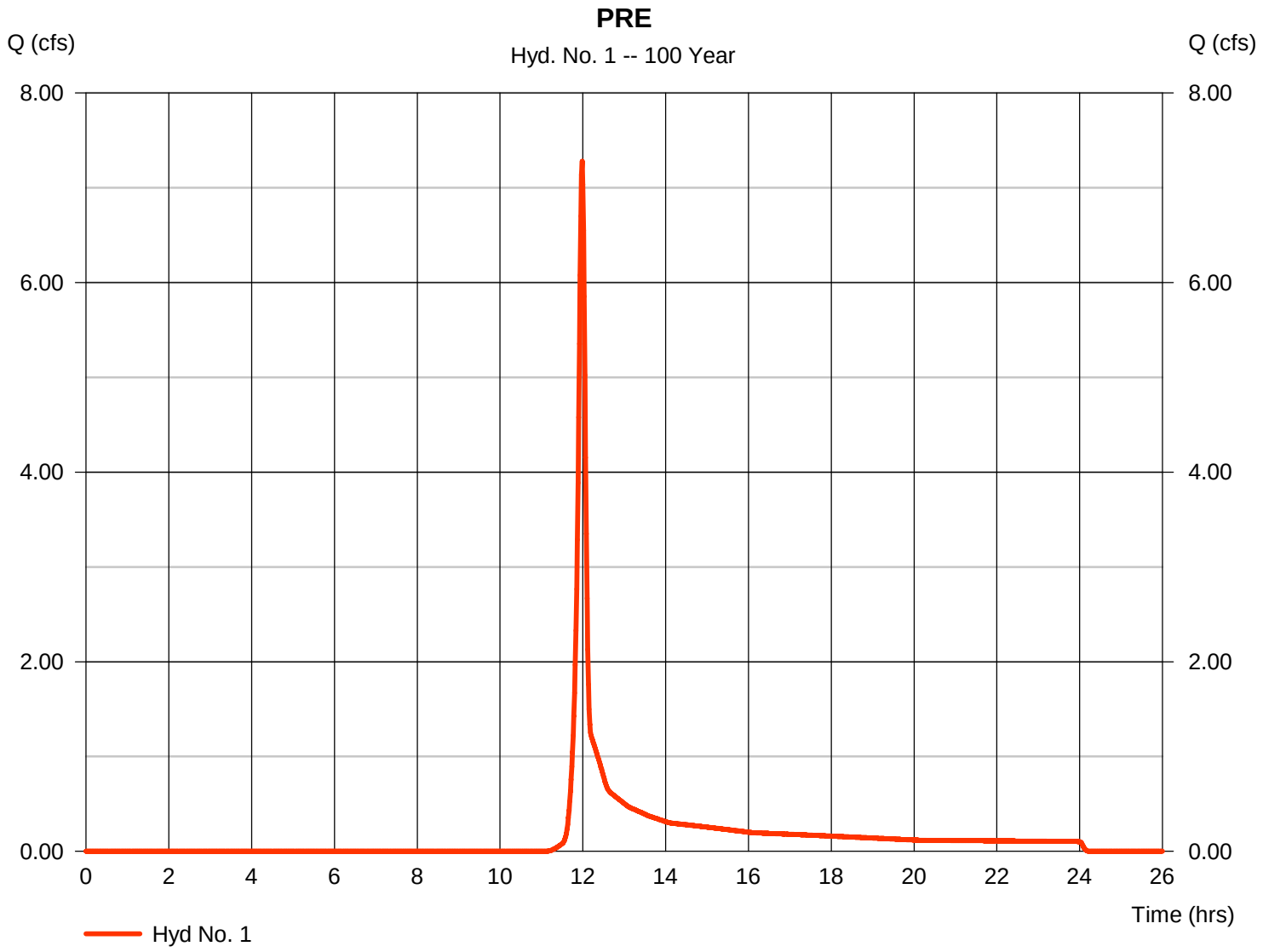
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.280 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.98 hrs
Time interval	=	1 min	Hyd. volume	=	15,675 cuft
Drainage area	=	2.530 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.10 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.530 x 58)] / 2.530



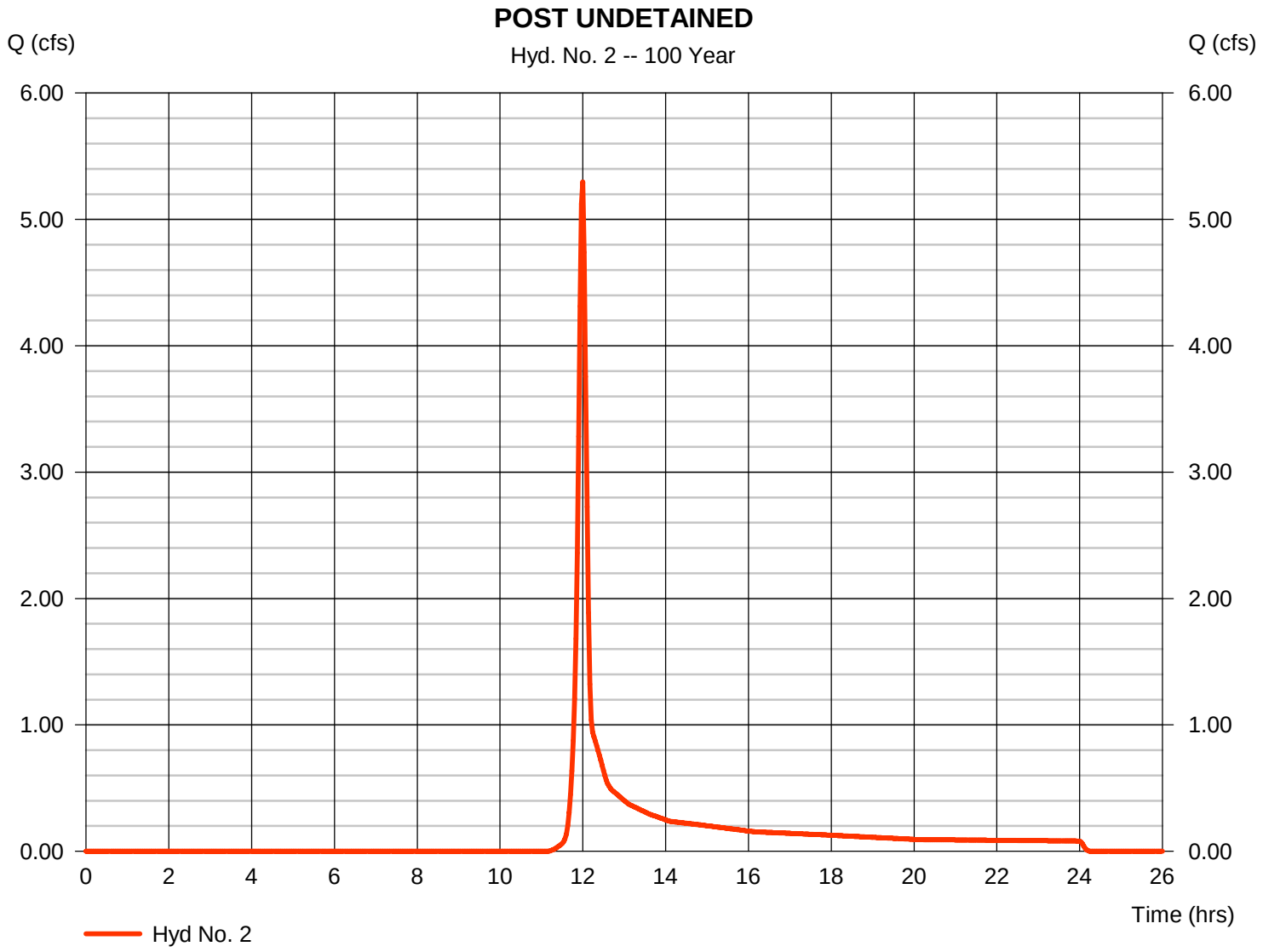
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.297 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	12,391 cuft
Drainage area	=	1.950 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.60 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



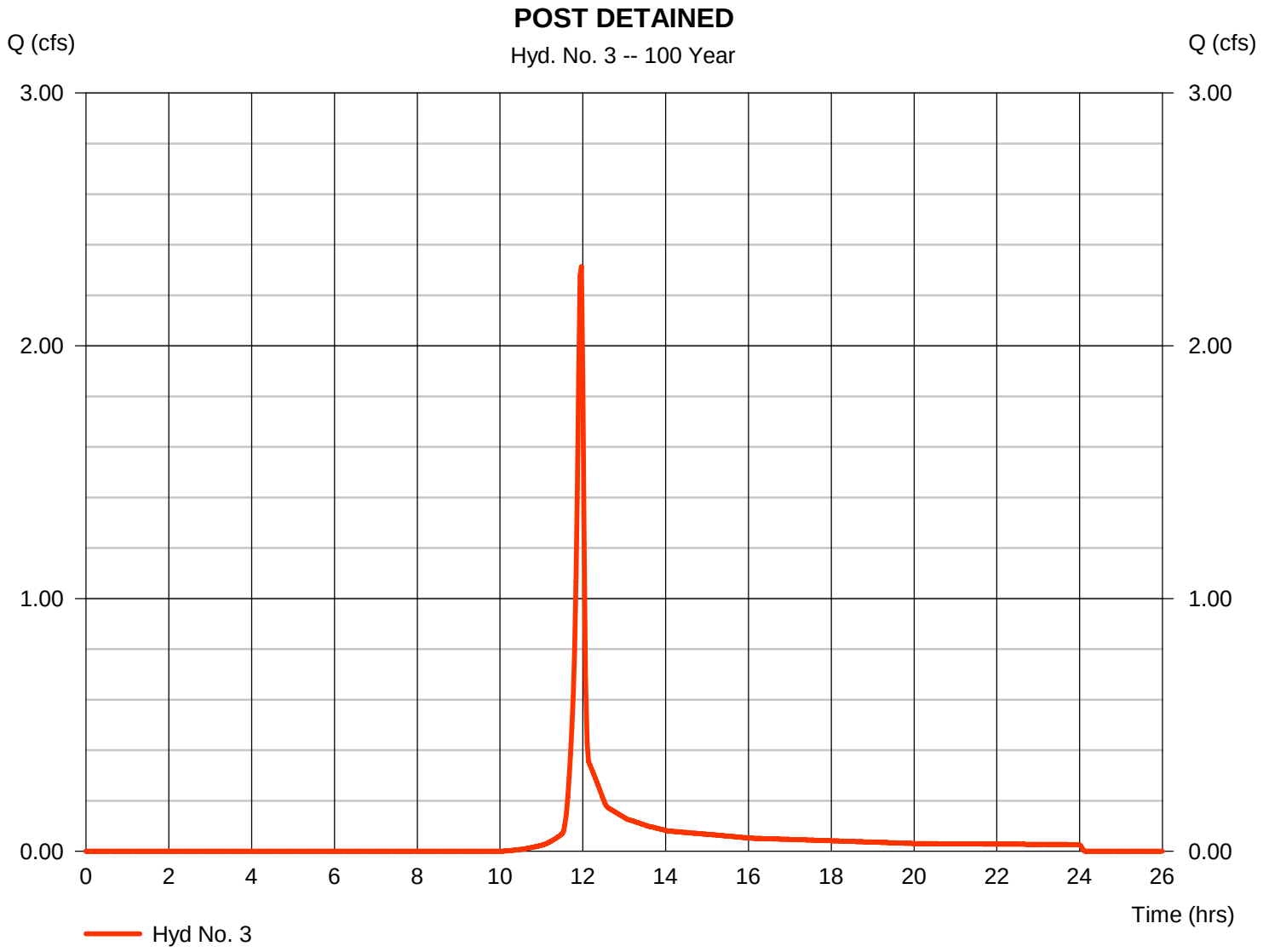
Hydrograph Report

Hyd. No. 3

POST DETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.312 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	4,627 cuft
Drainage area	=	0.580 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.10 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580

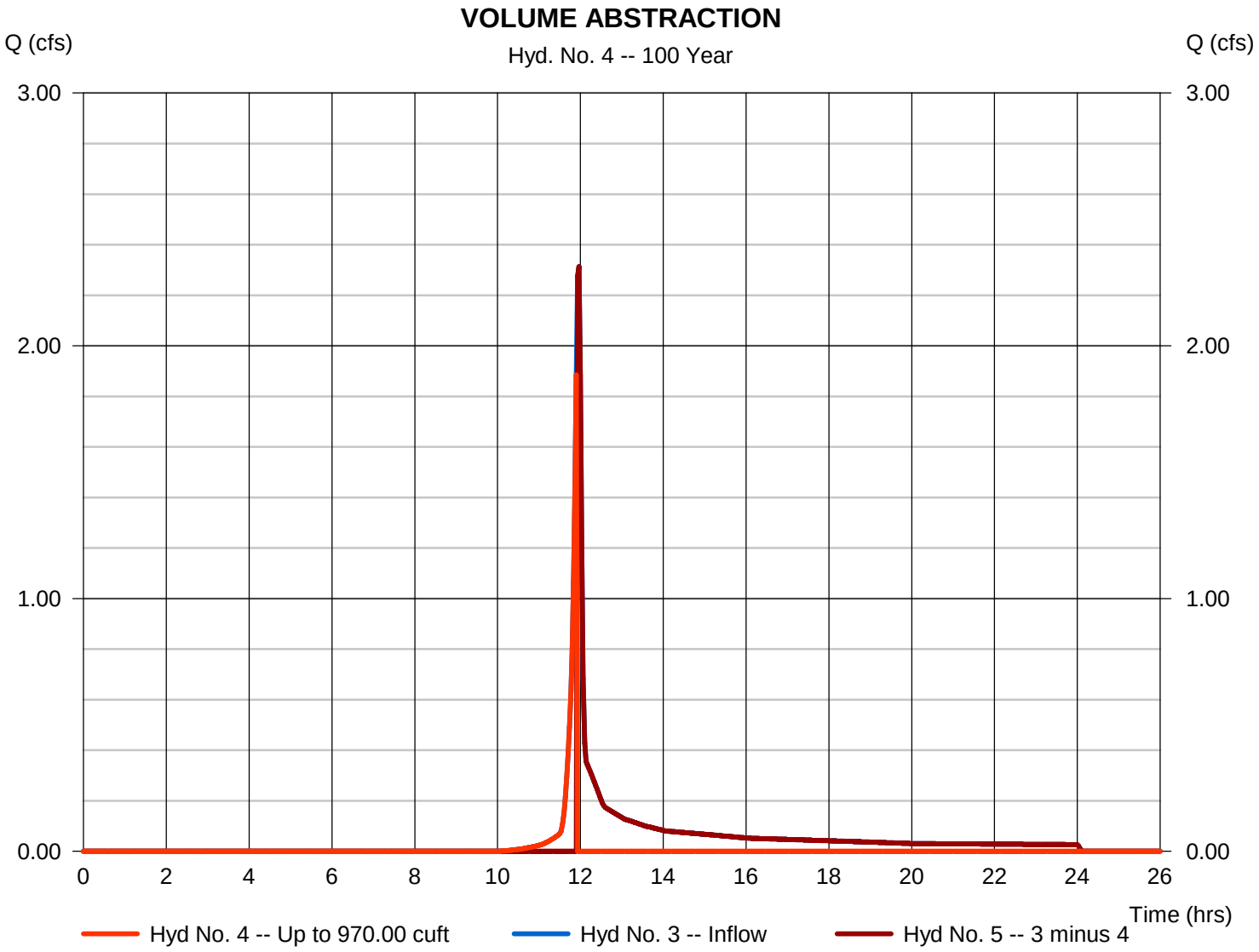


Hydrograph Report

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.885 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.90 hrs
Time interval	= 2 min	Hyd. volume	= 1,015 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

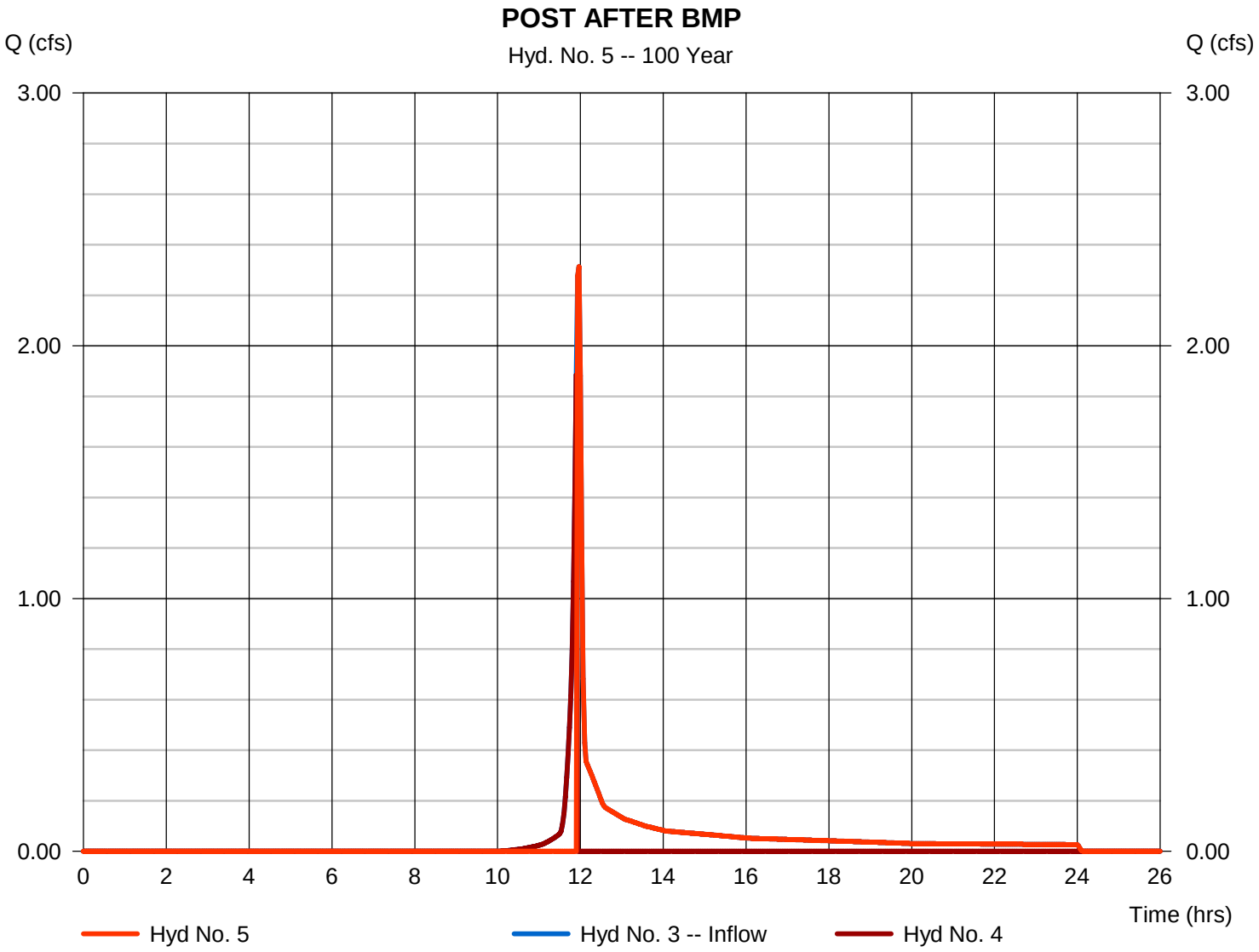


Hydrograph Report

Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 2.312 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 3,611 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

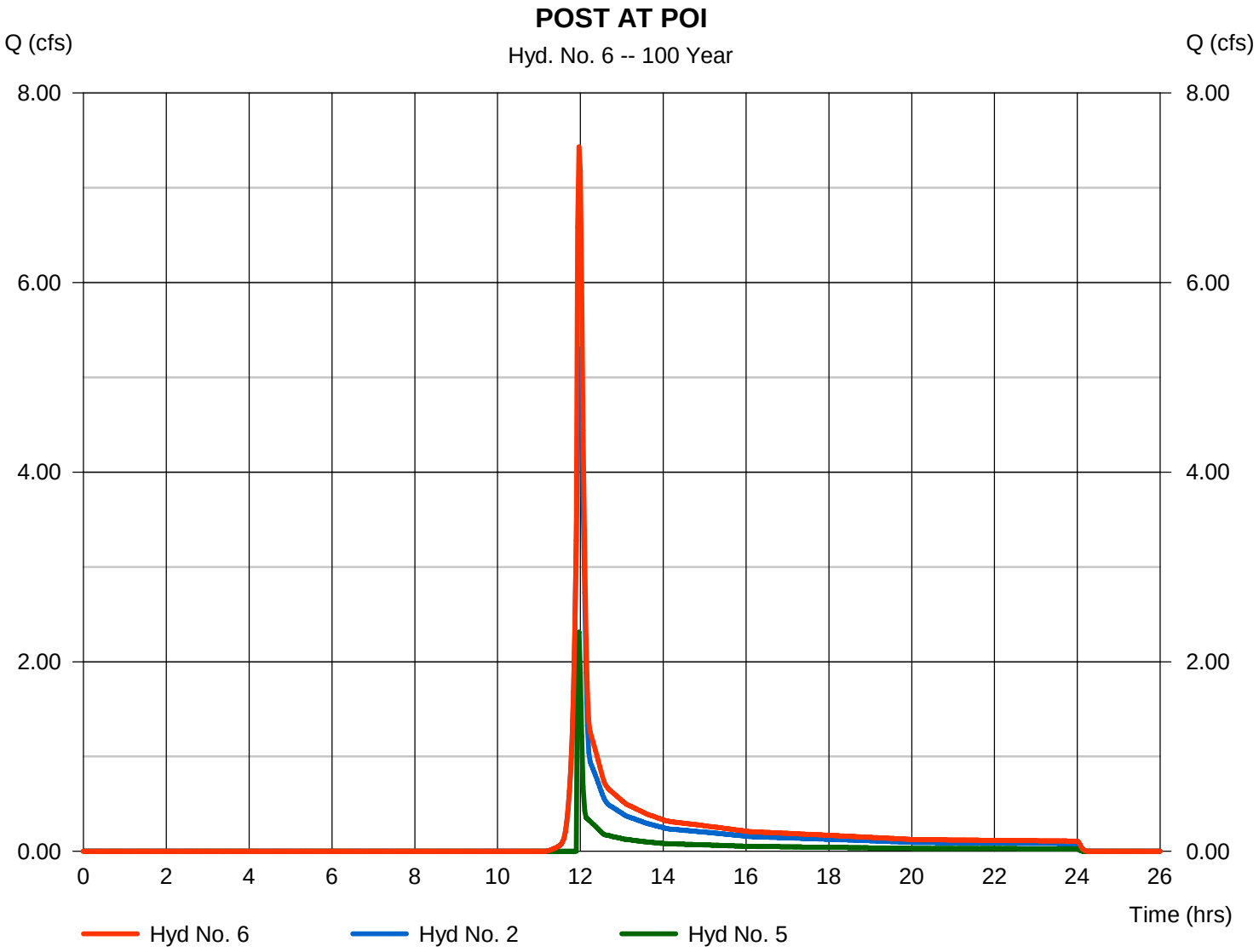


Hydrograph Report

Hyd. No. 6

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 7.433 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 16,003 cuft
Inflow hyds.	= 2, 5	Contrib. drain. area	= 1.950 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	39.8915	9.9000	0.8800	--------
2	47.2145	10.1000	0.8721	--------
3	0.0000	0.0000	0.0000	--------
5	49.1407	9.5000	0.8258	--------
10	46.6495	8.4000	0.7811	--------
25	46.5911	7.6000	0.7402	--------
50	44.7104	6.7000	0.7024	--------
100	42.4007	5.8000	0.6641	--------

File name: Valley Forge 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	3.70	2.87	2.36	2.01	1.75	1.56	1.40	1.28	1.18	1.09	1.01	0.95
2	4.42	3.45	2.84	2.42	2.12	1.89	1.70	1.55	1.43	1.33	1.24	1.16
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	5.40	4.23	3.50	3.00	2.64	2.36	2.14	1.96	1.81	1.68	1.57	1.48
10	6.14	4.80	3.98	3.42	3.01	2.70	2.45	2.25	2.09	1.95	1.83	1.72
25	7.14	5.58	4.64	4.00	3.53	3.18	2.90	2.67	2.48	2.32	2.18	2.06
50	7.95	6.19	5.15	4.45	3.95	3.56	3.25	3.01	2.80	2.62	2.47	2.34
100	8.73	6.78	5.65	4.90	4.35	3.94	3.61	3.35	3.12	2.93	2.77	2.63

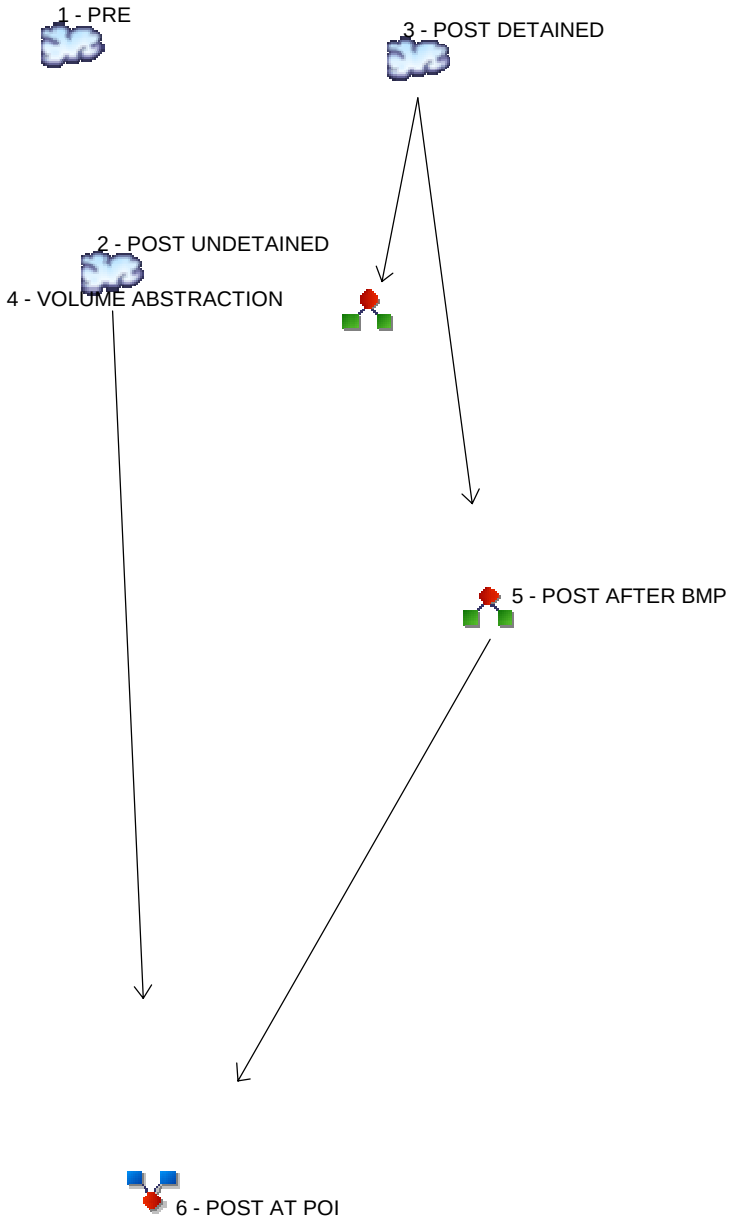
Tc = time in minutes. Values may exceed 60.

ESCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Valley Forge\Hydraflow Rev 1\Valley Forge 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	2.24	2.69	0.00	3.34	3.88	4.65	5.30	5.99
SCS 6-Hr	1.48	1.78	0.00	2.23	2.59	3.12	3.56	4.03
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
4	Diversion1	VOLUME ABSTRACTION
5	Diversion2	POST AFTER BMP
6	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	------	-------	0.276	-------	-------	-------	-------	-------	-------	PRE
2	SCS Runoff	------	-------	0.185	-------	-------	-------	-------	-------	-------	POST UNDETAINED
3	SCS Runoff	------	-------	0.091	-------	-------	-------	-------	-------	-------	POST DETAINED
4	Diversion1	3	-------	0.091	-------	-------	-------	-------	-------	-------	VOLUME ABSTRACTION
5	Diversion2	3	-------	0.000	-------	-------	-------	-------	-------	-------	POST AFTER BMP
6	Combine	2, 5	-------	0.185	-------	-------	-------	-------	-------	-------	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	0.276	1	722	1,627	------	------	------	PRE
2	SCS Runoff	0.185	2	722	1,283	------	------	------	POST UNDETAINED
3	SCS Runoff	0.091	2	746	776	------	------	------	POST DETAINED
4	Diversion1	0.091	2	746	776	3	------	------	VOLUME ABSTRACTION
5	Diversion2	0.000	2	n/a	0	3	------	------	POST AFTER BMP
6	Combine	0.185	2	722	1,283	2, 5	------	------	POST AT POI

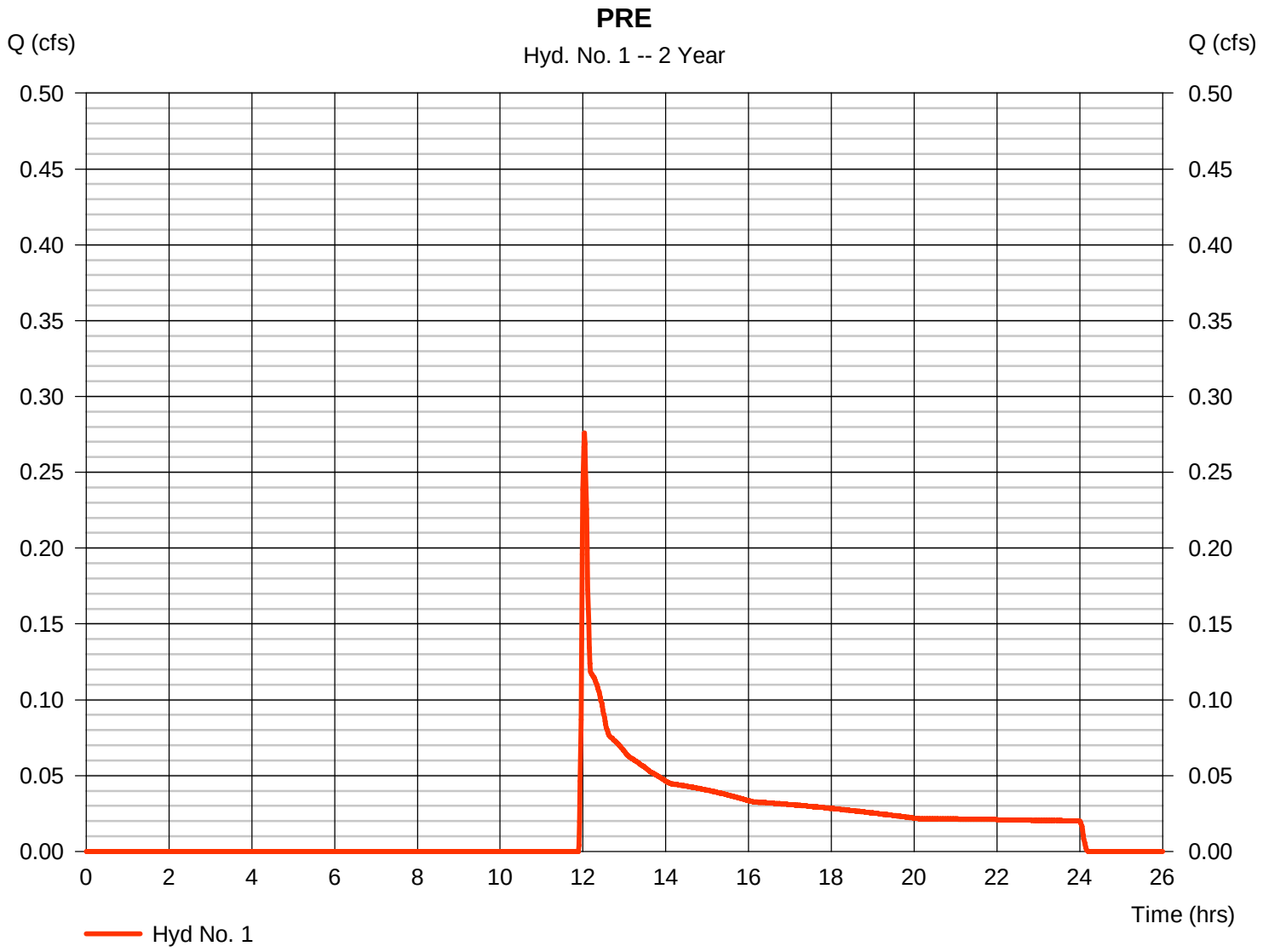
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.276 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.03 hrs
Time interval	=	1 min	Hyd. volume	=	1,627 cuft
Drainage area	=	2.530 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.10 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.530 x 58)] / 2.530



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)	= 2.69		0.00		0.00		
Land slope (%)	= 5.79		0.00		0.00		
Travel Time (min)	**= 5.84**	**+**	**0.00**	**+**	**0.00**	**=**	**5.84**
Shallow Concentrated Flow							
Flow length (ft)	= 671.00		0.00		0.00		
Watercourse slope (%)	= 15.66		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=6.38		0.00		0.00		
Travel Time (min)	**= 1.75**	**+**	**0.00**	**+**	**0.00**	**=**	**1.75**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 0.56		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=5.11						
			0.00				
					0.00		
Flow length (ft)	({0})140.0		0.0		0.0		
Travel Time (min)	**= 0.46**	**+**	**0.00**	**+**	**0.00**	**=**	**0.46**

Total Travel Time, Tc ..... 8.10 min

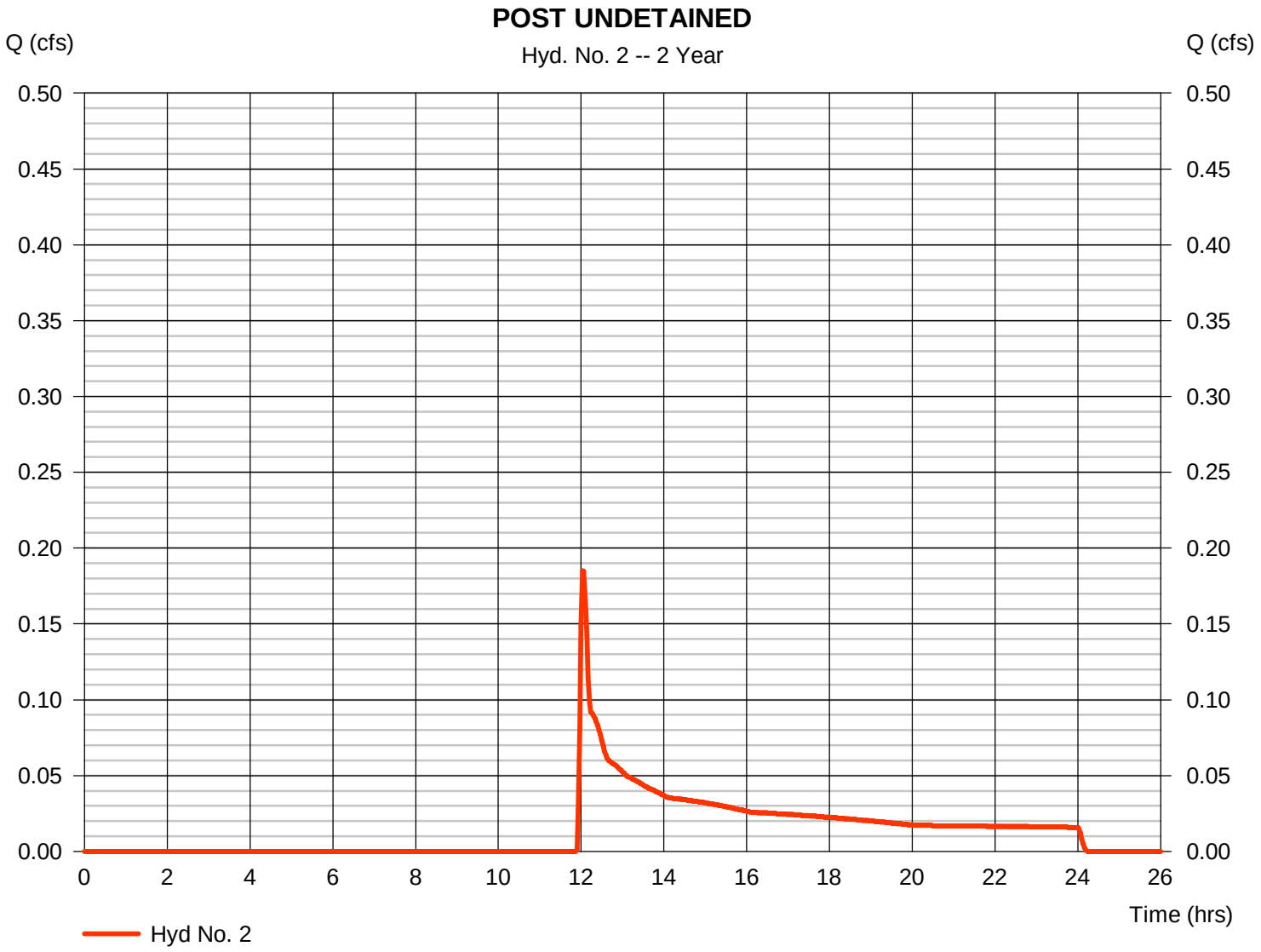
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.185 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 1,283 cuft
Drainage area	= 1.950 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.60 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



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)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.69		0.00		0.00		
Land slope (%)	= 7.00		0.00		0.00		
Travel Time (min)	**= 5.42**	**+**	**0.00**	**+**	**0.00**	**=**	**5.42**
Shallow Concentrated Flow							
Flow length (ft)	= 422.00		43.00		0.00		
Watercourse slope (%)	= 16.00		9.30		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=6.45		6.20		0.00		
Travel Time (min)	**= 1.09**	**+**	**0.12**	**+**	**0.00**	**=**	**1.21**
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 ..... 6.60 min

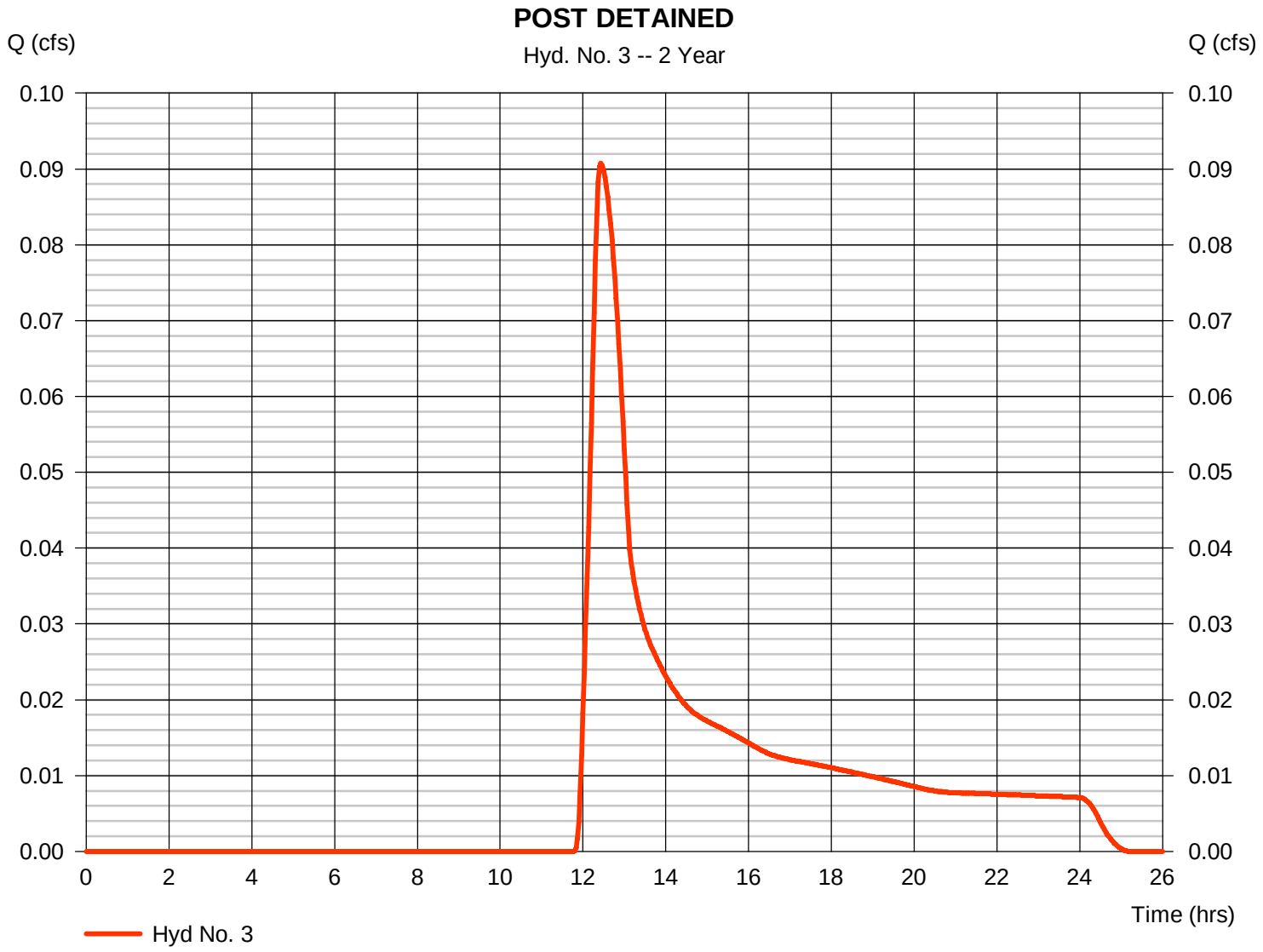
Hydrograph Report

Hyd. No. 3

POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.091 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.43 hrs
Time interval	= 2 min	Hyd. volume	= 776 cuft
Drainage area	= 0.580 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 46.70 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580

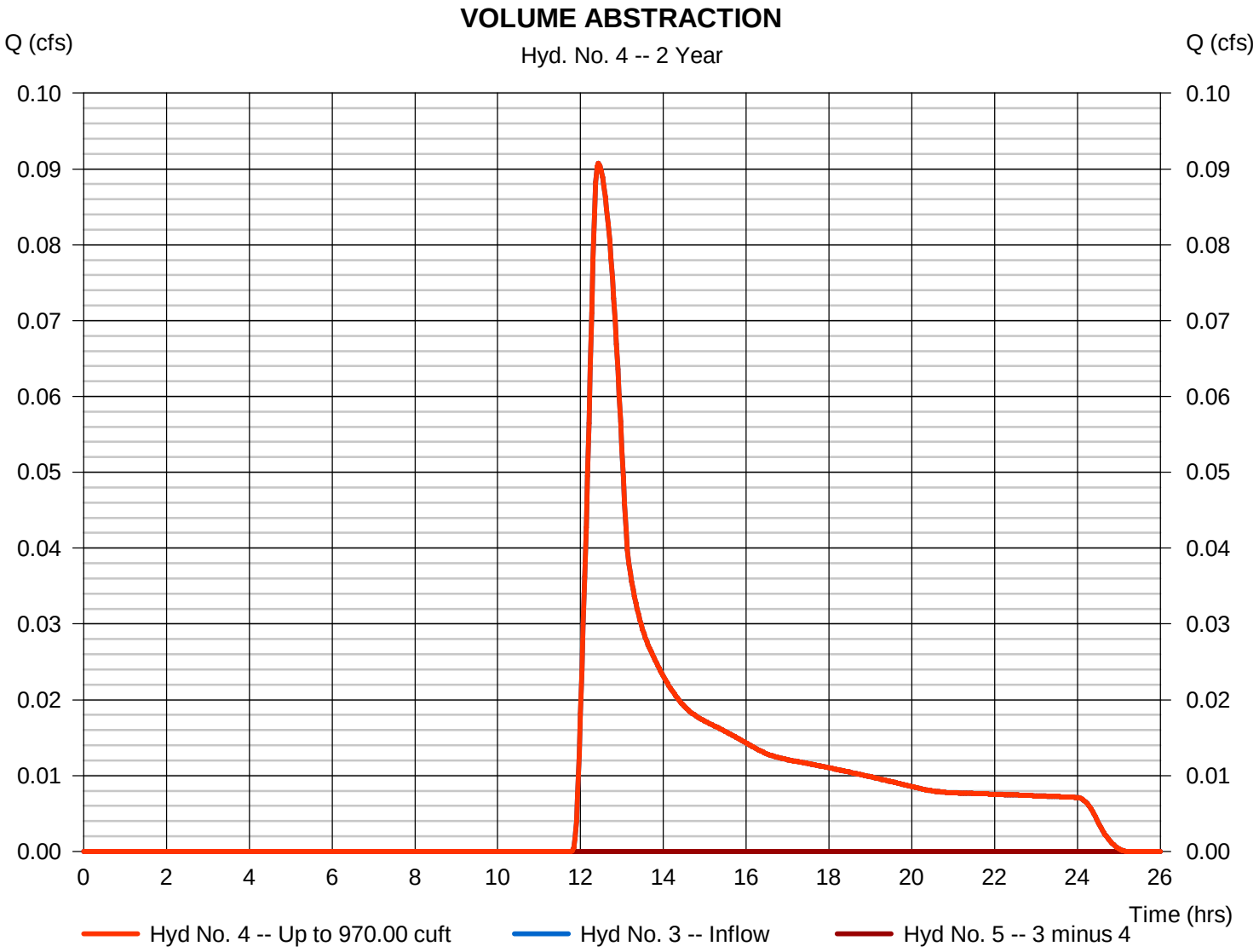


Hydrograph Report

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.091 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.43 hrs
Time interval	= 2 min	Hyd. volume	= 776 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

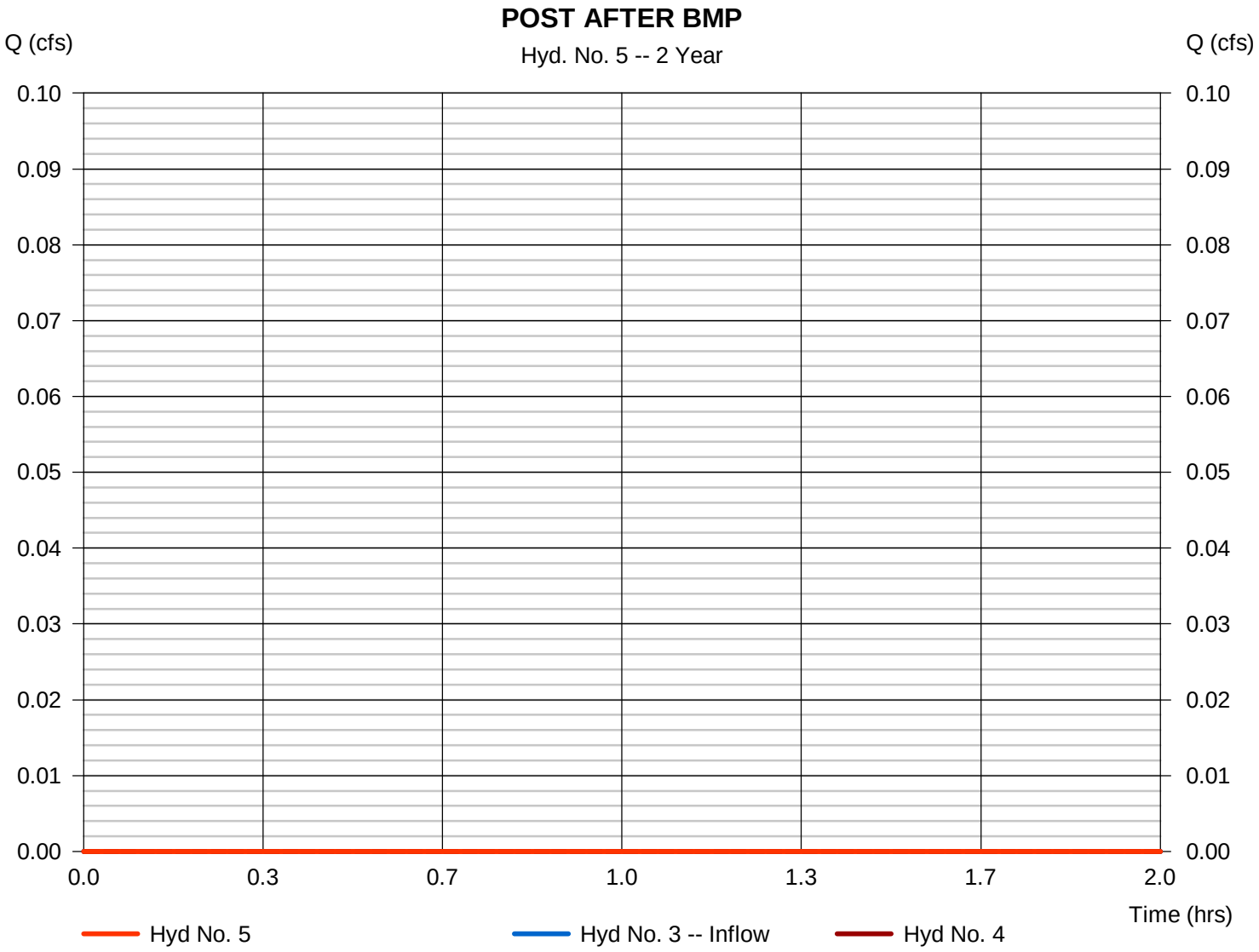


Hydrograph Report

Hyd. No. 5

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	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

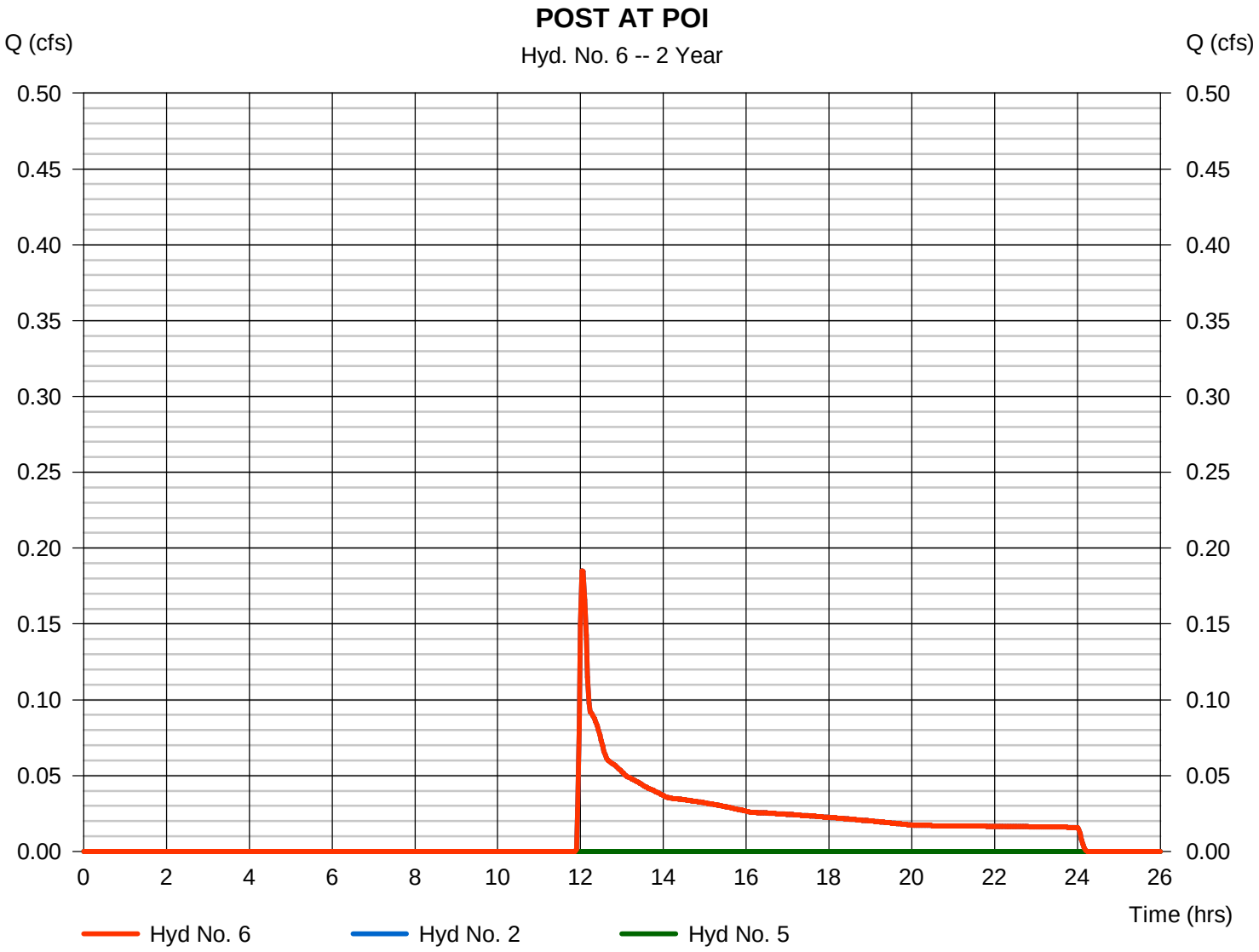


Hydrograph Report

Hyd. No. 6

POST AT POI

Hydrograph type	=	Combine	Peak discharge	=	0.185 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	1,283 cuft
Inflow hyds.	=	2, 5	Contrib. drain. area	=	1.950 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	39.8915	9.9000	0.8800	--------
2	47.2145	10.1000	0.8721	--------
3	0.0000	0.0000	0.0000	--------
5	49.1407	9.5000	0.8258	--------
10	46.6495	8.4000	0.7811	--------
25	46.5911	7.6000	0.7402	--------
50	44.7104	6.7000	0.7024	--------
100	42.4007	5.8000	0.6641	--------

File name: Valley Forge 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	3.70	2.87	2.36	2.01	1.75	1.56	1.40	1.28	1.18	1.09	1.01	0.95
2	4.42	3.45	2.84	2.42	2.12	1.89	1.70	1.55	1.43	1.33	1.24	1.16
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	5.40	4.23	3.50	3.00	2.64	2.36	2.14	1.96	1.81	1.68	1.57	1.48
10	6.14	4.80	3.98	3.42	3.01	2.70	2.45	2.25	2.09	1.95	1.83	1.72
25	7.14	5.58	4.64	4.00	3.53	3.18	2.90	2.67	2.48	2.32	2.18	2.06
50	7.95	6.19	5.15	4.45	3.95	3.56	3.25	3.01	2.80	2.62	2.47	2.34
100	8.73	6.78	5.65	4.90	4.35	3.94	3.61	3.35	3.12	2.93	2.77	2.63

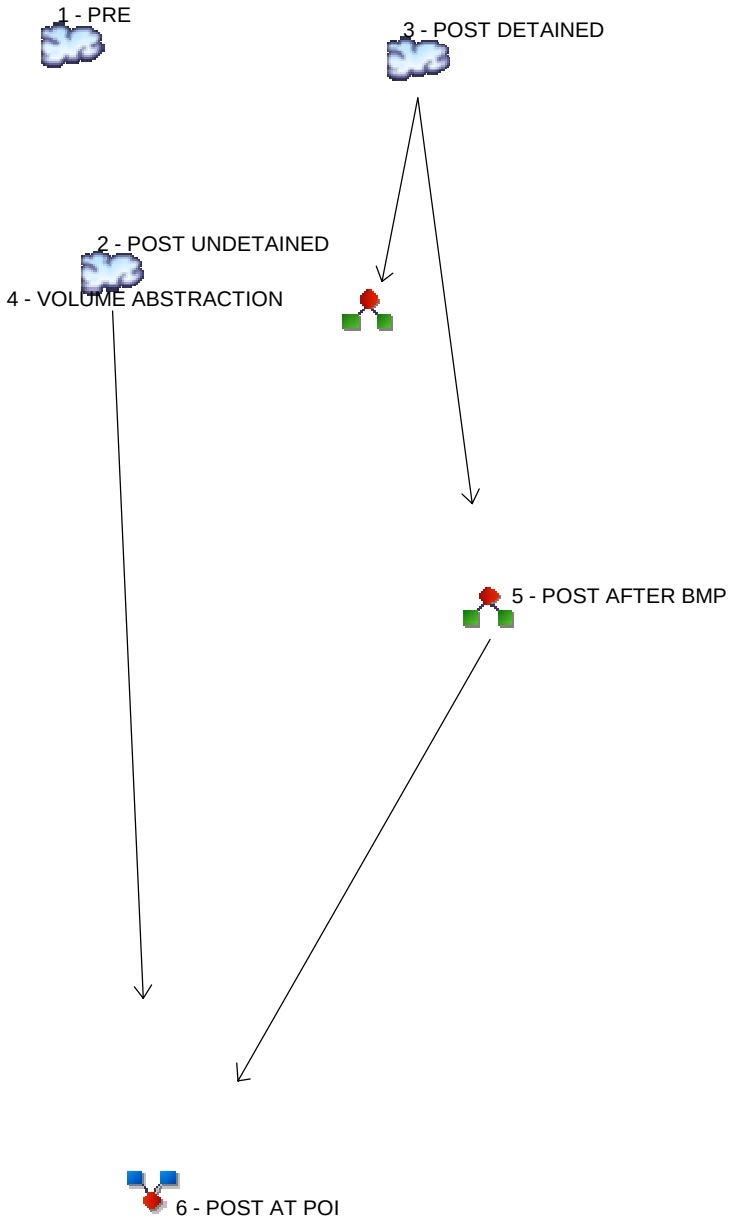
Tc = time in minutes. Values may exceed 60.

ESCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Valley Forge\Hydraflow Rev 1\Valley Forge 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	2.24	2.69	0.00	3.34	3.88	4.65	5.30	5.99
SCS 6-Hr	1.48	1.78	0.00	2.23	2.59	3.12	3.56	4.03
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
4	Diversion1	VOLUME ABSTRACTION
5	Diversion2	POST AFTER BMP
6	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	------	-------	-------	-------	-------	2.141	-------	-------	-------	PRE
2	SCS Runoff	------	-------	-------	-------	-------	1.546	-------	-------	-------	POST UNDETAINED
3	SCS Runoff	------	-------	-------	-------	-------	0.473	-------	-------	-------	POST DETAINED
4	Diversion1	3	-------	-------	-------	-------	0.473	-------	-------	-------	VOLUME ABSTRACTION
5	Diversion2	3	-------	-------	-------	-------	0.075	-------	-------	-------	POST AFTER BMP
6	Combine	2, 5	-------	-------	-------	-------	1.546	-------	-------	-------	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	2.141	1	720	5,474	------	------	------	PRE
2	SCS Runoff	1.546	2	720	4,327	------	------	------	POST UNDETAINED
3	SCS Runoff	0.473	2	730	1,989	------	------	------	POST DETAINED
4	Diversion1	0.473	2	730	971	3	------	------	VOLUME ABSTRACTION
5	Diversion2	0.075	2	782	1,018	3	------	------	POST AFTER BMP
6	Combine	1.546	2	720	5,345	2, 5	------	------	POST AT POI

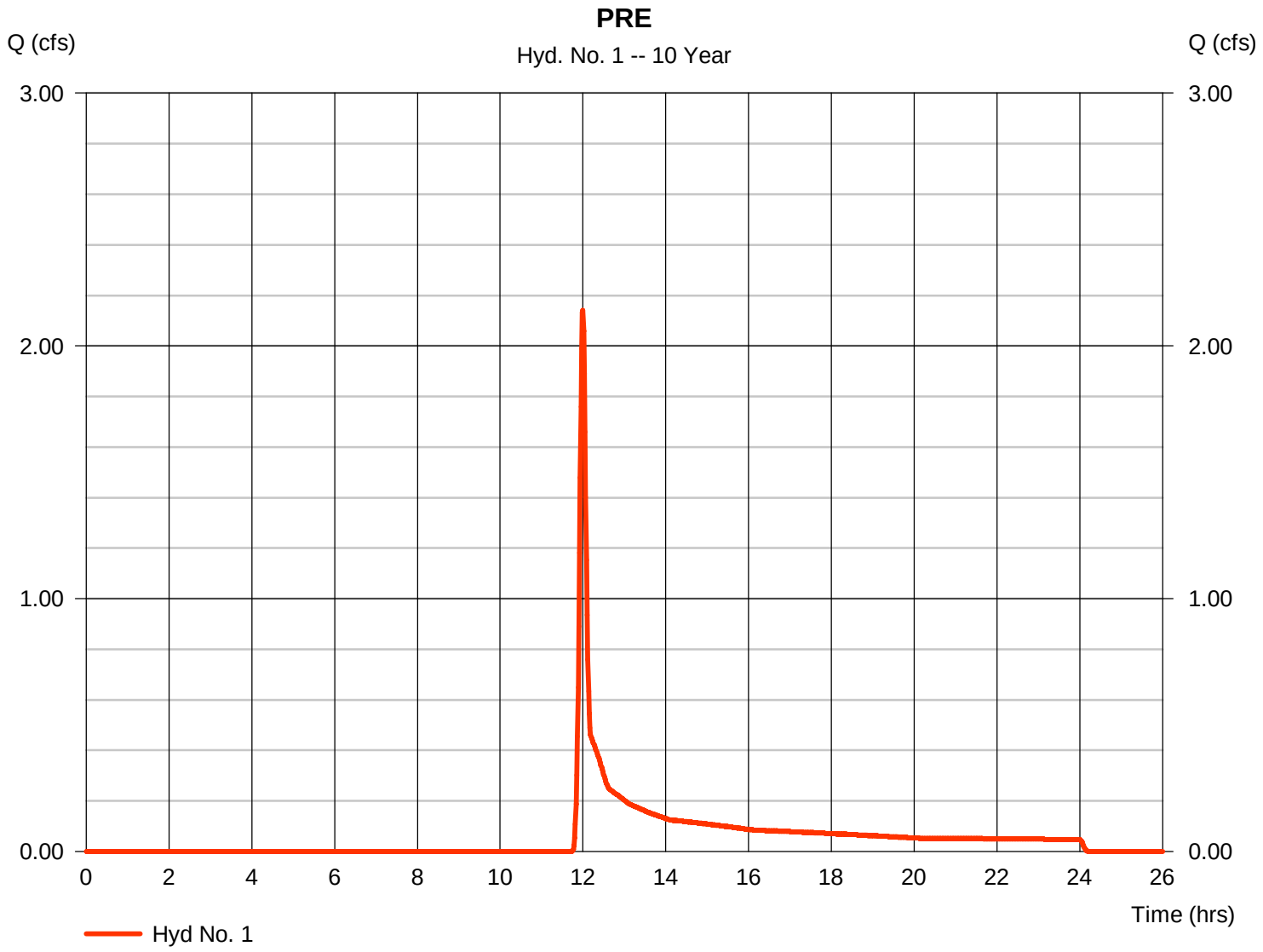
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.141 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.00 hrs
Time interval	=	1 min	Hyd. volume	=	5,474 cuft
Drainage area	=	2.530 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.10 min
Total precip.	=	3.88 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.530 x 58)] / 2.530



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)	= 2.69		0.00		0.00		
Land slope (%)	= 5.79		0.00		0.00		
Travel Time (min)	**= 5.84**	**+**	**0.00**	**+**	**0.00**	**=**	**5.84**
Shallow Concentrated Flow							
Flow length (ft)	= 671.00		0.00		0.00		
Watercourse slope (%)	= 15.66		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=6.38		0.00		0.00		
Travel Time (min)	**= 1.75**	**+**	**0.00**	**+**	**0.00**	**=**	**1.75**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 0.56		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=5.11						
			0.00				
					0.00		
Flow length (ft)	({0})140.0		0.0		0.0		
Travel Time (min)	**= 0.46**	**+**	**0.00**	**+**	**0.00**	**=**	**0.46**

Total Travel Time, Tc ..... 8.10 min

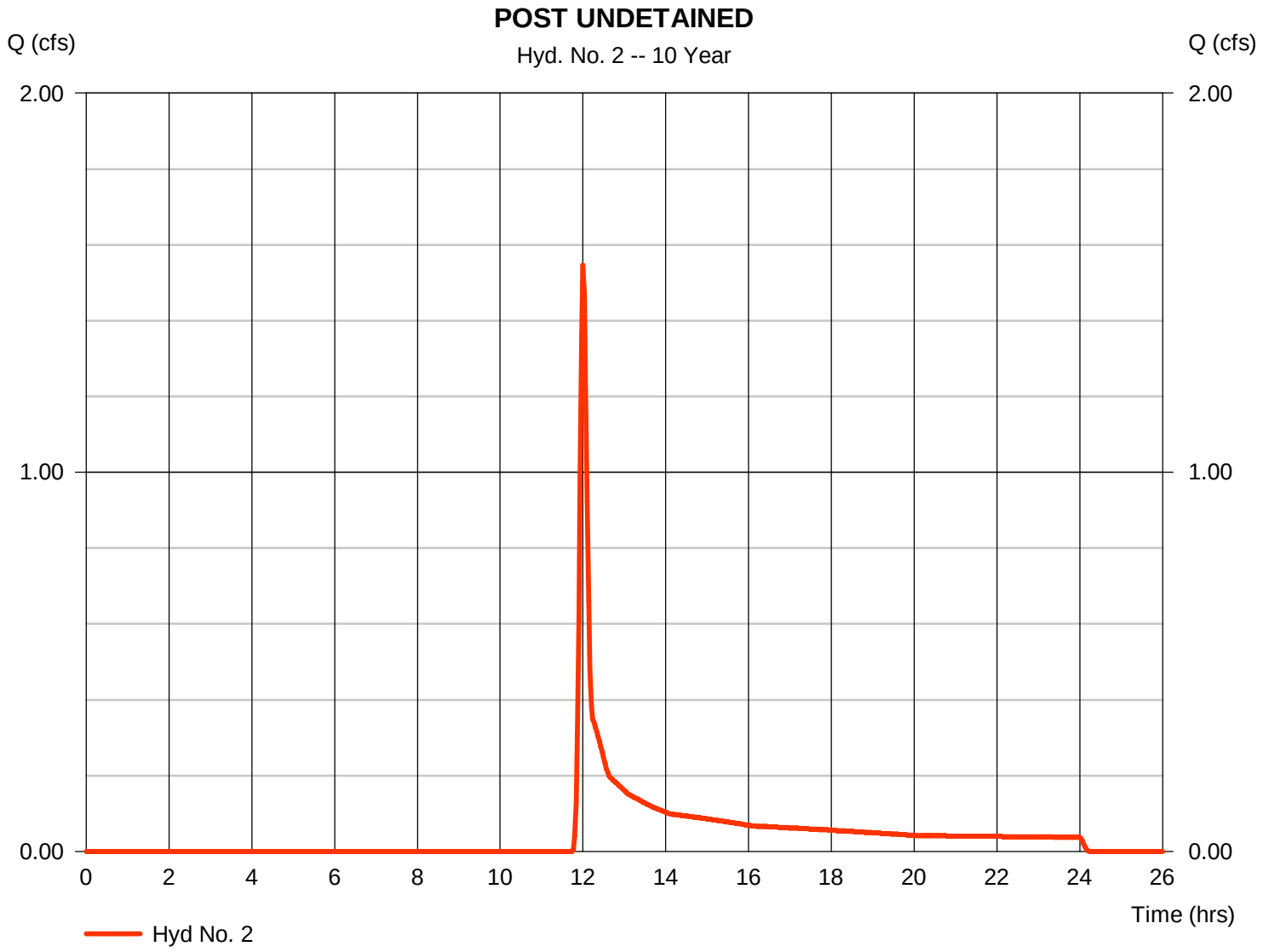
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.546 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	4,327 cuft
Drainage area	=	1.950 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.60 min
Total precip.	=	3.88 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



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)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.69		0.00		0.00		
Land slope (%)	= 7.00		0.00		0.00		
Travel Time (min)	**= 5.42**	**+**	**0.00**	**+**	**0.00**	**=**	**5.42**
Shallow Concentrated Flow							
Flow length (ft)	= 422.00		43.00		0.00		
Watercourse slope (%)	= 16.00		9.30		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=6.45		6.20		0.00		
Travel Time (min)	**= 1.09**	**+**	**0.12**	**+**	**0.00**	**=**	**1.21**
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 ..... 6.60 min

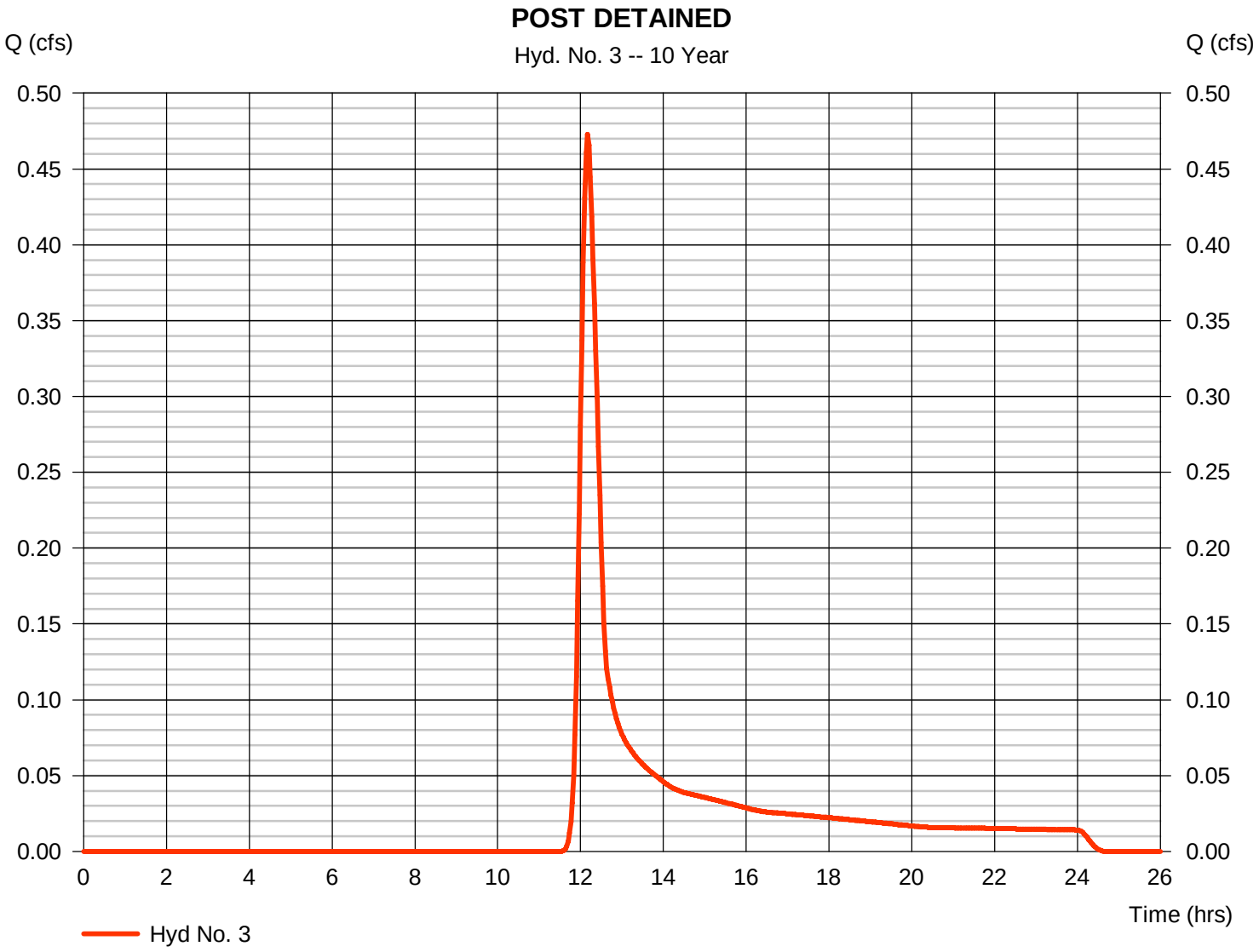
Hydrograph Report

Hyd. No. 3

POST DETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.473 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	1,989 cuft
Drainage area	=	0.580 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	23.60 min
Total precip.	=	3.88 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580

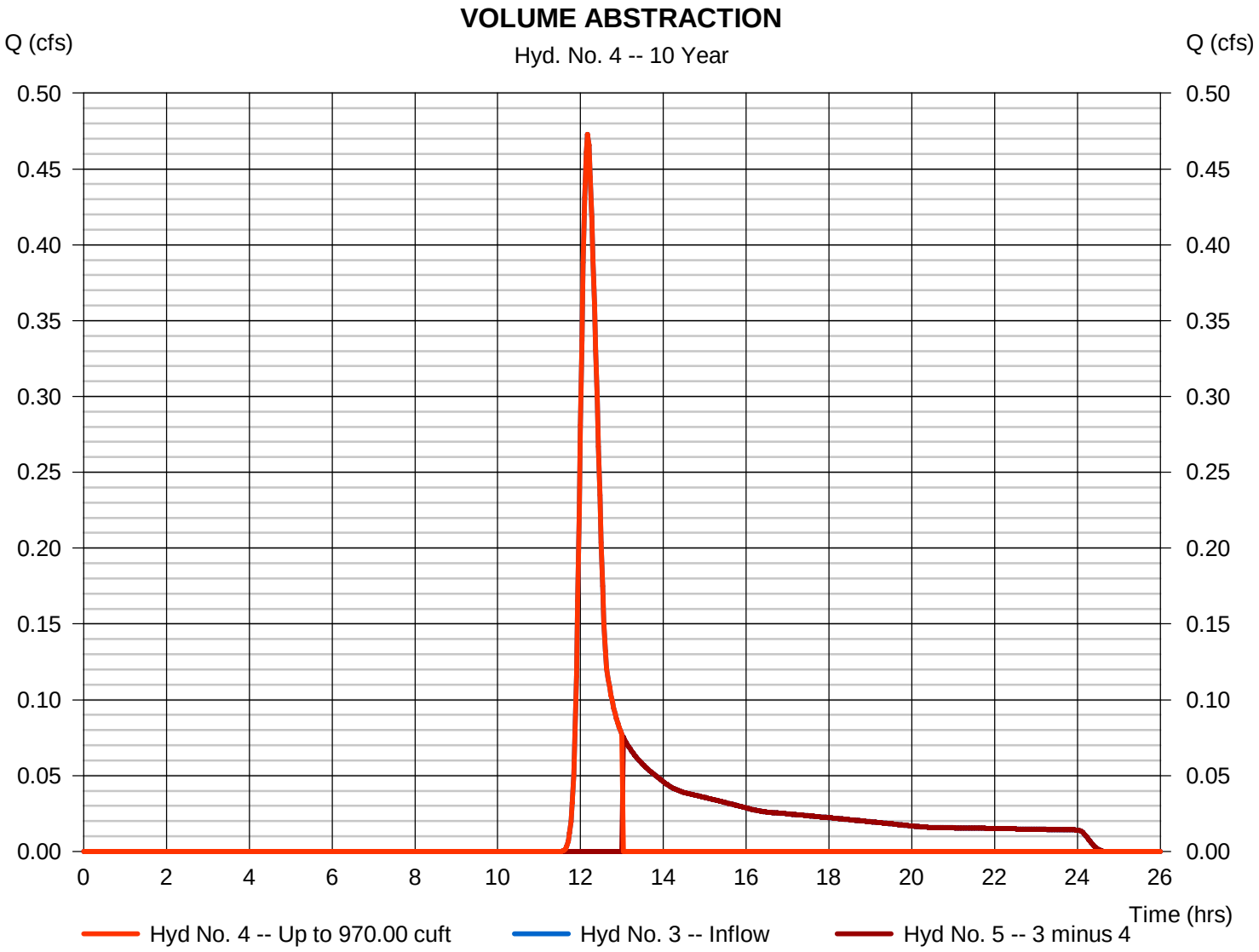


Hydrograph Report

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.473 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 971 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

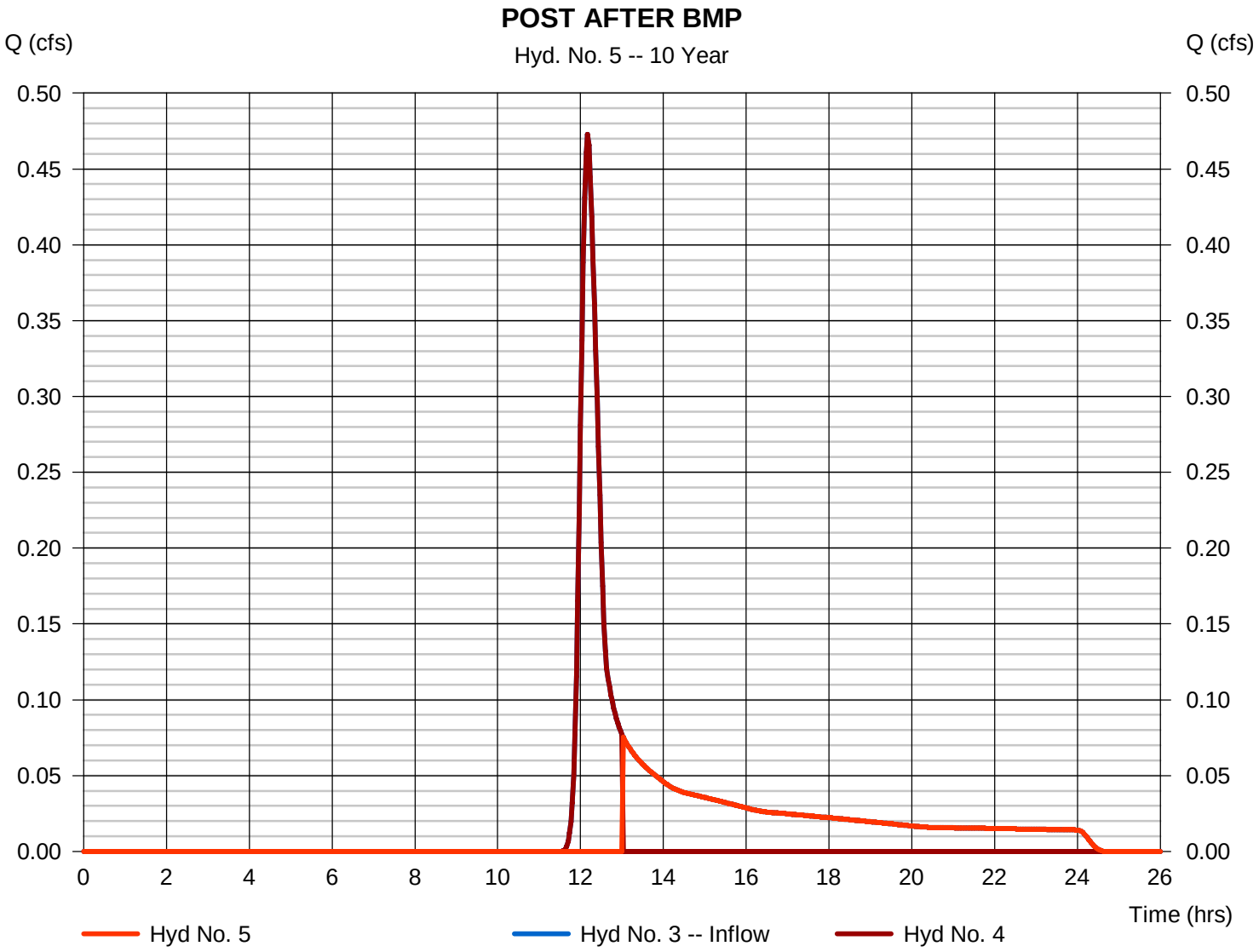


Hydrograph Report

Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.075 cfs
Storm frequency	= 10 yrs	Time to peak	= 13.03 hrs
Time interval	= 2 min	Hyd. volume	= 1,018 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

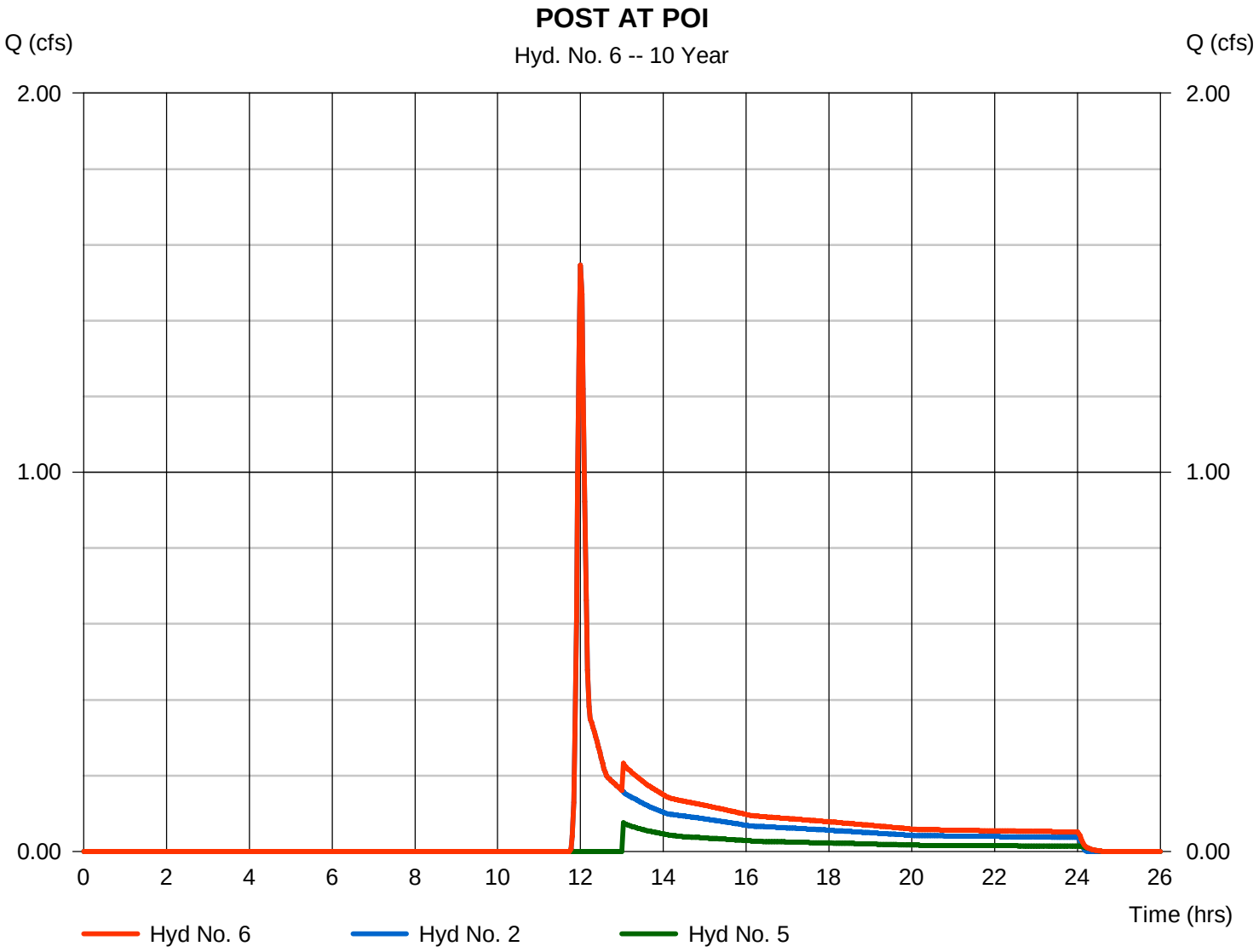


Hydrograph Report

Hyd. No. 6

POST AT POI

Hydrograph type	=	Combine	Peak discharge	=	1.546 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	5,345 cuft
Inflow hyds.	=	2, 5	Contrib. drain. area	=	1.950 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	39.8915	9.9000	0.8800	--------
2	47.2145	10.1000	0.8721	--------
3	0.0000	0.0000	0.0000	--------
5	49.1407	9.5000	0.8258	--------
10	46.6495	8.4000	0.7811	--------
25	46.5911	7.6000	0.7402	--------
50	44.7104	6.7000	0.7024	--------
100	42.4007	5.8000	0.6641	--------

File name: Valley Forge 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	3.70	2.87	2.36	2.01	1.75	1.56	1.40	1.28	1.18	1.09	1.01	0.95
2	4.42	3.45	2.84	2.42	2.12	1.89	1.70	1.55	1.43	1.33	1.24	1.16
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	5.40	4.23	3.50	3.00	2.64	2.36	2.14	1.96	1.81	1.68	1.57	1.48
10	6.14	4.80	3.98	3.42	3.01	2.70	2.45	2.25	2.09	1.95	1.83	1.72
25	7.14	5.58	4.64	4.00	3.53	3.18	2.90	2.67	2.48	2.32	2.18	2.06
50	7.95	6.19	5.15	4.45	3.95	3.56	3.25	3.01	2.80	2.62	2.47	2.34
100	8.73	6.78	5.65	4.90	4.35	3.94	3.61	3.35	3.12	2.93	2.77	2.63

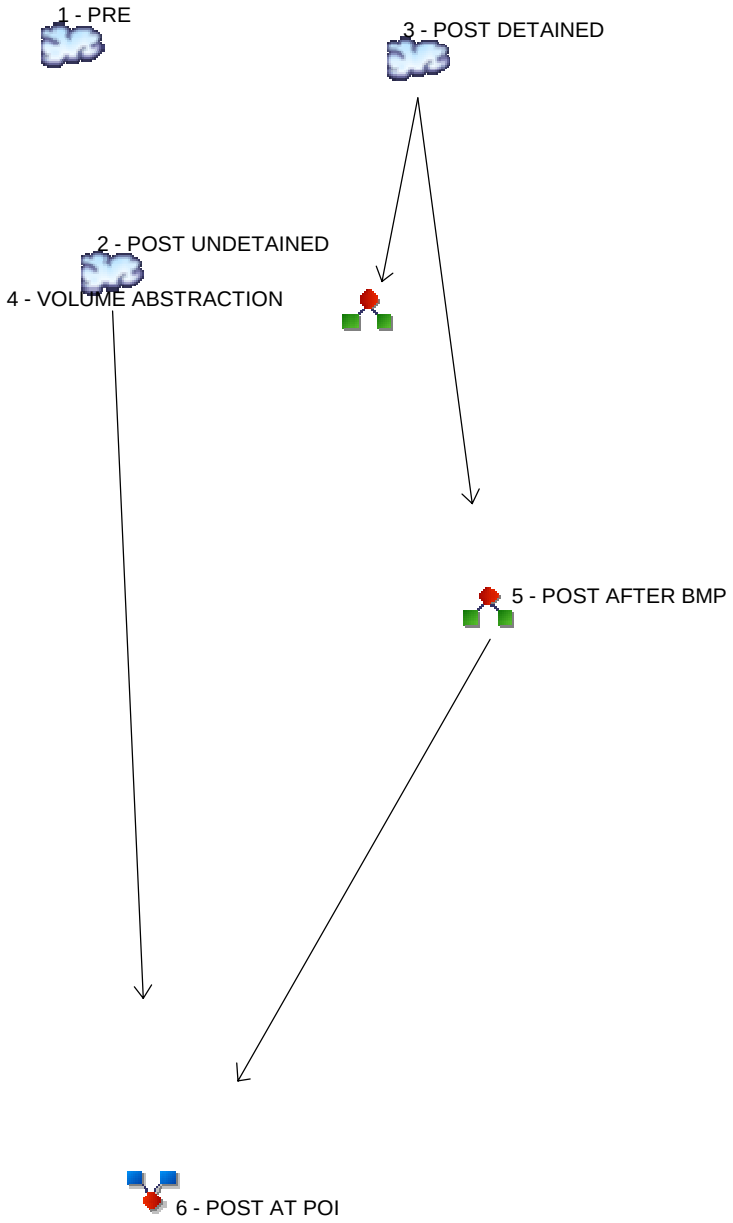
Tc = time in minutes. Values may exceed 60.

ESCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Valley Forge\Hydraflow Rev 1\Valley Forge 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	2.24	2.69	0.00	3.34	3.88	4.65	5.30	5.99
SCS 6-Hr	1.48	1.78	0.00	2.23	2.59	3.12	3.56	4.03
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
4	Diversion1	VOLUME ABSTRACTION
5	Diversion2	POST AFTER BMP
6	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	------	-------	-------	-------	-------	-------	-------	5.441	-------	PRE
2	SCS Runoff	------	-------	-------	-------	-------	-------	-------	3.956	-------	POST UNDETAINED
3	SCS Runoff	------	-------	-------	-------	-------	-------	-------	1.314	-------	POST DETAINED
4	Diversion1	3	-------	-------	-------	-------	-------	-------	1.314	-------	VOLUME ABSTRACTION
5	Diversion2	3	-------	-------	-------	-------	-------	-------	1.228	-------	POST AFTER BMP
6	Combine	2, 5	-------	-------	-------	-------	-------	-------	3.956	-------	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	5.441	1	719	11,975	------	------	------	PRE
2	SCS Runoff	3.956	2	720	9,467	------	------	------	POST UNDETAINED
3	SCS Runoff	1.314	2	724	3,810	------	------	------	POST DETAINED
4	Diversion1	1.314	2	724	1,033	3	------	------	VOLUME ABSTRACTION
5	Diversion2	1.228	2	726	2,777	3	------	------	POST AFTER BMP
6	Combine	3.956	2	720	12,244	2, 5	------	------	POST AT POI

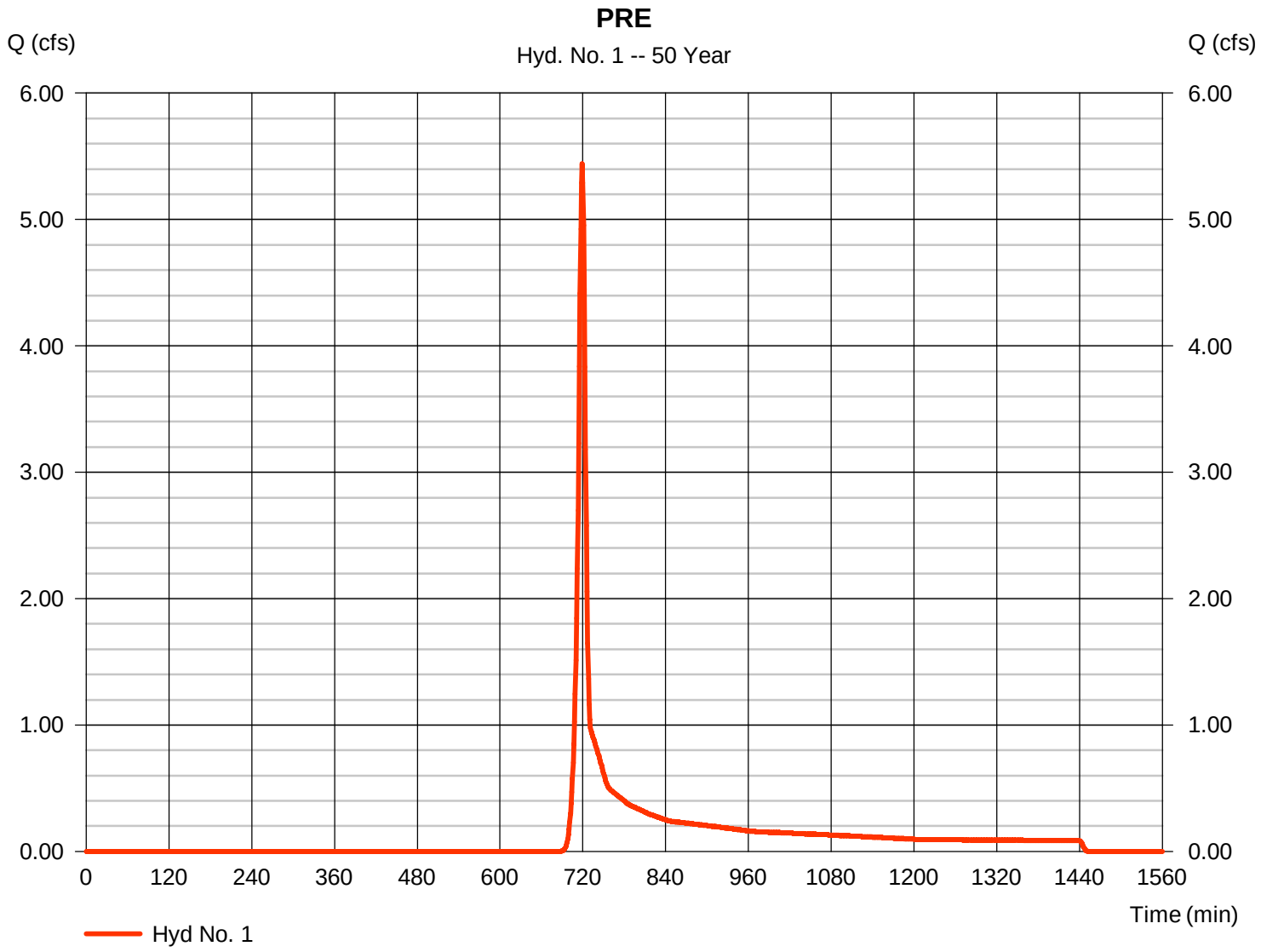
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.441 cfs
Storm frequency	=	50 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	11,975 cuft
Drainage area	=	2.530 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.10 min
Total precip.	=	5.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.530 x 58)] / 2.530



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)	= 2.69		0.00		0.00		
Land slope (%)	= 5.79		0.00		0.00		
Travel Time (min)	**= 5.84**	**+**	**0.00**	**+**	**0.00**	**=**	**5.84**
Shallow Concentrated Flow							
Flow length (ft)	= 671.00		0.00		0.00		
Watercourse slope (%)	= 15.66		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=6.38		0.00		0.00		
Travel Time (min)	**= 1.75**	**+**	**0.00**	**+**	**0.00**	**=**	**1.75**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 0.56		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=5.11						
			0.00				
					0.00		
Flow length (ft)	({0})140.0		0.0		0.0		
Travel Time (min)	**= 0.46**	**+**	**0.00**	**+**	**0.00**	**=**	**0.46**

Total Travel Time, Tc ..... 8.10 min

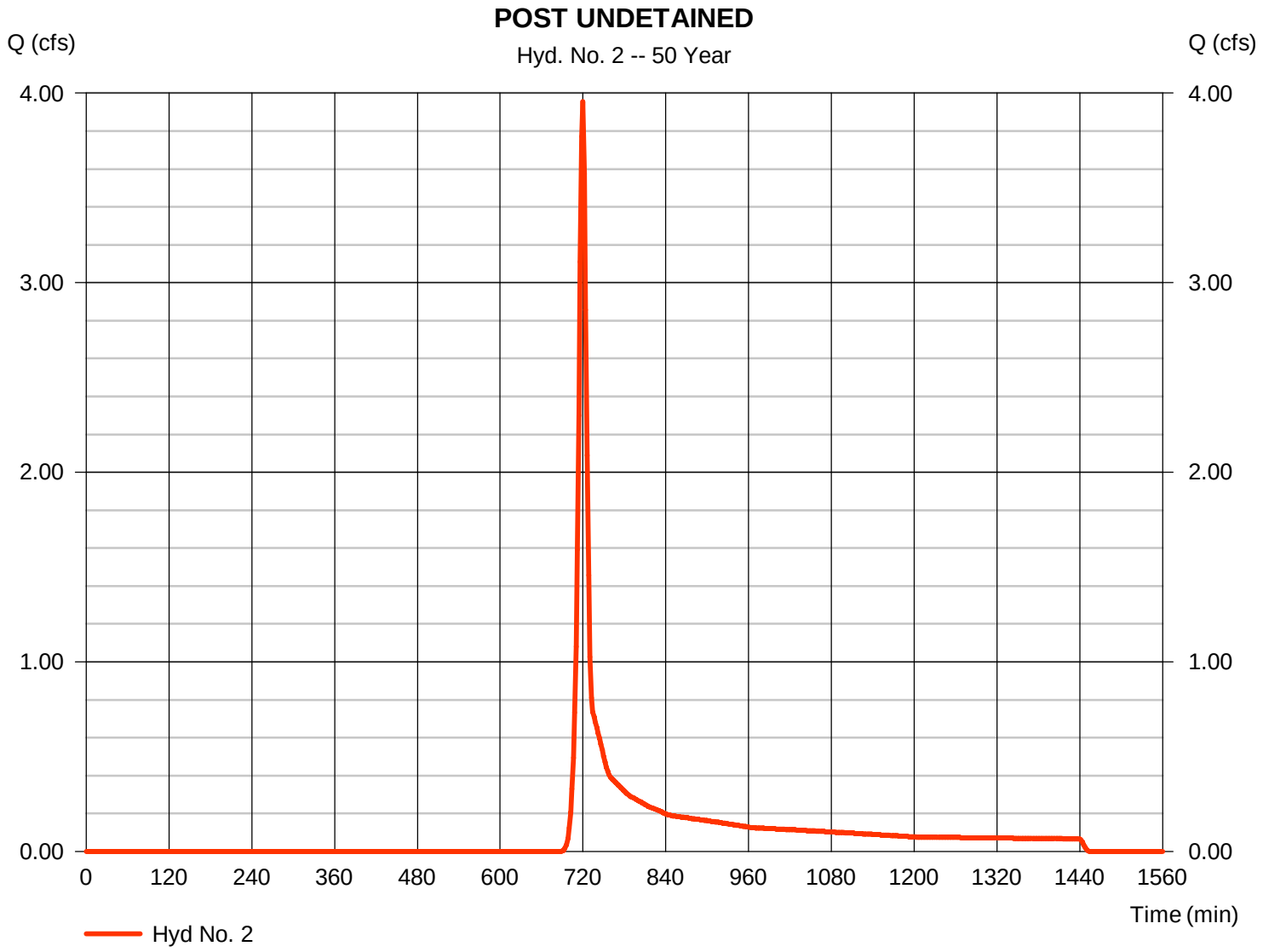
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 3.956 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 9,467 cuft
Drainage area	= 1.950 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.60 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



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)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.69		0.00		0.00		
Land slope (%)	= 7.00		0.00		0.00		
Travel Time (min)	**= 5.42**	**+**	**0.00**	**+**	**0.00**	**=**	**5.42**
Shallow Concentrated Flow							
Flow length (ft)	= 422.00		43.00		0.00		
Watercourse slope (%)	= 16.00		9.30		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=6.45		6.20		0.00		
Travel Time (min)	**= 1.09**	**+**	**0.12**	**+**	**0.00**	**=**	**1.21**
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 ..... 6.60 min

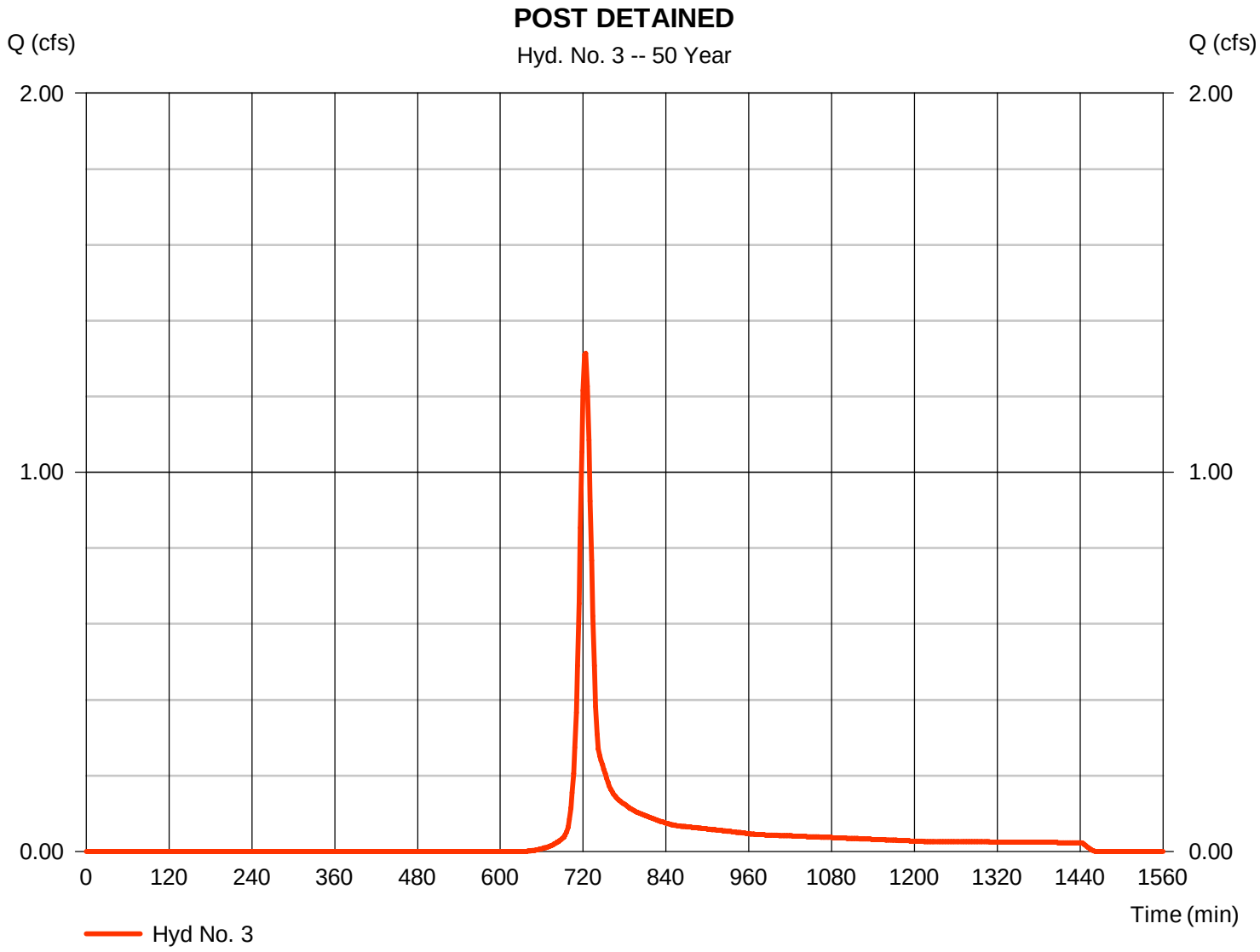
Hydrograph Report

Hyd. No. 3

POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.314 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 3,810 cuft
Drainage area	= 0.580 ac	Curve number	= 65*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.90 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580

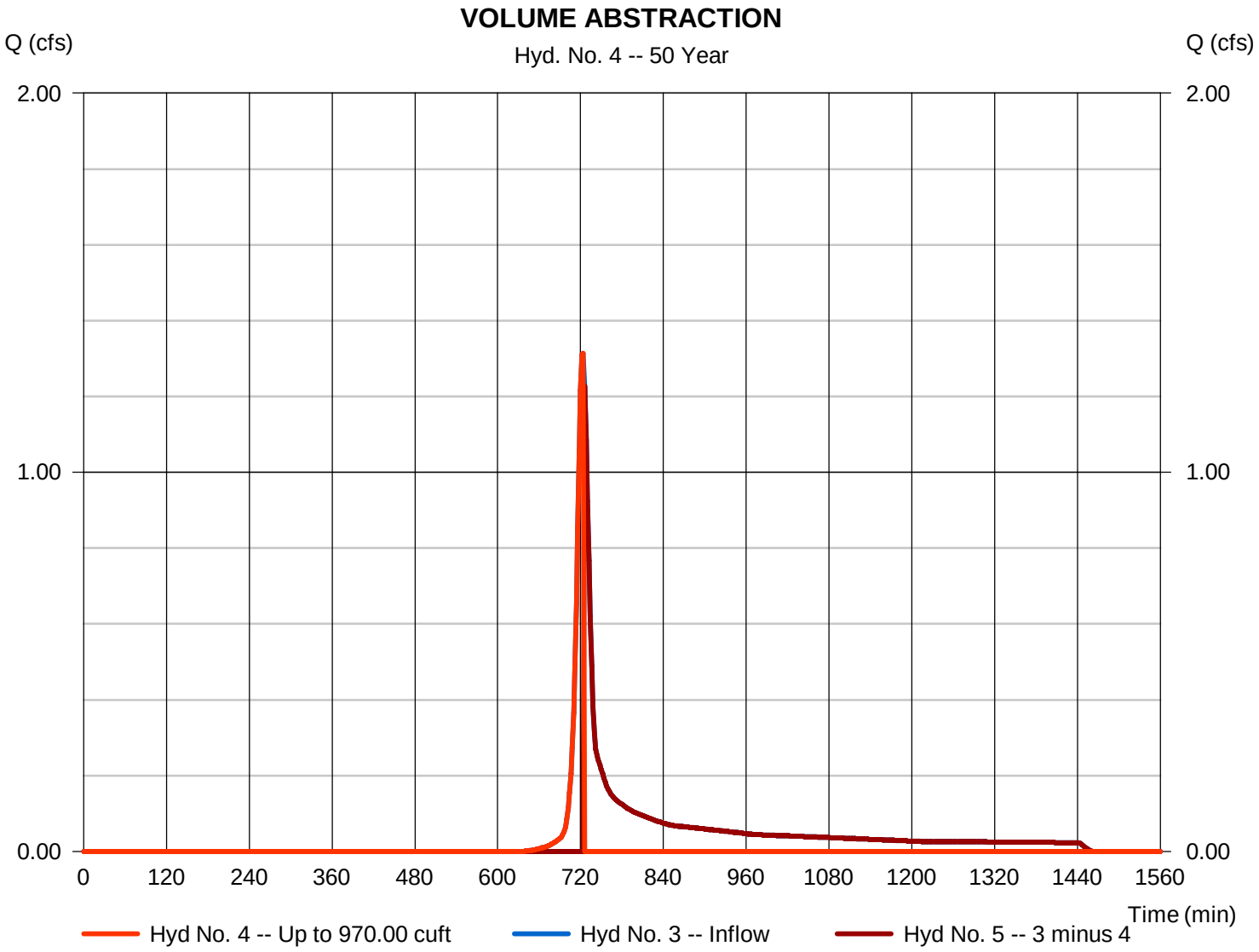


Hydrograph Report

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.314 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,033 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

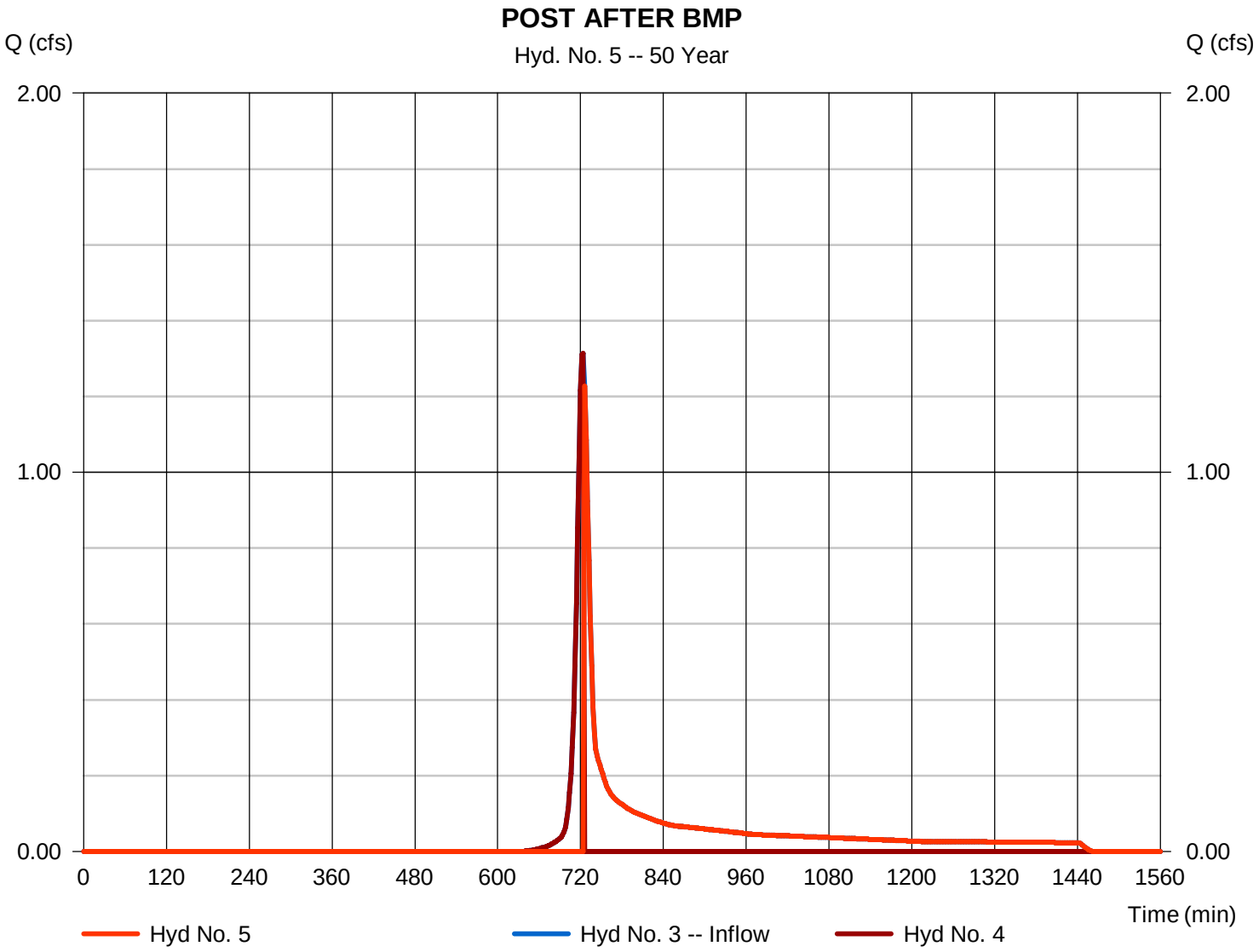


Hydrograph Report

Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 1.228 cfs
Storm frequency	= 50 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 2,777 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

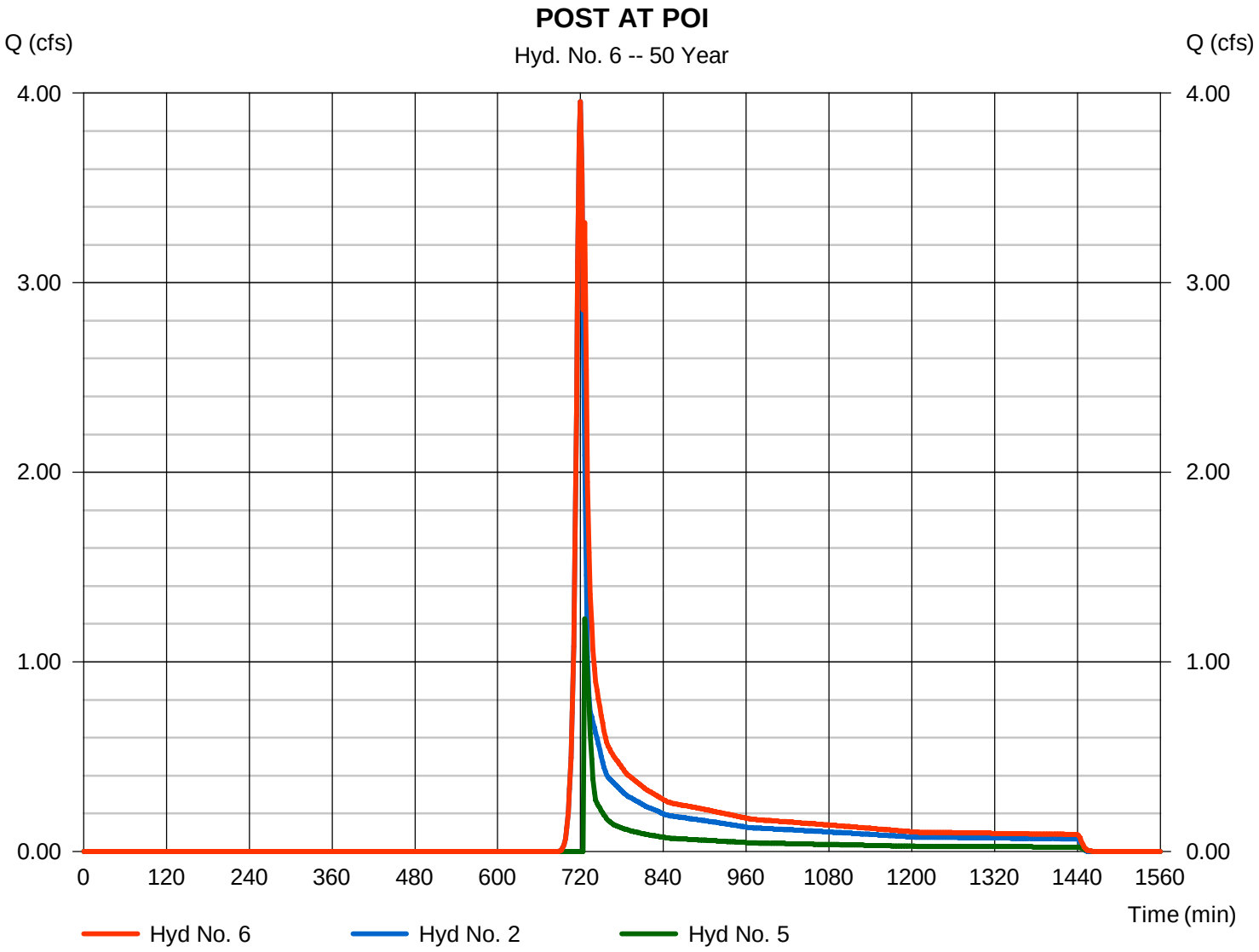


Hydrograph Report

Hyd. No. 6

POST AT POI

Hydrograph type	=	Combine	Peak discharge	=	3.956 cfs
Storm frequency	=	50 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	12,244 cuft
Inflow hyds.	=	2, 5	Contrib. drain. area	=	1.950 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	39.8915	9.9000	0.8800	--------
2	47.2145	10.1000	0.8721	--------
3	0.0000	0.0000	0.0000	--------
5	49.1407	9.5000	0.8258	--------
10	46.6495	8.4000	0.7811	--------
25	46.5911	7.6000	0.7402	--------
50	44.7104	6.7000	0.7024	--------
100	42.4007	5.8000	0.6641	--------

File name: Valley Forge 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	3.70	2.87	2.36	2.01	1.75	1.56	1.40	1.28	1.18	1.09	1.01	0.95
2	4.42	3.45	2.84	2.42	2.12	1.89	1.70	1.55	1.43	1.33	1.24	1.16
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	5.40	4.23	3.50	3.00	2.64	2.36	2.14	1.96	1.81	1.68	1.57	1.48
10	6.14	4.80	3.98	3.42	3.01	2.70	2.45	2.25	2.09	1.95	1.83	1.72
25	7.14	5.58	4.64	4.00	3.53	3.18	2.90	2.67	2.48	2.32	2.18	2.06
50	7.95	6.19	5.15	4.45	3.95	3.56	3.25	3.01	2.80	2.62	2.47	2.34
100	8.73	6.78	5.65	4.90	4.35	3.94	3.61	3.35	3.12	2.93	2.77	2.63

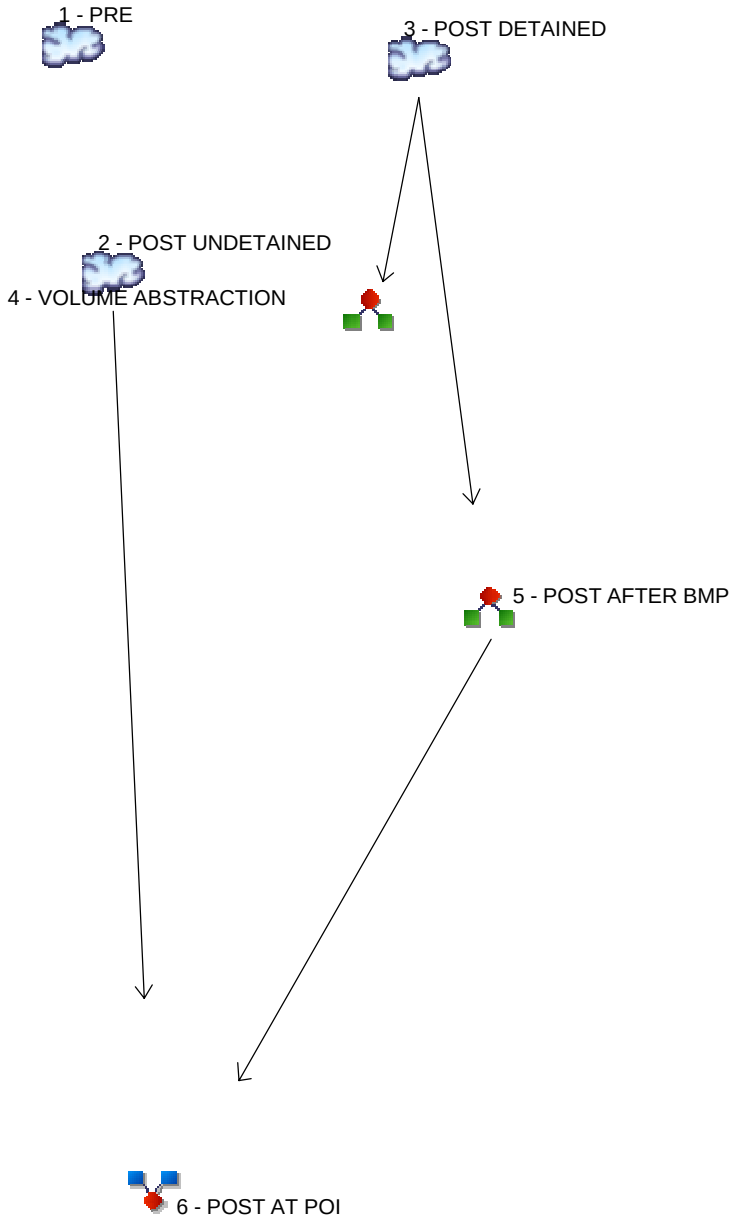
Tc = time in minutes. Values may exceed 60.

ESCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Valley Forge\Hydraflow Rev 1\Valley Forge 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	2.24	2.69	0.00	3.34	3.88	4.65	5.30	5.99
SCS 6-Hr	1.48	1.78	0.00	2.23	2.59	3.12	3.56	4.03
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
4	Diversion1	VOLUME ABSTRACTION
5	Diversion2	POST AFTER BMP
6	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	------	-------	-------	-------	-------	-------	-------	-------	7.280	PRE
2	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	5.297	POST UNDETAINED
3	SCS Runoff	------	-------	-------	-------	-------	-------	-------	-------	1.937	POST DETAINED
4	Diversion1	3	-------	-------	-------	-------	-------	-------	-------	1.746	VOLUME ABSTRACTION
5	Diversion2	3	-------	-------	-------	-------	-------	-------	-------	1.937	POST AFTER BMP
6	Combine	2, 5	-------	-------	-------	-------	-------	-------	-------	7.224	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	7.280	1	719	15,675	------	------	------	PRE
2	SCS Runoff	5.297	2	720	12,391	------	------	------	POST UNDETAINED
3	SCS Runoff	1.937	2	722	5,089	------	------	------	POST DETAINED
4	Diversion1	1.746	2	718	1,042	3	------	------	VOLUME ABSTRACTION
5	Diversion2	1.937	2	722	4,047	3	------	------	POST AFTER BMP
6	Combine	7.224	2	720	16,439	2, 5	------	------	POST AT POI

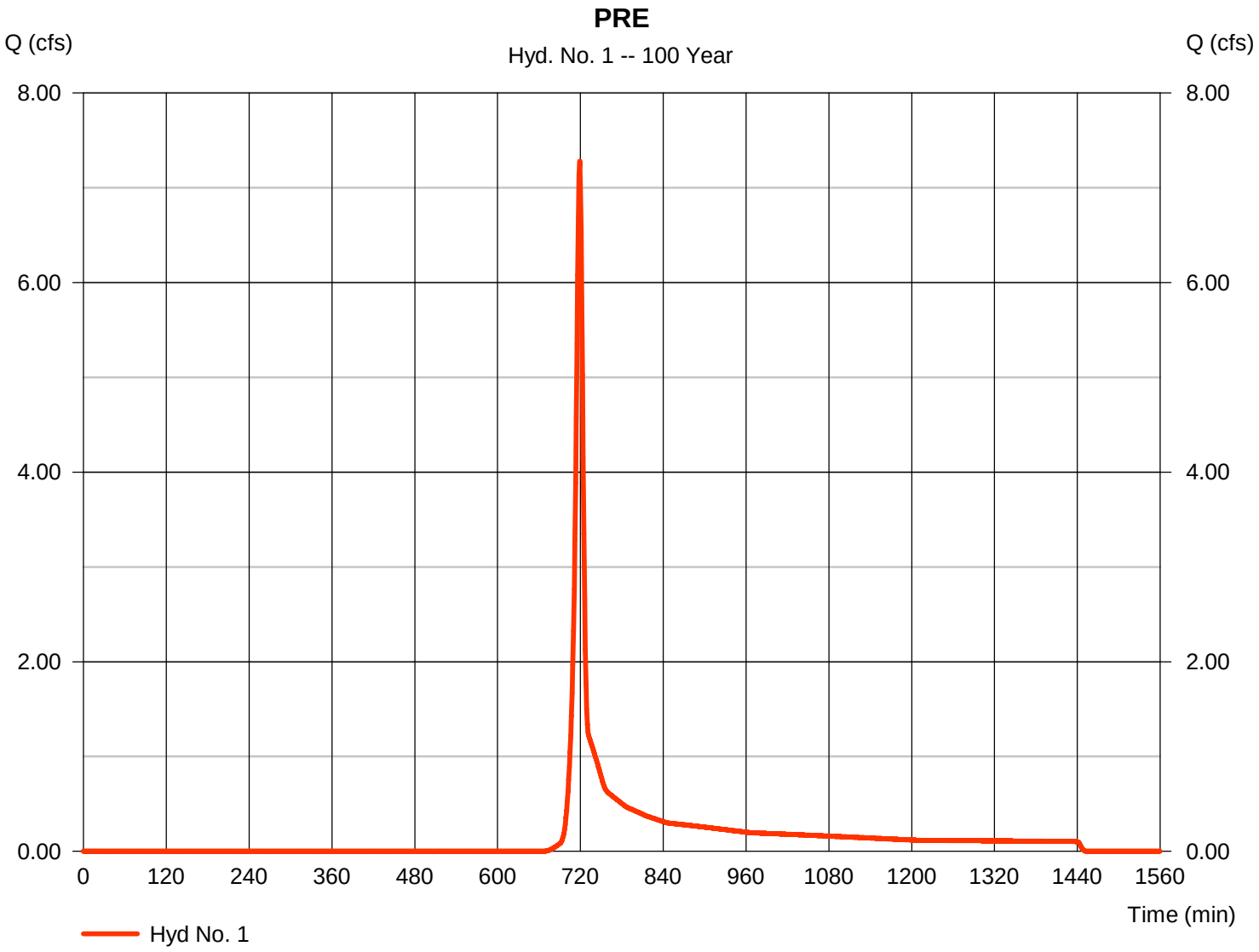
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.280 cfs
Storm frequency	=	100 yrs	Time to peak	=	719 min
Time interval	=	1 min	Hyd. volume	=	15,675 cuft
Drainage area	=	2.530 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.10 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.530 x 58)] / 2.530



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)	= 2.69		0.00		0.00		
Land slope (%)	= 5.79		0.00		0.00		
Travel Time (min)	**= 5.84**	**+**	**0.00**	**+**	**0.00**	**=**	**5.84**
Shallow Concentrated Flow							
Flow length (ft)	= 671.00		0.00		0.00		
Watercourse slope (%)	= 15.66		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=6.38		0.00		0.00		
Travel Time (min)	**= 1.75**	**+**	**0.00**	**+**	**0.00**	**=**	**1.75**
Channel Flow							
X sectional flow area (sqft)	= 16.00		0.00		0.00		
Wetted perimeter (ft)	= 28.00		0.00		0.00		
Channel slope (%)	= 0.56		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=5.11						
			0.00				
					0.00		
Flow length (ft)	({0})140.0		0.0		0.0		
Travel Time (min)	**= 0.46**	**+**	**0.00**	**+**	**0.00**	**=**	**0.46**

Total Travel Time, Tc ..... 8.10 min

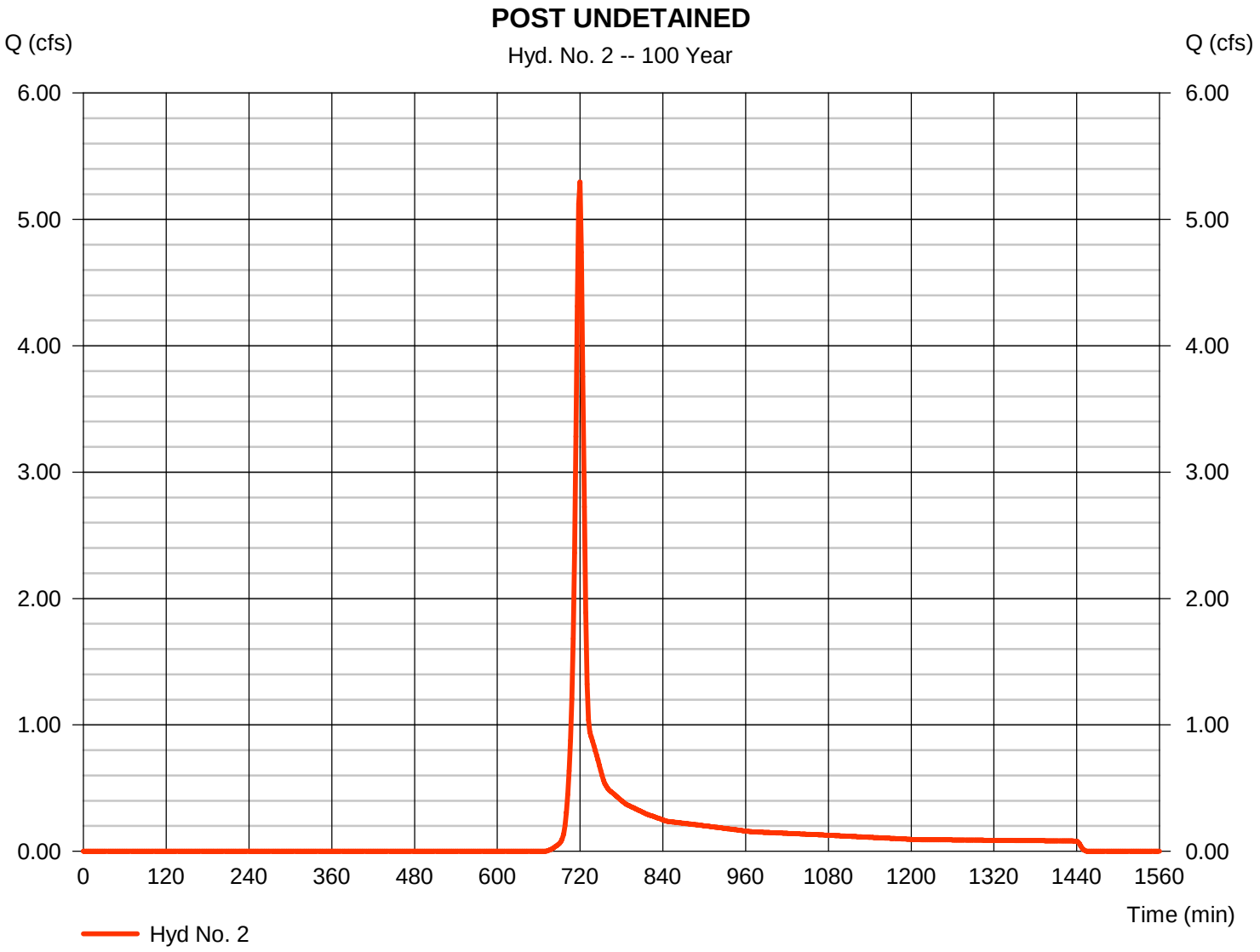
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.297 cfs
Storm frequency	=	100 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	12,391 cuft
Drainage area	=	1.950 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.60 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 85) + (1.570 x 58) + (0.370 x 58)] / 1.950



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)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.69		0.00		0.00		
Land slope (%)	= 7.00		0.00		0.00		
Travel Time (min)	**= 5.42**	**+**	**0.00**	**+**	**0.00**	**=**	**5.42**
Shallow Concentrated Flow							
Flow length (ft)	= 422.00		43.00		0.00		
Watercourse slope (%)	= 16.00		9.30		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=6.45		6.20		0.00		
Travel Time (min)	**= 1.09**	**+**	**0.12**	**+**	**0.00**	**=**	**1.21**
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 ..... 6.60 min

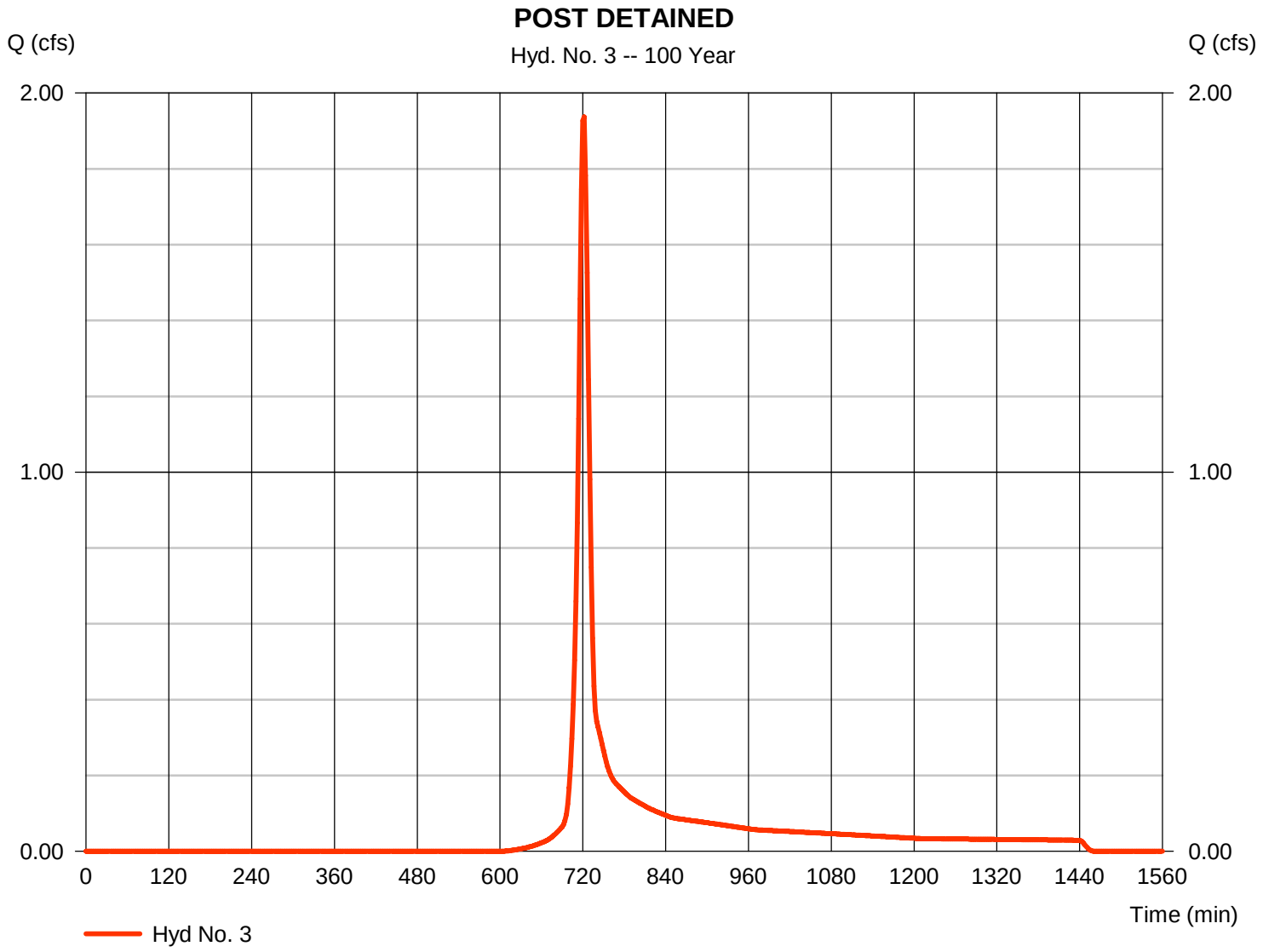
Hydrograph Report

Hyd. No. 3

POST DETAINED

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.937 cfs
Storm frequency	=	100 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	5,089 cuft
Drainage area	=	0.580 ac	Curve number	=	65*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	13.09 min
Total precip.	=	5.99 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 85) + (0.440 x 58)] / 0.580

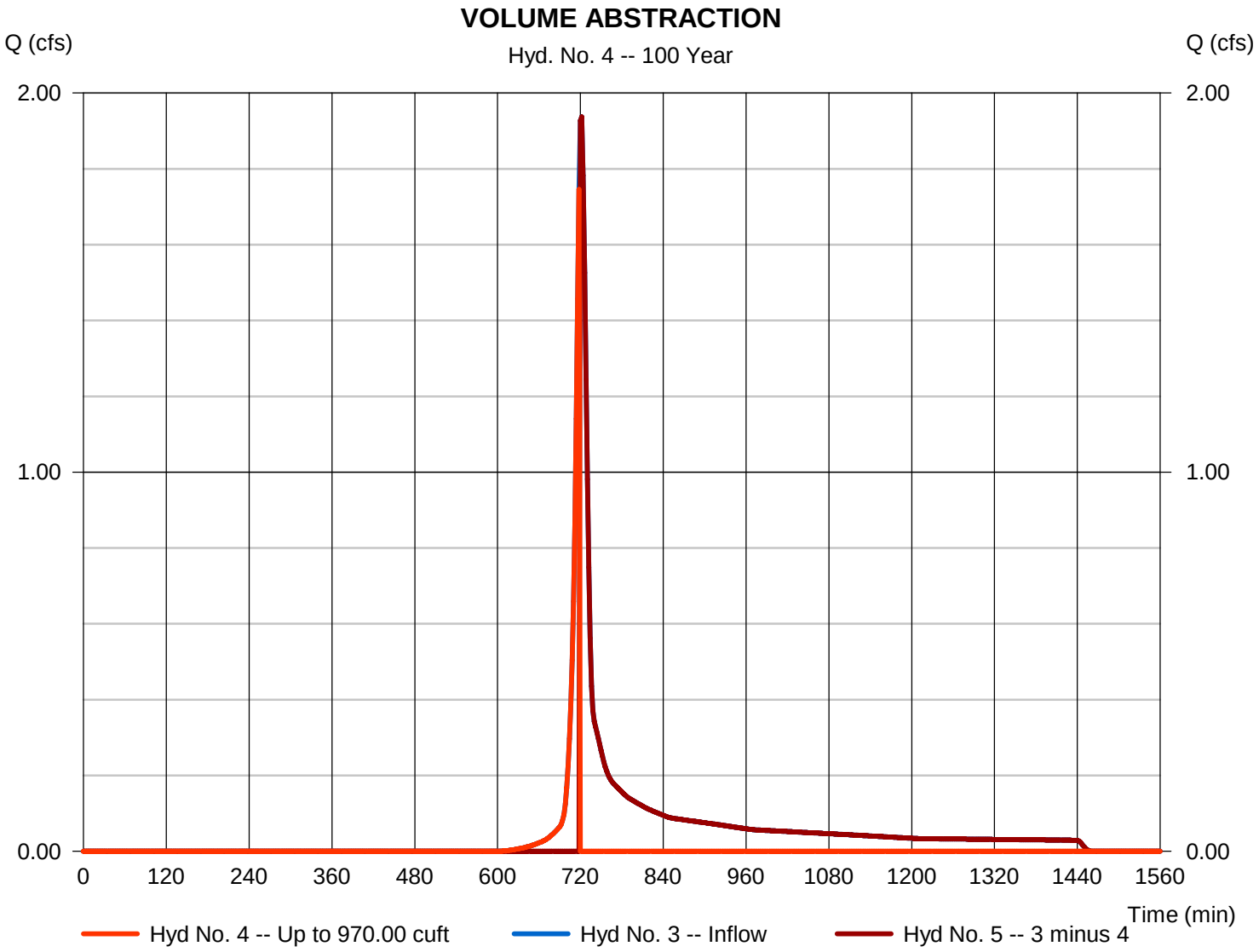


Hydrograph Report

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.746 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 1,042 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

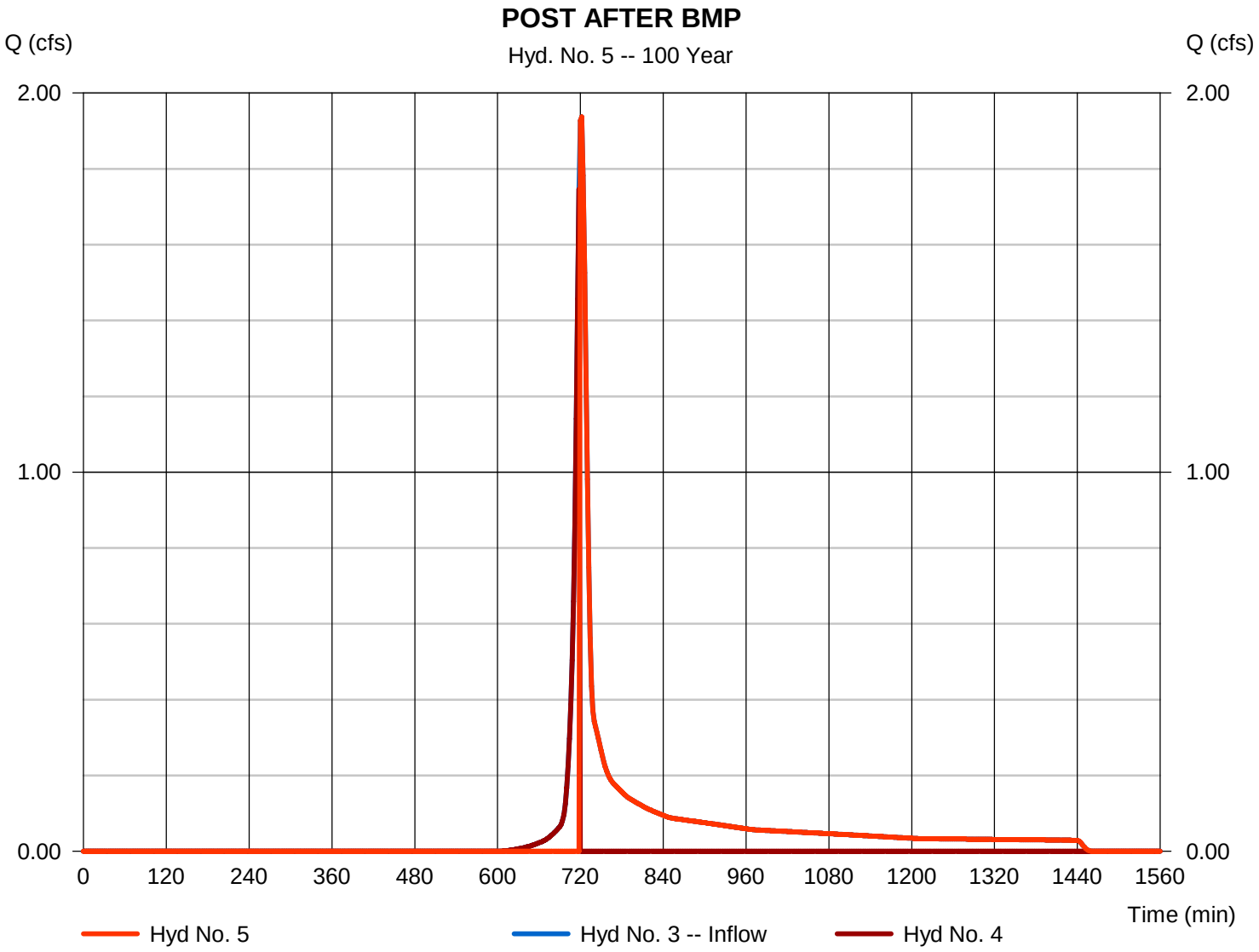


Hydrograph Report

Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 1.937 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 4,047 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 970.00 cuft

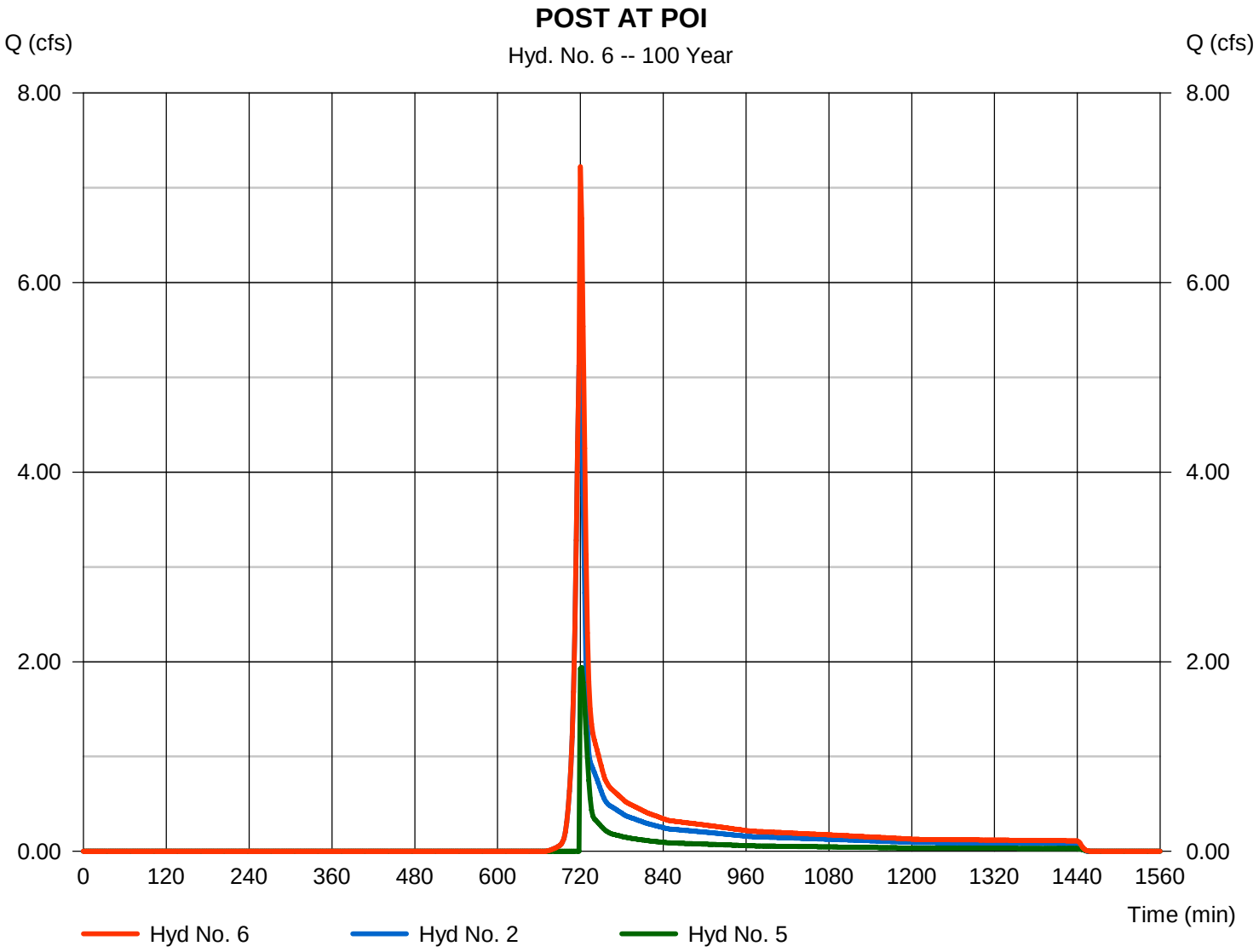


Hydrograph Report

Hyd. No. 6

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 7.224 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 16,439 cuft
Inflow hyds.	= 2, 5	Contrib. drain. area	= 1.950 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	39.8915	9.9000	0.8800	--------
2	47.2145	10.1000	0.8721	--------
3	0.0000	0.0000	0.0000	--------
5	49.1407	9.5000	0.8258	--------
10	46.6495	8.4000	0.7811	--------
25	46.5911	7.6000	0.7402	--------
50	44.7104	6.7000	0.7024	--------
100	42.4007	5.8000	0.6641	--------

File name: Valley Forge 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	3.70	2.87	2.36	2.01	1.75	1.56	1.40	1.28	1.18	1.09	1.01	0.95
2	4.42	3.45	2.84	2.42	2.12	1.89	1.70	1.55	1.43	1.33	1.24	1.16
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	5.40	4.23	3.50	3.00	2.64	2.36	2.14	1.96	1.81	1.68	1.57	1.48
10	6.14	4.80	3.98	3.42	3.01	2.70	2.45	2.25	2.09	1.95	1.83	1.72
25	7.14	5.58	4.64	4.00	3.53	3.18	2.90	2.67	2.48	2.32	2.18	2.06
50	7.95	6.19	5.15	4.45	3.95	3.56	3.25	3.01	2.80	2.62	2.47	2.34
100	8.73	6.78	5.65	4.90	4.35	3.94	3.61	3.35	3.12	2.93	2.77	2.63

Tc = time in minutes. Values may exceed 60.

ESCGP-2\PPP\02 SCRO\07 PCSM\Attach 4 Stormwater Calcs\Valley Forge\Hydraflow Rev 1\Valley Forge 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	2.24	2.69	0.00	3.34	3.88	4.65	5.30	5.99
SCS 6-Hr	1.48	1.78	0.00	2.23	2.59	3.12	3.56	4.03
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