

## **Wolf Bridge**

## TETRA TECH, INC.

By: RH    Date: 10/31/2016    Subject: Wolf Bridge Road  
Checked By: JB    Date: 11/2/2016    PCSM Design and Evaluation

### **PURPOSE:**

The purpose of these calculations is to design a Post-Construction Stormwater Management (PCSM) Plan for the Wolf Bridge Road block valve site as part of the Sunoco Pipeline L.P. Pennsylvania Pipeline Project. The site is located within Middlesex Township, Cumberland County, Pennsylvania. Permanent stormwater controls will be developed to satisfy PADEP and Cumberland County'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 Wolf Bridge Road block valve is located within the Conodoguinet Creek watershed which has a 100% release rate. All other design standards within Cumberland County's approved Act 167 Plan are consistent with the requirements in PADEP's Stormwater BMP Manual. The PCSM design at the Wolf Bridge Road block valve has been designed for consistency with Cumberland County'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.

Due to the presence of shallow ground cover and shallow bedrock surrounding the Wolf Bridge Road block valve site, it is not possible to infiltrate the 2-year/24-hour stormwater runoff volume increase. Volume reducing BMPs in the PADEP Stormwater BMP Manual were analyzed on a case-by-case basis but did not meet their respective requirements. As a result, a slow-release BMP has been proposed.

#### **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.

- Cumberland County's approved Act 167 plan establishes release rate requirements for various watersheds throughout the county. The Wolf Bridge Road block valve site is located in the Conodoguinet Creek watershed, which has 100% release rates.

This site will utilize a slow-release trench to manage the two-year through 100-year peak rate increases. The proposed BMP will increase the post-construction 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. The use of a slow-release BMP has been approved by PADEP as an appropriate way to meet the requirements of Control Guideline 1 when onsite infiltration is not feasible.

### **Infiltration**

Onsite infiltration testing was 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, it was determined that the soil cover at the Wolf Bridge block valve site was too thin for infiltration tests to be properly performed. A soil boring was taken to determine the depth to seasonal high groundwater and shallow bedrock or another confining layer. Due to the presence of shallow bedrock, it is not possible to maintain 2 feet of separation between a volume-reducing BMP and bedrock.

The post-construction stormwater management design utilizes a slow-release BMP to manage runoff volume due to thin soil cover and onsite and due to the presence of shallow bedrock.

### **Loading Ratio**

The loading ratio guidelines do not apply because the design does not propose an infiltration BMP.

### **Disturbed Area**

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

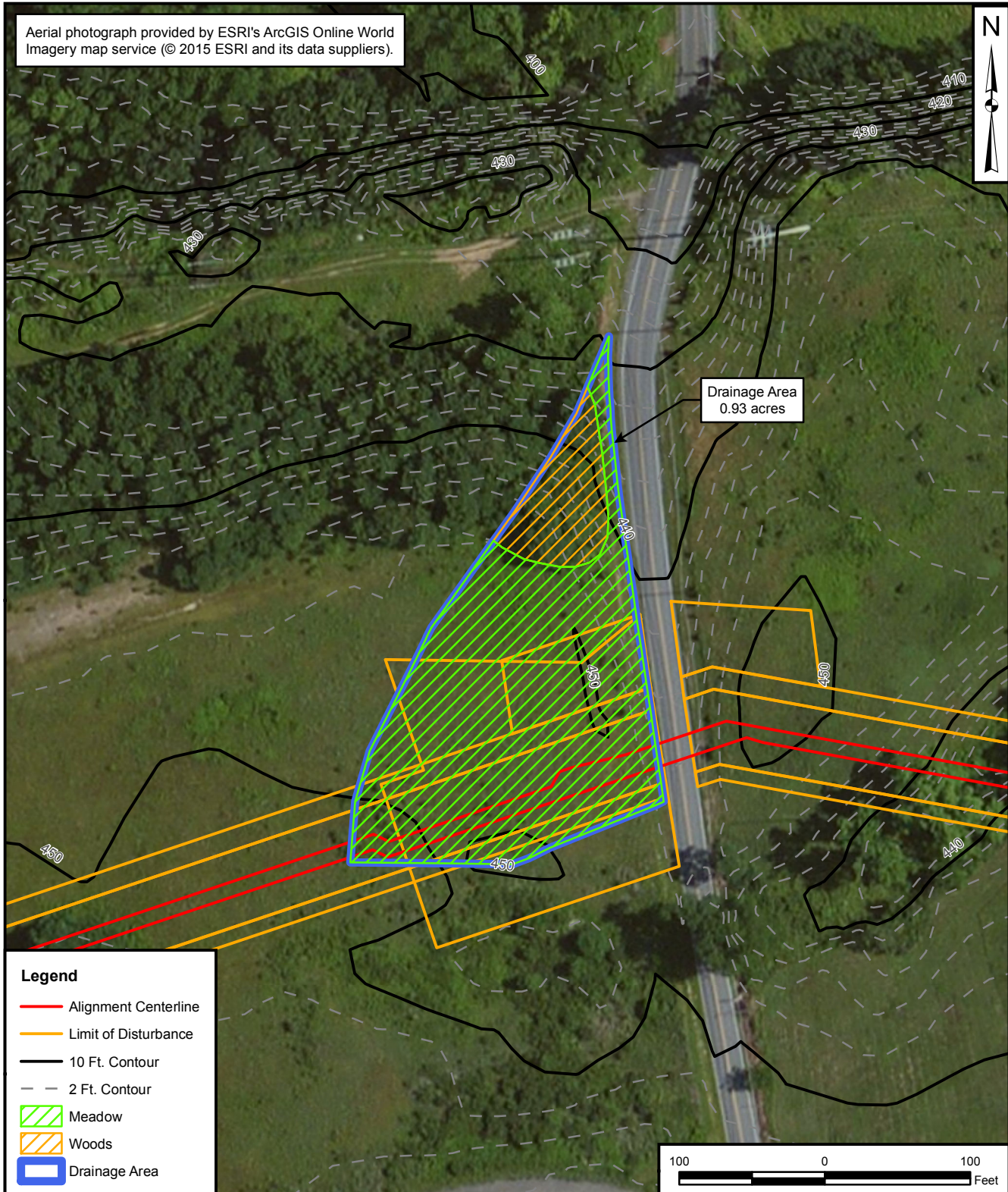
### **Karst Topography**

The Wolf Bridge block valve site is not located in an area of known karst terrain.







### **Special Protection Watershed**

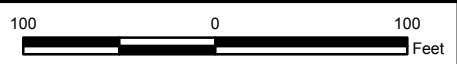
The Wolf Bridge block valve site is not located within a special protection watershed, so antidegradation requirements do not apply.

Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2015 ESRI and its data suppliers).



**Legend**

-  Alignment Centerline
-  Limit of Disturbance
-  10 Ft. Contour
-  2 Ft. Contour
-  Meadow
-  Woods
-  Drainage Area

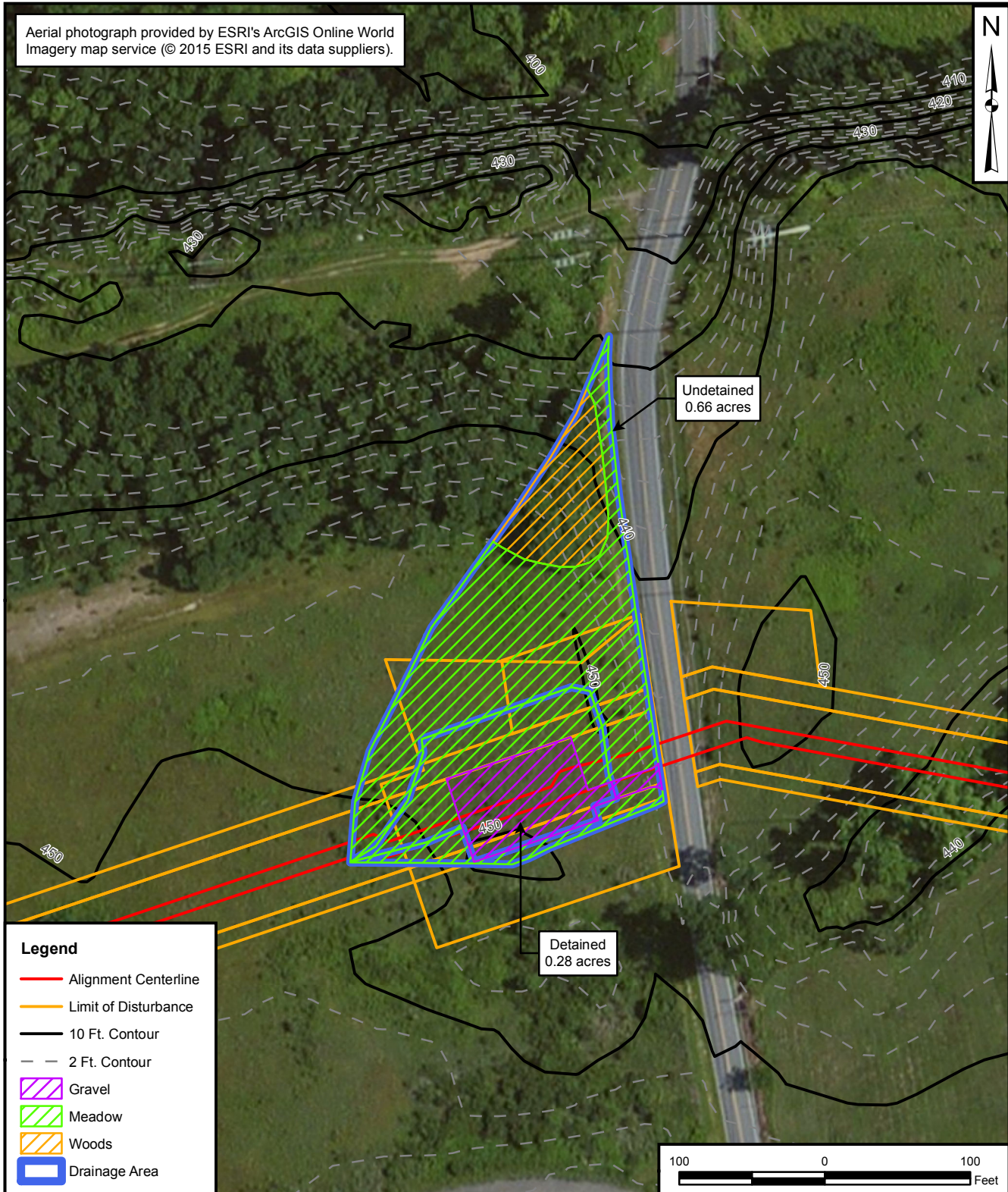


PRE-DEVELOPMENT DRAINAGE AREA MAP  
 WOLF BRIDGE ROAD  
 PENNSYLVANIA PIPELINE PROJECT  
 SUNOCO LOGISTICS, L.P.  
 CUMBERLAND COUNTY, PENNSYLVANIA

DRAWN BY: J. HERNING 05/06/15	
CHECKED BY: J. BRODY 11/09/16	
APPROVED BY:	
CONTRACT NUMBER: 112IC05958	
FIGURE NUMBER	REV
1	0

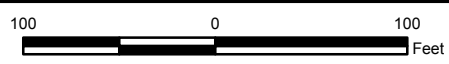


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**Legend**

- Alignment Centerline
- Limit of Disturbance
- 10 Ft. Contour
- 2 Ft. Contour
- Gravel
- Meadow
- Woods
- Drainage Area



**POST-DEVELOPMENT DRAINAGE AREA MAP**  
**WOLF BRIDGE ROAD**  
**PENNSYLVANIA PIPELINE PROJECT**  
**SUNOCO LOGISTICS, L.P.**  
**CUMBERLAND COUNTY, PENNSYLVANIA**

DRAWN BY: J. HERNING 05/06/15	
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: Middlesex Twp, Pennsylvania,**  
**USA\***

**Latitude: 40.2369°, Longitude: -77.1651°**

**Elevation: 449 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**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.319 (0.284-0.360)	0.380 (0.338-0.429)	0.454 (0.403-0.513)	0.512 (0.453-0.576)	0.585 (0.517-0.658)	0.644 (0.566-0.723)	0.707 (0.618-0.791)	0.766 (0.666-0.856)	0.855 (0.736-0.955)	0.923 (0.789-1.03)
10-min	0.503 (0.449-0.568)	0.601 (0.534-0.680)	0.717 (0.637-0.810)	0.806 (0.714-0.907)	0.918 (0.810-1.03)	1.00 (0.882-1.13)	1.09 (0.957-1.23)	1.18 (1.03-1.32)	1.31 (1.12-1.46)	1.40 (1.20-1.56)
15-min	0.624 (0.556-0.704)	0.747 (0.664-0.844)	0.896 (0.795-1.01)	1.01 (0.892-1.13)	1.15 (1.02-1.29)	1.26 (1.11-1.42)	1.37 (1.20-1.54)	1.49 (1.29-1.66)	1.64 (1.41-1.83)	1.76 (1.50-1.96)
30-min	0.842 (0.752-0.951)	1.02 (0.905-1.15)	1.25 (1.11-1.42)	1.43 (1.27-1.61)	1.67 (1.47-1.88)	1.86 (1.63-2.09)	2.05 (1.79-2.30)	2.25 (1.96-2.52)	2.53 (2.18-2.83)	2.76 (2.36-3.08)
60-min	1.04 (0.929-1.18)	1.27 (1.13-1.43)	1.59 (1.42-1.80)	1.85 (1.64-2.08)	2.20 (1.94-2.47)	2.49 (2.18-2.79)	2.79 (2.44-3.13)	3.12 (2.71-3.48)	3.58 (3.08-4.00)	3.96 (3.38-4.42)
2-hr	1.20 (1.06-1.35)	1.45 (1.28-1.64)	1.84 (1.63-2.07)	2.15 (1.90-2.42)	2.63 (2.31-2.94)	3.04 (2.65-3.40)	3.50 (3.03-3.90)	4.02 (3.46-4.47)	4.81 (4.10-5.35)	5.51 (4.65-6.13)
3-hr	1.30 (1.16-1.48)	1.57 (1.39-1.79)	1.98 (1.76-2.25)	2.32 (2.05-2.63)	2.83 (2.48-3.20)	3.27 (2.86-3.69)	3.77 (3.27-4.24)	4.34 (3.73-4.87)	5.21 (4.43-5.84)	5.98 (5.03-6.70)
6-hr	1.61 (1.44-1.84)	1.94 (1.73-2.21)	2.43 (2.16-2.75)	2.84 (2.51-3.21)	3.46 (3.04-3.90)	4.01 (3.50-4.50)	4.63 (4.02-5.19)	5.34 (4.59-5.97)	6.43 (5.46-7.18)	7.39 (6.21-8.25)
12-hr	1.99 (1.76-2.27)	2.38 (2.10-2.71)	2.97 (2.62-3.38)	3.49 (3.07-3.95)	4.28 (3.73-4.83)	4.99 (4.32-5.61)	5.81 (4.98-6.51)	6.74 (5.74-7.54)	8.21 (6.89-9.16)	9.53 (7.89-10.6)
24-hr	2.37 (2.17-2.61)	2.84 (2.61-3.13)	3.53 (3.24-3.89)	4.15 (3.79-4.56)	5.13 (4.63-5.59)	6.02 (5.40-6.54)	7.08 (6.30-7.65)	8.33 (7.33-8.96)	10.4 (8.97-11.1)	12.2 (10.5-13.0)
2-day	2.73 (2.49-3.04)	3.28 (2.99-3.65)	4.08 (3.71-4.54)	4.78 (4.33-5.31)	5.90 (5.30-6.51)	6.93 (6.18-7.62)	8.14 (7.20-8.92)	9.57 (8.38-10.4)	11.9 (10.2-12.9)	14.0 (11.9-15.2)
3-day	2.91 (2.66-3.22)	3.49 (3.19-3.86)	4.32 (3.94-4.78)	5.05 (4.59-5.57)	6.20 (5.61-6.81)	7.26 (6.51-7.96)	8.51 (7.57-9.30)	9.97 (8.78-10.9)	12.3 (10.7-13.4)	14.5 (12.4-15.7)
4-day	3.09 (2.83-3.40)	3.69 (3.39-4.07)	4.55 (4.18-5.02)	5.31 (4.85-5.83)	6.50 (5.91-7.12)	7.60 (6.85-8.30)	8.87 (7.94-9.67)	10.4 (9.18-11.3)	12.8 (11.1-13.8)	15.0 (12.9-16.2)
7-day	3.60 (3.33-3.96)	4.30 (3.98-4.73)	5.27 (4.85-5.78)	6.11 (5.61-6.69)	7.42 (6.77-8.11)	8.61 (7.80-9.39)	9.99 (8.98-10.9)	11.6 (10.3-12.6)	14.1 (12.4-15.3)	16.4 (14.3-17.8)
10-day	4.15 (3.86-4.52)	4.95 (4.60-5.38)	5.98 (5.55-6.50)	6.87 (6.37-7.45)	8.24 (7.58-8.92)	9.45 (8.65-10.2)	10.8 (9.85-11.7)	12.4 (11.2-13.4)	14.9 (13.3-16.0)	17.1 (15.1-18.4)
20-day	5.66 (5.33-6.05)	6.68 (6.29-7.14)	7.86 (7.38-8.38)	8.85 (8.30-9.43)	10.3 (9.65-11.0)	11.6 (10.8-12.3)	13.1 (12.1-13.9)	14.7 (13.5-15.5)	17.1 (15.6-18.1)	19.2 (17.3-20.3)
30-day	7.01 (6.63-7.46)	8.24 (7.78-8.76)	9.53 (8.99-10.1)	10.6 (9.98-11.3)	12.2 (11.4-12.9)	13.6 (12.7-14.4)	15.0 (14.0-15.9)	16.7 (15.5-17.7)	19.1 (17.6-20.2)	21.1 (19.3-22.4)
45-day	8.84 (8.41-9.35)	10.3 (9.82-10.9)	11.8 (11.2-12.4)	12.9 (12.3-13.6)	14.6 (13.8-15.4)	16.1 (15.2-16.9)	17.6 (16.5-18.5)	19.2 (18.0-20.2)	21.6 (20.1-22.7)	23.5 (21.8-24.9)
60-day	10.6 (10.1-11.1)	12.3 (11.7-12.9)	13.9 (13.2-14.6)	15.2 (14.4-15.9)	17.1 (16.2-17.9)	18.6 (17.6-19.5)	20.3 (19.1-21.3)	22.0 (20.7-23.1)	24.6 (23.0-25.8)	26.6 (24.8-28.0)

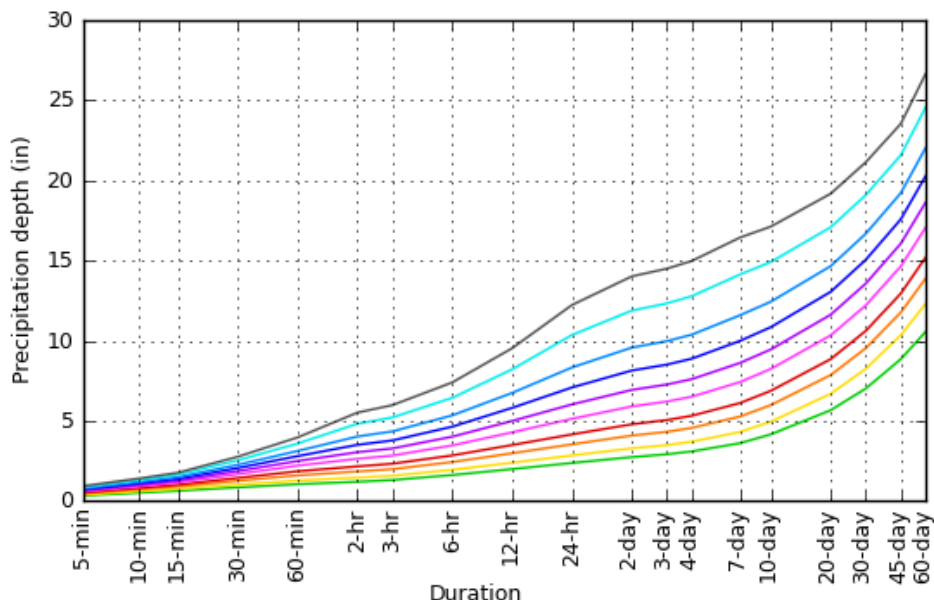
<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration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

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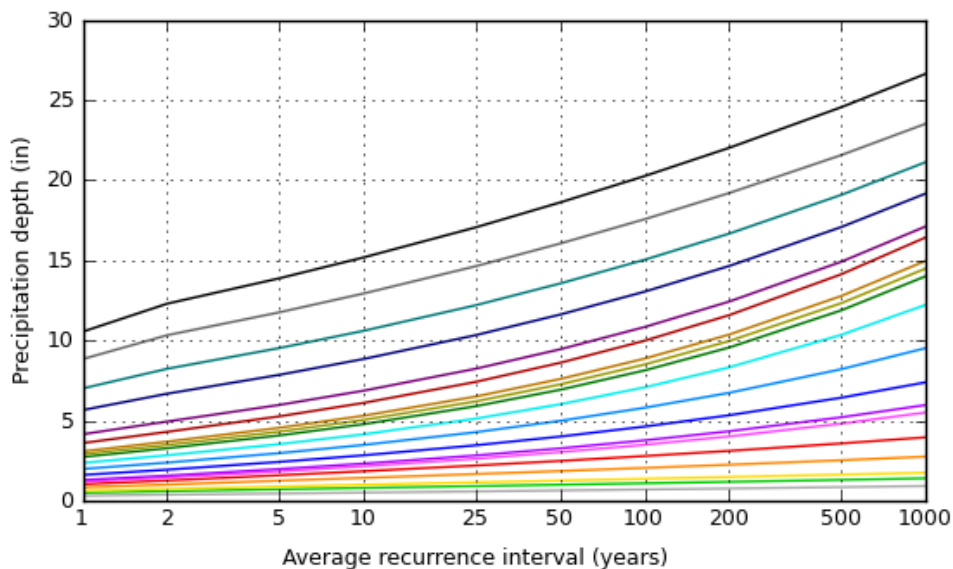


### PF graphical

PDS-based depth-duration-frequency (DDF) curves  
 Latitude: 40.2369°, Longitude: -77.1651°



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000



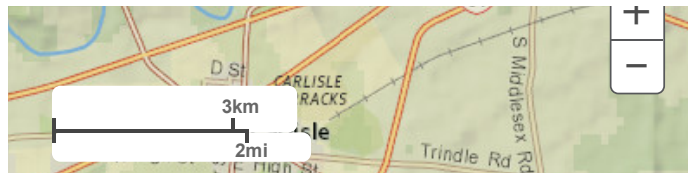
Duration
5-min
10-min
15-min
30-min
60-min
2-hr
3-hr
6-hr
12-hr
24-hr
2-day
3-day
4-day
7-day
10-day
20-day
30-day
45-day
60-day

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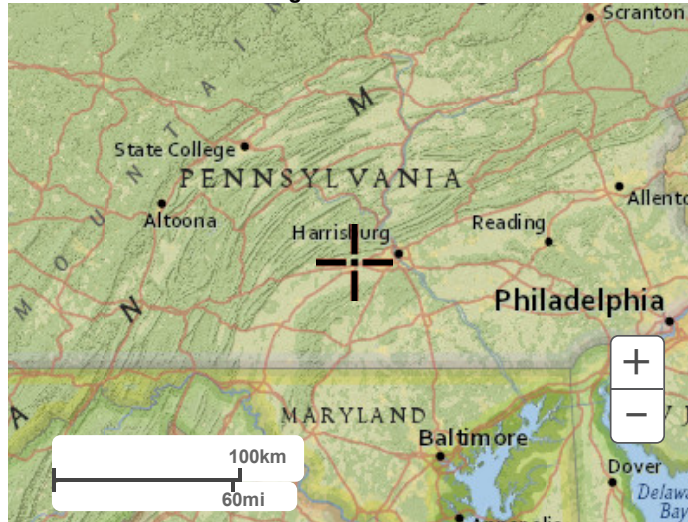
### Maps & aerials

#### Small scale terrain

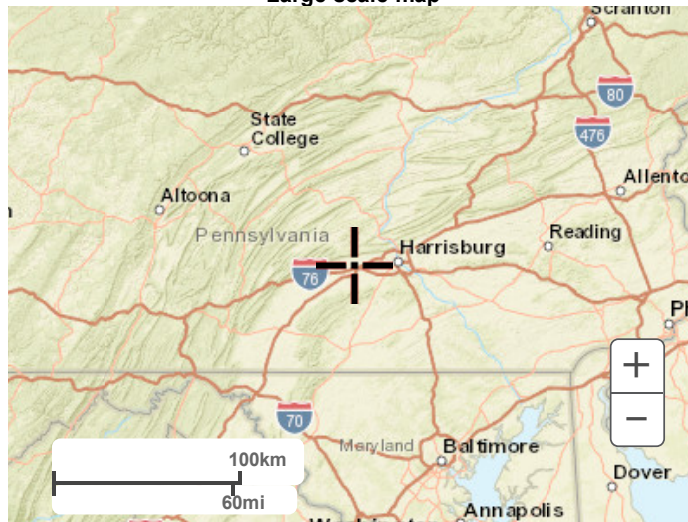




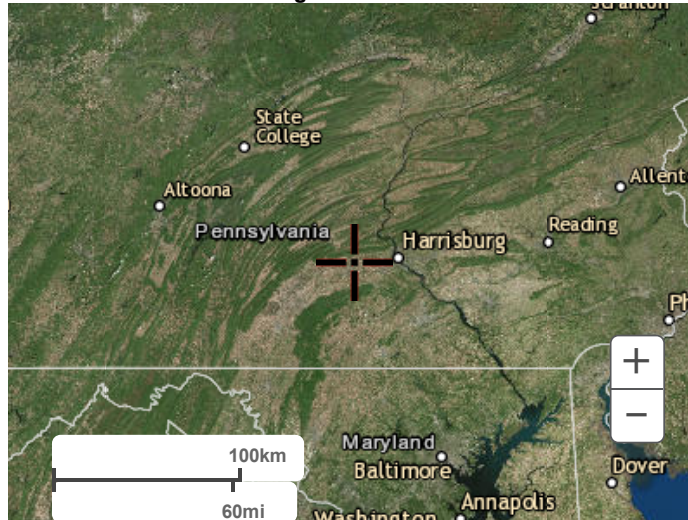
Large scale terrain



Large scale map



Large scale aerial



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**WORKSHEET 1. GENERAL SITE INFORMATION**

**Date:** November 11, 2016

**Project Name:** Wolf Bridge Valve Site and Access Road

**Municipality:** Middlesex

**County:** Cumberland

**Total Area (acres):** 0.93

**Major River Basin:** Mid-Atlantic Region

**Watershed:** Susquehanna River

**Sub Basin:** Lower Susquehanna-Swatara

**Nearest Surface Water to Receive Runoff:** Conodoguinet Creek

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

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

***Is Project Subject to, or Part of:***

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

**Existing or Planned drinking water supply?** YES   
NO

**If yes, distance from proposed discharge (miles):** \_\_\_\_\_

**Approved Act 167 Plan?** YES   
NO

**Existing River Conservation Plan?** YES   
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.

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:			
<b>TOTAL EXISTING:</b>		<b>0.00</b>	<b>0.00</b>

## 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
<b>TOTAL</b>	<b>0.00 Ac</b>

Site Area	Minus	Protected Area	=	Stormwater Management Area
0.58	-	0	=	0.58
				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 <sup>2</sup>	x 1/4" x 1/12	=	_____ ft <sup>3</sup>
	_____			
Meadow	_____ ft <sup>2</sup>	x 1/3" x 1/12	=	_____ ft <sup>3</sup>

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

*For Trees within 100 feet of impervious area:*

Tree Canopy	_____ ft <sup>2</sup>	x 1/2" x 1/12	=	_____ ft <sup>3</sup>
	_____			

#### 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 <sup>2</sup>	x 1/3" x 1/12	=	_____ ft <sup>3</sup>
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*For all other disconnected roof areas*

Roof Area	_____ ft <sup>2</sup>	x 1/4" x 1/12	=	_____ ft <sup>3</sup>
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#### 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 <sup>2</sup>	x 1/3" x 1/12	=	_____ ft <sup>3</sup>
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*For all other disconnected roof areas*

Impervious Area	_____ ft <sup>2</sup>	x 1/4" x 1/12	=	_____ ft <sup>3</sup>
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**TOTAL NON-STRUCTURAL VOLUME CREDIT\*** \_\_\_\_\_ ft<sup>3</sup>

*\*For use on Worksheet 5*



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

PROJECT: Wolf Bridge Valve Site and Access Road  
 Drainage Area: 0.93 acres  
 2-Year Rainfall: 2.84 in

Total Site Area: 0.58 acres  
 Protected Site Area: N/A acres  
 Managed Site Area: 0.58 acres

Existing Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	la (0.2*S)	Q Runoff <sup>1</sup> (in)	Runoff Volume <sup>3</sup> (ft <sup>3</sup> )
Meadow	B	25,265	0.58	58	7.24	1.45	0.22	472
Woods	B	0	0.00	55	8.18	1.64	0.15	0
<b>TOTAL:</b>		<b>25,265</b>	<b>0.58</b>					<b>472</b>

Developed Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	la (0.2*S)	Q Runoff <sup>1</sup> (in)	Runoff Volume <sup>3</sup> (ft <sup>3</sup> )
Impervious - Gravel	B	6,098	0.14	85	1.76	0.35	1.45	739
Meadow	B	19,166	0.44	58	7.24	1.45	0.22	358
Woods	B	0	0.00	55	8.18	1.64	0.15	0
<b>TOTAL:</b>		<b>25,265</b>	<b>0.58</b>					<b>1,098</b>

2-Year Volume Increase (ft <sup>3</sup> ):	<b>625</b>
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**2-Year Volume Increase = Developed Conditions Runoff Volume - Existing Conditions Runoff Volume**

- Runoff (in) =  $Q = (P - 0.2S) / (P + 0.8S)$  where  
 P = 2-Year Rainfall (in)  
 S =  $(1000/CN) - 10$
- Runoff Volume (CF) =  $Q \times \text{Area} \times 1/12$   
 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:** Wolf Bridge Valve Site and Access Road  
**SUB-BASIN:** DA-1

**Required Control Volume (ft<sup>3</sup>) - from Worksheet 4:** 625  
**Non-structural Volume Credit (ft<sup>3</sup>) - from Worksheet 3:** N/A  
 (maximum is 25% of required volume)  
**Structural Volume Reqmt (ft<sup>3</sup>)** 625  
 (Required Control Volume minus Non-structural Credit)

Proposed BMPs from PA Stormwater Best Management Practices Manual Chapter 6	Area (ft <sup>2</sup> )	Volume Reduction Permanently Removed (ft <sup>3</sup> )
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/Bioretenion		
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		
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	327	687
<b>Total Structural Volume (ft<sup>3</sup>):</b>		<b>687</b>
<b>Structural Volume Requirement (ft<sup>3</sup>):</b>		<b>625</b>
<b>DIFFERENCE:</b>		<b>-62</b>

**VOLUME CREDIT DETERMINATION**

- 1 Detained area runoff volume from Hydraflow = 681 cf
- 2 Storage volume of the BMP = 2,834 cf
- 3 Infiltrated volume within 72 hours after the 2-yr/24-hr event  
 (Infiltration Rate/12) x Infiltration Area x 72 hrs = 2,073 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	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.5.4 - Cluster Uses at Each Site	<input type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.1 - Minimize Total Disturbed Area	<input checked="" type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.6.3 - Re-Vegetate / Re-Forest Disturbed Areas (Native Species)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
NS BMP 5.9.1 - Street Sweeping / Vacuuming	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.1 - Riparian Buffer Restoration	<input type="checkbox"/>	<input type="checkbox"/>
Structural BMP 6.7.2 - Landscape Restoration	<input type="checkbox"/>	<input type="checkbox"/>

**SECONDARY BMPs FOR NITRATE:**

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



**TIME OF CONCENTRATION ADJUSTMENT**

POST CONSTRUCTION TC TO BMP (DETAINED TC) BEFORE ADJUSTMENT 12.6 MIN

STRUCTURAL VOLUME PROVIDED BY BMP 681 CF - 2 YEAR/24-HR STORM ONLY  
2834 CF - FOR ALL OTHER REMAINING STORM EVENTS

RATES OF RUNOFF TO THE BMP (FROM HYDRAFLOW REPORT)

Storm Event	Q (CFS)
2 YR/24 HR	0.247
10 YR/24 HR	0.594
50 YR/24 HR	1.176
100 YR/24 HR	1.533

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	0.247	45.951
10 YR/24 HR	0.594	79.517
50 YR/24 HR	1.176	40.164
100 YR/24 HR	1.533	30.811

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	0.247	45.951	58.551
10 YR/24 HR	0.594	79.517	92.117
50 YR/24 HR	1.176	40.164	52.764
100 YR/24 HR	1.533	30.811	43.411

### Underdrain Dewatering Rate Calculation

Project: Wolf Bridge

BMP: 1

Filter Media				
Layer	Media	Thickness - T (ft)	Min. Infiltration Rate - K (ft/min) <sup>1</sup>	Flow Rate (cfs) <sup>2</sup>
1	Clean Gravel	N/A	2	N/A
2	Coarse Sand	N/A	0.02	N/A
3	Fine Sand	2	0.002	0.00818
4	Other <sup>3</sup>	N/A	N/A	N/A
<b>Minimum Flow Rate (cfs)</b>				<b>0.008</b>

1. From Principles of Geotechnical Engineering Third Edition, Braja Das, 1994

2.  $Q=KA(Hm+T)/T$

A = Area (square feet) = 327

Hm = Head above media (feet) = 1.5

3. Infiltration rate measured in field or laboratory

Perforated Pipe				
Pipe	Perforation Area (square inch) <sup>4</sup>	# Perforations per Foot - N	Pipe Length - L (ft)	Flow Rate (cfs) <sup>5</sup>
1	1.00	1	109	4.96
2	N/A	N/A	N/A	N/A
<b>Total Flow Rate (cfs)</b>				<b>4.96</b>

4. Reference: [PVC: certainteed.com](http://PVC.certainteed.com) [HDPE: ads-pipe.com](http://HDPE.ads-pipe.com)

5.  $Q= N*L*cAo\sqrt{2GH}$

c = Orifice Coefficient = 0.6

Ao= Perforation Area (sq. ft.) 0.007

G= Grav. Accel. (ft/sec<sup>2</sup>) 32.2

H= Average Head (ft) = 3

Pipe Discharge				
Pipe	Pipe Diameter - D (in)	Pipe Roughness Coefficient - n	Pipe Slope - S <sup>6</sup>	Flow Rate (cfs) <sup>7</sup>
1	4	0.012	0.003058104	0.11
2	N/A	N/A	N/A	N/A
<b>Total Flow Rate (cfs)</b>				<b>0.11</b>

6. For flat pipe, use hydraulic grade (pipe diameter/pipe length) for the pipe slope

7. From Manning's equation (attach separate calculation worksheet)

Limiting flow rate from combined underdrain system - Ql (cfs) =	<b>0.008</b>
BMP Ponding Volume, Based on 2-year/24-hour flow to BMP (cu-ft) =	<b>681</b>
Total Dewatering Volume including volume in voids(cu-ft) =	<b>943</b>
Dewatering Time (sec) = 2HA/Ql =	<b>115,303</b>
Dewatering Time (hrs) =	<b>32.03</b>

---

## Slow Release Pipe Discharge

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### Project Description

Friction Method	Manning Formula
Solve For	Full Flow Capacity

### Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00306	ft/ft
Normal Depth	0.33	ft
Diameter	0.33	ft
Discharge	0.11	ft <sup>3</sup> /s

### Results

Discharge	0.11	ft <sup>3</sup> /s
Normal Depth	0.33	ft
Flow Area	0.09	ft <sup>2</sup>
Wetted Perimeter	1.05	ft
Hydraulic Radius	0.08	ft
Top Width	0.00	ft
Critical Depth	0.19	ft
Percent Full	100.0	%
Critical Slope	0.00806	ft/ft
Velocity	1.31	ft/s
Velocity Head	0.03	ft
Specific Energy	0.36	ft
Froude Number	0.00	
Maximum Discharge	0.12	ft <sup>3</sup> /s
Discharge Full	0.11	ft <sup>3</sup> /s
Slope Full	0.00306	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	%



---

## Slow Release Pipe Discharge

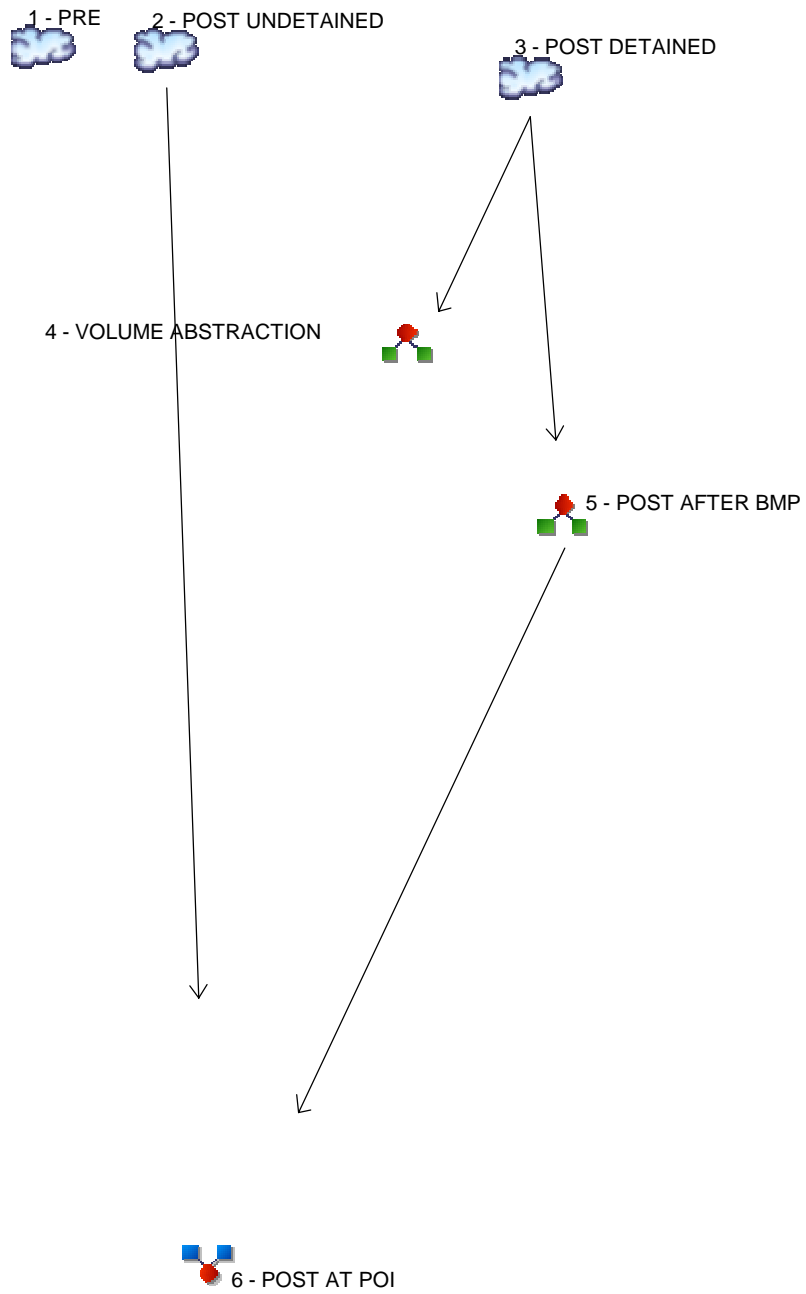
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### GVF Output Data

Normal Depth Over Rise	100.00	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.19	ft
Channel Slope	0.00306	ft/ft
Critical Slope	0.00806	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
4 Diversion1	VOLUME ABSTRACTION
5 Diversion2	POST AFTER BMP
6 Combine	POST AT POI

# Hydrograph Return Period Recap

Hydroflow 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	-----	-----	0.120	-----	-----	0.805	-----	2.272	3.235	PRE
2	SCS Runoff	-----	-----	0.110	-----	-----	0.630	-----	1.699	2.396	POST UNDETAINED
3	SCS Runoff	-----	-----	0.247	-----	-----	0.594	-----	1.176	1.533	POST DETAINED
4	Diversion1	3	-----	0.247	-----	-----	0.594	-----	1.176	1.533	VOLUME ABSTRACTION
5	Diversion2	3	-----	0.000	-----	-----	0.000	-----	0.018	0.066	POST AFTER BMP
6	Combine	2, 5	-----	0.110	-----	-----	0.630	-----	1.699	2.396	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	0.120	2	724	781	-----	-----	-----	PRE	
2	SCS Runoff	0.110	2	724	617	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	0.247	2	722	702	-----	-----	-----	POST DETAINED	
4	Diversion1	0.247	2	722	702	3	-----	-----	VOLUME ABSTRACTION	
5	Diversion2	0.000	2	n/a	0	3	-----	-----	POST AFTER BMP	
6	Combine	0.110	2	724	617	2, 5	-----	-----	POST AT POI	
Wolf.gpw					Return Period: 2 Year			Monday, 10 / 24 / 2016		

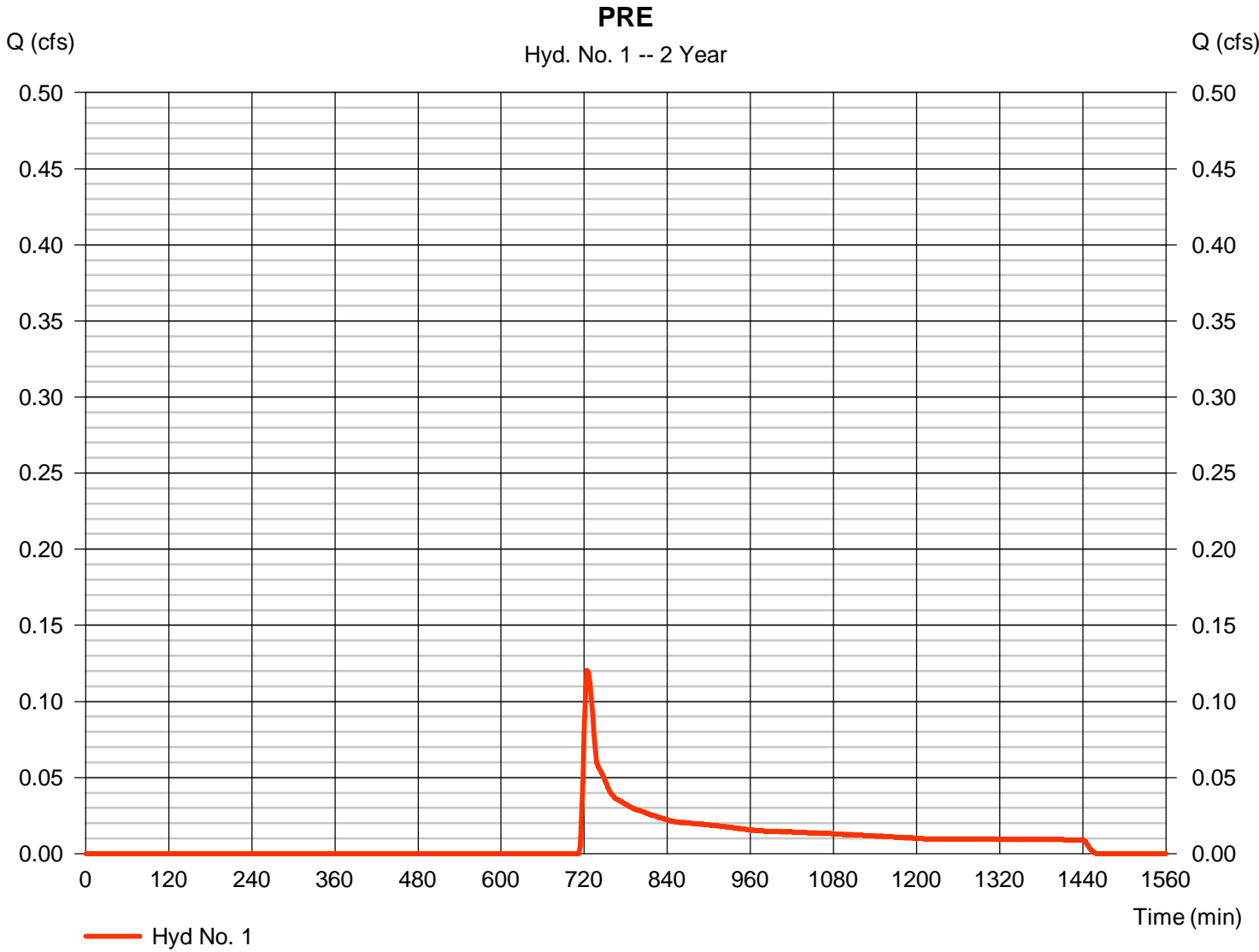
# Hydrograph Report

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 0.120 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 781 cuft
Drainage area	= 0.930 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 2.84 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.800 x 58)] / 0.930



# TR55 Tc Worksheet

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

## Hyd. No. 1

PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.84	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 11.48</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 11.48</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 350.00	0.00	0.00	
Watercourse slope (%)	= 5.40	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=3.75	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.56</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.56</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>13.00 min</b>



# Hydrograph Report

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

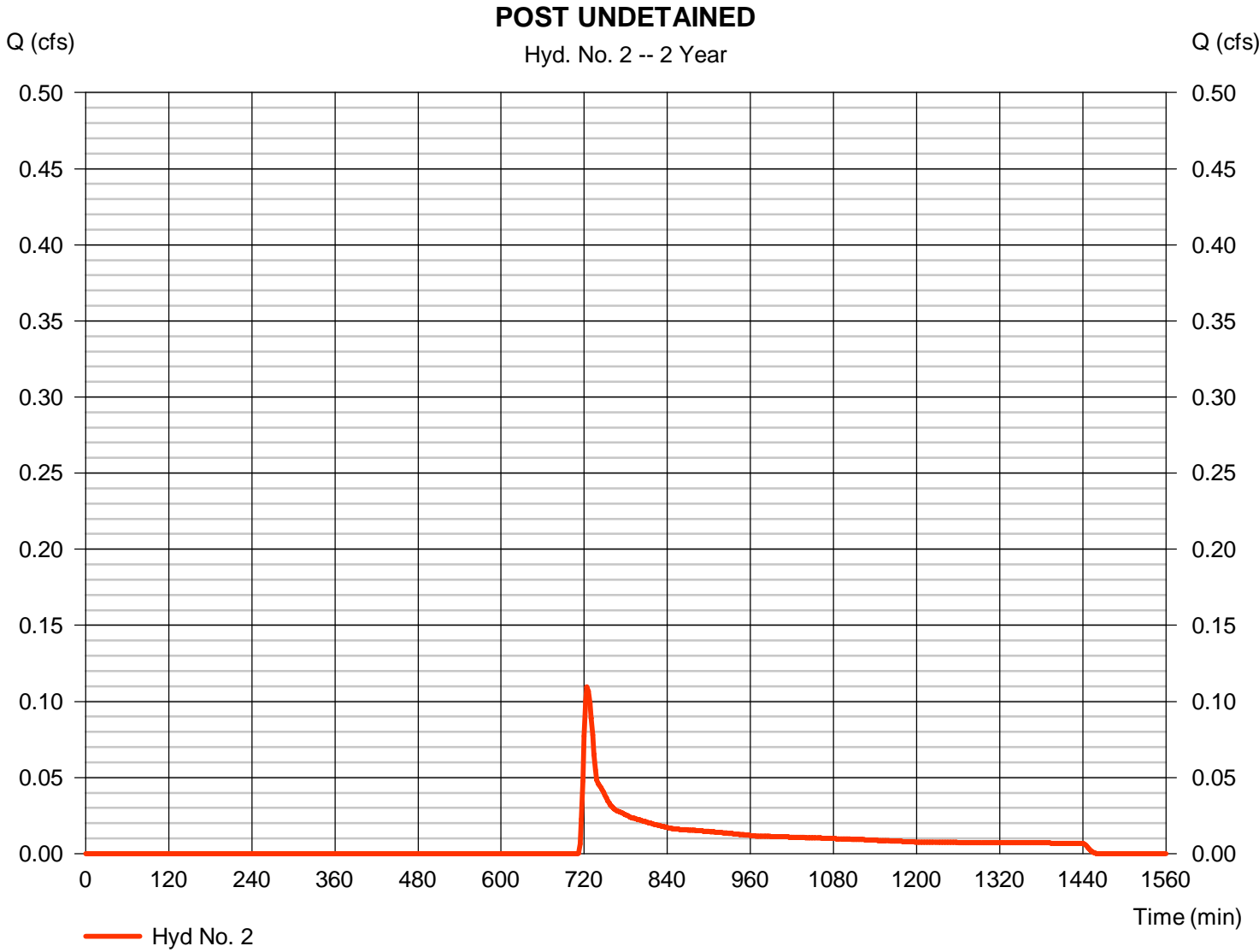
Monday, 10 / 24 / 2016

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.110 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 617 cuft
Drainage area	= 0.660 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 2.84 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.010 x 85) + (0.520 x 58)] / 0.660



# TR55 Tc Worksheet

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

## Hyd. No. 2

POST UNDETAINED

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.84	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 11.48</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 11.48</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 350.00	0.00	0.00	
Watercourse slope (%)	= 5.40	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=3.75	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.56</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.56</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>13.00 min</b>

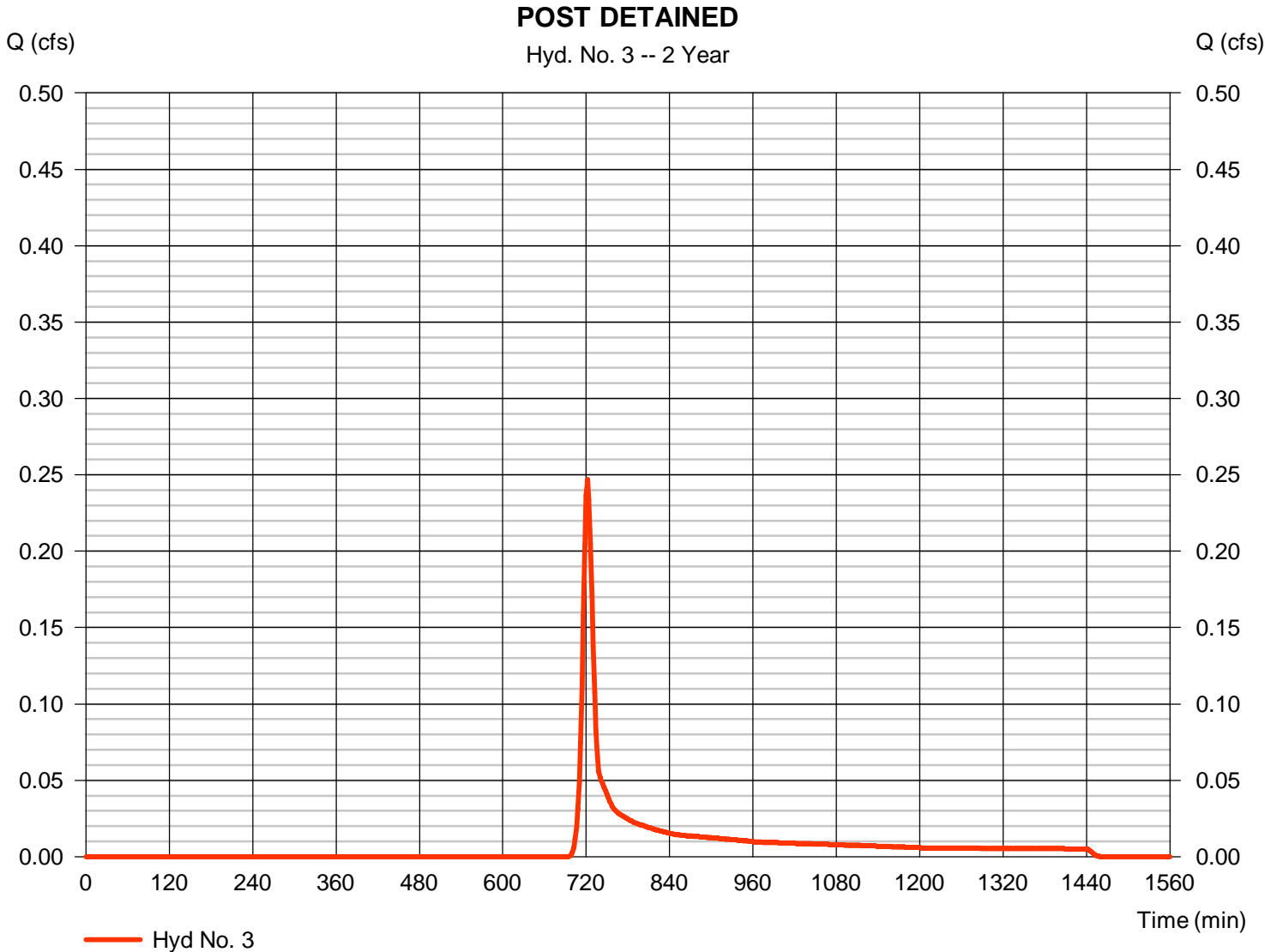
# Hydrograph Report

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.247 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 702 cuft
Drainage area	= 0.280 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.58 min
Total precip.	= 2.84 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.130 x 85) + (0.150 x 58)] / 0.280



# TR55 Tc Worksheet

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

## Hyd. No. 3

POST DETAINED

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.84	2.84	2.84	
Land slope (%)	= 1.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 11.48</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 11.48</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 131.00	0.00	0.00	
Watercourse slope (%)	= 1.50	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=1.98	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.10</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.10</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>12.58 min</b>

# Hydrograph Report

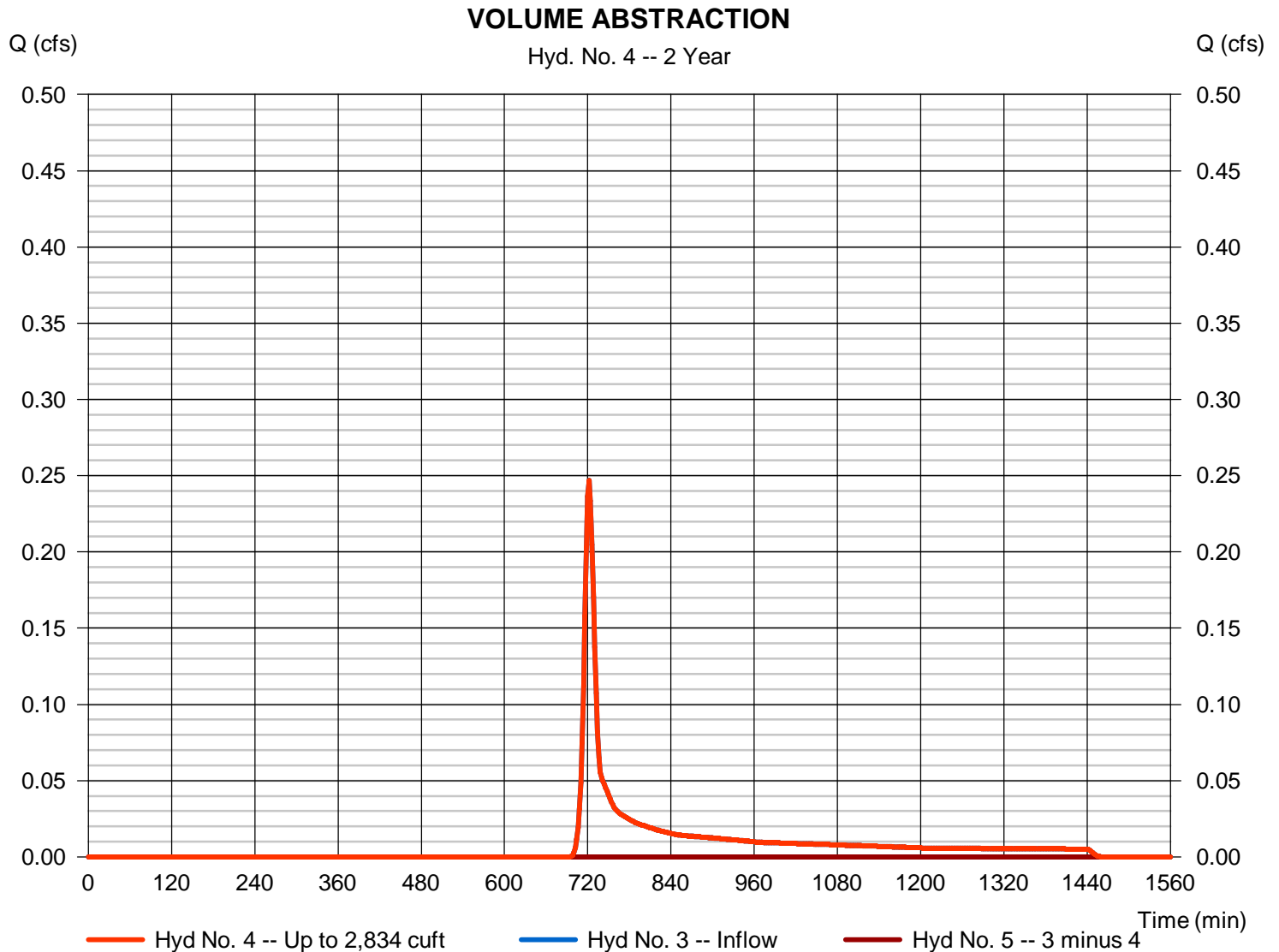
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Monday, 10 / 24 / 2016

## Hyd. No. 4

### VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.247 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 702 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft



# Hydrograph Report

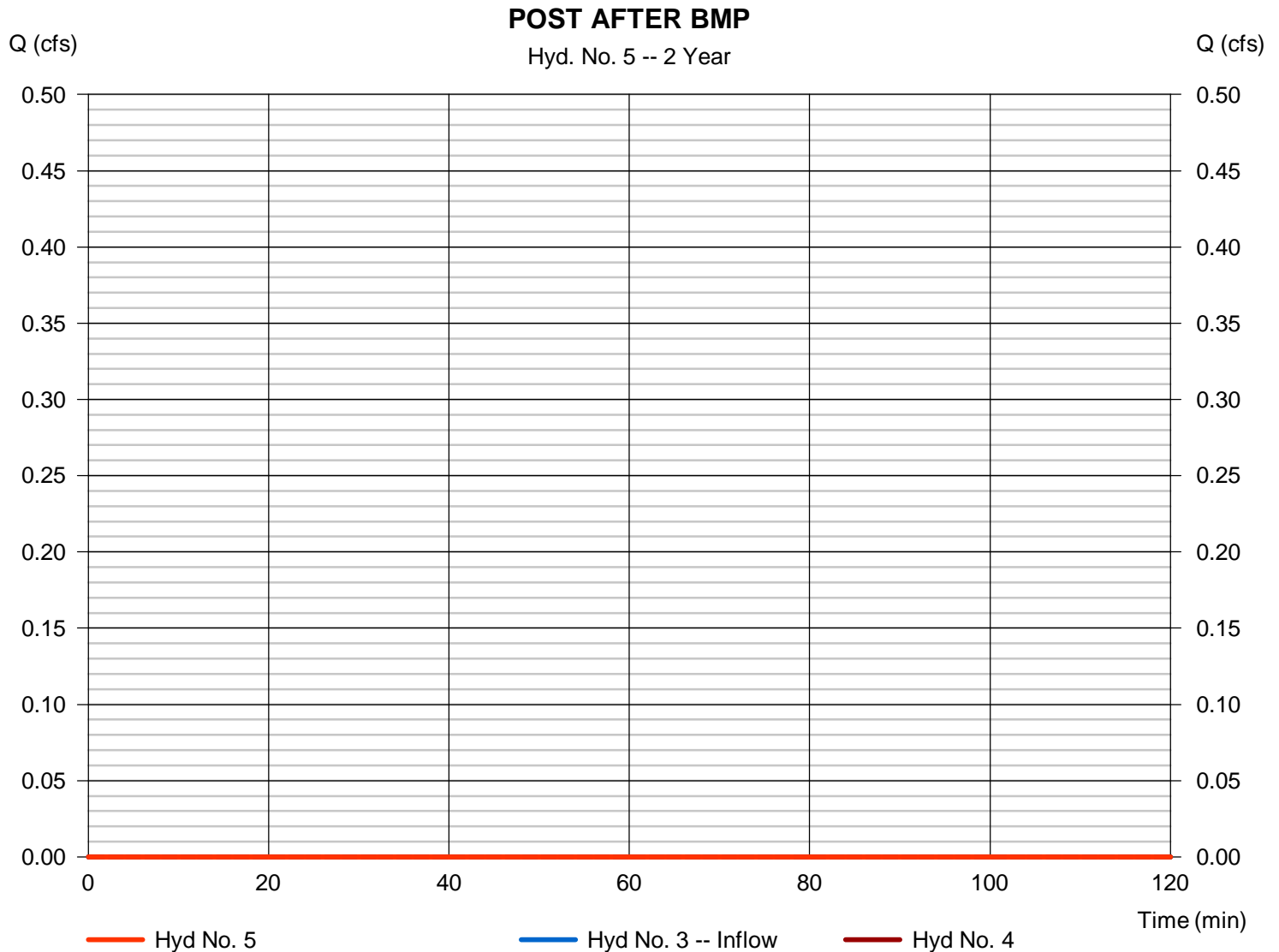
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Monday, 10 / 24 / 2016

## 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	= 2,834 cuft





# Hydrograph Report

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

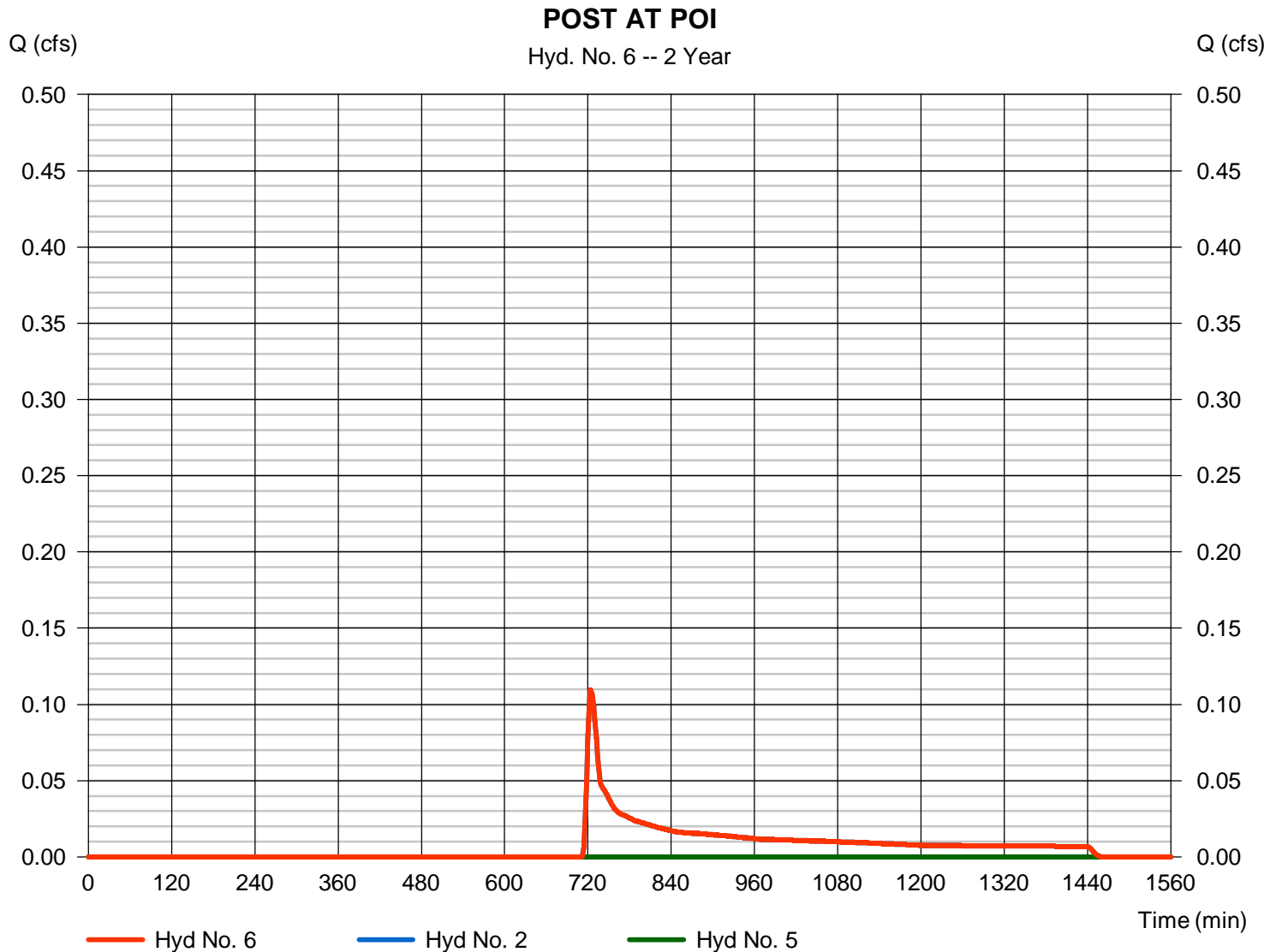
Monday, 10 / 24 / 2016

## Hyd. No. 6

POST AT POI

Hydrograph type = Combine  
Storm frequency = 2 yrs  
Time interval = 2 min  
Inflow hyds. = 2, 5

Peak discharge = 0.110 cfs  
Time to peak = 724 min  
Hyd. volume = 617 cuft  
Contrib. drain. area = 0.660 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	0.805	2	722	2,555	-----	-----	-----	PRE
2	SCS Runoff	0.630	2	722	1,939	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	0.594	2	722	1,570	-----	-----	-----	POST DETAINED
4	Diversion1	0.594	2	722	1,570	3	-----	-----	VOLUME ABSTRACTION
5	Diversion2	0.000	2	n/a	0	3	-----	-----	POST AFTER BMP
6	Combine	0.630	2	722	1,939	2, 5	-----	-----	POST AT POI
Wolf.gpw					Return Period: 10 Year			Monday, 10 / 24 / 2016	

# Hydrograph Report

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

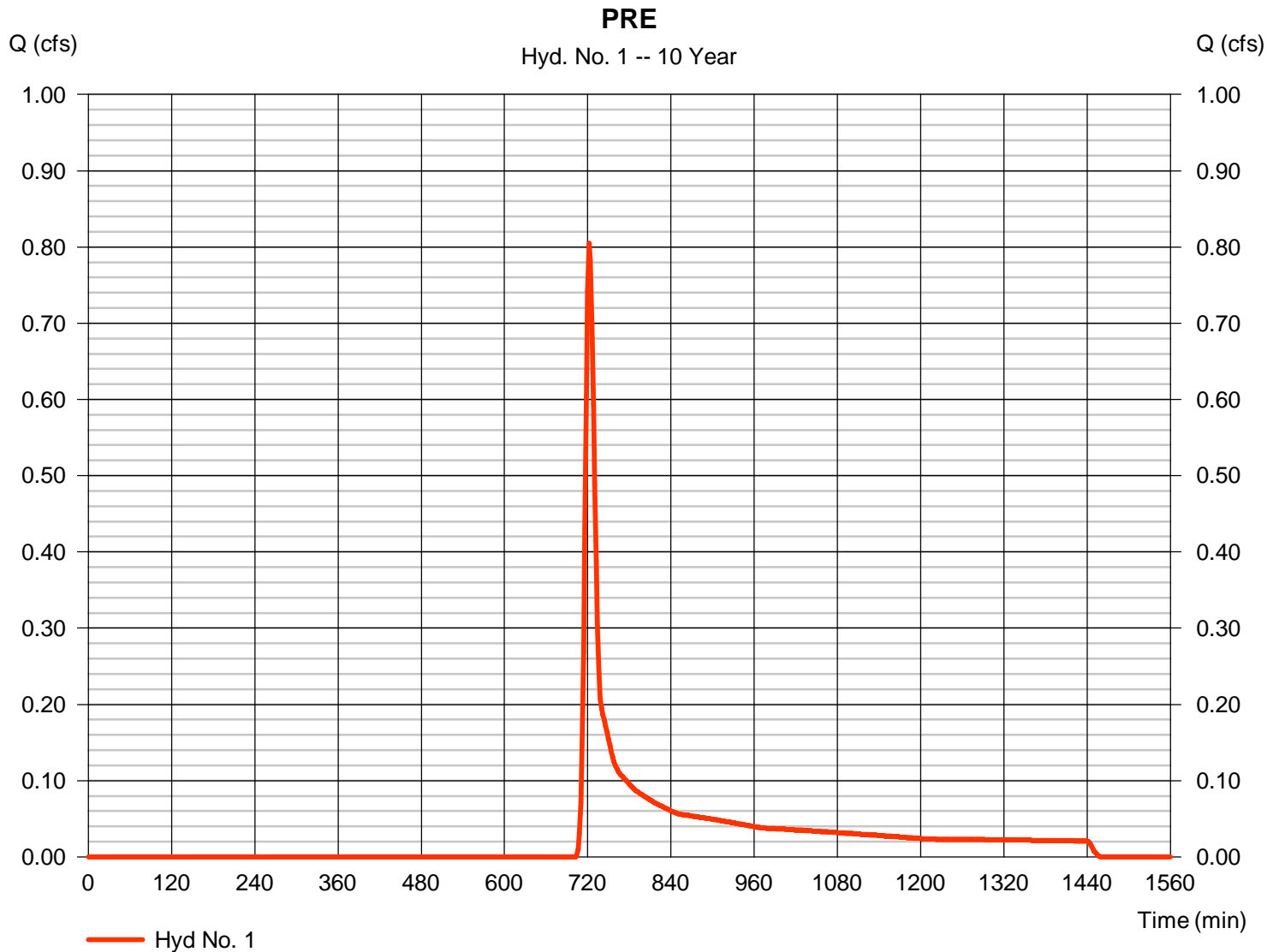
Monday, 10 / 24 / 2016

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 0.805 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 2,555 cuft
Drainage area	= 0.930 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 4.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.800 x 58)] / 0.930



# Hydrograph Report

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

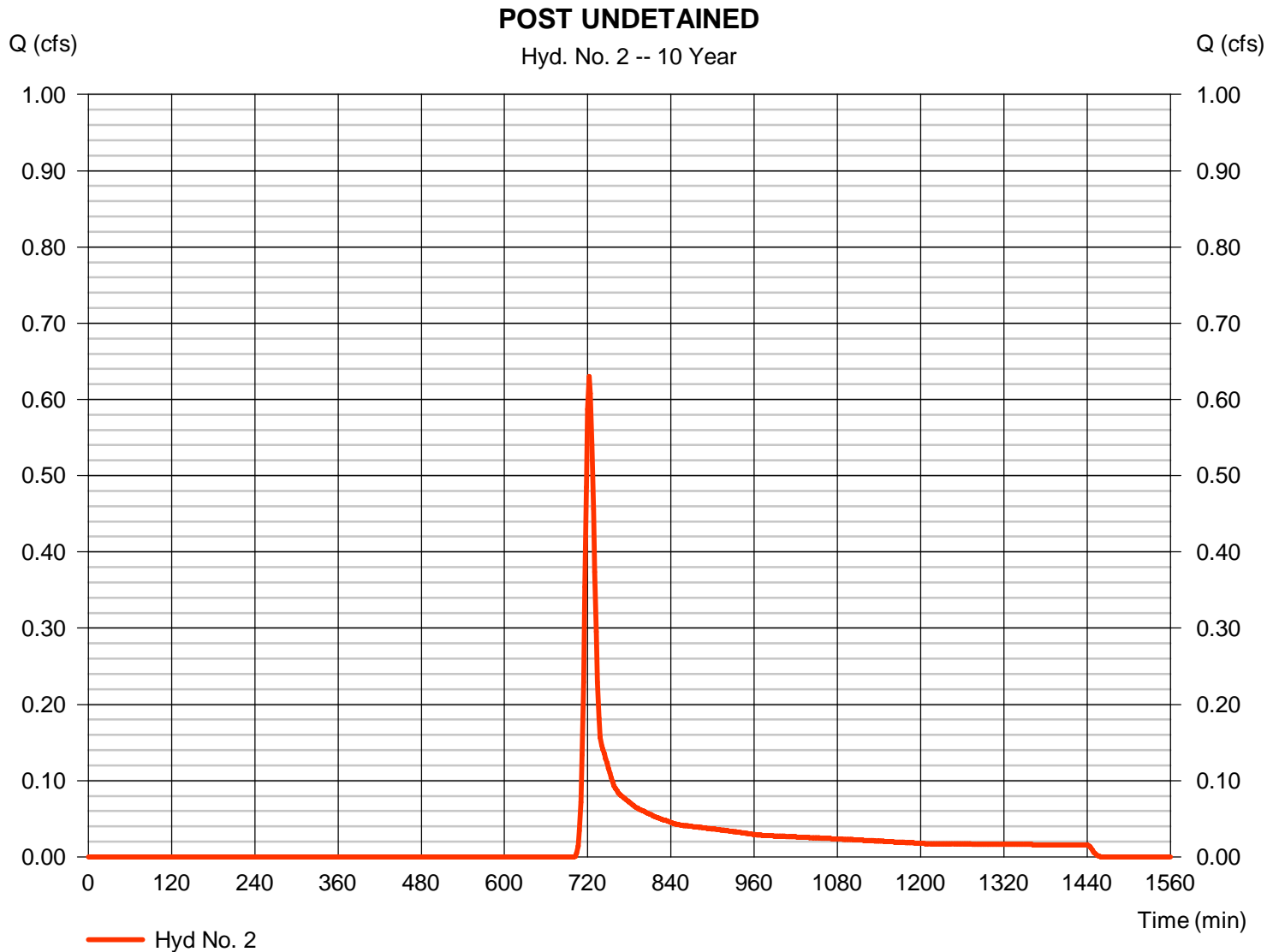
Monday, 10 / 24 / 2016

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.630 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 1,939 cuft
Drainage area	= 0.660 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 4.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.010 x 85) + (0.520 x 58)] / 0.660



# Hydrograph Report

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

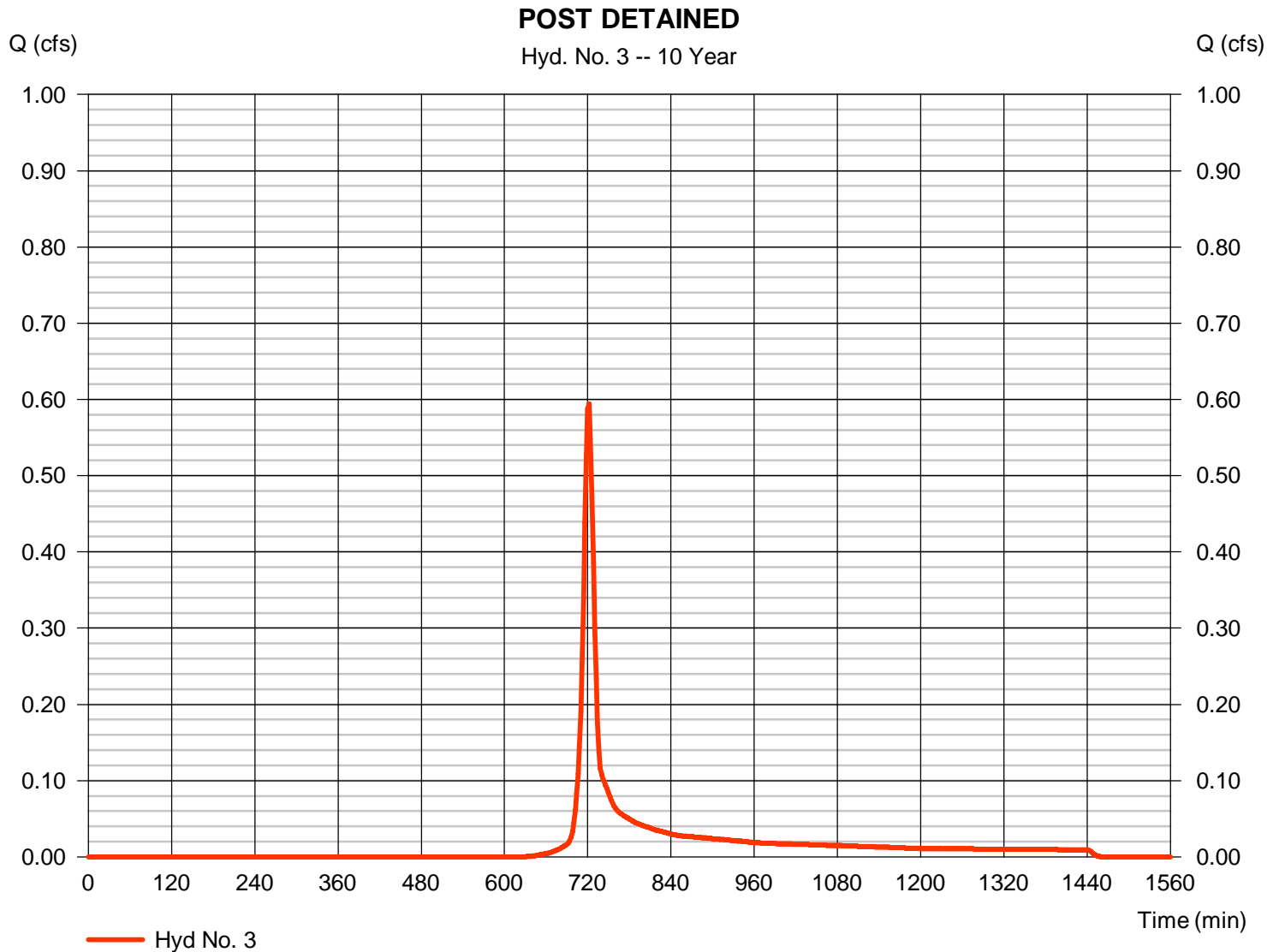
Monday, 10 / 24 / 2016

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.594 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 1,570 cuft
Drainage area	= 0.280 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.58 min
Total precip.	= 4.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.130 x 85) + (0.150 x 58)] / 0.280



# Hydrograph Report

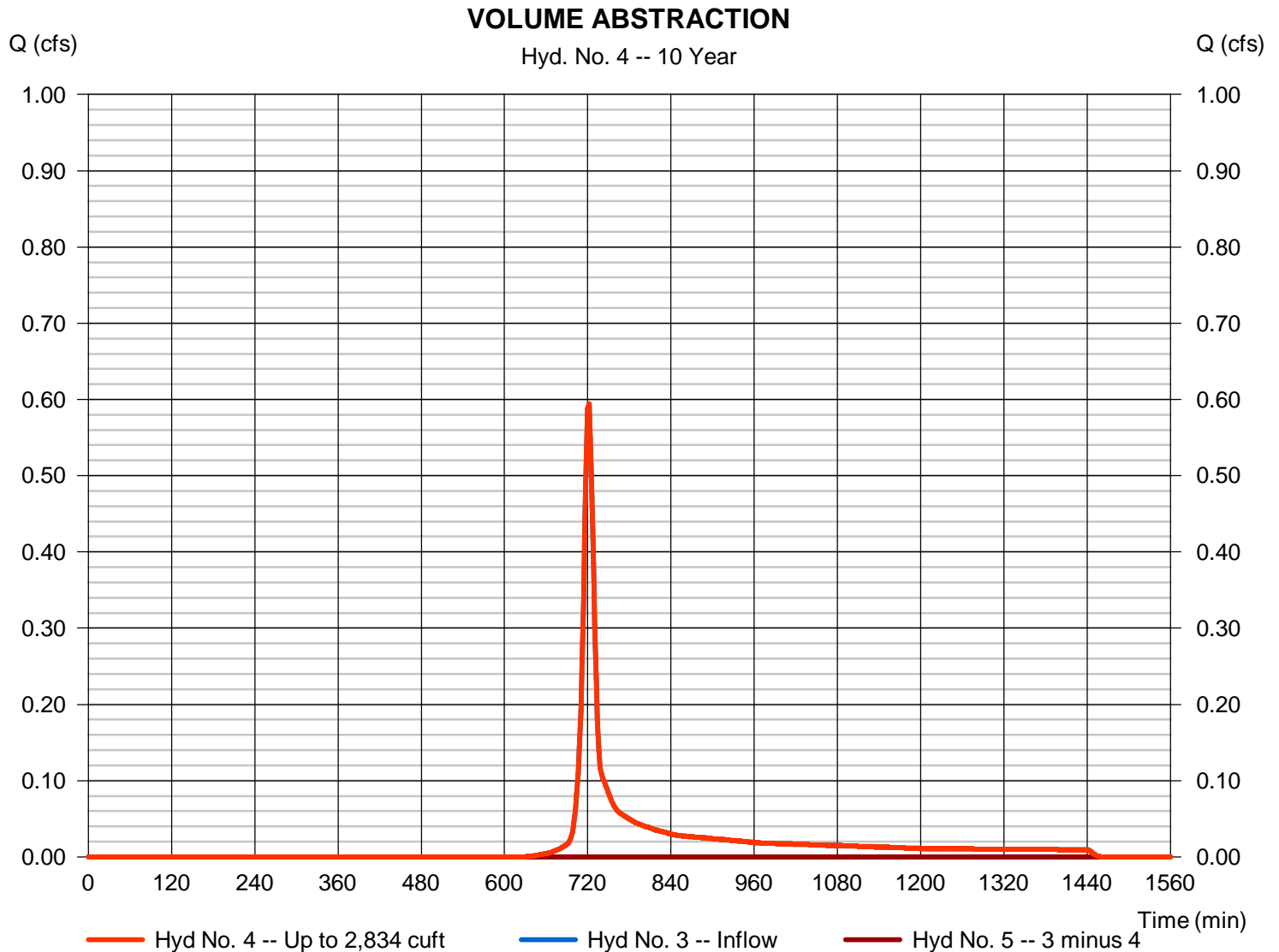
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 4

### VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.594 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 1,570 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft





# Hydrograph Report

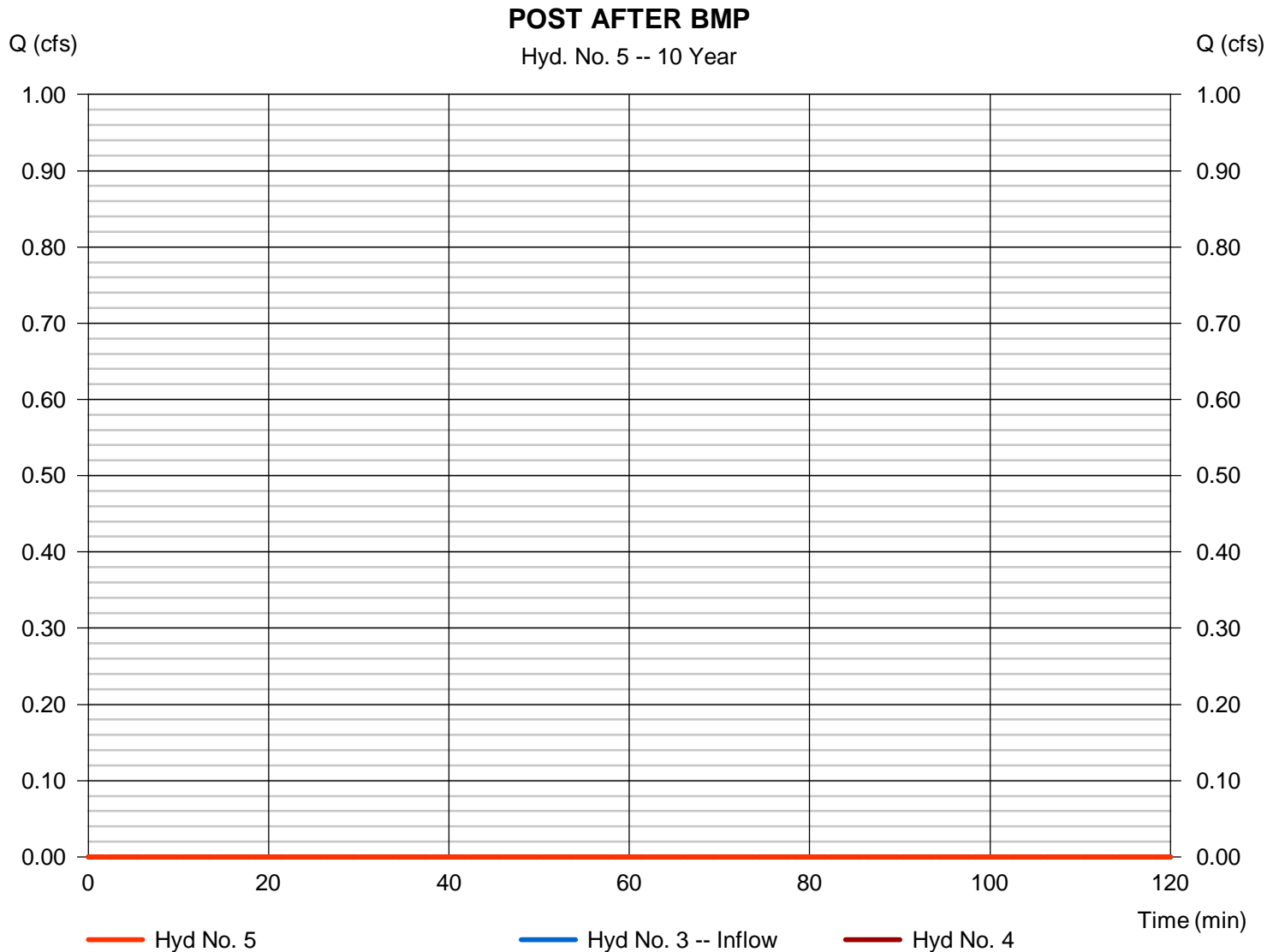
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.000 cfs
Storm frequency	= 10 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	= 2,834 cuft



# Hydrograph Report

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

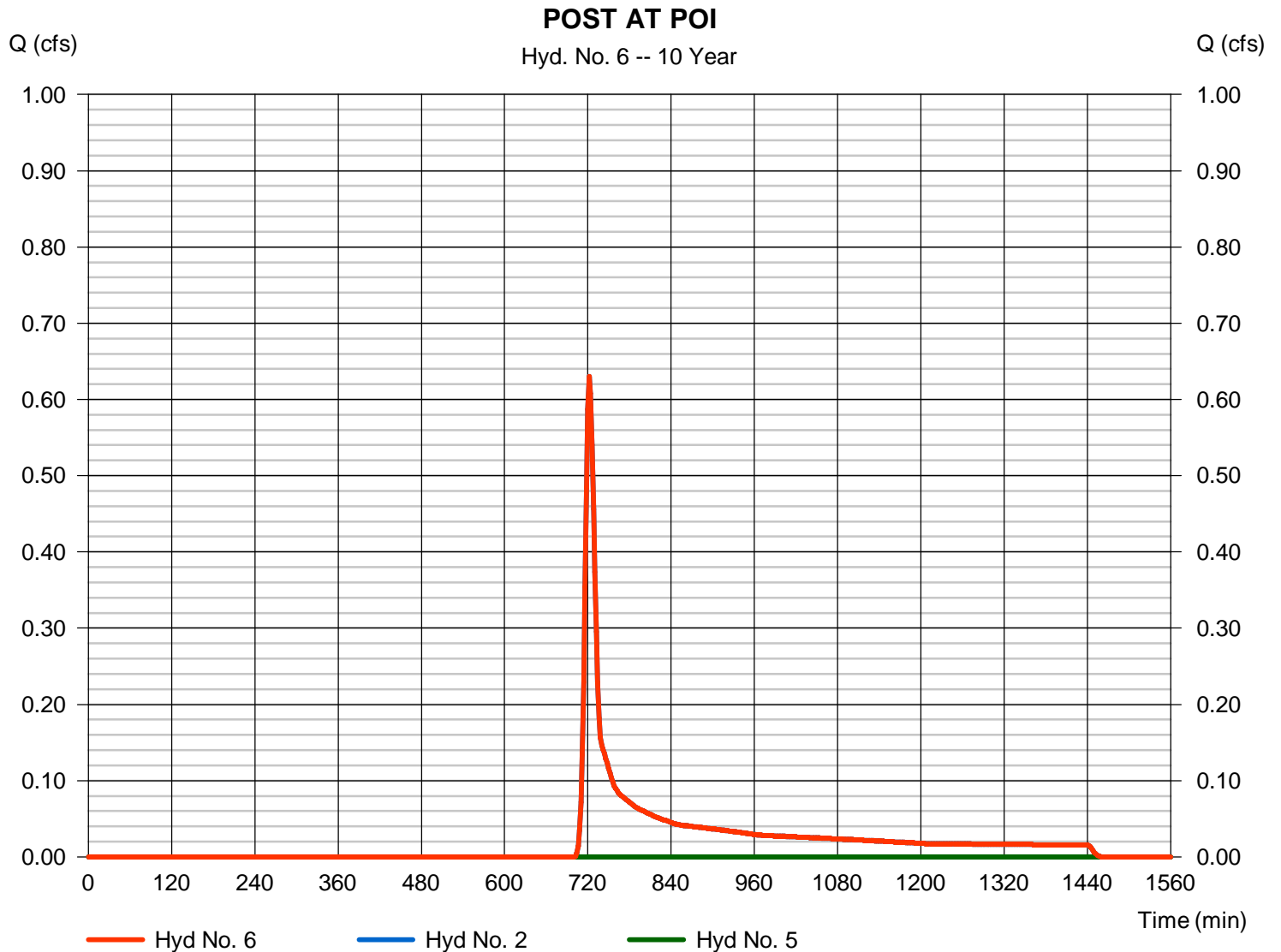
Monday, 10 / 24 / 2016

## Hyd. No. 6

POST AT POI

Hydrograph type = Combine  
 Storm frequency = 10 yrs  
 Time interval = 2 min  
 Inflow hyds. = 2, 5

Peak discharge = 0.630 cfs  
 Time to peak = 722 min  
 Hyd. volume = 1,939 cuft  
 Contrib. drain. area = 0.660 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	2.272	2	722	6,160	-----	-----	-----	PRE
2	SCS Runoff	1.699	2	722	4,574	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	1.176	2	720	3,055	-----	-----	-----	POST DETAINED
4	Diversion1	1.176	2	720	2,834	3	-----	-----	VOLUME ABSTRACTION
5	Diversion2	0.018	2	1230	221	3	-----	-----	POST AFTER BMP
6	Combine	1.699	2	722	4,795	2, 5	-----	-----	POST AT POI
Wolf.gpw					Return Period: 50 Year			Monday, 10 / 24 / 2016	

# Hydrograph Report

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

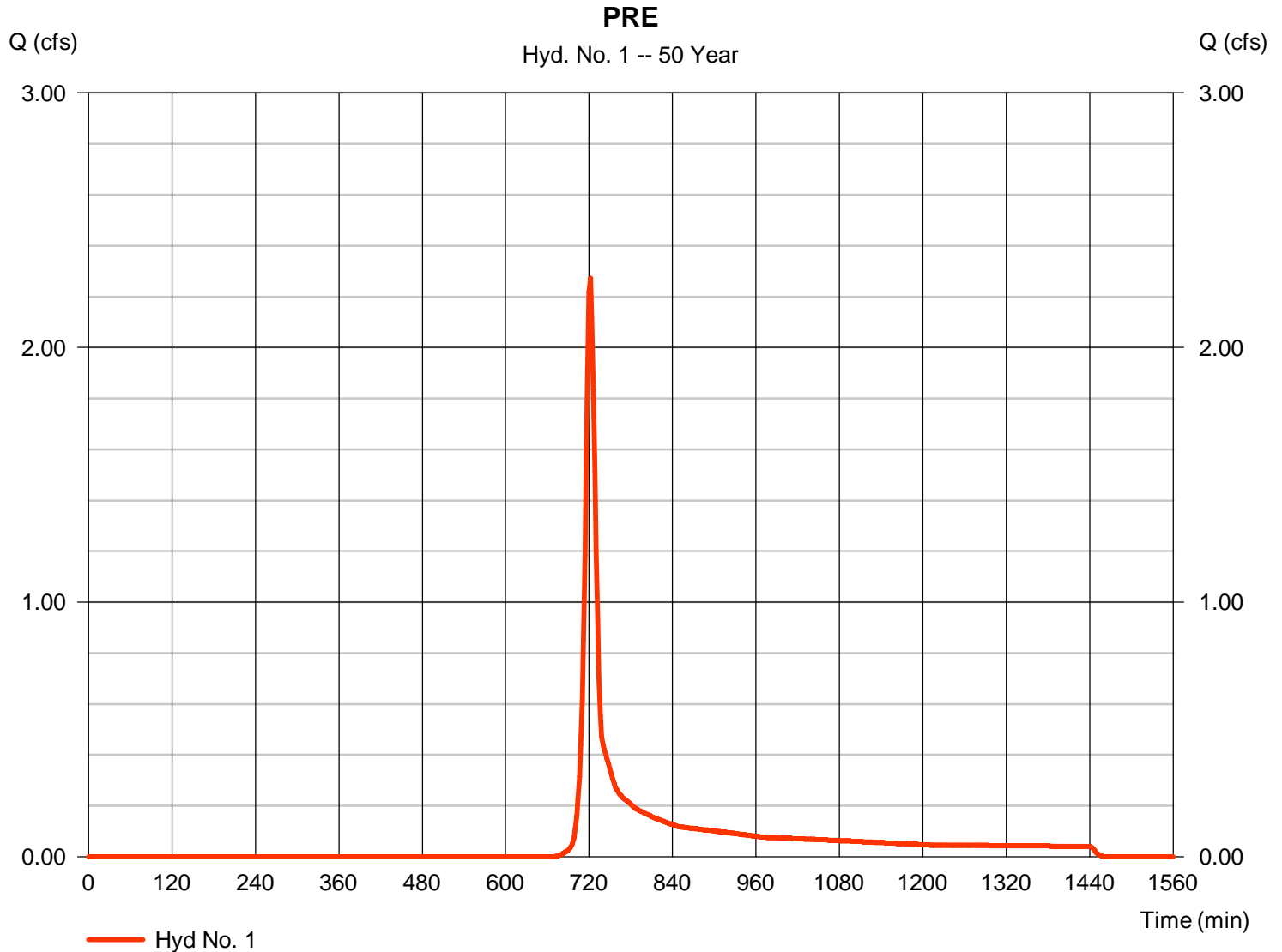
Monday, 10 / 24 / 2016

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 2.272 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 6,160 cuft
Drainage area	= 0.930 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 6.02 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.800 x 58)] / 0.930



# Hydrograph Report

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

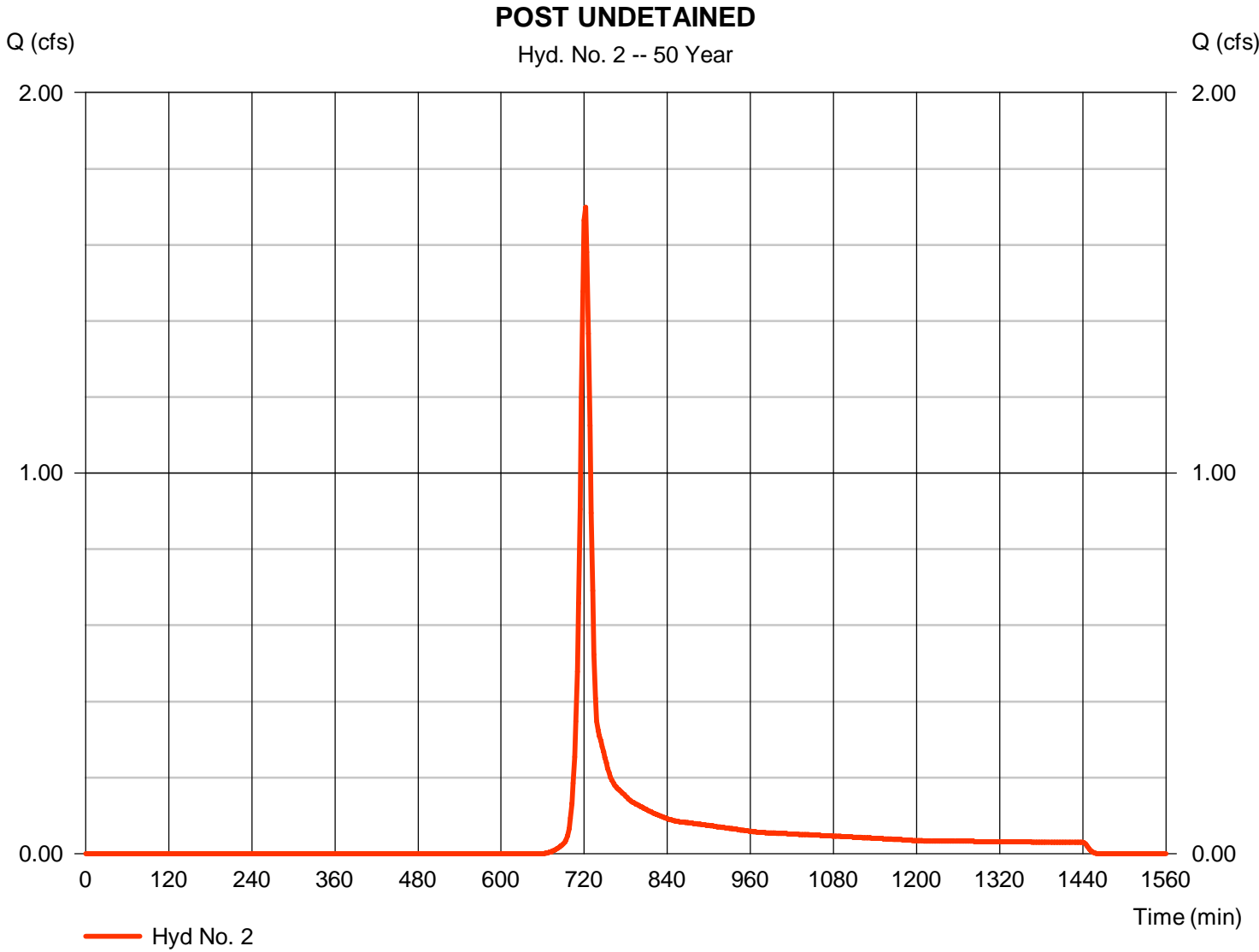
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## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.699 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 4,574 cuft
Drainage area	= 0.660 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 6.02 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.010 x 85) + (0.520 x 58)] / 0.660



# Hydrograph Report

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

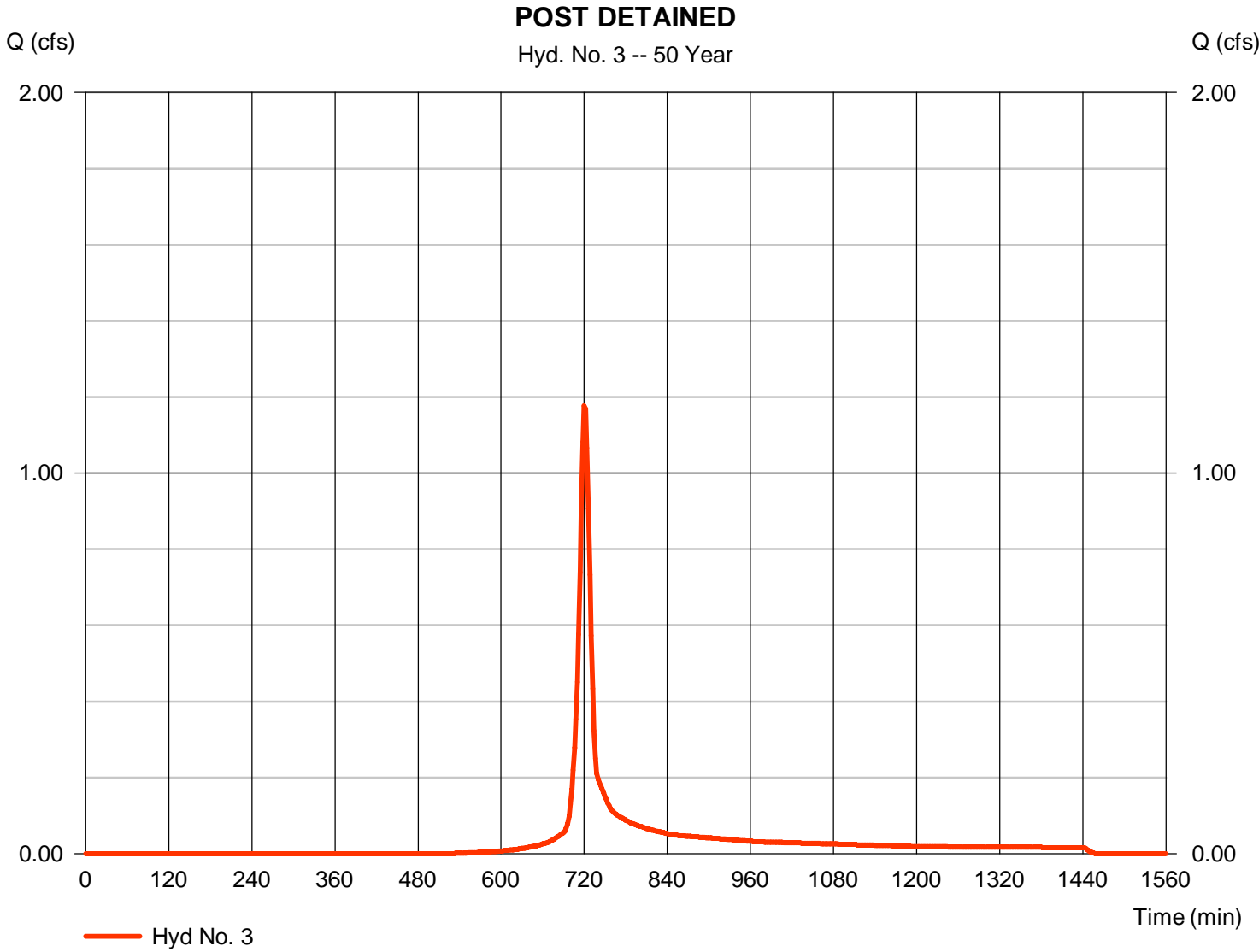
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## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.176 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 3,055 cuft
Drainage area	= 0.280 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.58 min
Total precip.	= 6.02 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.130 x 85) + (0.150 x 58)] / 0.280



# Hydrograph Report

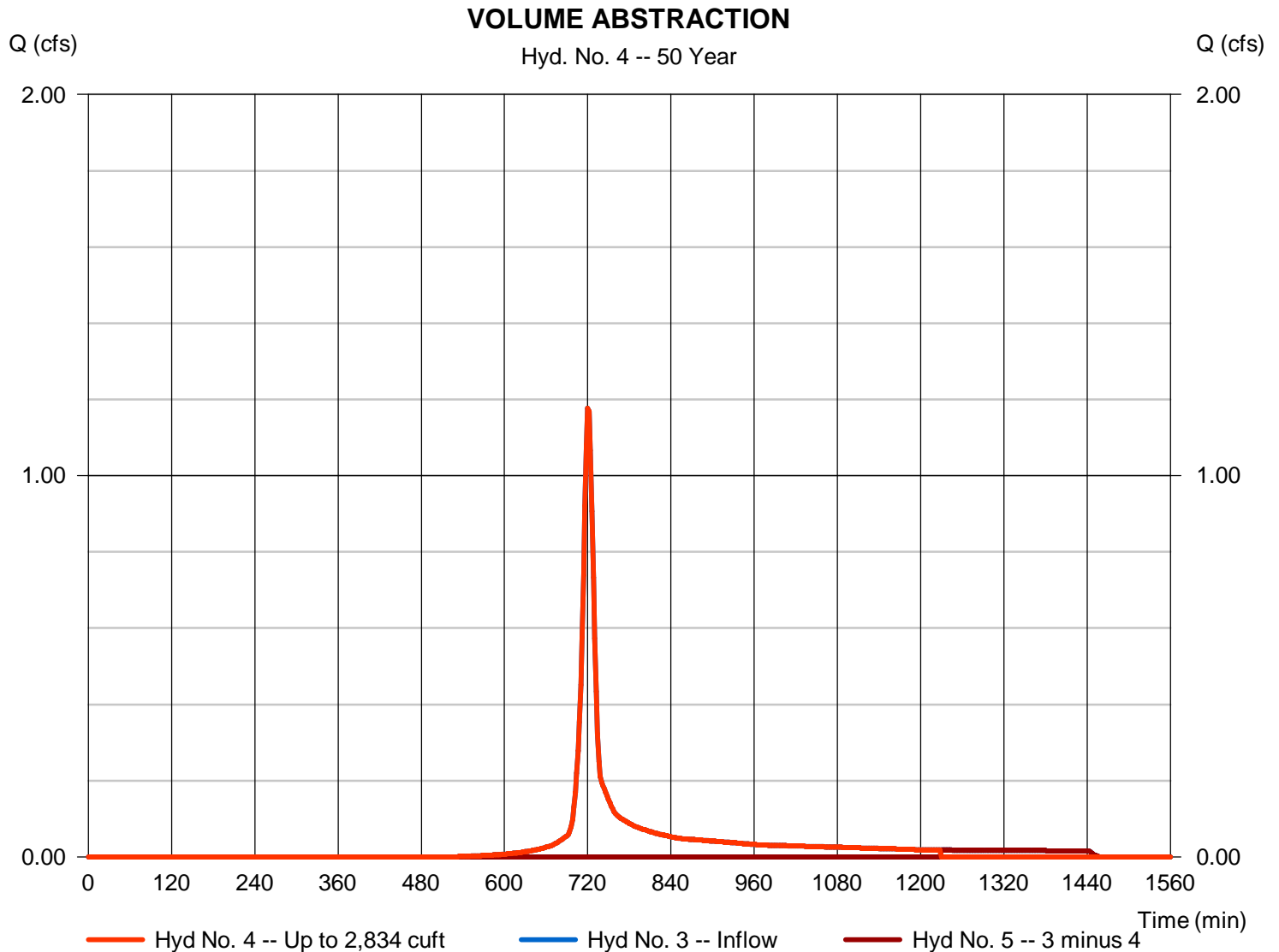
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 4

### VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.176 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 2,834 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft



# Hydrograph Report

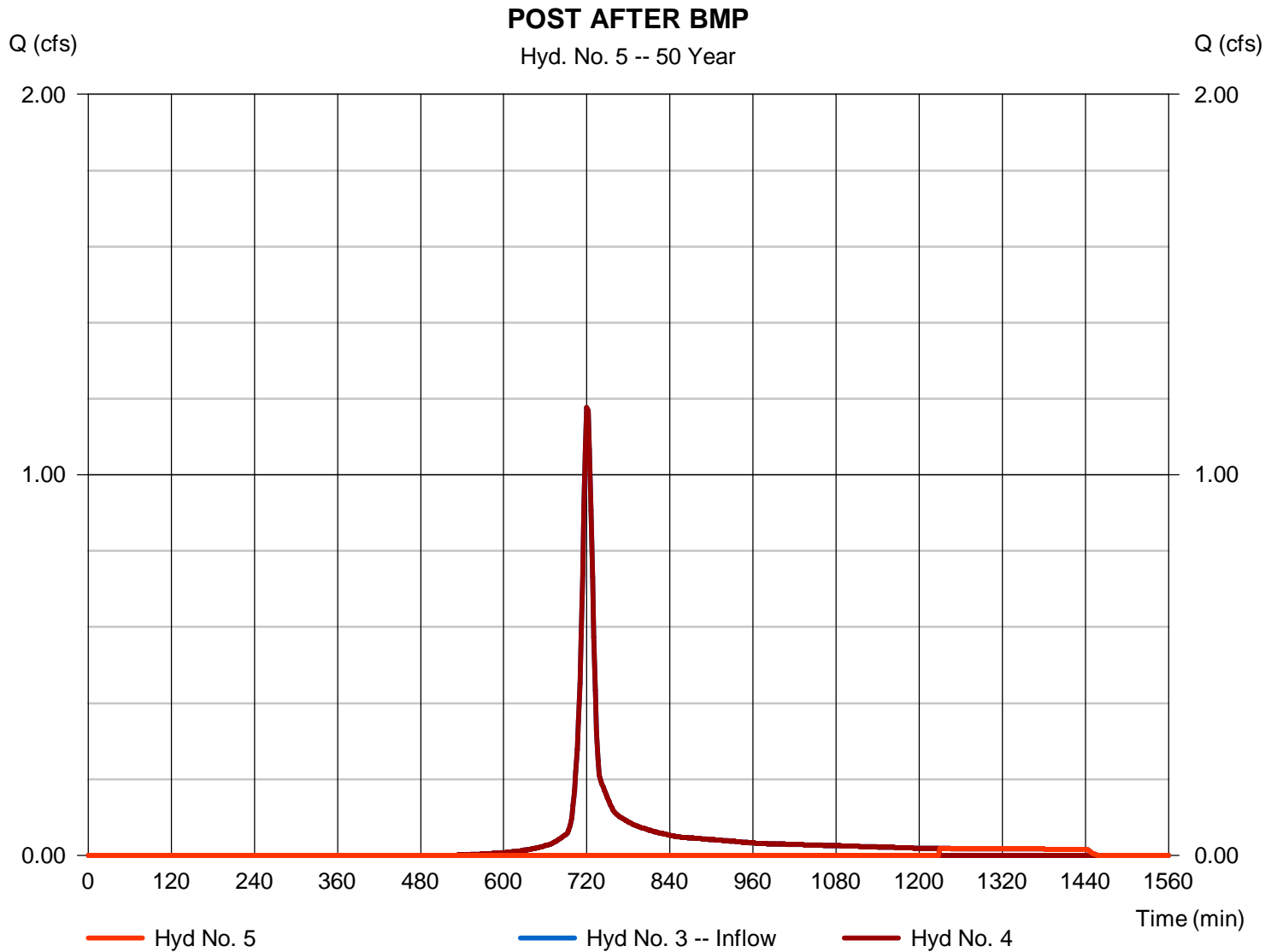
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.018 cfs
Storm frequency	= 50 yrs	Time to peak	= 1230 min
Time interval	= 2 min	Hyd. volume	= 221 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft





# Hydrograph Report

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

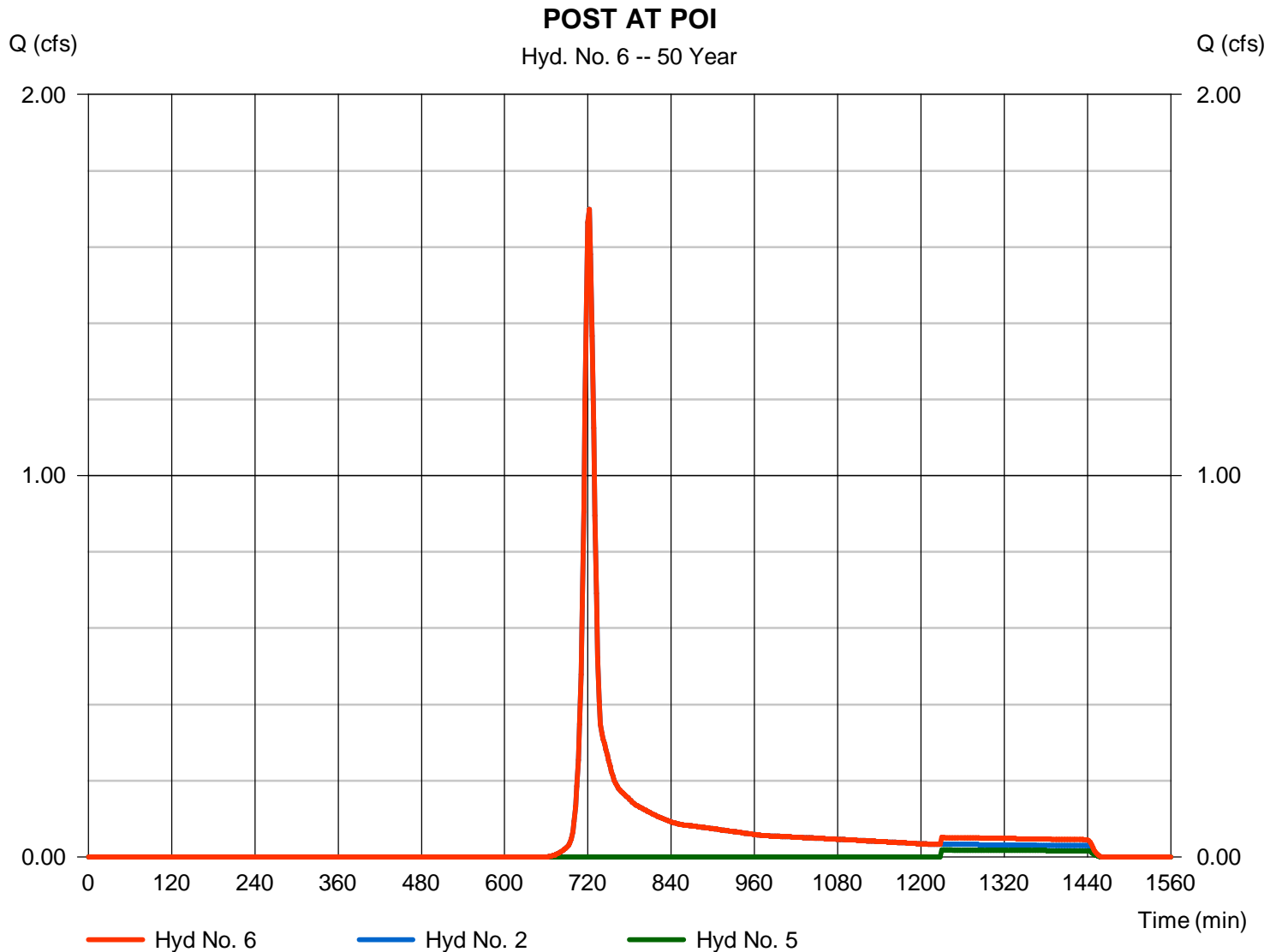
Monday, 10 / 24 / 2016

## Hyd. No. 6

POST AT POI

Hydrograph type = Combine  
 Storm frequency = 50 yrs  
 Time interval = 2 min  
 Inflow hyds. = 2, 5

Peak discharge = 1.699 cfs  
 Time to peak = 722 min  
 Hyd. volume = 4,795 cuft  
 Contrib. drain. area = 0.660 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	3.235	2	722	8,577	-----	-----	-----	PRE	
2	SCS Runoff	2.396	2	722	6,329	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	1.533	2	720	3,973	-----	-----	-----	POST DETAINED	
4	Diversion1	1.533	2	720	2,837	3	-----	-----	VOLUME ABSTRACTION	
5	Diversion2	0.066	2	840	1,137	3	-----	-----	POST AFTER BMP	
6	Combine	2.396	2	722	7,466	2, 5	-----	-----	POST AT POI	
Wolf.gpw					Return Period: 100 Year			Monday, 10 / 24 / 2016		

# Hydrograph Report

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

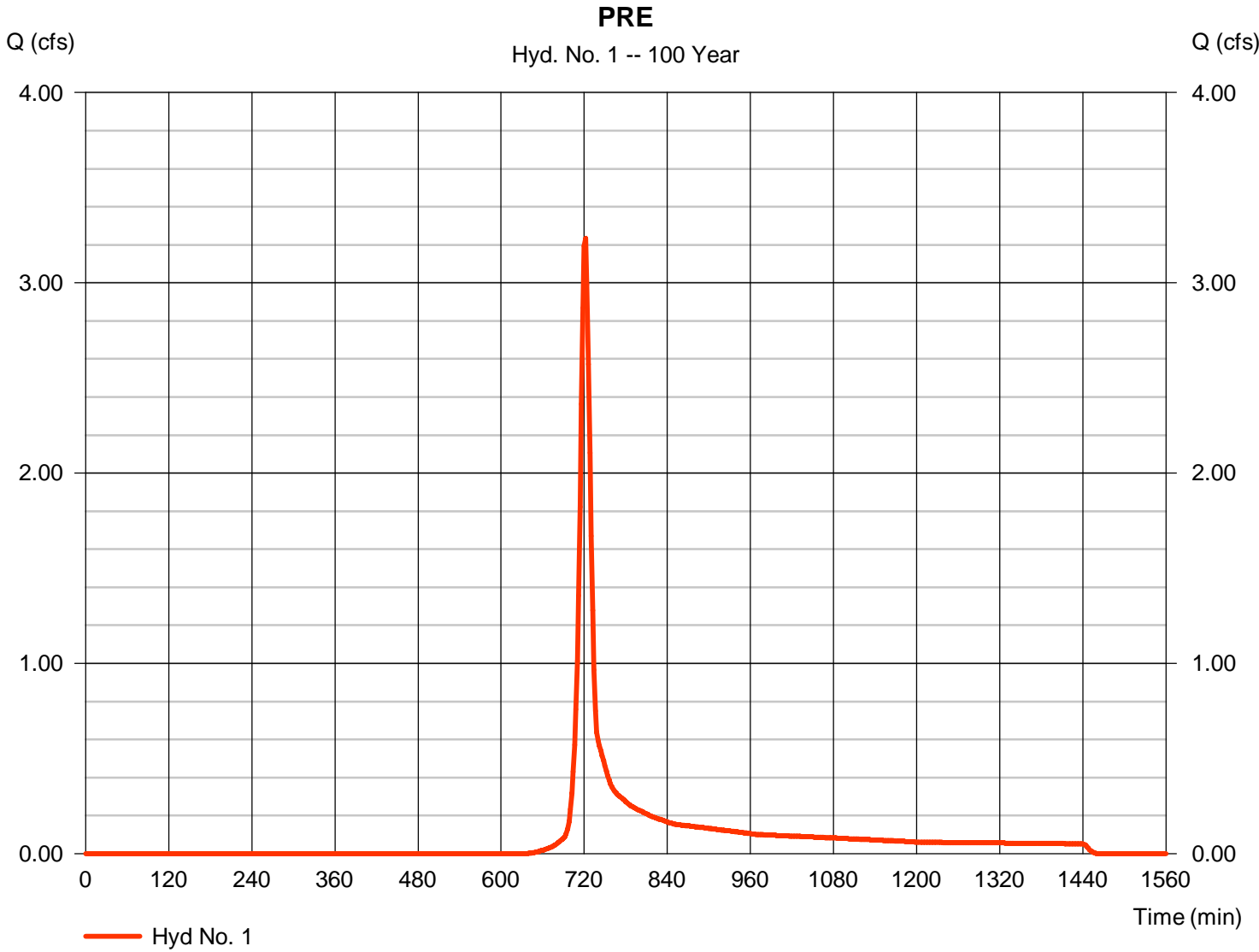
Monday, 10 / 24 / 2016

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 3.235 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 8,577 cuft
Drainage area	= 0.930 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 7.08 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.800 x 58)] / 0.930



# Hydrograph Report

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

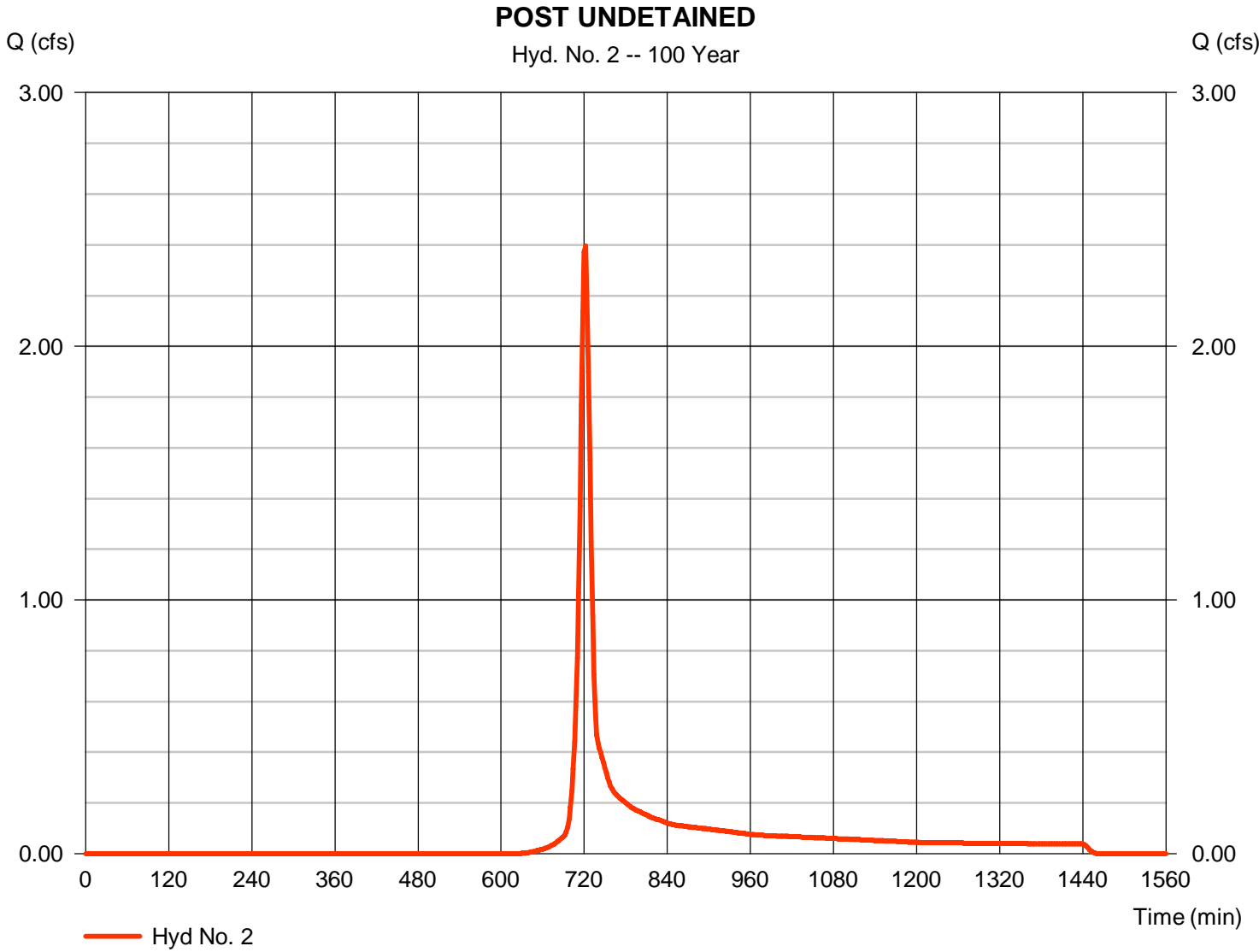
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## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 2.396 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 6,329 cuft
Drainage area	= 0.660 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 7.08 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.010 x 85) + (0.520 x 58)] / 0.660



# Hydrograph Report

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

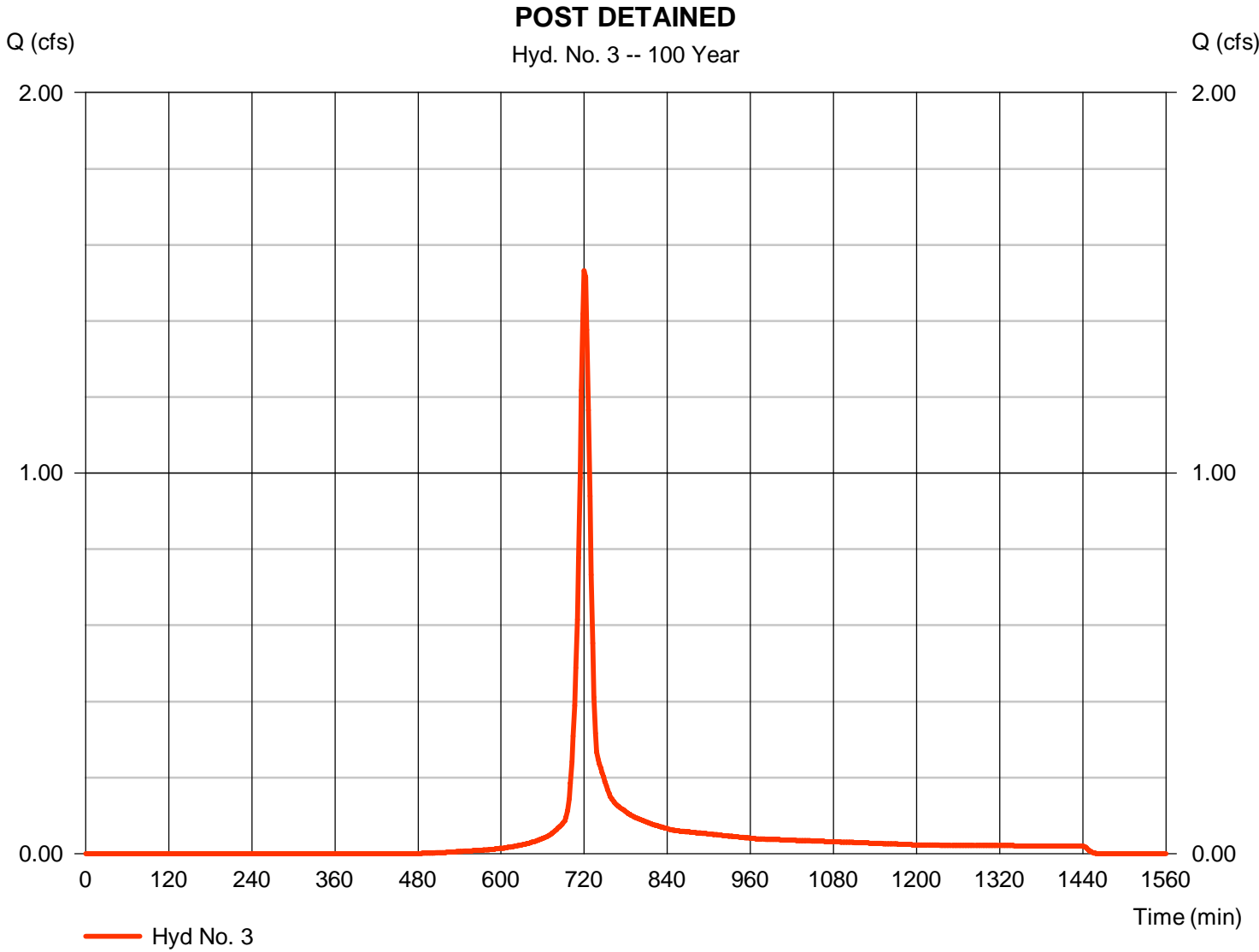
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## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.533 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 3,973 cuft
Drainage area	= 0.280 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 12.58 min
Total precip.	= 7.08 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.130 x 85) + (0.150 x 58)] / 0.280



# Hydrograph Report

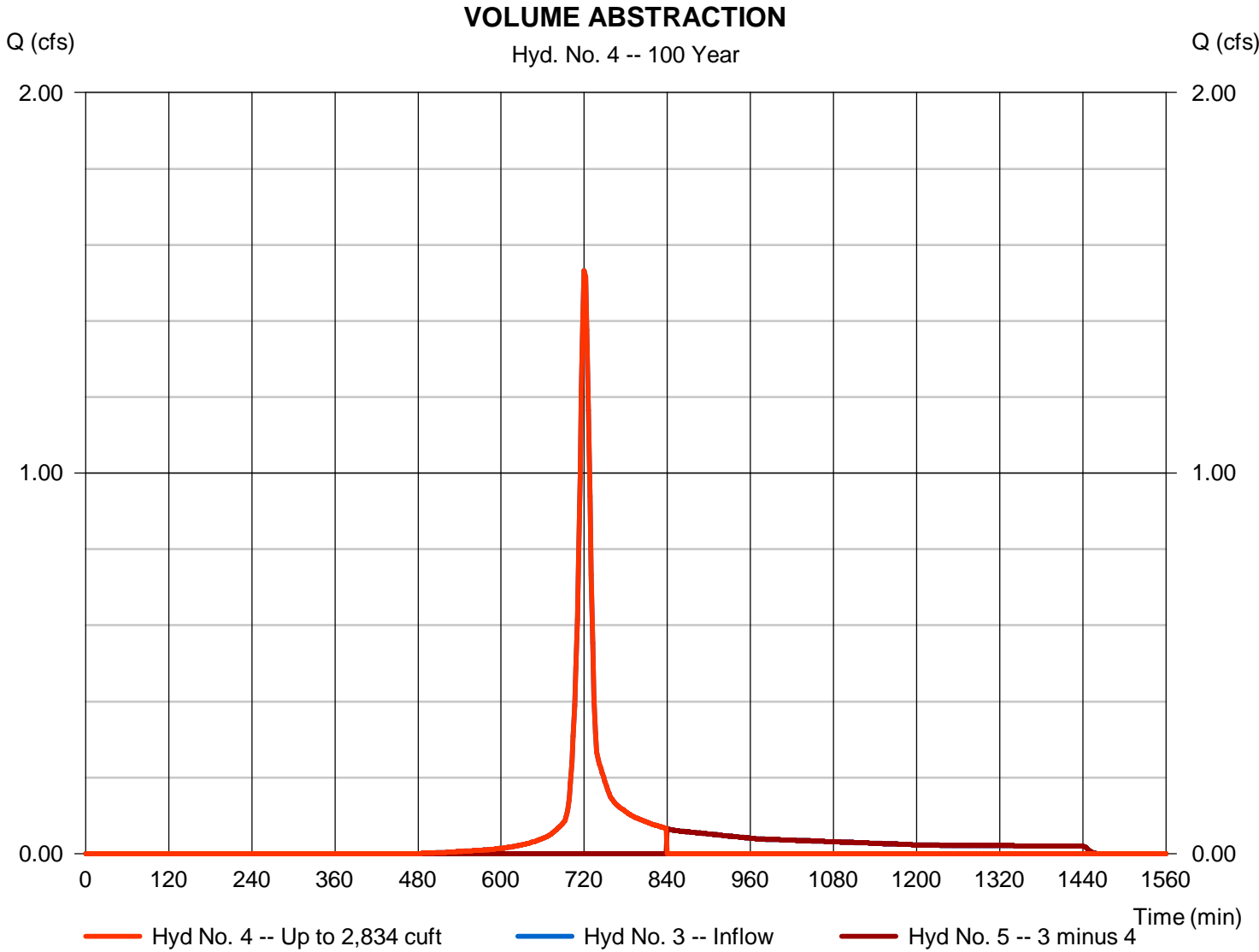
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 4

### VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.533 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 2,837 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft



# Hydrograph Report

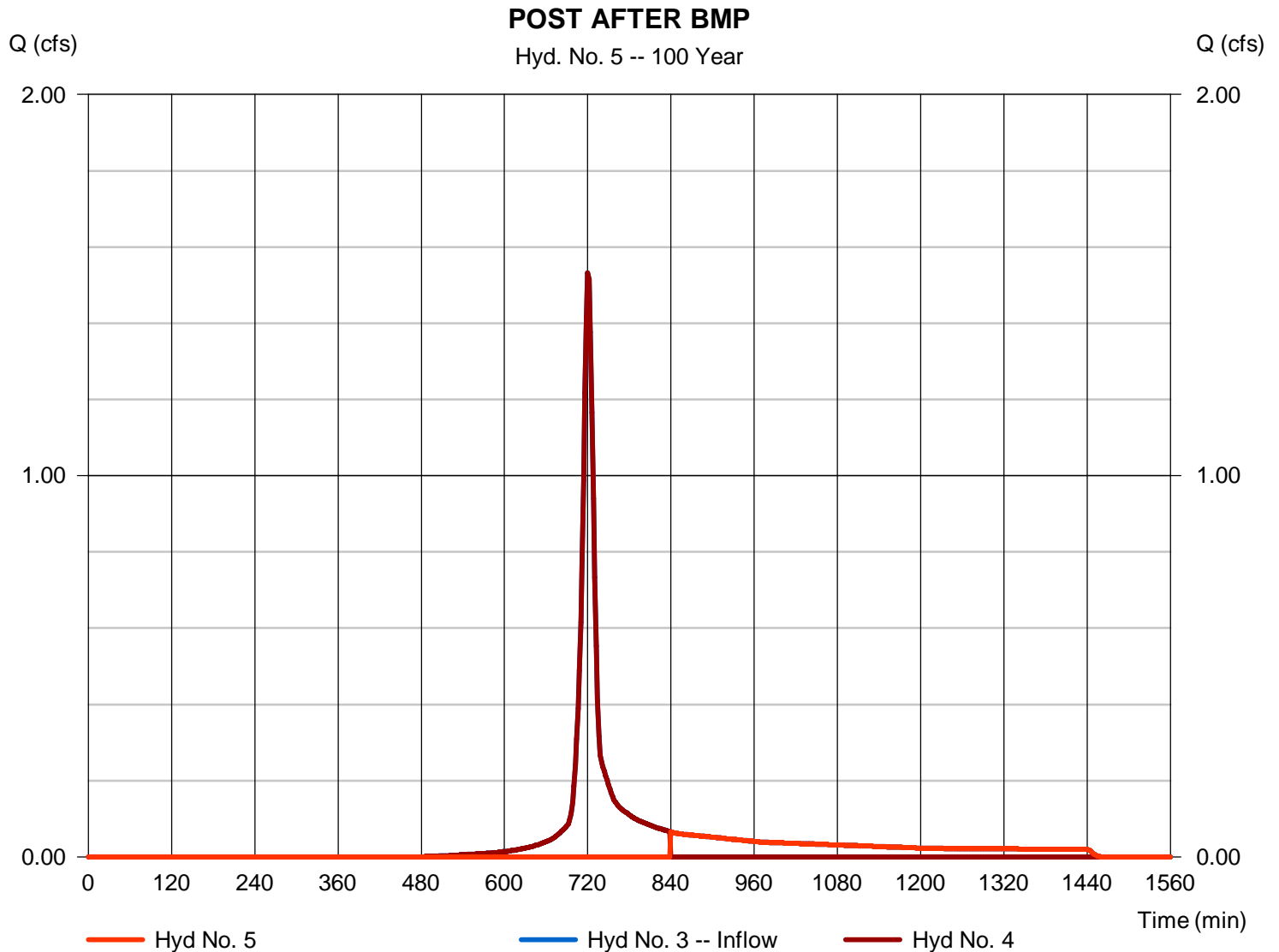
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.066 cfs
Storm frequency	= 100 yrs	Time to peak	= 840 min
Time interval	= 2 min	Hyd. volume	= 1,137 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft



# Hydrograph Report

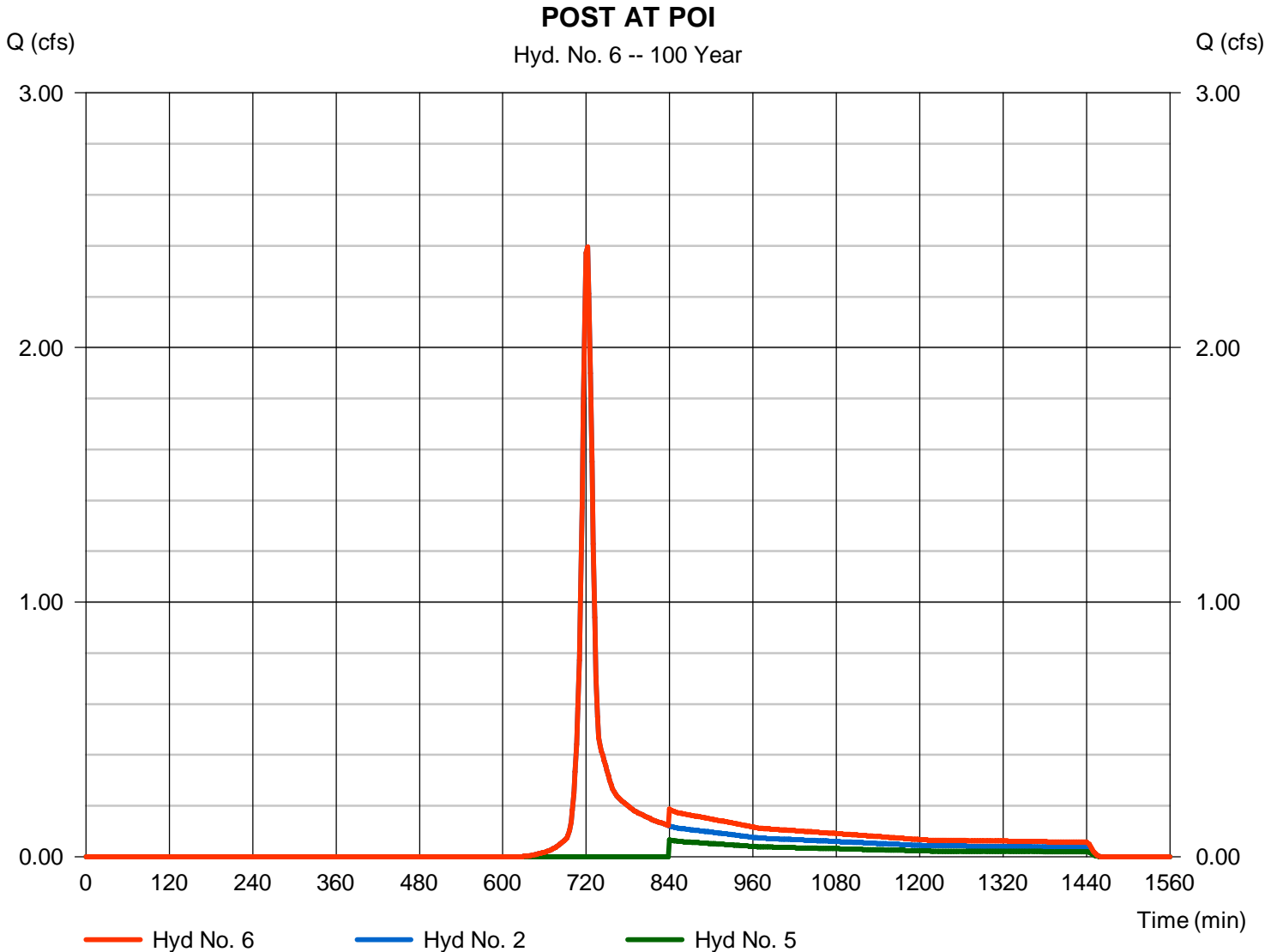
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 6

POST AT POI

Hydrograph type	= Combine	Peak discharge	= 2.396 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 7,466 cuft
Inflow hyds.	= 2, 5	Contrib. drain. area	= 0.660 ac

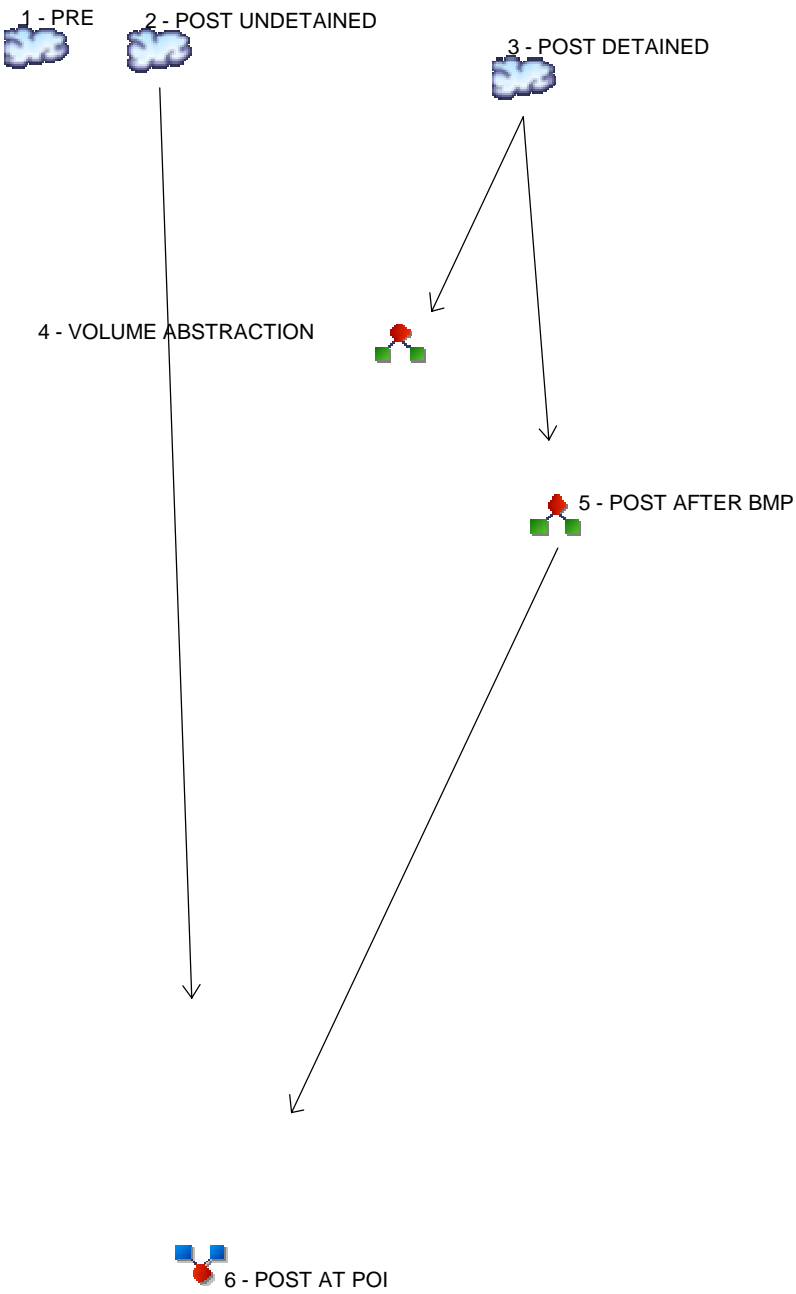






# Watershed Model Schematic

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

Hydroflow 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	-----	-----	0.120	-----	-----	-----	-----	-----	-----	PRE
2	SCS Runoff	-----	-----	0.110	-----	-----	-----	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	-----	-----	0.087	-----	-----	-----	-----	-----	-----	POST DETAINED
4	Diversion1	3	-----	0.087	-----	-----	-----	-----	-----	-----	VOLUME ABSTRACTION
5	Diversion2	3	-----	0.000	-----	-----	-----	-----	-----	-----	POST AFTER BMP
6	Combine	2, 5	-----	0.110	-----	-----	-----	-----	-----	-----	POST AT POI



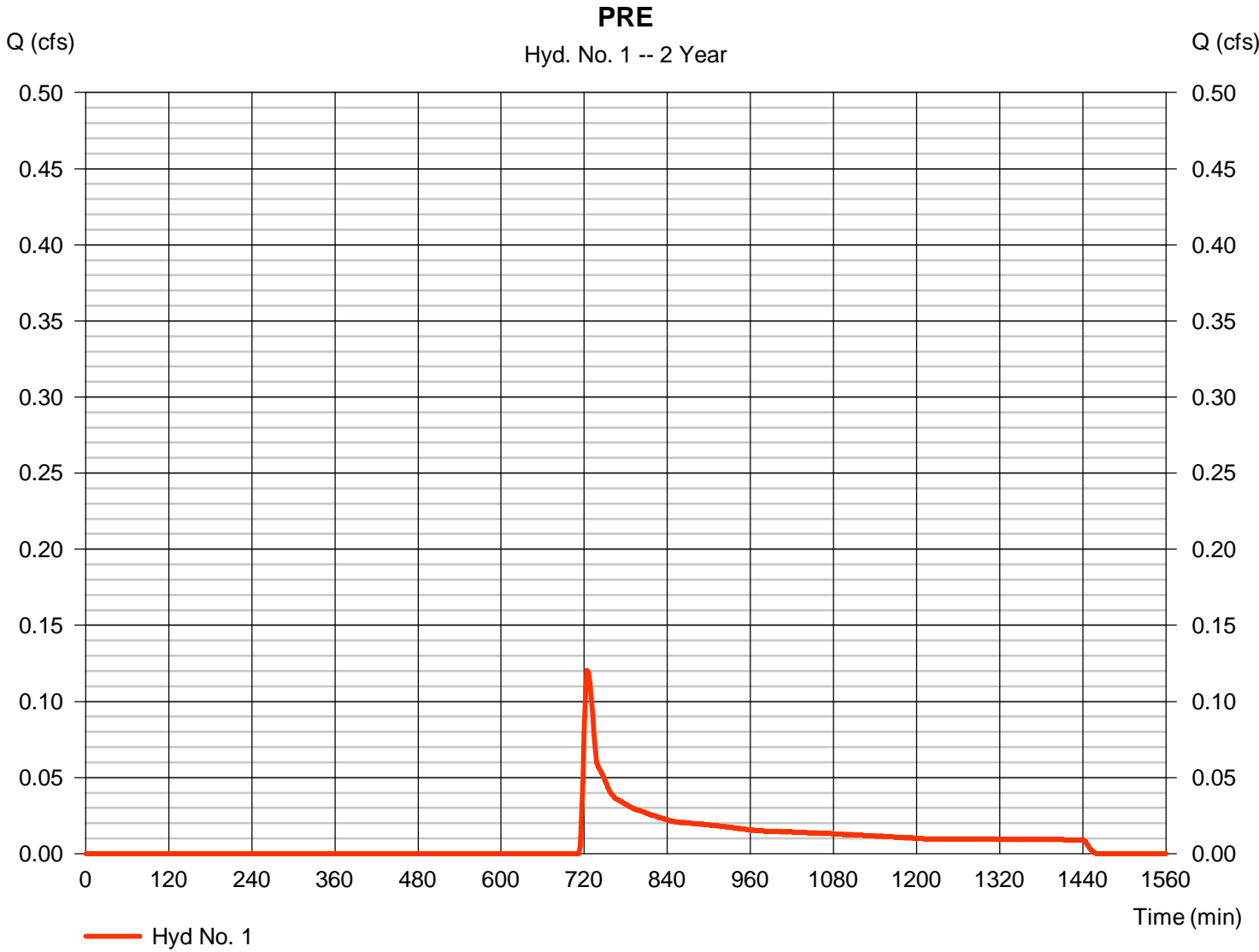
# Hydrograph Report

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 0.120 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 781 cuft
Drainage area	= 0.930 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 2.84 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.800 x 58)] / 0.930



# TR55 Tc Worksheet

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

## Hyd. No. 1

PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.84	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 11.48</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 11.48</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 350.00	0.00	0.00	
Watercourse slope (%)	= 5.40	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=3.75	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.56</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.56</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>13.00 min</b>

# Hydrograph Report

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

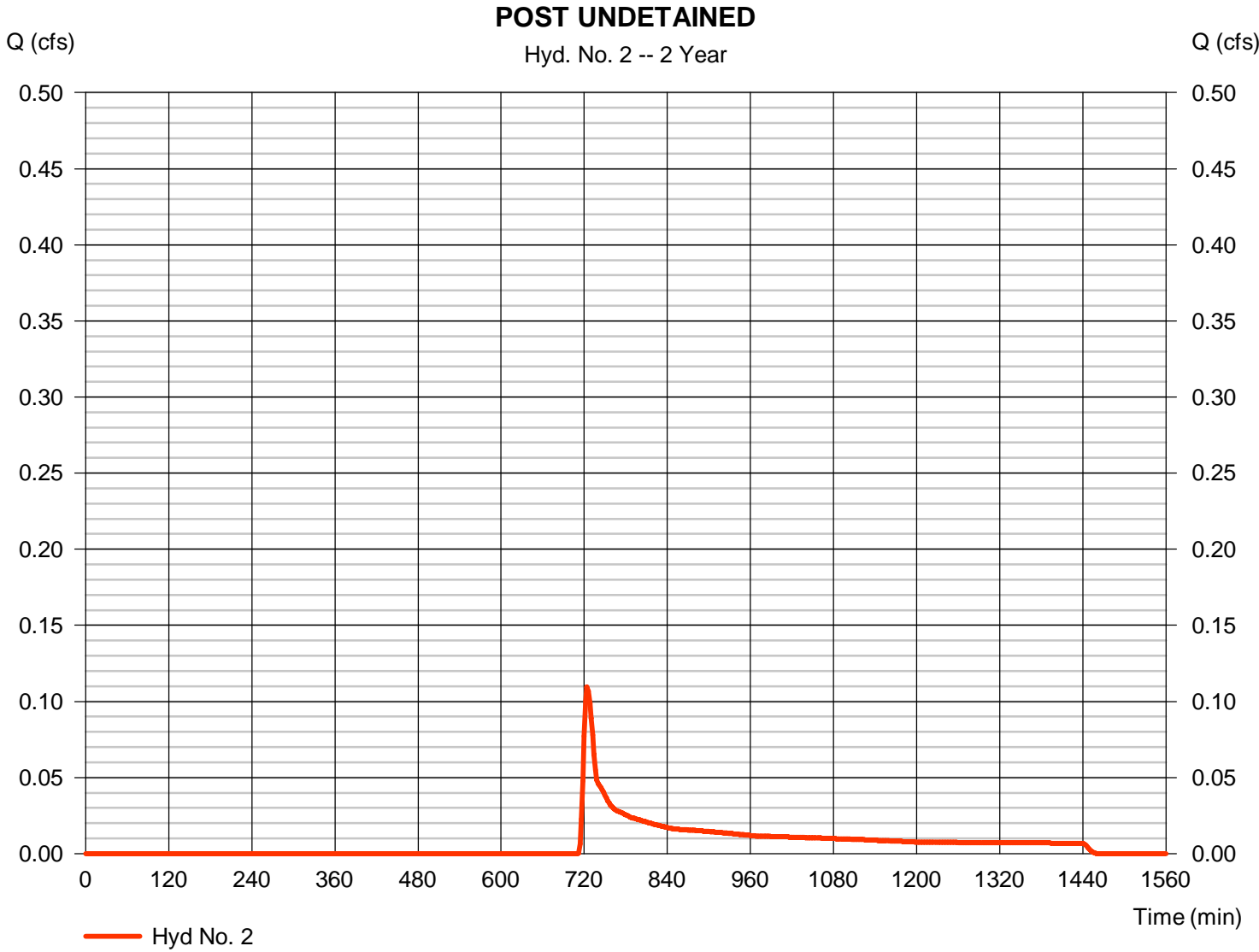
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## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.110 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 617 cuft
Drainage area	= 0.660 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 2.84 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.010 x 85) + (0.520 x 58)] / 0.660



# TR55 Tc Worksheet

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

## Hyd. No. 2

POST UNDETAINED

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.84	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 11.48</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 11.48</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 350.00	0.00	0.00	
Watercourse slope (%)	= 5.40	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=3.75	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.56</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.56</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>13.00 min</b>



# Hydrograph Report

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

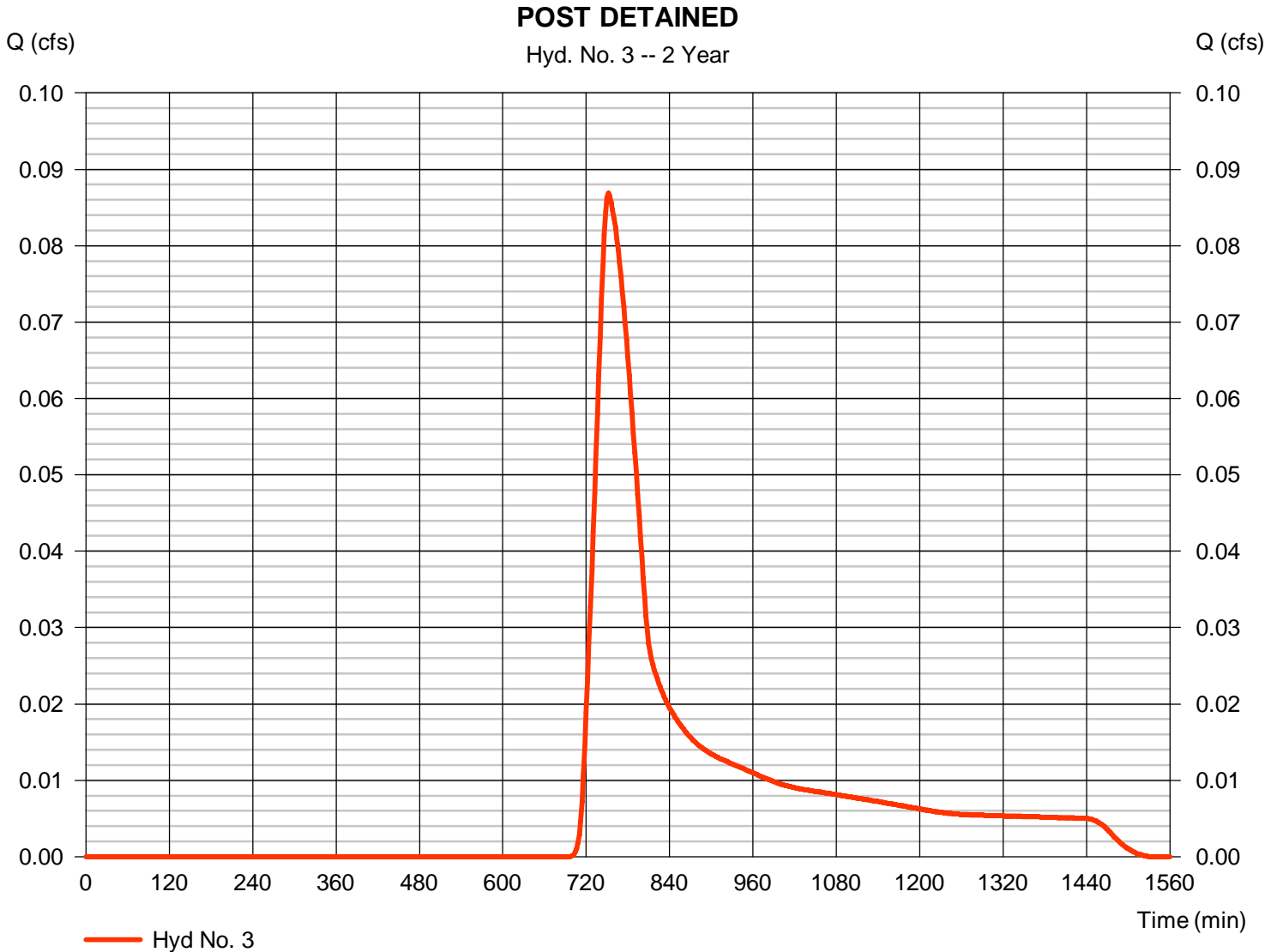
Monday, 10 / 24 / 2016

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.087 cfs
Storm frequency	= 2 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 681 cuft
Drainage area	= 0.280 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 58.55 min
Total precip.	= 2.84 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.130 x 85) + (0.150 x 58)] / 0.280



# Hydrograph Report

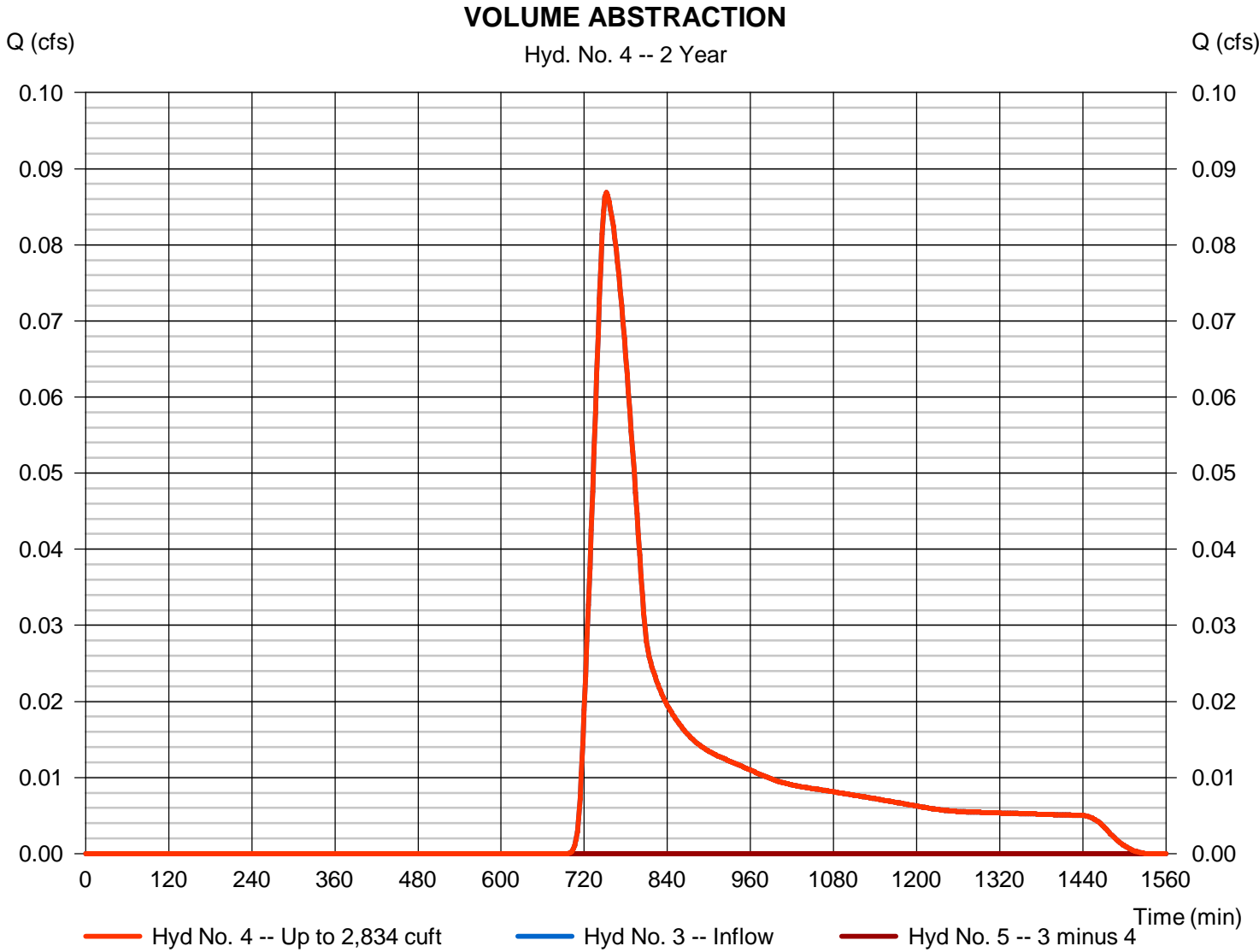
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 4

### VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.087 cfs
Storm frequency	= 2 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 681 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft



# Hydrograph Report

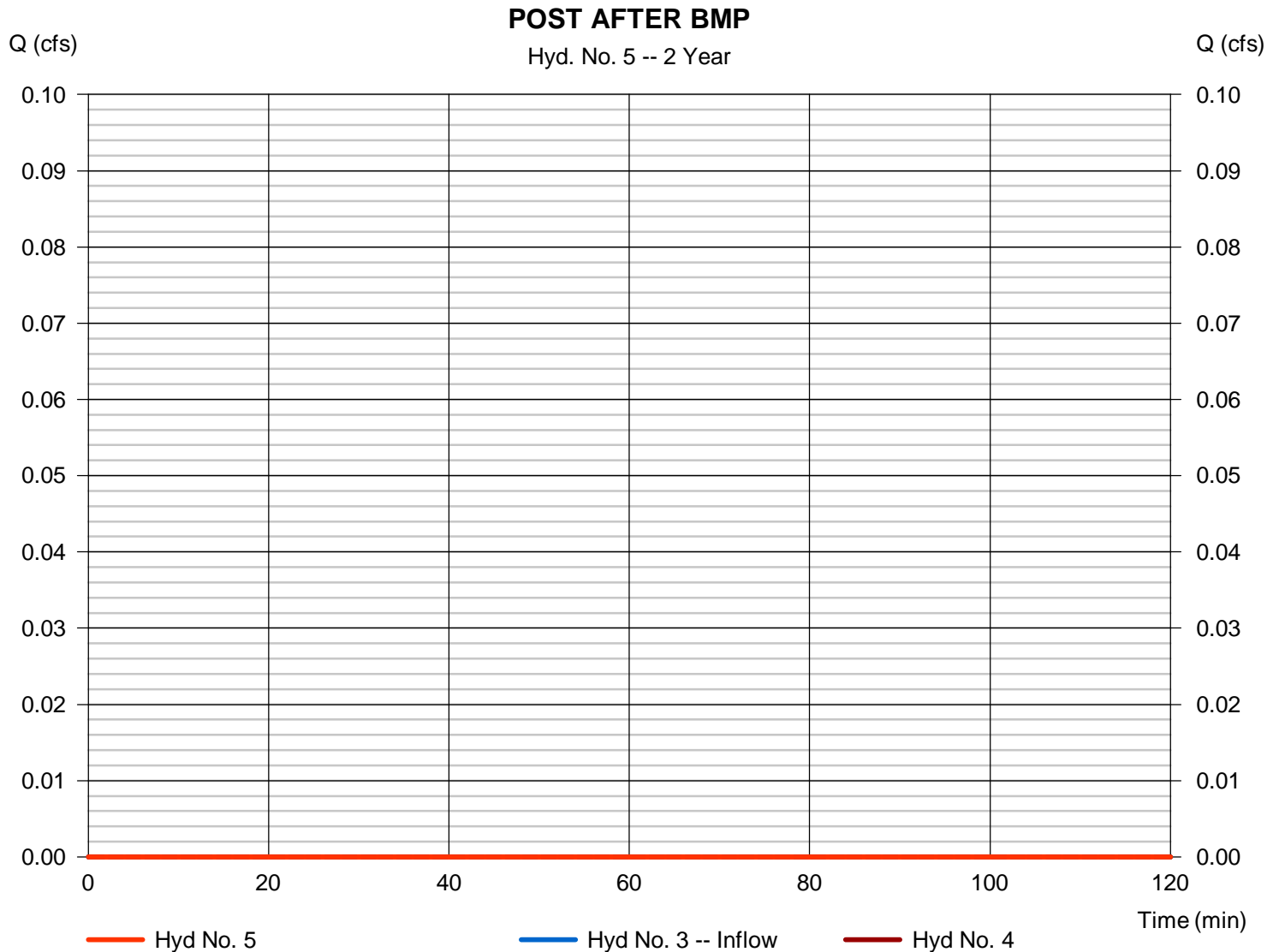
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## 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	= 2,834 cuft



# Hydrograph Report

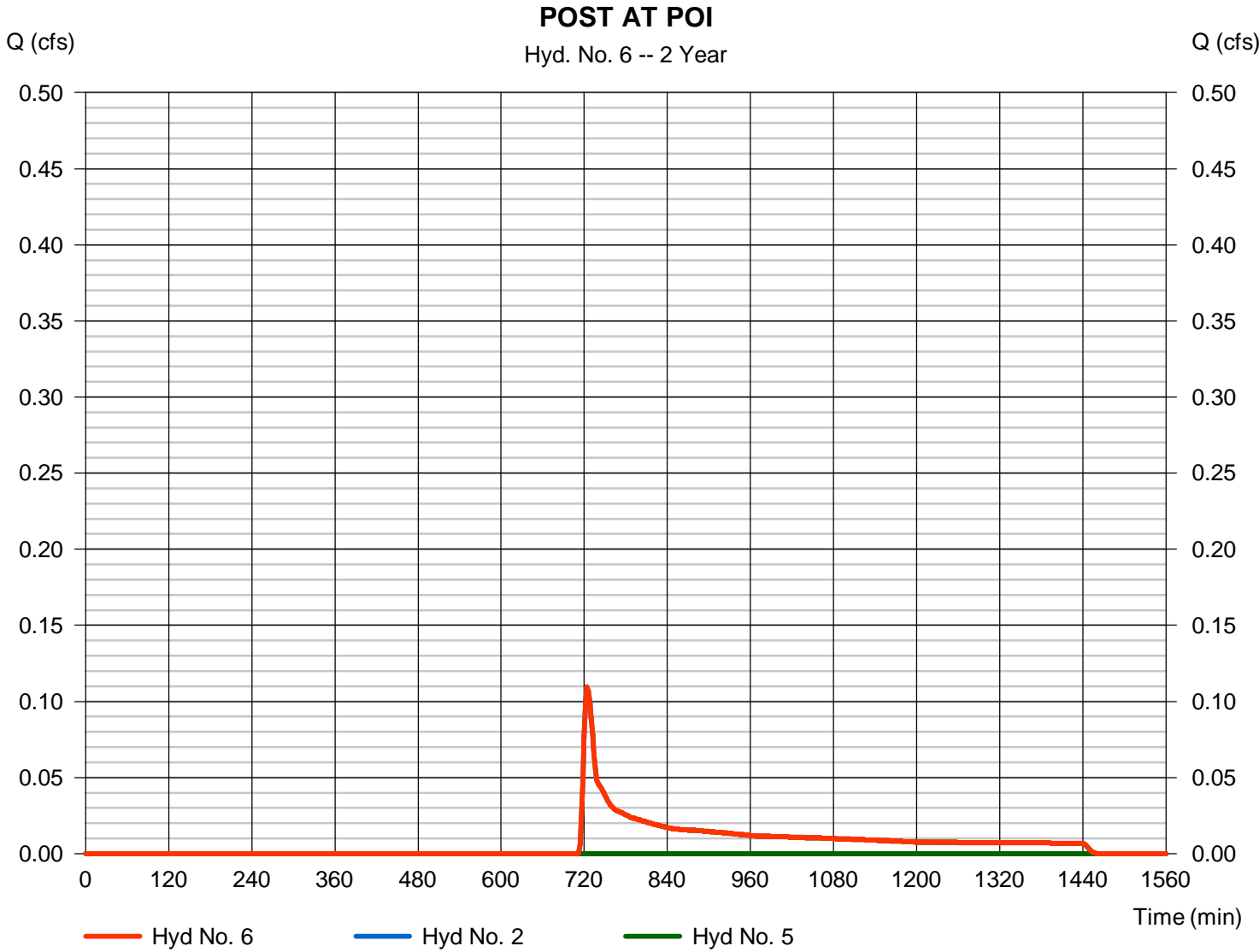
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 6

POST AT POI

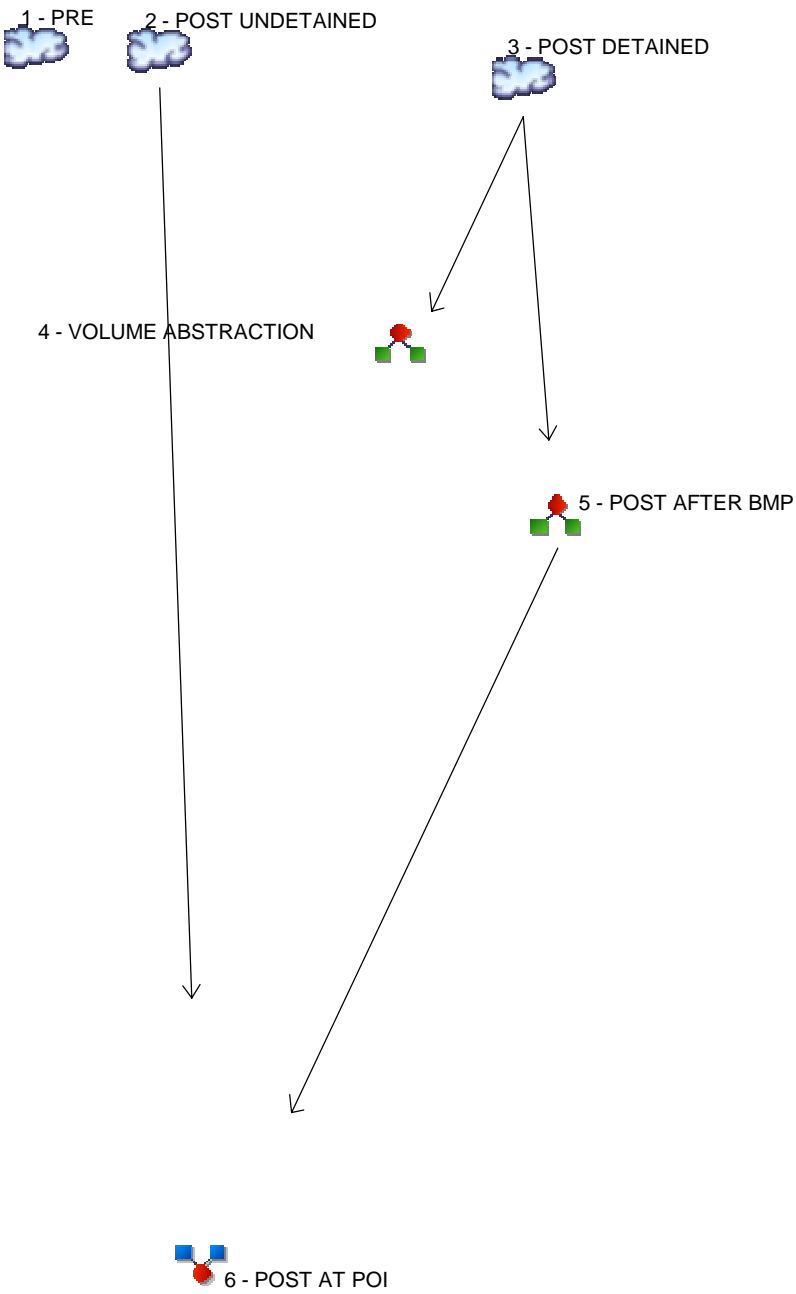
Hydrograph type	= Combine	Peak discharge	= 0.110 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 617 cuft
Inflow hyds.	= 2, 5	Contrib. drain. area	= 0.660 ac





# 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

Hydroflow 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	-----	-----	-----	-----	-----	0.805	-----	-----	-----	PRE
2	SCS Runoff	-----	-----	-----	-----	-----	0.630	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	-----	-----	-----	-----	-----	0.159	-----	-----	-----	POST DETAINED
4	Diversion1	3	-----	-----	-----	-----	0.159	-----	-----	-----	VOLUME ABSTRACTION
5	Diversion2	3	-----	-----	-----	-----	0.000	-----	-----	-----	POST AFTER BMP
6	Combine	2, 5	-----	-----	-----	-----	0.630	-----	-----	-----	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	0.805	2	722	2,555	-----	-----	-----	PRE
2	SCS Runoff	0.630	2	722	1,939	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	0.159	2	772	1,529	-----	-----	-----	POST DETAINED
4	Diversion1	0.159	2	772	1,529	3	-----	-----	VOLUME ABSTRACTION
5	Diversion2	0.000	2	n/a	0	3	-----	-----	POST AFTER BMP
6	Combine	0.630	2	722	1,939	2, 5	-----	-----	POST AT POI



# Hydrograph Report

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

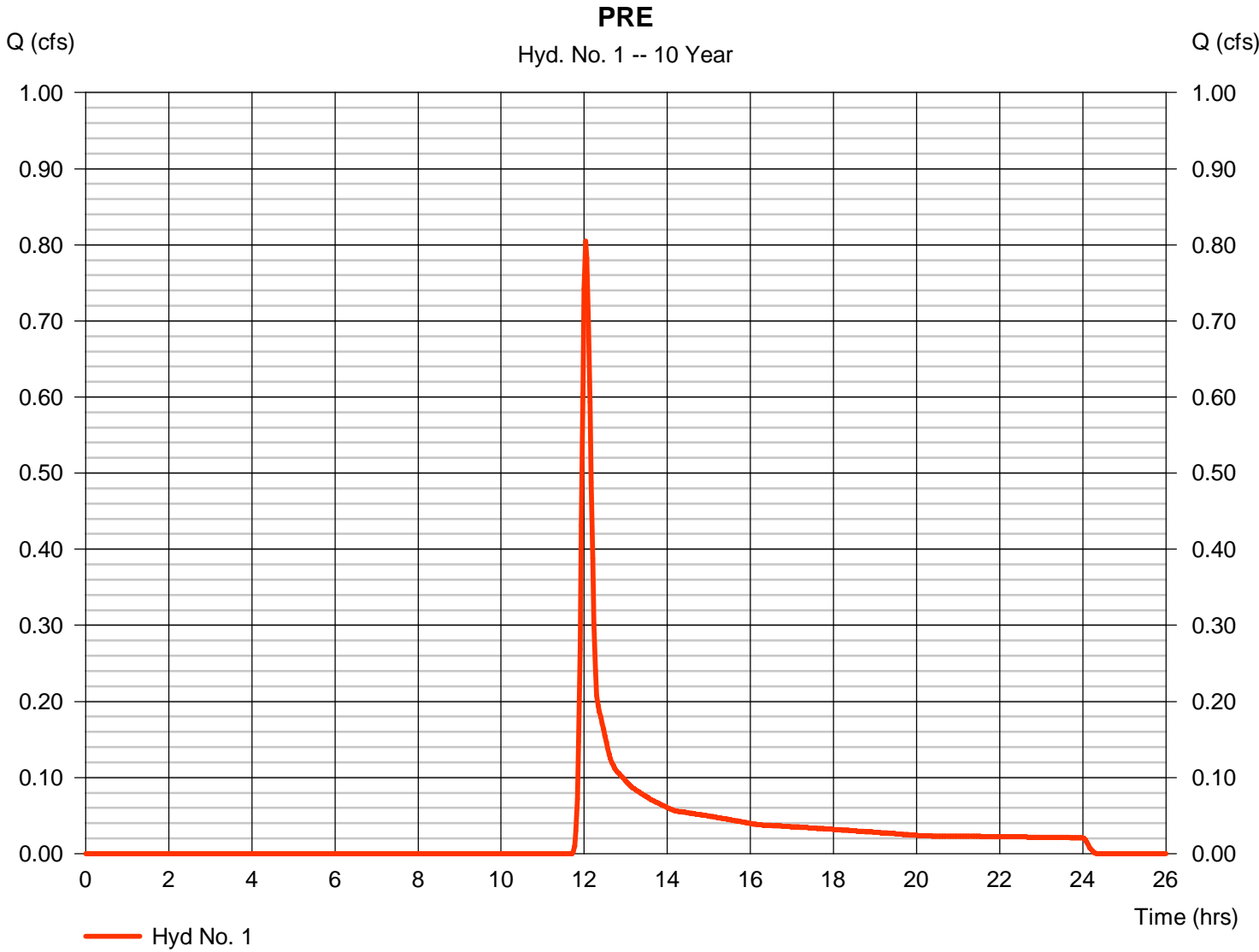
Monday, 10 / 24 / 2016

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 0.805 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 2,555 cuft
Drainage area	= 0.930 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 4.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.800 x 58)] / 0.930



# TR55 Tc Worksheet

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

## Hyd. No. 1

PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.84	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 11.48</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 11.48</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 350.00	0.00	0.00	
Watercourse slope (%)	= 5.40	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=3.75	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.56</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.56</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>13.00 min</b>

# Hydrograph Report

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

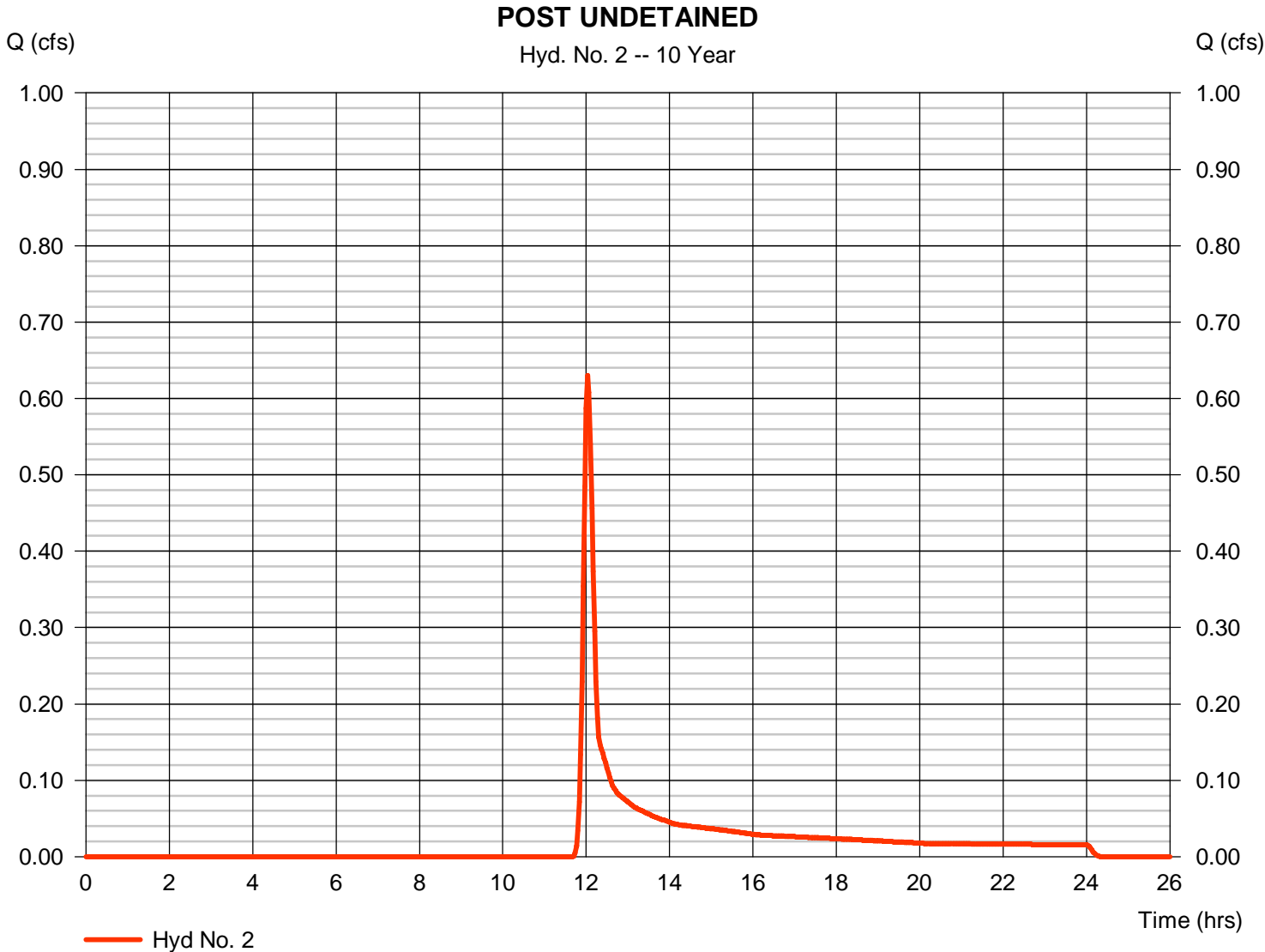
Monday, 10 / 24 / 2016

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.630 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 1,939 cuft
Drainage area	= 0.660 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 4.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.010 x 85) + (0.520 x 58)] / 0.660



# TR55 Tc Worksheet

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

## Hyd. No. 2

POST UNDETAINED

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.84	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 11.48</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 11.48</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 350.00	0.00	0.00	
Watercourse slope (%)	= 5.40	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=3.75	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.56</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.56</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>13.00 min</b>

# Hydrograph Report

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

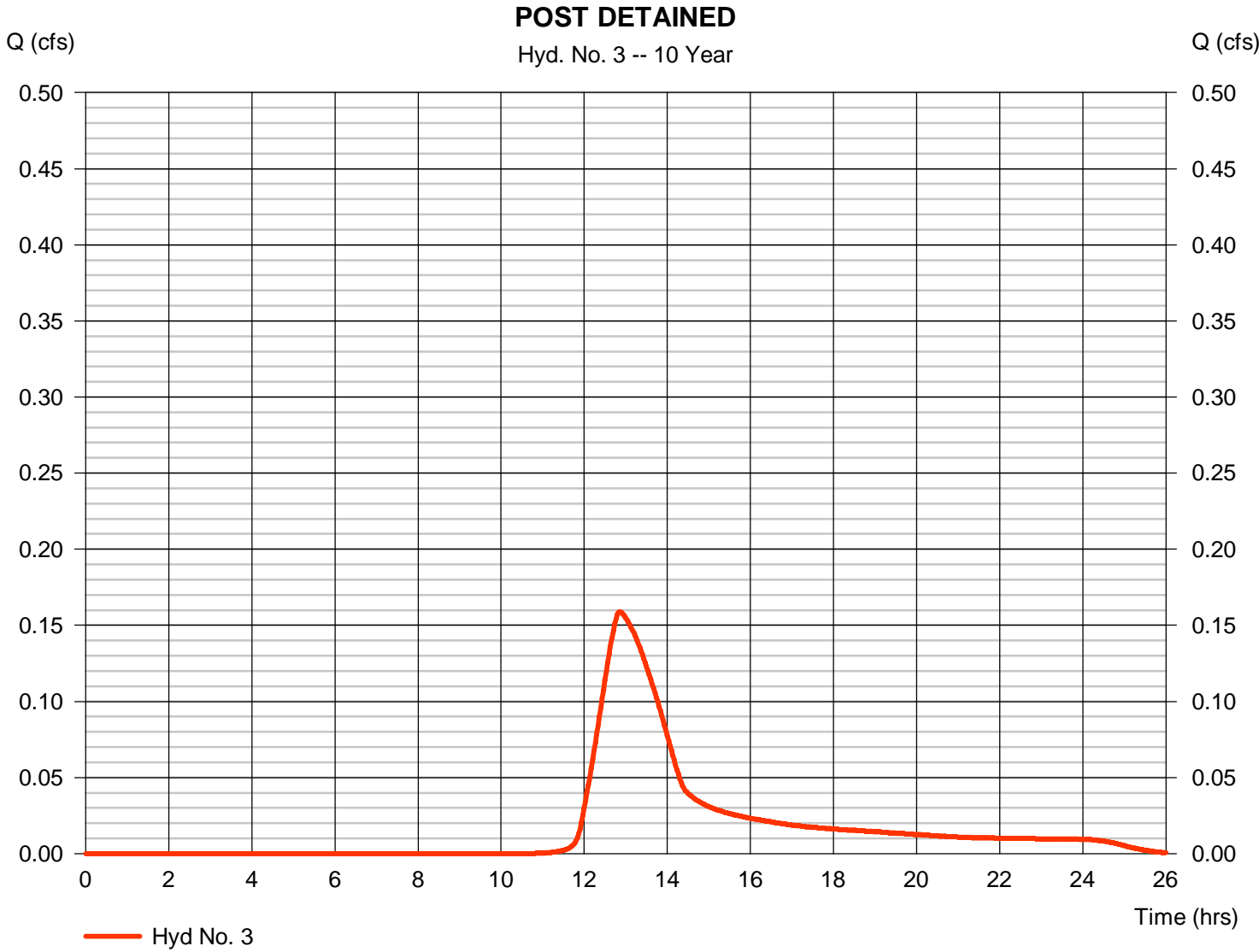
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## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.159 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.87 hrs
Time interval	= 2 min	Hyd. volume	= 1,529 cuft
Drainage area	= 0.280 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 92.12 min
Total precip.	= 4.15 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.130 x 85) + (0.150 x 58)] / 0.280



# Hydrograph Report

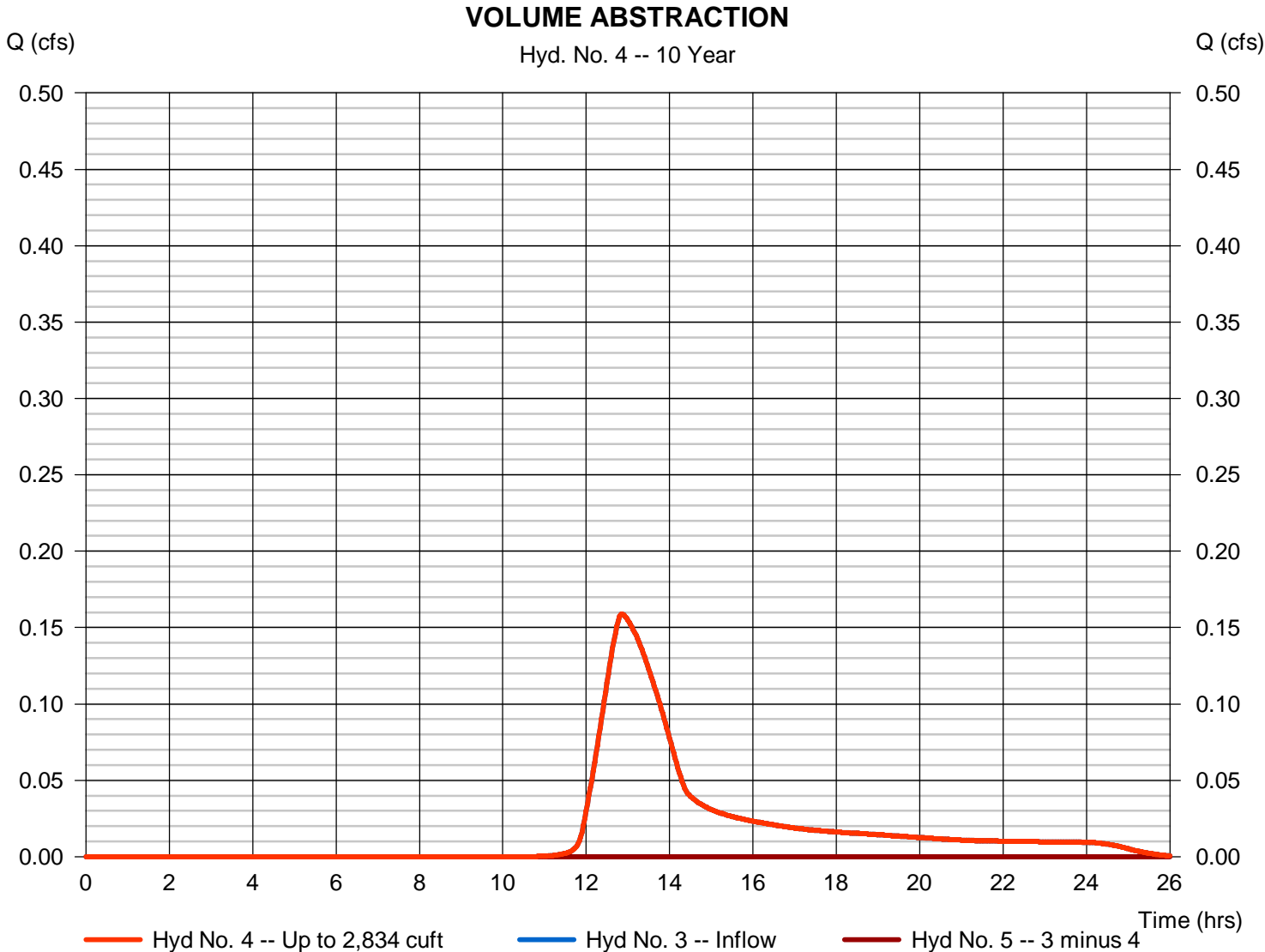
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 4

### VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.159 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.87 hrs
Time interval	= 2 min	Hyd. volume	= 1,529 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft



# Hydrograph Report

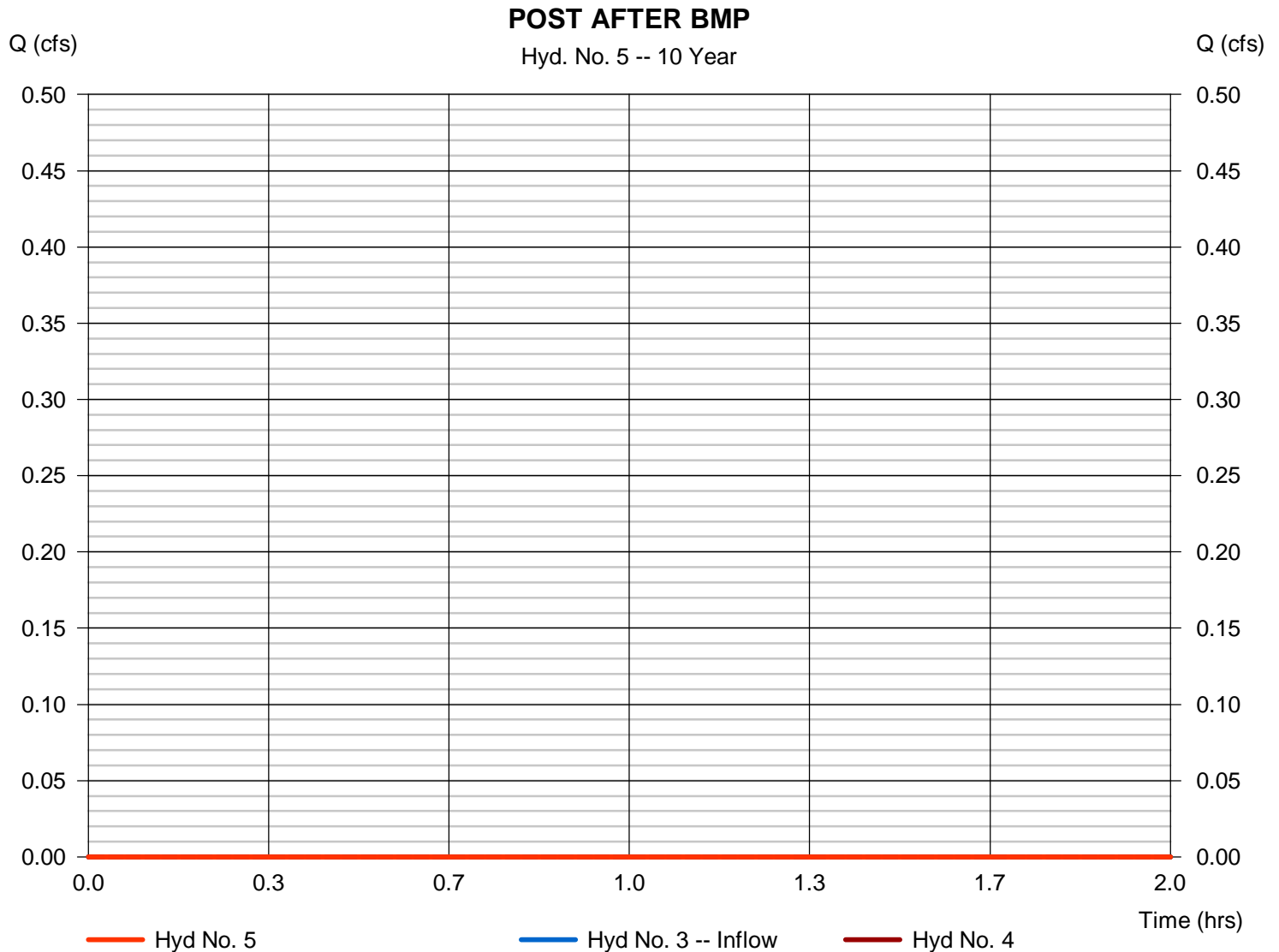
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.000 cfs
Storm frequency	= 10 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	= 2,834 cuft



# Hydrograph Report

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

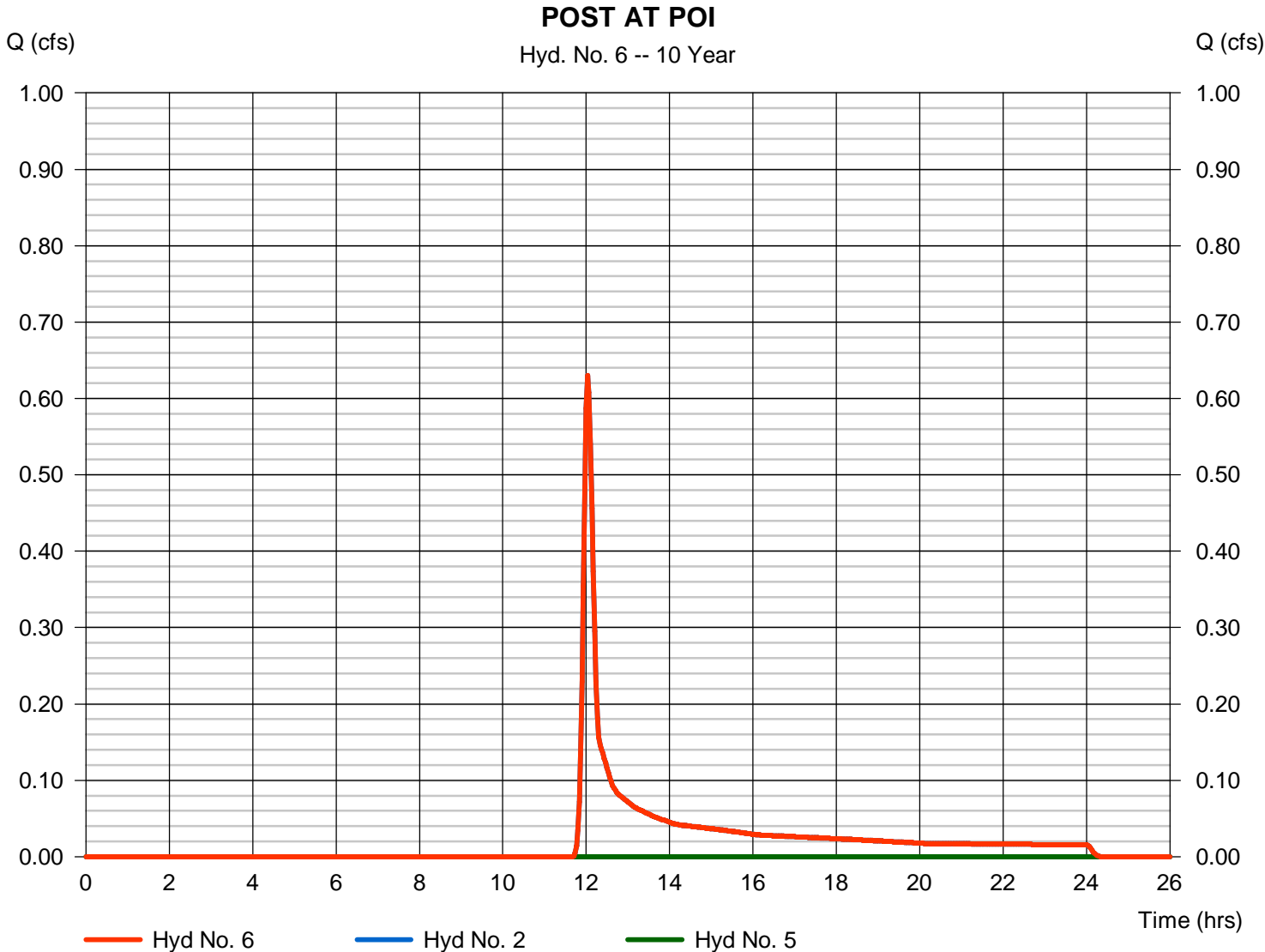
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## Hyd. No. 6

POST AT POI

Hydrograph type = Combine  
Storm frequency = 10 yrs  
Time interval = 2 min  
Inflow hyds. = 2, 5

Peak discharge = 0.630 cfs  
Time to peak = 12.03 hrs  
Hyd. volume = 1,939 cuft  
Contrib. drain. area = 0.660 ac

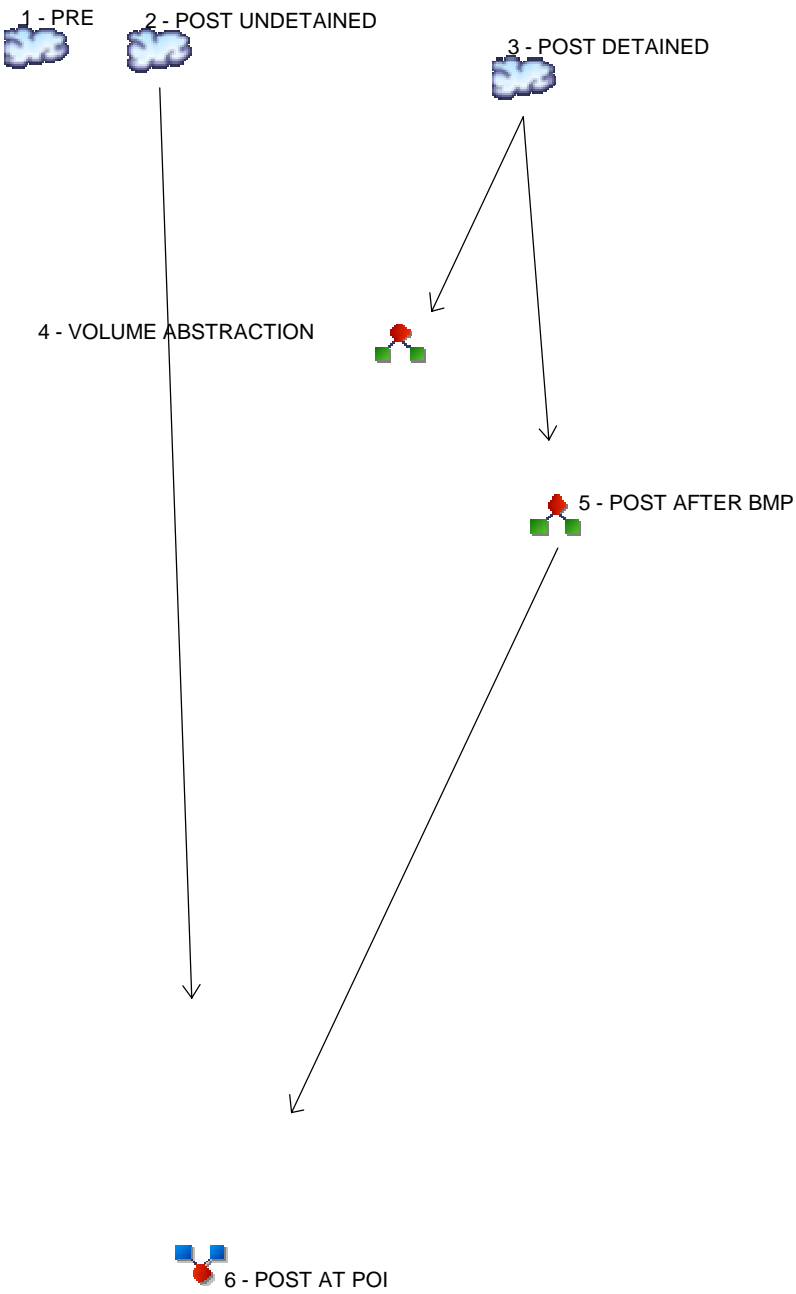






# Watershed Model Schematic

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

Hydroflow 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	-----	-----	-----	-----	-----	-----	-----	2.272	-----	PRE
2	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	1.699	-----	POST UNDETAINED
3	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	0.495	-----	POST DETAINED
4	Diversion1	3	-----	-----	-----	-----	-----	-----	0.495	-----	VOLUME ABSTRACTION
5	Diversion2	3	-----	-----	-----	-----	-----	-----	0.017	-----	POST AFTER BMP
6	Combine	2, 5	-----	-----	-----	-----	-----	-----	1.699	-----	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	2.272	2	722	6,160	-----	-----	-----	PRE
2	SCS Runoff	1.699	2	722	4,574	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	0.495	2	746	2,986	-----	-----	-----	POST DETAINED
4	Diversion1	0.495	2	746	2,834	3	-----	-----	VOLUME ABSTRACTION
5	Diversion2	0.017	2	1322	151	3	-----	-----	POST AFTER BMP
6	Combine	1.699	2	722	4,726	2, 5	-----	-----	POST AT POI
50 year adjusted.gpw					Return Period: 50 Year			Monday, 10 / 24 / 2016	

# Hydrograph Report

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

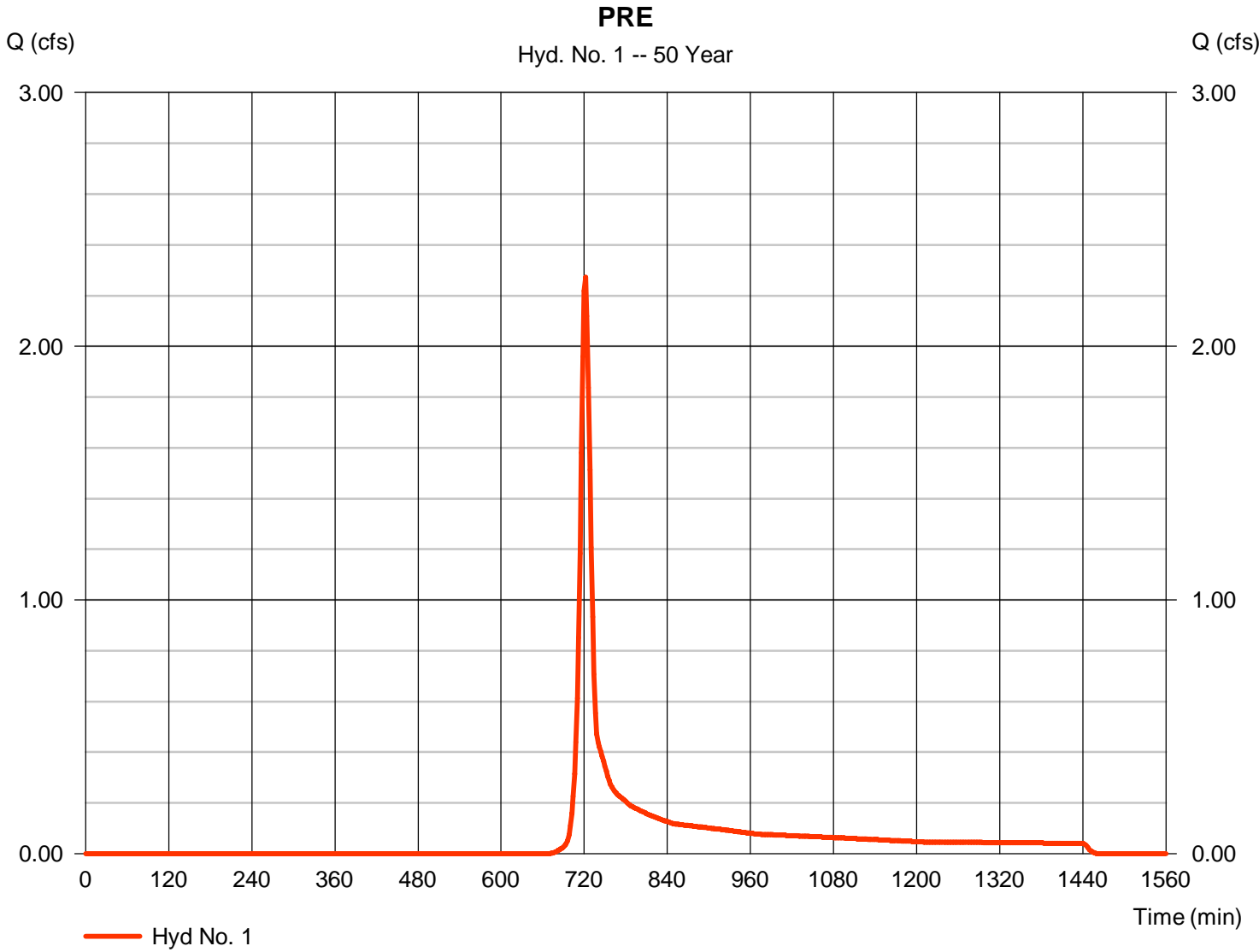
Monday, 10 / 24 / 2016

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 2.272 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 6,160 cuft
Drainage area	= 0.930 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 6.02 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.800 x 58)] / 0.930



# TR55 Tc Worksheet

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

## Hyd. No. 1

PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.84	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 11.48</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 11.48</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 350.00	0.00	0.00	
Watercourse slope (%)	= 5.40	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=3.75	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.56</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.56</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>13.00 min</b>

# Hydrograph Report

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

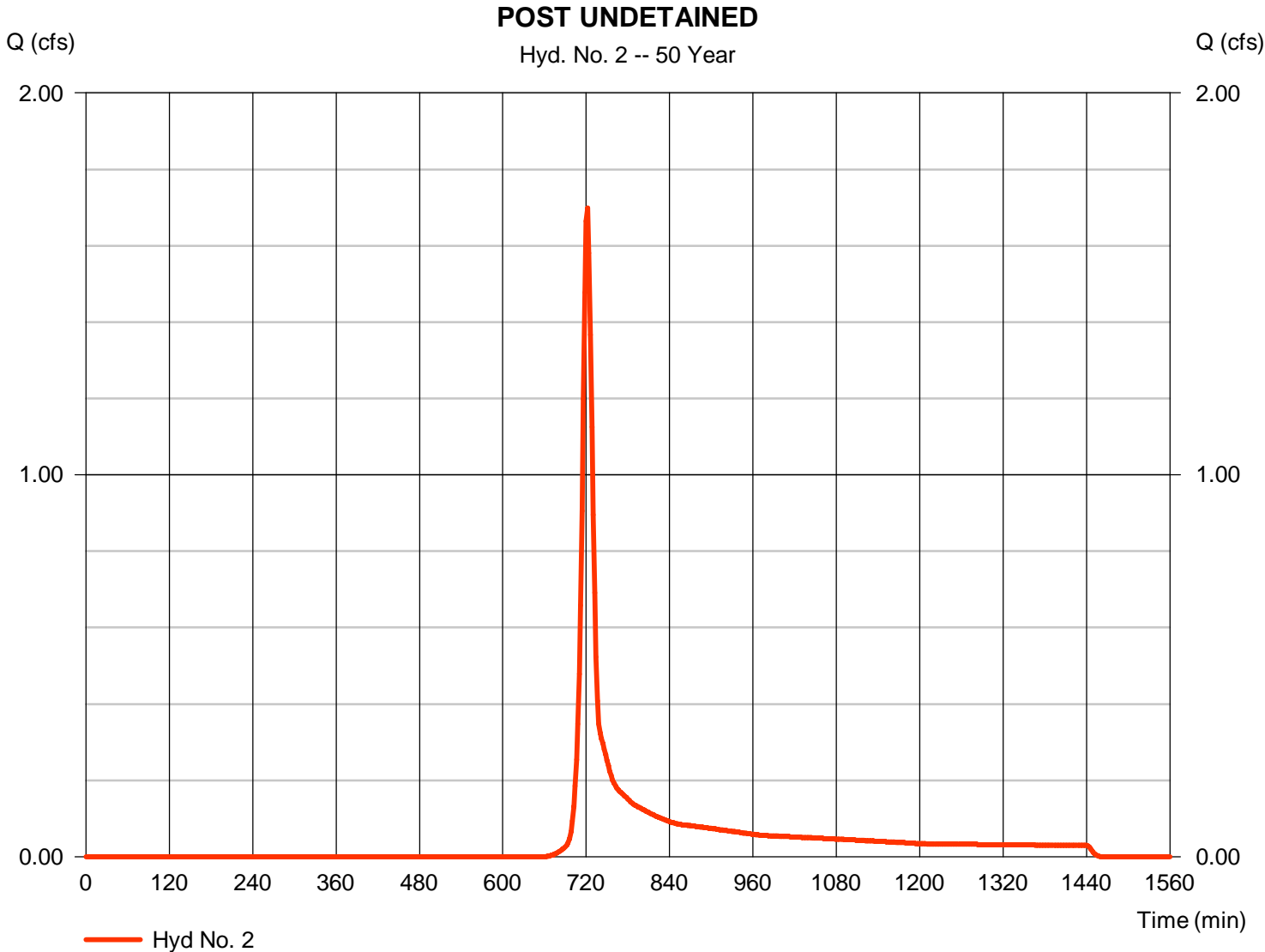
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## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.699 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 4,574 cuft
Drainage area	= 0.660 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 6.02 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.010 x 85) + (0.520 x 58)] / 0.660



# TR55 Tc Worksheet

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

## Hyd. No. 2

POST UNDETAINED

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.84	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 11.48</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 11.48</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 350.00	0.00	0.00	
Watercourse slope (%)	= 5.40	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=3.75	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.56</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.56</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>13.00 min</b>



# Hydrograph Report

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

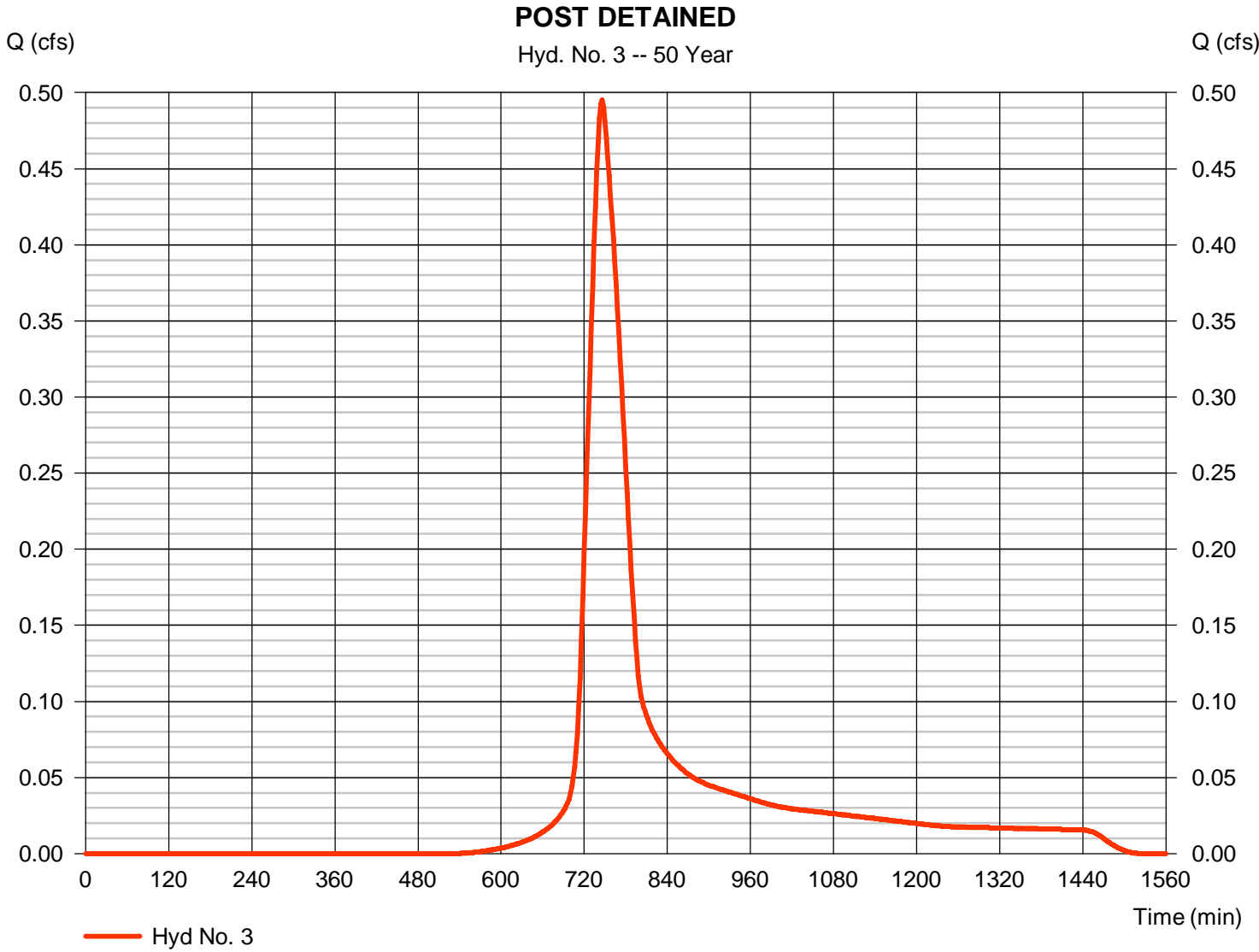
Monday, 10 / 24 / 2016

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.495 cfs
Storm frequency	= 50 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 2,986 cuft
Drainage area	= 0.280 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 52.76 min
Total precip.	= 6.02 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.130 x 85) + (0.150 x 58)] / 0.280



# Hydrograph Report

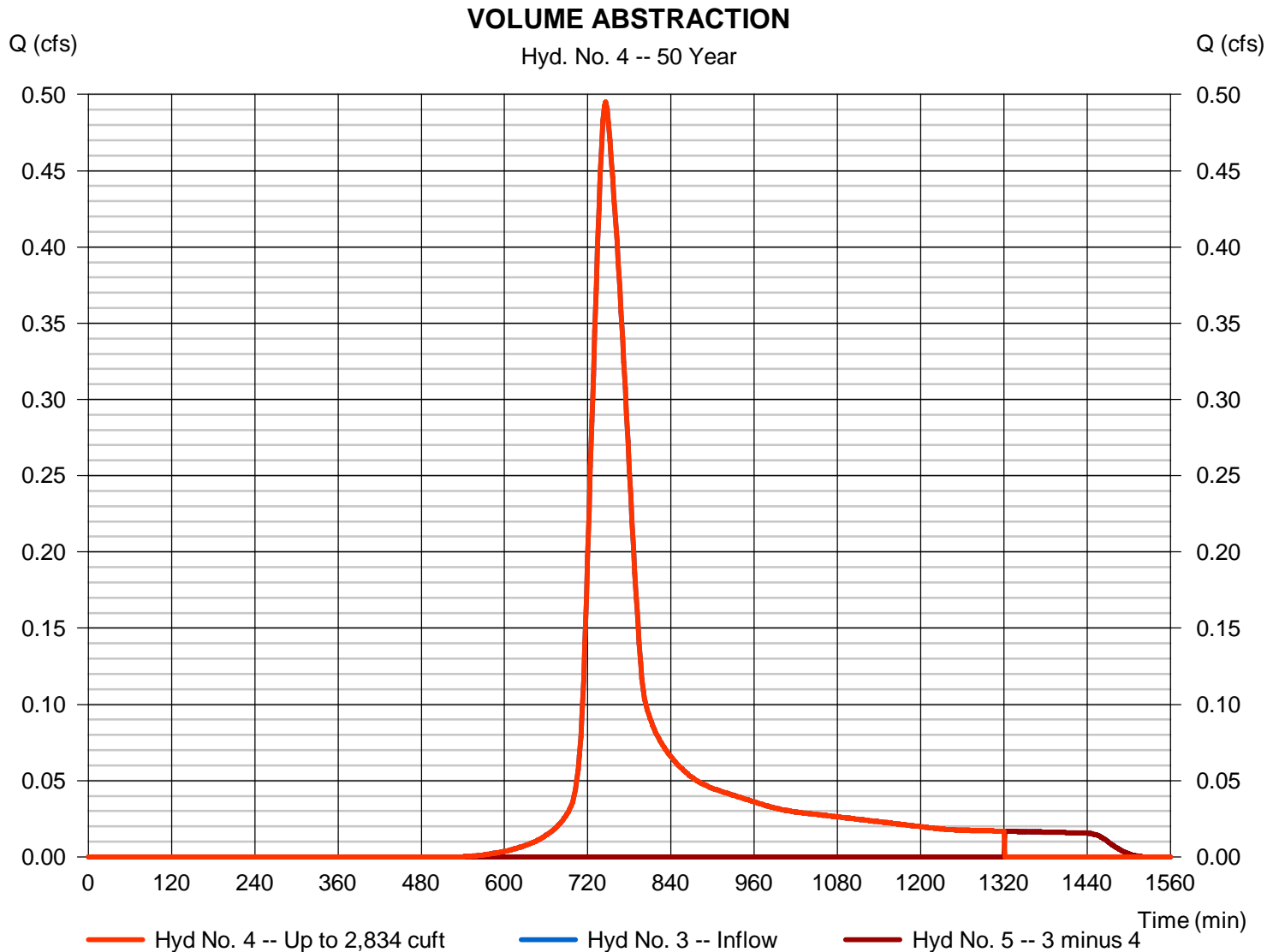
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 4

### VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.495 cfs
Storm frequency	= 50 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 2,834 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft



# Hydrograph Report

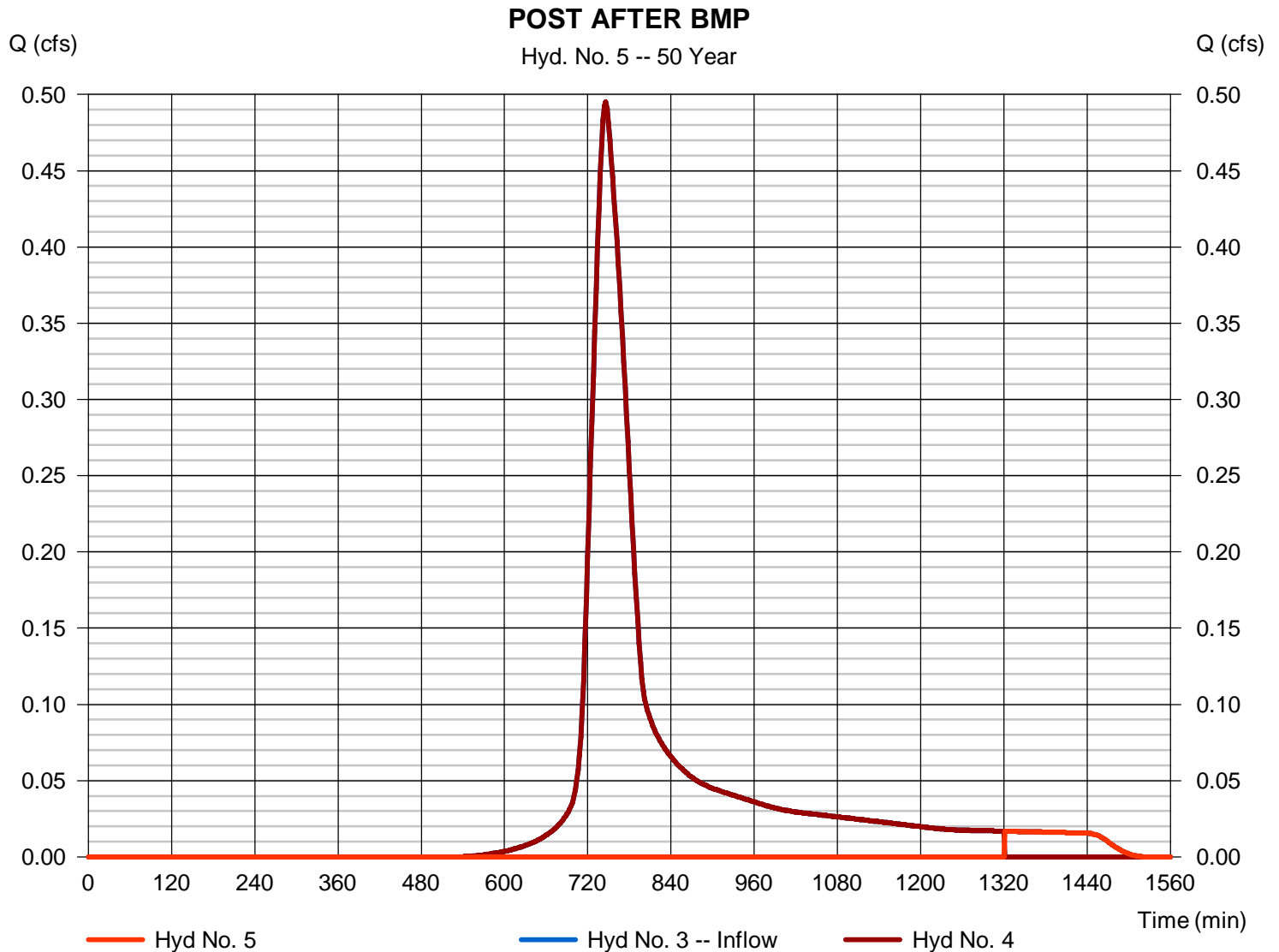
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 5

### POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.017 cfs
Storm frequency	= 50 yrs	Time to peak	= 1322 min
Time interval	= 2 min	Hyd. volume	= 151 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft



# Hydrograph Report

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

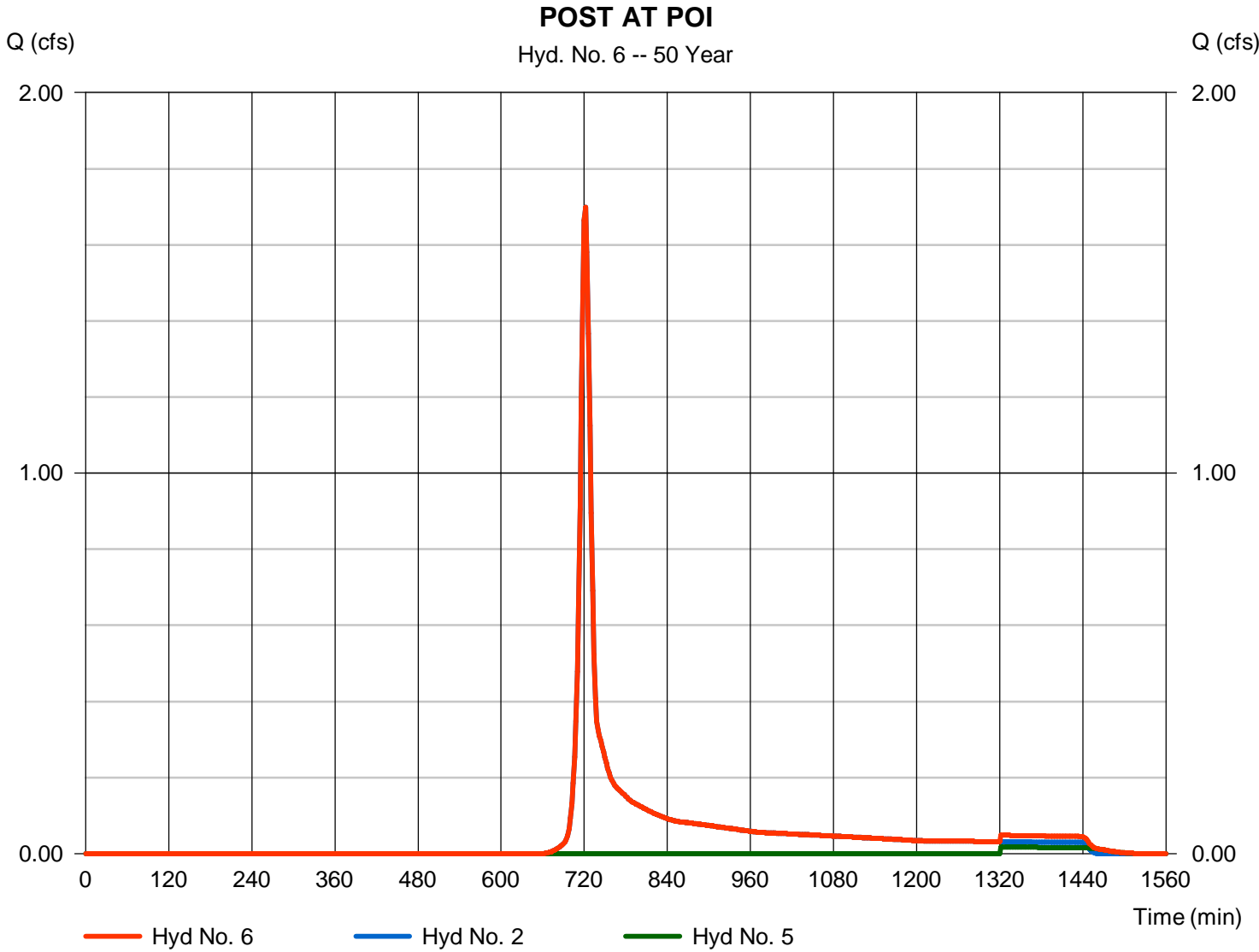
Monday, 10 / 24 / 2016

## Hyd. No. 6

POST AT POI

Hydrograph type = Combine  
Storm frequency = 50 yrs  
Time interval = 2 min  
Inflow hyds. = 2, 5

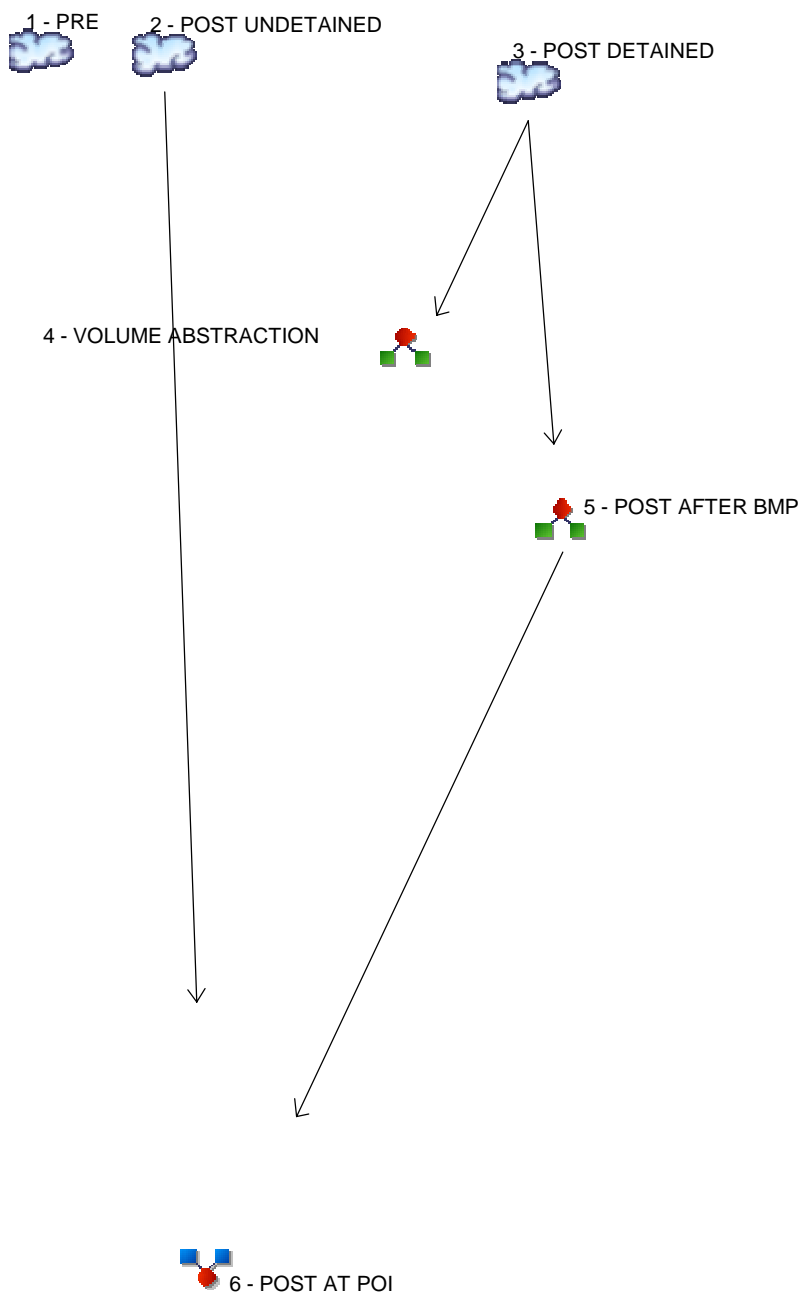
Peak discharge = 1.699 cfs  
Time to peak = 722 min  
Hyd. volume = 4,726 cuft  
Contrib. drain. area = 0.660 ac





# 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

Hydroflow 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	-----	-----	-----	-----	-----	-----	-----	-----	3.235	PRE
2	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	-----	2.396	POST UNDETAINED
3	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	-----	0.752	POST DETAINED
4	Diversion1	3	-----	-----	-----	-----	-----	-----	-----	0.752	VOLUME ABSTRACTION
5	Diversion2	3	-----	-----	-----	-----	-----	-----	-----	0.059	POST AFTER BMP
6	Combine	2, 5	-----	-----	-----	-----	-----	-----	-----	2.396	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	3.235	2	722	8,577	-----	-----	-----	PRE
2	SCS Runoff	2.396	2	722	6,329	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	0.752	2	740	3,890	-----	-----	-----	POST DETAINED
4	Diversion1	0.752	2	740	2,834	3	-----	-----	VOLUME ABSTRACTION
5	Diversion2	0.059	2	878	1,056	3	-----	-----	POST AFTER BMP
6	Combine	2.396	2	722	7,385	2, 5	-----	-----	POST AT POI
100 year adjusted.gpw					Return Period: 100 Year			Monday, 10 / 24 / 2016	



# Hydrograph Report

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

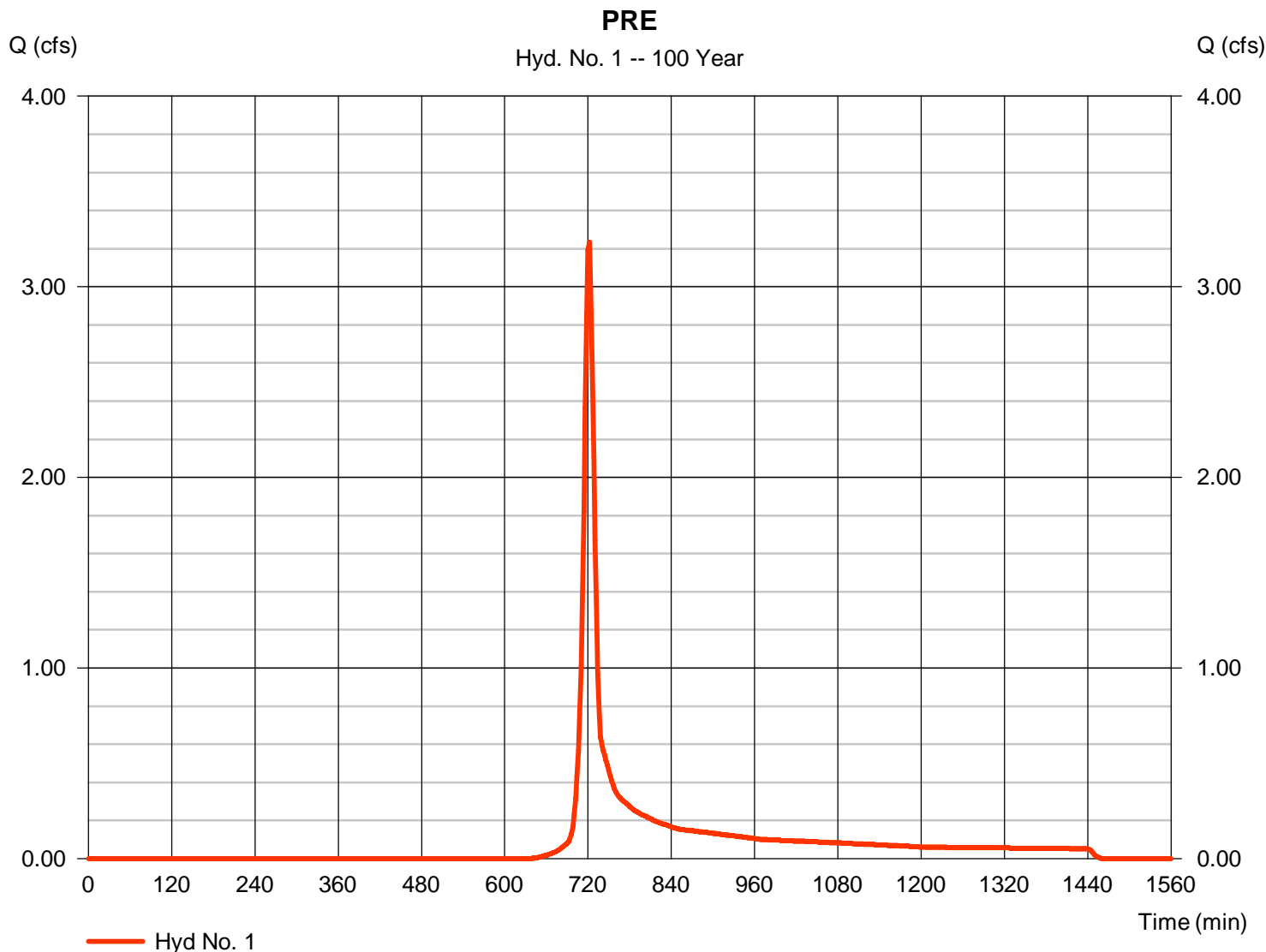
Monday, 10 / 24 / 2016

## Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 3.235 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 8,577 cuft
Drainage area	= 0.930 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 7.08 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.800 x 58)] / 0.930



# TR55 Tc Worksheet

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

## Hyd. No. 1

PRE

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.84	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 11.48</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 11.48</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 350.00	0.00	0.00	
Watercourse slope (%)	= 5.40	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=3.75	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.56</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.56</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>13.00 min</b>

# Hydrograph Report

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

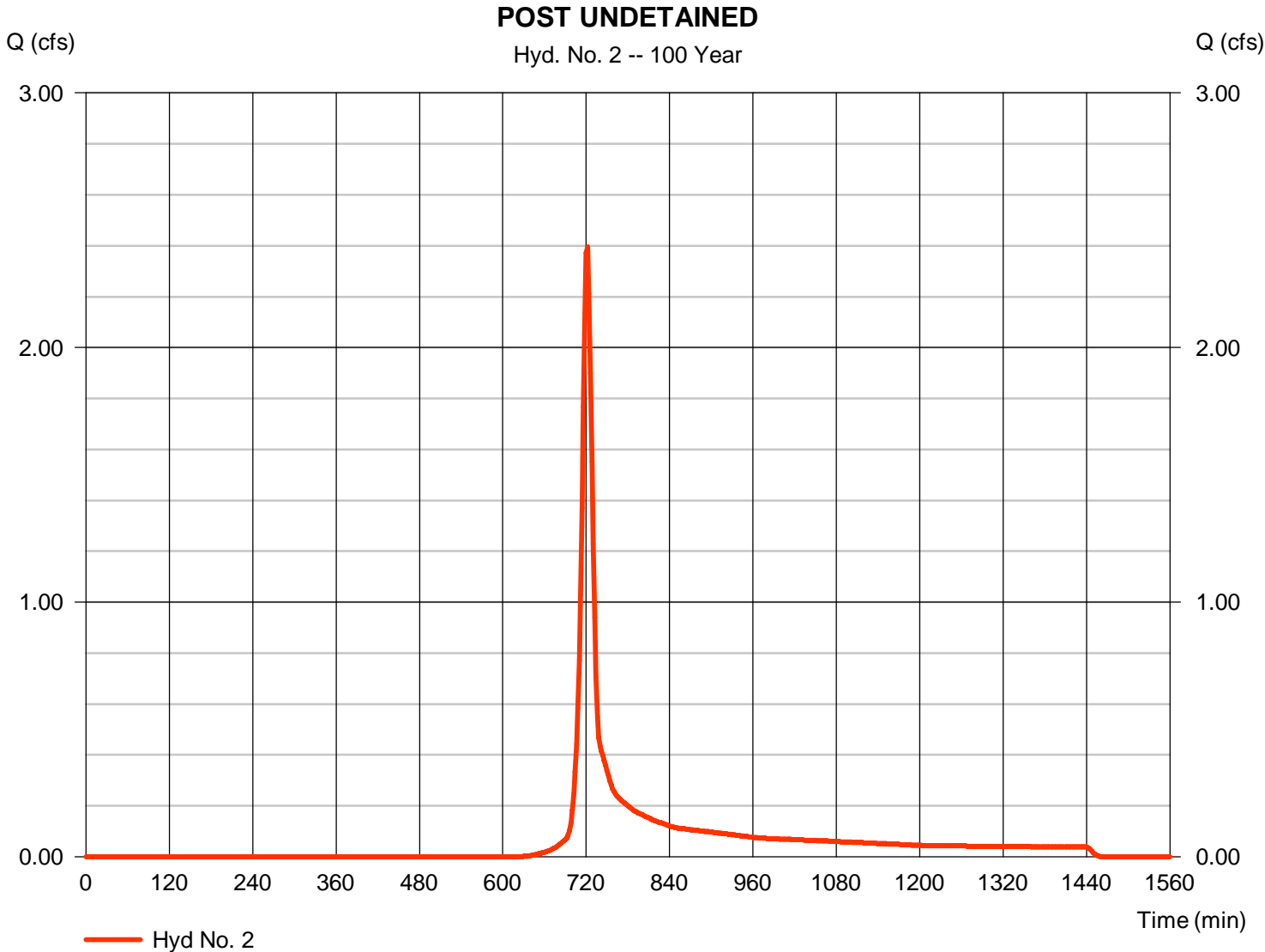
Monday, 10 / 24 / 2016

## Hyd. No. 2

### POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 2.396 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 6,329 cuft
Drainage area	= 0.660 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.00 min
Total precip.	= 7.08 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.010 x 77) + (0.110 x 55) + (0.010 x 78) + (0.010 x 85) + (0.520 x 58)] / 0.660



# TR55 Tc Worksheet

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

## Hyd. No. 2

POST UNDETAINED

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
<b>Sheet Flow</b>				
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)	= 2.84	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 11.48</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 11.48</b>
<b>Shallow Concentrated Flow</b>				
Flow length (ft)	= 350.00	0.00	0.00	
Watercourse slope (%)	= 5.40	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=3.75	0.00	0.00	
<b>Travel Time (min)</b>	<b>= 1.56</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 1.56</b>
<b>Channel Flow</b>				
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	
<b>Travel Time (min)</b>	<b>= 0.00</b>	<b>+ 0.00</b>	<b>+ 0.00</b>	<b>= 0.00</b>
<b>Total Travel Time, Tc .....</b>				<b>13.00 min</b>

# Hydrograph Report

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

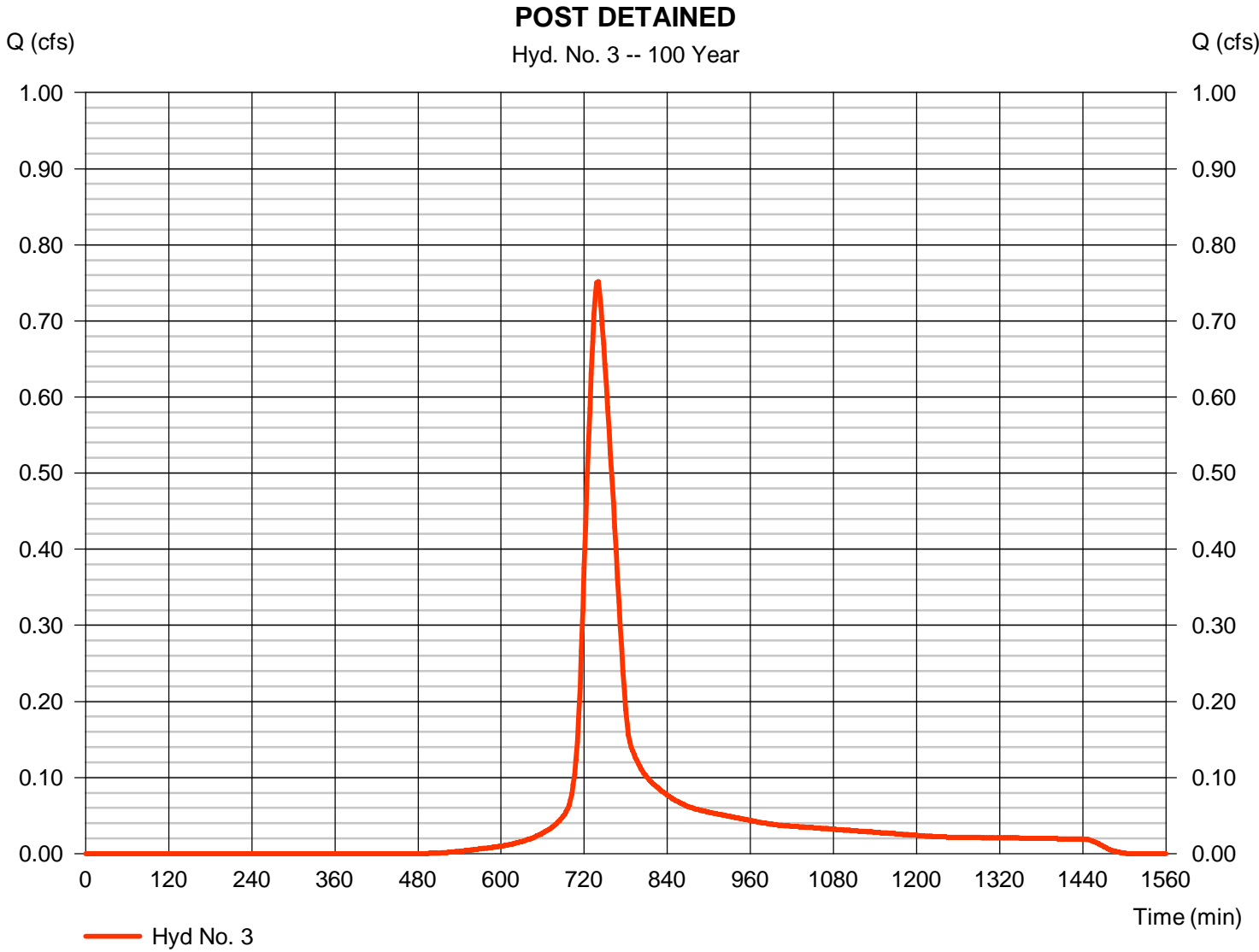
Monday, 10 / 24 / 2016

## Hyd. No. 3

### POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.752 cfs
Storm frequency	= 100 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 3,890 cuft
Drainage area	= 0.280 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 43.41 min
Total precip.	= 7.08 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

\* Composite (Area/CN) = [(0.130 x 85) + (0.150 x 58)] / 0.280



# Hydrograph Report

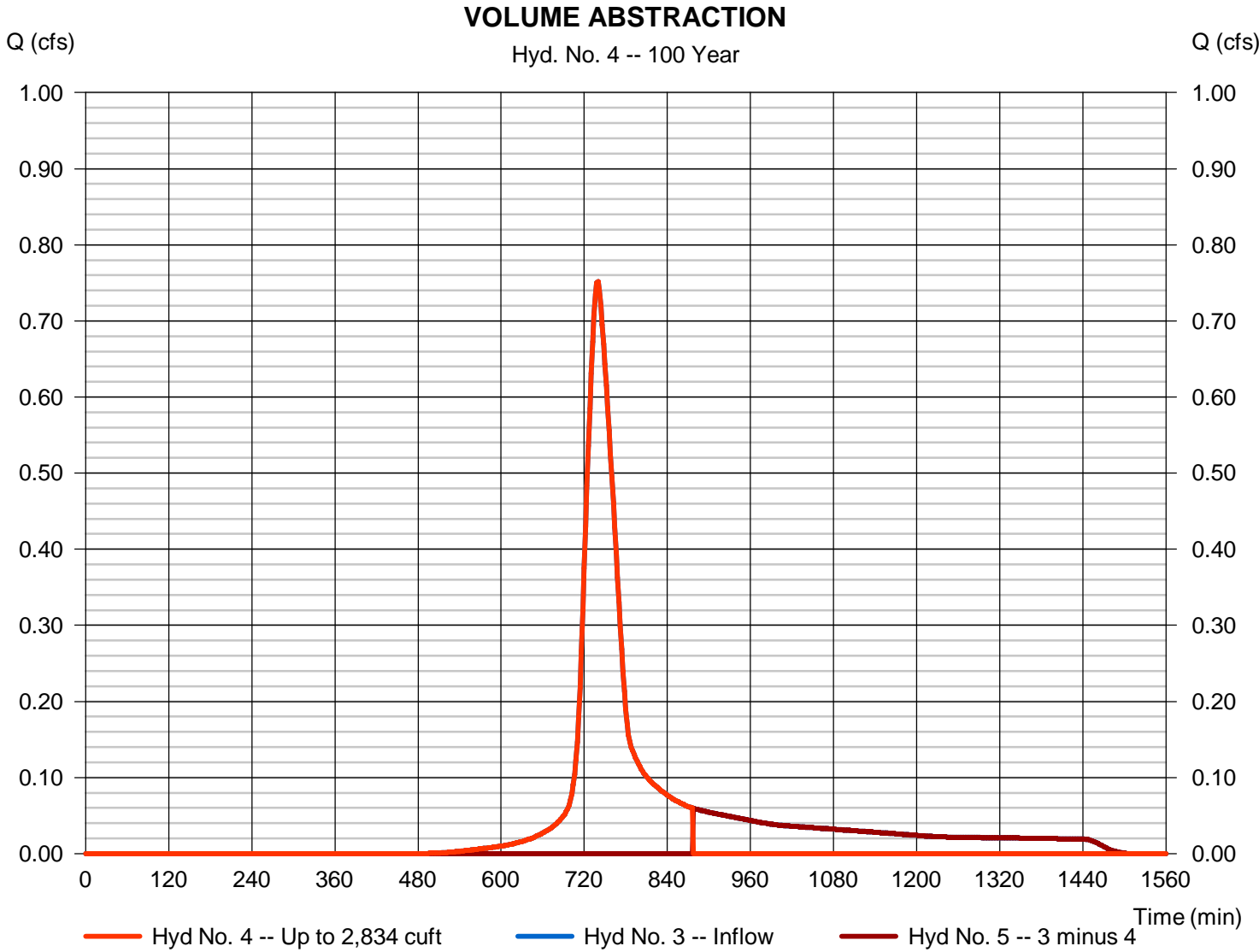
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 4

### VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.752 cfs
Storm frequency	= 100 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 2,834 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft



# Hydrograph Report

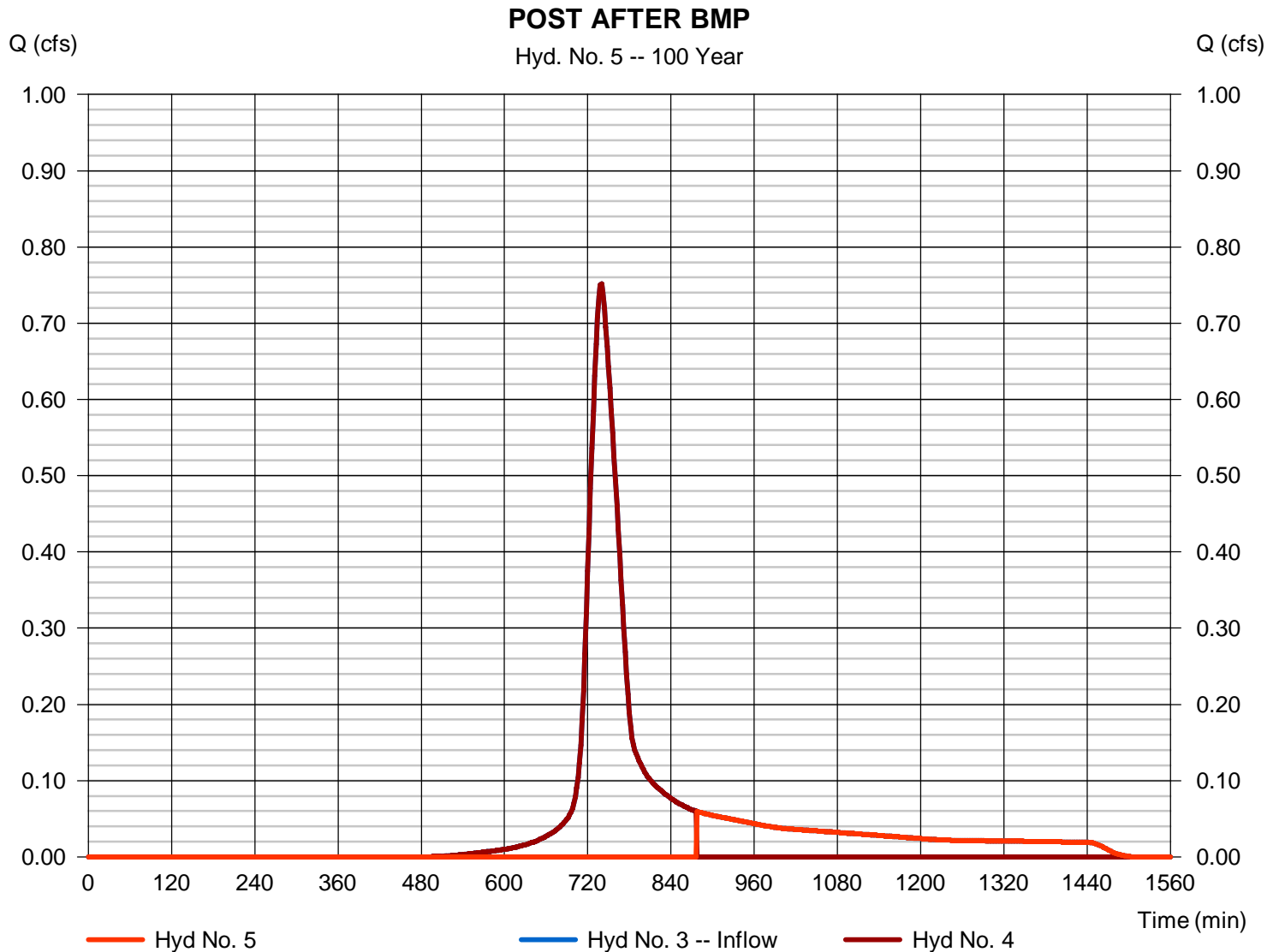
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

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## Hyd. No. 5

### POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.059 cfs
Storm frequency	= 100 yrs	Time to peak	= 878 min
Time interval	= 2 min	Hyd. volume	= 1,056 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 2,834 cuft



# Hydrograph Report

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

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## Hyd. No. 6

POST AT POI

Hydrograph type = Combine  
Storm frequency = 100 yrs  
Time interval = 2 min  
Inflow hyds. = 2, 5

Peak discharge = 2.396 cfs  
Time to peak = 722 min  
Hyd. volume = 7,385 cuft  
Contrib. drain. area = 0.660 ac

