

Gates

TETRA TECH, INC.

By: RH Date: 11/11/2016 Subject: Gates Road
Checked By: JB Date: 11/13/2016 PCSM Design and Evaluation

PURPOSE:

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

Dauphin County has a County-wide Act 167 plan with specific requirements for Spring Creek (East), where the block valve is located. The PCSM design at the Gates Road block valve site has been designed for consistency with Dauphin 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.

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

Recommended Peak Rate Control Guideline

The recommended control guideline for peak rate control is:

- Do not increase the peak rate of discharge for the 2-year through 100-year events (at minimum); as necessary, provide additional peak rate control as required by applicable and approved Act 167 plan.
- The Gates Road block valve site is located in Spring Creek (East) watershed, subwatershed SP5. This particular subwatershed has the release rate requirements listed below.

Subwatershed	1-Year	2-Year	10-Year	25-Year	50-Year	100-Year
SP5	100%	90%	90%	90%	100%	100%

This site will utilize an infiltration berm to manage the two-year through 100-year peak rate increases. The requirements from both PADEP and Dauphin County's Act 167 Plan are met with this proposed design. This BMP will also help to increase the time of concentration for the drainage area encompassing the block valve.

Recommended Water Quality Control Guideline

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

Infiltration

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

During the onsite infiltration tests, the depth to seasonal high groundwater and shallow bedrock or another confining layer were evaluated. 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 0.7:1.

The maximum drainage area loading ratio of 8:1 has been met. The drainage area loading ratio for the site is 3.2:1.

Disturbed Area

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

Karst Topography

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

Special Protection Watershed

Gates Road block valve is located within a siltation impaired watershed. The project site was designed to minimize the total amount of impervious area. The impervious area for the Gates Road valve was limited to the amount that is required to safely construct and operate the block valve. In addition, the previously proposed gravel turn-around was eliminated, and replaced with a grass area. Finally, an existing access road was utilized for the site, thus eliminating the need to create a larger impervious area.

Non-discharge alternatives were analyzed for this block valve site. The location of the Gates Road block valve site was evaluated by ASME B31.4 Valve Spacing 434.15.2(e) which states that mainline valves should not be more than 7.5 miles apart. The valve sites were located in such a way that they avoided environmentally sensitive areas (such as wetlands and floodplains), were close to an existing road, and close to power. Land owner preference was also accounted for while locating the block valve sites. Once all of these factors were taken into account, several block valve sites, including Gates Road, were located in special protection or siltation impaired watersheds.

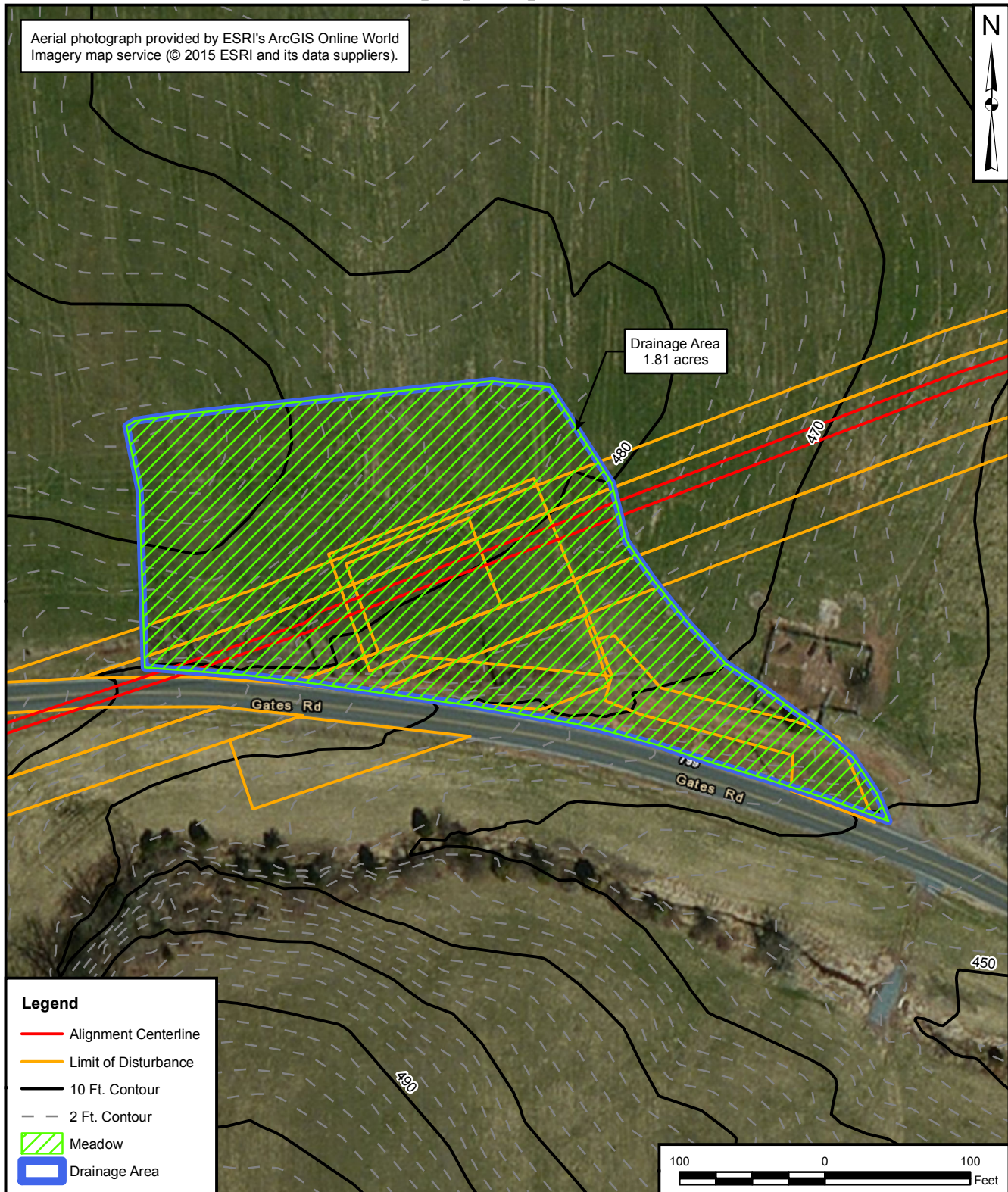
Non-discharge alternatives were also considered when determining the type of BMP proposed. Gates Road block valve site utilizes an infiltration berm to manage stormwater. Stormwater runoff is infiltrated to the maximum extent possible. Stormwater runoff is spread out to flow through areas that have been restored to meadow conditions, to an infiltration berm, or to undisturbed area. There will not be an increase in stormwater runoff rate or volume to prevent the physical degradation of the receiving water, such as scour, and stream bank destabilization. Stormwater runoff volume is not increasing throughout post-construction, and any post-construction stormwater discharge is managed so that it will not degrade the physical, chemical or biological characteristics of the receiving stream.

Runoff from the site will be managed by a downslope infiltration berm. Pondered runoff will be temporarily stored upslope of the berm until it infiltrates and filters through the soil media. Due to the design of the berm, which maintains a constant elevation through the entire berm length, the stormwater runoff will be released in sheet flow down a stabilized slope, without causing erosion, rather than concentrating the flow. Filtration through the existing vegetation and soil is an efficient way to remove suspended stormwater pollutants such as sediment, as the suspended particles are physically filtered from the stormwater as it flows through the vegetation and percolates into the soil.

The extent of the disturbed area will be minimized, and the duration of disturbance will be minimized by stabilizing disturbed areas as soon as practicable. Cut and fill for the project site has been minimized. Where possible based on the criteria listed above, sites were located in areas with shallow slopes to minimize the amount of cut and fill required. There is minimal cut and fill required at the Gates Road block valve site. All of the block valve sites were graded towards the natural slope. No direct discharge to surface water occurs at the site. The site will be restored promptly with proper vegetative cover techniques.

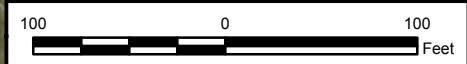
Antidegradation requirements for the special protection watershed are met because the post-construction stormwater infiltration volume equals or exceeds the pre-construction stormwater infiltration volume, and post-construction stormwater discharge is pretreated via infiltration berms. The runoff is managed so that it will not degrade the physical, chemical, or biological characteristics of the receiving stream.

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



Legend

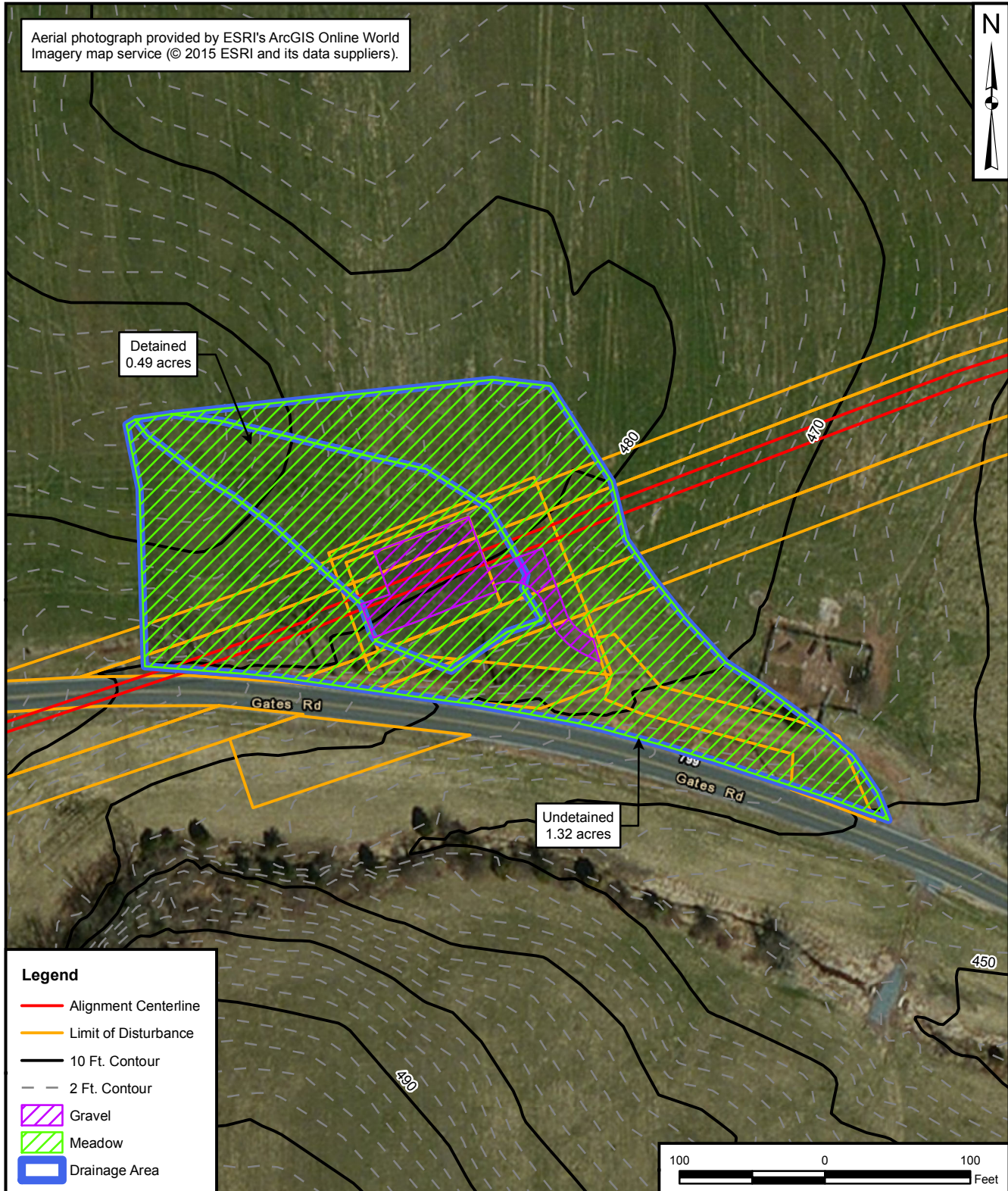
- Alignment Centerline
- Limit of Disturbance
- 10 Ft. Contour
- 2 Ft. Contour
- Meadow
- Drainage Area



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

DRAWN BY: J. HERNING 05/04/15	
CHECKED BY: J. BRODY 11/09/16	
APPROVED BY:	
CONTRACT NUMBER: 112IC05958	
FIGURE NUMBER	1
REV	0

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Legend

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



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

DRAWN BY: J. HERNING 05/04/15	
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: Conewago Twp, Pennsylvania,
USA*



Latitude: 40.247°, Longitude: -76.6182°
Elevation: 474.34 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

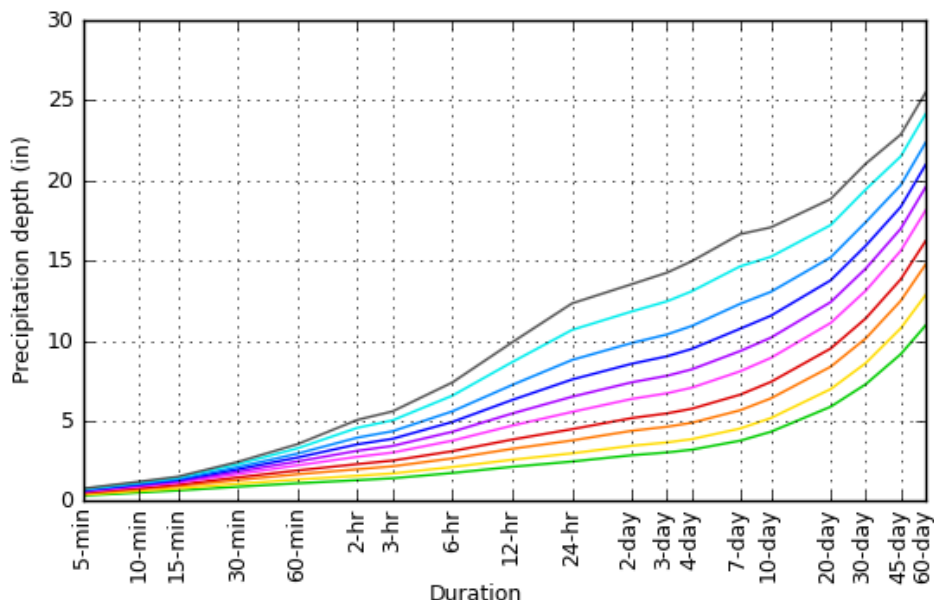
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.325 (0.293-0.359)	0.386 (0.349-0.428)	0.454 (0.409-0.503)	0.504 (0.453-0.558)	0.563 (0.504-0.623)	0.605 (0.541-0.669)	0.647 (0.576-0.714)	0.685 (0.606-0.757)	0.732 (0.644-0.809)	0.768 (0.671-0.850)
10-min	0.518 (0.468-0.574)	0.617 (0.557-0.685)	0.726 (0.655-0.806)	0.803 (0.722-0.889)	0.893 (0.800-0.988)	0.960 (0.857-1.06)	1.02 (0.911-1.13)	1.08 (0.956-1.19)	1.15 (1.01-1.27)	1.20 (1.05-1.33)
15-min	0.646 (0.583-0.715)	0.773 (0.698-0.858)	0.916 (0.825-1.02)	1.01 (0.912-1.12)	1.13 (1.01-1.25)	1.21 (1.08-1.34)	1.29 (1.15-1.43)	1.36 (1.21-1.50)	1.45 (1.28-1.60)	1.51 (1.32-1.67)
30-min	0.883 (0.797-0.978)	1.06 (0.962-1.18)	1.30 (1.17-1.44)	1.46 (1.32-1.62)	1.67 (1.49-1.84)	1.82 (1.63-2.01)	1.97 (1.75-2.18)	2.11 (1.87-2.33)	2.29 (2.02-2.54)	2.43 (2.12-2.69)
60-min	1.10 (0.993-1.22)	1.33 (1.21-1.48)	1.66 (1.50-1.84)	1.90 (1.71-2.11)	2.22 (1.99-2.45)	2.46 (2.20-2.72)	2.71 (2.41-2.99)	2.95 (2.61-3.26)	3.28 (2.89-3.63)	3.54 (3.09-3.92)
2-hr	1.29 (1.17-1.44)	1.57 (1.42-1.74)	1.98 (1.78-2.19)	2.30 (2.07-2.54)	2.75 (2.47-3.04)	3.13 (2.79-3.45)	3.53 (3.12-3.89)	3.95 (3.47-4.36)	4.56 (3.96-5.04)	5.06 (4.36-5.60)
3-hr	1.41 (1.27-1.57)	1.71 (1.55-1.91)	2.16 (1.95-2.40)	2.51 (2.26-2.80)	3.02 (2.70-3.34)	3.43 (3.05-3.80)	3.87 (3.42-4.29)	4.34 (3.81-4.81)	5.02 (4.35-5.57)	5.58 (4.79-6.20)
6-hr	1.74 (1.57-1.95)	2.11 (1.90-2.37)	2.65 (2.38-2.97)	3.10 (2.77-3.46)	3.76 (3.34-4.18)	4.32 (3.81-4.79)	4.92 (4.31-5.46)	5.59 (4.85-6.19)	6.57 (5.62-7.27)	7.39 (6.25-8.20)
12-hr	2.13 (1.91-2.41)	2.57 (2.30-2.91)	3.25 (2.90-3.67)	3.83 (3.40-4.32)	4.70 (4.14-5.28)	5.45 (4.77-6.10)	6.30 (5.45-7.04)	7.24 (6.20-8.07)	8.66 (7.29-9.65)	9.90 (8.21-11.0)
24-hr	2.46 (2.25-2.72)	2.97 (2.72-3.28)	3.77 (3.45-4.17)	4.47 (4.08-4.93)	5.55 (5.01-6.09)	6.50 (5.83-7.11)	7.58 (6.72-8.25)	8.79 (7.71-9.56)	10.7 (9.21-11.6)	12.3 (10.5-13.3)
2-day	2.85 (2.61-3.16)	3.44 (3.15-3.82)	4.38 (4.00-4.85)	5.17 (4.71-5.72)	6.37 (5.75-7.02)	7.40 (6.64-8.15)	8.56 (7.62-9.41)	9.86 (8.68-10.8)	11.8 (10.2-13.0)	13.5 (11.6-14.8)
3-day	3.02 (2.78-3.33)	3.65 (3.35-4.02)	4.63 (4.24-5.10)	5.46 (4.99-6.01)	6.71 (6.09-7.37)	7.81 (7.03-8.55)	9.02 (8.06-9.86)	10.4 (9.19-11.3)	12.5 (10.8-13.6)	14.2 (12.2-15.6)
4-day	3.19 (2.94-3.51)	3.85 (3.55-4.23)	4.88 (4.48-5.35)	5.75 (5.27-6.30)	7.07 (6.43-7.71)	8.21 (7.42-8.95)	9.49 (8.51-10.3)	10.9 (9.70-11.9)	13.1 (11.5-14.2)	15.0 (12.9-16.3)
7-day	3.76 (3.48-4.10)	4.51 (4.18-4.93)	5.65 (5.22-6.17)	6.63 (6.11-7.22)	8.09 (7.40-8.79)	9.35 (8.51-10.2)	10.7 (9.71-11.7)	12.3 (11.0-13.3)	14.6 (12.9-15.9)	16.6 (14.5-18.1)
10-day	4.31 (4.02-4.66)	5.17 (4.82-5.59)	6.40 (5.95-6.91)	7.43 (6.89-8.01)	8.92 (8.23-9.61)	10.2 (9.35-11.0)	11.6 (10.5-12.4)	13.0 (11.8-14.0)	15.2 (13.6-16.4)	17.1 (15.1-18.4)
20-day	5.88 (5.53-6.27)	6.98 (6.56-7.44)	8.38 (7.87-8.94)	9.51 (8.91-10.1)	11.1 (10.4-11.8)	12.4 (11.6-13.2)	13.8 (12.8-14.7)	15.2 (14.0-16.2)	17.2 (15.7-18.3)	18.8 (17.1-20.1)
30-day	7.28 (6.87-7.73)	8.60 (8.12-9.13)	10.1 (9.57-10.8)	11.4 (10.7-12.1)	13.1 (12.3-13.9)	14.5 (13.6-15.4)	15.9 (14.8-16.9)	17.4 (16.1-18.5)	19.4 (17.9-20.7)	21.0 (19.3-22.4)
45-day	9.16 (8.70-9.65)	10.8 (10.2-11.4)	12.5 (11.9-13.2)	13.8 (13.1-14.6)	15.6 (14.8-16.4)	17.0 (16.1-17.9)	18.3 (17.3-19.3)	19.7 (18.5-20.7)	21.5 (20.1-22.7)	22.9 (21.3-24.1)
60-day	11.0 (10.4-11.5)	12.8 (12.2-13.5)	14.8 (14.1-15.5)	16.2 (15.4-17.0)	18.1 (17.2-19.0)	19.6 (18.6-20.5)	21.0 (19.8-22.0)	22.4 (21.1-23.5)	24.1 (22.7-25.4)	25.5 (23.9-26.8)

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

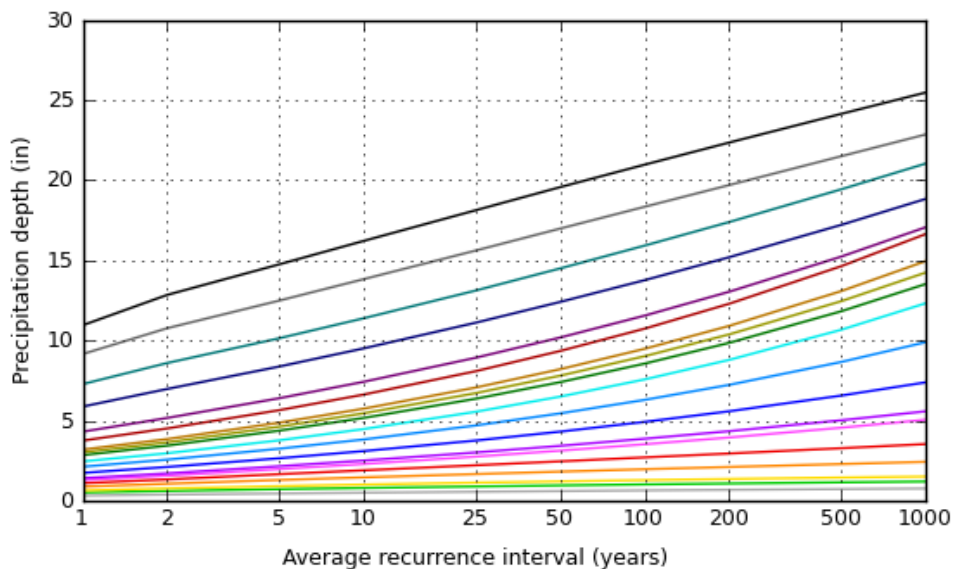
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PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 40.2470°, Longitude: -76.6182°



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



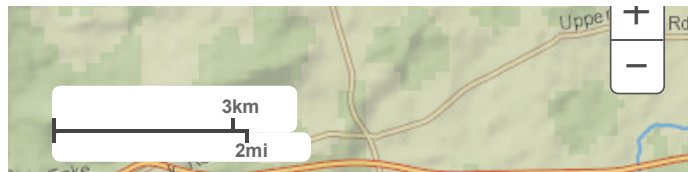
Duration
5-min
10-min
15-min
30-min
60-min
2-hr
3-hr
6-hr
12-hr
24-hr
2-day
3-day
4-day
7-day
10-day
20-day
30-day
45-day
60-day

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Maps & aerials

Small scale terrain





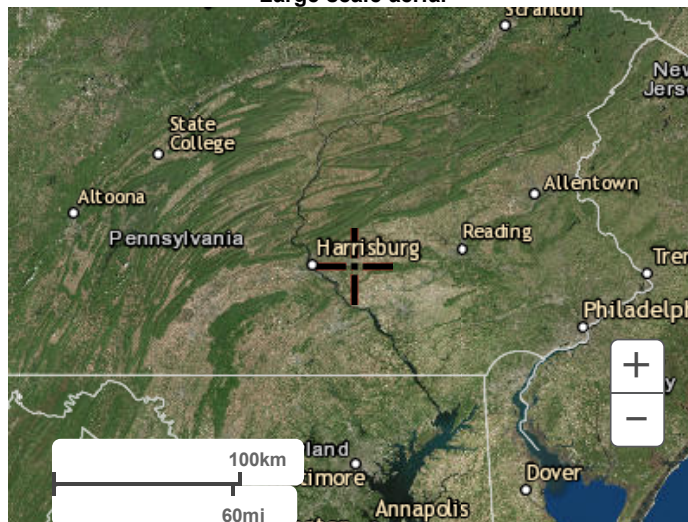
Large scale terrain



Large scale map



Large scale aerial



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WORKSHEET 1. GENERAL SITE INFORMATION

Date: November 11, 2016

Project Name: Gates Road

Municipality: Conewago

County: Dauphin

Total Area (acres): 1.81

Major River Basin: Susquehanna River

Watershed: Little Swatara and Quittapahilla Creeks

Sub Basin: Spring Creek (East)

Nearest Surface Water to Receive Runoff: Trib 09509 To Spring Creek

Chapter 93 - Designated Water Use: WWF

Impaired according to Chapter 303(d) list? YES
List Causes of Impairment: NO
Source Unknown - Pathogens, Agriculture - Organic Enrichment/Low D.O. ; Agriculture - Siltation

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:			
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
0.89	-	0	=	0.89
				This is the area that requires stormwater management

VOLUME CREDITS

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

Lawn _____ ft² x 1/4" x 1/12 = _____ ft³

Meadow _____ ft² x 1/3" x 1/12 = _____ ft³

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

For Trees within 100 feet of impervious area:

Tree Canopy _____ ft² x 1/2" x 1/12 = _____ ft³

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 _____ ft² x 1/3" x 1/12 = _____ ft³

For all other disconnected roof areas

Roof Area _____ ft² x 1/4" x 1/12 = _____ ft³

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 _____ ft² x 1/3" x 1/12 = _____ ft³

For all other disconnected roof areas

Impervious Area _____ ft² x 1/4" x 1/12 = _____ ft³

TOTAL NON-STRUCTURAL VOLUME CREDIT* _____ ft³

*For use on Worksheet 5

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

PROJECT: Gates Road
 Drainage Area: 1.81 acres
 2-Year Rainfall: 2.97 in

Total Site Area: 0.89 acres
 Protected Site Area: N/A acres
 Managed Site Area: 0.89 acres

Existing Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	la (0.2*S)	Q Runoff ¹ (in)	Runoff Volume ³ (ft ³)
Woods	B	0.00	0.00	55	8.18	1.64	0.19	0
Meadow	B	38768	0.89	58	7.24	1.45	0.26	854
TOTAL:		38768	0.89					854

Developed Conditions

Cover Type/Condition	Soil Type	Area (sf)	Area (ac)	CN	S	la (0.2*S)	Q Runoff ¹ (in)	Runoff Volume ³ (ft ³)
Impervious - Gravel	B	5663	0.13	85	1.76	0.35	1.56	738
Meadow	B	33106	0.76	58	7.24	1.45	0.26	729
TOTAL:		38768	0.89					1,467

2-Year Volume Increase (ft³):	613
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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: Gates Road
 SUB-BASIN: _____

Required Control Volume (ft³) - from Worksheet 4: 613
 Non-structural Volume Credit (ft³) - from Worksheet 3: N/A
 (maximum is 25% of required volume)
 Structural Volume Reqmt (ft³) 613
 (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/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	1,607	811
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:		
Total Structural Volume (ft³):		811
Structural Volume Requirement (ft³):		613
DIFFERENCE:		-198

VOLUME CREDIT DETERMINATION

- 1 Detained area runoff volume from Hydraflow = 811 cf
- 2 Storage volume of the BMPs = 2,343 cf
- 3 Infiltrated volume within 72 hours after the 2-yr/24-hr event
 (Infiltration Rate/12) x Infiltration Area x 72 hrs = 121,014 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

7.0 MIN

STRUCTURAL VOLUME PROVIDED BY BMP

811 CF FOR 2-YR/24-HR STORM EVENT
2,219 CF FOR 10-YR/24-HR STORM EVENT
2,343 CF FOR ALL REMANING STORM EVENTS

RATES OF RUNOFF TO THE BMP (FROM HYDRAFLOW REPORT)

Storm Event	Q (CFS)
2 YR/24 HR	0.285
10 YR/24 HR	0.943
50 YR/24 HR	2.041
100 YR/24 HR	2.678

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	0.285	47.427
10 YR/24 HR	0.943	39.219
50 YR/24 HR	2.041	19.133
100 YR/24 HR	2.678	14.582

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	0.285	47.43	54.43
10 YR/24 HR	0.943	39.22	46.22
50 YR/24 HR	2.041	19.13	26.13
100 YR/24 HR	2.678	14.58	21.58

INFILTRATION BERM DEWATERING CALCULATION

SITE NAME: GATES ROAD

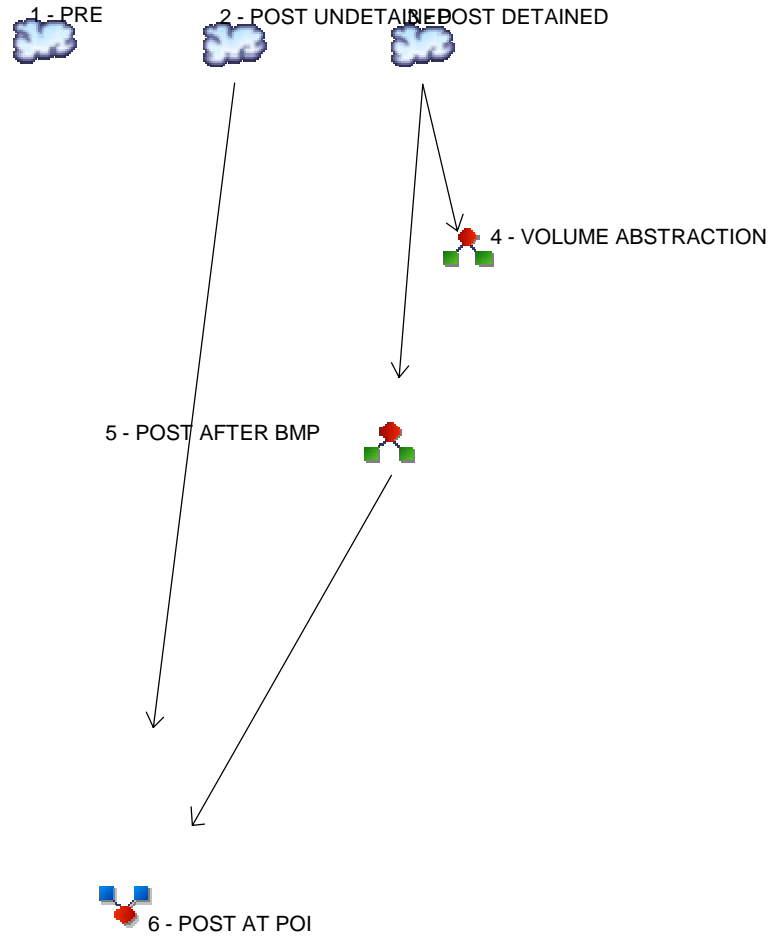
STORAGE VOLUME 811 CF AFTER 2-YEAR/24-HOUR STORM
DESIGN INFILTRATION RATE 3.00 IN/HR IT-A RECOMMENDED RATE
INFILTRATION AREA 2,343 SF

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

DEWATERING TIME =	1.4 HOURS
--------------------------	------------------

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	-----	-----	0.471	-----	-----	2.571	-----	6.376	8.660	PRE
2	SCS Runoff	-----	-----	0.344	-----	-----	1.875	-----	4.650	6.316	POST UNDETAINED
3	SCS Runoff	-----	-----	0.285	-----	-----	0.943	-----	2.041	2.678	POST DETAINED
4	Diversion1	3	-----	0.285	-----	-----	0.943	-----	2.041	2.678	VOLUME ABSTRACTION
5	Diversion2	3	-----	0.000	-----	-----	0.000	-----	0.266	1.817	POST AFTER BMP
6	Combine	2, 5	-----	0.344	-----	-----	1.875	-----	4.650	6.316	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	0.471	2	720	1,625	-----	-----	-----	PRE	
2	SCS Runoff	0.344	2	720	1,185	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	0.285	2	720	811	-----	-----	-----	POST DETAINED	
4	Diversion1	0.285	2	720	811	3	-----	-----	VOLUME ABSTRACTION	
5	Diversion2	0.000	2	n/a	0	3	-----	-----	POST AFTER BMP	
6	Combine	0.344	2	720	1,185	2, 5	-----	-----	POST AT POI	
Gates Road.gpw					Return Period: 2 Year			Wednesday, 11 / 9 / 2016		

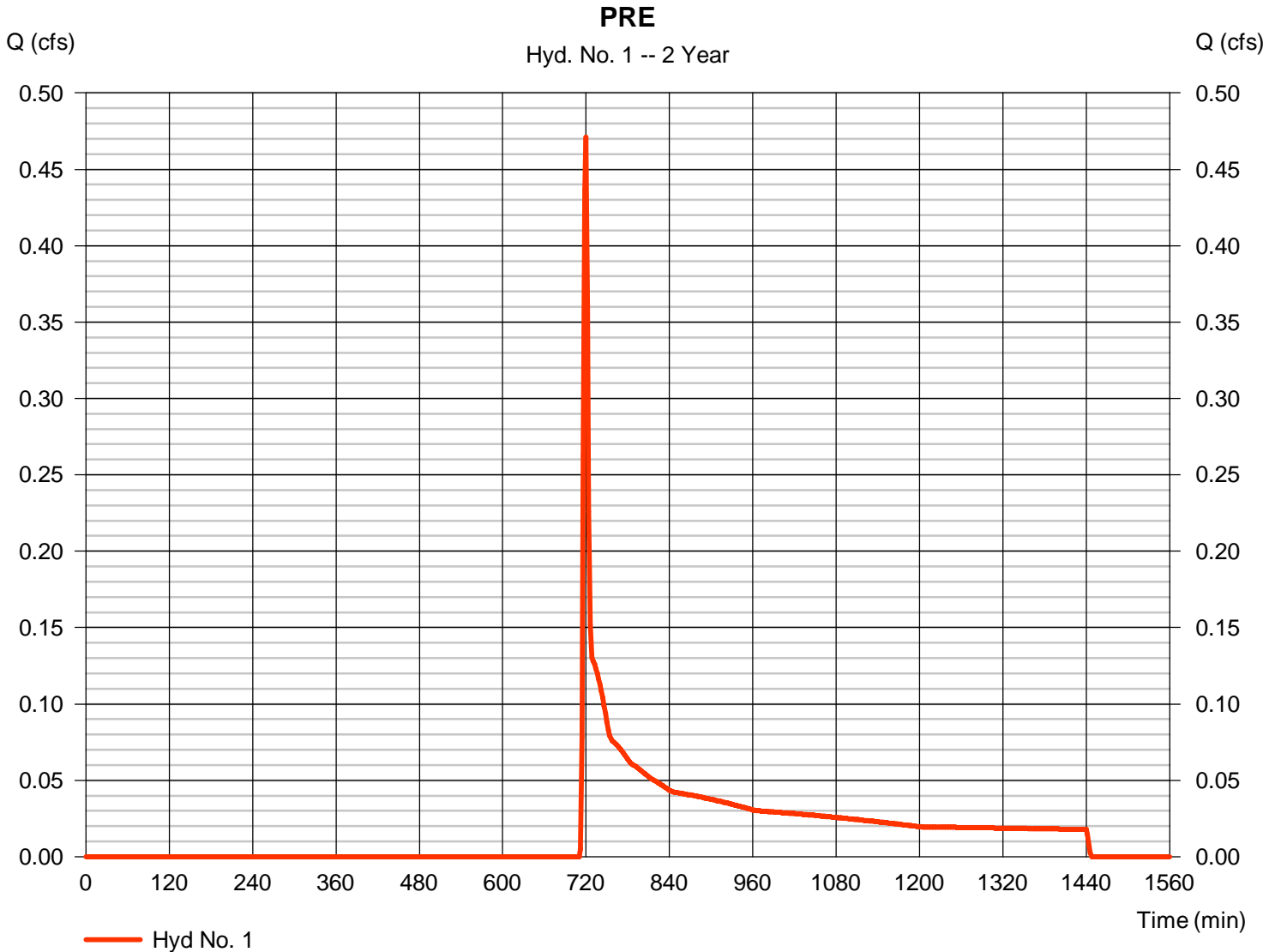
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 0.471 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 1,625 cuft
Drainage area	= 1.810 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 2.97 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



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>
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)	= 2.97	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 4.89	+ 0.00	+ 0.00	= 4.89
Shallow Concentrated Flow				
Flow length (ft)	= 173.00	22.00	123.00	
Watercourse slope (%)	= 9.10	1.60	4.50	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=4.87	2.04	3.42	
Travel Time (min)	= 0.59	+ 0.18	+ 0.60	= 1.37
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	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				6.30 min

Hydrograph Report

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

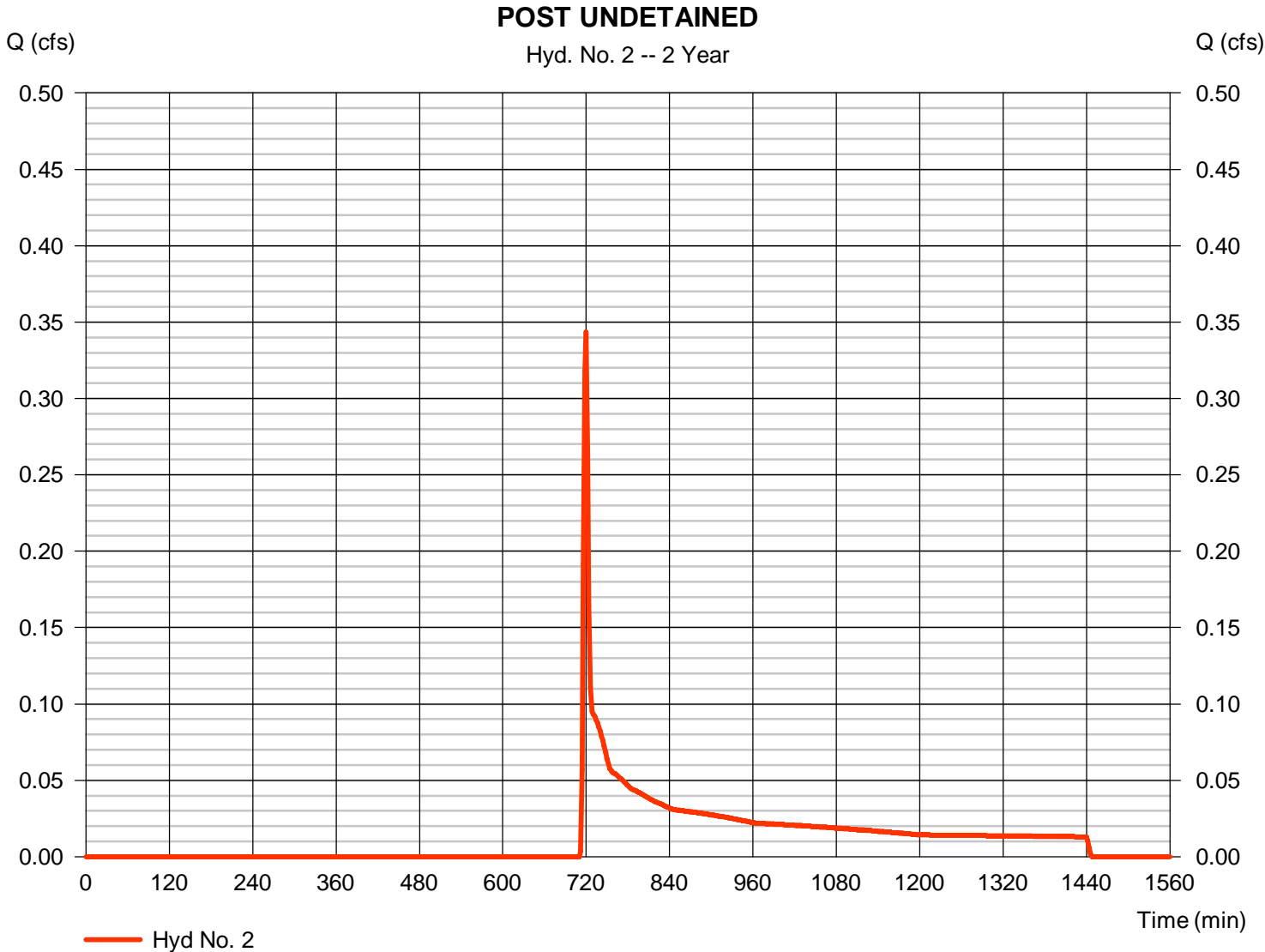
Wednesday, 11 / 9 / 2016

Hyd. No. 2

POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.344 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 1,185 cuft
Drainage area	= 1.320 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 2.97 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



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>
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)	= 2.97	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 4.89	+ 0.00	+ 0.00	= 4.89
Shallow Concentrated Flow				
Flow length (ft)	= 173.00	22.00	123.00	
Watercourse slope (%)	= 9.10	1.60	4.50	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=4.87	2.04	3.42	
Travel Time (min)	= 0.59	+ 0.18	+ 0.60	= 1.37
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	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				6.30 min

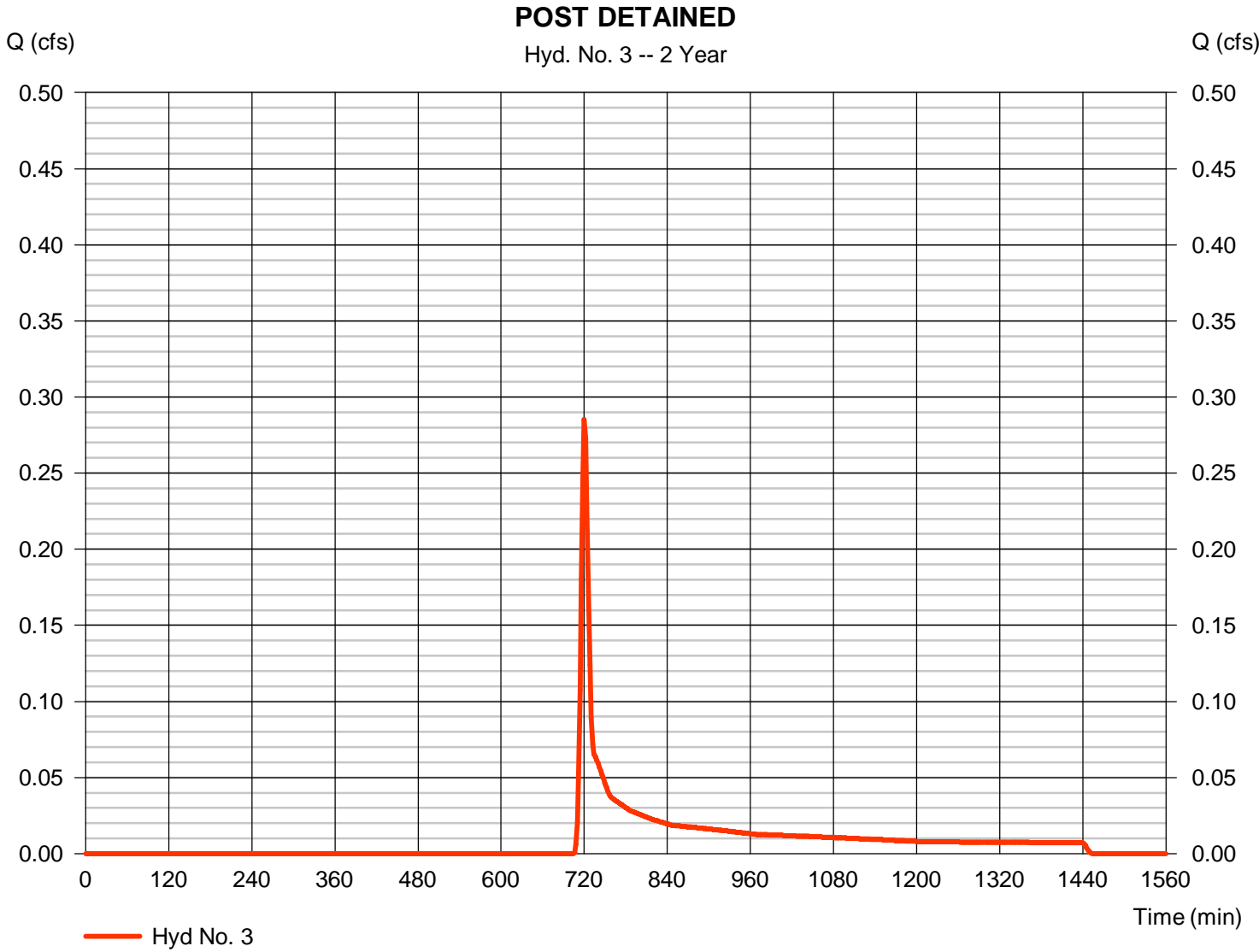
Hydrograph Report

Hyd. No. 3

POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.285 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 811 cuft
Drainage area	= 0.490 ac	Curve number	= 64*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.00 min
Total precip.	= 2.97 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



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>
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)	= 2.97	0.00	0.00	
Land slope (%)	= 5.00	0.00	0.00	
Travel Time (min)	= 5.90	+ 0.00	+ 0.00	= 5.90
Shallow Concentrated Flow				
Flow length (ft)	= 179.00	55.00	32.00	
Watercourse slope (%)	= 7.30	5.50	3.10	
Surface description	= Unpaved	Paved	Unpaved	
Average velocity (ft/s)	=4.36	4.77	2.84	
Travel Time (min)	= 0.68	+ 0.19	+ 0.19	= 1.06
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				7.00 min

Hydrograph Report

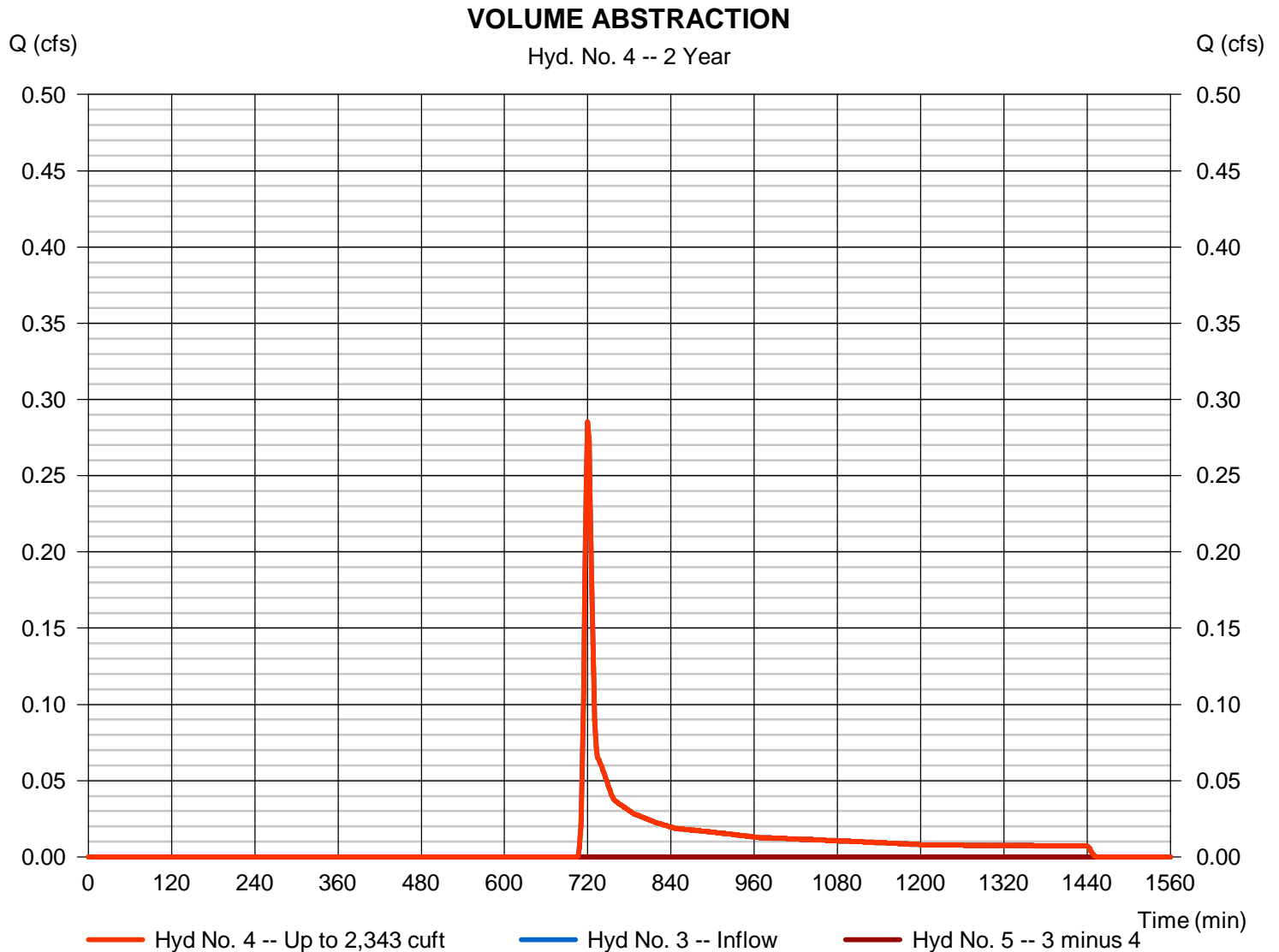
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.285 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 811 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

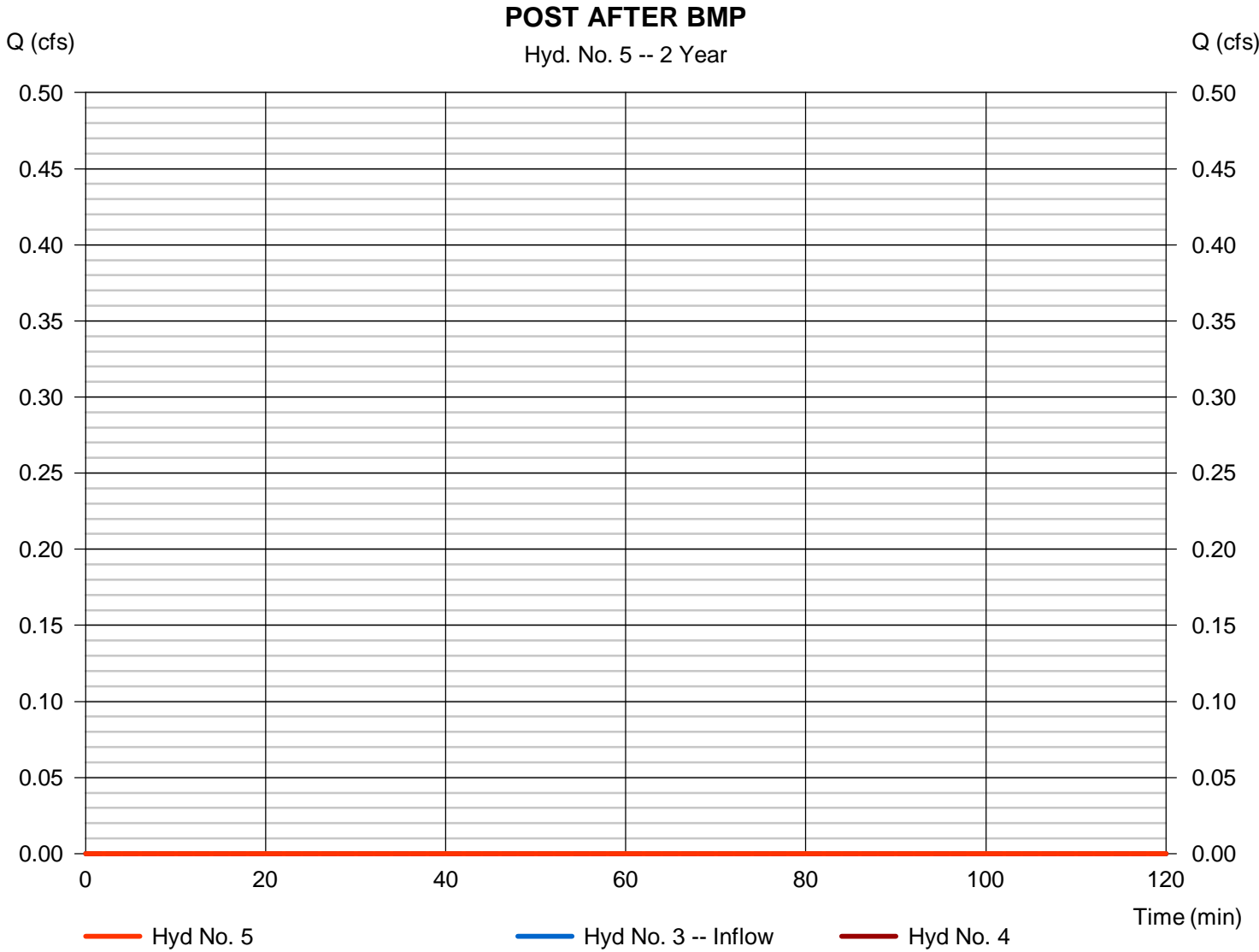
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 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	= 2,343 cuft



Hydrograph Report

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

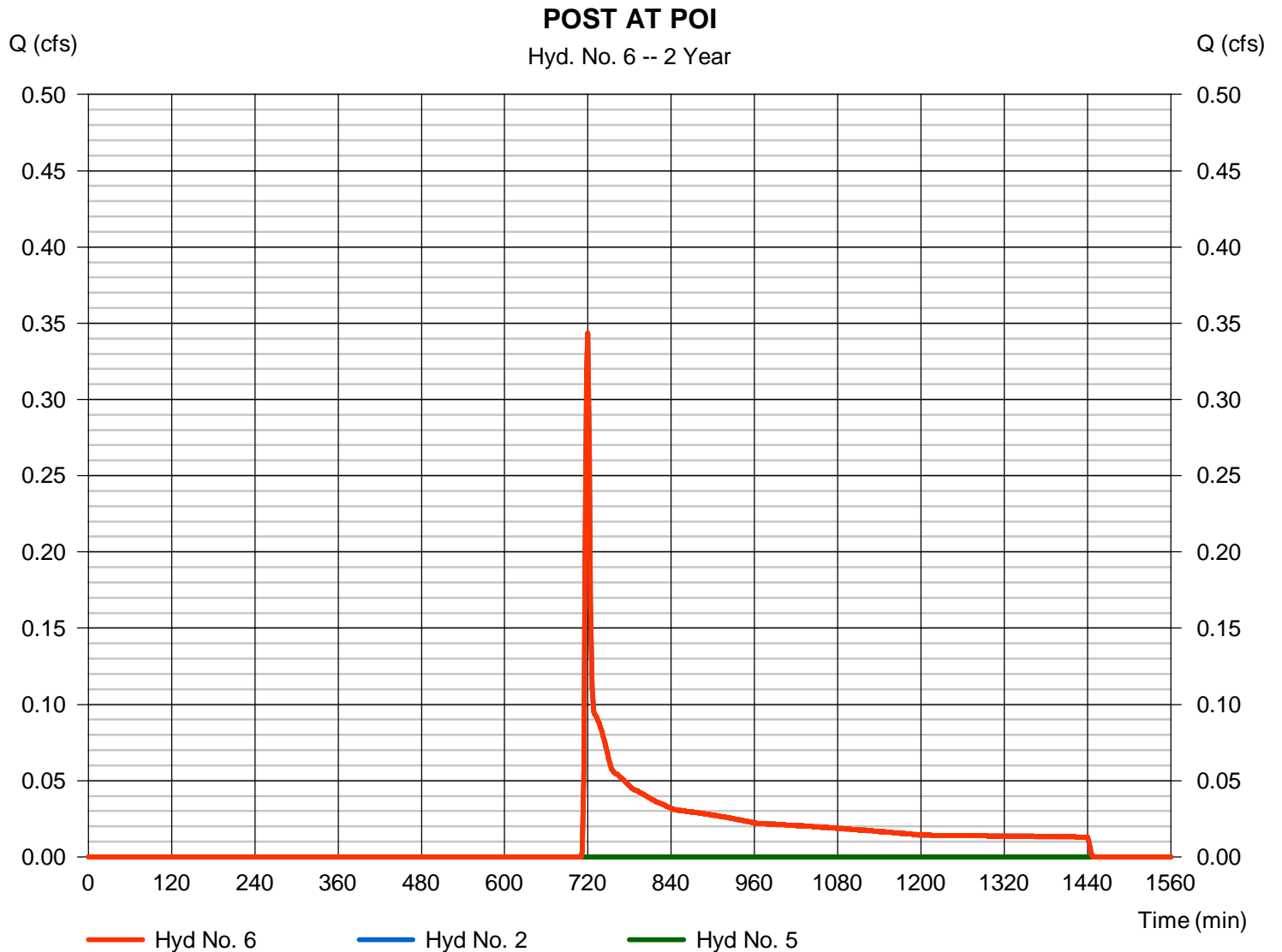
Wednesday, 11 / 9 / 2016

Hyd. No. 6

POST AT POI

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

Peak discharge = 0.344 cfs
Time to peak = 720 min
Hyd. volume = 1,185 cuft
Contrib. drain. area = 1.320 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	2.571	2	718	5,480	-----	-----	-----	PRE	
2	SCS Runoff	1.875	2	718	3,996	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	0.943	2	720	2,219	-----	-----	-----	POST DETAINED	
4	Diversion1	0.943	2	720	2,219	3	-----	-----	VOLUME ABSTRACTION	
5	Diversion2	0.000	2	n/a	0	3	-----	-----	POST AFTER BMP	
6	Combine	1.875	2	718	3,996	2, 5	-----	-----	POST AT POI	
Gates Road.gpw					Return Period: 10 Year			Wednesday, 11 / 9 / 2016		

Hydrograph Report

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

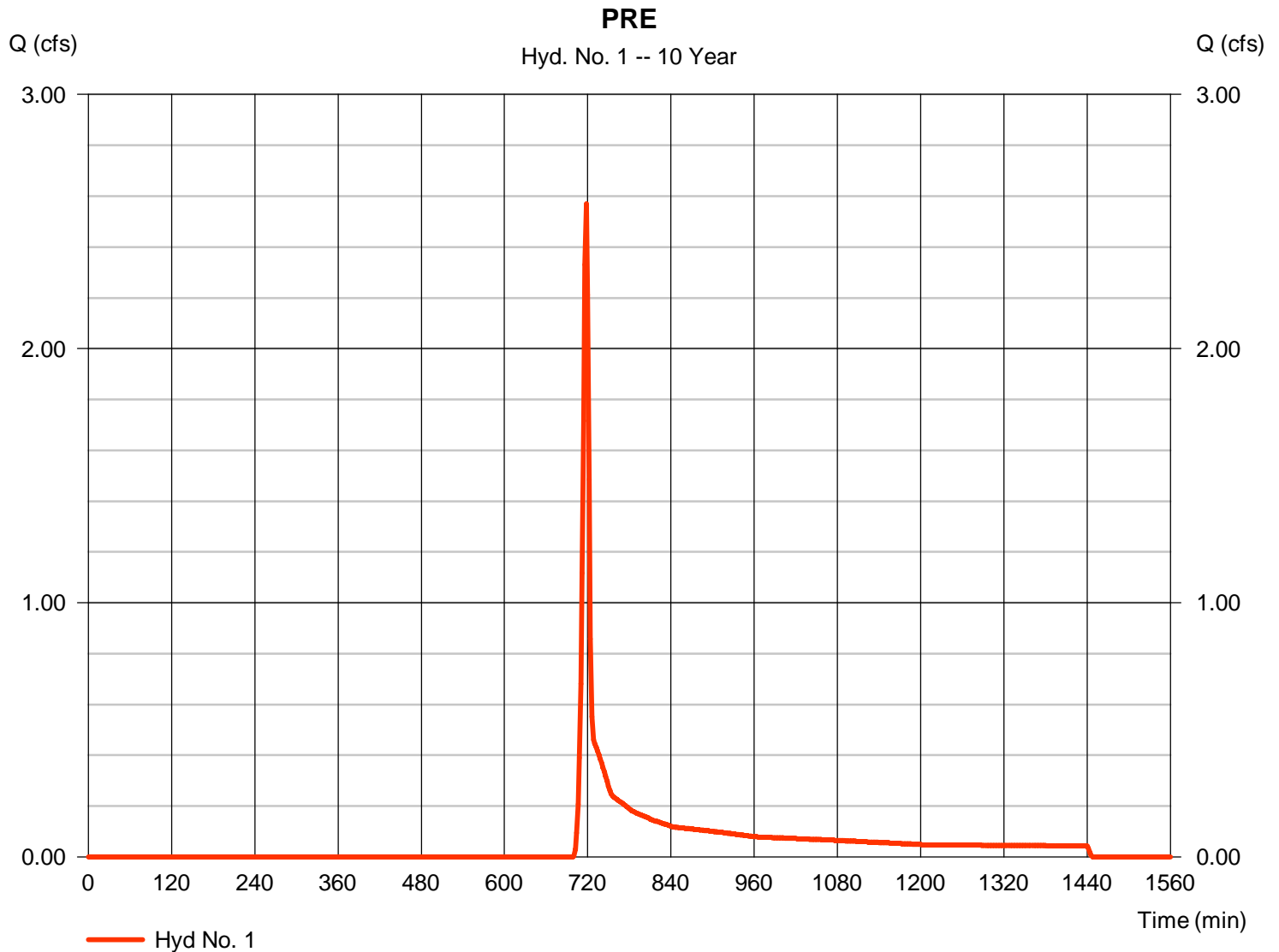
Wednesday, 11 / 9 / 2016

Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 2.571 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 5,480 cuft
Drainage area	= 1.810 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



Hydrograph Report

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

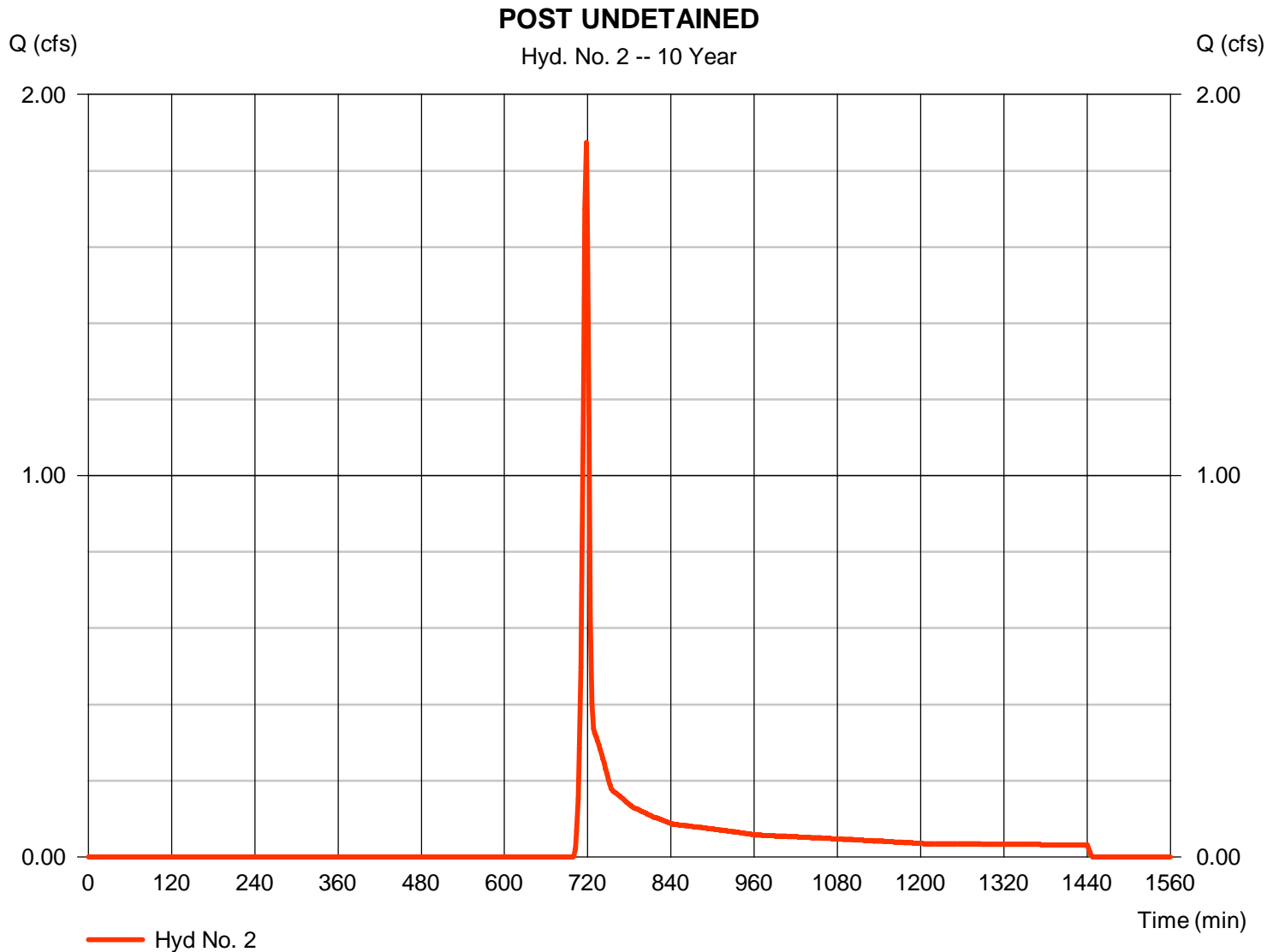
Wednesday, 11 / 9 / 2016

Hyd. No. 2

POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.875 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 3,996 cuft
Drainage area	= 1.320 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



Hydrograph Report

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

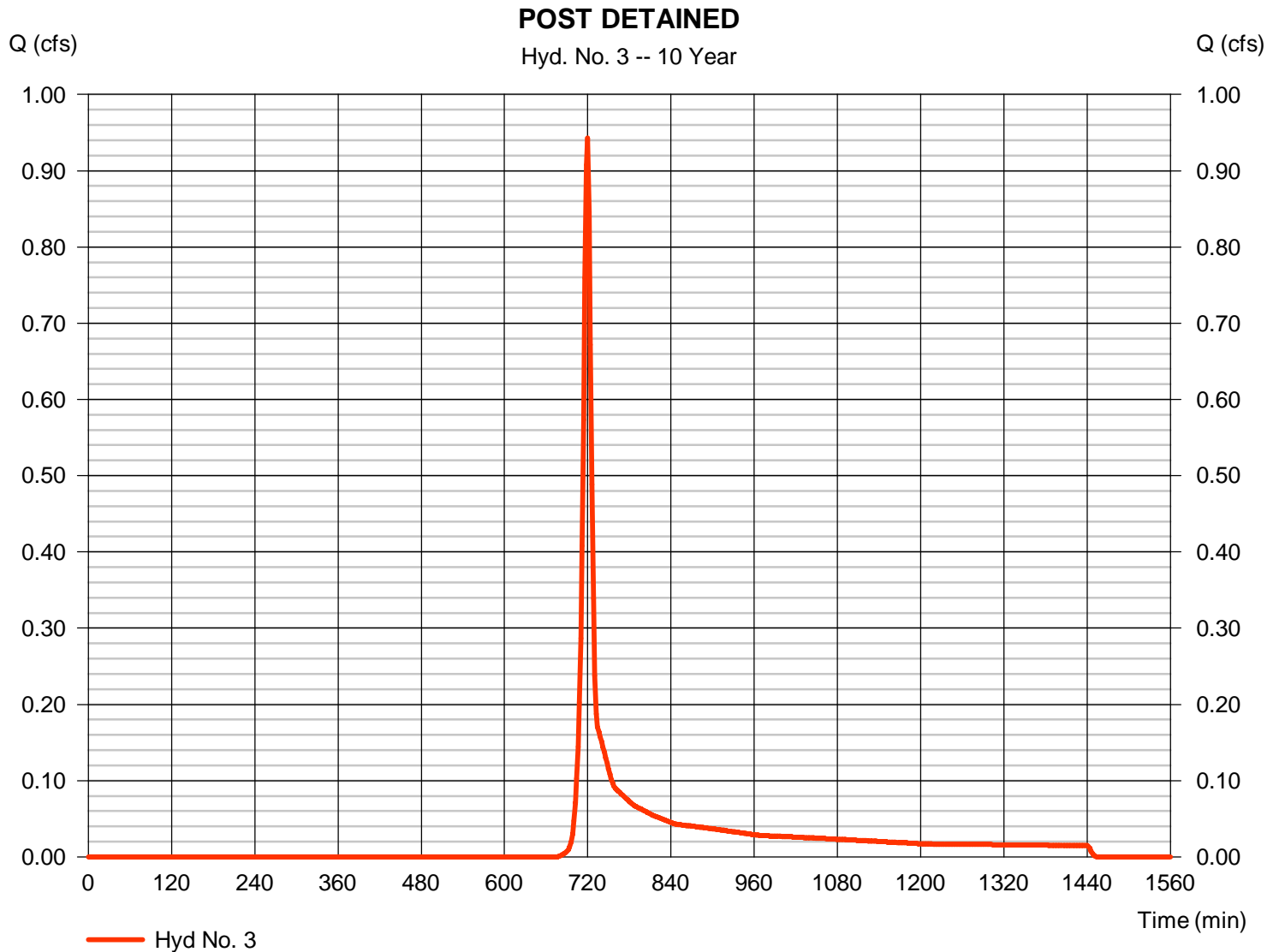
Wednesday, 11 / 9 / 2016

Hyd. No. 3

POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.943 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 2,219 cuft
Drainage area	= 0.490 ac	Curve number	= 64*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.00 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



Hydrograph Report

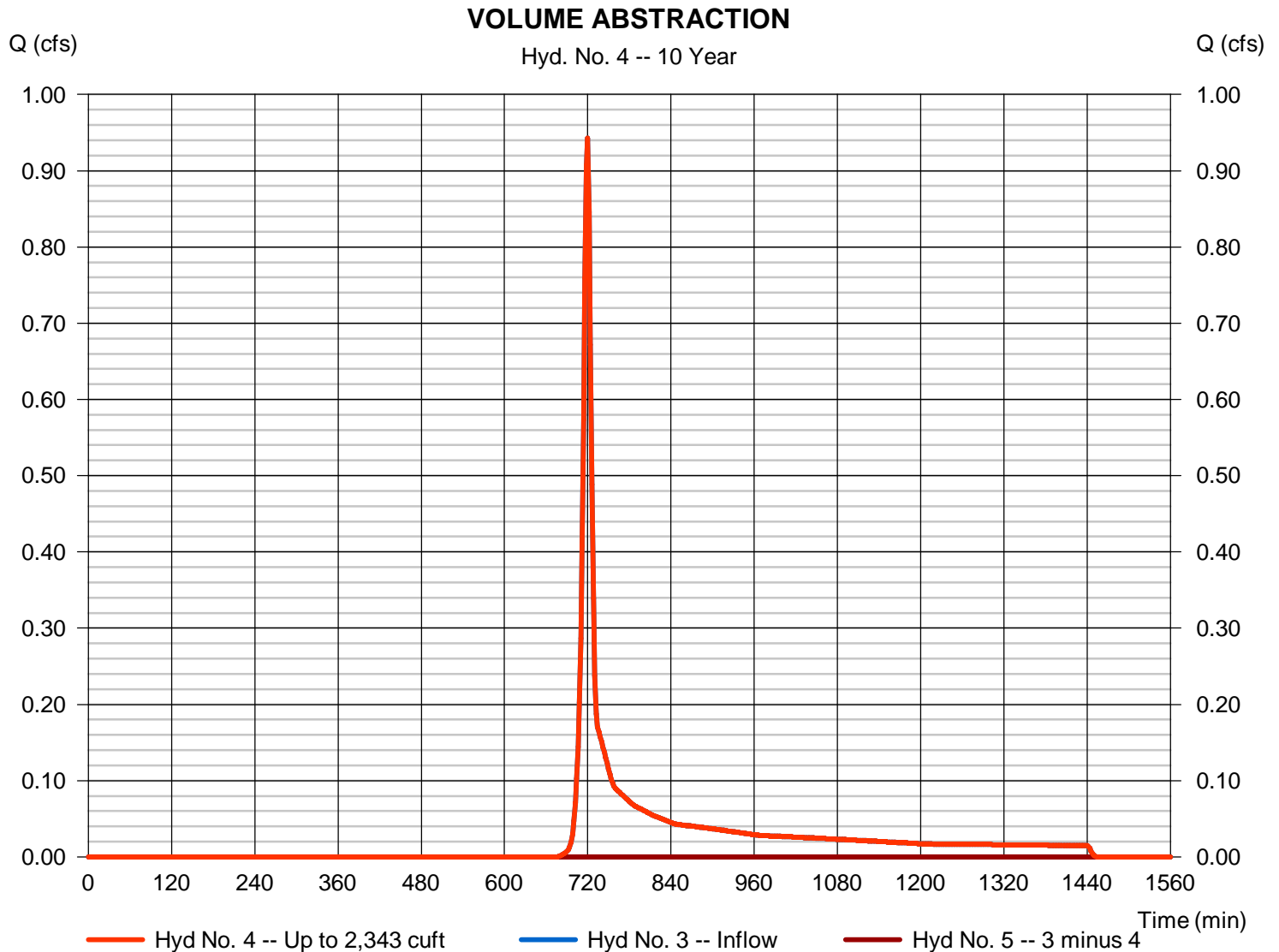
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.943 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 2,219 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

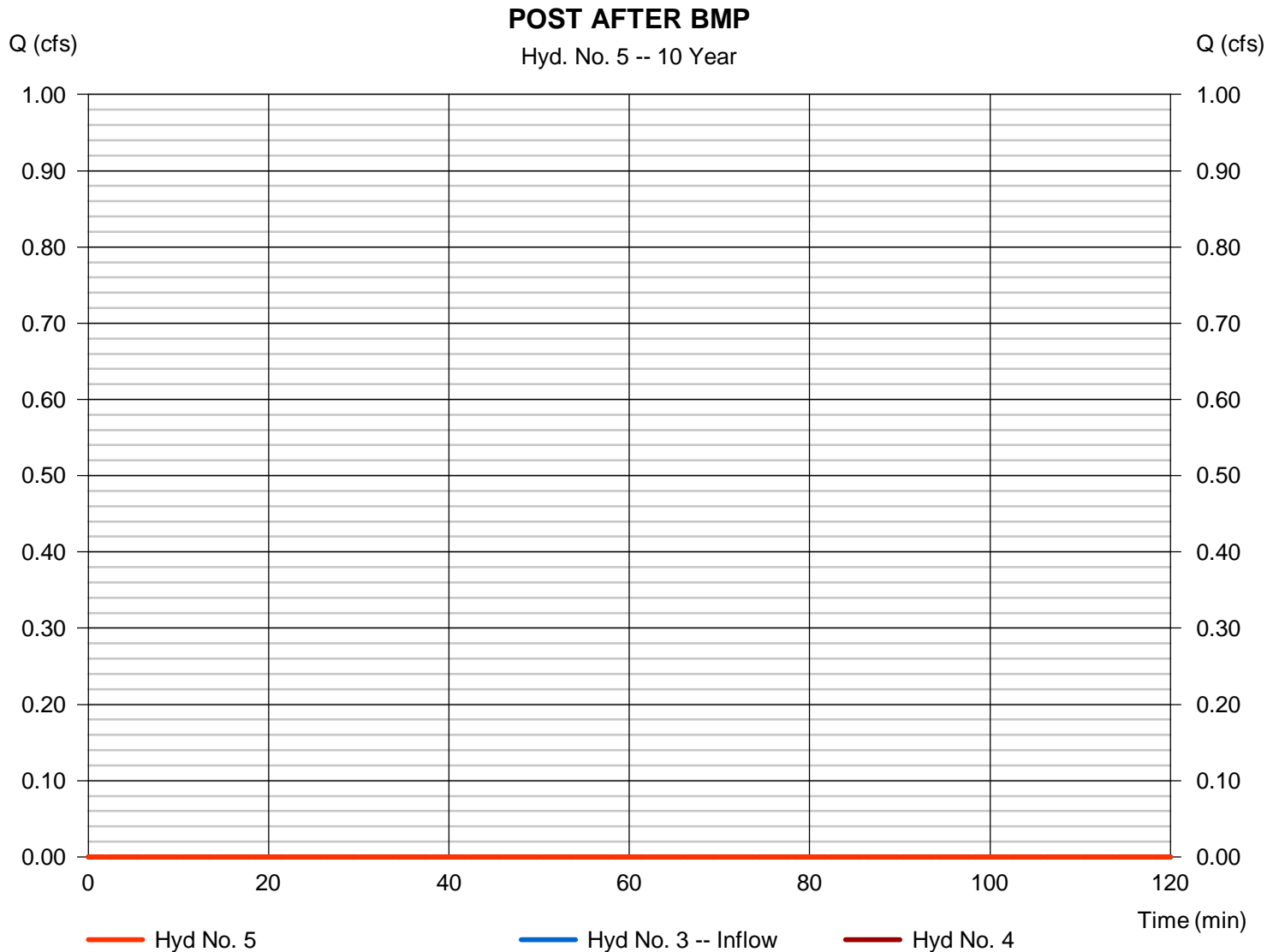
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

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	= 2,343 cuft



Hydrograph Report

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

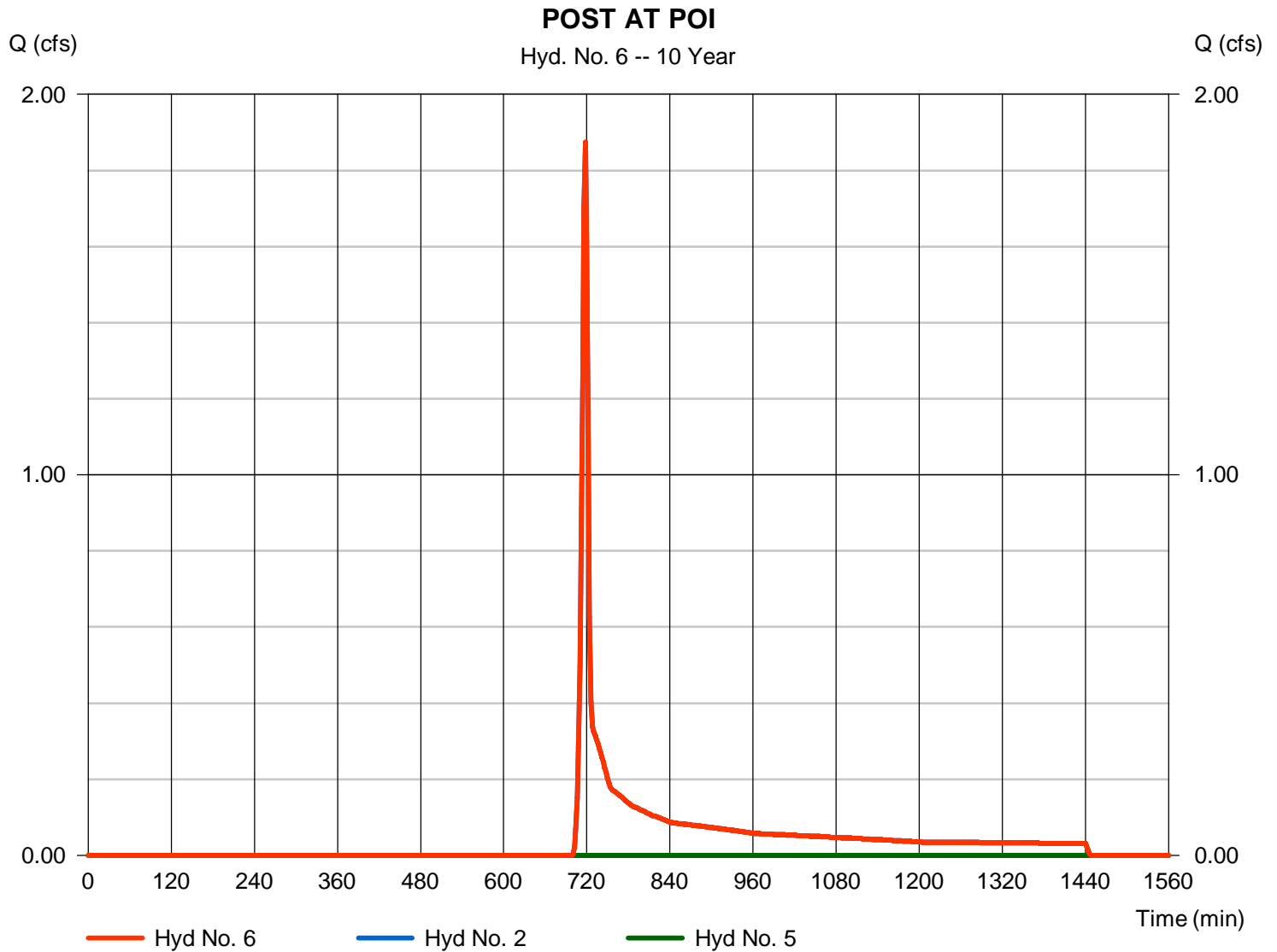
Wednesday, 11 / 9 / 2016

Hyd. No. 6

POST AT POI

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

Peak discharge = 1.875 cfs
Time to peak = 718 min
Hyd. volume = 3,996 cuft
Contrib. drain. area = 1.320 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	6.376	2	718	12,787	-----	-----	-----	PRE	
2	SCS Runoff	4.650	2	718	9,325	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	2.041	2	720	4,672	-----	-----	-----	POST DETAINED	
4	Diversion1	2.041	2	720	2,375	3	-----	-----	VOLUME ABSTRACTION	
5	Diversion2	0.266	2	744	2,297	3	-----	-----	POST AFTER BMP	
6	Combine	4.650	2	718	11,622	2, 5	-----	-----	POST AT POI	
Gates Road.gpw					Return Period: 50 Year			Wednesday, 11 / 9 / 2016		

Hydrograph Report

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

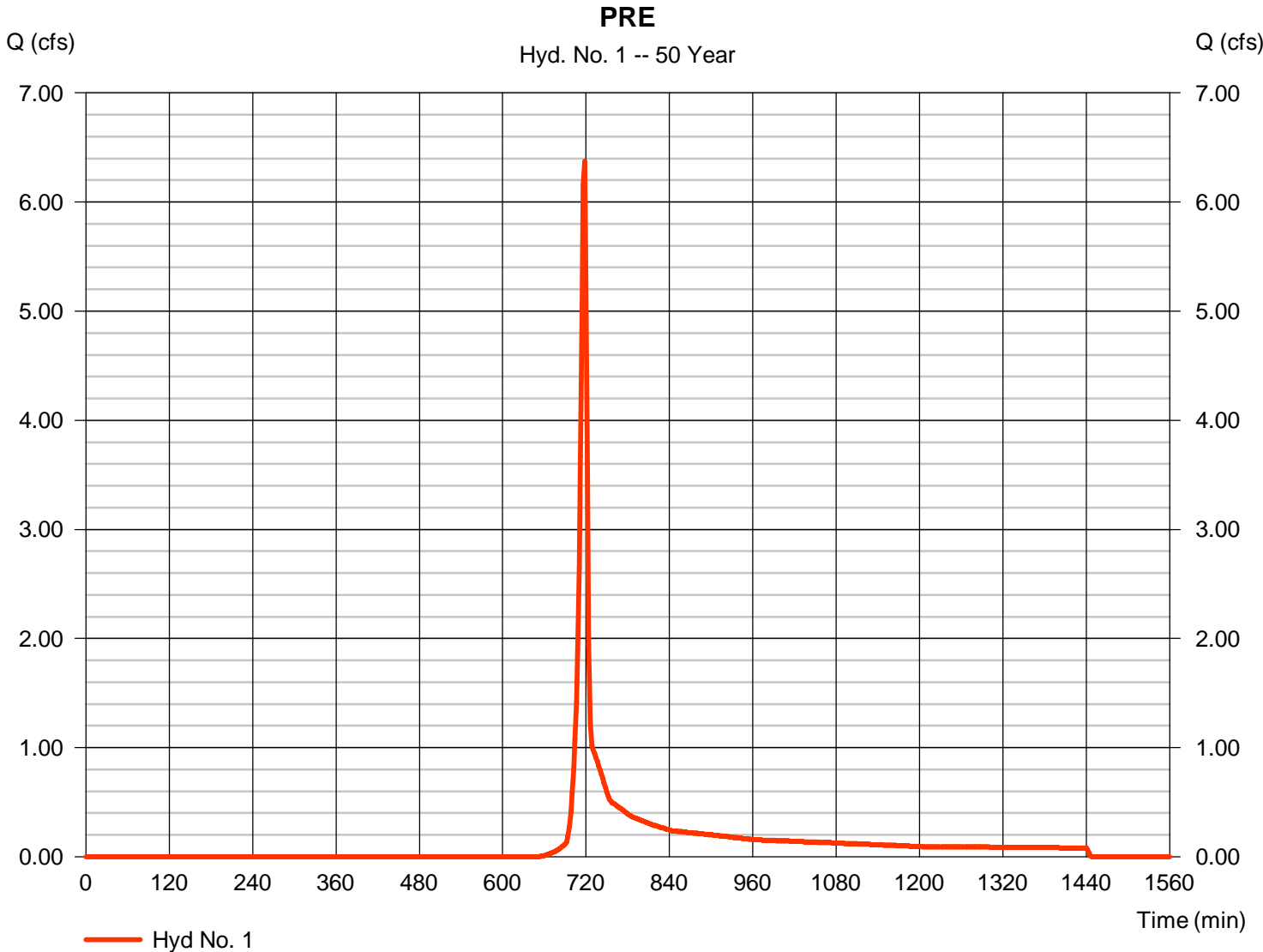
Wednesday, 11 / 9 / 2016

Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 6.376 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 12,787 cuft
Drainage area	= 1.810 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 6.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



Hydrograph Report

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

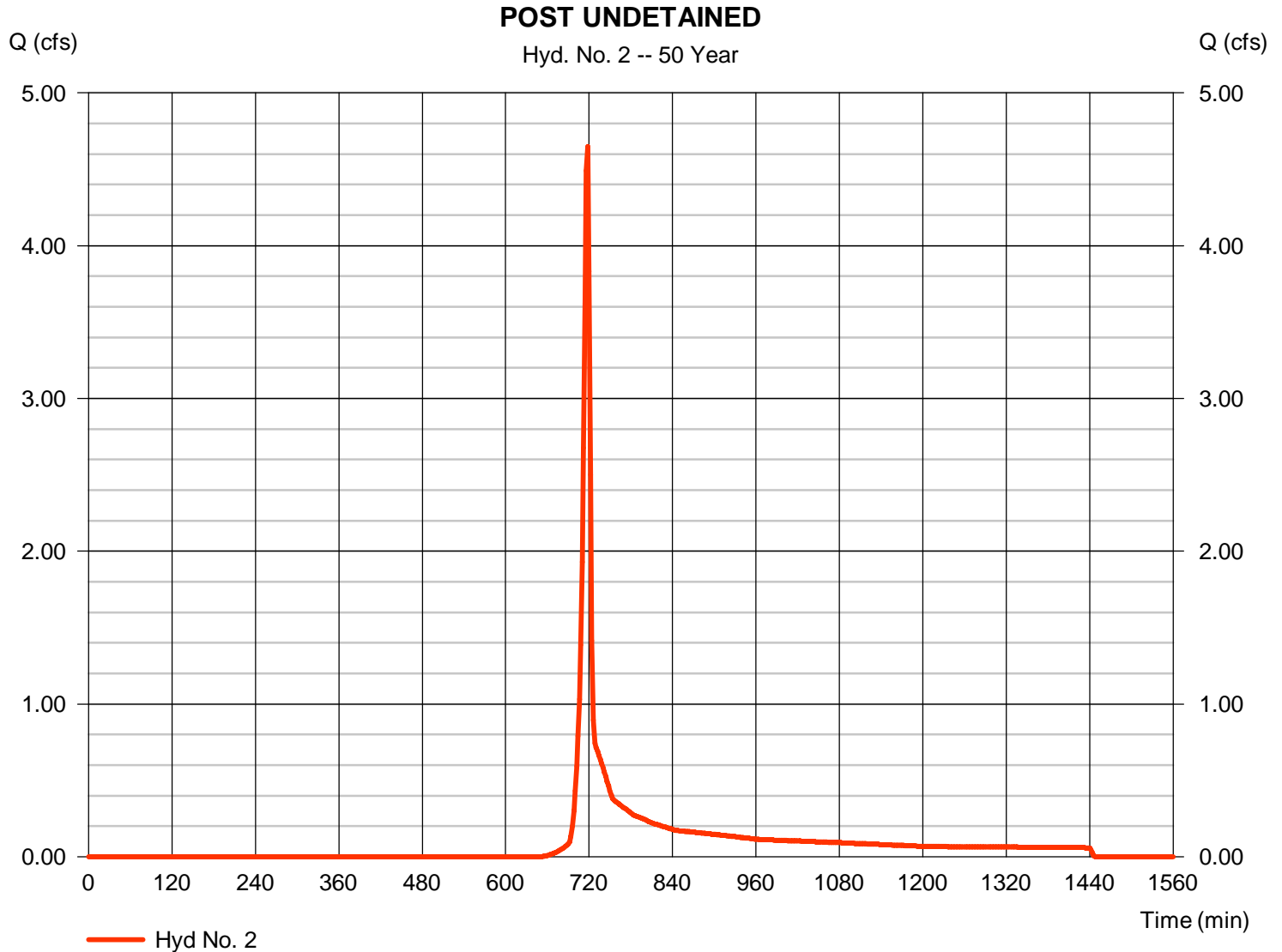
Wednesday, 11 / 9 / 2016

Hyd. No. 2

POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 4.650 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 9,325 cuft
Drainage area	= 1.320 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 6.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



Hydrograph Report

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

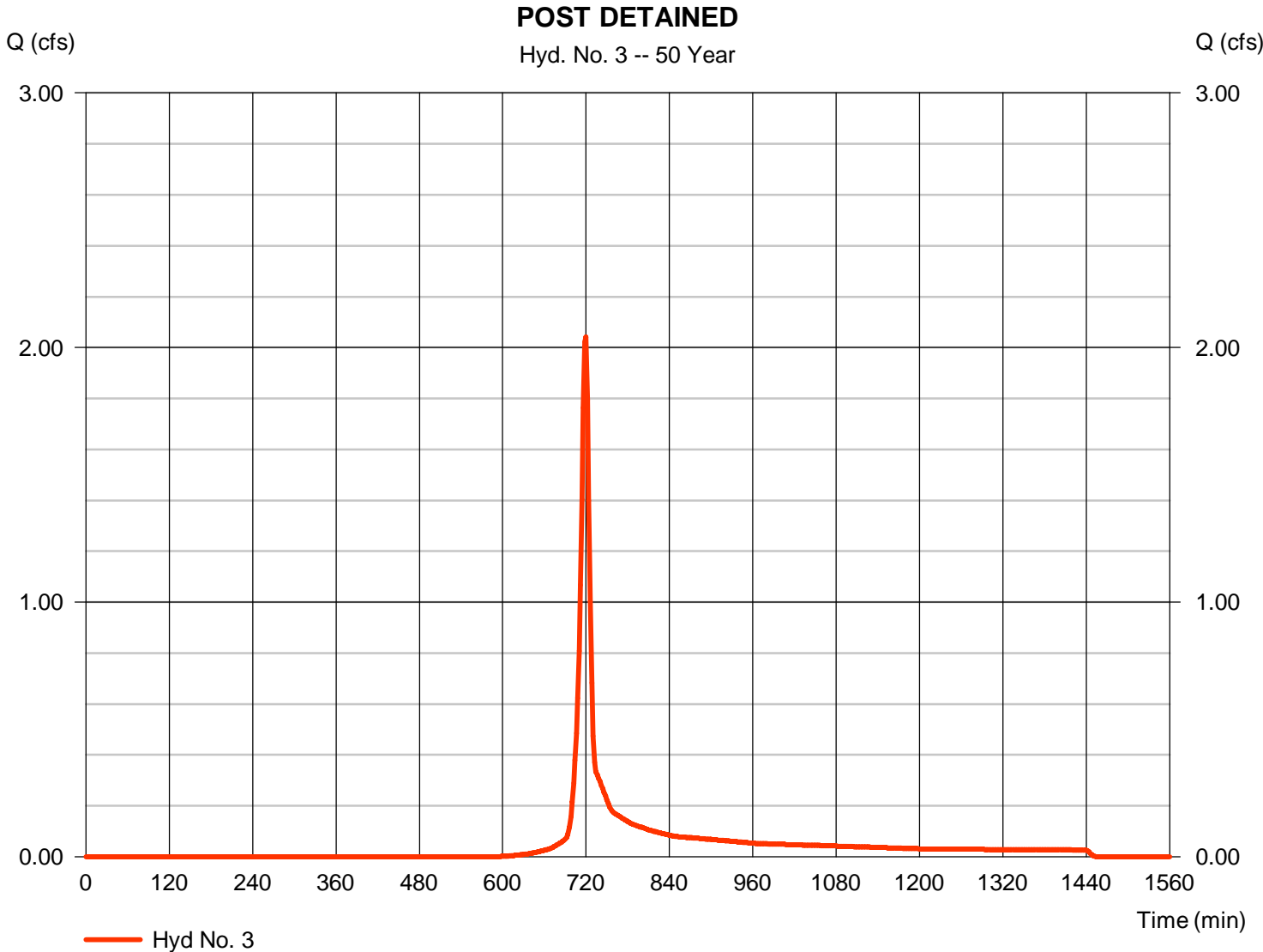
Wednesday, 11 / 9 / 2016

Hyd. No. 3

POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 2.041 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 4,672 cuft
Drainage area	= 0.490 ac	Curve number	= 64*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.00 min
Total precip.	= 6.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



Hydrograph Report

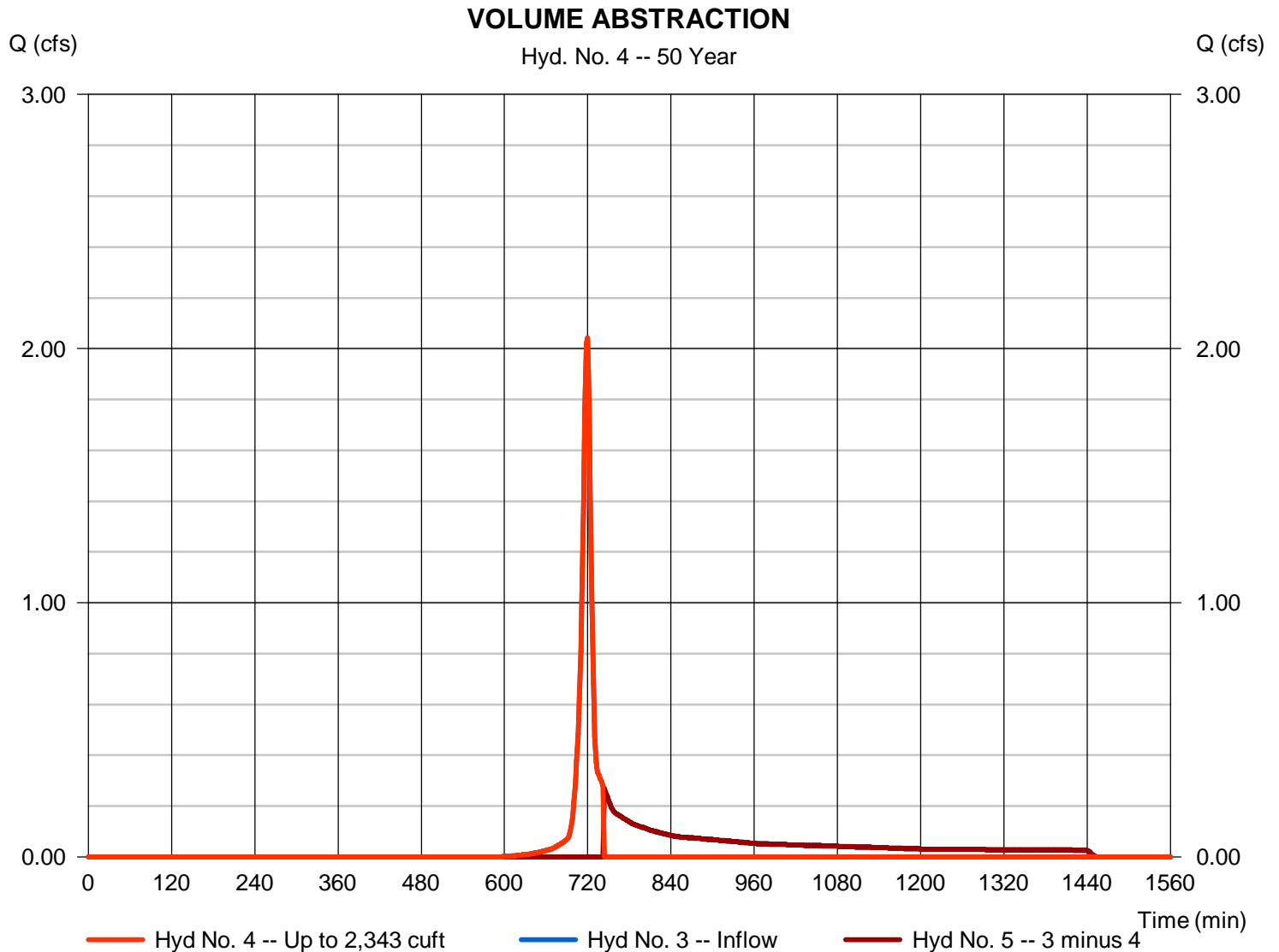
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 2.041 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 2,375 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

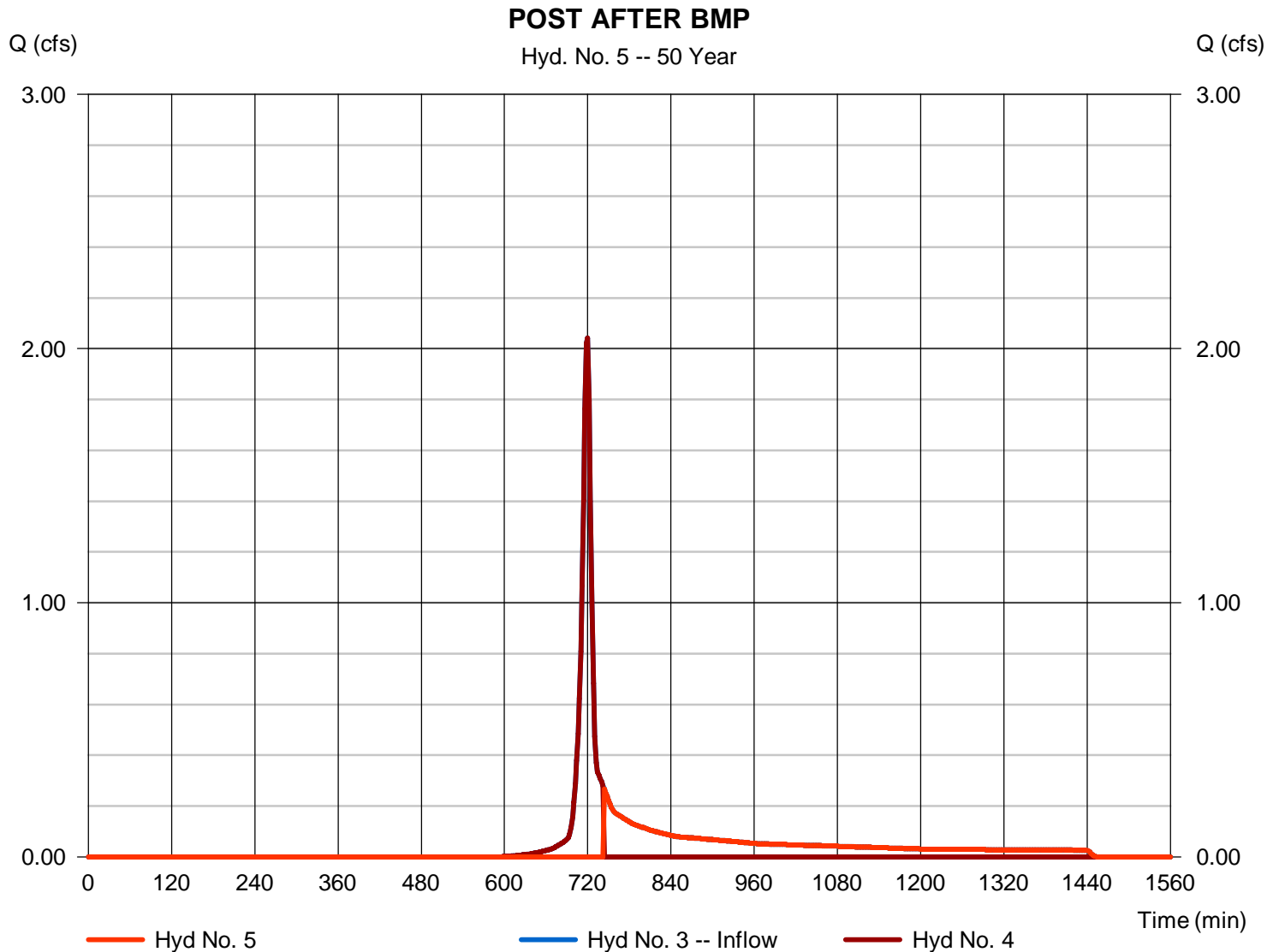
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.266 cfs
Storm frequency	= 50 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 2,297 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

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

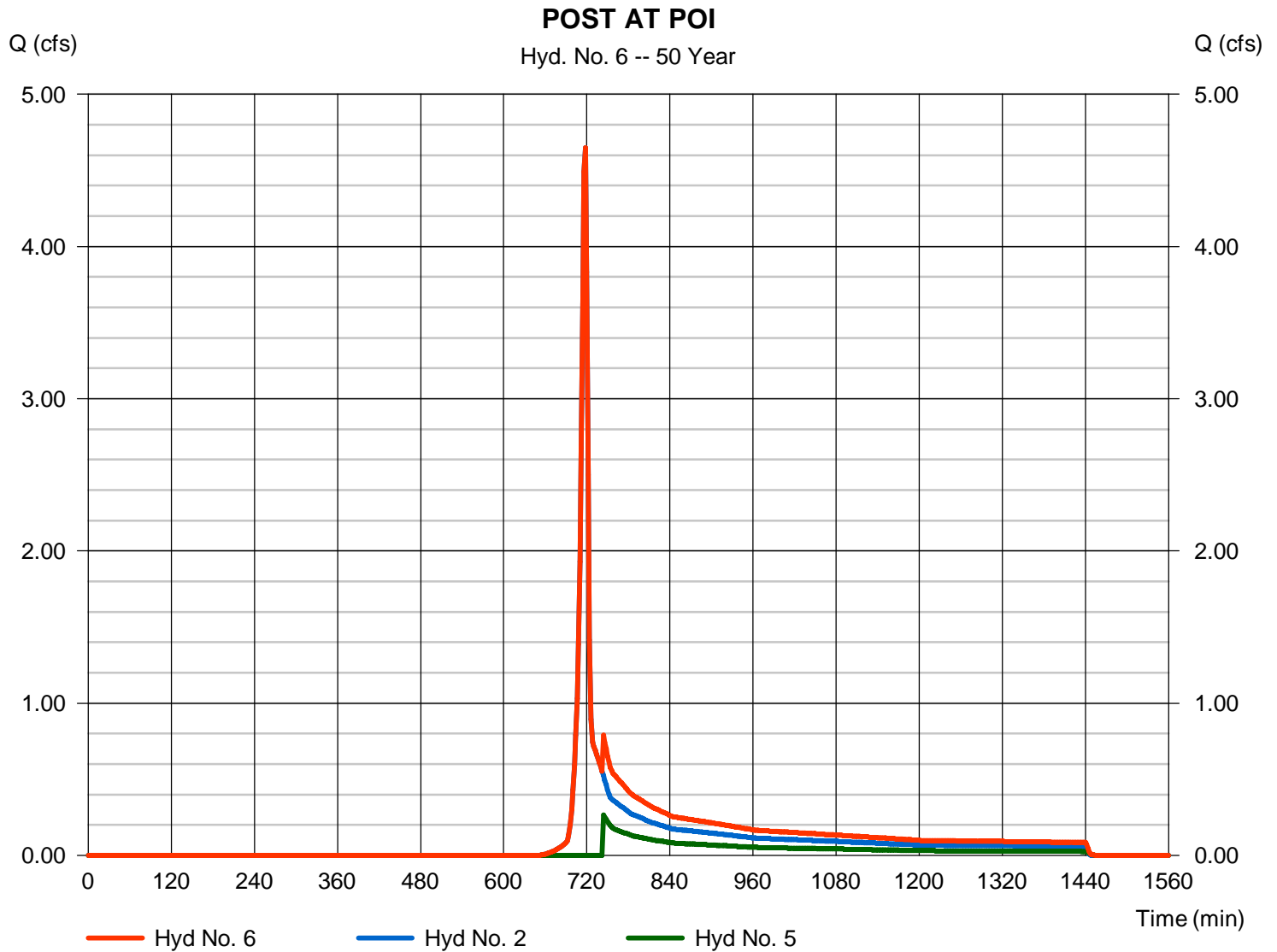
Wednesday, 11 / 9 / 2016

Hyd. No. 6

POST AT POI

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

Peak discharge = 4.650 cfs
Time to peak = 718 min
Hyd. volume = 11,622 cuft
Contrib. drain. area = 1.320 ac



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description	
1	SCS Runoff	8.660	2	718	17,318	-----	-----	-----	PRE	
2	SCS Runoff	6.316	2	718	12,629	-----	-----	-----	POST UNDETAINED	
3	SCS Runoff	2.678	2	720	6,135	-----	-----	-----	POST DETAINED	
4	Diversion1	2.678	2	720	2,415	3	-----	-----	VOLUME ABSTRACTION	
5	Diversion2	1.817	2	724	3,720	3	-----	-----	POST AFTER BMP	
6	Combine	6.316	2	718	16,350	2, 5	-----	-----	POST AT POI	
Gates Road.gpw					Return Period: 100 Year			Wednesday, 11 / 9 / 2016		

Hydrograph Report

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

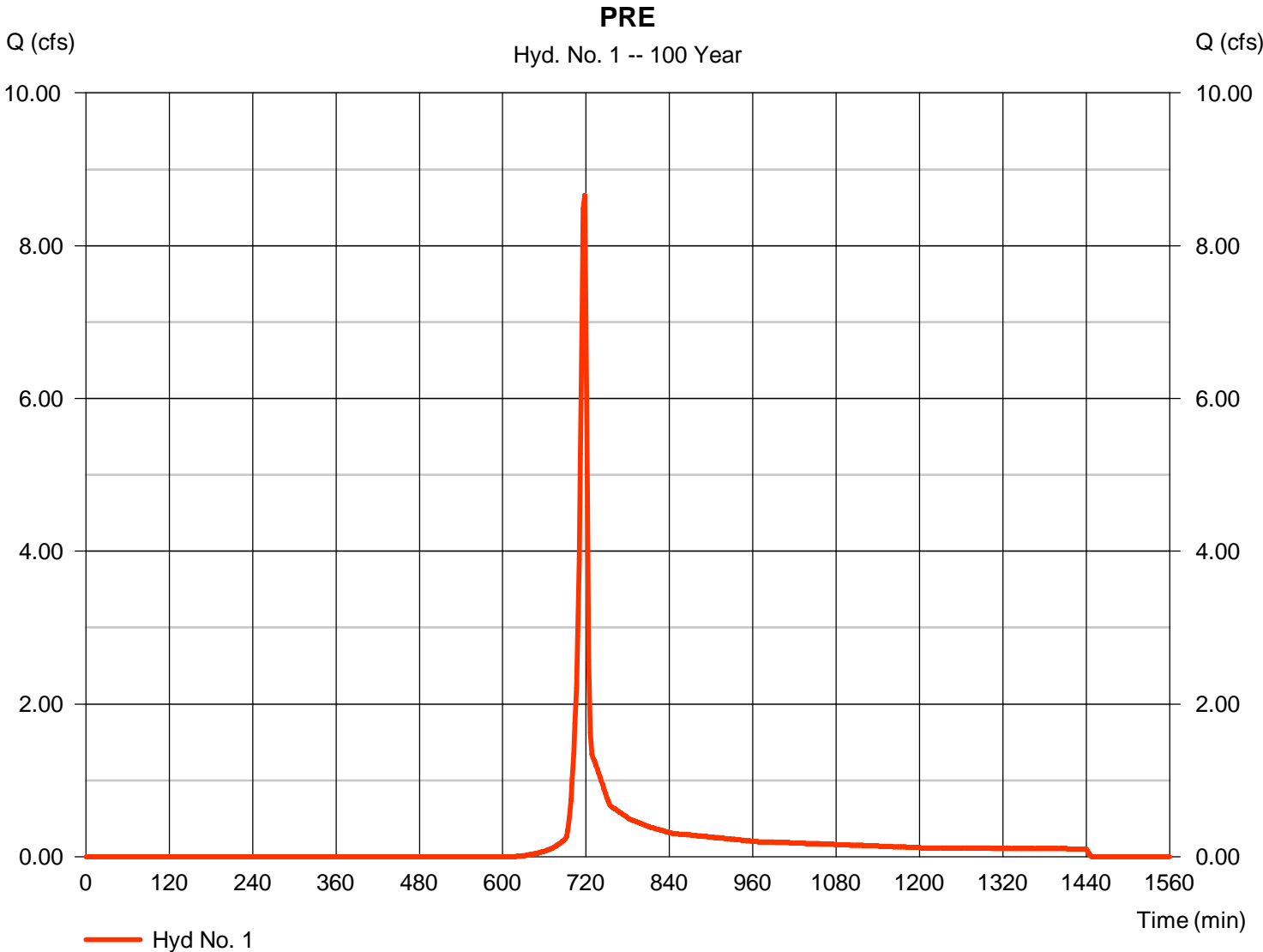
Wednesday, 11 / 9 / 2016

Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 8.660 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 17,318 cuft
Drainage area	= 1.810 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 7.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



Hydrograph Report

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

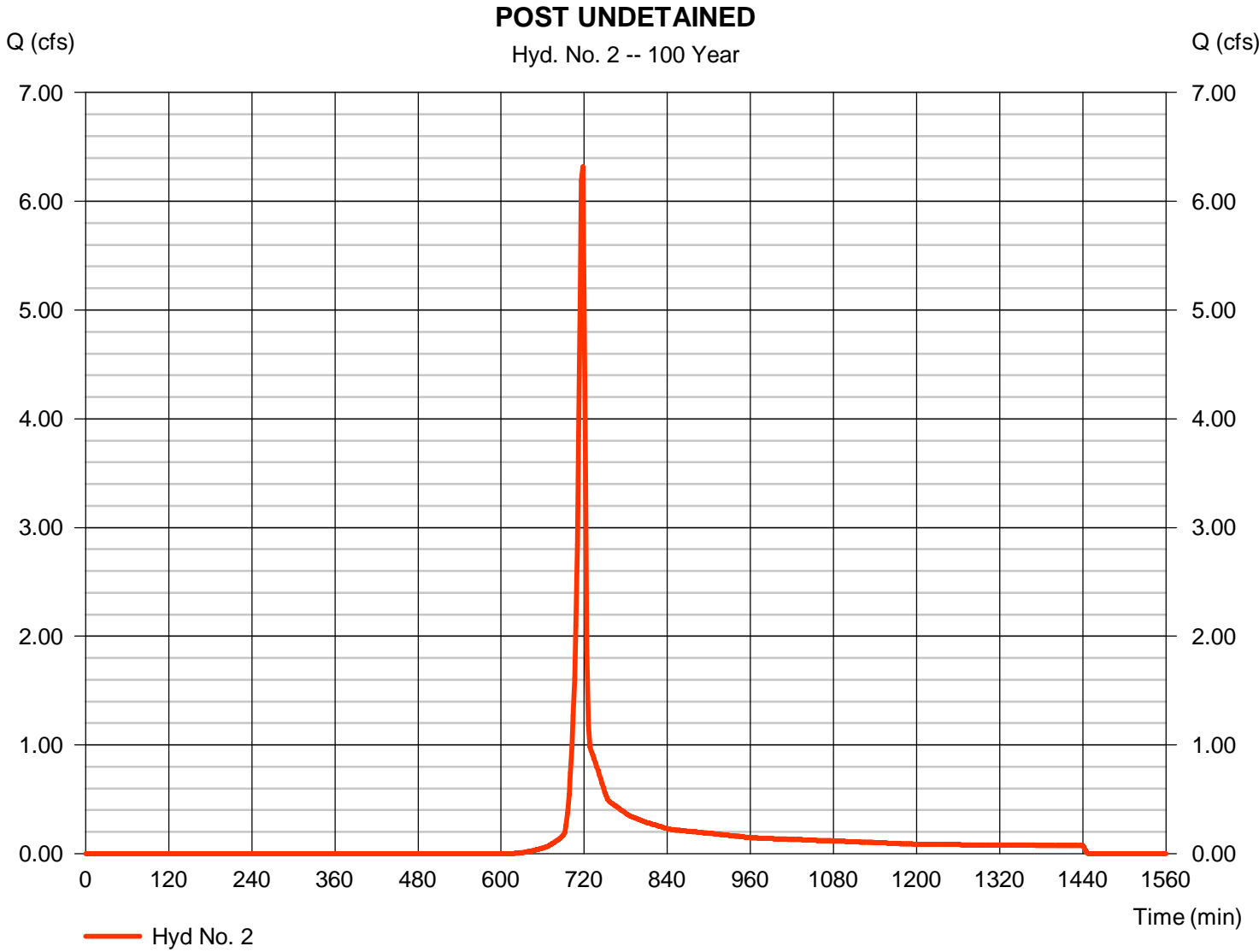
Wednesday, 11 / 9 / 2016

Hyd. No. 2

POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 6.316 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 12,629 cuft
Drainage area	= 1.320 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 7.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



Hydrograph Report

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

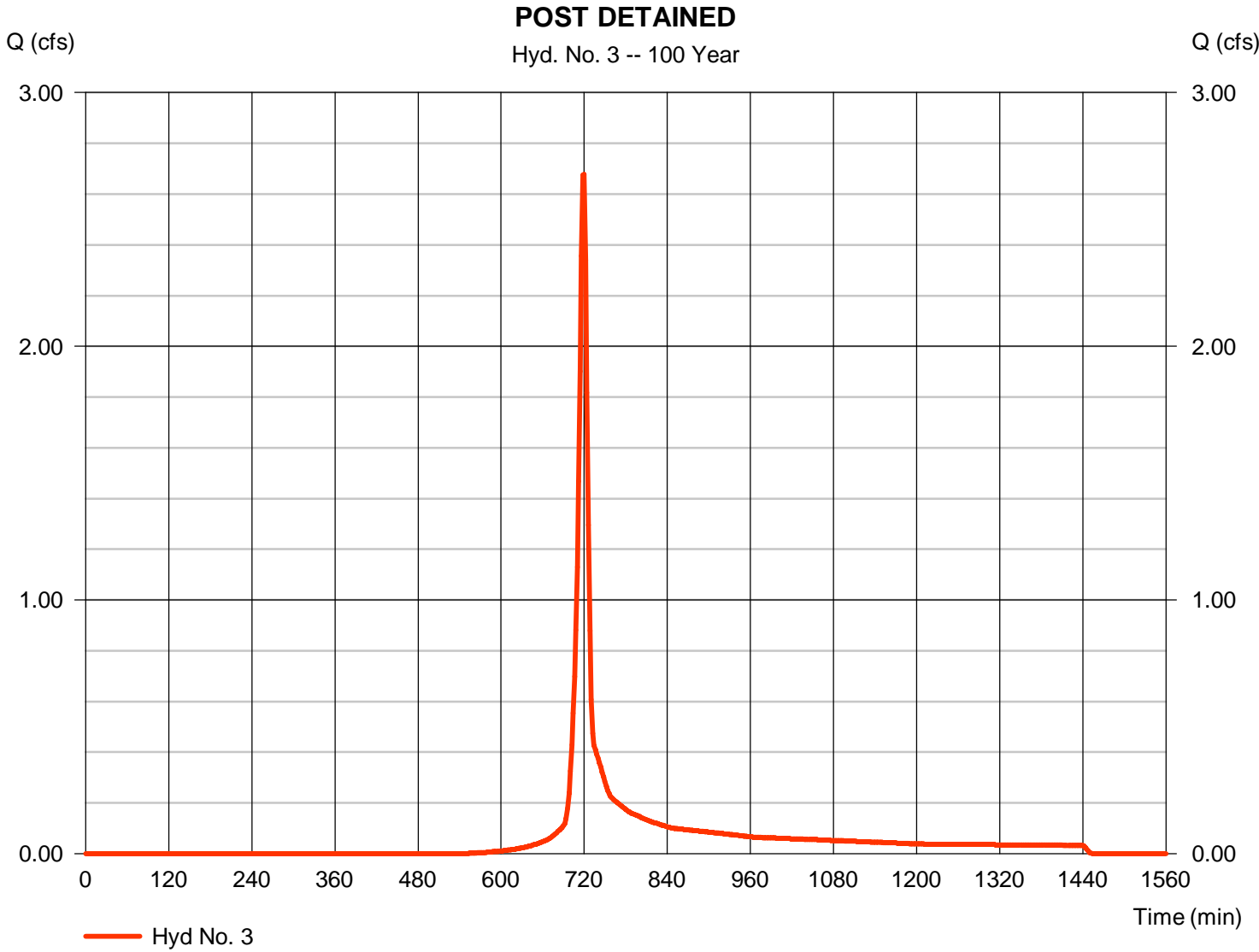
Wednesday, 11 / 9 / 2016

Hyd. No. 3

POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 2.678 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 6,135 cuft
Drainage area	= 0.490 ac	Curve number	= 64*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.00 min
Total precip.	= 7.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



Hydrograph Report

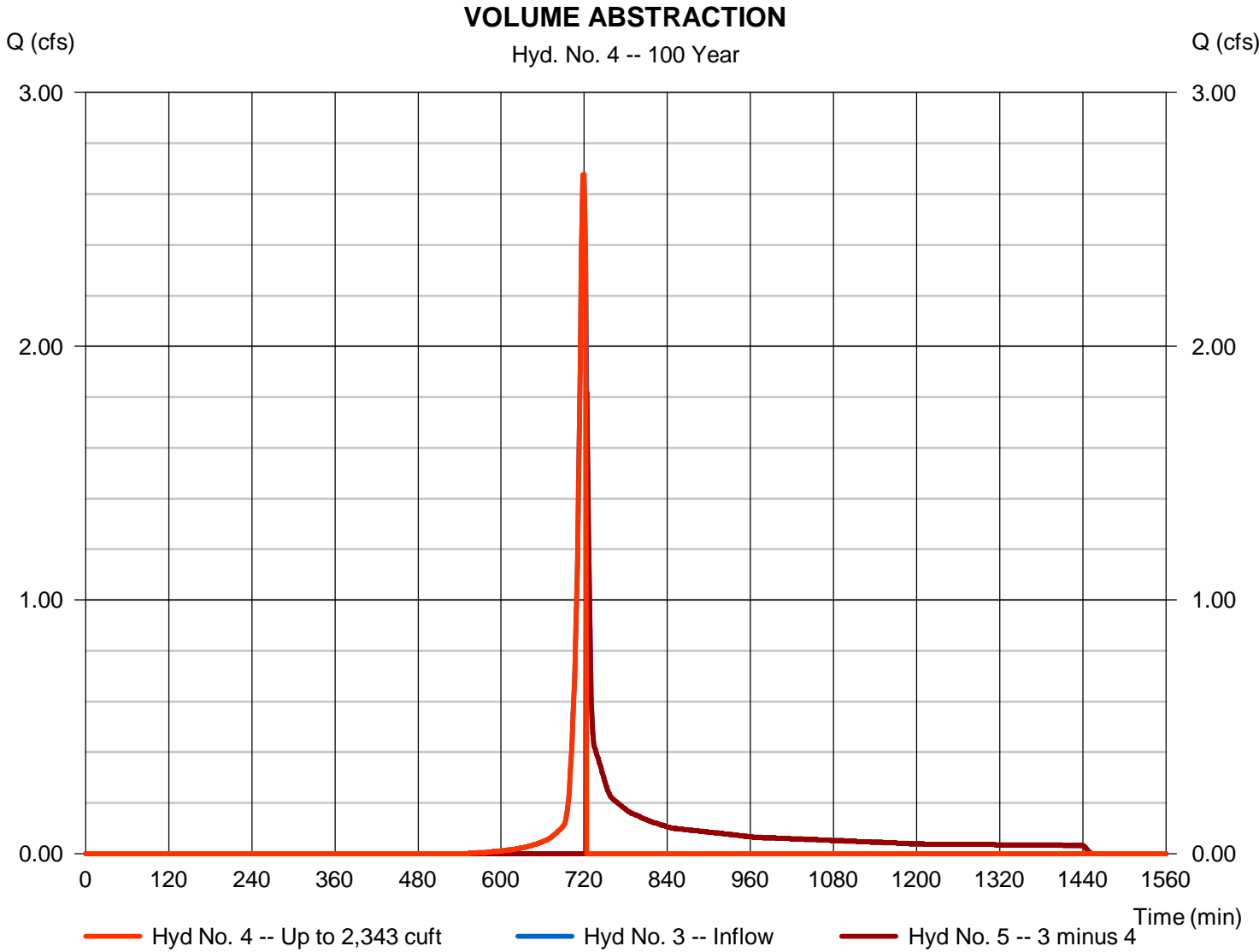
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 2.678 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 2,415 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

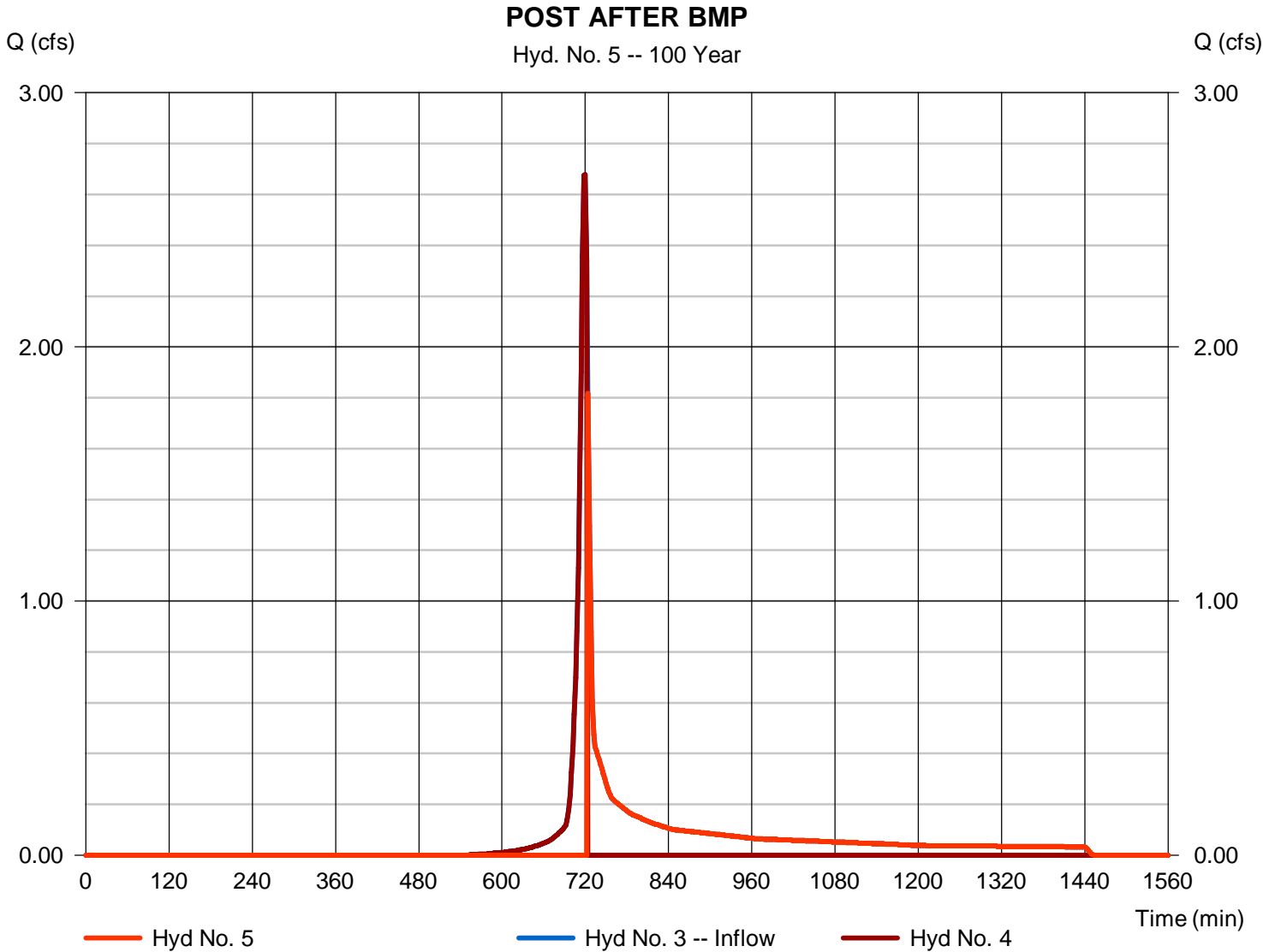
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 1.817 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 3,720 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

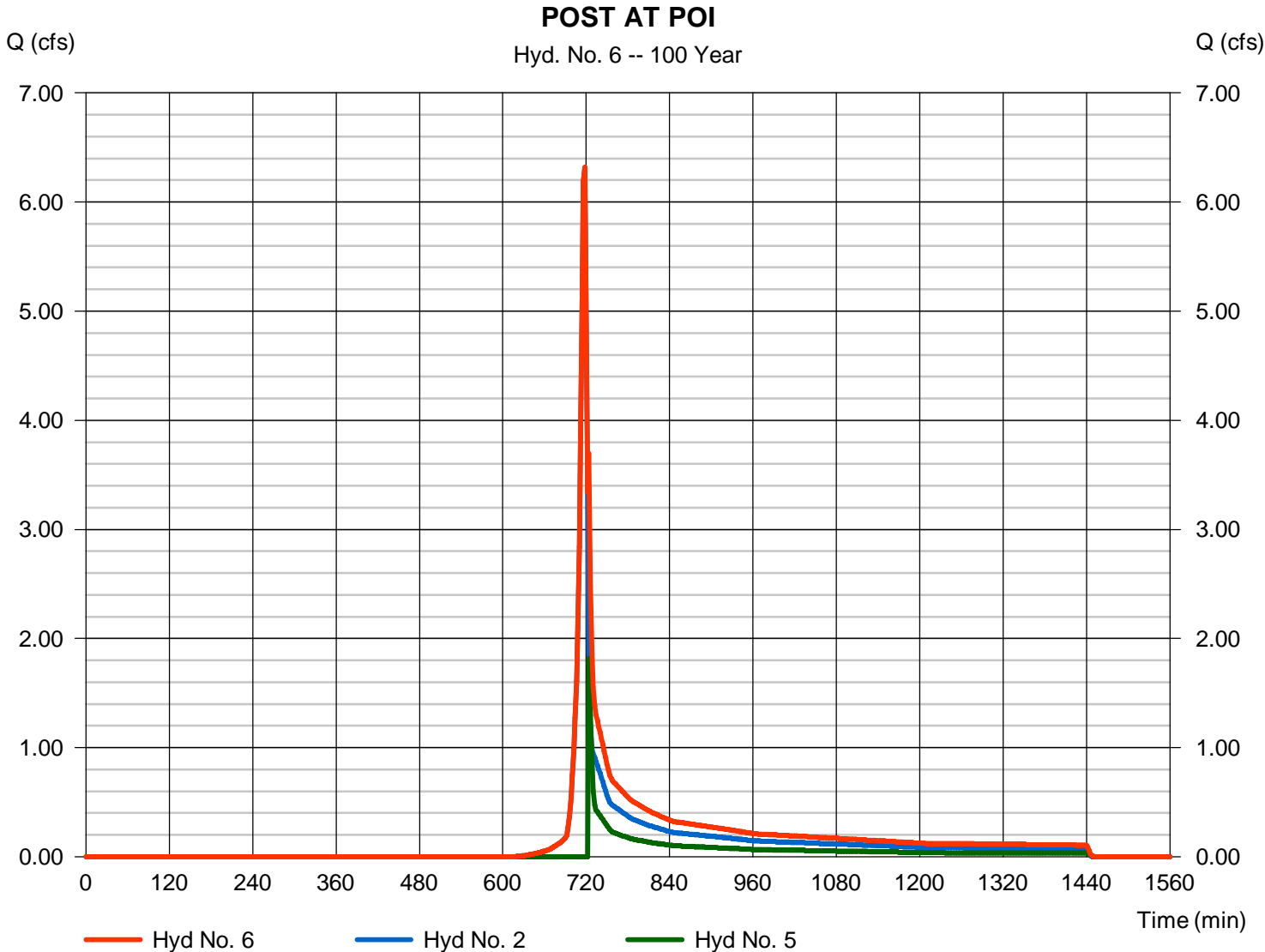
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 6

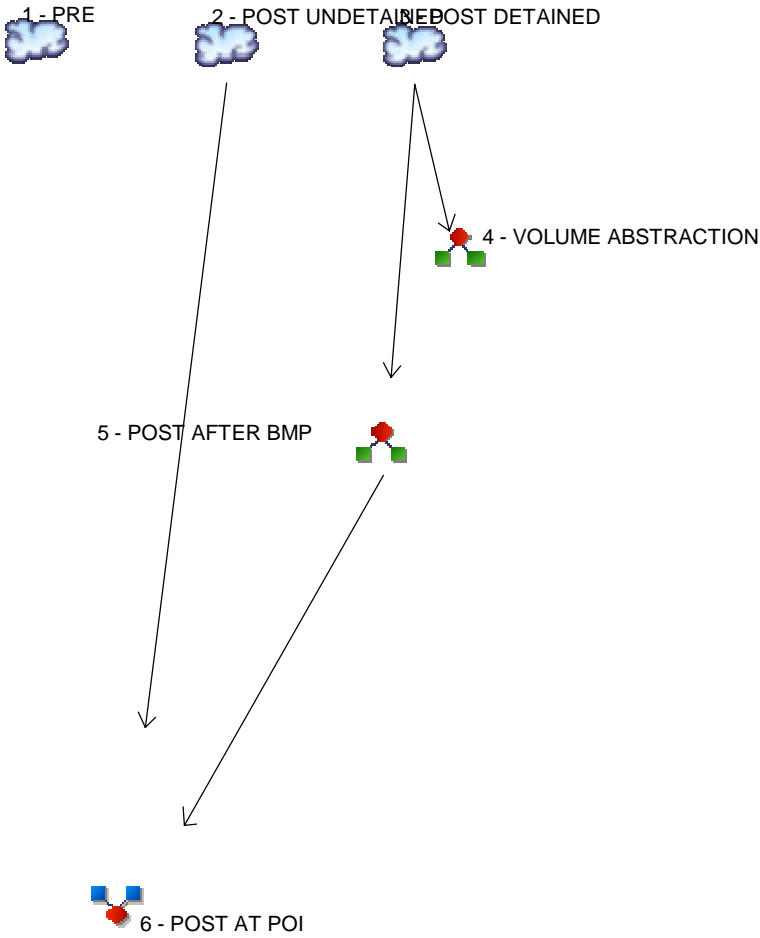
POST AT POI

Hydrograph type	= Combine	Peak discharge	= 6.316 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 16,350 cuft
Inflow hyds.	= 2, 5	Contrib. drain. area	= 1.320 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	-----	-----	0.471	-----	-----	-----	-----	-----	-----	PRE
2	SCS Runoff	-----	-----	0.344	-----	-----	-----	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	-----	-----	0.096	-----	-----	-----	-----	-----	-----	POST DETAINED
4	Diversion1	3	-----	0.096	-----	-----	-----	-----	-----	-----	VOLUME ABSTRACTION
5	Diversion2	3	-----	0.000	-----	-----	-----	-----	-----	-----	POST AFTER BMP
6	Combine	2, 5	-----	0.344	-----	-----	-----	-----	-----	-----	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	0.471	2	720	1,625	-----	-----	-----	PRE
2	SCS Runoff	0.344	2	720	1,185	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	0.096	2	748	811	-----	-----	-----	POST DETAINED
4	Diversion1	0.096	2	748	811	3	-----	-----	VOLUME ABSTRACTION
5	Diversion2	0.000	2	n/a	0	3	-----	-----	POST AFTER BMP
6	Combine	0.344	2	720	1,185	2, 5	-----	-----	POST AT POI

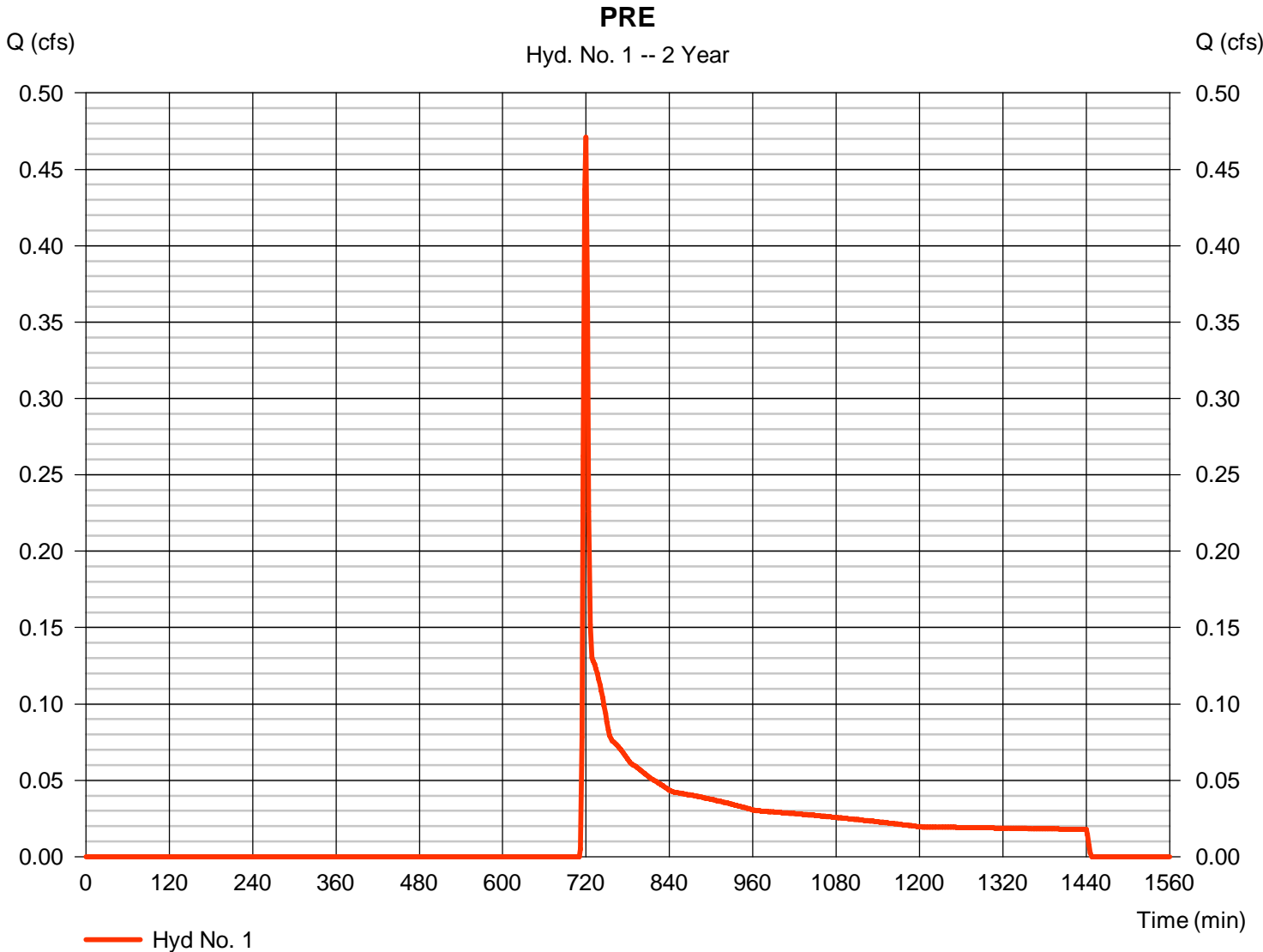
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 0.471 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 1,625 cuft
Drainage area	= 1.810 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 2.97 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



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>
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)	= 2.97	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 4.89	+ 0.00	+ 0.00	= 4.89
Shallow Concentrated Flow				
Flow length (ft)	= 173.00	22.00	123.00	
Watercourse slope (%)	= 9.10	1.60	4.50	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=4.87	2.04	3.42	
Travel Time (min)	= 0.59	+ 0.18	+ 0.60	= 1.37
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				6.30 min

Hydrograph Report

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

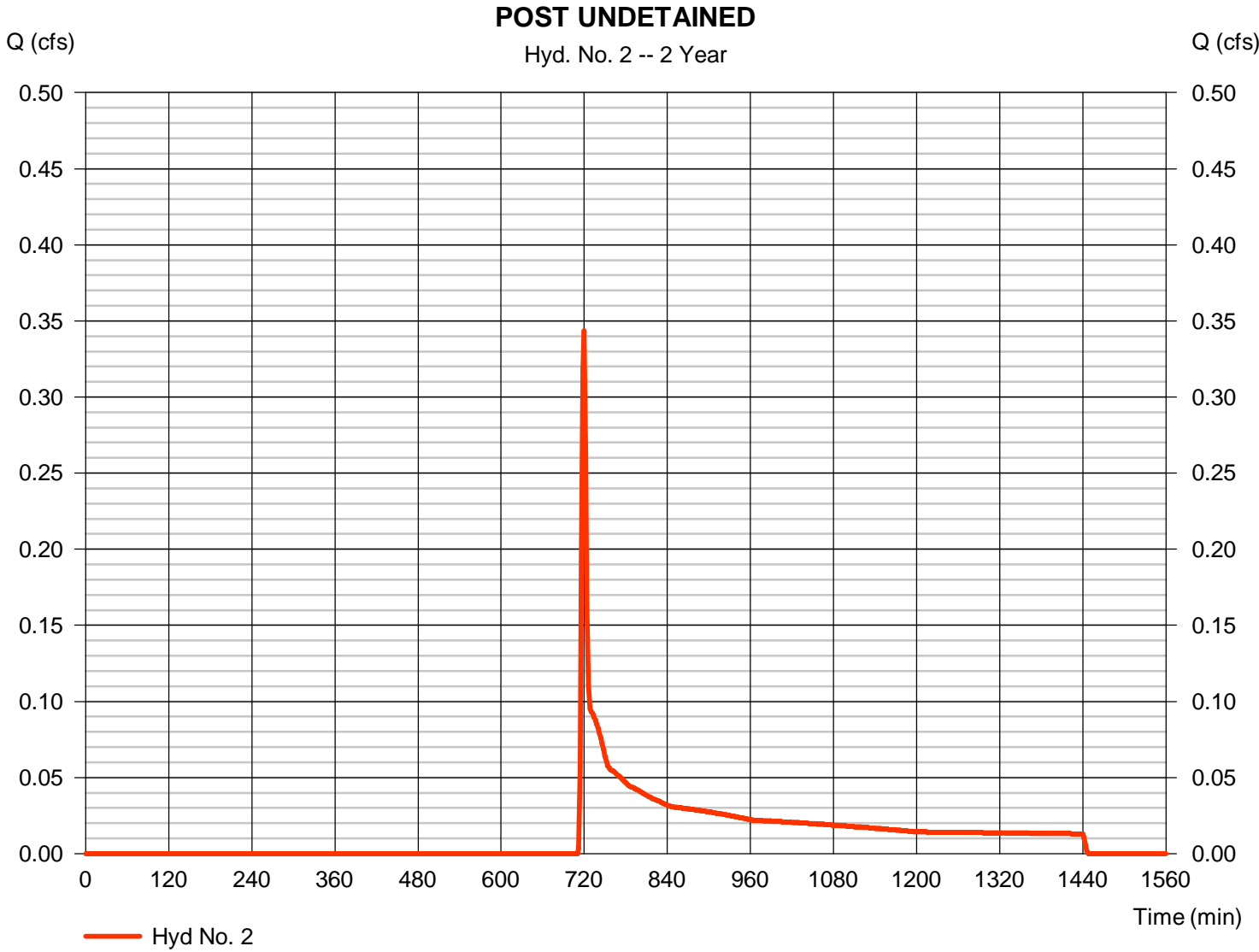
Wednesday, 11 / 9 / 2016

Hyd. No. 2

POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.344 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 1,185 cuft
Drainage area	= 1.320 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 2.97 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



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>
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)	= 2.97	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 4.89	+ 0.00	+ 0.00	= 4.89
Shallow Concentrated Flow				
Flow length (ft)	= 173.00	22.00	123.00	
Watercourse slope (%)	= 9.10	1.60	4.50	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=4.87	2.04	3.42	
Travel Time (min)	= 0.59	+ 0.18	+ 0.60	= 1.37
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				6.30 min

Hydrograph Report

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

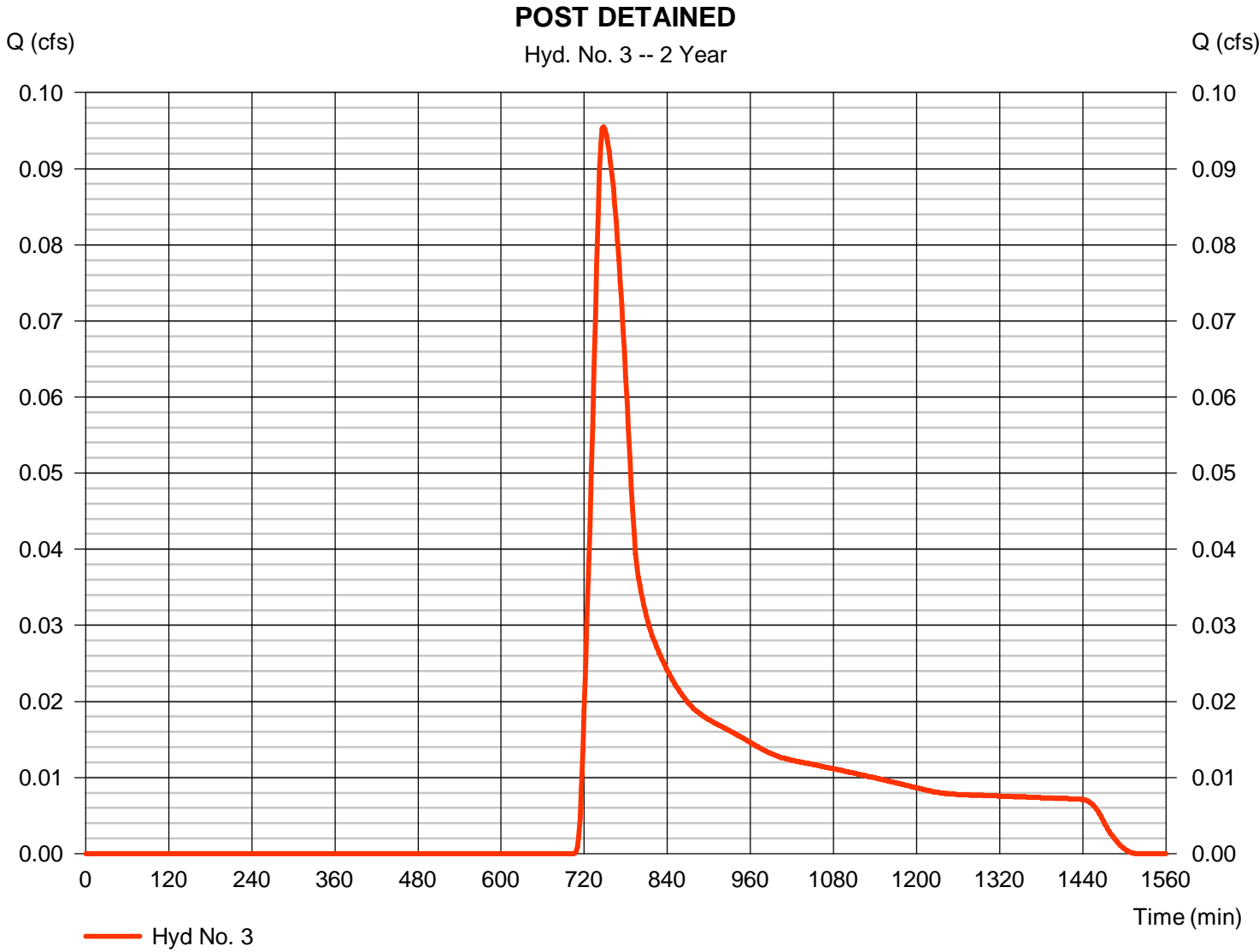
Wednesday, 11 / 9 / 2016

Hyd. No. 3

POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.096 cfs
Storm frequency	= 2 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 811 cuft
Drainage area	= 0.490 ac	Curve number	= 64*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 47.40 min
Total precip.	= 2.97 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



Hydrograph Report

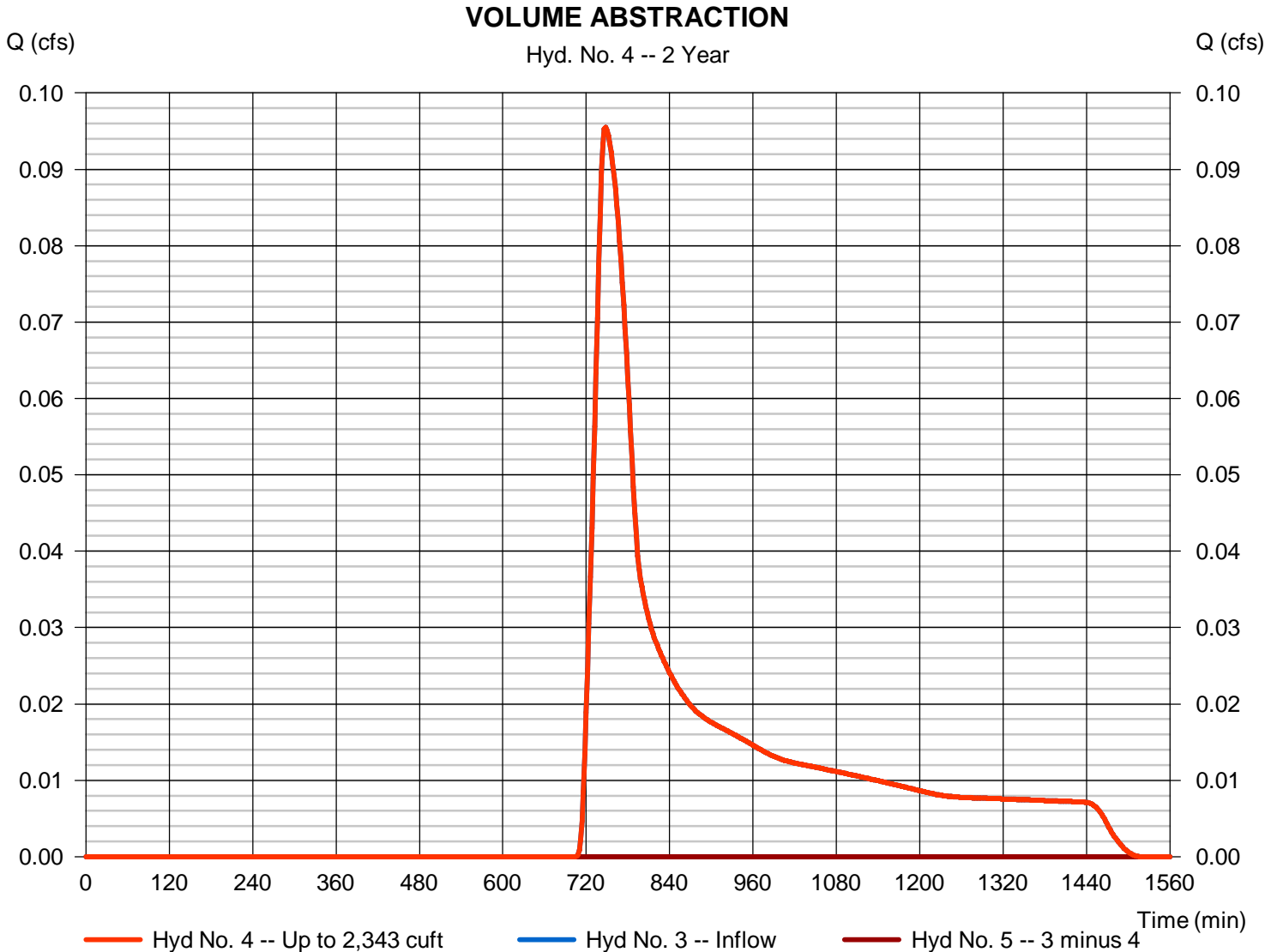
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.096 cfs
Storm frequency	= 2 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 811 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

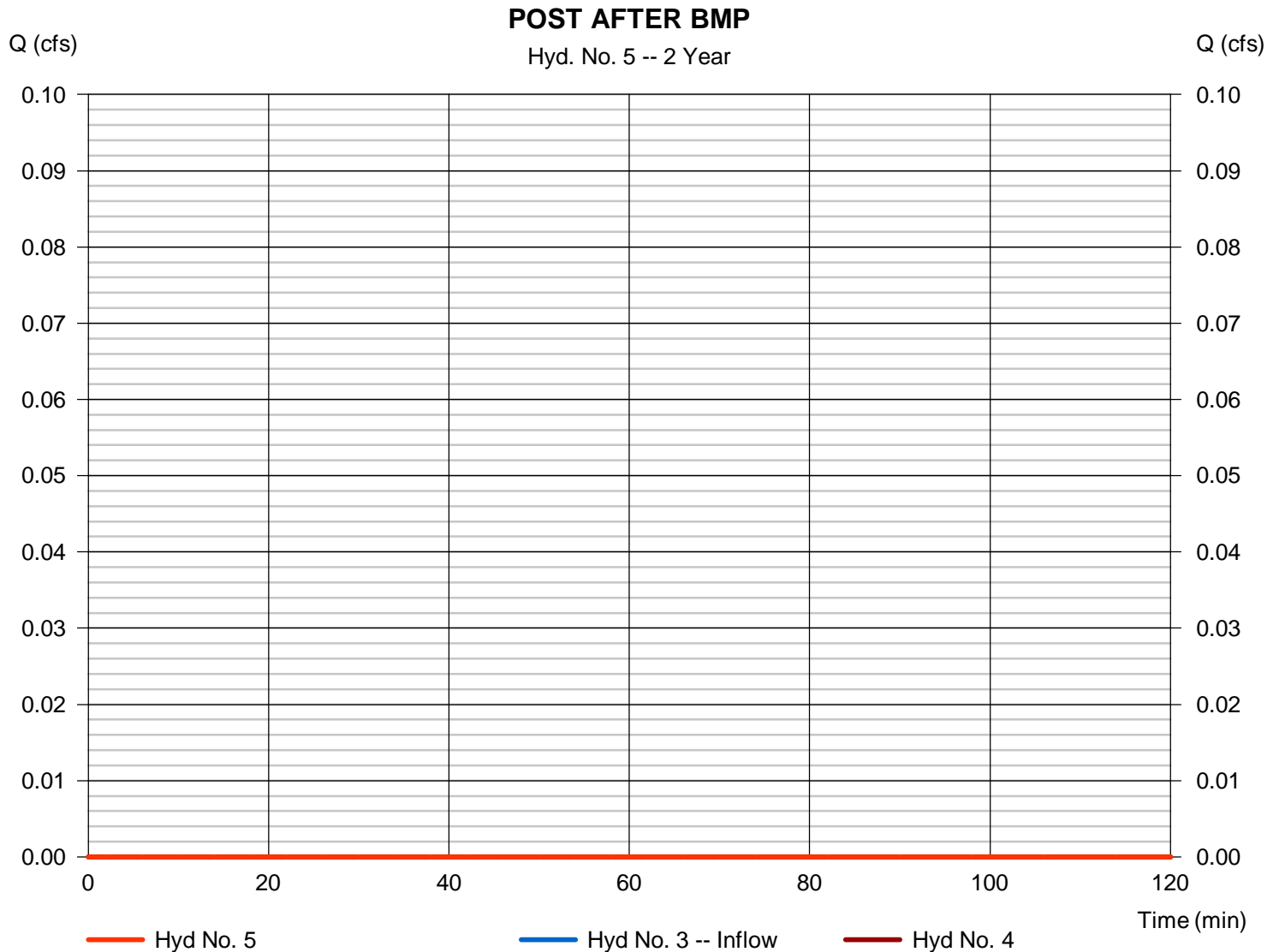
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 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	= 2,343 cuft



Hydrograph Report

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

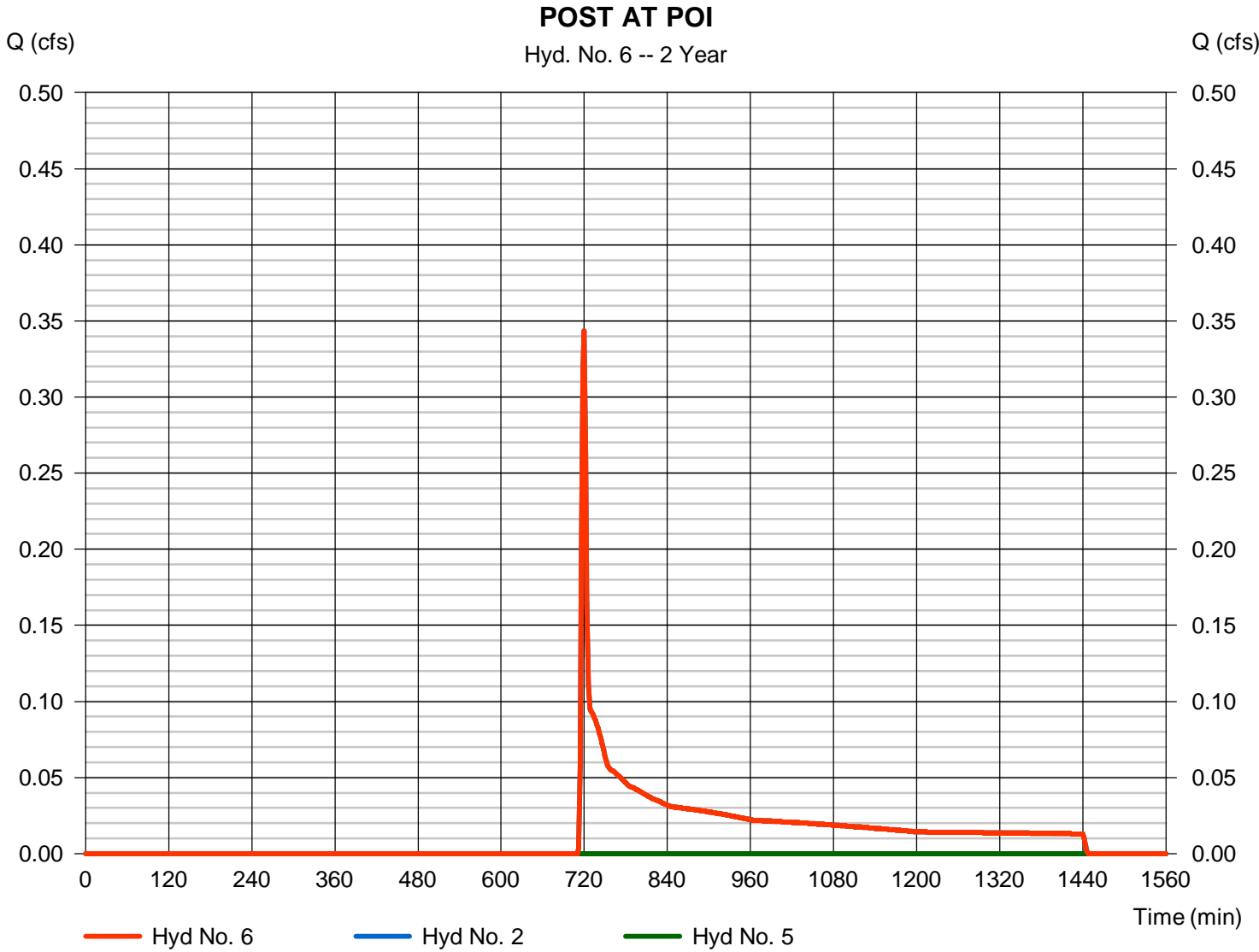
Wednesday, 11 / 9 / 2016

Hyd. No. 6

POST AT POI

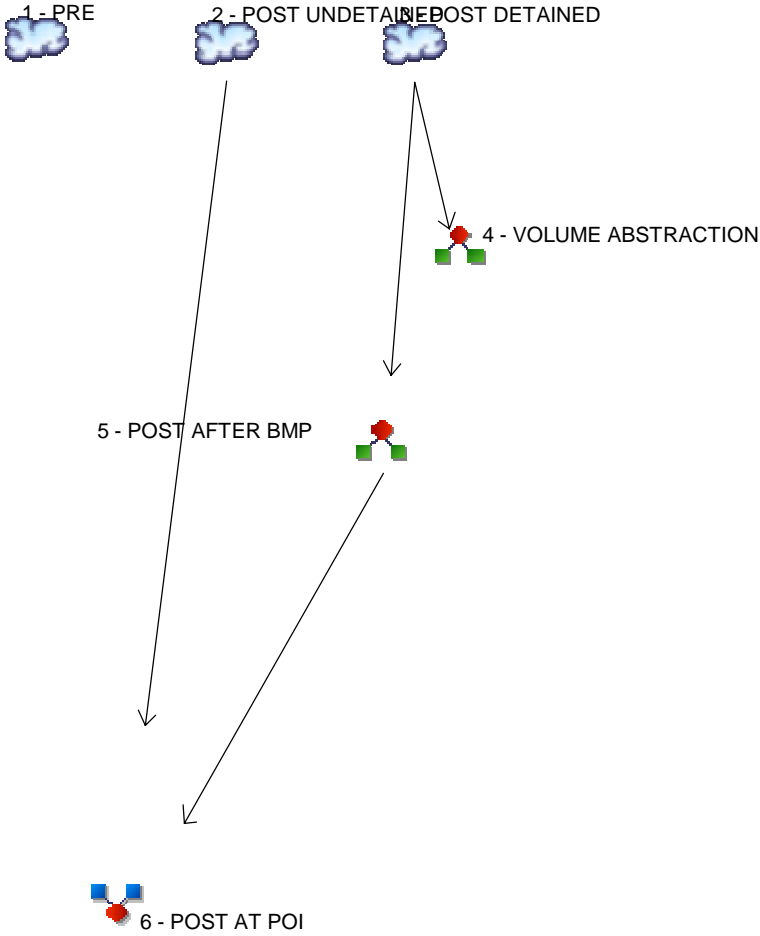
Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 2 min
Inflow hyds. = 2, 5

Peak discharge = 0.344 cfs
Time to peak = 720 min
Hyd. volume = 1,185 cuft
Contrib. drain. area = 1.320 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	-----	-----	-----	-----	-----	2.571	-----	-----	-----	PRE
2	SCS Runoff	-----	-----	-----	-----	-----	1.875	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	-----	-----	-----	-----	-----	0.363	-----	-----	-----	POST DETAINED
4	Diversion1	3	-----	-----	-----	-----	0.363	-----	-----	-----	VOLUME ABSTRACTION
5	Diversion2	3	-----	-----	-----	-----	0.000	-----	-----	-----	POST AFTER BMP
6	Combine	2, 5	-----	-----	-----	-----	1.875	-----	-----	-----	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	2.571	2	718	5,480	-----	-----	-----	PRE
2	SCS Runoff	1.875	2	718	3,996	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	0.363	2	742	2,199	-----	-----	-----	POST DETAINED
4	Diversion1	0.363	2	742	2,199	3	-----	-----	VOLUME ABSTRACTION
5	Diversion2	0.000	2	n/a	0	3	-----	-----	POST AFTER BMP
6	Combine	1.875	2	718	3,996	2, 5	-----	-----	POST AT POI

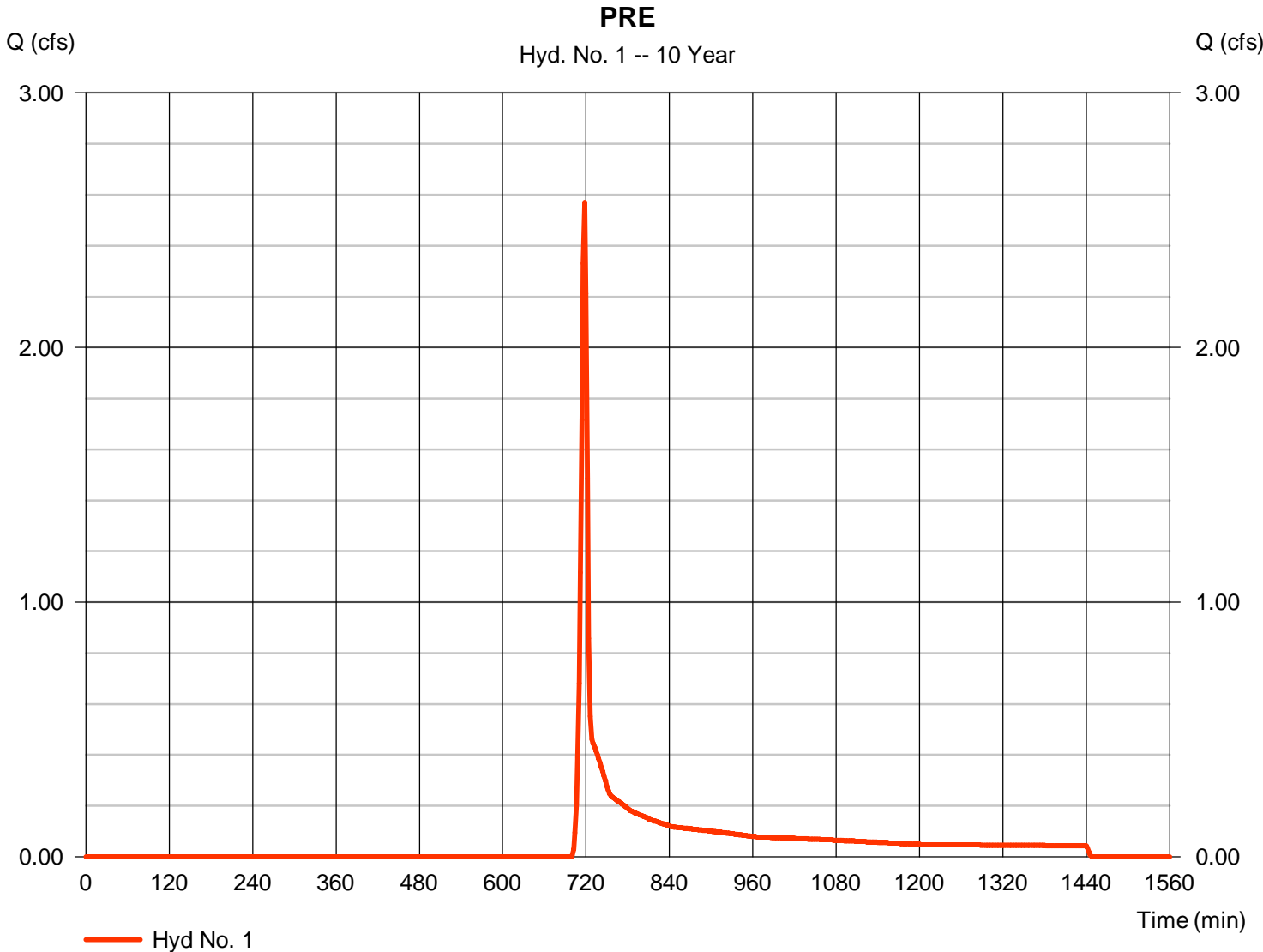
Hydrograph Report

Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 2.571 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 5,480 cuft
Drainage area	= 1.810 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



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>
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)	= 2.97	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 4.89	+ 0.00	+ 0.00	= 4.89
Shallow Concentrated Flow				
Flow length (ft)	= 173.00	22.00	123.00	
Watercourse slope (%)	= 9.10	1.60	4.50	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=4.87	2.04	3.42	
Travel Time (min)	= 0.59	+ 0.18	+ 0.60	= 1.37
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				6.30 min

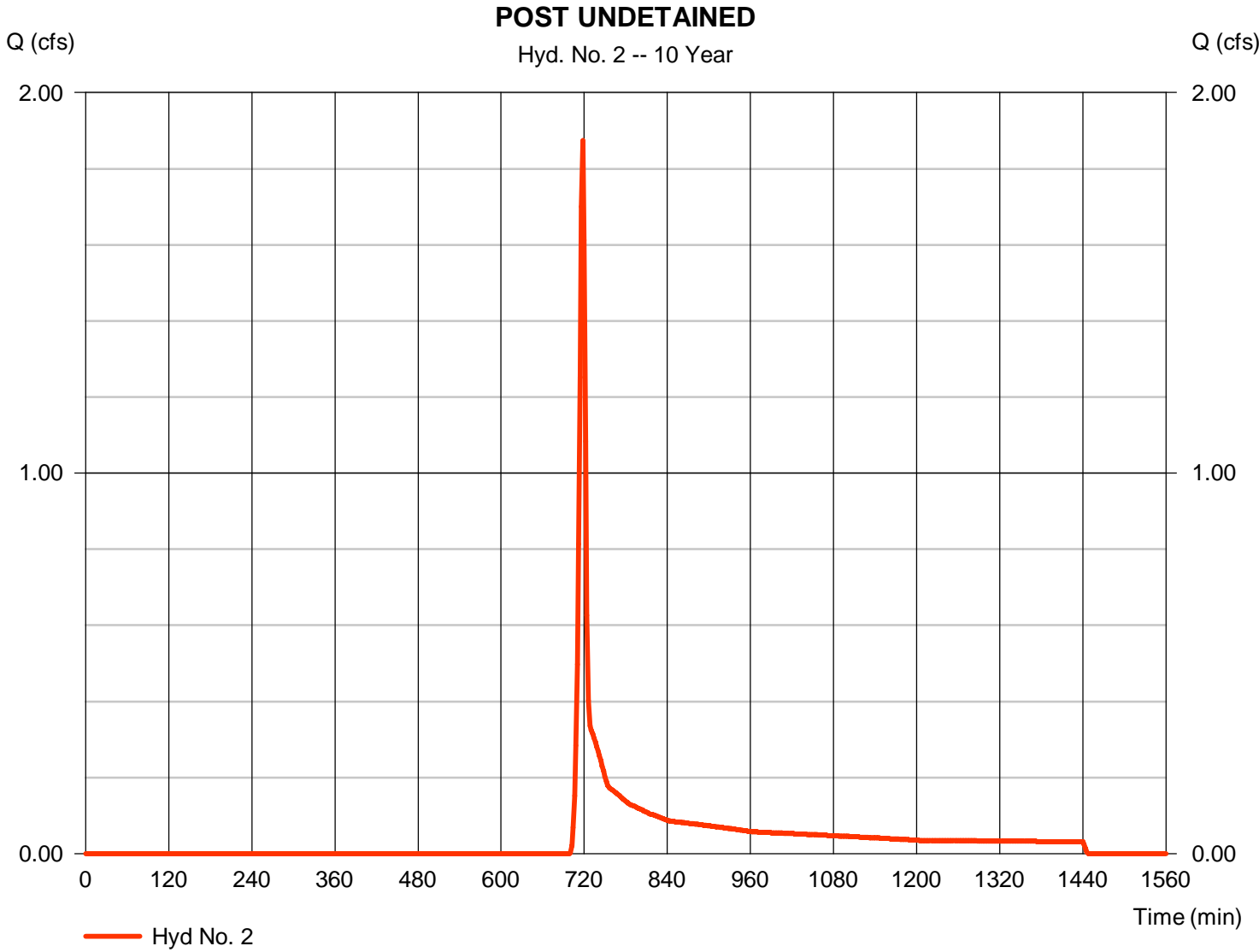
Hydrograph Report

Hyd. No. 2

POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.875 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 3,996 cuft
Drainage area	= 1.320 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



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>
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)	= 2.97	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 4.89	+ 0.00	+ 0.00	= 4.89
Shallow Concentrated Flow				
Flow length (ft)	= 173.00	22.00	123.00	
Watercourse slope (%)	= 9.10	1.60	4.50	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=4.87	2.04	3.42	
Travel Time (min)	= 0.59	+ 0.18	+ 0.60	= 1.37
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				6.30 min

Hydrograph Report

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

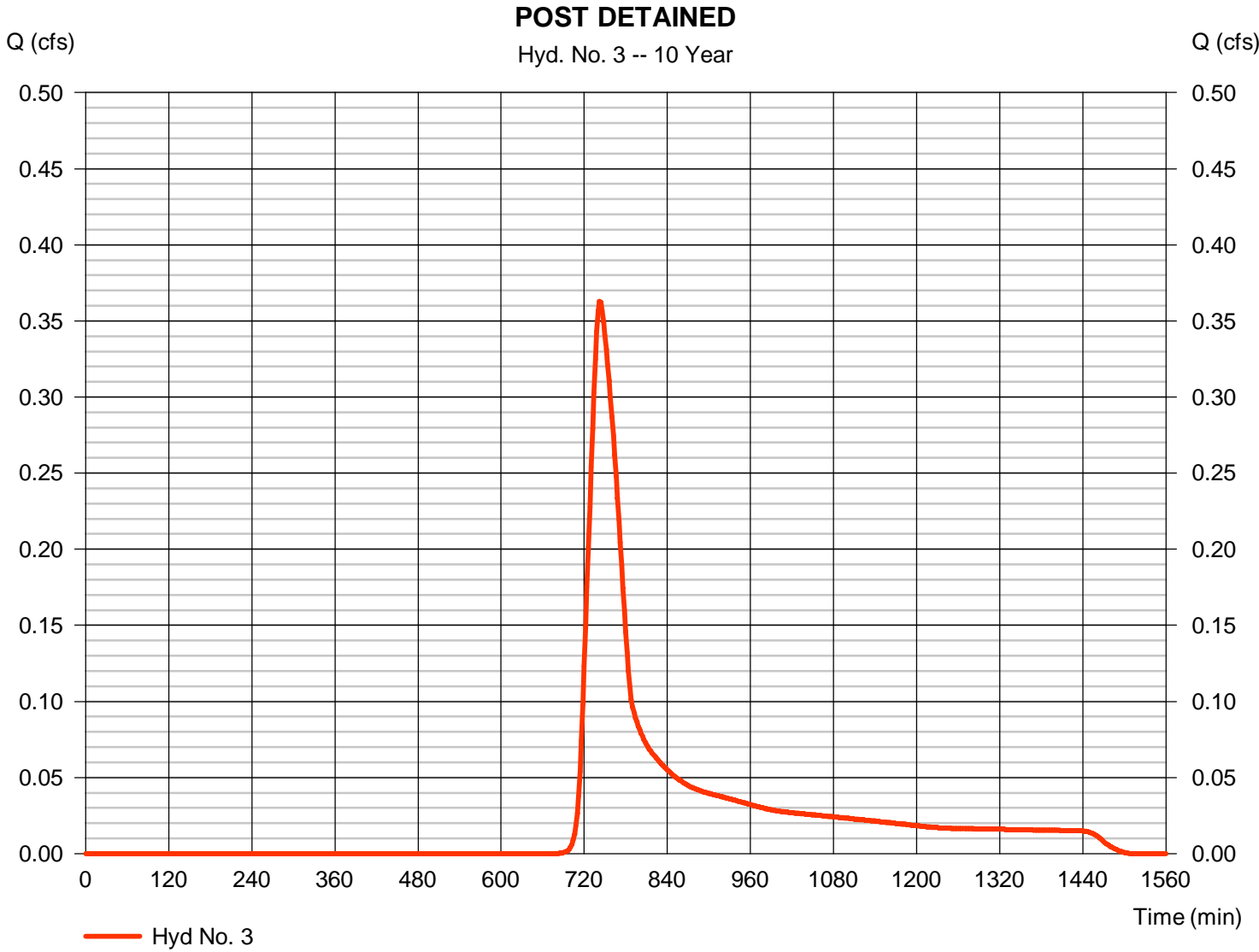
Wednesday, 11 / 9 / 2016

Hyd. No. 3

POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.363 cfs
Storm frequency	= 10 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 2,199 cuft
Drainage area	= 0.490 ac	Curve number	= 64*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 46.22 min
Total precip.	= 4.47 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



Hydrograph Report

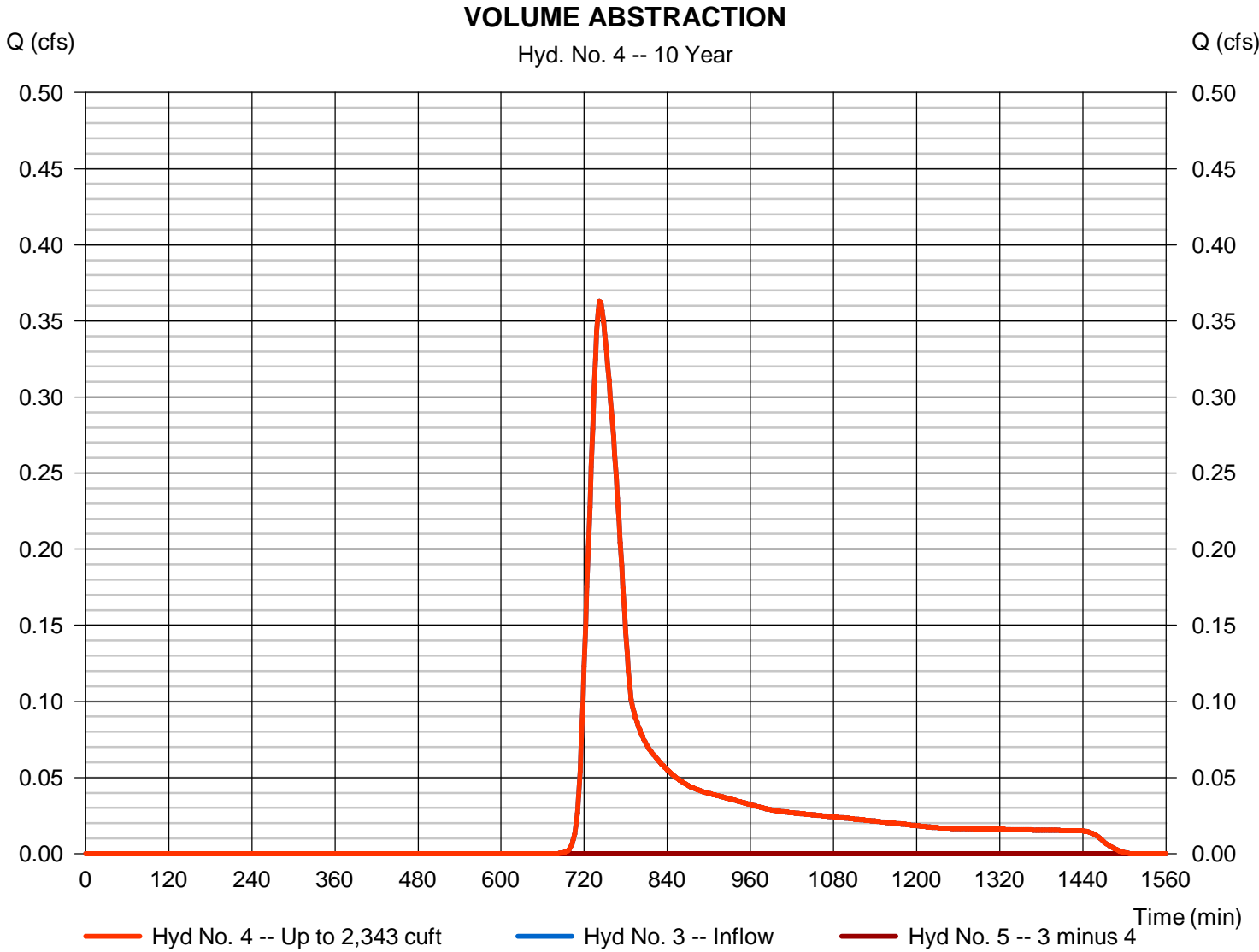
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 0.363 cfs
Storm frequency	= 10 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 2,199 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

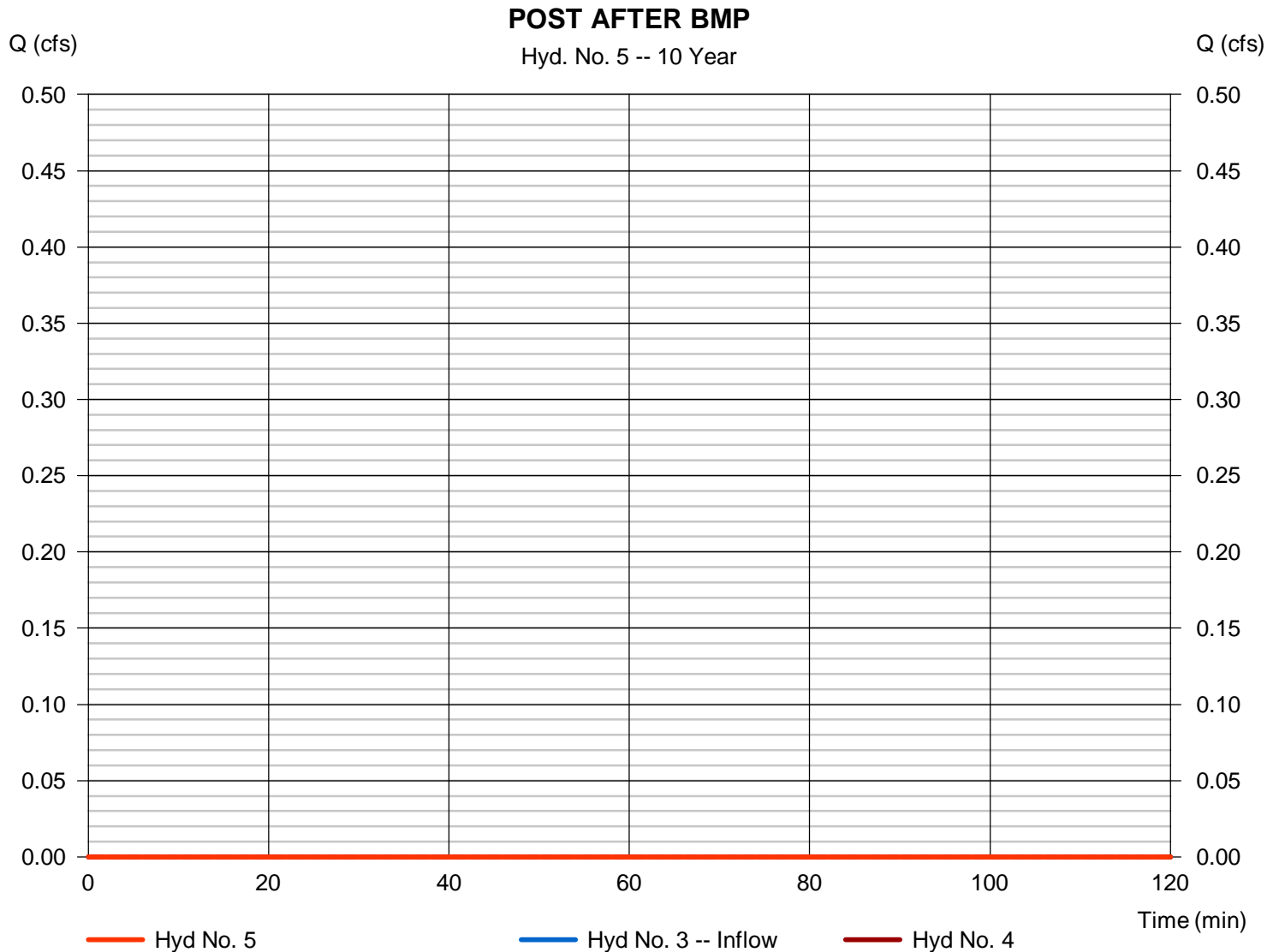
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

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	= 2,343 cuft



Hydrograph Report

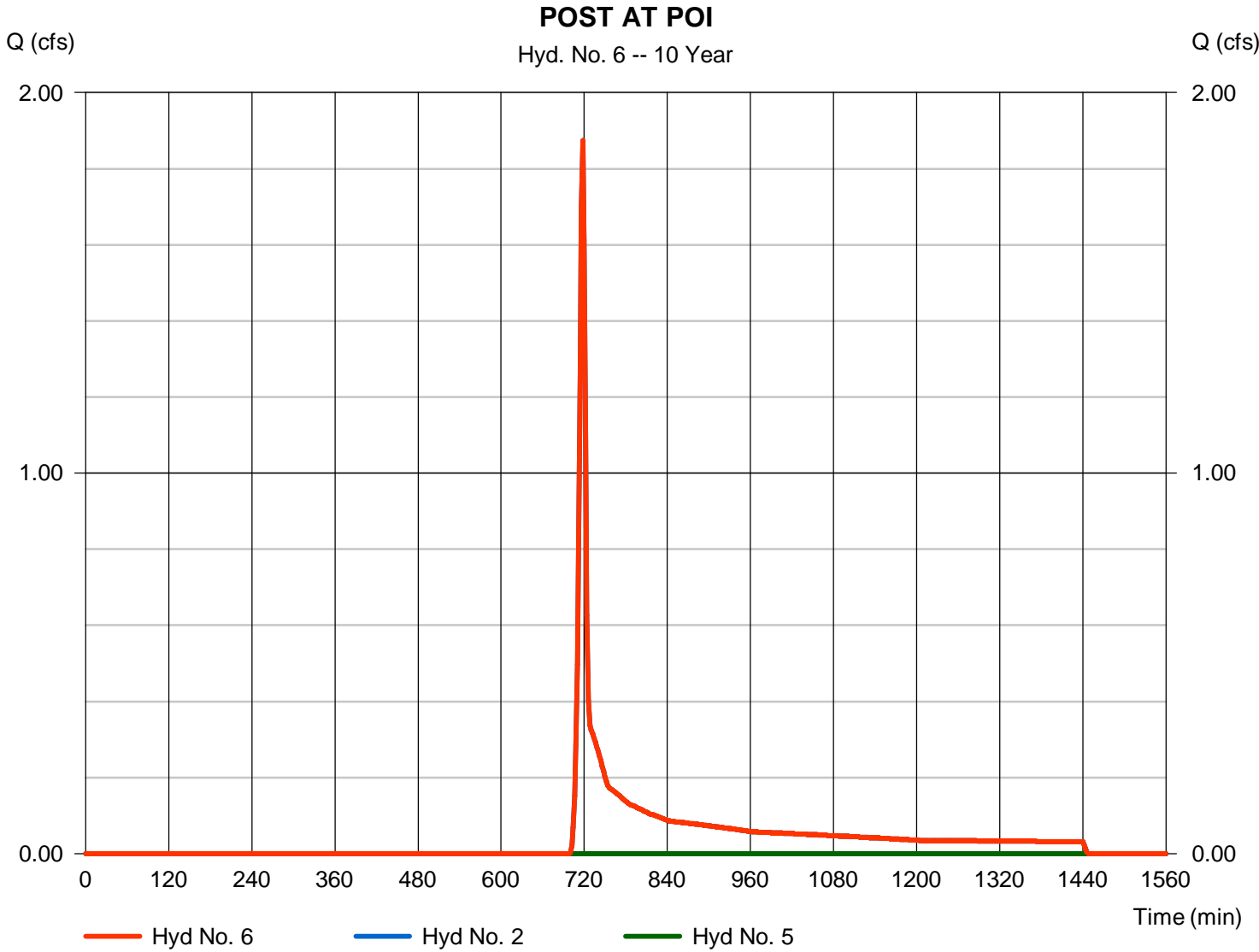
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 6

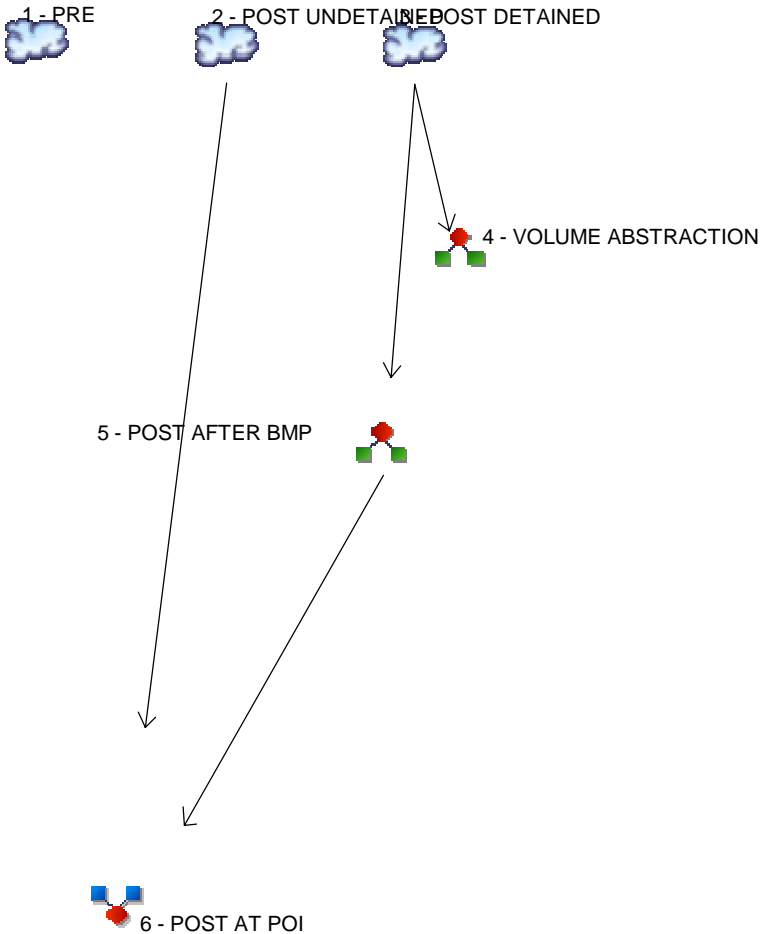
POST AT POI

Hydrograph type	= Combine	Peak discharge	= 1.875 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 3,996 cuft
Inflow hyds.	= 2, 5	Contrib. drain. area	= 1.320 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	-----	-----	-----	-----	-----	-----	-----	6.376	-----	PRE
2	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	4.650	-----	POST UNDETAINED
3	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	1.221	-----	POST DETAINED
4	Diversion1	3	-----	-----	-----	-----	-----	-----	1.221	-----	VOLUME ABSTRACTION
5	Diversion2	3	-----	-----	-----	-----	-----	-----	0.252	-----	POST AFTER BMP
6	Combine	2, 5	-----	-----	-----	-----	-----	-----	4.650	-----	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	6.376	2	718	12,787	-----	-----	-----	PRE
2	SCS Runoff	4.650	2	718	9,325	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	1.221	2	730	4,599	-----	-----	-----	POST DETAINED
4	Diversion1	1.221	2	730	2,356	3	-----	-----	VOLUME ABSTRACTION
5	Diversion2	0.252	2	758	2,243	3	-----	-----	POST AFTER BMP
6	Combine	4.650	2	718	11,568	2, 5	-----	-----	POST AT POI

Hydrograph Report

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

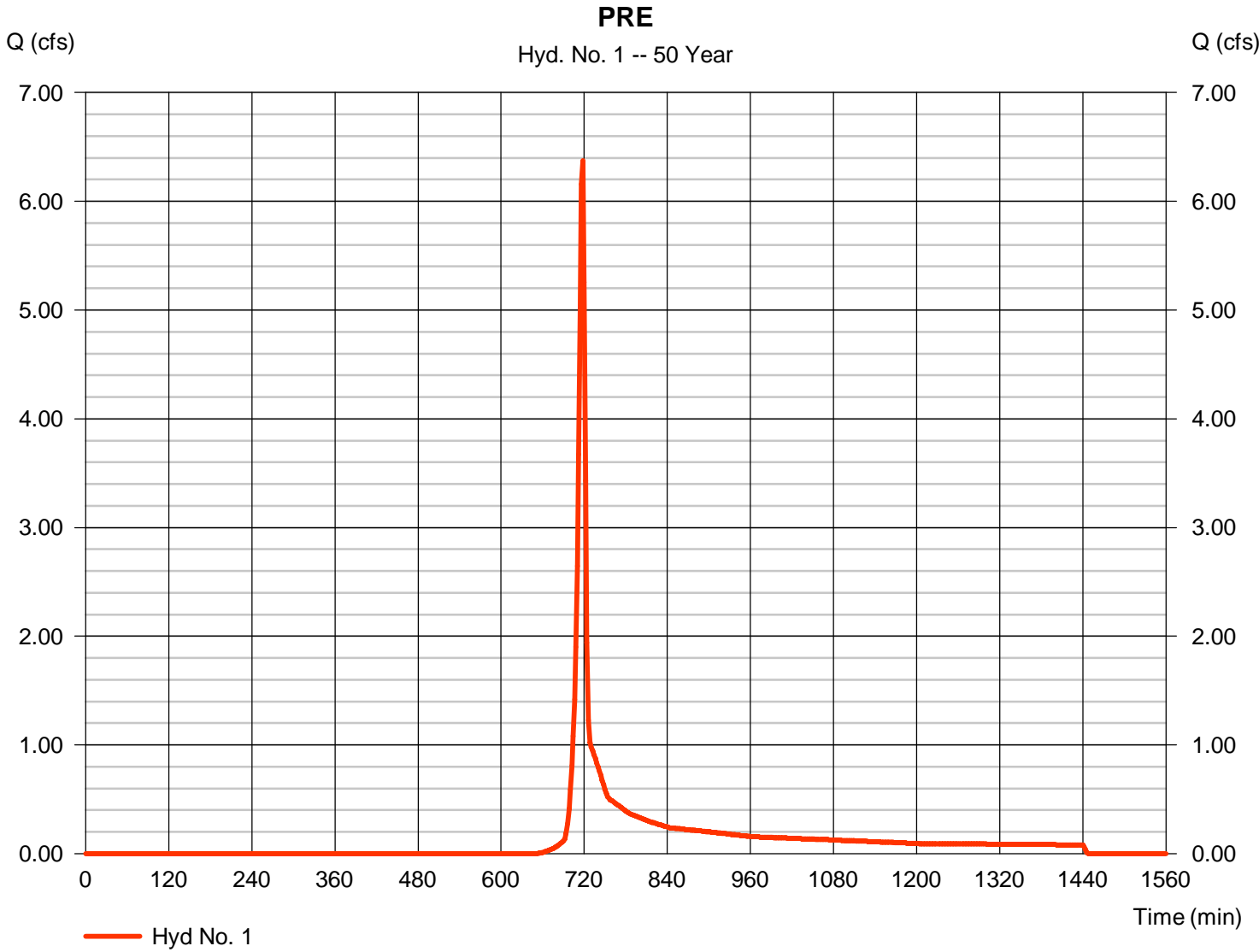
Wednesday, 11 / 9 / 2016

Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 6.376 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 12,787 cuft
Drainage area	= 1.810 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 6.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



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>
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)	= 2.97	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 4.89	+ 0.00	+ 0.00	= 4.89
Shallow Concentrated Flow				
Flow length (ft)	= 173.00	22.00	123.00	
Watercourse slope (%)	= 9.10	1.60	4.50	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=4.87	2.04	3.42	
Travel Time (min)	= 0.59	+ 0.18	+ 0.60	= 1.37
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				6.30 min

Hydrograph Report

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

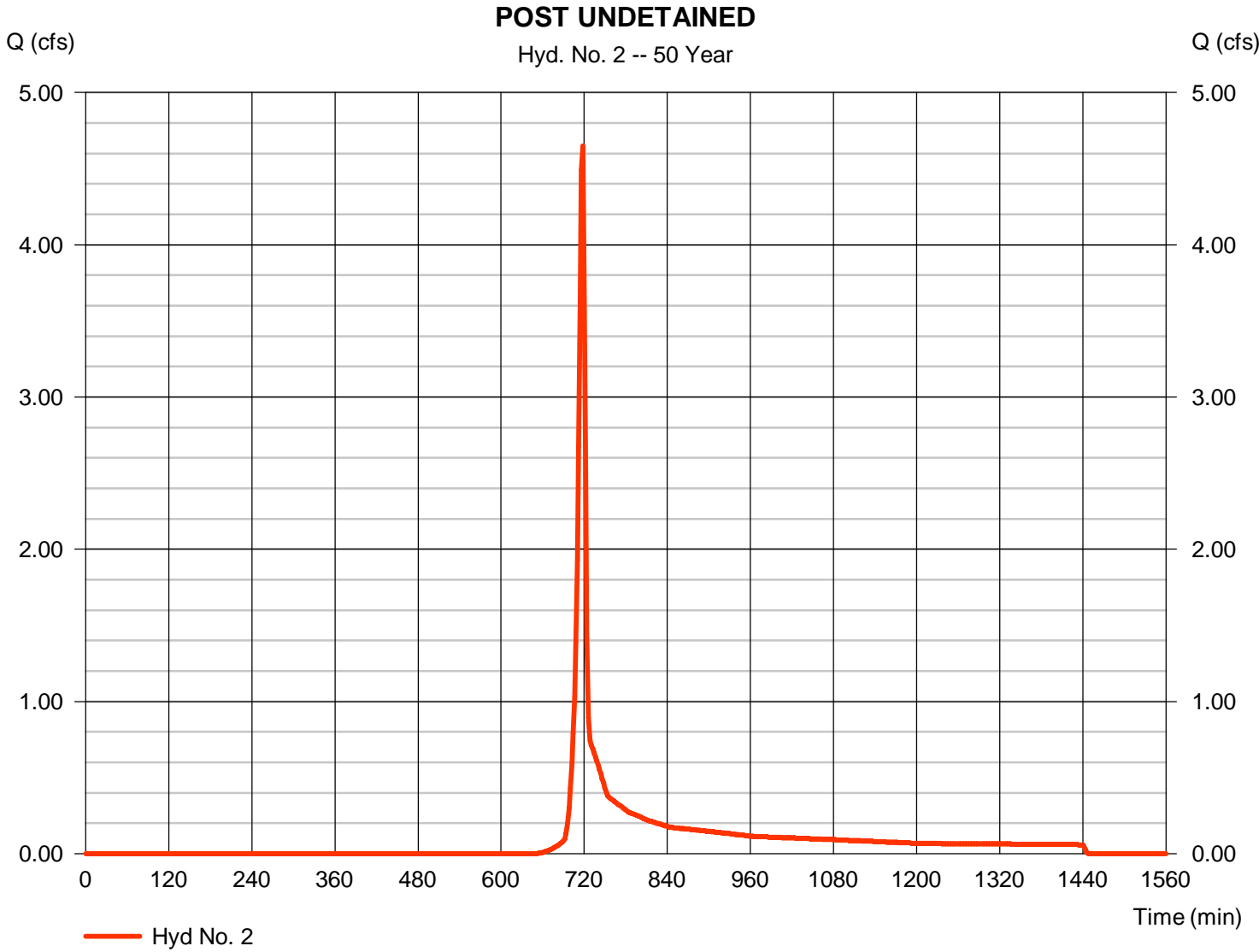
Wednesday, 11 / 9 / 2016

Hyd. No. 2

POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 4.650 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 9,325 cuft
Drainage area	= 1.320 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 6.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



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>
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)	= 2.97	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 4.89	+ 0.00	+ 0.00	= 4.89
Shallow Concentrated Flow				
Flow length (ft)	= 173.00	22.00	123.00	
Watercourse slope (%)	= 9.10	1.60	4.50	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=4.87	2.04	3.42	
Travel Time (min)	= 0.59	+ 0.18	+ 0.60	= 1.37
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	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				6.30 min

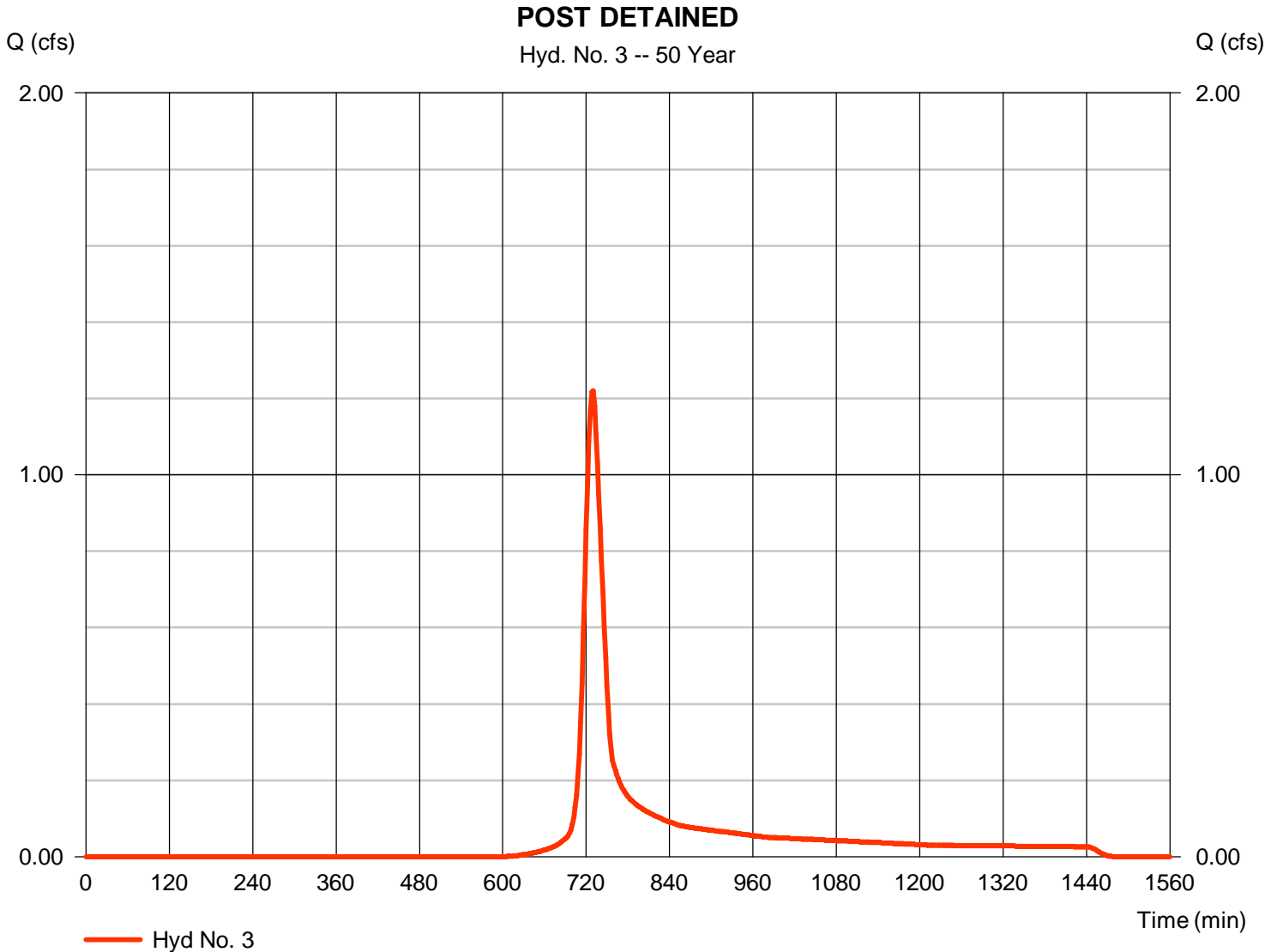
Hydrograph Report

Hyd. No. 3

POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.221 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 4,599 cuft
Drainage area	= 0.490 ac	Curve number	= 64*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.13 min
Total precip.	= 6.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



Hydrograph Report

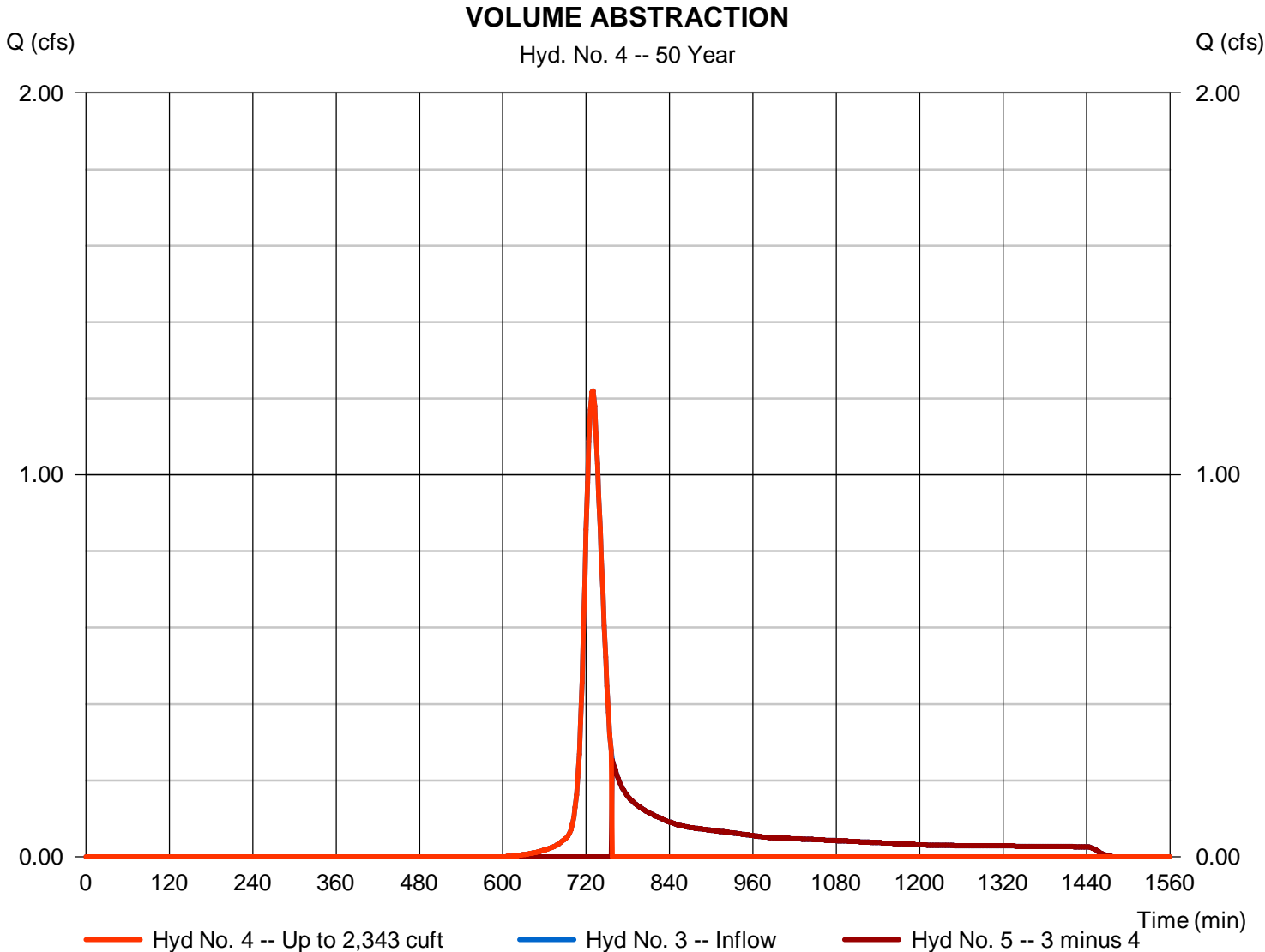
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.221 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 2,356 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

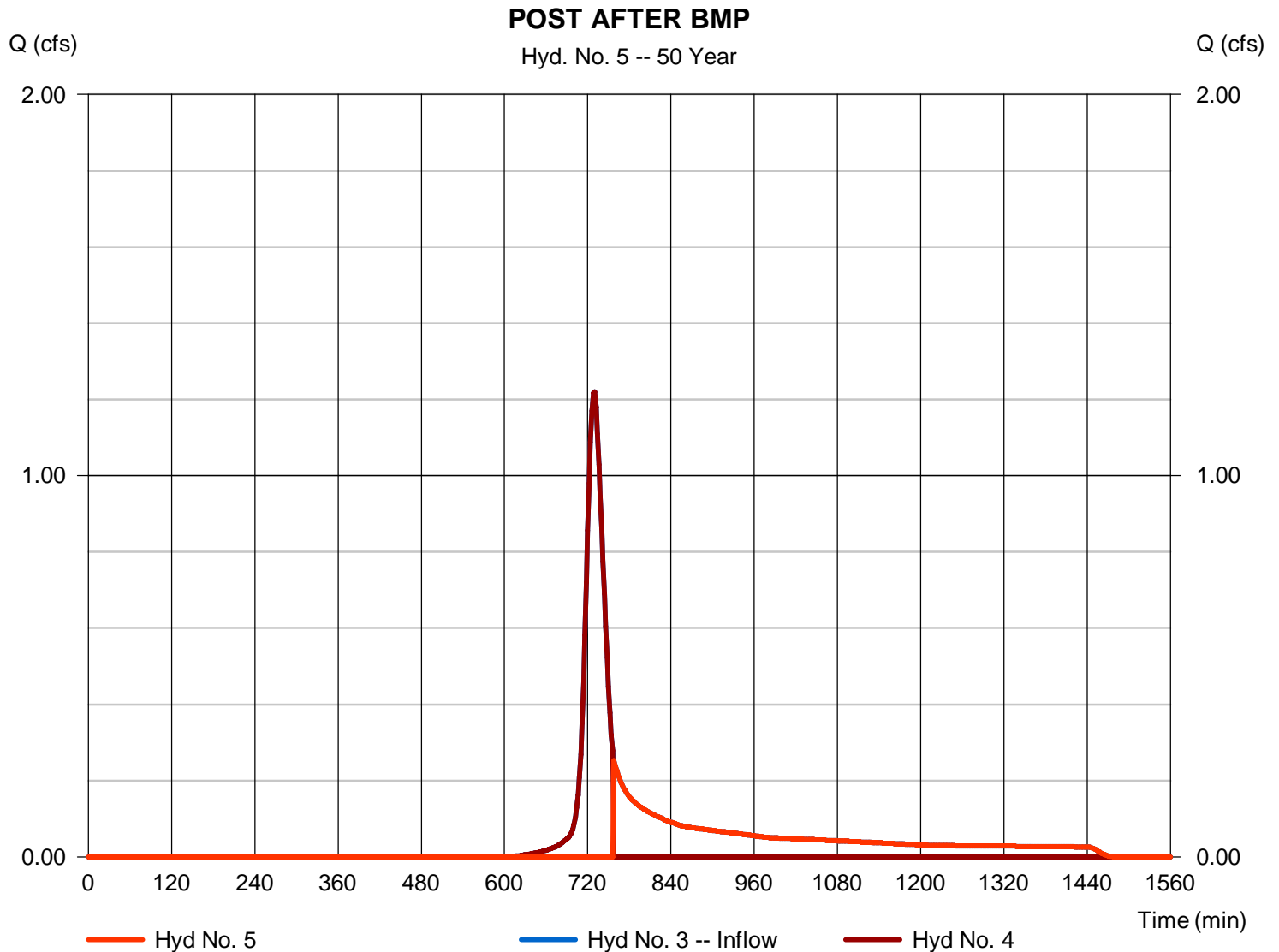
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 0.252 cfs
Storm frequency	= 50 yrs	Time to peak	= 758 min
Time interval	= 2 min	Hyd. volume	= 2,243 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

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

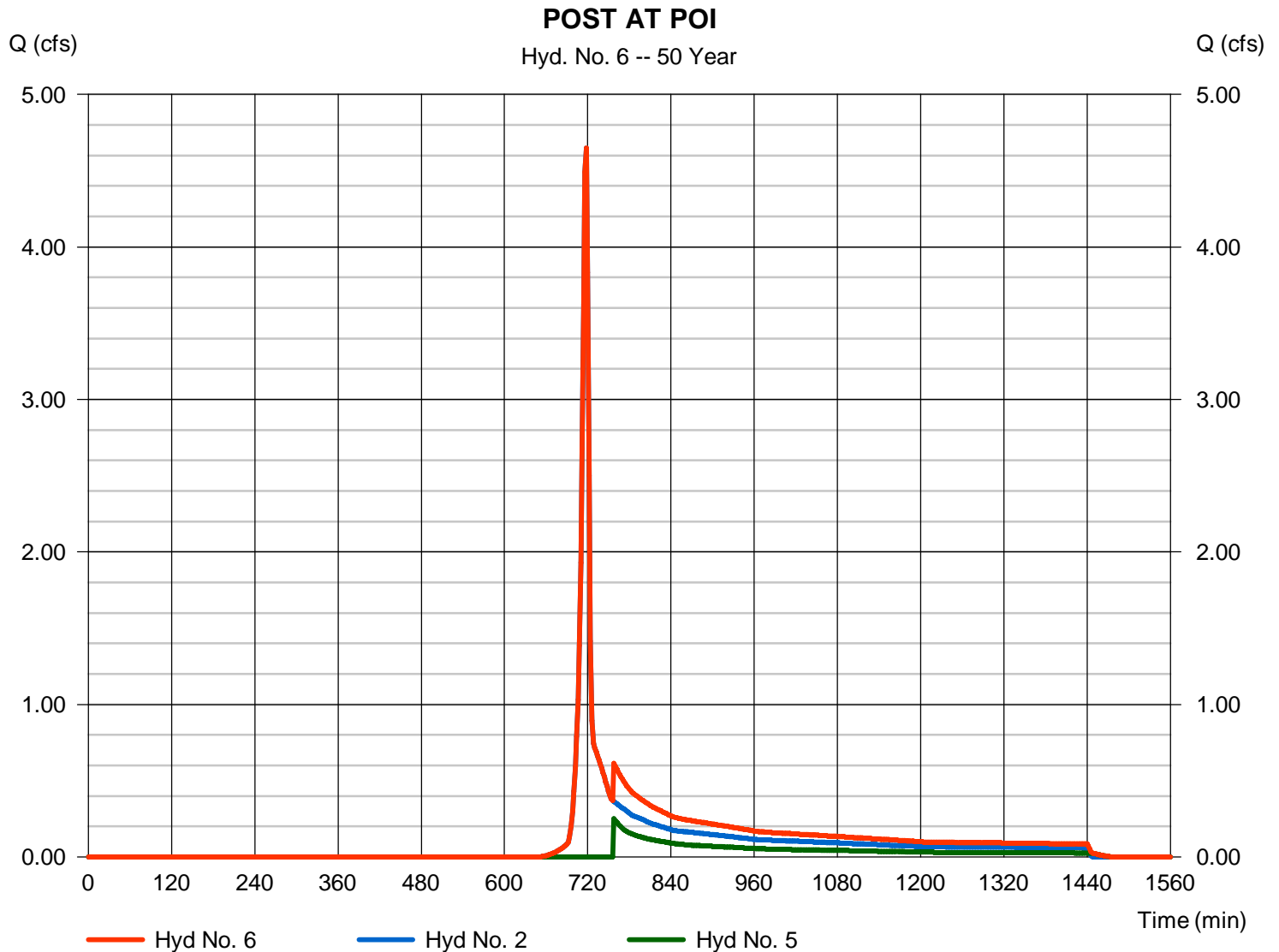
Wednesday, 11 / 9 / 2016

Hyd. No. 6

POST AT POI

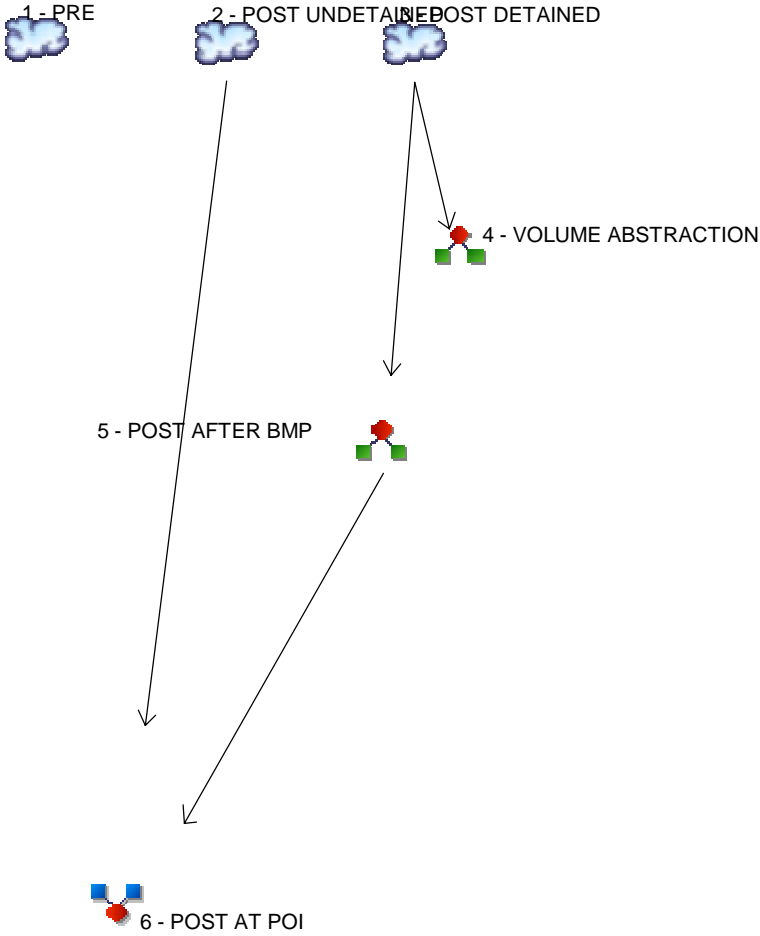
Hydrograph type = Combine
Storm frequency = 50 yrs
Time interval = 2 min
Inflow hyds. = 2, 5

Peak discharge = 4.650 cfs
Time to peak = 718 min
Hyd. volume = 11,568 cuft
Contrib. drain. area = 1.320 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	-----	-----	-----	-----	-----	-----	-----	-----	8.660	PRE
2	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	-----	6.316	POST UNDETAINED
3	SCS Runoff	-----	-----	-----	-----	-----	-----	-----	-----	1.785	POST DETAINED
4	Diversion1	3	-----	-----	-----	-----	-----	-----	-----	1.785	VOLUME ABSTRACTION
5	Diversion2	3	-----	-----	-----	-----	-----	-----	-----	1.315	POST AFTER BMP
6	Combine	2, 5	-----	-----	-----	-----	-----	-----	-----	6.316	POST AT POI

Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	8.660	2	718	17,318	-----	-----	-----	PRE
2	SCS Runoff	6.316	2	718	12,629	-----	-----	-----	POST UNDETAINED
3	SCS Runoff	1.785	2	726	6,245	-----	-----	-----	POST DETAINED
4	Diversion1	1.785	2	726	2,435	3	-----	-----	VOLUME ABSTRACTION
5	Diversion2	1.315	2	736	3,810	3	-----	-----	POST AFTER BMP
6	Combine	6.316	2	718	16,439	2, 5	-----	-----	POST AT POI

Hydrograph Report

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

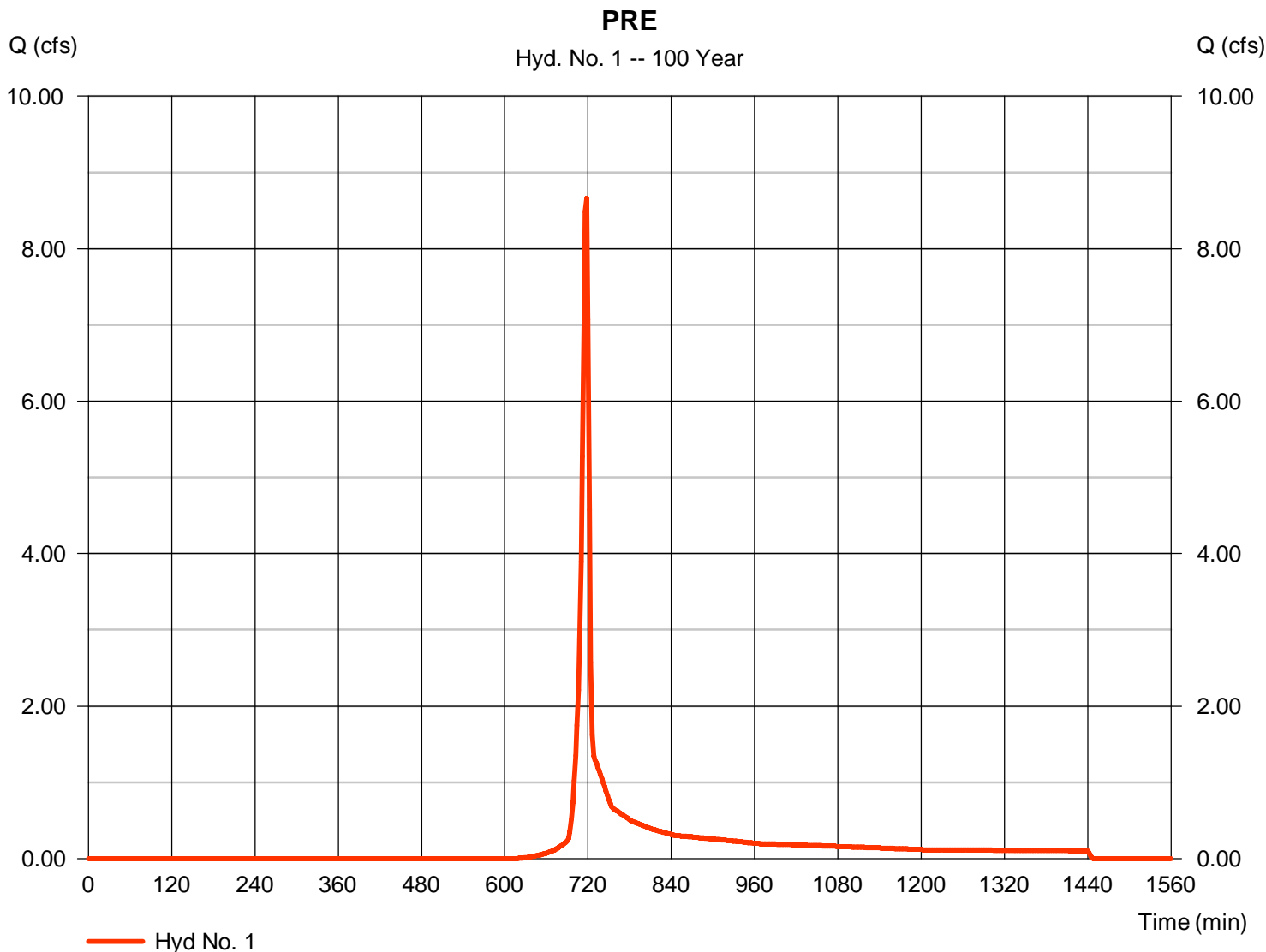
Wednesday, 11 / 9 / 2016

Hyd. No. 1

PRE

Hydrograph type	= SCS Runoff	Peak discharge	= 8.660 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 17,318 cuft
Drainage area	= 1.810 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 7.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.810 x 58)] / 1.810



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>
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)	= 2.97	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 4.89	+ 0.00	+ 0.00	= 4.89
Shallow Concentrated Flow				
Flow length (ft)	= 173.00	22.00	123.00	
Watercourse slope (%)	= 9.10	1.60	4.50	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=4.87	2.04	3.42	
Travel Time (min)	= 0.59	+ 0.18	+ 0.60	= 1.37
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				6.30 min

Hydrograph Report

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

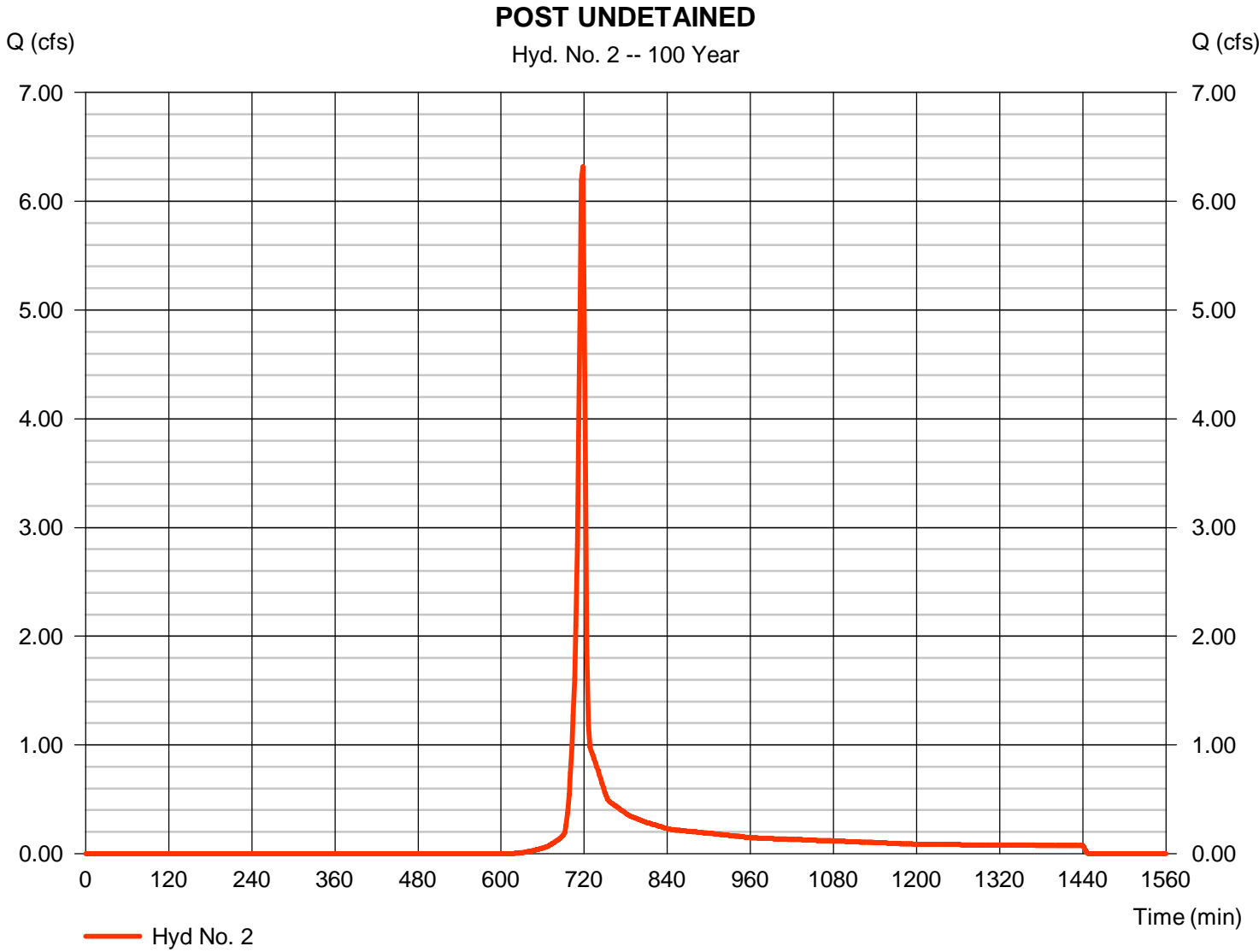
Wednesday, 11 / 9 / 2016

Hyd. No. 2

POST UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 6.316 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 12,629 cuft
Drainage area	= 1.320 ac	Curve number	= 58*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.30 min
Total precip.	= 7.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.020 x 85) + (1.300 x 58)] / 1.320



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>
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)	= 2.97	0.00	0.00	
Land slope (%)	= 8.00	0.00	0.00	
Travel Time (min)	= 4.89	+ 0.00	+ 0.00	= 4.89
Shallow Concentrated Flow				
Flow length (ft)	= 173.00	22.00	123.00	
Watercourse slope (%)	= 9.10	1.60	4.50	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=4.87	2.04	3.42	
Travel Time (min)	= 0.59	+ 0.18	+ 0.60	= 1.37
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				6.30 min

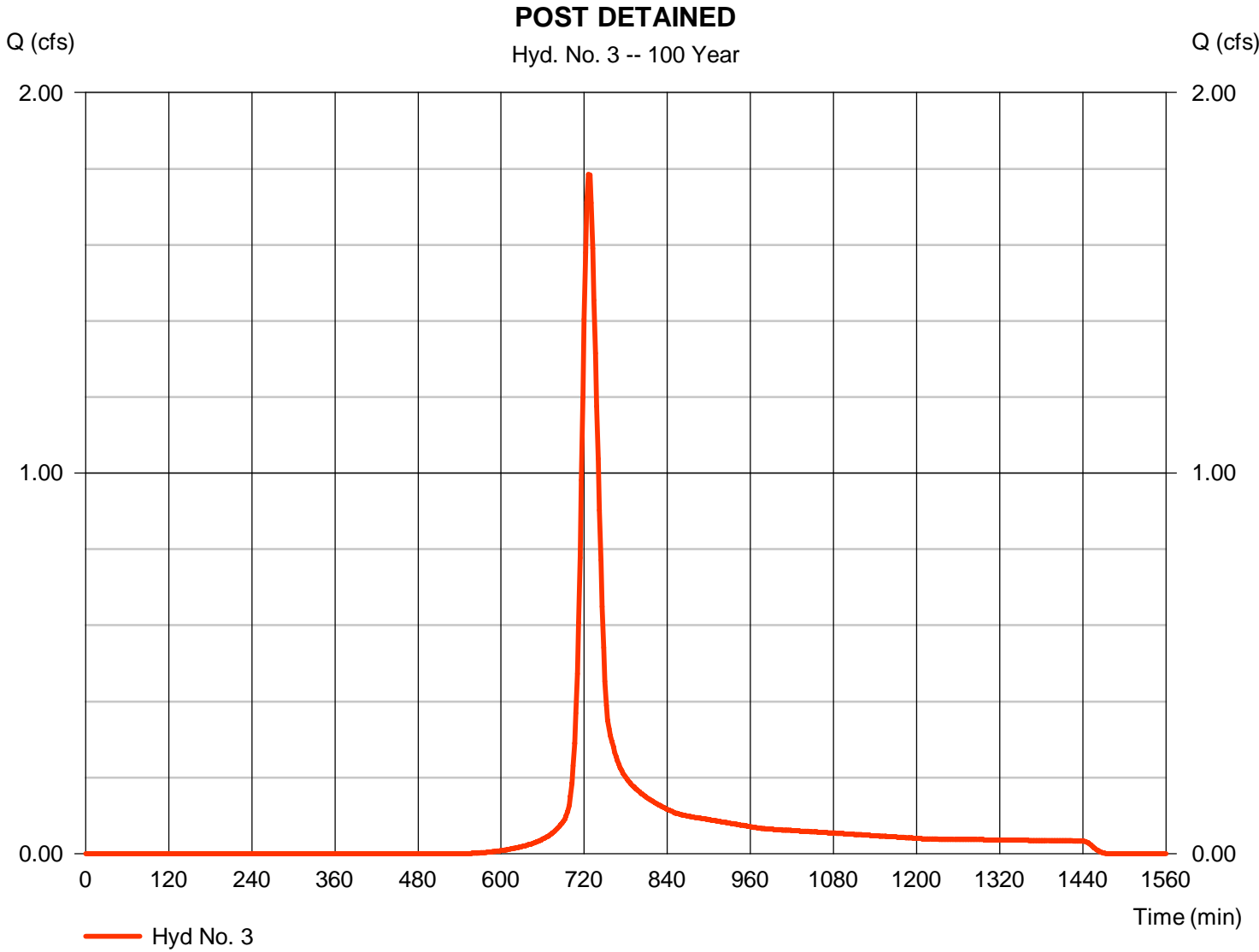
Hydrograph Report

Hyd. No. 3

POST DETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.785 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 6,245 cuft
Drainage area	= 0.490 ac	Curve number	= 64*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 21.58 min
Total precip.	= 7.58 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.110 x 85) + (0.380 x 58)] / 0.490



Hydrograph Report

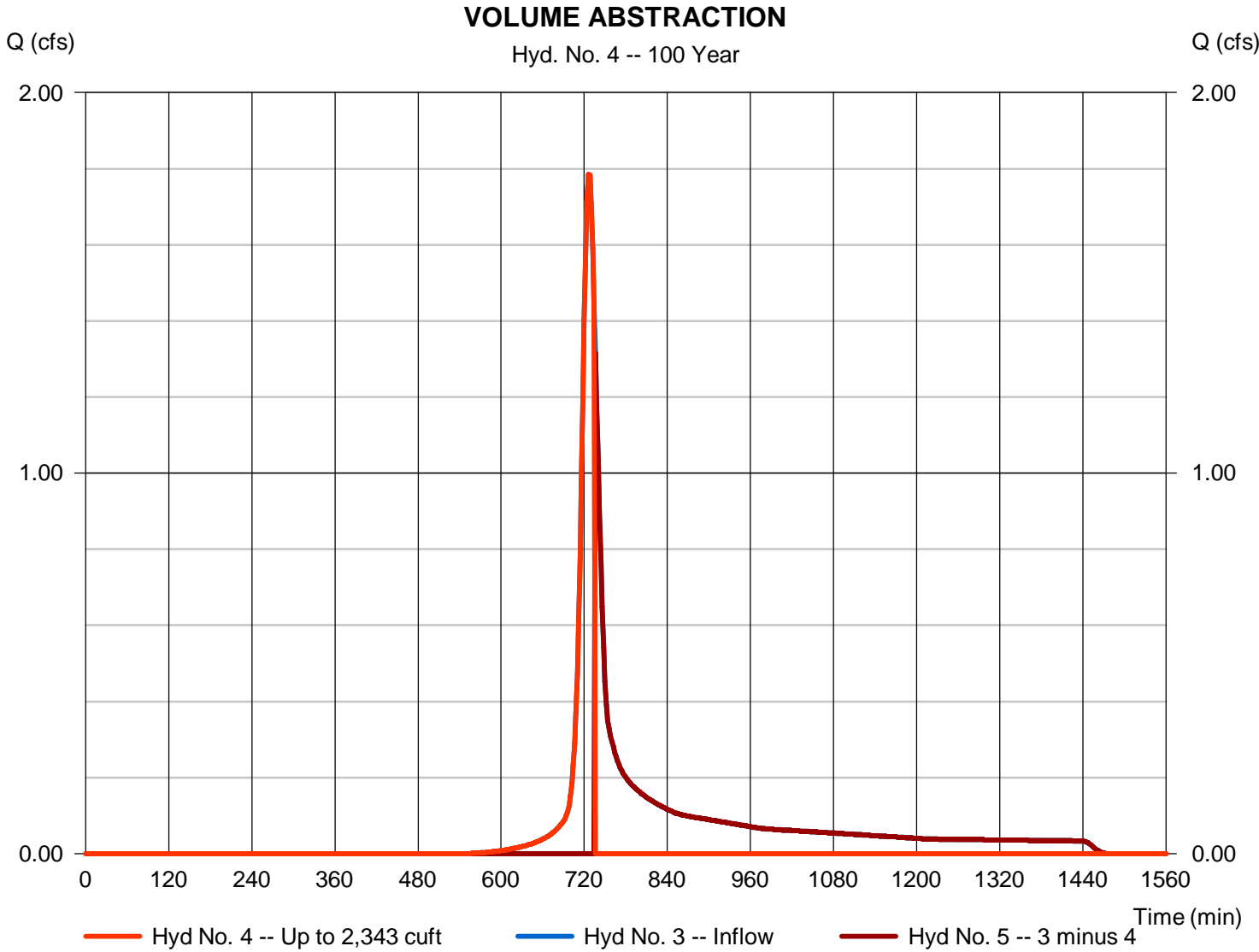
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 4

VOLUME ABSTRACTION

Hydrograph type	= Diversion1	Peak discharge	= 1.785 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 2,435 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 5
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

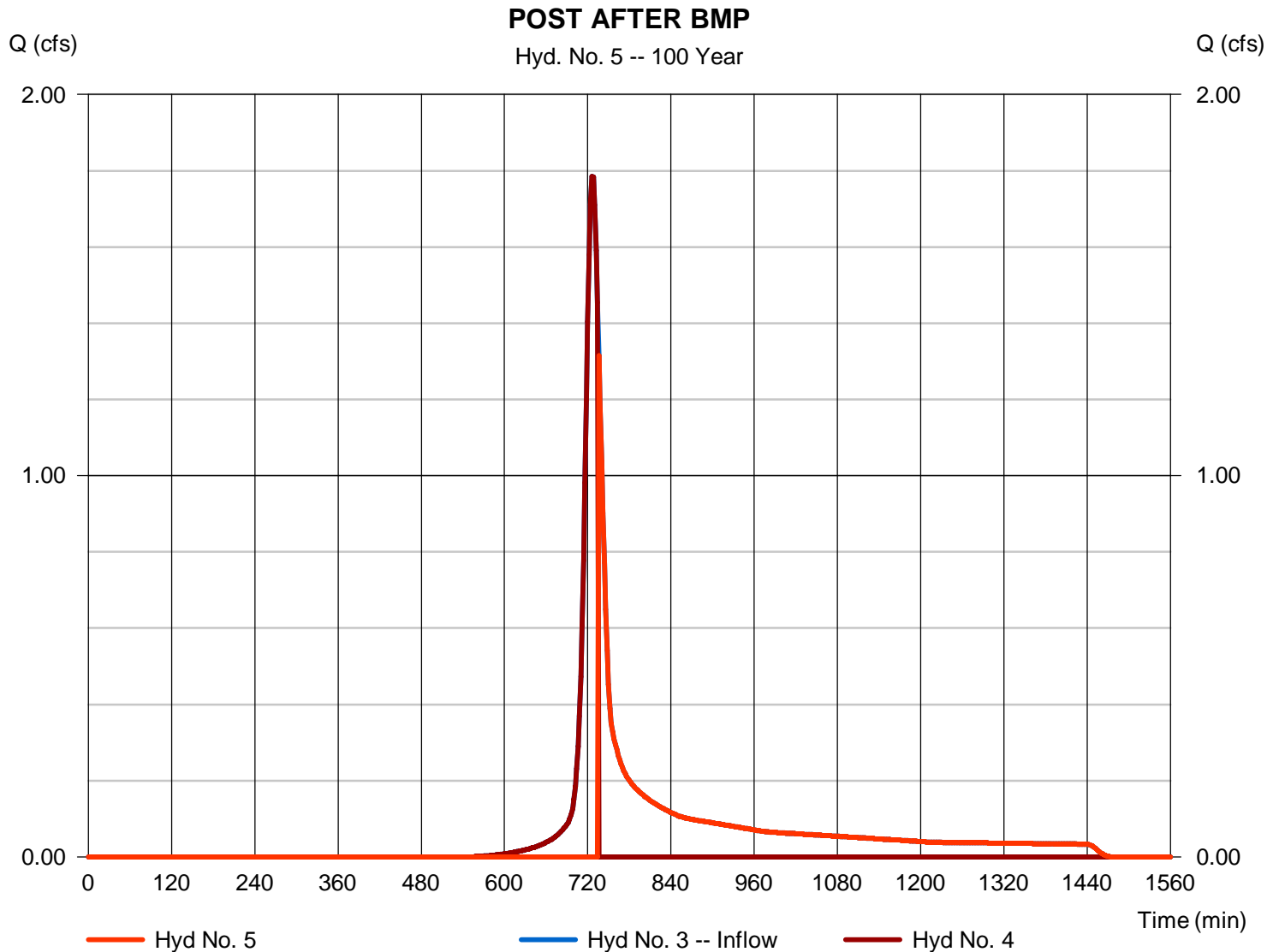
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Wednesday, 11 / 9 / 2016

Hyd. No. 5

POST AFTER BMP

Hydrograph type	= Diversion2	Peak discharge	= 1.315 cfs
Storm frequency	= 100 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 3,810 cuft
Inflow hydrograph	= 3 - POST DETAINED	2nd diverted hyd.	= 4
Diversion method	= First Flush Volume	Volume Up To	= 2,343 cuft



Hydrograph Report

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

Wednesday, 11 / 9 / 2016

Hyd. No. 6

POST AT POI

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

Peak discharge = 6.316 cfs
Time to peak = 718 min
Hyd. volume = 16,439 cuft
Contrib. drain. area = 1.320 ac

