PLD Piedmont Land Design, PLLC

8522-204 Six Forks Road ◆ Raleigh, NC 27615 ◆ (919) 845-7600 ◆ Fax: (919) 845-7703

Downstream Impact Analysis

for

Mack Todd Road Townhomes

Zebulon North Carolina

5/5/25

Prepared by:

Piedmont Land Design. PLLC
8522-204 Six Forks Rd.
Raleigh, NC

Project Narrative

The proposed residential project is located on a 2.3 acre vacant, mostly wooded lot. The proposed development includes construction of 13 townhomes. The site is located in Zebulon, NC, and is located in the Neuse River watershed basin .

Downstream Impact Analysis

Requirements:

Per Zebulon ordinance 151.36, the following is required:

(A) Downstream impact analysis.

(1) The downstream impact analysis must be performed in accordance with the "10% rule," and a copy of the analysis must be provided with the permit application. The purpose of the downstream impact analysis is to determine if the project will cause any impacts on flooding or channel degradation downstream of the project site. The analysis must include the assumptions, results and supporting calculations to show safe passage of post-development design flows downstream. This analysis shall be performed at the outlet(s) of the site, and downstream at each tributary junction to the point(s) in the conveyance system where the area of the portion of the site draining into the system is less than or equal to 10% of the total drainage area above that point.

(2) The typical steps in the application of the 10% rule are:

(a) Using a topographic map, determine the point downstream where the proposed site equals 10% of the total drainage area, called the 10% point. Identify all tributary junctions between the downstream site boundary and the 10% point. All points identified, as well as the outlet of the site, are known as 10% rule comparison points.

(b) Using a hydrologic model with existing land uses, determine the pre-development peak runoff rate (cfs) for the ten-year design storm event at each comparison point.

(c) Insert the proposed site design and proposed BMPs into the land uses and determine the post-development peak runoff rate for the ten-year design storm at each comparison point.

(d) If the post-development peak discharge rate is equal to or less than pre-development conditions at all comparison points, no further analysis is required

Methodolgy:

The site is adjacent to an existing stream. All runoff from the project discharges into this stream at the SE corner of the property. The drainage area at this point is 307 acres. The project site is 2.3 acres. Therefore, a point directly off-site of the property is the point at which the site is 10% of the total drainage area. This is the downstream analysis point . There are no tributary junctions between the downstream site boundary and the downstream analysis point.

Drainage Area calculations:

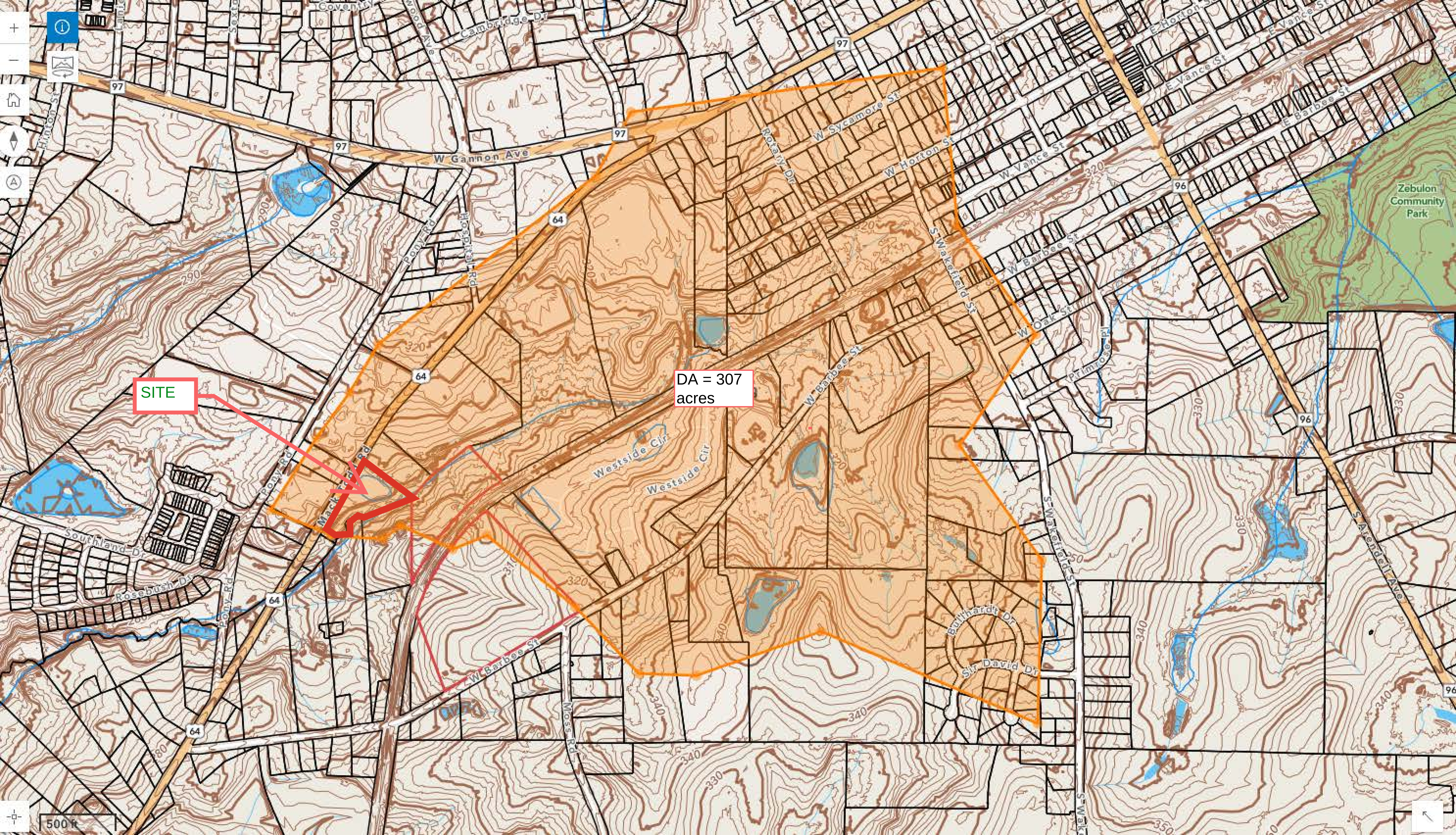
Pre-developed
Drainage Area = 307 acres
Assume C soils and CN=70
Q10 = 686 cfs

Post-developed
The total post-developed flow at the analysis point was obtained by combining the routed post-developed hydrograph, the post-developed bypass hydrograph, and the pre-developed hydrograph to get a total post-developed flow at the discharge point.
Q10 = 687 cfs.

Please refer to the Stormwater Management Report for complete calculations for the SCM routing and bypass hydrographs.

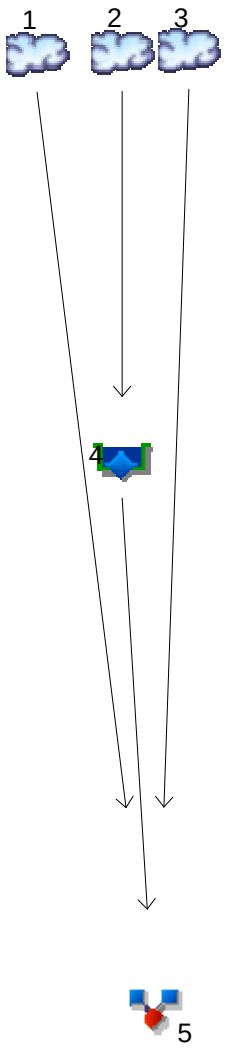
Conclusion

The pre and post-development flows are essentially unchanged (0.15% increase), and there are no points to analyze, therefore, no further analysis is required.


DA = 307
acres
SITE
W Gannon Ave
W Sycamore St
W Horton St
Rotary Dr
S Wakefield St
W Barbee St
Westside Cir
Westside Cir
Pony Rd
Hospital Rd
Cambridge Dr
Southland Dr
Rosebush Dr
Moss Rd
Burkhardt Dr
Sir David Dr
W Oak St
W Vance St
E Vance St
E Horton St
E Barbee St
S Arendell Ave
Zebulon Community Park
Primrose Ln
500 ft

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

Hyd.	Origin	Description
1	SCS Runoff	DP #1 - PRE
2	SCS Runoff	DP#1 - POST TO SCM
3	SCS Runoff	DP #1 - BYPASS
4	Reservoir	Routing
5	Combine	Total flow at Discharge point #1

Hydrograph Report

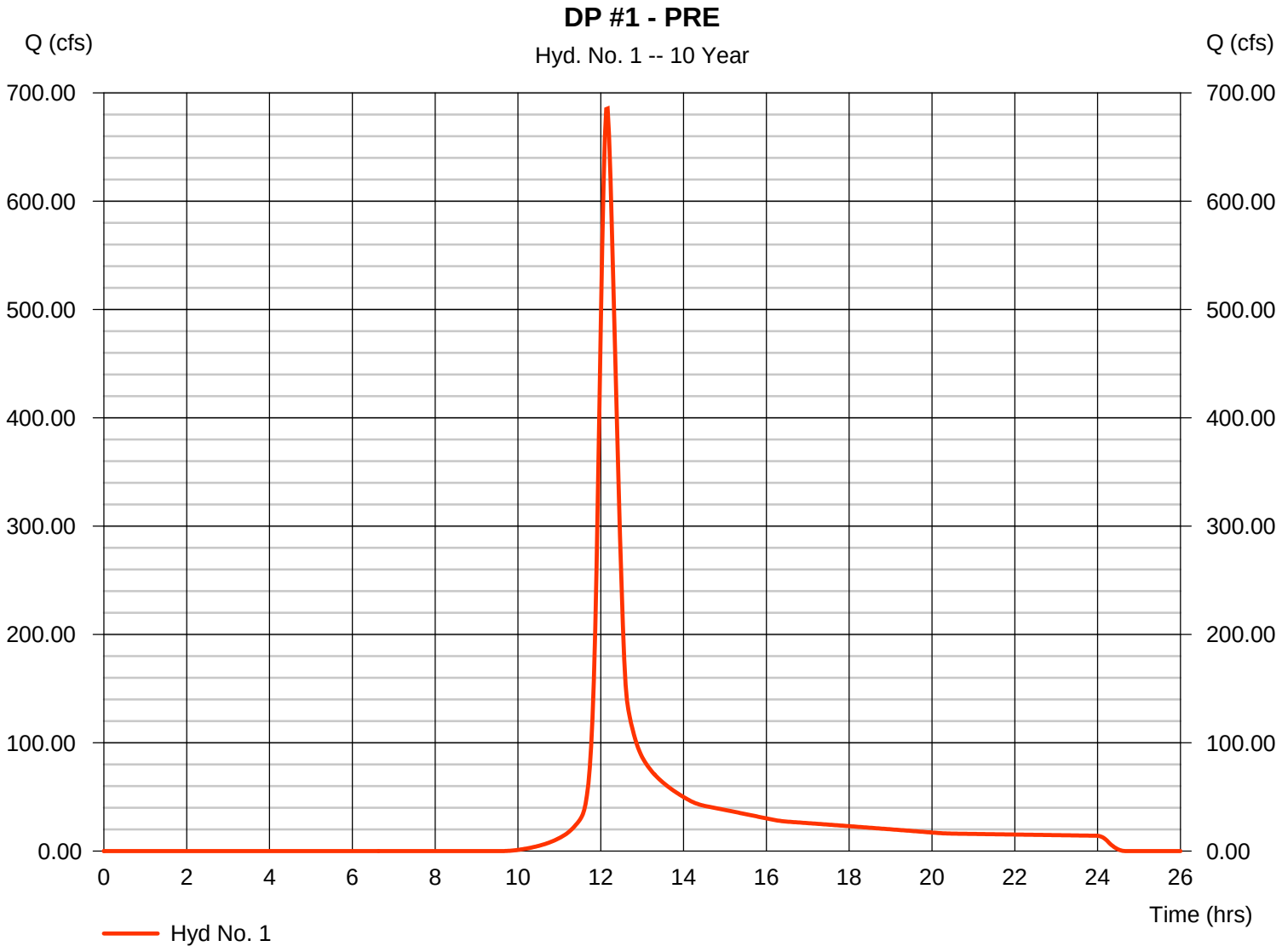
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 02 / 3 / 2025

Hyd. No. 1

DP #1 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	685.52 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	2,568,477 cuft
Drainage area	=	320.000 ac	Curve number	=	70*
Basin Slope	=	2.0 %	Hydraulic length	=	5000 ft
Tc method	=	KIRPICH	Time of conc. (Tc)	=	24.80 min
Total precip.	=	5.28 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.200 x 70) + (0.400 x 74)] / 320.000



Hydrograph Report

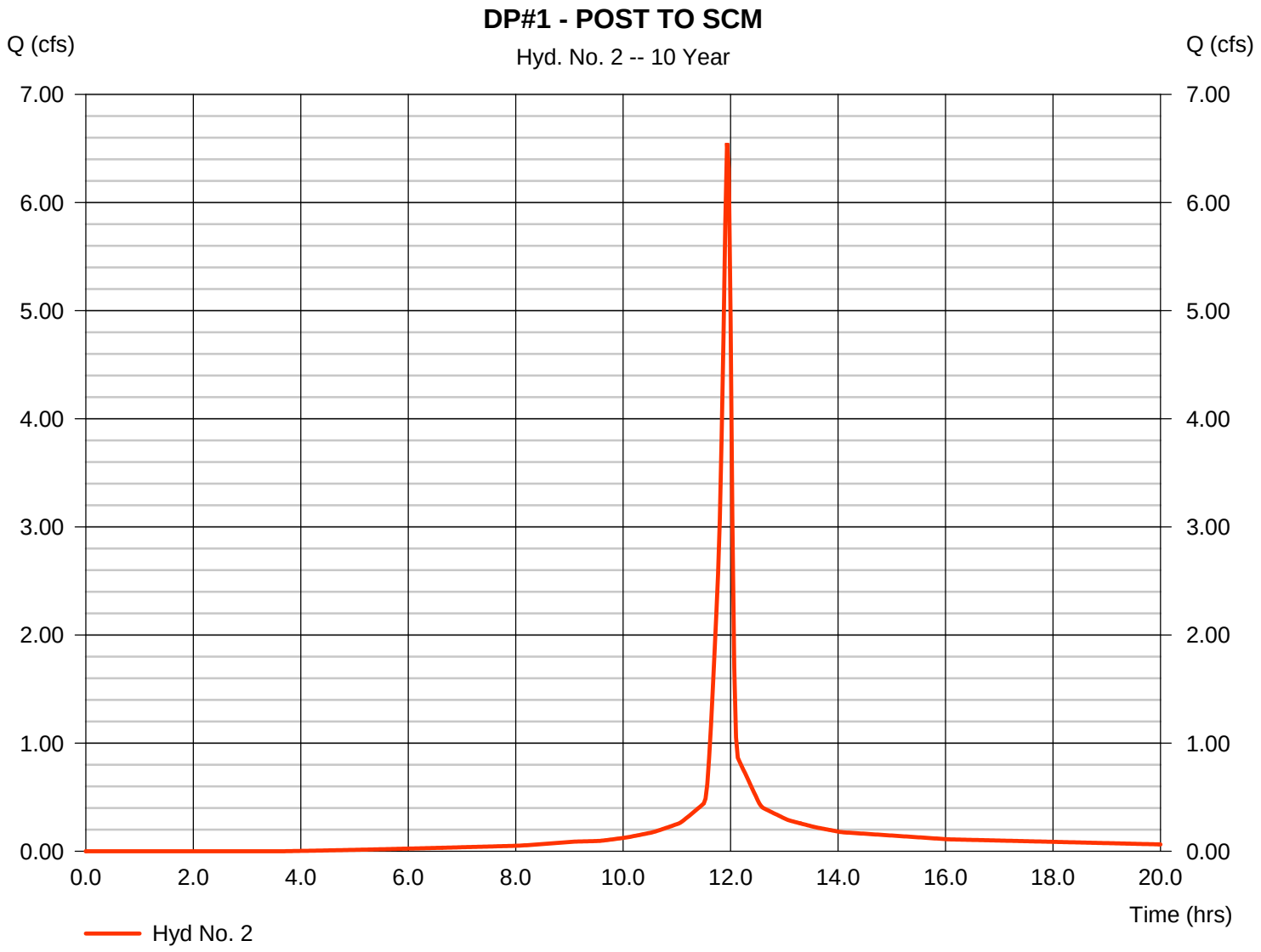
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 02 / 3 / 2025

Hyd. No. 2

DP#1 - POST TO SCM

Hydrograph type	= SCS Runoff	Peak discharge	= 6.550 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 14,112 cuft
Drainage area	= 1.000 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.680 x 98) + (0.320 x 74)] / 1.000



Hydrograph Report

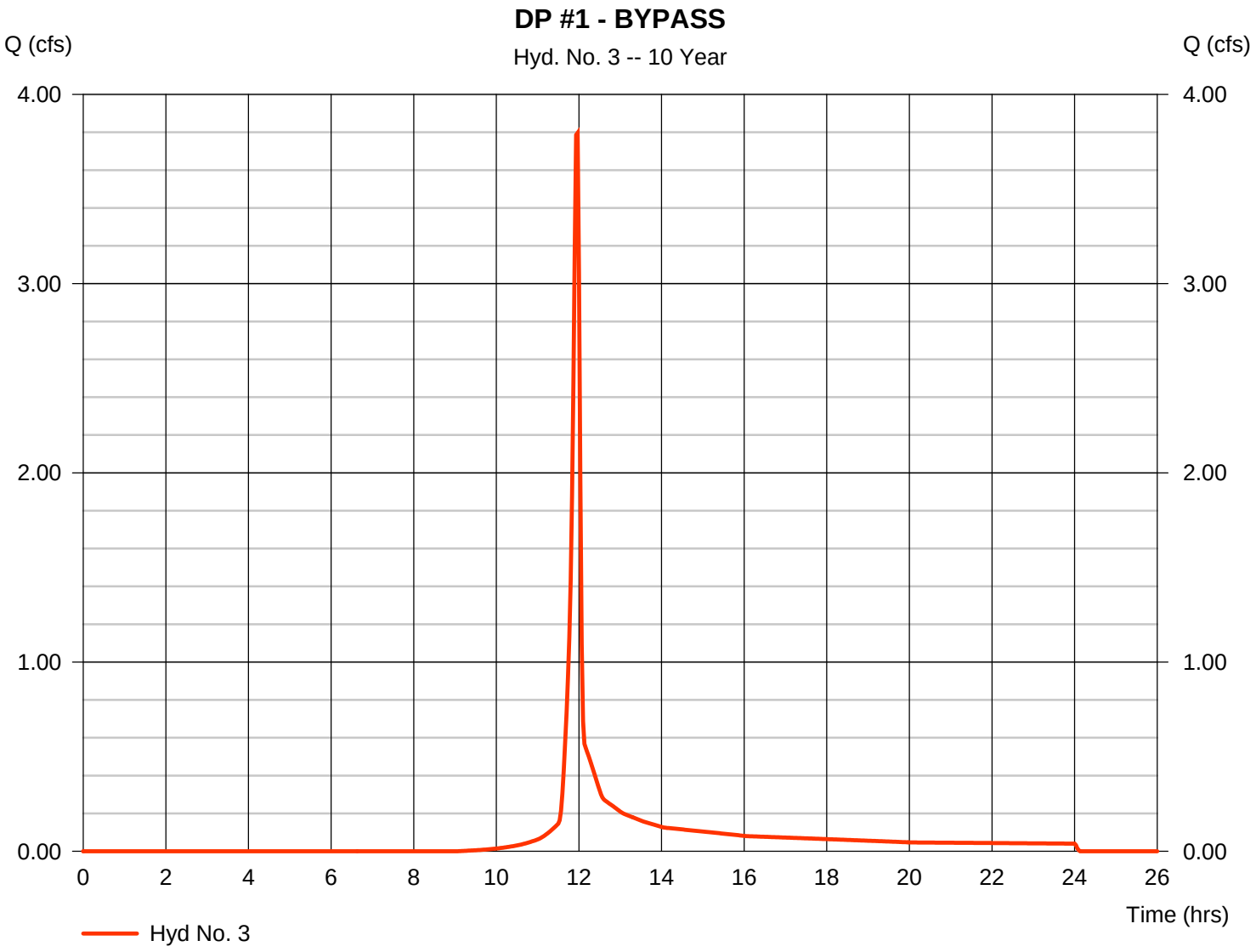
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 02 / 3 / 2025

Hyd. No. 3

DP #1 - BYPASS

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.797 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	7,645 cuft
Drainage area	=	0.930 ac	Curve number	=	72*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.28 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.460 x 70) + (0.470 x 74)] / 0.930



Hydrograph Report

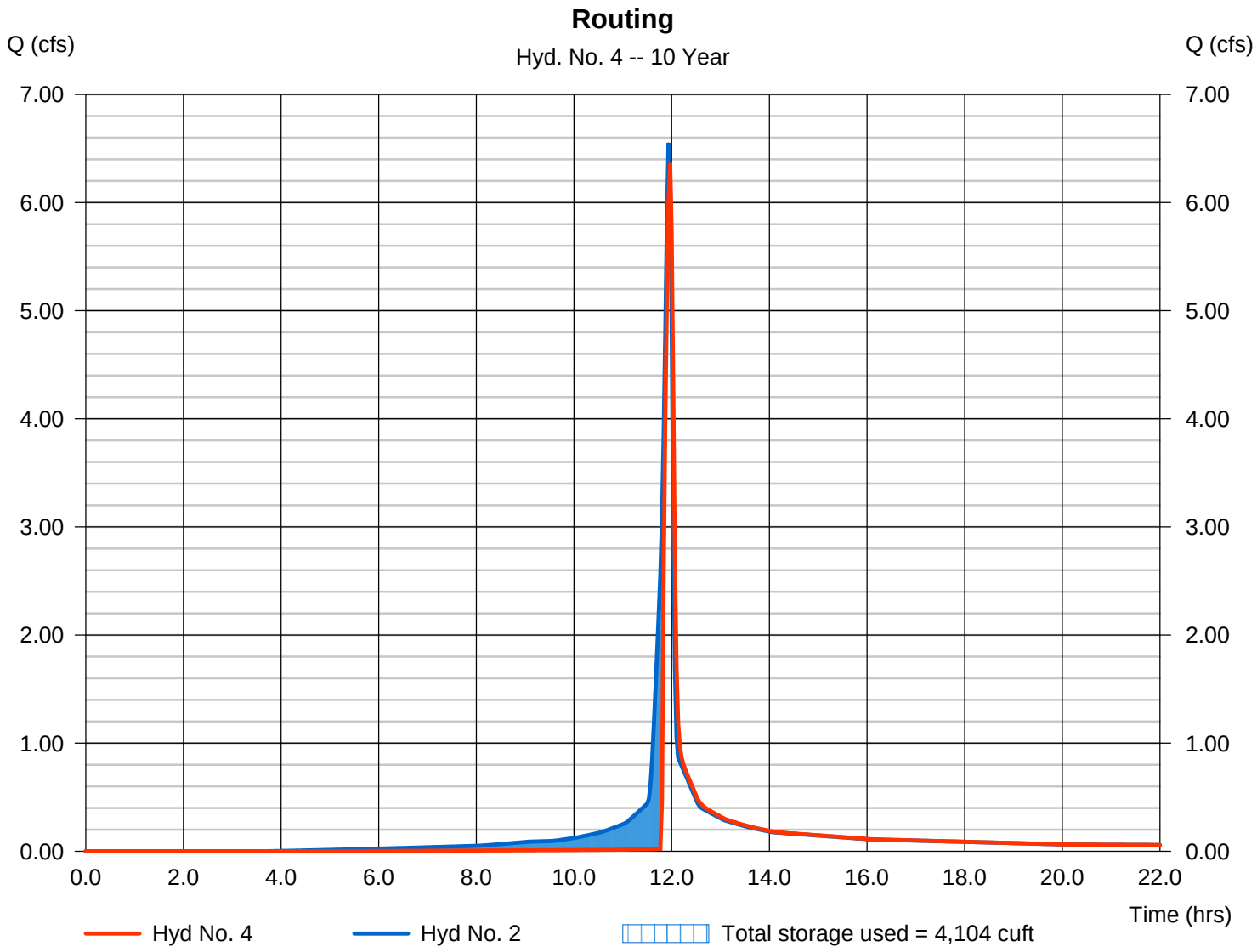
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 02 / 3 / 2025

Hyd. No. 4

Routing

Hydrograph type	=	Reservoir	Peak discharge	=	6.366 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	14,014 cuft
Inflow hyd. No.	=	2 - DP#1 - POST TO SCM	Max. Elevation	=	281.09 ft
Reservoir name	=	SCM	Max. Storage	=	4,104 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 02 / 3 / 2025

Hyd. No. 5

Total flow at Discharge point #1

Hydrograph type	=	Combine	Peak discharge	=	687.05 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	2,590,134 cuft
Inflow hyds.	=	1, 3, 4	Contrib. drain. area	=	320.930 ac