OLD BLACKSBURG HIGH SCHOOL RESIDENTIAL DEVELOPMENT

Tax Map: 227-A 4, 227-A 4C, 041-A 2

PDG # 18-0086

Stormwater Management Concept For Rezoning Application

April 30, 2019

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SECTION 1: STORMWATER MANAGEMENT

1.1 General Information

1. Existing Conditions: The site is currently occupied by a public school building, auxiliary buildings and parking lots, as well as recreational facilities and an undeveloped open space area which are outside of the proposed development area. The site is bound by Patrick Henry Drive to the southwest, Grove Avenue to the northwest, and residential properties to the east and south.

   The existing soil information and maps are shown in Appendix A. The existing soils include the following soil types:
   - 7D: Berks and Weikert very stony soils, 15 to 35 percent slopes
   - 11B: Duffield-Ernest complex, 2 to 7 percent slopes
   - 16B: Groseclose and Poplimento soils, 2 to 7 percent slopes
   - 16C: Groseclose and Poplimento soils, 7 to 15 percent slopes
   - 16D: Groseclose and Poplimento soils, 15 to 25 percent slopes
   - 29: Udorthents and Urban land

2. Proposed Conditions: The proposed development will include 111 townhomes, sidewalks, streets, and supporting infrastructure.

   Demolition of the existing school building and auxiliary structures will be permitted and completed separately, and is not included as part of this concept. Per discussions with Town Staff, the pre-development land cover prior to demolition will conditionally serve as the pre-development land cover for the residential development. During construction the demolished and undeveloped areas will become disturbed and runoff from the site will need to be controlled by temporary erosion and sediment control measures. These measures will adhere to the requirements set forth by the Virginia Erosion and Sediment Control Handbook.

3. Rainfall Values: Rainfall values were based on NOAA Atlas 14 rainfall precipitation frequency data. Rational runoff method was utilized to determine peak design flows for the storm sewer capacity analysis. Rainfall values can be found in Appendix B and are available online at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=va.

4. Time of Concentration: Times of Concentration (Tc) for drainage areas were assumed to be 6 minutes based on the minimum value permitted for the NRCS TR-55 method for hydrologic analysis. The minimum value is assumed for this site because runoff is relatively immediately collected in the storm sewer system and conveyed in this system to the analysis point.

5. Hydrologic Methodology: The NRCS TR-55 method was used to calculate pre- and post-development runoff peak flows and volumes for the site and overall watershed. Calculations were performed using Autodesk Hydraflow Hydrographs software.

6. Hydraulic Methodology: The StormTech Detention System was sized using ADS (Manufacturer) Design Tools and routed using Autodesk Hydraflow software. For the purposes of this analysis no other storm sewer analysis was completed, given the post-development Curve Numbers will be reduced from the pre-development condition. The storm sewer network will be sized and analyzed during design development for capacity to contain the 10-year storm event down to the limits of analysis.

7. Pre-Development Drainage Areas

   The pre-developed site is divided into three drainage areas as described below. Appendix B contains the pre-developed drainage map and runoff calculations. Existing conditions were evaluated using AutoCAD's Hydraflow Hydrograph's extension utilizing the SCS method. Structure 25, a curb inlet located on Patrick Henry Drive downstream of the development serves as the limit of analysis for the stormwater concept.

   Drainage areas "A" (project site) and "B" (beyond project limits) include the school, parking lots, and wooded area surrounding the property as well as a portion of the southern residential neighborhood, and is collected by an existing storm sewer network and conveys runoff off the property towards Patrick Henry Drive to Structure 25. The system ultimately outfalls to Stroubles Central Branch from a box-culvert system at a location approximately 1,050-feet north of Owens Street.

   Drainage area "C1" (off-site) includes the existing recreational area in the front of the property, a section of Patrick Henry Drive, and open space area in front of the sports complex. C1 is collected by existing storm sewers and is conveyed southwest of the property to Patrick Henry Drive, which then connects to drainage area "B".

   Drainage area "C2" (off-site) includes residences on Grove Ave and Price St, and forested area northeast of Price Street. C2 is collected by existing man-made channels and storm sewer, and is conveyed to the "C1" system.

Pre-development Land Cover Summary:

Drainage Area	Area (acres)	Impervious (acres)	Turf D Soils (acres)	Forest/Open D Soils (acres)	CN
A	13.18	8.89	4.29	-	92
B	17.09	1.95	9.54	5.60	81
C1*	18.03	-	-	-	83
C2*	13.35	-	-	-	77

*Drainage Area hydrologic data provided by Town of Blacksburg GIS.

Time of Concentration:

Drainage Area	Tc (minutes)
A	6
B	6
C1	14.5
C2	15.4

Pre-development Peak Flow Rates:

Drainage Area	Return Period				
	1-Year (cfs)	2-Year (cfs)	10-Year (cfs)	25-Year (cfs)	100-Year (cfs)
A	32.40	41.54	67.14	83.86	112.54
B	27.51	38.06	70.33	92.18	130.18
C1	19.92	28.42	54.17	71.81	102.70
C2	9.44	14.69	31.84	44.21	66.47

Refer to Figure 1 for the Pre-ReDevelopment Drainage Area Map and Appendix B for calculations.

8. Post-Development Drainage Areas

Stormwater will be collected by the proposed storm sewer system which will tie in to an existing stormwater conveyance system before ultimately discharging to the Central Branch of Stroubles Creek. This stormwater analysis is performed under the assumption that only the residential portion of the site ("Area 2" of Figure 2.2 in the Rezoning Application) is developed. Any future development (including but not limited to Area 1 or additional development within Area 2) shall independently adhere to the codes and regulations of the local and state authorities.

The post-developed project site is divided into four drainage areas. Appendix D contains the post-developed drainage map and runoff calculations for the four drainage areas. Proposed conditions were evaluated using AutoCAD's Hydraflow

Hydrograph's extension and utilizing the SCS method. Minimum Tc of 6 minutes was used except for Areas "C1" and "C2".

The proposed development will reduce the overall impervious area of the site by 1.61 acres.

Drainage area "A" will be split into two sub-drainage areas. The northeastern sub-drainage area (Area A1) will drain to a proposed storm sewer system that collects runoff to be treated by an isolator row and tied into the existing storm sewer system that eventually drains to the previously mentioned stormwater analysis point. The southwestern sub-drainage area (Area B1) will drain to existing inlets for the storm sewer system that conveys runoff to the stormwater analysis point.

Drainage area "B" will be split into to two sub-drainage areas as well. The northeastern portion (Area A2) will drain to the aforementioned proposed storm sewer system (collecting both areas A1 and A2), and the southwestern portion (Area B2) will drain to existing inlets to be conveyed to the existing storm sewer system (along with area B1).

The off-site "C1" and "C2" drainage areas will connect to the proposed Drainage Area "B1" storm system and will be included in the 10-year capacity analysis of the system.

Post-development Land Cover Summary:

Drainage Area	Area (acres)	Impervious (acres)	Turf D Soils (acres)	Woods D Soils (acres)	CN	Tc (min)
***A1**	6.60	3.72	2.88	-	90	6.0
***A2**	11.35	0.58	5.72	5.05	80	6.0
B1	6.58	3.93	2.65	-	91	6.0
B2	5.74	1.00	4.19	0.55	83	6.0

* Drainage Areas contributing to the underground detention system.

Post-development Peak Flow Rates:

Drainage Area	Peak Flow Rate				
	1-Year (cfs)	2-Year (cfs)	10-Year (cfs)	25-Year (cfs)	100-Year (cfs)
A1	14.74	19.28	32.14	40.58	55.08
A2	14.27	20.72	40.75	54.93	79.98
B1	15.44	19.98	32.80	41.18	55.57
B2	8.72	12.19	22.87	30.18	42.94

Refer to Figure 2 for the post-development drainage area map, and Appendix C for hydrologic and hydraulic calculations.

1.2 Water Quality Compliance (9VAC25-870-65)

1. The VRRM spreadsheet was used to calculate the phosphorous removal requirements for the site. While the total impervious area will be reduced by 1.61 acres as part of the development, the area of disturbance (13.74 acres) is significant enough to warrant an annual phosphorous removal requirement of 1.49 lbs. Because the project will require a reduction in peak flow rate for the 1-year storm event to satisfy energy balance requirements (as discussed in the Downstream Considerations section), the proposed StormTech Isolator Row will also satisfy the water quality requirements of this project by providing a nutrient reduction of 3.88 lbs/year.

2. Proposed Best Management Practices (BMPs)
    a. StormTech Isolator Row (Proprietary) w/ approved 40% TP removal efficiency
        i. Location: Utilized as a small-scale UGD located in open space on-site.
        ii. Total system CDA of 17.95-acres;
            a. 6.60 Acres treated by BMP (3.72-acres impervious, 2.88-acres turf).
        iii. **3.88 lbs / acre / year of phosphorus removal provided**
        iv. Refer to Appendix C for the VRRM spreadsheet.

3. Compliance:
    a. 3.88 lbs on-site removal provided (1.49 lbs removal required)

1.3 Water Quantity Compliance (9VAC-25-840-40)

Downstream Channel Adequacy – MS-19 (9VAC-25-840-40)

Downstream channel adequacy is met on this project by meeting the water quantity control criteria as outlined in 9VAC25-870-66, as described below. Each drainage area of the project was analyzed for compliance with Channel Protection (*9VAC25-870-66B)* and Flood Protection (*9VAC25-870-66C)* criteria.

1. Site Development Drainage Analysis*:*
   a. Total Drainage area (combined drainage areas reaching Limits of Analysis, see figures 1 & 2) in the pre- and post-development condition leaves the site in an existing storm sewer system towards Patrick Henry Drive.

i.	Pre-Development	Q_p 1-year	= 77.79-cfs	RV = 195,455-cf
ii.	*Post-Development*	*Q_p 1-year*	*= 74.89-cfs*	*RV = 189,235-cf*
iii.	Pre-Development	Q_p 2-year	= 108.98-cfs	RV = 273,336-cf
iv.	*Post-Development*	*Q_p 2-year*	*= 105.82-cfs*	*RV = 266,123-cf*
v.	Pre-Development	Q_p 10-year	= 202.53-cfs	RV = 514,278-cf
vi.	*Post-Development*	*Q_p 10-year*	*= 199.03-cfs*	*RV = 505,026-cf*

   b. Channel & Flood Protection Compliance: Risk of downstream erosion of natural channels reduced by utilizing StormTech Isolator Row to reduce 1-year peak flow rate from site to an acceptable value based on energy balance calculation (Energy Balance calculation provided in Appendix D). The 2 and 10-year peak flow rates and volumes are reduced, thus flooding is not anticipated due to the development associated with this project.

2. Proposed Stormwater Management Facilities
   a. Underground Detention System of one (1) Isolator Rows
      i. Basis of Design: StormTech MC4500 with Isolator Row BMP
      ii. Location: N 37° 12’ 13.36”, W 80° 24’ 28.22”
      iii. Maximum Storage: 1,221-cuft
      iv. Quantity and Quality Control

1.4 Post-Construction Inspections

1. ***BMP Description:*** ***<u>Underground Detention System</u>***

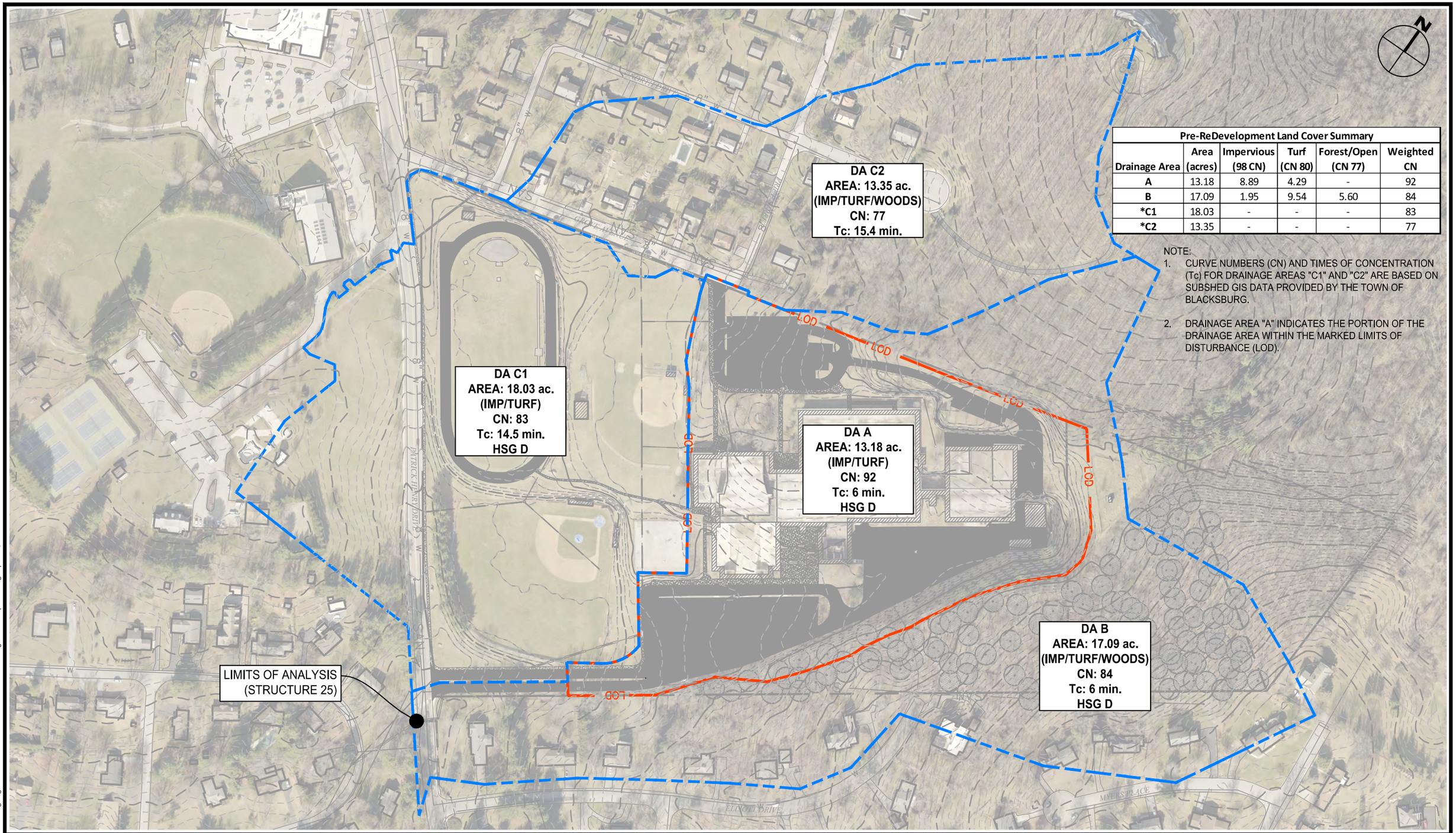
   a. Installation Schedule: Following upslope disturbance/stabilization

   b. Maintenance and Inspection:

Description	Method	Frequency	Time of year
Visual Inspection and Cleaning	When the average depth of sediment exceeds 3-inches throughout the length of the Isolator Row, clean-out should be performed. JetVac is recommended for sediment removal. Vacuum manhole sump as needed, inspect and clean upstream catch basins and manholes as needed.	Every 6 months for first year of operation, Annually thereafter	Spring

   c. Responsible Persons: Owner

Figures



Pre-ReDevelopment Land Cover Summary					
Drainage Area	Area (acres)	Impervious (98 CN)	Turf (CN 80)	Forest/Open (CN 77)	Weighted CN
A	13.18	8.89	4.29	-	92
B	17.09	1.95	9.54	5.60	84
*C1	18.03	-	-	-	83
*C2	13.35	-	-	-	77

NOTE:
1. CURVE NUMBERS (CN) AND TIMES OF CONCENTRATION (Tc) FOR DRAINAGE AREAS "C1" AND "C2" ARE BASED ON SUBSHED GIS DATA PROVIDED BY THE TOWN OF BLACKSBURG.
2. DRAINAGE AREA "A" INDICATES THE PORTION OF THE DRAINAGE AREA WITHIN THE MARKED LIMITS OF DISTURBANCE (LOD).

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DRAWN: JLK
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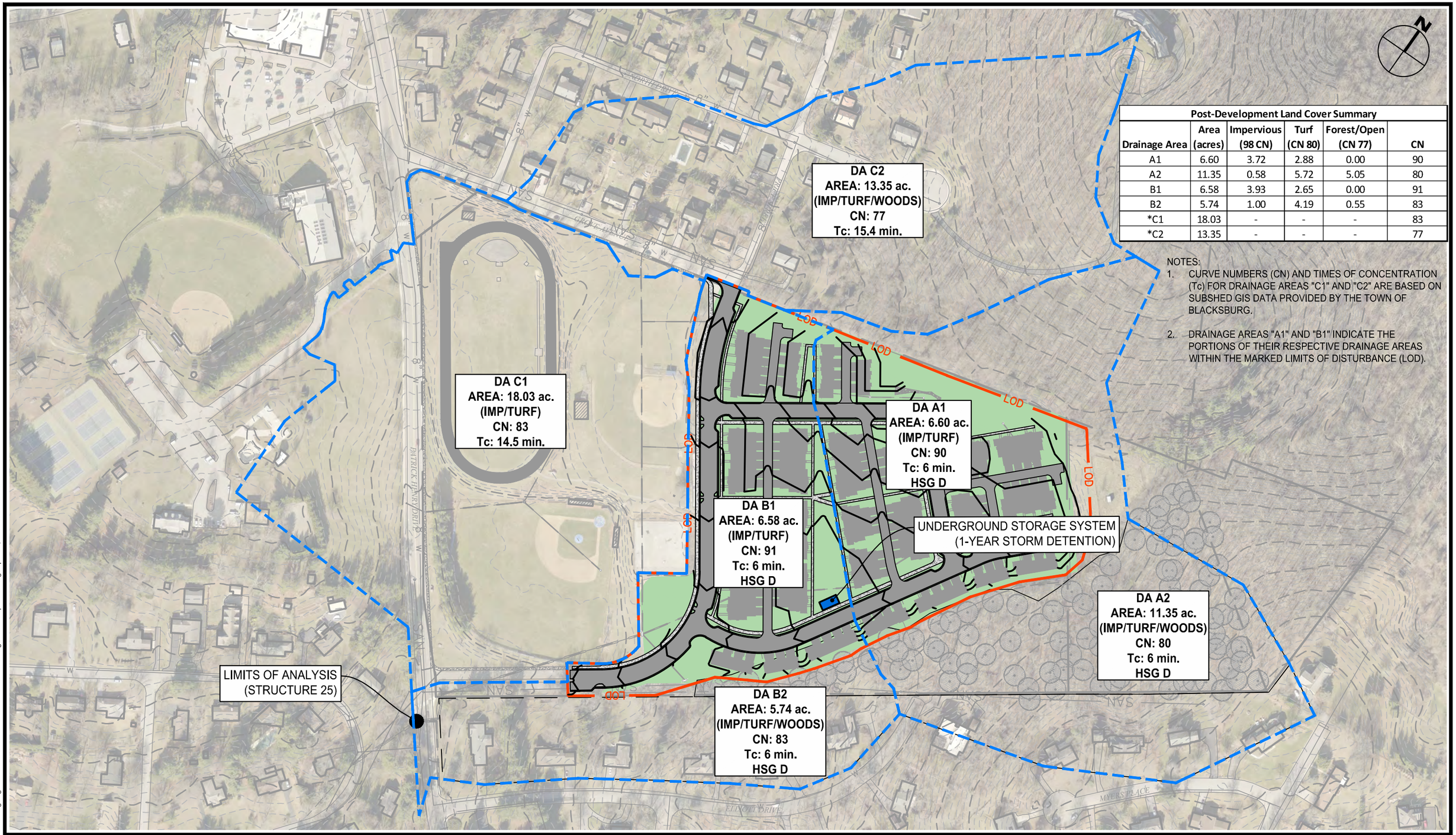
PRE-DEVELOPMENT DRAINAGE AREA MAP
OBHS STORMWATER CONCEPT PLAN
TOWN OF BLACKSBURG, VIRGINIA

SCALE: 1" = 200'
PROJECT: 18-0086

FIGURE 1

S:\2018 Projects\18-0086 Blacksburg High School\6 DWG\X-18-0086 - PRD - Drainage Area Map Pre.dwg April 29, 2019 3:13:42 PM



Post-Development Land Cover Summary

Drainage Area	Area (acres)	Impervious (98 CN)	Turf (CN 80)	Forest/Open (CN 77)	CN
A1	6.60	3.72	2.88	0.00	90
A2	11.35	0.58	5.72	5.05	80
B1	6.58	3.93	2.65	0.00	91
B2	5.74	1.00	4.19	0.55	83
*C1	18.03	-	-	-	83
*C2	13.35	-	-	-	77

NOTES:

1. CURVE NUMBERS (CN) AND TIMES OF CONCENTRATION (Tc) FOR DRAINAGE AREAS "C1" AND "C2" ARE BASED ON SUBSHED GIS DATA PROVIDED BY THE TOWN OF BLACKSBURG.
2. DRAINAGE AREAS "A1" AND "B1" INDICATE THE PORTIONS OF THEIR RESPECTIVE DRAINAGE AREAS WITHIN THE MARKED LIMITS OF DISTURBANCE (LOD).

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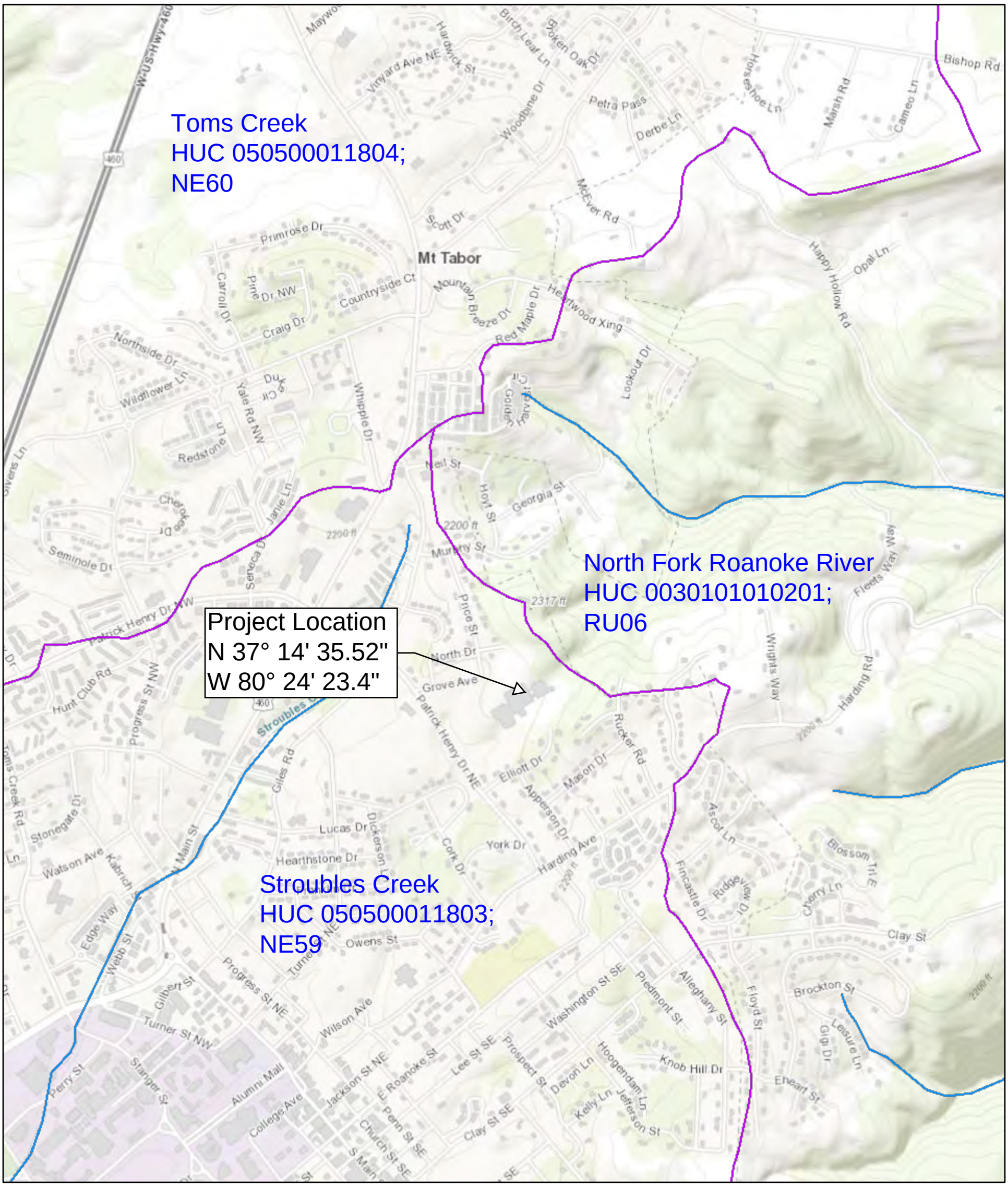
POST-DEVELOPMENT DRAINAGE AREA MAP
OBHS STORMWATER CONCEPT PLAN
TOWN OF BLACKSBURG, VIRGINIA

SCALE: 1" = 200'
PROJECT: 18-0086

FIGURE 2

S:\2018 Projects\18-0086 Blacksburg High School\6 DWG\X-18-0086 - PRD - Drainage Area Map Post.dwg April 29, 2019 8:51:08 AM

Watershed Map



4/29/2019, 4:56:53 PM

1:18,000

0 0.15 0.3 0.6 mi

0 0.25 0.5 1 km

Waterbodies

Subwatersheds

Streams

Figure 3

US EPA
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c)

Appendix A

NRCS Custom Soil Resource Report & NOAA Atlas 14 Rainfall Data

Map Scale: 1:3,260 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 22, 2012—Feb 5, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
7D	Berks and Weikert very stony soils, 15 to 35 percent slopes	1.2	3.8%
11B	Duffield-Ernest complex, 2 to 7 percent slopes	3.4	11.2%
16B	Groseclose and Poplimento soils, 2 to 7 percent slopes	1.2	4.0%
16C	Groseclose and Poplimento soils, 7 to 15 percent slopes	6.7	21.8%
16D	Groseclose and Poplimento soils, 15 to 25 percent slopes	0.9	2.8%
29	Udorthents and Urban land	17.3	56.4%
Totals for Area of Interest		**30.6**	**100.0%**

Montgomery County, Virginia

7D—Berks and Weikert very stony soils, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: kc39
Elevation: 1,700 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition

Berks and similar soils: 50 percent
Weikert and similar soils: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Berks

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 7 inches: channery silt loam
H2 - 7 to 23 inches: very channery silt loam
H3 - 23 to 33 inches: extremely channery silt loam
H4 - 33 to 79 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 1.5 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B

Forage suitability group: Droughty Soils (G128XB012VA)
Hydric soil rating: No

Description of Weikert

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 4 inches: very channery silt loam
H2 - 4 to 13 inches: very channery silt loam
H3 - 13 to 79 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Percent of area covered with surface fragments: 1.5 percent
Depth to restrictive feature: 10 to 20 inches to paralithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

Montgomery County, Virginia

11B—Duffield-Ernest complex, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: kc1q
Elevation: 1,300 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Duffield and similar soils: 45 percent
Ernest and similar soils: 35 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Duffield

Setting

Landform: Drainageways
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Loamy colluvial, alluvial, eolian sediments underlain by loamy and clayey residuum of limestone and shale

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 37 inches: silty clay loam
H3 - 37 to 79 inches: clay

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 48 to 99 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Ernest

Setting

Landform: Drainageways
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Interbedded limestone and shale residuum

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 26 inches: silty clay loam
H3 - 26 to 50 inches: silty clay loam
H4 - 50 to 79 inches: silty clay loam

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 20 to 35 inches to fragipan
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Purdy

Percent of map unit: 3 percent
Landform: Stream terraces, depressions
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

Montgomery County, Virginia

16B—Groseclose and Poplimento soils, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: kc22
Elevation: 1,700 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Groseclose and similar soils: 45 percent
Poplimento and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Groseclose

Setting

Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Limestone, shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 28 inches: clay
H3 - 28 to 39 inches: clay
H4 - 39 to 51 inches: clay
H5 - 51 to 79 inches: clay loam

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e

Hydrologic Soil Group: C
Hydric soil rating: No

Description of Poplimento

Setting

Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Limestone, shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 35 inches: clay
H3 - 35 to 55 inches: clay
H4 - 55 to 79 inches: channery silty clay loam

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Hydric soil rating: No

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

Montgomery County, Virginia

16C—Groseclose and Poplimento soils, 7 to 15 percent slopes

Map Unit Setting

National map unit symbol: kc23
Elevation: 1,700 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Groseclose and similar soils: 45 percent
Poplimento and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Groseclose

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Limestone, shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 28 inches: clay
H3 - 28 to 39 inches: clay
H4 - 39 to 51 inches: clay
H5 - 51 to 79 inches: clay loam

Properties and qualities

Slope: 7 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: C
Hydric soil rating: No

Description of Poplimento

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Limestone, shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 35 inches: clay
H3 - 35 to 55 inches: clay
H4 - 55 to 79 inches: channery silty clay loam

Properties and qualities

Slope: 7 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

Montgomery County, Virginia

16D—Groseclose and Poplimento soils, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: kc24
Elevation: 1,700 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Groseclose and similar soils: 45 percent
Poplimento and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Groseclose

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Limestone, shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 10 inches: loam
H2 - 10 to 28 inches: clay
H3 - 28 to 39 inches: clay
H4 - 39 to 51 inches: clay
H5 - 51 to 79 inches: clay loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: C
Hydric soil rating: No

Description of Poplimento

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Limestone, shale, siltstone, and sandstone residuum

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 35 inches: clay
H3 - 35 to 55 inches: clay
H4 - 55 to 79 inches: channery silty clay loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

Montgomery County, Virginia

29—Udorthents and Urban land

Map Unit Setting

National map unit symbol: kc2r
Elevation: 1,300 to 3,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 117 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 45 percent
Urban land: 30 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Landform: Hills
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Limestone, shale, sandstone, or granite residuum

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Description of Urban Land

Setting

Landform: Hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Limestone, shale, sandstone, or granite residuum

Minor Components

Purdy

Percent of map unit: 3 percent
Landform: Stream terraces, depressions
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Montgomery County, Virginia
Survey Area Data: Version 11, Aug 28, 2018

NOAA Atlas 14, Volume 2, Version 3
BLACKSBURG 3 SE
Station ID: 44-0766
Location name: Blacksburg, Virginia, USA*
Latitude: 37.2017°, Longitude: -80.4133°
Elevation:
Elevation (station metadata): 2100 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	0.297 (0.270-0.329)	0.354 (0.321-0.393)	0.426 (0.385-0.472)	0.477 (0.429-0.527)	0.540 (0.483-0.596)	0.583 (0.518-0.646)	0.626 (0.551-0.696)	0.665 (0.580-0.743)	0.712 (0.612-0.803)	0.747 (0.633-0.848)
10-min	0.475 (0.431-0.525)	0.567 (0.514-0.628)	0.682 (0.616-0.755)	0.763 (0.687-0.843)	0.860 (0.769-0.950)	0.929 (0.825-1.03)	0.995 (0.876-1.11)	1.06 (0.919-1.18)	1.13 (0.968-1.27)	1.18 (0.997-1.34)
15-min	0.594 (0.538-0.656)	0.713 (0.646-0.790)	0.862 (0.779-0.955)	0.965 (0.869-1.07)	1.09 (0.975-1.21)	1.18 (1.04-1.30)	1.26 (1.11-1.40)	1.33 (1.16-1.49)	1.42 (1.22-1.60)	1.48 (1.25-1.68)
30-min	0.814 (0.738-0.900)	0.984 (0.892-1.09)	1.23 (1.11-1.36)	1.40 (1.26-1.55)	1.62 (1.44-1.78)	1.77 (1.57-1.96)	1.93 (1.70-2.14)	2.07 (1.81-2.31)	2.26 (1.94-2.54)	2.39 (2.03-2.72)
60-min	1.01 (0.920-1.12)	1.24 (1.12-1.37)	1.57 (1.42-1.74)	1.82 (1.64-2.01)	2.15 (1.92-2.38)	2.40 (2.13-2.66)	2.65 (2.34-2.95)	2.91 (2.53-3.25)	3.24 (2.78-3.65)	3.49 (2.96-3.96)
2-hr	1.18 (1.07-1.30)	1.43 (1.30-1.59)	1.83 (1.66-2.02)	2.13 (1.93-2.36)	2.54 (2.27-2.81)	2.86 (2.54-3.16)	3.18 (2.80-3.53)	3.50 (3.05-3.91)	3.93 (3.36-4.43)	4.26 (3.60-4.85)
3-hr	1.27 (1.15-1.40)	1.54 (1.40-1.70)	1.95 (1.77-2.15)	2.27 (2.06-2.50)	2.70 (2.43-2.97)	3.04 (2.71-3.35)	3.38 (2.99-3.75)	3.74 (3.26-4.16)	4.21 (3.61-4.74)	4.58 (3.86-5.21)
6-hr	1.55 (1.43-1.69)	1.87 (1.72-2.04)	2.34 (2.15-2.56)	2.73 (2.49-2.98)	3.26 (2.95-3.57)	3.69 (3.31-4.05)	4.14 (3.67-4.56)	4.62 (4.04-5.11)	5.29 (4.51-5.91)	5.82 (4.87-6.56)
12-hr	1.87 (1.73-2.05)	2.25 (2.08-2.46)	2.82 (2.59-3.08)	3.29 (3.01-3.59)	3.96 (3.59-4.32)	4.53 (4.06-4.95)	5.14 (4.54-5.63)	5.80 (5.03-6.40)	6.76 (5.71-7.55)	7.55 (6.24-8.52)
24-hr	2.28 (2.12-2.46)	2.76 (2.56-2.98)	3.51 (3.25-3.78)	4.11 (3.80-4.43)	5.00 (4.60-5.38)	5.74 (5.24-6.17)	6.54 (5.93-7.02)	7.40 (6.66-7.95)	8.66 (7.68-9.33)	9.70 (8.52-10.5)
2-day	2.71 (2.52-2.92)	3.28 (3.05-3.54)	4.14 (3.84-4.46)	4.84 (4.47-5.20)	5.83 (5.36-6.26)	6.65 (6.09-7.14)	7.52 (6.85-8.09)	8.46 (7.64-9.10)	9.79 (8.75-10.6)	10.9 (9.62-11.8)
3-day	2.88 (2.69-3.10)	3.48 (3.24-3.75)	4.39 (4.08-4.72)	5.11 (4.75-5.49)	6.15 (5.68-6.59)	7.00 (6.43-7.51)	7.90 (7.22-8.48)	8.86 (8.03-9.52)	10.2 (9.16-11.0)	11.4 (10.1-12.3)
4-day	3.05 (2.85-3.28)	3.69 (3.44-3.96)	4.63 (4.32-4.97)	5.39 (5.02-5.78)	6.47 (5.99-6.93)	7.35 (6.77-7.87)	8.29 (7.59-8.88)	9.27 (8.42-9.94)	10.7 (9.58-11.5)	11.8 (10.5-12.8)
7-day	3.55 (3.31-3.81)	4.27 (3.99-4.59)	5.31 (4.95-5.70)	6.13 (5.70-6.58)	7.27 (6.73-7.79)	8.19 (7.55-8.77)	9.14 (8.39-9.81)	10.1 (9.24-10.9)	11.5 (10.4-12.4)	12.6 (11.3-13.6)
10-day	4.09 (3.83-4.37)	4.91 (4.60-5.24)	6.00 (5.61-6.41)	6.85 (6.39-7.30)	7.99 (7.43-8.51)	8.87 (8.22-9.46)	9.77 (9.02-10.4)	10.7 (9.81-11.4)	11.9 (10.9-12.8)	12.9 (11.7-13.8)
20-day	5.56 (5.24-5.89)	6.61 (6.24-7.01)	7.92 (7.47-8.40)	8.94 (8.42-9.47)	10.3 (9.68-10.9)	11.4 (10.6-12.0)	12.5 (11.6-13.2)	13.5 (12.5-14.4)	15.0 (13.8-15.9)	16.1 (14.7-17.2)
30-day	6.90 (6.52-7.30)	8.17 (7.71-8.63)	9.60 (9.06-10.1)	10.7 (10.1-11.3)	12.1 (11.4-12.8)	13.2 (12.3-13.9)	14.2 (13.3-15.0)	15.2 (14.1-16.1)	16.5 (15.3-17.5)	17.5 (16.1-18.6)
45-day	8.75 (8.30-9.22)	10.3 (9.76-10.8)	11.9 (11.3-12.5)	13.1 (12.4-13.8)	14.7 (13.8-15.4)	15.8 (14.9-16.6)	16.9 (15.8-17.8)	17.9 (16.8-18.9)	19.2 (17.9-20.3)	20.1 (18.7-21.3)
60-day	10.5 (10.0-11.1)	12.3 (11.7-13.0)	14.1 (13.4-14.8)	15.3 (14.6-16.1)	16.9 (16.1-17.8)	18.1 (17.1-19.0)	19.1 (18.1-20.1)	20.1 (19.0-21.2)	21.3 (20.0-22.5)	22.1 (20.8-23.4)

[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

Appendix B

Pre-Development Stormwater Calculations

Hydrograph Report

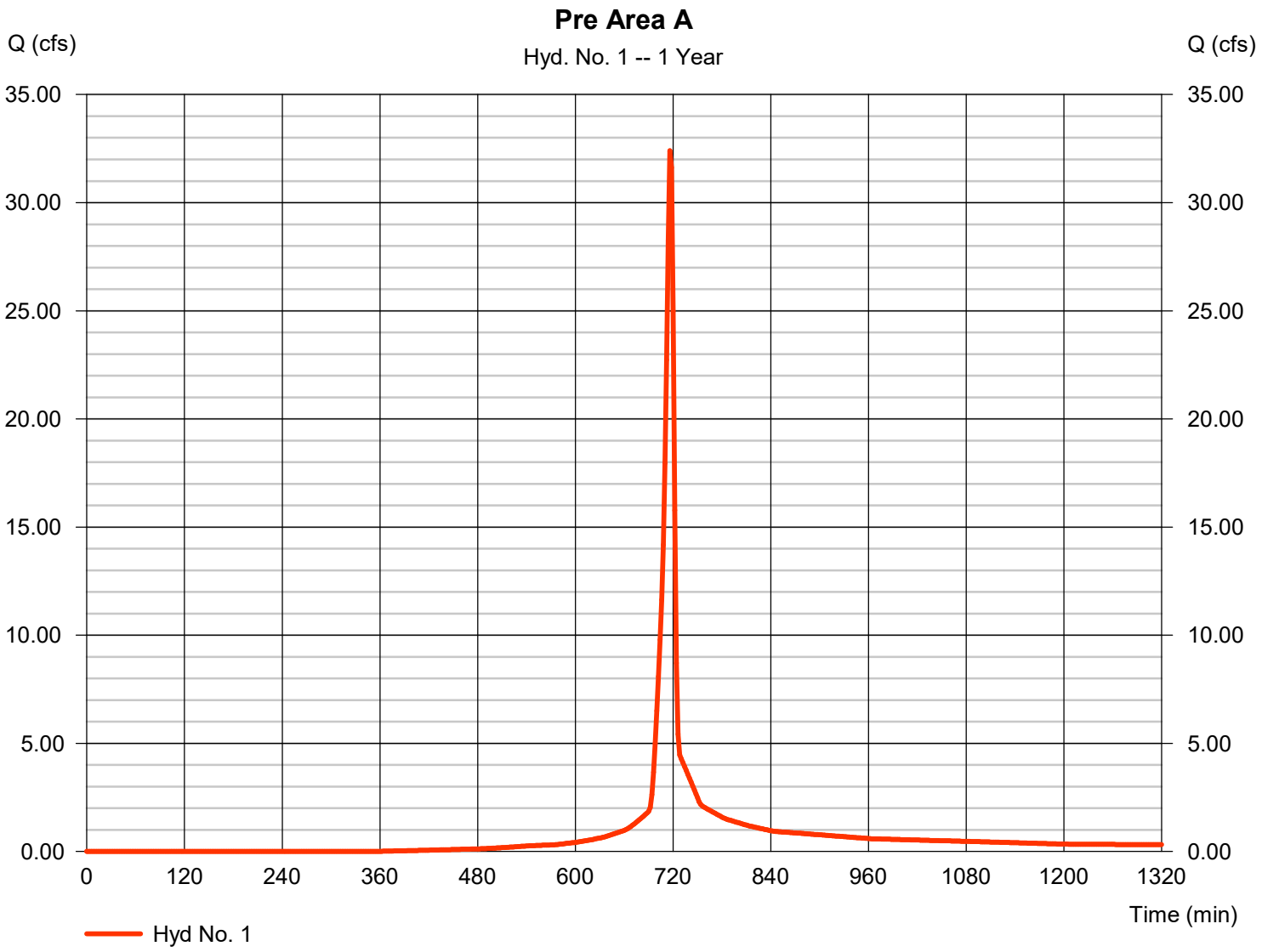
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 1

Pre Area A

Hydrograph type	= SCS Runoff	Peak discharge	= 32.40 cfs
Storm frequency	= 1 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 66,860 cuft
Drainage area	= 13.180 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(8.890 x 98) + (4.290 x 80)] / 13.180



Hydrograph Report

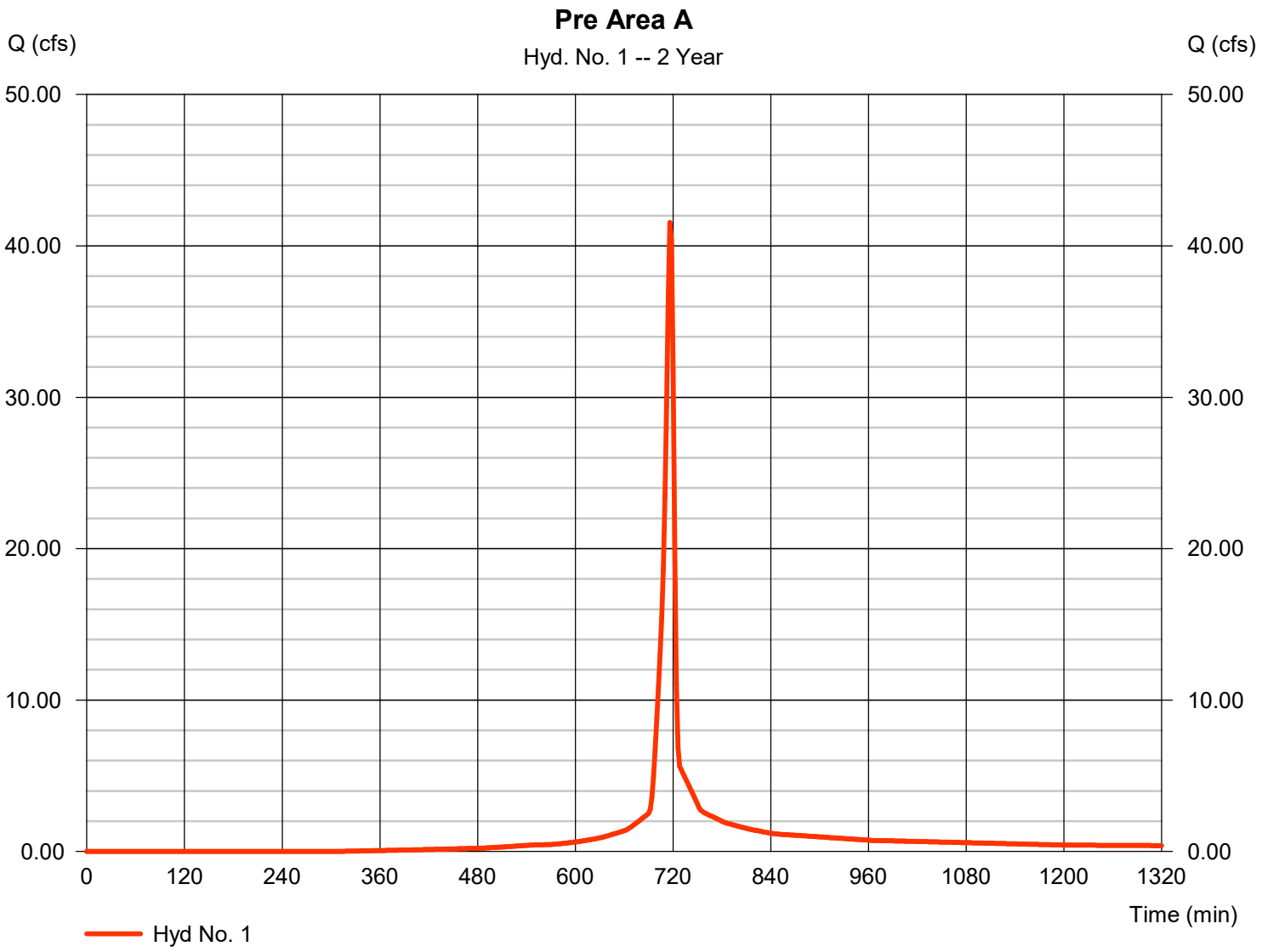
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 1

Pre Area A

Hydrograph type	= SCS Runoff	Peak discharge	= 41.54 cfs
Storm frequency	= 2 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 86,806 cuft
Drainage area	= 13.180 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.76 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(8.890 x 98) + (4.290 x 80)] / 13.180



Hydrograph Report

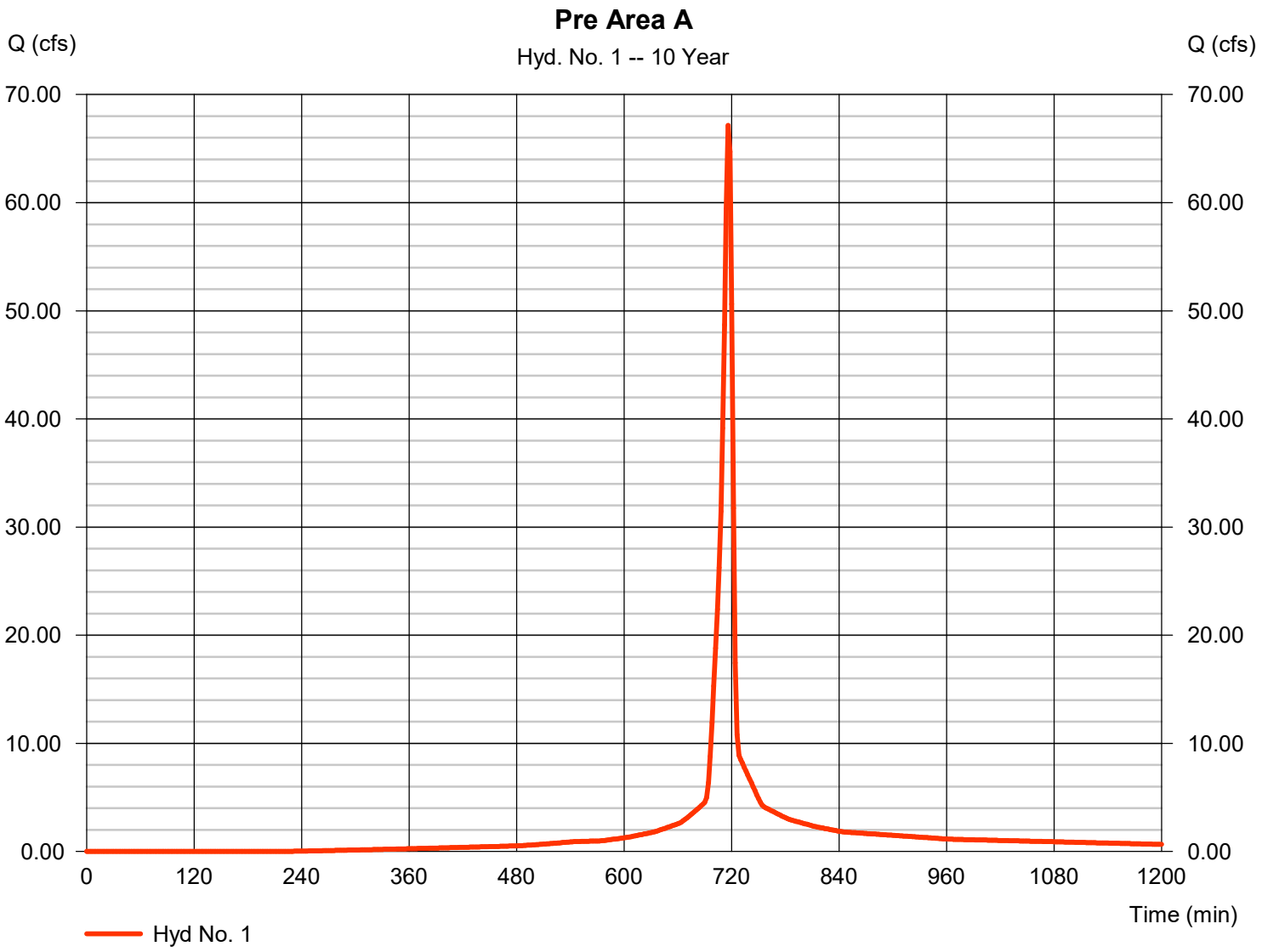
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 1

Pre Area A

Hydrograph type	= SCS Runoff	Peak discharge	= 67.14 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 144,601 cuft
Drainage area	= 13.180 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(8.890 x 98) + (4.290 x 80)] / 13.180



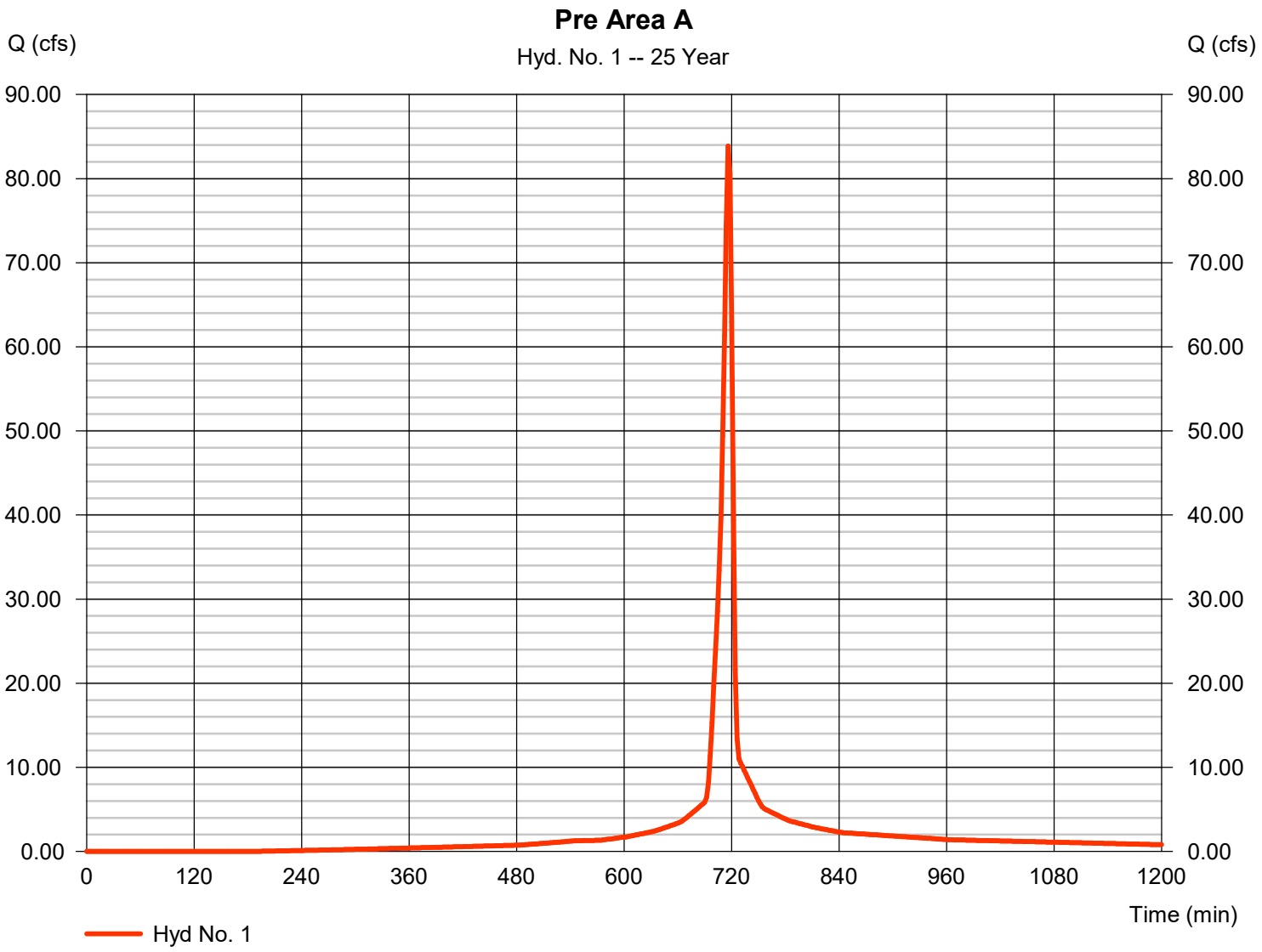
Hydrograph Report

Hyd. No. 1

Pre Area A

Hydrograph type	= SCS Runoff	Peak discharge	= 83.86 cfs
Storm frequency	= 25 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 183,417 cuft
Drainage area	= 13.180 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(8.890 x 98) + (4.290 x 80)] / 13.180



Hydrograph Report

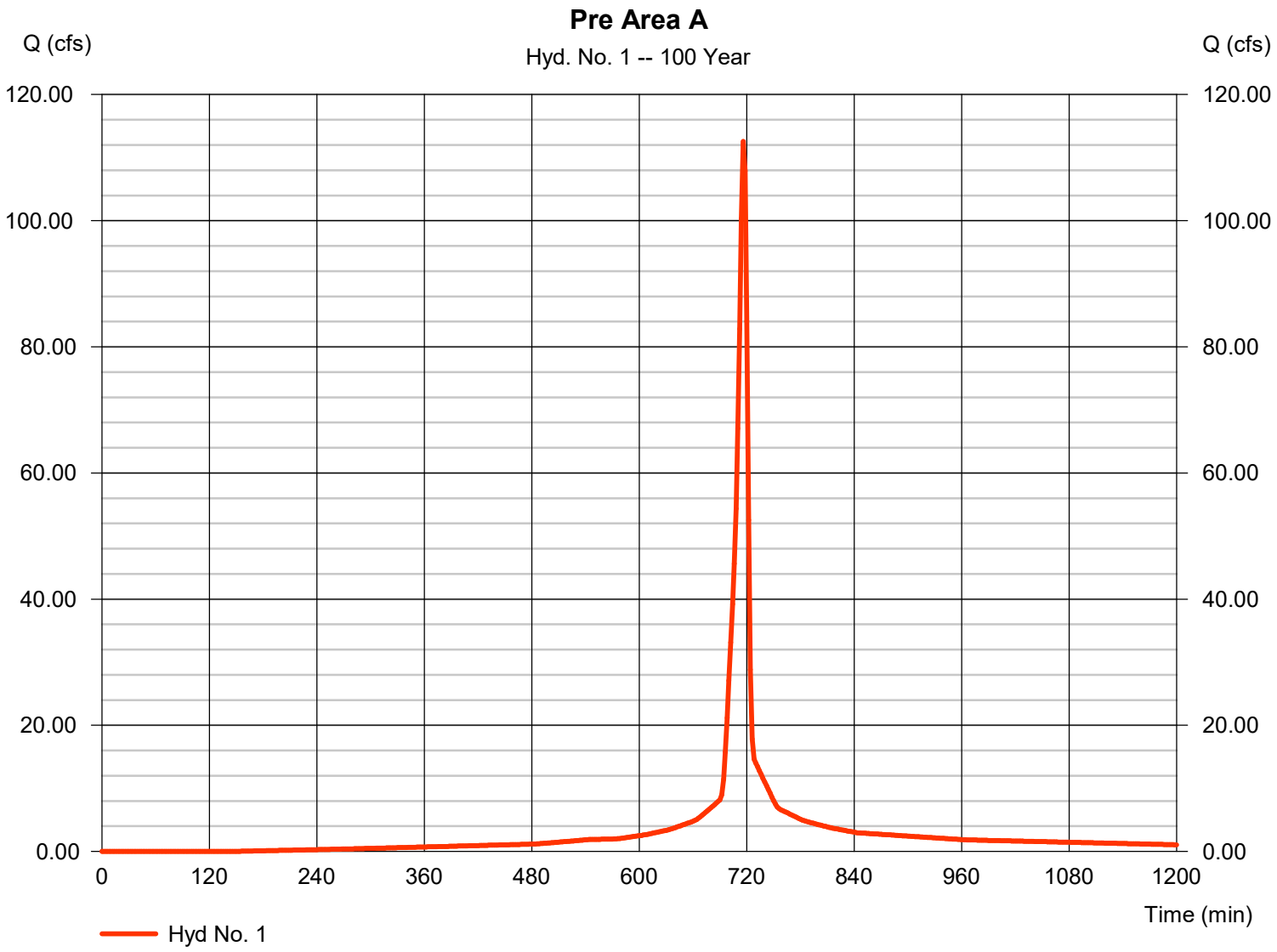
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 1

Pre Area A

Hydrograph type	= SCS Runoff	Peak discharge	= 112.54 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 251,224 cuft
Drainage area	= 13.180 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.54 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(8.890 x 98) + (4.290 x 80)] / 13.180



Hydrograph Report

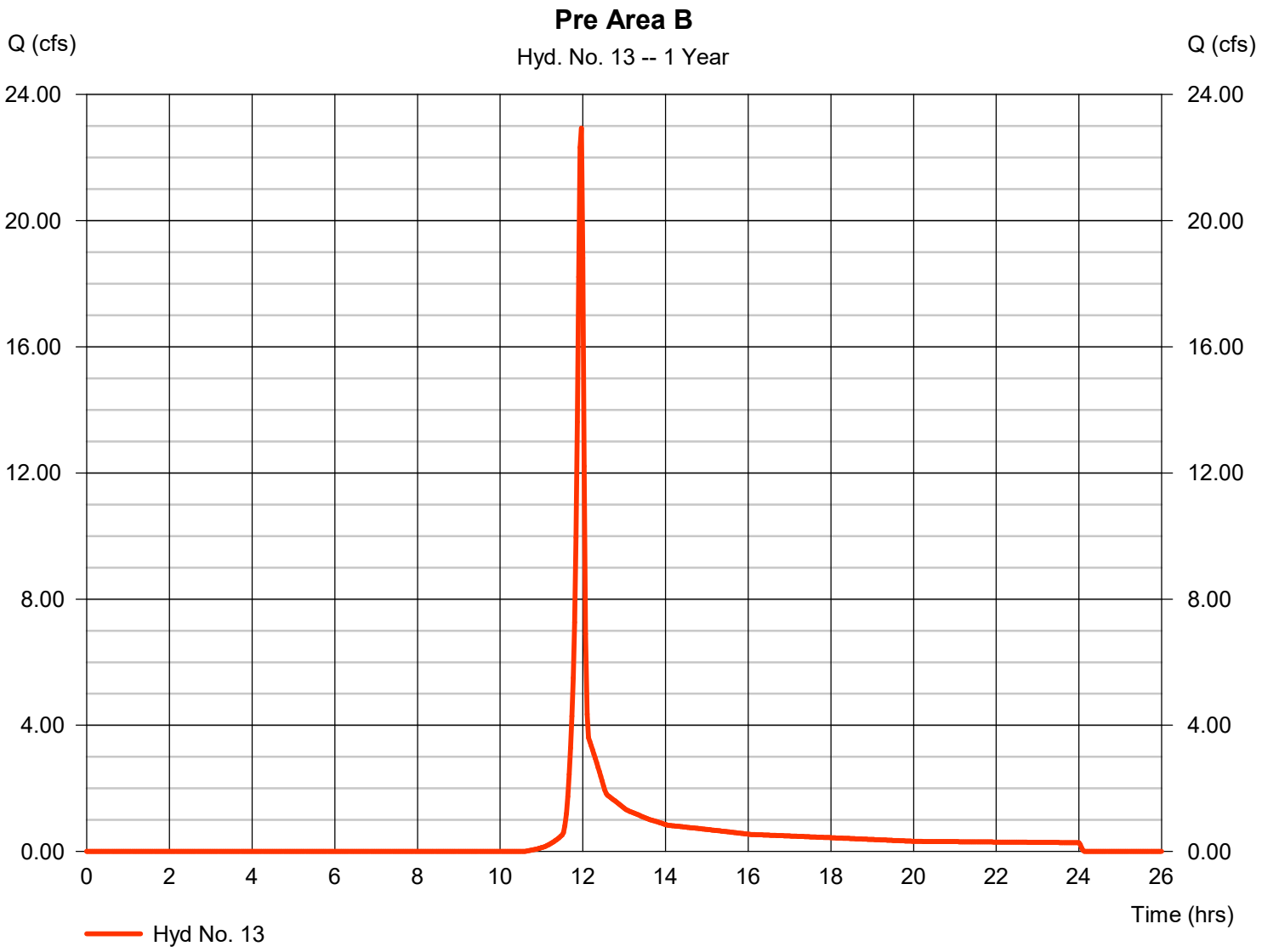
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 13

Pre Area B

Hydrograph type	= SCS Runoff	Peak discharge	= 22.93 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 45,884 cuft
Drainage area	= 17.090 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.530 x 98) + (3.860 x 80) + (5.600 x 77) + (7.100 x 84)] / 17.090



Hydrograph Report

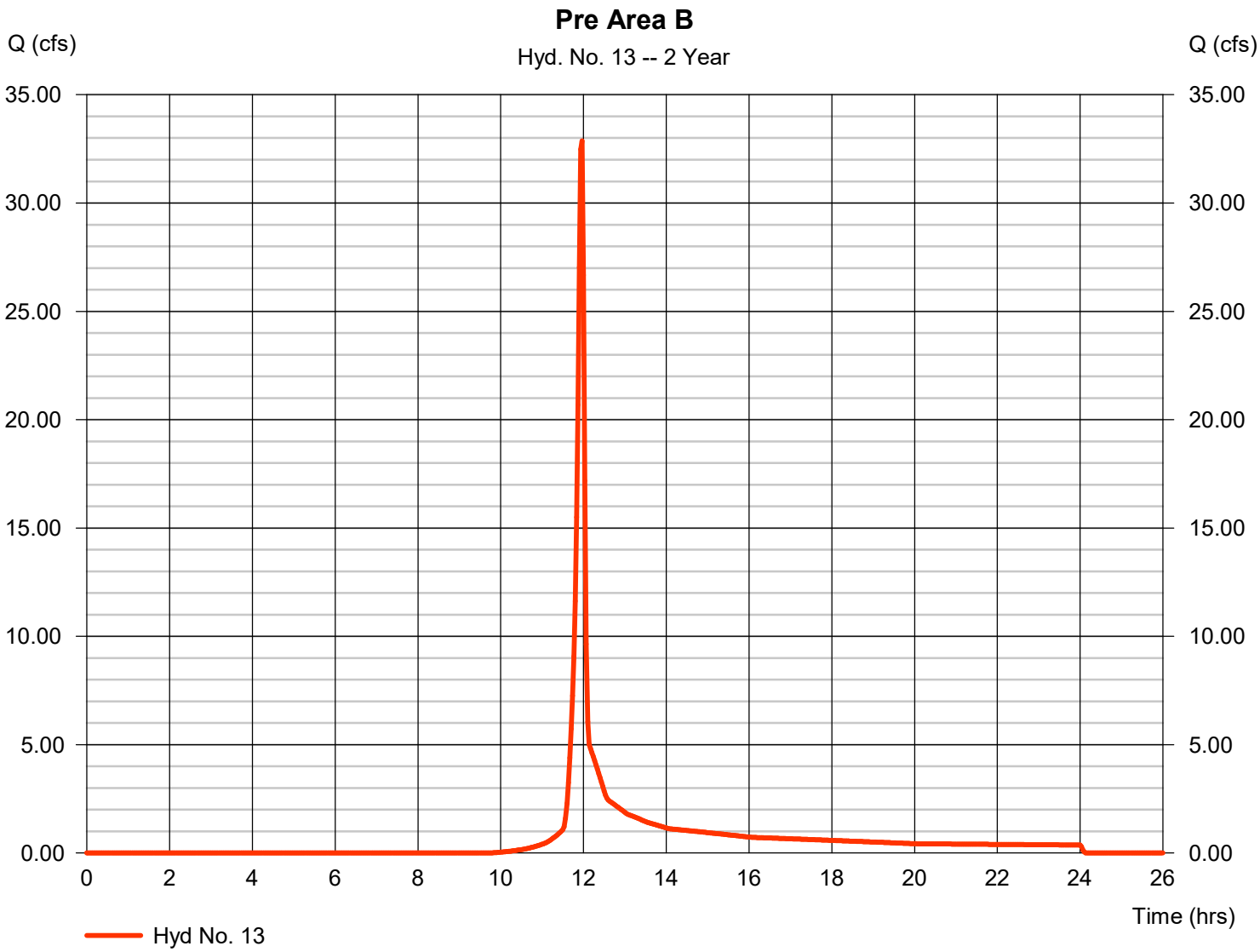
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 13

Pre Area B

Hydrograph type	= SCS Runoff	Peak discharge	= 32.86 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 65,830 cuft
Drainage area	= 17.090 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.76 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.530 x 98) + (3.860 x 80) + (5.600 x 77) + (7.100 x 84)] / 17.090



Hydrograph Report

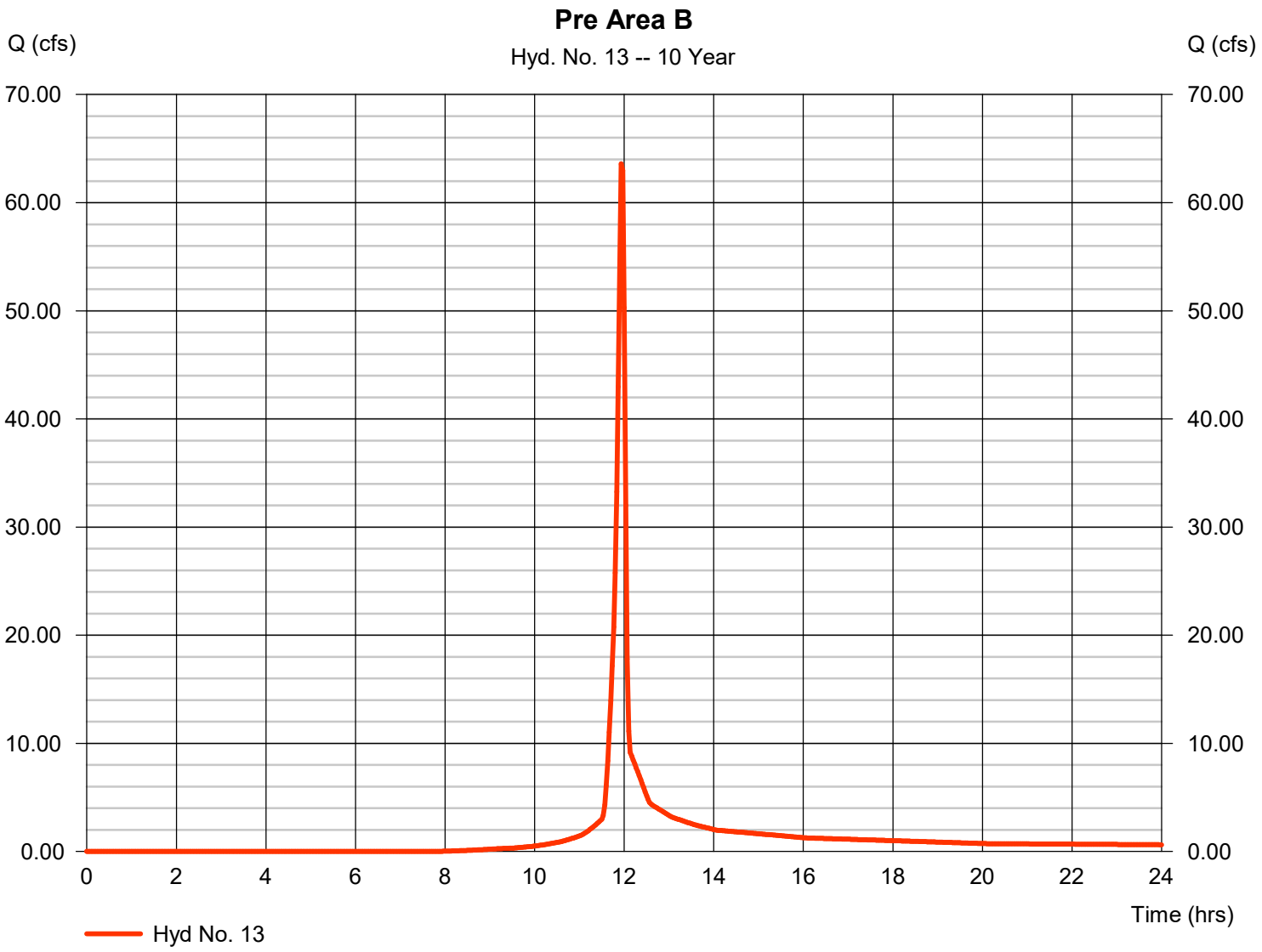
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 13

Pre Area B

Hydrograph type	= SCS Runoff	Peak discharge	= 63.60 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 128,781 cuft
Drainage area	= 17.090 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.530 x 98) + (3.860 x 80) + (5.600 x 77) + (7.100 x 84)] / 17.090



Hydrograph Report

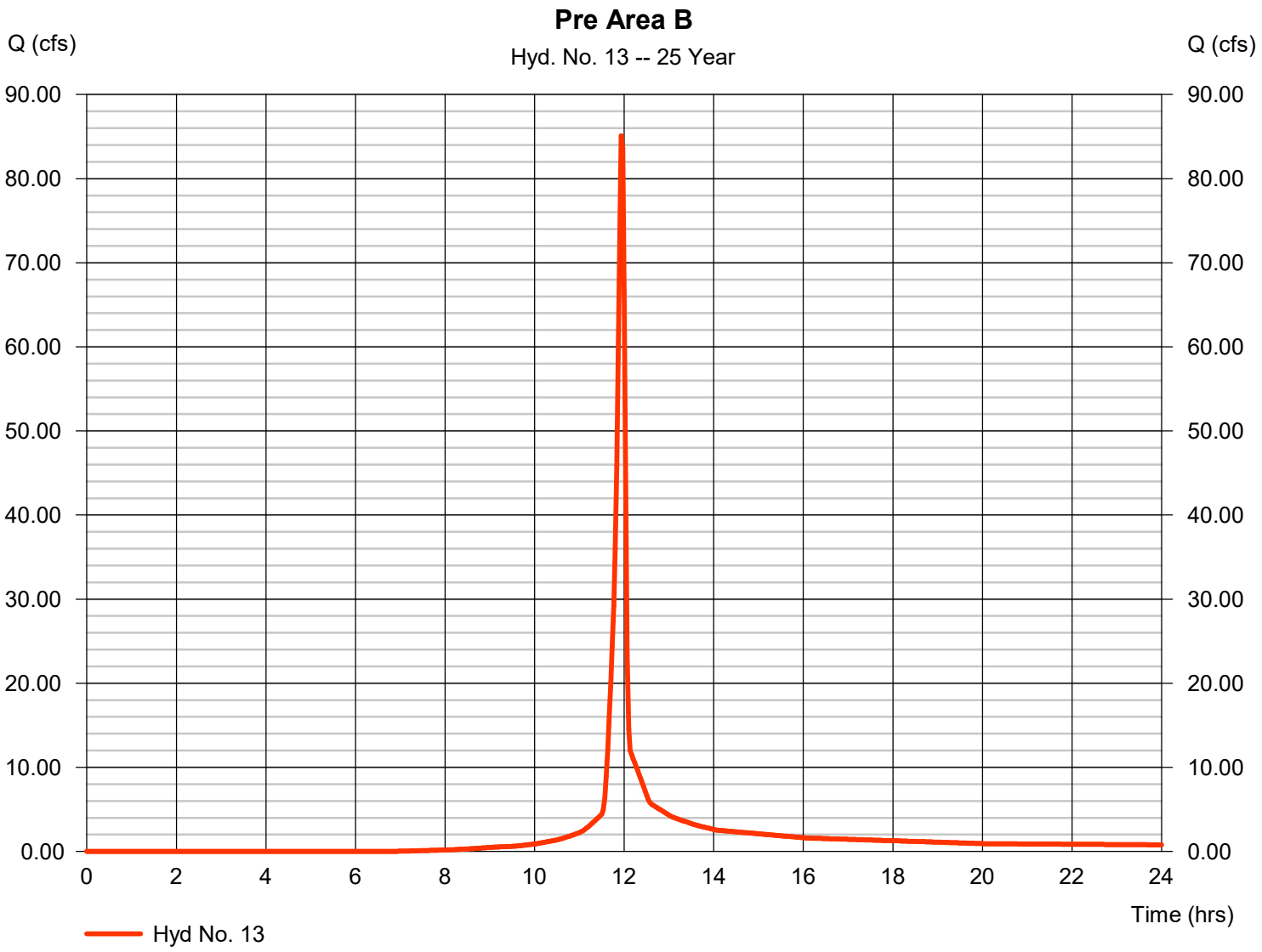
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 13

Pre Area B

Hydrograph type	= SCS Runoff	Peak discharge	= 85.11 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 173,625 cuft
Drainage area	= 17.090 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.530 x 98) + (3.860 x 80) + (5.600 x 77) + (7.100 x 84)] / 17.090



Hydrograph Report

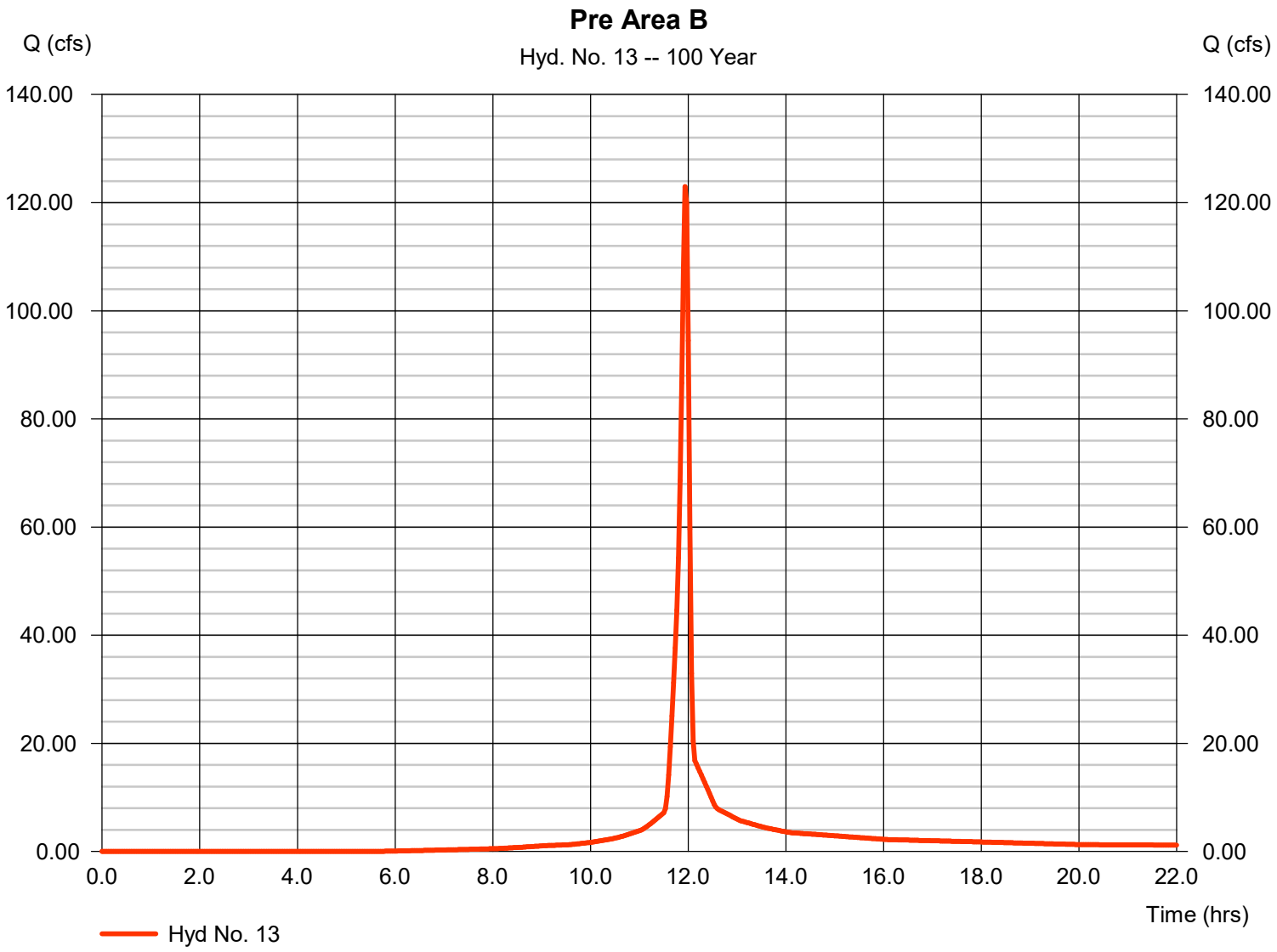
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 13

Pre Area B

Hydrograph type	= SCS Runoff	Peak discharge	= 122.95 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 254,676 cuft
Drainage area	= 17.090 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.54 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.530 x 98) + (3.860 x 80) + (5.600 x 77) + (7.100 x 84)] / 17.090



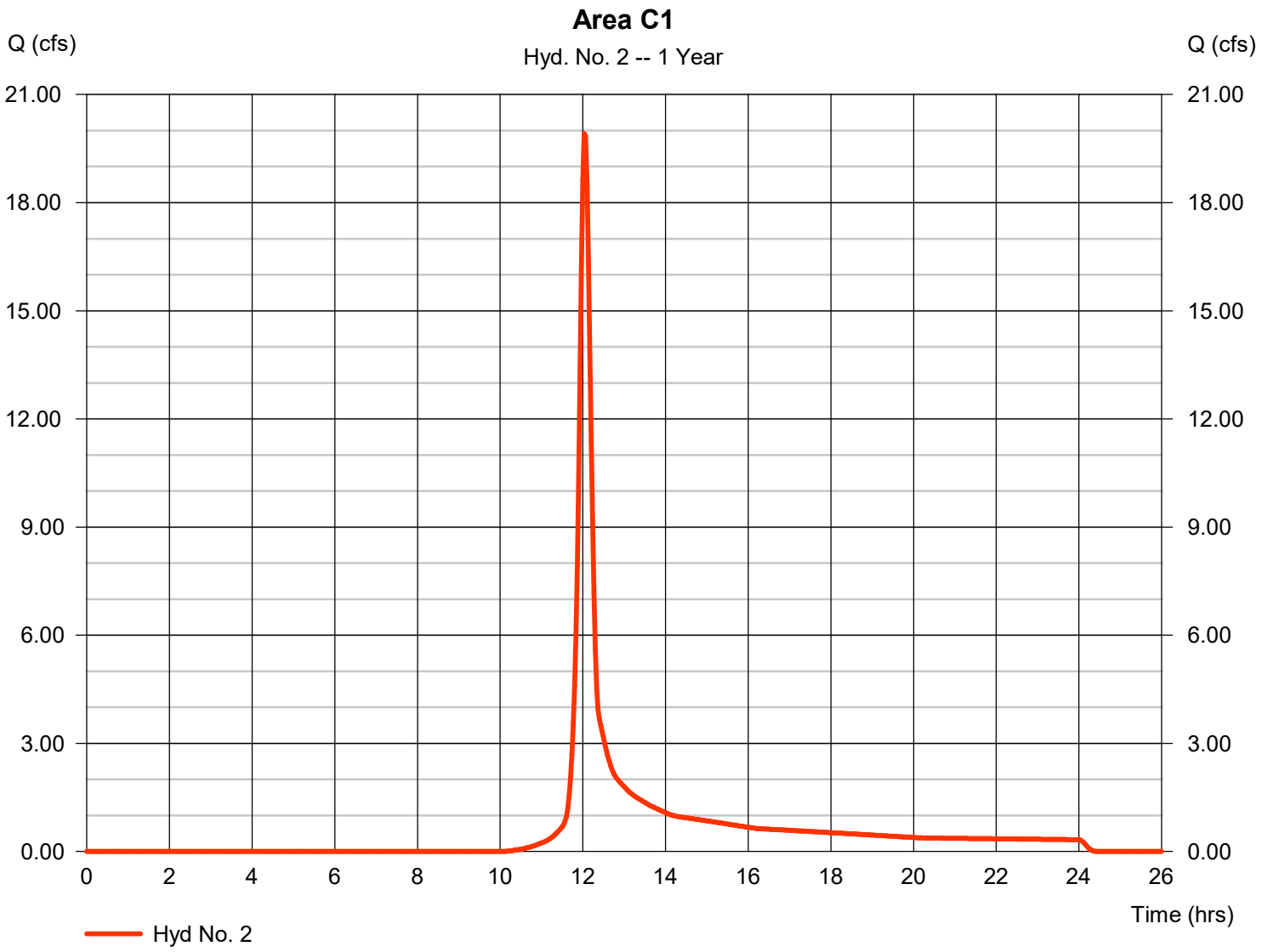
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 2

Area C1

Hydrograph type	= SCS Runoff	Peak discharge	= 19.92 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 56,968 cuft
Drainage area	= 18.030 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.50 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



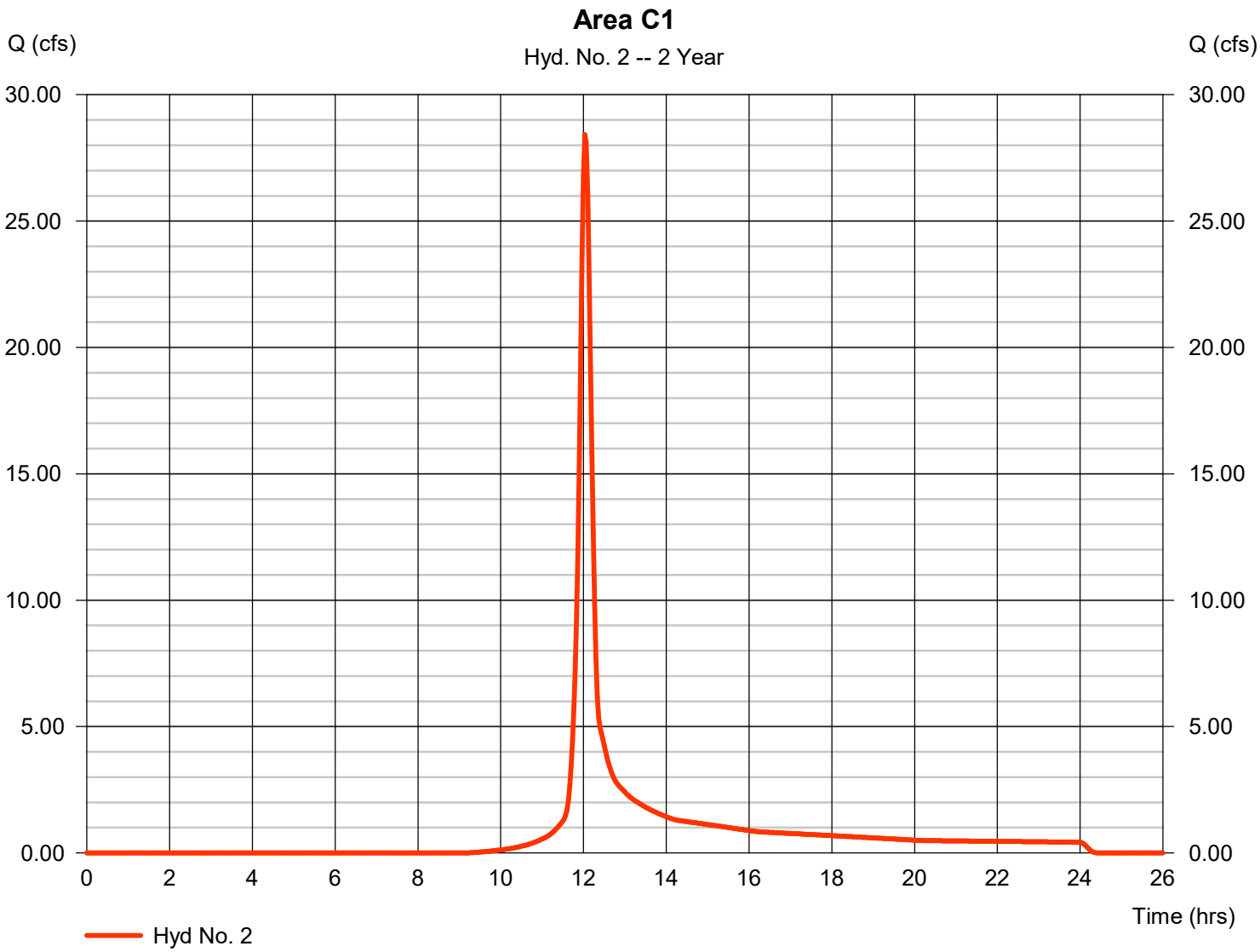
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 2

Area C1

Hydrograph type	= SCS Runoff	Peak discharge	= 28.42 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 80,143 cuft
Drainage area	= 18.030 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.50 min
Total precip.	= 2.76 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

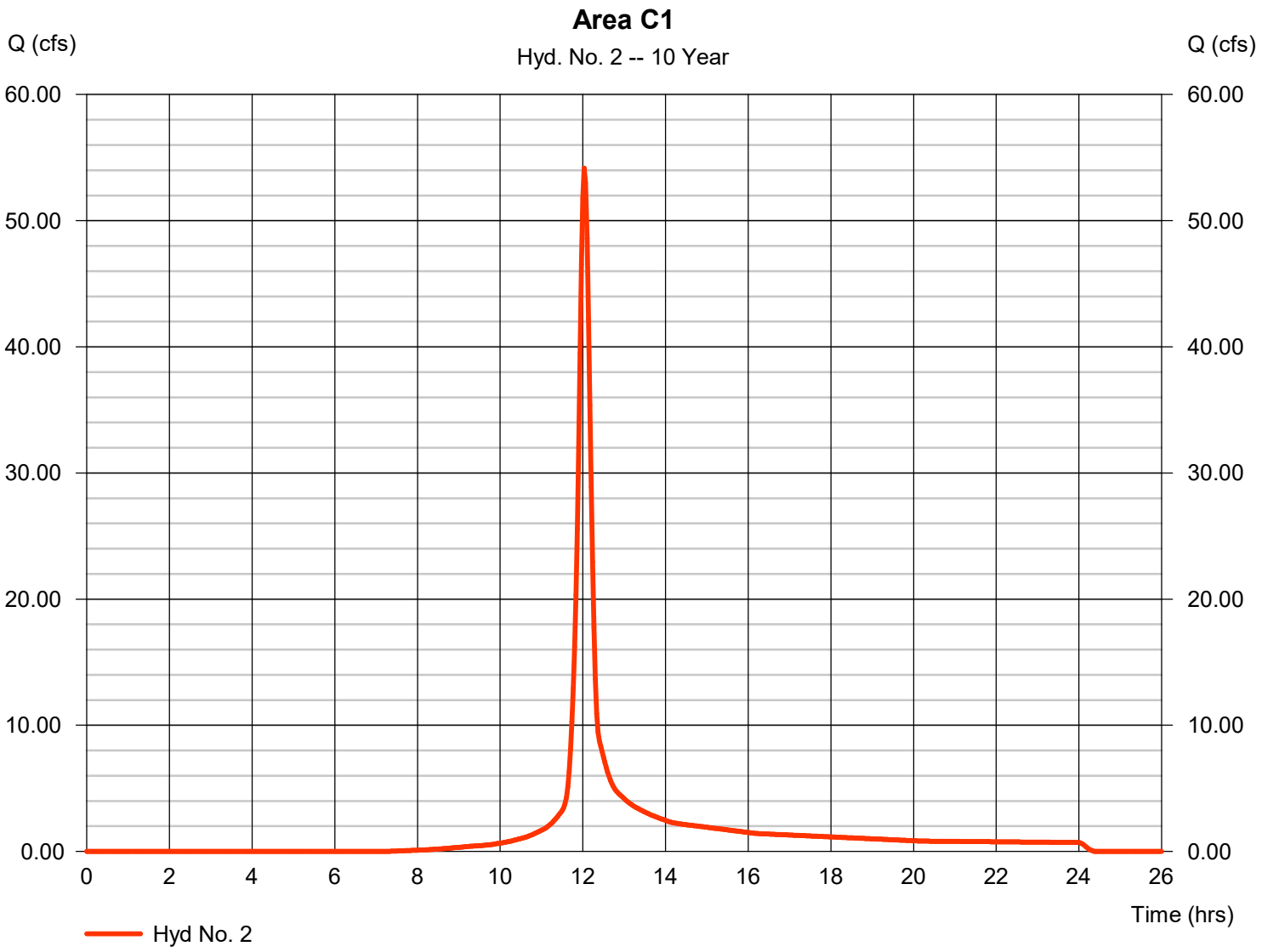


Hydrograph Report

Hyd. No. 2

Area C1

Hydrograph type	= SCS Runoff	Peak discharge	= 54.17 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 151,998 cuft
Drainage area	= 18.030 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.50 min
Total precip.	= 4.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



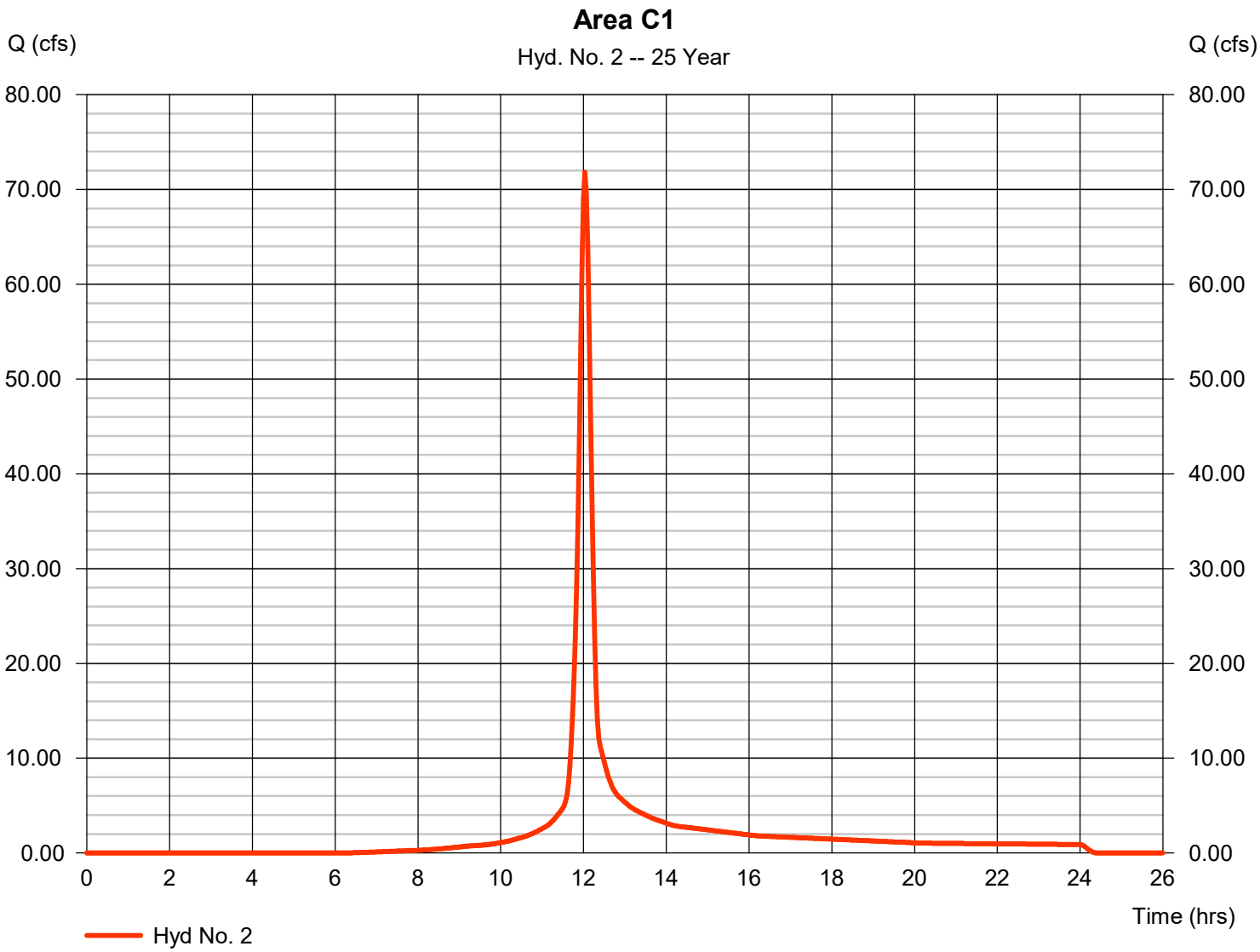
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 2

Area C1

Hydrograph type	= SCS Runoff	Peak discharge	= 71.81 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 202,548 cuft
Drainage area	= 18.030 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.50 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



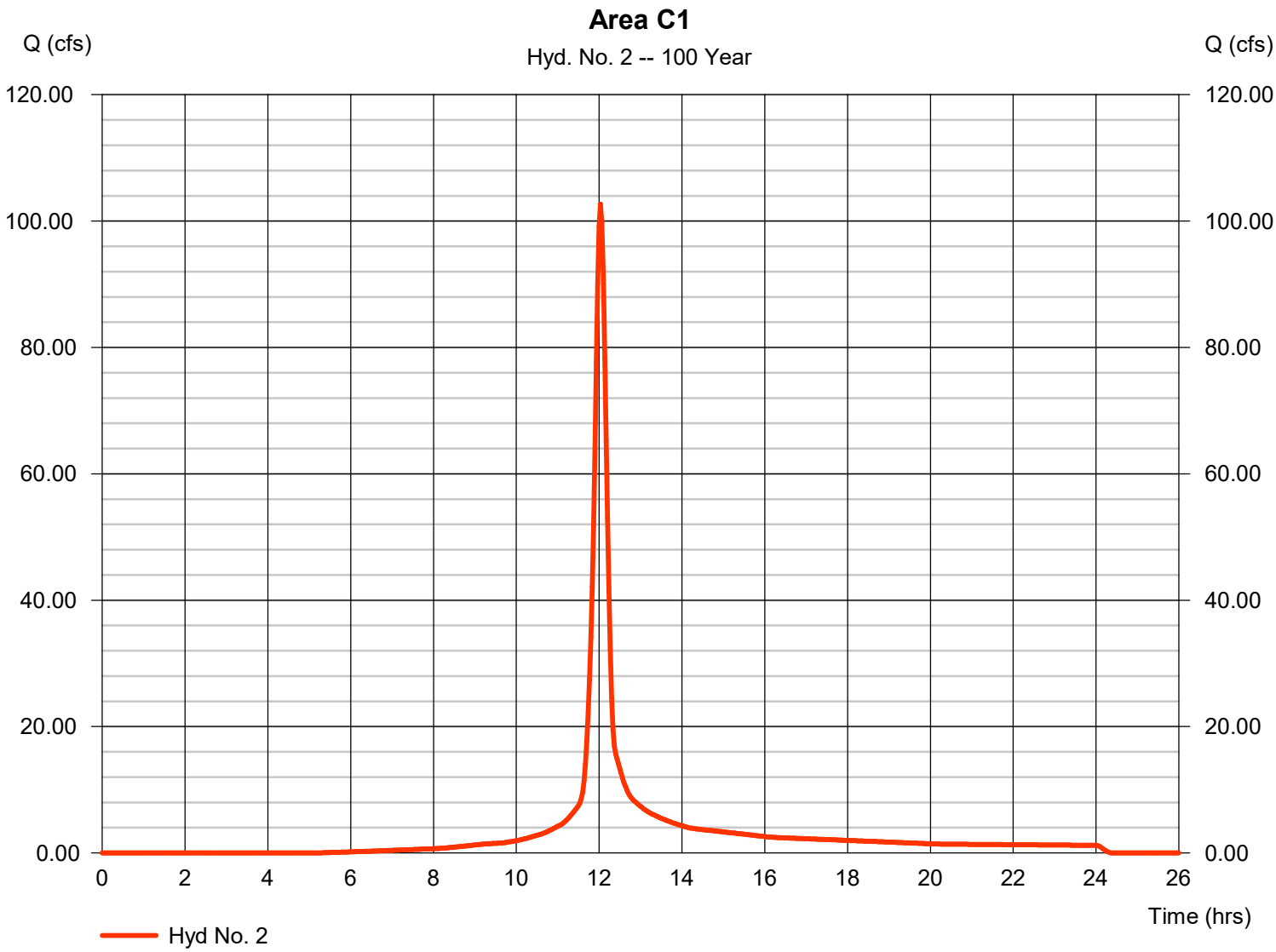
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 2

Area C1

Hydrograph type	= SCS Runoff	Peak discharge	= 102.70 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 293,226 cuft
Drainage area	= 18.030 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.50 min
Total precip.	= 6.54 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



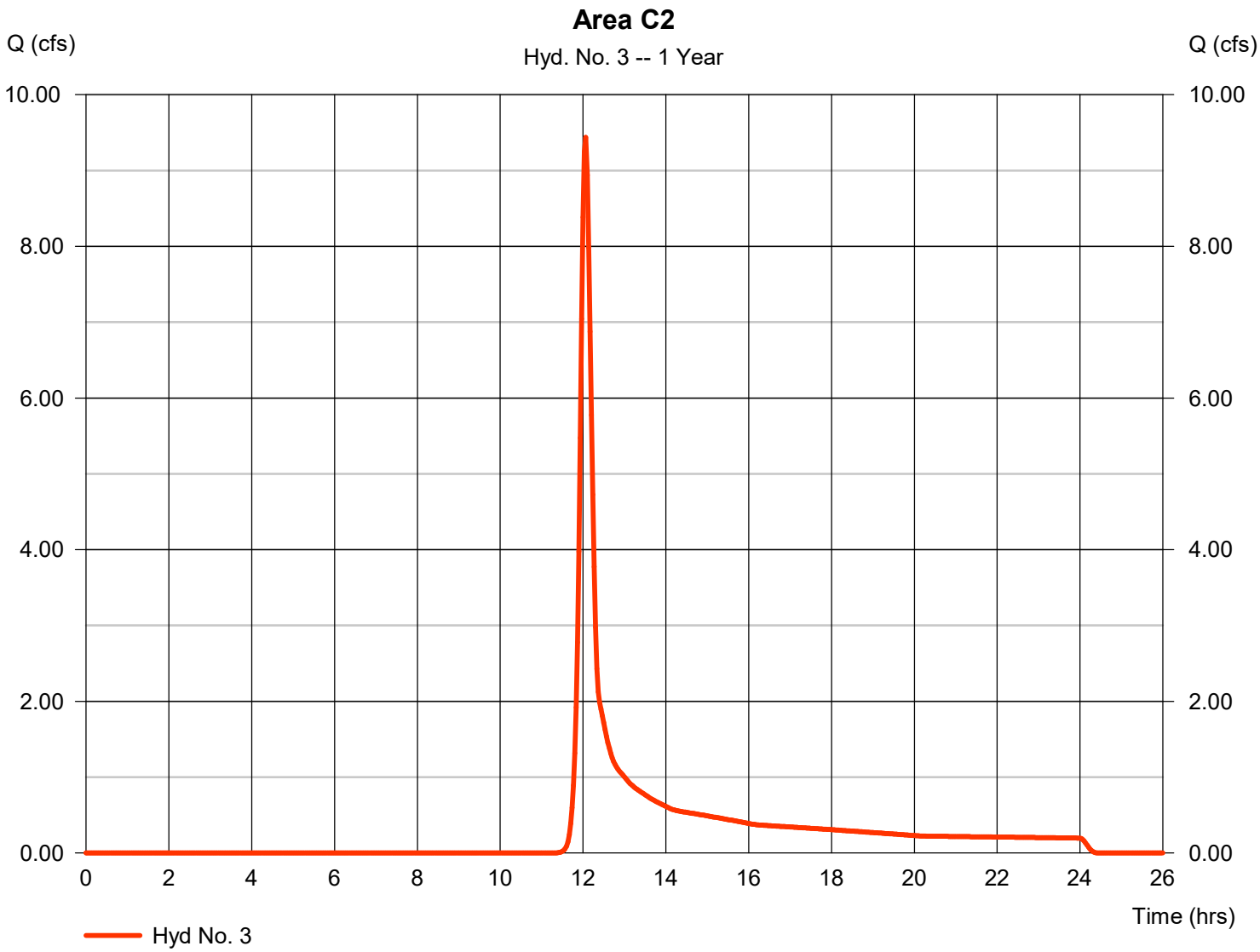
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 3

Area C2

Hydrograph type	= SCS Runoff	Peak discharge	= 9.437 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 28,646 cuft
Drainage area	= 13.350 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.40 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

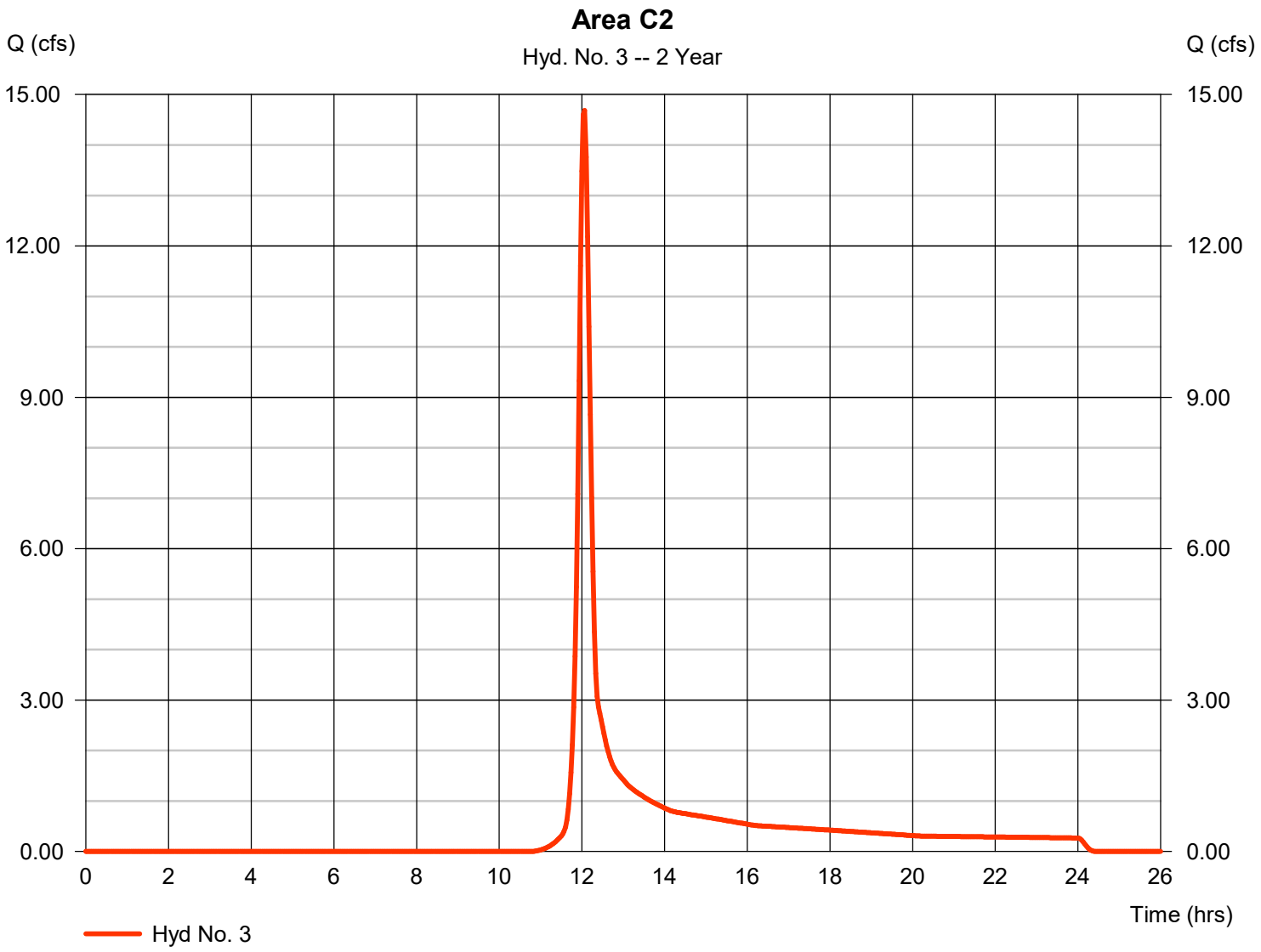


Hydrograph Report

Hyd. No. 3

Area C2

Hydrograph type	= SCS Runoff	Peak discharge	= 14.69 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 42,911 cuft
Drainage area	= 13.350 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.40 min
Total precip.	= 2.76 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

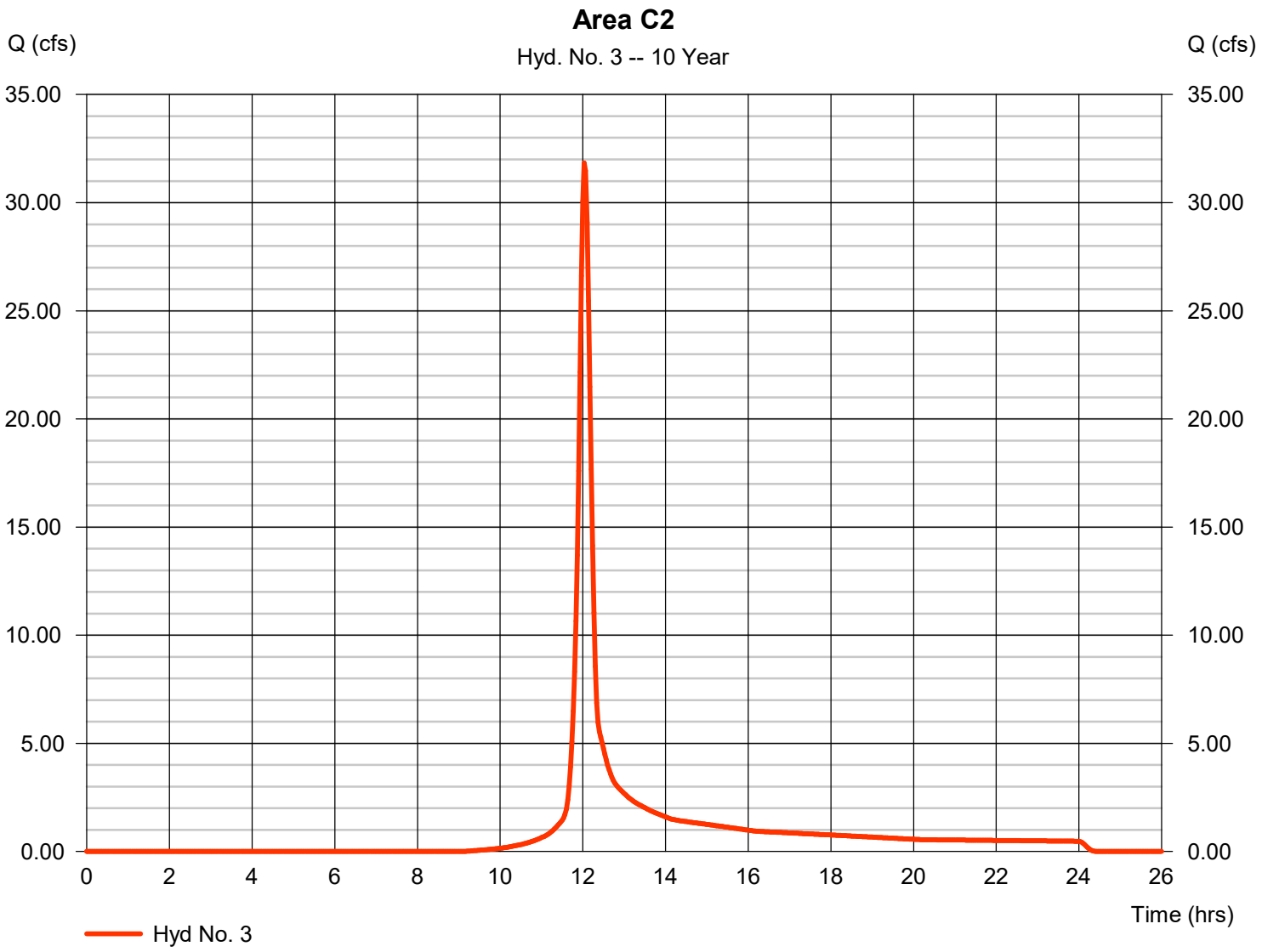


Hydrograph Report

Hyd. No. 3

Area C2

Hydrograph type	= SCS Runoff	Peak discharge	= 31.84 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 89,694 cuft
Drainage area	= 13.350 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.40 min
Total precip.	= 4.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

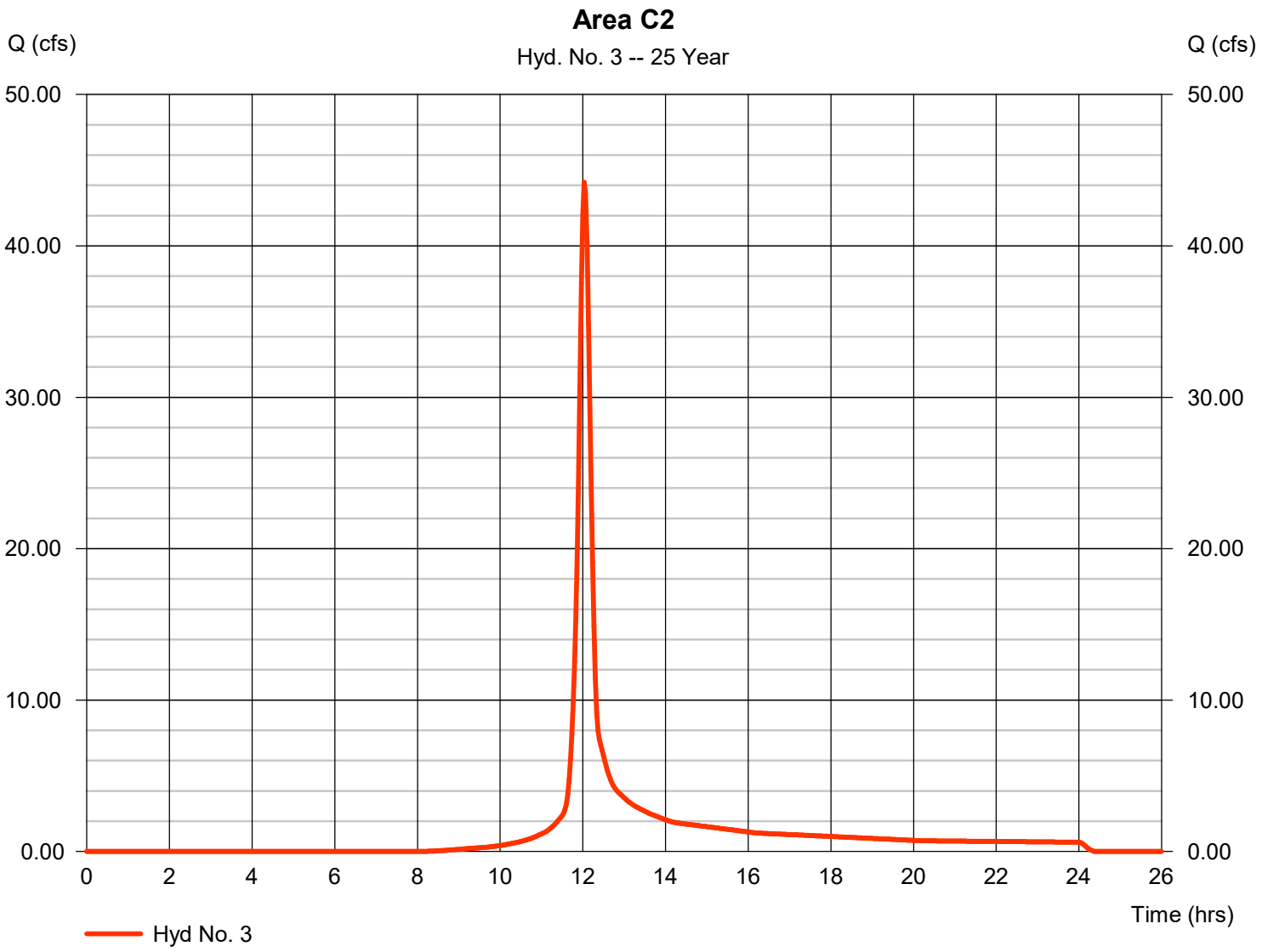


Hydrograph Report

Hyd. No. 3

Area C2

Hydrograph type	= SCS Runoff	Peak discharge	= 44.21 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 123,934 cuft
Drainage area	= 13.350 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.40 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



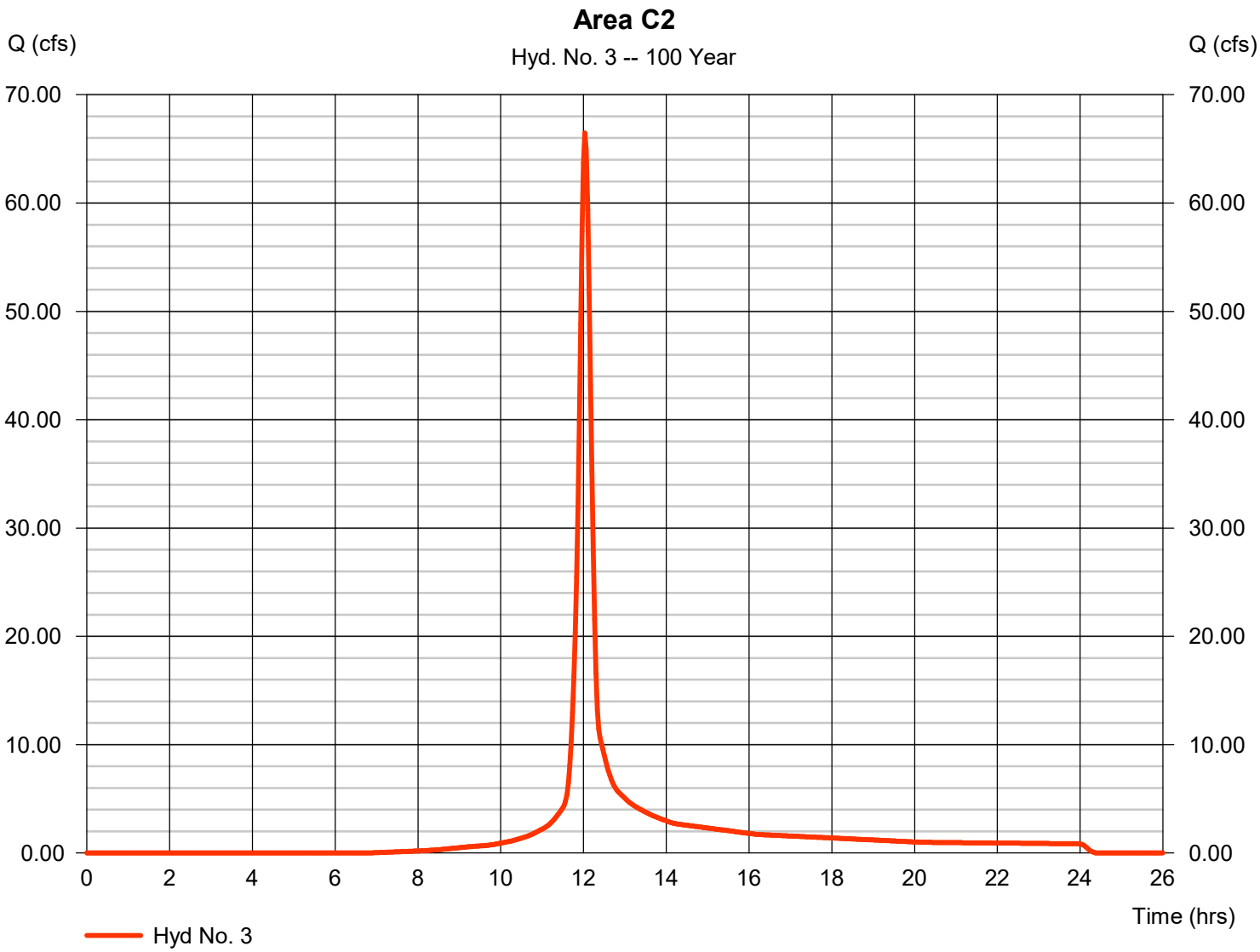
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 3

Area C2

Hydrograph type	= SCS Runoff	Peak discharge	= 66.47 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 186,858 cuft
Drainage area	= 13.350 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.40 min
Total precip.	= 6.54 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

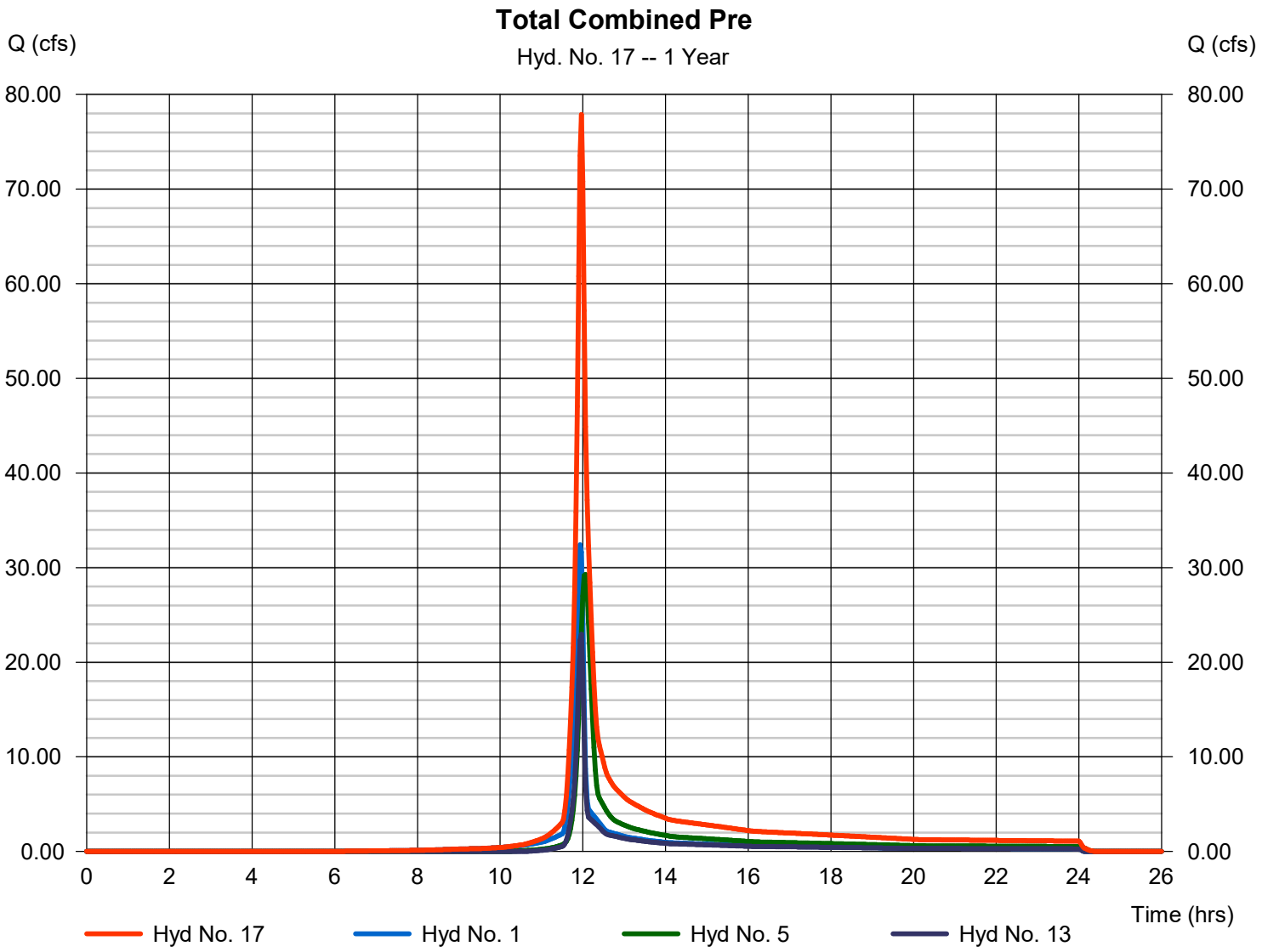


Hydrograph Report

Hyd. No. 17

Total Combined Pre

Hydrograph type	= Combine	Peak discharge	= 77.88 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 198,358 cuft
Inflow hyds.	= 1, 5, 13	Contrib. drain. area	= 30.270 ac

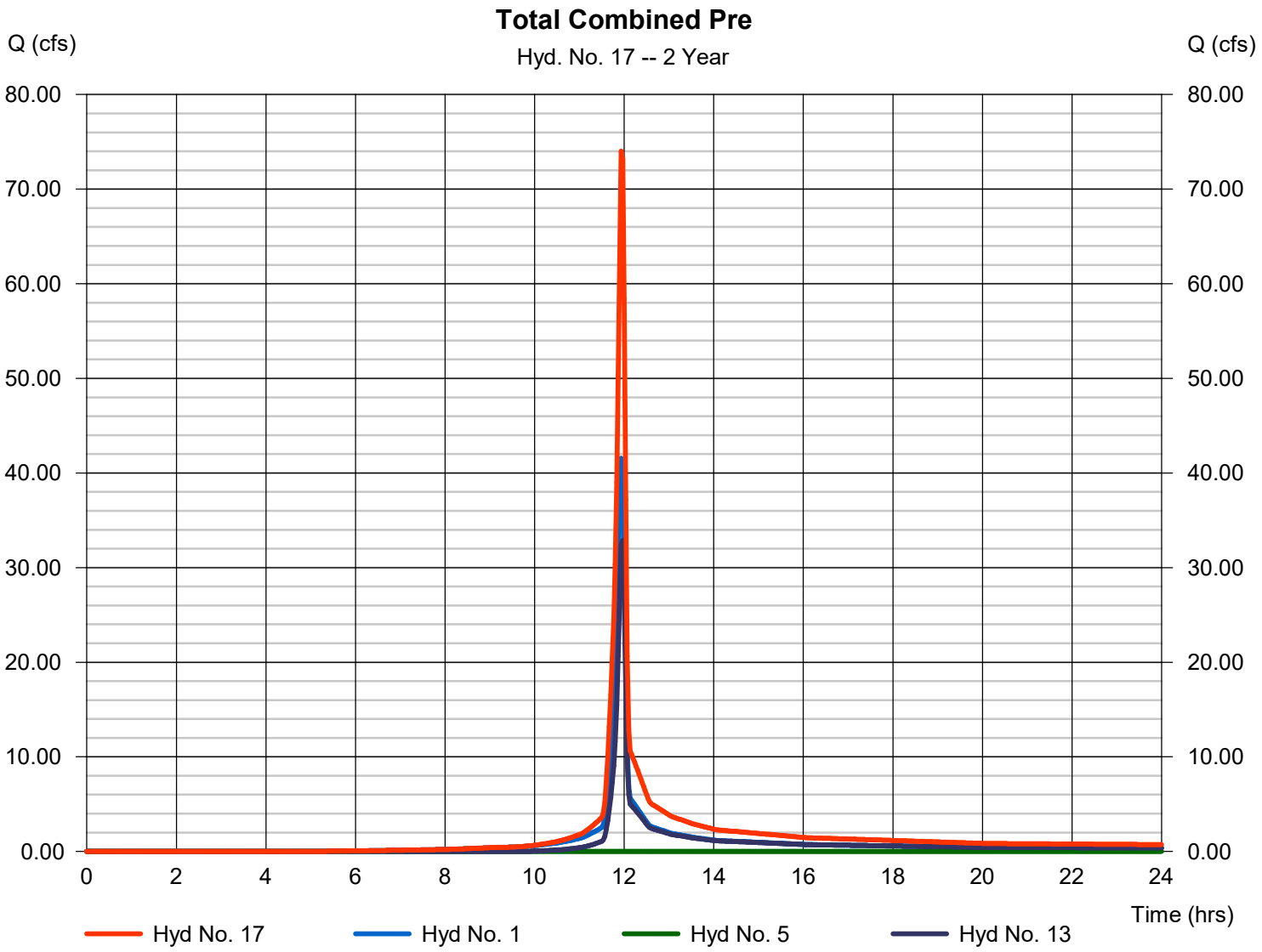


Hydrograph Report

Hyd. No. 17

Total Combined Pre

Hydrograph type	= Combine	Peak discharge	= 74.02 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 152,636 cuft
Inflow hyds.	= 1, 5, 13	Contrib. drain. area	= 30.270 ac

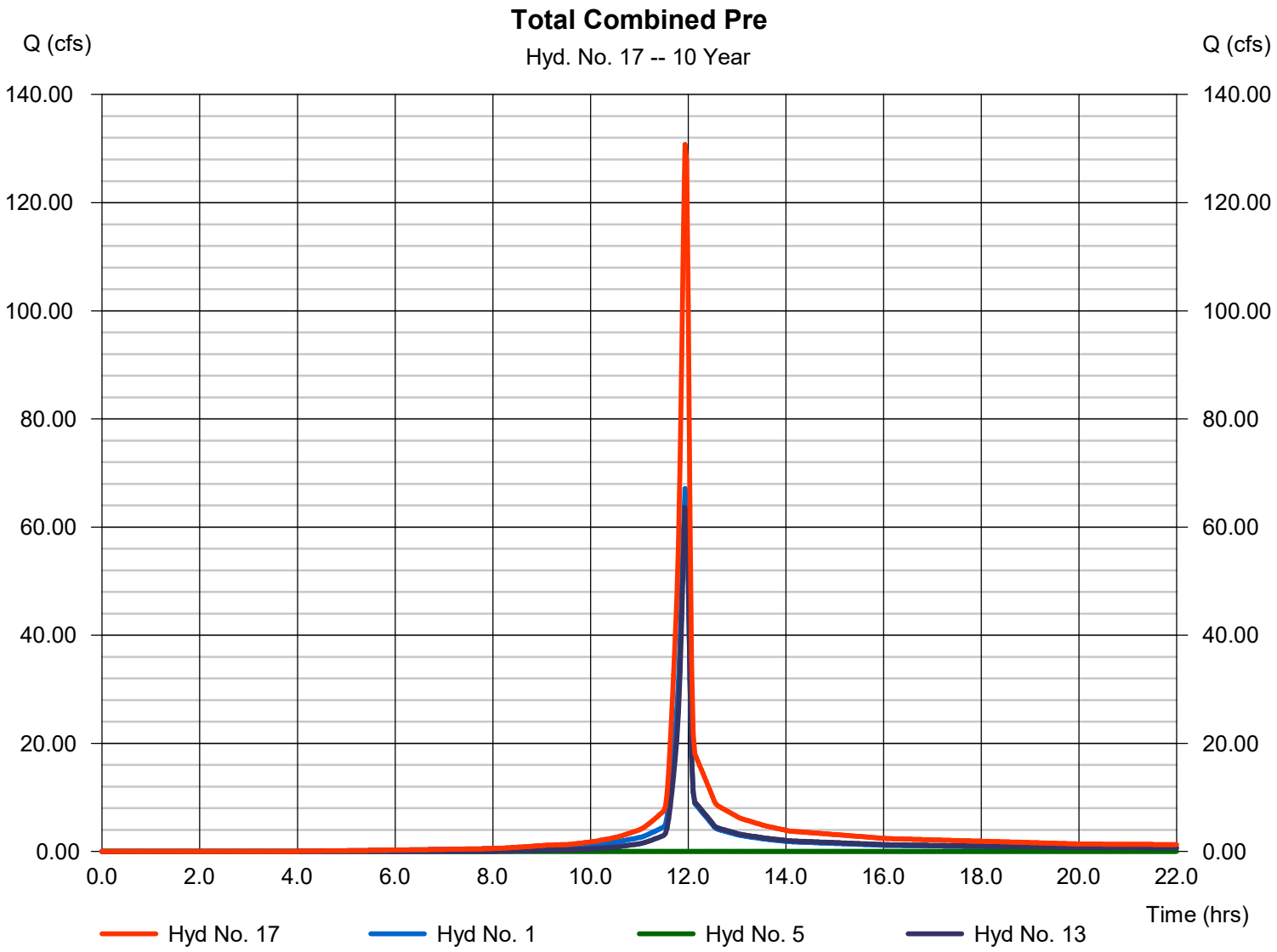


Hydrograph Report

Hyd. No. 17

Total Combined Pre

Hydrograph type	= Combine	Peak discharge	= 130.74 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 273,382 cuft
Inflow hyds.	= 1, 5, 13	Contrib. drain. area	= 30.270 ac

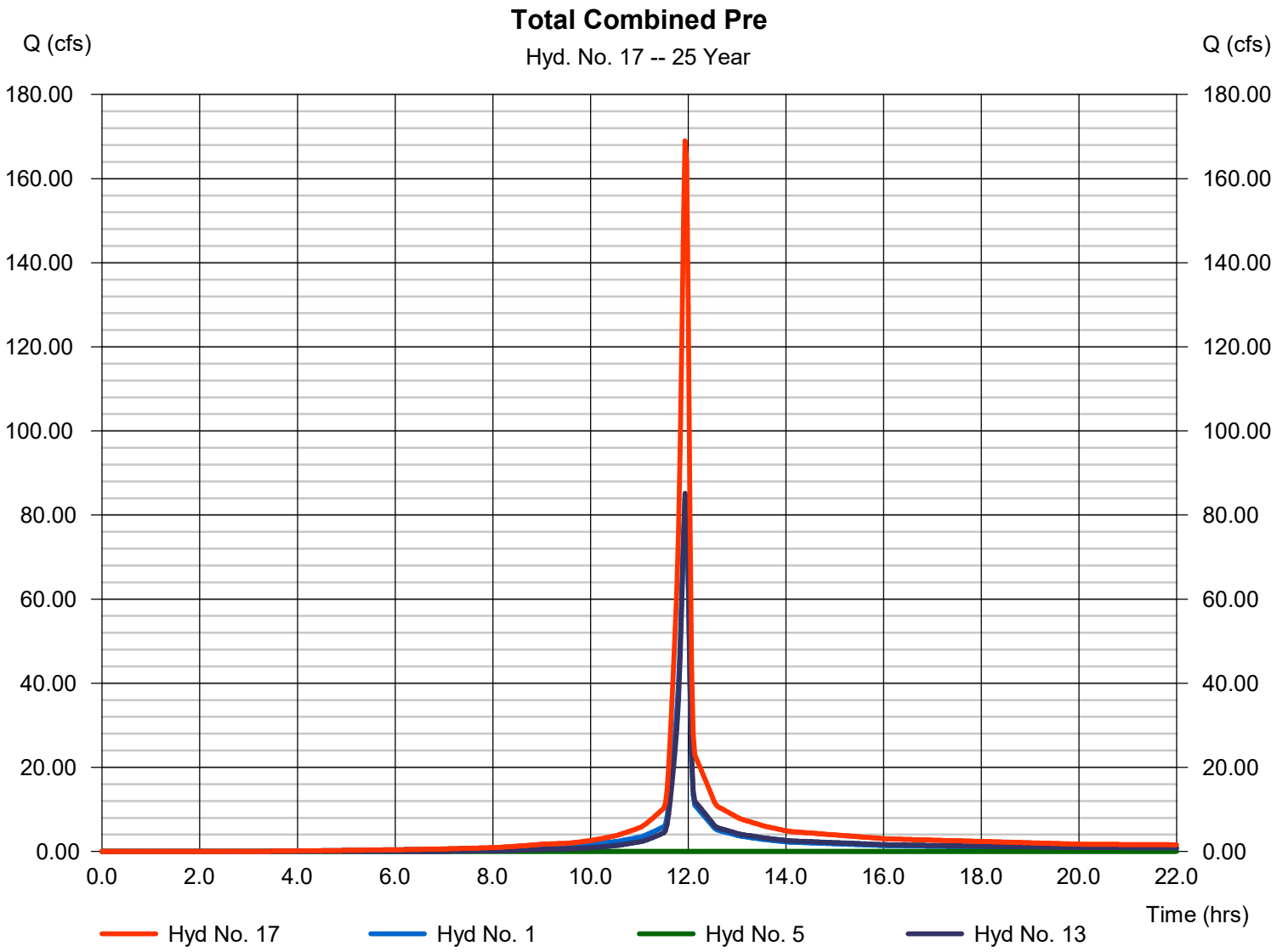


Hydrograph Report

Hyd. No. 17

Total Combined Pre

Hydrograph type	= Combine	Peak discharge	= 168.98 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 357,042 cuft
Inflow hyds.	= 1, 5, 13	Contrib. drain. area	= 30.270 ac

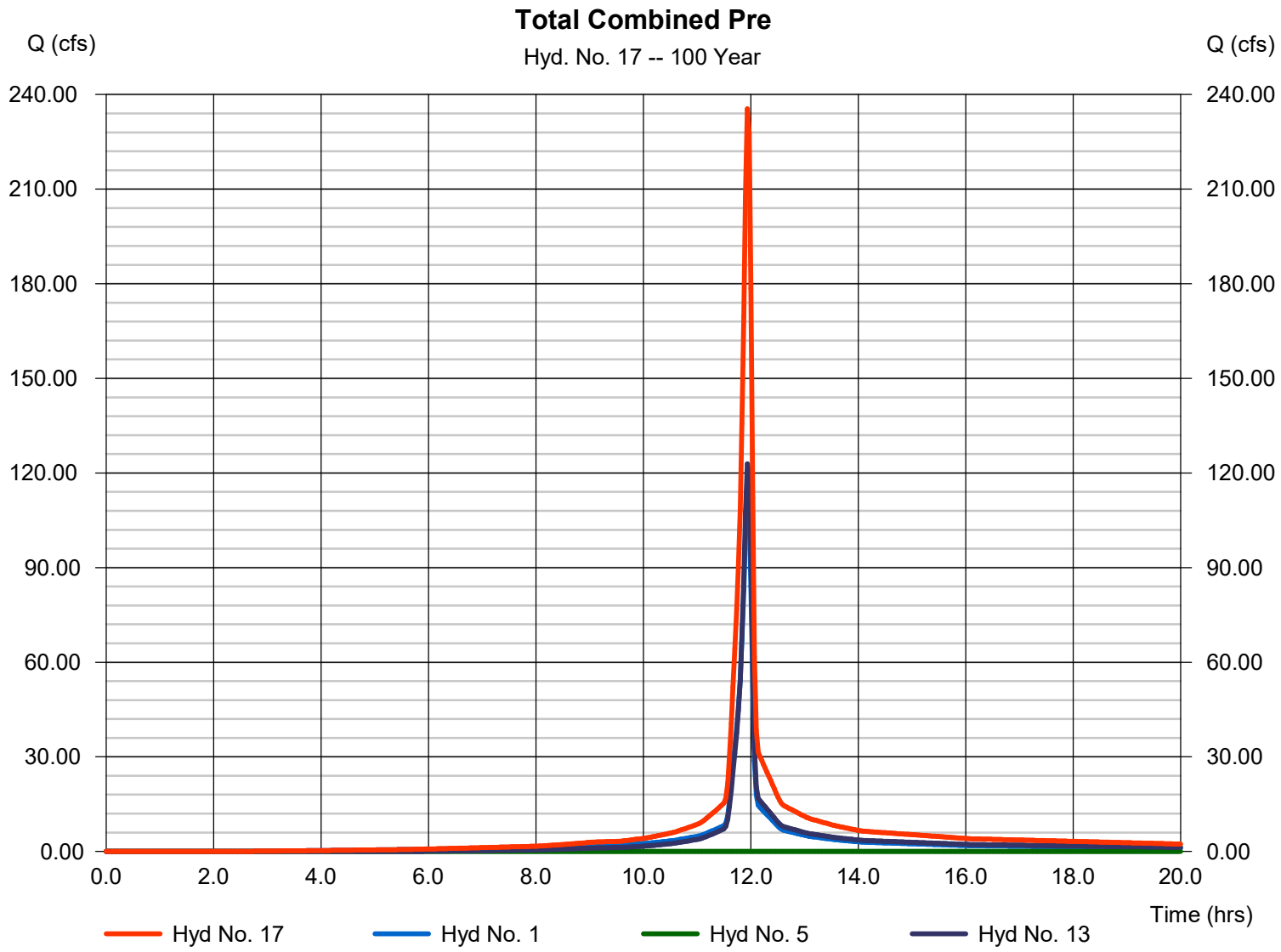


Hydrograph Report

Hyd. No. 17

Total Combined Pre

Hydrograph type	= Combine	Peak discharge	= 235.50 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 505,899 cuft
Inflow hyds.	= 1, 5, 13	Contrib. drain. area	= 30.270 ac



Appendix C

Post-Development Stormwater Calculations

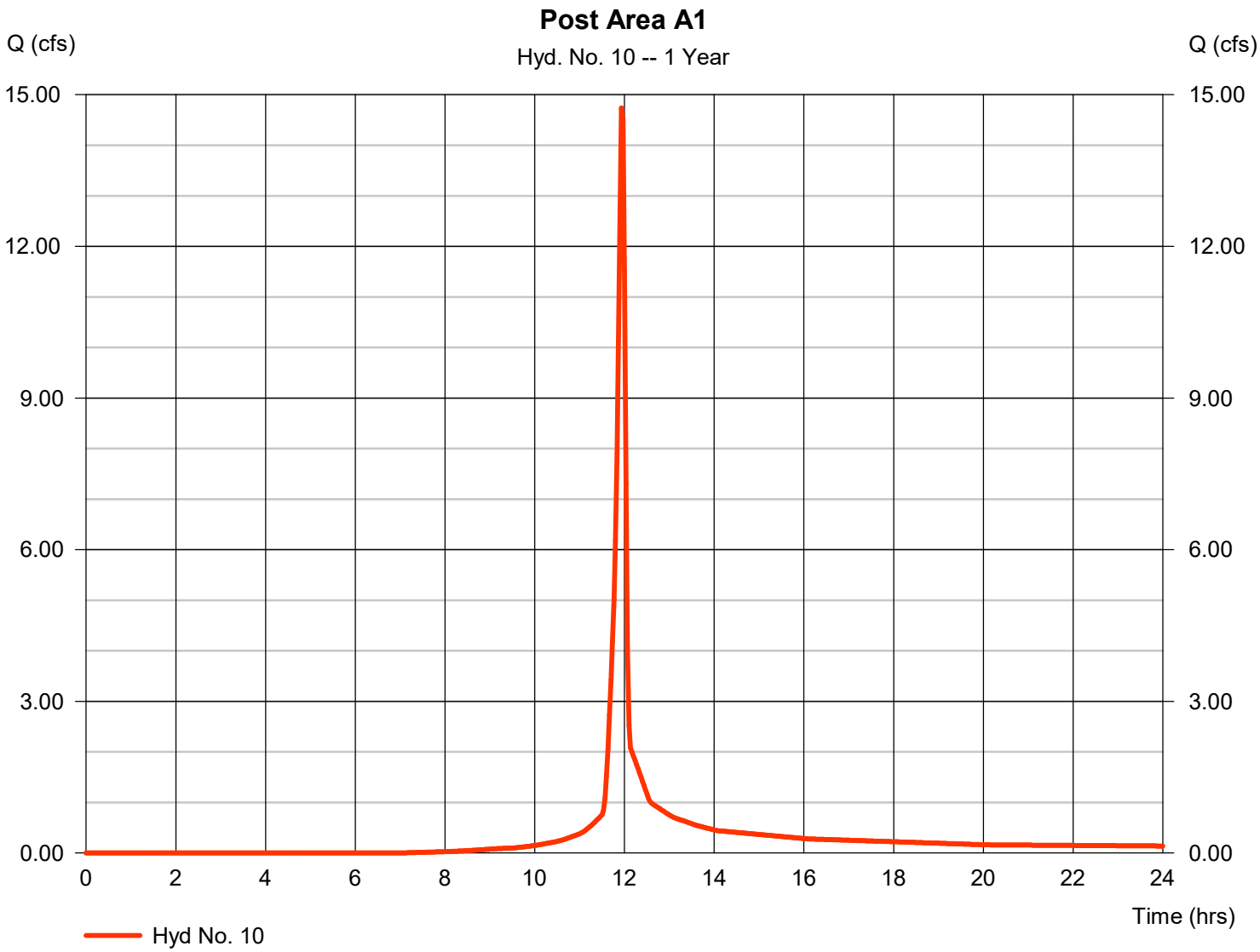
Hydrograph Report

Hyd. No. 10

Post Area A1

Hydrograph type	= SCS Runoff	Peak discharge	= 14.74 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 30,013 cuft
Drainage area	= 6.600 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.720 x 98) + (2.880 x 80)] / 6.600



Hydrograph Report

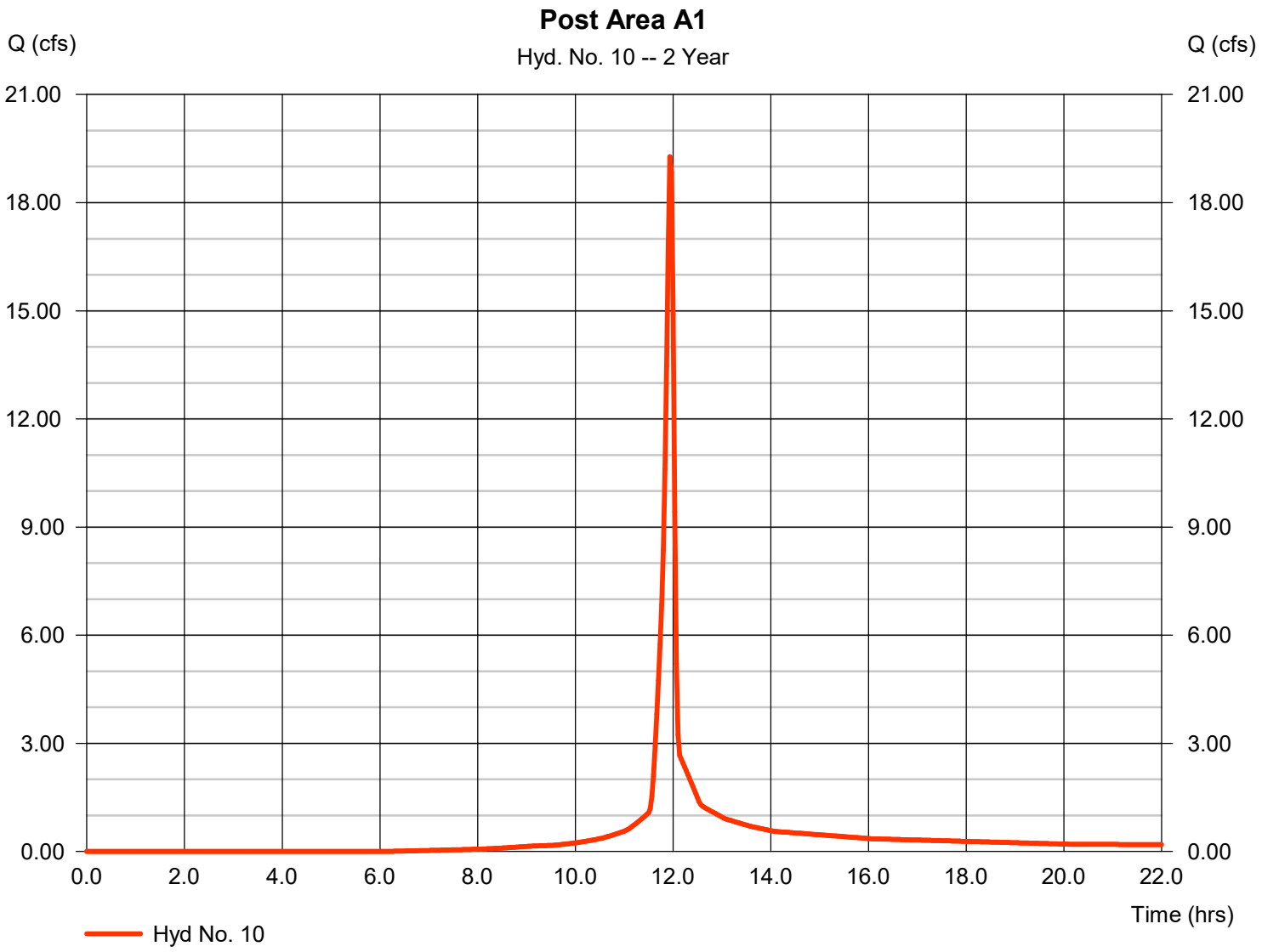
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 10

Post Area A1

Hydrograph type	= SCS Runoff	Peak discharge	= 19.28 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 39,643 cuft
Drainage area	= 6.600 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.76 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.720 x 98) + (2.880 x 80)] / 6.600



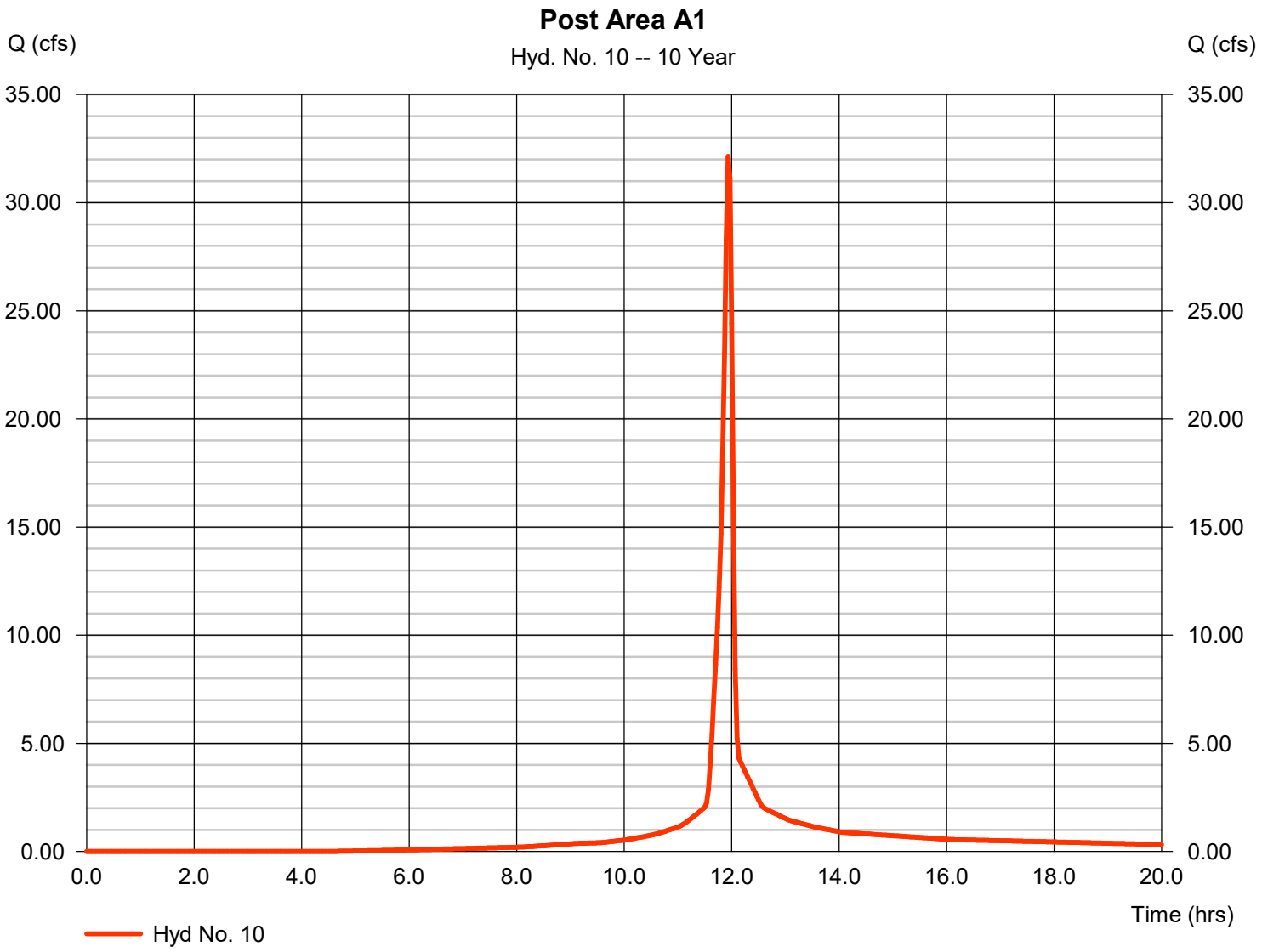
Hydrograph Report

Hyd. No. 10

Post Area A1

Hydrograph type	= SCS Runoff	Peak discharge	= 32.14 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 67,913 cuft
Drainage area	= 6.600 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.720 x 98) + (2.880 x 80)] / 6.600



Hydrograph Report

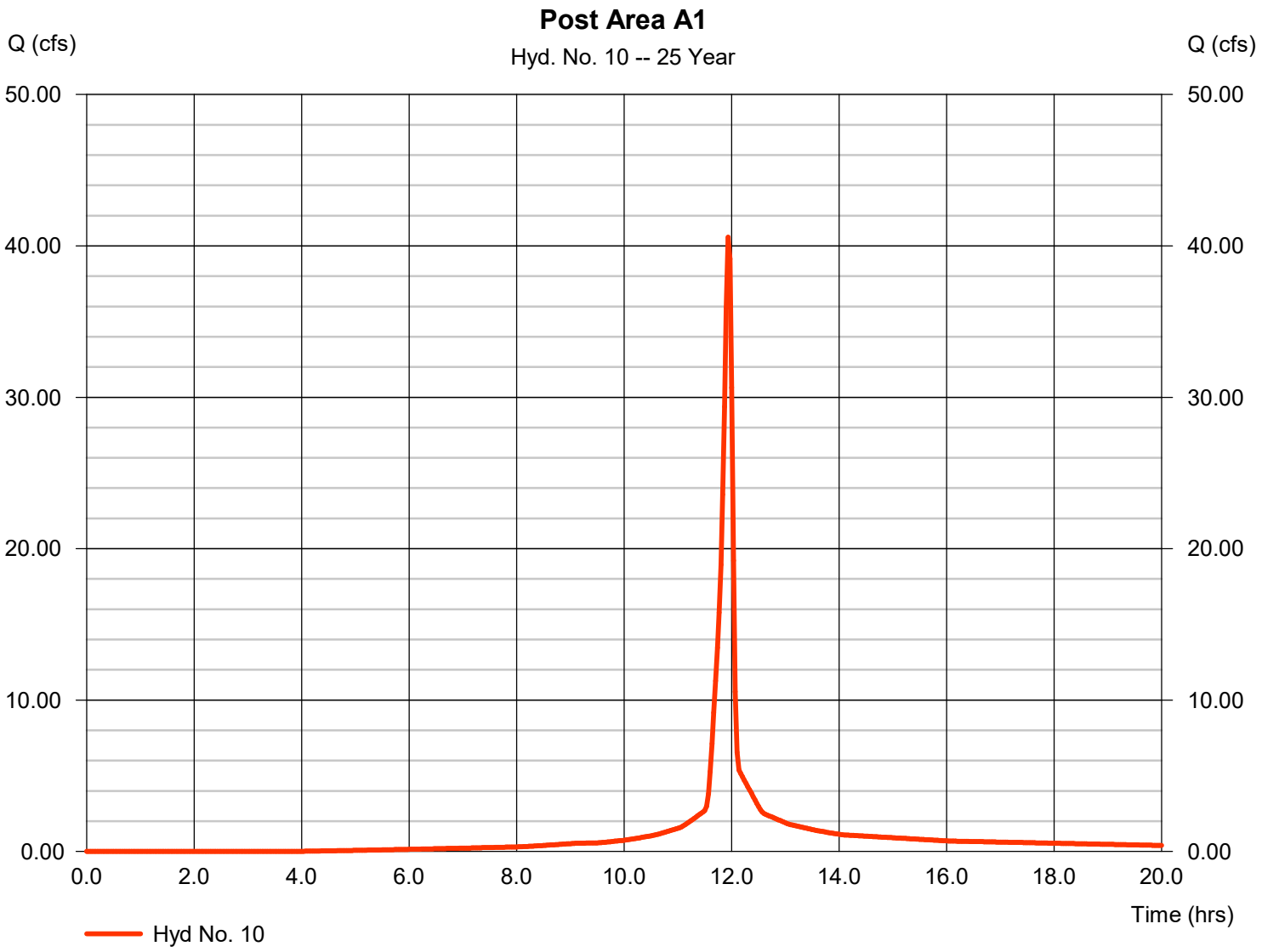
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 10

Post Area A1

Hydrograph type	= SCS Runoff	Peak discharge	= 40.58 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 87,064 cuft
Drainage area	= 6.600 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.720 x 98) + (2.880 x 80)] / 6.600



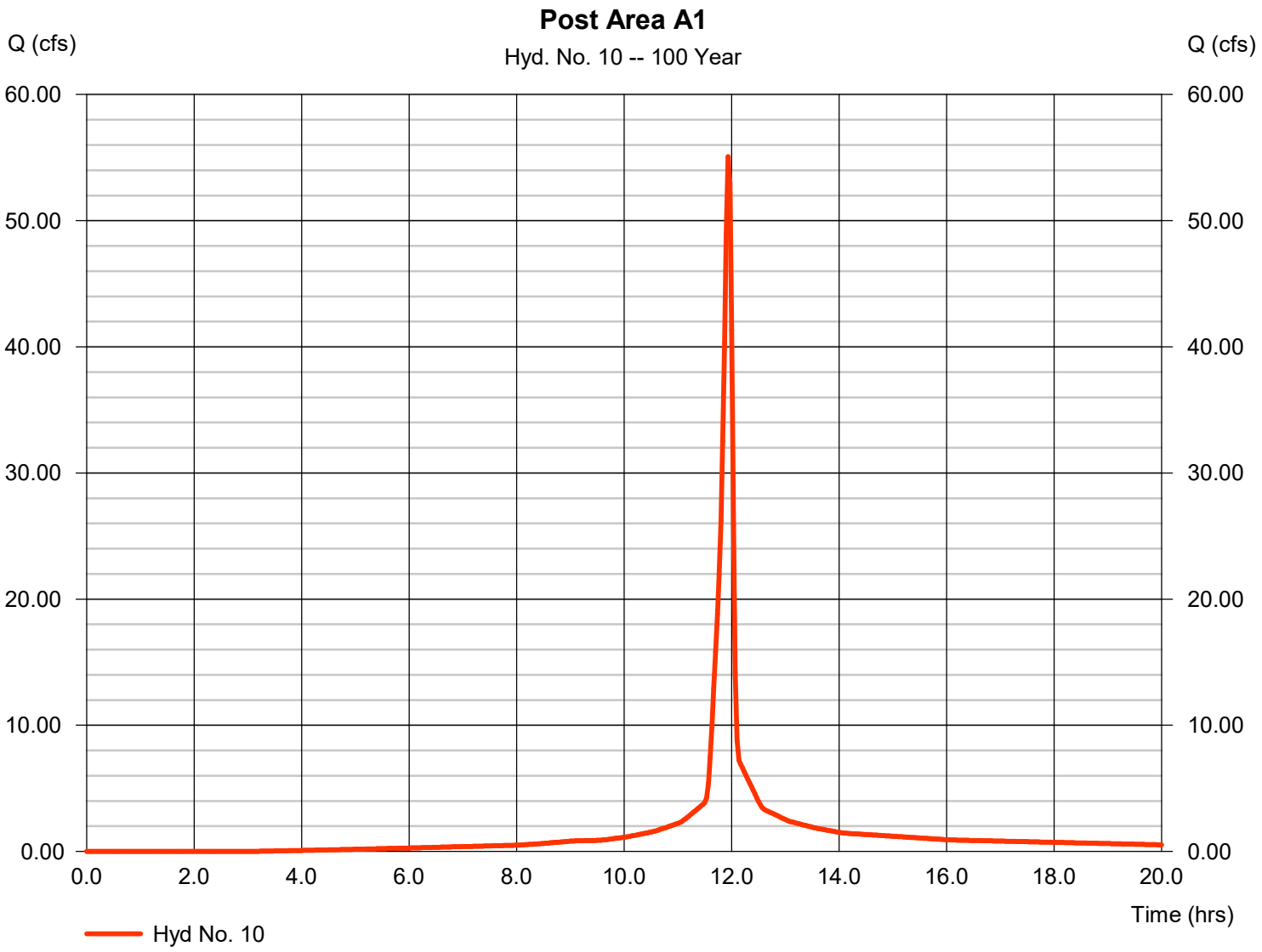
Hydrograph Report

Hyd. No. 10

Post Area A1

Hydrograph type	= SCS Runoff	Peak discharge	= 55.08 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 120,678 cuft
Drainage area	= 6.600 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.54 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.720 x 98) + (2.880 x 80)] / 6.600



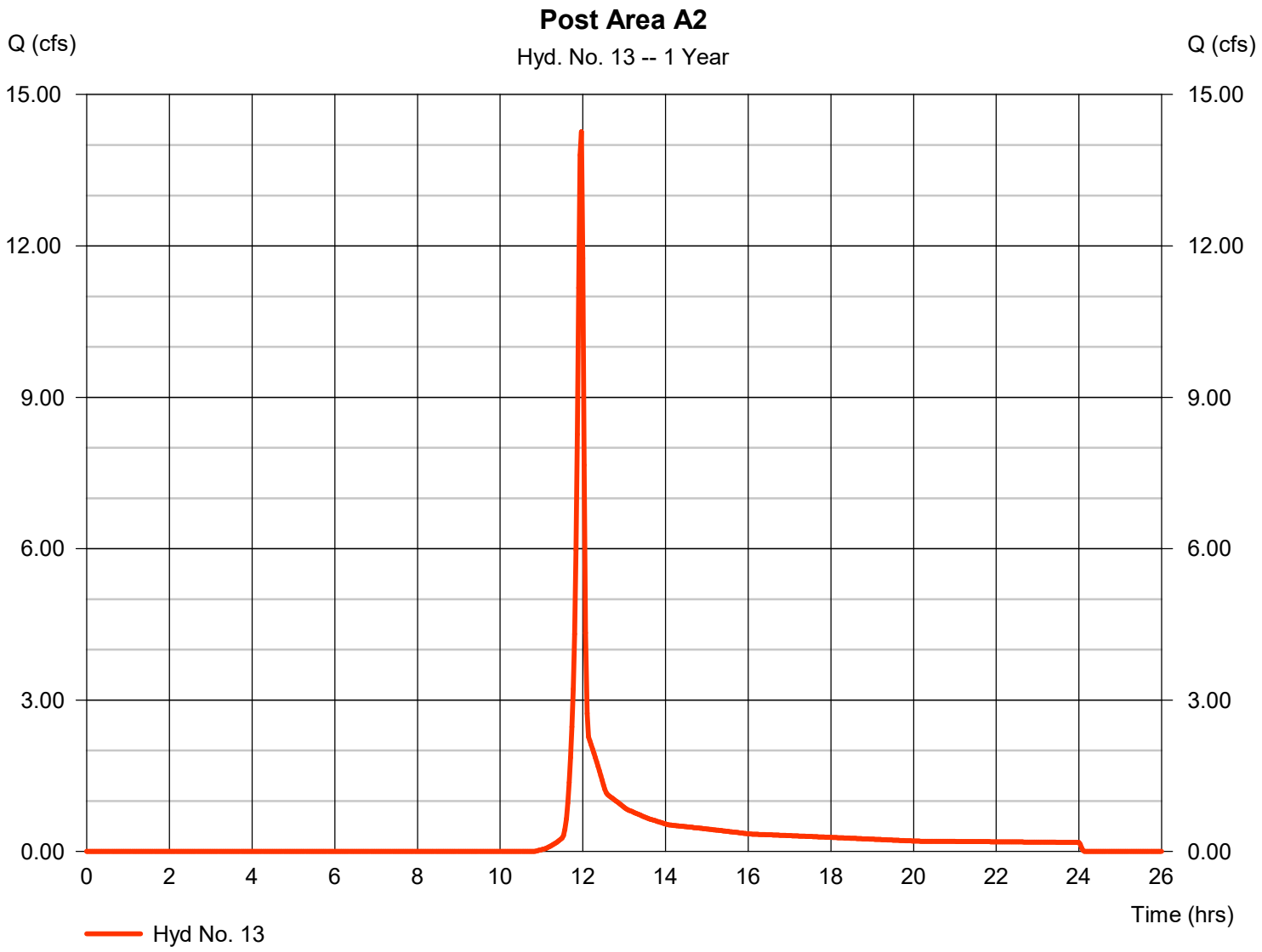
Hydrograph Report

Hyd. No. 13

Post Area A2

Hydrograph type	= SCS Runoff	Peak discharge	= 14.27 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 28,594 cuft
Drainage area	= 11.350 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.400 x 80) + (5.050 x 77) + (2.900 x 84)] / 11.350



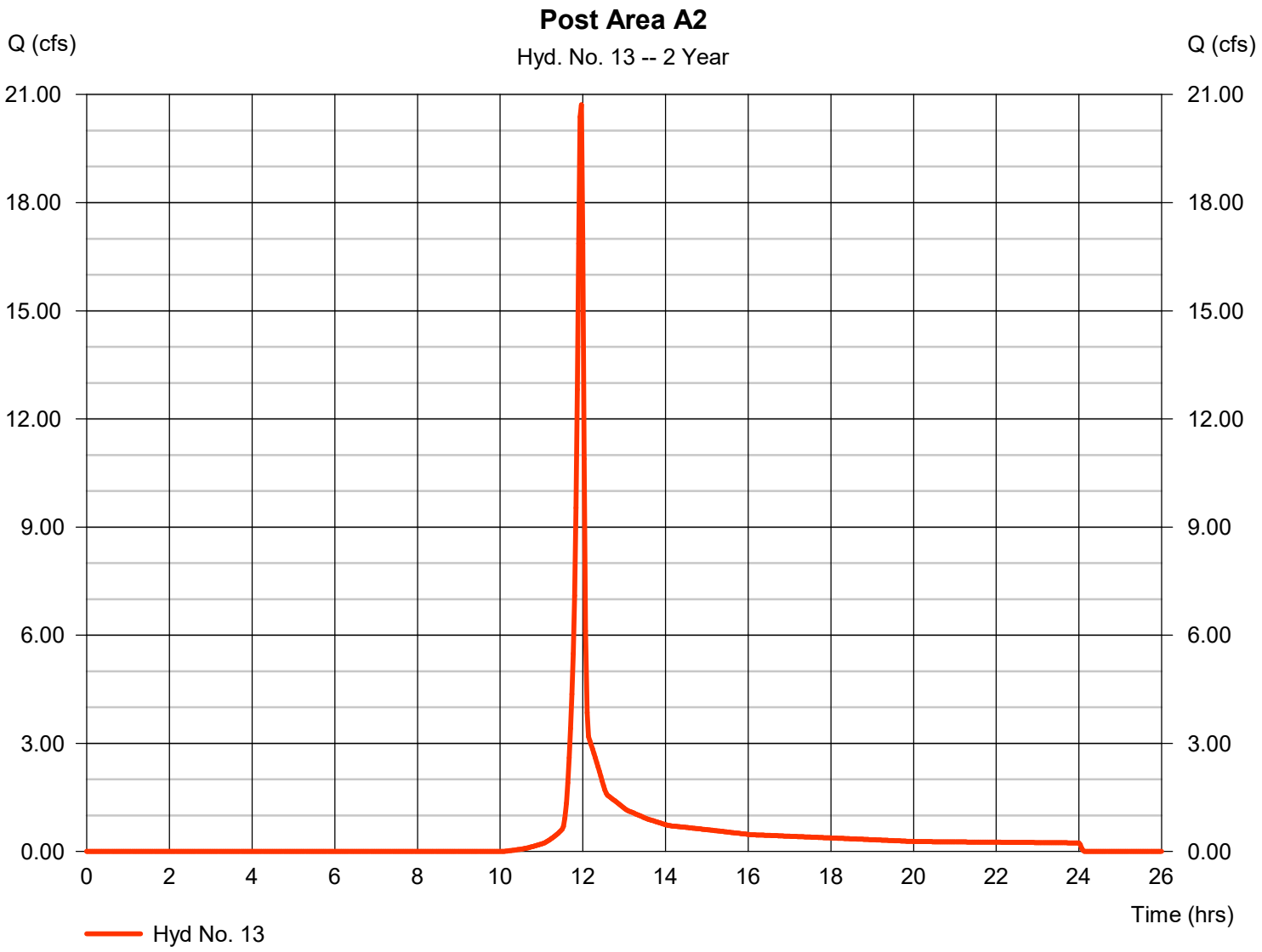
Hydrograph Report

Hyd. No. 13

Post Area A2

Hydrograph type	= SCS Runoff	Peak discharge	= 20.72 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 41,446 cuft
Drainage area	= 11.350 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.76 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.400 x 80) + (5.050 x 77) + (2.900 x 84)] / 11.350



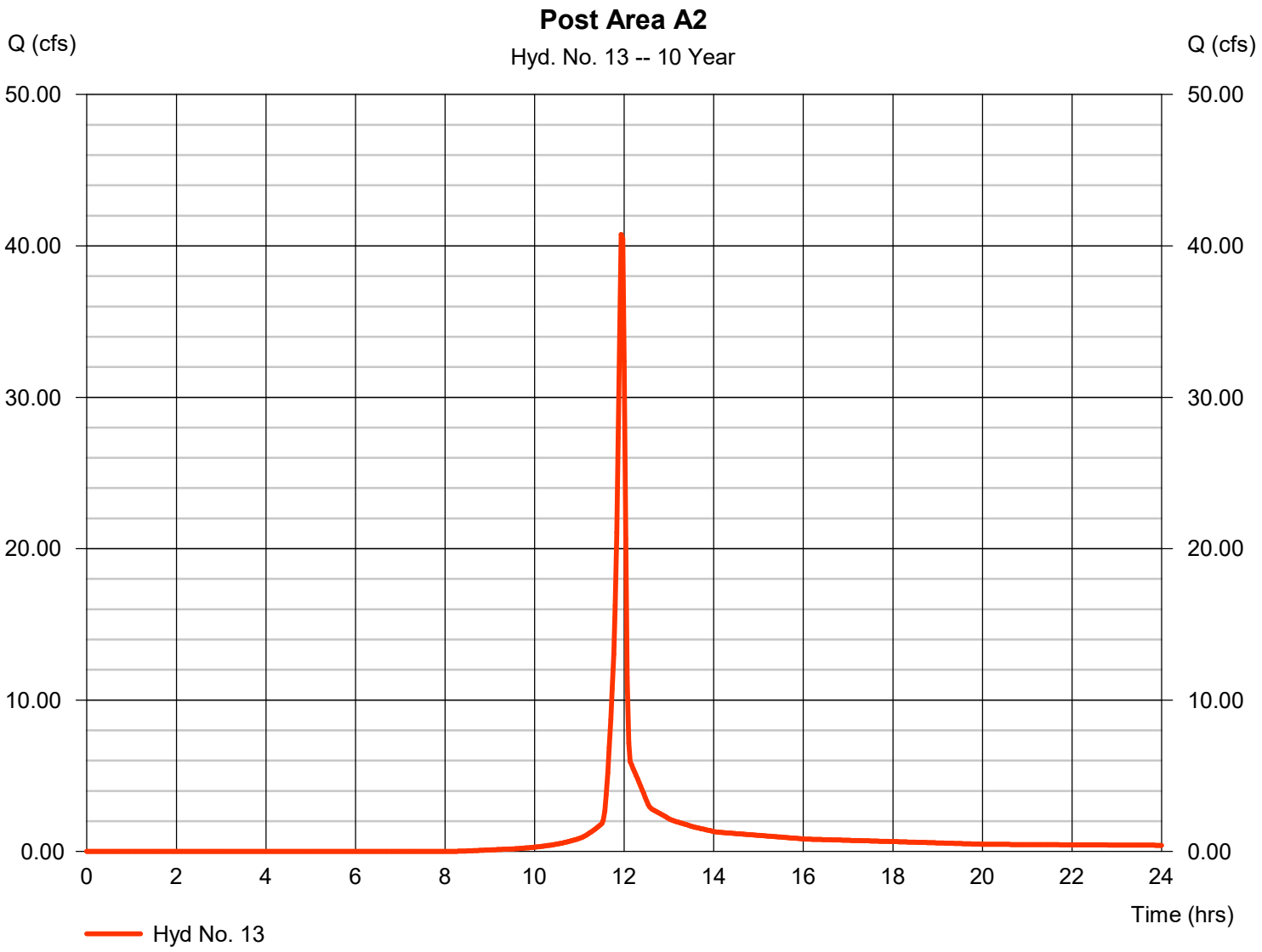
Hydrograph Report

Hyd. No. 13

Post Area A2

Hydrograph type	= SCS Runoff	Peak discharge	= 40.75 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 82,385 cuft
Drainage area	= 11.350 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.400 x 80) + (5.050 x 77) + (2.900 x 84)] / 11.350



Hydrograph Report

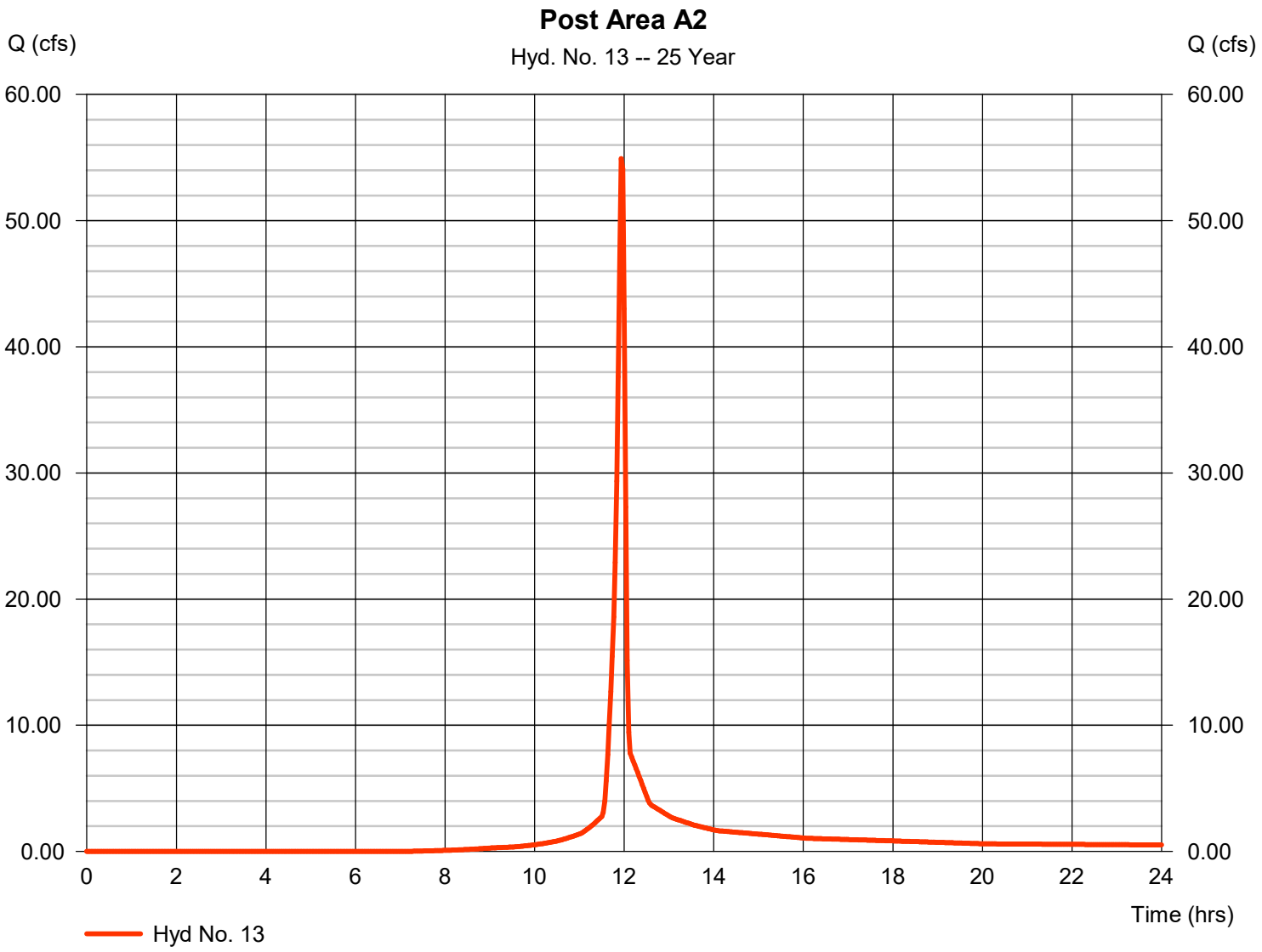
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 13

Post Area A2

Hydrograph type	= SCS Runoff	Peak discharge	= 54.93 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 111,738 cuft
Drainage area	= 11.350 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.400 x 80) + (5.050 x 77) + (2.900 x 84)] / 11.350



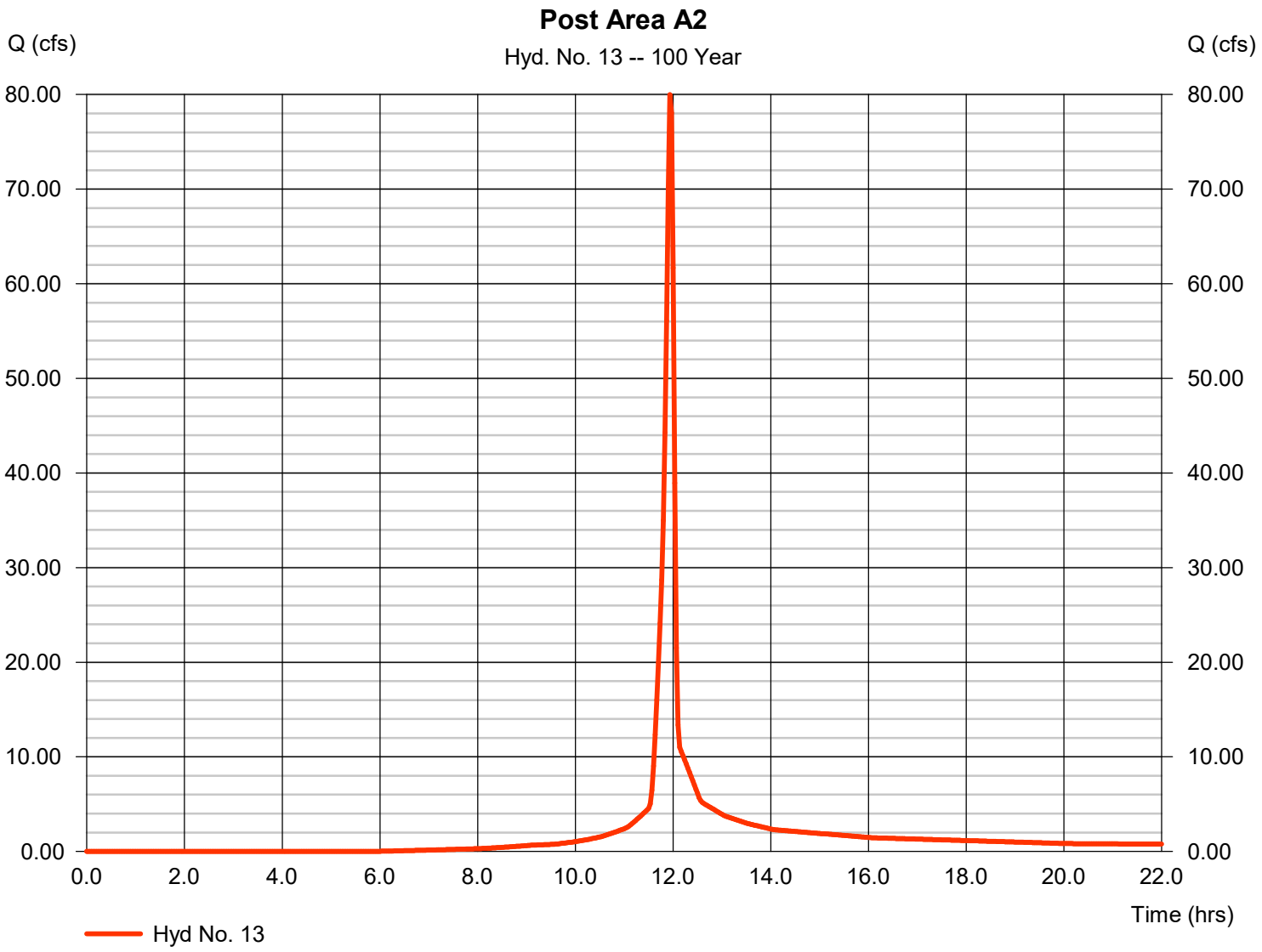
Hydrograph Report

Hyd. No. 13

Post Area A2

Hydrograph type	= SCS Runoff	Peak discharge	= 79.98 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 165,002 cuft
Drainage area	= 11.350 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.54 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.400 x 80) + (5.050 x 77) + (2.900 x 84)] / 11.350



Hydrograph Report

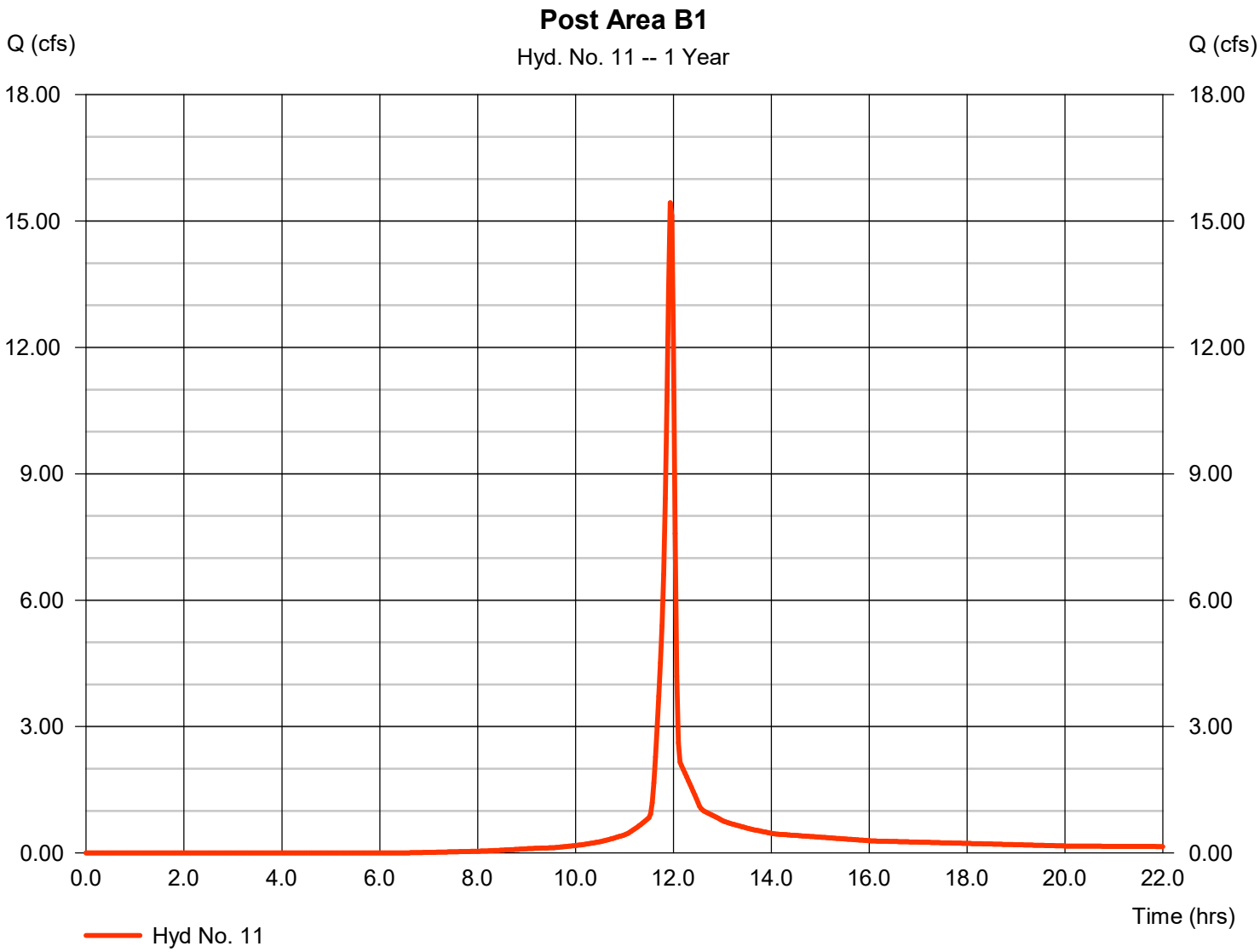
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 11

Post Area B1

Hydrograph type	= SCS Runoff	Peak discharge	= 15.44 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 31,611 cuft
Drainage area	= 6.580 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.930 x 98) + (2.650 x 80)] / 6.580



Hydrograph Report

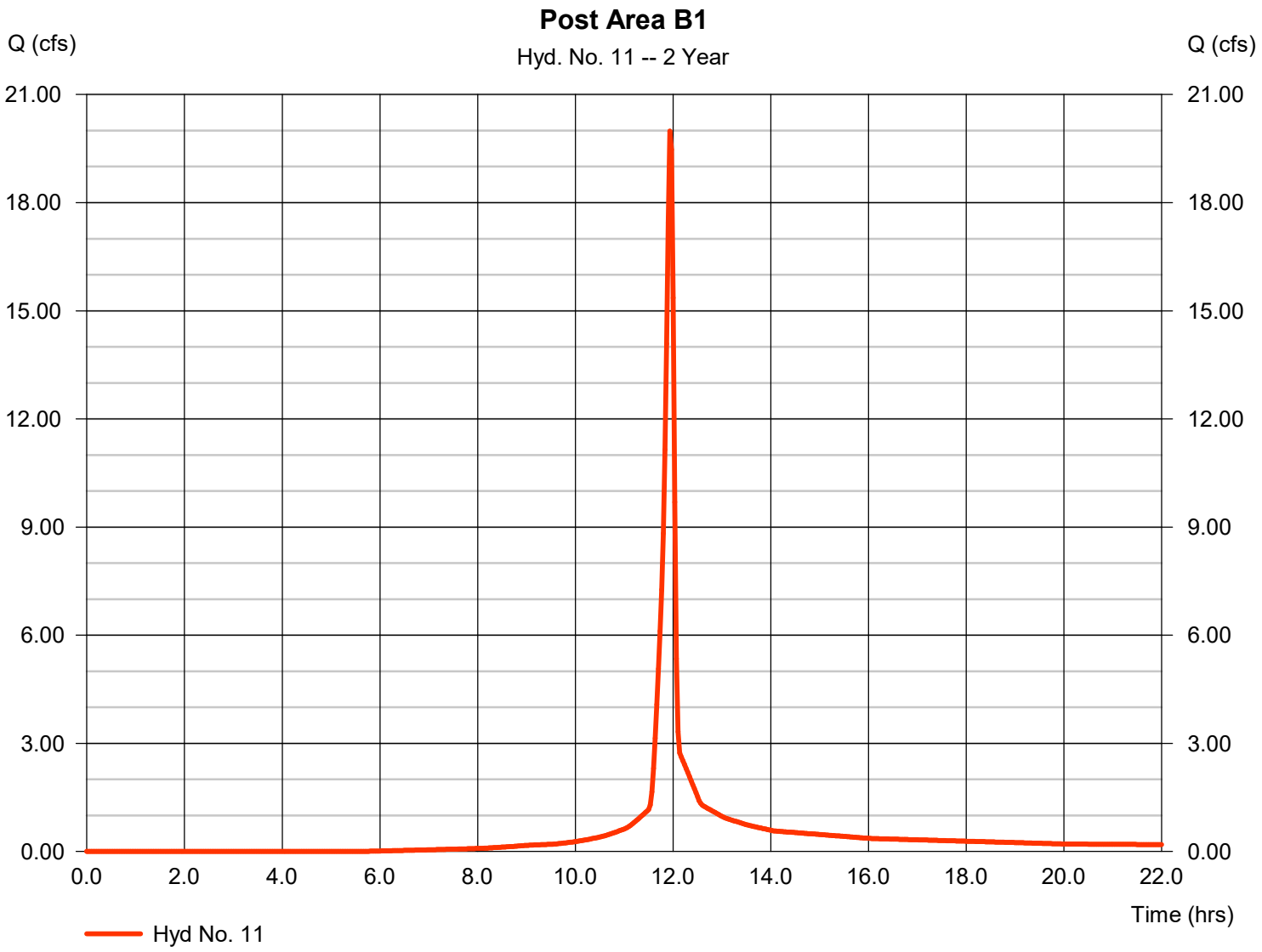
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 11

Post Area B1

Hydrograph type	= SCS Runoff	Peak discharge	= 19.98 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 41,395 cuft
Drainage area	= 6.580 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.76 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.930 x 98) + (2.650 x 80)] / 6.580



Hydrograph Report

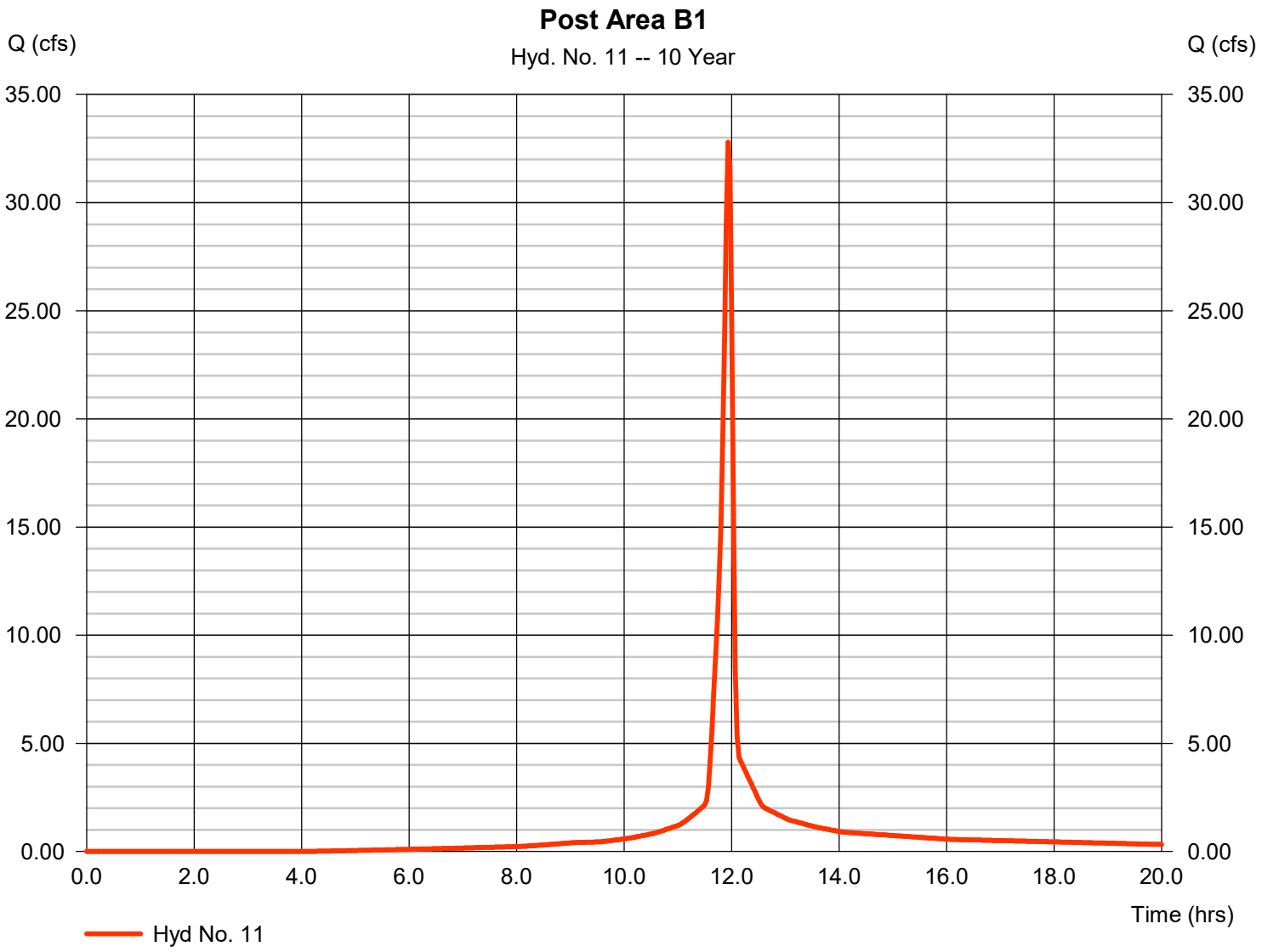
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 11

Post Area B1

Hydrograph type	= SCS Runoff	Peak discharge	= 32.80 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 69,927 cuft
Drainage area	= 6.580 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.930 x 98) + (2.650 x 80)] / 6.580



Hydrograph Report

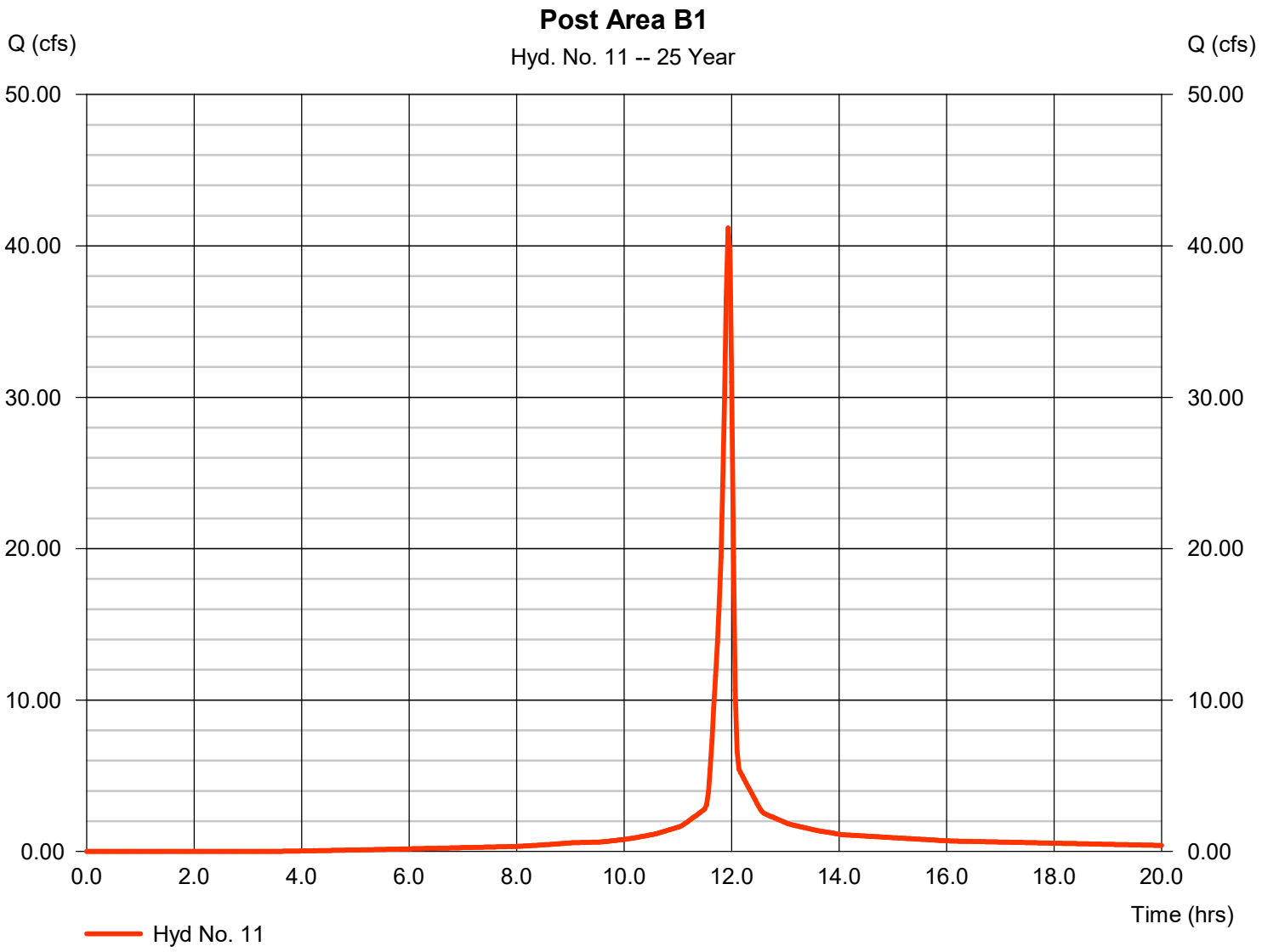
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 11

Post Area B1

Hydrograph type	= SCS Runoff	Peak discharge	= 41.18 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 89,169 cuft
Drainage area	= 6.580 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.930 x 98) + (2.650 x 80)] / 6.580



Hydrograph Report

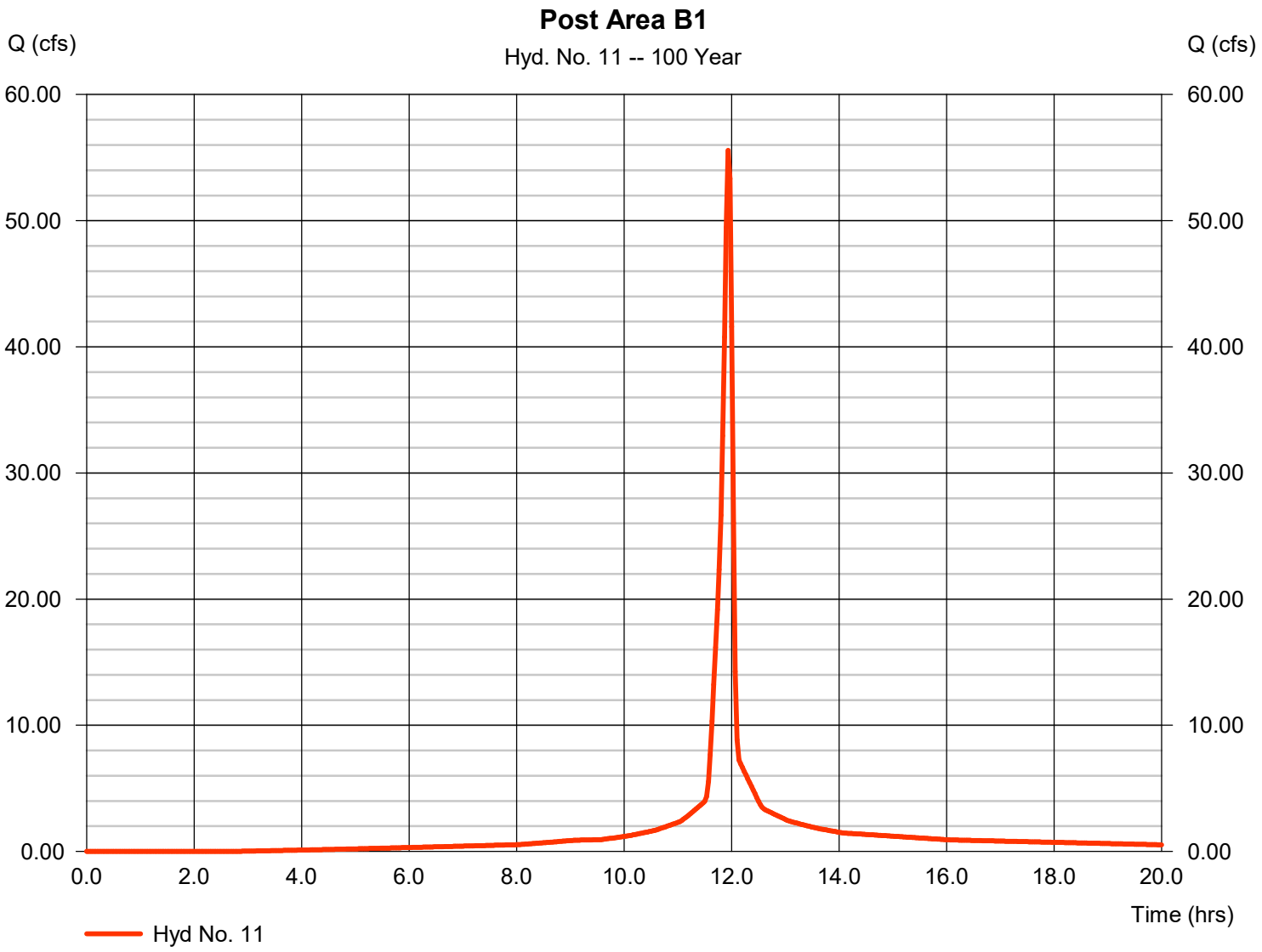
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 11

Post Area B1

Hydrograph type	= SCS Runoff	Peak discharge	= 55.57 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 122,859 cuft
Drainage area	= 6.580 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.54 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.930 x 98) + (2.650 x 80)] / 6.580



Hydrograph Report

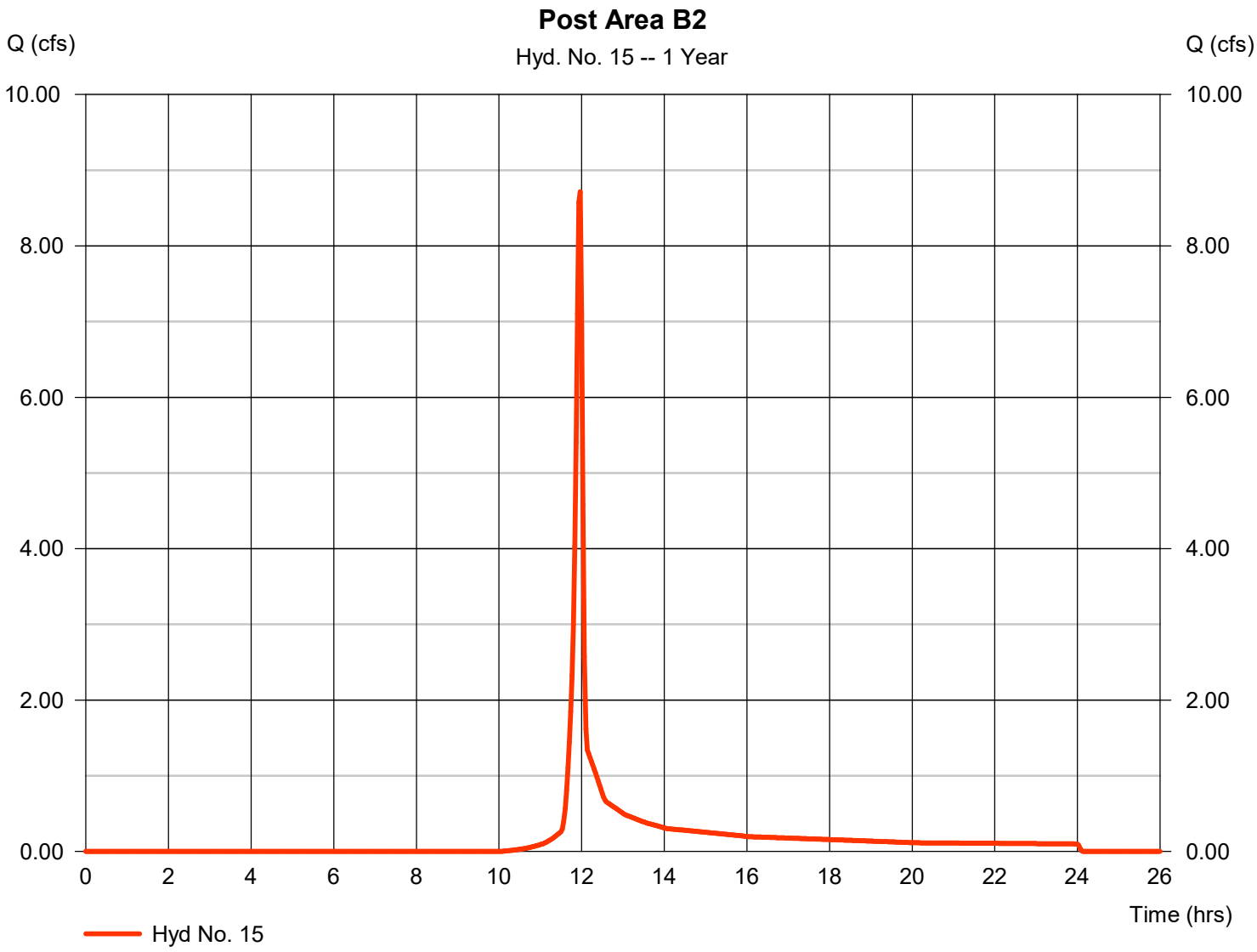
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 15

Post Area B2

Hydrograph type	= SCS Runoff	Peak discharge	= 8.716 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 17,439 cuft
Drainage area	= 5.740 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.160 x 98) + (0.830 x 80) + (0.550 x 77) + (4.200 x 84)] / 5.740



Hydrograph Report

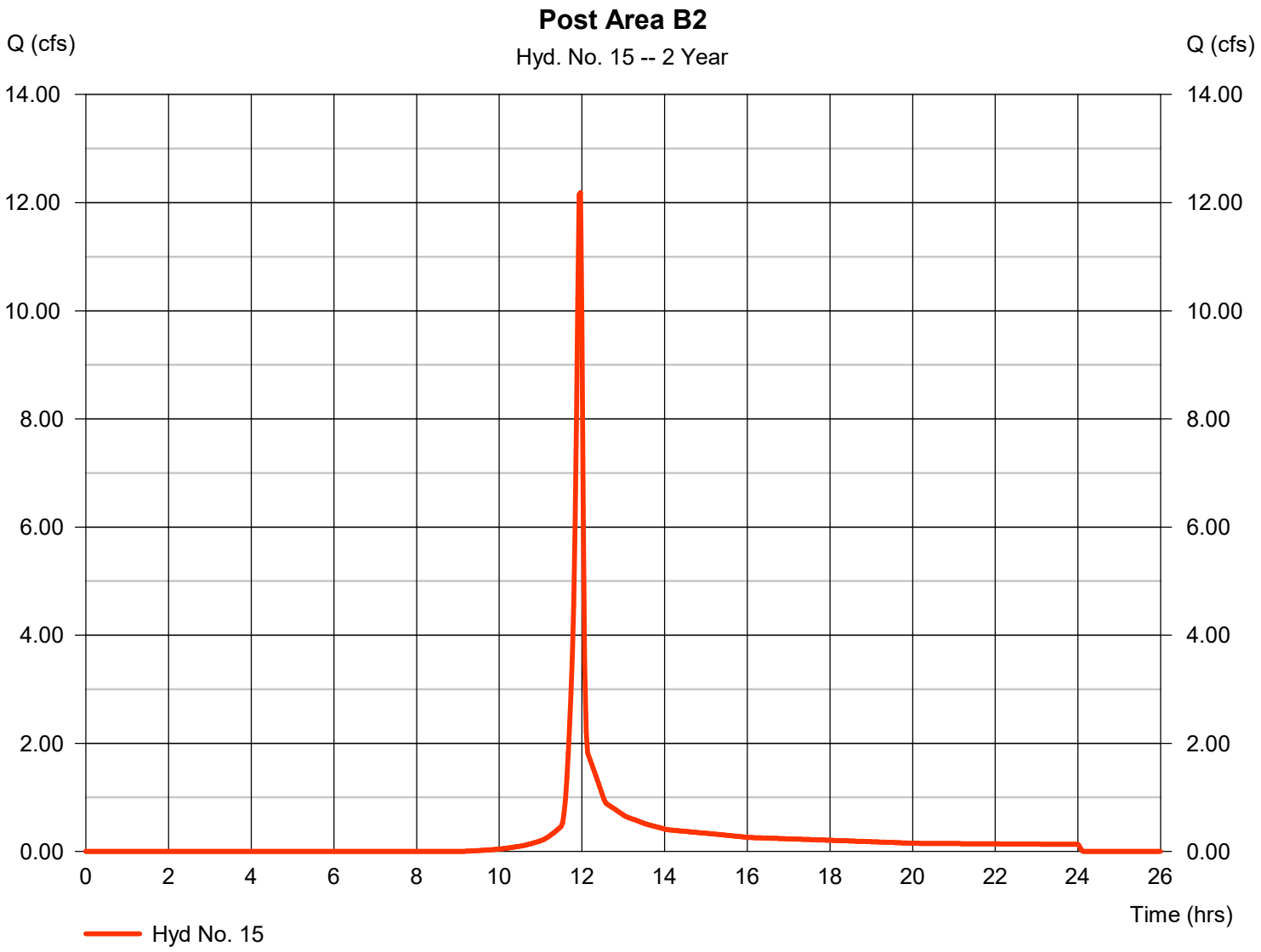
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 15

Post Area B2

Hydrograph type	= SCS Runoff	Peak discharge	= 12.19 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 24,533 cuft
Drainage area	= 5.740 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.76 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.160 x 98) + (0.830 x 80) + (0.550 x 77) + (4.200 x 84)] / 5.740



Hydrograph Report

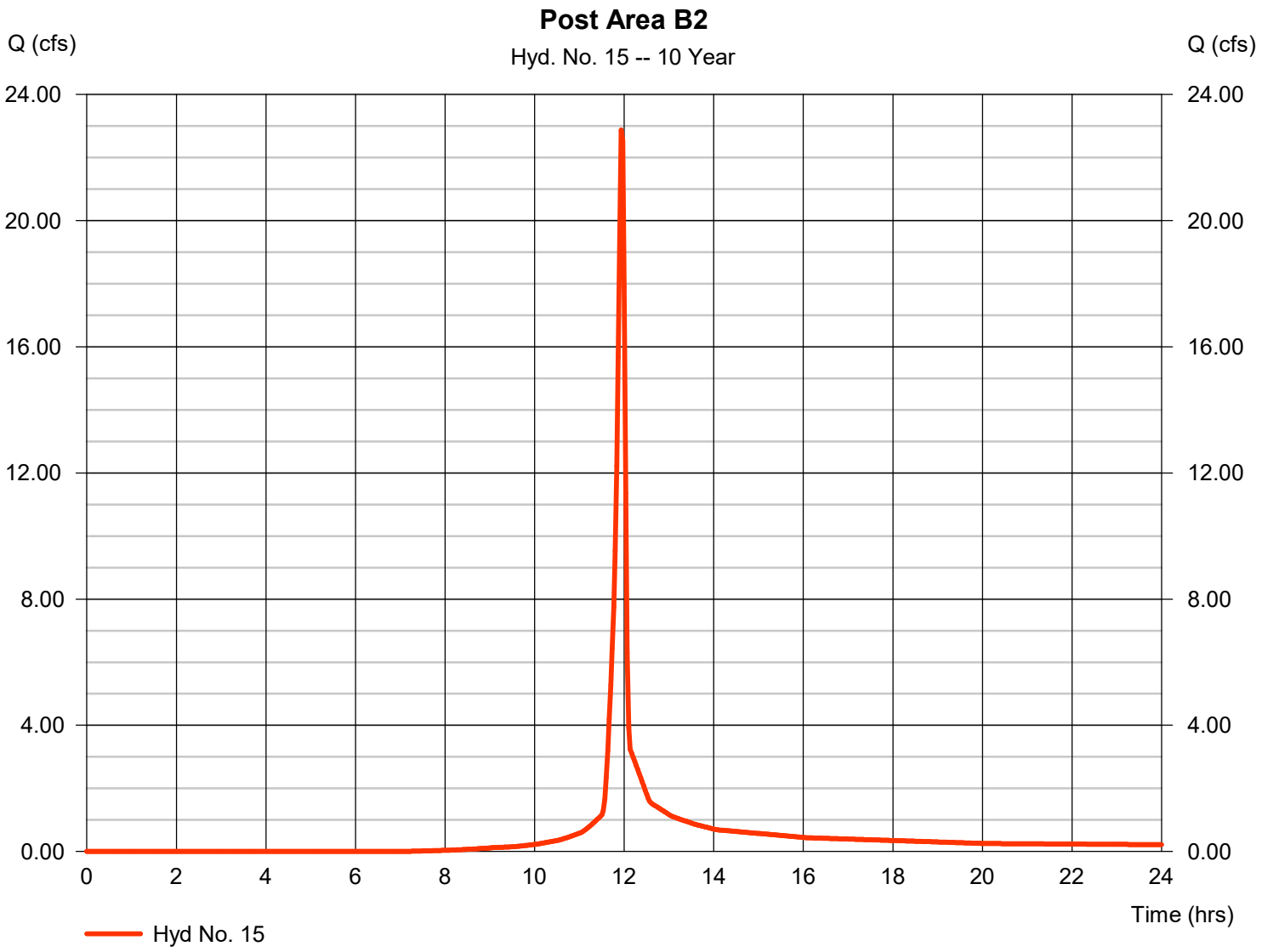
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 15

Post Area B2

Hydrograph type	= SCS Runoff	Peak discharge	= 22.87 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 46,529 cuft
Drainage area	= 5.740 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.160 x 98) + (0.830 x 80) + (0.550 x 77) + (4.200 x 84)] / 5.740



Hydrograph Report

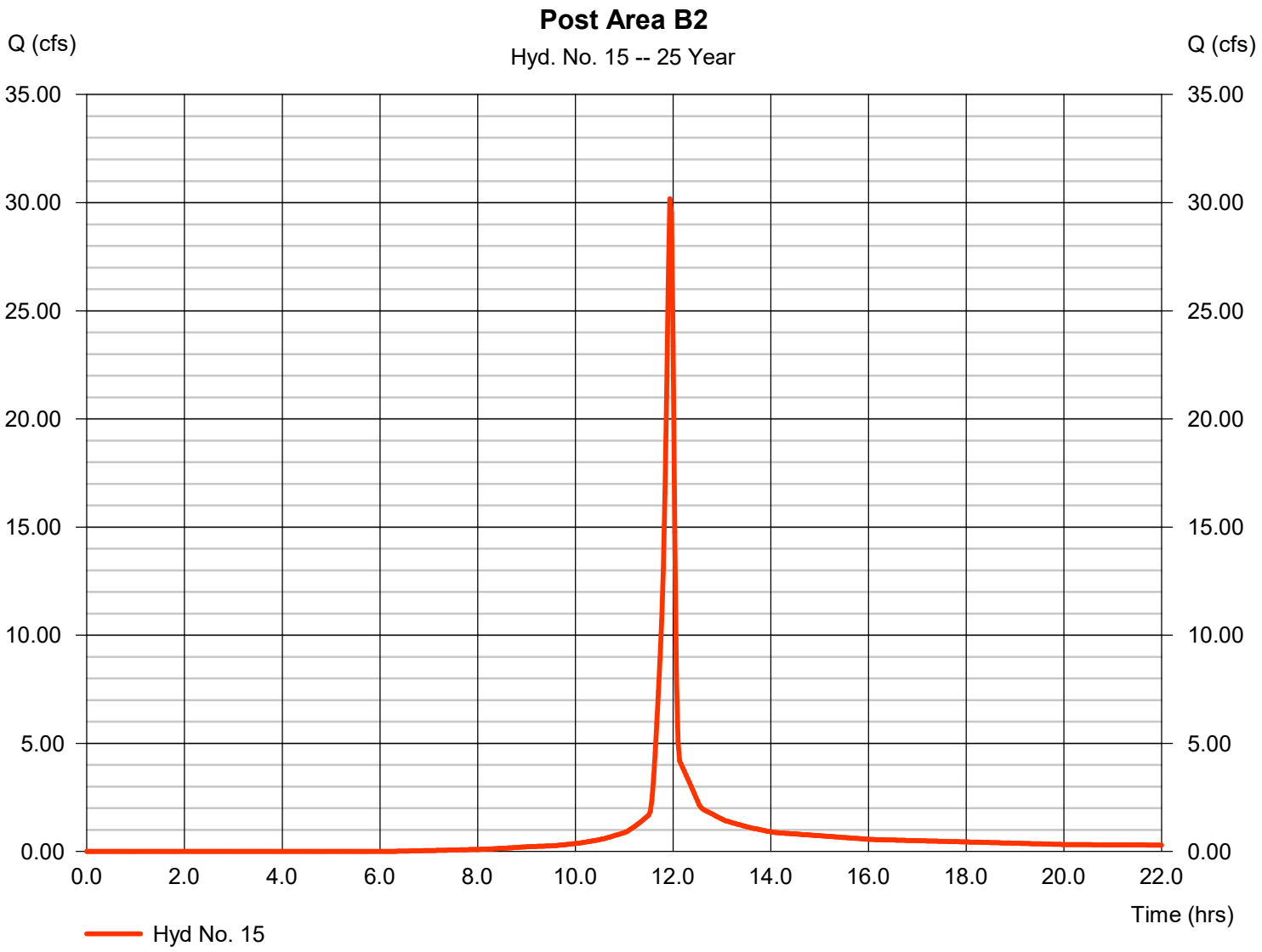
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 15

Post Area B2

Hydrograph type	= SCS Runoff	Peak discharge	= 30.18 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 62,003 cuft
Drainage area	= 5.740 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.160 x 98) + (0.830 x 80) + (0.550 x 77) + (4.200 x 84)] / 5.740



Hydrograph Report

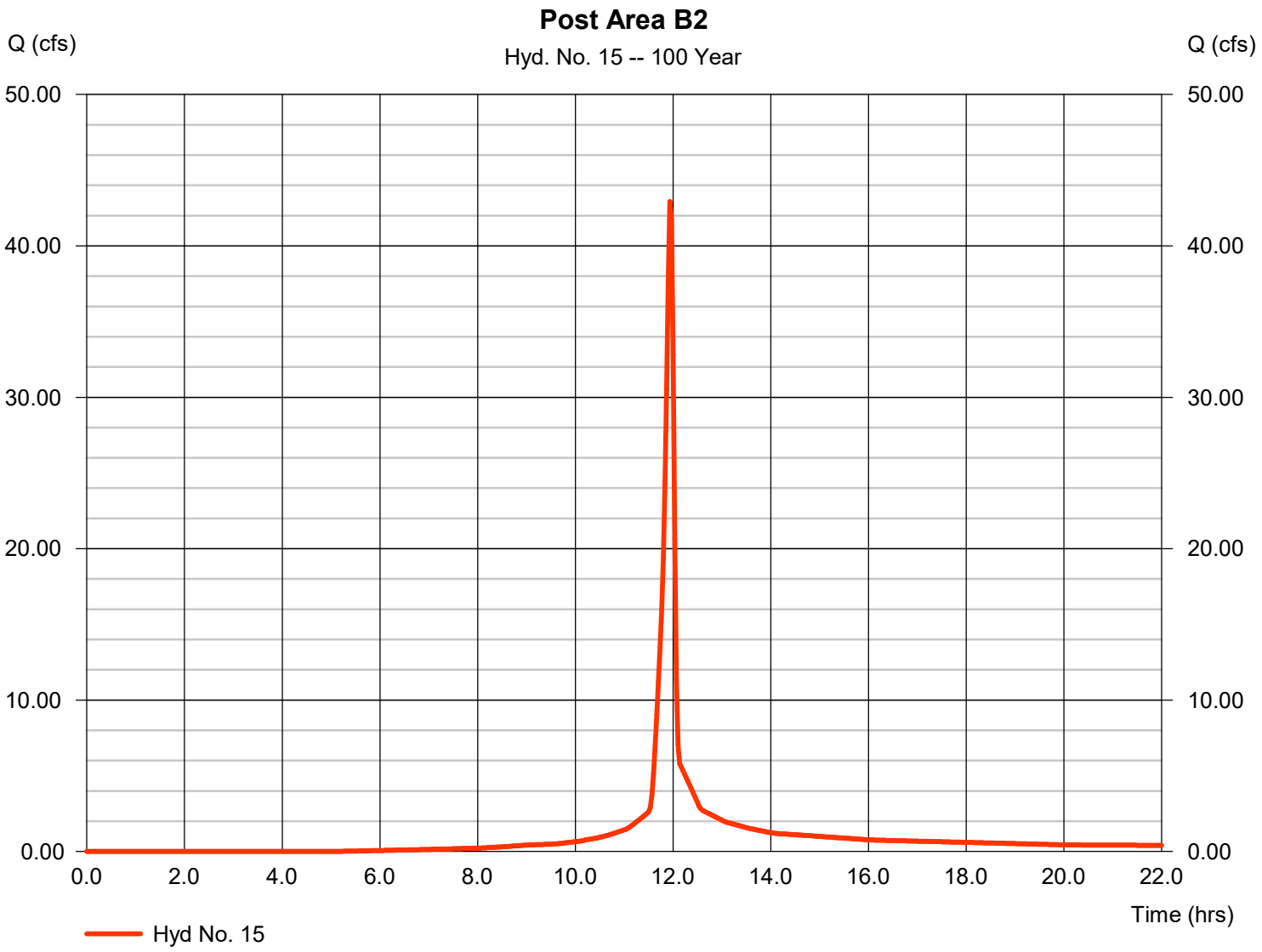
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 15

Post Area B2

Hydrograph type	= SCS Runoff	Peak discharge	= 42.94 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 89,760 cuft
Drainage area	= 5.740 ac	Curve number	= 83*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.54 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.160 x 98) + (0.830 x 80) + (0.550 x 77) + (4.200 x 84)] / 5.740



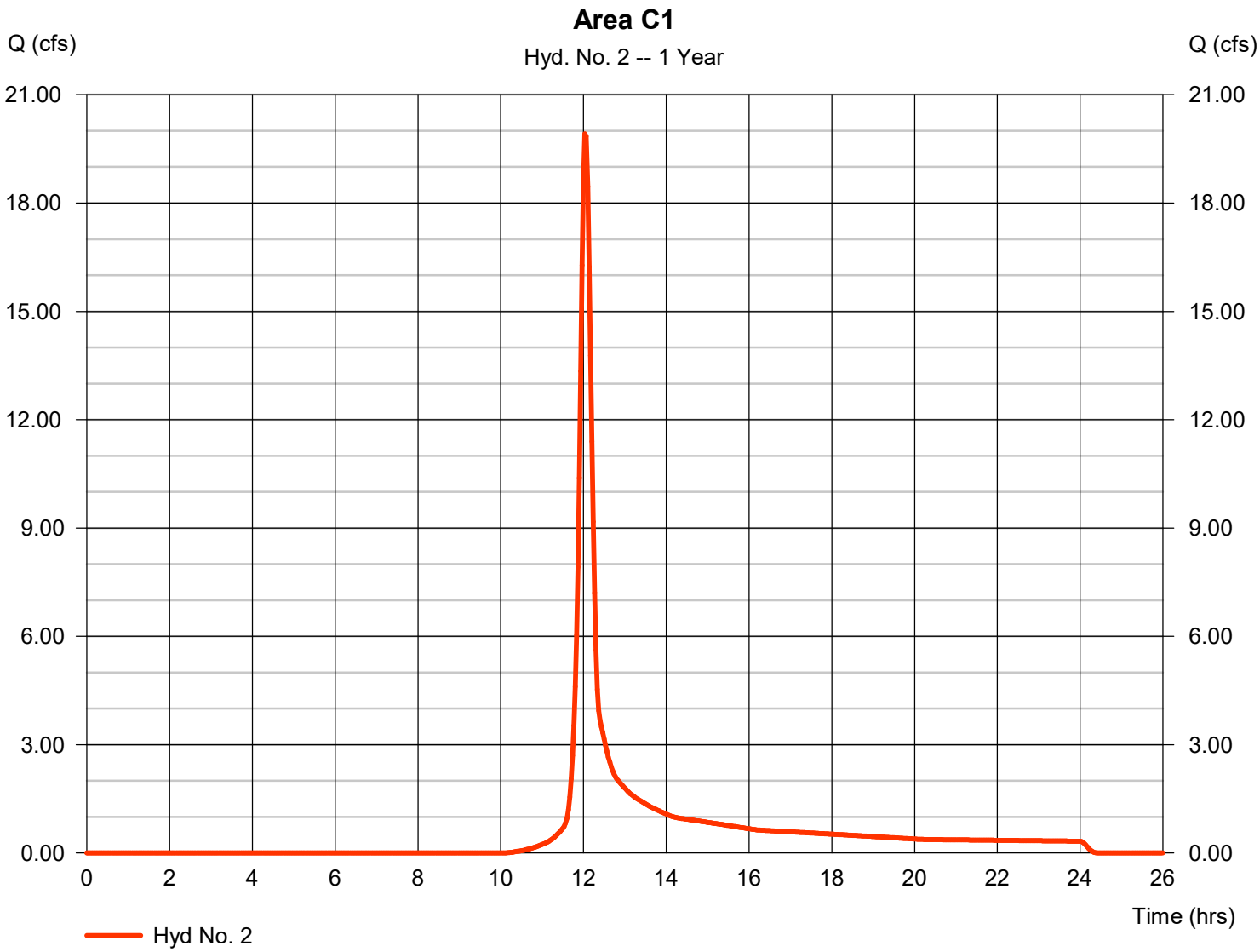
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 2

Area C1

Hydrograph type	= SCS Runoff	Peak discharge	= 19.92 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 56,968 cuft
Drainage area	= 18.030 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.50 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



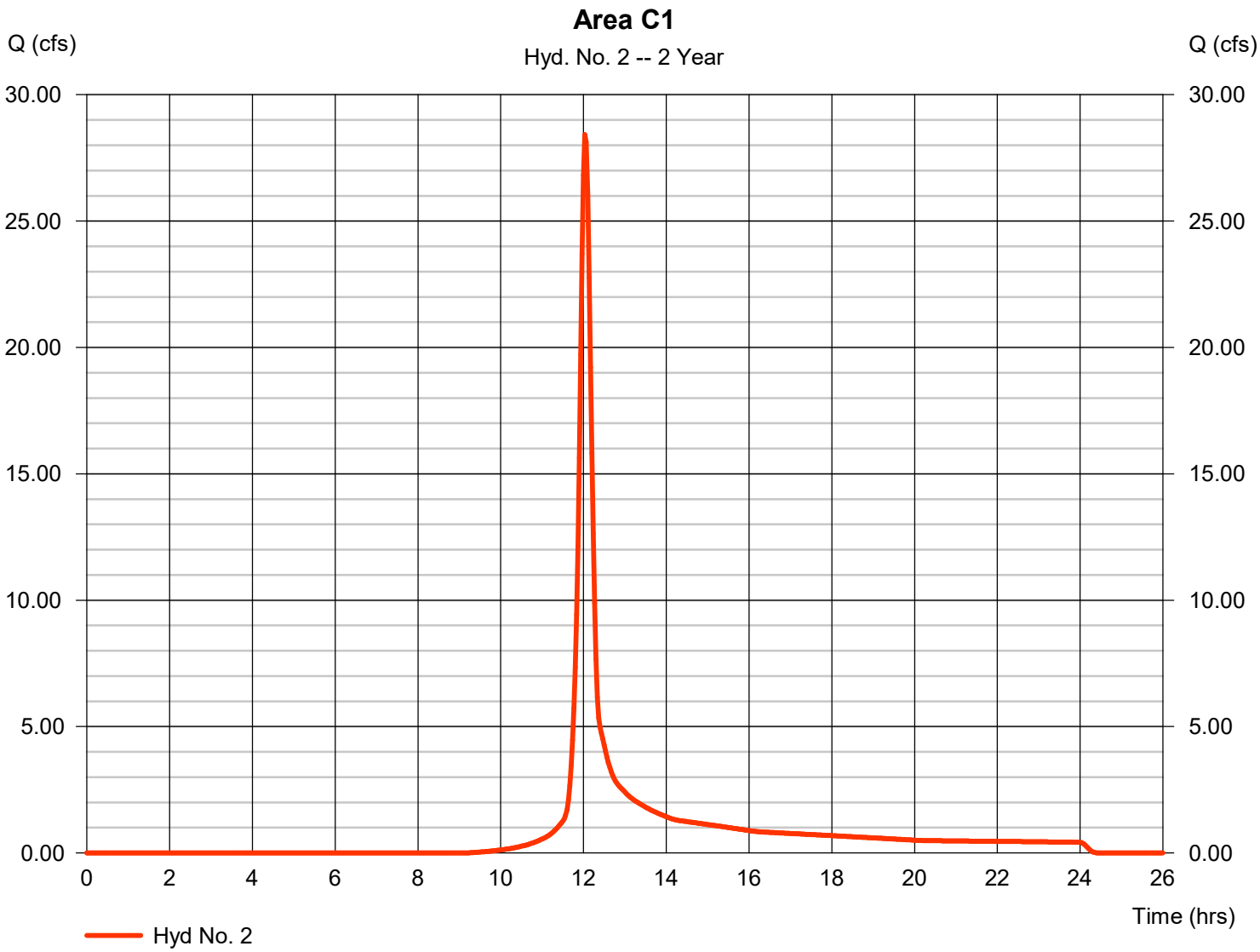
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 2

Area C1

Hydrograph type	= SCS Runoff	Peak discharge	= 28.42 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 80,143 cuft
Drainage area	= 18.030 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.50 min
Total precip.	= 2.76 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



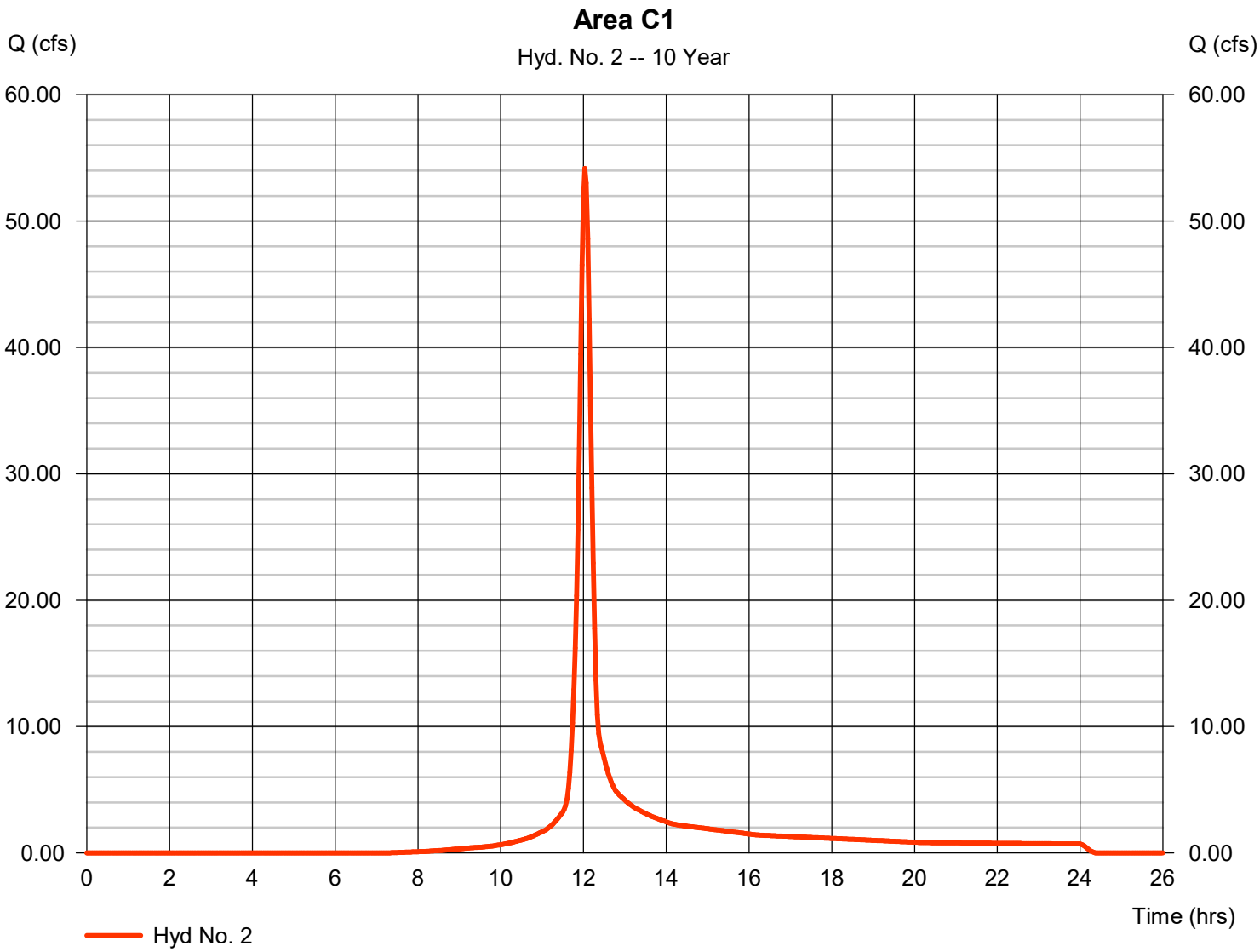
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 2

Area C1

Hydrograph type	= SCS Runoff	Peak discharge	= 54.17 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 151,998 cuft
Drainage area	= 18.030 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.50 min
Total precip.	= 4.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



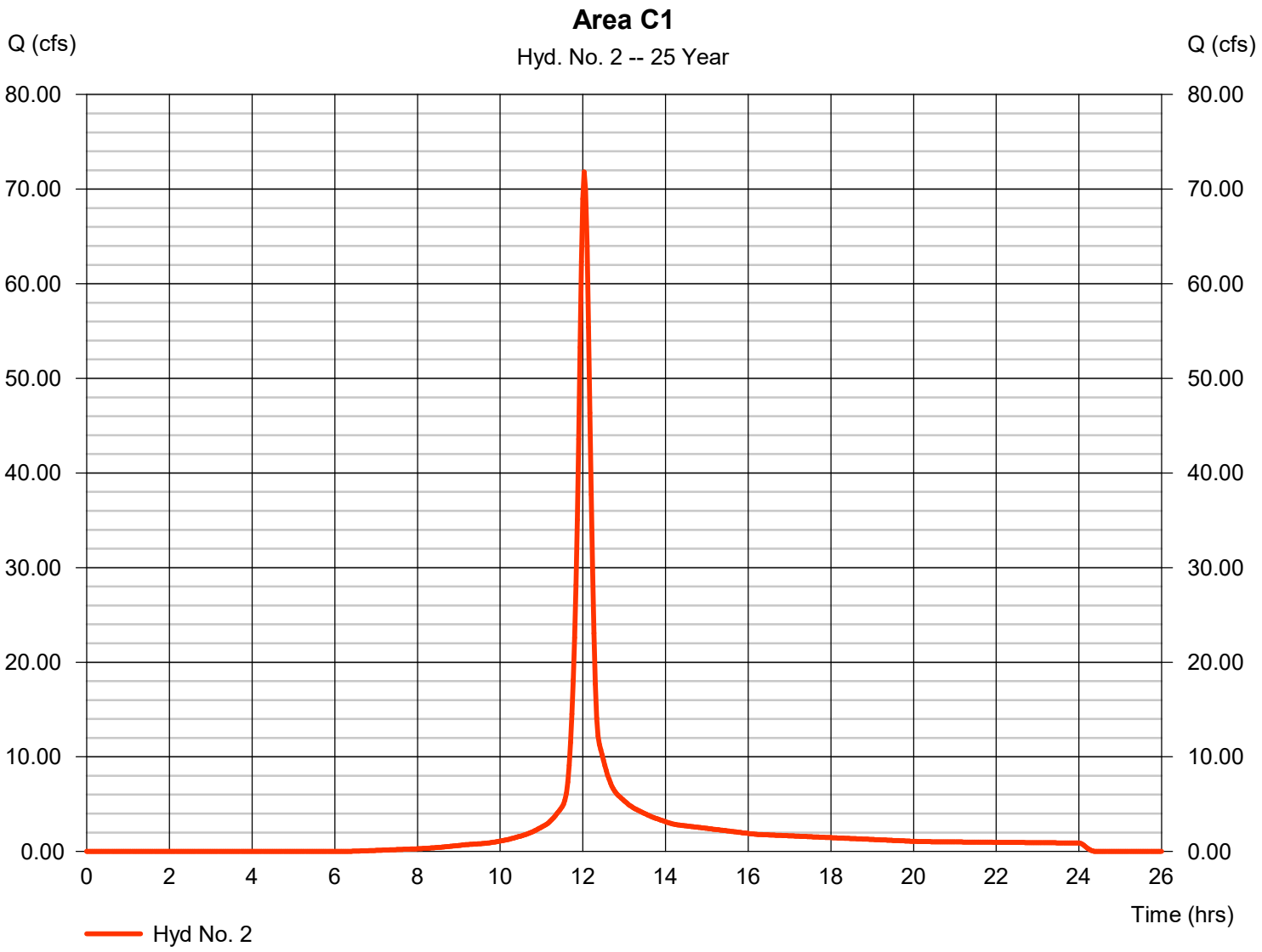
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 2

Area C1

Hydrograph type	= SCS Runoff	Peak discharge	= 71.81 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 202,548 cuft
Drainage area	= 18.030 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.50 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



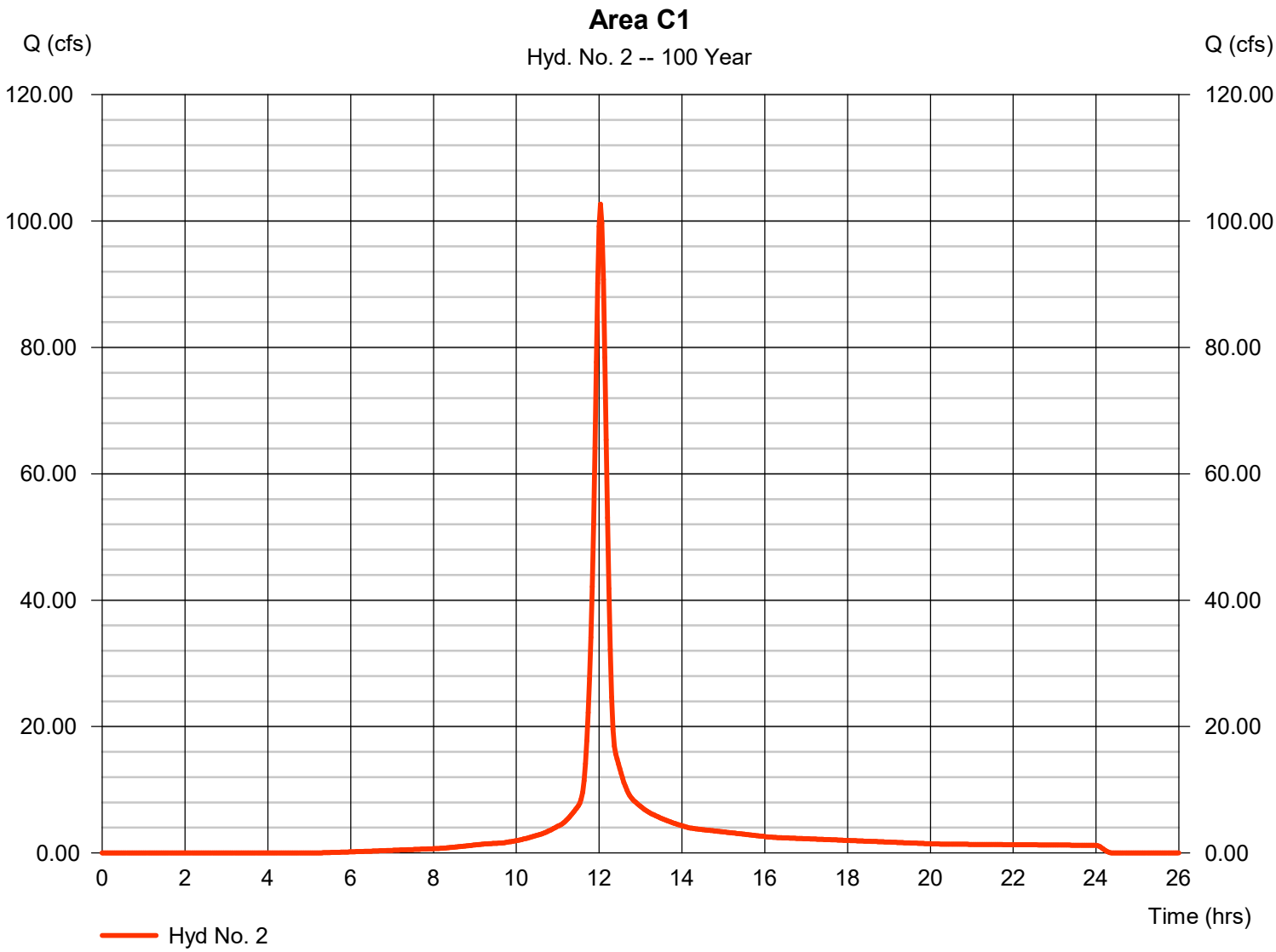
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 2

Area C1

Hydrograph type	= SCS Runoff	Peak discharge	= 102.70 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 293,226 cuft
Drainage area	= 18.030 ac	Curve number	= 83
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.50 min
Total precip.	= 6.54 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

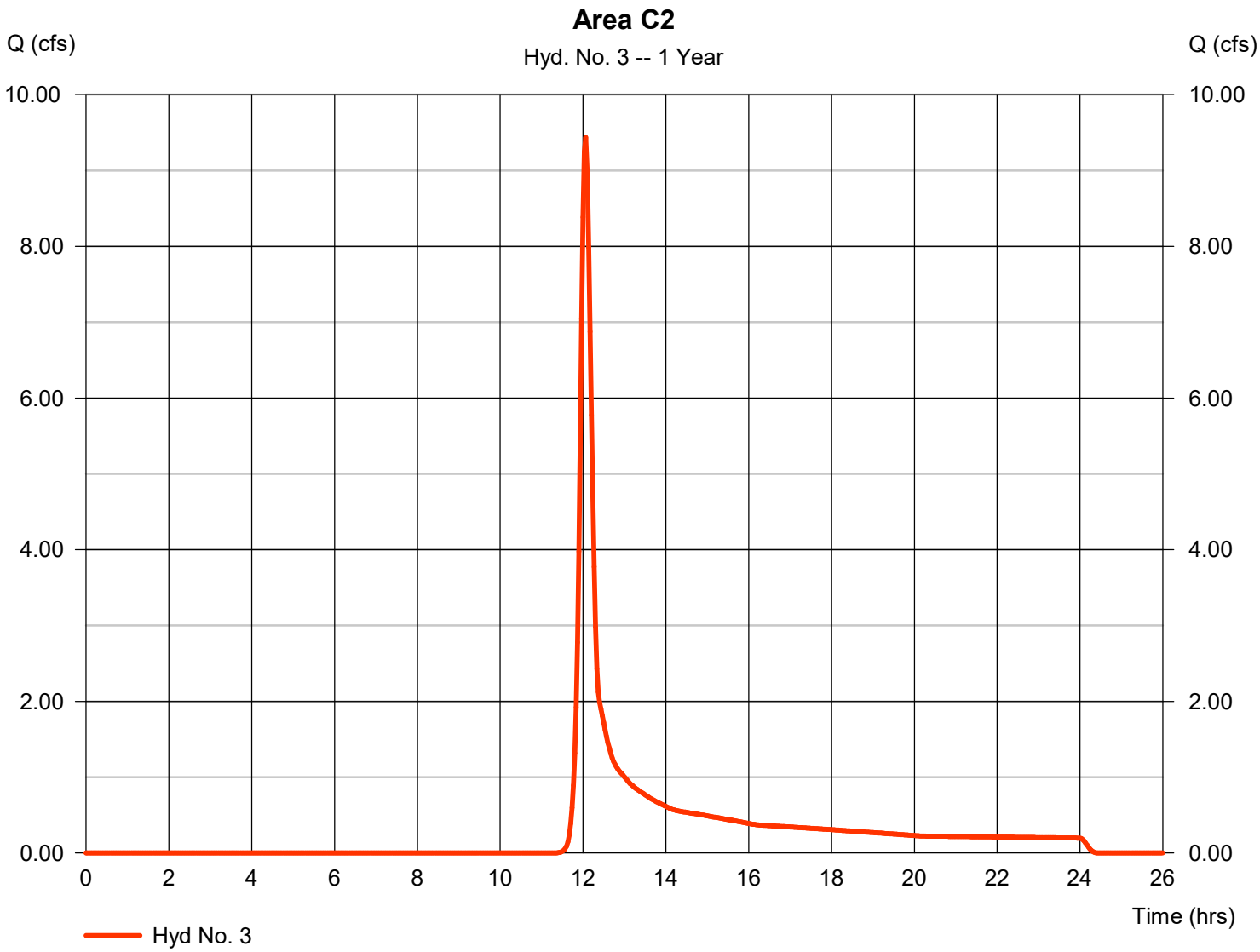


Hydrograph Report

Hyd. No. 3

Area C2

Hydrograph type	= SCS Runoff	Peak discharge	= 9.437 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 28,646 cuft
Drainage area	= 13.350 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.40 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

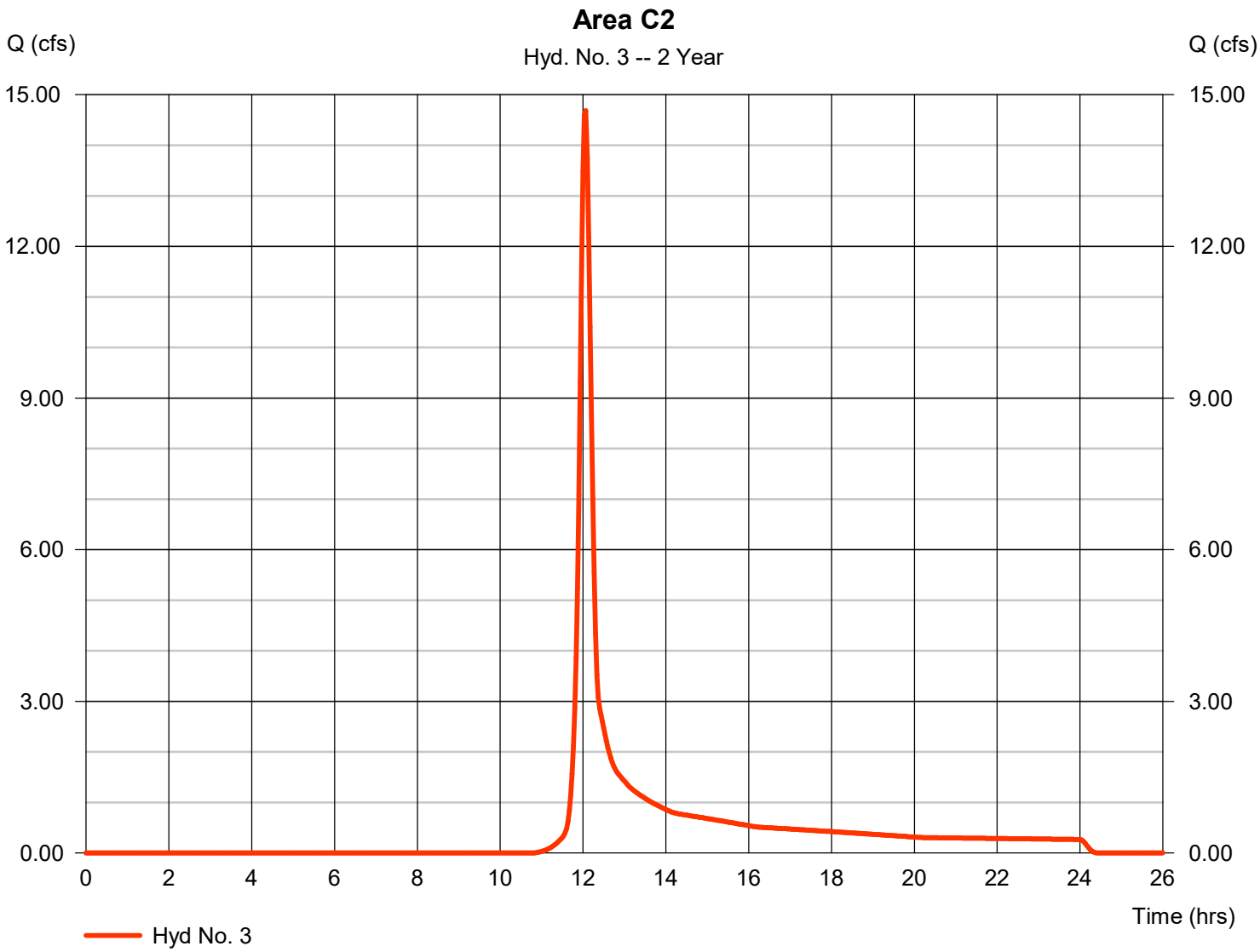


Hydrograph Report

Hyd. No. 3

Area C2

Hydrograph type	= SCS Runoff	Peak discharge	= 14.69 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 42,911 cuft
Drainage area	= 13.350 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.40 min
Total precip.	= 2.76 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



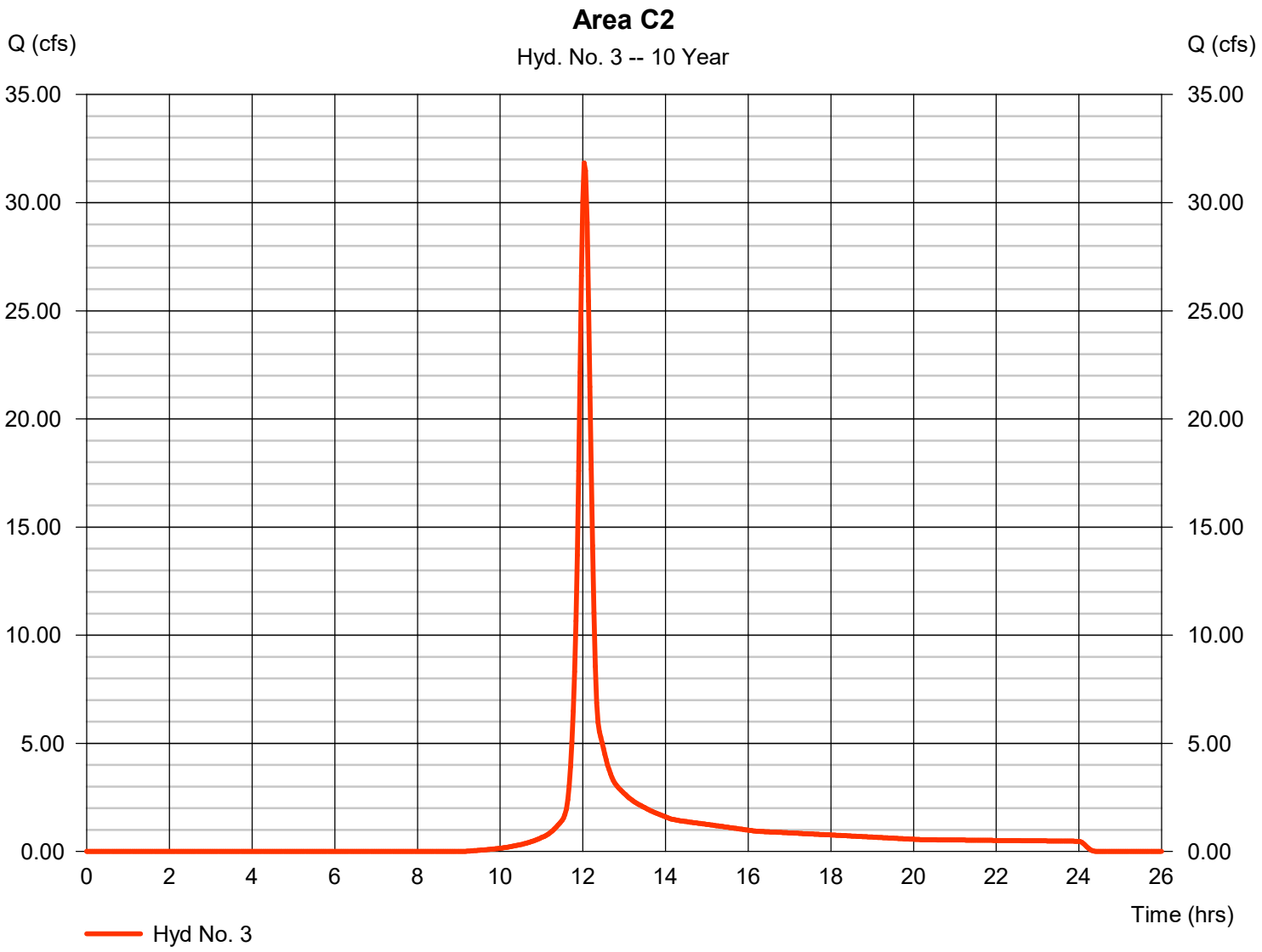
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 3

Area C2

Hydrograph type	= SCS Runoff	Peak discharge	= 31.84 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 89,694 cuft
Drainage area	= 13.350 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.40 min
Total precip.	= 4.11 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



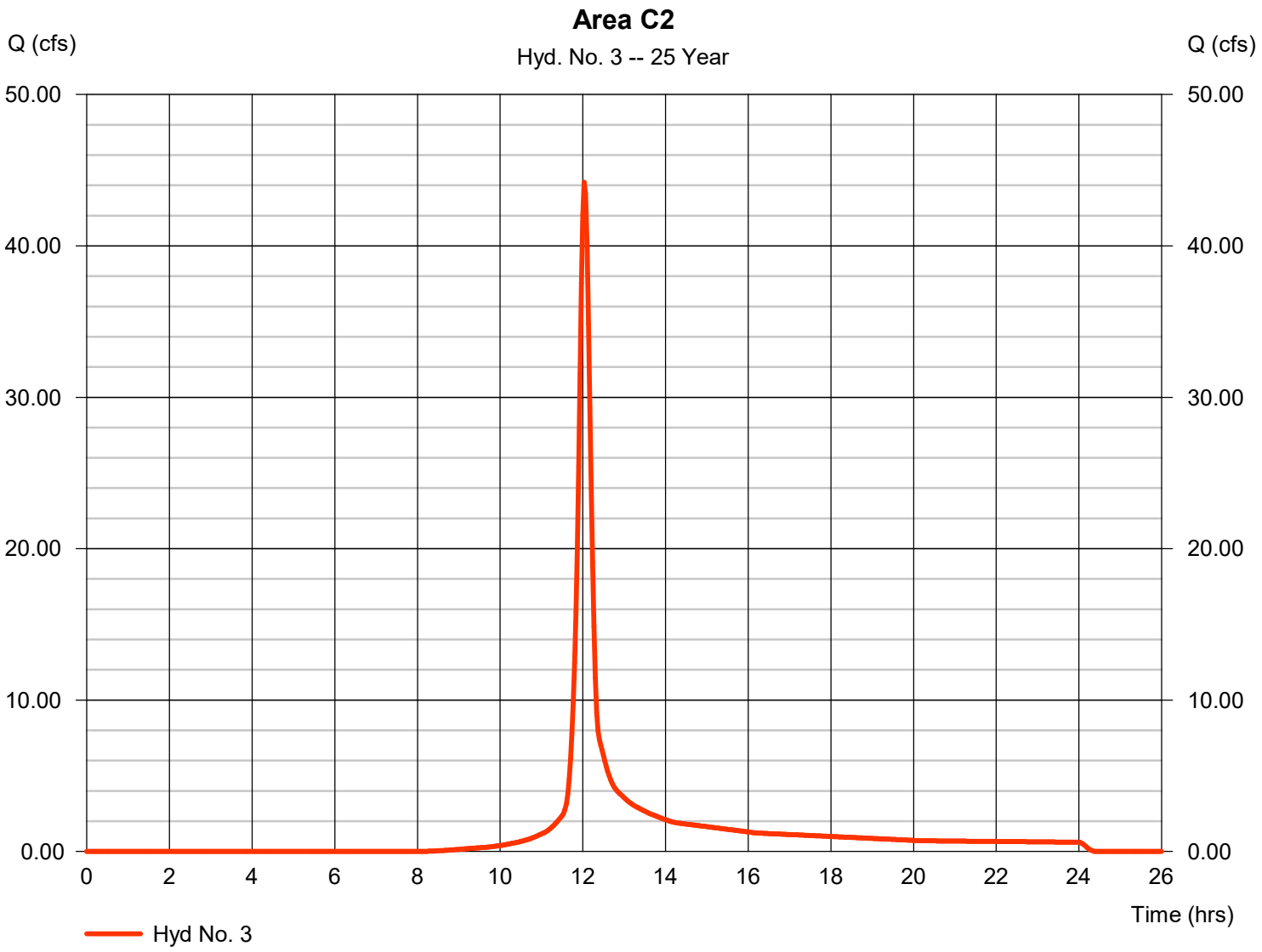
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 3

Area C2

Hydrograph type	= SCS Runoff	Peak discharge	= 44.21 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 123,934 cuft
Drainage area	= 13.350 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.40 min
Total precip.	= 5.00 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



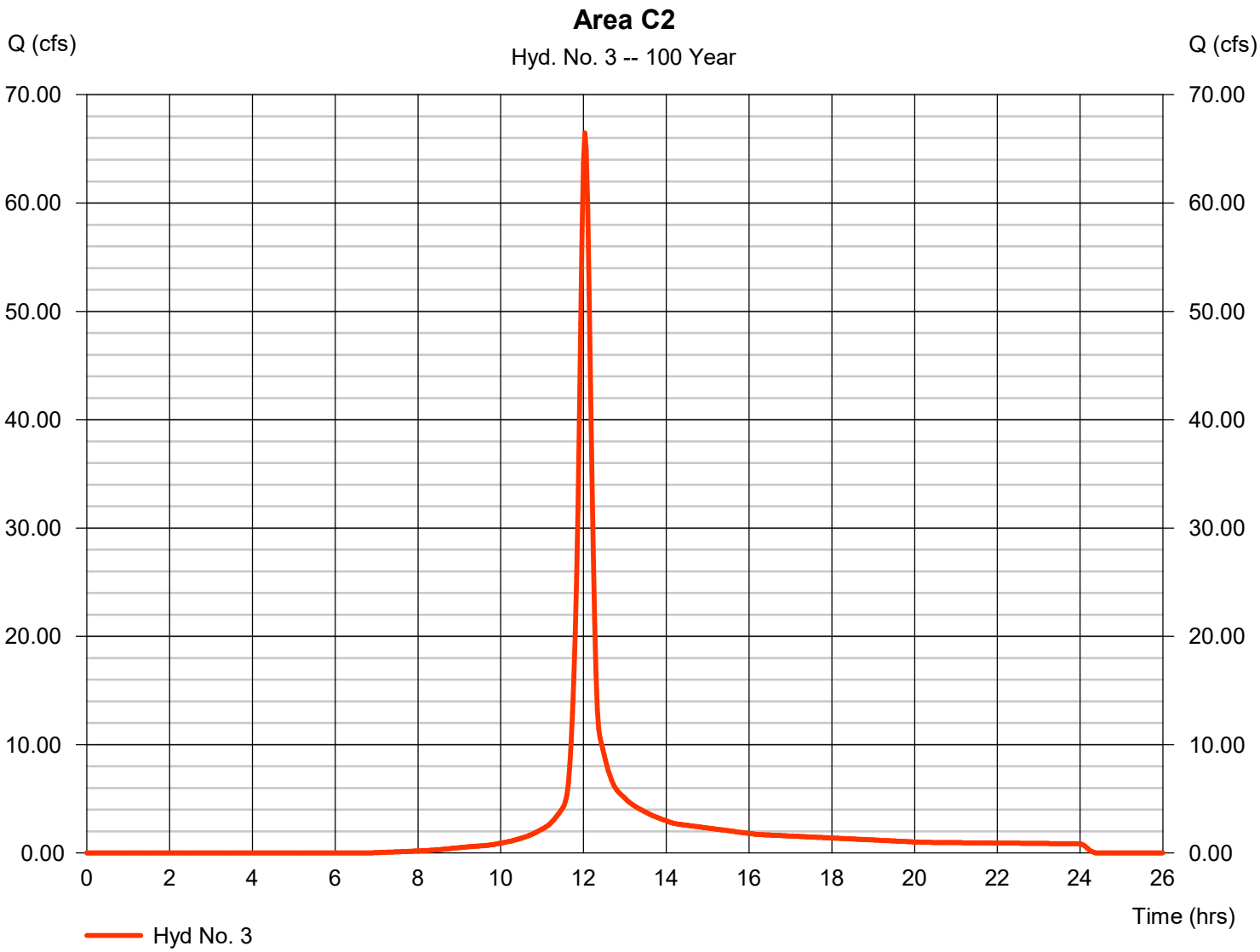
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 3

Area C2

Hydrograph type	= SCS Runoff	Peak discharge	= 66.47 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 186,858 cuft
Drainage area	= 13.350 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.40 min
Total precip.	= 6.54 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

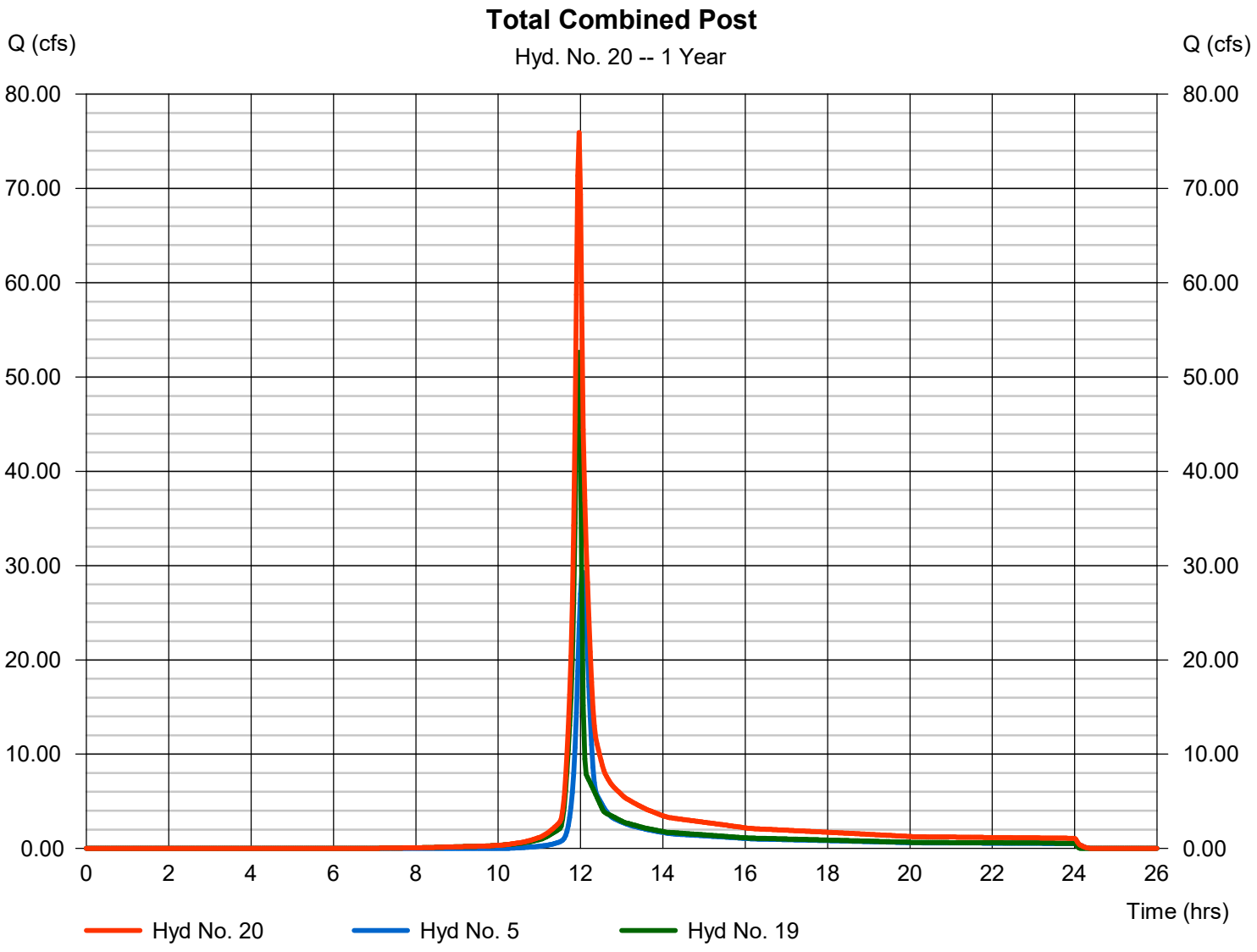


Hydrograph Report

Hyd. No. 20

Total Combined Post

Hydrograph type	= Combine	Peak discharge	= 75.93 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 193,271 cuft
Inflow hyds.	= 5, 19	Contrib. drain. area	= 0.000 ac

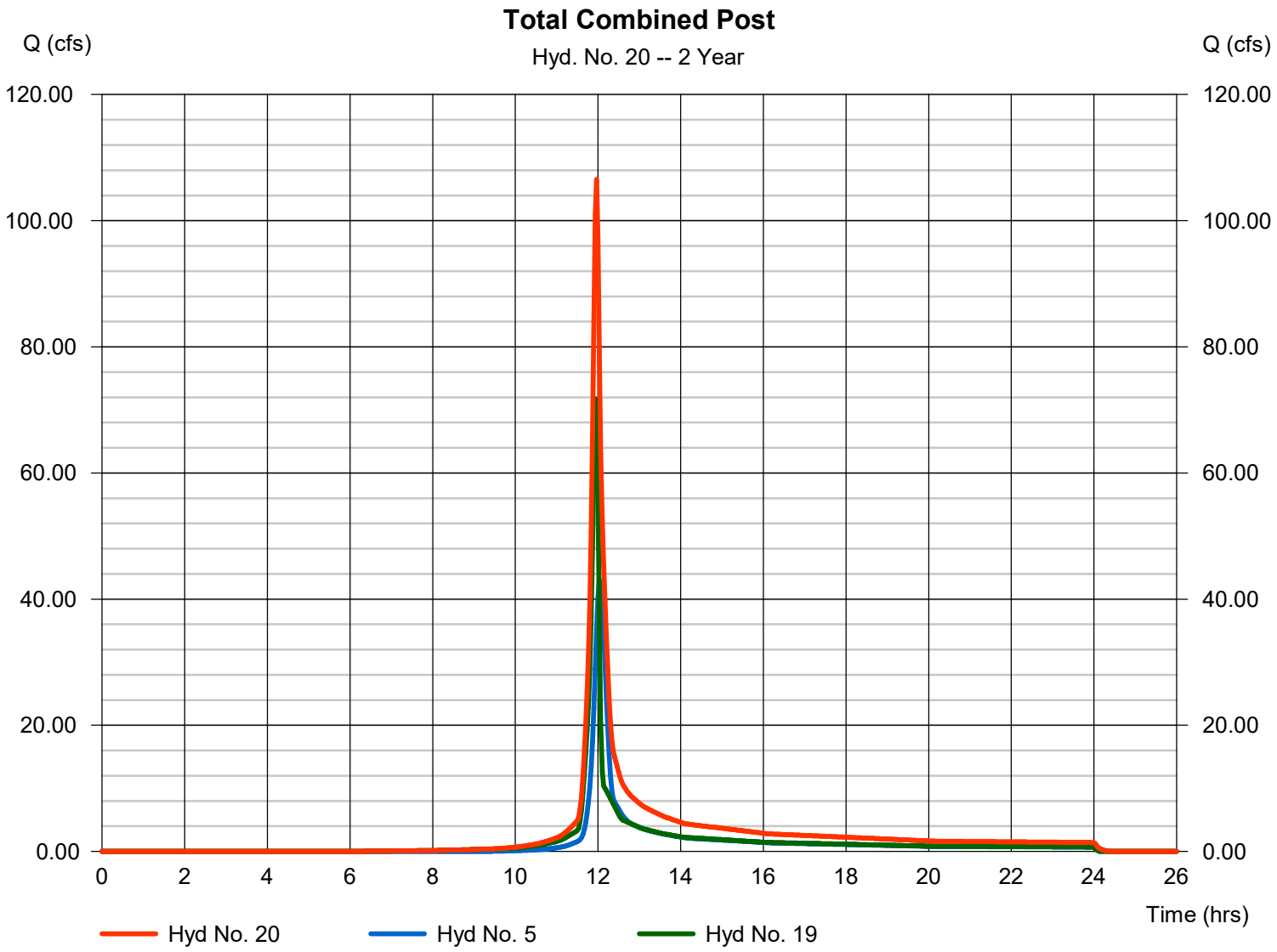


Hydrograph Report

Hyd. No. 20

Total Combined Post

Hydrograph type	= Combine	Peak discharge	= 106.54 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 270,072 cuft
Inflow hyds.	= 5, 19	Contrib. drain. area	= 0.000 ac



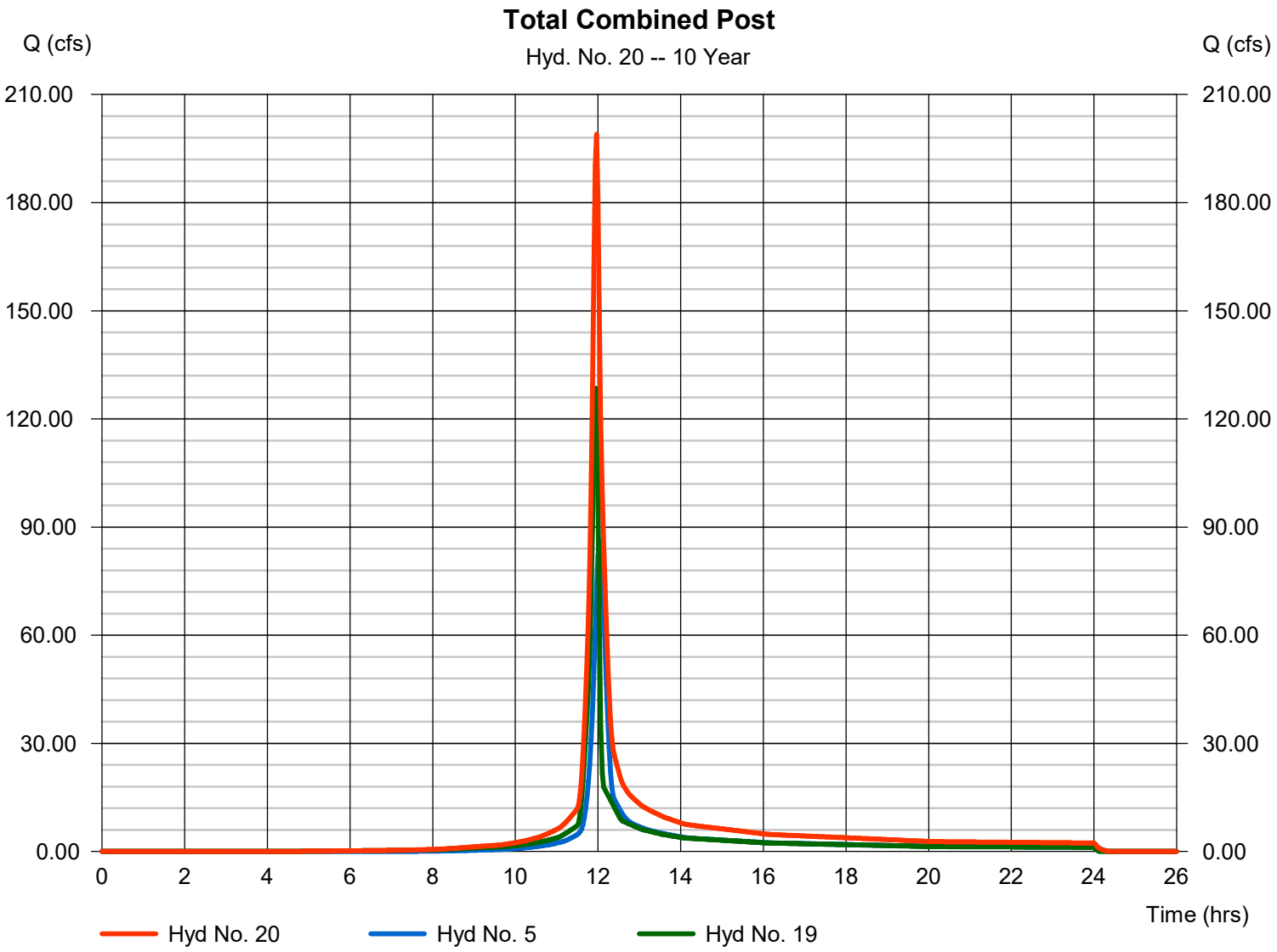
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 20

Total Combined Post

Hydrograph type	= Combine	Peak discharge	= 198.91 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 508,444 cuft
Inflow hyds.	= 5, 19	Contrib. drain. area	= 0.000 ac



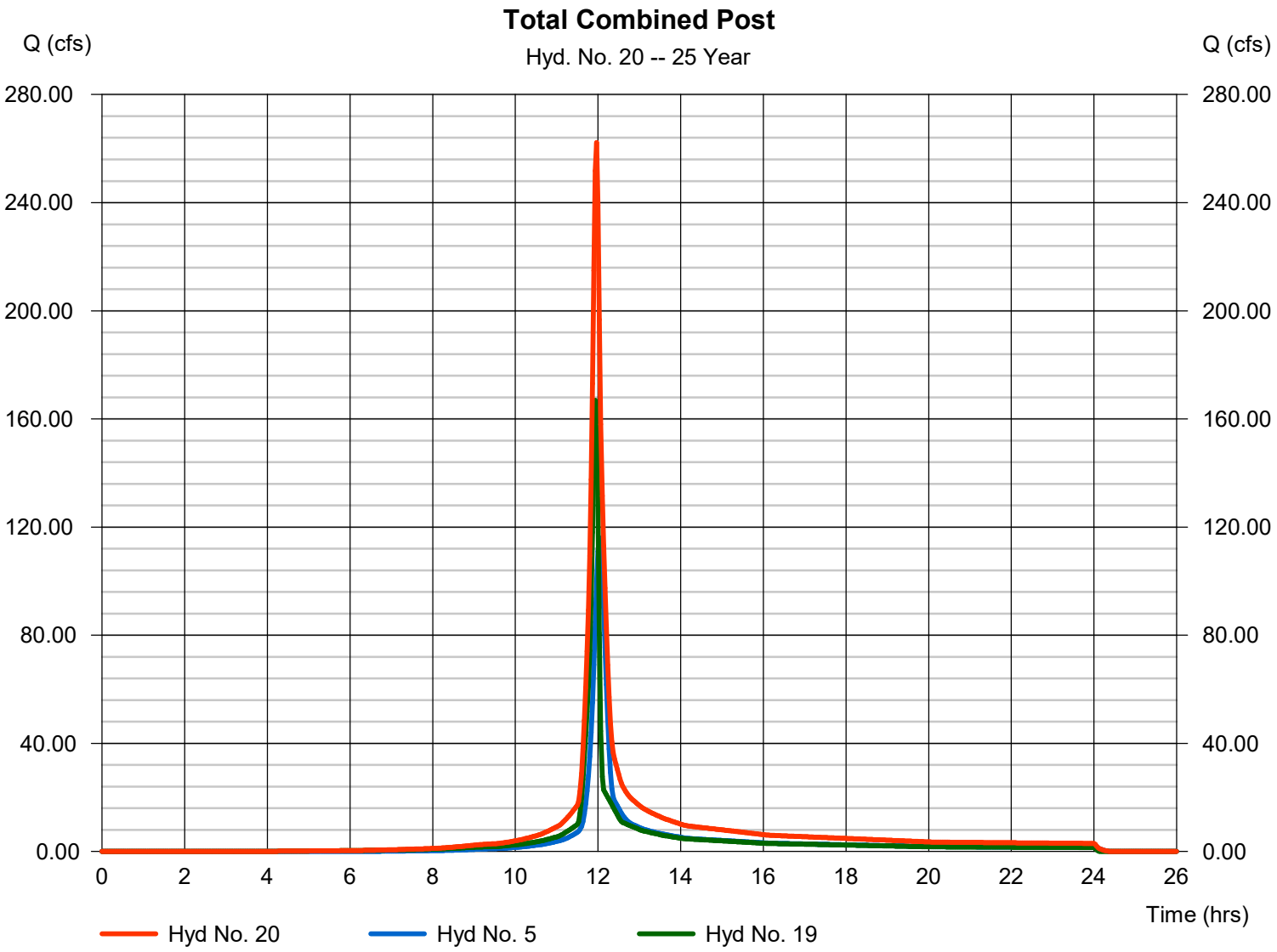
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 20

Total Combined Post

Hydrograph type	= Combine	Peak discharge	= 262.27 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 676,455 cuft
Inflow hyds.	= 5, 19	Contrib. drain. area	= 0.000 ac



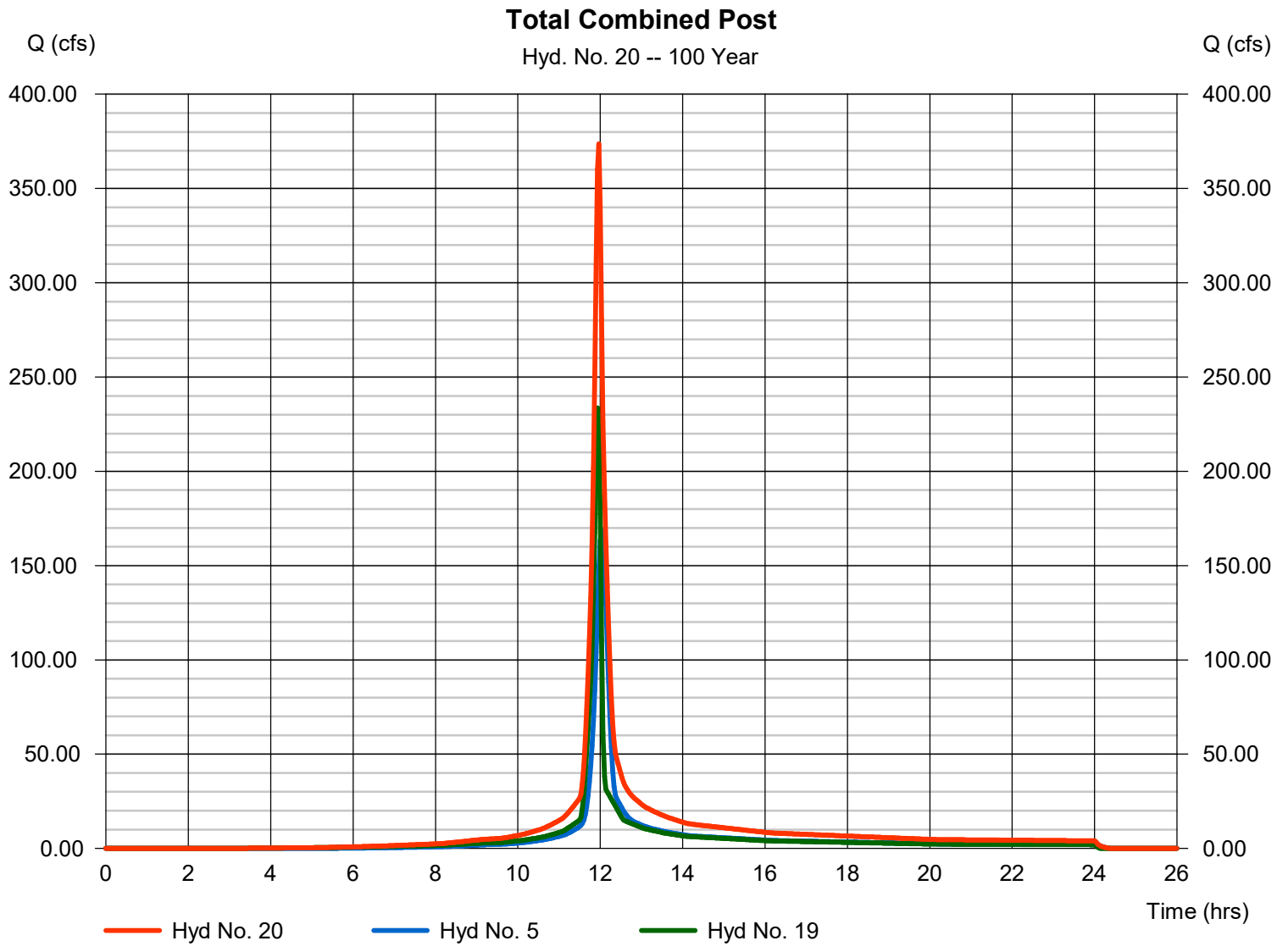
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 20

Total Combined Post

Hydrograph type	= Combine	Peak discharge	= 373.57 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 978,385 cuft
Inflow hyds.	= 5, 19	Contrib. drain. area	= 0.000 ac



Appendix D

Energy Balance Analysis

Hydrograph Report

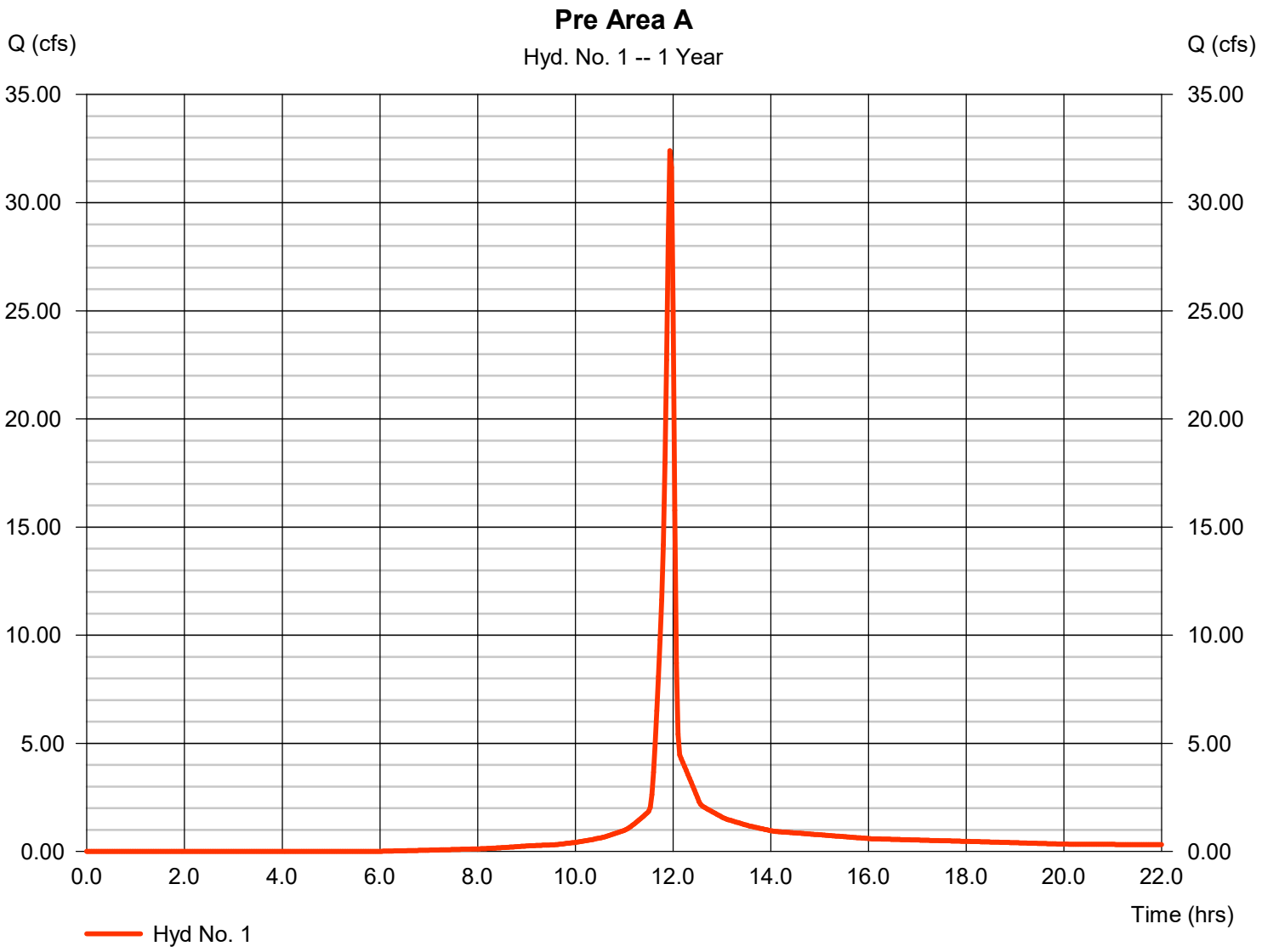
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 1

Pre Area A

Hydrograph type	= SCS Runoff	Peak discharge	= 32.40 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 66,860 cuft
Drainage area	= 13.180 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(8.890 x 98) + (4.290 x 80)] / 13.180



Hydrograph Report

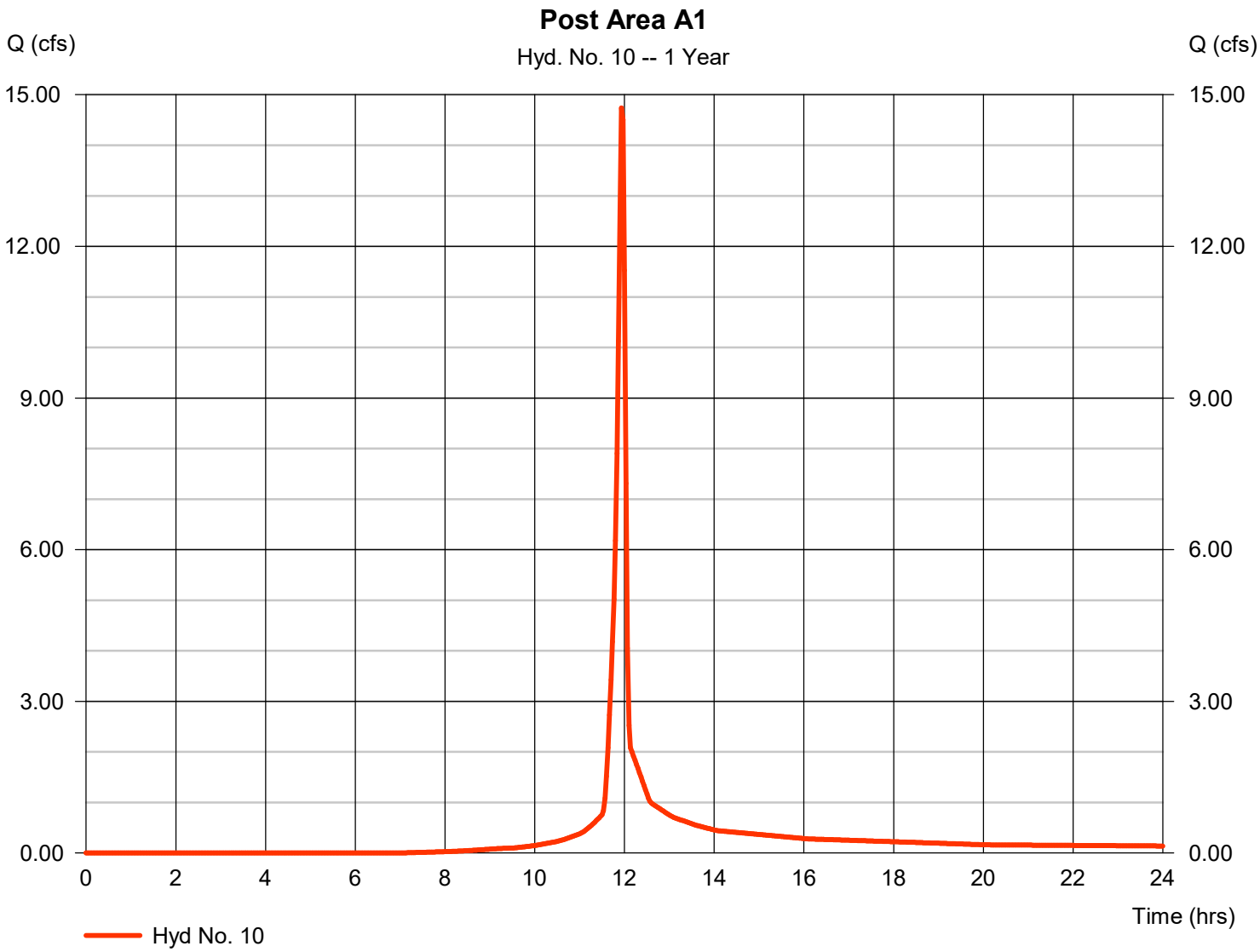
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 10

Post Area A1

Hydrograph type	= SCS Runoff	Peak discharge	= 14.74 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 30,013 cuft
Drainage area	= 6.600 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.720 x 98) + (2.880 x 80)] / 6.600



Pond Report

Pond No. 2 - StormTech Isolator Row

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	n/a	0	0
0.50	100.50	n/a	140	140
1.00	101.00	n/a	198	338
1.50	101.50	n/a	253	592
2.00	102.00	n/a	248	839
2.50	102.50	n/a	240	1,079
3.00	103.00	n/a	229	1,308
3.50	103.50	n/a	215	1,523
4.00	104.00	n/a	194	1,717
4.50	104.50	n/a	155	1,872
5.00	105.00	n/a	140	2,012
5.50	105.50	n/a	140	2,152
6.00	106.00	n/a	200	2,352
6.50	106.50	n/a	200	2,552
7.00	107.00	n/a	200	2,752
7.50	107.50	n/a	200	2,952

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	0.00	0.00	0.00
Span (in)	= 15.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 101.95	0.00	0.00	0.00
Length (ft)	= 1.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	100.00	0.00	---	---	---	---	---	---	---	---	---	0.000
0.50	140	100.50	0.00	---	---	---	---	---	---	---	---	---	0.000
1.00	338	101.00	0.00	---	---	---	---	---	---	---	---	---	0.000
1.50	592	101.50	0.00	---	---	---	---	---	---	---	---	---	0.000
2.00	839	102.00	0.01 oc	---	---	---	---	---	---	---	---	---	0.010
2.50	1,079	102.50	0.34 oc	---	---	---	---	---	---	---	---	---	0.338
3.00	1,308	103.00	0.72 oc	---	---	---	---	---	---	---	---	---	0.717
3.50	1,523	103.50	4.44 oc	---	---	---	---	---	---	---	---	---	4.443
4.00	1,717	104.00	7.05 ic	---	---	---	---	---	---	---	---	---	7.053
4.50	1,872	104.50	8.20 ic	---	---	---	---	---	---	---	---	---	8.197
5.00	2,012	105.00	9.20 ic	---	---	---	---	---	---	---	---	---	9.200
5.50	2,152	105.50	10.10 ic	---	---	---	---	---	---	---	---	---	10.10
6.00	2,352	106.00	10.93 ic	---	---	---	---	---	---	---	---	---	10.93
6.50	2,552	106.50	11.70 ic	---	---	---	---	---	---	---	---	---	11.70
7.00	2,752	107.00	12.43 ic	---	---	---	---	---	---	---	---	---	12.43
7.50	2,952	107.50	13.11 ic	---	---	---	---	---	---	---	---	---	13.11

Hydrograph Report

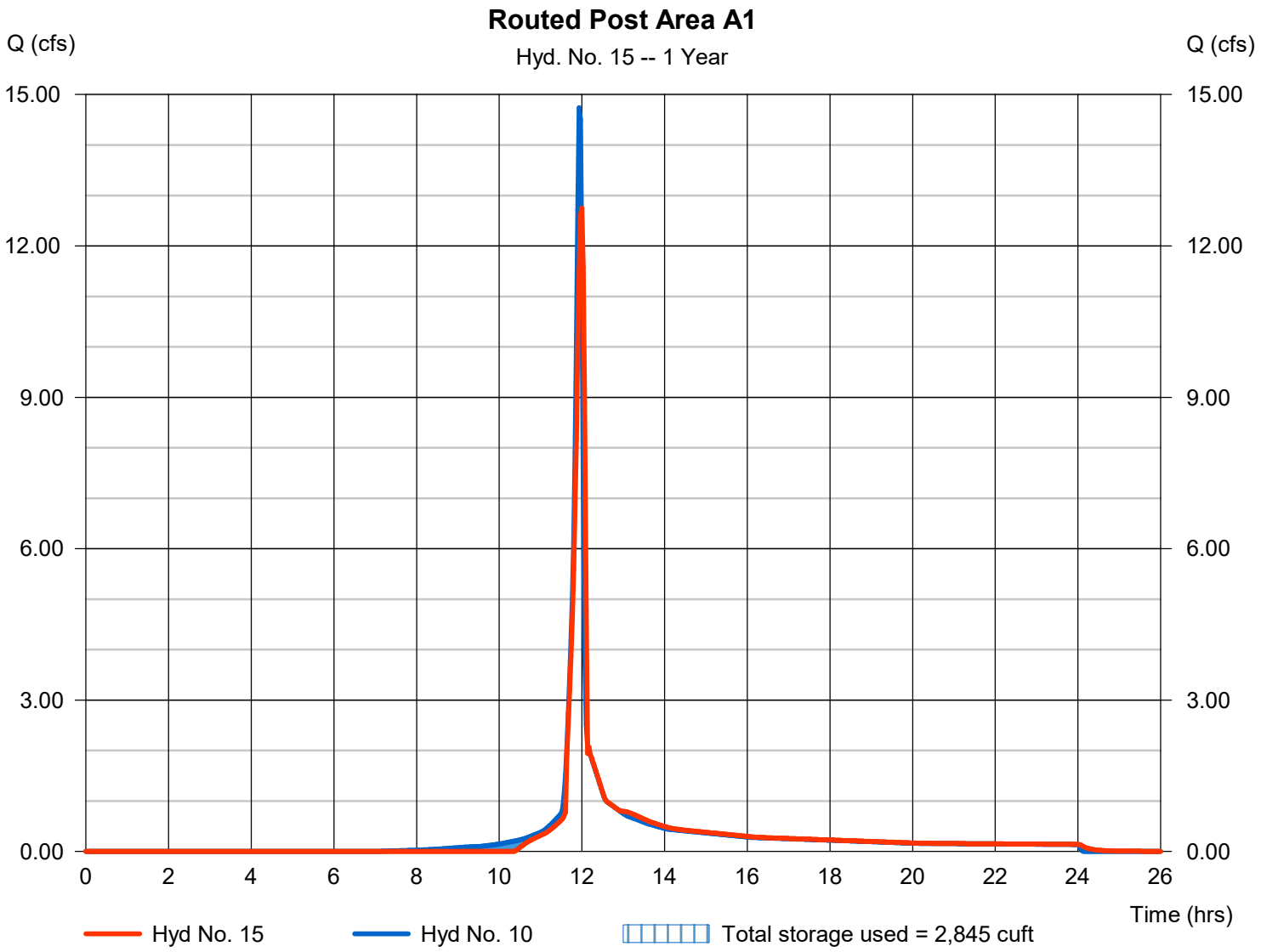
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 15

Routed Post Area A1

Hydrograph type	= Reservoir	Peak discharge	= 12.75 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 29,196 cuft
Inflow hyd. No.	= 10 - Post Area A1	Max. Elevation	= 107.42 ft
Reservoir name	= StormTech Isolator Row	Max. Storage	= 2,845 cuft

Storage Indication method used.



Hydrograph Report

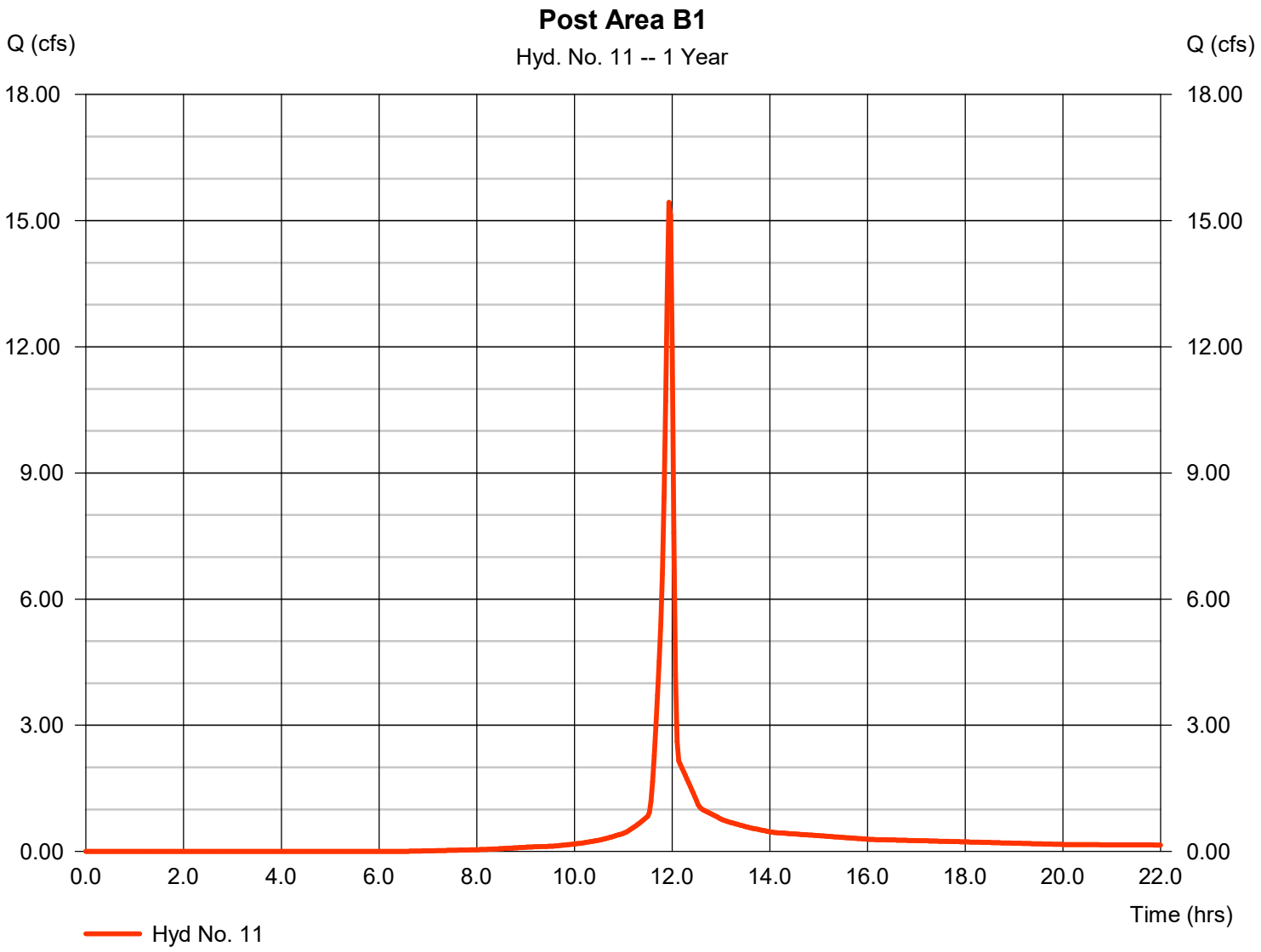
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 04 / 29 / 2019

Hyd. No. 11

Post Area B1

Hydrograph type	= SCS Runoff	Peak discharge	= 15.44 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 31,611 cuft
Drainage area	= 6.580 ac	Curve number	= 91*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.28 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.930 x 98) + (2.650 x 80)] / 6.580

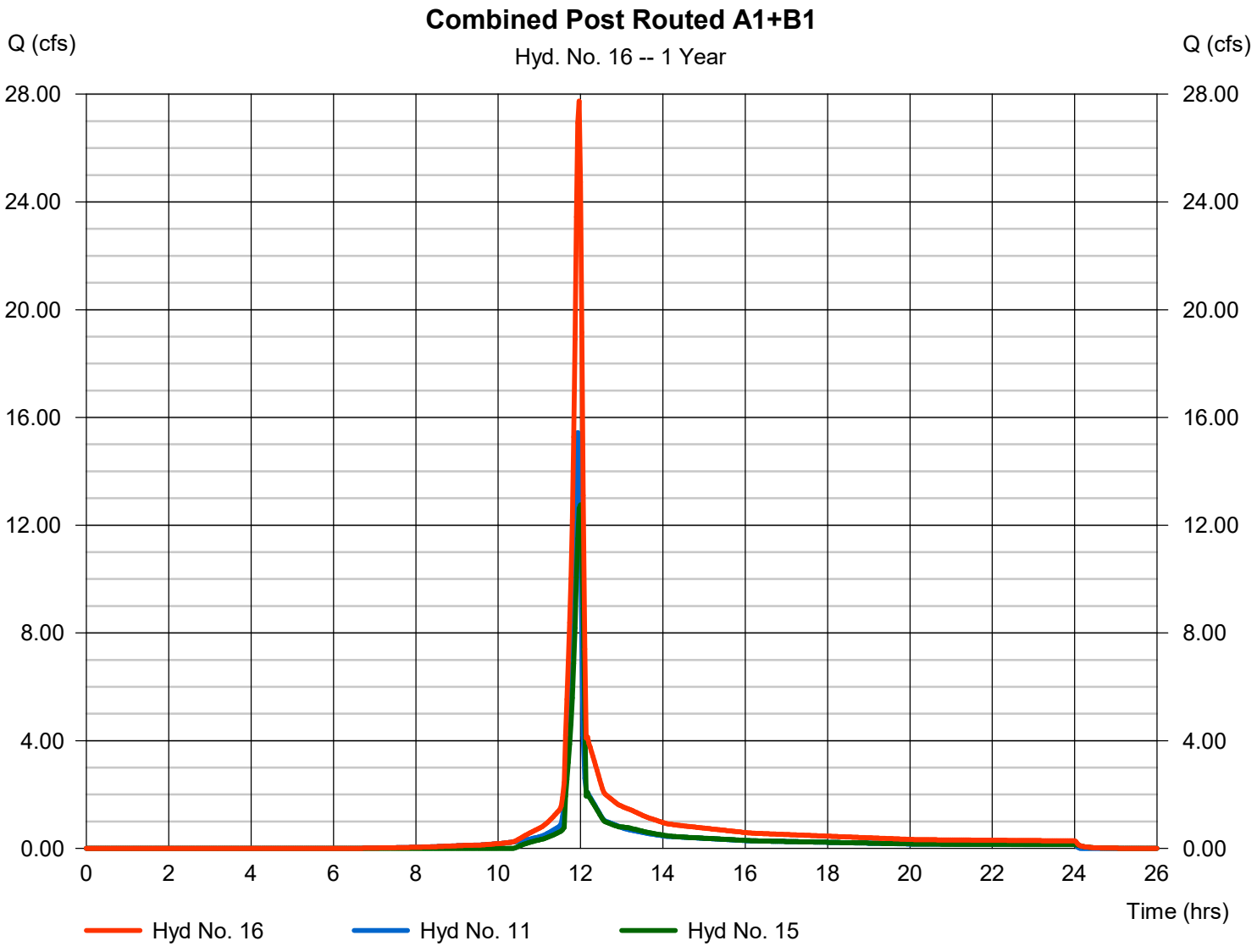


Hydrograph Report

Hyd. No. 16

Combined Post Routed A1+B1

Hydrograph type	= Combine	Peak discharge	= 27.74 cfs
Storm frequency	= 1 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 60,807 cuft
Inflow hyds.	= 11, 15	Contrib. drain. area	= 6.580 ac



parker DESIGN GROUP

Job #	18-0086
Date:	23-Apr-19
By:	JLK

Discharge to Natural Channel

Evaluation Point A

Drainage Area: **13.74** Acres

The maximum peak flow rate from the one-year 24-hour storm is calculated with the following methodology:

$Q_{Developed} \leq I.F. * (Q_{Pre\text{-}Developed} * RV_{Pre\text{-}Developed})/RV_{Developed}$

Under no condition shall $Q_{Developed}$ be greater than $Q_{Pre\text{-}Developed}$ nor shall $QD_{eveloped}$ be required to be less than that calculated in the equation $(Q_{Forest} * RV_{Forest})/RV_{Developed}$

Where:

$Q_{Developed}$ = The allowable peak flow rate of runoff from the developed site =	(See below)	
$RV_{Developed}$ = The volume of runoff from the site in the developed condition =	61,624	cuft
$Q_{Pre\text{-}Developed}$ = The peak flow rate of runoff from the site in the pre-developed condition =	32.40	cfs
$RV_{Pre\text{-}Developed}$ = The volume of runoff from the site in pre-developed condition =	66,860	cuft
Q_{Forest} = The peak flow rate of runoff from the site in a forested condition =	9.71	cfs
RV_{Forest} = The volume of runoff from the site in a forested condition =	29,483	cuft
I.F. (Improvement Factor) equals 0.8 for sites > 1 acre or 0.9 for sites ≤ 1 acre =	0.8	

$I.F. * (Q_{Pre\text{-}Developed} * RV_{Pre\text{-}Developed})/RV_{Developed}$ =	28.12	cfs
$(Q_{Forest} * RV_{Forest})/RV_{Developed}$ =	4.65	cfs

For the 1-YR 24-HR Storm the Max $Q_{Developed}$ = 28.12 cfs

Appendix E

Virginia Runoff Reduction Analysis

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - Version 3.0

○ 2011 BMP Standards and Specifications ◉ 2013 Draft BMP Standards and Specifications

Project Name:	18-0086 - SAS Old Blacksburg High School	CLEAR ALL	data input cells
Date:			constant values
	Linear Development Project?	No	calculation cells
Site Information			final results

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* →	13.74	*Check:*	
		BMP Design Specifications List:	2013 Draft Stds & Specs
Maximum reduction required:	*20%*	*Linear project?*	No
The site's net increase in impervious cover (acres) is:	*0*	*Land cover areas entered correctly?*	✓
Post-Development TP Load Reduction for Site (lb/yr):	*1.49*	*Total disturbed area entered?*	✓

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land					0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed				4.47	4.47
Impervious Cover (acres)				9.27	9.27
					13.74

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land					0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed				6.37	6.37
Impervious Cover (acres)				7.37	7.37
Area Check	**OK.**	**OK.**	**OK.**	**OK.**	13.74

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre

Pre-ReDevelopment	Listed	Adjusted[1]
Forest/Open Space Cover (acres)	0.00	0.00
Weighted Rv(forest)	0.00	0.00
% Forest	0%	0%
Managed Turf Cover (acres)	4.47	4.47
Weighted Rv(turf)	0.25	0.25
% Managed Turf	33%	33%
Impervious Cover (acres)	9.27	9.27
Rv(impervious)	0.95	0.95
% Impervious	67%	67%
Total Site Area (acres)	**13.74**	**13.74**
Site Rv	**0.72**	**0.72**

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.8270	0.8270
Pre-ReDevelopment Treatment Volume (cubic feet)	36,024	36,024
Pre-ReDevelopment TP Load (lb/yr)	**22.63**	**22.63**
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	1.65	1.65
Baseline TP Load (lb/yr) (**0.41 lbs/acre/yr** applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		*5.63*

[1] *Adjusted Land Cover Summary:*
Pre ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requriement for new impervious cover (based on new development load limit, 0.41 lbs/acre/year).

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)

Post ReDev. & New Impervious	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	6.37
Weighted Rv (turf)	0.25
% Managed Turf	46%
Impervious Cover (acres)	7.37
Rv(impervious)	0.95
% Impervious	54%
Final Site Area (acres)	**13.74**
Final Post Dev Site Rv	**0.63**

Land Cover Summary-Post

Post-ReDevelopment	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	6.37
Weighted Rv (turf)	0.25
% Managed Turf	46%
ReDev. Impervious Cover (acres)	7.37
Rv(impervious)	0.95
% Impervious	54%
Total ReDev. Site Area (acres)	**13.74**
ReDev Site Rv	**0.63**

Land Cover Summary-Post

Post-Development New Impervious	
New Impervious Cover (acres)	0.00
Rv(impervious)	--

Treatment Volume and Nutrient Load

Final Post-Development Treatment Volume (acre-ft)	0.7162	**Post-ReDevelopment Treatment Volume (acre-ft)**	0.7162	**Post-Development Treatment Volume (acre-ft)**	--
Final Post-Development Treatment Volume (cubic feet)	31,196	**Post-ReDevelopment Treatment Volume (cubic feet)**	31,196	**Post-Development Treatment Volume (cubic feet)**	--
Final Post-Development TP Load (lb/yr)	**19.60**	**Post-ReDevelopment Load (TP) (lb/yr)***	**19.60**	**Post-Development TP Load (lb/yr)**	--
Final Post-Development TP Load per acre (lb/acre/yr)	1.43	Post-ReDevelopment TP Load per acre (lb/acre/yr)	1.43		
		Max. Reduction Required (Below Pre-ReDevelopment Load)	**20%**		
		TP Load Reduction Required for Redeveloped Area (lb/yr)	**1.49**	**TP Load Reduction Required for New Impervious Area (lb/yr)**	**0**

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	**1.49**

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	161.92	Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	140.22

Site Results (Water Quality Compliance)

Area Checks	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
FOREST/OPEN SPACE (ac)	0.00	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER (ac)	3.72	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER TREATED (ac)	3.72	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA (ac)	2.88	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA TREATED (ac)	2.88	0.00	0.00	0.00	0.00	OK.
AREA CHECK	OK.	OK.	OK.	OK.	OK.	

Site Treatment Volume (ft^3) 31,196

Runoff Reduction Volume and TP By Drainage Area

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	TOTAL
RUNOFF REDUCTION VOLUME ACHIEVED (ft^3)	0	0	0	0	0	0
TP LOAD AVAILABLE FOR REMOVAL (lb/yr)	9.70	0.00	0.00	0.00	0.00	9.70
TP LOAD REDUCTION ACHIEVED (lb/yr)	3.88	0.00	0.00	0.00	0.00	3.88
TP LOAD REMAINING (lb/yr)	5.83	0.00	0.00	0.00	0.00	5.83
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	0.00	0.00	0.00	0.00	0.00	0.00

Total Phosphorus

FINAL POST-DEVELOPMENT TP LOAD (lb/yr)	19.60
TP LOAD REDUCTION REQUIRED (lb/yr)	1.49
TP LOAD REDUCTION ACHIEVED (lb/yr)	3.88
TP LOAD REMAINING (lb/yr):	15.72
REMAINING TP LOAD REDUCTION REQUIRED (lb/yr):	0.00 **

** TARGET TP REDUCTION EXCEEDED BY 2.38 LB/YEAR **

Total Nitrogen (For Information Purposes)

POST-DEVELOPMENT LOAD (lb/yr)	140.22
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	0.00
REMAINING POST-DEVELOPMENT NITROGEN LOAD (lb/yr)	140.22

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - Version 3.0

BMP Design Specifications List: **2013 Draft Stds & Specs**

Site Summary

Total Rainfall (in):	**43**
Total Disturbed Acreage:	**13.74**

Site Land Cover Summary

Pre-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.00	0.00	0.00	4.47	4.47	33
Impervious Cover (acres)	0.00	0.00	0.00	9.27	9.27	67
					13.74	100

Post-ReDevelopment Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals	% of Total
Forest/Open (acres)	0.00	0.00	0.00	0.00	0.00	0
Managed Turf (acres)	0.00	0.00	0.00	6.37	6.37	46
Impervious Cover (acres)	0.00	0.00	0.00	7.37	7.37	54
					13.74	100

Site Tv and Land Cover Nutrient Loads

	Final Post-Development (Post-ReDevelopment & New Impervious)	Post-ReDevelopment	Post-Development (New Impervious)	Adjusted Pre-ReDevelopment
Site Rv	0.63	0.63	--	0.72
Treatment Volume (ft^3)	31,196	31,196	--	36,024
TP Load (lb/yr)	19.60	19.60	--	22.63

Pre-ReDevelopment TP Load per acre (lb/acre/yr)	Final Post-Development TP Load per acre (lb/acre/yr)	Post-ReDevelopment TP Load per acre (lb/acre/yr)
1.65	**1.43**	**1.43**

Total TP Load Reduction Required (lb/yr)	**1.49**	1.49	0

	Final Post-Development Load (Post-ReDevelopment & New Impervious)	Pre-ReDevelopment
TN Load (lb/yr)	140.22	161.92

Site Compliance Summary

Maximum % Reduction Required Below Pre-ReDevelopment Load	20%

Total Runoff Volume Reduction (ft^3)	0	
Total TP Load Reduction Achieved (lb/yr)	3.88	
Total TN Load Reduction Achieved (lb/yr)	0.00	
Remaining Post Development TP Load (lb/yr)	15.72	
Remaining TP Load Reduction (lb/yr) Required	**0.00**	**** TARGET TP REDUCTION EXCEEDED BY 2.38 LB/YEAR ****