ACCURATE ENGINEERING, PC
CONSULTING ENGINEERS

STORMWATER REPORT
FOR
BUNKER HILL DEVELPMENT

BLOCK 11.06, LOT 11.01
BLOCK 120.01, LOT 16.01

TOWNSHIP OF FRANKLIN
SOMERSET COUNTY, NEW JERSEY

July 21, 2021
REV 1 – November 22, 2021

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1. INTRODUCTION

The purposed of this report is to study the hydrological effect of the proposed residential development. The analysis consists of estimating the pre-development and post-development site peak runoff, to determine if any storm measures are required, to support the project. The stormwater measures are required to maintain the runoff quantity, quality and recharge of the existing conditions.

2. PROJECT LOCATION AND SITE DESCRIPTION

The project site consists of approximately 4.03± acres fronting on Bunker Hill Road and State Highway 27, in Franklin Township, Somerset County, New Jersey. The analysis in this report deals with this site and an offsite area that is being routed past the site is included in the drainage analysis. The project site is also known as lot 11.01 in Block 11.06 and Lot 16.01 in Block 20.01 as shown on the Franklin Township Tax Map 146 (Figure-1). The additional areas of the neighboring lot that drains to our lot are to be routed under the proposed conveyance system to continue to the existing drainage are in the rear of our lot.

The existing site includes of two 1 1/2-story frame dwellings, a frame garage, a shed, paved driveways, and concrete walks. Currently, 17.48% of the lot consists of impervious surfaces. The applicant is proposing to construct eight (8) residential lots in a Major Subdivision along with a proposed road and driveways.

The project is detailed on the Major Subdivision plans, which have been prepared by Accurate Engineering, PC.

Figure-1 Tax Map

3. EXISTING HYDROLOGY

According to the Web Soil Survey developed by the USDA Natural Resources Conservation Service, Somerset County Soils Survey Report (see Figure-2), the following soil types are exhibited onsite in the area proposed for construction:

Table-1
Soil Type & Group

Soil Symbol	Soil Name	Soil Group
RorAt	Rowland Silt Loam	C
PeoC	Penn Channery Silt Loam	C
PeoB	Penn Channery Silt Loam	C

Figure-2 Soils Map

4. DRAINAGE ANALYSIS

BASIS FOR DESIGN

The basis for design of the proposed plan is to develop a stormwater management system that would allow the proposed development, to be constructed neither increasing offsite flooding, nor degrading water quality, thus complying with all relevant township, county, soil conservation district and NJDEP Stormwater Rules and Regulations.

To achieve these requirements the system must incorporate onsite infiltration basins to limit runoff rates to predevelopment conditions and to trap the contaminants associated with runoff from the proposed development.

The methodology outlined in Technical Report No. 55 of the Soil Conservation Service is used to determine the potential drainage impacts of the proposed project and for the design of the proposed detention basin.

Also as part of the storm water management system a conveyance systems consisting of catch basins and pipes, are proposed to convey the storm runoff generated from the proposed commercial site to the proposed basin.

The proposed conveyance system shall be designed to accommodate the 25-year storm frequency. Manning's equation shall be applied to size the proposed pipes of the proposed conveyance system.

SITE RUNOFF

The pre-development and post-development site peak runoff shall be calculated utilizing the TR-55 Methodology, to determine the impact of the proposed development, to accommodate the following design criteria:

- Reduction of quantity runoff to the required reduction.
- Stormwater quality.
- Groundwater recharge.

PRE-DEVELOPMENT SITE RUNOFF

The existing drainage area map is shown on the attached map (Figure-3). The figure depicts the drainage area exist on site and consists of sub-area EDA and Undetained.

The site runoff generated by the existing sub-areas is estimated by utilizing the TR-55 Methodology. The existing drainage corresponding to the disturbed area, and is characterized as follow:

Sub-area EDA:

This sub-area drains toward the West - East side of the property via sheet flow.

Existing Drainage Area=	3.46 acres (HSG "C")
Land cover	
Building & Structure=	0.10 Acres CN=98
Gravel Drive =	0.23 Acres CN=89
Woods =	1.90 Acres CN=70
Grass =	1.23 Acres CN=74

The following table presents the runoff curve numbers, was extracted from the TR-55 Manual

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.
2 ***Poor:*** <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
3 ***Poor:*** <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
4 Actual curve number is less than 30; use CN = 30 for runoff computations.
5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
6 ***Poor:*** Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Time of Concentration (Tc):

TC= 18 minutes
100' @ 3.55%, 242' @ 4.31%

The Pre-development Site peak runoff is calculated utilizing and in-house software, based on the TR-55 Methodology. Please refer to Appendix-2 for supporting calculations.

The following table summarizes the Pre-development site peak runoff for various storm frequencies,

Table-2
Pre-development
Site Peak Runoff (Sub-Area EDA#1)

FREQUENCY (YEAR)	PEAK RUNOFF (CFS)
2	2.91
10	6.43
100	14.91

The proposed drainage system is designed to treat only the area, sub area EDA, to be revised for the proposed development. The undetained area is not proposed to be disturbed and will drain as it originally did previously.

POST-DEVELOPMENT SITE RUNOFF

Post-development drainage area map is shown on Figure-4, and runoff shows sub-areas contributing to the conveyance systems and the undetained areas. The site peak runoff generated by the proposed development will be conveyed to the proposed infiltration basin for the conveyance system and then join with the undetained and routed drainage to the rear of the lot as it did originally.

The Characteristic of each sub-area and Curve Number are summarized in Appendix-1 and listed below:

The characteristic of each sub-area and curve number are summarized below:

PDA-1:

Drainage Area = 0.73 acres (HSG "C")
Land cover =
- Building = 0.17 acres (HSG "C") CN=98
- Pavement = 0.20 acres (HSG "C") CN=98
- Walk = 0.05 acres (HSG "C") CN=98
- Grass = 0.31 acres (HSG "C") CN=74

Time of Concentration (Tc) = 6.0 minutes (Minimum time of concentration used)

The total PDA-1 site peak runoff generated and discharging into the proposed infiltration basin is summarized in the following table:

Table-5
PDA-1 Site Peak Runoff

FREQUENCY (YEAR)	PEAK RUNOFF (CFS)
2	1.66
10	2.80
100	5.12

PDA-2:

Drainage Area = 0.52 acres (HSG "C")
Land cover =
- Building = 0.10 acres (HSG "C") CN=98
- Pavement = 0.19 acres (HSG "C") CN=98
- Walk = 0.04 acres (HSG "C") CN=98
- Grass = 0.19 acres (HSG "C") CN=74

Time of Concentration (Tc) = 6.0 minutes (Minimum time of concentration used)

The total PDA-2 site peak runoff generated and discharging into the proposed infiltration basin is summarized in the following table:

Table-6
PDA-2 Site Peak Runoff

FREQUENCY (YEAR)	PEAK RUNOFF (CFS)
2	1.24
10	2.05
100	3.71

PDA-3:

Drainage Area = 0.64 acres (HSG "C")
Land cover =
Woods = 0.15 acres (HSG "C") CN=70
Grass = 0.49 acres (HSG "C") CN=74

Time of Concentration (Tc) = 14.7 minutes

100' @ 1.25%, 250' @ 0.70%

The total PDA-3 site peak runoff generated and discharging into the existing drainage systems in Bunker Hill Road is summarized in the following table:

Table-6
PDA-3 Site Peak Runoff

FREQUENCY (YEAR)	PEAK RUNOFF (CFS)
2	0.54
10	1.24
100	2.78

PDA-Basin:

Drainage Area = 0.24 acres (HSG "C")
Land cover =
Basin Bottom = 0.14 acres (HSG "C") CN=98
Grass = 0.10 acres (HSG "C") CN=74

Time of Concentration (Tc) = 6.0 minutes (Minimum time of concentration used)

The total PDA-2 site peak runoff generated and The total PDA-2 site peak runoff generated and discharging into the proposed infiltration basin is summarized in the following table:

Table-6
PDA-Basin Site Peak Runoff

FREQUENCY (YEAR)	PEAK RUNOFF (CFS)
2	0.55
10	0.92
100	1.69

The following table shows a comparison between pre- and post-development site peak runoff:

Table-7
Total PDA-Detained
Total Site Peak Runoff (Pre-Routing)

FREQUENCY (YEAR)	PEAK RUNOFF (CFS)
2	3.82
10	6.70
100	12.67

PDA-UNDETAINED:

Drainage Area = 1.32 acres (HSG “C”)
Land cover =
Woods = 0.19 acres (HSG “C”) CN=70
Grass = 1.13 acres (HSG “C”) CN=74

Time of Concentration (Tc) = 11.0 minutes
22’ @ 2.27%, 88’ @ 9.75%, 95’ @ 5.49%

The total PDA-Undetained site peak runoff generated and discharging into the existing drainage systems in Prospect Plains Road is summarized in the following table:

Table-6
PDA-UNDETAINED Site Peak Runoff

FREQUENCY (YEAR)	PEAK RUNOFF (CFS)
2	1.26
10	2.89
100	6.48

Table-7
Total PDA
Total Site Peak Runoff (Pre-Routing)

FREQUENCY (YEAR)	PEAK RUNOFF (CFS)
2	4.80
10	9.14
100	18.35

The following table shows a comparison between pre- and post-development site peak runoff:

Table-8
Peak Runoff Comparison
Total Pre-development vs. Total Post-Development

STORM FREQUENCY	PRE-DEVELOPMENT PEAK RUNOFF (cfs)	POSTDEVELOPMENT PEAK RUNOFF (cfs)	COMMENTS
2	2.91	4.80	Post>Pre
10	6.43	9.14	Post>Pre
100	14.21	18.35	Post>Pre

The proposed routed area runoff matches the existing routed area runoff so no additional stormwater methods are required for the routed area from offsite.

5. DETENTION BASIN:

A detention basin is required to reduce the post development runoff according to section (N.J.A.C. 5:21-7.5.d). Please refer to Appendix 5 for pond routing.

The TR-55 Method has been utilized to determine the volume required by the proposed detention basin.

BASIN VOULME & OUTLET STRUCTURE:

The proposed detention basin is designed based on following Design Criteria:

- The Post development runoff for the 2-year storm event is less than the predevelopment site runoff by 50%.
- The Post development runoff for the 10-year storm event is less than the predevelopment site runoff by 75%.
- The Post development runoff for the 100-year storm event is less than the predevelopment site runoff by 80%.
- Meet the water quality design criteria as depicted in the NJDEP PMB manual.
- The basin outlet structure is designed to meet the storage and discharge requirements.

Based on the above listed criteria, the following table summarizes the allowable post-development site peak runoff:

Table-9
Allowable Site Peak Runoff

STORM FREQUENCY	PRE-DEVELOPMENT PEAK RUNOFF (cfs)	ALLOWABLE SITE RUNOFF (cfs)	COMMENTS
2	2.91	(2.91 X 0.50 = 1.46)	50% Reduction
10	6.43	(6.43 X 0.75 = 4.82)	75% Reduction
100	14.21	(14.21 X 0.80 = 11.37)	80% reduction

PONDS SUMMARY DATA:
Detention Basin:

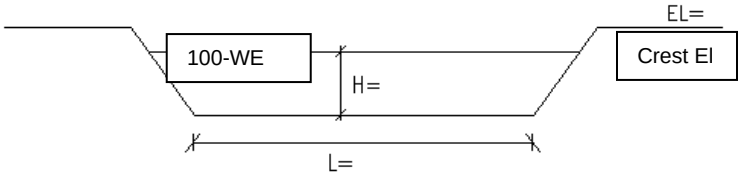
1-Type of Basin:	Infiltration Basin
2-Name of Creek, stream, or area Into which the basins discharges:	Sheet Flow
3- Post development Watershed Data:	Drainage area contributing to proposed detention basin is the sum of the PDA Sub-areas

Table-10
Proposed Infiltration Basin
Routed Peak Flow

Storm Event	Peak Out Flow	Maximum Water Elevation
2-year	0.05	167.21
10-year	0.37	167.91
100-year	5.40	168.73

EMERGENCY SPILLWAY:

The double E Inlet located within the basin is intended to function as the emergency spillway. It has been designed to accommodate the 100-year post-development peak outflow including minimum one (1) foot of freeboard above the design water surface elevation at the spillway.



The discharge equation for broad crested weir:

$Q = C_w L H^{1.5}$

Where,
Q_{100} = design discharge
C_w = Coefficient = 3.3

H = head on spillway
L = Length of the crest (In this case is
The length of edges around the opening of the Double E Inlet)

Emergency spillway

And, flow velocity is given in the following Eq.:

$$V=Q_{100}/A$$

Where,
A= Flow Cross-sectional area
A= H * L

Table-18
Emergency Spillway Data

Basin#	Q_{100}	C_w	Spillway		H=WE-EL	L	A=LxH SQ.FT.	V=Q/A	BERM EL	COMMENT
			WE_{100}	CREST EL.						
Basin	5.47	3.3	169.10	169.00	0.10	50	5	1.09	170.00	GRASS

Please refer to Appendix-4 for supporting calculations.

6. WATER QUALITY

The proposed stormwater measures shall be designed to reduce the post-construction load of total suspended solid "TSS" in stormwater runoff generated from the water quality design storm "1.25 inch of rainfall in two hours", by 80% as per the NJDEP Rules and Regulations section N.J.A.C.7: 8-5.5. Infiltration Basin and Detention Basin have a rate of TSS removal rates of 80% & 60%. Per rules and regulations the ratio of TSS depends on the following parameters:

1- Extended detention time of the 1.25" of rainfall in two hours.
2- Infiltration basin, where the lowest invert in the basin is set at or higher than the maximum storm quality design water surface.
3- Stormfilter device.

Parameter No. 2 is used to achieve the required 80% removal rate of TSS. Please refer to Appendix-5 for supporting calculations.

The runoff generated by the water quality storm is estimated to be 1,351 cu.ft., which is the runoff generated by the impervious area in post-development condition. The water quality volume has been routed through the infiltration basin, and concluded water elevation is less than the lowest invert in basin (WE=165.20, lowest invert of the basin=167.00). Therefore, the water quality criteria are adequate.

Dewatering Time:

Estimated dewatering for water quality is calculated as follow:

Time-Q-peak = 1.83 hour
Draining time = 28 hours

Total dewatering time = 28.00 – 1.83 = 26.17 hours, which is less than allowed time of 72 hours (OK)

7. GROUNDWATER RECHARGE:

The design requirement for Groundwater Recharge is as depicted in Section N.J.A.C. 7:8-5.4 of the NJDEP rules and regulations, which is as follow:

1- Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100 percent of the average annual pre-construction groundwater recharge volume for the site.
2- Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from pre-construction to post-construction for the two-year storm infiltrated.

Design criteria listed in item #2 is utilized. From Appendix-6 we conclude the volume required to be recharged is estimated to be **647** cu.ft.

The 2-year storm water runoff volume collected by the infiltration basin is estimated to be **7,781** cu.ft which is greater than the required recharge volume of **647** cu.ft. The 2-year storm volume was routed through the infiltration basin and concluded water elevation 165.71 which is less than lowest invert in basin of 167.00.

Dewatering time is calculated as follow:
Peak Time= 13.10 hours
Drain Time= 48 hours

Dewatering time= 48.00 – 13.10 = 34.90 hours < 72 hours (OK)

LOW IMPACT DEVELOPMENT SUMMARY
According to the NJDEP Stormwater Management Rules at N.J.A.C. 7:8 and in accordance with the Franklin Township Stormwater Ordinance, the groundwater recharge, stormwater quality, and stormwater quantity standards established by the rules for major land development projects must be met by incorporating nine specific nonstructural stormwater management strategies into the project's design to the maximum extent practicable.

The project has met the Nonstructural stormwater management strategies to the maximum extent practicable. The nonstructural strategies points system (NSPS) has been prepared and is included in the appendices. The following is a summary of the Nonstructural stormwater management strategies incorporated into the site design:

a) Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss.
Rip Rap aprons have been provided at the headwalls.

b) Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces:
Impervious coverage for the site has been minimized.

c) Maximize the protection of natural drainage features and vegetation.
Only the areas necessary for the construction of the proposed development will be cleared.

d) Minimize the decrease in the "time of concentration" from pre-construction to post construction. "Time of concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the drainage area to the point of interest within a watershed.
The decrease in time of concentration between the predevelopment and postdevelopment condition has been minimized by maintaining the existing drainage patterns on the site whenever feasible and through the use of vegetated conveyance.

e) Minimize land disturbance including clearing and grading.
Clearing and grading have been minimized to the maximum extent possible.

f) Minimize soil compaction.
Soil compaction will be minimized where feasible.

g) Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides.
The landscape design for this project employs the use of native ornamental, shade, and shrubs on the site. Because native and adapted trees and shrubs have been chosen for this project, the landscape will also require less use of fertilizers and pesticides.

h) Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas.
Vegetated conveyance is proposed to collect and direct the runoff from the proposed roadway and the proposed single family lots.

i) Provide other source controls to prevent or minimize the use or exposure of pollutants at the site in order to prevent or minimize the release of those pollutants into stormwater runoff. Such source controls include, but are not limited to:

    1. Site design features that help to prevent accumulation of trash and debris in drainage systems.
    Proposed inlets on site will comply with the NJPDES storm drain inlet criteria. Eco-curbs or approved equal, which are catch basin curb tops, will be provided. They will have debris retention openings to prevent debris from entering the storm drainage system.

    2. Site design features that help to prevent discharge of trash and debris from drainage systems.
    The infiltration basin will trap the larger debris and floatables

discharged from the site. It is anticipated that no large floatable will be discharged from the basin as the majority of impervious pavement surfaces are routed through the basin.

3. Site design features that help to prevent and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments; and

There are no known pollutants located on site, furthermore, the site is not located in an area with high pollutants, and therefore, this strategy is not applicable.

4. When establishing vegetation after land disturbance, applying fertilizer in accordance with the requirements established under the Soil Erosion and Sediment Control Act, NJSA. 4:24-39 et seq., and implementing rules.

The applicant intends to apply fertilizer in accordance with the requirements established under the Soil Erosion and Sediment Control Act.

8. STORMWATER CONVEYANCE SYSTEM

The stormwater collection and conveyance structures are designed based on section 5-21-7.3 of the RSIS standards. The proposed conveyance system is design to accommodate the 25-year storm. Please refer to Appendix-9 for design calculations for the PDA areas and for the Routed area pipe.

9. SEDIMENT AND EROSION CONTROL

To control and minimize offsite impacts due to soil erosion during construction, a soil erosion and sediment control plan will be prepared for the development in accordance with the latest "Standards for Soil Erosion and Sediment Control in New Jersey" by the N.J. State Soil Conservation Measures:

- Crushed stone stabilized construction entrances to reduce tracking of sediment onto the existing adjacent roads.
- Silt fence around all limits of disturbance.
- Hay bale inlet protection.
- Riprap apron at all pipe outfalls.
- Temporary seeding and mulching of all disturbed acres, which will remain, exposed for 30 days or more.
- Permanent seeding or sodding within 10 days of the final grading.
- Use of the proposed detention basins as sediment basins during construction

In accordance with the N.J. Soil Erosion and Sediment Control Act, the subdivision maps will be submitted to Freehold Soil Conservation District for review and certification. The district will be notified 72 hours in advance of any land disturbance activities.

Sediment Basin Calculations:

The proposed detention basin shall be utilized as a temporary sediment basin during construction. The design of the sediment basin and outlet are to be shown in the erosion and sedimentation control plan and narratives. Please refer to Appendix-10 for supporting calculations.

From Appendix-10 we conclude the required volume by sediment basin to be 14,390 ct.ft. The required volume is available in the proposed infiltration basin at an elevation 165.00. Therefore in order to utilize the outlet structure and basin as sediment basin during construction, the 2.5" orifice shall be plugged completely during construction.

Rip•Rap Apron:

Please refer to Appendix-10 for supporting calculations.

10. CONCLUSION

The storm water management plan for the proposed development is consistent with all regulatory design standards. When the detention facility is in place, peak runoff rates after development will be significantly decreased when compared to predevelopment runoff rates. The table below summarizes the pre and post development runoff:

Table-19
Peak Runoff Comparison
Total Pre-development vs. Total Post-Development

STORM FREQUENCY	PRE-DEVELOPMENT PEAK RUNOFF (cfs)	ALLOWABLE SITE RUNOFF (cfs)	POST- DEVELOPMENT PEAK RUNOFF (cfs)	COMMENTS
2	2.91	(2.91 X 0.50 = 1.46)	1.26	OK
10	6.43	(6.43 X 0.75 = 4.82)	2.89	OK
100	14.21	(14.21 X 0.80 = 11.37)	11.27	OK

From the above summary table we conclude that the proposed stormwater measures are adequate and meet all design criteria for water quantity, quality and recharge.

APPENDICES

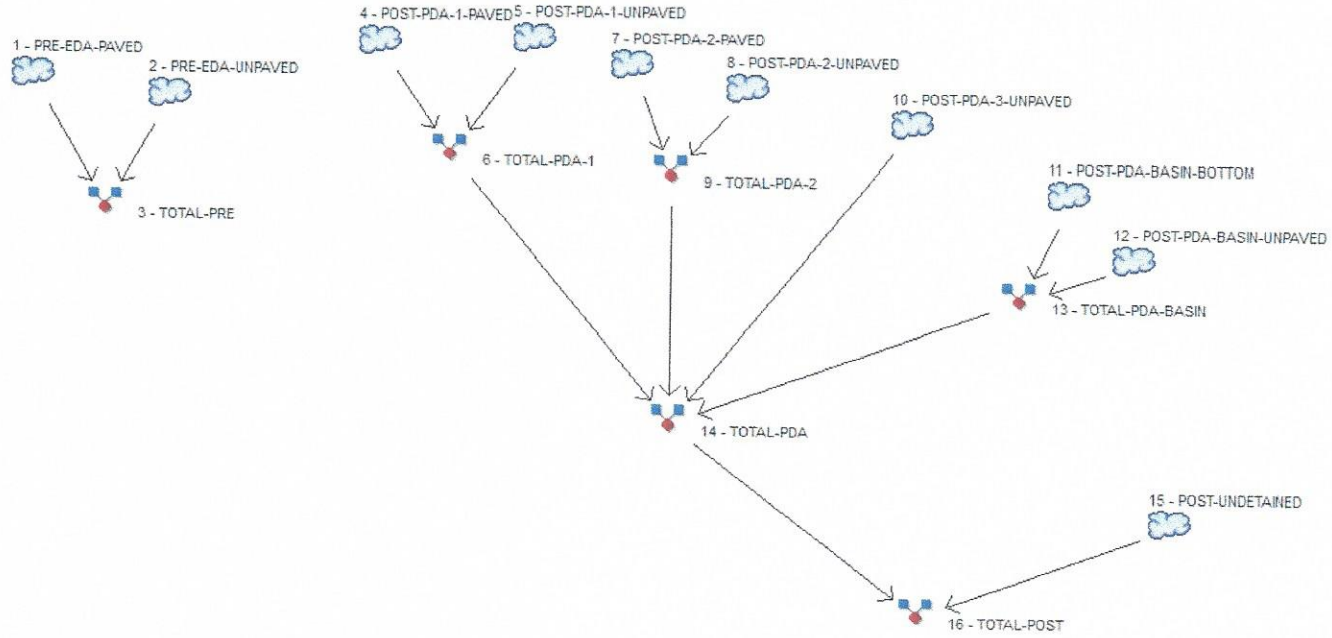
APPENDIX 1

CURVE NUMBER & AREA CALCULATIONS

APPENDIX 2

PRE-DEVELOPMENT SITE RUNOFF COMPUTATIONS

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE-EDA-PAVED
2	SCS Runoff	PRE-EDA-UNPAVED
3	Combine	TOTAL-PRE
4	SCS Runoff	POST-PDA-1-PAVED
5	SCS Runoff	POST-PDA-1-UNPAVED
6	Combine	TOTAL-PDA-1
7	SCS Runoff	POST-PDA-2-PAVED
8	SCS Runoff	POST-PDA-2-UNPAVED
9	Combine	TOTAL-PDA-2
10	SCS Runoff	POST-PDA-3-UNPAVED
11	SCS Runoff	POST-PDA-BASIN-BOTTOM
12	SCS Runoff	POST-PDA-BASIN-UNPAVED
13	Combine	TOTAL-PDA-BASIN
14	Combine	TOTAL-PDA
15	SCS Runoff	POST-UNDETAINED
16	Combine	TOTAL-POST

TR55 Tc Worksheet

Hyd. No. 1

PRE-EDA-PAVED

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.400	0.011	0.011	
Flow length (ft)	= 100.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.30	0.00	0.00	
Land slope (%)	= 3.55	0.00	0.00	
Travel Time (min)	**= 16.81**	**+ 0.00**	**+ 0.00**	**= 16.81**
Shallow Concentrated Flow				
Flow length (ft)	= 242.00	0.00	0.00	
Watercourse slope (%)	= 4.31	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 3.35	0.00	0.00	
Travel Time (min)	**= 1.20**	**+ 0.00**	**+ 0.00**	**= 1.20**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	**= 0.00**	**+ 0.00**	**+ 0.00**	**= 0.00**

Total Travel Time, Tc ..... 18.00 min

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

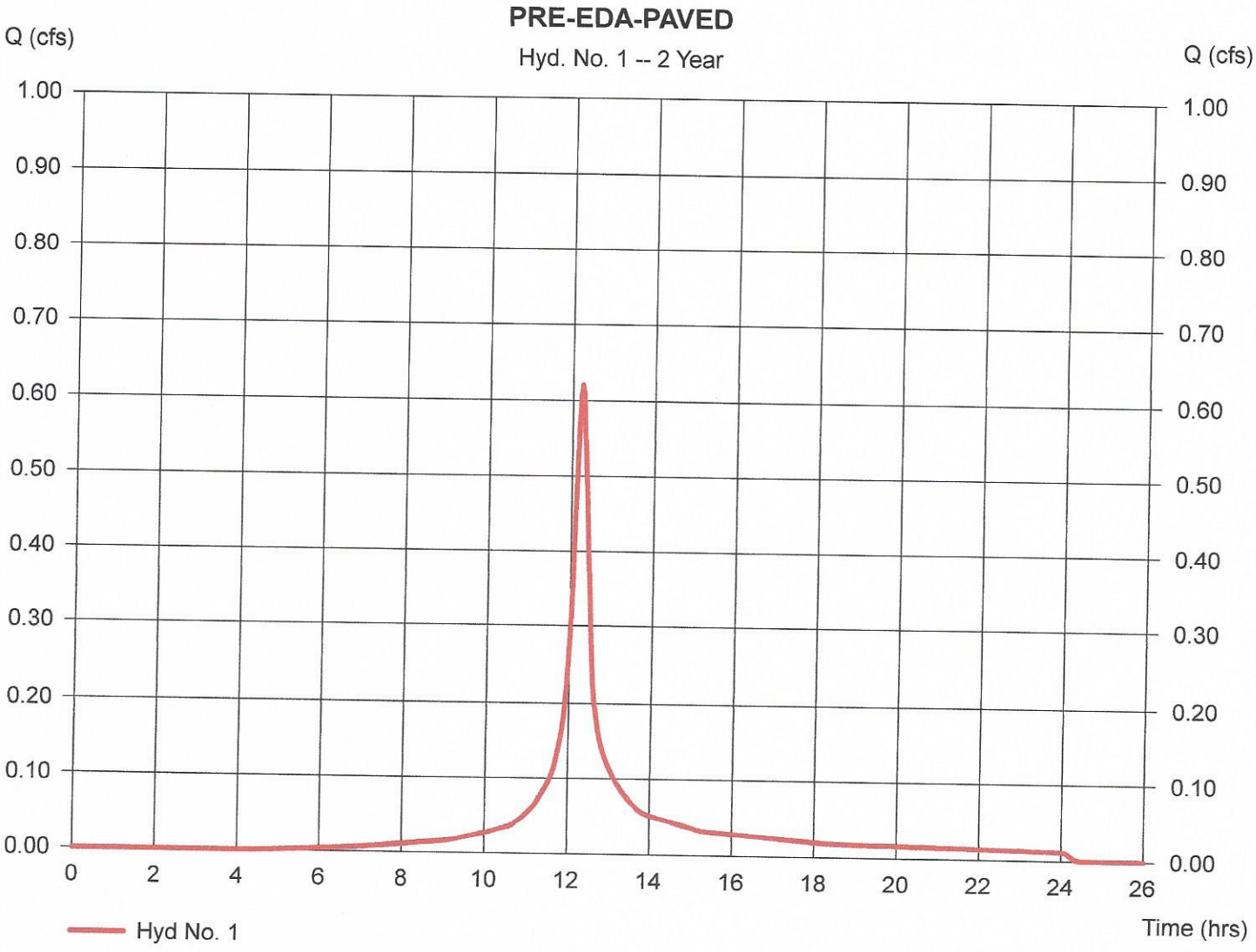
Tuesday, Nov 2, 2021

Hyd. No. 1

PRE-EDA-PAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.620 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 2,918 cuft
Drainage area	= 0.330 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.00 min
Total precip.	= 3.29 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 98) + (0.230 x 89)] / 0.330



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

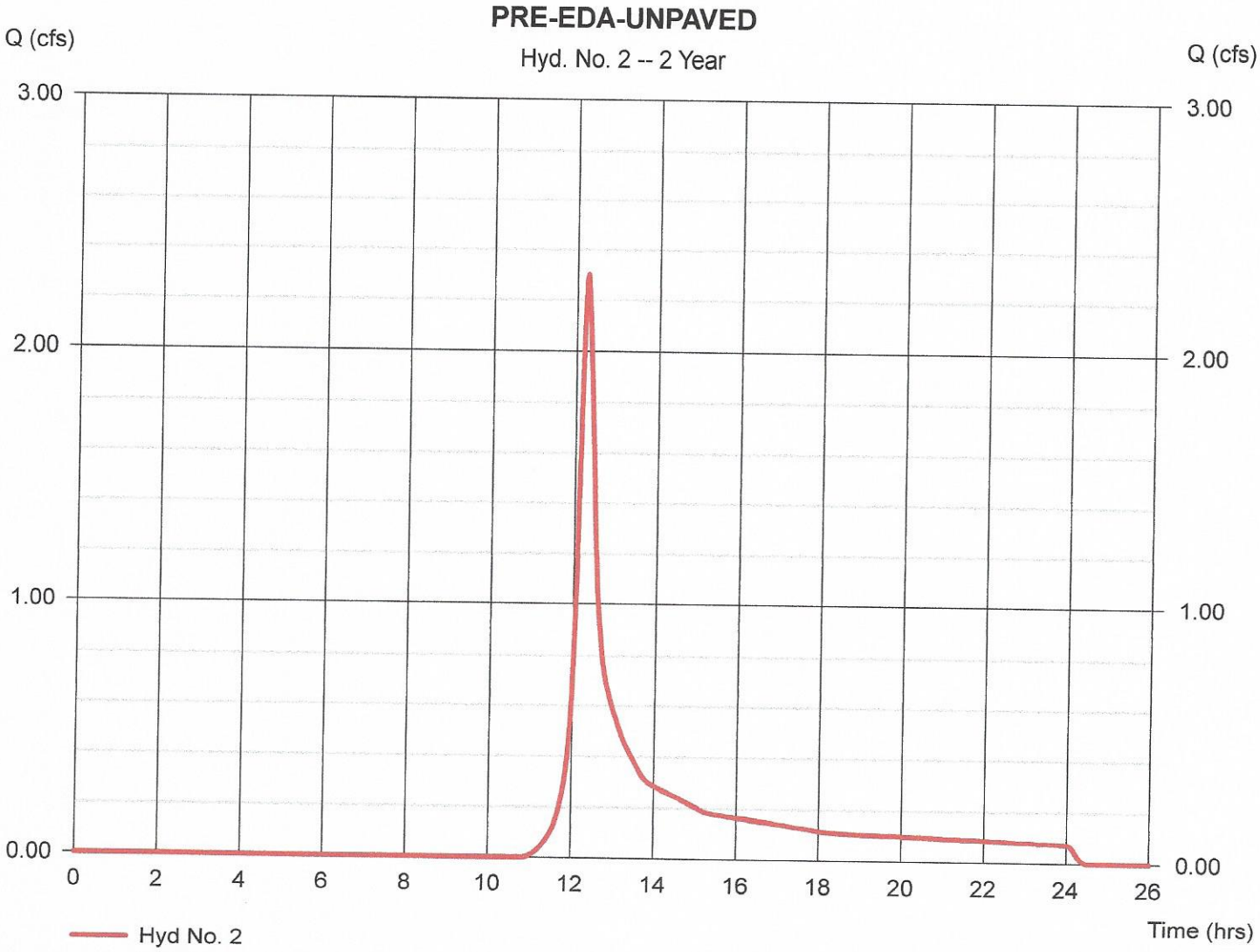
Tuesday, Nov 2, 2021

Hyd. No. 2

PRE-EDA-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 2.301 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 11,202 cuft
Drainage area	= 3.130 ac	Curve number	= 72*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.00 min
Total precip.	= 3.29 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(1.900 x 70) + (1.230 x 74)] / 3.130



Hydrograph Report

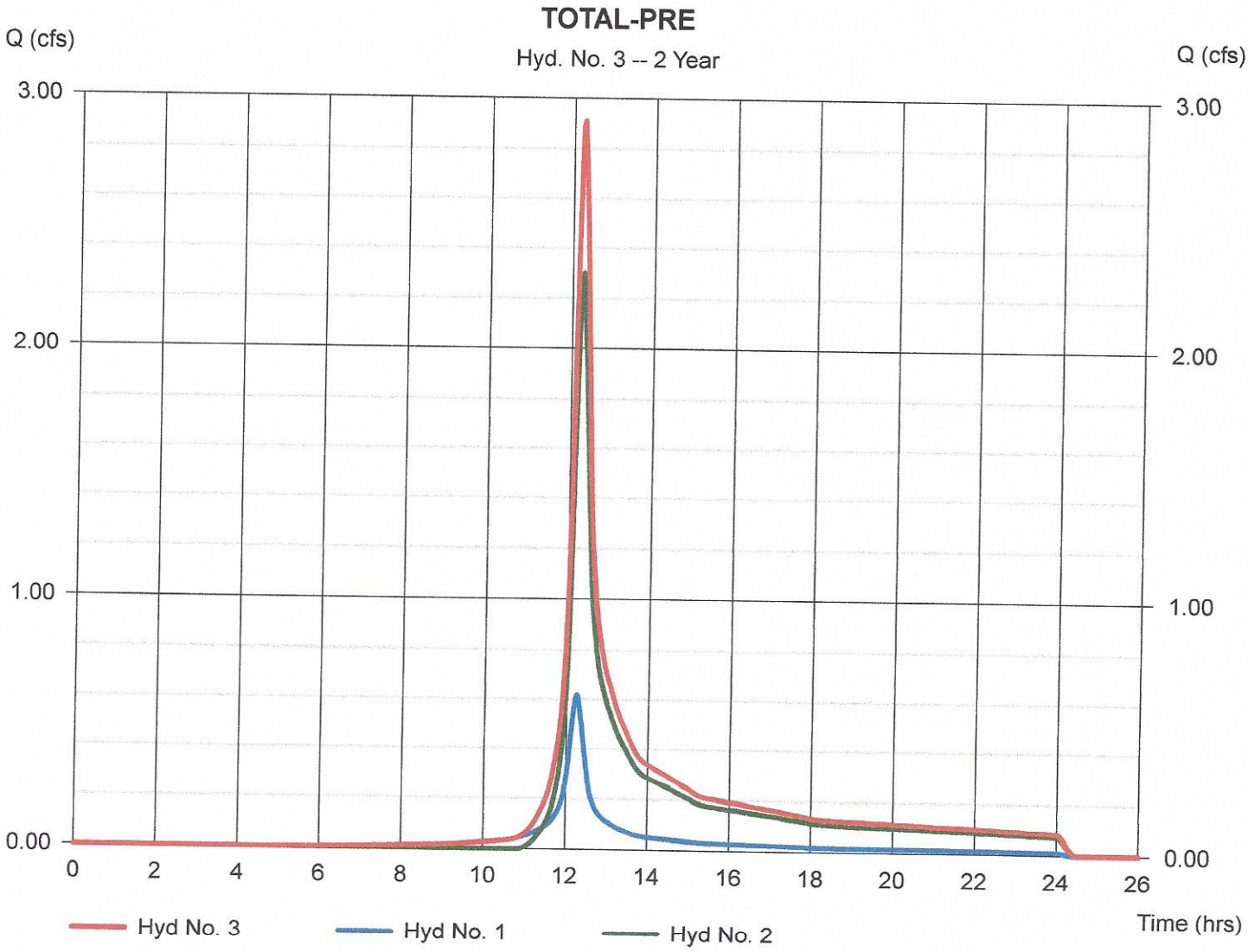
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 3

TOTAL-PRE

Hydrograph type	= Combine	Peak discharge	= 2.911 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 14,121 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 3.460 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

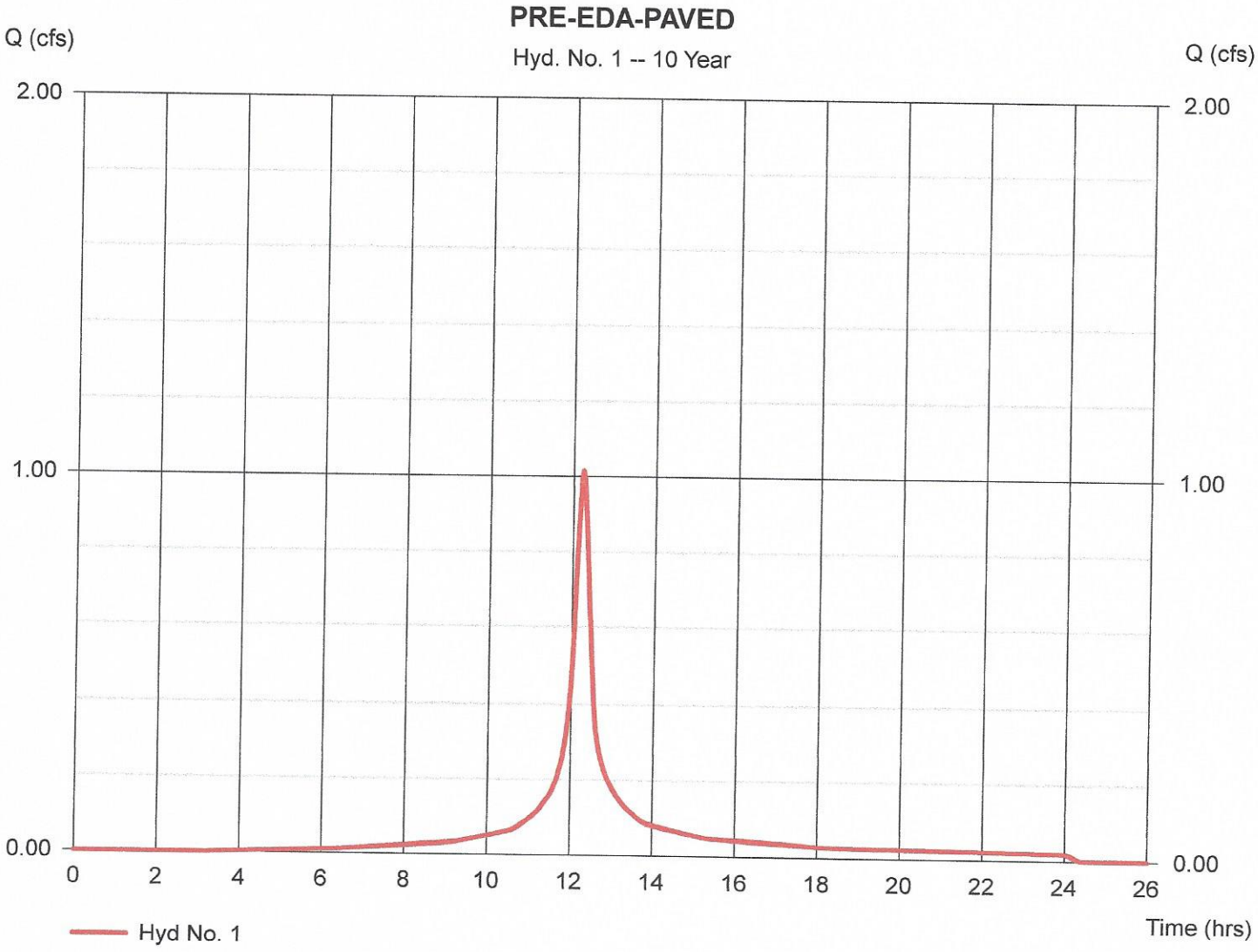
Tuesday, Nov 2, 2021

Hyd. No. 1

PRE-EDA-PAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.016 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 4,910 cuft
Drainage area	= 0.330 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.00 min
Total precip.	= 5.01 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 98) + (0.230 x 89)] / 0.330



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

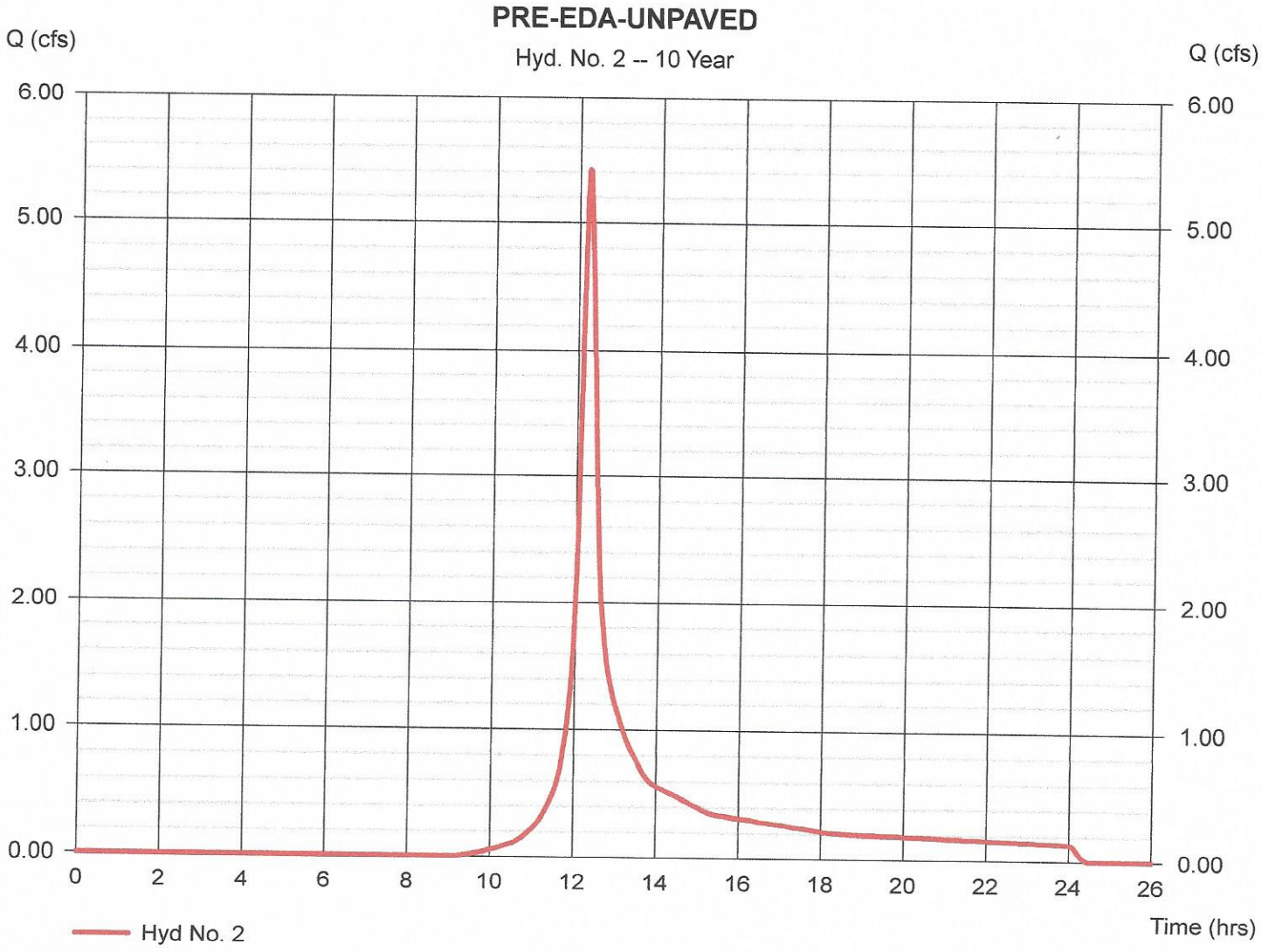
Tuesday, Nov 2, 2021

Hyd. No. 2

PRE-EDA-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 5.418 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 25,060 cuft
Drainage area	= 3.130 ac	Curve number	= 72*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.00 min
Total precip.	= 5.01 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(1.900 x 70) + (1.230 x 74)] / 3.130



Hydrograph Report

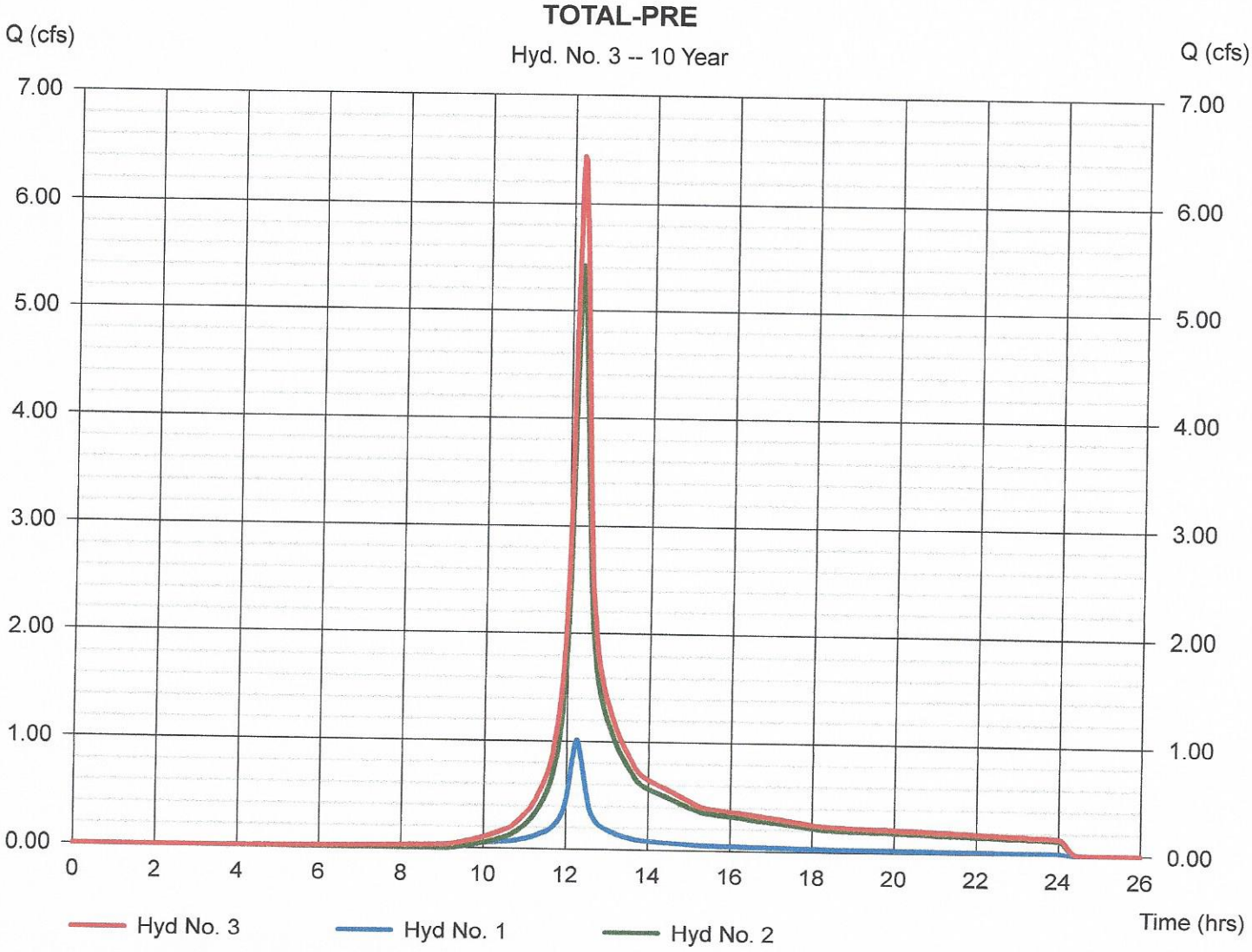
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 3

TOTAL-PRE

Hydrograph type	= Combine	Peak discharge	= 6.433 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 29,970 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 3.460 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

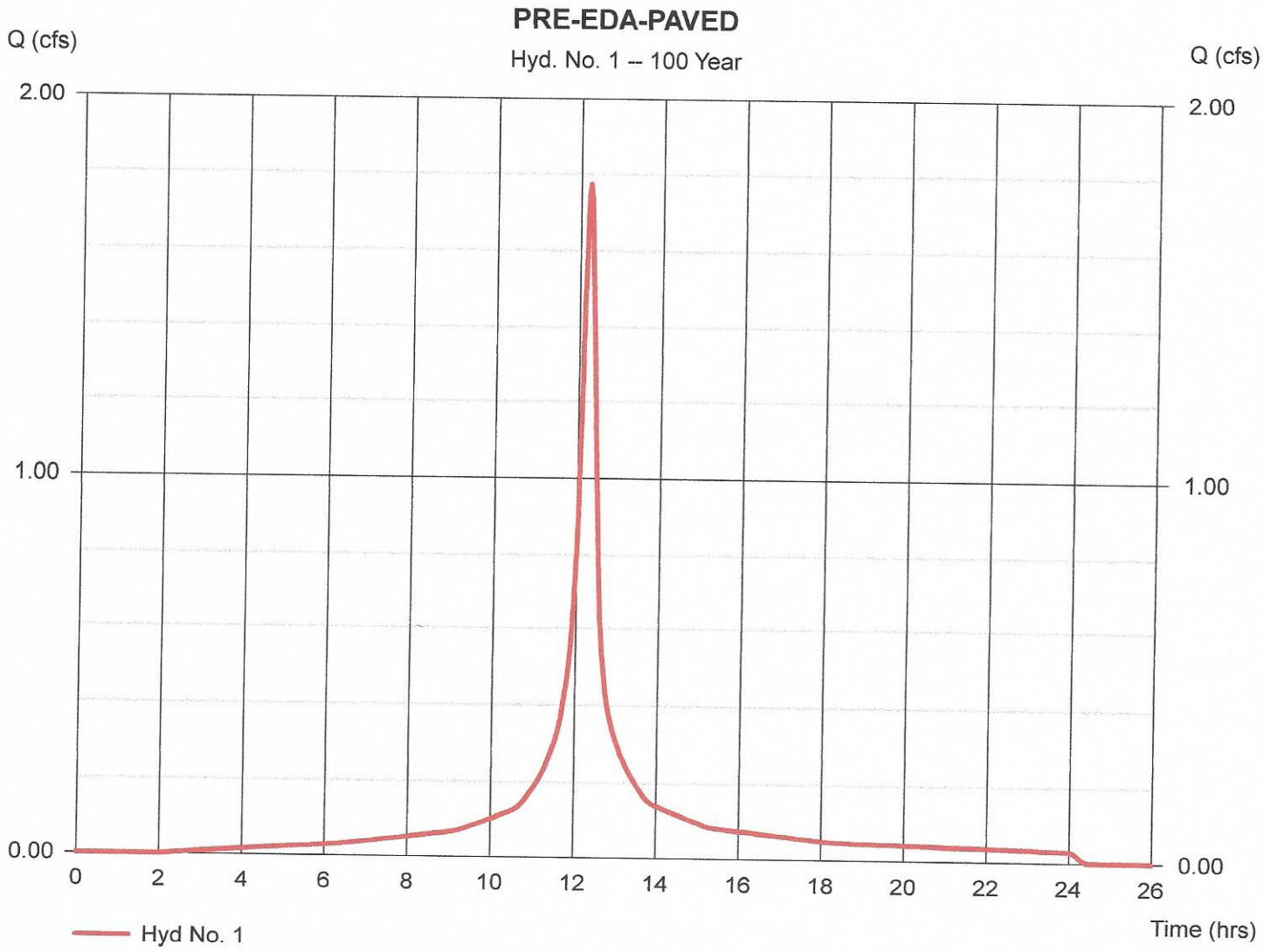
Tuesday, Nov 2, 2021

Hyd. No. 1

PRE-EDA-PAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.775 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 8,876 cuft
Drainage area	= 0.330 ac	Curve number	= 92*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.00 min
Total precip.	= 8.37 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 98) + (0.230 x 89)] / 0.330



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

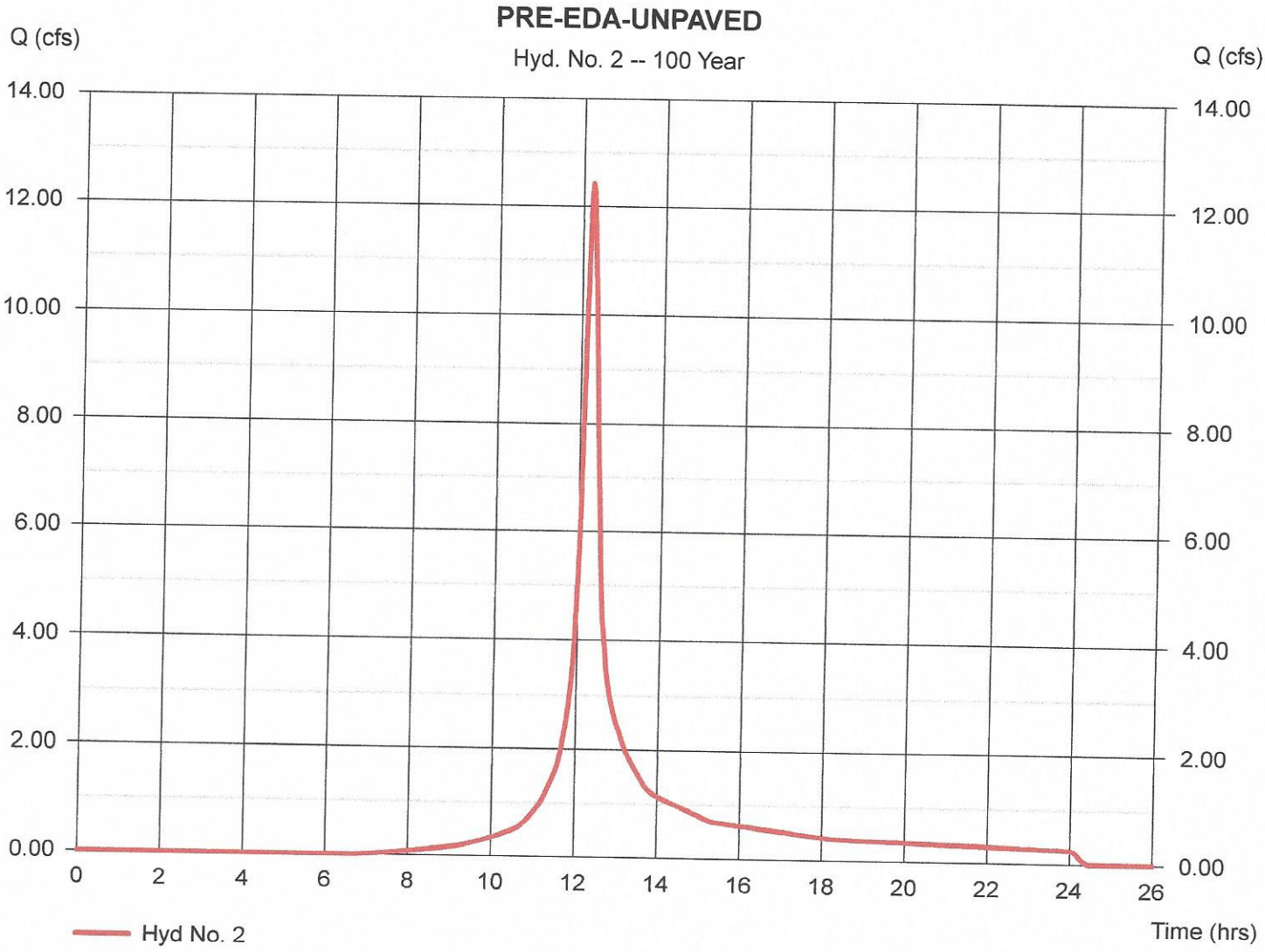
Tuesday, Nov 2, 2021

Hyd. No. 2

PRE-EDA-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 12.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 57,043 cuft
Drainage area	= 3.130 ac	Curve number	= 72*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 18.00 min
Total precip.	= 8.37 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(1.900 x 70) + (1.230 x 74)] / 3.130



Hydrograph Report

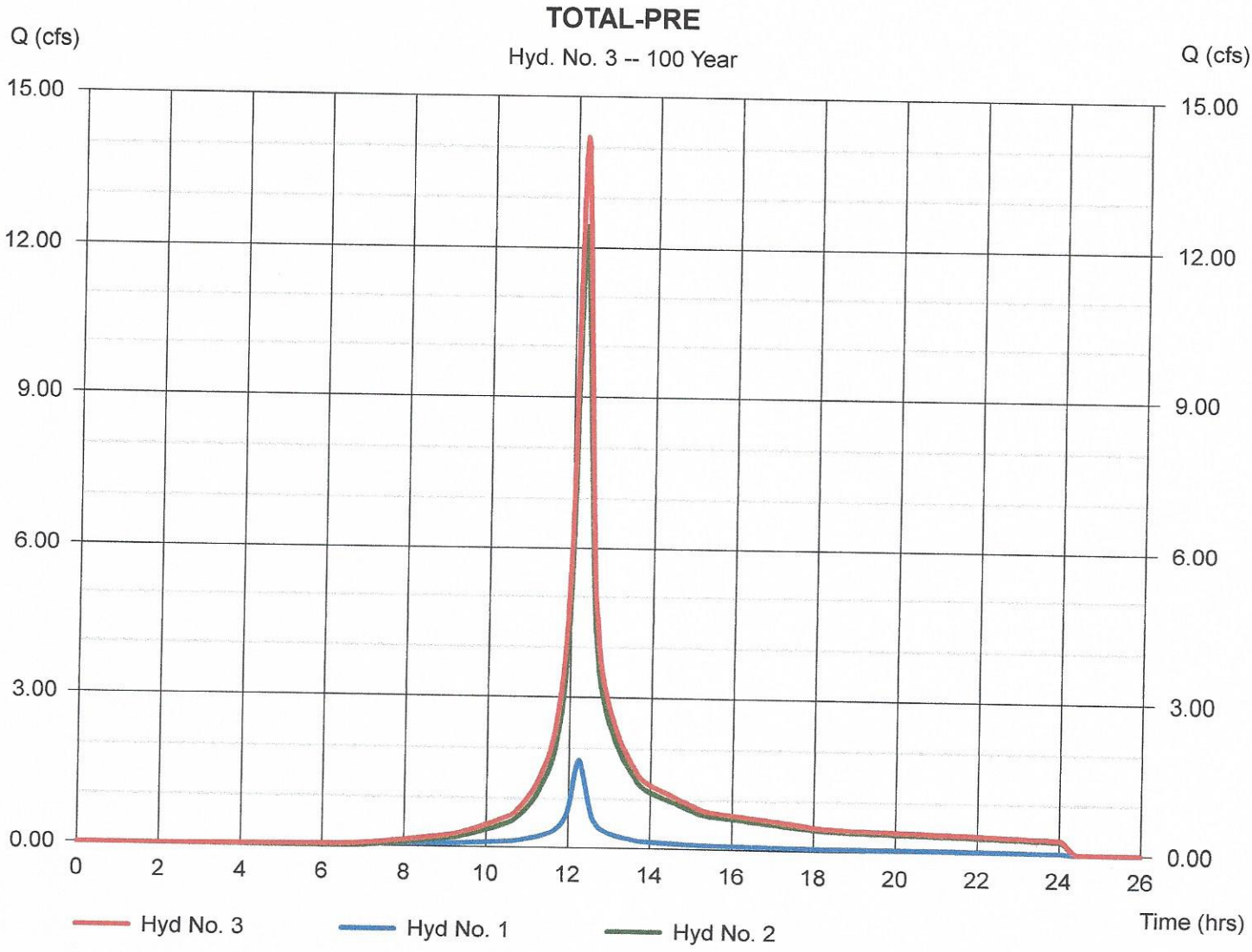
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 3

TOTAL-PRE

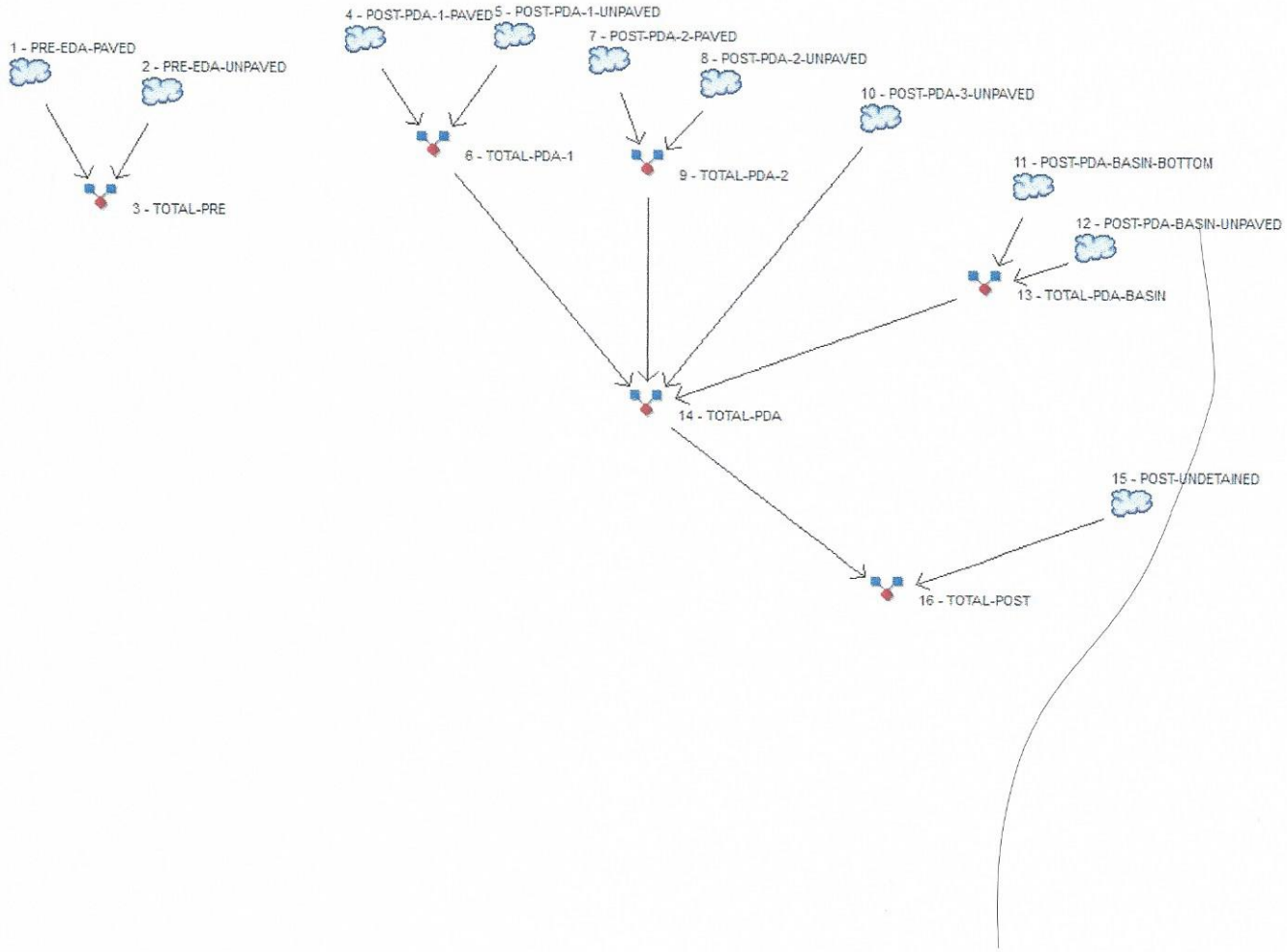
Hydrograph type	= Combine	Peak discharge	= 14.21 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 65,920 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 3.460 ac



APPENDIX 3

POST-DEVELOPMENT SITE RUNOFF COMPUTATIONS

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	PRE-EDA-PAVED
2	SCS Runoff	PRE-EDA-UNPAVED
3	Combine	TOTAL-PRE
4	SCS Runoff	POST-PDA-1-PAVED
5	SCS Runoff	POST-PDA-1-UNPAVED
6	Combine	TOTAL-PDA-1
7	SCS Runoff	POST-PDA-2-PAVED
8	SCS Runoff	POST-PDA-2-UNPAVED
9	Combine	TOTAL-PDA-2
10	SCS Runoff	POST-PDA-3-UNPAVED
11	SCS Runoff	POST-PDA-BASIN-BOTTOM
12	SCS Runoff	POST-PDA-BASIN-UNPAVED
13	Combine	TOTAL-PDA-BASIN
14	Combine	TOTAL-PDA
15	SCS Runoff	POST-UNDETAINED
16	Combine	TOTAL-POST

TR55 Tc Worksheet

Hyd. No. 10

POST-PDA-3-UNPAVED

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 100.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.29	0.00	0.00	
Land slope (%)	= 1.25	0.00	0.00	
Travel Time (min)	**= 11.66 +**	**0.00 +**	**0.00 =**	**11.66**
Shallow Concentrated Flow				
Flow length (ft)	= 250.00	0.00	0.00	
Watercourse slope (%)	= 0.70	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 1.35	0.00	0.00	
Travel Time (min)	**= 3.09 +**	**0.00 +**	**0.00 =**	**3.09**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	**= 0.00 +**	**0.00 +**	**0.00 =**	**0.00**

Total Travel Time, Tc ..... 14.70 min

TR55 Tc Worksheet

Hyd. No. 15

POST-UNDETAINED

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.400	0.150	0.011	
Flow length (ft)	= 22.0	88.0	0.0	
Two-year 24-hr precip. (in)	= 3.29	3.29	0.00	
Land slope (%)	= 2.27	9.75	0.00	
Travel Time (min)	**= 6.00 +**	**4.63 +**	**0.00 =**	**10.62**
Shallow Concentrated Flow				
Flow length (ft)	= 95.00	0.00	0.00	
Watercourse slope (%)	= 5.49	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 3.78	0.00	0.00	
Travel Time (min)	**= 0.42 +**	**0.00 +**	**0.00 =**	**0.42**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	**= 0.00 +**	**0.00 +**	**0.00 =**	**0.00**

Total Travel Time, Tc ..... 11.00 min

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

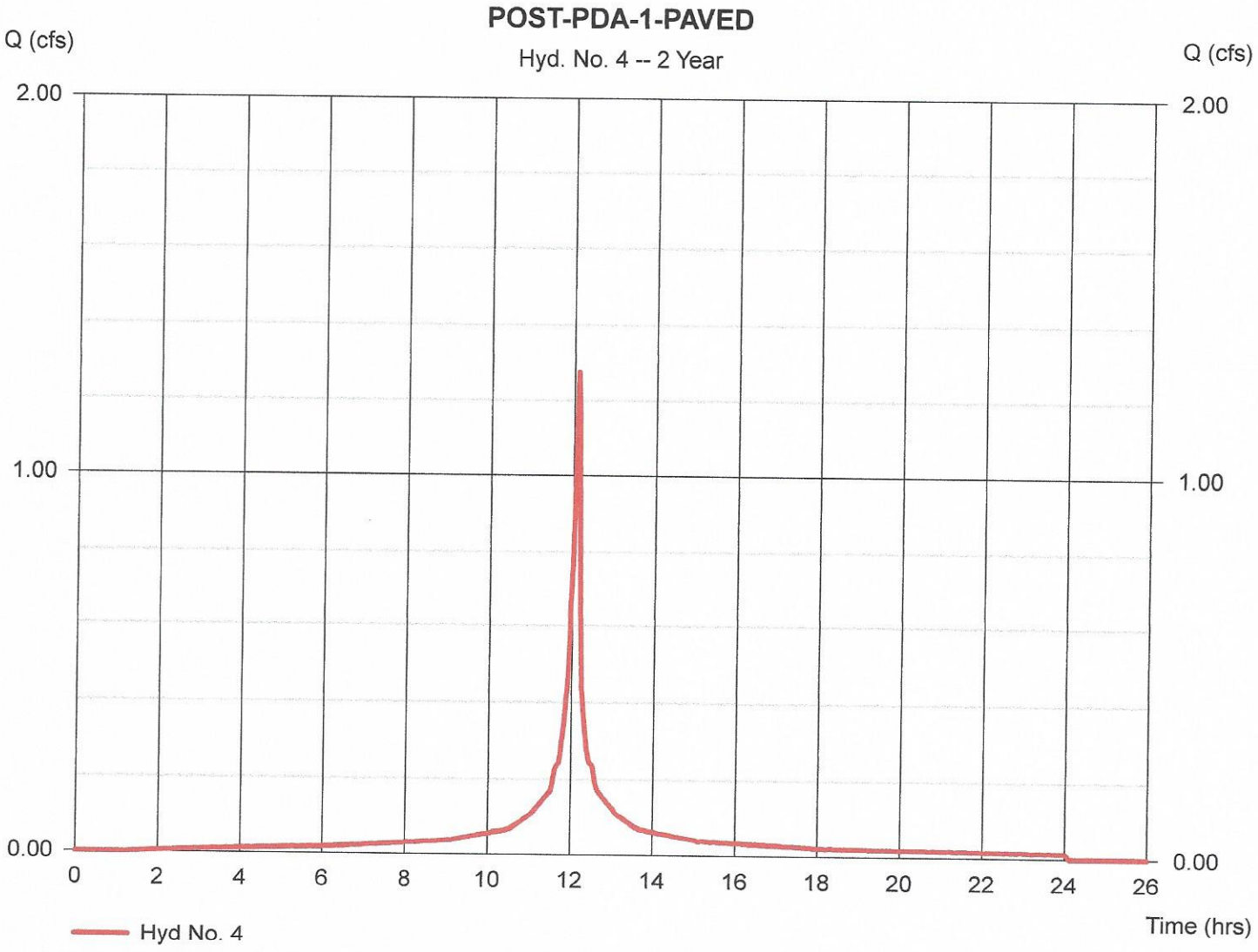
Tuesday, Nov 2, 2021

Hyd. No. 4

POST-PDA-1-PAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.276 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 4,370 cuft
Drainage area	= 0.420 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.29 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 98) + (0.200 x 98) + (0.050 x 98)] / 0.420



Hydrograph Report

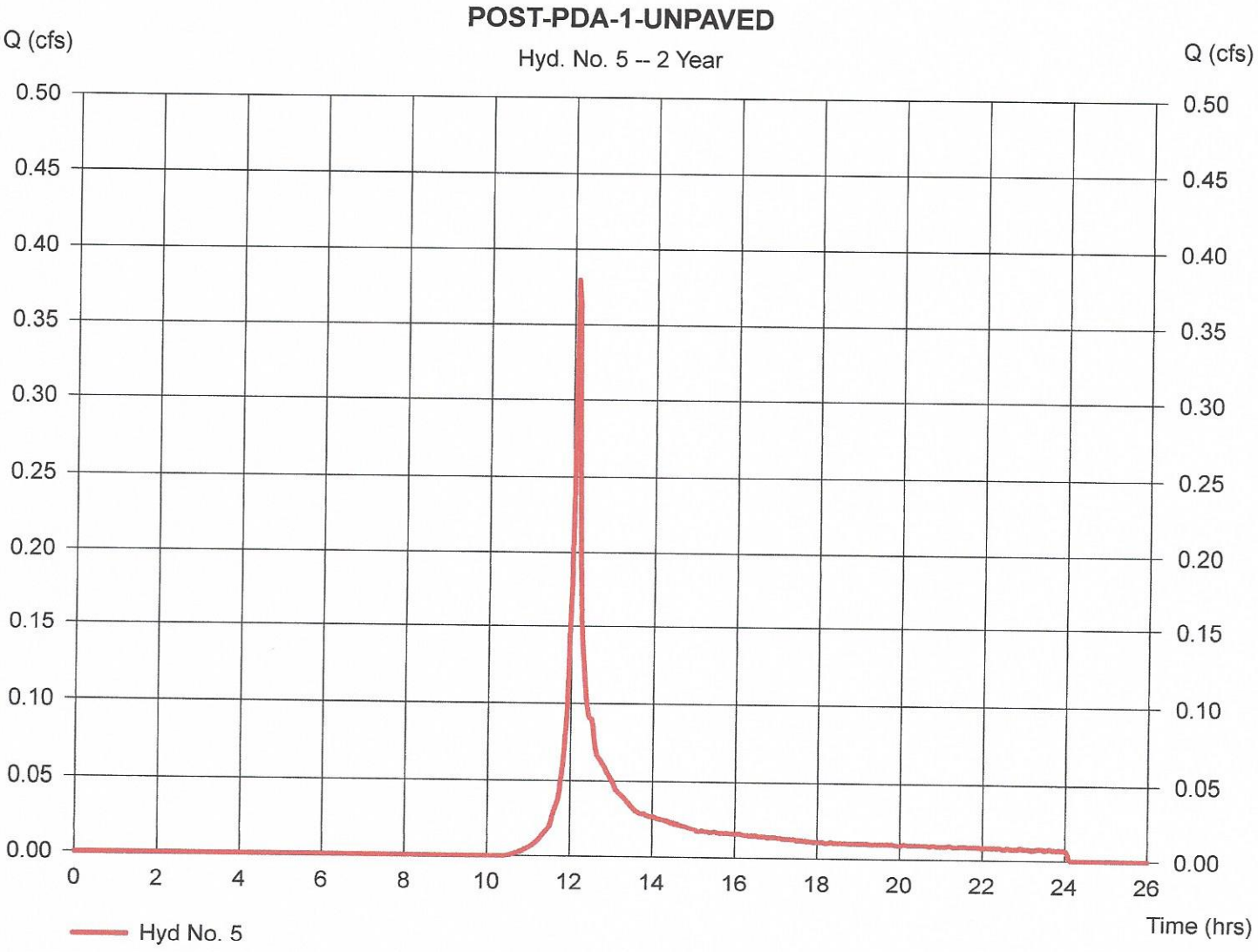
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 5

POST-PDA-1-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.380 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 1,158 cuft
Drainage area	= 0.310 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.29 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



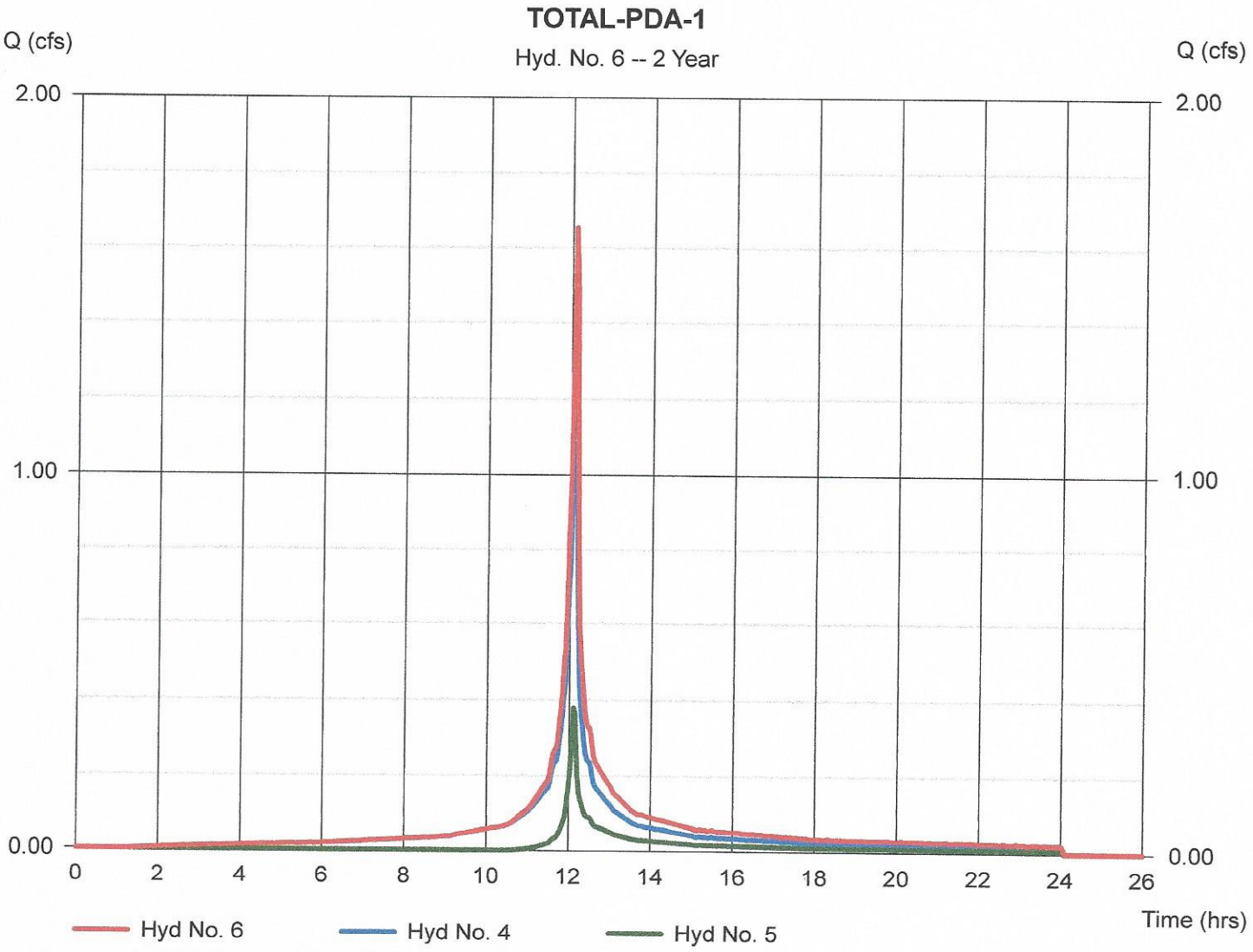
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 6

TOTAL-PDA-1

Hydrograph type	= Combine	Peak discharge	= 1.655 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 5,527 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 0.730 ac



Hydrograph Report

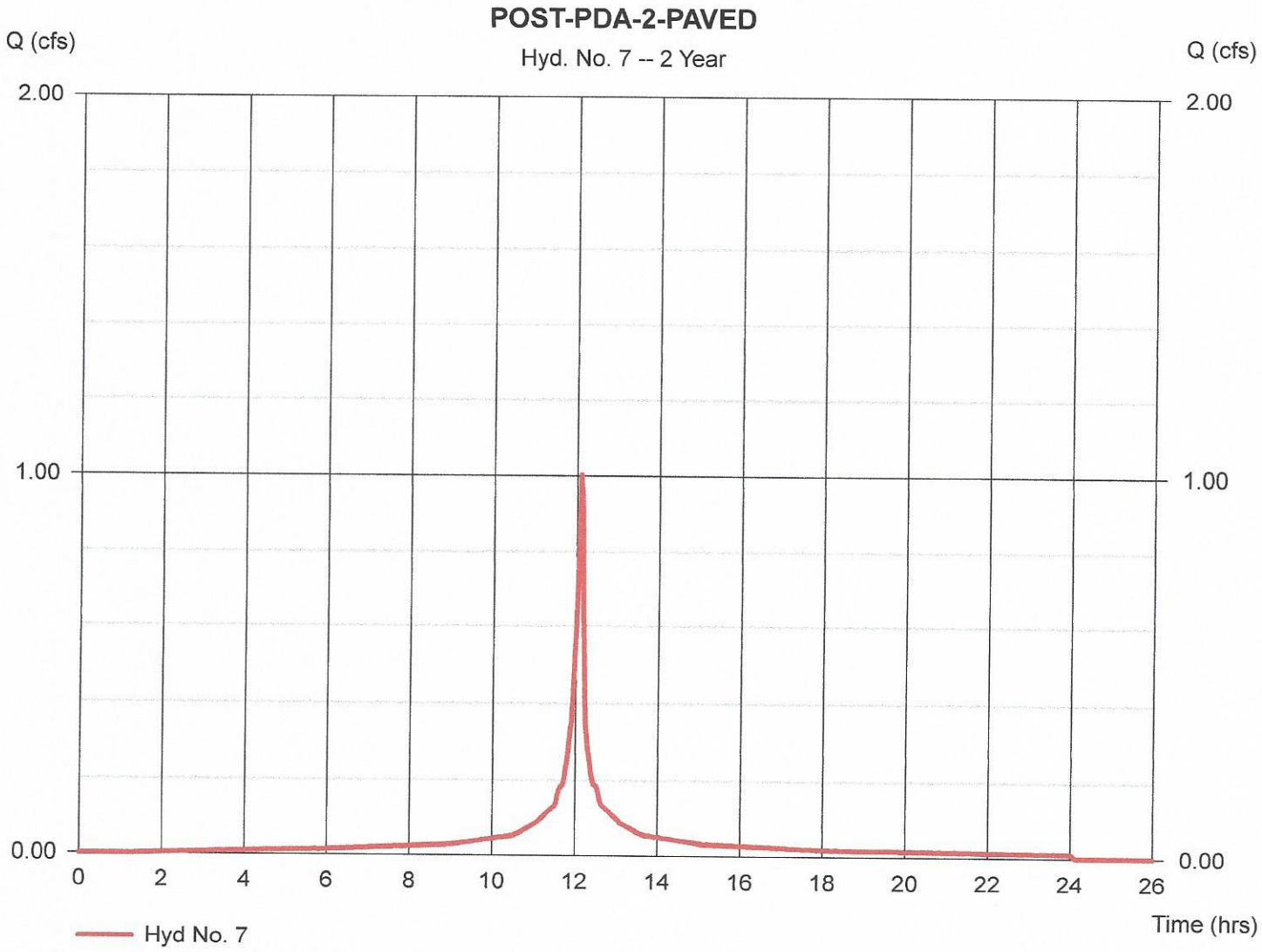
Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 7

POST-PDA-2-PAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.002 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 3,433 cuft
Drainage area	= 0.330 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.29 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 98) + (0.190 x 98) + (0.040 x 98)] / 0.330



Hydrograph Report

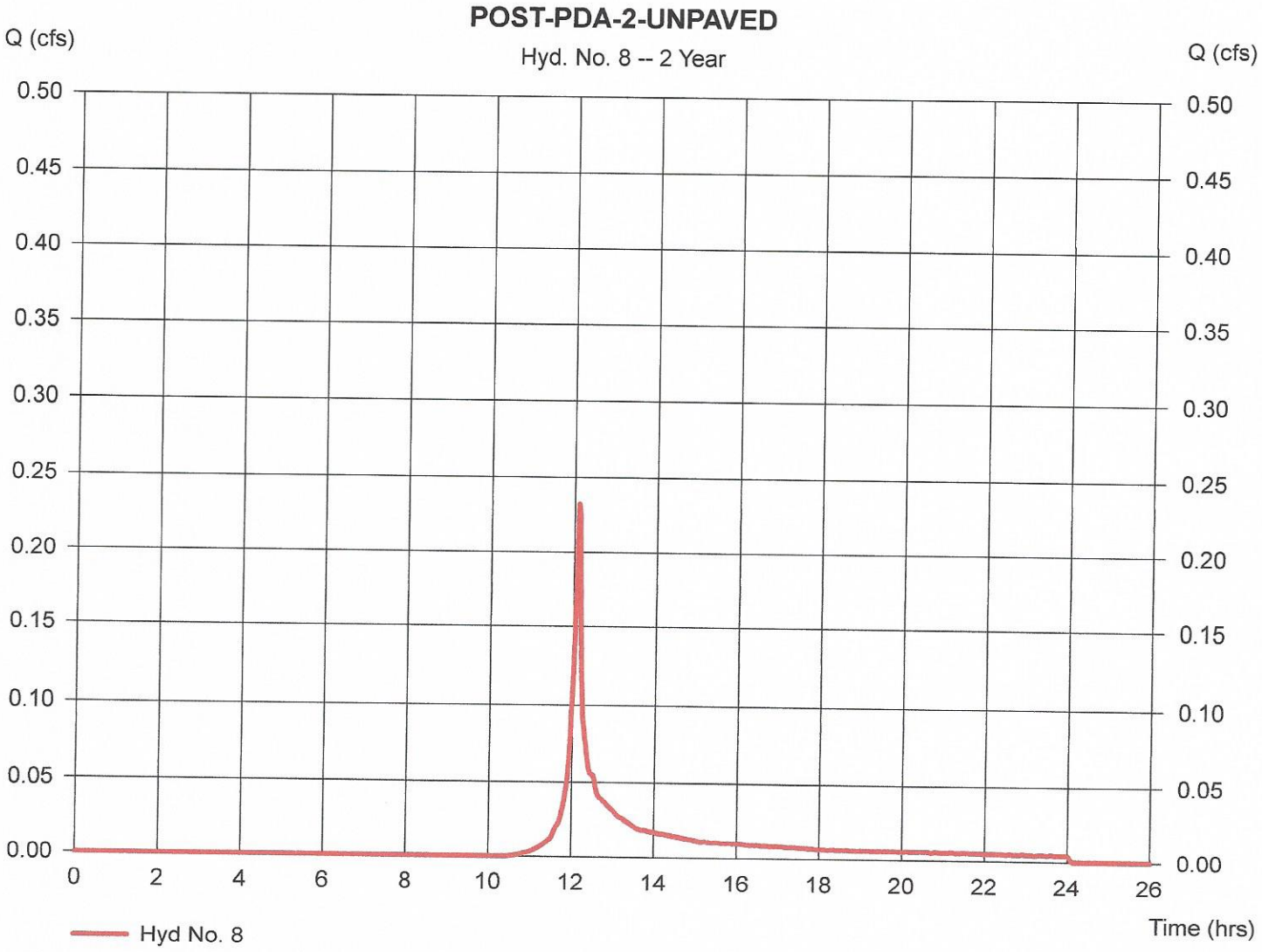
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 8

POST-PDA-2-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.233 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 709 cuft
Drainage area	= 0.190 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.29 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



Hydrograph Report

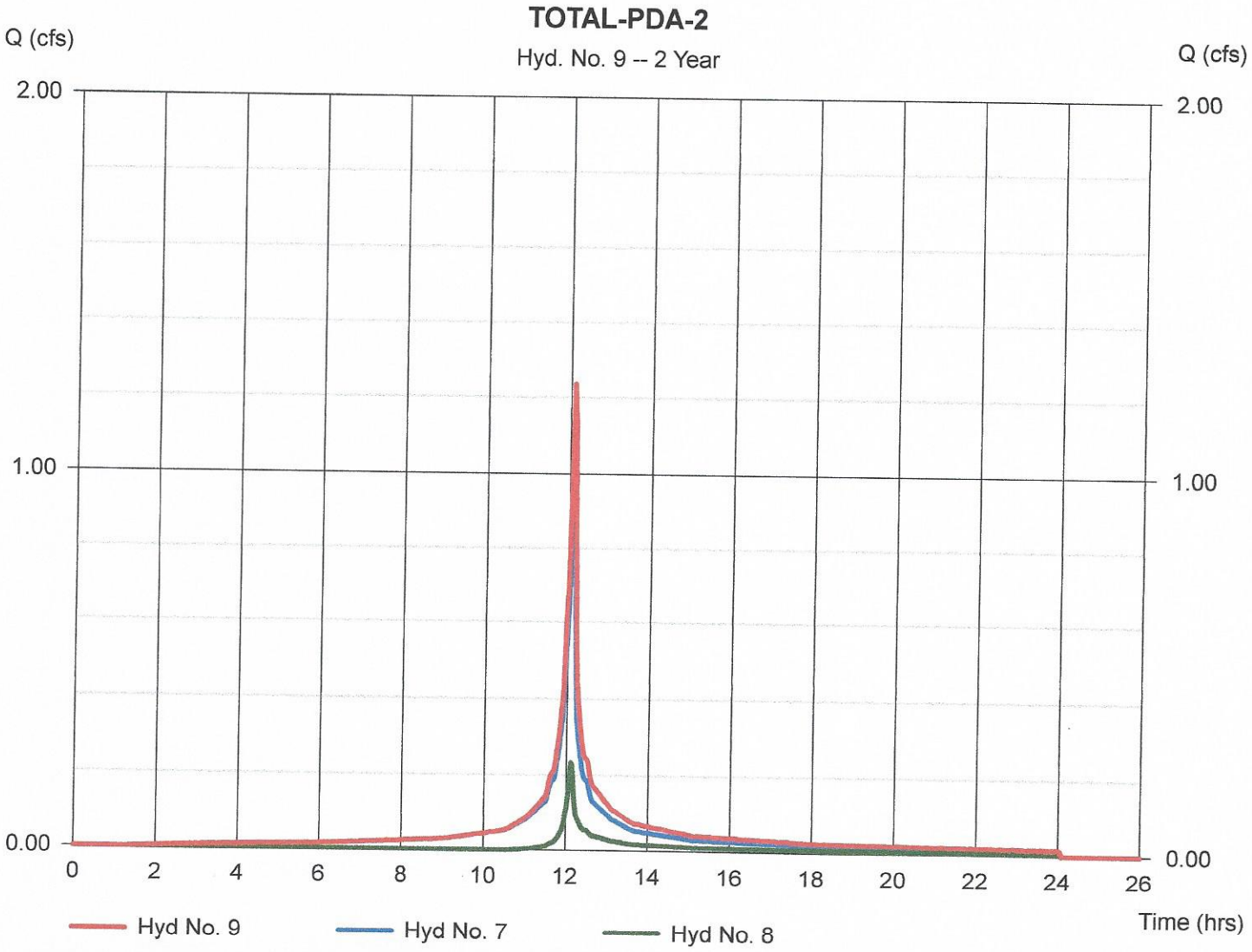
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 9

TOTAL-PDA-2

Hydrograph type	= Combine	Peak discharge	= 1.235 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 4,143 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 0.520 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

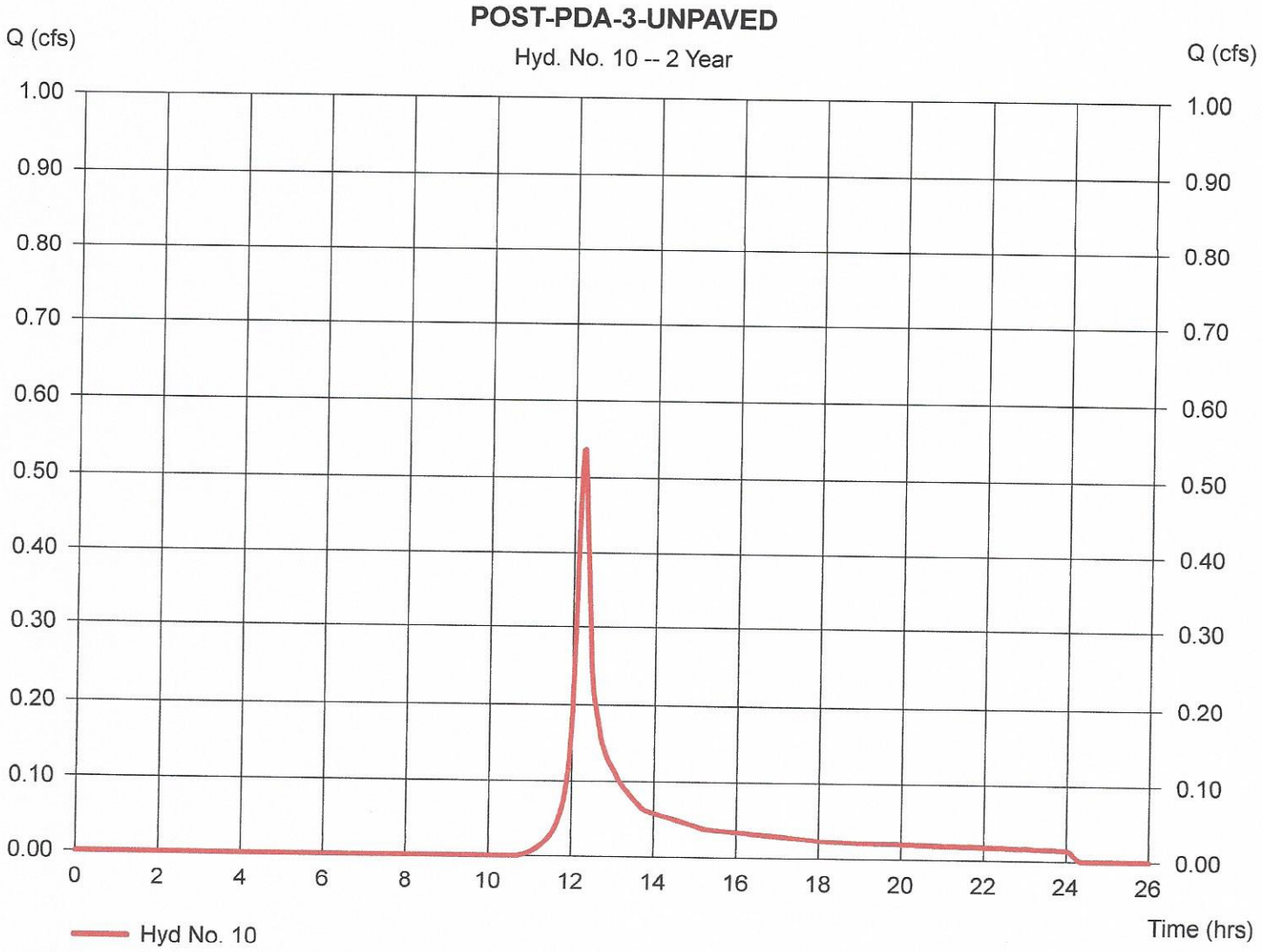
Tuesday, Nov 2, 2021

Hyd. No. 10

POST-PDA-3-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.537 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 2,358 cuft
Drainage area	= 0.640 ac	Curve number	= 73*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.70 min
Total precip.	= 3.29 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.150 x 70) + (0.490 x 74)] / 0.640



Hydrograph Report

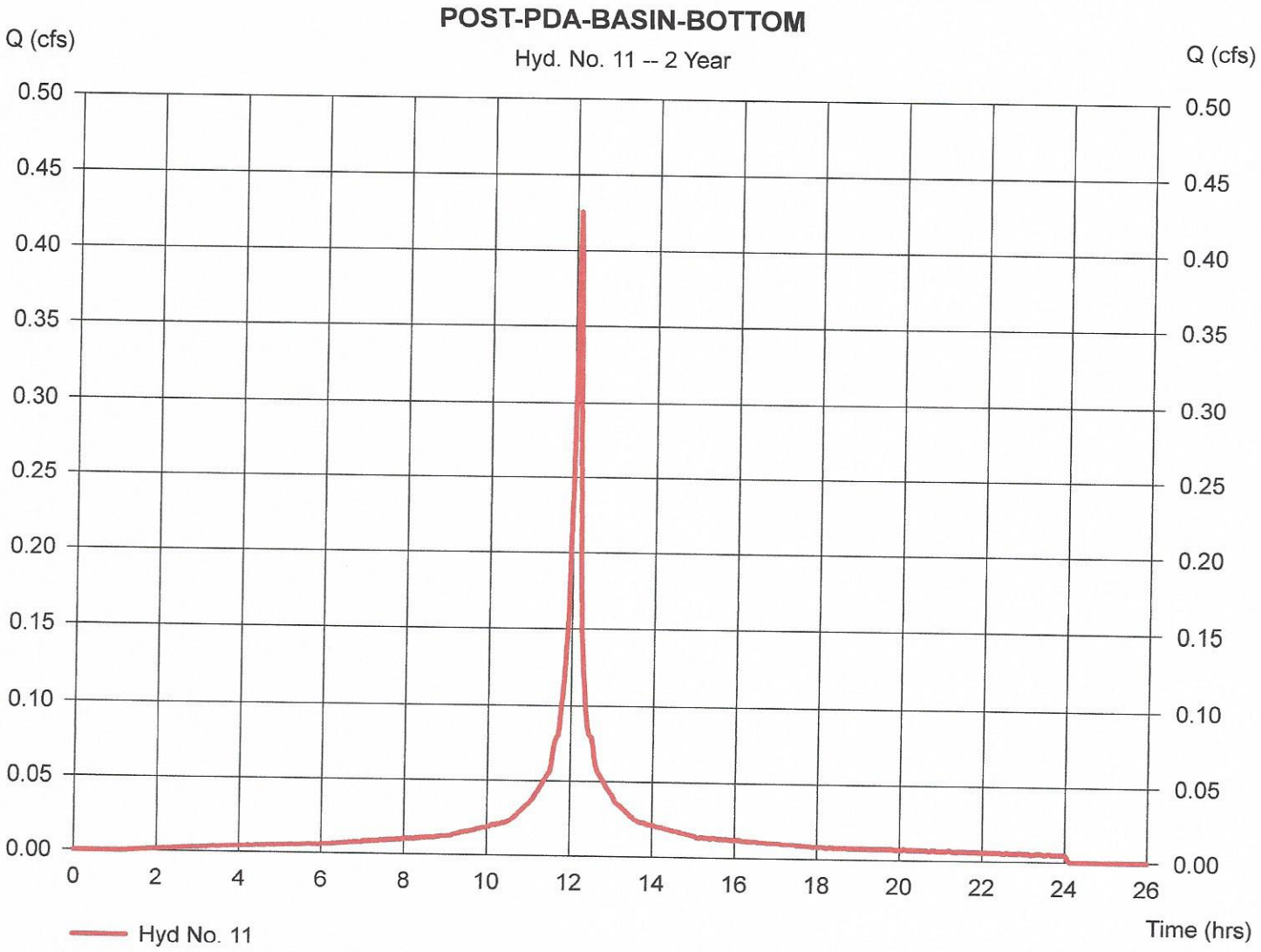
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 11

POST-PDA-BASIN-BOTTOM

Hydrograph type	= SCS Runoff	Peak discharge	= 0.425 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 1,457 cuft
Drainage area	= 0.140 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.29 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



Hydrograph Report

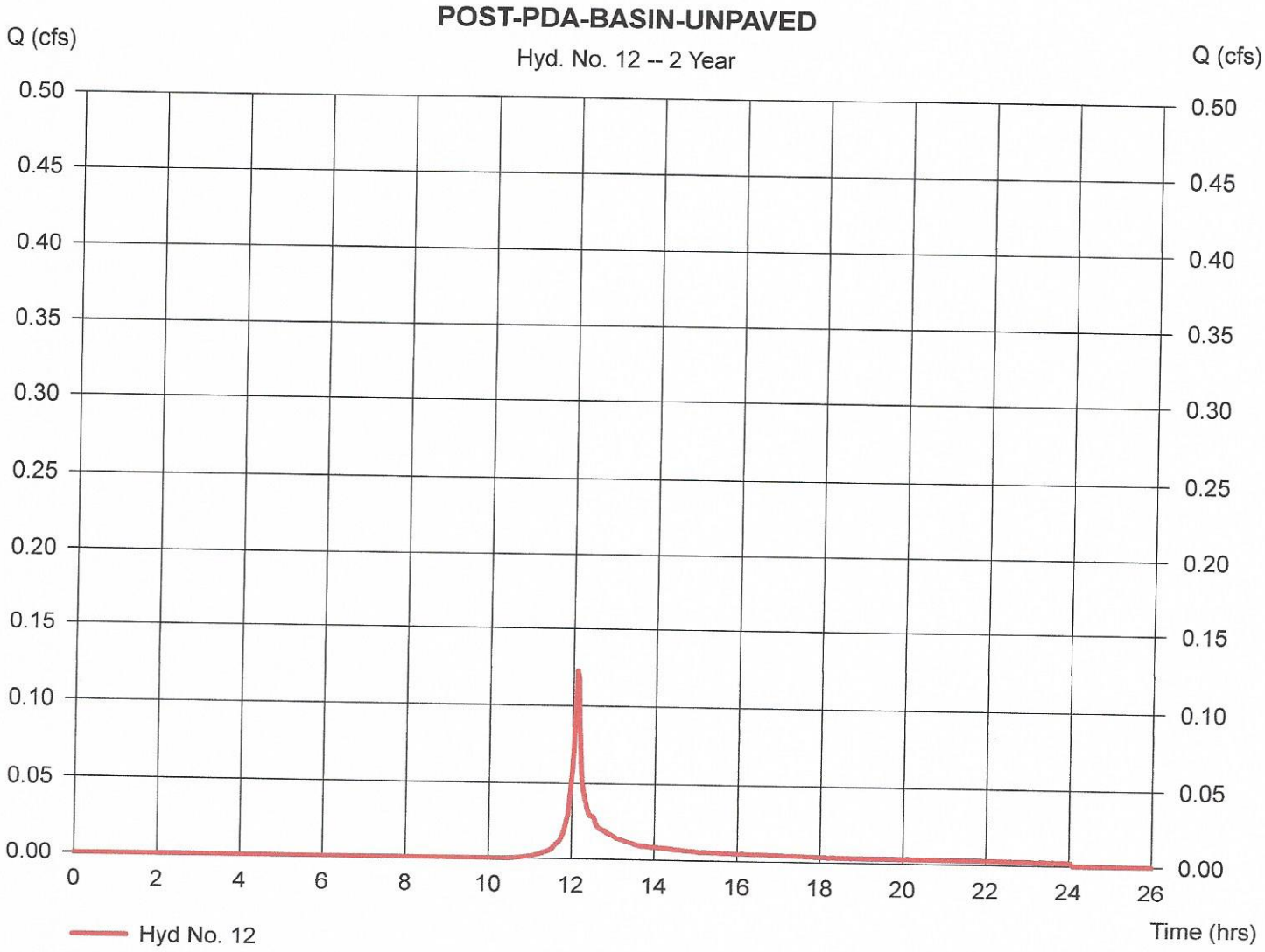
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 12

POST-PDA-BASIN-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.122 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 373 cuft
Drainage area	= 0.100 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.29 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



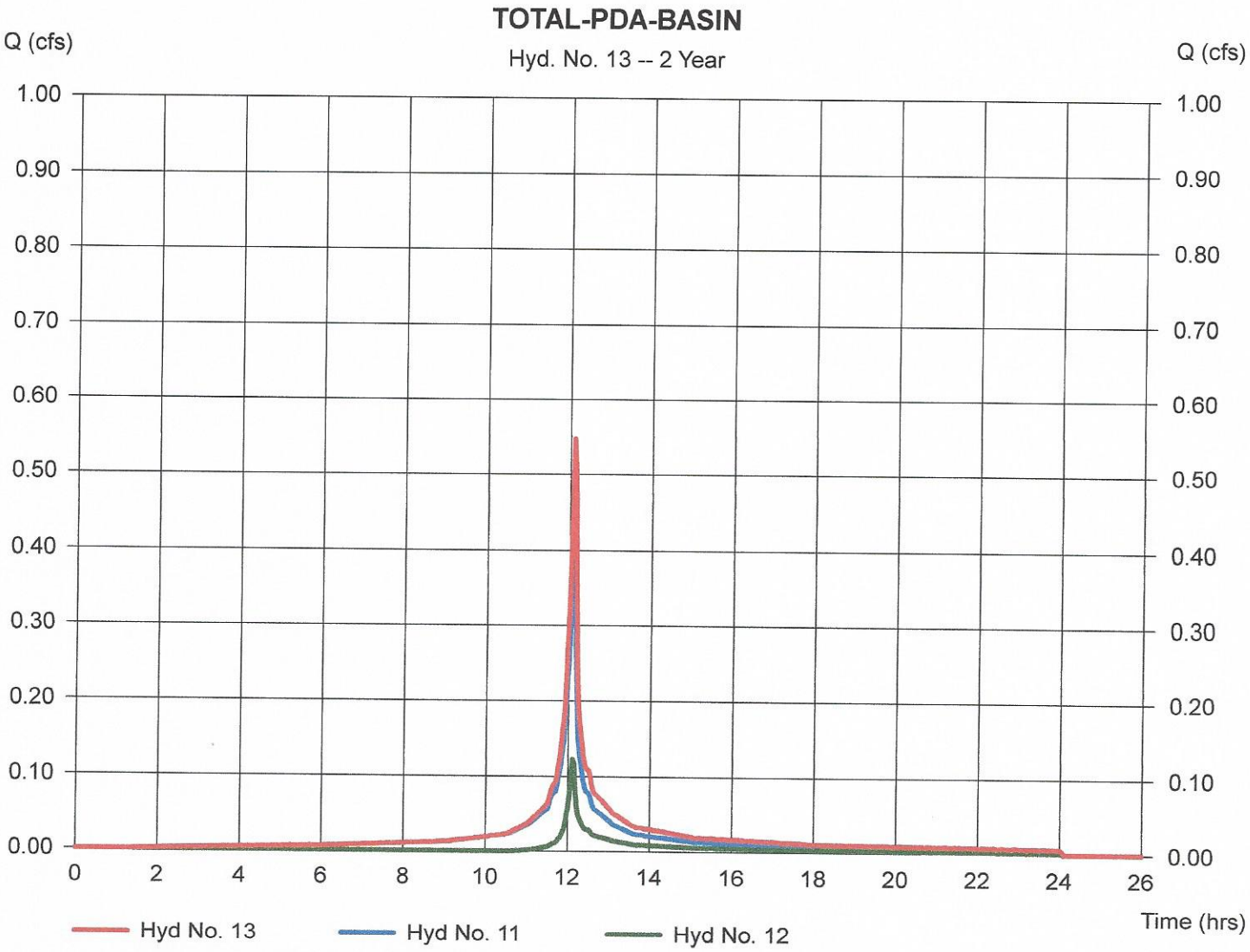
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 13

TOTAL-PDA-BASIN

Hydrograph type	= Combine	Peak discharge	= 0.548 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 1,830 cuft
Inflow hyds.	= 11, 12	Contrib. drain. area	= 0.240 ac



Hydrograph Report

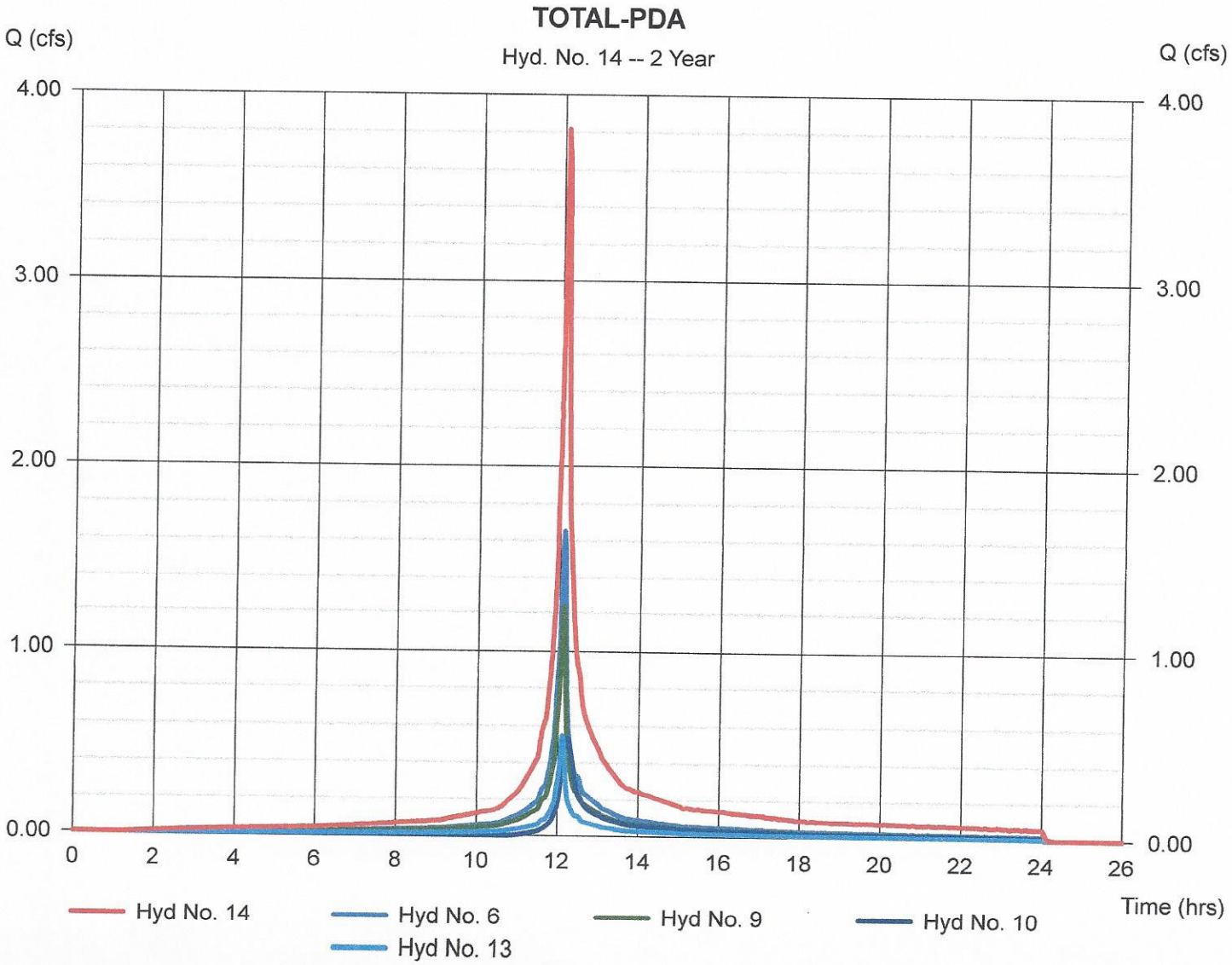
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 14

TOTAL-PDA

Hydrograph type	= Combine	Peak discharge	= 3.816 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 13,857 cuft
Inflow hyds.	= 6, 9, 10, 13	Contrib. drain. area	= 0.640 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

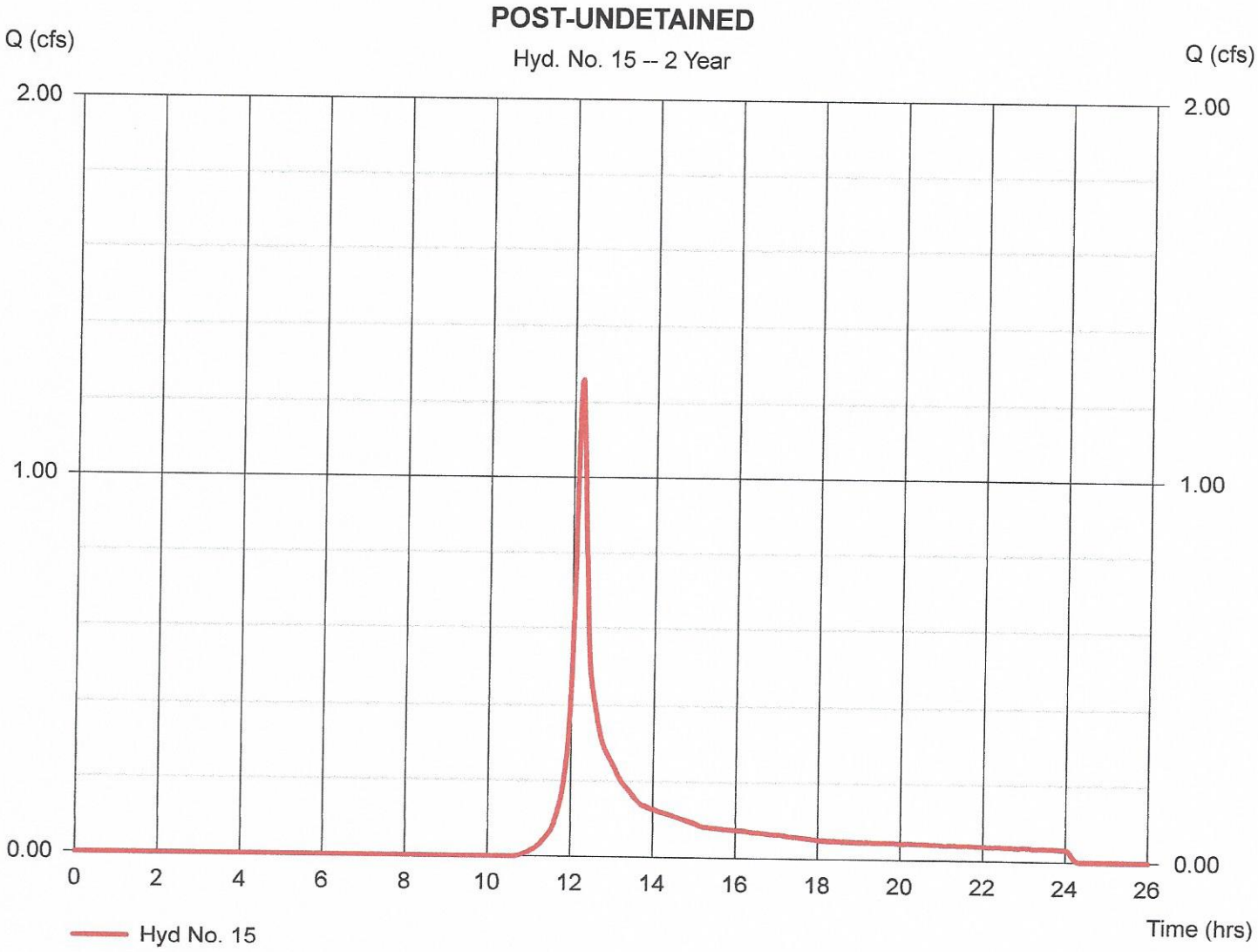
Tuesday, Nov 2, 2021

Hyd. No. 15

POST-UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.258 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 5,143 cuft
Drainage area	= 1.320 ac	Curve number	= 73*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.00 min
Total precip.	= 3.29 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.190 x 70) + (1.130 x 74)] / 1.320



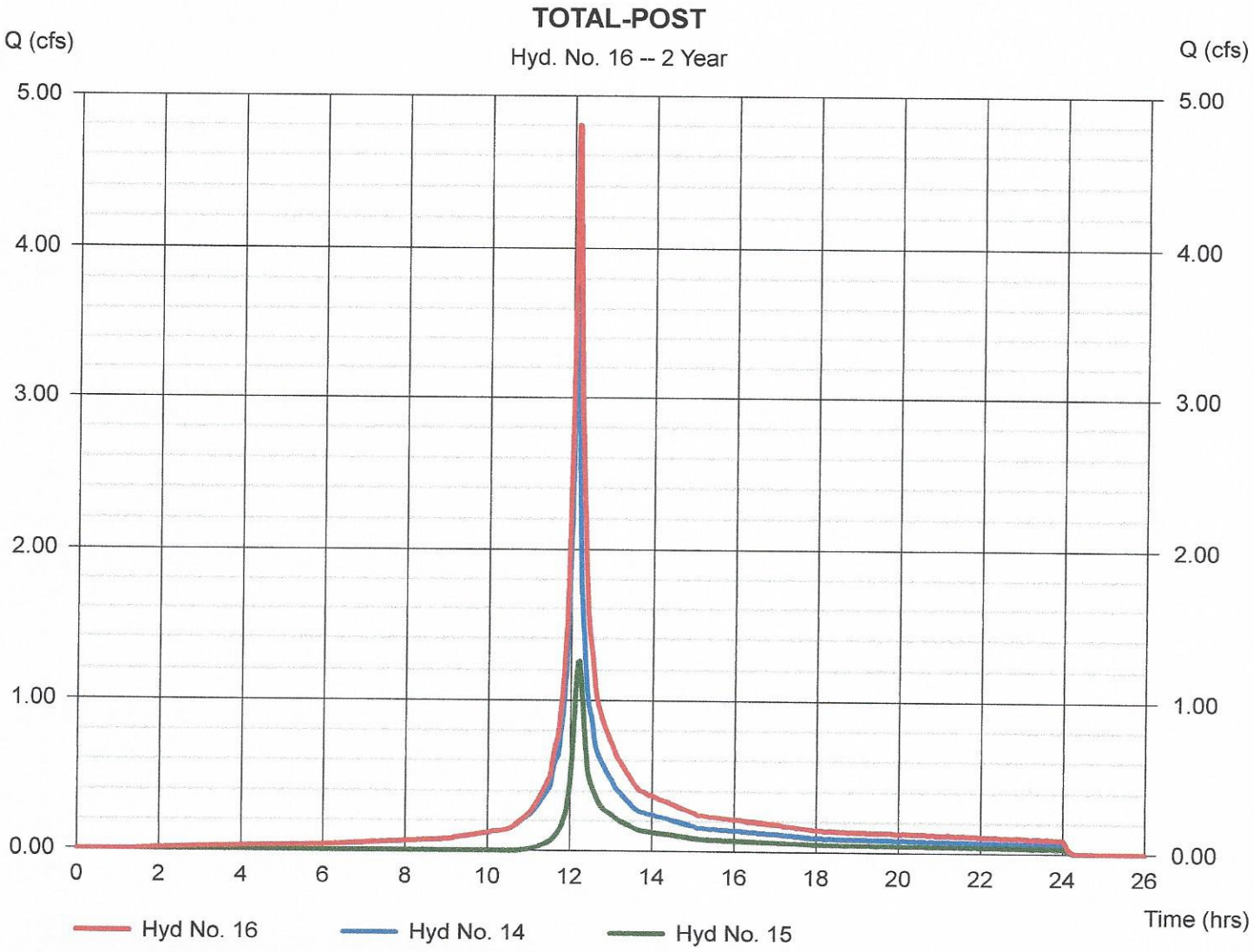
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 16

TOTAL-POST

Hydrograph type	= Combine	Peak discharge	= 4.801 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 19,000 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 1.320 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

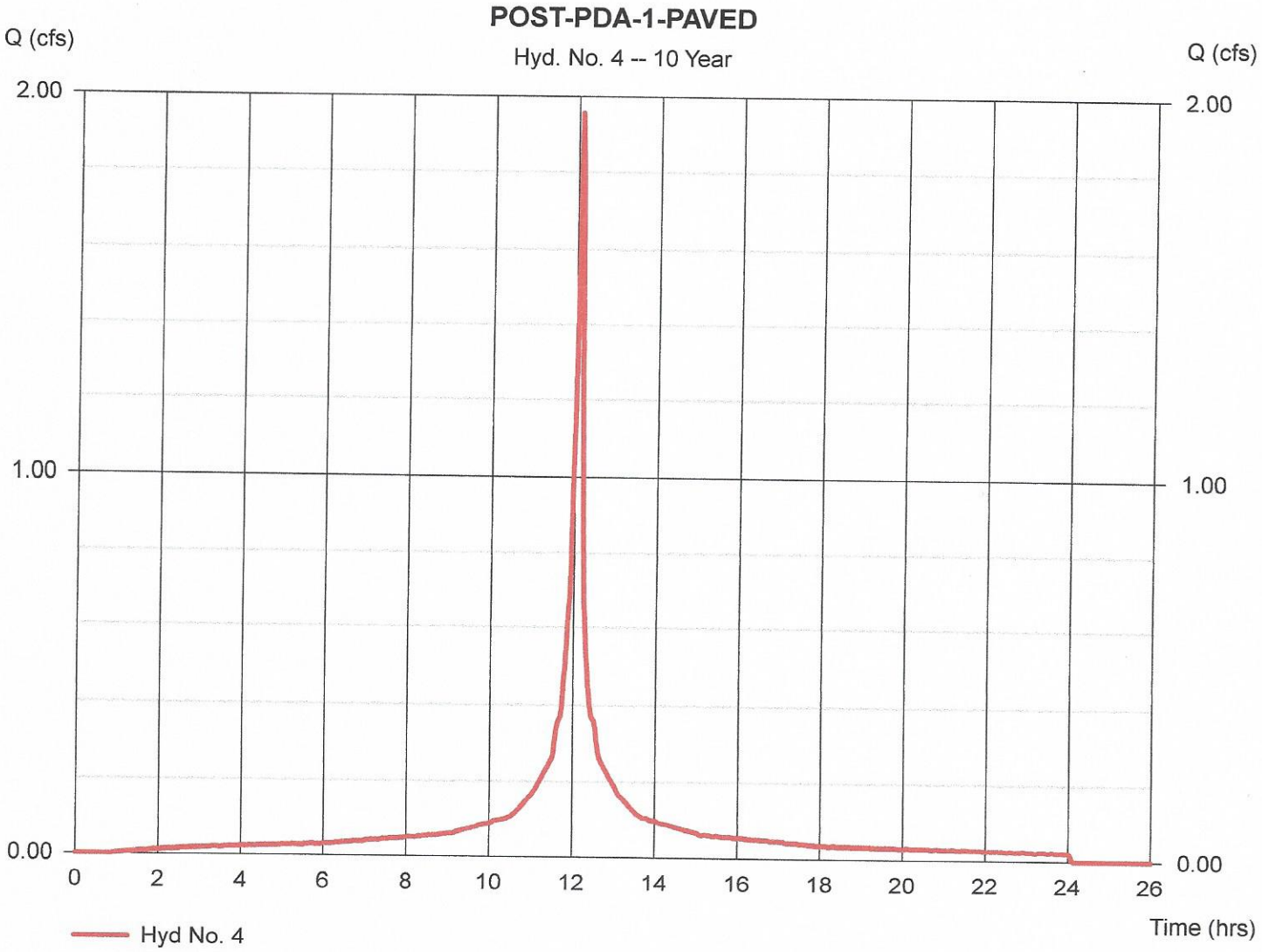
Tuesday, Nov 2, 2021

Hyd. No. 4

POST-PDA-1-PAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.955 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 6,822 cuft
Drainage area	= 0.420 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.01 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 98) + (0.200 x 98) + (0.050 x 98)] / 0.420



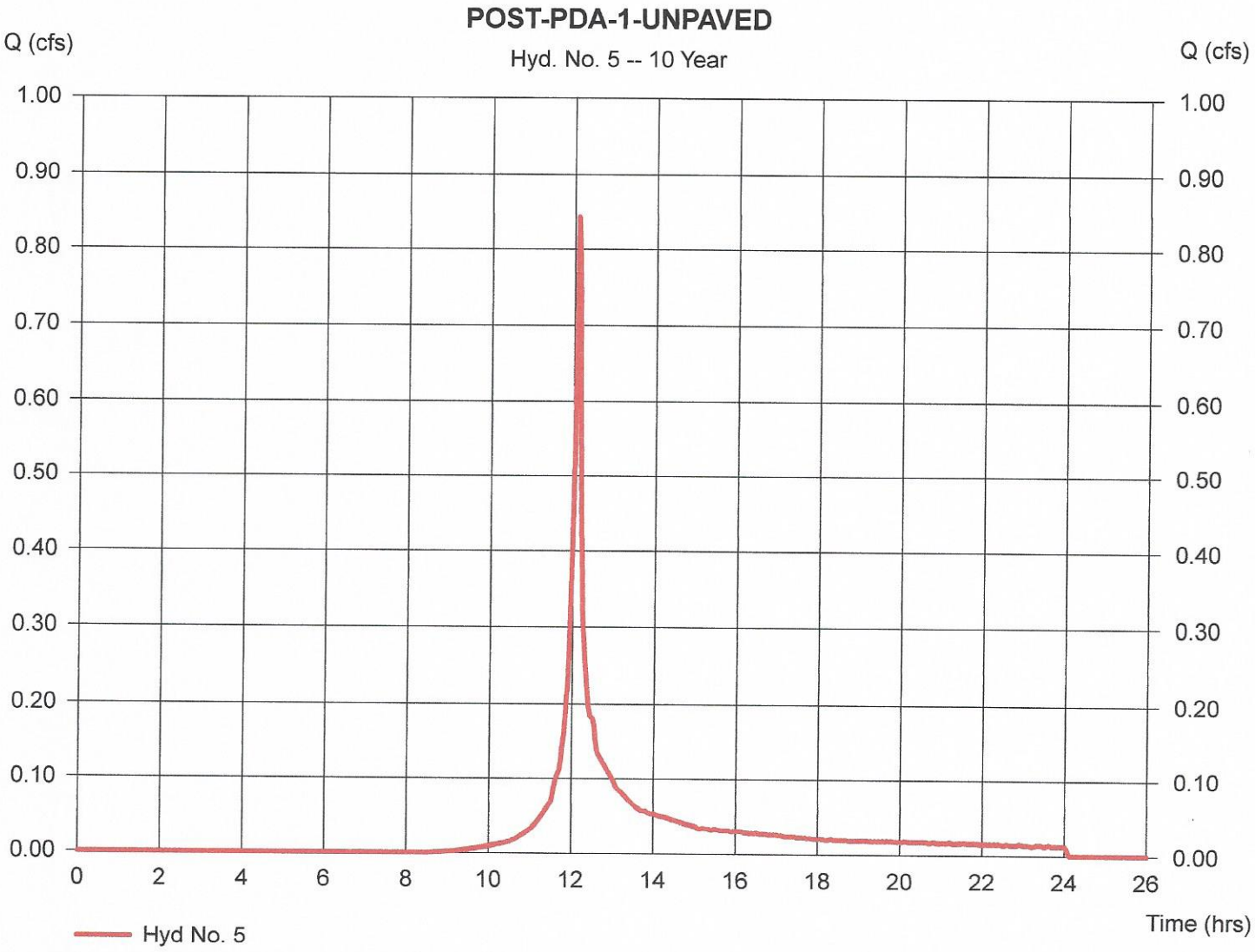
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 5

POST-PDA-1-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.843 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 2,503 cuft
Drainage area	= 0.310 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.01 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



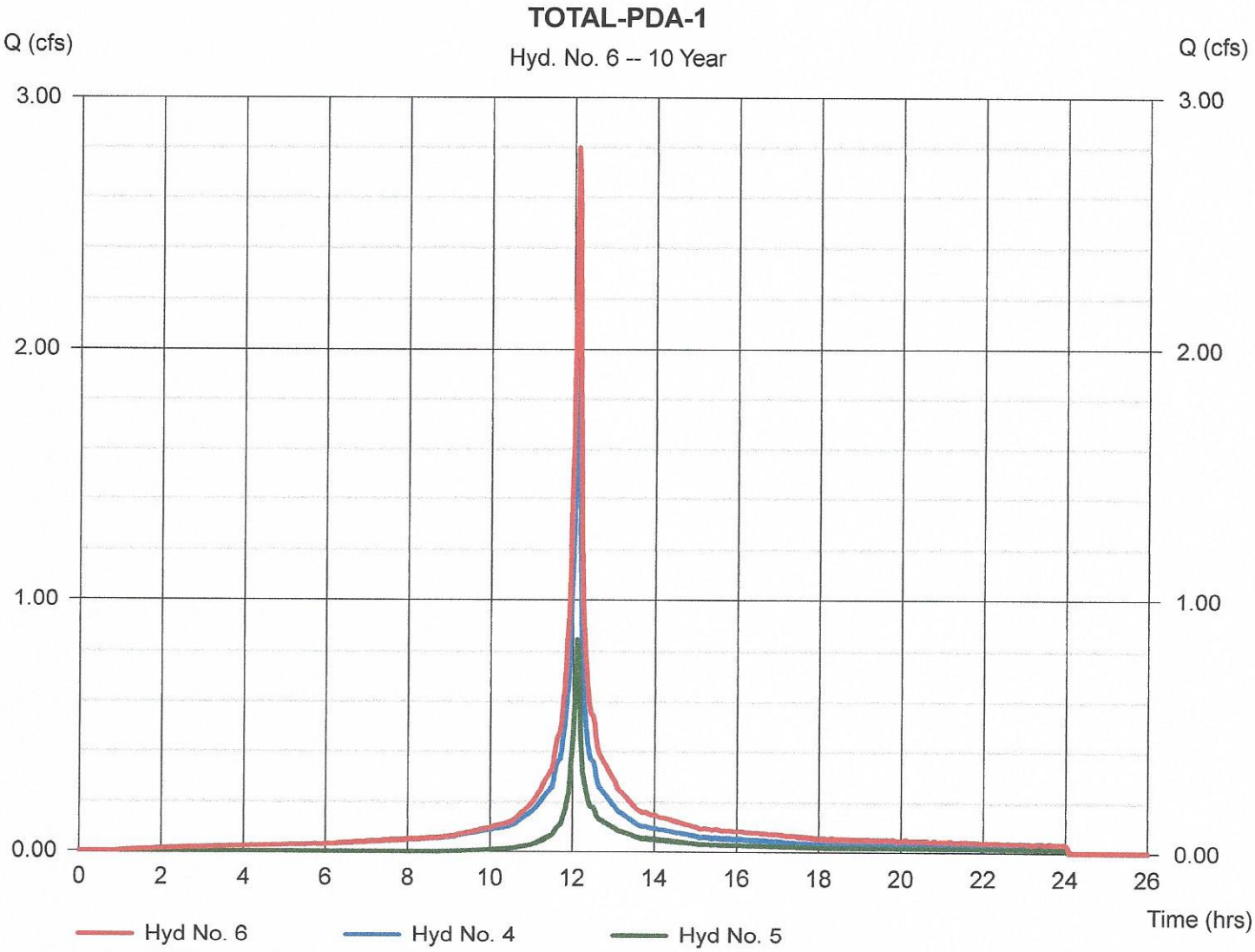
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 6

TOTAL-PDA-1

Hydrograph type	= Combine	Peak discharge	= 2.798 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 9,325 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 0.730 ac



Hydrograph Report

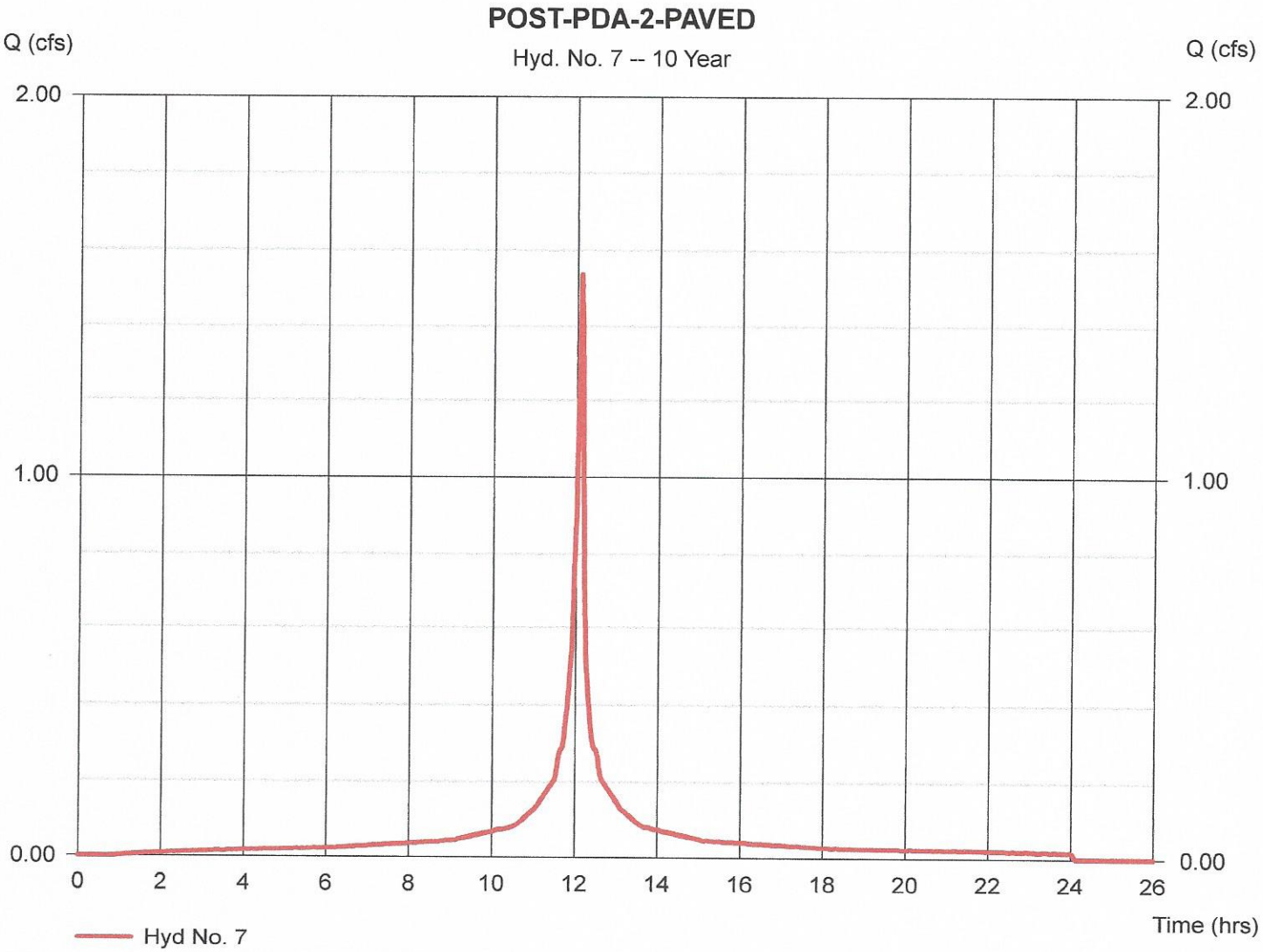
Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 7

POST-PDA-2-PAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.536 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 5,360 cuft
Drainage area	= 0.330 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.01 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 98) + (0.190 x 98) + (0.040 x 98)] / 0.330



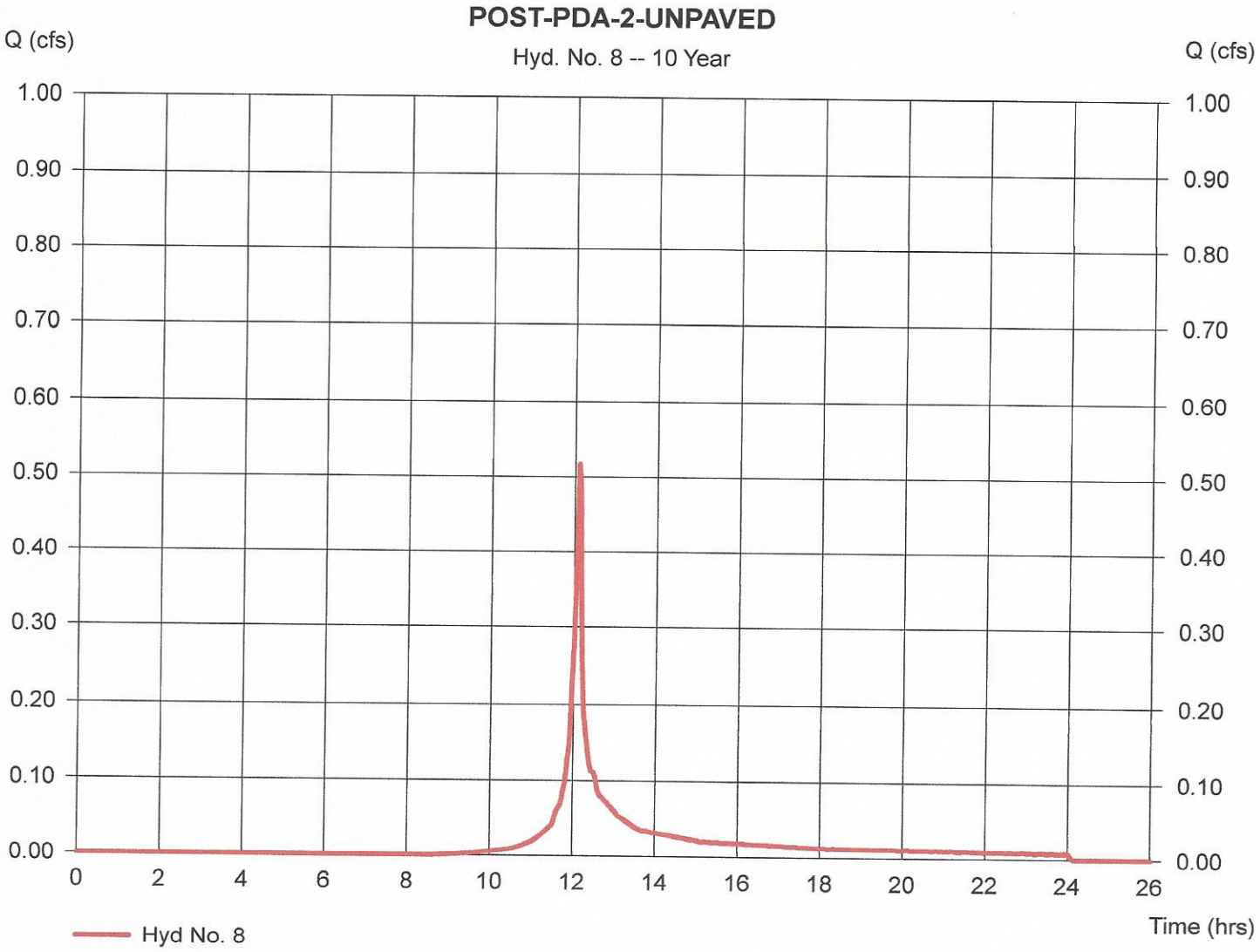
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 8

POST-PDA-2-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.517 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 1,534 cuft
Drainage area	= 0.190 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.01 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



Hydrograph Report

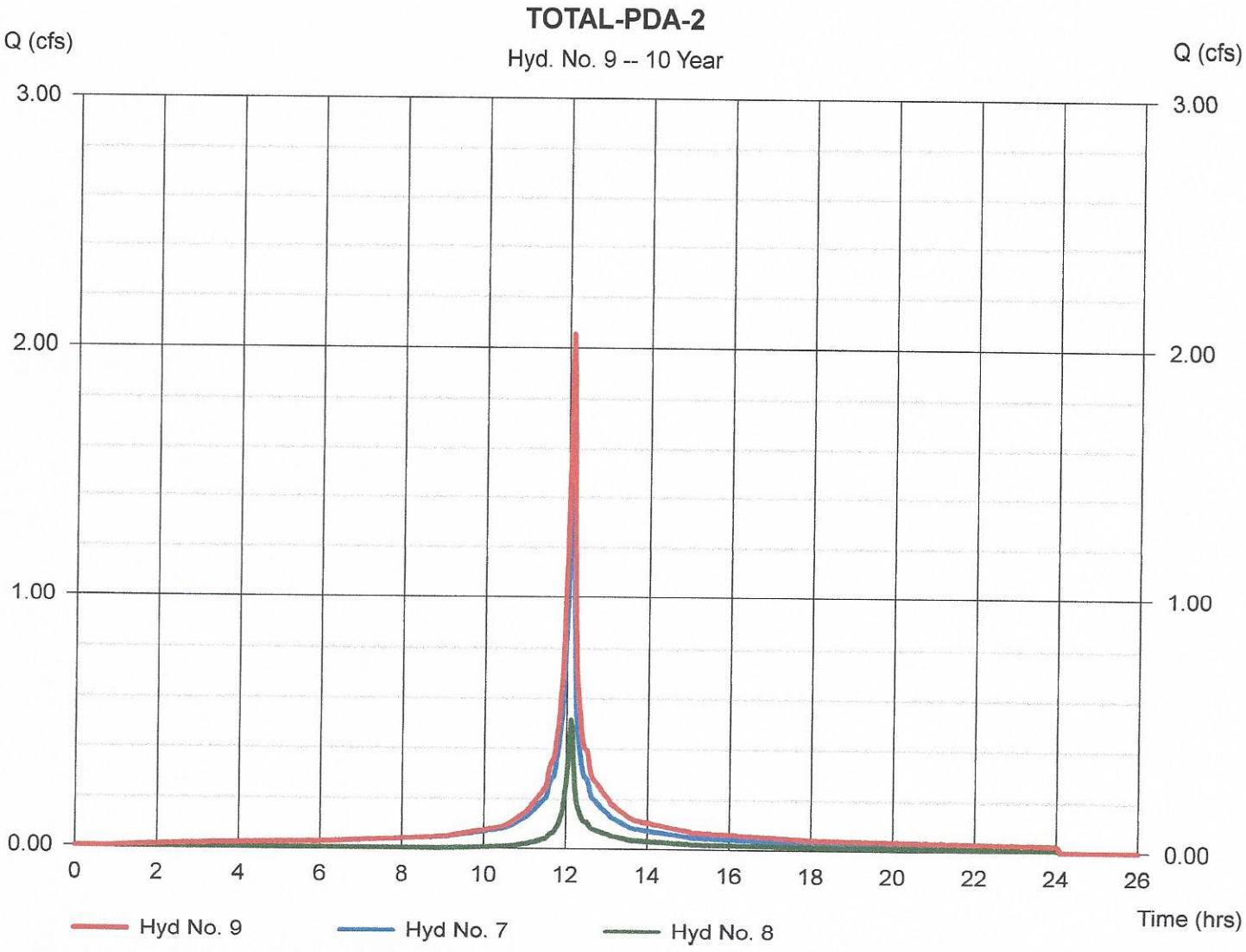
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 9

TOTAL-PDA-2

Hydrograph type	= Combine	Peak discharge	= 2.053 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 6,894 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 0.520 ac



Hydrograph Report

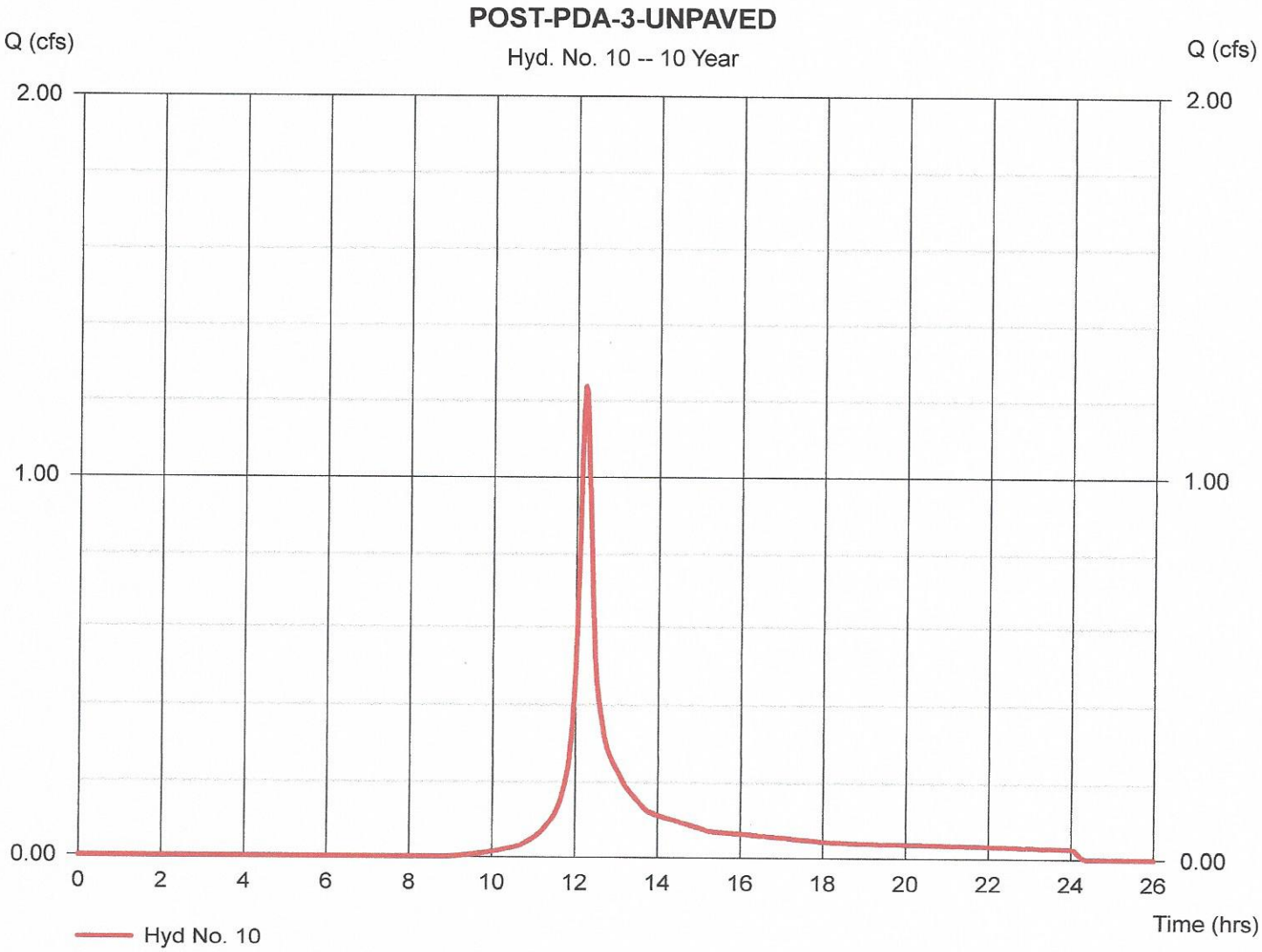
Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 10

POST-PDA-3-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.237 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 5,183 cuft
Drainage area	= 0.640 ac	Curve number	= 73*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.70 min
Total precip.	= 5.01 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.150 x 70) + (0.490 x 74)] / 0.640



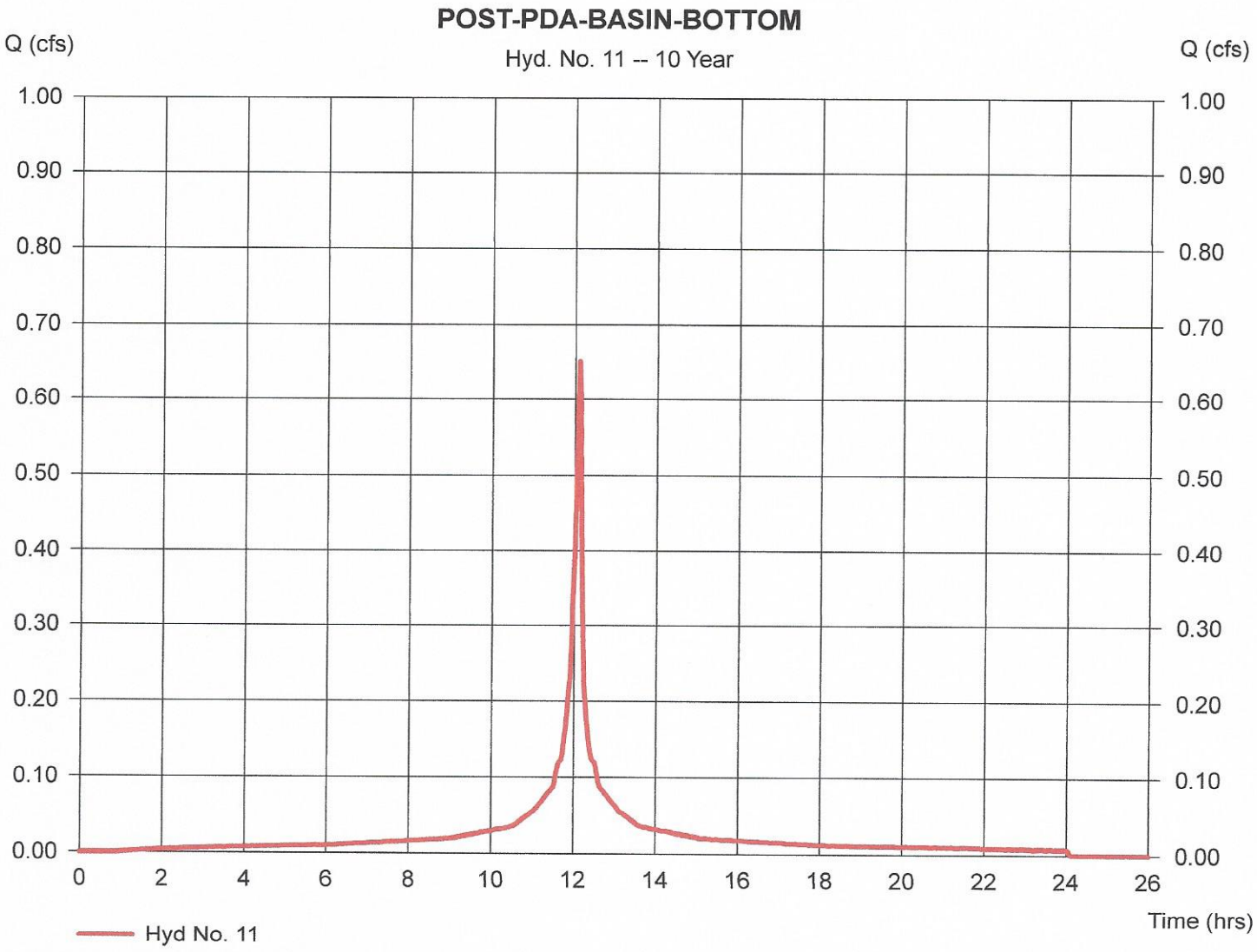
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 11

POST-PDA-BASIN-BOTTOM

Hydrograph type	= SCS Runoff	Peak discharge	= 0.652 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 2,274 cuft
Drainage area	= 0.140 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.01 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



Hydrograph Report

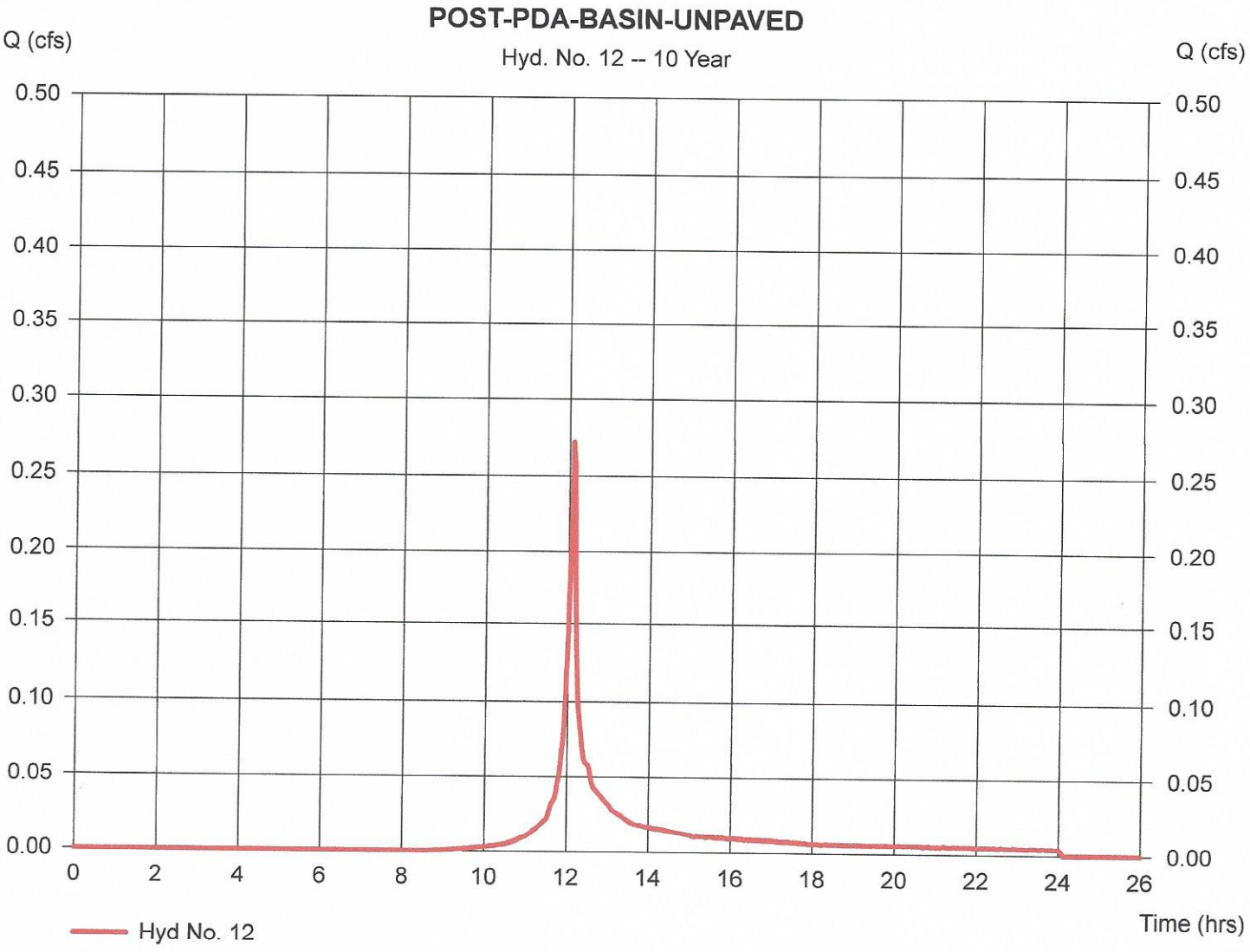
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 12

POST-PDA-BASIN-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.272 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 807 cuft
Drainage area	= 0.100 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.01 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



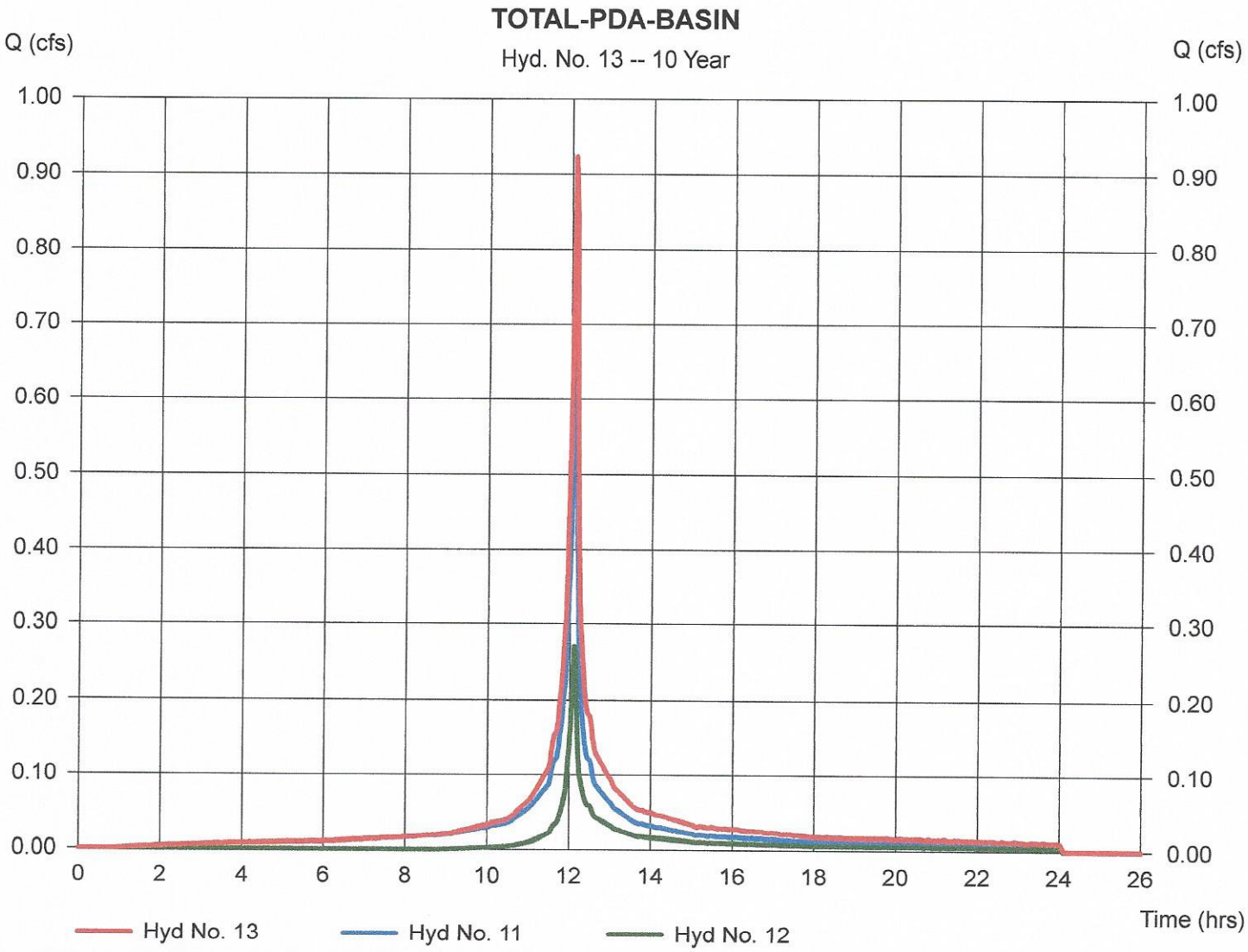
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 13

TOTAL-PDA-BASIN

Hydrograph type	= Combine	Peak discharge	= 0.924 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 3,081 cuft
Inflow hyds.	= 11, 12	Contrib. drain. area	= 0.240 ac



Hydrograph Report

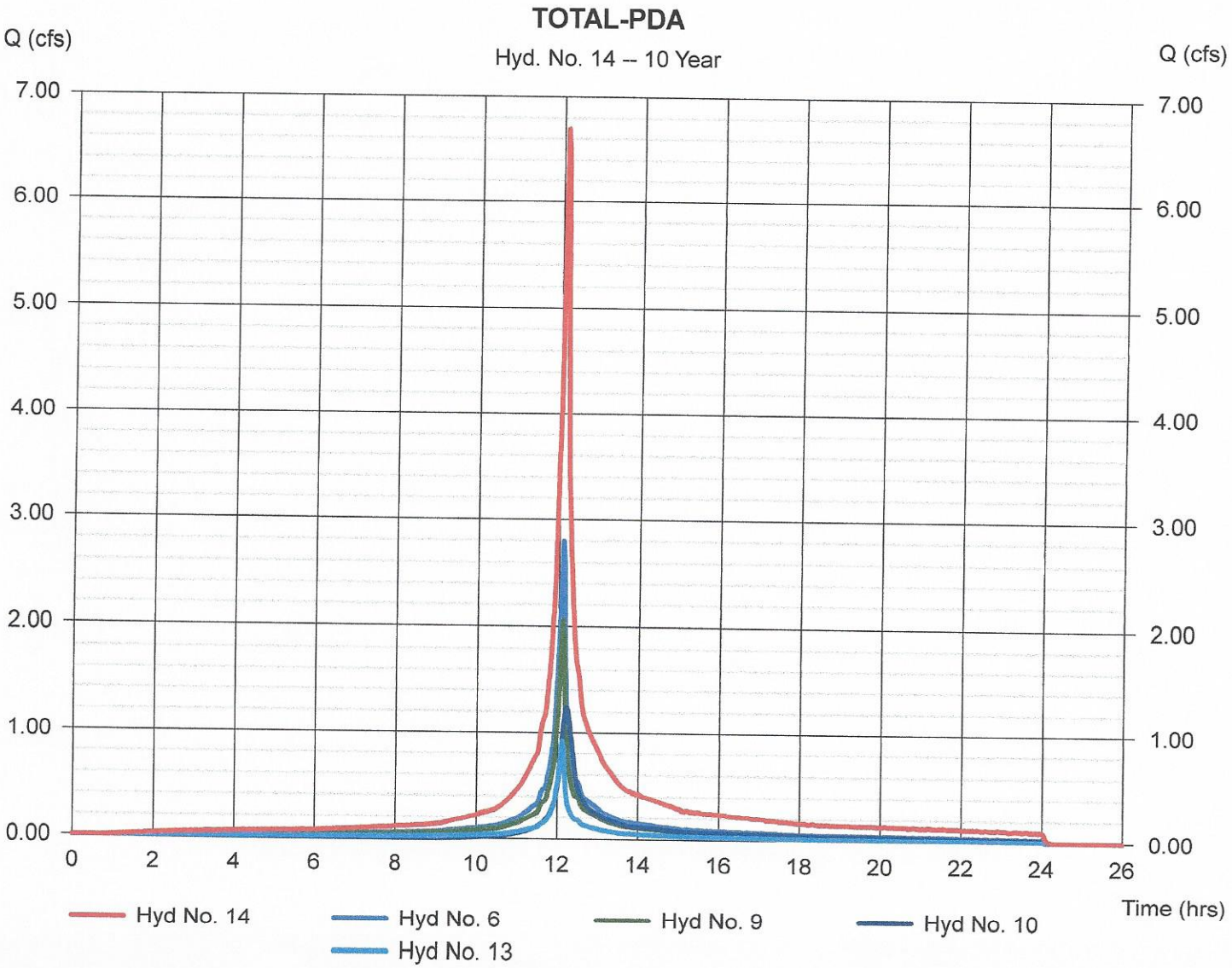
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 14

TOTAL-PDA

Hydrograph type	= Combine	Peak discharge	= 6.699 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 24,484 cuft
Inflow hyds.	= 6, 9, 10, 13	Contrib. drain. area	= 0.640 ac



Hydrograph Report

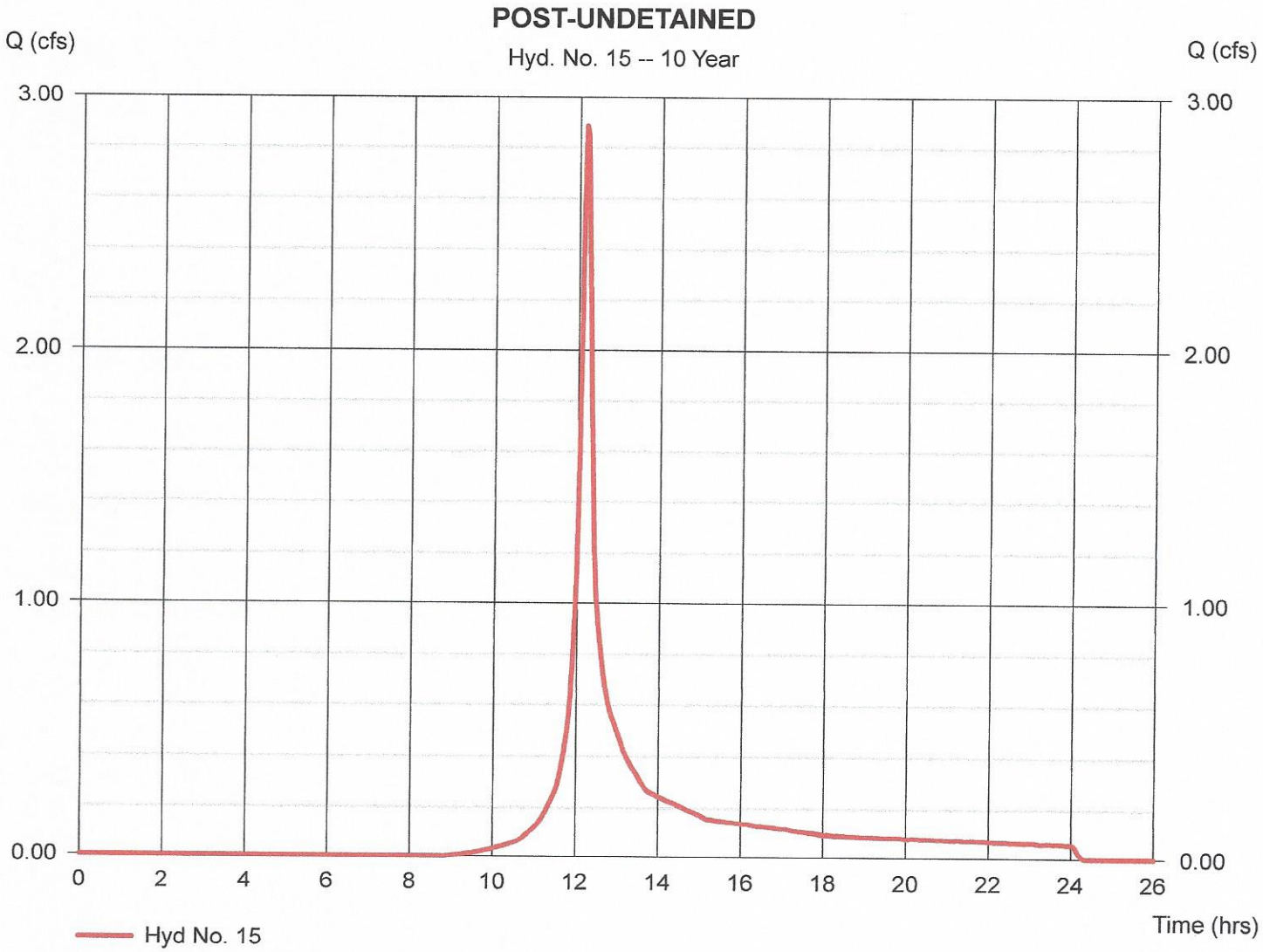
Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 15

POST-UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 2.885 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 11,307 cuft
Drainage area	= 1.320 ac	Curve number	= 73*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.00 min
Total precip.	= 5.01 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.190 x 70) + (1.130 x 74)] / 1.320



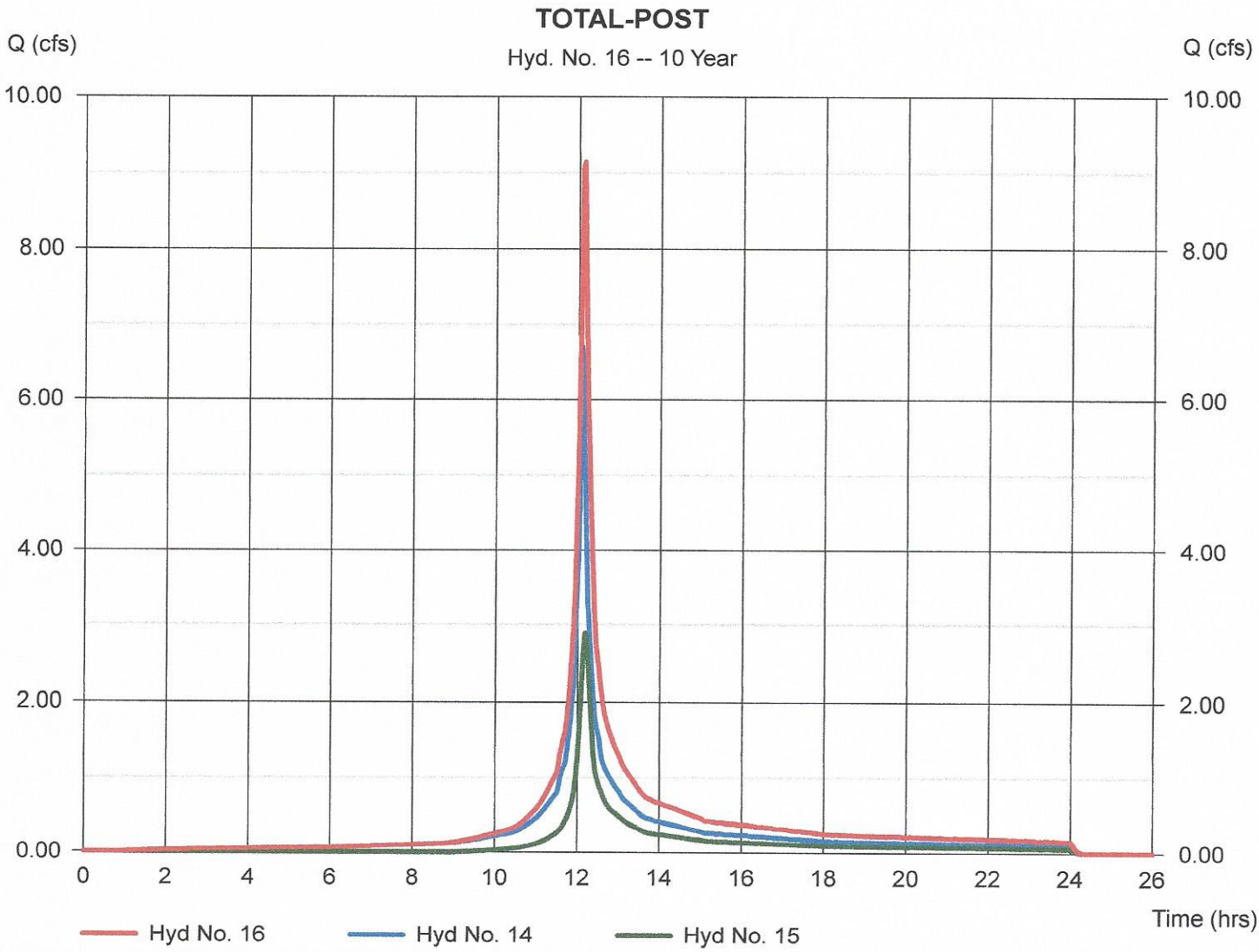
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 16

TOTAL-POST

Hydrograph type	= Combine	Peak discharge	= 9.135 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 35,791 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 1.320 ac



Hydrograph Report

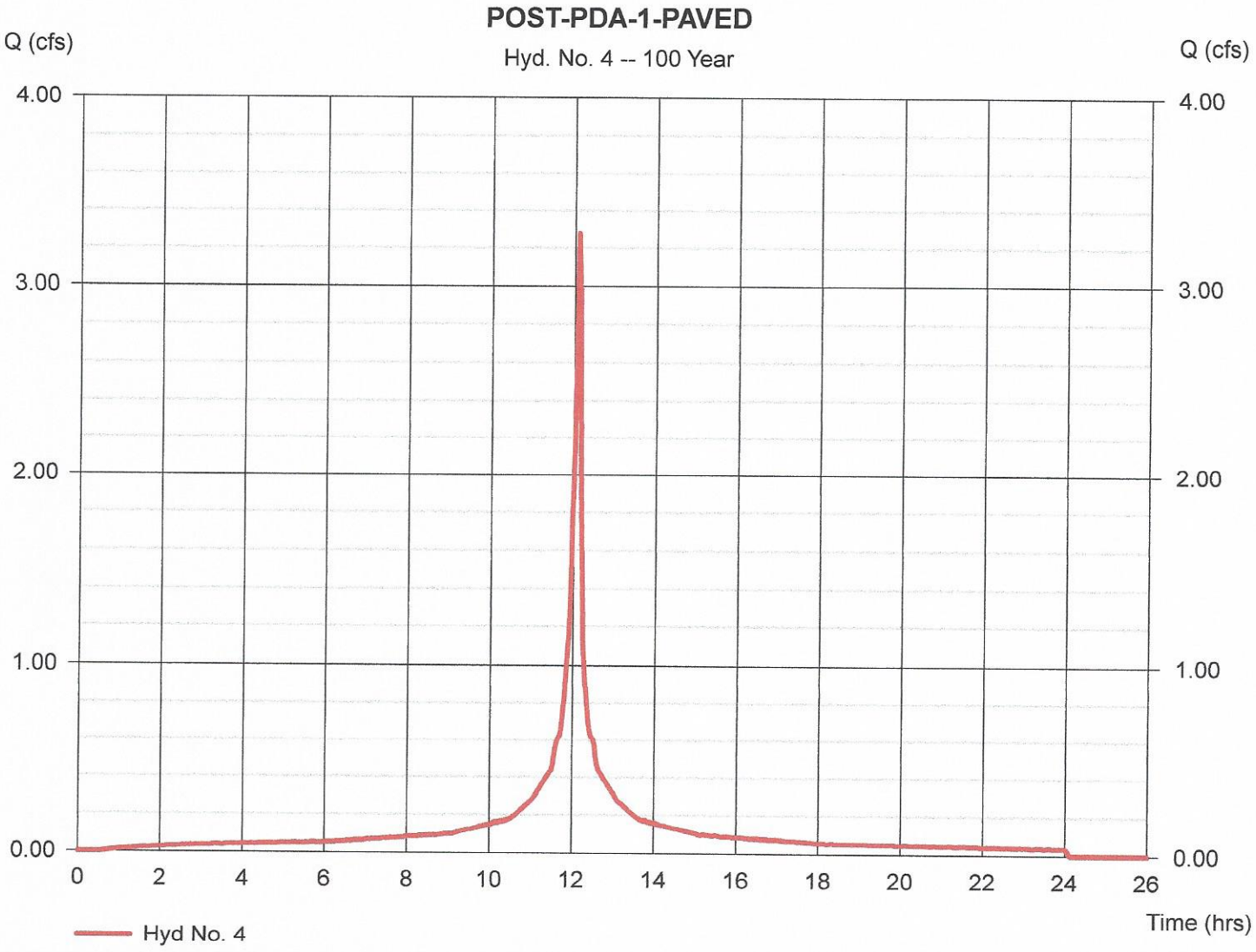
Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 4

POST-PDA-1-PAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 3.278 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 11,620 cuft
Drainage area	= 0.420 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.37 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 98) + (0.200 x 98) + (0.050 x 98)] / 0.420



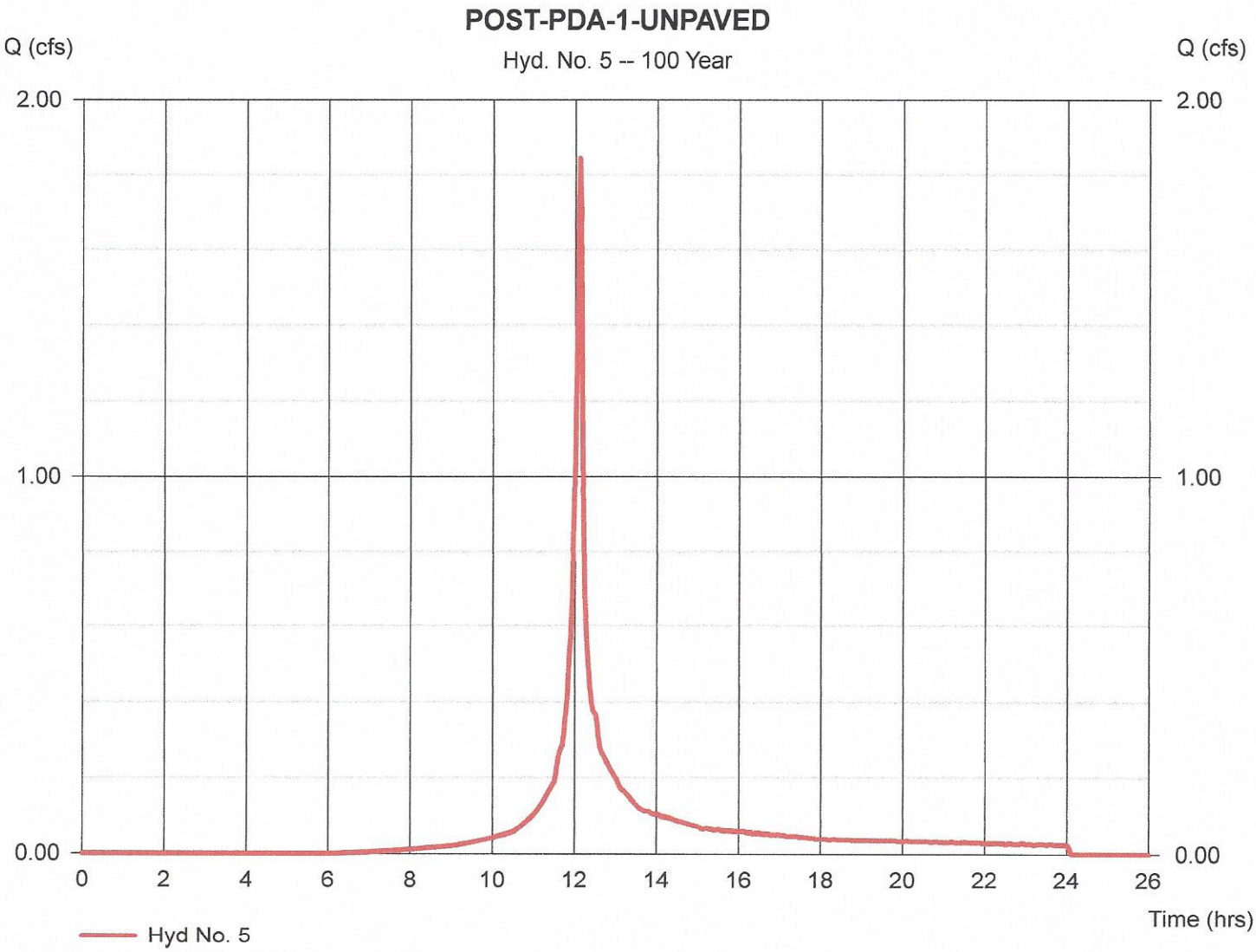
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 5

POST-PDA-1-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.844 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 5,547 cuft
Drainage area	= 0.310 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.37 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



Hydrograph Report

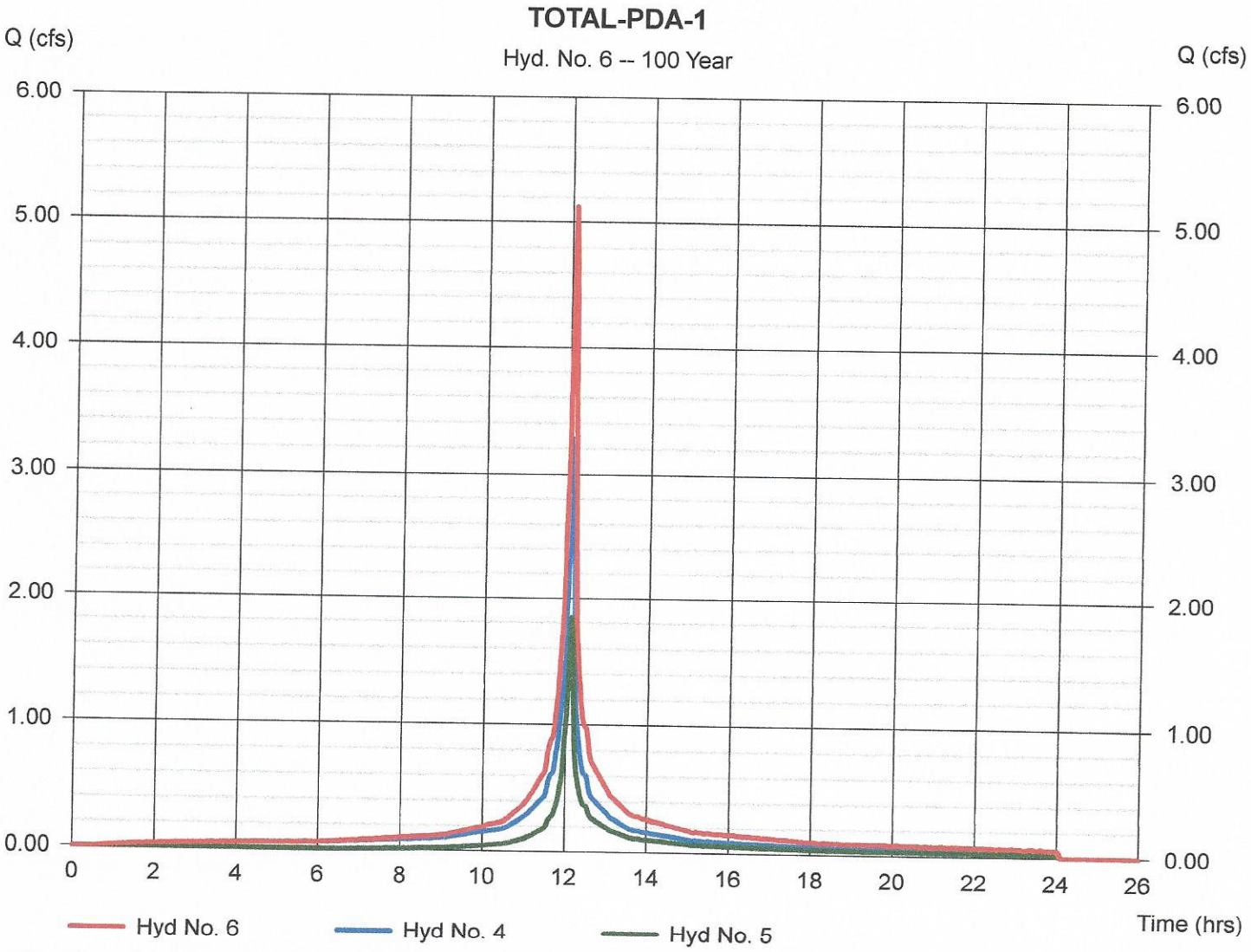
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 6

TOTAL-PDA-1

Hydrograph type	= Combine	Peak discharge	= 5.122 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 17,167 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 0.730 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

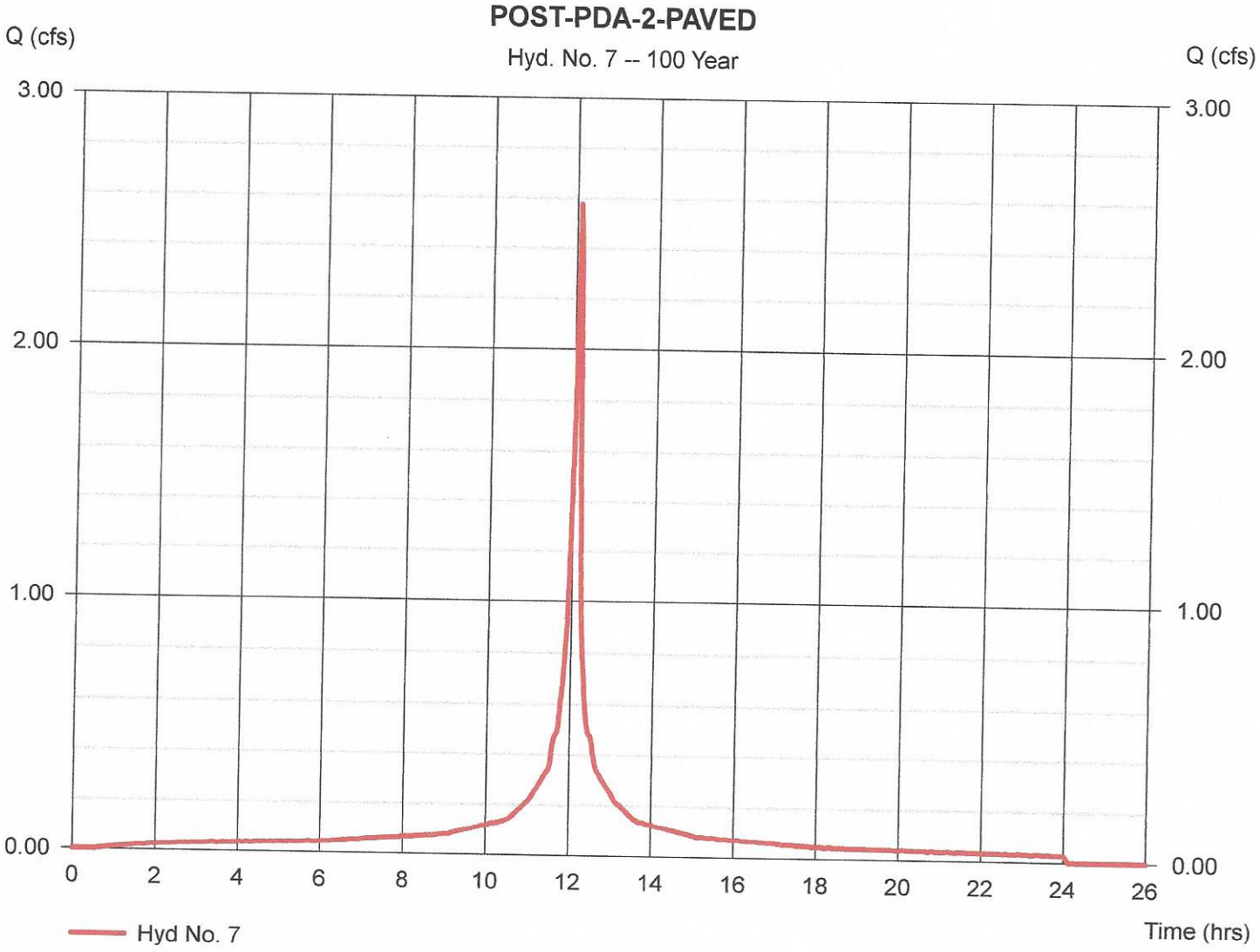
Tuesday, Nov 2, 2021

Hyd. No. 7

POST-PDA-2-PAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 2.576 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 9,130 cuft
Drainage area	= 0.330 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.37 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.100 x 98) + (0.190 x 98) + (0.040 x 98)] / 0.330



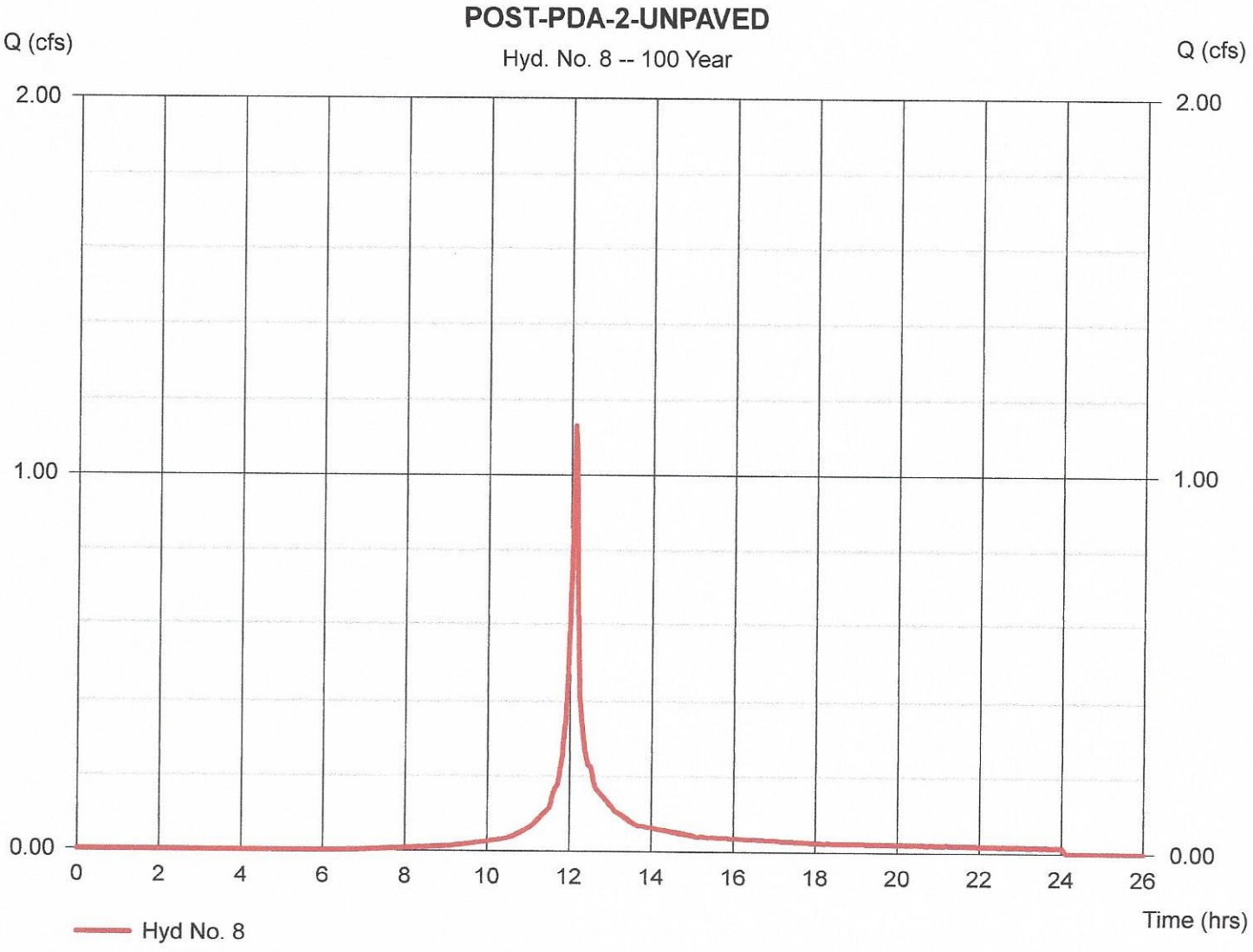
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 8

POST-PDA-2-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 1.130 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 3,400 cuft
Drainage area	= 0.190 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.37 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



Hydrograph Report

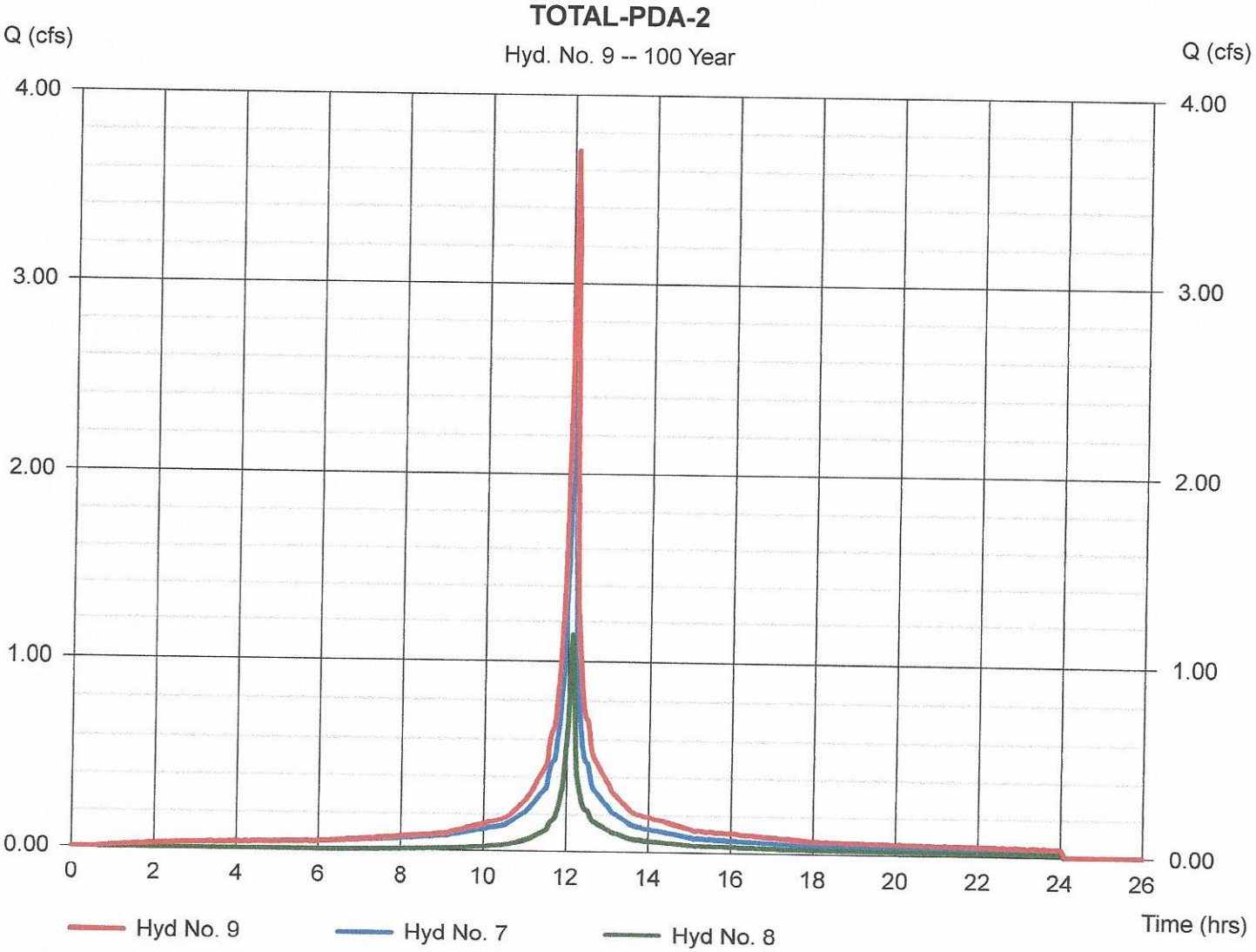
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 9

TOTAL-PDA-2

Hydrograph type	= Combine	Peak discharge	= 3.705 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 12,530 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 0.520 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

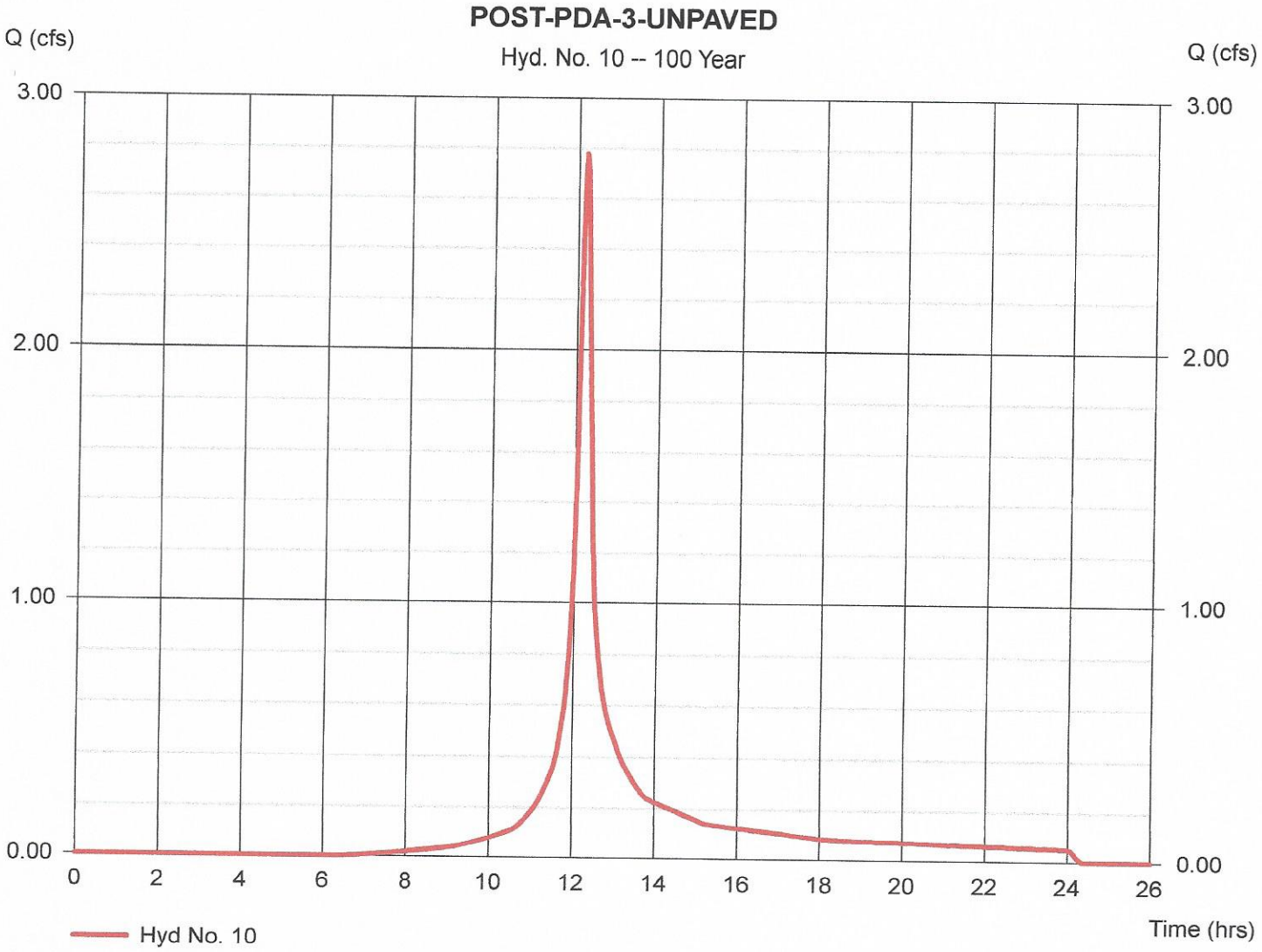
Tuesday, Nov 2, 2021

Hyd. No. 10

POST-PDA-3-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 2.779 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 11,641 cuft
Drainage area	= 0.640 ac	Curve number	= 73*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.70 min
Total precip.	= 8.37 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.150 x 70) + (0.490 x 74)] / 0.640



Hydrograph Report

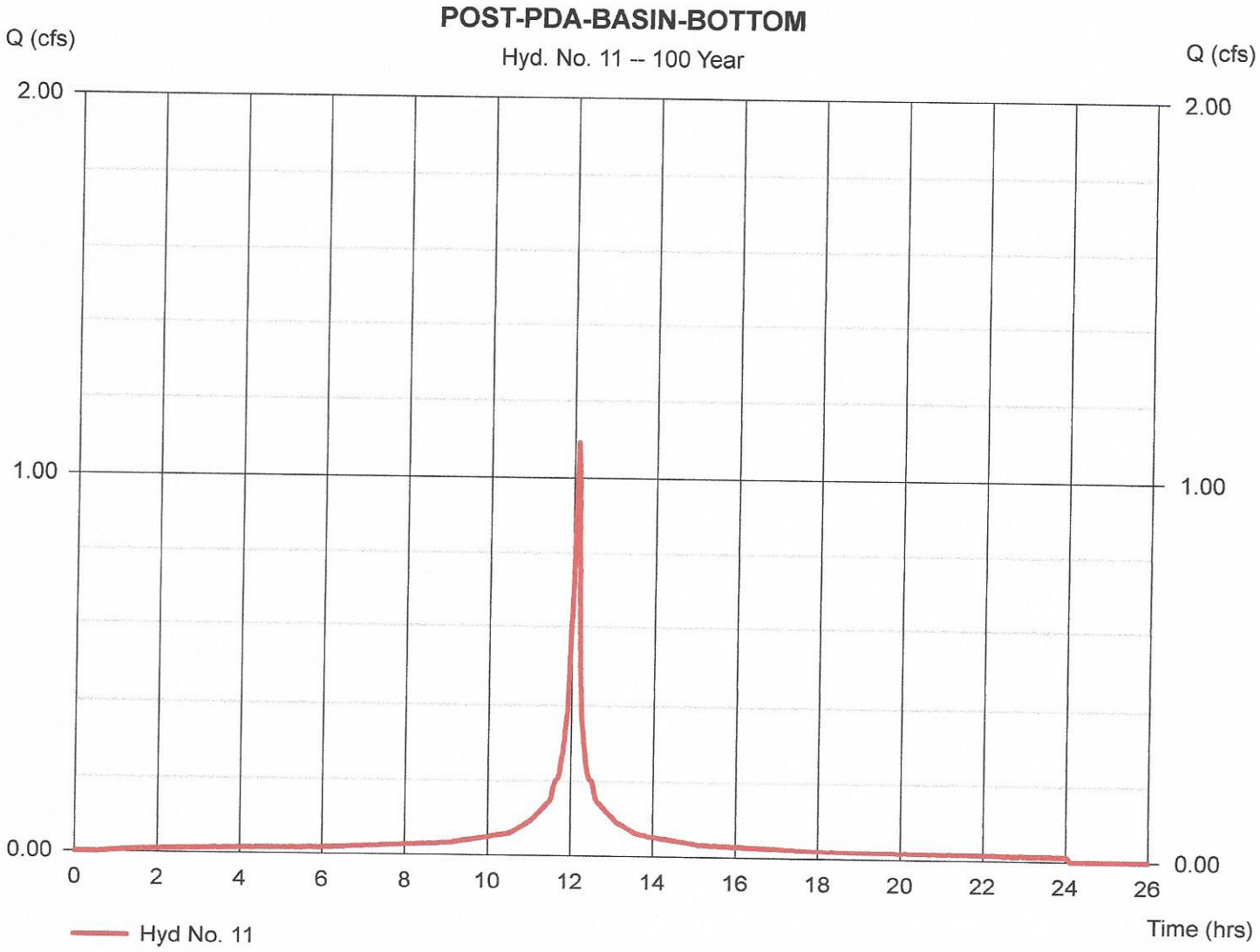
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 11

POST-PDA-BASIN-BOTTOM

Hydrograph type	= SCS Runoff	Peak discharge	= 1.093 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 3,873 cuft
Drainage area	= 0.140 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.37 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



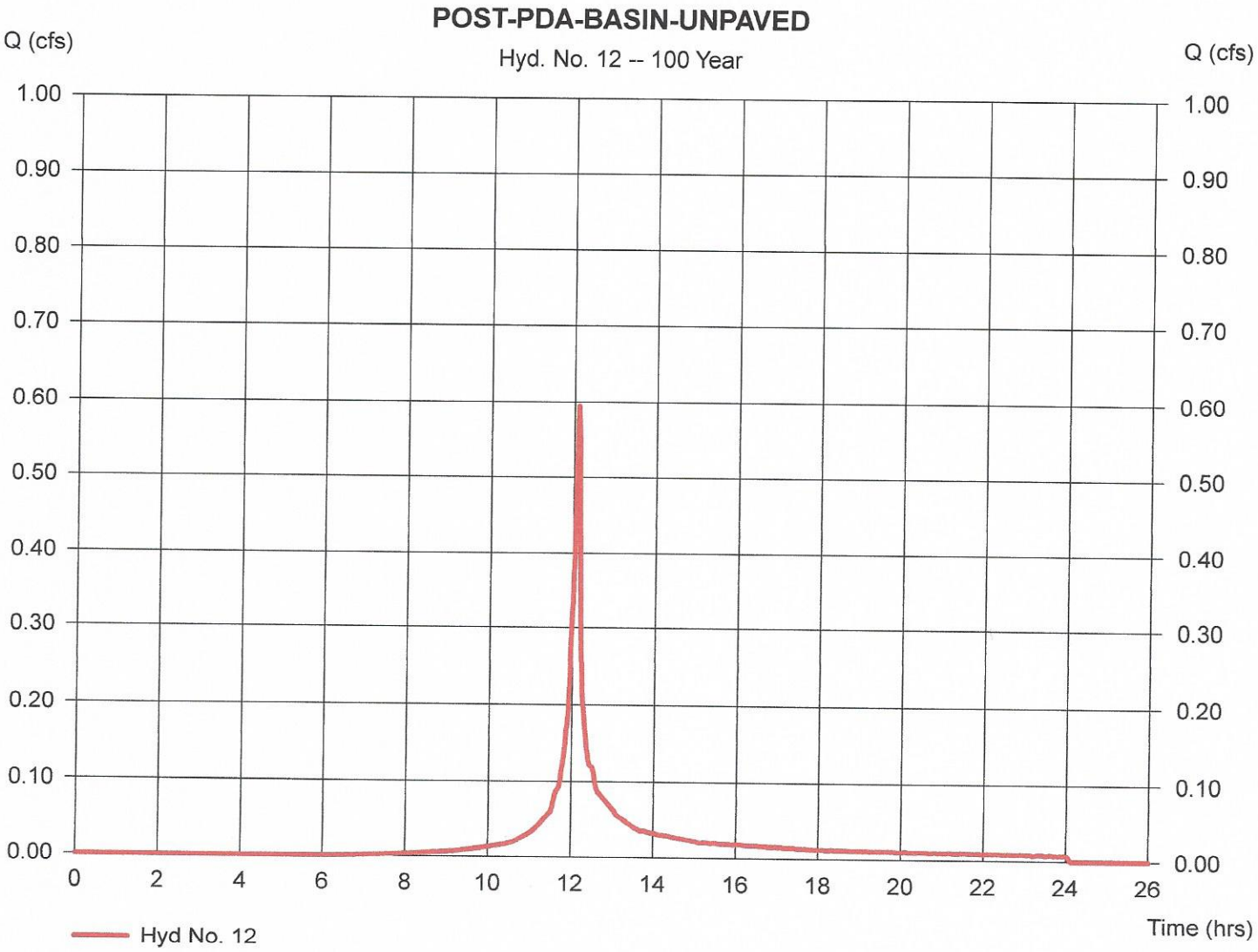
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 12

POST-PDA-BASIN-UNPAVED

Hydrograph type	= SCS Runoff	Peak discharge	= 0.595 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 1,789 cuft
Drainage area	= 0.100 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.37 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484



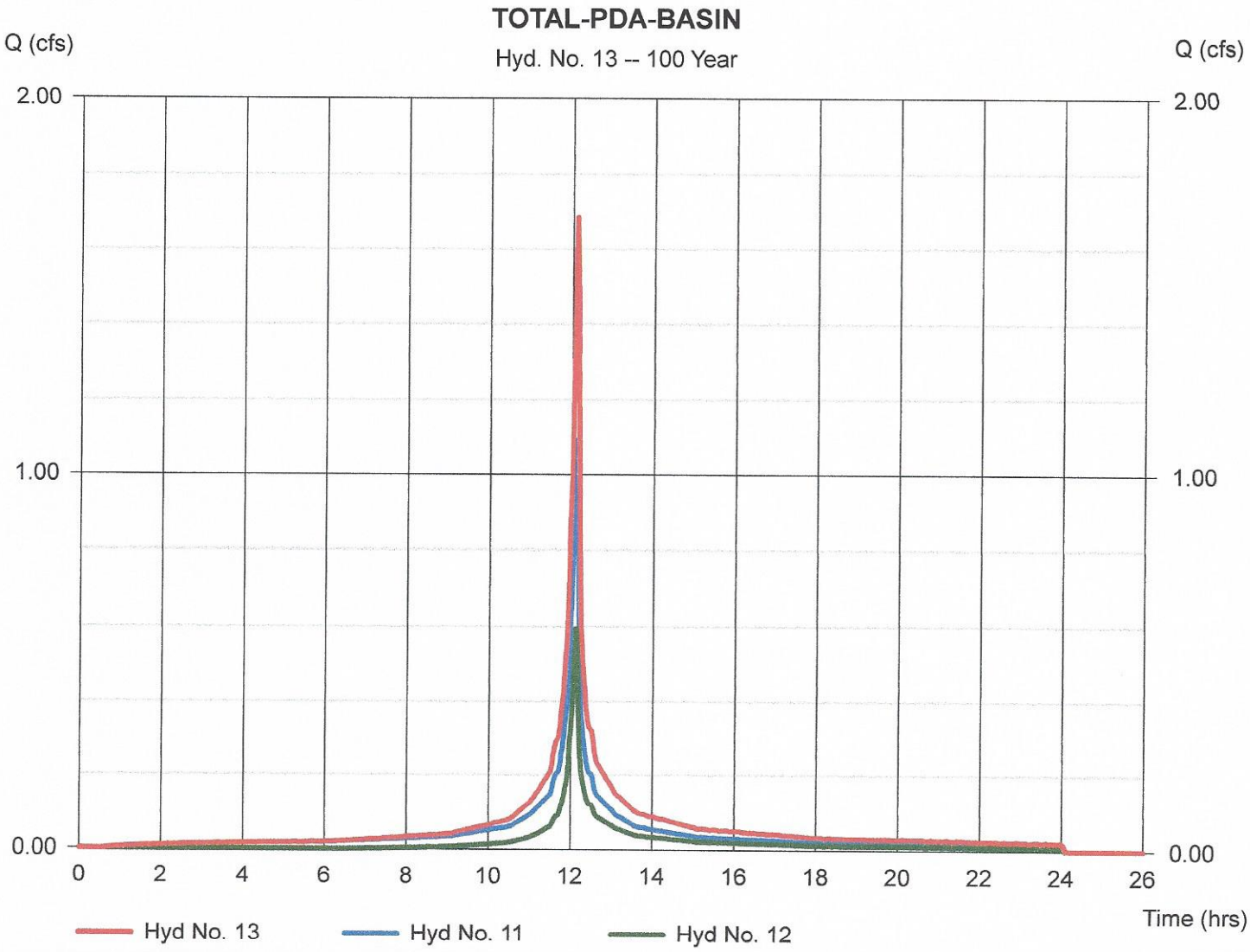
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Hyd. No. 13

TOTAL-PDA-BASIN

Hydrograph type	= Combine	Peak discharge	= 1.687 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 5,663 cuft
Inflow hyds.	= 11, 12	Contrib. drain. area	= 0.240 ac



Hydrograph Report

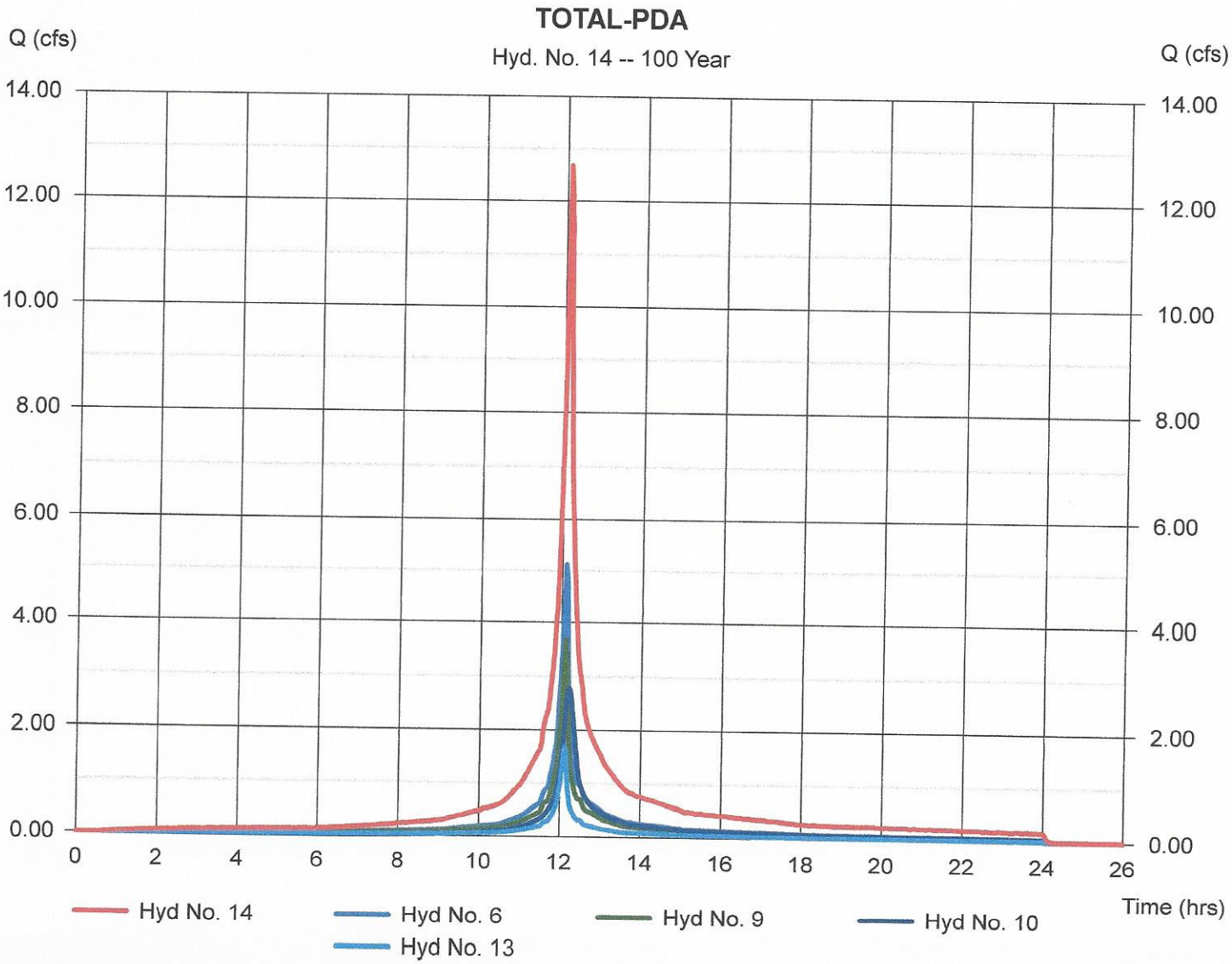
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 14

TOTAL-PDA

Hydrograph type	= Combine	Peak discharge	= 12.67 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 47,001 cuft
Inflow hyds.	= 6, 9, 10, 13	Contrib. drain. area	= 0.640 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.01

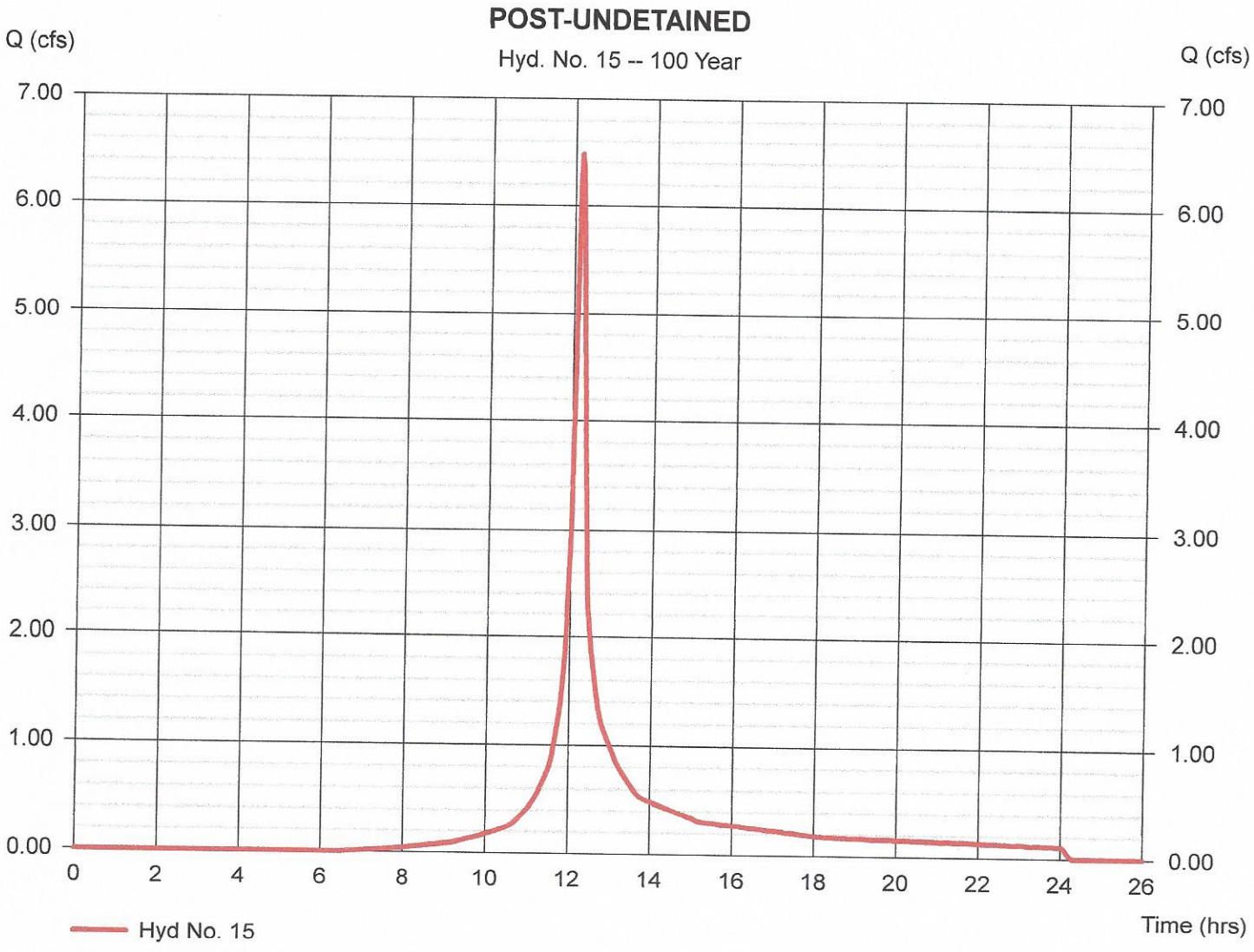
Tuesday, Nov 2, 2021

Hyd. No. 15

POST-UNDETAINED

Hydrograph type	= SCS Runoff	Peak discharge	= 6.481 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 25,394 cuft
Drainage area	= 1.320 ac	Curve number	= 73*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.00 min
Total precip.	= 8.37 in	Distribution	= Custom
Storm duration	= 24hr-NOAA_Type D.CDS	Shape factor	= 484

* Composite (Area/CN) = [(0.190 x 70) + (1.130 x 74)] / 1.320



Hydrograph Report

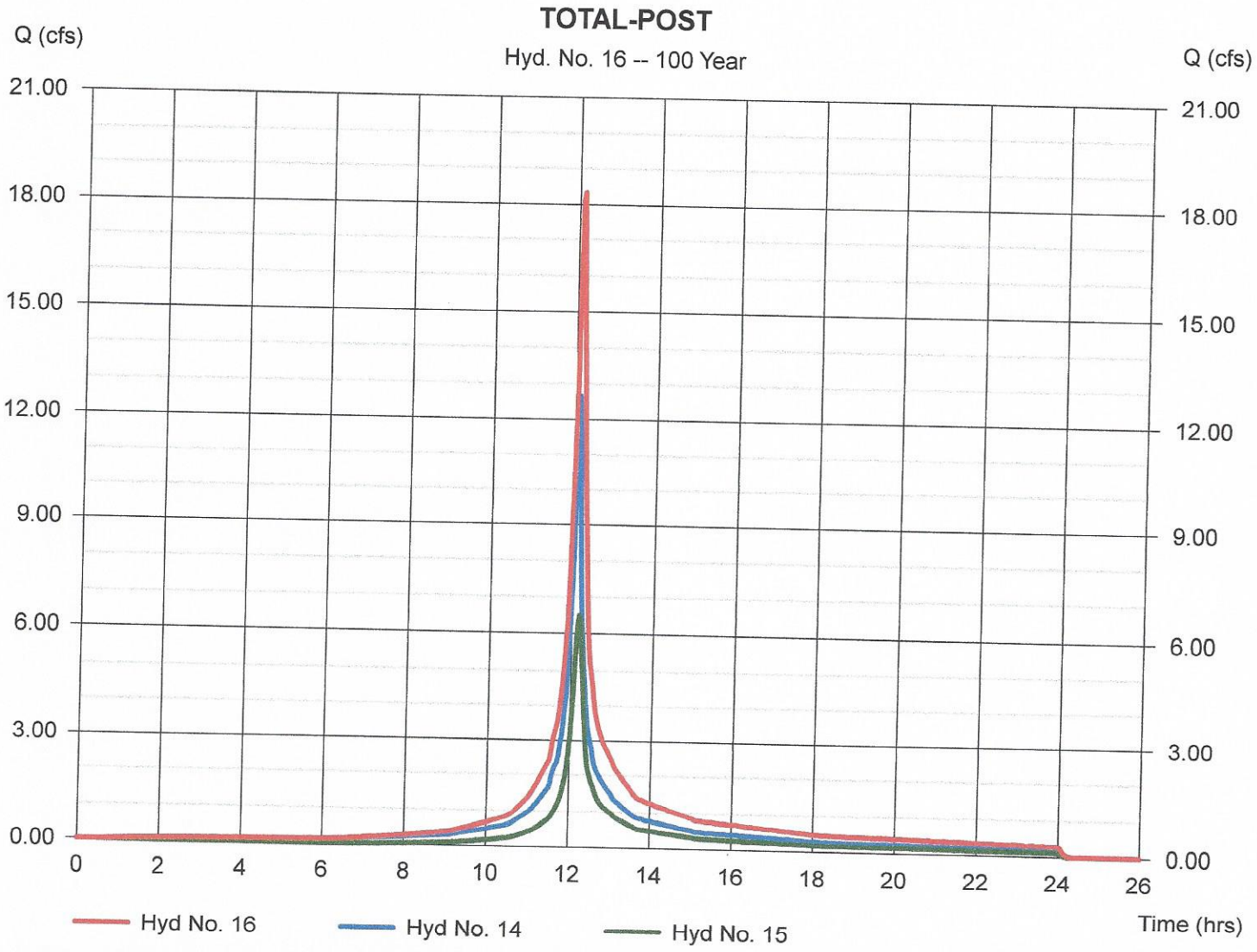
Hydraflow Hydrographs by Intelisolve v9.01

Tuesday, Nov 2, 2021

Hyd. No. 16

TOTAL-POST

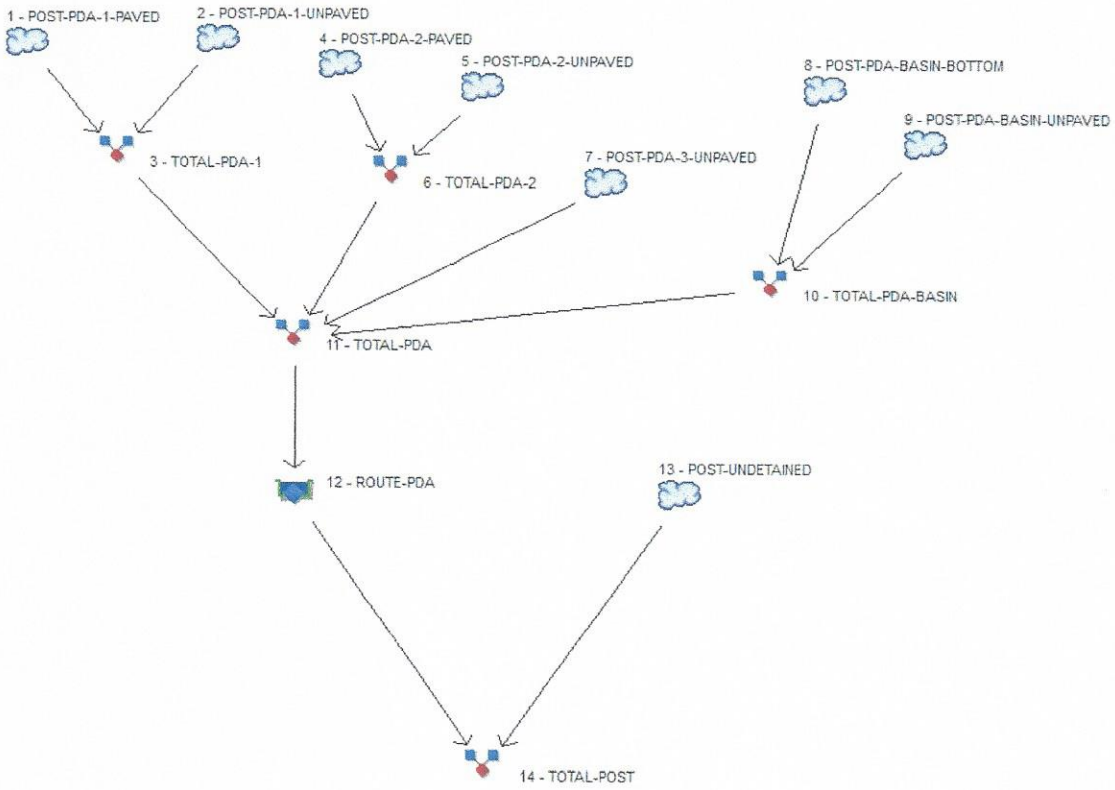
Hydrograph type	= Combine	Peak discharge	= 18.35 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 72,395 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 1.320 ac



APPENDIX 4

POND ROUTING

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	POST-PDA-1-PAVED
2	SCS Runoff	POST-PDA-1-UNPAVED
3	Combine	TOTAL-PDA-1
4	SCS Runoff	POST-PDA-2-PAVED
5	SCS Runoff	POST-PDA-2-UNPAVED
6	Combine	TOTAL-PDA-2
7	SCS Runoff	POST-PDA-3-UNPAVED
8	SCS Runoff	POST-PDA-BASIN-BOTTOM
9	SCS Runoff	POST-PDA-BASIN-UNPAVED
10	Combine	TOTAL-PDA-BASIN
11	Combine	TOTAL-PDA
12	Reservoir	ROUTE-PDA
13	SCS Runoff	POST-UNDETAINED
14	Combine	TOTAL-POST

TR55 Tc Worksheet

Hyd. No. 7

POST-PDA-3-UNPAVED

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.150	0.011	0.011	
Flow length (ft)	= 100.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.29	0.00	0.00	
Land slope (%)	= 1.25	0.00	0.00	
Travel Time (min)	**= 11.66 +**	**0.00 +**	**0.00 =**	**11.66**
Shallow Concentrated Flow				
Flow length (ft)	= 250.00	0.00	0.00	
Watercourse slope (%)	= 0.70	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 1.35	0.00	0.00	
Travel Time (min)	**= 3.09 +**	**0.00 +**	**0.00 =**	**3.09**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	**= 0.00 +**	**0.00 +**	**0.00 =**	**0.00**

Total Travel Time, Tc ..... 14.70 min

TR55 Tc Worksheet

Hyd. No. 13

POST-UNDETAINED

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.400	0.150	0.011	
Flow length (ft)	= 22.0	88.0	0.0	
Two-year 24-hr precip. (in)	= 3.29	3.29	0.00	
Land slope (%)	= 2.27	9.75	0.00	
Travel Time (min)	**= 6.00 +**	**4.63 +**	**0.00 =**	**10.62**
Shallow Concentrated Flow				
Flow length (ft)	= 95.00	0.00	0.00	
Watercourse slope (%)	= 5.49	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	= 3.78	0.00	0.00	
Travel Time (min)	**= 0.42 +**	**0.00 +**	**0.00 =**	**0.42**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	= 0.00	0.00	0.00	
Flow length (ft)	= 0.0	0.0	0.0	
Travel Time (min)	**= 0.00 +**	**0.00 +**	**0.00 =**	**0.00**

Total Travel Time, Tc ..... 11.00 min

Pond Report

Hydraflow Hydrographs by Intelisolve v9.01 — Tuesday, Nov 2, 2021

Pond No. 1 - INFIL-BASIN

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 165.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	165.00	5,858	0	0
1.00	166.00	5,858	5,857	5,857
2.00	167.00	5,858	5,857	11,715
3.00	168.00	5,858	5,857	17,572
4.00	169.00	5,858	5,857	23,430
5.00	170.00	5,858	5,857	29,287

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	2.50	0.00	0.00
Span (in)	= 15.00	2.50	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 163.00	167.00	0.00	0.00
Length (ft)	= 18.00	0.00	0.00	0.00
Slope (%)	= 3.50	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	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 1.75	0.00	0.00	0.00
Crest El. (ft)	= 167.80	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet and outlet control. Weir risers are checked for orifice conditions.