
Parkside Master Plan

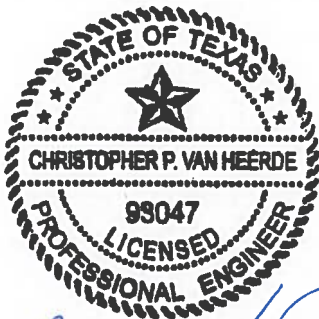
A distinguished project by:

Continental Homes of Texas, LP

Job No. 031.059

Preliminary Drainage Report

New Braunfels, Texas
November 2018



Chris Van Heerde, PE
11/19/18

Prepared by:



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1.0 General Information

HMT Engineering and Surveying has been retained by Continental Homes of Texas, LP to provide professional engineering services for the future development Parkside Subdivision located in the City of New Braunfels, Texas (Reference Attachment A). The entire tract is 220.84 acres of which 22.85 acres is used agriculturally and containing one single family residential home and three other buildings. The remainder 197.99 acres of the site is currently undeveloped and is proposed to be developed into a residential subdivision. The property is not within the 100-year floodplain, according to FEMA Flood Insurance Rate Map (FIRM) Number 4817C0120F date November 2, 2007 (Reference Attachment B). This report addresses the hydrology and hydraulics of the Parkside Subdivision.

The City of New Braunfels Drainage and Erosion Control Manual revised January 2018 was used for this analysis.

2.0 Hydrology Methodology Rational Method

The peak storm water runoff calculations were determined using the Soil Conservation Method as described in the City of New Braunfels Drainage and Erosion Control Manual. The time of concentration was calculated using sheet flow, shallow concentrated flow, and channel flow. The length of overland sheet flow conditions is limited to a maximum of 100 feet. The time of travel for sheet flow conditions is calculated using Manning's kinematic solution (Overtop and Meadows 1976). After 100 feet, the average velocity of the flow is determined using Figure 3-1 of the USDA Technical Release 55 Urban Hydrology for Small Watersheds. The time of travel for concentrated flow conditions is calculated using the equation below:

Sheet Flow

$$\text{Eq 4-4 } T_t = \frac{0.007(nL)^{0.8}}{(P_2^{0.5})(S^{0.4})} * 60$$

For shallow concentrated flow, using the average velocity as described above, the time of travel is calculated using this equation:

Shallow Concentration Flow

$$\text{Eq 4-5 } T_t = \frac{L}{(60)(16.1345)(S^{0.5})} * 60$$

For channelized flow, an estimated peak flow is used to calculate the velocity within the channel cross section for this segment. The time is then calculated using this velocity and the length of flow as shown in Eq 4-8 below.

Channel Flow

$$\text{Eq 4-8 } T_t = \frac{L}{60 * V} * 60$$

The runoff coefficient was determined based on the impervious cover within each sub-watershed. Rainfall intensities were calculated using the time of concentration and constants from Table 3-2

of the City of New Braunfels Drainage and Erosion Control manual for each storm event respectively (reference Attachment E for Hydrology Calculations).

3.0 Existing Conditions Hydrology

The existing site is currently grass/farmland and undeveloped with no existing impervious cover. The existing drainage area is composed of three drainage areas.

- Drainage area EX A consists of 116.38 acres that flows southwestwardly to concentration point EX B where the flow is channelized and discharges from the site into an existing TxDOT channel. There are no existing structures within this drainage area.
- Drainage area EX B consists of 80.47 acres that flows southwardly to concentration point EX B where the water then sheet flows onto the adjacent undeveloped property. There are no existing structures within this drainage area
- Drainage area EX C consists of 39.71 acres that flow southwestwardly to concentration point EX C. There are four existing buildings within the drainage area that is approximately 0.48 acres, and an existing road that is approximately 0.47 acres. These buildings and road are not within the City of New Braunfels City limits. Based on the use of the existing buildings, in our analysis a Curve number of 84 associated with R-1/R-1A Single Family was used for 0.95 acres of existing drainage area EX C. The remainder 38.79 acres was analyzed using the curve number 78 associated with Meadow – continuous grass, protected from grazing and generally mowed for hay.

Please refer to Attachment C for the Existing Drainage Area Map.

In order to be the most conservative with our calculations and because majority of the site is composed of Hydrologic Soil Group D, Soil Group D was assumed for all Curve Numbers. The Cover Description, Hydrologic Soil Group, and Curve Number used in our calculations to determine the weighted Curve Number can be found in the Table below.

Table 4-3: NRCS Runoff Curve Numbers		
Cover Description	Hydrologic Soil Group	Curve Number
R-1/R-1A Single Family	D	84
Meadow - continuous grass, protected from grazing and generally mowed for hay	D	78

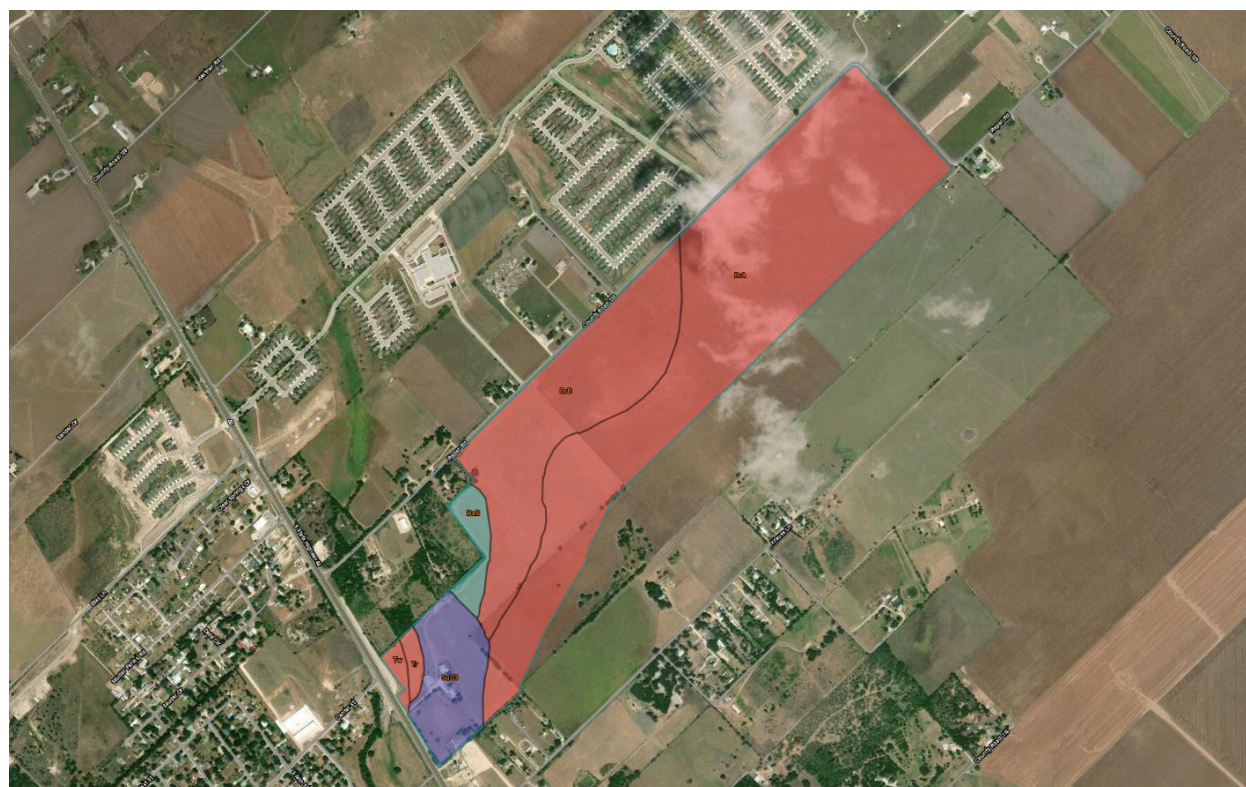
Table 1 - Existing Conditions Hydrology Calculations - City of New Braunfels									
Point of Concentration	Description	Drainage Area	Area	T _c	CN	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EX A	DA A Comparison	EX A	116.38	60.9	78.00	30.24	116.01	188.98	297.75
EX B	DA B Comparison	EX B	80.47	58.7	78.00	30.24	116.01	188.98	297.75
EX C	DA C Comparison	EX C	39.71	46.6	78.14	11.97	45.75	74.35	117.16

4.0 Proposed Conditions Hydrology

The proposed improvements will include residential lots, drainage features, park area, and streets. The Soil Conservation Service (SCS) method was used in this preliminary drainage analysis.

Table 4-2: Manning's "n" for overland flow

Manning's 'n' Value	
Dense Grass (used for existing grass conditions)	0.24
Bermuda Grass (used for proposed/developed grass conditions)	0.41



Summary by Map Unit — Guadalupe County, Texas (TX187)		Summary by Map Unit — Guadalupe County, Texas (TX187)		
Map unit symbol	Map unit name	Rating	Acres in A01	Percent of A01
BaB	Barbarosa silty clay, 1 to 3 percent slopes	C	6.5	2.7%
BrA	Branyon clay, 0 to 1 percent slopes	D	143.1	60.5%
BrB	Branyon clay, 1 to 3 percent slopes	D	61.8	26.1%
SuC3	Sunev loam, 3 to 5 percent slopes, eroded	B	20.9	8.8%
Tr	Tinn clay, 0 to 1 percent slopes, occasionally flooded	D	2.4	1.0%
TW	Tinn clay, 0 to 1 percent slopes, frequently flooded	D	2.0	0.9%
Totals for Area of Interest			236.6	100.0%

In order to be the most conservative with our calculations and because majority of the site is composed of Hydrologic Soil Group D, Soil Group D was assumed for all Curve Numbers. The Cover Description, Hydrologic Soil Group, and Curve Number used in our calculations to determine the weighted Curve Number can be found in the Table below.

Table 4-3: NRCS Runoff Curve Numbers		
Cover Description	Hydrologic Soil Group	Curve Number
C-3 Commercial	D	95
R-1/R-1A Single Family	D	84

The proposed site has been divided into three major drainage areas; DA A, DA B, and DA C. With further analysis in the future these drainage areas will be further broken down and analyzed in order to ensure street capacity, storm drain network sizing.

- Drainage area DA A consists of 121.74 acres that flow southwestwardly to concentration point A. There are several different improvements proposed within this drainage area in order to convey the water to Detention Basin A such as; Channel A1, Channel A2, Inlets and a storm drain pipe network. All water in drainage area DA A will eventually enter into the Detention Basin A where the storm water will be detained and released at a flow rate equal to or less than existing conditions. Detention Basin A releases into an existing TxDOT Channel. Please refer to Attachment D for the proposed drainage area map.
- Drainage area DA B consists of 75.11 acres that flow southerly to concentration point B. All water in drainage area DA B will eventually enter into the Detention Basin B where the water will be detained and released at a flow rate equal to or less than existing conditions. Detention Basin B releases into an adjacent undeveloped area with a broad low; therefore, the basin has been designed to spread the water back to existing conditions flow type where it then flows onto the adjacent property. Please refer to Attachment D for the proposed drainage area map.
- Drainage area DA C consists of 39.71 acres that flow southwestwardly to concentration point C. A portion of this drainage area is not within the City of New Braunfels City Limits, however, the Future Land use plan shows this tract as commercial. Therefore, in our analysis a Curve number of 95 associated with C-3 Commercial was used for entire area of drainage area DA C. The Parkside development will not include detention for any future development of any area within drainage area DA C, including the 22.85 acre tract. It will be the responsibility of the developer of the 22.85 acre tract to size their own detention and drainage facilities.

Table 2 - Proposed Conditions Hydrology Calculations - City of New Braunfels									
Point of Concentration	Description	Drainage Area	Area	T _c	CN	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
A	EX A Comparison	DA A	142.08	41.78	84.00	114.35	266.86	397.16	538.47
B	EX B Comparison	DA B	54.77	30.01	84.00	54.91	124.59	175.78	248.49
C	EX C Comparison	DA C	39.71	46.57	95.00	36.10	76.35	105.74	147.51

Table 3 - Detention Basin A Summary				
	Q ₂	Q ₁₀	Q ₂₅	Q ₁₀₀
Detention Basin Release Rate	13.81	106.95	166.1	271.14
Storage (cuft)	470,767	672,206	1,171,924	1,534,713

Table 4 - Detention Basin B Summary				
	Q ₂	Q ₁₀	Q ₂₅	Q ₁₀₀
Detention Basin Release Rate	7.32	24.54	40.42	65.80
Storage (cuft)	160,083	361,624	504,579	698,401

Table 5 - Existing to Proposed Comparison					
Point of Concentration	Drainage Area	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EXA	EXA	30.24	116.01	188.98	297.75
Detention Basin A Release Rate	A	13.81	106.95	166.10	271.14
Proposed is Less Than or Equal to Existing		YES	YES	YES	YES
Point of Concentration	Drainage Area	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EXB	EXB	11.97	45.75	74.35	117.16
Detention Basin B Release Rate	B	7.32	24.54	40.42	65.80
Proposed is Less Than or Equal to Existing		YES	YES	YES	YES
Point of Concentration	Drainage Area	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EXC	EXC	11.97	45.75	74.35	117.16
DA C	C	36.10	76.35	105.74	147.51
Proposed is Less Than or Equal to Existing		NO	NO	NO	NO

Detention for drainage area DA C will be provided by the developer of the 22.85 acre tract.

5.0 Hydraulics

The proposed residential development will contain storm drains and channels with adequate capacity to convey the proposed storm water runoff. Future analysis of this project contained more detailed calculations for the 2, 10, 25, and 100-year storm peak flows.

6.0 Detention

A preliminary design for Detention Basins A, B, and C was completed to ensure that the necessary land area was set aside for their final design. Based on our calculations, we have provided sufficient volume for adequate water quality treatment and have provided sufficient capacity within the extended detention basins for the 2-, 10-, 25-, and 100-year storm events. Furthermore, the basin are releasing at a lower flow rate than existing conditions; therefore, there is no fee-in-lieu of detention expected on this project.

Detention Basins A, B, and C were analyzed using the SCS method within the program Hydraflow Hydrograph. A summary of the storage volumes and resulting flows are shown in Tables 3, 4, 5 and 6 above. The Detention Basin calculations can be found in Attachment F.

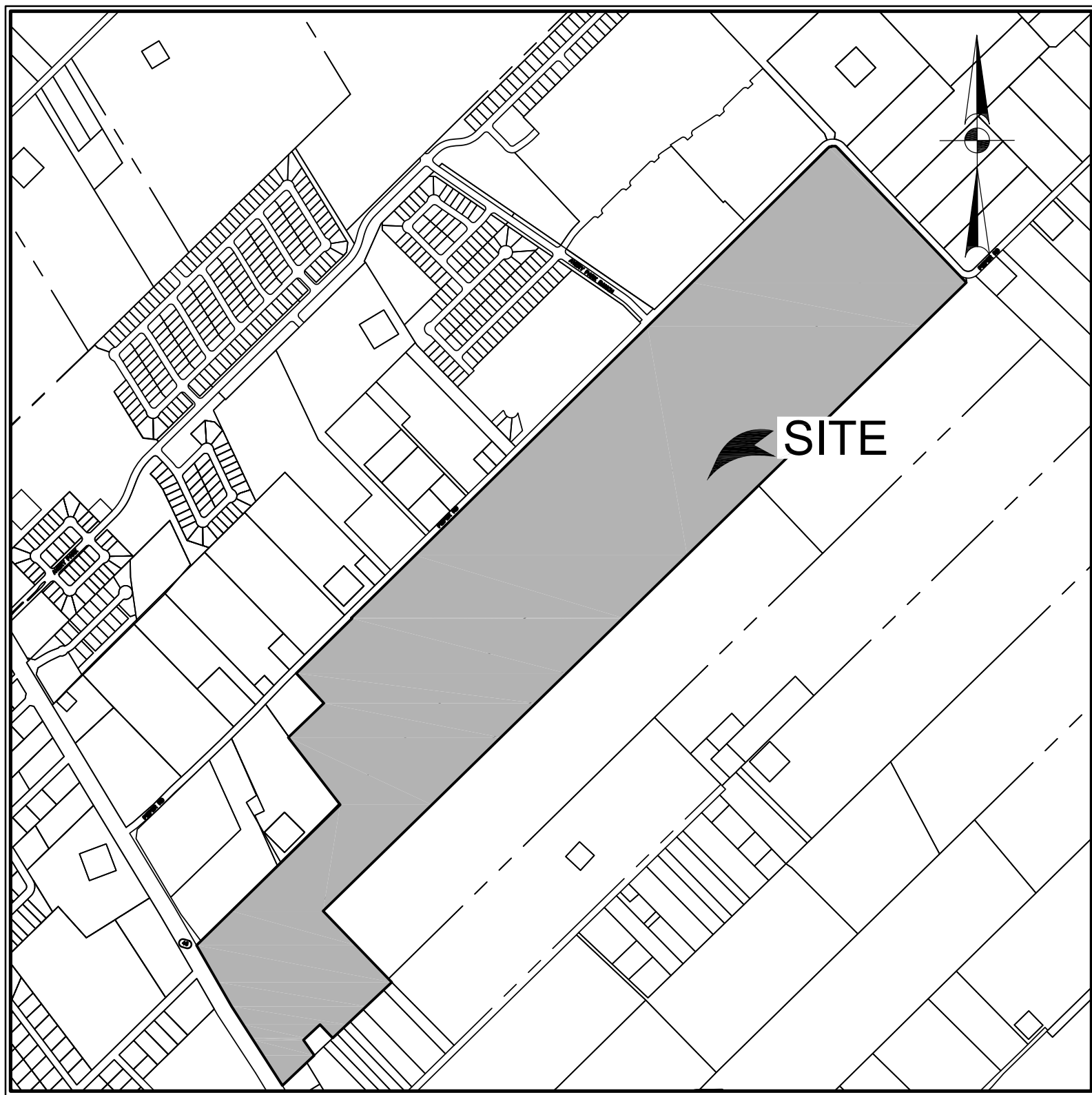
Detention for drainage area DA C is based on a commercial land use on the reserve lot. The detention basin design and final sizing will be determined at the time of development of that parcel which is not known at this time.

7.0 Conclusion

The preliminary proposed drainage improvements for the Parkside Subdivision was analyzed for the 2, 10, 25, and 100-year storm events and will be further analyzed in the future. This analysis was performed in accordance with the City of New Braunfels Drainage and Erosion Control Manual revised January 2018.

Attachment A

Location Map

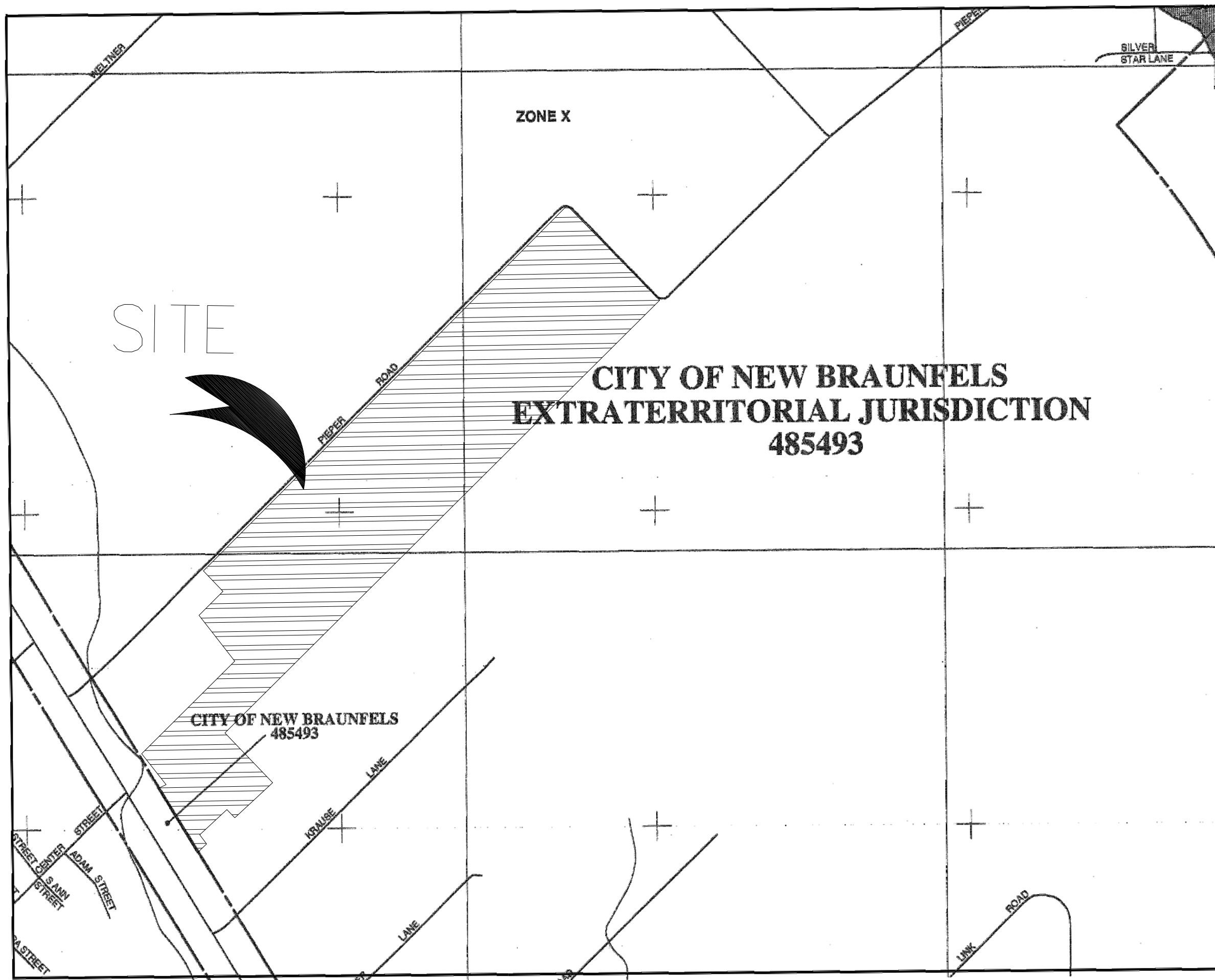


PROJECT LOCATION MAP

SCALE: N.T.S.

Attachment B

FEMA FIRM Map



MAP SCALE 1" = 1000'
500 0 1000 2000 FEET

FIRM
FLOOD INSURANCE RATE MAP
GUADALUPE COUNTY,
TEXAS
AND INCORPORATED AREAS

PANEL 120 OF 480
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GUADALUPE COUNTY	480288	0120	F
NEW BRAUNFELS, CITY OF	485493	0120	F

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.



MAP NUMBER
48187C0120F
EFFECTIVE DATE
NOVEMBER 2, 2007

Federal Emergency Management Agency

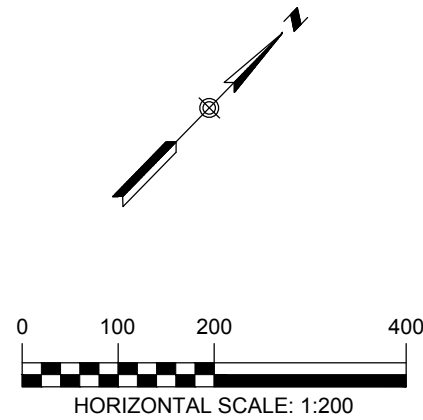
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.nema.fema.gov

Attachment C

Existing Drainage Area Map

Drawing Name: N:_Projects\031 - DR Norton\031.059 - 175 Ac. Friesenhahn Feasibility & Master Plan\Mass\031.059_PRELIM DRNG.dwg User: chrissh Nov 19, 2018 - 1:52pm

Table 1 - Existing Conditions Hydrology Calculations - City of New Braunfels									
Point of Concentration	Description	Drainage Area	Area	T _c	CN	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EX A	DA A Comparison	EX A	116.38	60.9	0.00	30.24	116.01	188.98	297.75
EX B	DA B Comparison	EX B	80.47	58.7	0.00	30.24	116.01	188.98	297.75
EX C	DA C Comparison	EX C	39.71	46.6	0.00	11.97	45.75	74.35	117.16



- 700 —

EXISTING CONTOURS
- 700 —

PROPOSED CONTOURS
- B.L.

BUILDING SETBACK LINE
- U.E.

UTILITY EASEMENT
- D.E.

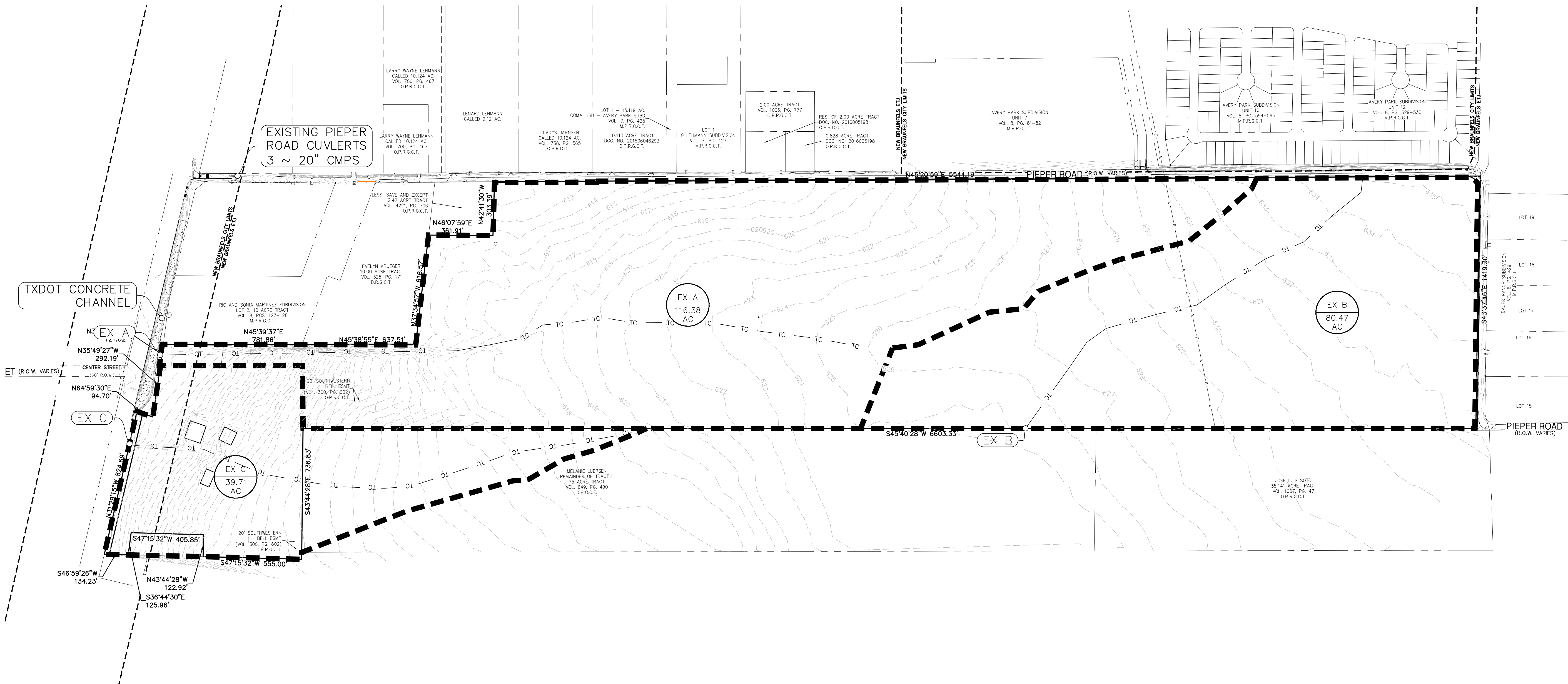
DRAINAGE EASEMENT
- — —

DRAINAGE AREA
- TC — TC —

TIME OF CONCENTRATION
- A-1

POINT OF CONCENTRATION
- DRAINAGE FLOW DIRECTION
- DA

ACRES
- DRAINAGE AREA LABEL



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TBPLS FIRM 10153600



11/19/2018

EXISTING DRAINAGE
AREA MAP
PARKSIDE SUBDIVISION

NO.	REVISION DESCRIPTION	REVISION DATE

DATE: SEPTEMBER

DRAWN BY: CAM

DESIGNED BY: CAM

REVIEWED BY: CVH

HMT PROJECT NO.:
031.059

SHEET

1

Attachment D

Proposed Drainage Area Map

Drawing Name: N:_Projects\031 - DR Norton\031.059 - PRELIM Drainage Report\031.059_PRELIM DRNG.dwg User: chrish Nov 19, 2018 - 14:59m

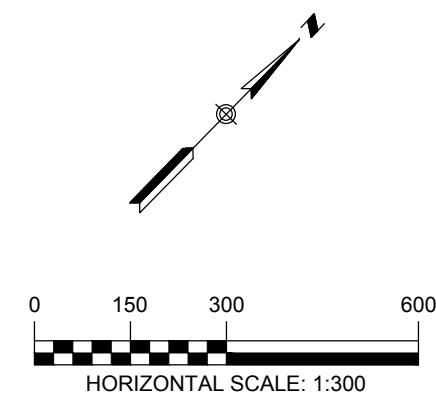
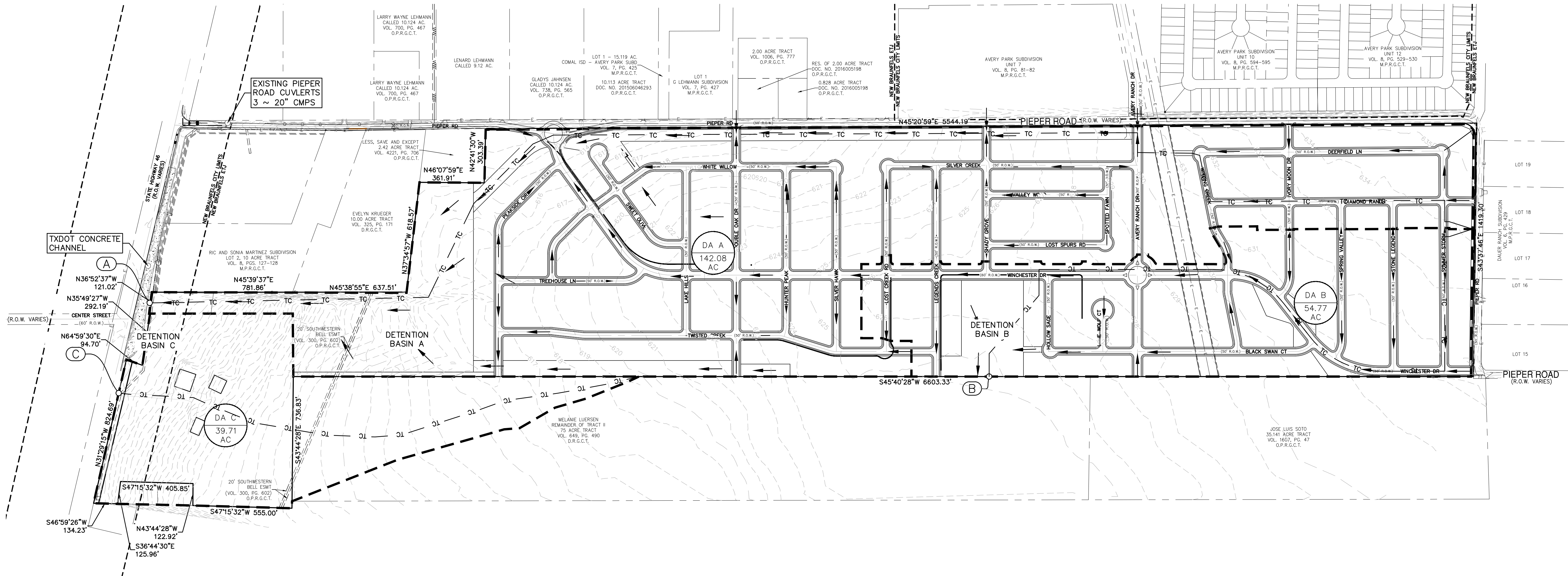
Table 2 - Proposed Conditions Hydrology Calculations - City of New Braunfels									
Point of Concentration	Description	Drainage Area	Area	T _c	CN	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
A	EX A Comparison	DA A	142.08	41.78	0.00	114.35	266.86	397.16	538.47
B	EX B Comparison	DA B	54.77	30.01	0.00	54.91	124.59	175.78	248.49
C	EX C Comparison	DA C	39.71	46.57	0.00	36.10	76.35	105.74	147.51

Table 3 - Detention Basin A Summary				
	Q ₂	Q ₁₀	Q ₂₅	Q ₁₀₀
Detention Basin Release Rate	13.81	106.95	166.1	271.14
Storage (cuft)	470,767	672,206	1,171,924	1,534,713

Table 4 - Detention Basin B Summary				
	Q ₂	Q ₁₀	Q ₂₅	Q ₁₀₀
Detention Basin Release Rate	7.32	24.54	40.42	65.80
Storage (cuft)	160,083	361,624	504,579	698,401

Table 5 - Detention Basin C Summary				
	Q ₂	Q ₁₀	Q ₂₅	Q ₁₀₀
Detention Basin Release Rate	3.25	9.07	18.68	35.80
Storage (cuft)	158,844	339,157	450,334	604,637

Table 6 - Existing to Proposed Comparison					
Point of Concentration	Drainage Area	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EX A	EX A	30.24	116.01	188.98	297.75
Detention Basin A Release Rate	A	13.81	106.95	166.10	271.14
Proposed is Less Than or Equal to Existing	YES	YES	YES	YES	YES
Point of Concentration	Drainage Area	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EX B	EX B	11.97	45.75	74.35	117.16
Detention Basin B Release Rate	B	7.32	24.54	40.42	65.80
Proposed is Less Than or Equal to Existing	YES	YES	YES	YES	YES
Point of Concentration	Drainage Area	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EX C	EX C	11.97	45.75	74.35	117.16
Detention Basin C Release Rate	C	3.25	9.07	18.68	35.80
Proposed is Less Than or Equal to Existing	YES	YES	YES	YES	YES



- LEGEND**
- EXISTING CONTOURS
 - PROPOSED CONTOURS
 - B.L. BUILDING SETBACK LINE
 - U.E. UTILITY EASEMENT
 - D.E. DRAINAGE EASEMENT
 - DRAINAGE AREA
 - TC TIME OF CONCENTRATION
 - POINT OF CONCENTRATION
 - DRAINAGE FLOW DIRECTION
 - DA ACRES
 - DRAINAGE AREA LABEL

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TBPLS FIRM F-10153600

HMT
ENGINEERING & SURVEYING



11/19/2018

**PROPOSED DRAINAGE
AREA MAP**
PARKSIDE SUBDIVISION

NO.	REVISION DESCRIPTION	REVISION DATE

DATE: SEPTEMBER 2018

DRAWN BY: CAM

DESIGNED BY: CAM

REVIEWED BY: CVH

HMT PROJECT NO.:
031.059

SHEET

2

Attachment E

Hydrology Calculations

Table 1 - Existing Conditions Hydrology Calculations - City of New Braunfels									
Point of Concentration	Description	Drainage Area	Area	T _c	CN	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EX A	DA A Comparison	EX A	116.38	60.9	78.00	30.24	116.01	188.98	297.75
EX B	DA B Comparison	EX B	80.47	58.7	78.00	30.24	116.01	188.98	297.75
EX C	DA C Comparison	EX C	39.71	46.6	78.14	11.97	45.75	74.35	117.16

Table 2 - Proposed Conditions Hydrology Calculations - City of New Braunfels									
Point of Concentration	Description	Drainage Area	Area	T _c	CN	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
A	EX A Comparison	DA A	142.08	41.78	84.00	114.35	266.86	397.16	538.47
B	EX B Comparison	DA B	54.77	30.01	84.00	54.91	124.59	175.78	248.49
C	EX C Comparison	DA C	39.71	46.57	95.00	36.10	76.35	105.74	147.51

Table 3 - Detention Basin A Summary				
	Q ₂	Q ₁₀	Q ₂₅	Q ₁₀₀
Detention Basin Release Rate	13.81	106.95	166.1	271.14
Storage (cuft)	470,767	672,206	1,171,924	1,534,713

Table 4 - Detention Basin B Summary				
	Q ₂	Q ₁₀	Q ₂₅	Q ₁₀₀
Detention Basin Release Rate	7.32	24.54	40.42	65.80
Storage (cuft)	160,083	361,624	504,579	698,401

Table 5 - Existing to Proposed Comparison					
Point of Concentration	Drainage Area	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EX A	EX A	30.24	116.01	188.98	297.75
Detention Basin A Release Rate	A	13.81	106.95	166.10	271.14
Proposed is Less Than or Equal to Existing		YES	YES	YES	YES
Point of Concentration	Drainage Area	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EX B	EX B	11.97	45.75	74.35	117.16
Detention Basin B Release Rate	B	7.32	24.54	40.42	65.80
Proposed is Less Than or Equal to Existing		YES	YES	YES	YES
Point of Concentration	Drainage Area	Q ₂ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₁₀₀ (cfs)
EX C	EX C	11.97	45.75	74.35	117.16
DA C	C	36.10	76.35	105.74	147.51
Proposed is Less Than or Equal to Existing		NO	NO	NO	NO

Existing

Watershed -

EX A

116.38 Acres

Time of Concentration

EX A

				hrs	min.
Sheet Flow	L (ft) =	100	Tt=	$.007(n*L)^{0.8}/P_2^{0.5}XS^{0.4}$	
	n=	0.24			
	S (%) =	0.20			
	P ₂ =	3.34	Tt=	0.33	20.0
Shallow Flow	L (ft) =	2189	Tt=	$(L)/(60*16.1345*S^{(0.5)})$	
(Unpaved)	S (%) =	0.4	Tt=		
				Tt=	35.75
Channel Flow	L (ft) =	1875			
(Channel Flow)	Est. V (ft/sec)=	6	V (fps) =	6.00	
			Tt=	$L/(60*V)$	
			Tt=	0.09	5.2

Tc	60.9 min.
----	------------------

"C" Value	78.00
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Weighted Curve Number	Hydrologic Soil Group	Curve Number	Area (acres)
R-1/R-1A Single Family	D	97	0.00
Meadow - continuous grass, protected from grazing and generally mowed for hay	D	78	116.38

Weighted Curve Number

78.00

Existing

Watershed -

EX B

80.47 Acres

Time of Concentration

EX B

				hrs	min.
Sheet Flow	L (ft) =	100	Tt=	$.007(n*L)^{0.8}/P_2^{0.5} \times S^{0.4}$	
	n=	0.24			
	S (%) =	0.70			
	P ₂ =	3.34	Tt=	0.33	20.0
Shallow Flow	L (ft) =	2370	Tt=	$(L)/(60*16.1345*S^{0.5})$	
(Unpaved)	S (%) =	0.4	Tt=		
				Tt=	38.71
Channel Flow	L (ft) =	0			
(Channel Flow)	Est. V (ft/sec)=	6	V (fps) =	6.00	
			Tt=	$L/(60*V)$	
			Tt=	0.00	0.0

Tc	58.7 min.
----	------------------

"C" Value	78.00
-----------	--------------

Weighted Curve Number	Hydrologic Soil Group	Curve Number	Area (acres)
R-1/R-1A Single Family	D	97	0.00
Meadow - continuous grass, protected from grazing and generally mowed for hay	D	78	80.47

Weighted Curve Number

78.00

Existing

Watershed -

EX C

39.71 Acres

Time of Concentration

EX C

				hrs	min.
Sheet Flow	L (ft) =	100	Tt=	$.007(n*L)^{0.8}/P_2^{0.5} \times S^{0.4}$	
	n=	0.24			
	S (%) =	0.50			
	P ₂ =	3.34	Tt=	0.33	20.0
Shallow Flow	L (ft) =	2889	Tt=	$(L)/(60*16.1345*S^{(0.5)})$	
(Unpaved)	S (%) =	1.26	Tt=		
				Tt=	26.59
Channel Flow	L (ft) =	0			
(Channel Flow)	Est. V (ft/sec)=	6	V (fps) =	6.00	
			Tt=	$L/(60*V)$	
			Tt=	0.00	0.0

Tc	46.6 min.
----	------------------

"C" Value	78.14
-----------	--------------

Weighted Curve Number	Hydrologic Soil Group	Curve Number	Area (acres)
R-1/R-1A Single Family	D	84	0.95
Meadow - continuous grass, protected from grazing and generally mowed for hay	D	78	38.76

Weighted Curve Number

78.14

Proposed

Watershed -
Time of Concentration

DA A
A

142.08 Acres

				hrs	min.
Sheet Flow	L (ft) =	100	Tt=	$.007(n*L)^{0.8}/P_2^{0.5}XS^{0.4}$	
	n=	0.24			
	S (%) =	1.00			
	P ₂ =	3.34	Tt=	0.31	18.4
Shallow Flow	L (ft) =	62	Tt=	$(L)/(60*16.1345*S^{(0.5)})$	
(Unpaved)	S (%) =	1	Tt=		
				Tt=	0.64
Channel Flow	L (ft) =	8174			
(Channel Flow)	Est. V (ft/sec)=	6	V (fps) =	6.00	
			Tt=	$L/(60*V)$	
			Tt=	0.38	22.7

Tc	41.8 min.
----	------------------

Curve Number	84.00
---------------------	--------------

Weighted Curve Number	Hydrologic Soil Group	Curve Number	Area (acres)
C-3 Commercial	D	95	0.00
R-1/R-1A Single Family	D	84	142.08

Weighted Curve Number

84.00

Proposed

Watershed -
Time of Concentration

DA B
B

54.77 Acres

				hrs	min.
Sheet Flow	L (ft) =	100	Tt=	$.007(n*L)^{0.8}/P_2^{0.5}XS^{0.4}$	
	n=	0.24			
	S (%) =	1.00			
	P ₂ =	3.34	Tt=	0.31	18.4
Shallow Flow	L (ft) =	62	Tt=	$(L)/(60*16.1345*S^{(0.5)})$	
(Unpaved)	S (%) =	1	Tt=		
	m				
				Tt=	0.64
Channel Flow	L (ft) =	3937			
(Channel Flow)	Est. V (ft/sec)=	6	V (fps) =	6.00	
			Tt=	$L/(60*V)$	
			Tt=	0.18	10.9

Tc	30.0 min.
----	------------------

Curve Number	84.00
---------------------	--------------

Weighted Curve Number	Hydrologic Soil Group	Curve Number	Area (acres)
C-3 Commercial	D	95	0.00
R-1/R-1A Single Family	D	84	54.77

Weighted Curve Number

84.00

Proposed

Watershed -
Time of Concentration

DA C
C

39.71 Acres

				hrs	min.
Sheet Flow	L (ft) =	100	Tt=	$.007(n*L)^{0.8}/P_2^{0.5}XS^{0.4}$	
	n=	0.24			
	S (%) =	0.50			
	P ₂ =	3.34	Tt=	0.33	20.0
Shallow Flow	L (ft) =	2889	Tt=	$(L)/(60*16.1345*S^{(0.5)})$	
(Unpaved)	S (%) =	1.26	Tt=		
				Tt=	26.59
Channel Flow	L (ft) =	0			
(Channel Flow)	Est. V (ft/sec)=	6	V (fps) =	6.00	
			Tt=	$L/(60*V)$	
			Tt=	0.00	0.0

Tc	46.6 min.
----	------------------

Curve Number	95.00
---------------------	--------------

Weighted Curve Number	Hydrologic Soil Group	Curve Number	Area (acres)
C-3 Commercial	D	95	22.85
R-1/R-1A Single Family	D	84	0.00

Weighted Curve Number

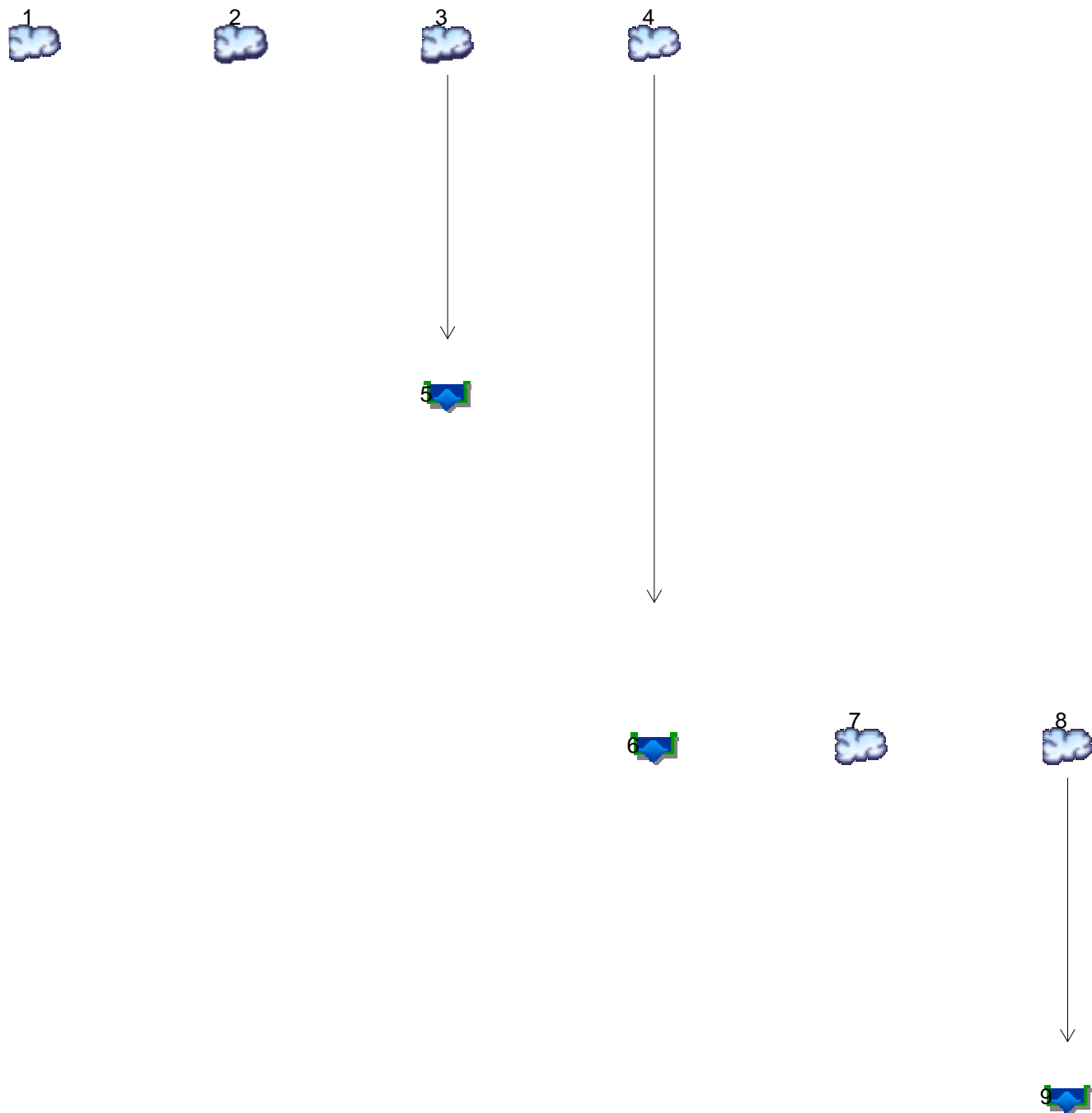
95.00

Attachment F

Hydrograph Calculations

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	EX A
2	SCS Runoff	EX B
3	SCS Runoff	A
4	SCS Runoff	B
5	Reservoir	A + BASIN A
6	Reservoir	B + BASIN B
7	SCS Runoff	EX C
8	SCS Runoff	C
9	Reservoir	DA C + BASIN C

Hydrograph Summary Report

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

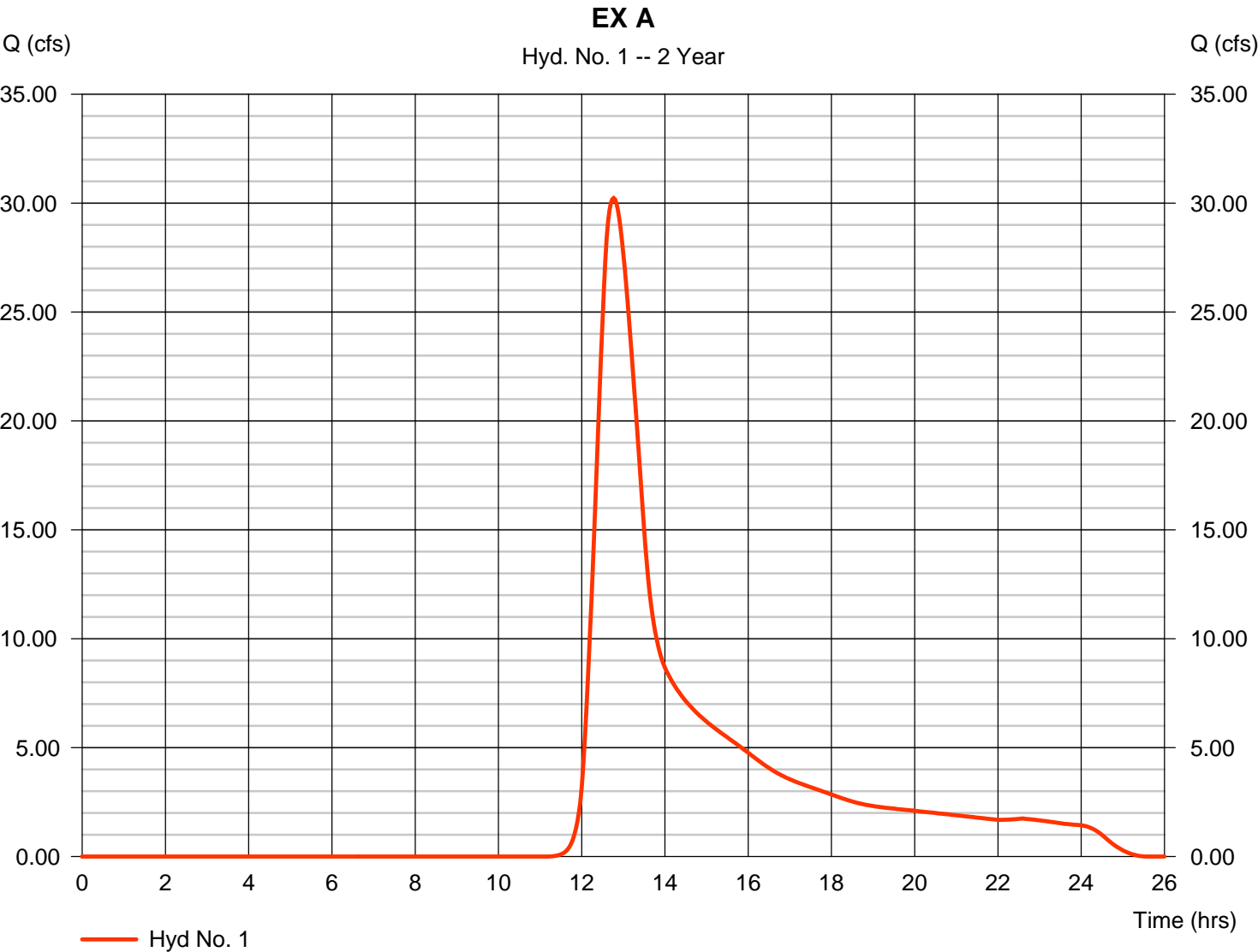
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	30.24	2	766	253,694	-----	-----	-----	EX A
2	SCS Runoff	20.91	2	766	175,414	-----	-----	-----	EX B
3	SCS Runoff	87.41	2	750	553,977	-----	-----	-----	A
4	SCS Runoff	40.27	2	740	211,637	-----	-----	-----	B
5	Reservoir	5.652	2	1030	146,473	3	601.41	433,398	A + BASIN A
6	Reservoir	4.576	2	860	211,603	4	620.66	115,577	B + BASIN B
7	SCS Runoff	11.97	2	756	85,790	-----	-----	-----	EX C
8	SCS Runoff	36.10	2	750	239,163	-----	-----	-----	C
9	Reservoir	3.250	2	924	227,159	8	584.59	158,844	DA C + BASIN C
031.059_SCS.gpw					Return Period: 2 Year			Monday, 11 / 19 / 2018	

Hydrograph Report

Hyd. No. 1

EX A

Hydrograph type	= SCS Runoff	Peak discharge	= 30.24 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.77 hrs
Time interval	= 2 min	Hyd. volume	= 253,694 cuft
Drainage area	= 116.380 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 60.90 min
Total precip.	= 2.20 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

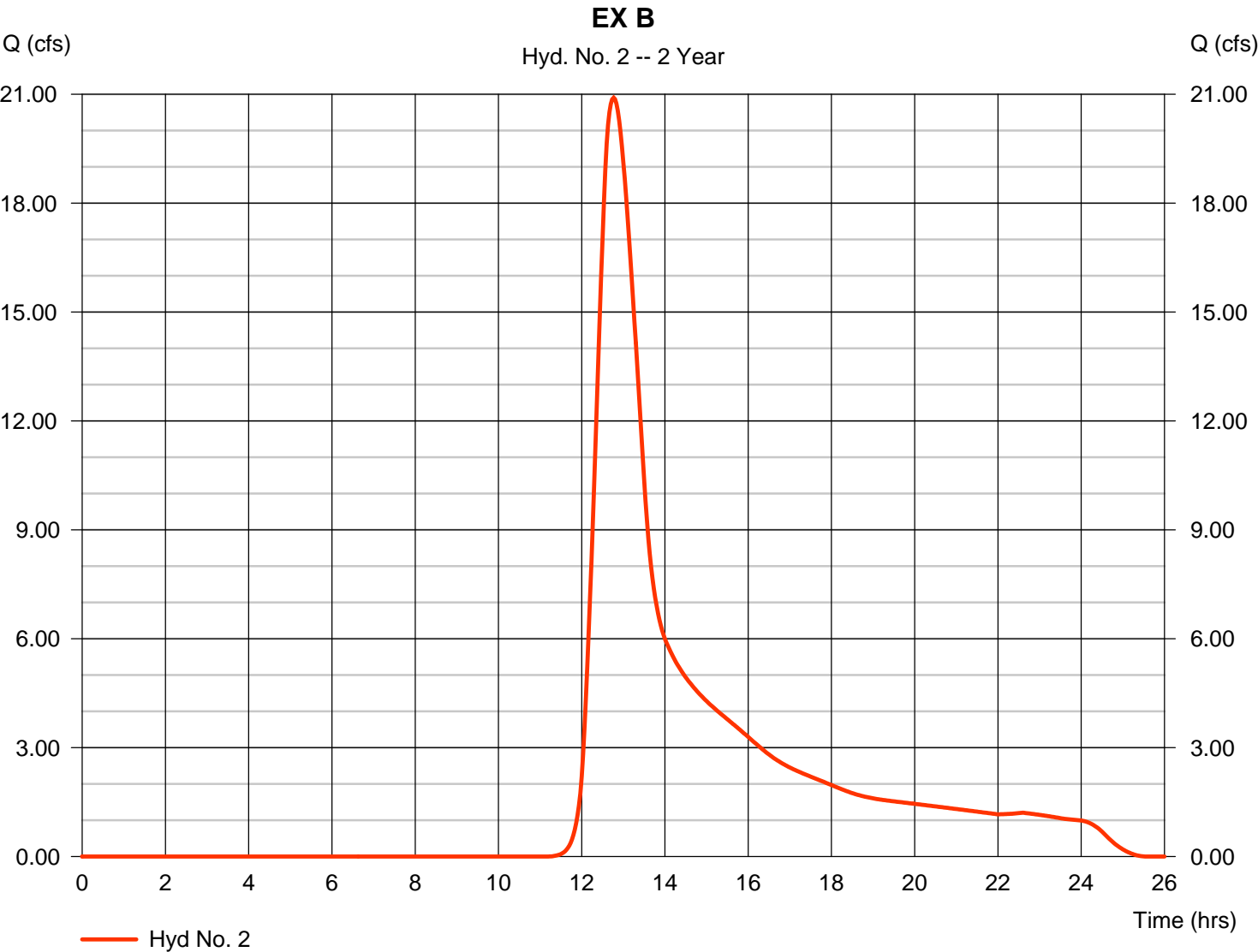


Hydrograph Report

Hyd. No. 2

EX B

Hydrograph type	= SCS Runoff	Peak discharge	= 20.91 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.77 hrs
Time interval	= 2 min	Hyd. volume	= 175,414 cuft
Drainage area	= 80.470 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 58.70 min
Total precip.	= 2.20 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

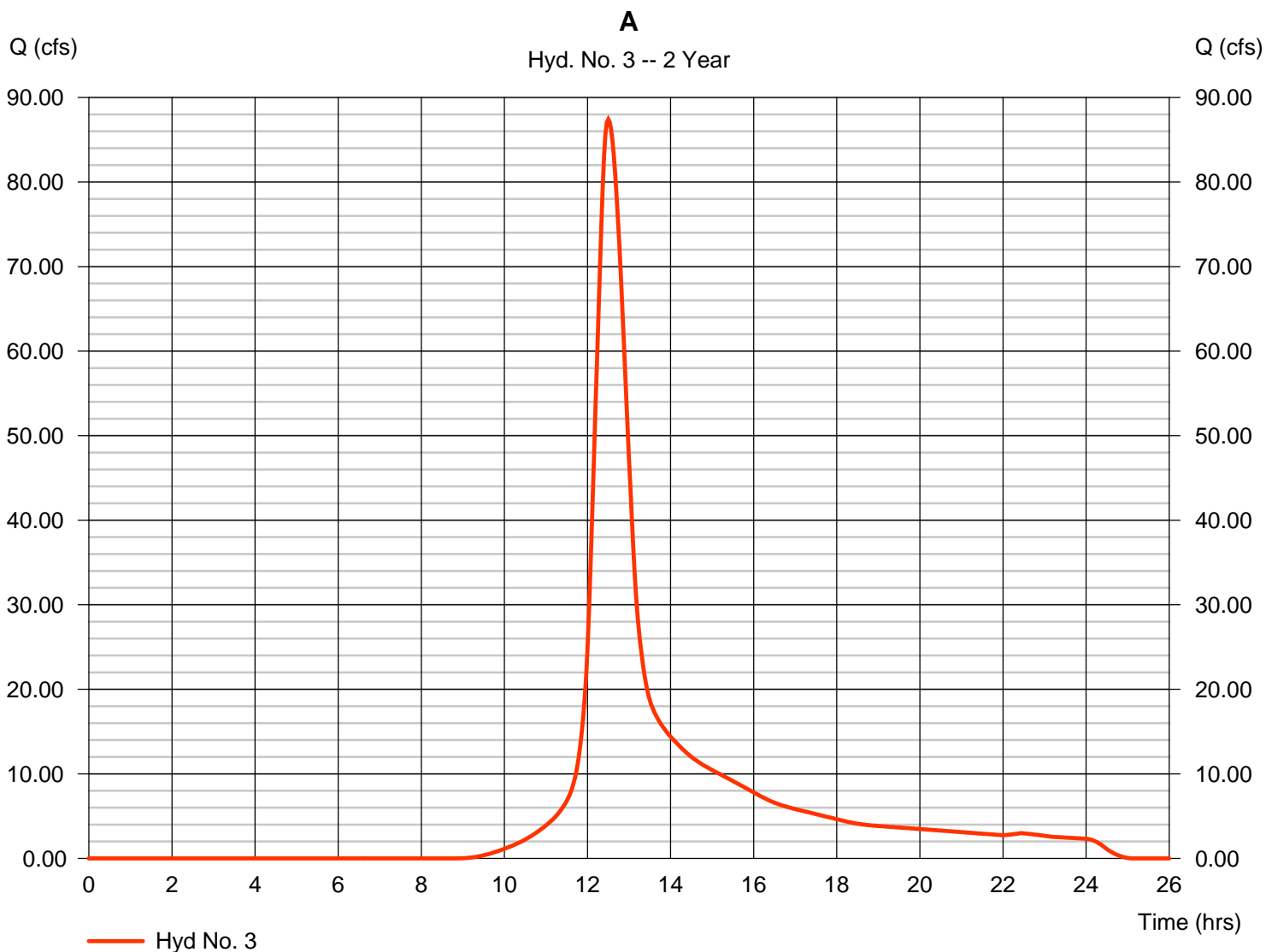
Monday, 11 / 19 / 2018

Hyd. No. 3

A

Hydrograph type = SCS Runoff
 Storm frequency = 2 yrs
 Time interval = 2 min
 Drainage area = 142.000 ac
 Basin Slope = 0.0 %
 Tc method = User
 Total precip. = 2.20 in
 Storm duration = 24 hrs

Peak discharge = 87.41 cfs
 Time to peak = 12.50 hrs
 Hyd. volume = 553,977 cuft
 Curve number = 87
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 41.80 min
 Distribution = Type III
 Shape factor = 484

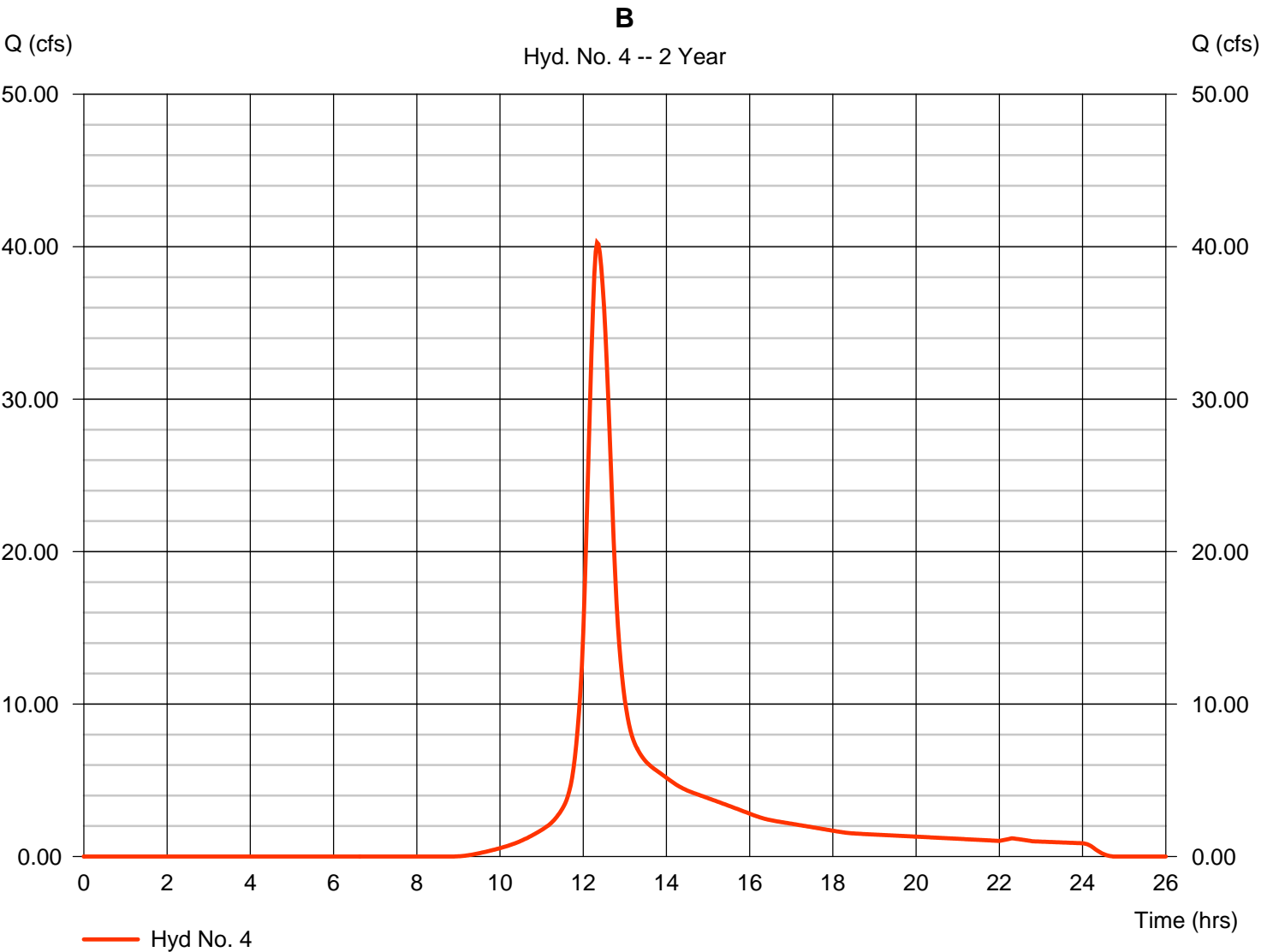


Hydrograph Report

Hyd. No. 4

B

Hydrograph type	= SCS Runoff	Peak discharge	= 40.27 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.33 hrs
Time interval	= 2 min	Hyd. volume	= 211,637 cuft
Drainage area	= 54.770 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.00 min
Total precip.	= 2.20 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



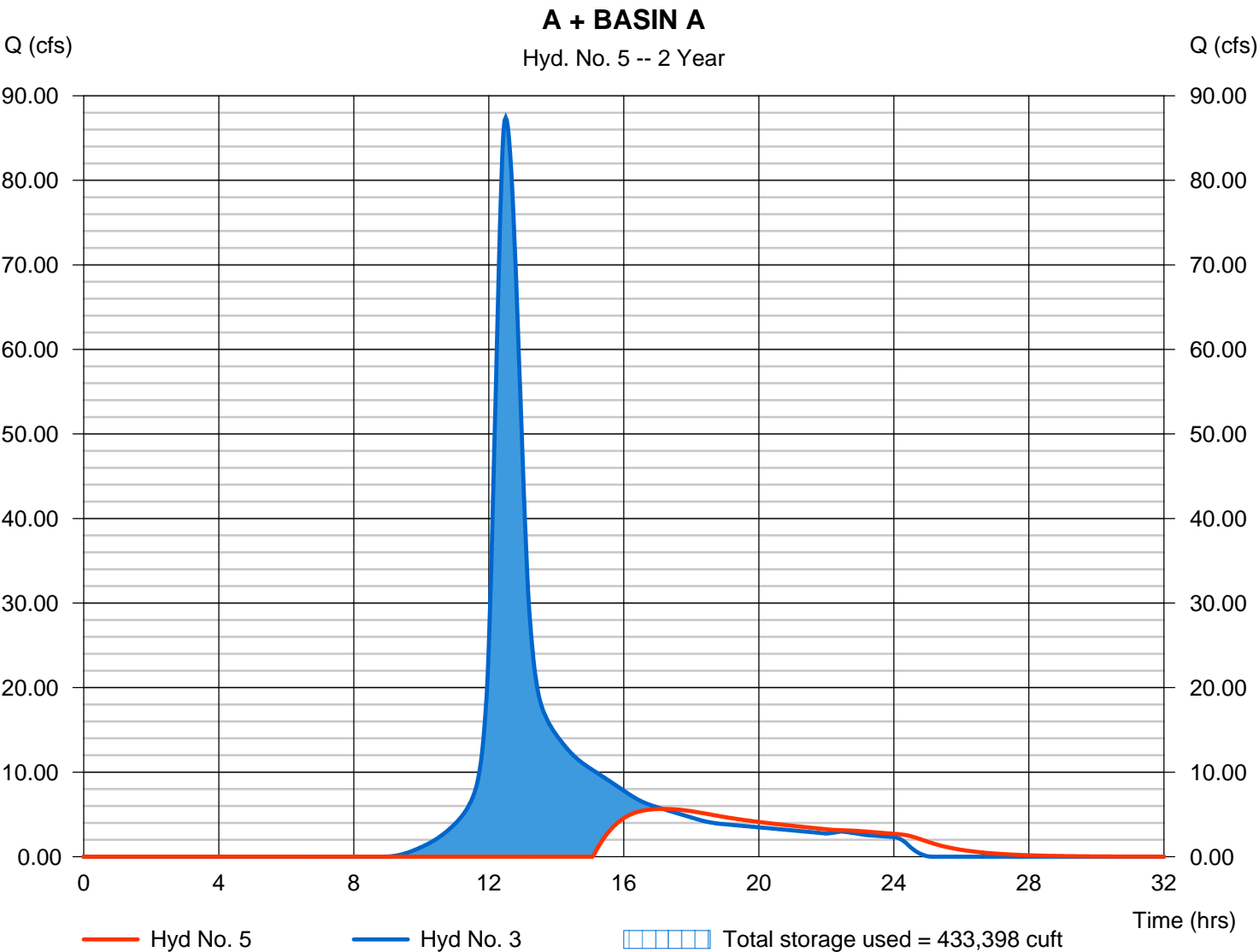
Hydrograph Report

Hyd. No. 5

A + BASIN A

Hydrograph type	= Reservoir	Peak discharge	= 5.652 cfs
Storm frequency	= 2 yrs	Time to peak	= 17.17 hrs
Time interval	= 2 min	Hyd. volume	= 146,473 cuft
Inflow hyd. No.	= 3 - A	Max. Elevation	= 601.41 ft
Reservoir name	= BASIN A	Max. Storage	= 433,398 cuft

Storage Indication method used.



Pond Report

8

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

Monday, 11 / 19 / 2018

Pond No. 1 - BASIN A

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Beginning Elevation = 599.86 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	599.86	00	0	0
1.00	600.86	260,000	130,000	130,000
6.00	605.86	850,000	2,775,000	2,905,000

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	Inactive	Inactive	Inactive
Span (in)	= 60.00	0.00	0.00	0.00
No. Barrels	= 2	0	0	0
Invert El. (ft)	= 599.86	0.00	0.00	0.00
Length (ft)	= 60.00	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)	= 15.00	Inactive	Inactive	Inactive
Crest El. (ft)	= 602.00	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)	= 601.61			

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	599.86	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.00	130,000	600.86	0.00	---	---	---	0.00	---	---	---	---	---	0.000
6.00	2,905,000	605.86	297.79 ic	---	---	---	378.80	---	---	---	---	---	676.59

Hydrograph Report

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

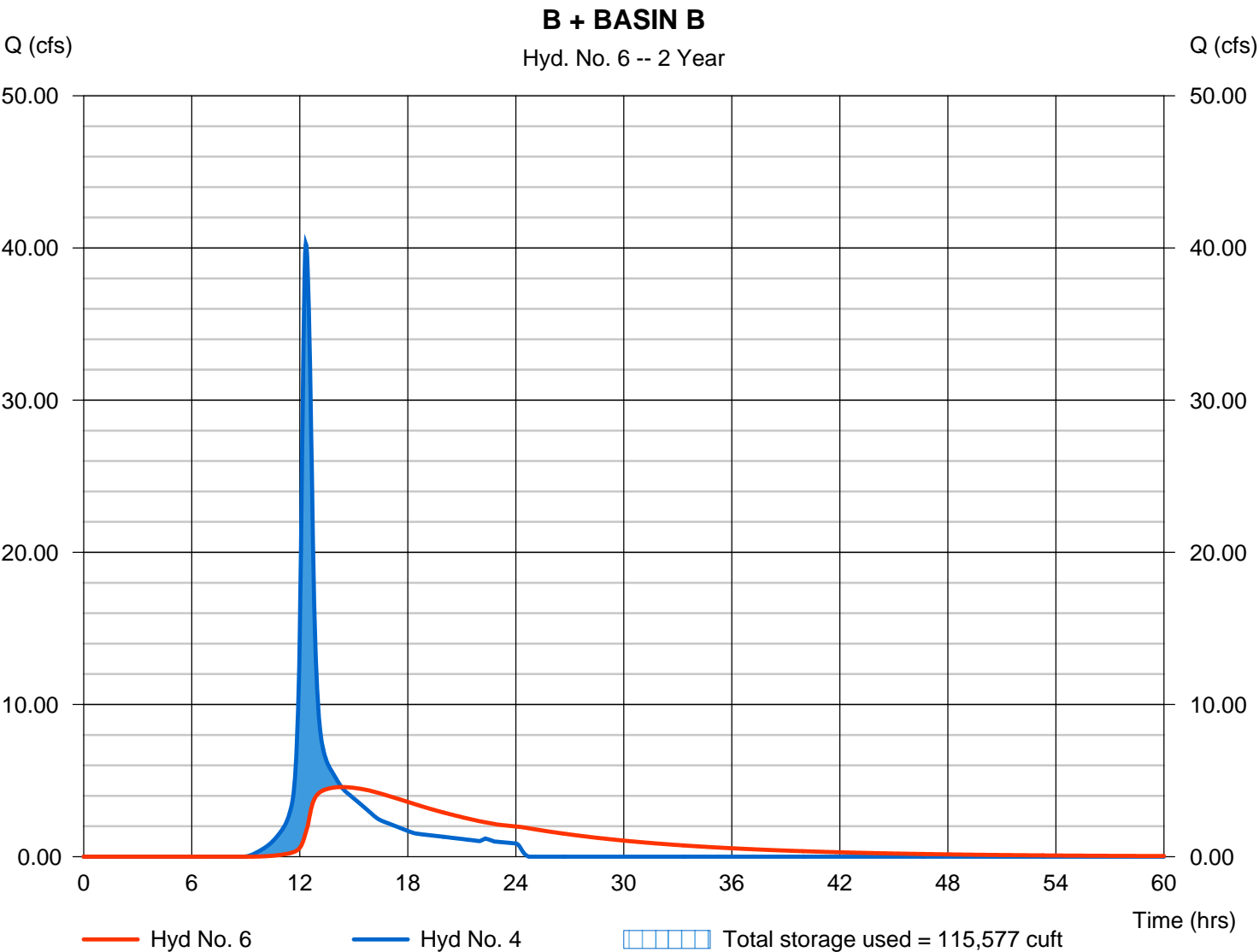
Monday, 11 / 19 / 2018

Hyd. No. 6

B + BASIN B

Hydrograph type	= Reservoir	Peak discharge	= 4.576 cfs
Storm frequency	= 2 yrs	Time to peak	= 14.33 hrs
Time interval	= 2 min	Hyd. volume	= 211,603 cuft
Inflow hyd. No.	= 4 - B	Max. Elevation	= 620.66 ft
Reservoir name	= BASIN B	Max. Storage	= 115,577 cuft

Storage Indication method used.



Pond No. 2 - BASIN B

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Beginning Elevation = 620.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	620.00	157,075	0	0
4.00	624.00	195,000	704,150	704,150

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	Inactive	Inactive	Inactive	Inactive
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	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)	= 60.00	Inactive	Inactive	Inactive
Crest El. (ft)	= 620.00	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 (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	620.00	---	---	---	---	0.00	---	---	---	---	---	0.000
4.00	704,150	624.00	---	---	---	---	66.60	---	---	---	---	---	66.60

Hydrograph Report

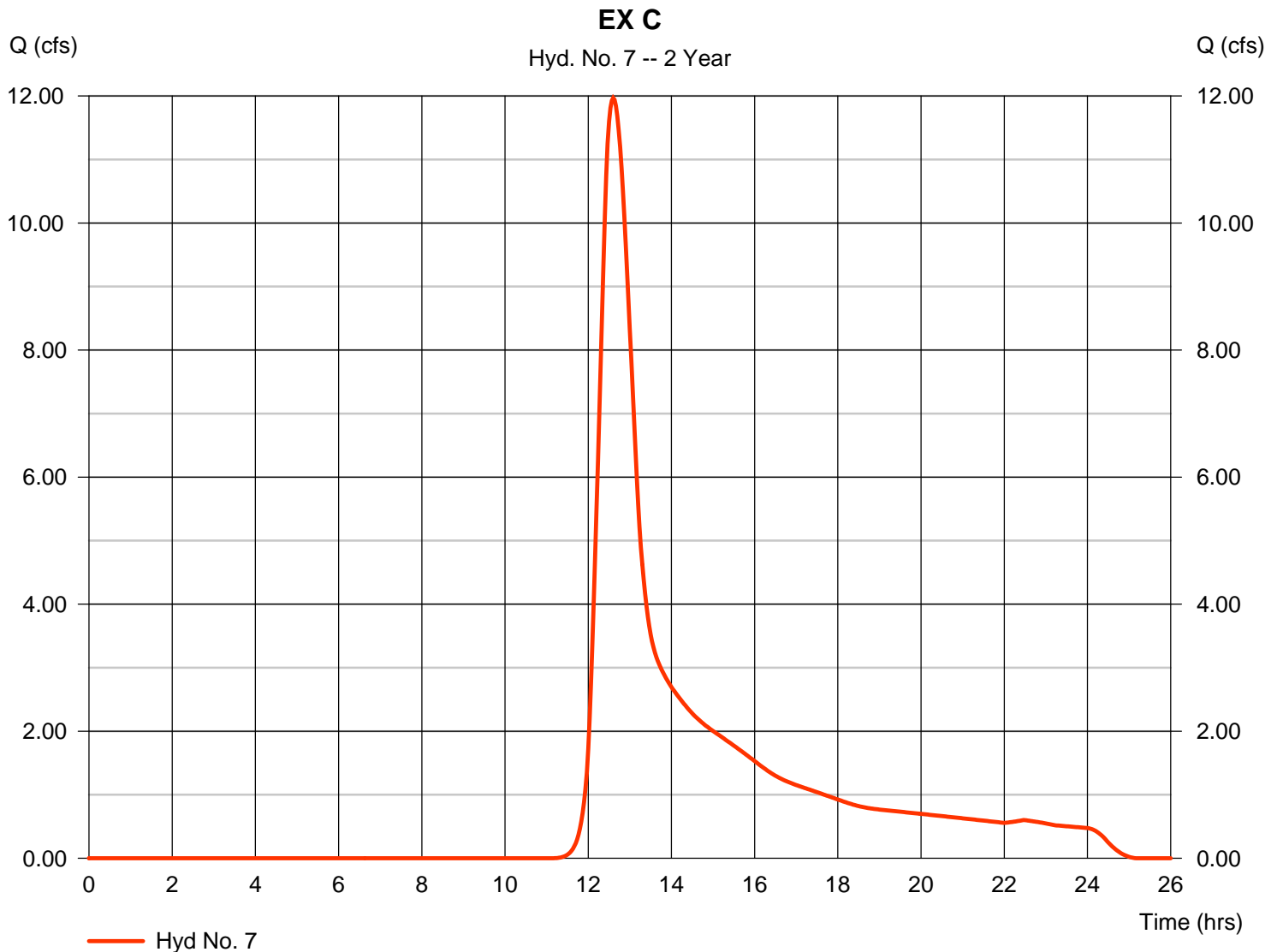
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 11 / 19 / 2018

Hyd. No. 7

EX C

Hydrograph type	= SCS Runoff	Peak discharge	= 11.97 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.60 hrs
Time interval	= 2 min	Hyd. volume	= 85,790 cuft
Drainage area	= 39.710 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 46.60 min
Total precip.	= 2.20 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

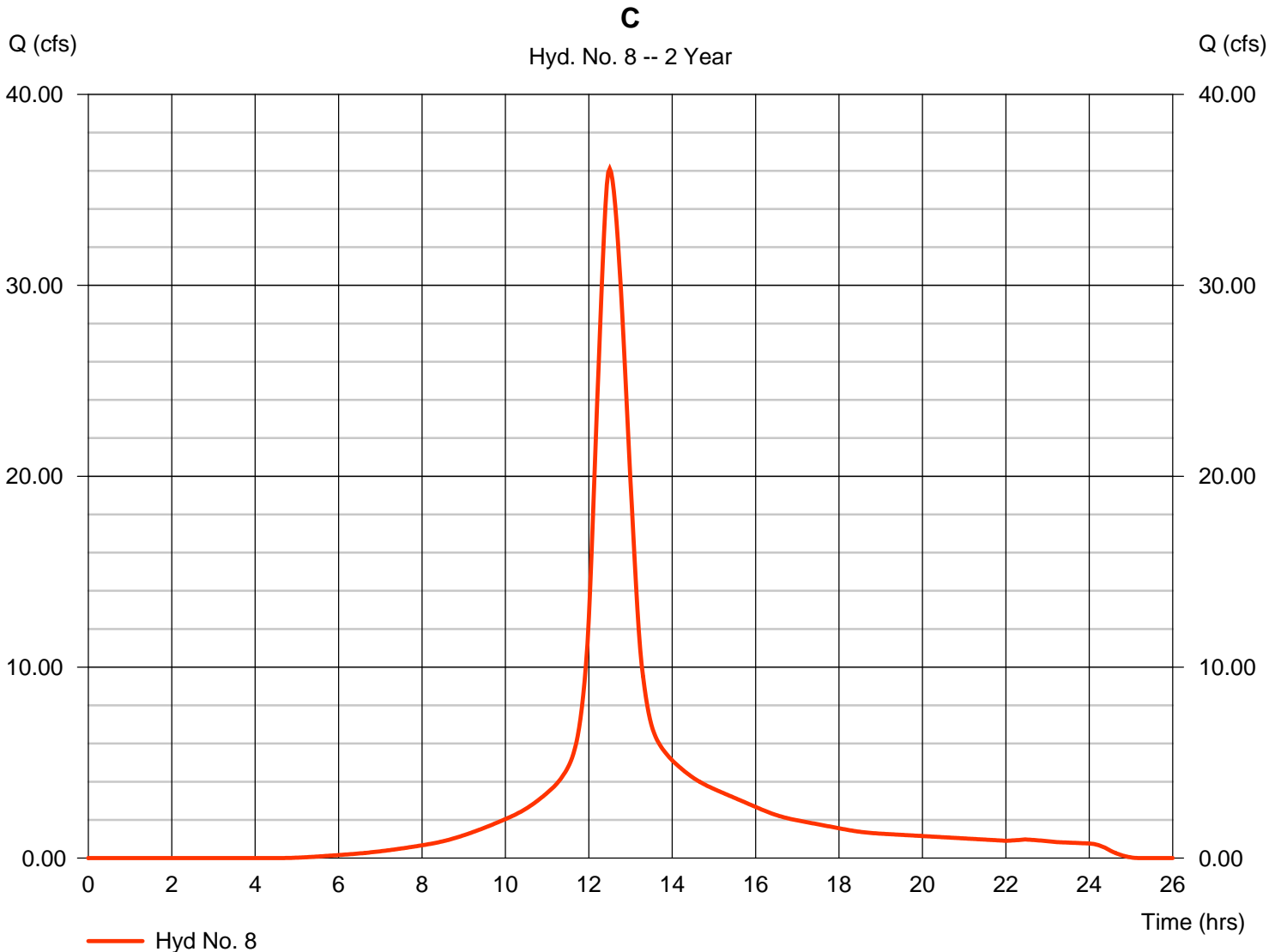
Monday, 11 / 19 / 2018

Hyd. No. 8

C

Hydrograph type = SCS Runoff
 Storm frequency = 2 yrs
 Time interval = 2 min
 Drainage area = 39.710 ac
 Basin Slope = 0.0 %
 Tc method = User
 Total precip. = 2.20 in
 Storm duration = 24 hrs

Peak discharge = 36.10 cfs
 Time to peak = 12.50 hrs
 Hyd. volume = 239,163 cuft
 Curve number = 95
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 46.60 min
 Distribution = Type III
 Shape factor = 484



Hydrograph Report

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

Monday, 11 / 19 / 2018

Hyd. No. 9

DA C + BASIN C

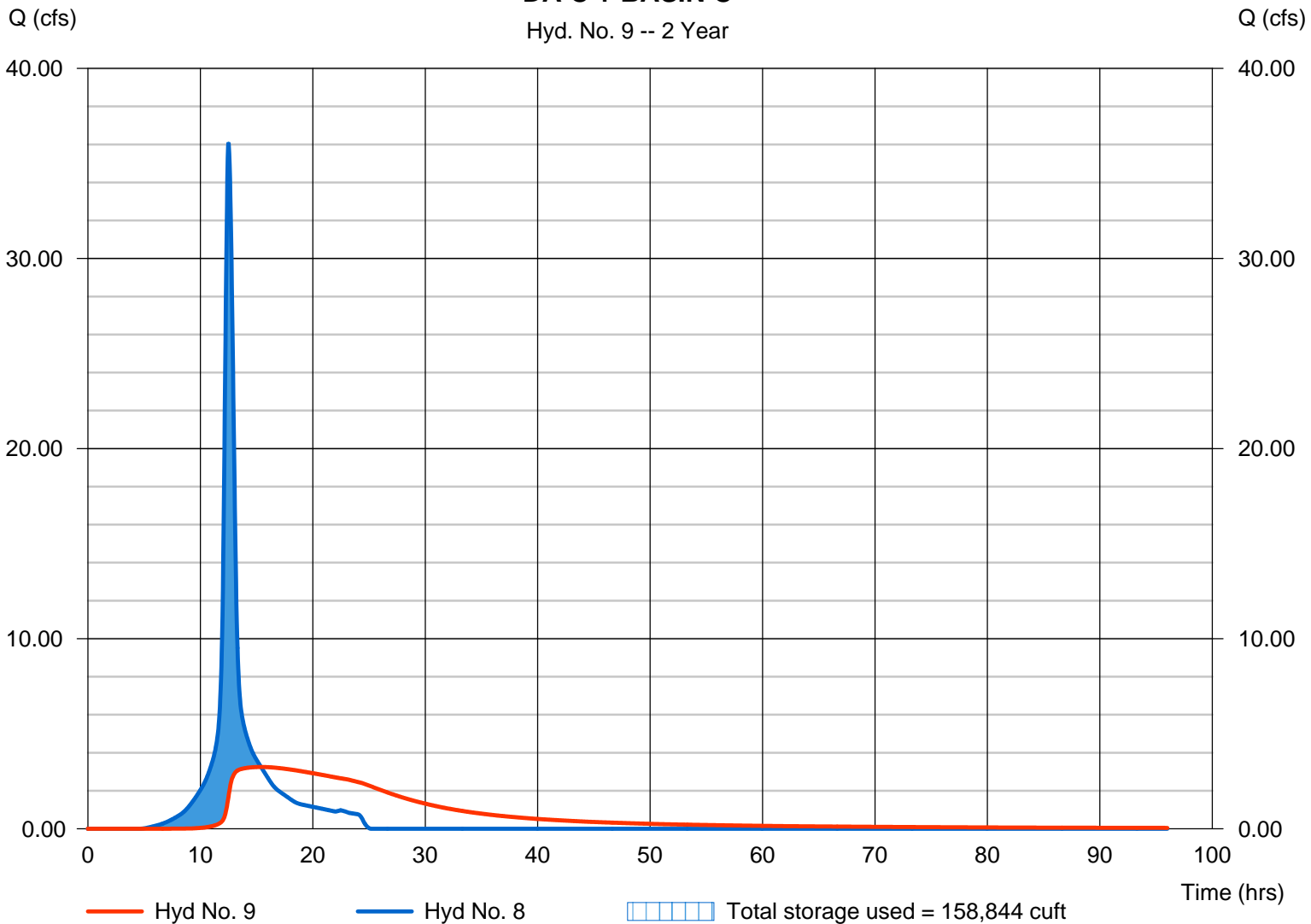
Hydrograph type = Reservoir
 Storm frequency = 2 yrs
 Time interval = 2 min
 Inflow hyd. No. = 8 - C
 Reservoir name = BASIN C

Peak discharge = 3.250 cfs
 Time to peak = 15.40 hrs
 Hyd. volume = 227,159 cuft
 Max. Elevation = 584.59 ft
 Max. Storage = 158,844 cuft

Storage Indication method used.

DA C + BASIN C

Hyd. No. 9 -- 2 Year



Pond No. 3 - BASIN C

Pond Data

Trapezoid -Bottom L x W = 400.0 x 300.0 ft, Side slope = 3.00:1, Bottom elev. = 583.30 ft, Depth = 6.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	583.30	120,000	0	0
0.60	583.90	122,533	72,759	72,759
1.20	584.50	125,092	74,286	147,045
1.80	585.10	127,677	75,829	222,874
2.40	585.70	130,287	77,388	300,262
3.00	586.30	132,924	78,962	379,224
3.60	586.90	135,587	80,552	459,776
4.20	587.50	138,275	82,157	541,933
4.80	588.10	140,989	83,778	625,711
5.40	588.70	143,730	85,414	711,126
6.00	589.30	146,496	87,066	798,192

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	Inactive	Inactive	Inactive
Span (in)	= 12.00	6.00	6.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 583.30	584.30	585.30	0.00
Length (ft)	= 60.00	60.00	60.00	0.00
Slope (%)	= 1.00	1.00	1.00	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)	= 2.00	5.00	40.00	Inactive
Crest El. (ft)	= 585.30	588.00	588.75	589.30
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	Rect	Rect	Rect
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	583.30	0.00	0.00	0.00	---	0.00	0.00	0.00	0.00	---	---	0.000
0.60	72,759	583.90	1.30 ic	0.00	0.00	---	0.00	0.00	0.00	0.00	---	---	1.299
1.20	147,045	584.50	3.08 oc	0.00	0.00	---	0.00	0.00	0.00	0.00	---	---	3.076
1.80	222,874	585.10	4.07 oc	0.00	0.00	---	0.00	0.00	0.00	0.00	---	---	4.069
2.40	300,262	585.70	4.86 oc	0.00	0.00	---	1.69	0.00	0.00	0.00	---	---	6.548
3.00	379,224	586.30	5.54 oc	0.00	0.00	---	6.66	0.00	0.00	0.00	---	---	12.20
3.60	459,776	586.90	6.15 oc	0.00	0.00	---	13.48	0.00	0.00	0.00	---	---	19.63
4.20	541,933	587.50	6.70 oc	0.00	0.00	---	21.73	0.00	0.00	0.00	---	---	28.44
4.80	625,711	588.10	7.21 oc	0.00	0.00	---	31.20	0.53	0.00	0.00	---	---	38.94
5.40	711,126	588.70	7.69 oc	0.00	0.00	---	41.75	9.75	0.00	0.00	---	---	59.19
6.00	798,192	589.30	8.14 oc	0.00	0.00	---	53.28	24.68	54.33	0.00	---	---	140.43

Hydrograph Summary Report

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

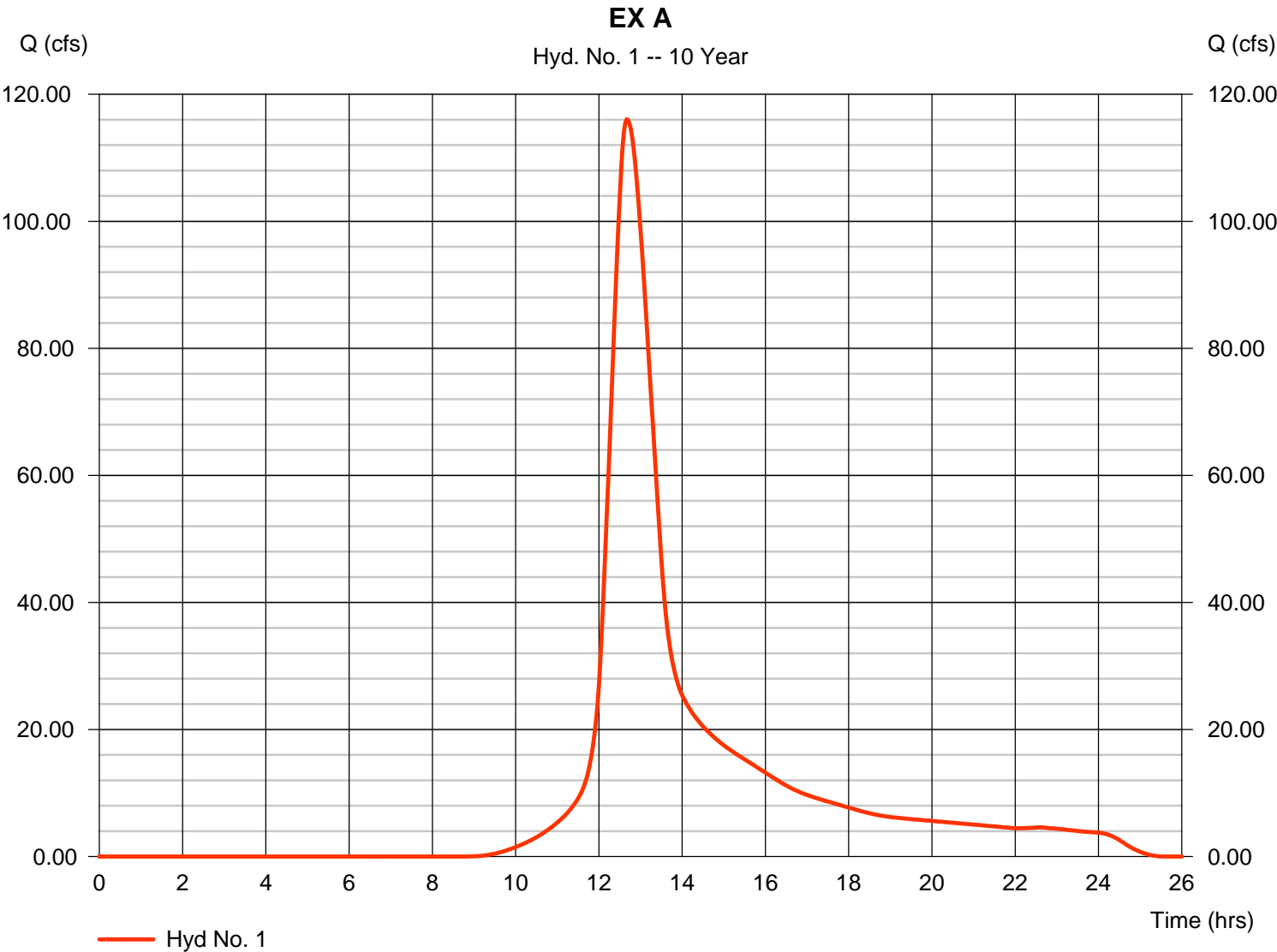
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	116.01	2	760	882,125	-----	-----	-----	EX A
2	SCS Runoff	80.21	2	760	609,938	-----	-----	-----	EX B
3	SCS Runoff	235.60	2	748	1,491,996	-----	-----	-----	A
4	SCS Runoff	108.36	2	740	569,989	-----	-----	-----	B
5	Reservoir	79.74	2	788	1,084,492	3	602.00	762,373	A + BASIN A
6	Reservoir	18.74	2	790	569,942	4	621.71	301,611	B + BASIN B
7	SCS Runoff	45.75	2	752	298,302	-----	-----	-----	EX C
8	SCS Runoff	76.35	2	750	525,401	-----	-----	-----	C
9	Reservoir	9.074	2	860	511,401	8	586.00	339,157	DA C + BASIN C
031.059_SCS.gpw					Return Period: 10 Year			Monday, 11 / 19 / 2018	

Hydrograph Report

Hyd. No. 1

EX A

Hydrograph type	= SCS Runoff	Peak discharge	= 116.01 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.67 hrs
Time interval	= 2 min	Hyd. volume	= 882,125 cuft
Drainage area	= 116.380 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 60.90 min
Total precip.	= 4.25 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

Monday, 11 / 19 / 2018

Hyd. No. 2

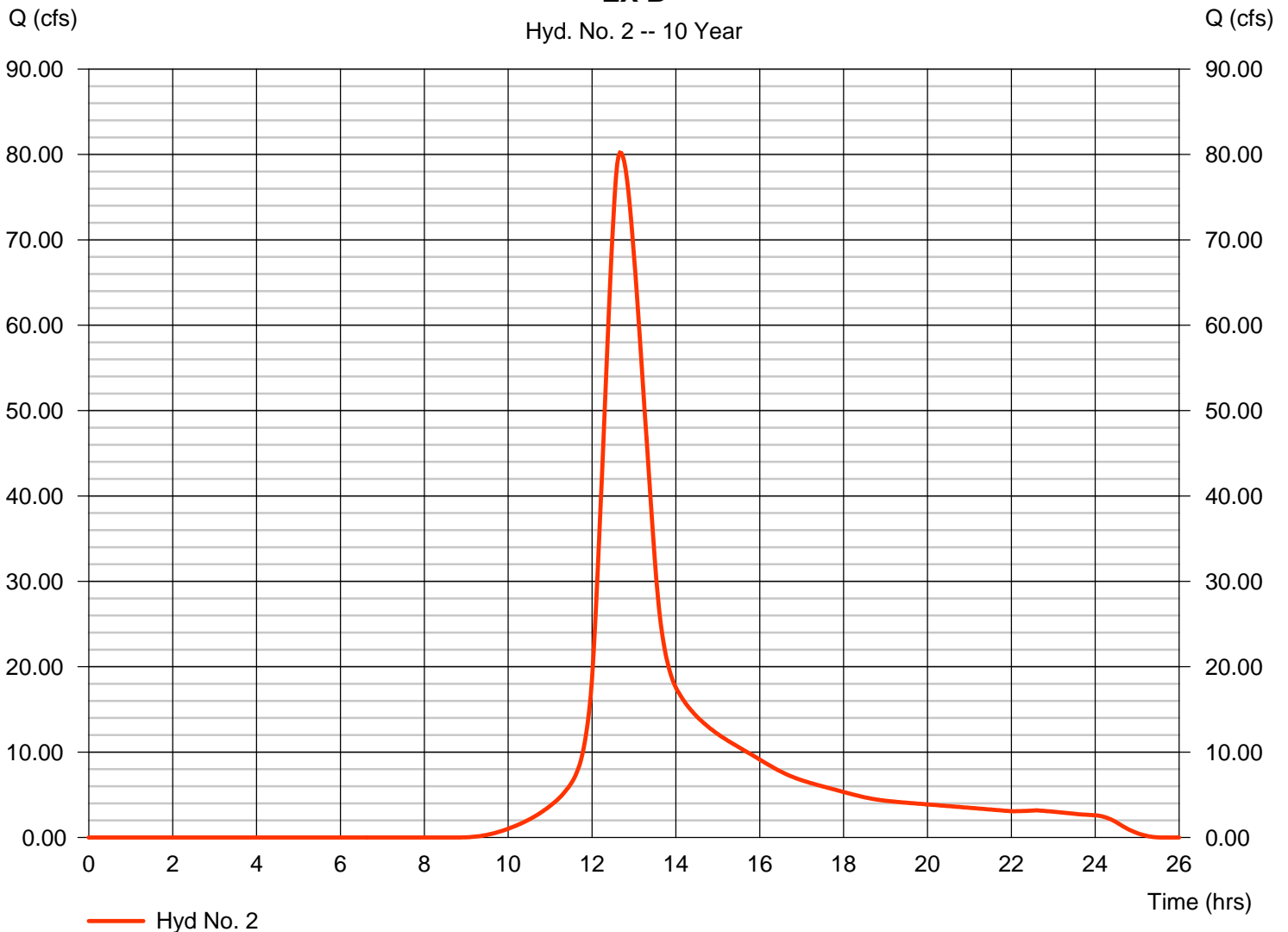
EX B

Hydrograph type = SCS Runoff
 Storm frequency = 10 yrs
 Time interval = 2 min
 Drainage area = 80.470 ac
 Basin Slope = 0.0 %
 Tc method = User
 Total precip. = 4.25 in
 Storm duration = 24 hrs

Peak discharge = 80.21 cfs
 Time to peak = 12.67 hrs
 Hyd. volume = 609,938 cuft
 Curve number = 78
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 58.70 min
 Distribution = Type III
 Shape factor = 484

EX B

Hyd. No. 2 -- 10 Year



Hydrograph Report

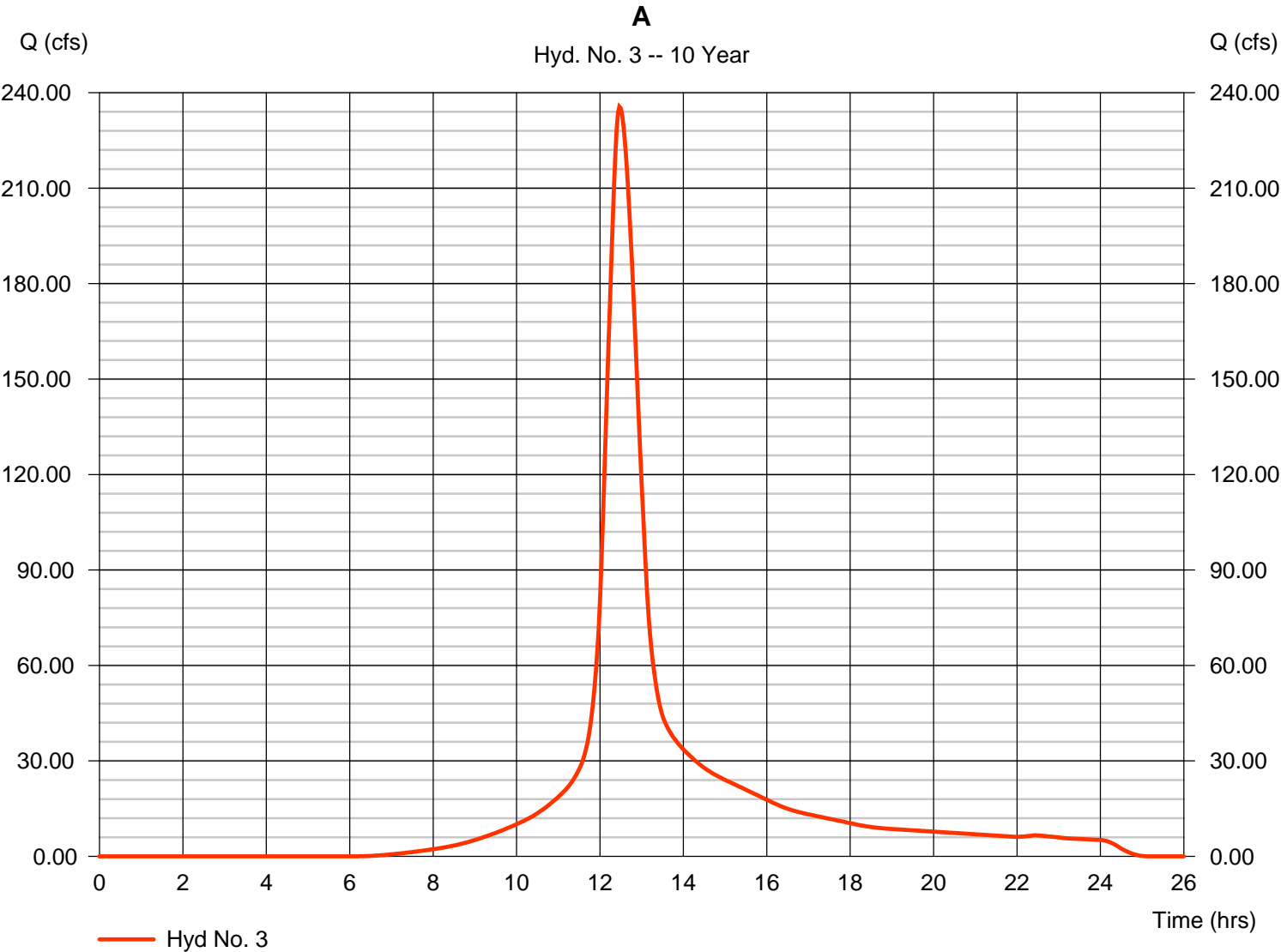
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 11 / 19 / 2018

Hyd. No. 3

A

Hydrograph type	= SCS Runoff	Peak discharge	= 235.60 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.47 hrs
Time interval	= 2 min	Hyd. volume	= 1,491,996 cuft
Drainage area	= 142.000 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 41.80 min
Total precip.	= 4.25 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

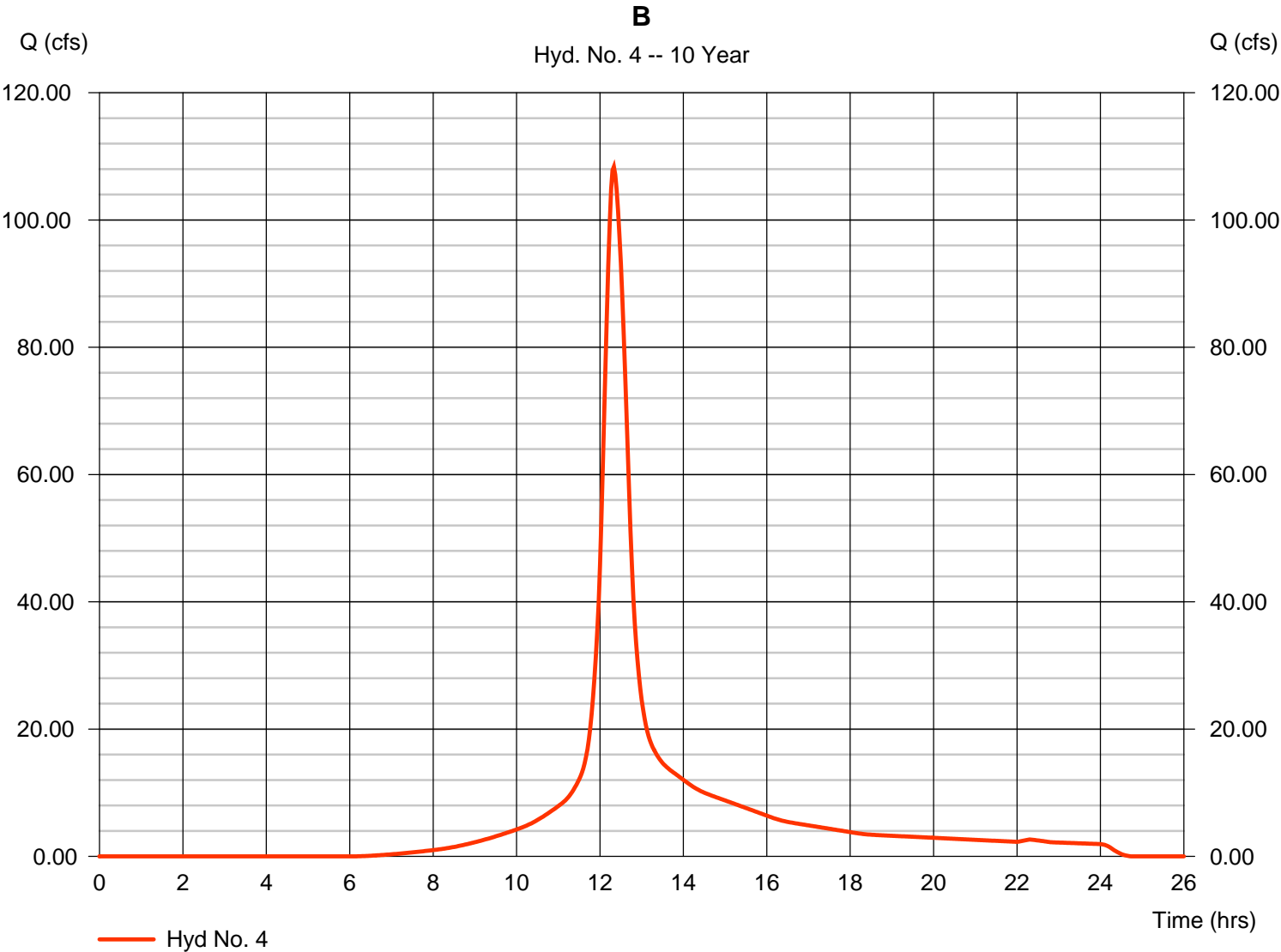


Hydrograph Report

Hyd. No. 4

B

Hydrograph type	= SCS Runoff	Peak discharge	= 108.36 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.33 hrs
Time interval	= 2 min	Hyd. volume	= 569,989 cuft
Drainage area	= 54.770 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.00 min
Total precip.	= 4.25 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

Monday, 11 / 19 / 2018

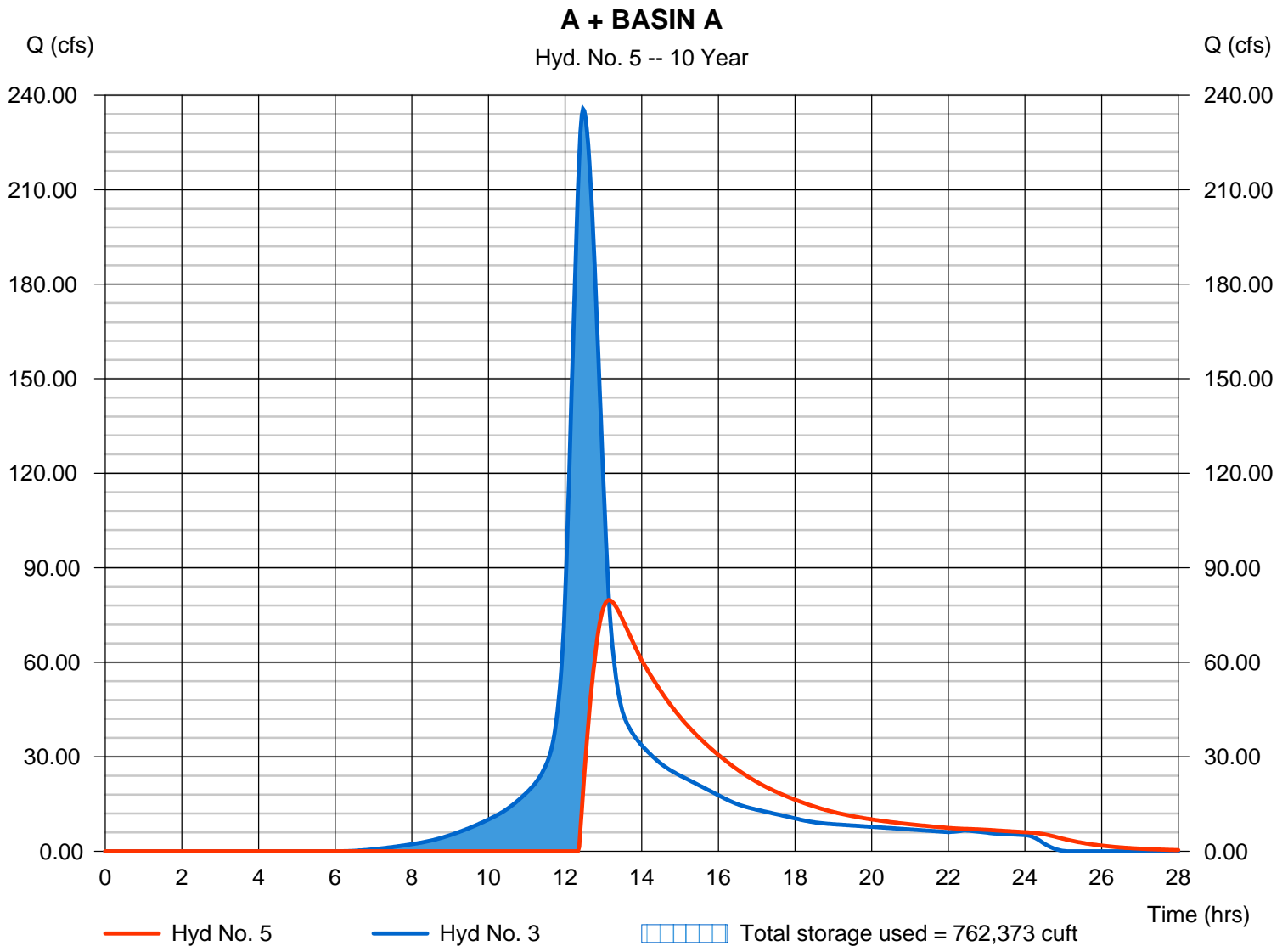
Hyd. No. 5

A + BASIN A

Hydrograph type = Reservoir
 Storm frequency = 10 yrs
 Time interval = 2 min
 Inflow hyd. No. = 3 - A
 Reservoir name = BASIN A

Peak discharge = 79.74 cfs
 Time to peak = 13.13 hrs
 Hyd. volume = 1,084,492 cuft
 Max. Elevation = 602.00 ft
 Max. Storage = 762,373 cuft

Storage Indication method used.



Hydrograph Report

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

Monday, 11 / 19 / 2018

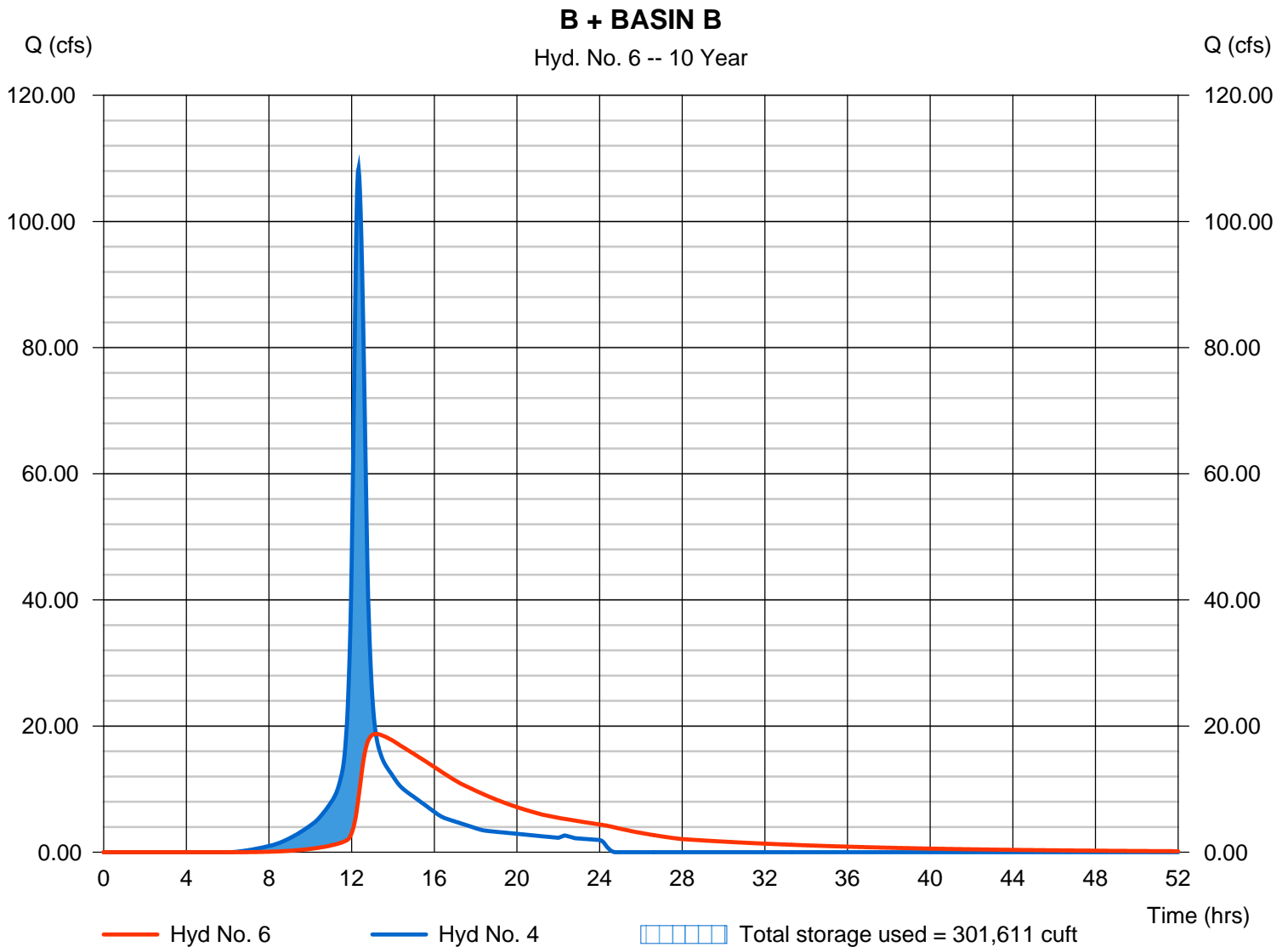
Hyd. No. 6

B + BASIN B

Hydrograph type = Reservoir
 Storm frequency = 10 yrs
 Time interval = 2 min
 Inflow hyd. No. = 4 - B
 Reservoir name = BASIN B

Peak discharge = 18.74 cfs
 Time to peak = 13.17 hrs
 Hyd. volume = 569,942 cuft
 Max. Elevation = 621.71 ft
 Max. Storage = 301,611 cuft

Storage Indication method used.



Hydrograph Report

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

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Hyd. No. 7

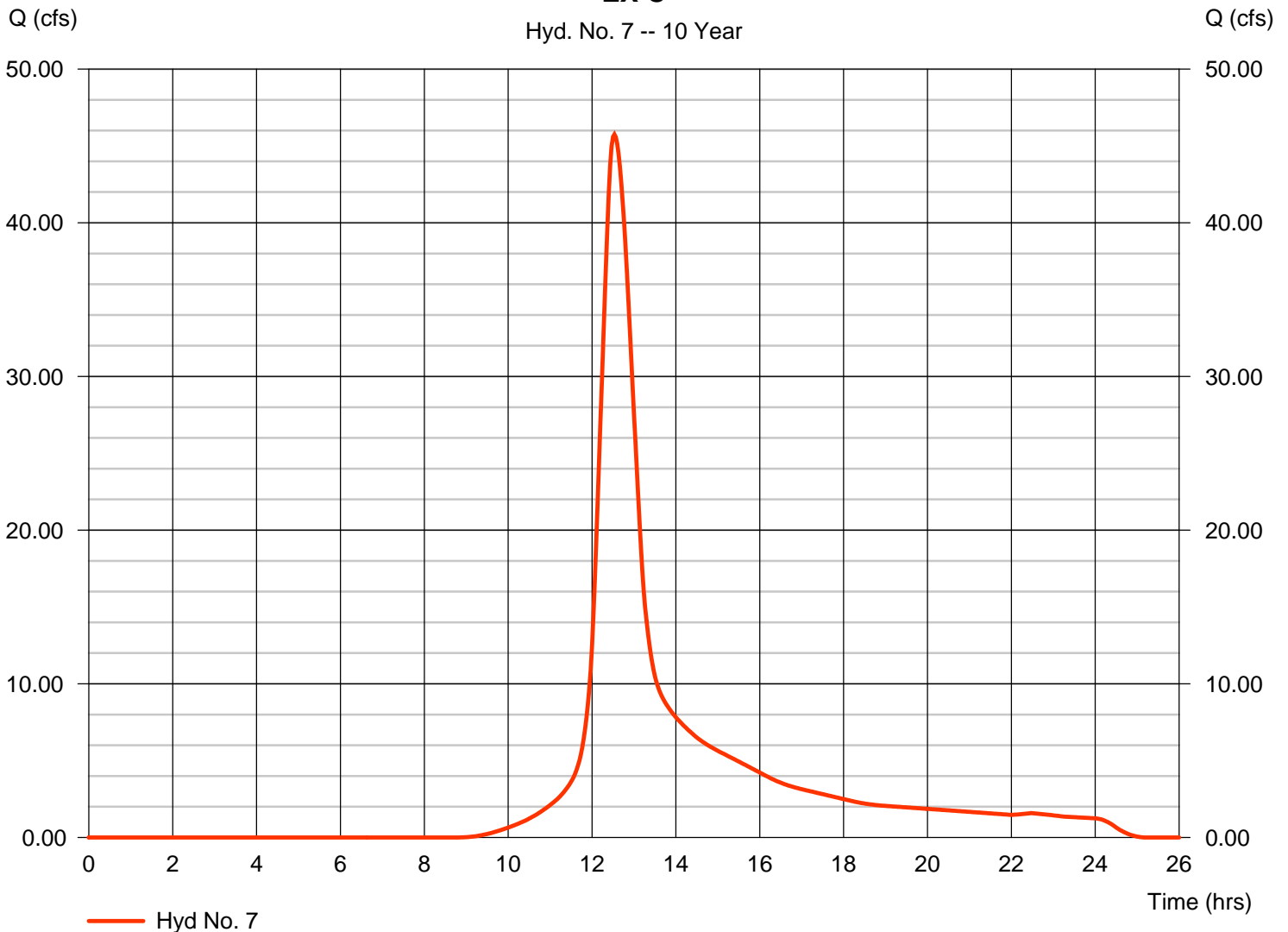
EX C

Hydrograph type = SCS Runoff
 Storm frequency = 10 yrs
 Time interval = 2 min
 Drainage area = 39.710 ac
 Basin Slope = 0.0 %
 Tc method = User
 Total precip. = 4.25 in
 Storm duration = 24 hrs

Peak discharge = 45.75 cfs
 Time to peak = 12.53 hrs
 Hyd. volume = 298,302 cuft
 Curve number = 78
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 46.60 min
 Distribution = Type III
 Shape factor = 484

EX C

Hyd. No. 7 -- 10 Year

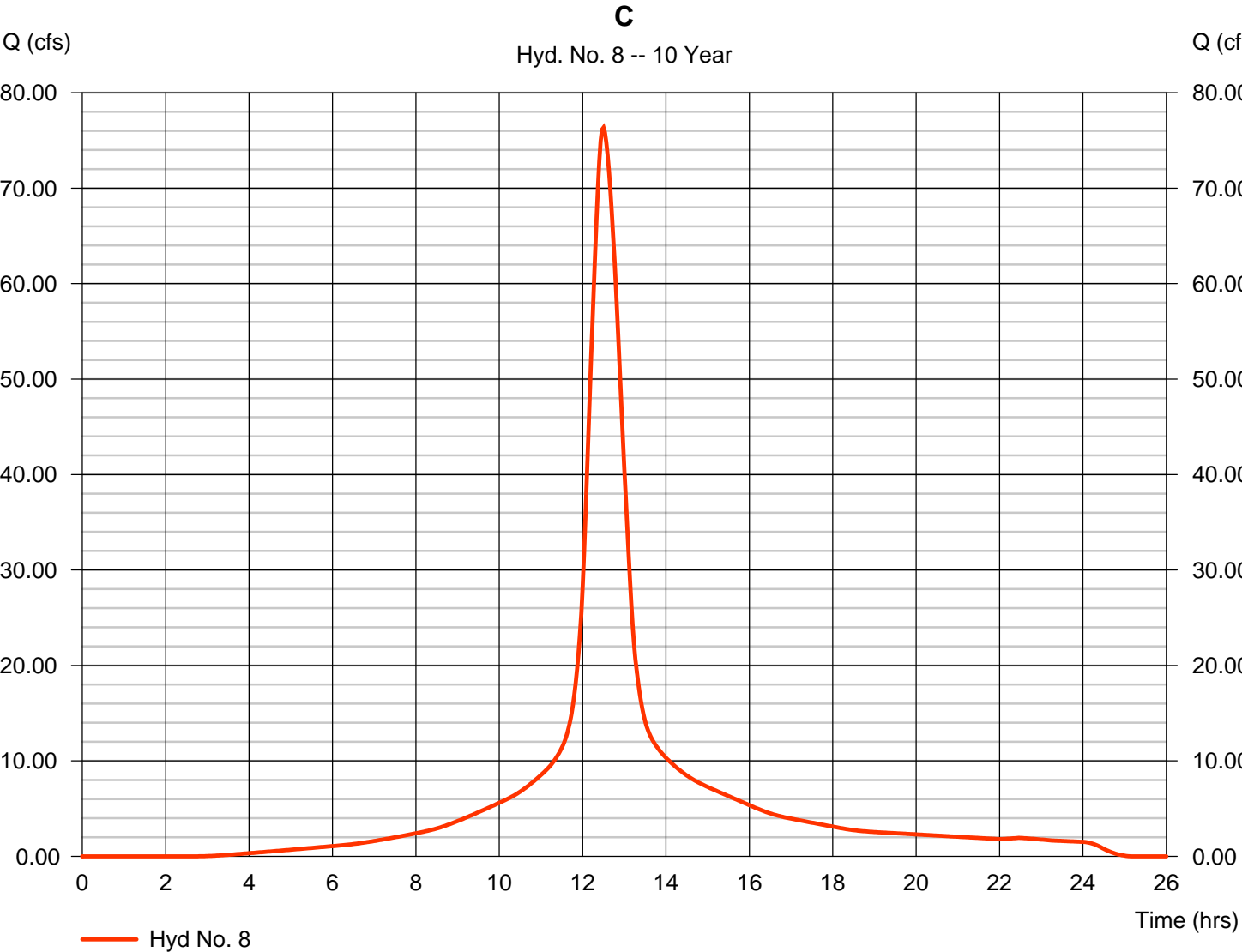


Hydrograph Report

Hyd. No. 8

C

Hydrograph type	= SCS Runoff	Peak discharge	= 76.35 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.50 hrs
Time interval	= 2 min	Hyd. volume	= 525,401 cuft
Drainage area	= 39.710 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 46.60 min
Total precip.	= 4.25 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

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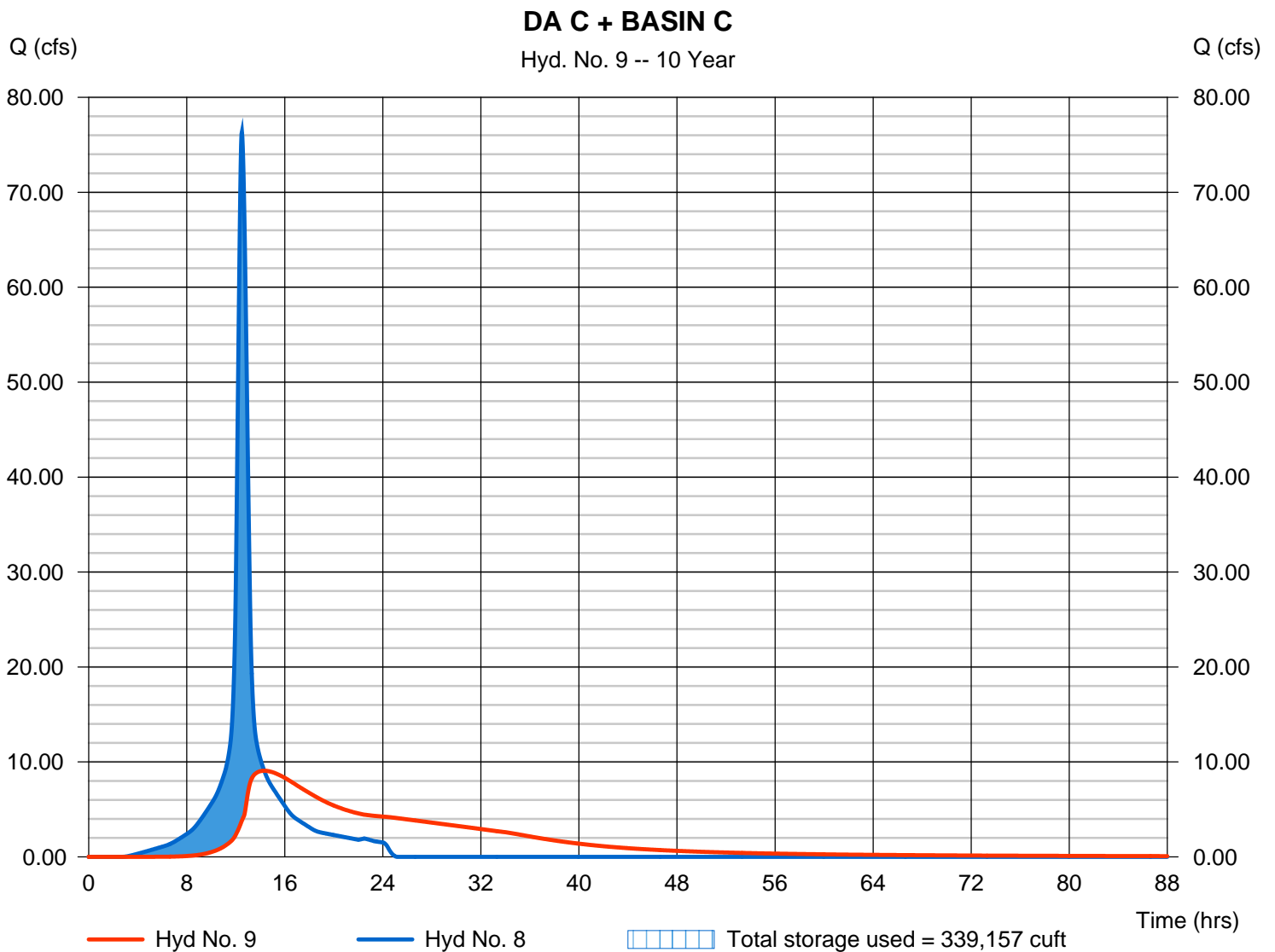
Hyd. No. 9

DA C + BASIN C

Hydrograph type = Reservoir
 Storm frequency = 10 yrs
 Time interval = 2 min
 Inflow hyd. No. = 8 - C
 Reservoir name = BASIN C

Peak discharge = 9.074 cfs
 Time to peak = 14.33 hrs
 Hyd. volume = 511,401 cuft
 Max. Elevation = 586.00 ft
 Max. Storage = 339,157 cuft

Storage Indication method used.



Hydrograph Summary Report

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

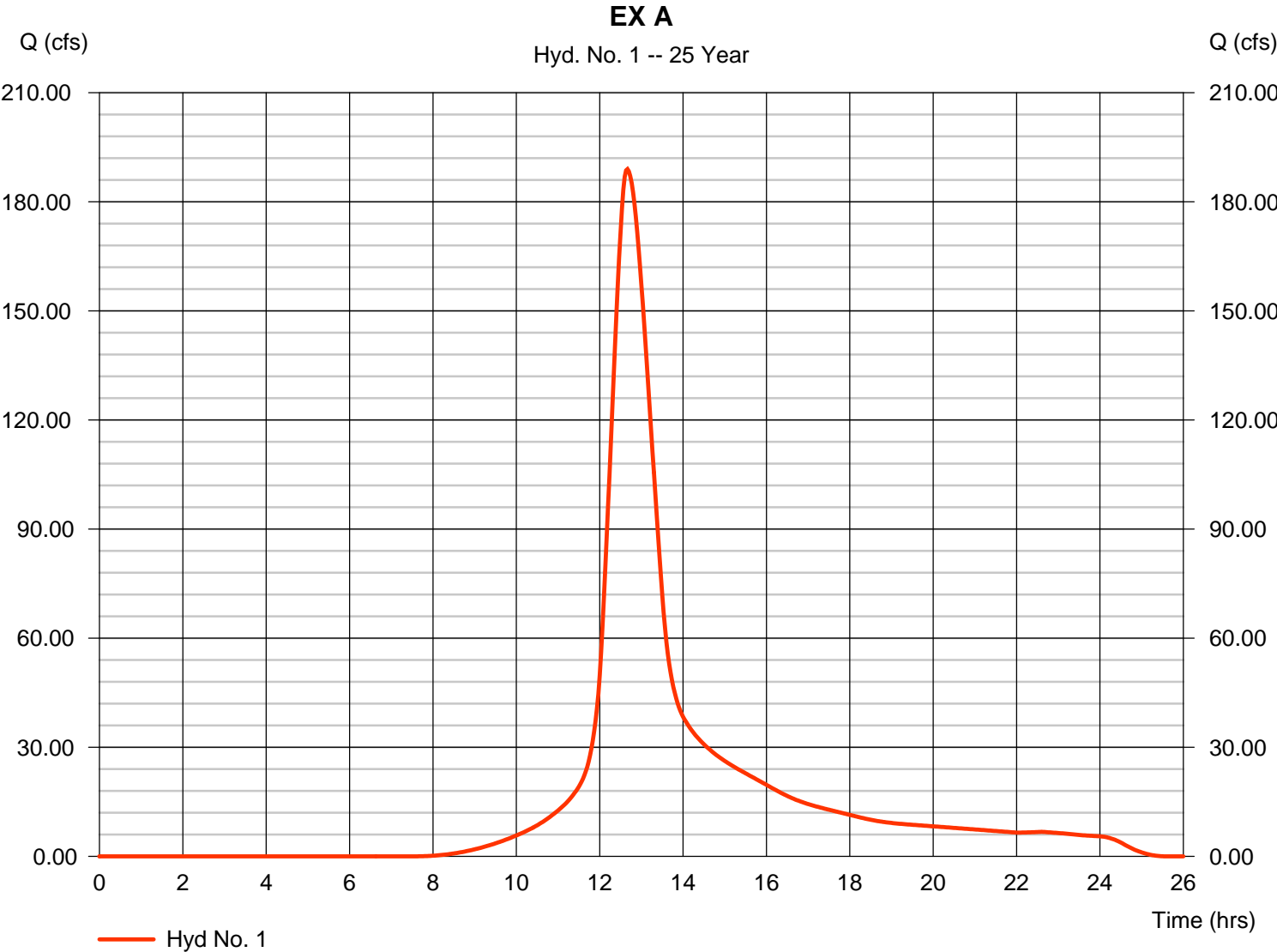
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	188.98	2	760	1,426,443	-----	-----	-----	EX A
2	SCS Runoff	130.67	2	760	986,303	-----	-----	-----	EX B
3	SCS Runoff	348.88	2	748	2,236,464	-----	-----	-----	A
4	SCS Runoff	160.15	2	740	854,398	-----	-----	-----	B
5	Reservoir	145.62	2	784	1,828,959	3	602.53	1,055,280	A + BASIN A
6	Reservoir	33.37	2	782	854,345	4	622.52	443,732	B + BASIN B
7	SCS Runoff	74.35	2	750	482,371	-----	-----	-----	EX C
8	SCS Runoff	105.74	2	750	740,468	-----	-----	-----	C
9	Reservoir	18.68	2	812	726,072	8	586.83	450,334	DA C + BASIN C
031.059_SCS.gpw					Return Period: 25 Year			Monday, 11 / 19 / 2018	

Hydrograph Report

Hyd. No. 1

EX A

Hydrograph type	= SCS Runoff	Peak discharge	= 188.98 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.67 hrs
Time interval	= 2 min	Hyd. volume	= 1,426,443 cuft
Drainage area	= 116.380 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 60.90 min
Total precip.	= 5.77 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

Monday, 11 / 19 / 2018

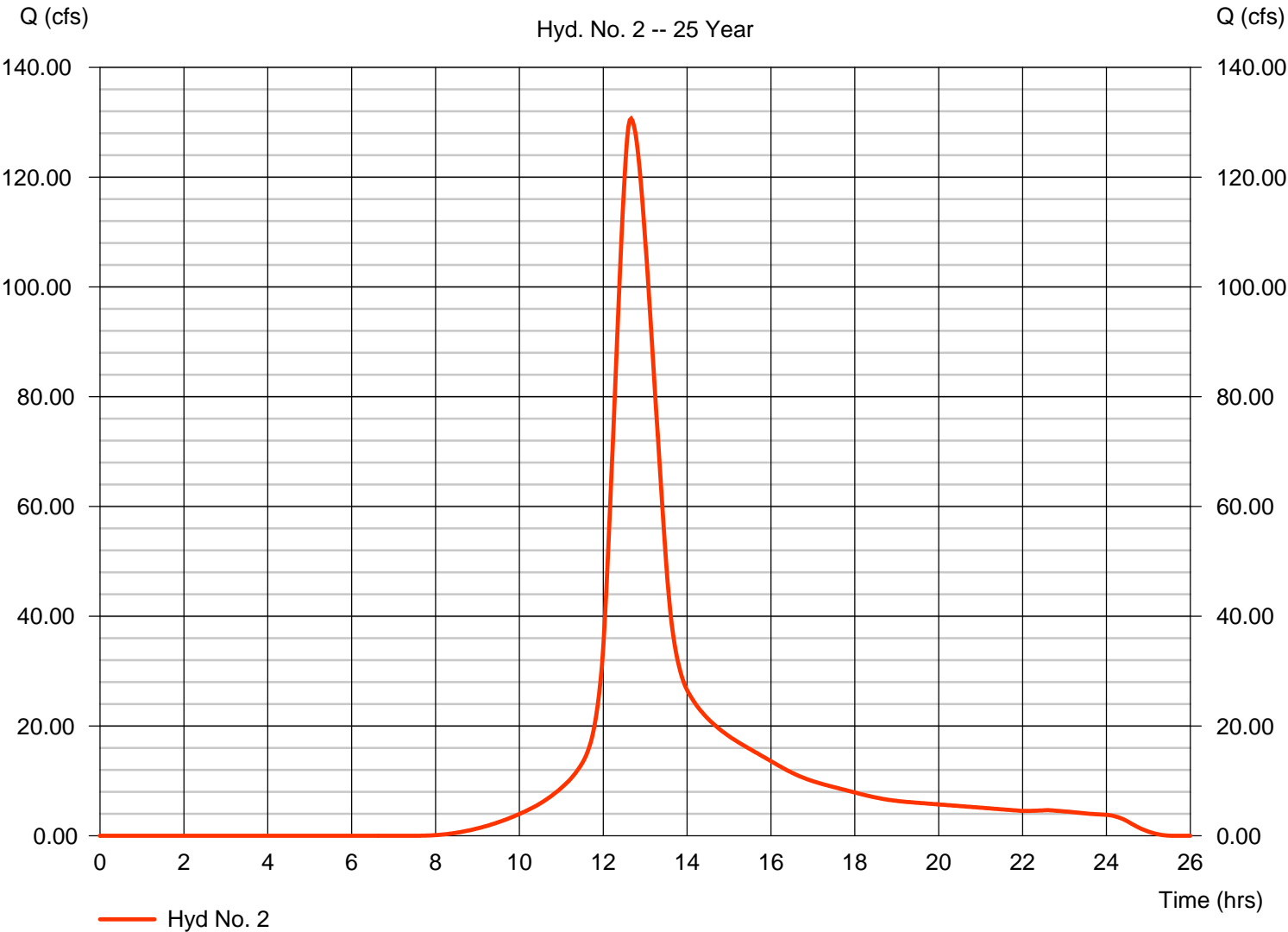
Hyd. No. 2

EX B

Hydrograph type	= SCS Runoff	Peak discharge	= 130.67 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.67 hrs
Time interval	= 2 min	Hyd. volume	= 986,303 cuft
Drainage area	= 80.470 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 58.70 min
Total precip.	= 5.77 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

EX B

Hyd. No. 2 -- 25 Year



Hydrograph Report

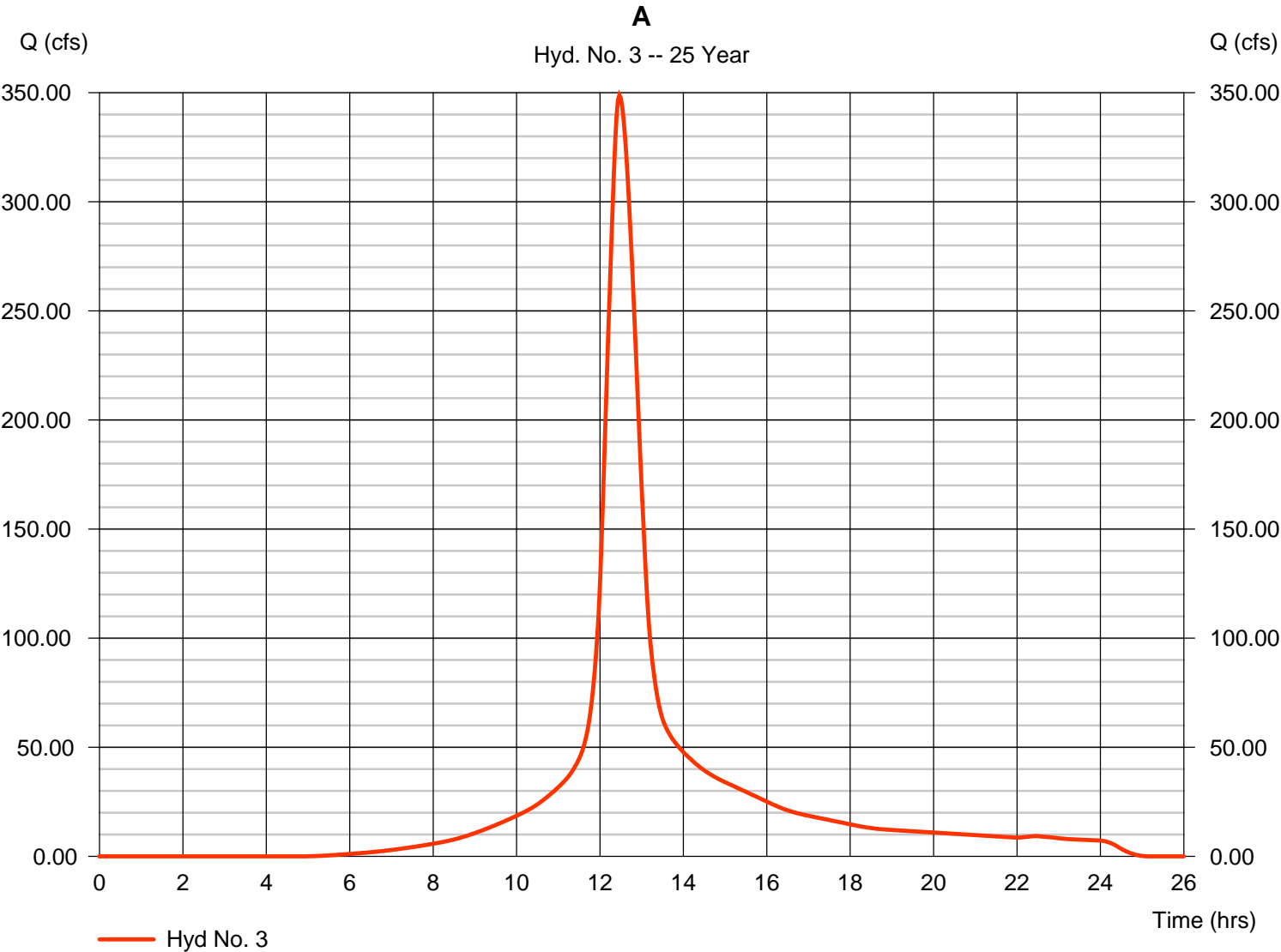
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 11 / 19 / 2018

Hyd. No. 3

A

Hydrograph type	= SCS Runoff	Peak discharge	= 348.88 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.47 hrs
Time interval	= 2 min	Hyd. volume	= 2,236,464 cuft
Drainage area	= 142.000 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 41.80 min
Total precip.	= 5.77 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

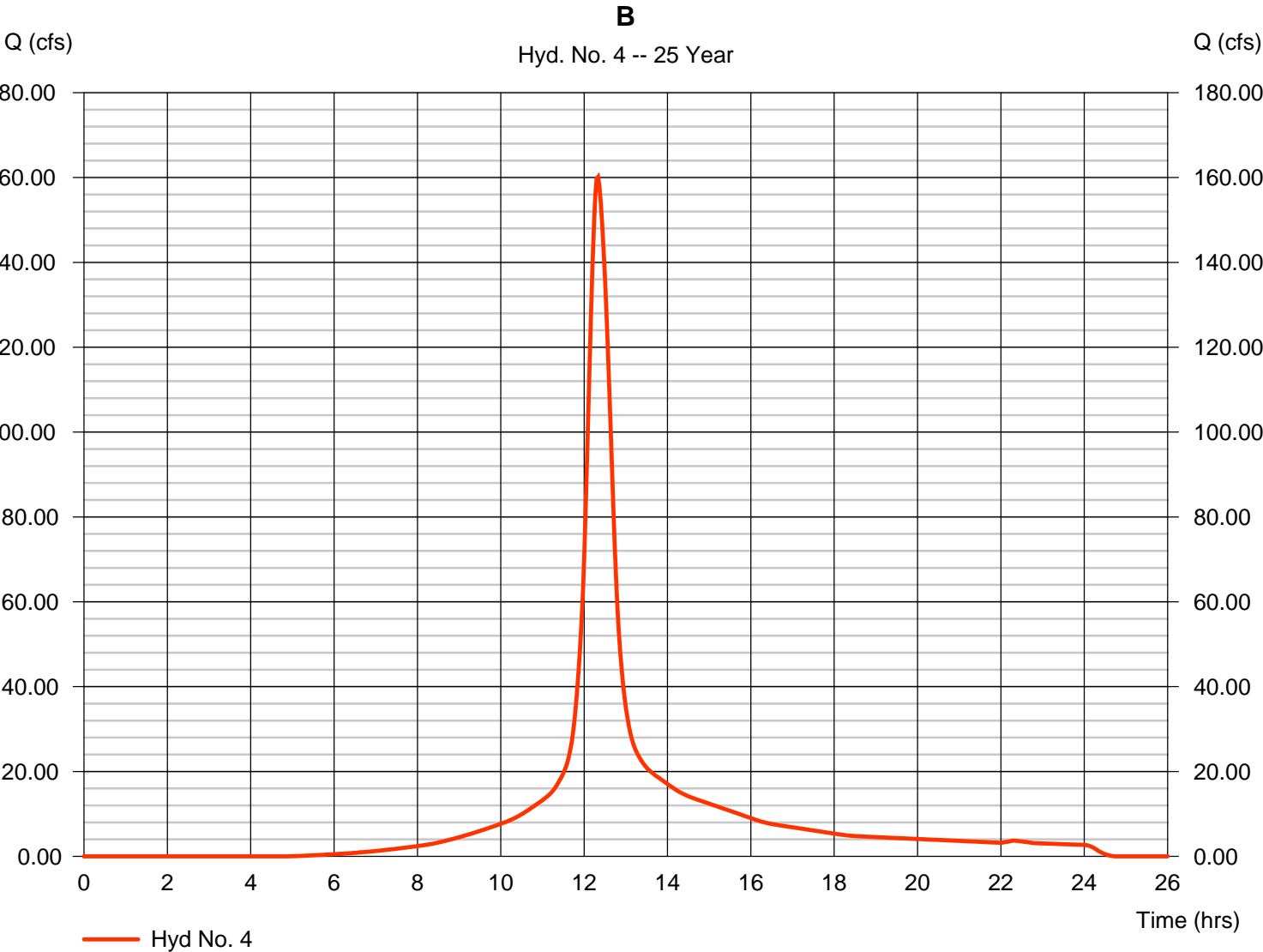
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 11 / 19 / 2018

Hyd. No. 4

B

Hydrograph type	= SCS Runoff	Peak discharge	= 160.15 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.33 hrs
Time interval	= 2 min	Hyd. volume	= 854,398 cuft
Drainage area	= 54.770 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.00 min
Total precip.	= 5.77 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

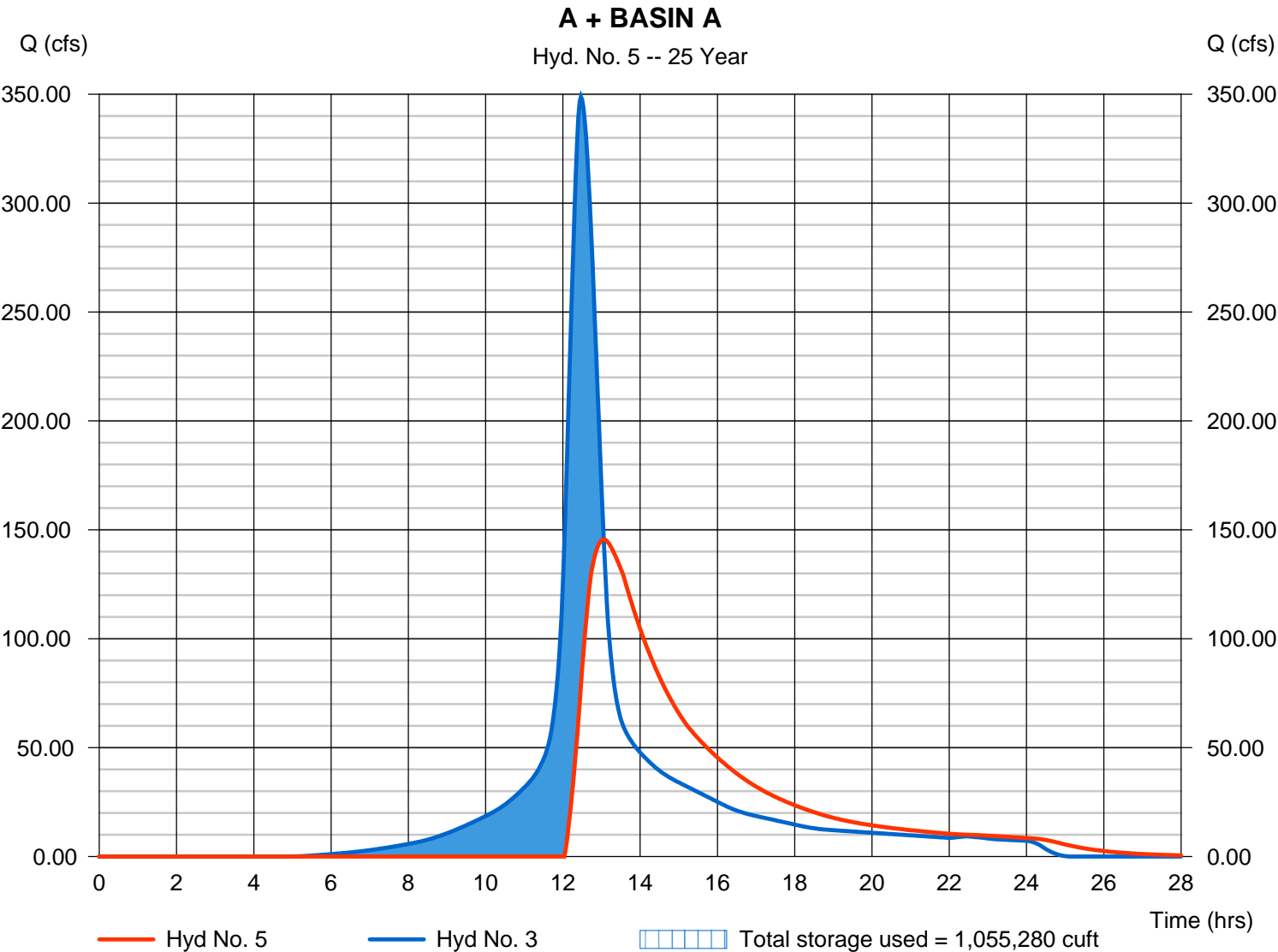
Monday, 11 / 19 / 2018

Hyd. No. 5

A + BASIN A

Hydrograph type	= Reservoir	Peak discharge	= 145.62 cfs
Storm frequency	= 25 yrs	Time to peak	= 13.07 hrs
Time interval	= 2 min	Hyd. volume	= 1,828,959 cuft
Inflow hyd. No.	= 3 - A	Max. Elevation	= 602.53 ft
Reservoir name	= BASIN A	Max. Storage	= 1,055,280 cuft

Storage Indication method used.



Hydrograph Report

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

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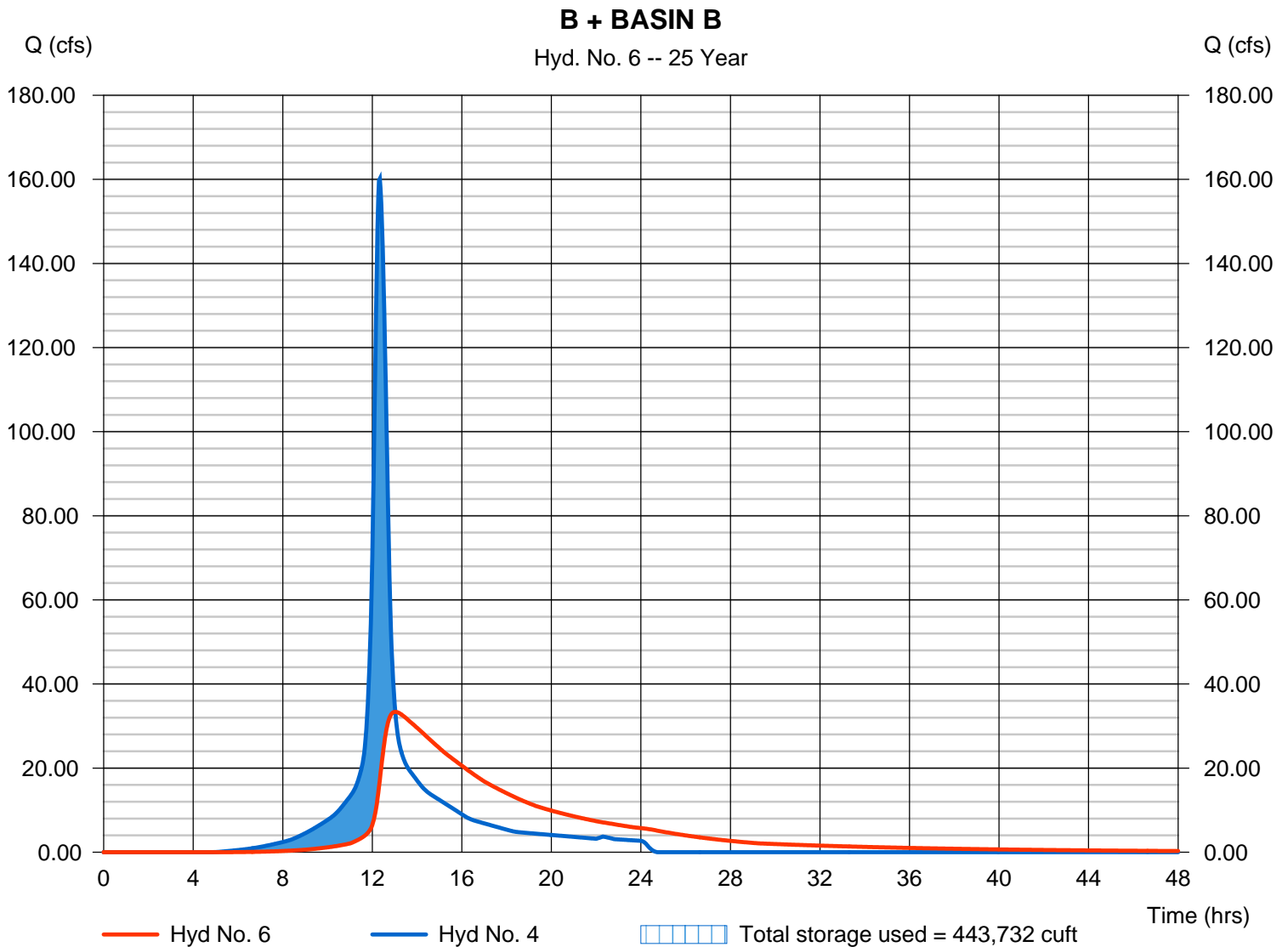
Hyd. No. 6

B + BASIN B

Hydrograph type = Reservoir
 Storm frequency = 25 yrs
 Time interval = 2 min
 Inflow hyd. No. = 4 - B
 Reservoir name = BASIN B

Peak discharge = 33.37 cfs
 Time to peak = 13.03 hrs
 Hyd. volume = 854,345 cuft
 Max. Elevation = 622.52 ft
 Max. Storage = 443,732 cuft

Storage Indication method used.

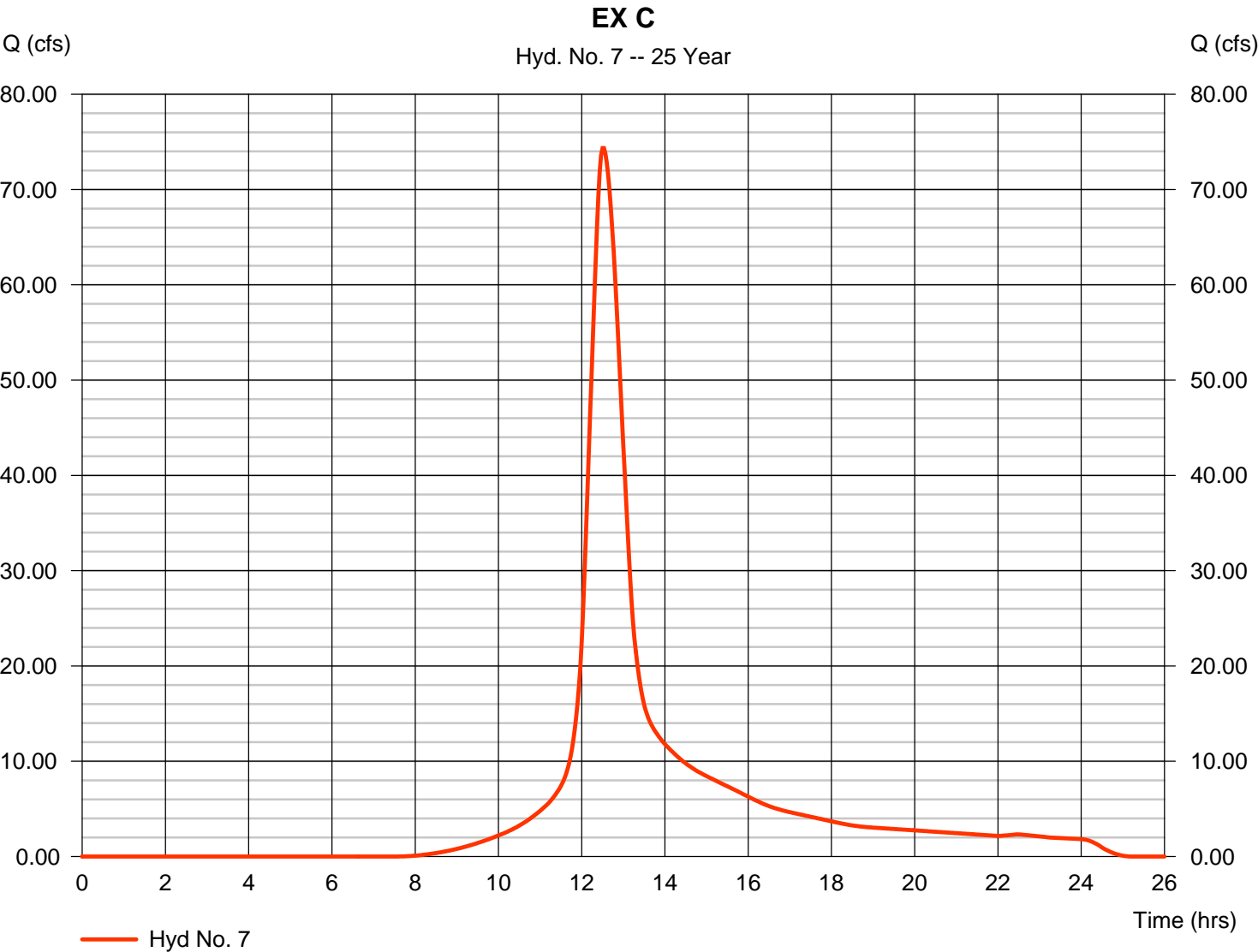


Hydrograph Report

Hyd. No. 7

EX C

Hydrograph type	= SCS Runoff	Peak discharge	= 74.35 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.50 hrs
Time interval	= 2 min	Hyd. volume	= 482,371 cuft
Drainage area	= 39.710 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 46.60 min
Total precip.	= 5.77 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

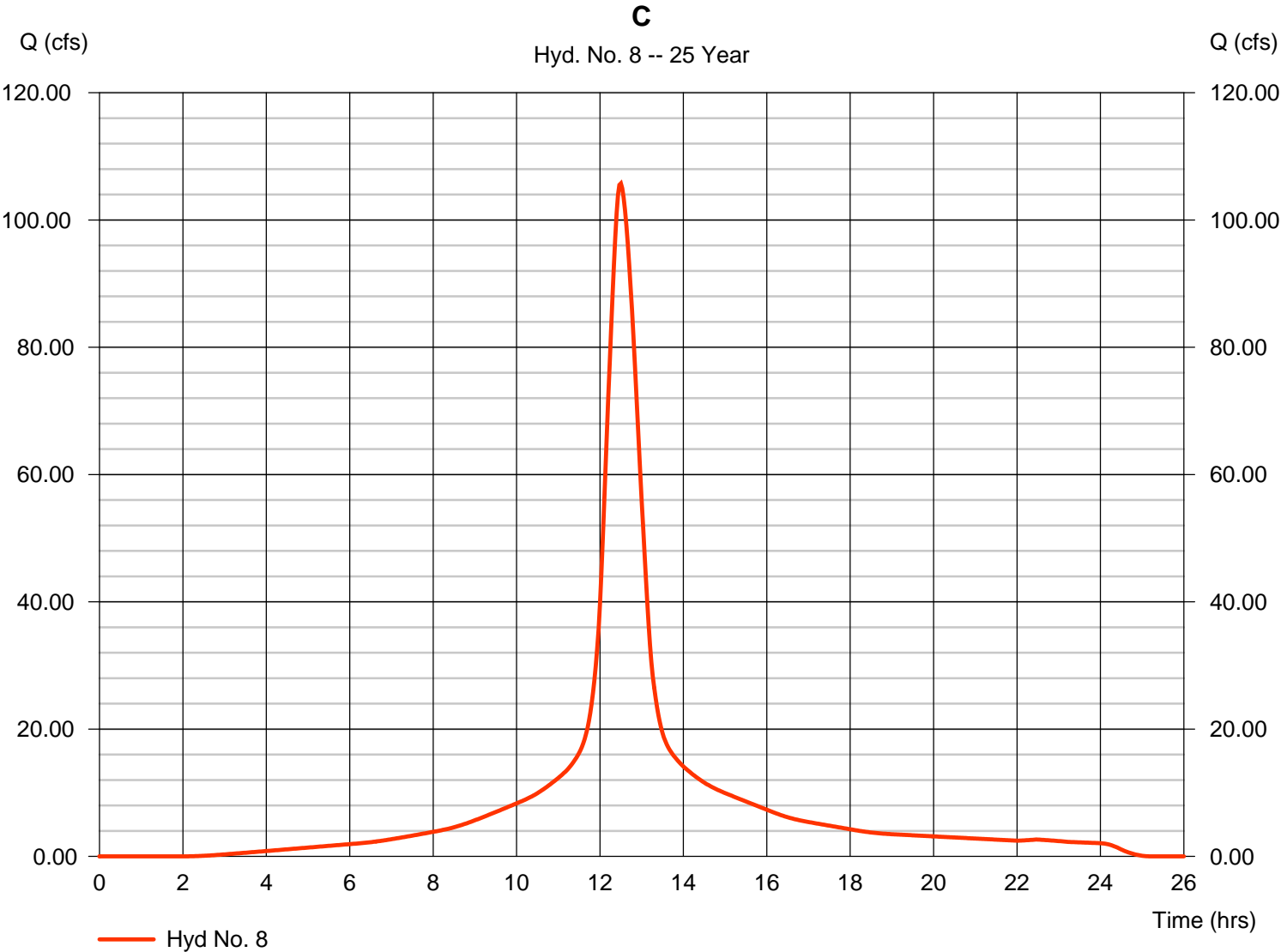


Hydrograph Report

Hyd. No. 8

C

Hydrograph type	= SCS Runoff	Peak discharge	= 105.74 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.50 hrs
Time interval	= 2 min	Hyd. volume	= 740,468 cuft
Drainage area	= 39.710 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 46.60 min
Total precip.	= 5.77 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

Monday, 11 / 19 / 2018

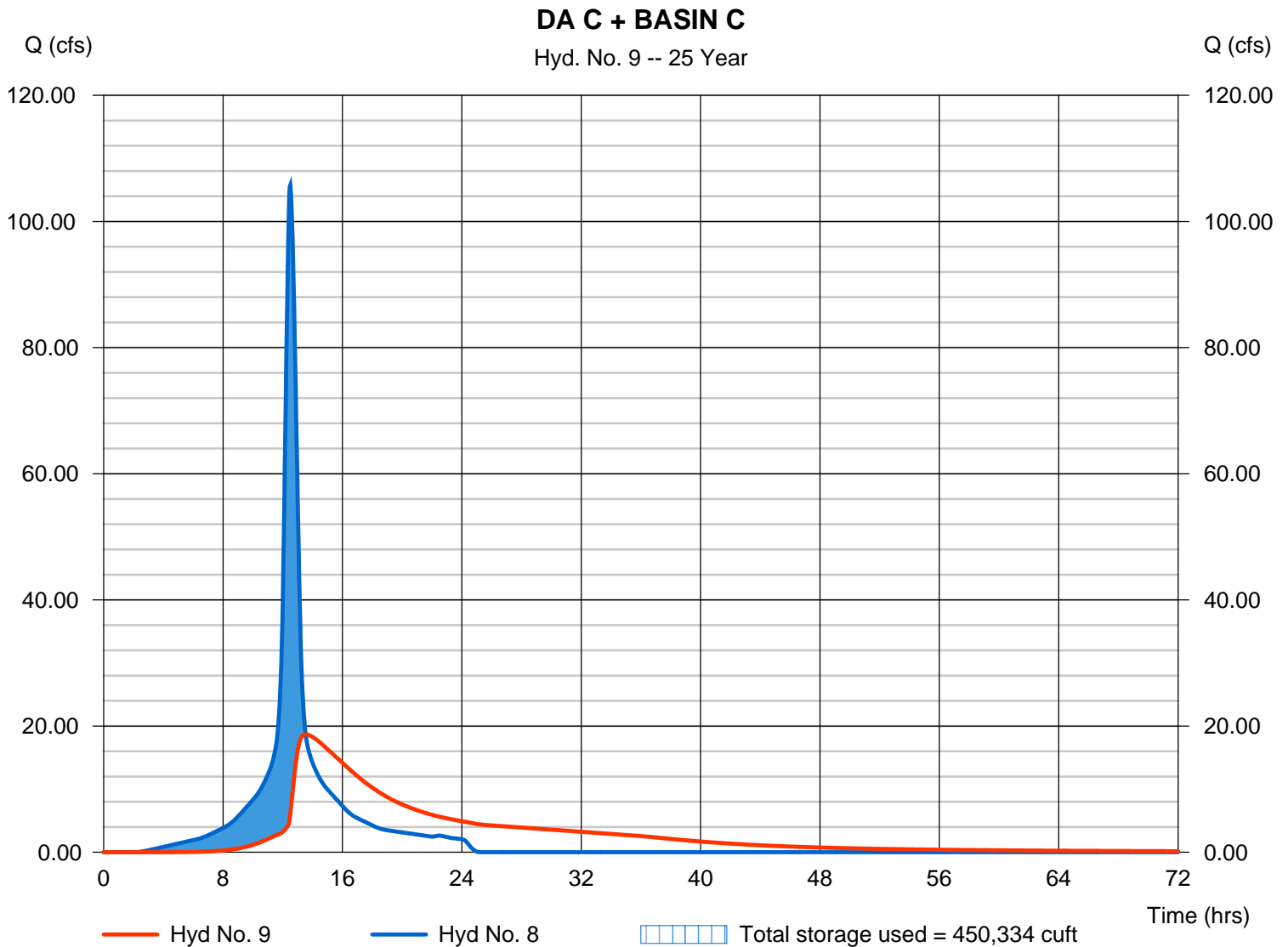
Hyd. No. 9

DA C + BASIN C

Hydrograph type = Reservoir
 Storm frequency = 25 yrs
 Time interval = 2 min
 Inflow hyd. No. = 8 - C
 Reservoir name = BASIN C

Peak discharge = 18.68 cfs
 Time to peak = 13.53 hrs
 Hyd. volume = 726,072 cuft
 Max. Elevation = 586.83 ft
 Max. Storage = 450,334 cuft

Storage Indication method used.



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	297.75	2	758	2,257,972	-----	-----	-----	EX A
2	SCS Runoff	205.88	2	758	1,561,256	-----	-----	-----	EX B
3	SCS Runoff	510.78	2	748	3,331,206	-----	-----	-----	A
4	SCS Runoff	234.08	2	740	1,272,623	-----	-----	-----	B
5	Reservoir	246.27	2	780	2,923,705	3	603.25	1,454,357	A + BASIN A
6	Reservoir	57.84	2	776	1,272,565	4	623.64	640,929	B + BASIN B
7	SCS Runoff	117.16	2	750	763,563	-----	-----	-----	EX C
8	SCS Runoff	147.54	2	750	1,050,239	-----	-----	-----	C
9	Reservoir	35.80	2	798	1,035,537	8	587.95	604,637	DA C + BASIN C
031.059_SCS.gpw					Return Period: 100 Year			Monday, 11 / 19 / 2018	

Hydrograph Report

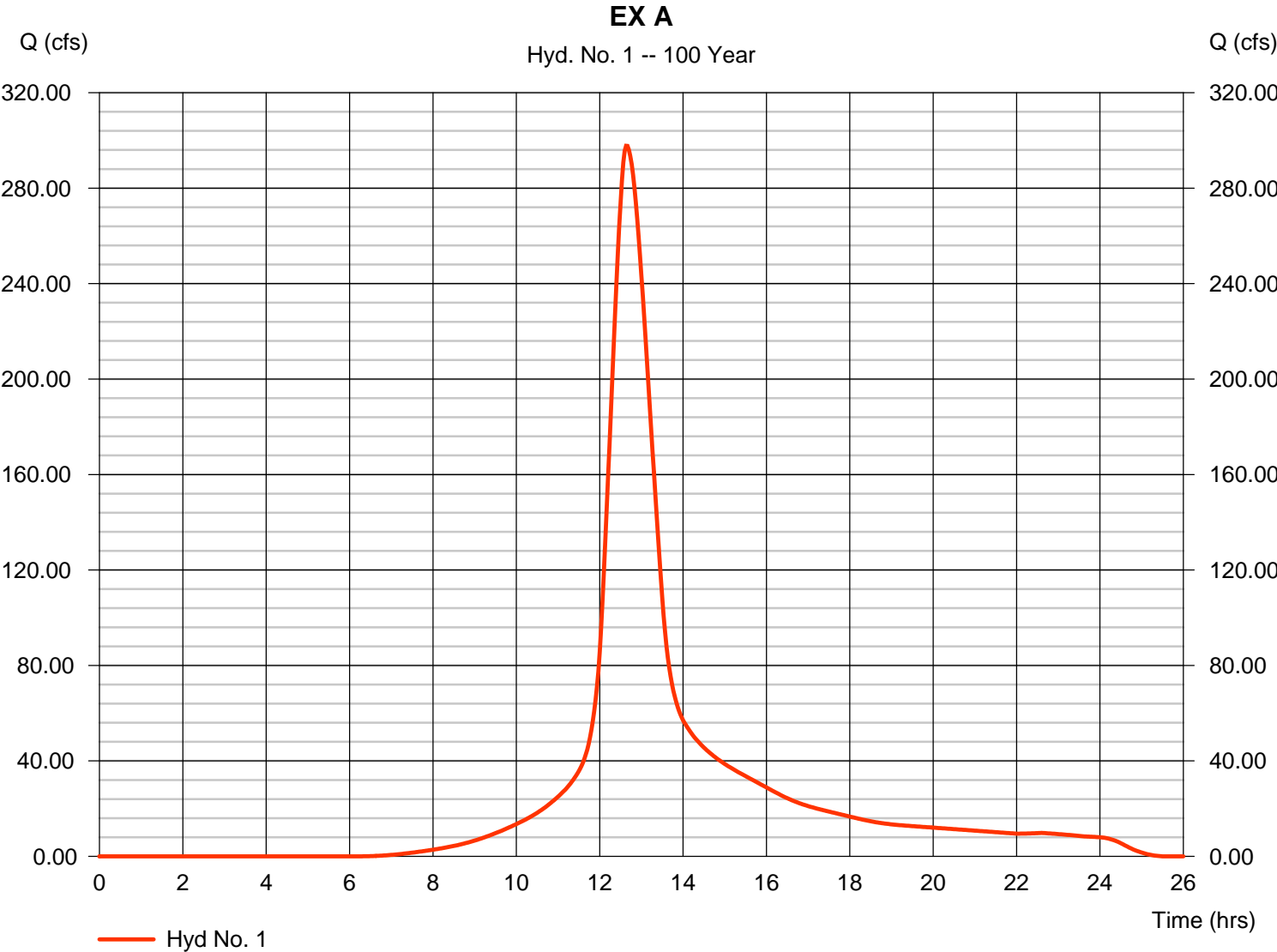
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 11 / 19 / 2018

Hyd. No. 1

EX A

Hydrograph type	= SCS Runoff	Peak discharge	= 297.75 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.63 hrs
Time interval	= 2 min	Hyd. volume	= 2,257,972 cuft
Drainage area	= 116.380 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 60.90 min
Total precip.	= 7.95 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

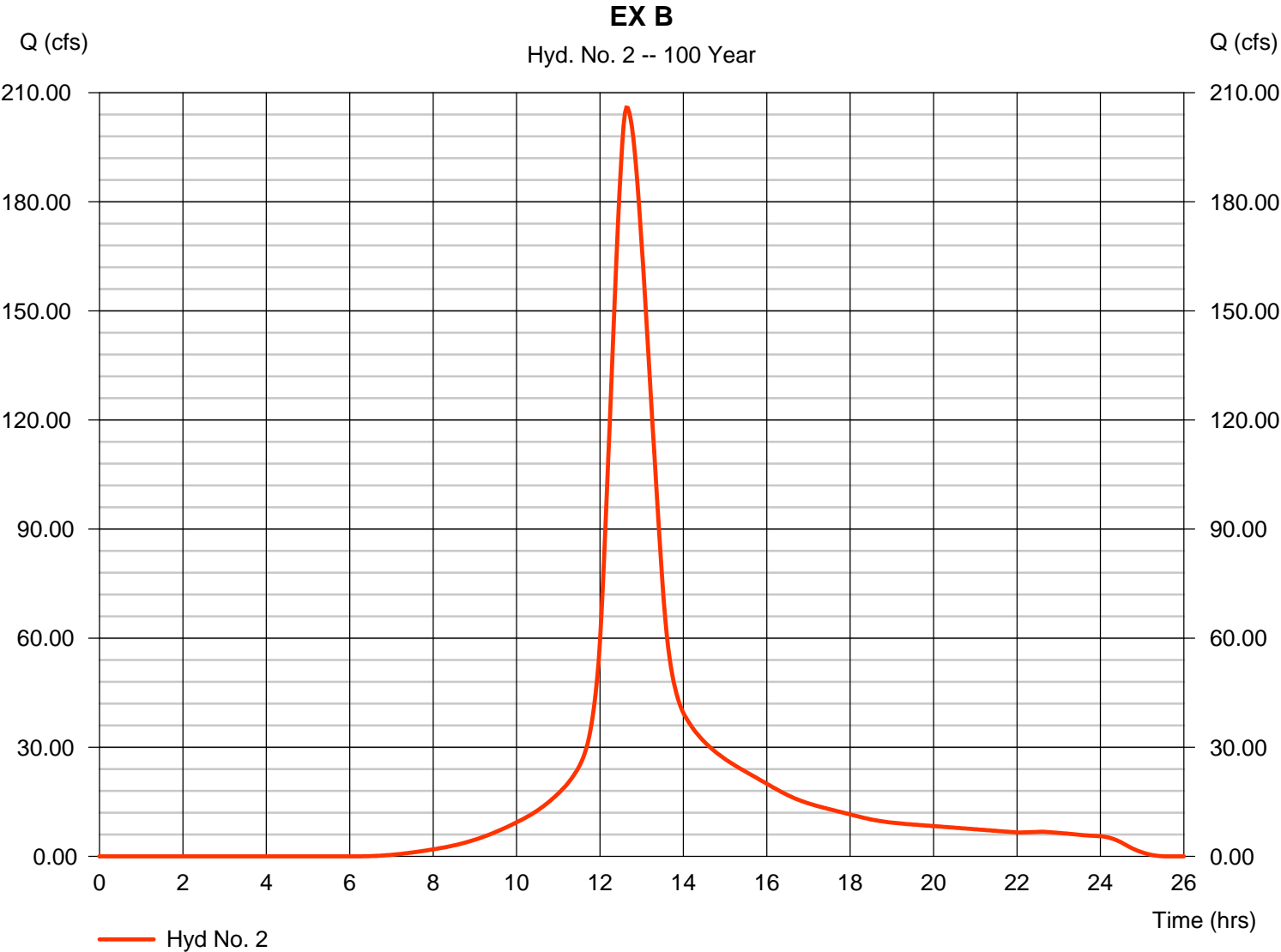


Hydrograph Report

Hyd. No. 2

EX B

Hydrograph type	= SCS Runoff	Peak discharge	= 205.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.63 hrs
Time interval	= 2 min	Hyd. volume	= 1,561,256 cuft
Drainage area	= 80.470 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 58.70 min
Total precip.	= 7.95 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

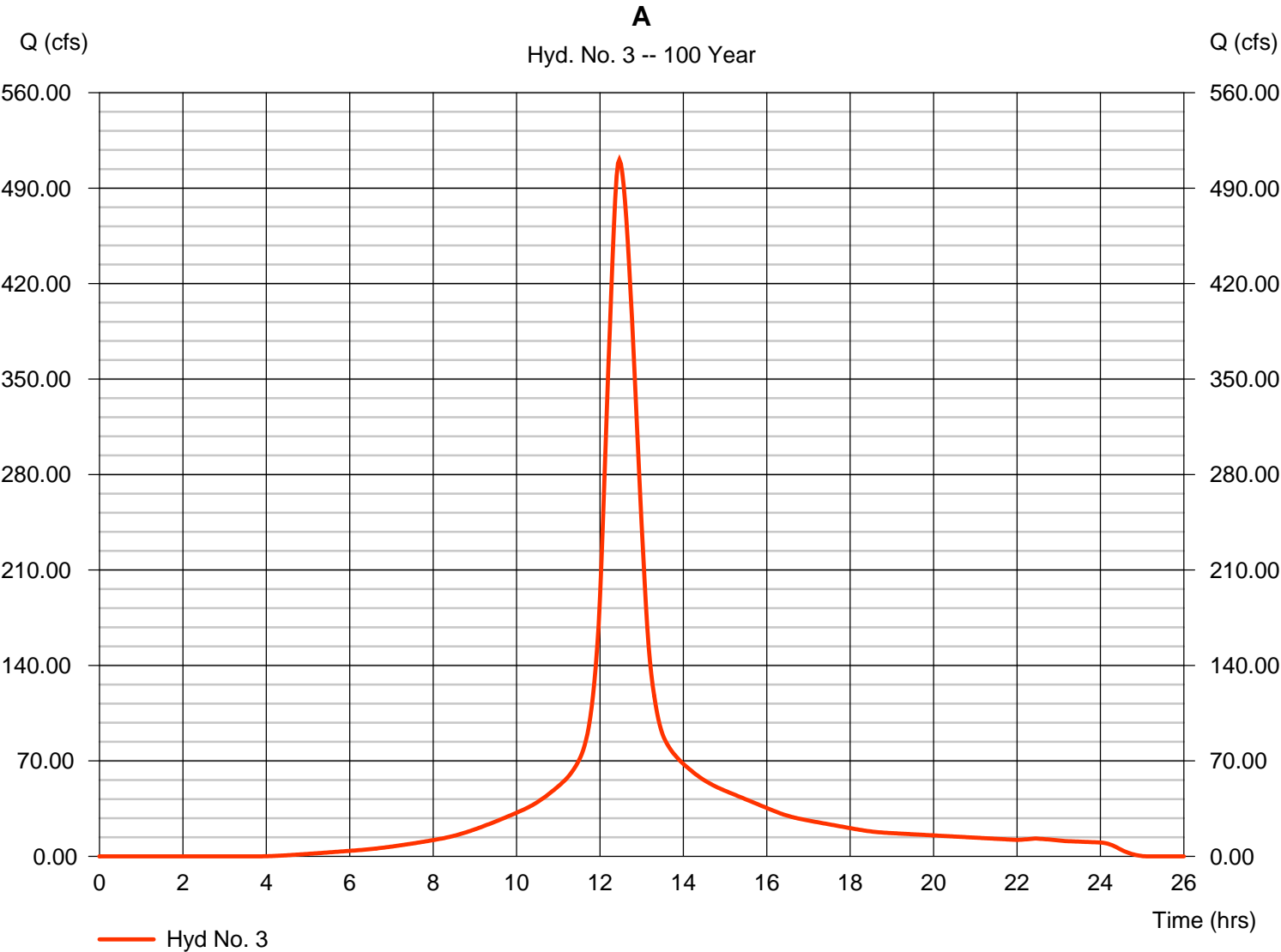
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 11 / 19 / 2018

Hyd. No. 3

A

Hydrograph type	= SCS Runoff	Peak discharge	= 510.78 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.47 hrs
Time interval	= 2 min	Hyd. volume	= 3,331,206 cuft
Drainage area	= 142.000 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 41.80 min
Total precip.	= 7.95 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

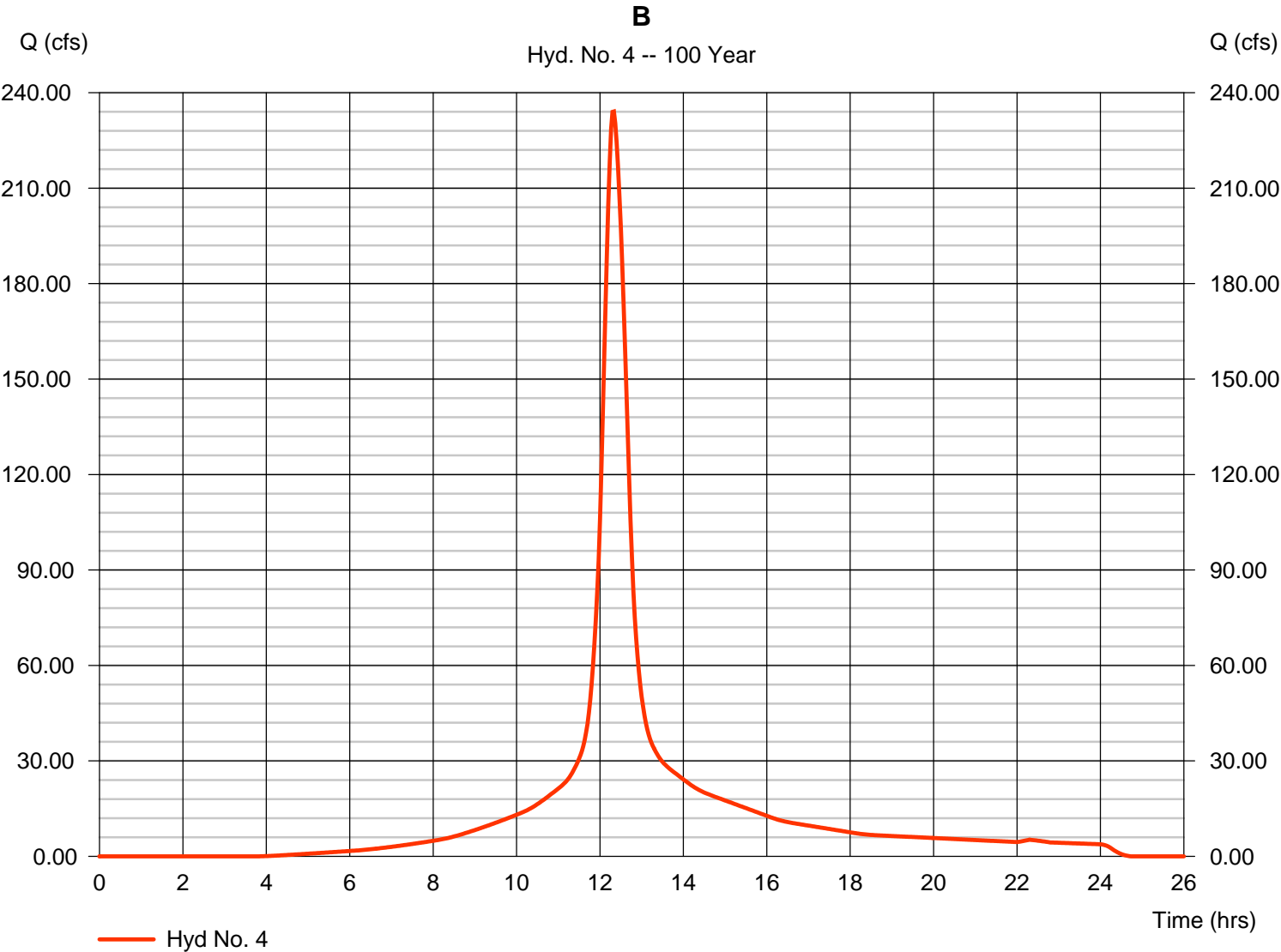
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 11 / 19 / 2018

Hyd. No. 4

B

Hydrograph type	= SCS Runoff	Peak discharge	= 234.08 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.33 hrs
Time interval	= 2 min	Hyd. volume	= 1,272,623 cuft
Drainage area	= 54.770 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.00 min
Total precip.	= 7.95 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

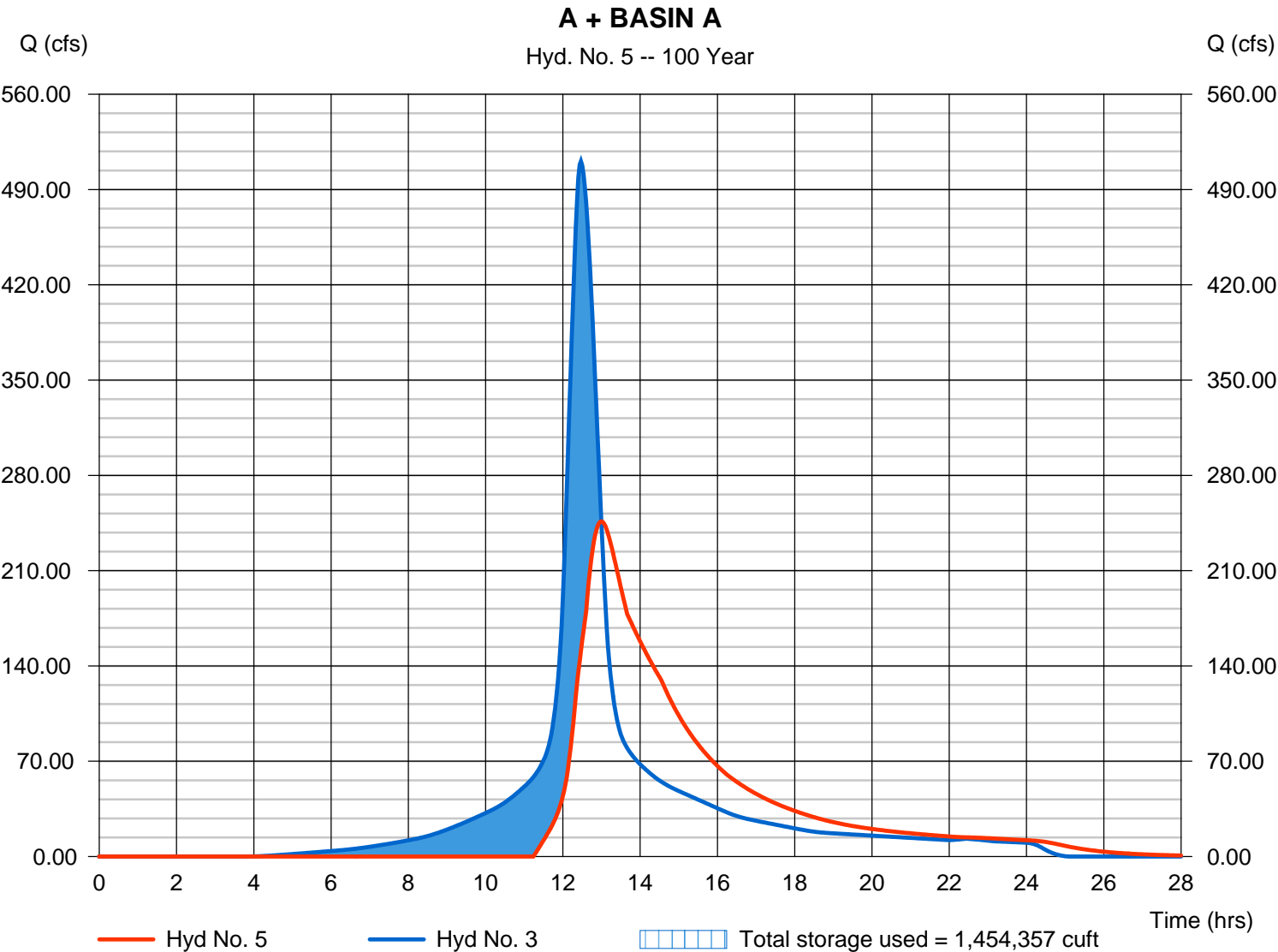
Monday, 11 / 19 / 2018

Hyd. No. 5

A + BASIN A

Hydrograph type	= Reservoir	Peak discharge	= 246.27 cfs
Storm frequency	= 100 yrs	Time to peak	= 13.00 hrs
Time interval	= 2 min	Hyd. volume	= 2,923,705 cuft
Inflow hyd. No.	= 3 - A	Max. Elevation	= 603.25 ft
Reservoir name	= BASIN A	Max. Storage	= 1,454,357 cuft

Storage Indication method used.



Hydrograph Report

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

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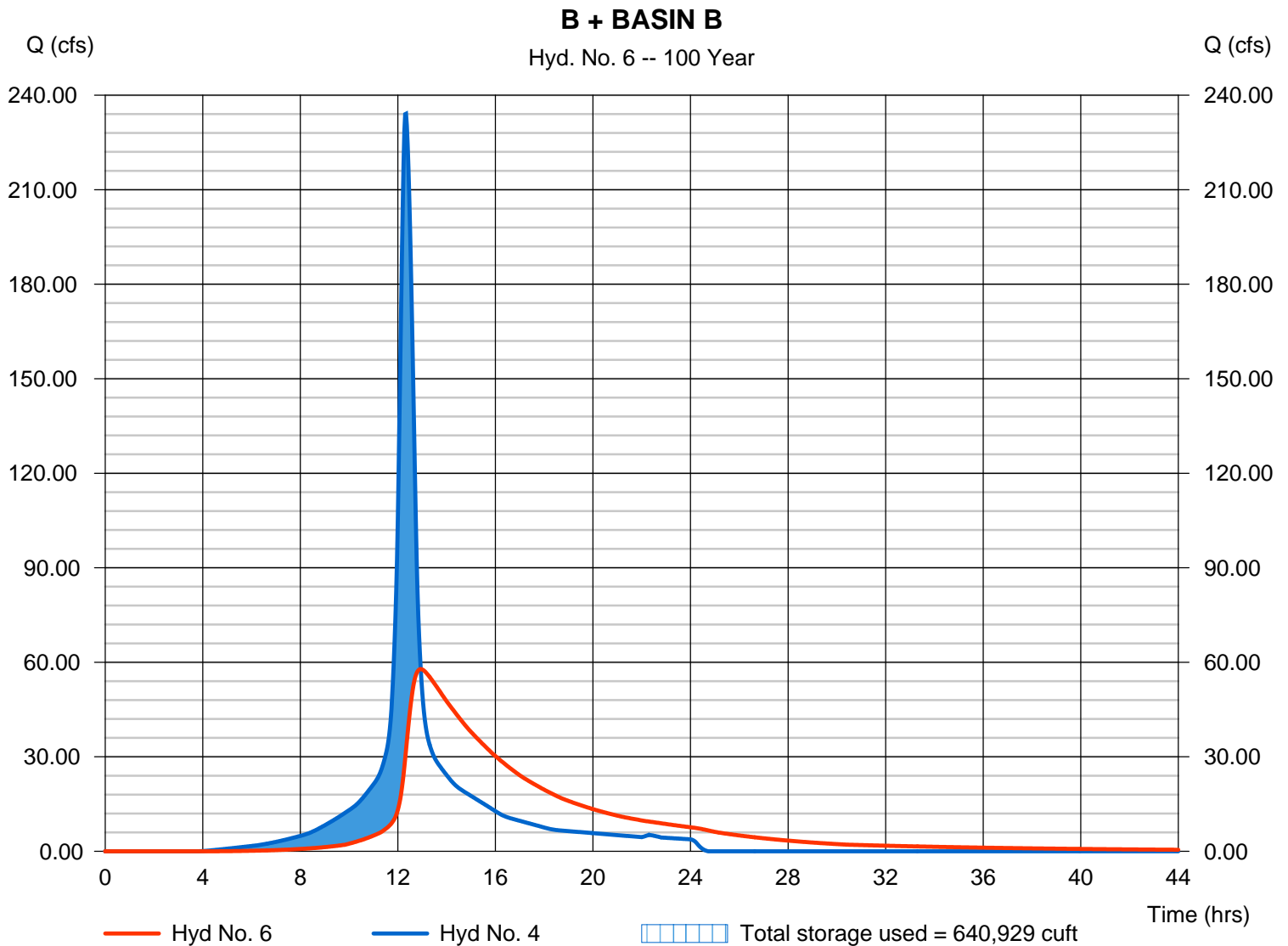
Hyd. No. 6

B + BASIN B

Hydrograph type = Reservoir
 Storm frequency = 100 yrs
 Time interval = 2 min
 Inflow hyd. No. = 4 - B
 Reservoir name = BASIN B

Peak discharge = 57.84 cfs
 Time to peak = 12.93 hrs
 Hyd. volume = 1,272,565 cuft
 Max. Elevation = 623.64 ft
 Max. Storage = 640,929 cuft

Storage Indication method used.

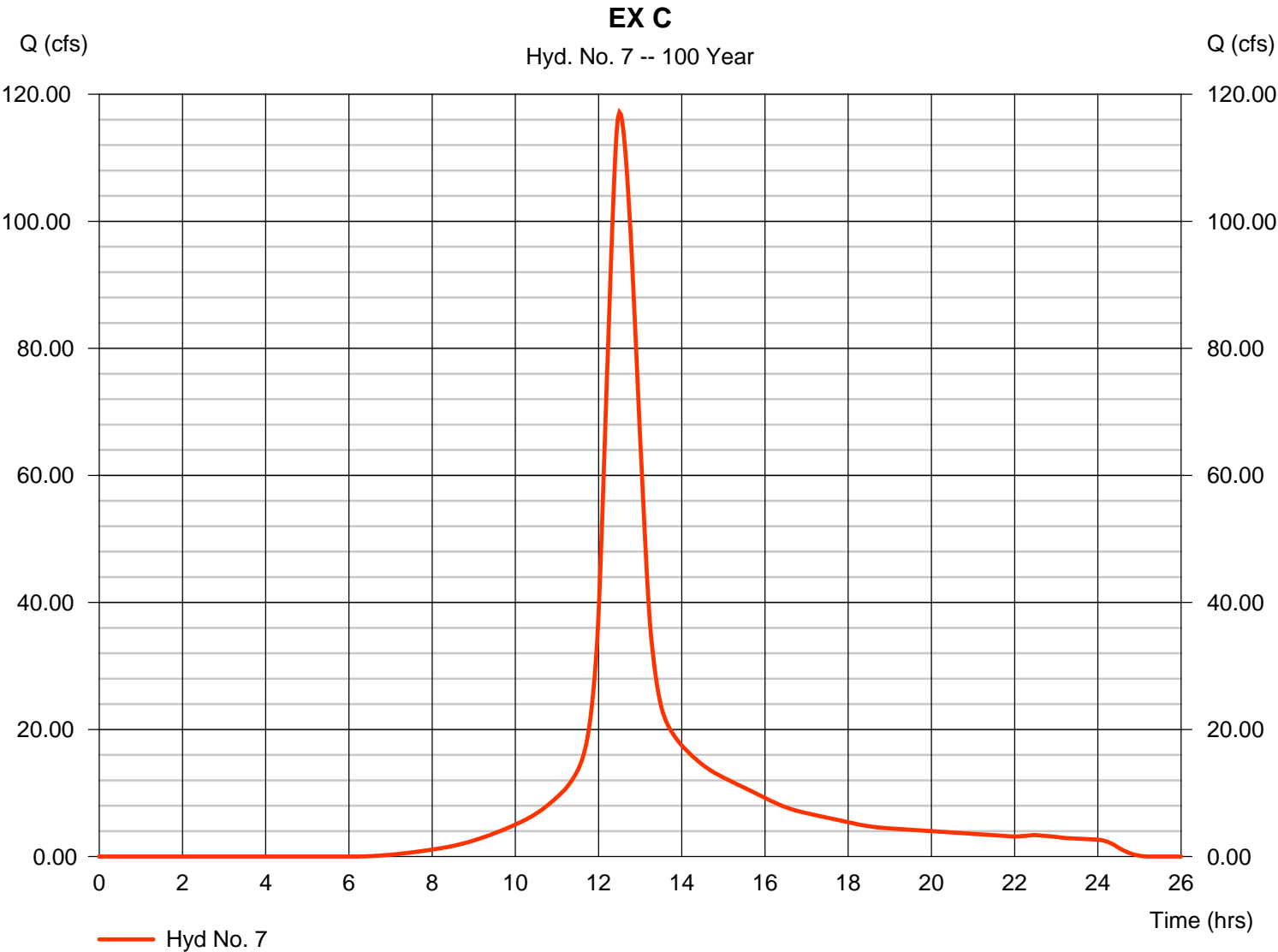


Hydrograph Report

Hyd. No. 7

EX C

Hydrograph type	= SCS Runoff	Peak discharge	= 117.16 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.50 hrs
Time interval	= 2 min	Hyd. volume	= 763,563 cuft
Drainage area	= 39.710 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 46.60 min
Total precip.	= 7.95 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

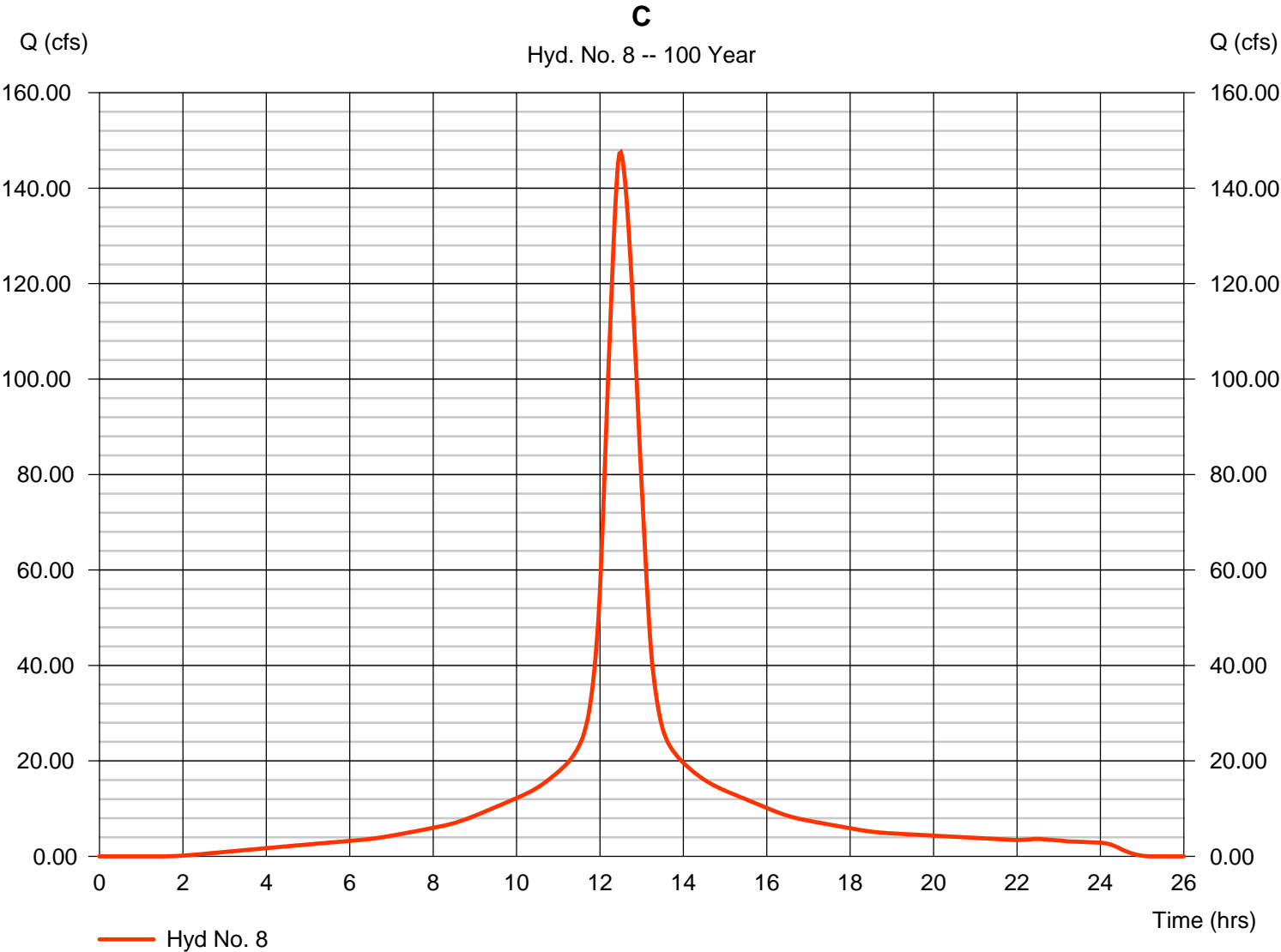
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 11 / 19 / 2018

Hyd. No. 8

C

Hydrograph type	= SCS Runoff	Peak discharge	= 147.54 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.50 hrs
Time interval	= 2 min	Hyd. volume	= 1,050,239 cuft
Drainage area	= 39.710 ac	Curve number	= 95
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 46.60 min
Total precip.	= 7.95 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

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

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Hyd. No. 9

DA C + BASIN C

Hydrograph type	= Reservoir	Peak discharge	= 35.80 cfs
Storm frequency	= 100 yrs	Time to peak	= 13.30 hrs
Time interval	= 2 min	Hyd. volume	= 1,035,537 cuft
Inflow hyd. No.	= 8 - C	Max. Elevation	= 587.95 ft
Reservoir name	= BASIN C	Max. Storage	= 604,637 cuft

Storage Indication method used.

