

DRAINAGE DESIGN SUMMARY

FOR

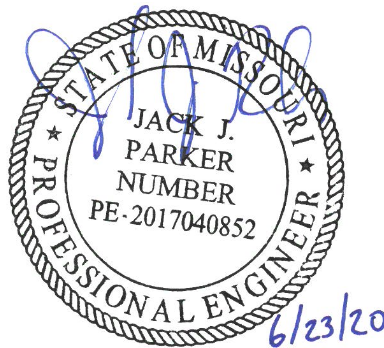
DCI Lee's Summit

Lee's Summit, Jackson County, Missouri

July 25, 2019

Revised August 23, 2019; November 6, 2019; November 26, 2019; January 8, 2020;

June 23, 2020



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DCI Lee's Summit

Lee's Summit, Jackson County, Missouri

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DCI Lee's Summit

Lee's Summit, Jackson County, Missouri

Drainage Design Summary

General Information

The proposed project consists of constructing a 10,220 sf +/- dialysis clinic with associated parking and site improvements. The existing site is located at 2023 NW Shamrock Avenue in Lee's Summit on Parcel ID 62-240-99-04-00-0-00-000. The property is bordered by NW Shamrock Avenue to the North and NW Pryor Road to the East. The project site is located within the southeast corner of Section 2, Township 47N, Range 32W in the Little Blue River watershed of Kansas City.

Methodology

The following methods were used in this drainage design study to model existing and proposed conditions for stormwater runoff:

- Hydraflow Hydrographs 2018 software
 - SCS/NRCS Curve Number Method
 - 24-Hour SCS Type II Rainfall Distribution
 - SCS TR-55 Method for Time of Concentration

Existing Conditions Analysis

Currently, the ±2.225-acre site is undeveloped with pasture-like land cover. The site is generally drains via sheet flow and shallow concentrated flow from the North to the Southeast corner of the property. Stormwater runoff exiting the site discharges into the existing public stormwater system in NW Pryor Road which eventually discharges into the Little Blue River.

In analyzing the existing conditions, the site was split into two drainage areas. The majority of the site is included in the North Drainage Area with the site outfall point in the Southeast corner of the property. Runoff from the North Drainage Area discharges into the public storm system in NW Pryor Road. The southern edge of the site is included in the South Drainage Area also with the site outfall point in the Southeast corner of the property. Runoff from the South Drainage Area discharges towards the neighboring property to the South and enters the public storm system further south along NW Pryor Road. Since both drainage areas discharge to the same final outfall, the public storm system in NW Pryor Road, the peak flows for the North and South Drainage Areas were combined in the analysis of the pre vs. post peak flows.

The North Drainage Area is 1.94 acres with a curve number of 84 and a time of concentration of 10.0 minutes. The South Drainage Area is 0.29 acres with a curve number of 84 and a time of concentration of 9.7 minutes.

The project site does not lie within a special flood hazard area per the federal emergency management agency, (FIRM) map no. 29095C0416G dated January 20, 2017.

The majority of the existing soil within the project site is Greenton-Urban land complex. A sliver of the existing soil near the Northwest corner of the property is Sharpsburg-Urban land complex. Both soil types are classified as Type D soil. The NRCS Soils Map can be found in Attachment 5.

A pre-developed drainage area map is included in Attachment 1 for a detailed view of the pre-developed site. Routing calculations produced by Hydraflow Hydrographs 2018 software are included in Attachment 2.



The pre-development flows to the site outfall point is as follows:

Pre-Development Peak Flows	
Storm Event	Existing Site Peak Flows (cfs)
2-year	6.3
10-year	11.4
100-year	18.2

Proposed Conditions Analysis

The proposed project consists of constructing a 10,220 sf +/- dialysis clinic with associated parking and site improvements. The proposed dialysis clinic is to be located centrally on the site. Proposed stormwater runoff is to be directed via sheet flow, shallow concentrated flow, and channel flow to an extended dry detention pond that is to be located at the south end of the site. A small portion of the south and eastern edge of the site will bypass the proposed extended dry detention pond and discharge to the public storm system along NW Pryor Road as in the existing conditions. A post-developed drainage area map is included in Attachment 1 for a detailed view of the post-developed site.

Detention and Water Quality Analysis

Per Section 5600 of the Kansas City Metropolitan Chapter APWA Standard Specification & Design Criteria manual, the maximum post-developed peak discharge rates from any development shall not exceed those as follows:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

Also, for comprehensive control a 40-hour extended detention of runoff from the local 90% mean annual event (1.37"/24-hour rainfall) must be achieved for the water quality volume.

The required water quality treatment volume was calculated to be 5,015 cf (0.115 ac-ft). See Attachment 4 for the water quality treatment volume calculations.

The proposed BMP practice chosen for this site is the extended dry detention basin. Calculations were generated following Chapter 8.10 of the Manual of Best Management Practices for Stormwater Quality. The proposed extended dry detention pond has a volume of 19,672 cf. The water quality treatment volume to be discharged over 40 hours is met at the elevation 963.5 in the proposed pond. The proposed outlet structure in the pond is to consist of a perforated riser with 6 holes with 4" vertical spacing up to the treatment volume elevation. Stormwater runoff exceeding the water quality treatment volume will discharge through two 6" orifices at an elevation of 963.8 and then a 24" pipe to the existing storm system in NW Pryor Road. The grated casting of the outlet structure is set at 966.20 to serve as an additional emergency overflow weir just above the 100 year storm elevation calculated to be 966.12 per the Hydraflow Hydrographs model which provides 2.68' of freeboard in normal operation. This grated casting on the primary outlet is also designed to operate in conjunction with an emergency spillway located on the East edge of the pond set at elevation 966.7 to pass the 100-Year storm from the contributing drainage area, however to be conservative the grated inlet was not utilized in the routing of the 100-year clogged/zero available storage condition and is solely routed through the earthen berm emergency spillway which result in a maximum water elevation of 967.0. The top of berm elevation for the proposed pond is 968.8 providing 1.8' of freeboard exceeding the minimum 1' of freeboard to the top of the berm assuming zero available storage in the ponds and zero flow through the primary outlet. See Attachment 2 for detention routing calculations. An additional Hydraflow Hydrographs Report has been provided for the clogged/zero available storage condition.



The overall post-development peak flows to the outfall are as follows:

Post-Development Peak Flows	
Storm Event	Proposed Site Peak Flows (cfs)
2-year	1.1
10-year	3.6
100-year	5.7

Storm Drainage Design

All stormwater pipes and structures have been designed to convey the 10-year storm event. Tailwater elevations were considered to be between the crown and critical depth of the pipes.

Pipe and structures calculations were compiled using Hydraflow Storm Sewers 2018 software and are included as Attachment 3. An Inlet Drainage Area Map detailing the areas discharging to each proposed inlet is included in Attachment 1.

Downstream Structure Analysis

The receiving storm system has been analyzed to ensure that the proposed development will not adversely impact the existing downstream system. The Inlet Drainage Area Map in Attachment 1 includes the drainage area for the receiving storm system, which is the 24" RCP leaving the proposed tie in structure (AI #1202) that runs south. The system has a capacity of 22.62 CFS at 1% slope. This capacity was calculated per Manning's Equation for full pipe flow as shown below:

$$Q_{cap} = VA$$

$$V = \frac{k}{n} \left(\frac{A}{P} \right)^{2/3} s^{1/2}$$

Where:

Q_{cap} = full flow capacity

V = Average velocity in the pipe

A = Area of pipe

k = Unit conversion factor: k=1.49 for English units

P = Perimeter of pipe

s = Downward slope of pipe

n = Manning's Roughness Coefficient

For the 10-Year Storm Event, the Lee's Summit Fire Station #3 (to the west of the site) is expected to send 2.16 cfs to structure AI #1202, per the development's Storm Water Drainage Study dated 01/16/2018. In addition, per this study the DCI project is expected to send 3.4 cfs to structure AI #1202 for the 10-year storm event. The 3.95-acre offsite drainage area is expected to send approximately 8.96 cfs to structure AI #1202 for the 10-year storm event. In total, the receiving storm system is expected to have a flow rate of 14.52 cfs for the 10-year storm event, which is well below the pipe's capacity.



Conclusions and Recommendations

The stormwater management system for the proposed development has been designed per Section 5600 of the Kansas City Metropolitan Chapter APWA Standard Specifications Design Criteria and the Manual of Best Management Practices for Stormwater Quality. Due to the increase in impervious area for the proposed development, water quality and detention requirements are to be met by the use of a proposed extended dry detention basin located on the South portion of the project site. The water quality treatment volume calculated to be 5,015 cf is to be released over 40 hours through a perforated riser. The detention requirements specify maximum release rates based on the lesser of either pre-developed peak flow rates or a predetermined flow rate per site acreage. The post-developed peak flow rates calculated for the 2-year, 10-year, and 100-year storm events are less than their respective allowable peak flow rates. The extended dry detention pond also has more than 2 feet of freeboard for all storm events in order to provide exceptional flood protection during extreme storm events.

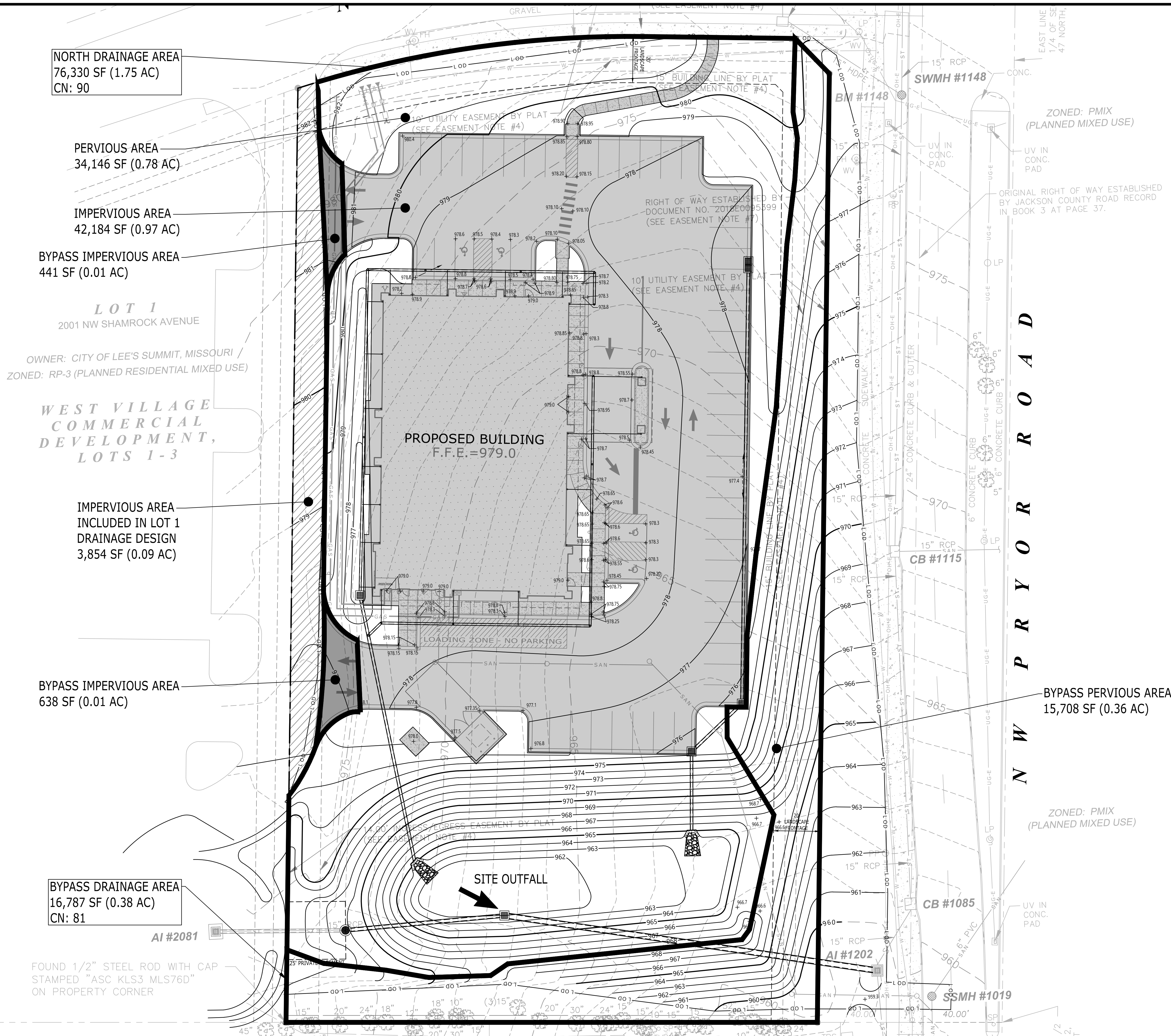
Pre- and Post- Peak Flows Comparison					
Storm Event	Pre-dev. Peak Flow (cfs)	Allowable Post-Dev. Peak Flow (cfs)		Post-Dev. Peak Flows (cfs)	Difference (+/-)
2-year	6.3	(0.5 cfs/2.225 ac)	1.1	1.1	-0.0
10-year	11.4	(2.0 cfs/2.225 ac)	4.5	3.6	-0.9
100-year	18.2	(3.0 cfs/2.225 ac)	6.7	5.7	-1.0

Attachments:

- Attachment 1 Site Drainage Area Maps
- Attachment 2 Hydraflow Hydrographs Routing Calculations
- Attachment 3 Hydraflow Storm Sewers Calculations
- Attachment 4 Water Quality Calculations
- Attachment 5 Supporting Documents

Attachment 1
Site Drainage Area Maps

P:\2018\20180111\Engineering\dwg\20180111_2019-11-01_Post Drainage Area Map.dwg-POST Nov. 01, 2019 cwalker



NORTH DRAINAGE AREA
76,330 SF (1.75 AC)
CN: 90

PERVIOUS AREA
34,146 SF (0.78 AC)

IMPERVIOUS AREA
42,184 SF (0.97 AC)

BYPASS IMPERVIOUS AREA
441 SF (0.01 AC)

LOT 1
2001 NW SHAMROCK AVENUE
OWNER: CITY OF LEE'S SUMMIT, MISSOURI /
ZONED: RP-3 (PLANNED RESIDENTIAL MIXED USE)

**WEST VILLAGE
COMMERCIAL
DEVELOPMENT,
LOTS 1 - 3**

IMPERVIOUS AREA
INCLUDED IN LOT 1
DRAINAGE DESIGN
3,854 SF (0.09 AC)

BYPASS IMPERVIOUS AREA
638 SF (0.01 AC)

BYPASS DRAINAGE AREA
16,787 SF (0.38 AC)
CN: 81

FOUND 1/2" STEEL ROD WITH CAP
STAMPED "ASC KLS3 MLS76D"
ON PROPERTY CORNER

NOTE: TIME OF CONCENTRATION CONSIDERED TO BE 5 MIN.

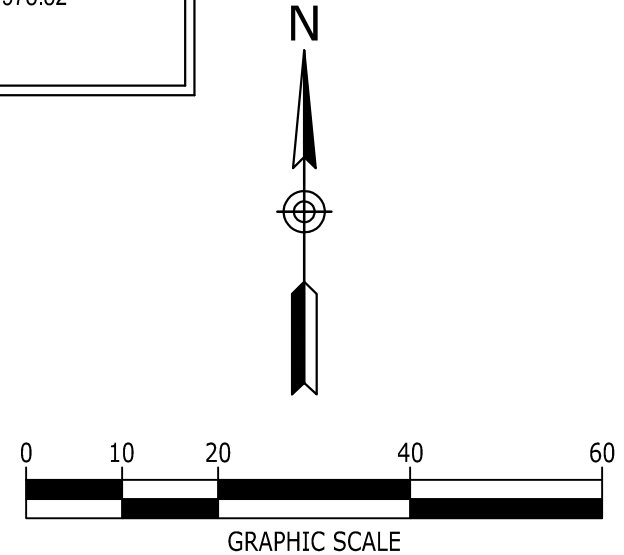
STORM WATER LEGEND
CB #1170
TOP ELEVATION = 980.66
F/L NORTH 15" RCP = 975.46
F/L SOUTHEAST 15" HDPE = 974.81
CB #1206
TOP ELEVATION = 981.70
F/L SOUTH 15" RCP = 976.20
F/L EAST = 976.70
(UNKNOWN PIPE SIZE & TYPE)
TCB = 980.76
CB #1173
TOP ELEVATION = 980.74
F/L SOUTH 15" RCP = 976.04
CB #1115
TOP ELEVATION = 968.97
F/L NORTH 15" RCP = 964.47
F/L SOUTH 15" RCP = 963.62
F/L EAST 15" RCP = 963.97
TCB = 968.01
AI #1202
TOP ELEVATION = 959.95
F/L NORTHEAST 15" RCP = 952.24
F/L SOUTH 24" RCP = 948.65
TCB = 958.57
CB #1085
TOP ELEVATION = 961.05
F/L NORTH 15" RCP = 954.50
F/L SOUTHWEST 15" RCP = 954.30
TCB = 960.10
AI #2081
TOP ELEVATION = 973.94
F/L EAST 15" RCP = 967.09
SWMH #1148
TOP ELEVATION = 978.52
F/L NORTH 15" RCP = 972.38
F/L SOUTH 15" RCP = 972.28
F/L NORTHWEST 15" HDPE = 974.04

SEWER LEGEND
SSMH #1019
TOP ELEVATION = 959.22
F/L NORTHEAST 6" PVC = 947.82
F/L SOUTH 6" PVC = 947.67

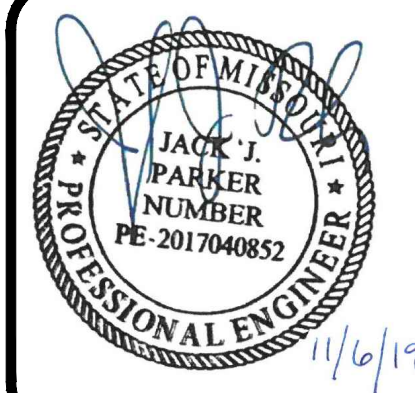
BENCHMARK LEGEND
BM #1148
TOP ELEVATION RIM OF SWMH = 978.52
DATUM = NAVD88



Know what's below.
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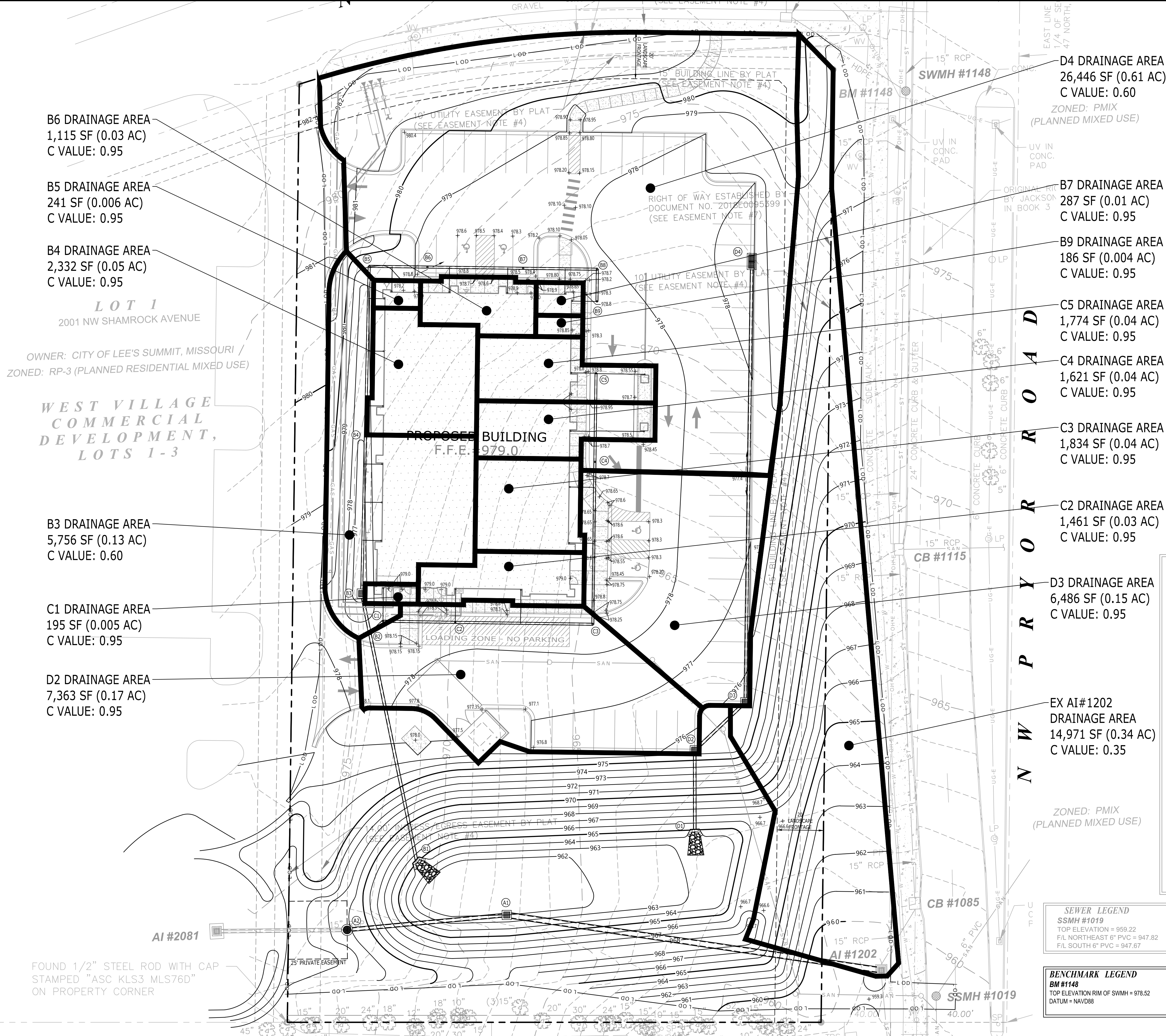


CONSTRUCTION DRAWINGS
DCI - LEE'S SUMMIT
2001 NW SHAMROCK AVENUE
LEE'S SUMMIT, MISSOURI, 64081
JACKSON COUNTY

NO.	DATE	DESCRIPTION

DRAWING TITLE
**POST DEVELOPED
DRAINAGE AREA
MAP**
PROJECT NUMBER
20180111
DRAWING NUMBER
POST

P:\2018\20180111\Engineering\dwg\20180111_2019-11-01_Inlet Drainage Area Map.dwg:NIJET Nov 01, 2019 ovalker



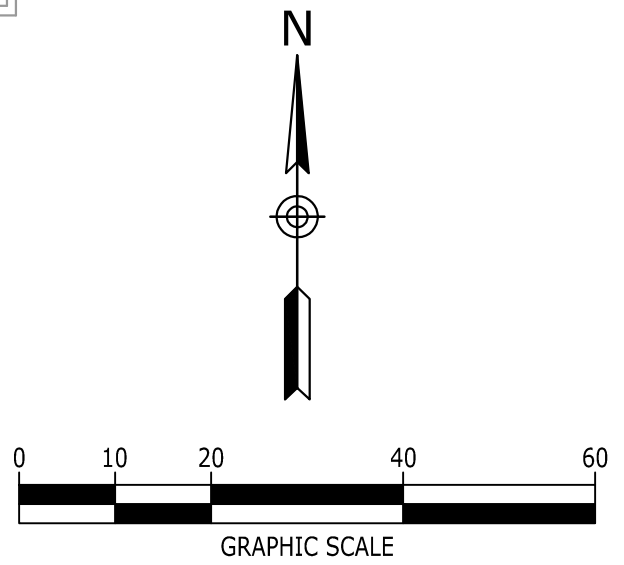
PIPE TABLE							
FROM CODE	FROM INV.	TO CODE	TO INV.	GRADE (%)	SIZE (INCHES)	LENGTH (L.F.)	TYPE
A1	958.00	EX AL#1202	948.85	5.61%	24"	163	RCP
A2	966.58	A1	958.20	12.13%	15"	69	RCP
B2	972.32	B1	963.50	8.82%	12"	100	HDPE
B3	972.50	B2	972.32	1.01%	12"	18	HDPE
B4	973.39	B3	972.70	1.00%	10"	69	HDPE
B5	974.11	B4	973.39	1.00%	10"	73	HDPE
B6	974.36	B5	974.11	1.00%	10"	25	HDPE
B7	974.77	B6	974.36	1.00%	10"	41	HDPE
B8	975.09	B7	974.77	1.00%	10"	32	HDPE
B9	975.23	B8	975.09	1.00%	10"	14	HDPE
C1	973.31	B2	972.32	12.63%	10"	8	HDPE
C2	973.62	C1	973.31	1.00%	10"	31	HDPE
C3	974.22	C2	973.62	1.00%	10"	59	HDPE
C4	974.92	C3	974.22	1.00%	10"	70	HDPE
C5	975.30	C4	974.92	1.00%	10"	38	HDPE
D2	969.00	D1	963.50	15.89%	12"	35	HDPE
D3	971.30	D2	969.20	6.99%	12"	30	HDPE
D4	973.50	D3	971.50	1.05%	12"	190	HDPE
EX AI #2081	967.09	A2	966.58	0.91%	15"	56	RCP

STRUCTURE TABLE		
CODE	DESCRIPTION	TOP GRATE
A1	POND OUTLET	966.20
A2	JUNCTION MANHOLE	971.20
B1	HEADWALL	NA
B2	CLEANOUT	978.70
B3	CATCH BASIN	976.50
B4	CLEANOUT	977.10
B5	CLEANOUT	979.00
B6	CLEANOUT	978.75
B7	CLEANOUT	978.40
B8	CLEANOUT	978.15
B9	CLEANOUT	978.30
C1	CLEANOUT	978.70
C2	CLEANOUT	978.28
C3	CLEANOUT	978.25
C4	CLEANOUT	978.67
C5	CLEANOUT	NA
D1	HEADWALL	965.60
D2	SINGLE CURB INLET	975.80
D3	SINGLE CURB INLET	975.80
D4	DOUBLE CURB INLET	977.60
EX AI #2081	EXISTING POND OUTLET	973.94
EX AL#1202	EXISTING CATCH BASIN	959.95

STORM WATER LEGEND
CB #1170
TOP ELEVATION = 980.66
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DATUM = NAVD88



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NO.	DATE	DESCRIPTION

DRAWING TITLE

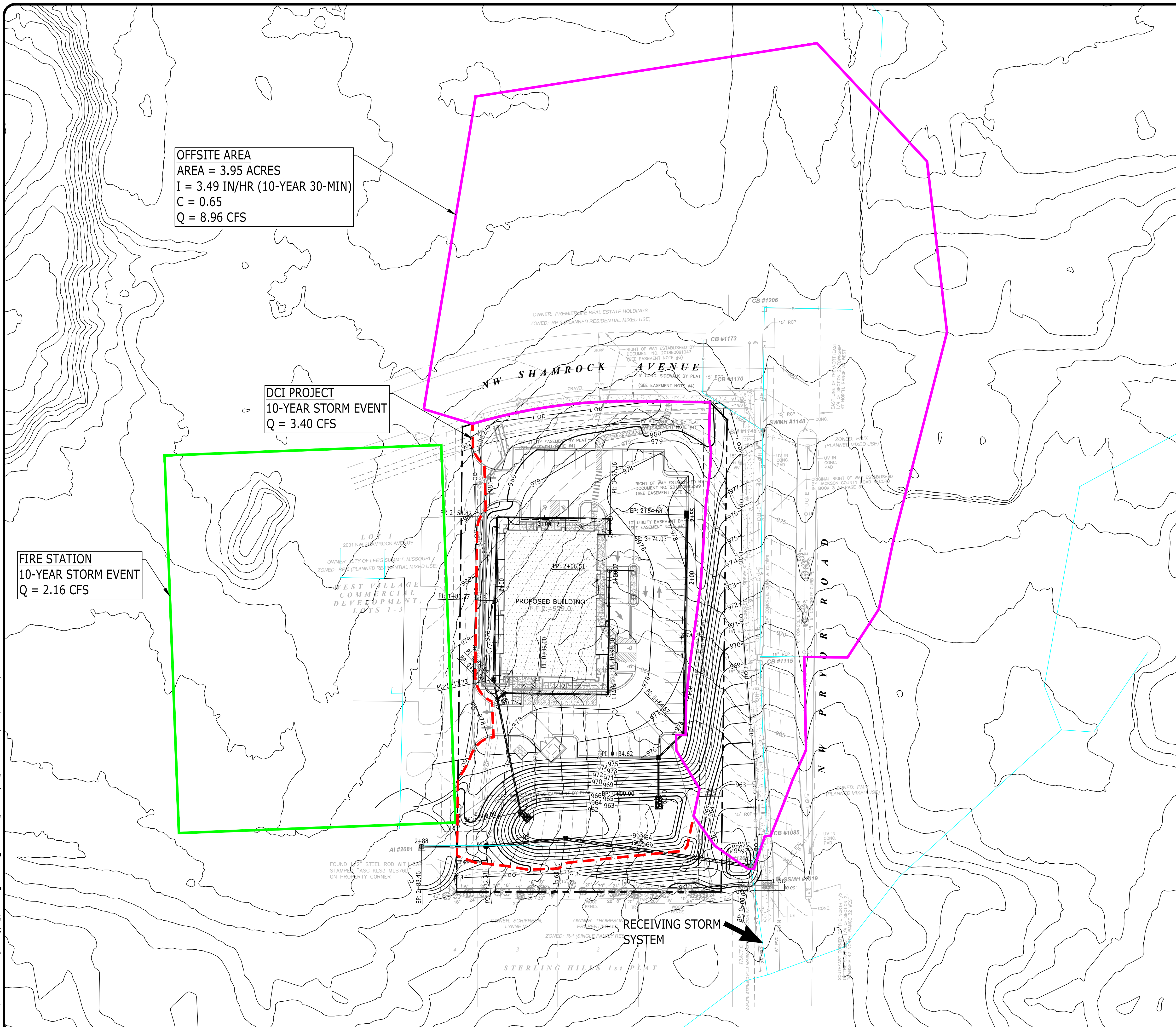
INLET DRAINAGE AREA MAP

PROJECT NUMBER

20180111

DRAWING NUMBER

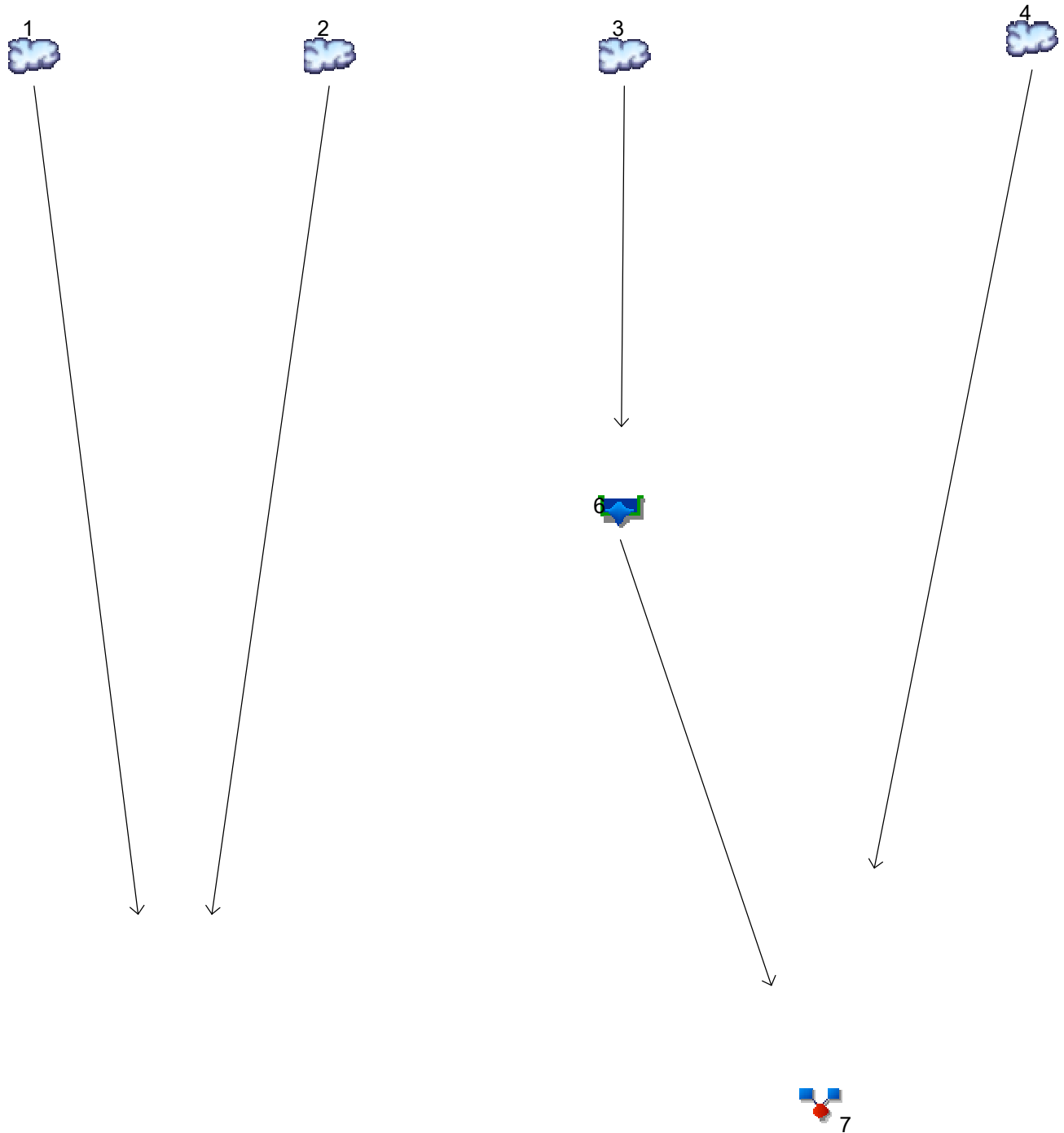
INLET



Attachment 2
Hydraflow Hydrographs Routing Calculations

Watershed Model Schematic

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



Legend



5

Hyd. Origin

Description

1	SCS Runoff	EXISTING NORTH
2	SCS Runoff	EXISTING SOUTH
3	SCS Runoff	PROPOSED NORTH
4	SCS Runoff	PROPOSED BYPASS
5	Combine	EXISTING SITE
6	Reservoir	PROPOSED TO DET
7	Combine	PROPOSED SITE

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	5.952	2	718	13,637	-----	-----	-----	EXISTING NORTH
2	SCS Runoff	0.811	2	720	2,102	-----	-----	-----	EXISTING SOUTH
3	SCS Runoff	6.980	2	716	14,579	-----	-----	-----	PROPOSED NORTH
4	SCS Runoff	0.921	2	716	1,861	-----	-----	-----	PROPOSED BYPASS
5	Combine	6.704	2	718	15,739	1, 2,	-----	-----	EXISTING SITE
6	Reservoir	0.817	2	734	14,127	3	964.13	7,764	PROPOSED TO DET
7	Combine	1.140	2	720	15,988	4, 6	-----	-----	PROPOSED SITE
20180111_2020-06-23 ROUTING CALCULATION Period: 21600pw					TRANSITION Period: 21600pw			Tuesday, 06 / 23 / 2020	

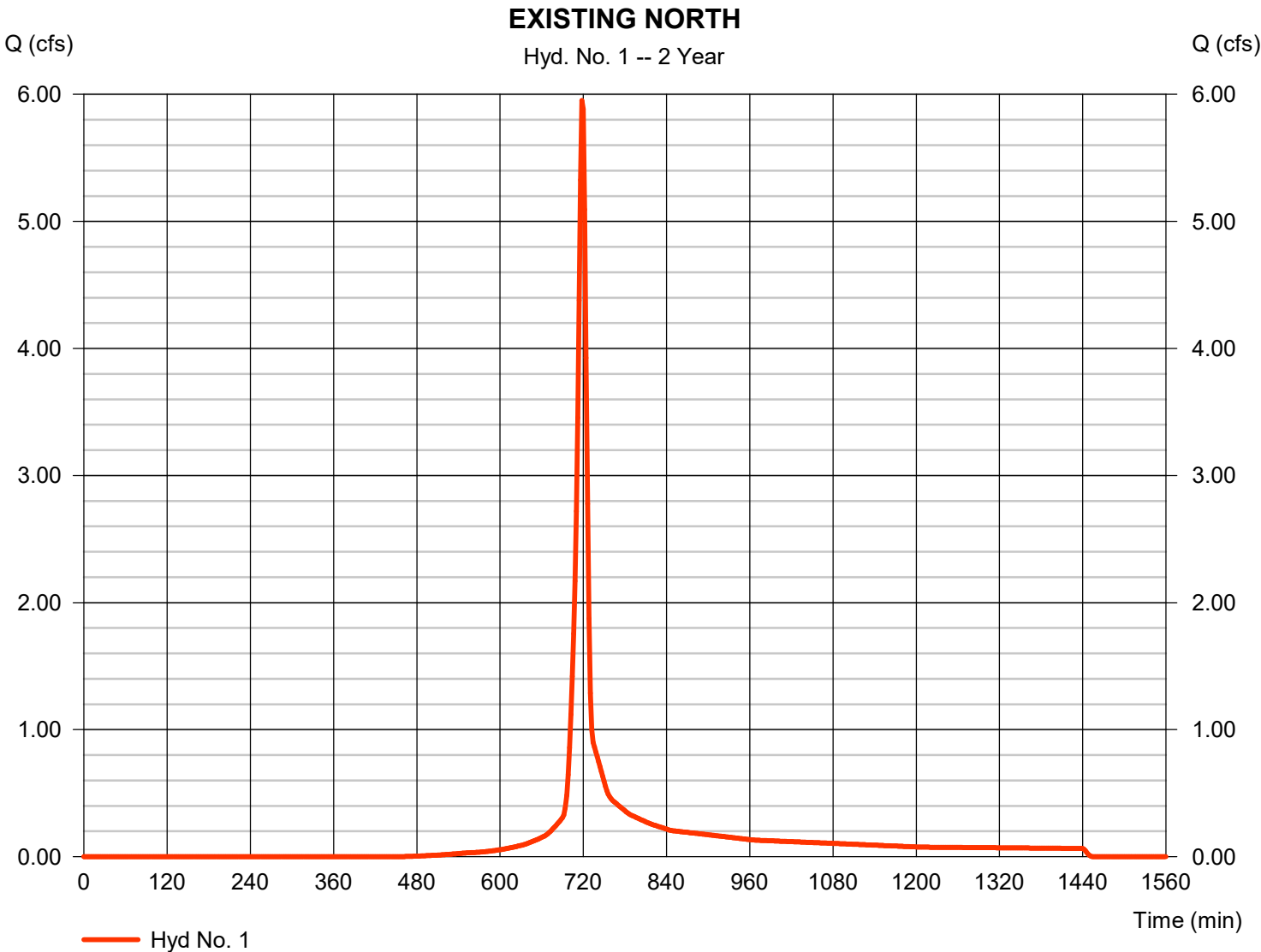
Hydrograph Report

Hyd. No. 1

EXISTING NORTH

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.952 cfs
Storm frequency	=	2 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	13,637 cuft
Drainage area	=	1.940 ac	Curve number	=	84*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	8.00 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.940 x 84)] / 1.940



TR55 Tc Worksheet

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

Hyd. No. 1

EXISTING NORTH

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
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)	= 3.50	0.00	0.00				
Land slope (%)	= 5.70	0.00	0.00				
Travel Time (min)	= 6.16	+	0.00	+	0.00	=	6.16
Shallow Concentrated Flow							
Flow length (ft)	= 367.00	0.00	0.00				
Watercourse slope (%)	= 4.06	0.00	0.00				
Surface description	= Unpaved	Paved	Paved				
Average velocity (ft/s)	=3.25	0.00	0.00				
Travel Time (min)	= 1.88	+	0.00	+	0.00	=	1.88
Channel Flow							
X sectional flow area (sqft)	= 0.00	0.00	0.00				
Wetted perimeter (ft)	= 0.00	0.00	0.00				
Channel slope (%)	= 0.00	0.00	0.00				
Manning's n-value	= 0.015	0.015	0.015				
Velocity (ft/s)	=0.00	0.00	0.00				
Flow length (ft)	((0})0.0	0.0	0.0				
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc				8.00 min			

Hydrograph Report

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

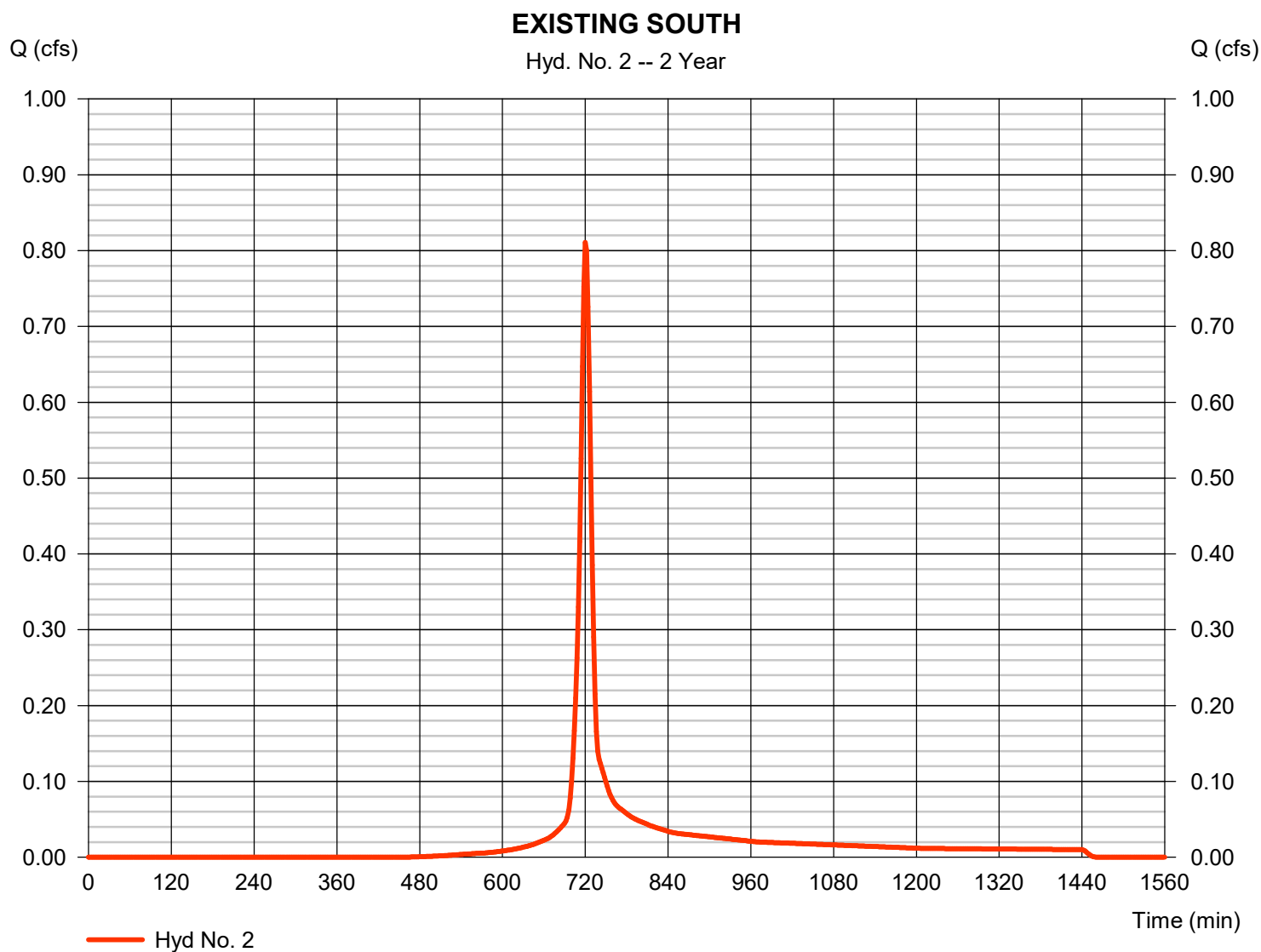
Tuesday, 06 / 23 / 2020

Hyd. No. 2

EXISTING SOUTH

Hydrograph type	= SCS Runoff	Peak discharge	= 0.811 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 2,102 cuft
Drainage area	= 0.290 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 10.10 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(0.290 \times 84)] / 0.290$



TR55 Tc Worksheet

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

Hyd. No. 2

EXISTING SOUTH

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>			
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)	= 3.50	0.00	0.00				
Land slope (%)	= 2.00	0.00	0.00				
Travel Time (min)	= 9.37	+	0.00	+	0.00	=	9.37
Shallow Concentrated Flow							
Flow length (ft)	= 206.00	0.00	0.00				
Watercourse slope (%)	= 7.52	0.00	0.00				
Surface description	= Unpaved	Paved	Paved				
Average velocity (ft/s)	=4.42	0.00	0.00				
Travel Time (min)	= 0.78	+	0.00	+	0.00	=	0.78
Channel Flow							
X sectional flow area (sqft)	= 0.00	0.00	0.00				
Wetted perimeter (ft)	= 0.00	0.00	0.00				
Channel slope (%)	= 0.00	0.00	0.00				
Manning's n-value	= 0.015	0.015	0.015				
Velocity (ft/s)	=0.00	0.00	0.00				
Flow length (ft)	((0})0.0	0.0	0.0				
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc				10.10 min			

Hydrograph Report

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

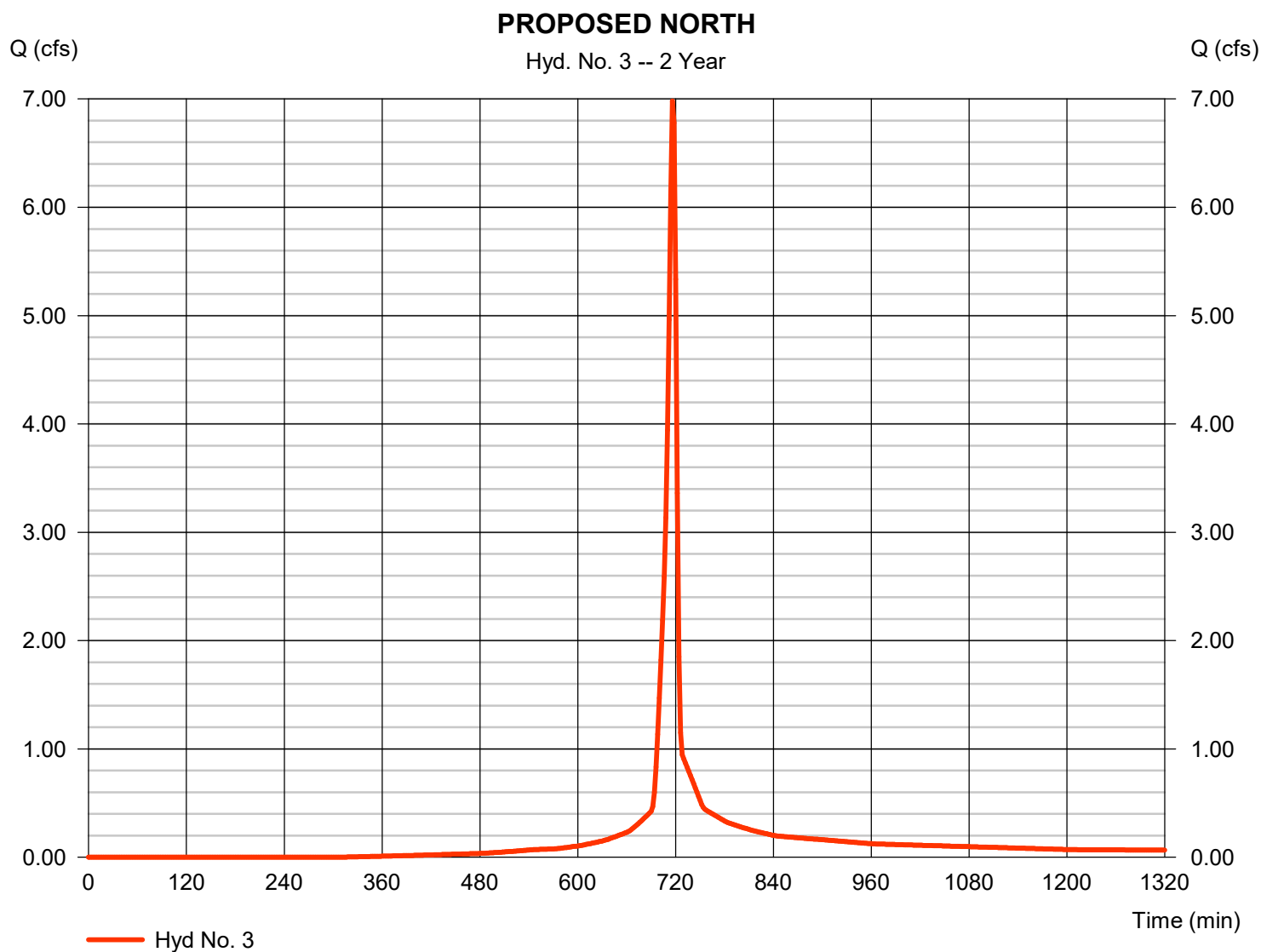
Tuesday, 06 / 23 / 2020

Hyd. No. 3

PROPOSED NORTH

Hydrograph type	= SCS Runoff	Peak discharge	= 6.980 cfs
Storm frequency	= 2 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 14,579 cuft
Drainage area	= 1.750 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(0.780 \times 80) + (0.970 \times 98)] / 1.750$



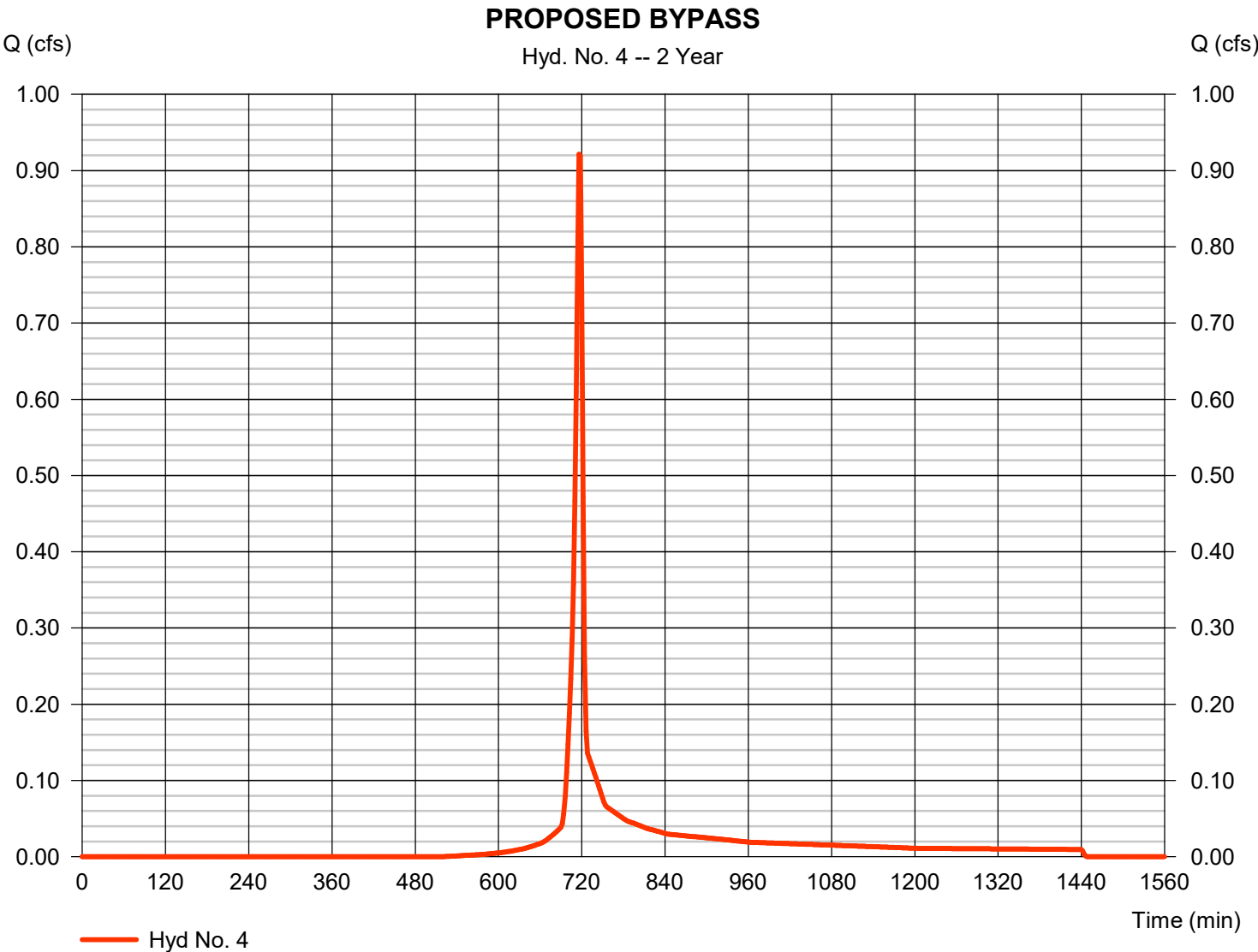
Hydrograph Report

Hyd. No. 4

PROPOSED BYPASS

Hydrograph type	= SCS Runoff	Peak discharge	= 0.921 cfs
Storm frequency	= 2 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 1,861 cuft
Drainage area	= 0.320 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 80) + (0.020 x 98)] / 0.320



Hydrograph Report

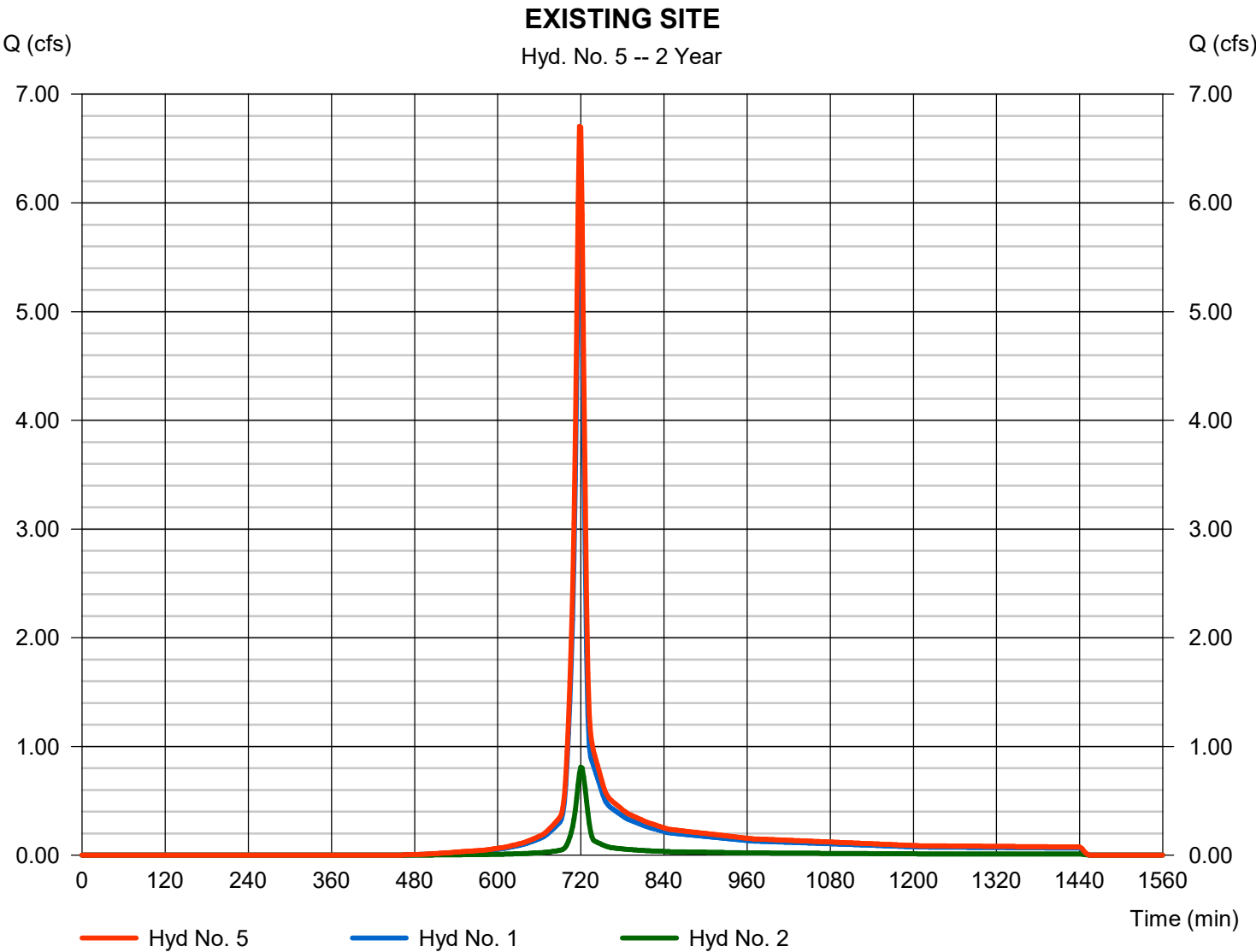
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Tuesday, 06 / 23 / 2020

Hyd. No. 5

EXISTING SITE

Hydrograph type	= Combine	Peak discharge	= 6.704 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 15,739 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 2.230 ac



Hydrograph Report

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

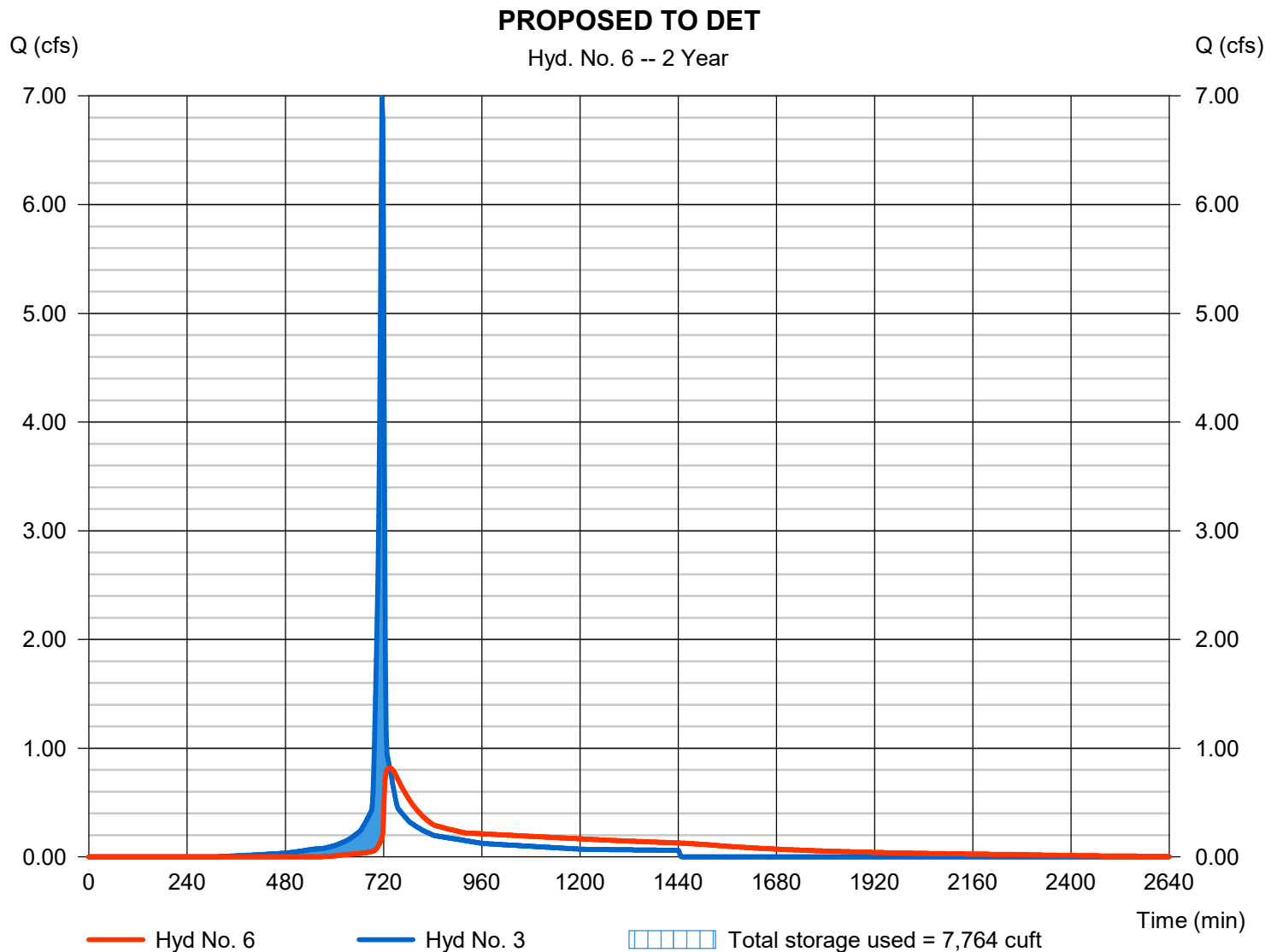
Tuesday, 06 / 23 / 2020

Hyd. No. 6

PROPOSED TO DET

Hydrograph type	= Reservoir	Peak discharge	= 0.817 cfs
Storm frequency	= 2 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 14,127 cuft
Inflow hyd. No.	= 3 - PROPOSED NORTH	Max. Elevation	= 964.13 ft
Reservoir name	= Detention Pond	Max. Storage	= 7,764 cuft

Storage Indication method used.



Pond Report

12

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

Tuesday, 06 / 23 / 2020

Pond No. 1 - Detention Pond

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Beginning Elevation = 961.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	961.00	10	0	0
1.00	962.00	1,575	793	793
2.00	963.00	3,200	2,388	3,180
3.00	964.00	4,610	3,905	7,085
4.00	965.00	5,590	5,100	12,185
5.00	966.00	6,670	6,130	18,315
5.20	966.20	6,895	1,357	19,672
6.00	967.00	7,809	5,882	25,553
7.00	968.00	9,002	8,406	33,959
7.70	968.70	9,869	6,605	40,564

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	6.00	6.00	1.00
Span (in)	= 24.00	6.00	6.00	1.00
No. Barrels	= 1	1	1	6
Invert El. (ft)	= 957.84	963.80	963.80	961.52
Length (ft)	= 160.20	1.00	1.00	1.65
Slope (%)	= 5.61	0.50	0.50	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	Yes

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	Inactive	Inactive	Inactive
Crest El. (ft)	= 966.20	966.70	0.00	0.00
Weir Coeff.	= 2.60	2.60	3.33	3.33
Weir Type	= Broad	Broad	---	---
Multi-Stage	= Yes	Yes	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	Civ A cfs	Civ B cfs	Civ 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	961.00	0.00	0.00	0.00	0.00	0.00	0.00	---	---	---	---	0.000
0.10	79	961.10	22.23 ic	0.00	0.00	0.00	0.00	0.00	---	---	---	---	0.000
0.20	159	961.20	22.23 ic	0.00	0.00	0.00	0.00	0.00	---	---	---	---	0.000
0.30	238	961.30	22.23 ic	0.00	0.00	0.00	0.00	0.00	---	---	---	---	0.000
0.40	317	961.40	22.23 ic	0.00	0.00	0.00	0.00	0.00	---	---	---	---	0.000
0.50	396	961.50	22.23 ic	0.00	0.00	0.00	0.00	0.00	---	---	---	---	0.000
0.60	476	961.60	22.23 ic	0.00	0.00	0.00	0.00	0.00	---	---	---	---	0.001
0.70	555	961.70	22.23 ic	0.00	0.00	0.00	0.00	0.00	---	---	---	---	0.005
0.80	634	961.80	22.23 ic	0.00	0.00	0.01	0.00	0.00	---	---	---	---	0.009
0.90	713	961.90	22.23 ic	0.00	0.00	0.01	0.00	0.00	---	---	---	---	0.015
1.00	793	962.00	22.23 ic	0.00	0.00	0.02	0.00	0.00	---	---	---	---	0.021
1.10	1,031	962.10	22.23 ic	0.00	0.00	0.03	0.00	0.00	---	---	---	---	0.028
1.20	1,270	962.20	22.23 ic	0.00	0.00	0.04	0.00	0.00	---	---	---	---	0.036
1.30	1,509	962.30	22.23 ic	0.00	0.00	0.04	0.00	0.00	---	---	---	---	0.044
1.40	1,748	962.40	22.23 ic	0.00	0.00	0.05	0.00	0.00	---	---	---	---	0.053
1.50	1,986	962.50	22.23 ic	0.00	0.00	0.06	0.00	0.00	---	---	---	---	0.062
1.60	2,225	962.60	22.23 ic	0.00	0.00	0.07	0.00	0.00	---	---	---	---	0.071
1.70	2,464	962.70	22.23 ic	0.00	0.00	0.08	0.00	0.00	---	---	---	---	0.082
1.80	2,703	962.80	22.23 ic	0.00	0.00	0.09	0.00	0.00	---	---	---	---	0.092
1.90	2,941	962.90	22.23 ic	0.00	0.00	0.10	0.00	0.00	---	---	---	---	0.103
2.00	3,180	963.00	22.23 ic	0.00	0.00	0.11	0.00	0.00	---	---	---	---	0.115
2.10	3,571	963.10	22.23 ic	0.00	0.00	0.13	0.00	0.00	---	---	---	---	0.126
2.20	3,961	963.20	22.23 ic	0.00	0.00	0.14	0.00	0.00	---	---	---	---	0.139
2.30	4,352	963.30	22.23 ic	0.00	0.00	0.15	0.00	0.00	---	---	---	---	0.151
2.40	4,742	963.40	22.23 ic	0.00	0.00	0.16	0.00	0.00	---	---	---	---	0.164
2.50	5,133	963.50	22.23 ic	0.00	0.00	0.18	0.00	0.00	---	---	---	---	0.177
2.60	5,523	963.60	22.23 ic	0.00	0.00	0.19	0.00	0.00	---	---	---	---	0.191
2.70	5,914	963.70	22.23 ic	0.00	0.00	0.20	0.00	0.00	---	---	---	---	0.205
2.80	6,304	963.80	22.23 ic	0.00	0.00	0.22	0.00	0.00	---	---	---	---	0.219
2.90	6,695	963.90	22.23 ic	0.03 ic	0.03 ic	0.23	0.00	0.00	---	---	---	---	0.294
3.00	7,085	964.00	22.23 ic	0.11 ic	0.11 ic	0.25	0.00	0.00	---	---	---	---	0.477
3.10	7,595	964.10	22.23 ic	0.23 ic	0.23 ic	0.26	0.00	0.00	---	---	---	---	0.724
3.20	8,105	964.20	22.23 ic	0.36 ic	0.36 ic	0.28	0.00	0.00	---	---	---	---	1.005

Continues on next page...

Detention Pond

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
3.30	8,615	964.30	22.23 ic	0.47 ic	0.47 ic	0.30	0.00	0.00	---	---	---	---	1.240
3.40	9,125	964.40	22.23 ic	0.56 ic	0.56 ic	0.31	0.00	0.00	---	---	---	---	1.429
3.50	9,635	964.50	22.23 ic	0.63 ic	0.63 ic	0.33	0.00	0.00	---	---	---	---	1.596
3.60	10,145	964.60	22.23 ic	0.70 ic	0.70 ic	0.34	0.00	0.00	---	---	---	---	1.746
3.70	10,655	964.70	22.23 ic	0.76 ic	0.76 ic	0.36	0.00	0.00	---	---	---	---	1.885
3.80	11,165	964.80	22.23 ic	0.82 ic	0.82 ic	0.38	0.00	0.00	---	---	---	---	2.015
3.90	11,675	964.90	22.23 ic	0.87 ic	0.87 ic	0.40	0.00	0.00	---	---	---	---	2.138
4.00	12,185	965.00	22.23 ic	0.92 ic	0.92 ic	0.41	0.00	0.00	---	---	---	---	2.256
4.10	12,798	965.10	22.23 ic	0.97 ic	0.97 ic	0.43	0.00	0.00	---	---	---	---	2.368
4.20	13,411	965.20	22.23 ic	1.01 ic	1.01 ic	0.45	0.00	0.00	---	---	---	---	2.477
4.30	14,024	965.30	22.23 ic	1.06 ic	1.06 ic	0.47	0.00	0.00	---	---	---	---	2.582
4.40	14,637	965.40	22.23 ic	1.10 ic	1.10 ic	0.49	0.00	0.00	---	---	---	---	2.683
4.50	15,250	965.50	22.23 ic	1.14 ic	1.14 ic	0.51	0.00	0.00	---	---	---	---	2.782
4.60	15,863	965.60	22.23 ic	1.18 ic	1.18 ic	0.52	0.00	0.00	---	---	---	---	2.878
4.70	16,476	965.70	22.23 ic	1.21 ic	1.21 ic	0.54	0.00	0.00	---	---	---	---	2.972
4.80	17,089	965.80	22.23 ic	1.25 ic	1.25 ic	0.56	0.00	0.00	---	---	---	---	3.065
4.90	17,702	965.90	22.23 ic	1.29 ic	1.29 ic	0.58	0.00	0.00	---	---	---	---	3.155
5.00	18,315	966.00	22.23 ic	1.32 ic	1.32 ic	0.60	0.00	0.00	---	---	---	---	3.244
5.02	18,451	966.02	22.23 ic	1.33 ic	1.33 ic	0.61	0.00	0.00	---	---	---	---	3.261
5.04	18,586	966.04	22.23 ic	1.33 ic	1.33 ic	0.61	0.00	0.00	---	---	---	---	3.279
5.06	18,722	966.06	22.23 ic	1.34 ic	1.34 ic	0.62	0.00	0.00	---	---	---	---	3.296
5.08	18,858	966.08	22.23 ic	1.35 ic	1.35 ic	0.62	0.00	0.00	---	---	---	---	3.314
5.10	18,993	966.10	22.23 ic	1.35 ic	1.35 ic	0.62	0.00	0.00	---	---	---	---	3.331
5.12	19,129	966.12	22.23 ic	1.36 ic	1.36 ic	0.63	0.00	0.00	---	---	---	---	3.348
5.14	19,265	966.14	22.23 ic	1.37 ic	1.37 ic	0.63	0.00	0.00	---	---	---	---	3.365
5.16	19,400	966.16	22.23 ic	1.37 ic	1.37 ic	0.64	0.00	0.00	---	---	---	---	3.383
5.18	19,536	966.18	22.23 ic	1.38 ic	1.38 ic	0.64	0.00	0.00	---	---	---	---	3.400
5.20	19,672	966.20	22.23 ic	1.39 ic	1.39 ic	0.64	0.00	0.00	---	---	---	---	3.417
5.28	20,260	966.28	22.23 ic	1.41 ic	1.41 ic	0.66	0.00	0.00	---	---	---	---	3.484
5.36	20,848	966.36	22.23 ic	1.44 ic	1.44 ic	0.68	0.00	0.00	---	---	---	---	3.551
5.44	21,436	966.44	22.23 ic	1.46 ic	1.46 ic	0.69	0.00	0.00	---	---	---	---	3.618
5.52	22,024	966.52	22.23 ic	1.49 ic	1.49 ic	0.71	0.00	0.00	---	---	---	---	3.683
5.60	22,612	966.60	22.23 ic	1.51 ic	1.51 ic	0.73	0.00	0.00	---	---	---	---	3.748
5.68	23,200	966.68	22.23 ic	1.53 ic	1.53 ic	0.75	0.00	0.00	---	---	---	---	3.812
5.76	23,789	966.76	22.23 ic	1.56 ic	1.56 ic	0.76	0.00	0.00	---	---	---	---	3.876
5.84	24,377	966.84	22.23 ic	1.58 ic	1.58 ic	0.78	0.00	0.00	---	---	---	---	3.939
5.92	24,965	966.92	22.23 ic	1.60 ic	1.60 ic	0.80	0.00	0.00	---	---	---	---	4.002
6.00	25,553	967.00	22.23 ic	1.62 ic	1.62 ic	0.82	0.00	0.00	---	---	---	---	4.064
6.10	26,394	967.10	22.23 ic	1.65 ic	1.65 ic	0.84	0.00	0.00	---	---	---	---	4.141
6.20	27,234	967.20	22.23 ic	1.68 ic	1.68 ic	0.86	0.00	0.00	---	---	---	---	4.217
6.30	28,075	967.30	22.23 ic	1.70 ic	1.70 ic	0.88	0.00	0.00	---	---	---	---	4.293
6.40	28,915	967.40	22.23 ic	1.73 ic	1.73 ic	0.91	0.00	0.00	---	---	---	---	4.368
6.50	29,756	967.50	22.23 ic	1.76 ic	1.76 ic	0.93	0.00	0.00	---	---	---	---	4.442
6.60	30,596	967.60	22.23 ic	1.78 ic	1.78 ic	0.95	0.00	0.00	---	---	---	---	4.516
6.70	31,437	967.70	22.23 ic	1.81 ic	1.81 ic	0.98	0.00	0.00	---	---	---	---	4.590
6.80	32,278	967.80	22.23 ic	1.83 ic	1.83 ic	1.00	0.00	0.00	---	---	---	---	4.663
6.90	33,118	967.90	22.23 ic	1.85 ic	1.85 ic	1.03	0.00	0.00	---	---	---	---	4.735
7.00	33,959	968.00	22.23 ic	1.88 ic	1.88 ic	1.05	0.00	0.00	---	---	---	---	4.808
7.07	34,619	968.07	22.23 ic	1.90 ic	1.90 ic	1.07	0.00	0.00	---	---	---	---	4.858
7.14	35,280	968.14	22.23 ic	1.91 ic	1.91 ic	1.08	0.00	0.00	---	---	---	---	4.908
7.21	35,940	968.21	22.23 ic	1.93 ic	1.93 ic	1.10	0.00	0.00	---	---	---	---	4.958
7.28	36,601	968.28	22.23 ic	1.94 ic	1.94 ic	1.12	0.00	0.00	---	---	---	---	5.007
7.35	37,261	968.35	22.23 ic	1.96 ic	1.96 ic	1.14	0.00	0.00	---	---	---	---	5.057
7.42	37,922	968.42	22.23 ic	1.98 ic	1.98 ic	1.15	0.00	0.00	---	---	---	---	5.106
7.49	38,582	968.49	22.23 ic	1.99 ic	1.99 ic	1.17	0.00	0.00	---	---	---	---	5.155
7.56	39,243	968.56	22.23 ic	2.01 ic	2.01 ic	1.19	0.00	0.00	---	---	---	---	5.204
7.63	39,903	968.63	22.23 ic	2.02 ic	2.02 ic	1.21	0.00	0.00	---	---	---	---	5.253
7.70	40,564	968.70	22.23 ic	2.04 ic	2.04 ic	1.22	0.00	0.00	---	---	---	---	5.302

...End

Hydrograph Report

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

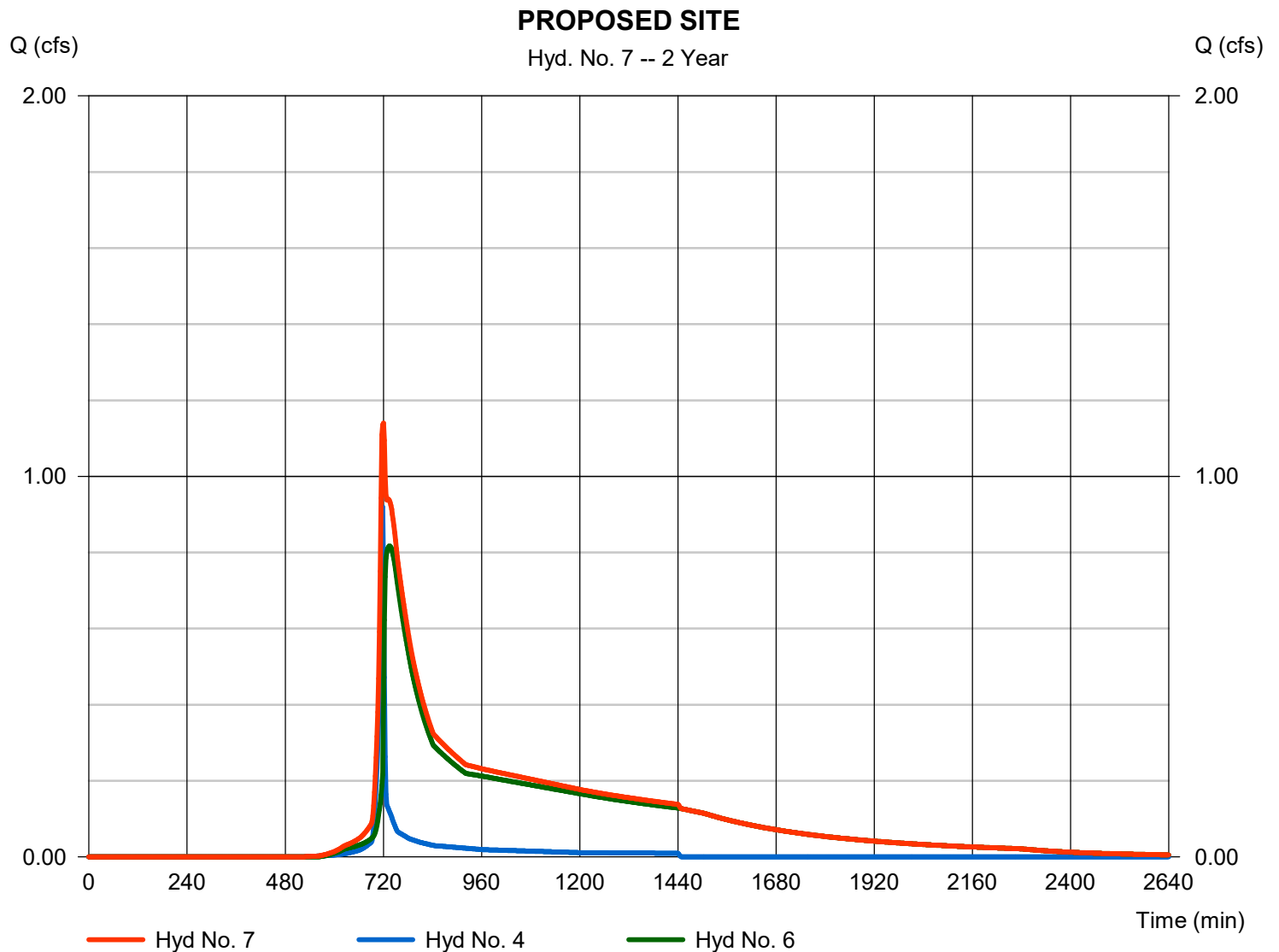
Tuesday, 06 / 23 / 2020

Hyd. No. 7

PROPOSED SITE

Hydrograph type = Combine
 Storm frequency = 2 yrs
 Time interval = 2 min
 Inflow hyds. = 4, 6

Peak discharge = 1.140 cfs
 Time to peak = 720 min
 Hyd. volume = 15,988 cuft
 Contrib. drain. area = 0.320 ac



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	10.72	2	718	24,971	-----	-----	-----	EXISTING NORTH
2	SCS Runoff	1.466	2	720	3,849	-----	-----	-----	EXISTING SOUTH
3	SCS Runoff	11.51	2	716	24,811	-----	-----	-----	PROPOSED NORTH
4	SCS Runoff	1.731	2	716	3,541	-----	-----	-----	PROPOSED BYPASS
5	Combine	12.09	2	718	28,821	1, 2,	-----	-----	EXISTING SITE
6	Reservoir	2.312	2	726	24,360	3	965.05	12,490	PROPOSED TO DET
7	Combine	3.599	2	718	27,901	4, 6	-----	-----	PROPOSED SITE
20180111_2020-06-23 ROUTING CALCULATION Period: 10 Year					TRANSITION Period: 10 Year			Tuesday, 06 / 23 / 2020	

Hydrograph Report

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

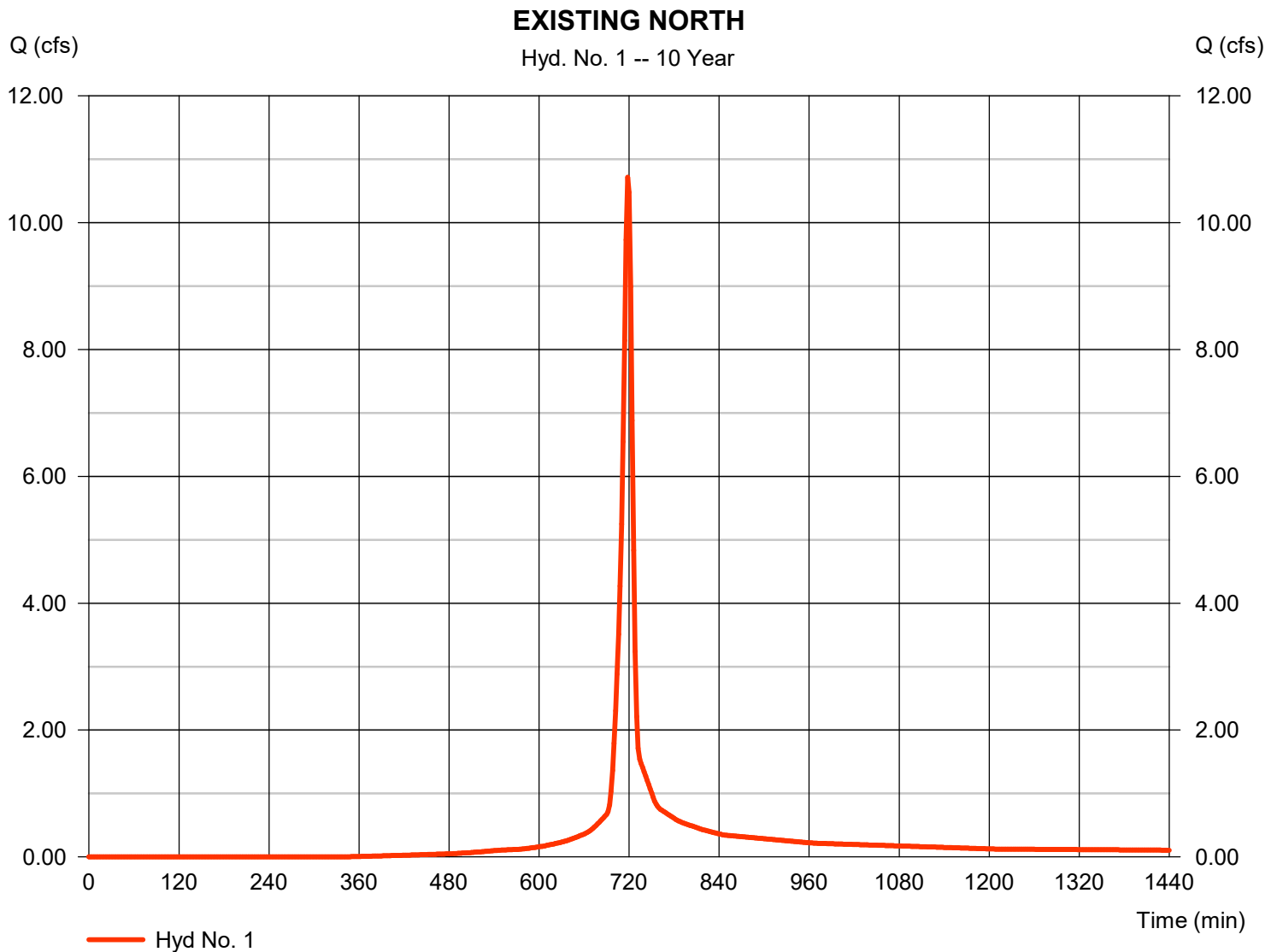
Tuesday, 06 / 23 / 2020

Hyd. No. 1

EXISTING NORTH

Hydrograph type	= SCS Runoff	Peak discharge	= 10.72 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 24,971 cuft
Drainage area	= 1.940 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.00 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(1.940 \times 84)] / 1.940$



Hydrograph Report

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

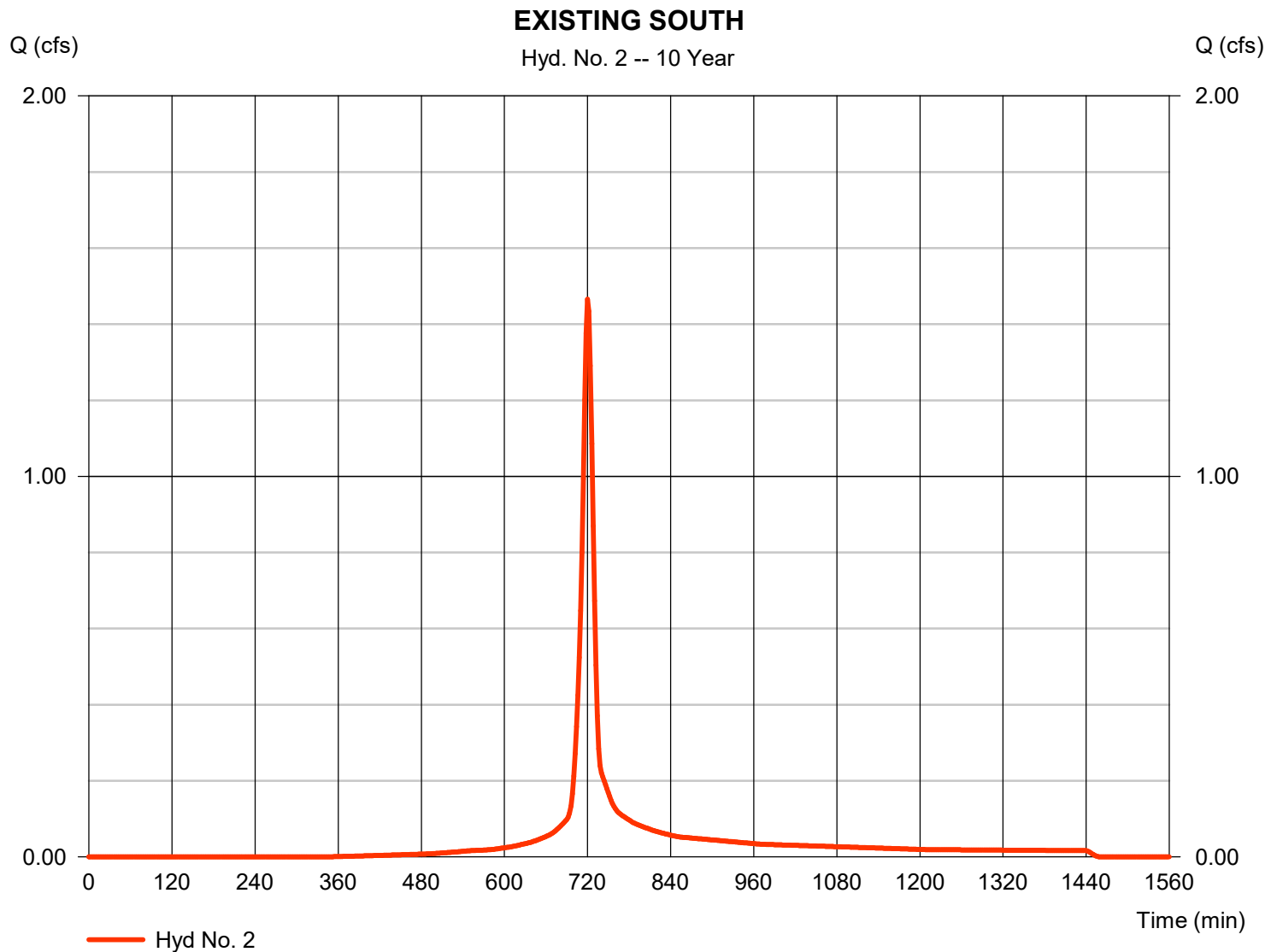
Tuesday, 06 / 23 / 2020

Hyd. No. 2

EXISTING SOUTH

Hydrograph type	= SCS Runoff	Peak discharge	= 1.466 cfs
Storm frequency	= 10 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 3,849 cuft
Drainage area	= 0.290 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 10.10 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(0.290 \times 84)] / 0.290$



Hydrograph Report

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

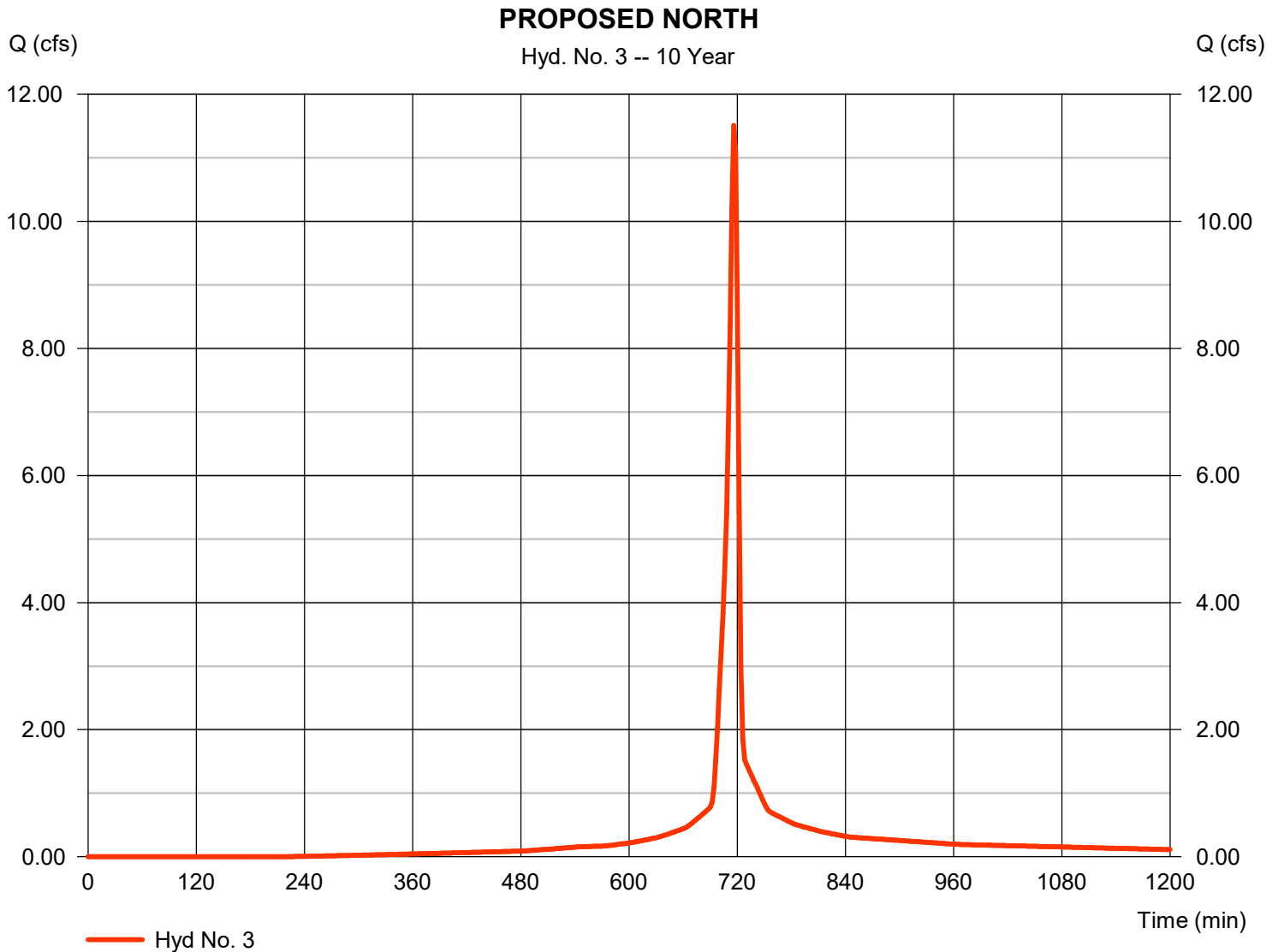
Tuesday, 06 / 23 / 2020

Hyd. No. 3

PROPOSED NORTH

Hydrograph type	= SCS Runoff	Peak discharge	= 11.51 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 24,811 cuft
Drainage area	= 1.750 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(0.780 \times 80) + (0.970 \times 98)] / 1.750$



Hydrograph Report

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

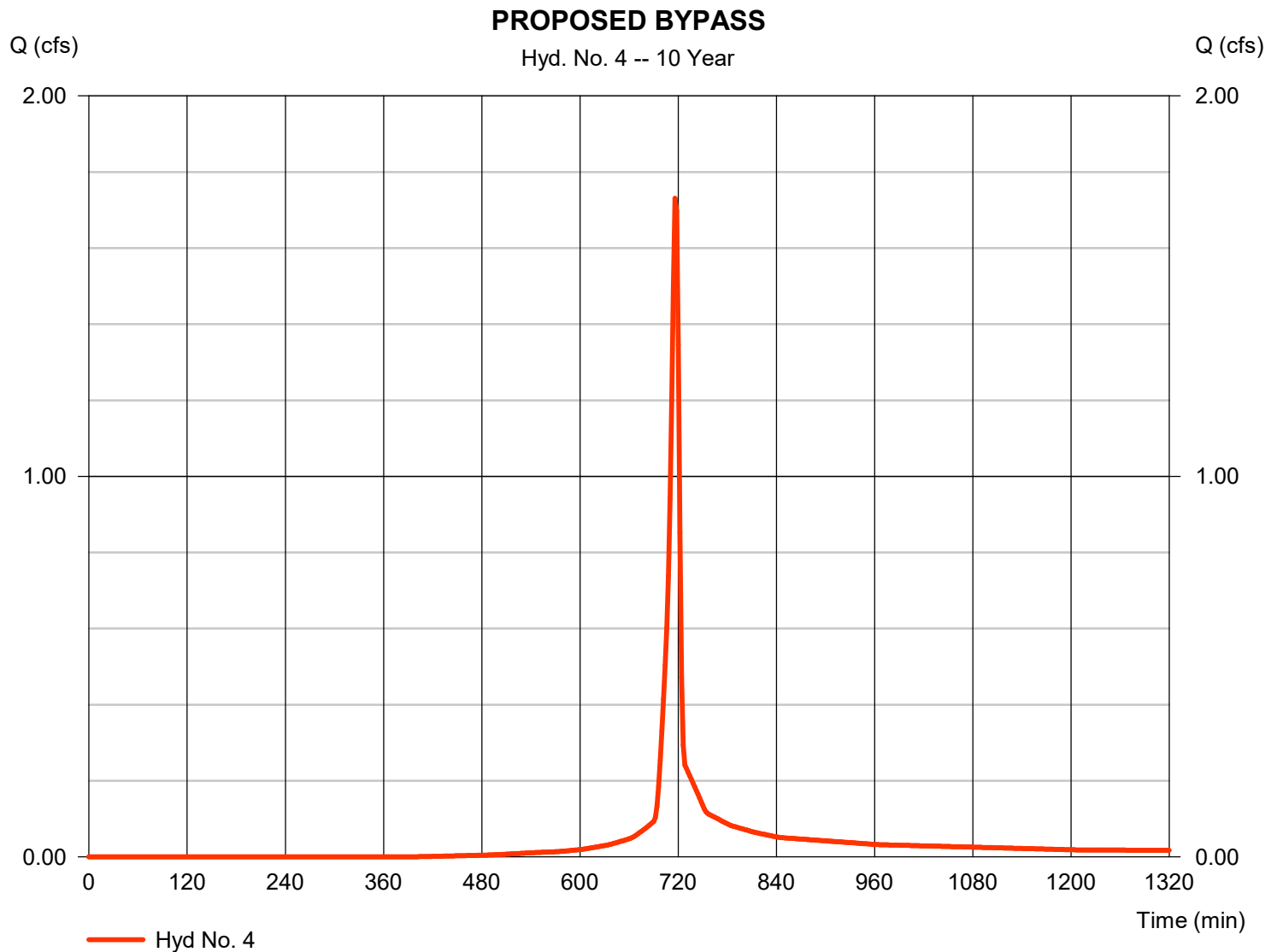
Tuesday, 06 / 23 / 2020

Hyd. No. 4

PROPOSED BYPASS

Hydrograph type	= SCS Runoff	Peak discharge	= 1.731 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 3,541 cuft
Drainage area	= 0.320 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(0.300 \times 80) + (0.020 \times 98)] / 0.320$



Hydrograph Report

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

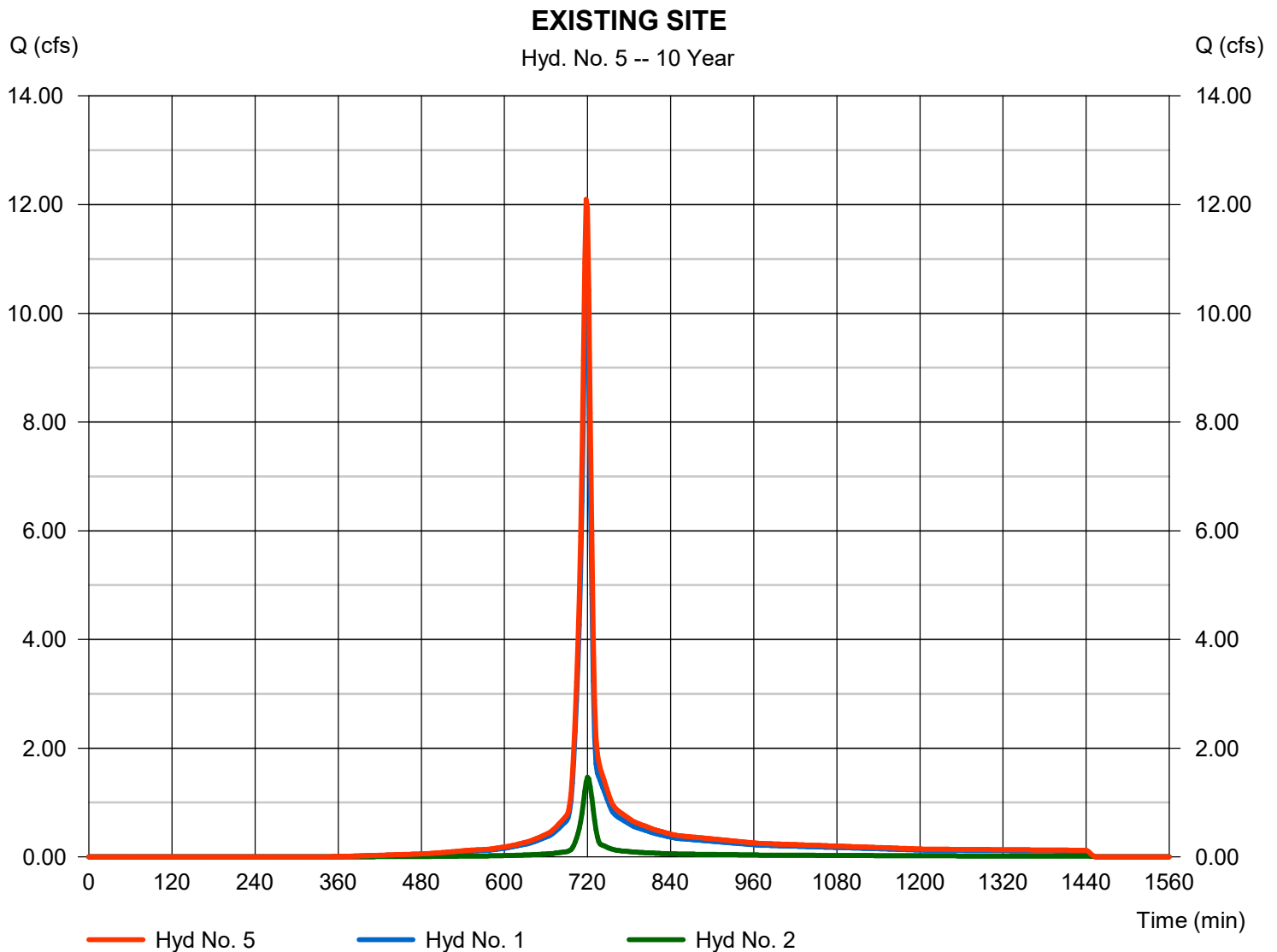
Tuesday, 06 / 23 / 2020

Hyd. No. 5

EXISTING SITE

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 2 min
Inflow hyds. = 1, 2

Peak discharge = 12.09 cfs
Time to peak = 718 min
Hyd. volume = 28,821 cuft
Contrib. drain. area = 2.230 ac



Hydrograph Report

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

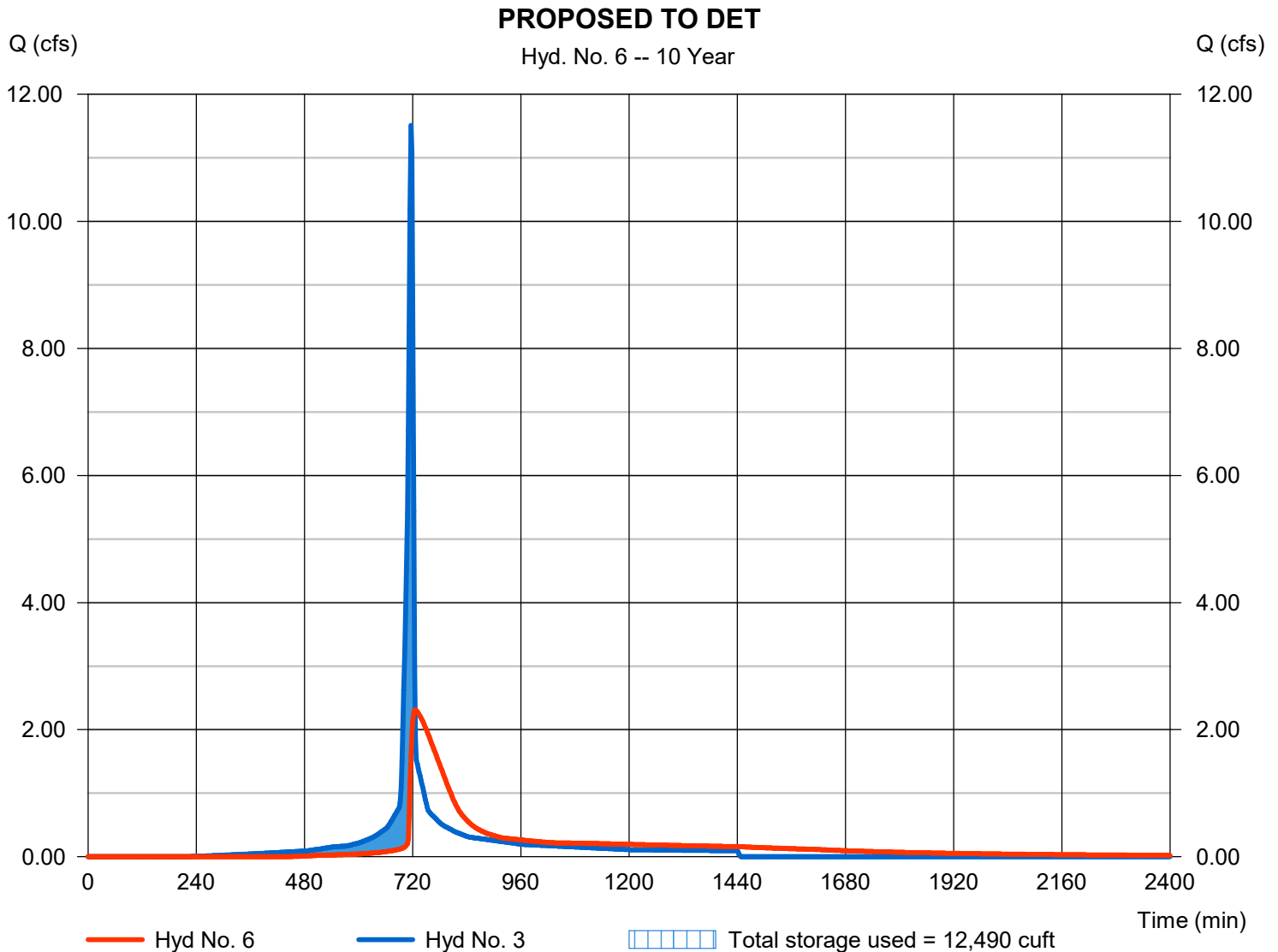
Tuesday, 06 / 23 / 2020

Hyd. No. 6

PROPOSED TO DET

Hydrograph type	= Reservoir	Peak discharge	= 2.312 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 24,360 cuft
Inflow hyd. No.	= 3 - PROPOSED NORTH	Max. Elevation	= 965.05 ft
Reservoir name	= Detention Pond	Max. Storage	= 12,490 cuft

Storage Indication method used.



Hydrograph Report

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

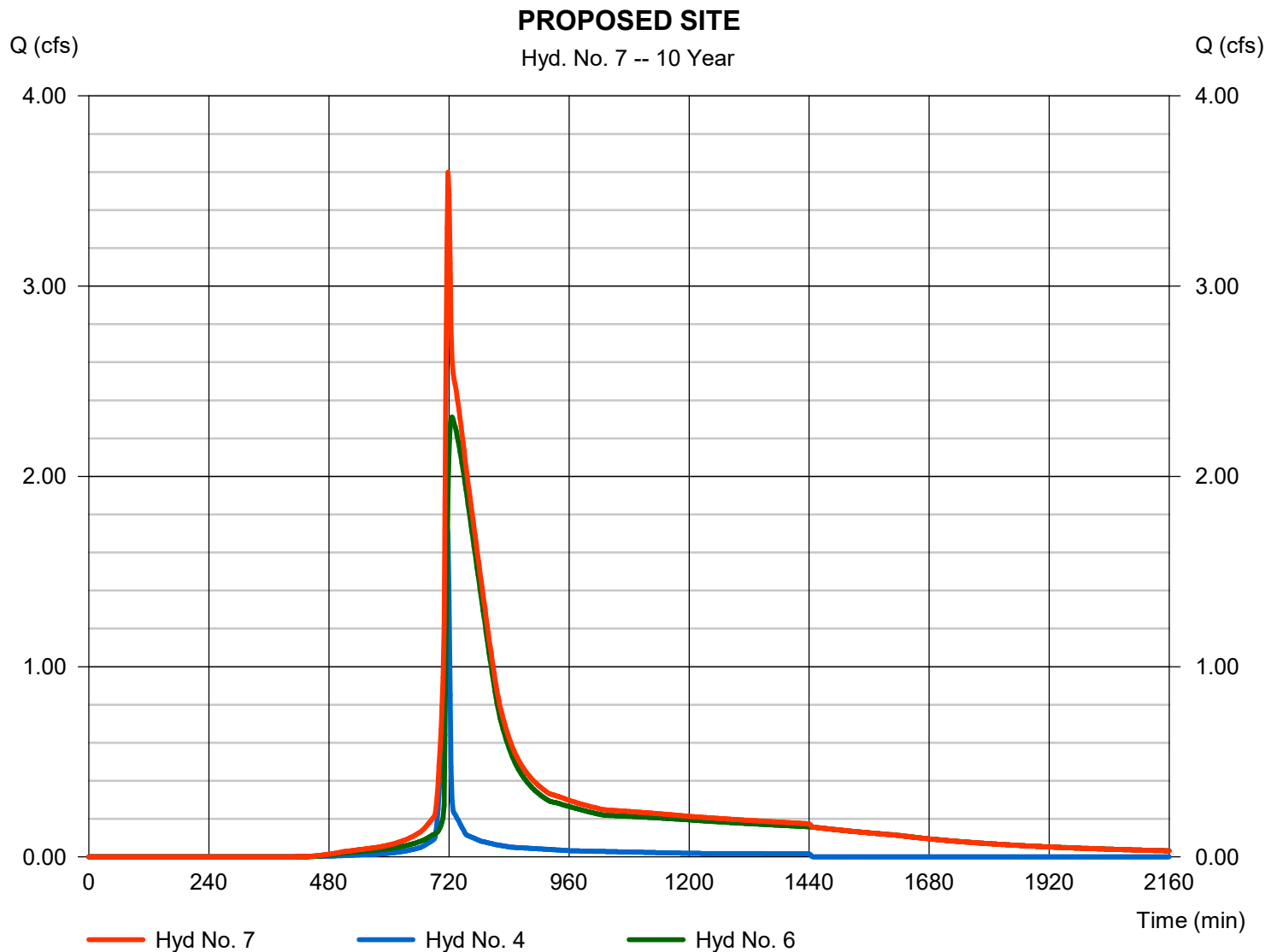
Tuesday, 06 / 23 / 2020

Hyd. No. 7

PROPOSED SITE

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 2 min
Inflow hyds. = 4, 6

Peak discharge = 3.599 cfs
Time to peak = 718 min
Hyd. volume = 27,901 cuft
Contrib. drain. area = 0.320 ac



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	17.14	2	718	40,898	-----	-----	-----	EXISTING NORTH
2	SCS Runoff	2.350	2	720	6,305	-----	-----	-----	EXISTING SOUTH
3	SCS Runoff	17.48	2	716	38,772	-----	-----	-----	PROPOSED NORTH
4	SCS Runoff	2.838	2	716	5,946	-----	-----	-----	PROPOSED BYPASS
5	Combine	19.36	2	718	47,203	1, 2,	-----	-----	EXISTING SITE
6	Reservoir	3.341	2	726	38,321	3	966.12	19,075	PROPOSED TO DET
7	Combine	5.710	2	718	44,267	4, 6	-----	-----	PROPOSED SITE
20180111_2020-06-23 ROUTING CALCULATION Period: 100 Year						Tuesday, 06 / 23 / 2020			

Hydrograph Report

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

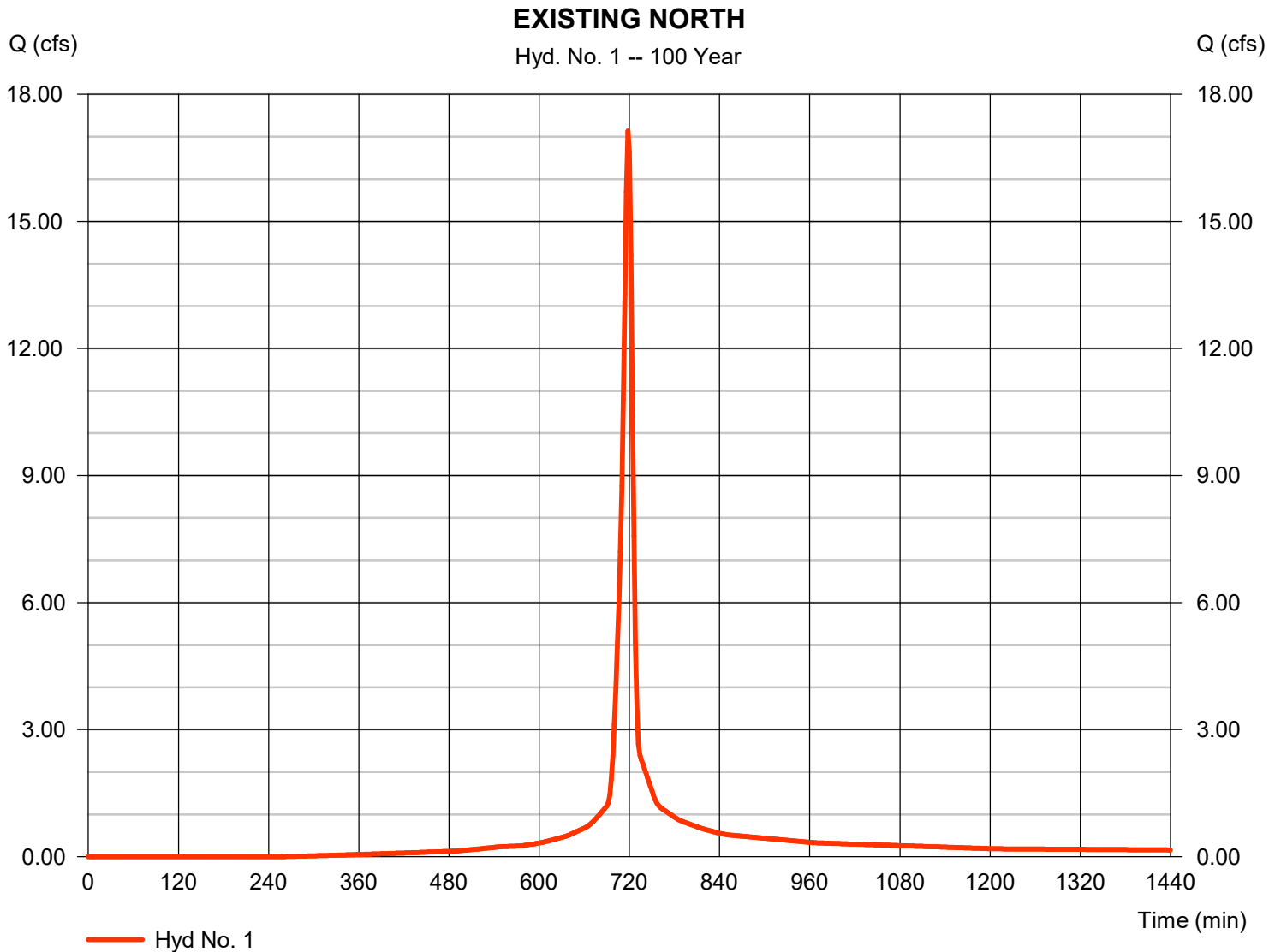
Tuesday, 06 / 23 / 2020

Hyd. No. 1

EXISTING NORTH

Hydrograph type	= SCS Runoff	Peak discharge	= 17.14 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 40,898 cuft
Drainage area	= 1.940 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.00 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(1.940 \times 84)] / 1.940$



Hydrograph Report

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

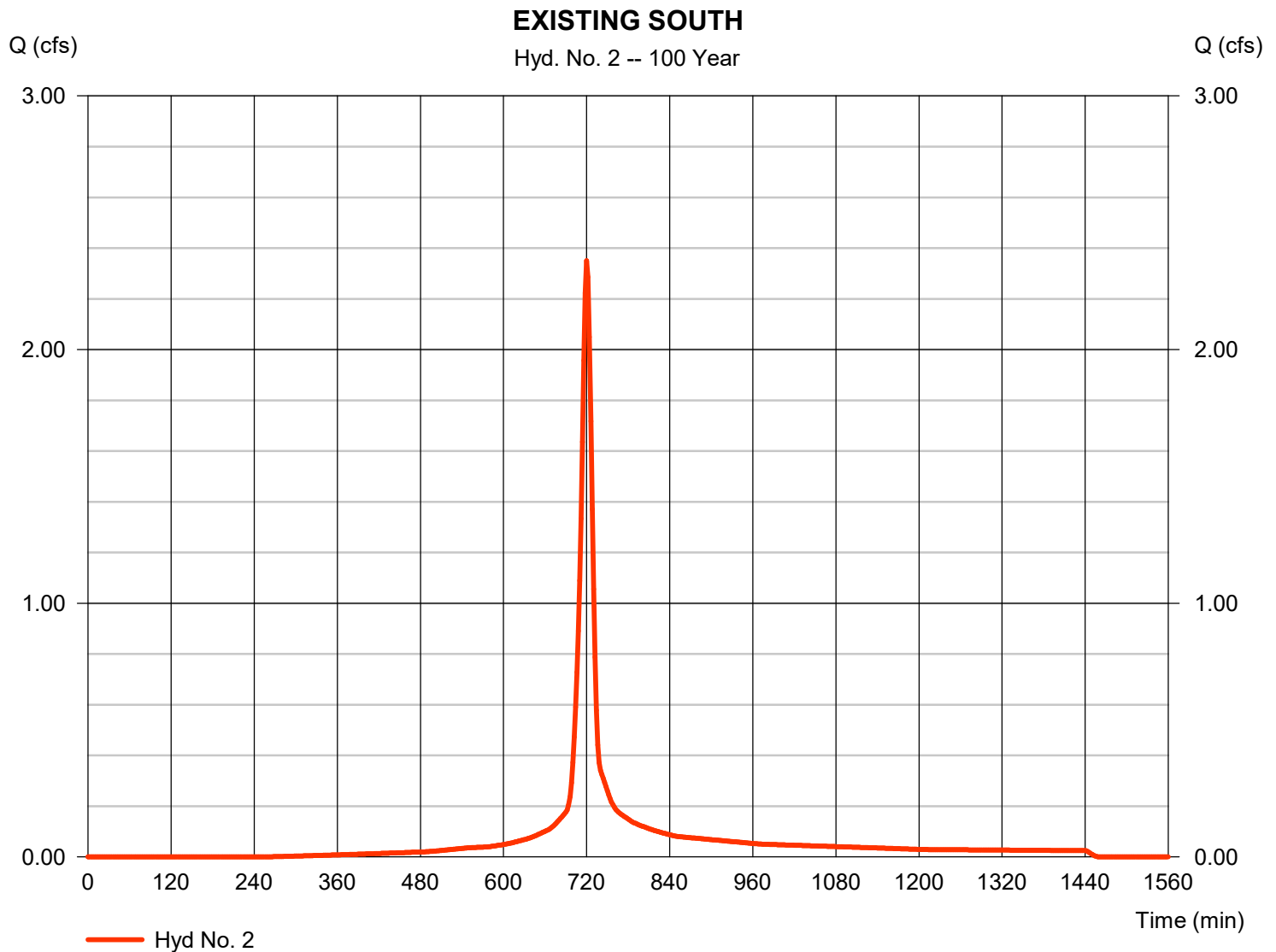
Tuesday, 06 / 23 / 2020

Hyd. No. 2

EXISTING SOUTH

Hydrograph type	= SCS Runoff	Peak discharge	= 2.350 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 6,305 cuft
Drainage area	= 0.290 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 10.10 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(0.290 \times 84)] / 0.290$



Hydrograph Report

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

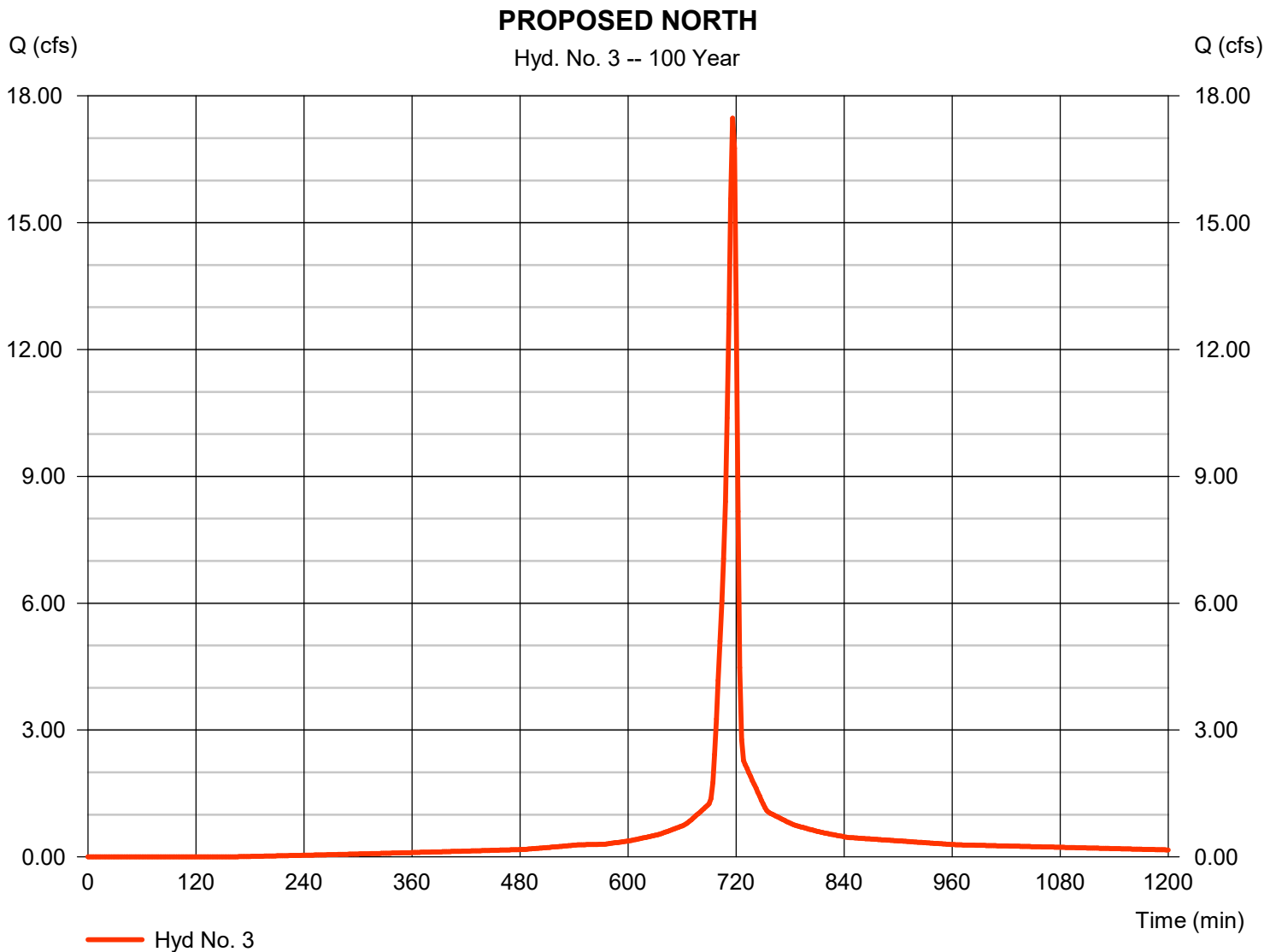
Tuesday, 06 / 23 / 2020

Hyd. No. 3

PROPOSED NORTH

Hydrograph type	= SCS Runoff	Peak discharge	= 17.48 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 38,772 cuft
Drainage area	= 1.750 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(0.780 \times 80) + (0.970 \times 98)] / 1.750$



Hydrograph Report

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

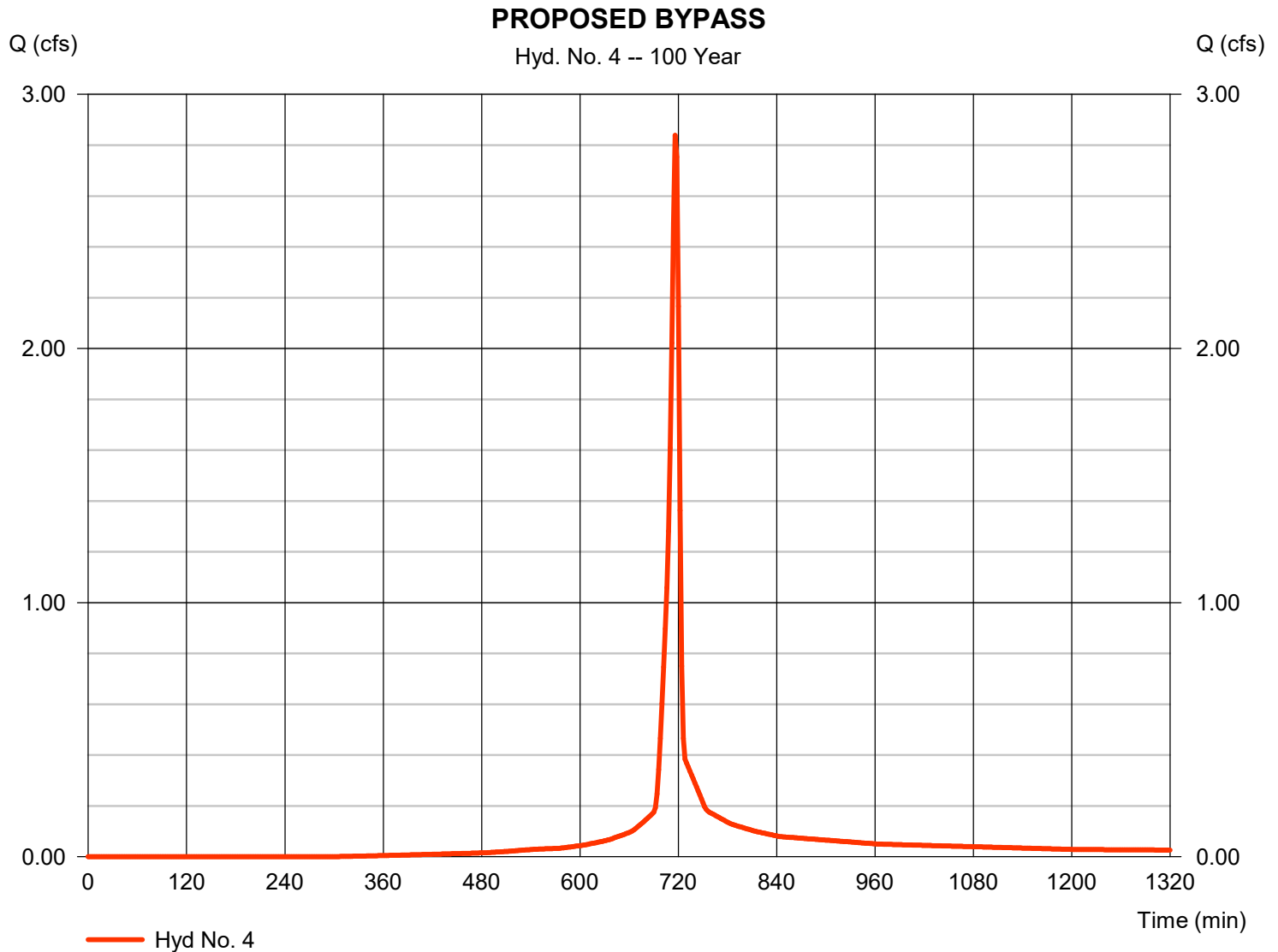
Tuesday, 06 / 23 / 2020

Hyd. No. 4

PROPOSED BYPASS

Hydrograph type	= SCS Runoff	Peak discharge	= 2.838 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 5,946 cuft
Drainage area	= 0.320 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(0.300 \times 80) + (0.020 \times 98)] / 0.320$



Hydrograph Report

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

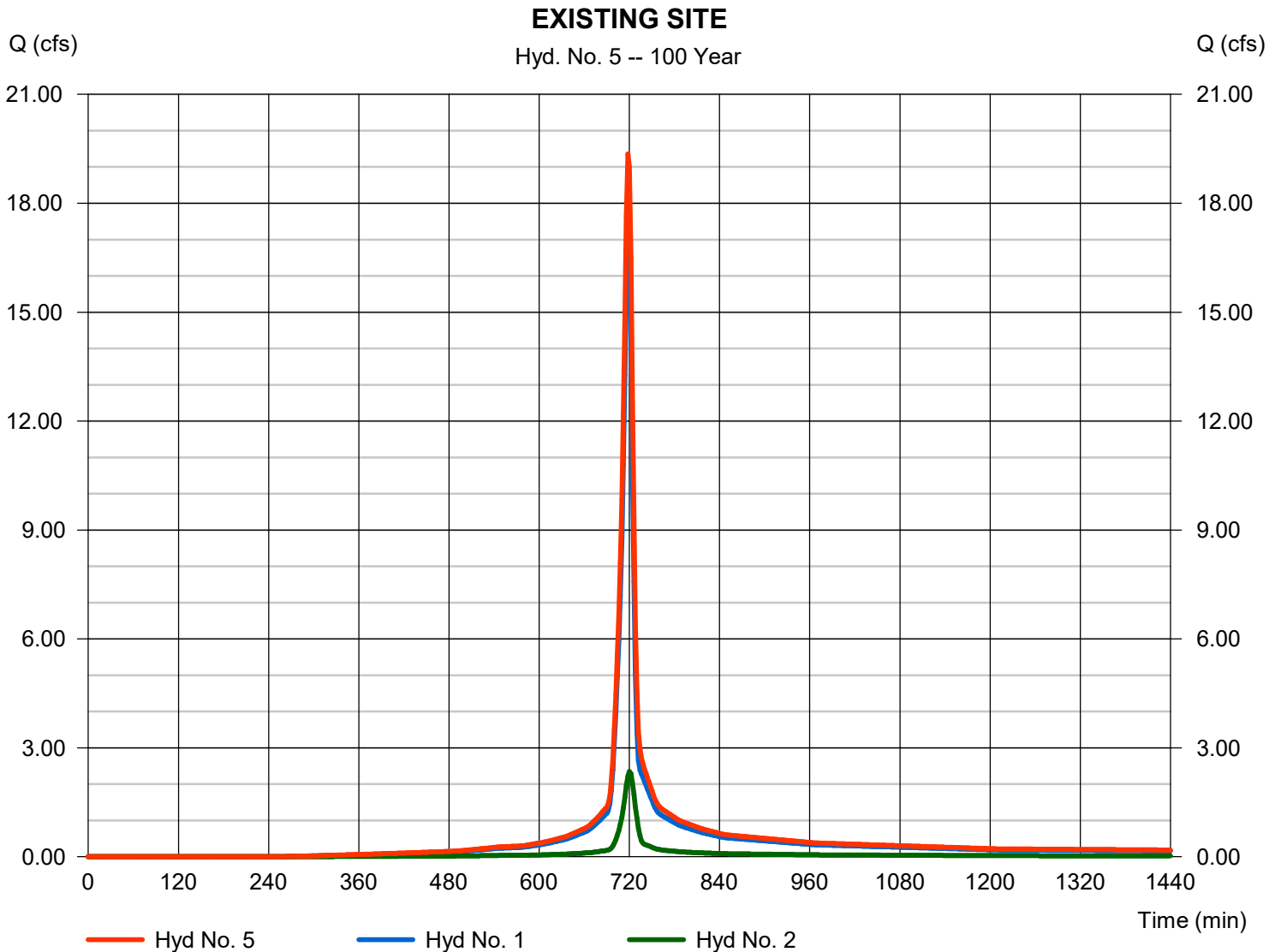
Tuesday, 06 / 23 / 2020

Hyd. No. 5

EXISTING SITE

Hydrograph type = Combine
 Storm frequency = 100 yrs
 Time interval = 2 min
 Inflow hyds. = 1, 2

Peak discharge = 19.36 cfs
 Time to peak = 718 min
 Hyd. volume = 47,203 cuft
 Contrib. drain. area = 2.230 ac



Hydrograph Report

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

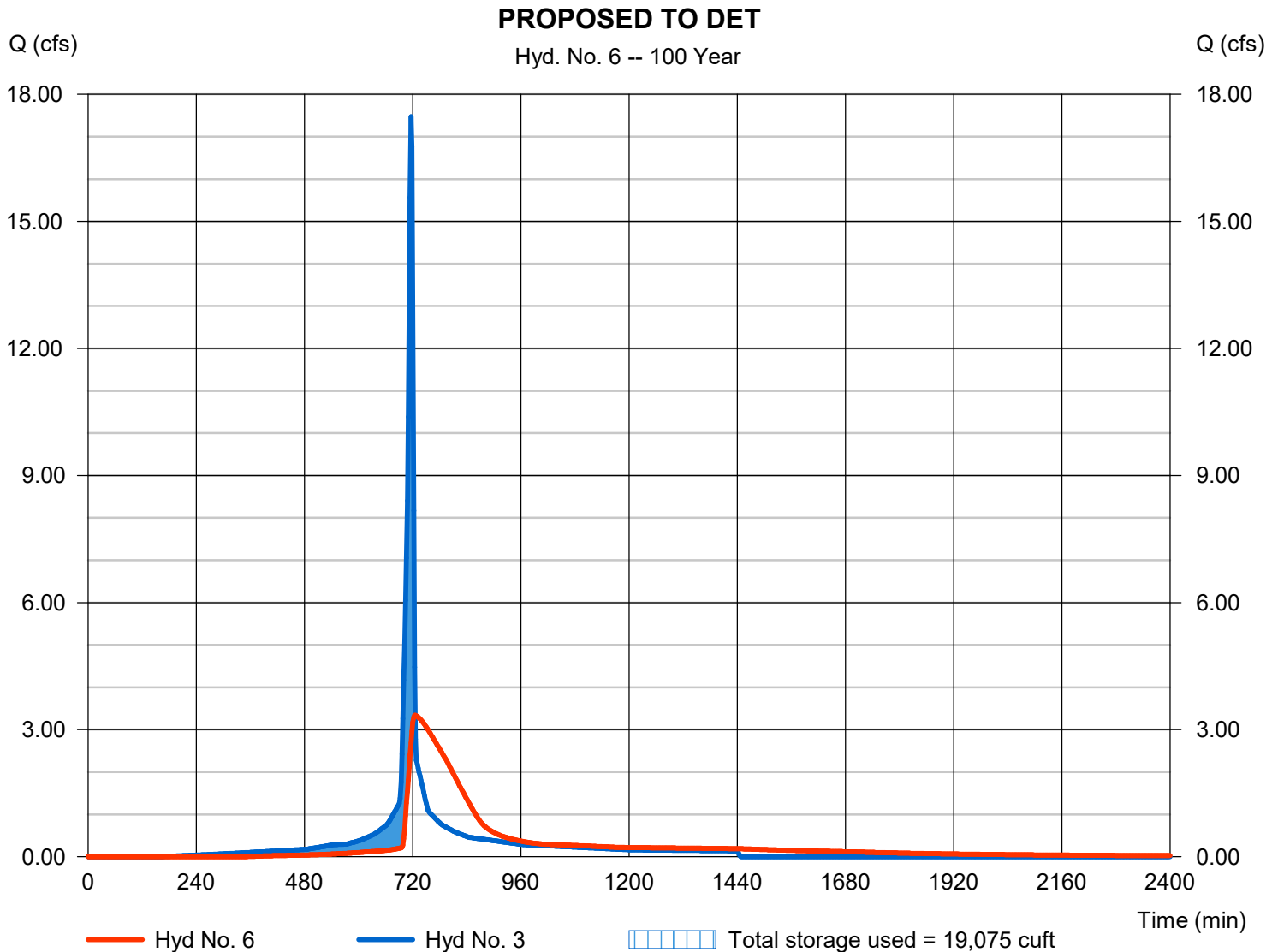
Tuesday, 06 / 23 / 2020

Hyd. No. 6

PROPOSED TO DET

Hydrograph type	= Reservoir	Peak discharge	= 3.341 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 38,321 cuft
Inflow hyd. No.	= 3 - PROPOSED NORTH	Max. Elevation	= 966.12 ft
Reservoir name	= Detention Pond	Max. Storage	= 19,075 cuft

Storage Indication method used.



Hydrograph Report

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

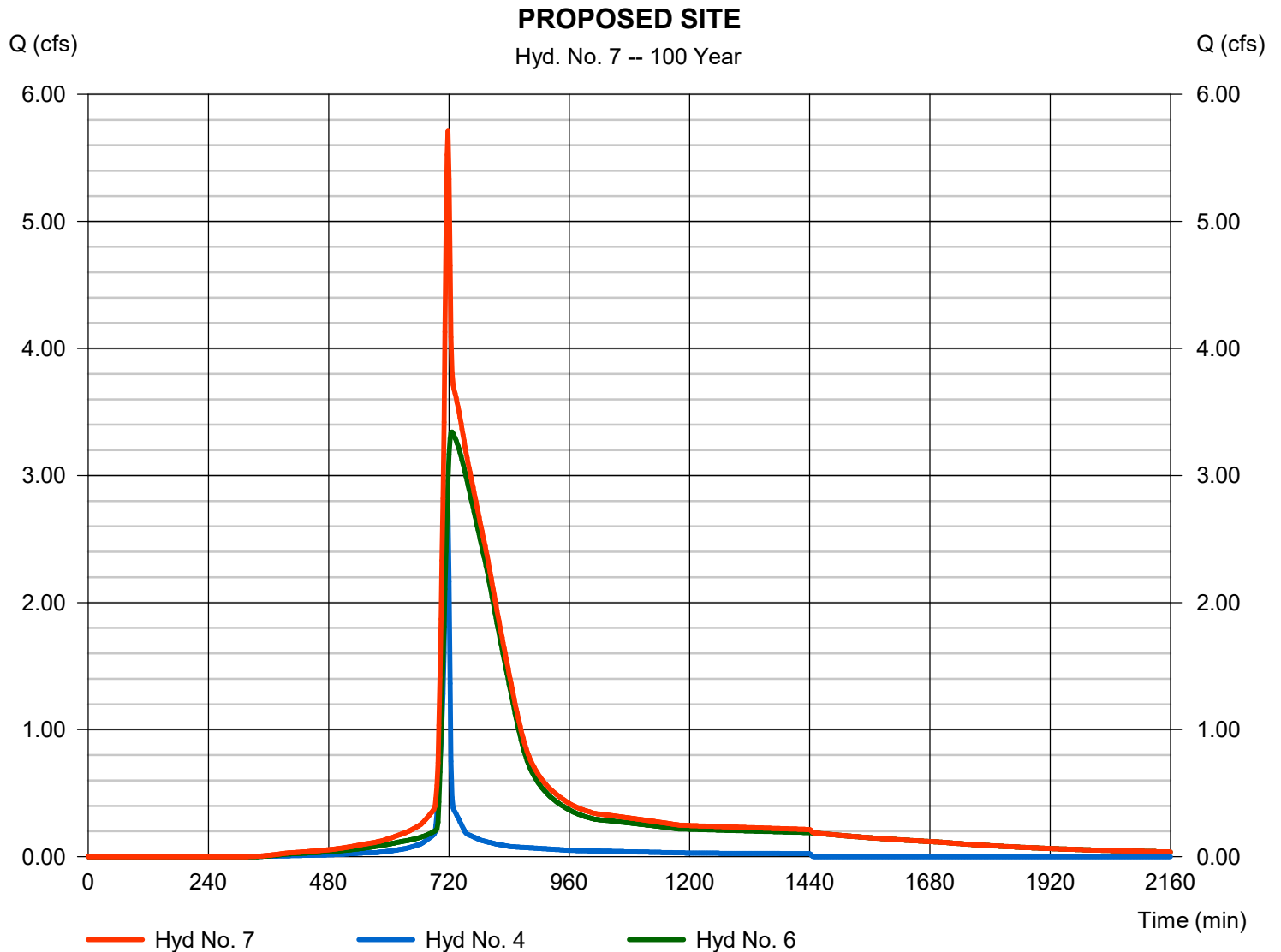
Tuesday, 06 / 23 / 2020

Hyd. No. 7

PROPOSED SITE

Hydrograph type = Combine
 Storm frequency = 100 yrs
 Time interval = 2 min
 Inflow hyds. = 4, 6

Peak discharge = 5.710 cfs
 Time to peak = 718 min
 Hyd. volume = 44,267 cuft
 Contrib. drain. area = 0.320 ac



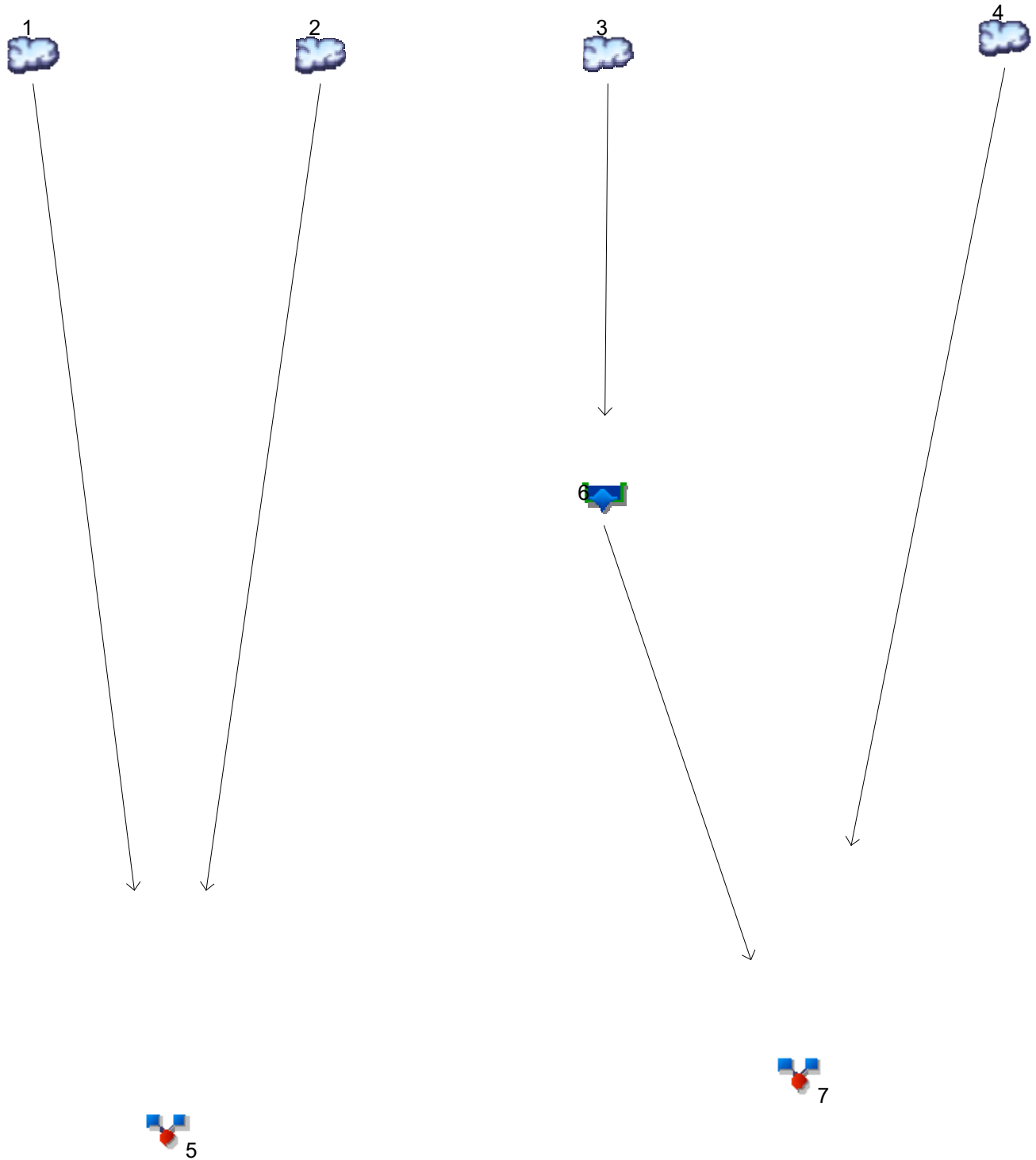
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TR-55 Tc Worksheet.....	7
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**CLOGGED/ ZERO AVAILABLE STORAGE ROUTING
100-YEAR EVENT**

Watershed Model Schematic

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



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	17.14	2	718	40,898	-----	-----	-----	EXISTING NORTH
2	SCS Runoff	2.350	2	720	6,305	-----	-----	-----	EXISTING SOUTH
3	SCS Runoff	17.48	2	716	38,772	-----	-----	-----	PROPOSED NORTH
4	SCS Runoff	2.838	2	716	5,946	-----	-----	-----	PROPOSED BYPASS
5	Combine	19.36	2	718	47,203	1, 2,	-----	-----	EXISTING SITE
6	Reservoir	16.85	2	718	35,243	3	967.00	25,531	PROPOSED TO DET
7	Combine	19.60	2	718	41,189	4, 6	-----	-----	PROPOSED SITE

Hydrograph Report

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

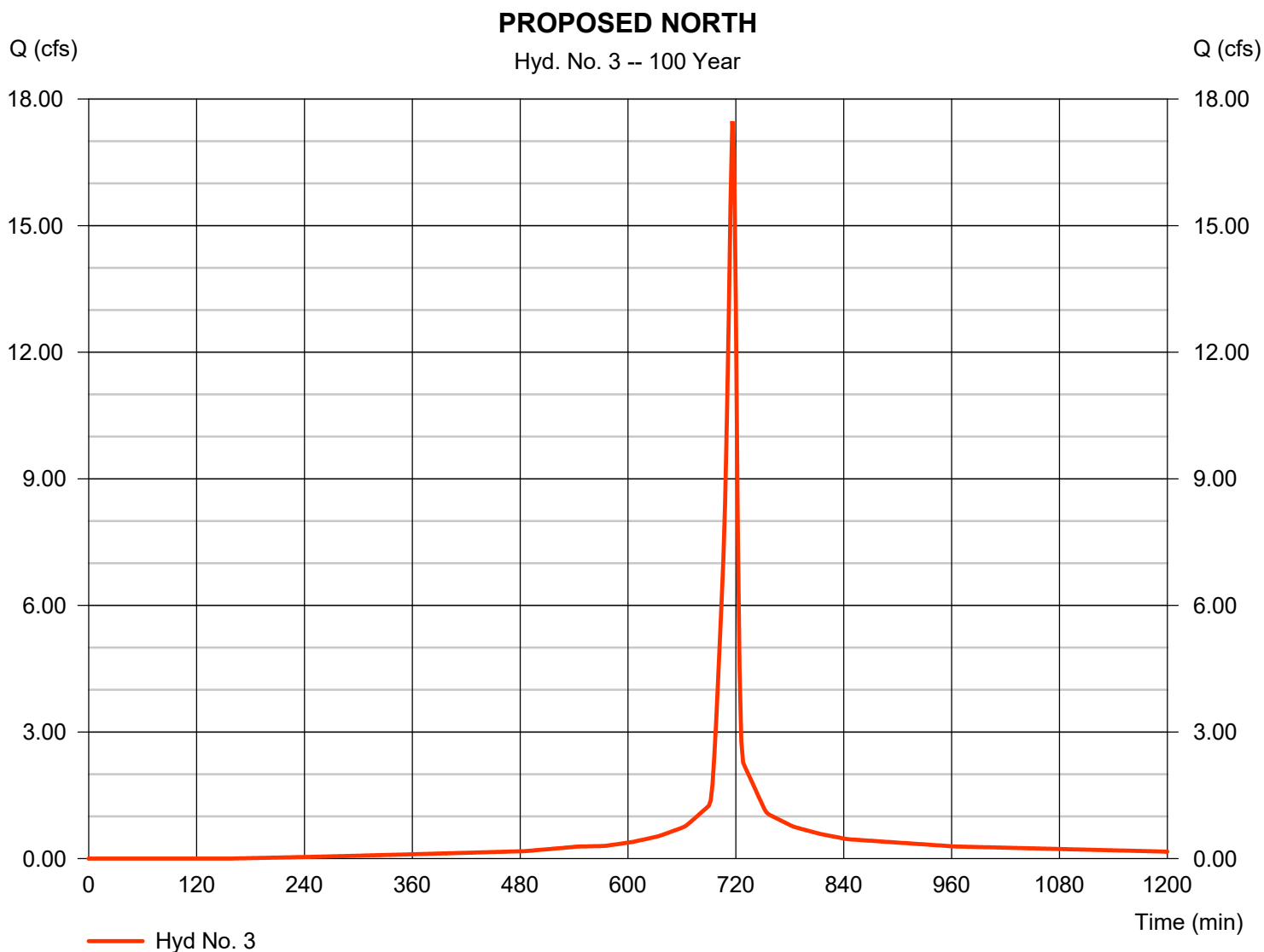
Thursday, 01 / 9 / 2020

Hyd. No. 3

PROPOSED NORTH

Hydrograph type	= SCS Runoff	Peak discharge	= 17.48 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 38,772 cuft
Drainage area	= 1.750 ac	Curve number	= 90*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = $[(0.780 \times 80) + (0.970 \times 98)] / 1.750$



Hydrograph Report

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

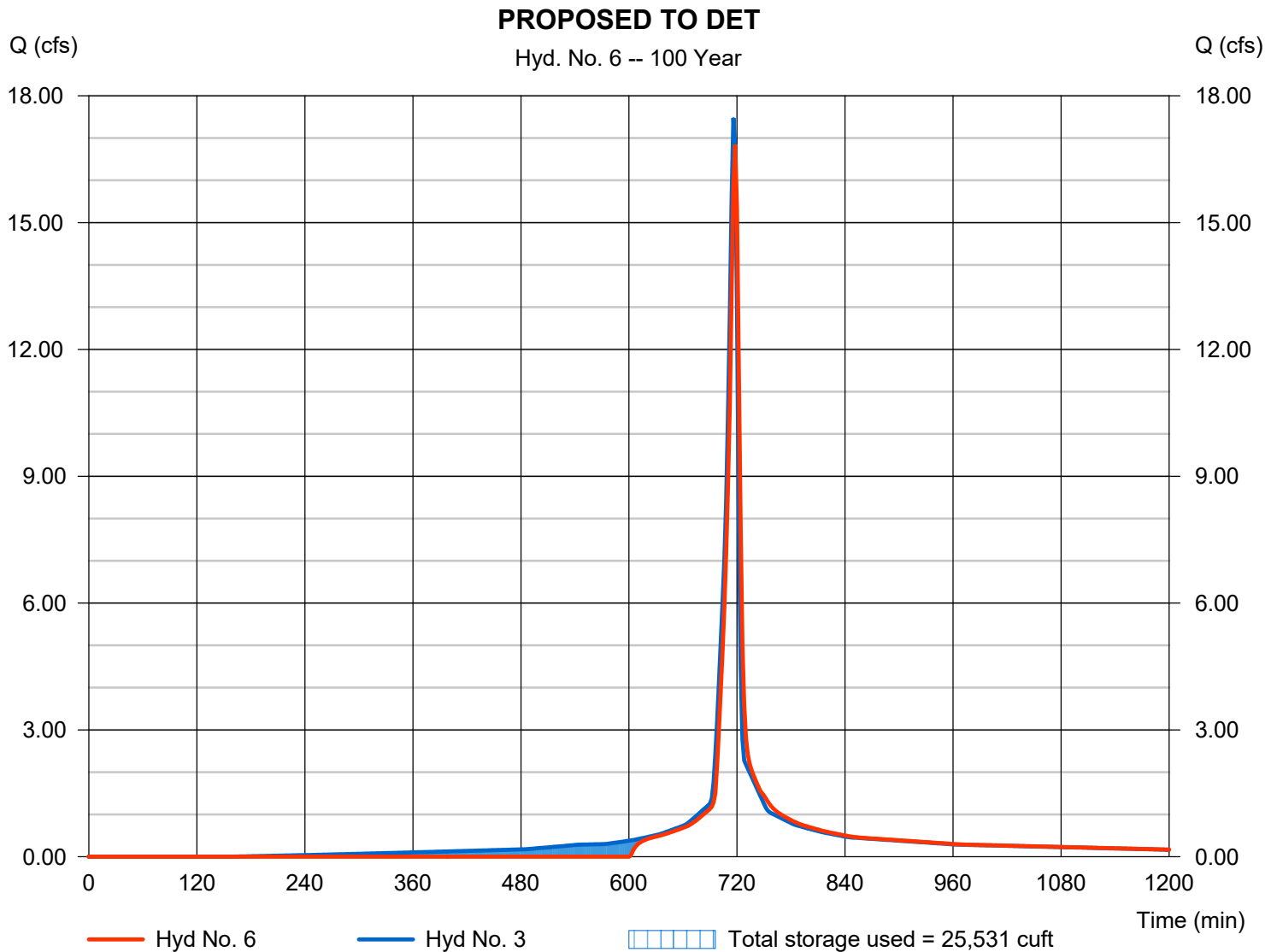
Thursday, 01 / 9 / 2020

Hyd. No. 6

PROPOSED TO DET

Hydrograph type	= Reservoir	Peak discharge	= 16.85 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 35,243 cuft
Inflow hyd. No.	= 3 - PROPOSED NORTH	Max. Elevation	= 967.00 ft
Reservoir name	= Detention Pond	Max. Storage	= 25,531 cuft

Storage Indication method used. Wet pond routing start elevation = 966.20 ft.



Pond No. 1 - Detention Pond

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Beginning Elevation = 961.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	961.00	10	0	0
1.00	962.00	1,575	793	793
2.00	963.00	3,200	2,388	3,180
3.00	964.00	4,610	3,905	7,085
4.00	965.00	5,590	5,100	12,185
5.00	966.00	6,670	6,130	18,315
5.20	966.20	6,895	1,357	19,672
6.00	967.00	7,809	5,881	25,553
7.00	968.00	9,002	8,405	33,958
7.70	968.70	9,869	6,605	40,563

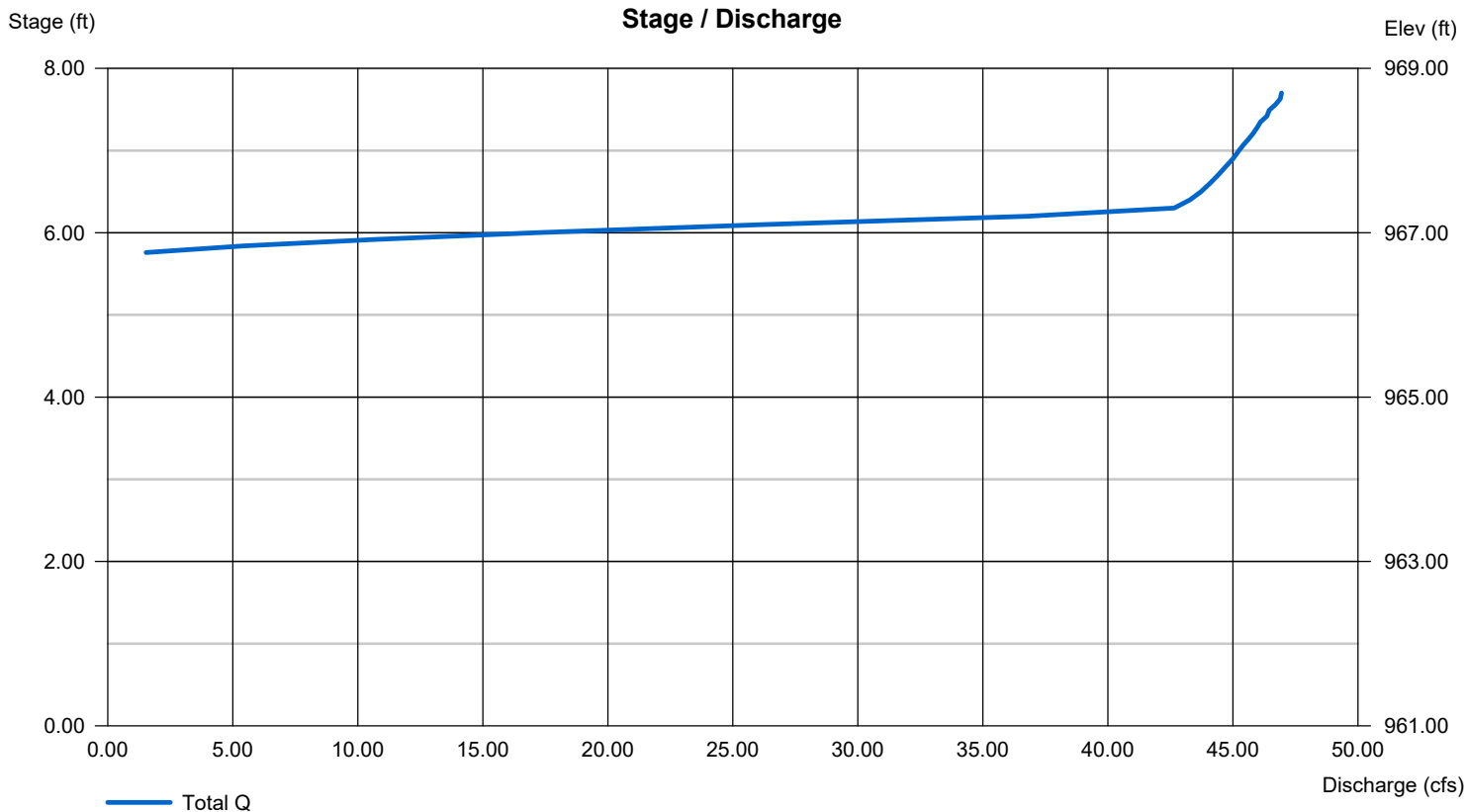
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	8.00	0.00	1.00
No. Barrels	= 1	1	0	6
Invert El. (ft)	= 958.00	963.80	0.00	961.52
Length (ft)	= 162.00	1.00	0.00	1.65
Slope (%)	= 5.61	0.50	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	Yes

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	40.00	Inactive	Inactive
Crest El. (ft)	= 966.20	966.70	0.00	0.00
Weir Coeff.	= 2.60	2.60	3.33	3.33
Weir Type	= Broad	Broad	---	---
Multi-Stage	= Yes	Yes	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).



Hydrograph Report

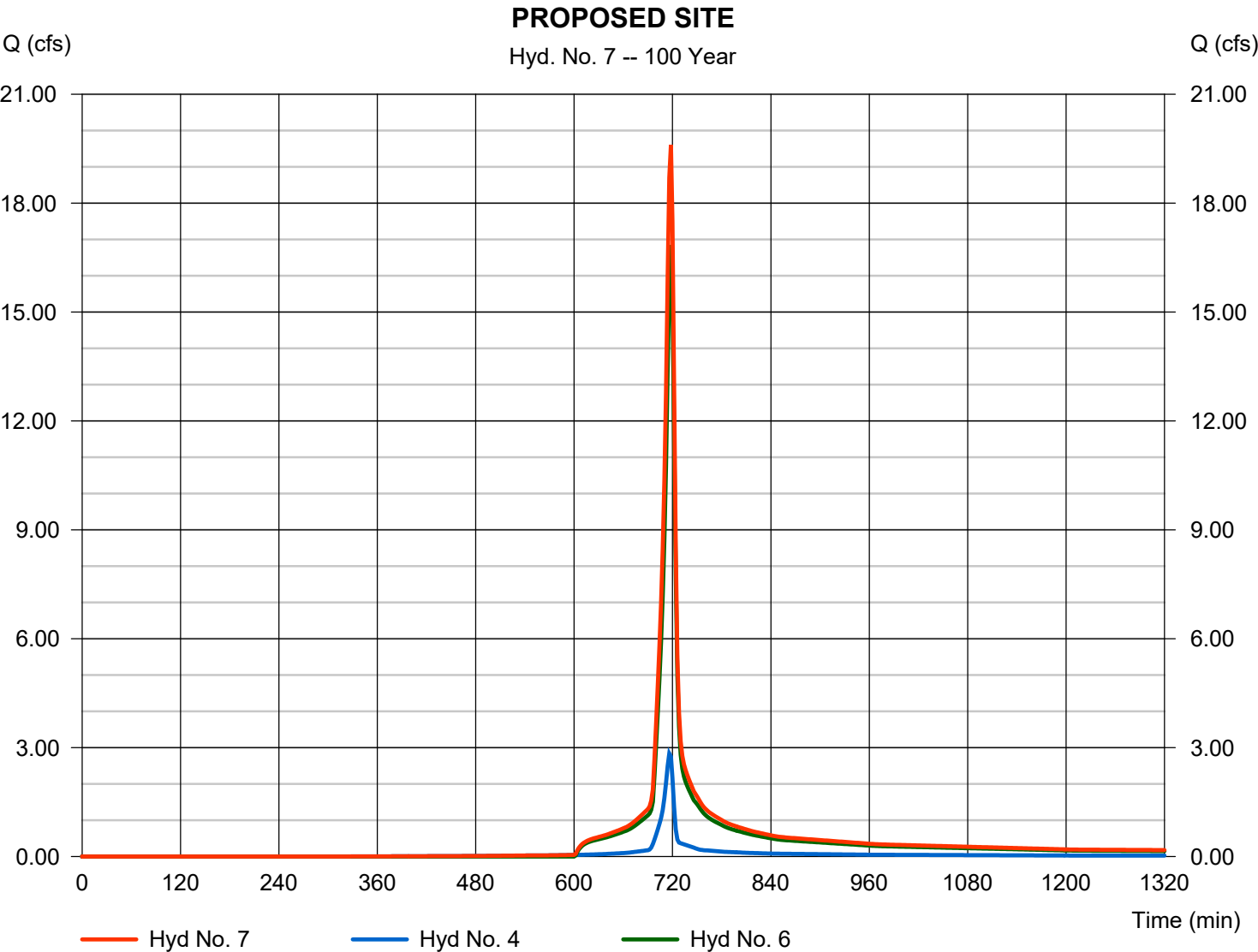
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 01 / 9 / 2020

Hyd. No. 7

PROPOSED SITE

Hydrograph type	= Combine	Peak discharge	= 19.60 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 41,189 cuft
Inflow hyds.	= 4, 6	Contrib. drain. area	= 0.320 ac



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Thursday, Aug 22 2019

Emergency Spillway

Trapezoidal

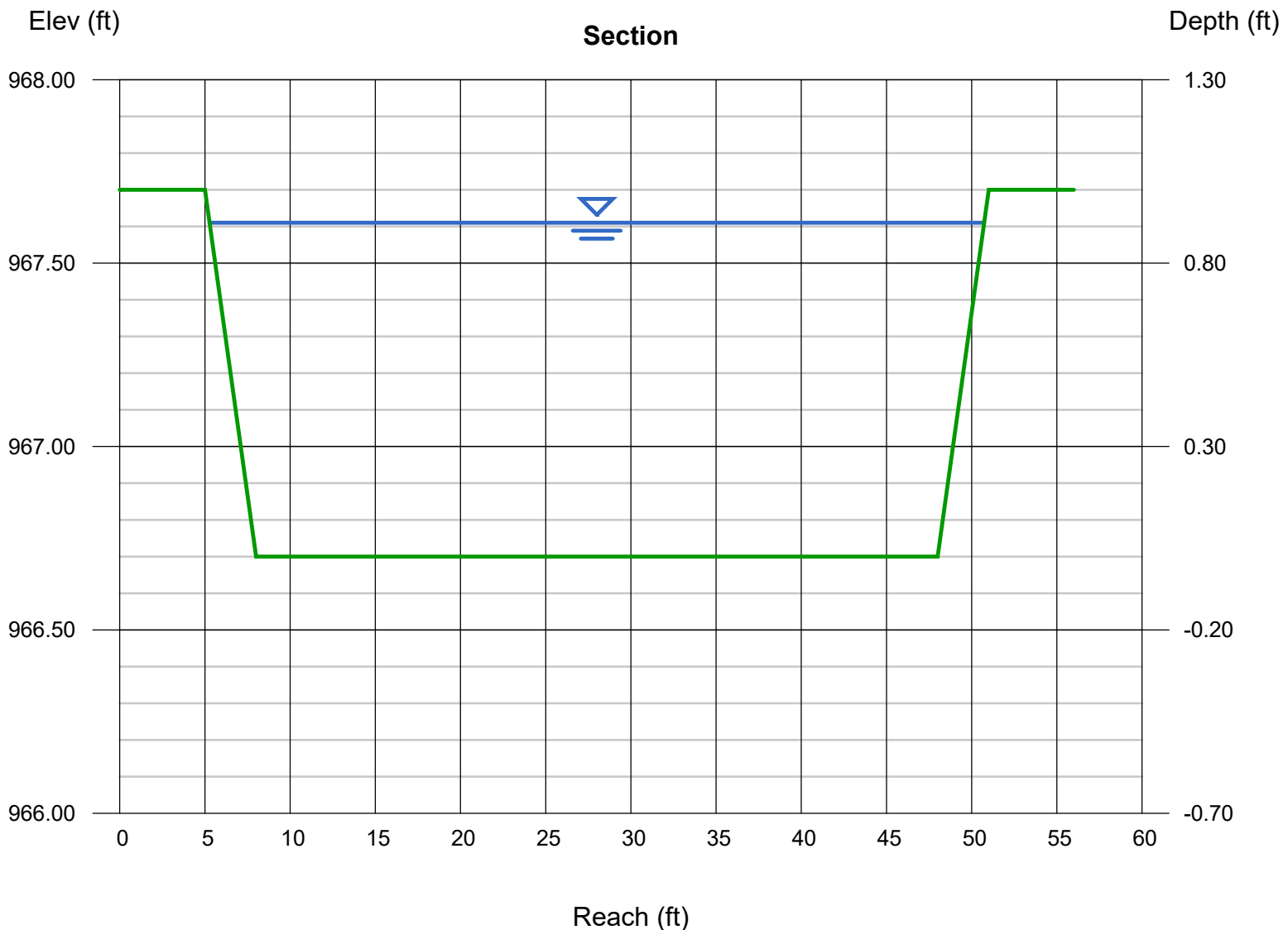
Bottom Width (ft) = 40.00
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 1.00
Invert Elev (ft) = 966.70
Slope (%) = 1.00
N-Value = 0.150

Calculations

Compute by: Known Q
Known Q (cfs) = 34.51

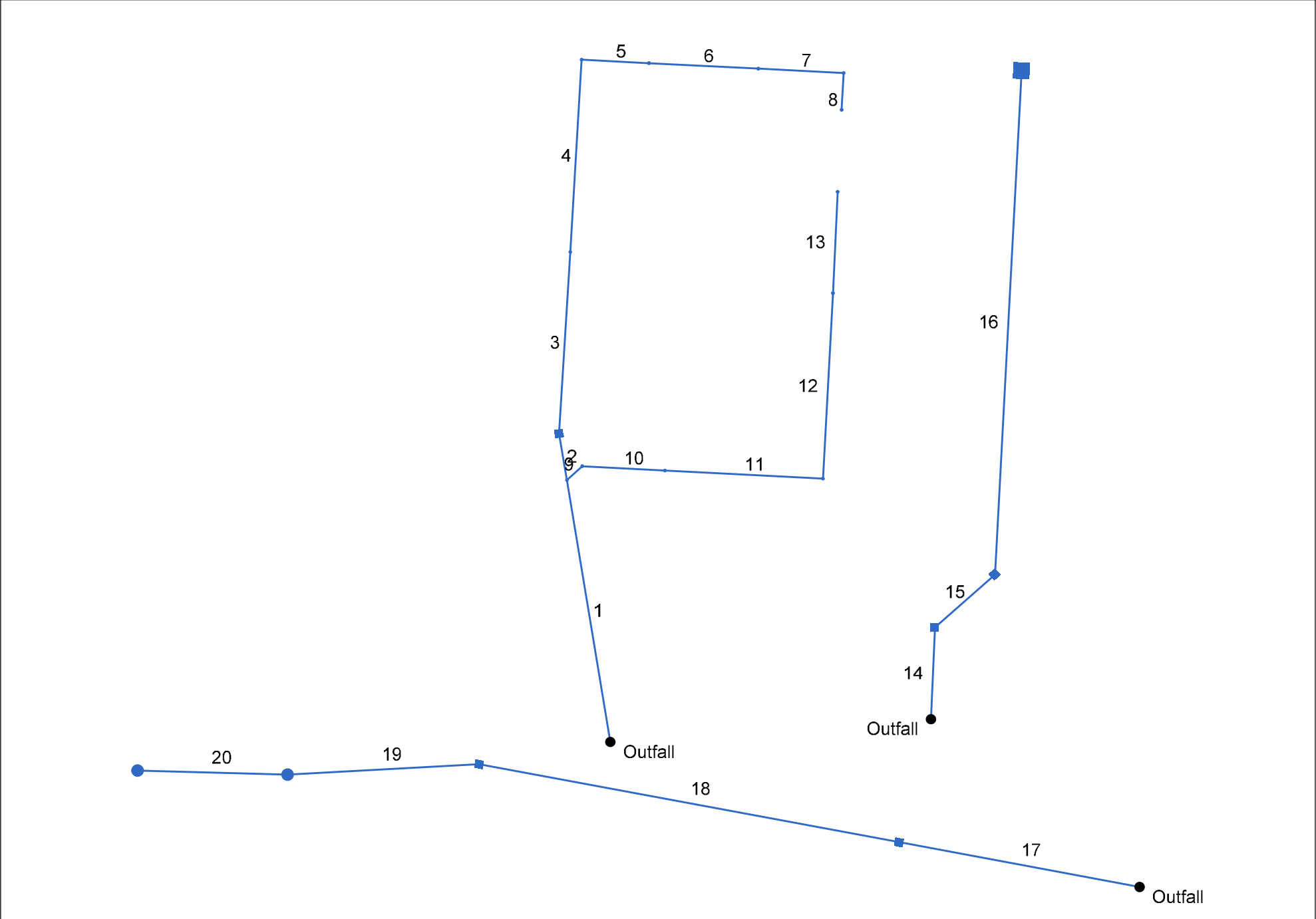
Highlighted

Depth (ft) = 0.91
Q (cfs) = 34.51
Area (sqft) = 38.88
Velocity (ft/s) = 0.89
Wetted Perim (ft) = 45.76
Crit Depth, Yc (ft) = 0.29
Top Width (ft) = 45.46
EGL (ft) = 0.92



Attachment 3
Hydraflow Storm Sewers Calculations

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 20180111_2020-06-23 Storm Sewers-field conditions.stm	Number of lines: 20	Date: 6/23/2020
---	---------------------	-----------------

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	B2-B1	2.29	12	Cir	99.99	963.50	972.32	8.821	964.32	972.97	n/a	972.97 j	End	Manhole
2	B3-B2	1.23	12	Cir	17.74	972.32	972.50	1.015	972.97	972.97	n/a	972.97 j	1	Grate
3	B4-B3	0.69	10	Cir	68.55	972.70	973.39	1.007	973.02	973.76	0.02	973.76	2	Manhole
4	B5-B4	0.36	10	Cir	72.55	973.39	974.11	0.992	973.76	974.37	n/a	974.37 j	3	Manhole
5	B6-B5	0.29	10	Cir	25.08	974.11	974.36	0.997	974.37	974.59	n/a	974.59 j	4	Manhole
6	B7-B6	0.09	10	Cir	41.25	974.36	974.77	0.994	974.59	974.90	n/a	974.90 j	5	Manhole
7	B8-B7	0.03	10	Cir	32.00	974.77	975.09	1.000	974.90	975.16	n/a	975.16 j	6	Manhole
8	B9-B8	0.03	10	Cir	13.88	975.09	975.23	1.009	975.16	975.30	n/a	975.30	7	Manhole
9	C1-B2	1.06	10	Cir	7.84	972.32	973.31	12.631	972.97	973.77	n/a	973.77 j	1	Manhole
10	C2-C1	0.99	10	Cir	31.16	973.31	973.62	0.995	973.77	974.06	n/a	974.06 j	9	Manhole
11	C3-C2	0.79	10	Cir	59.30	973.62	974.22	1.012	974.06	974.61	n/a	974.61 j	10	Manhole
12	C4-C3	0.53	10	Cir	70.00	974.22	974.92	1.000	974.61	975.24	n/a	975.24 j	11	Manhole
13	C5-C4	0.26	10	Cir	38.21	974.92	975.30	0.994	975.24	975.52	n/a	975.52 j	12	Manhole
14	D2-D1	4.67	12	Cir	34.62	963.50	969.00	15.888	964.45	969.90	n/a	969.90 j	End	Curb-Horiz
15	D3-D2	3.54	12	Cir	30.05	969.20	971.30	6.988	969.90	972.10	n/a	972.10	14	Curb-Horiz
16	D4-D3	2.55	12	Cir	190.01	971.50	973.50	1.053	972.12	974.18	n/a	974.18	15	Curb-Horiz
17	EX AL#1202-OUTFALL	8.04	24	Cir	91.74	947.73	948.65	1.003	949.23	949.66	n/a	949.66 j	End	Grate
18	A1-EX AL#1202	5.20	24	Cir	160.20	948.85	957.84	5.612	949.66	958.64	n/a	958.64 j	17	Grate
19	A2-A1	2.16	15	Cir	72.03	958.04	962.63	6.372	958.64	963.22	n/a	963.22 j	18	Manhole
20	EX A3-A2	2.16	15	Cir	56.15	966.58	967.09	0.908	967.09	967.68	n/a	967.68	19	Grate

Project File: 20180111_2020-06-23 Storm Sewers-field conditions.stm

Number of lines: 20

Run Date: 6/23/2020

NOTES: Return period = 10 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (l)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID	
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up		
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)		
1	End	99.99	0.00	0.39	0.00	0.00	0.33	0.0	5.0	7.0	2.29	10.58	3.79	12	8.82	963.50	972.32	964.32	972.97	965.10	978.70	B2-B1	
2	1	17.74	0.13	0.23	0.60	0.08	0.18	5.0	5.0	7.0	1.23	3.59	2.85	12	1.01	972.32	972.50	972.97	972.97	978.70	977.67	B3-B2	
3	2	68.55	0.05	0.10	0.95	0.05	0.10	5.0	5.0	7.0	0.69	2.20	3.28	10	1.01	972.70	973.39	973.02	973.76	977.67	977.10	B4-B3	
4	3	72.55	0.01	0.05	0.95	0.01	0.05	5.0	5.0	7.0	0.36	2.18	2.01	10	0.99	973.39	974.11	973.76	974.37	977.10	979.00	B5-B4	
5	4	25.08	0.03	0.04	0.95	0.03	0.04	5.0	5.0	7.0	0.29	2.19	2.16	10	1.00	974.11	974.36	974.37	974.59	979.00	978.75	B6-B5	
6	5	41.25	0.01	0.01	0.95	0.01	0.01	5.0	5.0	7.0	0.09	2.18	1.22	10	0.99	974.36	974.77	974.59	974.90	978.75	978.40	B7-B6	
7	6	32.00	0.00	0.00	0.00	0.00	0.00	0.0	5.0	7.0	0.03	2.19	0.86	10	1.00	974.77	975.09	974.90	975.16	978.40	978.15	B8-B7	
8	7	13.88	0.00	0.00	0.95	0.00	0.00	5.0	5.0	7.0	0.03	2.20	1.23	10	1.01	975.09	975.23	975.16	975.30	978.15	978.30	B9-B8	
9	1	7.84	0.01	0.16	0.95	0.01	0.15	5.0	5.0	7.0	1.06	7.78	2.89	10	12.63	972.32	973.31	972.97	973.77	978.70	978.70	C1-B2	
10	9	31.16	0.03	0.15	0.95	0.03	0.14	5.0	5.0	7.0	0.99	2.18	3.31	10	0.99	973.31	973.62	973.77	974.06	978.70	978.28	C2-C1	
11	10	59.30	0.04	0.12	0.95	0.04	0.11	5.0	5.0	7.0	0.79	2.20	2.92	10	1.01	973.62	974.22	974.06	974.61	978.28	978.25	C3-C2	
12	11	70.00	0.04	0.08	0.95	0.04	0.08	5.0	5.0	7.0	0.53	2.19	2.43	10	1.00	974.22	974.92	974.61	975.24	978.25	978.67	C4-C3	
13	12	38.21	0.04	0.04	0.95	0.04	0.04	5.0	5.0	7.0	0.26	2.18	1.82	10	0.99	974.92	975.30	975.24	975.52	978.67	978.80	C5-C4	
14	End	34.62	0.17	0.93	0.95	0.16	0.67	5.0	5.0	7.0	4.67	14.19	6.18	12	15.89	963.50	969.00	964.45	969.90	965.60	976.30	D2-D1	
15	14	30.05	0.15	0.76	0.95	0.14	0.51	5.0	5.0	7.0	3.54	9.41	5.65	12	6.99	969.20	971.30	969.90	972.10	976.30	976.30	D3-D2	
16	15	190.01	0.61	0.61	0.60	0.37	0.37	5.0	5.0	7.0	2.55	3.65	4.74	12	1.05	971.50	973.50	972.12	974.18	976.30	977.60	D4-D3	
17	End	91.74	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	8.04	22.65	4.12	24	1.00	947.73	948.65	949.23	949.66	950.00	959.95	EX AL#1202-OUT	
18	17	160.20	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	5.20	53.58	4.39	24	5.61	948.85	957.84	949.66	958.64	959.95	966.20	A1-EX AL#1202	
19	18	72.03	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.16	16.30	3.75	15	6.37	958.04	962.63	958.64	963.22	966.20	971.20	A2-A1	
20	19	56.15	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.16	6.15	4.20	15	0.91	966.58	967.09	967.09	967.68	971.20	973.94	EX A3-A2	
Project File: 20180111_2020-06-23 Storm Sewers-field conditions.stm																Number of lines: 20				Run Date: 6/23/2020			
NOTES:Intensity = 66.71 / (Inlet time + 12.50) ^ 0.79; Return period =Yrs. 10 ; Pipe travel time suppressed. ; c = cir e = ellip b = box																							

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	B2-B1	3.20	12	Cir	99.99	963.50	972.32	8.821	964.38	973.09	n/a	973.09 j	End	Manhole
2	B3-B2	1.72	12	Cir	17.74	972.32	972.50	1.015	973.09	973.06	n/a	973.06 j	1	Grate
3	B4-B3	0.96	10	Cir	68.55	972.70	973.39	1.007	973.09	973.82	0.03	973.82	2	Manhole
4	B5-B4	0.50	10	Cir	72.55	973.39	974.11	0.992	973.82	974.42	n/a	974.42 j	3	Manhole
5	B6-B5	0.41	10	Cir	25.08	974.11	974.36	0.997	974.42	974.64	n/a	974.64 j	4	Manhole
6	B7-B6	0.13	10	Cir	41.25	974.36	974.77	0.994	974.64	974.92	n/a	974.92 j	5	Manhole
7	B8-B7	0.04	10	Cir	32.00	974.77	975.09	1.000	974.92	975.17	n/a	975.17 j	6	Manhole
8	B9-B8	0.04	10	Cir	13.88	975.09	975.23	1.009	975.17	975.31	0.03	975.31	7	Manhole
9	C1-B2	1.48	10	Cir	7.84	972.32	973.31	12.631	973.09	973.85	n/a	973.85 j	1	Manhole
10	C2-C1	1.38	10	Cir	31.16	973.31	973.62	0.995	973.85	974.15	n/a	974.15 j	9	Manhole
11	C3-C2	1.11	10	Cir	59.30	973.62	974.22	1.012	974.15	974.69	n/a	974.69 j	10	Manhole
12	C4-C3	0.74	10	Cir	70.00	974.22	974.92	1.000	974.69	975.30	n/a	975.30 j	11	Manhole
13	C5-C4	0.37	10	Cir	38.21	974.92	975.30	0.994	975.30	975.56	n/a	975.56 j	12	Manhole
14	D2-D1	6.51	12	Cir	34.62	963.50	969.00	15.888	964.48	969.97	n/a	969.97 j	End	Curb-Horiz
15	D3-D2	4.94	12	Cir	30.05	969.20	971.30	6.988	969.97	972.21	0.76	972.21	14	Curb-Horiz
16	D4-D3	3.56	12	Cir	190.01	971.50	973.50	1.053	972.30	974.30	n/a	974.30	15	Curb-Horiz
17	EX AL#1202-OUTFALL	9.26	24	Cir	91.74	947.73	948.65	1.003	949.27	949.74	n/a	949.74 j	End	Grate
18	A1-EX AL#1202	6.42	24	Cir	160.20	948.85	957.84	5.612	949.74	958.74	n/a	958.74	17	Grate
19	A2-A1	3.38	15	Cir	72.03	958.04	962.63	6.372	958.74	963.37	n/a	963.37	18	Manhole
20	EX A3-A2	3.38	15	Cir	56.15	966.58	967.09	0.908	967.24	967.83	n/a	967.83	19	Grate

Project File: 20180111_2020-06-23 Storm Sewers-field conditions.stm

Number of lines: 20

Run Date: 6/23/2020

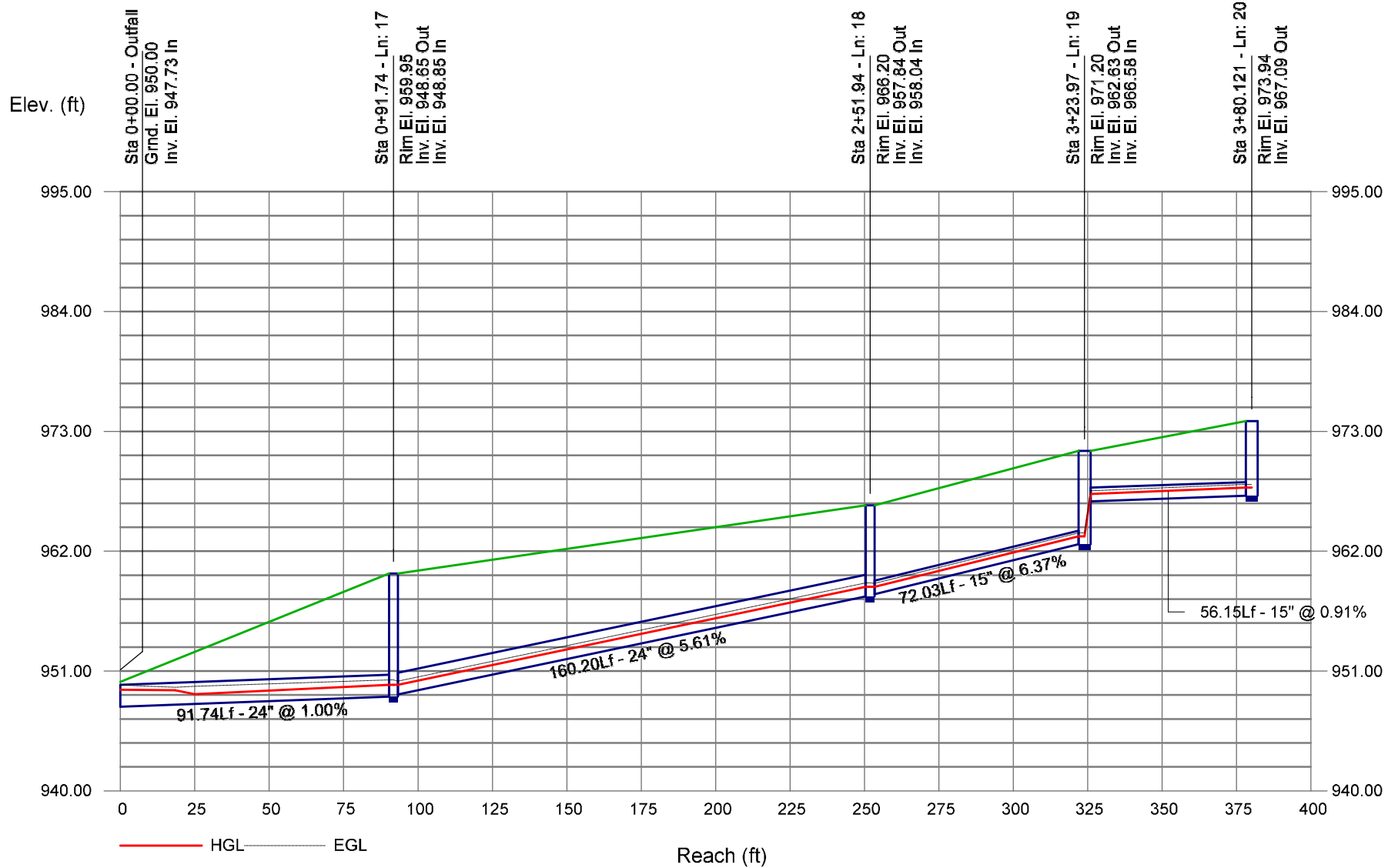
NOTES: Return period = 100 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len (ft)	Drng Area		Rnoff coeff (C)	Area x C		Tc		Rain (l) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID	
Line	To Line		Incr (ac)	Total (ac)		Incr (min)	Total (min)	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)		
1	End	99.99	0.00	0.39	0.00	0.00	0.33	0.0	5.0	9.7	3.20	10.58	4.66	12	8.82	963.50	972.32	964.38	973.09	965.10	978.70	B2-B1	
2	1	17.74	0.13	0.23	0.60	0.08	0.18	5.0	5.0	9.7	1.72	3.59	3.24	12	1.01	972.32	972.50	973.09	973.06	978.70	977.67	B3-B2	
3	2	68.55	0.05	0.10	0.95	0.05	0.10	5.0	5.0	9.7	0.96	2.20	3.62	10	1.01	972.70	973.39	973.09	973.82	977.67	977.10	B4-B3	
4	3	72.55	0.01	0.05	0.95	0.01	0.05	5.0	5.0	9.7	0.50	2.18	2.22	10	0.99	973.39	974.11	973.82	974.42	977.10	979.00	B5-B4	
5	4	25.08	0.03	0.04	0.95	0.03	0.04	5.0	5.0	9.7	0.41	2.19	2.38	10	1.00	974.11	974.36	974.42	974.64	979.00	978.75	B6-B5	
6	5	41.25	0.01	0.01	0.95	0.01	0.01	5.0	5.0	9.7	0.13	2.18	1.34	10	0.99	974.36	974.77	974.64	974.92	978.75	978.40	B7-B6	
7	6	32.00	0.00	0.00	0.00	0.00	0.00	0.0	5.0	9.7	0.04	2.19	0.94	10	1.00	974.77	975.09	974.92	975.17	978.40	978.15	B8-B7	
8	7	13.88	0.00	0.00	0.95	0.00	0.00	5.0	5.0	9.7	0.04	2.20	1.34	10	1.01	975.09	975.23	975.17	975.31	978.15	978.30	B9-B8	
9	1	7.84	0.01	0.16	0.95	0.01	0.15	5.0	5.0	9.7	1.48	7.78	3.37	10	12.63	972.32	973.31	973.09	973.85	978.70	978.70	C1-B2	
10	9	31.16	0.03	0.15	0.95	0.03	0.14	5.0	5.0	9.7	1.38	2.18	3.75	10	0.99	973.31	973.62	973.85	974.15	978.70	978.28	C2-C1	
11	10	59.30	0.04	0.12	0.95	0.04	0.11	5.0	5.0	9.7	1.11	2.20	3.28	10	1.01	973.62	974.22	974.15	974.69	978.28	978.25	C3-C2	
12	11	70.00	0.04	0.08	0.95	0.04	0.08	5.0	5.0	9.7	0.74	2.19	2.70	10	1.00	974.22	974.92	974.69	975.30	978.25	978.67	C4-C3	
13	12	38.21	0.04	0.04	0.95	0.04	0.04	5.0	5.0	9.7	0.37	2.18	2.01	10	0.99	974.92	975.30	975.30	975.56	978.67	978.80	C5-C4	
14	End	34.62	0.17	0.93	0.95	0.16	0.67	5.0	5.0	9.7	6.51	14.19	8.35	12	15.89	963.50	969.00	964.48	969.97	965.60	976.30	D2-D1	
15	14	30.05	0.15	0.76	0.95	0.14	0.51	5.0	5.0	9.7	4.94	9.41	7.11	12	6.99	969.20	971.30	969.97	972.21	976.30	976.30	D3-D2	
16	15	190.01	0.61	0.61	0.60	0.37	0.37	5.0	5.0	9.7	3.56	3.65	5.28	12	1.05	971.50	973.50	972.30	974.30	976.30	977.60	D4-D3	
17	End	91.74	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	9.26	22.65	4.44	24	1.00	947.73	948.65	949.27	949.74	950.00	959.95	EX AL#1202-OUT	
18	17	160.20	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	6.42	53.58	4.74	24	5.61	948.85	957.84	949.74	958.74	959.95	966.20	A1-EX AL#1202	
19	18	72.03	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.38	16.30	4.64	15	6.37	958.04	962.63	958.74	963.37	966.20	971.20	A2-A1	
20	19	56.15	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.38	6.15	4.80	15	0.91	966.58	967.09	967.24	967.83	971.20	973.94	EX A3-A2	
Project File: 20180111_2020-06-23 Storm Sewers-field conditions.stm																Number of lines: 20				Run Date: 6/23/2020			
NOTES:Intensity = 170.80 / (Inlet time + 18.20) ^ 0.91; Return period =Yrs. 100 ; Pipe travel time suppressed. ; c = cir e = ellip b = box																							

100-YR Hydraulic Profile

EXISTING POND TO EXISTING OUTLET THROUGH PROPOSED POND



Attachment 4
Water Quality Calculations

Date: 7/25/2019
Revised: 8/23/2019; 11/1/2019

Proposed Conditions

Drainage Area	Pervious Area (ac)	Impervious Area (ac)	Total Area, DA (ac)	Total Area, DA (sf)	Percent Site Impervious, I	Volumetric Runoff Coefficient, Rv = .05+.009I	Required WQ Treatment Volume, WQv=P(Rv) (in)	Required WQ Treatment Volume, WQv=P(Rv)(DA) (cf)
North	0.78	0.97	1.75	76,330	56.0%	0.554	0.759	4,827.75
Bypass	0.36	0.02	0.38	16,756	5.3%	0.098	0.134	186.90
Sum=							5014.64	

Extended Dry Detention Pond

Elevation-Area-Volume Table		
Elevation	Area (sf)	Volume (cf)
961	10	0
962	1,575	793
963	3,200	3,180
963.5	3,905	5,132
964	4,610	7,085
965	5,590	12,185
966	6,670	18,315
966.2	6,895	19,672

*WQv elevation

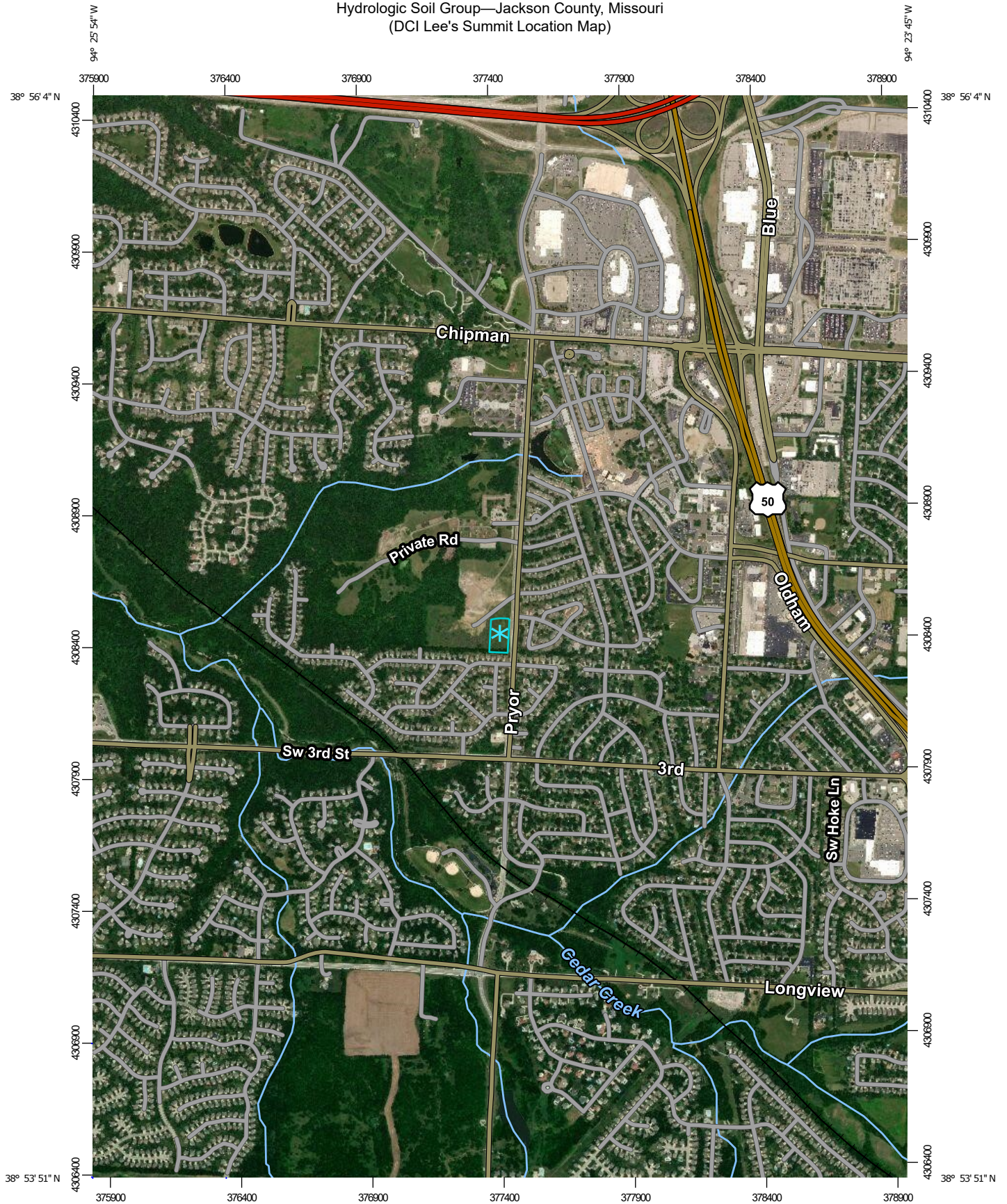
Extended Dry Detention Pond	Return Event (years)	Max Water Surface Elevation (ft)	Freeboard (ft)
	2	964.17	4.53
	10	965.09	3.61
	100	966.17	2.53

Perforated Riser

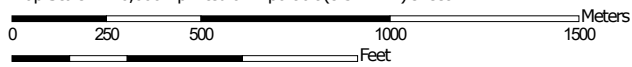
WQv Treatment Depth Above Lowest Orifice, Zwq	2.5 ft
Water Quality Volume	5,132 cf
Water Quality Volume	0.118 ac-ft
Recommended Max Outlet Area per Row, Ao	1.35 sq. in
$A_o = \frac{WQ_v}{(0.013(Z_{wq})^2 + 0.22(Z_{wq}) - 0.10)}$	
Number of columns, nc	1 column
Design circular perforation diameter, Dperf	1 in
Number of rows (4" vertical spacing), nr	6 rows
Perforation 1 Elevation	961.52
Perforation 2 Elevation	961.85
Perforation 3 Elevation	962.18
Perforation 4 Elevation	962.51
Perforation 5 Elevation	962.84
Perforation 6 Elevation	963.17

Attachment 5
Supporting Documents

Hydrologic Soil Group—Jackson County, Missouri (DCI Lee's Summit Location Map)



Map Scale: 1:20,000 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

* - Site Location



**Natural Resources
Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

7/8/2019
Page 1 of 4

Hydrologic Soil Group—Jackson County, Missouri
(DCI Lee's Summit)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Jackson County, Missouri
 Survey Area Data: Version 19, Sep 13, 2018

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

Date(s) aerial images were photographed: Jun 11, 2017—Sep 22, 2017

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10024	Greenton-Urban land complex, 5 to 9 percent slopes	D	2.2	97.6%
10128	Sharpsburg-Urban land complex, 2 to 5 percent slopes	D	0.1	2.4%
Totals for Area of Interest			2.2	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

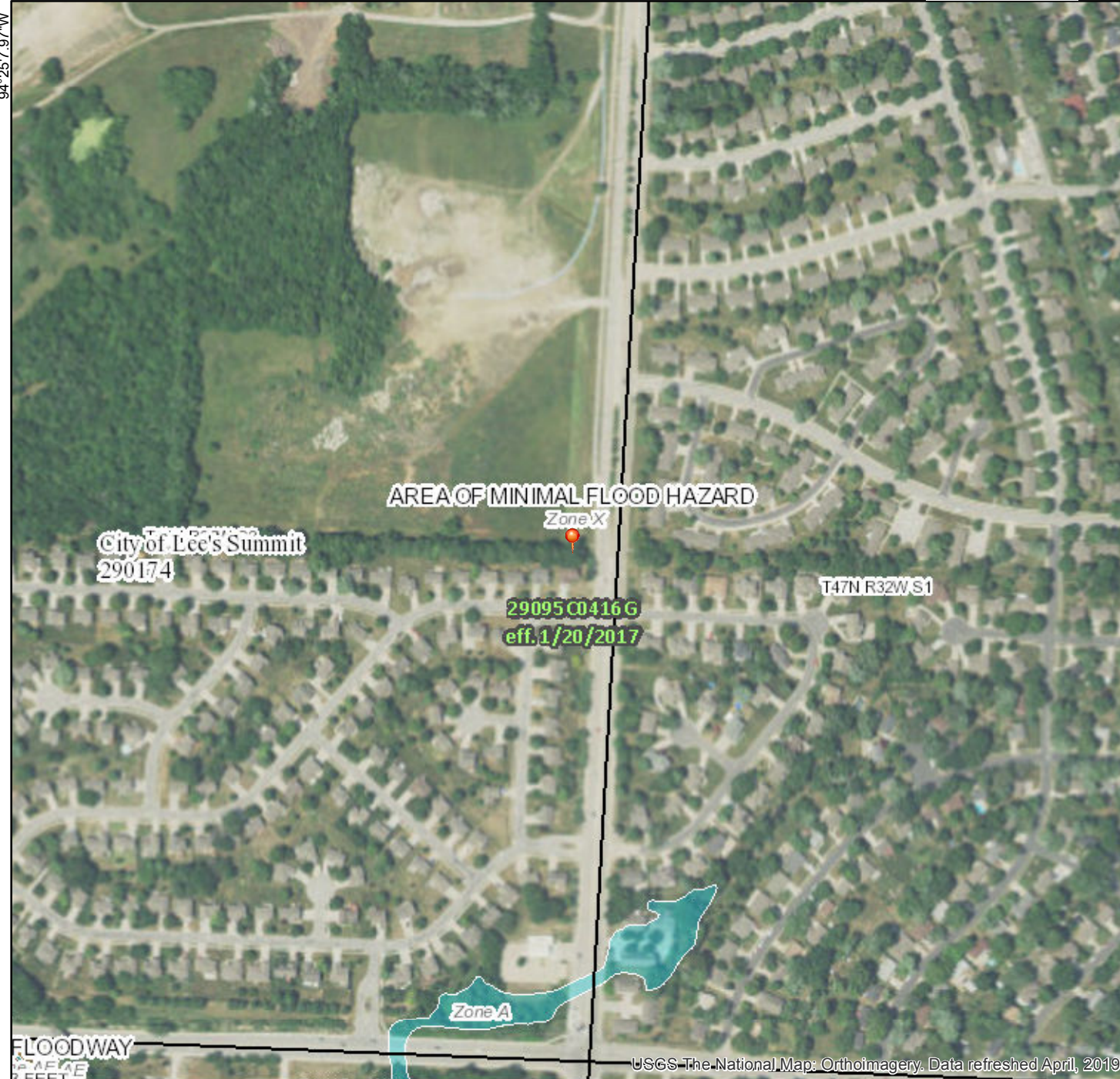
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette



38°55'10.28"N



0 250 500 1,000 1,500 2,000 Feet 1:6,000

USGS-The National Map: Orthoimagery. Data refreshed April, 2019.

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance
		17.5 Water Surface Elevation
		513 Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped



The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/9/2019 at 8:48:53 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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