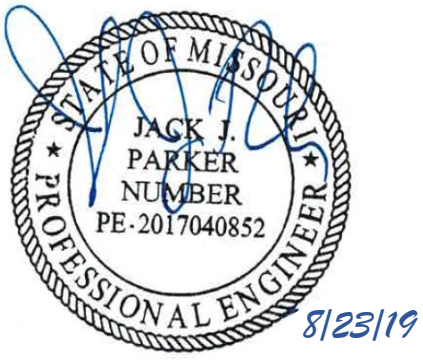
DRAINAGE DESIGN SUMMARY

FOR

DCI Lee's Summit

Lee's Summit, Jackson County, Missouri

July 25, 2019
Revised August 23, 2019



Prepared for:
Dialysis Clinic, Inc.
1633 Church Street, Suite 500
Nashville, TN 37203
(615) 327-3061

Prepared by:
Catalyst Design Group
5016 Centennial Boulevard, Suite 200
Nashville, TN 37209
(615)866-2410

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	6.303
10-year	11.37
100-year	18.21

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 an 8" orifice 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 just above the 100 year storm elevation at 966.20 to serve as an emergency overflow weir. The pond is also designed with an emergency spillway located on the East edge of the pond. The spillway is sized to pass the 1% storm from the contributing drainage area as well as the adjacent Fire department development's 1% storm with 1' of freeboard to the top of the dam assuming zero available storage in the ponds and zero flow through the primary outlet. See Attachment 2 for detention routing calculations.

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	1.308
10-year	3.679
100-year	5.937

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.

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 10-year and 100-year storm events are less than their respective allowable peak flow rates. The post-developed peak flow rate for the 2-year storm event exceeds the allowable peak flow rate by 0.2 cfs. This minor exceedance is considered to have negligible impact on the downstream infrastructure. 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.

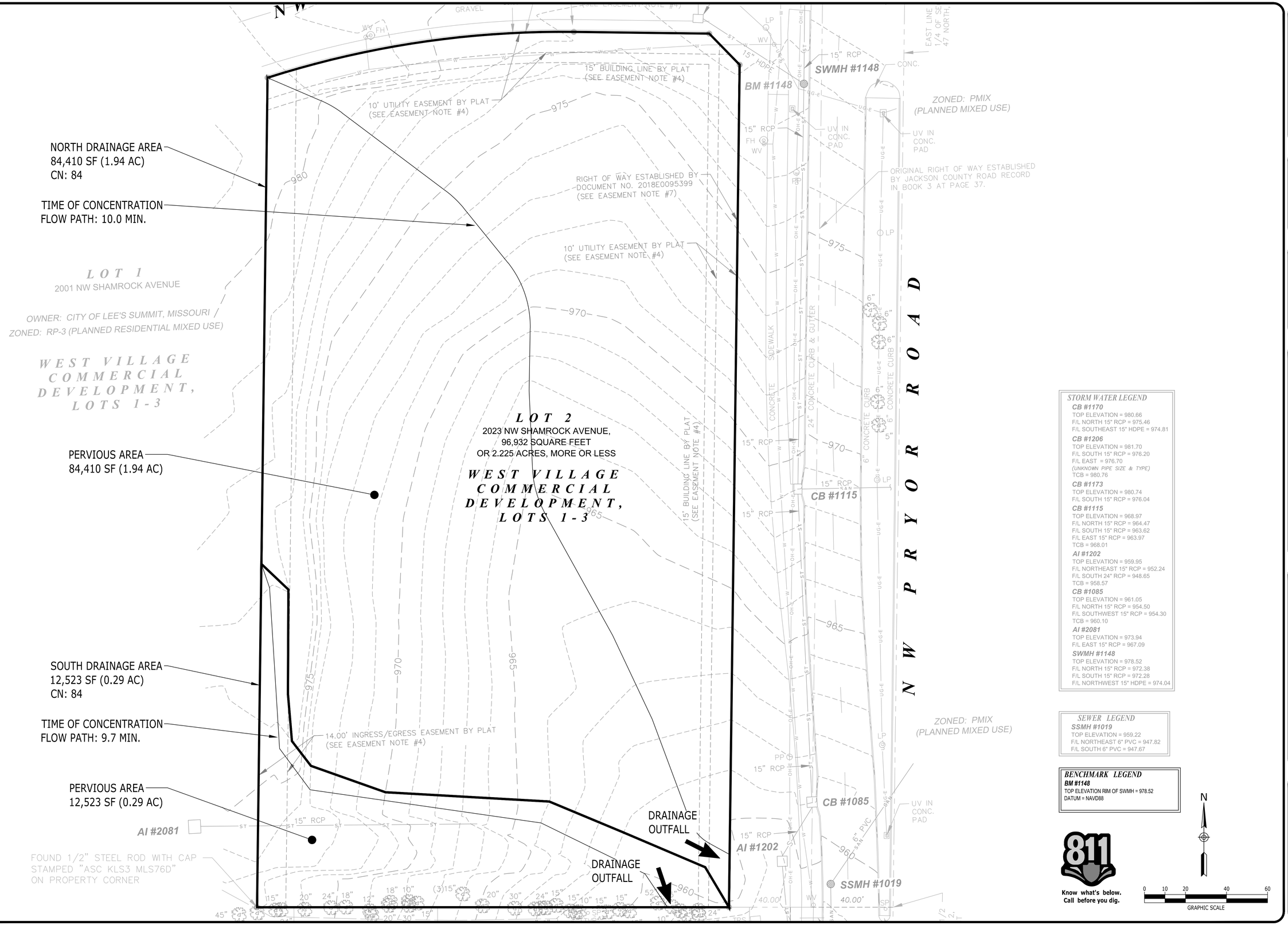
Pre- and Post- Peak Flows Comparison

Storm Event	*Pre-dev. Peak Flow (cfs)*	*Allowable Post-Dev. Peak Flow (cfs)*		*Post-Dev. Peak Flows (cfs)*	*Difference (+/-)*
2-year	6.303	(0.5 cfs/2.225 ac)	1.1125	1.308	+0.1955
10-year	11.37	(2.0 cfs/2.225 ac)	4.450	3.679	-0.771
100-year	18.21	(3.0 cfs/2.225 ac)	6.675	5.937	-0.738

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



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. Call before you dig.

0 10 20 40 60
GRAPHIC SCALE

Catalyst DESIGN GROUP
5016 CENTENNIAL BLVD, SUITE 200, NASHVILLE, TN 37209
(615) 866-2410 | WWW.CATALYST-DG.COM

DIALYSIS CLINIC, INC.
1633 CHURCH STREET, STE 500
NASHVILLE, TN 37203
615.327.3061

STATE OF MISSOURI
JACK T. PARKER
NUMBER PE-2017040852
PROFESSIONAL ENGINEER
11/15/19

PRELIMINARY

DCI - LEE'S SUMMIT

2023 NW SHAMROCK AVENUE
LEE'S SUMMIT, MISSOURI, 64081
JACKSON COUNTY

NO.	DATE	DESCRIPTION

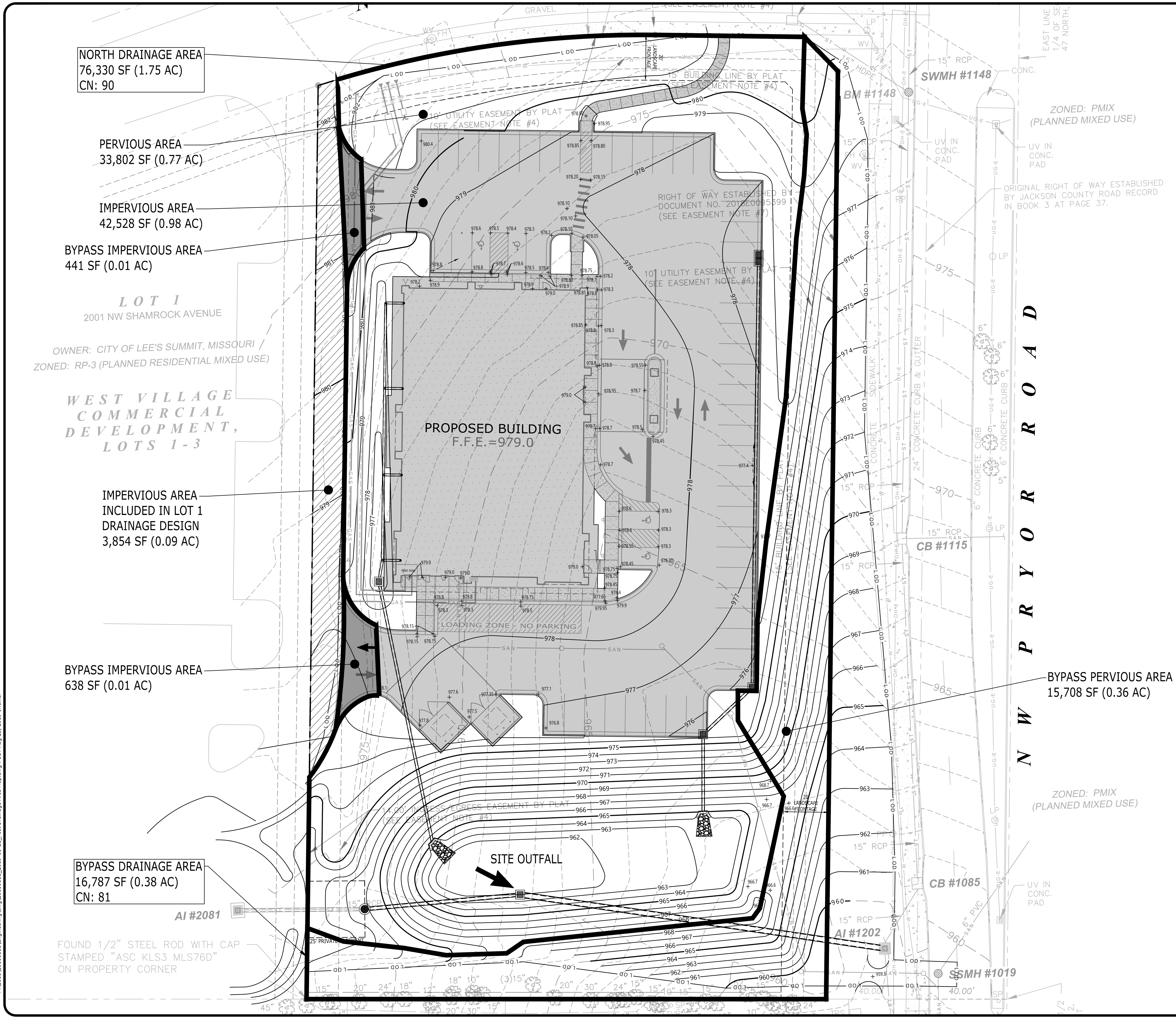
DRAWING TITLE

PRE DEVELOPED DRAINAGE AREA MAP

PROJECT NUMBER
20180111

DRAWING NUMBER
PRE

P:\2018\20180111\Engineering\dwg\20180111_Pre Drainage Area Map.dwg-PRE Jul 24, 2019 cwalker



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
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F/L SOUTH 15" RCP = 972.28
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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

811
Know what's below.
Call before you dig.

N

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GRAPHIC SCALE

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DIALYSIS CLINIC, INC.
1633 CHURCH STREET, STE 500
NASHVILLE, TN 37203
615.327.3061

STATE OF MISSOURI
JACK J. PARKER
NUMBER
PE-2017040852
PROFESSIONAL ENGINEER
8/23/19

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

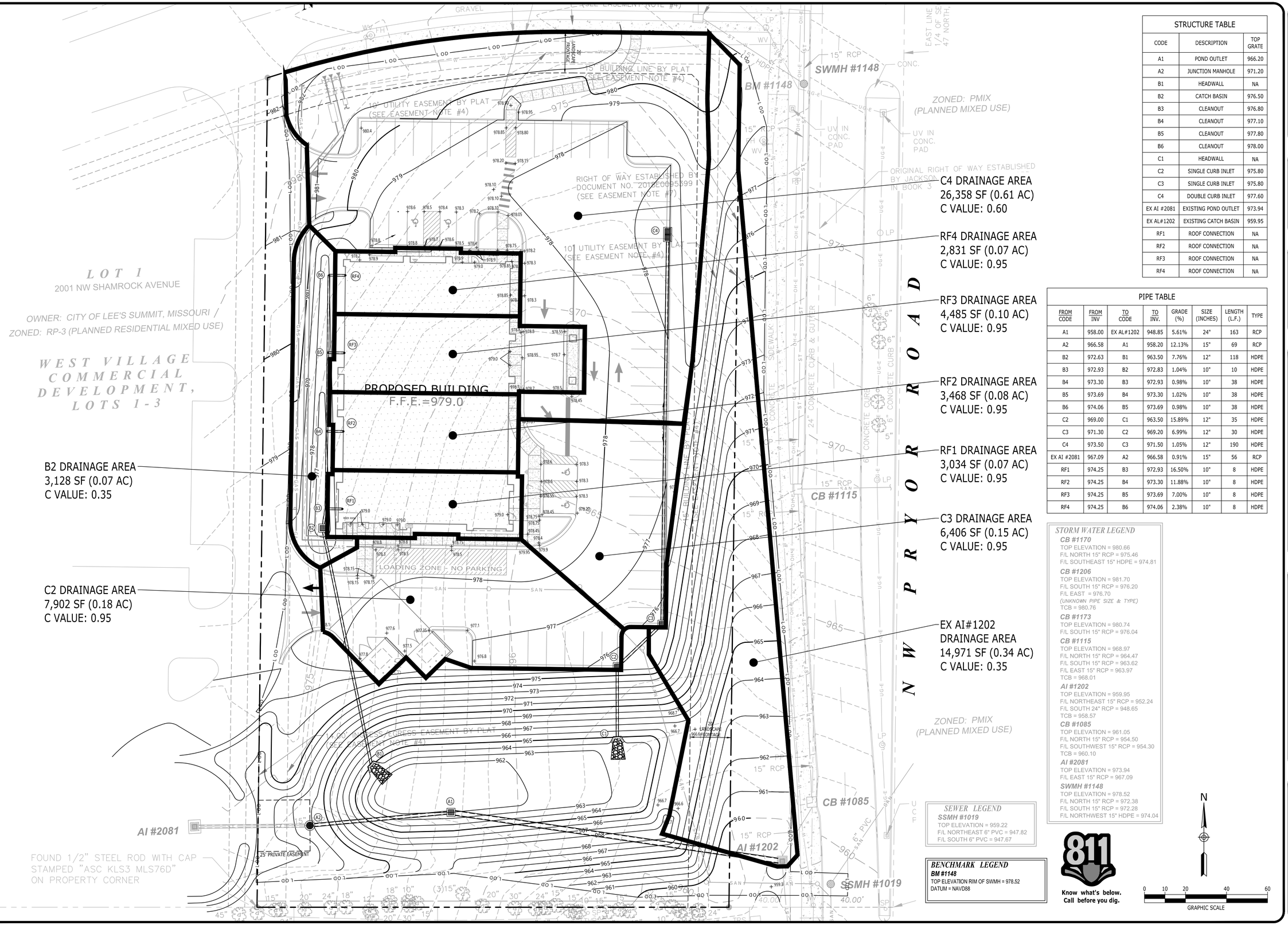
NO.	DATE	DESCRIPTION

DRAWING TITLE
POST DEVELOPED DRAINAGE AREA MAP

PROJECT NUMBER
20180111

DRAWING NUMBER
POST

P:\2018\20180111\Engineering\dwg\20180111_2019-08-21_Post Drainage Area Map.dwg-POST Aug 23, 2019 cwalker



STRUCTURE TABLE		
CODE	DESCRIPTION	TOP GRATE
A1	POND OUTLET	966.20
A2	JUNCTION MANHOLE	971.20
B1	HEADWALL	NA
B2	CATCH BASIN	976.50
B3	CLEANOUT	976.80
B4	CLEANOUT	977.10
B5	CLEANOUT	977.80
B6	CLEANOUT	978.00
C1	HEADWALL	NA
C2	SINGLE CURB INLET	975.80
C3	SINGLE CURB INLET	975.80
C4	DOUBLE CURB INLET	977.60
EX AI #2081	EXISTING POND OUTLET	973.94
EX AL#1202	EXISTING CATCH BASIN	959.95
RF1	ROOF CONNECTION	NA
RF2	ROOF CONNECTION	NA
RF3	ROOF CONNECTION	NA
RF4	ROOF CONNECTION	NA

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	972.63	B1	963.50	7.76%	12"	118	HDPE
B3	972.93	B2	972.83	1.04%	10"	10	HDPE
B4	973.30	B3	972.93	0.98%	10"	38	HDPE
B5	973.69	B4	973.30	1.02%	10"	38	HDPE
B6	974.06	B5	973.69	0.98%	10"	38	HDPE
C2	969.00	C1	963.50	15.89%	12"	35	HDPE
C3	971.30	C2	969.20	6.99%	12"	30	HDPE
C4	973.50	C3	971.50	1.05%	12"	190	HDPE
EX AI #2081	967.09	A2	966.58	0.91%	15"	56	RCP
RF1	974.25	B3	972.93	16.50%	10"	8	HDPE
RF2	974.25	B4	973.30	11.88%	10"	8	HDPE
RF3	974.25	B5	973.69	7.00%	10"	8	HDPE
RF4	974.25	B6	974.06	2.38%	10"	8	HDPE

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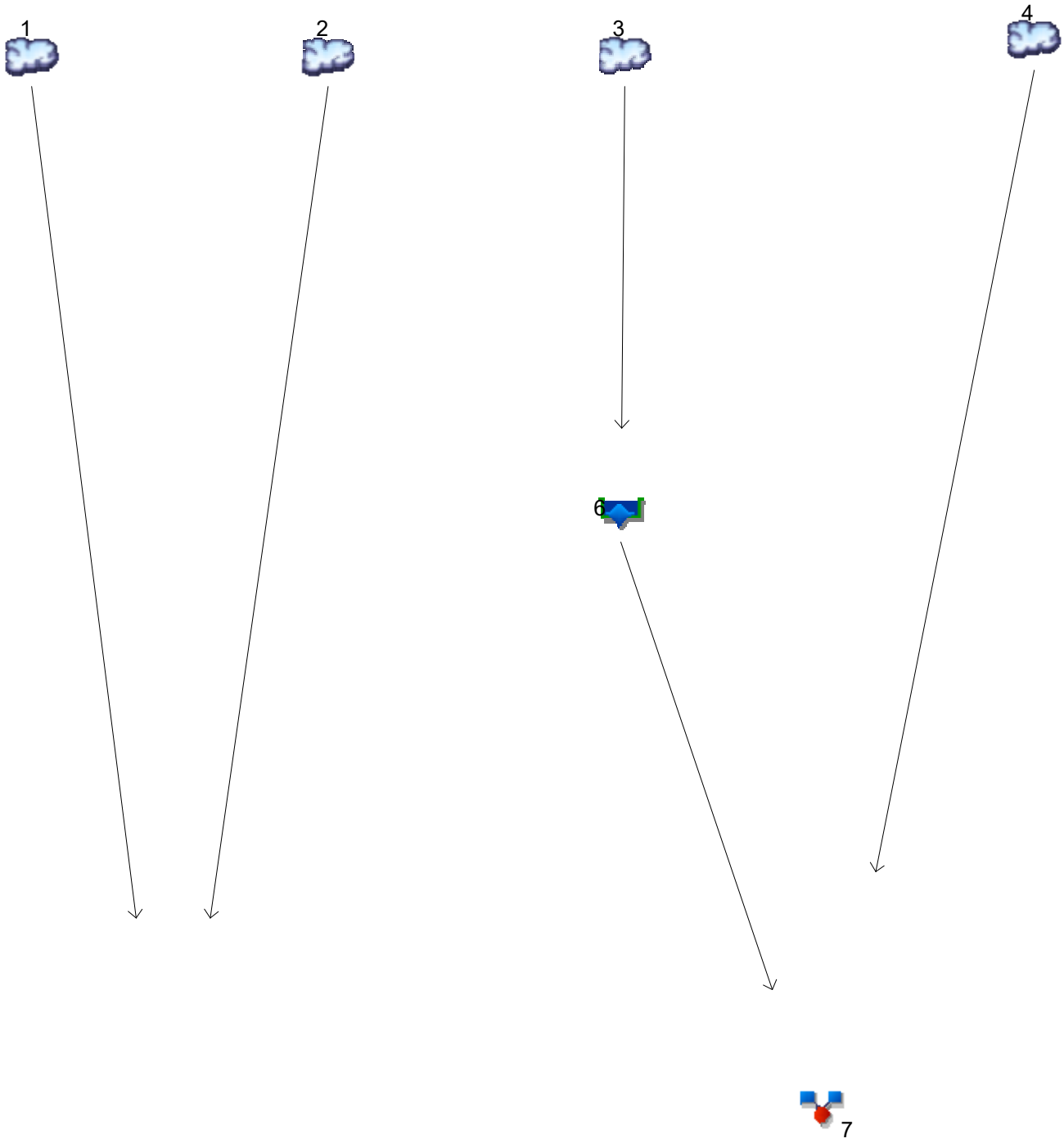
DRAWING NUMBER
INLET

P:\2018\20180111\Engineering\dwg\20180111_2019-08-21_Inlet Drainage Area Map.dwg-INLET Aug 23, 2019 cwalker

Attachment 2
Hydraflow Hydrographs Routing Calculations

Watershed Model Schematic

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



Legend

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

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IDF Report **31**

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	5.952	-------	-------	10.72	-------	-------	17.14	EXISTING NORTH
2	SCS Runoff	------	-------	0.811	-------	-------	1.466	-------	-------	2.350	EXISTING SOUTH
3	SCS Runoff	------	-------	6.980	-------	-------	11.51	-------	-------	17.48	PROPOSED NORTH
4	SCS Runoff	------	-------	1.094	-------	-------	2.056	-------	-------	3.371	PROPOSED BYPASS
5	Combine	1, 2,	-------	6.704	-------	-------	12.09	-------	-------	19.36	EXISTING SITE
6	Reservoir	3	-------	0.683	-------	-------	2.066	-------	-------	3.037	PROPOSED TO DET
7	Combine	4, 6	-------	1.308	-------	-------	3.679	-------	-------	5.937	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	1.094	2	716	2,209	------	------	------	PROPOSED BYPASS
5	Combine	6.704	2	718	15,739	1, 2,	------	------	EXISTING SITE
6	Reservoir	0.683	2	742	14,127	3	964.17	7,932	PROPOSED TO DET
7	Combine	1.308	2	718	16,337	4, 6	------	------	PROPOSED SITE

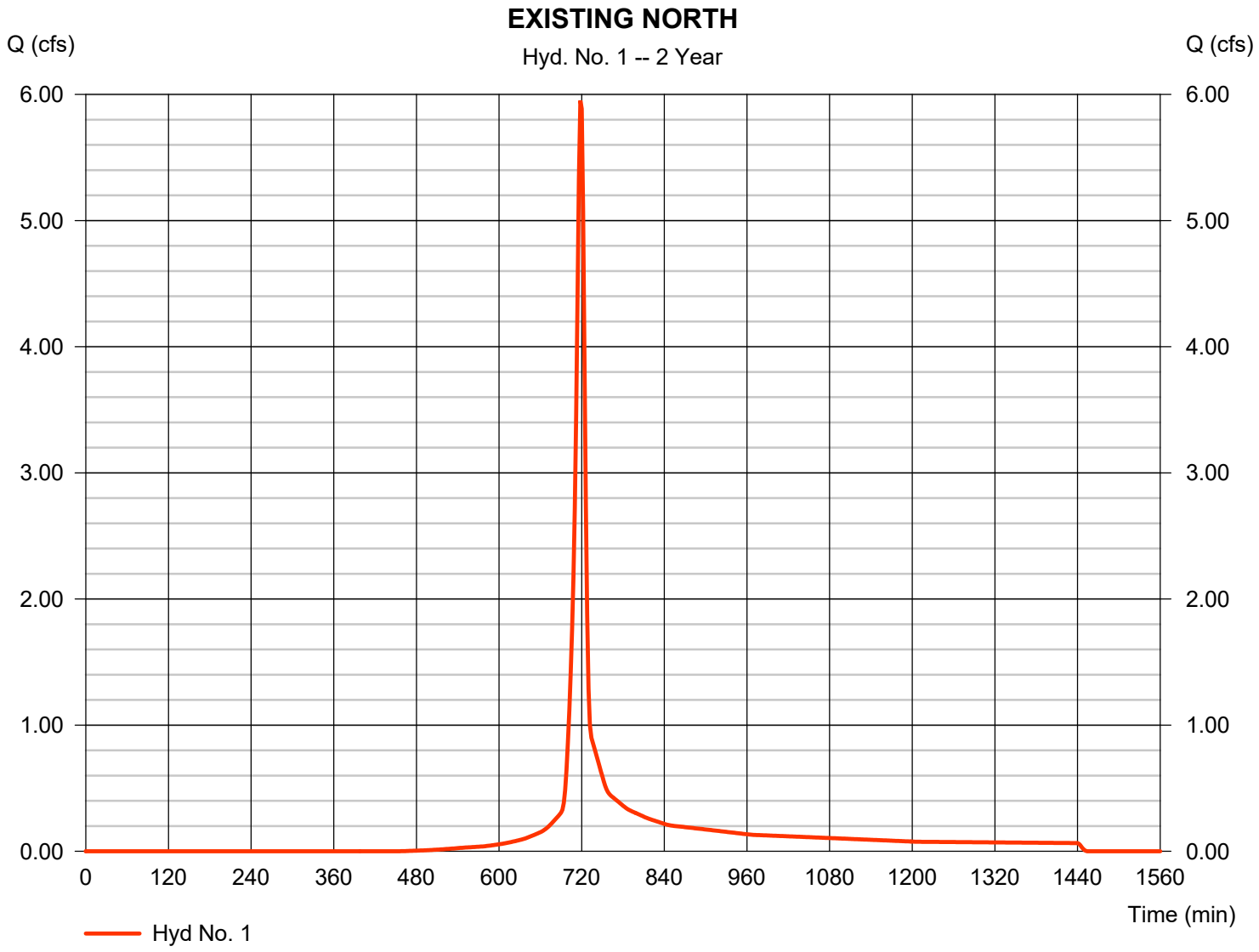
Hydrograph Report

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

Hyd. No. 1

EXISTING NORTH

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.50		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

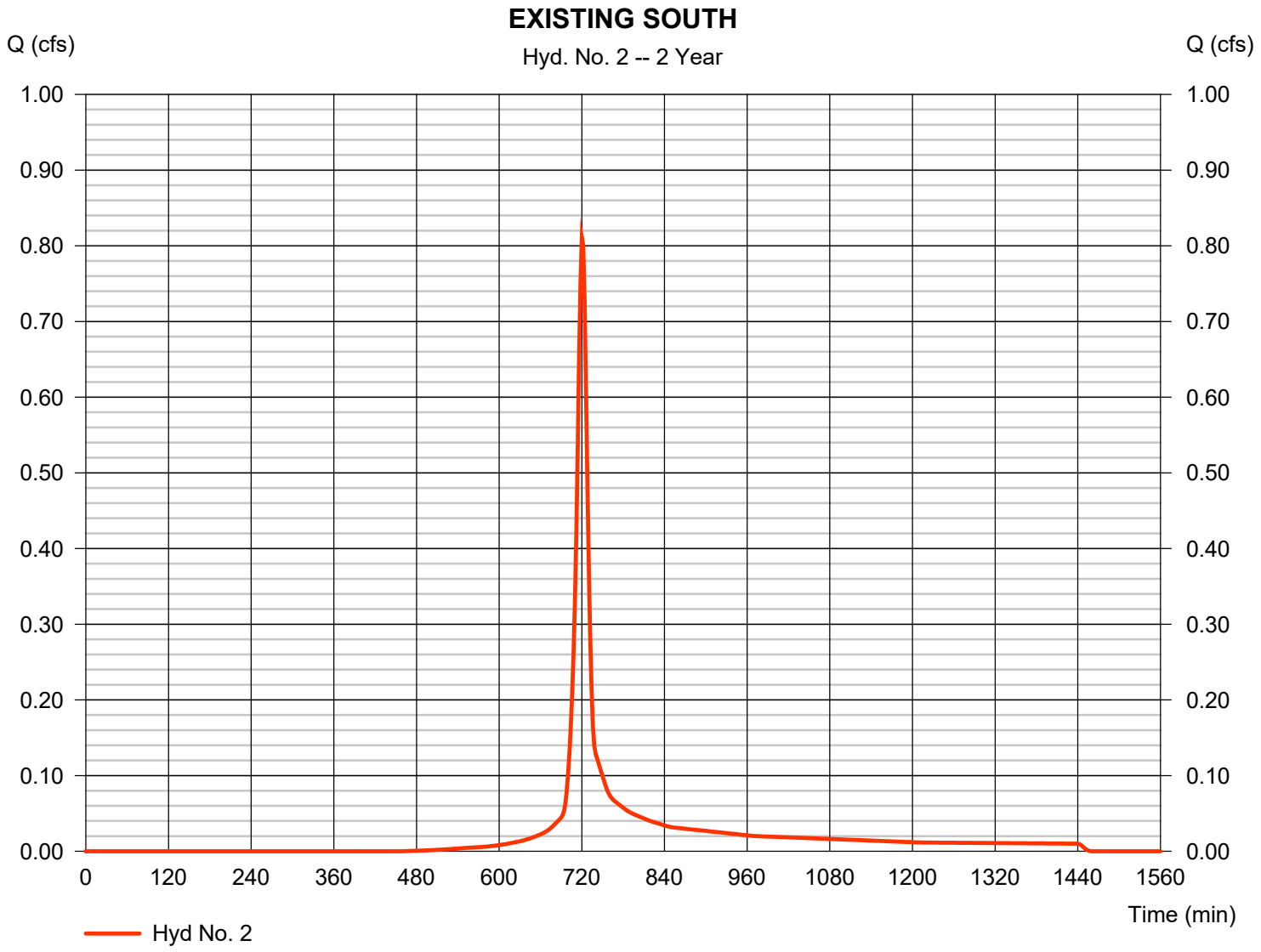
Hydrograph Report

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 x 84)] / 0.290



TR55 Tc Worksheet

Hyd. No. 2

EXISTING SOUTH

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.50		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

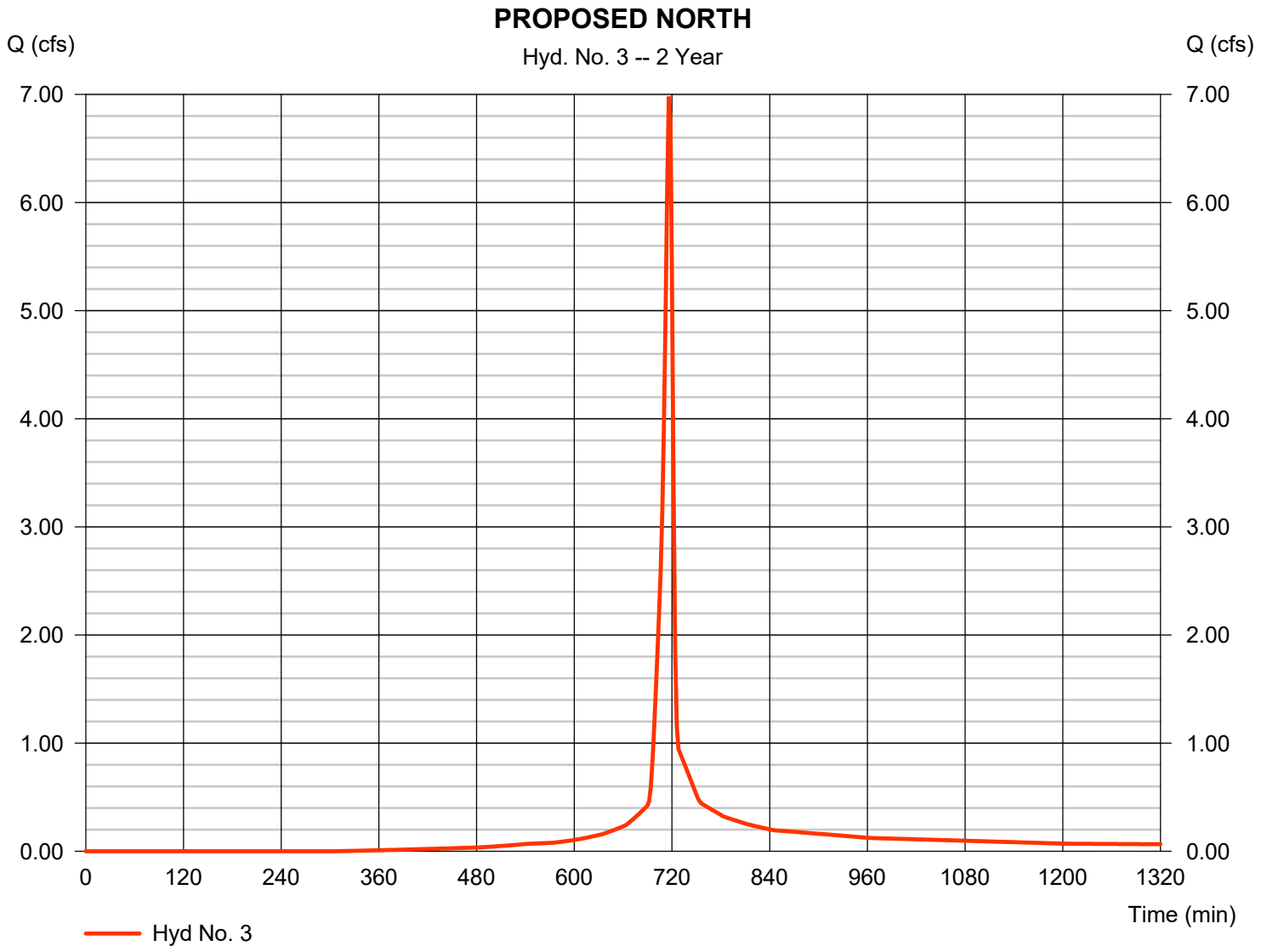
Hydrograph Report

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) = [(0.770 x 80) + (0.980 x 98)] / 1.750



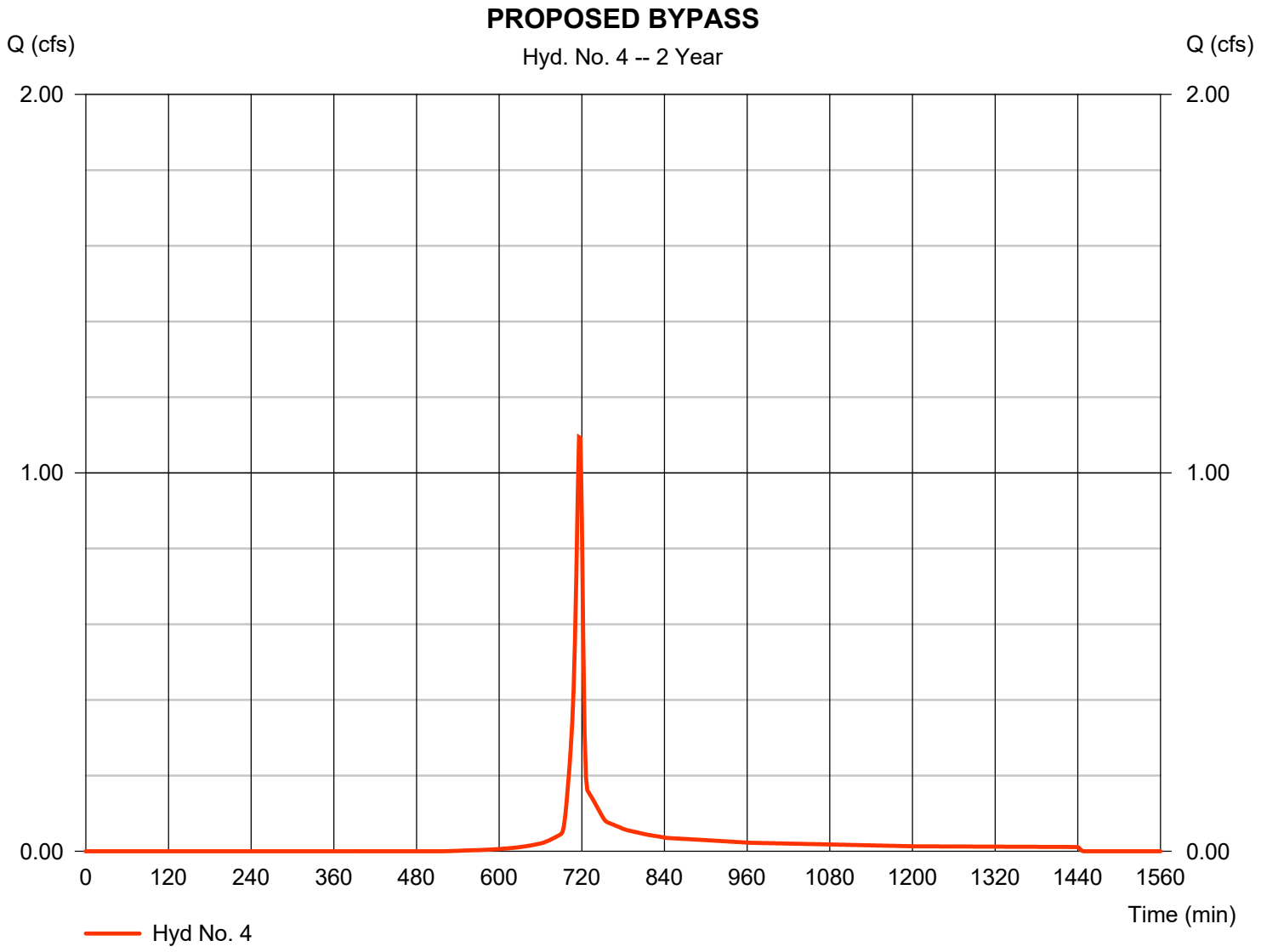
Hydrograph Report

Hyd. No. 4

PROPOSED BYPASS

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.094 cfs
Storm frequency	=	2 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	2,209 cuft
Drainage area	=	0.380 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) = [(0.360 x 80) + (0.020 x 98)] / 0.380

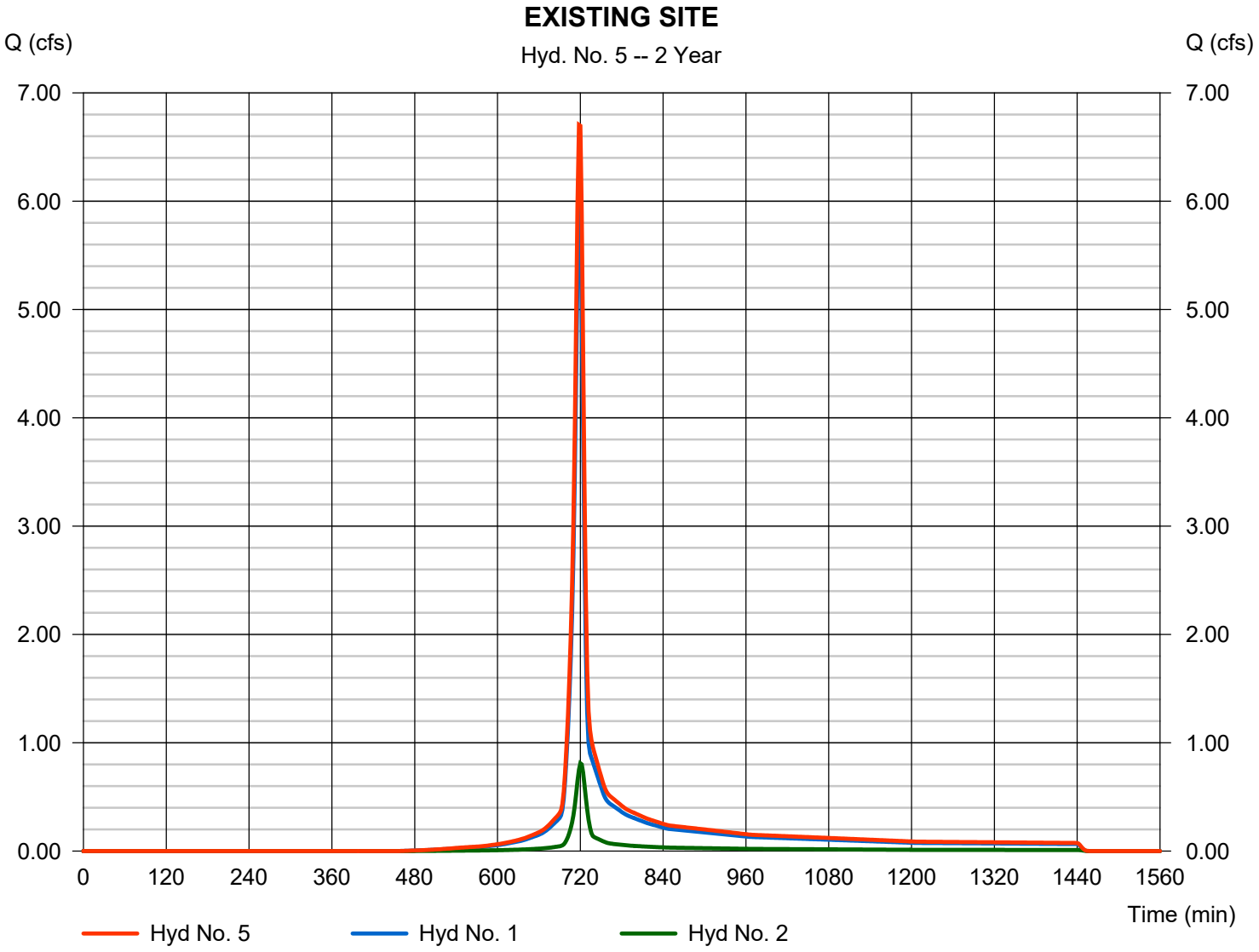


Hydrograph Report

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



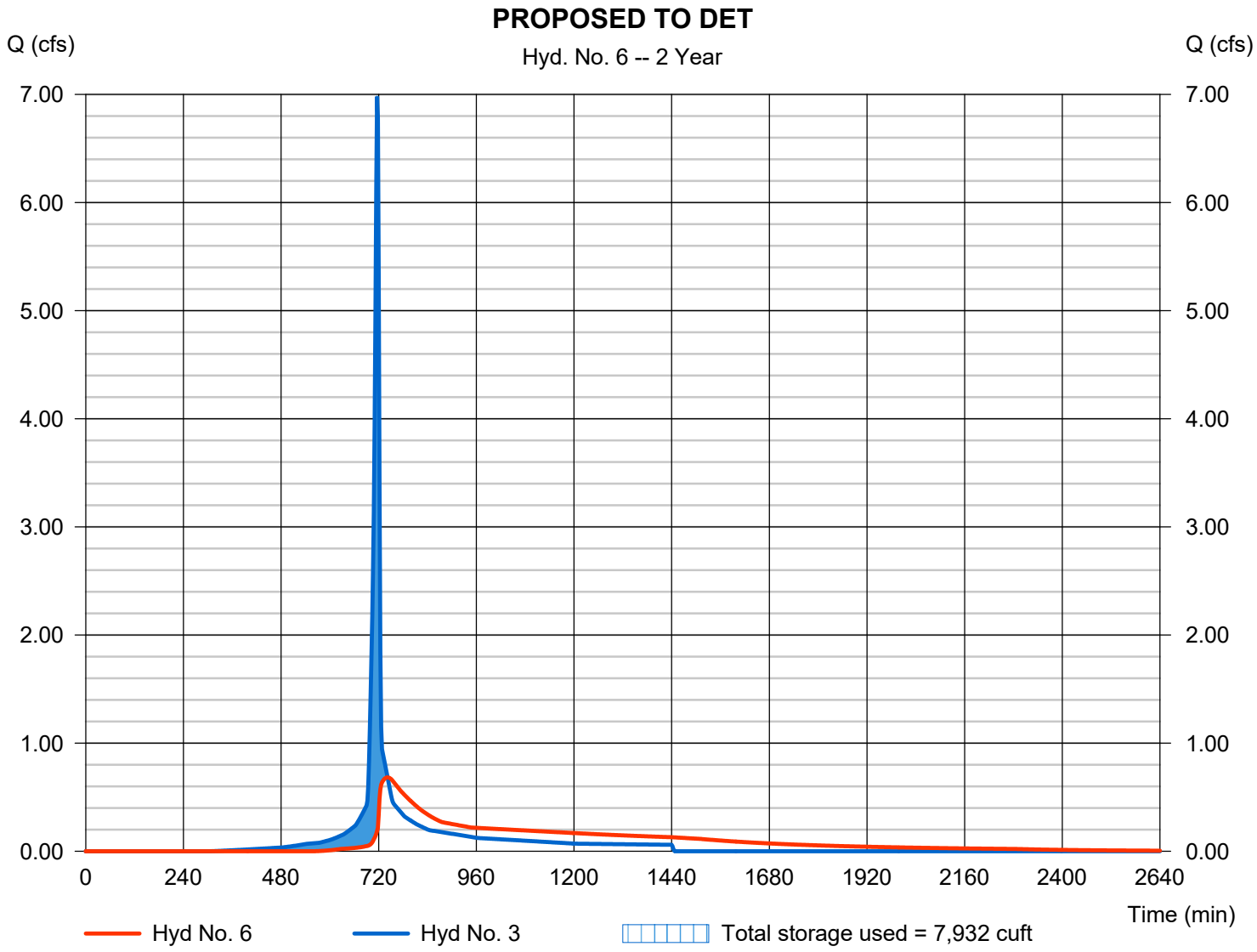
Hydrograph Report

Hyd. No. 6

PROPOSED TO DET

Hydrograph type	=	Reservoir	Peak discharge	=	0.683 cfs
Storm frequency	=	2 yrs	Time to peak	=	742 min
Time interval	=	2 min	Hyd. volume	=	14,127 cuft
Inflow hyd. No.	=	3 - PROPOSED NORTH	Max. Elevation	=	964.17 ft
Reservoir name	=	Detention Pond	Max. Storage	=	7,932 cuft

Storage Indication method used.



Pond No. 1 - Detention Pond

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining 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

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	8.00	Inactive	1.00
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 (%)	= 1.05	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)	= 12.00	Inactive	Inactive	Inactive
Crest El. (ft)	= 966.20	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= Yes	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	961.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.10	79	961.10	21.39 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.20	159	961.20	21.39 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.30	238	961.30	21.39 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.40	317	961.40	21.39 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.50	396	961.50	21.39 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.60	476	961.60	21.39 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.001
0.70	555	961.70	21.39 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.005
0.80	634	961.80	21.39 ic	0.00	---	0.01	0.00	---	---	---	---	---	0.009
0.90	713	961.90	21.39 ic	0.00	---	0.01	0.00	---	---	---	---	---	0.015
1.00	793	962.00	21.39 ic	0.00	---	0.02	0.00	---	---	---	---	---	0.021
1.10	1,031	962.10	21.39 ic	0.00	---	0.03	0.00	---	---	---	---	---	0.028
1.20	1,270	962.20	21.39 ic	0.00	---	0.04	0.00	---	---	---	---	---	0.036
1.30	1,509	962.30	21.39 ic	0.00	---	0.04	0.00	---	---	---	---	---	0.044
1.40	1,748	962.40	21.39 ic	0.00	---	0.05	0.00	---	---	---	---	---	0.053
1.50	1,986	962.50	21.39 ic	0.00	---	0.06	0.00	---	---	---	---	---	0.062
1.60	2,225	962.60	21.39 ic	0.00	---	0.07	0.00	---	---	---	---	---	0.071
1.70	2,464	962.70	21.39 ic	0.00	---	0.08	0.00	---	---	---	---	---	0.082
1.80	2,703	962.80	21.39 ic	0.00	---	0.09	0.00	---	---	---	---	---	0.092
1.90	2,941	962.90	21.39 ic	0.00	---	0.10	0.00	---	---	---	---	---	0.103
2.00	3,180	963.00	21.39 ic	0.00	---	0.11	0.00	---	---	---	---	---	0.115
2.10	3,571	963.10	21.39 ic	0.00	---	0.13	0.00	---	---	---	---	---	0.126
2.20	3,961	963.20	21.39 ic	0.00	---	0.14	0.00	---	---	---	---	---	0.139
2.30	4,352	963.30	21.39 ic	0.00	---	0.15	0.00	---	---	---	---	---	0.151
2.40	4,742	963.40	21.39 ic	0.00	---	0.16	0.00	---	---	---	---	---	0.164
2.50	5,133	963.50	21.39 ic	0.00	---	0.18	0.00	---	---	---	---	---	0.177
2.60	5,523	963.60	21.39 ic	0.00	---	0.19	0.00	---	---	---	---	---	0.191
2.70	5,914	963.70	21.39 ic	0.00	---	0.20	0.00	---	---	---	---	---	0.205
2.80	6,304	963.80	21.39 ic	0.00	---	0.22	0.00	---	---	---	---	---	0.219
2.90	6,695	963.90	21.39 ic	0.04 ic	---	0.23	0.00	---	---	---	---	---	0.270
3.00	7,085	964.00	21.39 ic	0.13 ic	---	0.25	0.00	---	---	---	---	---	0.384
3.10	7,595	964.10	21.39 ic	0.29 ic	---	0.26	0.00	---	---	---	---	---	0.550
3.20	8,105	964.20	21.39 ic	0.47 ic	---	0.28	0.00	---	---	---	---	---	0.751
3.30	8,615	964.30	21.39 ic	0.68 ic	---	0.30	0.00	---	---	---	---	---	0.975
3.40	9,125	964.40	21.39 ic	0.88 ic	---	0.31	0.00	---	---	---	---	---	1.187
3.50	9,635	964.50	21.39 ic	1.02 ic	---	0.33	0.00	---	---	---	---	---	1.345

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
3.60	10,145	964.60	21.39 ic	1.15 ic	---	0.34	0.00	---	---	---	---	---	1.492
3.70	10,655	964.70	21.39 ic	1.26 ic	---	0.36	0.00	---	---	---	---	---	1.626
3.80	11,165	964.80	21.39 ic	1.37 ic	---	0.38	0.00	---	---	---	---	---	1.750
3.90	11,675	964.90	21.39 ic	1.47 ic	---	0.40	0.00	---	---	---	---	---	1.867
4.00	12,185	965.00	21.39 ic	1.56 ic	---	0.41	0.00	---	---	---	---	---	1.978
4.10	12,798	965.10	21.39 ic	1.65 ic	---	0.43	0.00	---	---	---	---	---	2.083
4.20	13,411	965.20	21.39 ic	1.74 ic	---	0.45	0.00	---	---	---	---	---	2.185
4.30	14,024	965.30	21.39 ic	1.82 ic	---	0.47	0.00	---	---	---	---	---	2.283
4.40	14,637	965.40	21.39 ic	1.89 ic	---	0.49	0.00	---	---	---	---	---	2.378
4.50	15,250	965.50	21.39 ic	1.96 ic	---	0.51	0.00	---	---	---	---	---	2.470
4.60	15,863	965.60	21.39 ic	2.04 ic	---	0.52	0.00	---	---	---	---	---	2.560
4.70	16,476	965.70	21.39 ic	2.10 ic	---	0.54	0.00	---	---	---	---	---	2.647
4.80	17,089	965.80	21.39 ic	2.17 ic	---	0.56	0.00	---	---	---	---	---	2.733
4.90	17,702	965.90	21.39 ic	2.23 ic	---	0.58	0.00	---	---	---	---	---	2.817
5.00	18,315	966.00	21.39 ic	2.30 ic	---	0.60	0.00	---	---	---	---	---	2.900
5.02	18,451	966.02	21.39 ic	2.31 ic	---	0.61	0.00	---	---	---	---	---	2.916
5.04	18,586	966.04	21.39 ic	2.32 ic	---	0.61	0.00	---	---	---	---	---	2.932
5.06	18,722	966.06	21.39 ic	2.33 ic	---	0.62	0.00	---	---	---	---	---	2.948
5.08	18,858	966.08	21.39 ic	2.34 ic	---	0.62	0.00	---	---	---	---	---	2.965
5.10	18,993	966.10	21.39 ic	2.36 ic	---	0.62	0.00	---	---	---	---	---	2.981
5.12	19,129	966.12	21.39 ic	2.37 ic	---	0.63	0.00	---	---	---	---	---	2.997
5.14	19,265	966.14	21.39 ic	2.38 ic	---	0.63	0.00	---	---	---	---	---	3.013
5.16	19,400	966.16	21.39 ic	2.39 ic	---	0.64	0.00	---	---	---	---	---	3.029
5.18	19,536	966.18	21.39 ic	2.40 ic	---	0.64	0.00	---	---	---	---	---	3.045
5.20	19,672	966.20	21.39 ic	2.42 ic	---	0.64	0.00	---	---	---	---	---	3.060

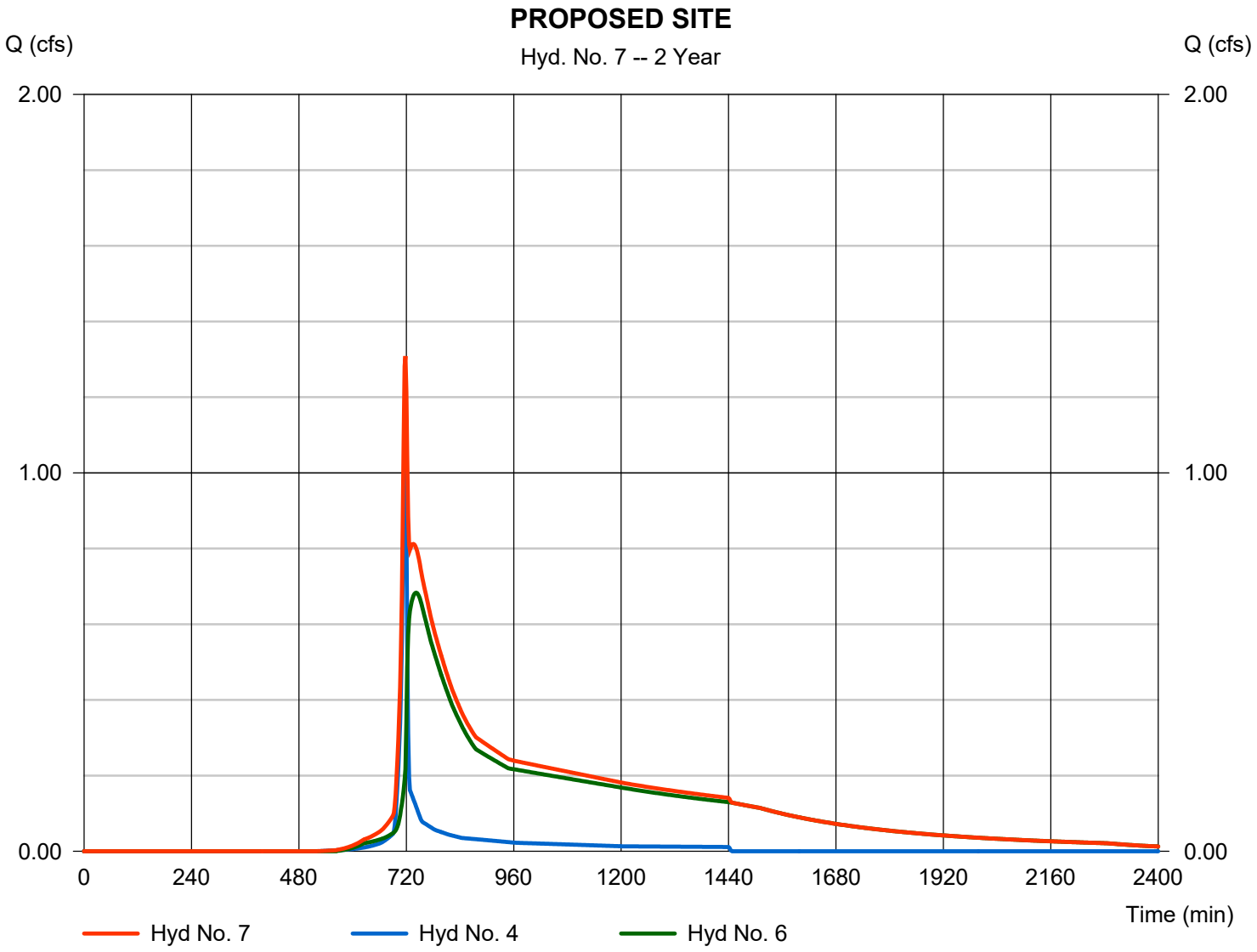
...End

Hydrograph Report

Hyd. No. 7

PROPOSED SITE

Hydrograph type	=	Combine	Peak discharge	=	1.308 cfs
Storm frequency	=	2 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	16,337 cuft
Inflow hyds.	=	4, 6	Contrib. drain. area	=	0.380 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	2.056	2	716	4,205	------	------	------	PROPOSED BYPASS
5	Combine	12.09	2	718	28,821	1, 2,	------	------	EXISTING SITE
6	Reservoir	2.066	2	726	24,360	3	965.09	12,699	PROPOSED TO DET
7	Combine	3.679	2	718	28,565	4, 6	------	------	PROPOSED SITE

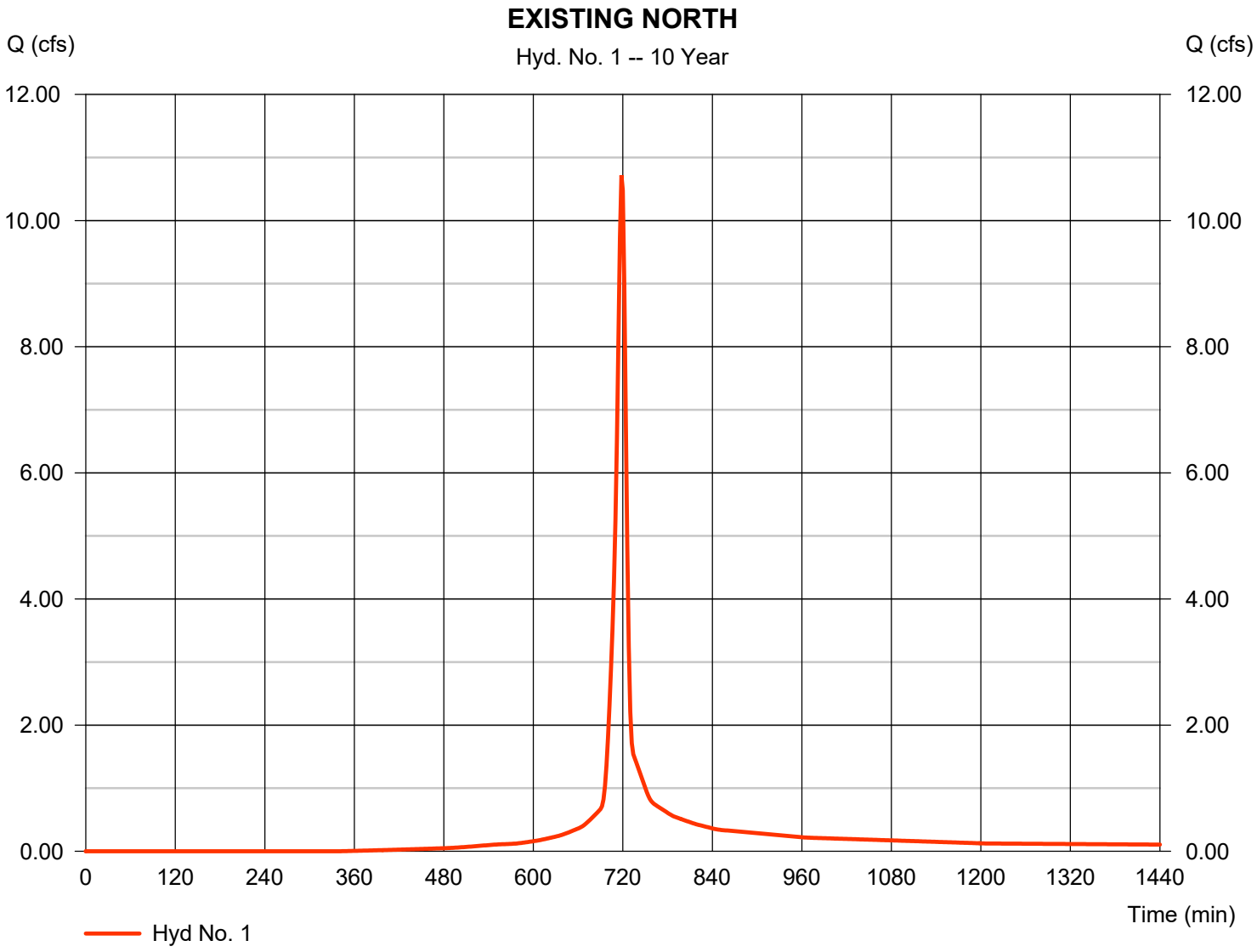
Hydrograph Report

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 x 84)] / 1.940



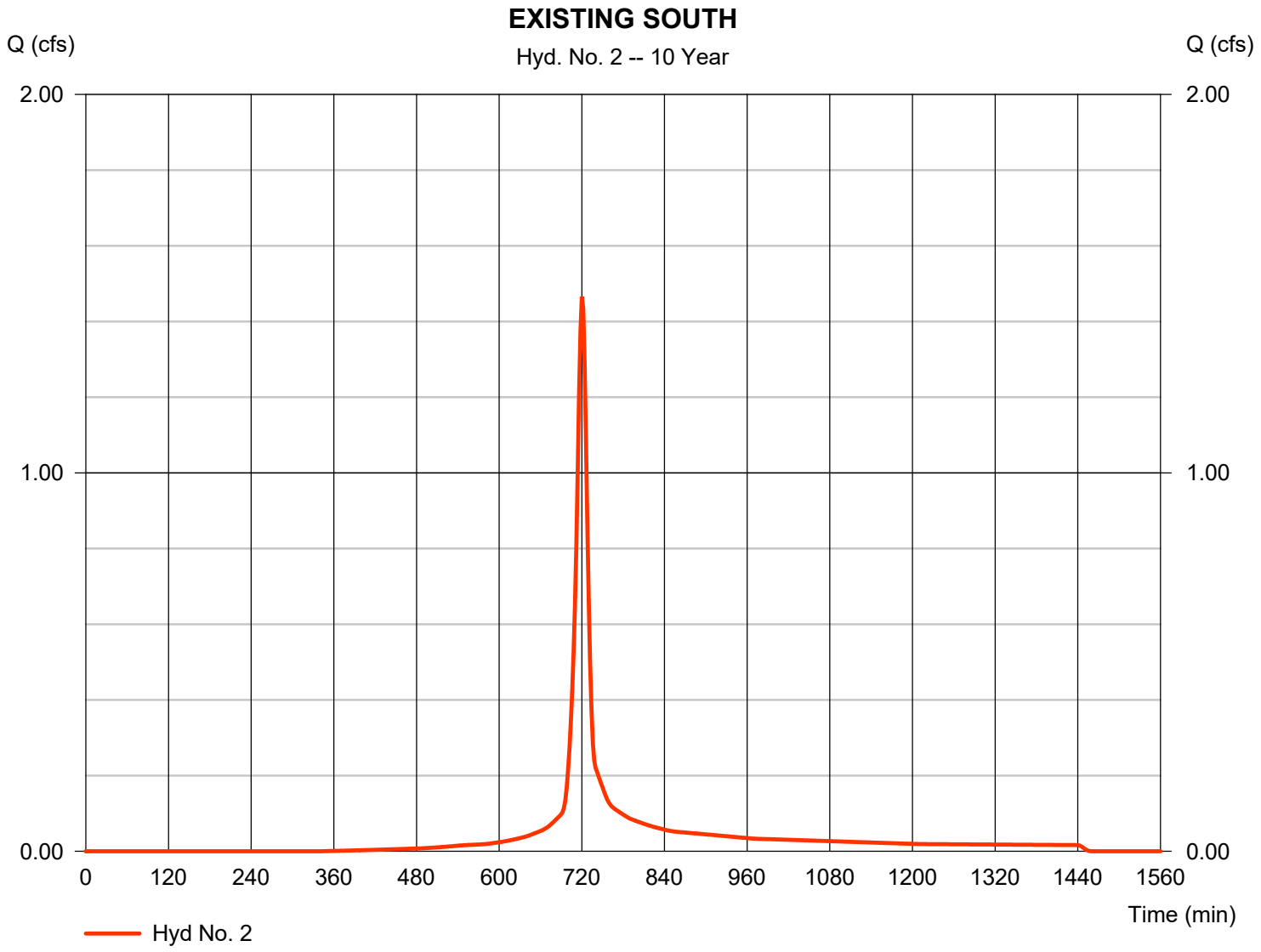
Hydrograph Report

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 x 84)] / 0.290



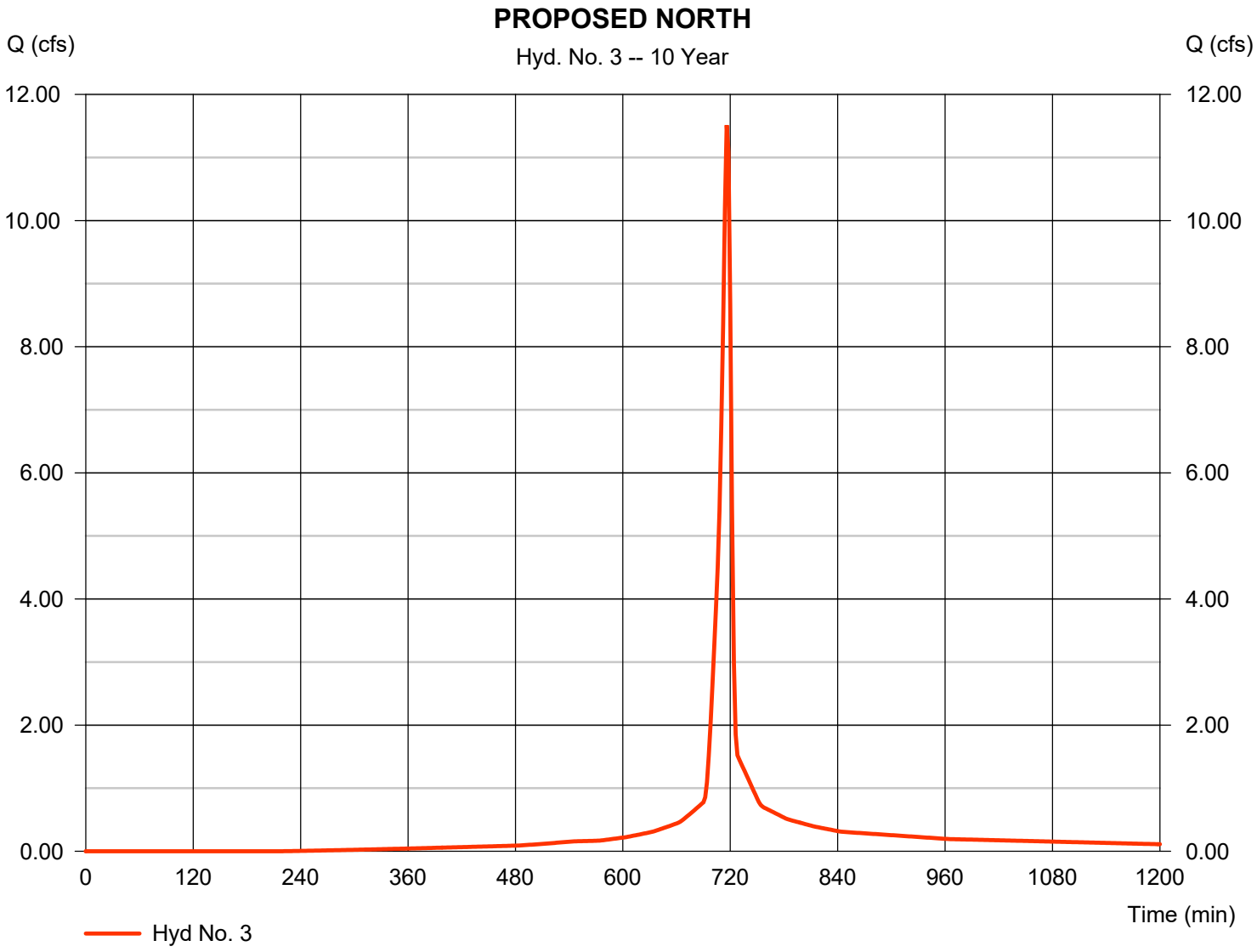
Hydrograph Report

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) = [(0.770 x 80) + (0.980 x 98)] / 1.750



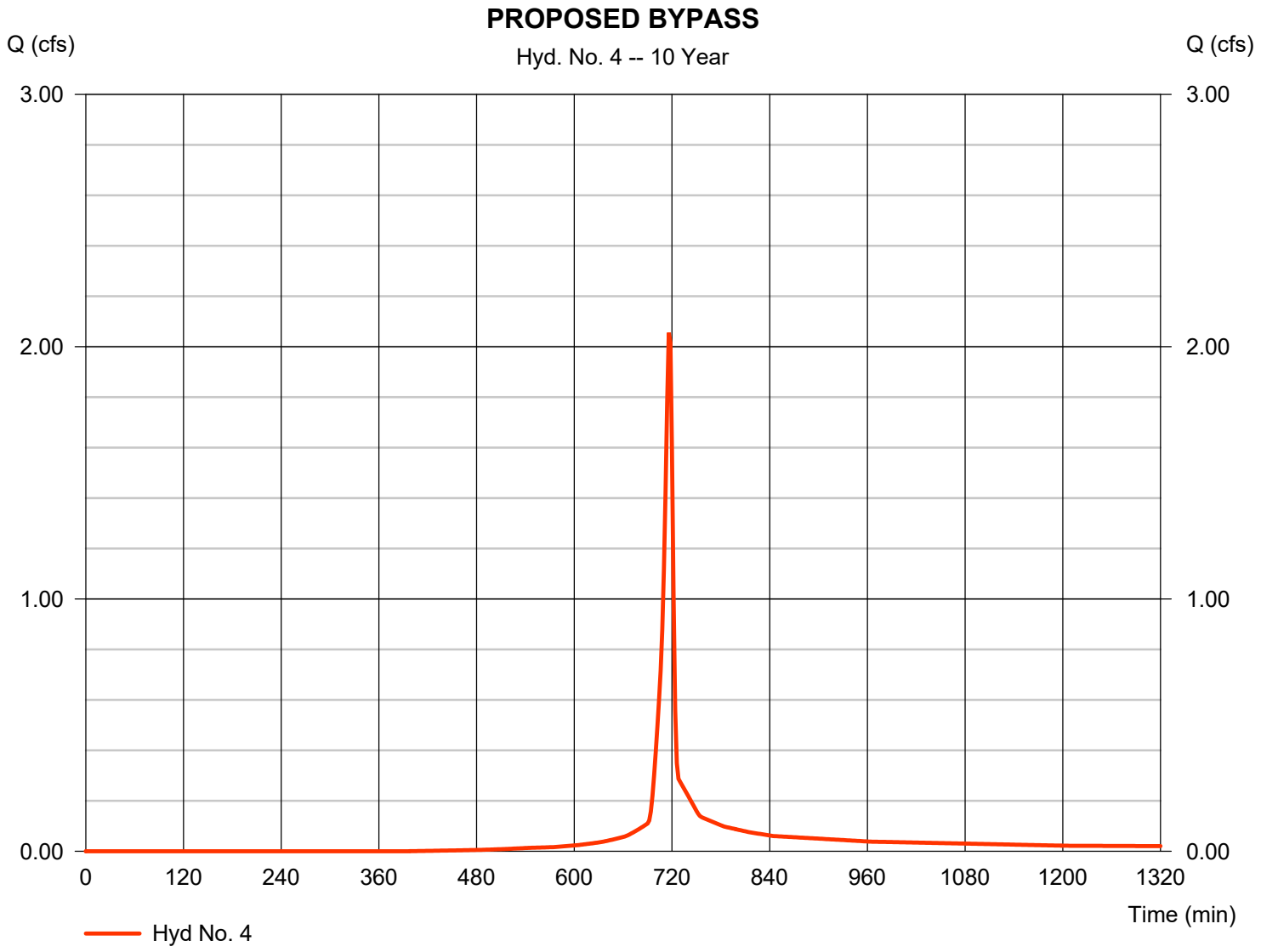
Hydrograph Report

Hyd. No. 4

PROPOSED BYPASS

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.056 cfs
Storm frequency	=	10 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	4,205 cuft
Drainage area	=	0.380 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) = [(0.360 x 80) + (0.020 x 98)] / 0.380

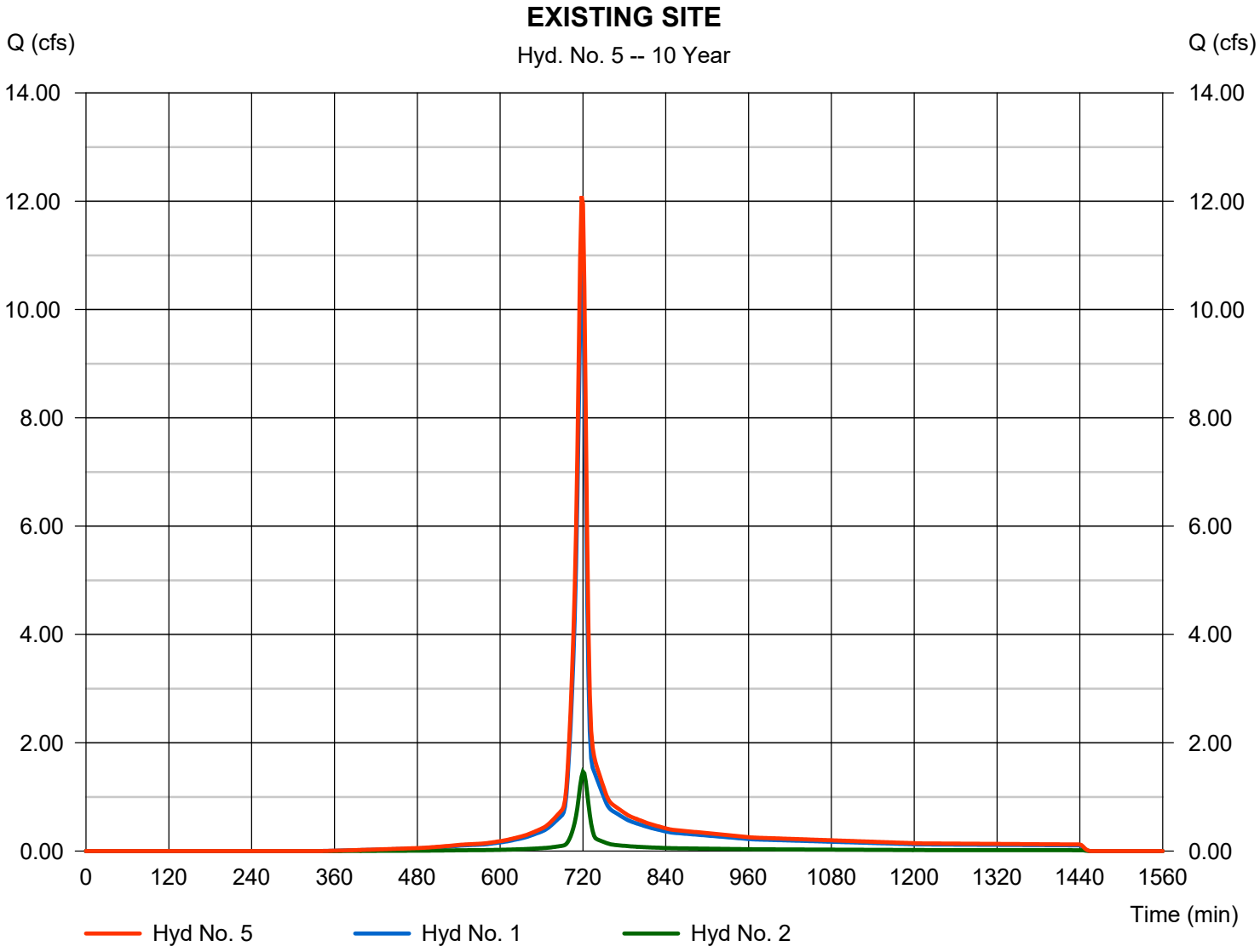


Hydrograph Report

Hyd. No. 5

EXISTING SITE

Hydrograph type	= Combine	Peak discharge	= 12.09 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 28,821 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 2.230 ac



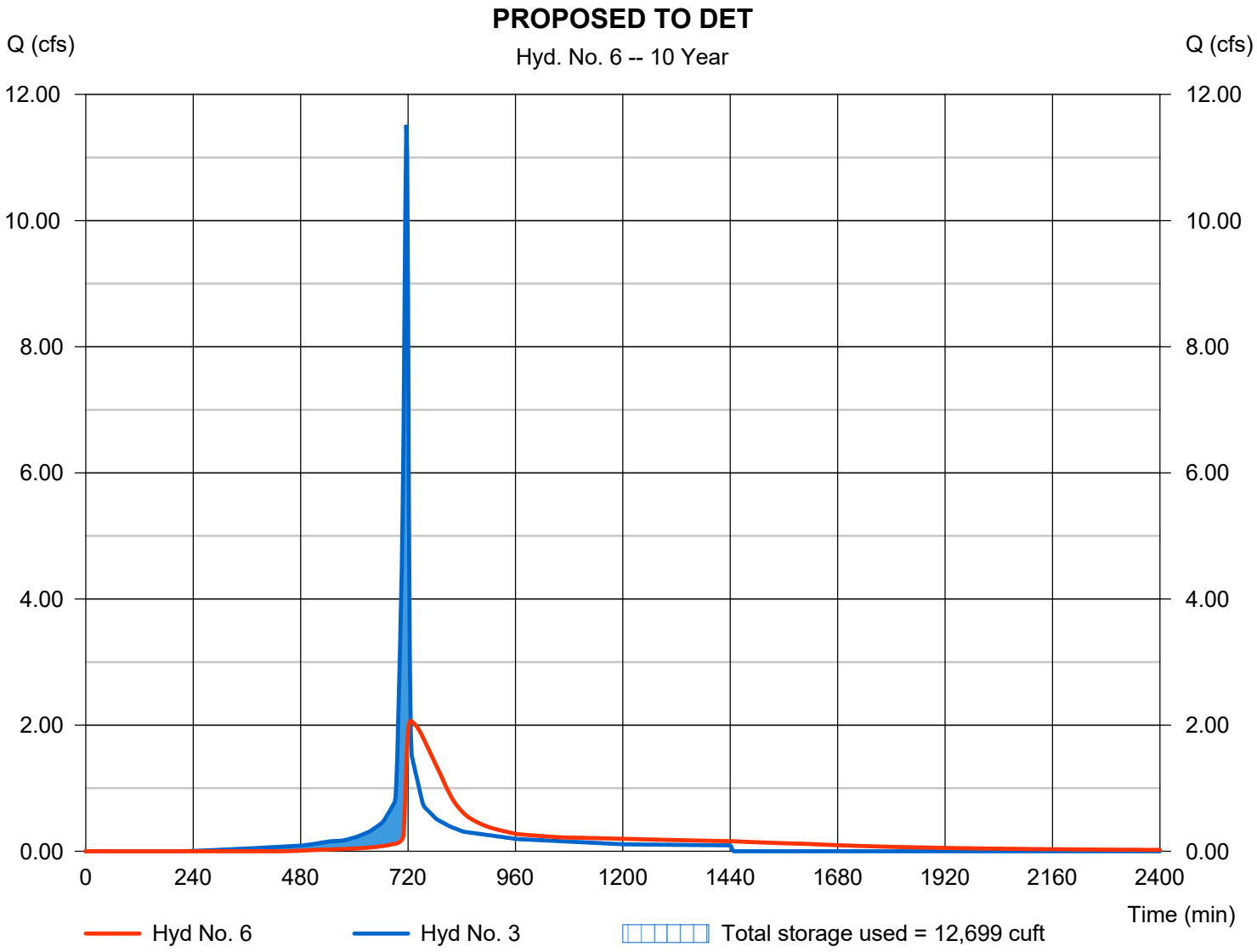
Hydrograph Report

Hyd. No. 6

PROPOSED TO DET

Hydrograph type	= Reservoir	Peak discharge	= 2.066 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	= 965.09 ft
Reservoir name	= Detention Pond	Max. Storage	= 12,699 cuft

Storage Indication method used.

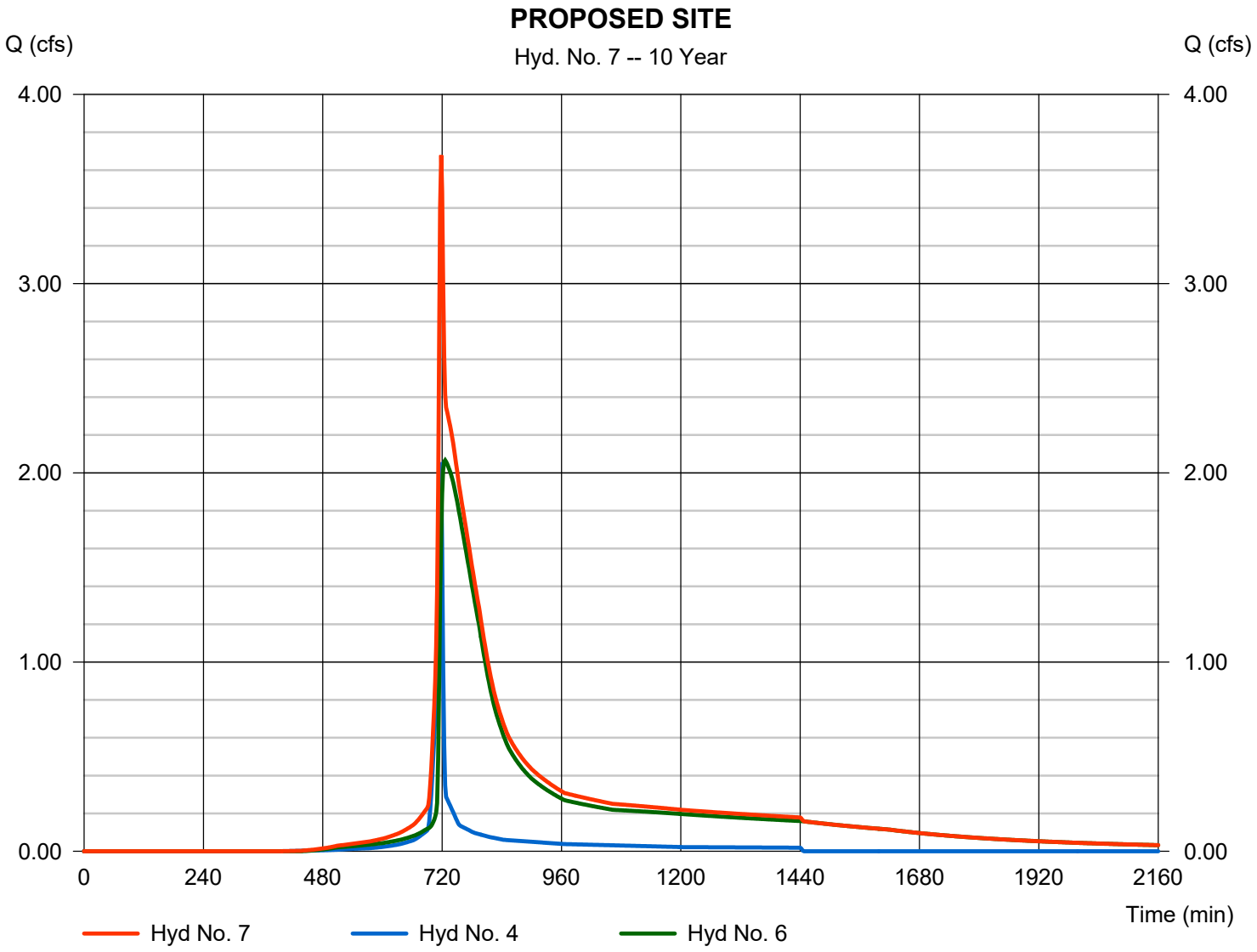


Hydrograph Report

Hyd. No. 7

PROPOSED SITE

Hydrograph type	=	Combine	Peak discharge	=	3.679 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	28,565 cuft
Inflow hyds.	=	4, 6	Contrib. drain. area	=	0.380 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	3.371	2	716	7,060	------	------	------	PROPOSED BYPASS
5	Combine	19.36	2	718	47,203	1, 2,	------	------	EXISTING SITE
6	Reservoir	3.037	2	726	38,321	3	966.17	19,468	PROPOSED TO DET
7	Combine	5.937	2	718	45,382	4, 6	------	------	PROPOSED SITE

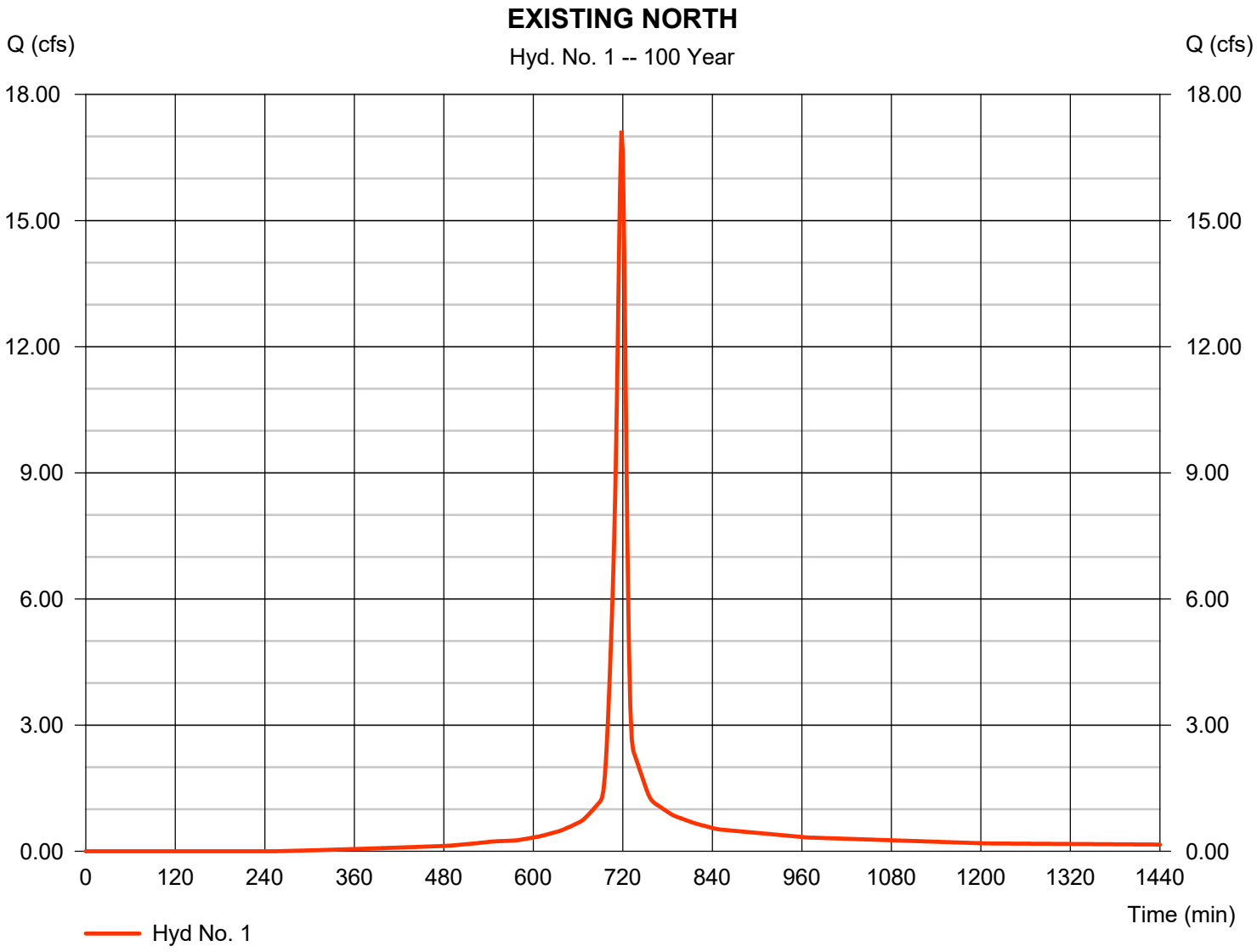
Hydrograph Report

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 x 84)] / 1.940



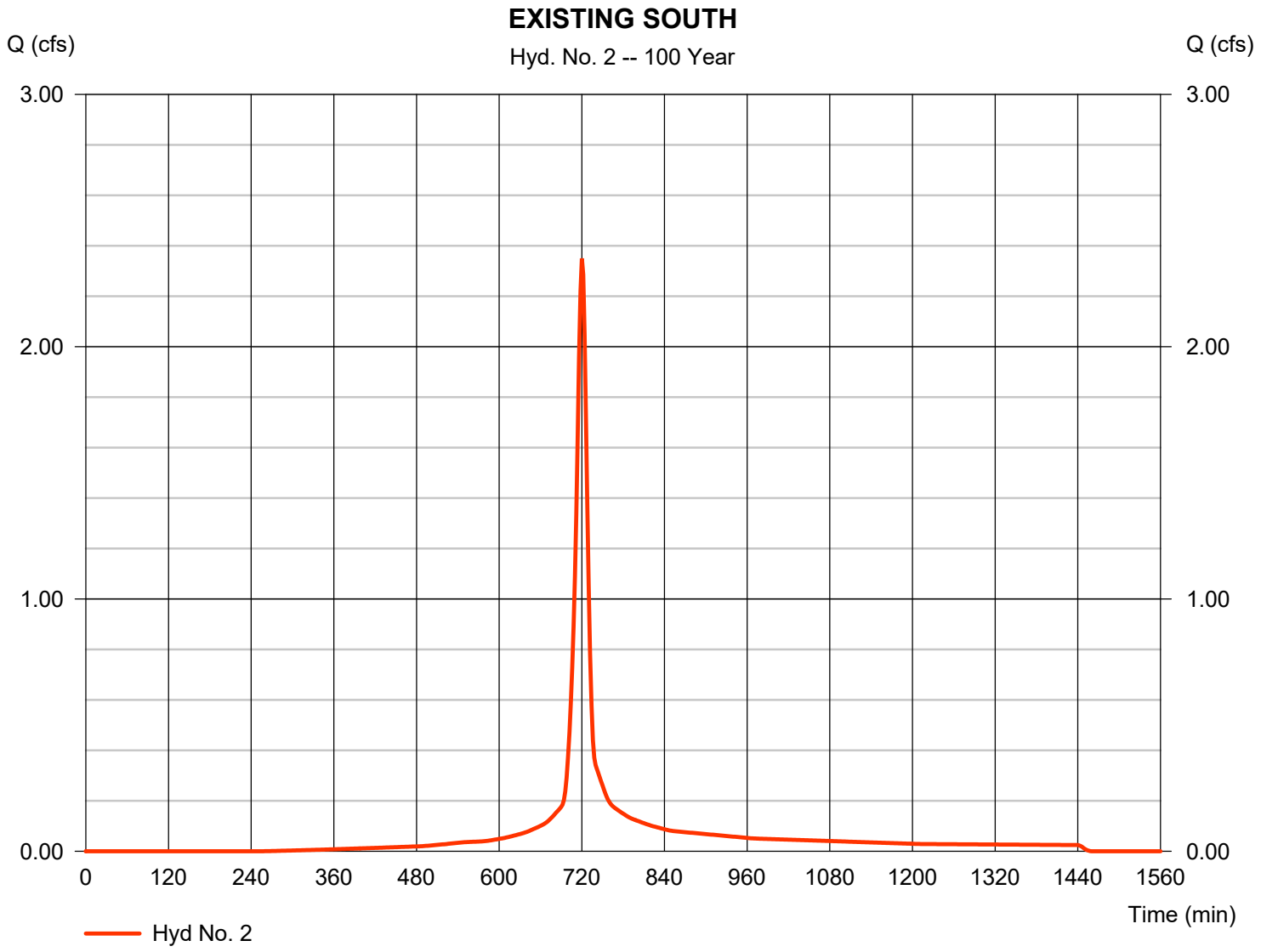
Hydrograph Report

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 x 84)] / 0.290



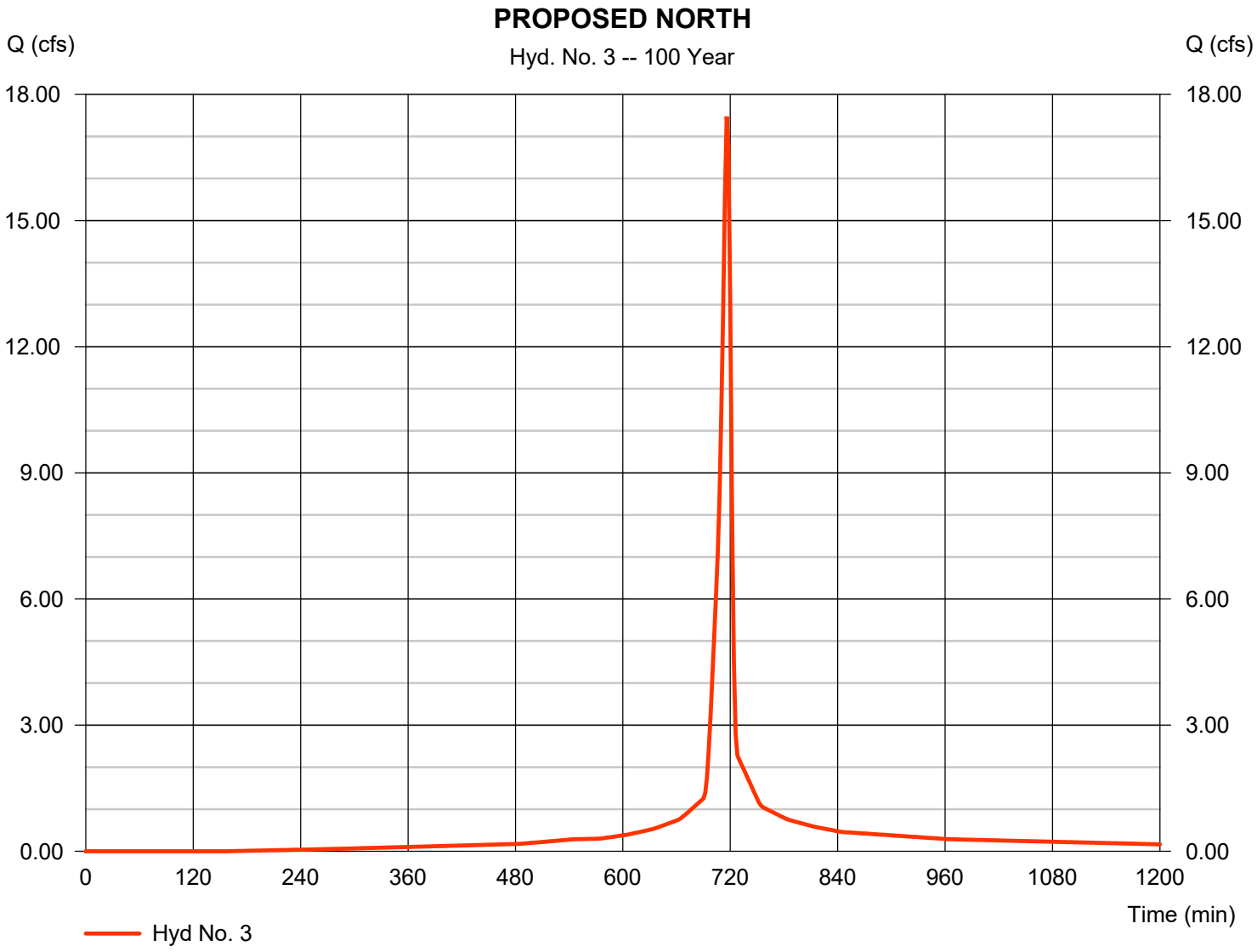
Hydrograph Report

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) = [(0.770 x 80) + (0.980 x 98)] / 1.750



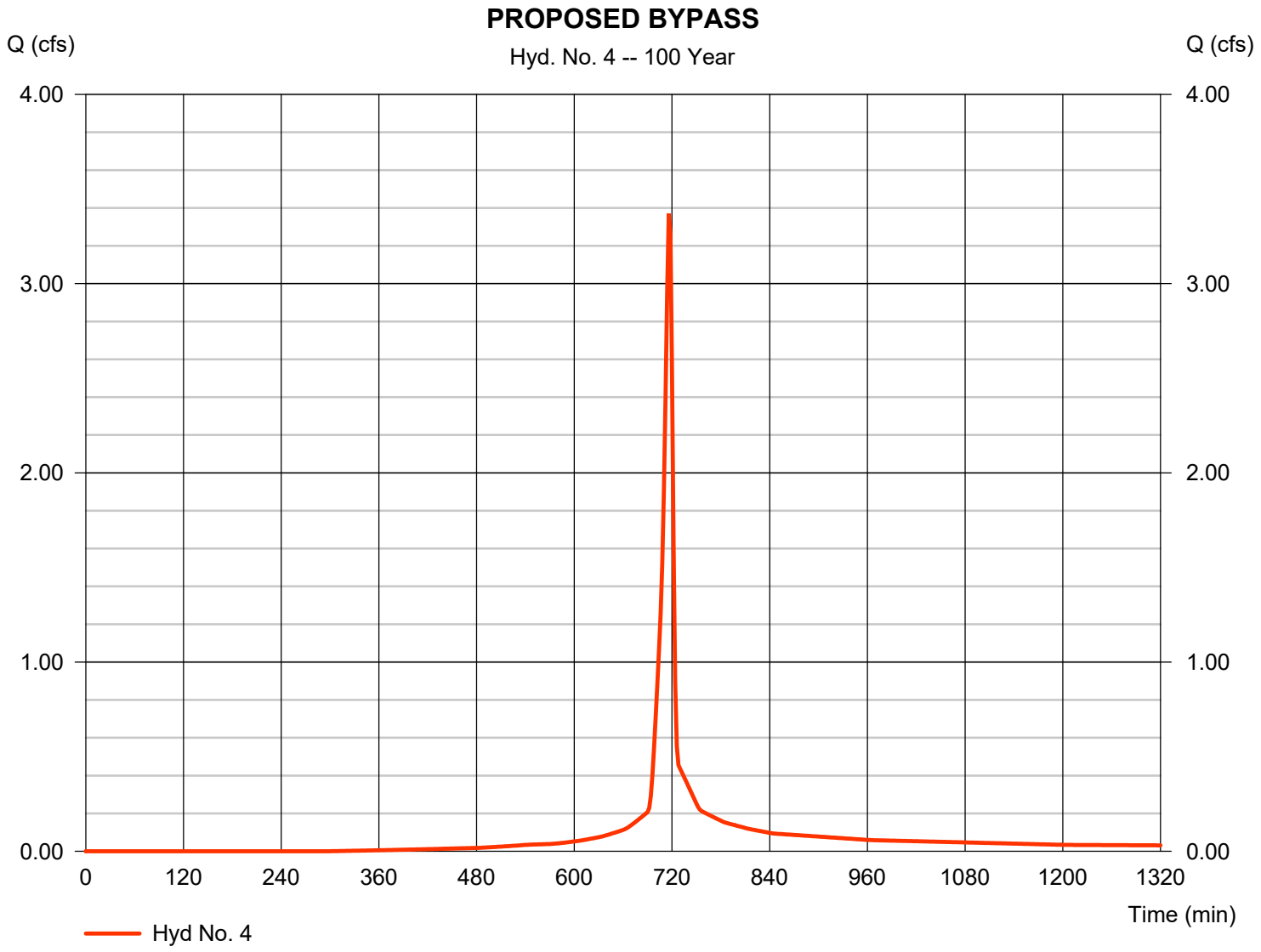
Hydrograph Report

Hyd. No. 4

PROPOSED BYPASS

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.371 cfs
Storm frequency	=	100 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	7,060 cuft
Drainage area	=	0.380 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) = [(0.360 x 80) + (0.020 x 98)] / 0.380

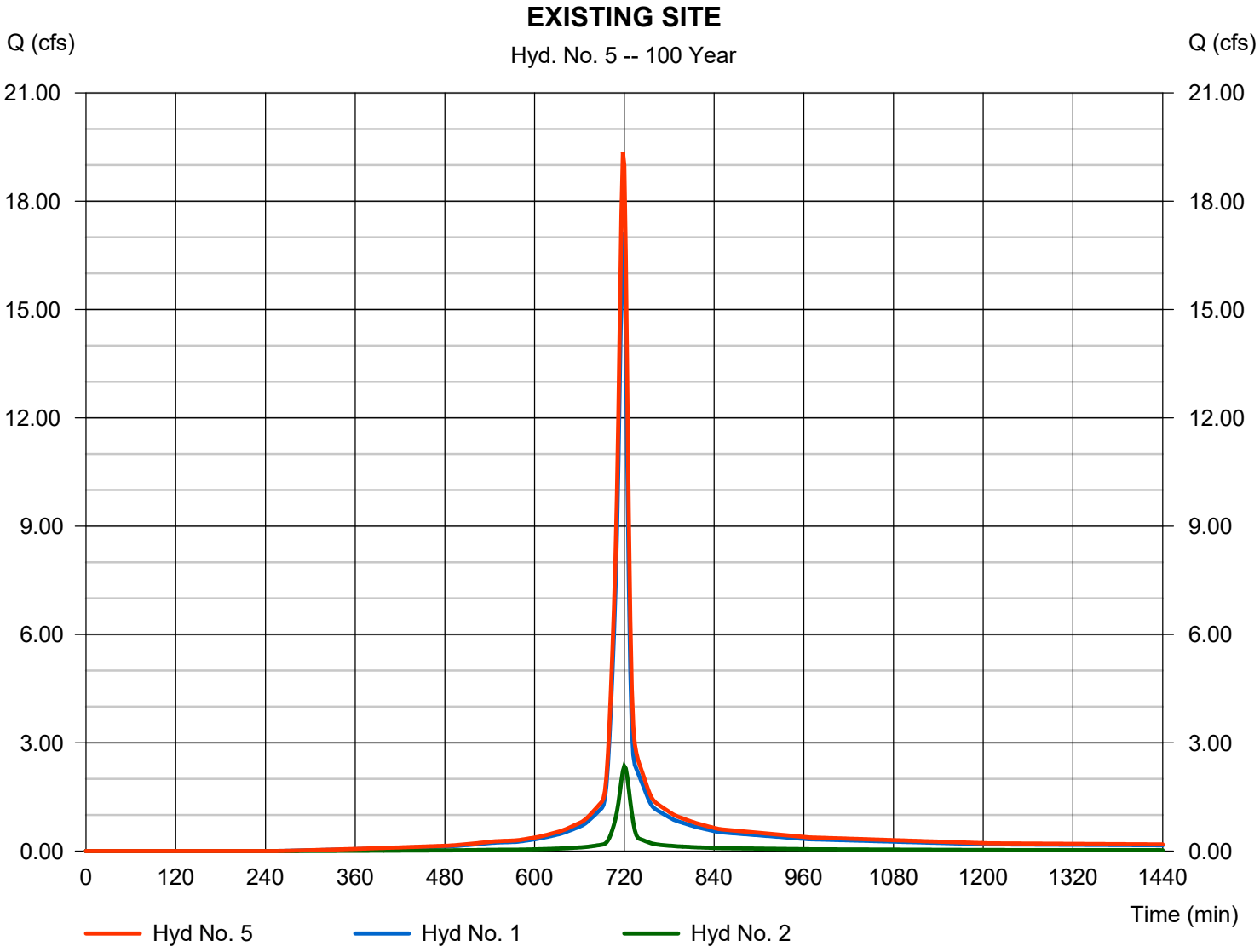


Hydrograph Report

Hyd. No. 5

EXISTING SITE

Hydrograph type	=	Combine	Peak discharge	=	19.36 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	47,203 cuft
Inflow hyds.	=	1, 2	Contrib. drain. area	=	2.230 ac



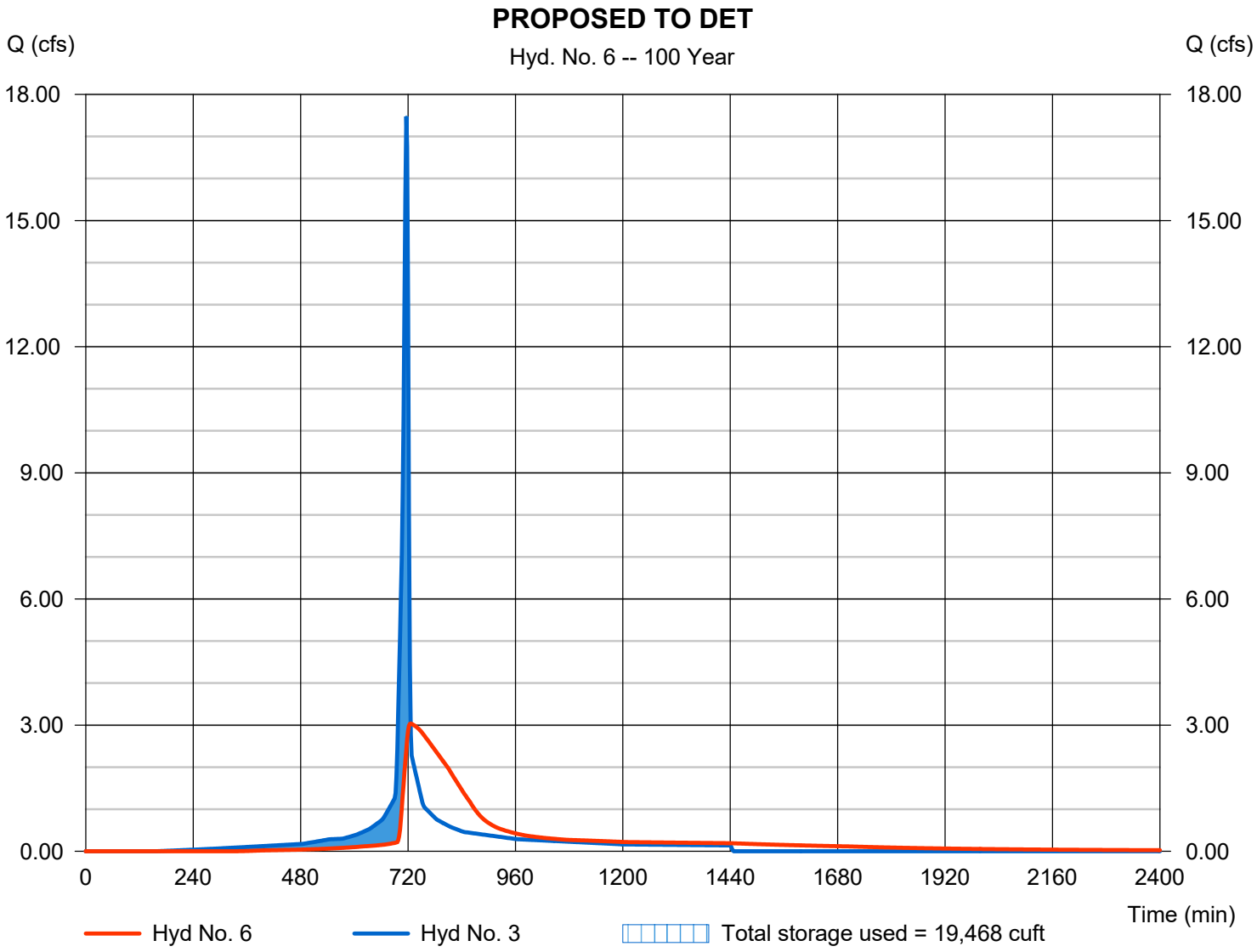
Hydrograph Report

Hyd. No. 6

PROPOSED TO DET

Hydrograph type	=	Reservoir	Peak discharge	=	3.037 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	=	966.17 ft
Reservoir name	=	Detention Pond	Max. Storage	=	19,468 cuft

Storage Indication method used.

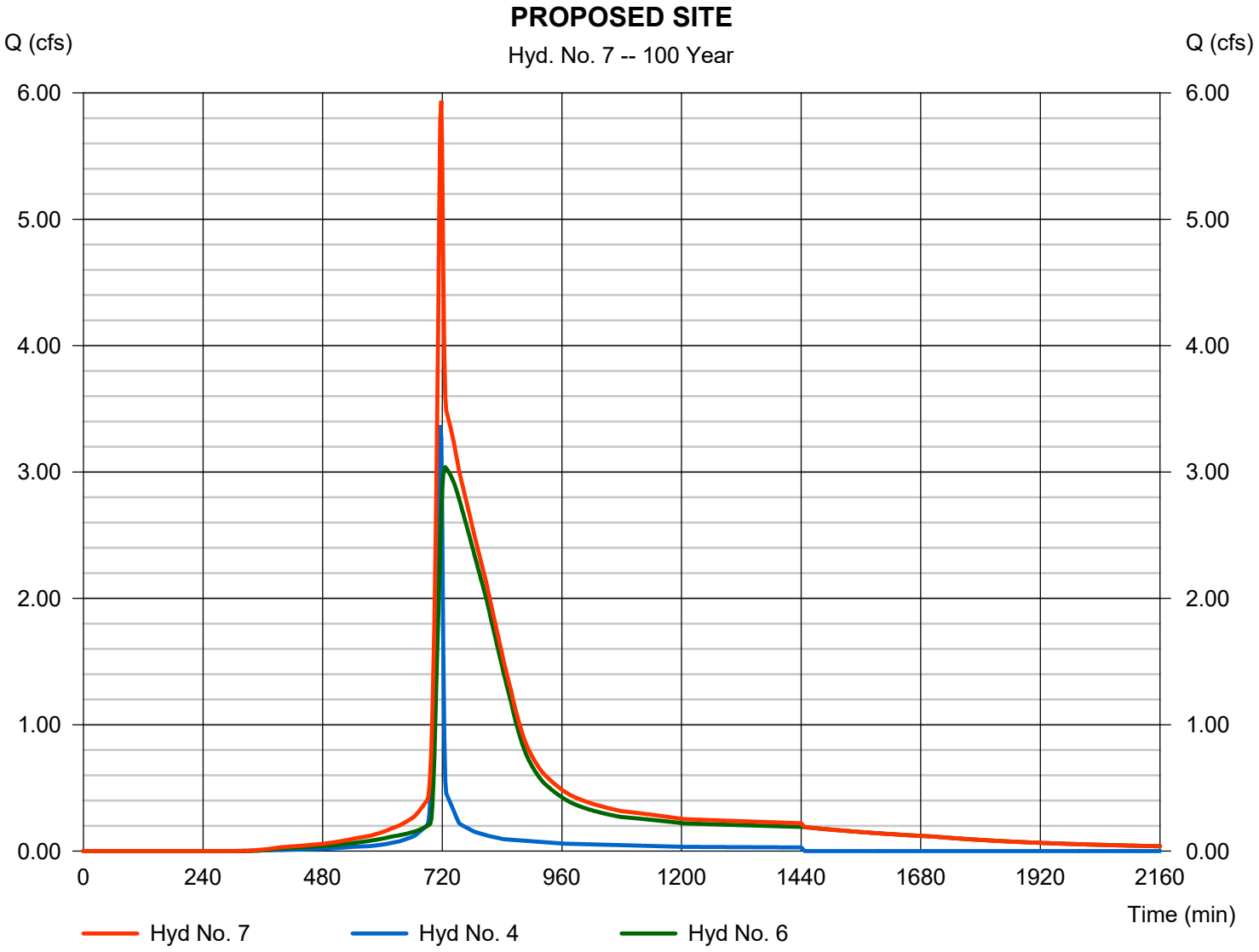


Hydrograph Report

Hyd. No. 7

PROPOSED SITE

Hydrograph type	=	Combine	Peak discharge	=	5.937 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	45,382 cuft
Inflow hyds.	=	4, 6	Contrib. drain. area	=	0.380 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	26.1250	4.3000	0.6753	--------
3	0.0000	0.0000	0.0000	--------
5	32.4010	4.4000	0.6735	--------
10	37.8784	4.5000	0.6734	--------
25	42.5803	4.1000	0.6577	--------
50	45.8000	3.8000	0.6449	--------
100	48.9298	3.5000	0.6340	--------

File name: Lee's Summit IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.79	4.33	3.54	3.03	2.67	2.40	2.19	2.02	1.88	1.76	1.66	1.57
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	7.16	5.38	4.40	3.77	3.32	2.99	2.73	2.52	2.34	2.20	2.07	1.96
10	8.32	6.26	5.12	4.39	3.88	3.49	3.19	2.94	2.74	2.57	2.42	2.29
25	9.97	7.47	6.12	5.25	4.64	4.18	3.82	3.53	3.29	3.09	2.91	2.76
50	11.27	8.43	6.90	5.93	5.24	4.73	4.33	4.00	3.73	3.50	3.31	3.14
100	12.60	9.39	7.69	6.61	5.85	5.28	4.83	4.47	4.18	3.92	3.71	3.52

Tc = time in minutes. Values may exceed 60.

Precip. file name: P:\2018\20180111\Engineering\Hydraflow\Lee's Summit Precipitation.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	3.50	0.00	0.00	5.30	0.00	0.00	7.70
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Aug 22 2019

Emergency Spillway

Trapezoidal

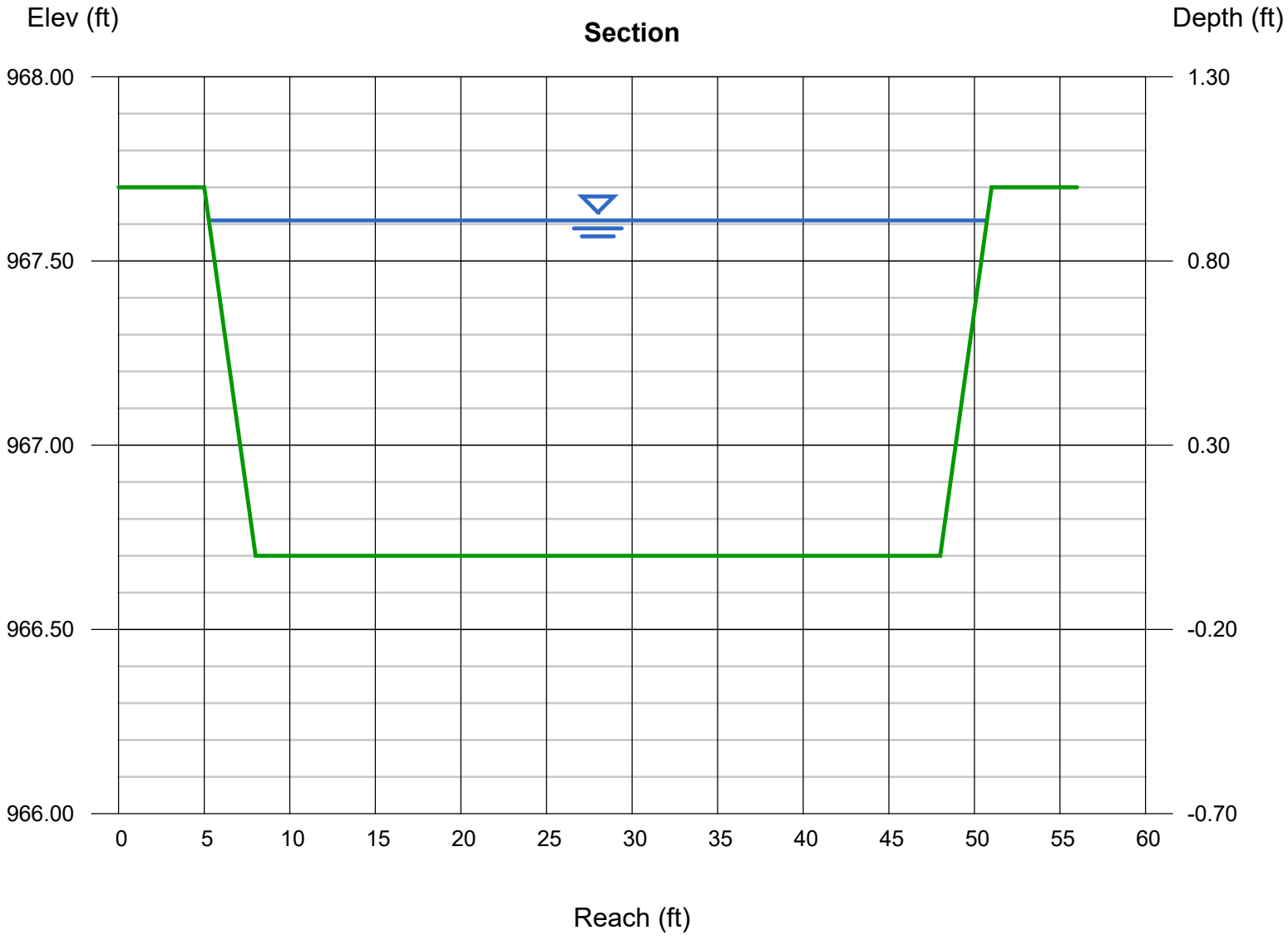
Bottom Width (ft)	= 40.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 966.70
Slope (%)	= 1.00
N-Value	= 0.150

Calculations

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

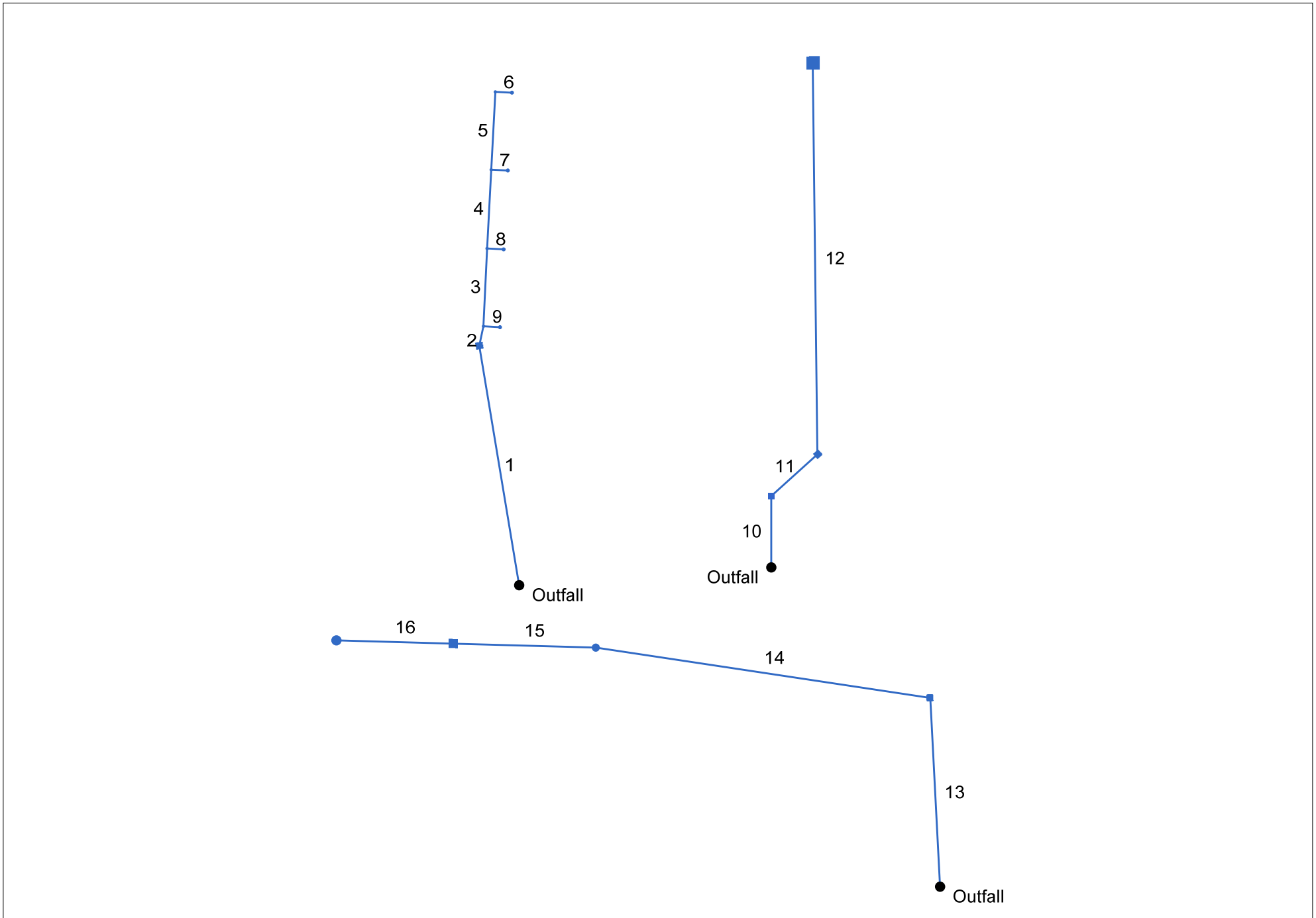
Highlighted

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_2019-08-23 Storm Sewers.stm	Number of lines: 16	Date: 8/22/2019

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	117.73	963.50	972.63	7.755	964.32	973.28	n/a	973.28 j	End	Grate
2	B3-B2	2.12	10	Cir	9.60	972.83	972.93	1.042	973.48	973.58	0.33	973.58	1	Manhole
3	B4-B3	1.66	10	Cir	37.80	972.93	973.30	0.979	973.58	973.88	n/a	973.88 j	2	Manhole
4	B5-B4	1.13	10	Cir	38.29	973.30	973.69	1.019	973.88	974.16	n/a	974.16 j	3	Manhole
5	B6-B5	0.46	10	Cir	37.80	973.69	974.06	0.979	974.16	974.36	n/a	974.36 j	4	Manhole
6	RF4-B6	0.46	10	Cir	8.00	974.06	974.25	2.375	974.36	974.55	n/a	974.55	5	Grate
7	RF3-B5	0.66	10	Cir	8.00	973.69	974.25	7.000	974.16	974.61	n/a	974.61 j	4	Grate
8	RF2-B4	0.53	10	Cir	8.00	973.30	974.25	11.875	973.88	974.57	n/a	974.57 j	3	Grate
9	RF1-B3	0.46	10	Cir	8.00	972.93	974.25	16.500	973.58	974.55	n/a	974.55 j	2	Grate
10	C2-C1	4.74	12	Cir	34.68	963.50	969.00	15.859	964.45	969.90	n/a	969.90 j	End	Curb-Horiz
11	C3-C2	3.54	12	Cir	30.04	969.20	971.30	6.991	969.90	972.10	n/a	972.10	10	Curb-Horiz
12	C4-C3	2.55	12	Cir	190.02	971.50	973.50	1.053	972.12	974.18	n/a	974.18	11	Curb-Horiz
13	Pipe - (4)	6.67	24	Cir	91.74	947.73	948.65	1.003	949.19	949.56	n/a	949.56 j	End	Grate
14	A1-EX AL#1202	5.84	24	Cir	163.20	948.85	958.00	5.607	949.56	958.85	n/a	958.85	13	Grate
15	A2-A1	2.16	15	Cir	69.11	958.20	966.58	12.125	958.85	967.17	n/a	967.17 j	14	Manhole
16	EX AI #2081 - A2	2.16	15	Cir	56.15	966.58	967.00	0.748	967.17	967.59	n/a	967.59	15	Grate

Project File: 20180111_2019-08-23 Storm Sewers.stm | Number of lines: 16 | Run Date: 8/22/2019

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

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	117.73	0.07	0.39	0.35	0.02	0.33	5.0	5.0	7.0	2.29	9.92	3.79	12	7.76	963.50	972.63	964.32	973.28	965.00	976.50	B2-B1
2	1	9.60	0.00	0.32	0.00	0.00	0.30	0.0	5.0	7.0	2.12	2.24	4.65	10	1.04	972.83	972.93	973.48	973.58	976.50	976.80	B3-B2
3	2	37.80	0.00	0.25	0.00	0.00	0.24	0.0	5.0	7.0	1.66	2.17	3.86	10	0.98	972.93	973.30	973.58	973.88	976.80	977.10	B4-B3
4	3	38.29	0.00	0.17	0.00	0.00	0.16	0.0	5.0	7.0	1.13	2.21	3.16	10	1.02	973.30	973.69	973.88	974.16	977.10	977.80	B5-B4
5	4	37.80	0.00	0.07	0.00	0.00	0.07	0.0	5.0	7.0	0.46	2.17	2.05	10	0.98	973.69	974.06	974.16	974.36	977.80	978.00	B6-B5
6	5	8.00	0.07	0.07	0.95	0.07	0.07	5.0	5.0	7.0	0.46	3.37	2.66	10	2.38	974.06	974.25	974.36	974.55	978.00	979.00	RF4-B6
7	4	8.00	0.10	0.10	0.95	0.10	0.10	5.0	5.0	7.0	0.66	5.79	2.52	10	7.00	973.69	974.25	974.16	974.61	977.80	979.00	RF3-B5
8	3	8.00	0.08	0.08	0.95	0.08	0.08	5.0	5.0	7.0	0.53	7.55	2.04	10	11.88	973.30	974.25	973.88	974.57	977.10	979.00	RF2-B4
9	2	8.00	0.07	0.07	0.95	0.07	0.07	5.0	5.0	7.0	0.46	8.90	1.83	10	16.50	972.93	974.25	973.58	974.55	976.80	979.00	RF1-B3
10	End	34.68	0.18	0.94	0.95	0.17	0.68	5.0	5.0	7.0	4.74	14.18	6.25	12	15.86	963.50	969.00	964.45	969.90	965.00	975.80	C2-C1
11	10	30.04	0.15	0.76	0.95	0.14	0.51	5.0	5.0	7.0	3.54	9.42	5.63	12	6.99	969.20	971.30	969.90	972.10	975.80	975.80	C3-C2
12	11	190.02	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	975.80	977.60	C4-C3
13	End	91.74	0.34	0.34	0.35	0.12	0.12	5.0	5.0	7.0	6.67	22.65	3.74	24	1.00	947.73	948.65	949.19	949.56	950.00	959.95	Pipe - (4)
14	13	163.20	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	5.84	53.56	5.18	24	5.61	948.85	958.00	949.56	958.85	959.95	966.20	A1-EX AL#1202
15	14	69.11	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.16	22.49	3.58	15	12.13	958.20	966.58	958.85	967.17	966.20	971.20	A2-A1
16	15	56.15	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.16	5.58	3.82	15	0.75	966.58	967.00	967.17	967.59	971.20	973.94	EX AI #2081 - A2

Project File: 20180111_2019-08-23 Storm Sewers.stm

Number of lines: 16

Run Date: 8/22/2019

NOTES:Intensity = 66.71 / (Inlet time + 12.50) ^ 0.79; Return period =Yrs. 10 ; Pipe travel time suppressed. ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	B2	0.17	0.00	0.17	0.00	Grate	0.0	0.00	2.60	2.30	2.30	Sag	2.00	0.050	0.020	0.013	0.08	1.63	0.08	1.63	0.0	Off
2	B3	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
3	B4	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
4	B5	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
5	B6	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
6	RF4	0.46	0.00	0.46	0.00	Grate	0.0	0.00	0.81	1.00	1.00	Sag	2.00	0.050	0.020	0.013	0.16	5.16	0.16	5.16	0.0	Off
7	RF3	0.66	0.00	0.66	0.00	Grate	0.0	0.00	0.81	1.00	1.00	Sag	2.00	0.050	0.020	0.013	0.20	7.02	0.20	7.02	0.0	Off
8	RF2	0.53	0.00	0.53	0.00	Grate	0.0	0.00	0.81	1.00	1.00	Sag	2.00	0.050	0.020	0.013	0.18	5.81	0.18	5.81	0.0	Off
9	RF1	0.46	0.00	0.46	0.00	Grate	0.0	0.00	0.81	1.00	1.00	Sag	2.00	0.050	0.020	0.013	0.16	5.16	0.16	5.16	0.0	Off
10	C2	1.19	0.00	1.19	0.00	Curb	4.0	2.30	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.26	9.87	0.26	9.87	0.0	Off
11	C3	0.99	0.00	0.99	0.00	Curb	4.0	2.30	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.23	8.74	0.23	8.74	0.0	Off
12	C4	2.55	0.00	2.55	0.00	Curb	4.0	4.60	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.32	13.17	0.32	13.17	0.0	Off
13	EX AL#1202	0.83	0.00	0.74	0.09	Grate	0.0	0.00	0.00	2.60	2.60	0.020	2.00	0.050	0.020	0.013	0.15	4.49	0.07	1.32	0.0	Off
14	A1	3.68*	0.00	3.68	0.00	Grate	0.0	0.00	2.30	2.60	2.60	Sag	2.00	0.050	0.020	0.013	0.36	14.81	0.36	14.81	0.0	Off
15	A2	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
16	EX AI #2081	2.16*	0.00	2.16	0.00	Grate	0.0	0.00	3.14	2.00	2.00	Sag	2.00	0.050	0.020	0.013	0.29	11.66	0.29	11.66	0.0	Off

Project File: 20180111_2019-08-23 Storm Sewers.stm | Number of lines: 16 | Run Date: 8/22/2019

NOTES: Inlet N-Values = 0.016; Intensity = 66.71 / (Inlet time + 12.50) ^ 0.79; Return period = 10 Yrs. ; * Indicates Known Q added. All curb inlets are Horiz throat.

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	3.19	12	Cir	117.73	963.50	972.63	7.755	964.38	973.39	n/a	973.39 j	End	Grate
2	B3-B2	2.95	10	Cir	9.60	972.83	972.93	1.042	973.62	973.76	0.45	974.21	1	Manhole
3	B4-B3	2.31	10	Cir	37.80	972.93	973.30	0.979	974.21*	974.63*	0.28	974.91	2	Manhole
4	B5-B4	1.57	10	Cir	38.29	973.30	973.69	1.019	974.91*	975.11*	0.13	975.24	3	Manhole
5	B6-B5	0.65	10	Cir	37.80	973.69	974.06	0.979	975.24*	975.27*	0.02	975.29	4	Manhole
6	RF4-B6	0.65	10	Cir	8.00	974.06	974.25	2.375	975.29*	975.30*	0.02	975.32	5	Grate
7	RF3-B5	0.92	10	Cir	8.00	973.69	974.25	7.000	975.24*	975.25*	0.04	975.30	4	Grate
8	RF2-B4	0.74	10	Cir	8.00	973.30	974.25	11.875	974.91	974.91	0.04	974.95	3	Grate
9	RF1-B3	0.65	10	Cir	8.00	972.93	974.25	16.500	974.21	974.60	n/a	974.60 j	2	Grate
10	C2-C1	6.60	12	Cir	34.68	963.50	969.00	15.859	964.48	969.97	n/a	969.97 j	End	Curb-Horiz
11	C3-C2	4.94	12	Cir	30.04	969.20	971.30	6.991	969.97	972.21	0.79	972.21	10	Curb-Horiz
12	C4-C3	3.56	12	Cir	190.02	971.50	973.50	1.053	972.30	974.30	n/a	974.30	11	Curb-Horiz
13	Pipe - (4)	10.48	24	Cir	91.74	947.73	948.65	1.003	949.31	949.81	n/a	949.81 j	End	Grate
14	A1-EX AL#1202	9.32	24	Cir	163.20	948.85	958.00	5.607	949.81	959.09	n/a	959.09	13	Grate
15	A2-A1	3.38	15	Cir	69.11	958.20	966.58	12.125	959.09	967.32	n/a	967.32 j	14	Manhole
16	EX AI #2081 - A2	3.38	15	Cir	56.15	966.58	967.00	0.748	967.32	967.74	n/a	967.74	15	Grate

Project File: 20180111_2019-08-23 Storm Sewers.stm

Number of lines: 16

Run Date: 8/22/2019

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	117.73	0.07	0.39	0.35	0.02	0.33	5.0	5.0	9.7	3.19	9.92	4.65	12	7.76	963.50	972.63	964.38	973.39	965.00	976.50	B2-B1
2	1	9.60	0.00	0.32	0.00	0.00	0.30	0.0	5.0	9.7	2.95	2.24	5.47	10	1.04	972.83	972.93	973.62	973.76	976.50	976.80	B3-B2
3	2	37.80	0.00	0.25	0.00	0.00	0.24	0.0	5.0	9.7	2.31	2.17	4.23	10	0.98	972.93	973.30	974.21	974.63	976.80	977.10	B4-B3
4	3	38.29	0.00	0.17	0.00	0.00	0.16	0.0	5.0	9.7	1.57	2.21	2.88	10	1.02	973.30	973.69	974.91	975.11	977.10	977.80	B5-B4
5	4	37.80	0.00	0.07	0.00	0.00	0.07	0.0	5.0	9.7	0.65	2.17	1.19	10	0.98	973.69	974.06	975.24	975.27	977.80	978.00	B6-B5
6	5	8.00	0.07	0.07	0.95	0.07	0.07	5.0	5.0	9.7	0.65	3.37	1.19	10	2.38	974.06	974.25	975.29	975.30	978.00	979.00	RF4-B6
7	4	8.00	0.10	0.10	0.95	0.10	0.10	5.0	5.0	9.7	0.92	5.79	1.69	10	7.00	973.69	974.25	975.24	975.25	977.80	979.00	RF3-B5
8	3	8.00	0.08	0.08	0.95	0.08	0.08	5.0	5.0	9.7	0.74	7.55	1.47	10	11.88	973.30	974.25	974.91	974.91	977.10	979.00	RF2-B4
9	2	8.00	0.07	0.07	0.95	0.07	0.07	5.0	5.0	9.7	0.65	8.90	2.06	10	16.50	972.93	974.25	974.21	974.60	976.80	979.00	RF1-B3
10	End	34.68	0.18	0.94	0.95	0.17	0.68	5.0	5.0	9.7	6.60	14.18	8.46	12	15.86	963.50	969.00	964.48	969.97	965.00	975.80	C2-C1
11	10	30.04	0.15	0.76	0.95	0.14	0.51	5.0	5.0	9.7	4.94	9.42	7.10	12	6.99	969.20	971.30	969.97	972.21	975.80	975.80	C3-C2
12	11	190.02	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	975.80	977.60	C4-C3
13	End	91.74	0.34	0.34	0.35	0.12	0.12	5.0	5.0	9.7	10.48	22.65	4.75	24	1.00	947.73	948.65	949.31	949.81	950.00	959.95	Pipe - (4)
14	13	163.20	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	9.32	53.56	5.80	24	5.61	948.85	958.00	949.81	959.09	959.95	966.20	A1-EX AL#1202
15	14	69.11	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.38	22.49	4.04	15	12.13	958.20	966.58	959.09	967.32	966.20	971.20	A2-A1
16	15	56.15	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.38	5.58	4.46	15	0.75	966.58	967.00	967.32	967.74	971.20	973.94	EX AI #2081 - A2

Project File: 20180111_2019-08-23 Storm Sewers.stm

Number of lines: 16

Run Date: 8/22/2019

NOTES:Intensity = 170.80 / (Inlet time + 18.20) ^ 0.91; Return period =Yrs. 100 ; Pipe travel time suppressed. ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter							Inlet			Byp Line No
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)	Depr (in)	
1	B2	0.24	0.00	0.24	0.00	Grate	0.0	0.00	2.60	2.30	2.30	Sag	2.00	0.050	0.020	0.013	0.10	2.09	0.10	2.09	0.0	Off
2	B3	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
3	B4	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
4	B5	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
5	B6	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
6	RF4	0.65	0.00	0.65	0.00	Grate	0.0	0.00	0.81	1.00	1.00	Sag	2.00	0.050	0.020	0.013	0.20	6.88	0.20	6.88	0.0	Off
7	RF3	0.92	0.00	0.92	0.00	Grate	0.0	0.00	0.81	1.00	1.00	Sag	2.00	0.050	0.020	0.013	0.24	9.20	0.24	9.20	0.0	Off
8	RF2	0.74	0.00	0.74	0.00	Grate	0.0	0.00	0.81	1.00	1.00	Sag	2.00	0.050	0.020	0.013	0.21	7.68	0.21	7.68	0.0	Off
9	RF1	0.65	0.00	0.65	0.00	Grate	0.0	0.00	0.81	1.00	1.00	Sag	2.00	0.050	0.020	0.013	0.20	6.88	0.20	6.88	0.0	Off
10	C2	1.66	0.00	1.66	0.00	Curb	4.0	2.30	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.31	12.32	0.31	12.32	0.0	Off
11	C3	1.38	0.00	1.38	0.00	Curb	4.0	2.30	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.28	10.91	0.28	10.91	0.0	Off
12	C4	3.56	0.00	3.56	0.00	Curb	4.0	4.60	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.39	16.43	0.39	16.43	0.0	Off
13	EX AL#1202	1.16	0.00	0.96	0.19	Grate	0.0	0.00	0.00	2.60	2.60	0.020	2.00	0.050	0.020	0.013	0.17	5.33	0.09	1.79	0.0	Off
14	A1	5.94*	0.00	5.94	0.00	Grate	0.0	0.00	2.30	2.60	2.60	Sag	2.00	0.050	0.020	0.013	0.47	20.29	0.47	20.29	0.0	Off
15	A2	0.00	0.00	0.00	0.00	MH	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
16	EX AI #2081	3.38*	0.00	3.38	0.00	Grate	0.0	0.00	3.14	2.00	2.00	Sag	2.00	0.050	0.020	0.013	0.38	15.89	0.38	15.89	0.0	Off

Project File: 20180111_2019-08-23 Storm Sewers.stm | Number of lines: 16 | Run Date: 8/22/2019

NOTES: Inlet N-Values = 0.016; Intensity = 170.80 / (Inlet time + 18.20) ^ 0.91; Return period = 100 Yrs. ; * Indicates Known Q added. All curb inlets are Horiz throat.

Attachment 4
Water Quality Calculations

DCI Lee's Summit
CDG #20180111

Date:	7/25/2019
Revised:	8/23/2019

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	0.77	0.98	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

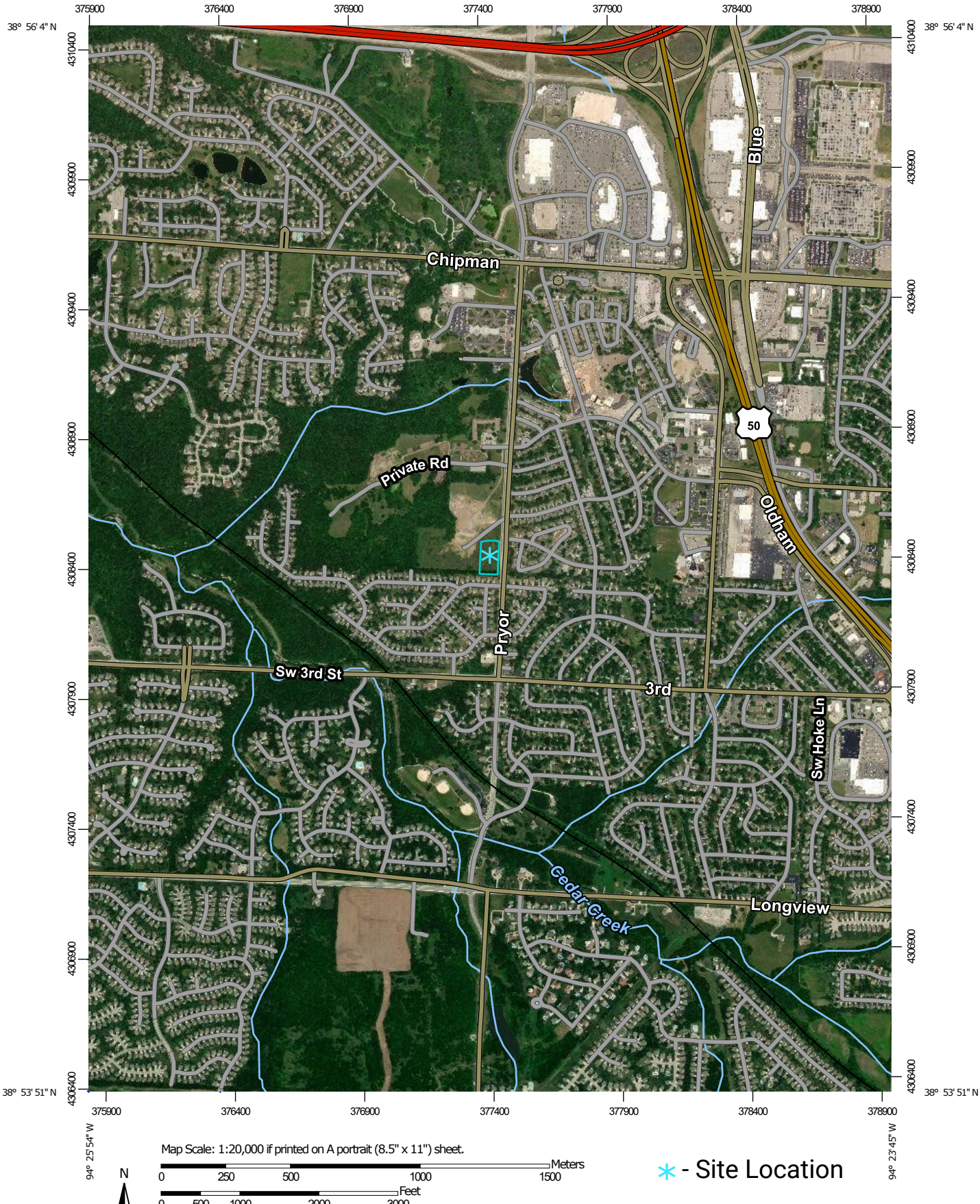
	Return Event (years)	Max Water Surface Elevation (ft)	Freeboard (ft)
Extended Dry Detention Pond	2	964.17	4.53
	10	965.09	3.61
	100	966.17	2.53

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 $A_o = \frac{WQ_v}{(0.013(Z_{wq}{}^2 + 0.22(Z_{wq}) - 0.10)}$	1.35 sq. in
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)



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

Map Scale: 1:766 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 35 70 140 210

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

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

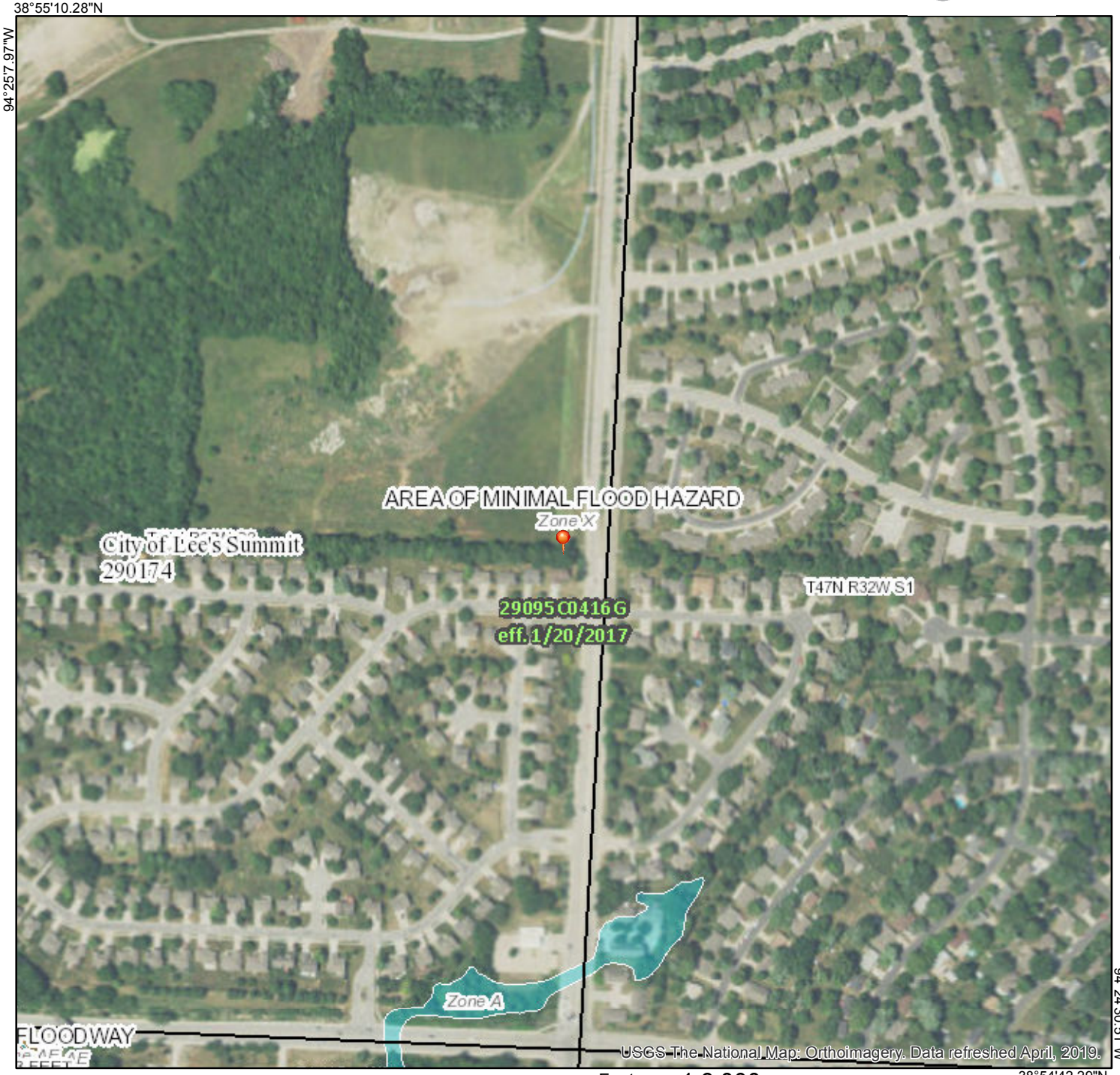
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA



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 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

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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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