RECORD
DRAINAGE DESIGN SUMMARY

FOR

DCI Lee's Summit

Lee's Summit, Jackson County, Missouri

March 5, 2021

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

Prepared by:
Catalyst Design Group
5100 Tennessee Avenue
Nashville, TN 37209
(615)622-7200

DCI Lee's Summit
Lee's Summit, Jackson County, Missouri

Table of Contents

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 Autodesk Hydraflow Hydrographs 2020 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	6.7
10-year	12.1
100-year	19.4

As-Built Post Developed Conditions Analysis

The project consisted of constructing a 10,220 sf +/- dialysis clinic with associated parking and site improvements. The new dialysis clinic is located centrally on the site. Stormwater runoff is 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 bypasses the extended dry detention pond and discharges 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.

The record drawings have been prepared based on as-built surveys by CFS Engineers, dated November 18, 2020 and updated February 4, 2021; February 24, 2021; and March 5, 2021. Catalyst Design Group is not responsible for any errors or omissions which may have been incorporated into these documents as a result. Those relying on this record document are advised to obtain independent verification of its accuracy.

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). The provided as-built water quality treatment volume provided was calculated to be 8,091 cf (0.186 ac-ft). See Attachment 4 for the as-built 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 as-built extended dry detention pond has a volume of 19,687 cf. The water quality treatment volume detained and released over 40 hours is provided below the (4) 4” orifices on the outlet structure. During construction, the proposed pond outlet structure was modified from the original design. A modification letter dated May 1, 2020 was submitted and approved by the City. The letter requested approval for the pond outlet structure, A1, to shift approximately 3’ along the downstream pipe from the original design location due to construction constraints in the field. The proposed invert in and invert out of Structure A1 were to be lowered approximately 0.16’ to accommodate the connection to the installed downstream pipe. Structure A1 was to be cast with a 0.16’ increase in height to allow the proposed outlet controls to remain at the design elevations. Another modification letter dated June 23, 2020 was submitted and approved by the City. The letter requested approval to replace the designed 8” orifice with two 6” orifices both set at elevation 963.80 due to potential conflict with the rebar locations in the structure. After the modification letter was submitted, the contractor x-rayed the rebar in the structure which showed conflict with the placement of the two 6” orifices. The last modification letter dated June 29, 2020 was submitted and approved by the City. The letter requested approval to remove the highest 1” orifice and replace the 8” orifice with four 4” orifices.

The as-built outlet structure in the pond consists of a perforated riser with (5) 1" holes with 4" vertical spacing to release the water treatment volume over 40 hours. Stormwater runoff exceeding the water quality treatment volume discharges through four 4" orifices at an elevation of 964.17 and then a 24" pipe to the existing storm system in NW Pryor Road. The elevations of the 1" holes and 4" orifices were slightly different than the approved elevations noted in the Pond Outlet Controls Modification Letter dated June, 29, 2020 due to contractor error core drilling the holes in the field. The grated casting of the outlet structure is set at 966.22 allowing water to exit the pond during the 100 year storm event. The emergency spillway located on the East edge of the pond has a bottom elevation of 966.66 to allow the 100-Year storm from the contributing drainage area to discharge should the pond be clogged and have zero available storage. The maximum water elevation of the 100 year storm discharging through the earthern berm emergency spillway was calculated to be 967.37. The top of berm elevation for the as-built emergency spillway is 968.87 providing more than the minimum 1' of freeboard as required to the top of the berm assuming zero available storage in the ponds and zero flow through the primary outlet. We are aware there is a spot shot along the top of the detention pond berm along the south edge of the pond at elevation 968.74. This elevation still provides more than 1' of freeboard in the event of a large storm event utilizes the emergency spillway. See Attachment 2 for as-built detention routing calculations. A Hydraflow Express Report has been provided for the emergency spillway with the pond's 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	3.1
100-year	5.3

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 2020 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:

$$Qcap = VA$$

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

Where:

$Qcap$ = *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 3.1 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 14.22 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 have been met by the use of the as-built extended dry detention basin located on the South portion of the project site. The water quality treatment volume of 8,091 cf has been provided and releases 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 as-built post-developed peak flow rates calculated for the 2-year, 10-year, and 100-year storm events are equal to or less than their respective allowable peak flow rates. The extended dry detention pond also provides 1 foot of freeboard for all storm events in order to provide exceptional flood protection during extreme storm events.

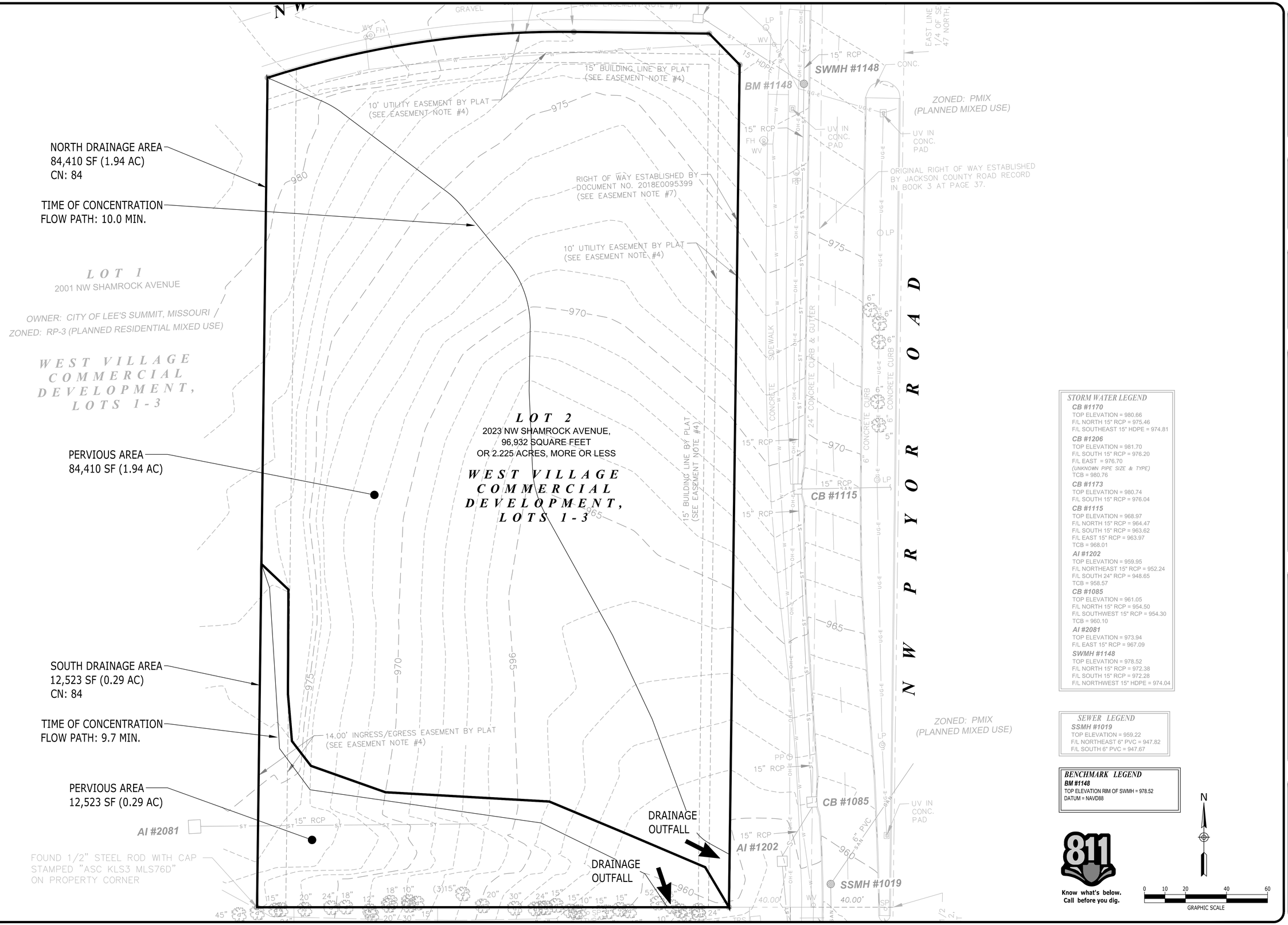
Pre- and Post- Peak Flows Comparison

Storm Event	*Pre-dev. Peak Flow (cfs)*	*Allowable Post-Dev. Peak Flow (cfs)*		*Post-Dev. Peak Flows (cfs)*	*Difference (+/-)*
2-year	6.7	(0.5 cfs/2.225 ac)	1.1	1.1	-0.0
10-year	12.1	(2.0 cfs/2.225 ac)	4.5	3.1	-1.4
100-year	19.4	(3.0 cfs/2.225 ac)	6.7	5.3	-1.4

Attachments:

Attachment 1 Site Drainage Area Maps
Attachment 2 *Autodesk 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

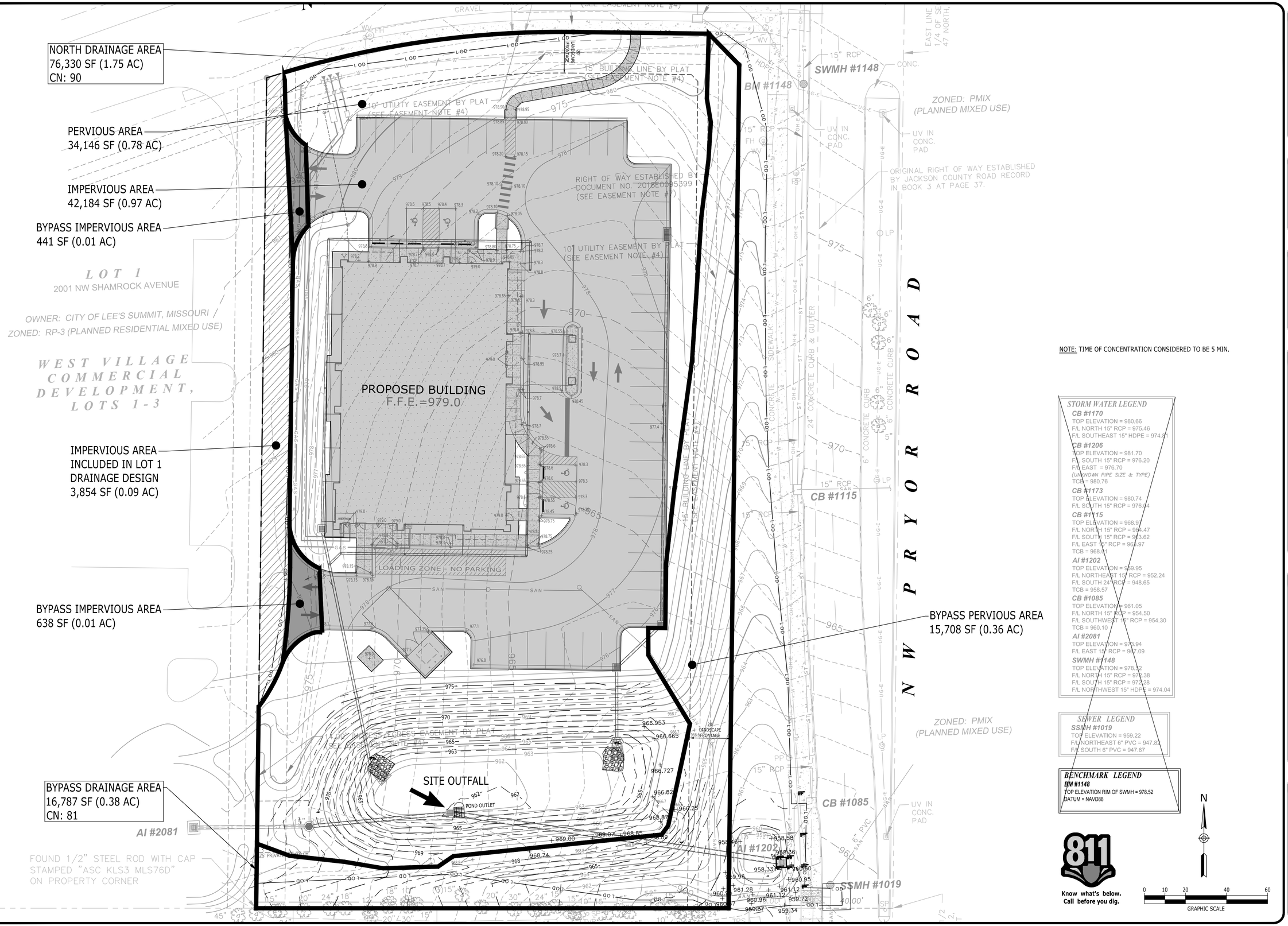
DRAWING TITLE

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 = 974.91

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 = 963.47
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

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TOP ELEVATION = 959.22
F/L NORTHEAST 6" PVC = 947.82
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BENCHMARK LEGEND

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STATE OF MISSOURI
JACK J. PARKER
NUMBER PE-2017040855
PROFESSIONAL ENGINEER
03/05/2021

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_2021-03-05_Post Drainage Area Map - RECORD.dwg-POST Mar 08, 2021 cwalker

B6 DRAINAGE AREA
1,115 SF (0.03 AC)
C VALUE: 0.95

B5 DRAINAGE AREA
241 SF (0.006 AC)
C VALUE: 0.95

B4 DRAINAGE AREA
2,332 SF (0.05 AC)
C VALUE: 0.95

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

B3 DRAINAGE AREA
5,756 SF (0.13 AC)
C VALUE: 0.60

C1 DRAINAGE AREA
195 SF (0.005 AC)
C VALUE: 0.95

D2 DRAINAGE AREA
7,363 SF (0.17 AC)
C VALUE: 0.95

D4 DRAINAGE AREA
26,446 SF (0.61 AC)
C VALUE: 0.60
ZONED: PMIX
(PLANNED MIXED USE)

B7 DRAINAGE AREA
287 SF (0.01 AC)
C VALUE: 0.95

B9 DRAINAGE AREA
186 SF (0.004 AC)
C VALUE: 0.95

C5 DRAINAGE AREA
1,774 SF (0.04 AC)
C VALUE: 0.95

C4 DRAINAGE AREA
1,621 SF (0.04 AC)
C VALUE: 0.95

C3 DRAINAGE AREA
1,834 SF (0.04 AC)
C VALUE: 0.95

C2 DRAINAGE AREA
1,461 SF (0.03 AC)
C VALUE: 0.95

D3 DRAINAGE AREA
6,486 SF (0.15 AC)
C VALUE: 0.95

EX AI#1202
DRAINAGE AREA
14,971 SF (0.34 AC)
C VALUE: 0.35

ZONED: PMIX
(PLANNED MIXED USE)

PROPOSED BUILDING
F.F.E.=979.0

LOADING ZONE - NO PARKING

RIGHT OF WAY ESTABLISHED BY DOCUMENT NO. 2015E0095599 (SEE EASEMENT NOTE #7)

10' UTILITY EASEMENT BY PLAT (SEE EASEMENT NOTE #4)

15' BUILDING LINE BY PLAT (SEE EASEMENT NOTE #4)

20' LANDSCAPE FRONTAGE

25' PRIVATE EASEMENT

POND OUTLET

SWMH #1148

BM #1148

CB #1115

CB #1085

AI #2081

AI #1202

SSMH #1019

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

PROPOSED ROAD

NW PRYOR

PIPE TABLE							
FROM CODE	FROM INV	TO CODE	TO INV.	GRADE (%)	SIZE (INCHES)	LENGTH (L.F.)	TYPE
A1	~~958.00~~ 957.82	EX AI#1202	~~948.85~~ 949.17	~~5.61%~~ 5.41%	24"	~~163~~ 160 - RECORD	RCP
A2	~~962.63~~ 962.79	A1	~~958.20~~ 958.12	~~6.41%~~ 6.31%	15"	~~69~~ 74 - RECORD	RCP
B2	~~971.14~~	B1	~~963.50~~ 963.84 - RECORD	~~7.64%~~	12"	~~100~~	HDPE
B3	~~972.50~~ 971.31 - RECORD	B2	~~971.14~~	~~7.64%~~	12"	~~18~~	HDPE
B4	~~973.39~~	B3	~~972.70~~ 971.51 - RECORD	~~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	974.97	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~~ 968.34	D1	~~963.50~~ 963.15	~~15.89%~~ 15.26%	12"	~~35~~ 34 -RECORD	HDPE
D3	~~971.30~~ 970.60	D2	~~969.20~~ 968.44	~~6.99%~~ 5.54%	12"	~~30~~ 39 -RECORD	HDPE
D4	~~973.50~~ 973.50	D3	~~971.50~~ 971.00	~~1.05%~~ 1.34%	12"	~~190~~ 186 - RECORD	HDPE
~~EX AI #2081~~	~~967.09~~	A2	~~966.58~~ 966.64	~~0.91%~~	15"	~~56~~ 74 -RECORD	RCP

STRUCTURE TABLE		
CODE	DESCRIPTION	TOP GRATE
A1	POND OUTLET	~~966.20~~ 966.22 -RECORD
A2	JUNCTION MANHOLE	~~971.20~~ 971.49 -RECORD
B1	HEADWALL	~~NA~~
B2	CLEANOUT	~~978.70~~
B3	CATCH BASIN	~~977.67~~ 976.41 -RECORD
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	978.85
D1	HEADWALL	~~NA~~
D2	SINGLE CURB INLET	~~976.30~~ 976.19 - RECORD
D3	SINGLE CURB INLET	~~976.30~~ 976.15 - RECORD
D4	DOUBLE CURB INLET	~~977.80~~ 977.00 - RECORD
EX AI #2081	EXISTING POND OUTLET	~~973.94~~
EX AL#1202	EXISTING CATCH BASIN	~~959.95~~ 959.88 - RECORD

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
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SWMH #1148
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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

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

N

0 10 20 40 60
GRAPHIC SCALE

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STATE OF MISSOURI
JAMES J. PARKER
NUMBER PE-2017040852
PROFESSIONAL ENGINEER
03/09/2021

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2001 NW SHAMROCK AVENUE
LEE'S SUMMIT, MISSOURI, 64081
JACKSON COUNTY

NO.	DATE	DESCRIPTION

DRAWING TITLE
INLET DRAINAGE AREA MAP

PROJECT NUMBER
20180111

DRAWING NUMBER
INLET

P:\2018\20180111\Engineering\dwg\20180111_2021-03-05_Inlet Drainage Area Map-RECORD.dwg-INLET Mar 08, 2021 cwalker

OFFSITE AREA
AREA = 3.95 ACRES
I = 3.49 IN/HR (10-YEAR 30-MIN)
C = 0.65
Q = 8.96 CFS

DCI PROJECT
10-YEAR STORM EVENT
Q = 3.40 CFS

FIRE STATION
10-YEAR STORM EVENT
Q = 2.16 CFS

RECEIVING STORM SYSTEM

PROPOSED BUILDING
F.F.E.=979.0

NW SHAMROCK AVENUE

NW PRYOR ROAD

NOTE: FLOWS FOR FIRE STATION AND DCI TAKEN FROM RESPECTIVE DRAINAGE REPORTS.

STORM WATER LEGEND

CB #1170
TOP ELEVATION = 980.66
F/L NORTH 15" RCP = 975.46
F/L SOUTHEAST 15" HDPE = 974.80

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 = 963.47
F/L SOUTH 15" RCP = 963.62
F/L EAST 15" RCP = 963.97
TCB = 968.07

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 = 971.94
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.

N

0 20 40 80 120
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 J. PARKER
NUMBER PE-2017040852
PROFESSIONAL ENGINEER
03/09/2021

CONSTRUCTION DRAWINGS

DCI - LEE'S SUMMIT

2001 NW SHAMROCK AVENUE
LEE'S SUMMIT, MISSOURI, 64081
JACKSON COUNTY

NO.	DATE	DESCRIPTION

DRAWING TITLE
OFFSITE DRAINAGE AREA MAP

PROJECT NUMBER
20180111

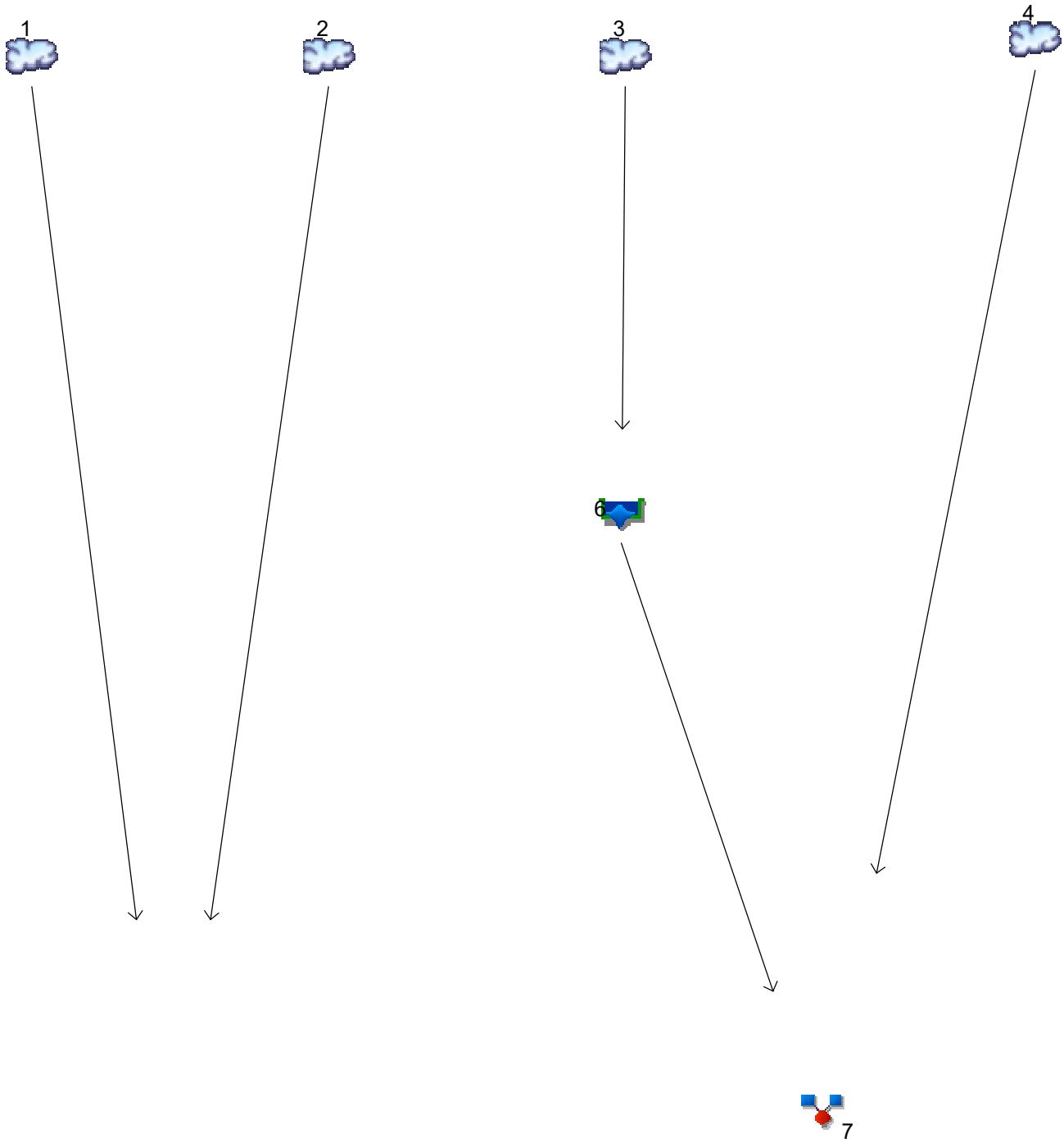
DRAWING NUMBER
OFFSITE

P:\2018\20180111\Engineering\dwg\20180111_2020-01-07_Offsite Drainage Area Map - RECORD.dwg-OFFSITE Mar 08, 2021 cwalter

Attachment 2
Autodesk Hydraflow Hydrographs Routing Calculations

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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

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	------	-------	0.921	-------	-------	1.731	-------	-------	2.838	PROPOSED BYPASS
5	Combine	1, 2,	-------	6.704	-------	-------	12.09	-------	-------	19.36	EXISTING SITE
6	Reservoir	3	-------	0.374	-------	-------	1.876	-------	-------	3.414	PROPOSED TO DET
7	Combine	4, 6	-------	1.084	-------	-------	3.097	-------	-------	5.313	PROPOSED SITE

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	0.374	2	772	14,505	3	964.29	8,628	PROPOSED TO DET
7	Combine	1.084	2	718	16,365	4, 6	------	------	PROPOSED SITE

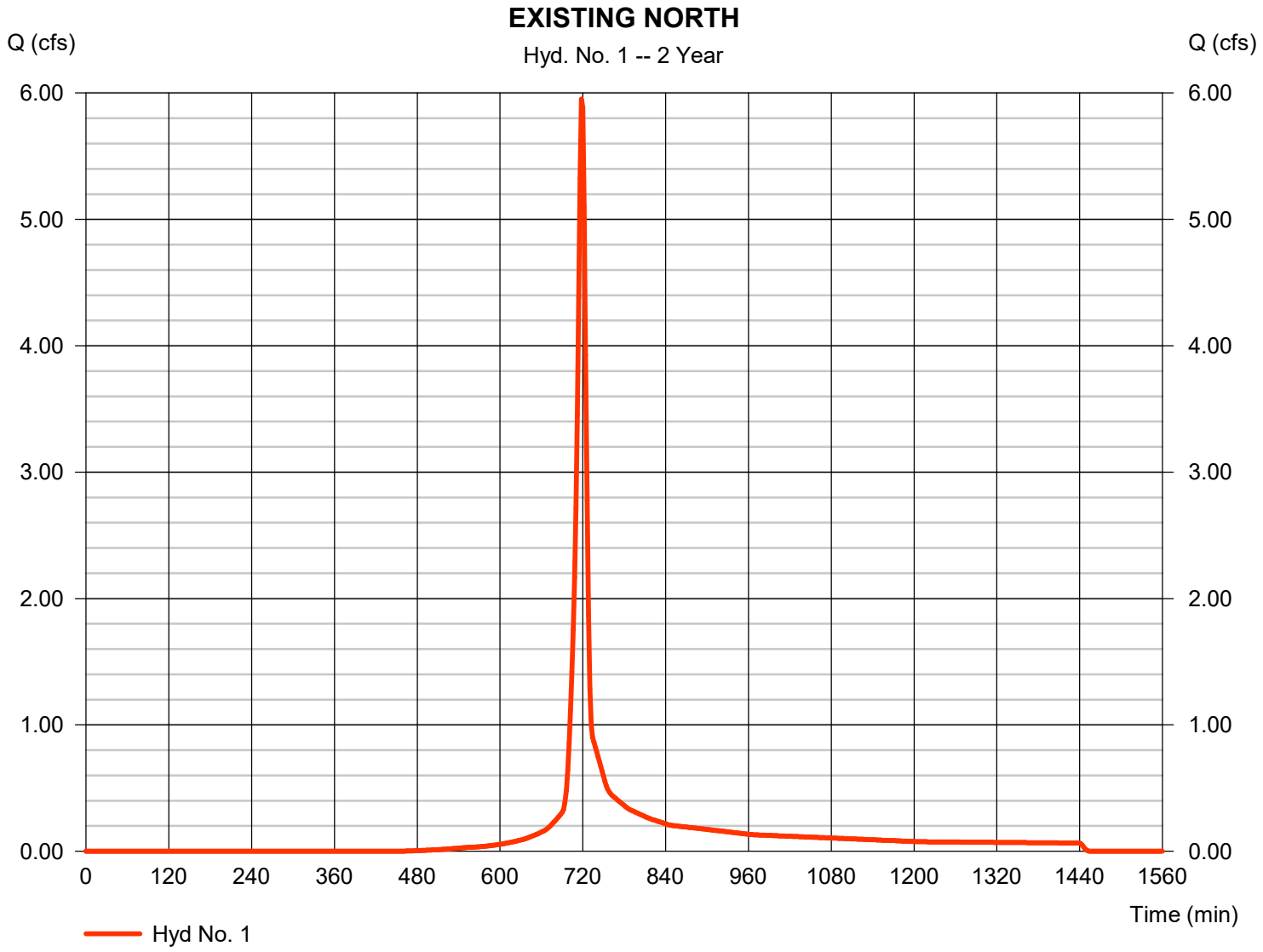
Hydrograph Report

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

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

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

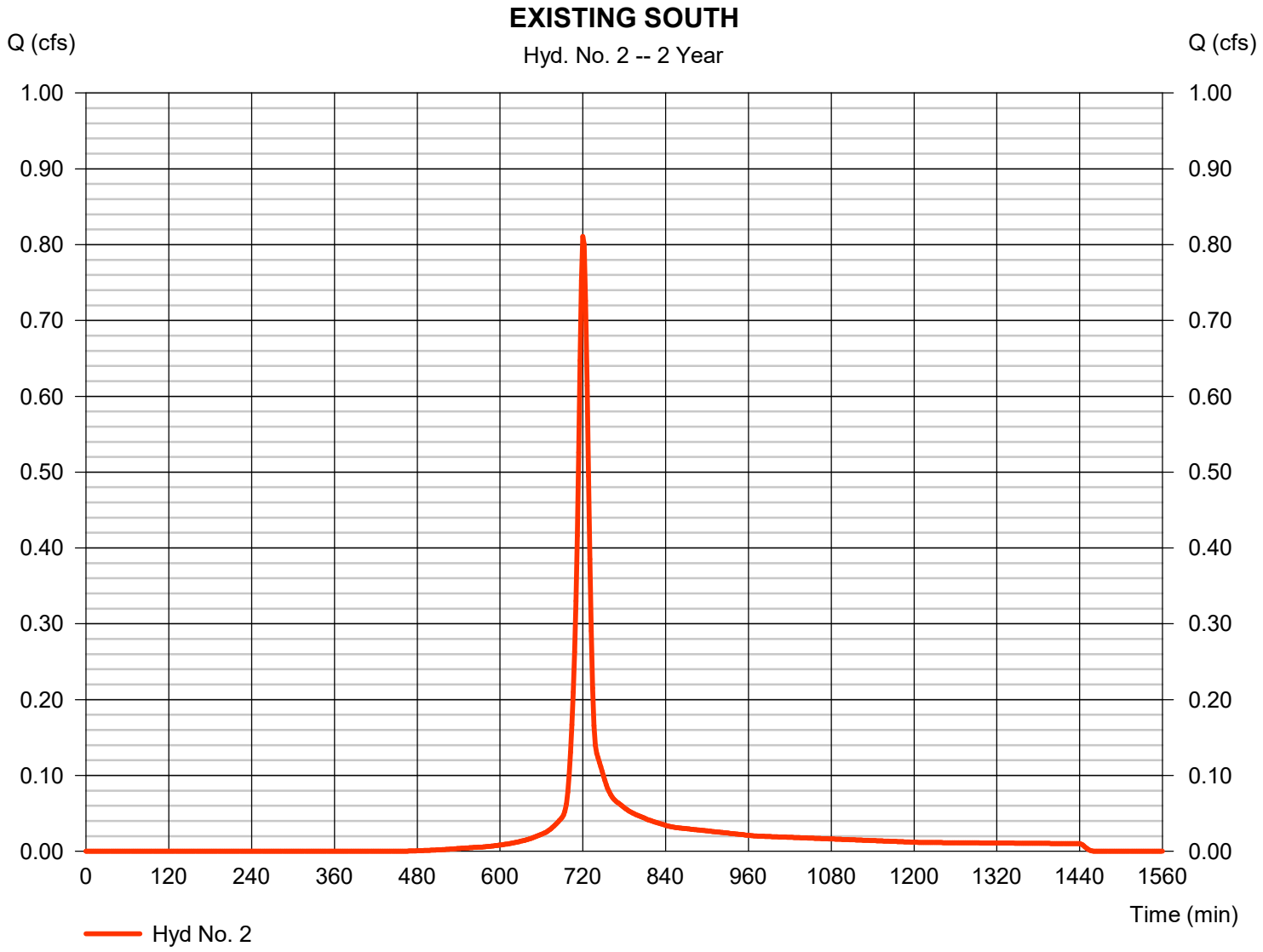
Hydrograph Report

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

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

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

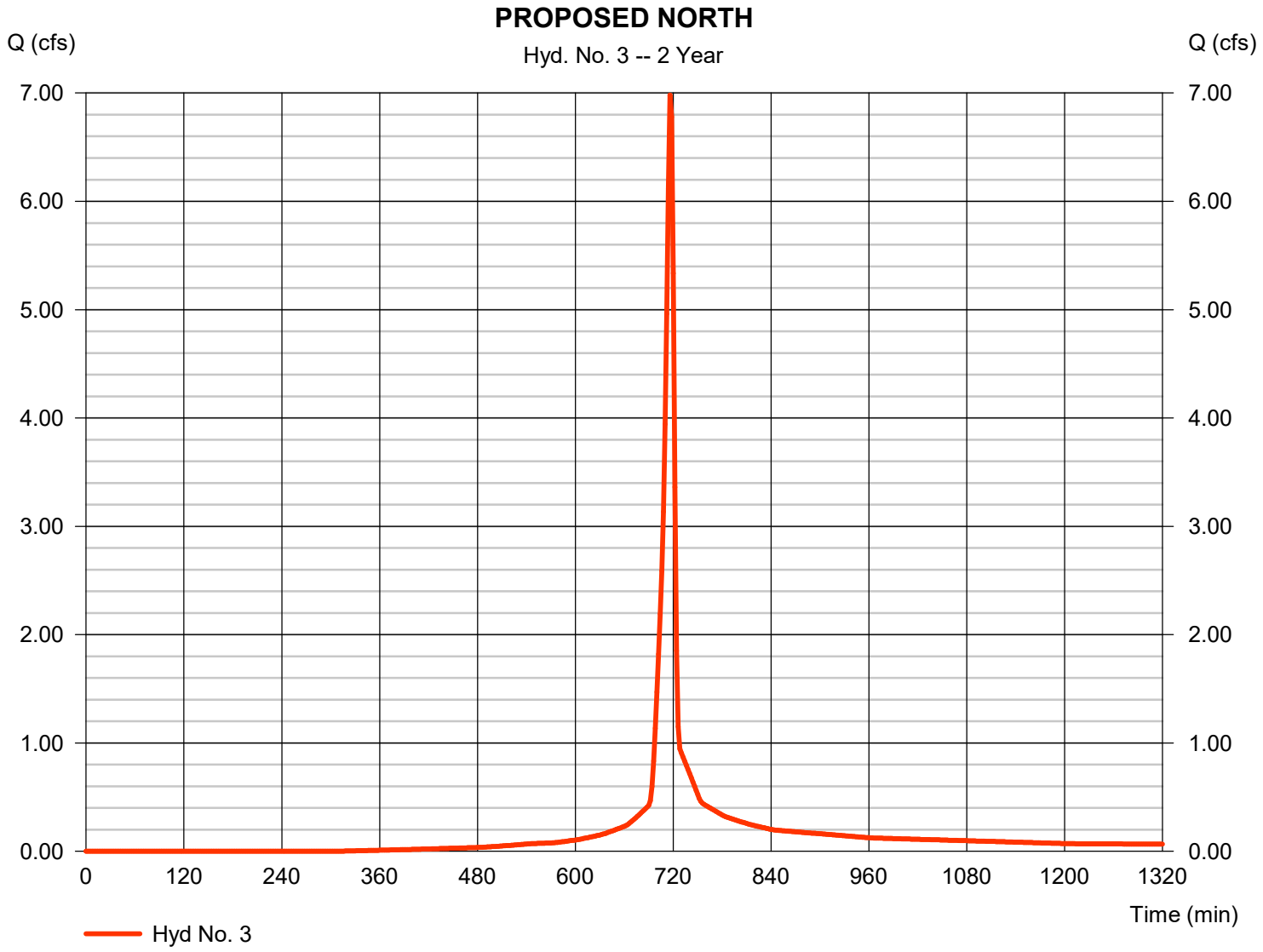
Hydrograph Report

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) = [(0.780 x 80) + (0.970 x 98)] / 1.750



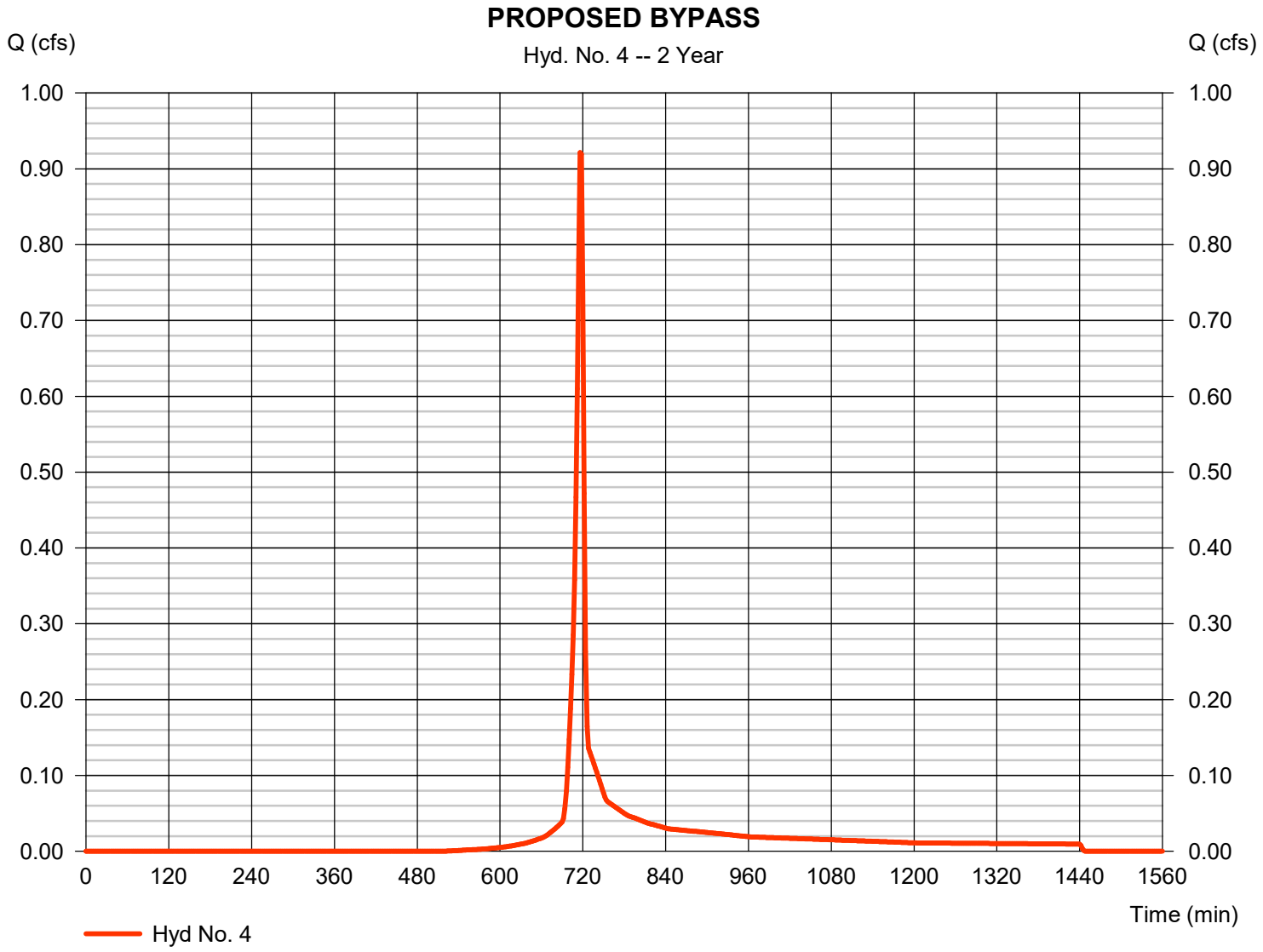
Hydrograph Report

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

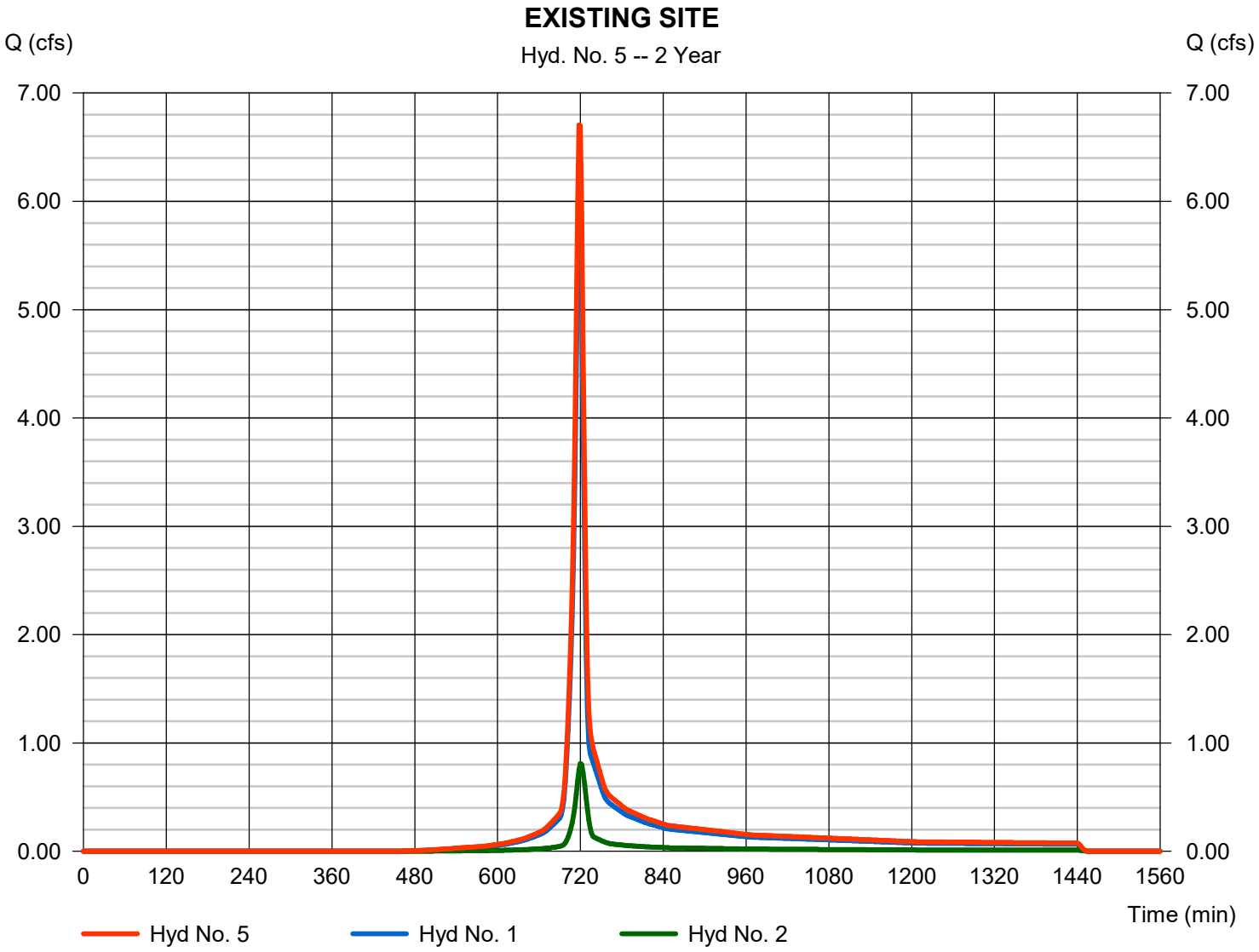


Hydrograph Report

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



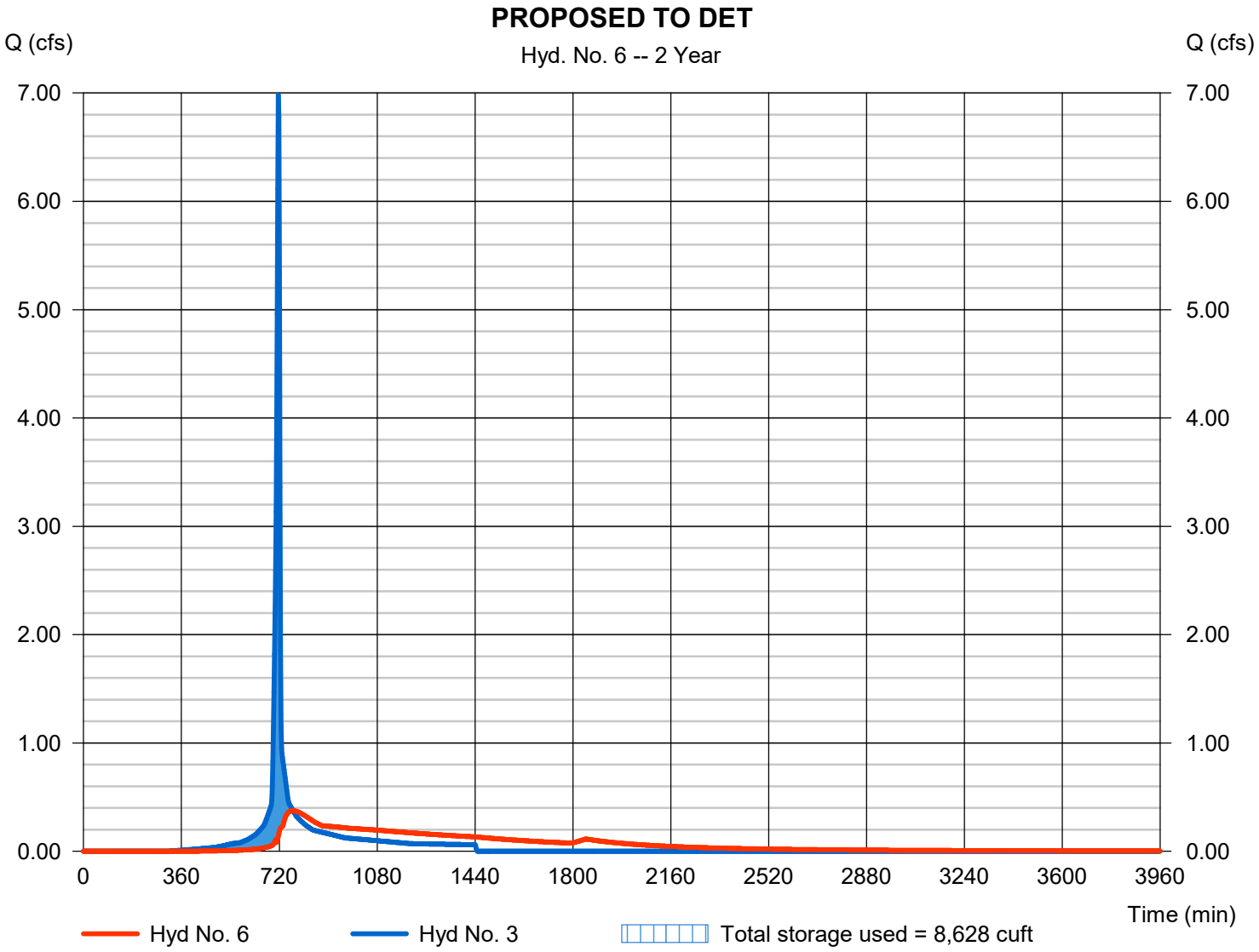
Hydrograph Report

Hyd. No. 6

PROPOSED TO DET

Hydrograph type	=	Reservoir	Peak discharge	=	0.374 cfs
Storm frequency	=	2 yrs	Time to peak	=	772 min
Time interval	=	2 min	Hyd. volume	=	14,505 cuft
Inflow hyd. No.	=	3 - PROPOSED NORTH	Max. Elevation	=	964.29 ft
Reservoir name	=	Detention Pond	Max. Storage	=	8,628 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 = 961.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	961.50	10	0	0
0.50	962.00	311	80	80
2.00	963.00	3,691	3,002	3,082
3.00	964.00	4,554	4,123	7,204
4.00	965.00	5,400	4,977	12,181
5.00	966.00	6,307	5,854	18,035
5.50	967.00	7,267	3,394	21,428

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	4.00	Inactive	1.00
Span (in)	= 24.00	4.00	0.00	1.00
No. Barrels	= 1	4	1	5
Invert El. (ft)	= 957.82	964.17	0.00	961.90
Length (ft)	= 160.00	1.00	0.00	1.35
Slope (%)	= 5.41	0.10	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)	= 16.00	Inactive	Inactive	Inactive
Crest El. (ft)	= 966.22	0.00	0.00	0.00
Weir Coeff.	= 2.60	2.60	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	961.50	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.05	8	961.55	24.76 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.10	16	961.60	24.76 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.15	24	961.65	24.76 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.20	32	961.70	24.76 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.25	40	961.75	24.76 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.30	48	961.80	24.76 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.35	56	961.85	24.76 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.40	64	961.90	24.76 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.45	72	961.95	24.76 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.001
0.50	80	962.00	24.76 ic	0.00	---	0.00	0.00	---	---	---	---	---	0.002
0.65	380	962.15	24.76 ic	0.00	---	0.01	0.00	---	---	---	---	---	0.008
0.80	681	962.30	24.76 ic	0.00	---	0.02	0.00	---	---	---	---	---	0.016
0.95	981	962.45	24.76 ic	0.00	---	0.03	0.00	---	---	---	---	---	0.026
1.10	1,281	962.60	24.76 ic	0.00	---	0.04	0.00	---	---	---	---	---	0.038
1.25	1,581	962.75	24.76 ic	0.00	---	0.05	0.00	---	---	---	---	---	0.051
1.40	1,881	962.90	24.76 ic	0.00	---	0.06	0.00	---	---	---	---	---	0.065
1.55	2,181	963.05	24.76 ic	0.00	---	0.08	0.00	---	---	---	---	---	0.080
1.70	2,481	963.20	24.76 ic	0.00	---	0.10	0.00	---	---	---	---	---	0.096
1.85	2,782	963.35	24.76 ic	0.00	---	0.11	0.00	---	---	---	---	---	0.113
2.00	3,082	963.00	24.76 ic	0.00	---	0.07	0.00	---	---	---	---	---	0.075
2.10	3,494	963.10	24.76 ic	0.00	---	0.09	0.00	---	---	---	---	---	0.085
2.20	3,906	963.20	24.76 ic	0.00	---	0.10	0.00	---	---	---	---	---	0.096
2.30	4,319	963.30	24.76 ic	0.00	---	0.11	0.00	---	---	---	---	---	0.107
2.40	4,731	963.40	24.76 ic	0.00	---	0.12	0.00	---	---	---	---	---	0.119
2.50	5,143	963.50	24.76 ic	0.00	---	0.13	0.00	---	---	---	---	---	0.131
2.60	5,555	963.60	24.76 ic	0.00	---	0.14	0.00	---	---	---	---	---	0.144
2.70	5,968	963.70	24.76 ic	0.00	---	0.16	0.00	---	---	---	---	---	0.157
2.80	6,380	963.80	24.76 ic	0.00	---	0.17	0.00	---	---	---	---	---	0.170
2.90	6,792	963.90	24.76 ic	0.00	---	0.18	0.00	---	---	---	---	---	0.183
3.00	7,204	964.00	24.76 ic	0.00	---	0.20	0.00	---	---	---	---	---	0.197
3.10	7,702	964.10	24.76 ic	0.00	---	0.21	0.00	---	---	---	---	---	0.212
3.20	8,200	964.20	24.76 ic	0.01 ic	---	0.23	0.00	---	---	---	---	---	0.235
3.30	8,697	964.30	24.76 ic	0.16 ic	---	0.24	0.00	---	---	---	---	---	0.396
3.40	9,195	964.40	24.76 ic	0.42 ic	---	0.26	0.00	---	---	---	---	---	0.677
3.50	9,693	964.50	24.76 ic	0.68 ic	---	0.27	0.00	---	---	---	---	---	0.953

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	10,190	964.60	24.76 ic	0.86 ic	---	0.29	0.00	---	---	---	---	---	1.150
3.70	10,688	964.70	24.76 ic	1.01 ic	---	0.30	0.00	---	---	---	---	---	1.317
3.80	11,186	964.80	24.76 ic	1.14 ic	---	0.32	0.00	---	---	---	---	---	1.464
3.90	11,684	964.90	24.76 ic	1.26 ic	---	0.34	0.00	---	---	---	---	---	1.598
4.00	12,181	965.00	24.76 ic	1.37 ic	---	0.35	0.00	---	---	---	---	---	1.723
4.10	12,767	965.10	24.76 ic	1.47 ic	---	0.37	0.00	---	---	---	---	---	1.839
4.20	13,352	965.20	24.76 ic	1.56 ic	---	0.39	0.00	---	---	---	---	---	1.950
4.30	13,937	965.30	24.76 ic	1.65 ic	---	0.41	0.00	---	---	---	---	---	2.056
4.40	14,523	965.40	24.76 ic	1.73 ic	---	0.42	0.00	---	---	---	---	---	2.157
4.50	15,108	965.50	24.76 ic	1.81 ic	---	0.44	0.00	---	---	---	---	---	2.255
4.60	15,693	965.60	24.76 ic	1.89 ic	---	0.46	0.00	---	---	---	---	---	2.350
4.70	16,279	965.70	24.76 ic	1.96 ic	---	0.48	0.00	---	---	---	---	---	2.442
4.80	16,864	965.80	24.76 ic	2.03 ic	---	0.50	0.00	---	---	---	---	---	2.532
4.90	17,449	965.90	24.76 ic	2.10 ic	---	0.52	0.00	---	---	---	---	---	2.620
5.00	18,035	966.00	24.76 ic	2.17 ic	---	0.54	0.00	---	---	---	---	---	2.706
5.05	18,374	966.05	24.76 ic	2.20 ic	---	0.55	0.00	---	---	---	---	---	2.748
5.10	18,713	966.10	24.76 ic	2.23 ic	---	0.56	0.00	---	---	---	---	---	2.790
5.15	19,053	966.15	24.76 ic	2.26 ic	---	0.57	0.00	---	---	---	---	---	2.831
5.20	19,392	966.20	24.76 ic	2.29 ic	---	0.58	0.00	---	---	---	---	---	2.872
5.25	19,732	966.25	24.76 ic	2.32 ic	---	0.59	0.22	---	---	---	---	---	3.128
5.30	20,071	966.30	24.76 ic	2.35 ic	---	0.60	0.94	---	---	---	---	---	3.894
5.35	20,410	966.35	24.76 ic	2.38 ic	---	0.61	1.95	---	---	---	---	---	4.942
5.40	20,750	966.40	24.76 ic	2.41 ic	---	0.62	3.18	---	---	---	---	---	6.208
5.45	21,089	966.45	24.76 ic	2.44 ic	---	0.63	4.59	---	---	---	---	---	7.658
5.50	21,428	967.00	31.87 ic	2.74 ic	---	0.47	28.66	---	---	---	---	---	31.87

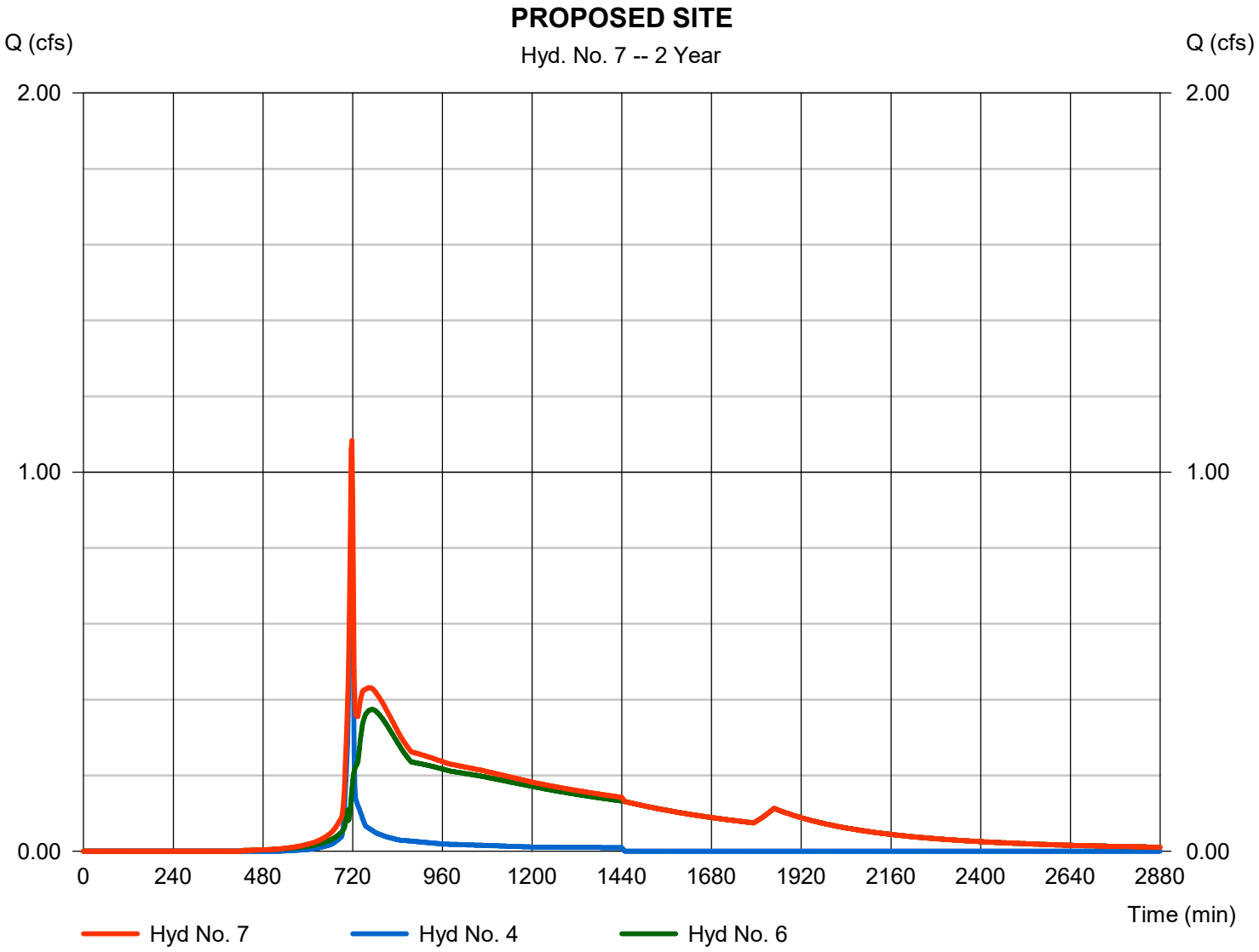
...End

Hydrograph Report

Hyd. No. 7

PROPOSED SITE

Hydrograph type	=	Combine	Peak discharge	=	1.084 cfs
Storm frequency	=	2 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	16,365 cuft
Inflow hyds.	=	4, 6	Contrib. drain. area	=	0.320 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	1.876	2	726	24,737	3	965.13	12,960	PROPOSED TO DET
7	Combine	3.097	2	718	28,279	4, 6	------	------	PROPOSED SITE

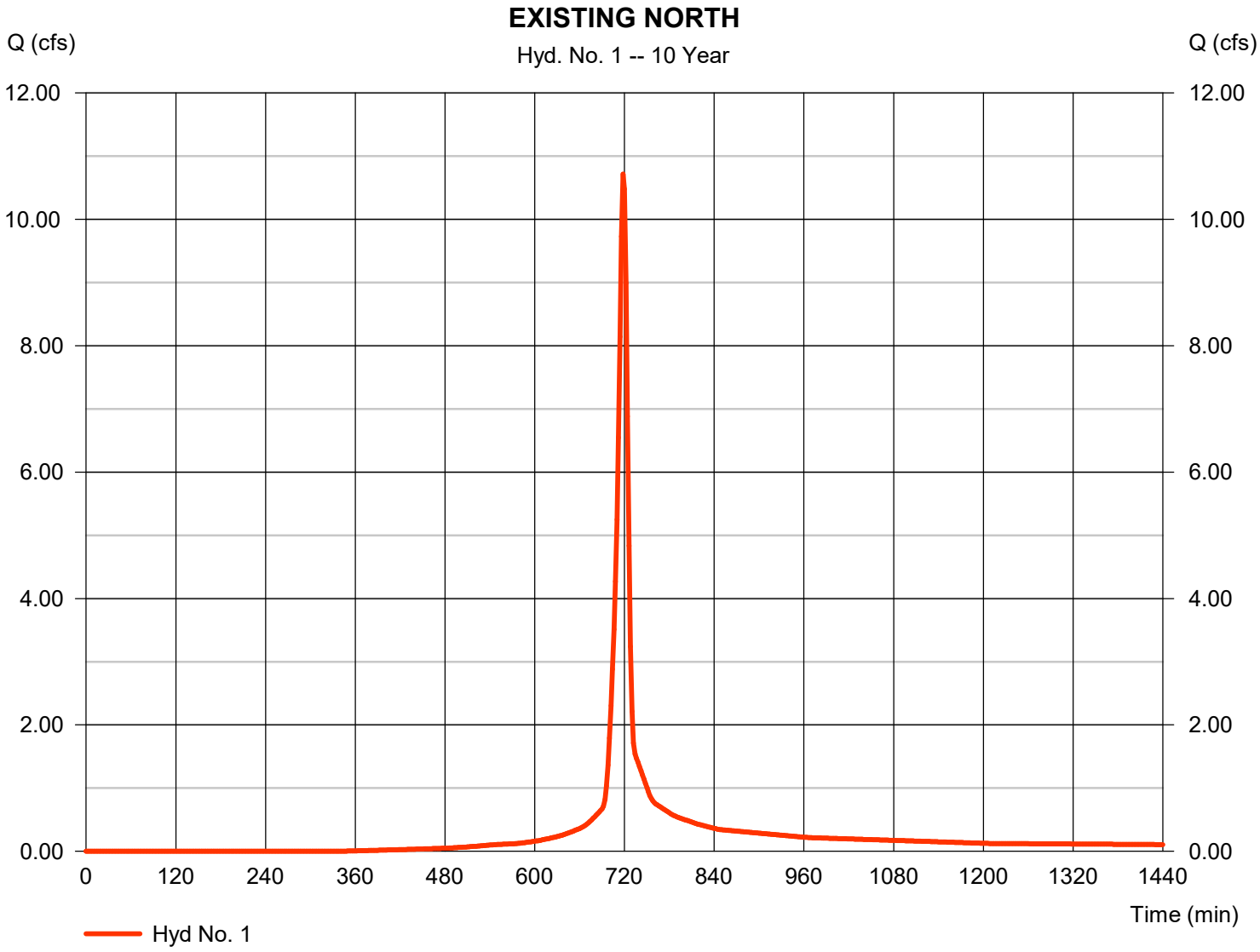
Hydrograph Report

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



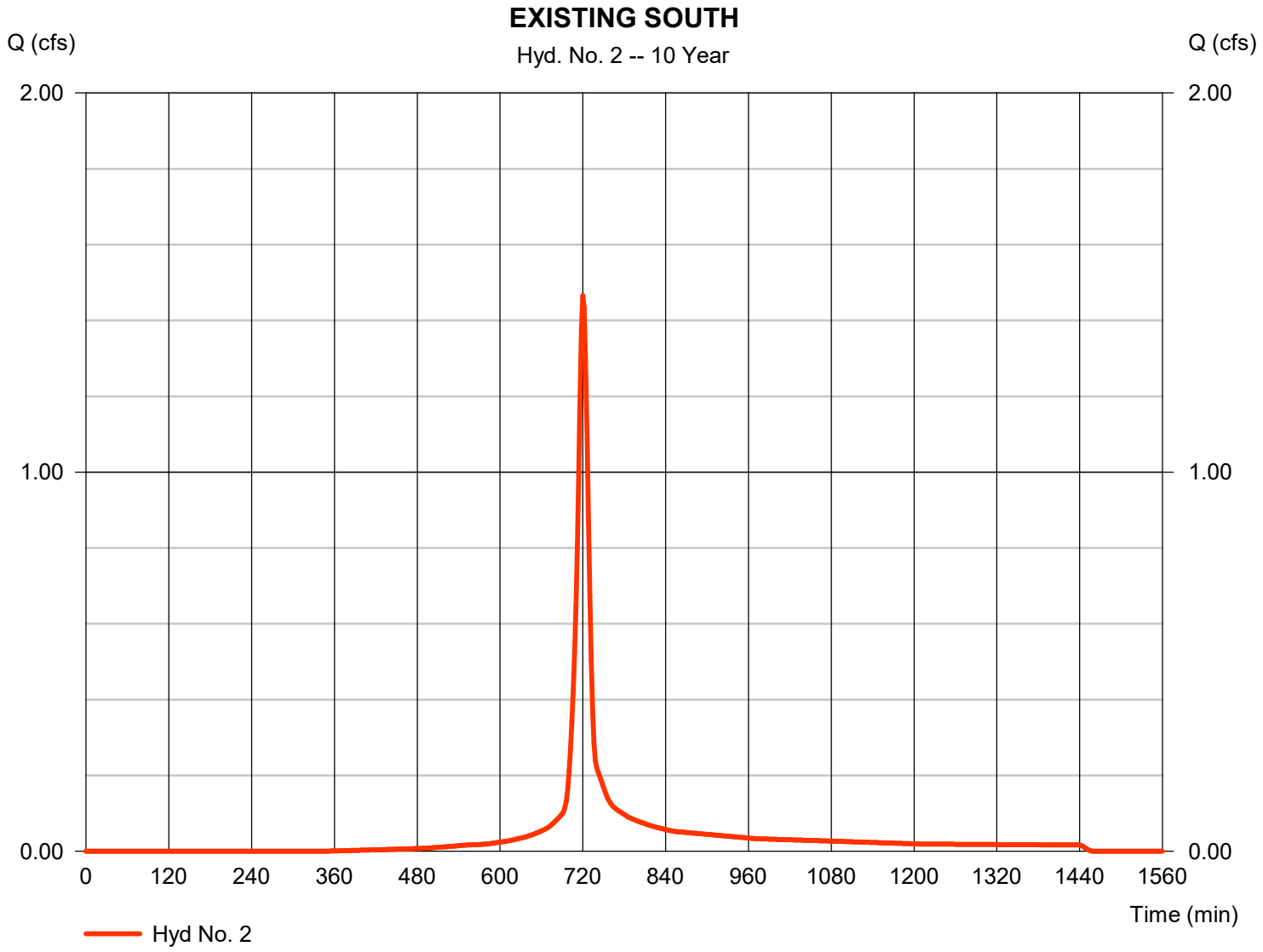
Hydrograph Report

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



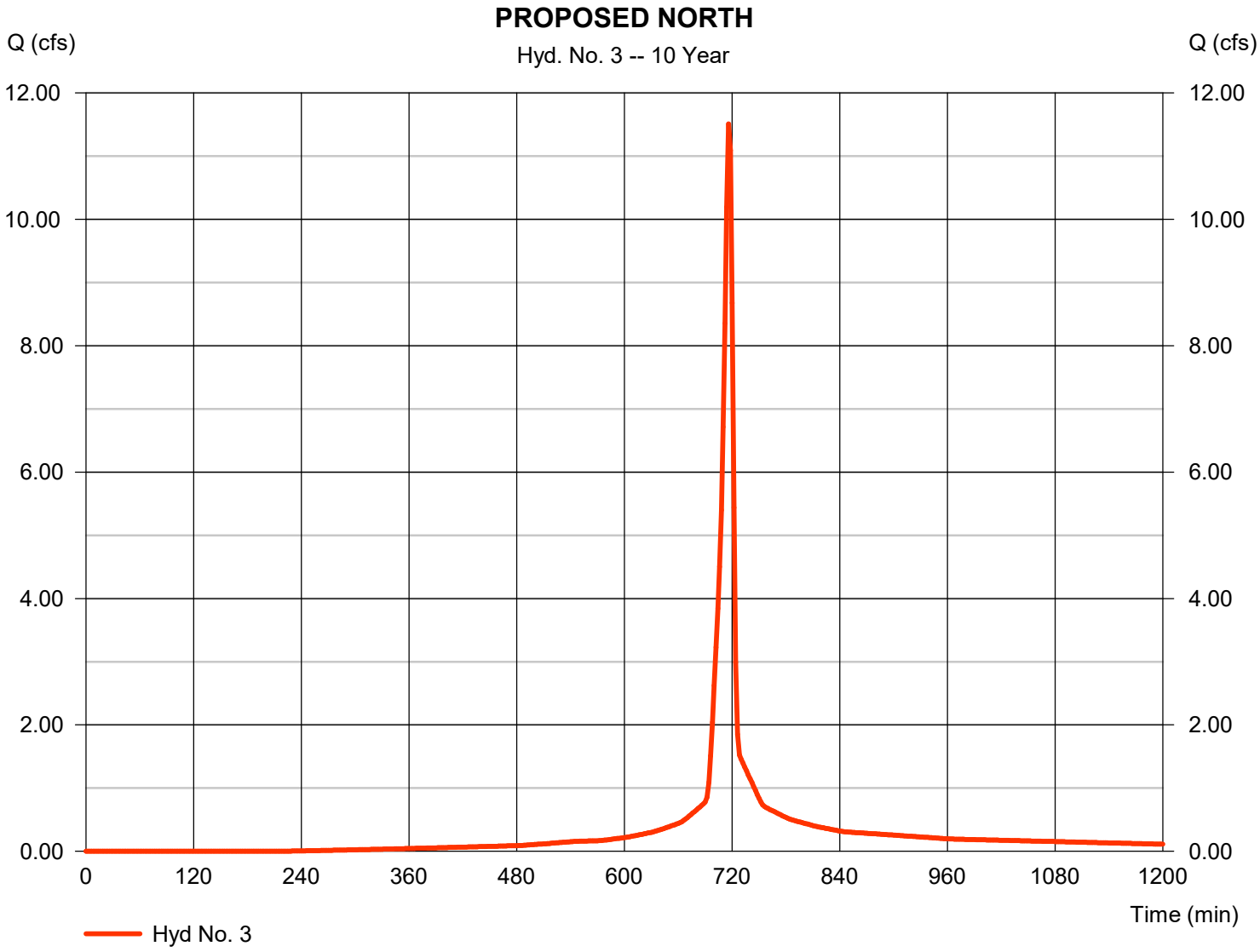
Hydrograph Report

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) = [(0.780 x 80) + (0.970 x 98)] / 1.750



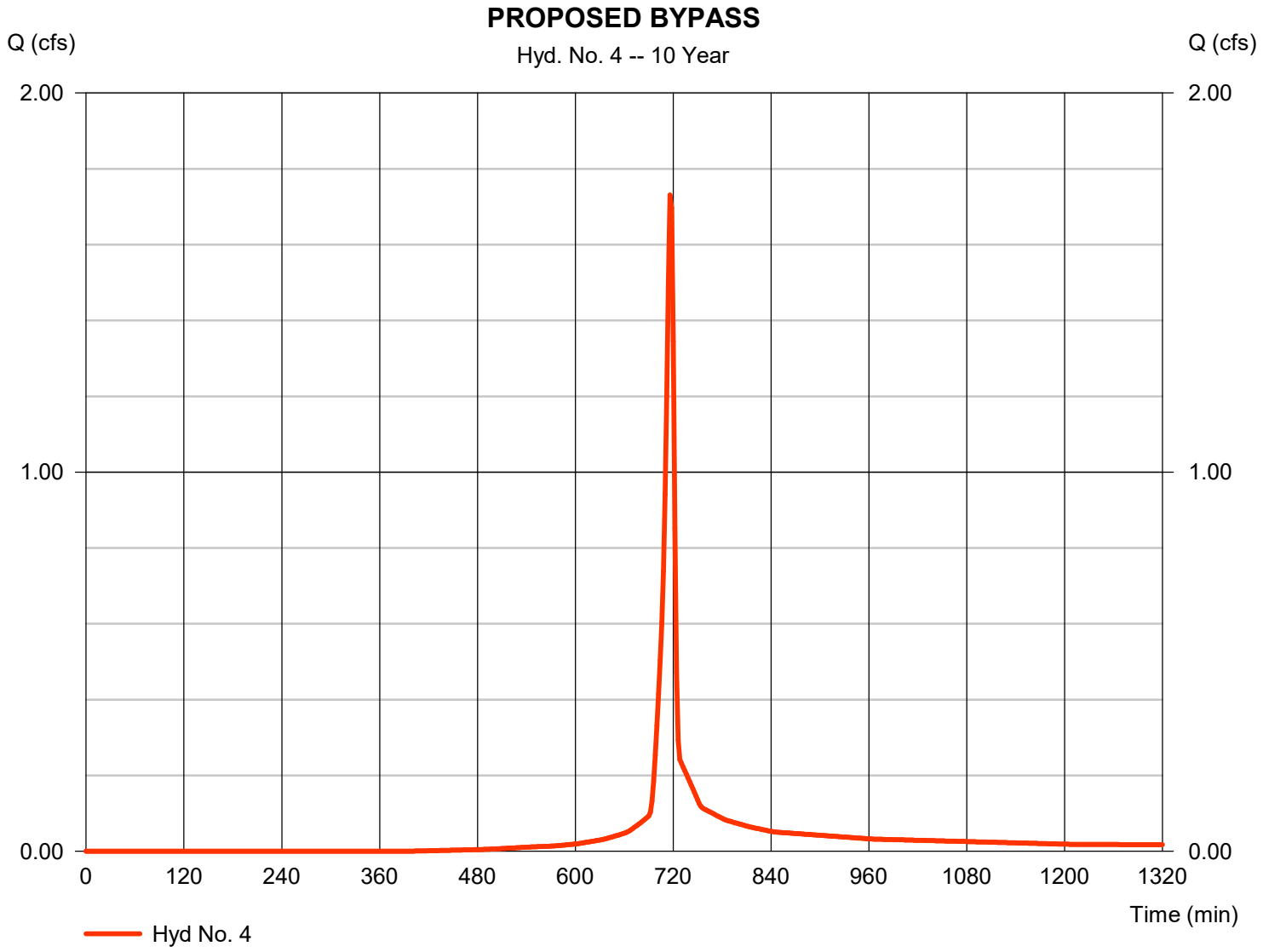
Hydrograph Report

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 x 80) + (0.020 x 98)] / 0.320

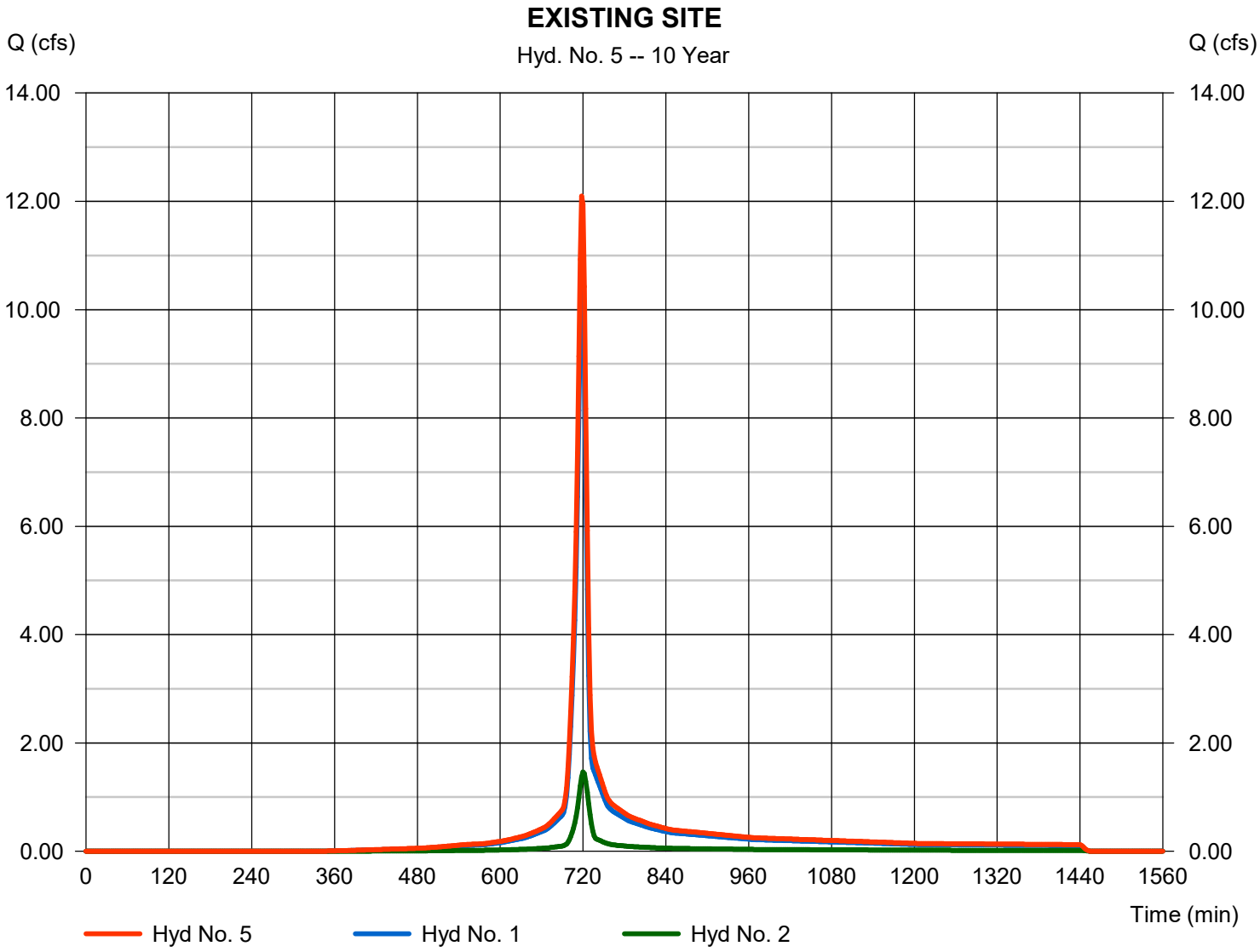


Hydrograph Report

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



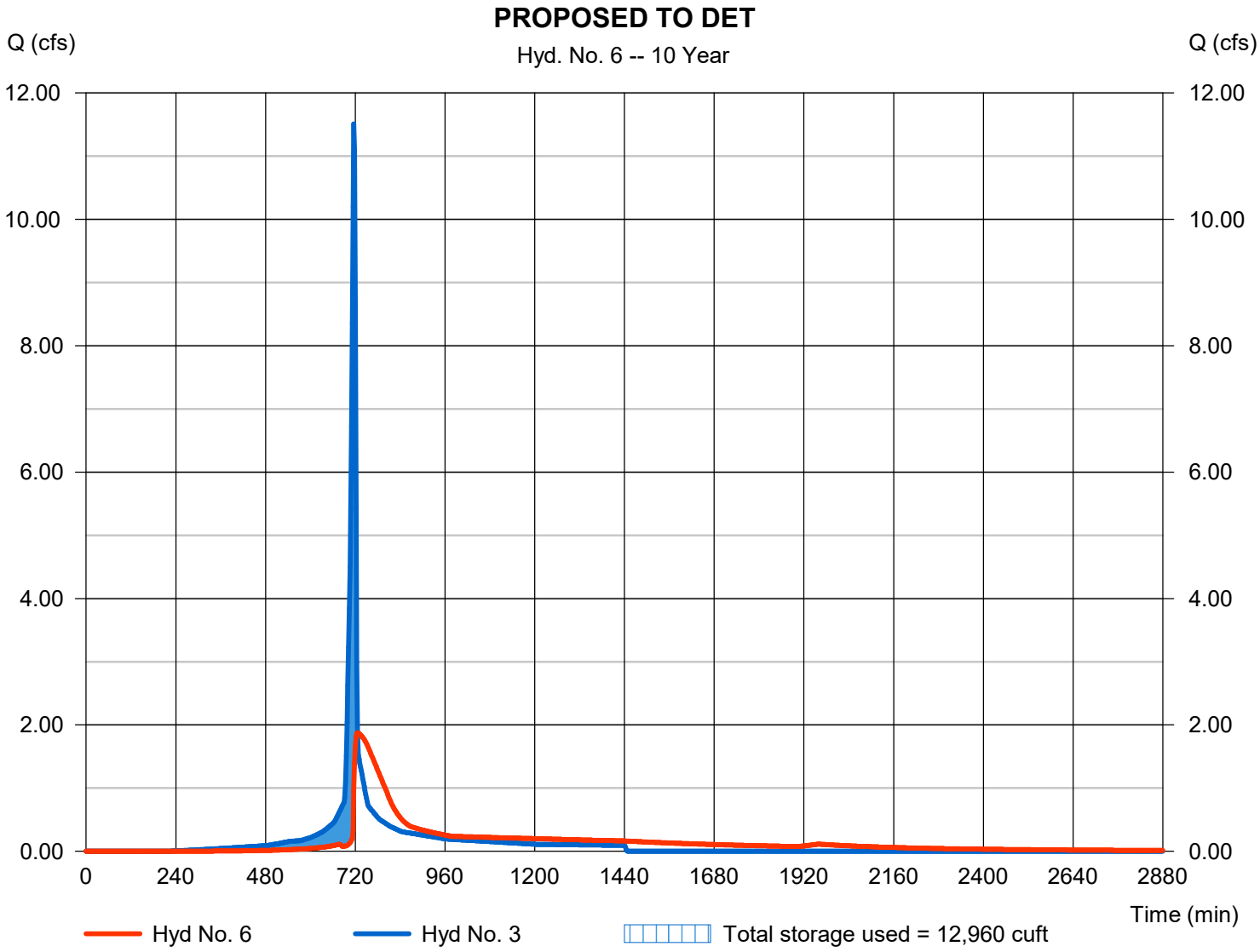
Hydrograph Report

Hyd. No. 6

PROPOSED TO DET

Hydrograph type	=	Reservoir	Peak discharge	=	1.876 cfs
Storm frequency	=	10 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	24,737 cuft
Inflow hyd. No.	=	3 - PROPOSED NORTH	Max. Elevation	=	965.13 ft
Reservoir name	=	Detention Pond	Max. Storage	=	12,960 cuft

Storage Indication method used.

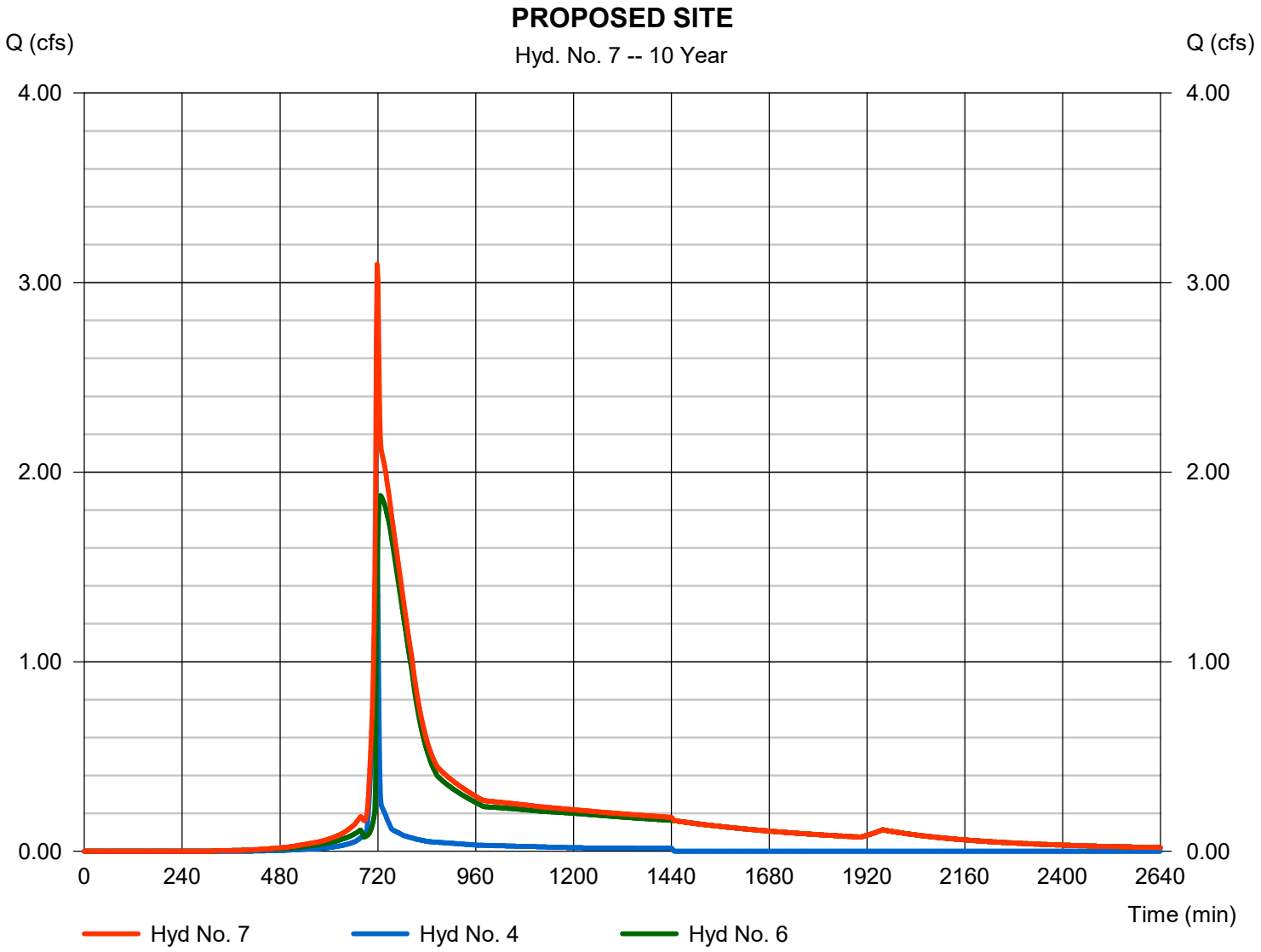


Hydrograph Report

Hyd. No. 7

PROPOSED SITE

Hydrograph type	=	Combine	Peak discharge	=	3.097 cfs
Storm frequency	=	10 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	28,279 cuft
Inflow hyds.	=	4, 6	Contrib. drain. area	=	0.320 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 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	3.414	2	726	38,699	3	966.27	19,858	PROPOSED TO DET
7	Combine	5.313	2	718	44,644	4, 6	------	------	PROPOSED SITE

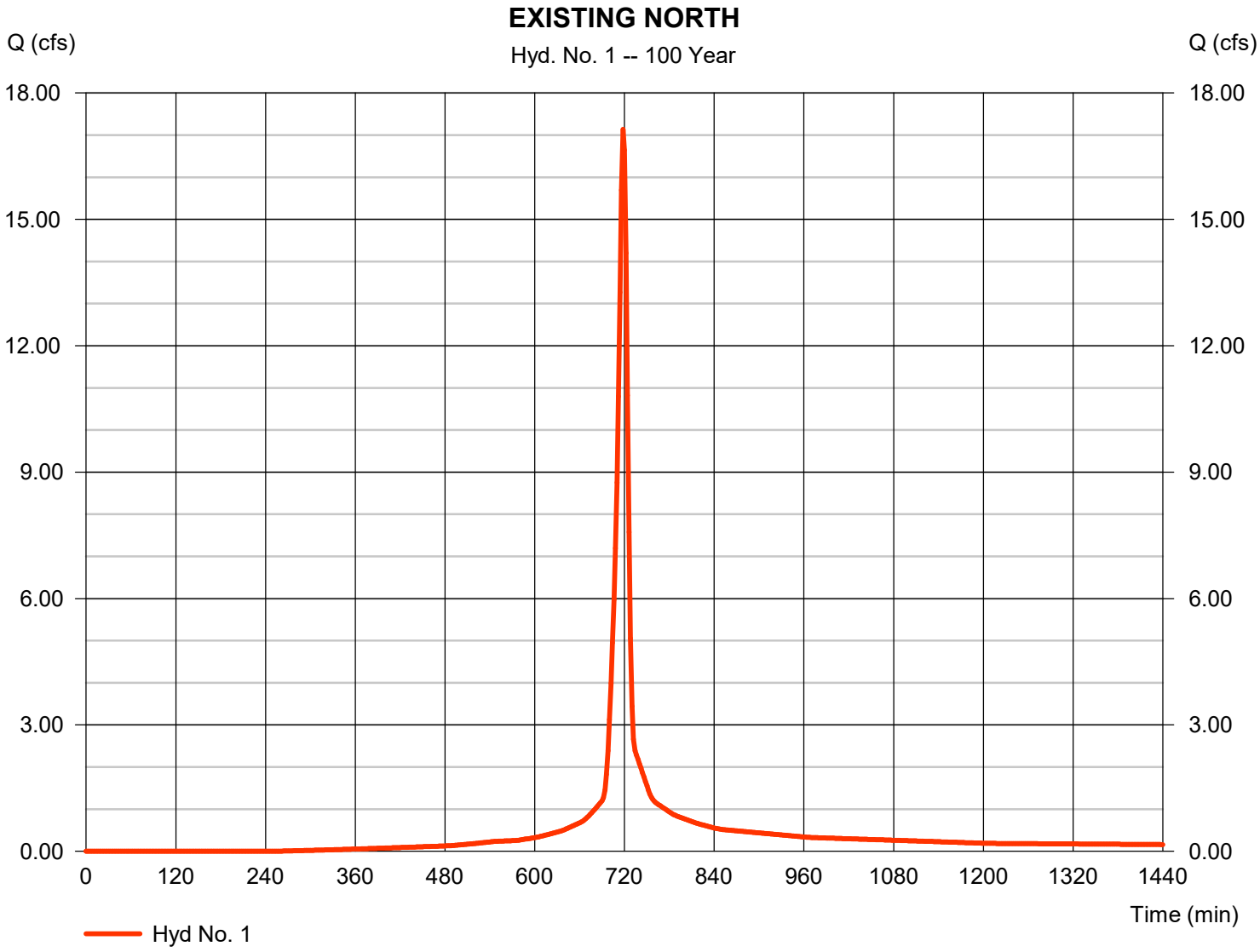
Hydrograph Report

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



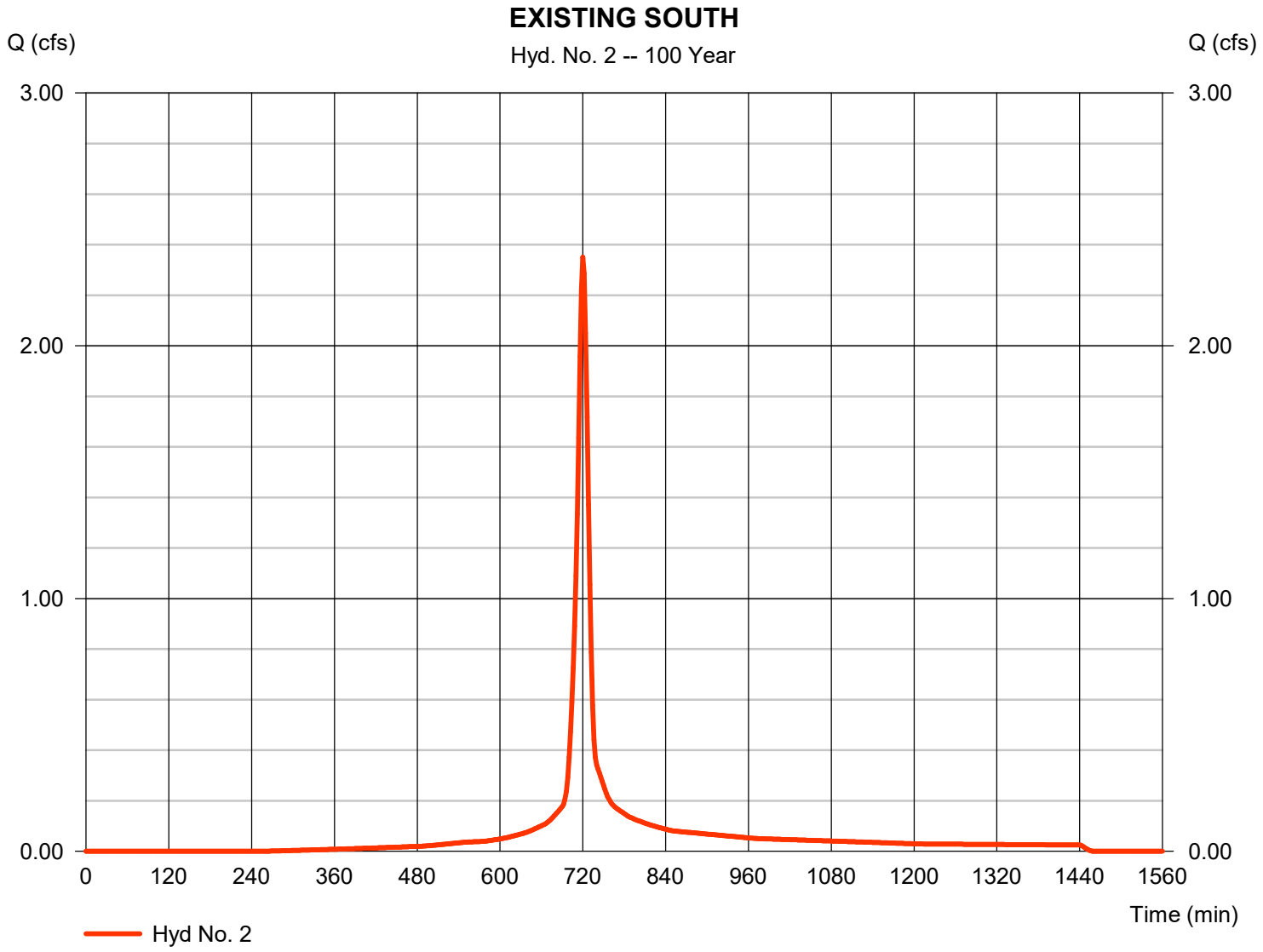
Hydrograph Report

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



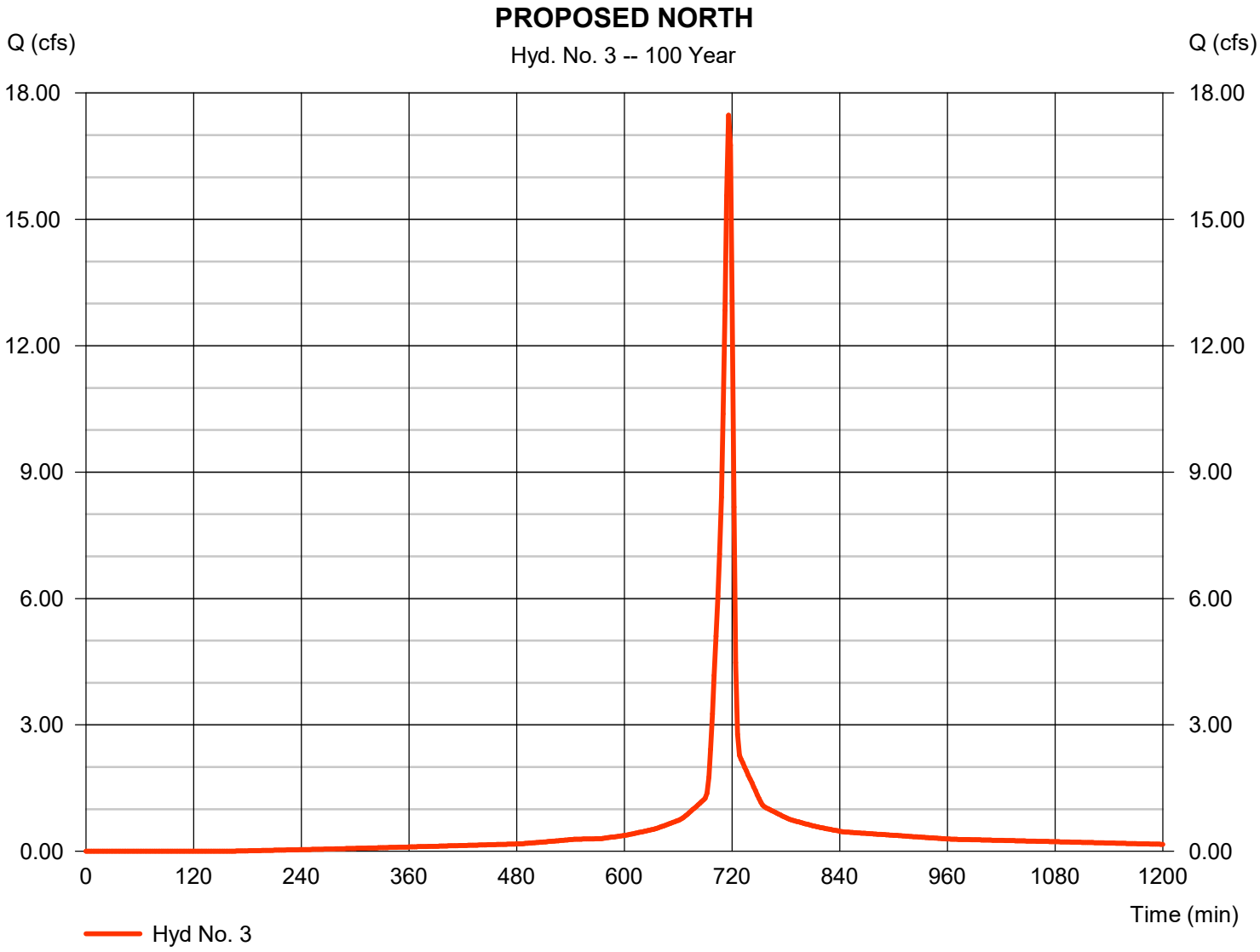
Hydrograph Report

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) = [(0.780 x 80) + (0.970 x 98)] / 1.750



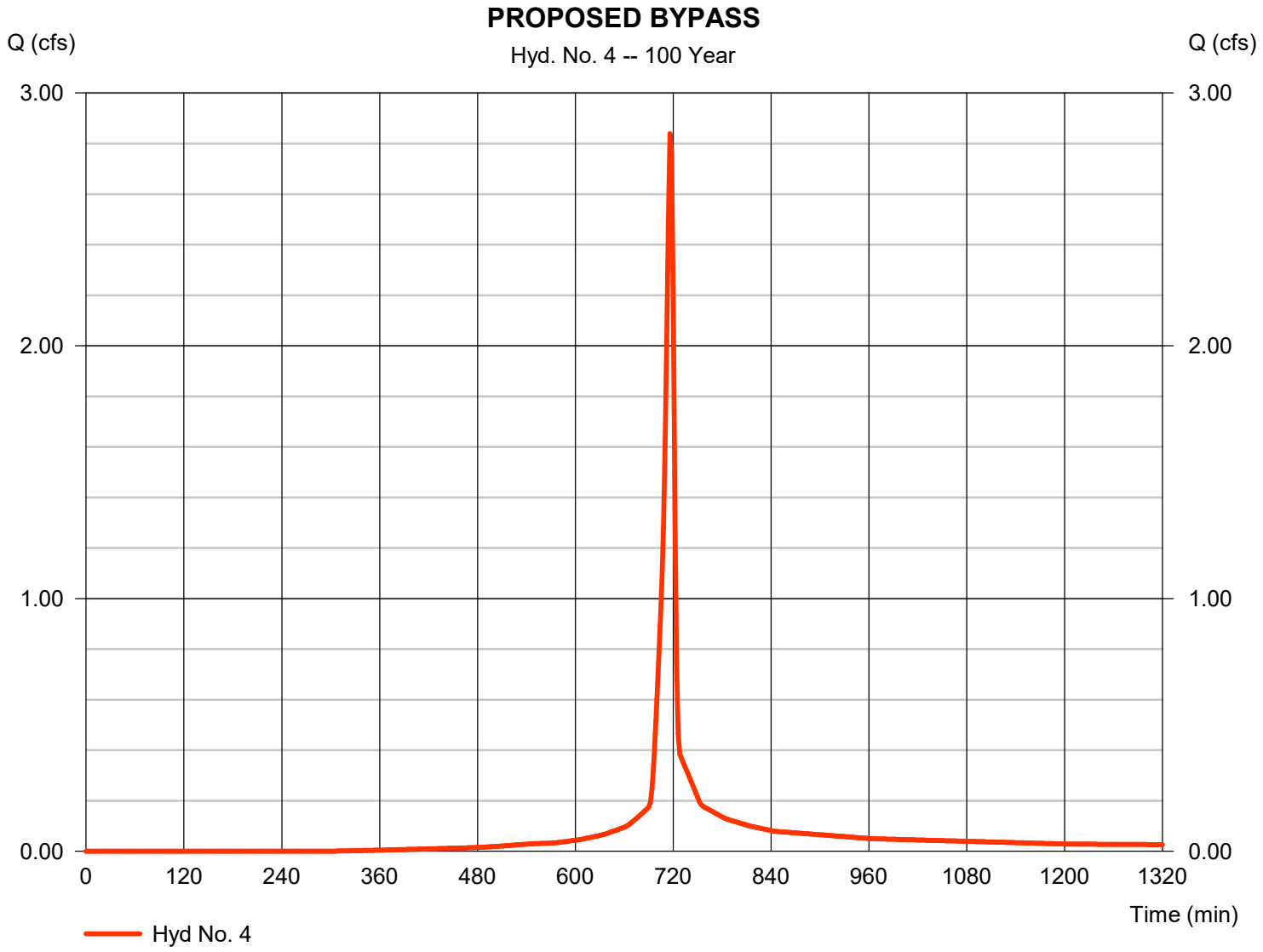
Hydrograph Report

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 x 80) + (0.020 x 98)] / 0.320

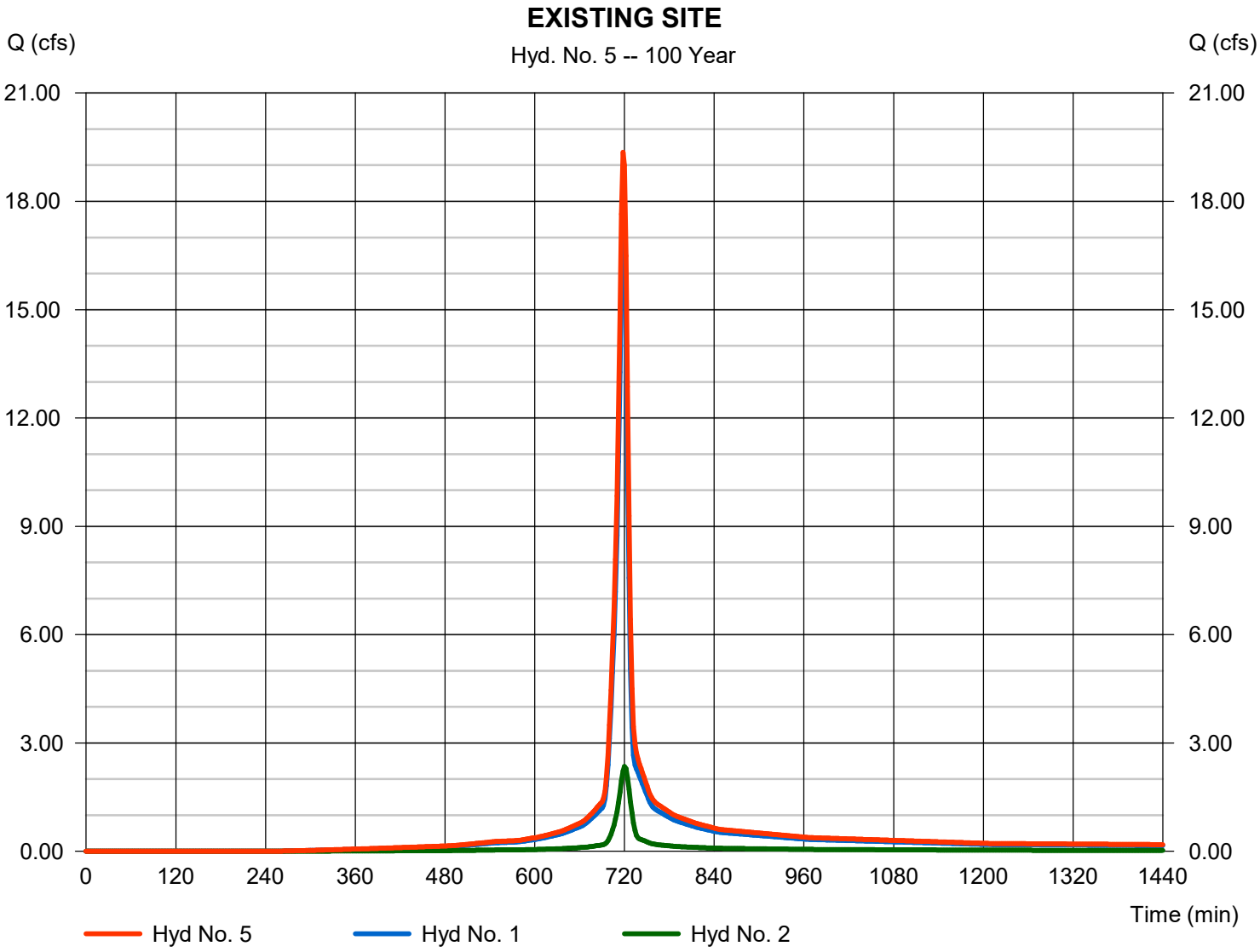


Hydrograph Report

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



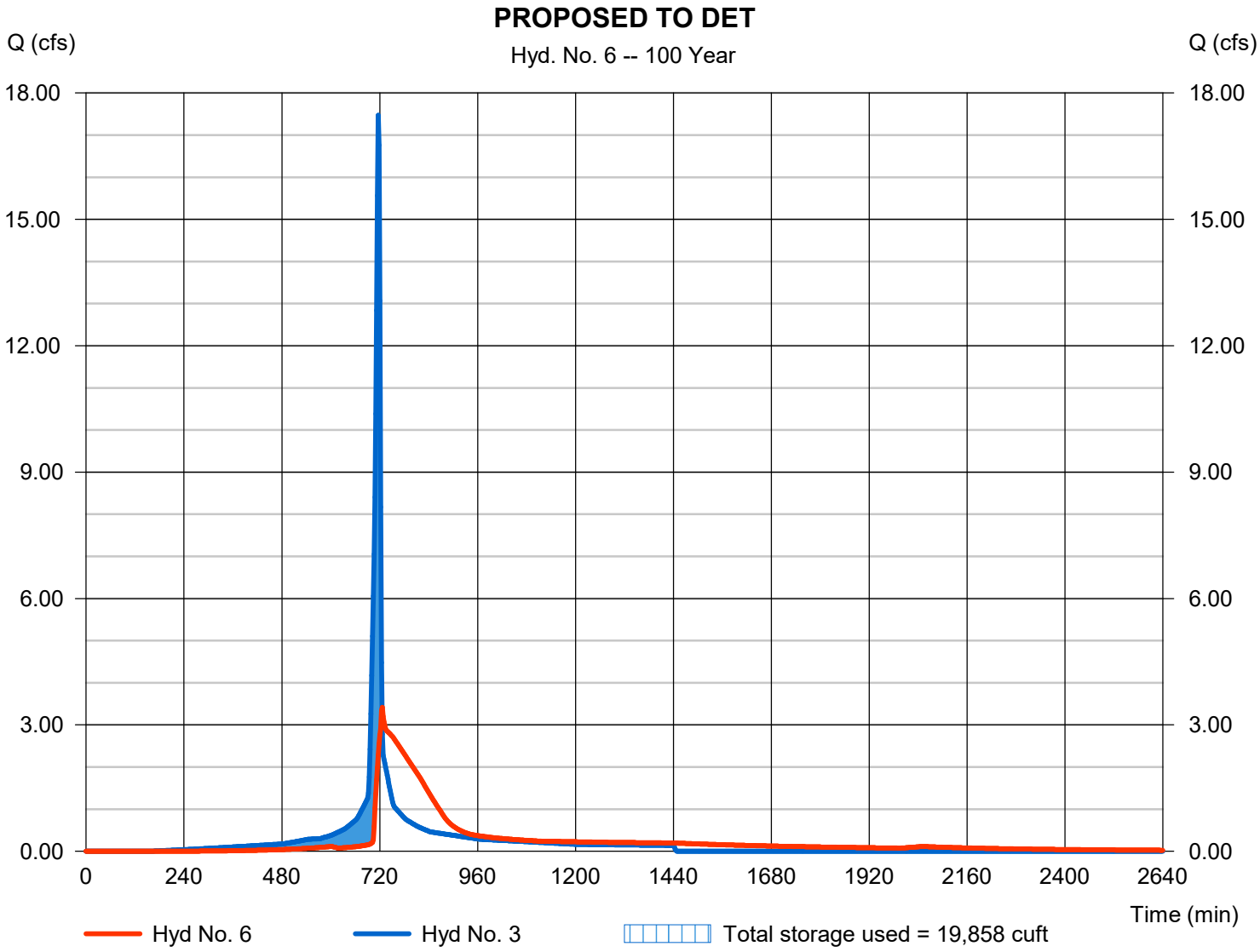
Hydrograph Report

Hyd. No. 6

PROPOSED TO DET

Hydrograph type	=	Reservoir	Peak discharge	=	3.414 cfs
Storm frequency	=	100 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	38,699 cuft
Inflow hyd. No.	=	3 - PROPOSED NORTH	Max. Elevation	=	966.27 ft
Reservoir name	=	Detention Pond	Max. Storage	=	19,858 cuft

Storage Indication method used.

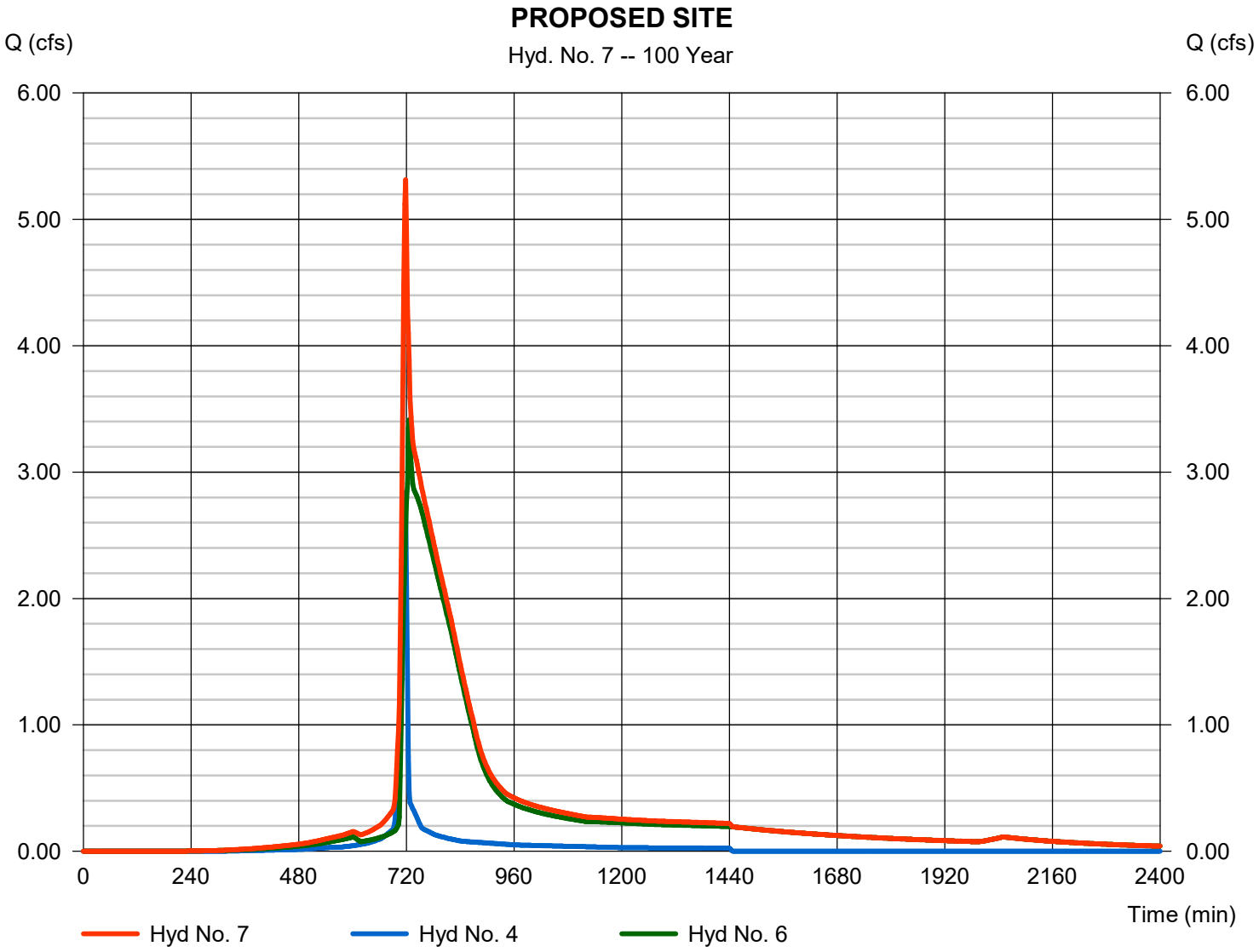


Hydrograph Report

Hyd. No. 7

PROPOSED SITE

Hydrograph type	= Combine	Peak discharge	= 5.313 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 44,644 cuft
Inflow hyds.	= 4, 6	Contrib. drain. area	= 0.320 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

Hydraflow Table of Contents

20180111_2021-02-25 ROUTING CALCULATIONS-RECORD.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020 Thursday, 02 / 25 / 2021

CLOGGED/ ZERO AVAILABLE STORAGE ROUTING
100-YEAR EVENT

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Mar 5 2021

Emergency Spillway-RECORD

User-defined

Invert Elev (ft)	= 966.66
Slope (%)	= 4.62
N-Value	= 0.150

Calculations

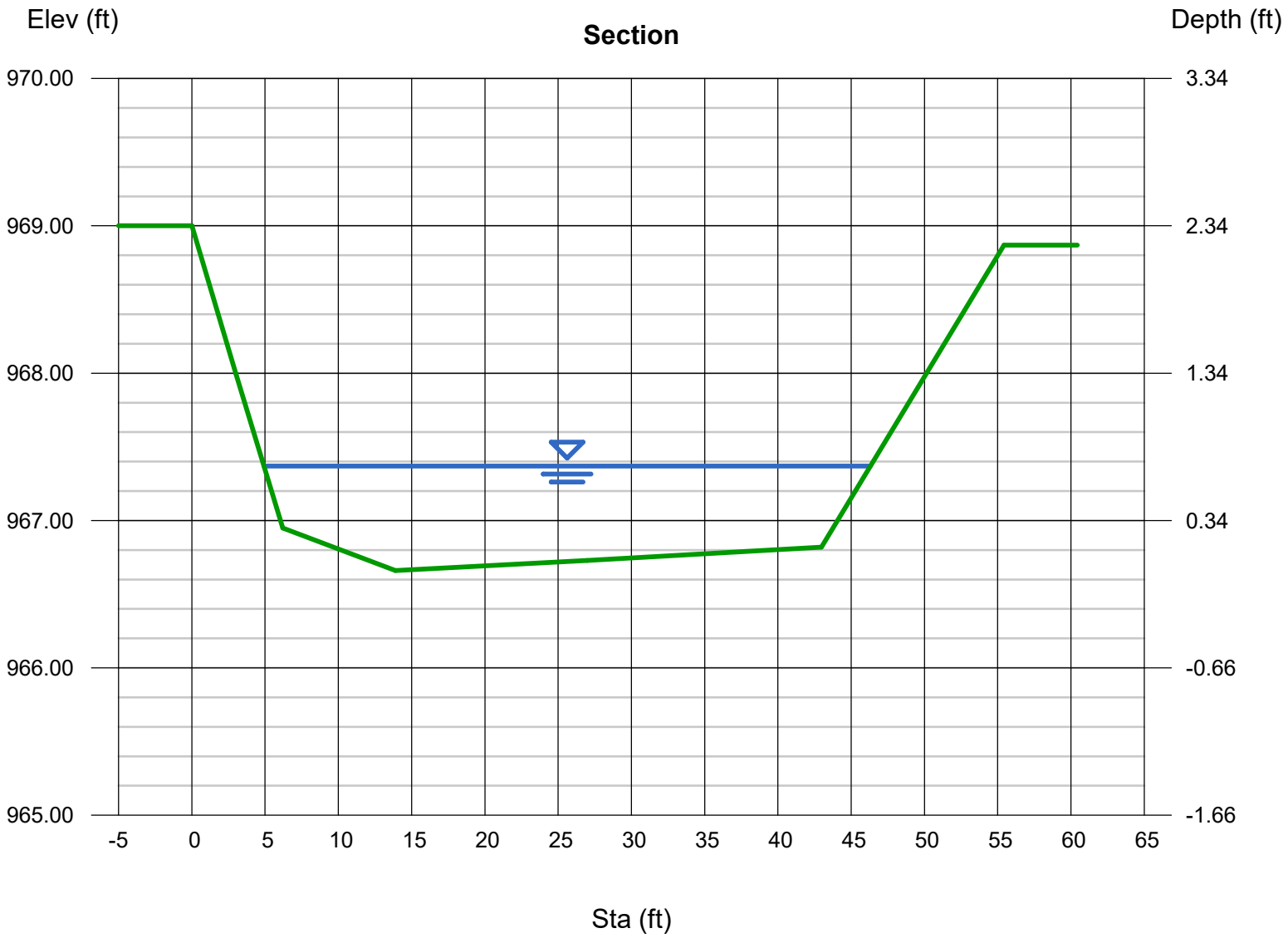
Compute by:	Known Q
Known Q (cfs)	= 34.51

Highlighted

Depth (ft)	= 0.71
Q (cfs)	= 34.51
Area (sqft)	= 23.88
Velocity (ft/s)	= 1.45
Wetted Perim (ft)	= 41.50
Crit Depth, Yc (ft)	= 0.40
Top Width (ft)	= 41.39
EGL (ft)	= 0.74

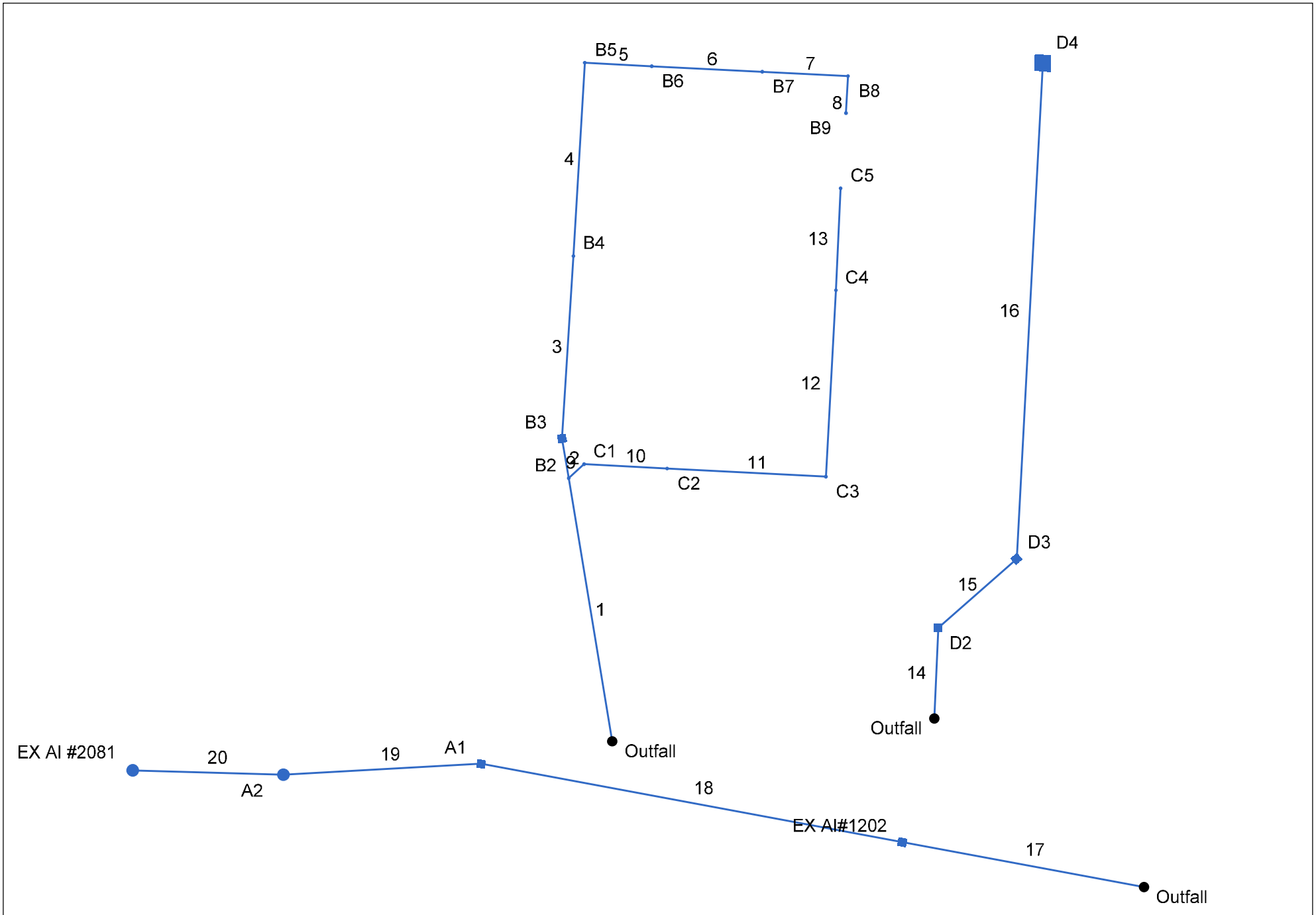
(Sta, El, n)-(Sta, El, n)...

(0.00, 969.00)-(3.00, 968.00, 0.150)-(6.20, 966.95, 0.150)-(13.90, 966.66, 0.150)-(26.99, 966.73, 0.150)-(42.96, 966.82, 0.150)-(55.43, 968.87, 0.150)



Attachment 3
Hydraflow Storm Sewers Calculations

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



Project File: 20180111_2020-11-24 Storm Sewers-RECORD.stm	Number of lines: 20	Date: 2/11/2021

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	99.986	963.84	970.33	6.491	964.66	970.98	n/a	970.98 j	End	Manhole
2	B3-B2	1.23	12	Cir	15.014	970.33	971.31	6.527	970.98	971.78	n/a	971.78 j	1	Grate
3	B4-B3	0.69	10	Cir	68.549	971.51	973.39	2.743	971.78	973.76	0.02	973.76	2	Manhole
4	B5-B4	0.36	10	Cir	72.548	973.39	974.11	0.992	973.76	974.37	n/a	974.37 j	3	Manhole
5	B6-B5	0.29	10	Cir	25.084	974.11	974.36	0.997	974.37	974.59	n/a	974.59 j	4	Manhole
6	B7-B6	0.09	10	Cir	41.250	974.36	974.77	0.994	974.59	974.90	n/a	974.90 j	5	Manhole
7	B8-B7	0.03	10	Cir	32.000	974.77	975.09	1.000	974.90	975.16	n/a	975.16 j	6	Manhole
8	B9-B8	0.03	10	Cir	13.875	975.09	975.23	1.009	975.16	975.30	n/a	975.30	7	Manhole
9	C1-B2	1.06	10	Cir	7.838	972.32	973.31	12.631	972.53	973.77	n/a	973.77	1	Manhole
10	C2-C1	0.99	10	Cir	31.160	973.31	973.62	0.995	973.77	974.06	n/a	974.06 j	9	Manhole
11	C3-C2	0.79	10	Cir	59.298	973.62	974.22	1.012	974.06	974.61	n/a	974.61 j	10	Manhole
12	C4-C3	0.53	10	Cir	70.000	974.22	974.92	1.000	974.61	975.24	n/a	975.24 j	11	Manhole
13	C5-C4	0.26	10	Cir	38.214	974.92	975.30	0.994	975.24	975.52	n/a	975.52 j	12	Manhole
14	D2-D1	4.67	12	Cir	34.000	963.15	968.34	15.265	964.10	969.24	n/a	969.24 j	End	Combination
15	D3-D2	3.54	12	Cir	39.000	968.44	970.60	5.538	969.24	971.40	n/a	971.40	14	Combination
16	D4-D3	2.55	12	Cir	186.000	971.00	973.50	1.344	971.57	974.18	n/a	974.18	15	Combination
17	EX AL#1202-OUTFALL	8.09	24	Cir	91.740	947.73	948.65	1.003	949.24	949.66	n/a	949.66 j	End	Grate
18	A1-EX AL#1202	5.25	24	Cir	160.000	949.17	957.82	5.406	949.66	958.63	0.15	958.63	17	Grate
19	A2-A1	2.16	15	Cir	74.000	958.12	962.79	6.311	958.63	963.38	n/a	963.38	18	Manhole
20	EX A3-A2	2.16	15	Cir	56.151	966.64	967.09	0.801	967.17	967.68	n/a	967.68	19	Grate

Project File: 20180111_2020-11-24 Storm Sewers-RECORD.stm | Number of lines: 20 | Run Date: 2/11/2021

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	99.986	0.00	0.39	0.00	0.00	0.33	0.0	5.0	7.0	2.29	9.07	3.79	12	6.49	963.84	970.33	964.66	970.98	965.10	978.70	B2-B1
2	1	15.014	0.13	0.23	0.60	0.08	0.18	5.0	5.0	7.0	1.23	9.10	2.85	12	6.53	970.33	971.31	970.98	971.78	978.70	976.41	B3-B2
3	2	68.549	0.05	0.10	0.95	0.05	0.10	5.0	5.0	7.0	0.69	3.63	3.77	10	2.74	971.51	973.39	971.78	973.76	976.41	977.10	B4-B3
4	3	72.548	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	25.084	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	41.250	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	32.000	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	13.875	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	7.838	0.01	0.16	0.95	0.01	0.15	5.0	5.0	7.0	1.06	7.78	6.72	10	12.63	972.32	973.31	972.53	973.77	978.70	978.70	C1-B2
10	9	31.160	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	59.298	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	70.000	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	38.214	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	34.000	0.17	0.93	0.95	0.16	0.67	5.0	5.0	7.0	4.67	13.91	6.18	12	15.26	963.15	968.34	964.10	969.24	965.60	976.19	D2-D1
15	14	39.000	0.15	0.76	0.95	0.14	0.51	5.0	5.0	7.0	3.54	8.38	5.26	12	5.54	968.44	970.60	969.24	971.40	976.19	976.15	D3-D2
16	15	186.000	0.61	0.61	0.60	0.37	0.37	5.0	5.0	7.0	2.55	4.13	5.00	12	1.34	971.00	973.50	971.57	974.18	976.15	977.00	D4-D3
17	End	91.740	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	8.09	22.65	4.13	24	1.00	947.73	948.65	949.24	949.66	950.00	959.97	EX AL#1202-OUT
18	17	160.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	5.25	52.59	6.59	24	5.41	949.17	957.82	949.66	958.63	959.97	966.22	A1-EX AL#1202
19	18	74.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.16	16.22	4.22	15	6.31	958.12	962.79	958.63	963.38	966.22	971.49	A2-A1
20	19	56.151	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.16	5.78	4.09	15	0.80	966.64	967.09	967.17	967.68	971.49	973.94	EX A3-A2

Project File: 20180111_2020-11-24 Storm Sewers-RECORD.stm

Number of lines: 20

Run Date: 2/11/2021

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	99.986	963.84	970.33	6.491	964.72	971.10	n/a	971.10 j	End	Manhole
2	B3-B2	1.72	12	Cir	15.014	970.33	971.31	6.527	971.10	971.87	n/a	971.87 j	1	Grate
3	B4-B3	0.96	10	Cir	68.549	971.51	973.39	2.743	971.87	973.82	0.03	973.82	2	Manhole
4	B5-B4	0.50	10	Cir	72.548	973.39	974.11	0.992	973.82	974.42	n/a	974.42 j	3	Manhole
5	B6-B5	0.41	10	Cir	25.084	974.11	974.36	0.997	974.42	974.64	n/a	974.64 j	4	Manhole
6	B7-B6	0.13	10	Cir	41.250	974.36	974.77	0.994	974.64	974.92	n/a	974.92 j	5	Manhole
7	B8-B7	0.04	10	Cir	32.000	974.77	975.09	1.000	974.92	975.17	n/a	975.17 j	6	Manhole
8	B9-B8	0.04	10	Cir	13.875	975.09	975.23	1.009	975.17	975.31	0.03	975.31	7	Manhole
9	C1-B2	1.48	10	Cir	7.838	972.32	973.31	12.631	972.57	973.85	n/a	973.85	1	Manhole
10	C2-C1	1.38	10	Cir	31.160	973.31	973.62	0.995	973.85	974.15	n/a	974.15 j	9	Manhole
11	C3-C2	1.11	10	Cir	59.298	973.62	974.22	1.012	974.15	974.69	n/a	974.69 j	10	Manhole
12	C4-C3	0.74	10	Cir	70.000	974.22	974.92	1.000	974.69	975.30	n/a	975.30 j	11	Manhole
13	C5-C4	0.37	10	Cir	38.214	974.92	975.30	0.994	975.30	975.56	n/a	975.56 j	12	Manhole
14	D2-D1	6.51	12	Cir	34.000	963.15	968.34	15.265	964.13	969.31	n/a	969.31 j	End	Combination
15	D3-D2	4.94	12	Cir	39.000	968.44	970.60	5.538	969.31	971.51	0.76	971.51	14	Combination
16	D4-D3	3.56	12	Cir	186.000	971.00	973.50	1.344	971.72	974.30	n/a	974.30	15	Combination
17	EX AL#1202-OUTFALL	11.53	24	Cir	91.740	947.73	948.65	1.003	949.34	949.87	n/a	949.87 j	End	Grate
18	A1-EX AL#1202	8.69	24	Cir	160.000	949.17	957.82	5.406	949.87	958.87	0.21	958.87	17	Grate
19	A2-A1	3.38	15	Cir	74.000	958.12	962.79	6.311	958.87	963.53	n/a	963.53 j	18	Manhole
20	EX A3-A2	3.38	15	Cir	56.151	966.64	967.09	0.801	967.33	967.83	n/a	967.83	19	Grate

Project File: 20180111_2020-11-24 Storm Sewers-RECORD.stm | Number of lines: 20 | Run Date: 2/11/2021

NOTES: Return period = 100 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	99.986	0.00	0.39	0.00	0.00	0.33	0.0	5.0	9.7	3.20	9.07	4.66	12	6.49	963.84	970.33	964.72	971.10	965.10	978.70	B2-B1
2	1	15.014	0.13	0.23	0.60	0.08	0.18	5.0	5.0	9.7	1.72	9.10	3.24	12	6.53	970.33	971.31	971.10	971.87	978.70	976.41	B3-B2
3	2	68.549	0.05	0.10	0.95	0.05	0.10	5.0	5.0	9.7	0.96	3.63	3.82	10	2.74	971.51	973.39	971.87	973.82	976.41	977.10	B4-B3
4	3	72.548	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	25.084	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	41.250	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	32.000	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	13.875	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	7.838	0.01	0.16	0.95	0.01	0.15	5.0	5.0	9.7	1.48	7.78	7.45	10	12.63	972.32	973.31	972.57	973.85	978.70	978.70	C1-B2
10	9	31.160	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	59.298	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	70.000	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	38.214	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	34.000	0.17	0.93	0.95	0.16	0.67	5.0	5.0	9.7	6.51	13.91	8.35	12	15.26	963.15	968.34	964.13	969.31	965.60	976.19	D2-D1
15	14	39.000	0.15	0.76	0.95	0.14	0.51	5.0	5.0	9.7	4.94	8.38	6.70	12	5.54	968.44	970.60	969.31	971.51	976.19	976.15	D3-D2
16	15	186.000	0.61	0.61	0.60	0.37	0.37	5.0	5.0	9.7	3.56	4.13	5.58	12	1.34	971.00	973.50	971.72	974.30	976.15	977.00	D4-D3
17	End	91.740	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	11.53	22.65	5.01	24	1.00	947.73	948.65	949.34	949.87	950.00	959.97	EX AL#1202-OUT
18	17	160.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	8.69	52.59	7.05	24	5.41	949.17	957.82	949.87	958.87	959.97	966.22	A1-EX AL#1202
19	18	74.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.38	16.22	4.43	15	6.31	958.12	962.79	958.87	963.53	966.22	971.49	A2-A1
20	19	56.151	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	3.38	5.78	4.68	15	0.80	966.64	967.09	967.33	967.83	971.49	973.94	EX A3-A2

Project File: 20180111_2020-11-24 Storm Sewers-RECORD.stm

Number of lines: 20

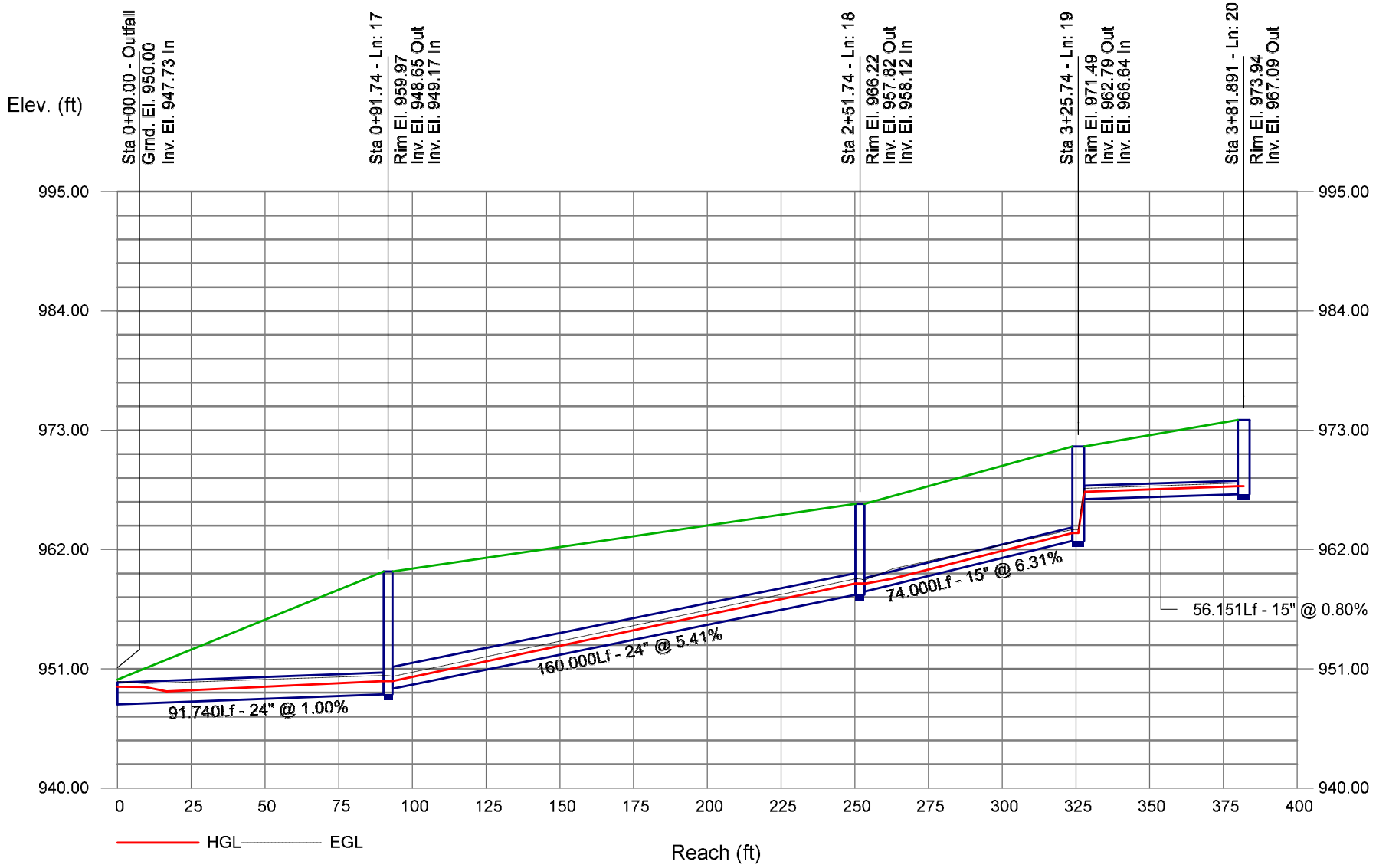
Run Date: 2/11/2021

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

Storm Sewer Profile

Proj. file: 20180111_2020-11-24 Storm Sewers-RECORD.stm

100-YR Hydraulic Profile
Existing Pond to Existing Outlet Through Proposed Pond - RECORD



Attachment 4
Water Quality Calculations

DCI Lee's Summit
CDG #20180111

Date: 3/5/2021 AS-BUILT CALCULATIONS

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	311	80
963	3,691	3,082
964	4,554	7,204
964.17	4,698	8,050
965	5,400	12,181
966	6,307	18,035
966.2	6,499	18,714

*WQv elevation

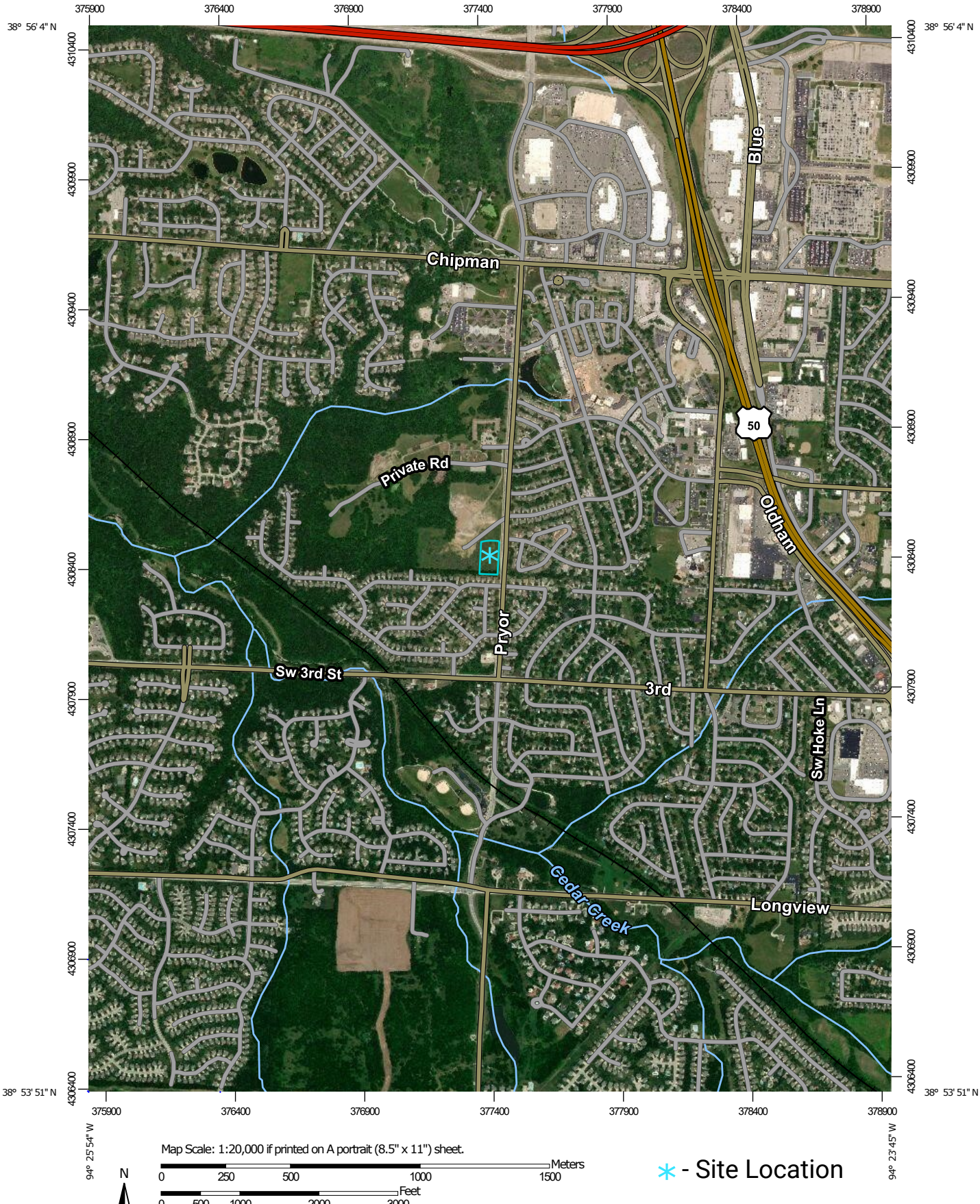
Extended Dry Detention Pond	Return Event (years)	Max Water Surface Elevation (ft)	Freeboard (ft)
	2	964.29	4.41
	10	965.13	3.57
	100	966.27	2.43

Perforated Riser

WQv Treatment Depth Above Lowest Orifice, Zwq	3 ft
Water Quality Volume	8,050 cf
Water Quality Volume	0.185 ac-ft
Recommended Max Outlet Area per Row, Ao $A_o = \frac{WQ_v}{(0.013(Z_{wq})^2 + 0.22(Z_{wq}) - 0.10)}$	1.49 sq. in
Number of columns, nc	1 column
Design circular perforation diameter, Dperf	1 in
Number of rows (4" vertical spacing), nr	5 rows
Perforation 1 Elevation	961.9
Perforation 2 Elevation	962.2
Perforation 3 Elevation	962.5
Perforation 4 Elevation	962.87
Perforation 5 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

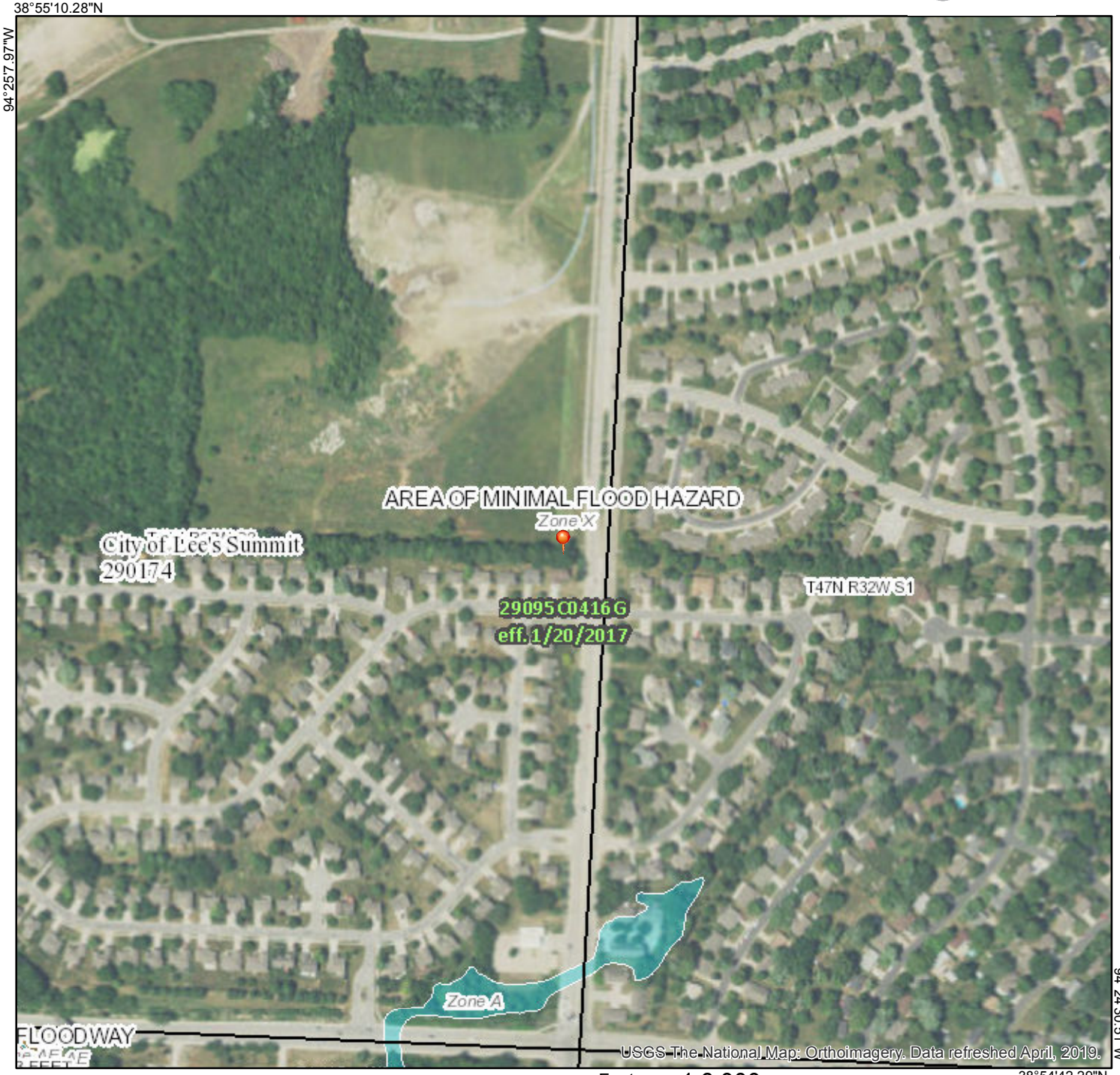
Aggregation Method: Dominant Condition

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

N

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

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

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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