FINAL STORMWATER MANAGEMENT REPORT

WHATABURGER
NE Quadrant of M 150 Hwy and SW Hollywood Drive
Lee's Summit, MO 64082

PREPARED FOR

PREPARED BY

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Appendices

General Information

Whataburger is proposing to construct a new restaurant in Lee's Summit, Missouri.

The subject parcel is located in the City of Lee's Summit, Jackson County, Missouri, in the northeast quadrant of the M 150 Hwy & SW Hollywood Drive intersection. The subject parcel is 1.45 acres and is an undeveloped lot. The site drains to the south and to the east. Adjacent land use in the project area is commercial. Proposed work includes the construction of the new Whataburger Restaurant, the associated parking lot, utility service lines and mainline connections, and a stormwater conveyance system, and storm water underground detention basin. A Project Location Map is provided in ***Appendix A.***

The project is located in the FEMA Flood Zone X (Area with Minimal Flood Hazard). The FIRMette condensed map of the FEMA floodplain map (FIRM 29095C05326, Eff. January 20, 2017) is included in ***Appendix A***.

The Soil Survey for Jackson County, Missouri, developed by the United States Department of Agriculture Soil Conservation Service, was referenced to determine the predominant soil types at the project site. One soil type was identified within the project limits and has been listed in the table below. The Custom Soil Resource Report for Jackson County, Missouri, which includes a soils map, can be found in ***Appendix D***.

Soil Types for the Project Site

Symbol	Description	Slope	Hydrologic Soil Group	Hydric Rating
10082	Arisburg-Urban land complex	1 to 5%	C	No

Methodology

Hydrologic calculations were performed using SCS methodology (TR-55), in accordance with the City of Lee's Summit requirements and APWA Sections 5602 and 5608, and implemented through Hydroflow Hydrograph's computation software. A theoretical Point of Interest, or Point of Analysis, was used as the basis for determining the release rate off-site from all proposed work within the project limits. Per the requirements, the site was analyzed for the 2 year, 10 year and 100 year storm events.

Analysis of the storm conveyance system, which ultimately discharges into the City of Lee's Summit municipal storm sewer system, was also performed. Hydraulic calculations were performed utilizing the Rational methodology for the 10-year storm event, and implemented through the Hydraflow Storm Sewer computation software.

Existing Conditions Analysis

The existing site is currently a combination of brush, trees and grass. It drains to both the south (towards Highway 150) and to the east (toward Arby's). The existing conditions analysis can be found in ***Appendix C***. The existing conditions map with the time of concentration can be found in ***Appendix B***. The pre-development time of concentration was determined to be 23.23 minutes based on the current site conditions. There is one point of interest (POI) for the project which is located in the northeast corner of the site – the existing inlet since the proposed site drainage will be connect to it.

The land cover curve numbers used for the existing conditions TR-55 runoff analysis are as follows:

Cover Type	Hydrologic Soil Type	Curve Number	Area
Open Space (Good)	C	74	1.44 ac
Impervious	C	98	0.01 ac

Storm Event	Existing Runoff (cfs)	Allowable Release Rate
2 Year	1.86	0.5 x site area = 0.5 x 1.45ac = 0.73 cfs
10 Year	4.02	2.0 x site area = 2.0 x 1.45ac = 2.90 cfs
100 Year	8.41	3.0 x site area = 3.0 x 1.45ac = 4.35 cfs

Proposed Conditions Analysis

The proposed site is currently a combination of impervious and grass. The post-developed undetained area drains to both the south (towards Highway 150) and to the east (toward Arby's). The post-developed detained area drains to the northeast to the existing inlet on SW Summitcrest Drive. The proposed conditions analysis can be found in ***Appendix C***. The proposed conditions map with the time of concentrations can be found in ***Appendix B.*** The post-development time of concentration was determined to be 14.4 minutes for the undetained area and 8.10 minutes for the detained area based on the proposed site conditions. There is one point of interest (POI) for the project which is located in the northeast corner of the site – the existing inlet since the proposed site drainage will be connect to it.

The land cover curve numbers used for the proposed undetained conditions TR-55 runoff analysis are as follows:

Cover Type	Hydrologic Soil Type	Curve Number	Area
Open Space (Good)	C	74	0.31 ac
Impervious	C	98	0.01 ac

The land cover curve numbers used for the proposed detained conditions TR-55 runoff analysis are as follows:

Cover Type	Hydrologic Soil Type	Curve Number	Area
Open Space (Good)	C	74	0.24 ac
Impervious	C	98	0.89 ac

The detained area will drain to an underground detention basin to be located on the east side of the site under the parking lot. The underground detention basin will then discharge connect into the inlet along SW Summitcrest Drive.

Storm Event	Allowable Runoff (cfs)	Total Postdeveloped Runoff (cfs)
2 Year	0.73	0.61
10 Year	2.90	1.24
100 Year	4.35	4.25

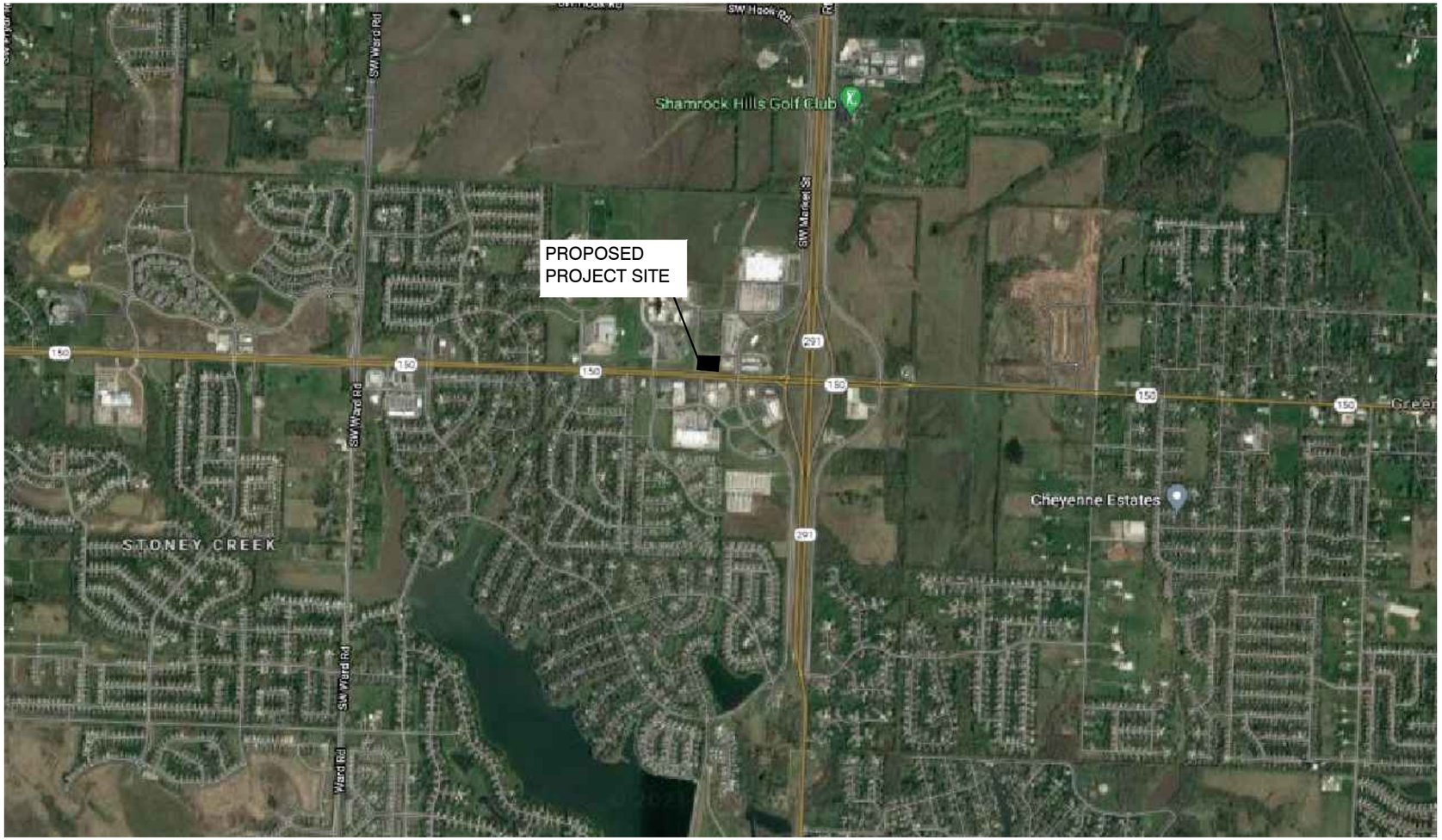
The site was analyzed for water quality. The 1.37"/24-hour storm was calculated for the site and the underground basin will release this storm to meet the 40-hour extended detention requirement. Additionally, the underground detention system will have an isolation row which will be sized to handle the "first flush" of storm runoff. The calculation is in the Hydroflow Hydrograph routing as the 1-year storm event in ***Appendix C***.

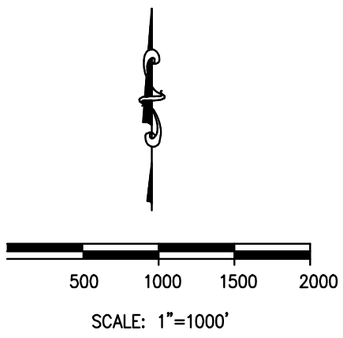
Conclusions and Recommendations

Whataburger is proposing to construct a new restaurant in Lee's Summit, Missouri. The existing site is currently a combination of brush, trees and grass. The proposed site will be a combination of grass and paving. Stormwater management will consist of an underground detention system designed to reduce the runoff to the required rates. As indicated above and shown by the attached calculations, the project is in compliance with the City of Lee's Summit / Kansas City Metropolitan Chapter of APWA Design Criteria stormwater requirements.

APPENDIX A

Project Location Map and FEMA Map





NOT FOR CONSTRUCTION

DRAWN BY	TDB
CHECKED BY APPROVED BY	PJK
ISSUE DATE	09/13/21

REVISION

#	DATE	DESCRIPTION

WHATABURGER

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PROJECT
WHATABURGER

NEQ HWY 150 & SW
HOLLYWOOD DR.
LEE'S SUMMIT, MO 64082
JACKSON COUNTY

PROJECT NO.: 40497-21

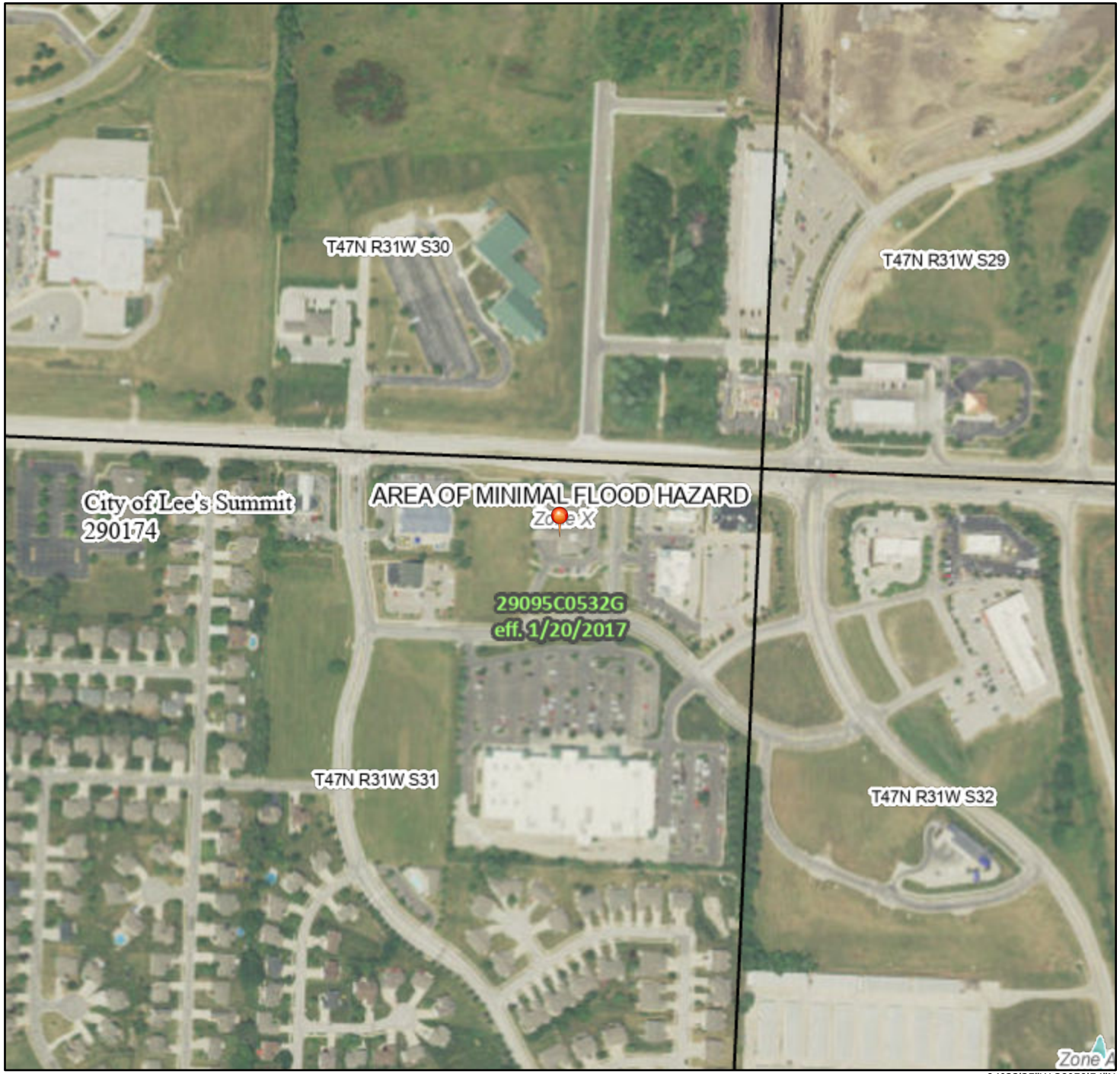
SHEET TITLE
PROJECT LOCATION
MAP

SHEET

National Flood Hazard Layer FIRMette

FEMA

94°23'13"W 38°51'22"N



94°22'35"W 38°50'54"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- 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.

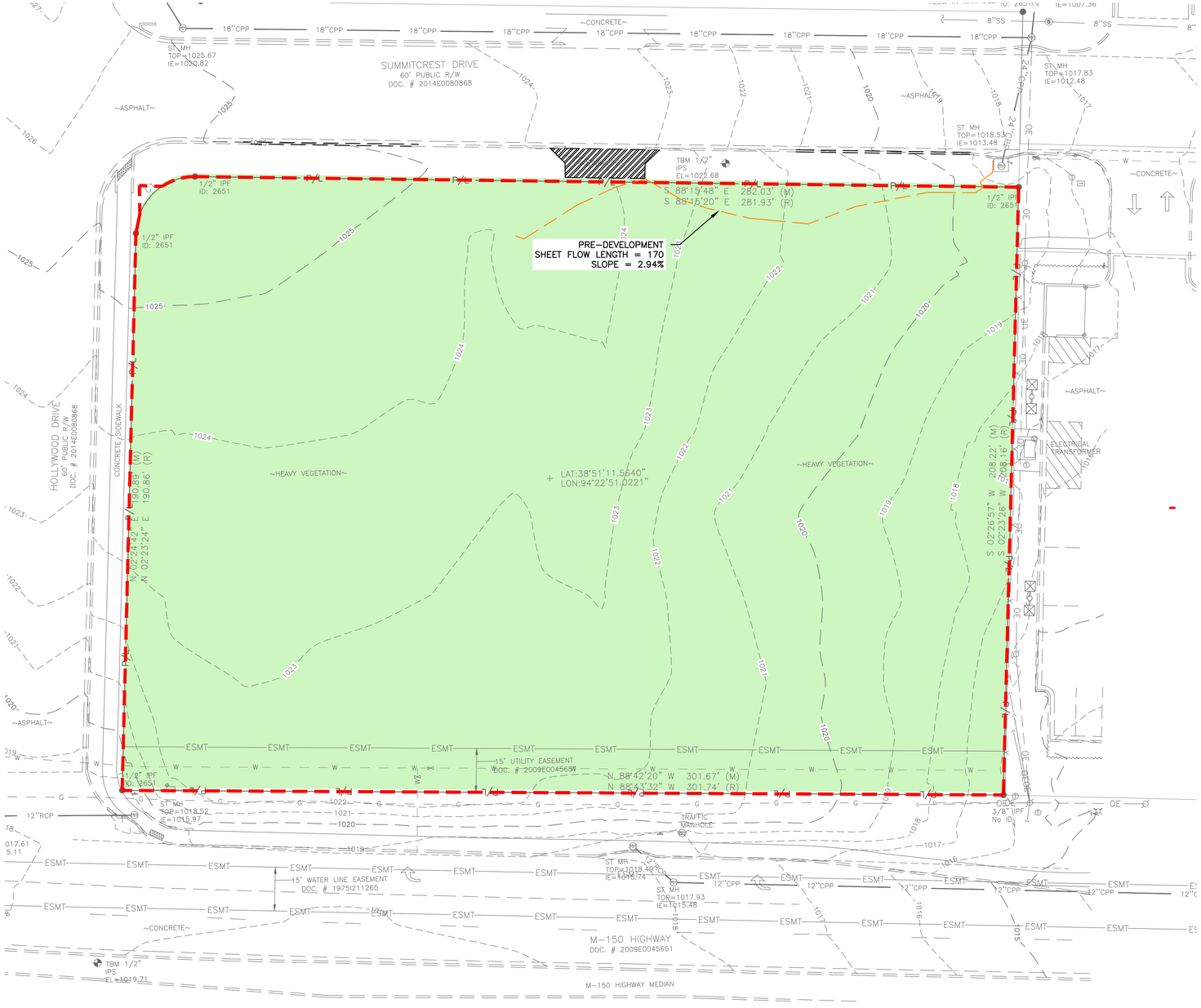
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/27/2021 at 1:40 PM 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.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX B

Predeveloped and Postdeveloped Drainage Area Maps



LEGEND

FEATURE	DESCRIPTION
	DRAINAGE AREA
	PRE-TIME OF CONCENTRATION
	OPEN SPACE/GRASS

ANALYSIS AREA BREAKDOWN

PRE-CONSTRUCTION CONDITIONS

COVER	ACRES
OPEN SPACE	1.44
IMPERVIOUS AREA	0.01
TOTAL	1.45

SCALE: 1"=20'

REVISION/DATE/DESCRIPTION	
SIR UPDATES	09/13/21
60% SET	01/24/22
PDP APPLICATION TO CITY	02/24/22
RESPONSE TO CITY COMMENTS I	03/29/22

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PROJECT

PROPOSED PT20M BUILDING

NEQ HWY 150 & SW HOLLYWOOD DR.
LEE'S SUMMIT, MO 64082

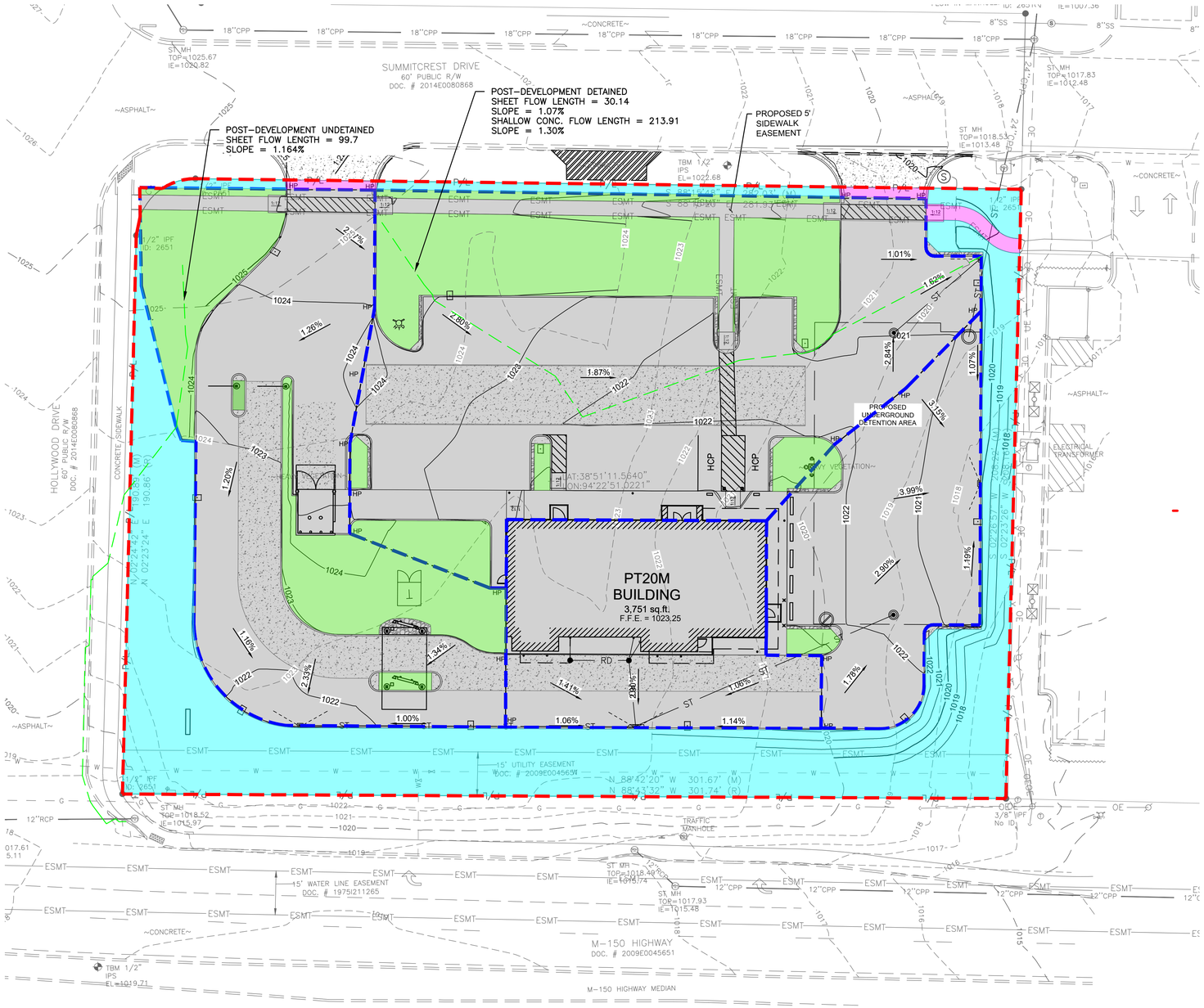
SHEET TITLE

PRE DRAINAGE MAP

DRAWN BY:	TDB
CHECKED BY:	PJK
PROJECT NO:	40497-21

DRAWING

C-5.0



LEGEND

FEATURE	DESCRIPTION
	UNDETAINED DRAINAGE AREA
	DETAINED DRAINAGE AREA
	POST TIME OF CONCENTRATION
	DETAINED OPEN SPACE/GRASS
	DETAINED IMPERVIOUS/GRAVEL AREA
	UNDETAINED OPEN SPACE/GRASS
	UNDETAINED IMPERVIOUS AREA/GRAVEL AREA

ANALYSIS AREA BREAKDOWN

POST-CONSTRUCTION CONDITIONS

	COVER	ACRES
DETAINED	OPEN SPACE	0.24
	IMPERVIOUS AREA	0.89
UNDETAINED	OPEN SPACE	0.31
	IMPERVIOUS AREA	0.01
	TOTAL	1.45

REVISION/DATE/DESCRIPTION

SIR UPDATES	09/13/21
60% SET	01/24/22
PDP APPLICATION TO CITY	02/24/22
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NOTICE

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PROJECT

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NEQ HWY 150 & SW HOLLYWOOD DR.
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SHEET TITLE

POST DRAINAGE MAP

DRAWN BY:	TDB
CHECKED BY:	PJK
PROJECT NO:	40497-21

DRAWING

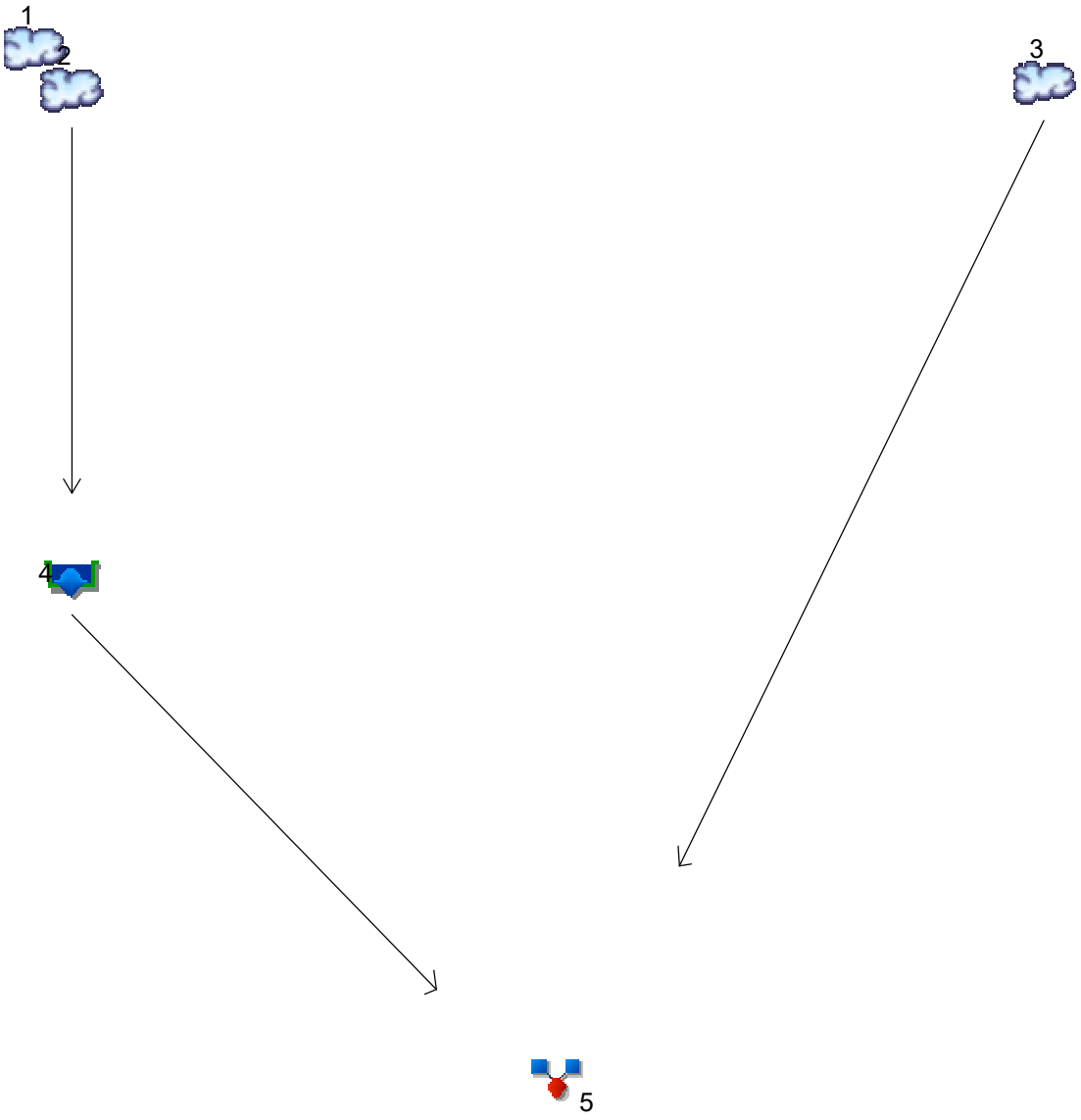
C-5.0

APPENDIX C

Stormwater Calculations

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020.4



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	------	0.056	1.857	-------	-------	4.021	-------	-------	8.411	Lee's Summit - Pre Development 1 to
2	SCS Runoff	------	1.338	4.888	-------	-------	7.818	-------	-------	13.13	Lee's Summit Post Model Detained
3	SCS Runoff	------	0.016	0.537	-------	-------	1.155	-------	-------	2.393	lee's Summit - Post Development Un
4	Reservoir	2	0.044	0.082	-------	-------	0.106	-------	-------	2.708	DETAINED ROUTING
5	Combine	3, 4	0.055	0.608	-------	-------	1.241	-------	-------	4.246	TOTAL POST DEVELOPED RUNOF

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020.4

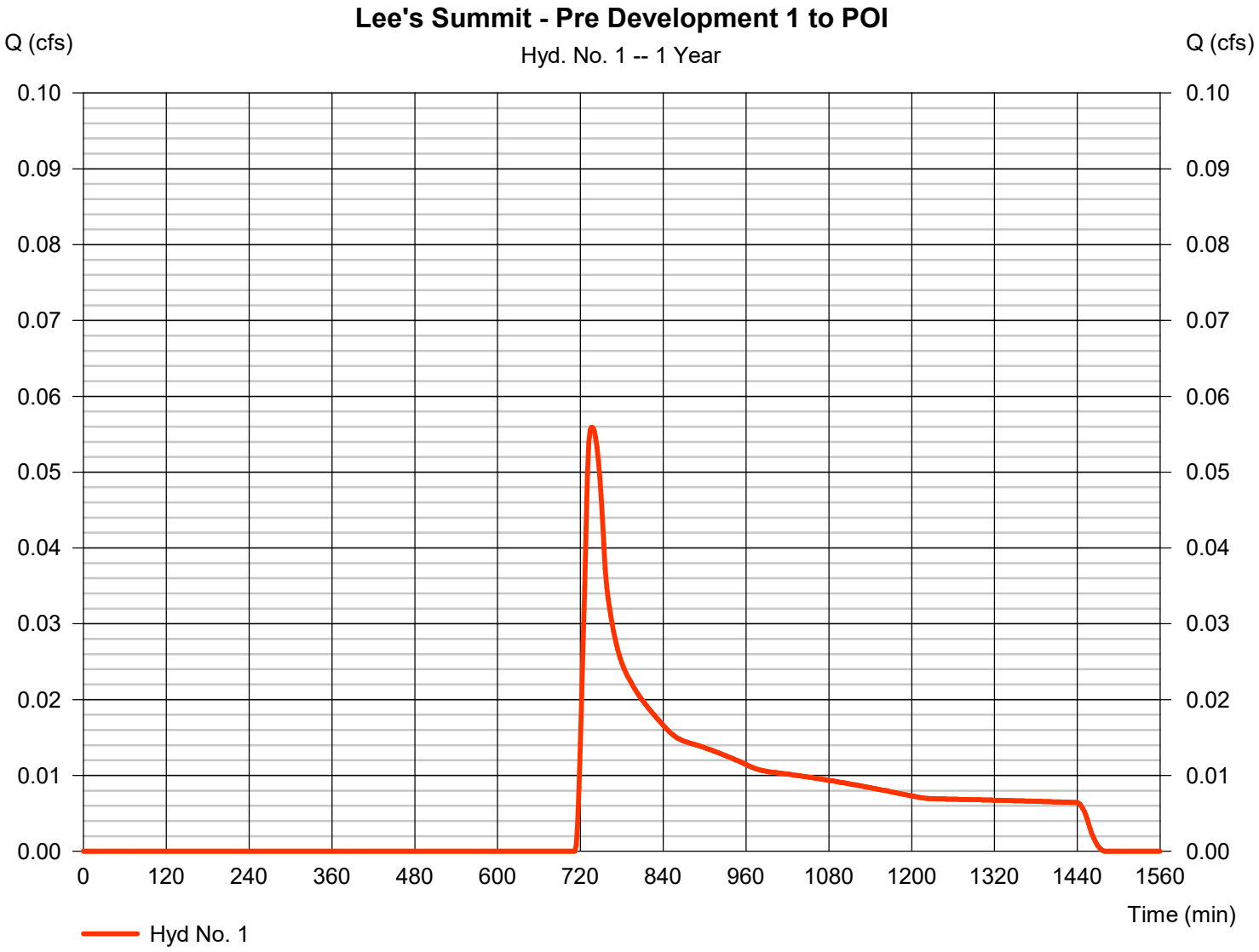
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.056	2	736	552	------	------	------	Lee's Summit - Pre Development 1 to
2	SCS Runoff	1.338	2	718	3,066	------	------	------	Lee's Summit Post Model Detained
3	SCS Runoff	0.016	2	728	121	------	------	------	lee's Summit - Post Development Un
4	Reservoir	0.044	2	866	3,040	2	1014.39	1,866	DETAINED ROUTING
5	Combine	0.055	2	728	3,160	3, 4	------	------	TOTAL POST DEVELOPED RUNOF

Hydrograph Report

Hyd. No. 1

Lee's Summit - Pre Development 1 to POI

Hydrograph type	= SCS Runoff	Peak discharge	= 0.056 cfs
Storm frequency	= 1 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 552 cuft
Drainage area	= 1.450 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 1.37 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

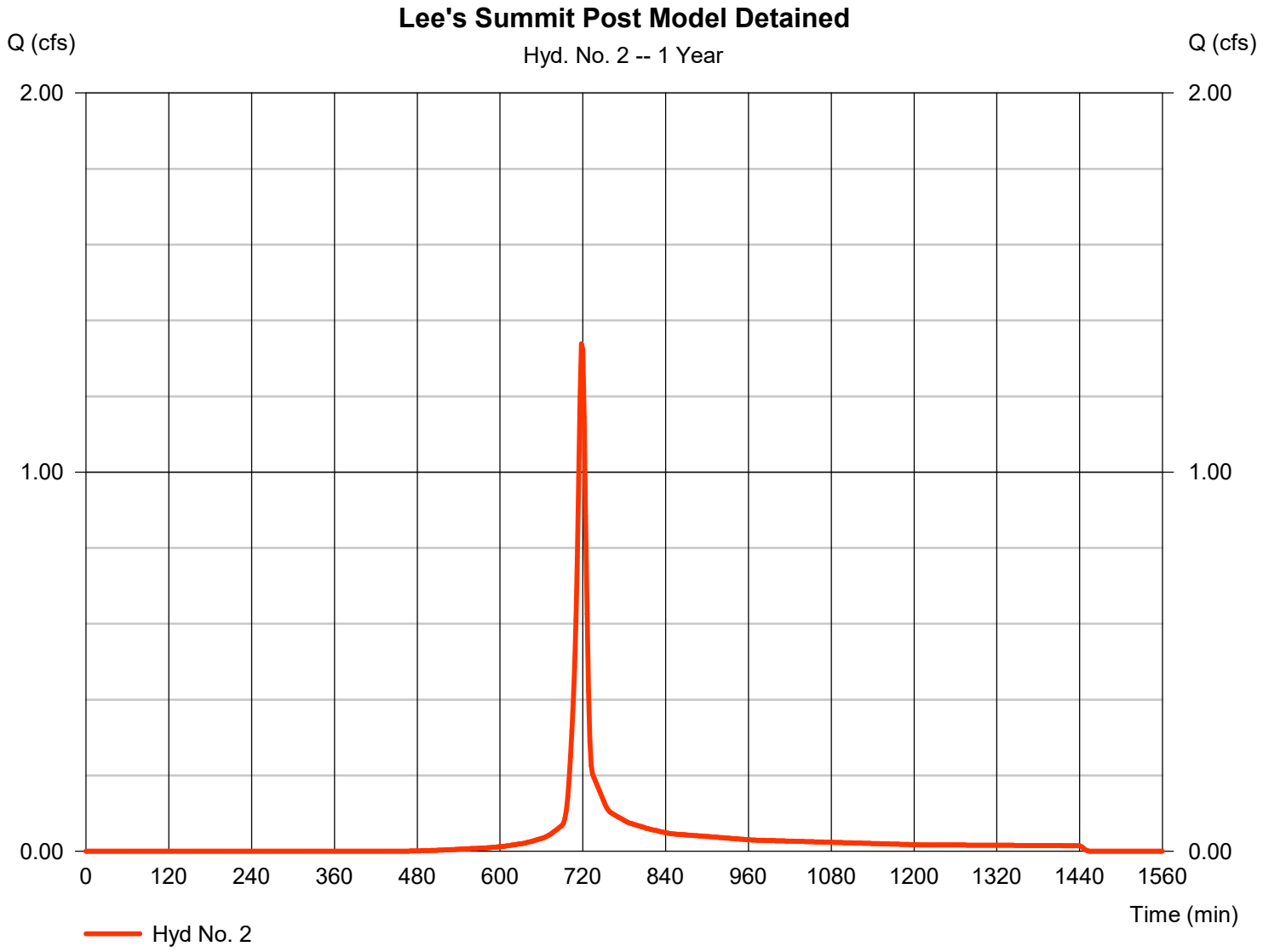


Hydrograph Report

Hyd. No. 2

Lee's Summit Post Model Detained

Hydrograph type	= SCS Runoff	Peak discharge	= 1.338 cfs
Storm frequency	= 1 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 3,066 cuft
Drainage area	= 1.120 ac	Curve number	= 93
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 1.37 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

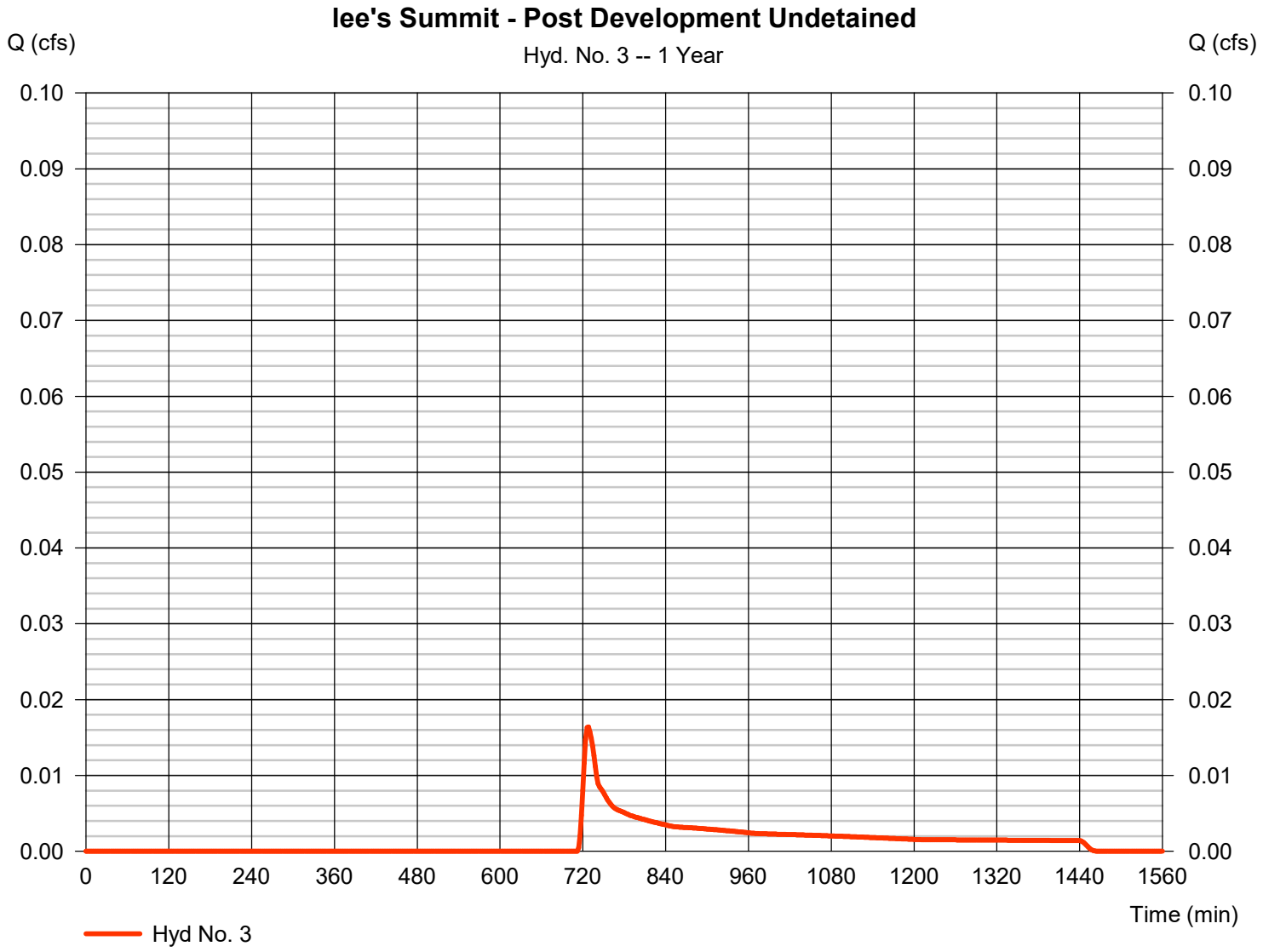


Hydrograph Report

Hyd. No. 3

lee's Summit - Post Development Undetained

Hydrograph type	= SCS Runoff	Peak discharge	= 0.016 cfs
Storm frequency	= 1 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 121 cuft
Drainage area	= 0.320 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.40 min
Total precip.	= 1.37 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



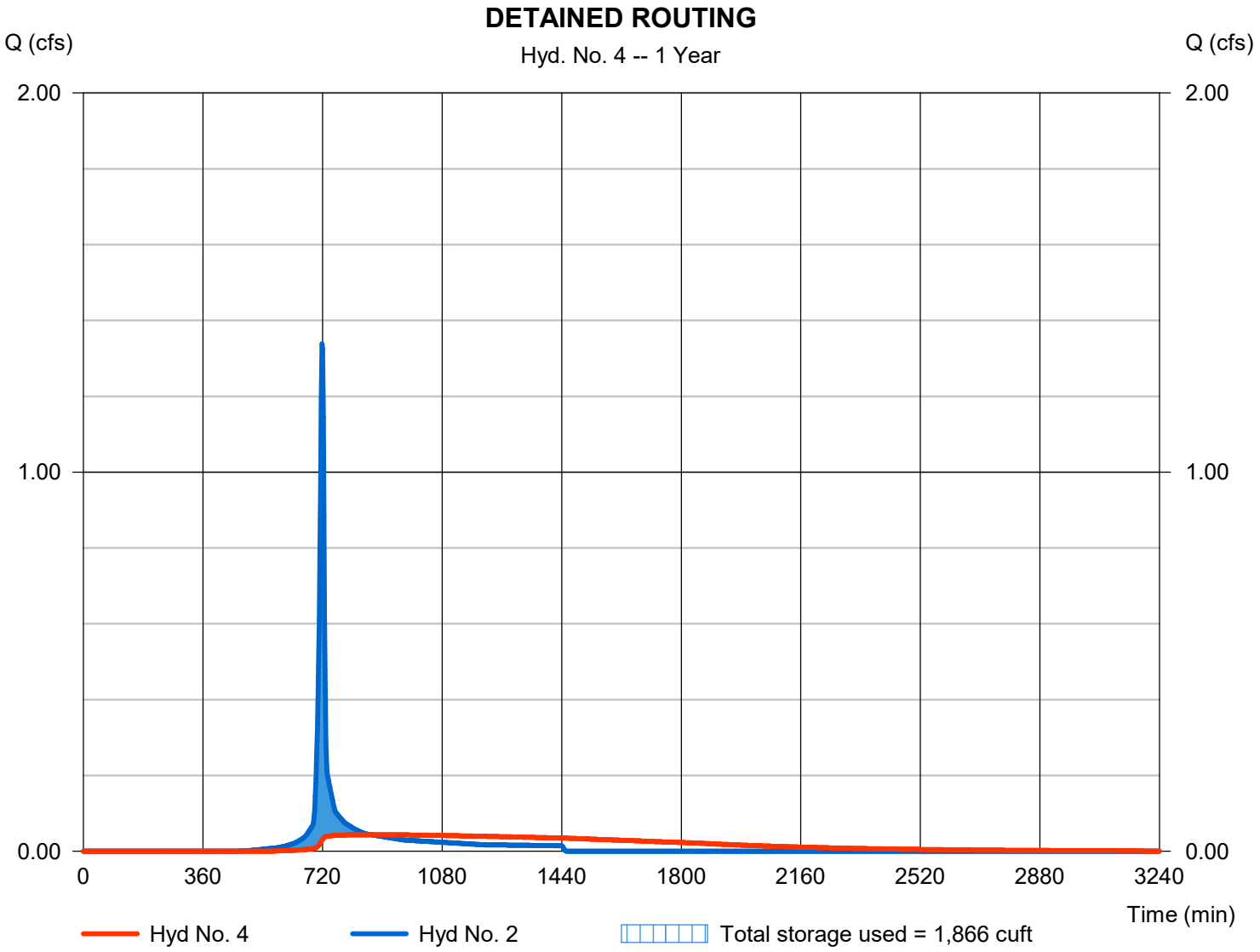
Hydrograph Report

Hyd. No. 4

DETAINED ROUTING

Hydrograph type	=	Reservoir	Peak discharge	=	0.044 cfs
Storm frequency	=	1 yrs	Time to peak	=	866 min
Time interval	=	2 min	Hyd. volume	=	3,040 cuft
Inflow hyd. No.	=	2 - Lee's Summit Post Model Detained	Max. Elevation	=	1014.39 ft
Reservoir name	=	ADS POND	Max. Storage	=	1,866 cuft

Storage Indication method used.



Pond No. 2 - ADS POND

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1013.75	n/a	0	0
1.00	1014.75	n/a	2,922	2,922
2.00	1015.75	n/a	5,415	8,337
3.00	1016.75	n/a	4,934	13,271
4.00	1017.75	n/a	4,008	17,279
5.00	1018.75	n/a	2,253	19,532
5.50	1019.25	n/a	1,013	20,545

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	1.50	0.00	0.00
Span (in)	= 15.00	1.50	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 1013.75	1013.75	0.00	0.00
Length (ft)	= 32.00	0.00	0.00	0.00
Slope (%)	= 0.88	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 2.90	0.00	0.00	0.00
Crest El. (ft)	= 1018.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by 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

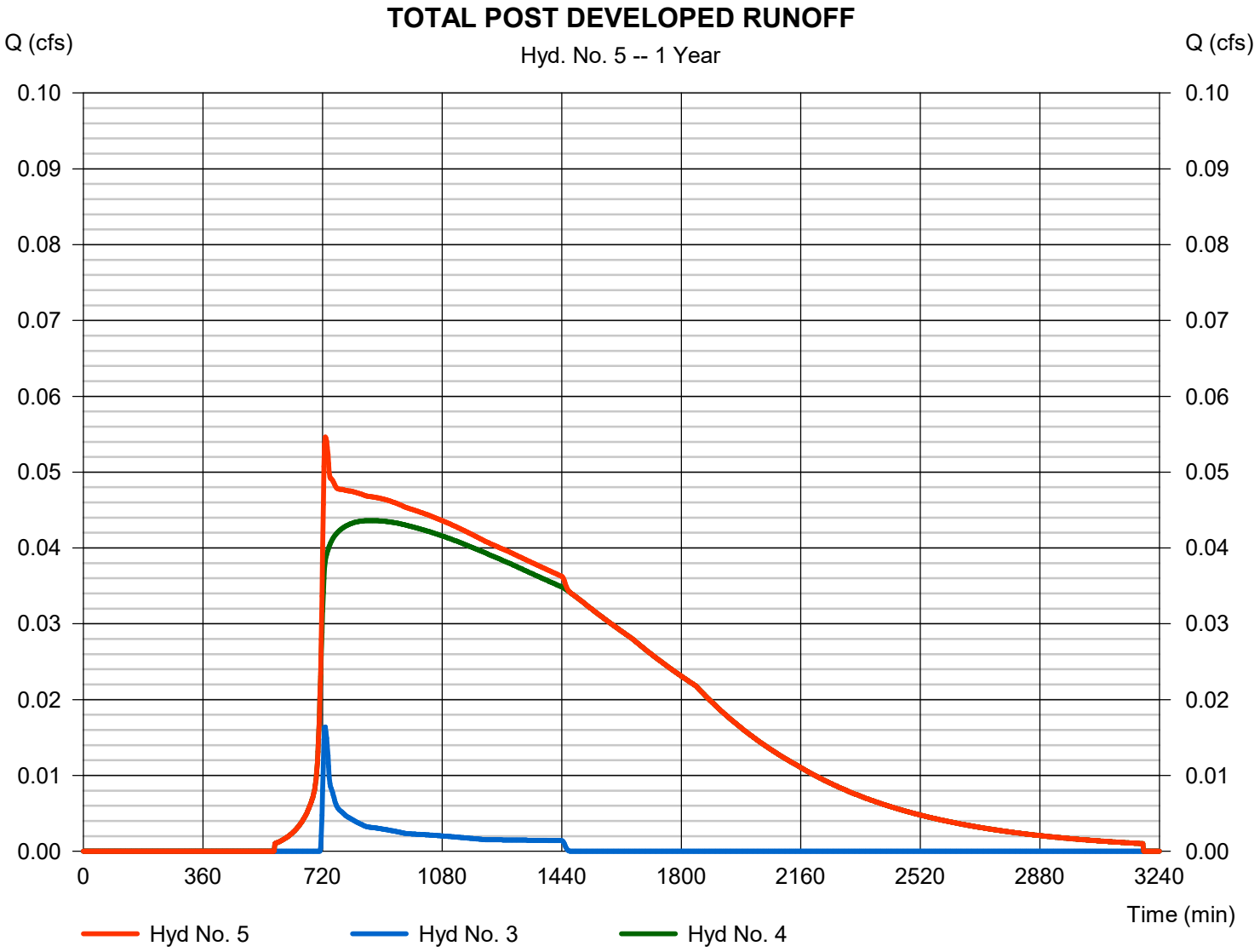
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1013.75	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.00	2,922	1014.75	0.06 ic	0.06 ic	---	---	0.00	---	---	---	---	---	0.056
2.00	8,337	1015.75	0.08 ic	0.08 ic	---	---	0.00	---	---	---	---	---	0.081
3.00	13,271	1016.75	0.10 ic	0.10 ic	---	---	0.00	---	---	---	---	---	0.100
4.00	17,279	1017.75	0.12 ic	0.12 ic	---	---	0.00	---	---	---	---	---	0.116
5.00	19,532	1018.75	0.14 ic	0.13 ic	---	---	1.21	---	---	---	---	---	1.337
5.50	20,545	1019.25	0.14 ic	0.14 ic	---	---	6.27	---	---	---	---	---	6.409

Hydrograph Report

Hyd. No. 5

TOTAL POST DEVELOPED RUNOFF

Hydrograph type	= Combine	Peak discharge	= 0.055 cfs
Storm frequency	= 1 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 3,160 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.320 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020.4

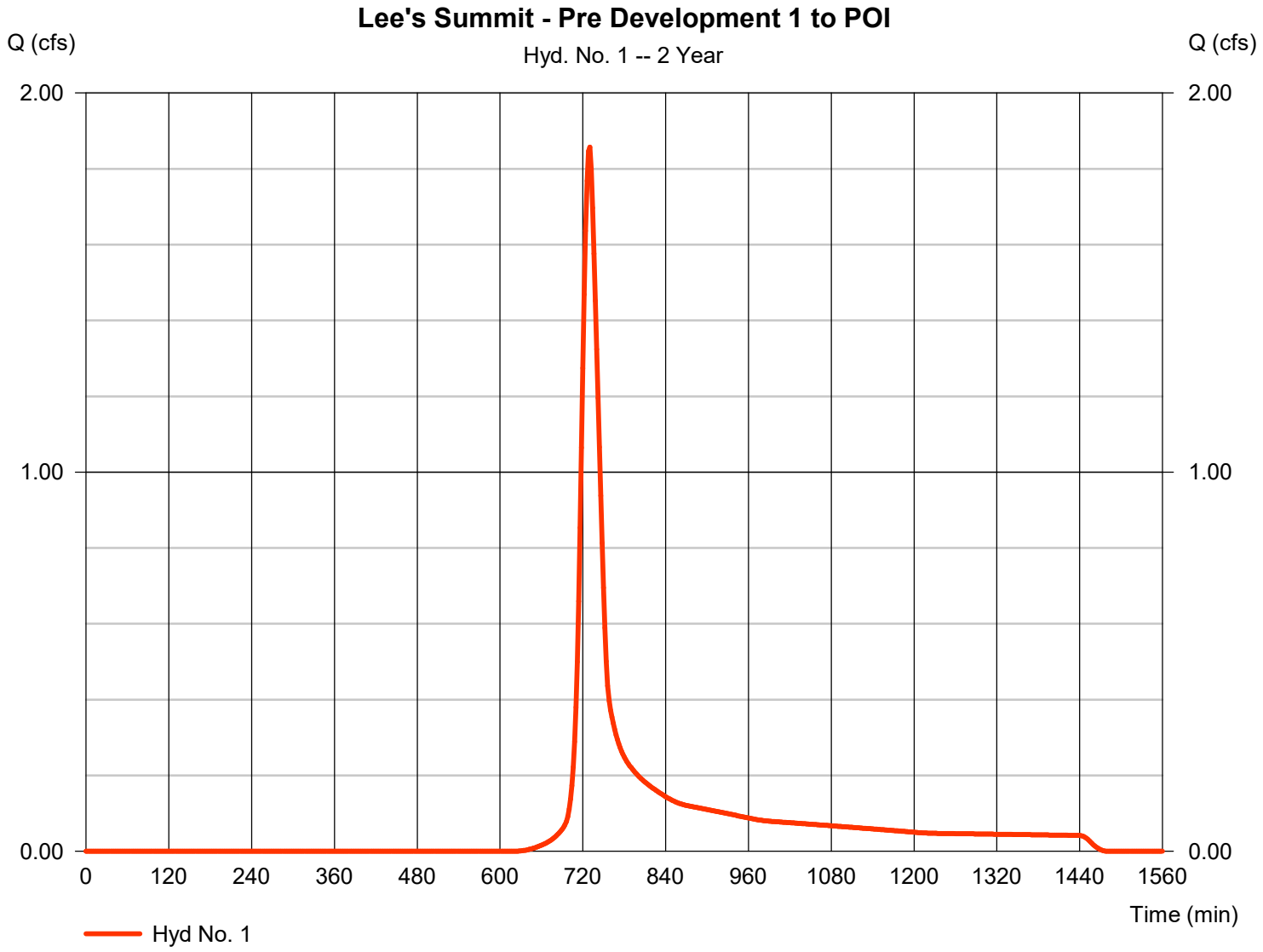
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.857	2	730	7,076	------	------	------	Lee's Summit - Pre Development 1 to
2	SCS Runoff	4.888	2	718	11,827	------	------	------	Lee's Summit Post Model Detained
3	SCS Runoff	0.537	2	722	1,547	------	------	------	lee's Summit - Post Development Un
4	Reservoir	0.082	2	1028	11,801	2	1015.79	8,521	DETAINED ROUTING
5	Combine	0.608	2	724	13,348	3, 4	------	------	TOTAL POST DEVELOPED RUNOF

Hydrograph Report

Hyd. No. 1

Lee's Summit - Pre Development 1 to POI

Hydrograph type	= SCS Runoff	Peak discharge	= 1.857 cfs
Storm frequency	= 2 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 7,076 cuft
Drainage area	= 1.450 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 3.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

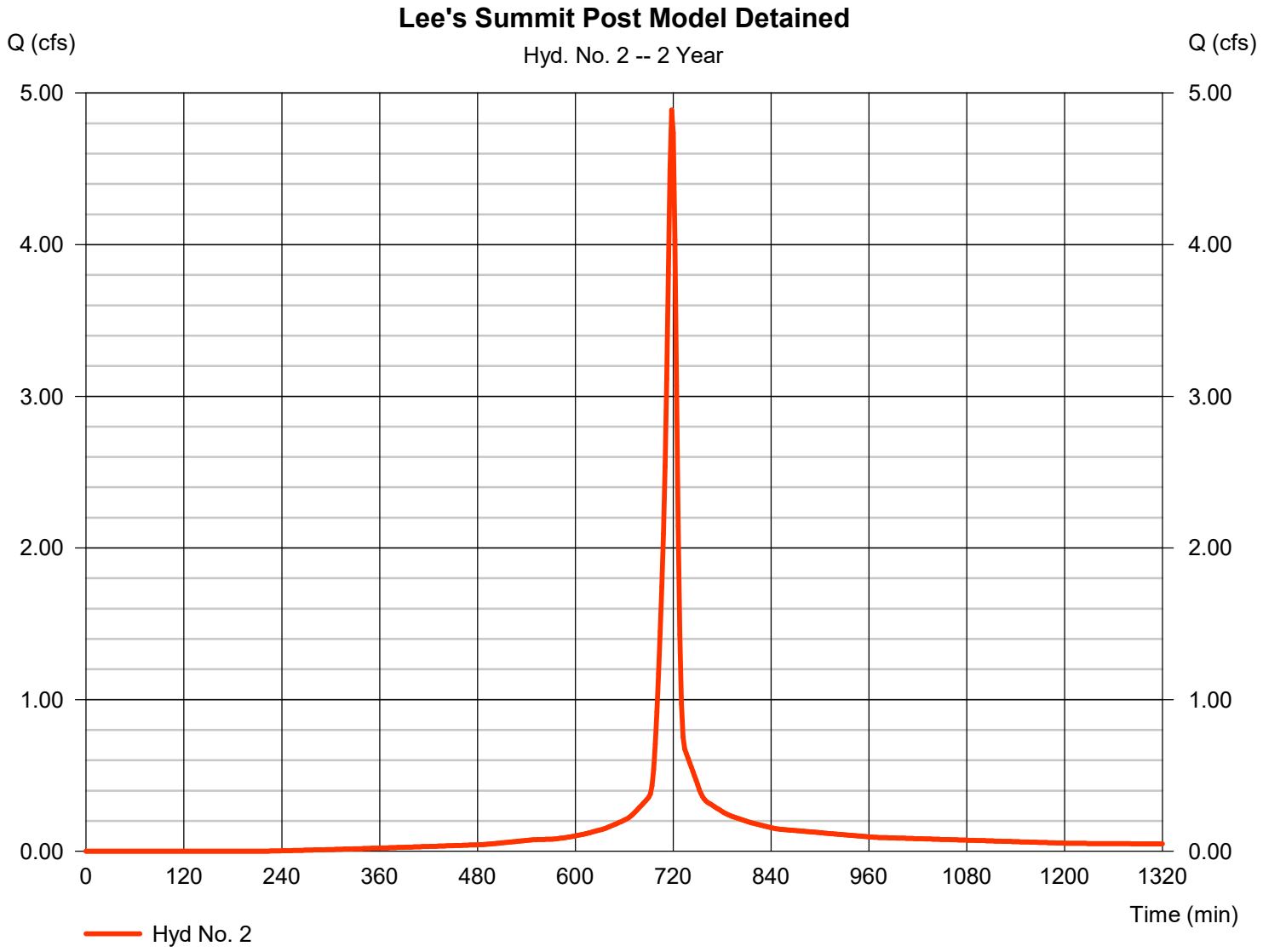


Hydrograph Report

Hyd. No. 2

Lee's Summit Post Model Detained

Hydrograph type	= SCS Runoff	Peak discharge	= 4.888 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 11,827 cuft
Drainage area	= 1.120 ac	Curve number	= 93
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 3.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

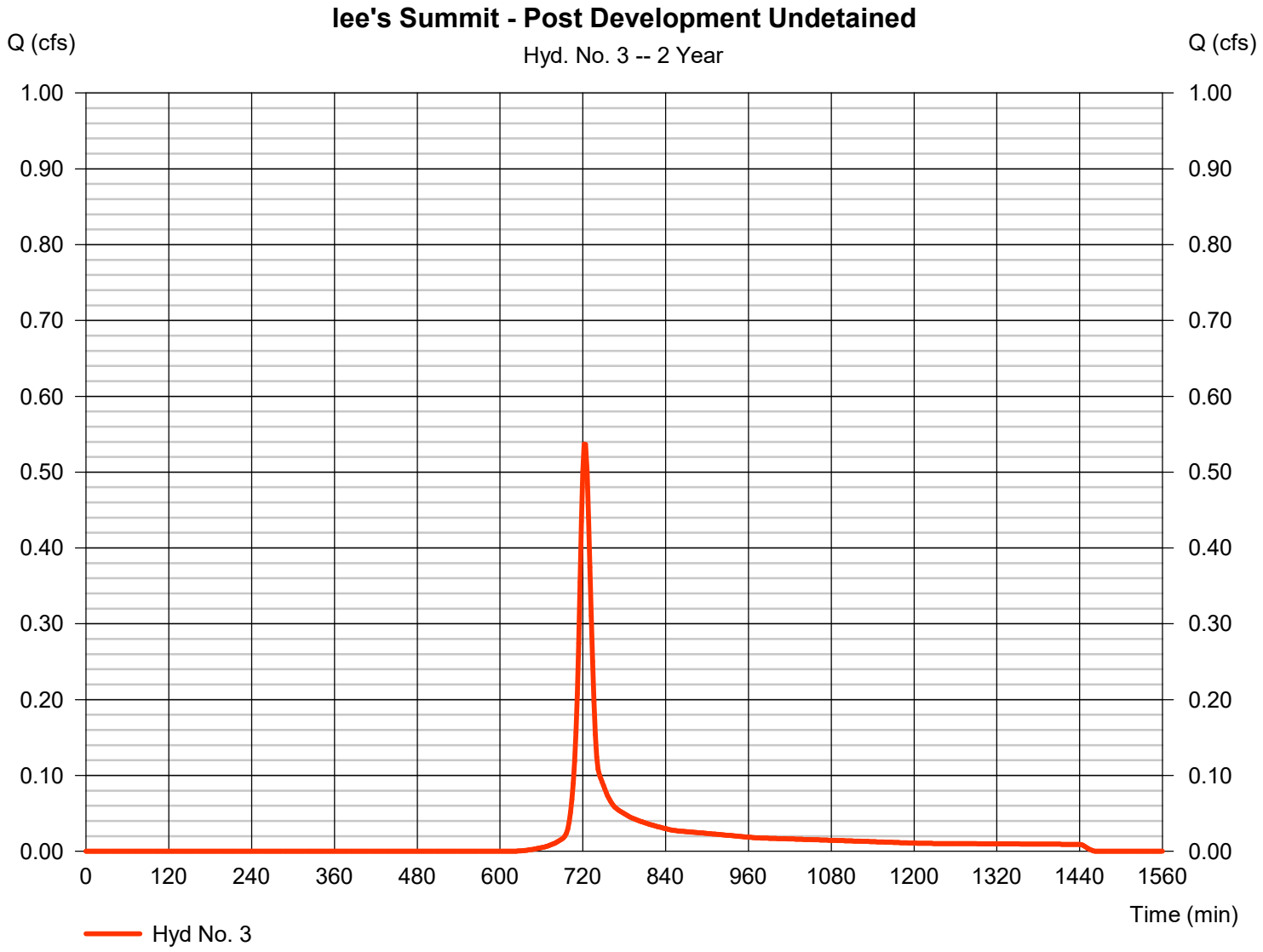


Hydrograph Report

Hyd. No. 3

lee's Summit - Post Development Undetained

Hydrograph type	= SCS Runoff	Peak discharge	= 0.537 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 1,547 cuft
Drainage area	= 0.320 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.40 min
Total precip.	= 3.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



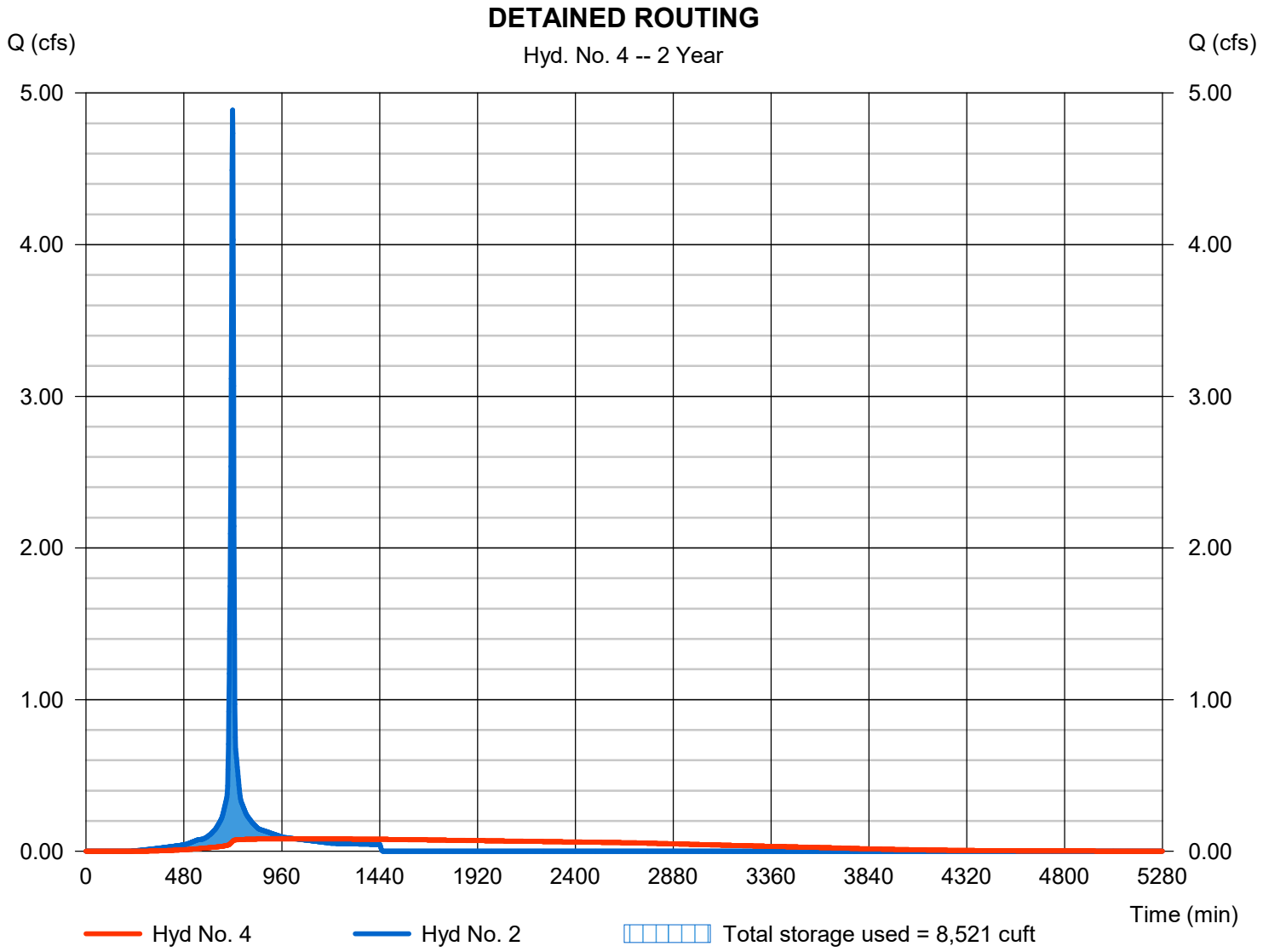
Hydrograph Report

Hyd. No. 4

DETAINED ROUTING

Hydrograph type	=	Reservoir	Peak discharge	=	0.082 cfs
Storm frequency	=	2 yrs	Time to peak	=	1028 min
Time interval	=	2 min	Hyd. volume	=	11,801 cuft
Inflow hyd. No.	=	2 - Lee's Summit Post Model Detained	Max. Elevation	=	1015.79 ft
Reservoir name	=	ADS POND	Max. Storage	=	8,521 cuft

Storage Indication method used.

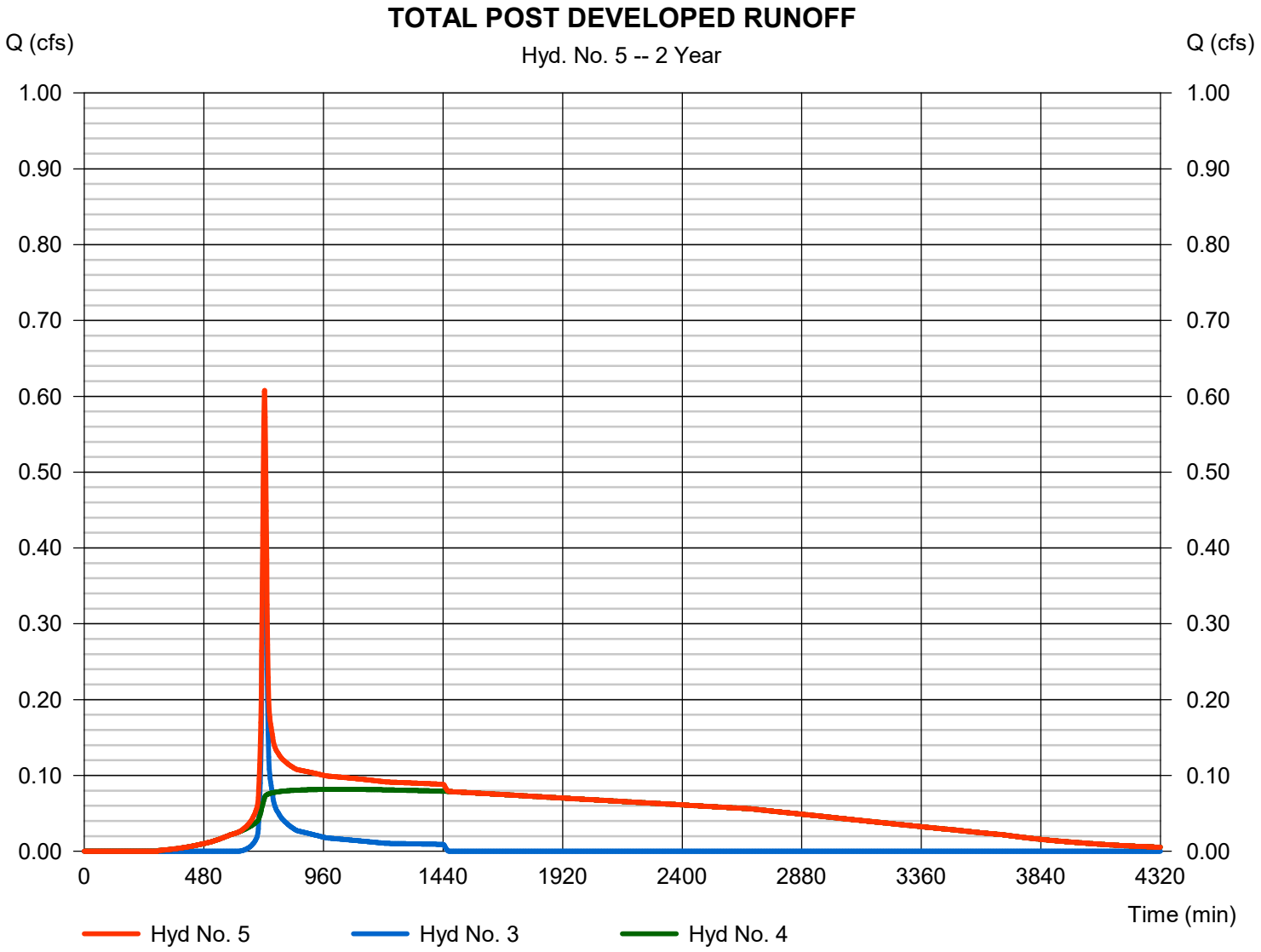


Hydrograph Report

Hyd. No. 5

TOTAL POST DEVELOPED RUNOFF

Hydrograph type	= Combine	Peak discharge	= 0.608 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 13,348 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.320 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020.4

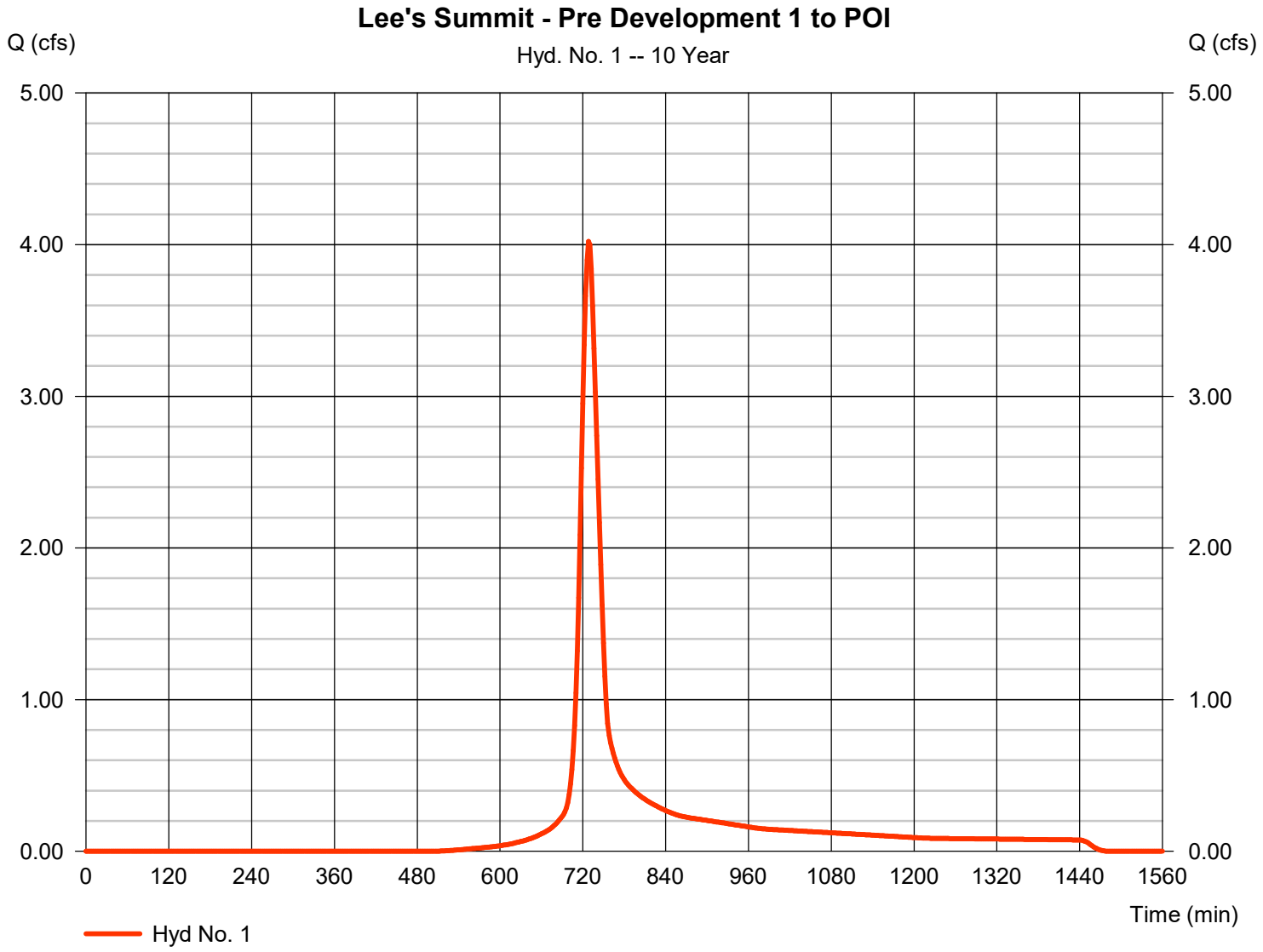
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.021	2	728	14,817	------	------	------	Lee's Summit - Pre Development 1 to
2	SCS Runoff	7.818	2	718	19,507	------	------	------	Lee's Summit Post Model Detained
3	SCS Runoff	1.155	2	722	3,239	------	------	------	lee's Summit - Post Development Un
4	Reservoir	0.106	2	1110	19,437	2	1017.11	14,729	DETAINED ROUTING
5	Combine	1.241	2	722	22,675	3, 4	------	------	TOTAL POST DEVELOPED RUNOF

Hydrograph Report

Hyd. No. 1

Lee's Summit - Pre Development 1 to POI

Hydrograph type	= SCS Runoff	Peak discharge	= 4.021 cfs
Storm frequency	= 10 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 14,817 cuft
Drainage area	= 1.450 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

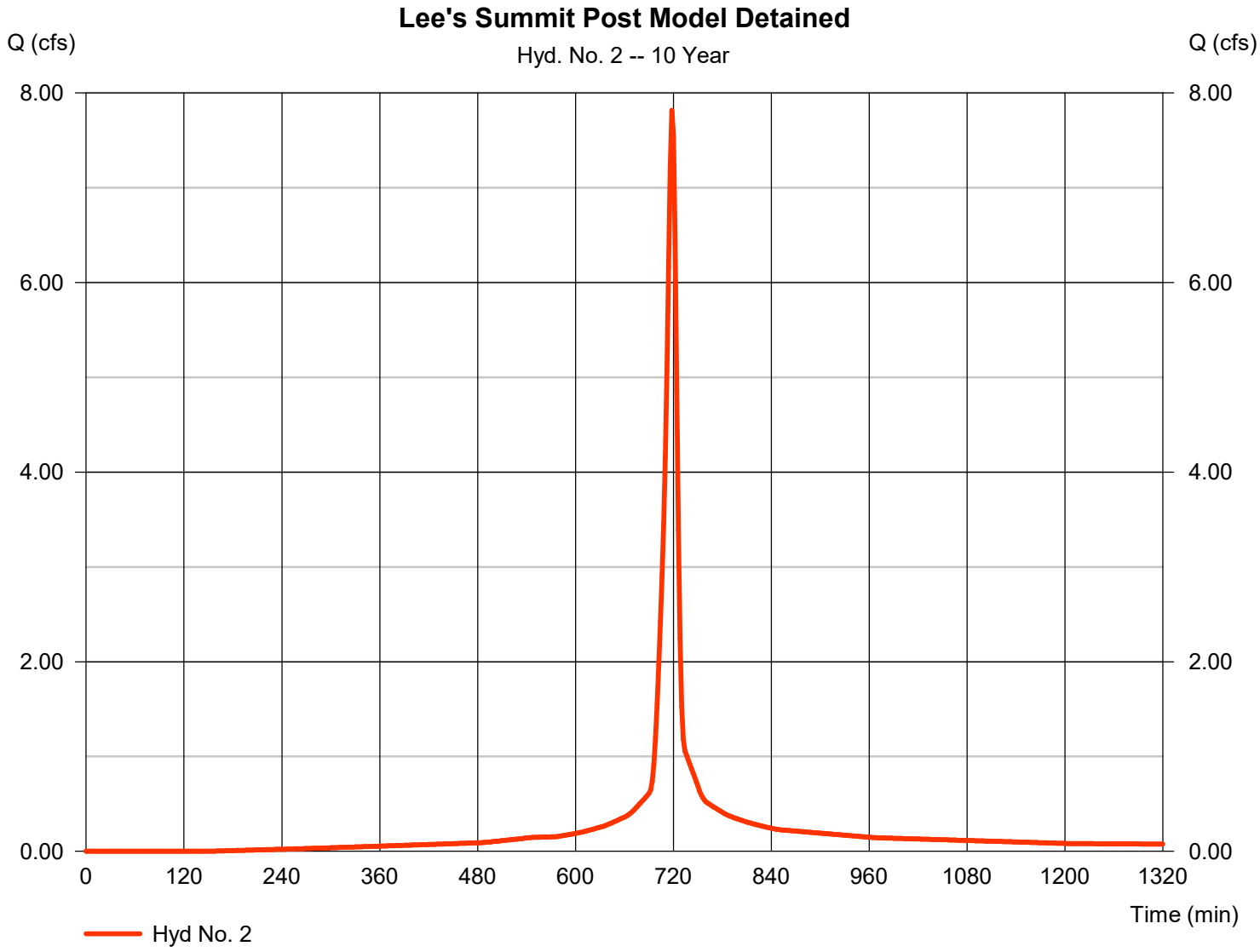


Hydrograph Report

Hyd. No. 2

Lee's Summit Post Model Detained

Hydrograph type	= SCS Runoff	Peak discharge	= 7.818 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 19,507 cuft
Drainage area	= 1.120 ac	Curve number	= 93
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

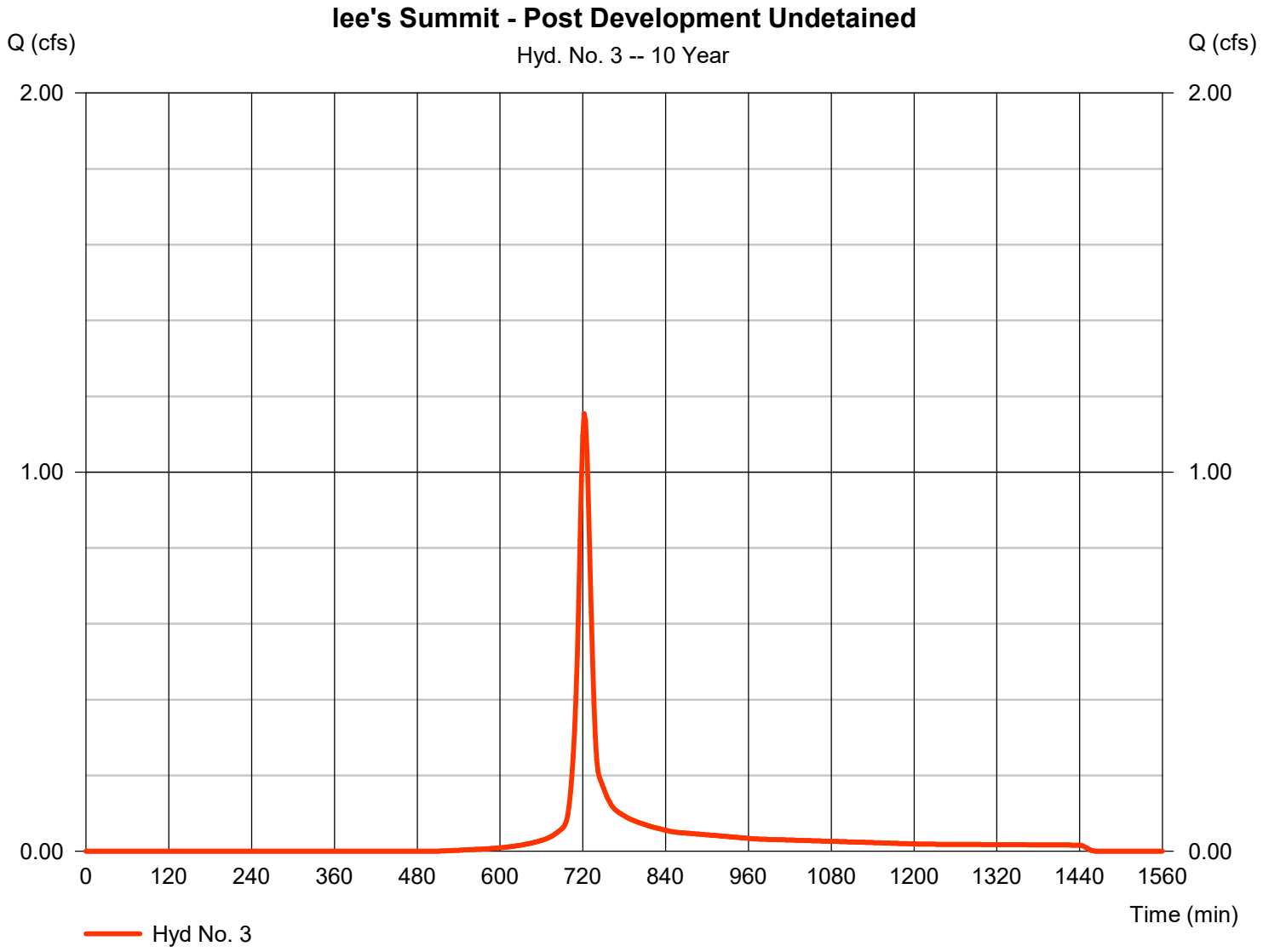


Hydrograph Report

Hyd. No. 3

lee's Summit - Post Development Undetained

Hydrograph type	= SCS Runoff	Peak discharge	= 1.155 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 3,239 cuft
Drainage area	= 0.320 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.40 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



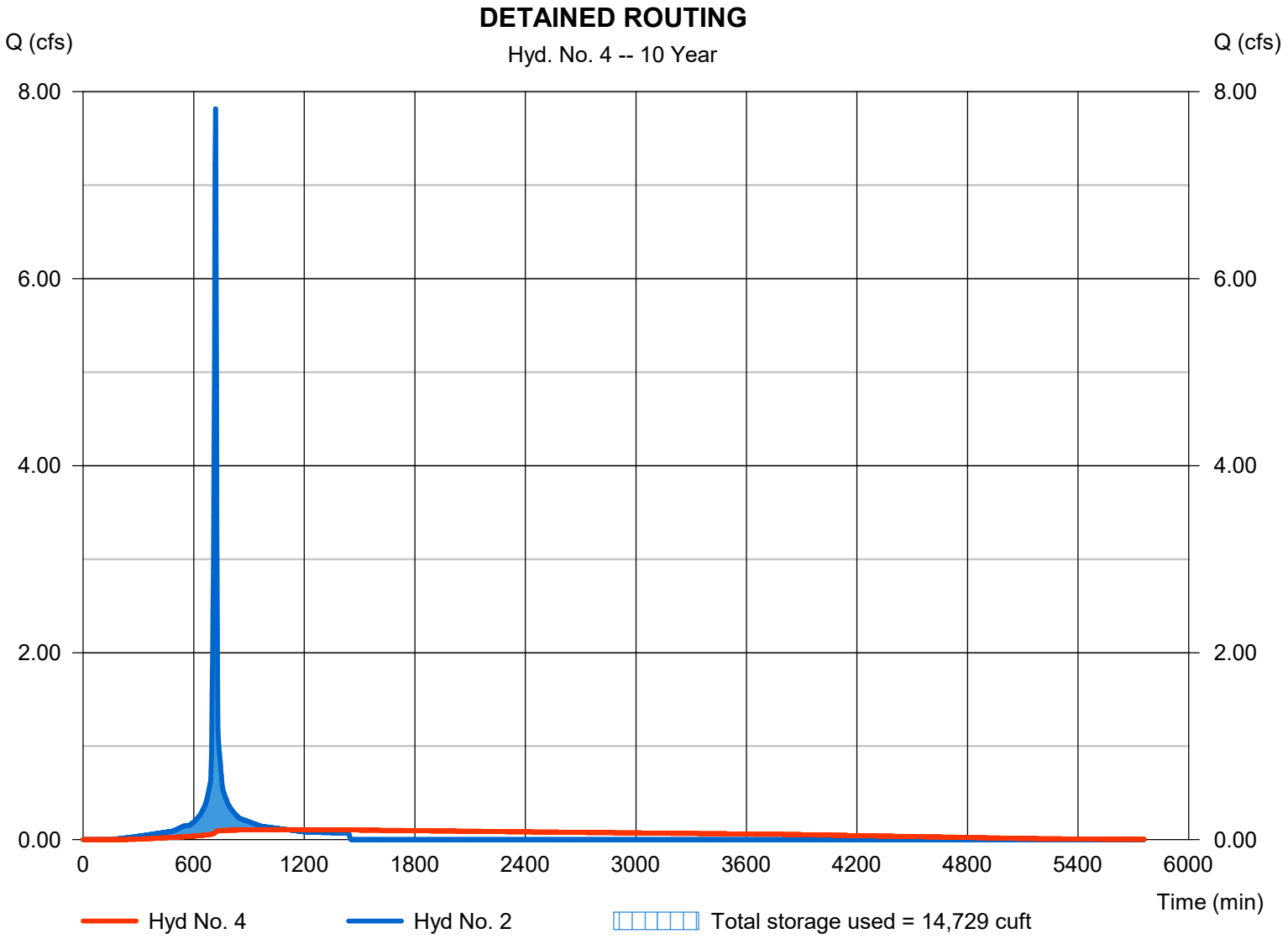
Hydrograph Report

Hyd. No. 4

DETAINED ROUTING

Hydrograph type	=	Reservoir	Peak discharge	=	0.106 cfs
Storm frequency	=	10 yrs	Time to peak	=	1110 min
Time interval	=	2 min	Hyd. volume	=	19,437 cuft
Inflow hyd. No.	=	2 - Lee's Summit Post Model Detained	Max. Elevation	=	1017.11 ft
Reservoir name	=	ADS POND	Max. Storage	=	14,729 cuft

Storage Indication method used.

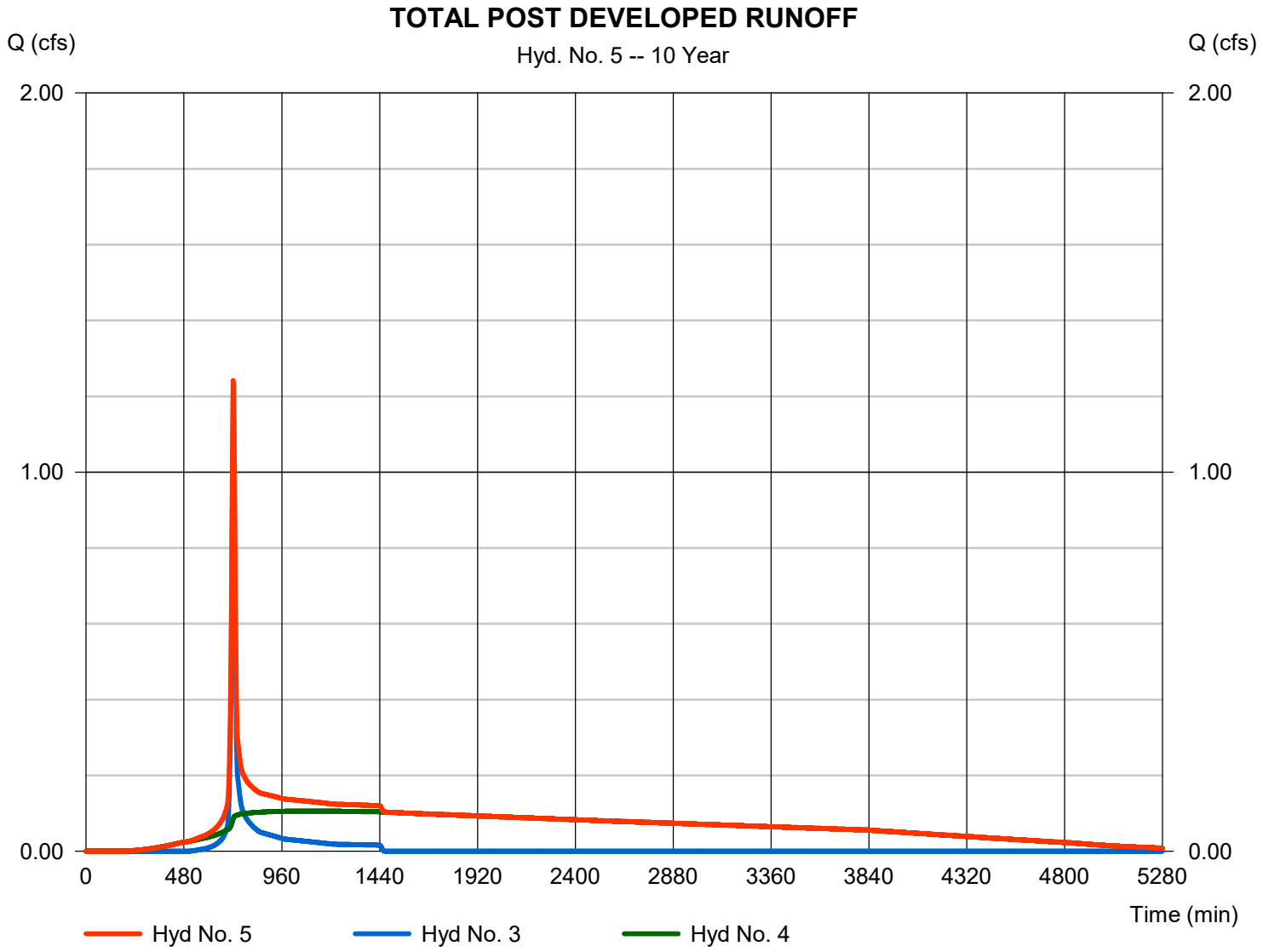


Hydrograph Report

Hyd. No. 5

TOTAL POST DEVELOPED RUNOFF

Hydrograph type	= Combine	Peak discharge	= 1.241 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 22,675 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.320 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020.4

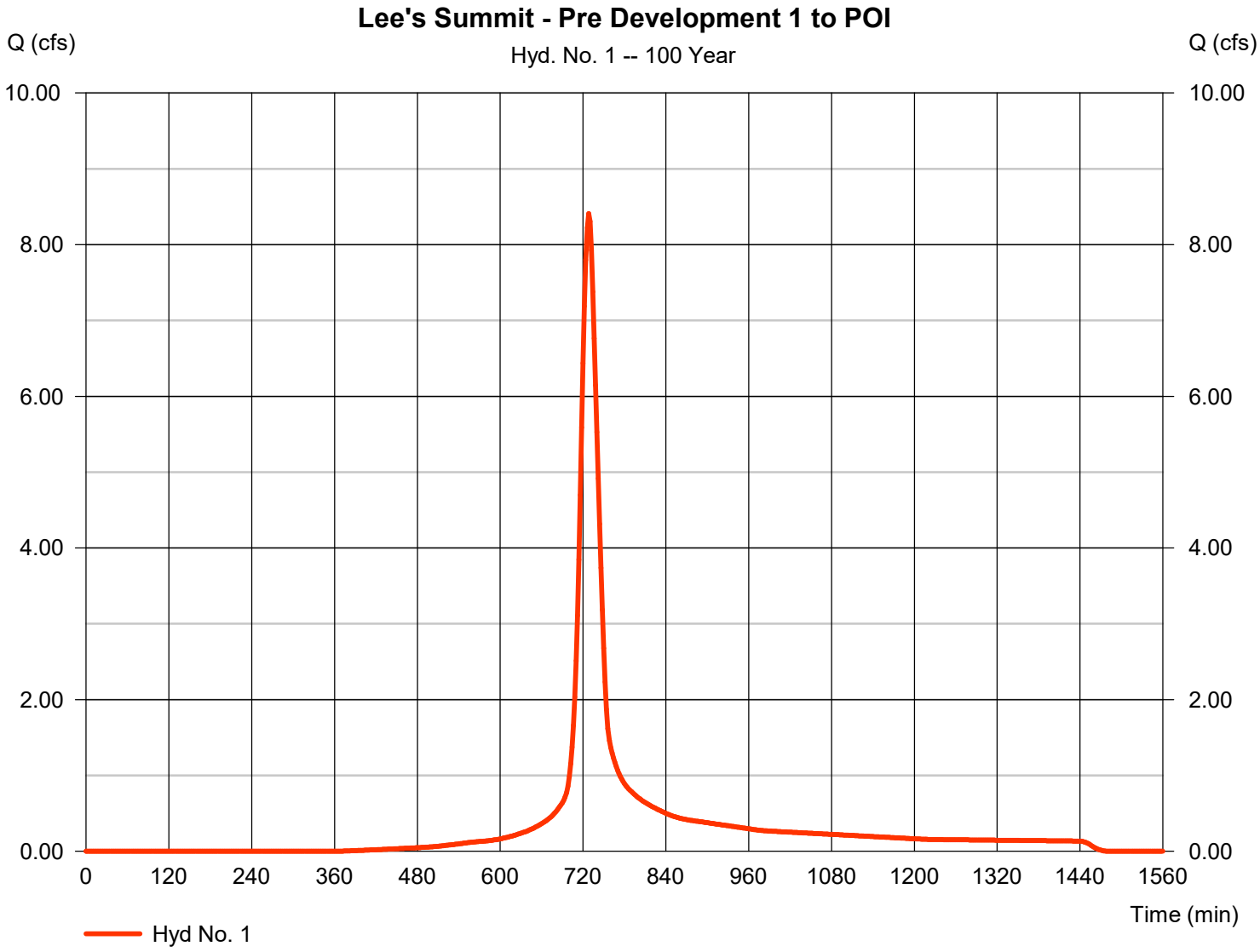
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	8.411	2	728	30,958	------	------	------	Lee's Summit - Pre Development 1 to
2	SCS Runoff	13.13	2	718	33,805	------	------	------	Lee's Summit Post Model Detained
3	SCS Runoff	2.393	2	722	6,767	------	------	------	lee's Summit - Post Development Un
4	Reservoir	2.708	2	730	33,469	2	1018.91	19,864	DETAINED ROUTING
5	Combine	4.246	2	730	40,236	3, 4	------	------	TOTAL POST DEVELOPED RUNOF

Hydrograph Report

Hyd. No. 1

Lee's Summit - Pre Development 1 to POI

Hydrograph type	= SCS Runoff	Peak discharge	= 8.411 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 30,958 cuft
Drainage area	= 1.450 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 9.16 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

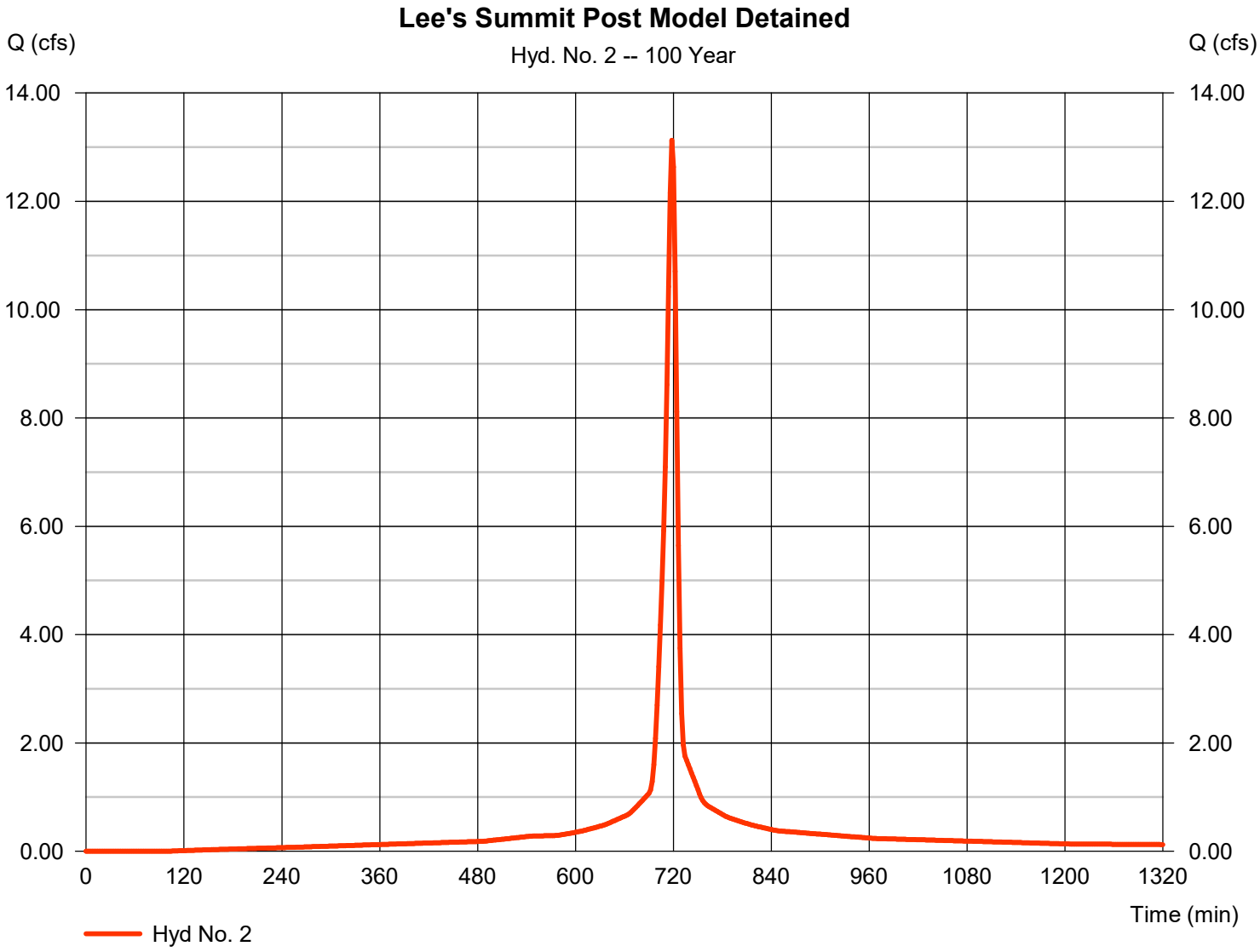


Hydrograph Report

Hyd. No. 2

Lee's Summit Post Model Detained

Hydrograph type	= SCS Runoff	Peak discharge	= 13.13 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 33,805 cuft
Drainage area	= 1.120 ac	Curve number	= 93
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.10 min
Total precip.	= 9.16 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

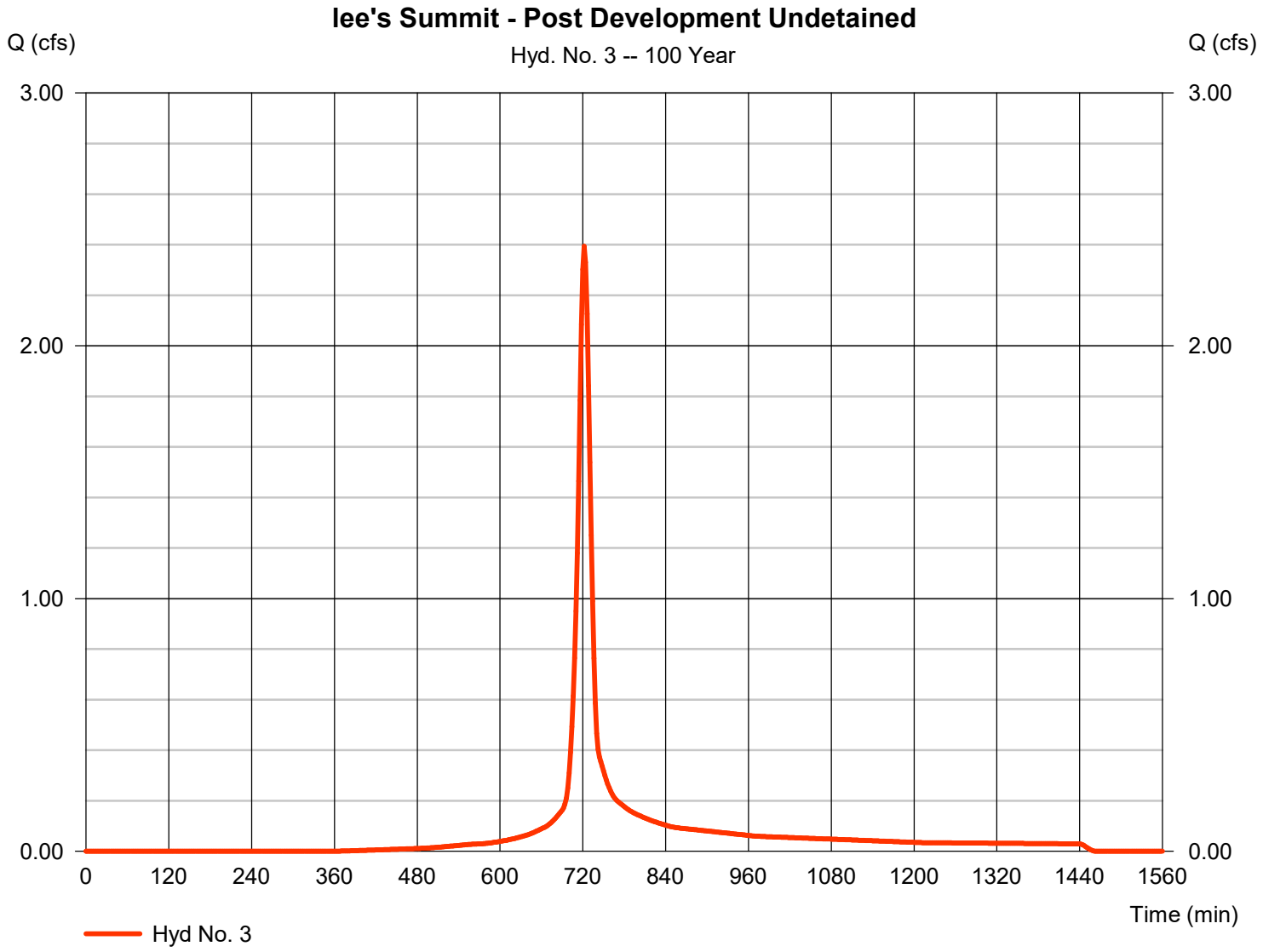


Hydrograph Report

Hyd. No. 3

lee's Summit - Post Development Undetained

Hydrograph type	= SCS Runoff	Peak discharge	= 2.393 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 6,767 cuft
Drainage area	= 0.320 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.40 min
Total precip.	= 9.16 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



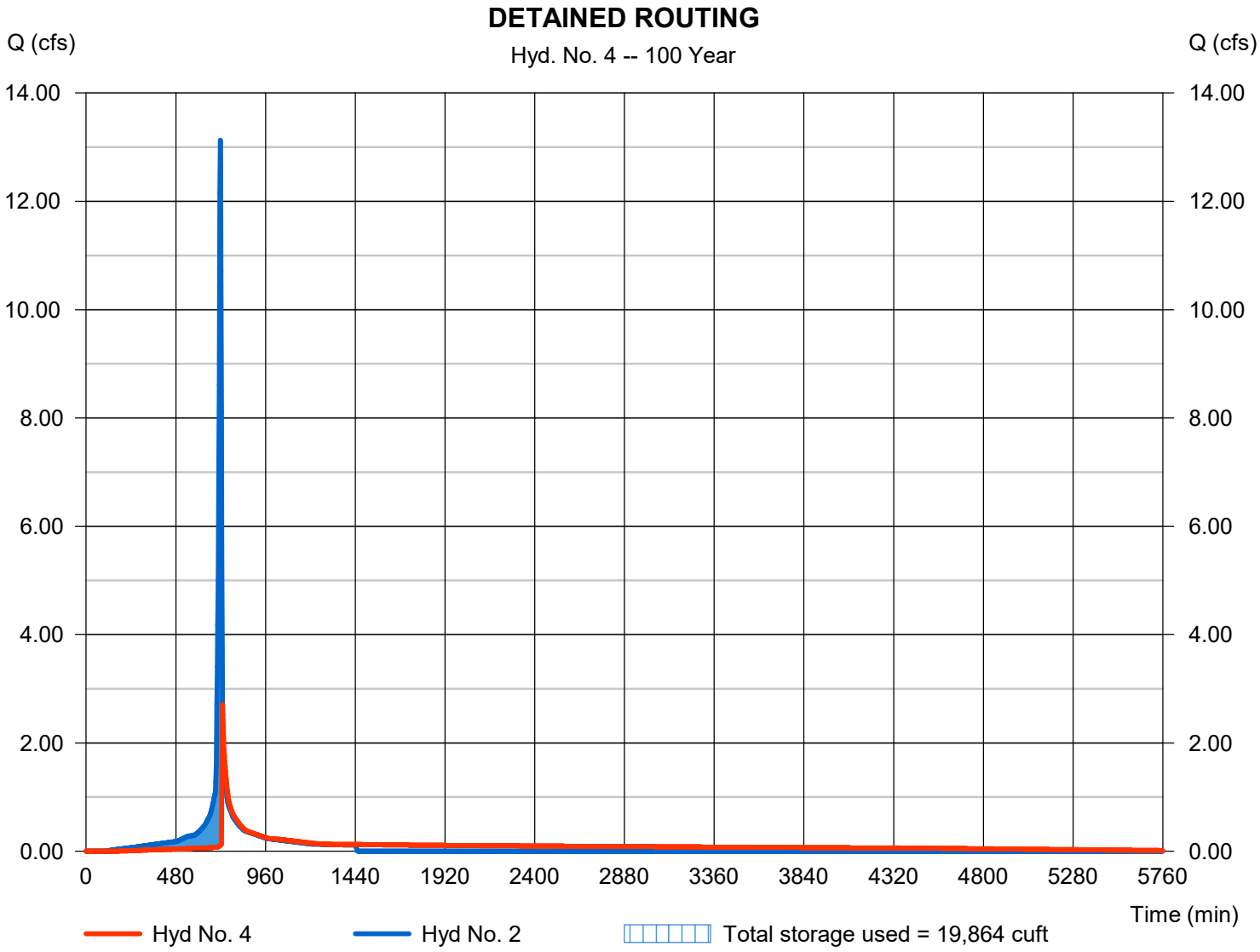
Hydrograph Report

Hyd. No. 4

DETAINED ROUTING

Hydrograph type	=	Reservoir	Peak discharge	=	2.708 cfs
Storm frequency	=	100 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	33,469 cuft
Inflow hyd. No.	=	2 - Lee's Summit Post Model Detained	Max. Elevation	=	1018.91 ft
Reservoir name	=	ADS POND	Max. Storage	=	19,864 cuft

Storage Indication method used.

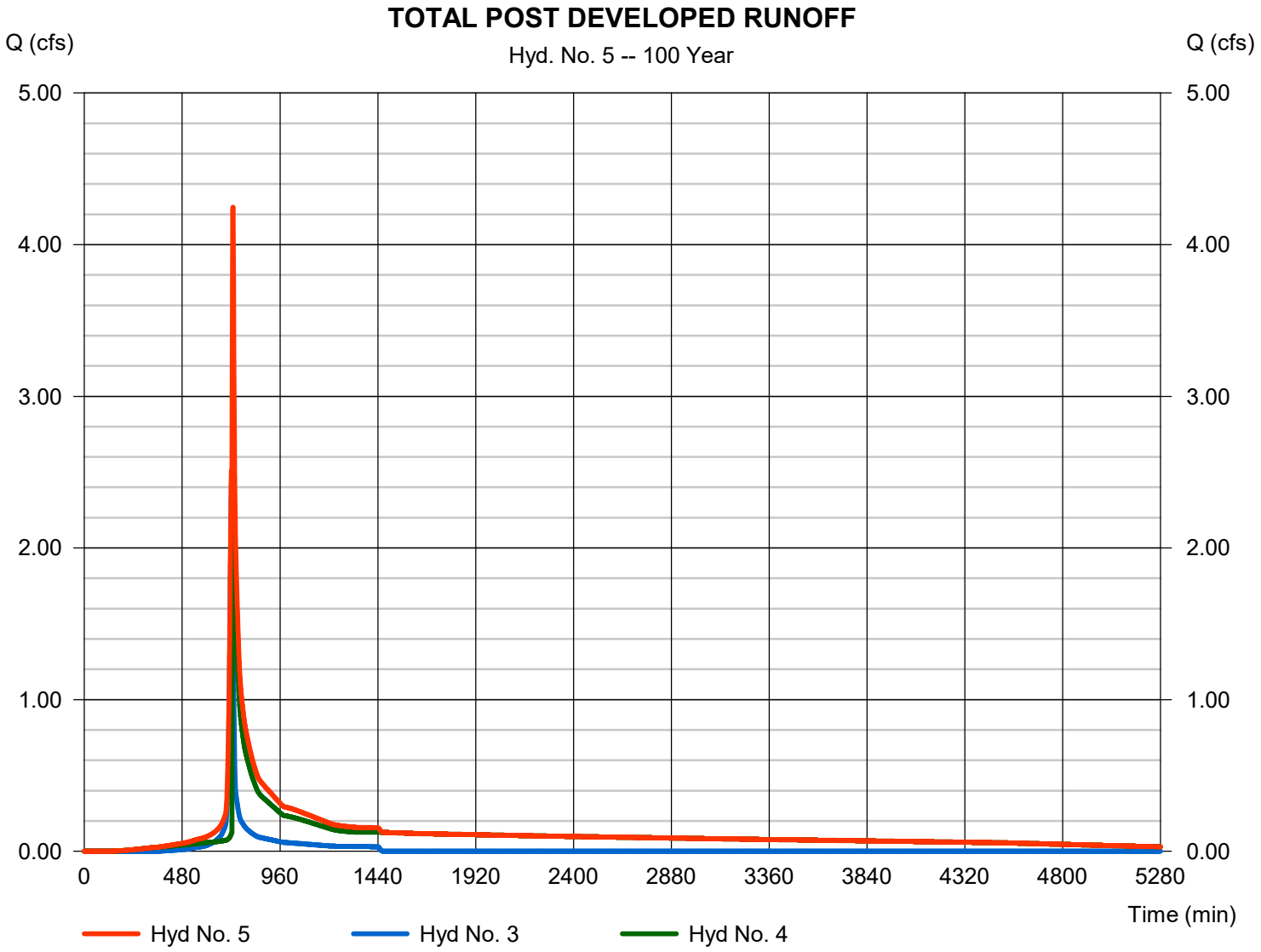


Hydrograph Report

Hyd. No. 5

TOTAL POST DEVELOPED RUNOFF

Hydrograph type	= Combine	Peak discharge	= 4.246 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 40,236 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.320 ac



APPENDIX D

Soils Information

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Jackson County, Missouri

February 9, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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 23, Sep 1, 2021

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	2.0	100.0%
Totals for Area of Interest		**2.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Jackson County, Missouri

10082—Arisburg-Urban land complex, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2w7ld
Elevation: 750 to 1,130 feet
Mean annual precipitation: 39 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Arisburg and similar soils: 61 percent
Urban land: 30 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Arisburg

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

Ap - 0 to 6 inches: silt loam
A - 6 to 13 inches: silt loam
Bt - 13 to 19 inches: silty clay loam
Btg - 19 to 56 inches: silty clay loam
BCg - 56 to 79 inches: silty clay loam

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R107BY007MO - Loess Upland Prairie
Hydric soil rating: No

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Sampsel

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Concave
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Hydric soil rating: Yes

Greenton

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Sharpsburg

Percent of map unit: 3 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

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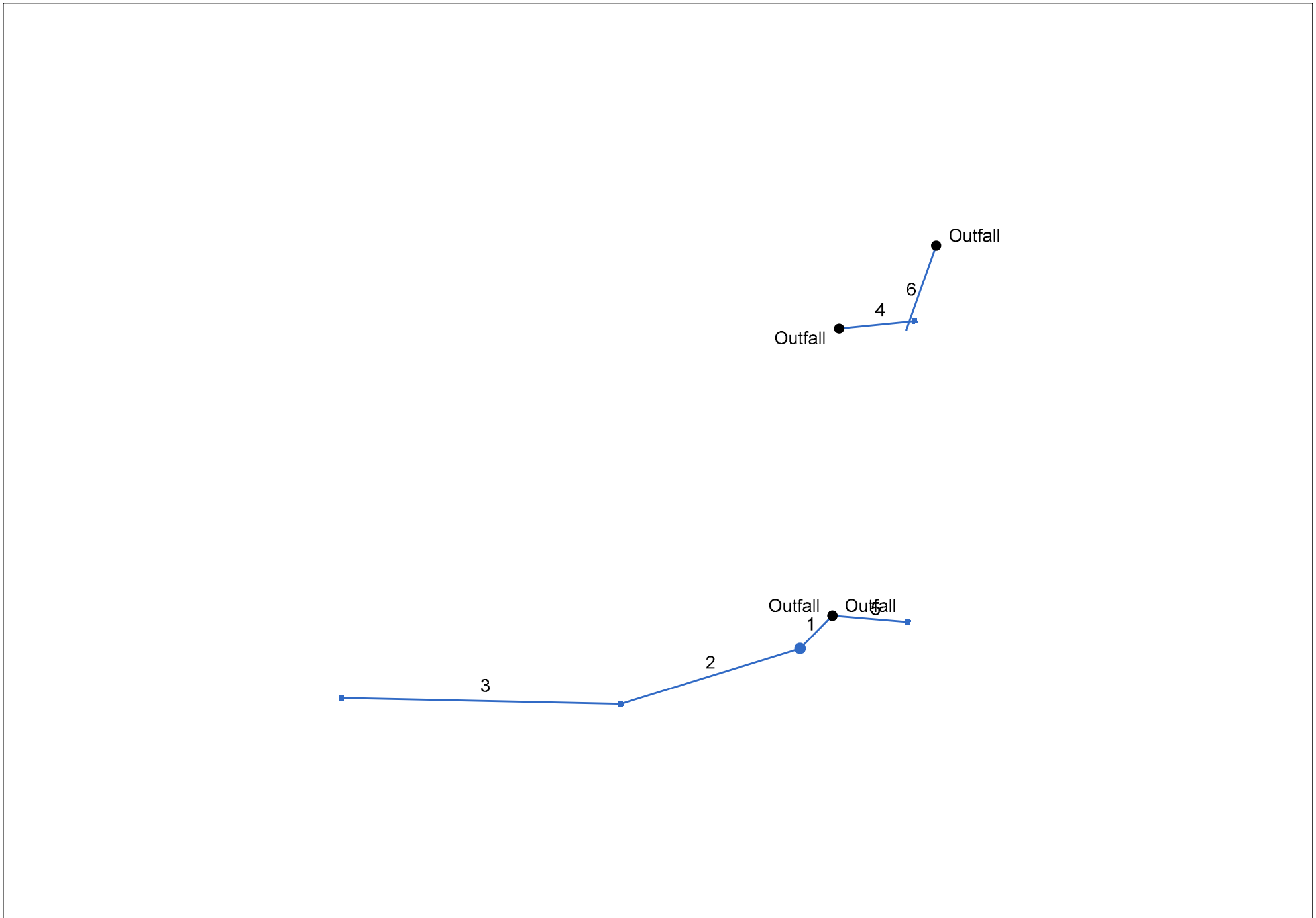
APPENDIX E

Storm Sewer Pipe Calculations

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



Project File: 220822_UPDATED PIPE NETWORK.stm	Number of lines: 6	Date: 8/26/2022

Structure Report

Struct No.	Structure ID	Junction Type	Rim Elev (ft)	Structure			Line Out			Line In		
				Shape	Length (ft)	Width (ft)	Size (in)	Shape	Invert (ft)	Size (in)	Shape	Invert (ft)
1	TYPE #29	Manhole	1022.40	Cir	4.00	4.00	15	Cir	1013.94	15	Cir	1013.94
2	TYPE #27	Curb-	1021.71	Rect	2.00	2.00	15	Cir	1014.71	15	Cir	1014.71
3	TYPE #26	Curb-	1021.75	Rect	2.00	2.00	15	Cir	1015.85			
4	TYPE #28	Curb-	1020.16	Rect	2.00	2.00	15	Cir	1015.34			
5	TYPE #36	Curb-	1020.67	Rect	2.00	2.00	15	Cir	1014.06			
6	Null Structure	None	1020.30	n/a	n/a	n/a	15	Cir	1013.75			

Project File: 220822_UPDATED PIPE NETWORK.stm | Number of Structures: 6 | Run Date: 8/26/2022

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	Pipe - 13	2.73	15	Cir	18.974	1013.75	1013.94	1.001	1014.41	1014.60	0.14	1014.60	End	Manhole
2	Pipe - 10	2.80	15	Cir	76.924	1013.94	1014.71	1.001	1014.60	1015.38	0.15	1015.38	1	Curb-
3	Pipe - 9	1.96	15	Cir	114.529	1014.71	1015.85	0.995	1015.38	1016.41	n/a	1016.41 j	2	Curb-
4	Pipe - 12	2.71	15	Cir	31.102	1013.75	1015.34	5.112	1014.41	1016.00	0.26	1016.00	End	Curb-
5	Pipe - 14	1.02	15	Cir	30.930	1013.75	1014.06	1.002	1014.15	1014.46	n/a	1014.46 j	End	Curb-
6	Pipe - 11	0.19	15	Cir	36.725	1013.48	1013.75	0.735	1013.65	1013.92	0.06	1013.92	End	None

Project File: 220822_UPDATED PIPE NETWORK.stm | Number of lines: 6 | Run Date: 8/26/2022

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	18.974	0.00	0.48	0.00	0.00	0.43	0.0	9.8	6.3	2.73	6.46	4.14	15	1.00	1013.75	1013.94	1014.41	1014.60	1017.94	1022.40	Pipe - 13
2	1	76.924	0.15	0.48	0.98	0.15	0.43	8.1	9.3	6.5	2.80	6.46	4.21	15	1.00	1013.94	1014.71	1014.60	1015.38	1022.40	1021.71	Pipe - 10
3	2	114.529	0.33	0.33	0.86	0.28	0.28	8.1	8.1	6.9	1.96	6.44	3.31	15	1.00	1014.71	1015.85	1015.38	1016.41	1021.71	1021.75	Pipe - 9
4	End	31.102	0.49	0.49	0.80	0.39	0.39	8.1	8.1	6.9	2.71	14.60	4.12	15	5.11	1013.75	1015.34	1014.41	1016.00	1017.94	1020.16	Pipe - 12
5	End	30.930	0.15	0.15	0.98	0.15	0.15	8.1	8.1	6.9	1.02	6.46	3.02	15	1.00	1013.75	1014.06	1014.15	1014.46	1017.94	1020.67	Pipe - 14
6	End	36.725	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.19	5.54	1.91	15	0.74	1013.48	1013.75	1013.65	1013.92	1018.53	1020.30	Pipe - 11

Project File: 220822_UPDATED PIPE NETWORK.stm | Number of lines: 6 | Run Date: 8/26/2022

NOTES:Intensity = 38.88 / (Inlet time + 4.60) ^ 0.68; Return period =Yrs. 10 ; c = cir e = ellip b = box

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
	(in)	(cfs)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	(ft)	Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)	(K)	(ft)
1	15	2.73	1013.75	1014.41	0.66	0.66	4.15	0.27	1014.68	0.000	18.974	1013.94	1014.60	0.66**	0.66	4.13	0.27	1014.87	0.000	0.000	n/a	0.53	0.14
2	15	2.80	1013.94	1014.60	0.66	0.66	4.24	0.27	1014.87	0.000	76.924	1014.71	1015.38	0.67**	0.67	4.17	0.27	1015.65	0.000	0.000	n/a	0.55	0.15
3	15	1.96	1014.71	1015.38	0.67	0.53	2.92	0.21	1015.60	0.000	114.529	1015.85	1016.41 j	0.56**	0.53	3.71	0.21	1016.62	0.000	0.000	n/a	1.00	n/a
4	15	2.71	1013.75	1014.41	0.66	0.66	4.12	0.26	1014.67	0.000	31.102	1015.34	1016.00	0.66**	0.66	4.12	0.26	1016.26	0.000	0.000	n/a	1.00	0.26
5	15	1.02	1013.75	1014.15	0.40	0.33	3.00	0.14	1014.29	0.000	30.930	1014.06	1014.46 j	0.40**	0.33	3.05	0.14	1014.60	0.000	0.000	n/a	1.00	0.14
6	15	0.19	1013.48	1013.65	0.17	0.10	1.90	0.06	1013.71	0.000	36.725	1013.75	1013.92	0.17**	0.10	1.93	0.06	1013.98	0.000	0.000	n/a	1.00	0.06

Project File: 220822_UPDATED PIPE NETWORK.stm | Number of lines: 6 | Run Date: 8/26/2022

Notes: ; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box