STORMWATER REPORT

Firestone Complete Auto Care

3501 SW Market Street
Lee's Summit, MO 64082

Jackson County

Gresham Smith Project # 40831.45

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TABLE OF CONTENTS

Body of Report

General Information
Methodology
Existing Conditions Analysis
Proposed Conditions Analysis
Conclusions and Recommendations

Appendix A – Drainage Area Maps

Existing conditions Point of Interest Map
Proposed Conditions Point of Interest Map

Appendix B – Onsite Drainage Calculations

Hydraflow Hydrographs Runoff Reports for 2, 10 and 100 Year
Hydraflow Hydrographs Runoff Reports for 100 Year Clogged Primary Outlet

Appendix C – Water Quality Calculations

Appendix D – NRCS Soil Map

GENERAL INFORMATION

The proposed Firestone Auto Care store is located on approximately 1.237 acres at 3501 SW Market Street in Lee's Summit, Jackson County, Missouri. The site is currently undeveloped. Existing slopes range from 1 to 5 percent, draining to the northeast (see Appendix A). The proposed development is a one story, 6,262 square foot commercial auto maintenance store with associated parking and utilities. Existing drainage patterns will be preserved in the proposed design, with the addition of a detention pond for stormwater discharge management and quality.

Approximately 49.6% of the proposed site will consist of the building footprint and pavement, and the remaining 50.4% will be grass and landscaped areas. See Figure 1 for a further pre and post development breakdown. The soils onsite consist of 16.6% Arisburg-Urban land complex loam, classified as Hydrologic soil group C and 83.4% Udarents-Urban land-Sampsel complex, classified as Hydrologic soil group C according to the NRCS Web Soil Survey. Runoff coefficients for soil group C were used in the following analysis, see table 1 below. None of the project site is located within a Flood Zone according to FEMA map number 29095C0532G, revised January 20, 2017. The proposed area of disturbance is 1.60 acres.

Table 1: Soil Classification Table (based on NRCS Web Soil Survey)

Soil Classification Name	Slope	Hydrologic Soil Group
Arisburg-Urban land complex (16.6% of site)	1 to 5 percent	C
Udarents-urban land-sampsel complex (83.4% of site)	2 to 5 percent	C

METHODOLOGY:

The general design approach for calculating the storm water runoff at the project location came from the APWA (American Public Works Association) hydrology section 5602 and stormwater detention and retention section 5608. The SCS method was used to calculate the peak flow rates of runoff at two points of interest. The SCS method was also used to develop the baseline unit hydrograph. SCS curve numbers are based on APWA Section 5602.3, as the entirety of the site falls under hydrologic soils C (74 for pervious locations and 98 for impervious areas). Design storm rainfall depths are taken from NOAA's Precipitation Data Server for the 24 hour duration on the 2 year, 10 year and 100 year storm events. There is a water quality element for the detention pond that is designed to store the water and drain it out slowly over a 40 hour period.

EXISTING CONDITIONS ANALYSIS:

The 1.237 acre property and the surrounding locations is currently 100% pervious. From the existing drainage patterns, 2 points of interest can be identified. The first is the storm grate to the North of the site along SW Market Street while the second is where the sheet flow from the site and surrounding location becomes concentrated flow to the east. The following land use areas and curve numbers shown below in figure 1 were developed using the TR-55 data:

Figure 1: Existing Conditions Curve Number Summary Table

Curve Numbers - Soil Group C (POI 1)		
Land Use	Curve Number	Predeveloped Acres
Impervious	98	0.286
Semi-Pervious (Gravel)	88	0.000
Pervious (Open Space)	74	0.421
	Total Area	0.708
Composite Curve Number		84

Curve Numbers - Soil Group C (POI 2)		
Land Use	Curve Number	Predeveloped Acres
Impervious	98	0.000
Semi-Pervious (Gravel)	88	0.000
Pervious (Open Space)	74	2.421
	Total Area	2.421
Composite Curve Number		74

The point of interest's locations, flow paths and drainage areas can be found in Appendix A. The flow path for POI 1, using the TR-55 Tc worksheet available in Autocad Civil 3d's Hydraflow software resulted in a time of concentration of 9.6 minutes for existing conditions. The flow path for POI 2, using the TR-55 Tc worksheet available in Autocad Civil 3d's Hydraflow software resulted in a time of concentration of 9.8 minutes for existing conditions. Using the SCS method of calculating storm runoff to each point of interest, the following flow rates were obtained:

FS SITE	24-HOUR RAINFALL	PRE-DEVELOPED RUNOFF FOR POI 1	PRE-DEVELOPED RUNOFF FOR POI 2
RECURRENCE INTERVAL	(IN.)	(C.F.S.)	(C.F.S.)
2-YEAR STORM	3.68	2.343	5.230
10-YEAR STORM	5.61	4.214	10.990
100-YEAR STORM	9.17	7.681	22.65

Detailed calculations for the existing conditions for points of interest 1 and 2 can be found in Appendix B.

PROPOSED CONDITIONS ANALYSIS:

The proposed site grading reduces the storm peak discharge and volume of runoff from the site through the use of a detention pond and outlet control structure. The pond is located to the east of the proposed building. The pond's exact location and outfall may be seen on Drawing C3.1. The detention pond is 5.60 feet from the lowest pond bottom elevation to the top of berm.

The point of interests storm flows were determined using the method presented in Section 5602.6 of the APWA 5600 Manual. Post-developed conditions from the detention pond are not to exceed 3 cfs per acre for the 100 year storm event, 2 cfs per acre for the 10 year storm event or 0.5 cfs per acre for the 2 year storm event. The remainder of the peripheral drainage elements near the right of way will require a waiver, but have calculated such that the pre-developed versus post-developed conditions have improved. The comprehensive control strategy also includes a water quality element for the detention pond which specifies that a 40 hour extended detention be provided for the 1.37 inch 90% mean annual storm event. For this project, a detention basin is incorporated to achieve the water quality and storm water management requirements. Refer to the Hydraflow calculations provided in Appendix B for detailed stage-storage volumes for the pond.

The water surface elevation needed to achieve the required Water Quality Volume was calculated as 1012.69 from the Hydraflow pond stage-storage graph provided in Appendix D. An elevation of 1014.65 was taken as the bottom of the rectangular weir in the Hydraflow model used for detention calculations to ensure that the water quality volume and release rates are met.

The outlet of the detention pond will be a precast concrete control structure with a rectangular weir set above the water quality volume storage elevation calculated. See sheet C903 for details of the outlet structure and underdrain connection.

The detention pond's emergency spillway was designed such that the 1% storm WSE maintains and 0.5 foot freeboard from the bottom of the spillway elevation to the top of the 100 year water storage elevation under normal conditions. This is achieved by setting the top of the pond berm to an elevation of 1016.45 and the bottom of the emergency spillway to an elevation of 1015.90. The 1% WSE of 1015.38 (0.52 feet below the bottom elevation of the emergency spillway). The detailed calculations can be found in Appendix B, while a detail of the detention overflow spillway can be found on sheet C903. A 100' wide emergency overflow spillway was designed to achieve the requirements stated above. The emergency spillway was designed to pass the 1% storm event with greater than a 0.5 foot of freeboard from the design stage to the top of the dam. A waiver will be needed in lieu of reaching the required 1 foot of freeboard for the zero available storage in the basin and zero flow through the primary outlet of the structure during a 100 year storm event.

Figure 2 shows the detailed breakdown of land use types used in calculating the curve numbers, using a Hydrologic Soil Group C.

Figure 1: Proposed Condition Curve Number Summary Table

Curve Numbers - Soil Group C (POI 1)		
Land Use	Curve Number	Post Developed Acres
Impervious	98	0.353
Semi-Pervious (Gravel)	88	0.000
Pervious (Open Space)	74	0.176
	Total Area	0.529
	Composite Curve Number	90

Curve Numbers - Soil Group C (POI 2)		
Land Use	Curve Number	To Pond Acres
Impervious	98	0.581
Semi-Pervious (Gravel)	88	0.000
Pervious (Open Space)	74	0.439
Total Area		1.020
Composite Curve Number		88

Curve Numbers - Soil Group C (POI 2)		
Land Use	Curve Number	Remainder of Post Developed Acres
Impervious	98	0.439
Semi-Pervious (Gravel)	88	0.000
Pervious (Open Space)	74	2.221
Total Area		2.660
Composite Curve Number		78

Figure 3: Stormwater Discharge Summary Table

FS SITE	24-HOUR RAINFALL	POST-DEVELOPED RUNOFF FOR POI 1	POST-DEVELOPED RUNOFF FOR POI 2	SITE DRAINAGE THRU DETENTION POND	POND WATER SURFACE ELEVATION	POND STORAGE VOLUME	FREE BOARD
RECURRENCE INTERVAL	(IN.)	(C.F.S.)	(C.F.S.)	(C.F.S.)	(FT.)	(CU. FT.)	(FT.)
2-YEAR STORM	3.68	2.248	3.581	0.043	1013.41	5,573	2.94
10-YEAR STORM	5.61	3.714	7.487	0.060	1014.62	10,492	1.73
100-YEAR STORM	9.17	6.376	16.55	3.021	1015.38	14,287	0.97

Stormwater quality is achieved through the use of an extended dry detention pond. The detention pond will provide temporary storage of stormwater runoff allowing settlement of suspended solids over a period of 40 hours. The reduction in flow from the pre-developed to post-developed conditions will correlate to a water quality improvement for the site and allow for TSS removal. Water Quality Volume required by the city of Lee's Summit is found by the equation below, given in Section 5600 of the Comprehensive Control Strategy Design and Construction Manual.

$$WQv = 1.37 * 0.05 + 0.009(Percent\ site\ imperviousness)$$

The percent site imperviousness will be 56.4%, yielding a required Water Quality Volume of 2,828 cubic feet. Adding in an additional 20%, a water quality volume of 3,394.15 cubic feet was used for design of this site.

An Extended Dry Detention Basin will be used to achieve the water quality requirement. A 4" perforated PVC riser will connect to the structure. The end of the PVC riser will be capped and a 1" water quality orifice drilled in the end cap and will dewater the pond in approximately 40 hours. The depth of water quality volume was found to be 1.94' (required water quality volume = 1012.69 – water quality orifice elevation = 1010.75) using the stage-storage table from Hydraflow as shown in Appendix D. A water quality elevation of 1014.65 was used in design of this site.

CONCLUSIONS AND RECOMMENDATIONS:

The flate release rates for the 2, 10 and 100 year storm events are achieved through the use of an extended dry detention basin, while the post development drainage patterns will match the existing conditions drainage pattern in the peripheral drainage areas flowing to tow (2) separate points of interest. The development of a Firestone Complete Auto Care store is proposed on an existing tract on 100% pervious land. This proposed site will consist of 56.4% impervious area. The majority of the 1.237 acre site (approximately 1.02 acres) will be routed through an extended dry detention pond utilizing a water quality and flow release element, as specified in Lee's Summit Design and Construction Manual (DCM). Two (2) points of interests were used in analysis of comparing existing conditions versus post-construction conditions for the peripheral drainage areas. Detailed drainage areas and calculations can be found in Appendix A and B, respectively. The following table summarizes the runoff conditions for this development:

		Peripheral Drainage		Peripheral Drainage		Flat release rate			
FS SITE	24-HOUR RAINFALL	PRE-DEVELOPED RUNOFF FOR POI 1	POST-DEVELOPED RUNOFF FOR POI 1	PRE-DEVELOPED RUNOFF FOR POI 2	POST-DEVELOPED RUNOFF FOR POI 2	SITE DRAINAGE THRU DETENTION POND	POND WATER SURFACE ELEVATION	POND STORAGE VOLUME	FREE BOARD
RECURRENCE INTERVAL	(IN.)	(C.F.S.)	(C.F.S.)	(C.F.S.)	(C.F.S.)	(C.F.S.)	(FT.)	(CU. FT.)	(FT.)
2-YEAR STORM	3.68	2.34	2.248	5.23	3.581	0.043	1013.41	5,573	3.04
10-YEAR STORM	5.61	4.21	3.714	10.99	7.487	0.060	1014.62	10,492	1.83
100-YEAR STORM	9.17	7.68	6.376	22.65	16.55	3.021	1015.38	14,287	1.07
	Top of berm		1016.45						

In accordance with the Lee's Summit Design and Construction Manual (DCM) Section 1002.A, the proposed Firestone site will apply for a modification to the following specification:

Perimeter drainage issue which will include specific citations of the Design and Construction Manual related to the peak discharge requirements, as well as supporting documentation, in particular a comparison between pre-development versus post-development peak flow rates for the peripheral areas. The emergency spillway was designed to pass the 1% storm event with greater than a 0.5 foot of freeboard from the design stage to the top of the dam. A waiver will be needed in lieu of reaching the required 1 foot of freeboard for the zero available storage in the basin and zero flow through the primary outlet of the structure during a 100 year storm event.

APPENDIX A

Drainage Area Maps

EXISTING CONDITIONS ANALYSIS (POI 1):

DRAINAGE STUDY AREA = 0.708 ACRES
IMPERVIOUS AREA (CN = 98) = 0.286 ACRES
PERVIOUS AREA, OPEN SPACE (CN = 74) = 0.421 ACRES
COMPOSITE CURVE NUMBER, CN = 84
TIME OF CONCENTRATION = 9.60 MINUTES
PEAK RUNOFF (100 YEAR STORM) = 7.68 CFS

EXISTING CONDITIONS ANALYSIS (POI 2):

DRAINAGE STUDY AREA = 2.421 ACRES
IMPERVIOUS AREA (CN = 98) = 0.000 ACRES
PERVIOUS AREA, OPEN SPACE (CN = 74) = 2.421 ACRES
COMPOSITE CURVE NUMBER, CN = 74
TIME OF CONCENTRATION = 9.8 MINUTES
PEAK RUNOFF (100 YEAR STORM) = 22.65 CFS

POI # 1

POI 1TIME OF CONCENTRATION FLOW PATH
Tc = 9.60 MINUTES

POI 1 PROJECT AREA IN EXISTING CONDITONS

POI 2 TIME OF CONCENTRATION FLOW PATH
Tc = 9.80 MINUTES

POI 2 PROJECT AREA IN EXISTING CONDITONS

POI # 2

NORTH

50' 0 50' 100'
GRAPHIC SCALE

LEGEND

IMPERVIOUS

PERVIOUS (OPEN SPACE)

EXISTING CONDITIONS

PROPOSED CONDITIONS ANALYSIS (POI 1):

DRAINAGE STUDY AREA = 0.529 ACRES
IMPERVIOUS AREA (CN = 98) = 0.353 ACRES
PERVIOUS AREA, OPEN SPACE (CN = 74) = 0.176 ACRES
COMPOSITE CURVE NUMBER, CN = 90
TIME OF CONCENTRATION = 5 MINUTES
PEAK RUNOFF (100 YEAR STORM WITH DETENTION) = 6.376 CFS

PROPOSED CONDITIONS ANALYSIS (POI 2):

DRAINAGE STUDY AREA = 2.660 ACRES
IMPERVIOUS AREA (CN = 98) = 0.439 ACRES
PERVIOUS AREA, OPEN SPACE (CN = 74) = 2.221 ACRES
COMPOSITE CURVE NUMBER, CN = 78
TIME OF CONCENTRATION = 5 MINUTES
PEAK RUNOFF (100 YEAR STORM WITH DETENTION) = 16.55 CFS

PROPOSED DRAINAGE AREA TO DETENTION POND:

DRAINAGE AREA = 1.020 ACRES
IMPERVIOUS AREA (CN = 98) = 0.581 ACRES
PERVIOUS AREA, OPEN SPACE (CN = 74) = 0.439 ACRES
COMPOSITE CURVE NUMBER, CN = 88
TIME OF CONCENTRATION = 5 MINUTES

NORTH

60' 0 60' 120'

GRAPHIC SCALE

LEGEND

IMPERVIOUS

PERVIOUS (OPEN SPACE)

PROPOSED SITE BYPASS

POI 1 PROJECT AREA IN PROPOSED CONDITIONS

POI # 1

POI 2 PROJECT AREA IN FUTURE CONDITIONS

100' WIDE EMERGENCY SPILLWAY ELEV. = 1015.90

SITE

DETENTION POND
100-YEAR W.S.E. = 1015.38

POI # 2

PROPOSED CONDITIONS

DASHED LINE REPRESENTS DRAINAGE AREA TO THE PROPOSED DETENTION POND

STORM SEWER MANHOLE
TOP ELEV. 1010.47
16"PIPE FL NW. 1006.87
16"PIPE FL SE. 1007.07

STORM SEWER MANHOLE
TOP ELEV. 1010.18
16"PIPE FL NW. 1006.98

STORM SEWER MANHOLE
TOP ELEV. 1016.40
16"PIPE FL S. 1013.30

STORM SEWER MANHOLE
TOP ELEV. 1015.41
48"PIPE FL E. 1003.11
48"PIPE FL W. 1002.06

STORM SEWER MANHOLE
TOP ELEV. 1013.65
48"PIPE FL N. 1001.40
48"PIPE FL S. 1001.45

STORM SEWER MANHOLE
TOP ELEV. 1005.06
36"PIPE FL W. 999.76
36"PIPE FL E. 999.66

30"CPP FL N. 999.37

STORM SEWER MANHOLE

48"CMP

12"CPP FL 998.81

8"FW

6"FW

1"W

APPENDIX B

Onsite Drainage Calculations

Hydraflow Table of Contents

Watershed Model Schematic **1**

Hydrograph Return Period Recap **2**

2 - Year

Summary Report **3**

Hydrograph Reports **4**

Hydrograph No. 2, SCS Runoff, Existing to POI 1 4

TR-55 Tc Worksheet 5

Hydrograph No. 4, SCS Runoff, Proposed to POI 1 6

Hydrograph No. 6, SCS Runoff, Existing to POI 2 7

Hydrograph No. 8, SCS Runoff, Prop to Detention Pond 8

Hydrograph No. 10, Reservoir, Detention Pond 9

Pond Report - Detention Pond 10

Hydrograph No. 12, SCS Runoff, Remainder Prop to POI 2 11

Hydrograph No. 14, Combine, Total to POI 2 12

10 - Year

Summary Report **13**

Hydrograph Reports **14**

Hydrograph No. 2, SCS Runoff, Existing to POI 1 14

Hydrograph No. 4, SCS Runoff, Proposed to POI 1 15

Hydrograph No. 6, SCS Runoff, Existing to POI 2 16

Hydrograph No. 8, SCS Runoff, Prop to Detention Pond 17

Hydrograph No. 10, Reservoir, Detention Pond 18

Hydrograph No. 12, SCS Runoff, Remainder Prop to POI 2 19

Hydrograph No. 14, Combine, Total to POI 2 20

100 - Year

Summary Report **21**

Hydrograph Reports **22**

Hydrograph No. 2, SCS Runoff, Existing to POI 1 22

Hydrograph No. 4, SCS Runoff, Proposed to POI 1 23

Hydrograph No. 6, SCS Runoff, Existing to POI 2 24

Hydrograph No. 8, SCS Runoff, Prop to Detention Pond 25

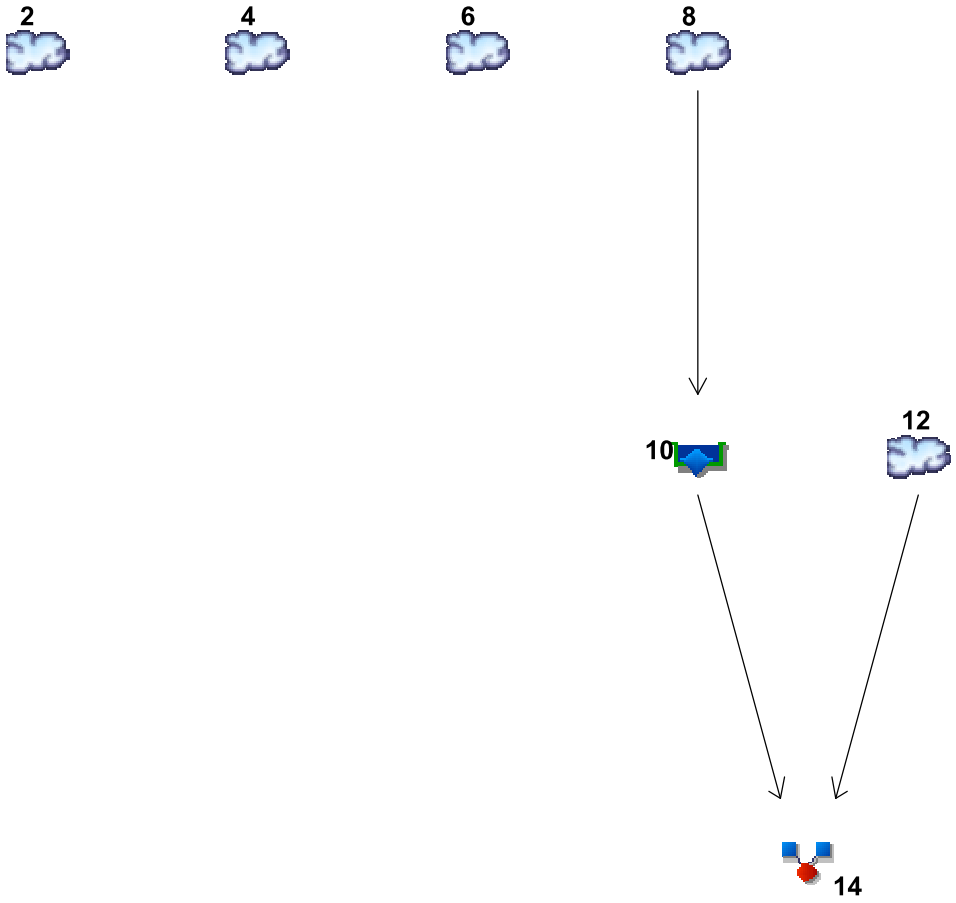
Hydrograph No. 10, Reservoir, Detention Pond 26

Hydrograph No. 12, SCS Runoff, Remainder Prop to POI 2 27

Hydrograph No. 14, Combine, Total to POI 2 28

IDF Report **29**

Watershed Model Schematic



Legend

Hyd.	Origin	Description
2	SCS Runoff	Existing to POI 1
4	SCS Runoff	Proposed to POI 1
6	SCS Runoff	Existing to POI 2
8	SCS Runoff	Prop to Detention Pond
10	Reservoir	Detention Pond
12	SCS Runoff	Remainder Prop to POI 2
14	Combine	Total to POI 2

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	
2	SCS Runoff	------	-------	2.343	-------	-------	4.214	-------	-------	7.681	Existing to POI 1
4	SCS Runoff	------	-------	2.248	-------	-------	3.714	-------	-------	6.376	Proposed to POI 1
6	SCS Runoff	------	-------	5.230	-------	-------	10.99	-------	-------	22.65	Existing to POI 2
8	SCS Runoff	------	-------	4.086	-------	-------	6.926	-------	-------	12.10	Prop to Detention Pond
10	Reservoir	8	-------	0.043	-------	-------	0.060	-------	-------	3.021	Detention Pond
12	SCS Runoff	------	-------	3.543	-------	-------	7.442	-------	-------	15.34	Remainder Prop to POI 2
14	Combine	10, 12,	-------	3.581	-------	-------	7.487	-------	-------	16.55	Total to POI 2

Hydrograph Summary Report

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

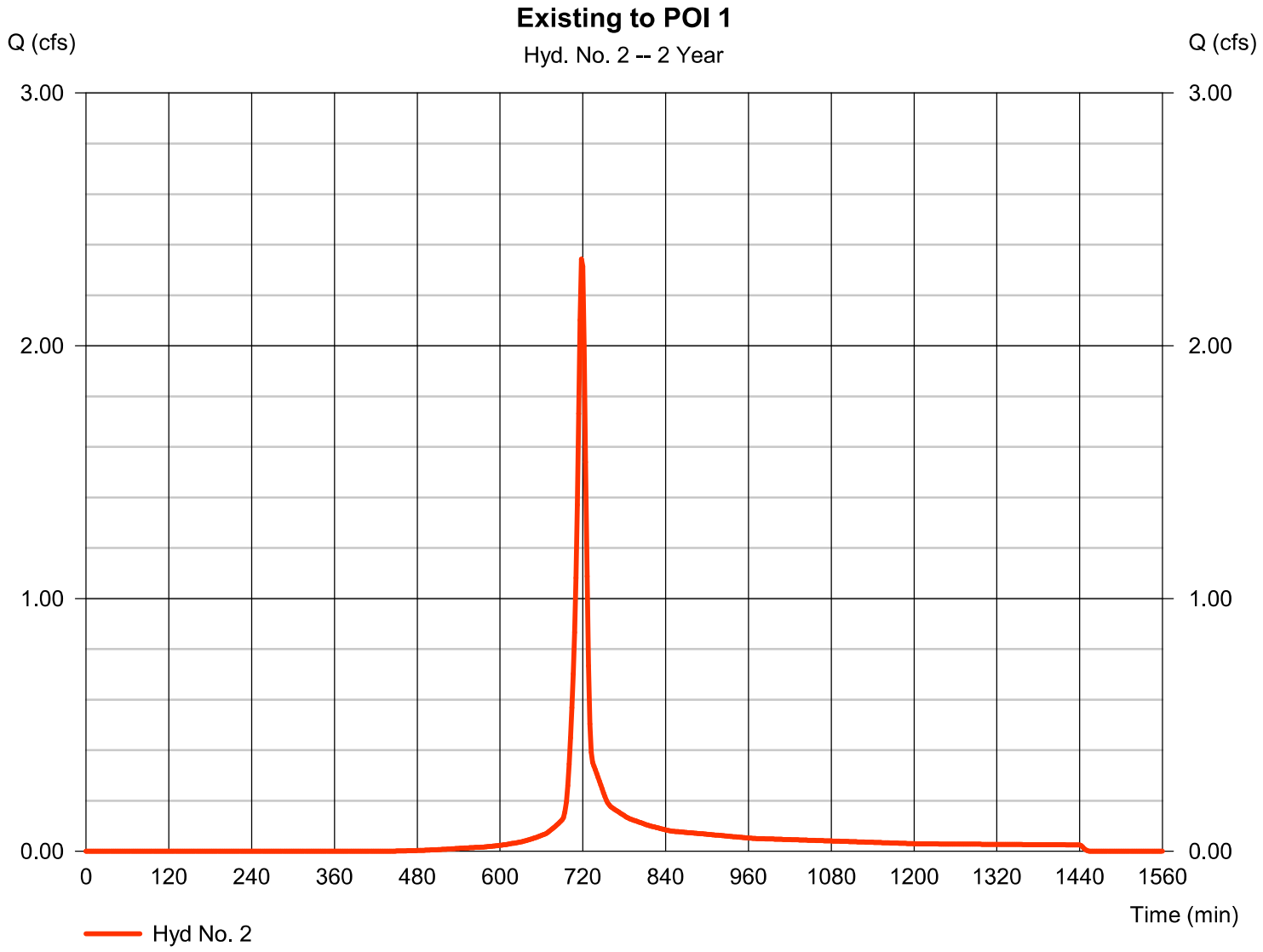
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
2	SCS Runoff	2.343	2	718	5,375	------	------	------	Existing to POI 1
4	SCS Runoff	2.248	2	716	4,711	------	------	------	Proposed to POI 1
6	SCS Runoff	5.230	2	720	12,002	------	------	------	Existing to POI 2
8	SCS Runoff	4.086	2	716	8,447	------	------	------	Prop to Detention Pond
10	Reservoir	0.043	2	954	4,837	8	1013.41	5,573	Detention Pond
12	SCS Runoff	3.543	2	720	8,130	------	------	------	Remainder Prop to POI 2
14	Combine	3.581	2	720	12,967	10, 12,	------	------	Total to POI 2

Hydrograph Report

Hyd. No. 2

Existing to POI 1

Hydrograph type	= SCS Runoff	Peak discharge	= 2.343 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 5,375 cuft
Drainage area	= 0.708 ac	Curve number	= 84
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.60 min
Total precip.	= 3.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 2

Existing to POI 1

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)	= 3.68		0.00		0.00		
Land slope (%)	= 2.24		0.00		0.00		
Travel Time (min)	**= 8.73**	**+**	**0.00**	**+**	**0.00**	**=**	**8.73**
Shallow Concentrated Flow							
Flow length (ft)	= 100.00		0.00		0.00		
Watercourse slope (%)	= 1.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.98		0.00		0.00		
Travel Time (min)	**= 0.84**	**+**	**0.00**	**+**	**0.00**	**=**	**0.84**
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**

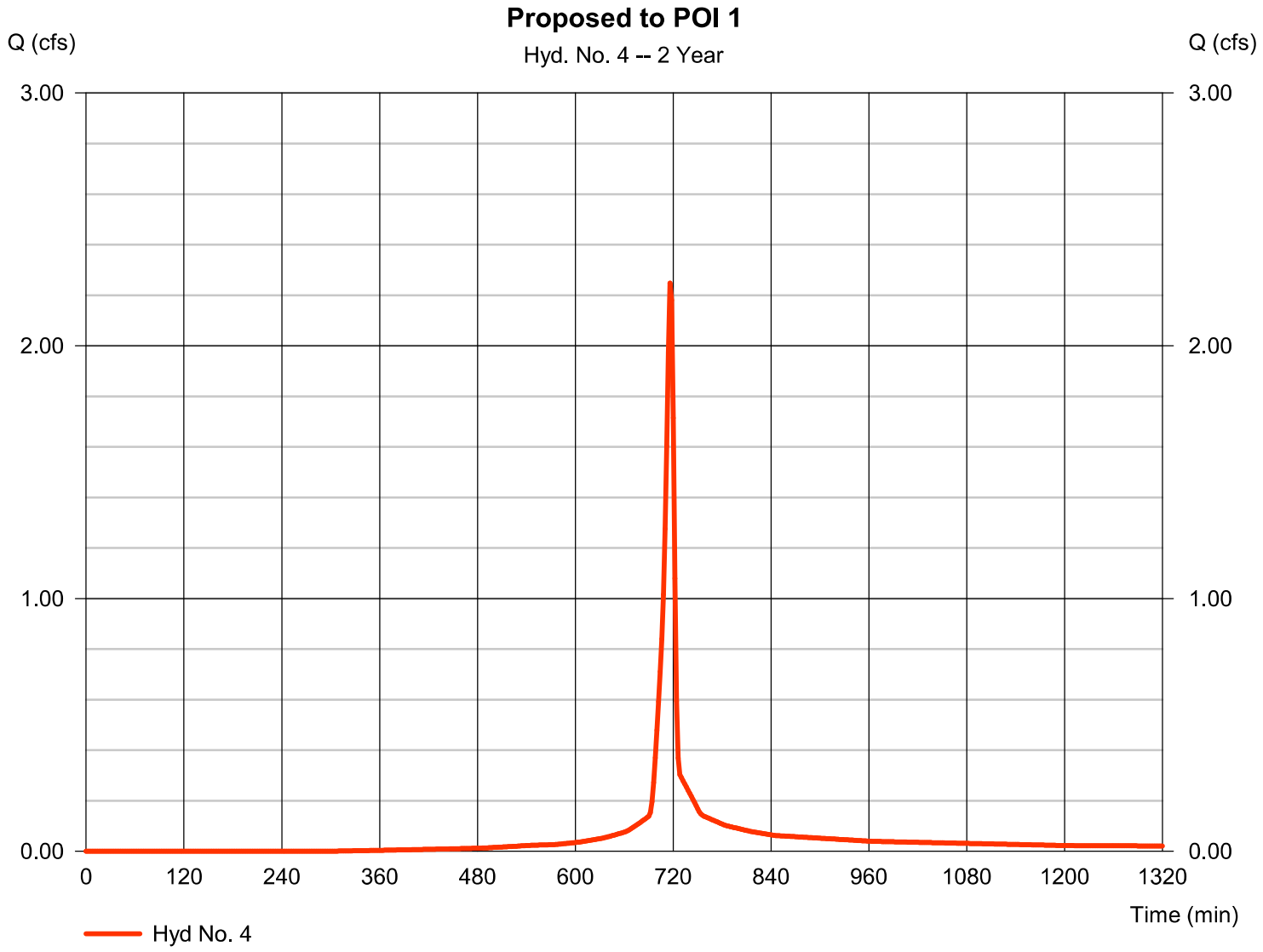
Total Travel Time, Tc ..... 9.60 min

Hydrograph Report

Hyd. No. 4

Proposed to POI 1

Hydrograph type	= SCS Runoff	Peak discharge	= 2.248 cfs
Storm frequency	= 2 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 4,711 cuft
Drainage area	= 0.529 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

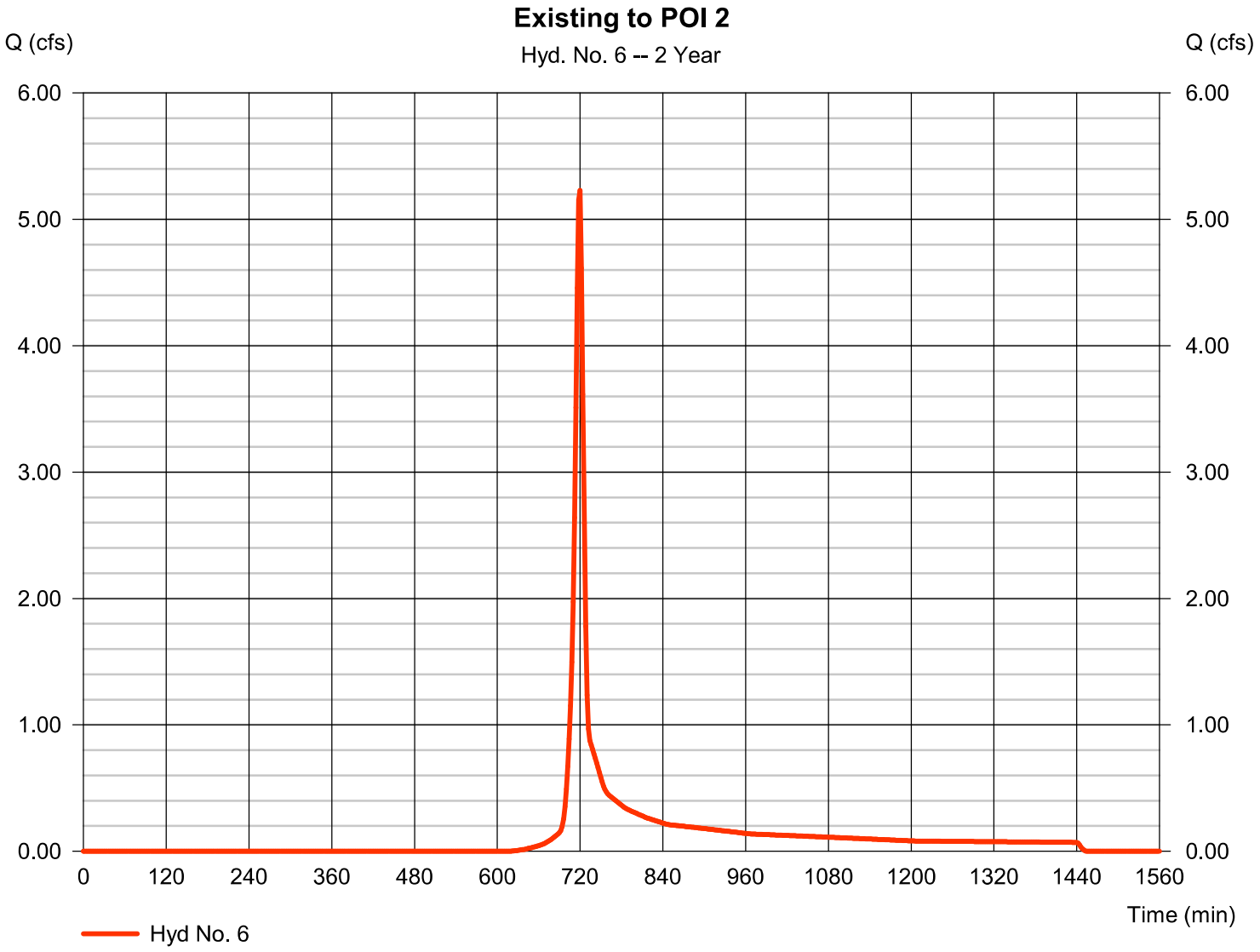


Hydrograph Report

Hyd. No. 6

Existing to POI 2

Hydrograph type	= SCS Runoff	Peak discharge	= 5.230 cfs
Storm frequency	= 2 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 12,002 cuft
Drainage area	= 2.421 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.80 min
Total precip.	= 3.68 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

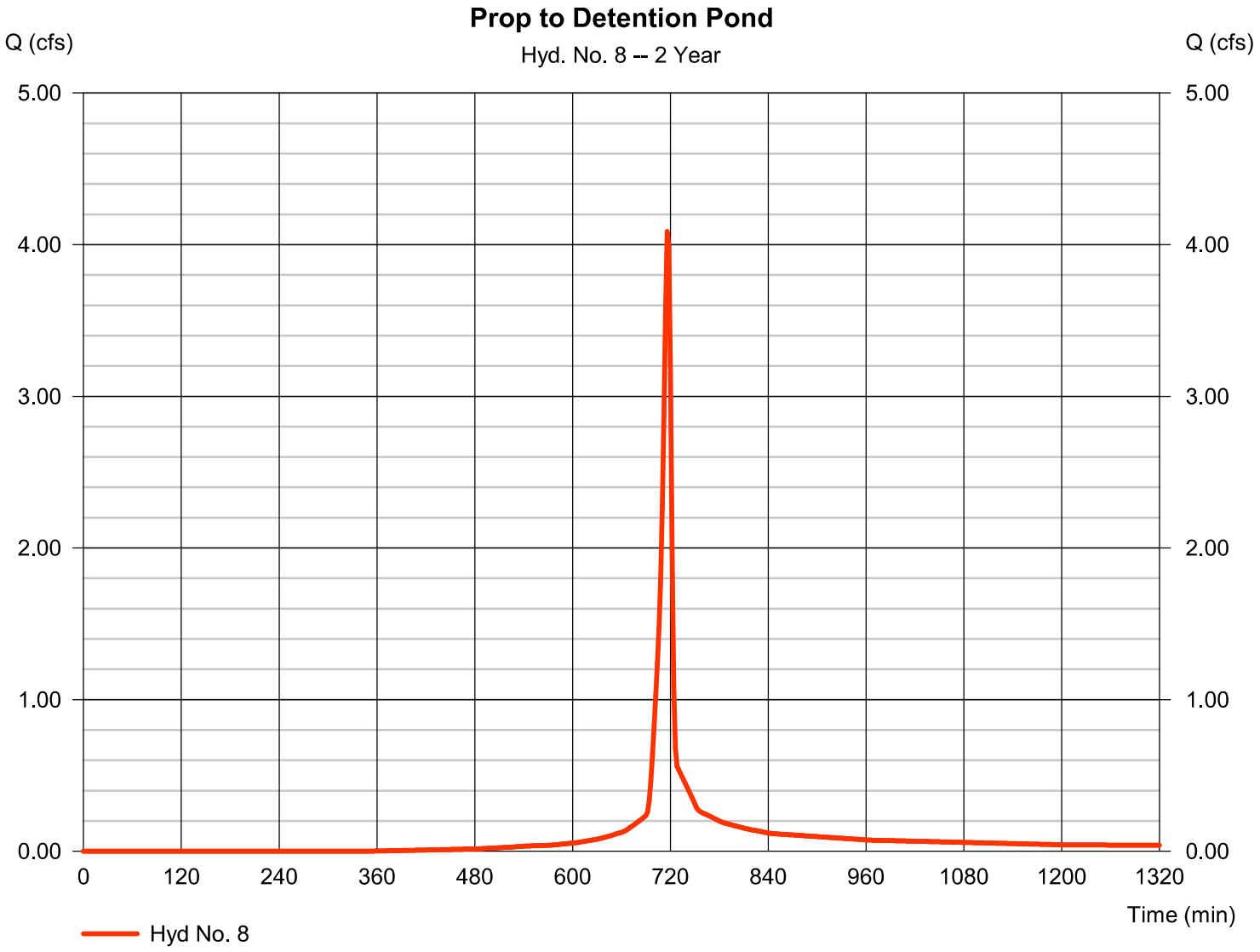


Hydrograph Report

Hyd. No. 8

Prop to Detention Pond

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.086 cfs
Storm frequency	=	2 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	8,447 cuft
Drainage area	=	1.020 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	3.68 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



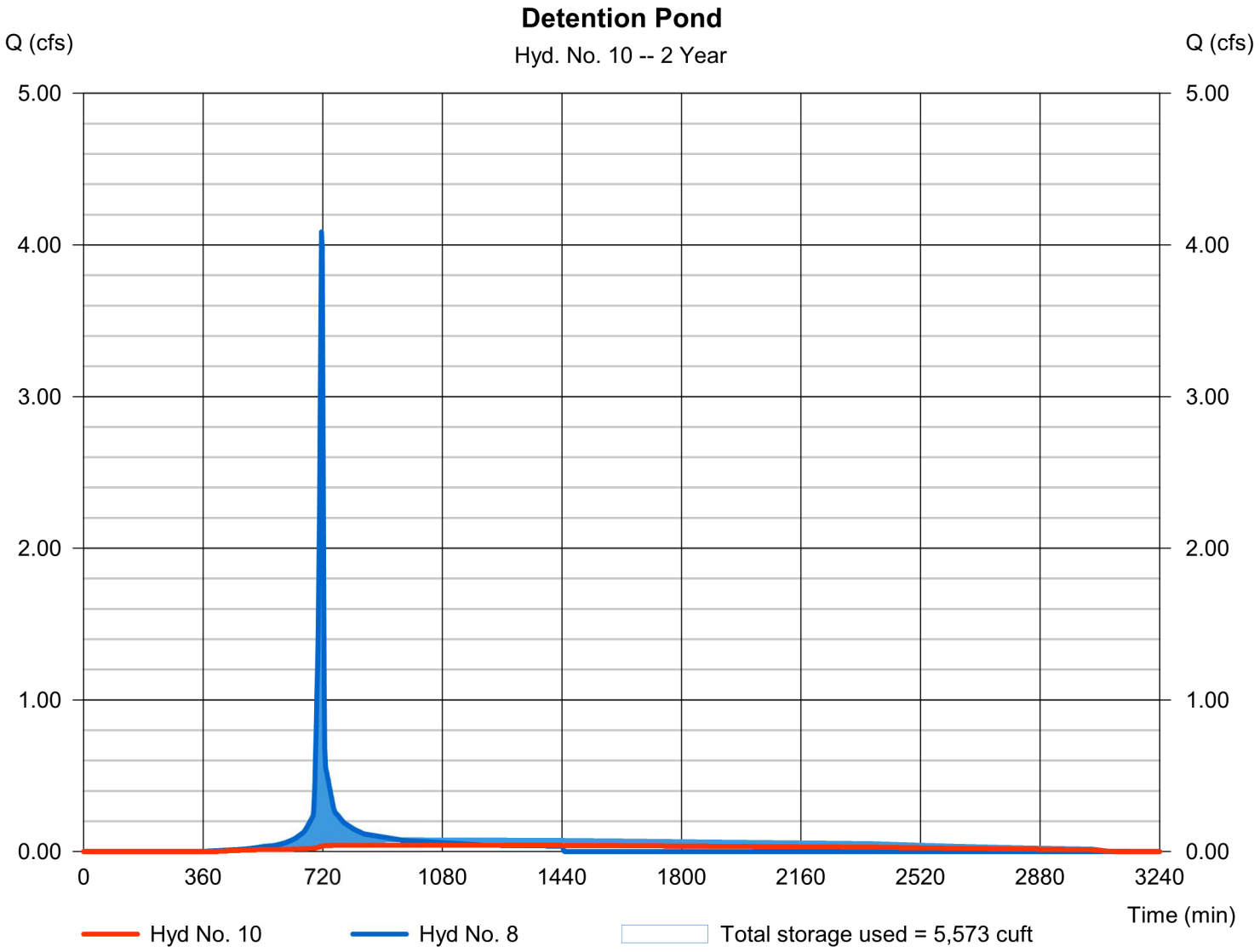
Hydrograph Report

Hyd. No. 10

Detention Pond

Hydrograph type	= Reservoir	Peak discharge	= 0.043 cfs
Storm frequency	= 2 yrs	Time to peak	= 954 min
Time interval	= 2 min	Hyd. volume	= 4,837 cuft
Inflow hyd. No.	= 8 - Prop to Detention Pond	Max. Elevation	= 1013.41 ft
Reservoir name	= Detention Pond	Max. Storage	= 5,573 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 1 - Detention Pond

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1010.75 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1010.75	05	0	0
0.25	1011.00	429	40	40
1.25	1012.00	2,392	1,278	1,318
2.25	1013.00	3,167	2,770	4,088
3.25	1014.00	4,039	3,594	7,682
4.25	1015.00	5,010	4,515	12,197
5.25	1016.00	6,079	5,535	17,733
5.70	1016.45	6,483	2,826	20,558

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	1.00	0.00	0.00
Span (in)	= 12.00	1.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 1010.65	1010.75	0.00	0.00
Length (ft)	= 30.00	0.50	0.00	0.00
Slope (%)	= 0.50	0.50	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 11.00	100.00	1.00	0.00
Crest El. (ft)	= 1015.30	1015.90	1014.65	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	Rect	---
Multi-Stage	= Yes	No	Yes	No

Exfil.(in/hr) = 0.420 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

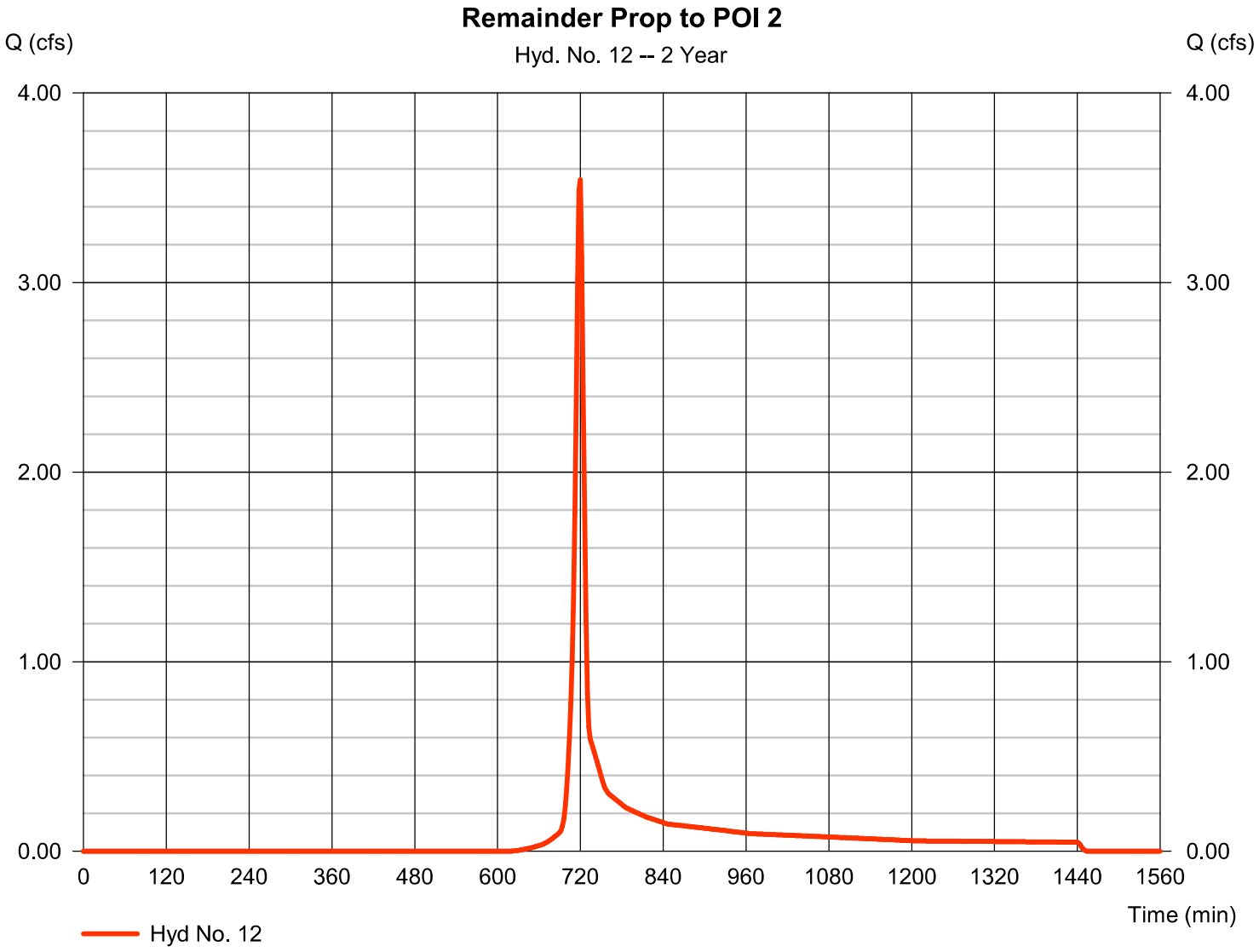
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1010.75	0.00	0.00	---	---	0.00	0.00	0.00	---	0.000	---	0.000
0.25	40	1011.00	0.04 ic	0.01 ic	---	---	0.00	0.00	0.00	---	0.004	---	0.016
1.25	1,318	1012.00	0.04 ic	0.03 ic	---	---	0.00	0.00	0.00	---	0.023	---	0.052
2.25	4,088	1013.00	0.04 ic	0.04 ic	---	---	0.00	0.00	0.00	---	0.031	---	0.070
3.25	7,682	1014.00	0.04 ic	0.05 ic	---	---	0.00	0.00	0.00	---	0.039	---	0.086
4.25	12,197	1015.00	0.70 oc	0.05 ic	---	---	0.00	0.00	0.69	---	0.049	---	0.792
5.25	17,733	1016.00	8.31 ic	0.06 ic	---	---	6.98 s	10.53	1.32 s	---	0.059	---	18.95
5.70	20,558	1016.45	8.70 ic	0.06 ic	---	---	7.56 s	135.82	1.13 s	---	0.063	---	144.65

Hydrograph Report

Hyd. No. 12

Remainder Prop to POI 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.543 cfs
Storm frequency	=	2 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	8,130 cuft
Drainage area	=	1.640 ac	Curve number	=	74
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	9.80 min
Total precip.	=	3.68 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

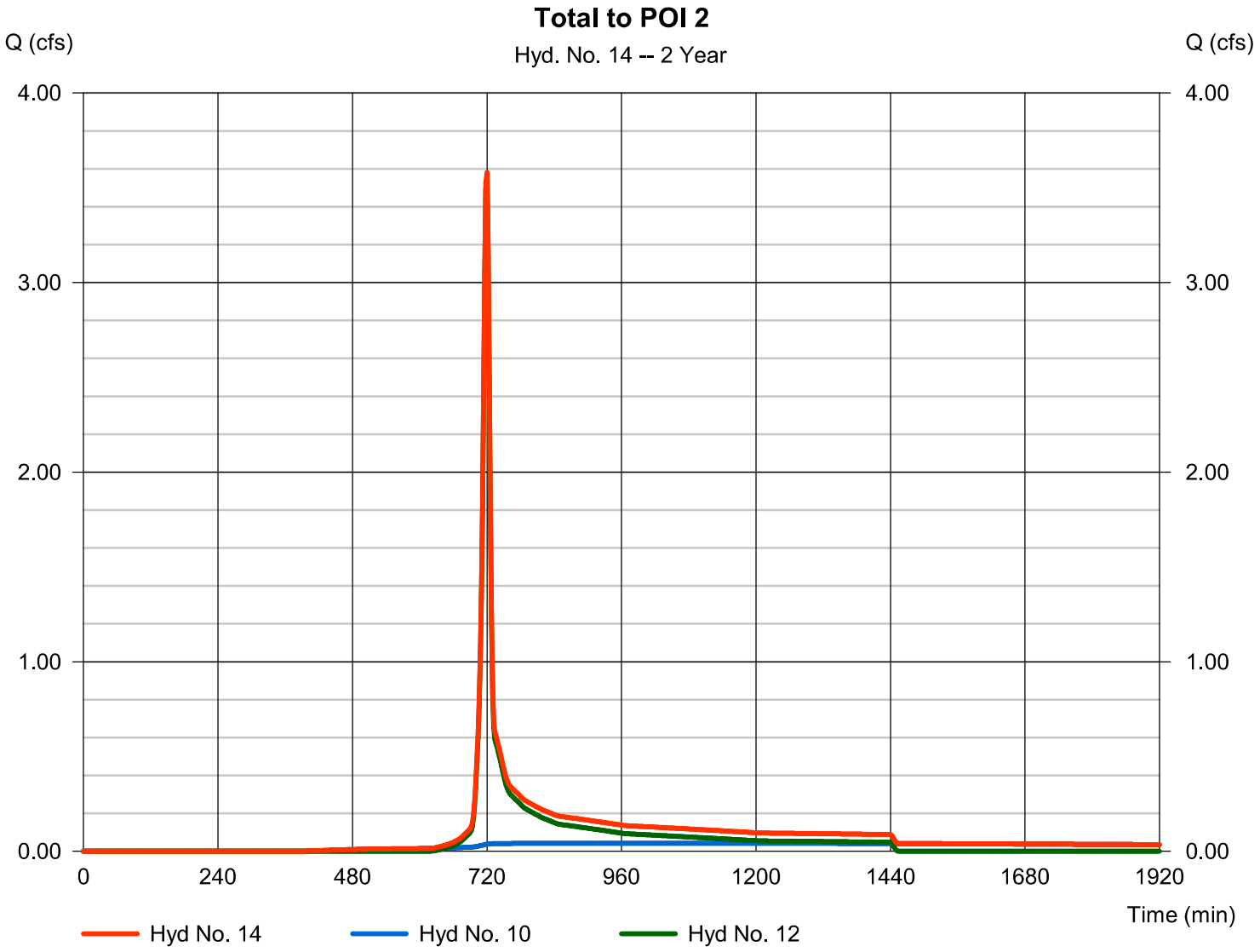


Hydrograph Report

Hyd. No. 14

Total to POI 2

Hydrograph type	=	Combine	Peak discharge	=	3.581 cfs
Storm frequency	=	2 yrs	Time to peak	=	720 min
Time interval	=	2 min	Hyd. volume	=	12,967 cuft
Inflow hyds.	=	10, 12	Contrib. drain. area	=	1.640 ac



Hydrograph Summary Report

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

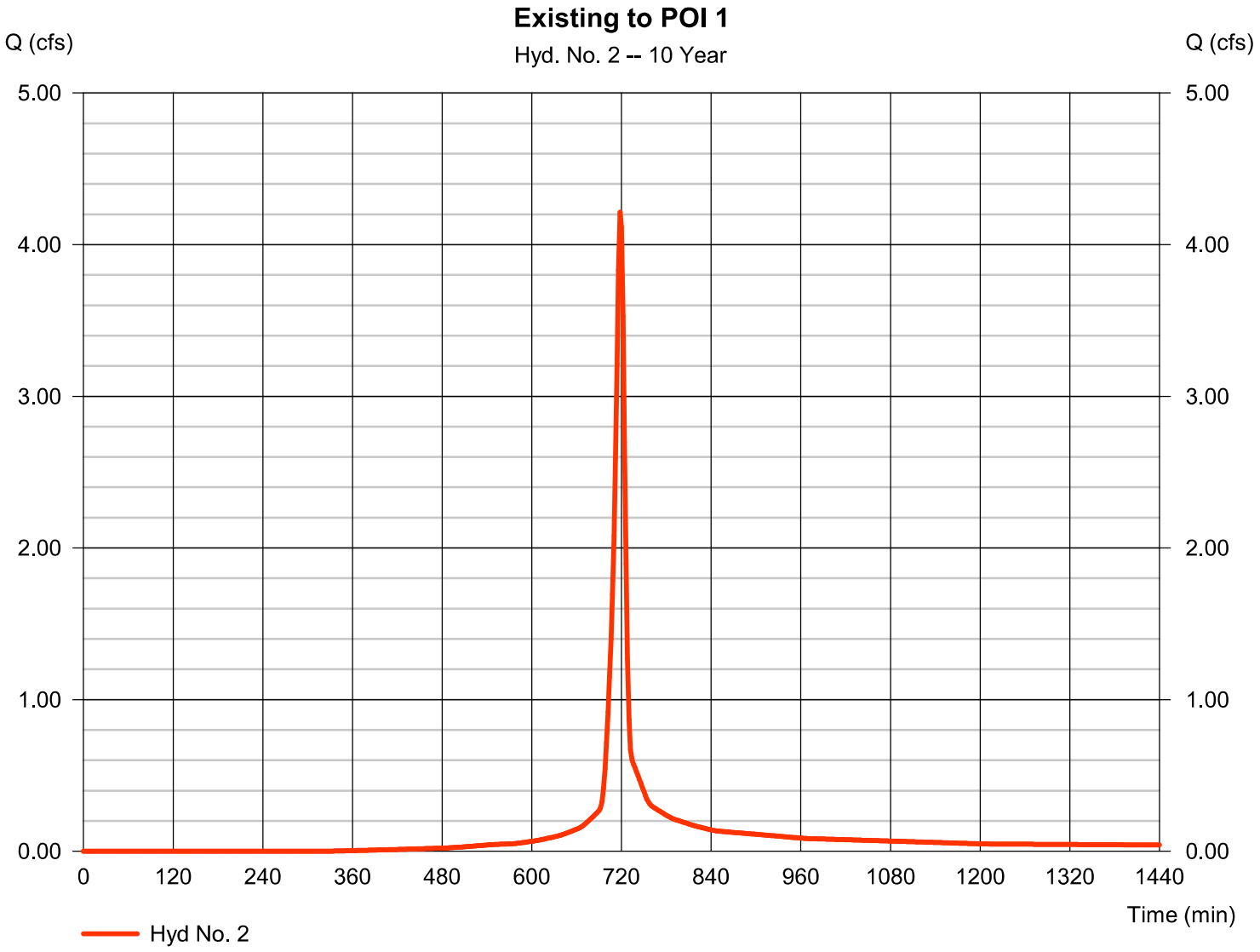
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
2	SCS Runoff	4.214	2	718	9,851	------	------	------	Existing to POI 1
4	SCS Runoff	3.714	2	716	8,041	------	------	------	Proposed to POI 1
6	SCS Runoff	10.99	2	718	25,132	------	------	------	Existing to POI 2
8	SCS Runoff	6.926	2	716	14,757	------	------	------	Prop to Detention Pond
10	Reservoir	0.060	2	1026	8,257	8	1014.62	10,492	Detention Pond
12	SCS Runoff	7.442	2	718	17,025	------	------	------	Remainder Prop to POI 2
14	Combine	7.487	2	718	25,281	10, 12,	------	------	Total to POI 2

Hydrograph Report

Hyd. No. 2

Existing to POI 1

Hydrograph type	= SCS Runoff	Peak discharge	= 4.214 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 9,851 cuft
Drainage area	= 0.708 ac	Curve number	= 84
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.60 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

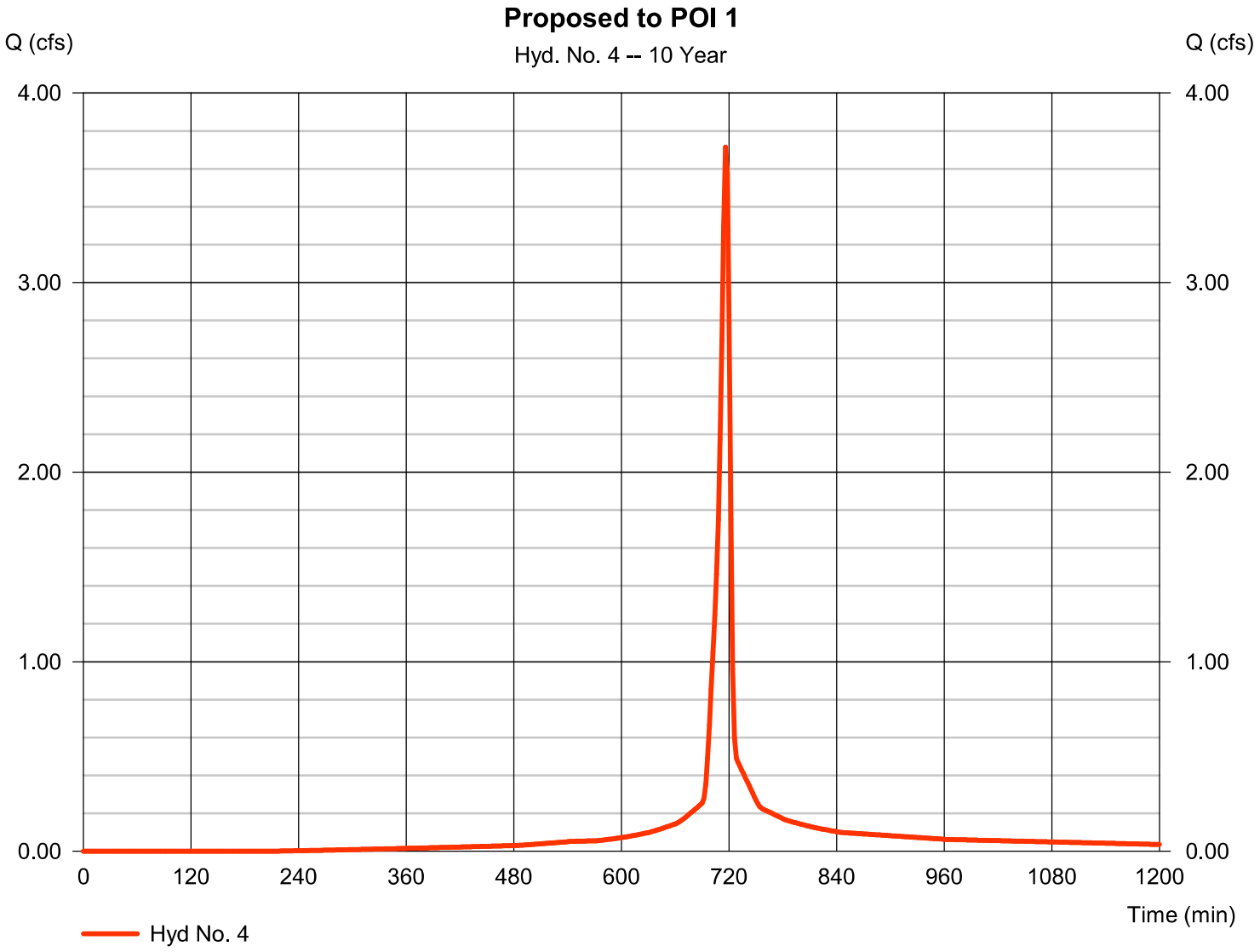


Hydrograph Report

Hyd. No. 4

Proposed to POI 1

Hydrograph type	= SCS Runoff	Peak discharge	= 3.714 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 8,041 cuft
Drainage area	= 0.529 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

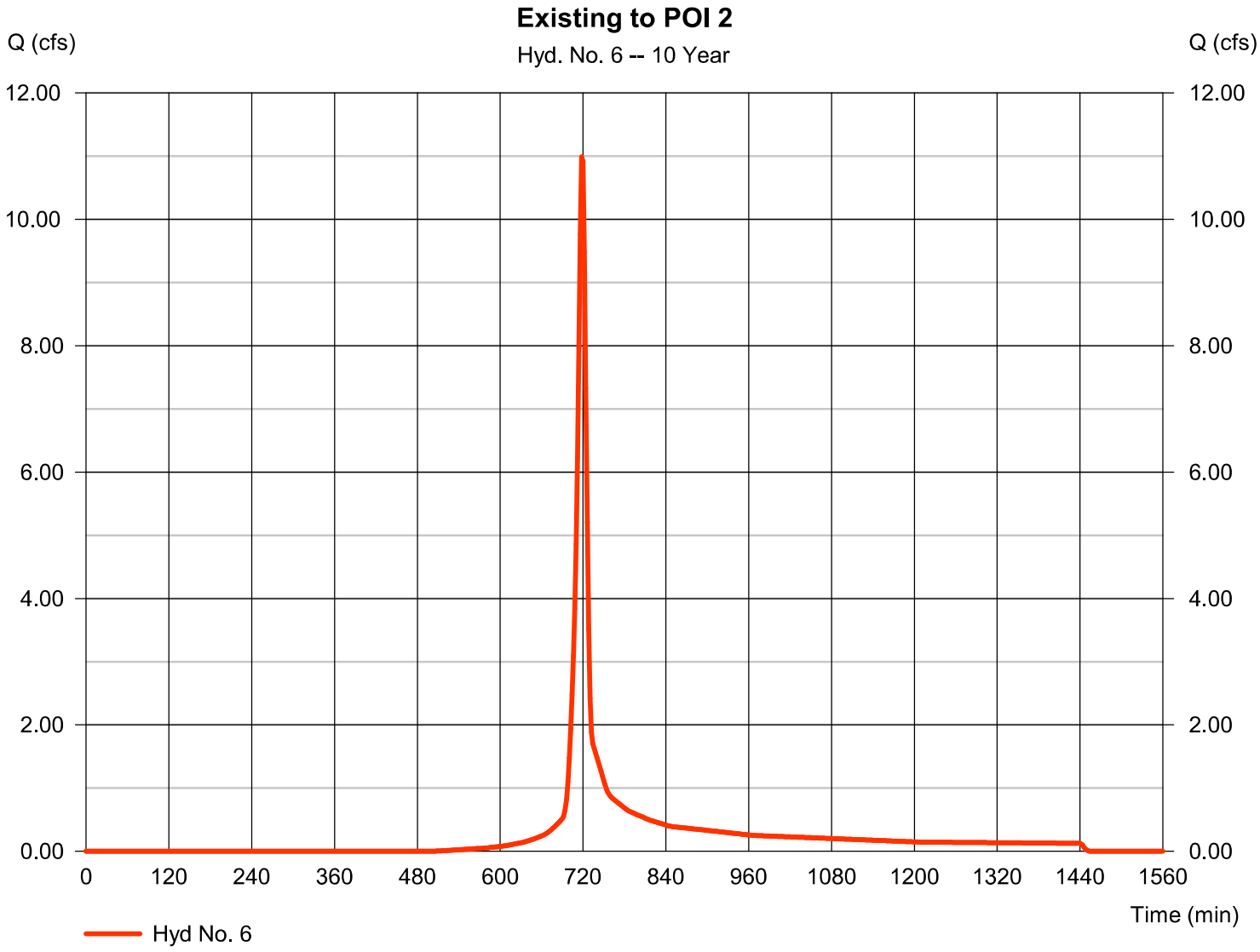


Hydrograph Report

Hyd. No. 6

Existing to POI 2

Hydrograph type	= SCS Runoff	Peak discharge	= 10.99 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 25,132 cuft
Drainage area	= 2.421 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.80 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

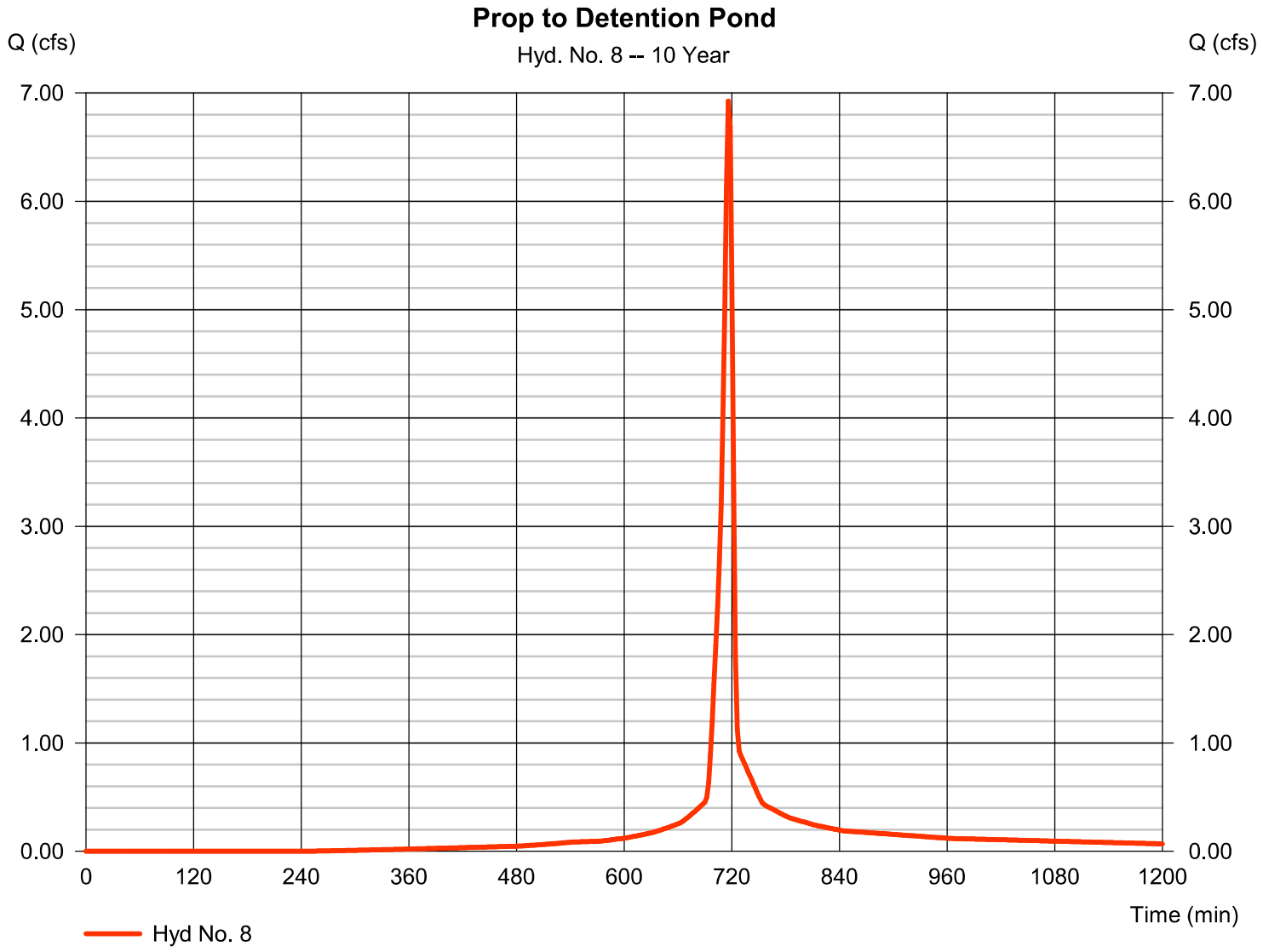


Hydrograph Report

Hyd. No. 8

Prop to Detention Pond

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.926 cfs
Storm frequency	=	10 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	14,757 cuft
Drainage area	=	1.020 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	5.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



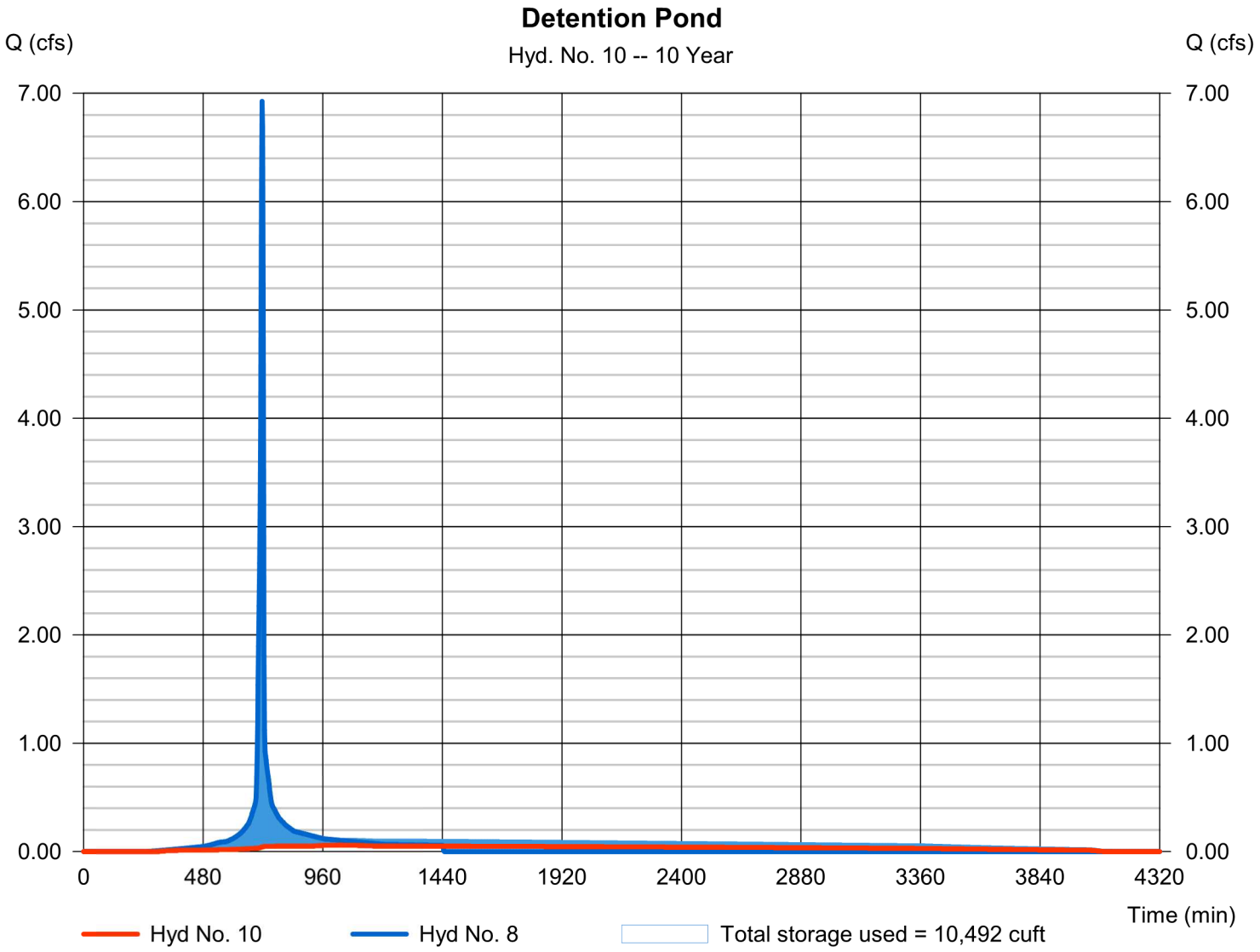
Hydrograph Report

Hyd. No. 10

Detention Pond

Hydrograph type	=	Reservoir	Peak discharge	=	0.060 cfs
Storm frequency	=	10 yrs	Time to peak	=	1026 min
Time interval	=	2 min	Hyd. volume	=	8,257 cuft
Inflow hyd. No.	=	8 - Prop to Detention Pond	Max. Elevation	=	1014.62 ft
Reservoir name	=	Detention Pond	Max. Storage	=	10,492 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

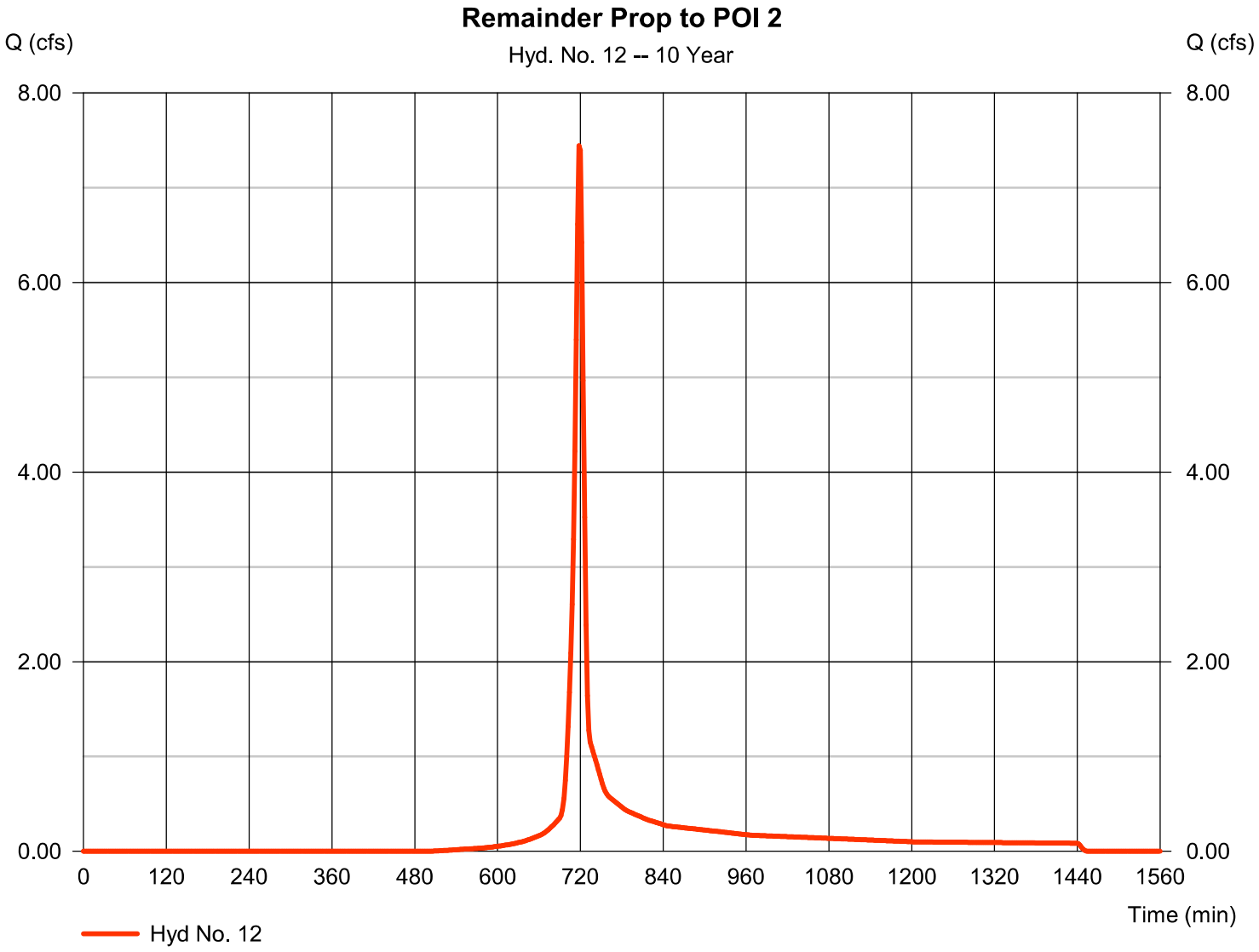


Hydrograph Report

Hyd. No. 12

Remainder Prop to POI 2

Hydrograph type	= SCS Runoff	Peak discharge	= 7.442 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 17,025 cuft
Drainage area	= 1.640 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.80 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

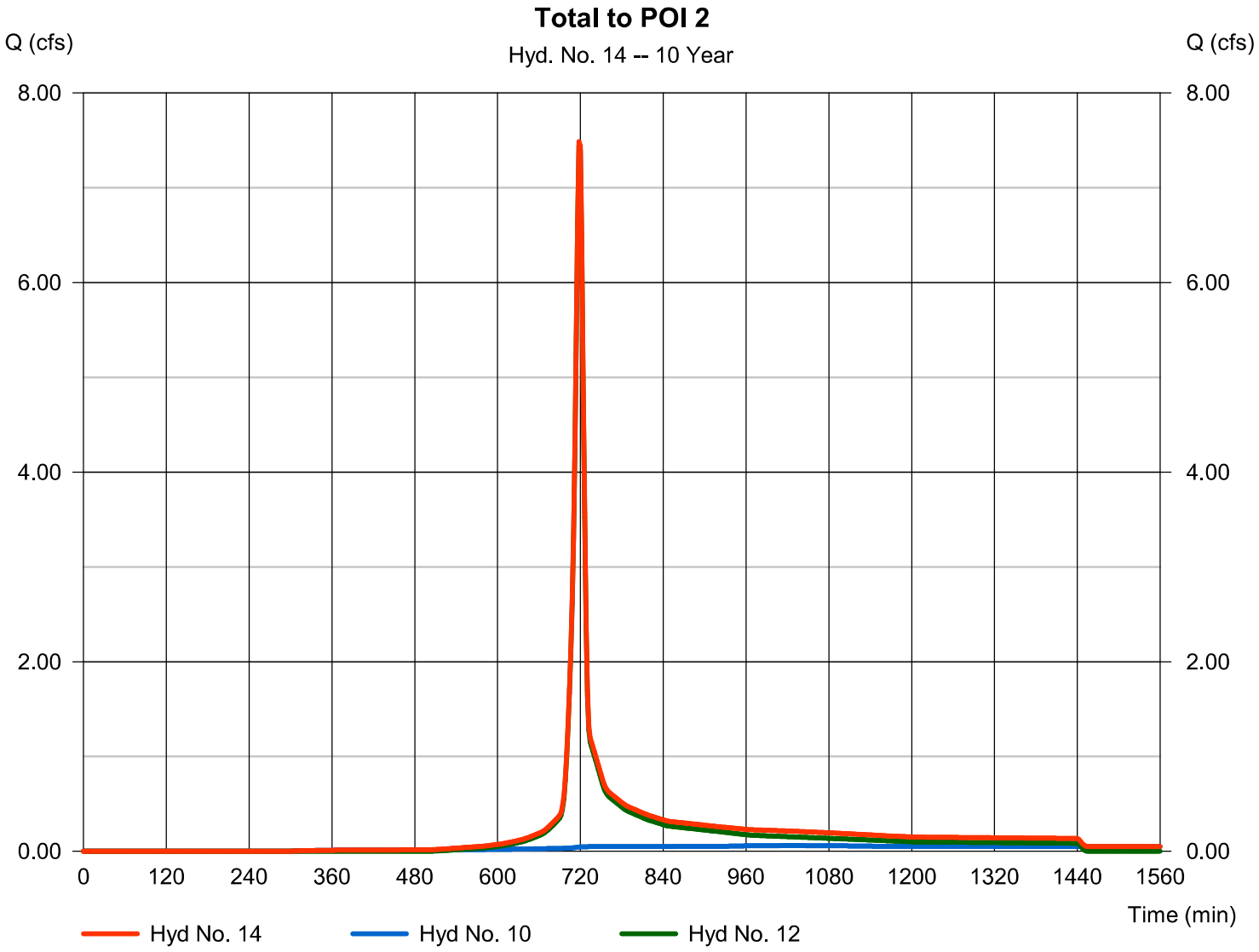


Hydrograph Report

Hyd. No. 14

Total to POI 2

Hydrograph type	= Combine	Peak discharge	= 7.487 cfs
Storm frequency	= 10 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 25,281 cuft
Inflow hyds.	= 10, 12	Contrib. drain. area	= 1.640 ac



Hydrograph Summary Report

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

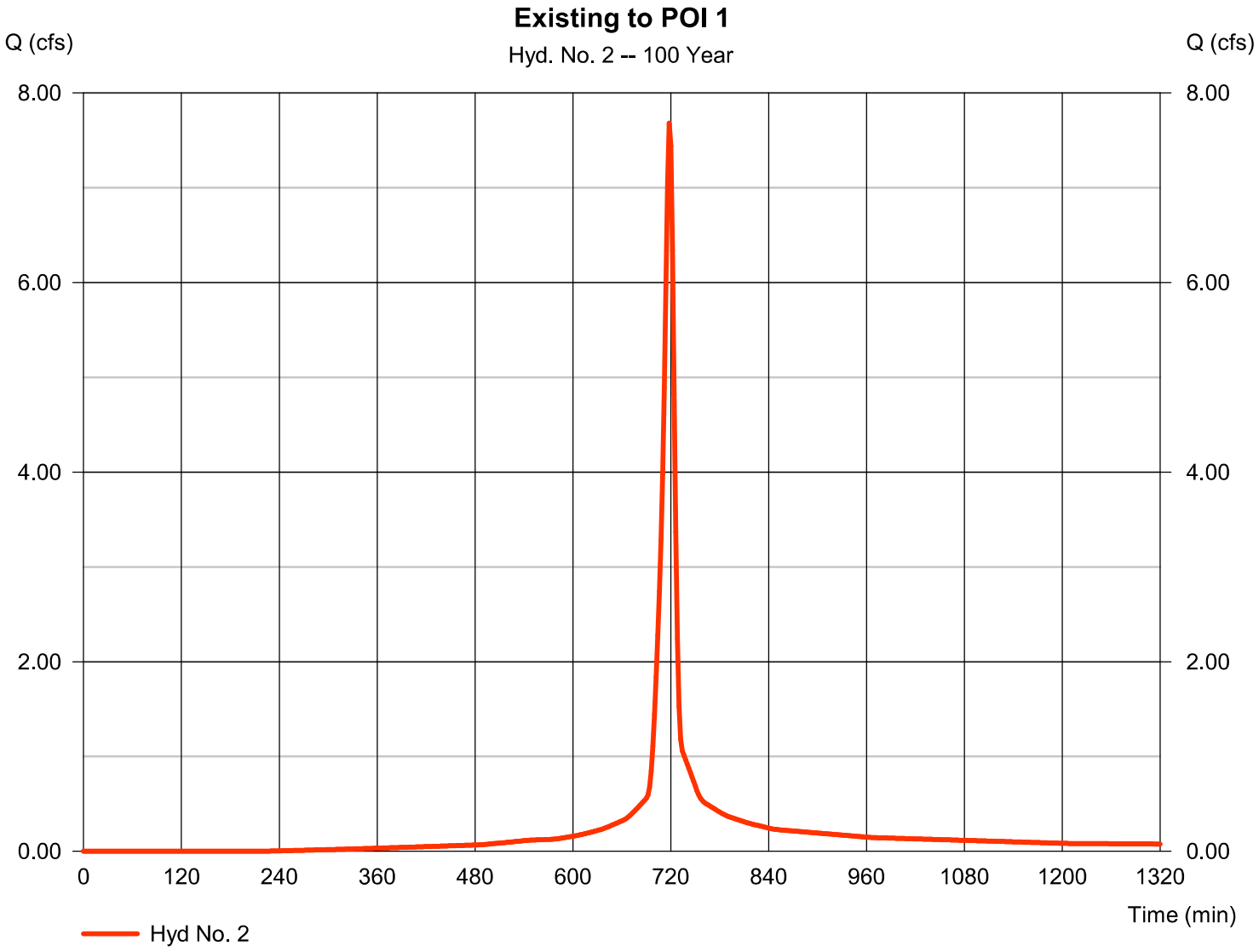
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
2	SCS Runoff	7.681	2	718	18,565	------	------	------	Existing to POI 1
4	SCS Runoff	6.376	2	716	14,329	------	------	------	Proposed to POI 1
6	SCS Runoff	22.65	2	718	52,590	------	------	------	Existing to POI 2
8	SCS Runoff	12.10	2	716	26,780	------	------	------	Prop to Detention Pond
10	Reservoir	3.021	2	724	19,633	8	1015.38	14,287	Detention Pond
12	SCS Runoff	15.34	2	718	35,625	------	------	------	Remainder Prop to POI 2
14	Combine	16.55	2	720	55,258	10, 12,	------	------	Total to POI 2

Hydrograph Report

Hyd. No. 2

Existing to POI 1

Hydrograph type	= SCS Runoff	Peak discharge	= 7.681 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 18,565 cuft
Drainage area	= 0.708 ac	Curve number	= 84
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.60 min
Total precip.	= 9.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

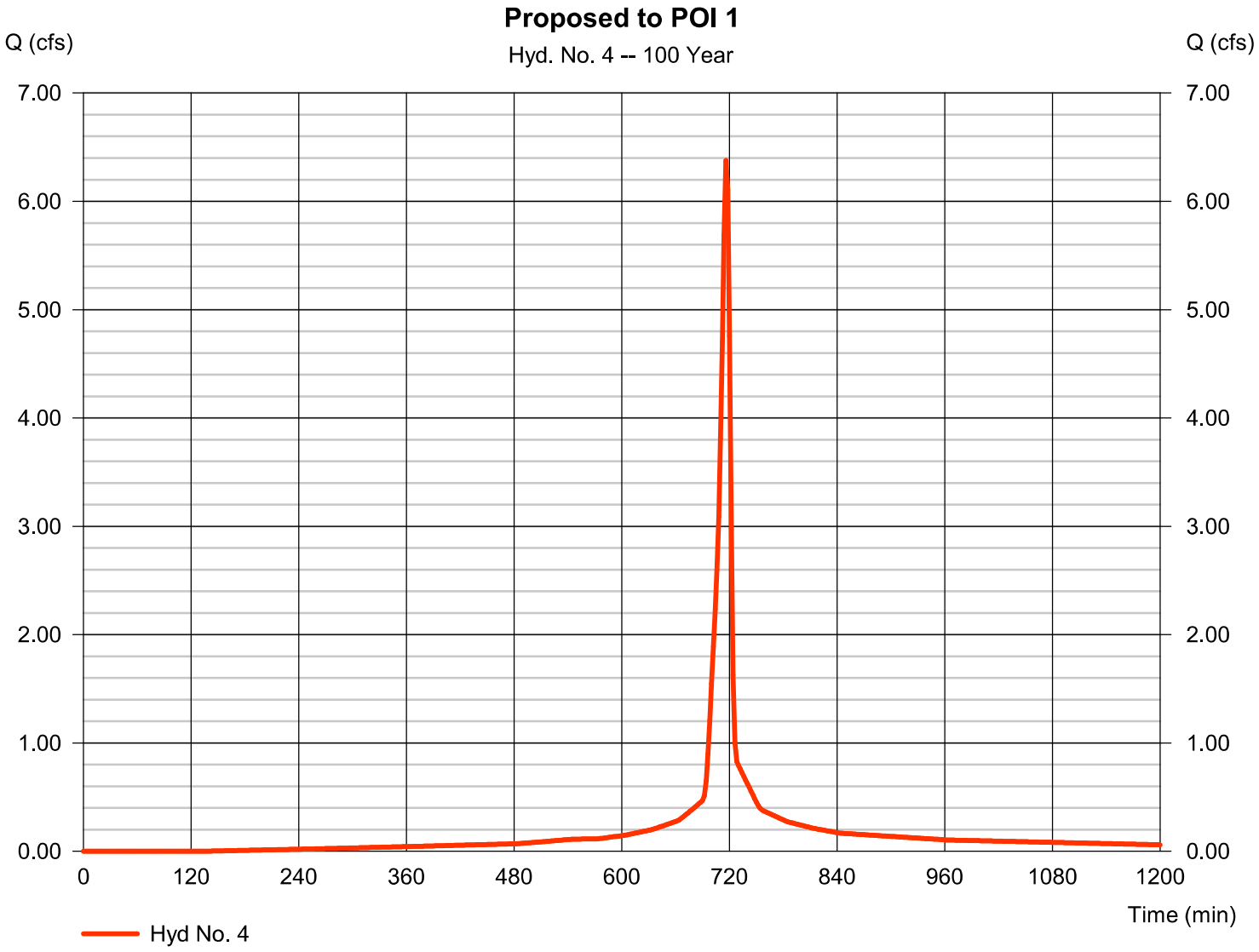


Hydrograph Report

Hyd. No. 4

Proposed to POI 1

Hydrograph type	= SCS Runoff	Peak discharge	= 6.376 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 14,329 cuft
Drainage area	= 0.529 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 9.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

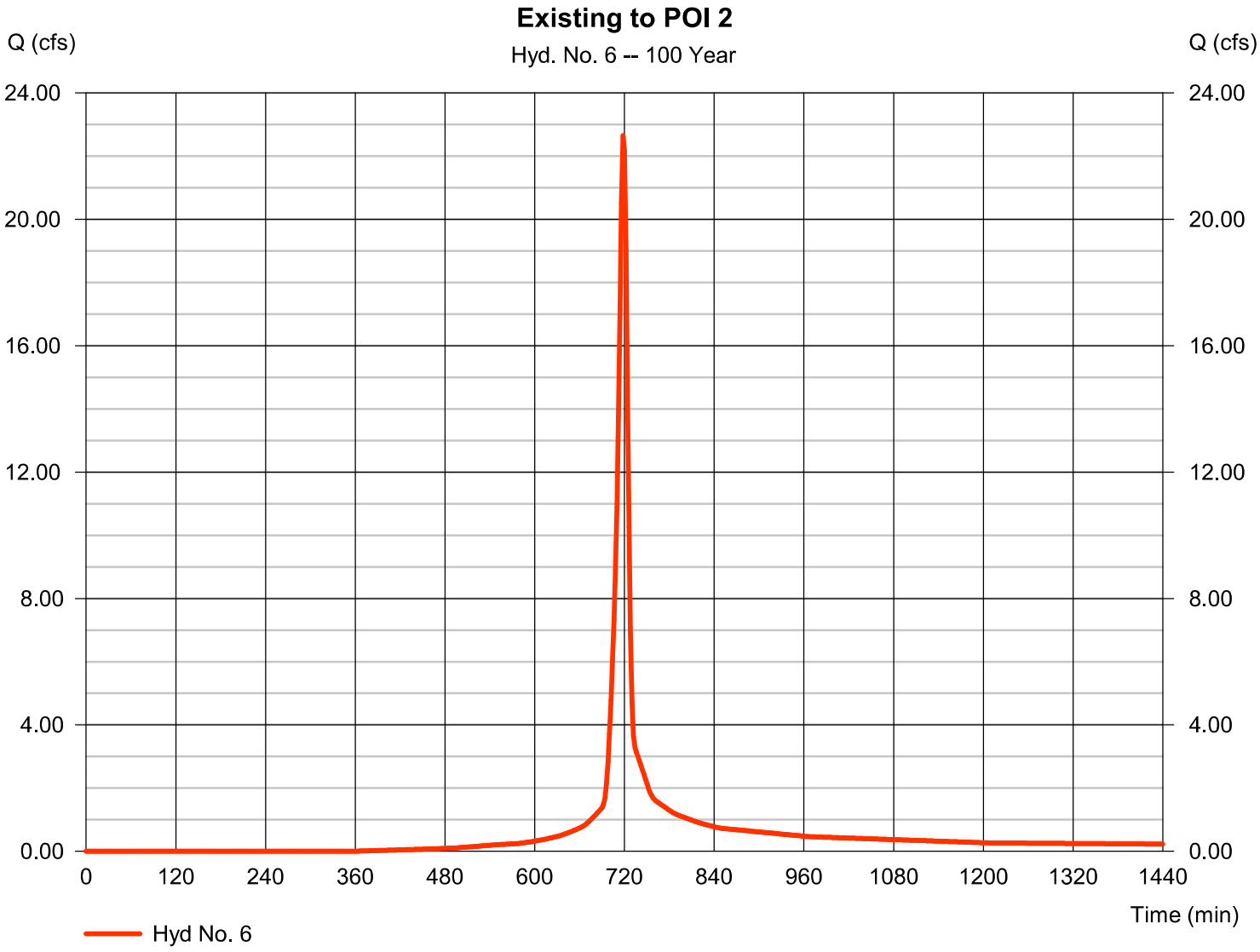


Hydrograph Report

Hyd. No. 6

Existing to POI 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	22.65 cfs
Storm frequency	=	100 yrs	Time to peak	=	718 min
Time interval	=	2 min	Hyd. volume	=	52,590 cuft
Drainage area	=	2.421 ac	Curve number	=	74
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	9.80 min
Total precip.	=	9.17 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

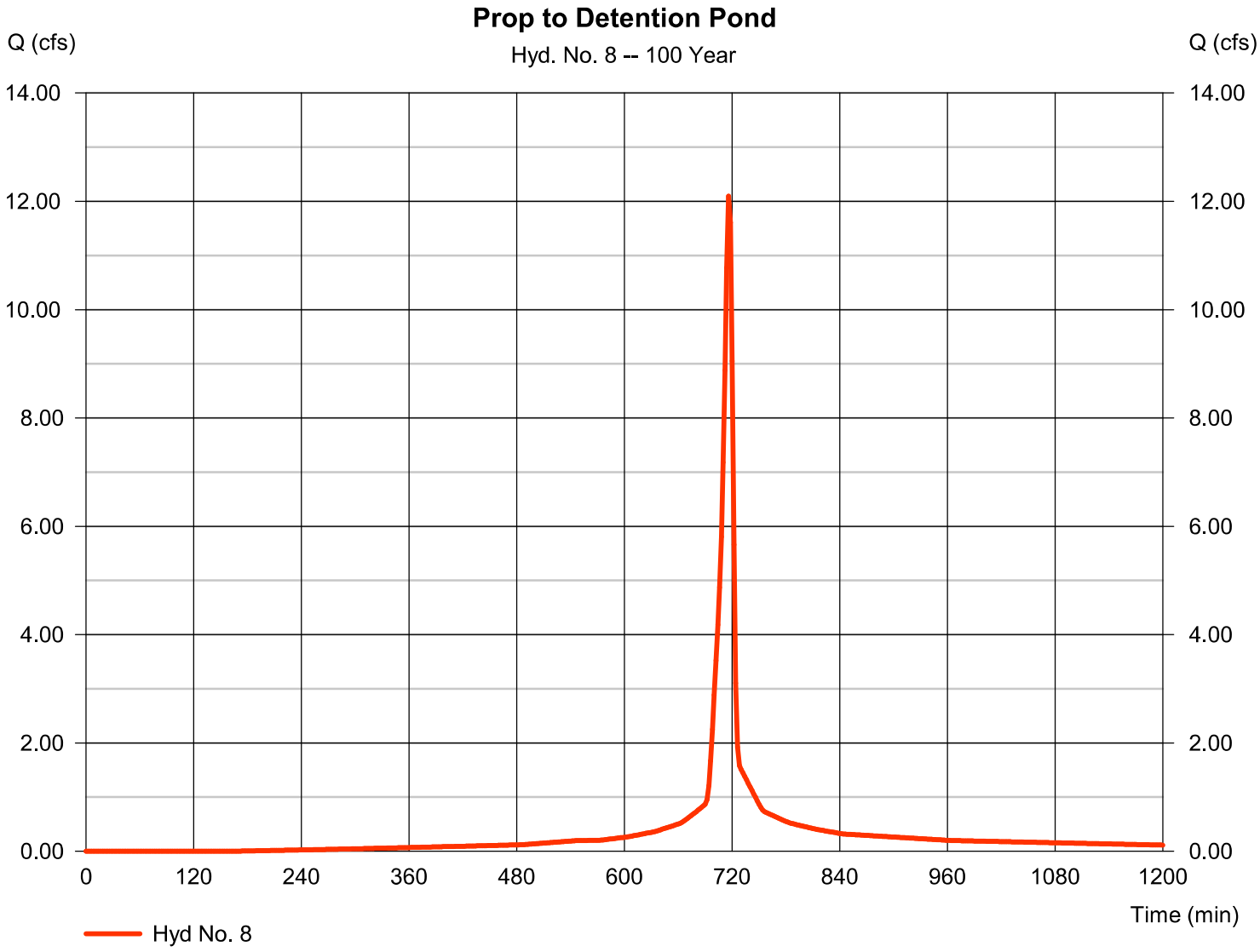


Hydrograph Report

Hyd. No. 8

Prop to Detention Pond

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.10 cfs
Storm frequency	=	100 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	26,780 cuft
Drainage area	=	1.020 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	9.17 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



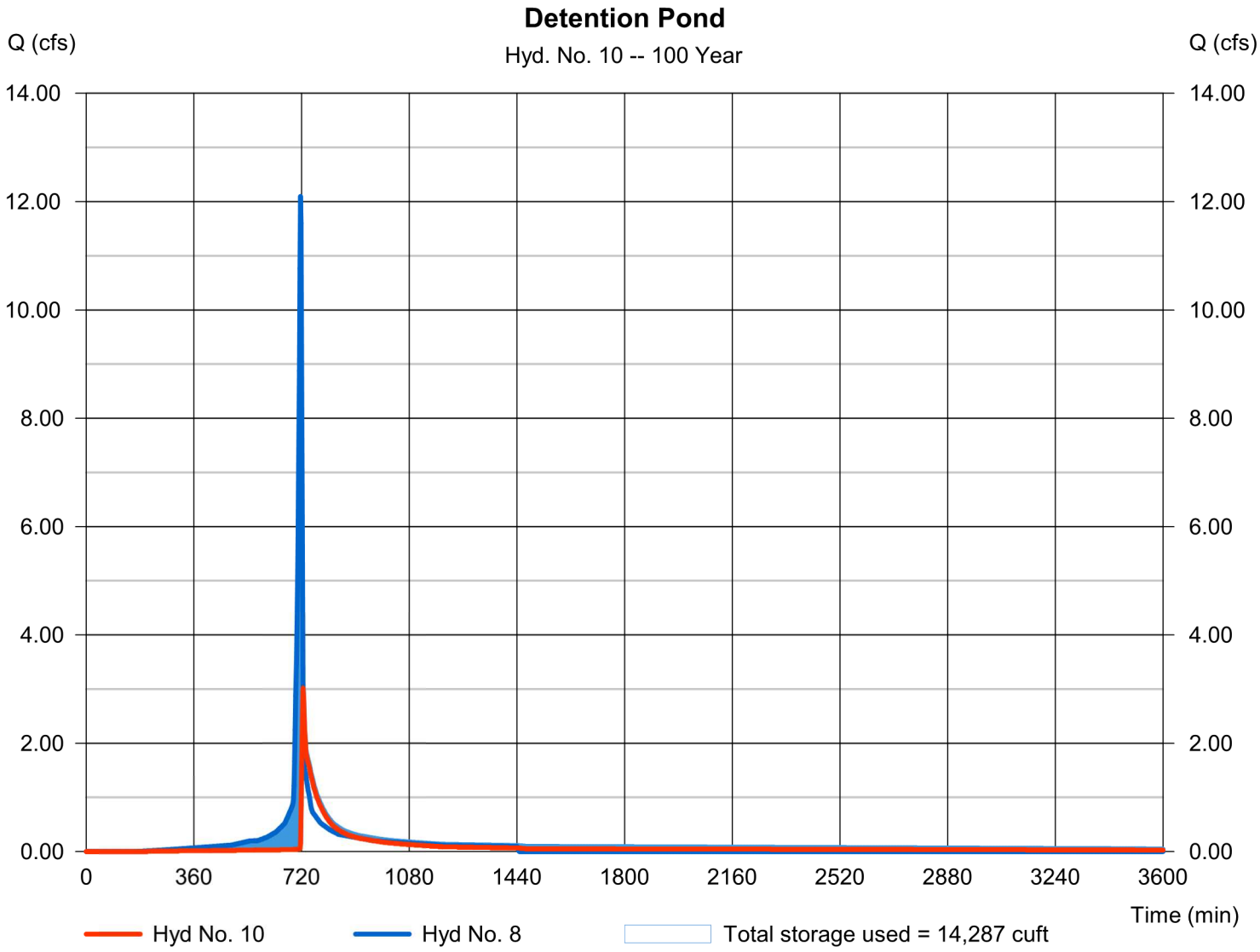
Hydrograph Report

Hyd. No. 10

Detention Pond

Hydrograph type	=	Reservoir	Peak discharge	=	3.021 cfs
Storm frequency	=	100 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	19,633 cuft
Inflow hyd. No.	=	8 - Prop to Detention Pond	Max. Elevation	=	1015.38 ft
Reservoir name	=	Detention Pond	Max. Storage	=	14,287 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

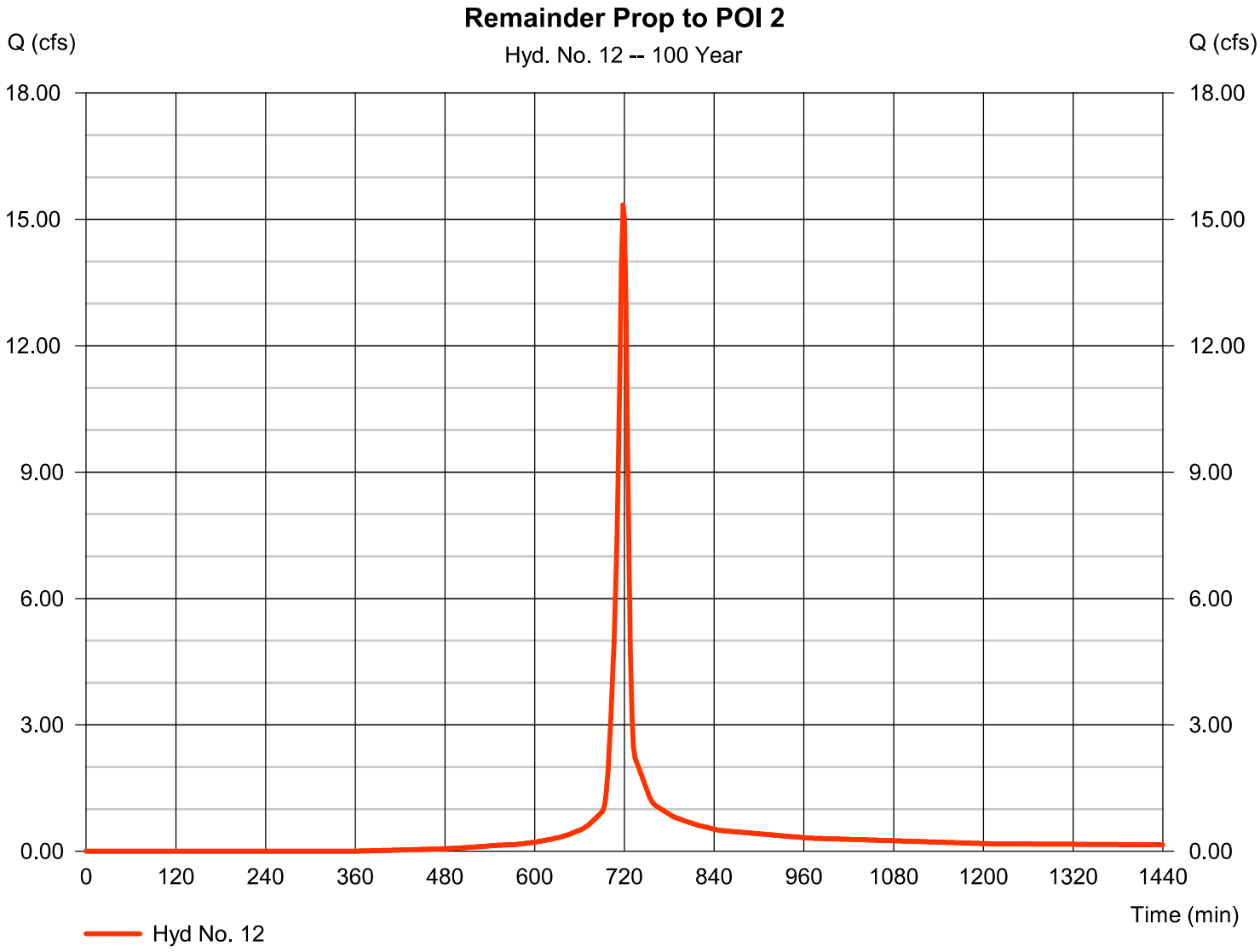


Hydrograph Report

Hyd. No. 12

Remainder Prop to POI 2

Hydrograph type	= SCS Runoff	Peak discharge	= 15.34 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 35,625 cuft
Drainage area	= 1.640 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.80 min
Total precip.	= 9.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

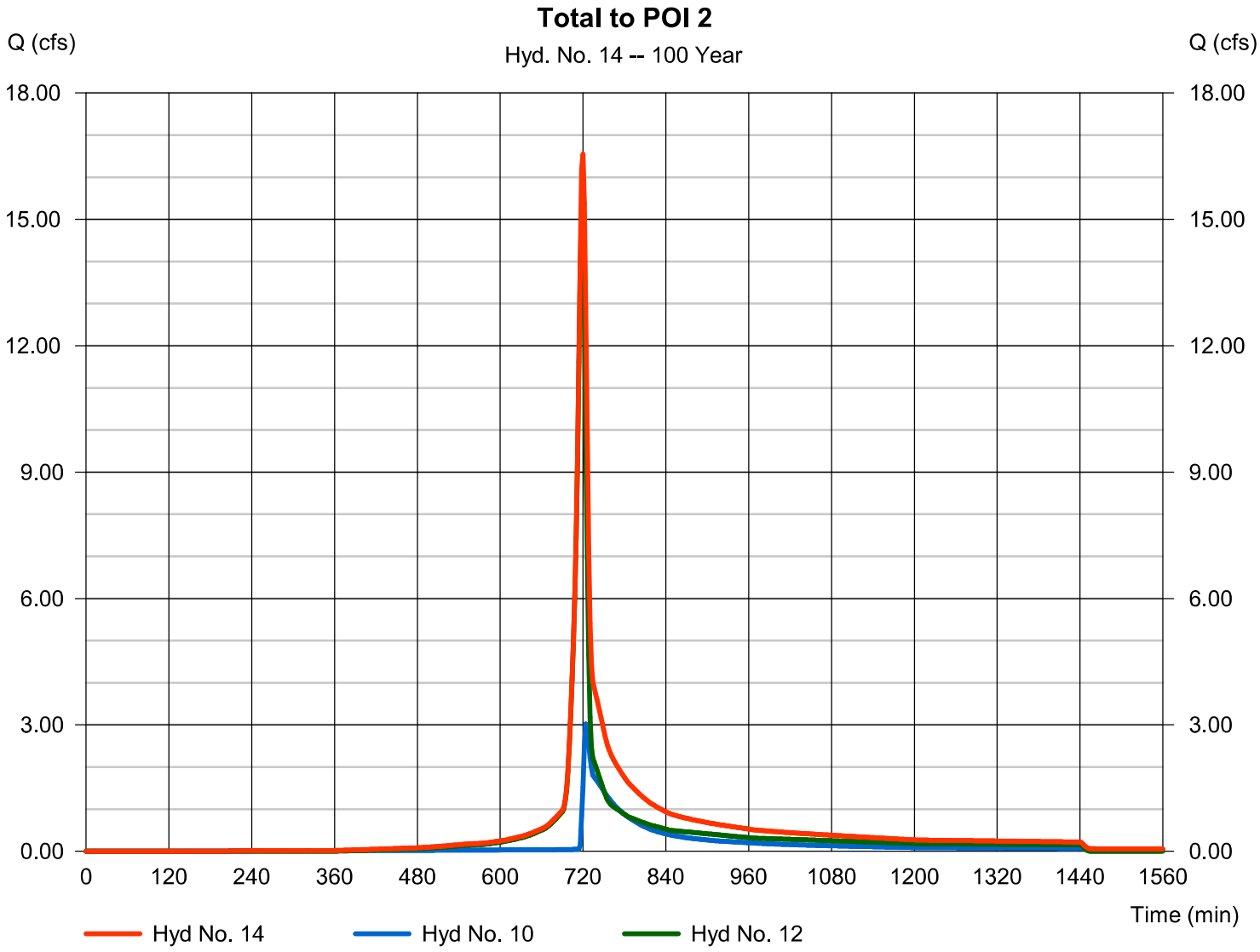


Hydrograph Report

Hyd. No. 14

Total to POI 2

Hydrograph type	= Combine	Peak discharge	= 16.55 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 55,258 cuft
Inflow hyds.	= 10, 12	Contrib. drain. area	= 1.640 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	21.2433	4.0000	0.6645	--------
2	26.1250	4.3000	0.6753	--------
3	0.0000	0.0000	0.0000	--------
5	33.6055	4.6000	0.6818	--------
10	38.8836	4.6000	0.6794	--------
25	45.4115	4.5000	0.6730	--------
50	48.7964	4.2000	0.6607	--------
100	52.0785	3.9000	0.6501	--------

File name: Lees Summit.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	4.93	3.68	3.00	2.57	2.27	2.04	1.86	1.72	1.60	1.50	1.41	1.34
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	7.19	5.40	4.42	3.79	3.34	3.00	2.74	2.52	2.35	2.20	2.07	1.96
10	8.36	6.29	5.15	4.41	3.89	3.50	3.19	2.95	2.74	2.57	2.42	2.29
25	9.98	7.51	6.15	5.28	4.66	4.19	3.83	3.53	3.29	3.08	2.90	2.75
50	11.26	8.45	6.93	5.94	5.25	4.73	4.32	3.99	3.72	3.49	3.29	3.12
100	12.57	9.41	7.71	6.61	5.85	5.27	4.82	4.45	4.15	3.90	3.68	3.49

Tc = time in minutes. Values may exceed 60.

Precip. file name: \\global.gsp\data\nf\na_nf05\4083145\01Work\03Tech\LP\01Storm\02Detention\SCS.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	3.09	3.68	0.00	4.71	5.61	6.94	8.02	9.17
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

Hydrograph Return Period Recap 1

100 - Year

Summary Report 2
Hydrograph Reports 3
Hydrograph No. 2, SCS Runoff, Existing to POI 1 3
TR-55 Tc Worksheet 4
Hydrograph No. 4, SCS Runoff, Proposed to POI 1 5
Hydrograph No. 6, SCS Runoff, Existing to POI 2 6
Hydrograph No. 8, SCS Runoff, Prop to Detention Pond 7
Hydrograph No. 10, Reservoir, Detention Pond 8
Pond Report - Detention Pond 9
Hydrograph No. 12, SCS Runoff, Remainder Prop to POI 2 10
Hydrograph No. 14, Combine, Total to POI 2 11

IDF Report 12

Hydrograph Return Period Recap

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

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	
2	SCS Runoff	------	-------	2.343	-------	-------	4.214	-------	-------	7.681	Existing to POI 1
4	SCS Runoff	------	-------	2.248	-------	-------	3.714	-------	-------	6.376	Proposed to POI 1
6	SCS Runoff	------	-------	5.230	-------	-------	10.99	-------	-------	22.65	Existing to POI 2
8	SCS Runoff	------	-------	4.086	-------	-------	6.926	-------	-------	12.10	Prop to Detention Pond
10	Reservoir	8	-------	0.000	-------	-------	0.000	-------	-------	1.041	Detention Pond
12	SCS Runoff	------	-------	3.543	-------	-------	7.442	-------	-------	15.34	Remainder Prop to POI 2
14	Combine	10, 12,	-------	3.543	-------	-------	7.442	-------	-------	15.34	Total to POI 2

Hydrograph Summary Report

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

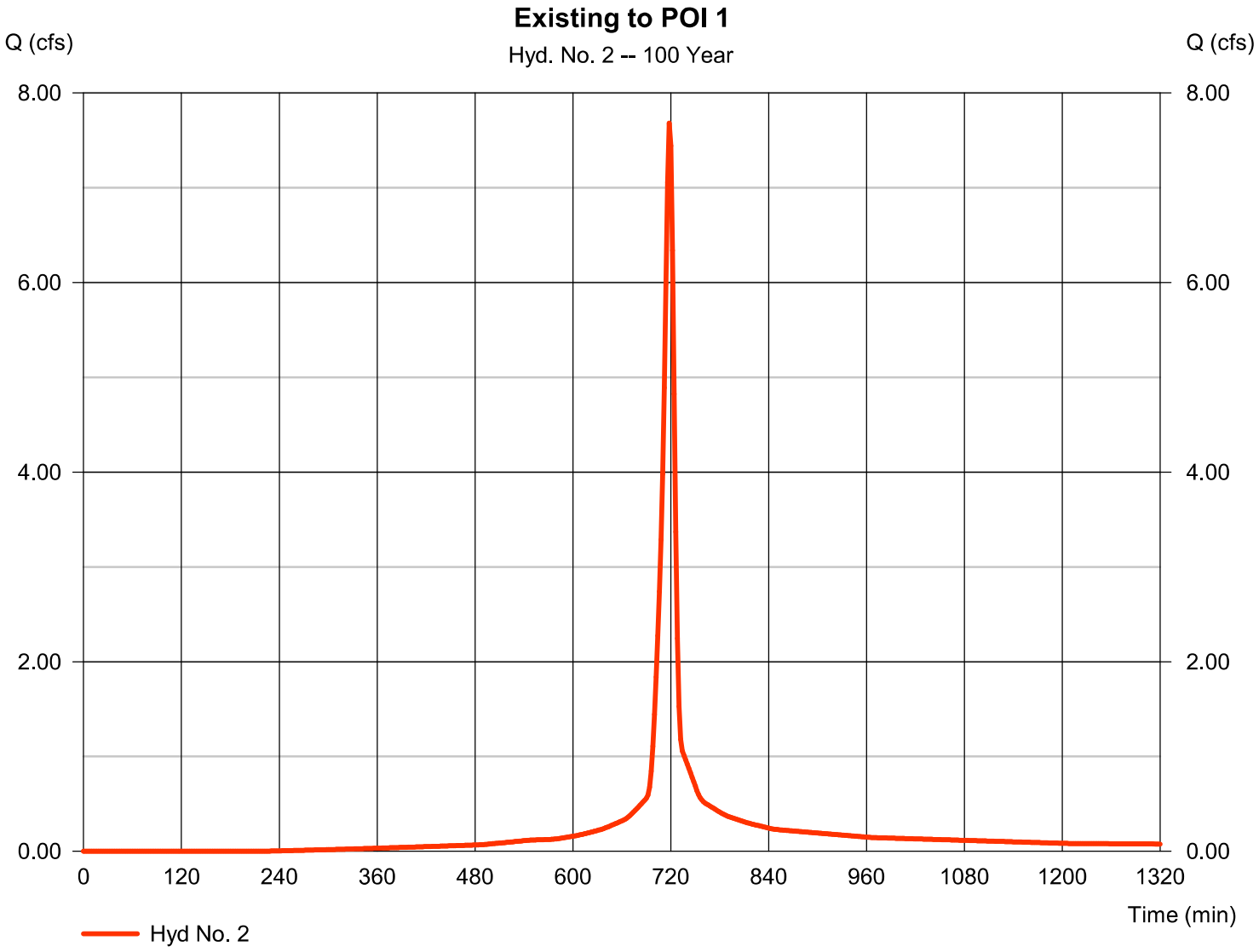
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
2	SCS Runoff	7.681	2	718	18,565	------	------	------	Existing to POI 1
4	SCS Runoff	6.376	2	716	14,329	------	------	------	Proposed to POI 1
6	SCS Runoff	22.65	2	718	52,590	------	------	------	Existing to POI 2
8	SCS Runoff	12.10	2	716	26,780	------	------	------	Prop to Detention Pond
10	Reservoir	1.041	2	744	6,554	8	1015.91	17,234	Detention Pond
12	SCS Runoff	15.34	2	718	35,625	------	------	------	Remainder Prop to POI 2
14	Combine	15.34	2	718	42,178	10, 12,	------	------	Total to POI 2

Hydrograph Report

Hyd. No. 2

Existing to POI 1

Hydrograph type	= SCS Runoff	Peak discharge	= 7.681 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 18,565 cuft
Drainage area	= 0.708 ac	Curve number	= 84
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 9.60 min
Total precip.	= 9.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 2

Existing to POI 1

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)	= 3.68		0.00		0.00		
Land slope (%)	= 2.24		0.00		0.00		
Travel Time (min)	**= 8.73**	**+**	**0.00**	**+**	**0.00**	**=**	**8.73**
Shallow Concentrated Flow							
Flow length (ft)	= 100.00		0.00		0.00		
Watercourse slope (%)	= 1.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.98		0.00		0.00		
Travel Time (min)	**= 0.84**	**+**	**0.00**	**+**	**0.00**	**=**	**0.84**
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**

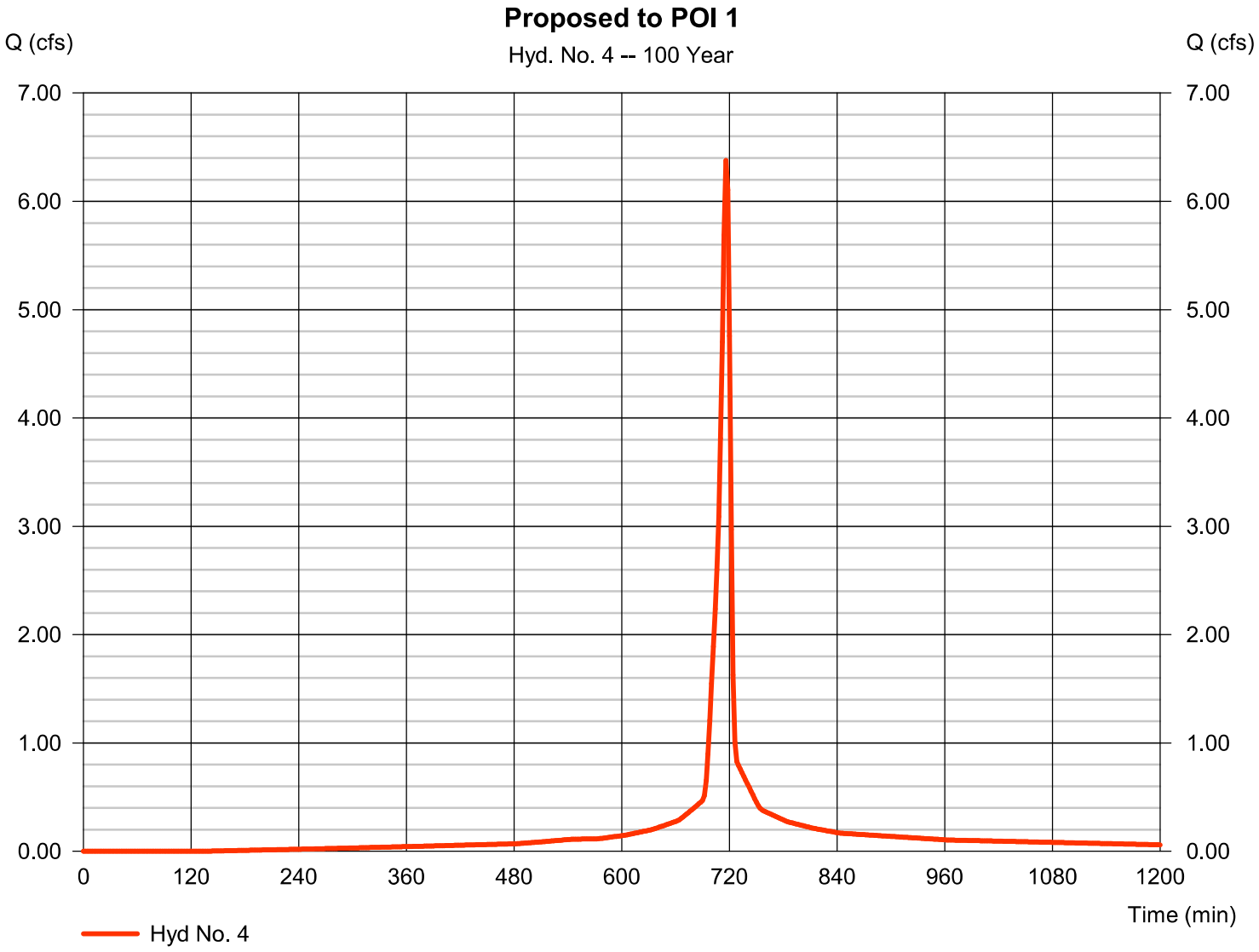
Total Travel Time, Tc ..... 9.60 min

Hydrograph Report

Hyd. No. 4

Proposed to POI 1

Hydrograph type	= SCS Runoff	Peak discharge	= 6.376 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 14,329 cuft
Drainage area	= 0.529 ac	Curve number	= 90
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 9.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

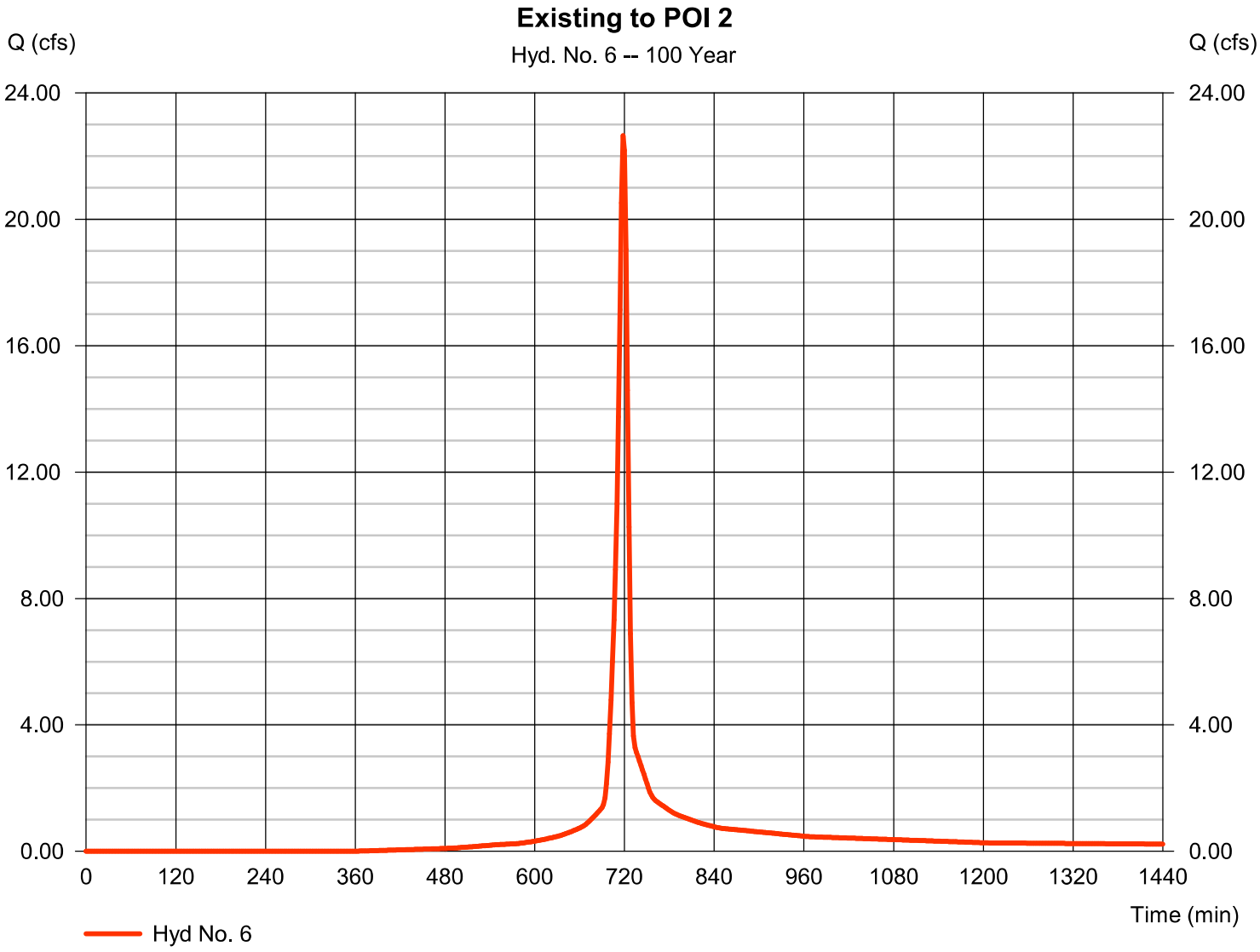


Hydrograph Report

Hyd. No. 6

Existing to POI 2

Hydrograph type	= SCS Runoff	Peak discharge	= 22.65 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 52,590 cuft
Drainage area	= 2.421 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.80 min
Total precip.	= 9.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

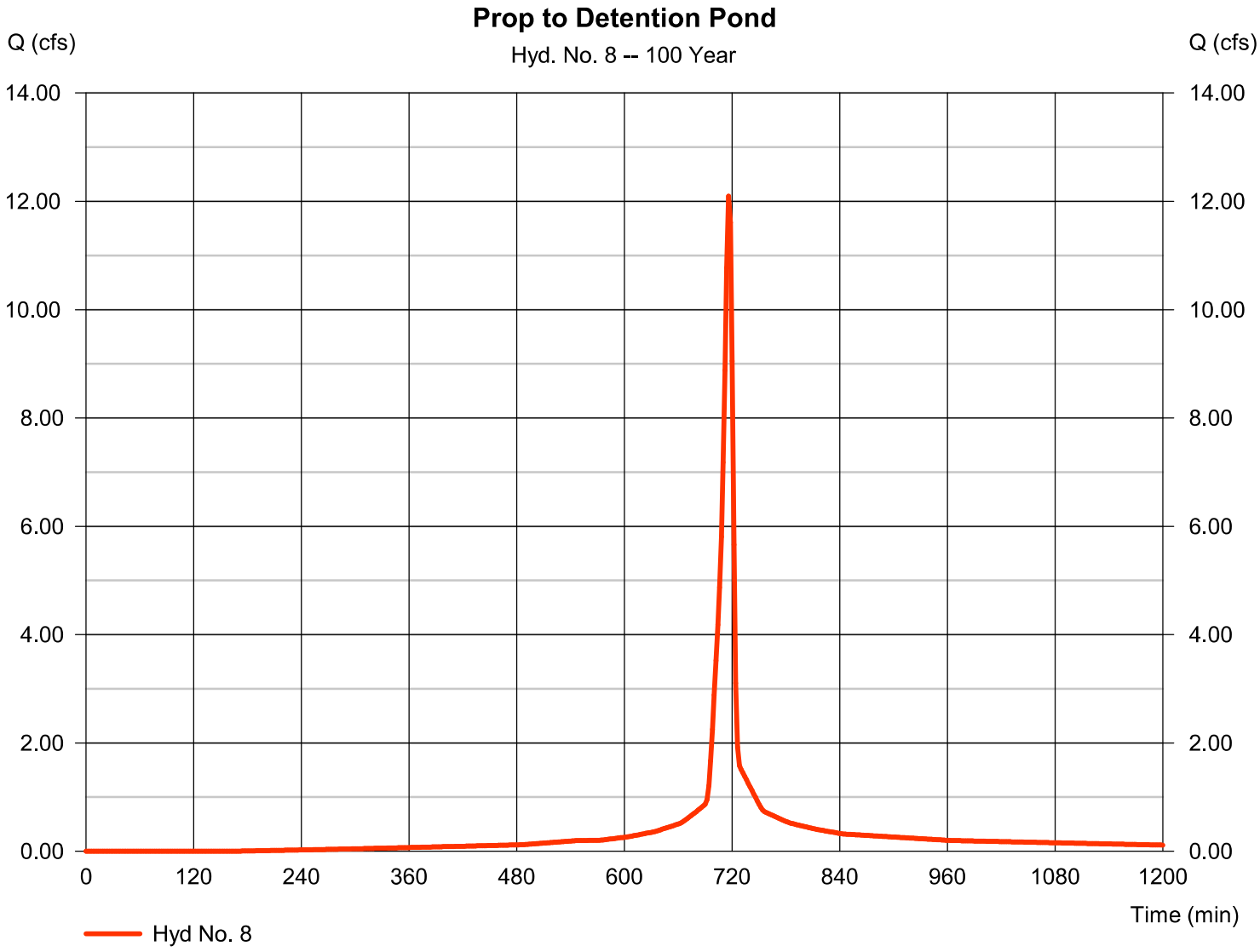


Hydrograph Report

Hyd. No. 8

Prop to Detention Pond

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.10 cfs
Storm frequency	=	100 yrs	Time to peak	=	716 min
Time interval	=	2 min	Hyd. volume	=	26,780 cuft
Drainage area	=	1.020 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	9.17 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



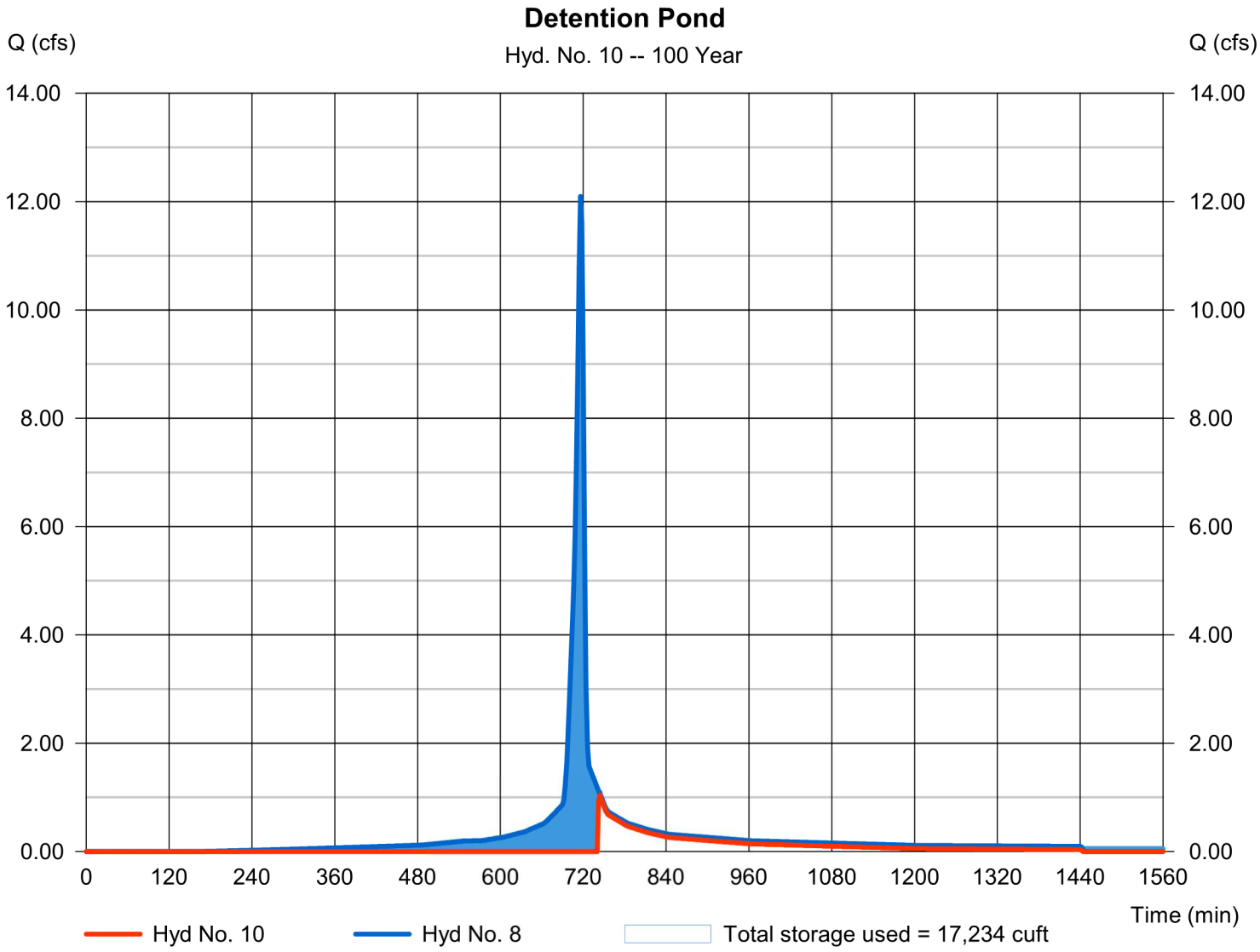
Hydrograph Report

Hyd. No. 10

Detention Pond

Hydrograph type	=	Reservoir	Peak discharge	=	1.041 cfs
Storm frequency	=	100 yrs	Time to peak	=	744 min
Time interval	=	2 min	Hyd. volume	=	6,554 cuft
Inflow hyd. No.	=	8 - Prop to Detention Pond	Max. Elevation	=	1015.91 ft
Reservoir name	=	Detention Pond	Max. Storage	=	17,234 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 1 - Detention Pond

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1010.75 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1010.75	05	0	0
0.25	1011.00	429	40	40
1.25	1012.00	2,392	1,278	1,318
2.25	1013.00	3,167	2,770	4,088
3.25	1014.00	4,039	3,594	7,682
4.25	1015.00	5,010	4,515	12,197
5.25	1016.00	6,079	5,535	17,733
5.70	1016.45	6,483	2,826	20,558

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	Inactive	Inactive	0.00	0.00
Span (in)	= 12.00	1.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 1010.65	1010.75	0.00	0.00
Length (ft)	= 30.00	0.50	0.00	0.00
Slope (%)	= 0.50	0.50	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	100.00	Inactive	0.00
Crest El. (ft)	= 1015.30	1015.90	1014.65	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	Rect	---
Multi-Stage	= Yes	No	Yes	No

Exfil.(in/hr)	= 0.420 (by Contour)
TW Elev. (ft)	= 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

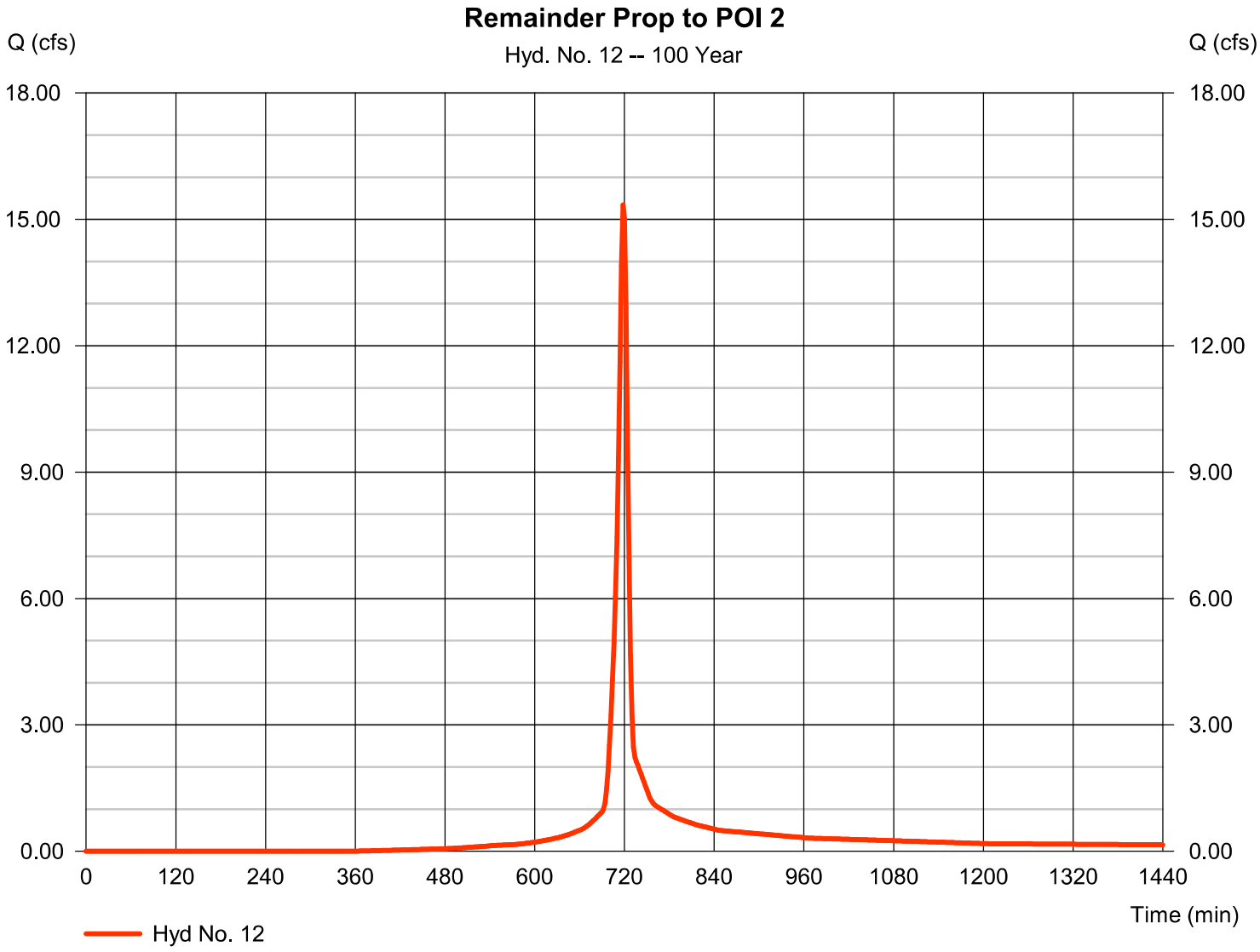
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1010.75	0.00	0.00	---	---	0.00	0.00	0.00	---	0.000	---	0.000
0.25	40	1011.00	0.00	0.00	---	---	0.00	0.00	0.00	---	0.004	---	0.004
1.25	1,318	1012.00	0.00	0.00	---	---	0.00	0.00	0.00	---	0.023	---	0.023
2.25	4,088	1013.00	0.00	0.00	---	---	0.00	0.00	0.00	---	0.031	---	0.031
3.25	7,682	1014.00	0.00	0.00	---	---	0.00	0.00	0.00	---	0.039	---	0.039
4.25	12,197	1015.00	0.00	0.00	---	---	0.00	0.00	0.00	---	0.049	---	0.049
5.25	17,733	1016.00	0.00	0.00	---	---	0.00	10.53	0.00	---	0.059	---	10.59
5.70	20,558	1016.45	0.00	0.00	---	---	0.00	135.82	0.00	---	0.063	---	135.89

Hydrograph Report

Hyd. No. 12

Remainder Prop to POI 2

Hydrograph type	= SCS Runoff	Peak discharge	= 15.34 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 35,625 cuft
Drainage area	= 1.640 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 9.80 min
Total precip.	= 9.17 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

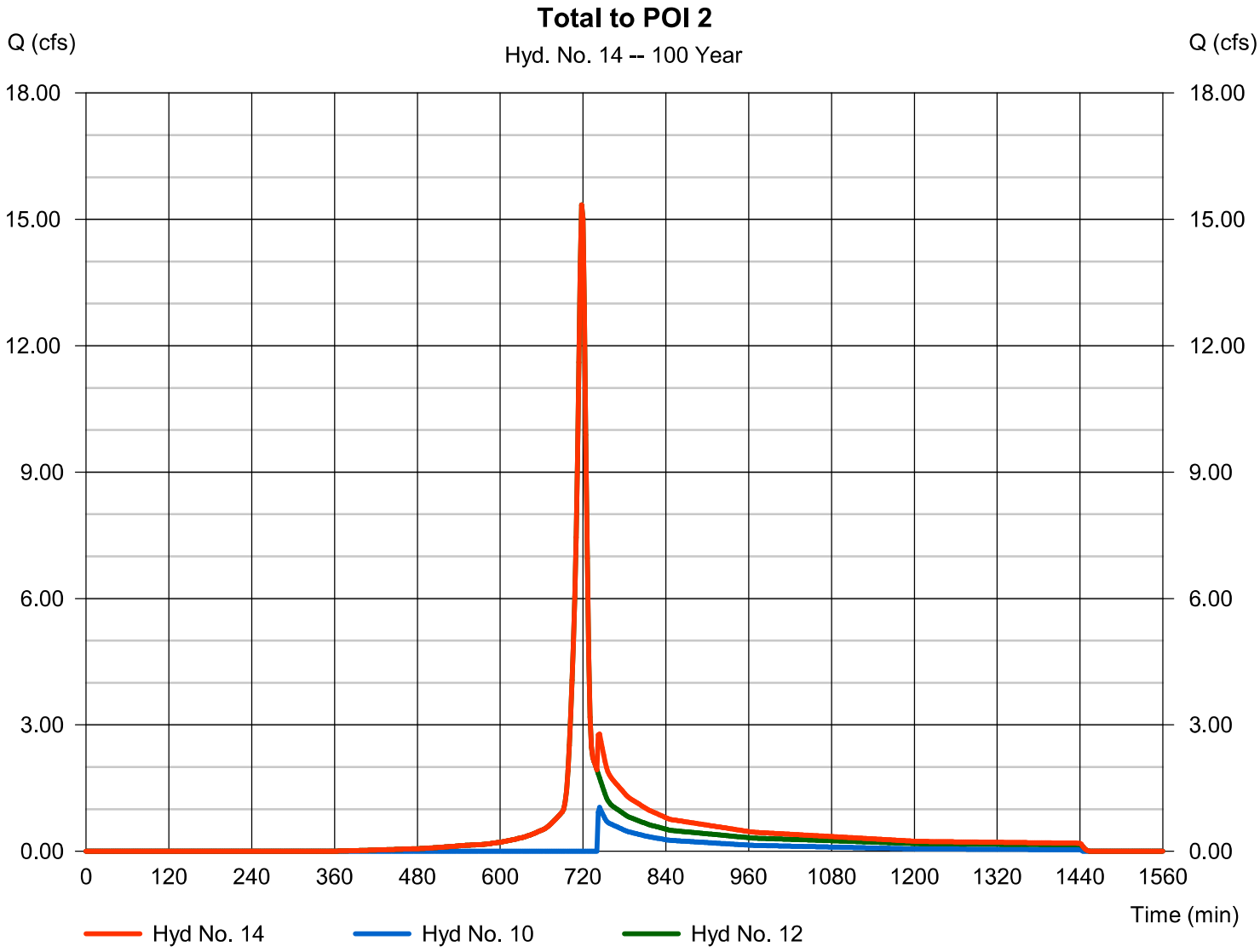


Hydrograph Report

Hyd. No. 14

Total to POI 2

Hydrograph type	= Combine	Peak discharge	= 15.34 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 42,178 cuft
Inflow hyds.	= 10, 12	Contrib. drain. area	= 1.640 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	21.2433	4.0000	0.6645	--------
2	26.1250	4.3000	0.6753	--------
3	0.0000	0.0000	0.0000	--------
5	33.6055	4.6000	0.6818	--------
10	38.8836	4.6000	0.6794	--------
25	45.4115	4.5000	0.6730	--------
50	48.7964	4.2000	0.6607	--------
100	52.0785	3.9000	0.6501	--------

File name: Lees Summit.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	4.93	3.68	3.00	2.57	2.27	2.04	1.86	1.72	1.60	1.50	1.41	1.34
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	7.19	5.40	4.42	3.79	3.34	3.00	2.74	2.52	2.35	2.20	2.07	1.96
10	8.36	6.29	5.15	4.41	3.89	3.50	3.19	2.95	2.74	2.57	2.42	2.29
25	9.98	7.51	6.15	5.28	4.66	4.19	3.83	3.53	3.29	3.08	2.90	2.75
50	11.26	8.45	6.93	5.94	5.25	4.73	4.32	3.99	3.72	3.49	3.29	3.12
100	12.57	9.41	7.71	6.61	5.85	5.27	4.82	4.45	4.15	3.90	3.68	3.49

Tc = time in minutes. Values may exceed 60.

Precip. file name: \\global.gsp\data\nf\na_nf05\4083145\01Work\03Tech\LP\01Storm\02Detention\SCS.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	3.09	3.68	0.00	4.71	5.61	6.94	8.02	9.17
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

APPENDIX C

Water Quality Calculations

WATER QUALITY POND CALCULATIONS-PERFORATED PIPE

Project: Firestone Complete Auto Care, Lee's Summit, MO ***Date: 11/18/19***
GSP# 40831.45 ***Revised Date: 2/20/20***

Calculate Water Quality Volume

P (in.), rainfall for 90% storm event	1.37
I, impervious cover by %	56.4
R_v, runoff coeffcient = 0.05 + 0.009 x I	0.56
A (ac), drainage area	1.02
WQ_v (ac-ft), water quality volume = P x R_v x A/12	0.06
WQ_v (ft^3), water quality volume converted units	2828
Add 20% WQv (ft3), water quality volume converted units	**3394.15**

Pond Areas

Elevation (ft)	Area (ft^2)	Elev. Difference (ft)	Increment Volume (ft^3)	Total Volume (ft^3)
1010.75	5			0
1011	429	0.25	54	54
1012	2392	1	1411	1465
1013	3167	1	2780	4244
1014	4039	1	3603	7847
1015	5010	1	4525	12372
1016	6079	1	5545	17916
1016.35	6483	0.35	2198	20115
		Required WQ_v elevation (ft)		1012.69
			Weir elevation (ft)	1014.65

Size Low Flow Orifice

C, orifice coefficient	0.66
T (hrs), drawdown time (should be between 24 and 48 hrs)	40
g (ft/s^2), gravity	32.20
$Q_{wq, avg}$ (cfs), average release rate of WQ_v	0.024
$H_{wq, avg}$ (ft), average head on the water quality outlet	0.97
A_{wq} (ft^2), the orifice area	0.005
D_{wq} (ft), the orifice area	0.08
D_{wq} (in), the orifice area	0.91
Use D=	**1.00**

APPENDIX D

NRCS Soil Map

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

October 22, 2019

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

Preface..... 2
How Soil Surveys Are Made.....5
Soil Map..... 8
Soil Map.....9
Legend.....10
Map Unit Legend..... 11
Map Unit Descriptions.....11
Jackson County, Missouri..... 13
10082—Arisburg-Urban land complex, 1 to 5 percent slopes.....13
10180—Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes.... 14
Soil Information for All Uses.....17
Soil Properties and Qualities..... 17
Soil Physical Properties..... 17
Saturated Hydraulic Conductivity (Ksat).....17
Soil Qualities and Features.....20
Hydrologic Soil Group..... 20
References.....25

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 20, Sep 16, 2019

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.

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	0.6	16.6%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	3.0	83.4%
Totals for Area of Interest		**3.6**	**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
Natural 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
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: Loess Upland Prairie (R107BY007MO)
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: Interbedded Sedimentary Upland Savanna (R109XY010MO)
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: Loess Upland Prairie (R109XY002MO)
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: Loess Upland Prairie (R109XY002MO)
Hydric soil rating: No

10180—Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1n85h
Elevation: 600 to 900 feet
Mean annual precipitation: 33 to 43 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 175 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Udarents and similar soils: 41 percent
Urban land: 39 percent
Sampsel and similar soils: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udarents

Setting

Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Mine spoil or earthy fill

Typical profile

C1 - 0 to 5 inches: silt loam
C2 - 5 to 80 inches: silty clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Deep Loess Upland Prairie (R107BY002MO)
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

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

Interpretive groups

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

Description of Sampsel

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from shale

Typical profile

Ap - 0 to 13 inches: silty clay loam
Bt - 13 to 80 inches: silty clay

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C/D
Ecological site: Wet Footslope Prairie (R112XY041MO)
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

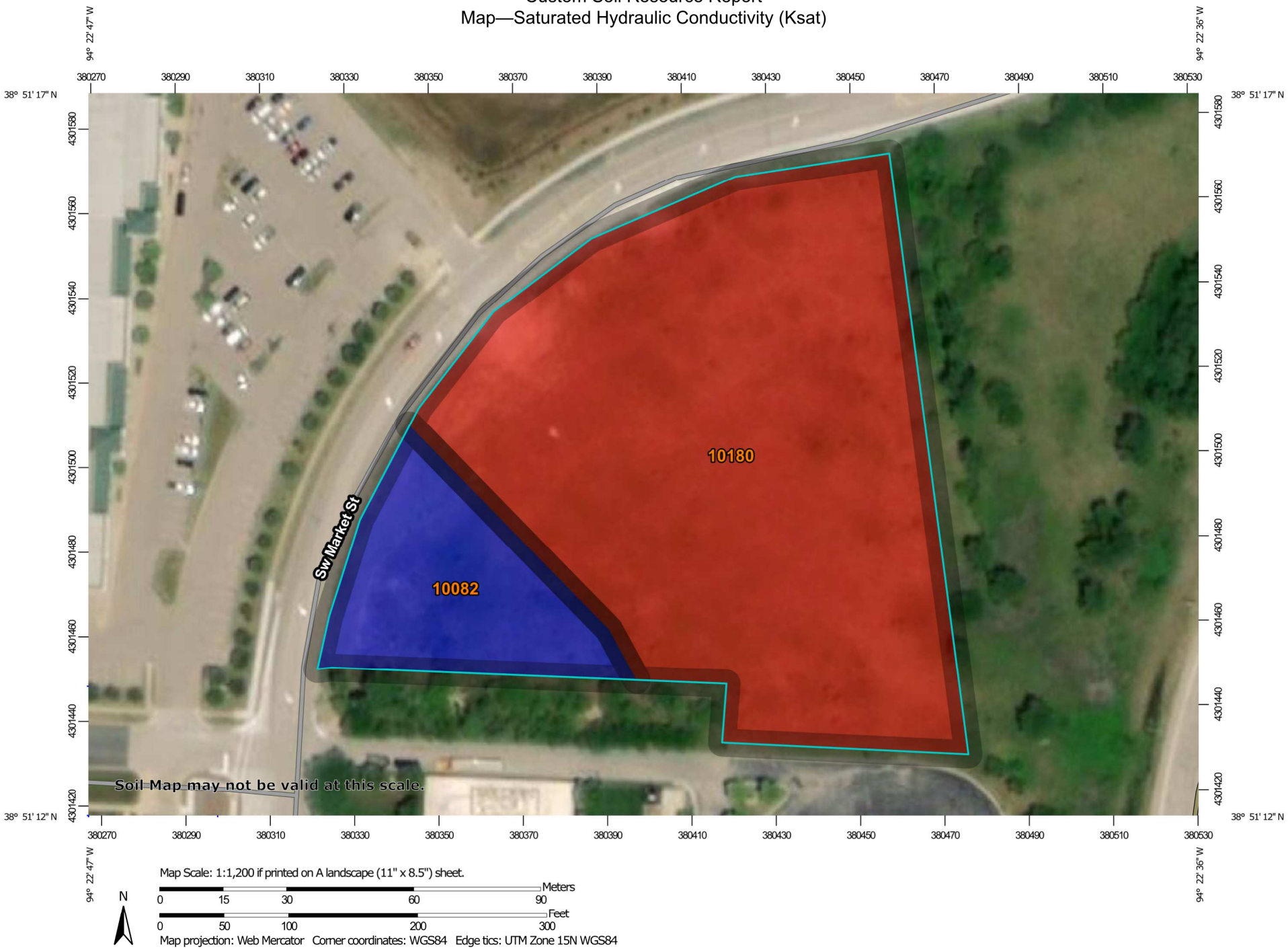
Saturated Hydraulic Conductivity (Ksat)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Custom Soil Resource Report
Map—Saturated Hydraulic Conductivity (Ksat)



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

<= 2.9163

> 2.9163 and <= 3.8300

Not rated or not available

Soil Rating Lines

<= 2.9163

> 2.9163 and <= 3.8300

Not rated or not available

Soil Rating Points

<= 2.9163

> 2.9163 and <= 3.8300

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 20, Sep 16, 2019

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.

Table—Saturated Hydraulic Conductivity (Ksat)

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	3.8300	0.6	16.6%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	2.9163	3.0	83.4%
Totals for Area of Interest			**3.6**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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.

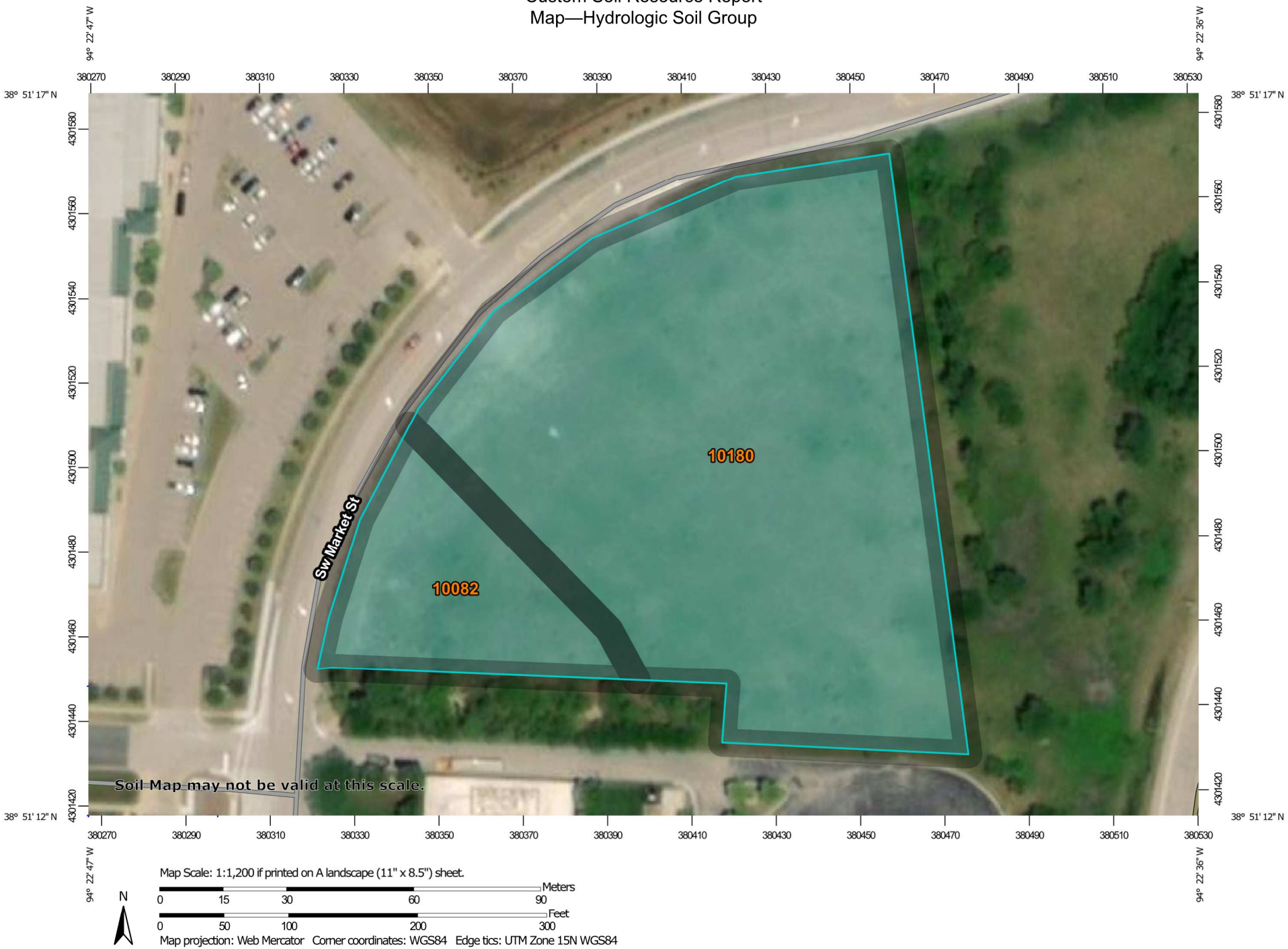
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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.

Custom Soil Resource Report
Map—Hydrologic Soil Group



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.

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Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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Survey Area Data: Version 20, Sep 16, 2019

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

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Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	C	0.6	16.6%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	C	3.0	83.4%
Totals for Area of Interest			**3.6**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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