STORM WATER DRAINAGE REPORT

LOTS 9A, 11A, 13A
A REPLAT OF LOTS 9-14, BLOCK 5
LOWE'S ADDITION
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

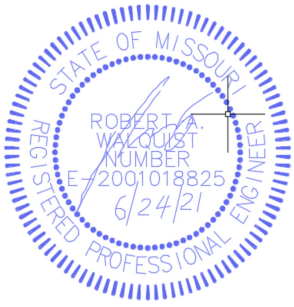
PREPARED FOR

705 HIGH STREET LLC

PREPARED BY

Quist Engineering Inc
821 NE Columbus St
Lee's Summit, MO 64063

Date Prepared: June 24, 2021



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3.0 PROJECT OVERVIEW

The proposed project is a lot split for three proposed duplexes in Lee's Summit, Jackson County, Missouri. The area is residential with the current zoning as R-1 (Single Family Residential), with a proposed zoning of P-MIX (Planned Mixed Use). The total area of the property contains approximately 0.49 acres, with the proposed lot splits making three 0.16 acre tracts of land. The subject property does not lie in a floodplain.

There are two areas for drainage to occur: in the front and back yards. Drainage Area 1 is designated as the front yard area, and Drainage Area 2 is the back yard. Both areas flow easterly off the subject property as shown on the drainage map. The north side of the property drains to the existing graded ditches along the side of the road. There is not an enclosed system on this street. The south or rear of the property drains to the east and then to the south across a parking lot to the ditches in front of the commercial property. The commercial property drains to the ditch from the parking to using flumes.

The proposed development does not change drainage areas or switch flow patterns except for putting the duplexes in on the property. Most of the area is developed and was established as single family residential zoning previously and the existing drainage system was designed accordingly.

4.0 DRAINAGE ASSESSMENT OF THE PROJECT

The site has an existing house and garage with drives located on the half acre property. For the purpose of this study we will use an SCS Type II Storm, using curve numbers 82 and 88 for pre-development and post-development flows, respectively, as per APWA Table 5602-3. A time of concentration of 5 minutes was used based on the minimum design standards for APWA 5600. Calculations were performed with Civil 3D Stormwater and the Hydraflow extension.

Attached is the pre and post-development drainage areas. We are proposing to detain the South portion Lots 11A and 13A, along with off-site drainage from the West, the total area being 0.29 acres. The portion left undetained will be the North portion of Lots 11A and 13A, along with Lot 9A, the total area being 0.26 acres. Downspouts from each proposed building will be routed to yard inlets in the backyard, where the underground detention facility will be.

We are proposing to use underground detention, with 15” HDPE pipes and 6” cover to reduce peak runoff rates to less than or equal to existing conditions. We are proposing a stormwater easement to be over the proposed detention facilities to prevent construction and minimize the load over detention facilities. Lot 13A will discharge into Lot 11A, and Lot 11A will discharge in Lot 9A, allowing the flow to discharge into the existing swales along the rear of the property. The proposed outlet structure from Lot 11A will be a 10” pipe to reduce the release rates.

Based on the City’s requirements the owners of Lot 11A and 9A will need to give point discharge

agreements for the discharge of the basin on their lots. Lot 9A will not have a release as the upstream detention results in a flow that keeps the total allowed flow below the maximum release rates.

The following is the modeling information for the hydrographs to be analyzed in the proposed storm:

Hyd #	Description
1	Total Site, Existing Conditions, CN=82, 0.49 acres
2	Off-Site Runoff from the West (C-1), CN=82, 0.05 acres
3	Detained portion of subject property (A-1), CN=88, 0.23 acres
4	Combined Detained Portion of Hyd #2 and Hyd #3
5	Undetained portion of subject property (A-2), CN=88, 0.26 acres
6	Routed Hyd #4 through underground detention

The following is the existing conditions runoff release rates:

Storm Event	Release Rate (cfs)
2yr	0.6 cfs
10yr	1.8 cfs
100yr	4.2 cfs

The following is the post-development release rates:

Storm Event	Total runoff running into Basin (cfs) (Hyd #4)	Total runoff from the basin (cfs) (Hyd #6)	Total off-site runoff thru the basin (cfs) (Hyd #2)	Undetained runoff from the site (cfs) (Hyd #5)	Total site runoff (cfs) (Hyd #6 + #5)
2yr	0.5	0.2	0.1	0.4	$0.6 \leq 0.6$
10yr	1.2	0.6	0.2	1.1	$1.7 \leq 1.8$
100yr	2.6	1.1	0.51	2.4	$3.5 \leq 4.2$

The following is the proposed storage volumes and maximum elevation:

Storm Event	Storage Required (cu ft)	Storage Provided (cu ft)	Maximum Elevation	Flowline Elevation
2yr	315	1781	1009.80	1009.5
10yr	773	1781	1010.15	1009.5
100yr	1764	1781	1011.25	1009.5

5.0 TEMPORARY EROSION AND SEDIMENT CONTROL

Erosion and sediment control will be required during construction to limit the amount of soil leaving the site due to runoff. The ensure that soil does not leave the property or enter the street and any downstream drains, a silt fence will be installed around the perimeter of the site. To prevent mud and dirt entering the street from vehicles entering and leaving the construction site, a temporary construction entrance will also be installed. Inspection of the erosion control devices will be required throughout construction to ensure that they are working as intended and not becoming damaged or inoperative.

6.0 Conclusions and Summary

There is a total reduction in runoff after the proposed underground detention facilities are installed. We believe that the proposed detention facility will also help the downstream facilities by having lower release rates from the subject property.

6.0 APPENDIX

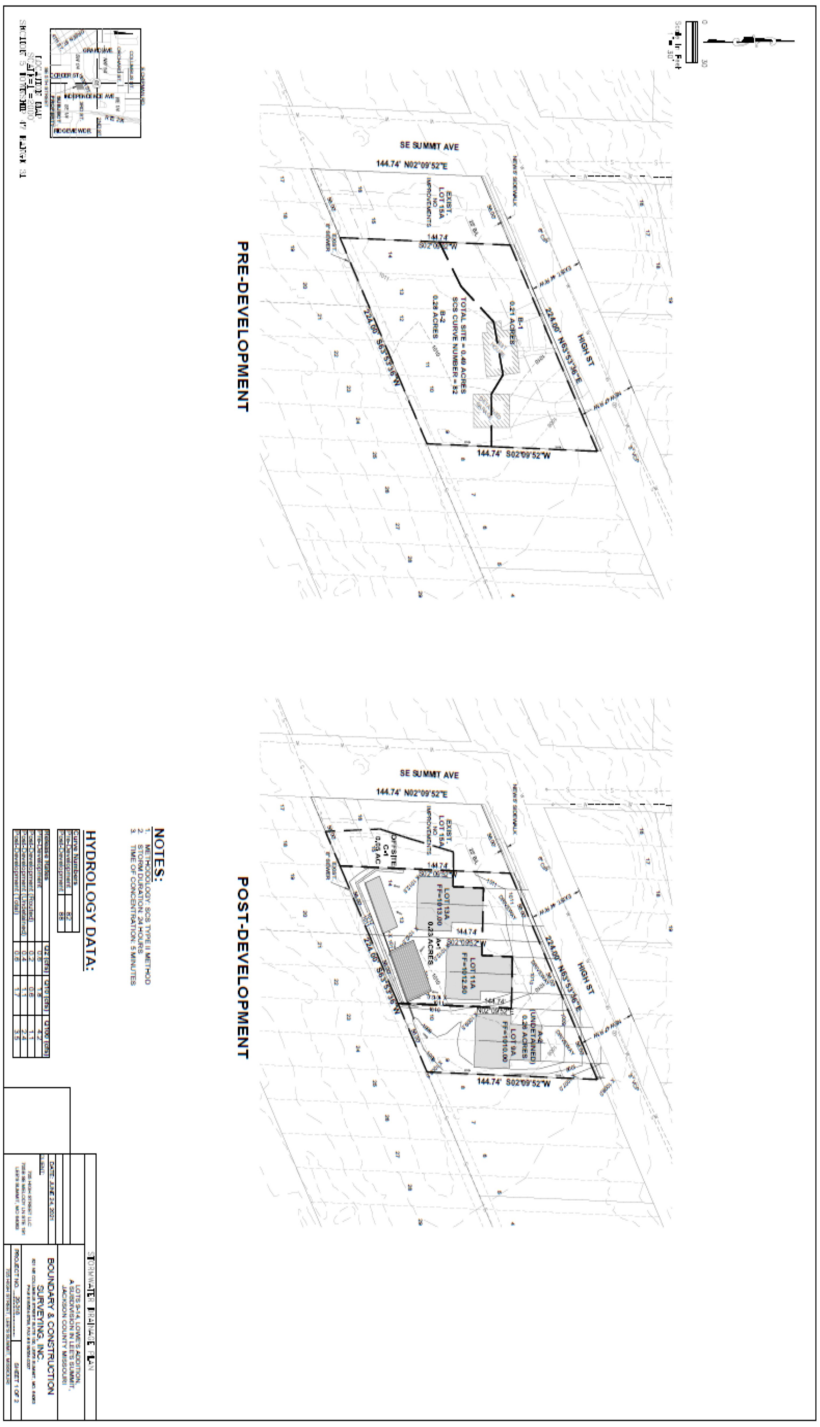

Figure A1. Drainage Area Map

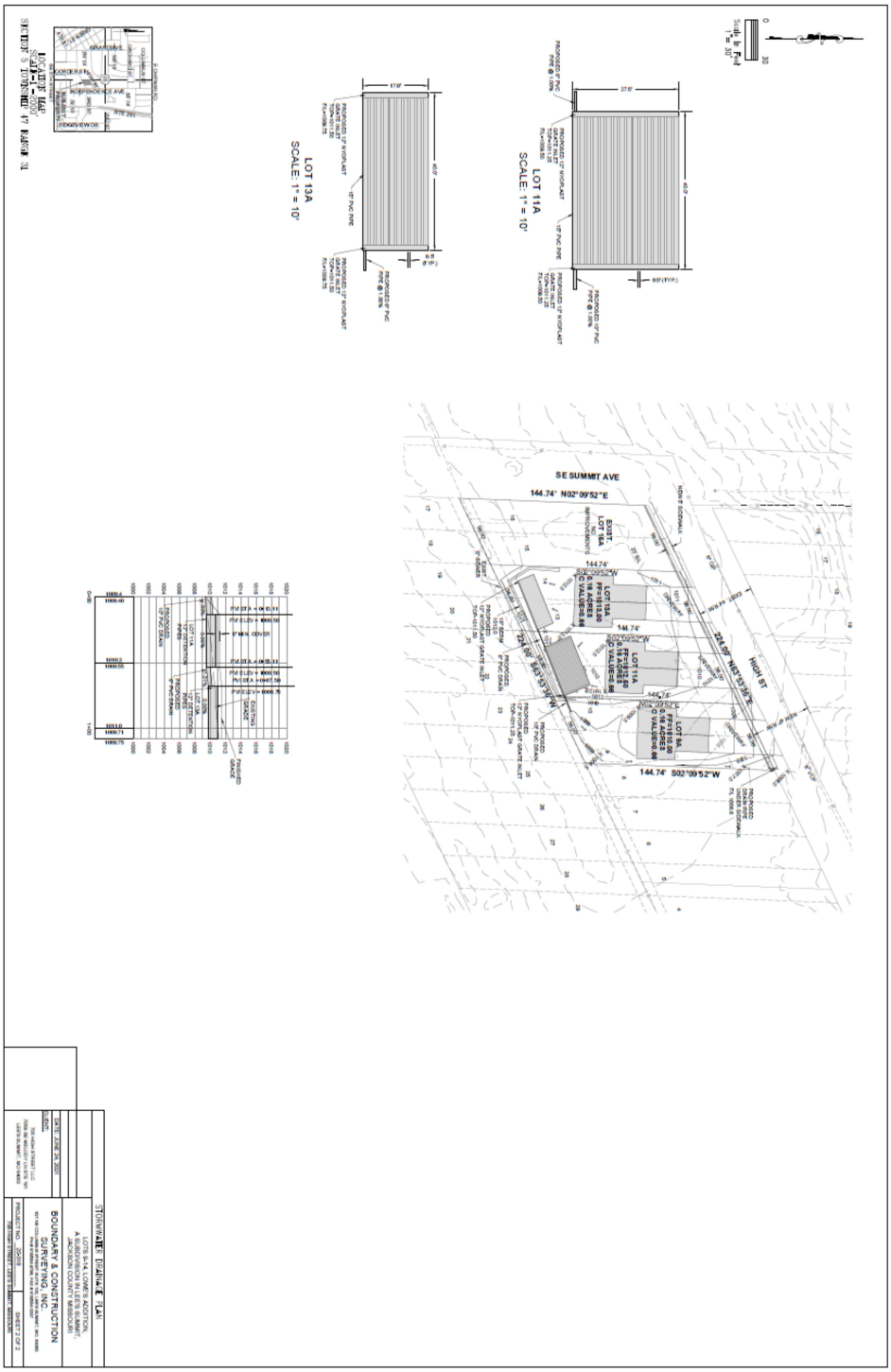

Figure A2. Underground Detention Plan and Profile

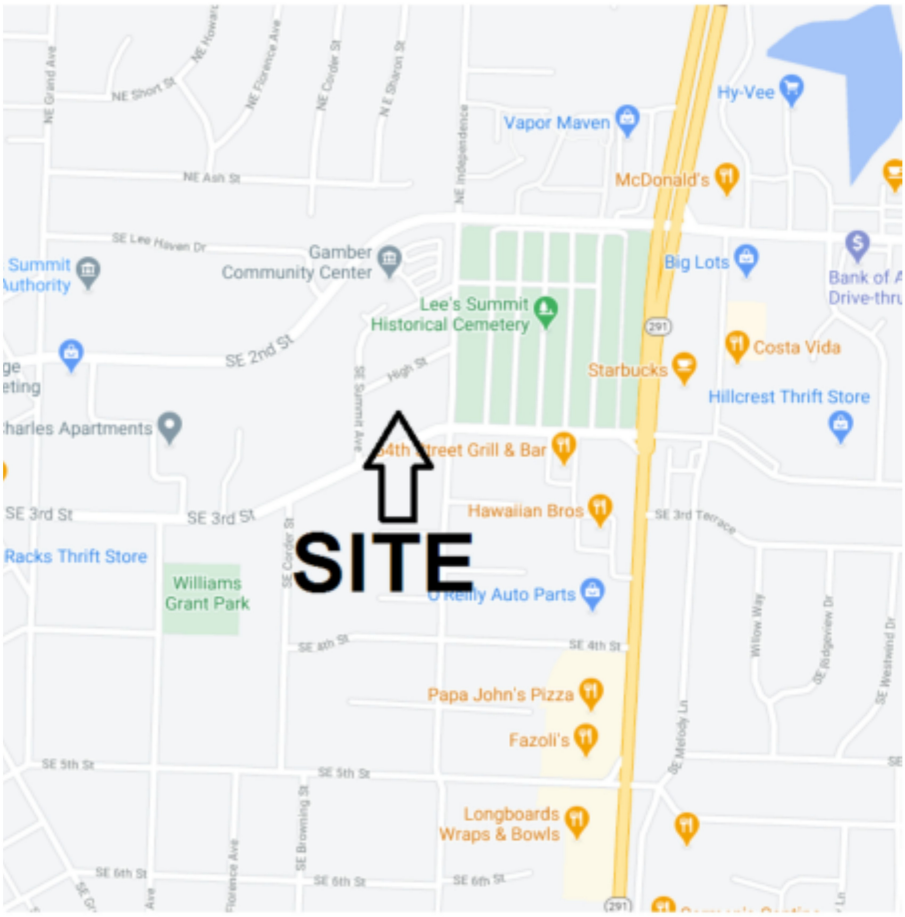

Figure A3. Site Location Map

Figure A4. USGS Map

Figure A5. Aerial View

Figure A6. Firmette Map

Hydraflow Table of Contents

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Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v2018.3 Tuesday, 06 / 29 / 2021

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v2018.3

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	------	-------	0.569	-------	-------	1.782	-------	-------	4.156	Total Site Pre
2	SCS Runoff	------	-------	0.070	-------	-------	0.218	-------	-------	0.509	Off-Site West
3	SCS Runoff	------	-------	0.391	-------	-------	1.004	-------	-------	2.116	Lot 11A/13A Detained
4	Combine	2, 3	-------	0.460	-------	-------	1.222	-------	-------	2.625	Total Detained
5	SCS Runoff	------	-------	0.442	-------	-------	1.134	-------	-------	2.392	On-Site Undetained
6	Reservoir	4	-------	0.225	-------	-------	0.590	-------	-------	1.113	Route

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v2018.3

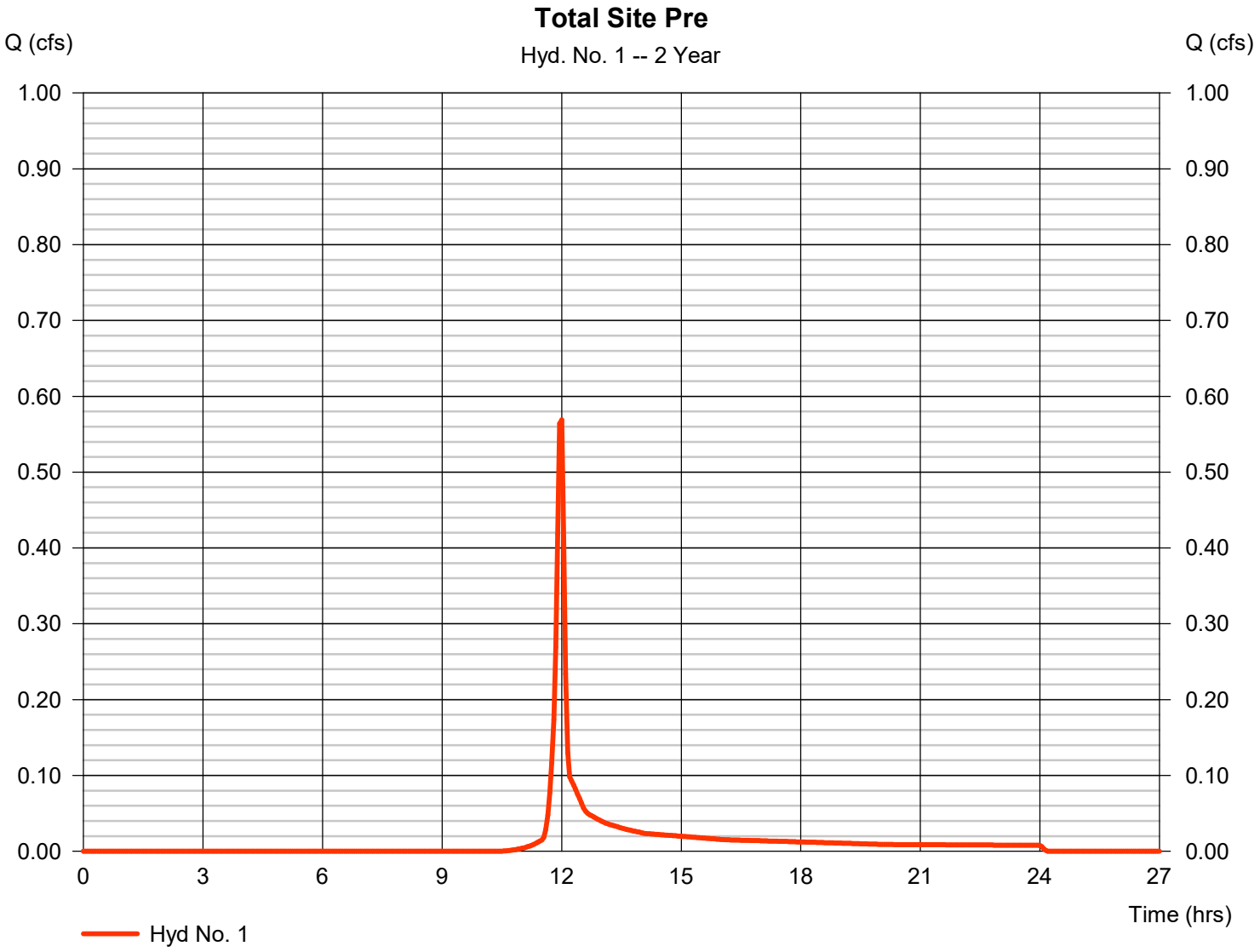
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.569	3	720	1,307	------	------	------	Total Site Pre
2	SCS Runoff	0.070	3	720	160	------	------	------	Off-Site West
3	SCS Runoff	0.391	3	717	883	------	------	------	Lot 11A/13A Detained
4	Combine	0.460	3	717	1,043	2, 3	------	------	Total Detained
5	SCS Runoff	0.442	3	717	999	------	------	------	On-Site Undetained
6	Reservoir	0.225	3	726	1,027	4	1009.80	315	Route

Hydrograph Report

Hyd. No. 1

Total Site Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 0.569 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.00 hrs
Time interval	= 3 min	Hyd. volume	= 1,307 cuft
Drainage area	= 0.490 ac	Curve number	= 82
Basin Slope	= 1.0 %	Hydraulic length	= 150 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

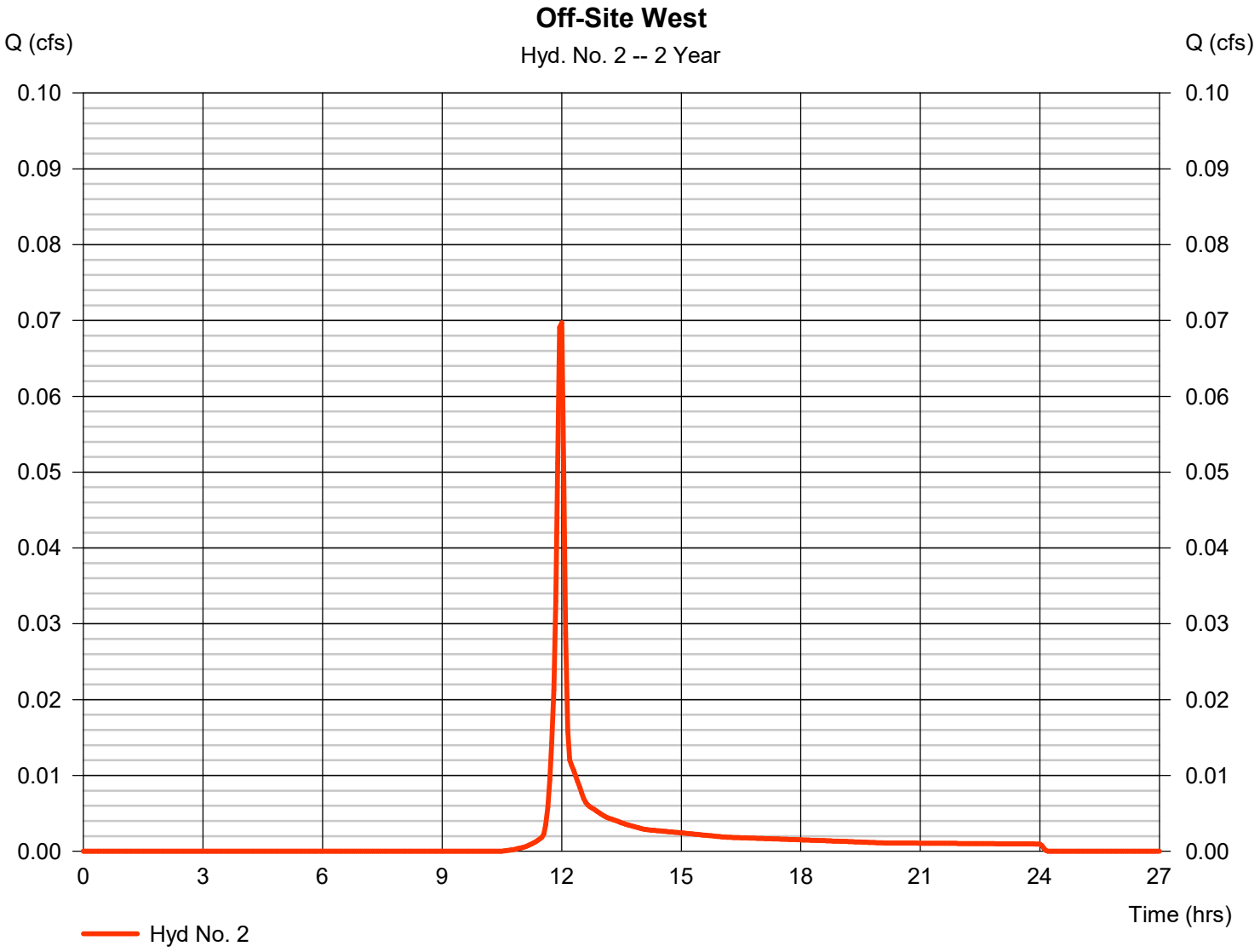


Hydrograph Report

Hyd. No. 2

Off-Site West

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.070 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.00 hrs
Time interval	=	3 min	Hyd. volume	=	160 cuft
Drainage area	=	0.060 ac	Curve number	=	82
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	2.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

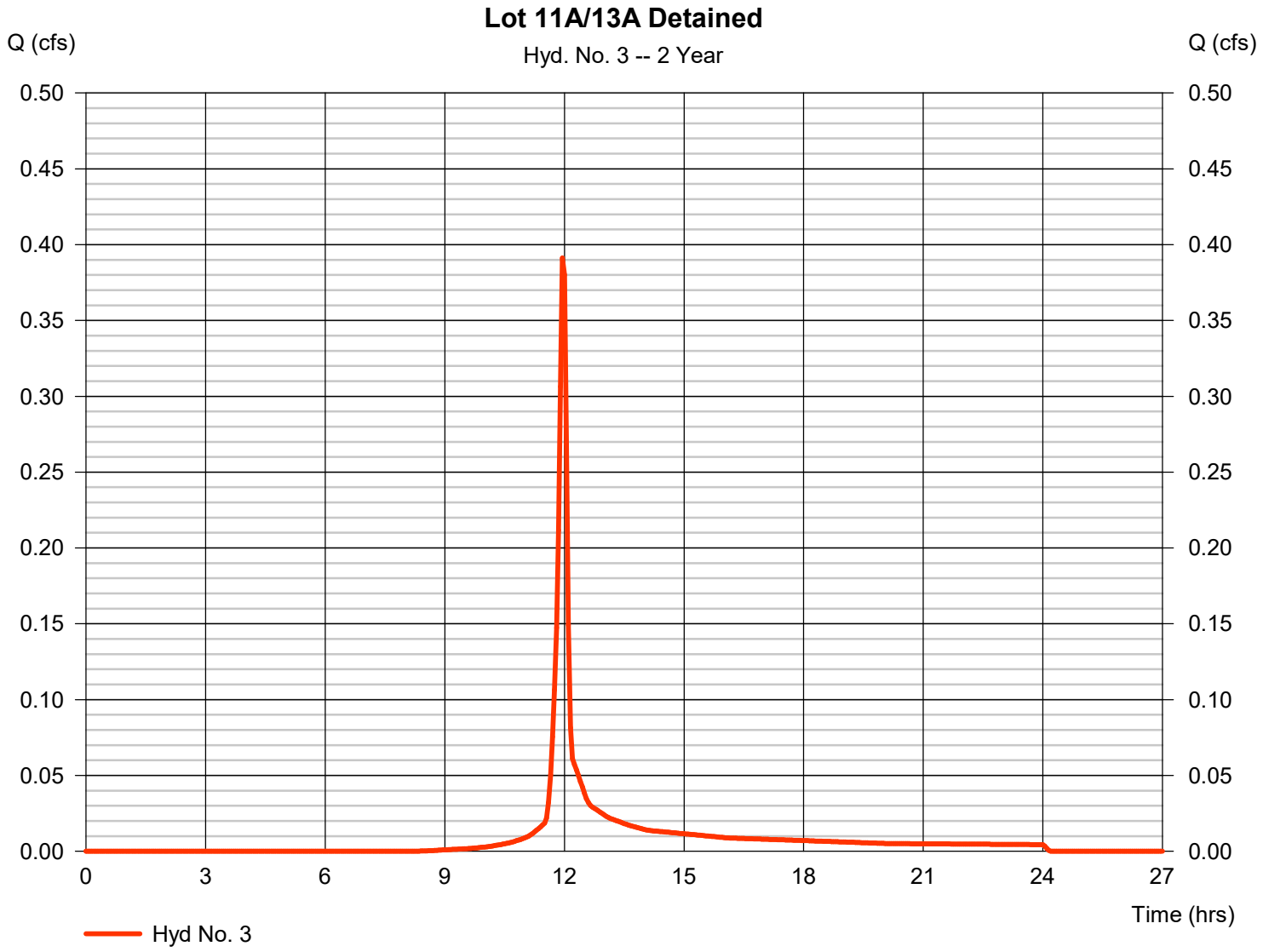


Hydrograph Report

Hyd. No. 3

Lot 11A/13A Detained

Hydrograph type	= SCS Runoff	Peak discharge	= 0.391 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.95 hrs
Time interval	= 3 min	Hyd. volume	= 883 cuft
Drainage area	= 0.230 ac	Curve number	= 88
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

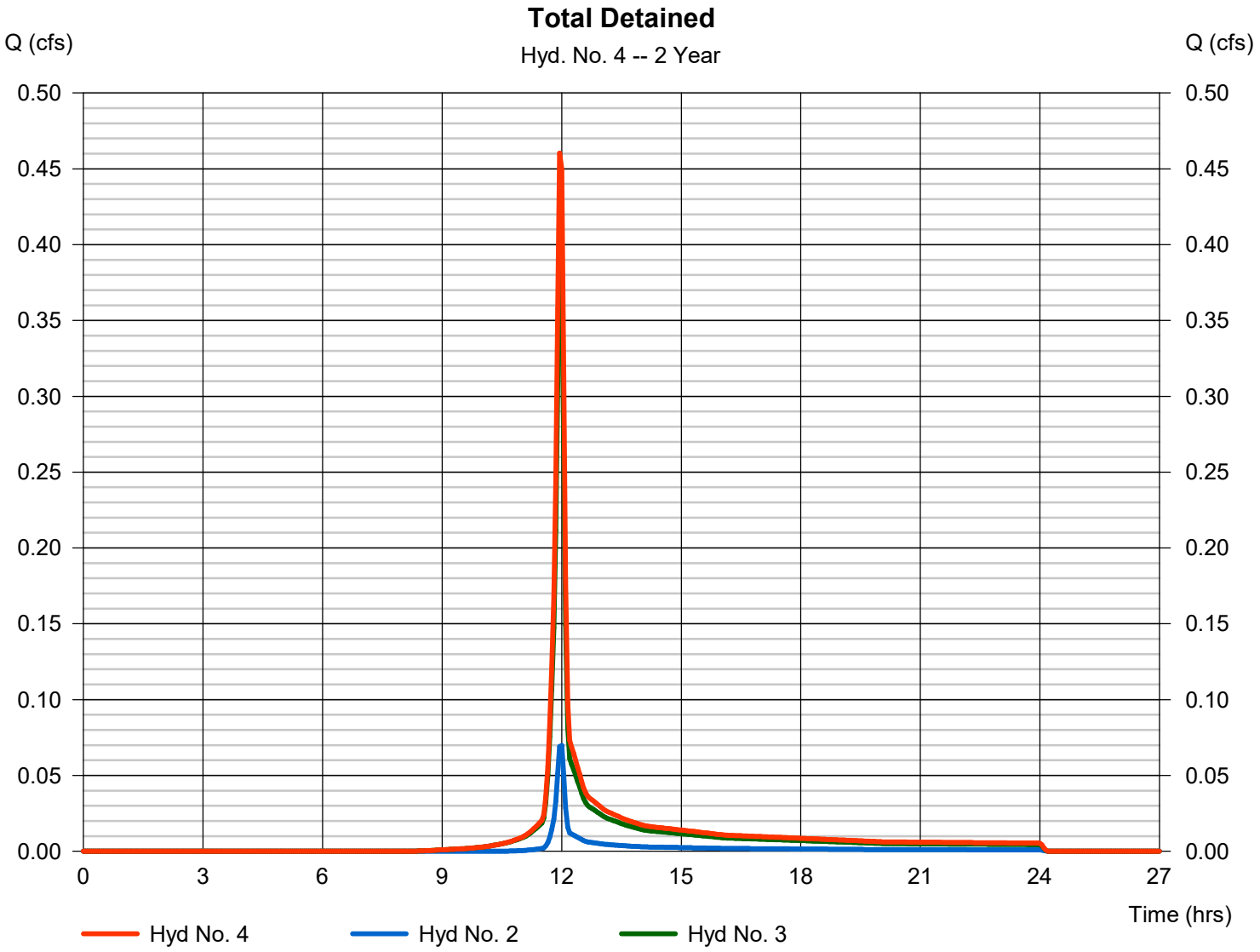


Hydrograph Report

Hyd. No. 4

Total Detained

Hydrograph type	= Combine	Peak discharge	= 0.460 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.95 hrs
Time interval	= 3 min	Hyd. volume	= 1,043 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 0.290 ac

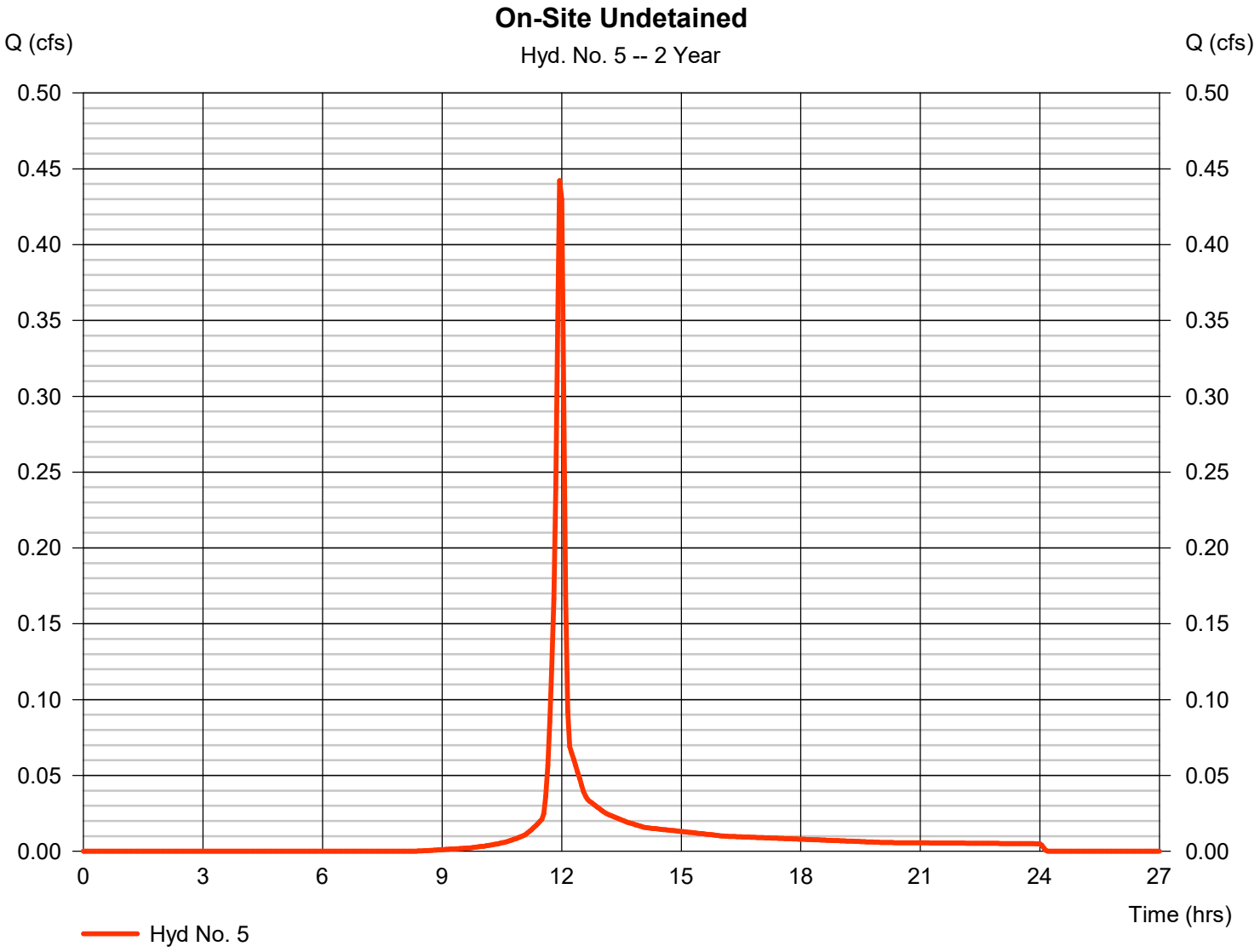


Hydrograph Report

Hyd. No. 5

On-Site Undetained

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.442 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.95 hrs
Time interval	=	3 min	Hyd. volume	=	999 cuft
Drainage area	=	0.260 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	2.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



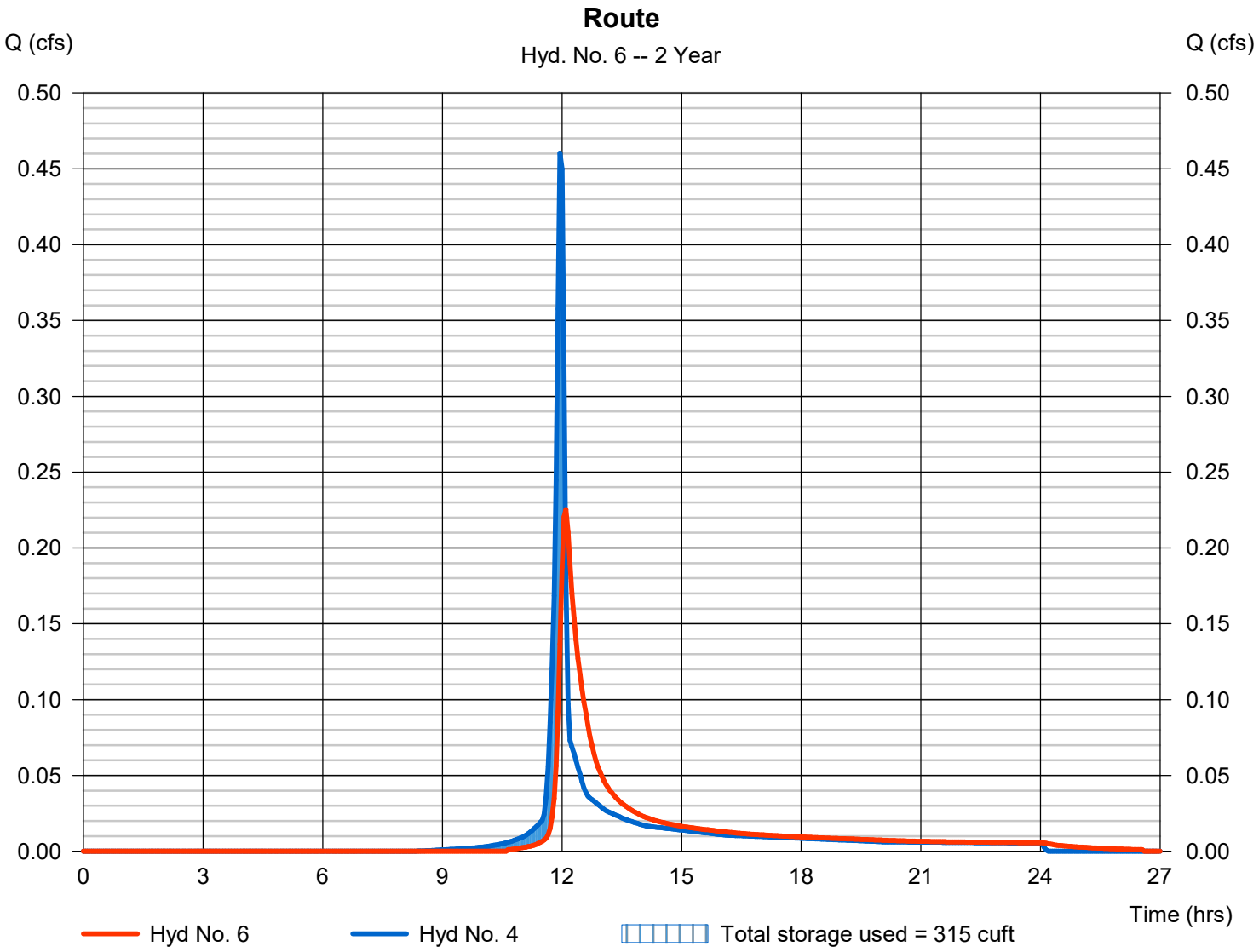
Hydrograph Report

Hyd. No. 6

Route

Hydrograph type	=	Reservoir	Peak discharge	=	0.225 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.10 hrs
Time interval	=	3 min	Hyd. volume	=	1,027 cuft
Inflow hyd. No.	=	4 - Total Detained	Max. Elevation	=	1009.80 ft
Reservoir name	=	Detention	Max. Storage	=	315 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v2018.3

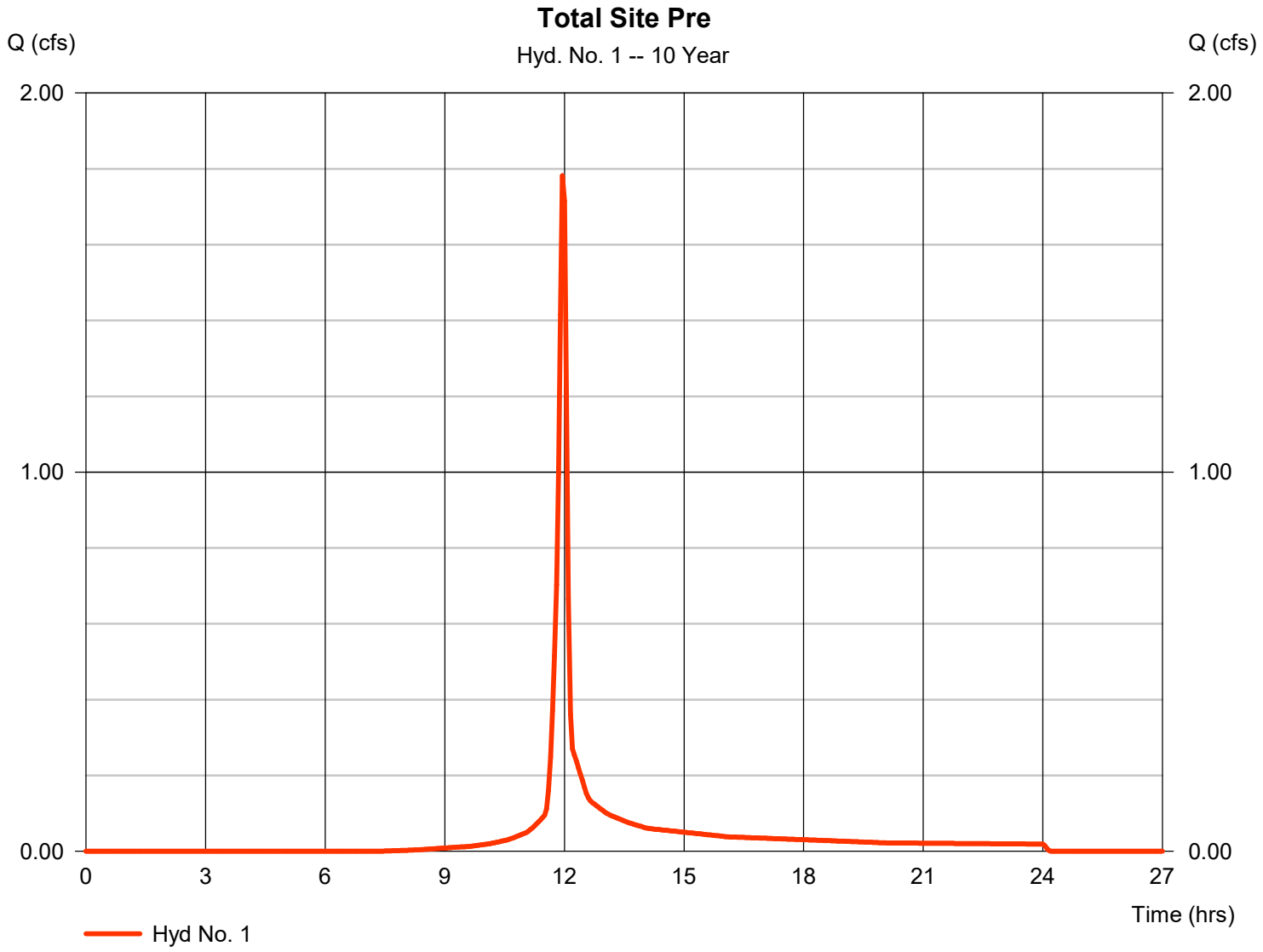
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.782	3	717	4,032	------	------	------	Total Site Pre
2	SCS Runoff	0.218	3	717	494	------	------	------	Off-Site West
3	SCS Runoff	1.004	3	717	2,318	------	------	------	Lot 11A/13A Detained
4	Combine	1.222	3	717	2,812	2, 3	------	------	Total Detained
5	SCS Runoff	1.134	3	717	2,621	------	------	------	On-Site Undetained
6	Reservoir	0.590	3	726	2,795	4	1010.15	773	Route

Hydrograph Report

Hyd. No. 1

Total Site Pre

Hydrograph type	= SCS Runoff	Peak discharge	= 1.782 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.95 hrs
Time interval	= 3 min	Hyd. volume	= 4,032 cuft
Drainage area	= 0.490 ac	Curve number	= 82
Basin Slope	= 1.0 %	Hydraulic length	= 150 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

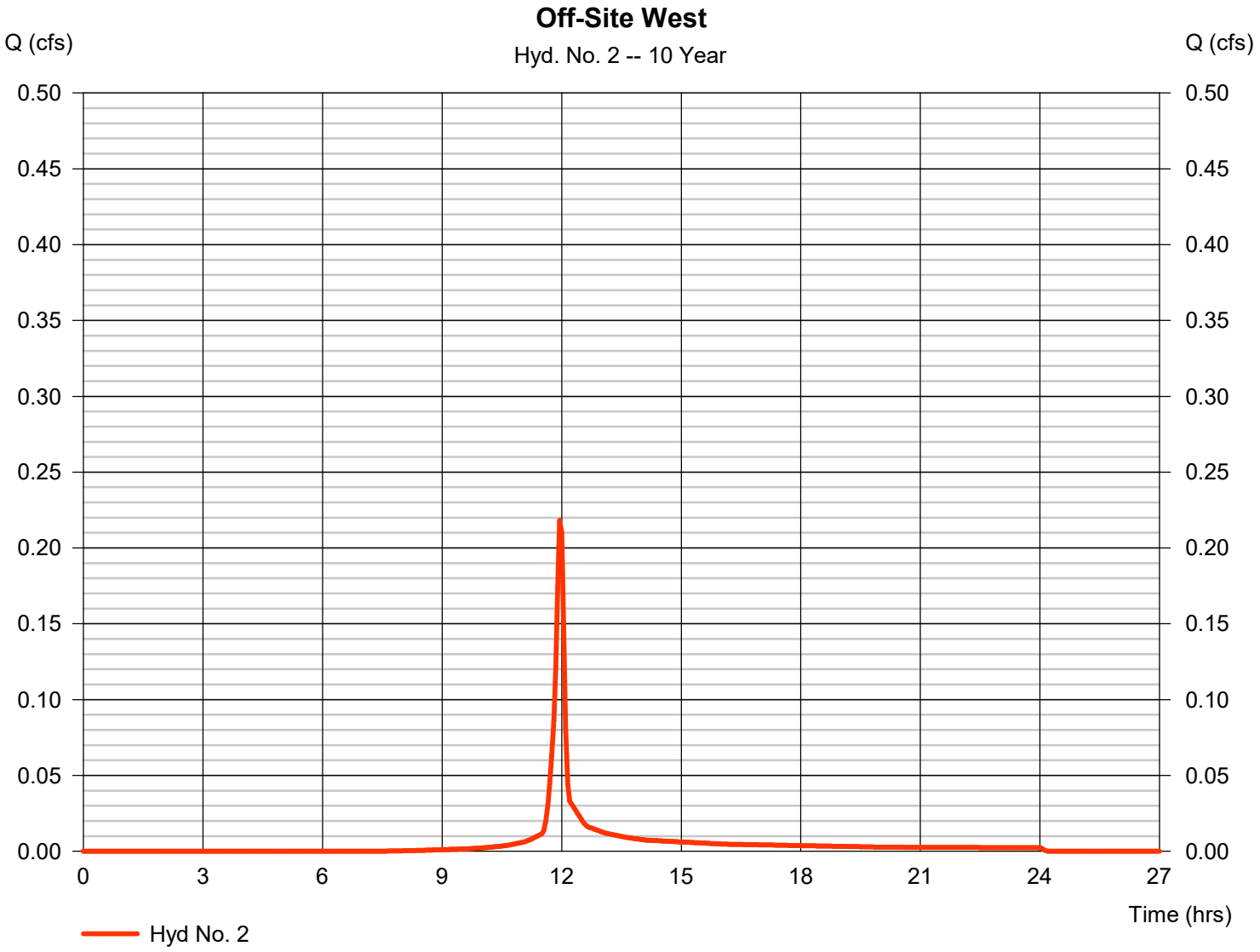


Hydrograph Report

Hyd. No. 2

Off-Site West

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.218 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.95 hrs
Time interval	=	3 min	Hyd. volume	=	494 cuft
Drainage area	=	0.060 ac	Curve number	=	82
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	4.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

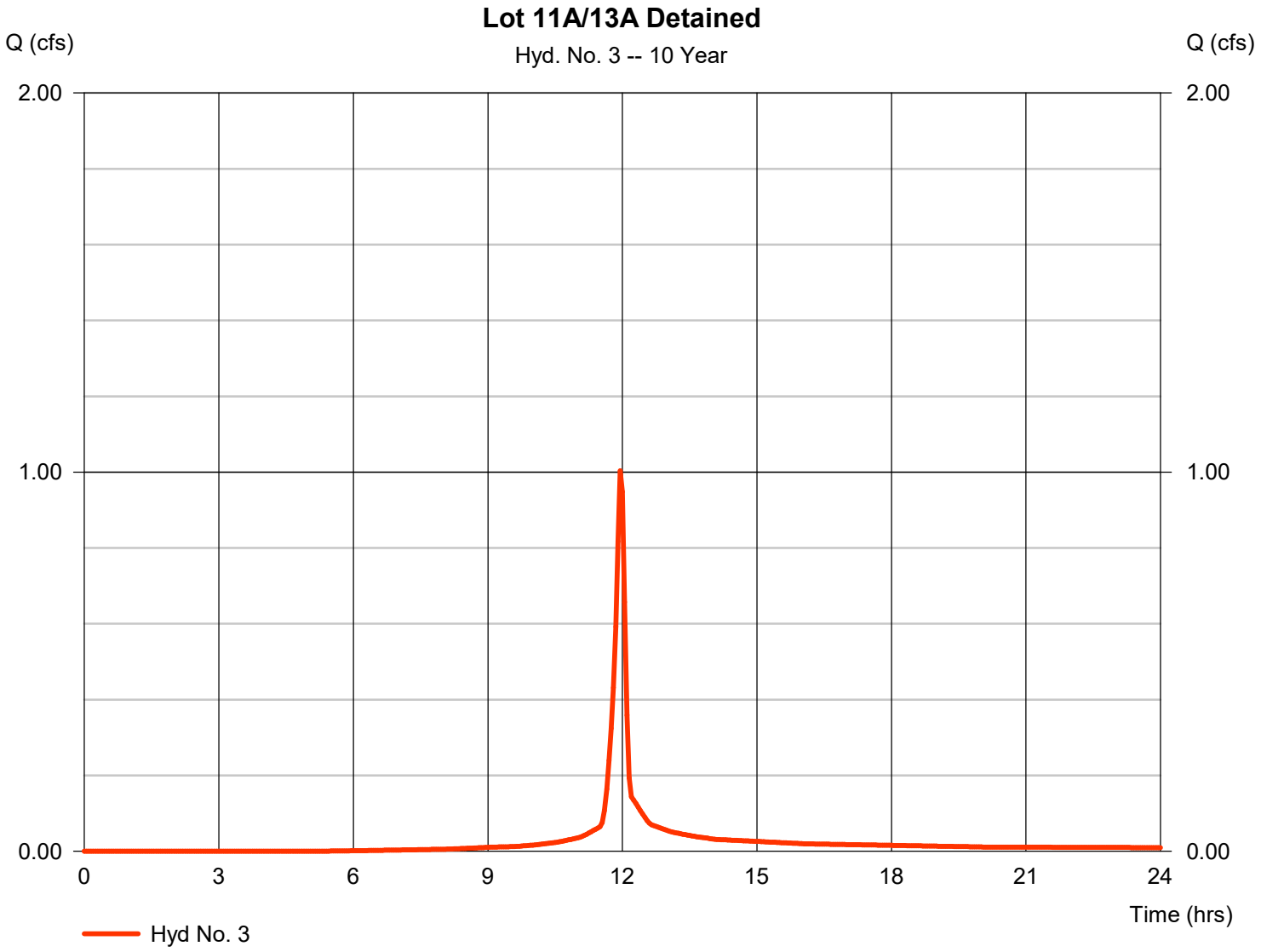


Hydrograph Report

Hyd. No. 3

Lot 11A/13A Detained

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.004 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.95 hrs
Time interval	=	3 min	Hyd. volume	=	2,318 cuft
Drainage area	=	0.230 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	4.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

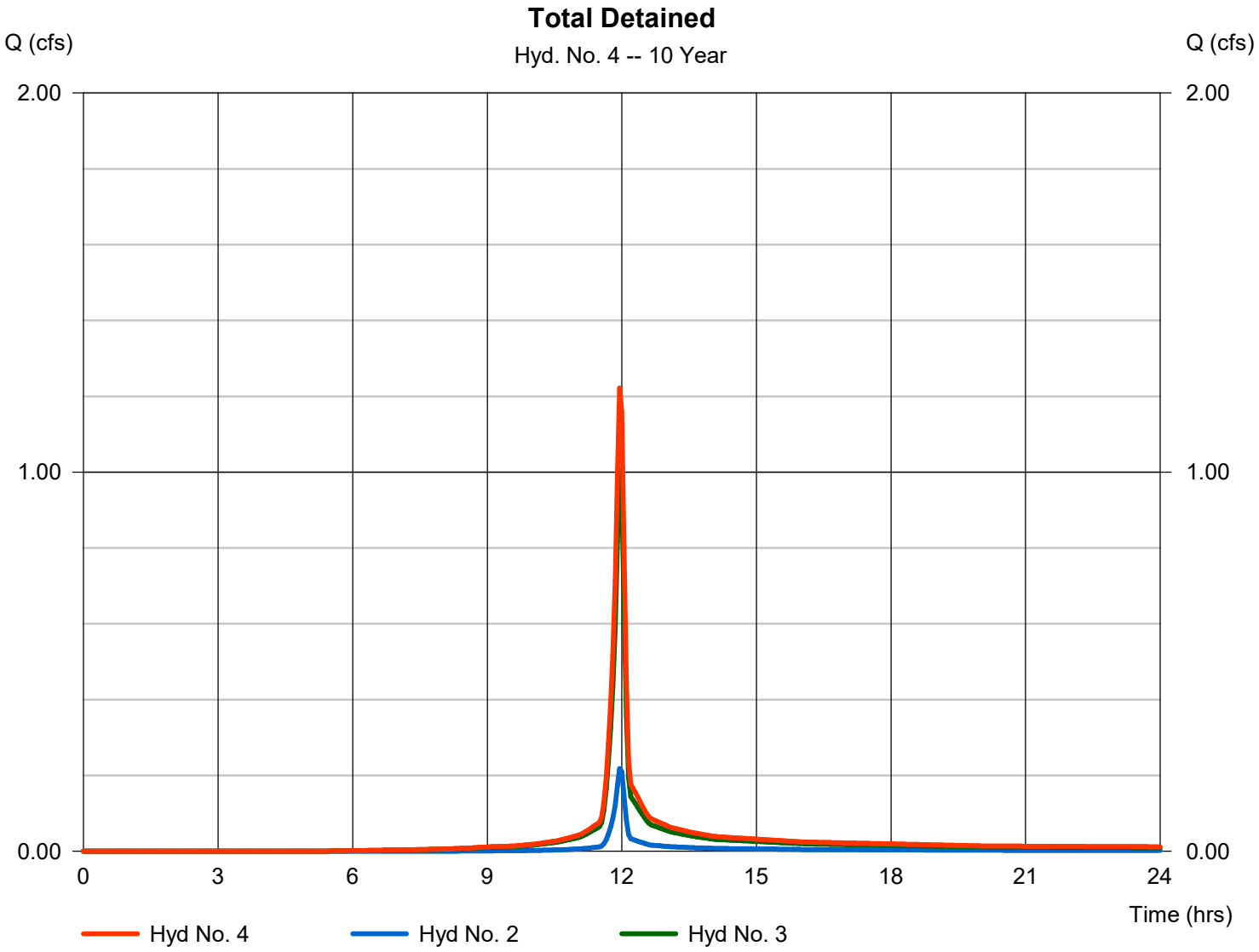


Hydrograph Report

Hyd. No. 4

Total Detained

Hydrograph type	= Combine	Peak discharge	= 1.222 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.95 hrs
Time interval	= 3 min	Hyd. volume	= 2,812 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 0.290 ac

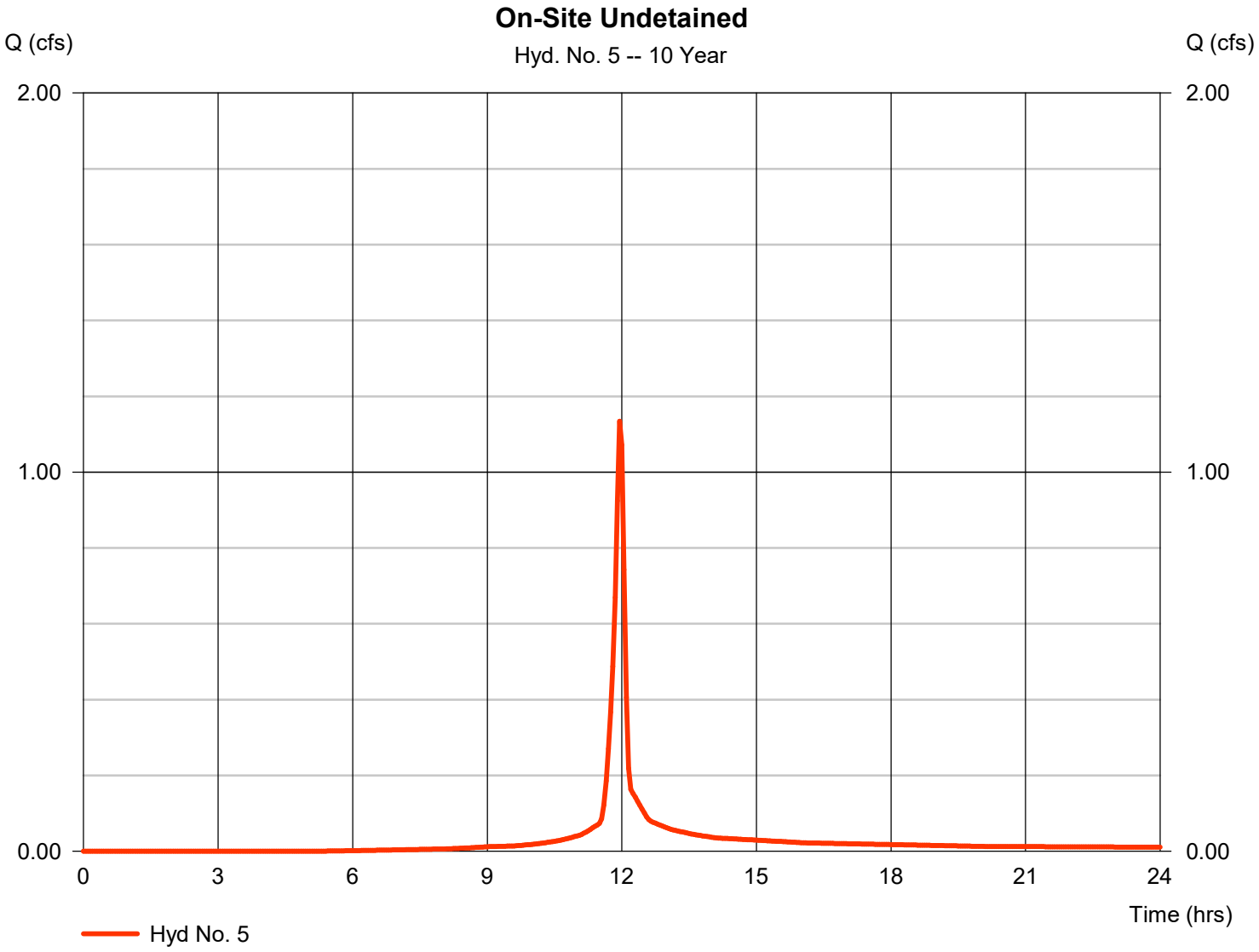


Hydrograph Report

Hyd. No. 5

On-Site Undetained

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.134 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.95 hrs
Time interval	=	3 min	Hyd. volume	=	2,621 cuft
Drainage area	=	0.260 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	4.25 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



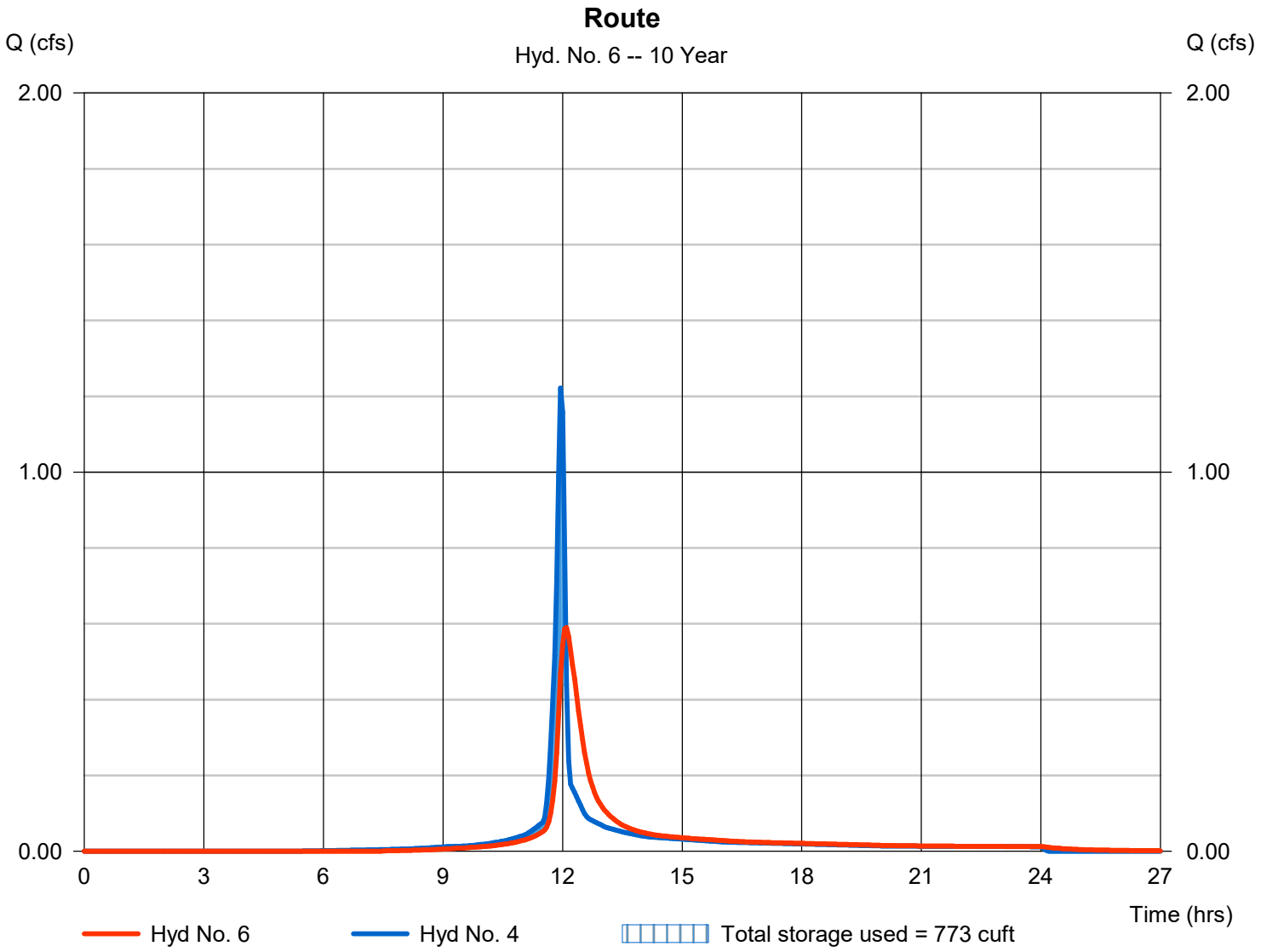
Hydrograph Report

Hyd. No. 6

Route

Hydrograph type	=	Reservoir	Peak discharge	=	0.590 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.10 hrs
Time interval	=	3 min	Hyd. volume	=	2,795 cuft
Inflow hyd. No.	=	4 - Total Detained	Max. Elevation	=	1010.15 ft
Reservoir name	=	Detention	Max. Storage	=	773 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2018 by Autodesk, Inc. v2018.3

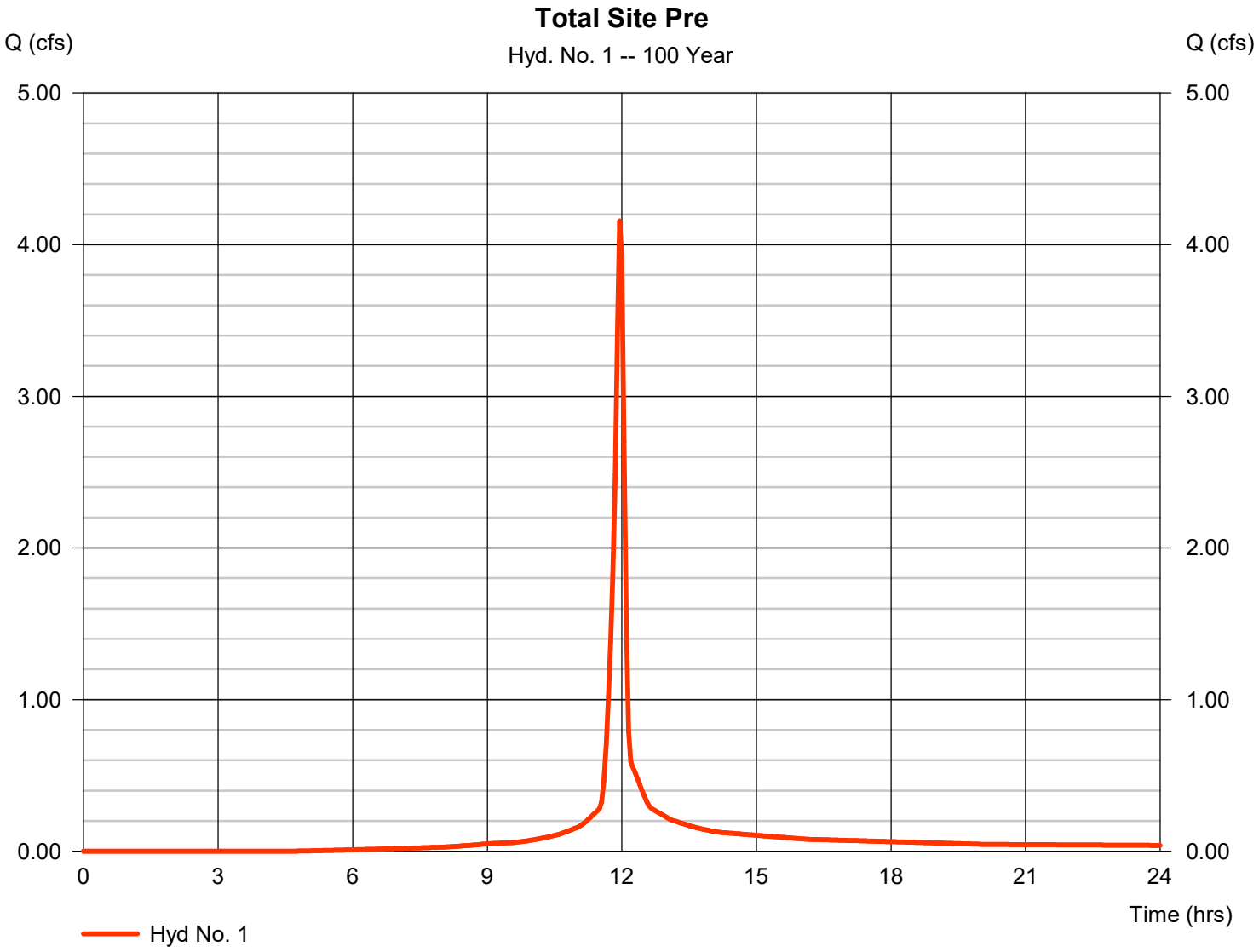
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.156	3	717	9,692	------	------	------	Total Site Pre
2	SCS Runoff	0.509	3	717	1,187	------	------	------	Off-Site West
3	SCS Runoff	2.116	3	717	5,103	------	------	------	Lot 11A/13A Detained
4	Combine	2.625	3	717	6,290	2, 3	------	------	Total Detained
5	SCS Runoff	2.392	3	717	5,768	------	------	------	On-Site Undetained
6	Reservoir	1.113	3	726	6,273	4	1011.25	1,764	Route

Hydrograph Report

Hyd. No. 1

Total Site Pre

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.156 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.95 hrs
Time interval	=	3 min	Hyd. volume	=	9,692 cuft
Drainage area	=	0.490 ac	Curve number	=	82
Basin Slope	=	1.0 %	Hydraulic length	=	150 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	7.95 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

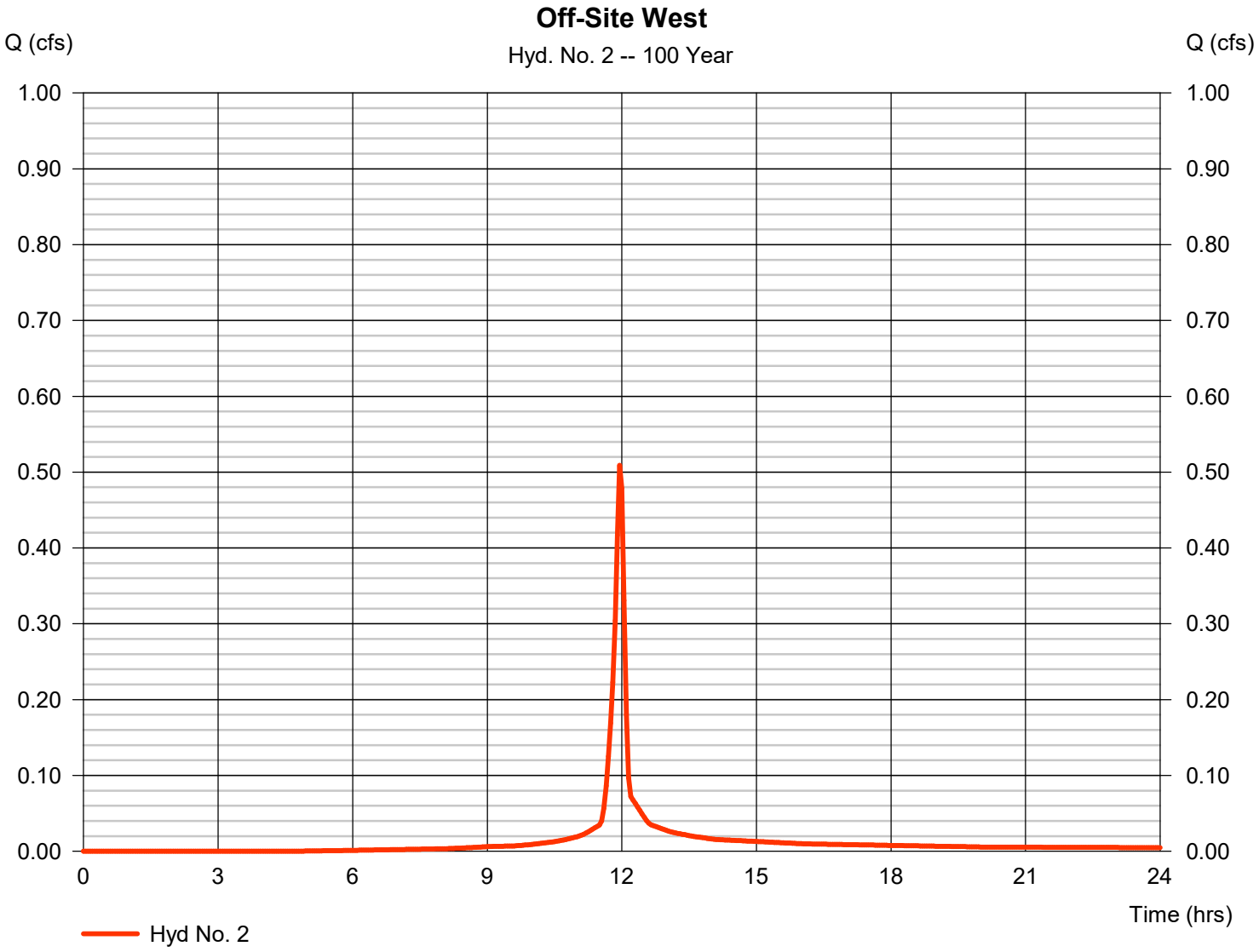


Hydrograph Report

Hyd. No. 2

Off-Site West

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.509 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.95 hrs
Time interval	=	3 min	Hyd. volume	=	1,187 cuft
Drainage area	=	0.060 ac	Curve number	=	82
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	7.95 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

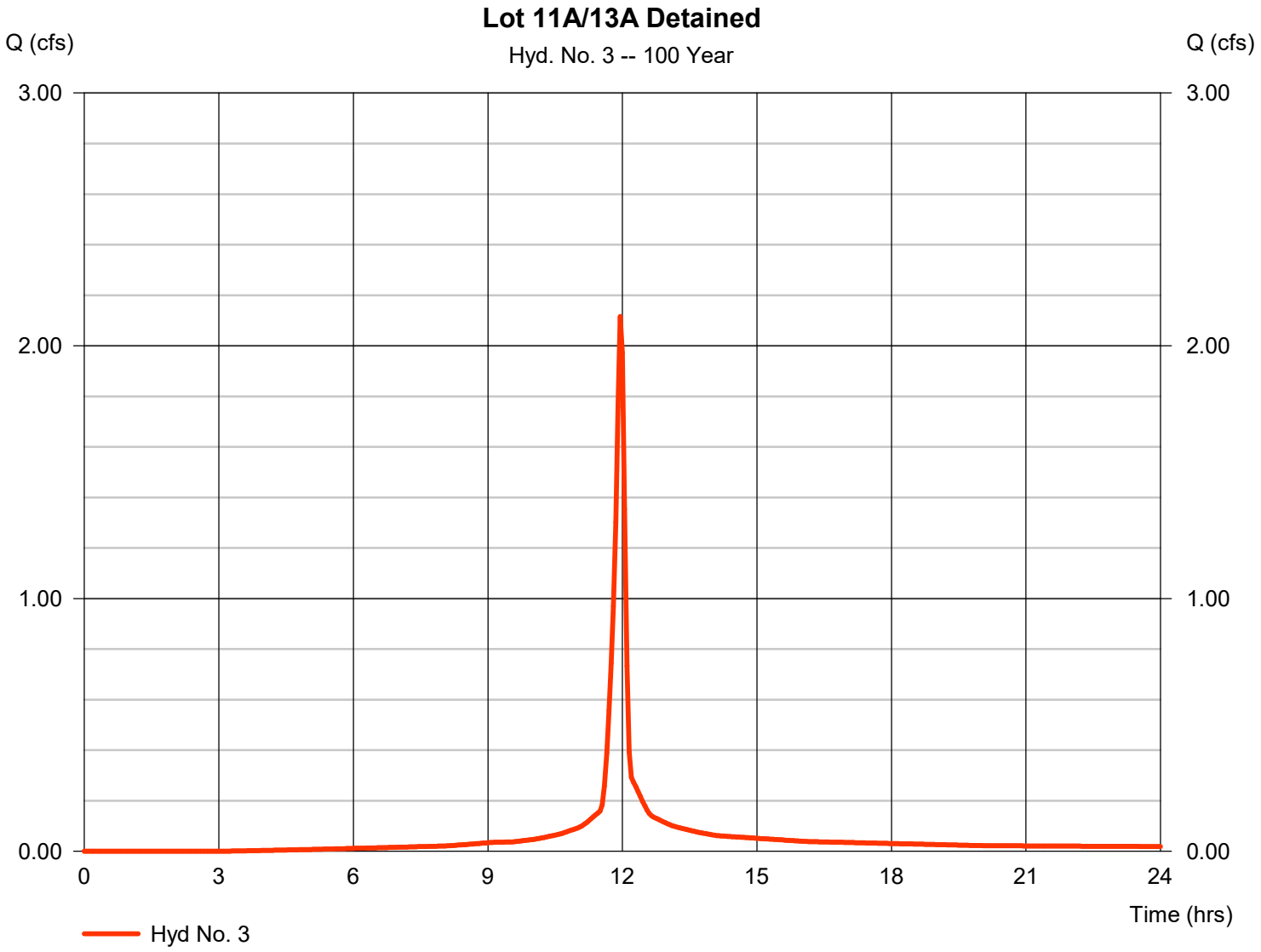


Hydrograph Report

Hyd. No. 3

Lot 11A/13A Detained

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.116 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.95 hrs
Time interval	=	3 min	Hyd. volume	=	5,103 cuft
Drainage area	=	0.230 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	7.95 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

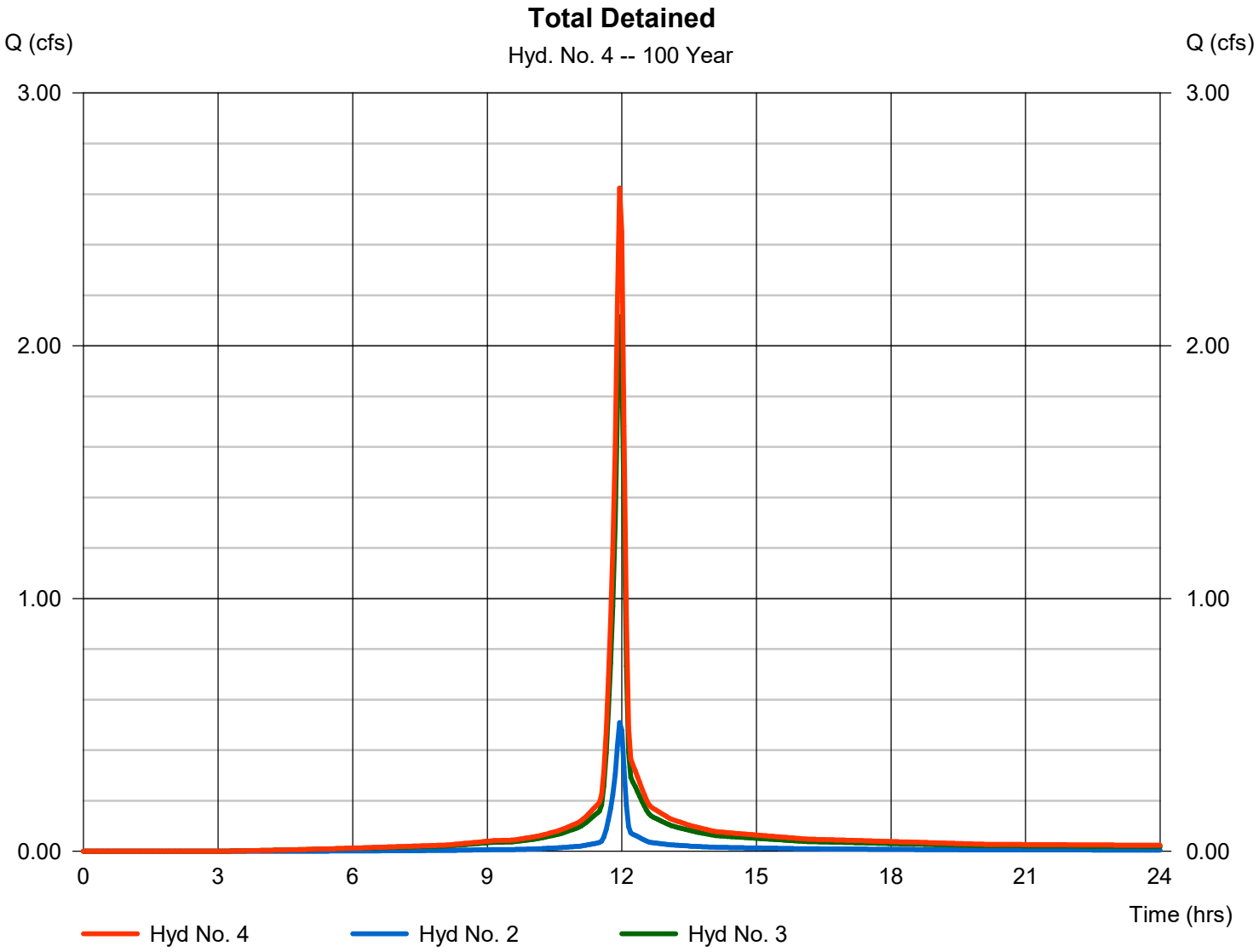


Hydrograph Report

Hyd. No. 4

Total Detained

Hydrograph type	= Combine	Peak discharge	= 2.625 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.95 hrs
Time interval	= 3 min	Hyd. volume	= 6,290 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 0.290 ac

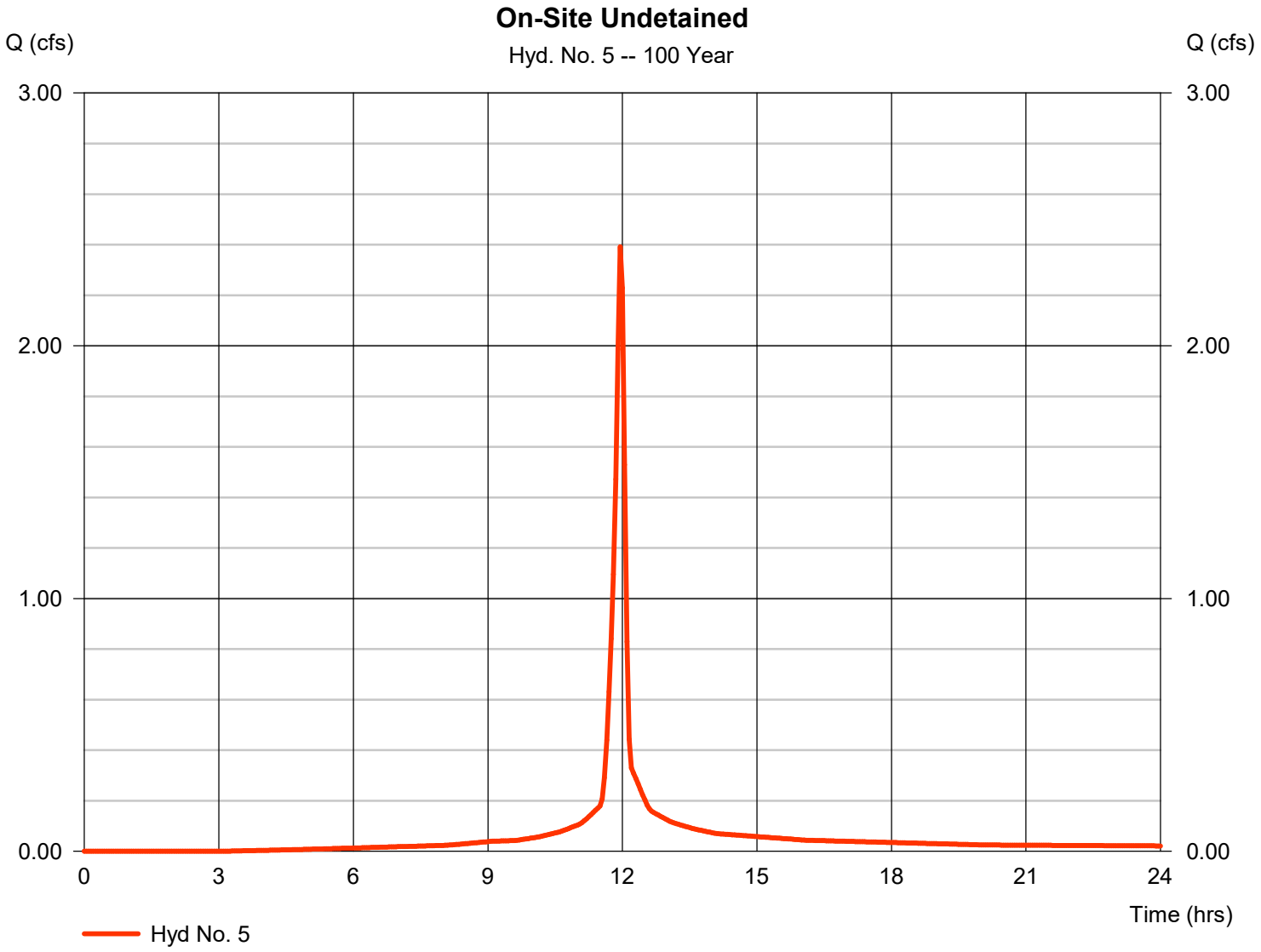


Hydrograph Report

Hyd. No. 5

On-Site Undetained

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.392 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.95 hrs
Time interval	=	3 min	Hyd. volume	=	5,768 cuft
Drainage area	=	0.260 ac	Curve number	=	88
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	5.00 min
Total precip.	=	7.95 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Report

Hyd. No. 6

Route

Hydrograph type	=	Reservoir	Peak discharge	=	1.113 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.10 hrs
Time interval	=	3 min	Hyd. volume	=	6,273 cuft
Inflow hyd. No.	=	4 - Total Detained	Max. Elevation	=	1011.25 ft
Reservoir name	=	Detention	Max. Storage	=	1,764 cuft

Storage Indication method used.