

CIVIL ENGINEERING
ENVIRONMENTAL
SURVEYING
LANDSCAPE ARCHITECTURE
GEOTECHNICAL

STORMWATER MANAGEMENT CALCULATIONS

Tanna Retail
Block 191, Lot 5
Cranford Township
Union County, New Jersey



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SYSTEM SUMMARY

The proposed improvements for the above-referenced property consist of the construction of a 1-story building and general site improvements. The work results in a net increase of impervious coverage of 3,482 square feet over current conditions. According to Cranford Township Ordinance Section 364, any development with over 1,000 square feet of change in impervious cover shall incorporate a stormwater management design. The design of the proposed stormwater management system design is as follows:

The stormwater from the building is collected via four drains located on the roof. It is then transported through a 6in pipe below the roof down to the proposed rear yard inlet. The yard inlet has been designed to collect the surface runoff from the concrete walkway, trash enclosure, and stone area surrounding the stormwater system which then discharges the runoff directly into the proposed system. The system is designed with the post development conditions modeled as 100% impervious. However, 317 square feet of the lot is open gravel, which is considered pervious. The storage system is located in the rear of the property and is comprised of two, 20LF, perforated, 12in, schedule 40 PVC pipes at a 0% slope.

As shown in the tube permeameter tests, the soils on the site have a high permeability rate, therefore; infiltration was incorporated into the stormwater detention design. The infiltration rate utilized in the design of the system is half of the maximum rate of 1in per hour per the NJBMP manual. This rate is significantly below the actual permeability of the site to allow the water in the system adequate time to drain. Due to the high permeability rate of the soil on the site, there are no anticipated impacts to neighboring properties as a result of the increased amount of stormwater runoff.

A stone trench surrounds the two perforated pipes and an outlet control structure is located at the end of the system in the northwest corner of the property. The outlet control structure gives the water within the system time to infiltrate. A 30LF, 6in PVC pipe at a 0.5% slope leads from the outlet control structure to another yard inlet on the western side of the property. This inlet collects any stormwater that has bypassed the underground system to ensure that no water gets trapped between the two structures. Exiting this inlet is a 5LF, 6in PVC pipe at a 0.75% slope. A 3in x 6in schedule 40 PVC reducer coupling is used to transition to a 58LF, 3in PVC pipe through the proposed building at a 0.75% slope. The pipe through the proposed building is limited to three inches due to the height of the curb discharge point at the street level. This pipe ends at the curb in the front of the property and discharges onto North Union Street. The stormwater management system is designed to infiltrate the majority of the runoff produced on the site so that there is minimal discharge onto the road.



CN - RUNOFF CURVE NUMBERS (TR55)

Drainage Area	Soil Name HSG	Cover Description	CN	Area (sf)	Area (Ac)	CN*Area	CN (Weighted)
EX-DA	UR(D)	Roof & Concrete	98	105	0.00	0.002	
	Total			105	0.002	0.002	98
EX-DA	UR(D)	Open Space (Fair Condition)	84	3,482	0.08	0.067	
	Total			3,482	0.080	0.067	84
PROP-DA	UR(D)	Roof & Concrete Gravel	98	3,270	0.08	0.074	
			91	317	0.01	0.007	
	Total			3,587	0.082	0.080	97

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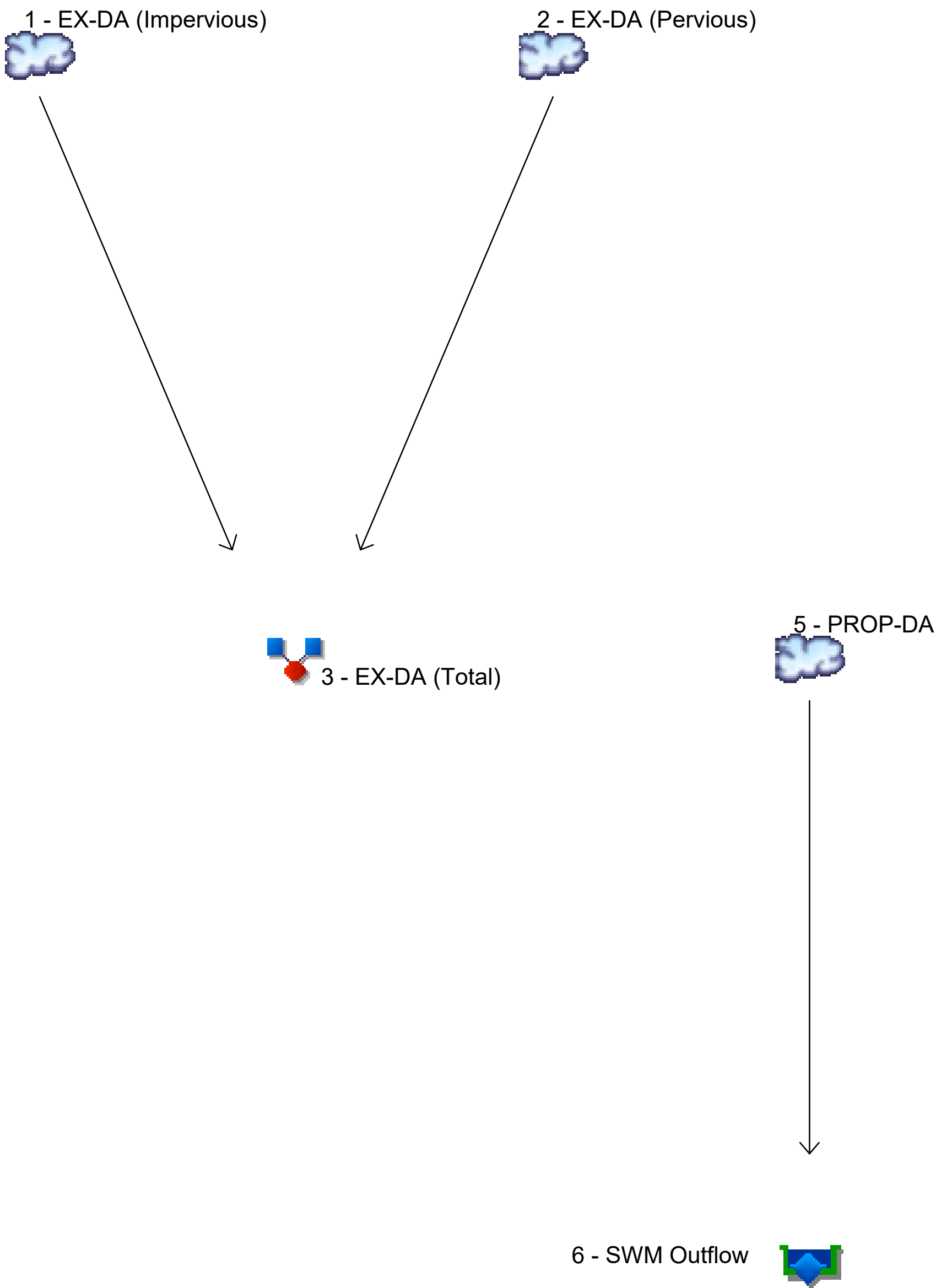
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Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	EX-DA (Impervious)
2	SCS Runoff	EX-DA (Pervious)
3	Combine	EX-DA (Total)
5	SCS Runoff	PROP-DA
6	Reservoir	SWM Outflow

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	
1	SCS Runoff	-----	-----	0.006	-----	-----	0.009	-----	-----	0.014	EX-DA (Impervious)
2	SCS Runoff	-----	-----	0.147	-----	-----	0.270	-----	-----	0.517	EX-DA (Pervious)
3	Combine	1, 2	-----	0.153	-----	-----	0.279	-----	-----	0.532	EX-DA (Total)
5	SCS Runoff	-----	-----	0.225	-----	-----	0.349	-----	-----	0.590	PROP-DA
6	Reservoir	5	-----	0.140	-----	-----	0.270	-----	-----	0.514	SWM Outflow
Proj. file: SWM-Design2.gpw										Tuesday, 03 / 24 / 2020	

Hydrograph Summary Report

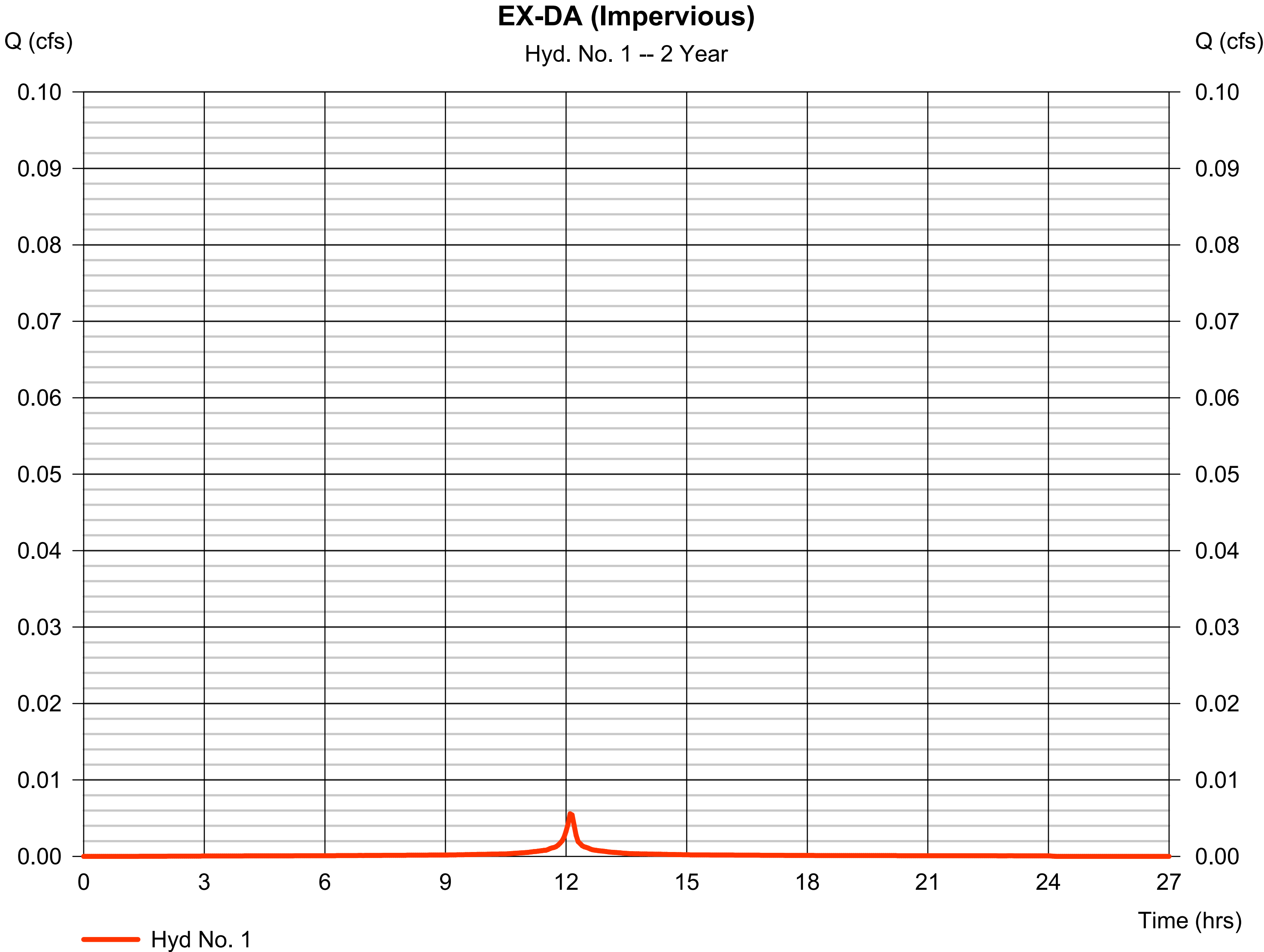
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.006	3	726	22	-----	-----	-----	EX-DA (Impervious)
2	SCS Runoff	0.147	3	729	504	-----	-----	-----	EX-DA (Pervious)
3	Combine	0.153	3	729	526	1, 2	-----	-----	EX-DA (Total)
5	SCS Runoff	0.225	3	726	853	-----	-----	-----	PROP-DA
6	Reservoir	0.140	3	729	107	5	100.96	92.6	SWM Outflow
SWM-Design2.gpw					Return Period: 2 Year			Tuesday, 03 / 24 / 2020	

Hyd. No. 1

EX-DA (Impervious)

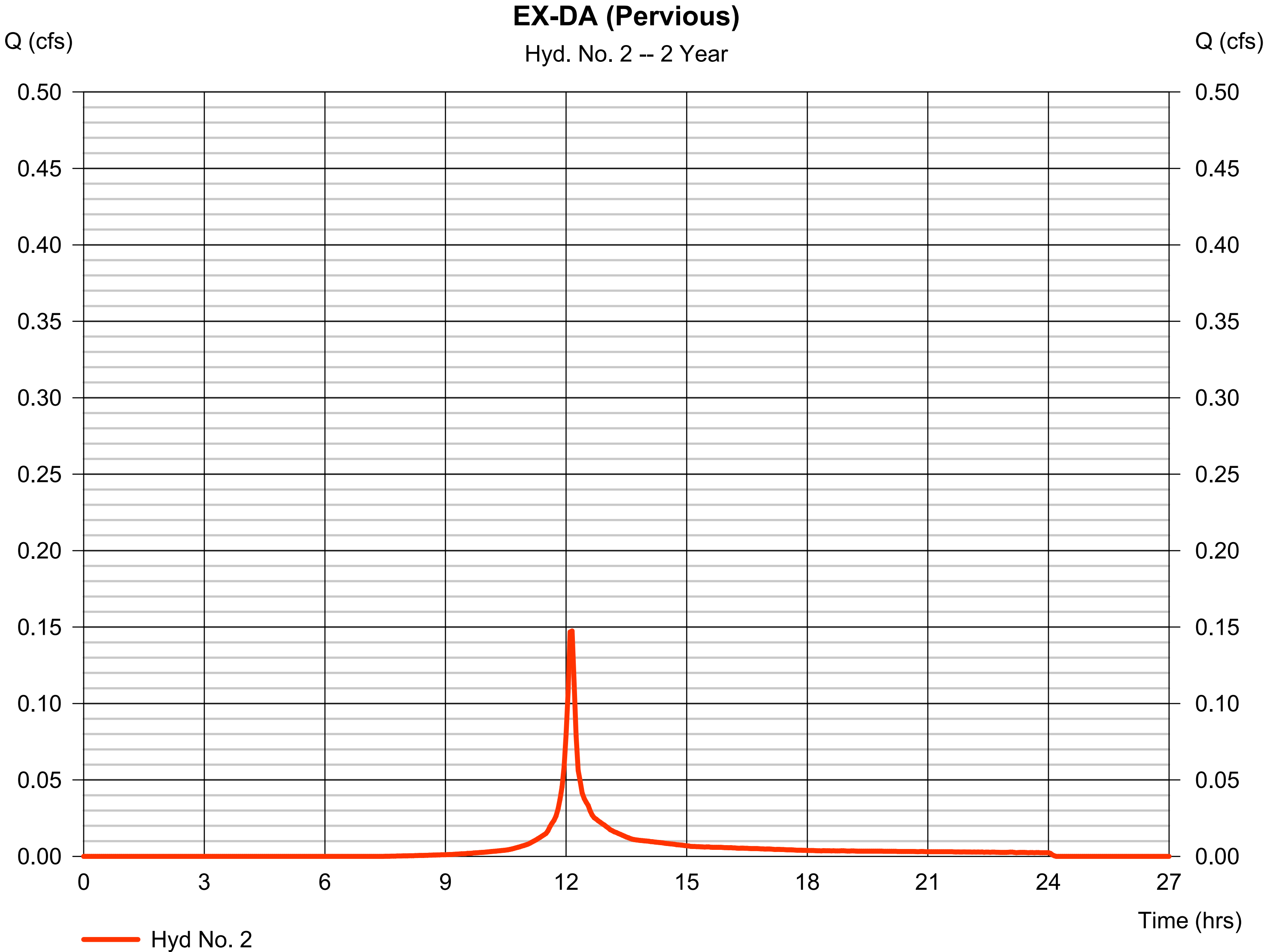
Hydrograph type	= SCS Runoff	Peak discharge	= 0.006 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 3 min	Hyd. volume	= 22 cuft
Drainage area	= 0.002 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.40 in	Distribution	= Custom
Storm duration	= R:\Hydraflow Standards\NOAA Standard Factors		= 484



Hyd. No. 2

EX-DA (Pervious)

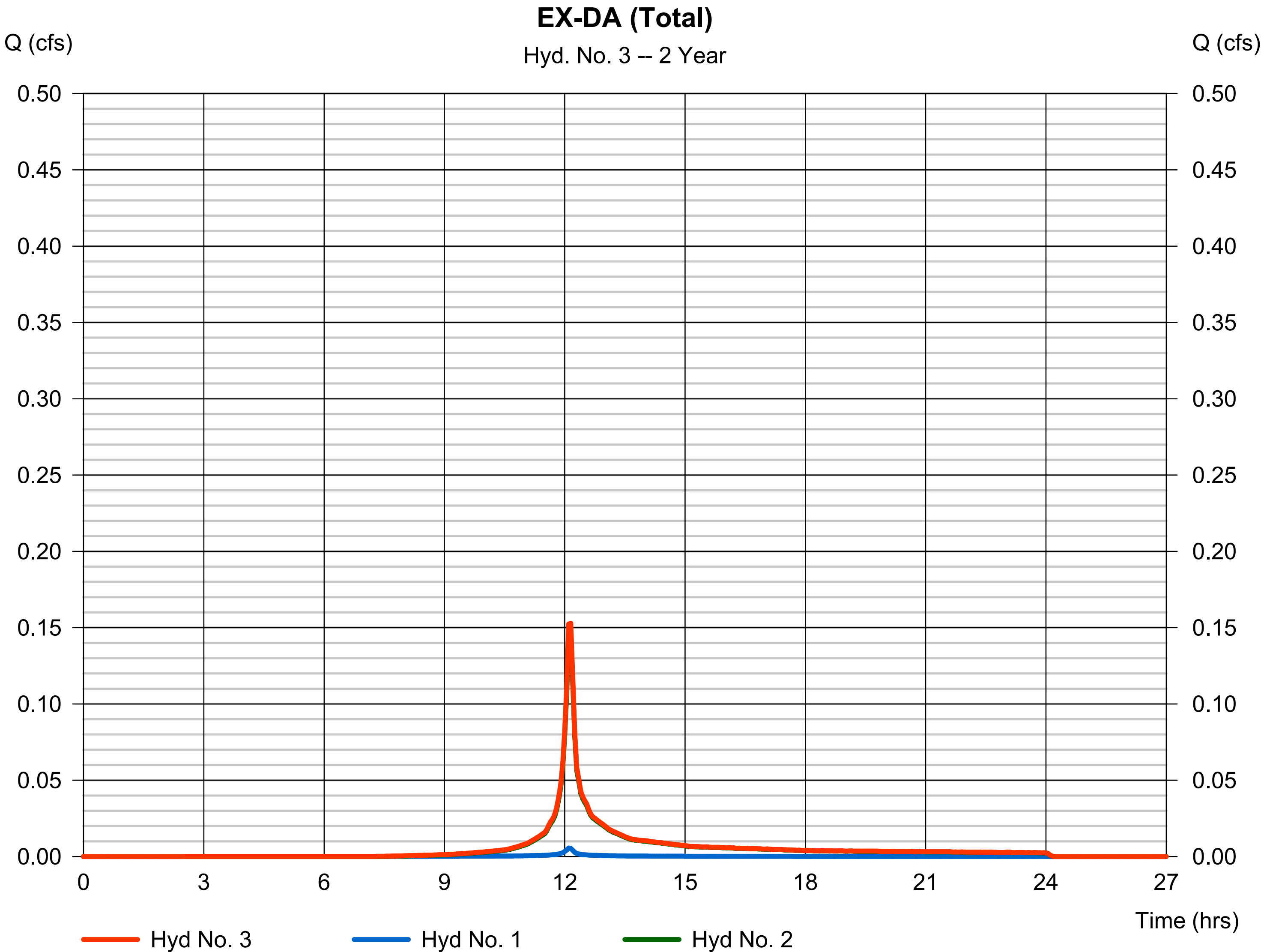
Hydrograph type	= SCS Runoff	Peak discharge	= 0.147 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.15 hrs
Time interval	= 3 min	Hyd. volume	= 504 cuft
Drainage area	= 0.080 ac	Curve number	= 84
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.40 in	Distribution	= Custom
Storm duration	= R:\Hydraflow Standards\NOAA Standard	Dur factor	= 484



Hyd. No. 3

EX-DA (Total)

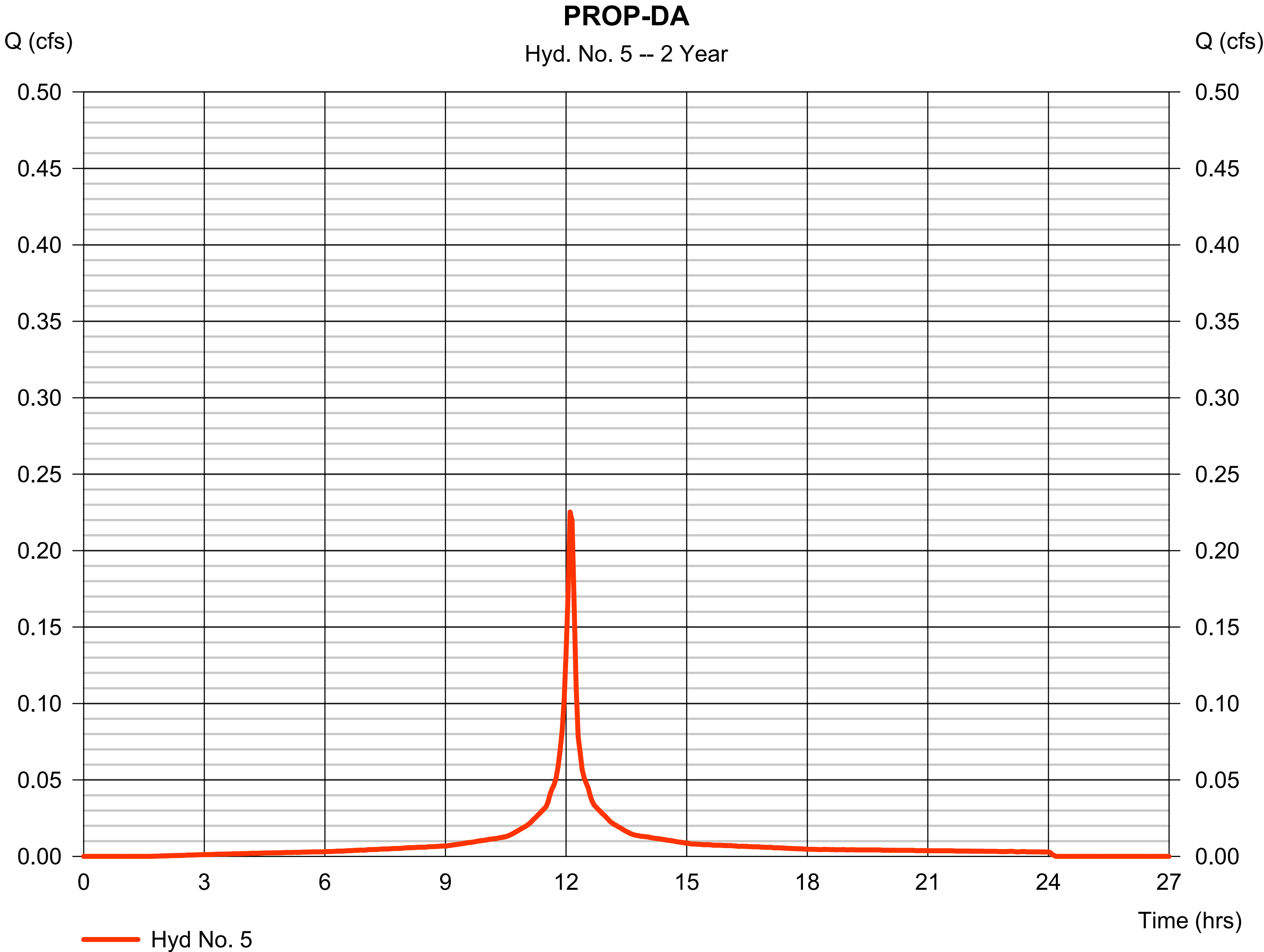
Hydrograph type	= Combine	Peak discharge	= 0.153 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.15 hrs
Time interval	= 3 min	Hyd. volume	= 526 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.082 ac



Hyd. No. 5

PROP-DA

Hydrograph type	= SCS Runoff	Peak discharge	= 0.225 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.10 hrs
Time interval	= 3 min	Hyd. volume	= 853 cuft
Drainage area	= 0.082 ac	Curve number	= 97
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.40 in	Distribution	= Custom
Storm duration	= R:\Hydraflow Standards\NOAA Standard Factors		= 484

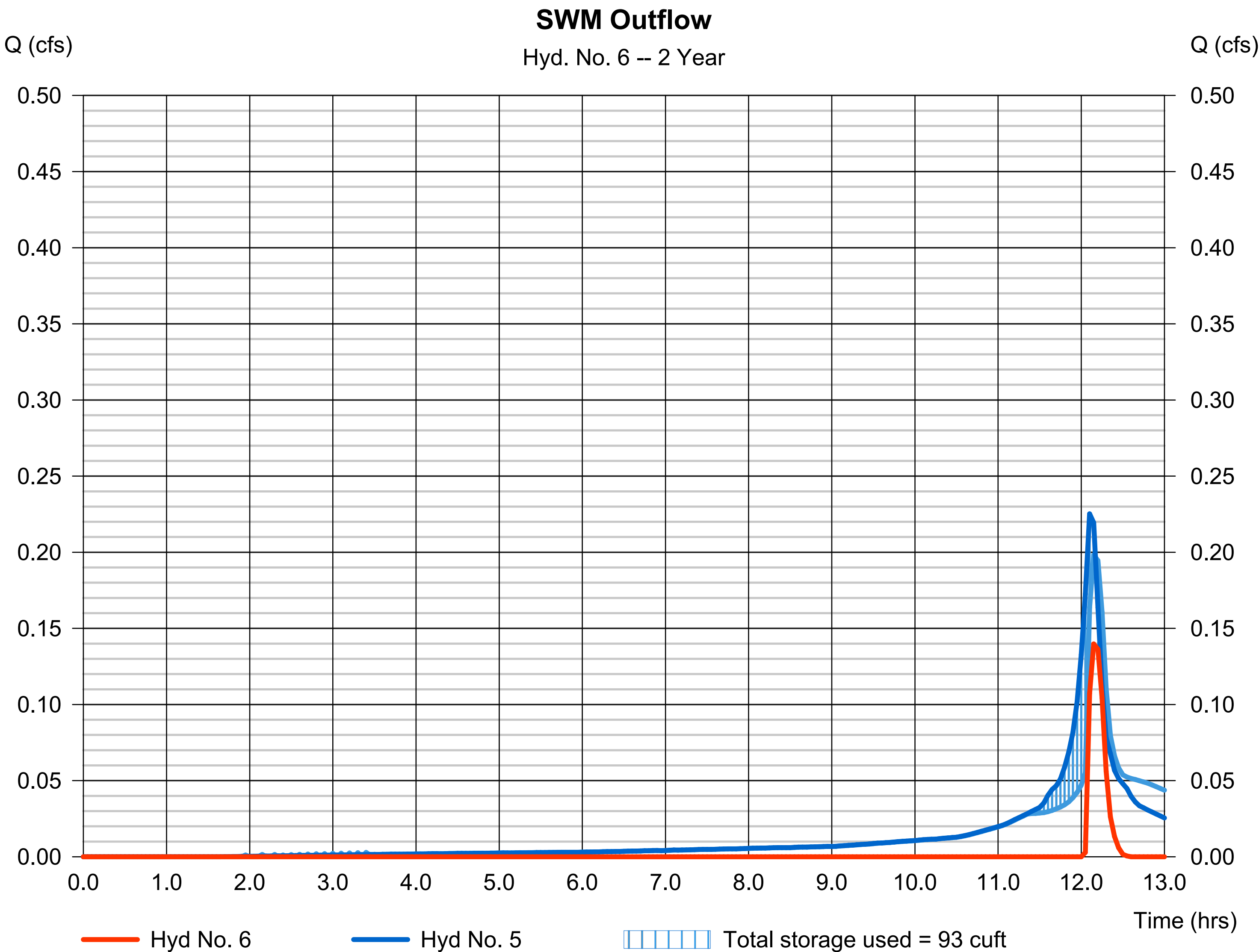


Hyd. No. 6

SWM Outflow

Hydrograph type	= Reservoir	Peak discharge	= 0.140 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.15 hrs
Time interval	= 3 min	Hyd. volume	= 107 cuft
Inflow hyd. No.	= 5 - PROP-DA	Max. Elevation	= 100.96 ft
Reservoir name	= U/G Chamber	Max. Storage	= 93 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond No. 1 - U/G Chamber

Pond Data

UG Chambers -Invert elev. = 100.30 ft, Rise x Span = 1.00 x 1.00 ft, Barrel Len = 40.00 ft, No. Barrels = 1, Slope = 0.00%, Headers = No
Encasement -Invert elev. = 99.30 ft, Width = 3.00 ft, Height = 2.75 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	99.30	n/a	0	0
0.28	99.58	n/a	13	13
0.55	99.85	n/a	13	26
0.82	100.13	n/a	13	40
1.10	100.40	n/a	14	54
1.38	100.68	n/a	19	72
1.65	100.95	n/a	20	92
1.92	101.23	n/a	18	111
2.20	101.50	n/a	14	124
2.48	101.78	n/a	13	138
2.75	102.05	n/a	13	151

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 6.00	2.50	Inactive	0.00
Span (in)	= 6.00	2.50	0.00	0.00
No. Barrels	= 1	2	1	0
Invert El. (ft)	= 100.55	100.60	0.00	0.00
Length (ft)	= 70.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	2.00	Inactive	Inactive
Crest El. (ft)	= 101.70	101.30	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Rect	---	---
Multi-Stage	= Yes	Yes	No	No
Exfil.(in/hr)	= 10.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	99.30	0.00	0.00	---	---	0.00	0.00	---	---	0.000	---	0.000
0.28	13	99.58	0.00	0.00	---	---	0.00	0.00	---	---	0.033	---	0.033
0.55	26	99.85	0.00	0.00	---	---	0.00	0.00	---	---	0.038	---	0.038
0.82	40	100.13	0.00	0.00	---	---	0.00	0.00	---	---	0.043	---	0.043
1.10	54	100.40	0.00	0.00	---	---	0.00	0.00	---	---	0.048	---	0.048
1.38	72	100.68	0.02 ic	0.02 ic	---	---	0.00	0.00	---	---	0.053	---	0.074
1.65	92	100.95	0.14 ic	0.14 ic	---	---	0.00	0.00	---	---	0.058	---	0.197
1.92	111	101.23	0.21 ic	0.21 ic	---	---	0.00	0.00	---	---	0.063	---	0.269
2.20	124	101.50	0.51 oc	0.08 ic	---	---	0.00	0.43 s	---	---	0.069	---	0.581
2.48	138	101.78	0.62 oc	0.02 ic	---	---	0.20 s	0.39 s	---	---	0.074	---	0.688
2.75	151	102.05	0.69 oc	0.00 ic	---	---	0.38 s	0.22 s	---	---	0.079	---	0.684

Hydrograph Summary Report

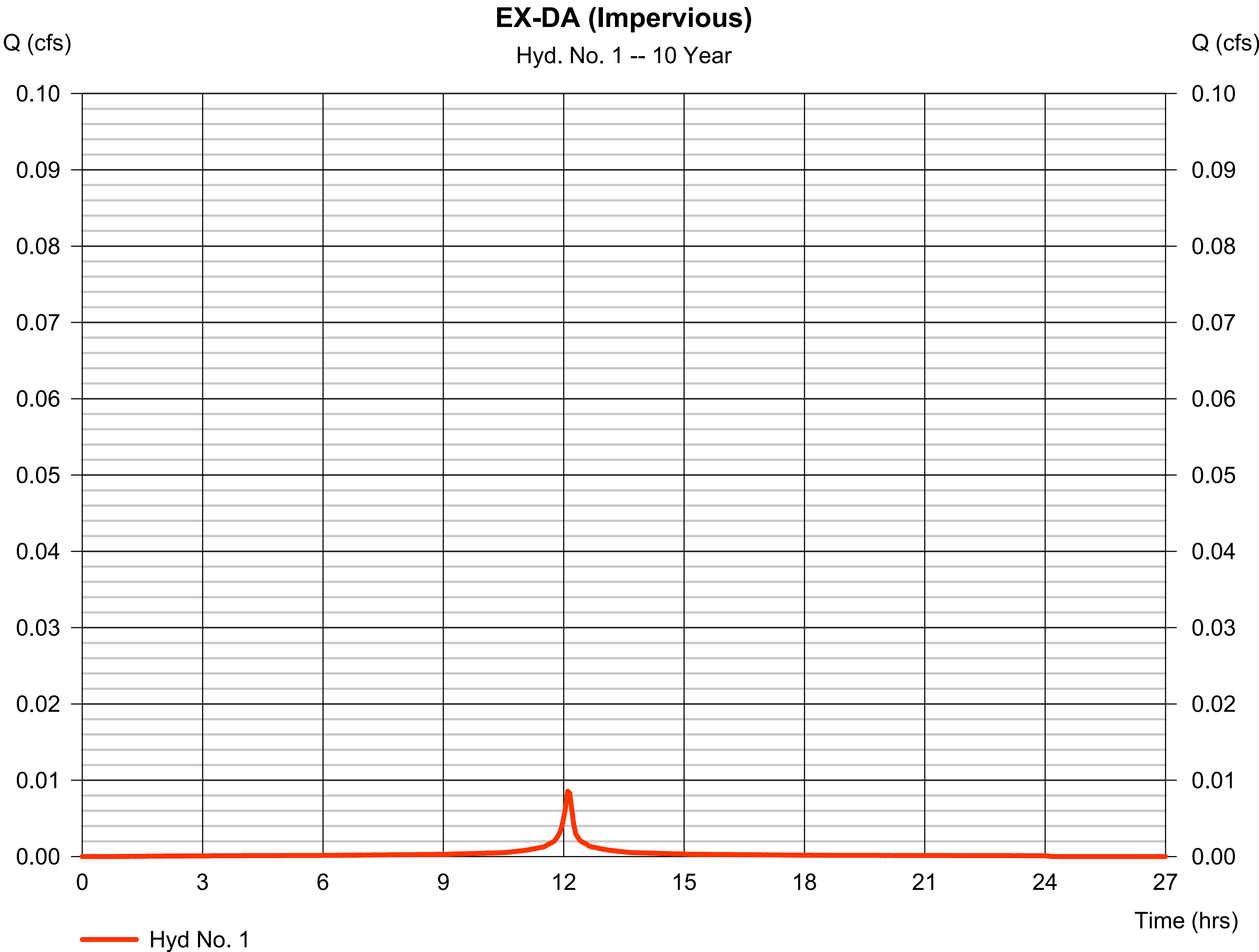
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.009	3	726	34	-----	-----	-----	EX-DA (Impervious)
2	SCS Runoff	0.270	3	726	938	-----	-----	-----	EX-DA (Pervious)
3	Combine	0.279	3	726	972	1, 2	-----	-----	EX-DA (Total)
5	SCS Runoff	0.349	3	726	1,350	-----	-----	-----	PROP-DA
6	Reservoir	0.270	3	729	286	5	101.34	116	SWM Outflow
SWM-Design2.gpw					Return Period: 10 Year			Tuesday, 03 / 24 / 2020	

Hyd. No. 1

EX-DA (Impervious)

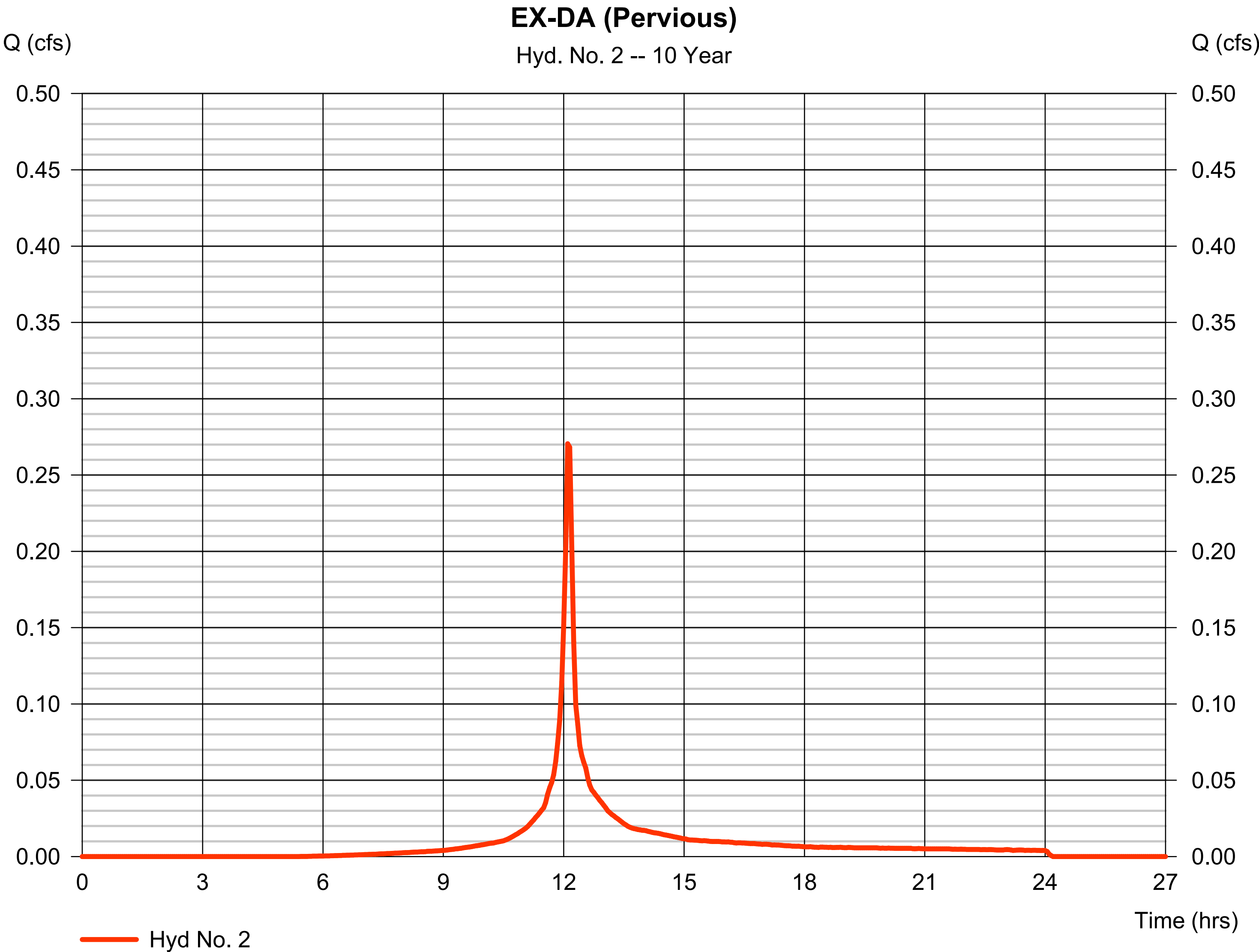
Hydrograph type	=	SCS Runoff	Peak discharge	=	0.009 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.10 hrs
Time interval	=	3 min	Hyd. volume	=	34 cuft
Drainage area	=	0.002 ac	Curve number	=	98
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	5.19 in	Distribution	=	Custom
Storm duration	=	R:\Hydraflow Standards\NOAA Standard	Dur factor	=	484



Hyd. No. 2

EX-DA (Pervious)

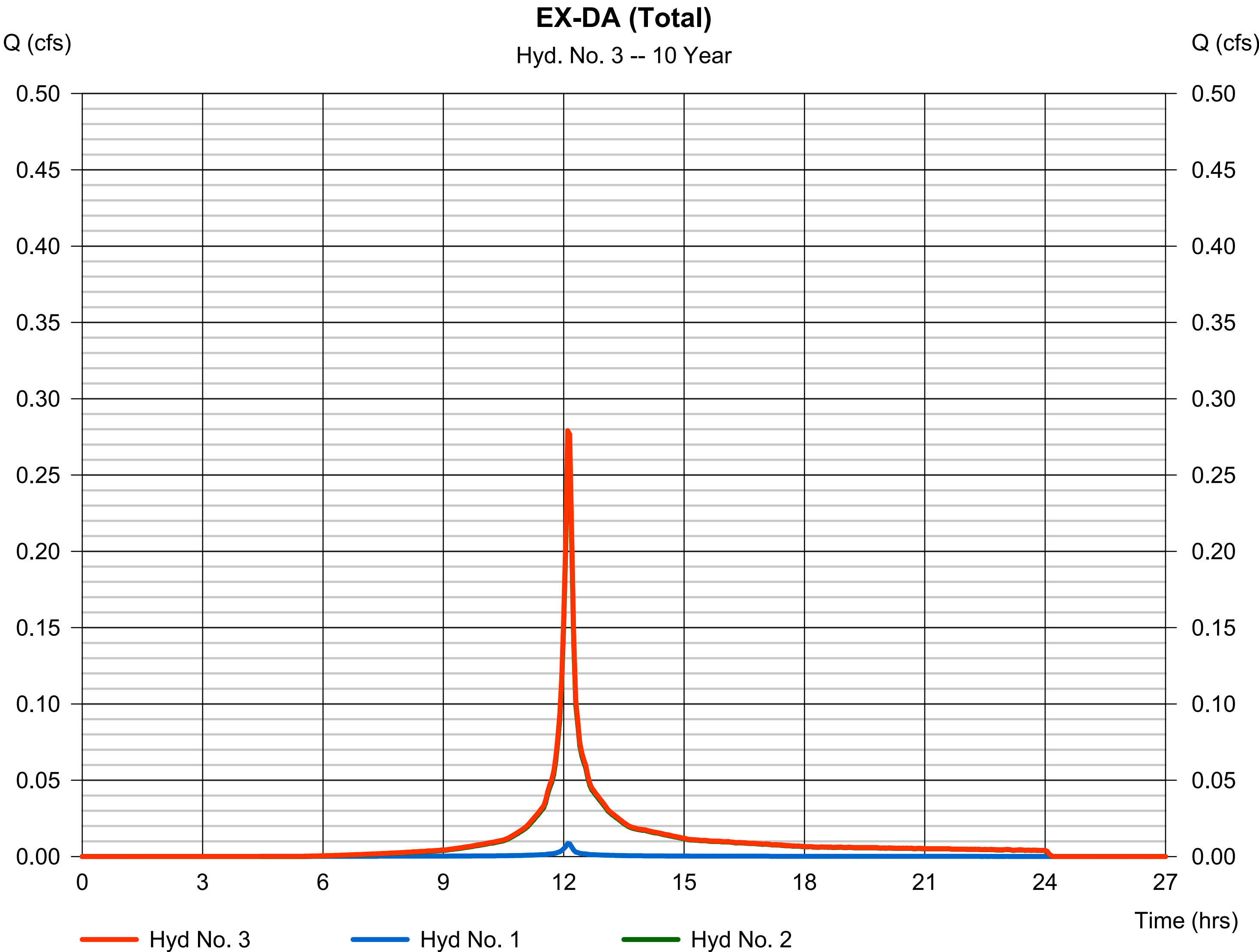
Hydrograph type	= SCS Runoff	Peak discharge	= 0.270 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 3 min	Hyd. volume	= 938 cuft
Drainage area	= 0.080 ac	Curve number	= 84
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.19 in	Distribution	= Custom
Storm duration	= R:\Hydraflow Standards\NOAA Standard	Duration	= 484



Hyd. No. 3

EX-DA (Total)

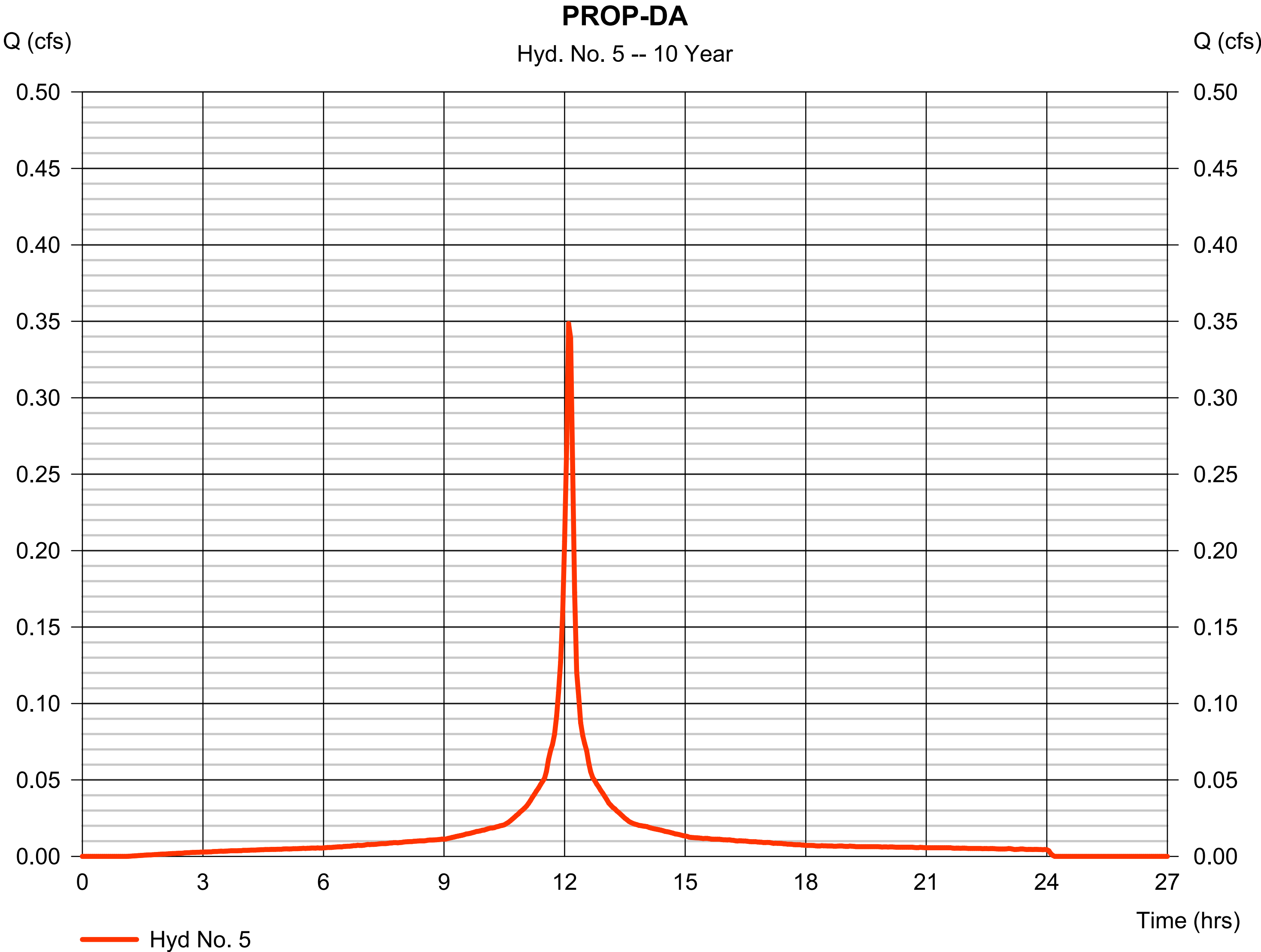
Hydrograph type	= Combine	Peak discharge	= 0.279 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 3 min	Hyd. volume	= 972 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.082 ac



Hyd. No. 5

PROP-DA

Hydrograph type	= SCS Runoff	Peak discharge	= 0.349 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.10 hrs
Time interval	= 3 min	Hyd. volume	= 1,350 cuft
Drainage area	= 0.082 ac	Curve number	= 97
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.19 in	Distribution	= Custom
Storm duration	= R:\Hydraflow Standards\NOAA Standard	Dur factor	= 484

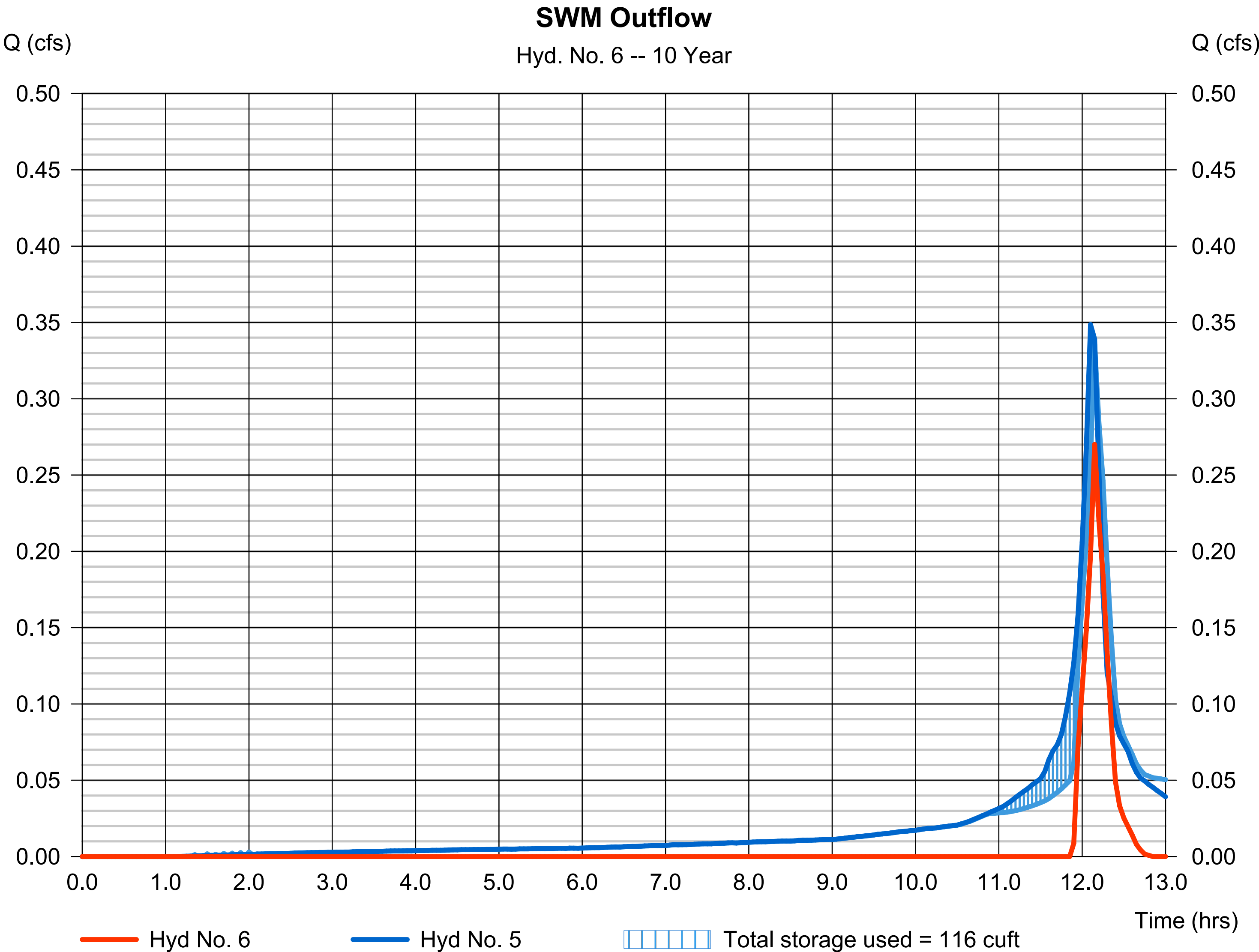


Hyd. No. 6

SWM Outflow

Hydrograph type	= Reservoir	Peak discharge	= 0.270 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.15 hrs
Time interval	= 3 min	Hyd. volume	= 286 cuft
Inflow hyd. No.	= 5 - PROP-DA	Max. Elevation	= 101.34 ft
Reservoir name	= U/G Chamber	Max. Storage	= 116 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Summary Report

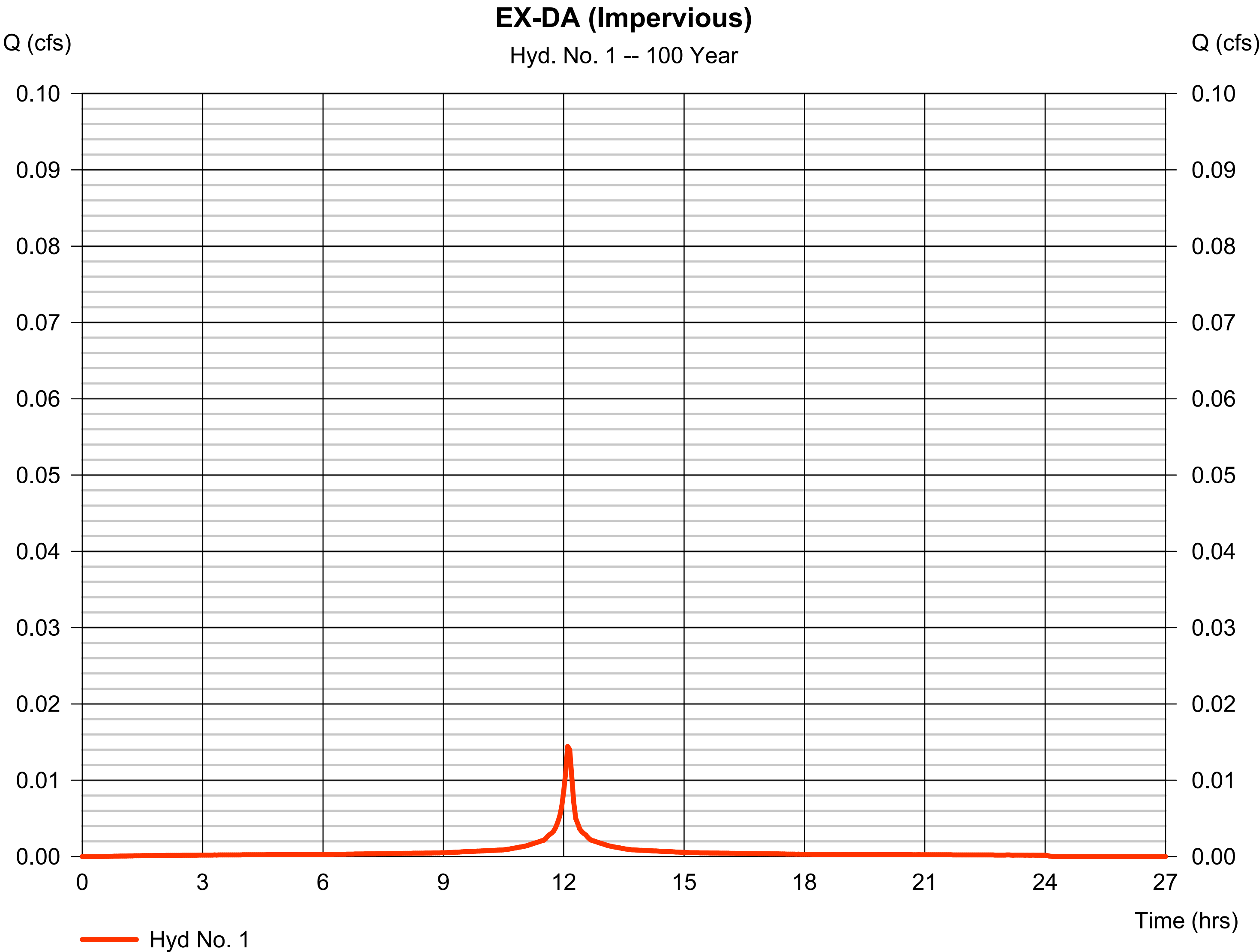
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.014	3	726	58	-----	-----	-----	EX-DA (Impervious)
2	SCS Runoff	0.517	3	726	1,848	-----	-----	-----	EX-DA (Pervious)
3	Combine	0.532	3	726	1,906	1, 2	-----	-----	EX-DA (Total)
5	SCS Runoff	0.590	3	726	2,333	-----	-----	-----	PROP-DA
6	Reservoir	0.514	3	729	730	5	101.50	125	SWM Outflow
SWM-Design2.gpw					Return Period: 100 Year			Tuesday, 03 / 24 / 2020	

Hyd. No. 1

EX-DA (Impervious)

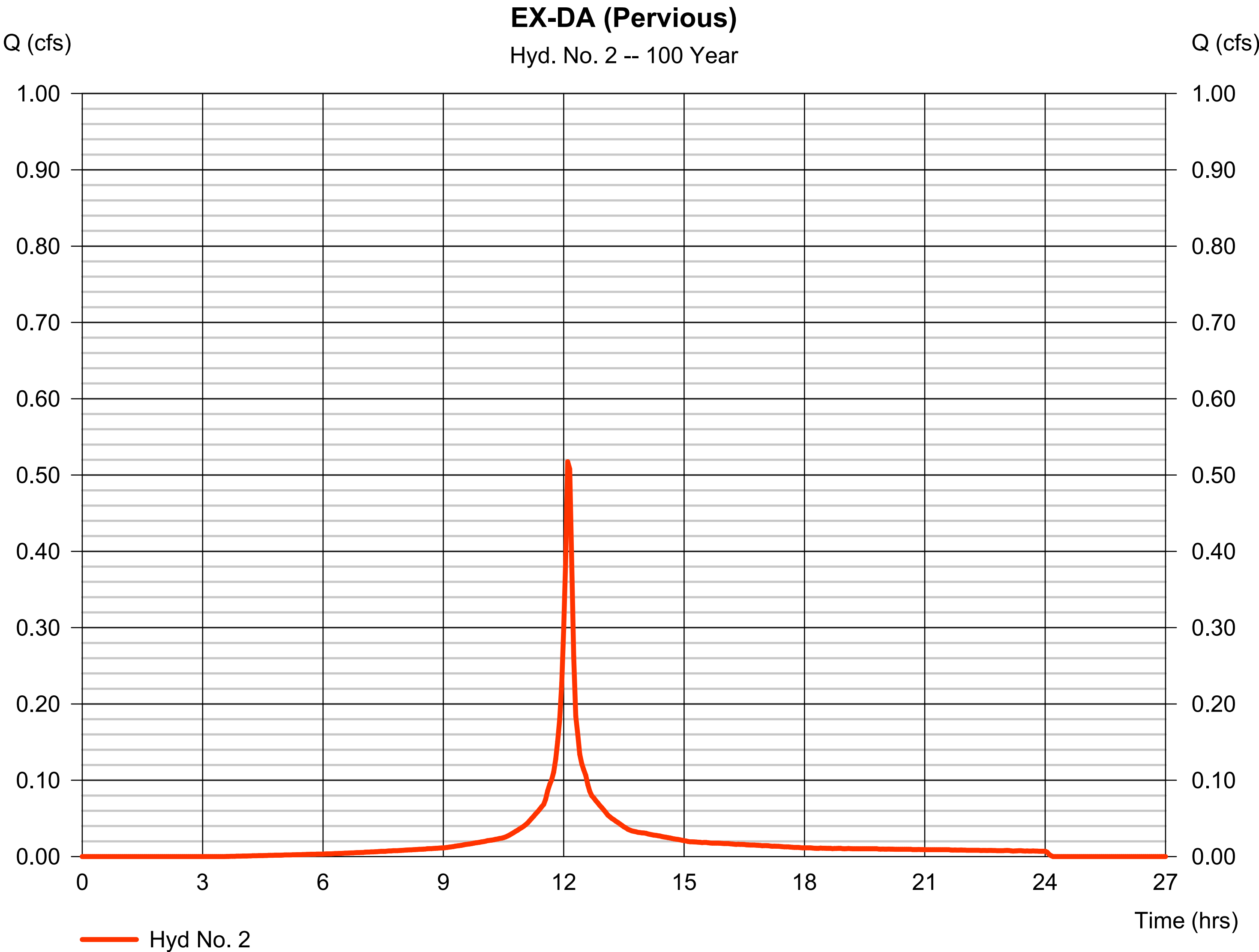
Hydrograph type	= SCS Runoff	Peak discharge	= 0.014 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 3 min	Hyd. volume	= 58 cuft
Drainage area	= 0.002 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.72 in	Distribution	= Custom
Storm duration	= R:\Hydraflow Standards\NOAA Standard	Duration	= 484



Hyd. No. 2

EX-DA (Pervious)

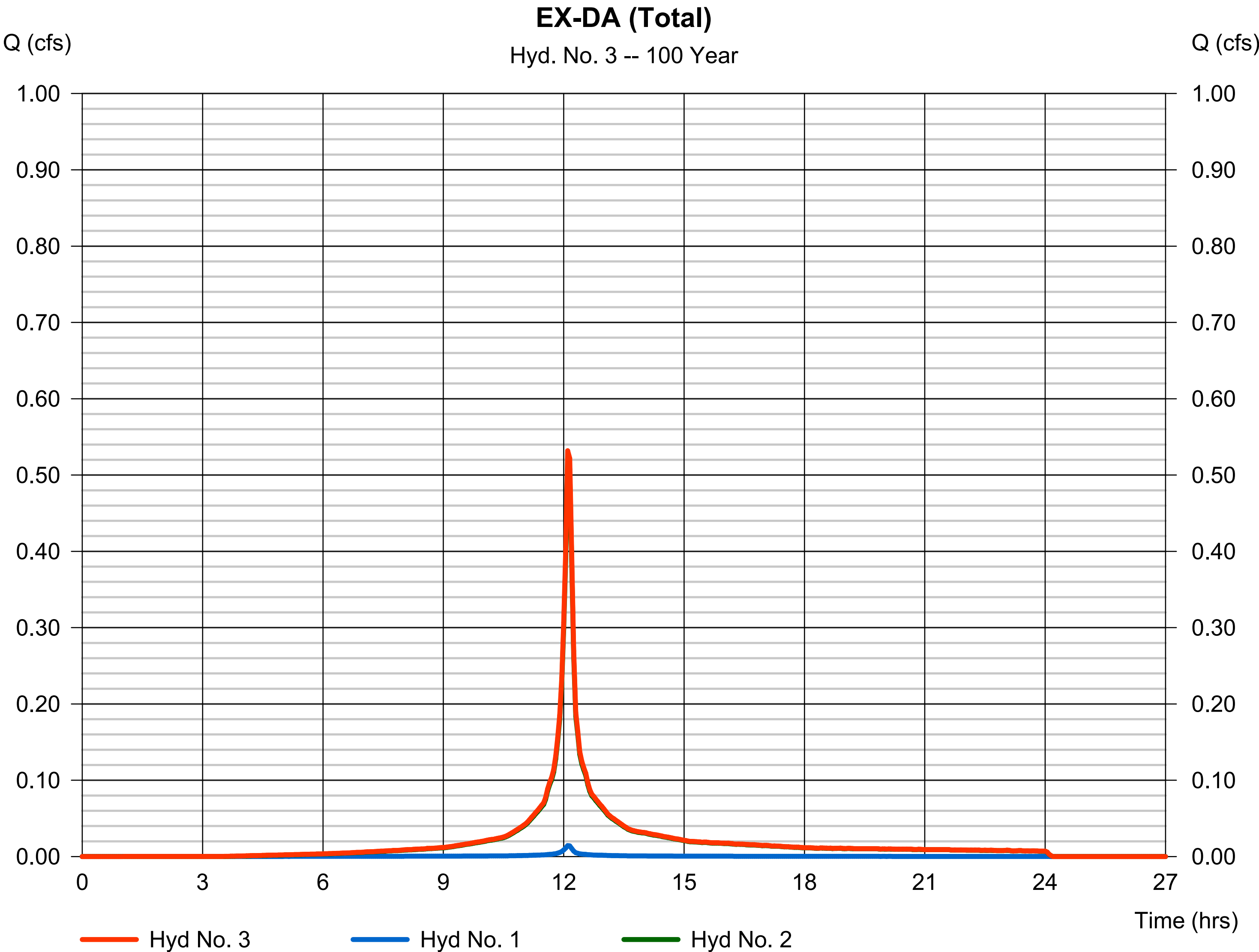
Hydrograph type	= SCS Runoff	Peak discharge	= 0.517 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 3 min	Hyd. volume	= 1,848 cuft
Drainage area	= 0.080 ac	Curve number	= 84
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.72 in	Distribution	= Custom
Storm duration	= R:\Hydraflow Standards\NOAA Standard factors		= 484



Hyd. No. 3

EX-DA (Total)

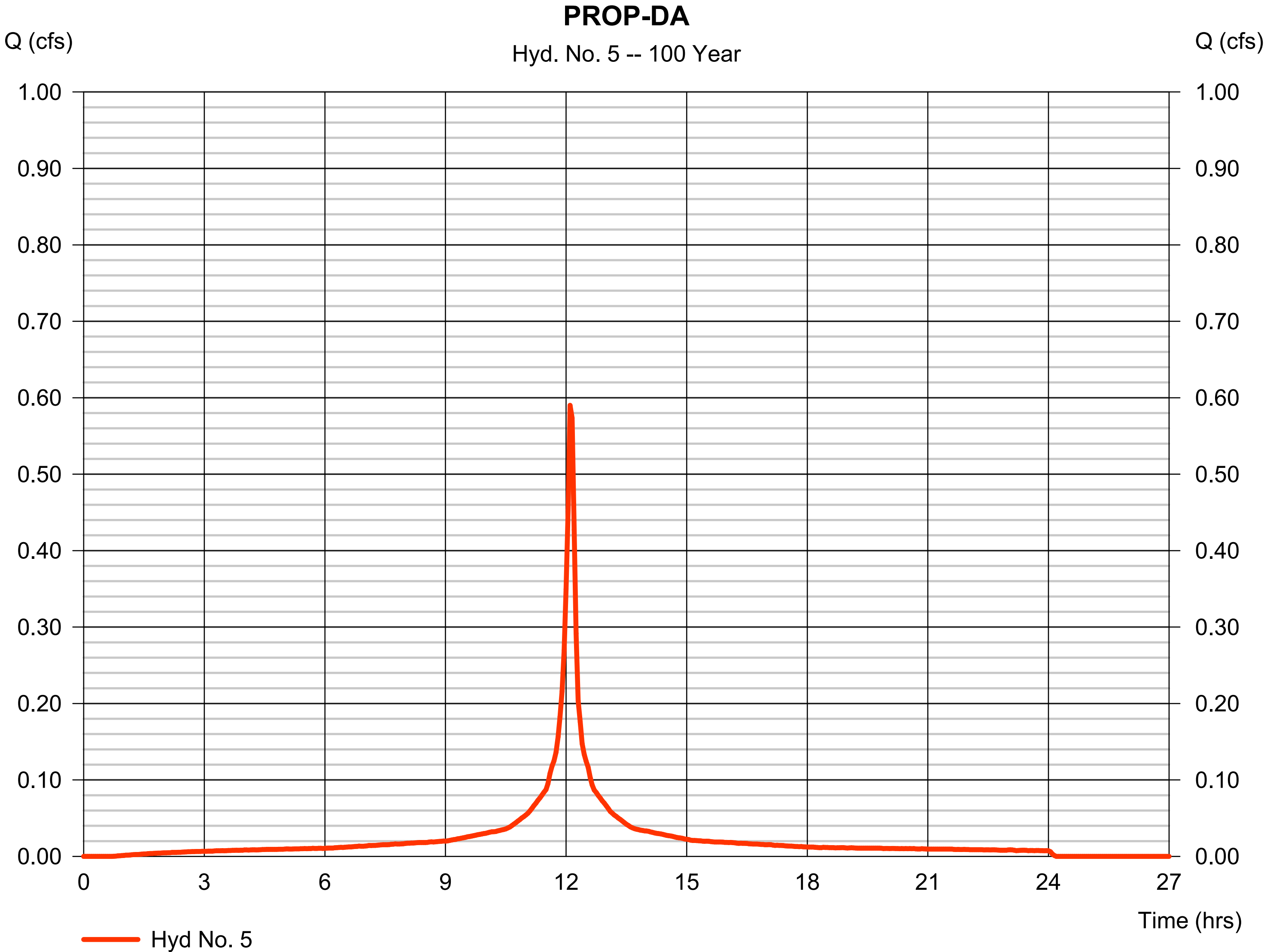
Hydrograph type	= Combine	Peak discharge	= 0.532 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 3 min	Hyd. volume	= 1,906 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 0.082 ac



Hyd. No. 5

PROP-DA

Hydrograph type	= SCS Runoff	Peak discharge	= 0.590 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 3 min	Hyd. volume	= 2,333 cuft
Drainage area	= 0.082 ac	Curve number	= 97
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 8.72 in	Distribution	= Custom
Storm duration	= R:\Hydraflow Standards\NOAA Standard	Dur factor	= 484

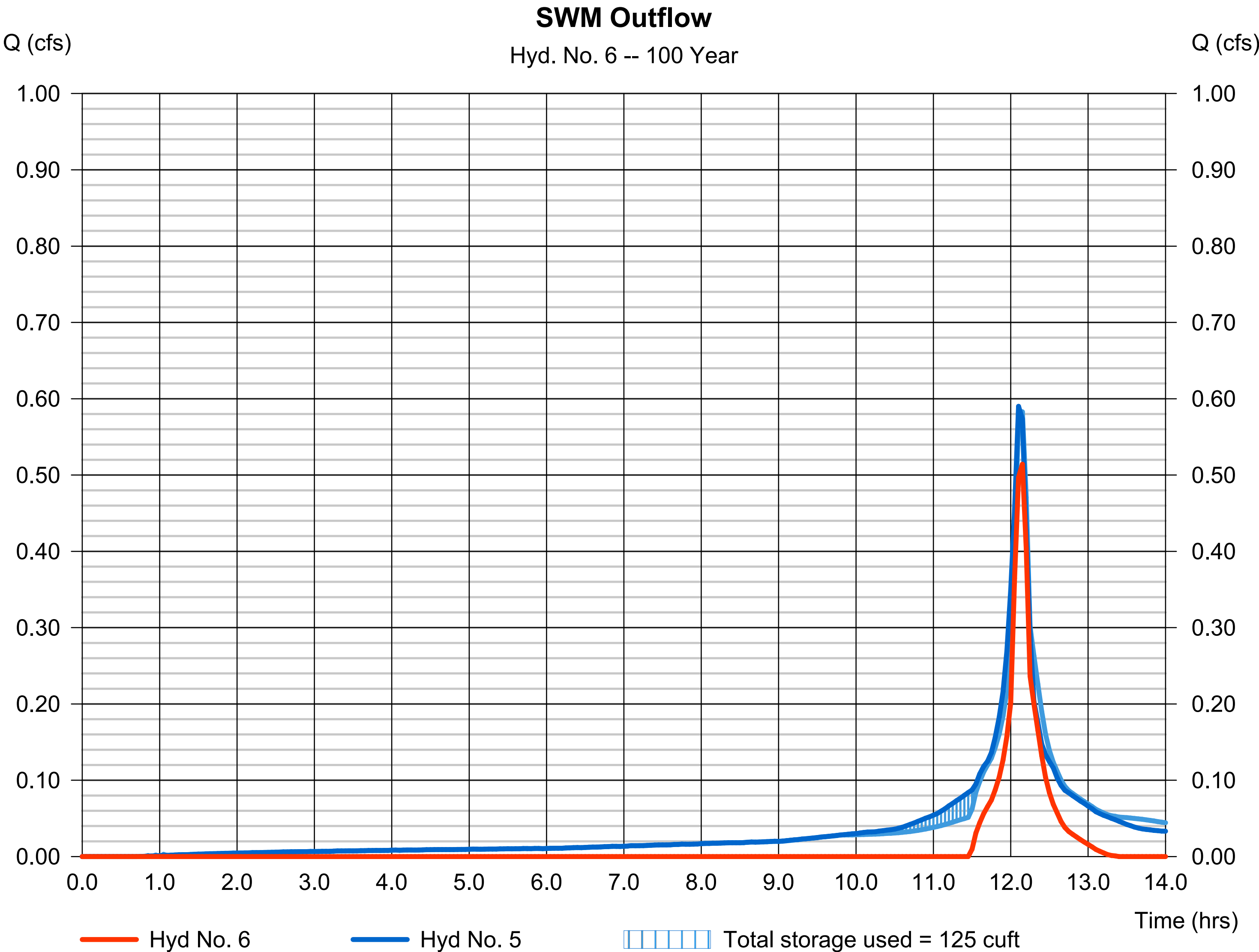


Hyd. No. 6

SWM Outflow

Hydrograph type	= Reservoir	Peak discharge	= 0.514 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.15 hrs
Time interval	= 3 min	Hyd. volume	= 730 cuft
Inflow hyd. No.	= 5 - PROP-DA	Max. Elevation	= 101.50 ft
Reservoir name	= U/G Chamber	Max. Storage	= 125 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	-----
2	69.8703	13.1000	0.8658	-----
3	0.0000	0.0000	0.0000	-----
5	79.2597	14.6000	0.8369	-----
10	88.2351	15.5000	0.8279	-----
25	102.6072	16.5000	0.8217	-----
50	114.8193	17.2000	0.8199	-----
100	127.1596	17.8000	0.8186	-----

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
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	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: R:\Hydroflow Standards\UnionCounty.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	3.40	0.00	4.50	5.19	0.00	7.30	8.72
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	2.75	0.00	0.00	6.50	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	2.75	0.00	0.00	6.50	0.00
Custom	1.25	3.40	0.00	2.80	5.19	0.00	6.00	8.72



NOAA Atlas 14, Volume 2, Version 3
Location name: Cranford, New Jersey, USA*
Latitude: 40.6569°, Longitude: -74.3033°
Elevation: 78.54 ft**

* source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.334 (0.306-0.367)	0.398 (0.364-0.437)	0.472 (0.430-0.517)	0.524 (0.477-0.575)	0.588 (0.533-0.645)	0.634 (0.572-0.694)	0.678 (0.609-0.743)	0.718 (0.641-0.788)	0.768 (0.679-0.845)	0.804 (0.706-0.887)
10-min	0.534 (0.489-0.586)	0.637 (0.583-0.699)	0.755 (0.688-0.829)	0.838 (0.763-0.920)	0.938 (0.850-1.03)	1.01 (0.911-1.11)	1.08 (0.967-1.18)	1.14 (1.02-1.25)	1.22 (1.07-1.34)	1.27 (1.11-1.40)
15-min	0.667 (0.611-0.733)	0.801 (0.733-0.879)	0.955 (0.871-1.05)	1.06 (0.965-1.16)	1.19 (1.08-1.30)	1.28 (1.15-1.40)	1.36 (1.22-1.49)	1.44 (1.28-1.58)	1.53 (1.35-1.68)	1.59 (1.40-1.75)
30-min	0.915 (0.837-1.00)	1.11 (1.01-1.21)	1.36 (1.24-1.49)	1.54 (1.40-1.69)	1.76 (1.60-1.93)	1.92 (1.74-2.11)	2.09 (1.87-2.29)	2.24 (2.00-2.45)	2.43 (2.15-2.68)	2.58 (2.26-2.84)
60-min	1.14 (1.04-1.25)	1.39 (1.27-1.52)	1.74 (1.59-1.91)	2.00 (1.82-2.19)	2.34 (2.13-2.57)	2.61 (2.35-2.86)	2.87 (2.58-3.15)	3.14 (2.80-3.44)	3.49 (3.09-3.84)	3.76 (3.30-4.15)
2-hr	1.40 (1.27-1.54)	1.70 (1.55-1.88)	2.16 (1.96-2.38)	2.51 (2.27-2.77)	3.00 (2.70-3.31)	3.41 (3.05-3.75)	3.82 (3.39-4.21)	4.26 (3.75-4.69)	4.86 (4.24-5.37)	5.35 (4.62-5.91)
3-hr	1.56 (1.42-1.72)	1.90 (1.73-2.10)	2.41 (2.19-2.66)	2.81 (2.55-3.10)	3.36 (3.03-3.70)	3.81 (3.41-4.20)	4.28 (3.81-4.71)	4.76 (4.20-5.25)	5.44 (4.74-6.00)	5.98 (5.17-6.61)
6-hr	2.00 (1.82-2.22)	2.43 (2.22-2.69)	3.08 (2.80-3.40)	3.61 (3.26-3.97)	4.36 (3.91-4.79)	4.99 (4.44-5.47)	5.66 (5.00-6.20)	6.38 (5.58-6.99)	7.42 (6.40-8.13)	8.28 (7.06-9.09)
12-hr	2.48 (2.26-2.74)	3.01 (2.75-3.33)	3.84 (3.49-4.23)	4.53 (4.10-4.98)	5.55 (4.98-6.07)	6.43 (5.72-7.01)	7.38 (6.49-8.04)	8.43 (7.33-9.19)	9.98 (8.52-10.9)	11.3 (9.50-12.3)
24-hr	2.81 (2.59-3.05)	3.40 (3.14-3.70)	4.36 (4.03-4.75)	5.19 (4.77-5.64)	6.43 (5.87-6.98)	7.51 (6.81-8.15)	8.72 (7.82-9.46)	10.1 (8.91-10.9)	12.1 (10.5-13.2)	13.8 (11.9-15.1)
2-day	3.31 (3.04-3.62)	4.00 (3.68-4.38)	5.12 (4.70-5.59)	6.05 (5.53-6.60)	7.42 (6.75-8.09)	8.60 (7.77-9.37)	9.87 (8.85-10.8)	11.3 (9.99-12.3)	13.3 (11.6-14.7)	15.1 (13.0-16.7)
3-day	3.49 (3.21-3.81)	4.22 (3.88-4.61)	5.37 (4.93-5.86)	6.32 (5.79-6.89)	7.71 (7.03-8.39)	8.89 (8.05-9.67)	10.2 (9.13-11.1)	11.5 (10.3-12.6)	13.6 (11.9-14.9)	15.2 (13.2-16.8)
4-day	3.66 (3.38-3.99)	4.43 (4.09-4.83)	5.62 (5.17-6.12)	6.60 (6.05-7.18)	8.00 (7.31-8.70)	9.18 (8.34-9.98)	10.4 (9.40-11.4)	11.8 (10.5-12.9)	13.8 (12.1-15.1)	15.4 (13.4-17.0)
7-day	4.33 (4.01-4.68)	5.20 (4.82-5.62)	6.46 (5.98-6.98)	7.50 (6.93-8.11)	8.99 (8.26-9.72)	10.2 (9.34-11.1)	11.6 (10.5-12.5)	13.0 (11.6-14.1)	15.0 (13.2-16.4)	16.6 (14.5-18.3)
10-day	4.95 (4.61-5.33)	5.92 (5.51-6.37)	7.24 (6.73-7.80)	8.33 (7.73-8.97)	9.87 (9.11-10.6)	11.1 (10.2-12.0)	12.5 (11.4-13.5)	13.9 (12.5-15.0)	15.8 (14.1-17.3)	17.4 (15.4-19.1)
20-day	6.69 (6.28-7.13)	7.94 (7.45-8.47)	9.47 (8.88-10.1)	10.7 (9.99-11.4)	12.3 (11.5-13.1)	13.6 (12.6-14.5)	14.9 (13.7-15.9)	16.2 (14.9-17.4)	17.9 (16.3-19.3)	19.3 (17.4-20.8)
30-day	8.33 (7.88-8.81)	9.84 (9.31-10.4)	11.5 (10.9-12.2)	12.8 (12.1-13.5)	14.4 (13.6-15.2)	15.7 (14.7-16.6)	16.9 (15.8-17.9)	18.1 (16.9-19.2)	19.6 (18.2-20.9)	20.7 (19.1-22.2)
45-day	10.6 (10.0-11.2)	12.5 (11.8-13.1)	14.4 (13.6-15.1)	15.8 (15.0-16.6)	17.7 (16.7-18.6)	19.1 (18.0-20.1)	20.4 (19.2-21.5)	21.7 (20.3-22.9)	23.3 (21.7-24.7)	24.5 (22.7-26.1)
60-day	12.7 (12.1-13.3)	14.9 (14.2-15.6)	17.0 (16.2-17.9)	18.6 (17.7-19.5)	20.6 (19.5-21.6)	22.0 (20.8-23.2)	23.3 (22.1-24.6)	24.6 (23.2-26.0)	26.1 (24.5-27.7)	27.2 (25.4-28.9)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

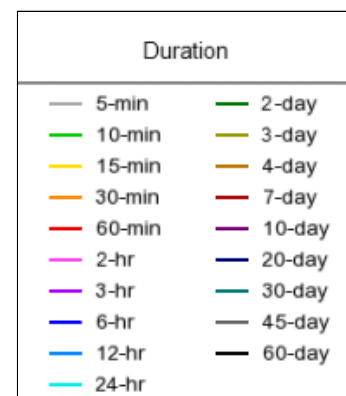
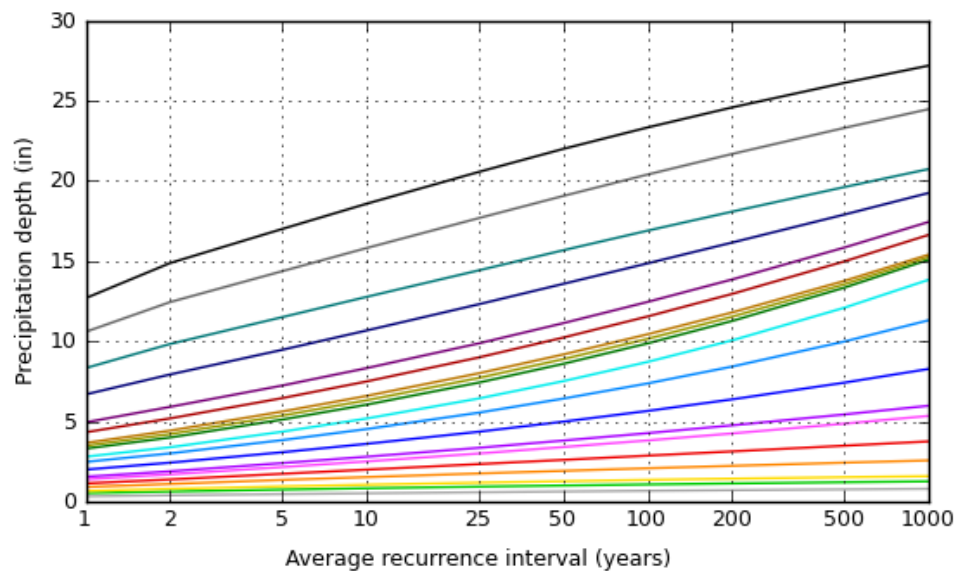
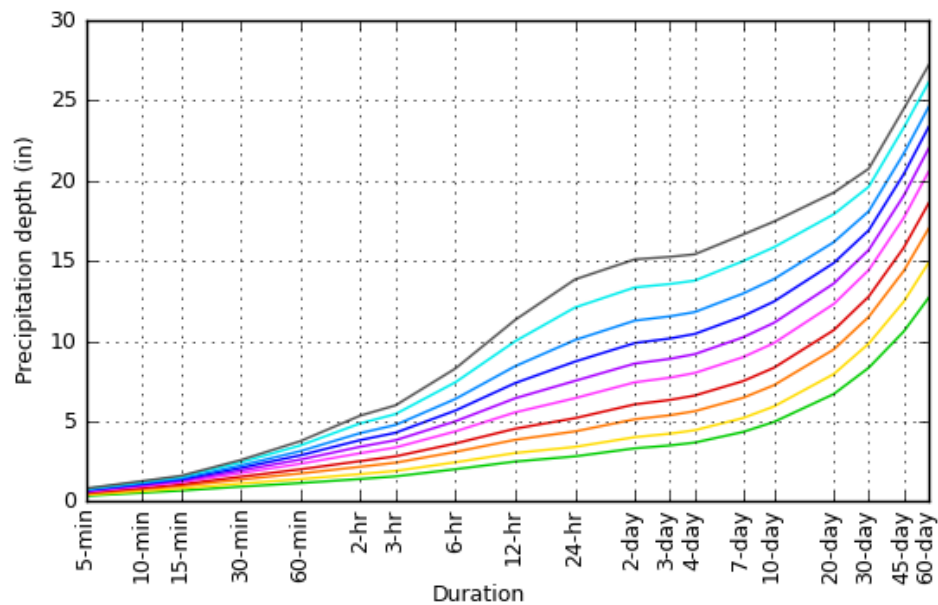
Please refer to NOAA Atlas 14 document for more information.

[Back to Top](#)

PF graphical

PDS-based depth-duration-frequency (DDF) curves

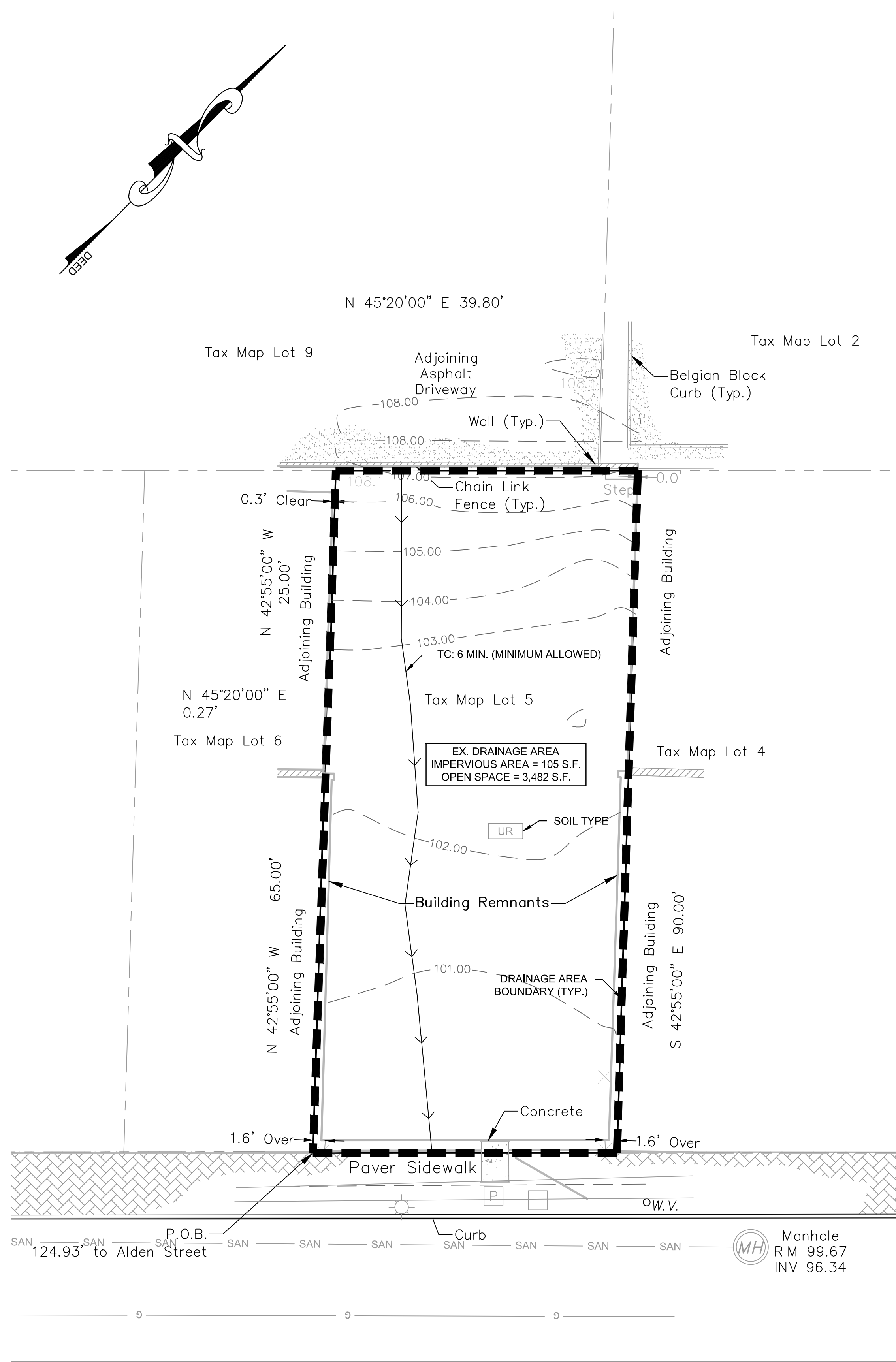
Latitude: 40.6569°, Longitude: -74.3033°



NOAA Atlas 14, Volume 2, Version 3

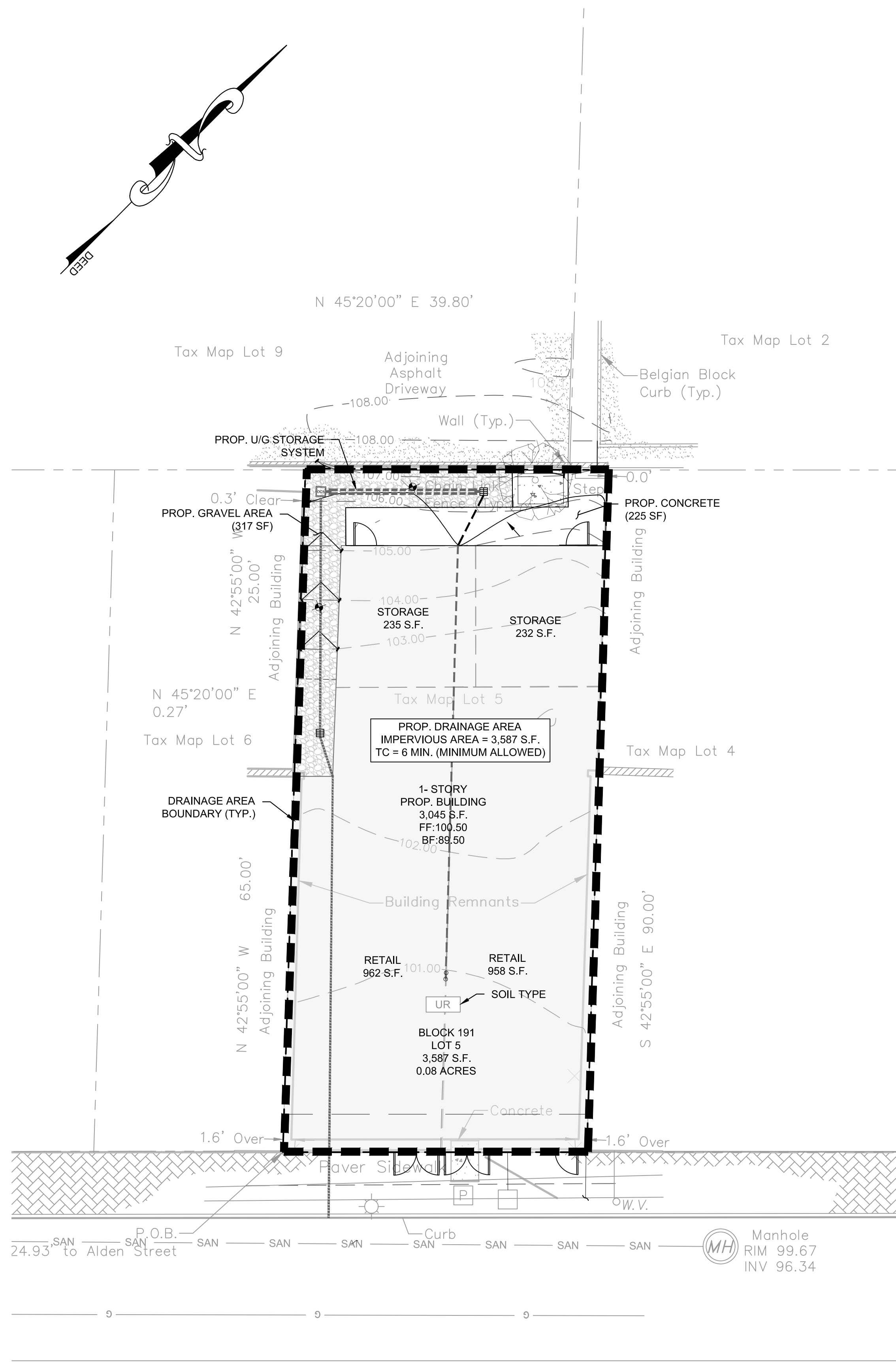
Created (GMT): Mon Feb 24 15:25:54 2020

[Back to Top](#)**Maps & arials****Small scale terrain**



North Union Avenue
(55' Wide)

PRE-DEVELOPMENT DRAINAGE AREA MAP
SCALE 1"=10'



North Union Avenue
(55' Wide)

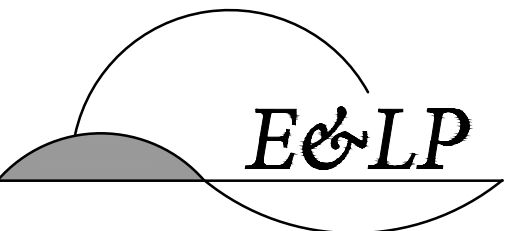
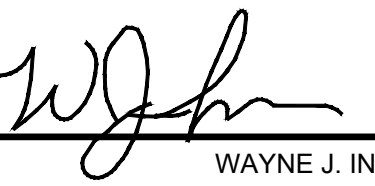
POST-DEVELOPMENT DRAINAGE AREA MAP
SCALE 1"=10'

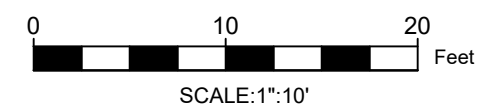
U/G STORAGE SYSTEM DISCHARGE		
STORM	PEAK BASIN DISCHARGE	MAX. STORAGE
2-YEAR	0.140 CFS	92.6 CF
10-YEAR	0.270 CFS	116 CF
100-YEAR	0.514 CFS	125 CF

LEGEND: SOIL GROUPS		
SOIL GROUP SYMBOL	SOIL GROUP NAME	HYDROLOGIC SOIL GROUP
UR	URBAN LAND	D

SOIL INFORMATION SHOWN ABOVE PER NATURAL RESOURCE CONSERVATION SERVICE WEB SOIL SURVEY MAPPING

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140 WEST MAIN STREET HIGH BRIDGE, NJ 08829			
PH. 908-238-0544 FAX. 908-238-9572			
A PROFESSIONAL ASSOCIATION			
CERTIFICATE OF AUTHORIZATION NO.: 24GA28021500 EXP. 8/31/2020			
1	PER TOWNSHIP COMMENTS	AA	03/26/20
NO.	REVISION	BY	DATE
03/26/2020			
DATE			
			
WAYNE J. INGRAM			
PROFESSIONAL ENGINEER			
N.J. P.E. NO. 24GB04258200			
PROJECT:			
TANNA RETAIL			
111-115 NORTH UNION AVENUE			
BLOCK 191; LOT 5			
CRANFORD TOWNSHIP			
UNION COUNTY NEW JERSEY			
TITLE:			
DRAINAGE AREA MAP			
JOB NO.:		19194	
SCALE:		1"=10'	
DESIGNED:		JZ	
CHECKED:		ADR	
FILENAME:		EXDA.DWG	
DATE:		10/29/2019	
		DRAWING NO.:	
		1	





140 West Main Street
High Bridge, NJ 08829
T: 908.238.0544 F: 908.238.9572

200 American Metro Blvd
Suite 114
Hamilton, NJ 08619
T: 609.454.3433 F: 908.238.9572

22 N. 3rd Street | Philadelphia, PA 19106

Municipality: Cranford Township Block: 191 Lot: 5

Soil Log and Interpretation

1 Soil Log #: SL-1 Date of Soil Log: 03/12/20 Method: Profile Pit

2 Log:

Depth (inches)	Munsell Color Name & Symbol; Estimated Textural Class; Estimated Volume % Coarse Fragments; Structure; Consistence; Mottling Abundance, Size and Contrast
0 - 15"	Topsoil;
15 - 60"	2.5YR 3/6; Sandy Loam; 10% Gravel, 15% Cobble; SAB, Moist, Friable
60 - 120"	2.5YR 4/8; Sandy Clay Loam; 10% Gravel, 15% Cobble, 10% Stone: SAB, Moist, Friable

3 Ground Water Observations:

Seepage Observed - Depth (inches): _____
Pit Flooded - Depth (inches): _____ after _____ hours of observation

4 Soil Limiting Zones (Check ALL applicable categories):

_____ Fractured Rock Substratum - Depth to Top: _____
_____ Massive Rock Substratum - Depth to Top: _____
_____ Excessively Coarse Horizon - Depth Top to Bottom: _____
_____ Excessively Coarse Substratum - Depth to Top: _____
_____ Hydraulically Restrictive Horizon - Depth Top to Bottom: _____
_____ Hydraulically Restrictive Substratum - Depth to Top: _____
_____ Perched Zone of Saturation - Depth Top to Bottom: _____
_____ Regional Zone of Saturation - Depth to Top: _____

5 I hereby certify that the information furnished on this form is true and accurate. I am aware that falsification of data is a violation of the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.) and is subject to penalties as prescribed in N.J.A.C. 7:14-8.

Signature of Site Evaluator: _____ Date: _____

Signature and Seal of Professional Engineer: _____

License #: 24GE05449900 Date: _____



140 West Main Street
High Bridge, NJ 08829
T: 908.238.0544 F: 908.238.9572

200 American Metro Blvd
Suite 114
Hamilton, NJ 08619
T: 609.454.3433 F: 908.238.9572

22 N. 3rd Street | Philadelphia, PA 19106

Municipality: Cranford Township Block: 191 Lot: 5

Soil Log and Interpretation

1 Soil Log #: SL-2 Date of Soil Log: 03/12/20 Method: Profile Pit

2 Log:

Depth (inches)	Munsell Color Name & Symbol; Estimated Textural Class; Estimated Volume % Coarse Fragments; Structure; Consistence; Mottling Abundance, Size and Contrast
-------------------	--

0 - 12"	Topsoil;
---------	----------

12 - 40"	2.5YR 3/6; Sandy Loam; 10% Gravel, 15% Cobble; SAB, Moist, Friable
----------	--

40 - 115"	2.5YR 4/8; Sandy Clay Loam; 10% Gravel, 20% Cobble; SAB, Moist, Friable
-----------	---

3 Ground Water Observations:

_____ Seepage Observed - Depth (inches): _____

_____ Pit Flooded - Depth (inches): _____ after _____ hours of observation

4 Soil Limiting Zones (Check ALL applicable categories):

_____	Fractured Rock Substratum - Depth to Top:	_____
_____	Massive Rock Substratum - Depth to Top:	_____
_____	Excessively Coarse Horizon - Depth Top to Bottom:	_____
_____	Excessively Coarse Substratum - Depth to Top:	_____
_____	Hydraulically Restrictive Horizon - Depth Top to Bottom:	_____
_____	Hydraulically Restrictive Substratum - Depth to Top:	_____
_____	Perched Zone of Saturation - Depth Top to Bottom:	_____
_____	Regional Zone of Saturation - Depth to Top:	_____

5 I hereby certify that the information furnished on this form is true and accurate. I am aware that falsification of data is a violation of the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.) and is subject to penalties as prescribed in N.J.A.C. 7:14-8.

Signature of Site Evaluator: _____ Date: _____

Signature and Seal of Professional Engineer: _____

License #: 24GE05449900 Date: _____

Engineering & Land Planning Associates

Project: Tanna Commercial Date: 3/12/2020
Location: 111 North Union Ave, Cranford, NJ Sample: IN PLACE
Test By: Annika Asplund SL-1 @ 110"

L=	4.500	T1=	38	<u>Disturbed</u>	
H1=	6.000	T2=	38	Tube Weight	698
H2=	4.500	T3=	72	Gross Weight	1,165
r=	1.125	T4=	56	Net Weight	467
R=	1.125	T5=	67	Sample Vol. (in ³)	17.88328125
		T(sec.)=	67	(cm ³)	293.1069797
		T(min.)=	1.12	Bulk Density	1.593274921
					min. 1.2 gr/cm ³
Soil Permeability:			<u>69.56</u>		
Soil Class:			<u>K5</u>		

Engineering & Land Planning Associates

Project: Tanna Commercial Date: 4/17/2020
Location: 111 North Union Ave, Cranford, NJ Sample: IN PLACE
Test By: Annika Asplund SL-1 @ 110"

L=	4.500	T1=	42	<u>Disturbed</u>	
H1=	6.000	T2=	45	Tube Weight	695
H2=	4.500	T3=	70	Gross Weight	1,182
r=	1.125	T4=	62	Net Weight	487
R=	1.125	T5=	68	Sample Vol. (in ³)	17.88328125
		T(sec.)=	68	(cm ³)	293.1069797
		T(min.)=	1.13	Bulk Density	1.661509393
					min. 1.2 gr/cm ³
Soil Permeability:			<u>68.54</u>		
Soil Class:			<u>K5</u>		

Engineering & Land Planning Associates

Project: Tanna Commercial Date: 3/12/2020
Location: 111 North Union Ave, Cranford, NJ Sample: IN PLACE
Test By: Annika Asplund SL-2 @ 110"

				<u>Disturbed</u>	
L=	4.500	T1=	43	Tube Weight	251
H1=	6.000	T2=	56	Gross Weight	665
H2=	4.500	T3=	57	Net Weight	414
r=	0.750	T4=	62		
R=	0.750	T5=	65	Sample Vol. (in ³)	7.948125
		T(sec.)=	65	(cm ³)	130.2697688
		T(min.)=	1.08	Bulk Density	3.178020534
					min. 1.2 gr/cm ³
Soil Permeability:			<u>71.70</u>		
Soil Class:			<u>K5</u>		

Engineering & Land Planning Associates

Project: Tanna Commercial Date: 4/17/2020
Location: 111 North Union Ave, Cranford, NJ Sample: IN PLACE
Test By: Annika Asplund SL-2 @ 110"

L=	4.500	T1=	46	<u>Disturbed</u>	
H1=	6.000	T2=	61	Tube Weight	263
H2=	4.500	T3=	63	Gross Weight	668
r=	0.750	T4=	58	Net Weight	405
R=	0.750	T5=	66	Sample Vol. (in ³)	7.948125
		T(sec.)=	66	(cm ³)	130.2697688
		T(min.)=	1.10	Bulk Density	3.108933131
					min. 1.2 gr/cm ³
Soil Permeability:			<u>70.61</u>		
Soil Class:			<u>K5</u>		