HARBOR CONSULTANTS INC.

STORMWATER MANAGEMENT REPORT

FOR

No. 40-42 JACKSON DRIVE & 677-679 RARITAN ROAD

LOTS 2, 3 & 6.01, BLOCK 640

TOWNSHIP OF CRANFORD
UNION COUNTY, NEW JERSEY

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Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Thursday, Apr 16, 2020

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2019118_ModRat-Rev2.gpw

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INTRODUCTION

This report has been prepared to evaluate the stormwater management requirements of the proposed development. The site is located within Zone C-1 (Commercial-1 District) and Zone NC (Neighborhood Commercial District) and is known as Lots 2, 3, & 6.01, Block 640 as shown on the Township of Cranford Tax Map Sheet #159. The property is located at No. 40-42 Jackson Drive & 677-679 Raritan Road, Cranford, Union County, New Jersey. The site depicted on the Tax Map is located in Exhibit 1 of this Report.

The site is presently developed by an existing warehouse building, asphalt driveway, parking areas, sidewalk and landscape areas. There are two existing driveways from Jackson drive that provide access to the eastern parking lot. The two driveways from Moen Avenue provide access to the loading area and parking lot. The property is bounded to the north by Jackson Drive, to the south by Raritan Road and a commercial building located at the intersection of Raritan Road and Moen Avenue, to the west by Moen Avenue and to the east by residential developments and commercial properties along Jackson Drive. The existing building footprint and parking areas located within the west portion of the property will remain undisturbed except for a new building addition and garage doors that will be constructed within the south and west sections of the building respectively. The center and south portions of the eastern parking lot will be disturbed, and the existing two driveways located at the north east portion of the site on Jackson drive will be widened. The remaining parking areas will not be disturbed, except for milling and repaving as required. A new concrete curb island and permeable pavers will be constructed within the disturbed center portion of the parking lot. The overall proposed improvements also include paving, curbs, sidewalks, lighting, landscaping, striping and miscellaneous items to complete the project. The existing underground and above ground drainage system will not be disturbed, with the exceptions of replacing the type “B” curb inlets to Type “E” and manhole covers.

The entire site is not located within the flood hazard area as shown in Exhibit 3 - FEMA Map of this report.

The site improvements are subject to meet the requirements of the current land use ordinance of the Township of Cranford and the Standards for Soil Erosion and Sediment Control in New

Jersey.

The site civil engineering plans prepared for this development are entitled "Preliminary and Final Site Plan, No. 40-42 Jackson Drive & 677-679 Raritan Road, Lots 2, 3 & 6.01, Block 640, Township of Cranford, Union County, New Jersey.", last revised April 16, 2020. These plans reflect the findings documented within this report.

HYDROLOGIC METHODOLOGIES

This drainage study will be conducted in two parts. Part one using the Rational Method to calculate the peak flow rates and flow reductions (Appendix A), and part two will be using the Modified Rational Method to calculate runoff volumes and storage capacity of the permeable pavers (Appendix B)

The times of concentrations were determined by TR-55 methodology and a minimum of 10 minutes was utilized in accordance with RSIS. Hydrographs were calculated using the computer program Hydraflow Hydrographs 2009, Version 6.066 by Autodesk, Inc.

EXISTING DRAINAGE PATTERNS

Pre-development conditions are comprised of Watersheds DA-1 and DA-2. Watershed DA-1 is subdivided into drainage areas DA-1A, DA-1B and DA-1C as shown on the predevelopment drainage plan. The entire track is tributary to the Rahway River drainage basin.

Drainage area DA-1A is comprised of 2.38 acres of land that is collected in the existing above ground detention basin located within the north corner of the site. Stormwater runoff from the above ground detention basin is discharged into the existing drainage system on Jackson Drive. Drainage area DA-1B consists of 0.51 acres of land that are also tributary to the existing drainage system on Jackson Drive. However, this drainage area is not controlled by the existing above ground basin. Drainage area DA-1C is a small onsite drainage area of 0.02 acres that is

collected in the two inlets located in the vicinity of Berwood Drive. Stormwater from these inlets are bypassed and discharged directly into the stormwater drainage system on Jackson Drive.

Drainage area DA-2 consists of 0.13 acres of land that generally drains overland toward the southerly property line and is collected into the existing drainage system on Raritan Road.

The total existing drainage areas studied were 3.04 acres that is a mixture of pervious and impervious areas respectively. All existing pervious areas have been considered in good conditions. To simplify the analysis and to keep it consistent, that portion of the site that will be entirely undisturbed has not been included in the calculations. The undisturbed portion of the site is located within the west portion of the site. The pre-development drainage plan is included in Exhibit 5 of this report.

The topography of the site generally slopes in the north-west direction. The high point of the site, elevation of 73.1 +/-, is located along the south east property line between drainage areas DA-1A and DA-2. The low point of the site, elevation 59.0 +/-, is found near the northerly property line in the above ground detention basin. The site depicted on the U.S.G.S. Topographic Map is shown in Exhibit 2 of this Report.

PROPOSED DRAINAGE PATTERNS

Post-development conditions are comprised of Watersheds DA-1 and DA-2. Watershed DA-1 is subdivided into drainage areas DA-1A, DA-1B, DA-1C and DA-1P (to permeable pavers) as shown on the postdevelopment drainage plans. Post-development Watershed DA-1A consists of 2.11 acres of drainage areas that will be collected in the existing above ground detention basin located within the north corner of the site. Stormwater runoff from the above ground detention basin is discharged into the existing drainage system on Jackson Drive. Post-development Watershed DA-1B consists of 0.40 acres of drainage areas that will continue to run uncontrolled toward the drainage system on Jackson Drive. Drainage area DA-1C is a small onsite drainage area of 0.02 acres that will continue to be tributary to the two existing inlets located in the

vicinity of Berwood Drive. Stormwater from these inlets are bypassed and discharged directly into the stormwater drainage system on Jackson Drive.

Postdevelopment Watershed DA-2 consists of 0.08 acres of drainage areas that will continue to run overland toward the southerly property line and is collected into the existing drainage system on Raritan Road.

Postdevelopment Watershed DA-1P consists of 0.43 acres of drainage areas tributary to the permeable pavers.

The proposed storage volume of the permeable pavers, as shown in subsequent chapters of this report, has been designed to accommodate the anticipated 2-year, 10-year and 100-year runoff resulting from Drainage area DA-1P.

The proposed project was designed so that the existing stream corridor will not be altered after the proposed development, therefore maintaining existing drainage patterns as much as possible. The post-development drainage plan is included in Exhibit 5 of this report.

SOILS

The soils on the site were found using the NRCS (Natural Resource Conservation Service) GIS based soil survey maps. They are classified in accordance with the Hydrologic Soil Groupings (HSG) of A, B, C and D. The HSG is an indication of the soils ability to infiltrate stormwater and consequently produce runoff. A soil with an HSG = A demonstrates excellent infiltration capabilities, while a soil with HSG = B indicates a soil with very good to good infiltration capabilities, a “C” soil has moderate infiltration capabilities, and a “D” soil has very poor infiltration capabilities. The soil survey shows that the south portion of the site consists of Booton-Urban land-Haledon complex (BovB), 0 to 8 percent slopes; with a hydrologic soil group classification of “C”, and the north section of the site consists of Urban land (UR). The soil

survey's description of this material is vague insofar as describing color, texture, and other identifying characteristics and do not have a hydrologic soil group rating. It is assumed that the hydrologic soil group classifications of the onsite Urban land soils are within the HSG classification "C" due to their immediate proximity abutting the Boonton-Urban land-Haledon complex soils. Therefore, for drainage calculations purposes, the hydrological soil group classification (HSGC) will be "C" for the entire site. The soils map and descriptions are included in Exhibit 4.

GROUNDWATER RECHARGE

According to N.J.A.C. 7:8. because the project falls within a previously developed area of the urban redevelopment area, which is shown as Metropolitan Planning Area (PAl) on the State Plan Policy Map, this site is not subject to groundwater recharge / infiltration requirements.
Plan Policy Map, this site is not subject to groundwater recharge / infiltration requirements.

WATER QUANTITY AND QUALITY

The stormwater management rules contained within N.J.A.C. 7:8 require that stormwater flow reductions apply to "Major Development" which is any development that disturbs an acre or more of land or increases the impervious coverage by 0.25 acres. However, the water quality standard at N.J.A.C. 7:8-5.5 apply only if there is a net increase of 0.25 acres or more of impervious surface onsite. The proposed project will not disturb more than one acre of land and will not increase the impervious coverage by 0.25 acres or more. The overall disturbance area is 41,970 sf and the existing overall impervious areas will be reduced from 127,777 sf to 126,104 sf as shown on the disturbance area calculations and schedule of impervious lot coverage Tables shown on Sheet 4 – Grading and Utility Plan of the site civil engineering plans prepared for this development. Therefore, the proposed project is exempt from the water quantity and water quality requirements at N.J.A.C. 7:8-5.5. However, a permeable paver area will be installed to provide water quantity and quality control for proposed Drainage area DA-1P.

To simplify the analysis and to keep it consistent, that portion of the site that will be entirely undisturbed has not been included in the drainage calculations. The existing and proposed land cover areas within the studied drainage areas were 3.04 acres that is a mixture of pervious and impervious areas respectively as shown on Table 1 below and the drainage plans under Exhibit 5. As indicated above, refer to the tables on the Sheet 4 – Grading and Utility Plan for the overall disturbance and impervious areas calculations.

TABLE 1

Existing VS. Proposed Land Cover Areas

Existing Conditions		**Proposed Conditions**	
Land Cover	**Area (Acres)**	**Land Cover**	**Area (Acres)**
Impervious	1.90	Impervious	1.86
Pervious	1.14	Pervious	1.18
Total	**3.04**	**Total**	**3.04**

The runoff hydrographs are included in Appendix A.

1.0 ANALYSIS OF PREDEVELOPMENT CONDITIONS

We have determined the predevelopment runoff for Drainage Areas DA-1A, DA-1B, DA-1C, and DA-2 as documented in the following sections of this report.

1.1 Drainage Area DA-1A

Drainage runoff that is collected in the existing above ground detention basin located within the north corner of the site and discharged into the existing inlet on Jackson Drive.

1.1.1 Area and Curve Number

H.S.G.	USE	SOIL	C	AREA (ac)
C	Pervious	BovB & UR	0.51	0.72
	Impervious		0.99	1.66
	TOTAL			2.38

Weighted C = 0.84

1.1.2 Time of Concentration

Tc = 7.11 min. (Hydraflow Calcs.) ……..Use Tc=10 min

1.1.3 Peak Runoff

Runoff hydrographs are included in Appendix A of this report. A summary of the peak flows is shown on Tables 1-1a and 1-1b.

TABLE 1-1a

Existing Peak Runoff – DA-1A (Without Above Ground Basin Control)

Storm Frequency (YRS)	Existing Peak Flow (CFS)
2	8.49
10	11.45
100	15.29

TABLE 1-1b

Existing Peak Runoff – DA-1A (With Above Ground Basin Control)

Storm Frequency (YRS)	Existing Peak Flow (CFS)
2	8.20
10	10.05
100	11.65

1.2 Drainage Area DA-1B

Consists of uncontrolled drainage areas tributary to the existing drainage system on Jackson Drive.

1.2.1 Area and Curve Number

H.S.G.	USE	SOIL	C	AREA (ac)
C	Pervious	UR	0.51	0.29
	Impervious		0.99	0.22
	TOTAL			0.51

Weighted C = 0.72

1.2.2 Time of Concentration

Tc = 10 min. (Assumed)

1.2.3 Peak Runoff

Runoff hydrographs are included in Appendix A of this report. A summary of the peak flows is shown on Table 1-2.

TABLE 1-2

Existing Peak Runoff – DA-1B

Storm Frequency (YRS)	Existing Peak Flow (CFS)
2	1.56
10	2.10
100	2.81

1.3 Drainage Area DA-1C

Consists of uncontrolled drainage areas that will bypass toward the existing drainage system on Jackson Drive.

1.3.1 Area and Curve Number

H.S.G.	USE	SOIL	C	AREA (ac)
C	Pervious	BovB & UR	0.51	0.02

Weighted C = 0.51

1.3.2 Time of Concentration

Tc = 10 min. (Assumed)

1.3.3 Peak Runoff

Runoff hydrographs are included in Appendix A of this report. A summary of the peak flows is shown on Table 1-3.

TABLE 1-3

Existing Peak Runoff – DA-1C

Storm Frequency (YRS)	Existing Peak Flow (CFS)
2	0.04
10	0.06
100	0.08

1.4 Total Existing Runoff - Drainage Area DA-1 with Above Ground Basin

Predevelopment runoff hydrographs are presented in Appendix A. Total combined Peak discharges for DA-1 are shown on Table 1-4.

TABLE 1-4

Total Existing Peak Runoff – DA-1

Storm Frequency (YRS)	Total Peak Flow (CFS)
2	9.80
10	12.00
100	14.11

1.5 Drainage Area DA-2

Consists of uncontrolled drainage areas tributary to the existing drainage system on Raritan Road.

1.5.1 Area and Curve Number

H.S.G.	USE	SOIL	C	AREA (ac)
C	Pervious	BovB	0.51	0.11
	Impervious		0.99	0.02
	TOTAL			0.13

Weighted C = 0.58

1.5.2 Time of Concentration

Tc = 10 min. (Assumed)

1.5.3 Peak Runoff

Runoff hydrographs are included in Appendix A of this report. A summary of the peak flows is shown on Table 1-5.

TABLE 1-5

Existing Peak Runoff – DA-2

Storm Frequency (YRS)	Existing Peak Flow (CFS)
2	0.32
10	0.43
100	0.58

2.0 ANALYSIS OF POSTDEVELOPMENT CONDITIONS

We have determined the postdevelopment runoff for Drainage areas DA-1A, DA-1B, DA-1C DA-1P (to permeable pavers) and DA-2 as documented in the following sections of this report.

2.1 Drainage Area DA-1A

Drainage runoff that will be controlled by the existing above ground detention basin that discharges into the existing inlet on Jackson Drive.

2.1.1 Area and Curve Number

H.S.G.	USE	SOIL	C	AREA (ac)
C	Pervious	BovB & UR	0.51	0.69
	Impervious		0.99	1.42
	TOTAL			2.11

Weighted C = 0.83

2.1.2 Time of Concentration

Tc = 7.05 min. (Hydraflow Calcs.) ……..Use Tc=10 min

2.1.3 Peak Runoff

Runoff hydrographs are included in Appendix A of this report. A summary of the peak flows without the above ground detention basin control is shown on Table 2-1.

TABLE 2-1

Proposed Peak Runoff – DA-1A (Without Above Ground Basin Control)

Storm Frequency (YRS)	Proposed Peak Flow (CFS)
2	7.43
10	10.03
100	13.39

2.2 Drainage Area DA-1B

Drainage runoff that will continue to run uncontrolled toward the drainage system on Jackson Drive.

2.2.1 Area and Curve Number

H.S.G.	USE	SOIL	C	AREA (ac)
C	Pervious	UR	0.51	0.23
	Impervious		0.99	0.17
	TOTAL			0.40

Weighted C = 0.71

2.2.2 Time of Concentration

Tc = 10 min. (Assumed)

2.2.3 Peak Runoff

Runoff hydrographs are included in Appendix A of this report. A summary of the peak flows is shown on Table 2-2.

TABLE 2-2

Proposed Peak Runoff – DA-1B

Storm Frequency (YRS)	Proposed Peak Flow (CFS)
2	1.21
10	1.63
100	2.17

2.3 Drainage Area DA-1C

Consists of uncontrolled drainage areas that will continue to bypass toward the existing drainage system on Jackson Drive.

2.3.1 Area and Curve Number

H.S.G.	USE	SOIL	C	AREA (ac)
C	Pervious	BovB & UR	0.51	0.02

Weighted C = 0.51

2.3.2 Time of Concentration

Tc = 10 min. (Assumed)

2.3.3 Peak Runoff

Runoff hydrographs are included in Appendix A of this report. A summary of the peak flows is shown on Table 2-3.

TABLE 2-3

Existing Peak Runoff – DA-1C

Storm Frequency (YRS)	Existing Peak Flow (CFS)
2	0.04
10	0.06
100	0.08

2.4 Drainage Area DA-P (to Permeable Pavers)

Drainage runoff tributary to the permeable pavers.

2.4.1 Area and Curve Number

H.S.G.	USE	SOIL	C	AREA (ac)
C	Pervious	UR	0.51	0.16
	Impervious		0.99	0.26
	TOTAL			0.42

Weighted C = 0.81

2.4.2 Time of Concentration

Tc = 10 min. (Assumed)

2.4.3 Peak Runoff

Runoff hydrographs are included in Appendix A of this report. A summary of the peak flows is shown on Table 2-4.

TABLE 2-4

Proposed Peak Runoff – DA-1P

Storm Frequency (YRS)	Proposed Peak Flow (CFS)
2	1.48
10	2.00
100	2.66

2.5 Total Proposed Runoff - Drainage Area DA-1 (Without Permeable Paver Control)

Postdevelopment runoff hydrographs are presented in Appendix A. The total combined Peak discharges for DA-1, assuming that the permeable paver system is malfunctioning and will not allow any infiltration, are shown on Table 2-5.

TABLE 2-5

Total proposed Peak Runoff – DA-1

Storm Frequency (YRS)	Total Peak Flow (CFS)
2	9.72
10	11.79
100	13.77

2.6 Total Proposed Runoff - Drainage Area DA-1 (With Permeable Paver Control)

Postdevelopment runoff hydrographs are presented in Appendix A. The total combined Peak discharges with the introduction of the permeable paver system are shown on Table 2-6.

TABLE 2-6

Total proposed Peak Runoff – DA-1

Storm Frequency (YRS)	Total Peak Flow (CFS)
2	8.43
10	10.91
100	12.85

2.7 Drainage Area DA-2

Drainage area that will continue to run overland toward the rear property line.

2.7.1 Area and Curve Number

H.S.G.	USE	SOIL	C	AREA (ac)
C	Pervious	BovB	0.51	0.08

C = 0.51

2.7.2 Time of Concentration

Tc = 10 min. (Assumed)

2.7.3 Peak Runoff

Runoff hydrographs are included in Appendix A of this report. A summary of the peak flows is shown on Table 2-7.

TABLE 2-7

Proposed Peak Runoff – DA-2

Storm Frequency (YRS)	Existing Peak Flow (CFS)
2	0.17
10	0.23
100	0.31

3.0 EXISTING & ALLOWABLE VS. PROPOSED PEAK FLOWS

Table 3-1 below summarizes the stormwater routing analysis for the 2, 10 and 100-year storm events at each point of discharge. Drainage are DA-1 has been analyzed under two scenarios. Scenario 1 assumes that the permeable paver area is malfunctioning and will not allow any infiltration. Scenario 2 assumes that the permeable paver system is functioning as designed.

TABLE 3-1

Total Existing Allowable VS. Total Proposed

Storm (YRS)	Peak Rates-North DA-1 (CFS)				Peak Rates-South DA-2 (CFS)		
	Existing	Allowable	Proposed Without Pervious Paver	Proposed With Pervious Paver	Existing	Allowable	Proposed
2	9.80	9.80	9.72	8.43	0.32	0.32	0.17
10	12.00	12.00	11.79	10.91	0.43	0.43	0.23
100	14.11	14.11	13.77	12.85	0.58	0.58	0.31

The existing peak flows for drainage areas DA-1 and DA-2 have been reduced for each storm event. In addition, the peak flows for DA-1 have been reduced under the above two mentioned scenarios as shown on columns 5 and 6 of the above Table 3-1. The permeable paver system will provide an additional stormwater quantity and quality control for the proposed project.

CONCLUSION

The proposed stormwater management design will safely convey all developed runoff from the project while reducing the overall peak runoff from the Facility.

Soil erosion and sediment control measures will be incorporated with construction as shown on the soil erosion and sediment control plan and details.

CHART 1

RUNOFF COEFFICIENTS “C”

2019118 – LOTS 2, 3 & 6.01, BLOCK 640, CRANFORD, NJ
By: JOSE M. BETANCES, P.E. AUGUST 23, 2019

RUNOFF COEFFICIENTS – "C" (FROM R.S.I.S. MANUAL)…

Table 7.2 Runoff Coefficients (Antecedent Moisture Condition) AMCII

		HYDROLOGIC SOIL GROUP			
LAND-USE DESCRIPTION		**A**	**B**	**C**	**D**
Cultivated land:					
without conservation treatment		0.49	0.67	0.81	0.88
with conservation treatment		0.27	0.43	0.61	0.67
Pasture or range land:					
poor condition		0.38	0.63	0.78	0.84
good condition		NA	0.25	0.51	0.65
Meadow					
good condition		NA	NA	0.44	0.61
Wood or forest land:					
thin stand, poor cover, no mulch		NA	NA	0.59	0.79
good cover		NA	NA	0.45	0.59
Open spaces, lawns, parks, golf courses, cemeteries:					
good condition, grass cover on 75% or more of area		NA	0.25	**0.51**	0.65
fair condition, grass cover on 50-75% of area		NA	0.45	0.63	0.74
Commercial and business areas (85% impervious)		0.84	0.90	0.93	0.96
Industrial districts (72% impervious)		0.67	0.81	0.88	0.92
Residential:					
Average lot size	*Average impervious*				
1/8 acre	65%	0.59	0.76	0.86	0.90
1/4 acre	38%	0.25	0.55	0.70	0.80
1/3 acre	30%	NA	0.49	0.67	0.78
1/2 acre	25%	NA	0.45	0.65	0.76
1 acre	20%	NA	0.41	0.63	0.74
Paved parking lots, roofs, driveways, etc.		0.99	0.99	**0.99**	0.99
Streets and roads:					
paved with curbs and storm sewers		0.99	0.99	0.99	0.99
gravel		0.57	0.76	0.84	0.88
dirt		0.49	0.69	0.80	0.84

NOTE: NA denotes information is not available; design engineers should rely on another authoritative source.

SOURCE: Technical Manual for Land Use Regulation Program, Department of Environmental Protection, Bureaus of Inland and Coastal Regulations, Stream Encroachment Permits (Trenton, New Jersey, revised September 1995), p. 12.

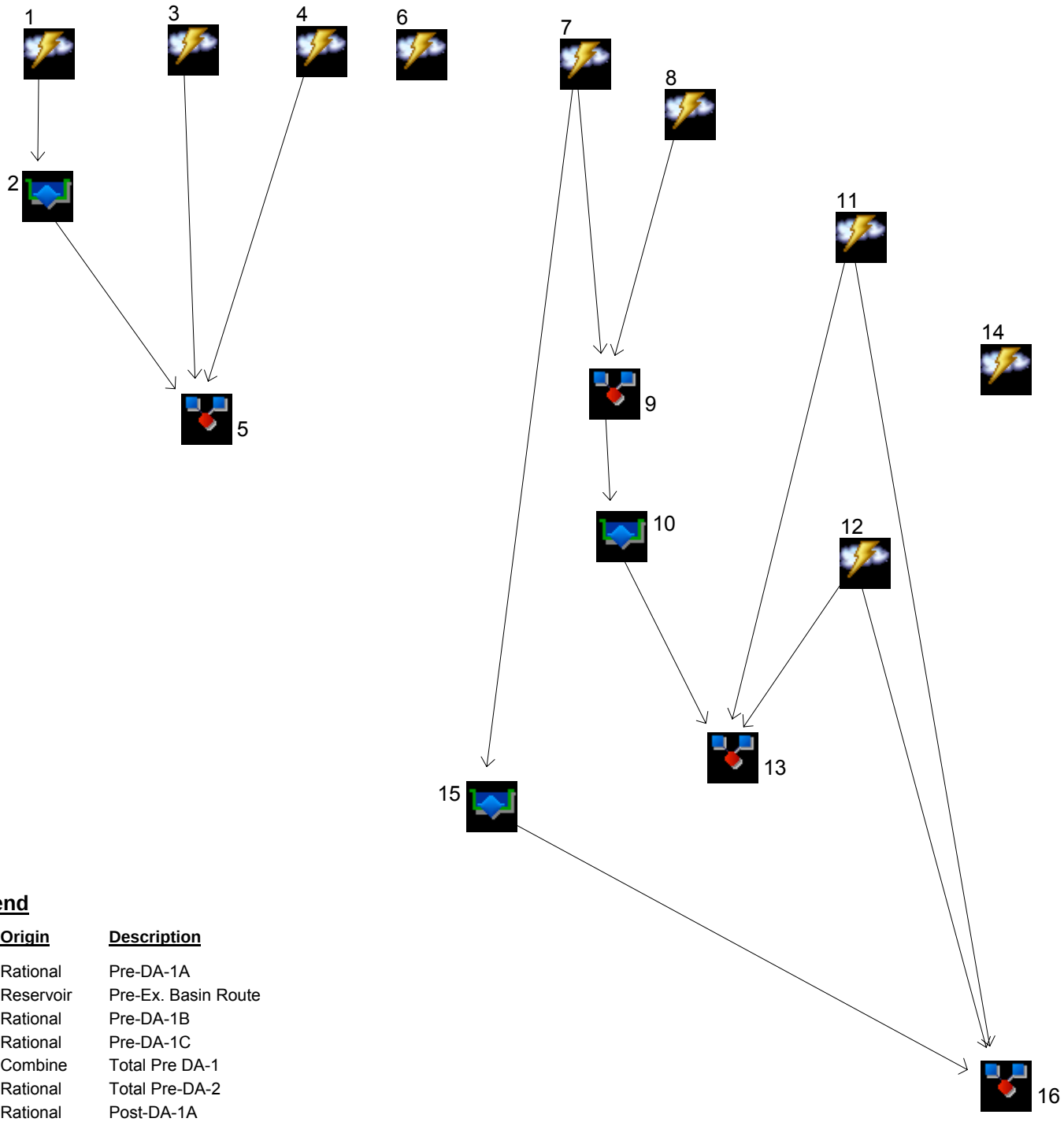
APPENDIX A

2, 10, & 100 YEARS STORM FREQUENCY HYDROGRAPHS

RATIONAL - PEAK FLOW RATES

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066



Legend

Hyd.	Origin	Description
1	Rational	Pre-DA-1A
2	Reservoir	Pre-Ex. Basin Route
3	Rational	Pre-DA-1B
4	Rational	Pre-DA-1C
5	Combine	Total Pre DA-1
6	Rational	Total Pre-DA-2
7	Rational	Post-DA-1A
8	Rational	Post-DA-1P
9	Combine	Post DA-1 to Ex Basin
10	Reservoir	Post-Ex.Basin/No Paver
11	Rational	Post-DA-1B
12	Rational	Post-DA-1C
13	Combine	Total Post DA-1-No Pervious Paver
14	Rational	Total Post-DA-2
15	Reservoir	Post-Ex.Basin w/Paver
16	Combine	Total Post DA-1-With Pervious Paver

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	Rational	------	-------	8.487	-------	-------	11.45	-------	-------	15.29	Pre-DA-1A
2	Reservoir	1	-------	8.201	-------	-------	10.05	-------	-------	11.65	Pre-Ex. Basin Route
3	Rational	------	-------	1.559	-------	-------	2.103	-------	-------	2.808	Pre-DA-1B
4	Rational	------	-------	0.043	-------	-------	0.058	-------	-------	0.078	Pre-DA-1C
5	Combine	2, 3, 4	-------	9.803	-------	-------	12.00	-------	-------	14.11	Total Pre DA-1
6	Rational	------	-------	0.320	-------	-------	0.432	-------	-------	0.577	Total Pre-DA-2
7	Rational	------	-------	7.434	-------	-------	10.03	-------	-------	13.39	Post-DA-1A
8	Rational	------	-------	1.479	-------	-------	1.995	-------	-------	2.663	Post-DA-1P
9	Combine	7, 8	-------	8.913	-------	-------	12.03	-------	-------	16.06	Post DA-1 to Ex Basin
10	Reservoir	9	-------	8.475	-------	-------	10.28	-------	-------	11.92	Post-Ex.Basin/No Paver
11	Rational	------	-------	1.206	-------	-------	1.627	-------	-------	2.172	Post-DA-1B
12	Rational	------	-------	0.043	-------	-------	0.058	-------	-------	0.078	Post-DA-1C
13	Combine	10, 11, 12	-------	9.811	-------	-------	11.88	-------	-------	14.16	Total Post DA-1-No Pervious Paver
14	Rational	------	-------	0.173	-------	-------	0.234	-------	-------	0.312	Total Post-DA-2
15	Reservoir	7	-------	7.989	-------	-------	9.805	-------	-------	11.22	Post-Ex.Basin w/Paver
16	Combine	11, 12, 15	-------	8.863	-------	-------	11.15	-------	-------	13.25	Total Post DA-1-With Pervious Paver

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	Rational	8.487	1	10	5,092	------	------	------	Pre-DA-1A
2	Reservoir	8.201	1	10	4,590	1	60.21	698	Pre-Ex. Basin Route
3	Rational	1.559	1	10	935	------	------	------	Pre-DA-1B
4	Rational	0.043	1	10	26	------	------	------	Pre-DA-1C
5	Combine	9.803	1	10	5,551	2, 3, 4	------	------	Total Pre DA-1
6	Rational	0.320	1	10	192	------	------	------	Total Pre-DA-2
7	Rational	7.434	1	10	4,461	------	------	------	Post-DA-1A
8	Rational	1.479	1	10	887	------	------	------	Post-DA-1P
9	Combine	8.913	1	10	5,348	7, 8	------	------	Post DA-1 to Ex Basin
10	Reservoir	8.475	1	10	4,846	9	60.23	710	Post-Ex.Basin/No Paver
11	Rational	1.206	1	10	723	------	------	------	Post-DA-1B
12	Rational	0.043	1	10	26	------	------	------	Post-DA-1C
13	Combine	9.811	1	8	4,655	10, 11, 12	------	------	Total Post DA-1-No Pervious Paver
14	Rational	0.173	1	10	104	------	------	------	Total Post-DA-2
15	Reservoir	7.989	1	7	3,020	7	60.21	694	Post-Ex.Basin w/Paver
16	Combine	8.863	1	7	3,770	11, 12, 15	------	------	Total Post DA-1-With Pervious Paver

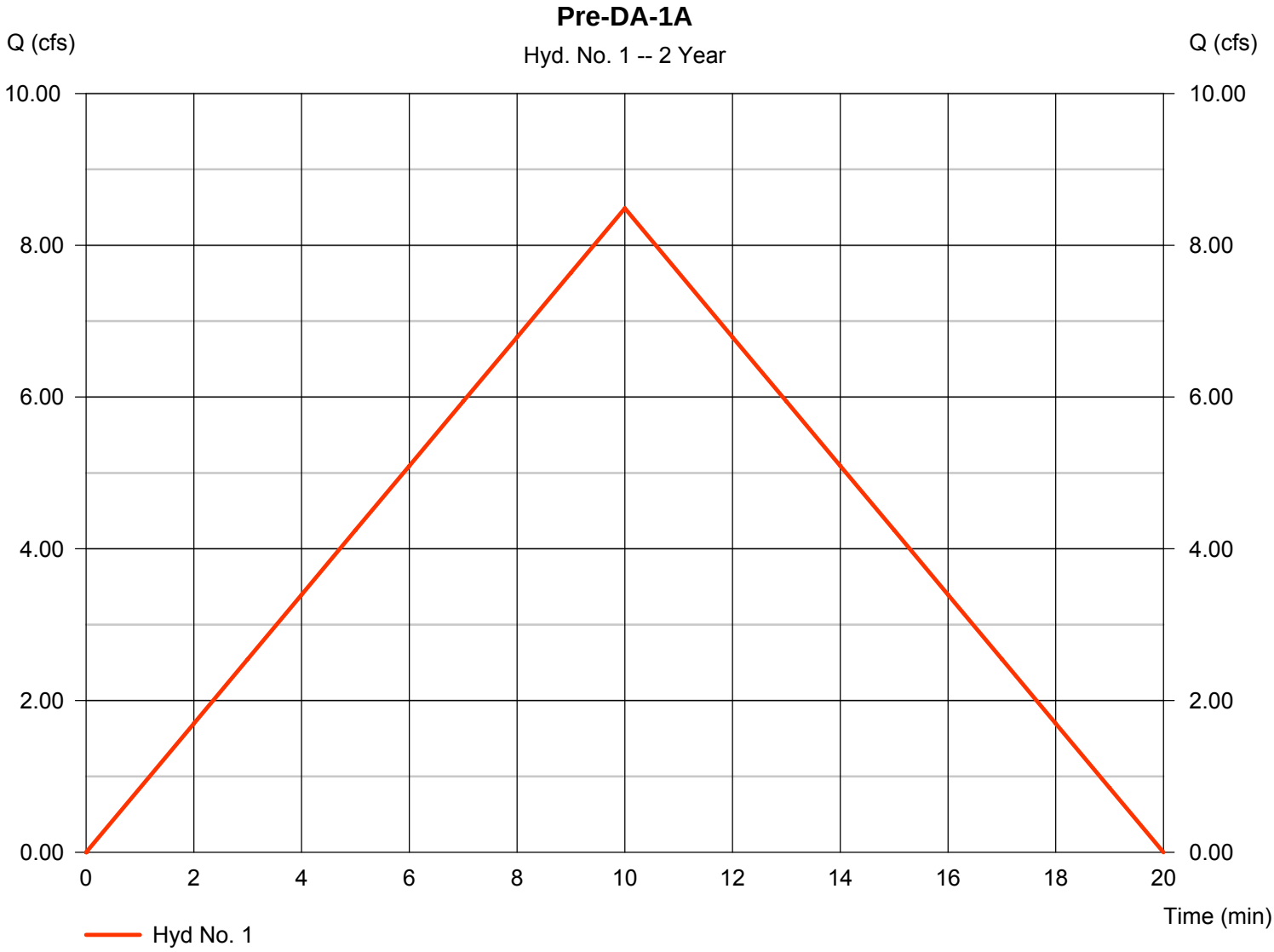
Hydrograph Report

Hyd. No. 1

Pre-DA-1A

Hydrograph type	=	Rational	Peak discharge	=	8.487 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	5,092 cuft
Drainage area	=	2.380 ac	Runoff coeff.	=	0.84*
Intensity	=	4.245 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.720 x 0.51) + (1.660 x 0.99)] / 2.380



TR55 Tc Worksheet

Hyd. No. 1

Pre-DA-1A

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.150		
Flow length (ft)	= 53.0		97.0		0.0		
Two-year 24-hr precip. (in)	= 3.38		3.38		0.00		
Land slope (%)	= 4.00		1.88		0.00		
Travel Time (min)	**= 4.35**	**+**	**1.18**	**+**	**0.00**	**=**	**5.53**
Shallow Concentrated Flow							
Flow length (ft)	= 218.00		0.00		0.00		
Watercourse slope (%)	= 1.60		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	= 2.57		0.00		0.00		
Travel Time (min)	**= 1.41**	**+**	**0.00**	**+**	**0.00**	**=**	**1.41**
Channel Flow							
X sectional flow area (sqft)	= 3.14		3.14		0.00		
Wetted perimeter (ft)	= 6.28		6.28		0.00		
Channel slope (%)	= 0.36		1.50		0.00		
Manning's n-value	= 0.013		0.013		0.015		
Velocity (ft/s)	= 4.32		8.82		0.00		
Flow length (ft)	= 33.0		21.0		0.0		
Travel Time (min)	**= 0.13**	**+**	**0.04**	**+**	**0.00**	**=**	**0.17**

Total Travel Time, Tc ..... 7.11 min

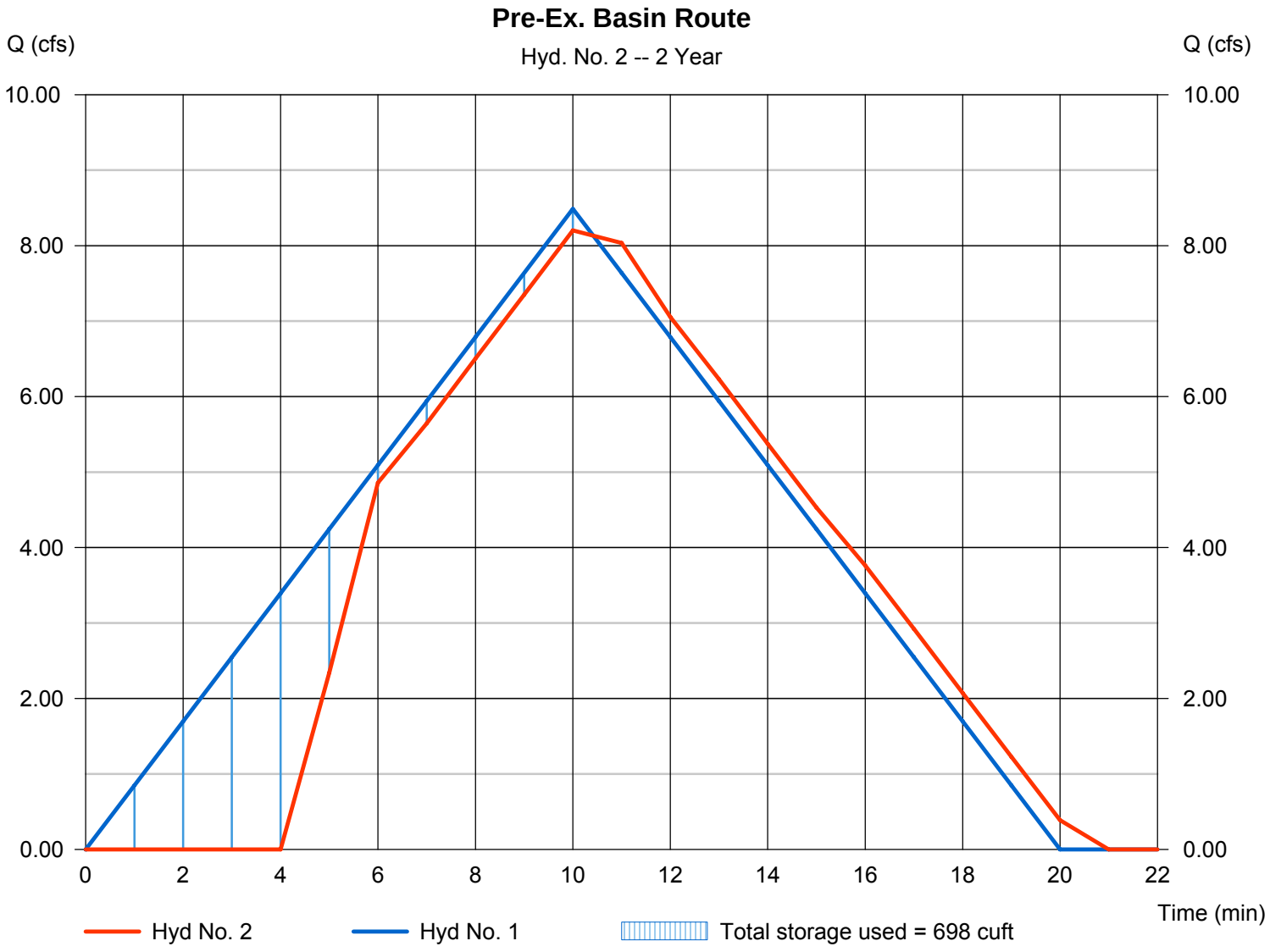
Hydrograph Report

Hyd. No. 2

Pre-Ex. Basin Route

Hydrograph type	=	Reservoir	Peak discharge	=	8.201 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	4,590 cuft
Inflow hyd. No.	=	1 - Pre-DA-1A	Max. Elevation	=	60.21 ft
Reservoir name	=	Ex. Basin	Max. Storage	=	698 cuft

Storage Indication method used.



Pond No. 1 - Ex. Basin

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 57.49 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	57.49	00	0	0
1.51	59.00	195	147	147
2.51	60.00	595	395	542
3.51	61.00	985	790	1,332
4.51	62.00	1,310	1,148	2,480

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 16.00	0.00	0.00	0.00
Span (in)	= 16.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 57.49	0.00	0.00	0.00
Length (ft)	= 14.00	0.00	0.00	0.00
Slope (%)	= 0.01	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	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 59.91	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	57.49	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.15	15	57.64	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.30	29	57.79	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.45	44	57.94	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.60	59	58.09	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.76	74	58.25	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.91	88	58.40	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.06	103	58.55	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.21	118	58.70	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.36	133	58.85	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.51	147	59.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.61	187	59.10	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.71	226	59.20	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.81	266	59.30	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.91	305	59.40	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.01	345	59.50	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.11	384	59.60	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.21	424	59.70	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.31	463	59.80	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.41	503	59.90	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.51	542	60.00	1.44 oc	---	---	---	1.44	---	---	---	---	---	1.439
2.61	621	60.10	4.41 oc	---	---	---	4.41	---	---	---	---	---	4.413
2.71	700	60.20	8.32 oc	---	---	---	8.32	---	---	---	---	---	8.321
2.81	779	60.30	9.54 ic	---	---	---	9.54 s	---	---	---	---	---	9.542
2.91	858	60.40	9.91 ic	---	---	---	9.91 s	---	---	---	---	---	9.907
3.01	937	60.50	10.20 ic	---	---	---	10.19 s	---	---	---	---	---	10.19
3.11	1,016	60.60	10.45 ic	---	---	---	10.44 s	---	---	---	---	---	10.44
3.21	1,095	60.70	10.68 ic	---	---	---	10.67 s	---	---	---	---	---	10.67
3.31	1,174	60.80	10.90 ic	---	---	---	10.89 s	---	---	---	---	---	10.89
3.41	1,253	60.90	11.11 ic	---	---	---	11.09 s	---	---	---	---	---	11.09
3.51	1,332	61.00	11.32 ic	---	---	---	11.32 s	---	---	---	---	---	11.32
3.61	1,447	61.10	11.52 ic	---	---	---	11.49 s	---	---	---	---	---	11.49
3.71	1,562	61.20	11.71 ic	---	---	---	11.69 s	---	---	---	---	---	11.69
3.81	1,676	61.30	11.91 ic	---	---	---	11.87 s	---	---	---	---	---	11.87
3.91	1,791	61.40	12.10 ic	---	---	---	12.03 s	---	---	---	---	---	12.03
4.01	1,906	61.50	12.28 ic	---	---	---	12.23 s	---	---	---	---	---	12.23
4.11	2,021	61.60	12.47 ic	---	---	---	12.40 s	---	---	---	---	---	12.40
4.21	2,135	61.70	12.65 ic	---	---	---	12.58 s	---	---	---	---	---	12.58
4.31	2,250	61.80	12.83 ic	---	---	---	12.82 s	---	---	---	---	---	12.82
4.41	2,365	61.90	13.00 ic	---	---	---	12.96 s	---	---	---	---	---	12.96

Continues on next page...

Ex. Basin

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
4.51	2,480	62.00	13.17 ic	---	---	---	13.01 s	---	---	---	---	---	13.01

...End

Hydrograph Report

Hyd. No. 3

Pre-DA-1B

Hydrograph type	=	Rational	Peak discharge	=	1.559 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	935 cuft
Drainage area	=	0.510 ac	Runoff coeff.	=	0.72*
Intensity	=	4.245 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.290 x 0.51) + (0.220 x 0.99)] / 0.510

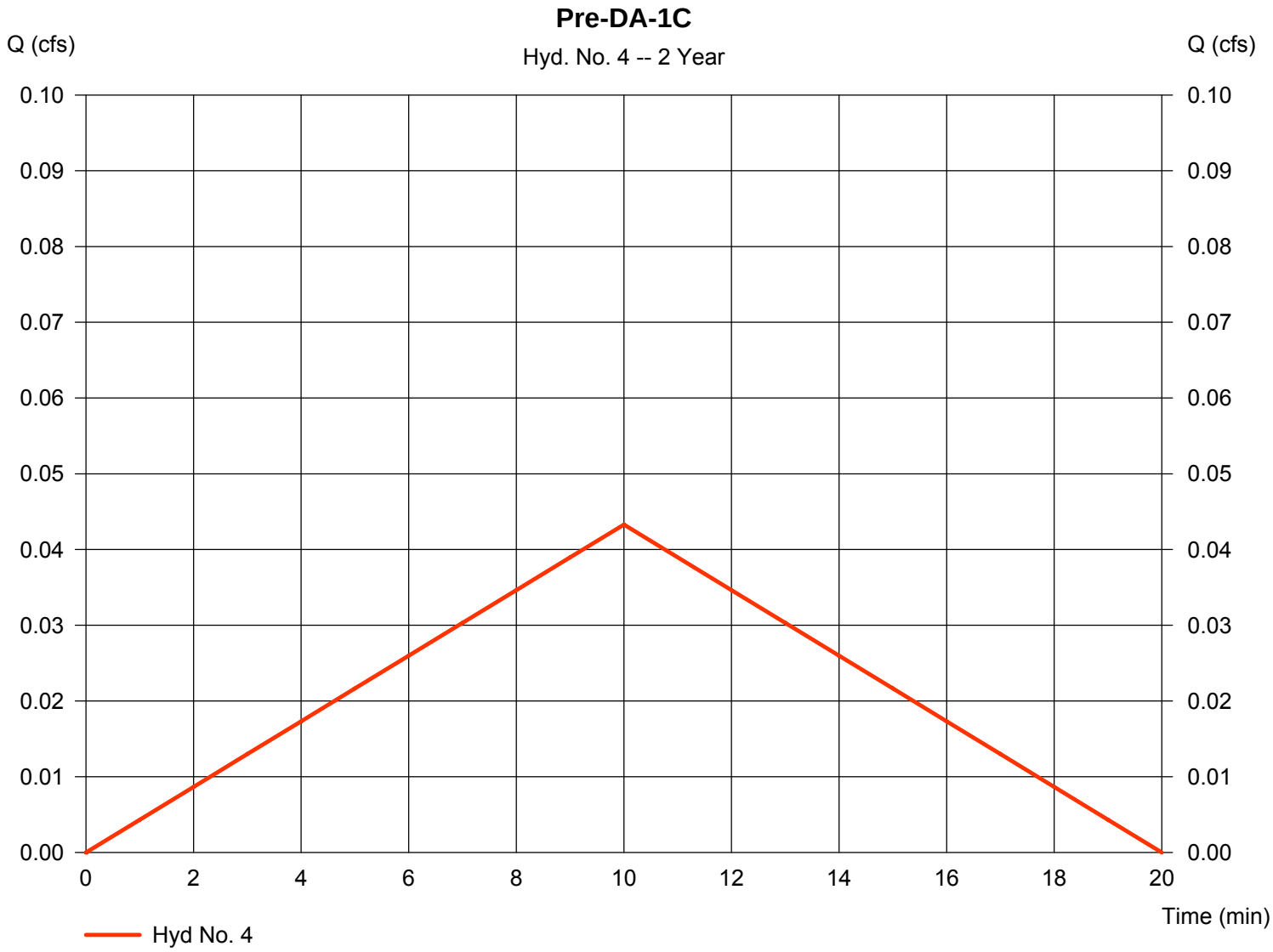
Hydrograph Report

Hyd. No. 4

Pre-DA-1C

Hydrograph type	=	Rational	Peak discharge	=	0.043 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	26 cuft
Drainage area	=	0.020 ac	Runoff coeff.	=	0.51*
Intensity	=	4.245 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.020 x 0.51)] / 0.020

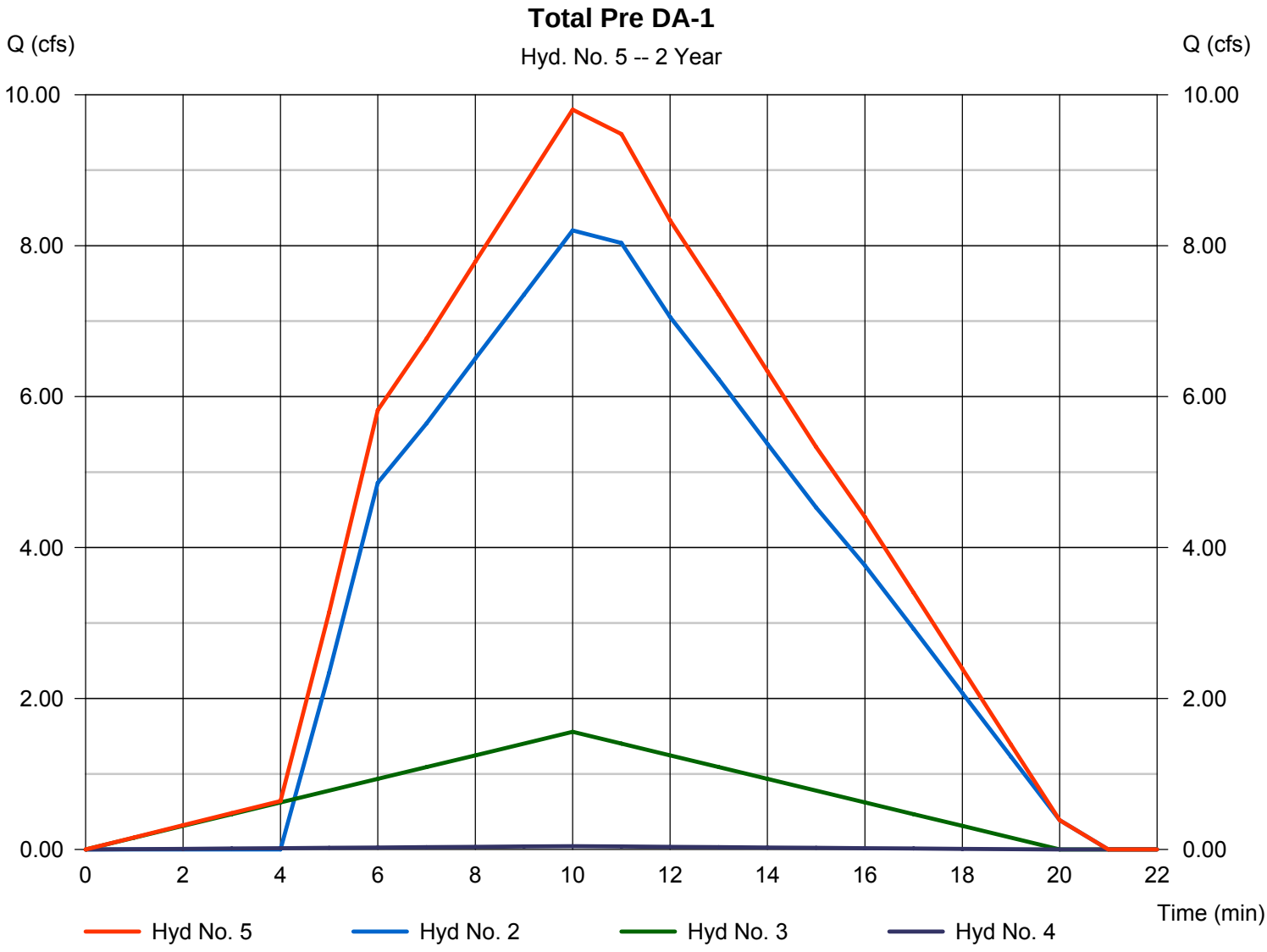


Hydrograph Report

Hyd. No. 5

Total Pre DA-1

Hydrograph type	= Combine	Peak discharge	= 9.803 cfs
Storm frequency	= 2 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 5,551 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 0.530 ac



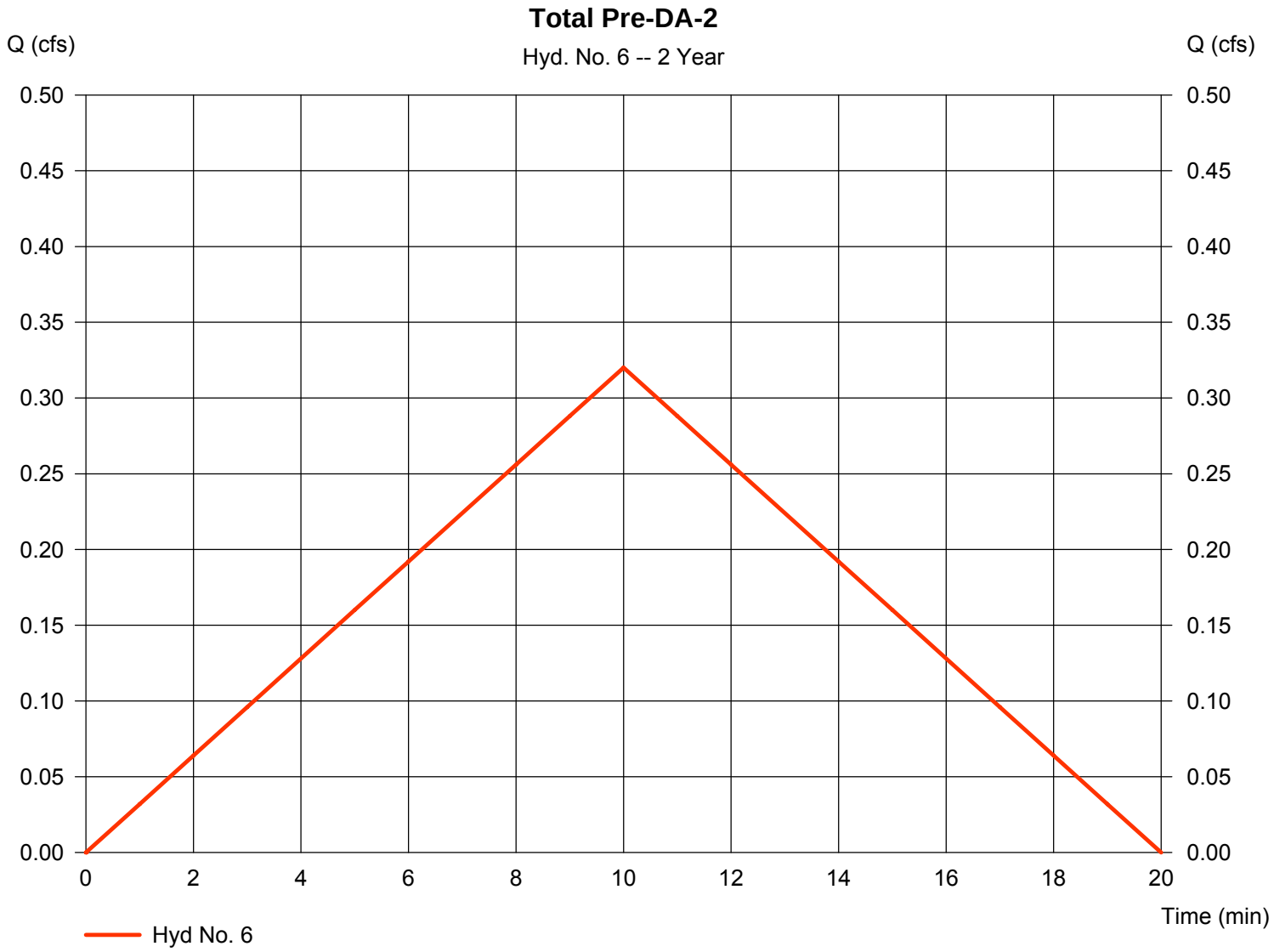
Hydrograph Report

Hyd. No. 6

Total Pre-DA-2

Hydrograph type	=	Rational	Peak discharge	=	0.320 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	192 cuft
Drainage area	=	0.130 ac	Runoff coeff.	=	0.58*
Intensity	=	4.245 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.110 x 0.51) + (0.020 x 0.99)] / 0.130



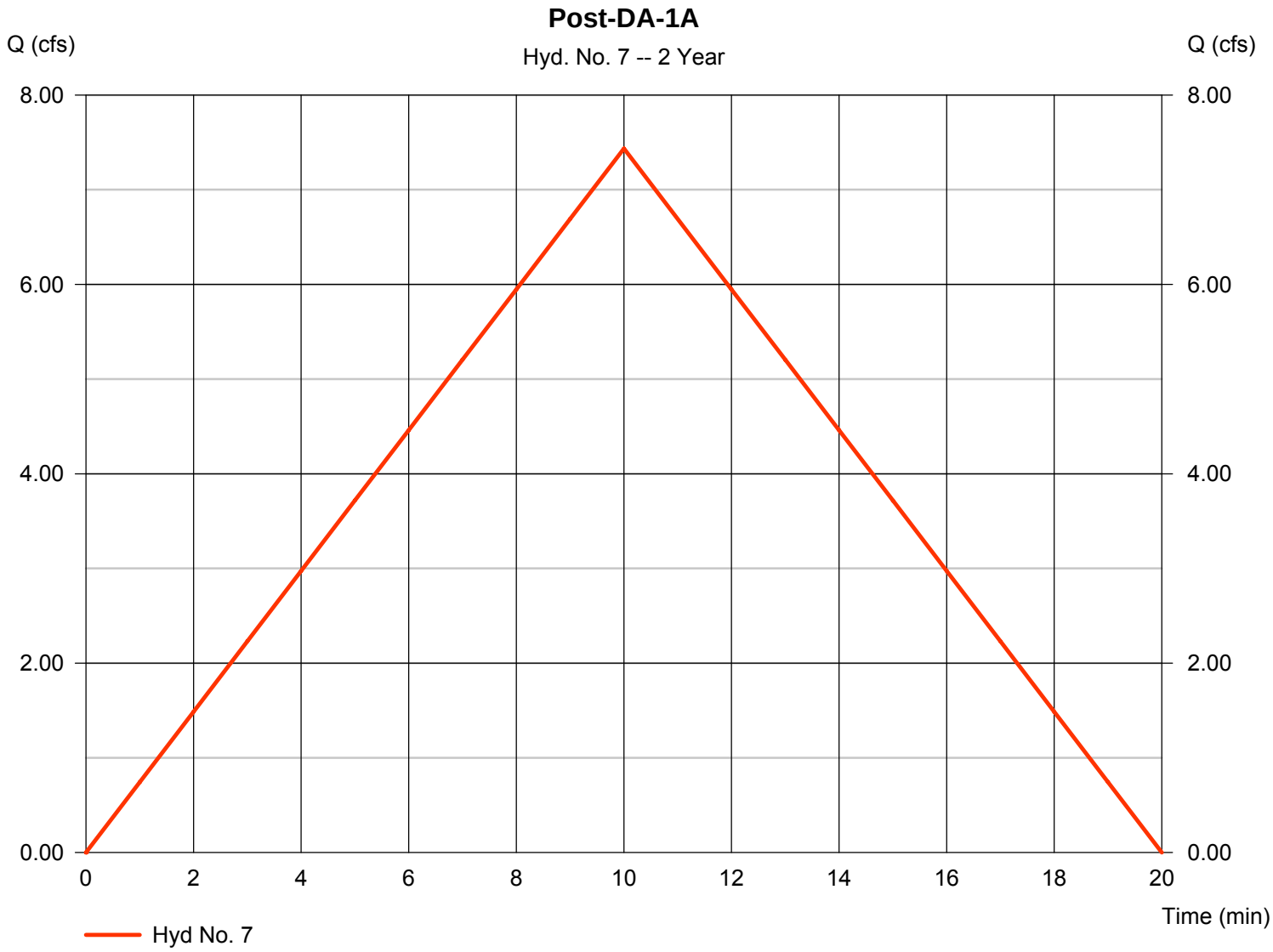
Hydrograph Report

Hyd. No. 7

Post-DA-1A

Hydrograph type	=	Rational	Peak discharge	=	7.434 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	4,461 cuft
Drainage area	=	2.110 ac	Runoff coeff.	=	0.83*
Intensity	=	4.245 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.690 x 0.51) + (1.420 x 0.99)] / 2.110



TR55 Tc Worksheet

Hyd. No. 7

Post-DA-1A

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 53.0		97.0		0.0		
Two-year 24-hr precip. (in)	= 3.38		3.38		0.00		
Land slope (%)	= 4.00		1.88		0.00		
Travel Time (min)	**= 4.35**	**+**	**1.18**	**+**	**0.00**	**=**	**5.53**
Shallow Concentrated Flow							
Flow length (ft)	= 216.00		0.00		0.00		
Watercourse slope (%)	= 1.70		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	= 2.65		0.00		0.00		
Travel Time (min)	**= 1.36**	**+**	**0.00**	**+**	**0.00**	**=**	**1.36**
Channel Flow							
X sectional flow area (sqft)	= 3.14		3.14		0.00		
Wetted perimeter (ft)	= 6.28		6.28		0.00		
Channel slope (%)	= 0.36		1.50		0.00		
Manning's n-value	= 0.013		0.013		0.015		
Velocity (ft/s)	= 4.32		8.82		0.00		
Flow length (ft)	= 33.0		21.0		0.0		
Travel Time (min)	**= 0.13**	**+**	**0.04**	**+**	**0.00**	**=**	**0.17**

Total Travel Time, Tc ..... 7.05 min

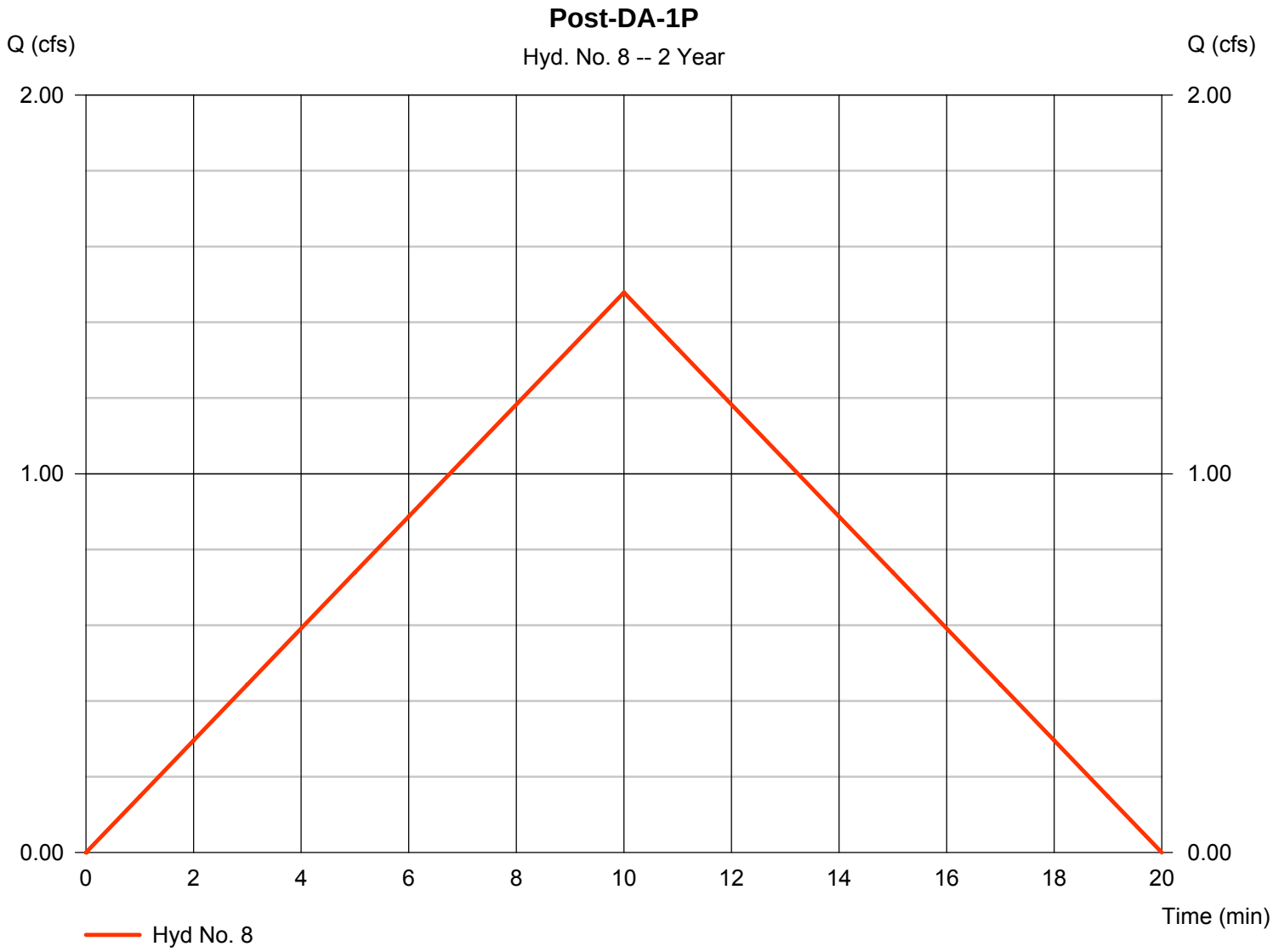
Hydrograph Report

Hyd. No. 8

Post-DA-1P

Hydrograph type	=	Rational	Peak discharge	=	1.479 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	887 cuft
Drainage area	=	0.430 ac	Runoff coeff.	=	0.81*
Intensity	=	4.245 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.160 x 0.51) + (0.270 x 0.99)] / 0.430

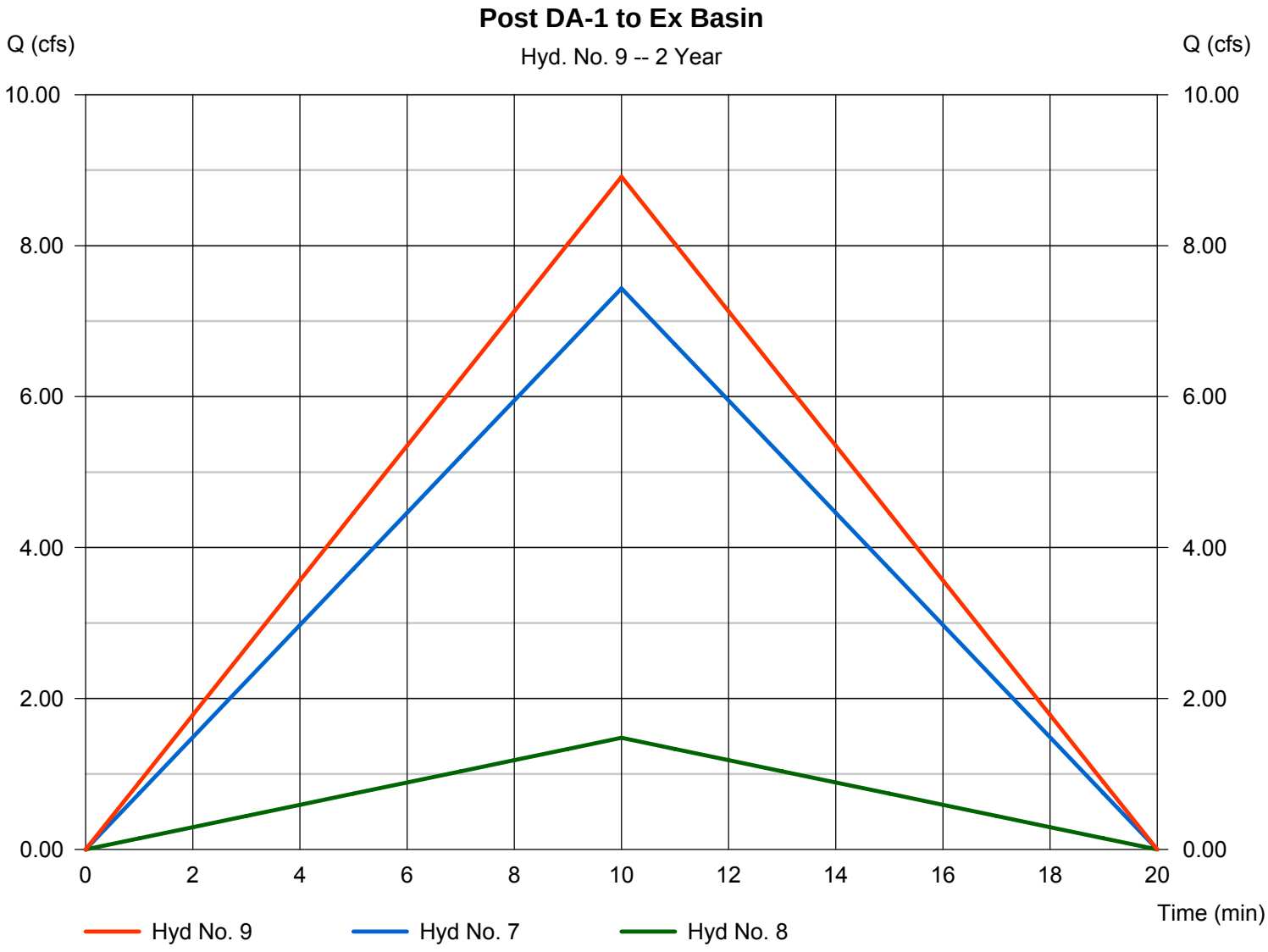


Hydrograph Report

Hyd. No. 9

Post DA-1 to Ex Basin

Hydrograph type	= Combine	Peak discharge	= 8.913 cfs
Storm frequency	= 2 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 5,348 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 2.540 ac



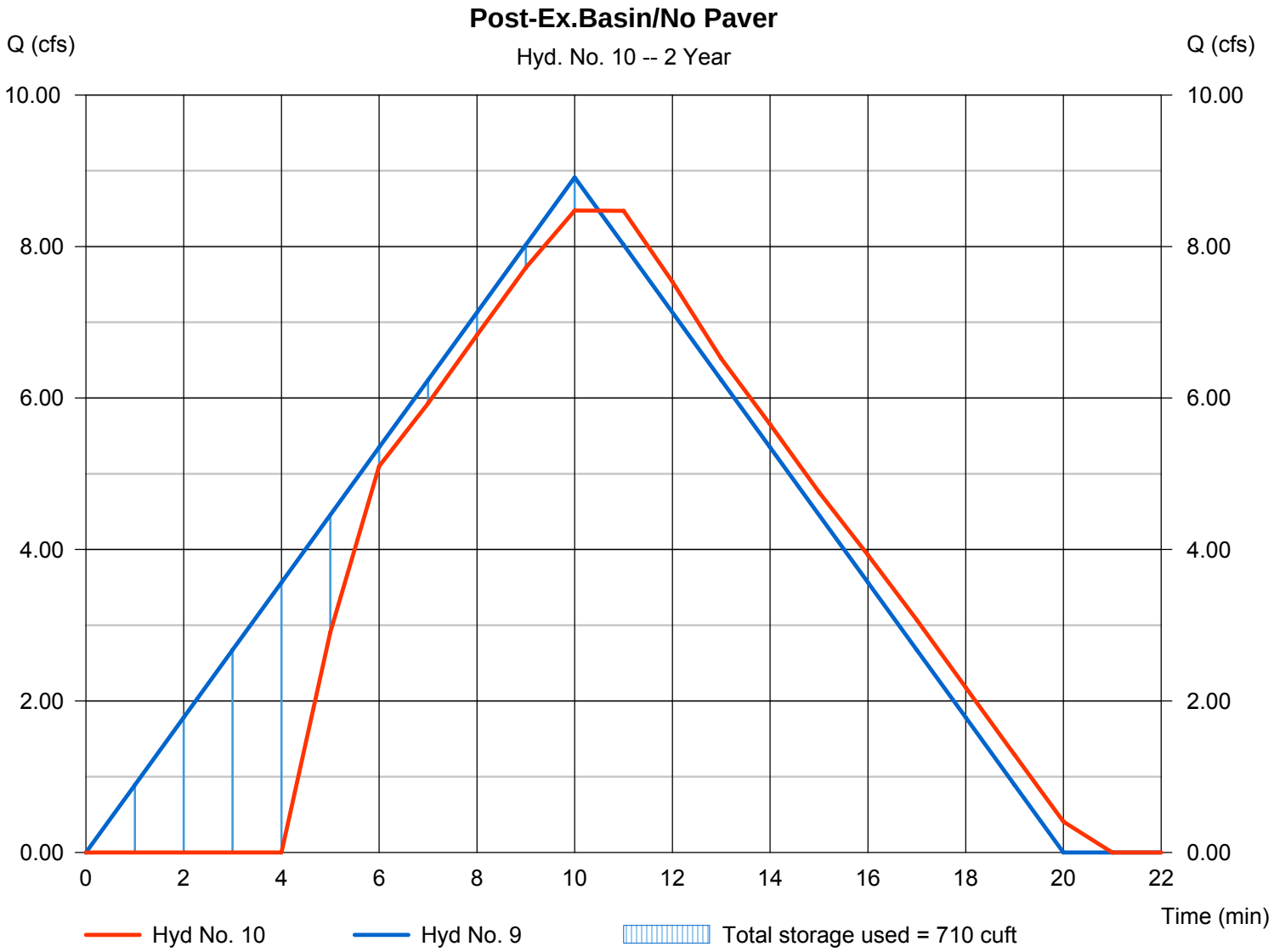
Hydrograph Report

Hyd. No. 10

Post-Ex.Basin/No Paver

Hydrograph type	=	Reservoir	Peak discharge	=	8.475 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	4,846 cuft
Inflow hyd. No.	=	9 - Post DA-1 to Ex Basin	Max. Elevation	=	60.23 ft
Reservoir name	=	Ex. Basin	Max. Storage	=	710 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Ex. Basin

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 57.49 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	57.49	00	0	0
1.51	59.00	195	147	147
2.51	60.00	595	395	542
3.51	61.00	985	790	1,332
4.51	62.00	1,310	1,148	2,480

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 16.00	0.00	0.00	0.00
Span (in)	= 16.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 57.49	0.00	0.00	0.00
Length (ft)	= 14.00	0.00	0.00	0.00
Slope (%)	= 0.01	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	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 59.91	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	57.49	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.15	15	57.64	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.30	29	57.79	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.45	44	57.94	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.60	59	58.09	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.76	74	58.25	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.91	88	58.40	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.06	103	58.55	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.21	118	58.70	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.36	133	58.85	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.51	147	59.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.61	187	59.10	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.71	226	59.20	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.81	266	59.30	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.91	305	59.40	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.01	345	59.50	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.11	384	59.60	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.21	424	59.70	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.31	463	59.80	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.41	503	59.90	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.51	542	60.00	1.44 oc	---	---	---	1.44	---	---	---	---	---	1.439
2.61	621	60.10	4.41 oc	---	---	---	4.41	---	---	---	---	---	4.413
2.71	700	60.20	8.32 oc	---	---	---	8.32	---	---	---	---	---	8.321
2.81	779	60.30	9.54 ic	---	---	---	9.54 s	---	---	---	---	---	9.542
2.91	858	60.40	9.91 ic	---	---	---	9.91 s	---	---	---	---	---	9.907
3.01	937	60.50	10.20 ic	---	---	---	10.19 s	---	---	---	---	---	10.19
3.11	1,016	60.60	10.45 ic	---	---	---	10.44 s	---	---	---	---	---	10.44
3.21	1,095	60.70	10.68 ic	---	---	---	10.67 s	---	---	---	---	---	10.67
3.31	1,174	60.80	10.90 ic	---	---	---	10.89 s	---	---	---	---	---	10.89
3.41	1,253	60.90	11.11 ic	---	---	---	11.09 s	---	---	---	---	---	11.09
3.51	1,332	61.00	11.32 ic	---	---	---	11.32 s	---	---	---	---	---	11.32
3.61	1,447	61.10	11.52 ic	---	---	---	11.49 s	---	---	---	---	---	11.49
3.71	1,562	61.20	11.71 ic	---	---	---	11.69 s	---	---	---	---	---	11.69
3.81	1,676	61.30	11.91 ic	---	---	---	11.87 s	---	---	---	---	---	11.87
3.91	1,791	61.40	12.10 ic	---	---	---	12.03 s	---	---	---	---	---	12.03
4.01	1,906	61.50	12.28 ic	---	---	---	12.23 s	---	---	---	---	---	12.23
4.11	2,021	61.60	12.47 ic	---	---	---	12.40 s	---	---	---	---	---	12.40
4.21	2,135	61.70	12.65 ic	---	---	---	12.58 s	---	---	---	---	---	12.58
4.31	2,250	61.80	12.83 ic	---	---	---	12.82 s	---	---	---	---	---	12.82
4.41	2,365	61.90	13.00 ic	---	---	---	12.96 s	---	---	---	---	---	12.96

Continues on next page...

Ex. Basin

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
4.51	2,480	62.00	13.17 ic	---	---	---	13.01 s	---	---	---	---	---	13.01

...End

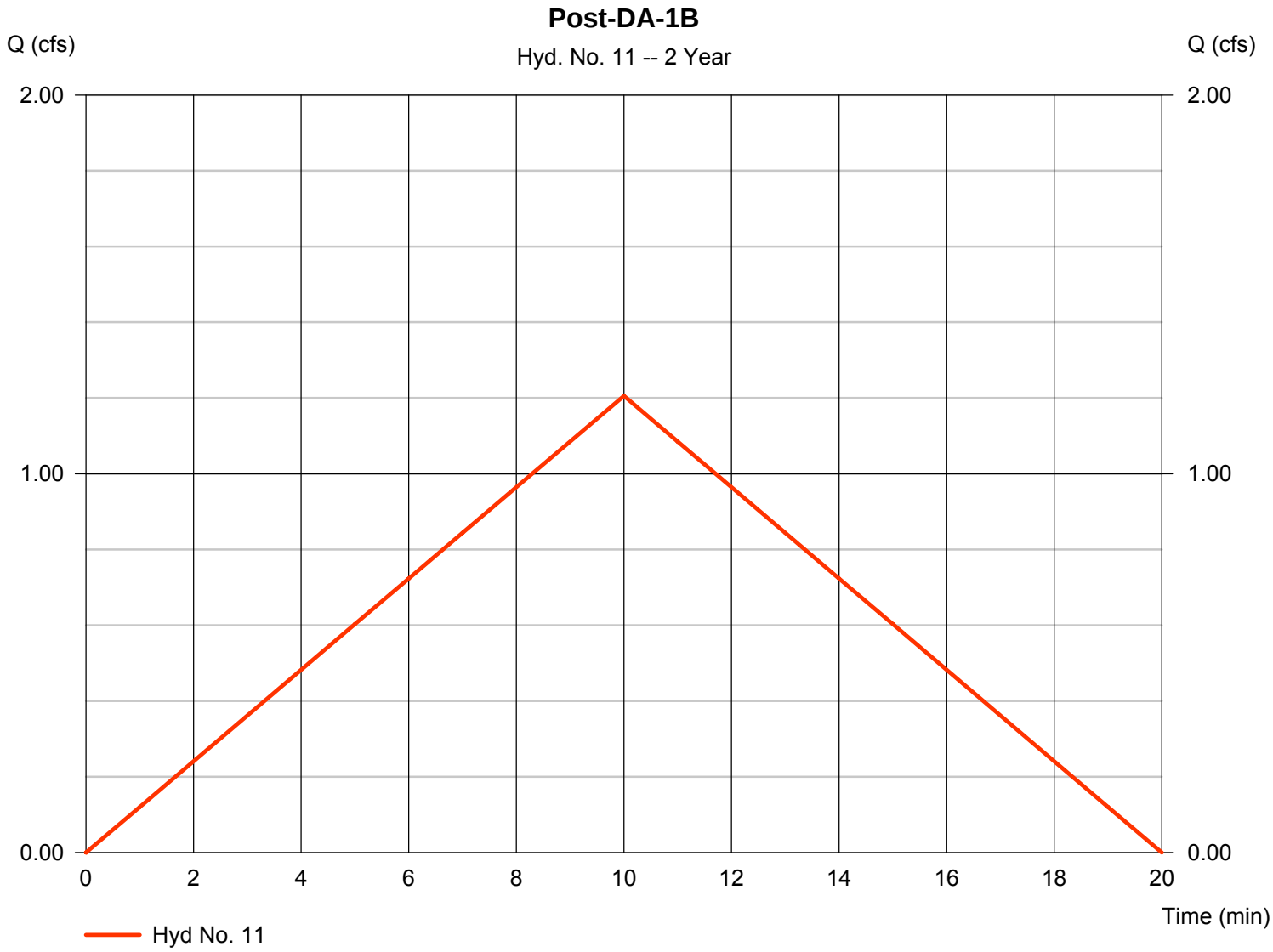
Hydrograph Report

Hyd. No. 11

Post-DA-1B

Hydrograph type	=	Rational	Peak discharge	=	1.206 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	723 cuft
Drainage area	=	0.400 ac	Runoff coeff.	=	0.71*
Intensity	=	4.245 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.230 x 0.51) + (0.170 x 0.99)] / 0.400



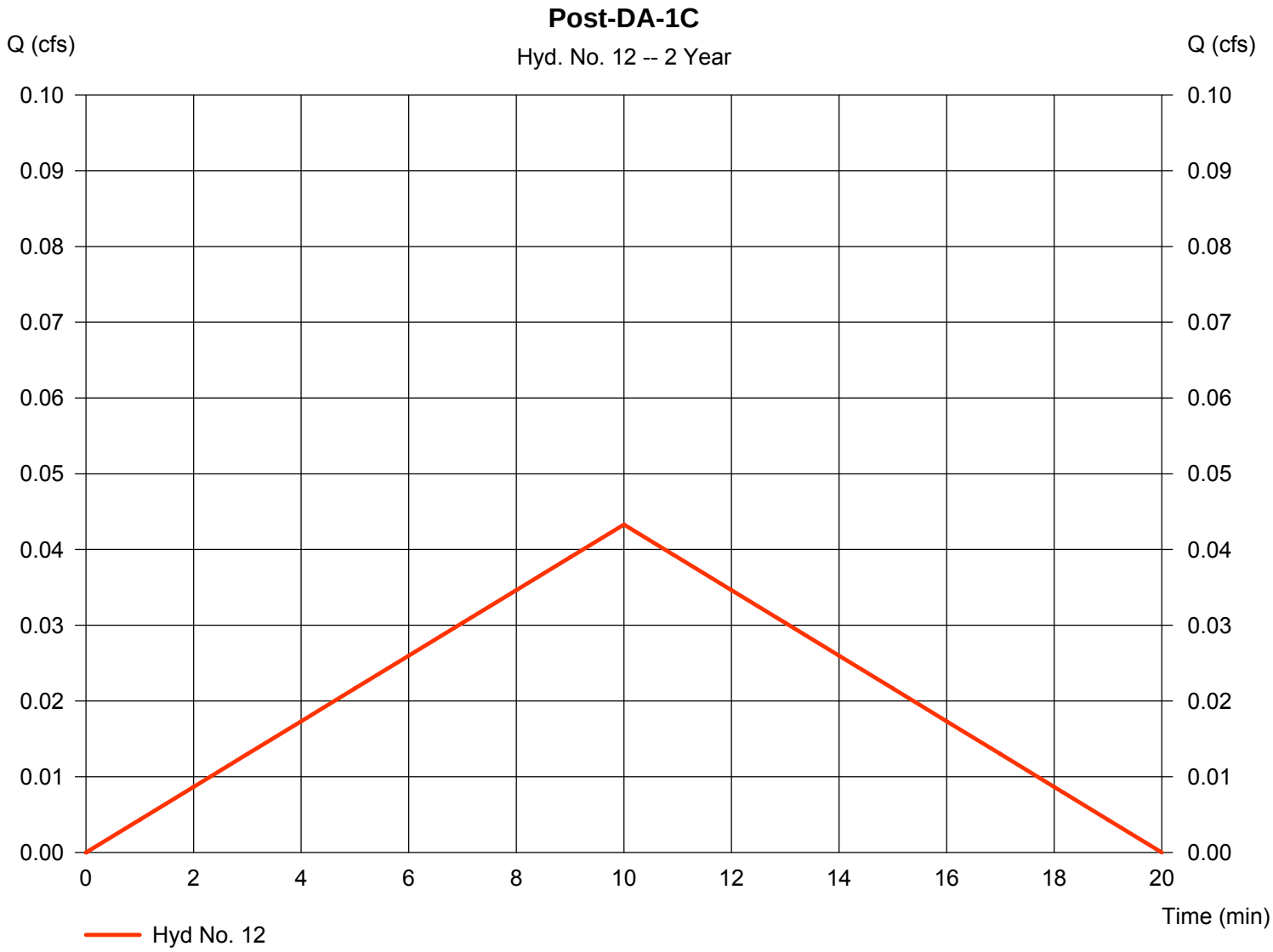
Hydrograph Report

Hyd. No. 12

Post-DA-1C

Hydrograph type	=	Rational	Peak discharge	=	0.043 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	26 cuft
Drainage area	=	0.020 ac	Runoff coeff.	=	0.51*
Intensity	=	4.245 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.020 x 0.51)] / 0.020

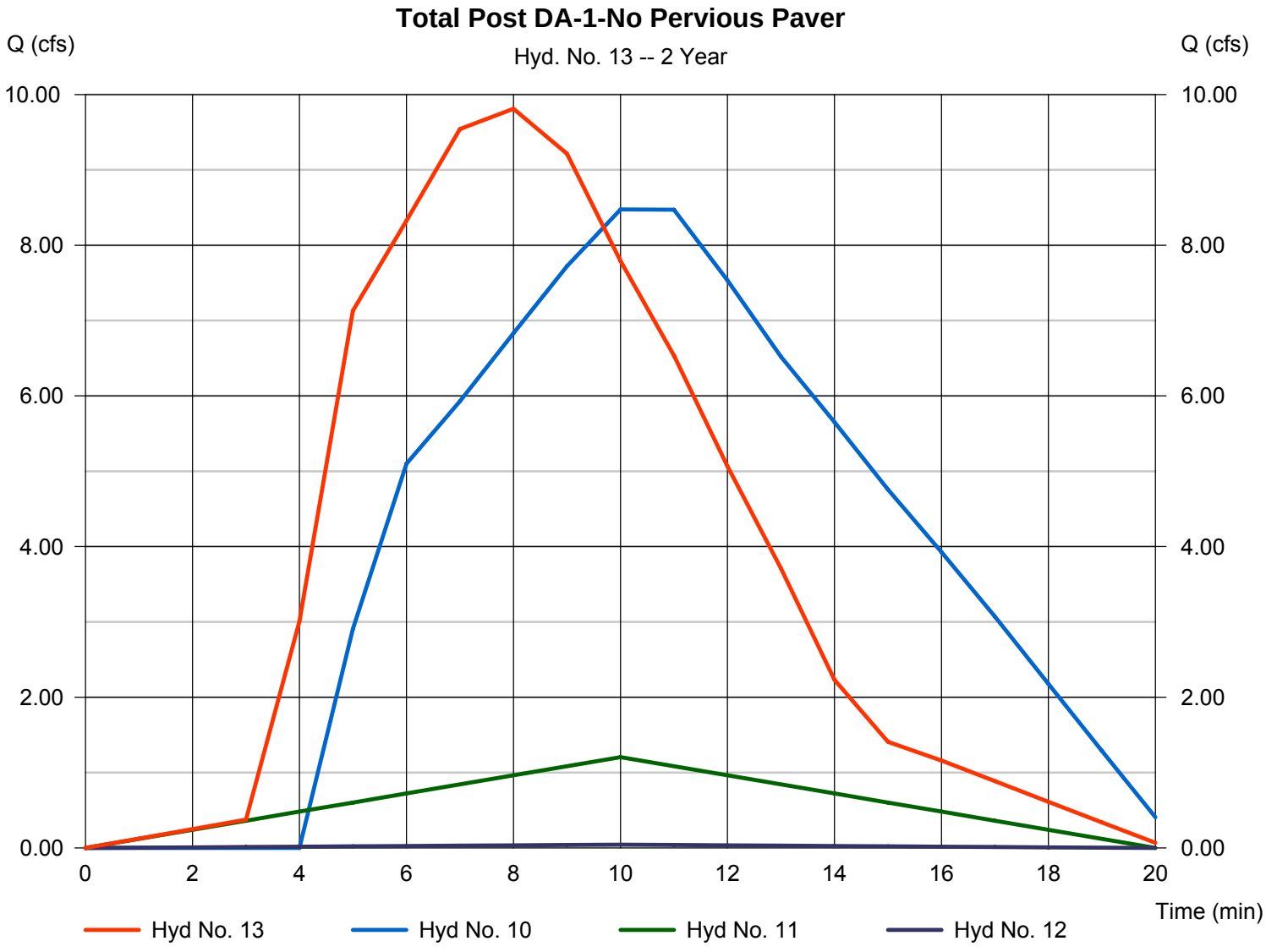


Hydrograph Report

Hyd. No. 13

Total Post DA-1-No Pervious Paver

Hydrograph type	= Combine	Peak discharge	= 9.811 cfs
Storm frequency	= 2 yrs	Time to peak	= 8 min
Time interval	= 1 min	Hyd. volume	= 4,655 cuft
Inflow hyds.	= 10, 11, 12	Contrib. drain. area	= 0.420 ac



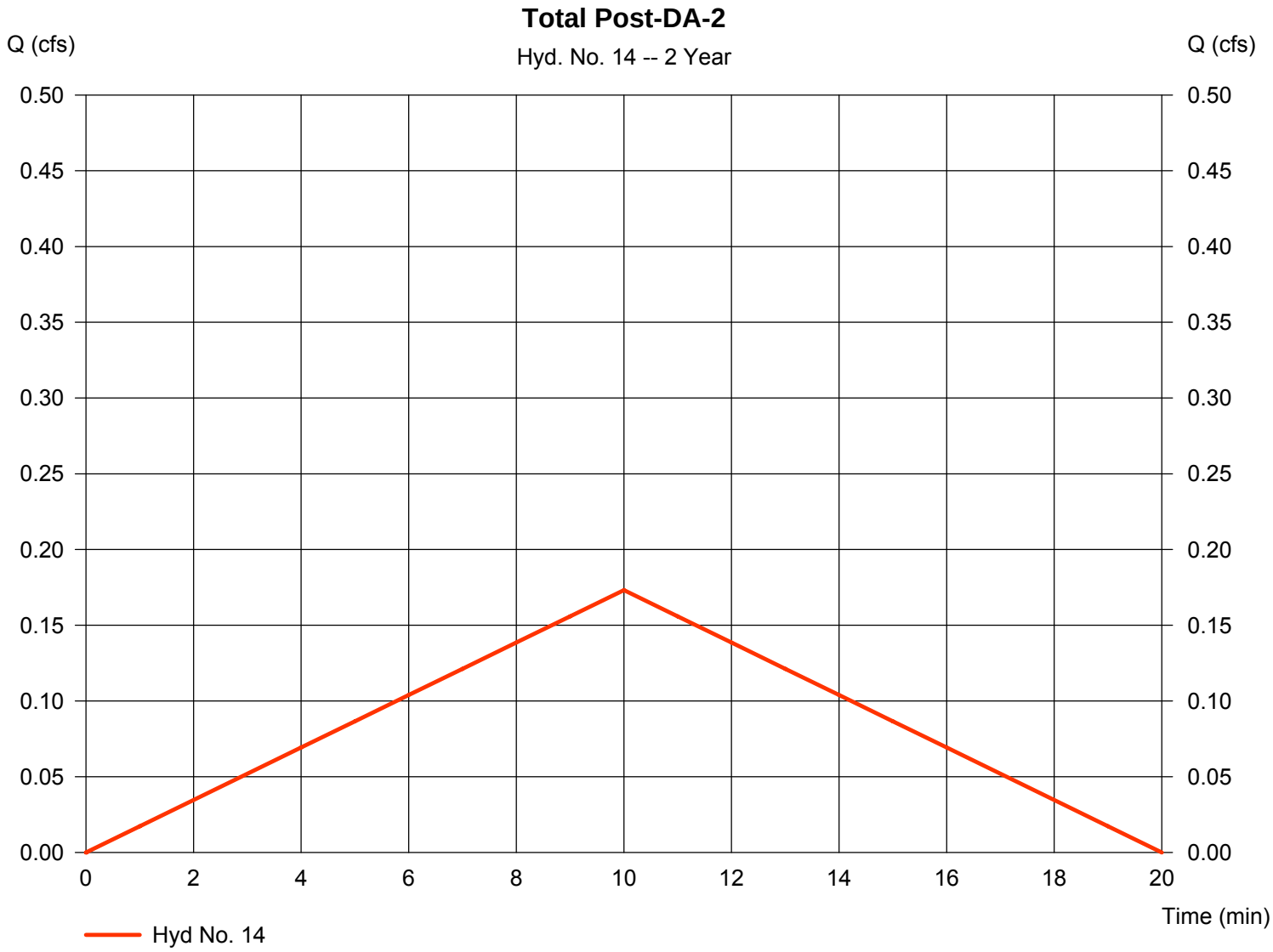
Hydrograph Report

Hyd. No. 14

Total Post-DA-2

Hydrograph type	=	Rational	Peak discharge	=	0.173 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	104 cuft
Drainage area	=	0.080 ac	Runoff coeff.	=	0.51*
Intensity	=	4.245 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.080 x 0.51)] / 0.080



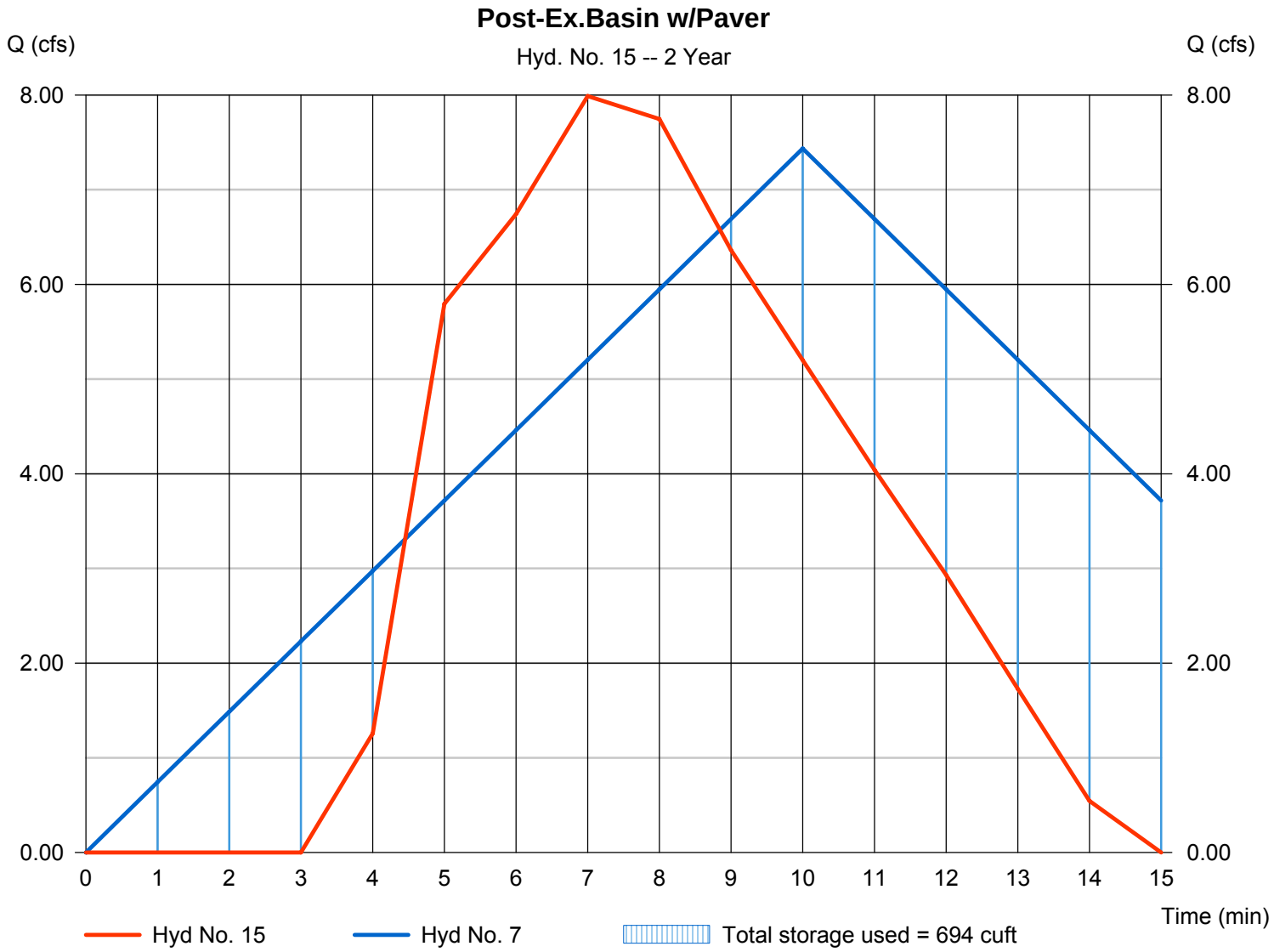
Hydrograph Report

Hyd. No. 15

Post-Ex.Basin w/Paver

Hydrograph type	=	Reservoir	Peak discharge	=	7.989 cfs
Storm frequency	=	2 yrs	Time to peak	=	7 min
Time interval	=	1 min	Hyd. volume	=	3,020 cuft
Inflow hyd. No.	=	7 - Post-DA-1A	Max. Elevation	=	60.21 ft
Reservoir name	=	Ex. Basin	Max. Storage	=	694 cuft

Storage Indication method used.



Pond No. 1 - Ex. Basin

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 57.49 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	57.49	00	0	0
1.51	59.00	195	147	147
2.51	60.00	595	395	542
3.51	61.00	985	790	1,332
4.51	62.00	1,310	1,148	2,480

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 16.00	0.00	0.00	0.00
Span (in)	= 16.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 57.49	0.00	0.00	0.00
Length (ft)	= 14.00	0.00	0.00	0.00
Slope (%)	= 0.01	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	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 59.91	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	57.49	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.15	15	57.64	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.30	29	57.79	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.45	44	57.94	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.60	59	58.09	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.76	74	58.25	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.91	88	58.40	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.06	103	58.55	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.21	118	58.70	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.36	133	58.85	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.51	147	59.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.61	187	59.10	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.71	226	59.20	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.81	266	59.30	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.91	305	59.40	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.01	345	59.50	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.11	384	59.60	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.21	424	59.70	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.31	463	59.80	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.41	503	59.90	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.51	542	60.00	1.44 oc	---	---	---	1.44	---	---	---	---	---	1.439
2.61	621	60.10	4.41 oc	---	---	---	4.41	---	---	---	---	---	4.413
2.71	700	60.20	8.32 oc	---	---	---	8.32	---	---	---	---	---	8.321
2.81	779	60.30	9.54 ic	---	---	---	9.54 s	---	---	---	---	---	9.542
2.91	858	60.40	9.91 ic	---	---	---	9.91 s	---	---	---	---	---	9.907
3.01	937	60.50	10.20 ic	---	---	---	10.19 s	---	---	---	---	---	10.19
3.11	1,016	60.60	10.45 ic	---	---	---	10.44 s	---	---	---	---	---	10.44
3.21	1,095	60.70	10.68 ic	---	---	---	10.67 s	---	---	---	---	---	10.67
3.31	1,174	60.80	10.90 ic	---	---	---	10.89 s	---	---	---	---	---	10.89
3.41	1,253	60.90	11.11 ic	---	---	---	11.09 s	---	---	---	---	---	11.09
3.51	1,332	61.00	11.32 ic	---	---	---	11.32 s	---	---	---	---	---	11.32
3.61	1,447	61.10	11.52 ic	---	---	---	11.49 s	---	---	---	---	---	11.49
3.71	1,562	61.20	11.71 ic	---	---	---	11.69 s	---	---	---	---	---	11.69
3.81	1,676	61.30	11.91 ic	---	---	---	11.87 s	---	---	---	---	---	11.87
3.91	1,791	61.40	12.10 ic	---	---	---	12.03 s	---	---	---	---	---	12.03
4.01	1,906	61.50	12.28 ic	---	---	---	12.23 s	---	---	---	---	---	12.23
4.11	2,021	61.60	12.47 ic	---	---	---	12.40 s	---	---	---	---	---	12.40
4.21	2,135	61.70	12.65 ic	---	---	---	12.58 s	---	---	---	---	---	12.58
4.31	2,250	61.80	12.83 ic	---	---	---	12.82 s	---	---	---	---	---	12.82
4.41	2,365	61.90	13.00 ic	---	---	---	12.96 s	---	---	---	---	---	12.96

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Ex. Basin

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
4.51	2,480	62.00	13.17 ic	---	---	---	13.01 s	---	---	---	---	---	13.01

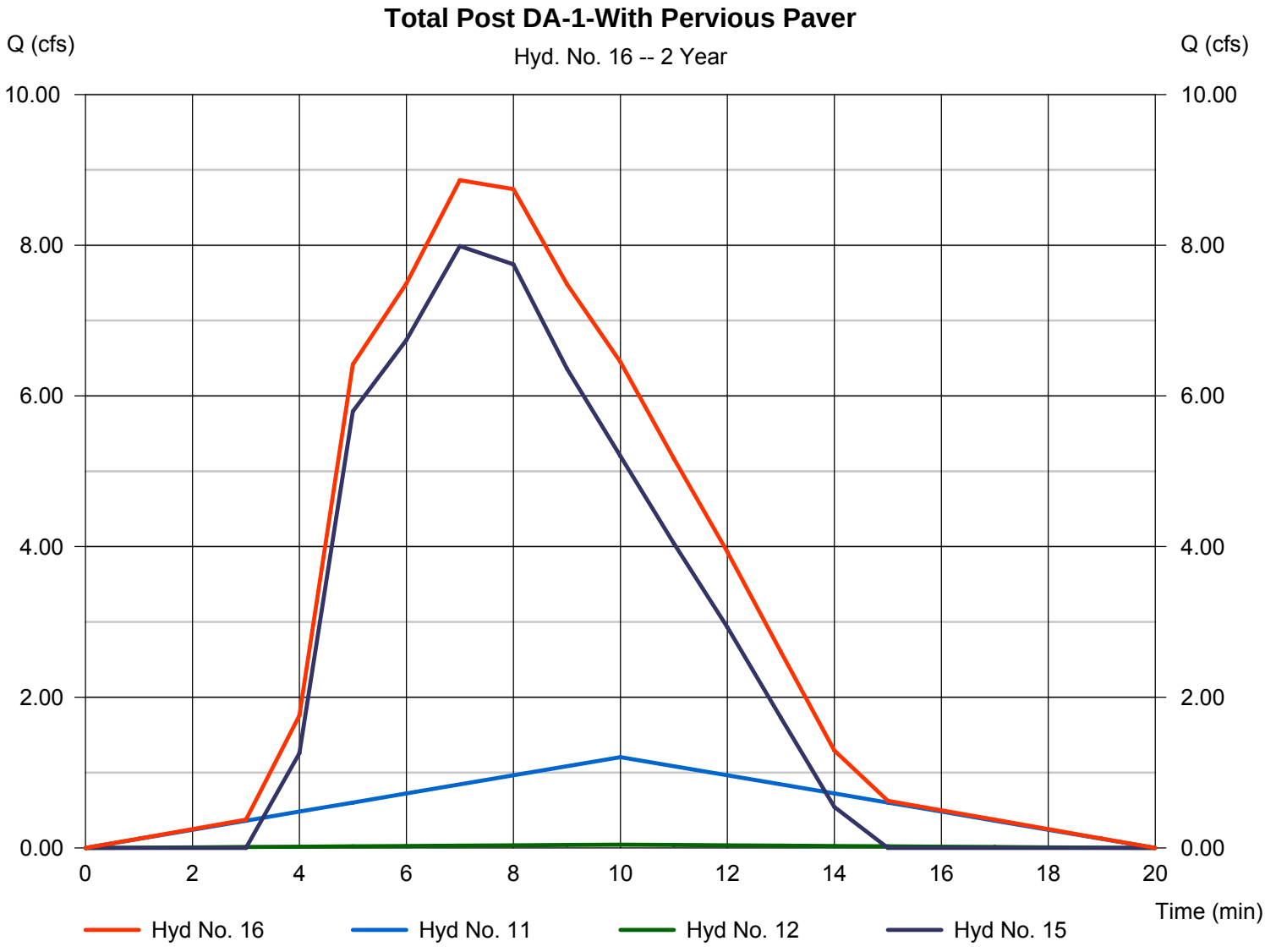
...End

Hydrograph Report

Hyd. No. 16

Total Post DA-1-With Pervious Paver

Hydrograph type	= Combine	Peak discharge	= 8.863 cfs
Storm frequency	= 2 yrs	Time to peak	= 7 min
Time interval	= 1 min	Hyd. volume	= 3,770 cuft
Inflow hyds.	= 11, 12, 15	Contrib. drain. area	= 0.420 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	Rational	11.45	1	10	6,870	------	------	------	Pre-DA-1A
2	Reservoir	10.05	1	11	6,369	1	60.46	898	Pre-Ex. Basin Route
3	Rational	2.103	1	10	1,262	------	------	------	Pre-DA-1B
4	Rational	0.058	1	10	35	------	------	------	Pre-DA-1C
5	Combine	12.00	1	11	7,666	2, 3, 4	------	------	Total Pre DA-1
6	Rational	0.432	1	10	259	------	------	------	Total Pre-DA-2
7	Rational	10.03	1	10	6,018	------	------	------	Post-DA-1A
8	Rational	1.995	1	10	1,197	------	------	------	Post-DA-1P
9	Combine	12.03	1	10	7,215	7, 8	------	------	Post DA-1 to Ex Basin
10	Reservoir	10.28	1	11	6,714	9	60.56	966	Post-Ex.Basin/No Paver
11	Rational	1.627	1	10	976	------	------	------	Post-DA-1B
12	Rational	0.058	1	10	35	------	------	------	Post-DA-1C
13	Combine	11.88	1	9	6,397	10, 11, 12	------	------	Total Post DA-1-No Pervious Paver
14	Rational	0.234	1	10	140	------	------	------	Total Post-DA-2
15	Reservoir	9.805	1	8	4,190	7	60.38	836	Post-Ex.Basin w/Paver
16	Combine	11.15	1	8	5,201	11, 12, 15	------	------	Total Post DA-1-With Pervious Paver

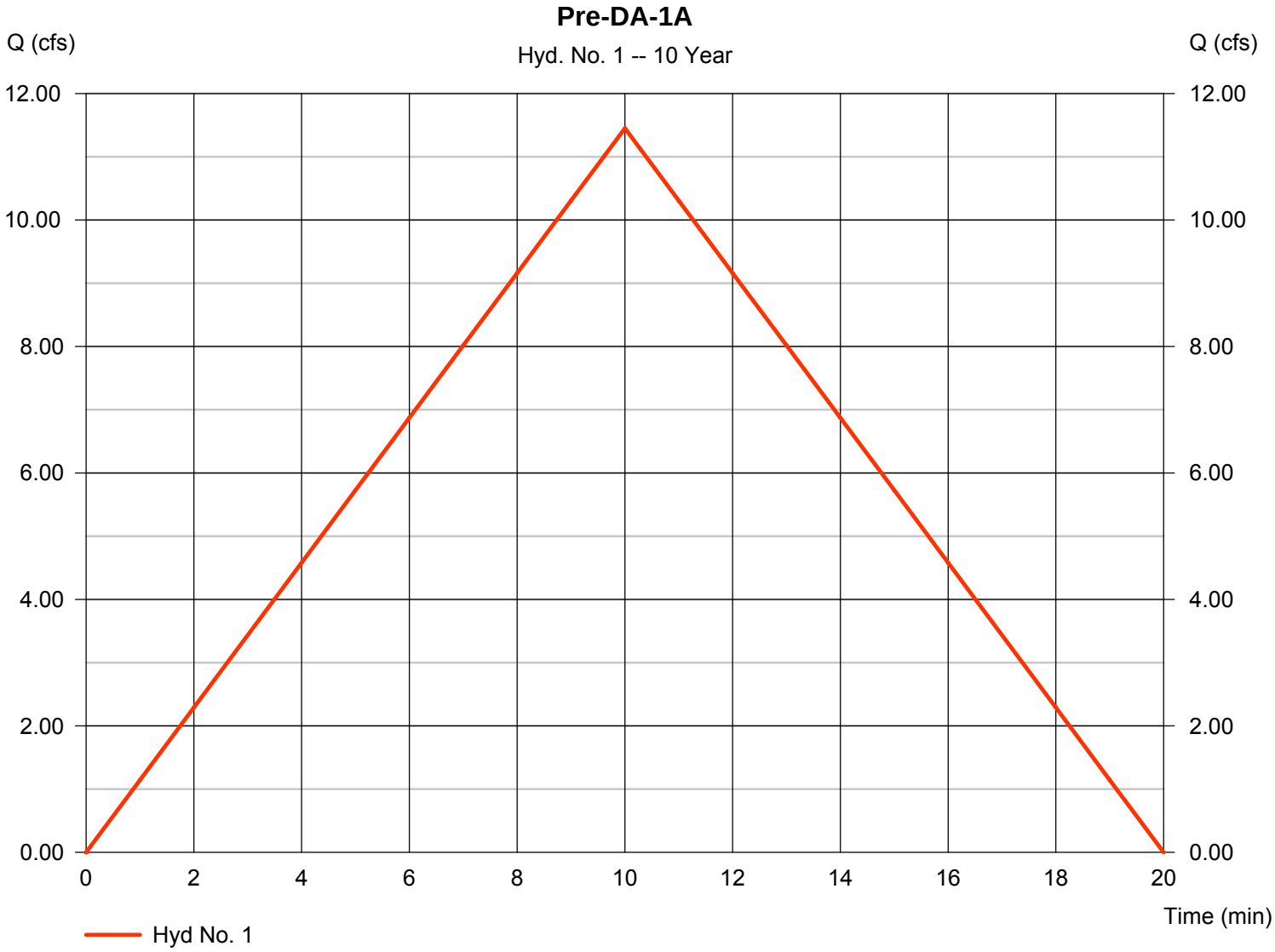
Hydrograph Report

Hyd. No. 1

Pre-DA-1A

Hydrograph type	=	Rational	Peak discharge	=	11.45 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	6,870 cuft
Drainage area	=	2.380 ac	Runoff coeff.	=	0.84*
Intensity	=	5.727 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.720 x 0.51) + (1.660 x 0.99)] / 2.380



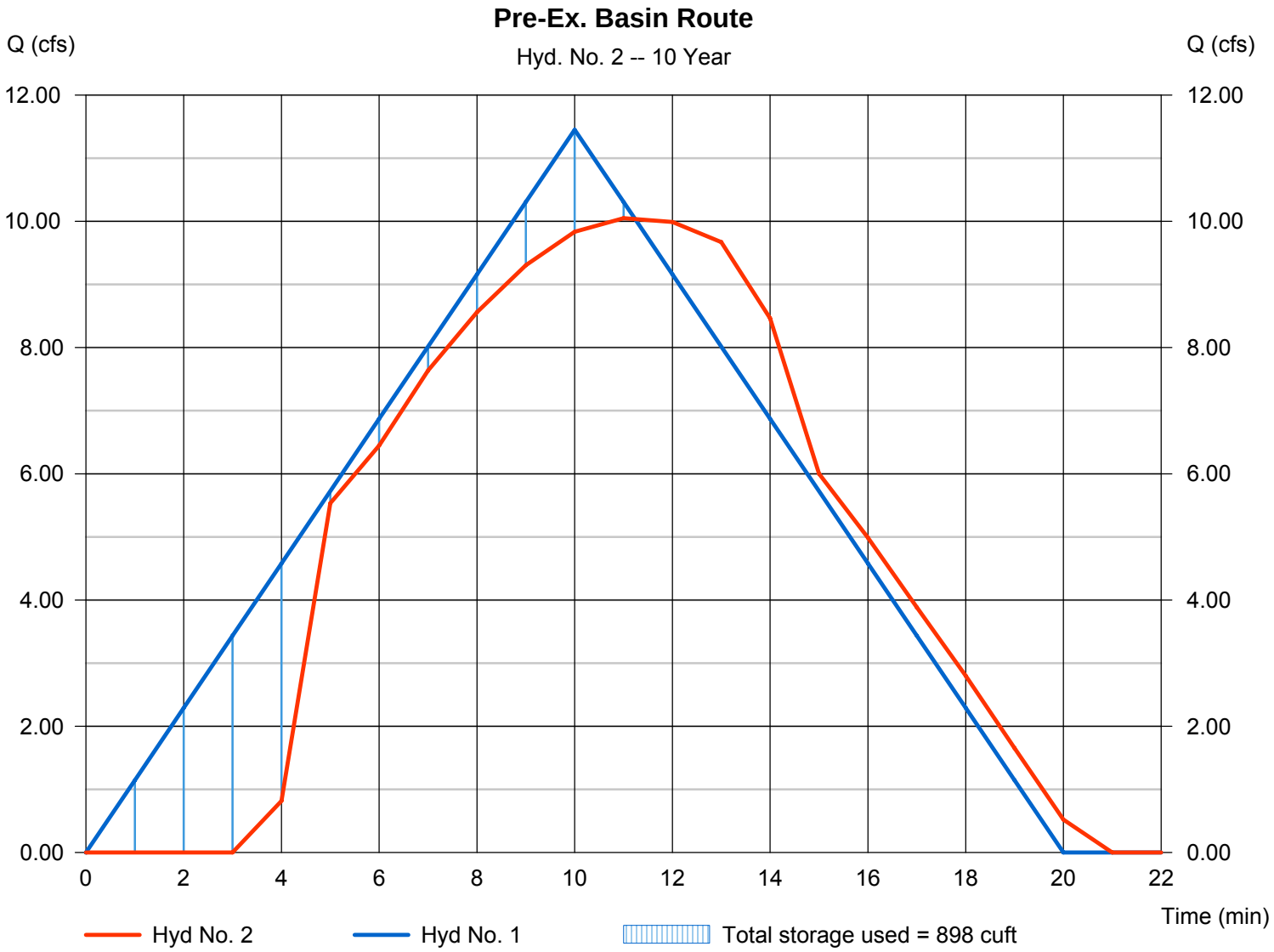
Hydrograph Report

Hyd. No. 2

Pre-Ex. Basin Route

Hydrograph type	=	Reservoir	Peak discharge	=	10.05 cfs
Storm frequency	=	10 yrs	Time to peak	=	11 min
Time interval	=	1 min	Hyd. volume	=	6,369 cuft
Inflow hyd. No.	=	1 - Pre-DA-1A	Max. Elevation	=	60.46 ft
Reservoir name	=	Ex. Basin	Max. Storage	=	898 cuft

Storage Indication method used.



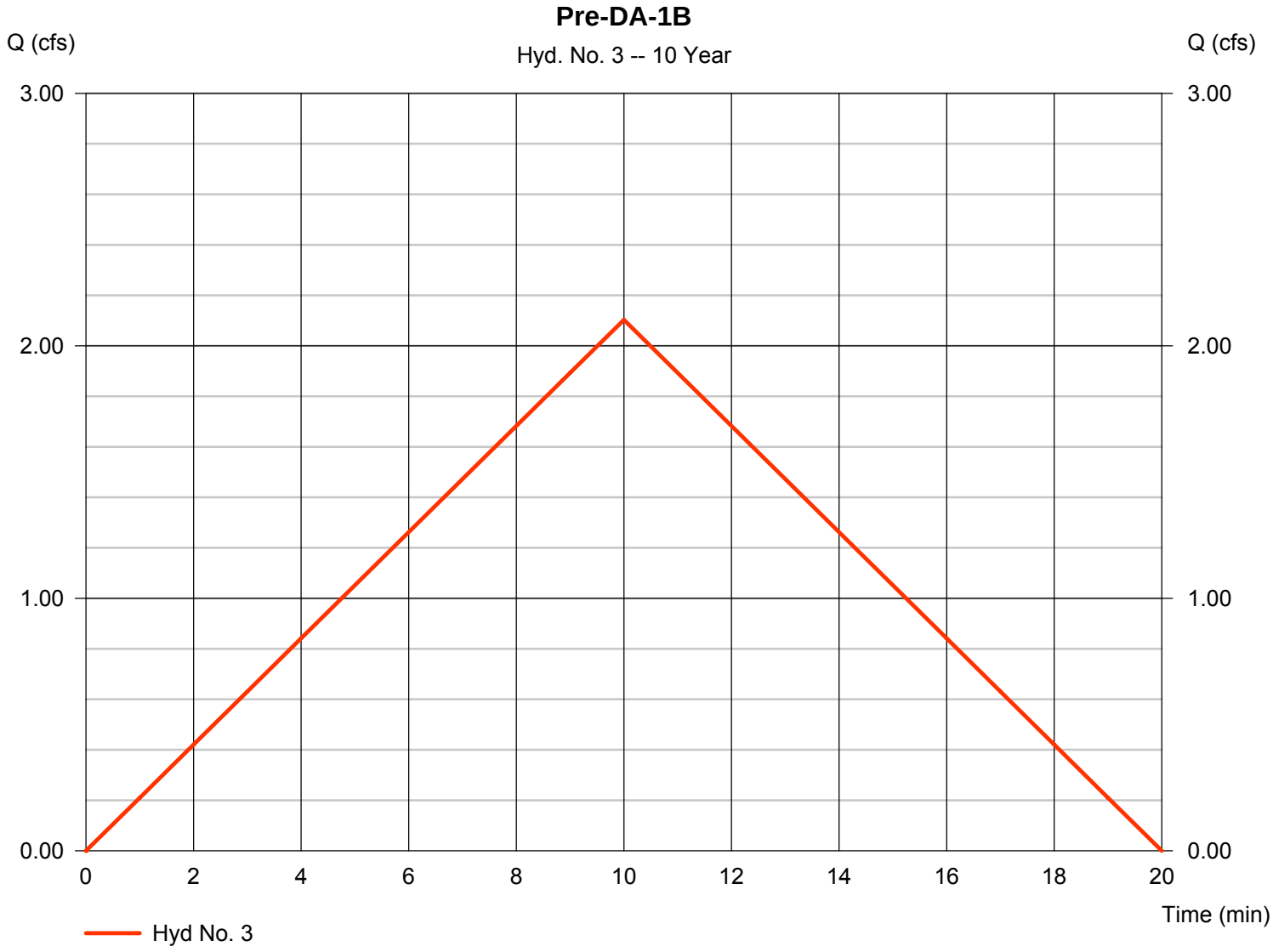
Hydrograph Report

Hyd. No. 3

Pre-DA-1B

Hydrograph type	=	Rational	Peak discharge	=	2.103 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	1,262 cuft
Drainage area	=	0.510 ac	Runoff coeff.	=	0.72*
Intensity	=	5.727 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.290 x 0.51) + (0.220 x 0.99)] / 0.510



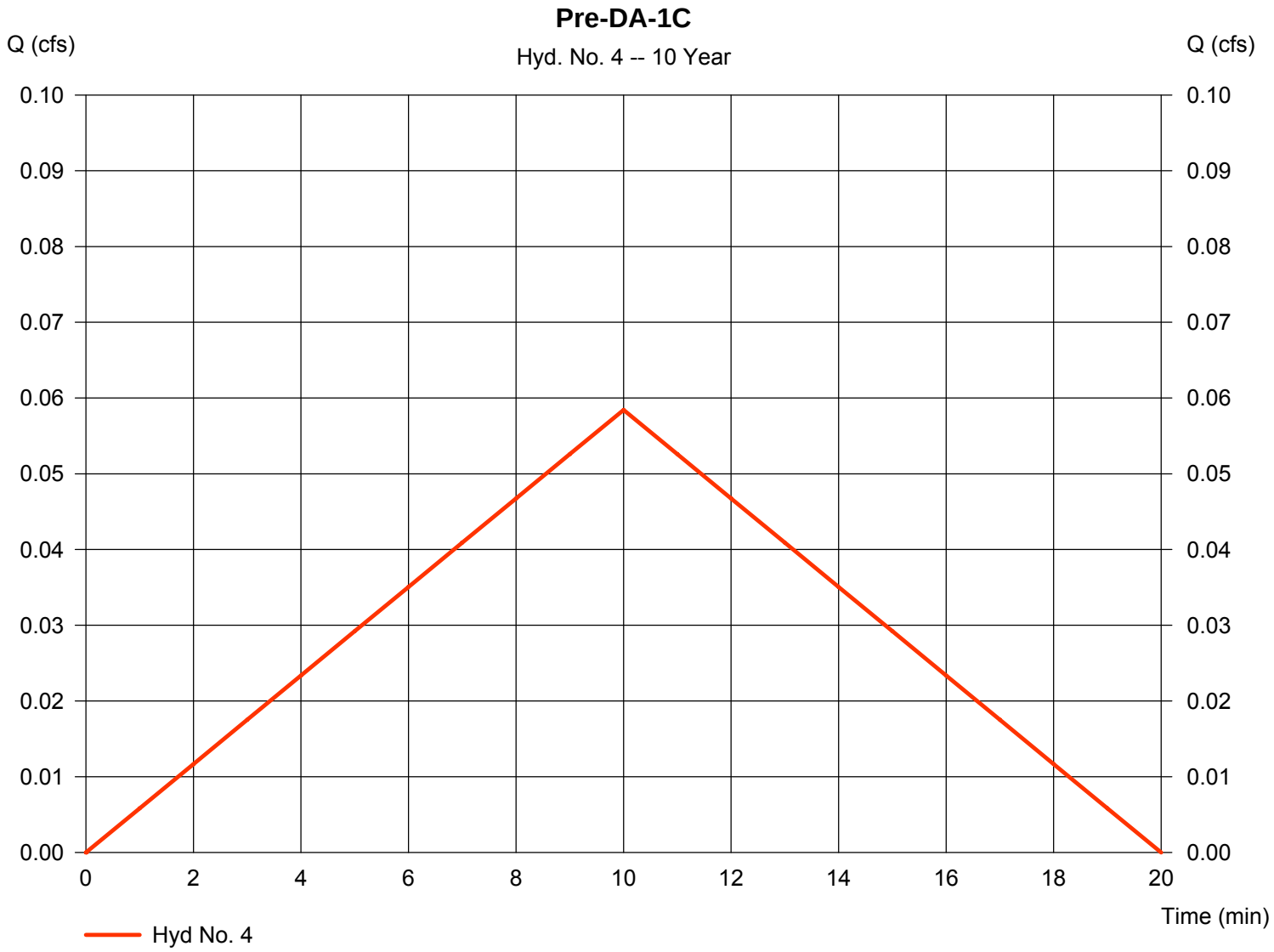
Hydrograph Report

Hyd. No. 4

Pre-DA-1C

Hydrograph type	=	Rational	Peak discharge	=	0.058 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	35 cuft
Drainage area	=	0.020 ac	Runoff coeff.	=	0.51*
Intensity	=	5.727 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.020 x 0.51)] / 0.020

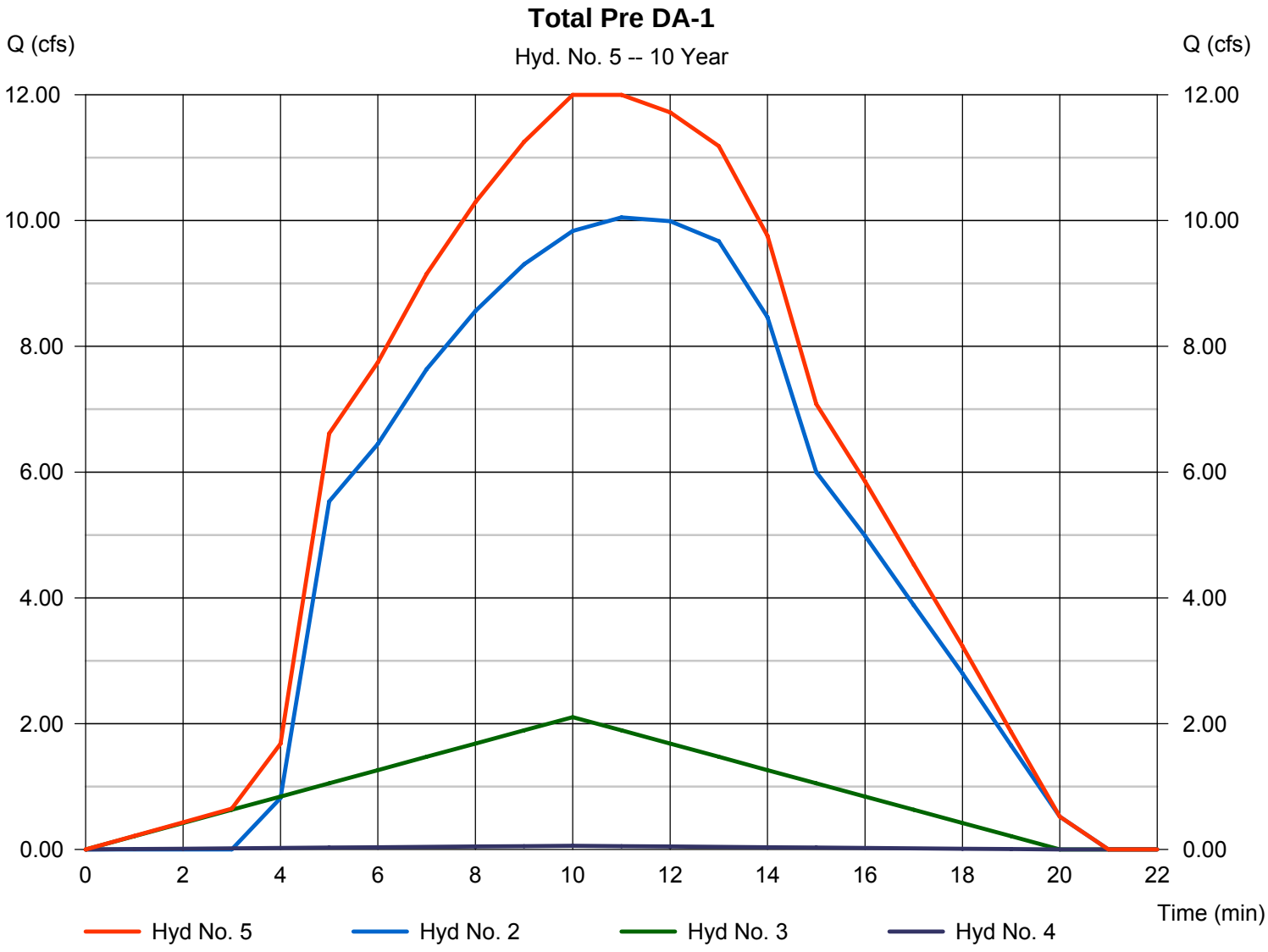


Hydrograph Report

Hyd. No. 5

Total Pre DA-1

Hydrograph type	= Combine	Peak discharge	= 12.00 cfs
Storm frequency	= 10 yrs	Time to peak	= 11 min
Time interval	= 1 min	Hyd. volume	= 7,666 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 0.530 ac



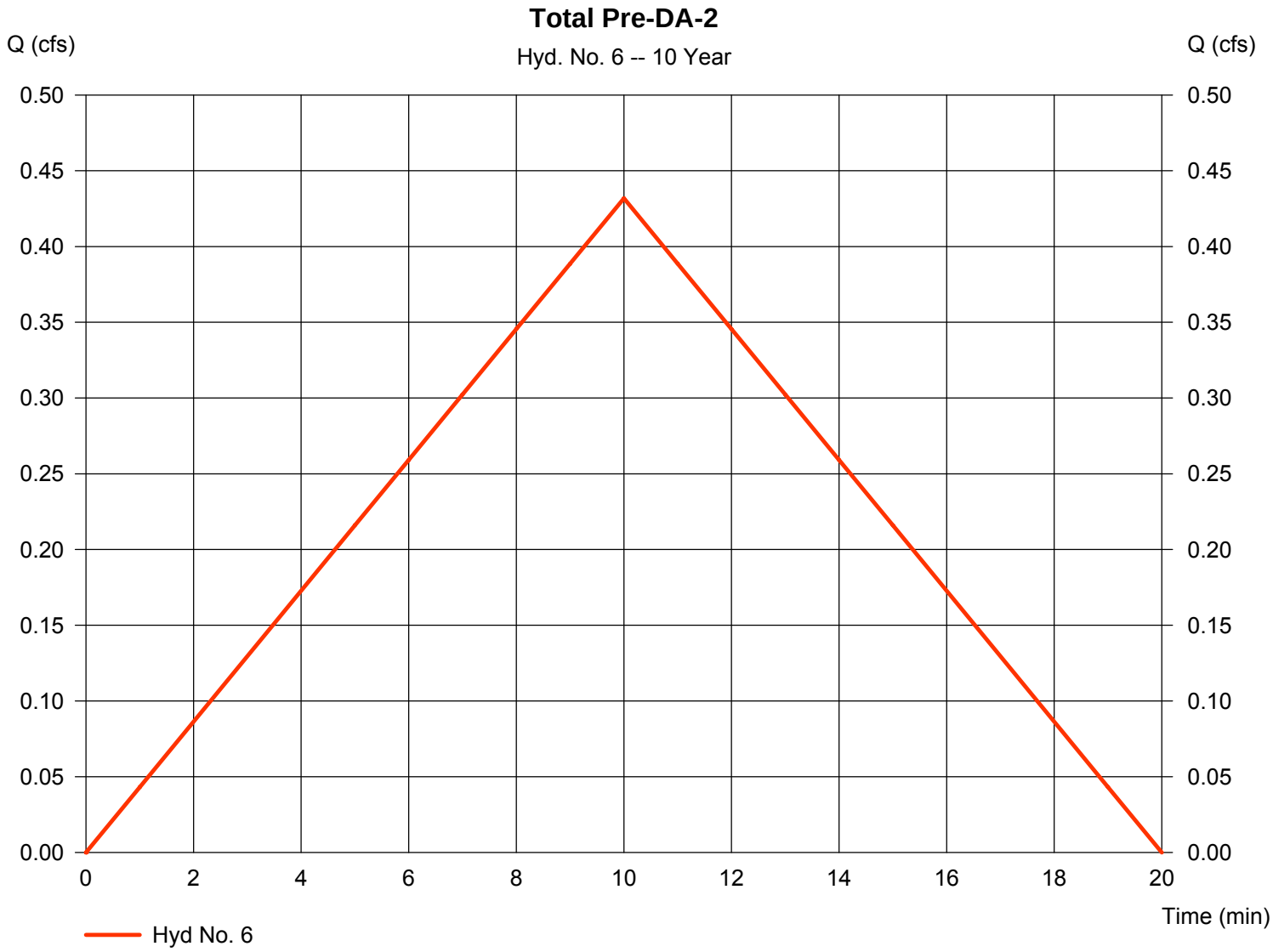
Hydrograph Report

Hyd. No. 6

Total Pre-DA-2

Hydrograph type	=	Rational	Peak discharge	=	0.432 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	259 cuft
Drainage area	=	0.130 ac	Runoff coeff.	=	0.58*
Intensity	=	5.727 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.110 x 0.51) + (0.020 x 0.99)] / 0.130



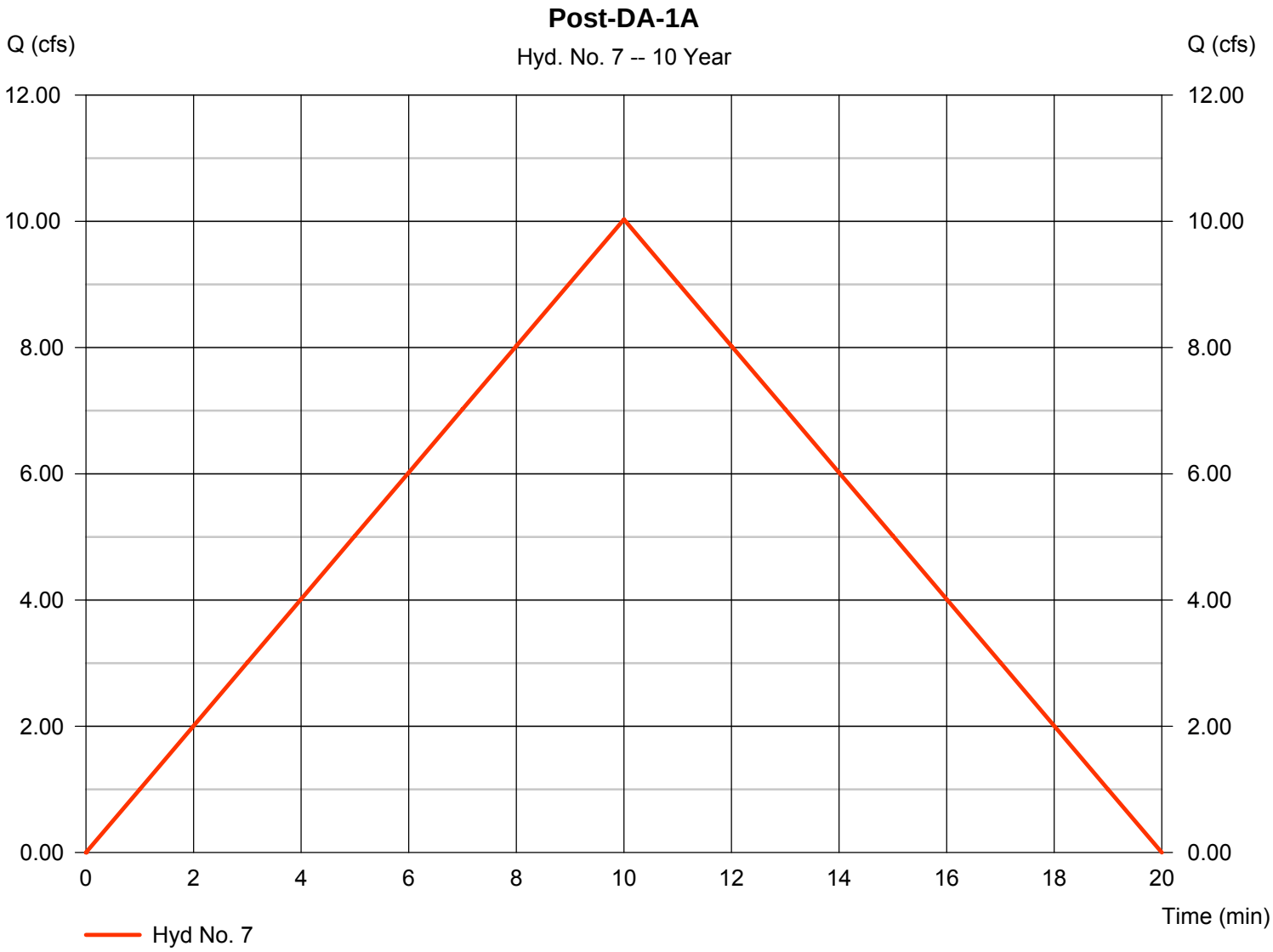
Hydrograph Report

Hyd. No. 7

Post-DA-1A

Hydrograph type	=	Rational	Peak discharge	=	10.03 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	6,018 cuft
Drainage area	=	2.110 ac	Runoff coeff.	=	0.83*
Intensity	=	5.727 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.690 x 0.51) + (1.420 x 0.99)] / 2.110



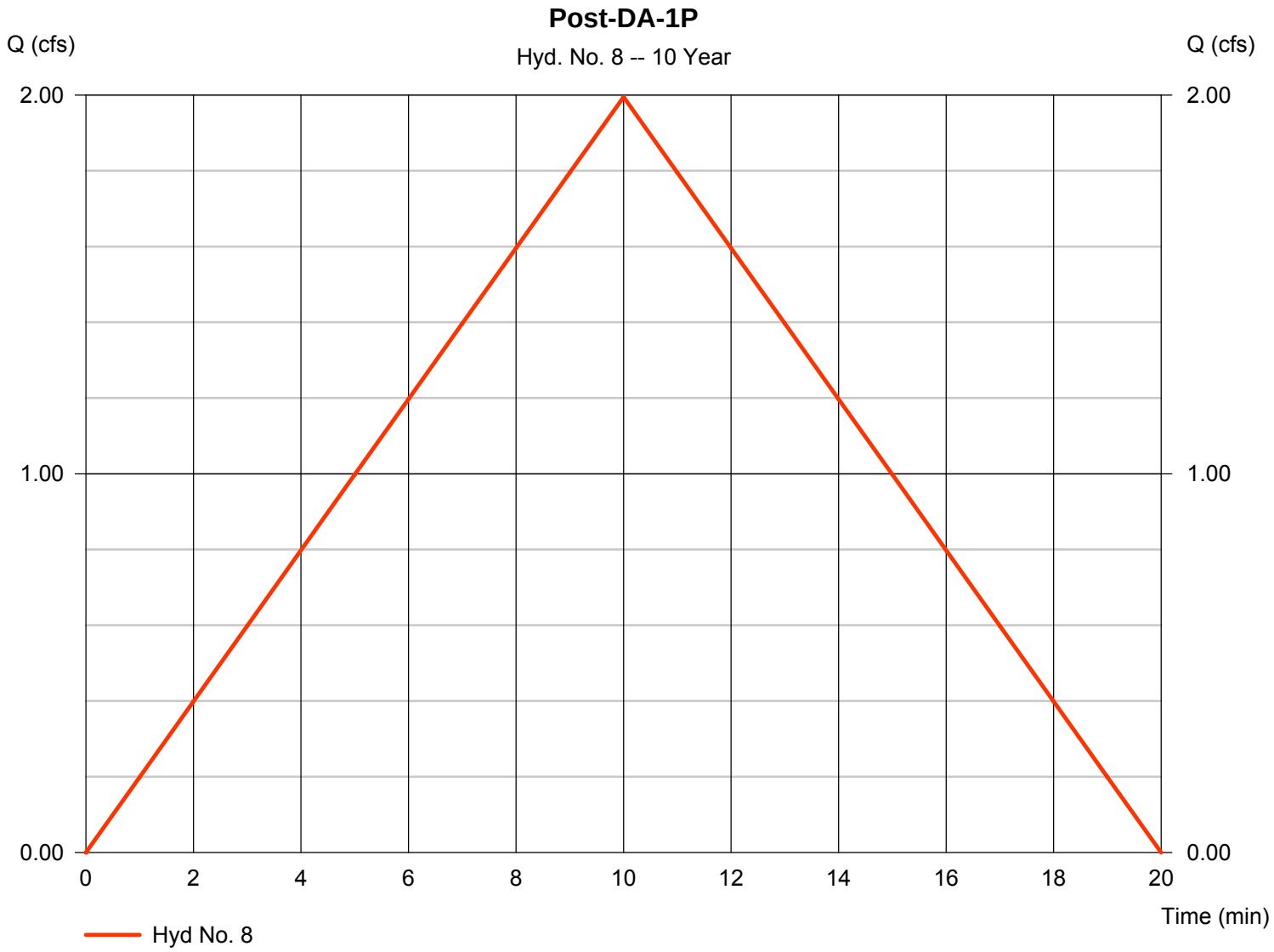
Hydrograph Report

Hyd. No. 8

Post-DA-1P

Hydrograph type	=	Rational	Peak discharge	=	1.995 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	1,197 cuft
Drainage area	=	0.430 ac	Runoff coeff.	=	0.81*
Intensity	=	5.727 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.160 x 0.51) + (0.270 x 0.99)] / 0.430

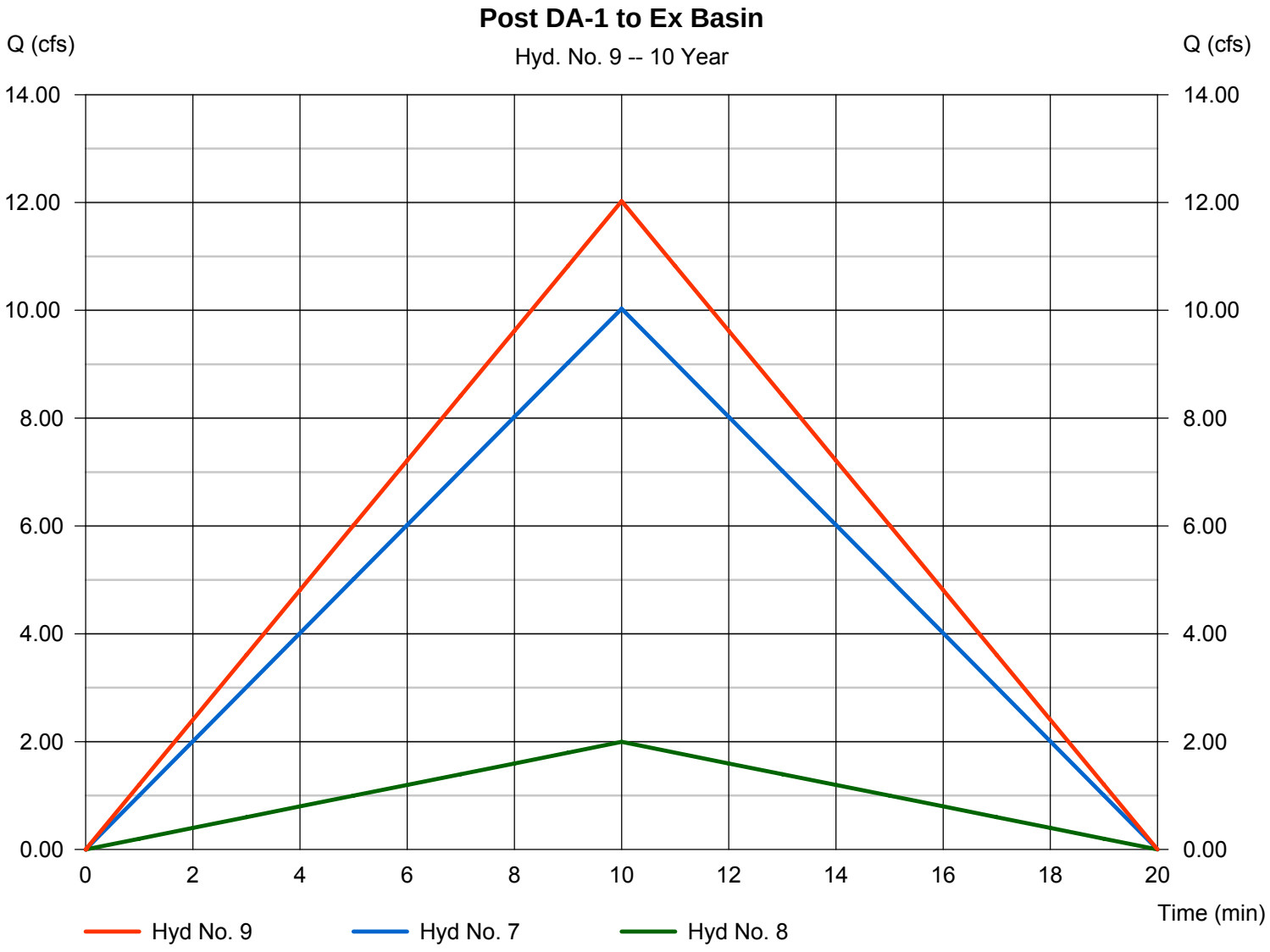


Hydrograph Report

Hyd. No. 9

Post DA-1 to Ex Basin

Hydrograph type	= Combine	Peak discharge	= 12.03 cfs
Storm frequency	= 10 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 7,215 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 2.540 ac



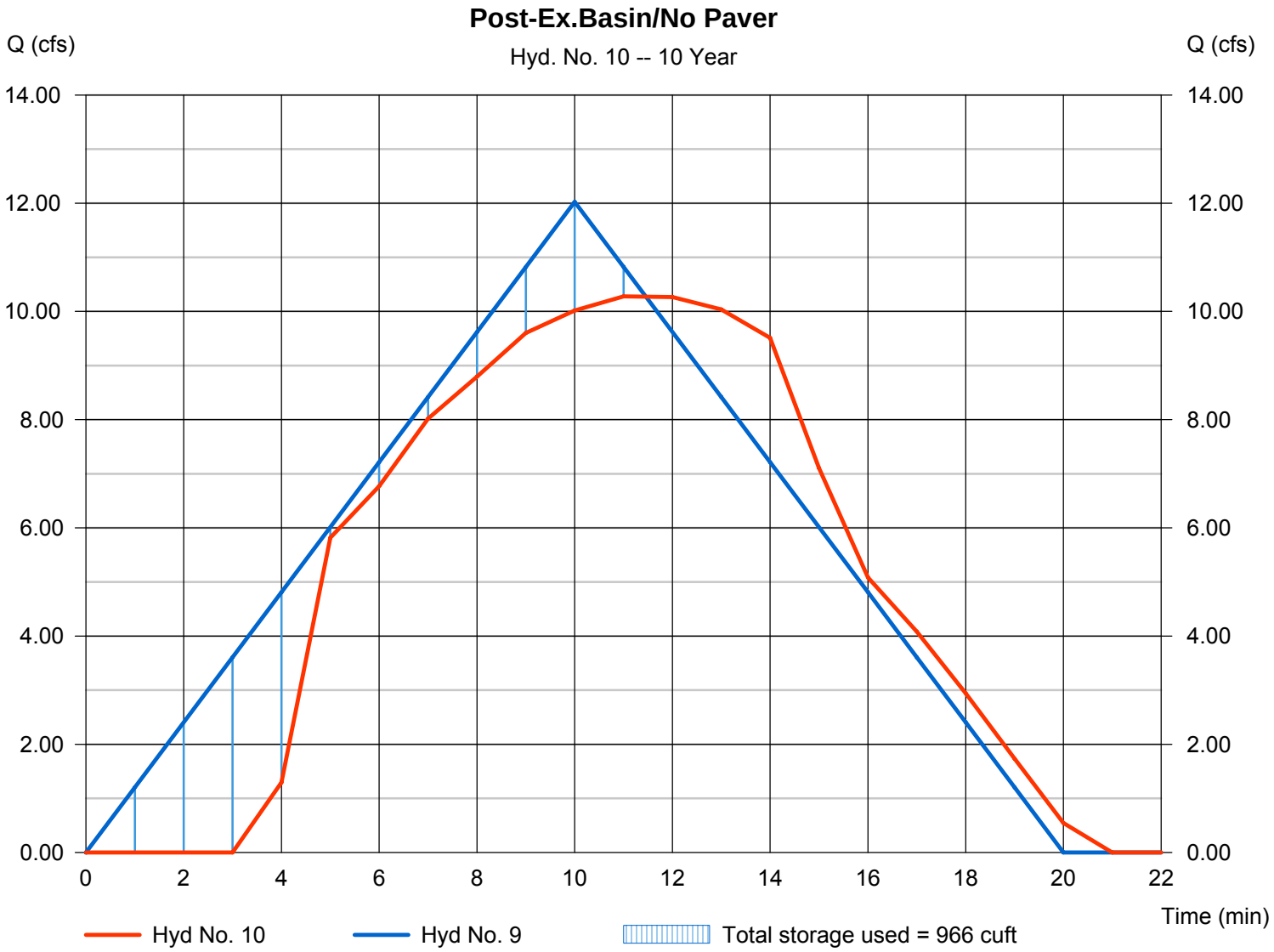
Hydrograph Report

Hyd. No. 10

Post-Ex.Basin/No Paver

Hydrograph type	=	Reservoir	Peak discharge	=	10.28 cfs
Storm frequency	=	10 yrs	Time to peak	=	11 min
Time interval	=	1 min	Hyd. volume	=	6,714 cuft
Inflow hyd. No.	=	9 - Post DA-1 to Ex Basin	Max. Elevation	=	60.56 ft
Reservoir name	=	Ex. Basin	Max. Storage	=	966 cuft

Storage Indication method used.



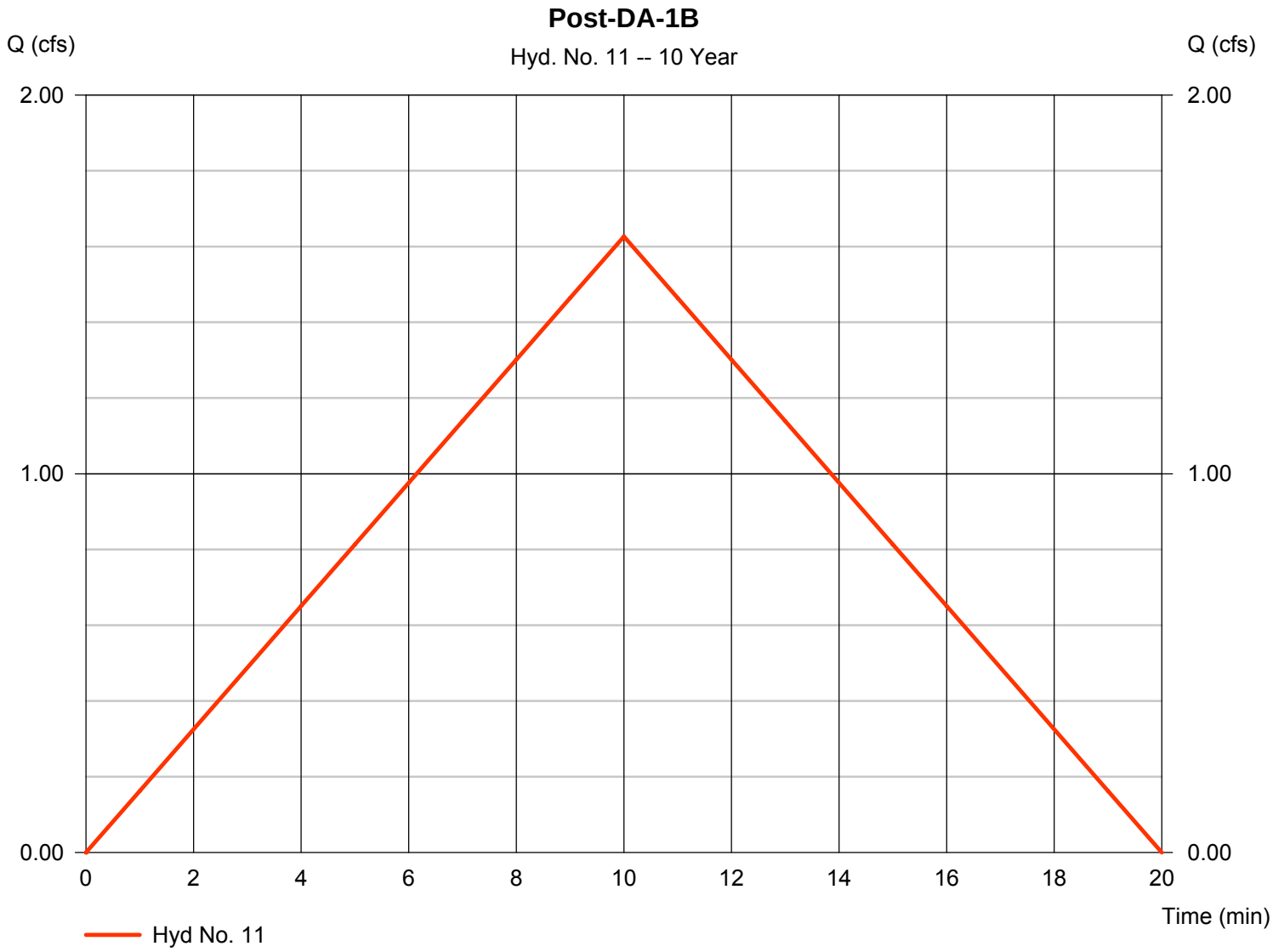
Hydrograph Report

Hyd. No. 11

Post-DA-1B

Hydrograph type	=	Rational	Peak discharge	=	1.627 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	976 cuft
Drainage area	=	0.400 ac	Runoff coeff.	=	0.71*
Intensity	=	5.727 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.230 x 0.51) + (0.170 x 0.99)] / 0.400



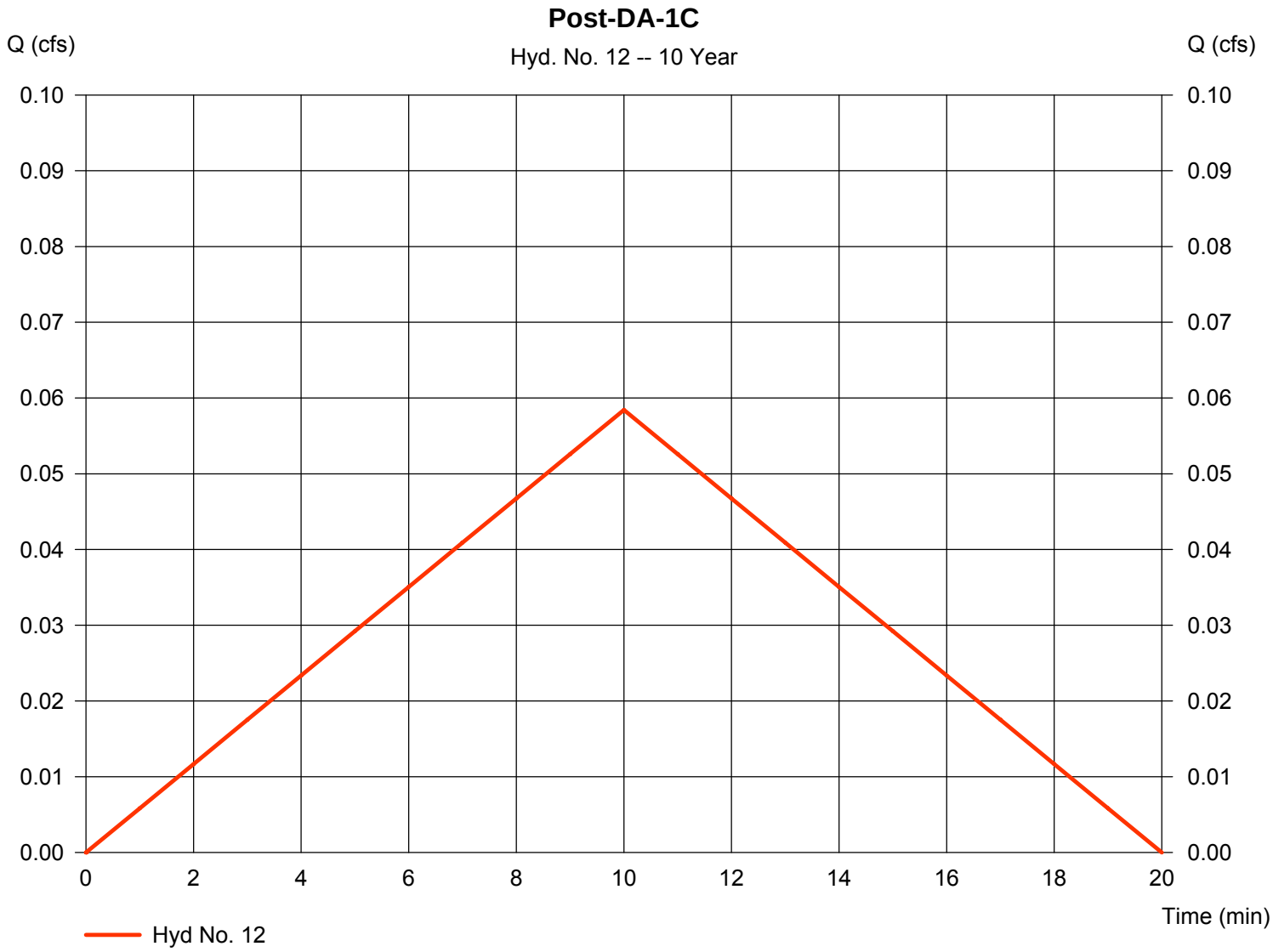
Hydrograph Report

Hyd. No. 12

Post-DA-1C

Hydrograph type	=	Rational	Peak discharge	=	0.058 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	35 cuft
Drainage area	=	0.020 ac	Runoff coeff.	=	0.51*
Intensity	=	5.727 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.020 x 0.51)] / 0.020

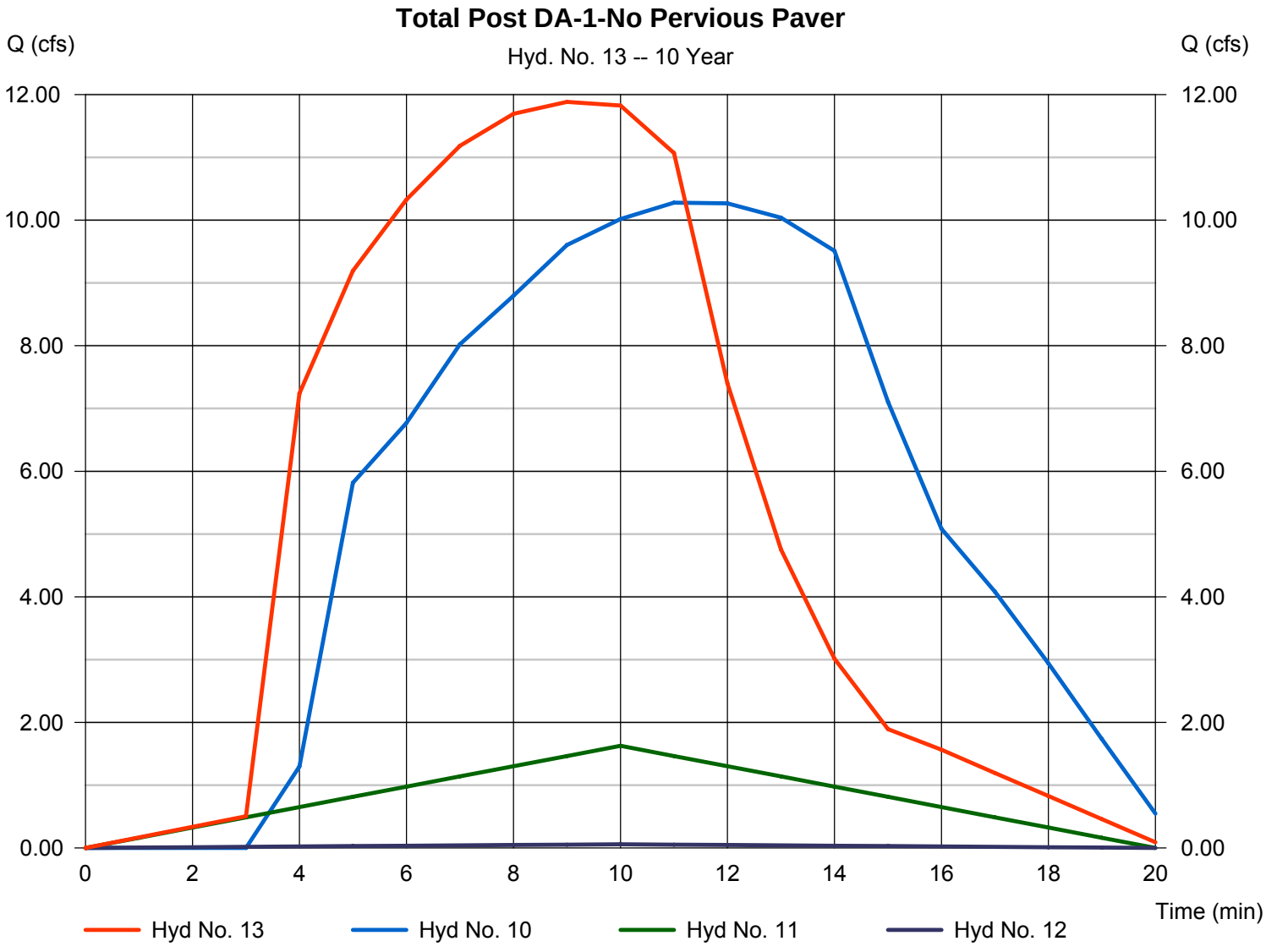


Hydrograph Report

Hyd. No. 13

Total Post DA-1-No Pervious Paver

Hydrograph type	= Combine	Peak discharge	= 11.88 cfs
Storm frequency	= 10 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 6,397 cuft
Inflow hyds.	= 10, 11, 12	Contrib. drain. area	= 0.420 ac



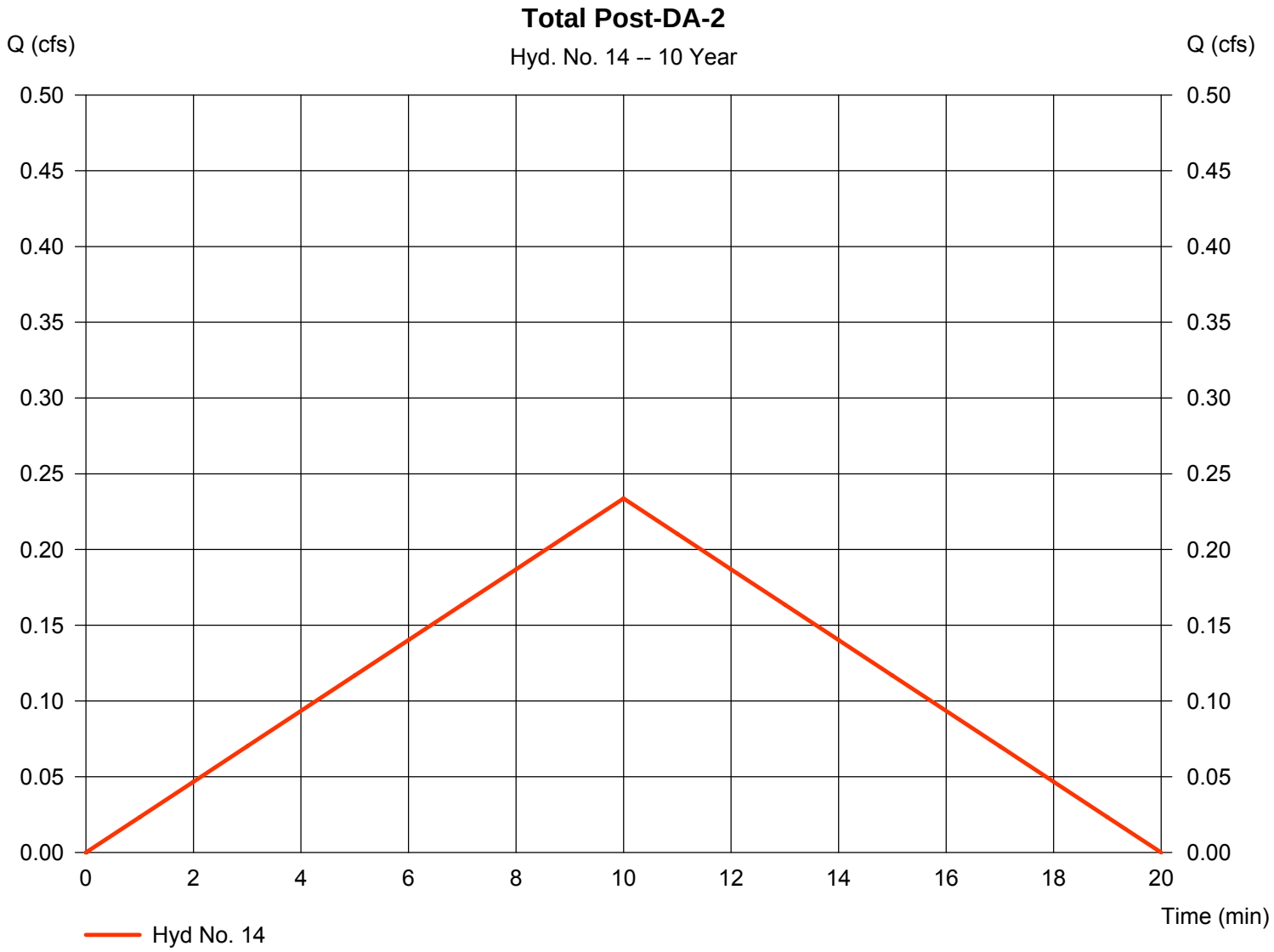
Hydrograph Report

Hyd. No. 14

Total Post-DA-2

Hydrograph type	=	Rational	Peak discharge	=	0.234 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	140 cuft
Drainage area	=	0.080 ac	Runoff coeff.	=	0.51*
Intensity	=	5.727 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.080 x 0.51)] / 0.080



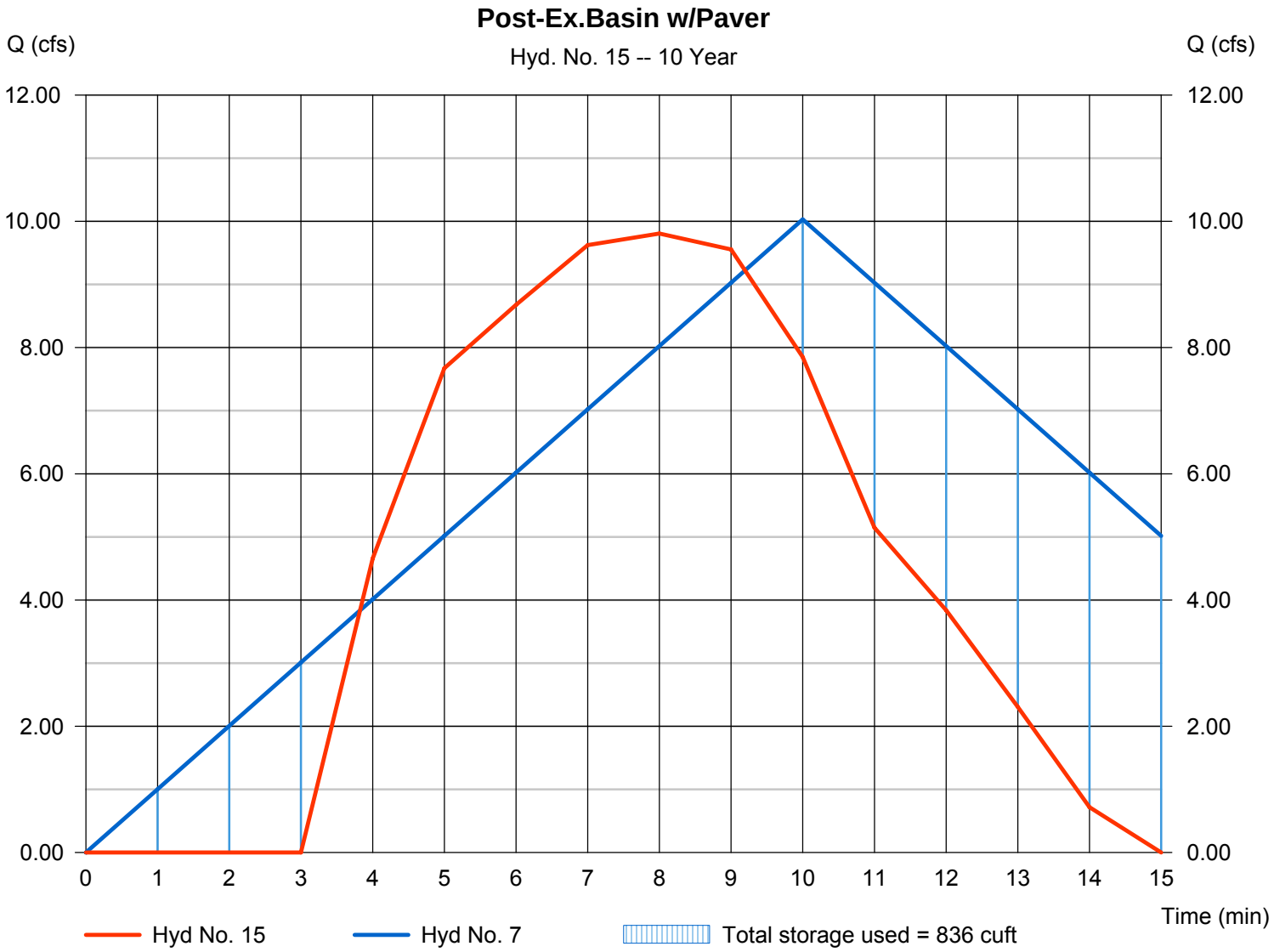
Hydrograph Report

Hyd. No. 15

Post-Ex.Basin w/Paver

Hydrograph type	=	Reservoir	Peak discharge	=	9.805 cfs
Storm frequency	=	10 yrs	Time to peak	=	8 min
Time interval	=	1 min	Hyd. volume	=	4,190 cuft
Inflow hyd. No.	=	7 - Post-DA-1A	Max. Elevation	=	60.38 ft
Reservoir name	=	Ex. Basin	Max. Storage	=	836 cuft

Storage Indication method used.

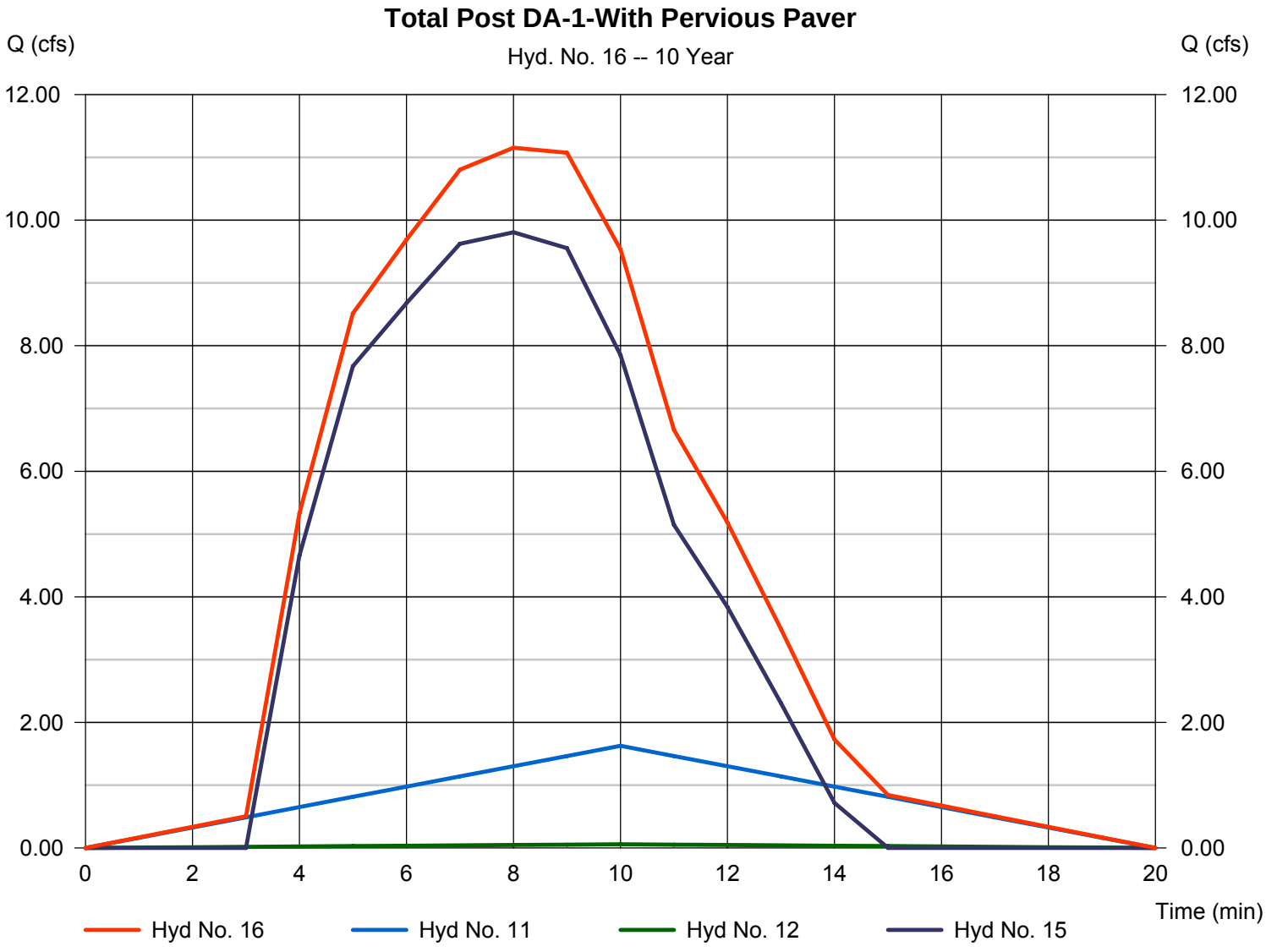


Hydrograph Report

Hyd. No. 16

Total Post DA-1-With Pervious Paver

Hydrograph type	= Combine	Peak discharge	= 11.15 cfs
Storm frequency	= 10 yrs	Time to peak	= 8 min
Time interval	= 1 min	Hyd. volume	= 5,201 cuft
Inflow hyds.	= 11, 12, 15	Contrib. drain. area	= 0.420 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	Rational	15.29	1	10	9,173	------	------	------	Pre-DA-1A
2	Reservoir	11.65	1	12	8,672	1	61.20	1,541	Pre-Ex. Basin Route
3	Rational	2.808	1	10	1,685	------	------	------	Pre-DA-1B
4	Rational	0.078	1	10	47	------	------	------	Pre-DA-1C
5	Combine	14.11	1	11	10,403	2, 3, 4	------	------	Total Pre DA-1
6	Rational	0.577	1	10	346	------	------	------	Total Pre-DA-2
7	Rational	13.39	1	10	8,035	------	------	------	Post-DA-1A
8	Rational	2.663	1	10	1,598	------	------	------	Post-DA-1P
9	Combine	16.06	1	10	9,634	7, 8	------	------	Post DA-1 to Ex Basin
10	Reservoir	11.92	1	13	9,133	9	61.35	1,711	Post-Ex.Basin/No Paver
11	Rational	2.172	1	10	1,303	------	------	------	Post-DA-1B
12	Rational	0.078	1	10	47	------	------	------	Post-DA-1C
13	Combine	14.16	1	10	8,700	10, 11, 12	------	------	Total Post DA-1-No Pervious Paver
14	Rational	0.312	1	10	187	------	------	------	Total Post-DA-2
15	Reservoir	11.22	1	9	5,754	7	60.98	1,298	Post-Ex.Basin w/Paver
16	Combine	13.25	1	9	7,104	11, 12, 15	------	------	Total Post DA-1-With Pervious Paver

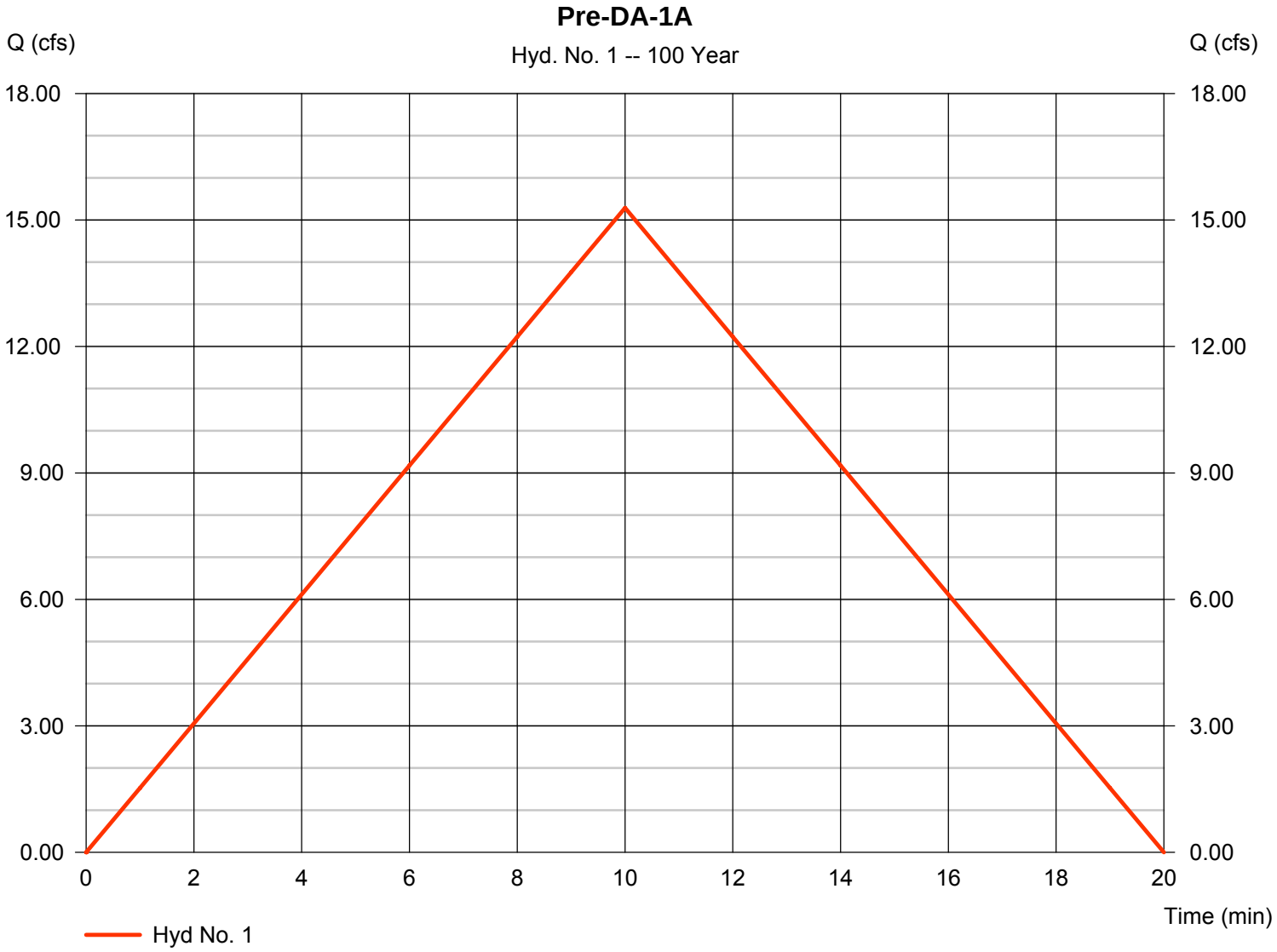
Hydrograph Report

Hyd. No. 1

Pre-DA-1A

Hydrograph type	=	Rational	Peak discharge	=	15.29 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	9,173 cuft
Drainage area	=	2.380 ac	Runoff coeff.	=	0.84*
Intensity	=	7.647 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.720 x 0.51) + (1.660 x 0.99)] / 2.380



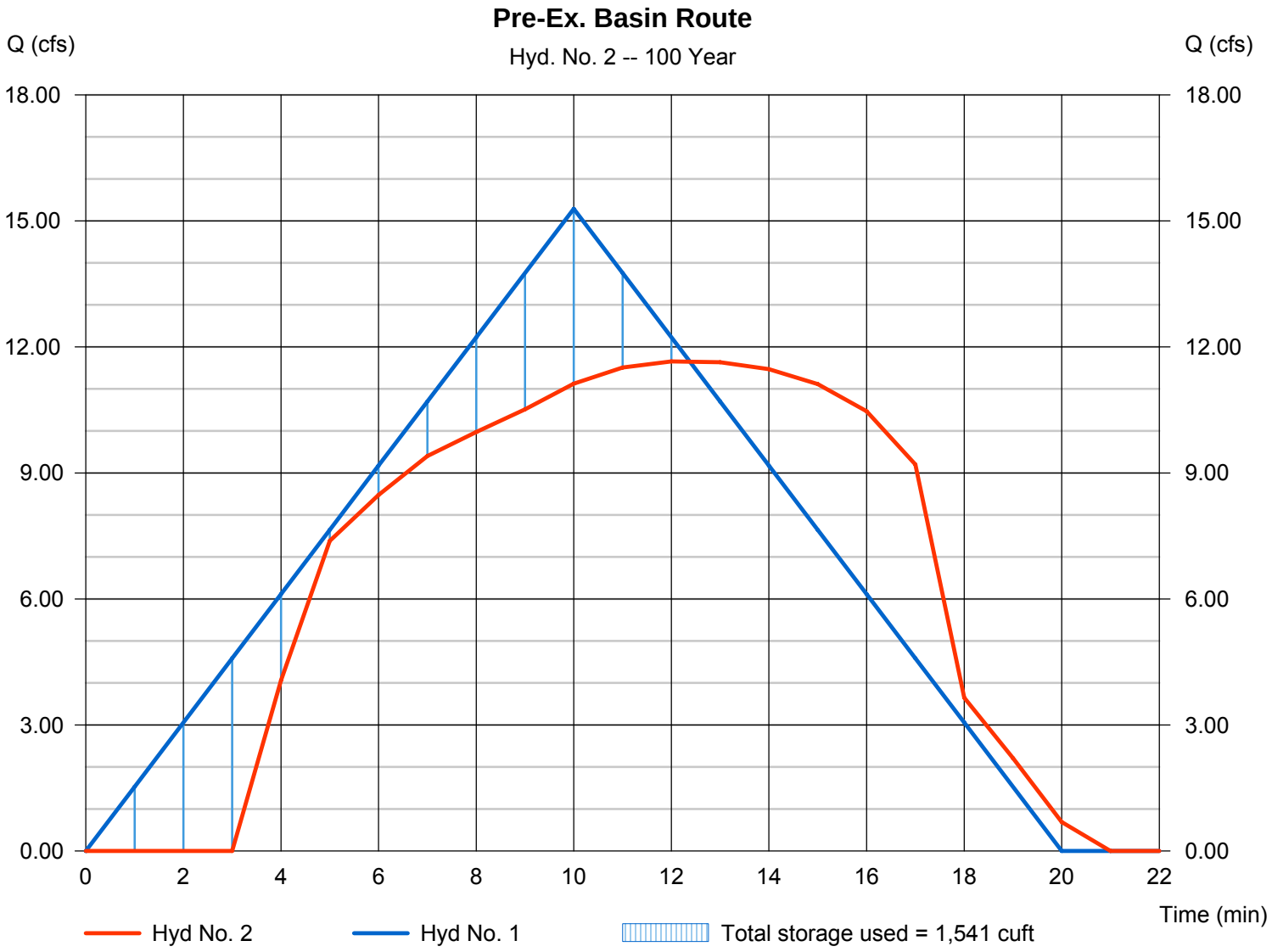
Hydrograph Report

Hyd. No. 2

Pre-Ex. Basin Route

Hydrograph type	=	Reservoir	Peak discharge	=	11.65 cfs
Storm frequency	=	100 yrs	Time to peak	=	12 min
Time interval	=	1 min	Hyd. volume	=	8,672 cuft
Inflow hyd. No.	=	1 - Pre-DA-1A	Max. Elevation	=	61.20 ft
Reservoir name	=	Ex. Basin	Max. Storage	=	1,541 cuft

Storage Indication method used.



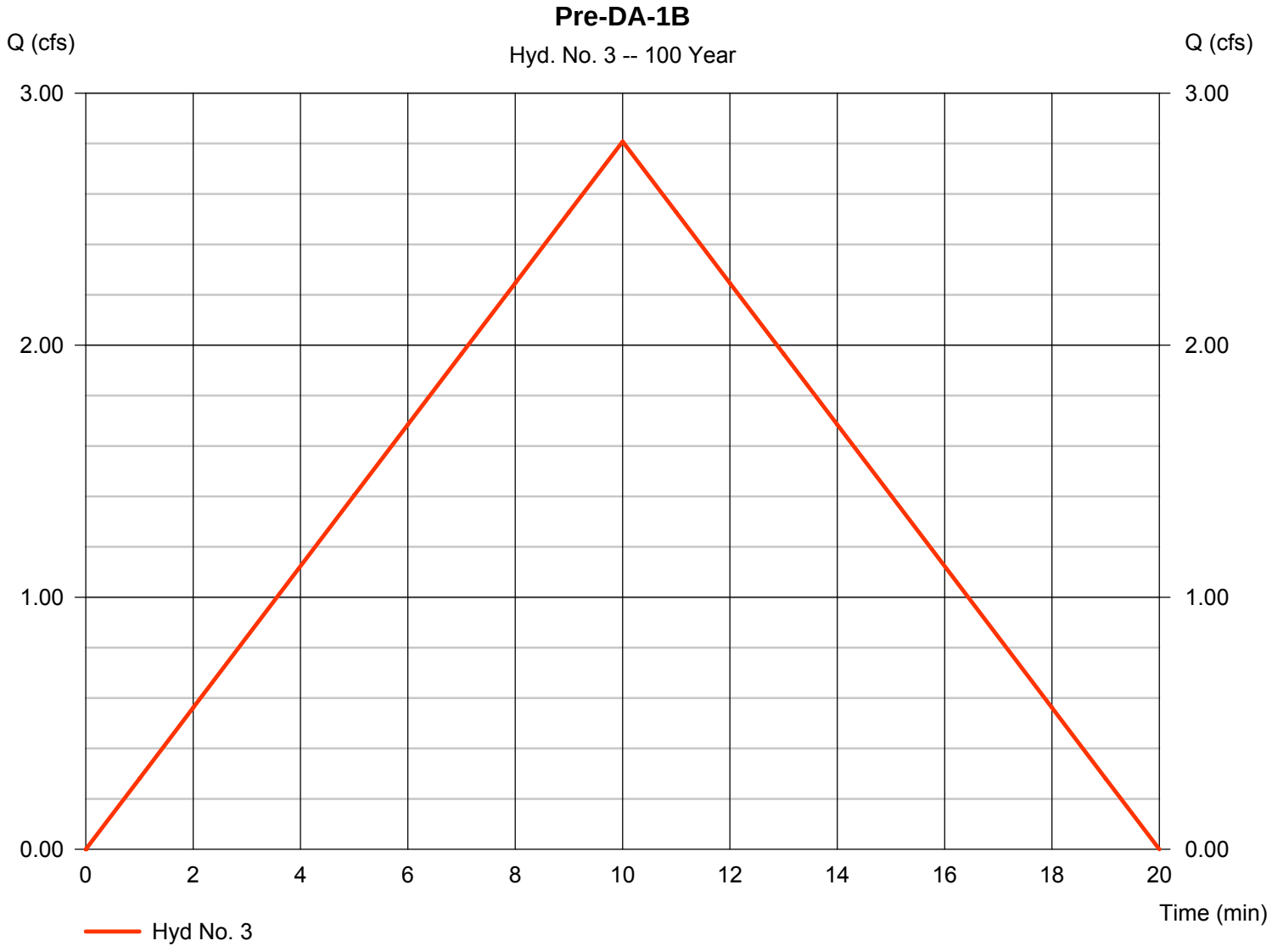
Hydrograph Report

Hyd. No. 3

Pre-DA-1B

Hydrograph type	=	Rational	Peak discharge	=	2.808 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	1,685 cuft
Drainage area	=	0.510 ac	Runoff coeff.	=	0.72*
Intensity	=	7.647 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.290 x 0.51) + (0.220 x 0.99)] / 0.510



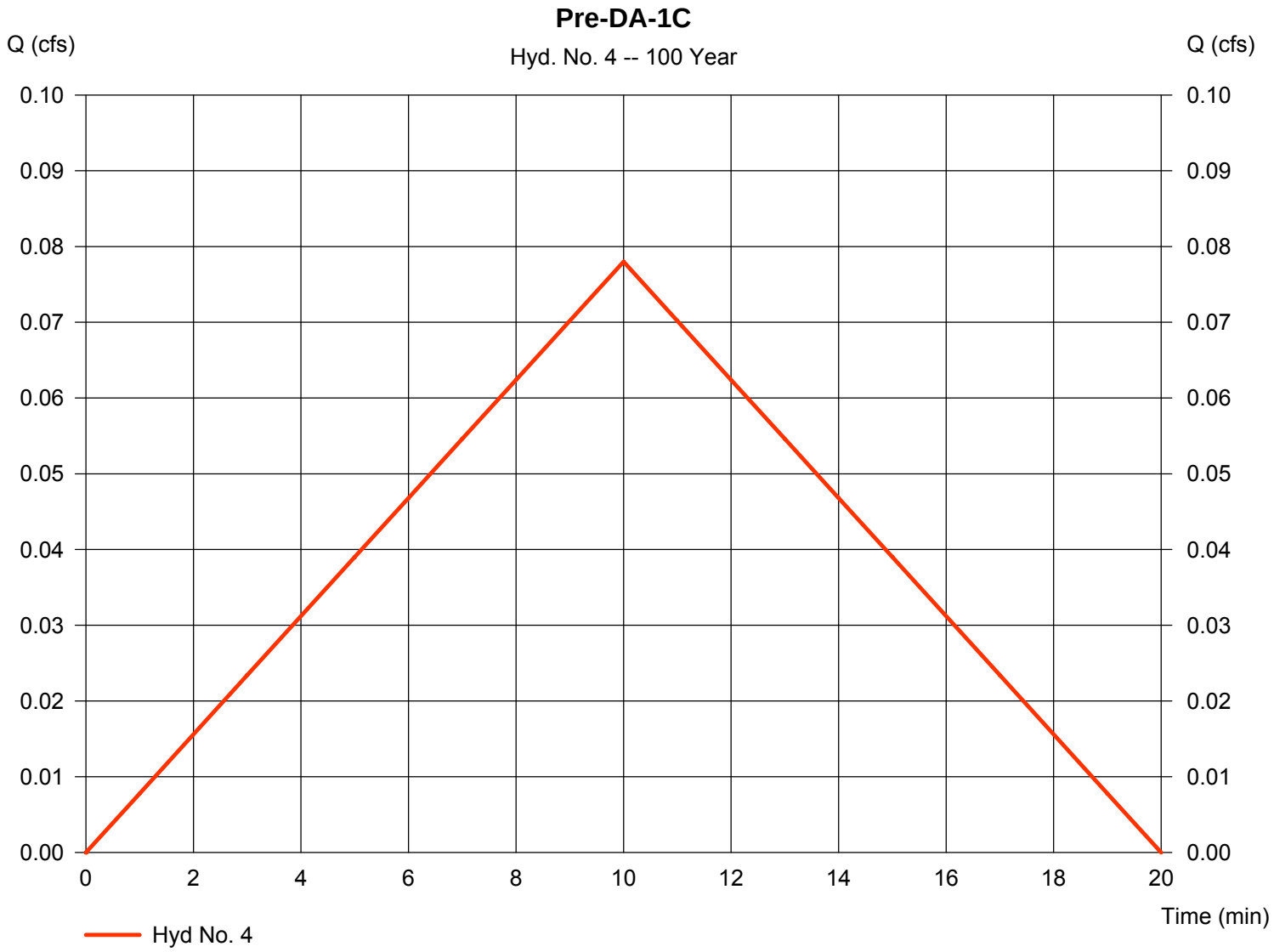
Hydrograph Report

Hyd. No. 4

Pre-DA-1C

Hydrograph type	=	Rational	Peak discharge	=	0.078 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	47 cuft
Drainage area	=	0.020 ac	Runoff coeff.	=	0.51*
Intensity	=	7.647 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.020 x 0.51)] / 0.020

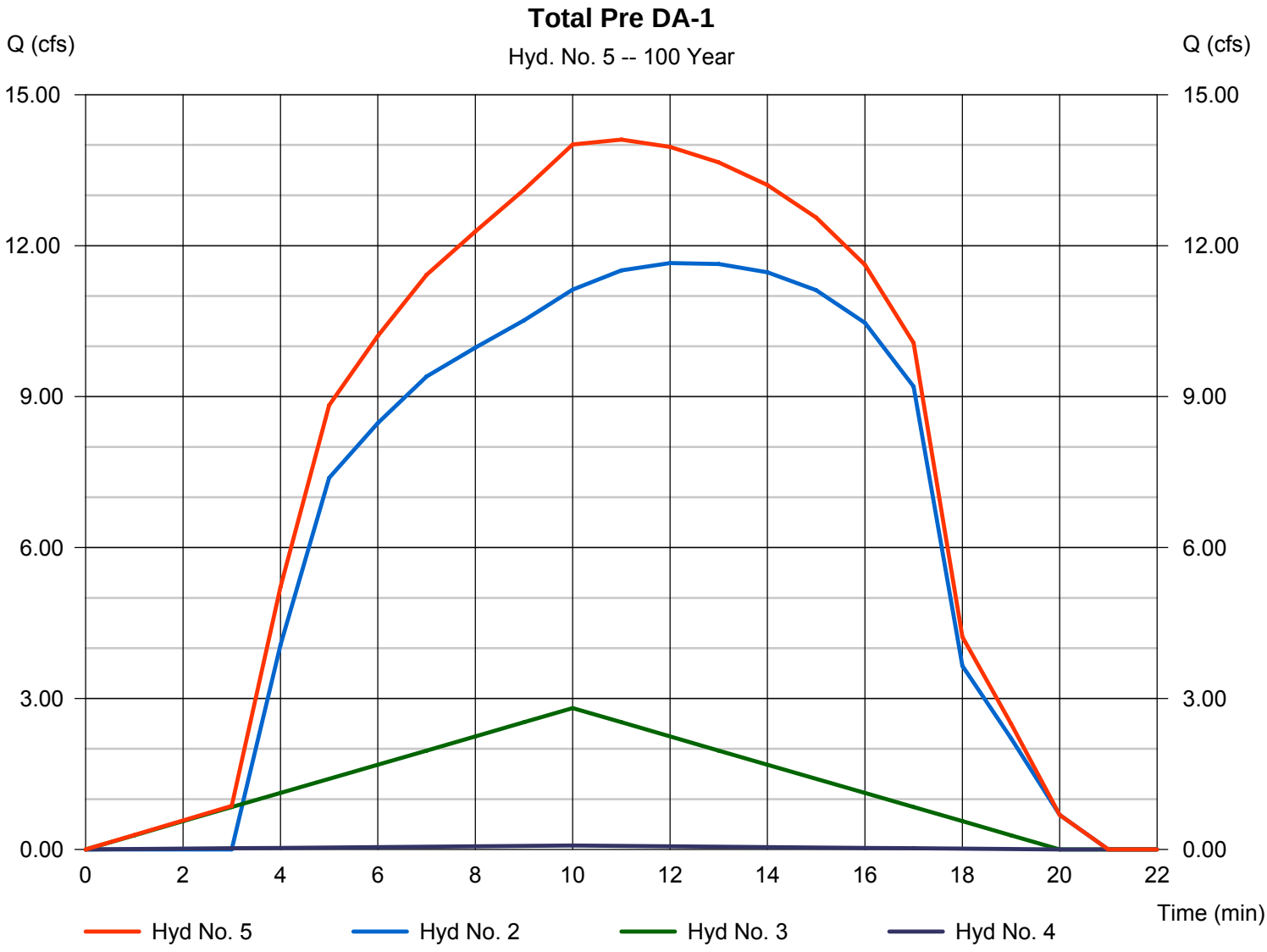


Hydrograph Report

Hyd. No. 5

Total Pre DA-1

Hydrograph type	= Combine	Peak discharge	= 14.11 cfs
Storm frequency	= 100 yrs	Time to peak	= 11 min
Time interval	= 1 min	Hyd. volume	= 10,403 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 0.530 ac



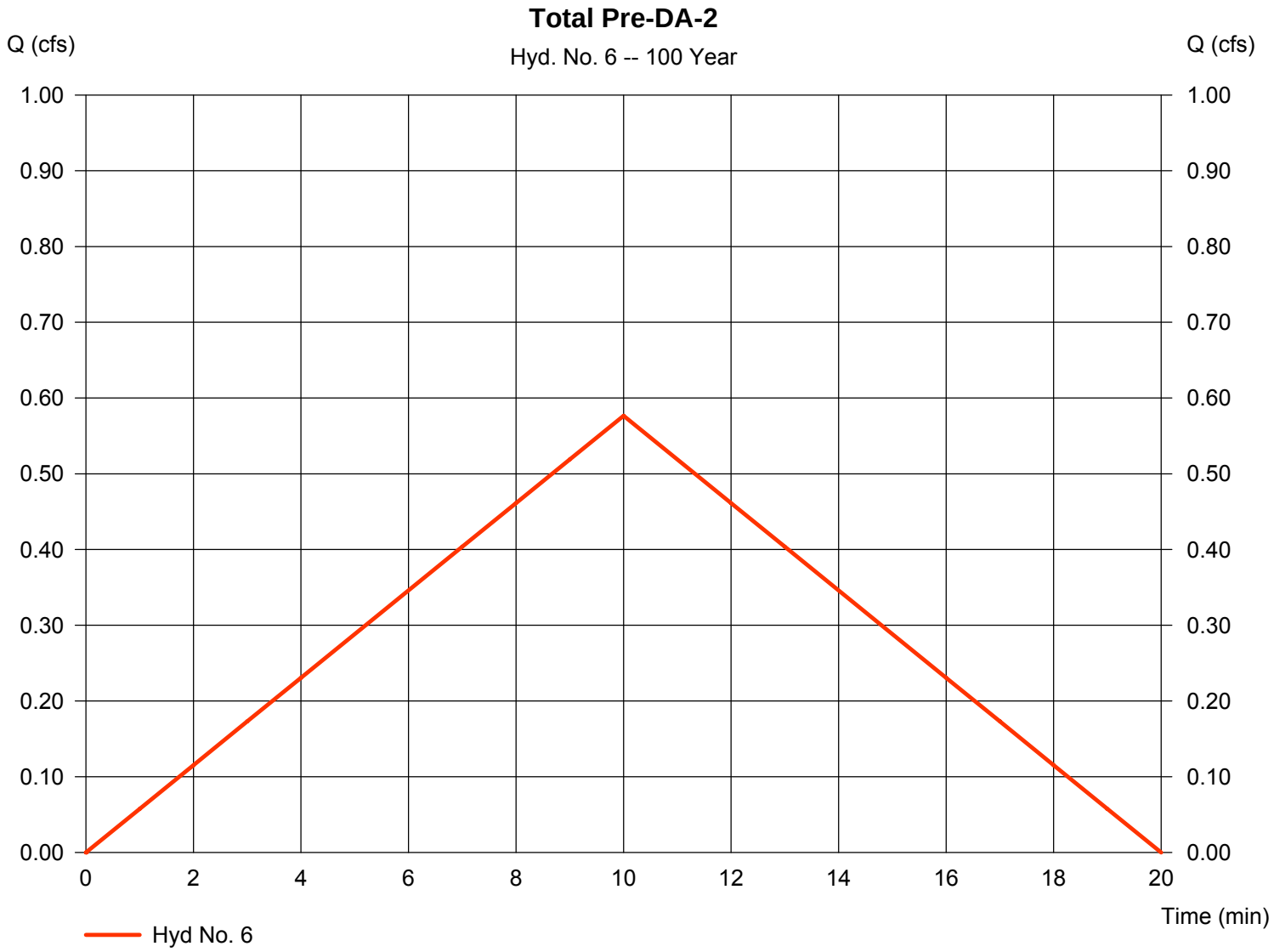
Hydrograph Report

Hyd. No. 6

Total Pre-DA-2

Hydrograph type	=	Rational	Peak discharge	=	0.577 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	346 cuft
Drainage area	=	0.130 ac	Runoff coeff.	=	0.58*
Intensity	=	7.647 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.110 x 0.51) + (0.020 x 0.99)] / 0.130



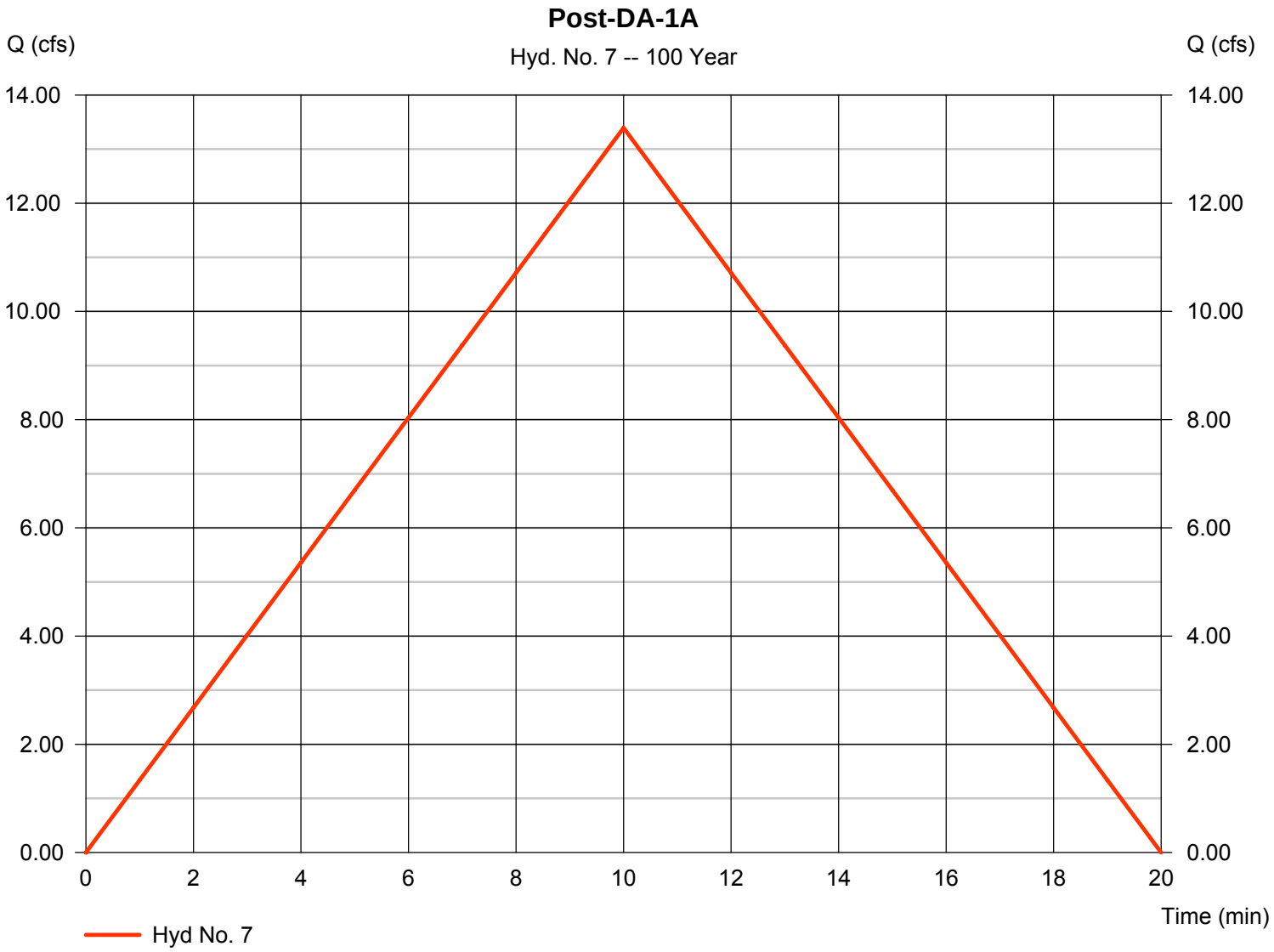
Hydrograph Report

Hyd. No. 7

Post-DA-1A

Hydrograph type	=	Rational	Peak discharge	=	13.39 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	8,035 cuft
Drainage area	=	2.110 ac	Runoff coeff.	=	0.83*
Intensity	=	7.647 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.690 x 0.51) + (1.420 x 0.99)] / 2.110



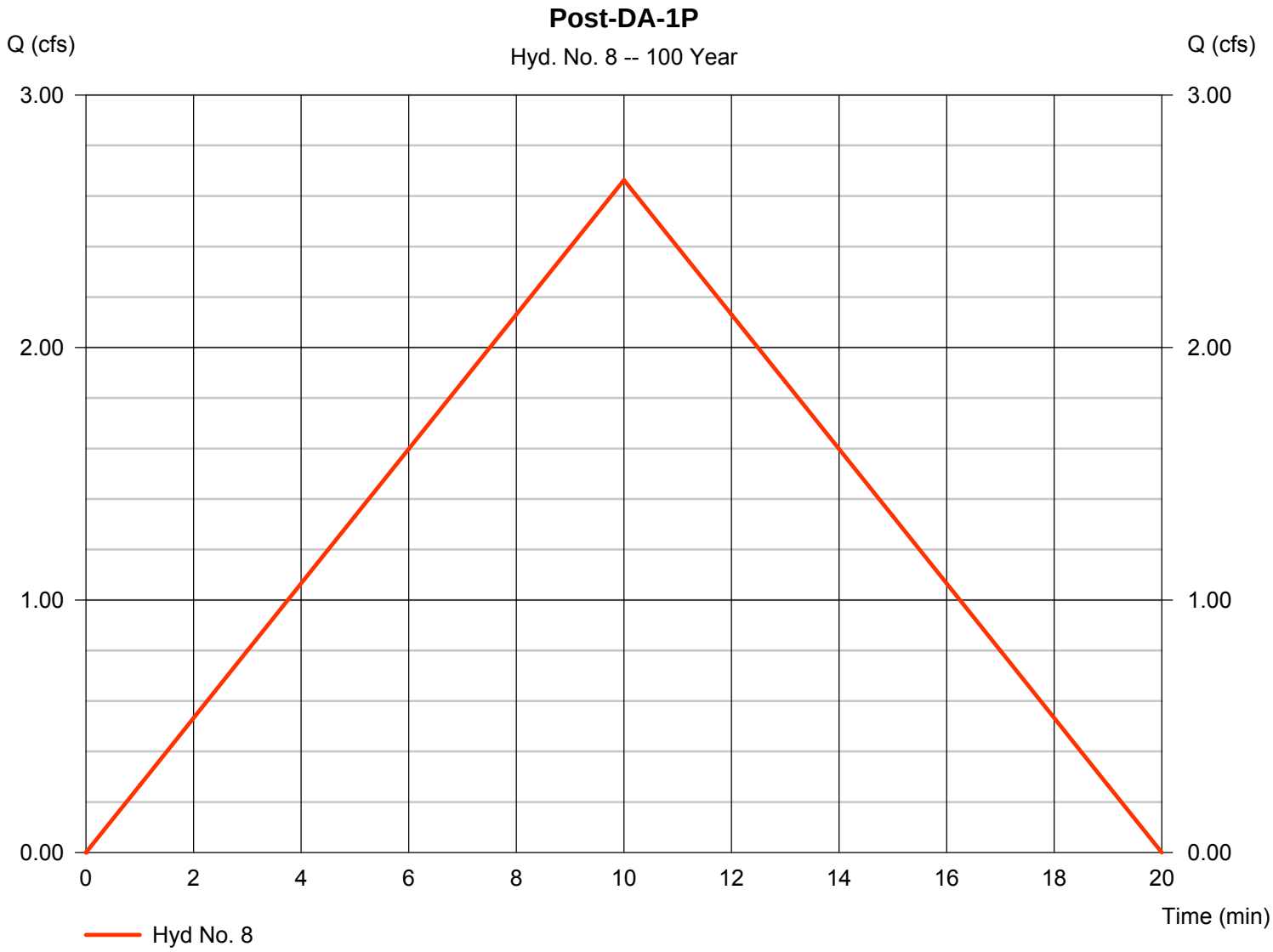
Hydrograph Report

Hyd. No. 8

Post-DA-1P

Hydrograph type	=	Rational	Peak discharge	=	2.663 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	1,598 cuft
Drainage area	=	0.430 ac	Runoff coeff.	=	0.81*
Intensity	=	7.647 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.160 x 0.51) + (0.270 x 0.99)] / 0.430

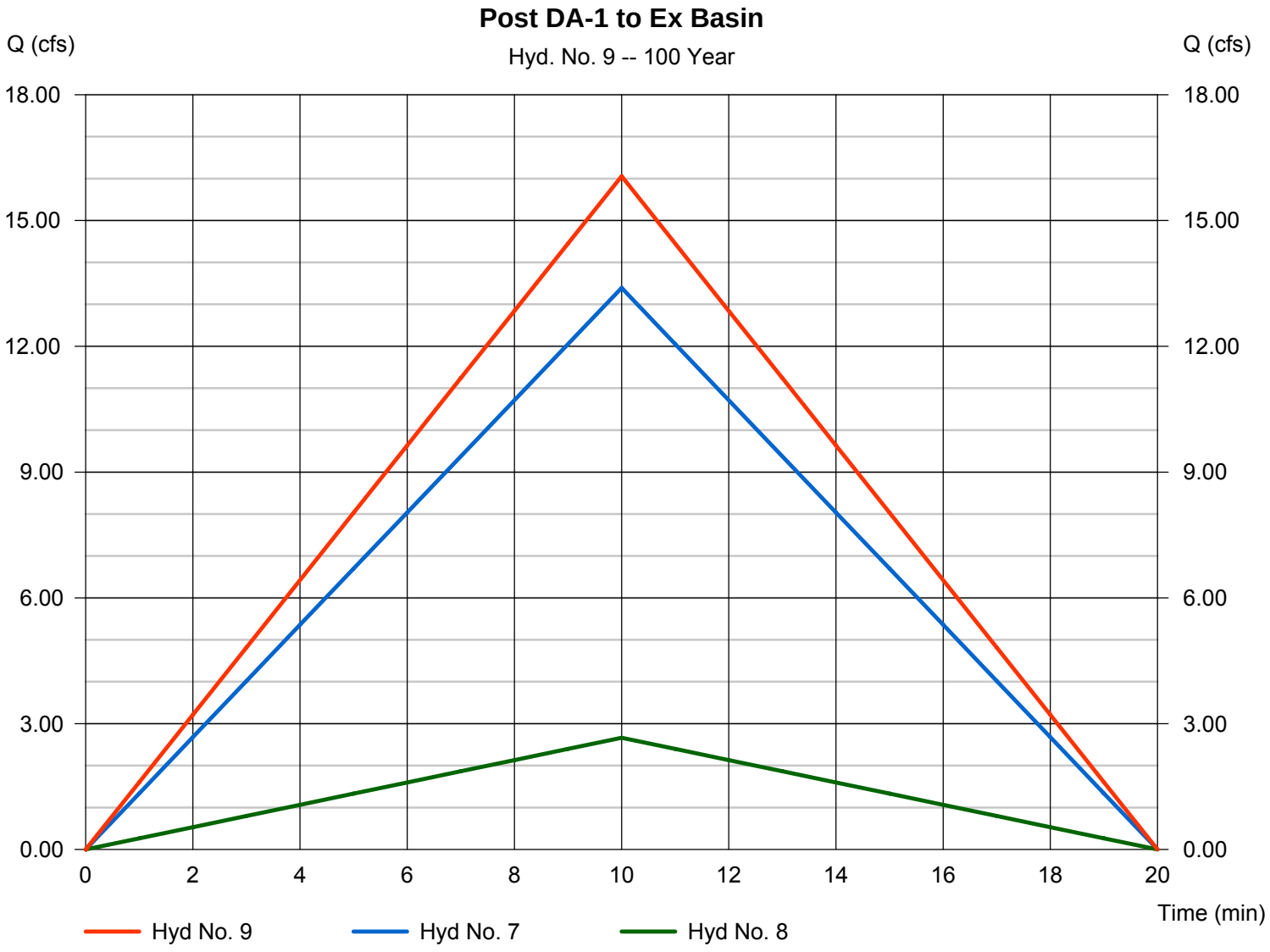


Hydrograph Report

Hyd. No. 9

Post DA-1 to Ex Basin

Hydrograph type	= Combine	Peak discharge	= 16.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 9,634 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 2.540 ac



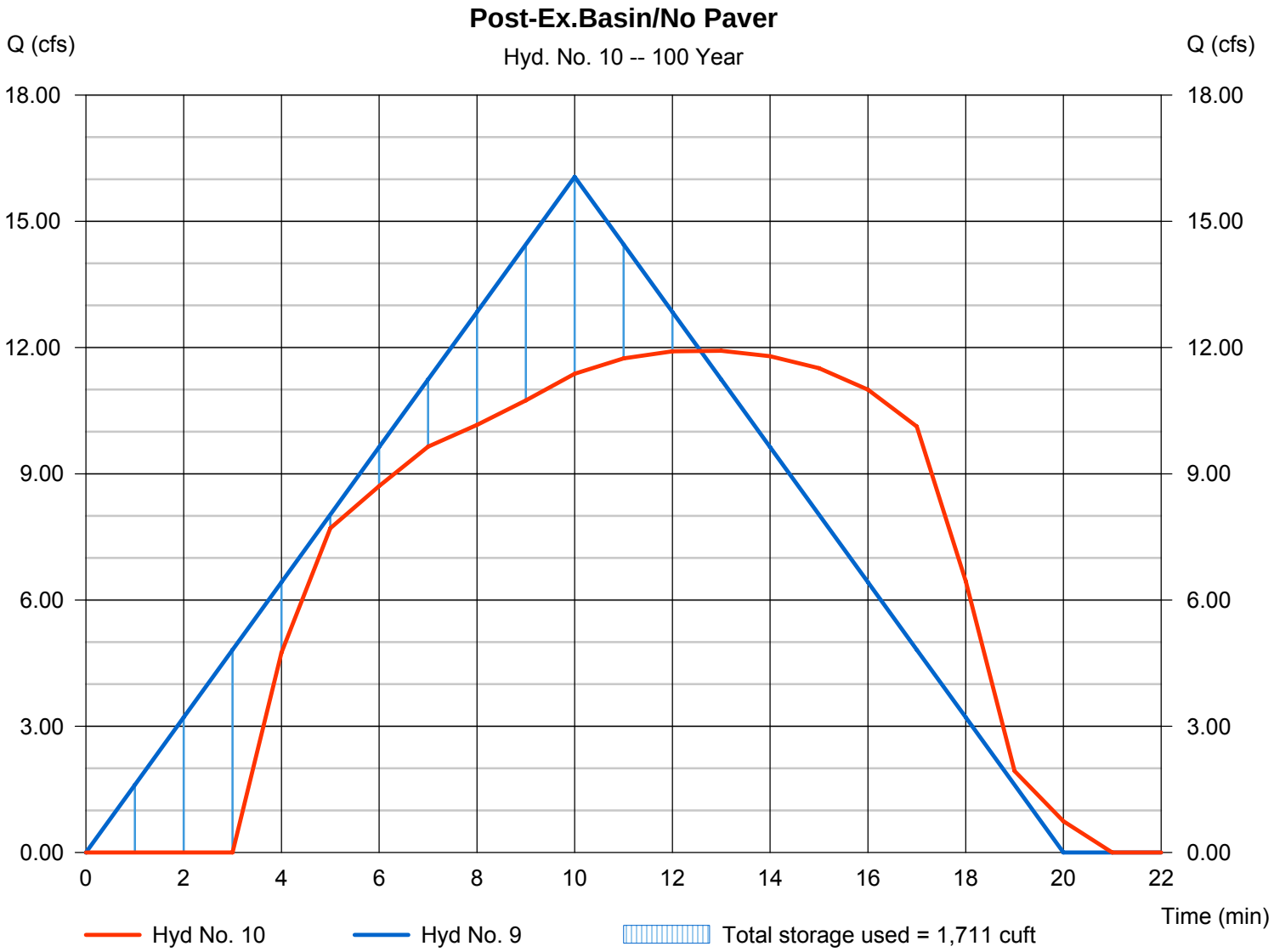
Hydrograph Report

Hyd. No. 10

Post-Ex.Basin/No Paver

Hydrograph type	=	Reservoir	Peak discharge	=	11.92 cfs
Storm frequency	=	100 yrs	Time to peak	=	13 min
Time interval	=	1 min	Hyd. volume	=	9,133 cuft
Inflow hyd. No.	=	9 - Post DA-1 to Ex Basin	Max. Elevation	=	61.35 ft
Reservoir name	=	Ex. Basin	Max. Storage	=	1,711 cuft

Storage Indication method used.



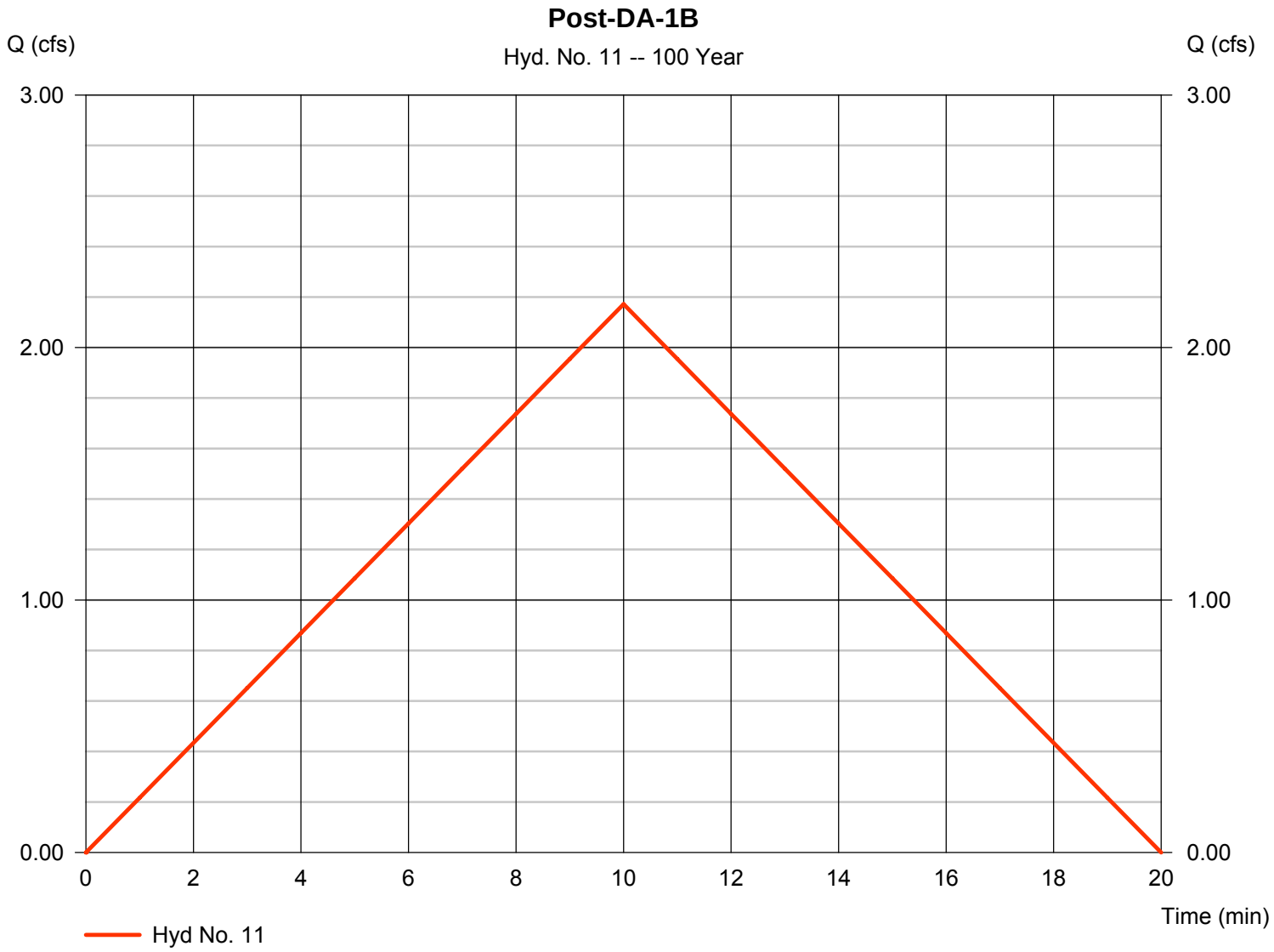
Hydrograph Report

Hyd. No. 11

Post-DA-1B

Hydrograph type	=	Rational	Peak discharge	=	2.172 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	1,303 cuft
Drainage area	=	0.400 ac	Runoff coeff.	=	0.71*
Intensity	=	7.647 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.230 x 0.51) + (0.170 x 0.99)] / 0.400



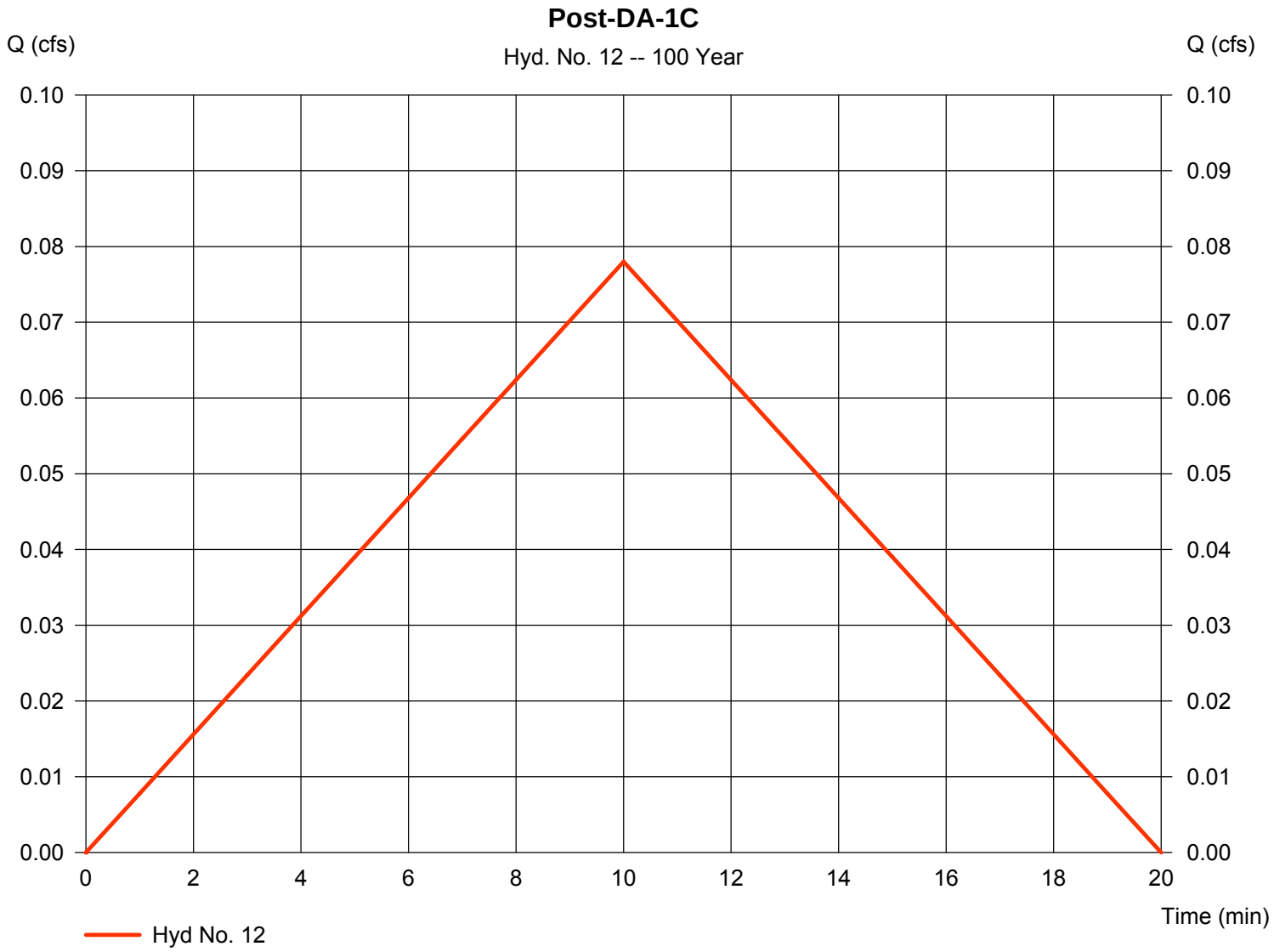
Hydrograph Report

Hyd. No. 12

Post-DA-1C

Hydrograph type	=	Rational	Peak discharge	=	0.078 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	47 cuft
Drainage area	=	0.020 ac	Runoff coeff.	=	0.51*
Intensity	=	7.647 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.020 x 0.51)] / 0.020

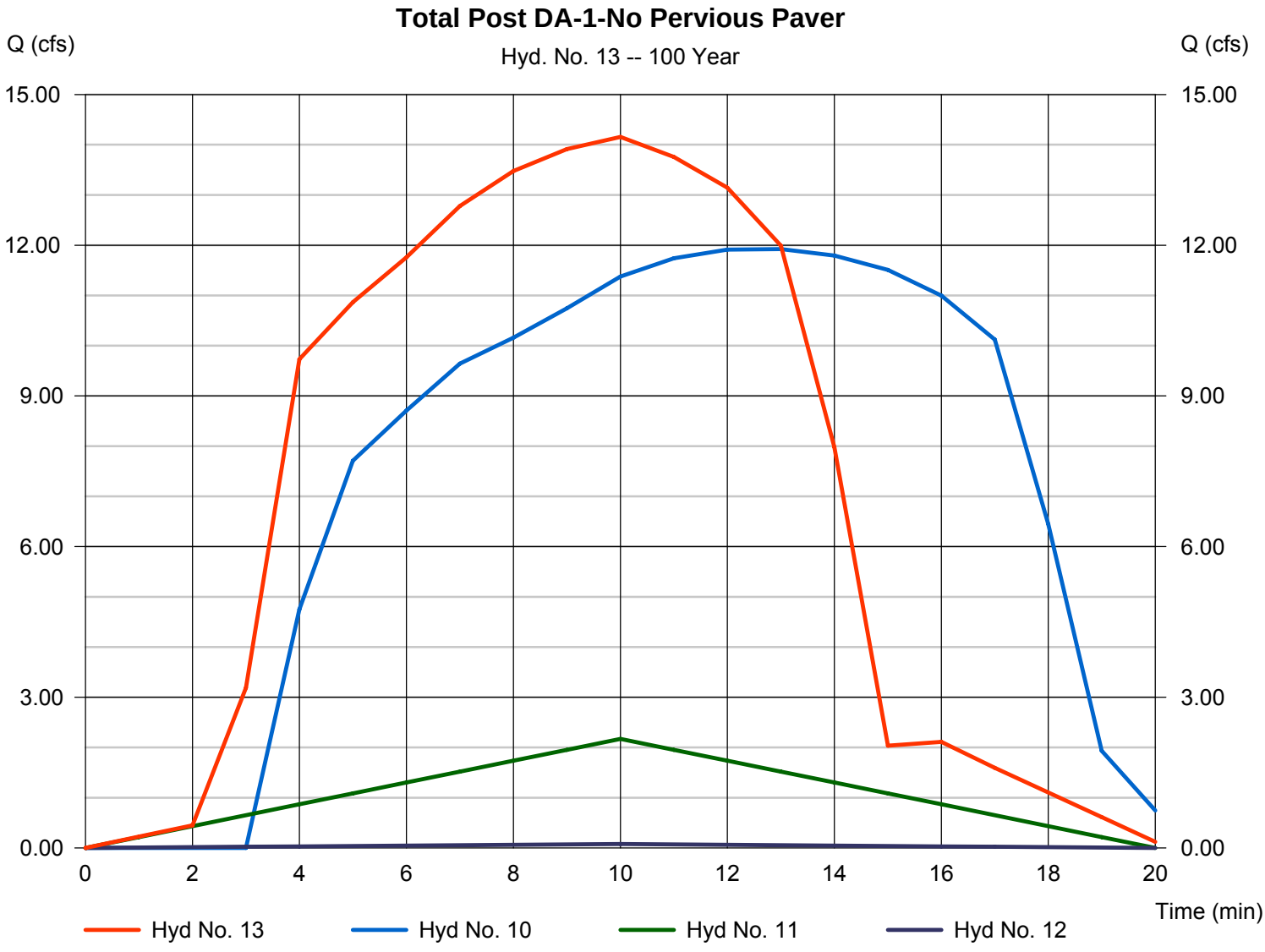


Hydrograph Report

Hyd. No. 13

Total Post DA-1-No Pervious Paver

Hydrograph type	= Combine	Peak discharge	= 14.16 cfs
Storm frequency	= 100 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 8,700 cuft
Inflow hyds.	= 10, 11, 12	Contrib. drain. area	= 0.420 ac



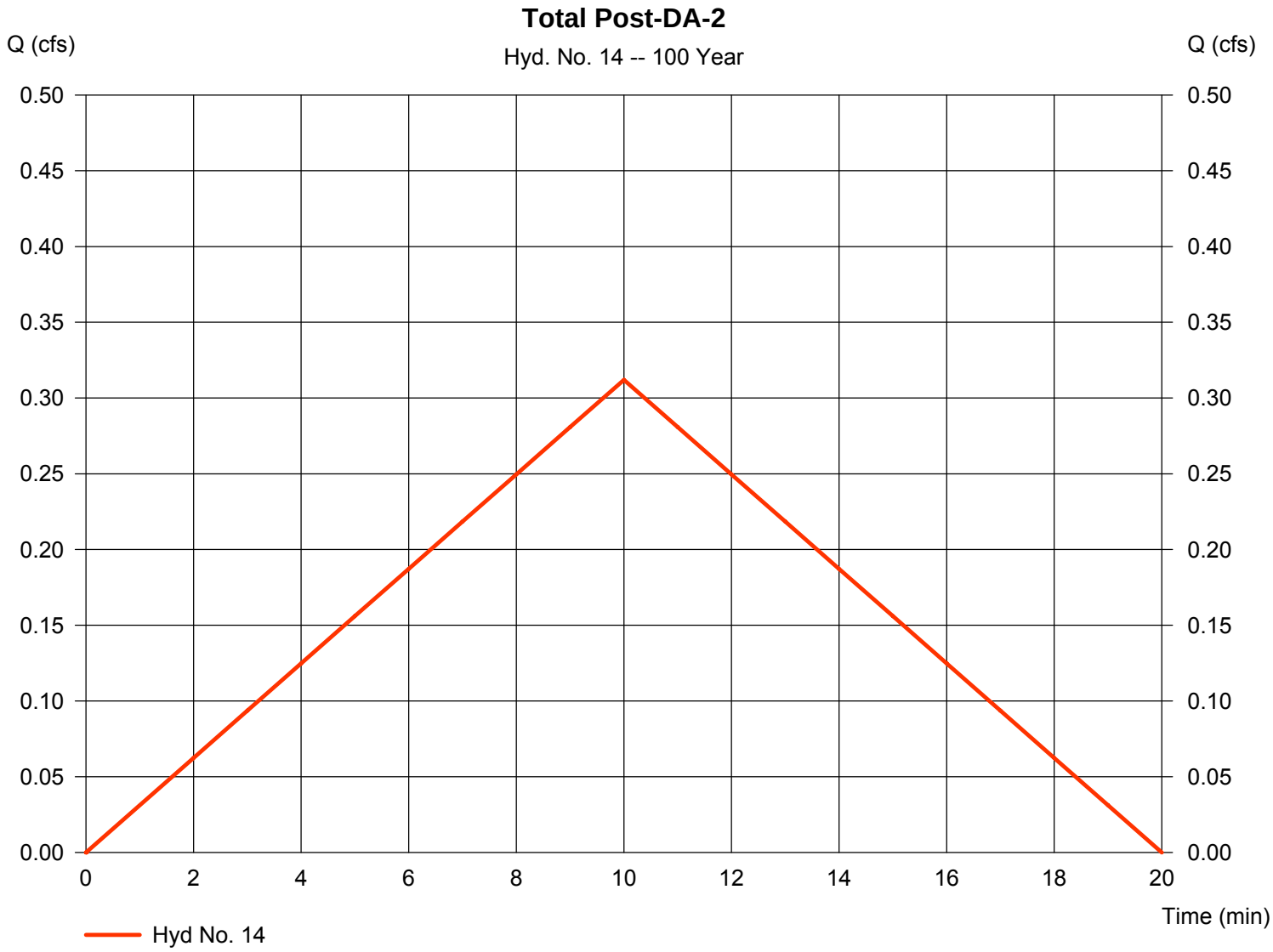
Hydrograph Report

Hyd. No. 14

Total Post-DA-2

Hydrograph type	=	Rational	Peak discharge	=	0.312 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	187 cuft
Drainage area	=	0.080 ac	Runoff coeff.	=	0.51*
Intensity	=	7.647 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Asc/Rec limb fact	=	1/1

* Composite (Area/C) = [(0.080 x 0.51)] / 0.080



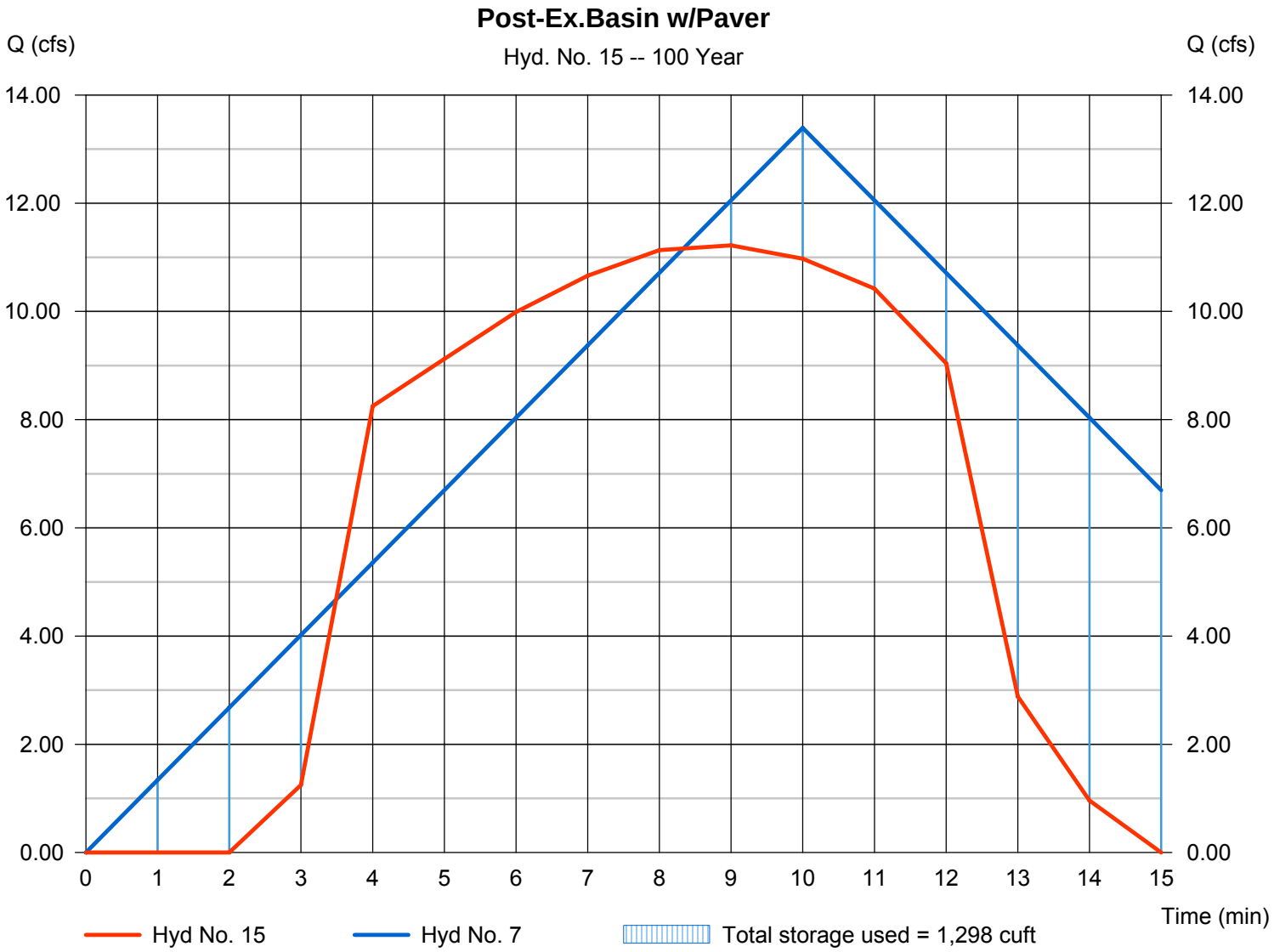
Hydrograph Report

Hyd. No. 15

Post-Ex.Basin w/Paver

Hydrograph type	=	Reservoir	Peak discharge	=	11.22 cfs
Storm frequency	=	100 yrs	Time to peak	=	9 min
Time interval	=	1 min	Hyd. volume	=	5,754 cuft
Inflow hyd. No.	=	7 - Post-DA-1A	Max. Elevation	=	60.98 ft
Reservoir name	=	Ex. Basin	Max. Storage	=	1,298 cuft

Storage Indication method used.

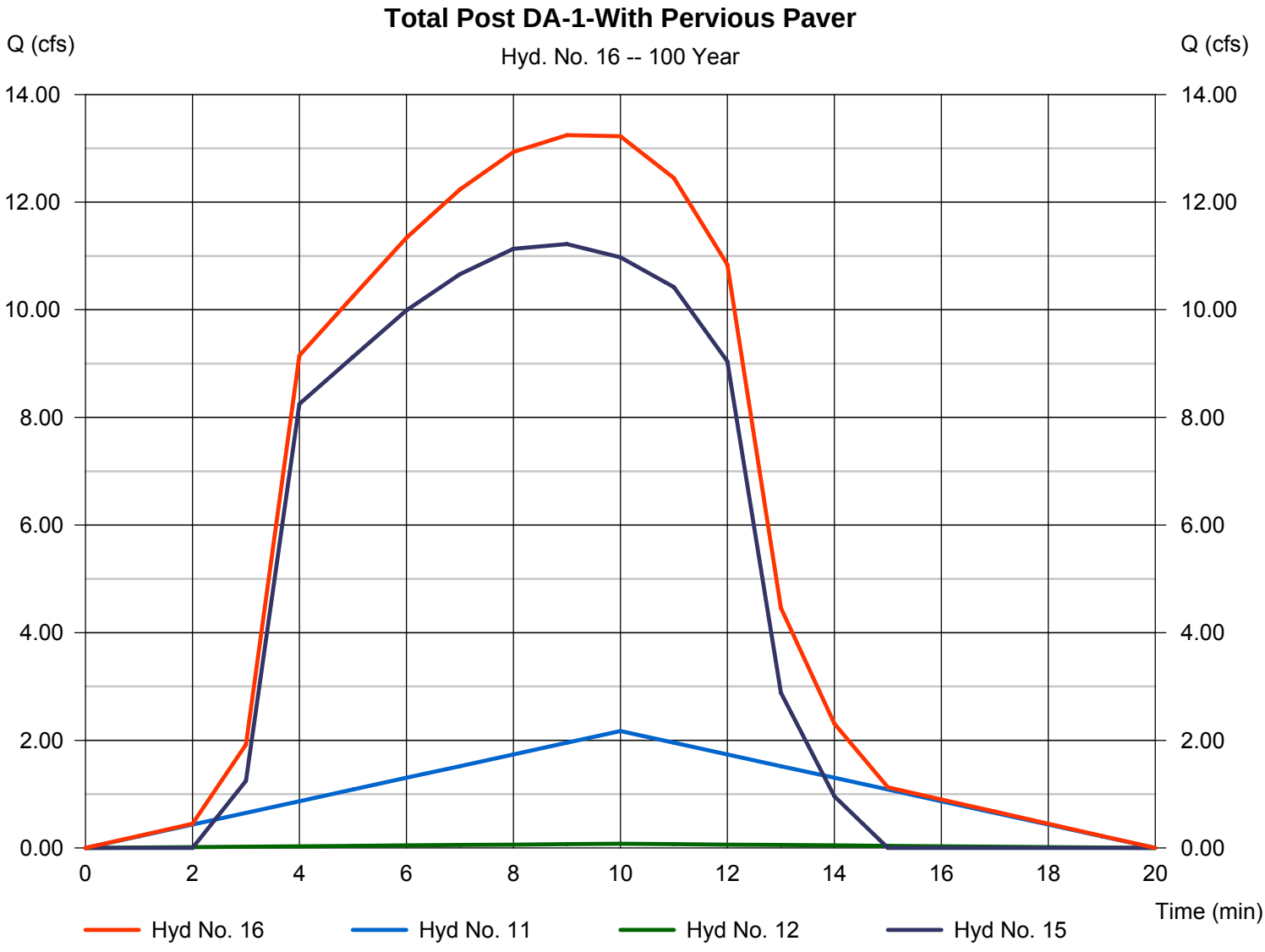


Hydrograph Report

Hyd. No. 16

Total Post DA-1-With Pervious Paver

Hydrograph type	= Combine	Peak discharge	= 13.25 cfs
Storm frequency	= 100 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 7,104 cuft
Inflow hyds.	= 11, 12, 15	Contrib. drain. area	= 0.420 ac



APPENDIX B

2, 10, & 100 YEARS STORM FREQUENCY REQUIRED PERMEABLE PAVER STORAGE

MODIFIED RATIONAL - RUNOFF VOLUMES

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

1

Legend

Hyd.	Origin	Description
1	Mod. Rational	Post-DA-1P (to New Pavers)

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	Mod. Rational	0.347	1	10	2,061	------	------	------	Post-DA-1P (to New Pavers)

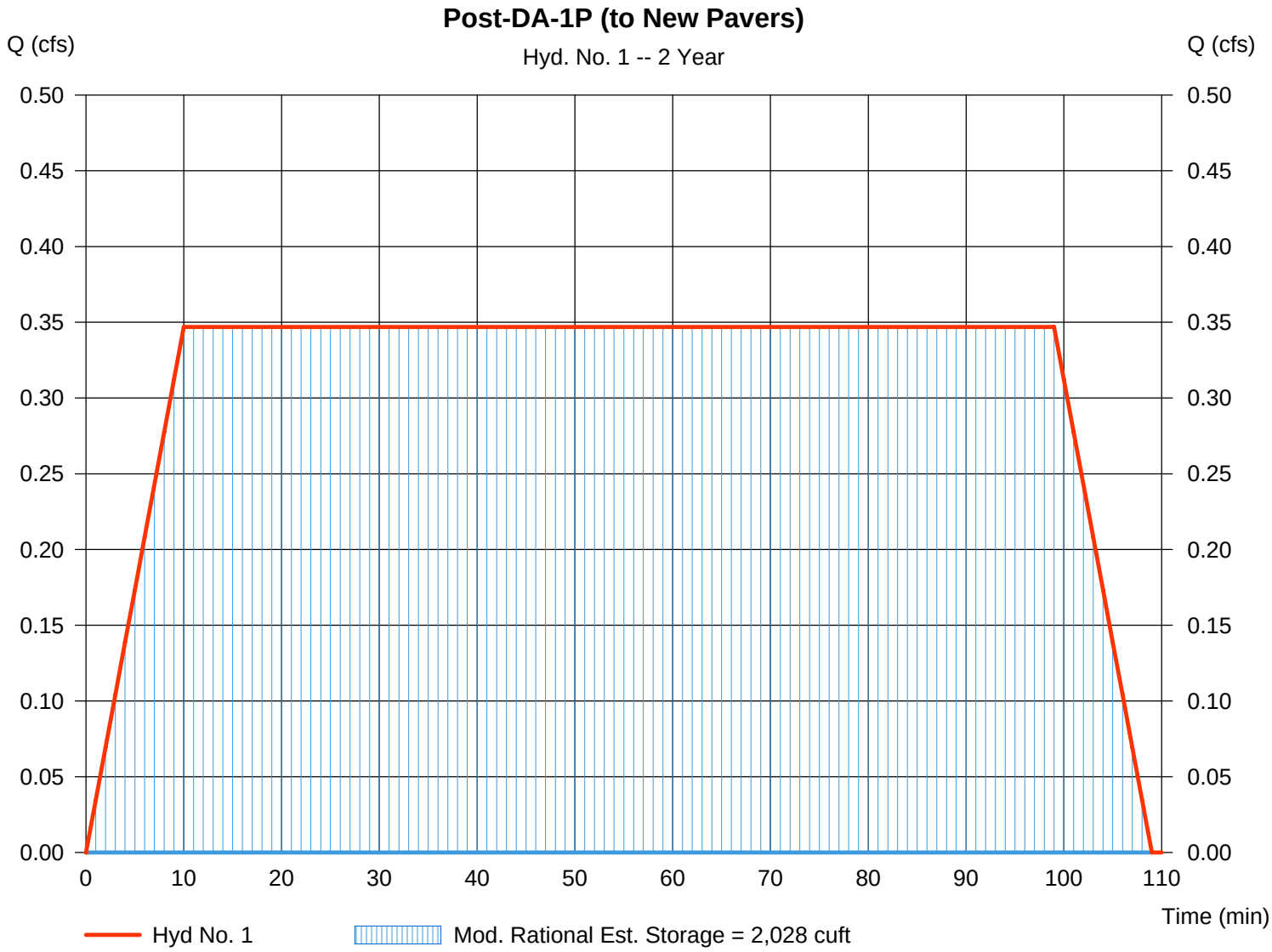
Hydrograph Report

Hyd. No. 1

Post-DA-1P (to New Pavers)

Hydrograph type	=	Mod. Rational	Peak discharge	=	0.347 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	2,061 cuft
Drainage area	=	0.430 ac	Runoff coeff.	=	0.81*
Intensity	=	0.996 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Storm duration	=	9.9 x Tc
Target Q	=	0.010 cfs	Est. Req'd Storage	=	2,028 cuft

* Composite (Area/C) = [(0.160 x 0.51) + (0.270 x 0.99)] / 0.430



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	Mod. Rational	0.467	1	10	2,775	------	------	------	Post-DA-1P (to New Pavers)

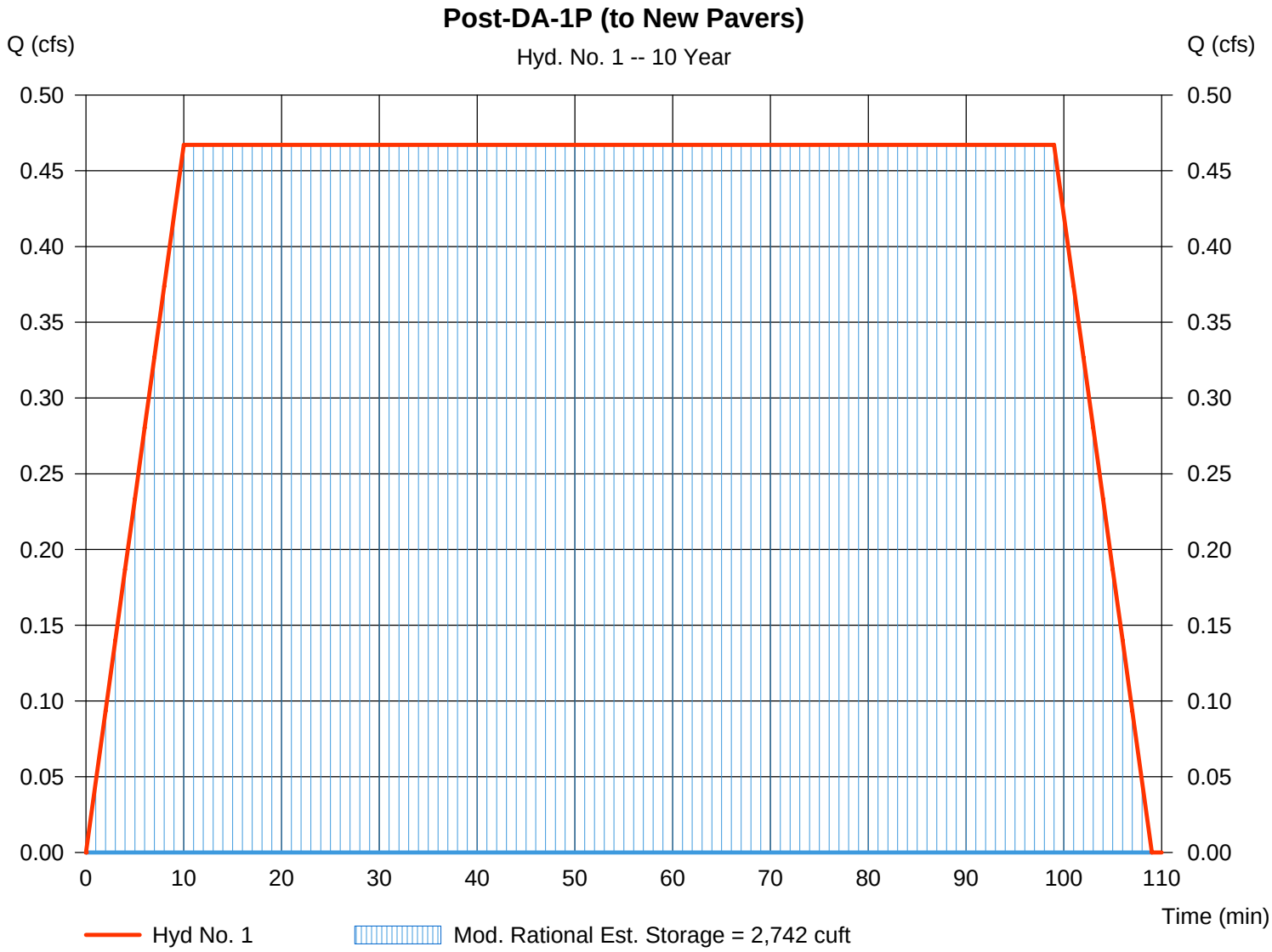
Hydrograph Report

Hyd. No. 1

Post-DA-1P (to New Pavers)

Hydrograph type	=	Mod. Rational	Peak discharge	=	0.467 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	2,775 cuft
Drainage area	=	0.430 ac	Runoff coeff.	=	0.81*
Intensity	=	1.341 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Storm duration	=	9.9 x Tc
Target Q	=	0.010 cfs	Est. Req'd Storage	=	2,742 cuft

* Composite (Area/C) = [(0.160 x 0.51) + (0.270 x 0.99)] / 0.430



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	Mod. Rational	0.686	1	10	4,075	------	------	------	Post-DA-1P (to New Pavers)

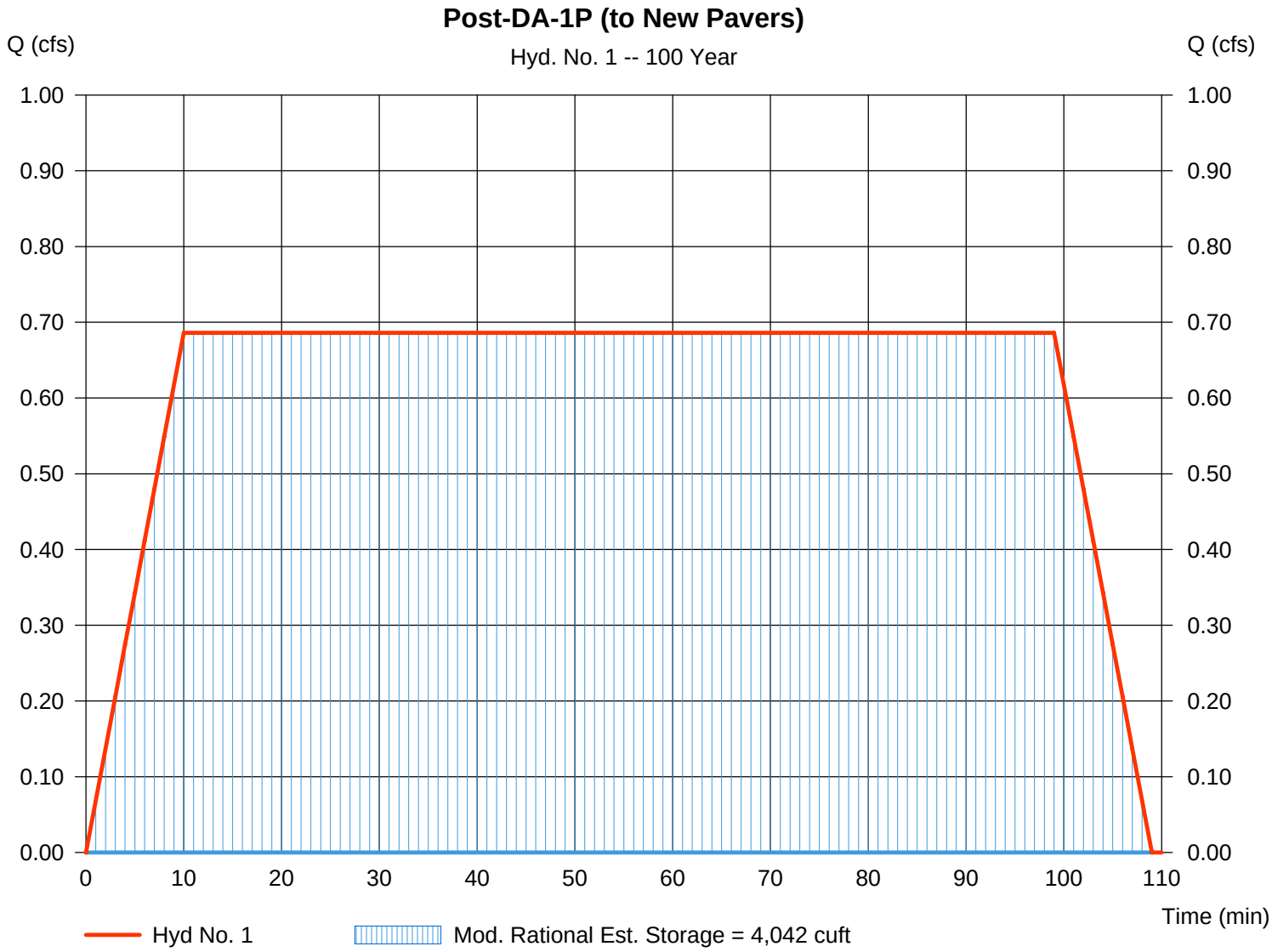
Hydrograph Report

Hyd. No. 1

Post-DA-1P (to New Pavers)

Hydrograph type	=	Mod. Rational	Peak discharge	=	0.686 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	4,075 cuft
Drainage area	=	0.430 ac	Runoff coeff.	=	0.81*
Intensity	=	1.970 in/hr	Tc by User	=	10.00 min
IDF Curve	=	NJ Rational.IDF	Storm duration	=	9.9 x Tc
Target Q	=	0.010 cfs	Est. Req'd Storage	=	4,042 cuft

* Composite (Area/C) = [(0.160 x 0.51) + (0.270 x 0.99)] / 0.430



BRICK PAVER PARKING INFILTRATION ANALYSIS

New Permeable Pavers Area	=	8,633ft^2
Drainage Area to Permeable Pavers	=	18,706 ft^2
Storage Required	=	2,061 ft^3 (2-yr Storm)
		2,775 ft^3 (10-yr Storm)
		4,075 ft^3 (100-yr Storm)
Volume of existing storm sewer located in the new stone storage area	=	187 ft^3

Storage Provided:

$Vol_{Provided} = 1.25\,ft \times 8{,}633\,ft^2$ - 187 ft^3 = 10,604.25 ft^3

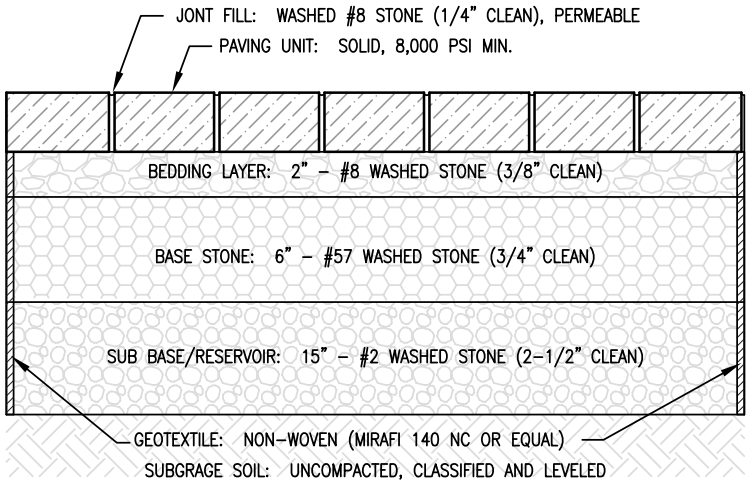
$Vol_{Provided} = 10{,}604.25\,ft^3$

Use clean stone (40% voids)

$NET.Vol_{Provided} = 10{,}604.25\,ft^3 \times 40\%$

$NET.Vol_{Provided} = 4{,}241.70\,ft^3$ > 4,075 ft^3 …….OK

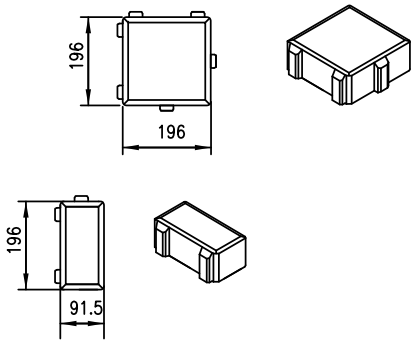
Provide 1.25 ft (15-in) of clean stone for storage below entire new permeable paver parking area additional to structural stone.



INSTALLATION NOTES:

1. INSTALL IN ACCORDANCE WITH MANUFACTURERS RECOMMENDATIONS.
2. LAY UNITS HAND TIGHT TO DESIGNATED PATTERN. LAY UNITS UP–SLOPE. ASSURE UNITS ARE TIGHT AGAINST END CONSTRAINTS. AVOID USING UNITS LESS THAN 3/4" WIDE.
3. BEDDING LAYER TO BE AASHTO #8, 1/4" CLEAN STONE TO A DEPTH OF 2". AVOID CONTAMINATION FROM FINES & DEBRIS. COMPACT USING A 10 TON STATIC ROLLER, MINIMUM 4 PASSES.
4. BASE STONE TO BE AASHTO #57 – 3/4" CLEAN STONE. INSTALL IN 4"–6" LIFTS WITH A 10 TON STATIC ROLLER USING A MINIMUM OF 4 PASSES.
5. INSTALL FILTER FABRIC ALONG SIDE PERIMETER ONLY.
6. JOINT FILL TO BE AASHTO #8, 1/4" CLEAN STONE. PREVENT CONTAMINATION FROM FINES AND DEBRIS. SWEEP STONE TO FILL JOINTS. VIBRATE WITH A 5,000 LB. CENTRIFUGAL FORCE RATED MACHINE. SWEEP AND VIBRATE A SECOND TIME. CHECK TO ASSURE JOINTS ARE FULL.

CONCRETE



JOINTS

DRAINAGE JOINT:
JOINT AREA AS PERCENTAGE OF THE SURFACE: ABOUT 8.5%
JOINT WIDTHS:13 MM

DRAINAGE JOINT:
JOINT AREA AS PERCENTAGE OF THE SURFACE: ABOUT 22%
JOINT WIDTHS:25 MM

DEMAND JOINTS–MATERIAL

DRAINAGE JOINT:
0.0068 M^3 PER M^2 FOR 80 MM STONE HEIGHT
0.0085 M^3 PER M^2 FOR 100 MM STONE HEIGHT

GRASS JOINT:
0.0176 M^3 PER M^2 FOR 80 MM STONE HEIGHT
0.0220 M^3 PER M^2 FOR 100 MM STONE HEIGHT

MAIN STONE (FOR DRAINAGE JOINT)	STONE HEIGHT [MM]	
	80	100
WEIGHT [KG/STONE]	7.4	9.3
WEIGHT [KG/M^2]	169	212
DEMAND [STONES/M^2]	22.8	

MAIN STONE (FOR GRASS JOINT	STONE HEIGHT [MM]	
	80	100
WEIGHT [KG/STONE]	7.4	9.3
WEIGHT [KG/M^2]*	152	190
DEMAND [STONES/M^2]	20.4	

* LOADING WEIGHT WHEN PACKED FOR A DRAINAGE JOINT

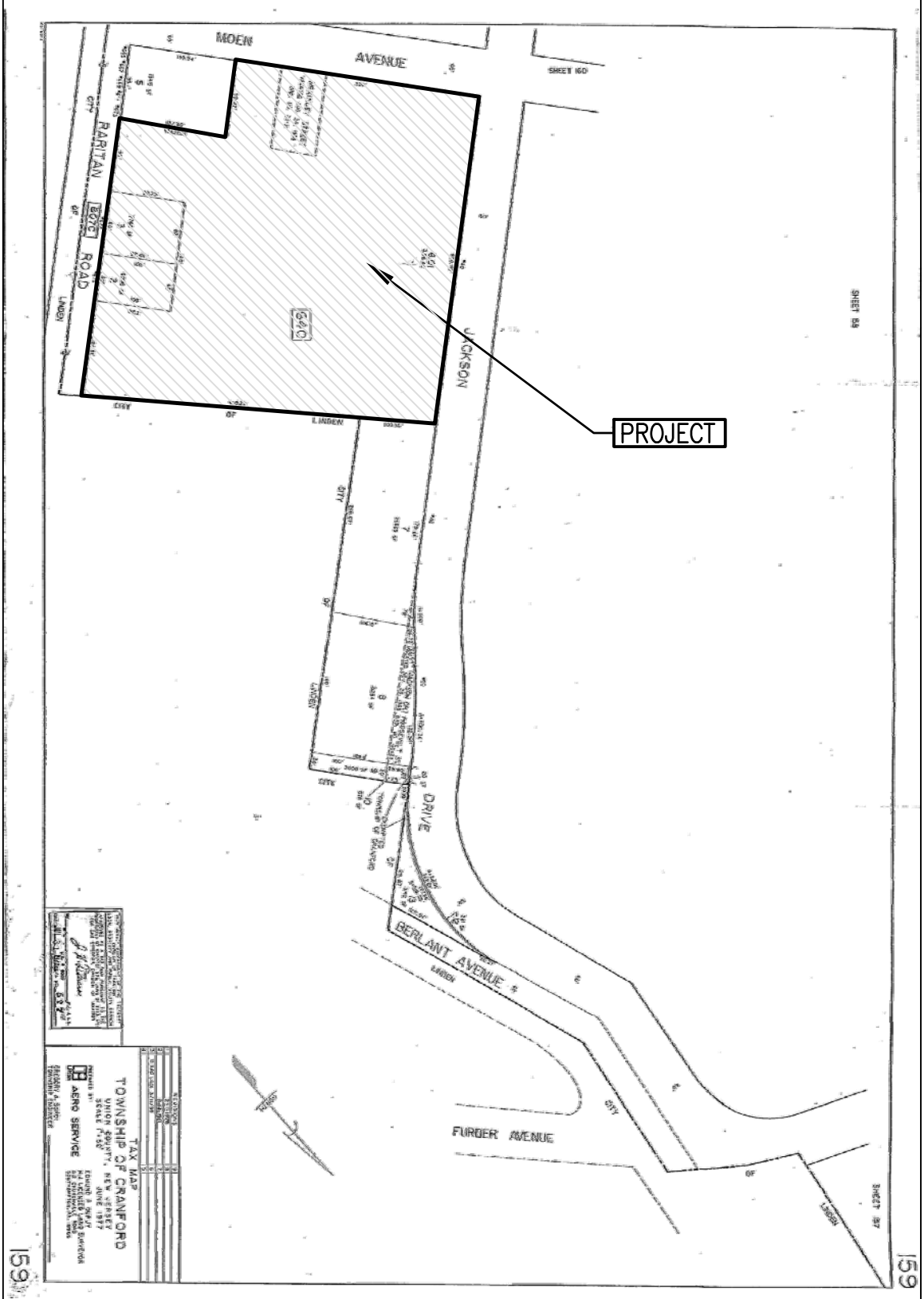
EDGING STONE	STONE HEIGHT [MM]	
	80	100
WEIGHT [KG/STONE]	3.5	4.4
WEIGHT [KG/M^2]	160	201
DEMAND [STONES/M^2]	45.6	
[STONE/METER OF EDGE]	2.4	

PERMEABLE PAVER DRIVEWAY DETAIL

N.T.S.

EXHIBIT 1

LOCATION ON TAX MAP



Harbor Consultants Inc.
Engineers & Surveyors
320 NORTH AVENUE EAST
CRANFORD, N.J. 07016
Phone (908) 276-2715 Fax (908) 709-1738

PRELIMINARY & FINAL SITE PLAN
No. 40-42 JACKSON DRIVE & 677-679 RARITAN ROAD
LOTS 2, 3 & 6.01, BLOCK 640

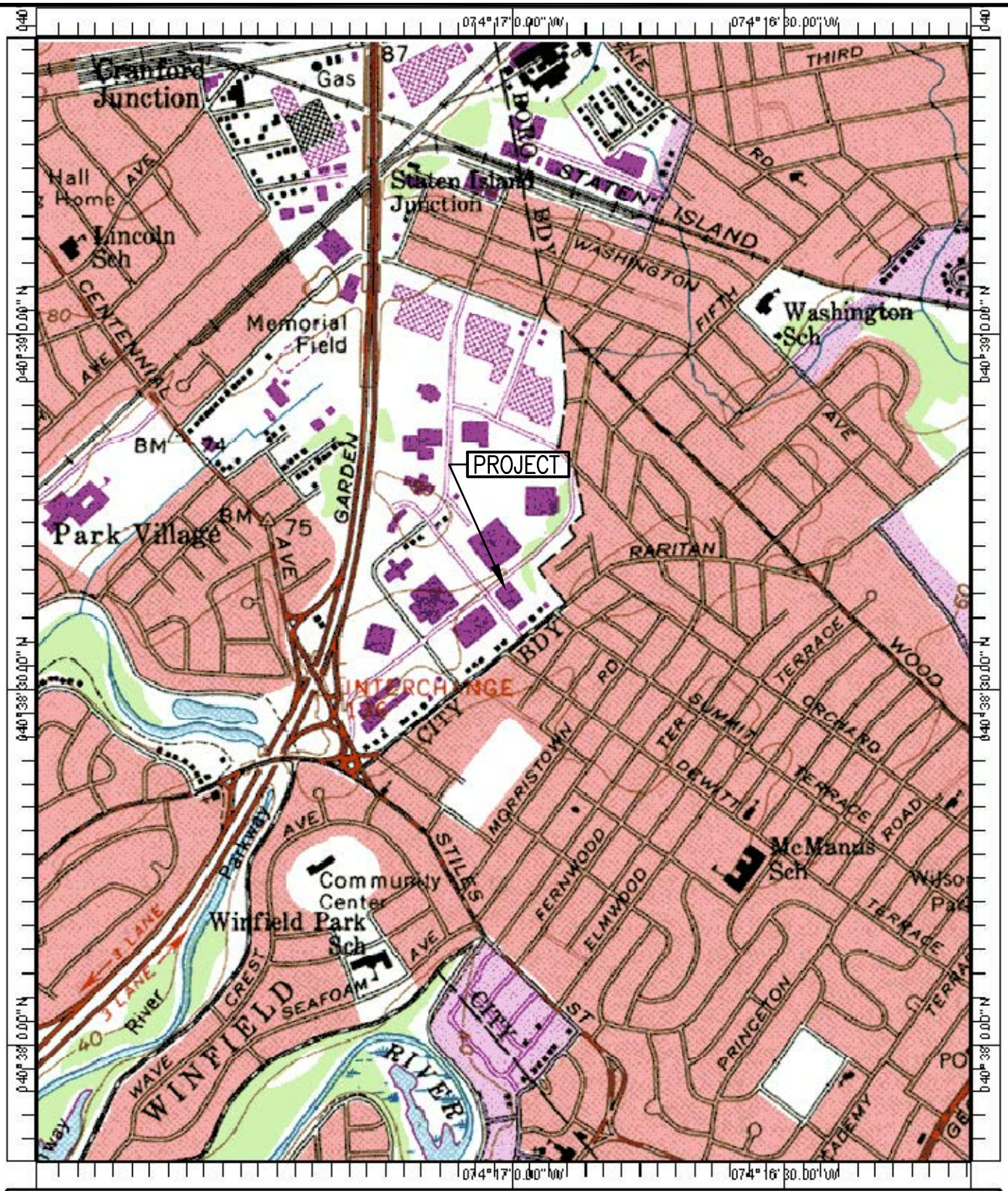
Township of Cranford, Union County, New Jersey
Project:2017036 Date:04/10/2018

EXHIBIT 1
Tax Map

By: S.P.
Scale:N.T.S.

EXHIBIT 2

USGS MAP



Name: ROSELLE
Date: 4/5/2018
Scale: 1 inch equals 1000 feet

Location: 040° 38' 37.6" N 074° 17' 00.9" W

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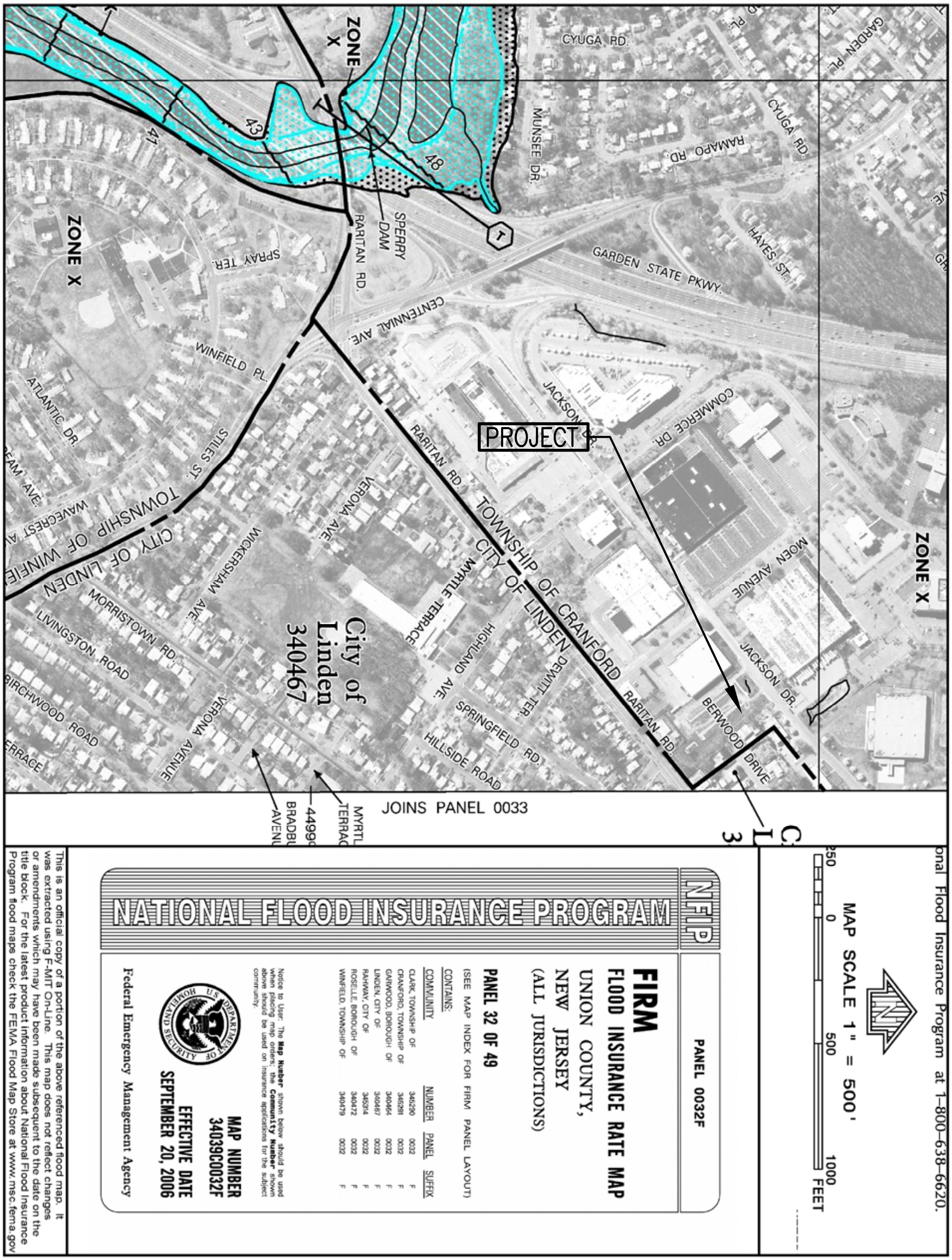
Township of Cranford, Union County, New Jersey
Project:2017036 Date:04/10/2018

EXHIBIT 2
USGS QUAD Map

By: S.P.
Scale:N.T.S.

EXHIBIT 3

FEMA MAP



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PRELIMINARY & FINAL SITE PLAN
No. 40-42 JACKSON DRIVE & 677-679 RARITAN ROAD
LOTS 2, 3 & 6.01, BLOCK 640

Township of Cranford, Union County, New Jersey
Project:2017036 Date:04/10/2018

EXHIBIT 4
FEMA Map

By: S.P.
Scale:N.T.S.

EXHIBIT 4

SOILS REPORT

Map Scale: 1:1,800 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Union County, New Jersey
Survey Area Data: Version 12, Sep 13, 2018

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

Date(s) aerial images were photographed: Aug 25, 2014—Sep 27, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BovB	Boonton-Urban land-Haledon complex, 0 to 8 percent slopes	C	9.1	52.6%
HatB	Haledon-Urban land-Hasbrouck complex, 0 to 8 percent slopes	C	0.7	4.0%
UR	Urban land		7.5	43.4%
Totals for Area of Interest			**17.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

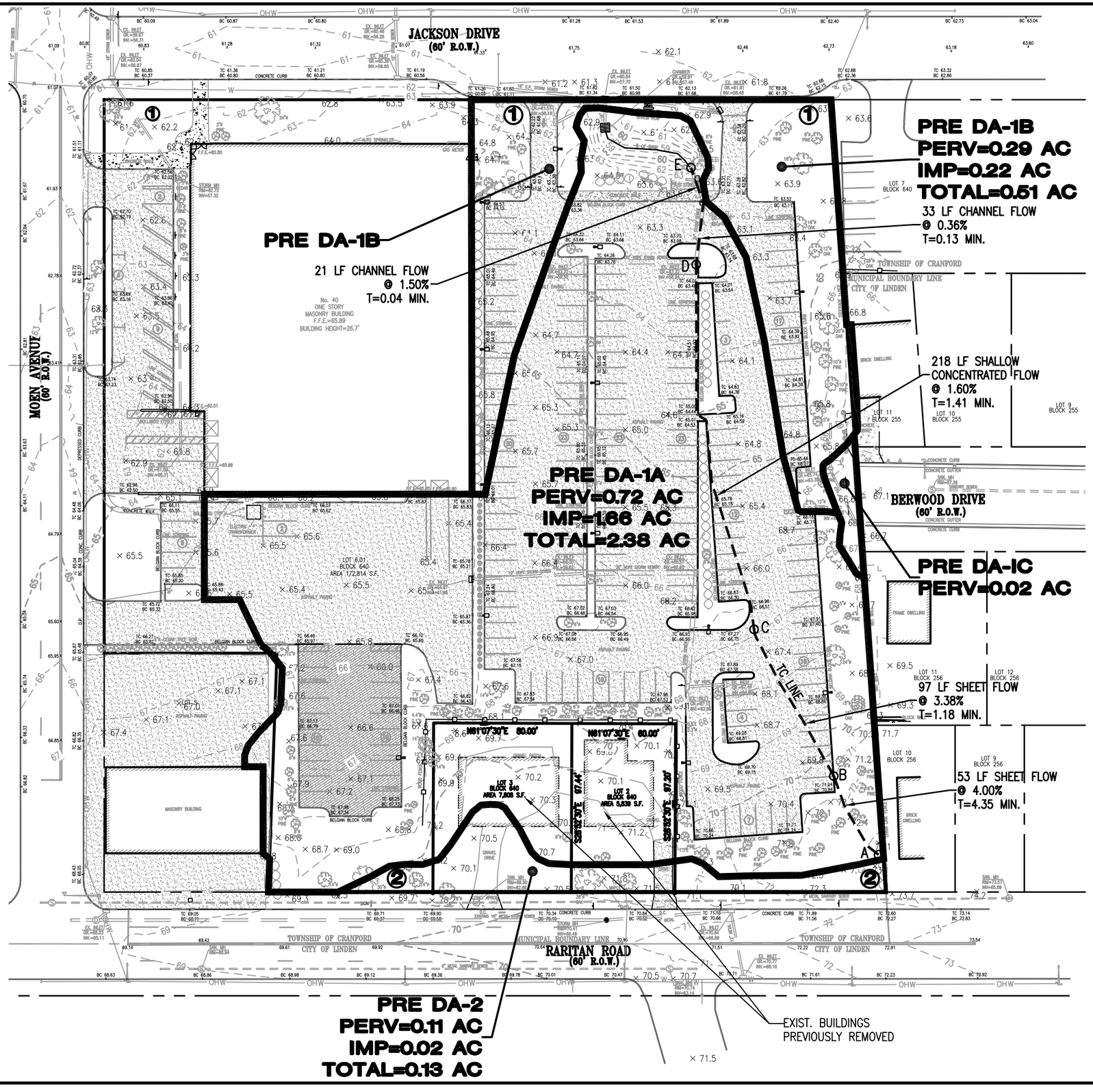
Tie-break Rule: Higher

EXHIBIT 5

PREDEVELOPMENT DRAINAGE PLAN

AND

POSTDEVELOPMENT DRAINAGE PLAN



LEGEND

DRAIN AREA DELINEATION

POINT OF DISCHARGE

REV.	DATE	DESCRIPTION	CHK'D.	APPV'D

Harbor Consultants Inc.
Engineers & Surveyors
320 NORTH AVENUE EAST
CRANFORD, N.J. 07016
Phone (908) 276-2715 Fax (908) 709-1738
Email: info@hcicg.net

1 of 2

PRELIMINARY AND FINAL SITE PLAN

PREDEVELOPMENT DRAINAGE PLAN

No. 40-42 JACKSON DRIVE & 677-679 RARITAN ROAD

LOTS 2, 3 & 6.01, BLOCK 640

TOWNSHIP OF CRANFORD UNION COUNTY NEW JERSEY

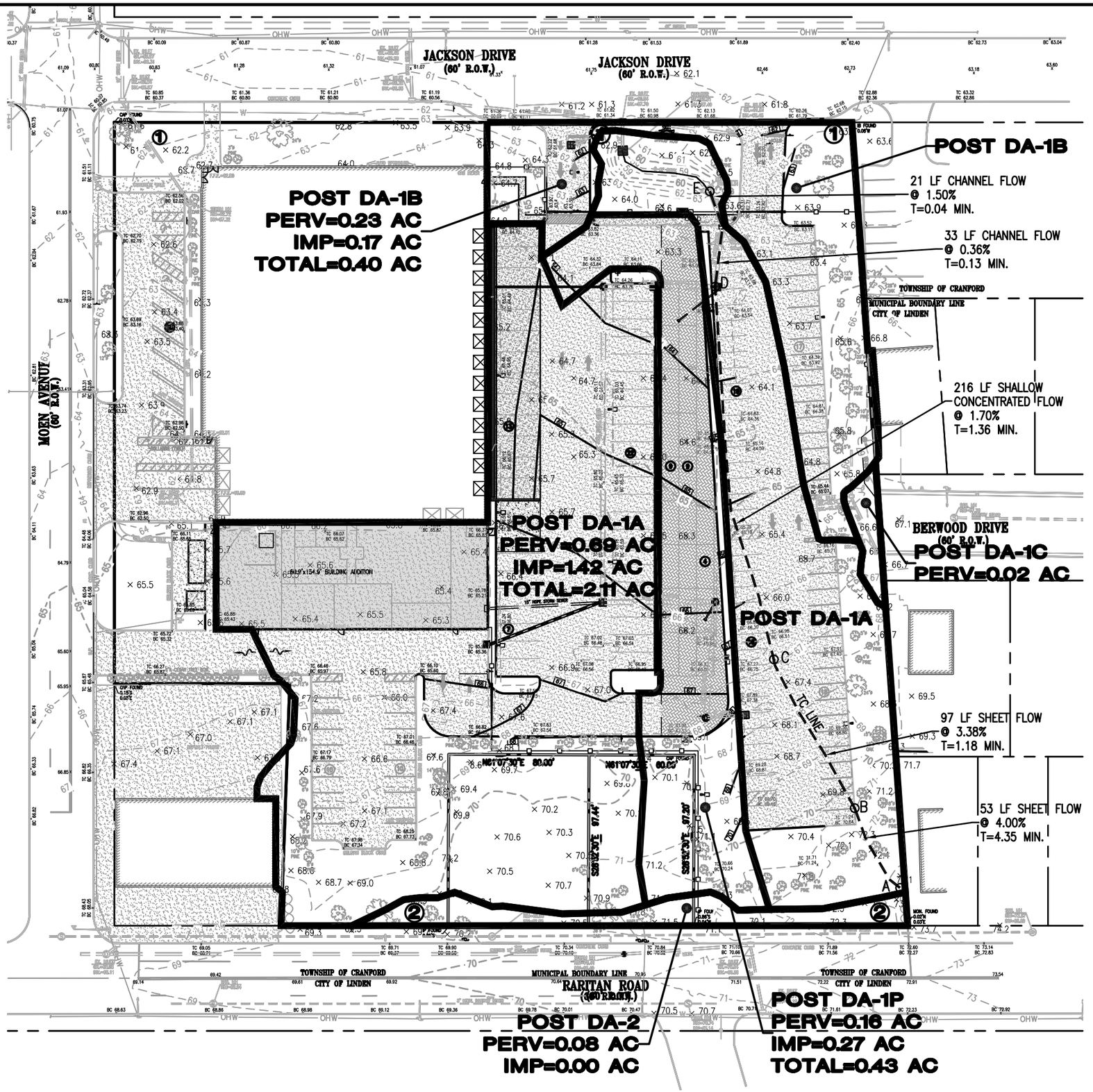
DESIGNER:

JOSE M. BETANCES, PE

N.J. LIC. No. 49055

SCALE:	DATE:	DESIGNED BY:	DRAWN BY:	WORK FILE:	CERTIFICATE OF AUTHORIZATION No.	PROJECT No:
1"=60'	4/16/20	J.M.B.	J.M.B.	2019118_DRAINAGE-PRE	24GA27962100	2019118

T:\2019118 - Food Truck 40-42 Jackson Drive , Cranford\Civil\Drainage\2019118_Drainage-Pre_041620.dwg, 4/17/2020 7:37:11 PM



LEGEND

DRAIN AREA DELINEATION

① POINT OF DISCHARGE

REV.	DATE	DESCRIPTION	CHK'D.	APPV'D

Harbor Consultants Inc.
Engineers & Surveyors
320 NORTH AVENUE EAST
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Phone (908) 276-2715 Fax (908) 709-1738
Email: info@hcicg.net

2 of 2

PRELIMINARY AND FINAL SITE PLAN

POSTDEVELOPMENT DRAINAGE PLAN

No. 40-42 JACKSON DRIVE & 677-679 RARITAN ROAD

LOTS 2, 3 & 6.01, BLOCK 640

TOWNSHIP OF CRANFORD UNION COUNTY NEW JERSEY

DESIGNER:

JOSE M. BETANCES, PE

N.J. LIC. No. 49055

SCALE:	DATE:	DESIGNED BY:	DRAWN BY:	WORK FILE:	CERTIFICATE OF AUTHORIZATION No.	PROJECT No:
1"=60'	4/16/20	J.M.B.	J.M.B.	2019118_DRAINAGE-POST	24GA27962100	2019118

T:\2019118 - Food Truck 40-42 Jackson Drive , Cranford\Civil\Drainage\2019118_Drainage-Post_041620.dwg, 4/17/2020 7:32:45 PM

ANNEX 1

STORMWATER MANAGEMENT OPERATIONS AND MAINTENANCE MANUAL

HARBOR CONSULTANTS INC.

STORMWATER MANAGEMENT

OPERATIONS AND MAINTENANCE MANUAL

FOR

No. 40-42 JACKSON DRIVE & 677-679 RARITAN ROAD

LOTS 2, 3 & 6.01, BLOCK 640

TOWNSHIP OF CRANFORD
UNION COUNTY, NEW JERSEY

September 30, 2019
Rev. April 16, 2020

CIVIL, ENVIRONMENTAL & MUNICIPAL ENGINEERING · PLANNING · SURVEYING · CONSTRUCTION SERVICES
320 North Avenue East · Cranford, NJ 07016 · Tel. 908-276-2715 · Fax 908-709-1738

TABLE OF CONTENTS

SECTION: **PAGE**

I. INTRODUCTION

The purpose of this manual is to provide operation and maintenance guidelines for operating the proposed stormwater management facilities located at No. 40-42 Jackson Drive & 677-679 Raritan Road, Cranford, Union County, New Jersey.

II. GENERAL

A well organized Stormwater Management Operations and Maintenance Manual (O&M) program will protect the facilities against deterioration and prolong its life. The cost of a proper O&M program is minuscule compared to the cost of major repairs for reconstruction of the facilities after a failure. This manual establishes a basic O&M program based primarily on systematic inspections by the operator. During each inspection a record of the inspected elements will be prepared.

This manual is intended as a guide for the operator and outlines the proper procedures for conducting routine O&M for the pervious pavers system. A continuous record of the O&M for the facilities must be maintained. At least two (2) copies of this manual shall be kept by the operator at all times. All correspondence and maintenance checklists shall be distributed for inclusion into the manuals

This manual has been prepared to provide the inspector with a simple and systematic method for inspecting, operating and maintaining the facilities. For the most part, the O&M for the facilities involves observation rather than evaluation. The following sections provide a step by step procedure to assist the Inspector in performing all duties in a rational and orderly manner.

Each time an inspection reveals the need for maintenance, the inspector shall notify the operator who will perform the required work. Each time maintenance is performed, the inspector must record the incident and place a copy of the maintenance report in this manual.

III. OPERATION & MAINTENANCE

1. Description of Facility:

Pervious Paver: The drainage system consists of a pervious paver system along the parking area. A geotextile filter fabric will be installed along the sides of the storage bed to prevent the migration of fine particles under the surrounding soils. The first layer is the permeable paver stones, followed by a 2", #8 washed clean stone, followed by a 6" base stone of #57 washed clean stone and a 15" subbase/reservoir of #2 washed stone.

Aboveground Detention System: The system is located within the north corner of the site along Jackson Drive. The drainage collection system of the site will ultimately discharge into the aboveground basin. Stormwater runoff from the aboveground basin is discharged thru an outlet control structure into the drainage system on Jackson Drive.

Collection System: The onsite stormwater collection system consists of various storm sewer pipes of 15", 24" and 30" diameters, inlets, manholes and a trench drain for the loading dock. The collection system is located within the interior parking lots of Lot 6.01. The entire collection system is tributary to the aboveground detention basin, except for the two inlets and pipes located near Berwood Drive which discharge directly into the public drainage system on Jackson Drive.

2. Inspection Procedure:

The most effective means of conducting the inspection is to treat each component of the system as an individual element in accordance with the inspection checklist found in Sections VIII and IX of this manual. The sequence for inspection of the facility is as follows:

a) Observe the entire surface over the system for settlement. This may be an indication of a collapsed or ruptured pipe or structure.
b) Check the downstream area for erosion.
c) Replenish aggregate in joints if more than ½ in. (13 mm) from chamfer bottoms on paver surfaces.
d) Inspect vegetation around PICP perimeter for cover & soil stability, repair/replant as needed Inspect and repair all paver surface deformations exceeding 1/2 in. (13 mm).
e) Repair pavers offset by more than 1/4 in. (6 mm) above/below adjacent units or curbs, inlets etc.
f) Replace cracked paver units impairing surface structural integrity.
g) Check the interior of the system for build-up of sediment and structural integrity of the pipes.
h) Observe the condition of the inlets, manholes and outlet control structure. Check for settlement, cracks or signs of structural failure or fatigue. Check

for clogging of the pipes.

i) Check the condition of all pipes with respect to settlement or blockages.
j) Record all observations that do not appear to be normal conditions.
k) The findings of the above inspection elements shall be recorded in a written report.

3. Corrective Action:

Immediate maintenance usually requires construction equipment and professional guidance. Immediate maintenance is characterized by the following:

a) Repair or replace damaged pavers.
b) Excessive saturation of ground surface.
c) Repair or replace damaged pipes.
d) Repair structural damage to inlet and manhole structure.
e) Deterioration of the existing drainage system.
f) Clear inlet and manhole structures of debris.
g) Clear a blocked pipe.

4. Continuing Maintenance:

Continuing maintenance will occur on a regular basis and can be performed during the informal inspections or in accordance with the maintenance schedule. Continuing maintenance shall be in accordance with the maintenance checklist and recorded on the maintenance log contained in Section IX of this manual.

Continuing maintenance includes:

a) Observation of any wet areas or springs.
b) Removing of sediment from interior of system.
c) Removing accumulated trash and debris.
d) Monitoring upstream development within the watershed.

IV. INSPECTION SCHEDULE

Permeable Paver: 1 to 2 times annually (typically spring/fall): vacuum surface, adjust vacuuming schedule per sediment loading and/or any sand deposits from winter.

Winter: Remove snow with standard plow/snow blowing equipment; monitor ice on surface for reduced salt use than typically used on impervious pavements.

Water ponding on surface immediately after a storm (paver joints or openings severely loaded with sediment): test surface infiltration rate using ASTM C1701. Vacuum clean to remove surface sediment and soiled aggregate (typically ½ to 1 in. or 13-25 mm deep), refill joints with clean aggregate, sweep surface clean and test infiltration rate again per C1701 to minimum 50% increase.

Overall Drainage System: Additional guidelines for the drainage system are attached in Sections VIII and IX of this manual. Inspections are performed twice a year, once in May and once in November, and after each major storm event. Routine maintenance shall be performed immediately after each major storm event. A written report shall be prepared by the facilities manager for action. All maintenance activities shall be documented.

V. PLAN REVIEW

This section shall be periodically updated to incorporate additional plans and sketches that are developed for the operations, maintenance, inspection or rehabilitation of the facilities and ancillary features. The Inspector shall review available plans prior to conducting an inspection of the basin.

VI. TOOLS & EQUIPMENT

The following is a list of required equipment for routine O&M procedures and inspection:

1. A clip board, a pencil and the inspection checklist – the inspection checklist is included in the following section.
2. A standard 6-foot collapsible ruler.
3. A camera – photographs or observed portions of the basin will provide a measure of performance when comparing past and present maintenance practices or Conditions.
4. A probe – any stiff light stick or rod with a blunt tip of sufficient strength to penetrate

soil. The probe can provide information on conditions below the surface of the ground such as the depth and softness of a saturated area.

5. A weed wacker – can be used to clear non-visible areas.
6. A flashlight – a flashlight can be used to observe the inside of the outlet pipes.

VII. RESPONSIBILITY / FACILITIES MANAGER

The following shall be designated facilities manager and shall be responsible to oversee the operation and maintenance of the facilities. The facilities manager shall be responsible for implementing inspections, performing maintenance and corrective actions and maintaining records of all activities.

Any conveyance of ownership will transfer full responsibility for compliance of the maintenance and repairs. Copies of this maintenance manual should be provided to the local mosquito control or extermination commission upon request.

The responsible party shall also maintain the logs for all inspections and maintenance and should they be required for his responsibilities, make them available to a public entity with an administrative, health, environmental or safety authority.

Facility Manager Contact Information:

Food Truck, Inc.
110 Wall Street, Suite 2-011
New York, NY 10005
Tel 646-745-6841

Facility Location:
40-42 Jackson Drive
Cranford, NJ 07016

SECTION VIII

FORMS

Inspection Checklist
for
Stormwater Management Facilities

Name of Facility: _____

Location: _____ Date: _____

Weather: _____

Facility Item	O.K.[1]	Routine[2]	Urgent[3]	Comments[4]
1. Inlet Structure				
A. Condition of Structure				
B. Erosion				
C. Trash and Debris				
D. Sediment				
E. Aesthetics				
F. Other:				
2. Outlet Structure: (Detention)				
A. Condition of Structure				
B. Erosion				
C. Trash and Debris				
D. Sediment				
E. Aesthetics				
F. Other:				
3. Perimeter				
A.Vegetation				
B. Erosion				
C. Trash and Debris				
E. Aesthetics				
G. Other:				
4. Miscellaneous				
A. Effectiveness of Exist. Maint. Prog.				
B. Potential Mosquito Habitats				
C. Mosquitoes				
D. Other				

1 The item checked is in good condition, and the maintenance program is adequate

2 The item checked requires attention, but does not present an immediate threat to the facility function or other facility components.

3 The item checked requires immediate attention to kepp the facility operational or to prevent damage to other facility components.

4 Provide explanation and details if columns 2 or 3 are checked.

Remarks: (Refer to Item No., If Applicable):

Inspector: _____

Inspection Log
for
Stormwater Management Facilities

Name of Facility: _____

Location: _____

Facility Item	Date:									
	Indicate Condition (i.e. 1, 2 or 3)									
1. Inlet Structure										
A. Condition of Structure										
B. Erosion										
C. Trash and Debris										
D. Sediment										
E. Aesthetics										
F. Other:										
2. Outlet Structure: (Detention)										
A. Condition of Structure										
B. Erosion										
C. Trash and Debris										
D. Sediment										
G. Aesthetics										
G. Other:										
3. Miscellaneous										
A. Effectiveness of Exist.										
Maint. Program										
B. Potential Mosquito Habitat										
C. Mosquitoes										
D. Other										

1 The item checked is in good condition, and the maintenance program is adequate

2 The item checked requires attention, but does not present an immediate threat to the facility function or other facility components.

3 The item checked requires immediate attention to kepp the facility operational or to prevent damage to other facility components.

Remarks: (Refer to Item No., If Applicable):

Maintenance Log
for
Stormwater Management Facilities

Name of Facility: _____

Location: _____

A. Preventative Maintenance

Date:										

Work Item

(√) Completed

1. Grass Cutting

A. Perimeter Areas										
B. Access Areas and Roads										
C. Other:										

2. Grass Mainenance

A. Fertilizing										
B. Re-Seeding										
C. De-Thatching										
D. Pest Control										
E. Other:										

3. Vegetative Cover

A. Fertilizing										
B. Pruning										
C. Pest Control										
D. Other:										

4. Trash and Debris Removal

A. Perimeter Areas										
B. Access Areas										
C. Inlets										
D. Outlets and Trash Racks										
E. Other										

5. Sediment Removal

A. Inlets										
B. Outlets and Trash Racks										
C. Other										

6. Elimination of Potential Mosquito Breeding Habitats

7. Other Preventative Maintenance

A.										
B.										
C.										

B. Corrective Maintenance

Work Item										
1. Removal of Debris & Sediment										
2. Structural Repairs										
3. Dewatering										
4. Control of Mosquitoes										
5. Erosion Repair										
6. Elimination of Trees, Brush, Roots & Animal Burrow										
7. Snow & Ice Removal										
8. Other										

C. Aesthetic Maintenance

Work Item										
1. Graffiti Removal										
2. Grass Trimming										
3. Weeding										
4. Other										

Maintenance Work Order and Checklist
for
Stormwater Management Facilities

Name of Facility: _____

Location: _____ Date: _____

Crew: _____ Work Started: date _____ time _____
Equipment: _____ Work Complet date _____ time _____
Weather: _____ Total Manhours of Work: _____

A. Preventative Maintenance

Work Item	Items Required (√)	Items Done (√)	Comments and Special Instructions
1. Grass Cutting			
A. Perimeter Areas			
B. Access Areas and Roads			
C. Other:			
2. Grass Mainenance			
A. Fertilizing			
B. Re-Seeding			
C. De-Thatching			
D. Pest Control			
E. Other:			
3. Vegetative Cover			
A. Fertilizing			
B. Pruning			
C. Pest Control			
D. Other:			
4. Trash and Debris Removal			
A. Perimeter Areas			
B. Access Areas			
C. Inlets			
D. Outlets and Trash Racks			
E. Other			
5. Sediment Removal			
A. Inlets			
B. Outlets and Trash Racks			
C. Other			
6. Elimination of Potential Mosquito Breeding Habitats			

7. Other Preventative Maintenance

A.			
B.			
C.			

B. Corrective Maintenance

Work Item	Items Required (√)	Items Done (√)	Location, Comments and Special Instructions
1. Removal of Debris & Sediment			
2. Structural Repairs			
3. Dewatering			
4. Control of Mosquitoes			
5. Erosion Repair			
6. Elimination of Trees, Brush, Roots & Animal Burrow			
7. Snow & Ice Removal			
8. Other			

C. Aesthetic Maintenance

Work Item	Items Required (√)	Items Done (√)	Location, Comments
1. Graffiti Removal			
2. Grass Trimming			
3. Weeding			
4. Other			

Remarks: (Refer to Item No., If Applicable):

Work Order Prepared By: _____

Work Completed By: _____

SECTION IX

PERVIOUS PAVERS MAINTENANCE GUIDE

Pervious Pavers Maintenance Guide

Ramsey-Washington Metro Watershed District

Inspection Checklist	Y/N		If yes, perform the following maintenance.
Are weeds growing between the pavers?	Yes ☐	No ☐	Pull all weeds out by the roots to prevent them from returning. Do not use herbicide as it may infiltrate to the groundwater.
Has sediment accumulated between the pavers?	Yes ☐	No ☐	If spaces between pavers are clogged and preventing water from infiltrating, the pavers should be vacuum swept* and aggregate fill material replaced.
Are trash, excessive leaves, grass clippings, or other debris present?	Yes ☐	No ☐	Remove any debris present.
Are any pavers damaged or broken?	Yes ☐	No ☐	Repair damage or replace pavers as needed.
Has the fill material between the pavers been depleted?	Yes ☐	No ☐	Replenish aggregate fill material as necessary.
Is there standing water on or between the pavers 48 hours or more after a rainfall?	Yes ☐	No ☐	This is an indication that your pervious pavers are not functioning as designed, likely due to a larger problem that will require further study and action.

Additional Comments:

Importance of Pervious Pavers

The pervious pavers on your property make a significant positive impact on the water quality of nearby lakes and streams. This kind of surface is designed to reduce stormwater runoff by allowing water to drain through the spaces between the pavers. Water then moves to a layer of coarse gravel. It is temporarily stored in spaces between rocks underneath the pavers until it moves to the surrounding soil. The soil naturally removes pollutants such as phosphorus, nitrogen, and heavy metals from the water. This helps prevent these and other pollutants from entering our lakes and streams where they can cause unwanted algae and degrade water quality. Thank you for your help in protecting our water resources by keeping your pervious pavers looking great and functioning properly.

*A vacuum sweeper is a piece of equipment that removes sediment and other types of debris from the spaces between the pavers. This must be done if pavers become clogged with debris in order to help the pavers drain water properly. Following a thorough cleaning, aggregate fill material must be replaced.