DRAINAGE & STORMWATER MANAGEMENT REPORT

Proposed Residential Conservation Subdivision

Roxbury Road, East Lyme

Prepared For:

Roxbury Road, LLC
282 Franklin Street
Norwich, Connecticut 06360

August 5, 2021

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East Lyme, Connecticut

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1.0 Narrative

The proposed project is a five lot residential conservation subdivision located on Roxbury Road. The location of the site in reference to the USGS Quad Map is attached as Figure 1, and a location map is included on the subdivision plans.

Existing Conditions

The existing property is approximately 8.6 acres of primarily undeveloped woodland with rock outcrops as shown on the subdivision plans. Portions of the property have been disturbed for septic system preparations. An aerial view of the existing property and surrounding area is attached as Figure 2. Existing ground elevations on the site range from approximately 134 to 88. In general stormwater from the property flows via overland flow from north to south/southeast toward an existing approximately 52 acre inland wetland system. A portion of the northeast corner of the property flows offsite to the east. A pre-development watershed map and stormwater flow path is included as Figure 3. The limit of the study for Watershed #1 is along the wetland boundary located to the south/southeast of the proposed development. The limit of the study for Watershed #2 is to the undisturbed tree line located to the east of the proposed lot 1 development.

Proposed Development

The proposed development includes the construction of five residential buildings with associated driveways. Two of the lots will have frontage and access along Roxbury Road. Three of the lots will be located behind (south) of the frontage lots and will be accessed from a common driveway. The proposed site grading has been designed to match the existing drainage patterns as closely as possible. As a low impact development measure stormwater throughout the site will be managed by sheet flow, grass swales, and rain gardens. To help match the existing drainage patterns stormwater runoff from the development will flow toward the existing wetland system located to the east and south of the proposed development via overland flow. Stormwater from the northeast corner of the site will continue to flow toward the east through a rain garden, prior to leaving the site. There is no stormwater point discharge proposed as part of this development. A post development watershed map and stormwater flow path is included as Figure 4.

Analysis:

The overall site stormwater analysis was performed for the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year frequency storms using the USDA/NRCS TR-55 method to determine the peak flow rates and runoff volumes from the existing and post development site. Precipitation data, rainfall intensities, and distribution were acquired from NOAA Atlas 14, Volume 10, Version 3 for the site, and are included in Appendix A. The soils onsite fall into the hydrologic soil group B in the upland areas, and D in the wetlands. A copy of the soil mapping is included in Appendix B. Post development areas that include the placement of 1-foot or more of clean gravel fill and

select fill in accordance with the CT Public Health Code and vegetation, and rain gardens that include 2-feet of pervious topsoil mix have been determined to be in hydrologic soil group A. The runoff curve numbers for the site are based on the ground cover and hydrologic soil group and are included in Table 1.

A summary of the pre-development and post development peak flow rates from the site are included in Table 2. Hydrographs detailing the calculations are included in the Calculations section. Due to the inclusion of low impact development measures including grass swales, rain gardens and gravel/select fill areas with new vegetation the proposed development will reduce the peak flow rates offsite. The reduction will have no negative impact on the wetland system or downstream watershed.

A summary of the pre-development and post development runoff volumes from the site are included in Table 3. The hydrograph volumes are included in the Hydrograph Summary Reports in the Calculations section. Rain gardens #1 and #2 that lie within Watershed 1 were not modeled within the Hydrograph program and therefore their available storage volume is not included in the Hydrograph Summary Report. These rain garden volumes are included in Table 3 and will mitigate the site runoff volumes to provide for no increase in runoff volume from the site. Within Watershed 2, rain garden #3 was modeled in the program and the runoff volume reduction is reflected in the Hydrograph Summary Report and is shown in Table 3.

Table 1 – Curve Numbers

Runoff curve numbers for the existing and post development conditions were compiled from Table 2-2 of the USDA/NRCS TR-55 manual. The following curve numbers were used for the calculations:

Watershed #1

Pre Development	CN	Area
Impervious (roofs, pavement, rock outcrop, etc.)	98	0.30
Woods, HSG B, Poor Condition	66	1.40
Woods, HSG B, Fair Condition	60	5.19

Post Development Conditions	CN	Area
Impervious (roofs, pavement, rock outcrop, etc.)	98	0.70
Open Space (lawns, etc.), HSG B, Good Condition:	61	2.90
Woods, HSG B, Poor Condition	66	0.10
Woods, HSG B, Fair Condition	60	2.90
Rain Gardens/Grass Swales/New Fill Areas	39	0.30

Watershed #2

Pre Development	CN	Area
Impervious (roofs, pavement, rock outcrop, etc.)	98	0.03
Woods, HSG B, Fair Condition	60	0.14

Post Development Conditions	CN	Area
Impervious (roofs, pavement, rock outcrop, etc.)	98	0.04
Open Space (lawns, etc.), HSG B, Good Condition:	61	0.13
Rain Gardens	39	0.01

Weighted curve number calculations are included in the hydrograph reports.

Table 2 – Peak Flow Summary

WATERSHED #1	Peak Flow Rate (CFS)					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Pre Development :	2.673	5.404	8.049	12.060	15.260	18.850
Post Development :	2.620	5.283	7.869	11.780	14.920	18.440
Change :	-0.053	-0.121	-0.180	-0.280	-0.340	-0.410
Percent Change :	-1.98%	-2.24%	-2.24%	-2.32%	-2.23%	-2.18%

WATERSHED #2	Peak Flow Rate (CFS)					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Pre Development :	0.148	0.272	0.387	0.556	0.688	0.834
Post Development :	0.000	0.025	0.112	0.324	0.584	0.823
Change :	-0.148	-0.247	-0.275	-0.232	-0.104	-0.011
Percent Change :	-100.00%	-90.81%	-71.06%	-41.73%	-15.12%	-1.32%

Table 3 – Runoff Volume Summary

WATERSHED #1	Runoff Volume (CF)					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Pre Development :	15,750	28,198	40,096	58,144	72,647	88,992
Post Development :	15,915	28,493	40,516	58,753	73,408	89,924
Less Rain Garden Storage :	1,629	1,629	1,629	1,629	1,629	1,629
Change :	-1,464	-1,334	-1,209	-1,020	-868	-697
Percent Change :	-9.30%	-4.73%	-3.02%	-1.75%	-1.19%	-0.78%

WATERSHED #2	Runoff Volume (CF)					
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year
Pre Development :	523	886	1,223	1,726	2,125	2,570
Post Development :	0	347	711	1,251	1,678	2,154
Change :	-523	-539	-512	-475	-447	-416
Percent Change :	-100.00%	-60.84%	-41.86%	-27.52%	-21.04%	-16.19%

2.0 Stormwater Quality

To meet the Connecticut DEEP stormwater discharge water quality requirements low impact development measures have been designed for the site in accordance with the 2004 Connecticut Stormwater Quality Manual to treat the proposed runoff. To help match the existing drainage patterns stormwater runoff from the development will flow toward the existing wetland system via overland flow. A minimum 100-ft undisturbed upland wooded area will surround the wetlands. Yuan et al. (2009) reviewed the effectiveness of vegetated buffers on water quality and found that "the sediment trapping efficiency was at least 80% for all buffer widths of greater than approximately 5 m." While slope had an impact on the sediment trapping efficiency in the studies, buffer width in excess of 15 m (49.2-ft) produced sediment trapping efficiencies of 80% or more. All land clearing for the proposed development is at least 103-ft from the wetland boundary. This buffer will provide more than adequate width to treat the stormwater runoff and provide the 80% removal of total suspended solids in accordance with the Stormwater Quality Manual prior to entering the wetland system.

Rain Garden #1 is proposed to treat a portion of the common driveway. The rain garden provides adequate volume to treat the stormwater runoff from the common driveway in accordance with the DEEP Stormwater Quality Manual, calculations are attached.

Rain Garden #3 is proposed to treat a portion of the Lot 1 driveway that flows offsite to the east. The rain garden provides adequate volume to treat the stormwater runoff from the common driveway in accordance with the DEEP Stormwater Quality Manual, calculations are attached.

References

Yuan, Yongping, Binger, Ronald L., and Locke, Martin A., 2009, A Review if effectiveness of vegetative buffers on sediment trapping in agricultural areas, *Ecohydrology* 2, 321-336 (2009)

Rain Garden #1 – Water Quality Volume Calculation:

The stormwater from a portion of the common driveway for Lots 3, 4, and 5 will be directed to a rain garden to provide water quality improvements. The driveway will be pitched between stations 2+10 and station 4+20 toward a grass swale that will direct the stormwater to the rain garden. The basin volume has been sized to store the water quality volume (WQV) in accordance with the 2004 Connecticut Stormwater Quality Manual. The minimum volume is as follows:

Water Quality Basin Sizing - Rain Garden #1		
Sizing in Accordance with Chapter 7.4 of the DEP 2004 Storm Water Quality Manual Water Quality Volume (WQV) = (1")(R)(A) / 12 R = 0.05 + 0.009(I) I = percent of impervious cover A = watershed area		
Total Watershed Area (Ac.) :	2.02	
Watershed Impervious Area (Ac.) :	0.18	
I =	8.9%	
R =	0.130	
Required WQV =	0.022	Ac.-Ft
	954.7	CF
WQV Provided :	**1,086**	CF

Rain Garden #3 – Water Quality Volume Calculation:

The stormwater from a portion of the driveway for Lot 1 that flows to the east will be directed to a rain garden to provide water quality improvements. The basin volume has been sized to store the water quality volume (WQV) in accordance with the 2004 Connecticut Stormwater Quality Manual. The minimum volume is as follows:

Water Quality Basin Sizing - Rain Garden #3		
Sizing in Accordance with Chapter 7.4 of the DEP 2004 Storm Water Quality Manual Water Quality Volume (WQV) = (1")(R)(A) / 12 R = 0.05 + 0.009(I) I = percent of impervious cover A = watershed area		
Total Watershed Area (Ac.) :	0.18	
Watershed Impervious Area (Ac.) :	0.04	
I =	22.2%	
R =	0.250	
Required WQV =	0.004	Ac.-Ft
	163.4	CF
WQV Provided :	**543**	CF

3.0 Groundwater Recharge

For the purposes of the calculation, the required groundwater recharge volume will be provided within rain garden #1 as follows:

Per DEP 2004 Storm Water Quality Manual:
Hydrologic Soil Group Approach
Required Ground Water Recharge Volume (GRV) = (D)(A)(I) / 12

GRV = groundwater recharge volume (ac-ft)
D = depth of runoff to be recharged (in.) (table 7.4 of the manual)
A = site area (acres)
I = post-development site imperviousness (decimal)

A (total): 6.90 ac.
A (impervious): 0.70 ac.

I = 0.70 ac. / 6.90 ac. = 0.10

NRCS Soil Group "B": D = 0.25 in. (from table 7-4)

GRV = (0.25 in)(6.9 ac.)(0.10) / 12 = 0.014 ac-ft = 610 cf (required)

Provided: 1,086 cf provided in rain garden #1below the high level overflow

4.0 Grass Swale Calculations

A grass swale has been designed to run parallel with the common driveway for Lots 3, 4, and 5. The grass swale will convey stormwater from a portion of the common driveway and the embankment south of the lot 3 house to Rain Garden #1. The rational method was used to determine the peak flow rate for the 100-year storm for the swale. As a factor of safety a high runoff coefficient of 0.8 was used for the watershed. The peak flow rate for the 100-year storm is 7.9 CFS, a hydrograph report is included in the Calculations section.

Channel reports for the swale are included in the Calculations sections. The calculations were run for two extreme scenarios: The swale at the shallowest slope with dense vegetation to ensure the swale has adequate capacity to convey the flow, and the swale at the steepest slope with fair vegetation to ensure the stormwater velocity will not be erosive.

The calculations show that the swale has adequate capacity to convey the 100-year storm.

The maximum velocity within the swale is 2.48 ft/s. The general soil for the swale would be a sandy loam and loam. The maximum permissible velocity would be 2.5 ft/s, assuming the established grass swale had a fair vegetative condition. The maximum velocity of 2.48 ft/s for a 100-year storm falls below this threshold.

Figure VW-1 Maximum Permissible Velocity (ft./sec.)

Soil Texture	Channel Vegetation Condition[1]			
	Poor	Fair	Good	Stone Center
Sand, silt loam, sandy loam, loamy sand, loam and muck	2.0	2.5	3.5	8.0
Silty clay loam, sandy clay loam, clay, clay loam, sandy clay, silty clay	3.0	4.0	5.0	8.0

[1]For channels with geosynthetic turf reinforcement, permissible velocities shall be designed on a product-specific basis and for long duration flows (>24 hours).

Source: USDA-NRCS

5.0 Stormwater Management

During Construction

The stormwater pollution prevention plan and all erosion and sedimentation control measures have been designed in accordance with the 2002 Connecticut Guidelines for Soil Erosion and Sedimentation Control.

The location of erosion and sedimentation control measures for the overall subdivision and the individual lot development are included in the subdivision plan set. Construction details and an erosion and sedimentation control narrative are also included in the plan set. The narrative and construction details outline the requirements for stabilization of disturbed areas, slope stabilization requirements, and maintenance requirements.

In general silt fence, will be installed around the perimeter of the development. A stone anti-tracking pad will be installed at the construction entrance to each driveway. Stockpile areas will be surrounded by silt fence, hay bales, or sediment logs (wattles).

Stormwater Management & Pollution Prevention:

Provisions for stormwater management and pollution prevention are outlined on the plans and are as follows:

1. Pollution Prevention Team:
   The Contractor shall be responsible for carrying out the provisions of the plan.
2. Sweeping:
   Impervious surfaces beyond the work site shall be swept clean of sand, silt, and litter daily at the end of the work day.
3. Outside Storage:
   Accessories or equipment stored outside shall be covered or maintained to minimize the possibility of these materials or their residue passing to stormwater.
4. Washing:
   No washing of vehicles, accessories, equipment, or appliances in the work site.
5. Maintenance and Inspection:
   a. The Contractor shall inspect, repair, and/or replace erosion control measures every 7 days and immediately following any significant rainfall or snow melt.
   b. Sediment deposits must be removed when deposits reach approximately one-half the height of the barrier.
   c. Daily dust control using water or approved equal shall be provided for all earth stockpiles, earth piled along excavations, surfaces of backfilled trenches and gravel surfaces.

6. Spills or Accidental Discharges:
    a. Comply with State and Federal regulations to contain and clean up any spill or discharge and dispose of materials at an approved facility.
    b. Contact Connecticut DEEP oil and chemical spill response division 860-424-3338.
    c. The following steps should be performed as soon as possible
        - Stop the source of the spill
        - Contain the spill
        - Cover the spill with absorbent material such as kitty litter, saw dust, or oil absorbent pads. Do not use straw.
        - Dispose of absorber in accordance with Local and State regulations.

Post Construction

There are no point discharges, stormwater structures, other infrastructure, or public improvements that would require Town operations or maintenance. The individual homeowners will be responsible for routine operation and maintenance of the rain gardens and grass swales onsite. The typical maintenance and operations schedule and requirements for these features is as follows

Maintenance Schedule for Rain Gardens	
Activity	Schedule
• Mow Bottom	As needed
• Replenish mulch around plantings	Yearly or as needed
• Remove sediment and leaf litter	Semi-annual During April (after snow melt) Between Nov. 15 and Dec. 15 (after leaf fall)

Maintenance Schedule for Grass Swales	
Activity	Schedule
• Remove sediment and leaf litter	Semi-annual During April (after snow melt) Between Nov. 15 and Dec. 15 (after leaf fall)
• Mow	As needed

FIGURES

CLA Engineers, Inc.
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LOCATION MAP

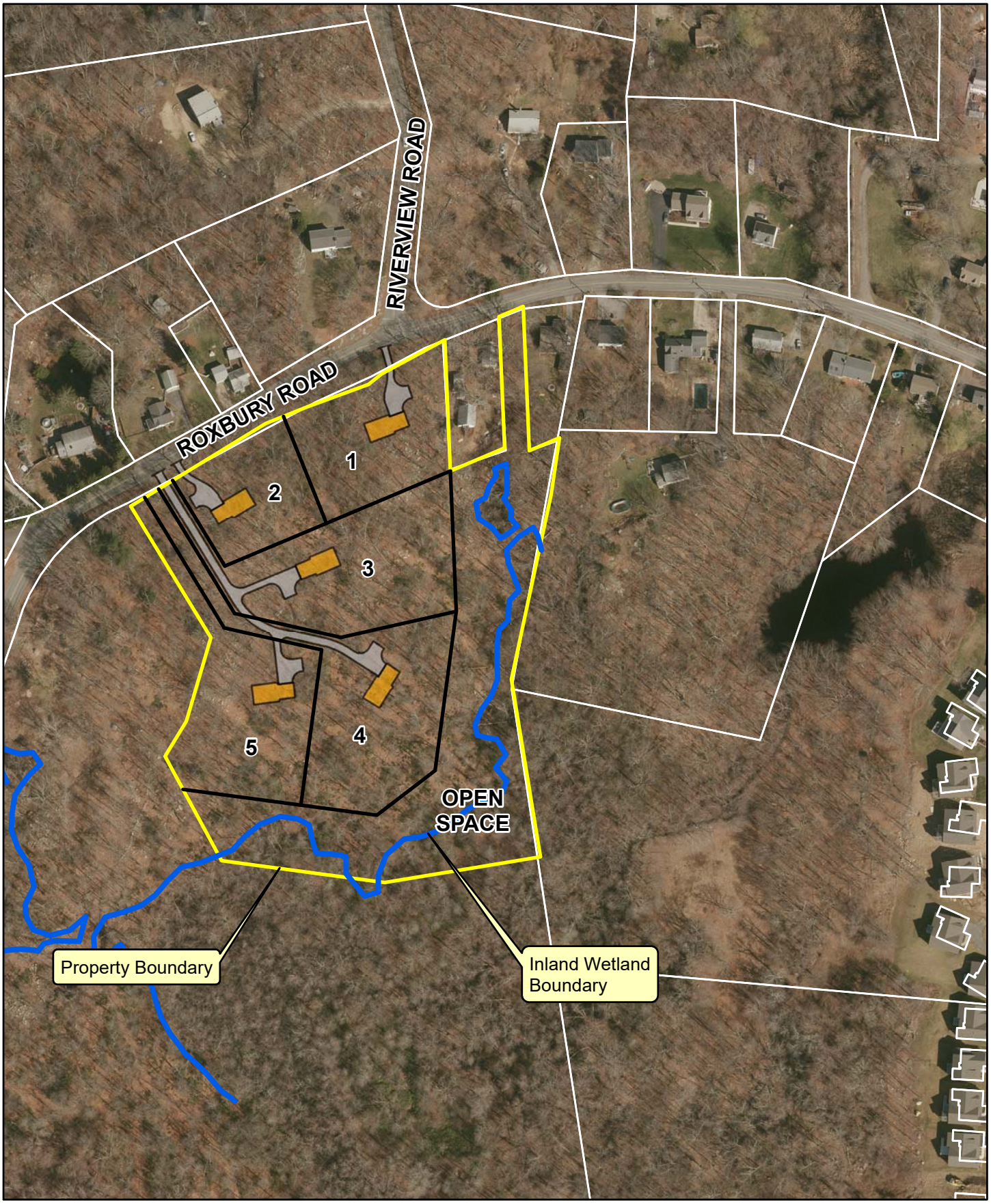
Proposed Residential
Conservation Subdivision
Roxbury Road, East Lyme, Connecticut
Niantic Quad (#101)

DATE: Feb. 3, 2020
SCALE: 1 in = 2,000 ft
SOURCE: USGS Quad

N

FIGURE

1



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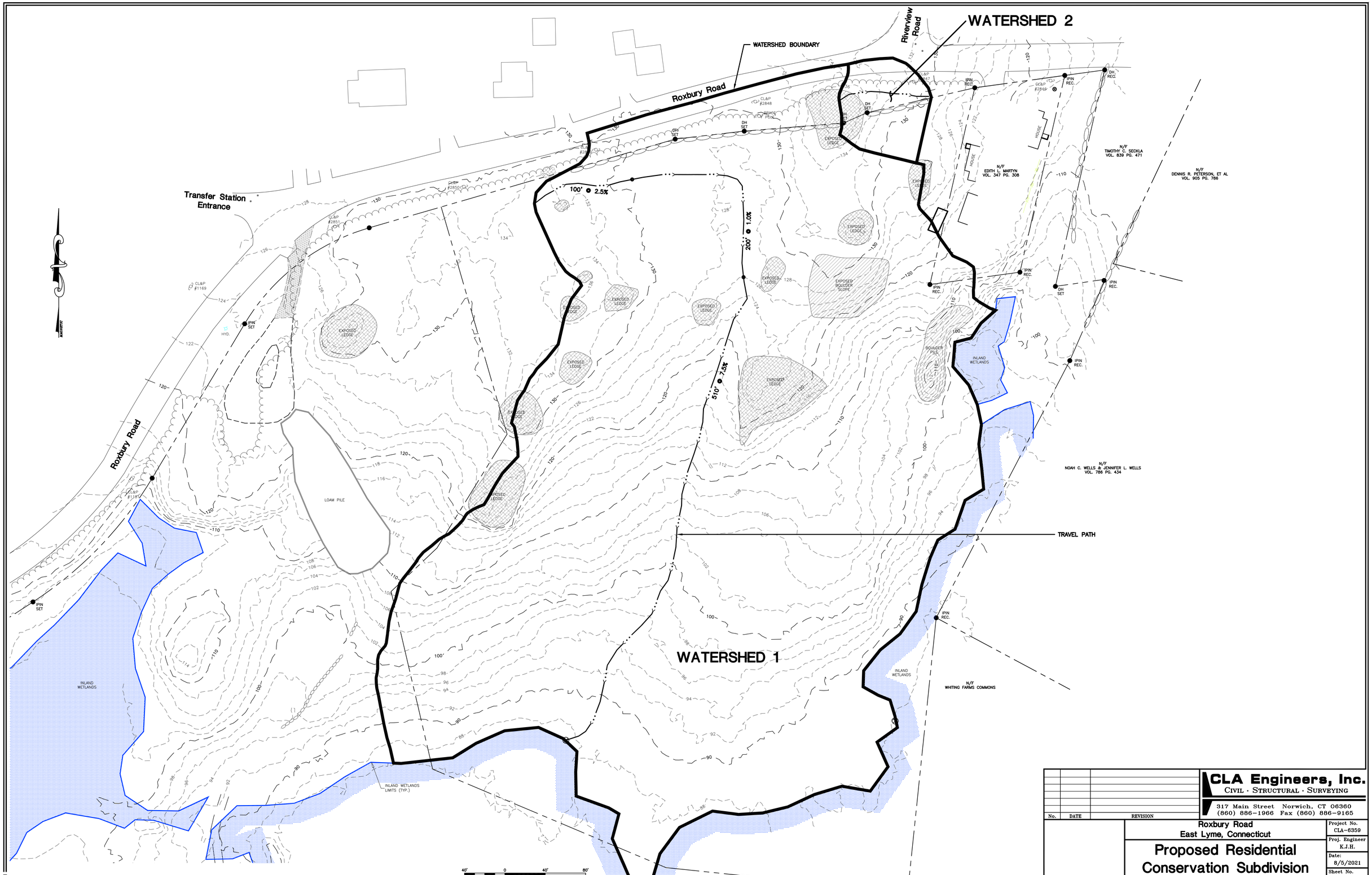
AERIAL MAP

Proposed Residential Conservation Subdivision
Roxbury Road, East Lyme, Connecticut

DATE: Feb. 3, 2020
SCALE: 1 in = 200 ft
SOURCE: CT ECO
N

FIGURE
2



CLA

No.	DATE	REVISION

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Roxbury Road
East Lyme, Connecticut

Proposed Residential Conservation Subdivision

Pre Development Watersheds

Project No. CLA-6359
Proj. Engineer K.J.H.
Date: 8/5/2021
Sheet No. 3

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WATERSHED 2

WATERSHED BOUNDARY

Roxbury Road

Riverview Road

Transfer Station Entrance

RAIN GARDEN #3

RAIN GARDEN

RAIN GARDEN #1

PROPOSED TREE LINE AND CLEARING LIMITS (TYP.)

TRAVEL PATH

VEGETATED FILL SLOPE

VEGETATED FILL SLOPE (SELECT FILL)

PROPOSED 3 BEDROOM HOUSE F.F.=135.0±

PROPOSED 4 BEDROOM HOUSE F.F.=126.0±

PROPOSED 4 BEDROOM HOUSE F.F.=117.0±

PROPOSED 4 BEDROOM HOUSE F.F.=105.5±

PREVIOUSLY APPROVED 2-BEDROOM RESIDENCE

CAR PORT

GAR.

DECK

EXPOSED LEDGE

EXPOSED BOULDER SLOPE

LOAM PILE

BOULDER PILE

INLAND WETLANDS

INLAND WETLANDS LIMITS (TYP.)

100' @ 2.2%

188' @ 1.5%

123' @ 9.5% (AVERAGED W/ SECTION DOWNSTREAM OF RAIN GARDEN)

90' @ 0.1%

240' @ 9.5% (AVERAGED W/ SECTION UPSTREAM OF RAIN GARDEN)

1

2

3

4

5

OPEN SPACE

WATERSHED 1

N/F TIMOTHY C. SECKLA VOL. 839 PG. 471

N/F EDITH L. MARTYN VOL. 347 PG. 308

N/F DENNIS R. PETERSON, ET AL VOL. 905 PG. 786

N/F NOAH C. WELLS & JENNIFER L. WELLS VOL. 786 PG. 434

N/F WHITING FARMS COMMONS

CL&P #2848

CL&P #2850

CL&P #1169

CL&P #1187

IPIN REC.

IPIN SET

DH SET

DH REC.

HYD.

HOUSE

SCALE: 1"=40'

40' 0 40' 80'

CLA

No.	DATE	REVISION

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Roxbury Road
East Lyme, Connecticut

Proposed Residential Conservation Subdivision

Post Development Watershed

Project No. CLA-6359
Proj. Engineer K.J.H.
Date: 8/5/2021
Sheet No. 4

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CALCULATIONS:

Hydrograph Reports
2, 5, 10, 25, 50, and 100-Year Frequencies

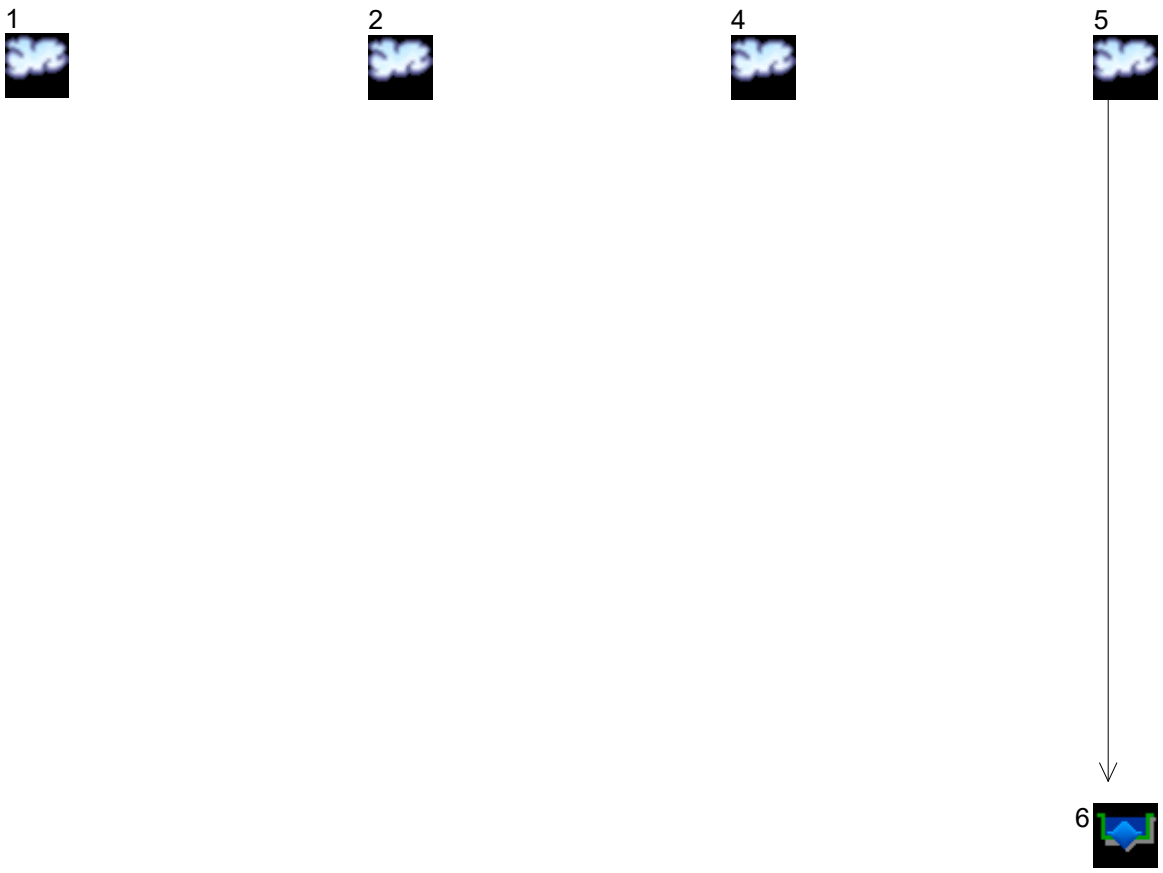
Hydraflow Table of Contents

6359 - TR55.gpw

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Aug 6, 2021

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	Watershed 1 - PRE
2	SCS Runoff	Watershed 1 - POST
4	SCS Runoff	Watershed 2 - PRE
5	SCS Runoff	Watershed 2 - POST
6	Reservoir	Rain Garden #3 Disch.

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	------	-------	2.673	-------	5.404	8.049	12.06	15.26	18.85	Watershed 1 - PRE
2	SCS Runoff	------	-------	2.620	-------	5.283	7.869	11.78	14.92	18.44	Watershed 1 - POST
4	SCS Runoff	------	-------	0.148	-------	0.272	0.387	0.556	0.688	0.834	Watershed 2 - PRE
5	SCS Runoff	------	-------	0.170	-------	0.305	0.429	0.610	0.752	0.908	Watershed 2 - POST
6	Reservoir	5	-------	0.000	-------	0.025	0.112	0.324	0.584	0.823	Rain Garden #3 Disch.

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	SCS Runoff	2.673	1	742	15,750	------	------	------	Watershed 1 - PRE
2	SCS Runoff	2.620	1	744	15,915	------	------	------	Watershed 1 - POST
4	SCS Runoff	0.148	1	725	523	------	------	------	Watershed 2 - PRE
5	SCS Runoff	0.170	1	725	588	------	------	------	Watershed 2 - POST
6	Reservoir	0.000	1	792	0	5	129.93	509	Rain Garden #3 Disch.

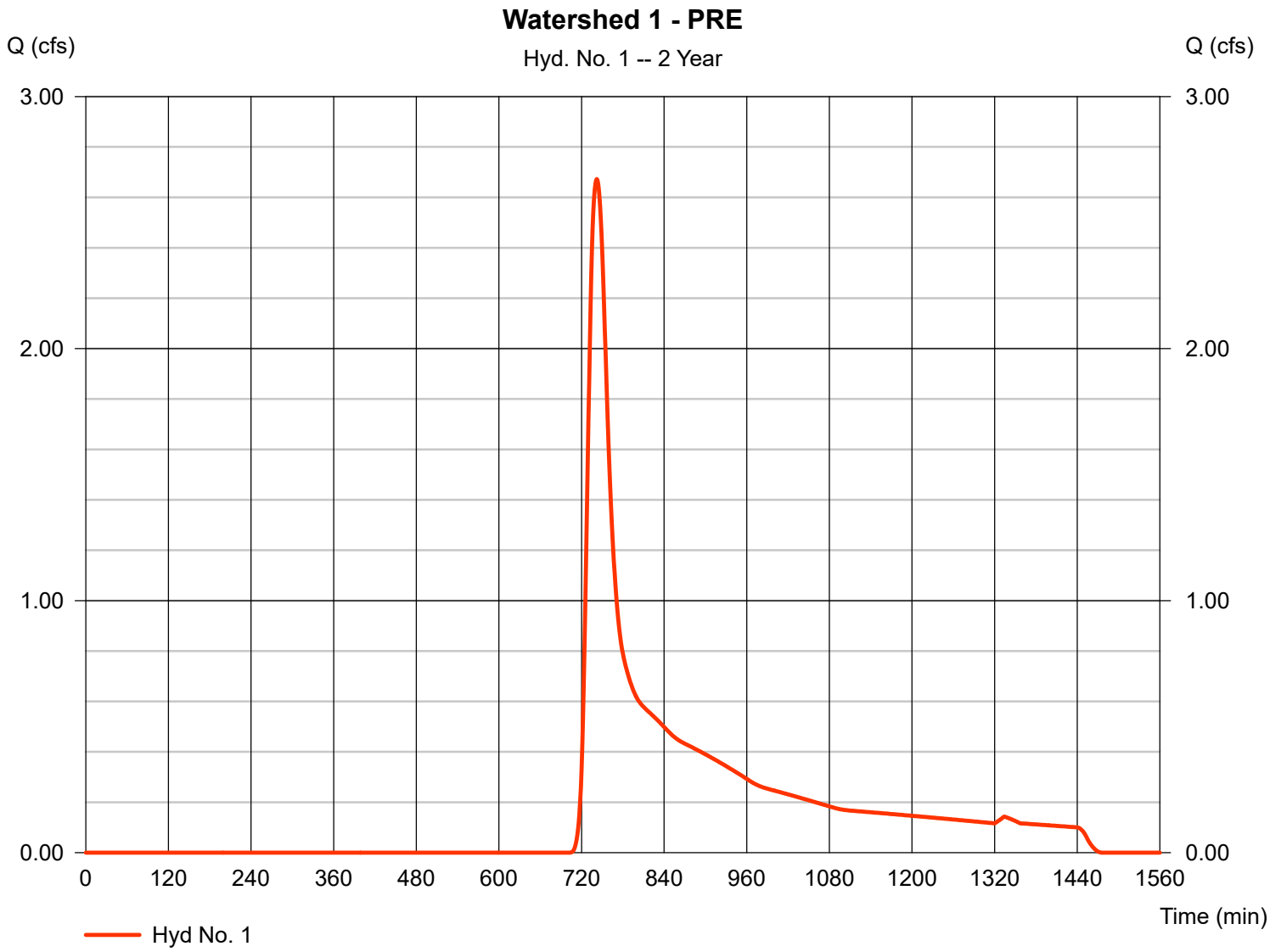
Hydrograph Report

Hyd. No. 1

Watershed 1 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.673 cfs
Storm frequency	=	2 yrs	Time to peak	=	742 min
Time interval	=	1 min	Hyd. volume	=	15,750 cuft
Drainage area	=	6.890 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.90 min
Total precip.	=	3.45 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(5.190 x 60) + (1.400 x 66) + (0.300 x 98)] / 6.890



TR55 Tc Worksheet

Hyd. No. 1

Watershed 1 - PRE

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.400		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.45		0.00		0.00		
Land slope (%)	=	2.50		0.00		0.00		
Travel Time (min)	**=**	**18.92**	**+**	**0.00**	**+**	**0.00**	**=**	**18.92**
Shallow Concentrated Flow								
Flow length (ft)	=	200.00		510.00		0.00		
Watercourse slope (%)	=	1.00		7.50		0.00		
Surface description	=	Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=	1.61		4.42		0.00		
Travel Time (min)	**=**	**2.07**	**+**	**1.92**	**+**	**0.00**	**=**	**3.99**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 22.90 min

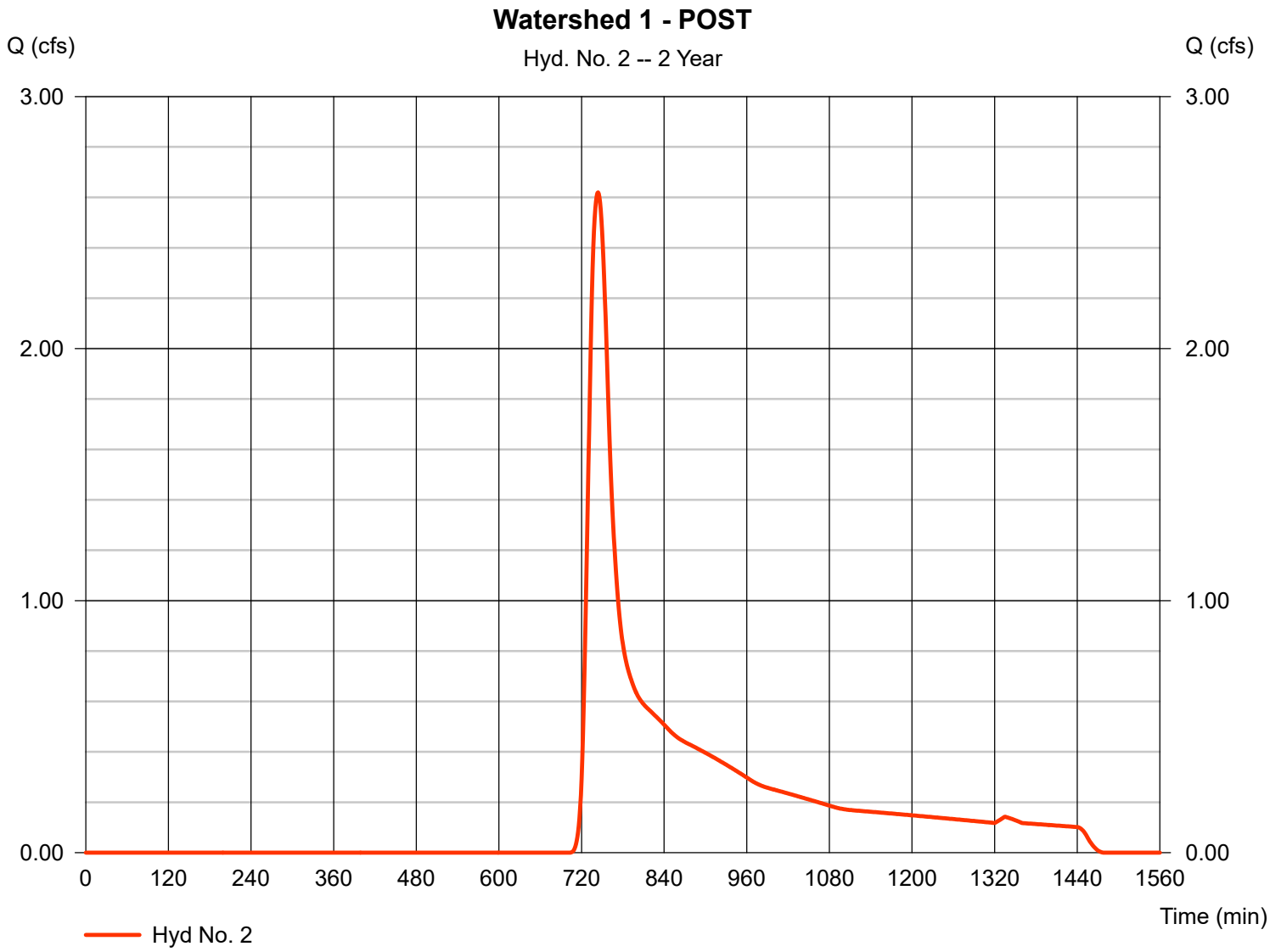
Hydrograph Report

Hyd. No. 2

Watershed 1 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.620 cfs
Storm frequency	=	2 yrs	Time to peak	=	744 min
Time interval	=	1 min	Hyd. volume	=	15,915 cuft
Drainage area	=	6.900 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.80 min
Total precip.	=	3.45 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.300 x 39) + (2.900 x 60) + (2.900 x 61) + (0.100 x 66) + (0.700 x 98)] / 6.900



TR55 Tc Worksheet

Hyd. No. 2

Watershed 1 - POST

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.400		0.011		0.011		
Flow length (ft)	=	100.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.45		0.00		0.00		
Land slope (%)	=	2.50		0.00		0.00		
Travel Time (min)	**=**	**18.92**	**+**	**0.00**	**+**	**0.00**	**=**	**18.92**
Shallow Concentrated Flow								
Flow length (ft)	=	188.00		100.00		365.00		
Watercourse slope (%)	=	1.50		0.25		9.50		
Surface description	=	Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=	1.98		0.81		4.97		
Travel Time (min)	**=**	**1.59**	**+**	**2.07**	**+**	**1.22**	**=**	**4.87**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=	0.00		0.00		0.00		
Flow length (ft)	=	0.0		0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 23.80 min

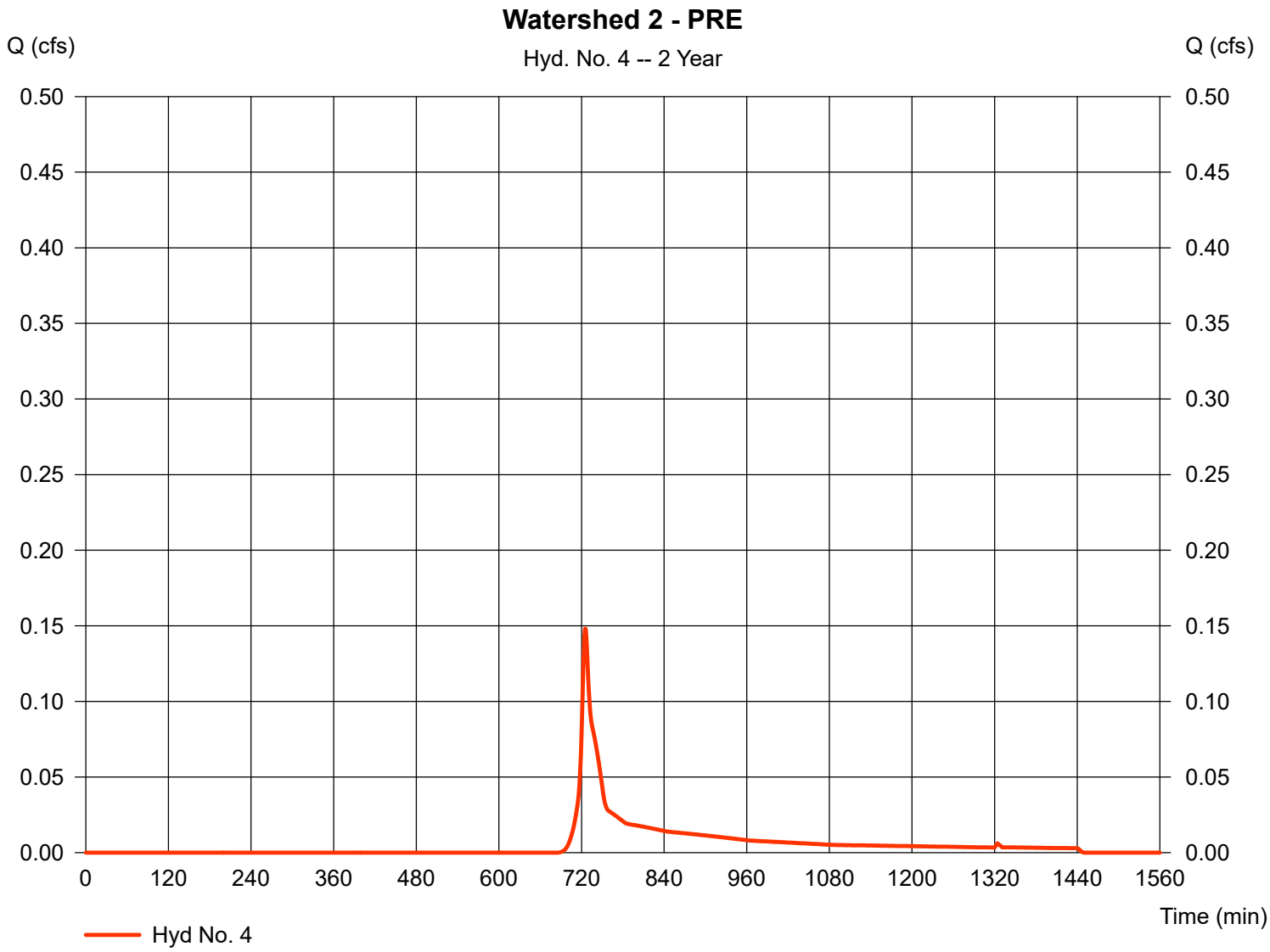
Hydrograph Report

Hyd. No. 4

Watershed 2 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.148 cfs
Storm frequency	=	2 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	523 cuft
Drainage area	=	0.170 ac	Curve number	=	67*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	3.45 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 60) + (0.030 x 98)] / 0.170



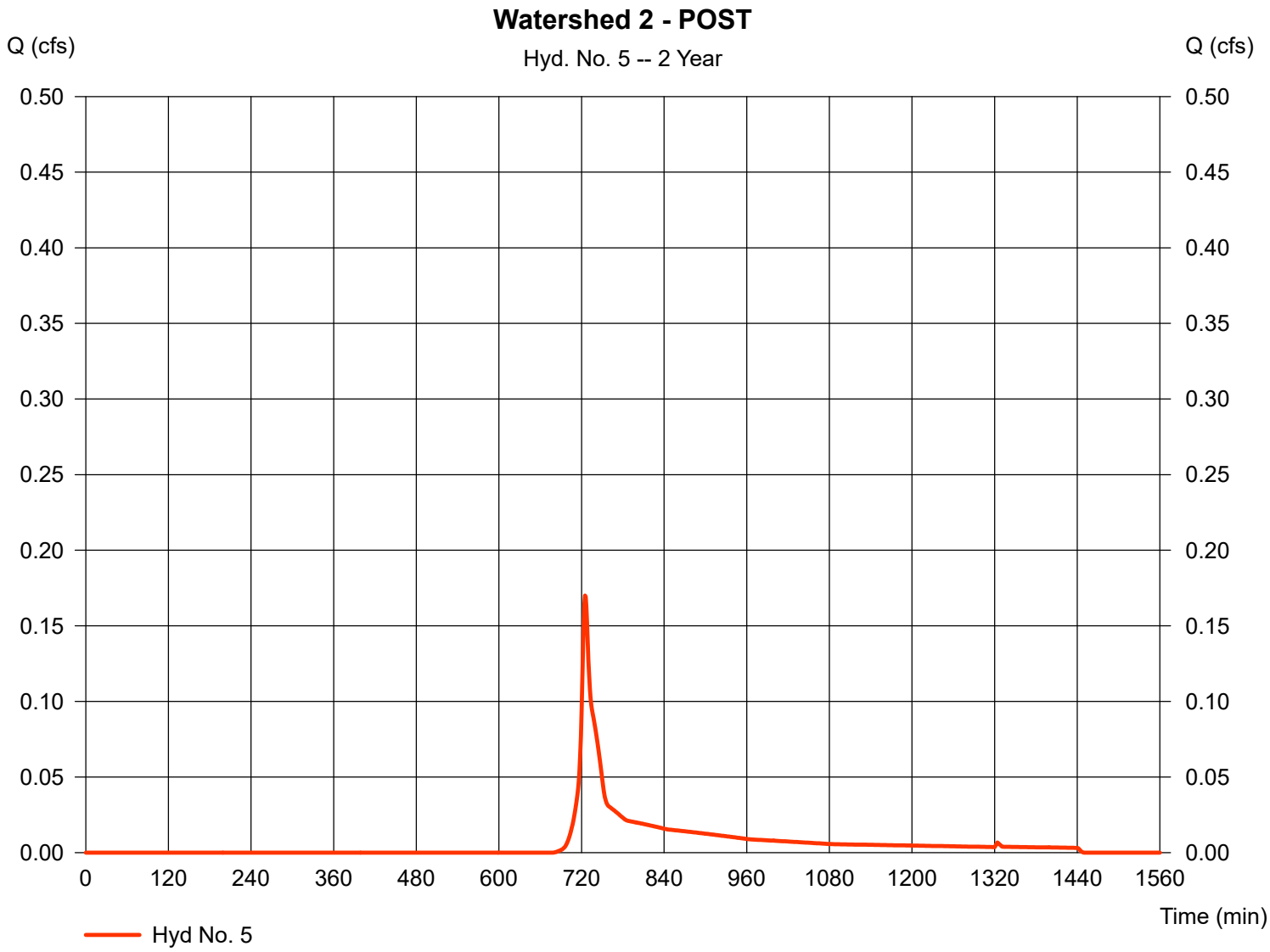
Hydrograph Report

Hyd. No. 5

Watershed 2 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.170 cfs
Storm frequency	=	2 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	588 cuft
Drainage area	=	0.180 ac	Curve number	=	68*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	3.45 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 39) + (0.130 x 61) + (0.040 x 98)] / 0.180



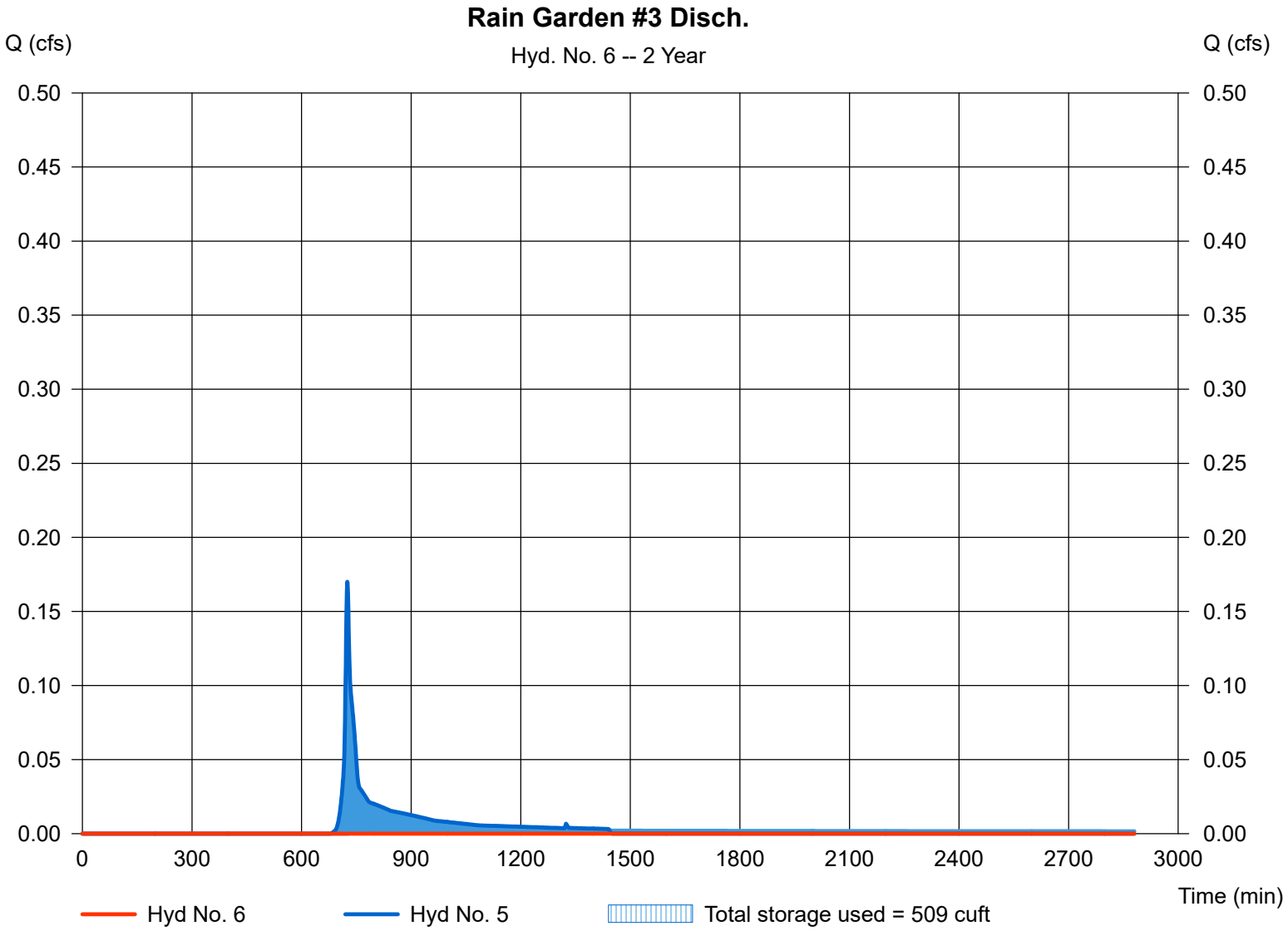
Hydrograph Report

Hyd. No. 6

Rain Garden #3 Disch.

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	2 yrs	Time to peak	=	792 min
Time interval	=	1 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	5 - Watershed 2 - POST	Max. Elevation	=	129.93 ft
Reservoir name	=	Rain Garden #3	Max. Storage	=	509 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 1 - Rain Garden #3

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 128.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	128.50	177	0	0
0.50	129.00	283	114	114
1.00	129.50	415	173	287
1.50	130.00	615	256	543
1.80	130.30	717	200	743

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	Inactive	Inactive	Inactive	Inactive
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	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

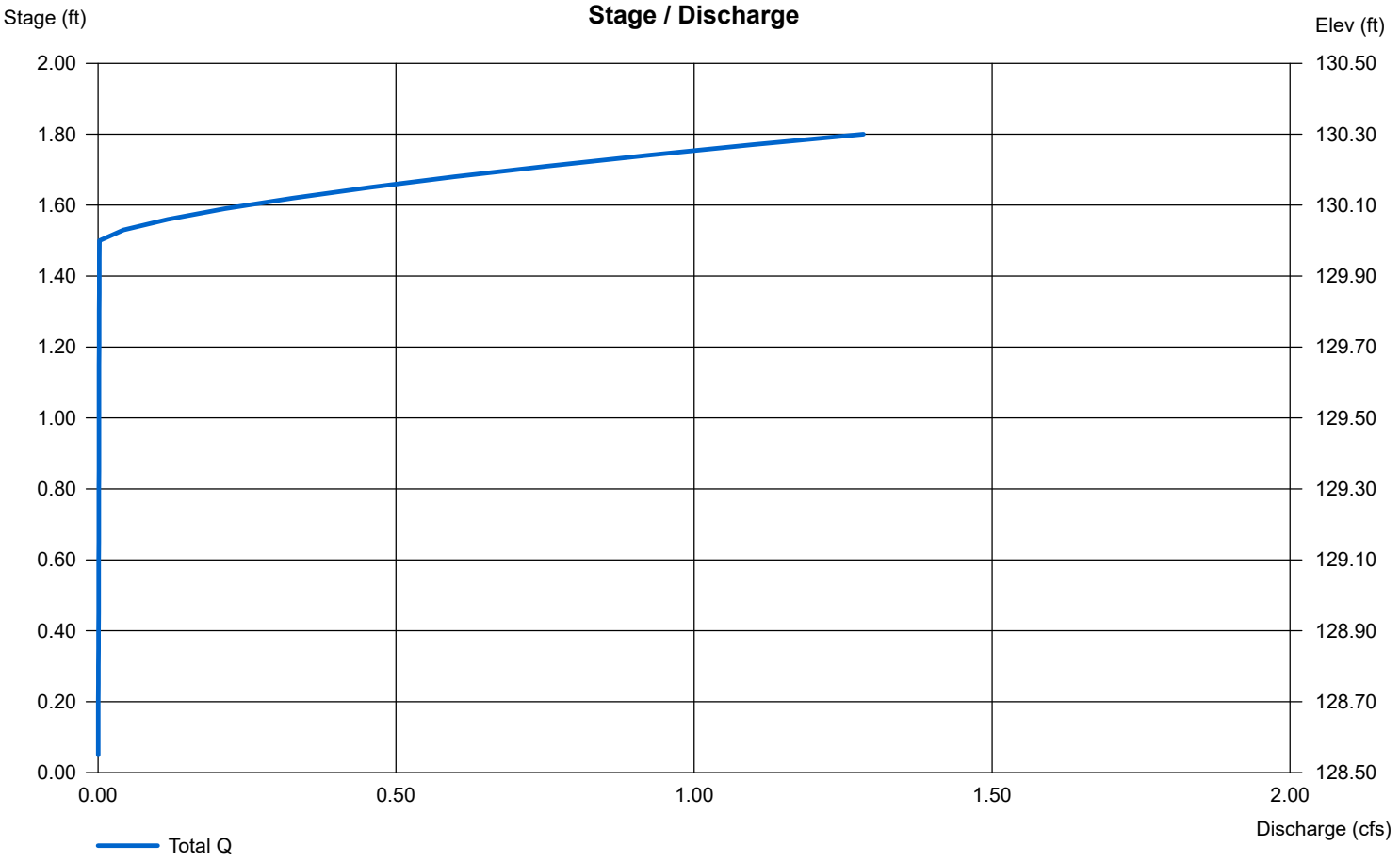
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 3.00	0.00	0.00	0.00
Crest El. (ft)	= 130.00	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.150 (by Contour)

TW Elev. (ft) = 0.00

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



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	SCS Runoff	5.404	1	739	28,198	------	------	------	Watershed 1 - PRE
2	SCS Runoff	5.283	1	740	28,493	------	------	------	Watershed 1 - POST
4	SCS Runoff	0.272	1	725	886	------	------	------	Watershed 2 - PRE
5	SCS Runoff	0.305	1	725	983	------	------	------	Watershed 2 - POST
6	Reservoir	0.025	1	822	347	5	130.02	556	Rain Garden #3 Disch.

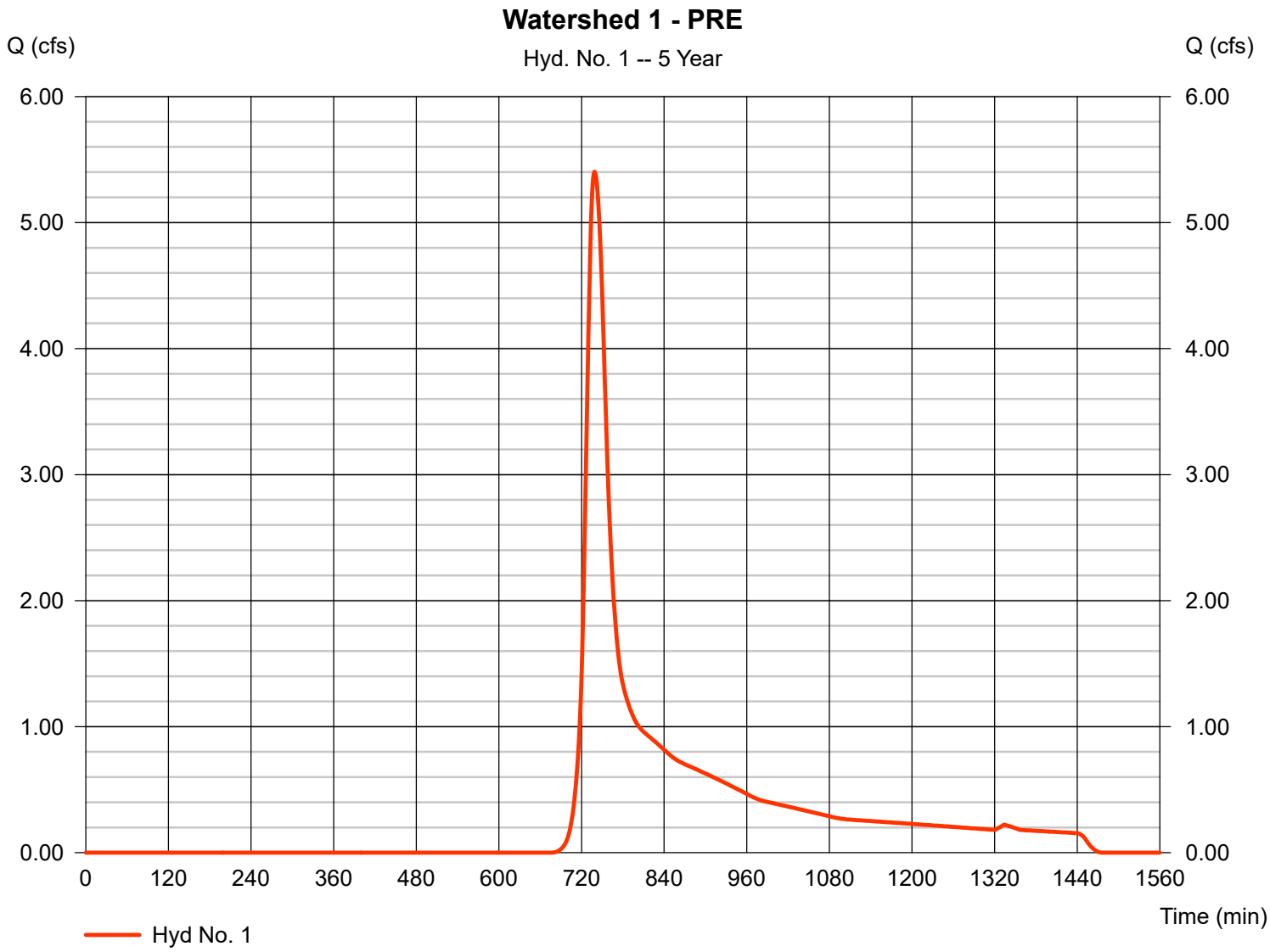
Hydrograph Report

Hyd. No. 1

Watershed 1 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.404 cfs
Storm frequency	=	5 yrs	Time to peak	=	739 min
Time interval	=	1 min	Hyd. volume	=	28,198 cuft
Drainage area	=	6.890 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.90 min
Total precip.	=	4.39 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(5.190 x 60) + (1.400 x 66) + (0.300 x 98)] / 6.890



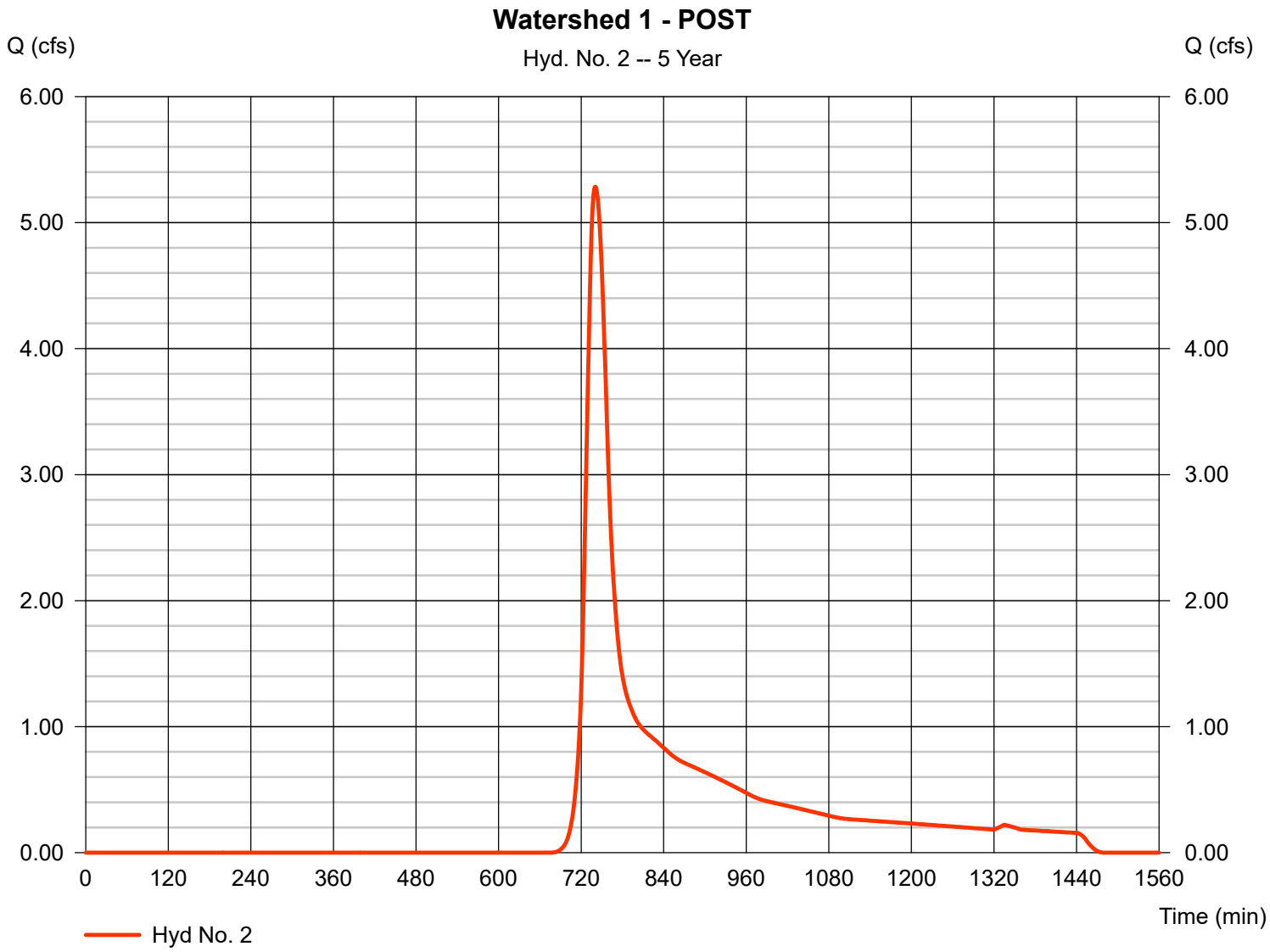
Hydrograph Report

Hyd. No. 2

Watershed 1 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.283 cfs
Storm frequency	=	5 yrs	Time to peak	=	740 min
Time interval	=	1 min	Hyd. volume	=	28,493 cuft
Drainage area	=	6.900 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.80 min
Total precip.	=	4.39 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.300 x 39) + (2.900 x 60) + (2.900 x 61) + (0.100 x 66) + (0.700 x 98)] / 6.900



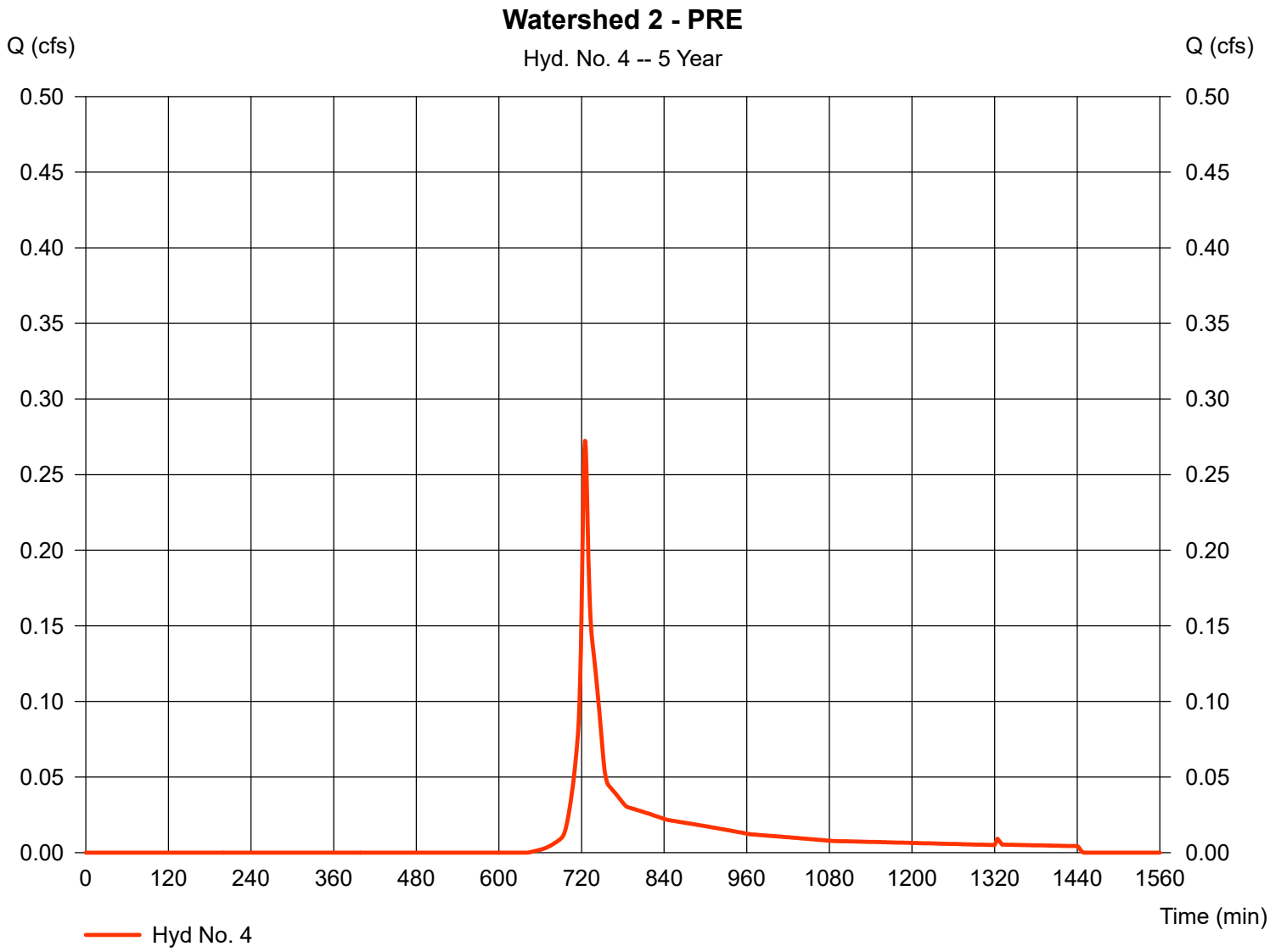
Hydrograph Report

Hyd. No. 4

Watershed 2 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.272 cfs
Storm frequency	=	5 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	886 cuft
Drainage area	=	0.170 ac	Curve number	=	67*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	4.39 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 60) + (0.030 x 98)] / 0.170



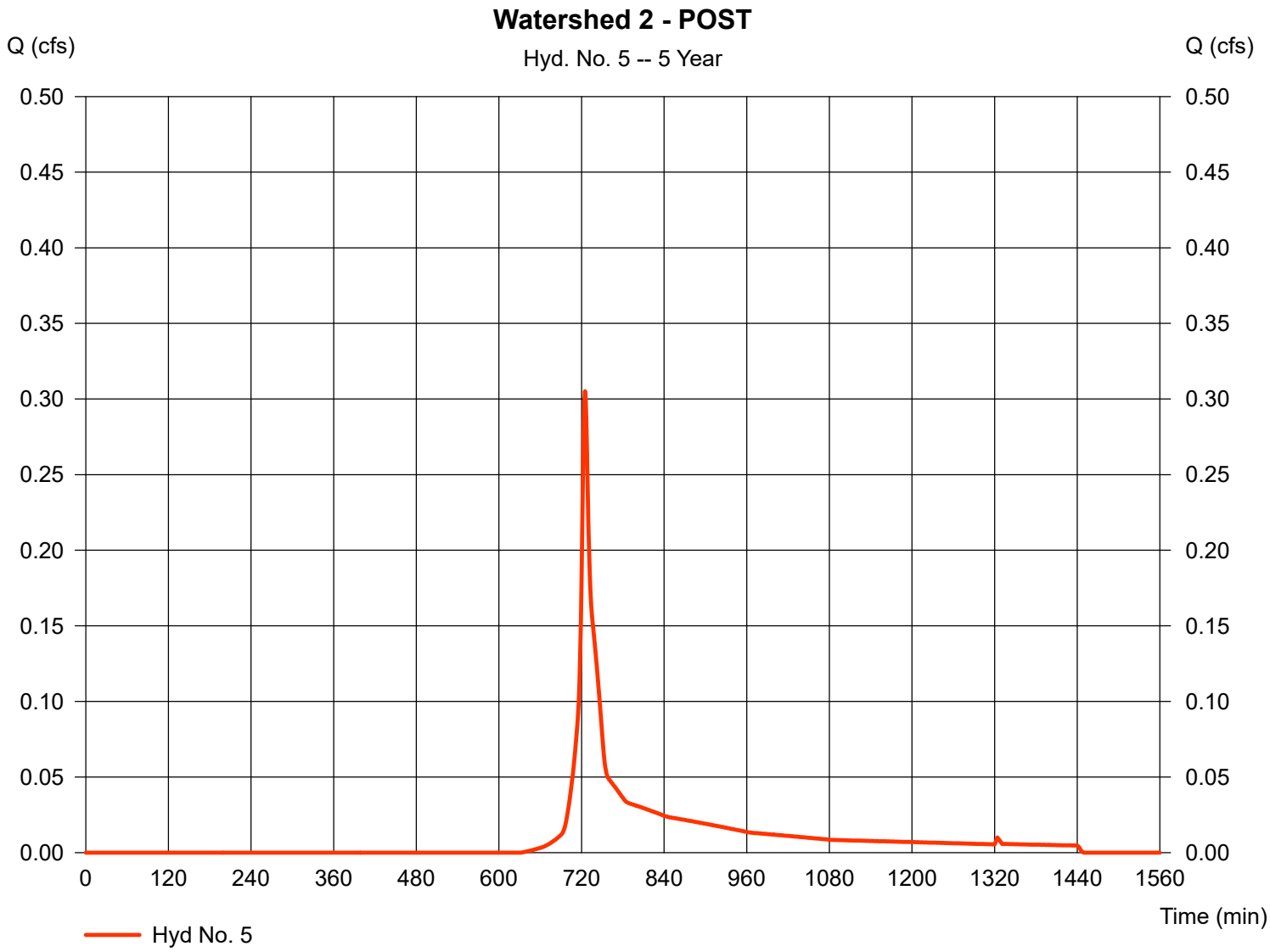
Hydrograph Report

Hyd. No. 5

Watershed 2 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.305 cfs
Storm frequency	=	5 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	983 cuft
Drainage area	=	0.180 ac	Curve number	=	68*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	4.39 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 39) + (0.130 x 61) + (0.040 x 98)] / 0.180



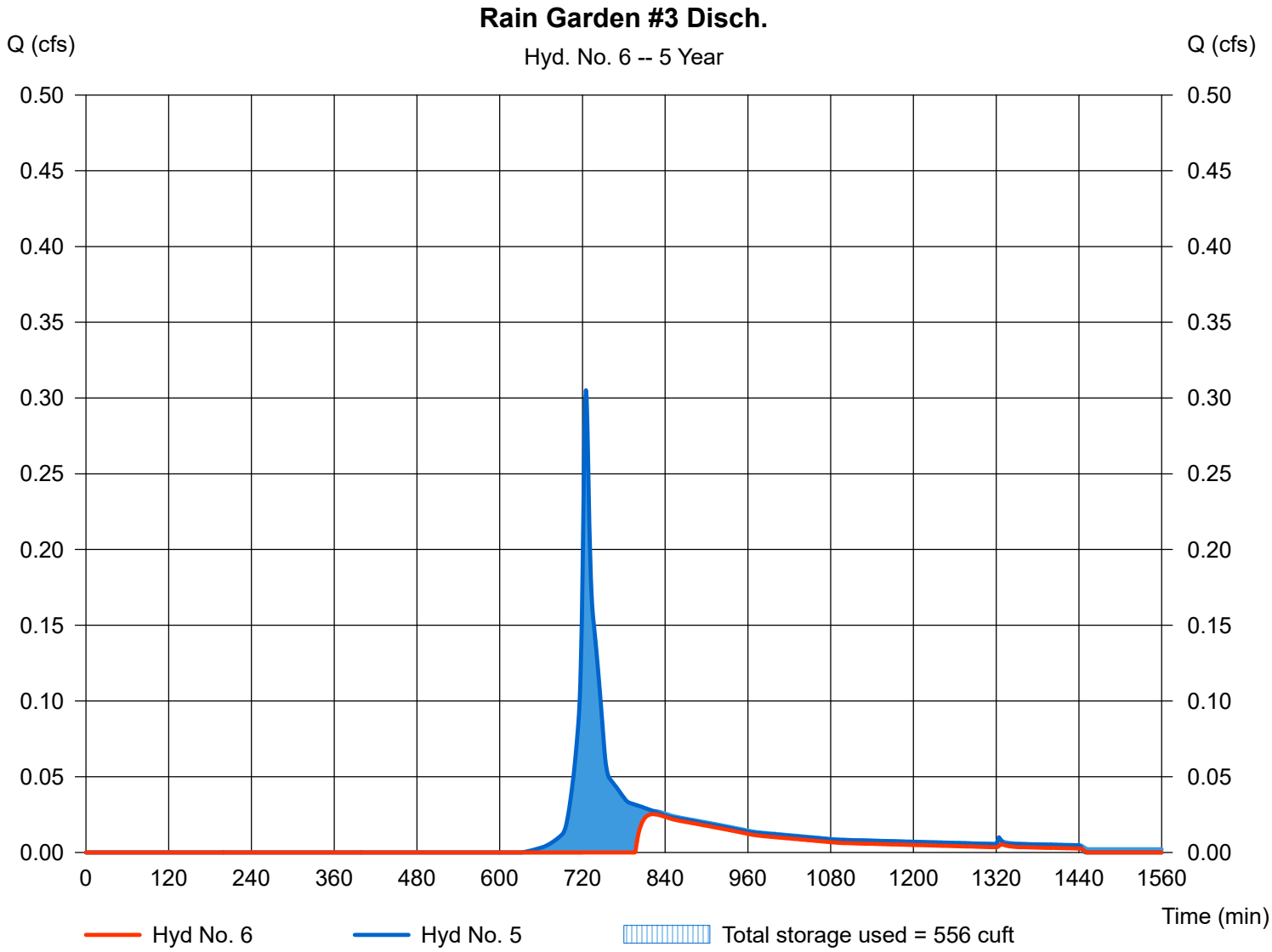
Hydrograph Report

Hyd. No. 6

Rain Garden #3 Disch.

Hydrograph type	=	Reservoir	Peak discharge	=	0.025 cfs
Storm frequency	=	5 yrs	Time to peak	=	822 min
Time interval	=	1 min	Hyd. volume	=	347 cuft
Inflow hyd. No.	=	5 - Watershed 2 - POST	Max. Elevation	=	130.02 ft
Reservoir name	=	Rain Garden #3	Max. Storage	=	556 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



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	SCS Runoff	8.049	1	738	40,096	------	------	------	Watershed 1 - PRE
2	SCS Runoff	7.869	1	739	40,516	------	------	------	Watershed 1 - POST
4	SCS Runoff	0.387	1	725	1,223	------	------	------	Watershed 2 - PRE
5	SCS Runoff	0.429	1	725	1,349	------	------	------	Watershed 2 - POST
6	Reservoir	0.112	1	749	711	5	130.06	582	Rain Garden #3 Disch.

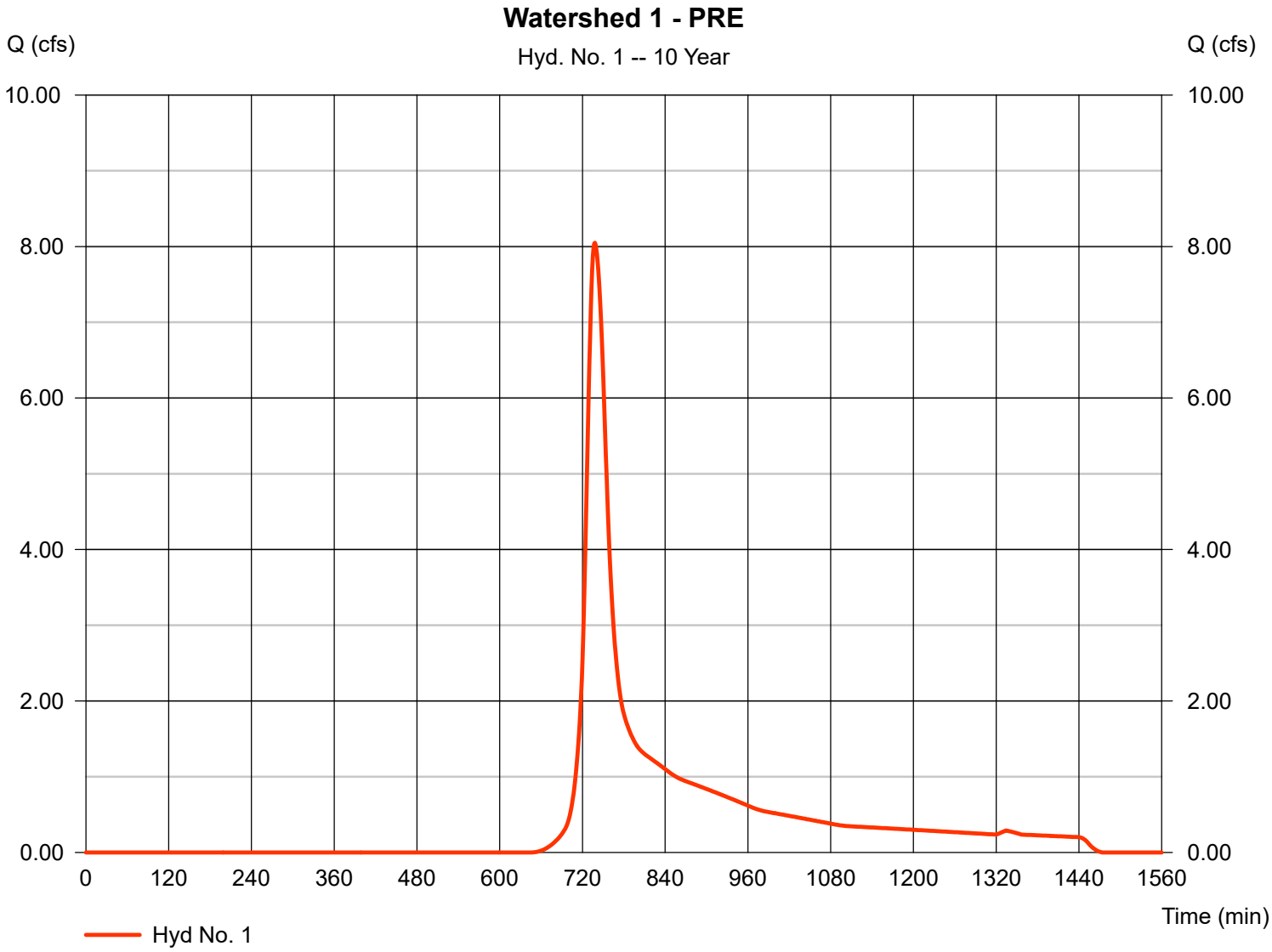
Hydrograph Report

Hyd. No. 1

Watershed 1 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.049 cfs
Storm frequency	=	10 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	40,096 cuft
Drainage area	=	6.890 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.90 min
Total precip.	=	5.17 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(5.190 x 60) + (1.400 x 66) + (0.300 x 98)] / 6.890



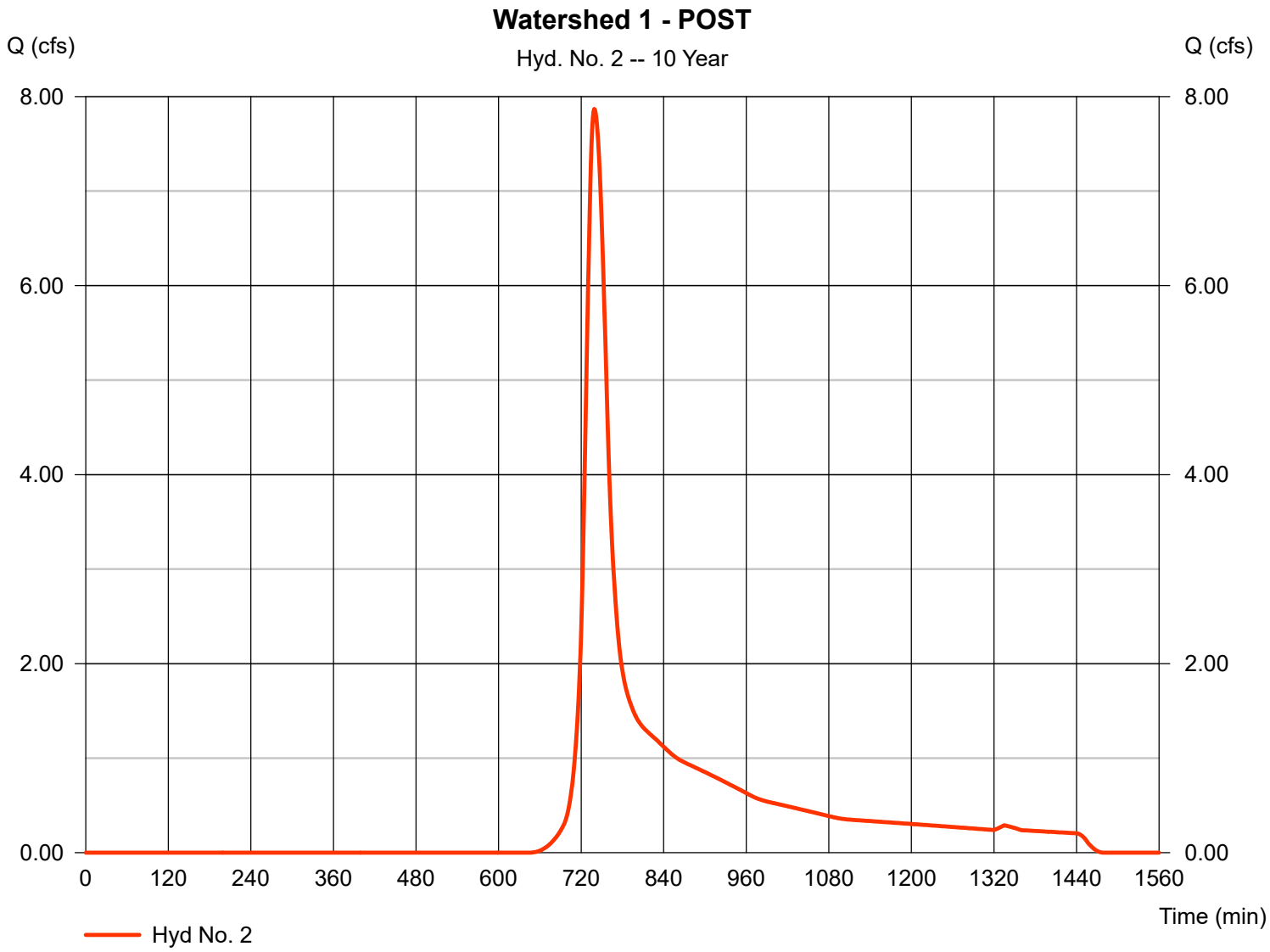
Hydrograph Report

Hyd. No. 2

Watershed 1 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.869 cfs
Storm frequency	=	10 yrs	Time to peak	=	739 min
Time interval	=	1 min	Hyd. volume	=	40,516 cuft
Drainage area	=	6.900 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.80 min
Total precip.	=	5.17 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.300 x 39) + (2.900 x 60) + (2.900 x 61) + (0.100 x 66) + (0.700 x 98)] / 6.900



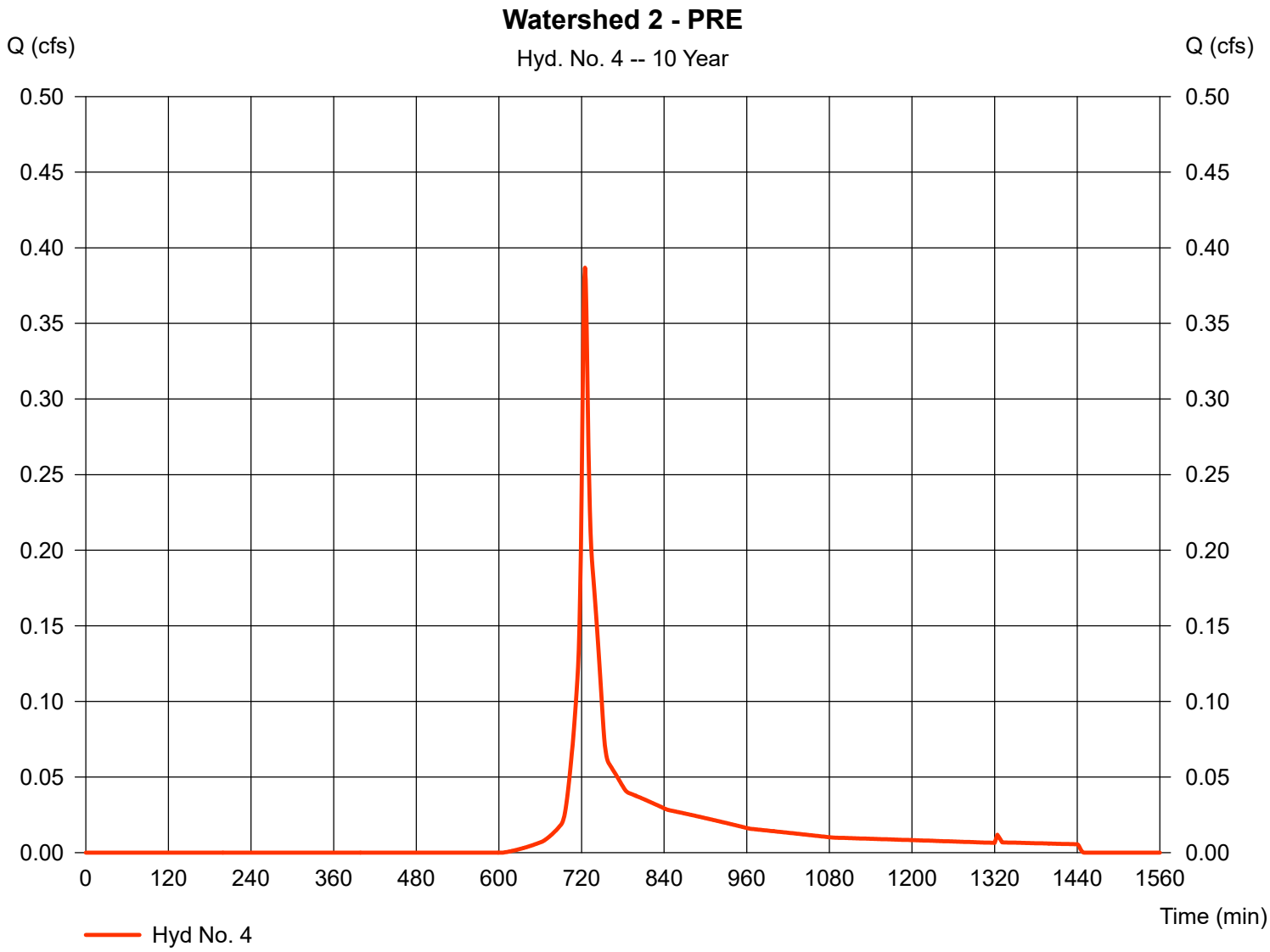
Hydrograph Report

Hyd. No. 4

Watershed 2 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.387 cfs
Storm frequency	=	10 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	1,223 cuft
Drainage area	=	0.170 ac	Curve number	=	67*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	5.17 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 60) + (0.030 x 98)] / 0.170



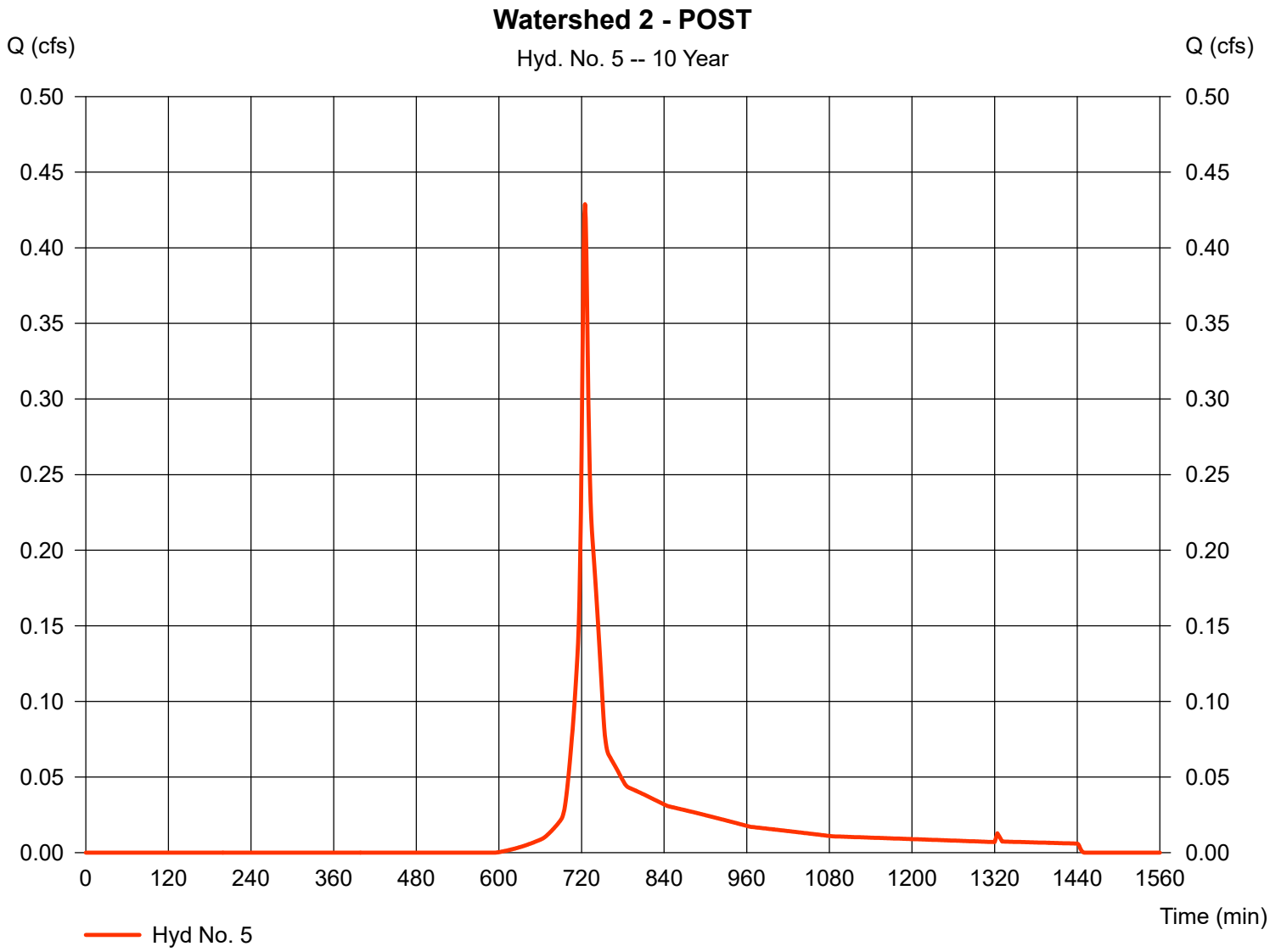
Hydrograph Report

Hyd. No. 5

Watershed 2 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.429 cfs
Storm frequency	=	10 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	1,349 cuft
Drainage area	=	0.180 ac	Curve number	=	68*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	5.17 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 39) + (0.130 x 61) + (0.040 x 98)] / 0.180



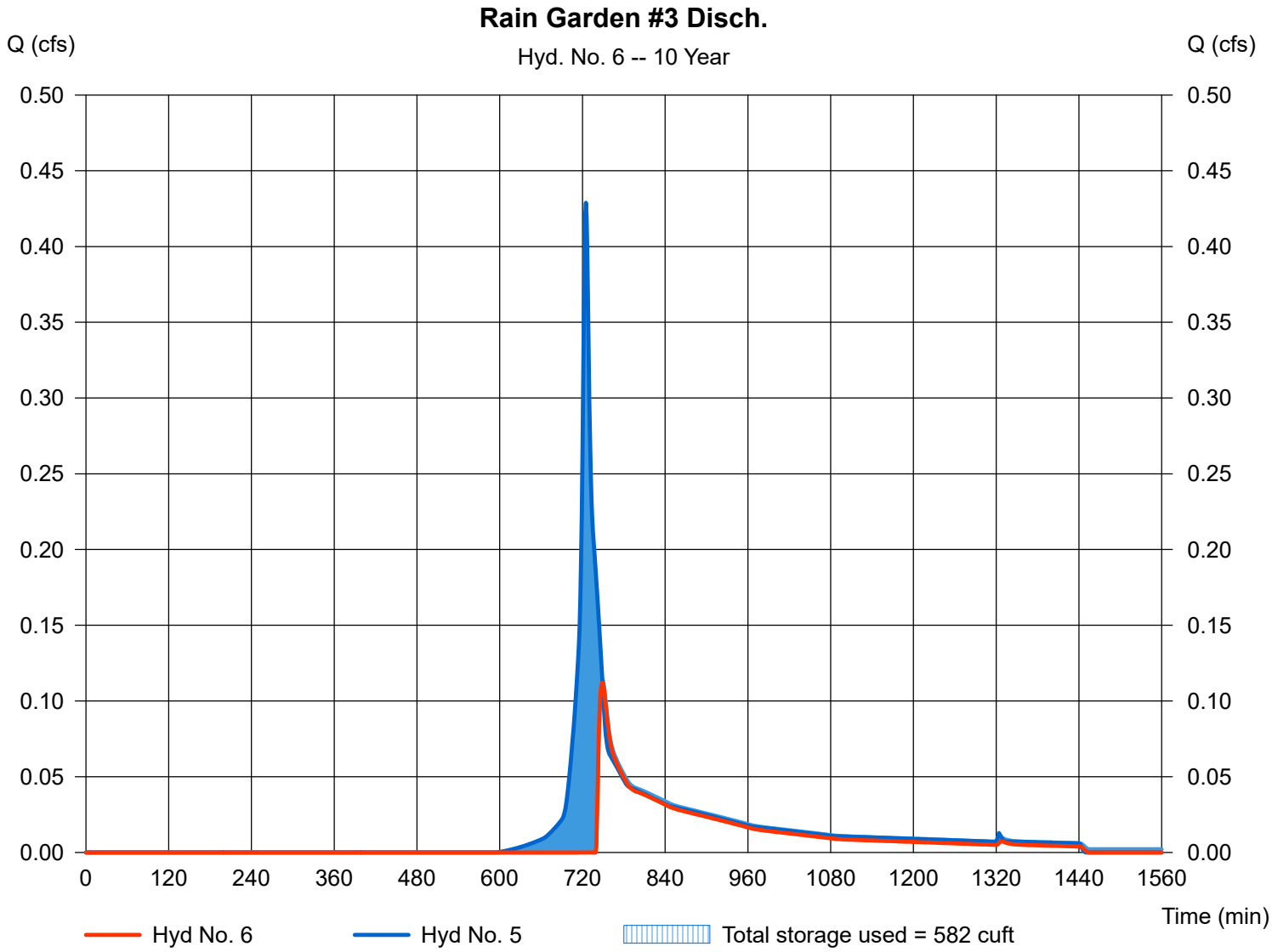
Hydrograph Report

Hyd. No. 6

Rain Garden #3 Disch.

Hydrograph type	=	Reservoir	Peak discharge	=	0.112 cfs
Storm frequency	=	10 yrs	Time to peak	=	749 min
Time interval	=	1 min	Hyd. volume	=	711 cuft
Inflow hyd. No.	=	5 - Watershed 2 - POST	Max. Elevation	=	130.06 ft
Reservoir name	=	Rain Garden #3	Max. Storage	=	582 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



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	SCS Runoff	12.06	1	737	58,144	------	------	------	Watershed 1 - PRE
2	SCS Runoff	11.78	1	738	58,753	------	------	------	Watershed 1 - POST
4	SCS Runoff	0.556	1	725	1,726	------	------	------	Watershed 2 - PRE
5	SCS Runoff	0.610	1	725	1,891	------	------	------	Watershed 2 - POST
6	Reservoir	0.324	1	733	1,251	5	130.12	623	Rain Garden #3 Disch.

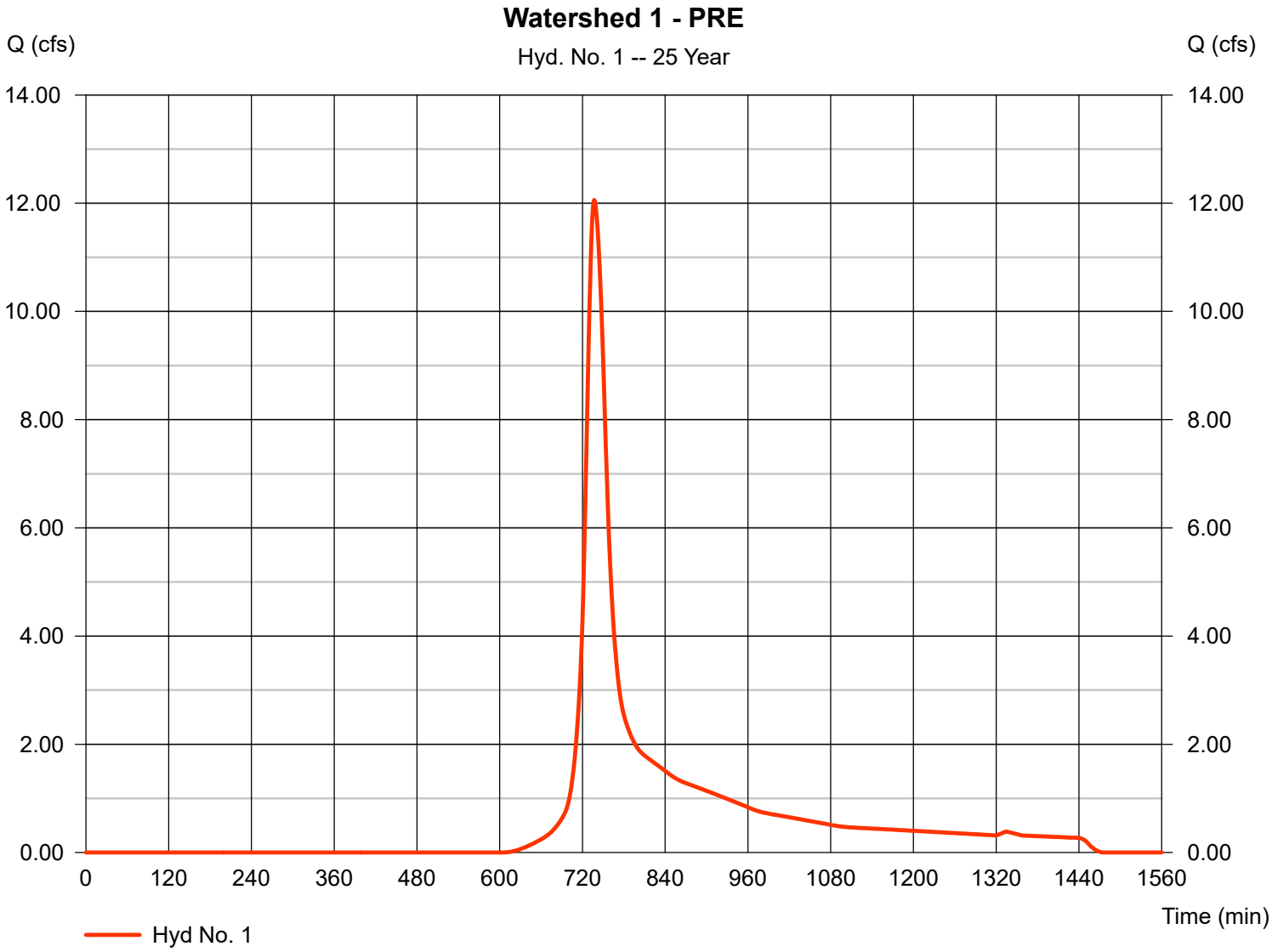
Hydrograph Report

Hyd. No. 1

Watershed 1 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.06 cfs
Storm frequency	=	25 yrs	Time to peak	=	737 min
Time interval	=	1 min	Hyd. volume	=	58,144 cuft
Drainage area	=	6.890 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.90 min
Total precip.	=	6.24 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(5.190 x 60) + (1.400 x 66) + (0.300 x 98)] / 6.890



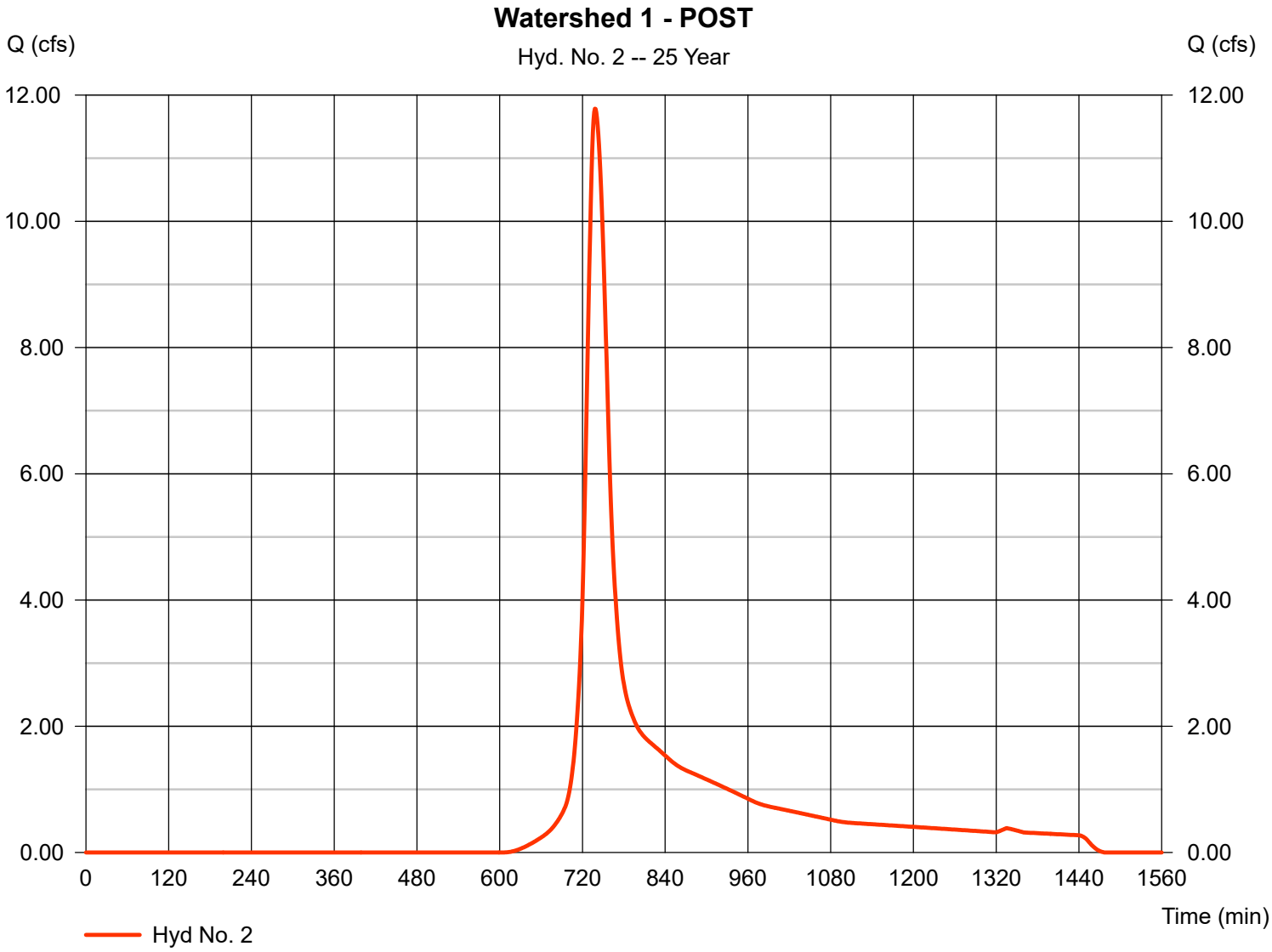
Hydrograph Report

Hyd. No. 2

Watershed 1 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.78 cfs
Storm frequency	=	25 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	58,753 cuft
Drainage area	=	6.900 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.80 min
Total precip.	=	6.24 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.300 x 39) + (2.900 x 60) + (2.900 x 61) + (0.100 x 66) + (0.700 x 98)] / 6.900



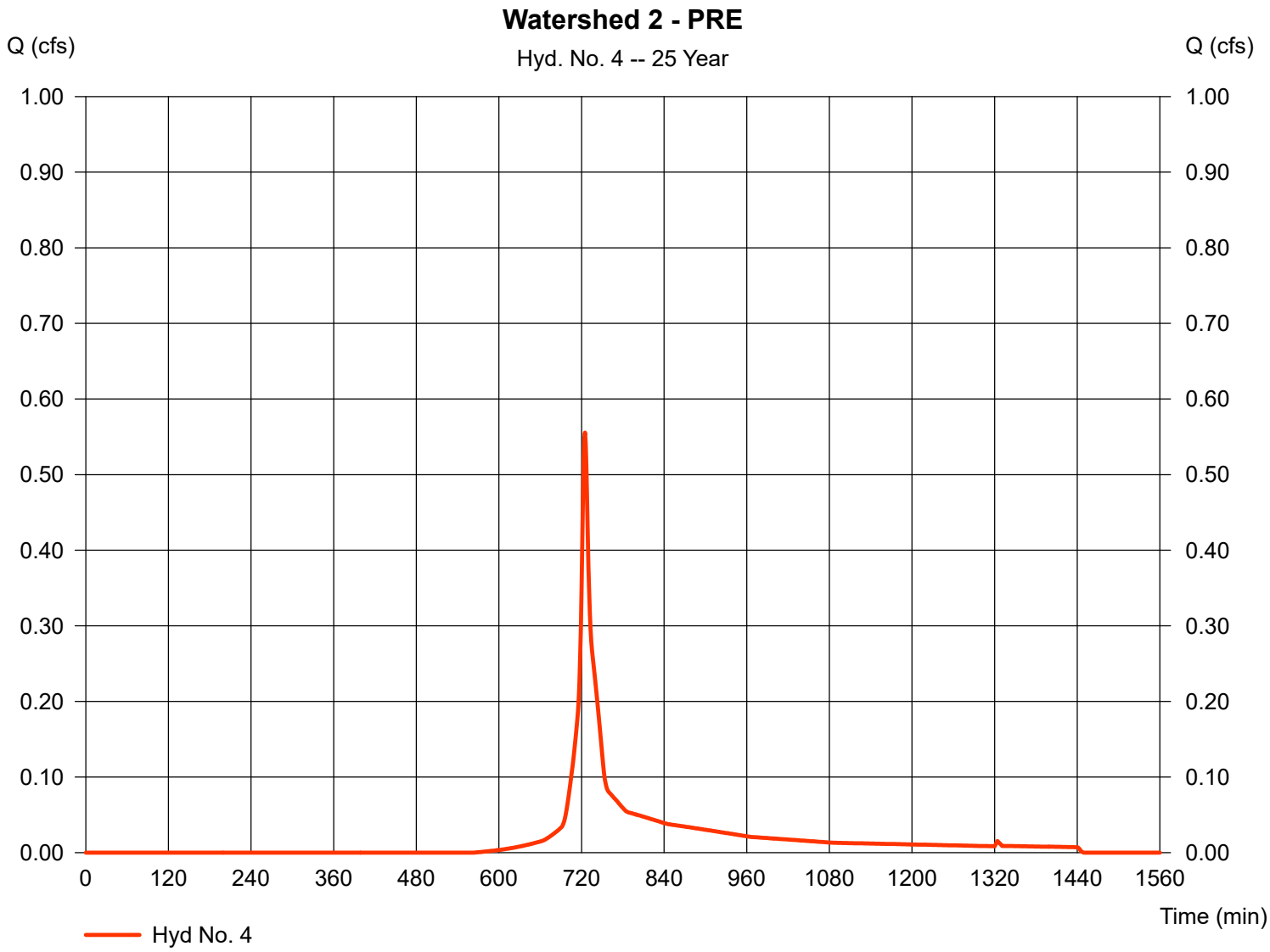
Hydrograph Report

Hyd. No. 4

Watershed 2 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.556 cfs
Storm frequency	=	25 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	1,726 cuft
Drainage area	=	0.170 ac	Curve number	=	67*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.24 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 60) + (0.030 x 98)] / 0.170



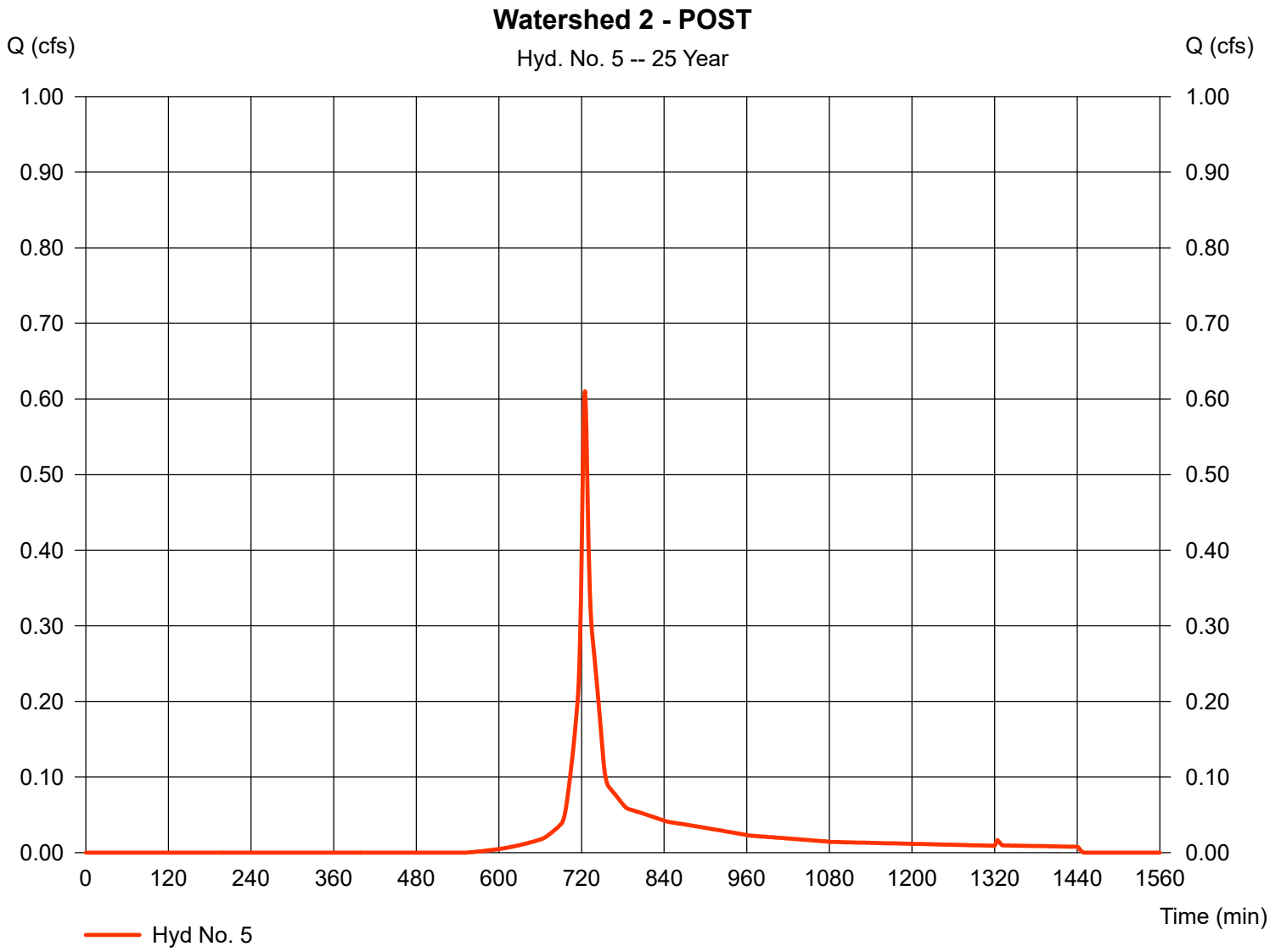
Hydrograph Report

Hyd. No. 5

Watershed 2 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.610 cfs
Storm frequency	=	25 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	1,891 cuft
Drainage area	=	0.180 ac	Curve number	=	68*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.24 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 39) + (0.130 x 61) + (0.040 x 98)] / 0.180



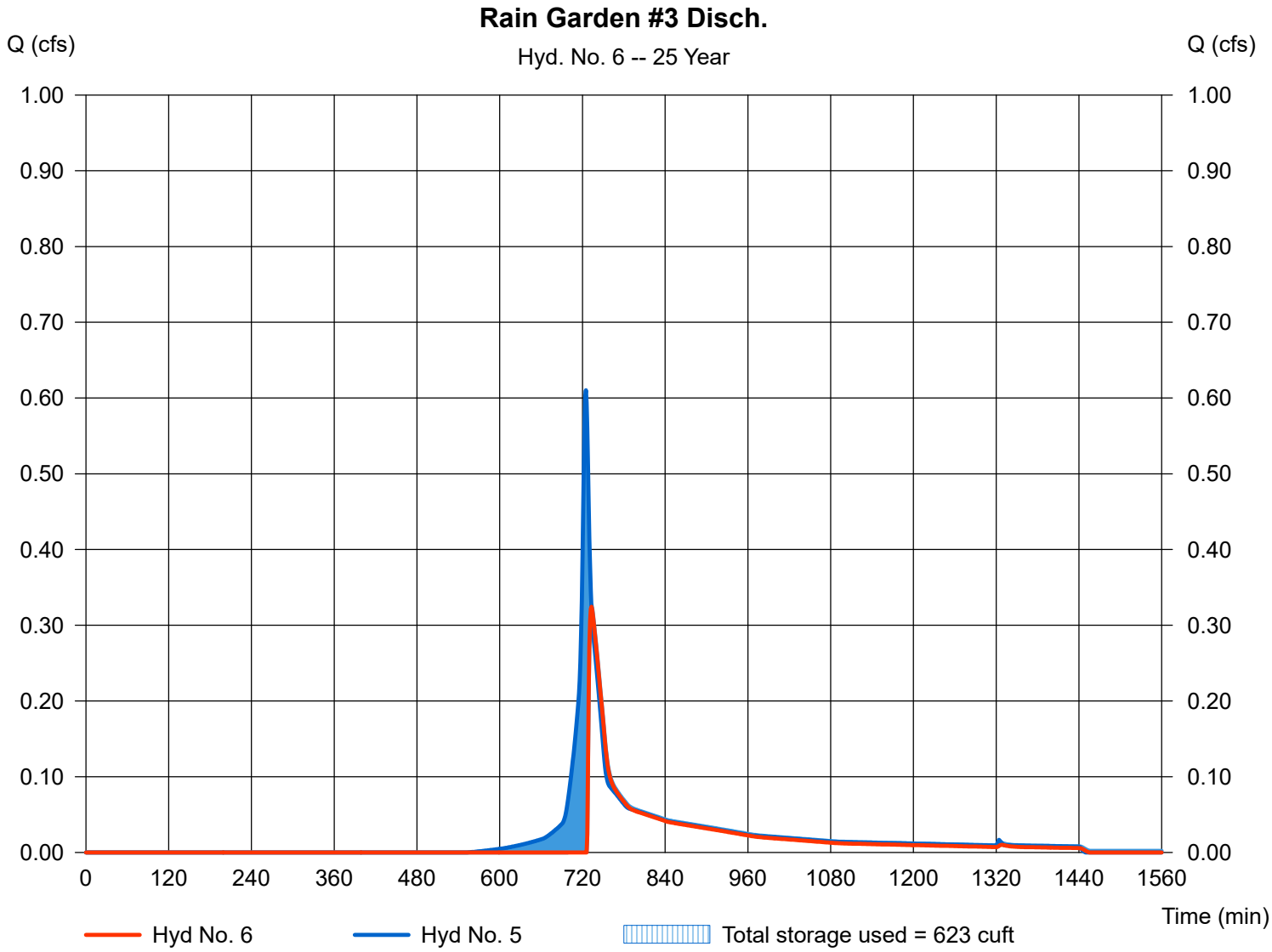
Hydrograph Report

Hyd. No. 6

Rain Garden #3 Disch.

Hydrograph type	=	Reservoir	Peak discharge	=	0.324 cfs
Storm frequency	=	25 yrs	Time to peak	=	733 min
Time interval	=	1 min	Hyd. volume	=	1,251 cuft
Inflow hyd. No.	=	5 - Watershed 2 - POST	Max. Elevation	=	130.12 ft
Reservoir name	=	Rain Garden #3	Max. Storage	=	623 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



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	SCS Runoff	15.26	1	737	72,647	------	------	------	Watershed 1 - PRE
2	SCS Runoff	14.92	1	738	73,408	------	------	------	Watershed 1 - POST
4	SCS Runoff	0.688	1	725	2,125	------	------	------	Watershed 2 - PRE
5	SCS Runoff	0.752	1	725	2,320	------	------	------	Watershed 2 - POST
6	Reservoir	0.584	1	729	1,678	5	130.18	661	Rain Garden #3 Disch.

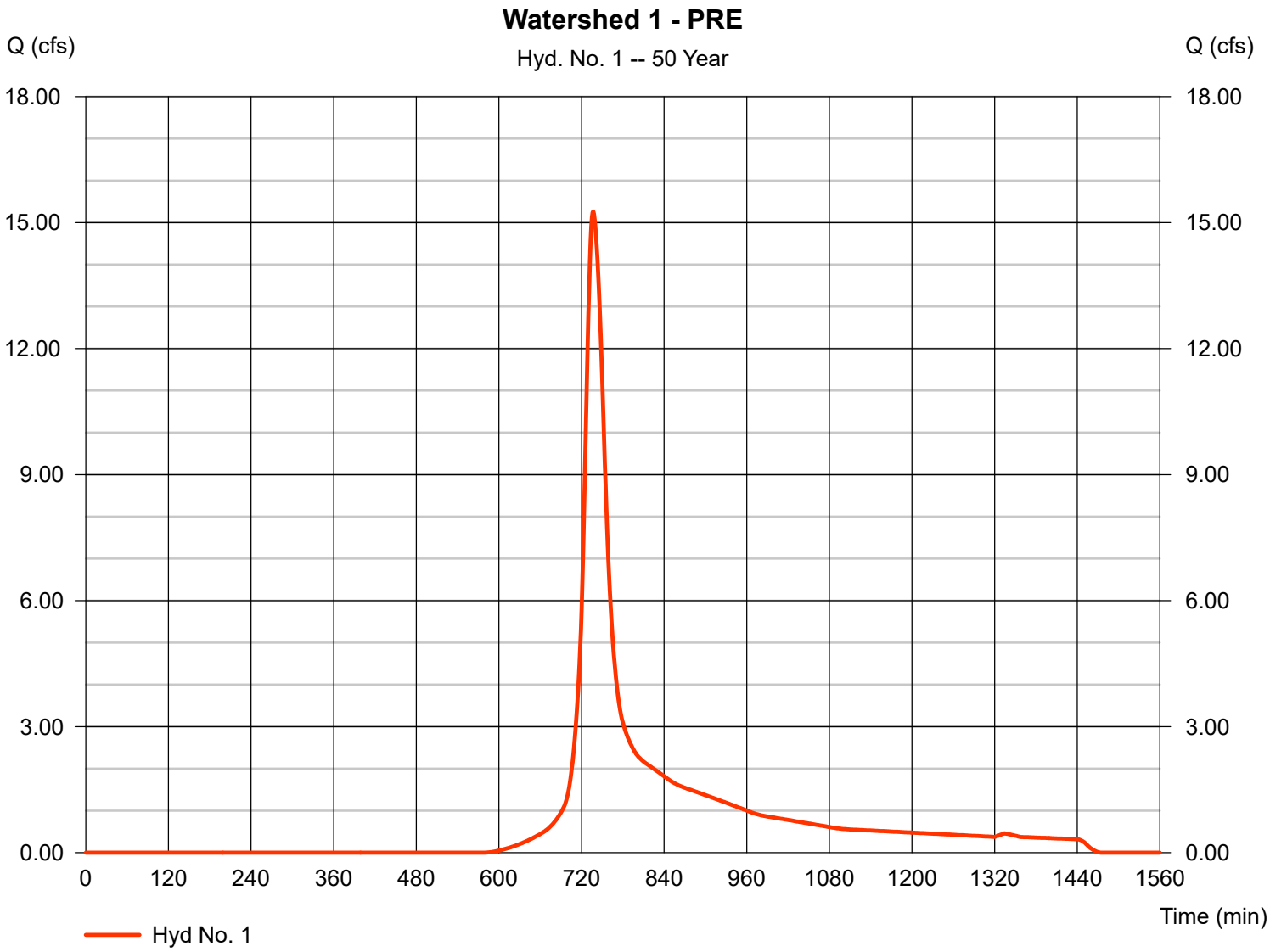
Hydrograph Report

Hyd. No. 1

Watershed 1 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	15.26 cfs
Storm frequency	=	50 yrs	Time to peak	=	737 min
Time interval	=	1 min	Hyd. volume	=	72,647 cuft
Drainage area	=	6.890 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.90 min
Total precip.	=	7.04 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(5.190 x 60) + (1.400 x 66) + (0.300 x 98)] / 6.890



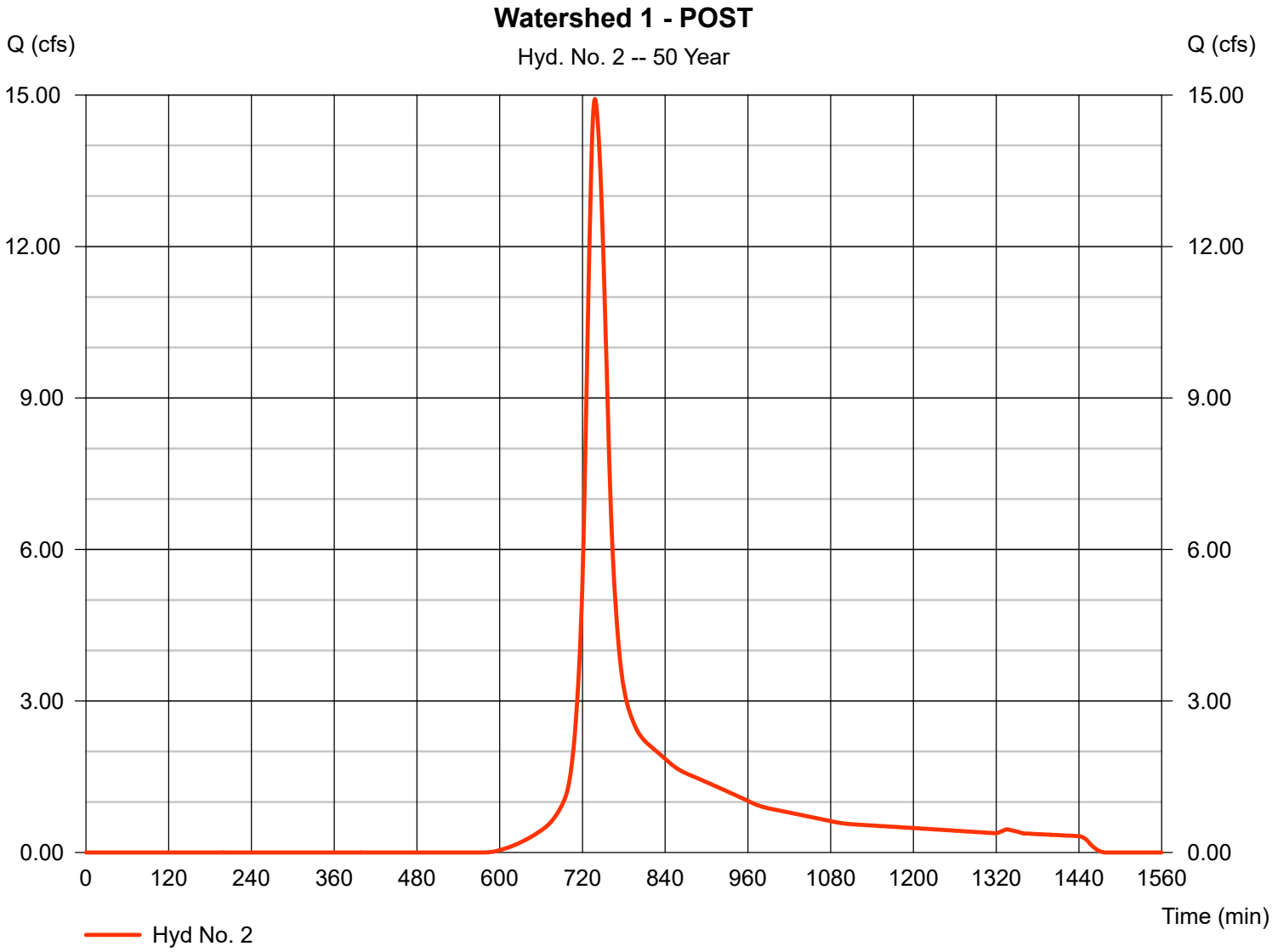
Hydrograph Report

Hyd. No. 2

Watershed 1 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	14.92 cfs
Storm frequency	=	50 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	73,408 cuft
Drainage area	=	6.900 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.80 min
Total precip.	=	7.04 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.300 x 39) + (2.900 x 60) + (2.900 x 61) + (0.100 x 66) + (0.700 x 98)] / 6.900



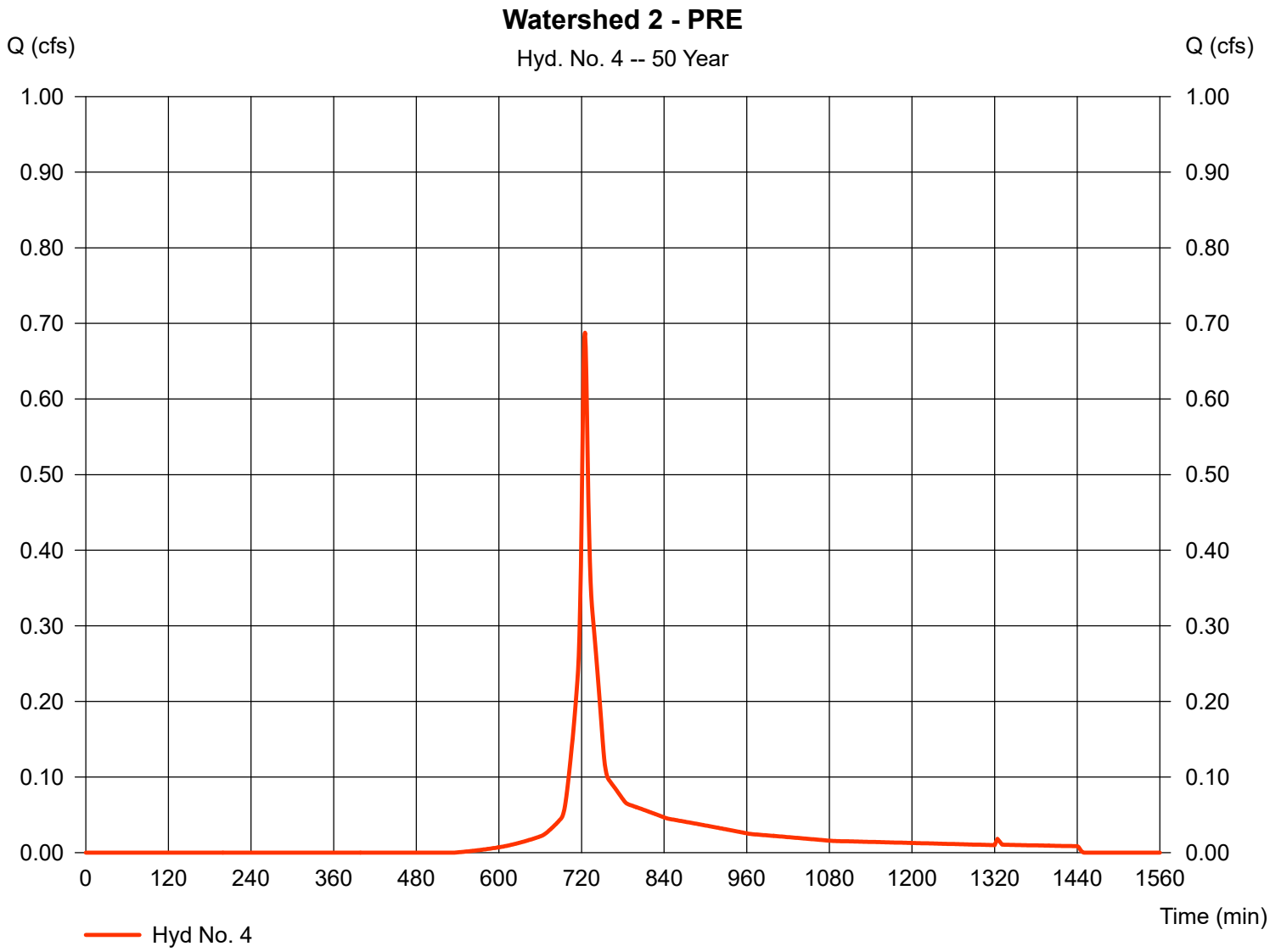
Hydrograph Report

Hyd. No. 4

Watershed 2 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.688 cfs
Storm frequency	=	50 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	2,125 cuft
Drainage area	=	0.170 ac	Curve number	=	67*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.04 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 60) + (0.030 x 98)] / 0.170



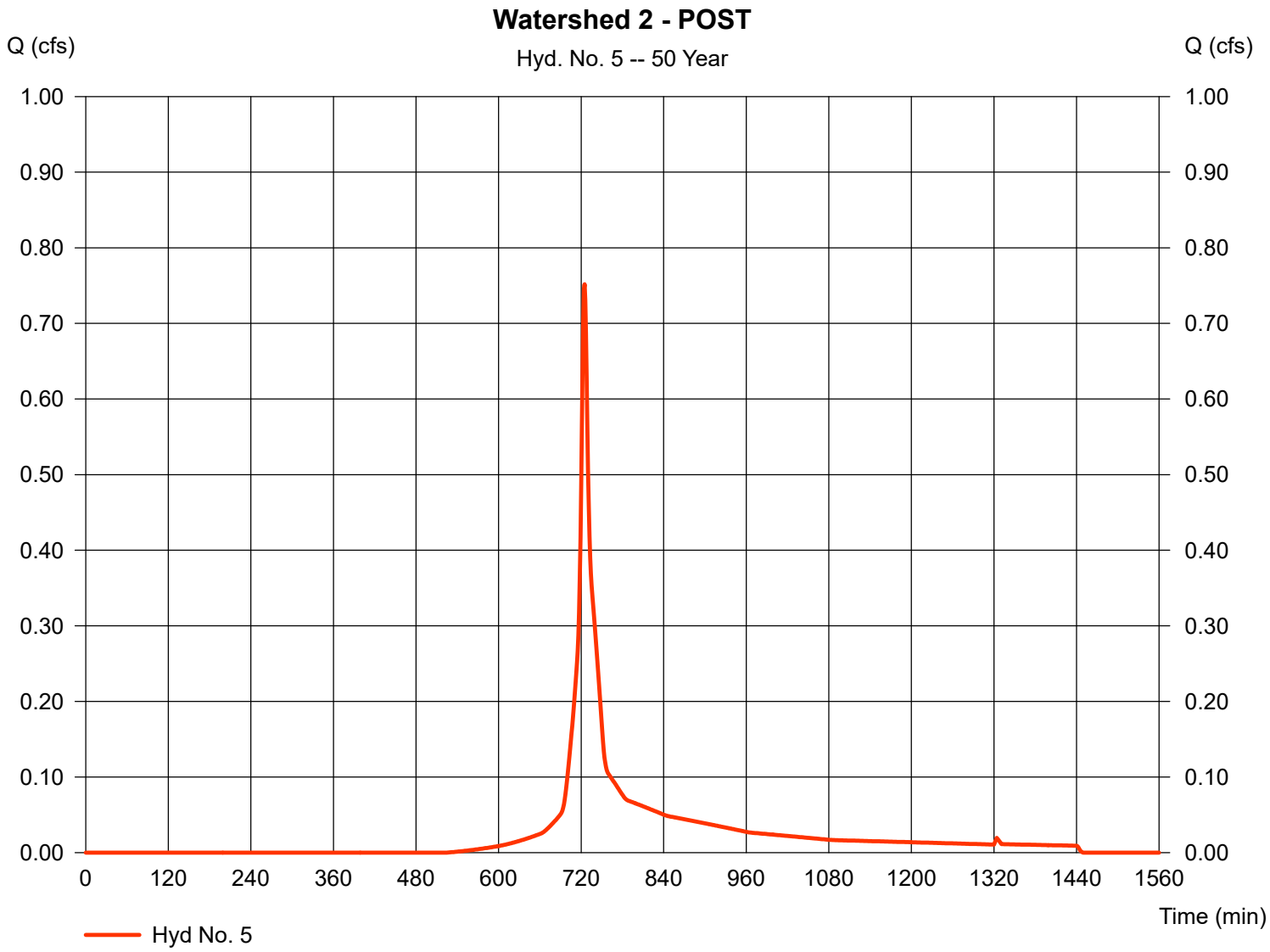
Hydrograph Report

Hyd. No. 5

Watershed 2 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.752 cfs
Storm frequency	=	50 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	2,320 cuft
Drainage area	=	0.180 ac	Curve number	=	68*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.04 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 39) + (0.130 x 61) + (0.040 x 98)] / 0.180



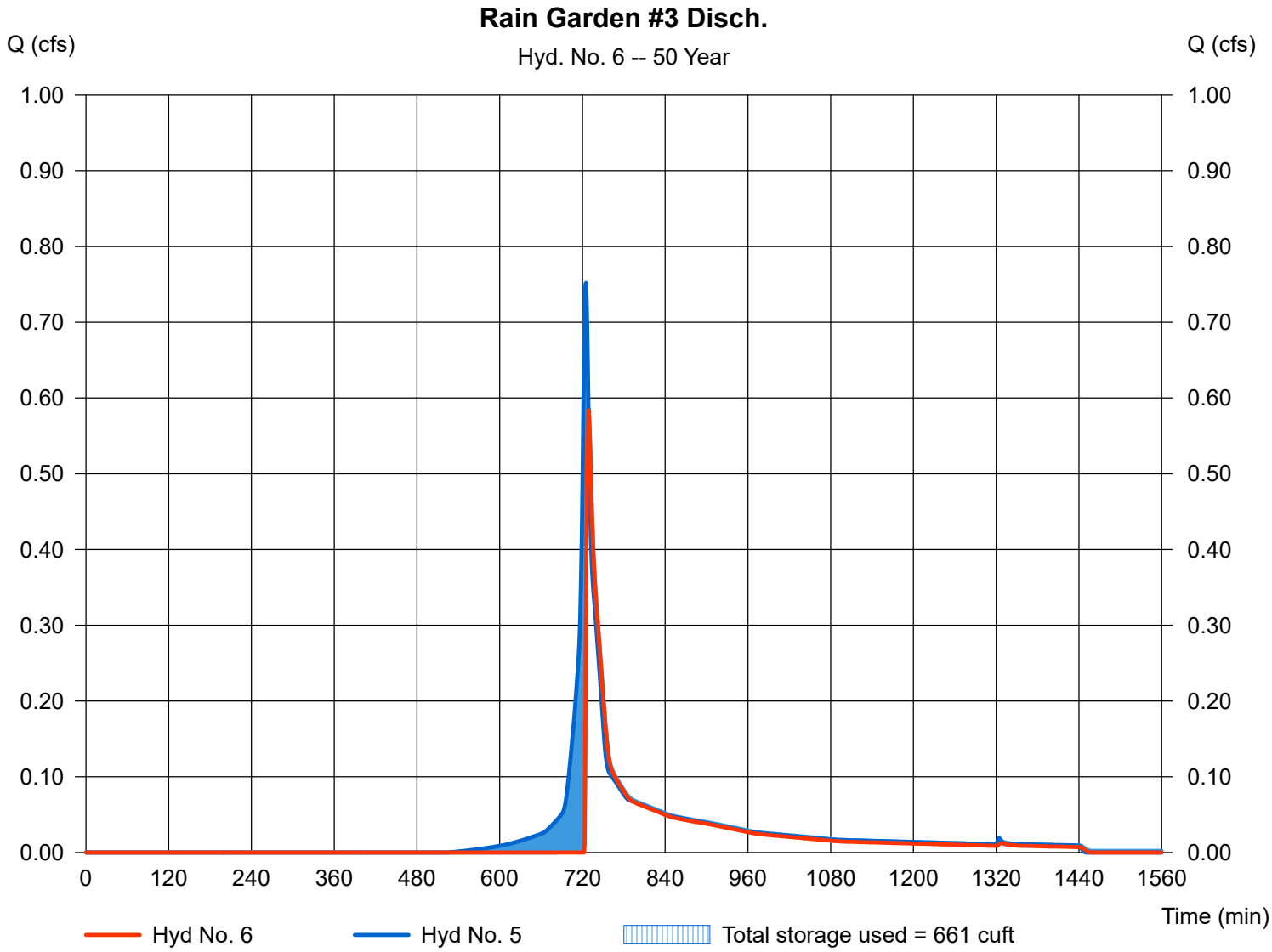
Hydrograph Report

Hyd. No. 6

Rain Garden #3 Disch.

Hydrograph type	=	Reservoir	Peak discharge	=	0.584 cfs
Storm frequency	=	50 yrs	Time to peak	=	729 min
Time interval	=	1 min	Hyd. volume	=	1,678 cuft
Inflow hyd. No.	=	5 - Watershed 2 - POST	Max. Elevation	=	130.18 ft
Reservoir name	=	Rain Garden #3	Max. Storage	=	661 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



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	SCS Runoff	18.85	1	736	88,992	------	------	------	Watershed 1 - PRE
2	SCS Runoff	18.44	1	738	89,924	------	------	------	Watershed 1 - POST
4	SCS Runoff	0.834	1	725	2,570	------	------	------	Watershed 2 - PRE
5	SCS Runoff	0.908	1	725	2,797	------	------	------	Watershed 2 - POST
6	Reservoir	0.823	1	727	2,154	5	130.22	692	Rain Garden #3 Disch.

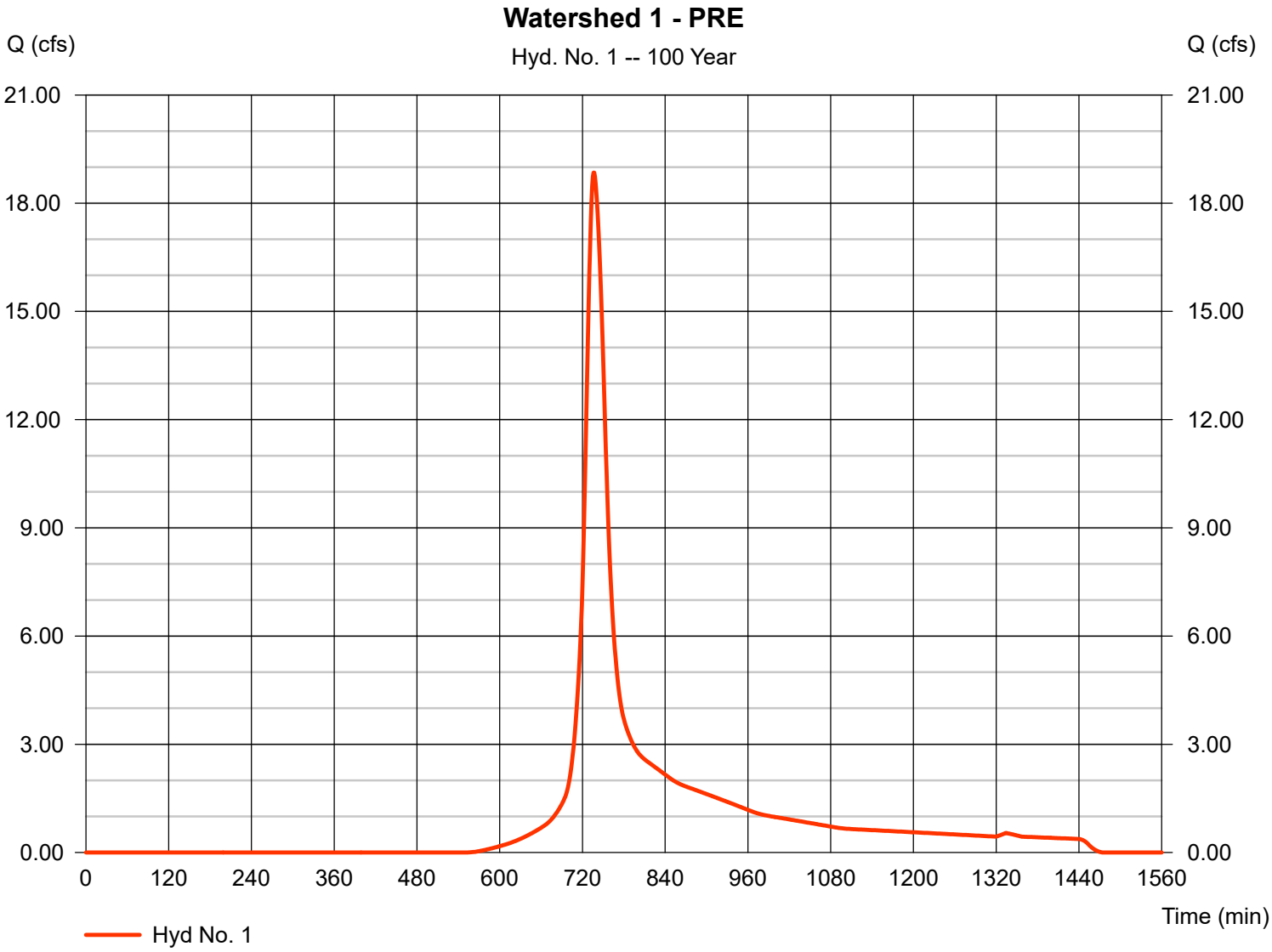
Hydrograph Report

Hyd. No. 1

Watershed 1 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	18.85 cfs
Storm frequency	=	100 yrs	Time to peak	=	736 min
Time interval	=	1 min	Hyd. volume	=	88,992 cuft
Drainage area	=	6.890 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	22.90 min
Total precip.	=	7.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(5.190 x 60) + (1.400 x 66) + (0.300 x 98)] / 6.890



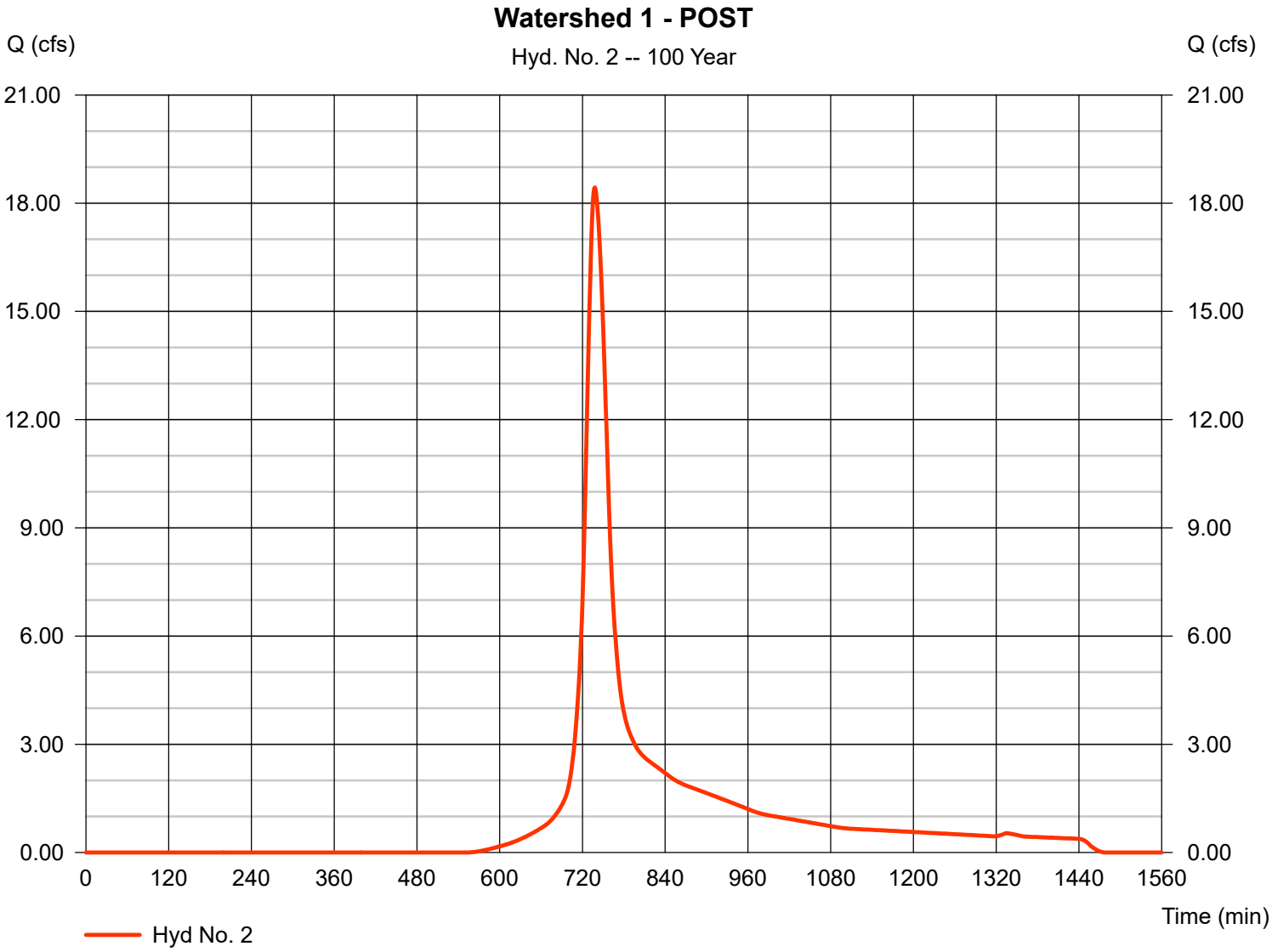
Hydrograph Report

Hyd. No. 2

Watershed 1 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	18.44 cfs
Storm frequency	=	100 yrs	Time to peak	=	738 min
Time interval	=	1 min	Hyd. volume	=	89,924 cuft
Drainage area	=	6.900 ac	Curve number	=	63*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	23.80 min
Total precip.	=	7.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.300 x 39) + (2.900 x 60) + (2.900 x 61) + (0.100 x 66) + (0.700 x 98)] / 6.900



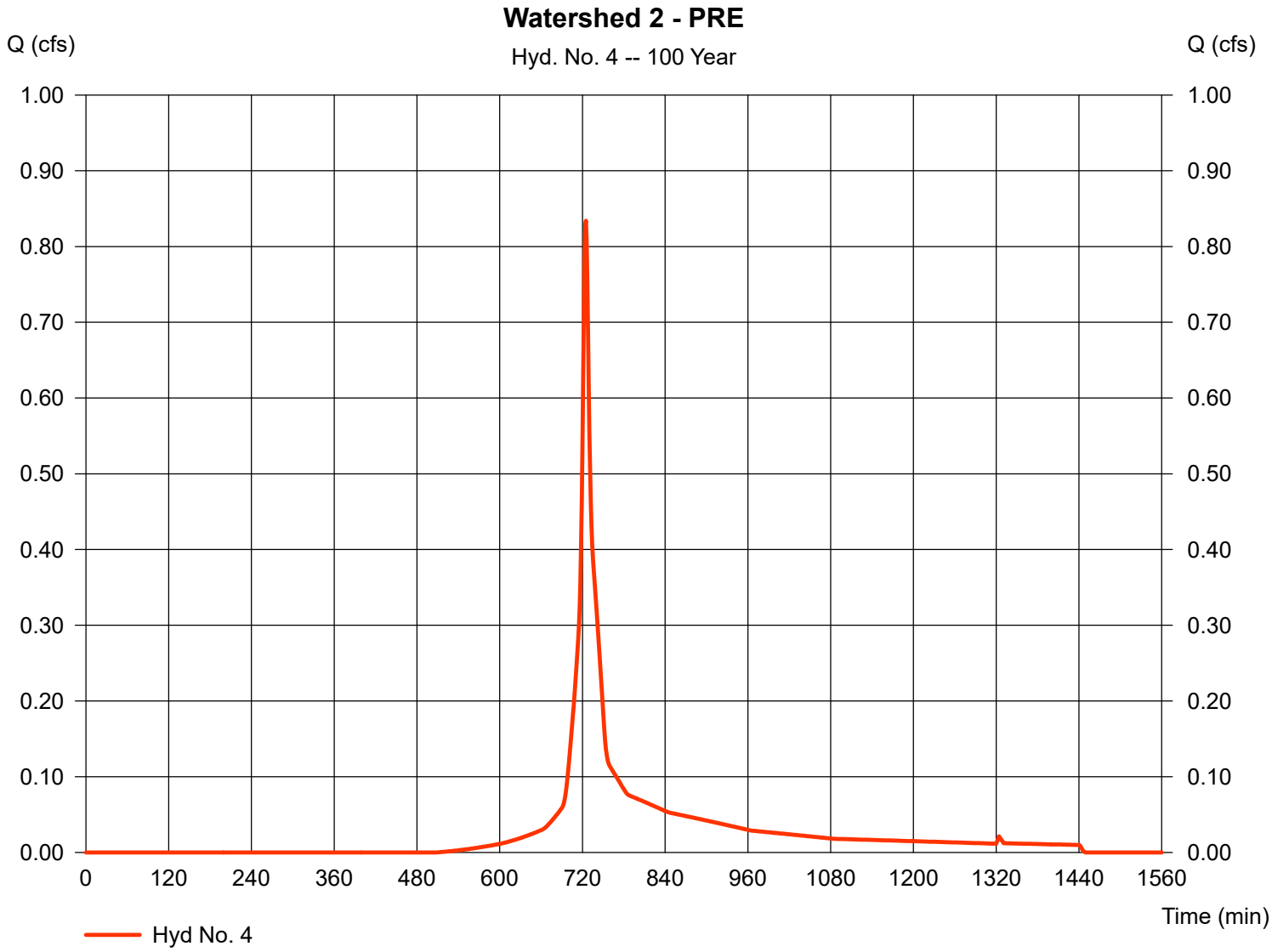
Hydrograph Report

Hyd. No. 4

Watershed 2 - PRE

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.834 cfs
Storm frequency	=	100 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	2,570 cuft
Drainage area	=	0.170 ac	Curve number	=	67*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.140 x 60) + (0.030 x 98)] / 0.170



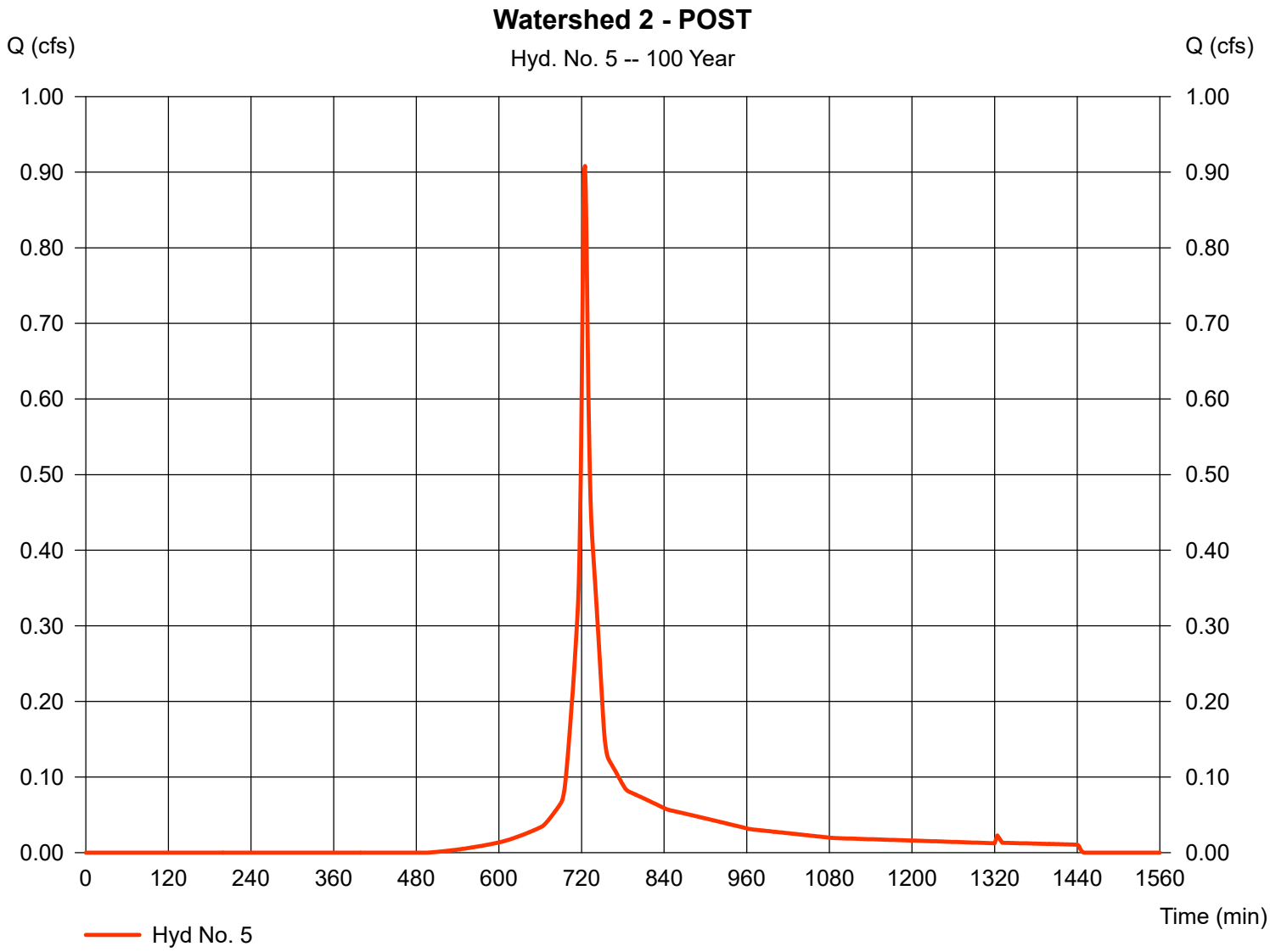
Hydrograph Report

Hyd. No. 5

Watershed 2 - POST

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.908 cfs
Storm frequency	=	100 yrs	Time to peak	=	725 min
Time interval	=	1 min	Hyd. volume	=	2,797 cuft
Drainage area	=	0.180 ac	Curve number	=	68*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	USER	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.90 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 39) + (0.130 x 61) + (0.040 x 98)] / 0.180



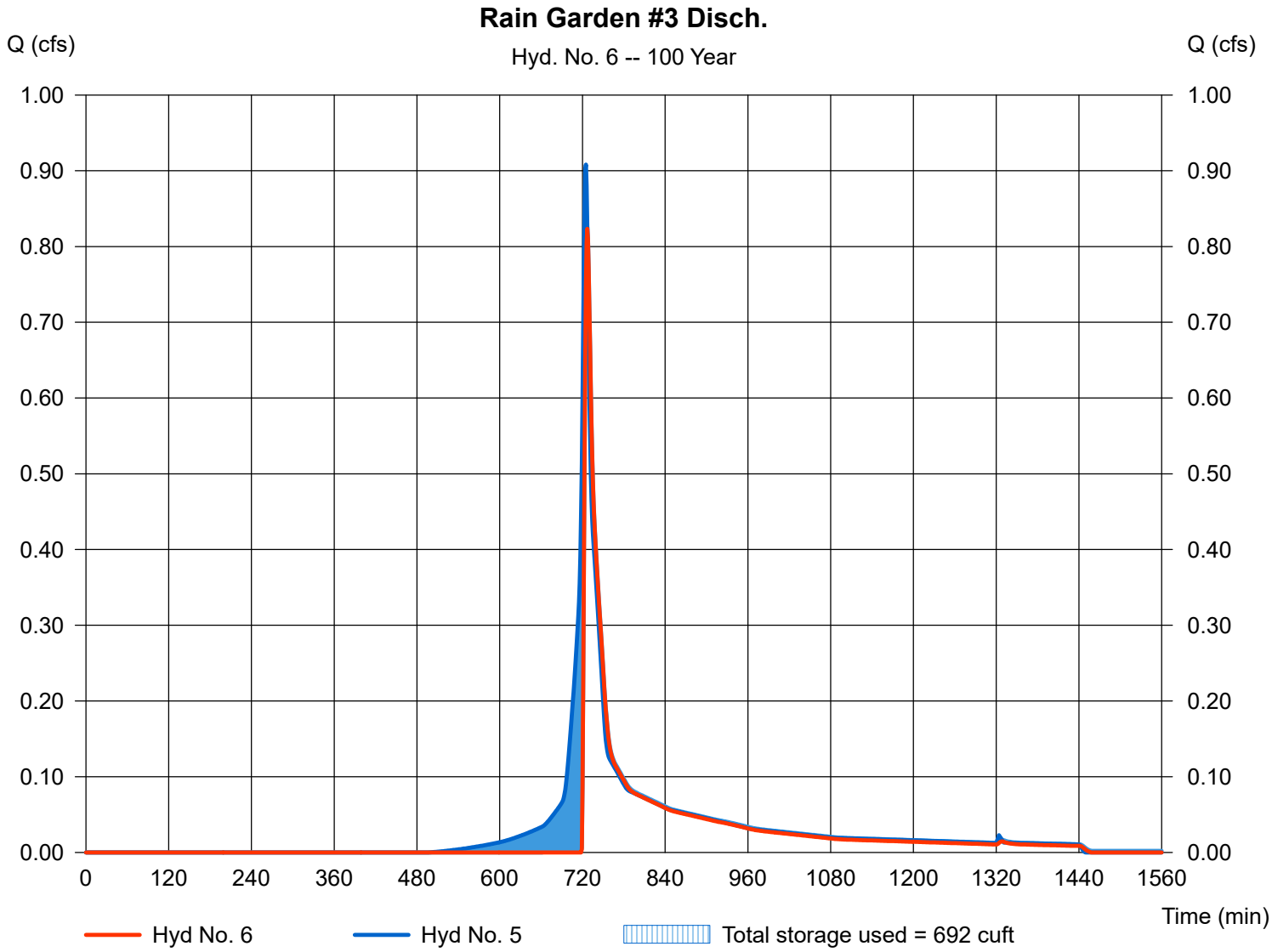
Hydrograph Report

Hyd. No. 6

Rain Garden #3 Disch.

Hydrograph type	=	Reservoir	Peak discharge	=	0.823 cfs
Storm frequency	=	100 yrs	Time to peak	=	727 min
Time interval	=	1 min	Hyd. volume	=	2,154 cuft
Inflow hyd. No.	=	5 - Watershed 2 - POST	Max. Elevation	=	130.22 ft
Reservoir name	=	Rain Garden #3	Max. Storage	=	692 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



CALCULATIONS:

Grass Swale

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	7.903	1	21	9,958	------	------	------	Swale

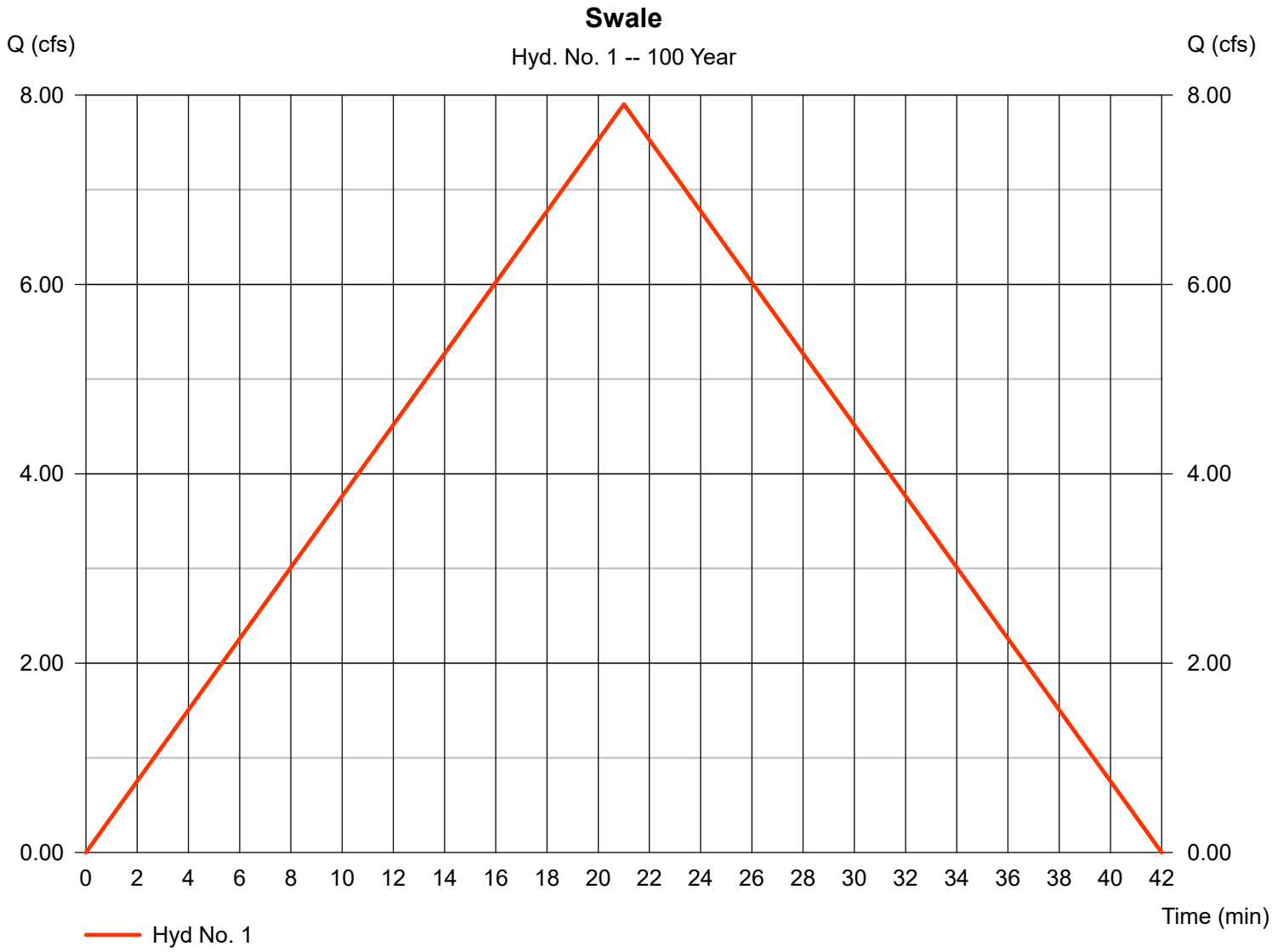
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Friday, Aug 6, 2021

Hyd. No. 1

Swale

Hydrograph type	=	Rational	Peak discharge	=	7.903 cfs
Storm frequency	=	100 yrs	Time to peak	=	21 min
Time interval	=	1 min	Hyd. volume	=	9,958 cuft
Drainage area	=	1.850 ac	Runoff coeff.	=	0.8
Intensity	=	5.340 in/hr	Tc by TR55	=	21.00 min
IDF Curve	=	NOAA Atlas 14.IDF	Asc/Rec limb fact	=	1/1



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Wednesday, Jan 22 2020

Grass Swale - Low Slope

Trapezoidal

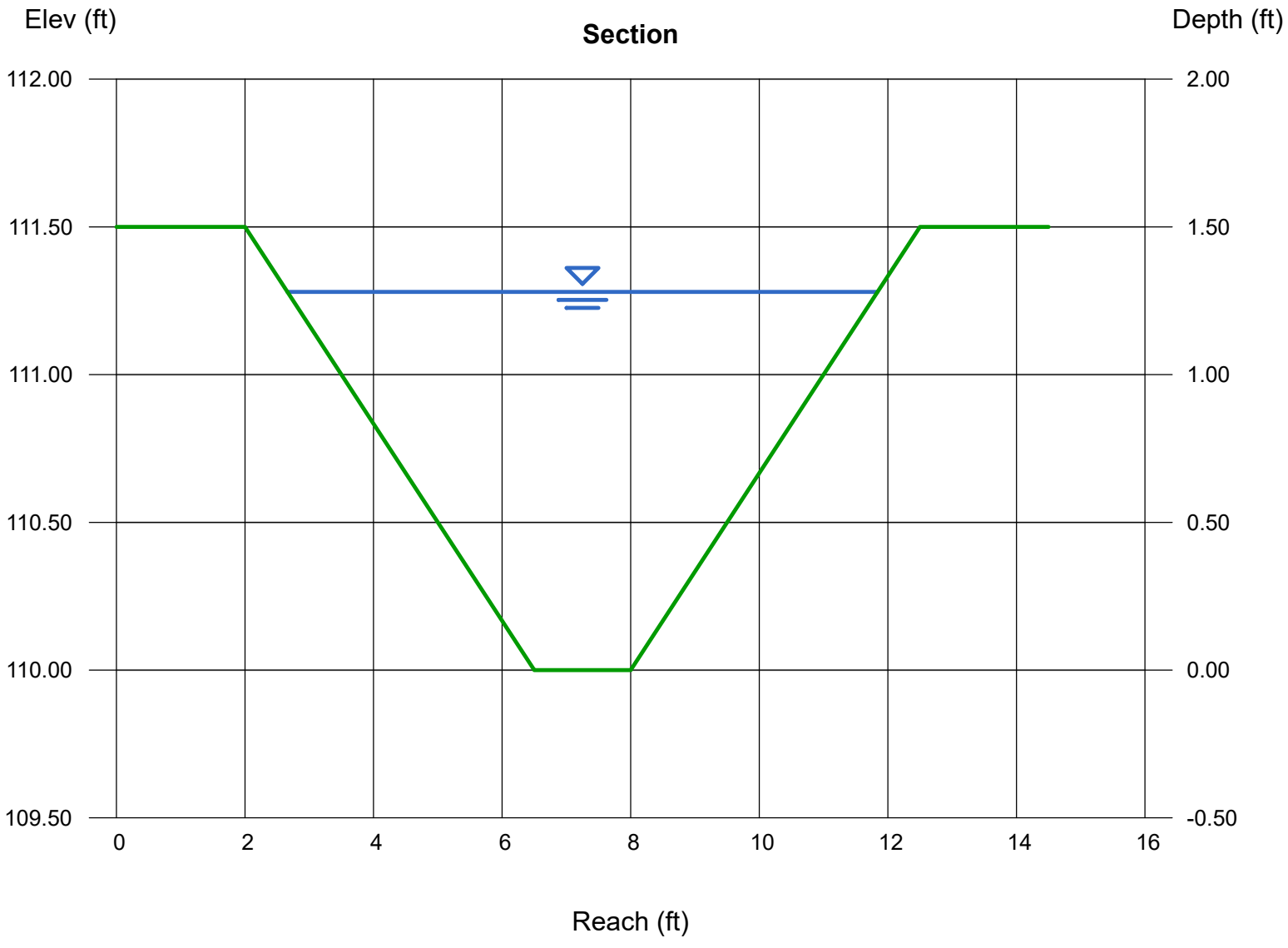
Bottom Width (ft)	= 1.50
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 110.00
Slope (%)	= 5.50
N-Value	= 0.240

Calculations

Compute by:	Known Q
Known Q (cfs)	= 7.90

Highlighted

Depth (ft)	= 1.28
Q (cfs)	= 7.900
Area (sqft)	= 6.84
Velocity (ft/s)	= 1.16
Wetted Perim (ft)	= 9.60
Crit Depth, Yc (ft)	= 0.64
Top Width (ft)	= 9.18
EGL (ft)	= 1.30



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Wednesday, Jan 22 2020

Grass Swale - Steep Slope

Trapezoidal

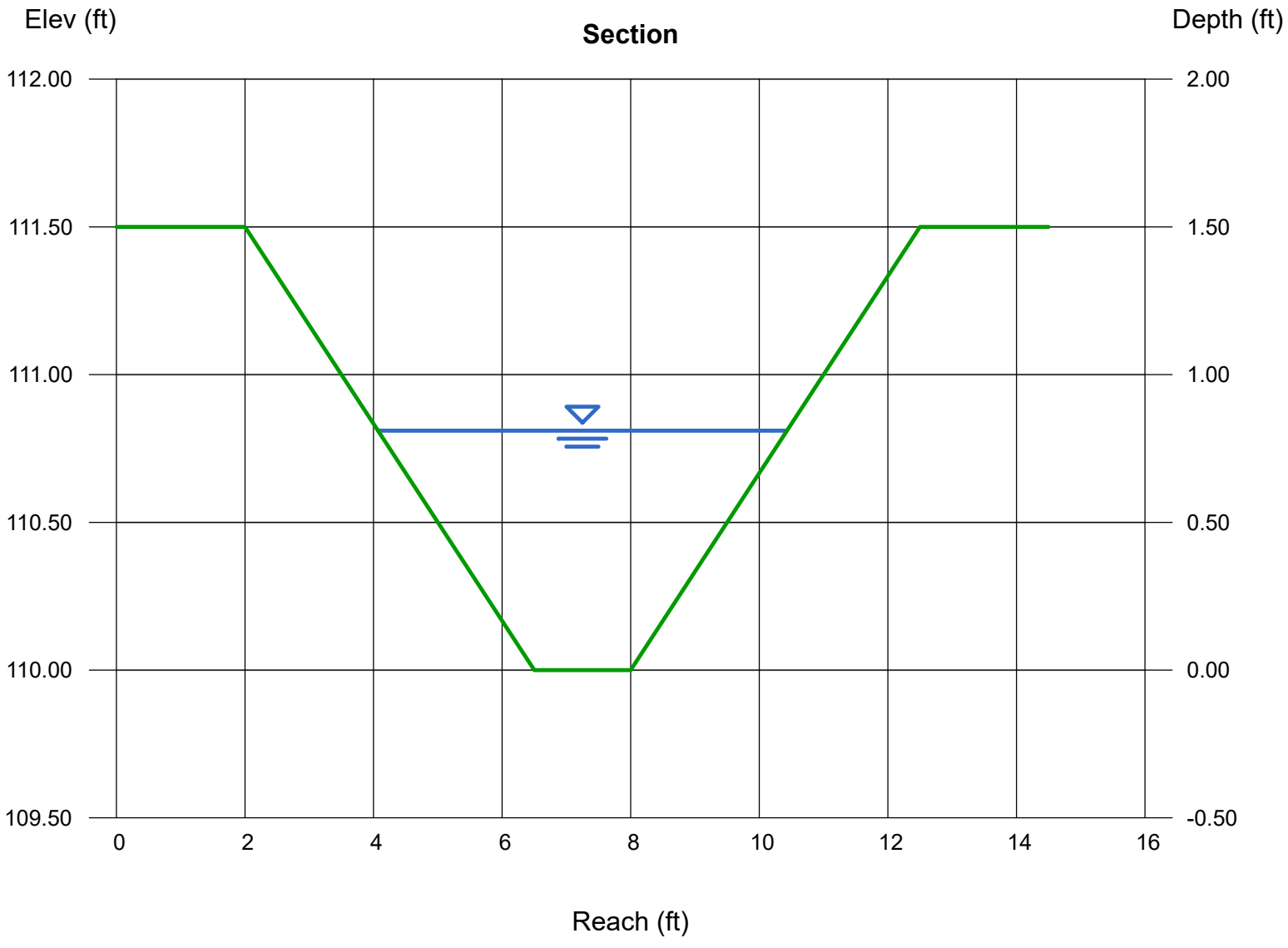
Bottom Width (ft)	= 1.50
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 110.00
Slope (%)	= 17.00
N-Value	= 0.150

Calculations

Compute by:	Known Q
Known Q (cfs)	= 7.90

Highlighted

Depth (ft)	= 0.81
Q (cfs)	= 7.900
Area (sqft)	= 3.18
Velocity (ft/s)	= 2.48
Wetted Perim (ft)	= 6.62
Crit Depth, Yc (ft)	= 0.64
Top Width (ft)	= 6.36
EGL (ft)	= 0.91



APPENDIX A

Support Information

NOAA Atlas 14, Volume 10, Version 3
Location name: Niantic, Connecticut, USA*
Latitude: 41.3351°, Longitude: -72.217°
Elevation: 116.08 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.336 (0.260-0.426)	0.403 (0.311-0.511)	0.512 (0.394-0.651)	0.602 (0.460-0.768)	0.726 (0.539-0.961)	0.819 (0.596-1.10)	0.917 (0.651-1.27)	1.03 (0.691-1.45)	1.19 (0.772-1.73)	1.33 (0.841-1.95)
10-min	0.477 (0.368-0.604)	0.571 (0.440-0.724)	0.725 (0.557-0.922)	0.852 (0.652-1.09)	1.03 (0.764-1.36)	1.16 (0.845-1.56)	1.30 (0.922-1.81)	1.46 (0.980-2.05)	1.69 (1.09-2.44)	1.88 (1.19-2.77)
15-min	0.561 (0.433-0.711)	0.671 (0.518-0.852)	0.852 (0.655-1.08)	1.00 (0.767-1.28)	1.21 (0.898-1.60)	1.37 (0.994-1.84)	1.53 (1.08-2.12)	1.72 (1.15-2.42)	1.99 (1.29-2.88)	2.22 (1.40-3.25)
30-min	0.791 (0.611-1.00)	0.947 (0.731-1.20)	1.20 (0.924-1.53)	1.41 (1.08-1.81)	1.70 (1.26-2.26)	1.92 (1.40-2.59)	2.15 (1.53-2.99)	2.42 (1.62-3.40)	2.80 (1.81-4.04)	3.11 (1.97-4.57)
60-min	1.02 (0.789-1.29)	1.22 (0.943-1.55)	1.55 (1.19-1.97)	1.82 (1.40-2.33)	2.20 (1.63-2.91)	2.48 (1.81-3.34)	2.78 (1.97-3.86)	3.12 (2.09-4.38)	3.61 (2.33-5.21)	4.01 (2.54-5.89)
2-hr	1.34 (1.04-1.68)	1.60 (1.25-2.02)	2.03 (1.58-2.57)	2.39 (1.85-3.03)	2.89 (2.16-3.79)	3.26 (2.39-4.35)	3.65 (2.61-5.04)	4.11 (2.77-5.72)	4.78 (3.11-6.84)	5.34 (3.39-7.77)
3-hr	1.55 (1.22-1.94)	1.86 (1.45-2.33)	2.36 (1.84-2.97)	2.78 (2.15-3.50)	3.35 (2.52-4.38)	3.78 (2.79-5.03)	4.23 (3.04-5.82)	4.76 (3.23-6.61)	5.55 (3.62-7.91)	6.22 (3.96-8.99)
6-hr	1.98 (1.56-2.45)	2.36 (1.86-2.93)	2.99 (2.35-3.73)	3.52 (2.75-4.40)	4.24 (3.21-5.49)	4.77 (3.55-6.30)	5.35 (3.87-7.28)	6.02 (4.10-8.27)	7.01 (4.59-9.89)	7.85 (5.02-11.2)
12-hr	2.45 (1.95-3.02)	2.92 (2.33-3.60)	3.70 (2.93-4.57)	4.34 (3.42-5.39)	5.23 (3.99-6.72)	5.89 (4.40-7.70)	6.59 (4.79-8.89)	7.41 (5.07-10.1)	8.62 (5.67-12.0)	9.63 (6.19-13.7)
24-hr	2.87 (2.31-3.51)	3.45 (2.77-4.21)	4.39 (3.51-5.38)	5.17 (4.11-6.36)	6.24 (4.80-7.96)	7.04 (5.31-9.14)	7.90 (5.79-10.6)	8.91 (6.13-12.0)	10.4 (6.89-14.4)	11.7 (7.54-16.4)
2-day	3.21 (2.60-3.88)	3.89 (3.15-4.72)	5.01 (4.04-6.09)	5.94 (4.76-7.25)	7.21 (5.61-9.15)	8.16 (6.21-10.5)	9.19 (6.81-12.3)	10.4 (7.22-13.9)	12.3 (8.19-16.9)	14.0 (9.06-19.4)
3-day	3.47 (2.83-4.19)	4.21 (3.43-5.08)	5.42 (4.39-6.55)	6.42 (5.17-7.79)	7.79 (6.08-9.83)	8.81 (6.74-11.3)	9.91 (7.38-13.2)	11.3 (7.82-15.0)	13.3 (8.88-18.2)	15.1 (9.81-20.9)
4-day	3.73 (3.05-4.48)	4.50 (3.68-5.41)	5.76 (4.69-6.95)	6.80 (5.50-8.24)	8.24 (6.45-10.4)	9.31 (7.14-11.9)	10.5 (7.80-13.8)	11.9 (8.25-15.7)	14.0 (9.34-19.0)	15.8 (10.3-21.8)
7-day	4.45 (3.67-5.31)	5.28 (4.35-6.31)	6.64 (5.44-7.95)	7.76 (6.33-9.33)	9.31 (7.33-11.6)	10.5 (8.06-13.3)	11.7 (8.75-15.3)	13.2 (9.22-17.3)	15.4 (10.3-20.7)	17.3 (11.3-23.6)
10-day	5.15 (4.27-6.13)	6.02 (4.98-7.16)	7.43 (6.12-8.87)	8.61 (7.05-10.3)	10.2 (8.08-12.6)	11.4 (8.83-14.4)	12.7 (9.50-16.4)	14.2 (9.97-18.5)	16.4 (11.0-21.9)	18.2 (11.9-24.7)
20-day	7.31 (6.11-8.62)	8.24 (6.88-9.72)	9.76 (8.11-11.5)	11.0 (9.10-13.1)	12.8 (10.1-15.5)	14.1 (10.9-17.4)	15.4 (11.5-19.5)	16.9 (11.9-21.8)	18.9 (12.8-25.0)	20.4 (13.4-27.4)
30-day	9.11 (7.65-10.7)	10.1 (8.46-11.8)	11.7 (9.75-13.7)	13.0 (10.8-15.3)	14.8 (11.8-17.9)	16.2 (12.6-19.9)	17.6 (13.1-22.0)	19.0 (13.5-24.4)	20.8 (14.1-27.4)	22.2 (14.6-29.6)
45-day	11.3 (9.58-13.2)	12.4 (10.4-14.5)	14.1 (11.8-16.5)	15.4 (12.9-18.2)	17.4 (13.9-20.8)	18.9 (14.7-22.9)	20.3 (15.2-25.1)	21.7 (15.5-27.6)	23.3 (15.9-30.4)	24.4 (16.1-32.4)
60-day	13.2 (11.2-15.4)	14.3 (12.1-16.6)	16.1 (13.5-18.7)	17.5 (14.7-20.5)	19.5 (15.7-23.3)	21.1 (16.5-25.5)	22.6 (16.9-27.8)	23.9 (17.1-30.4)	25.5 (17.4-33.1)	26.5 (17.5-35.0)

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

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

Please refer to NOAA Atlas 14 document for more information.

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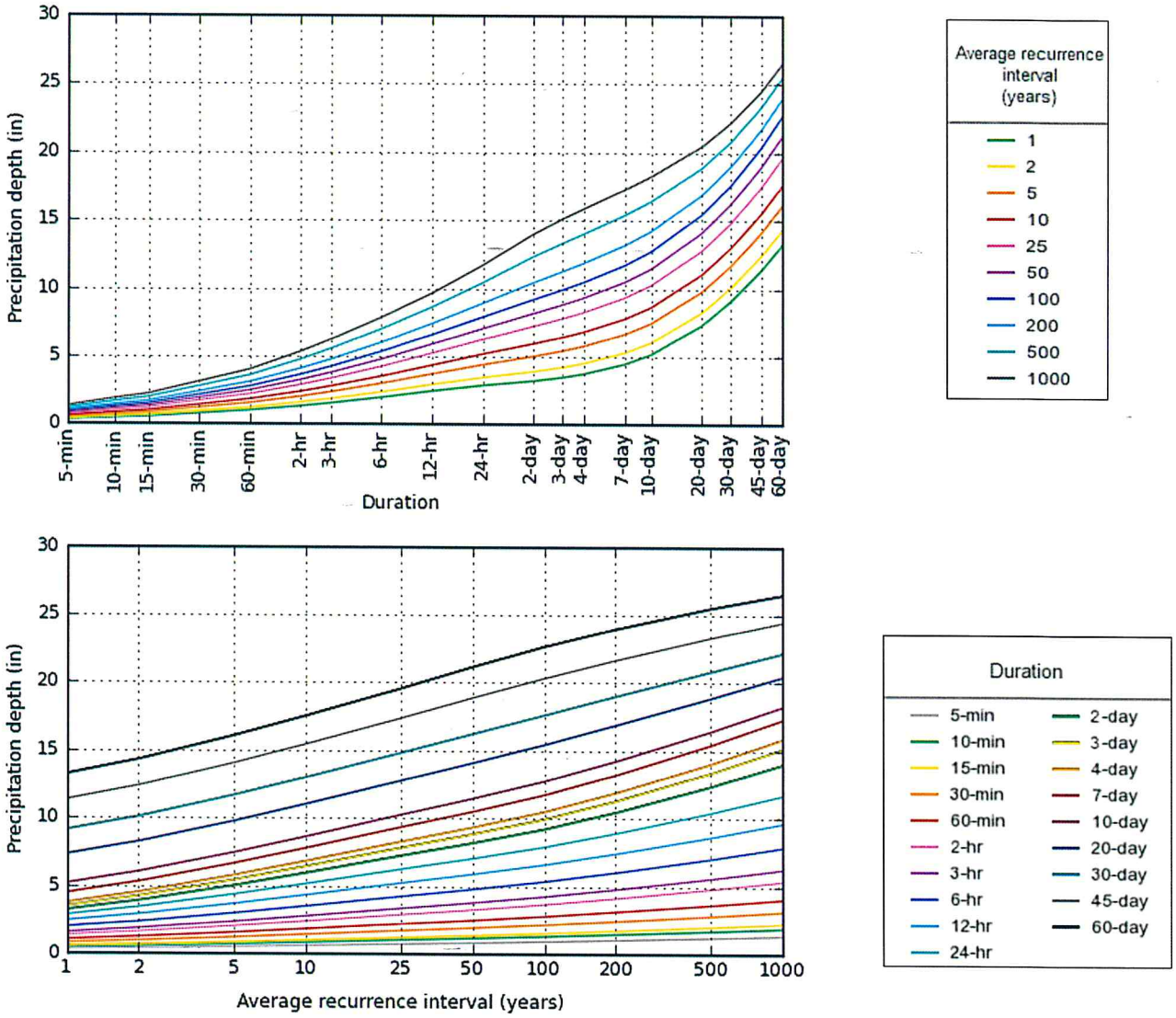
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 41.3351°, Longitude: -72.2170°



NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Wed Dec 11 19:31:24 2019

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Maps & aerials

Small scale terrain

NOAA Atlas 14, Volume 10, Version 3
Location name: Niantic, Connecticut, USA*
Latitude: 41.3351°, Longitude: -72.217°
Elevation: 116.08 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	4.03 (3.12-5.11)	4.84 (3.73-6.13)	6.14 (4.73-7.81)	7.22 (5.52-9.22)	8.71 (6.47-11.5)	9.83 (7.15-13.2)	11.0 (7.81-15.3)	12.3 (8.29-17.4)	14.3 (9.26-20.7)	15.9 (10.1-23.4)
10-min	2.86 (2.21-3.62)	3.43 (2.64-4.34)	4.35 (3.34-5.53)	5.11 (3.91-6.53)	6.17 (4.58-8.17)	6.96 (5.07-9.37)	7.79 (5.53-10.8)	8.75 (5.88-12.3)	10.1 (6.56-14.7)	11.3 (7.15-16.6)
15-min	2.24 (1.73-2.84)	2.68 (2.07-3.41)	3.41 (2.62-4.33)	4.01 (3.07-5.12)	4.84 (3.59-6.40)	5.46 (3.98-7.36)	6.12 (4.34-8.50)	6.86 (4.62-9.66)	7.96 (5.15-11.5)	8.86 (5.61-13.0)
30-min	1.58 (1.22-2.00)	1.89 (1.46-2.40)	2.40 (1.85-3.06)	2.83 (2.16-3.61)	3.41 (2.53-4.51)	3.84 (2.80-5.18)	4.31 (3.05-5.98)	4.83 (3.24-6.79)	5.59 (3.62-8.09)	6.22 (3.94-9.14)
60-min	1.02 (0.789-1.29)	1.22 (0.943-1.55)	1.55 (1.19-1.97)	1.82 (1.40-2.33)	2.20 (1.63-2.91)	2.48 (1.81-3.34)	2.78 (1.97-3.86)	3.12 (2.09-4.38)	3.61 (2.33-5.21)	4.01 (2.54-5.89)
2-hr	0.669 (0.521-0.841)	0.801 (0.624-1.01)	1.02 (0.788-1.28)	1.20 (0.922-1.52)	1.44 (1.08-1.90)	1.63 (1.20-2.18)	1.82 (1.31-2.52)	2.05 (1.39-2.86)	2.39 (1.55-3.42)	2.67 (1.70-3.88)
3-hr	0.517 (0.405-0.647)	0.619 (0.484-0.776)	0.786 (0.613-0.987)	0.925 (0.717-1.17)	1.12 (0.839-1.46)	1.26 (0.927-1.67)	1.41 (1.01-1.94)	1.59 (1.07-2.20)	1.85 (1.21-2.63)	2.07 (1.32-2.99)
6-hr	0.330 (0.261-0.410)	0.394 (0.311-0.490)	0.500 (0.393-0.622)	0.587 (0.459-0.734)	0.707 (0.536-0.917)	0.797 (0.592-1.05)	0.893 (0.645-1.22)	1.00 (0.684-1.38)	1.17 (0.767-1.65)	1.31 (0.839-1.88)
12-hr	0.203 (0.162-0.250)	0.243 (0.193-0.299)	0.307 (0.243-0.379)	0.360 (0.284-0.447)	0.434 (0.331-0.558)	0.489 (0.366-0.639)	0.547 (0.398-0.738)	0.615 (0.421-0.837)	0.715 (0.471-0.999)	0.799 (0.514-1.13)
24-hr	0.120 (0.096-0.146)	0.144 (0.115-0.176)	0.183 (0.146-0.224)	0.215 (0.171-0.265)	0.260 (0.200-0.332)	0.293 (0.221-0.381)	0.329 (0.241-0.441)	0.371 (0.255-0.500)	0.434 (0.287-0.601)	0.487 (0.314-0.684)
2-day	0.067 (0.054-0.081)	0.081 (0.066-0.098)	0.104 (0.084-0.127)	0.124 (0.099-0.151)	0.150 (0.117-0.191)	0.170 (0.129-0.219)	0.191 (0.142-0.255)	0.217 (0.150-0.290)	0.257 (0.171-0.352)	0.291 (0.189-0.405)
3-day	0.048 (0.039-0.058)	0.058 (0.048-0.071)	0.075 (0.061-0.091)	0.089 (0.072-0.108)	0.108 (0.084-0.137)	0.122 (0.094-0.157)	0.138 (0.103-0.183)	0.156 (0.109-0.208)	0.185 (0.123-0.252)	0.210 (0.136-0.290)
4-day	0.039 (0.032-0.047)	0.047 (0.038-0.056)	0.060 (0.049-0.072)	0.071 (0.057-0.086)	0.086 (0.067-0.108)	0.097 (0.074-0.124)	0.109 (0.081-0.144)	0.124 (0.086-0.164)	0.146 (0.097-0.198)	0.165 (0.107-0.227)
7-day	0.026 (0.022-0.032)	0.031 (0.026-0.038)	0.040 (0.032-0.047)	0.046 (0.038-0.056)	0.055 (0.044-0.069)	0.062 (0.048-0.079)	0.070 (0.052-0.091)	0.078 (0.055-0.103)	0.092 (0.061-0.123)	0.103 (0.067-0.140)
10-day	0.021 (0.018-0.026)	0.025 (0.021-0.030)	0.031 (0.026-0.037)	0.036 (0.029-0.043)	0.043 (0.034-0.053)	0.048 (0.037-0.060)	0.053 (0.040-0.069)	0.059 (0.042-0.077)	0.068 (0.046-0.091)	0.076 (0.050-0.103)
20-day	0.015 (0.013-0.018)	0.017 (0.014-0.020)	0.020 (0.017-0.024)	0.023 (0.019-0.027)	0.027 (0.021-0.032)	0.029 (0.023-0.036)	0.032 (0.024-0.041)	0.035 (0.025-0.045)	0.039 (0.027-0.052)	0.043 (0.028-0.057)
30-day	0.013 (0.011-0.015)	0.014 (0.012-0.016)	0.016 (0.014-0.019)	0.018 (0.015-0.021)	0.021 (0.016-0.025)	0.022 (0.017-0.028)	0.024 (0.018-0.031)	0.026 (0.019-0.034)	0.029 (0.020-0.038)	0.031 (0.020-0.041)
45-day	0.011 (0.009-0.012)	0.011 (0.010-0.013)	0.013 (0.011-0.015)	0.014 (0.012-0.017)	0.016 (0.013-0.019)	0.017 (0.014-0.021)	0.019 (0.014-0.023)	0.020 (0.014-0.026)	0.022 (0.015-0.028)	0.023 (0.015-0.030)
60-day	0.009 (0.008-0.011)	0.010 (0.008-0.012)	0.011 (0.009-0.013)	0.012 (0.010-0.014)	0.014 (0.011-0.016)	0.015 (0.011-0.018)	0.016 (0.012-0.019)	0.017 (0.012-0.021)	0.018 (0.012-0.023)	0.018 (0.012-0.024)

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

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

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based intensity-duration-frequency (IDF) curves
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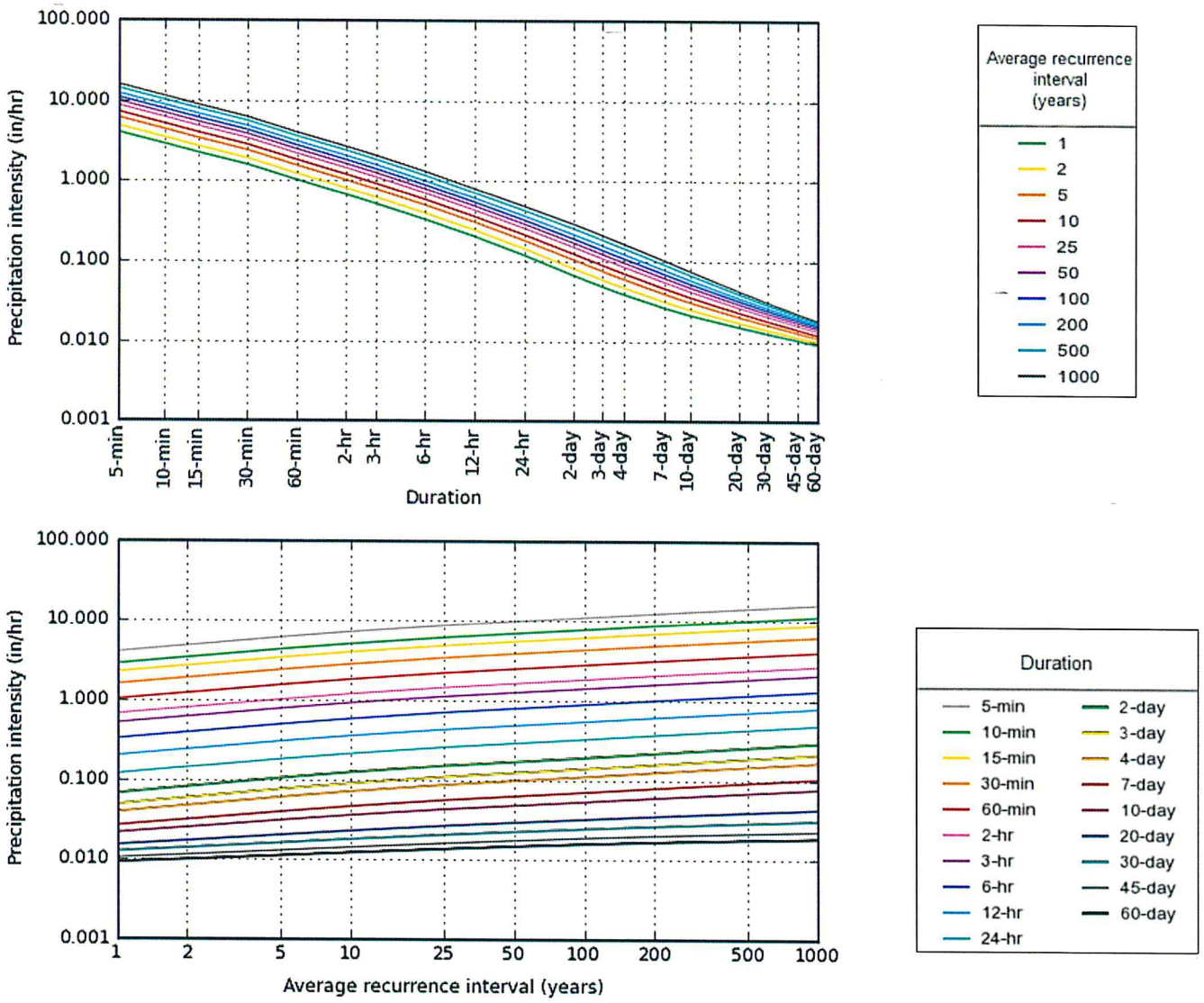

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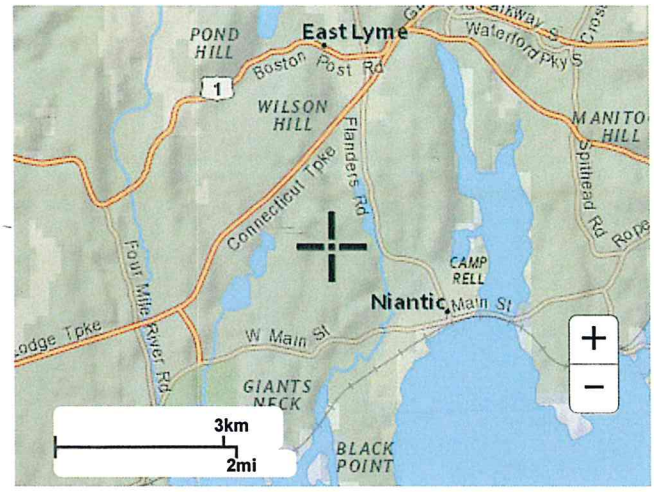
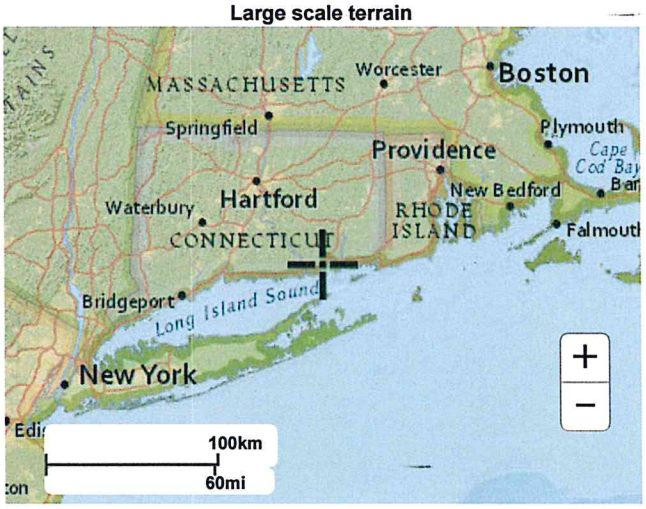
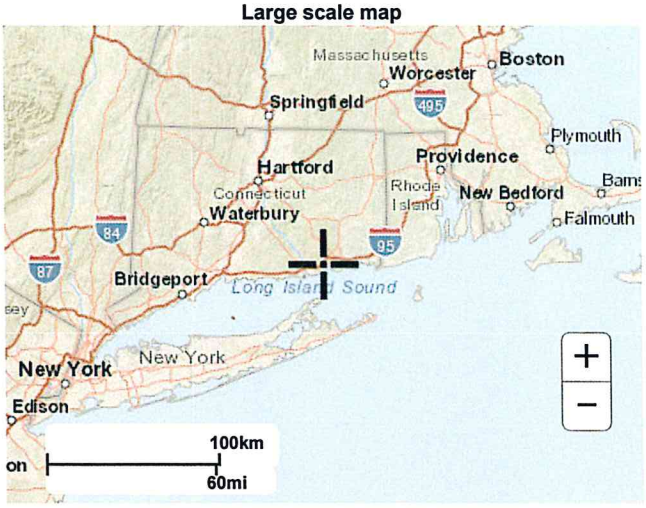


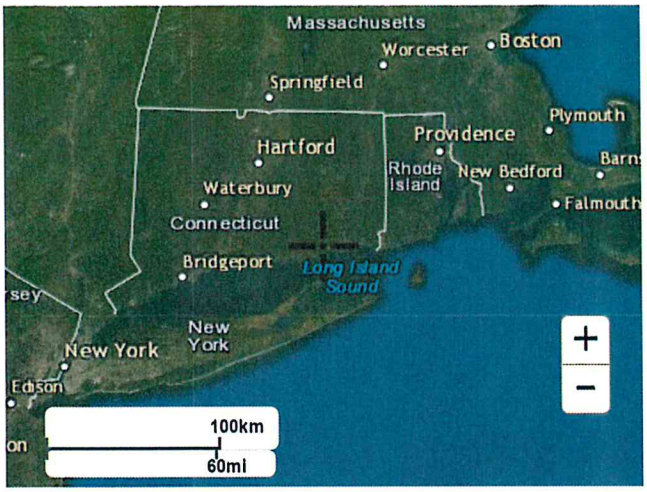
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2/]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2/]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3/]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4/]	48	65	73
Woods—grass combination (orchard or tree farm). [5/]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6/]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4/]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.

2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 *Poor*: <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

APPENDIX B

Soil Resource Report

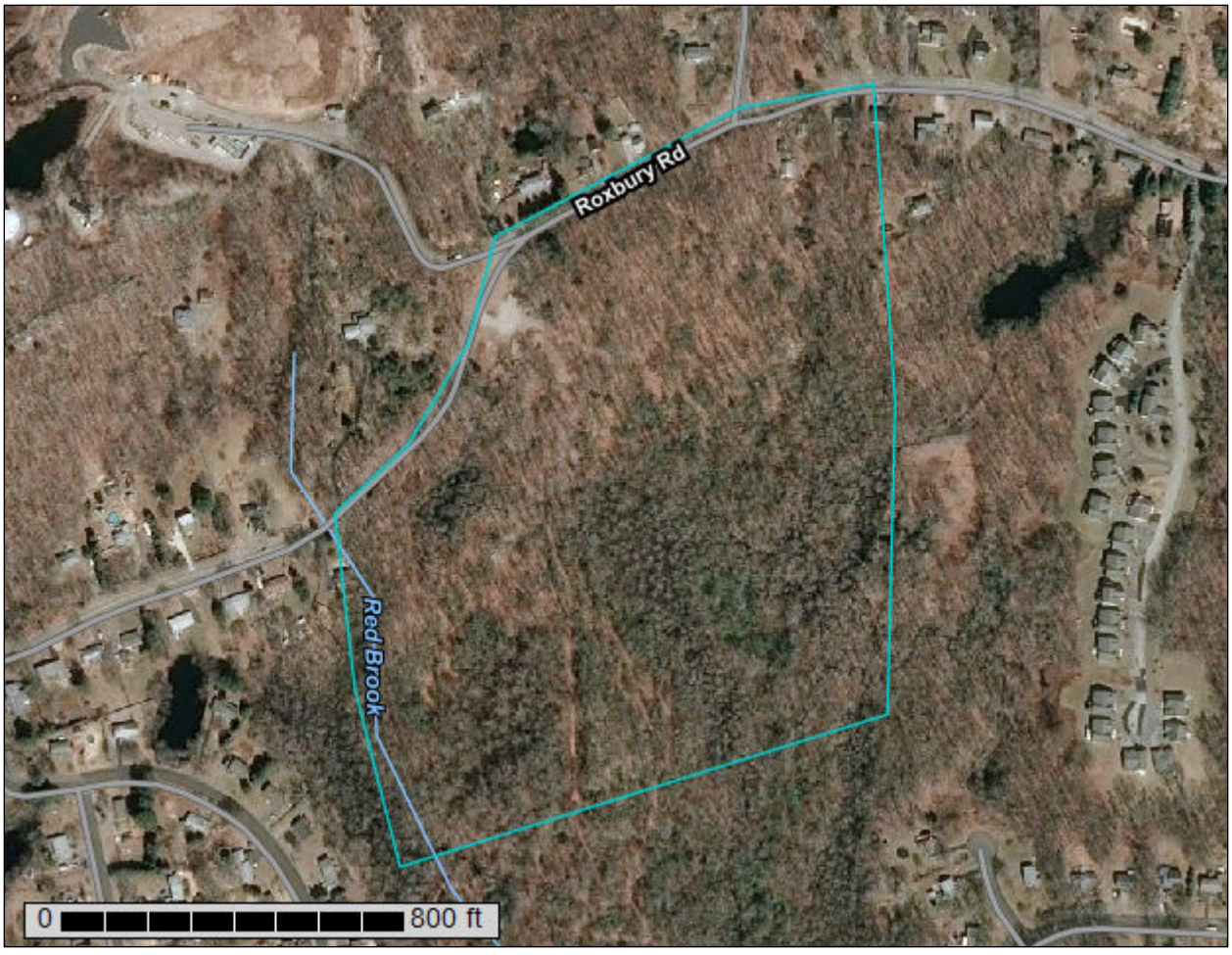
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for State of Connecticut



January 24, 2020

Preface

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

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

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

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

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

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

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Contents

Soil Information for All Uses

Soil Properties and Qualities

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

Soil Qualities and Features

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

Hydrologic Soil Group

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

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

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

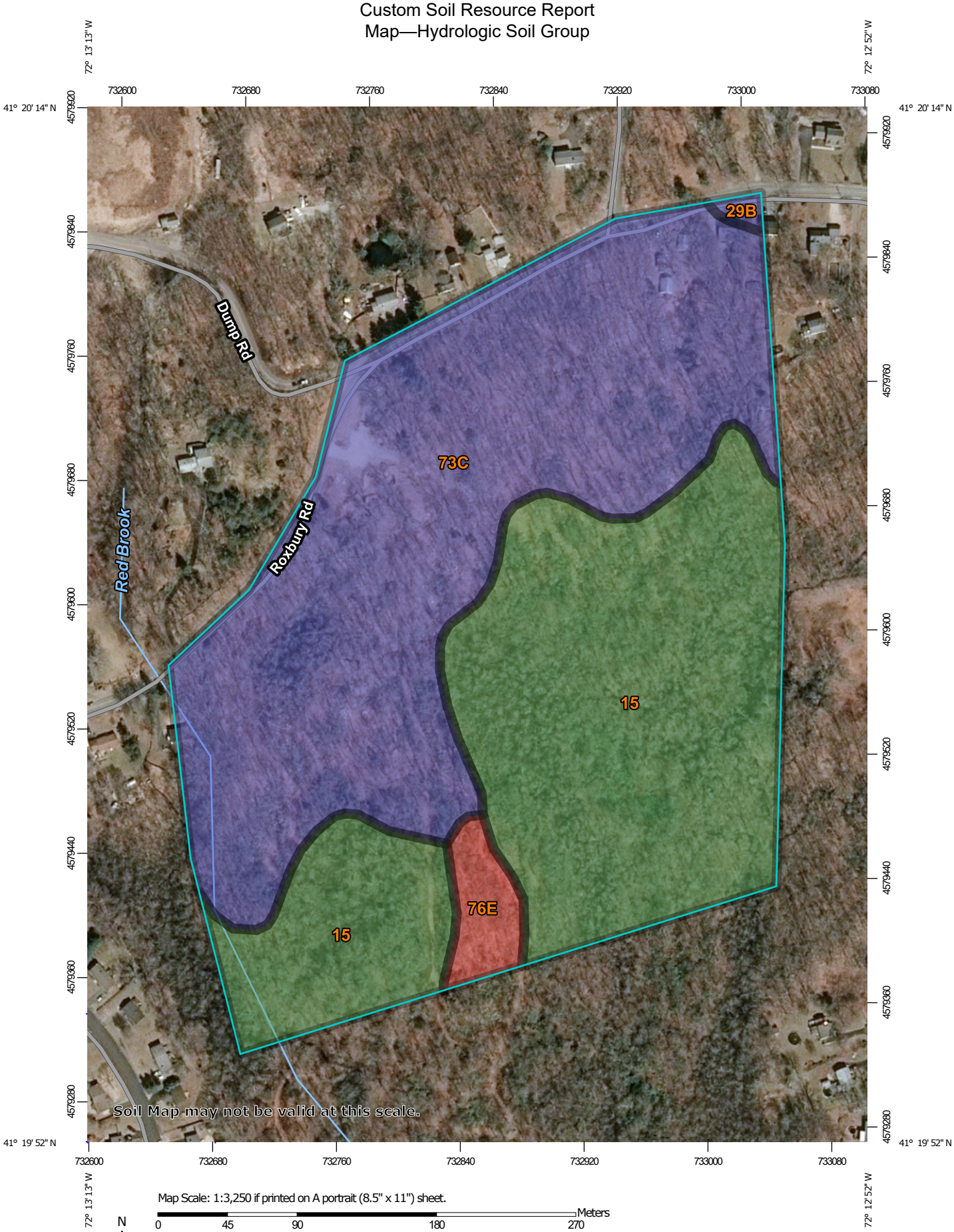
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:3,250 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

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 1:12,000.

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: State of Connecticut
Survey Area Data: Version 19, Sep 13, 2019

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

Date(s) aerial images were photographed: Mar 20, 2019—Mar 27, 2019

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
15	Scarboro muck, 0 to 3 percent slopes	A/D	17.5	45.3%
29B	Agawam fine sandy loam, 3 to 8 percent slopes	B	0.1	0.3%
73C	Charlton-Chatfield complex, 0 to 15 percent slopes, very rocky	B	20.0	51.8%
76E	Rock outcrop-Hollis complex, 3 to 45 percent slopes	D	1.0	2.6%
Totals for Area of Interest			**38.7**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher