3.6 Drainage Calculations

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Stormwater Management

The proposed project is to redevelop an existing mixed use site located on Great Road.

Pre Development-

The existing site is approximately 2.44 ac and contains an office building, a retail building, three single family dwellings and associated appurtenances. For the stormwater analysis, the existing site conditions from 1990 were used, prior to the conversion of the dwellings on 19 and 29 Great Road to retail space. The site has been divided into 2 subcatchments as shown on the attached drainage map.

Subcatchment 1 is the majority of the site and drains to Great Road uncontrolled. Subcatchment 2 is portion of woods and open space located to the east that flows off-site.

Post Development-

The proposed work is to retain the historical dwellings at 7, 19 and 29 Great Road while adding retail space and 10 single family dwellings. The dwelling at 7 Great Road will be moved and converted to retail space while the retail space at 19 and 29 Great Road will be converted back to single family dwellings. The result will be a total of 14 single family dwellings and approximately 8,000 square feet of retail space. The proposed subcatchments are shown on the attached drainage map.

Subcatchment 1 is located to the north and east of the site and contains 10 single family dwellings and the majority of the driveway. Runoff from subcatchment 1 will be directed to a Contech Vortsentry unit sized to treat the first flush volume. From there it will directed to a subsurface infiltration structure where stormwater will be infiltrated. Subcatchment 2 is located to the south and contains the retail building and associated parking lot. Runoff will be directed to a subsurface infiltration structure with a Contech CDS unit sized to treat the first flush volume. Subcatchment 3 is located to the west and contains an existing retail building, garage and associated pavement. Runoff will be directed to a catch basin and subsurface infiltration structure. Subcatchment 4 is the portion of driveway located to the west. Runoff will flow uncontrolled to the drainage system on Great Road.

In accordance with the Town of Acton Zoning Bylaw, Section 10.4.3.1, the peak rate of stormwater runoff will not exceed the existing rate based on a 10-year storm event. In addition, the system design will not result in a serious flood hazard during the 100-year storm event. The peak runoff rates have been summarized in the following tables.

Discharge Summary Tables

In accordance with the Rules and Regulations for Site Plan Special Permits, water balance calculations have also been performed. Detailed calculations for water balance, inlet grate capacity, and pipe sizing are attached.

Compliance with MA DEP Stormwater Management Standards

Compliance with the Stormwater Management Standards is as follows:

Standard 1: No Untreated Discharges
No untreated discharges to wetlands are proposed. Additional runoff from the site is to be treated with Contech units and infiltrated in subsurface infiltration structures. Roof runoff will be treated by roof drywells.

Standard 2: Peak Rate Attenuation
The Post-Development peak discharge rates must not be increased from pre-development rates for the 2-year, 10-year, and 100-year storm events. Also, offsite flood impact from the 100-year storm must not be increased. With a combination of infiltration and detention, the peak runoff rate and volume have been decreased. The peak runoff rates have been summarized in the following tables.

Discharge Summary Tables

Total Runoff

2-year Storm		10-year Storm		100-year Storm	
Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)
0.071	0.044	0.765	0.153	2.684	0.345

Total Volume

2-year Storm		10-year Storm		100-year Storm	
Pre (cf)	Post (cf)	Pre (cf)	Post (cf)	Pre (cf)	Post (cf)
1,220	199	4,955	513	12,741	1060

Standard 3: Stormwater Recharge
The subsurface infiltration structures have been sized to infiltrate the required recharge volume as specified in the Massachusetts Stormwater Handbook. The "Simple Dynamic" method was used in sizing the required storage volume to infiltrate the recharging runoff. Calculations were performed to insure drawdown within 72 hours to provide storage for the next storm event. Detailed calculations showing compliance with Standard 3 have been attached to this report.

Standard 4: Water Quality
The required water quality volume for this project is 1" of runoff over the impervious area for the subsurface infiltration structures since the infiltration rate is greater than 2.4 inches per hour. This volume will be treated to meet the 80% TSS removal requirement of Standard 4. Also, 44% TSS removal will be provided prior to infiltration. Calculations showing treatment levels are attached.

Standard 5: Land Uses with Higher Potential Pollutant Loads
The site is will not contain "land uses with higher potential pollutant loads."

Standard 6: Critical Areas
The site does not discharge runoff to critical areas.

Standard 7: Redevelopment
The proposed project qualifies as redevelopment but meets all the requirements for new development.

Standard 8: Construction Period Controls
The erosion and sedimentation control measures will be followed in accordance with the Erosion and Sedimentation Control Plan and will be consistent with the requirements of the NPDES Construction General Permit. The project will require coverage under the NPDES Construction General Permit.

Standard 9: Operation and Maintenance Plan
An Operation and Maintenance Plan is included in this report.

Standard 10: Illicit Discharges to Drainage System
An Illicit Discharge Compliance will be provided prior to the discharge of stormwater runoff to the post-construction stormwater BMP's.

Design Basis

1. The United States Department of Agriculture Natural Resource Conservation Service (N.R.C.S.) TR55 methodology was used to determine offsite rates of runoff.
2. The twenty-four hour rainfall, taken from N.R.C.S. publications, is 6.4 inches for the 100-year storm, 4.5 inches for the 10-year storm, and 3.1 inches for the 2-year storm event.
3. The hydrologic calculations were performed using the computer program: "Hydraflow Hydrographs 2007" by Intelisolve.
4. The soil types of the site were taken from the N.R.C.S. Soil Survey Map for Middlesex County.
5. Soil conditions and estimated seasonal high groundwater table were based on on-site soil evaluations.
6. The Natural Resources Conservation Service (N.R.C.S.) soil survey indicated the presences of Windsor Loamy Sand and Merrimac-Urban land complex. These soil groups rate as Hydrologic Group A.

Pre-Development Hydrology

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	0.071	2	754	1,220	----	------	------	Subcatchment 1
2	SCS Runoff	0.000	2	n/a	0	----	------	------	Subcatchment 2
4	Combine	0.071	2	754	1,220	1, 2,	------	------	Pre-Total

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	0.765	2	738	4,954	----	------	------	Subcatchment 1
2	SCS Runoff	0.000	2	1324	2	----	------	------	Subcatchment 2
4	Combine	0.765	2	738	4,955	1, 2,	------	------	Pre-Total

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

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	2.684	2	732	12,712	----	------	------	Subcatchment 1
2	SCS Runoff	0.002	2	746	29	----	------	------	Subcatchment 2
4	Combine	2.684	2	732	12,741	1, 2,	------	------	Pre-Total

Worksheet 2: Runoff curve number and runoff **SM-939B**

Project: 7, 9, 19-29 Great Road By WJH Date 1/13/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present Developed Subcatchment 1

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			0.49	48.30
626B & 255C A	Woods- Good Condition	30			0.12	3.47
626B & 255C A	Open Space-Good Condition	39			1.76	68.57
626B & 255C A	Gravel-Good Condition	76			0.07	5.45
				Totals =	2.44	125.78

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{125.78}{2.44} = 51.59$; Use CN = 51.6

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.1	4.5	6.4
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.14	0.57	1.47
Runoff, Q.....	cf	1248	5072	13020

D-2 (210-VI-TR-55, Second Ed., June 1986)

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-939B

Project: 7, 9, 19-29 Great Road By WJH Date 1/13/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present Developed
Circle one: Tc Tt through subarea Subcatchment 1A

Sheet flow (Applicable to Tc only)		Segment ID	A-B	B-C		
1. Surface Description (table 3-1)			Woods	Grass		
2. Mannings roughness coeff., n (table 3-1)			0.6	0.24		
3. Flow length, L (total L <= 300 ft)		ft	28	12		
4. Two-yr 24-hr rainfall, P2		in	3.1	3.1		
5. Land Slope, s		ft/ft	0.02	0.02		
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.18	0.04		0.23

Shallow concentrated Flow		Segment ID	C-D	D-E		
7. Surface Description (paved or unpaved)			UNPAVED	PAVED		
8. Flow Length, L		ft	170	80		
9. Watercourse slope, s		ft/ft	0.08	0.088		
10. Average Velocity, V (figure 3-1)		ft/s	4.56	6.03		
11. Tt = L / 3600V	Compute Tt	hr	0.01	0.00		0.01

Channel flow		Segment ID				
12. Cross sectional flow area, a		sf				
13. Wetted perimeter, pw		ft				
14. Hydraulic radius, r=a/wp	Compute r	ft				
15. Channel Slope, s		ft/ft				
16. Manning's roughness coeff., n						
17. V = 1.49 r^2/3 s^1/2 / n	Compute V	ft/s				
18. Flow length, L		ft				
19. Tt = L / 3600V	Compute Tt	hr				0.00

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.24
min 14.4

(210-VI-TR-55, Second Ed., June 1986)

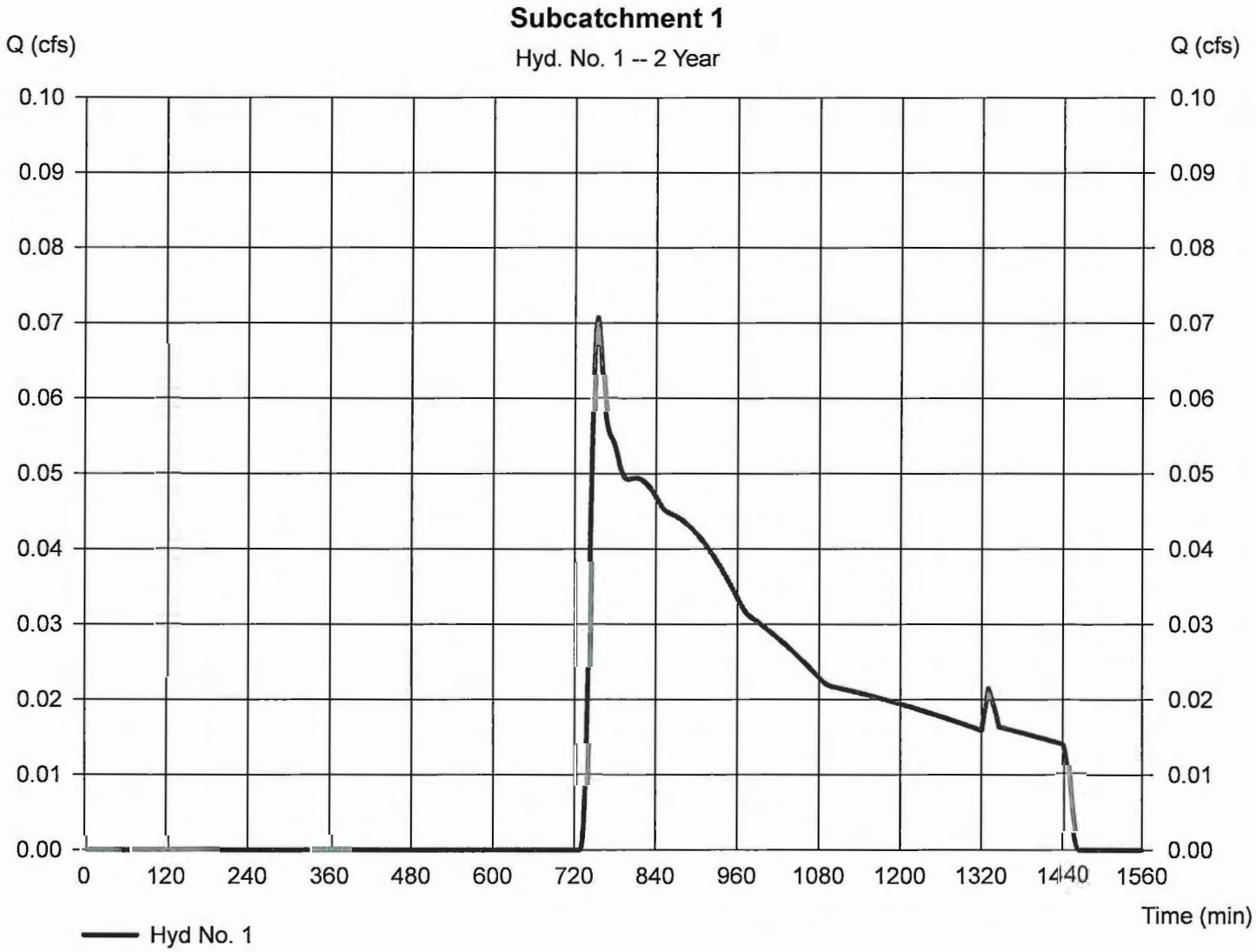
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Feb 5, 2015

Hyd. No. 1

Subcatchment 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.071 cfs
Storm frequency	= 2 yrs	Time to peak	= 754 min
Time interval	= 2 min	Hyd. volume	= 1,220 cuft
Drainage area	= 2.440 ac	Curve number	= 51.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 14.40 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



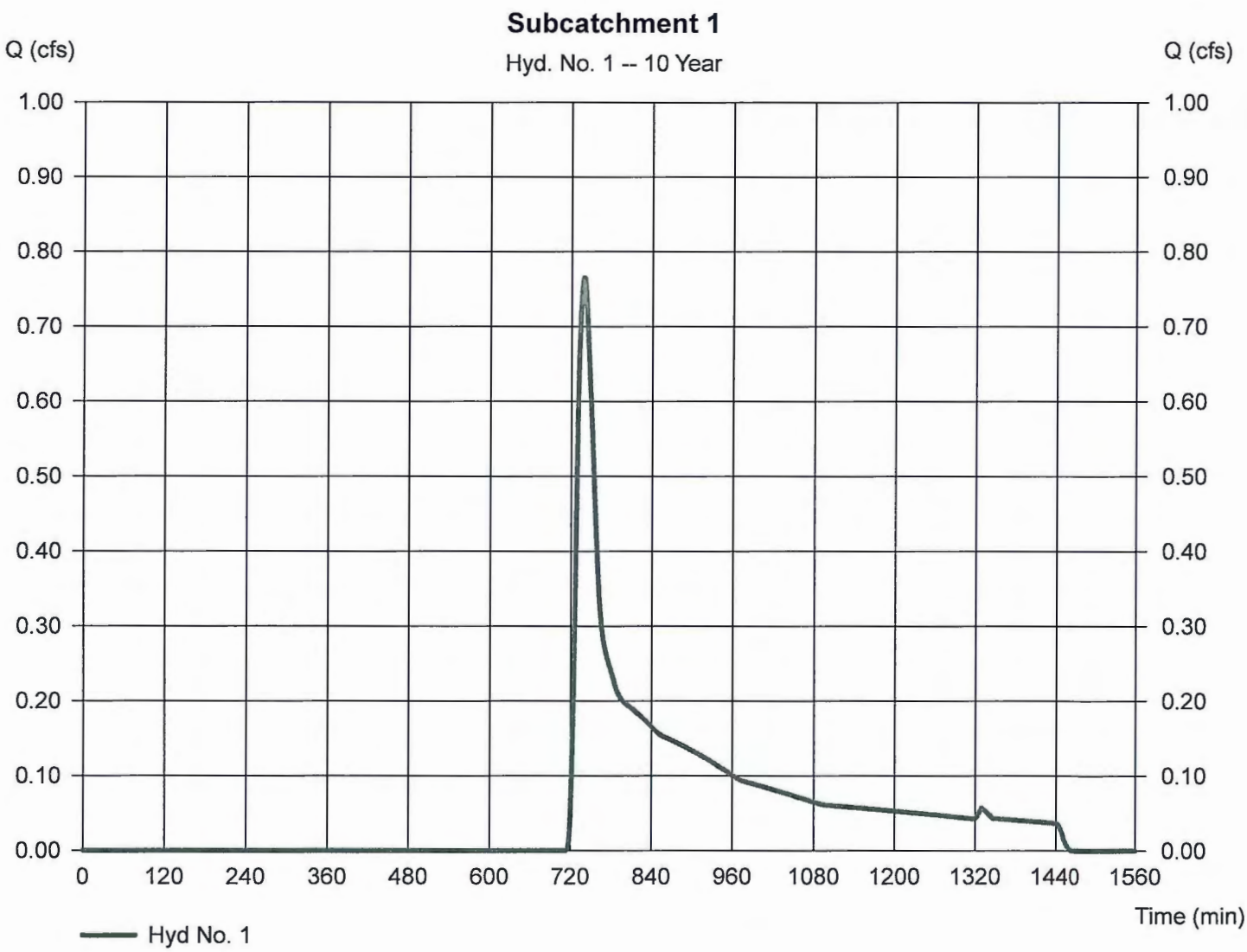
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Feb 5, 2015

Hyd. No. 1

Subcatchment 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.765 cfs
Storm frequency	= 10 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 4,954 cuft
Drainage area	= 2.440 ac	Curve number	= 51.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 14.40 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



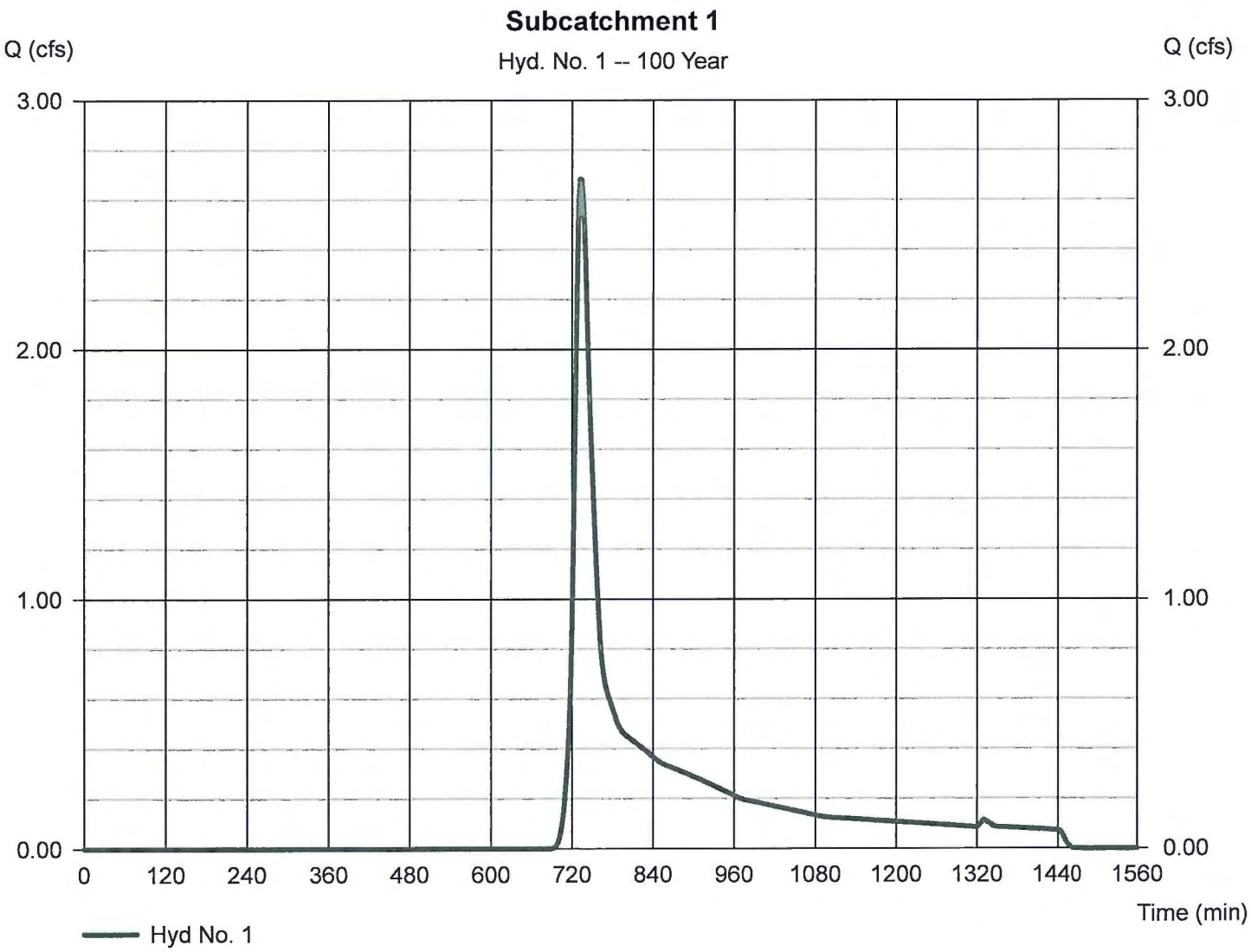
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Feb 5, 2015

Hyd. No. 1

Subcatchment 1

Hydrograph type	= SCS Runoff	Peak discharge	= 2.684 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 12,712 cuft
Drainage area	= 2.440 ac	Curve number	= 51.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 14.40 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-939B**

Project: 7, 9, 19-29 Great Road By WJH Date 1/13/2015

Location: Acton, MA Checked _____ Date _____

Circle one: [Present] Developed Subcatchment 2

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			0.00	0.00
626B & 255C A	Woods- Good Condition	30			0.02	0.59
626B & 255C A	Open Space-Good Condition	39			0.01	0.55
					Totals =	0.03	1.14

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{1.14}{0.03} = 33.76$; Use CN = 33.8

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.1	4.5	6.4
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.04	0.02	0.28
Runoff, Q.....	cf	4	2	34

(210-VI-TR-55, Second Ed., June 1986)

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-939B

Project: 7, 9, 19-29 Great Road By WJH Date 1/13/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present Developed Subcatchment 2
Circle one: Tc Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			Woods			
2. Mannings roughness coeff., n (table 3-1)			0.6			
3. Flow length, L (total L <= 300 ft)		ft	15			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.26			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.04			0.04

Shallow concentrated Flow		Segment ID				
7. Surface Description (paved or unpaved)						
8. Flow Length, L		ft				
9. Watercourse slope, s		ft/ft				
10. Average Velocity, V (figure 3-1)		ft/s				
11. Tt = L / 3600V	Compute Tt	hr				0.00

Channel flow		Segment ID				
12. Cross sectional flow area, a		sf				
13. Wetted perimeter, pw		ft				
14. Hydraulic radius, r=a/wp	Compute r	ft				
15. Channel Slope, s		ft/ft				
16. Manning's roughness coeff., n						
17. V = 1.49 r^2/3 s^1/2 / n	Compute V	ft/s				
18. Flow length, L		ft				
19. Tt = L / 3600V	Compute Tt	hr				0.00

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.10
min 6.0

(210-VI-TR-55, Second Ed., June 1986)

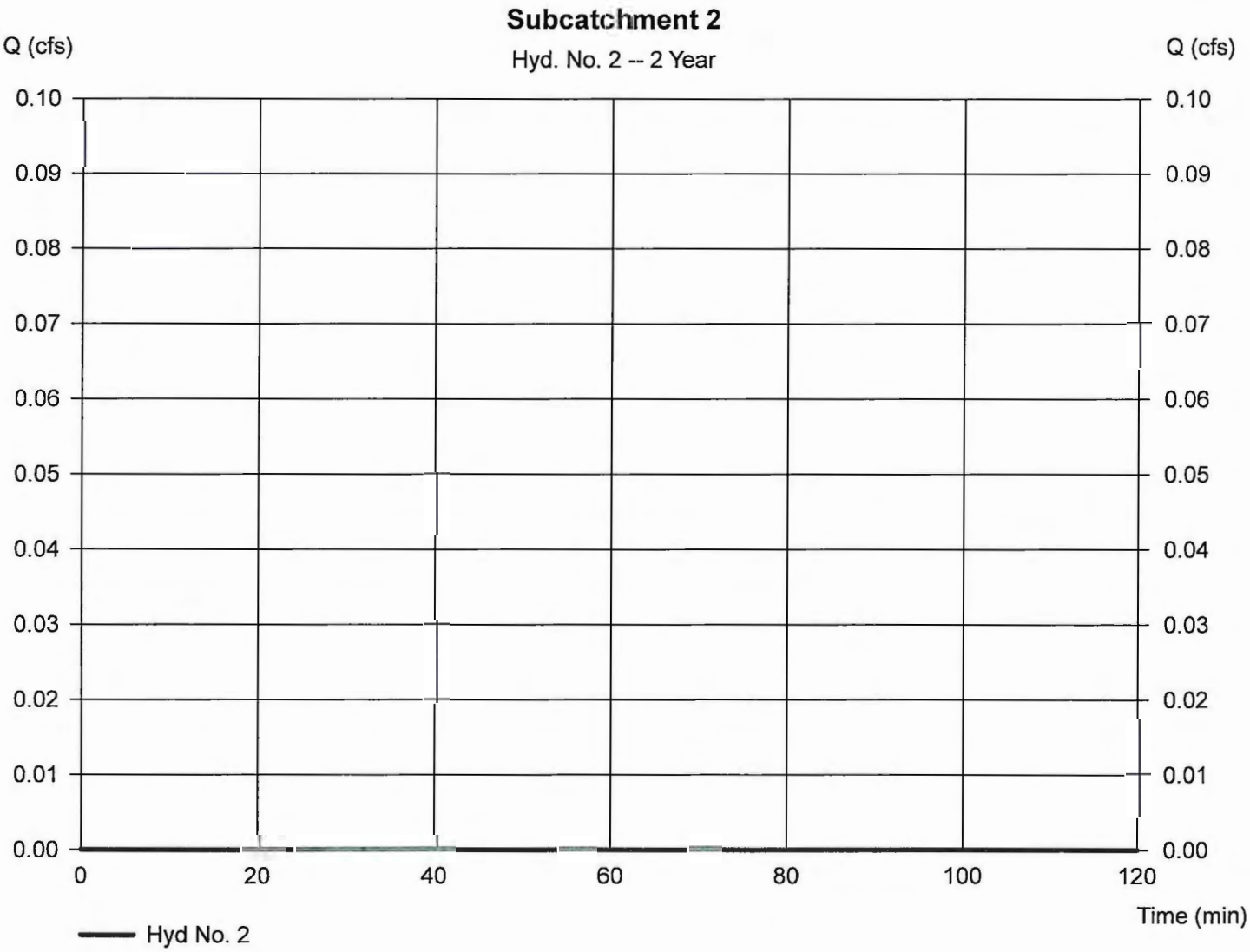
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Feb 5, 2015

Hyd. No. 2

Subcatchment 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Drainage area	= 0.030 ac	Curve number	= 33.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



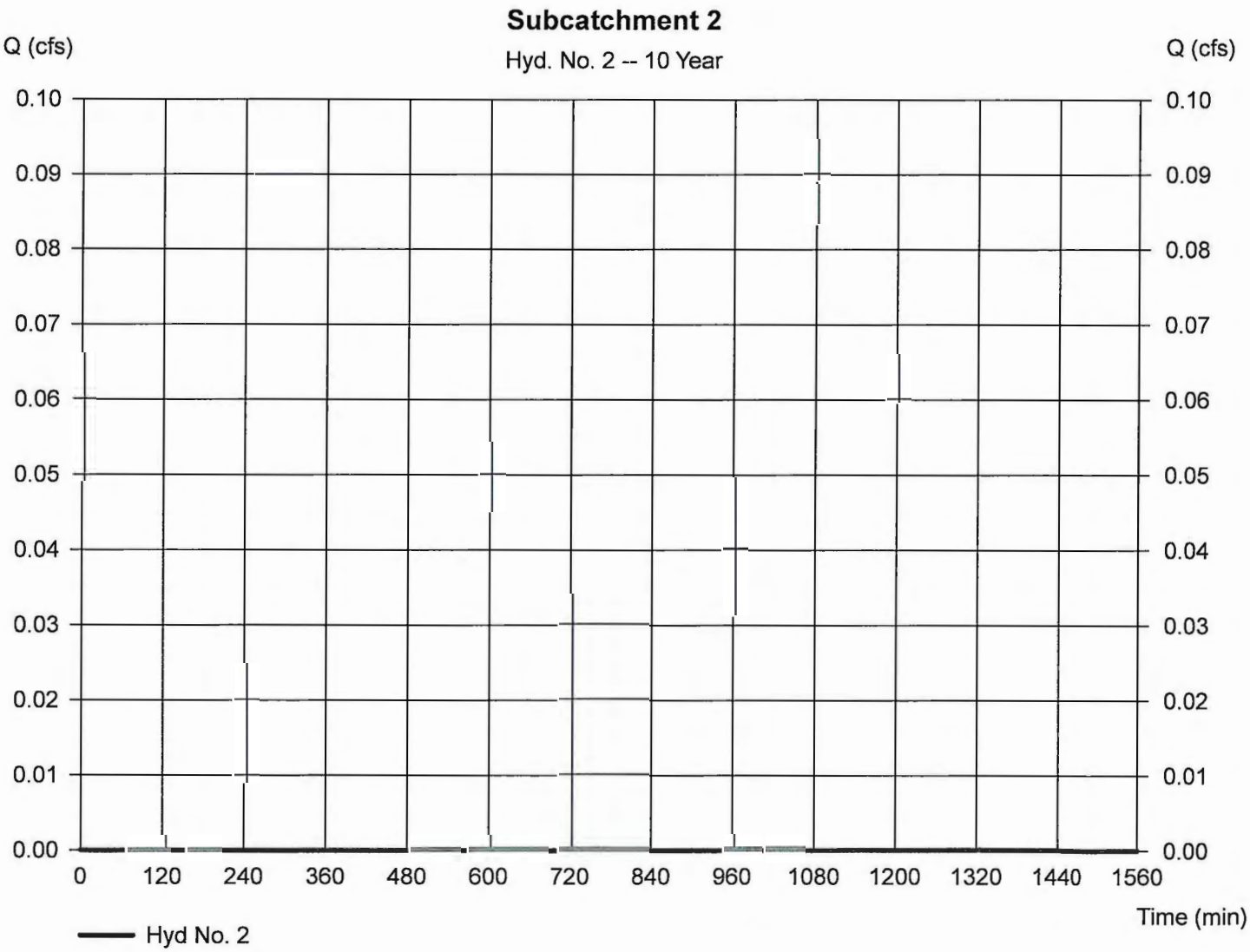
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Feb 5, 2015

Hyd. No. 2

Subcatchment 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= 1324 min
Time interval	= 2 min	Hyd. volume	= 2 cuft
Drainage area	= 0.030 ac	Curve number	= 33.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



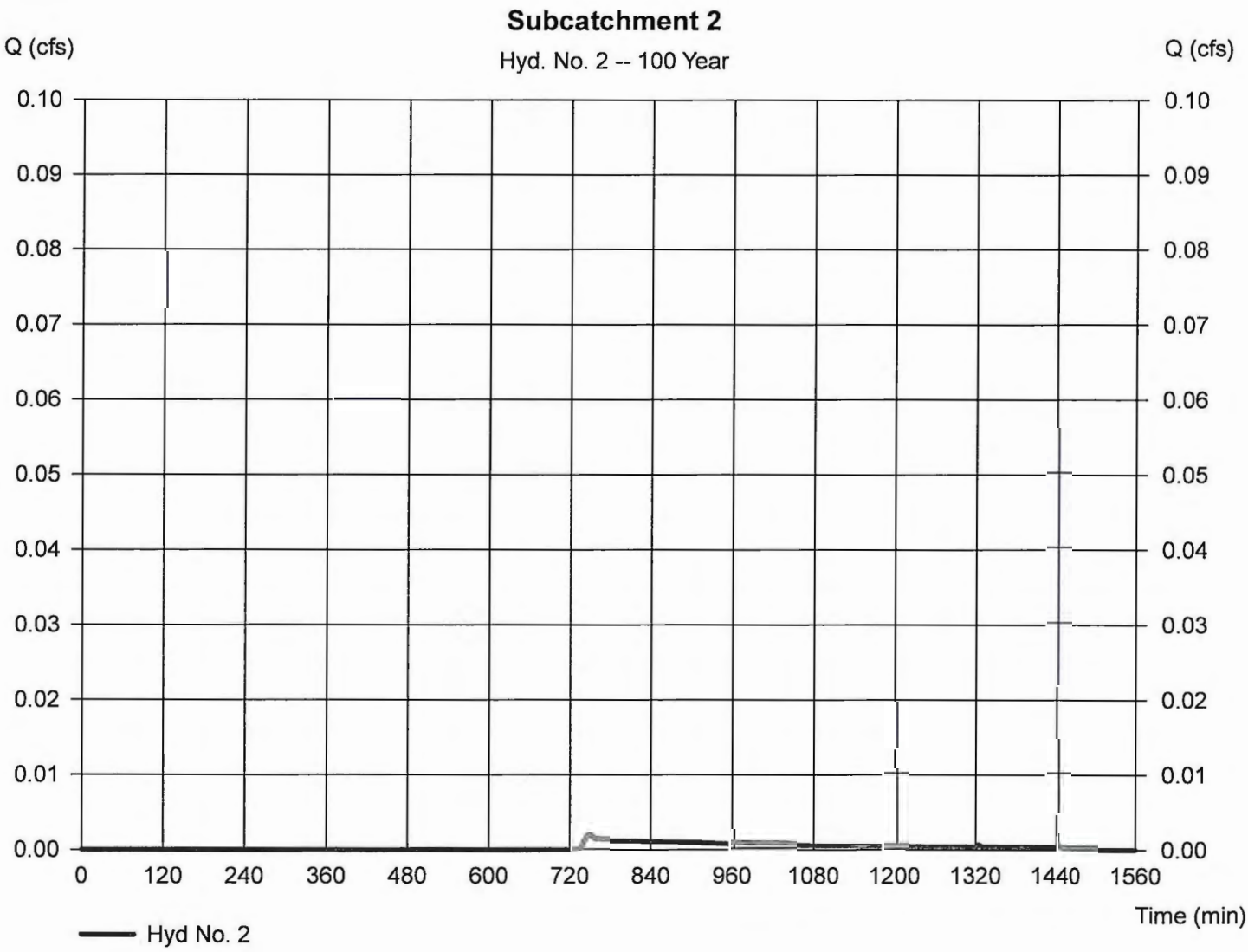
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Feb 5, 2015

Hyd. No. 2

Subcatchment 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.002 cfs
Storm frequency	= 100 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 29 cuft
Drainage area	= 0.030 ac	Curve number	= 33.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



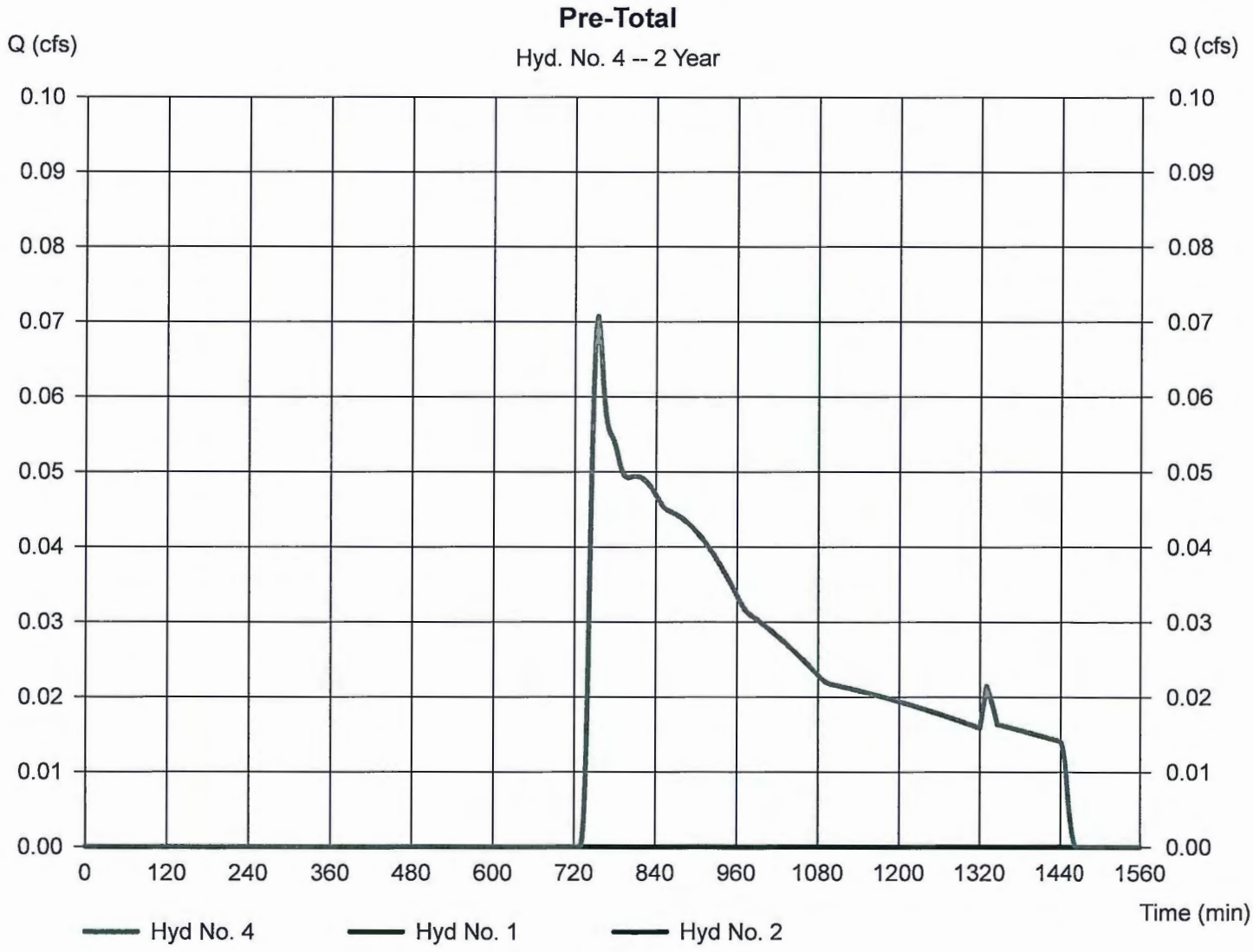
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Feb 5, 2015

Hyd. No. 4

Pre-Total

Hydrograph type	= Combine	Peak discharge	= 0.071 cfs
Storm frequency	= 2 yrs	Time to peak	= 754 min
Time interval	= 2 min	Hyd. volume	= 1,220 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 2.470 ac



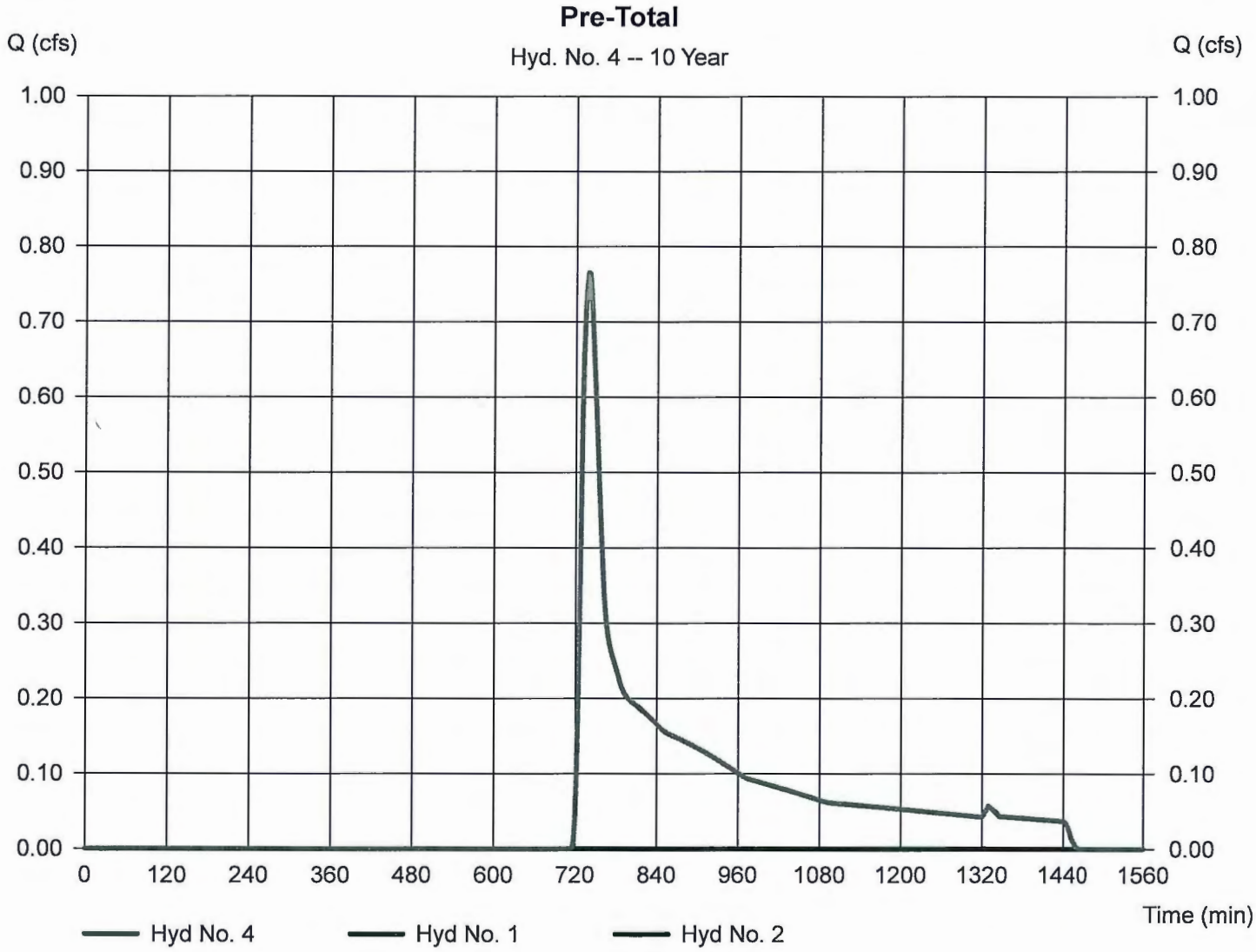
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Feb 5, 2015

Hyd. No. 4

Pre-Total

Hydrograph type	= Combine	Peak discharge	= 0.765 cfs
Storm frequency	= 10 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 4,955 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 2.470 ac



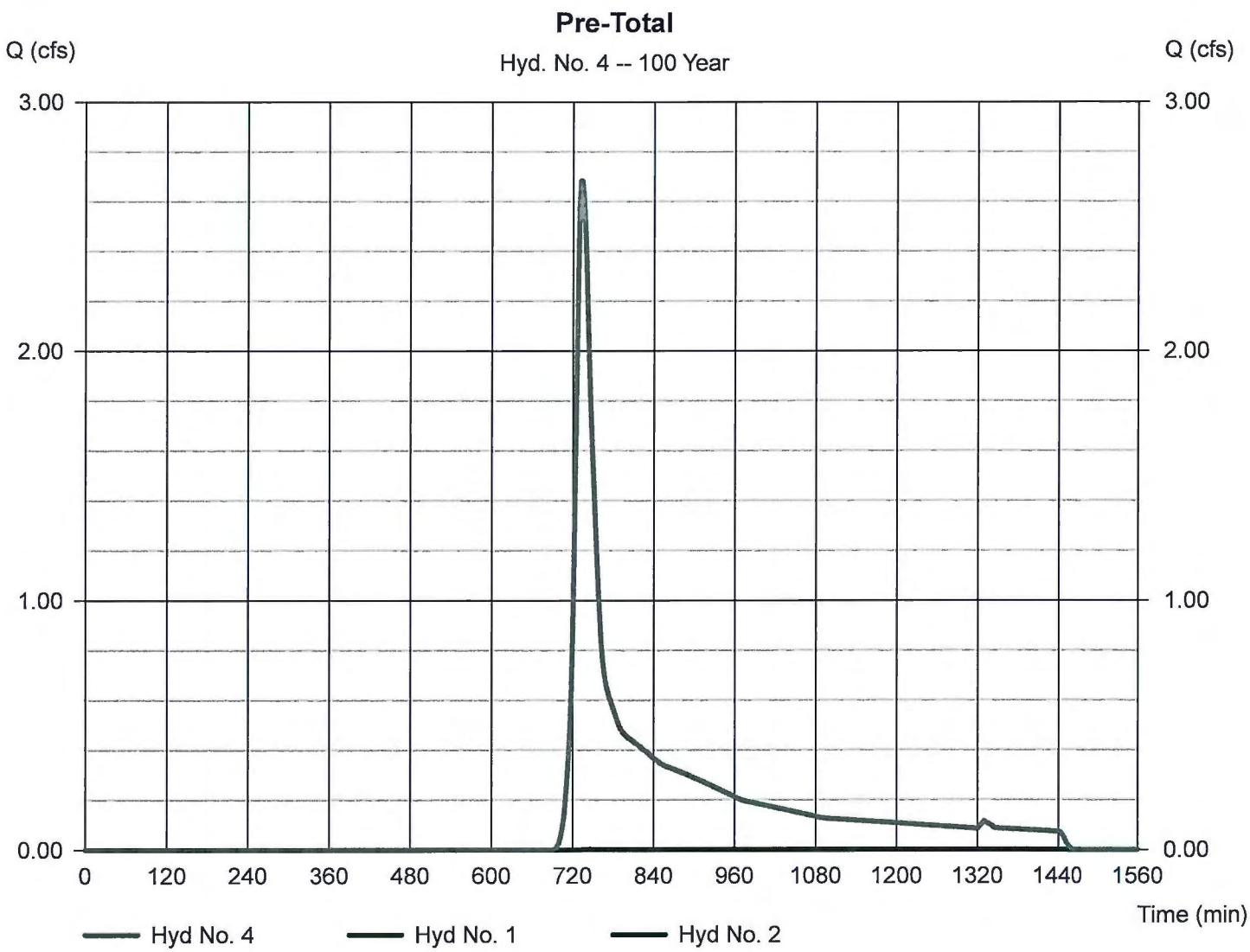
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Feb 5, 2015

Hyd. No. 4

Pre-Total

Hydrograph type	= Combine	Peak discharge	= 2.684 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 12,741 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 2.470 ac



Post-Development Hydrology

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	0.532	2	730	2,497	---	-----	-----	Subcatchment 1
2	Reservoir	0.310	2	748	2,497	1	134.91	233	Subsurface Inf. 1
4	SCS Runoff	0.366	2	724	1,218	---	-----	-----	Subcatchment 2
5	Reservoir	0.148	2	742	1,218	4	128.64	159	Subsurface Inf. 2
7	SCS Runoff	0.116	2	724	436	---	-----	-----	Subcatchment 3
8	Reservoir	0.053	2	742	436	7	129.48	45.3	Subsurface Inf. 3
10	SCS Runoff	0.044	2	726	199	---	-----	-----	Subcatchment 4
12	SCS Runoff	1.595	2	724	5,368	---	-----	-----	Roofs to RD-1
13	Reservoir	0.385	2	746	5,368	12	131.66	1,208	Roof Drywell 1
15	SCS Runoff	0.261	2	724	878	---	-----	-----	Roofs to RD-2
16	Reservoir	0.070	2	744	878	15	135.89	179	Roof Drywell 2

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	1.423	2	730	5,754	---	-----	-----	Subcatchment 1
2	Reservoir	0.454	2	756	5,753	1	136.38	1,308	Subsurface Inf. 1
4	SCS Runoff	0.852	2	724	2,604	---	-----	-----	Subcatchment 2
5	Reservoir	0.196	2	750	2,604	4	129.74	649	Subsurface Inf. 2
7	SCS Runoff	0.321	2	724	1,017	---	-----	-----	Subcatchment 3
8	Reservoir	0.074	2	750	1,017	7	130.75	246	Subsurface Inf. 3
10	SCS Runoff	0.153	2	724	513	---	-----	-----	Subcatchment 4
12	SCS Runoff	2.331	2	724	7,981	---	-----	-----	Roofs to RD-1
13	Reservoir	0.461	2	748	7,981	12	132.54	2,099	Roof Drywell 1
15	SCS Runoff	0.381	2	724	1,306	---	-----	-----	Roofs to RD-2
16	Reservoir	0.081	2	748	1,306	15	136.60	321	Roof Drywell 2

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

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	2.866	2	730	11,146	---	-----	-----	Subcatchment 1
2	Reservoir	0.655	2	760	11,146	1	138.42	3,467	Subsurface Inf. 1
4	SCS Runoff	1.609	2	724	4,813	---	-----	-----	Subcatchment 2
5	Reservoir	0.287	2	752	4,813	4	131.84	1,531	Subsurface Inf. 2
7	SCS Runoff	0.658	2	724	1,986	---	-----	-----	Subcatchment 3
8	Reservoir	0.117	2	752	1,986	7	133.40	633	Subsurface Inf. 3
10	SCS Runoff	0.345	2	724	1,060	---	-----	-----	Subcatchment 4
12	SCS Runoff	3.327	2	724	11,532	---	-----	-----	Roofs to RD-1
13	Reservoir	0.624	2	748	11,532	12	134.40	3,346	Roof Drywell 1
15	SCS Runoff	0.544	2	724	1,887	---	-----	-----	Roofs to RD-2
16	Reservoir	0.100	2	750	1,887	15	137.77	525	Roof Drywell 2

Worksheet 2: Runoff curve number and runoff SM-939B

Project: 7, 9, 19 & 29 Great Road By WJH Date 11/18/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present [Developed] Subcatchment 1

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			0.50	49.27
626B & 255C A	Open Space-Good Condition	39			0.53	20.64
626B & 255C A	Woods- Good Condition	30			0.02	0.61
				Totals =	1.05	70.52

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{70.52}{1.05} =$ 67.01 ; Use CN = 67.0

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.1	4.5	6.4
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.64	1.46	2.84
Runoff, Q.....	cf	2429	5594	10836

D-2 (210-VI-TR-55, Second Ed., June 1986)

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-939B

Project: 7, 9, 19 & 29 Great Road By WJH Date 11/18/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present | Developed Subcatchment 1

Circle one: Tc | Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B	B-C		
1. Surface Description (table 3-1)			Woods	Grass		
2. Mannings roughness coeff., n (table 3-1)			0.6	0.24		
3. Flow length, L (total L <= 300 ft)		ft	10	40		
4. Two-yr 24-hr rainfall, P2		in	3.1	3.1		
5. Land Slope, s		ft/ft	0.06	0.02		
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.05	0.12		0.17

Shallow concentrated Flow		Segment ID	C-D	D-E	E-F	
7. Surface Description (paved or unpaved)			UNPAVED	PAVED	PAVED	
8. Flow Length, L		ft	23	238	95	
9. Watercourse slope, s		ft/ft	0.04	0.01	0.09	
10. Average Velocity, V (figure 3-1)		ft/s	3.23	2.03	6.10	
11. Tt = L / 3600V	Compute Tt	hr	0.00	0.03	0.00	0.04

Channel flow		Segment ID				
12. Cross sectional flow area, a		sf				
13. Wetted perimeter, pw		ft				
14. Hydraulic radius, r=a/wp	Compute r	ft				
15. Channel Slope, s		ft/ft				
16. Manning's roughness coeff., n						
17. V = 1.49 r^2/3 s^1/2 / n	Compute V	ft/s				
18. Flow length, L		ft				
19. Tt = L / 3600V	Compute Tt	hr				0.00

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.21
min 12.4

(210-VI-TR-55, Second Ed., June 1986)

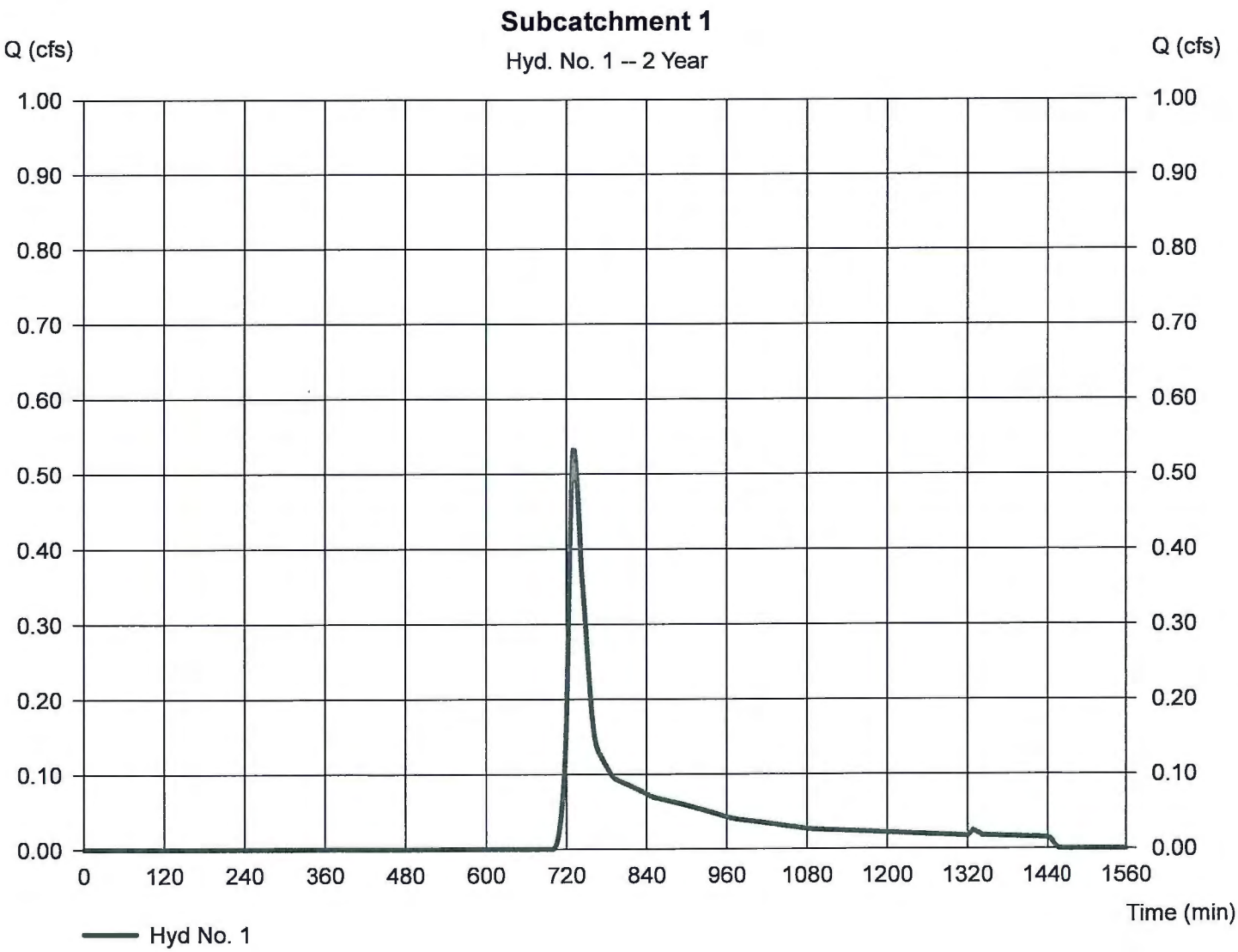
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 1

Subcatchment 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.532 cfs
Storm frequency	= 2 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 2,497 cuft
Drainage area	= 1.050 ac	Curve number	= 67
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.40 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



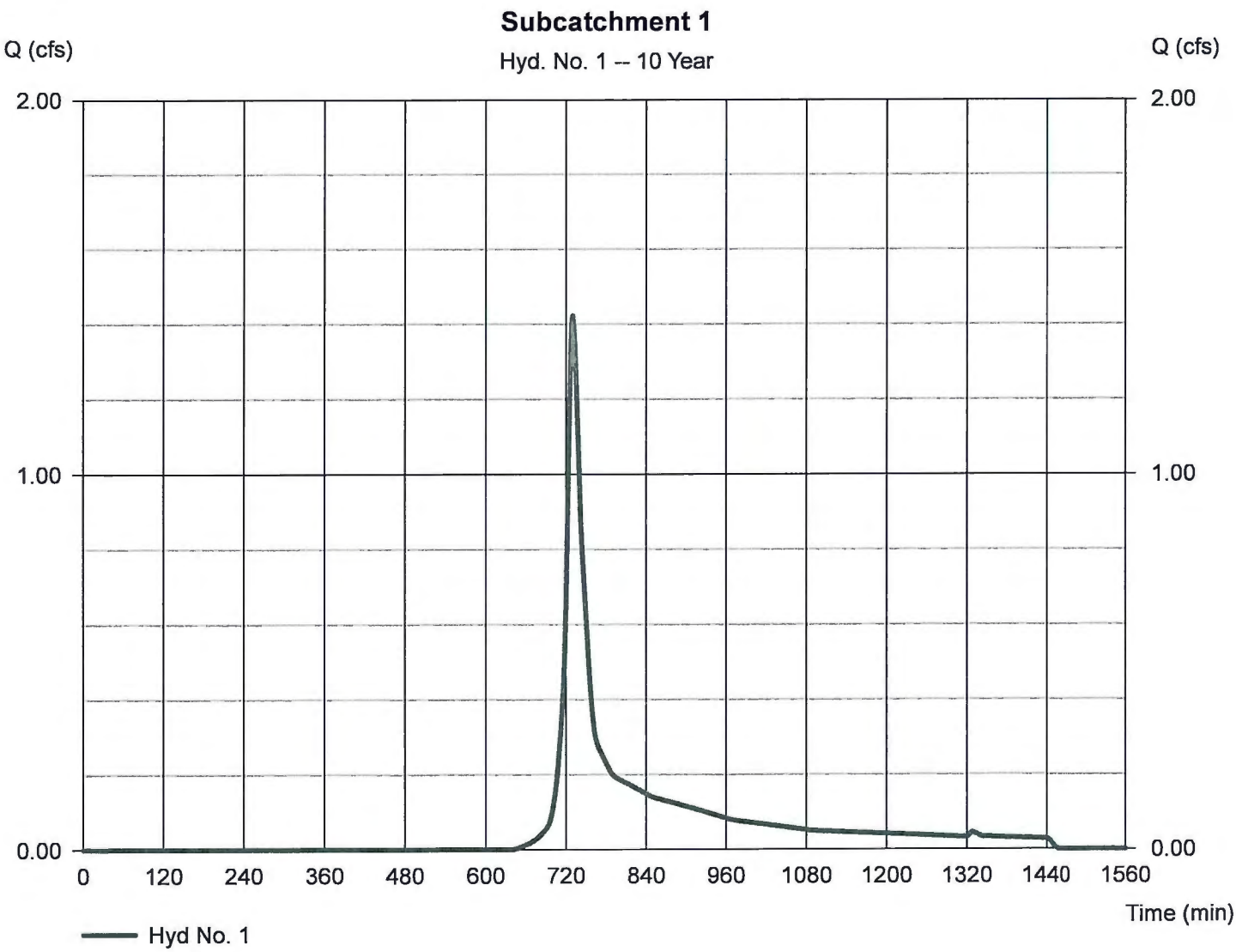
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 1

Subcatchment 1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.423 cfs
Storm frequency	= 10 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 5,754 cuft
Drainage area	= 1.050 ac	Curve number	= 67
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.40 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



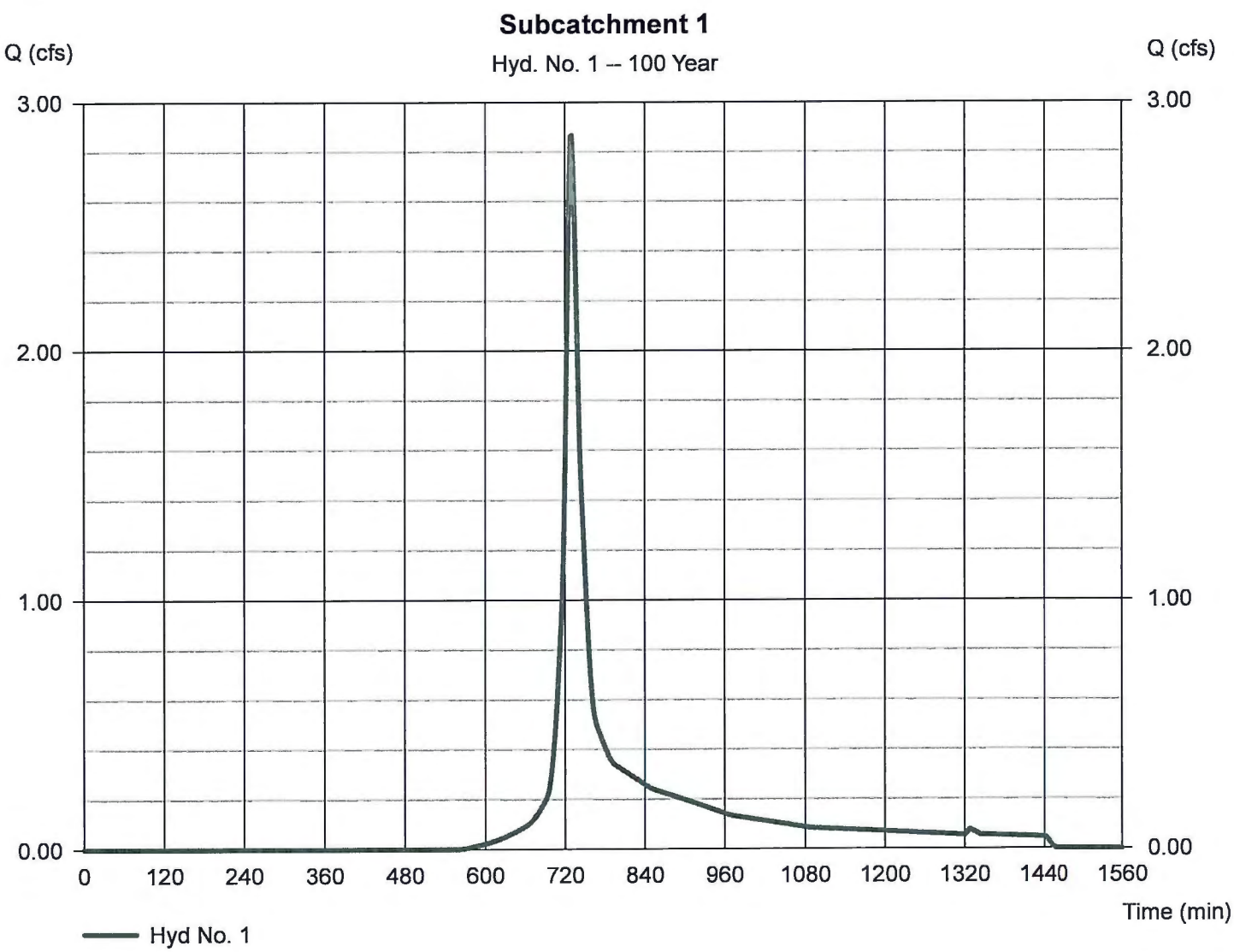
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 1

Subcatchment 1

Hydrograph type	= SCS Runoff	Peak discharge	= 2.866 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 11,146 cuft
Drainage area	= 1.050 ac	Curve number	= 67
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.40 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

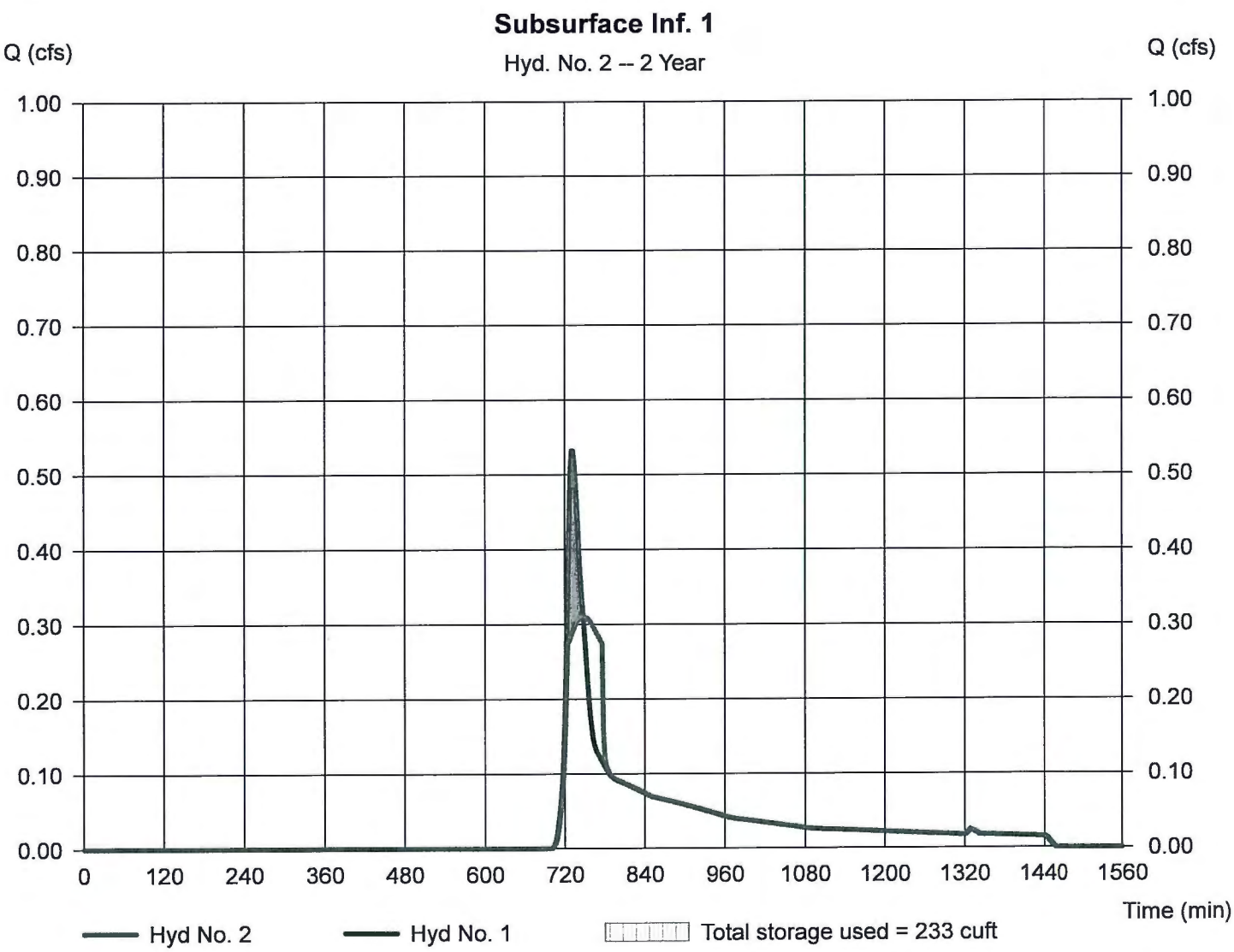
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 2

Subsurface Inf. 1

Hydrograph type	= Reservoir	Peak discharge	= 0.310 cfs
Storm frequency	= 2 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 2,497 cuft
Inflow hyd. No.	= 1 - Subcatchment 1	Max. Elevation	= 134.91 ft
Reservoir name	= Sub 1 Infiltration	Max. Storage	= 233 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

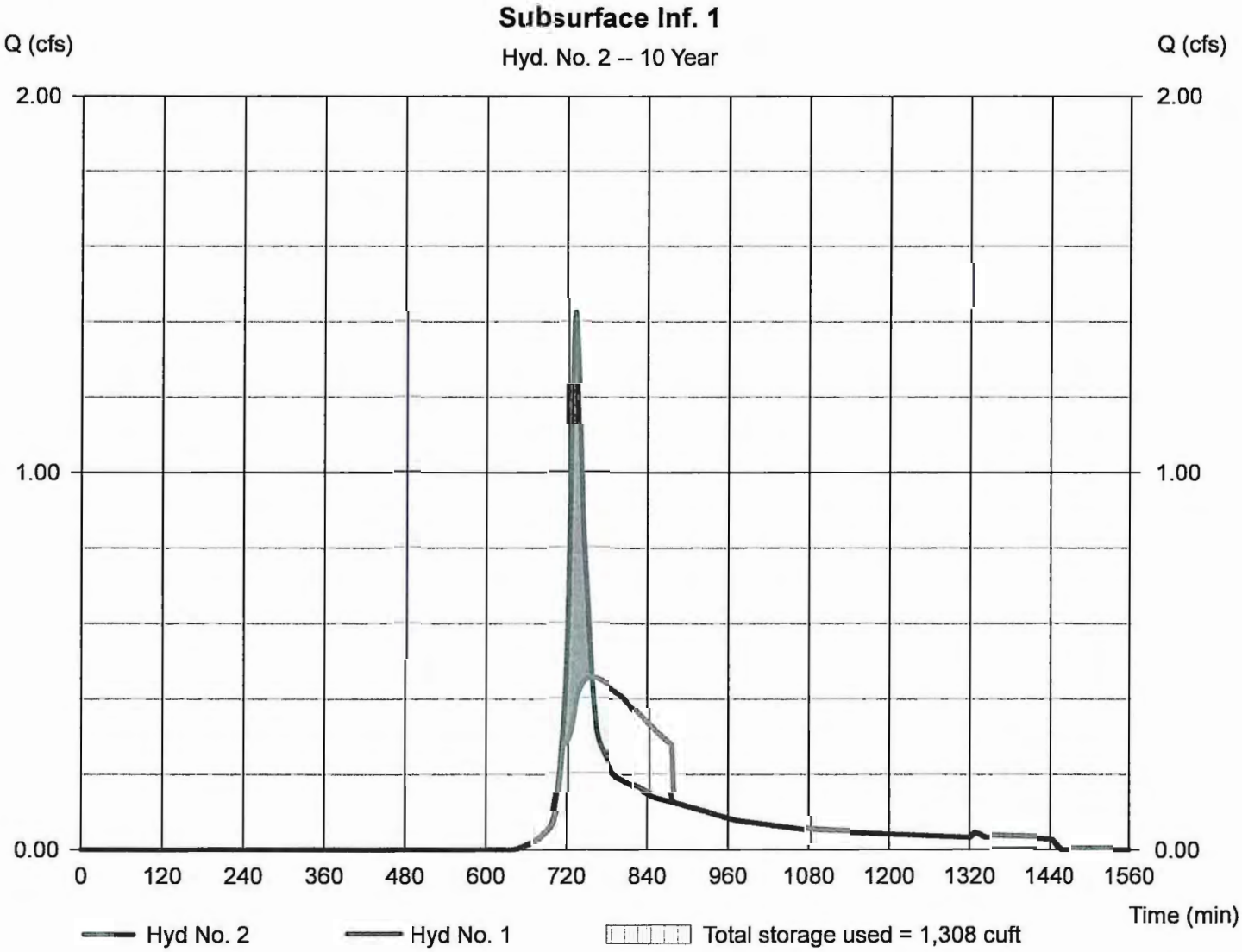
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Nov 19, 2015

Hyd. No. 2

Subsurface Inf. 1

Hydrograph type	= Reservoir	Peak discharge	= 0.454 cfs
Storm frequency	= 10 yrs	Time to peak	= 756 min
Time interval	= 2 min	Hyd. volume	= 5,753 cuft
Inflow hyd. No.	= 1 - Subcatchment 1	Max. Elevation	= 136.38 ft
Reservoir name	= Sub 1 Infiltration	Max. Storage	= 1,308 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

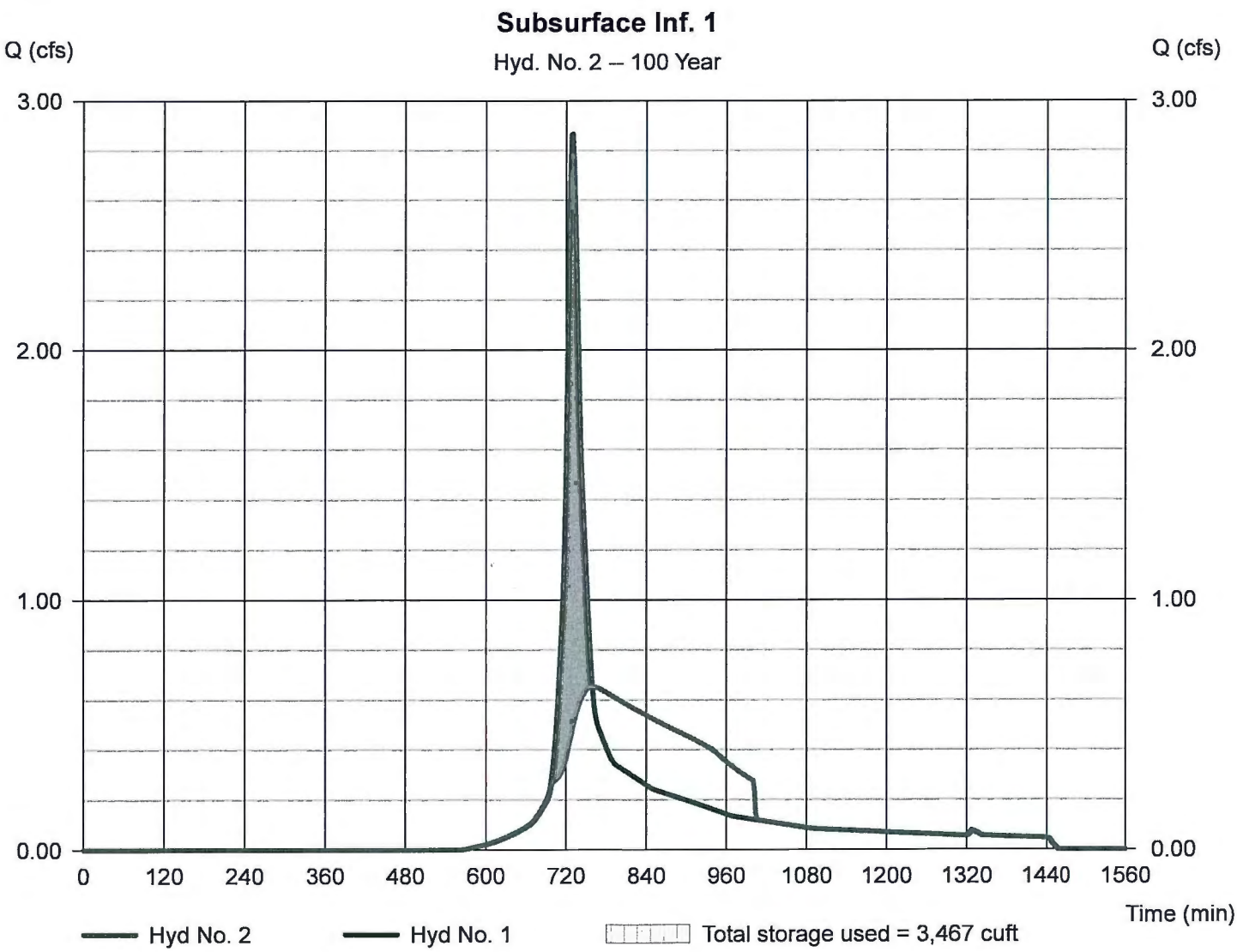
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 2

Subsurface Inf. 1

Hydrograph type	= Reservoir	Peak discharge	= 0.655 cfs
Storm frequency	= 100 yrs	Time to peak	= 760 min
Time interval	= 2 min	Hyd. volume	= 11,146 cuft
Inflow hyd. No.	= 1 - Subcatchment 1	Max. Elevation	= 138.42 ft
Reservoir name	= Sub 1 Infiltration	Max. Storage	= 3,467 cuft

Storage Indication method used. Outflow includes exfiltration.



Worksheet 2: Runoff curve number and runoff **SM-939B**

Project: 7, 9, 19 & 29 Great Road By WJH Date 11/18/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present **Developed** Subcatchment 2

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			0.24	23.42
626B & 255C A	Open Space-Good Condition	39			0.20	7.90
				Totals =	0.44	31.32

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{31.32}{0.44} =$ 70.94 ; Use CN = **70.9**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.1	4.5	6.4
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.82	1.74	3.22
Runoff, Q.....	cf	1307	2791	5157

(210-VI-TR-55, Second Ed., June 1986)

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-939B

Project: 7, 9, 19 & 29 Great Road By WJH Date 11/18/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present Developed Subcatchment 2

Circle one: Tc Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			Grass			
2. Mannings roughness coeff., n (table 3-1)			0.24			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.09			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.08			0.08

Shallow concentrated Flow		Segment ID	B-C	C-D	D-E	
7. Surface Description (paved or unpaved)			UNPAVED	UNPAVED	UNPAVED	
8. Flow Length, L		ft	22	12	127	
9. Watercourse slope, s		ft/ft	0.14	1	0.016	
10. Average Velocity, V (figure 3-1)		ft/s	6.04	16.13	2.04	
11. Tt = L / 3600V	Compute Tt	hr	0.00	0.00	0.02	0.02

Channel flow		Segment ID				
12. Cross sectional flow area, a		sf				
13. Wetted perimeter, pw		ft				
14. Hydraulic radius, r=a/wp	Compute r	ft				
15. Channel Slope, s		ft/ft				
16. Manning's roughness coeff., n						
17. V = 1.49 r^2/3 s^1/2 / n	Compute V	ft/s				
18. Flow length, L		ft				
19. Tt = L / 3600V	Compute Tt	hr				0.00

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.10
min 6.0

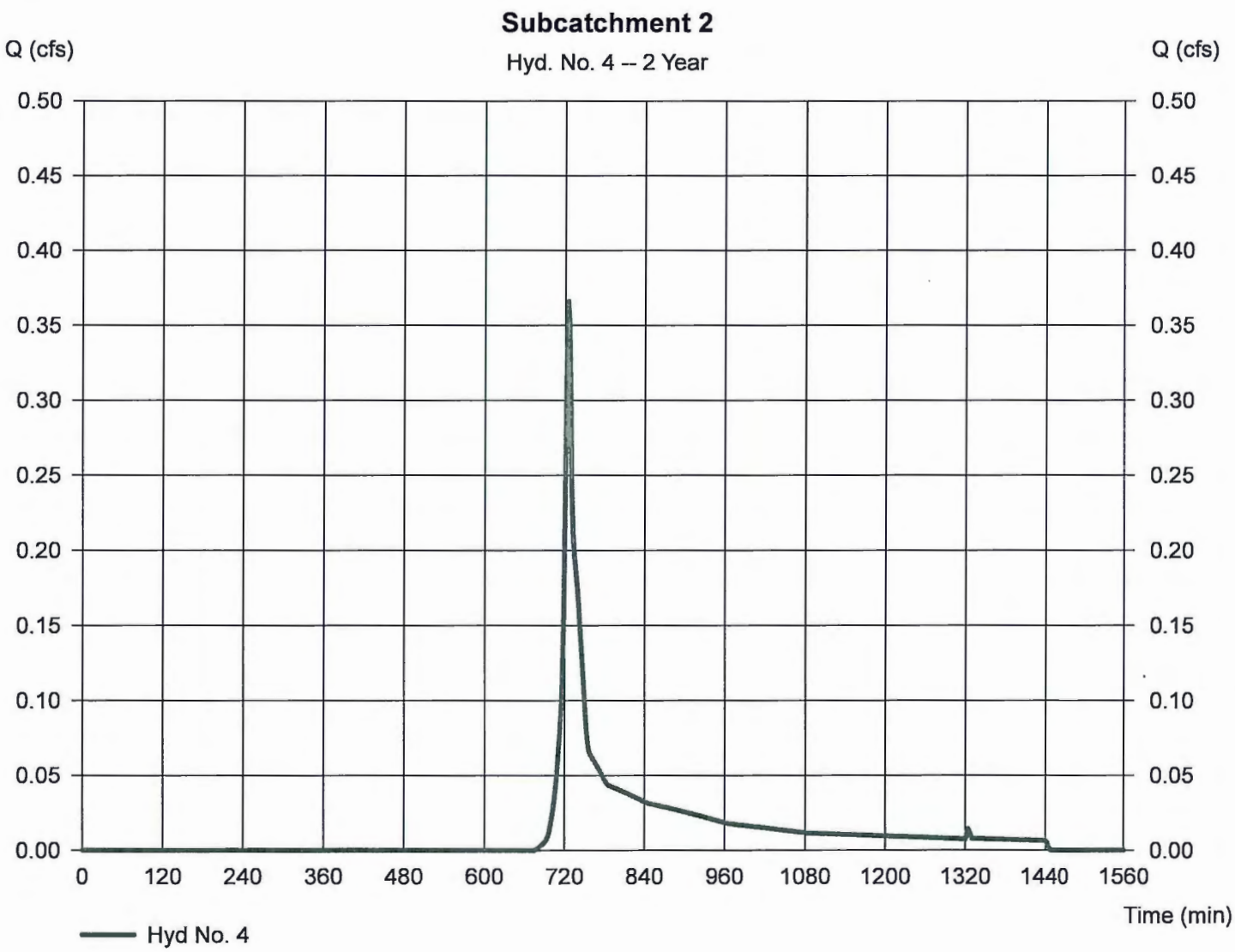
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 4

Subcatchment 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.366 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,218 cuft
Drainage area	= 0.440 ac	Curve number	= 70.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



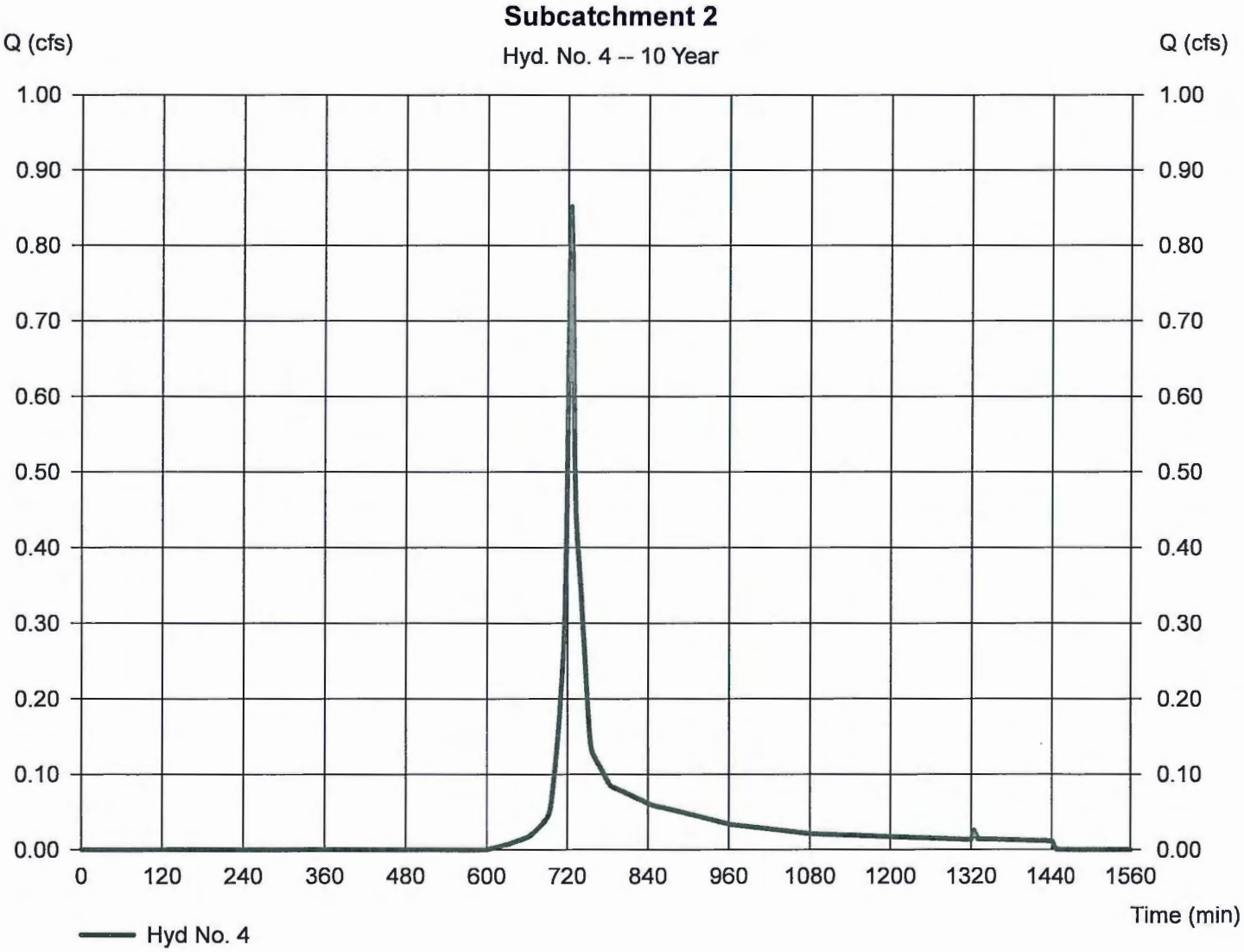
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 4

Subcatchment 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.852 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 2,604 cuft
Drainage area	= 0.440 ac	Curve number	= 70.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



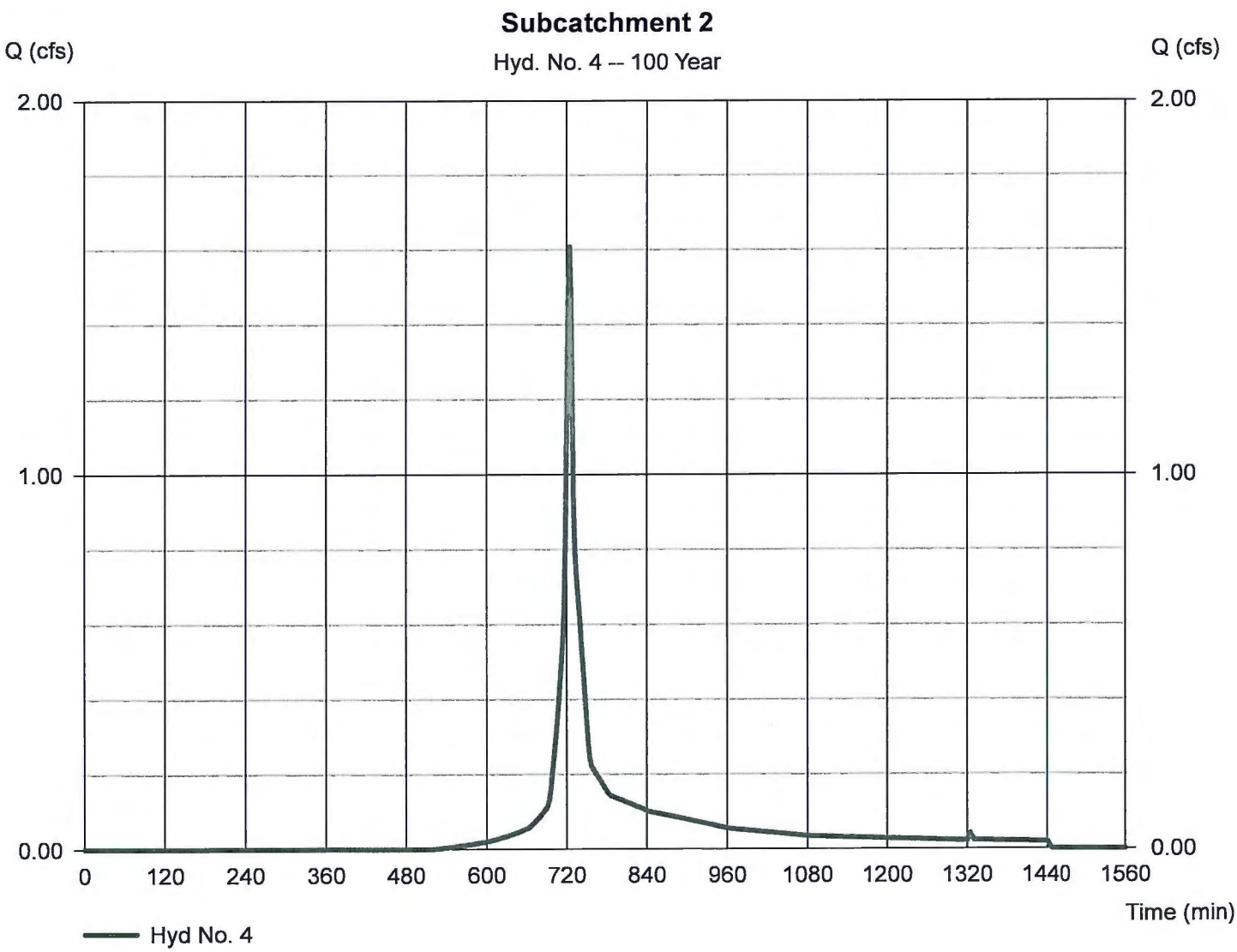
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 4

Subcatchment 2

Hydrograph type	= SCS Runoff	Peak discharge	= 1.609 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 4,813 cuft
Drainage area	= 0.440 ac	Curve number	= 70.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

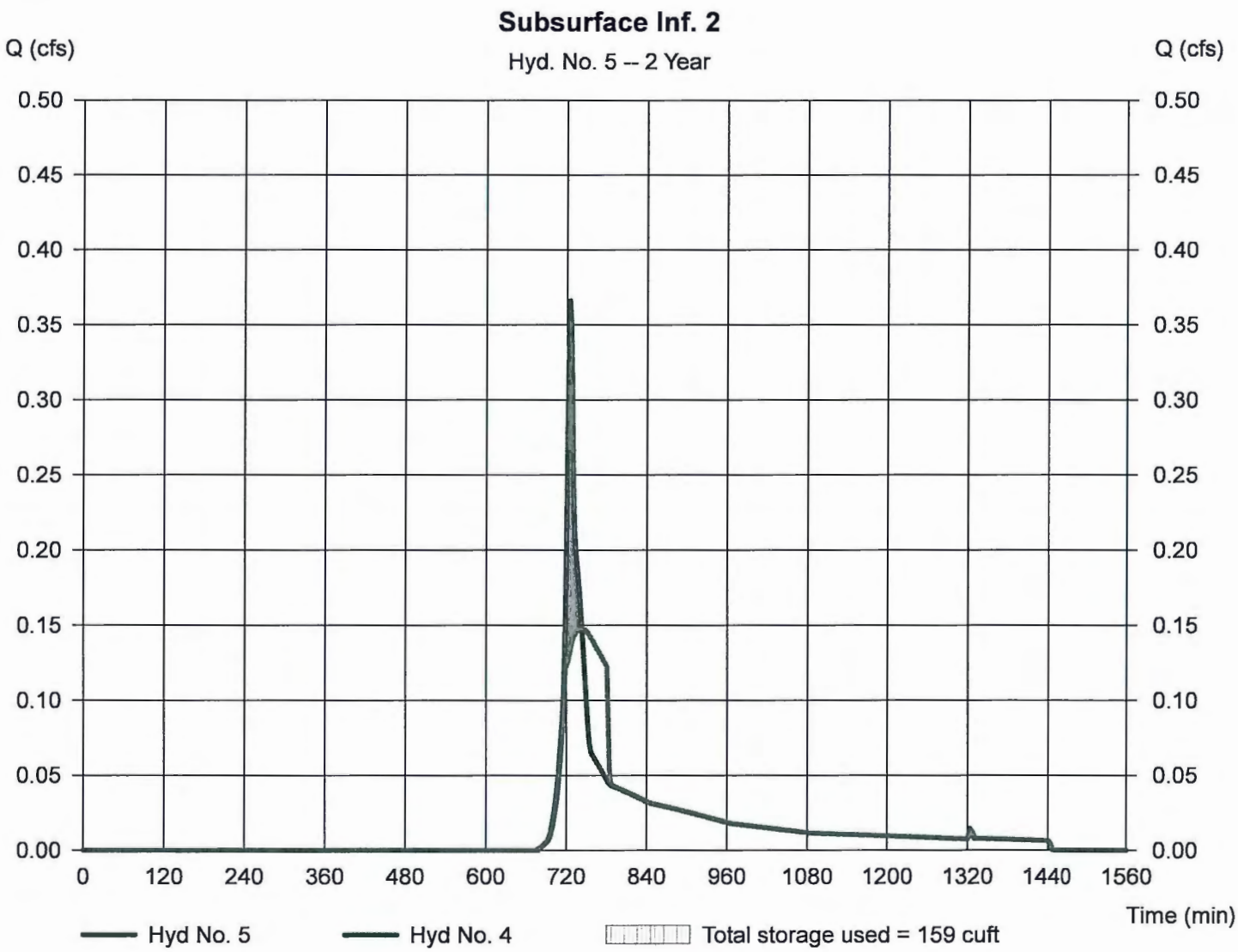
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 5

Subsurface Inf. 2

Hydrograph type	= Reservoir	Peak discharge	= 0.148 cfs
Storm frequency	= 2 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 1,218 cuft
Inflow hyd. No.	= 4 - Subcatchment 2	Max. Elevation	= 128.64 ft
Reservoir name	= Sub 2 Infiltration	Max. Storage	= 159 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

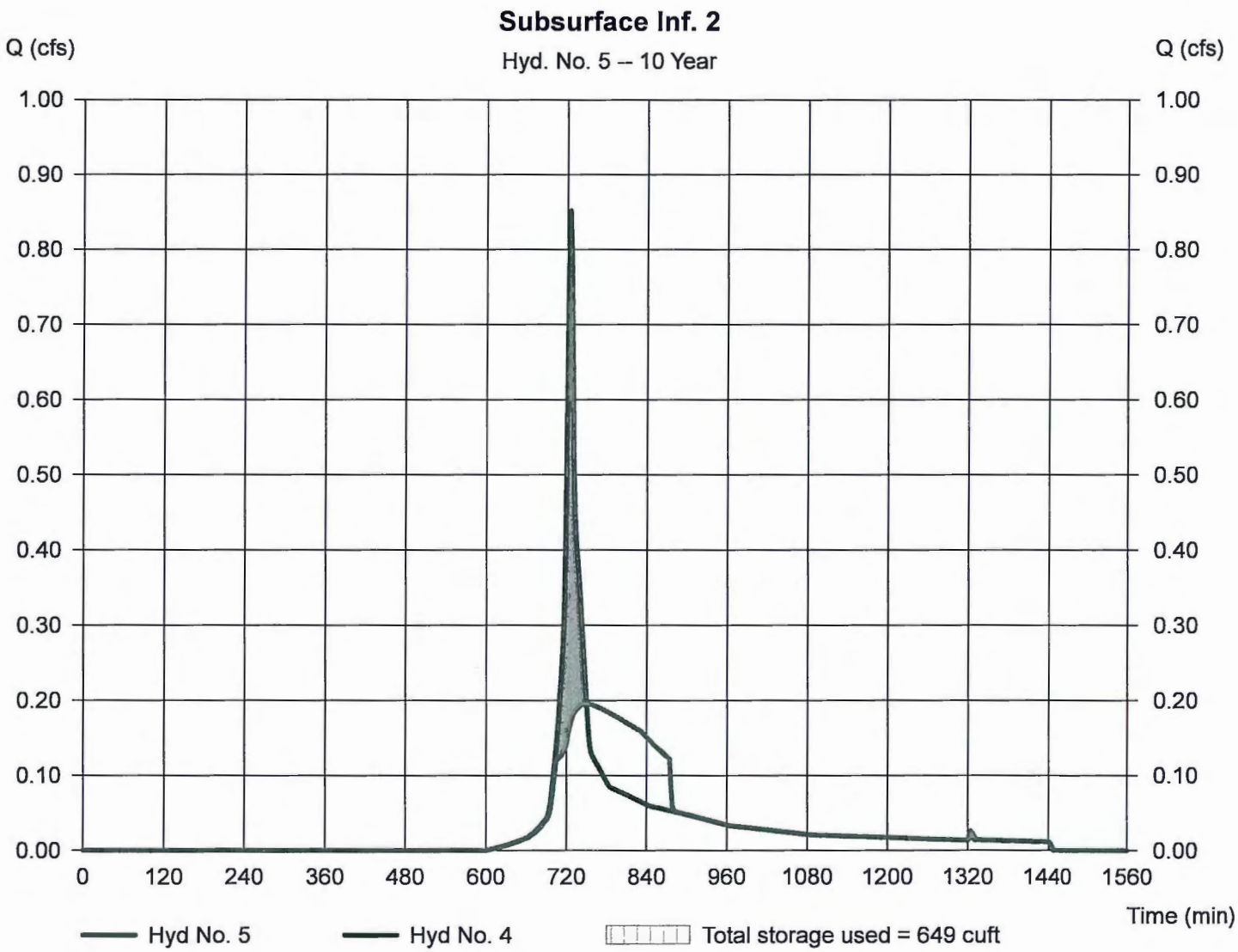
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 5

Subsurface Inf. 2

Hydrograph type	= Reservoir	Peak discharge	= 0.196 cfs
Storm frequency	= 10 yrs	Time to peak	= 750 min
Time interval	= 2 min	Hyd. volume	= 2,604 cuft
Inflow hyd. No.	= 4 - Subcatchment 2	Max. Elevation	= 129.74 ft
Reservoir name	= Sub 2 Infiltration	Max. Storage	= 649 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

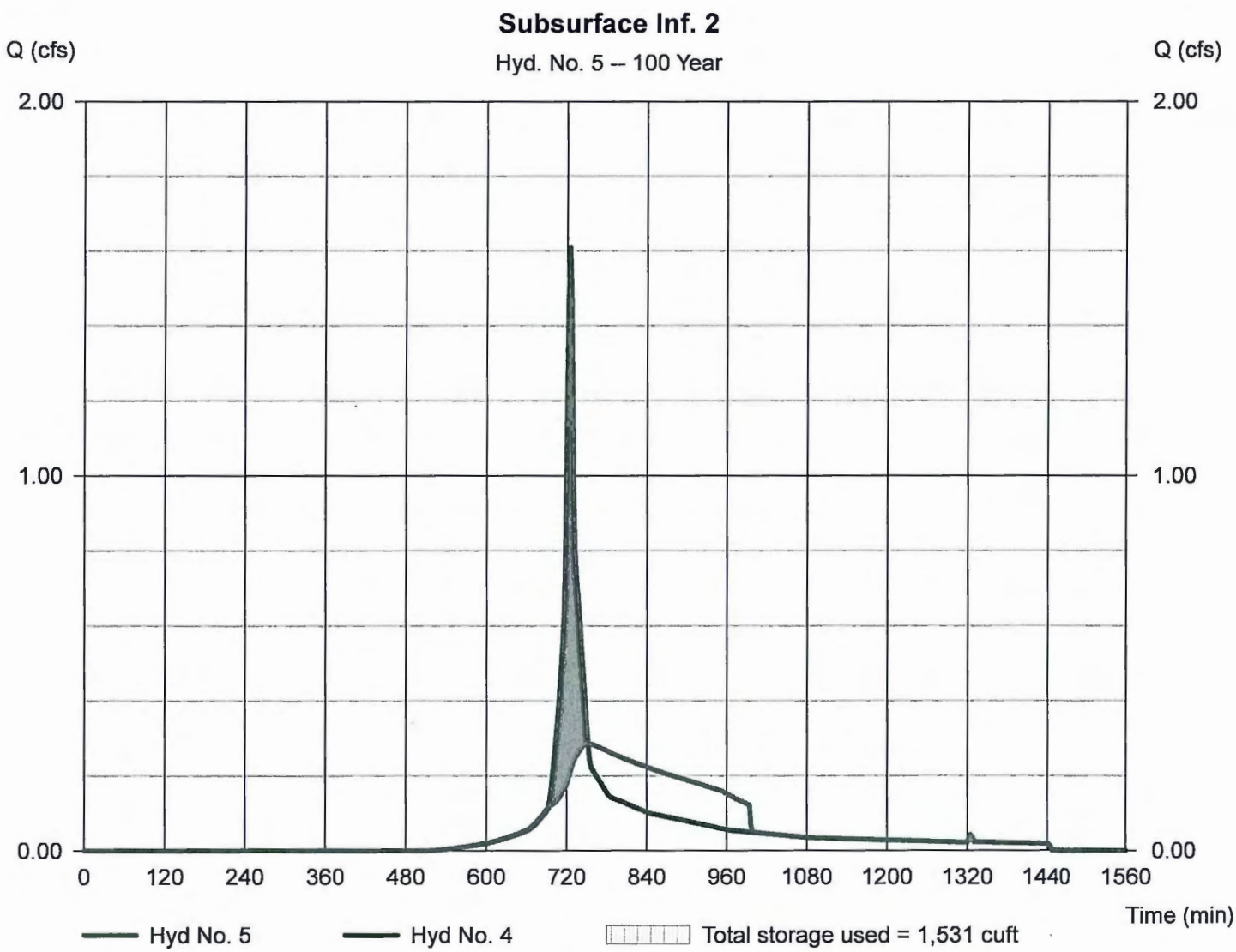
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Nov 19, 2015

Hyd. No. 5

Subsurface Inf. 2

Hydrograph type	= Reservoir	Peak discharge	= 0.287 cfs
Storm frequency	= 100 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 4,813 cuft
Inflow hyd. No.	= 4 - Subcatchment 2	Max. Elevation	= 131.84 ft
Reservoir name	= Sub 2 Infiltration	Max. Storage	= 1,531 cuft

Storage Indication method used. Outflow includes exfiltration.



Worksheet 2: Runoff curve number and runoff SM-939B

Project: 7, 9, 19 & 29 Great Road By WJH Date 11/18/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present [Developed] Subcatchment 3

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			0.10	9.74
626B & 255C A	Open Space-Good Condition	39			0.11	4.47
				Totals =	0.21	14.21

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{14.21}{0.21} = 66.39$; Use CN = 66.4

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.1	4.5	6.4
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.61	1.42	2.78
Runoff, Q.....	cf	474	1106	2159

D-2 (210-VI-TR-55, Second Ed., June 1986)

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-939B

Project: 7, 9, 19 & 29 Great Road By WJH Date 11/18/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present | Developed Subcatchment 3

Circle one: Tc | Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			Pavement			
2. Mannings roughness coeff., n (table 3-1)			0.011			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.02			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.01			0.01
Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			PAVED			
8. Flow Length, L		ft	49			
9. Watercourse slope, s		ft/ft	0.02			
10. Average Velocity, V (figure 3-1)		ft/s	2.87			
11. Tt = L / 3600V	Compute Tt	hr	0.00			0.00
Channel flow		Segment ID				
12. Cross sectional flow area, a		sf				
13. Wetted perimeter, pw		ft				
14. Hydraulic radius, r=a/wp	Compute r	ft				
15. Channel Slope, s		ft/ft				
16. Manning's roughness coeff., n						
17. V = 1.49 r^2/3 s^1/2 / n	Compute V	ft/s				
18. Flow length, L		ft				
19. Tt = L / 3600V	Compute Tt	hr				0.00

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.10
min 6.0

(210-VI-TR-55, Second Ed., June 1986)

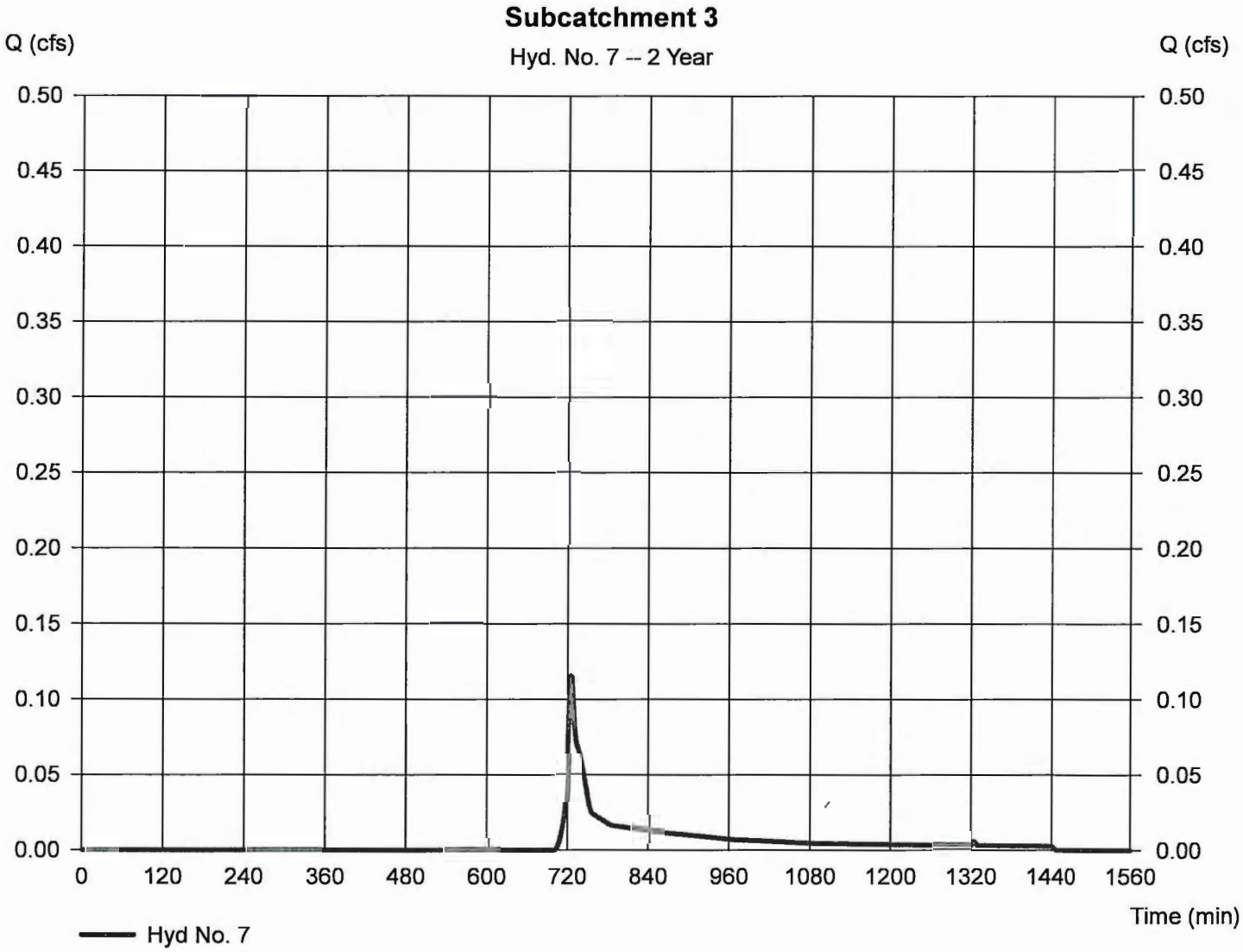
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 7

Subcatchment 3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.116 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 436 cuft
Drainage area	= 0.210 ac	Curve number	= 66.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



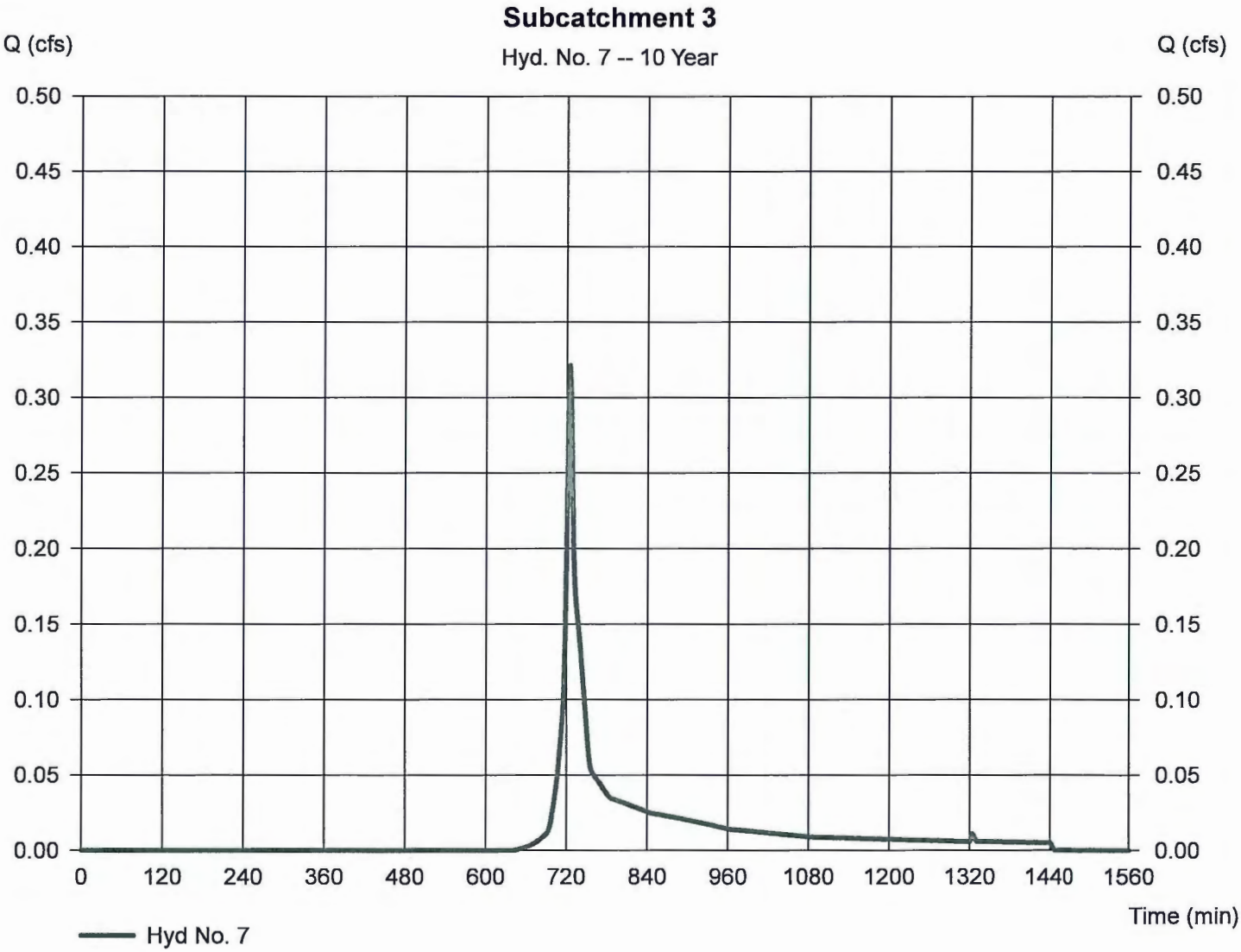
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 7

Subcatchment 3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.321 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,017 cuft
Drainage area	= 0.210 ac	Curve number	= 66.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



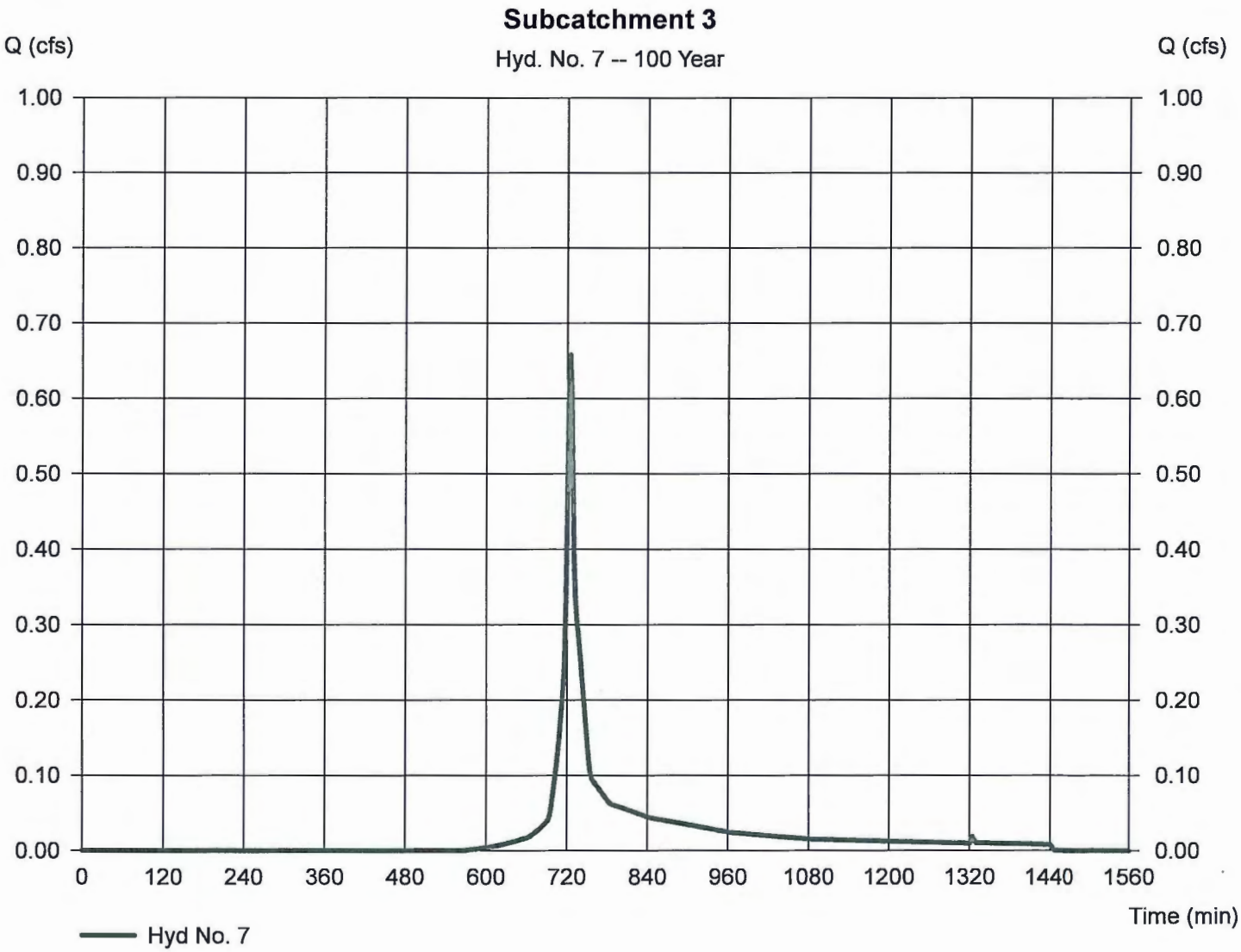
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 7

Subcatchment 3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.658 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,986 cuft
Drainage area	= 0.210 ac	Curve number	= 66.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

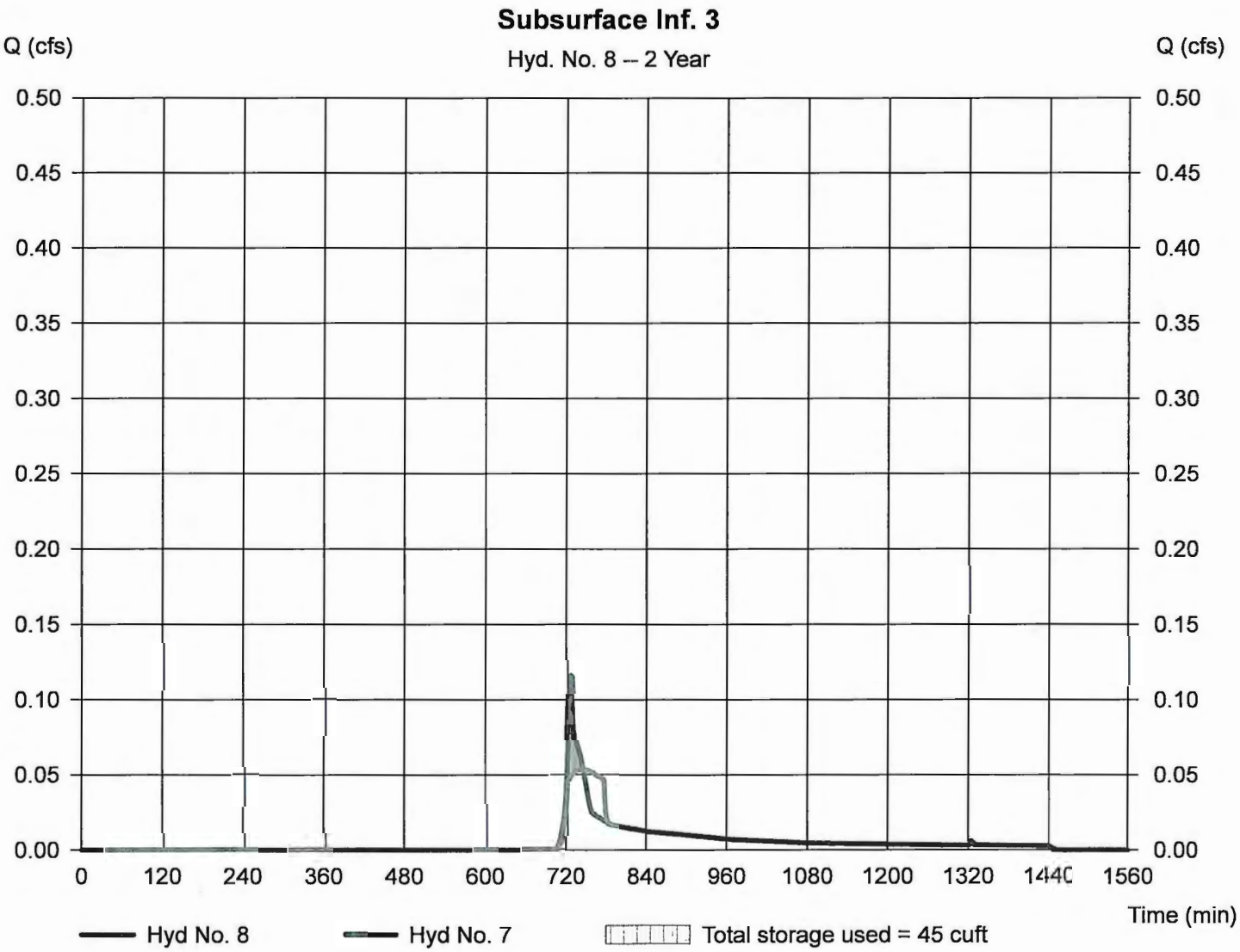
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 8

Subsurface Inf. 3

Hydrograph type	= Reservoir	Peak discharge	= 0.053 cfs
Storm frequency	= 2 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 436 cuft
Inflow hyd. No.	= 7 - Subcatchment 3	Max. Elevation	= 129.48 ft
Reservoir name	= Sub 3 Infiltration	Max. Storage	= 45 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

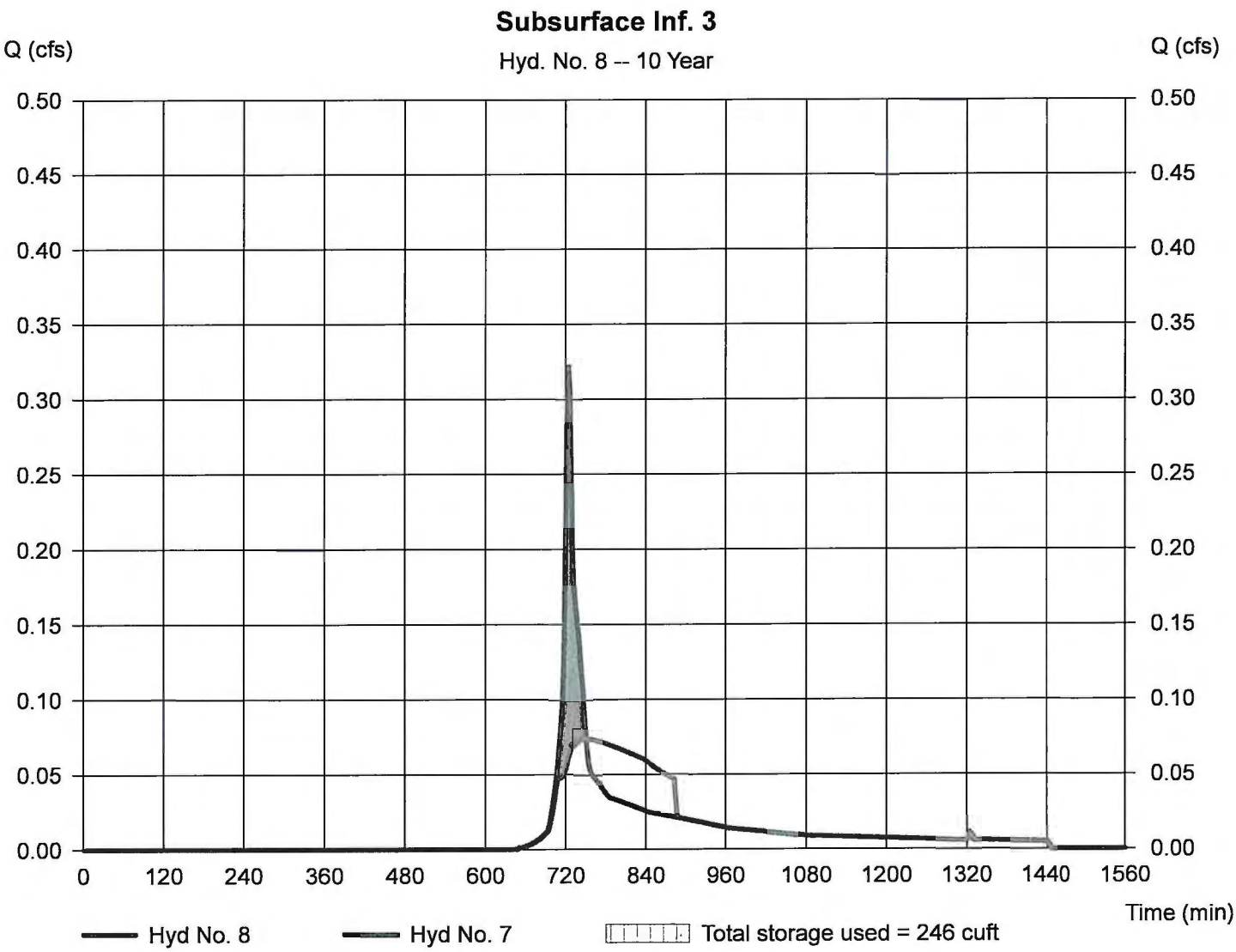
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 8

Subsurface Inf. 3

Hydrograph type	= Reservoir	Peak discharge	= 0.074 cfs
Storm frequency	= 10 yrs	Time to peak	= 750 min
Time interval	= 2 min	Hyd. volume	= 1,017 cuft
Inflow hyd. No.	= 7 - Subcatchment 3	Max. Elevation	= 130.75 ft
Reservoir name	= Sub 3 Infiltration	Max. Storage	= 246 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

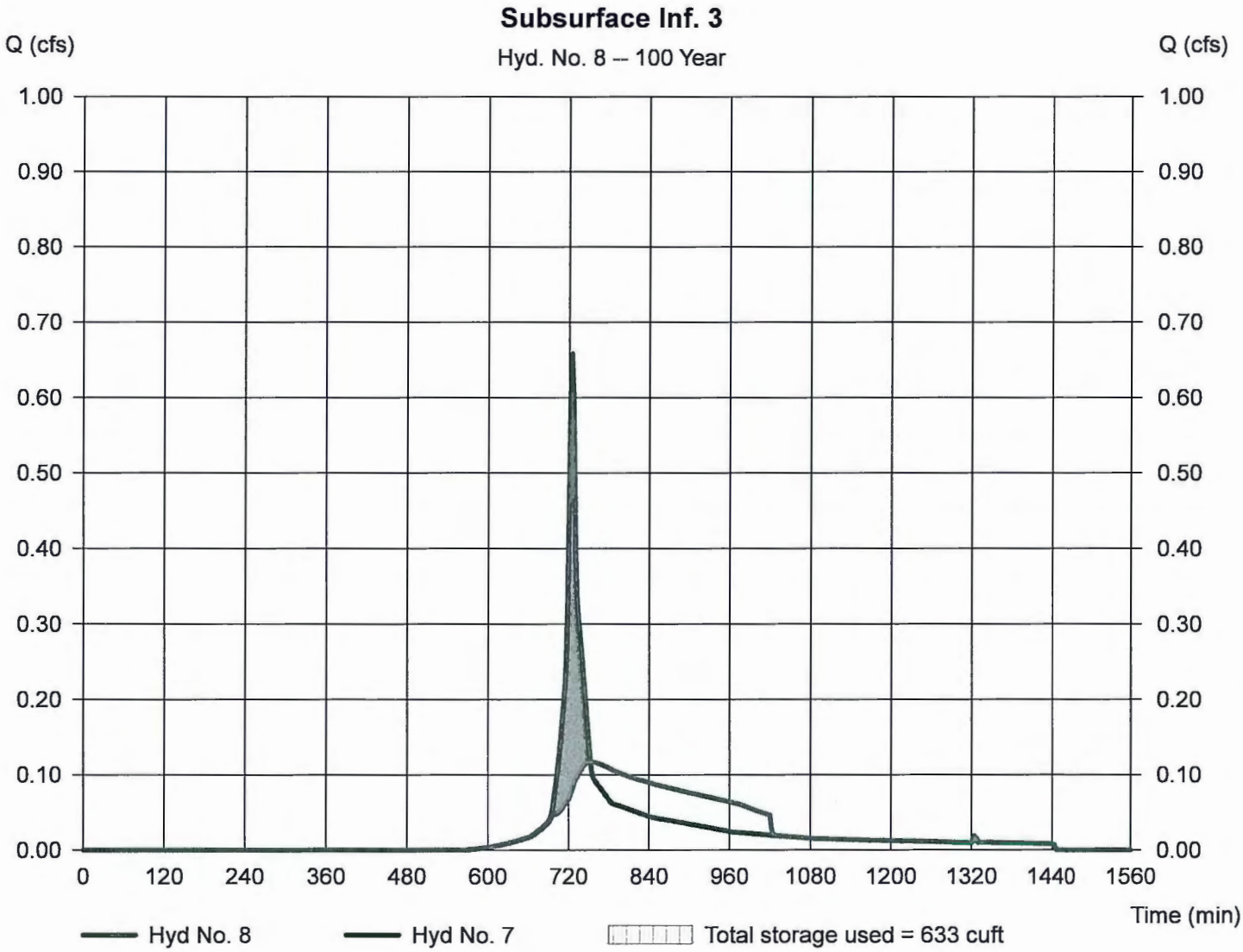
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 8

Subsurface Inf. 3

Hydrograph type	= Reservoir	Peak discharge	= 0.117 cfs
Storm frequency	= 100 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 1,986 cuft
Inflow hyd. No.	= 7 - Subcatchment 3	Max. Elevation	= 133.40 ft
Reservoir name	= Sub 3 Infiltration	Max. Storage	= 633 cuft

Storage Indication method used. Outflow includes exfiltration.



Worksheet 2: Runoff curve number and runoff SM-939B

Project: 7, 9, 19 & 29 Great Road By WJH Date 11/18/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present [Developed] Subcatchment 4

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			0.05	4.85
626B & 255C A	Open Space-Good Condition	39			0.08	2.96
				Totals =	0.13	7.80

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{7.80}{0.13} = 62.28$; Use CN = 62.3

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.1	4.5	6.4
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.45	1.16	2.39
Runoff, Q.....	cf	204	527	1089

D-2 (210-VI-TR-55, Second Ed., June 1986)

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-939B

Project: 7, 9, 19 & 29 Great Road By WJH Date 11/18/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present | Developed Subcatchment 4

Circle one: Tc | Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			Pavement			
2. Mannings roughness coeff., n (table 3-1)			0.011			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.1			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.01			0.01

Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			PAVED			
8. Flow Length, L		ft	57			
9. Watercourse slope, s		ft/ft	0.1			
10. Average Velocity, V (figure 3-1)		ft/s	6.43			
11. Tt = L / 3600V	Compute Tt	hr	0.00			0.00

Channel flow		Segment ID				
12. Cross sectional flow area, a		sf				
13. Wetted perimeter, pw		ft				
14. Hydraulic radius, r=a/wp	Compute r	ft				
15. Channel Slope, s		ft/ft				
16. Manning's roughness coeff., n						
17. V = 1.49 r^2/3 s^1/2 / n	Compute V	ft/s				
18. Flow length, L		ft				
19. Tt = L / 3600V	Compute Tt	hr				0.00

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.10
min 6.0

(210-VI-TR-55, Second Ed., June 1986)

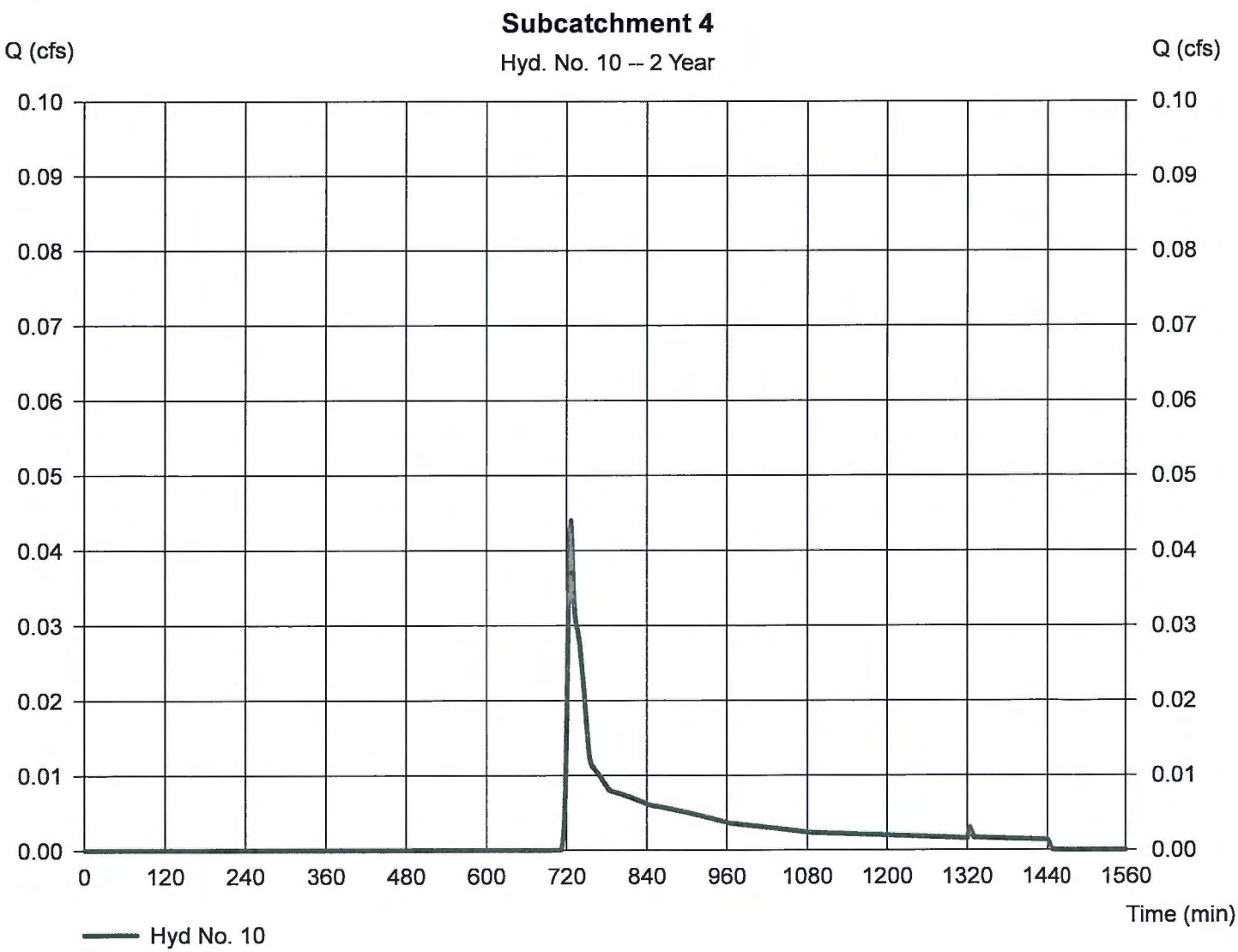
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 10

Subcatchment 4

Hydrograph type	= SCS Runoff	Peak discharge	= 0.044 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 199 cuft
Drainage area	= 0.130 ac	Curve number	= 62.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



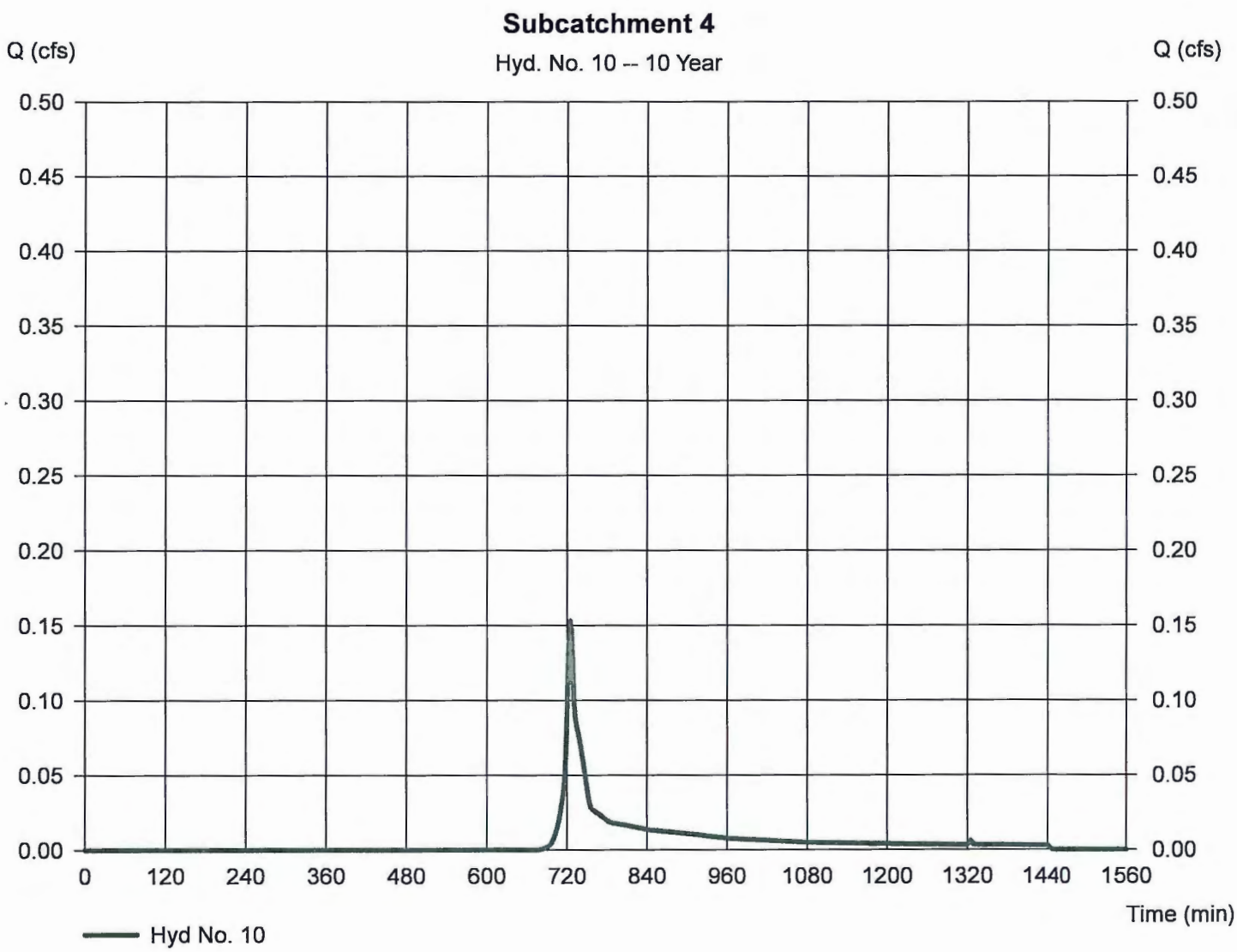
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 10

Subcatchment 4

Hydrograph type	= SCS Runoff	Peak discharge	= 0.153 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 513 cuft
Drainage area	= 0.130 ac	Curve number	= 62.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



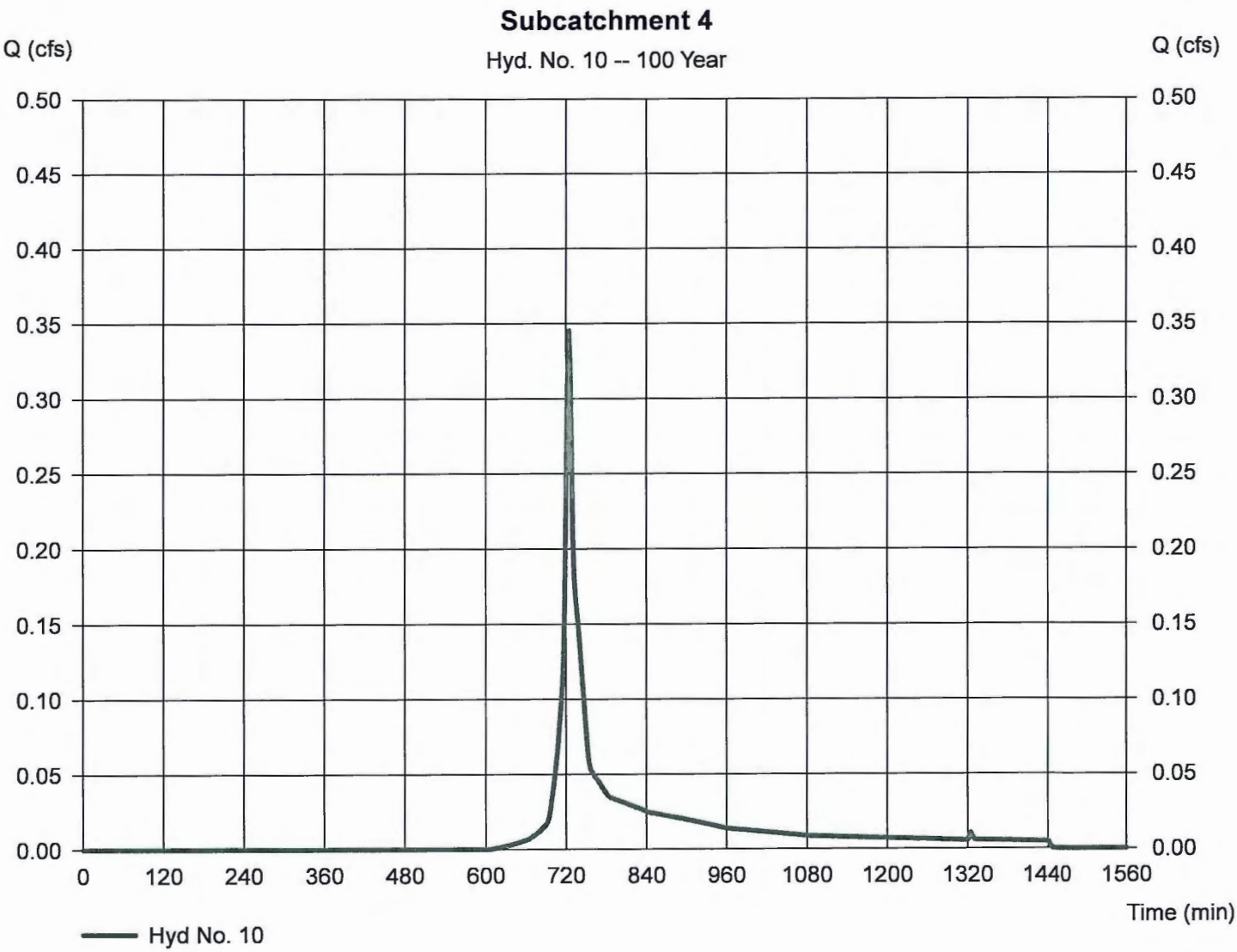
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 10

Subcatchment 4

Hydrograph type	= SCS Runoff	Peak discharge	= 0.345 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,060 cuft
Drainage area	= 0.130 ac	Curve number	= 62.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff SM-939B

Project: 7, 9, 19 & 29 Great Road By WJH Date 11/18/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present [Developed] Roof Drywell 1

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious (Roof)	98			0.55	53.94
				Totals =	0.55	53.94

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{53.94}{0.55} =$ 98.00 ; Use CN = 98.0

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.1	4.5	6.4
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	2.87	4.26	6.16
Runoff, Q.....	cf	5730	8520	12311

D-2 (210-VI-TR-55, Second Ed., June 1986)

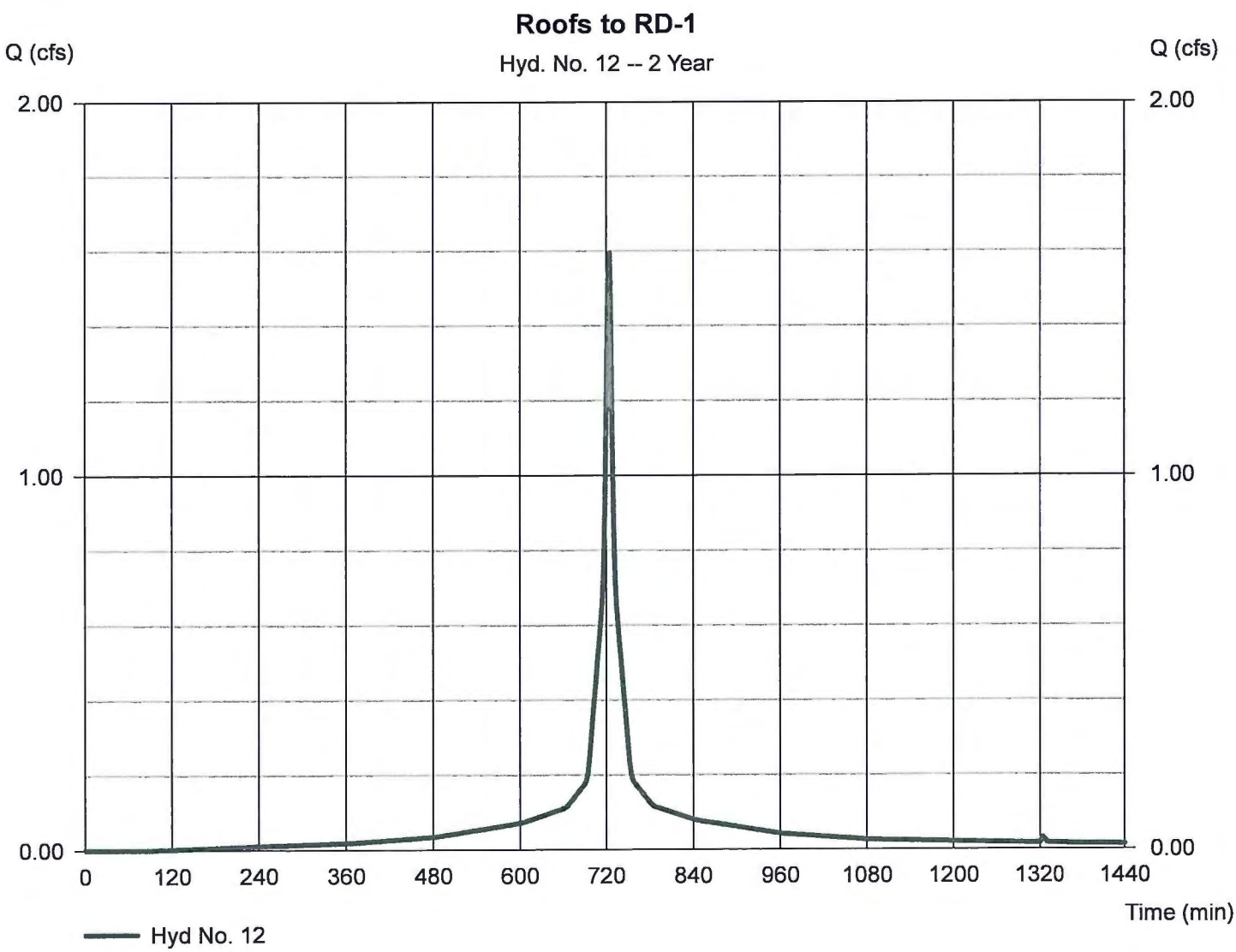
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 12

Roofs to RD-1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.595 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 5,368 cuft
Drainage area	= 0.550 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



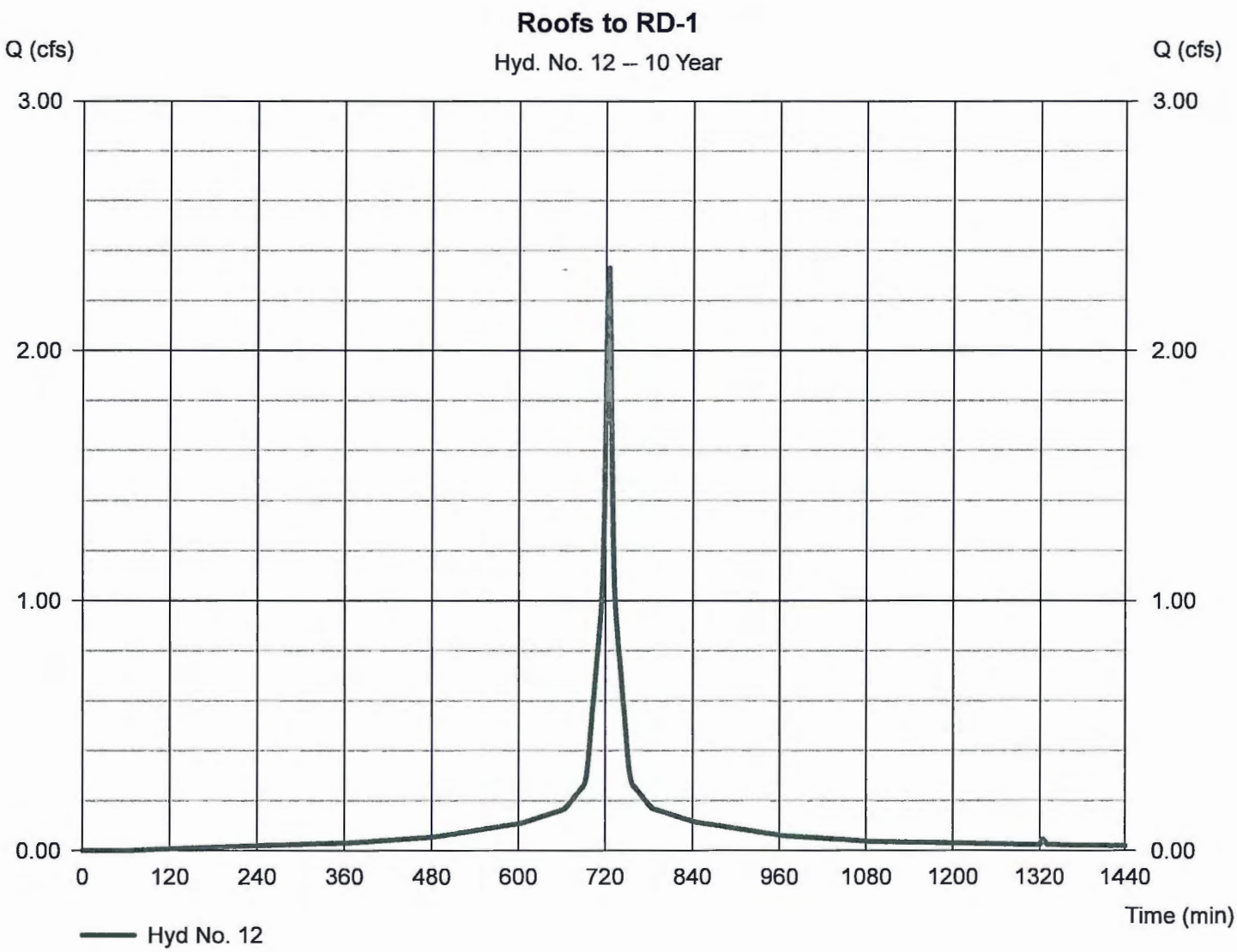
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 12

Roofs to RD-1

Hydrograph type	= SCS Runoff	Peak discharge	= 2.331 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 7,981 cuft
Drainage area	= 0.550 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



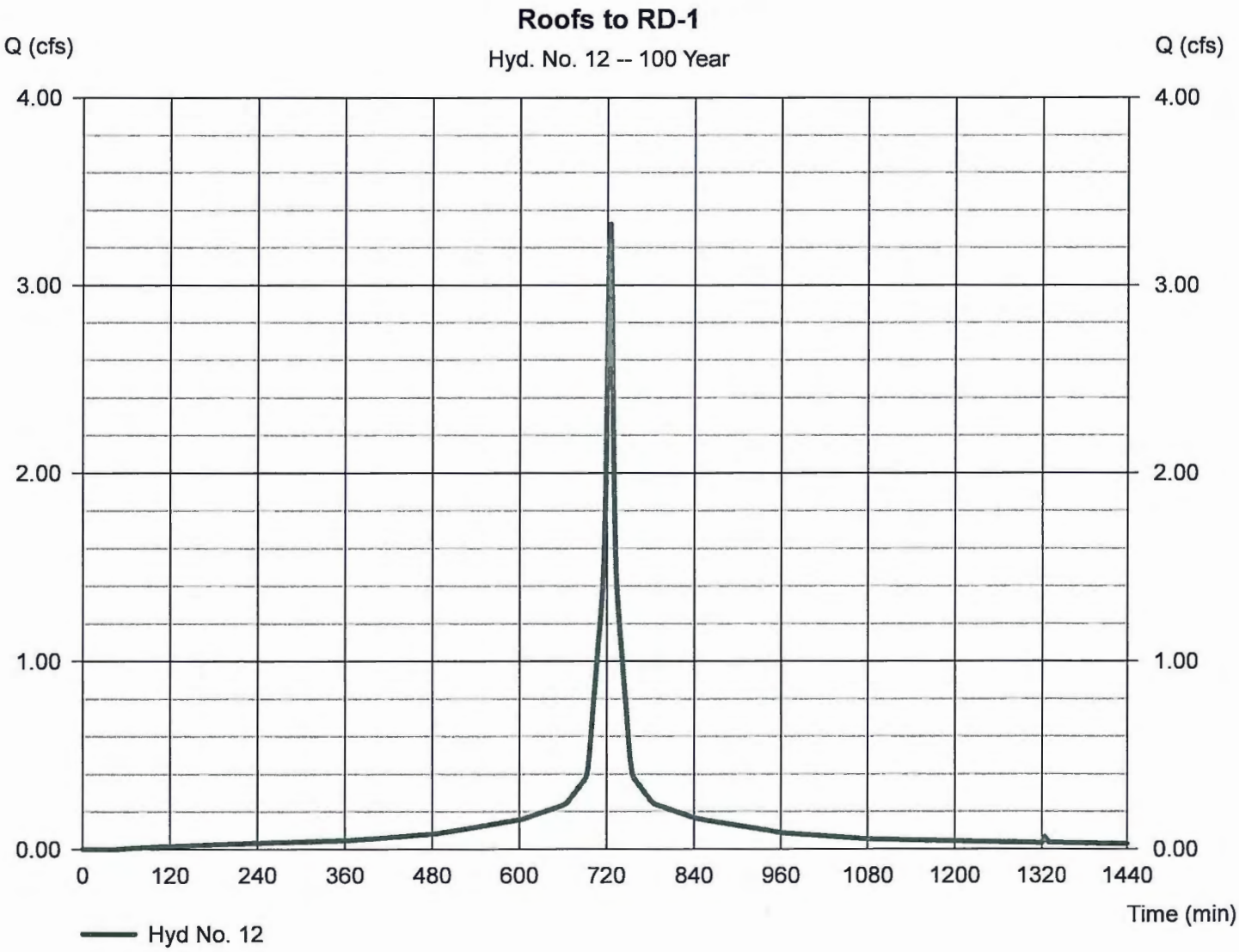
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 12

Roofs to RD-1

Hydrograph type	= SCS Runoff	Peak discharge	= 3.327 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 11,532 cuft
Drainage area	= 0.550 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

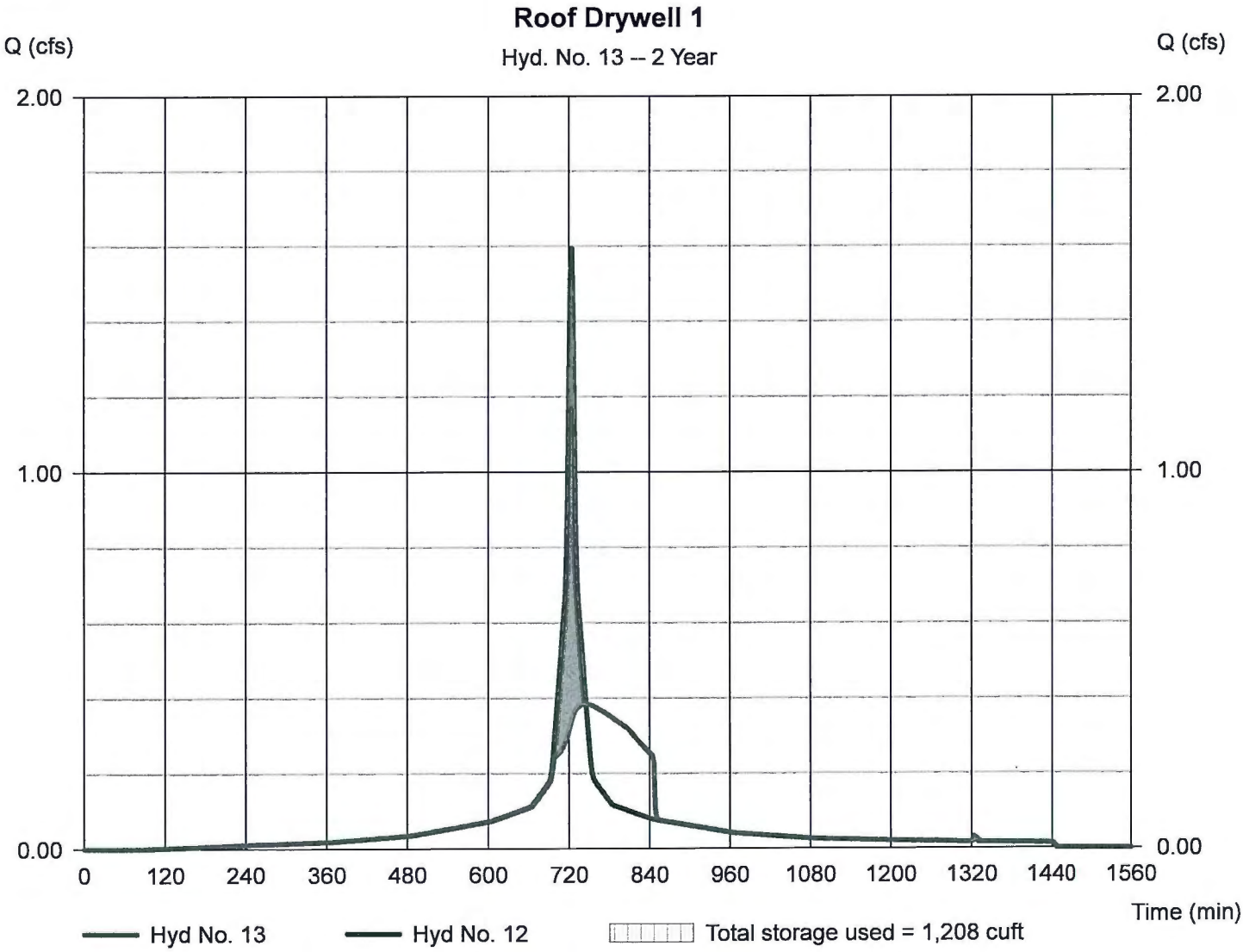
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 13

Roof Drywell 1

Hydrograph type	= Reservoir	Peak discharge	= 0.385 cfs
Storm frequency	= 2 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 5,368 cuft
Inflow hyd. No.	= 12 - Roofs to RD-1	Max. Elevation	= 131.66 ft
Reservoir name	= Roof Drywell 1	Max. Storage	= 1,208 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

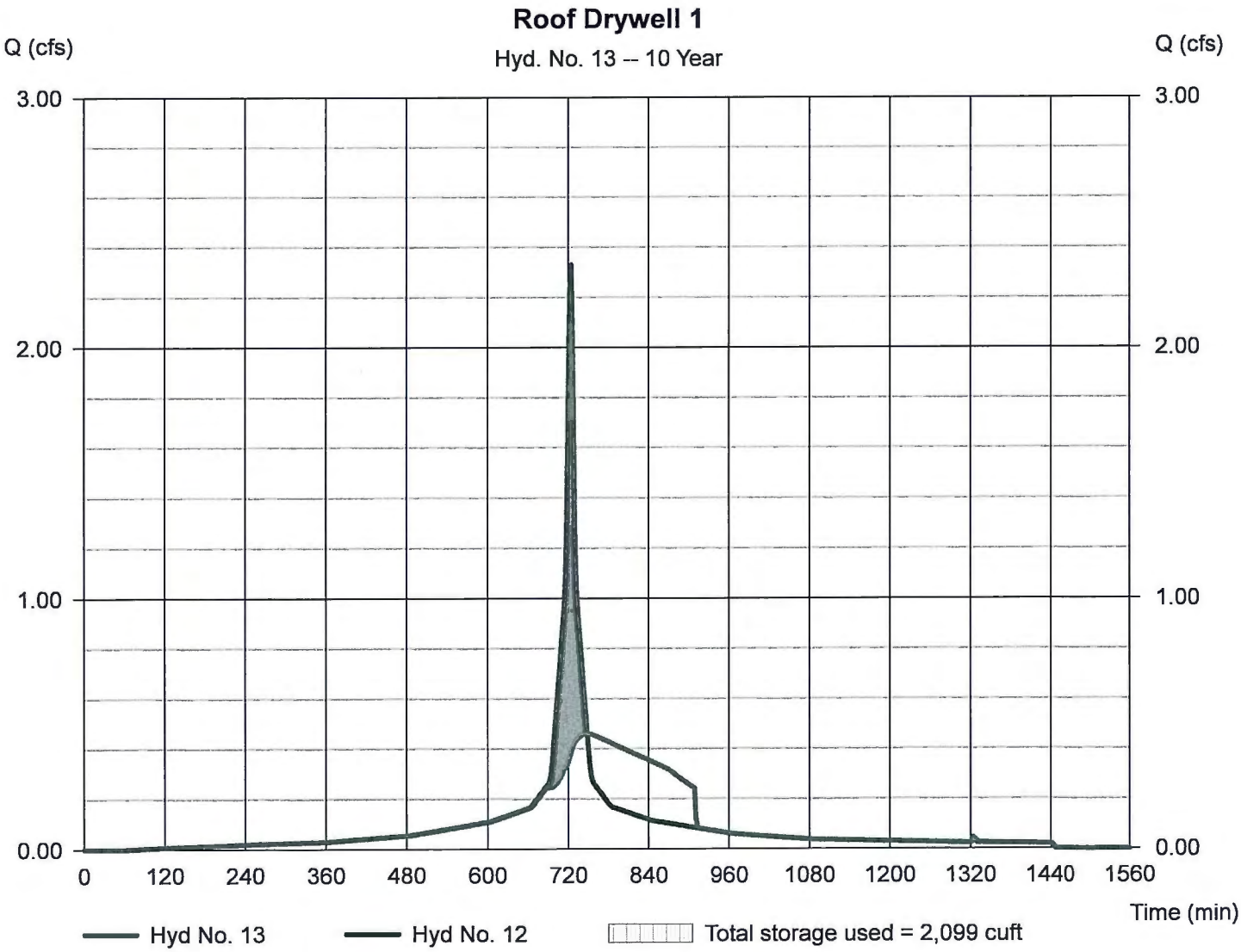
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 13

Roof Drywell 1

Hydrograph type	= Reservoir	Peak discharge	= 0.461 cfs
Storm frequency	= 10 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 7,981 cuft
Inflow hyd. No.	= 12 - Roofs to RD-1	Max. Elevation	= 132.54 ft
Reservoir name	= Roof Drywell 1	Max. Storage	= 2,099 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

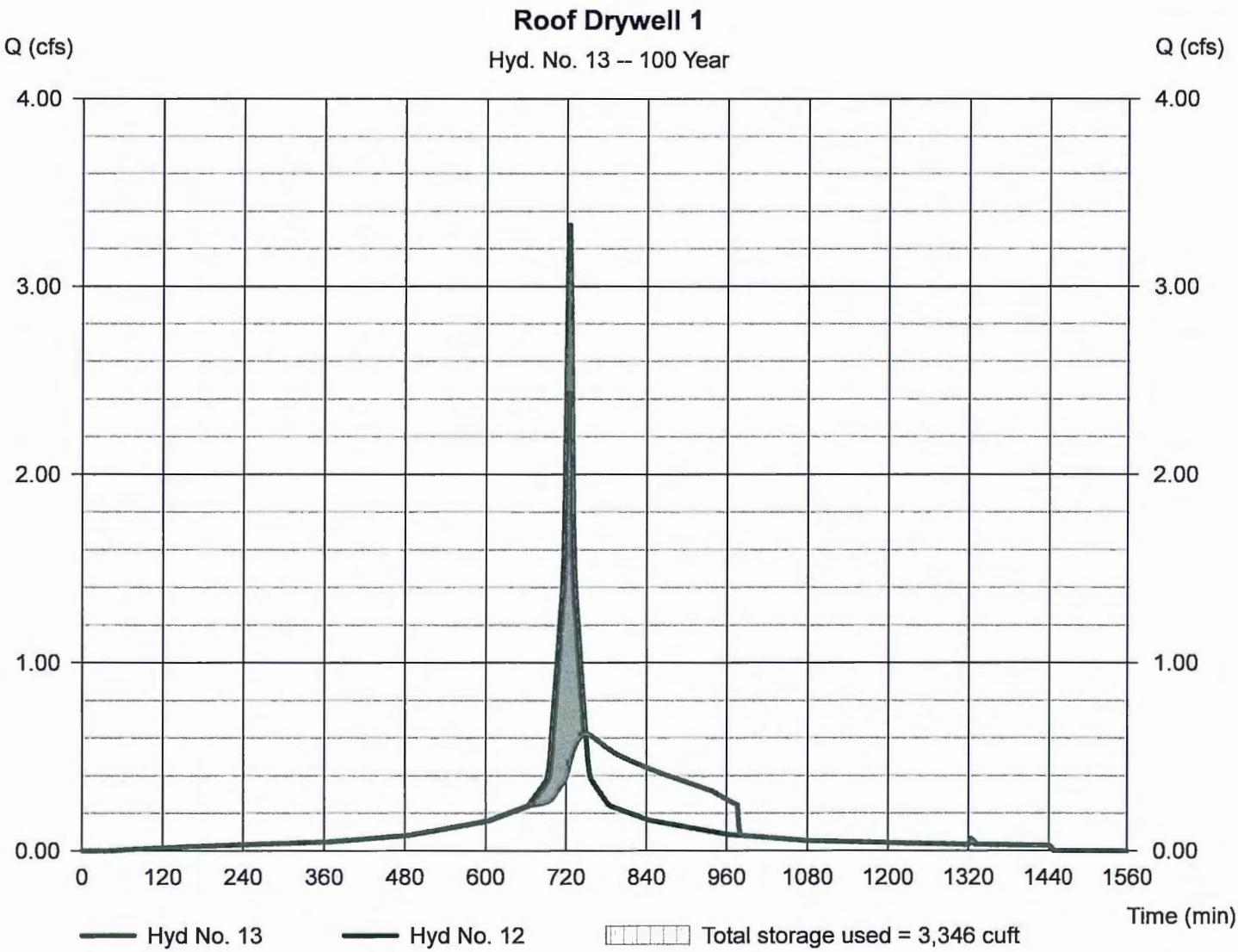
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 13

Roof Drywell 1

Hydrograph type	= Reservoir	Peak discharge	= 0.624 cfs
Storm frequency	= 100 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 11,532 cuft
Inflow hyd. No.	= 12 - Roofs to RD-1	Max. Elevation	= 134.40 ft
Reservoir name	= Roof Drywell 1	Max. Storage	= 3,346 cuft

Storage Indication method used. Outflow includes exfiltration.



Worksheet 2: Runoff curve number and runoff SM-939B

Project: 7, 9, 19 & 29 Great Road By WJH Date 11/18/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present **Developed** Roof Drywell 2

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious (Roof)	98			0.09	8.70
				Totals =	0.09	8.70

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{8.70}{0.09} =$ 98.00 ; Use CN = **98.0**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.1	4.5	6.4
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	2.87	4.26	6.16
Runoff, Q.....	cf	924	1374	1985

D-2 (210-VI-TR-55, Second Ed., June 1986)

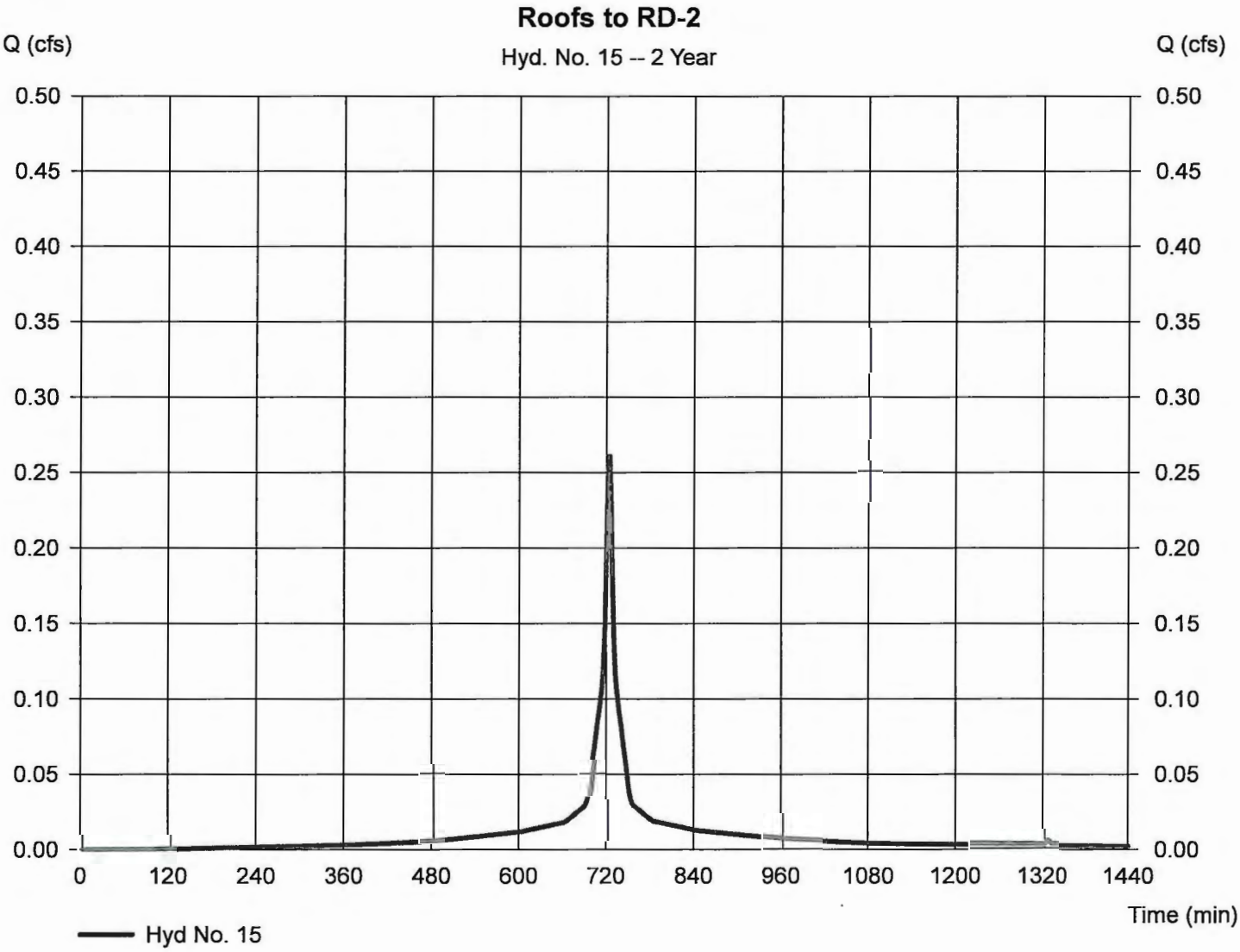
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 15

Roofs to RD-2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.261 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 878 cuft
Drainage area	= 0.090 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



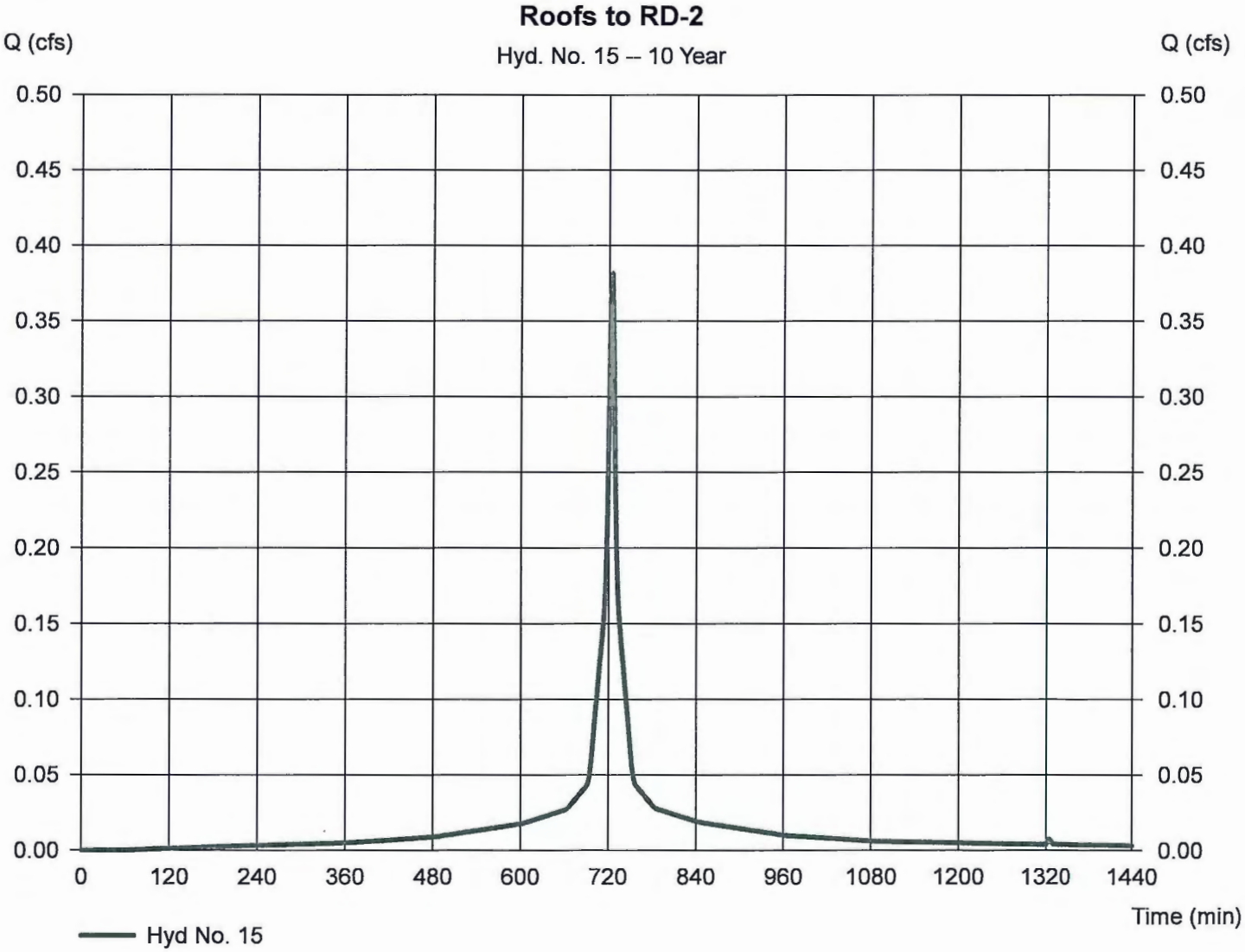
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 15

Roofs to RD-2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.381 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,306 cuft
Drainage area	= 0.090 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



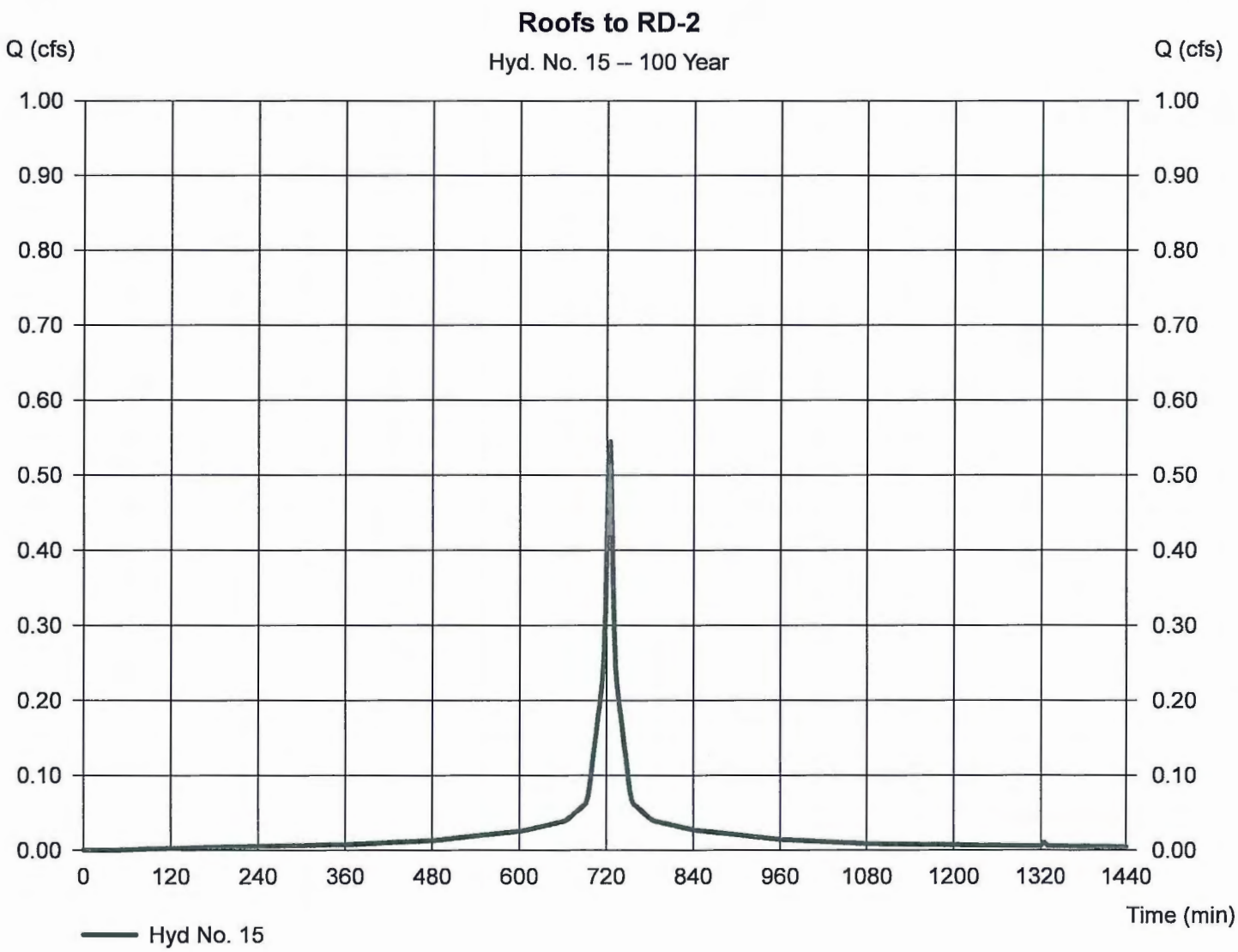
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 15

Roofs to RD-2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.544 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,887 cuft
Drainage area	= 0.090 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

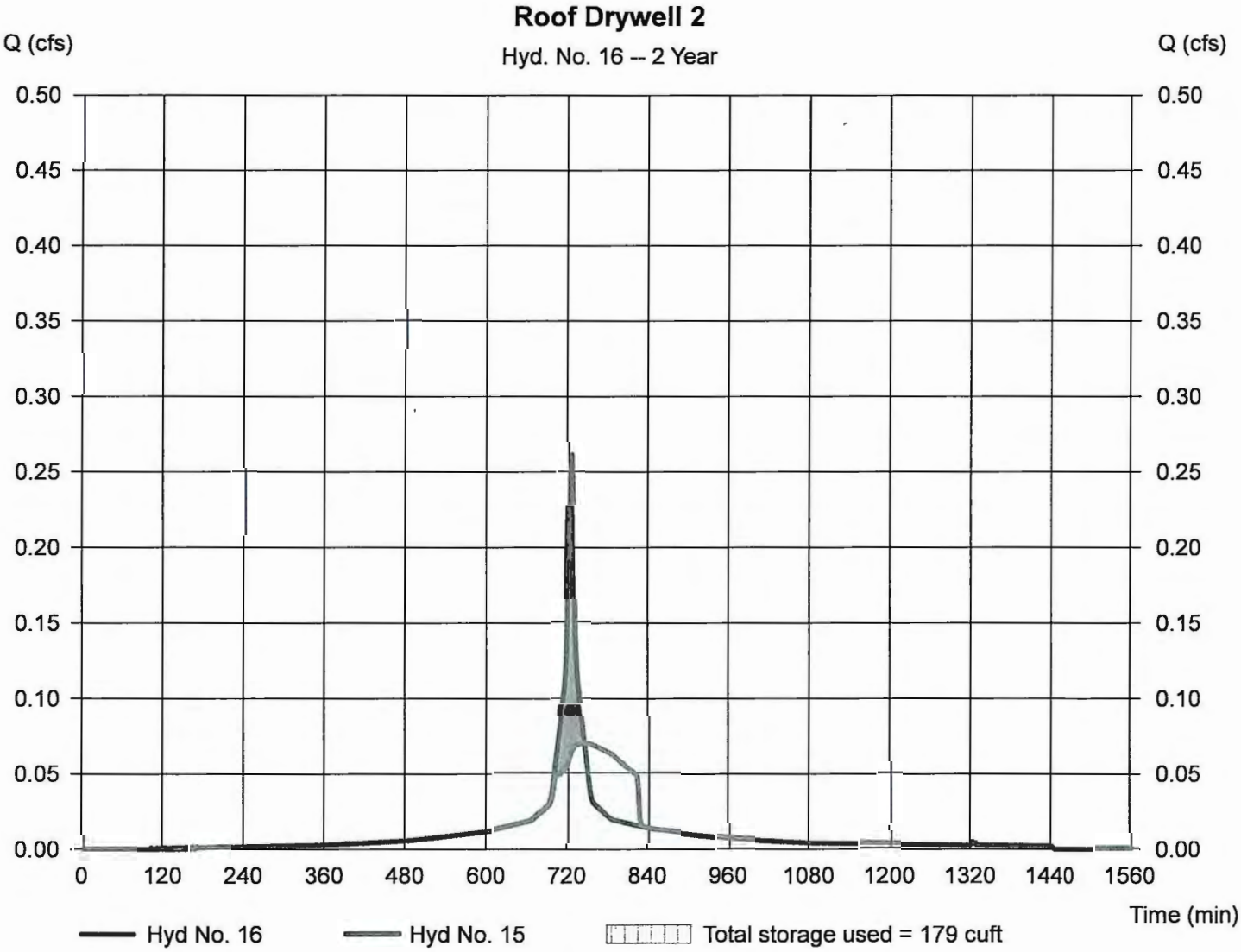
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 16

Roof Drywell 2

Hydrograph type	= Reservoir	Peak discharge	= 0.070 cfs
Storm frequency	= 2 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 878 cuft
Inflow hyd. No.	= 15 - Roofs to RD-2	Max. Elevation	= 135.89 ft
Reservoir name	= Roof Drywell 2	Max. Storage	= 179 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

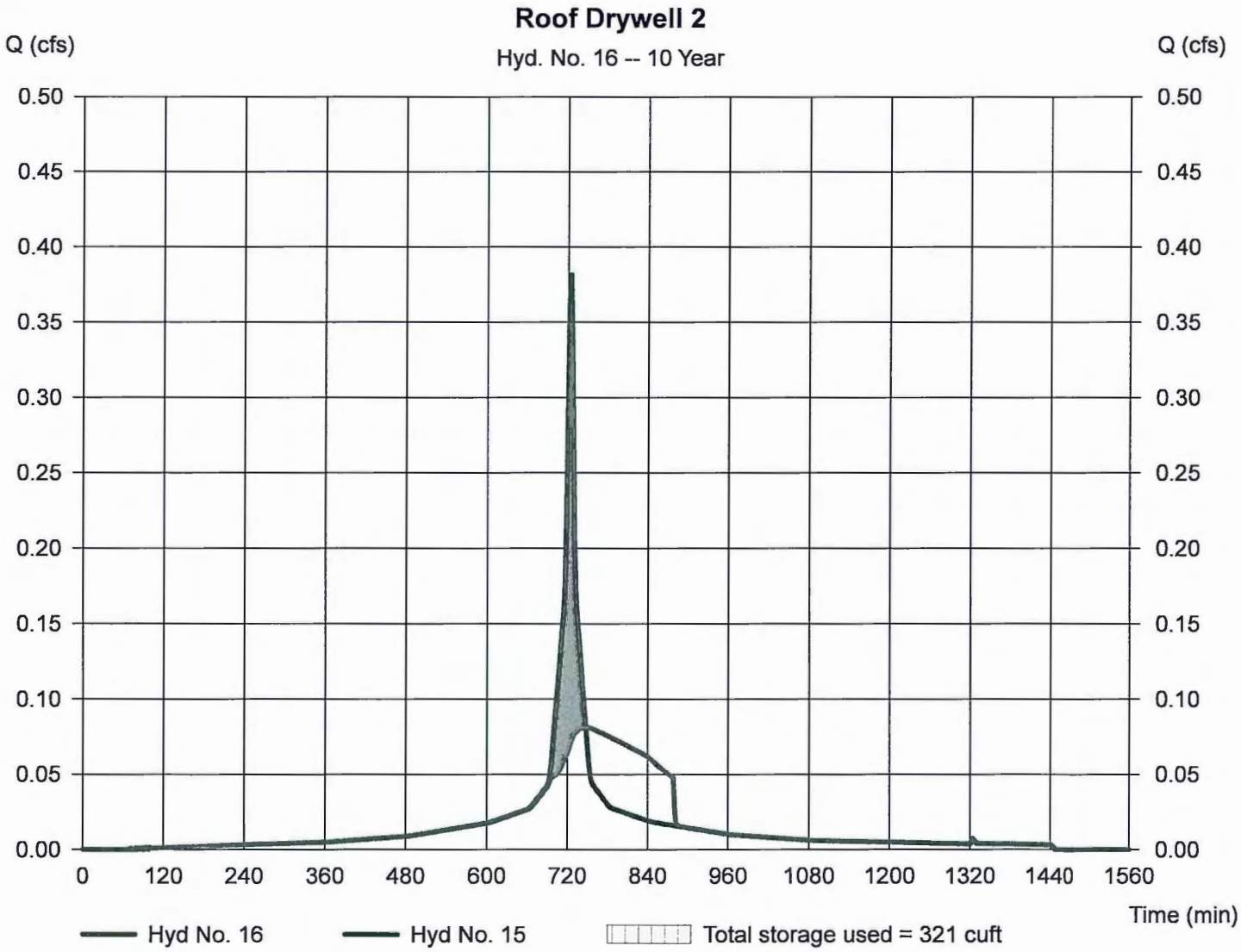
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 16

Roof Drywell 2

Hydrograph type	= Reservoir	Peak discharge	= 0.081 cfs
Storm frequency	= 10 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 1,306 cuft
Inflow hyd. No.	= 15 - Roofs to RD-2	Max. Elevation	= 136.60 ft
Reservoir name	= Roof Drywell 2	Max. Storage	= 321 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

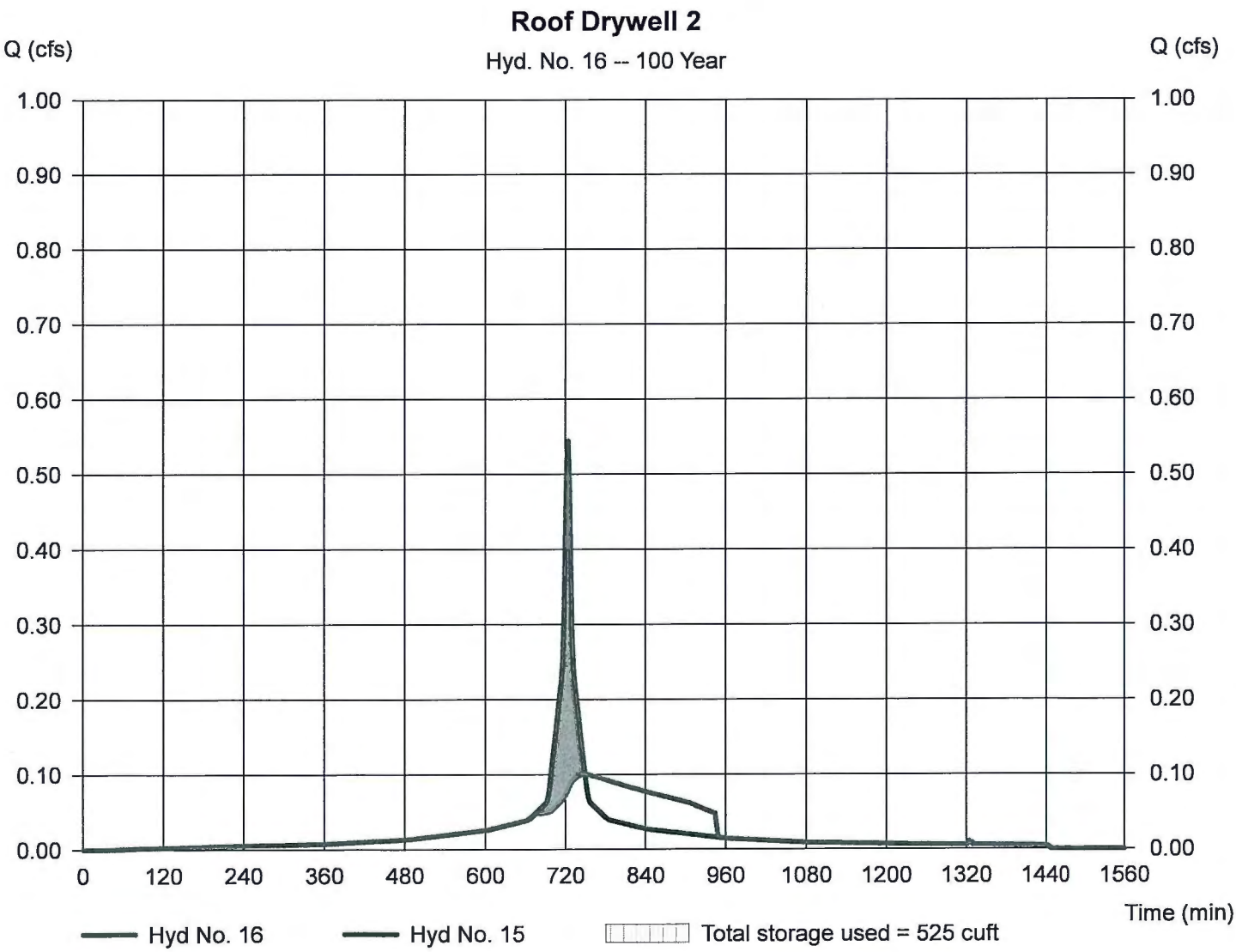
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Nov 19, 2015

Hyd. No. 16

Roof Drywell 2

Hydrograph type	= Reservoir	Peak discharge	= 0.100 cfs
Storm frequency	= 100 yrs	Time to peak	= 750 min
Time interval	= 2 min	Hyd. volume	= 1,887 cuft
Inflow hyd. No.	= 15 - Roofs to RD-2	Max. Elevation	= 137.77 ft
Reservoir name	= Roof Drywell 2	Max. Storage	= 525 cuft

Storage Indication method used. Outflow includes exfiltration.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Nov 19, 2015

Pond No. 10 - Sub 1 Infiltration

Pond Data

UG Chambers - Invert elev. = 136.00 ft, Rise x Span = 2.50 x 4.25 ft, Barrel Len = 42.72 ft, No. Barrels = 6, Slope = 0.00%, Headers = No
Encasement - Invert elev. = 134.50 ft, Width = 5.50 ft, Height = 4.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	134.50	n/a	0	0
0.45	134.95	n/a	254	254
0.90	135.40	n/a	254	508
1.35	135.85	n/a	254	761
1.80	136.30	n/a	449	1,211
2.25	136.75	n/a	541	1,752
2.70	137.20	n/a	524	2,276
3.15	137.65	n/a	495	2,771
3.60	138.10	n/a	447	3,218
4.05	138.55	n/a	350	3,568
4.50	139.00	n/a	254	3,822

Culvert / Orifice Structures

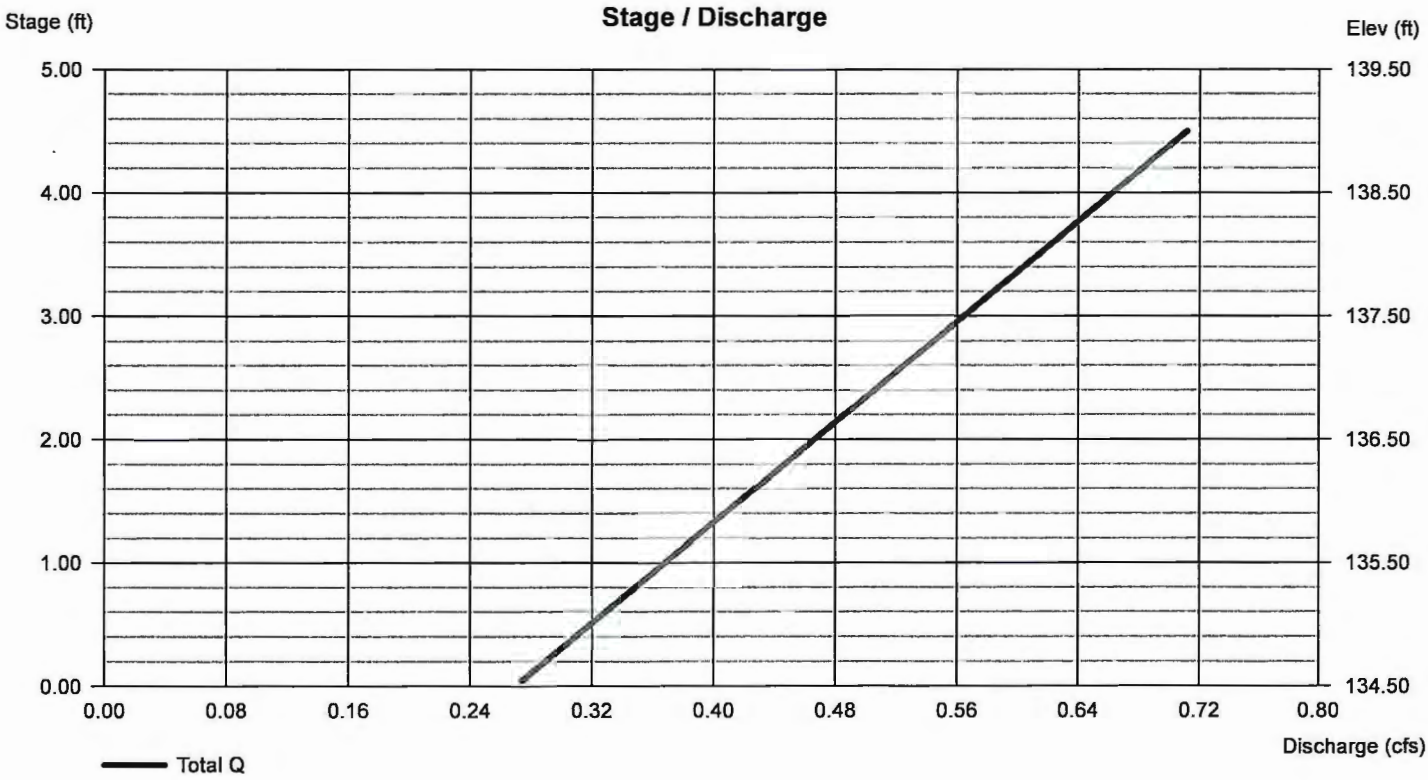
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 8.270 (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).



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Nov 19, 2015

Pond No. 3 - Sub 2 Infiltration

Pond Data

UG Chambers - Invert elev. = 129.00 ft, Rise x Span = 2.50 x 4.25 ft, Barrel Len = 28.48 ft, No. Barrels = 4, Slope = 0.00%, Headers = No
Encasement - Invert elev. = 128.00 ft, Width = 5.50 ft, Height = 4.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	128.00	n/a	0	0
0.45	128.45	n/a	113	113
0.90	128.90	n/a	113	226
1.35	129.35	n/a	214	440
1.80	129.80	n/a	240	680
2.25	130.25	n/a	232	911
2.70	130.70	n/a	218	1,129
3.15	131.15	n/a	196	1,325
3.60	131.60	n/a	148	1,473
4.05	132.05	n/a	113	1,586
4.50	132.50	n/a	113	1,699

Culvert / Orifice Structures

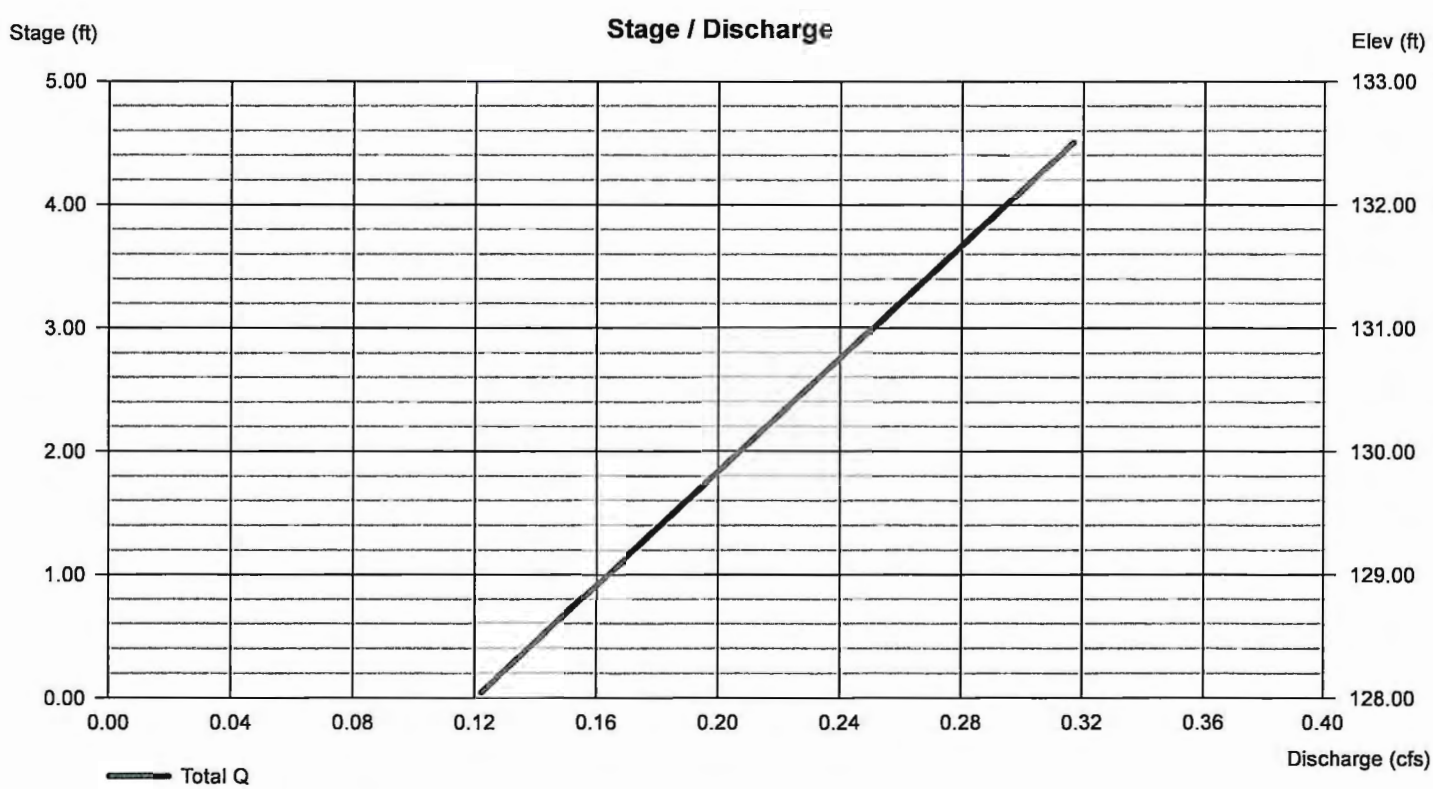
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 8.270 (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).



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Nov 19, 2015

Pond No. 6 - Sub 3 Infiltration

Pond Data

UG Chambers - Invert elev. = 130.00 ft, Rise x Span = 2.50 x 4.25 ft, Barrel Len = 14.24 ft, No. Barrels = 3, Slope = 0.00%, Headers = No
Encasement - Invert elev. = 129.00 ft, Width = 5.58 ft, Height = 4.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	129.00	n/a	0	0
0.45	129.45	n/a	43	43
0.90	129.90	n/a	43	86
1.35	130.35	n/a	81	167
1.80	130.80	n/a	91	257
2.25	131.25	n/a	88	345
2.70	131.70	n/a	82	427
3.15	132.15	n/a	74	501
3.60	132.60	n/a	56	557
4.05	133.05	n/a	43	600
4.50	133.50	n/a	43	643

Culvert / Orifice Structures

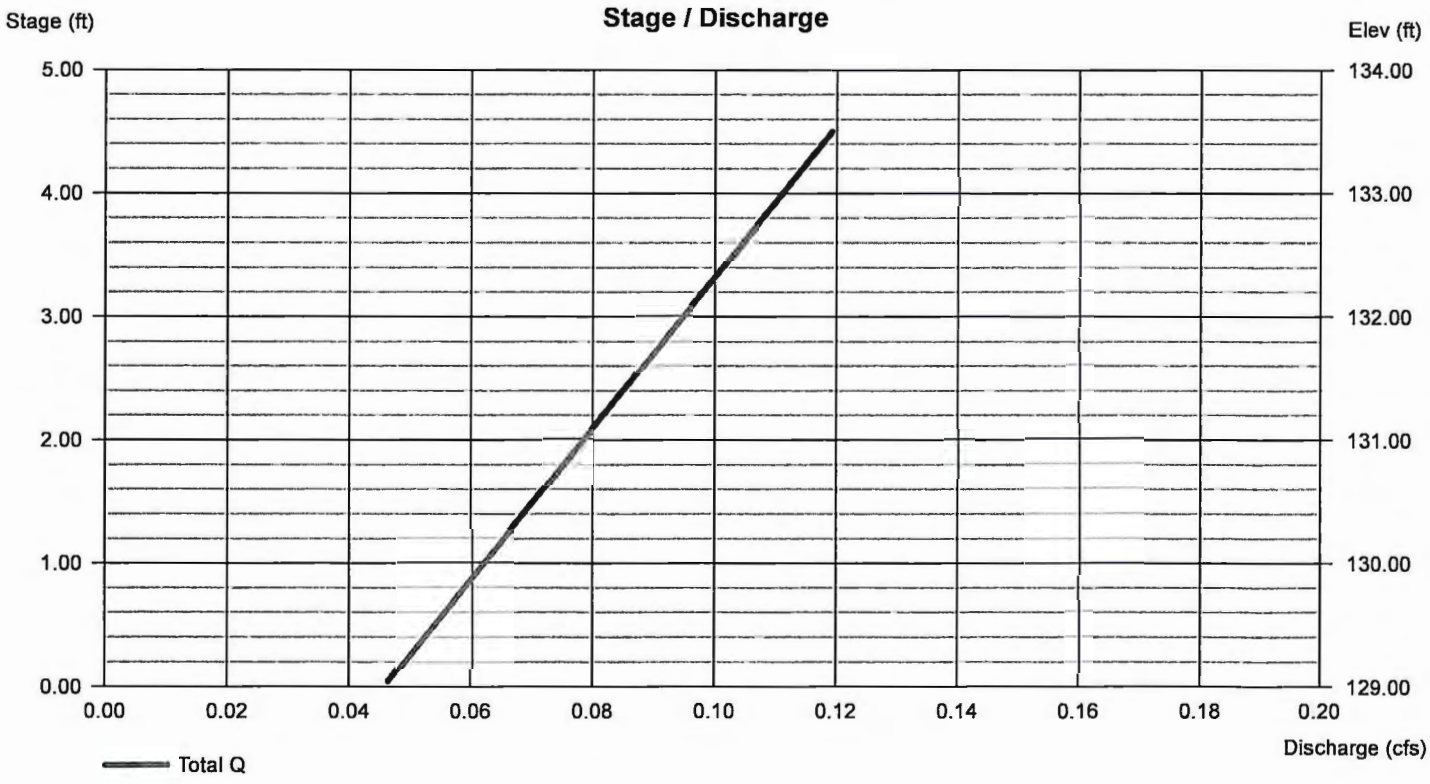
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 8.270 (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).



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Nov 19, 2015

Pond No. 1 - Roof Drywell 1

Pond Data

UG Chambers - Invert elev. = 131.00 ft, Rise x Span = 2.50 x 4.25 ft, Barrel Len = 56.96 ft, No. Barrels = 4, Slope = 0.00%, Headers = No
Encasement - Invert elev. = 130.00 ft, Width = 5.50 ft, Height = 4.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	130.00	n/a	0	0
0.45	130.45	n/a	226	226
0.90	130.90	n/a	226	451
1.35	131.35	n/a	428	880
1.80	131.80	n/a	480	1,359
2.25	132.25	n/a	464	1,823
2.70	132.70	n/a	436	2,259
3.15	133.15	n/a	391	2,650
3.60	133.60	n/a	296	2,946
4.05	134.05	n/a	226	3,171
4.50	134.50	n/a	226	3,397

Culvert / Orifice Structures

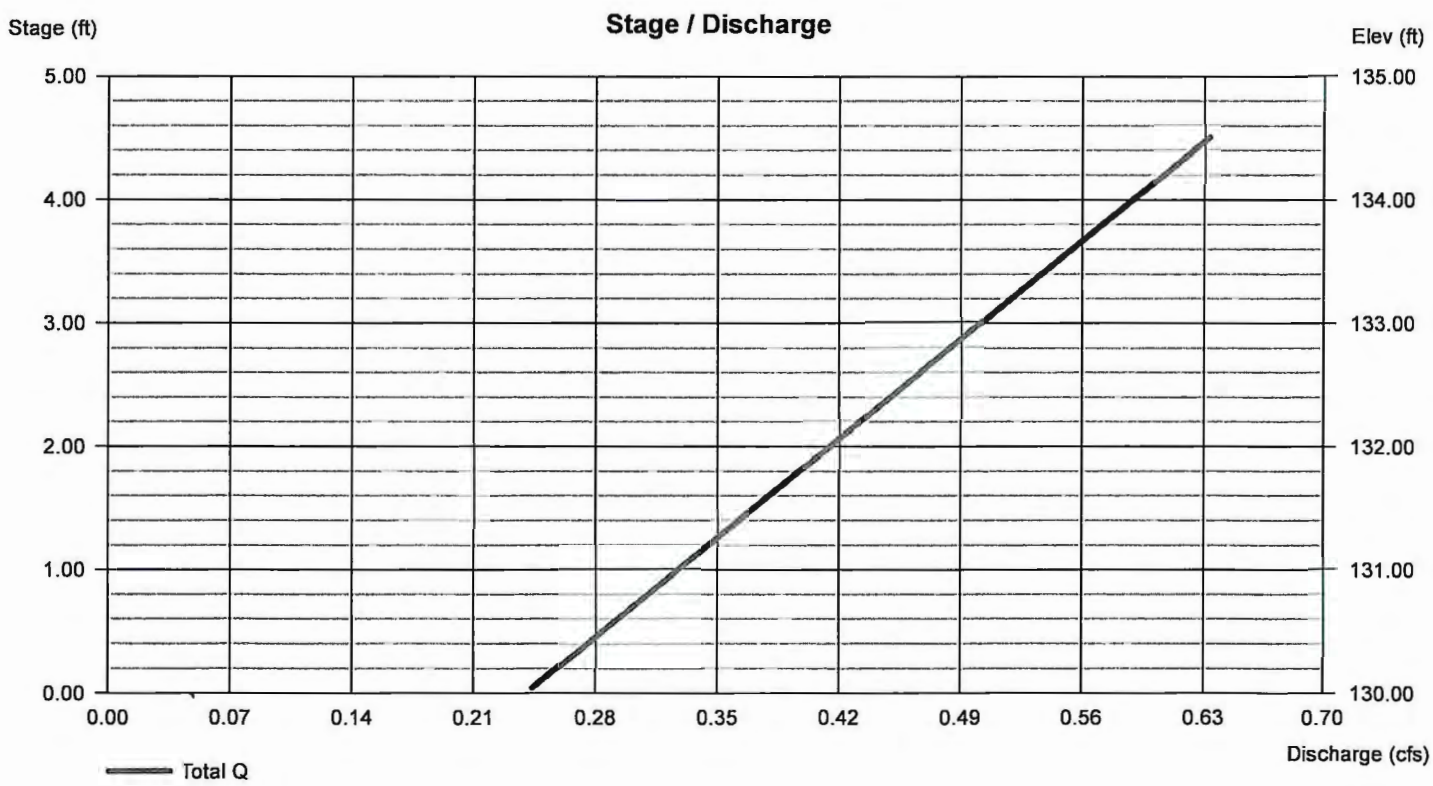
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 8.270 (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).



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Nov 19, 2015

Pond No. 4 - Roof Drywell 2

Pond Data

UG Chambers - Invert elev. = 135.50 ft, Rise x Span = 2.50 x 4.25 ft, Barrel Len = 21.36 ft, No. Barrels = 2, Slope = 0.00%, Headers = No
Encasement - Invert elev. = 134.50 ft, Width = 5.75 ft, Height = 4.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	134.50	n/a	0	0
0.45	134.95	n/a	44	44
0.90	135.40	n/a	44	88
1.35	135.85	n/a	82	171
1.80	136.30	n/a	92	263
2.25	136.75	n/a	89	351
2.70	137.20	n/a	84	435
3.15	137.65	n/a	75	510
3.60	138.10	n/a	57	568
4.05	138.55	n/a	44	612
4.50	139.00	n/a	44	656

Culvert / Orifice Structures

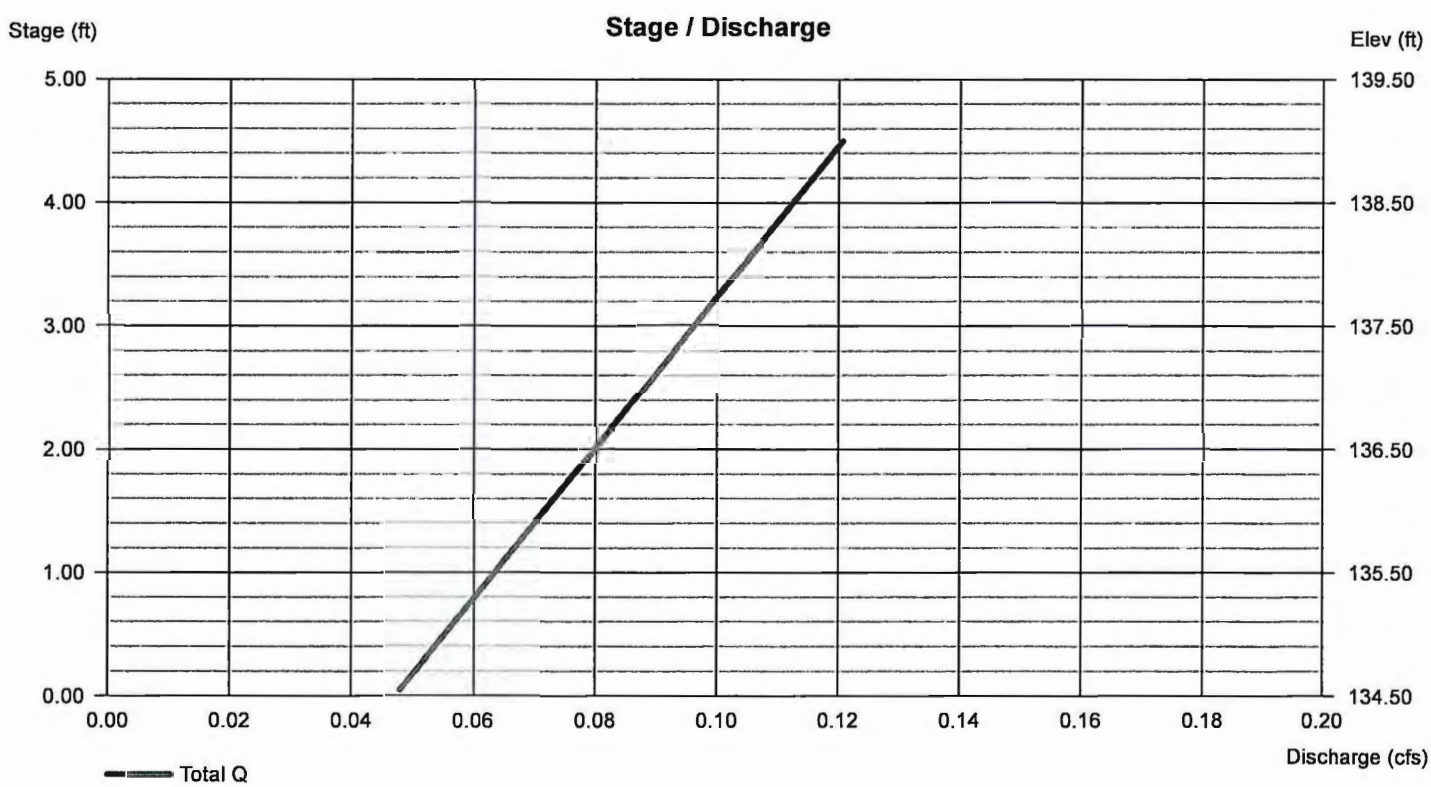
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 8.270 (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).



First Flush Volume Calculations

Project: First Village
Location: Acton, MA
Prepared For: Bill Hall - Stamski & McNary, Inc.

CONTECH ENGINEERED SOLUTIONS

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1.0" of runoff.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Given:

Structure Name	Impv. (acres)	A ($miles^2$)	t_c (min)	t_c (hr)	WQV (in)
CDS	0.24	0.0003734	6.0	0.100	1.00
VSHS	0.50	0.0007813	6.0	0.100	1.00

Procedure:

Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Structure Name	qu (csm/in.)
CDS	774.00
VSHS	774.00

1. Compute Q Rate using the following equation:

$$Q_1 = (qu)\ (A)\ (WQV)$$

where:

Q_1 = flow fate associated with first 1.0" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1.0" in this case)

Structure Name	Q_1 (cfs)
CDS	0.29
VSHS	0.60

VortSentry® HS Estimated Net Annual TSS Reduction

CONTECH ENGINEERED SOLUTIONS

FIRST VILLAGE
ACTON, MA
Model VSHS48
System VORTSENTRY

Design Ratio[1] = $\frac{\text{0.12 acres x 0.9}}{\text{63 ft3}}$ **= 0.002**

Rainfall Intensity "/hr	Flow Rate cfs	Operating Rate[2] cfs/ft^3	% Total Rainfall Depth[3]	Rmvl. Effcy[4] (%)	Rel. Effcy (%)
0.02	0.00	0.00003	10.2%	98.0%	10.0%
0.04	0.00	0.00007	9.6%	98.0%	9.5%
0.06	0.01	0.00010	9.4%	98.0%	9.3%
0.08	0.01	0.00014	7.7%	98.0%	7.6%
0.10	0.01	0.00017	8.6%	98.0%	8.4%
0.12	0.01	0.00021	6.3%	98.0%	6.2%
0.14	0.02	0.00024	4.7%	98.0%	4.6%
0.16	0.02	0.00028	4.6%	98.0%	4.5%
0.18	0.02	0.00031	3.5%	98.0%	3.5%
0.20	0.02	0.00034	4.3%	98.0%	4.3%
0.25	0.03	0.00043	8.0%	98.0%	7.8%
0.30	0.03	0.00052	5.6%	98.0%	5.5%
0.35	0.04	0.00060	4.4%	98.0%	4.3%
0.40	0.04	0.00069	2.5%	98.0%	2.5%
0.45	0.05	0.00077	2.5%	98.0%	2.5%
0.50	0.05	0.00086	1.4%	98.0%	1.4%
0.75	0.08	0.00129	5.0%	98.0%	4.9%
1.00	0.11	0.00172	1.0%	98.0%	1.0%
1.50	0.16	0.00258	0.0%	98.0%	0.0%
2.00	0.22	0.00344	0.0%	98.0%	0.0%
3.00	0.32	0.00516	0.5%	98.0%	0.5%
					98.0%
				% rain falling at >3"/hr =	0.0%
				Removal Efficiency Adjustment[4] =	6.5%
				Predicted Net Annual Load Removal Efficiency =	**91.5%**

1 - Design Ratio = (Total Drainage Area x Runoff Coefficient) / VortSentry HS Treatment Volume
= The Total Drainage Area and Runoff Coefficient are specified by the site engineer.
2 - Operating Rate (cfs/ft^3) = Rainfall Intensity ("/hr) x Design Ratio
3 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
4 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Calculated by: CJA	Date: 11/17/15	Checked by:	Date:

CDS ESTIMATED NET ANNUAL TSS REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

CONTECH ENGINEERED SOLUTIONS

FIRST VILLAGE
ACTON, MA
for SYSTEM: CDS-2015-4

Area	0.75	acres	CDS Model	
Weighted C	0.90		2015-4	
Tc	6	minutes	CDS Treatment Capacity	
			1.4	cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	100.0	10.2
0.04	9.6%	19.8%	0.03	0.03	100.0	9.6
0.06	9.4%	29.3%	0.04	0.04	100.0	9.4
0.08	7.7%	37.0%	0.05	0.05	99.5	7.7
0.10	8.6%	45.6%	0.07	0.07	99.1	8.5
0.12	6.3%	51.9%	0.08	0.08	98.6	6.2
0.14	4.7%	56.5%	0.09	0.09	98.2	4.6
0.16	4.6%	61.2%	0.11	0.11	97.7	4.5
0.18	3.5%	64.7%	0.12	0.12	97.3	3.4
0.20	4.3%	69.1%	0.14	0.14	96.8	4.2
0.25	8.0%	77.1%	0.17	0.17	95.7	7.6
0.30	5.6%	82.7%	0.20	0.20	94.5	5.3
0.35	4.4%	87.0%	0.24	0.24	93.4	4.1
0.40	2.5%	89.5%	0.27	0.27	92.2	2.3
0.45	2.5%	92.1%	0.30	0.30	91.1	2.3
0.50	1.4%	93.5%	0.34	0.34	89.9	1.2
0.75	5.0%	98.5%	0.51	0.51	84.2	4.2
1.00	1.0%	99.5%	0.68	0.68	78.5	0.8
1.50	0.0%	99.5%	1.01	1.01	67.0	0.0
2.00	0.0%	99.5%	1.35	1.35	55.6	0.0
3.00	0.5%	100.0%	2.03	1.40	37.2	0.2
						96.5

Removal Efficiency Adjustment[2] =	6.5%
Predicted % Annual Rainfall Treated =	93.4%
Predicted Net Annual Load Removal Efficiency =	**90.1%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Recharge Volume Calculations

Job: SM-939B

Calculated by: WJH
Date: 12/10/2015

Subcatchment 1

Soils: Merrimac-Urban Land Complex
Hydrologic Group: A
Required Recharge Volume
0.6 inches of runoff x impervious area

Impervious area: 0.50 acres
21,899 s.f.

Required Recharge Volume (Rv)

$$Rv = 21{,}899 \text{ s.f.} \times \frac{0.6}{12} = \mathbf{1{,}095 \text{ c.f.}}$$

Simple Dynamic Method
A=Rv / (D+KT)
Rv=A(D+kT)

D (depth of infiltration facility):	4.5	ft
K (saturated hydraulic conductivity):	8.27	inches/hour
	0.6891667	feet/hour
T (time):	2	hours
A=	1,453	s.f.
Voids=	0.40	
Volume of Chambers=	1,652	c.f.
Rv=	**3,577**	**c.f.** > **1,095 c.f.**

72 Hour Drawdown
Rv/(K x Bottom Area)= 1.09 Hours
1.09 < 72 hours O.K.

Subcatchment 2

Soils: Merrimac-Urban Land Complex

Hydrologic Group: A

Required Recharge Volume

0.6 inches of runoff x impervious area

Impervious area: 0.24 acres

10,410 s.f.

Required Recharge Volume (Rv)

$$Rv = 10{,}410 \text{ s.f.} \times \frac{0.6}{12} = \mathbf{521 \text{ c.f.}}$$

Simple Dynamic Method

A=Rv / (D+KT)

Rv=A(D+kT)

D (depth of infiltration facility):	4.5	ft
K (saturated hydraulic conductivity):	8.27	inches/hour
	0.6891667	feet/hour
T (time):	2	hours
A=	671	s.f.
Voids=	0.40	
Volume of Chambers=	734	c.f.
Rv=	**1,636**	**c.f.**

> 521 c.f.

72 Hour Drawdown

Rv/(K x Bottom Area)= 1.13 Hours

1.13 < 72 hours O.K.

Subcatchment 3

Soils: Merrimac-Urban Land Complex

Hydrologic Group: A

Required Recharge Volume

0.6 inches of runoff x impervious area

Impervious area: 0.10 acres

4,330 s.f.

Required Recharge Volume (Rv)

$$Rv = 4{,}330 \text{ s.f.} \times \frac{0.6}{12} = \mathbf{217 \text{ c.f.}}$$

Simple Dynamic Method

A=Rv / (D+KT)

Rv=A(D+kT)

D (depth of infiltration facility):	4.5	ft
K (saturated hydraulic conductivity):	8.27	inches/hour
	0.6891667	feet/hour
T (time):	2	hours
A=	306	s.f.
Voids=	0.40	
Volume of Chambers=	275	c.f.
Rv=	**711**	**c.f.**

711 c.f. > 217 c.f.

72 Hour Drawdown

Rv/(K x Bottom Area)= 1.03 Hours

1.03 < 72 hours O.K.

Pipe Sizing Calculations

DESIGN STORM: 10 YEAR
DATE: 12/10/2015
DONE BY: WJH
FILE: 939B RATIONAL METHOD

STORM SEWER DESIGN

(ADS N-12)"n"= 0.010 4"-10"
(ADS N-12)"n"= 0.012 12"-36"
(ADS N-12)"n"= 0.013 42"-60"
(Cast Iron)"n"= 0.011

PROJECT: SM-939B
LOCATION: Acton, MA

FROM	TO	LENGTH (FT)	TRIBUTARY AREA		TIME OF FLOW		RUNOFF COEFF. "C"	RAINFALL INTENSITY (IN/HR)	"Q" TOTAL RUNOFF (CFS)	SLOPE of PIPE (FT/FT)	DIAM (IN)	MANN. "n"	CAPACITY FULL (CFS)	VELOCITY FULL (FPS)	DESIGN FLOW				FALL IN PIPE (FT)	DRAIN INV. ELEVATION	
			INCR. (ACRES)	TOTAL (ACRES)	TO UPPER END (MIN)	TIME IN SECTION (MIN)									VELOCITY (FPS)	VELOCITY HEAD (FT)	DEPTH OF FLOW (FT)	TOTAL ENERGY HEAD (FT)		UPPER END	LOWER END
PCB-1	DMH-1	35	0.81	0.81	10	0.12	0.54	4.5	1.99	0.010	12	0.012	3.85	4.91	4.93	0.38	0.51	0.88	0.35	137.50	137.15
PCB-2	DMH-1	24	0.12	0.12	10	0.14	0.53	4.5	0.29	0.010	12	0.012	3.85	4.91	2.83	0.12	0.18	0.30	0.24	137.20	136.96
PCB-3	DMH-1	108	0.12	0.12	10	0.66	0.46	4.5	0.25	0.010	12	0.012	3.85	4.91	2.74	0.12	0.17	0.29	1.08	138.04	136.96
DMH-1	Vortsentry	3	0.00	1.05	10	0.01	0.53	5.5	3.09	0.033	12	0.012	7.03	8.96	8.64	1.16	0.46	1.62	0.10	136.86	136.76
PCB-4	Sub. Inf. 3	15	0.21	0.21	10	0.06	0.53	4.5	0.51	0.021	12	0.012	5.63	7.17	4.41	0.30	0.20	0.50	0.32	128.57	128.25
PCB-5	Contech	18	0.38	0.38	10	0.07	0.60	4.5	1.03	0.010	12	0.012	3.85	4.91	4.14	0.27	0.35	0.62	0.18	129.93	129.75
PCB-6	Contech	4	0.06	0.06	10	0.02	0.46	4.5	0.12	0.030	12	0.012	6.67	8.50	3.19	0.16	0.09	0.25	0.12	129.87	129.75
Contech	DMH-4	3	0.44	0.44	10	0.01	0.20	4.5	0.40	0.033	12	0.012	7.03	8.96	4.82	0.36	0.16	0.52	0.10	129.75	129.65
TD-1 & 2	CB-4	70	0.02	0.02	10	0.33	0.49	4.5	0.05	0.064	6	0.012	1.53	7.79	3.50	0.19	0.06	0.25	4.46	133.03	128.57

Closed Drainage System **SM-939B**

Project: 7, 9, 19 & 29 Great Road By WJH Date 11/24/2015

Location: Acton, MA Checked _____ Date _____

Rational Method

Q = peak flow rate, (cfs) i = rainfall intensity inches/hour

C = runoff coefficient, A = area (ac)
C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

PCB-1

Surface Cover	A (ac)	C	Product A x C
impervious	0.40	0.9	0.36
lands/grass	0.39	0.2	0.08
woods	0.02	0.15	0.00
sum =	0.81	sum =	0.44

C = **0.54** = total product / total area

PCB-2

Surface Cover	A (ac)	C	Product A x C
impervious	0.06	0.9	0.05
lands/grass	0.06	0.2	0.01
woods		0.15	0
sum =	0.12	sum =	0.06

C = **0.53** = total product / total area

PCB-3

Surface Cover	A (ac)	C	Product A x C
impervious	0.05	0.9	0.04
lands/grass	0.08	0.2	0.02
woods		0.15	0
sum =	0.12	sum =	0.06

C = **0.46** = total product / total area

DMH-1

Structure Number	A (ac)	C	Product A x C
PCB-1	0.81	0.54	0.44
PCB-2	0.12	0.53	0.06
PCB-3	0.12	0.46	0.06
sum =	1.05	sum =	0.56

C = **0.53** = total product / total area

PCB-4

Surface Cover	A (ac)	C	Product A x C
impervious	0.10	0.9	0.09
lands/grass	0.11	0.2	0.02
woods		0.15	0
sum =	0.21	sum =	0.11

C = **0.53** = total product / total area

PCB-5

Surface Cover	A (ac)	C	Product A x C
impervious	0.22	0.9	0.20
lands/grass	0.17	0.2	0.03
woods		0.15	0
sum =	0.38	sum =	0.23

C = **0.60** = total product / total area

PCB-6

Surface Cover	A (ac)	C	Product A x C
impervious	0.02	0.9	0.02
lands/grass	0.04	0.2	0.01
woods		0.15	0
sum =	0.06	sum =	0.03

C = **0.46** = total product / total area

DMH-4

Structure Number	A (ac)	C	Product A x C
PCB-5	0.38	0.23	0.09
PCB-6	0.06	0.03	0.00
sum =	0.44	sum =	0.09

C = **0.20** = total product / total area

TD-1 & 2

Structure Number	A (ac)	C	Product A x C
impervious	0.01	0.9	0.01
lands/grass	0.01	0.2	0.00
woods		0.15	0
sum =	0.02	sum =	0.01

C = **0.49** = total product / total area

Inlet Grate Capacity Calculations

Job: SM-939B

Calculated by: WJH
Date: 11/24/2015

LeBARON FOUNDRY, INC. LF248 inlet grate pass area A = 217 sq. in.
1.50694 sq. ft.

Q = (C*A* SQRT(2*g*h))*f

C = orifice coefficient
C = 0.6 square edges
A = inlet area
A = 1.51 sq. ft.
g = gravitational constant
g = 32.2 ft/sec^2
h = head on inlet
h = 0.33 ft. (low points)
0.17 ft. (on slope)
f = clogging factor
f = 0.66

Single Grate
Q (MAX)= 2.75 cfs (LP) low points LF248
Q (MAX)= 1.97 cfs (OS) on slope LF248
Double Grate
Q (MAX)= 5.50 cfs low points LF248
Q (MAX)= 3.95 cfs on slope LF248

*DATA USED IN TABLE TAKEN FROM STORM SEWER DESIGN 10YR.

	TRIBUTARY AREA (AC)	TIME OF CONC.	10 YR INTENSITY	C	Q=CiA Q10	POSITION	Q (MAX)	single grate	double grate
PCB-1	0.81	12.4	4.5	0.54	1.99	OS	3.95		yes
PCB-2	0.12	6	4.5	0.53	0.29	OS	3.95		yes
PCB-3	0.12	6	4.5	0.46	0.25	OS	2.75	yes	
PCB-4	0.21	6	4.5	0.53	0.51	OS	2.75	yes	
PCB-5	0.38	6	4.5	0.60	1.03	OS	1.97	yes	
PCB-6	0.06	6	4.5	0.46	0.12	OS	1.97	yes	

Soil Evaluation

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Owner Name: 29 Great Road

Map G5 Parcels 78 & 80

Street Address: Acton

MA

Map/Lot #: 01720

City

State

Zip Code

B. Site Information

1. (Check one) ☐ New Construction ☑ Upgrade ☐ Repair

2. Published Soil Survey Available? ☑ Yes ☐ No
   If yes: nesoil.com (Year Published) 1:25,000 (Publication Scale) 626B (Soil Map Unit)
   Soil Name: Merrimac-Urban land complex
   Soil Limitations: Filtering Capacity

3. Surficial Geological Report Available? ☑ Yes ☐ No
   If yes: MassGIS (Year Published) 1:25,000 (Publication Scale) (Map Unit)
   Geologic Material: Sand and Gravel
   Landform

4. Flood Rate Insurance Map
   Above the 500-year flood boundary? ☑ Yes ☐ No
   Within the 100-year flood boundary? ☐ Yes ☑ No
   Within the 500-year flood boundary? ☐ Yes ☑ No
   Within a velocity zone? ☐ Yes ☑ No

5. Wetland Area:
   National Wetland Inventory Map — Map Unit: DEP Wetlands - clear — Name:
   Wetlands Conservancy Program Map — Map Unit: — Name:

6. Current Water Resource Conditions (USGS): 11/2013 (Month/Year)
   Range: ☐ Above Normal ☑ Normal ☐ Below Normal

7. Other references reviewed:

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11/18/13 (Date) 8:20 (Time) RAIN (Weather)

1. Deep Observation Hole Logs

   Deep Hole Number TP-13-1 Ground Elevation at Surface of Hole _____

   Location (Identify on Plan) _____

2. Land Use: PARKING LOT (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5% (Slope (%))

   LANDSCAPE ISLAND (Vegetation) _____ (Landform) ON-SLOPE (Position on landscape (attach sheet))

3. Distances from: Open Water Body ____ feet Drainage Way ____ feet Possible Wet Area — feet

   Property Line >10' feet Drinking Water Well — feet Other _____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

   If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

   If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

   Estimated Depth to High Groundwater: >10'6" (Inches) _____ (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
29 GREAT ROAD
Site Address or Map/Lot Number
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole A: Deep Hole Number: TP-13-1

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-3"	A	10YR 3/2	—	—	—	LOAMY SAND	—	—	MASSIVE	FRIABLE	
3"-10"	B	10YR 4/3	—	—	—	LOAMY SAND	2%	—	MASSIVE	FRIABLE	
10"-126"	C	2.5Y 6/4	—	—	—	SAND	5%	1%	SG	LOOSE	

Additional Notes _____

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Site Address or Map/Lot Number

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11/13/13 (Date) 9:10 (Time) RAIN (Weather)

1. Deep Observation Hole Logs

Deep Hole Number _____ Ground Elevation at Surface of Hole _____

Location (Identify on Plan) _____

2. Land Use: PARKING LOT (e.g. woodland, agricultural field, vacant lot, etc.) — (Surface Stones) 0-5% (Slope (%))

PAVEMENT (Vegetation) _____ (Landform) DOWN-SLOPE (Position on landscape (attach sheet))

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Possible Wet Area — feet

Property Line >10' feet Drinking Water Well — feet Other _____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

If Yes: Depth Weeping from Pit _____ Depth Standing Water in Hole _____

Estimated Depth to High Groundwater: >126" (Inches) _____ (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

29 GREAT ROAD
Site Address or Map/Lot Number

Deep Observation Hole A: Deep Hole Number: TP-13-2

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6"	FILL										
6"-126	C	2.5Y 6/4	—	—	—	SAND	5%	—	SG	LOOSE	

Additional Notes _____

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Site Address or Map/Lot Number

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11/13/17 (Date) 9:15 (Time) RAIN (Weather)

1. Deep Observation Hole Logs

Deep Hole Number _____ Ground Elevation at Surface of Hole _____

Location (Identify on Plan) _____

2. Land Use: PARKING LOT (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5% (Slope (%))

PAVEMENT (Vegetation) _____ (Landform) ON-SLOPE (Position on landscape (attach sheet))

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Possible Wet Area — feet

Property Line 75' feet Drinking Water Well — feet Other _____

4. Parent Material: OUT WASH Unsuitable Materials Present: Yes ☐ No ☐

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

If Yes: Depth Weeping from Pit _____ Depth Standing Water in Hole _____

Estimated Depth to High Groundwater: 120" (Inches) _____ (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

29 GREAT ROAD (Site Address or Map/Lot Number)

Deep Observation Hole A: Deep Hole Number: TP-13-3

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6"	FILL										
6"-120"	C	2.5Y 6/4	—	—	—	SAND	5%	—	SG	LOOSE	

Additional Notes _____

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Site Address or Map/Lot Number

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11/18/13 (Date) 8:40 (Time) CLOUDY (Weather)

1. Deep Observation Hole Logs

Deep Hole Number _____ Ground Elevation at Surface of Hole _____

Location (Identify on Plan) _____

2. Land Use: PARKING LOT (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5% (Slope (%))

PAVEMENT (Vegetation) _____ (Landform) ON-SLOPE (Position on landscape (attach sheet))

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Possible Wet Area — feet

Property Line 710' feet Drinking Water Well — feet Other _____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

Estimated Depth to High Groundwater: 126" (Inches) _____ (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

29 GRAFTON ROAD
Site Address or Map/Lot Number

Deep Observation Hole A: Deep Hole Number: TP-13-4

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6"	FILL										
6"-126"	C	2.5Y 6/4	—	—	—	SAND	5%		SG	LOOSE	

Additional Notes _____

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Site Address or Map/Lot Number

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11/18/13 (Date) 9:30 (Time) RAIN (Weather)

1. Deep Observation Hole Logs

Deep Hole Number _____ Ground Elevation at Surface of Hole _____

Location (Identify on Plan) _____

2. Land Use: PARKING LOT (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 5-10% (Slope (%))

GRASS/SHRUBS (Vegetation) _____ (Landform) ON-SLOPE (Position on landscape (attach sheet))

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Possible Wet Area _____ feet

Property Line 710' feet Drinking Water Well — feet Other _____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

Estimated Depth to High Groundwater: 120" (Inches) _____ (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

27 GREAT ROAD
Site Address or Map/Lot Number

Deep Observation Hole A: Deep Hole Number: TP-13-5

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-3"	A	10YR 3/2	—	—	—	LOAMY SAND	—	—	MASSIVE	FRIABLE	
3-10"	B	10YR 4/3	—	—	—	LOAMY SAND	2%	—	MASSIVE	FRIABLE	
10"-120"	C	2.5Y 6/4	—	—	—	SAND	5%	—	SG	LOOSE	

Additional Notes _____

Commonwealth of Massachusetts
City/Town of
Percolation Test
Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

Owner Name

Street Address or Lot # 29 GREAT ROAD

City/Town ACTON State MA Zip Code 01720

Contact Person (if different from Owner) Telephone Number

B. Test Results

	Date / Time	Date / Time
	11/18/13 9:30	
Observation Hole #	PT-13-A	PT-13-B
Depth of Perc	60"	48"
Start Pre-Soak	9:30	9:35
End Pre-Soak	0:13	0:15
Time at 12"		
Time at 9"		
Time at 6"		
Time (9"-6")		
Rate (Min./Inch)	12 MPI	12 MPI
	Test Passed: ☒ Test Failed: ☐	Test Passed: ☒ Test Failed: ☐

Test Performed By: STAMSKI AND McNARY, INC. (BENJAMIN EWING)

Witnessed By: ACTON BOARD OF HEALTH (SHERYL BALL)

Comments:

Commonwealth of Massachusetts
City/Town of
Percolation Test
Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

Owner Name

29 GREAT ROAD

Street Address or Lot #

ACTON | MA | 01720

City/Town | State | Zip Code

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	Date 11/18/13	Time 9:30	Date	Time
Observation Hole #	PT-13-C		PT-13-D	
Depth of Perc	44"		50"	
Start Pre-Soak	9:40		7:45	
End Pre-Soak	UTS		UTS	
Time at 12"				
Time at 9"				
Time at 6"				
Time (9"-6")				
Rate (Min./Inch)	<2 MIN		<2 MIN	

Test Passed: ☒ Test Failed: ☐ | Test Passed: ☒ Test Failed: ☐

STAMSKI AND McNARY, INC. (BENJAMIN EWING)

Test Performed By:

ACTON BOARD OF HEALTH (SHERYL BALL)

Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of
Percolation Test
Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

Owner Name

29 GREAT ROAD
Street Address or Lot #

ACTON — MA — 01720
City/Town — State — Zip Code

Contact Person (if different from Owner) — Telephone Number

B. Test Results

	Date / Time	Date / Time
	11/18/13 9:30	
Observation Hole #	PT-13-E	
Depth of Perc	52"	
Start Pre-Soak	9:50	
End Pre-Soak	UTS	
Time at 12"		
Time at 9"		
Time at 6"		
Time (9"-6")		
Rate (Min./Inch)	42 MI	
	Test Passed: ☒ Test Failed: ☐	Test Passed: ☐ Test Failed: ☐

Test Performed By: STAMSKI AND McNARY, INC. (BENJAMIN EWING)

Witnessed By: ACTON BOARD OF HEALTH (SHERYL BALL)

Comments:

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

☐ Depth observed standing water in observation hole	A. _____ inches	B. _____ inches
☐ Depth weeping from side of observation hole	A. _____ inches	B. _____ inches
☒ Depth to soil redoximorphic features (mottles)	A. SEE ATTACHED inches	B. SOIL LOGS inches
☐ Groundwater adjustment (USGS methodology)	A. _____ inches	B. _____ inches

2. _____ Index Well Number _____ Reading Date _____ Index Well Level

_____ Adjustment Factor _____ Adjusted Groundwater Level

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed? Upper boundary: SEE ATTACHED inches Lower boundary: SOIL LOGS inches

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

[signature] Signature of Soil Evaluator	11/18/13 Date
BENJAMIN FENING SE2985 Typed or Printed Name of Soil Evaluator / License #	10/24/05 Date of Soil Evaluator Exam
SHERYL BALL Name of Board of Health Witness	ACTON Board of Health

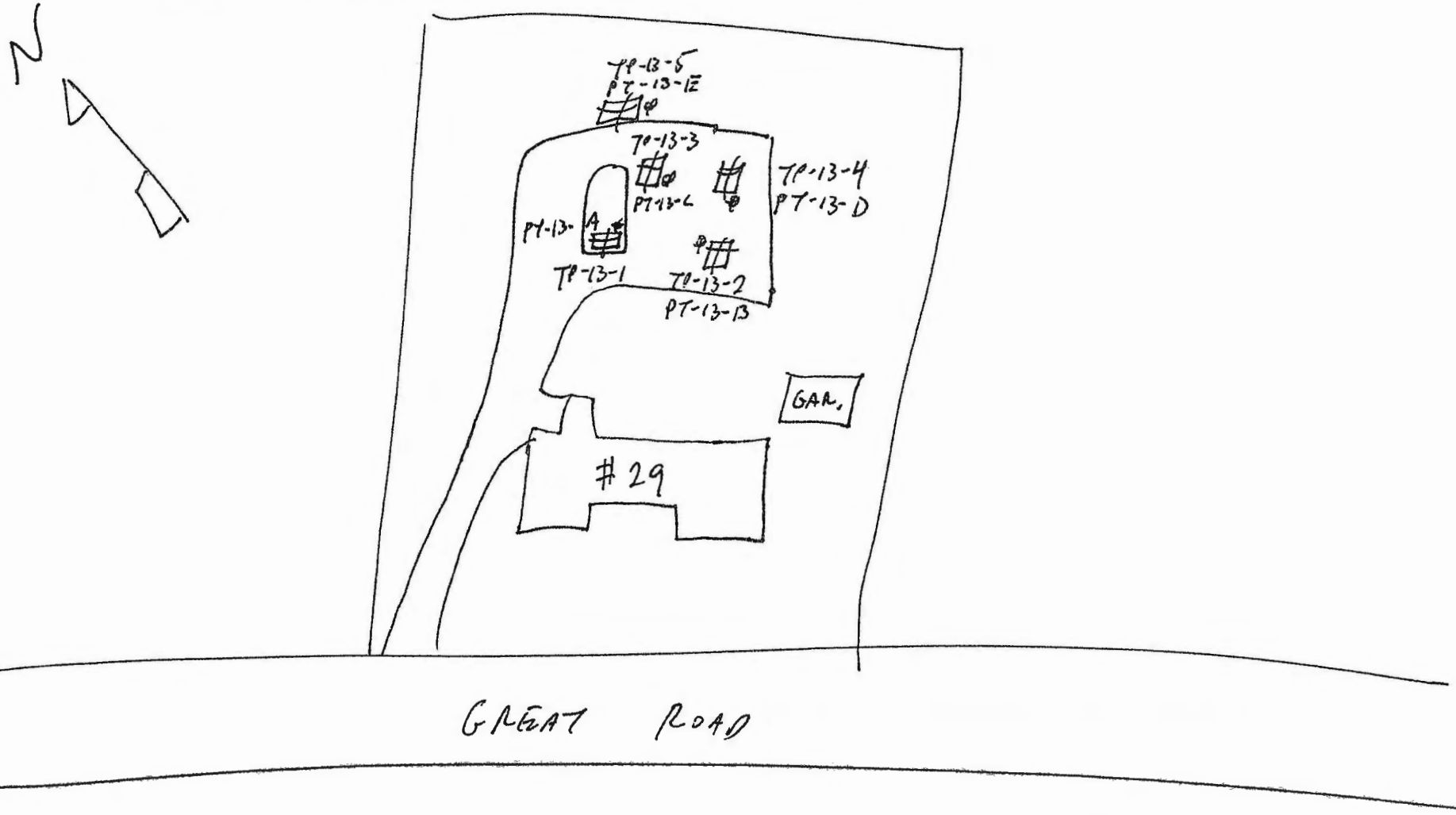
Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Commonwealth of Massachusetts
City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Field Diagrams

Use this sheet for field diagrams:



Commonwealth of Massachusetts
City/Town of ACTON

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Owner Name: KHALEDE

Street Address: 7-9 GREAT RD

Map/Lot #:

City: ACTON

State: MA

Zip Code: 01720

B. Site Information

1. (Check one) [X] New Construction [ ] Upgrade [ ] Repair

2. Published Soil Survey Available? [X] Yes [ ] No If yes: Year Published: NESOIL; Publication Scale: 1:25000; Soil Map Unit: 255C / 626B

   Soil Name: WINDSOR LOAMY SAND / MERRIMAC WATER LAND COMPLEX

   Soil Limitations:

3. Surficial Geological Report Available? [X] Yes [ ] No If yes: Year Published: MASS GIS; Publication Scale: 1:25000; Map Unit:

   Geologic Material: SAND + GRAVEL

   Landform:

4. Flood Rate Insurance Map

   Above the 500-year flood boundary? [X] Yes [ ] No

   Within the 100-year flood boundary? [ ] Yes [X] No

   Within the 500-year flood boundary? [ ] Yes [X] No

   Within a velocity zone? [ ] Yes [X] No

5. Wetland Area: National Wetland Inventory Map — Map Unit: — Name: —

   Wetlands Conservancy Program Map — Map Unit: — Name: —

6. Current Water Resource Conditions (USGS): 11/14 (Month/Year) Range: [ ] Above Normal [X] Normal [ ] Below Normal

7. Other references reviewed:

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

7-9 GREAT RD
Site Address or Map/Lot Number

C. On-Site Review

(minimum of two holes required at every proposed disposal area)

Deep Observation Hole A: 11-18-14 (Date) ____ (Time) CLEAR (Weather)

1. Deep Observation Hole Logs

   Deep Hole Number TP-14-1 Ground Elevation at Surface of Hole —

   Location (Identify on Plan) ____

2. Land Use: YARD (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5 (Slope (%))

   GRASS (Vegetation) ____ (Landform) ____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body — (feet) Drainage Way — (feet) Possible Wet Area — (feet)

   Property Line >10 (feet) Drinking Water Well >100 (feet) Other ____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

   If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

   If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

   Estimated Depth to High Groundwater: >132 (inches) — (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

7-9 GREAT RD
Site Address or Map/Lot Number

Deep Observation Hole A: Deep Hole Number: TP-14-1

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-66	FILL	—	—	—	—	—	—	—	—	—	
66-132	C	10YR5/3	—	—	—	SAND	—	—	SG	LOOSE	

Additional Notes WATER LINE ENCOUNTERED IN EAST EDGE OF PIT

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11-18-14 (Date) ____ (Time) CLEAR (Weather)

1. Deep Observation Hole Logs

   Deep Hole Number TP-14-2 Ground Elevation at Surface of Hole —

   Location (Identify on Plan) ____

2. Land Use: YARD (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5 (Slope (%))

   GRASS (Vegetation) ____ (Landform) ____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body — feet Drainage Way — feet Possible Wet Area — feet

   Property Line >10 feet Drinking Water Well >100 feet Other ____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

   If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

   If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

   Estimated Depth to High Groundwater: >132 inches — elevation

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole A: Deep Hole Number: TP-14-2

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-11	A	10YR3/2	—	—	—	LS	—	—	M	F	
11-30	B	10YR4/6	—	—	—	LS	—	—	M	F	
30-132	C	10YR5/3	—	—	—	SAND	—	—	SG	LOOSE	

Additional Notes ____

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11-18-14 (Date) ____ (Time) CLEAR (Weather)

1. Deep Observation Hole Logs

   Deep Hole Number TP-14-3 . Ground Elevation at Surface of Hole —

   Location (Identify on Plan) ____

2. Land Use: YARD (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5 (Slope (%))

   GRASS (Vegetation) ____ (Landform) ____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body — (feet) Drainage Way — (feet) Possible Wet Area — (feet)

   Property Line >10 (feet) . Drinking Water Well >100 (feet) Other ____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

   If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

   If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

   Estimated Depth to High Groundwater: >120 (inches) — (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole A: Deep Hole Number: TP-14-3

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8	A	10YR 3/2				LS	—	—	M	F	
8-24	B	10YR 4/6				LS	—	—	M	F	
24-120	C	10YR 5/3				SAND	—	—	SG	LOOSE	

Additional Notes ____

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

7-9 GAIT RD
Site Address or Map/Lot Number

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11/18/14 (Date) ____ (Time) CLEAR (Weather)

1. Deep Observation Hole Logs

   Deep Hole Number TPH-4 . Ground Elevation at Surface of Hole —

   Location (Identify on Plan) ____

2. Land Use: YARD (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5 (Slope (%))

   GRASS (Vegetation) ____ (Landform) ____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body — (feet) Drainage Way — (feet) Possible Wet Area — (feet)

   Property Line >10 (feet). Drinking Water Well >100 (feet) Other ____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

   If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

   If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

   Estimated Depth to High Groundwater: >132 (inches) — (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

7-9 GAIT RD
Site Address or Map/Lot Number

Deep Observation Hole A: Deep Hole Number: TP-H-4

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	A	10YR 3/2	—	—	—	LS	—	—	M	F	
12-30	B	10YR 4/6	—	—	—	LS	—	—	M	F	
30-132	C	10YR 5/3	—	—	—	SAND	—	—	SG	LOOSE	

Additional Notes ____

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11/18/14 (Date) ____ (Time) CLEAR (Weather)

1. Deep Observation Hole Logs

   Deep Hole Number TP-14-5 Ground Elevation at Surface of Hole —

   Location (Identify on Plan) ____

2. Land Use: YARD (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5 (Slope (%))

   GRASS (Vegetation) ____ (Landform) ____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body — (feet) Drainage Way — (feet) Possible Wet Area — (feet)

   Property Line >10 (feet) Drinking Water Well >100 (feet) Other ____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

   If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

   If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

   Estimated Depth to High Groundwater: >144 (inches) — (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole A: Deep Hole Number: TP-14-5

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-24	A	10YR 3/3	—	—	—	LS	—	—	M	F	
0-30	B	10YR 4/6	—	—	—	LS	—	—	M	F	
30-144	C	10YR 5/3	—	—	—	SAND	—	—	SG	LOOSE	

Additional Notes ____

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

7-9 GREAT RD
Site Address or Map/Lot Number

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11-18-14 (Date) _____ (Time) CLEAR (Weather)

1. Deep Observation Hole Logs

Deep Hole Number TP-14-6 Ground Elevation at Surface of Hole _____

Location (Identify on Plan) _____

2. Land Use: YARD (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5 (Slope (%))

GRASS (Vegetation) _____ (Landform) _____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body — (feet) Drainage Way — (feet) Possible Wet Area — (feet)

Property Line >10 (feet) Drinking Water Well >100 (feet) Other _____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

Estimated Depth to High Groundwater: >144 (inches) — (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

7-9 GREAT RD
Site Address or Map/Lot Number

Deep Observation Hole A: Deep Hole Number: TP-14-6

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	A	10YR 3/2	—	—	—	LS	—	—	M	F	
12-24	B	10YR 4/6	—	—	—	LS	—	—	M	F	
24-144	C	10YR 5/3	—	—		SAND	—	—	SG	LOOSE	

Additional Notes _____

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11-18-14 (Date) ____ (Time) CLEAR (Weather)

1. Deep Observation Hole Logs

   Deep Hole Number TP-14-7 Ground Elevation at Surface of Hole –

   Location (Identify on Plan) –

2. Land Use: YARD (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5 (Slope (%))

   GRASS (Vegetation) ____ (Landform) ____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body – (feet) Drainage Way – (feet) Possible Wet Area – (feet)

   Property Line >10 (feet) Drinking Water Well >100 (feet) Other ____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

   If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

   If Yes: Depth Weeping from Pit – Depth Standing Water in Hole –

   Estimated Depth to High Groundwater: >132 (inches) ____ (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole A: Deep Hole Number: TP-14-7

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	A	10YR 2/2	–	–	–	LS	–	–	M	F	
12-24	B	10YR 4/6	–	–	–	LS	–	–	M	F	
24-132	C	10YR 5/3	–	–	–	SAND	–	–	SG	LOOSE	

Additional Notes ____

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11-18-14 (Date) _____ (Time) CLEAR (Weather)

1. Deep Observation Hole Logs

Deep Hole Number TP-14-8 Ground Elevation at Surface of Hole _____

Location (Identify on Plan) _____

2. Land Use: YARD (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5 (Slope (%))

GRASS (Vegetation) _____ (Landform) _____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body — (feet) Drainage Way — (feet) Possible Wet Area — (feet)

Property Line >10 (feet) Drinking Water Well >100 (feet) Other _____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

Estimated Depth to High Groundwater: >132 (inches) _____ (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole A: Deep Hole Number: TP-14-8

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	A	10YR3/2	—	—	—	LS	—	—	M	F	
12-24	B	10YR4/6	—	—	—	LS	—	—	M	F	
24-132	C	10YR5/3	—	—	—	SAND		—	SG	LOOSE	

Additional Notes _____

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed disposal area)*

Deep Observation Hole A: 11-18-14 (Date) _____ (Time) CLEAR (Weather)

1. Deep Observation Hole Logs

   Deep Hole Number TP-149 Ground Elevation at Surface of Hole _____

   Location (Identify on Plan) _____

2. Land Use: YARD (e.g. woodland, agricultural field, vacant lot, etc.) NONE (Surface Stones) 0-5 (Slope (%))

   GRASS (Vegetation) _____ (Landform) _____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body — (feet) Drainage Way — (feet) Possible Wet Area — (feet)

   Property Line >110 (feet) Drinking Water Well >100 (feet) Other _____

4. Parent Material: OUTWASH Unsuitable Materials Present: Yes ☐ No ☒

   If Yes: Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☐

5. Groundwater Observed: Yes ☐ No ☒

   If Yes: Depth Weeping from Pit — Depth Standing Water in Hole —

   Estimated Depth to High Groundwater: >120 (inches) _____ (elevation)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection – Wastewater Permitting Program

7-9 GREAT RD
Site Address or Map/Lot Number

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole A: Deep Hole Number: TP-149

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	A	10YR 3/2	—	—	—	LS	—	—	M	F	
12-30	B	10YR 4/6	—	—	—	LS	—	—	M	F	
30-120	C	10YR 5/3	—	—	—	SAND	—	—	SG	LOOSE	

Additional Notes _____

Commonwealth of Massachusetts
City/Town of ALTON

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

JACK NORTON
Owner Name

7-9 GREAT RD
Street Address or Lot #

ALTON — MA — 01720
City/Town — State — Zip Code

Contact Person (if different from Owner) — Telephone Number

B. Test Results

	11-18-14 (Date)	9:15 (Time)	11-18-14 (Date)	9:30 (Time)
Observation Hole #	PT-14-A		PT-14-B	
Depth of Perc	54"		51"	
Start Pre-Soak	24 GALLONS		24 GALLONS	
End Pre-Soak	UNABLE TO		UTS	
Time at 12"	SATURATE			
Time at 9"				
Time at 6"				
Time (9"-6")				
Rate (Min./Inch)	<2MPI		<2MPI	
	Test Passed: ☒ Test Failed: ☐		Test Passed: ☒ Test Failed: ☐	

STAMSKI AND McNARY, INC - BILL HALL
Test Performed By:

ALTON BOARD OF HEALTH - SHERYL BALL
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of ACTON

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

JACK NORTON
Owner Name

7-9 GREAT RD
Street Address or Lot #

ACTON — City/Town
MA — State
01720 — Zip Code

Contact Person (if different from Owner)
Telephone Number

B. Test Results

	11-18-14	9:40	11-18-14	9:50
	Date	Time	Date	Time
Observation Hole #	PT-14-C		PT-14-D	
Depth of Perc	86"		55"	
Start Pre-Soak	24 GAL		24 GAL	
End Pre-Soak	UTS		UTS	
Time at 12"				
Time at 9"				
Time at 6"				
Time (9"-6")				
Rate (Min./Inch)	<2 MPI		<2 MPI	
	Test Passed: ☒		Test Passed: ☒	
	Test Failed: ☐		Test Failed: ☐	

STAMSKE AND MENARY, INC - BILL HALL
Test Performed By:

ACTON BOARD OF HEALTH - SHERYL BALL
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of ACTON

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

JACK NORTON
Owner Name

7-9 GREAT RD
Street Address or Lot #

ACTON — City/Town
MA — State
01720 — Zip Code

Contact Person (if different from Owner)
Telephone Number

B. Test Results

	11-18-14 / 10:05 (Date / Time)	11-18-14 / 10:25 (Date / Time)
Observation Hole #	PT-14-E	PT-14-F
Depth of Perc	58"	62"
Start Pre-Soak	24 GAL	24 GAL
End Pre-Soak	UTS	UTS
Time at 12"		
Time at 9"		
Time at 6"		
Time (9"-6")		
Rate (Min./Inch)	< 2 MPI	< 2 MPI
	Test Passed: [X] Test Failed: [ ]	Test Passed: [X] Test Failed: [ ]

STAMSKE AND MCNAMY, INC - BILL HALL
Test Performed By:

ACTON BOARD OF HEALTH - SHERYL BALL
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of ACTON

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

JACK NORTON
Owner Name

7-9 GREAT RD
Street Address or Lot #

ACTON — City/Town
MA — State
01720 — Zip Code

Contact Person (if different from Owner)
Telephone Number

B. Test Results

	11-18-14 (Date)	10:35 (Time)	11-18-14 (Date)	10:45 (Time)
Observation Hole #	PT-14-6		PT-14-4	
Depth of Perc	50"		52"	
Start Pre-Soak	24 GAL		24 GAL	
End Pre-Soak	UTS		UTS	
Time at 12"				
Time at 9"				
Time at 6"				
Time (9"-6")				
Rate (Min./Inch)	< 2 MPI		< 2 MPI	
	Test Passed: [X]		Test Passed: [X]	
	Test Failed: [ ]		Test Failed: [ ]	

STAMSKE AND MCNANY, INC - BILL HALL
Test Performed By:

ACTON BOARD OF HEALTH - SHERYL BALL
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of ACTON

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

JACK NORTON
Owner Name

7-9 GREAT RD
Street Address or Lot #

ACTON | MA | 01720
City/Town | State | Zip Code

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	Date: 11-18-14	Time: 11:00	Date:	Time:
Observation Hole #	PT-M-I			
Depth of Perc	60"			
Start Pre-Soak	24 GAL			
End Pre-Soak	VTS			
Time at 12"				
Time at 9"				
Time at 6"				
Time (9"-6")				
Rate (Min./Inch)	< 2 MPI			
	Test Passed: ☒ Test Failed: ☐		Test Passed: ☐ Test Failed: ☐	

STANSKE AND MANAY, INC - BILL HALL
Test Performed By:

ACTON BOARD OF HEALTH - SHERYL BALL
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of ACTON

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

☐ Depth observed standing water in observation hole	A. SEE inches	B. SEE inches
☐ Depth weeping from side of observation hole	A. SOIL inches	B. SOIL inches
☐ Depth to soil redoximorphic features (mottles)	A. LOGS inches	B. LOGS inches
☐ Groundwater adjustment (USGS methodology)	A. inches	B. inches

2. Index Well Number _____ Reading Date _____ Index Well Level _____

Adjustment Factor _____ Adjusted Groundwater Level _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☐ No

b. If yes, at what depth was it observed? Upper boundary: SEE SOIL LOGS inches Lower boundary: SEE SOIL LOGS inches

F. Certification

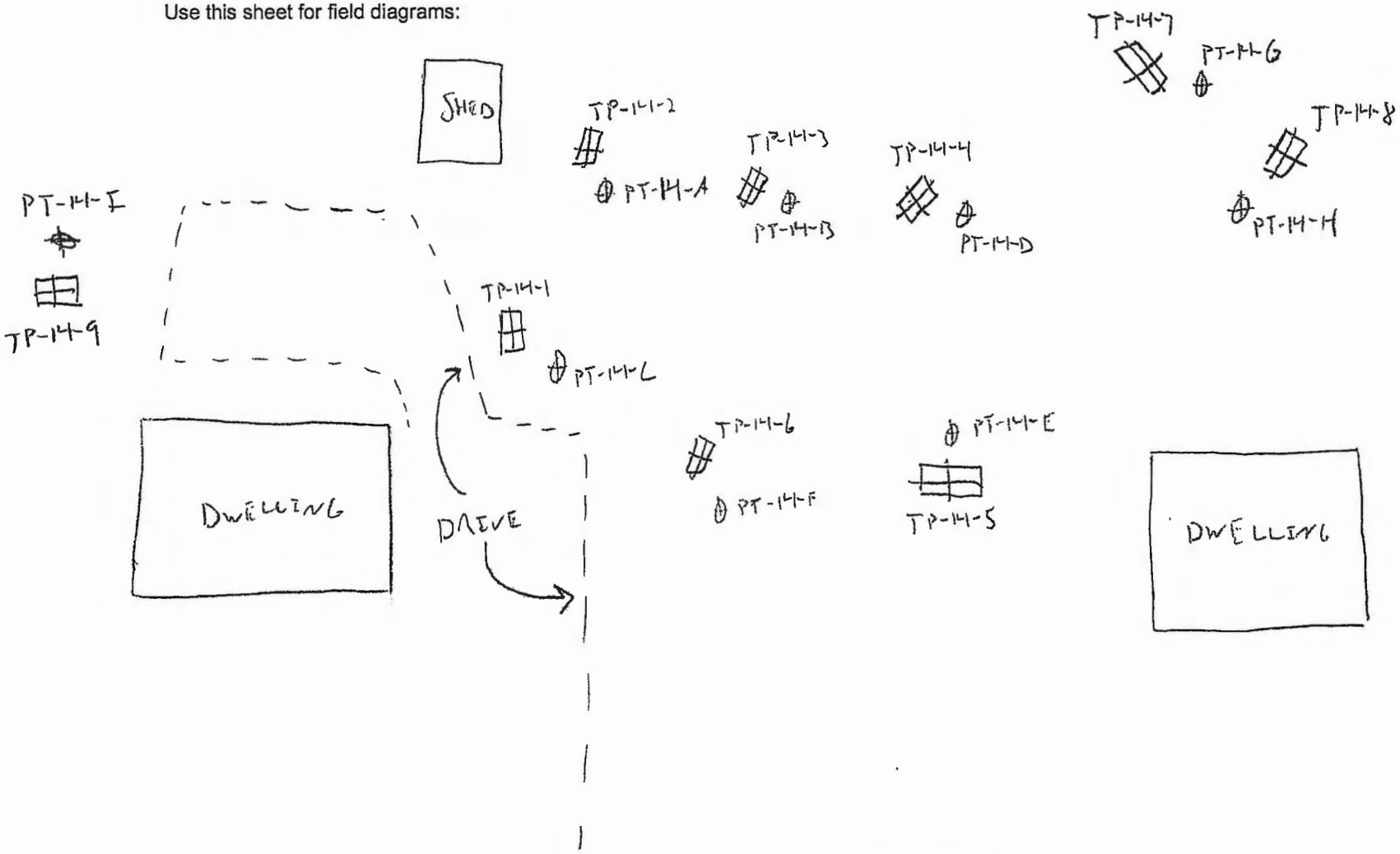
I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator	Date 11/18/14
Typed or Printed Name of Soil Evaluator / License # BELL HALL SE 13592	Date of Soil Evaluator Exam 7/2012
Name of Board of Health Witness SHERYL BALL	Board of Health ACTON

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Commonwealth of Massachusetts
City/Town of ACTON

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Field Diagrams

Use this sheet for field diagrams: