Design Basis

1. The rational method (Q=CIA) was used as a basis for sizing pipes. Runoff Coefficients: C=0.15 for woods, 0.20 for grass/landscaped areas, 0.76 for gravel, and 0.90 for impervious surfaces.
2. The 100-year storm was used for sizing pipes. Rainfall intensity values were taken from the U.S. Weather Bureau Technical Paper 40.
3. The United States Department of Agriculture Natural Resource Conservation Service (N.R.C.S.) TR55 methodology was used to determine offsite rates of runoff.
4. 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.
5. The hydrologic calculations were performed using the computer program: "Hydraflow Hydrographs 2007" by Intelisolve.
6. The soil types of the site were taken from the N.R.C.S. Soil Survey Map from nesoil.com.
7. Soil conditions and estimated seasonal high groundwater table were based on on-site soil evaluations.
8. The Hantoush Method was used for Mounding analysis.

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	0.001	2	1326	15	----	------	------	E1
2	SCS Runoff	0.000	2	n/a	0	----	------	------	E2
3	SCS Runoff	0.000	2	n/a	0	----	------	------	E3
4	SCS Runoff	0.000	2	n/a	0	----	------	------	E4
5	Reservoir	0.000	2	n/a	0	4	156.00	0.000	To Depression
6	Diversion1	0.000	2	n/a	0	5	------	------	Exfiltration
7	Diversion2	0.000	2	n/a	0	5	------	------	Overflow

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	0.018	2	746	255	----	------	------	E1
2	SCS Runoff	0.000	2	n/a	0	----	------	------	E2
3	SCS Runoff	0.002	2	1328	33	----	------	------	E3
4	SCS Runoff	0.012	2	892	322	----	------	------	E4
5	Reservoir	0.011	2	936	319	4	156.01	29.6	To Depression
6	Diversion1	0.011	2	936	319	5	------	------	Exfiltration
7	Diversion2	0.000	2	842	0	5	------	------	Overflow

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	0.162	2	730	944	----	------	------	E1
2	SCS Runoff	0.003	2	902	74	----	------	------	E2
3	SCS Runoff	0.035	2	754	793	----	------	------	E3
4	SCS Runoff	0.206	2	740	1,750	----	------	------	E4
5	Reservoir	0.088	2	774	1,747	4	156.05	236	To Depression
6	Diversion1	0.088	2	774	1,747	5	------	------	Exfiltration
7	Diversion2	0.000	2	902	0	5	------	------	Overflow

Worksheet 2: Runoff curve number and runoff **SM-4860**

Project: 267 Great Rd By JTM Date 6/27/14

Location: Acton, MA Checked _____ Date _____

Circle one: [Present] Developed E1

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
A	Woods	30			0.13	3.87
A	Open	39			0.14	5.34
	Impervious	98			0.03	2.45
A	Gravel	76			0.02	1.82
Totals =					0.32	13.49

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{13.49}{0.32} = 42.82$; Use CN = 42.8

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	0.01	0.22	0.81
Runoff, Q.....	cf	15	252	931

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-4860

Project: 267 Great Rd By JTM Date 6/27/2014

Location: Acton, MA Checked _____ Date _____

Circle one: Present / Developed
Circle one: Tc / Tt through subarea E1 _____

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)			0.4	0.24		
3. Flow length, L (total L <= 300 ft)		ft	9	41		
4. Two-yr 24-hr rainfall, P2		in	3.1	3.1		
5. Land Slope, s		ft/ft	0.027	0.04		
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.05	0.09		0.14
Shallow concentrated Flow		Segment ID	C-D			
7. Surface Description (paved or unpaved)			unpaved			
8. Flow Length, L		ft	25			
9. Watercourse slope, s		ft/ft	0.06			
10. Average Velocity, V (figure 3-1)		ft/s	3.95			
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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.14
min 8.3

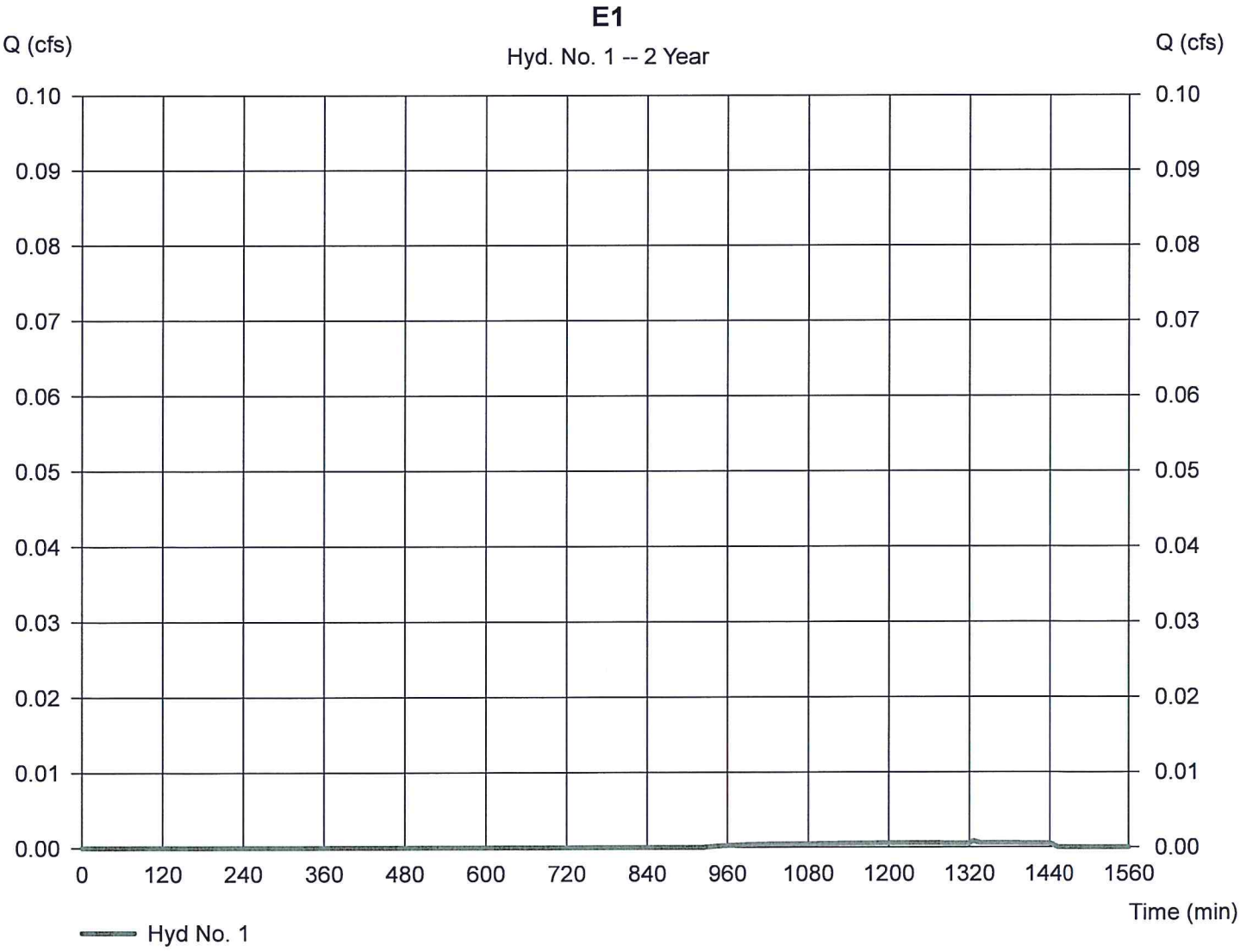
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 1

E1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.001 cfs
Storm frequency	= 2 yrs	Time to peak	= 1326 min
Time interval	= 2 min	Hyd. volume	= 15 cuft
Drainage area	= 0.320 ac	Curve number	= 42.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 8.30 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



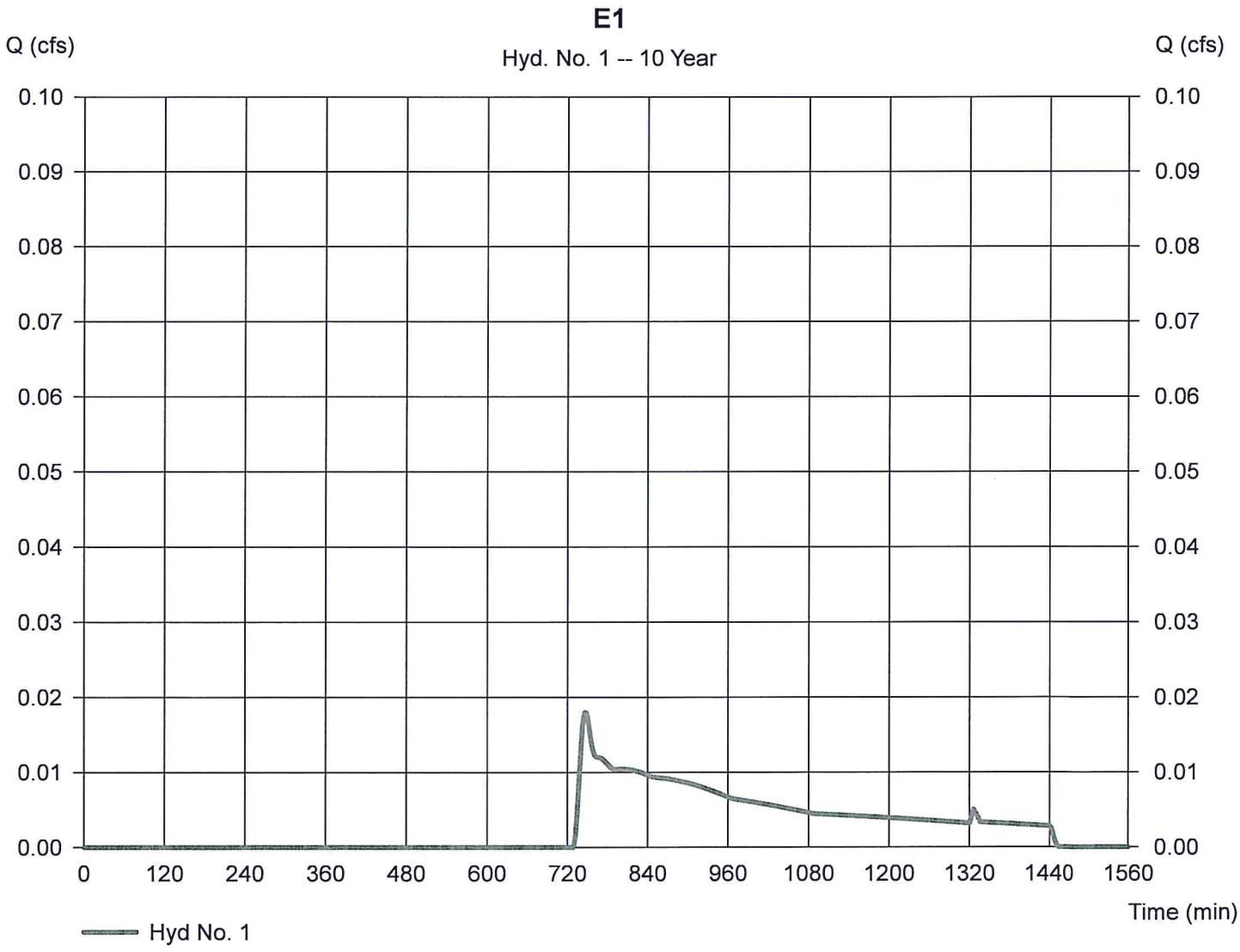
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 1

E1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.018 cfs
Storm frequency	= 10 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 255 cuft
Drainage area	= 0.320 ac	Curve number	= 42.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 8.30 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



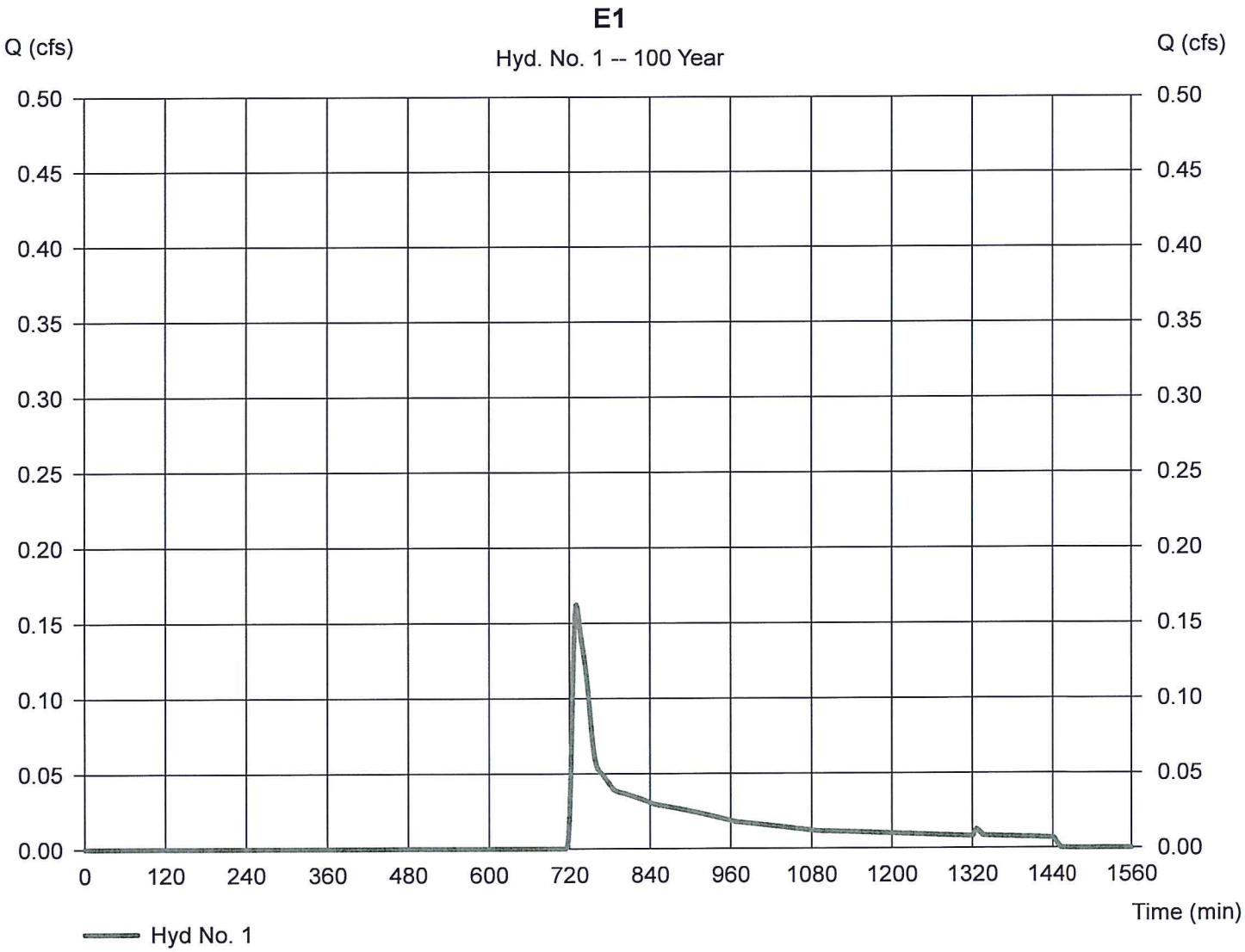
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 1

E1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.162 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 944 cuft
Drainage area	= 0.320 ac	Curve number	= 42.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 8.30 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-4860**

Project: 267 Great Rd By JTM Date 6/27/14

Location: Acton, MA Checked _____ Date _____

Circle one: [Present] Developed E2

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
A	Woods	30			0.17	5.01
	Totals =				0.17	5.01

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{5.01}{0.17} = 30.00$; Use CN = 30.0

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	0.11	0.00	0.12
Runoff, Q.....	cf	68	1	73

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-4860

Project: 267 Great Rd By JTM Date 6/27/2014

Location: Acton, MA Checked _____ Date _____

Circle one: Present / Developed
Circle one: Tc / Tt through subarea E2

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)			0.4			
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	0.055			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.14			0.14
Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			unpaved			
8. Flow Length, L		ft	33			
9. Watercourse slope, s		ft/ft	0.068			
10. Average Velocity, V (figure 3-1)		ft/s	4.21			
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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.14
min 8.5

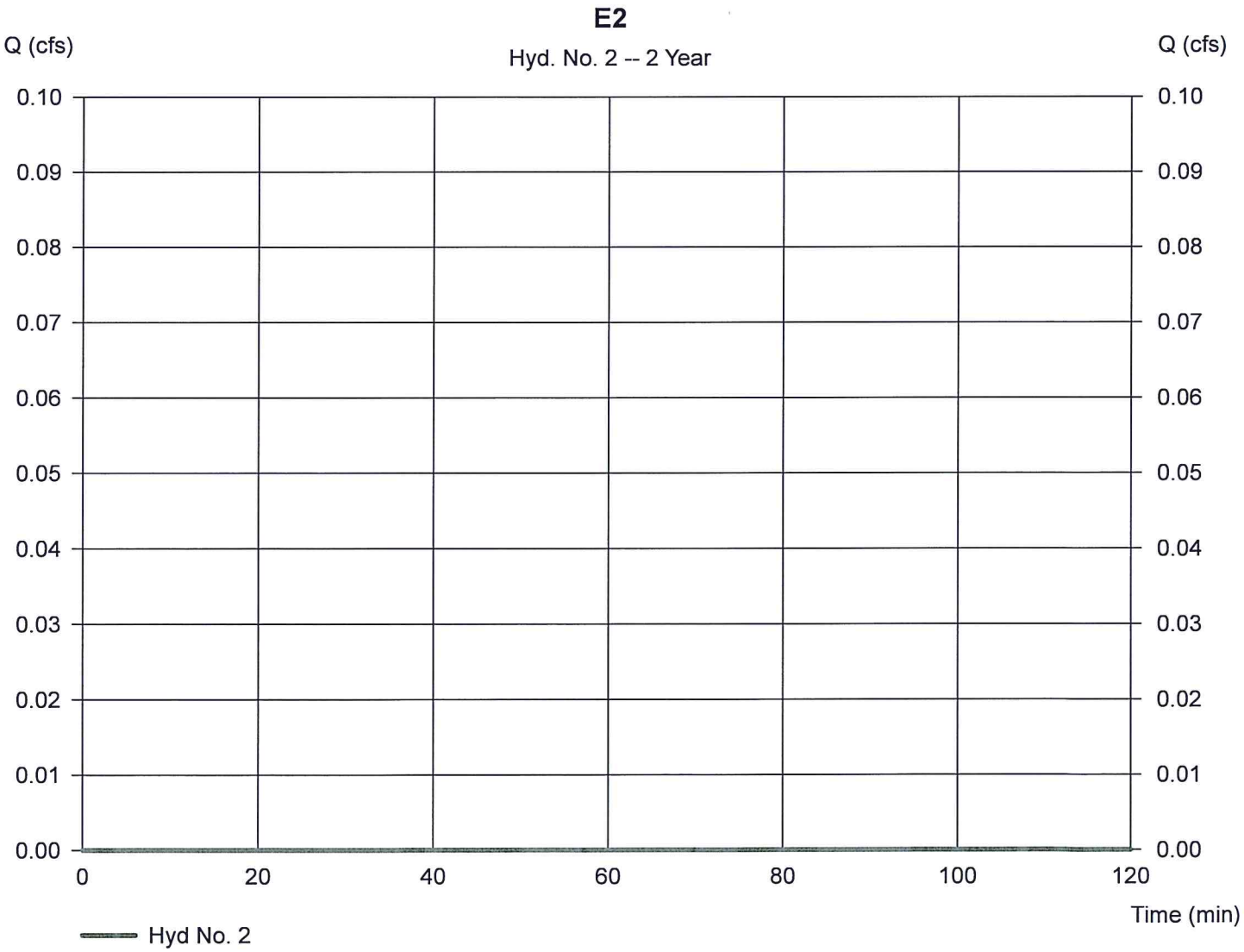
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 2

E2

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	= 0.170 ac	Curve number	= 30
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 8.50 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



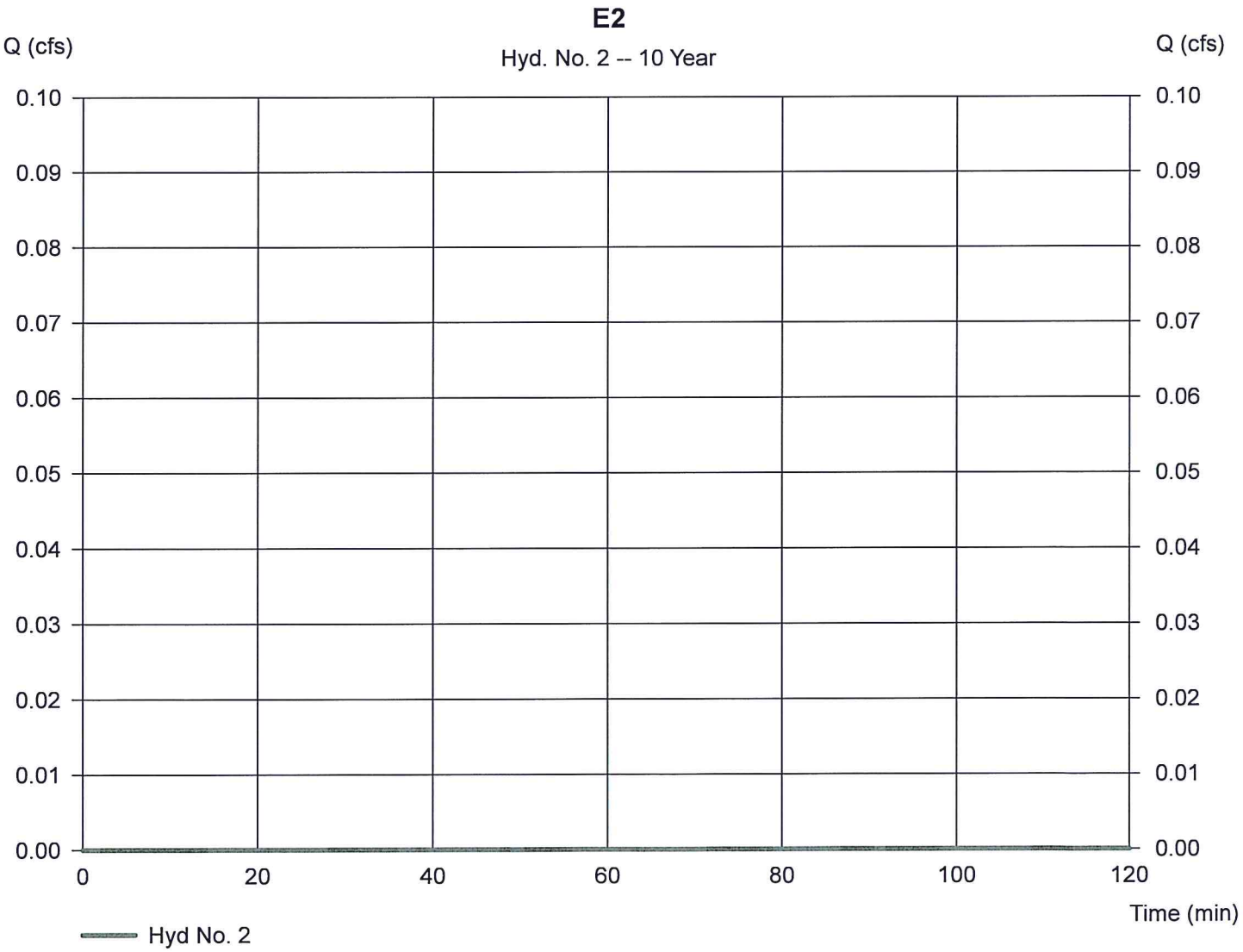
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 2

E2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Drainage area	= 0.170 ac	Curve number	= 30
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 8.50 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



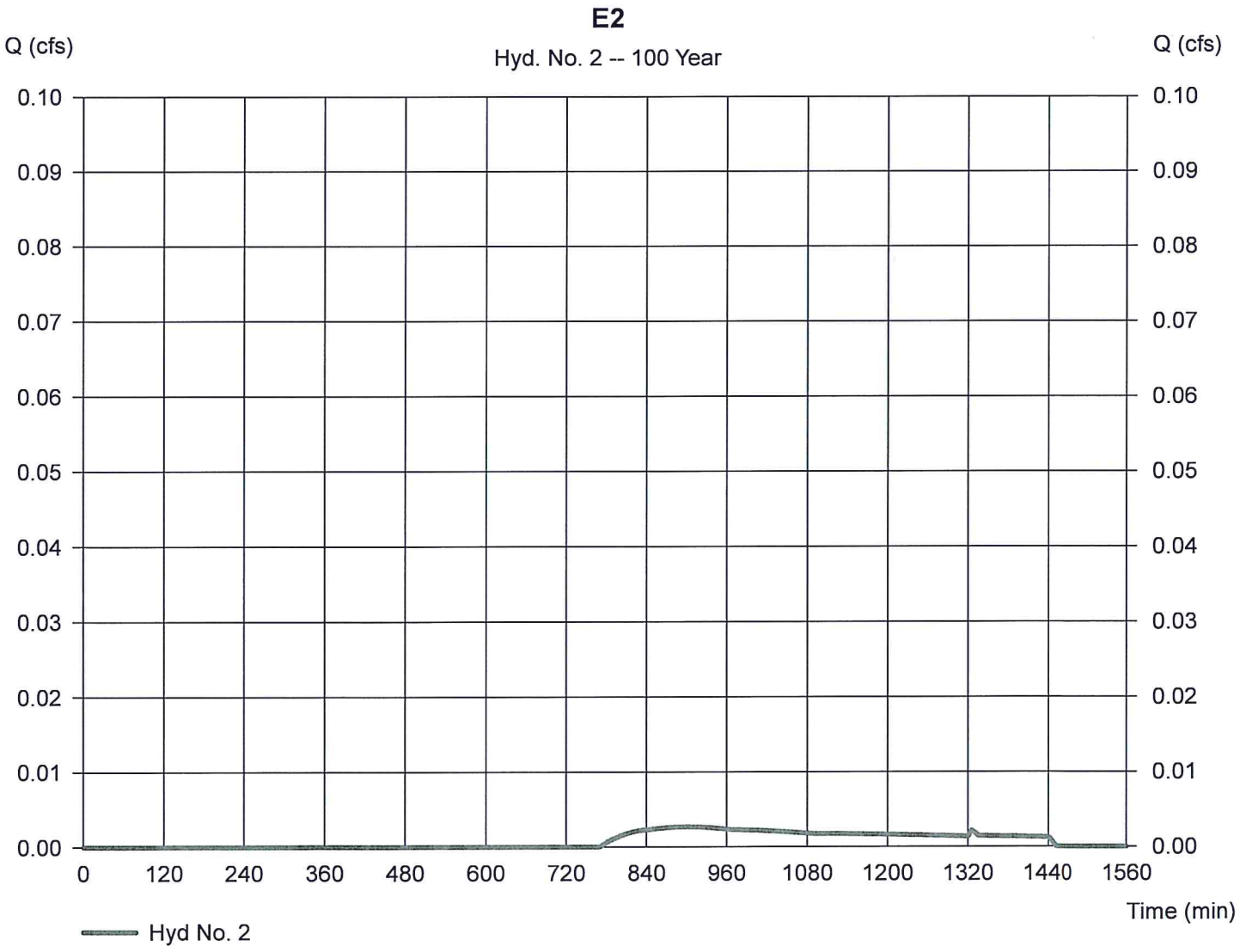
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 2

E2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.003 cfs
Storm frequency	= 100 yrs	Time to peak	= 902 min
Time interval	= 2 min	Hyd. volume	= 74 cuft
Drainage area	= 0.170 ac	Curve number	= 30
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 8.50 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-4860**

Project: 267 Great Rd By JTM Date 6/2/14

Location: Acton, MA Checked _____ Date _____

Circle one: [Present] Developed E3

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
A	Woods	30			0.77	23.13
A	Open	39			0.05	2.03
	Impervious	98			0.02	1.96
A	Gravel	76			0.02	1.37
Totals =					0.86	28.49

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{28.49}{0.86} = 33.08$; Use CN = 33.1

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	0.05	0.01	0.25
Runoff, Q.....	cf	145	31	768

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-4860

Project: 267 Great Rd By JTM Date 6/2/2014

Location: Acton, MA Checked _____ Date _____

Circle one: Present Developed E3
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)			0.4			
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	0.03			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.18			0.18
Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			unpaved			
8. Flow Length, L		ft	81			
9. Watercourse slope, s		ft/ft	0.027			
10. Average Velocity, V (figure 3-1)		ft/s	2.65			
11. Tt = L / 3600V	Compute Tt	hr	0.01			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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.19
min 11.2

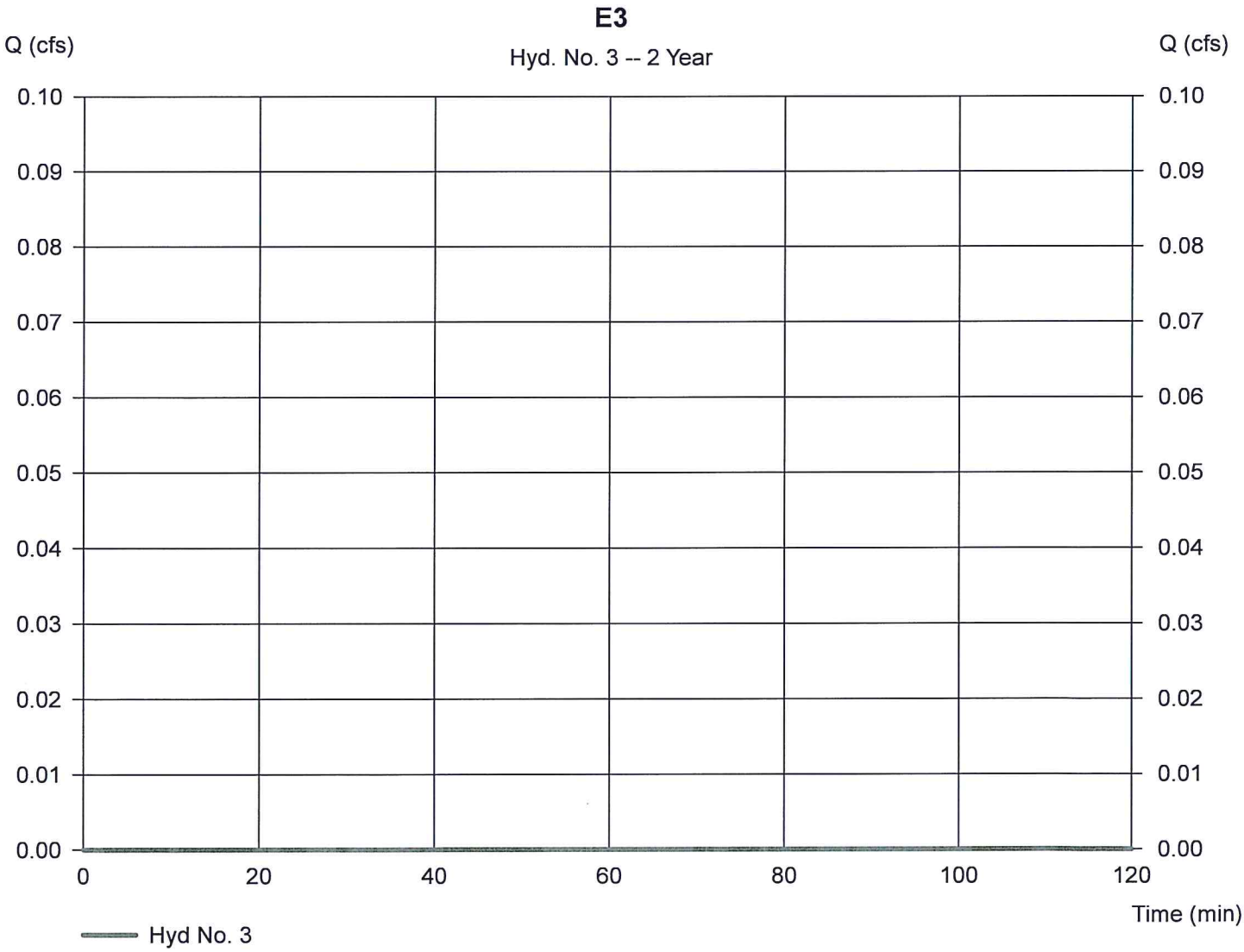
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 3

E3

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	= 0.860 ac	Curve number	= 33.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 11.20 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



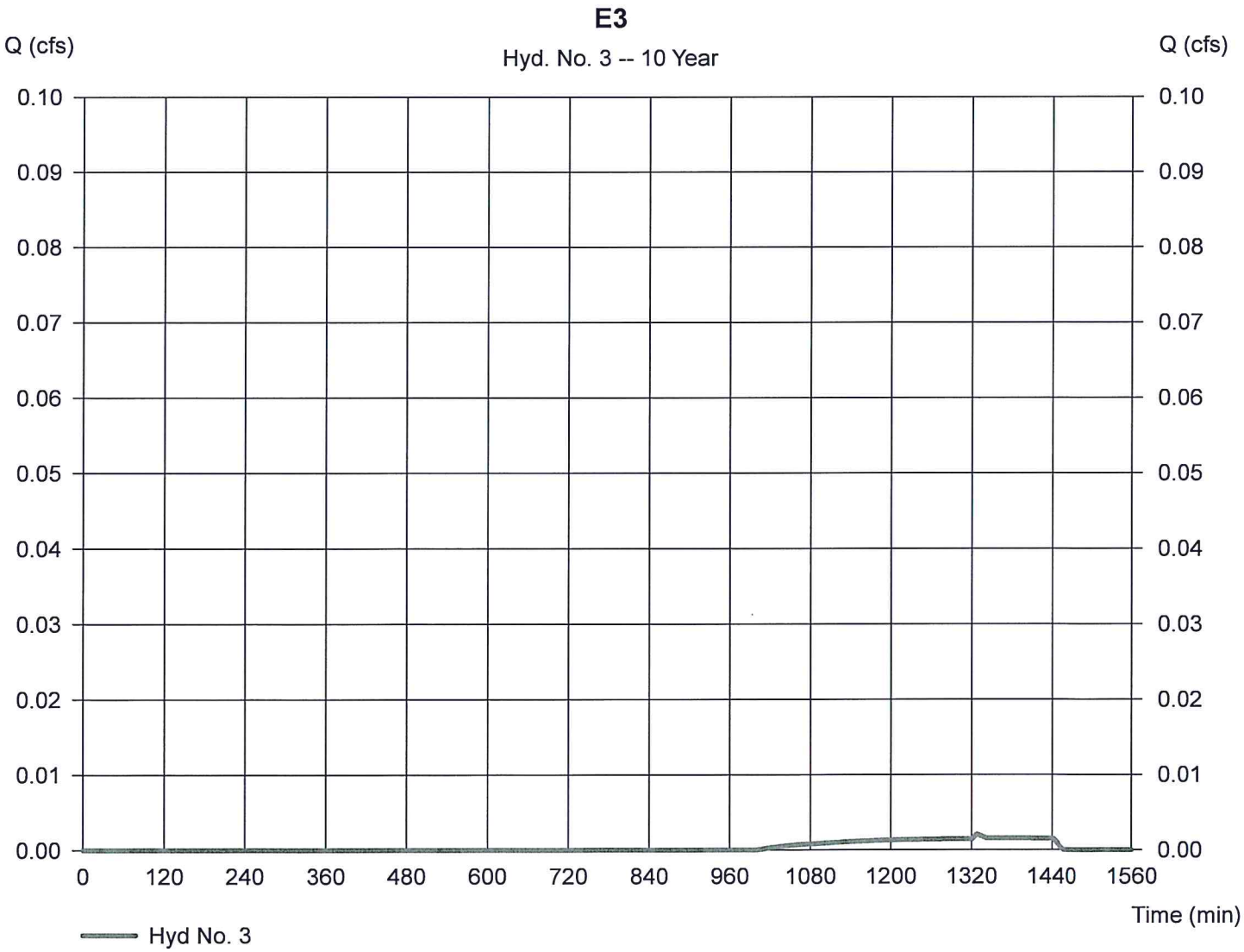
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 3

E3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.002 cfs
Storm frequency	= 10 yrs	Time to peak	= 1328 min
Time interval	= 2 min	Hyd. volume	= 33 cuft
Drainage area	= 0.860 ac	Curve number	= 33.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 11.20 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



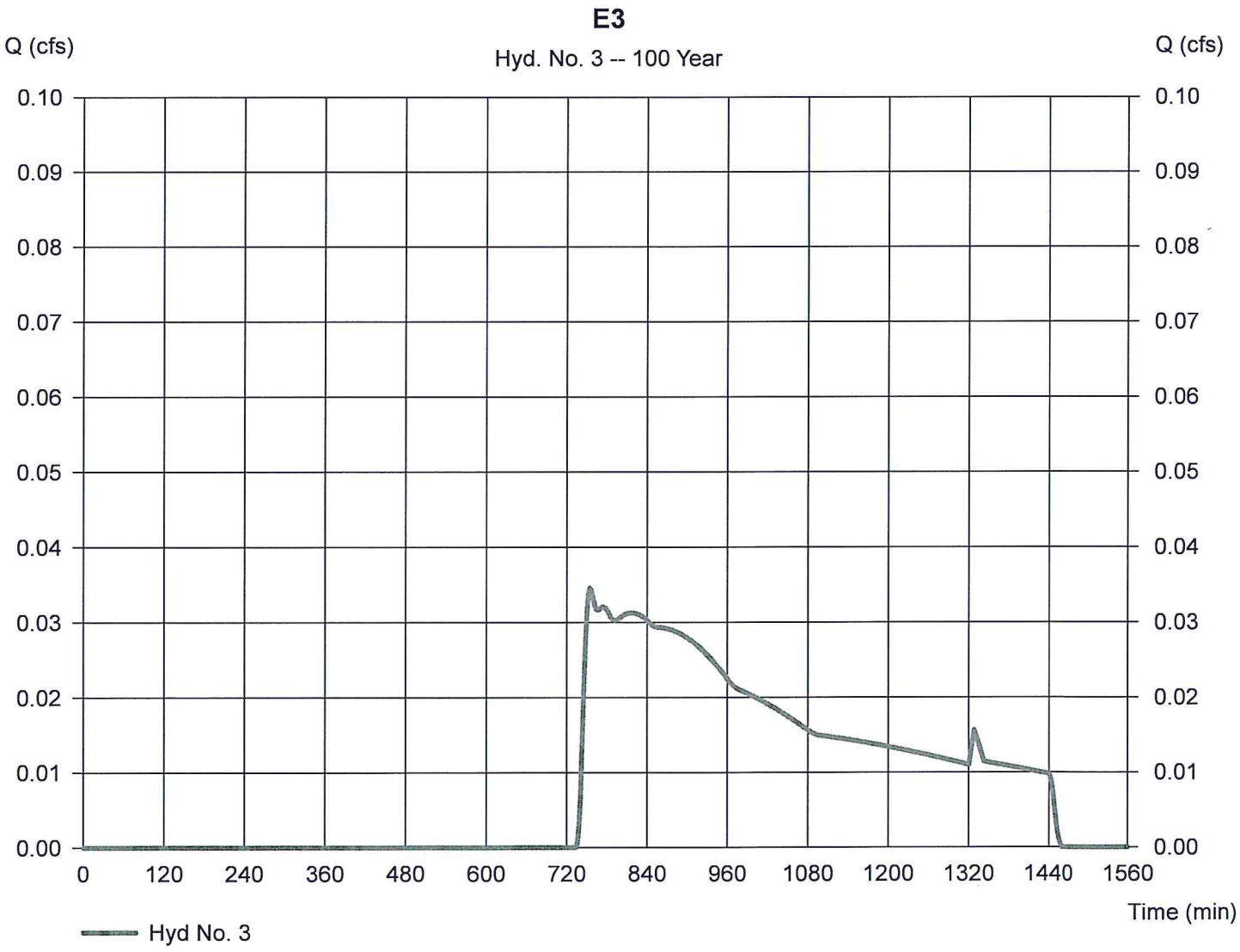
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 3

E3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.035 cfs
Storm frequency	= 100 yrs	Time to peak	= 754 min
Time interval	= 2 min	Hyd. volume	= 793 cuft
Drainage area	= 0.860 ac	Curve number	= 33.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 11.20 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-4860**

Project: 267 Great Rd By JTM Date 6/2/14

Location: Acton, MA Checked _____ Date _____

Circle one: [Present] Developed E4

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
A	Woods	30			0.53	15.96
A	Open	39			0.26	10.10
	Impervious	98			0.02	1.96
A	Gravel	76			0.09	6.46
1/ Use only one CN source per line.				Totals =	0.90	34.48

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{34.48}{0.90} = 38.48$; Use CN = 38.5

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	0.00	0.10	0.53
Runoff, Q.....	cf	2	319	1739

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-4860

Project: 267 Great Rd By JTM Date 6/2/2014

Location: Acton, MA Checked _____ Date _____

Circle one: Present / Developed
Circle one: Tc / Tt through subarea E4 _____

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)			0.4			
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	0.11			0.11
Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			unpaved			
8. Flow Length, L		ft	107			
9. Watercourse slope, s		ft/ft	0.037			
10. Average Velocity, V (figure 3-1)		ft/s	3.10			
11. Tt = L / 3600V	Compute Tt	hr	0.01			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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)	hr	0.12
	min	7.4

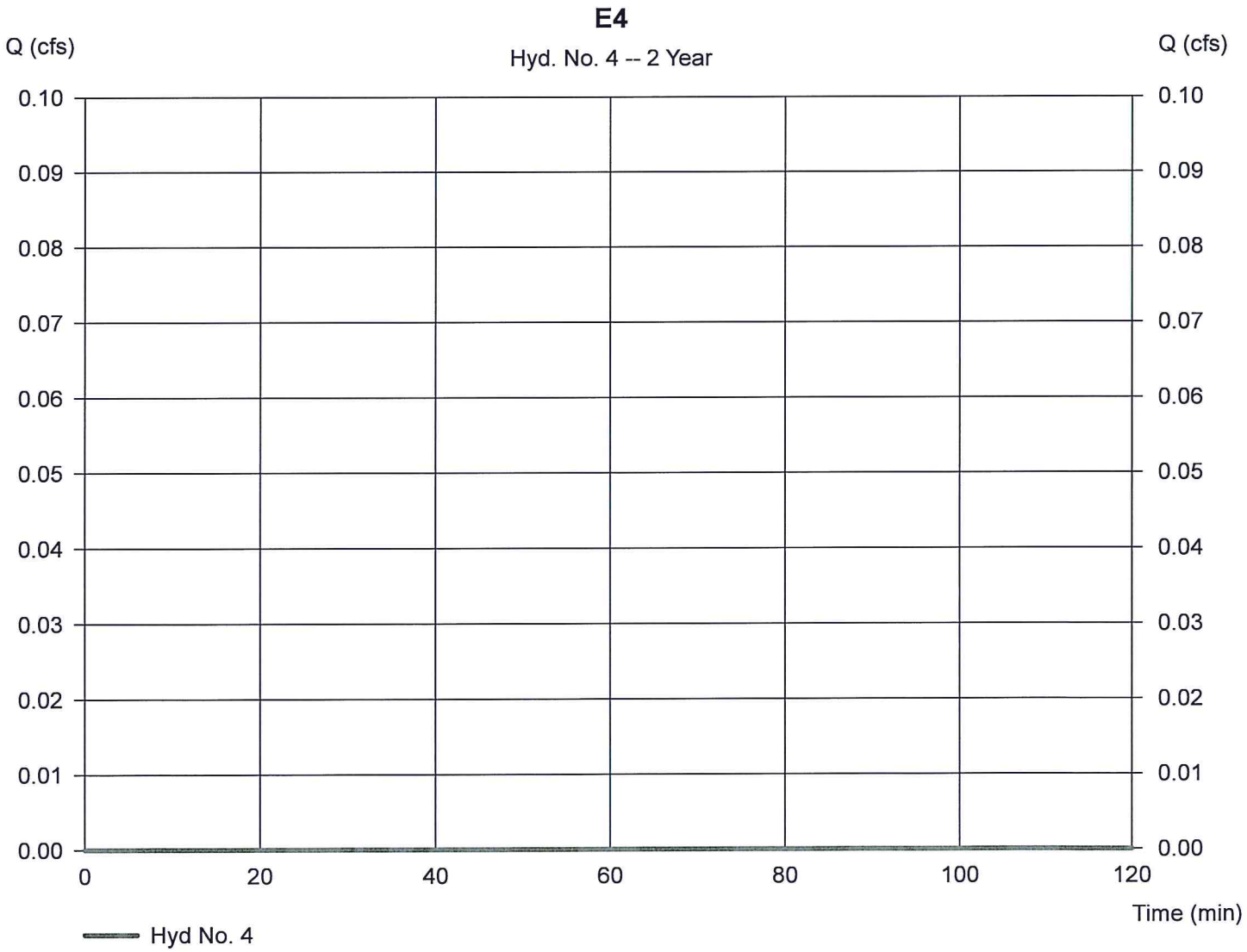
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 4

E4

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	= 0.900 ac	Curve number	= 38.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.40 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



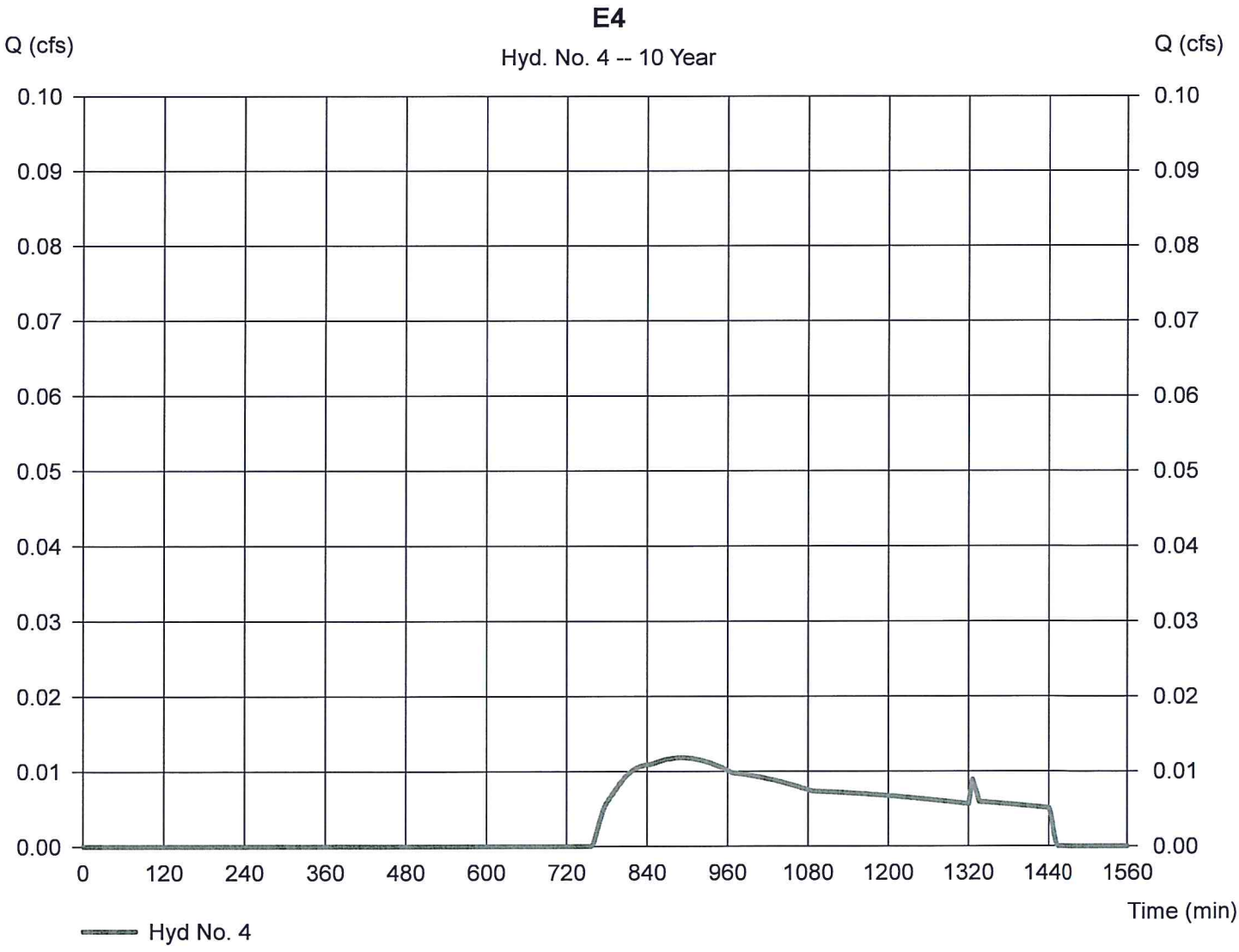
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 4

E4

Hydrograph type	= SCS Runoff	Peak discharge	= 0.012 cfs
Storm frequency	= 10 yrs	Time to peak	= 892 min
Time interval	= 2 min	Hyd. volume	= 322 cuft
Drainage area	= 0.900 ac	Curve number	= 38.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.40 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



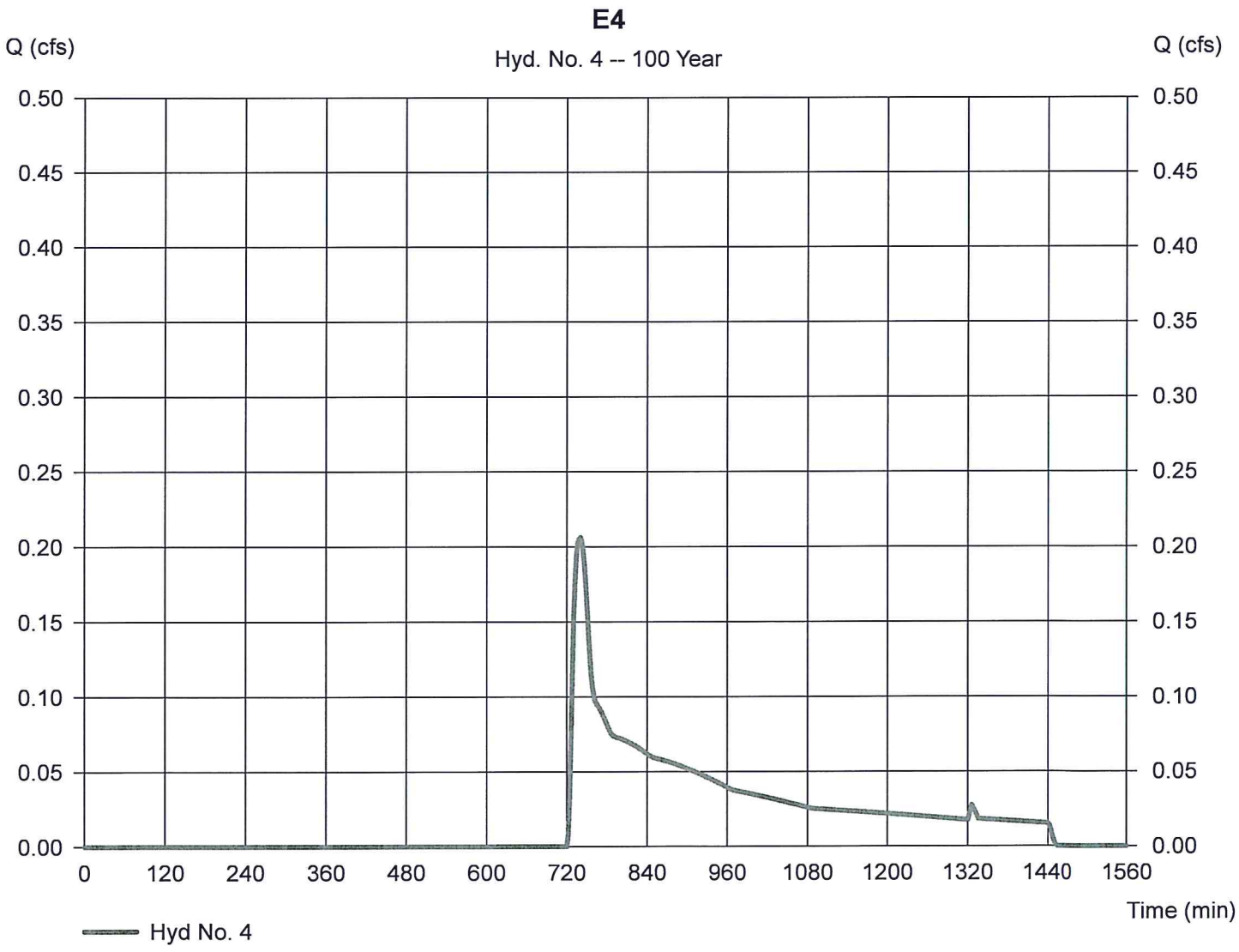
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 4

E4

Hydrograph type	= SCS Runoff	Peak discharge	= 0.206 cfs
Storm frequency	= 100 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 1,750 cuft
Drainage area	= 0.900 ac	Curve number	= 38.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.40 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

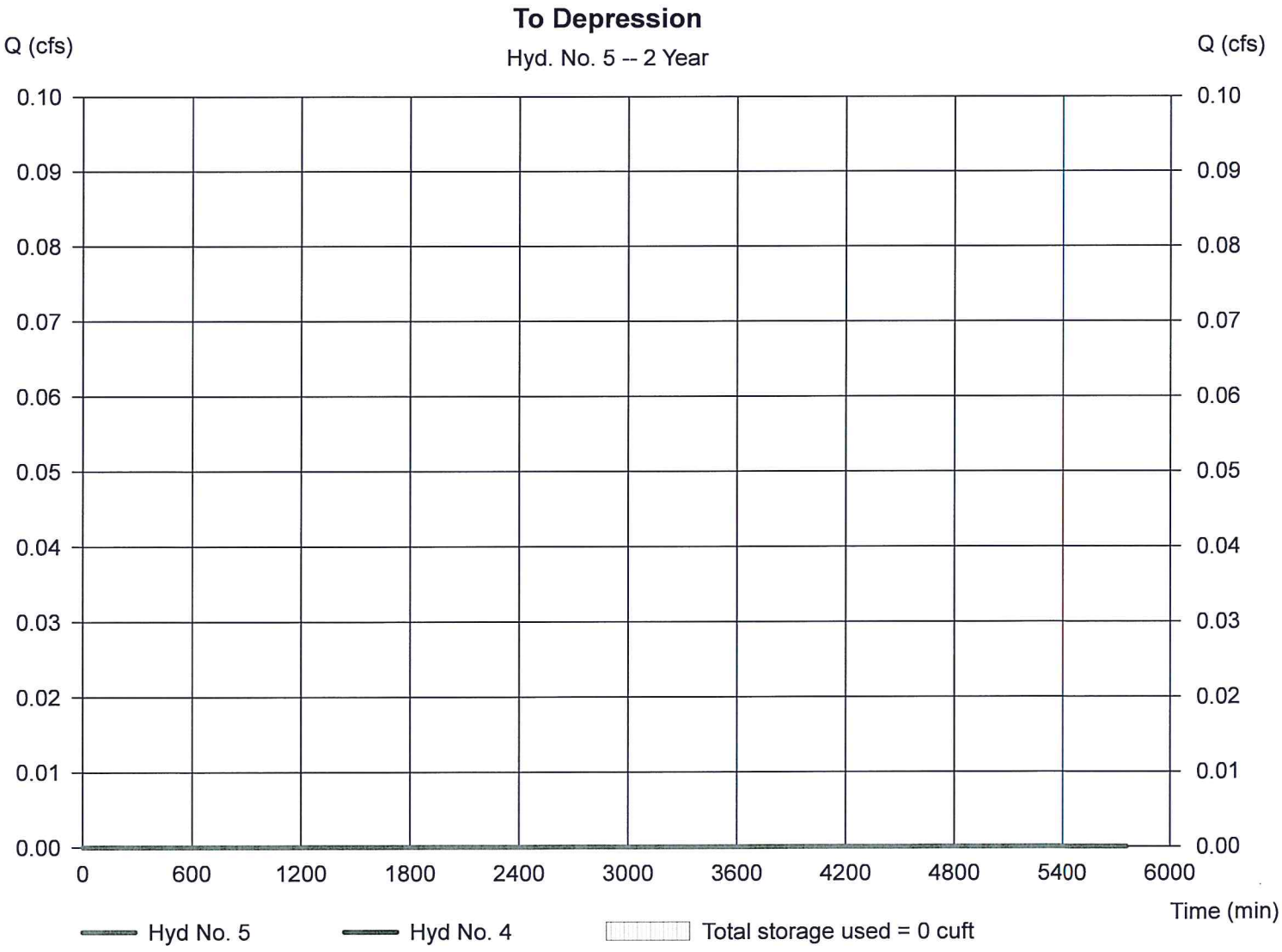
Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 5

To Depression

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 4 - E4	Max. Elevation	= 156.00 ft
Reservoir name	= On-site Depression	Max. Storage	= 0 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

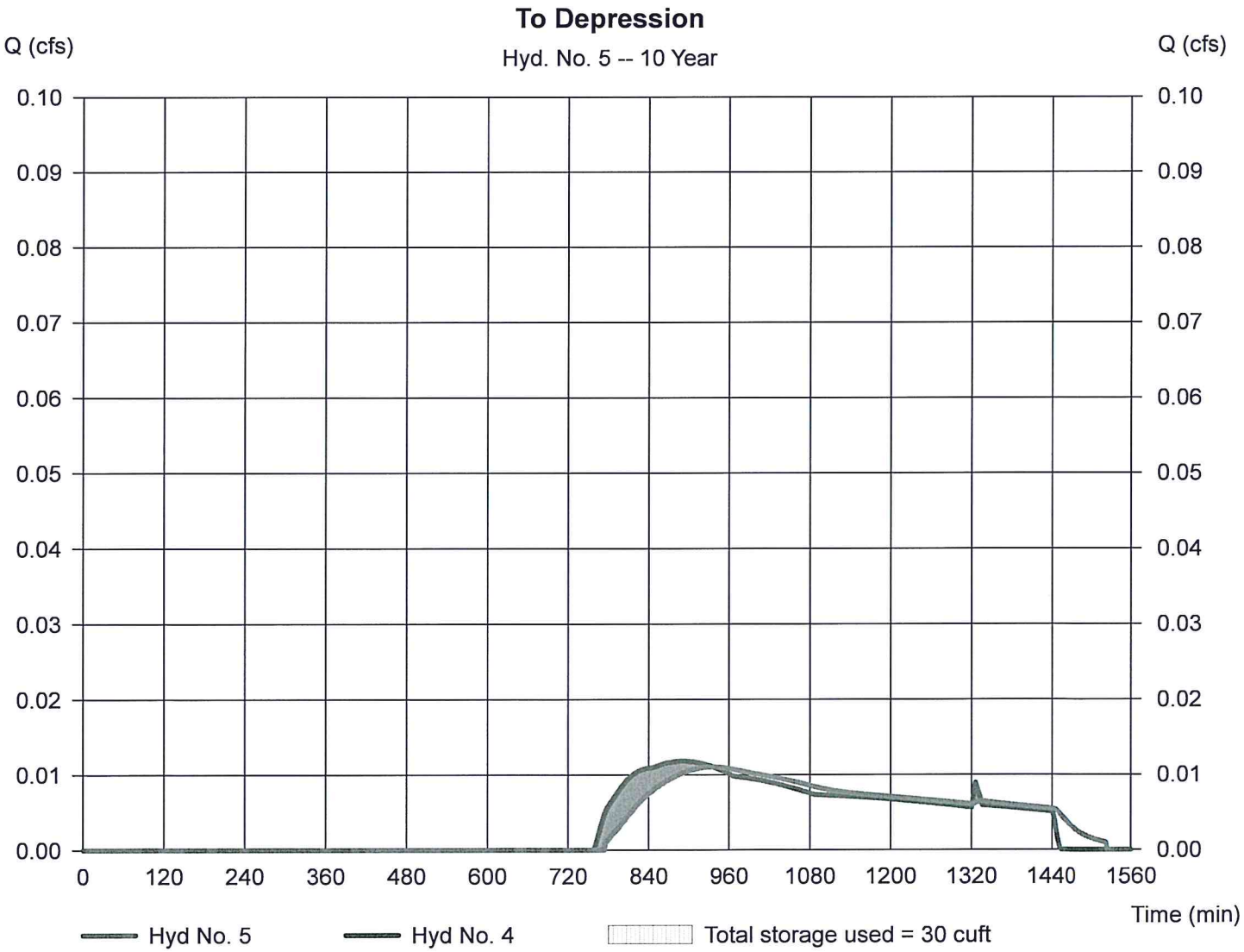
Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 5

To Depression

Hydrograph type	= Reservoir	Peak discharge	= 0.011 cfs
Storm frequency	= 10 yrs	Time to peak	= 936 min
Time interval	= 2 min	Hyd. volume	= 319 cuft
Inflow hyd. No.	= 4 - E4	Max. Elevation	= 156.01 ft
Reservoir name	= On-site Depression	Max. Storage	= 30 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

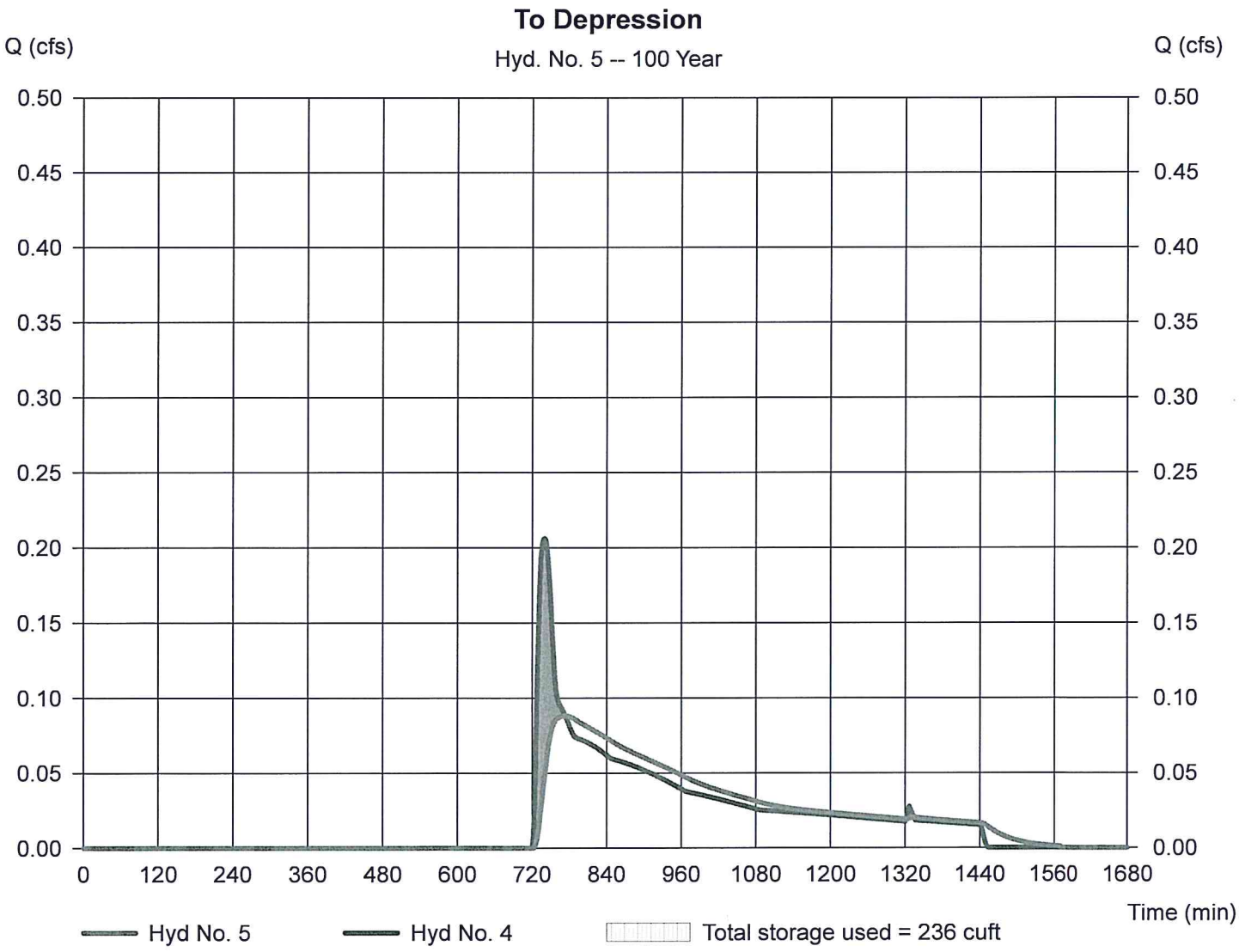
Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 5

To Depression

Hydrograph type	= Reservoir	Peak discharge	= 0.088 cfs
Storm frequency	= 100 yrs	Time to peak	= 774 min
Time interval	= 2 min	Hyd. volume	= 1,747 cuft
Inflow hyd. No.	= 4 - E4	Max. Elevation	= 156.05 ft
Reservoir name	= On-site Depression	Max. Storage	= 236 cuft

Storage Indication method used. Outflow includes exfiltration.



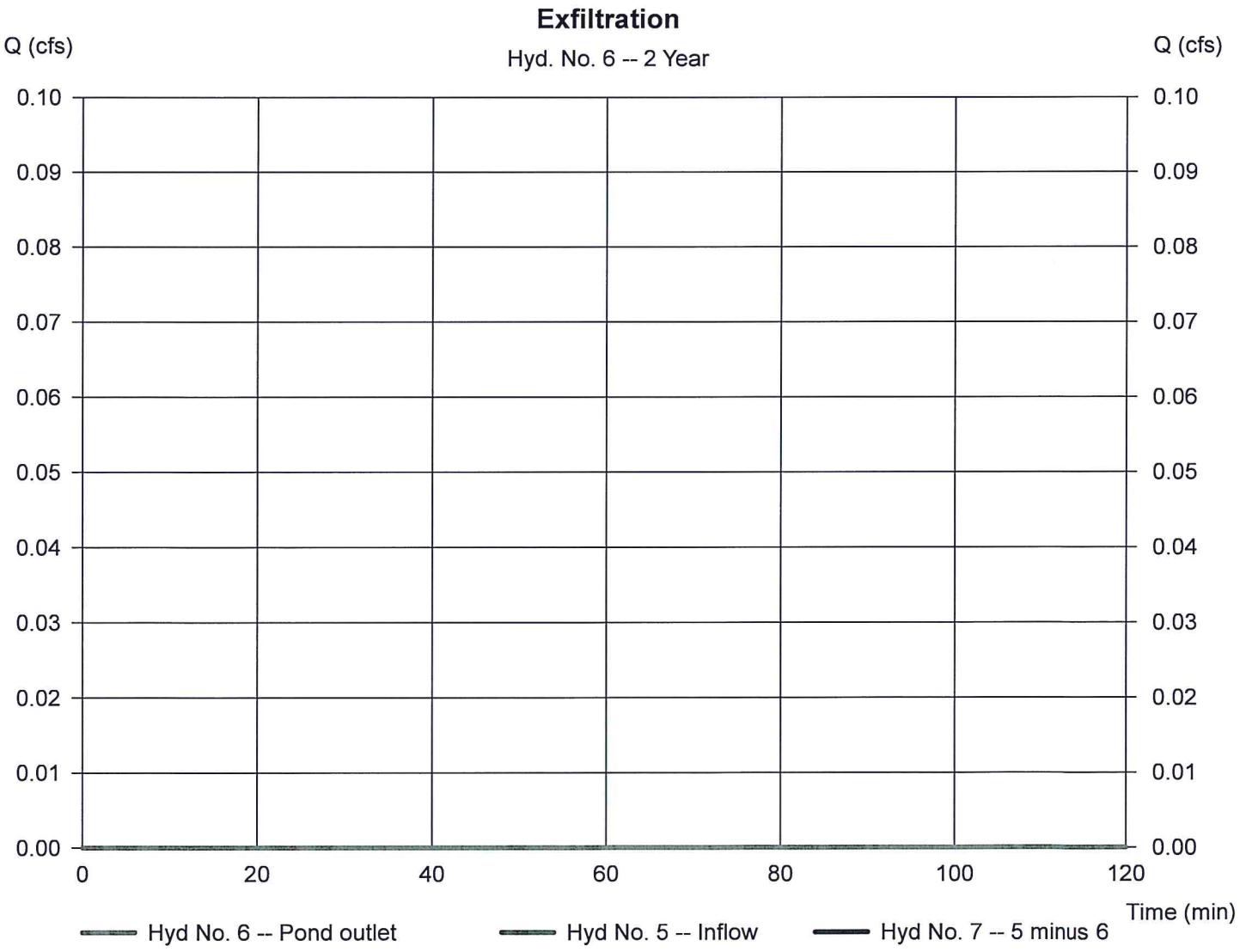
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 6

Exfiltration

Hydrograph type	= Diversion1	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hydrograph	= 5 - To Depression	2nd diverted hyd.	= 7
Diversion method	= Pond - On-site Depression	Pond structure	= Exfiltration



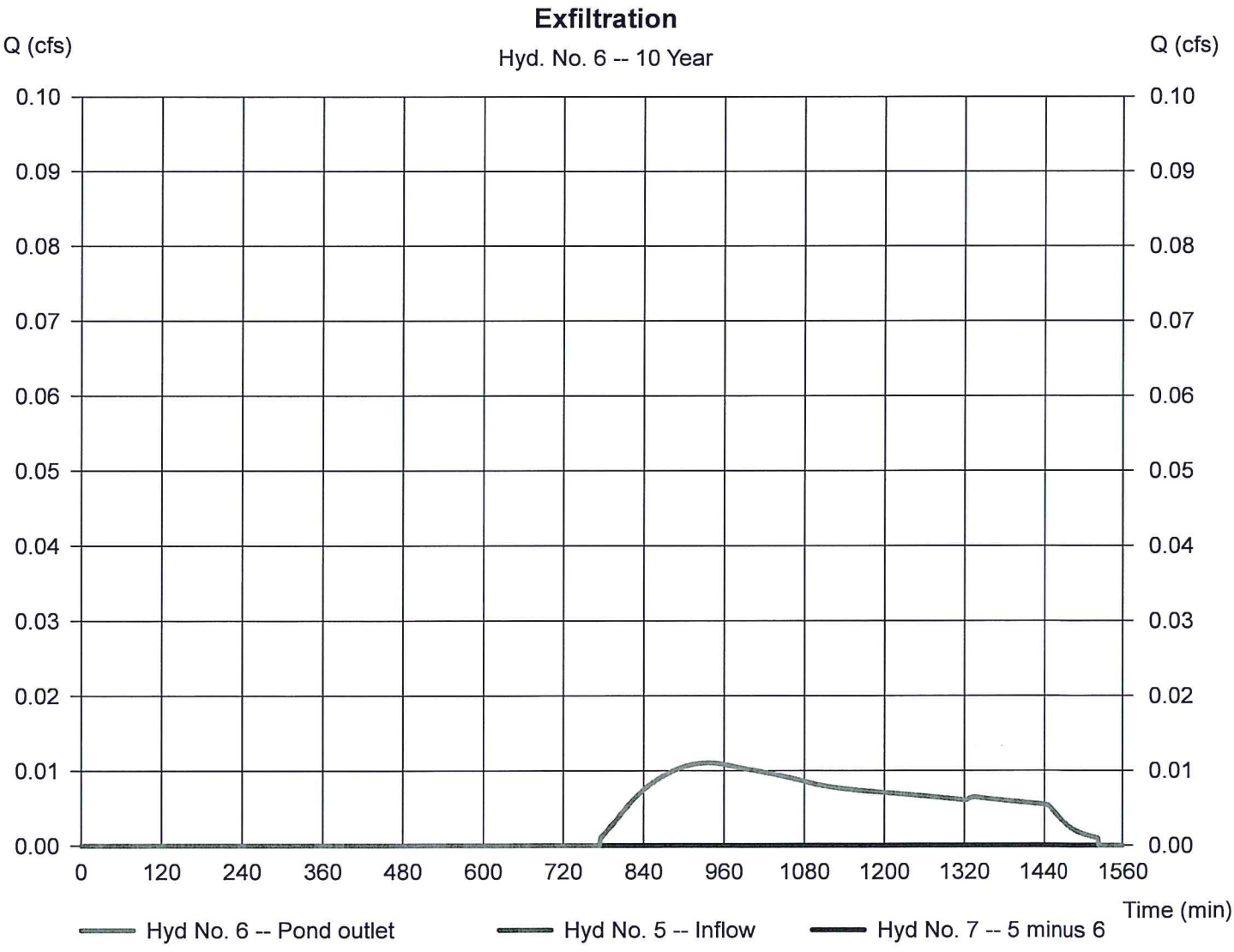
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 6

Exfiltration

Hydrograph type	= Diversion1	Peak discharge	= 0.011 cfs
Storm frequency	= 10 yrs	Time to peak	= 936 min
Time interval	= 2 min	Hyd. volume	= 319 cuft
Inflow hydrograph	= 5 - To Depression	2nd diverted hyd.	= 7
Diversion method	= Pond - On-site Depression	Pond structure	= Exfiltration



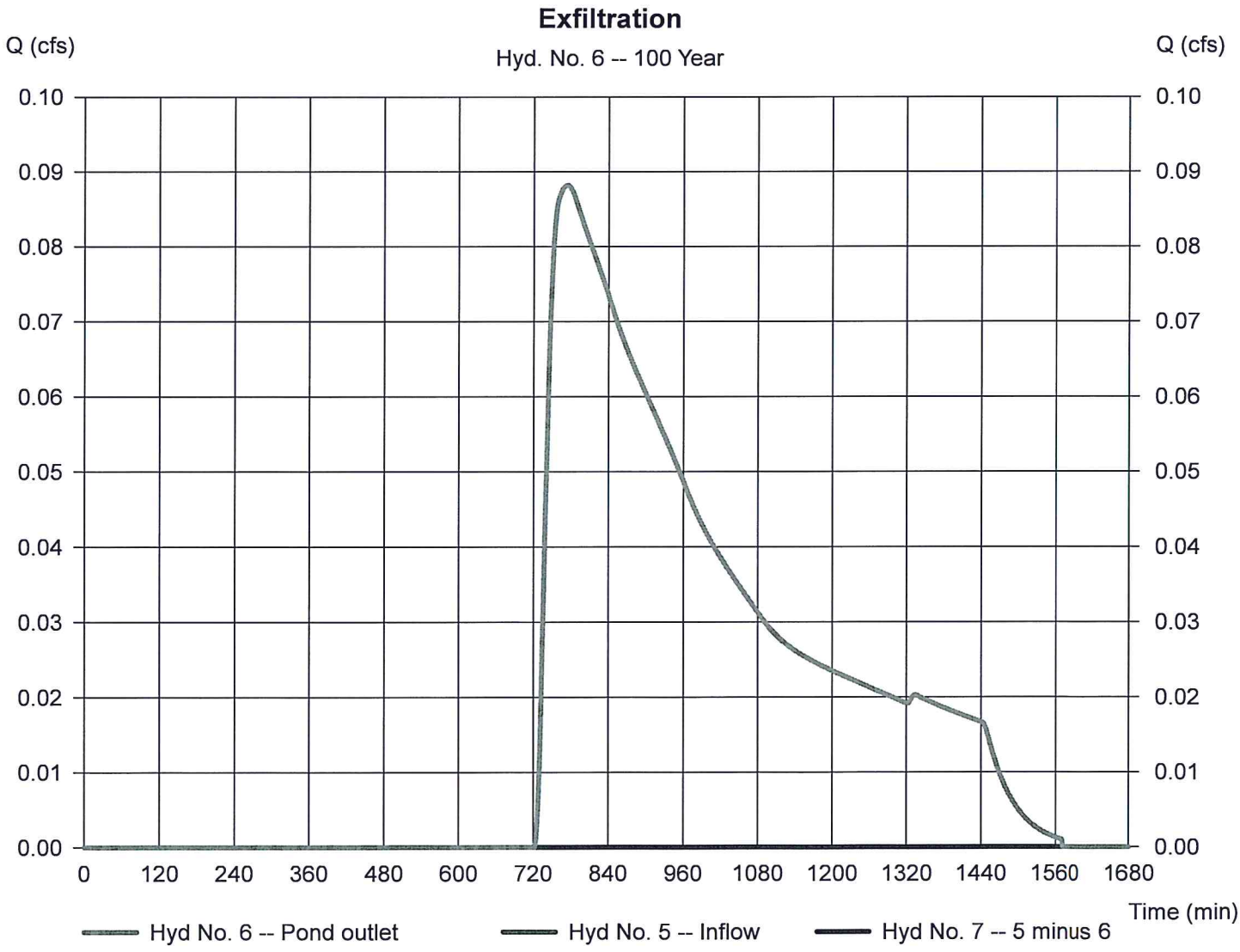
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 6

Exfiltration

Hydrograph type	= Diversion1	Peak discharge	= 0.088 cfs
Storm frequency	= 100 yrs	Time to peak	= 774 min
Time interval	= 2 min	Hyd. volume	= 1,747 cuft
Inflow hydrograph	= 5 - To Depression	2nd diverted hyd.	= 7
Diversion method	= Pond - On-site Depression	Pond structure	= Exfiltration



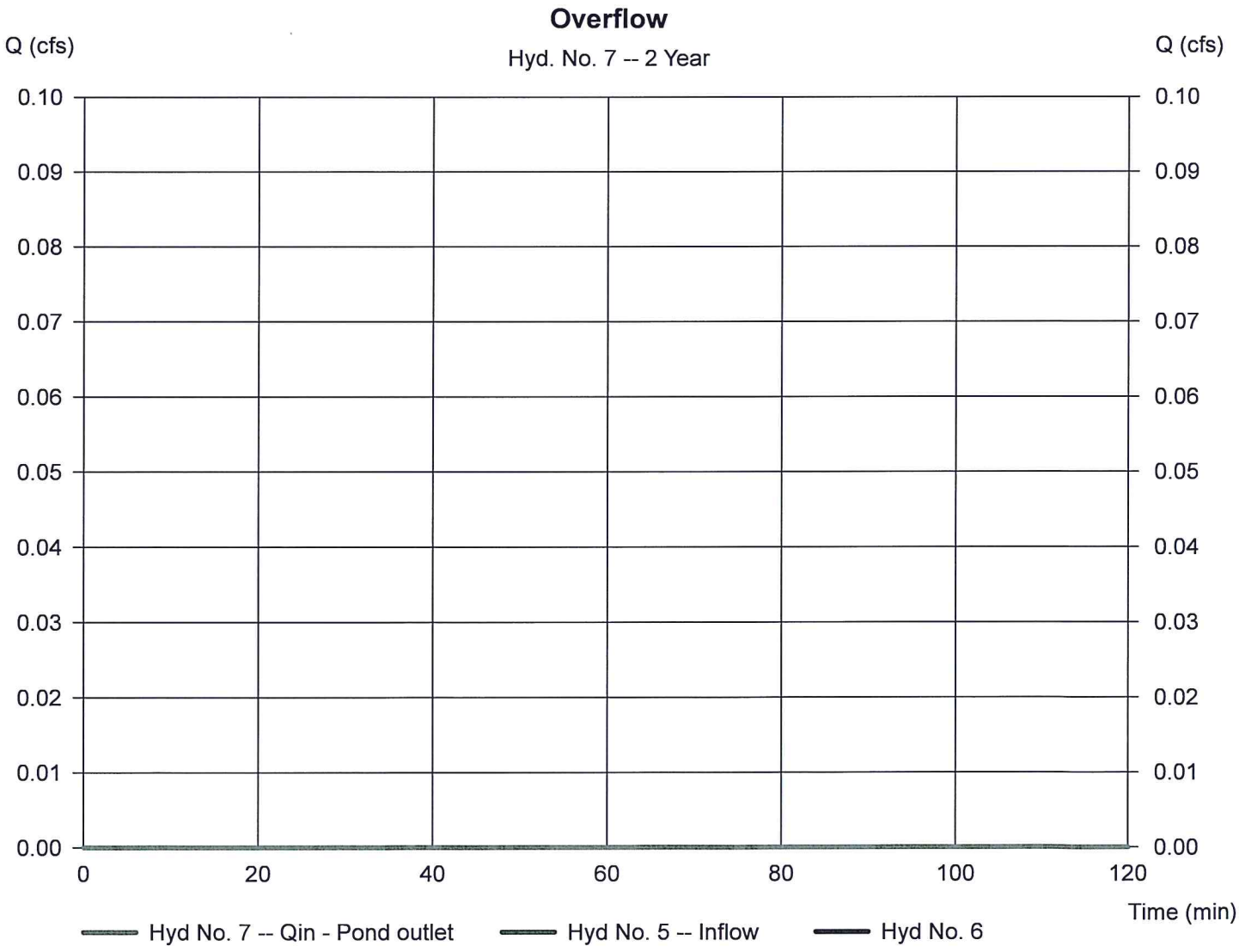
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 7

Overflow

Hydrograph type	= Diversion2	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hydrograph	= 5 - To Depression	2nd diverted hyd.	= 6
Diversion method	= Pond - On-site Depression	Pond structure	= Exfiltration



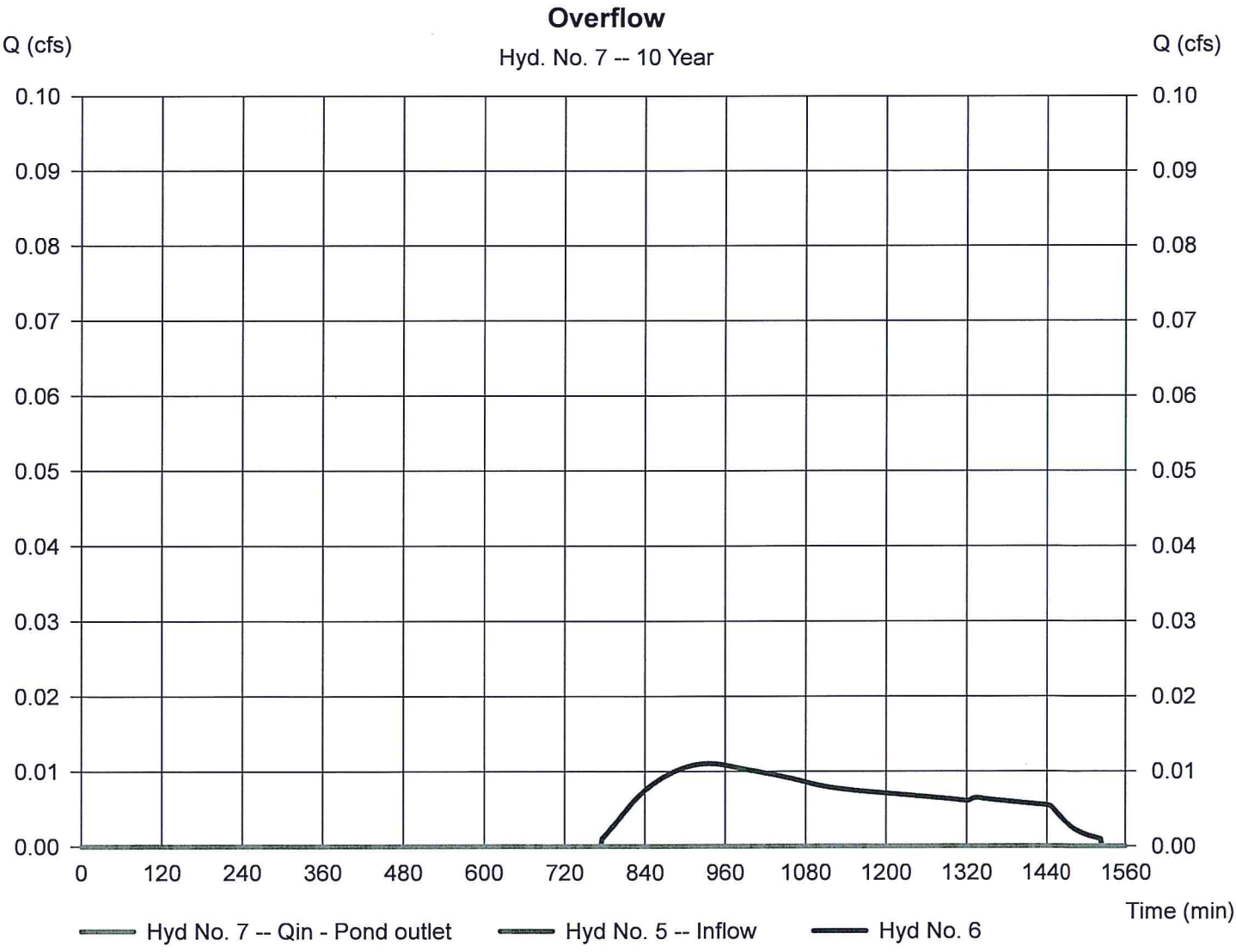
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 7

Overflow

Hydrograph type	= Diversion2	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= 842 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hydrograph	= 5 - To Depression	2nd diverted hyd.	= 6
Diversion method	= Pond - On-site Depression	Pond structure	= Exfiltration



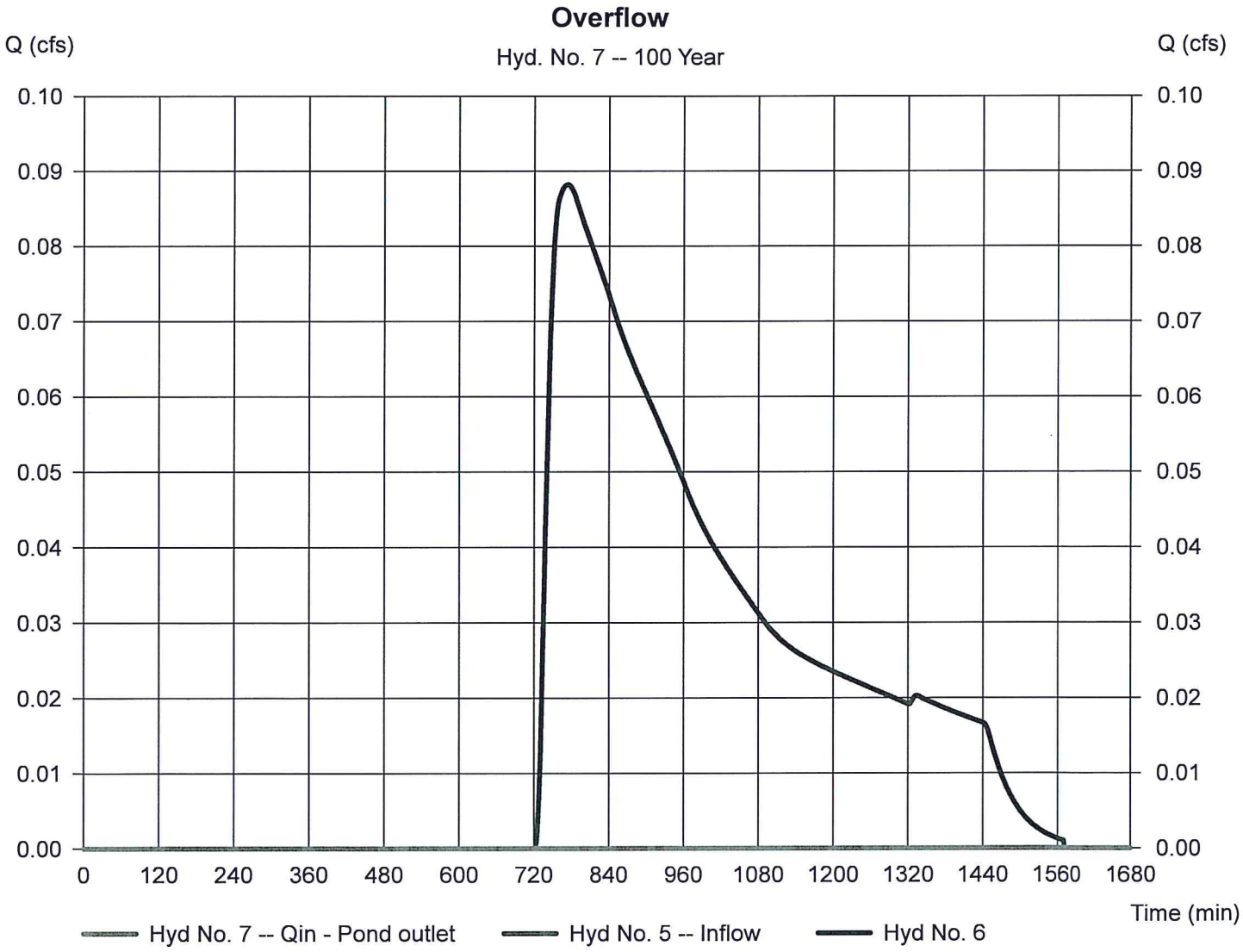
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 7

Overflow

Hydrograph type	= Diversion2	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 902 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hydrograph	= 5 - To Depression	2nd diverted hyd.	= 6
Diversion method	= Pond - On-site Depression	Pond structure	= Exfiltration



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Pond No. 1 - On-site Depression

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 156.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	156.00	1,499	0	0
1.00	157.00	9,950	5,103	5,103
2.00	158.00	14,090	11,959	17,062

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

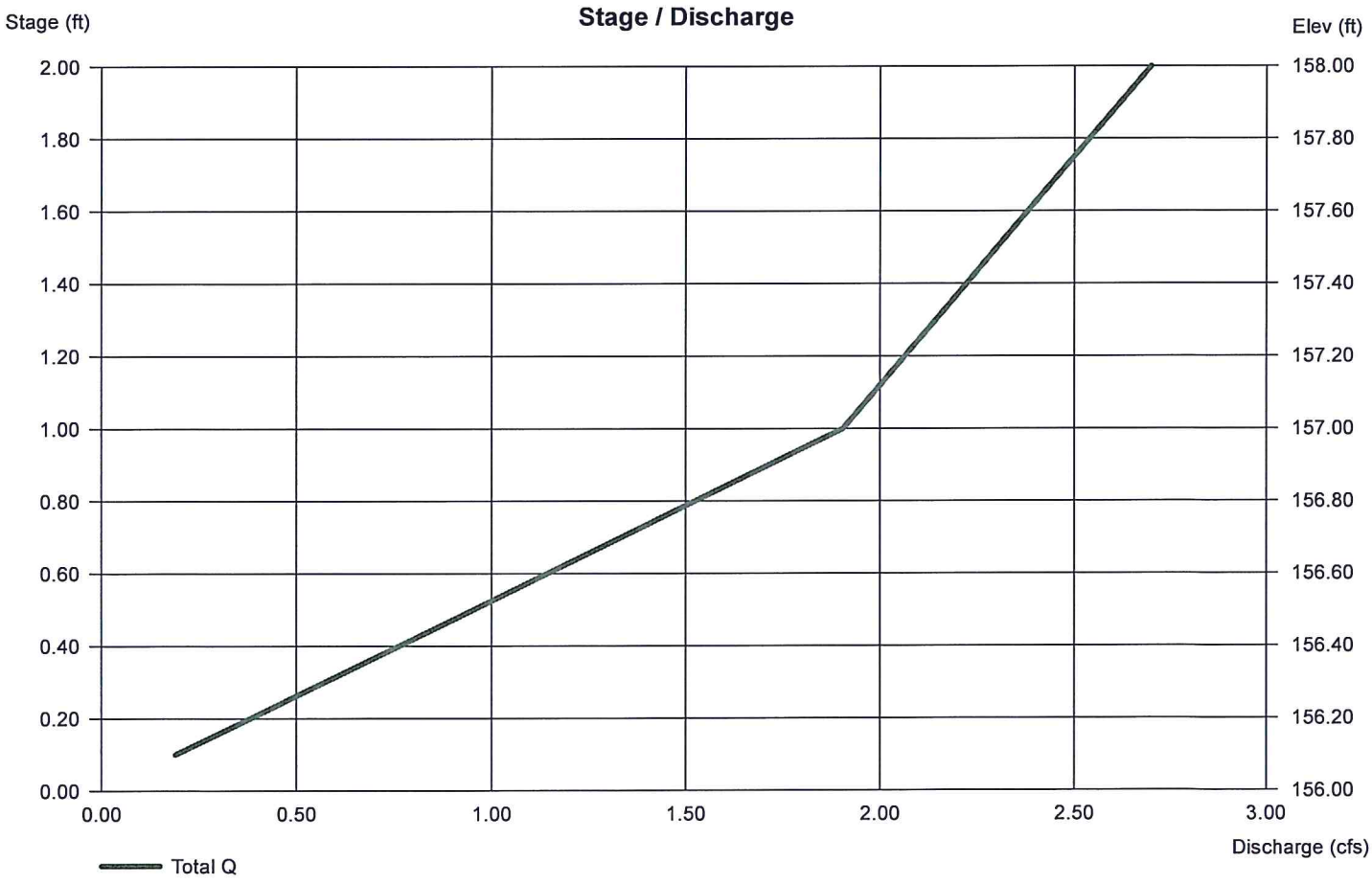
Weir Structures

	[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 Contour)

TW Elev. (ft) = 0.00

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



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	0.000	2	n/a	0	----	------	------	P1
2	SCS Runoff	0.000	2	n/a	0	----	------	------	P2
3	SCS Runoff	0.000	2	n/a	0	----	------	------	P3
4	SCS Runoff	0.429	2	726	1,660	----	------	------	P4
5	Reservoir	0.236	2	738	1,660	4	153.27	119	Infiltration Area
6	Diversion1	0.236	2	738	1,660	5	------	------	Exfiltration
7	Diversion2	0.000	2	714	0	5	------	------	Overflow
8	SCS Runoff	0.232	2	724	781	----	------	------	Roof Runoff
9	Reservoir	0.060	2	744	781	8	154.08	157	Roof Infiltration
10	Diversion1	0.060	2	744	781	9	------	------	Exfiltration
11	Diversion2	0.000	2	684	0	9	------	------	Overflow
12	SCS Runoff	0.133	2	726	711	----	------	------	P5
13	Reservoir	0.130	2	728	711	12	158.03	9.35	Infiltration Area 2
14	Diversion1	0.130	2	728	711	13	------	------	Exfiltration
15	Diversion2	0.000	2	730	0	13	------	------	Overflow
16	SCS Runoff	0.270	2	724	908	----	------	------	Dwelling Runoff
17	Reservoir	0.077	2	742	908	16	161.91	165	Dwelling Roof Drywell
18	Diversion1	0.077	2	742	908	17	------	------	Exfiltration
19	Diversion2	0.000	2	702	0	17	------	------	Overflow
20	Combine	0.000	2	730	0	3, 15,	------	------	Total Compared to E3

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	0.001	2	1326	22	----	------	------	P1
2	SCS Runoff	0.000	2	n/a	0	----	------	------	P2
3	SCS Runoff	0.000	2	1326	2	----	------	------	P3
4	SCS Runoff	1.234	2	724	3,935	----	------	------	P4
5	Reservoir	0.312	2	750	3,935	4	154.13	867	Infiltration Area
6	Diversion1	0.312	2	750	3,935	5	------	------	Exfiltration
7	Diversion2	0.000	2	702	0	5	------	------	Overflow
8	SCS Runoff	0.339	2	724	1,161	----	------	------	Roof Runoff
9	Reservoir	0.071	2	748	1,161	8	154.79	285	Roof Infiltration
10	Diversion1	0.071	2	748	1,161	9	------	------	Exfiltration
11	Diversion2	0.000	2	644	0	9	------	------	Overflow
12	SCS Runoff	0.556	2	724	1,942	----	------	------	P5
13	Reservoir	0.177	2	748	1,942	12	158.80	332	Infiltration Area 2
14	Diversion1	0.177	2	748	1,942	13	------	------	Exfiltration
15	Diversion2	0.000	2	822	0	13	------	------	Overflow
16	SCS Runoff	0.394	2	724	1,350	----	------	------	Dwelling Runoff
17	Reservoir	0.088	2	746	1,349	16	162.50	310	Dwelling Roof Drywell
18	Diversion1	0.088	2	746	1,349	17	------	------	Exfiltration
19	Diversion2	0.000	2	664	0	17	------	------	Overflow
20	Combine	0.000	2	1326	2	3, 15,	------	------	Total Compared to E3

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	0.019	2	746	251	----	------	------	P1
2	SCS Runoff	0.001	2	902	39	----	------	------	P2
3	SCS Runoff	0.007	2	830	201	----	------	------	P3
4	SCS Runoff	2.563	2	724	7,753	----	------	------	P4
5	Reservoir	0.462	2	752	7,753	4	155.85	2,383	Infiltration Area
6	Diversion1	0.462	2	752	7,753	5	------	------	Exfiltration
7	Diversion2	0.000	2	678	0	5	------	------	Overflow
8	SCS Runoff	0.484	2	724	1,677	----	------	------	Roof Runoff
9	Reservoir	0.088	2	750	1,677	8	155.99	466	Roof Infiltration
10	Diversion1	0.088	2	750	1,677	9	------	------	Exfiltration
11	Diversion2	0.000	2	574	0	9	------	------	Overflow
12	SCS Runoff	1.333	2	724	4,145	----	------	------	P5
13	Reservoir	0.253	2	752	4,145	12	160.21	1,178	Infiltration Area 2
14	Diversion1	0.253	2	752	4,145	13	------	------	Exfiltration
15	Diversion2	0.000	2	1158	0	13	------	------	Overflow
16	SCS Runoff	0.563	2	724	1,950	----	------	------	Dwelling Runoff
17	Reservoir	0.106	2	748	1,950	16	163.41	517	Dwelling Roof Drywell
18	Diversion1	0.106	2	748	1,950	17	------	------	Exfiltration
19	Diversion2	0.000	2	686	0	17	------	------	Overflow
20	Combine	0.007	2	830	201	3, 15,	------	------	Total Compared to E3

Worksheet 2: Runoff curve number and runoff **SM-4860**

Project: 267 Great Rd By JTM Date 8/26/15

Location: Acton, MA Checked _____ Date _____

Circle one: Present [Developed] P1

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
A	Woods	30			0.10	2.89
A	Open	39			0.11	4.24
	Impervious	98			0.00	0.00
A	Gravel	76			0.00	0.00
Totals =					0.21	7.13

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{7.13}{0.21} = 34.77$; Use CN = 34.8

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	0.02	0.03	0.33
Runoff, Q.....	cf	17	21	244

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-4860

Project: 267 Great Rd By JTM Date 8/26/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present | Developed — P1

Circle one: Tc | Tt through _____ subarea

			A-B	B-C		
Sheet flow (Applicable to Tc only)		Segment ID				
1. Surface Description (table 3-1)			Grass	Woods		
2. Mannings roughness coeff., n (table 3-1)			0.24	0.4		
3. Flow length, L (total L <= 300 ft)		ft	30	20		
4. Two-yr 24-hr rainfall, P2		in	3.1	3.1		
5. Land Slope, s		ft/ft	0.058	0.1		
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.06	0.05		0.11
Shallow concentrated Flow		Segment ID	C-D			
7. Surface Description (paved or unpaved)			unpaved			
8. Flow Length, L		ft	36			
9. Watercourse slope, s		ft/ft	0.034			
10. Average Velocity, V (figure 3-1)		ft/s	2.98			
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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.12

min 7.0

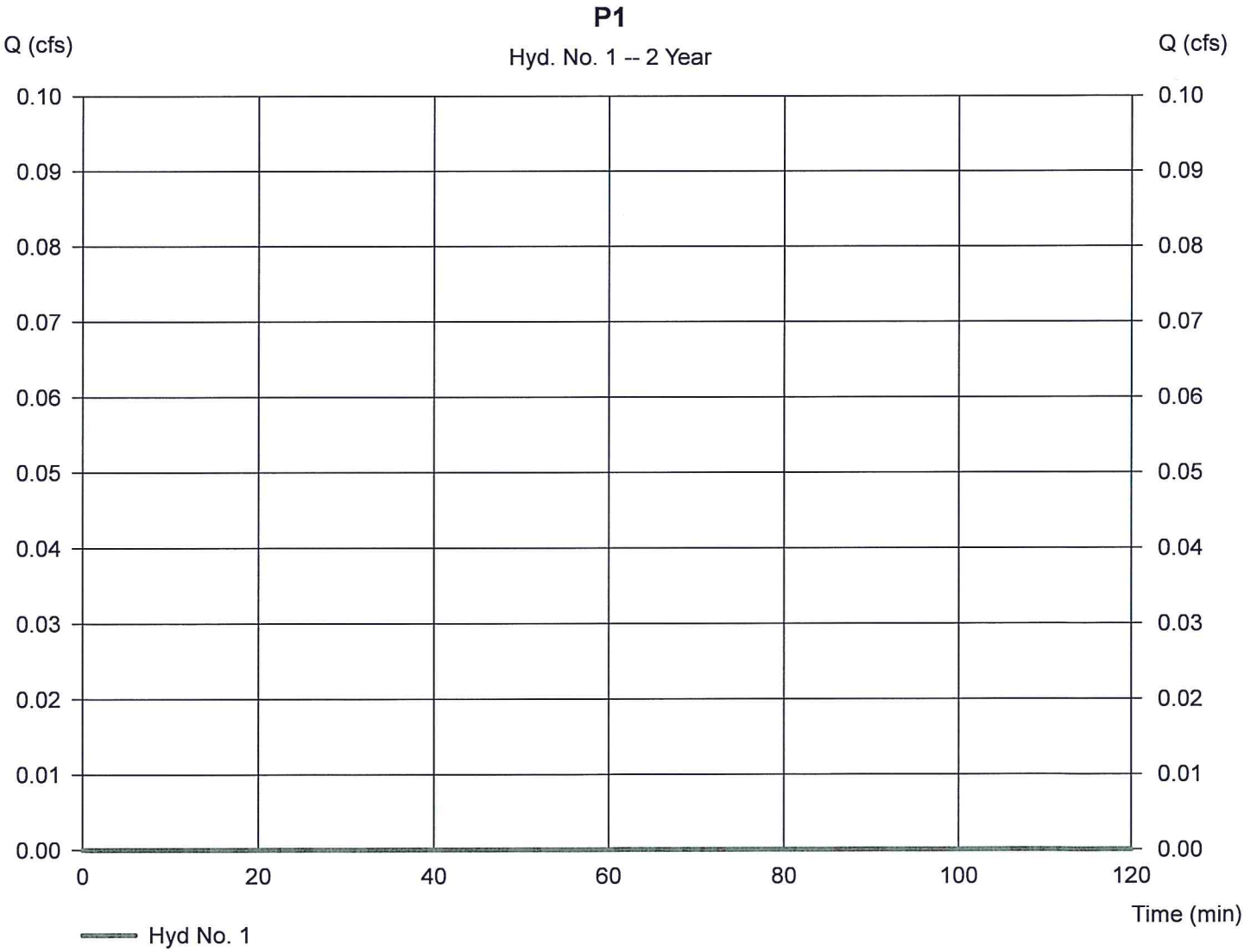
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 1

P1

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	= 0.210 ac	Curve number	= 34.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



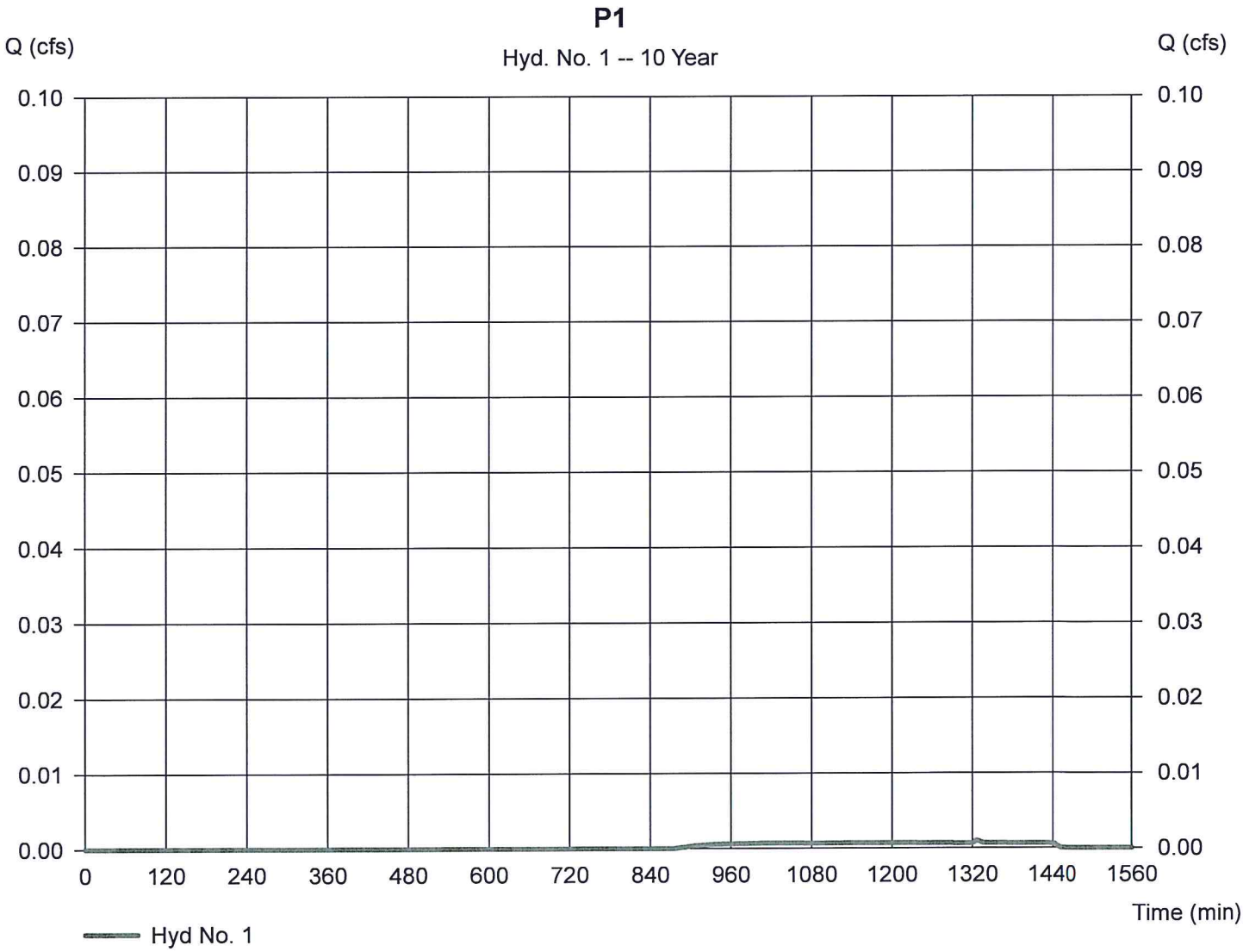
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 1

P1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.001 cfs
Storm frequency	= 10 yrs	Time to peak	= 1326 min
Time interval	= 2 min	Hyd. volume	= 22 cuft
Drainage area	= 0.210 ac	Curve number	= 34.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



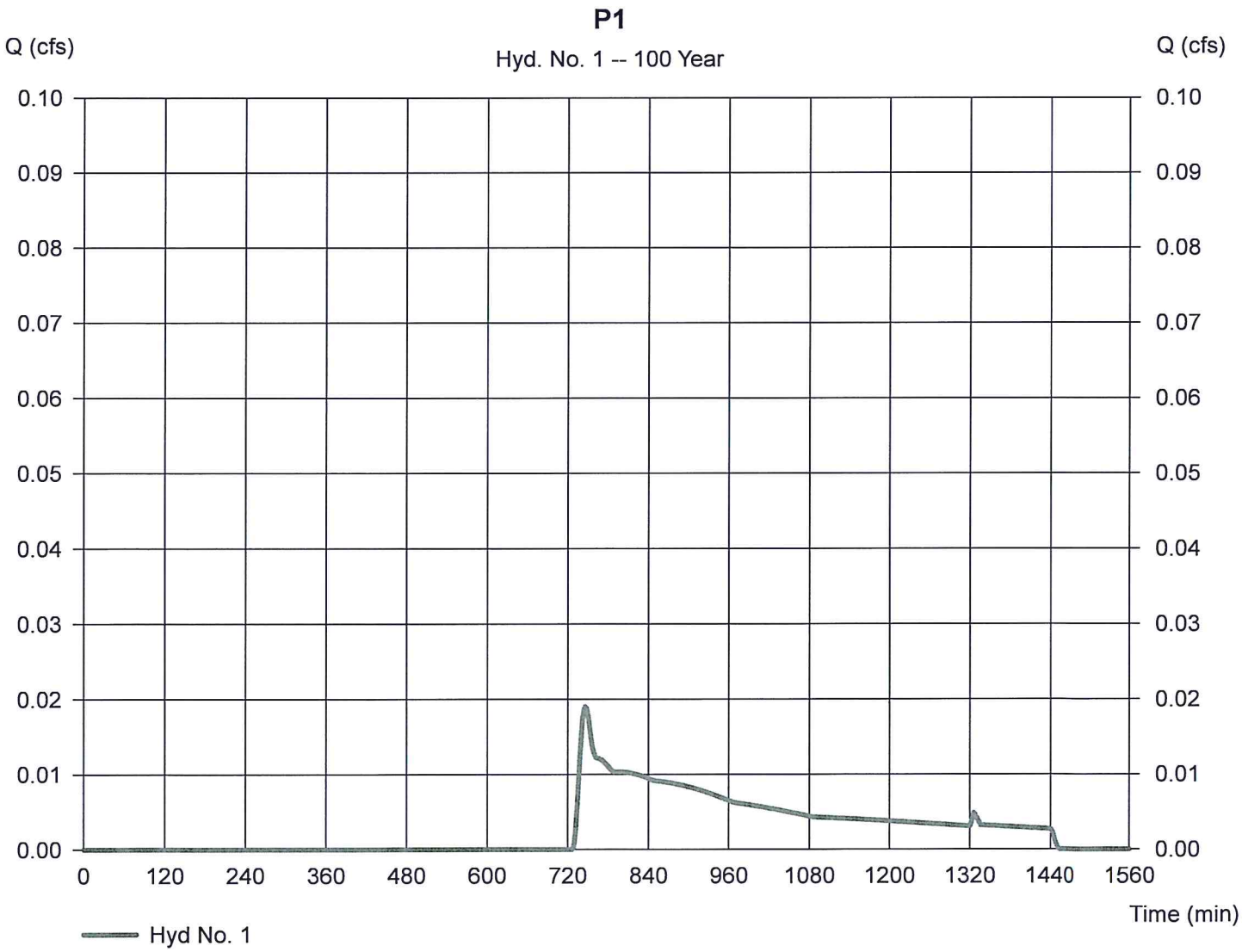
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 1

P1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.019 cfs
Storm frequency	= 100 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 251 cuft
Drainage area	= 0.210 ac	Curve number	= 34.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-4860**

Project: 267 Great Rd By JTM Date 8/26/15

Location: Acton, MA Checked _____ Date _____

Circle one: Present [Developed] P2

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
A	Woods	30			0.09	2.71
A	Open	39			0.00	0.00
	Impervious	98			0.00	0.00
A	Gravel	76			0.00	0.00
Totals =					0.09	2.71

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{2.71}{0.09} = 30.00$; Use CN = [30.0]

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	0.11	0.00	0.12
Runoff, Q.....	cf	37	0	39

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-4860

Project: 267 Great Rd By JTM Date 8/26/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present | Developed

Circle one: Tc | Tt through subarea P2

			A-B			
Sheet flow (Applicable to Tc only)		Segment ID				
1. Surface Description (table 3-1)			Woods			
2. Mannings roughness coeff., n (table 3-1)			0.4			
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	0.08			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.12			0.12
Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			unpaved			
8. Flow Length, L		ft	20			
9. Watercourse slope, s		ft/ft	0.05			
10. Average Velocity, V (figure 3-1)		ft/s	3.61			
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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.12

min 7.3

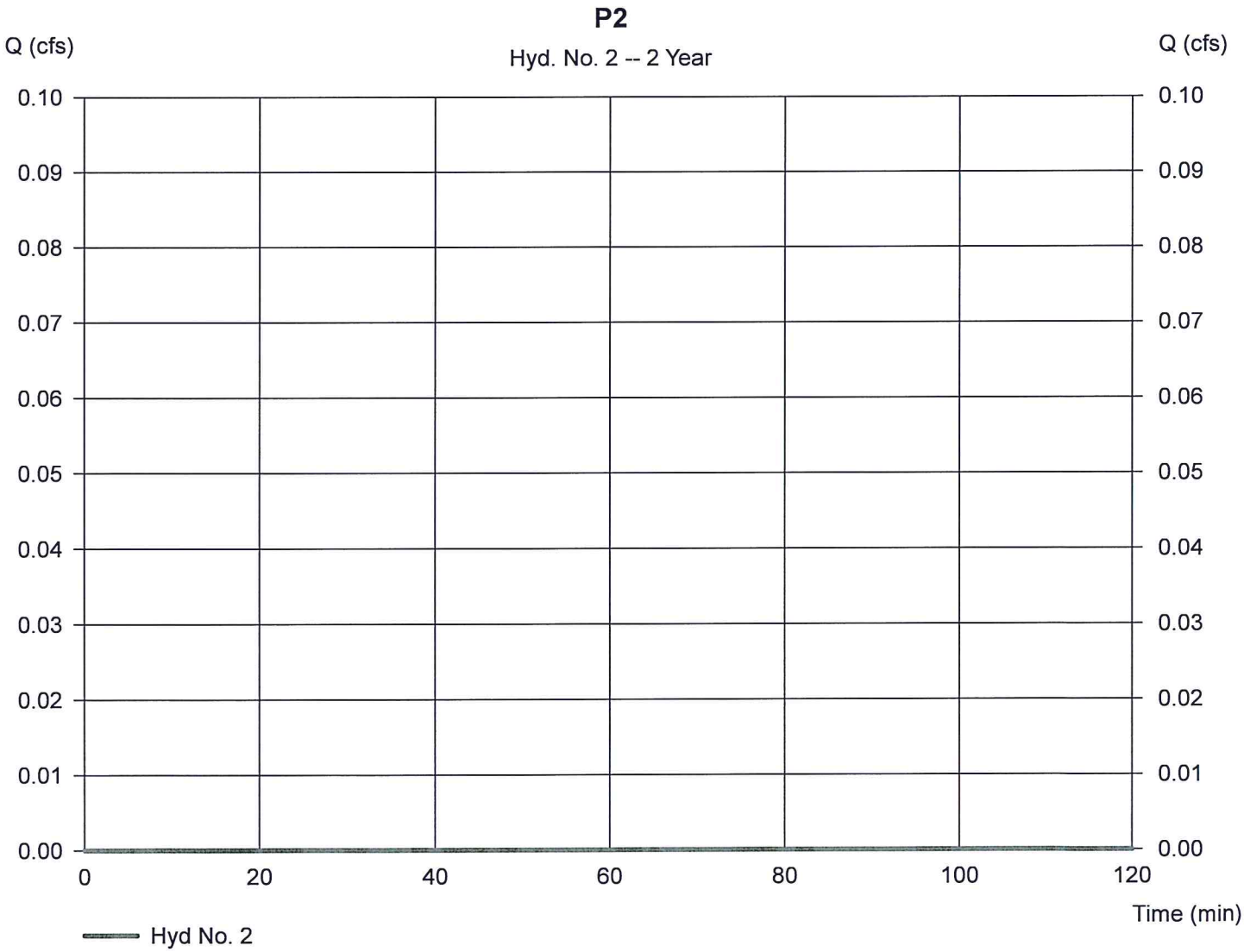
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 2

P2

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	= 0.090 ac	Curve number	= 30
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.30 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



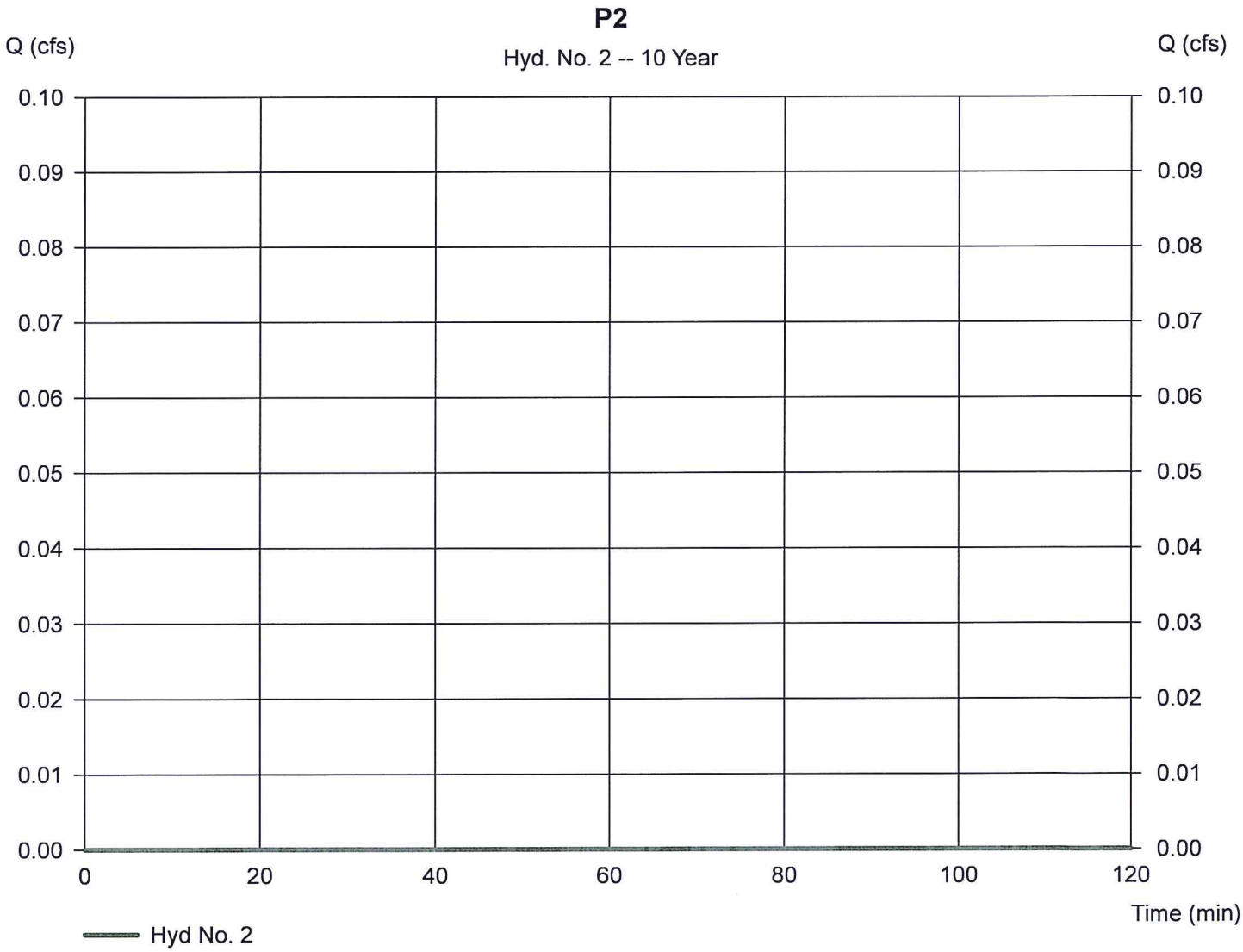
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 2

P2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Drainage area	= 0.090 ac	Curve number	= 30
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.30 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



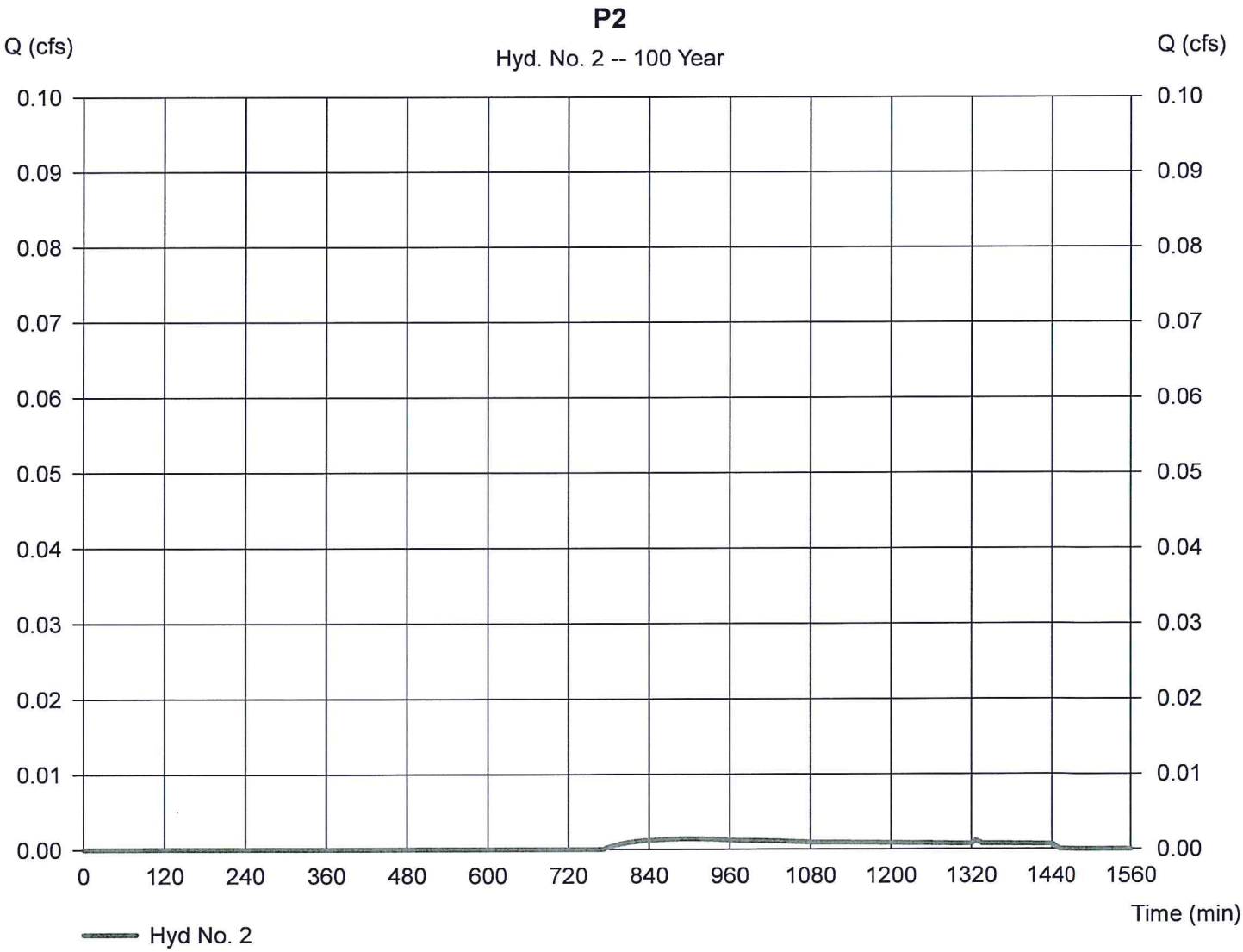
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Tuesday, Nov 3, 2015

Hyd. No. 2

P2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.001 cfs
Storm frequency	= 100 yrs	Time to peak	= 902 min
Time interval	= 2 min	Hyd. volume	= 39 cuft
Drainage area	= 0.090 ac	Curve number	= 30
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.30 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-4860**

Project: 267 Great Rd By JTM Date 8/26/15

Location: Acton, MA Checked _____ Date _____

Circle one: Present [Developed] P3

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
A	Woods	30			0.24	7.32
A	Open	39			0.06	2.16
	Impervious	98			0.00	0.00
A	Gravel	76			0.00	0.00
Totals =					0.30	9.49

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{9.49}{0.30} = 31.67$; Use CN = [31.7]

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.....	in	0.07	0.00	0.18
(Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)				
Runoff, Q.....	cf	79	2	200

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-4860

Project: 267 Great Rd By JTM Date 8/26/2015

Location: Acton, MA Checked _____ Date _____

Circle one: Present | Developed

Circle one: Tc | Tt through subarea P3 through _____

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)			0.4			
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	0.11			0.11
Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			unpaved			
8. Flow Length, L		ft	58			
9. Watercourse slope, s		ft/ft	0.039			
10. Average Velocity, V (figure 3-1)		ft/s	3.19			
11. Tt = L / 3600V	Compute Tt	hr	0.01			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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)	hr	0.12
	min	7.2