

Checklist for Stormwater Report



Checklist for Stormwater Report

A. Introduction

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



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.¹ This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8²
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

¹ The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

² For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

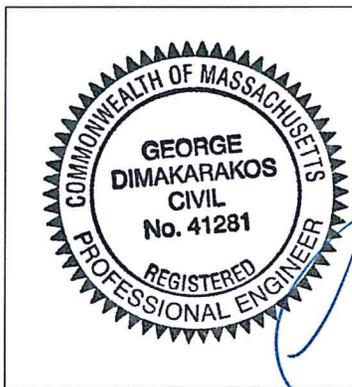
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



[Handwritten Signature]
8/26/16

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

- New development
- Redevelopment
- Mix of New Development and Redevelopment



Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- No disturbance to any Wetland Resource Areas
- Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- Reduced Impervious Area (Redevelopment Only)
- Minimizing disturbance to existing trees and shrubs
- LID Site Design Credit Requested:
 - Credit 1
 - Credit 2
 - Credit 3
- Use of "country drainage" versus curb and gutter conveyance and pipe
- Bioretention Cells (includes Rain Gardens)
- Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- Treebox Filter
- Water Quality Swale
- Grass Channel
- Green Roof
- Other (describe): Subsurface Drainage Structure

Standard 1: No New Untreated Discharges

- No new untreated discharges
- Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- Soil Analysis provided.
- Required Recharge Volume calculation provided.
- Required Recharge volume reduced through use of the LID site Design Credits.
- Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - Static
 - Simple Dynamic
 - Dynamic Field¹
- Runoff from all impervious areas at the site discharging to the infiltration BMP.
- Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - Site is comprised solely of C and D soils and/or bedrock at the land surface
 - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - Solid Waste Landfill pursuant to 310 CMR 19.000
 - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

¹ 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
 - Provisions for storing materials and waste products inside or under cover;
 - Vehicle washing controls;
 - Requirements for routine inspections and maintenance of stormwater BMPs;
 - Spill prevention and response plans;
 - Provisions for maintenance of lawns, gardens, and other landscaped areas;
 - Requirements for storage and use of fertilizers, herbicides, and pesticides;
 - Pet waste management provisions;
 - Provisions for operation and management of septic systems;
 - Provisions for solid waste management;
 - Snow disposal and plowing plans relative to Wetland Resource Areas;
 - Winter Road Salt and/or Sand Use and Storage restrictions;
 - Street sweeping schedules;
 - Provisions for prevention of illicit discharges to the stormwater management system;
 - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
 - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
 - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
 - Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - is within the Zone II or Interim Wellhead Protection Area
 - is near or to other critical areas
 - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - involves runoff from land uses with higher potential pollutant loads.
 - The Required Water Quality Volume is reduced through use of the LID site Design Credits.
 - Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
 - The ½" or 1" Water Quality Volume or
 - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the proprietary BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted *prior* to the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does *not* cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has *not* been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

- The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
- Limited Project
 - Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - Bike Path and/or Foot Path
 - Redevelopment Project
 - Redevelopment portion of mix of new and redevelopment.
- Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
 - Construction Period Operation and Maintenance Plan;
 - Names of Persons or Entity Responsible for Plan Compliance;
 - Construction Period Pollution Prevention Measures;
 - Erosion and Sedimentation Control Plan Drawings;
 - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
 - Vegetation Planning;
 - Site Development Plan;
 - Construction Sequencing Plan;
 - Sequencing of Erosion and Sedimentation Controls;
 - Operation and Maintenance of Erosion and Sedimentation Controls;
 - Inspection Schedule;
 - Maintenance Schedule;
 - Inspection and Maintenance Log Form.
- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

- The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- The project is **not** covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - Name of the stormwater management system owners;
 - Party responsible for operation and maintenance;
 - Schedule for implementation of routine and non-routine maintenance tasks;
 - Plan showing the location of all stormwater BMPs maintenance access areas;
 - Description and delineation of public safety features;
 - Estimated operation and maintenance budget; and
 - Operation and Maintenance Log Form.
- The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- An Illicit Discharge Compliance Statement is attached;
- NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

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	2.618	2	724	7,843	----	-----	-----	E1
2	SCS Runoff	5.514	2	724	16,590	----	-----	-----	E2
3	SCS Runoff	0.025	2	724	91	----	-----	-----	E3
92 PRE.gpw					Return Period: 2 Year		Thursday, Aug 25, 2016		

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	4.352	2	724	13,241	---	-----	-----	E1	
2	SCS Runoff	8.979	2	724	27,531	---	-----	-----	E2	
3	SCS Runoff	0.066	2	724	206	---	-----	-----	E3	
92 PRE.gpw					Return Period: 10 Year		Thursday, Aug 25, 2016			

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	6.710	2	724	20,868	----	-----	-----	E1
2	SCS Runoff	13.66	2	724	42,879	----	-----	-----	E2
3	SCS Runoff	0.131	2	724	395	----	-----	-----	E3
92 PRE.gpw					Return Period: 100 Year		Thursday, Aug 25, 2016		

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

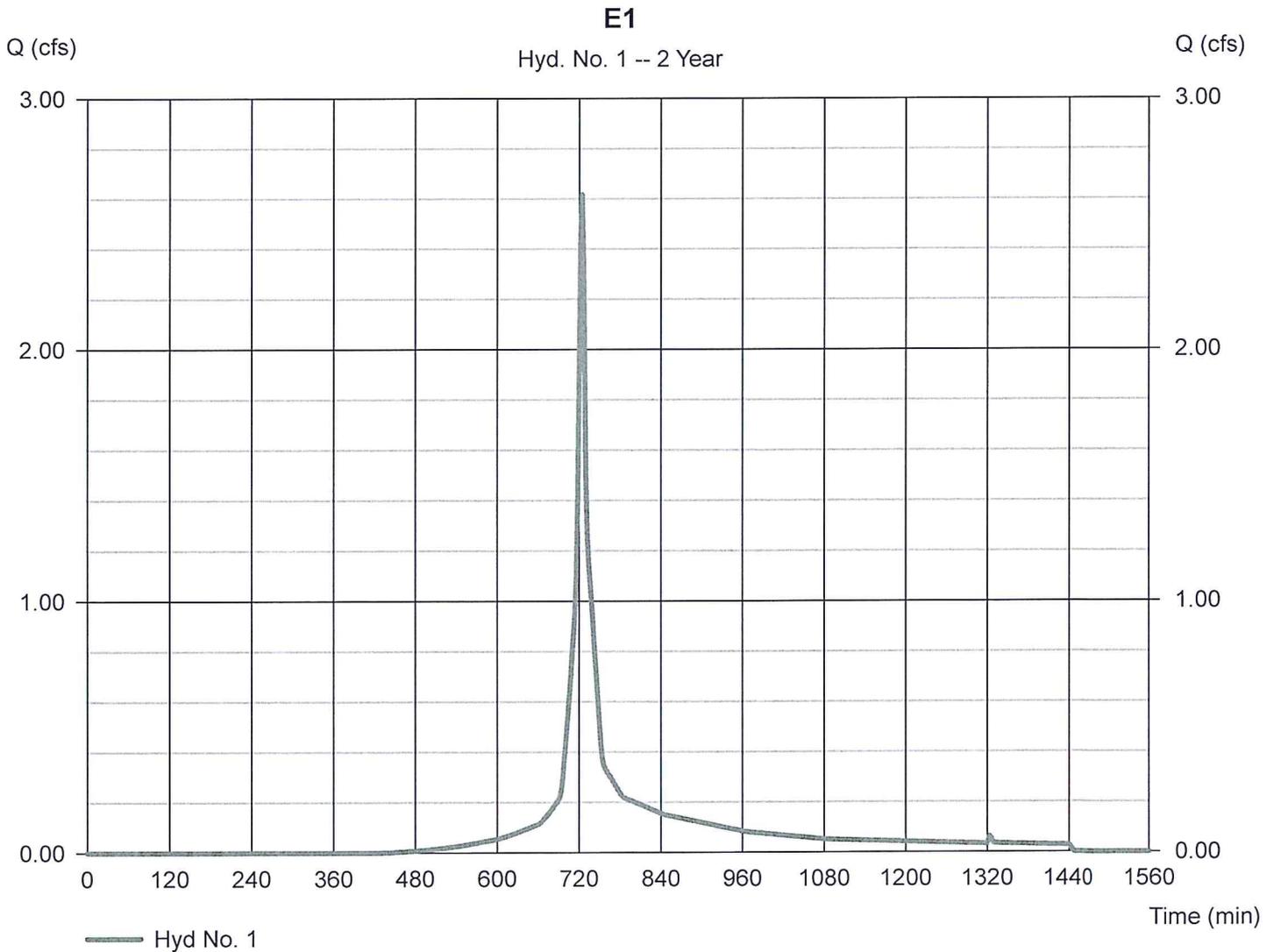
Wednesday, Jul 27, 2016

Hyd. No. 1

E1

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 1.240 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 2.618 cfs
Time to peak = 724 min
Hyd. volume = 7,843 cuft
Curve number = 87.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

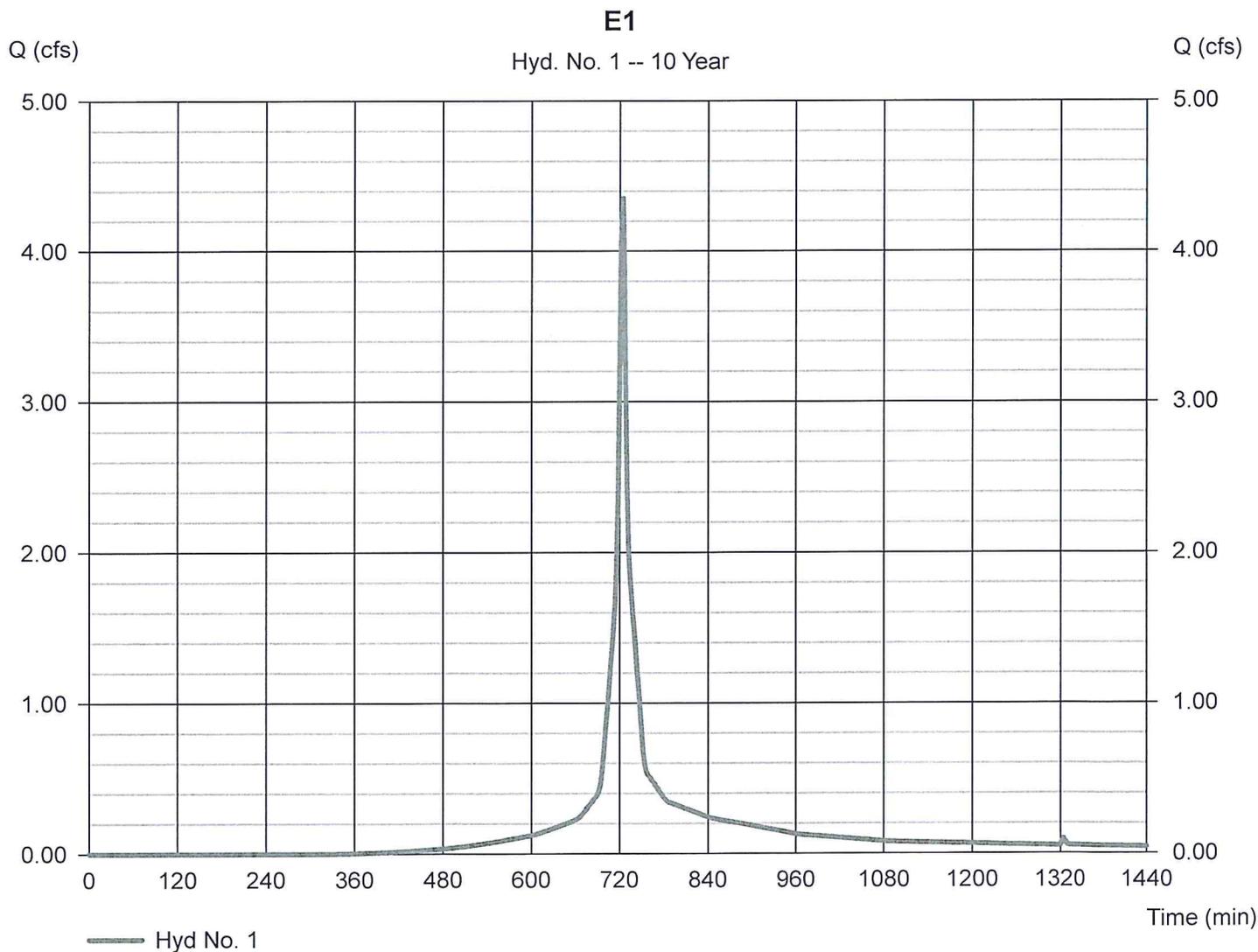
Wednesday, Jul 27, 2016

Hyd. No. 1

E1

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 1.240 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 4.352 cfs
Time to peak = 724 min
Hyd. volume = 13,241 cuft
Curve number = 87.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

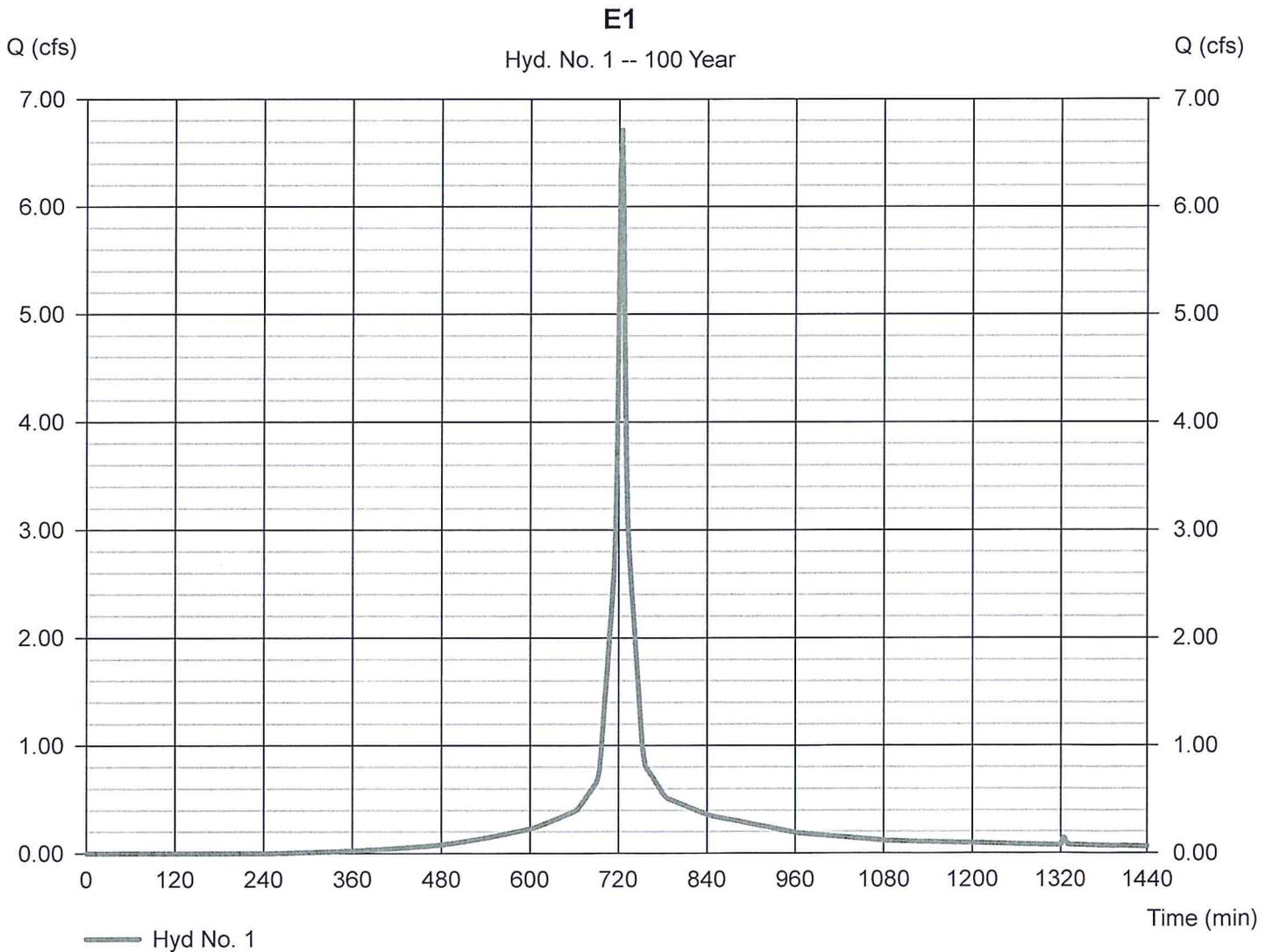
Wednesday, Jul 27, 2016

Hyd. No. 1

E1

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 1.240 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 6.710 cfs
Time to peak = 724 min
Hyd. volume = 20,868 cuft
Curve number = 87.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

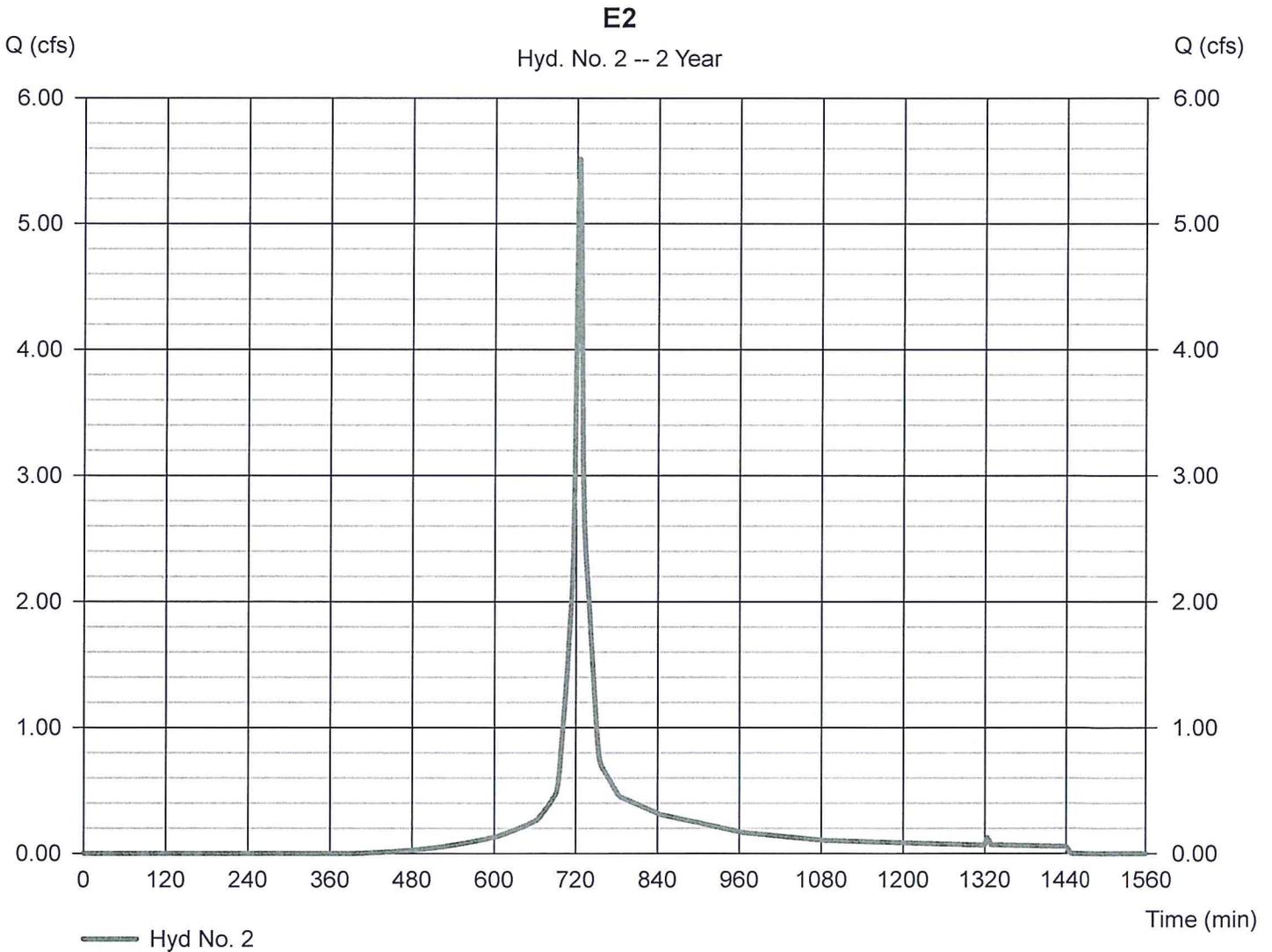
Thursday, Aug 25, 2016

Hyd. No. 2

E2

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 2.470 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 5.514 cfs
Time to peak = 724 min
Hyd. volume = 16,590 cuft
Curve number = 88.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

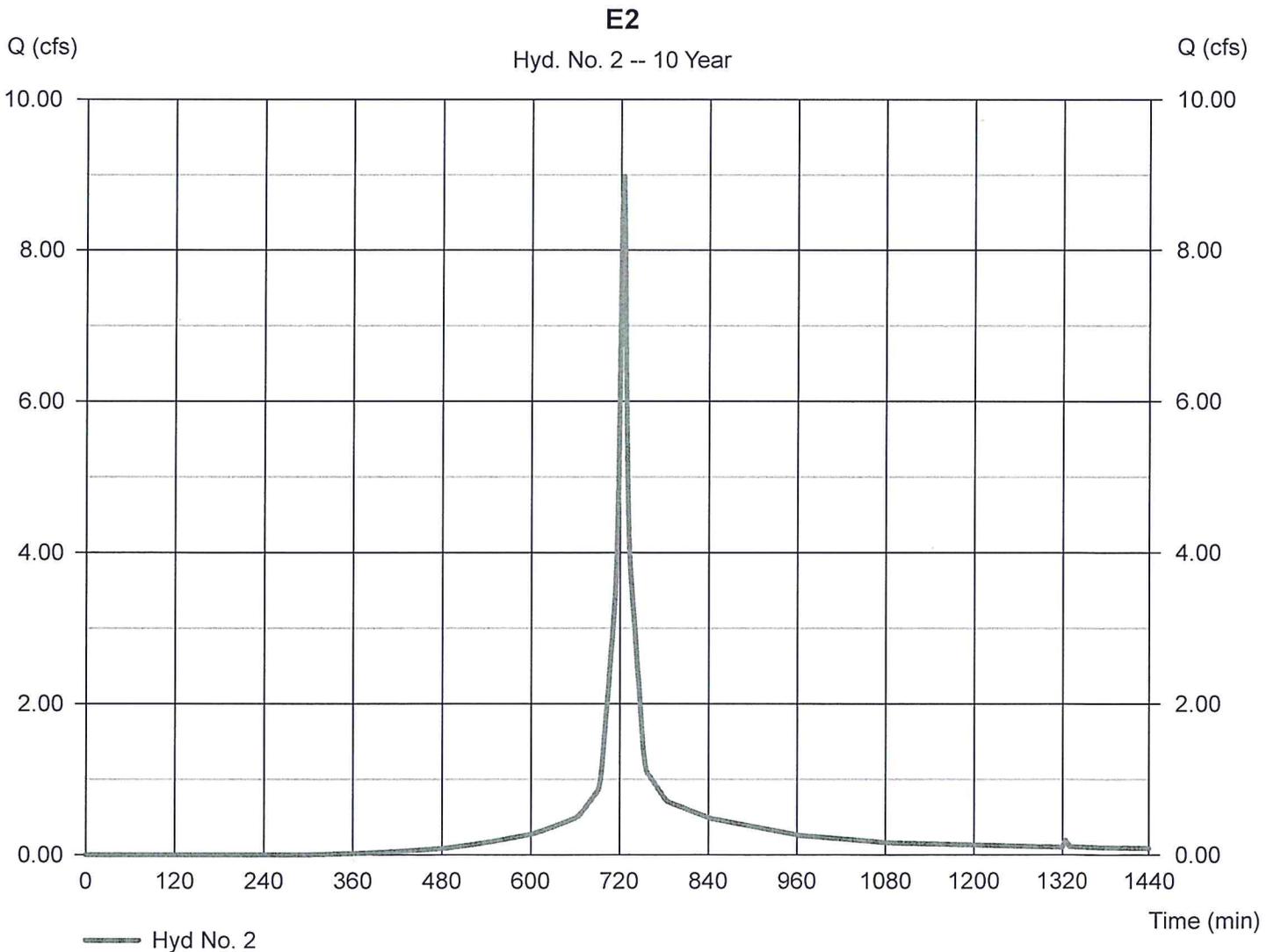
Thursday, Aug 25, 2016

Hyd. No. 2

E2

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 2.470 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 8.979 cfs
Time to peak = 724 min
Hyd. volume = 27,531 cuft
Curve number = 88.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

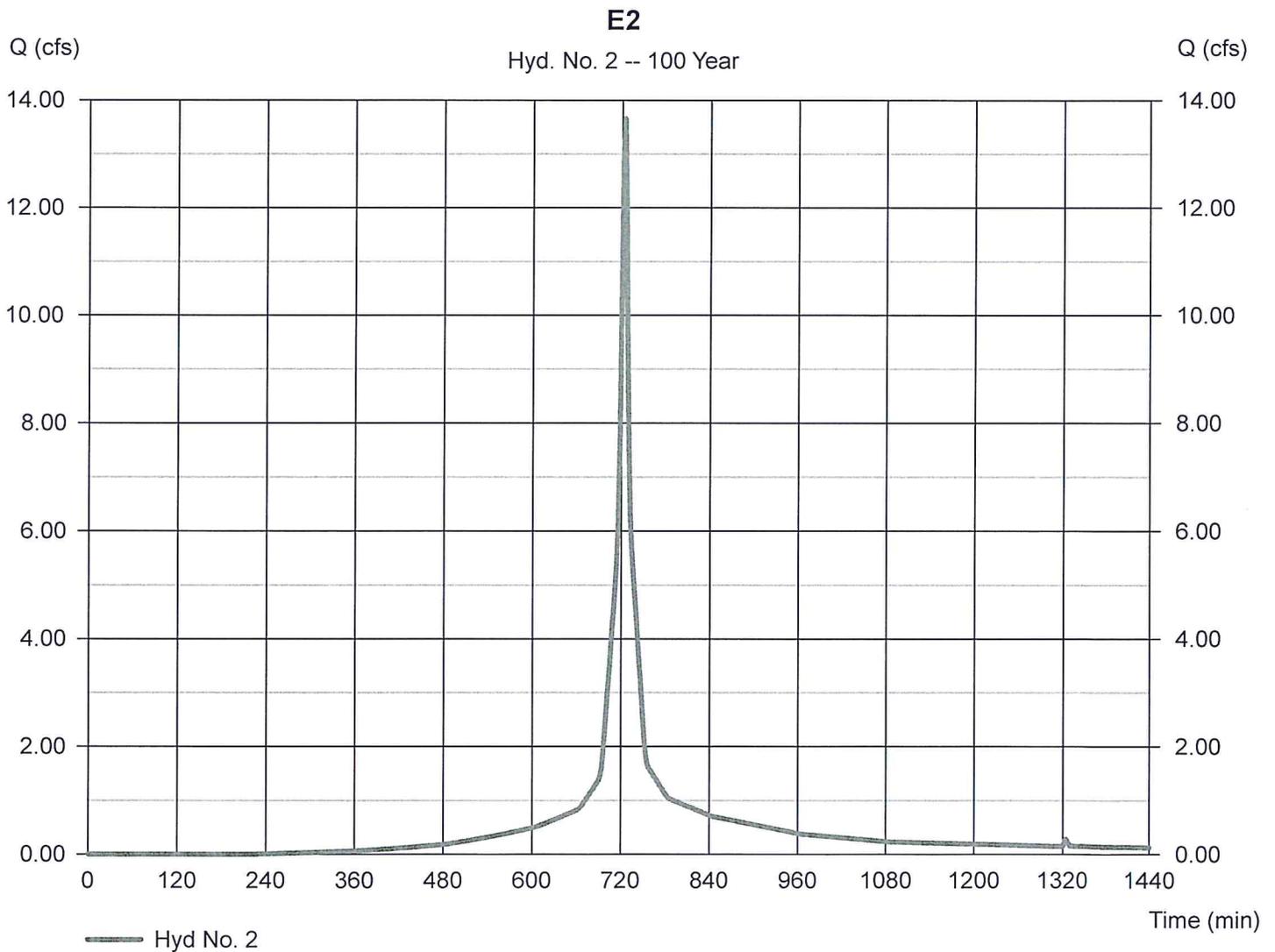
Thursday, Aug 25, 2016

Hyd. No. 2

E2

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 2.470 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 13.66 cfs
Time to peak = 724 min
Hyd. volume = 42,879 cuft
Curve number = 88.8
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

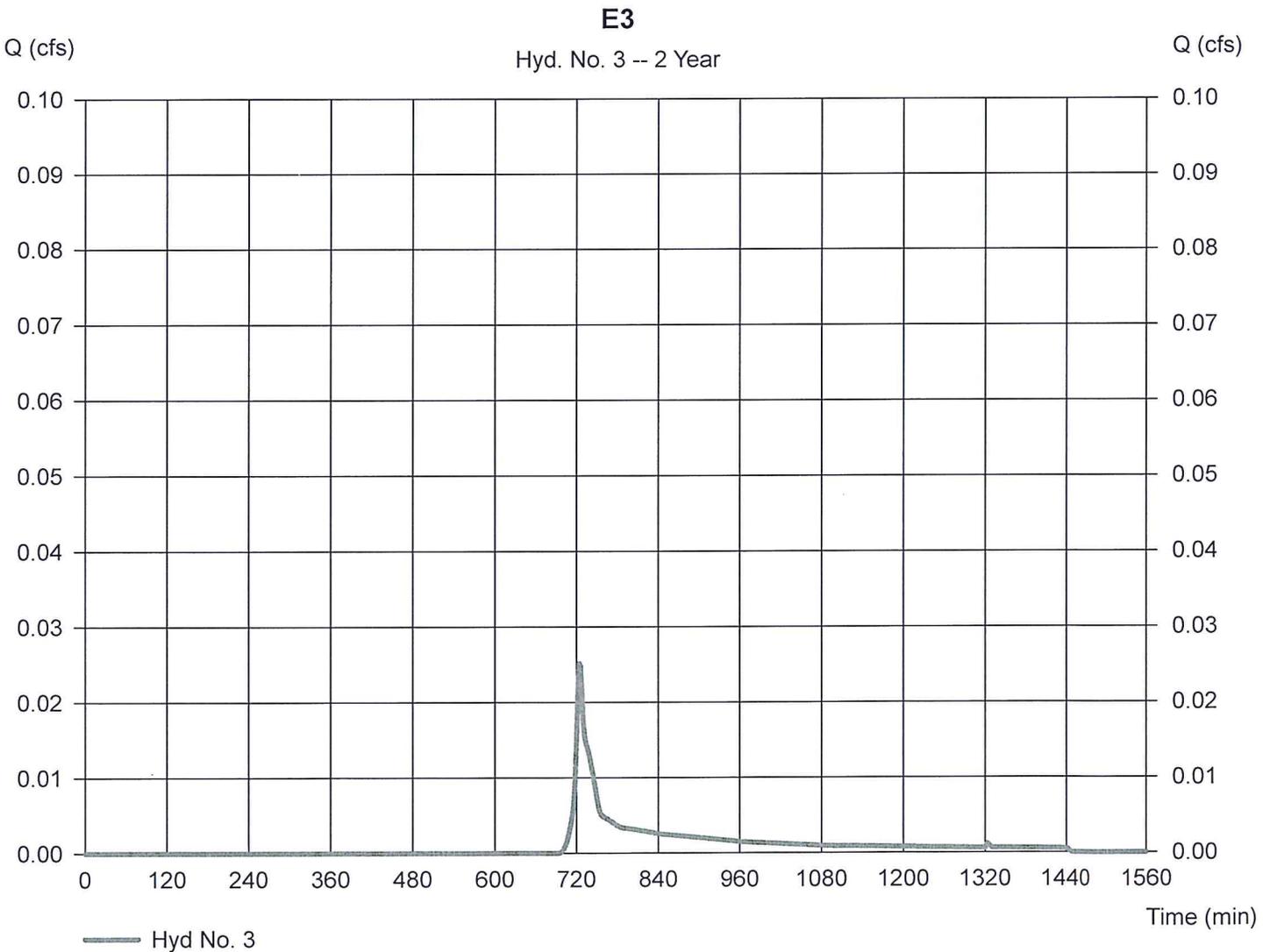
Wednesday, Jul 27, 2016

Hyd. No. 3

E3

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.040 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.025 cfs
Time to peak = 724 min
Hyd. volume = 91 cuft
Curve number = 67.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

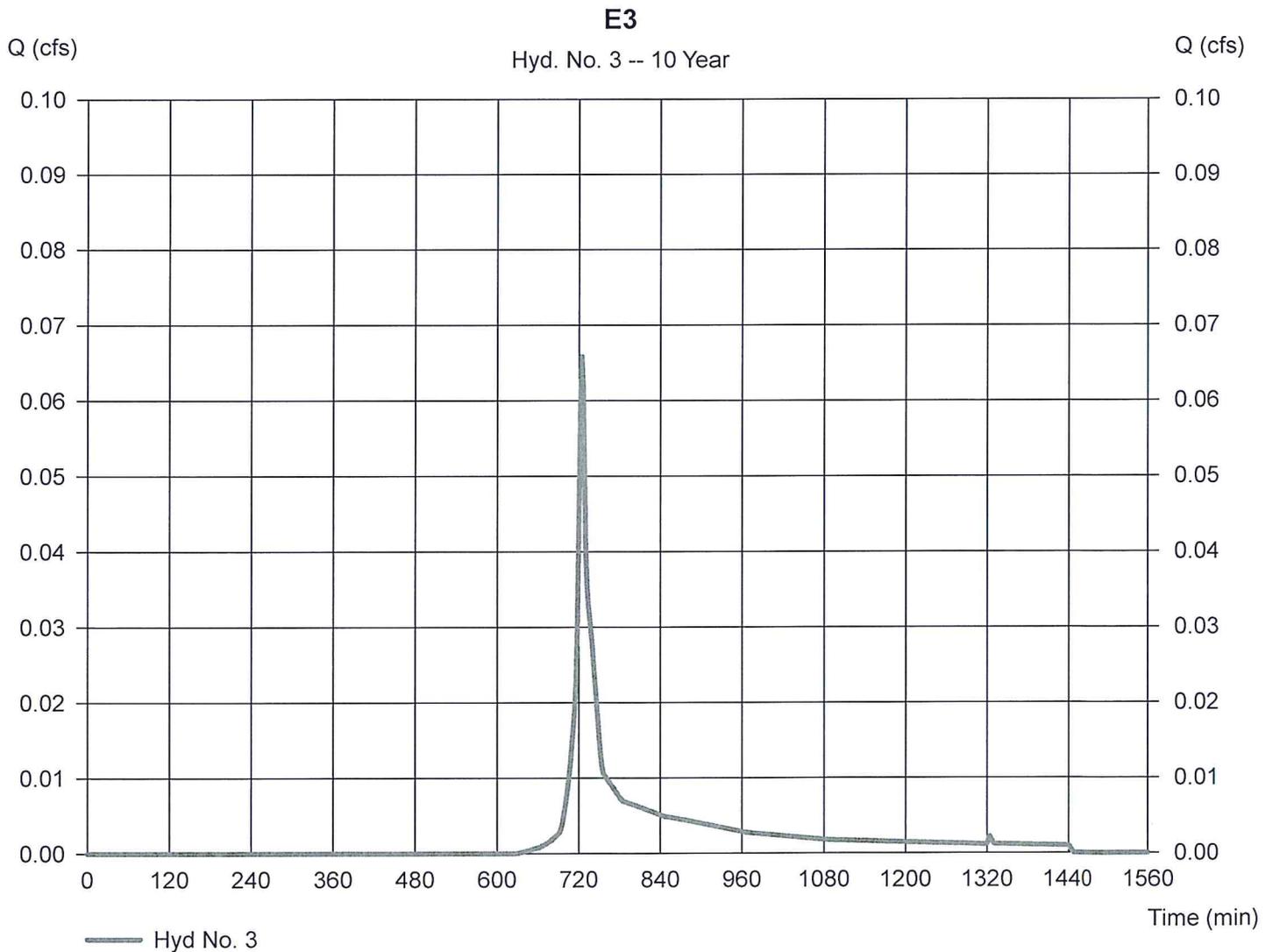
Wednesday, Jul 27, 2016

Hyd. No. 3

E3

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.040 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.066 cfs
Time to peak = 724 min
Hyd. volume = 206 cuft
Curve number = 67.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

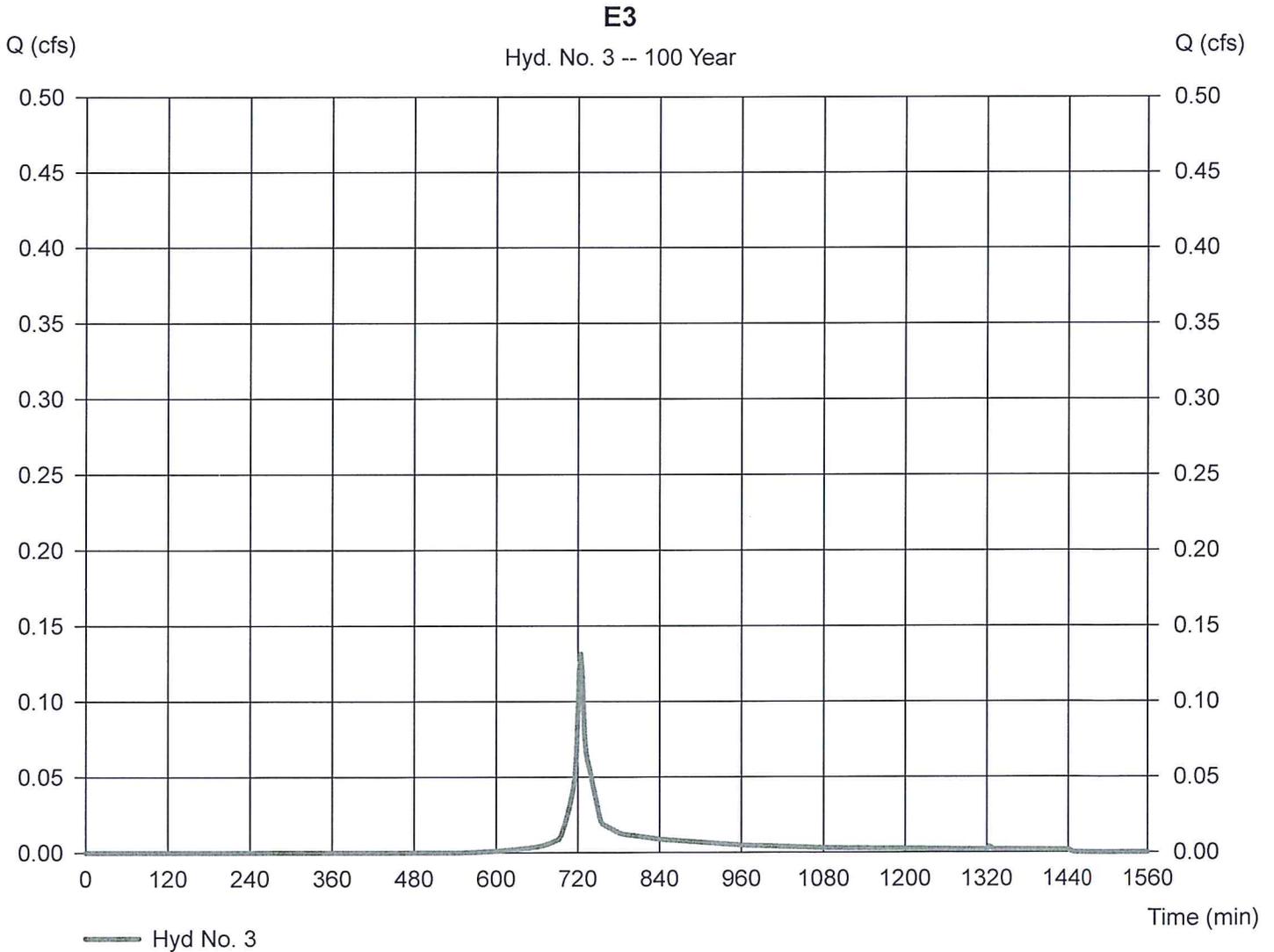
Wednesday, Jul 27, 2016

Hyd. No. 3

E3

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.040 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 0.131 cfs
Time to peak = 724 min
Hyd. volume = 395 cuft
Curve number = 67.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



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	2.501	2	724	7,497	---	-----	-----	P1
2	SCS Runoff	5.442	2	724	16,394	---	-----	-----	P2
3	SCS Runoff	0.024	2	724	82	---	-----	-----	P3
4	SCS Runoff	0.087	2	724	293	---	-----	-----	P4
5	Reservoir	0.010	2	756	292	4	212.62	97.7	Infiltration Area
6	SCS Runoff	0.281	2	724	947	---	-----	-----	P5
7	Reservoir	0.017	2	814	946	6	212.13	430	Roof Drywell
92 POST1.gpw					Return Period: 2 Year		Thursday, Aug 25, 2016		

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	4.138	2	724	12,609	---	-----	-----	P1
2	SCS Runoff	8.824	2	724	27,107	---	-----	-----	P2
3	SCS Runoff	0.057	2	724	175	---	-----	-----	P3
4	SCS Runoff	0.127	2	724	435	---	-----	-----	P4
5	Reservoir	0.011	2	774	435	4	212.87	164	Infiltration Area
6	SCS Runoff	0.411	2	724	1,408	---	-----	-----	P5
7	Reservoir	0.020	2	844	1,407	6	212.88	713	Roof Drywell
92 POST1.gpw					Return Period: 10 Year		Thursday, Aug 25, 2016		

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	6.362	2	724	19,823	---	-----	-----	P1
2	SCS Runoff	13.39	2	724	42,113	---	-----	-----	P2
3	SCS Runoff	0.109	2	724	325	---	-----	-----	P3
4	SCS Runoff	0.181	2	724	629	---	-----	-----	P4
5	Reservoir	0.013	2	792	629	4	213.26	264	Infiltration Area
6	SCS Runoff	0.587	2	724	2,034	---	-----	-----	P5
7	Reservoir	0.026	2	868	2,033	6	214.31	1,112	Roof Drywell
92 POST1.gpw					Return Period: 100 Year		Thursday, Aug 25, 2016		

Pond Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 27, 2016

Pond No. 1 - Infiltration Area

Pond Data

UG Chambers - Invert elev. = 212.50 ft, Rise x Span = 1.33 x 2.83 ft, Barrel Len = 21.36 ft, No. Barrels = 4, Slope = 0.00%, Headers = No
 Encasement - Invert elev. = 212.00 ft, Width = 3.73 ft, Height = 2.33 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	212.00	n/a	0	0
0.23	212.23	n/a	30	30
0.47	212.47	n/a	30	59
0.70	212.70	n/a	58	118
0.93	212.93	n/a	63	180
1.17	213.17	n/a	60	241
1.40	213.40	n/a	57	298
1.63	213.63	n/a	51	349
1.86	213.86	n/a	40	389
2.10	214.10	n/a	30	419
2.33	214.33	n/a	30	449

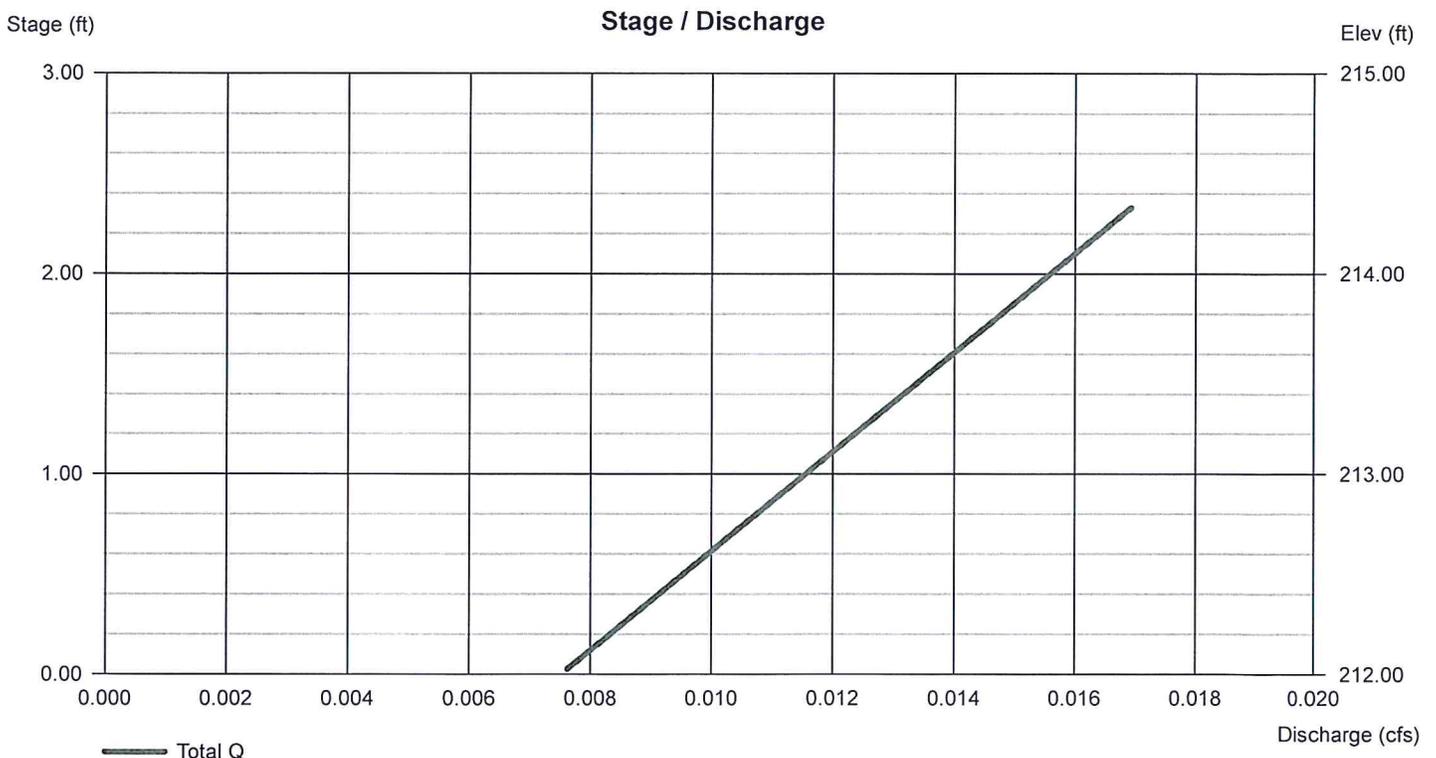
Culvert / Orifice Structures

	[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)	= 1.020 (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

Wednesday, Jul 27, 2016

Pond No. 4 - Roof Drywell

Pond Data

UG Chambers - Invert elev. = 212.00 ft, Rise x Span = 2.50 x 4.25 ft, Barrel Len = 28.49 ft, No. Barrels = 3, Slope = 0.00%, Headers = No
 Encasement - Invert elev. = 211.50 ft, Width = 5.25 ft, Height = 3.50 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	211.50	n/a	0	0
0.35	211.85	n/a	63	63
0.70	212.20	n/a	106	169
1.05	212.55	n/a	138	307
1.40	212.90	n/a	136	443
1.75	213.25	n/a	132	575
2.10	213.60	n/a	125	700
2.45	213.95	n/a	116	817
2.80	214.30	n/a	103	919
3.15	214.65	n/a	74	994
3.50	215.00	n/a	63	1,056

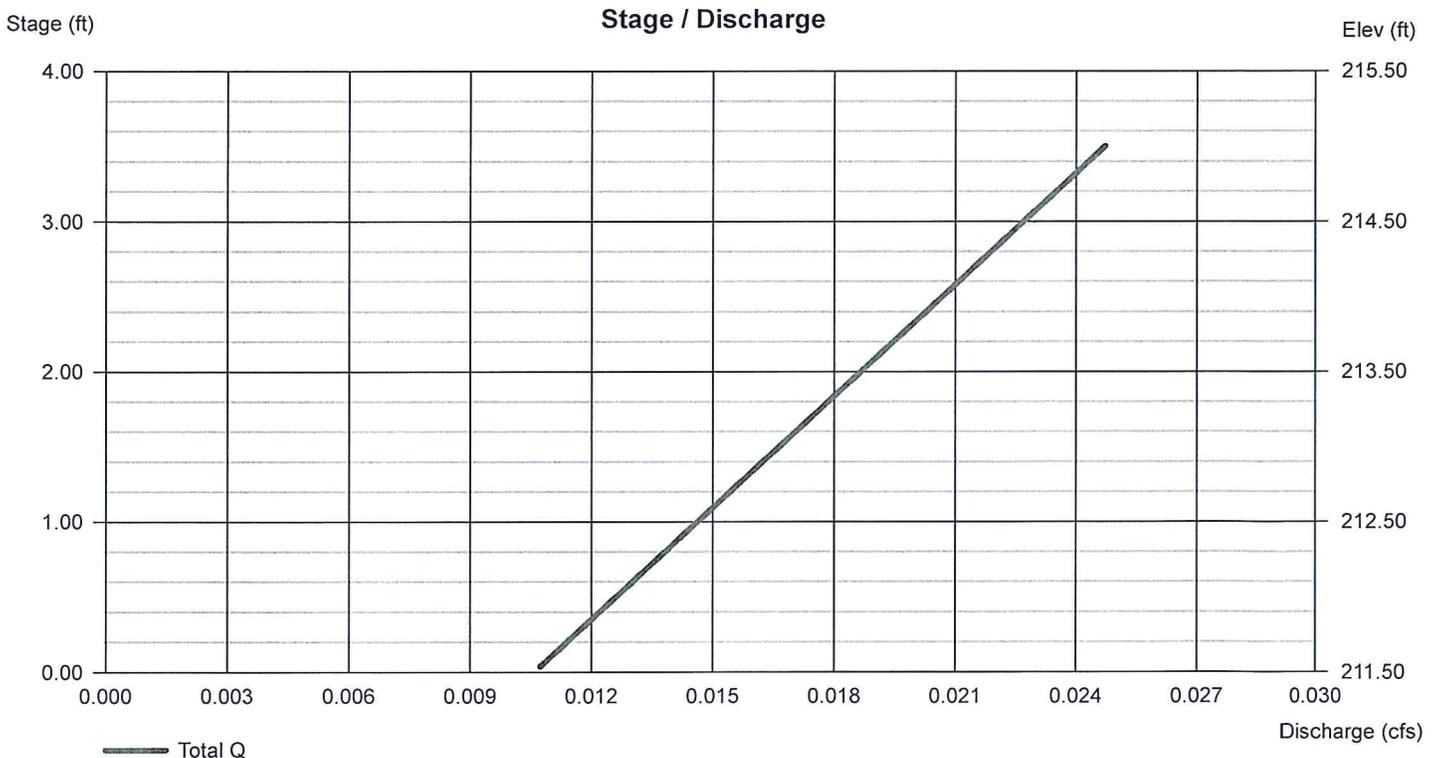
Culvert / Orifice Structures

	[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)	= 1.020 (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).



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

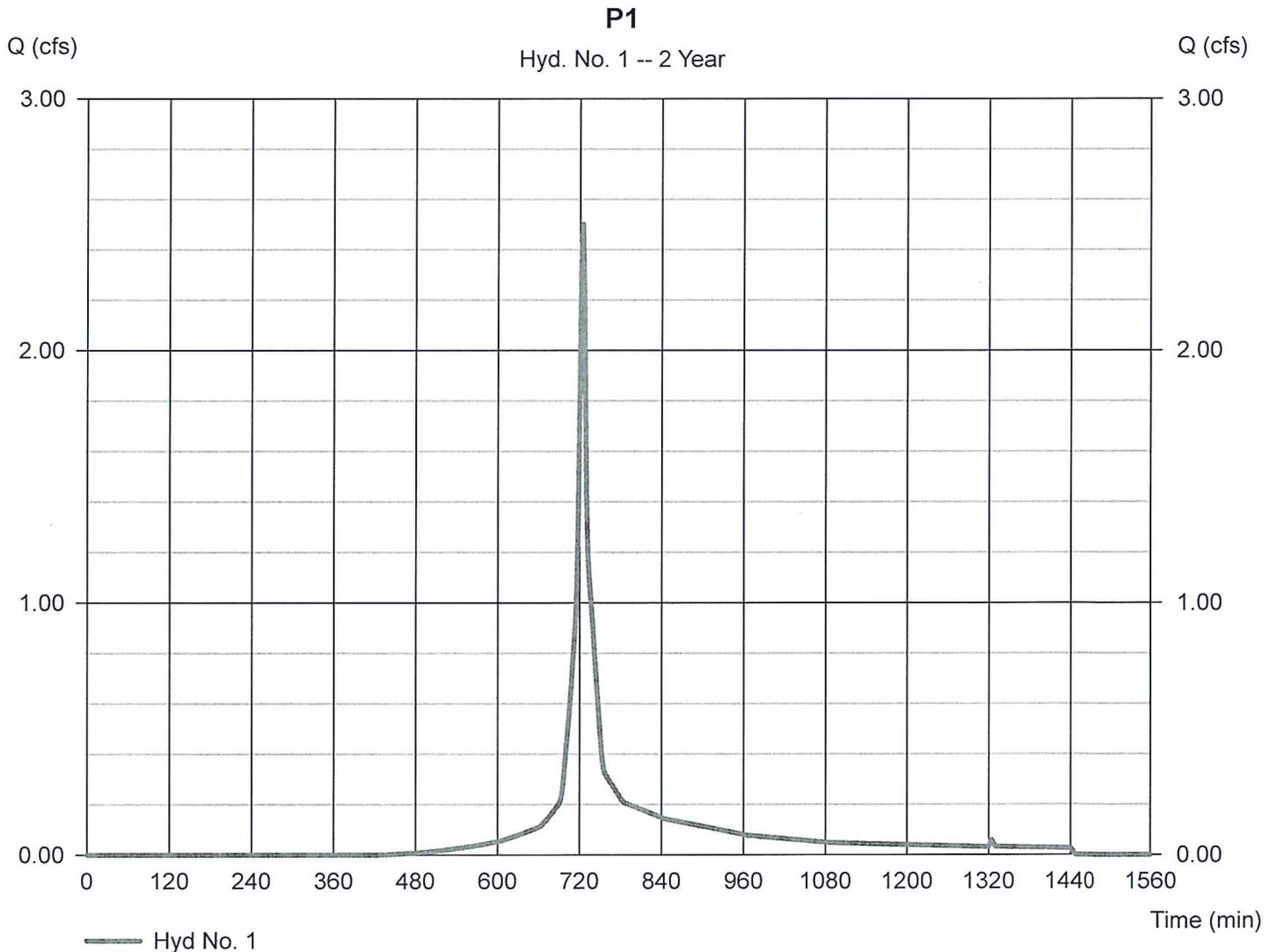
Wednesday, Jul 27, 2016

Hyd. No. 1

P1

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 1.170 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 2.501 cfs
Time to peak = 724 min
Hyd. volume = 7,497 cuft
Curve number = 87.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

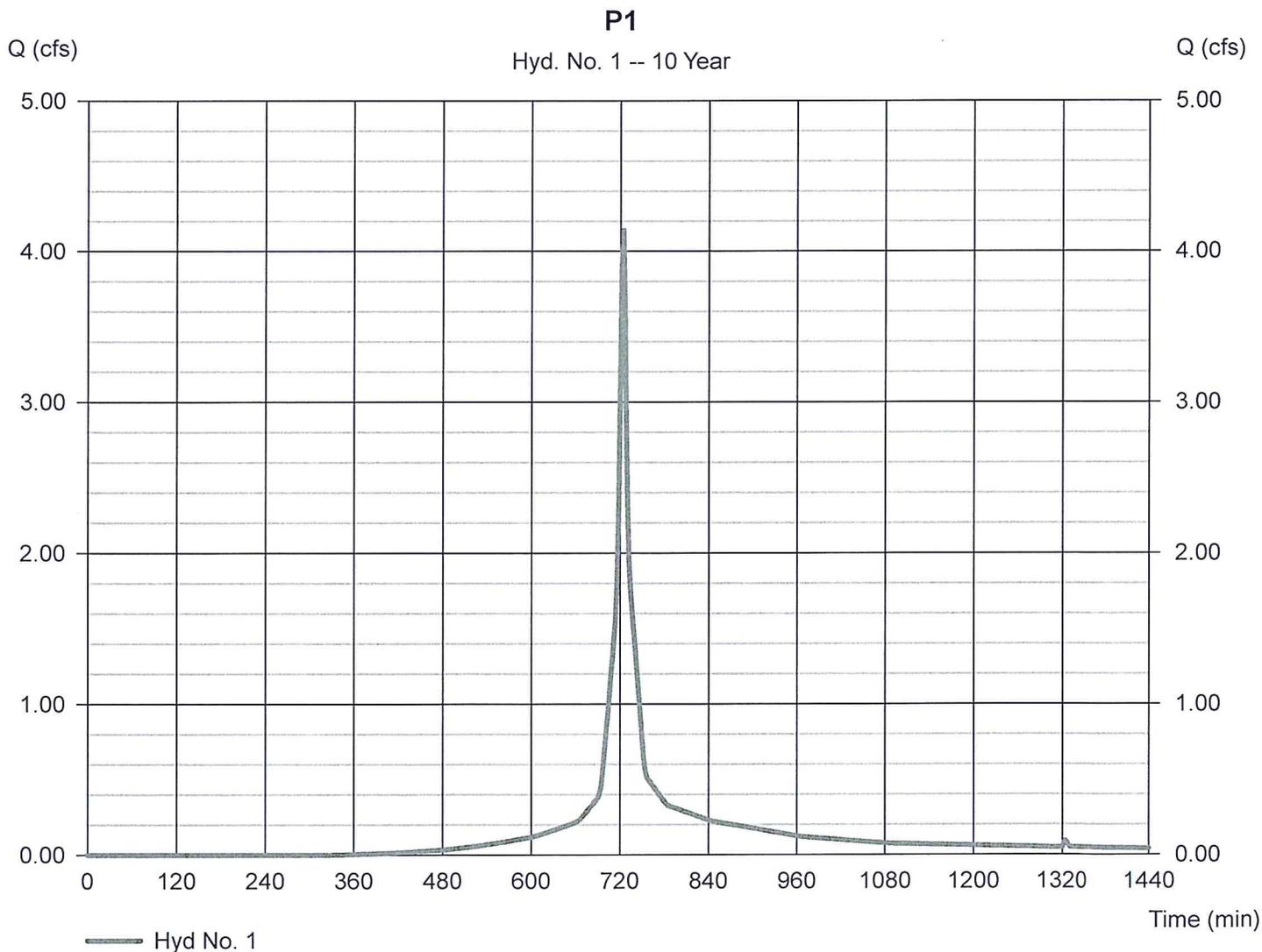
Wednesday, Jul 27, 2016

Hyd. No. 1

P1

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 1.170 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 4.138 cfs
Time to peak = 724 min
Hyd. volume = 12,609 cuft
Curve number = 87.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

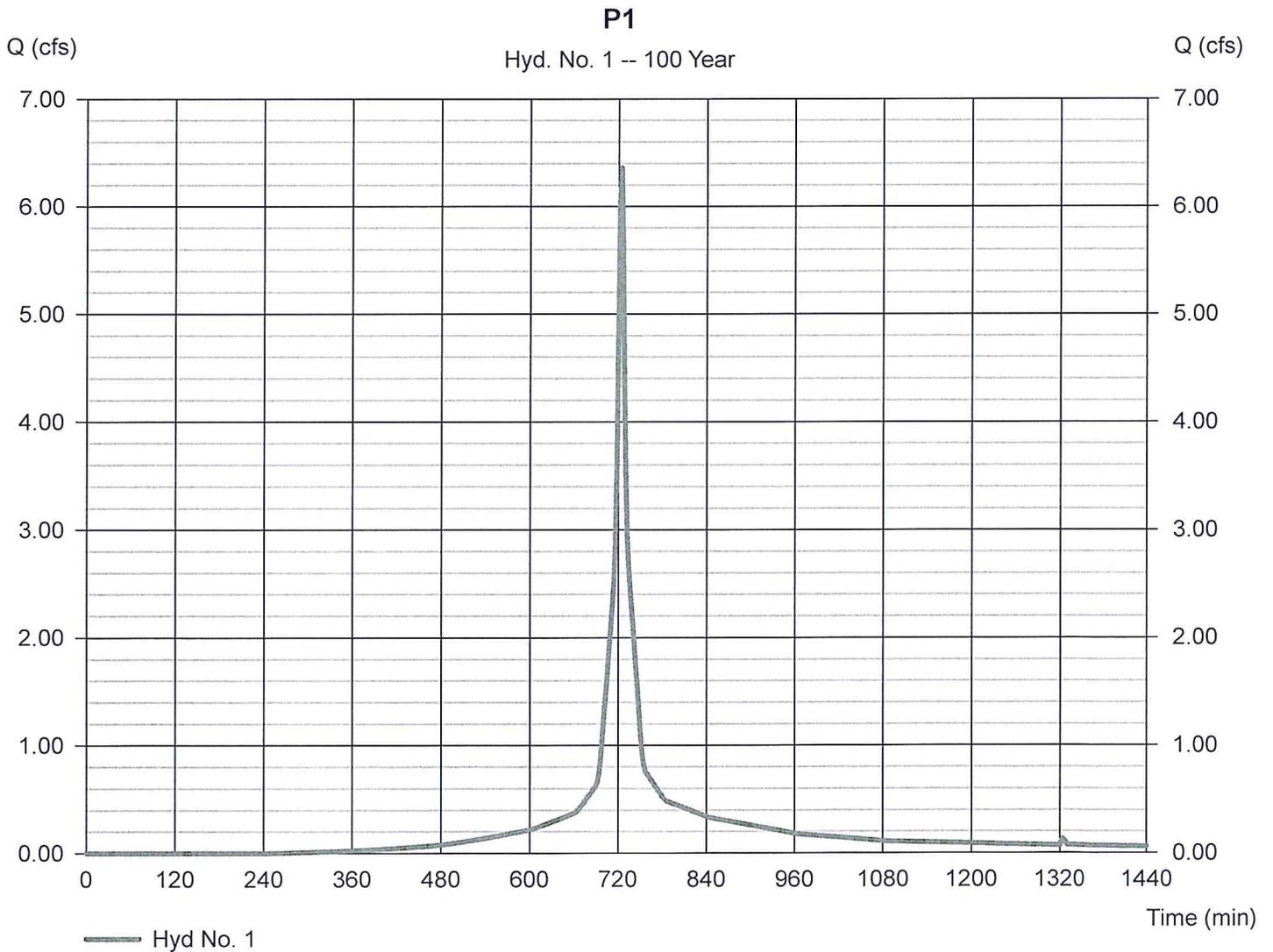
Wednesday, Jul 27, 2016

Hyd. No. 1

P1

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 1.170 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 6.362 cfs
Time to peak = 724 min
Hyd. volume = 19,823 cuft
Curve number = 87.7
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

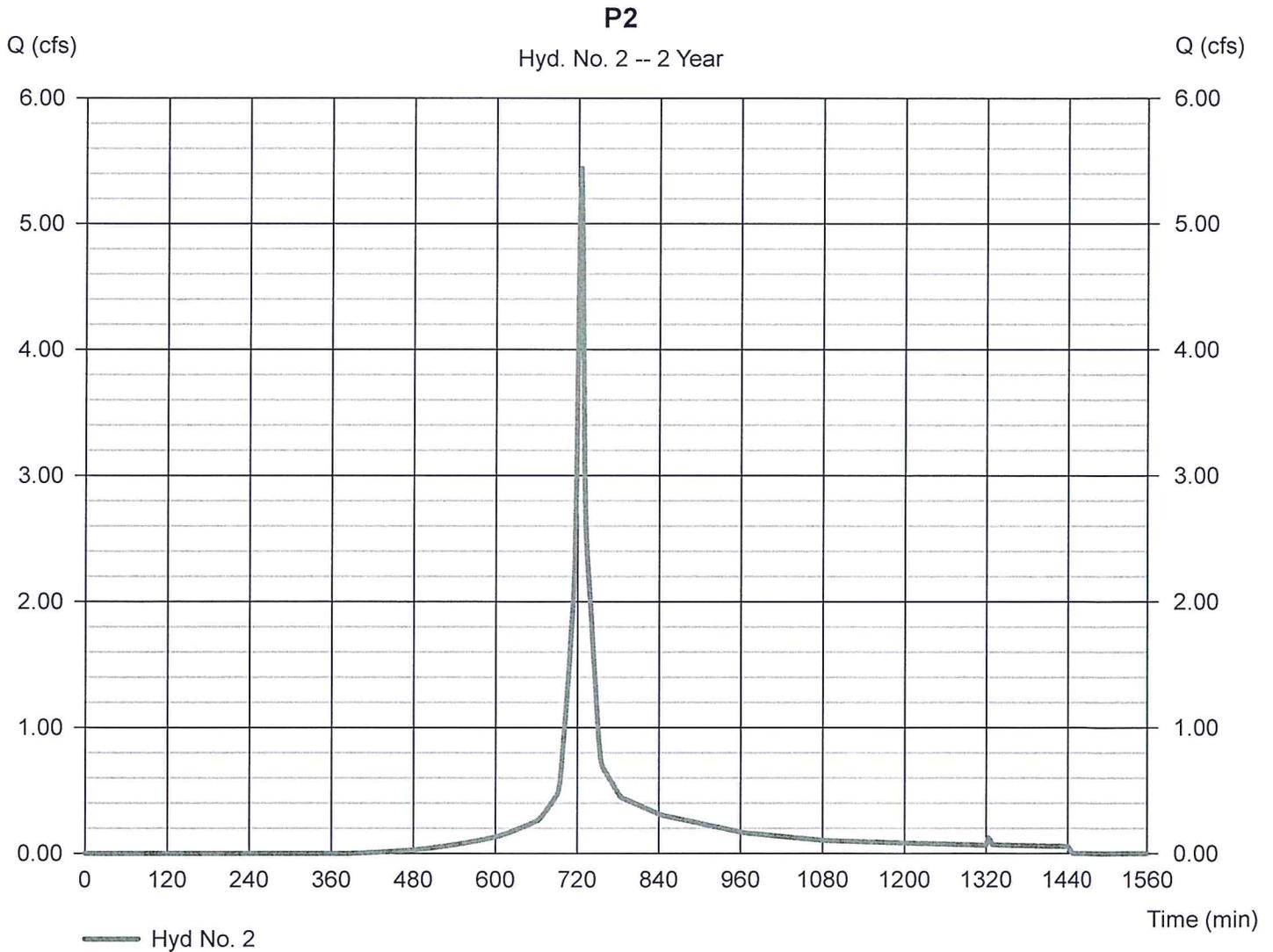
Thursday, Aug 25, 2016

Hyd. No. 2

P2

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 2.410 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 5.442 cfs
Time to peak = 724 min
Hyd. volume = 16,394 cuft
Curve number = 89.1
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

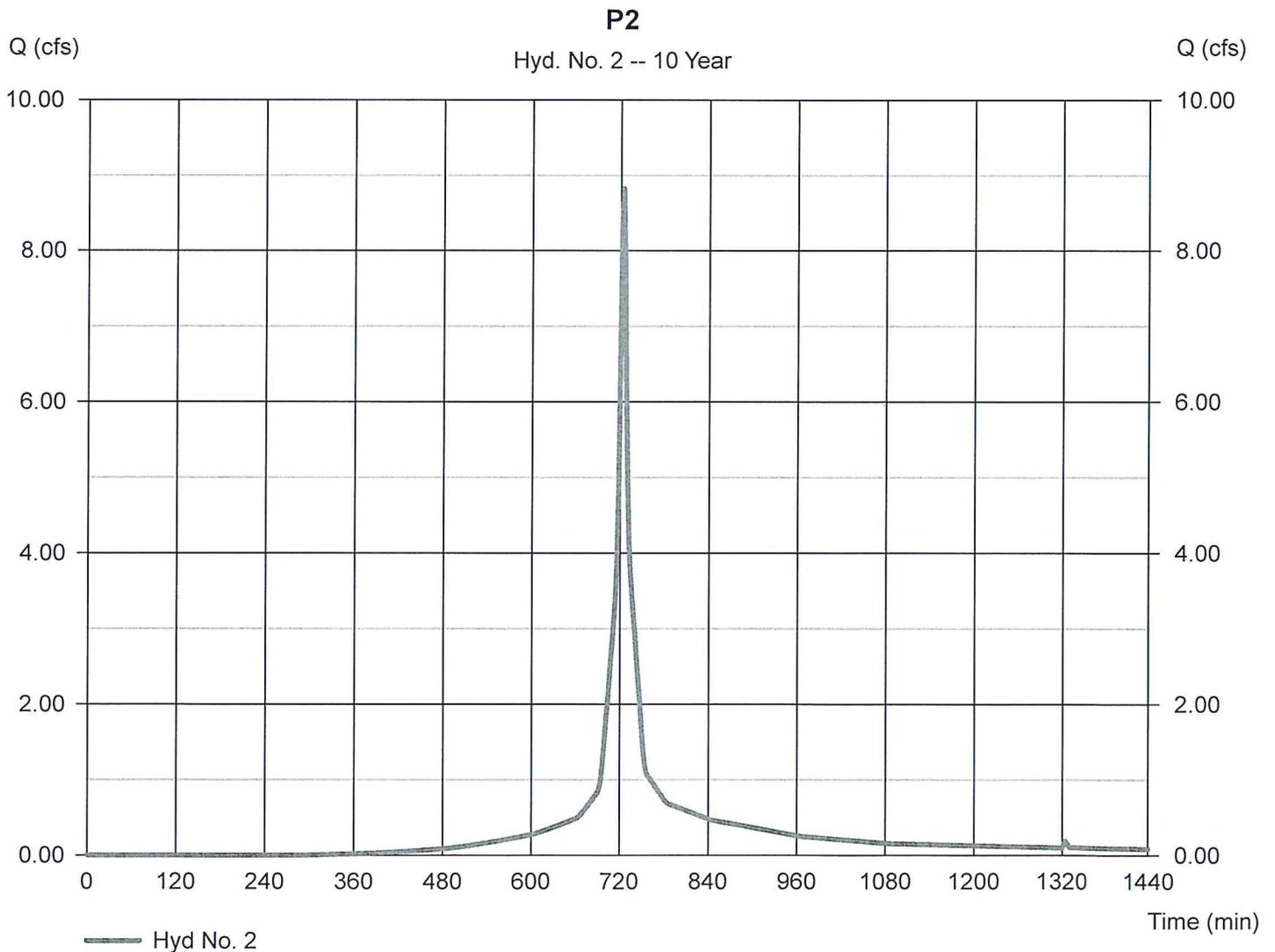
Thursday, Aug 25, 2016

Hyd. No. 2

P2

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 2.410 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 8.824 cfs
Time to peak = 724 min
Hyd. volume = 27,107 cuft
Curve number = 89.1
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

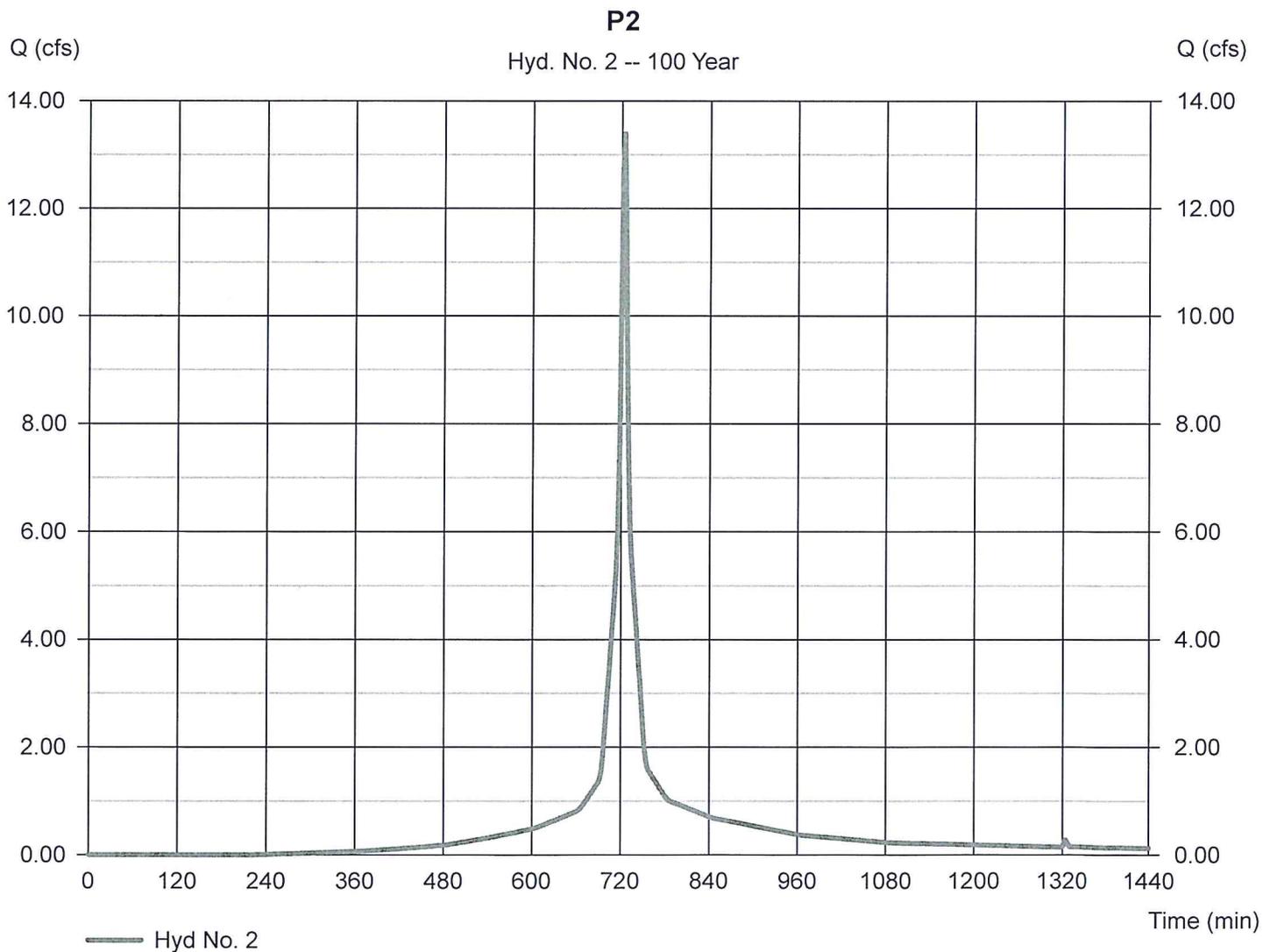
Thursday, Aug 25, 2016

Hyd. No. 2

P2

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 2.410 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 13.39 cfs
Time to peak = 724 min
Hyd. volume = 42,113 cuft
Curve number = 89.1
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

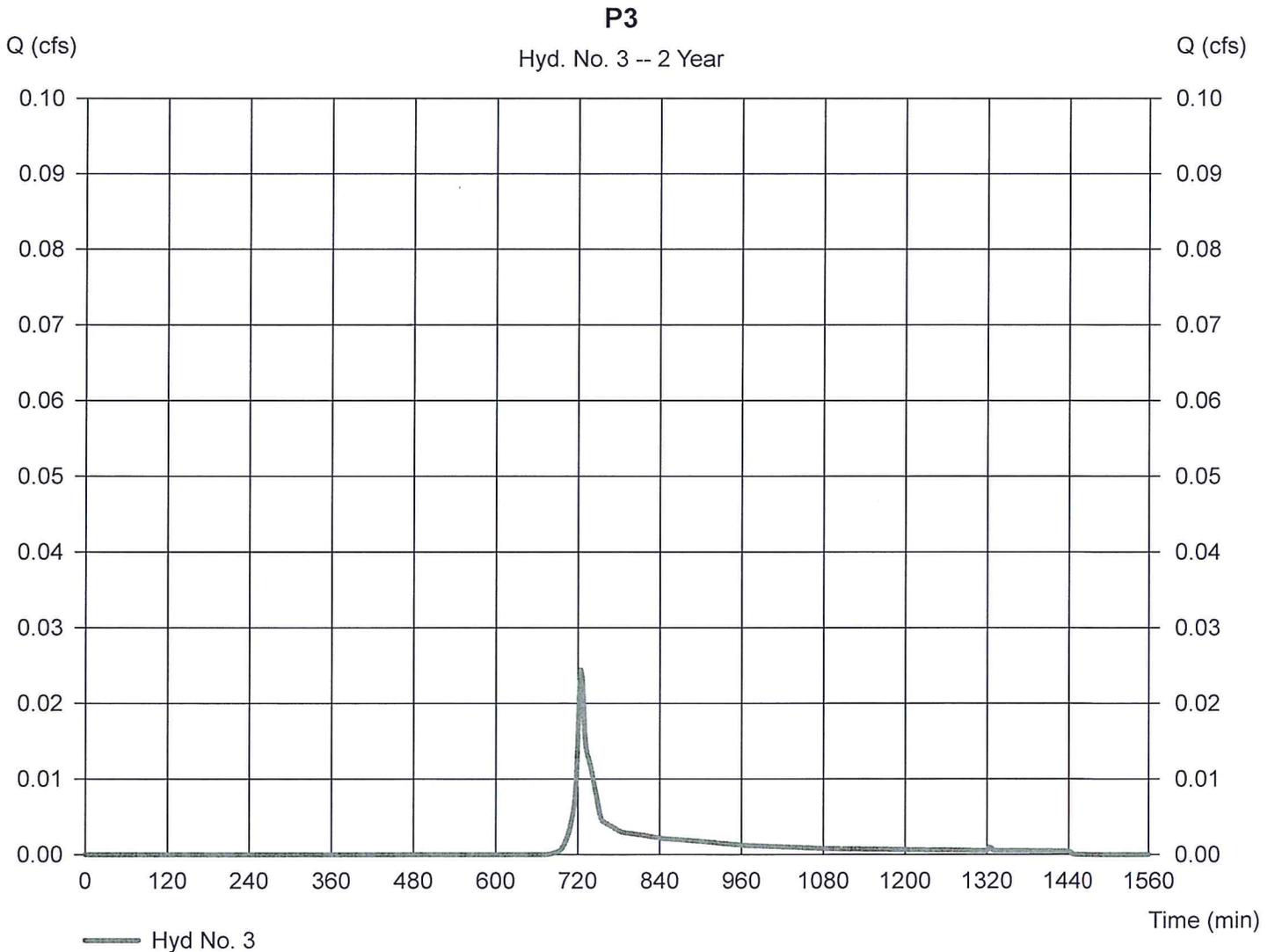
Wednesday, Jul 27, 2016

Hyd. No. 3

P3

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.030 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.024 cfs
Time to peak = 724 min
Hyd. volume = 82 cuft
Curve number = 70.6
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

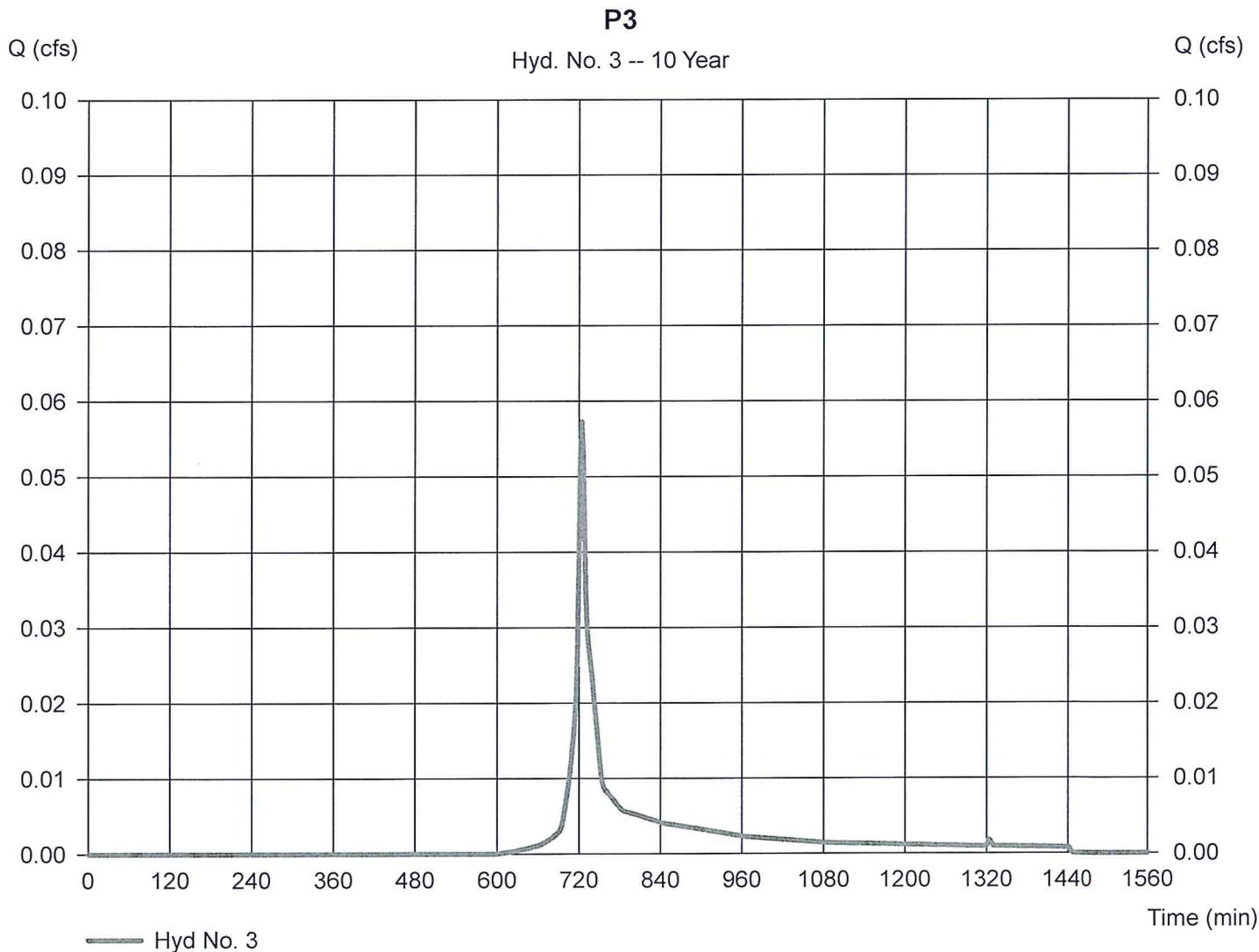
Wednesday, Jul 27, 2016

Hyd. No. 3

P3

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.030 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.057 cfs
Time to peak = 724 min
Hyd. volume = 175 cuft
Curve number = 70.6
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

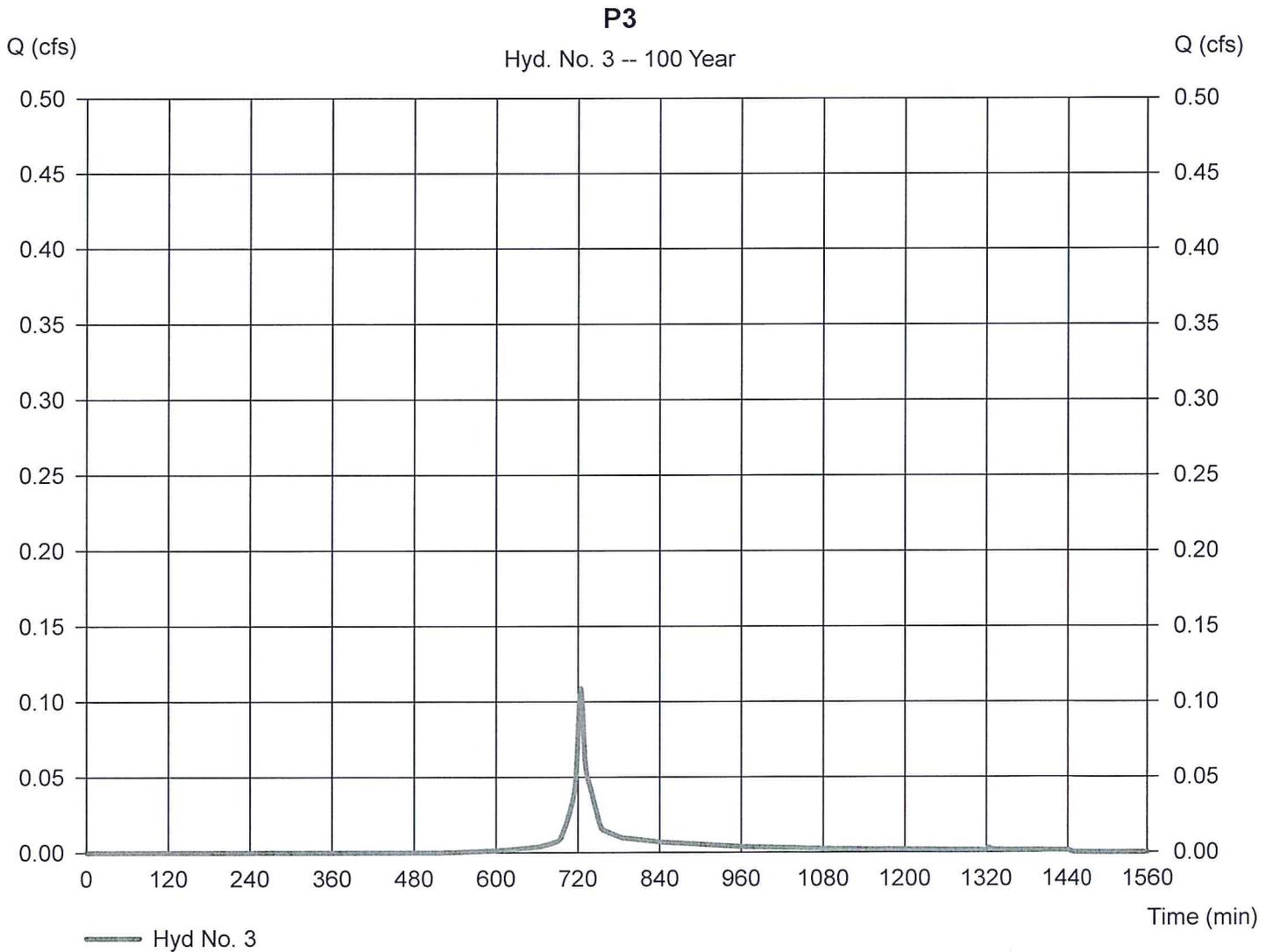
Wednesday, Jul 27, 2016

Hyd. No. 3

P3

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.030 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 0.109 cfs
Time to peak = 724 min
Hyd. volume = 325 cuft
Curve number = 70.6
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

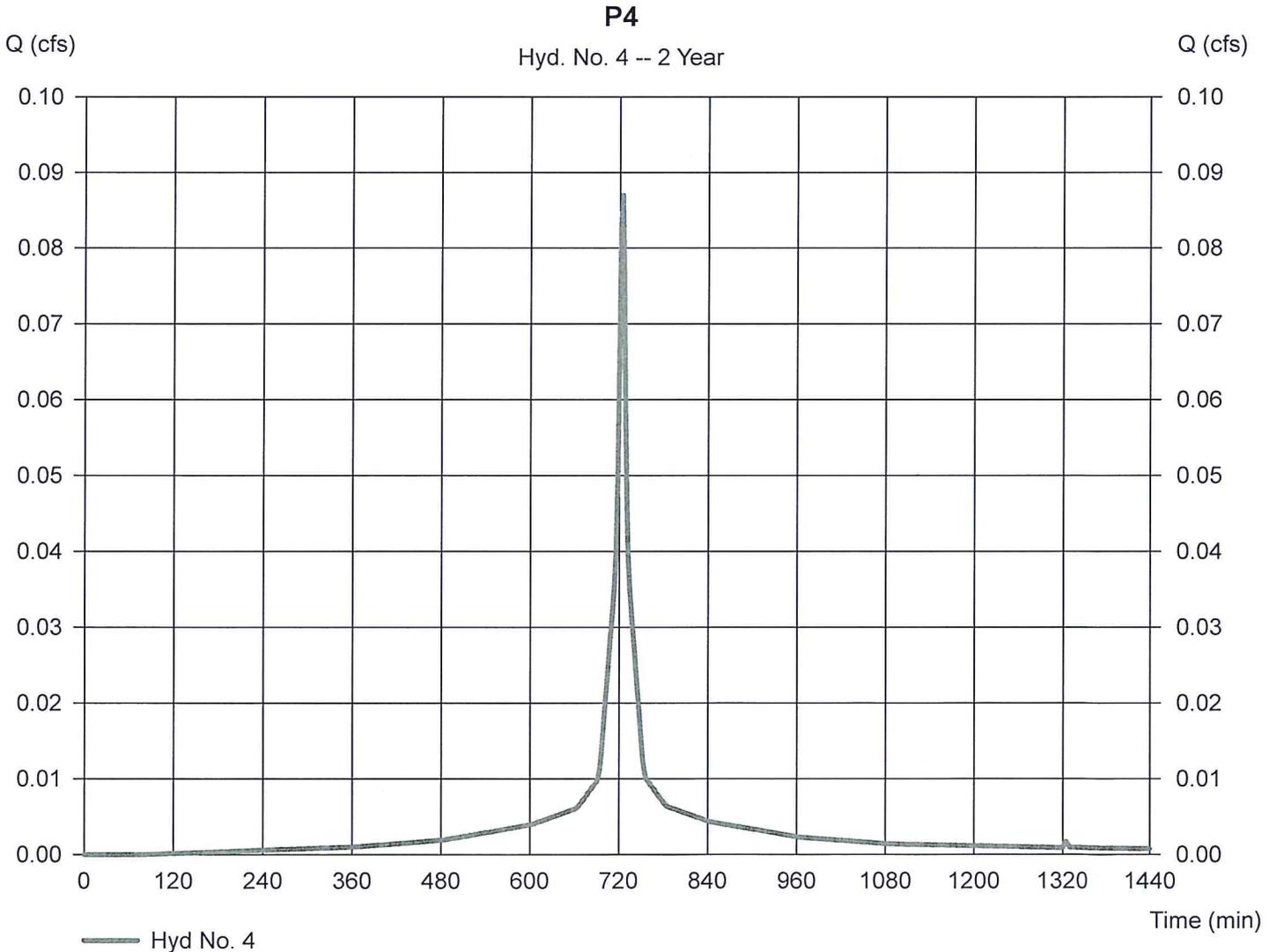
Wednesday, Jul 27, 2016

Hyd. No. 4

P4

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.030 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.087 cfs
Time to peak = 724 min
Hyd. volume = 293 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

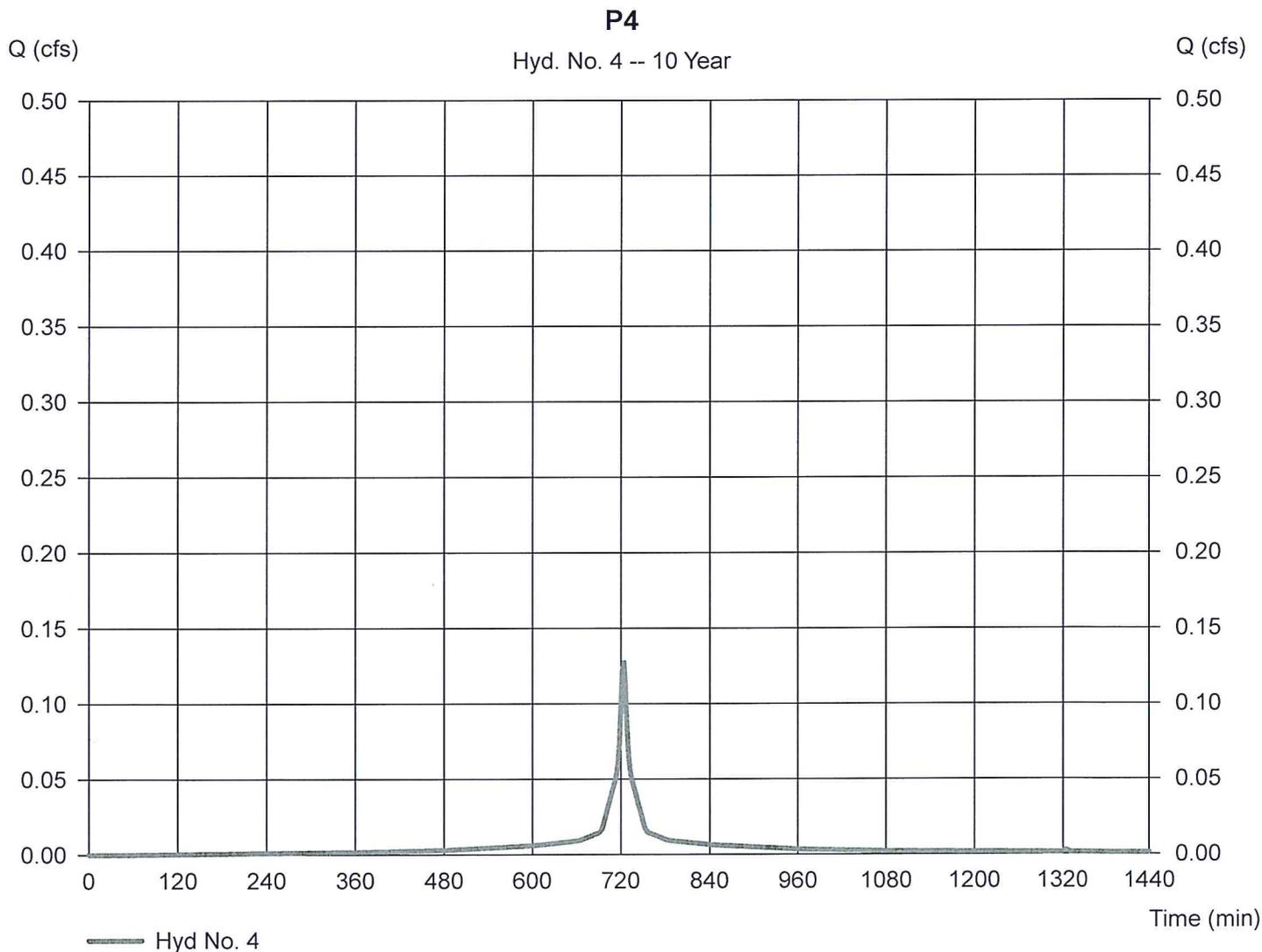
Wednesday, Jul 27, 2016

Hyd. No. 4

P4

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.030 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.127 cfs
Time to peak = 724 min
Hyd. volume = 435 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

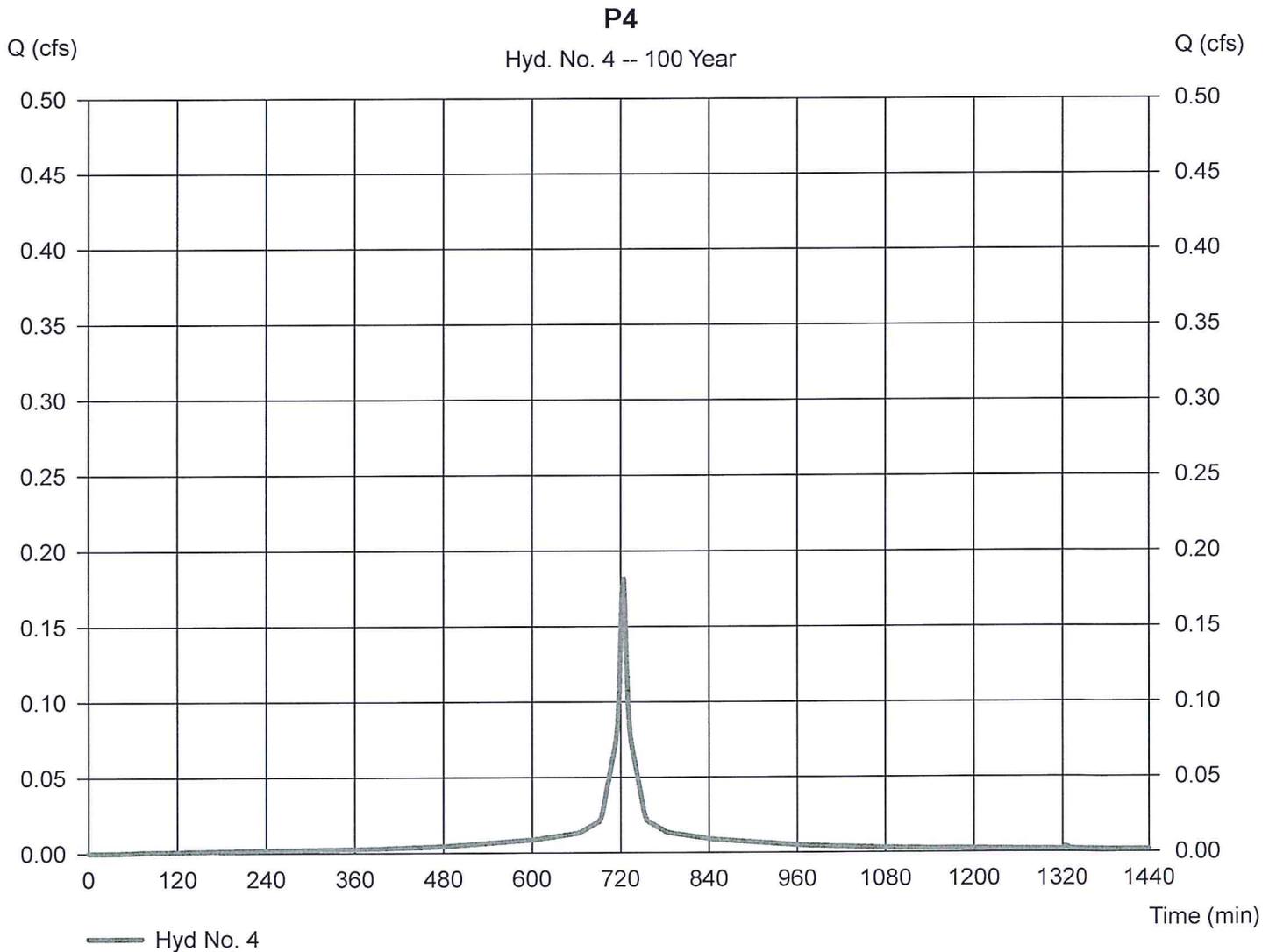
Wednesday, Jul 27, 2016

Hyd. No. 4

P4

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.030 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 0.181 cfs
Time to peak = 724 min
Hyd. volume = 629 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 27, 2016

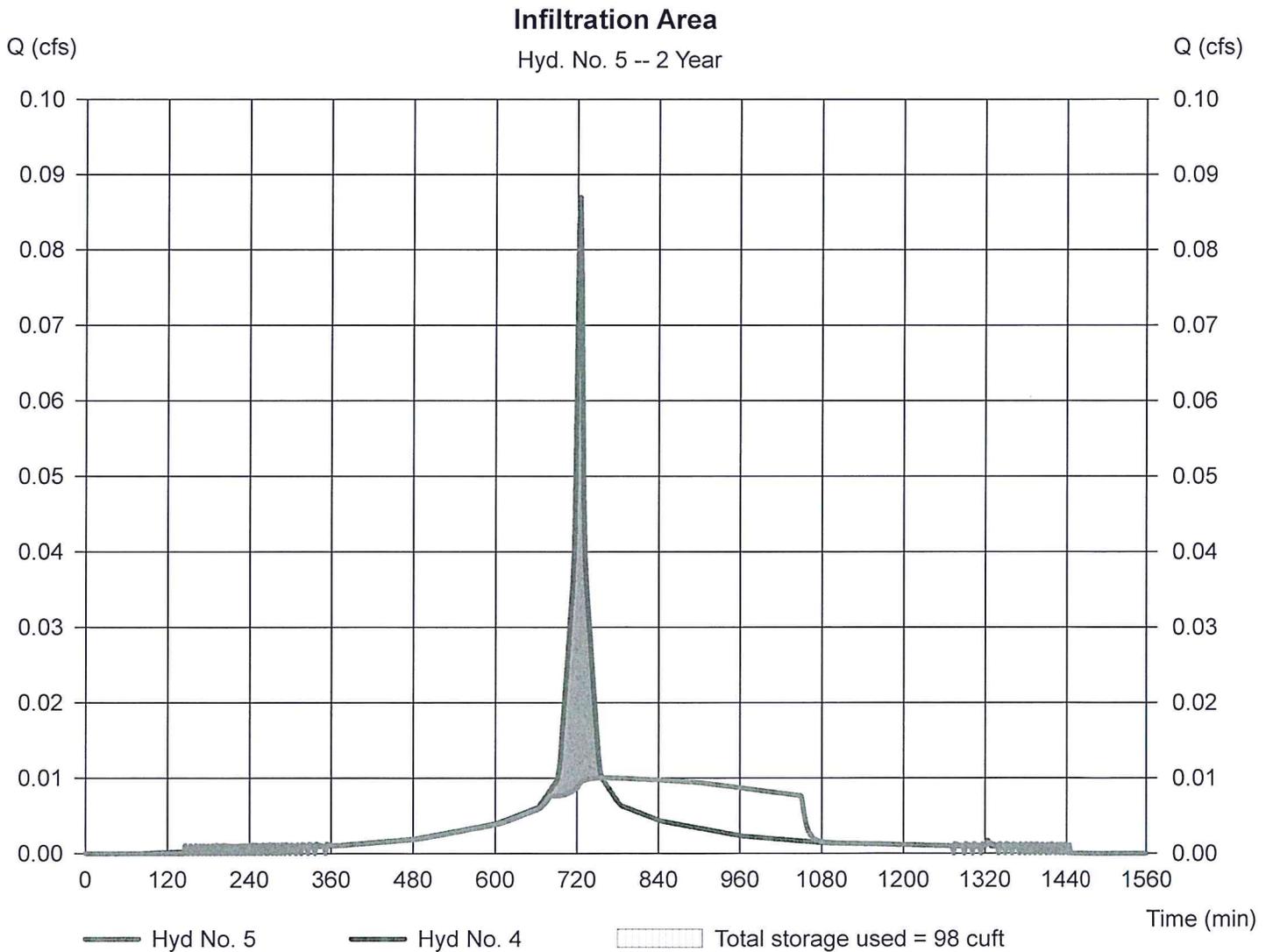
Hyd. No. 5

Infiltration Area

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 2 min
Inflow hyd. No. = 4 - P4
Reservoir name = Infiltration Area

Peak discharge = 0.010 cfs
Time to peak = 756 min
Hyd. volume = 292 cuft
Max. Elevation = 212.62 ft
Max. Storage = 98 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 27, 2016

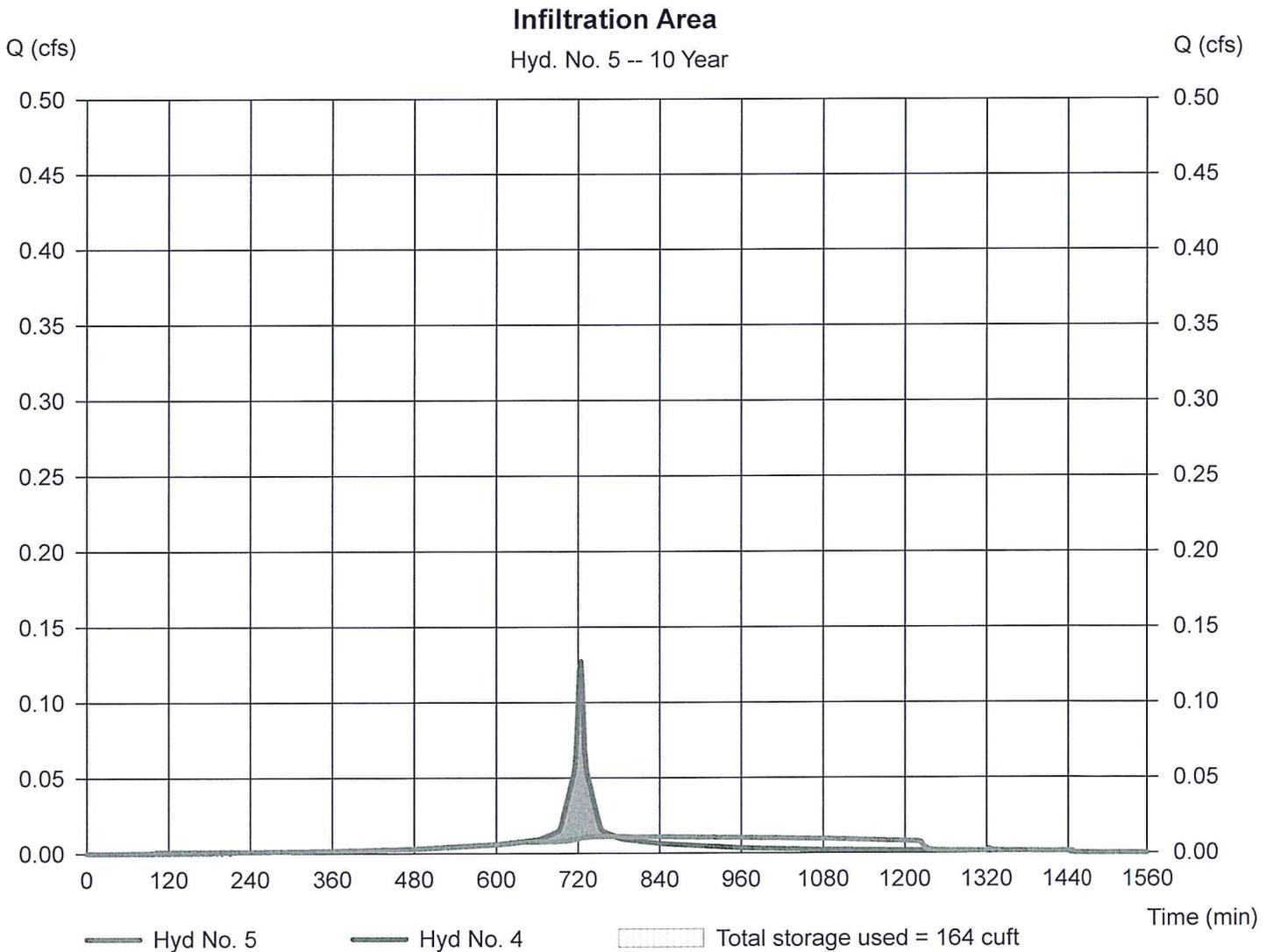
Hyd. No. 5

Infiltration Area

Hydrograph type = Reservoir
Storm frequency = 10 yrs
Time interval = 2 min
Inflow hyd. No. = 4 - P4
Reservoir name = Infiltration Area

Peak discharge = 0.011 cfs
Time to peak = 774 min
Hyd. volume = 435 cuft
Max. Elevation = 212.87 ft
Max. Storage = 164 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 27, 2016

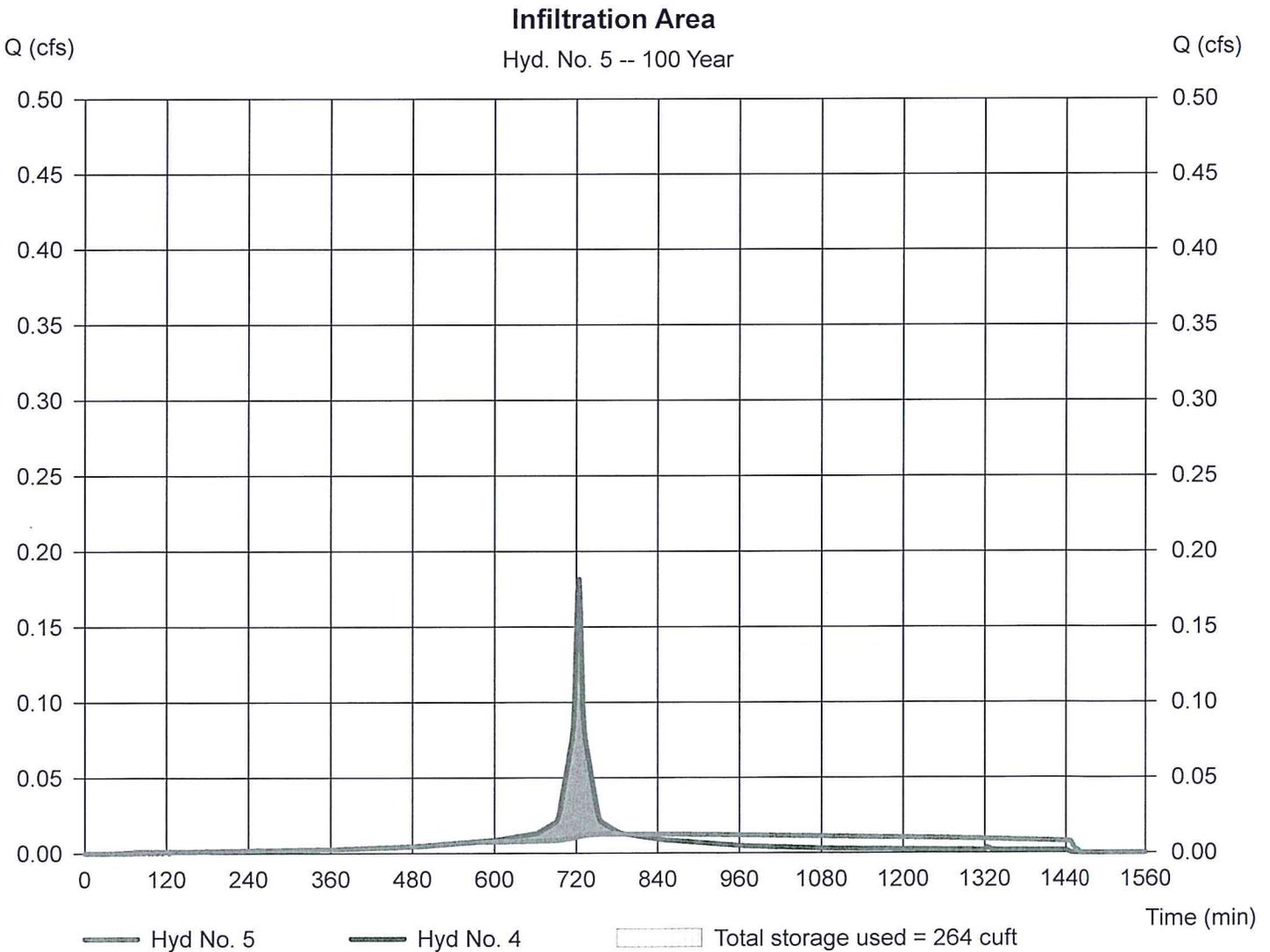
Hyd. No. 5

Infiltration Area

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 2 min
Inflow hyd. No. = 4 - P4
Reservoir name = Infiltration Area

Peak discharge = 0.013 cfs
Time to peak = 792 min
Hyd. volume = 629 cuft
Max. Elevation = 213.26 ft
Max. Storage = 264 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

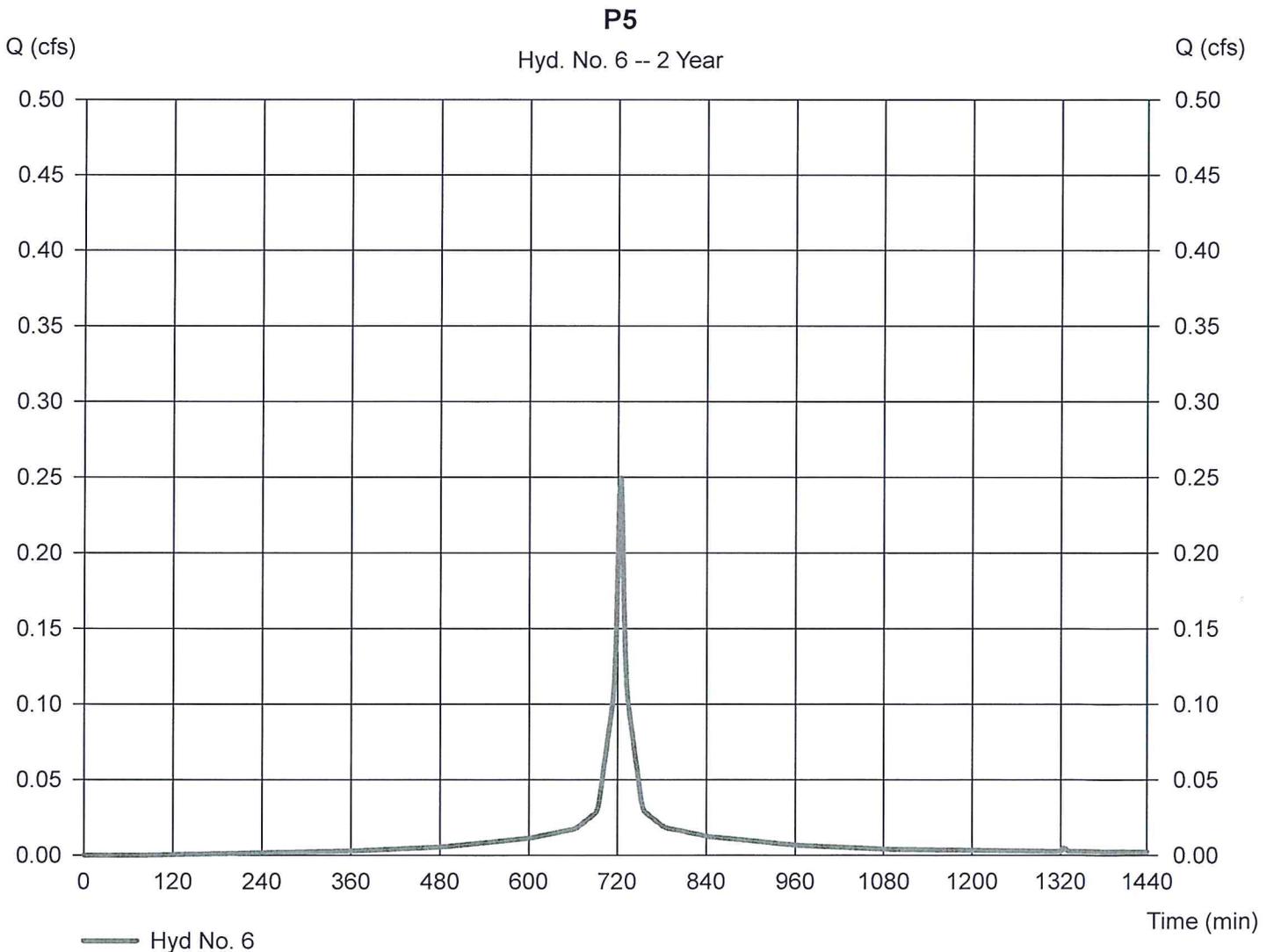
Wednesday, Jul 27, 2016

Hyd. No. 6

P5

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.086 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.249 cfs
Time to peak = 724 min
Hyd. volume = 839 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

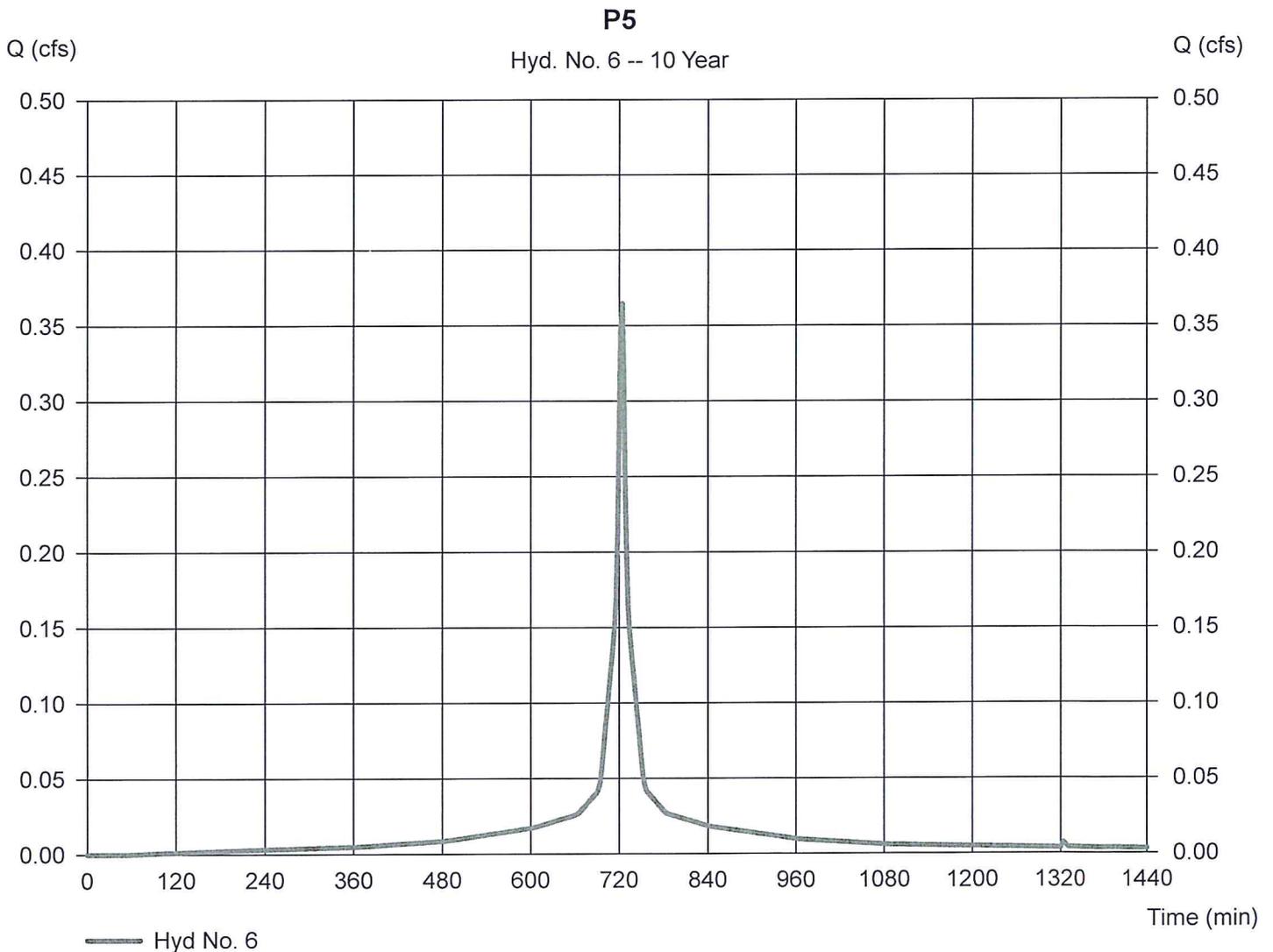
Wednesday, Jul 27, 2016

Hyd. No. 6

P5

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.086 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.364 cfs
Time to peak = 724 min
Hyd. volume = 1,248 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

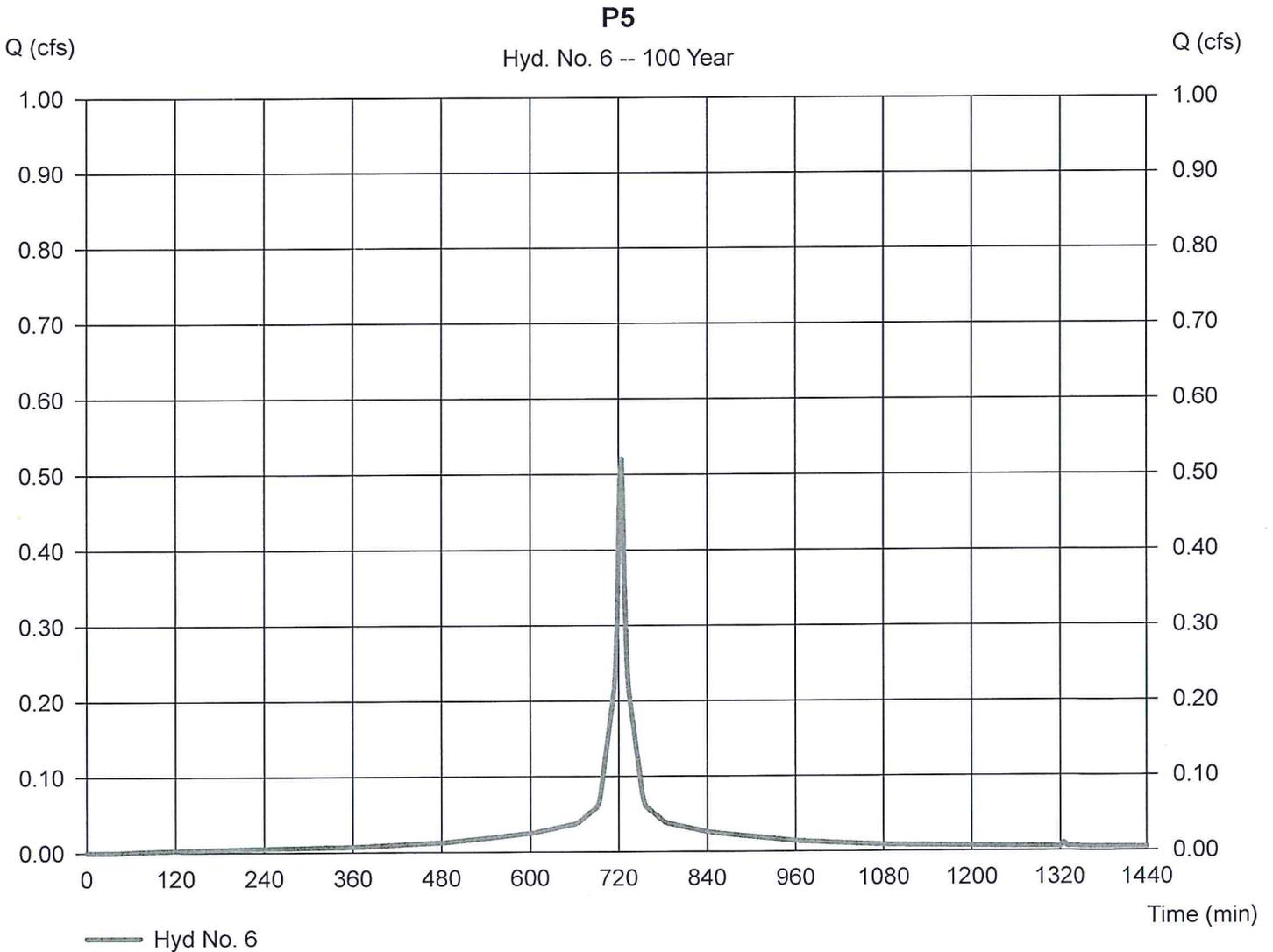
Wednesday, Jul 27, 2016

Hyd. No. 6

P5

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.086 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 0.520 cfs
Time to peak = 724 min
Hyd. volume = 1,803 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 27, 2016

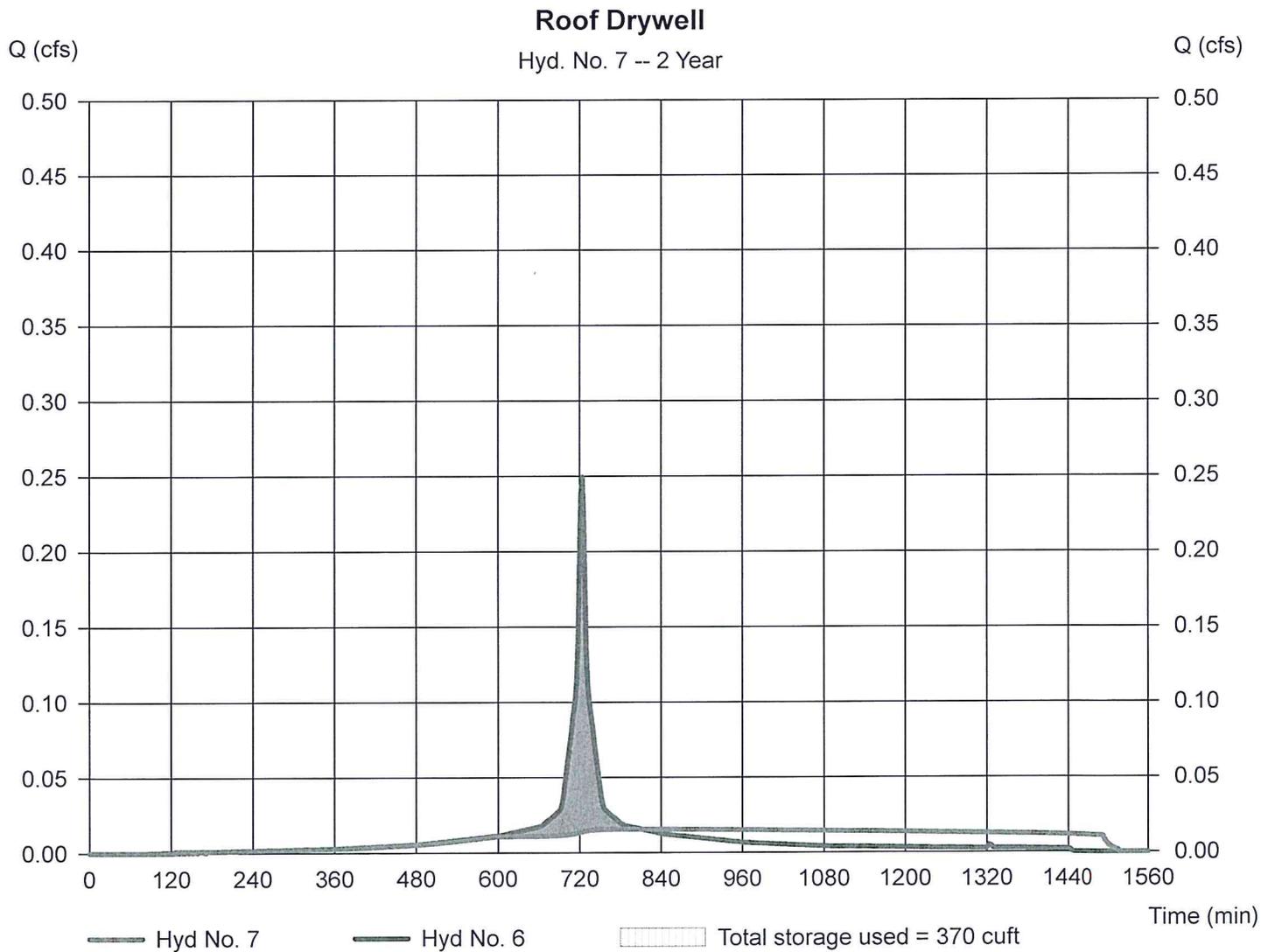
Hyd. No. 7

Roof Drywell

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 2 min
Inflow hyd. No. = 6 - P5
Reservoir name = Roof Drywell

Peak discharge = 0.015 cfs
Time to peak = 812 min
Hyd. volume = 839 cuft
Max. Elevation = 212.71 ft
Max. Storage = 370 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 27, 2016

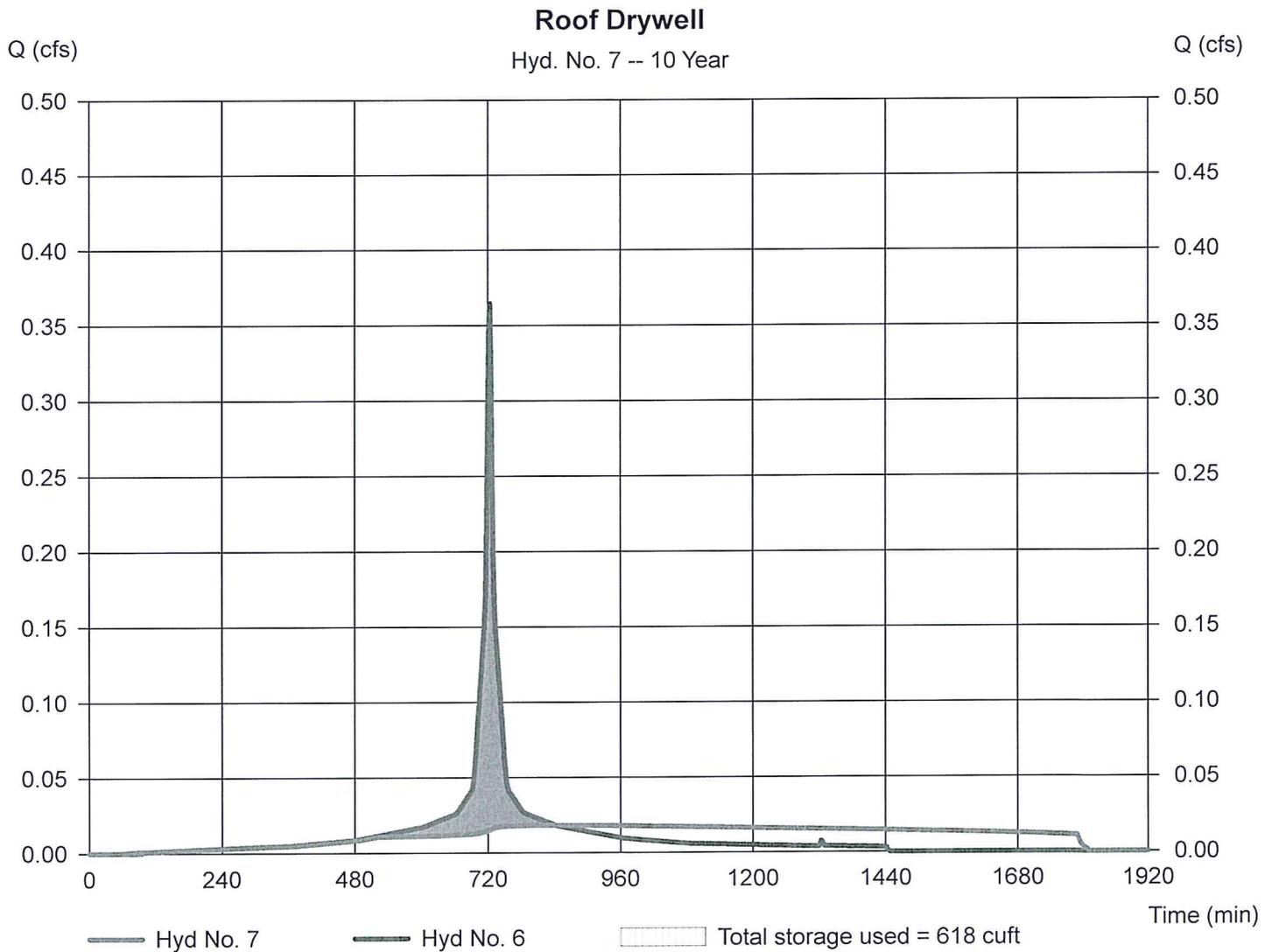
Hyd. No. 7

Roof Drywell

Hydrograph type = Reservoir
Storm frequency = 10 yrs
Time interval = 2 min
Inflow hyd. No. = 6 - P5
Reservoir name = Roof Drywell

Peak discharge = 0.018 cfs
Time to peak = 842 min
Hyd. volume = 1,247 cuft
Max. Elevation = 213.37 ft
Max. Storage = 618 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Jul 27, 2016

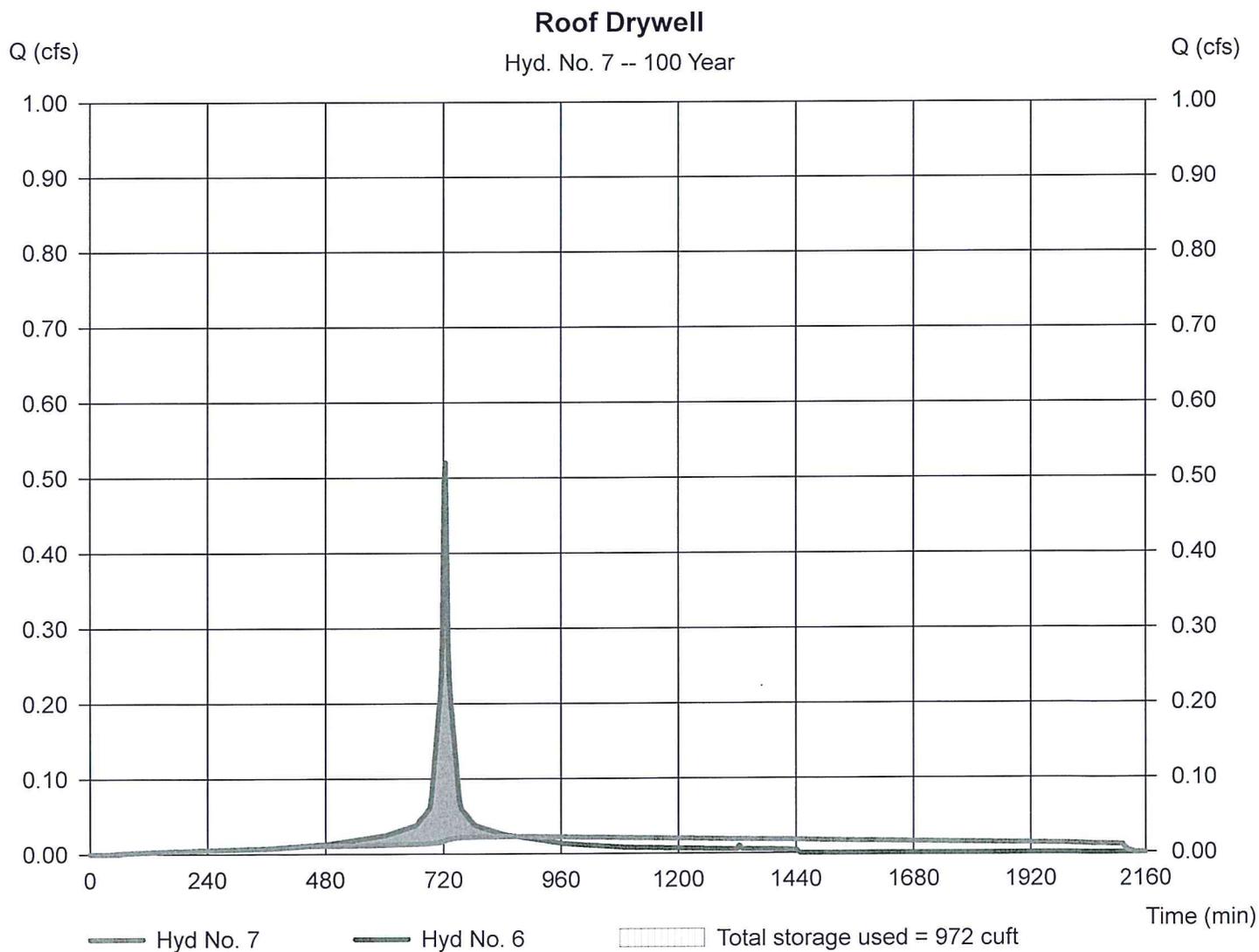
Hyd. No. 7

Roof Drywell

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 2 min
Inflow hyd. No. = 6 - P5
Reservoir name = Roof Drywell

Peak discharge = 0.023 cfs
Time to peak = 870 min
Hyd. volume = 1,803 cuft
Max. Elevation = 214.55 ft
Max. Storage = 972 cuft

Storage Indication method used. Outflow includes exfiltration.



Water Quality Volume Calculations

Project: 362-364 Central St
Location: Acton, MA
Prepared For: Stamski and McNary, Inc.



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)
DMH-1	0.02	0.0000352	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 t_c, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi²/watershed inches (csm/in).

Structure Name	qu (csm/in.)
DMH-1	774.00

1. Compute Q Rate using the following equation:

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

where:

- Q₁ = flow rate 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)
DMH-1	0.03

