Stormwater Management Report

For

Enclave at Boxborough
700-800 Massachusetts Ave
Boxborough, MA

December 22, 2016
Revised June 22, 2017

Applicant:	Boxborough Town Center, LLC P.O. Box 985 Acton, MA 01720

SM-2069

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Narrative

Enclave at Boxborough
Stormwater Management Narrative
December 22, 2016
Revised June 22, 2017

The proposed project is the construction of a 100 unit elderly two-family development, a clubhouse, pool, pickleball court, bocce court, and their associated appurtenances on a 62.84 acre lot. Stormwater management practices have been designed for the proposed private access driveways, parking lot, dwellings, and other impervious surfaces.

According to the Natural Resources Conservation Service (N.R.C.S.) soil survey indicated the presence of Swansea Muck, Freetown Muck, Ridgebury Fine Sandy Loam, Whitman Fine Sandy Loam, Charlton-Hollis-Rock outcrop, Hollis-Rock Outcrop-Charlton Complex, Paxton Fine Sandy Loam, Woodbridge Fine Sandy Loam, and Carlton Fine Sandy Loam. Carlton Fine Sandy Loam rate as Hydrologic Group A. Charlton-Hollis-Rock outcrop and Hollis-Rock Outcrop-Charlton complex rate as Hydrologic Group B. Paxton Fine Sandy Loam and Woodbridge Fine Sandy Loam rate as Hydrologic Group C. Swansea Muck, Freetown Muck, Ridgebury Fine Sandy Loam, and Whitman Fine Sandy Loam rate as Hydrologic Group D.

Pre-Development

The site currently consists of primarily woodlands with a single family dwelling and two paved driveway curb cuts located in the northern portion of the property. There is Bordering Vegetated Wetland (BVW) located in the northeast and northwest portion of the property. The development drainage was broken up into 6 subcatchments.

Runoff from subcatchment E1A, the northern portion of the site along Massachusetts Avenue, drains to the on-site Bordering Vegetated Wetlands associated with the intermittent stream in the center of the property prior to the existing pond. The vegetative coverage is primarily wooded with small amounts of impervious coverage from a portion of the existing dwelling and an old driveway. Excess runoff from the pond drains towards a culvert under Stow Road within a defined earthen channel.

Runoff from subcatchment E1B, the southern rear portion of the site, drains to the on-site Bordering Vegetated Wetlands associated with the intermittent stream in the center of the property prior to the existing pond. The vegetative coverage is primarily wooded with the exception of an on-site barn and cart-path. This site also accepts offsite runoff from the abutting Sheriff's Meadow and Tisbury Meadow developments consisting of open space, and impervious surfaces from driveway and dwellings.

Runoff from subcatchment E2, the northwest portion of the site, drains to a separate on-site Bordering Vegetated Wetlands along the site boundary. The vegetative coverage is primarily wooded with a small amount of impervious coverage from a portion of the existing dwelling and paved driveway.

Runoff from subcatchment E3 sheet flows off-site to the southwest near Priest Lane. The vegetative coverage is primarily wooded.

Runoff from subcatchment E4 sheet flows off-site to the south towards Burroughs Road. The vegetative coverage is primarily wooded.

Runoff from subcatchment E5 sheet flows off-site to the southeast towards stow Road. The vegetative site coverage is primarily wooded.

Post-Development

The project proposes a series of private roads to serve 50 two-family dwellings reserved for the elderly. A clubhouse, pool, pickleball court, bocce court, and extra parking are also proposed. The total length of road is approximately 4,958 feet long. The roadway will make use of deep sump hooded catch basins and a combination of infiltration basins and underground chambers. Some of the dwellings are connected to individual roof drywells, while others utilize infiltration basins.

Subcatchment P1A remains undeveloped with the exception of some grading for the road and infiltration basins, and remains similar to subcatchment E1A but a smaller area. It will continue to drain to the Bordering Vegetated Wetlands prior to the intermittent stream in the center of the site.

Subcatchment P1B remains undeveloped with the exception of some grading for the infiltration basins, soil absorption system, and a portion of the existing Sheriff's Meadow dwellings on the neighboring lot. It will remain similar to subcatchment E1B but a smaller area. It will continue to drain to the Bordering Vegetated Wetlands prior to the intermittent stream in the center of the site.

Subcatchment P1C contains a portion of Private Drive A, future reserve parking, associated sidewalk, the water supply treatment area, a portion of the parking associated with the clubhouse, a side yard area drain near the mail center and the roof of model units (Dwelling 1). It also contains open space around the proposed clubhouse. Runoff from the road and driveways are collected by deep sump and hooded catch basins within the road. Runoff is then directed into sediment forebays within the infiltration basin. An outlet structure will control the rate of runoff from this basin into subcatchment 1A.

Subcatchment P1D contains a portion of Private Drive A, the associated sidewalks, and the private drives to several of the two-family dwellings. It also contains open space around the proposed dwellings. Runoff from the road flows to catch basins, directing runoff to drainage manholes, a sediment forebay, and infiltration basin SMA-3. Roof runoff (Dwellings 2,3,4,5,16 & 17) previously directed to Roof Drywell 1, have been redirected to Infiltration Basin SMA-3. An outlet structure will control the rate of runoff from this basin into subcatchment 1B.

Subcatchment P1E contains a portion of Private Drive A, all of Private Drive C, open space around the proposed dwellings, and a portion of off-site land. It now contains units 2-5, 16-19 and 38-41. Runoff from the road flows to catch basins, directing runoff to drainage manholes, a sediment forebay, and infiltration basin SMA-4. The roof runoff from the units will be piped directly into the infiltration basin. An outlet structure will control the rate of runoff from this basin into subcatchment 1B.

Subcatchment P1F has been eliminated and combined into subcatchment 1E. The roof runoff from Dwellings 38, 39, 40 & 41 will now be collected by area drains along the site boundary and directed into Infiltration Basin SMA-4. This adjustment will maintain a woodland area behind the fire cistern along Drive A adjacent to Dwelling 41.

Subcatchment P1G has been adjusted and now collects roof runoff from Dwelling units 20-23, 34-37, 49-50 along with open space around these units, and some off-site land. Roof runoff will be collected by area drains or directed to roadway drainage and directed into Infiltration Basin SMA-6.

Subcatchment P1H contains all of Private Drive B, units 26-28 and now 32 & 33, and open space around these units. Roof runoff will be collected by the area drains and connected to the road drainage system. Runoff from the road flows to catch basins, directing runoff to drainage manholes, a sediment forebay, and subsurface infiltration chambers.

Subcatchment P1I contains units 24, 25, 29-31 and 42-48, and the open space in the center of Private Drive B. Roof runoff will be collected by the area drains. Open space runoff flows overland and eventually drains to a series of infiltration areas connected via pipes underneath Private Drive B.

Subcatchment P2A contains the portion of the adjusted Private Drive A that connects to Massachusetts Avenue, future reserved parking, the bocce and pickleball courts, the pool and surrounding patio, the clubhouse, and a portion of the associated parking. Runoff from the road and parking area flows to catch basins, directing runoff to drainage manholes, a sediment forebay, and infiltration basin SMA-1. An outlet structure will control the rate of runoff from this basin into subcatchment 2B.

Subcatchment P2B contains undeveloped open space behind the proposed clubhouse and amenities and Dwelling 1. Runoff will drain sheet flow towards the Bordering Vegetated Wetland along the property boundary.

Subcatchment P3 contains open space outside of the cul-de-sac area of Private Drive C, and includes the emergency connection to Priest Lane. Runoff from this subcatchment flows overland towards the southwest near Priest Lane and into the existing catch basin in Priest Lane. Additional vegetation has been retained along this boundary.

Subcatchment P4 contains a small amount of open space around the southern portion of Private Drive B behind Dwellings 32, 33 & 34. Area drains are provided to direct roof runoff into the development. Runoff will continue to sheet flow offsite to the south.

Subcatchment P5 contains a small amount of open space behind unit 31off Private Drive B at the southeastern portion of the site. Runoff from woodland flows offsite to the southeast.

Individual roof drywells in front of garage doors are provided for units 6, 7, 8 & 14. Roof Drywell 2 (RD2) is provided for units 9-13 near intersection of Drive A & Drive C.

There will be no increase in runoff leaving the site for the 2 year, 10 year, 25 year, and 100 year storm event comparing pre-development to post-development.

Design Basis

1. The United States Department of Agriculture Natural Resource Conservation Service (N.R.C.S.) TR55 methodology was used to determine offsite rates of runoff.
2. The twenty-four hour rainfall, taken from N.R.C.S. publications, is 6.4 inches for the 100-year storm, 5.3 inches for the 25-year storm, 4.5 inches for the 10-year storm, and 3.1 inches for the 2-year storm event.
3. The hydrologic calculations were performed using the computer program: "Hydraflow Hydrographs 2007" by Intelisolve.
4. The soil types of the site were taken from the N.R.C.S. Soil Survey Map for Middlesex County.
5. Soil conditions and estimated seasonal high groundwater table were based on on-site soil evaluations.
6. The Natural Resources Conservation Service (N.R.C.S.) soil survey indicated the presence of Swansea Muck, Freetown Muck, Ridgebury Fine Sandy Loam, Whitman Fine Sandy Loam, Charlton-Hollis-Rock outcrop, Hollis-Rock Outcrop-Charlton Complex, Paxton Fine Sandy Loam, Woodbridge Fine Sandy Loam, and Carlton Fine Sandy Loam. Carlton Fine Sandy Loam rate as Hydrologic Group A. Charlton-Hollis-Rock outcrop and Hollis-Rock Outcrop-Charlton complex rate as Hydrologic Group B. Paxton Fine Sandy Loam and Woodbridge Fine Sandy Loam rate as Hydrologic Group C. Swansea Muck, Freetown Muck, Ridgebury Fine Sandy Loam, and Whitman Fine Sandy Loam rate as Hydrologic Group D.

Checklist for Stormwater Report

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

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 8[2]
- 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

COMMONWEALTH OF MASSACHUSETTS
GEORGE DIMAKARAKOS
CIVIL
No. 41281
REGISTERED PROFESSIONAL ENGINEER

6/23/17

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 Structures, Sediment Forebays, Infiltration Basins

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 (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 Field[1]

☐ 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 (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 (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 propriety 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 (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 (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	1.216	2	744	9,894	----	------	------	E1A
2	SCS Runoff	2.441	2	750	26,575	----	------	------	E1B
3	SCS Runoff	0.338	2	752	3,402	----	------	------	E2
4	SCS Runoff	0.225	2	750	2,361	----	------	------	E3
5	SCS Runoff	0.133	2	750	1,402	----	------	------	E4
6	SCS Runoff	0.032	2	742	306	----	------	------	E5
8	Combine	3.534	2	748	36,468	1, 2,	------	------	TOTAL E1

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	5.900	2	734	29,999	----	------	------	E1A
2	SCS Runoff	15.12	2	740	90,124	----	------	------	E1B
3	SCS Runoff	1.790	2	742	10,871	----	------	------	E2
4	SCS Runoff	1.339	2	740	7,896	----	------	------	E3
5	SCS Runoff	0.795	2	740	4,689	----	------	------	E4
6	SCS Runoff	0.217	2	728	1,024	----	------	------	E5
8	Combine	20.66	2	738	120,123	1, 2,	------	------	TOTAL E1

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	9.627	2	732	44,653	----	------	------	E1A
2	SCS Runoff	26.03	2	738	138,050	----	------	------	E1B
3	SCS Runoff	2.977	2	740	16,404	----	------	------	E2
4	SCS Runoff	2.289	2	736	12,052	----	------	------	E3
5	SCS Runoff	1.359	2	736	7,157	----	------	------	E4
6	SCS Runoff	0.382	2	728	1,563	----	------	------	E5
8	Combine	35.34	2	736	182,703	1, 2,	------	------	TOTAL E1

2069 PRE 3a.gpw	Return Period: 25 Year	Thursday, Jun 22, 2017

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	15.54	2	732	67,563	----	------	------	E1A
2	SCS Runoff	43.94	2	736	214,225	----	------	------	E1B
3	SCS Runoff	4.885	2	738	25,126	----	------	------	E2
4	SCS Runoff	3.838	2	736	18,644	----	------	------	E3
5	SCS Runoff	2.279	2	736	11,072	----	------	------	E4
6	SCS Runoff	0.640	2	728	2,418	----	------	------	E5
8	Combine	59.03	2	734	281,789	1, 2,	------	------	TOTAL E1

Worksheet 2: Runoff curve number and runoff SM-2069

Project: 700-800 Mass Ave By JTM Date 9/23/16

Location: Boxborough, MA Checked RJH Date 6/15/2017

Circle one: Present Developed Subcatchment E-1A

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
B	Woods- Good Condition	55			8.40	462.16
B	Open- Good Condition	61			0.16	9.87
C	Woods- Good Condition	70			1.11	77.52
C	Open- Good Condition	74			0.02	1.26
D	Woods- Good Condition	77			0.00	0.24
	Impervious	98			0.10	9.84
				426564 Totals =	9.79	560.88

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{560.88}{9.79} =$ 57.28 ; Use CN = 57.3

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency......................................	yr	2	10	100
Rainfall, P (24-hour)........................	in	3.1	4.5	6.4
Runoff, Q... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.29	0.86	1.95
Runoff, Q...	cf	10139	30730	69241

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 9/23/2016

Location: Boxborough, MA Checked ________ Date ________

Circle one: Present Developed Subcatchment E-1A

Circle one: Tc Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			Woods			
2. Mannings roughness coeff., n (table 3-1)			0.6			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.04			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.22			0.22

Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			UNPAVED			
8. Flow Length, L		ft	325			
9. Watercourse slope, s		ft/ft	0.093			
10. Average Velocity, V (figure 3-1)		ft/s	4.92			
11. Tt = L / 3600V	Compute Tt	hr	0.02			0.02

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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.24
min 14.2

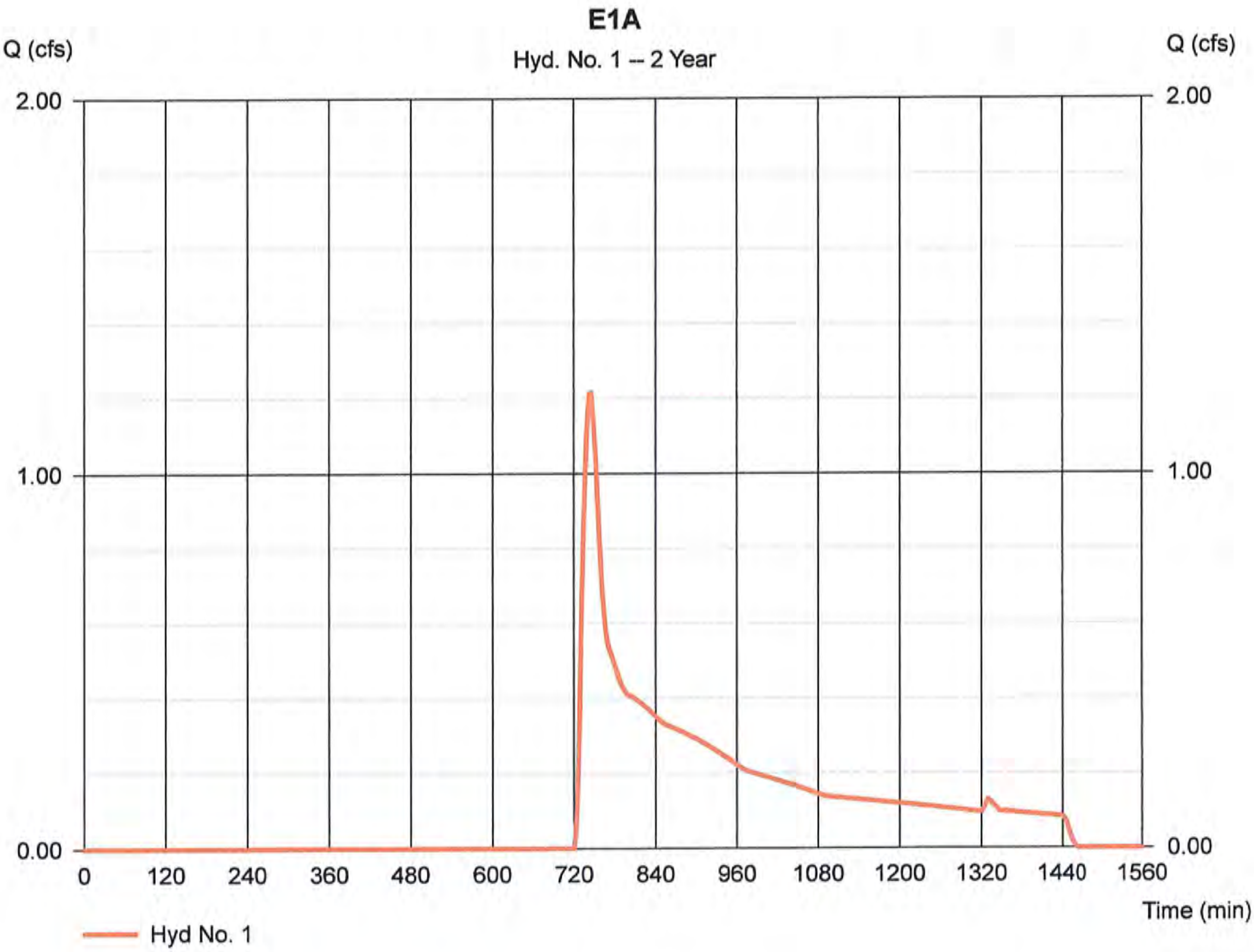
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 1

E1A

Hydrograph type	= SCS Runoff	Peak discharge	= 1.216 cfs
Storm frequency	= 2 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 9,894 cuft
Drainage area	= 9.790 ac	Curve number	= 57.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 14.20 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



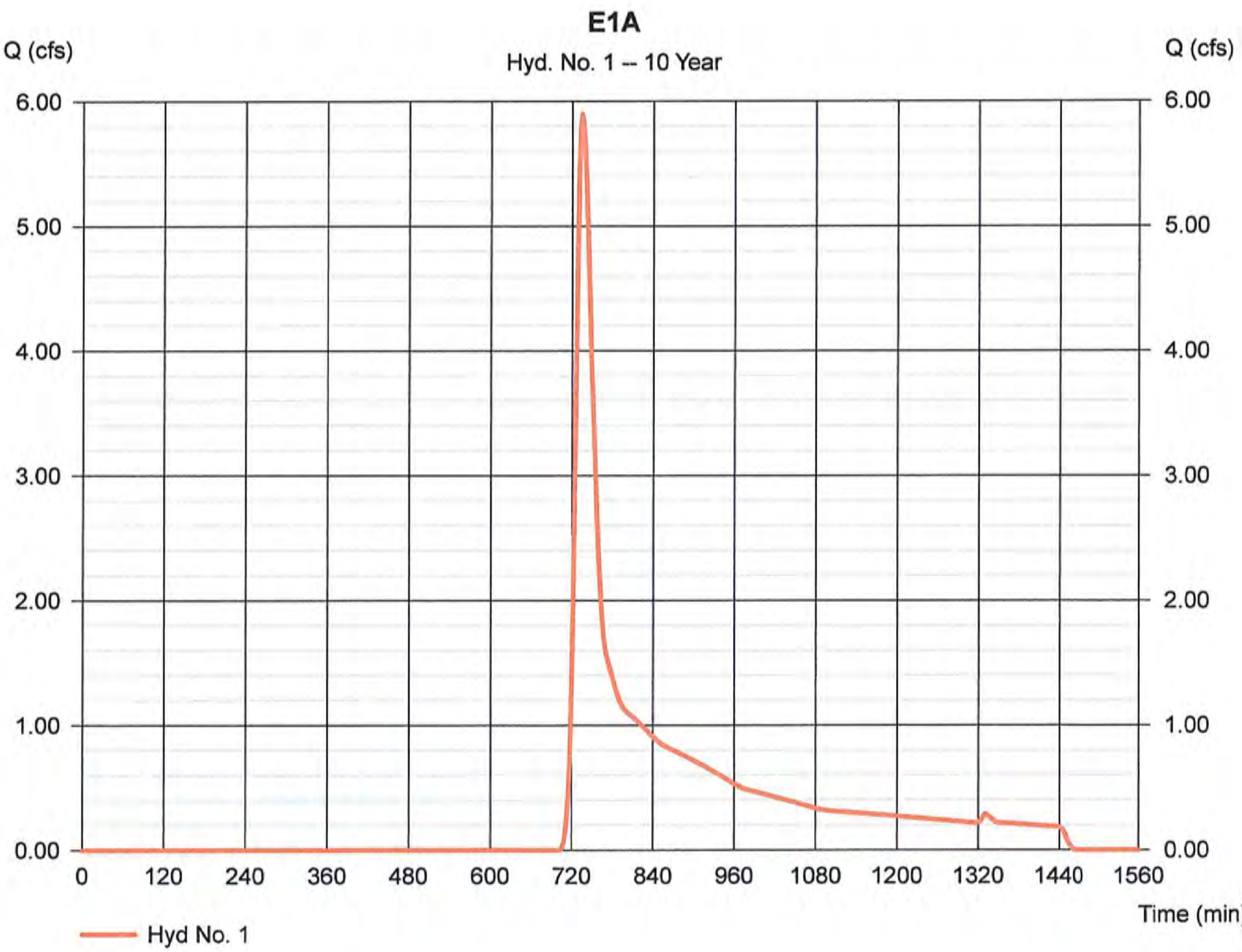
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 1

E1A

Hydrograph type	= SCS Runoff	Peak discharge	= 5.900 cfs
Storm frequency	= 10 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 29,999 cuft
Drainage area	= 9.790 ac	Curve number	= 57.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 14.20 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

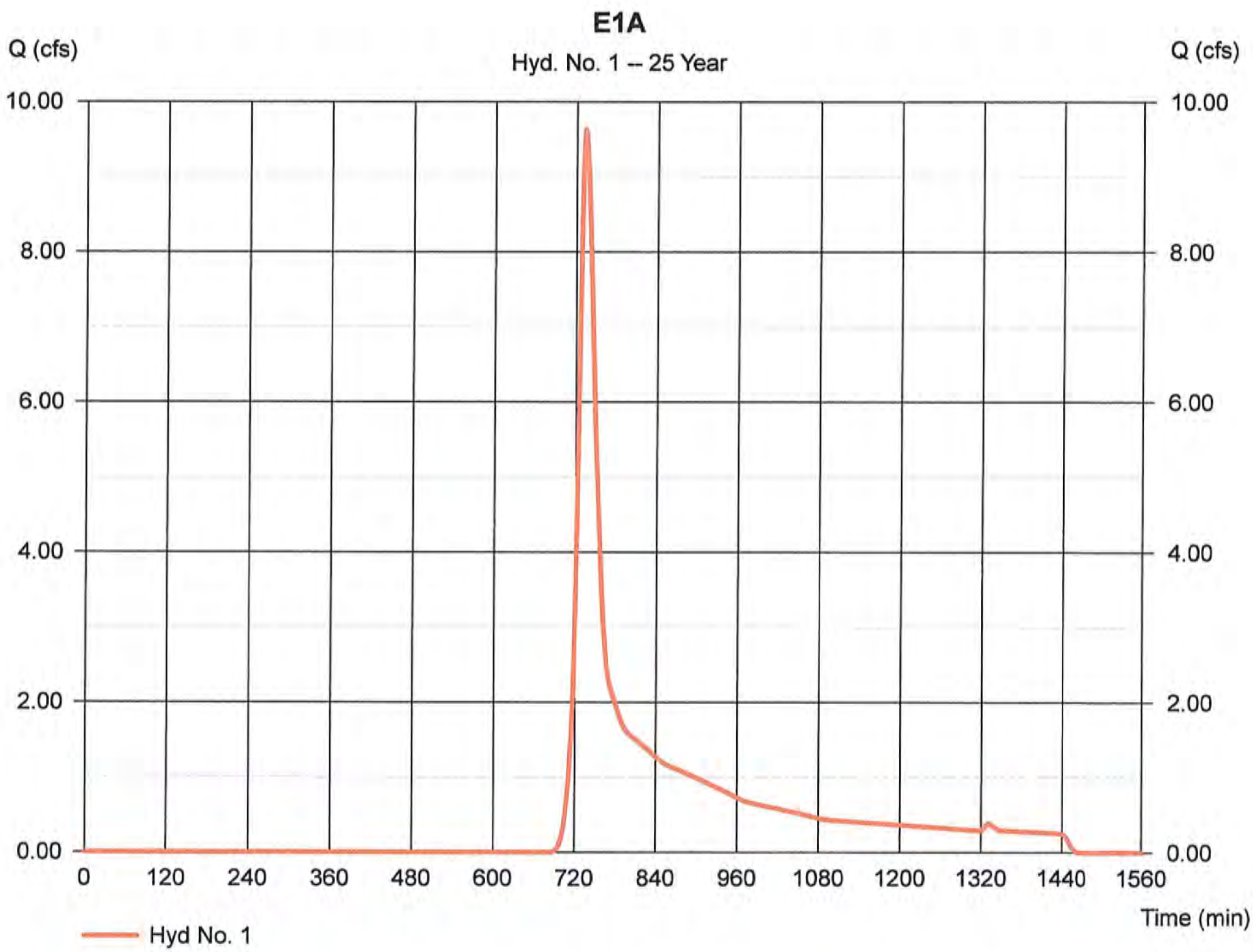


Hydrograph Report

Hyd. No. 1

E1A

Hydrograph type	= SCS Runoff	Peak discharge	= 9.627 cfs
Storm frequency	= 25 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 44,653 cuft
Drainage area	= 9.790 ac	Curve number	= 57.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 14.20 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



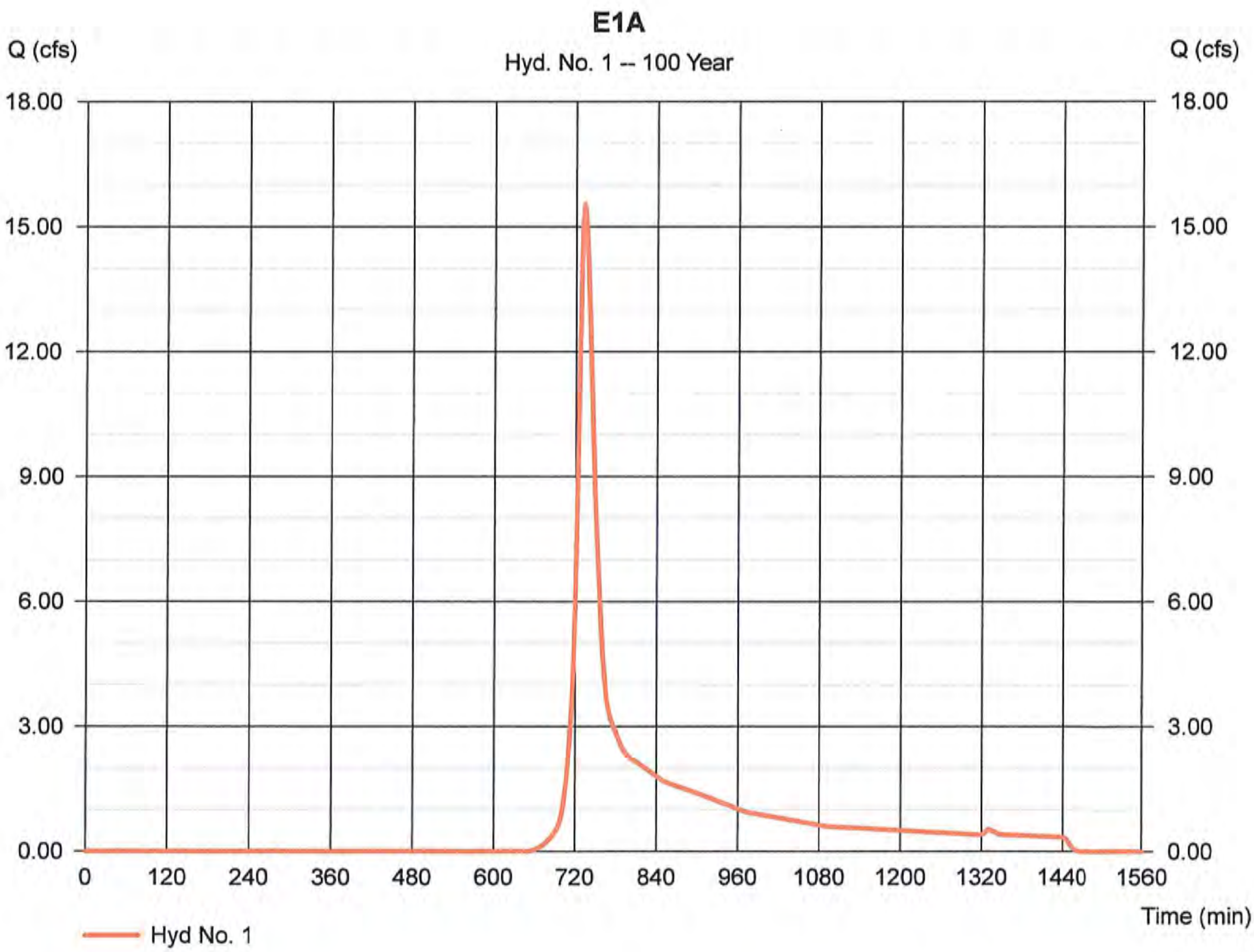
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 1

E1A

Hydrograph type	= SCS Runoff	Peak discharge	= 15.54 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 67,563 cuft
Drainage area	= 9.790 ac	Curve number	= 57.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 14.20 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-2069**

Project: 700-800 Mass Ave By JTM Date 9/23/16

Location: Boxborough, MA Checked RJH Date 6/15/2017

Circle one: Present Developed Subcatchment E-1B

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/			Area	Product of CN x Area
		Table 2-2	Fig. 2-3	Fig. 2-4	Acres	
B	Woods- Good Condition	55			23.49	1292.05
C	Woods- Good Condition	70			2.76	193.11
D	Woods- Good Condition	77			0.05	3.88
A	Woods- Good Condition	30			4.63	138.79
	Impervious	98			0.45	43.72
C	Open- Good Condition	74			1.26	93.10
C	Open- Fair Condition	79			0.54	42.55
B	Open- Good Condition	61			0.99	60.11
				1,487,814 Totals =	34.16	1867.31

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{1867.31}{34.16}$ = 54.67 ; Use CN = 54.7

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... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.21	0.73	1.73
Runoff, Q...	cf	26478	89933	213892

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 9/23/2016

Location: Boxborough, MA Checked ________ Date ________

Circle one: Present Developed Subcatchment E-1B

Circle one: Tc Tt through subarea

Sheet flow (Applicable to Tc only)			Segment ID	A-B			
1. Surface Description (table 3-1)				Woods			
2. Mannings roughness coeff., n (table 3-1)				0.6			
3. Flow length, L (total L <= 300 ft)		ft		50			
4. Two-yr 24-hr rainfall, P2		in		3.1			
5. Land Slope, s		ft/ft		0.054			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr		0.19			0.19

Shallow concentrated Flow			Segment ID	B-C			
7. Surface Description (paved or unpaved)				UNPAVED			
8. Flow Length, L		ft		963			
9. Watercourse slope, s		ft/ft		0.032			
10. Average Velocity, V (figure 3-1)		ft/s		2.89			
11. Tt = L / 3600V	Compute Tt	hr		0.09			0.09

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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.29
min 17.2

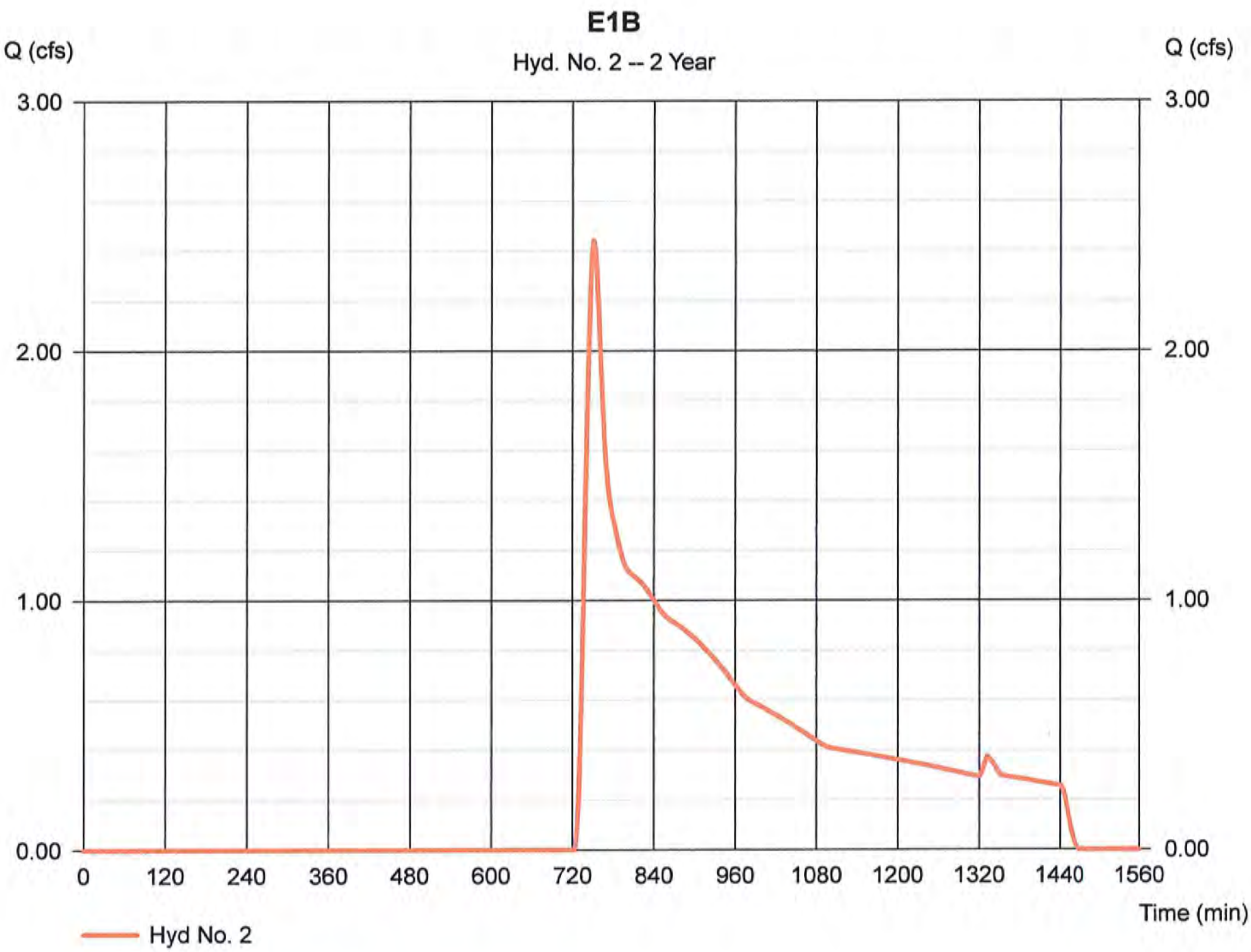
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 2

E1B

Hydrograph type	= SCS Runoff	Peak discharge	= 2.441 cfs
Storm frequency	= 2 yrs	Time to peak	= 750 min
Time interval	= 2 min	Hyd. volume	= 26,575 cuft
Drainage area	= 34.160 ac	Curve number	= 54.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.20 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

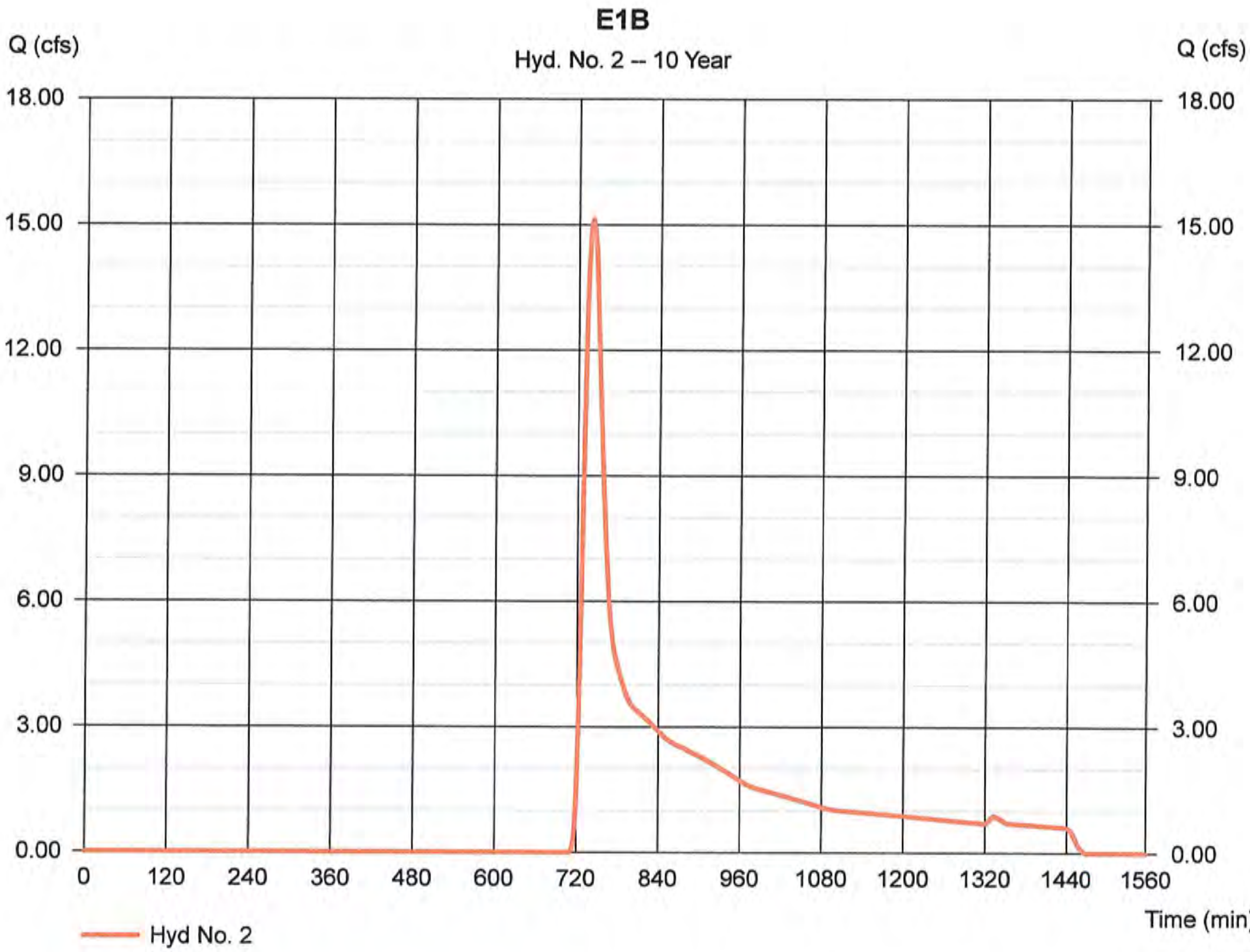


Hydrograph Report

Hyd. No. 2

E1B

Hydrograph type	= SCS Runoff	Peak discharge	= 15.12 cfs
Storm frequency	= 10 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 90,124 cuft
Drainage area	= 34.160 ac	Curve number	= 54.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.20 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

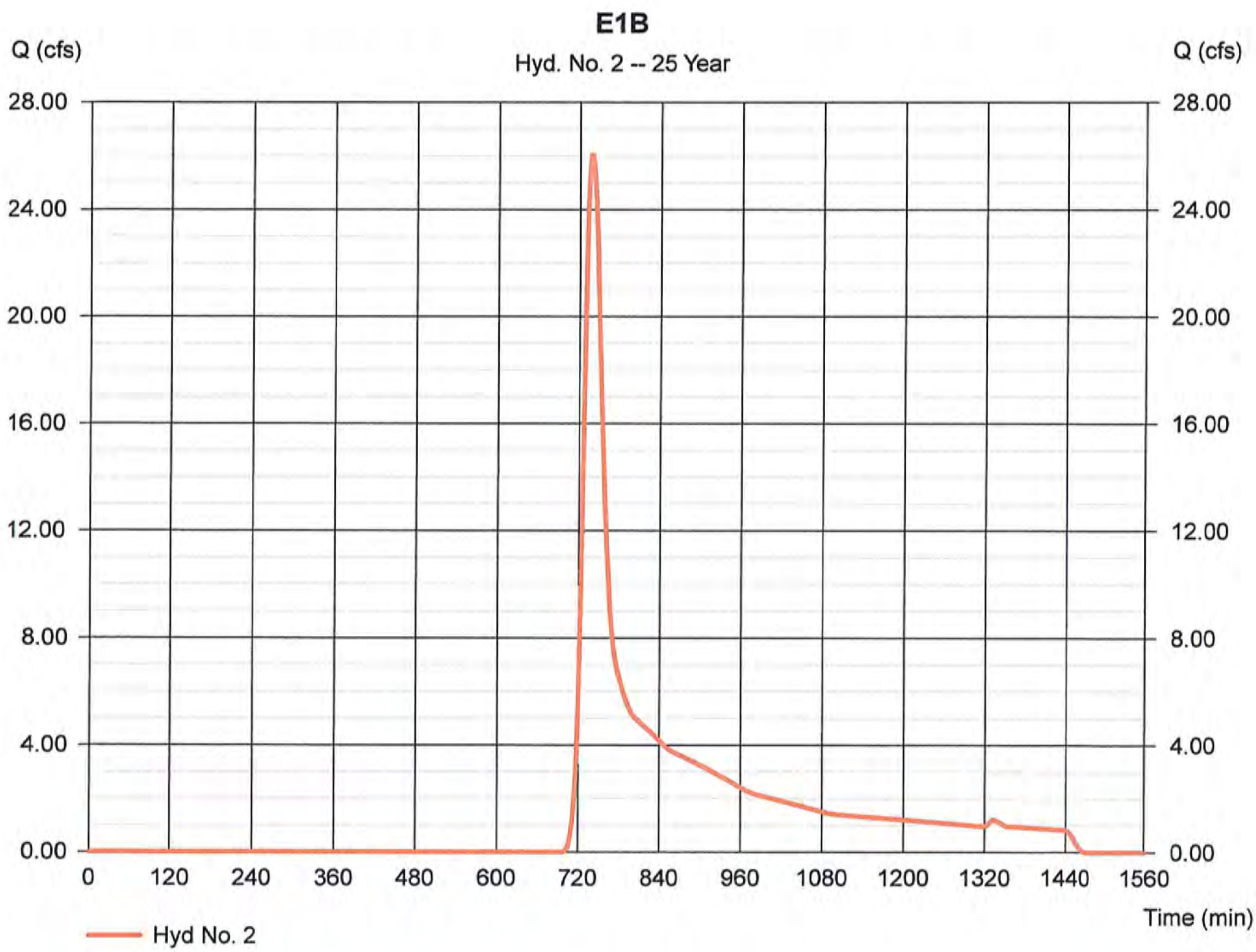


Hydrograph Report

Hyd. No. 2

E1B

Hydrograph type	= SCS Runoff	Peak discharge	= 26.03 cfs
Storm frequency	= 25 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 138,050 cuft
Drainage area	= 34.160 ac	Curve number	= 54.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.20 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



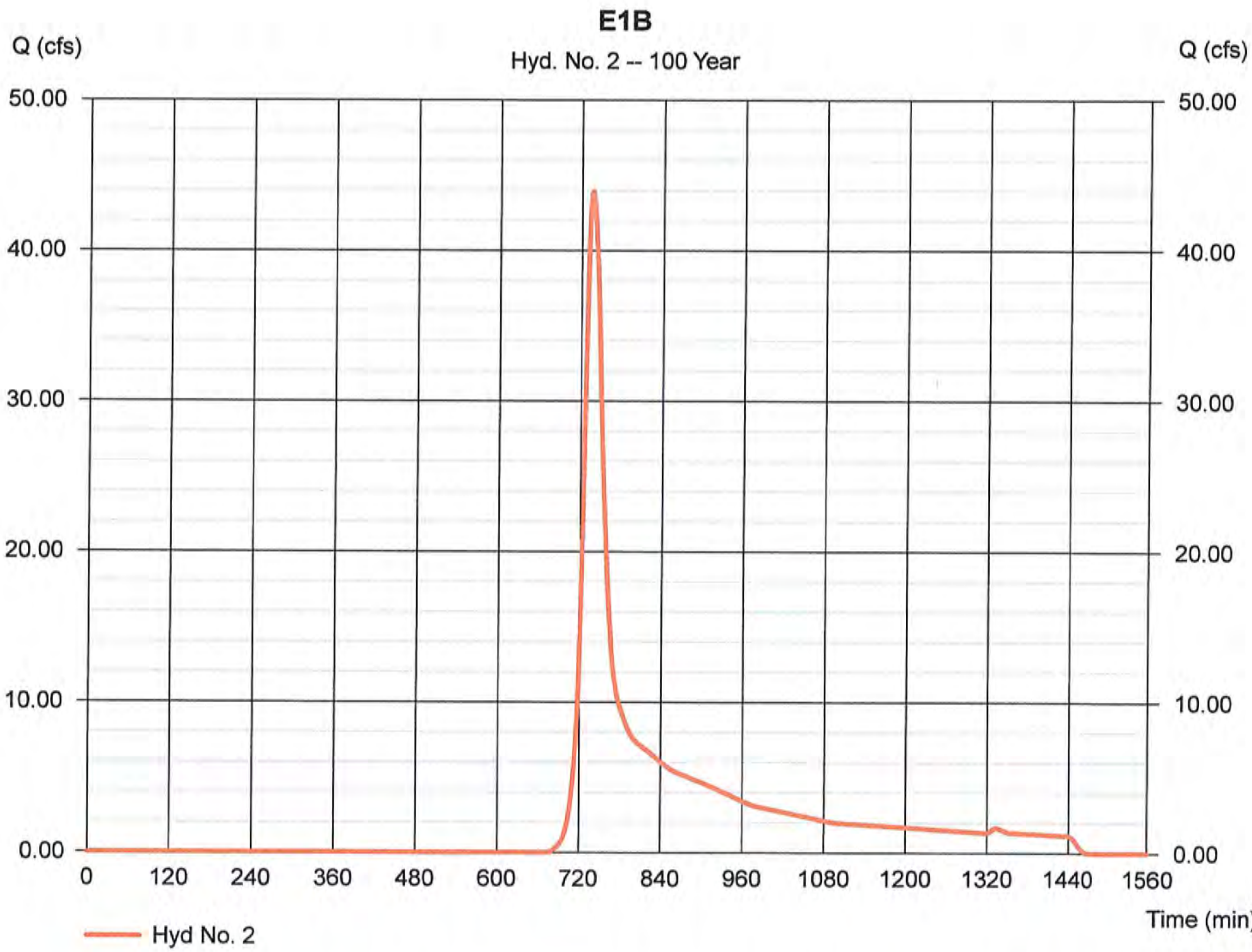
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 2

E1B

Hydrograph type	= SCS Runoff	Peak discharge	= 43.94 cfs
Storm frequency	= 100 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 214,225 cuft
Drainage area	= 34.160 ac	Curve number	= 54.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.20 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-2069**

Project: 700-800 Mass Ave By JTM Date 9/23/16

Location: Boxborough, MA Checked RJH Date 6/15/2017

Circle one: Present Developed Subcatchment E-2

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/			Area	Product of CN x Area
		Table 2-2	Fig. 2-3	Fig. 2-4	Acres	
-	Impervious	98			0.08	7.84
B	Woods- Good Condition	55			3.55	195.40
B	Open Space-Good Condition	61			0.06	3.95
				161059		
				Totals =	3.70	207.18

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{207.18}{3.70} =$ 56.04 ; Use CN = 56.0

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	0.25	0.80	1.84
Runoff, Q..	cf	3354	10698	24708

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 9/23/2016

Location: Boxborough, MA Checked Date

Circle one: Present Developed Subcatchment E-2

Circle one: Tc Tt through subarea

Sheet flow (Applicable to Tc only)	Segment ID		A-B			
1. Surface Description (table 3-1)			Woods			
2. Mannings roughness coeff., n (table 3-1)			0.6			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.012			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.35			0.35
Shallow concentrated Flow	Segment ID		B-C			
7. Surface Description (paved or unpaved)			UNPAVED			
8. Flow Length, L		ft	143			
9. Watercourse slope, s		ft/ft	0.059			
10. Average Velocity, V (figure 3-1)		ft/s	3.92			
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				0.00

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.36 min 21.9

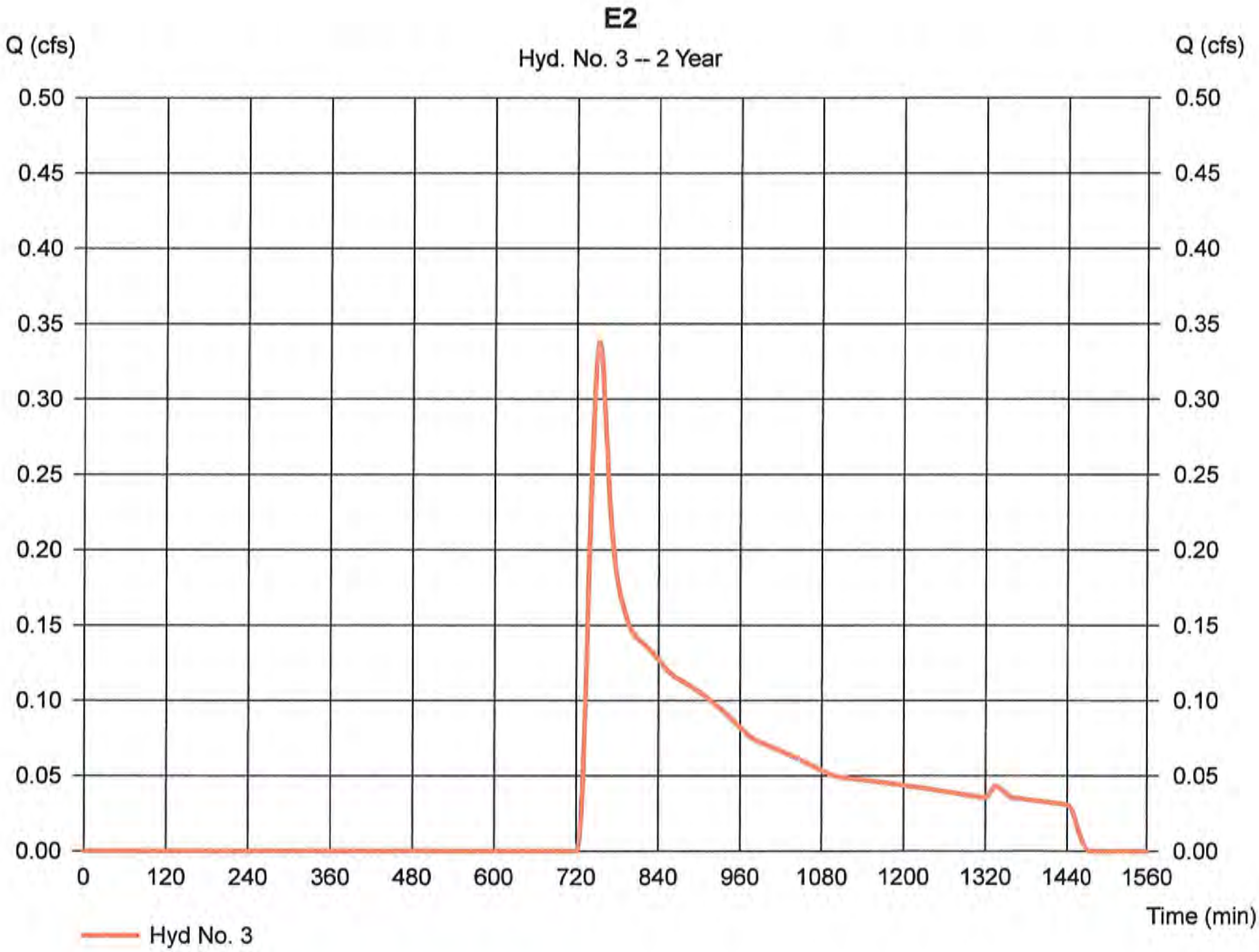
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 3

E2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.338 cfs
Storm frequency	= 2 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 3,402 cuft
Drainage area	= 3.700 ac	Curve number	= 56
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 21.90 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



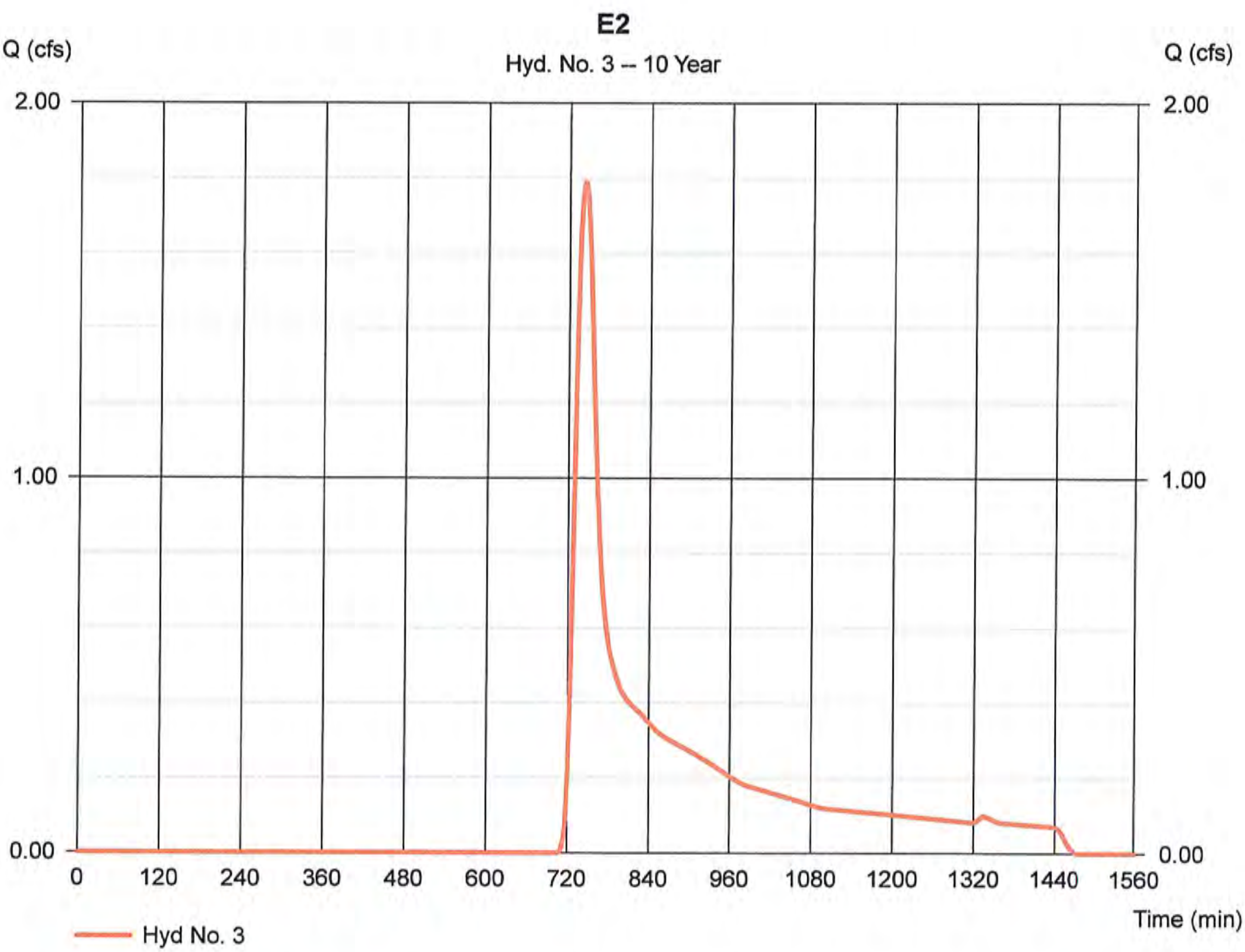
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 3

E2

Hydrograph type	= SCS Runoff	Peak discharge	= 1.790 cfs
Storm frequency	= 10 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 10,871 cuft
Drainage area	= 3.700 ac	Curve number	= 56
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 21.90 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



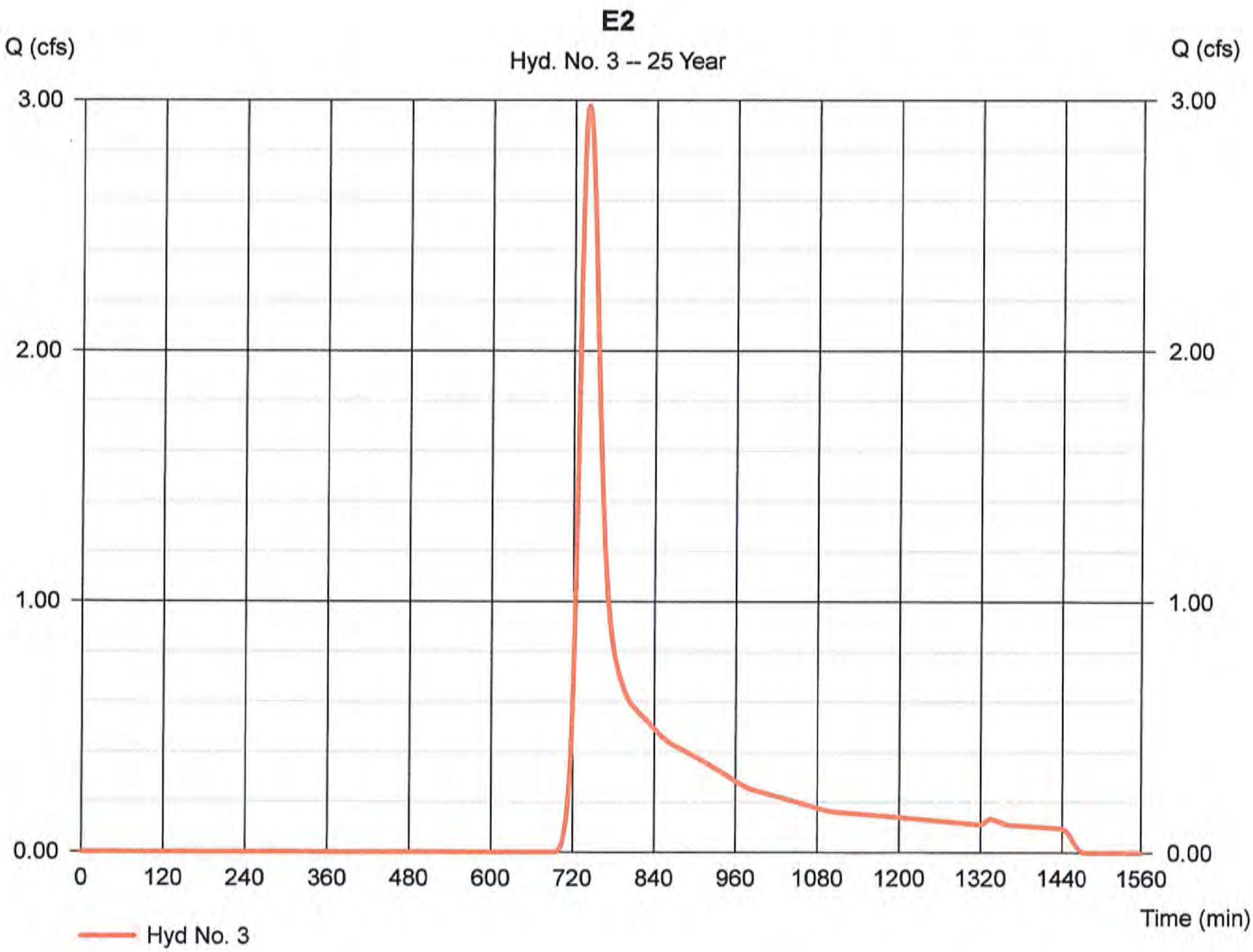
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 3

E2

Hydrograph type	= SCS Runoff	Peak discharge	= 2.977 cfs
Storm frequency	= 25 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 16,404 cuft
Drainage area	= 3.700 ac	Curve number	= 56
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 21.90 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



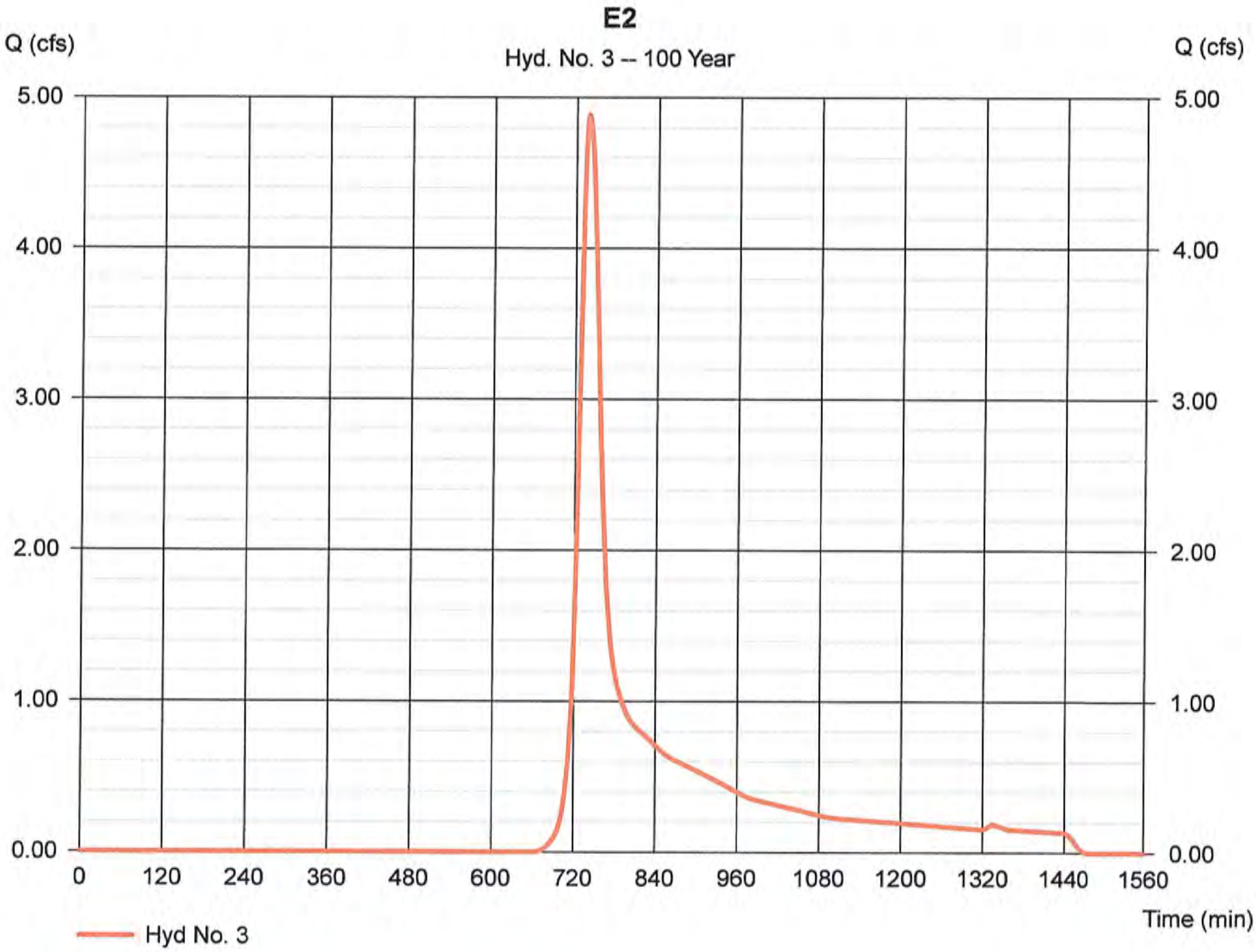
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 3

E2

Hydrograph type	= SCS Runoff	Peak discharge	= 4.885 cfs
Storm frequency	= 100 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 25,126 cuft
Drainage area	= 3.700 ac	Curve number	= 56
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 21.90 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-2069**

Project: 700-800 Mass Ave By JTM Date 9/23/16

Location: Boxborough, MA Checked RJH Date 6/15/2017

Circle one: $\boxed{\text{Present}}$ Developed Subcatchment E-3

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/			Area	Product of CN x Area
		Table 2-2	Fig. 2-3	Fig. 2-4	Acres	
B	Woods- Good Condition	55			2.93	160.95
				Totals =	2.93	160.95

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{160.95}{2.93}$ = 55.00 ; Use CN = $\boxed{55.0}$

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	0.22	0.74	1.75
Runoff, Q...	cf	2359	7887	18621

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 9/23/2016

Location: Boxborough, MA Checked ________ Date ________

Circle one: Present Developed Subcatchment E-3

Circle one: Tc Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			Woods			
2. Mannings roughness coeff., n (table 3-1)			0.6			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.02			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.29			0.29

Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			UNPAVED			
8. Flow Length, L		ft	221			
9. Watercourse slope, s		ft/ft	0.061			
10. Average Velocity, V (figure 3-1)		ft/s	3.98			
11. Tt = L / 3600V	Compute Tt	hr	0.02			0.02

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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.30

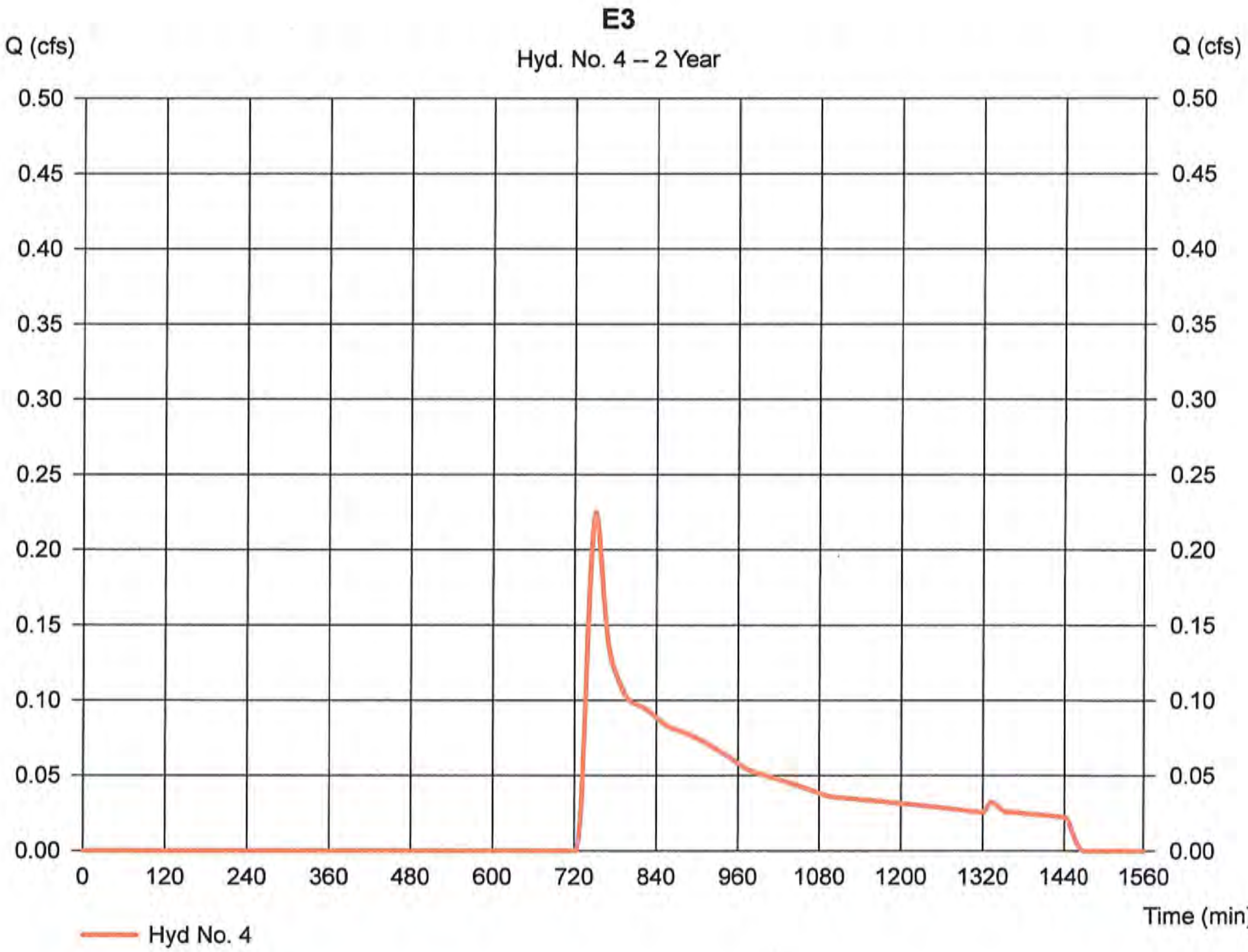
min 18.3

Hydrograph Report

Hyd. No. 4

E3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.225 cfs
Storm frequency	= 2 yrs	Time to peak	= 750 min
Time interval	= 2 min	Hyd. volume	= 2,361 cuft
Drainage area	= 2.930 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 18.30 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



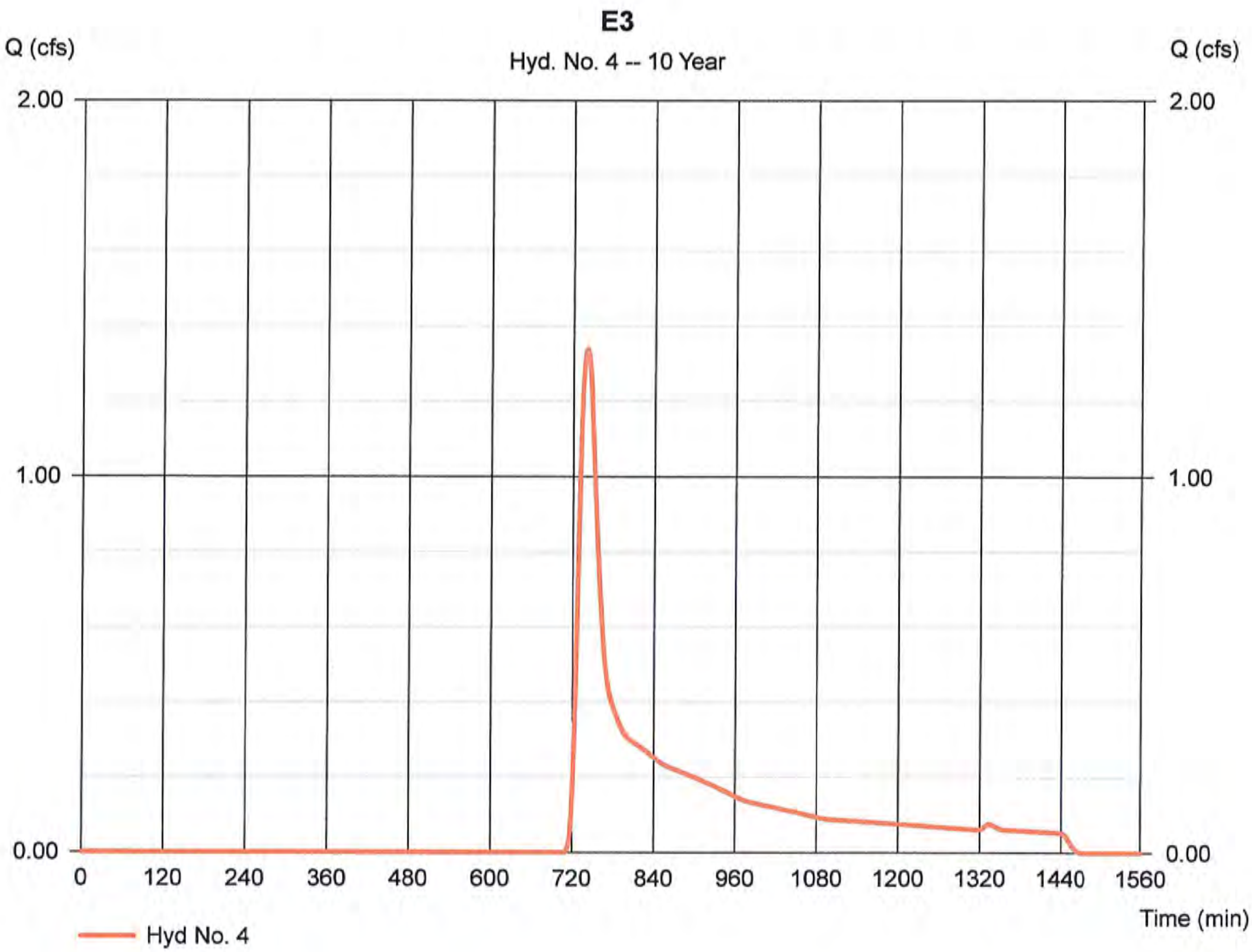
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 4

E3

Hydrograph type	= SCS Runoff	Peak discharge	= 1.339 cfs
Storm frequency	= 10 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 7,896 cuft
Drainage area	= 2.930 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 18.30 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



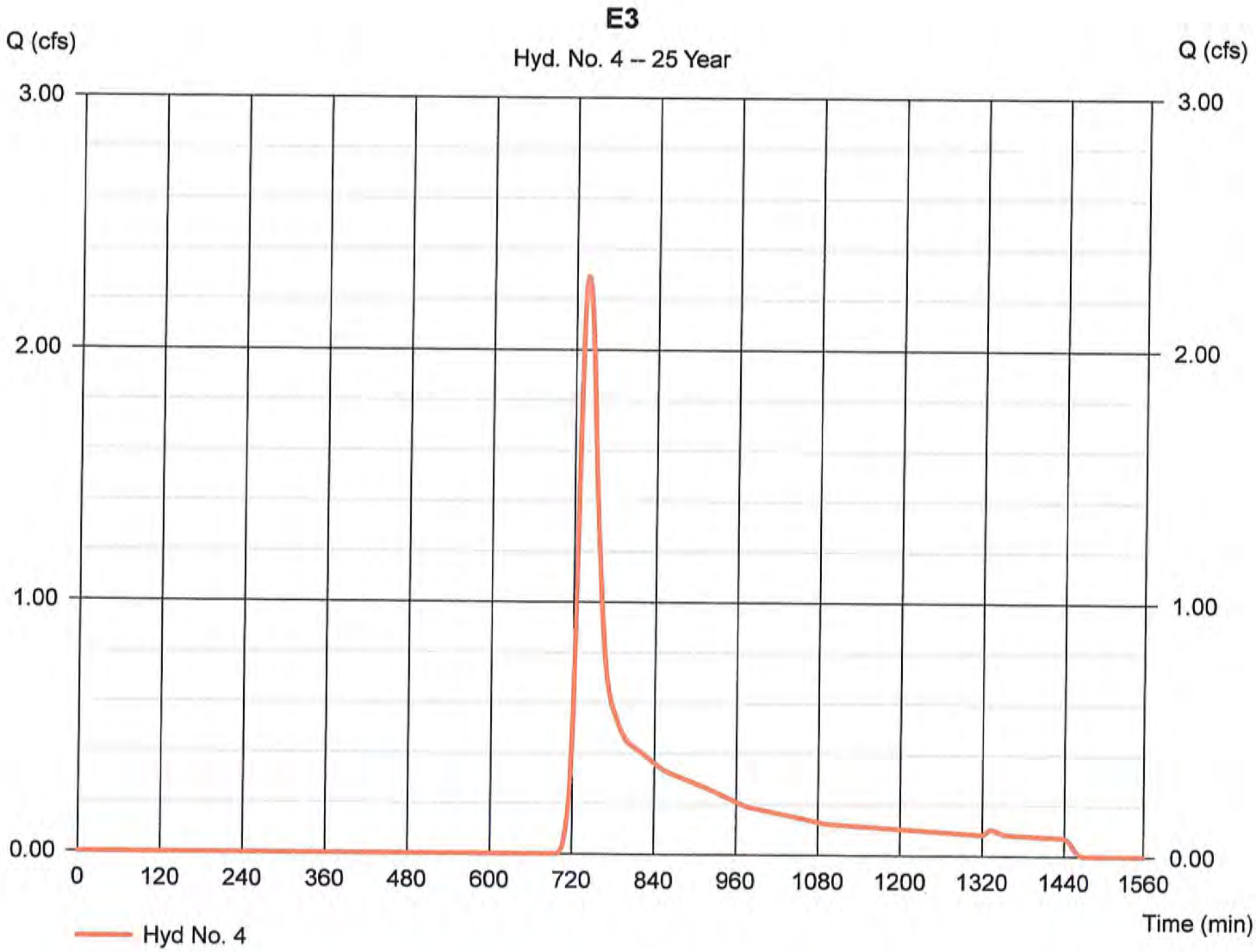
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 4

E3

Hydrograph type	= SCS Runoff	Peak discharge	= 2.289 cfs
Storm frequency	= 25 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 12,052 cuft
Drainage area	= 2.930 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 18.30 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



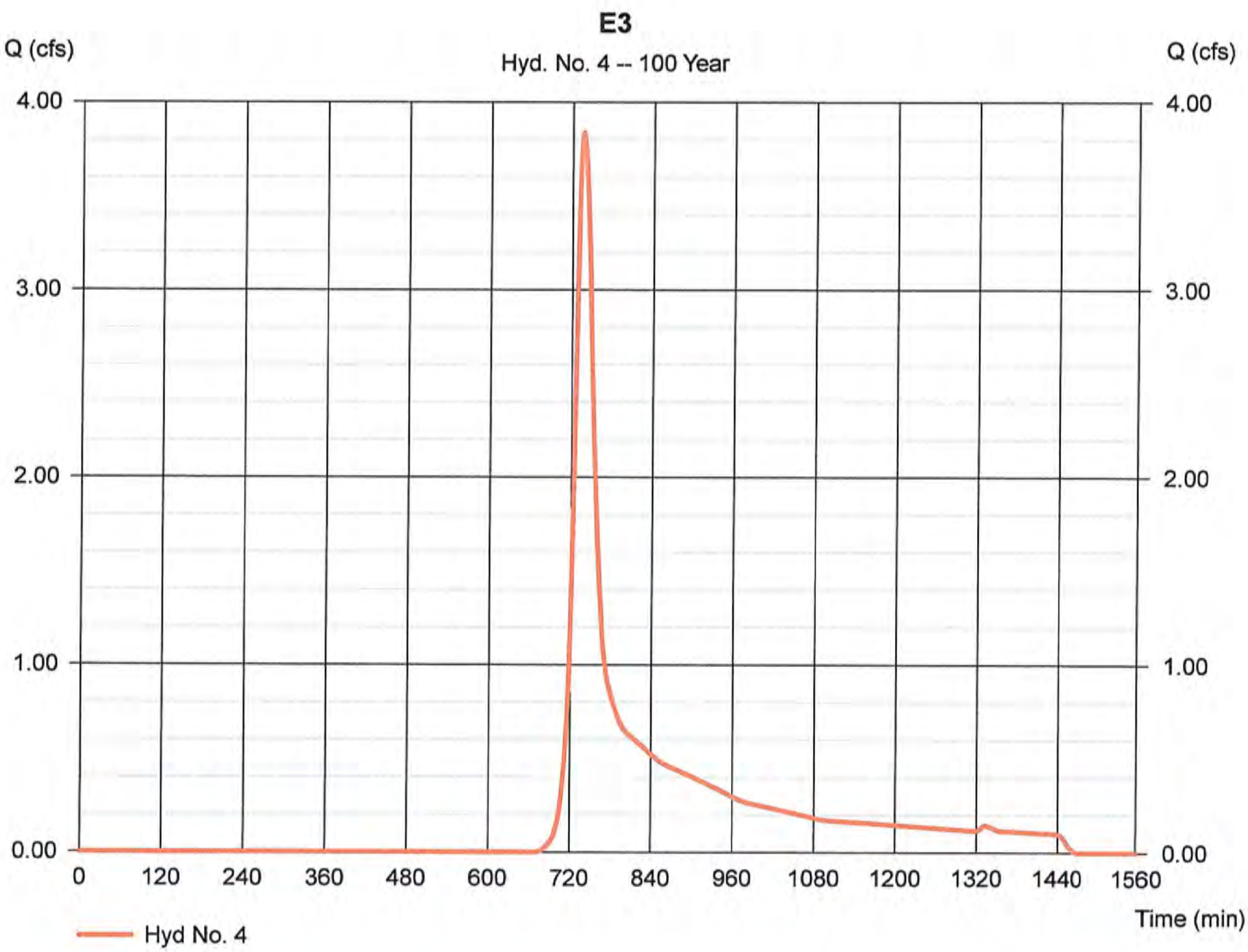
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 4

E3

Hydrograph type	= SCS Runoff	Peak discharge	= 3.838 cfs
Storm frequency	= 100 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 18,644 cuft
Drainage area	= 2.930 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 18.30 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff SM-2069

Project: 700-800 Mass Ave By JTM Date 9/23/16

Location: Boxborough, MA Checked ______ Date ______

Circle one: Present Developed Subcatchment E-4

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/			Area	Product of CN x Area
		Table 2-2	Fig. 2-3	Fig. 2-4	Acres	
B	Woods- Good Condition	55			1.74	95.60
				75715		

1/ Use only one CN source per line. Totals = 1.74 95.60

CN (weighted) = total product / total area = 95.60 / 1.74 = 55.00 ; Use CN = 55.0

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	0.22	0.74	1.75
Runoff, Q	cf	1401	4684	11060

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 9/23/2016

Location: Boxborough, MA Checked ________ Date ________

Circle one: Present Developed Subcatchment E-4
Circle one: Tc Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			Woods			
2. Mannings roughness coeff., n (table 3-1)			0.6			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.02			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.29			0.29

Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			UNPAVED			
8. Flow Length, L		ft	127			
9. Watercourse slope, s		ft/ft	0.11			
10. Average Velocity, V (figure 3-1)		ft/s	5.35			
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				0.00

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.30
min 17.7

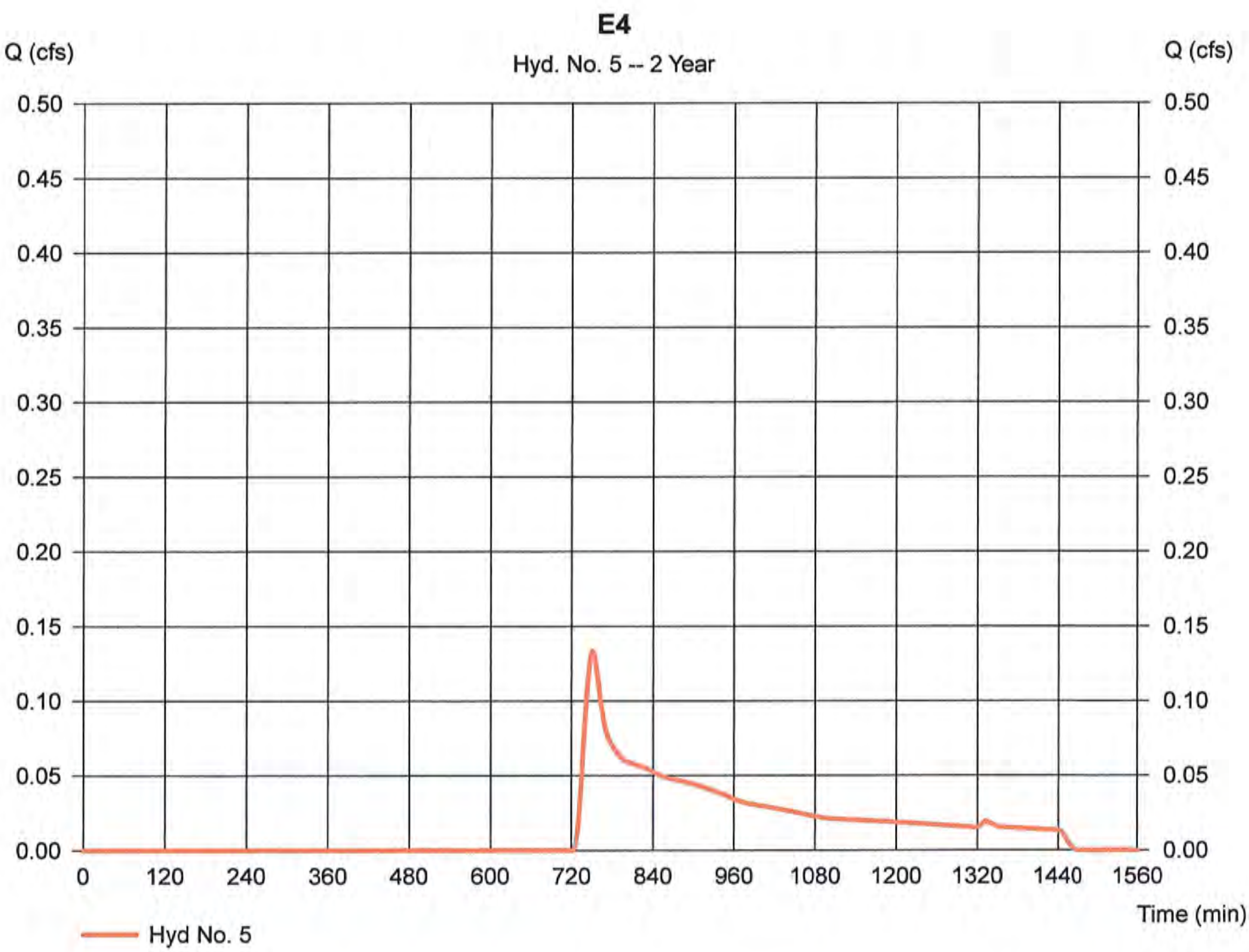
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 5

E4

Hydrograph type	= SCS Runoff	Peak discharge	= 0.133 cfs
Storm frequency	= 2 yrs	Time to peak	= 750 min
Time interval	= 2 min	Hyd. volume	= 1,402 cuft
Drainage area	= 1.740 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.70 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



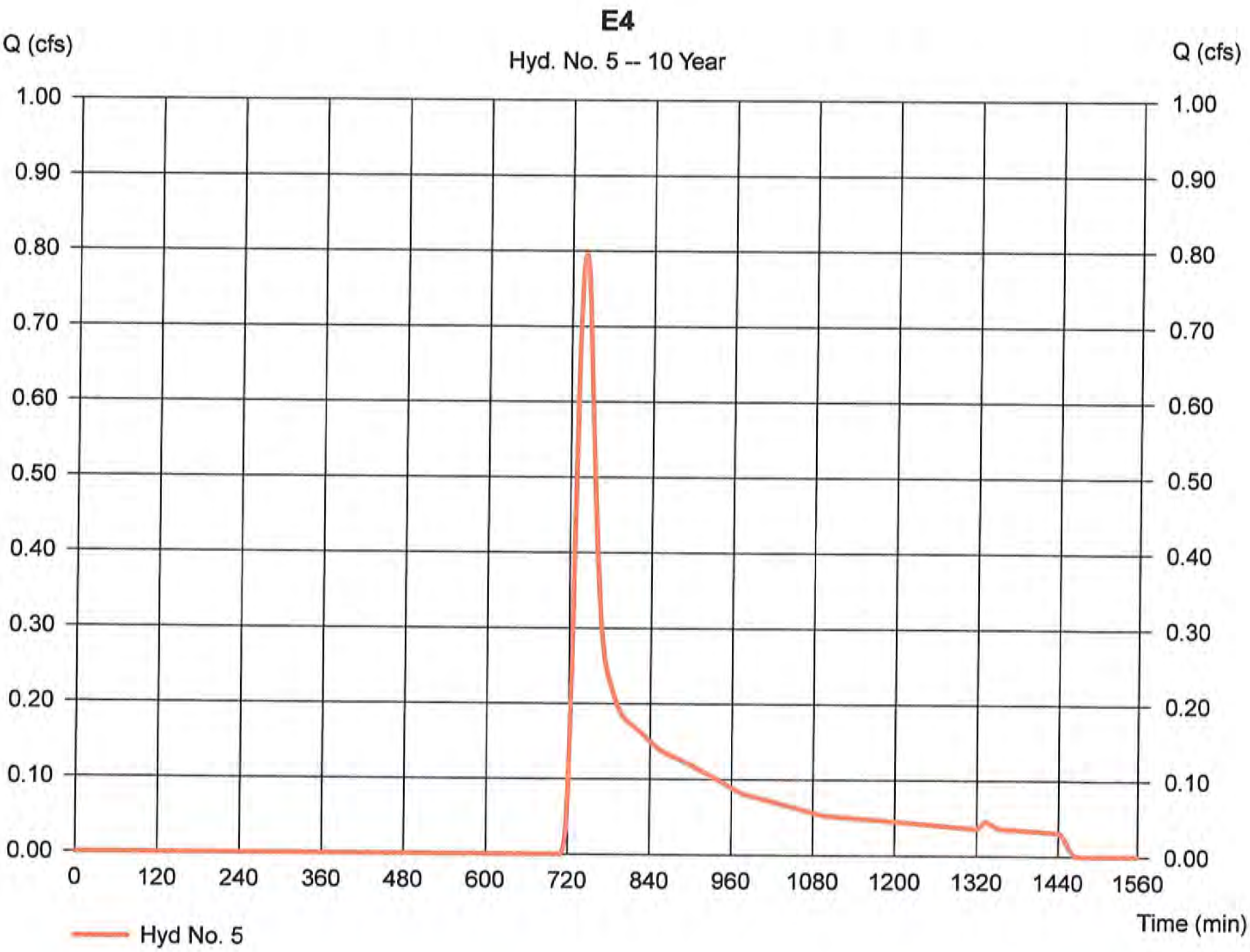
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 5

E4

Hydrograph type	= SCS Runoff	Peak discharge	= 0.795 cfs
Storm frequency	= 10 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 4,689 cuft
Drainage area	= 1.740 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.70 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



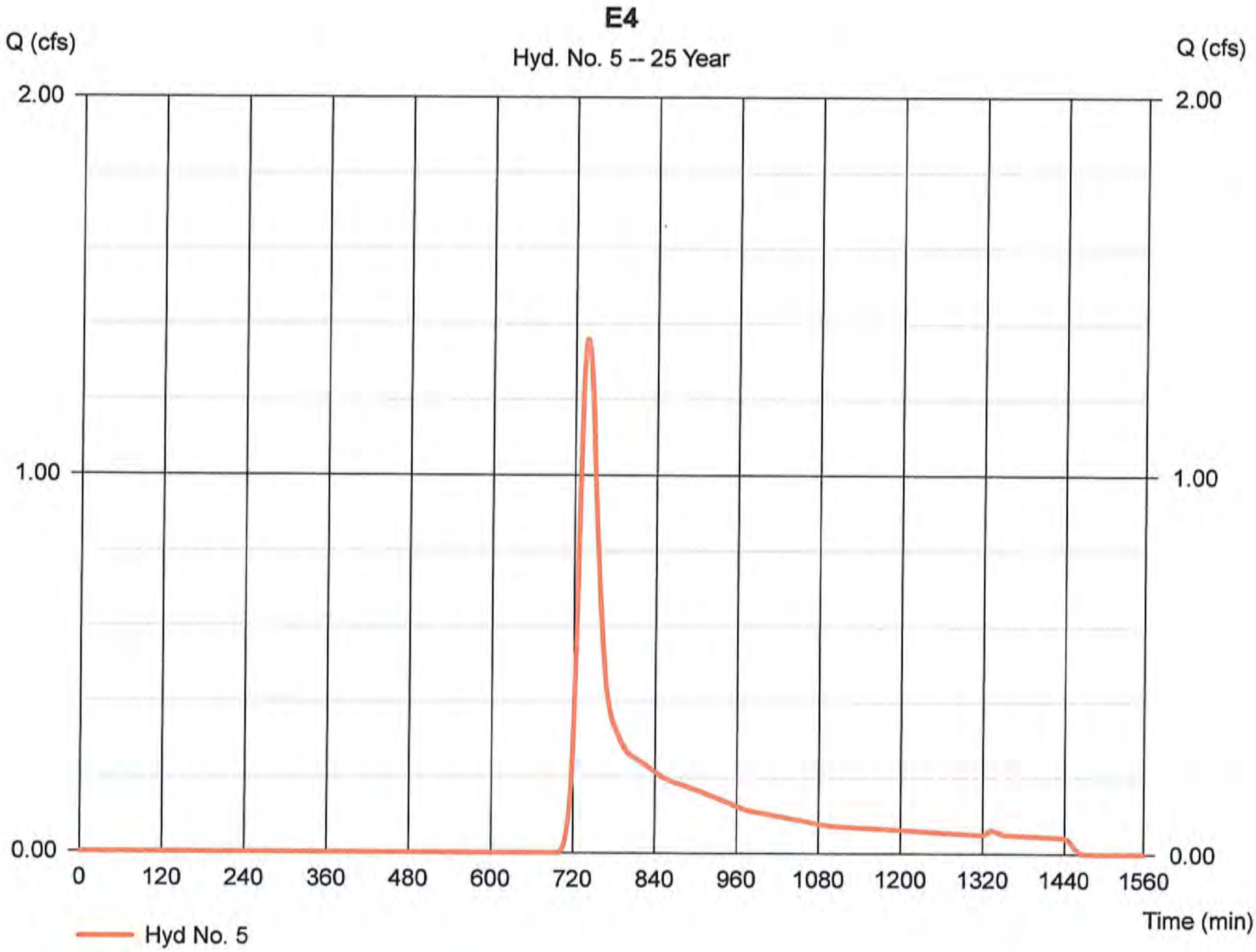
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 5

E4

Hydrograph type	= SCS Runoff	Peak discharge	= 1.359 cfs
Storm frequency	= 25 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 7,157 cuft
Drainage area	= 1.740 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.70 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



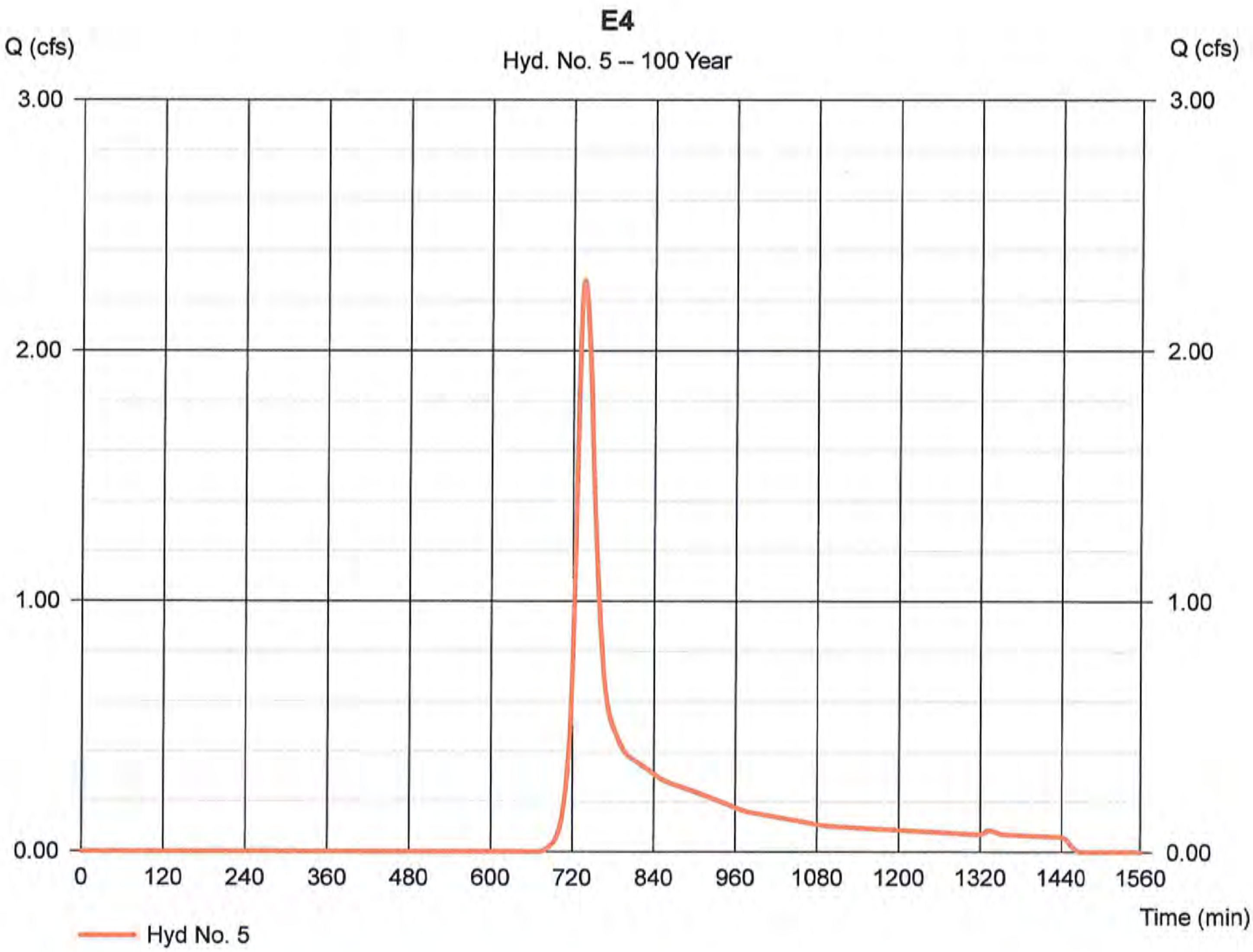
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 5

E4

Hydrograph type	= SCS Runoff	Peak discharge	= 2.279 cfs
Storm frequency	= 100 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 11,072 cuft
Drainage area	= 1.740 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.70 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-2069**

Project: 700-800 Mass Ave By JTM Date 9/23/16

Location: Boxborough, MA Checked RJH Date 6/15/2017

Circle one: Present Developed Subcatchment E-5

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
B	Woods- Good Condition	55			0.38	20.73
				16418		
				Totals =	0.38	20.73

1/ Use only one CN source per line.

CN (weighted) = total product / total area = 20.73 / 0.38 = 55.00 ; Use CN = 55.0

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	0.22	0.74	1.75
Runoff, Q..	cf	304	1016	2398

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 9/23/2016

Location: Boxborough, MA Checked ______ Date ______

Circle one: Present Developed Subcatchment E-5

Circle one: Tc Tt through subarea

		Segment ID	A-B			
Sheet flow (Applicable to Tc only)						
1. Surface Description (table 3-1)			Woods			
2. Mannings roughness coeff., n (table 3-1)			0.6			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.106			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.15			0.15

Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			UNPAVED			
8. Flow Length, L		ft	89			
9. Watercourse slope, s		ft/ft	0.109			
10. Average Velocity, V (figure 3-1)		ft/s	5.33			
11. Tt = L / 3600V	Compute Tt	hr	0.00			0.00

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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.15 min 9.2

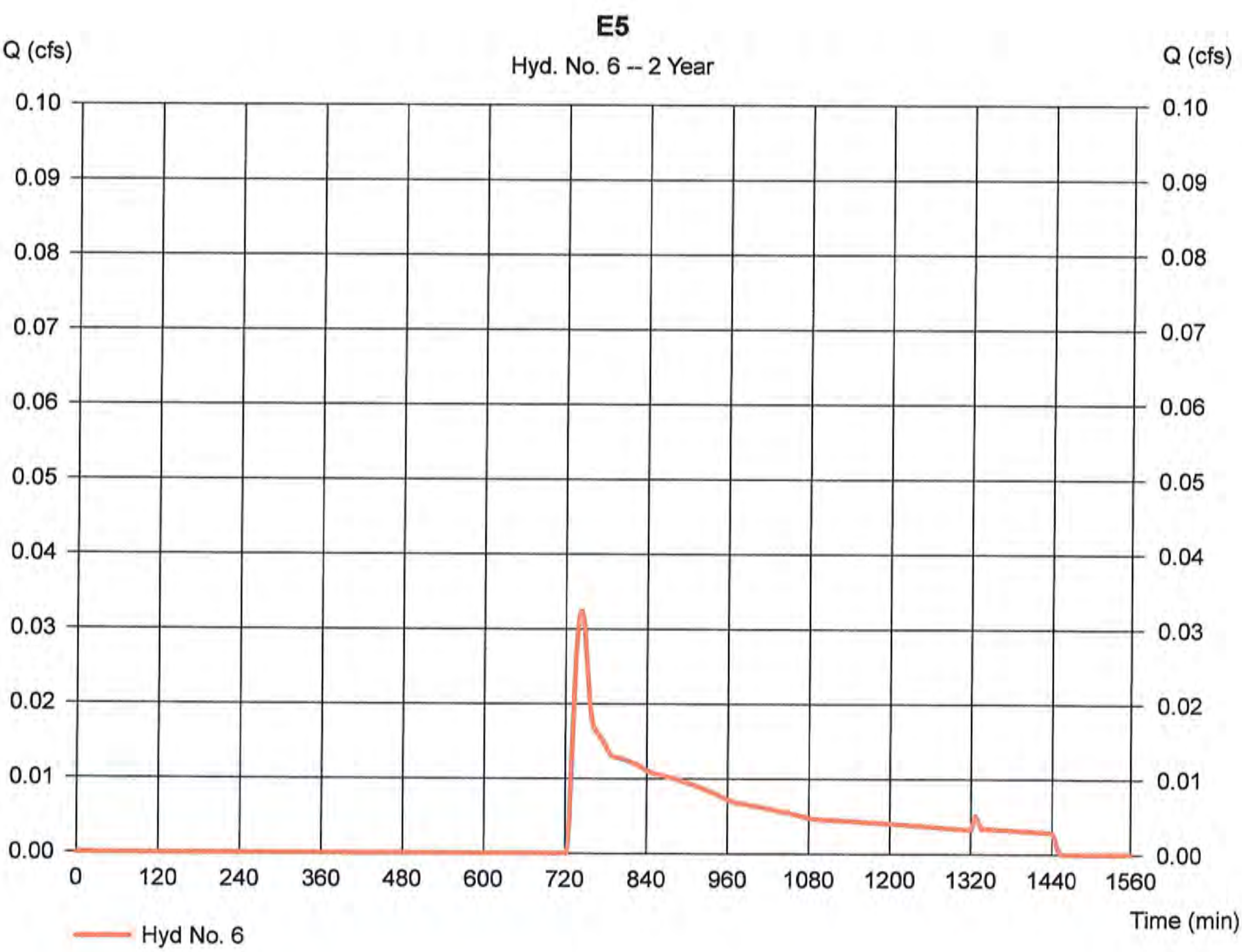
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 6

E5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.032 cfs
Storm frequency	= 2 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 306 cuft
Drainage area	= 0.380 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 9.20 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

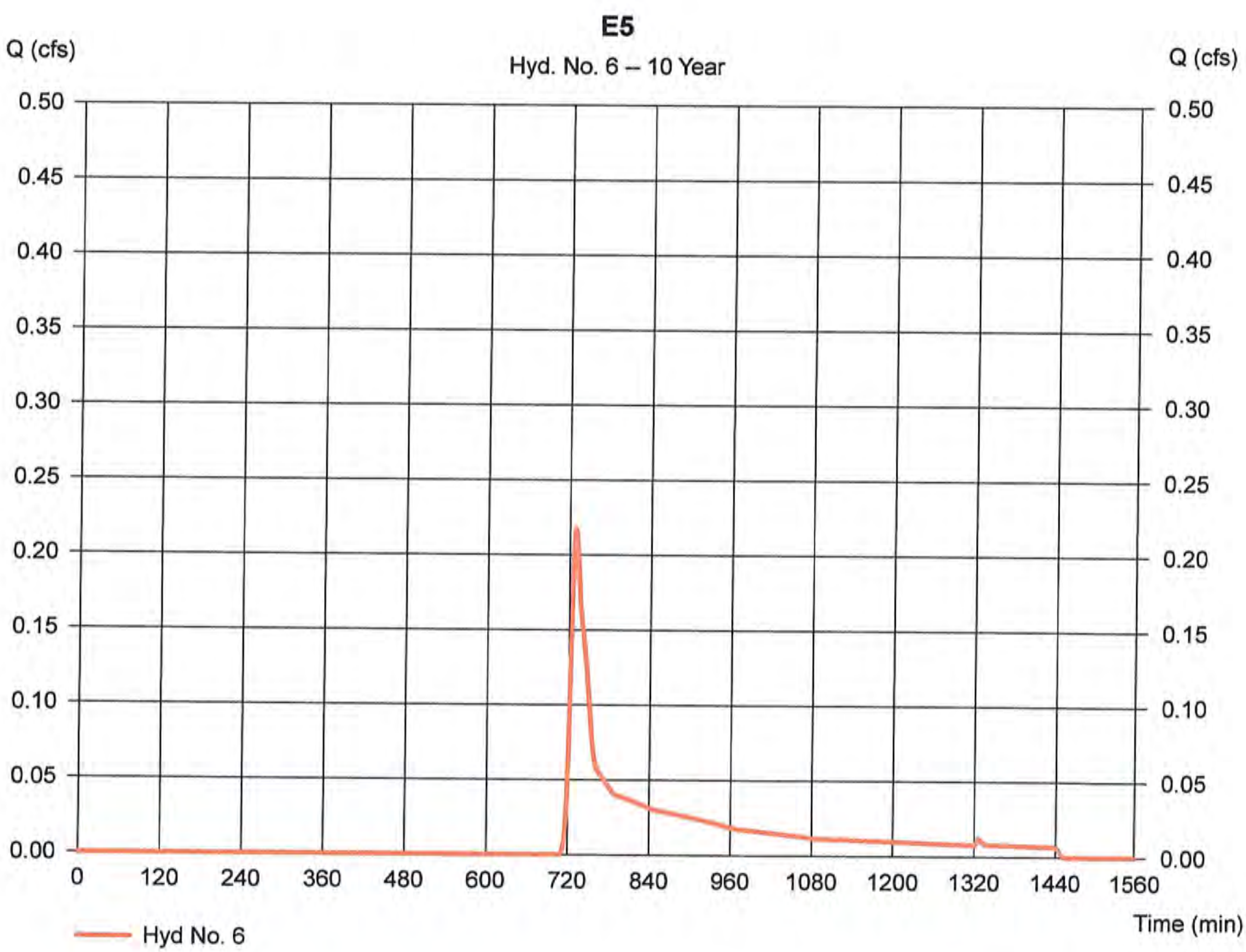
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 6

E5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.217 cfs
Storm frequency	= 10 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 1,024 cuft
Drainage area	= 0.380 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 9.20 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

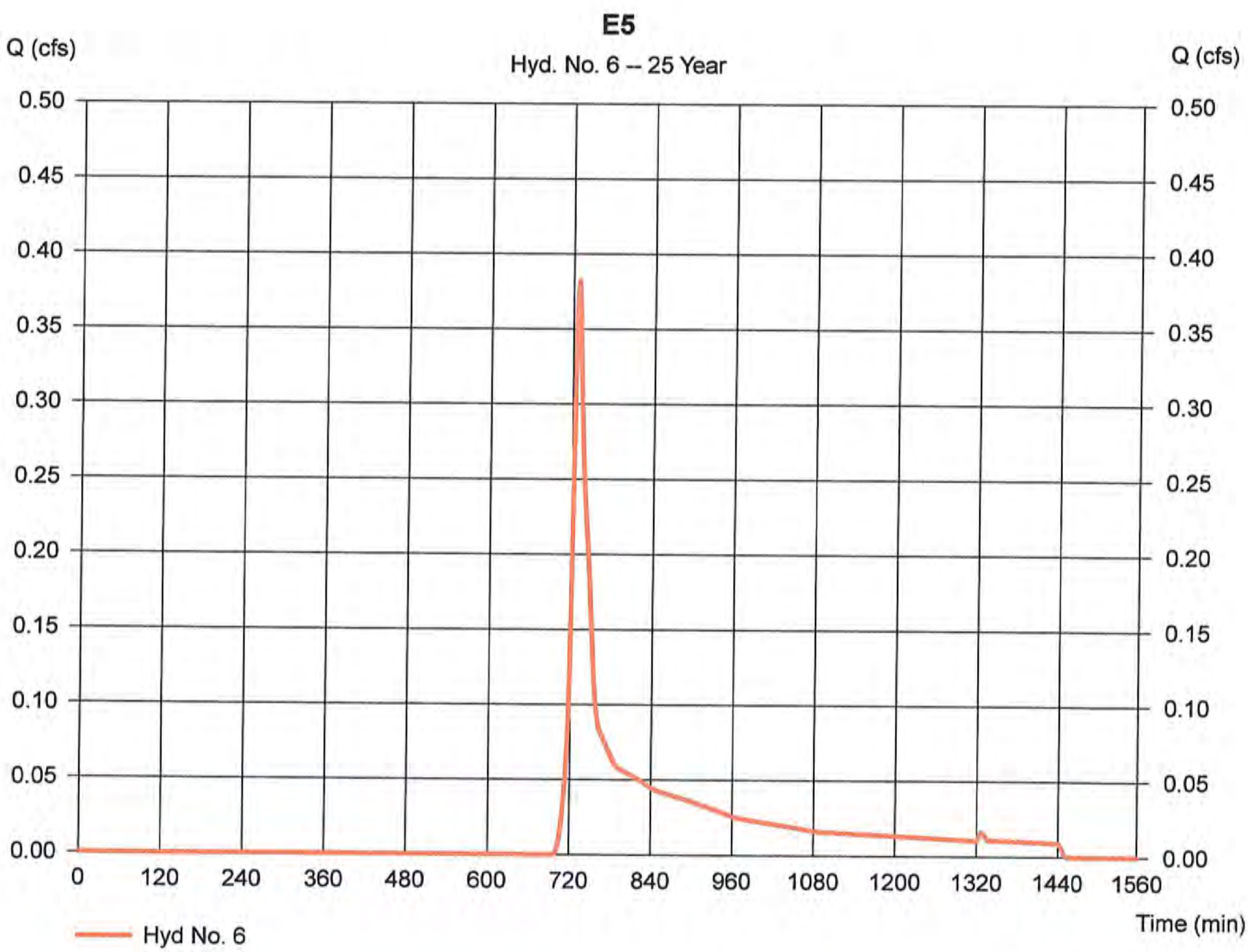
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 6

E5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.382 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 1,563 cuft
Drainage area	= 0.380 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 9.20 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

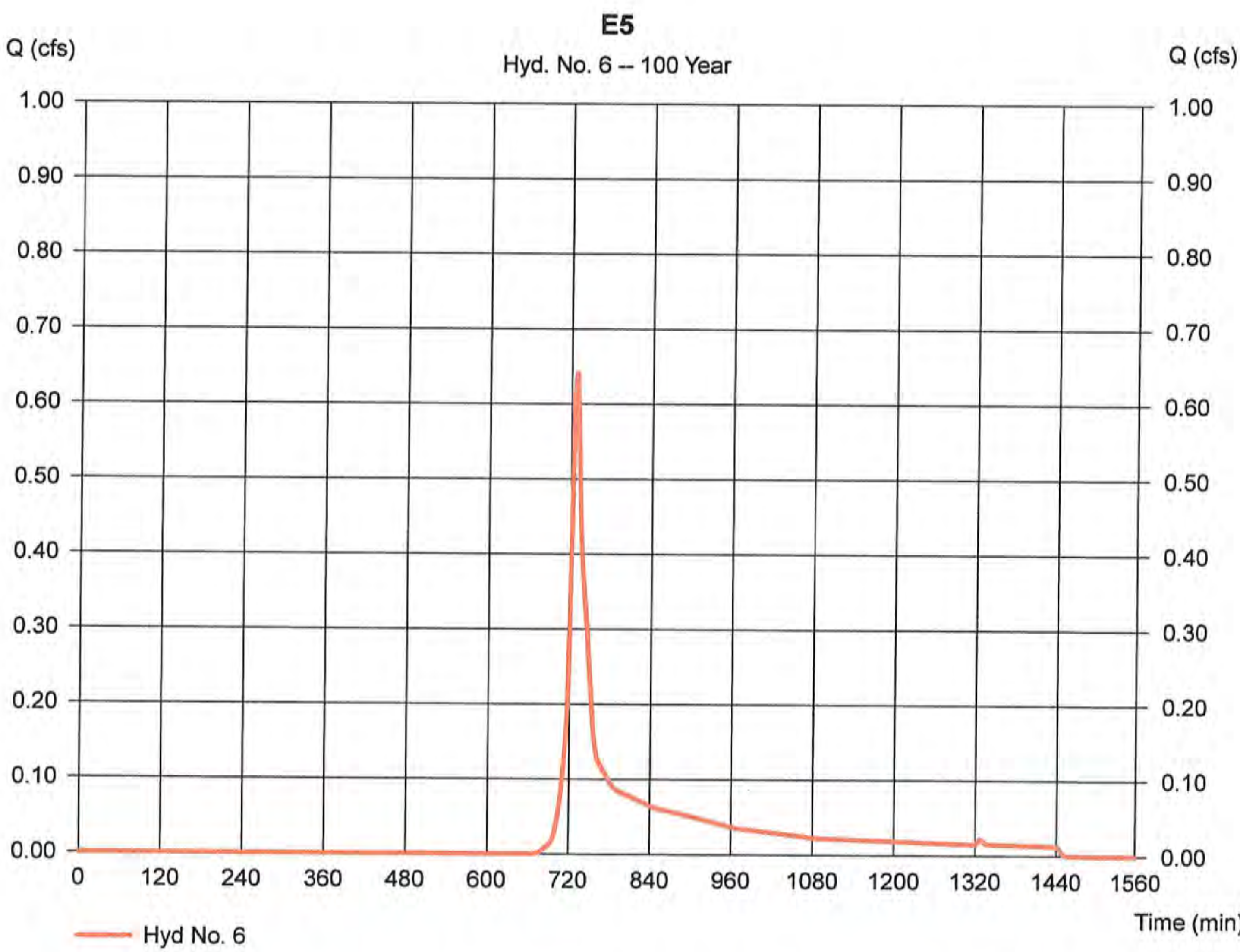
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 6

E5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.640 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 2,418 cuft
Drainage area	= 0.380 ac	Curve number	= 55
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 9.20 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



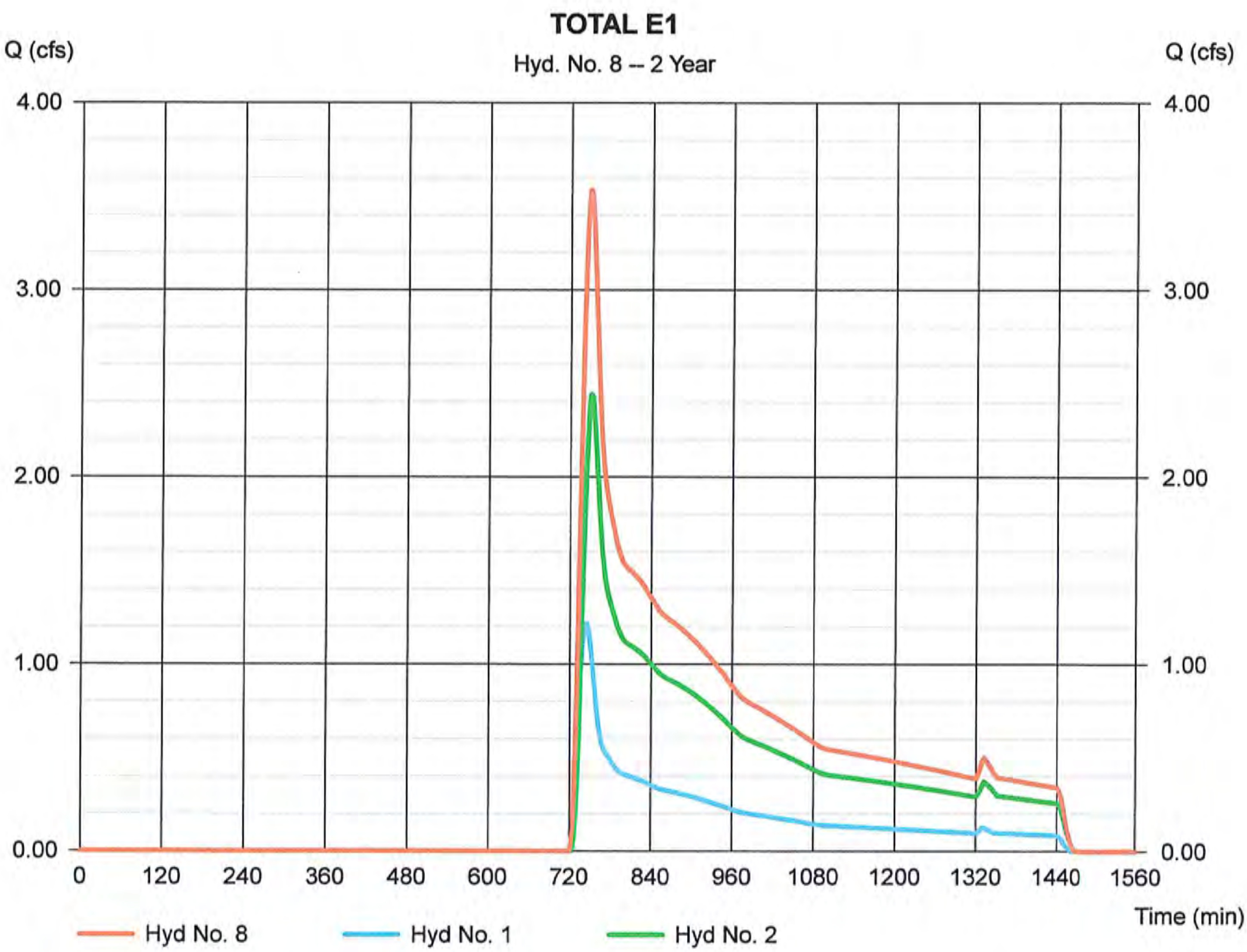
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 8

TOTAL E1

Hydrograph type	= Combine	Peak discharge	= 3.534 cfs
Storm frequency	= 2 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 36,468 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 43.950 ac



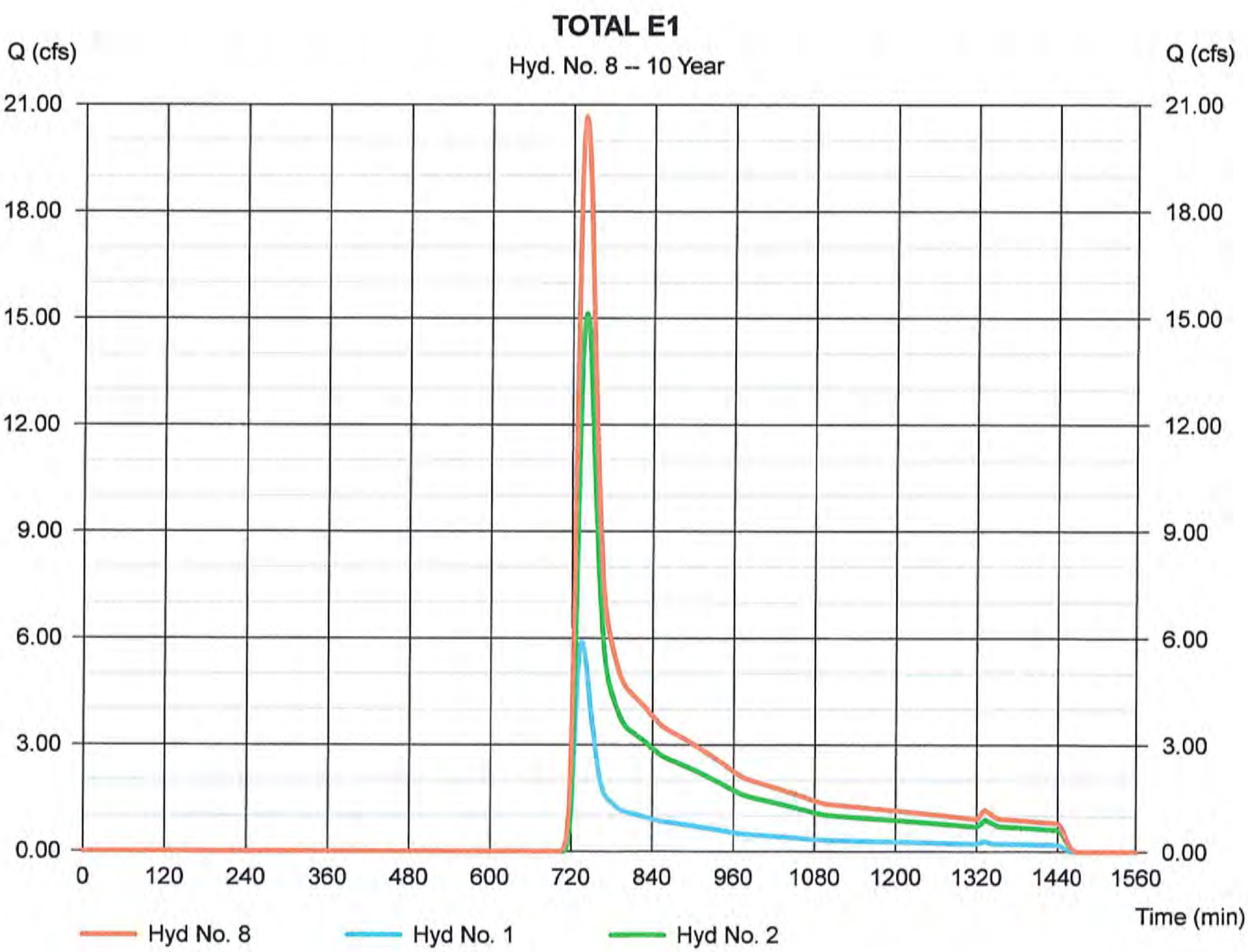
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 8

TOTAL E1

Hydrograph type	= Combine	Peak discharge	= 20.66 cfs
Storm frequency	= 10 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 120,123 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 43.950 ac



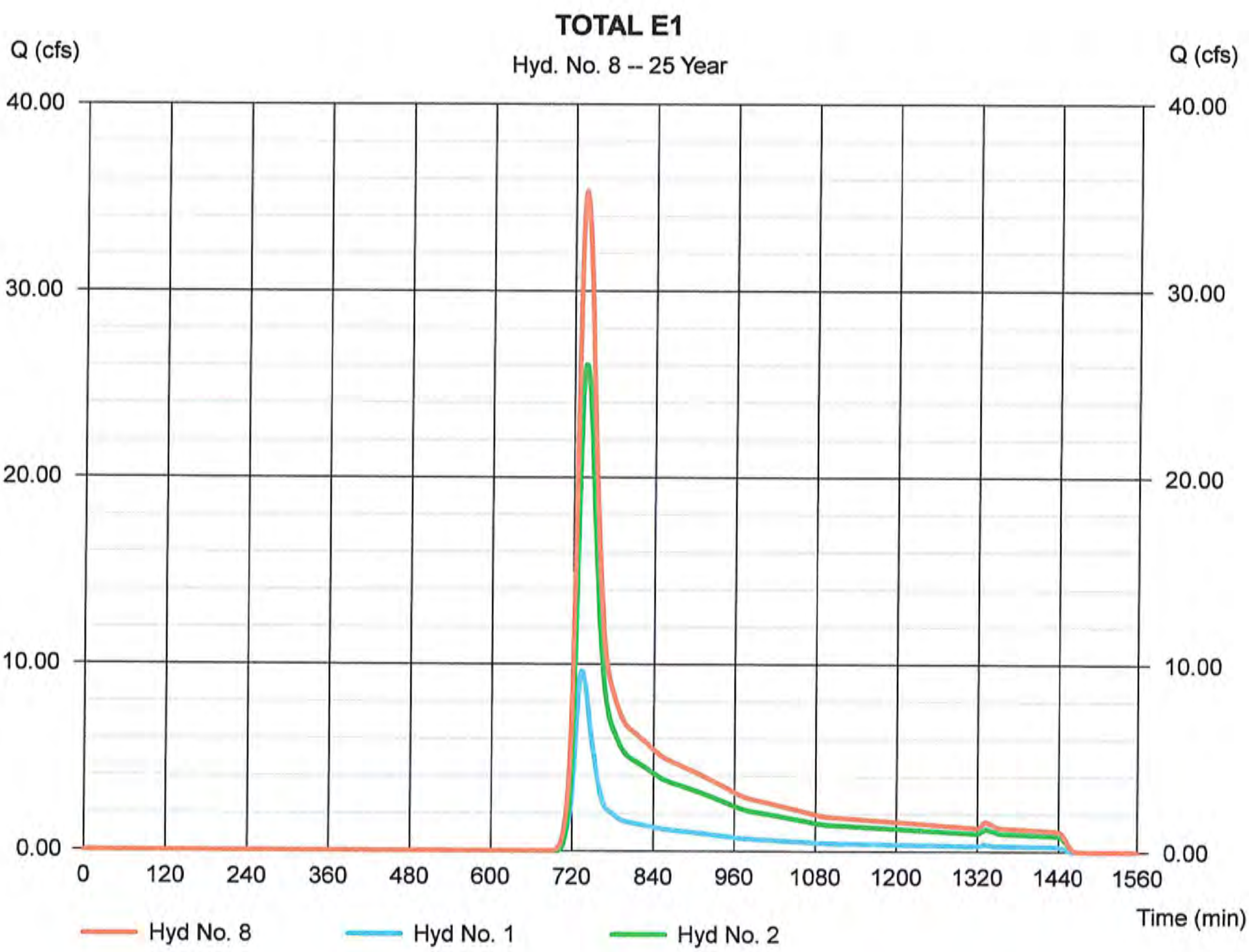
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 8

TOTAL E1

Hydrograph type	= Combine	Peak discharge	= 35.34 cfs
Storm frequency	= 25 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 182,703 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 43.950 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

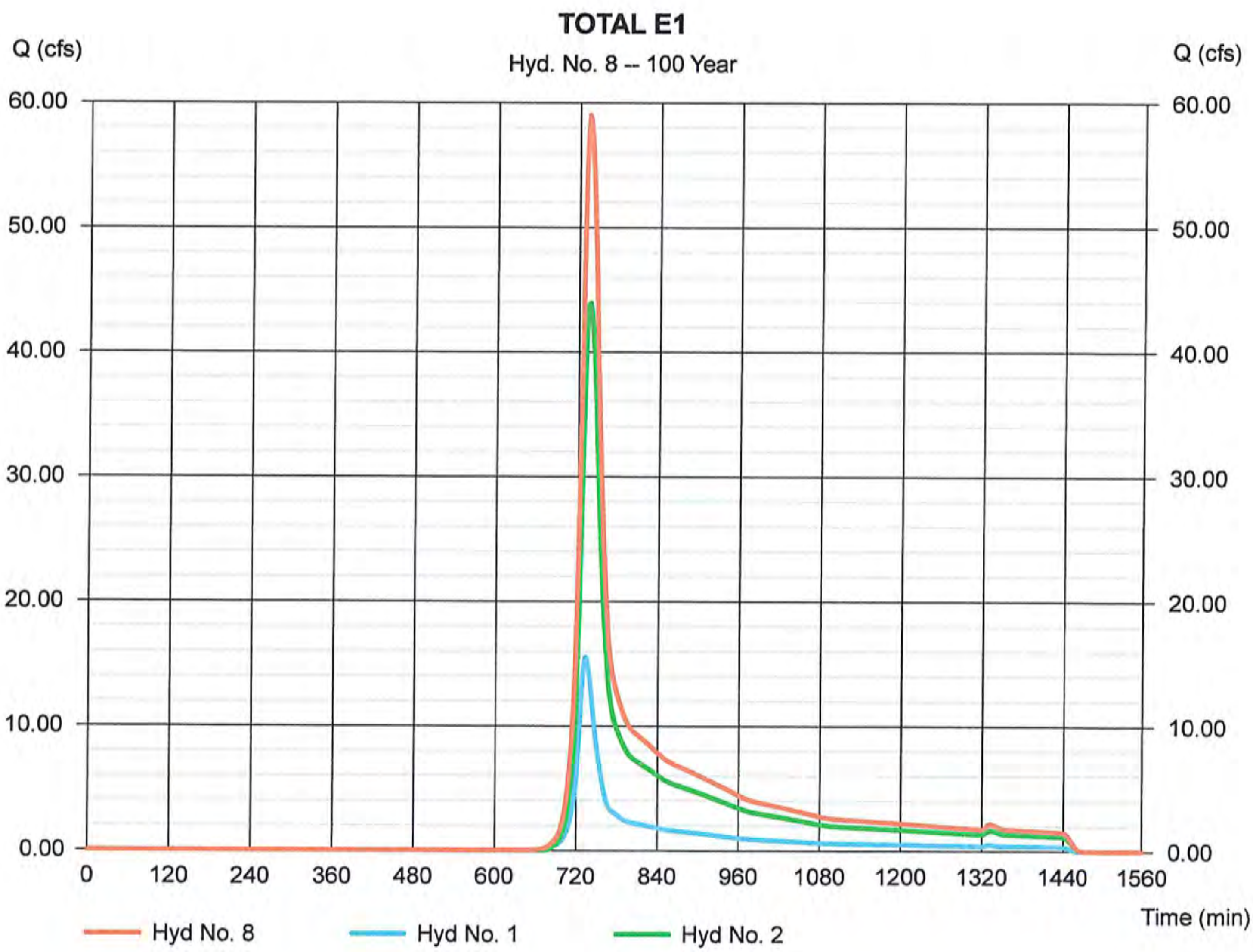
Thursday, Jun 22, 2017

Hyd. No. 8

TOTAL E1

Hydrograph type	= Combine
Storm frequency	= 100 yrs
Time interval	= 2 min
Inflow hyds.	= 1, 2

Peak discharge	= 59.03 cfs
Time to peak	= 734 min
Hyd. volume	= 281,789 cuft
Contrib. drain. area	= 43.950 ac



Post-Development Hydrology

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	0.827	2	742	6,886	—	—	—	P1A
2	SCS Runoff	1.979	2	724	6,047	—	—	—	P2A
3	Reservoir	0.000	2	2188	0	2	323.09	3,488	SMA 1
4	SCS Runoff	0.287	2	744	2,429	—	—	—	P2B
5	SCS Runoff	3.778	2	724	11,539	—	—	—	P1C
6	Reservoir	0.022	2	802	158	5	314.28	5,259	SMA 2
7	SCS Runoff	2.150	2	736	13,568	—	—	—	P1B
8	SCS Runoff	3.414	2	724	10,629	—	—	—	P1D
9	Reservoir	0.138	2	774	1,301	8	308.80	4,403	SMA 3
10	SCS Runoff	6.227	2	724	23,494	—	—	—	P1E
11	SCS Runoff	1.624	2	724	5,465	—	—	—	ROOFS (9-13)
12	Reservoir	0.000	2	480	0	11	2.56	2,347	RD 2 (9-13)
13	Combine	6.227	2	724	23,494	10, 12	—	—	TOTAL TO SMA 4
14	Reservoir	0.356	2	778	7,902	13	314.39	6,975	SMA 4
17	SCS Runoff	3.145	2	728	12,195	—	—	—	PIG
18	Reservoir	0.000	2	736	0	17	319.39	3,743	SMA 6
19	SCS Runoff	6.372	2	724	19,145	—	—	—	P1H
20	Reservoir	0.000	2	644	0	19	312.20	8,469	SMA 7
21	SCS Runoff	3.481	2	724	11,561	—	—	—	P1I
22	Reservoir	0.000	2	740	0	21	312.59	3,480	SMA 8
23	SCS Runoff	0.138	2	742	1,194	—	—	—	P3
25	SCS Runoff	0.133	2	744	976	—	—	—	P4
26	SCS Runoff	0.012	2	738	98	—	—	—	P5
29	Combine	3.286	2	738	29,814	1, 6, 7, 9, 14, 18,	—	—	<no description>
30	Combine	3.286	2	738	29,814	20, 22, 29	—	—	TOTAL P1
31	Combine	0.287	2	744	2,429	3, 4,	—	—	TOTAL P2
37	SCS Runoff	0.319	2	724	1,074	—	—	—	1 ROOF (6-8,14 or 15)
38	Reservoir	0.000	2	1268	0	37	2.43	512	Indiv. Roof Drywell

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	4.343	2	732	21,278	----	------	------	P1A
2	SCS Runoff	3.862	2	724	11,548	----	------	------	P2A
3	Reservoir	0.077	2	886	1,385	2	323.82	6,888	SMA 1
4	SCS Runoff	1.453	2	734	7,507	----	------	------	P2B
5	SCS Runoff	7.359	2	724	22,005	----	------	------	P1C
6	Reservoir	0.594	2	756	5,460	5	315.00	9,822	SMA 2
7	SCS Runoff	8.292	2	730	36,700	----	------	------	P1B
8	SCS Runoff	6.996	2	724	20,998	----	------	------	P1D
9	Reservoir	1.233	2	748	7,611	8	309.39	8,405	SMA 3
10	SCS Runoff	17.32	2	724	54,827	----	------	------	P1E
11	SCS Runoff	2.373	2	724	8,126	----	------	------	ROOFS (9-13)
12	Reservoir	0.000	2	394	0	11	3.95	3,900	RD 2 (9-13)
13	Combine	17.32	2	724	54,827	10, 12	------	------	TOTAL TO SMA 4
14	Reservoir	1.353	2	772	25,716	13	315.38	20,485	SMA 4
17	SCS Runoff	7.488	2	726	26,490	----	------	------	PIG
18	Reservoir	0.600	2	754	2,705	17	320.66	9,393	SMA 6
19	SCS Runoff	11.65	2	724	34,841	----	------	------	P1H
20	Reservoir	0.382	2	792	1,919	19	313.90	16,866	SMA 7
21	SCS Runoff	8.073	2	724	24,664	----	------	------	P1I
22	Reservoir	0.579	2	750	2,102	21	313.59	8,451	SMA 8
23	SCS Runoff	0.756	2	732	3,766	----	------	------	P3
25	SCS Runoff	0.525	2	736	2,733	----	------	------	P4
26	SCS Runoff	0.079	2	726	308	----	------	------	P5
29	Combine	14.37	2	732	99,469	1, 6, 7, 9, 14, 18,	------	------	<no description>
30	Combine	14.62	2	732	103,491	20, 22, 29	------	------	TOTAL P1
31	Combine	1.453	2	734	8,892	3, 4,	------	------	TOTAL P2
37	SCS Runoff	0.466	2	724	1,596	----	------	------	1 ROOF (6-8,14 or 15)
38	Reservoir	0.000	2	496	0	37	3.79	798	Indiv. Roof Drywell

2069 POST 3.gpw	Return Period: 10 Year	Thursday, Jun 22, 2017

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	7.218	2	730	31,835	----	------	------	P1A
2	SCS Runoff	5.002	2	724	14,950	----	------	------	P2A
3	Reservoir	0.204	2	826	3,936	2	324.10	8,381	SMA 1
4	SCS Runoff	2.397	2	732	11,232	----	------	------	P2B
5	SCS Runoff	9.526	2	724	28,473	----	------	------	P1C
6	Reservoir	1.750	2	748	10,030	5	315.21	11,975	SMA 2
7	SCS Runoff	12.75	2	730	52,977	----	------	------	P1B
8	SCS Runoff	9.199	2	724	27,496	----	------	------	P1D
9	Reservoir	2.814	2	740	12,668	8	309.59	9,843	SMA 3
10	SCS Runoff	24.65	2	724	75,770	----	------	------	P1E
11	SCS Runoff	2.801	2	724	9,648	----	------	------	ROOFS (9-13)
12	Reservoir	0.000	2	422	0	11	4.86	4,825	RD 2 (9-13)
13	Combine	24.65	2	724	75,770	10, 12	------	------	TOTAL TO SMA 4
14	Reservoir	3.941	2	752	41,518	13	315.83	28,036	SMA 4
17	SCS Runoff	10.32	2	726	35,791	----	------	------	PIG
18	Reservoir	0.948	2	754	6,580	17	321.26	13,051	SMA 6
19	SCS Runoff	14.77	2	724	44,362	----	------	------	P1H
20	Reservoir	1.967	2	752	8,826	19	314.43	19,252	SMA 7
21	SCS Runoff	11.00	2	724	33,130	----	------	------	P1I
22	Reservoir	1.379	2	748	5,896	21	314.06	11,328	SMA 8
23	SCS Runoff	1.271	2	730	5,664	----	------	------	P3
25	SCS Runoff	0.819	2	736	3,983	----	------	------	P4
26	SCS Runoff	0.133	2	724	462	----	------	------	P5
29	Combine	24.89	2	732	155,608	1, 6, 7, 9, 14, 18,	------	------	<no description>
30	Combine	25.93	2	736	170,330	20, 22, 29	------	------	TOTAL P1
31	Combine	2.429	2	734	15,168	3, 4,	------	------	TOTAL P2
37	SCS Runoff	0.550	2	724	1,895	----	------	------	1 ROOF (6-8,14 or 15)
38	Reservoir	0.000	2	580	0	37	4.61	970	Indiv. Roof Drywell

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	11.75	2	730	48,391	----	------	------	P1A
2	SCS Runoff	6.604	2	724	19,816	----	------	------	P2A
3	Reservoir	0.426	2	782	7,996	2	324.49	10,697	SMA 1
4	SCS Runoff	3.905	2	732	17,073	----	------	------	P2B
5	SCS Runoff	12.57	2	724	37,723	----	------	------	P1C
6	Reservoir	3.748	2	740	17,115	5	315.42	14,246	SMA 2
7	SCS Runoff	19.53	2	730	77,958	----	------	------	P1B
8	SCS Runoff	12.32	2	724	36,863	----	------	------	P1D
9	Reservoir	4.429	2	738	20,290	8	309.90	12,100	SMA 3
10	SCS Runoff	35.47	2	724	107,036	----	------	------	P1E
11	SCS Runoff	3.387	2	724	11,742	----	------	------	ROOFS (9-13)
12	Reservoir	0.000	2	316	0	11	6.69	6,085	RD 2 (9-13)
13	Combine	35.47	2	724	107,036	10, 12	------	------	TOTAL TO SMA 4
14	Reservoir	11.57	2	742	67,773	13	316.14	33,859	SMA 4
17	SCS Runoff	14.43	2	726	49,473	----	------	------	PIG
18	Reservoir	3.451	2	748	14,089	17	321.86	17,316	SMA 6
19	SCS Runoff	19.11	2	724	57,845	----	------	------	P1H
20	Reservoir	3.358	2	748	19,048	19	315.66	24,085	SMA 7
21	SCS Runoff	15.22	2	724	45,536	----	------	------	P1I
22	Reservoir	3.552	2	742	12,762	21	314.51	14,769	SMA 8
23	SCS Runoff	2.089	2	730	8,651	----	------	------	P3
25	SCS Runoff	1.275	2	734	5,913	----	------	------	P4
26	SCS Runoff	0.219	2	724	704	----	------	------	P5
29	Combine	48.73	2	732	245,616	1, 6, 7, 9, 14, 18,	------	------	<no description>
30	Combine	54.10	2	734	277,427	20, 22, 29	------	------	TOTAL P1
31	Combine	4.109	2	732	25,069	3, 4,	------	------	TOTAL P2
37	SCS Runoff	0.665	2	724	2,307	----	------	------	1 ROOF (6-8,14 or 15)
38	Reservoir	0.000	2	1756	0	37	5.78	1,216	Indiv. Roof Drywell

2069 POST 3.gpw	Return Period: 100 Year	Thursday, Jun 22, 2017

Worksheet 2: Runoff curve number and runoff **SM-2069**

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked RJH Date 6/22/2017

Circle one: Present Developed Subcatchment P-1A

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/			Area	Product of CN x Area
		Table 2-2	Fig. 2-3	Fig. 2-4	Acres	
B	Woods- Good Condition	55			4.09	225.05
B	Brush- Good Condition	48			1.45	69.66
C	Woods- Good Condition	70			1.07	74.70
C	Open- Good Condition	74			0.02	1.26
D	Woods- Good Condition	77			0.00	0.24
	Impervious (Sidewalk)	98			0.11	10.59
B	Gravel	85			0.04	3.42
				295270		
				Totals =	6.78	384.91

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{384.91}{6.78}$ = 56.78 ; Use CN = 56.8

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	0.27	0.84	1.91
Runoff, Q	cf	6667	20607	46881

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/2016

Location: Boxborough, MA Checked ________ Date ________

Circle one: Present **Developed** Subcatchment P P-1A

Circle one: **Tc** Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			WOODS			
2. Mannings roughness coeff., n (table 3-1)			0.6			
3. Flow length, L (total L <= 300 ft)		ft	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	0.19			0.19

Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			UNPAVED			
8. Flow Length, L		ft	116			
9. Watercourse slope, s		ft/ft	0.1			
10. Average Velocity, V (figure 3-1)		ft/s	5.10			
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				0.00

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.20
min 11.9

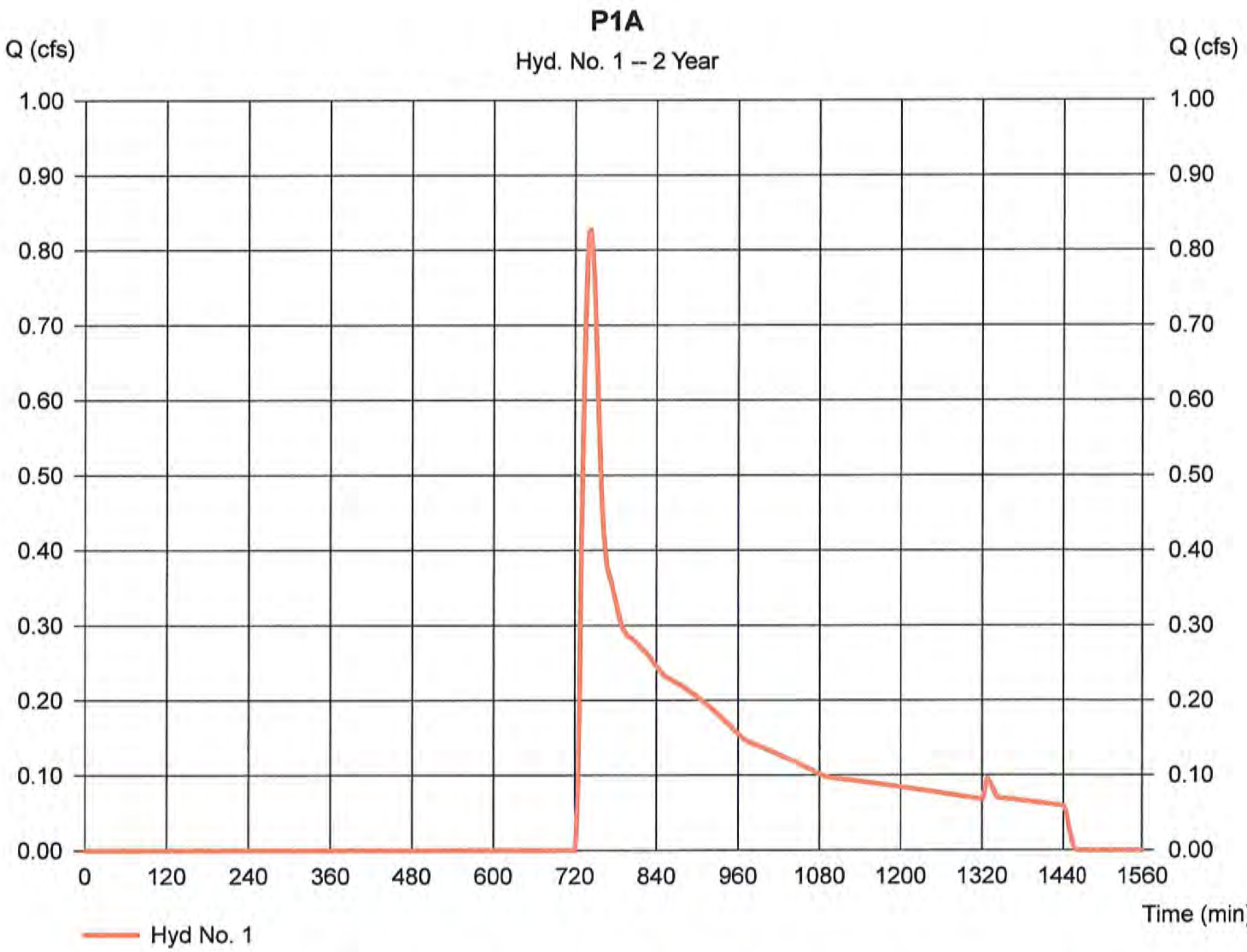
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 1

P1A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.827 cfs
Storm frequency	= 2 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 6,886 cuft
Drainage area	= 6.780 ac	Curve number	= 56.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 11.90 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

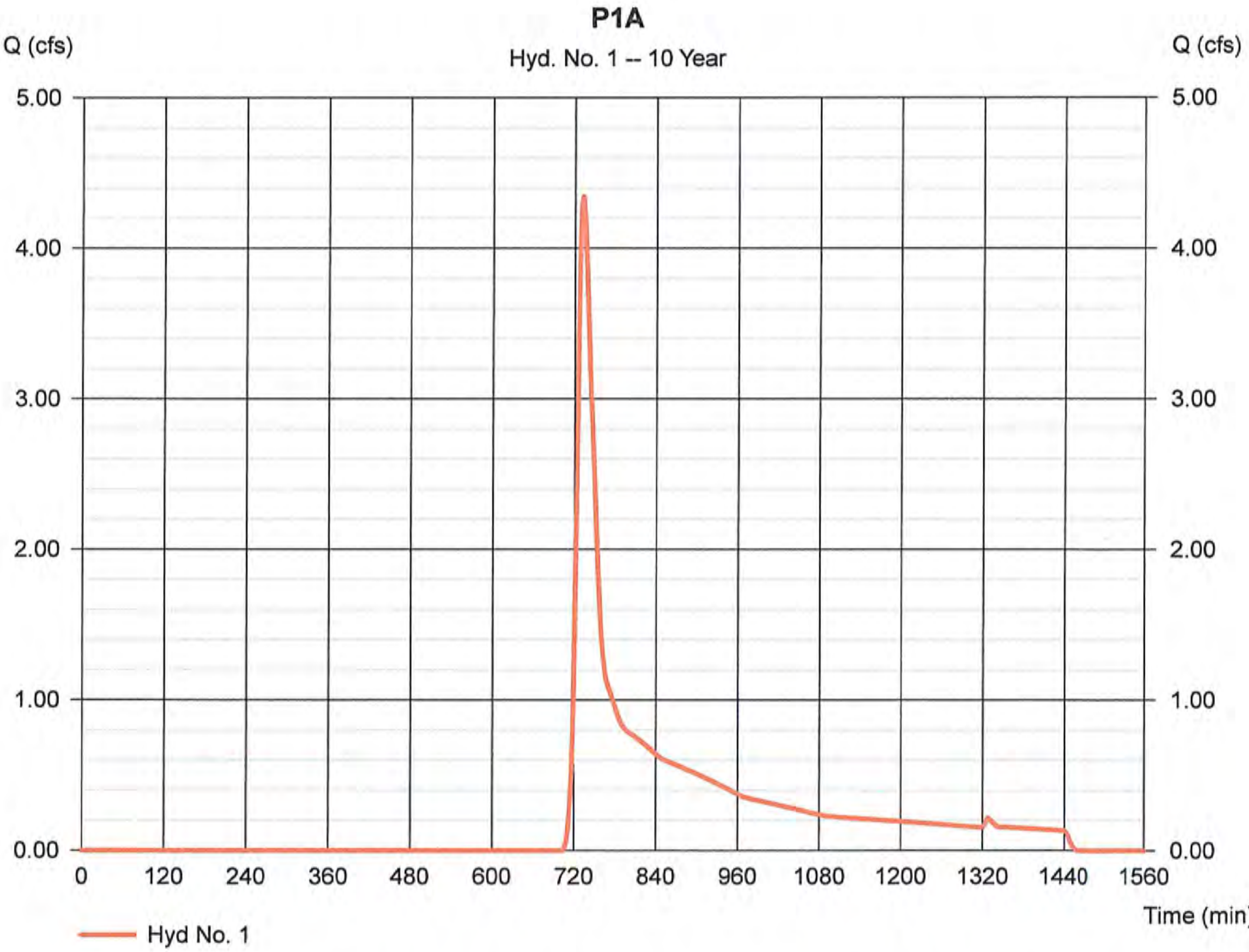


Hydrograph Report

Hyd. No. 1

P1A

Hydrograph type	= SCS Runoff	Peak discharge	= 4.343 cfs
Storm frequency	= 10 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 21,278 cuft
Drainage area	= 6.780 ac	Curve number	= 56.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 11.90 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



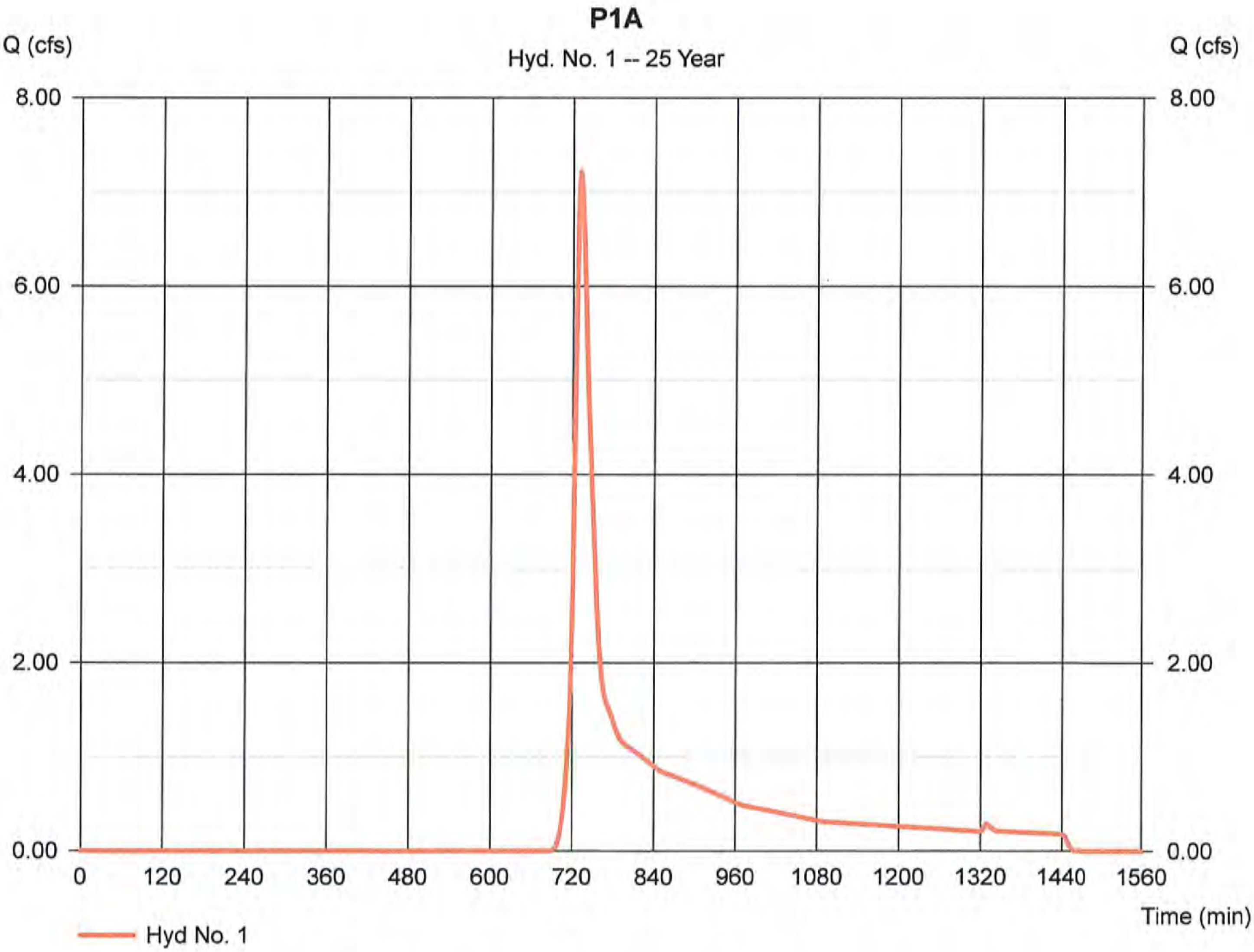
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 1

P1A

Hydrograph type	= SCS Runoff	Peak discharge	= 7.218 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 31,835 cuft
Drainage area	= 6.780 ac	Curve number	= 56.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 11.90 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

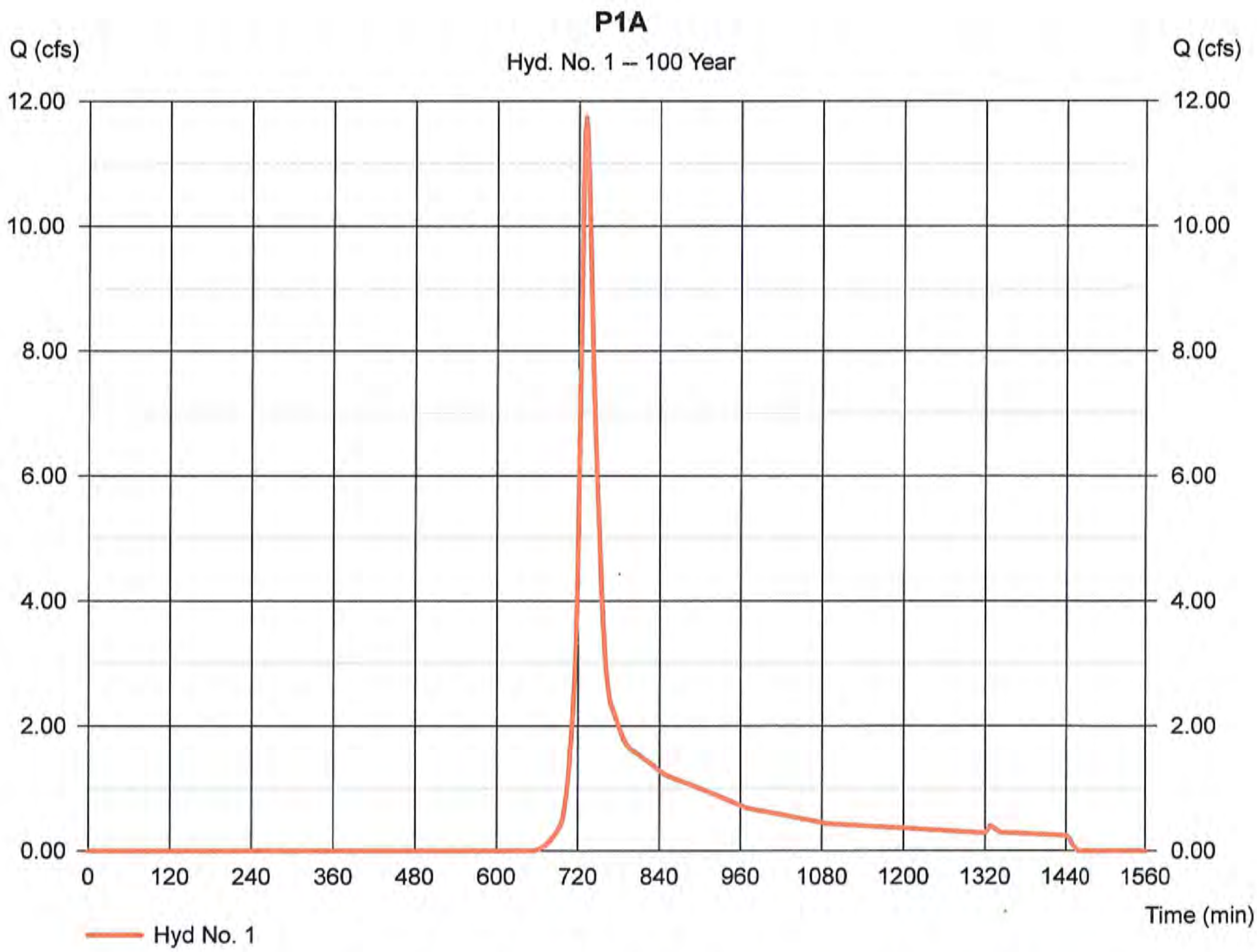


Hydrograph Report

Hyd. No. 1

P1A

Hydrograph type	= SCS Runoff	Peak discharge	= 11.75 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 48,391 cuft
Drainage area	= 6.780 ac	Curve number	= 56.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 11.90 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked RJH Date 6/22/2017

Circle one: Present Developed Subcatchment P-2A

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			0.68	66.54
B	Woods- Good Condition	55			0.00	0.00
B	Open Space-Good Condition	61			0.80	48.96
	Gravel	85			0.00	0.00
				64537 Totals =	1.48	115.50

1/ Use only one CN source per line.

CN (weighted) = total product / total area = 115.50 / 1.48 = 77.96 ; Use CN = 78.0

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	1.20	2.29	3.93
Runoff, Q	cf	6443	12312	21135

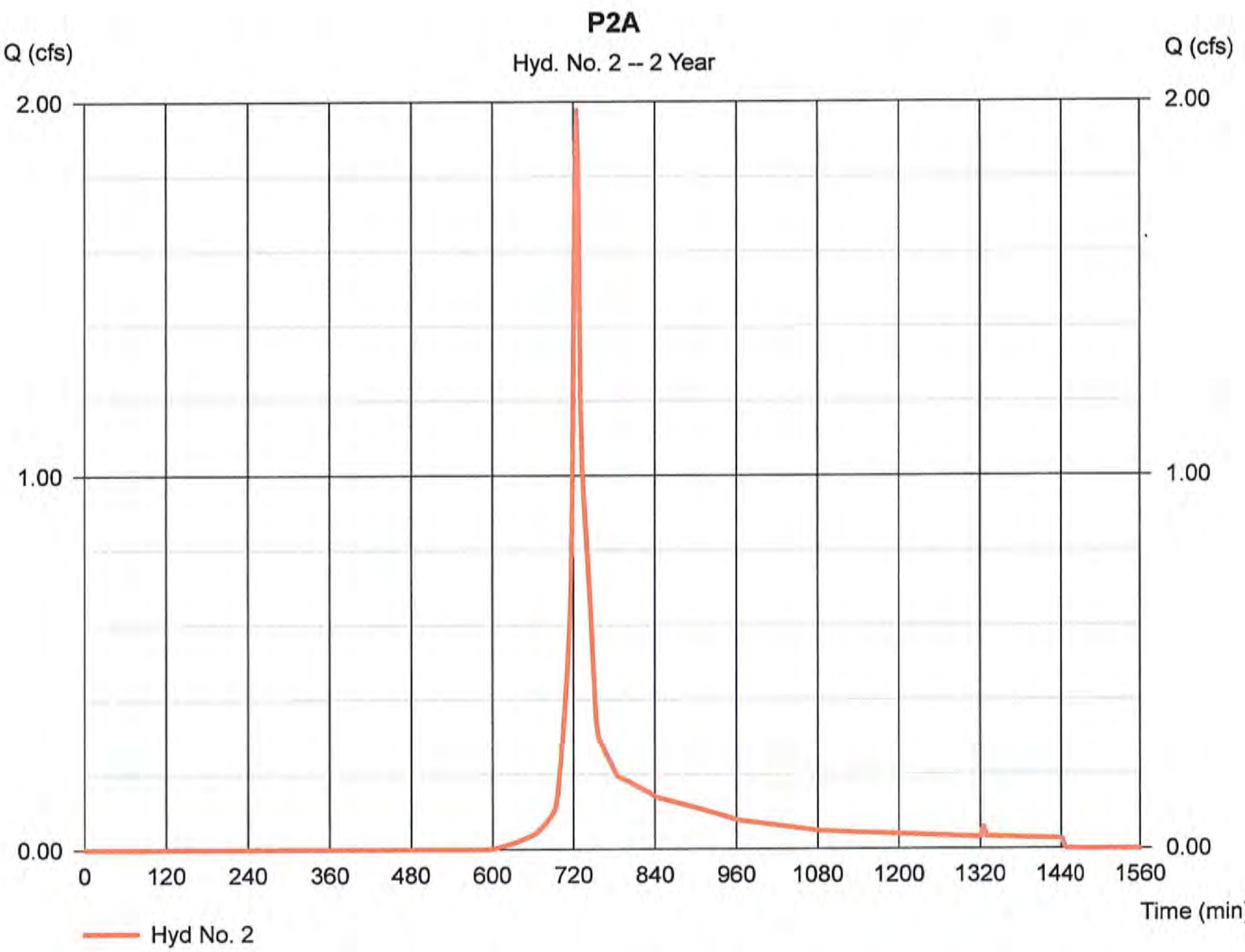
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 2

P2A

Hydrograph type	= SCS Runoff	Peak discharge	= 1.979 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 6,047 cuft
Drainage area	= 1.480 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



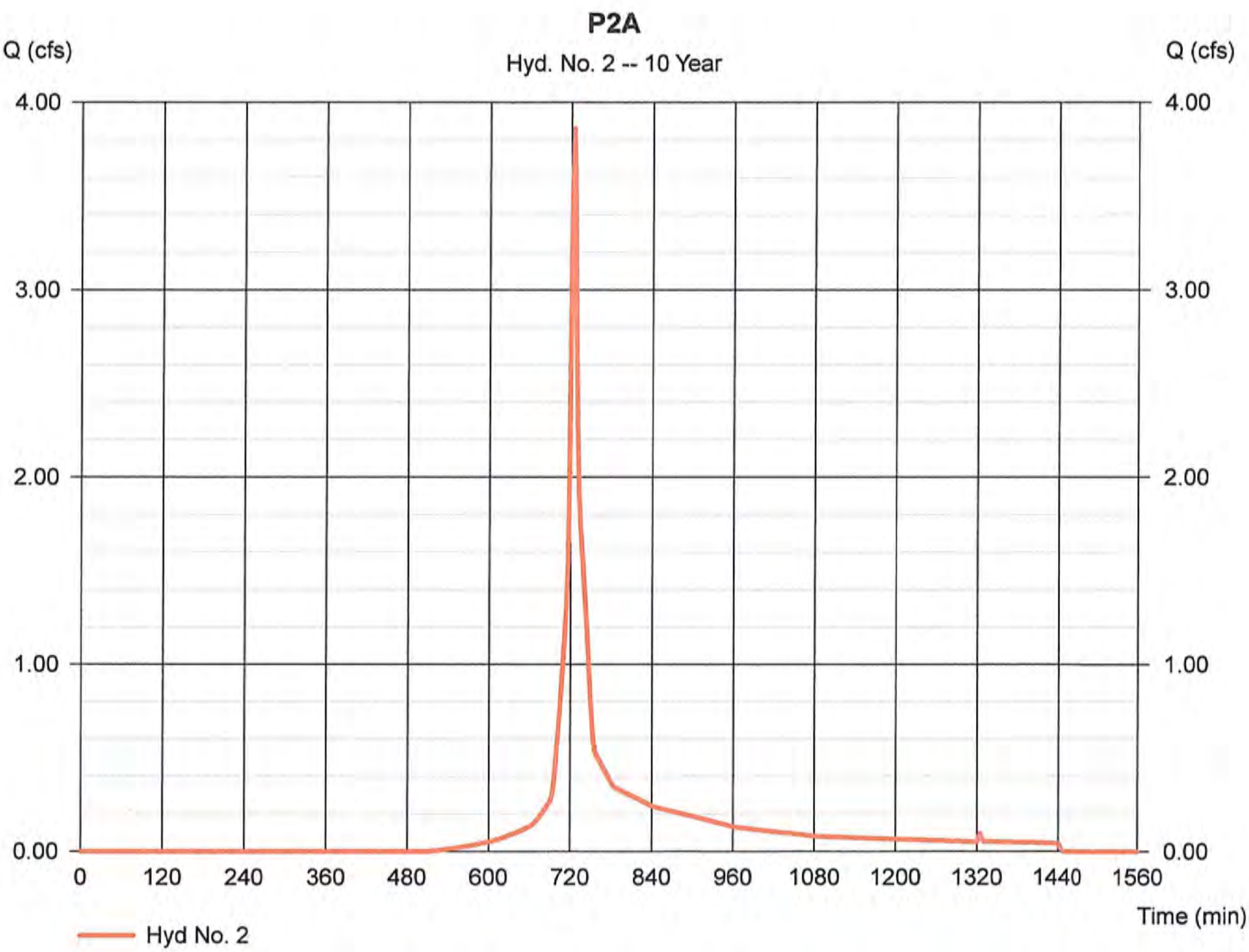
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 2

P2A

Hydrograph type	= SCS Runoff	Peak discharge	= 3.862 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 11,548 cuft
Drainage area	= 1.480 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



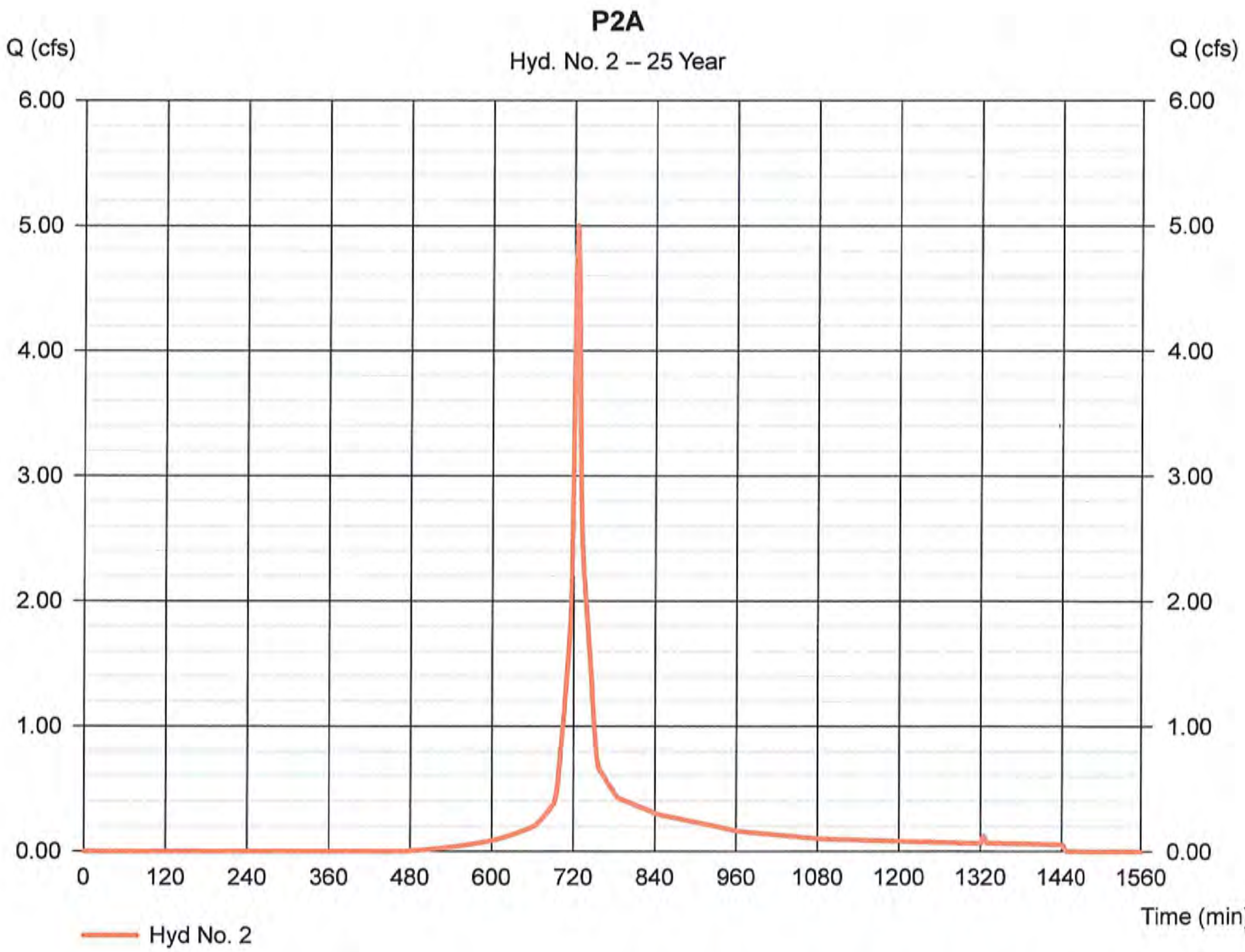
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 2

P2A

Hydrograph type	= SCS Runoff	Peak discharge	= 5.002 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 14,950 cuft
Drainage area	= 1.480 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



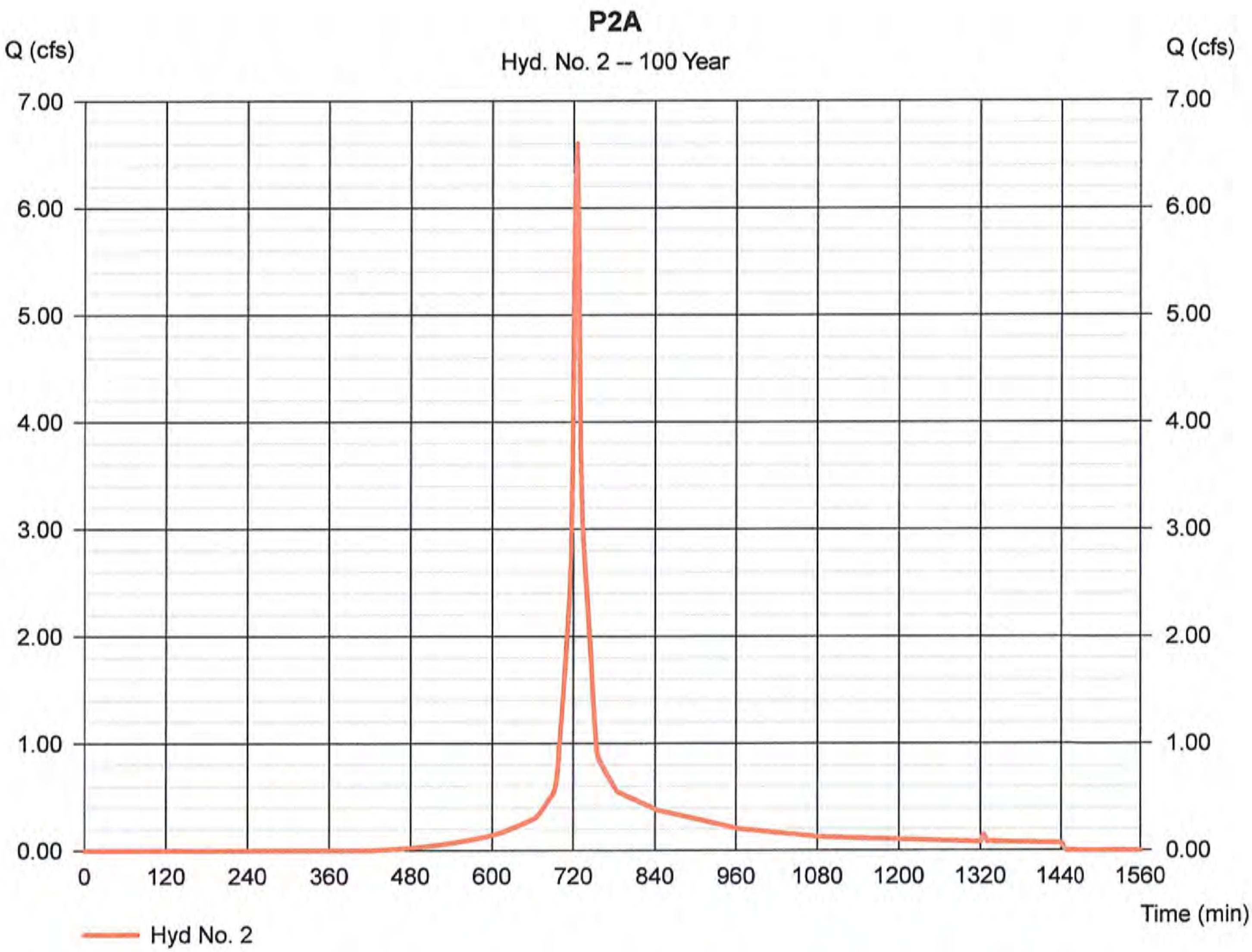
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 2

P2A

Hydrograph type	= SCS Runoff	Peak discharge	= 6.604 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 19,816 cuft
Drainage area	= 1.480 ac	Curve number	= 78
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

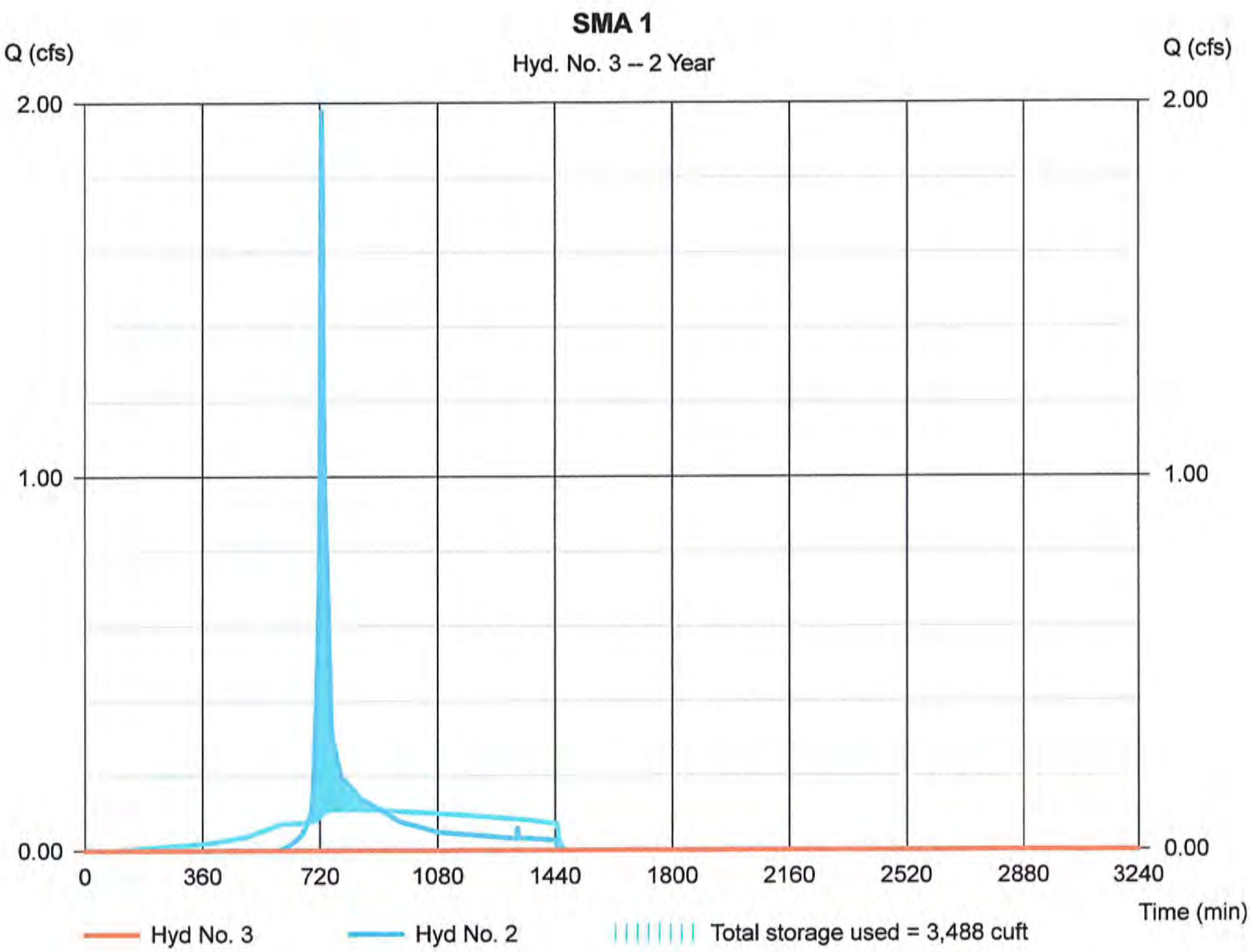
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 3

SMA 1

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 2188 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 2 - P2A	Max. Elevation	= 323.09 ft
Reservoir name	= SMA 1	Max. Storage	= 3,488 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

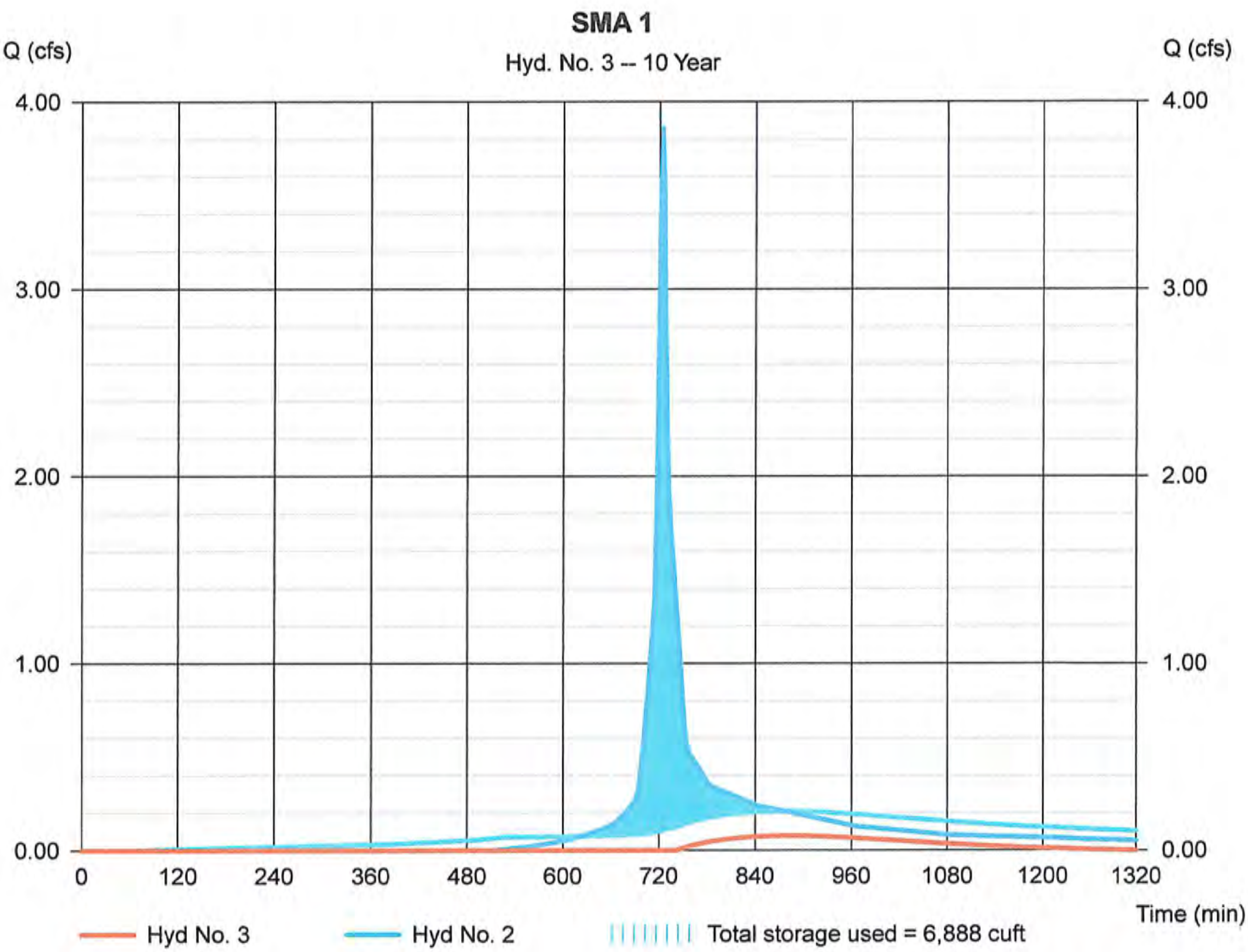
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 3

SMA 1

Hydrograph type	= Reservoir	Peak discharge	= 0.077 cfs
Storm frequency	= 10 yrs	Time to peak	= 886 min
Time interval	= 2 min	Hyd. volume	= 1,385 cuft
Inflow hyd. No.	= 2 - P2A	Max. Elevation	= 323.82 ft
Reservoir name	= SMA 1	Max. Storage	= 6,888 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

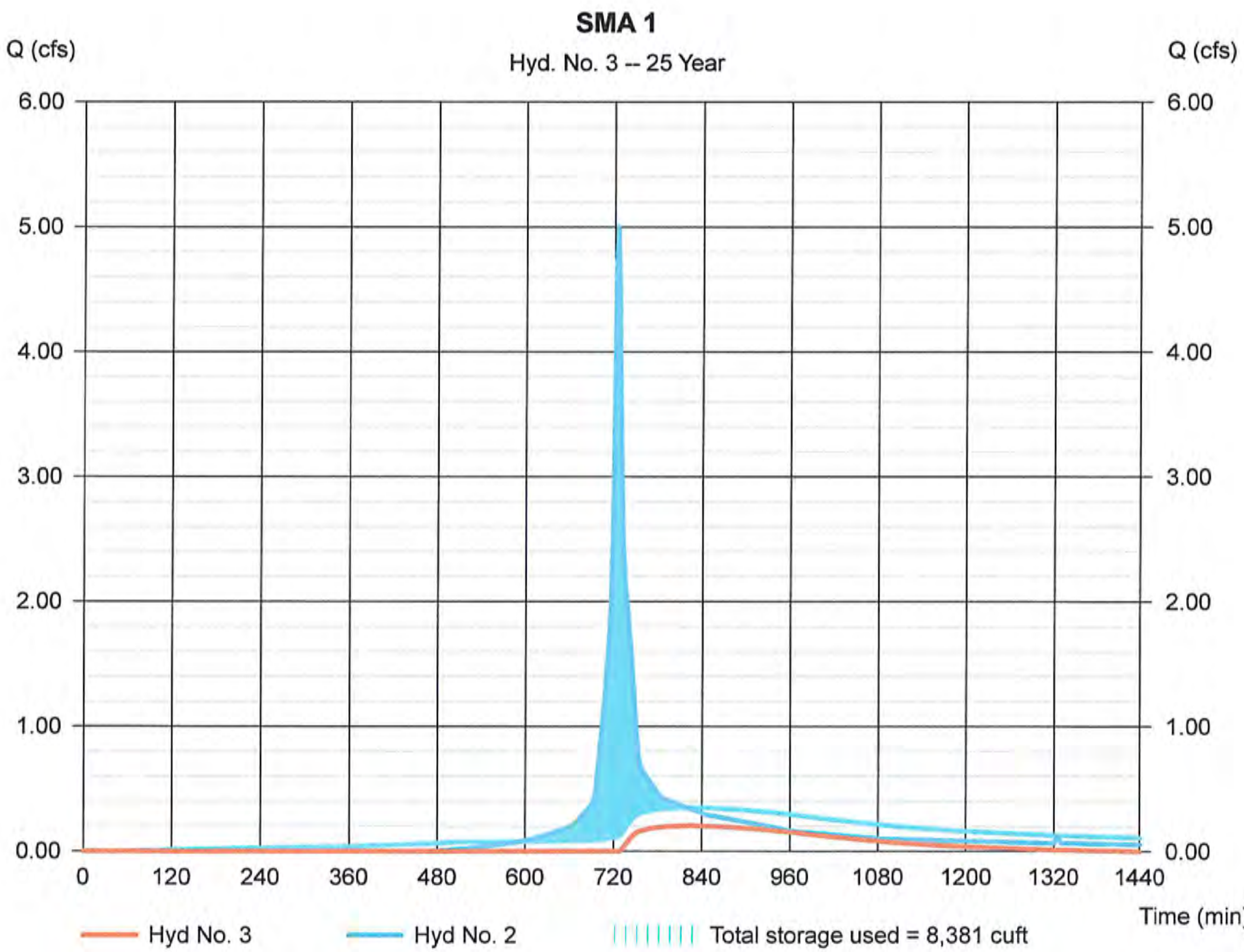
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 3

SMA 1

Hydrograph type	= Reservoir	Peak discharge	= 0.204 cfs
Storm frequency	= 25 yrs	Time to peak	= 826 min
Time interval	= 2 min	Hyd. volume	= 3,936 cuft
Inflow hyd. No.	= 2 - P2A	Max. Elevation	= 324.10 ft
Reservoir name	= SMA 1	Max. Storage	= 8,381 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

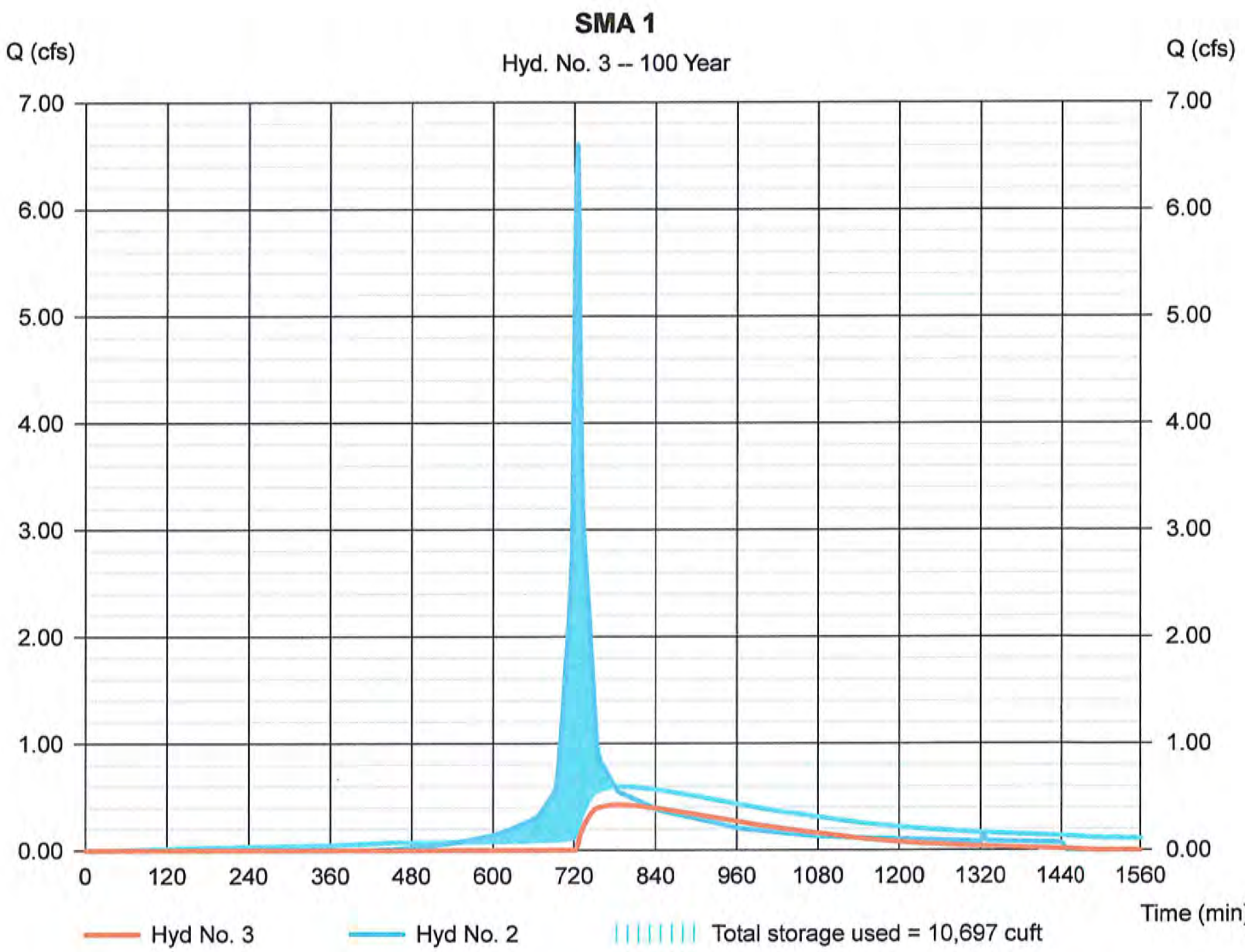
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 3

SMA 1

Hydrograph type	= Reservoir	Peak discharge	= 0.426 cfs
Storm frequency	= 100 yrs	Time to peak	= 782 min
Time interval	= 2 min	Hyd. volume	= 7,996 cuft
Inflow hyd. No.	= 2 - P2A	Max. Elevation	= 324.49 ft
Reservoir name	= SMA 1	Max. Storage	= 10,697 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Pond No. 2 - SMA 1

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 322.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	322.00	2,342	0	0
1.00	323.00	3,841	3,060	3,060
2.00	324.00	5,594	4,690	7,750
3.00	325.00	6,467	6,025	13,775
4.00	326.00	8,519	7,469	21,243

Culvert / Orifice Structures

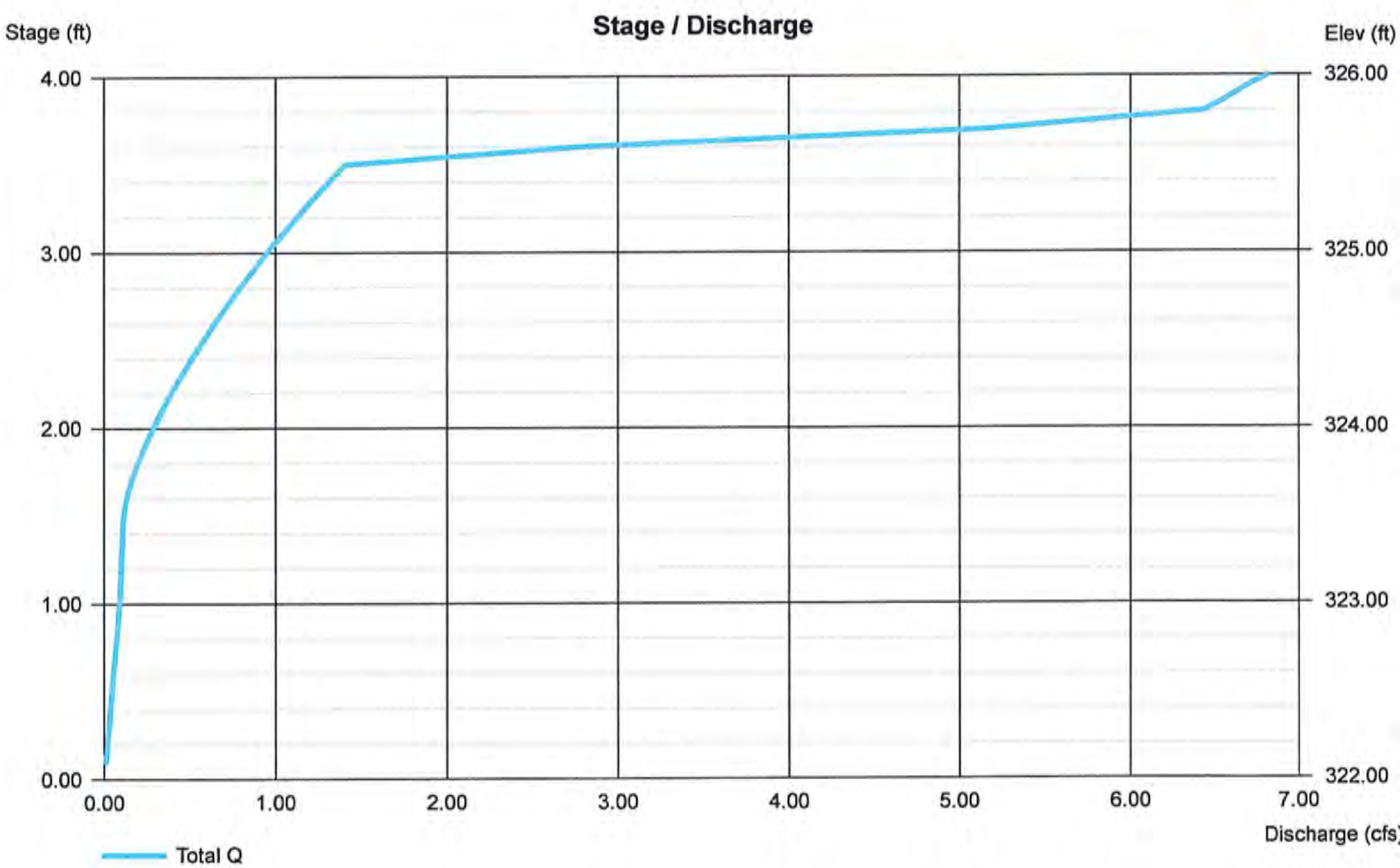
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 322.00	0.00	0.00	0.00
Length (ft)	= 150.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	0.13	0.00	0.00
Crest El. (ft)	= 325.50	323.50	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Riser	Rect	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 1.020 (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).



Worksheet 2: Runoff curve number and runoff SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked ______ Date ______

Circle one: Present Developed Subcatchment P-2B

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			0.00	0.00
B	Woods- Good Condition	55			1.78	97.74
B	Open Space-Good Condition	61			0.75	45.63
				109993.00 Totals =	2.53	143.37

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{143.37}{2.53} =$ 56.78 ; Use CN = 56.8

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	0.27	0.84	1.90
Runoff, Q	cf	2482	7673	17458

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/2016

Location: Boxborough, MA Checked ______ Date ______

Circle one: Present **Developed** SubcatchmentPP-2B

Circle one: **Tc** Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			WOODS			
2. Mannings roughness coeff., n (table 3-1)			0.6			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.04			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.22			0.22
Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			UNPAVED			
8. Flow Length, L		ft	67			
9. Watercourse slope, s		ft/ft	0.075			
10. Average Velocity, V (figure 3-1)		ft/s	4.42			
11. Tt = L / 3600V	Compute Tt	hr	0.00			0.00
Channel flow		Segment ID				
12. Cross sectional flow area, a		sf				
13. Wetted perimeter, pw		ft				
14. Hydraulic radius, r=a/wp	Compute r	ft				
15. Channel Slope, s		ft/ft				
16. Manning's roughness coeff., n						
17. V = 1.49 r^2/3 s^1/2 / n	Compute V	ft/s				
18. Flow length, L		ft				
19. Tt = L / 3600V	Compute Tt	hr				0.00

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.22
min 13.4

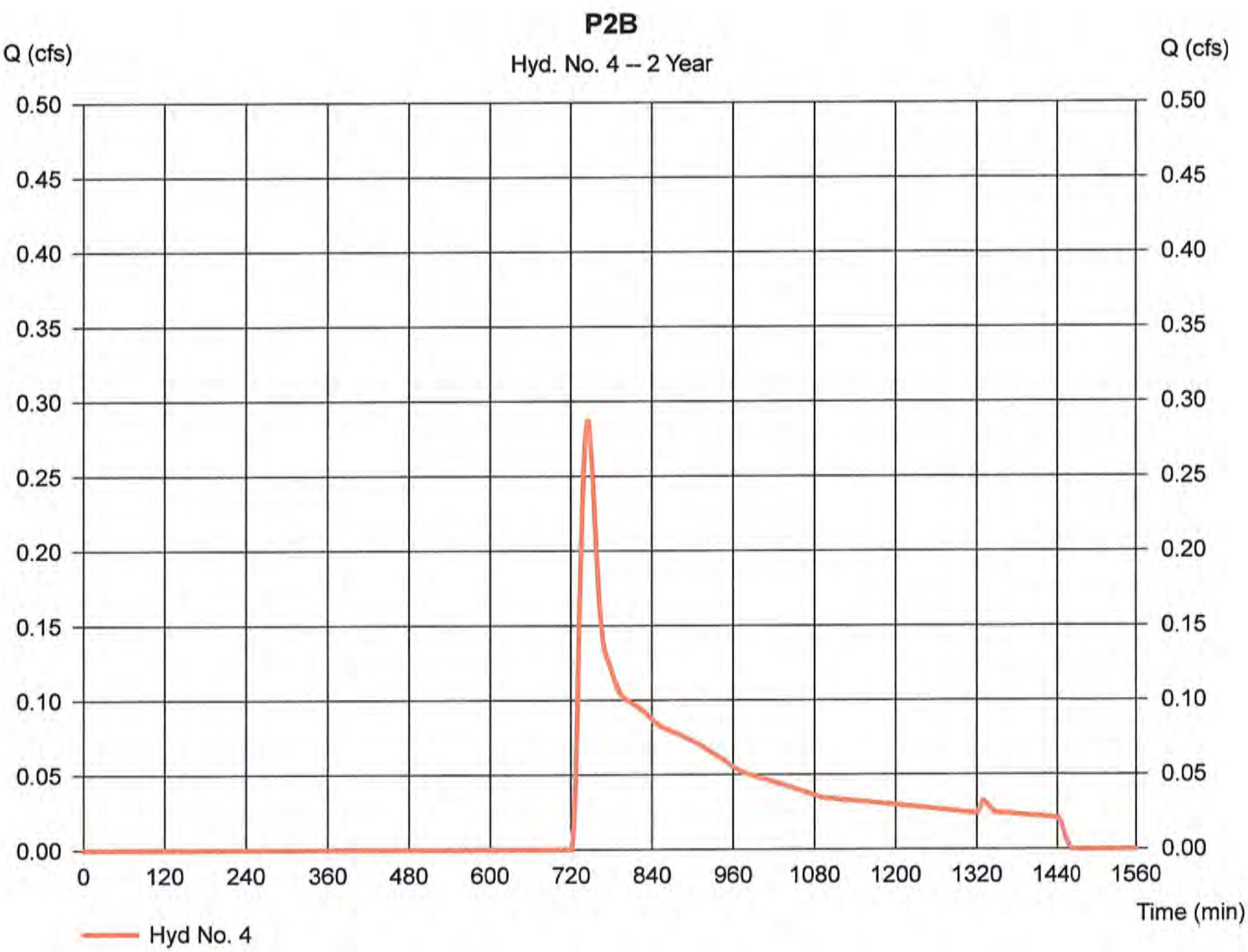
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 4

P2B

Hydrograph type	= SCS Runoff	Peak discharge	= 0.287 cfs
Storm frequency	= 2 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 2,429 cuft
Drainage area	= 2.530 ac	Curve number	= 56.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 13.40 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

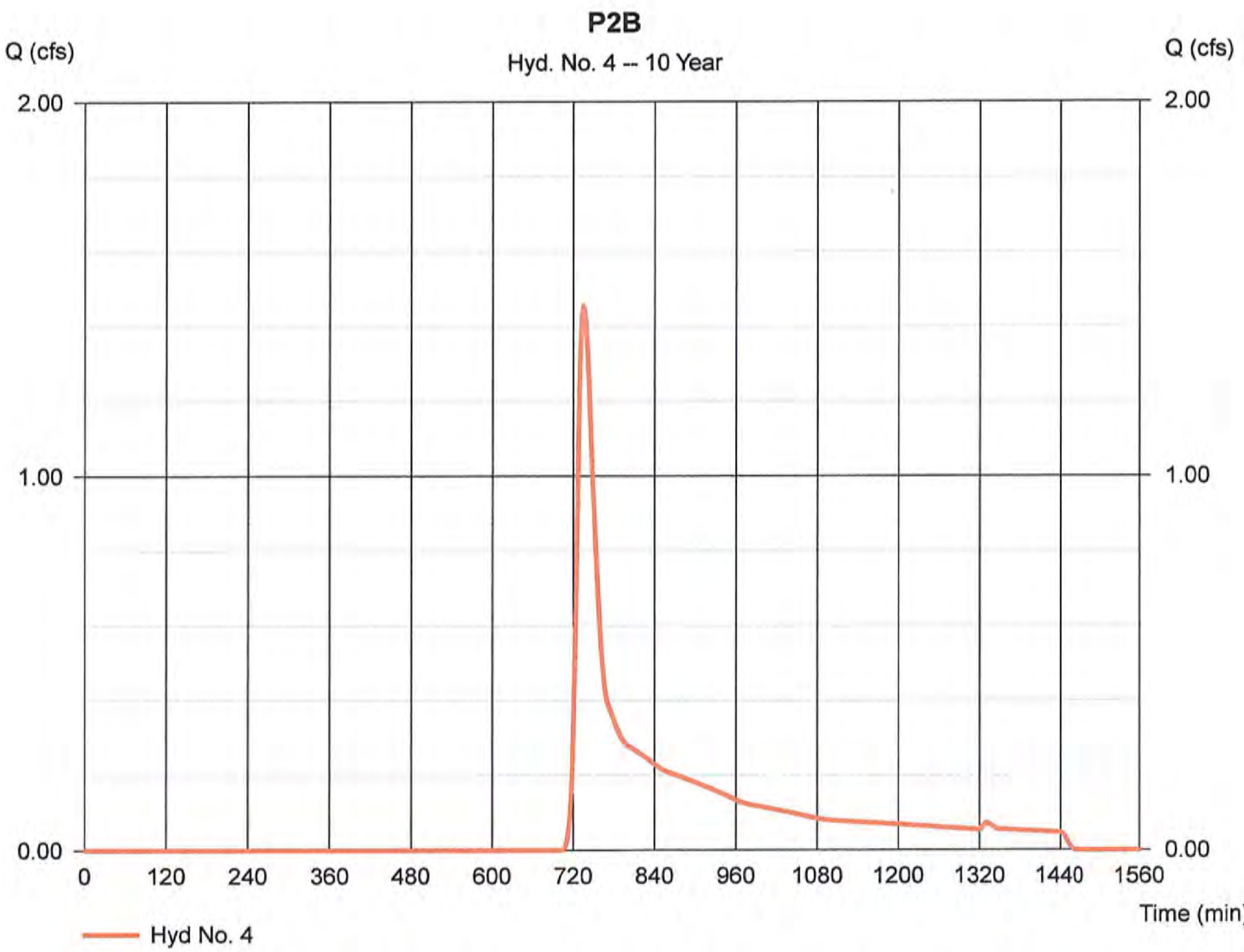
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 4

P2B

Hydrograph type	= SCS Runoff	Peak discharge	= 1.453 cfs
Storm frequency	= 10 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 7,507 cuft
Drainage area	= 2.530 ac	Curve number	= 56.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 13.40 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



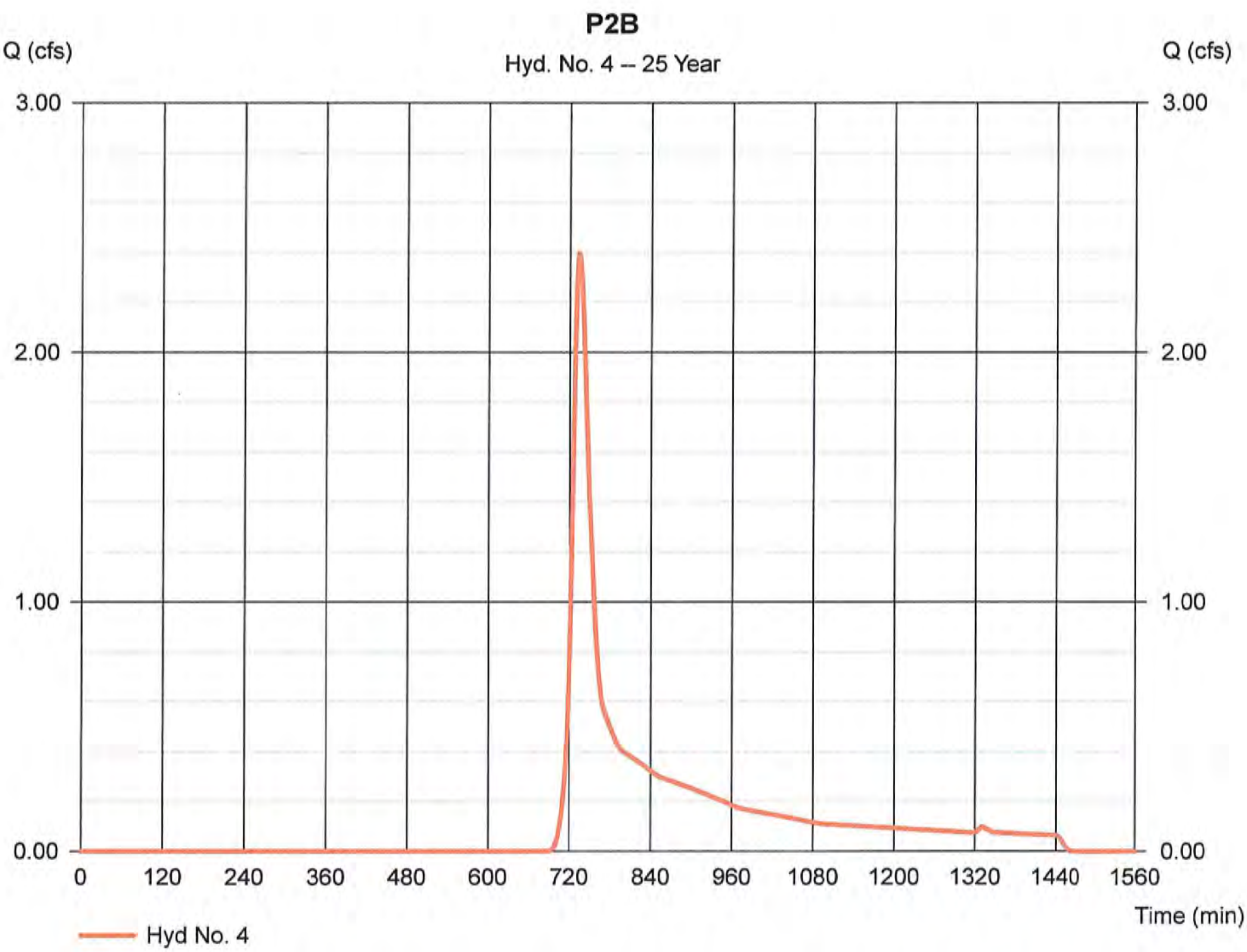
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 4

P2B

Hydrograph type	= SCS Runoff	Peak discharge	= 2.397 cfs
Storm frequency	= 25 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 11,232 cuft
Drainage area	= 2.530 ac	Curve number	= 56.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 13.40 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



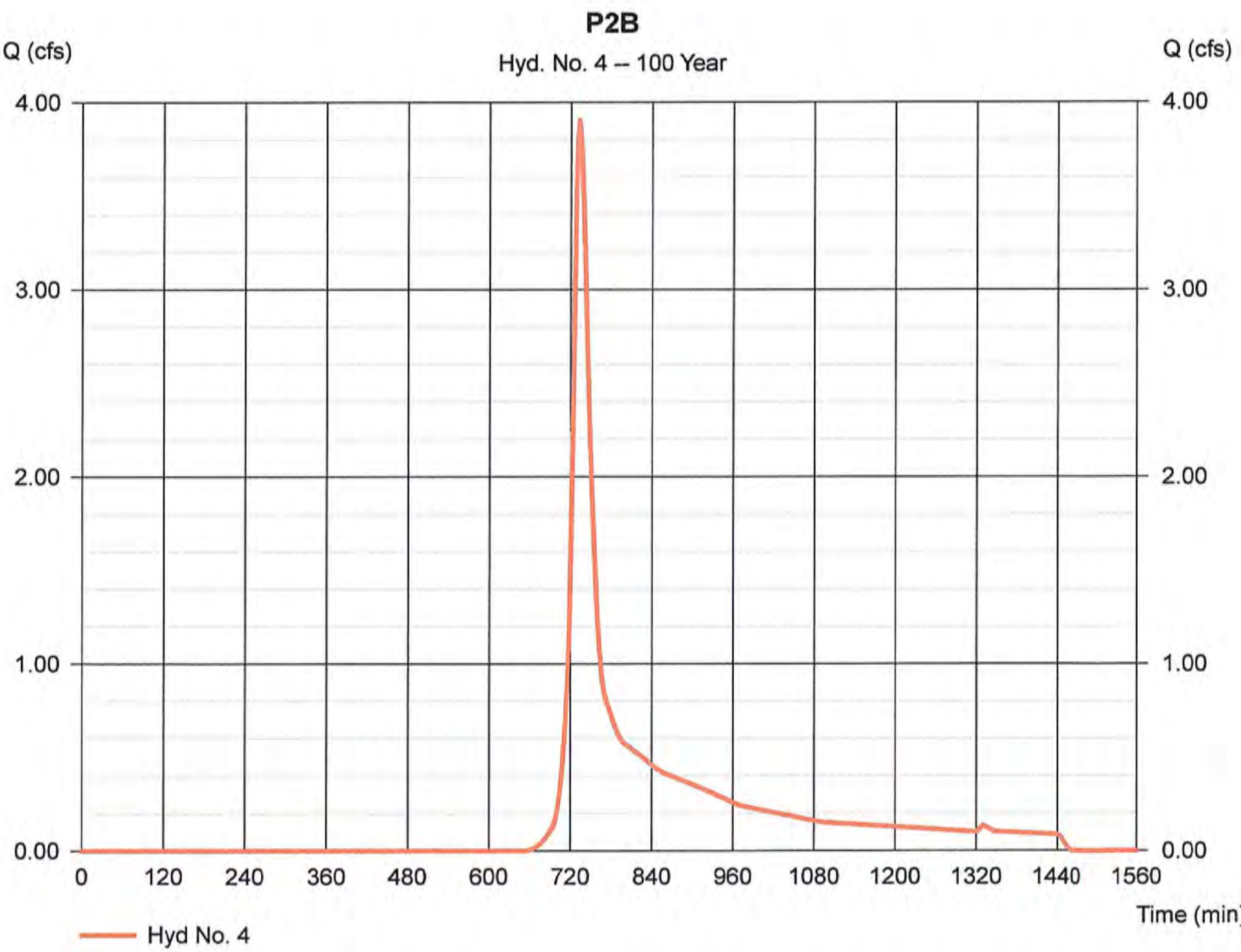
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 4

P2B

Hydrograph type	= SCS Runoff	Peak discharge	= 3.905 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 17,073 cuft
Drainage area	= 2.530 ac	Curve number	= 56.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 13.40 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked RJH Date 6/22/2017

Circle one: Present [Developed] Subcatchment P-1C

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			1.28	125.26
B	Woods- Good Condition	55			0.00	0.00
B	Open Space-Good Condition	61			1.50	91.78
B	Gravel	85			0.03	2.22
				122357 Totals =	2.81	219.26

1/ Use only one CN source per line.

CN (weighted) = total product / total area = 219.26 / 2.81 = 78.06 ; Use CN = 78.1

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	1.20	2.30	3.94
Runoff, Q..	cf	12278	23429	40180

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

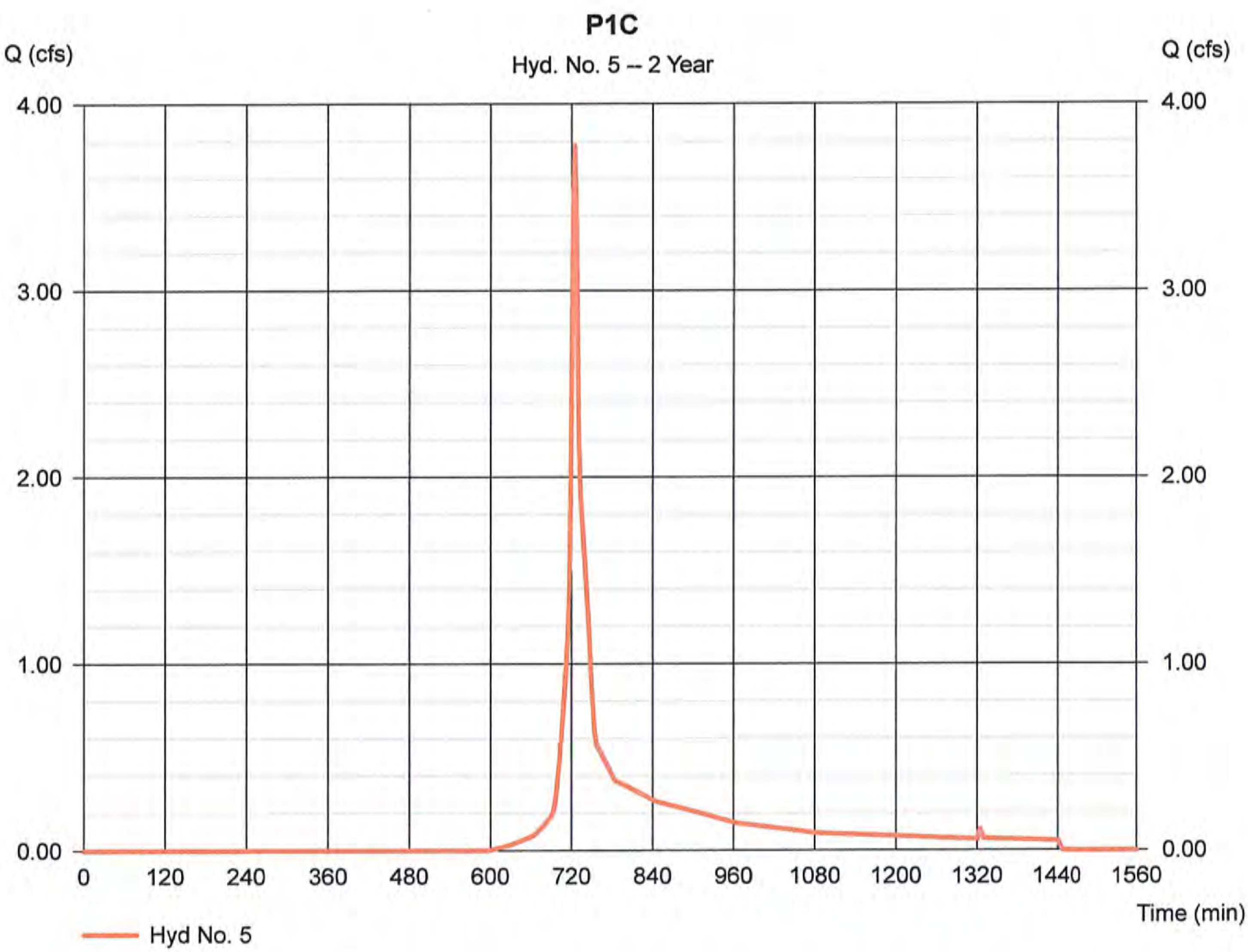
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 5

P1C

Hydrograph type	= SCS Runoff	Peak discharge	= 3.778 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 11,539 cuft
Drainage area	= 2.810 ac	Curve number	= 78.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



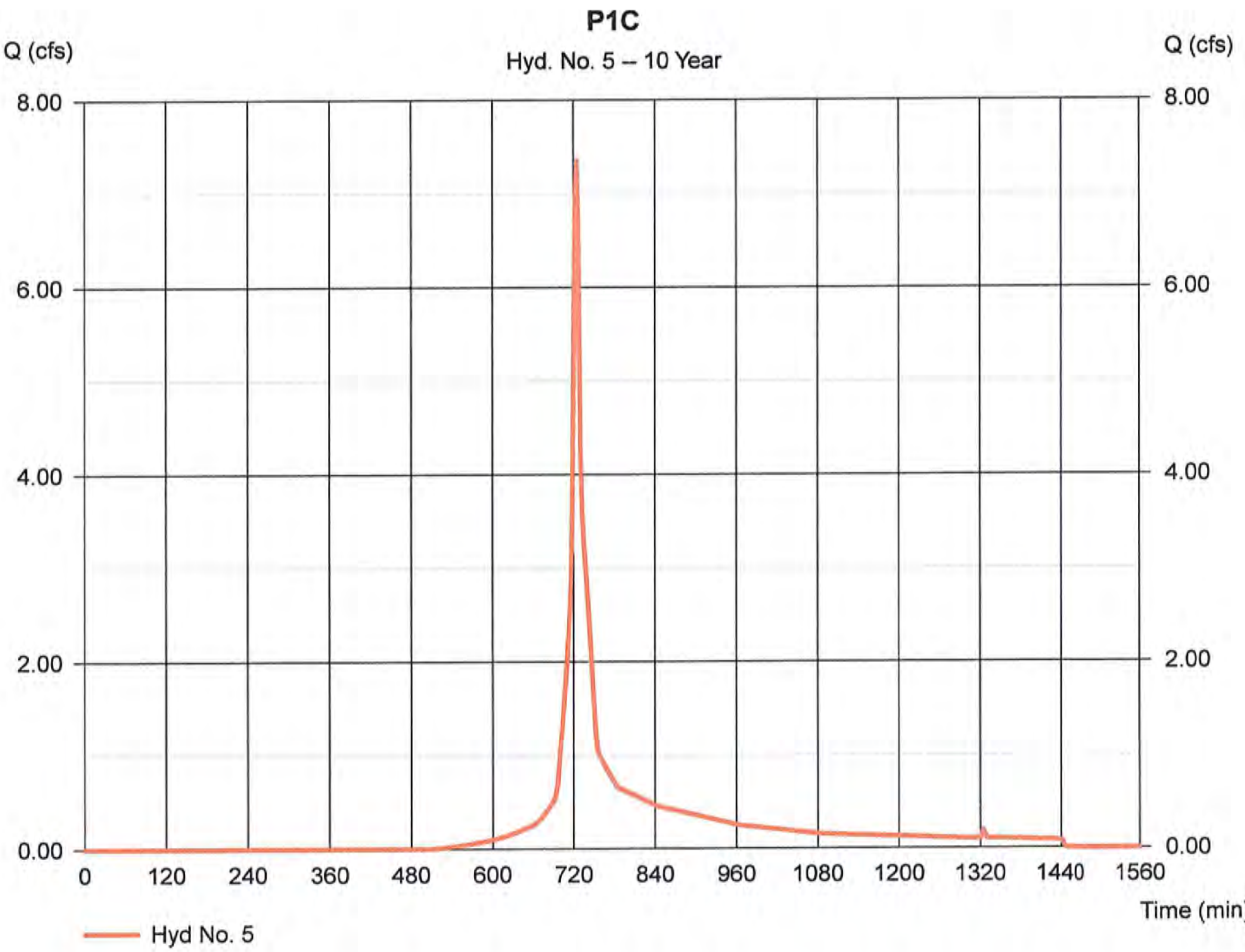
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 5

P1C

Hydrograph type	= SCS Runoff	Peak discharge	= 7.359 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 22,005 cuft
Drainage area	= 2.810 ac	Curve number	= 78.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



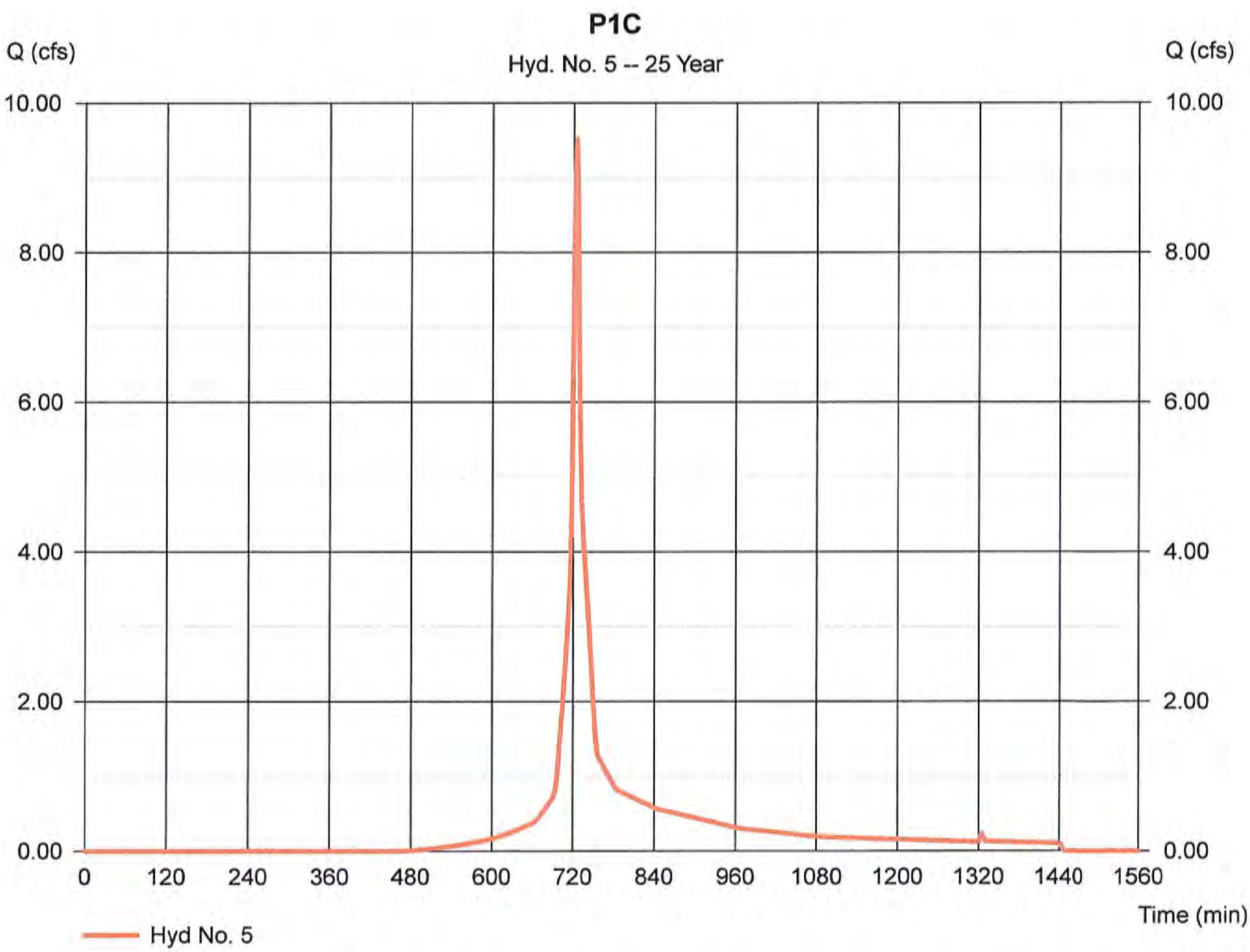
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 5

P1C

Hydrograph type	= SCS Runoff	Peak discharge	= 9.526 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 28,473 cuft
Drainage area	= 2.810 ac	Curve number	= 78.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



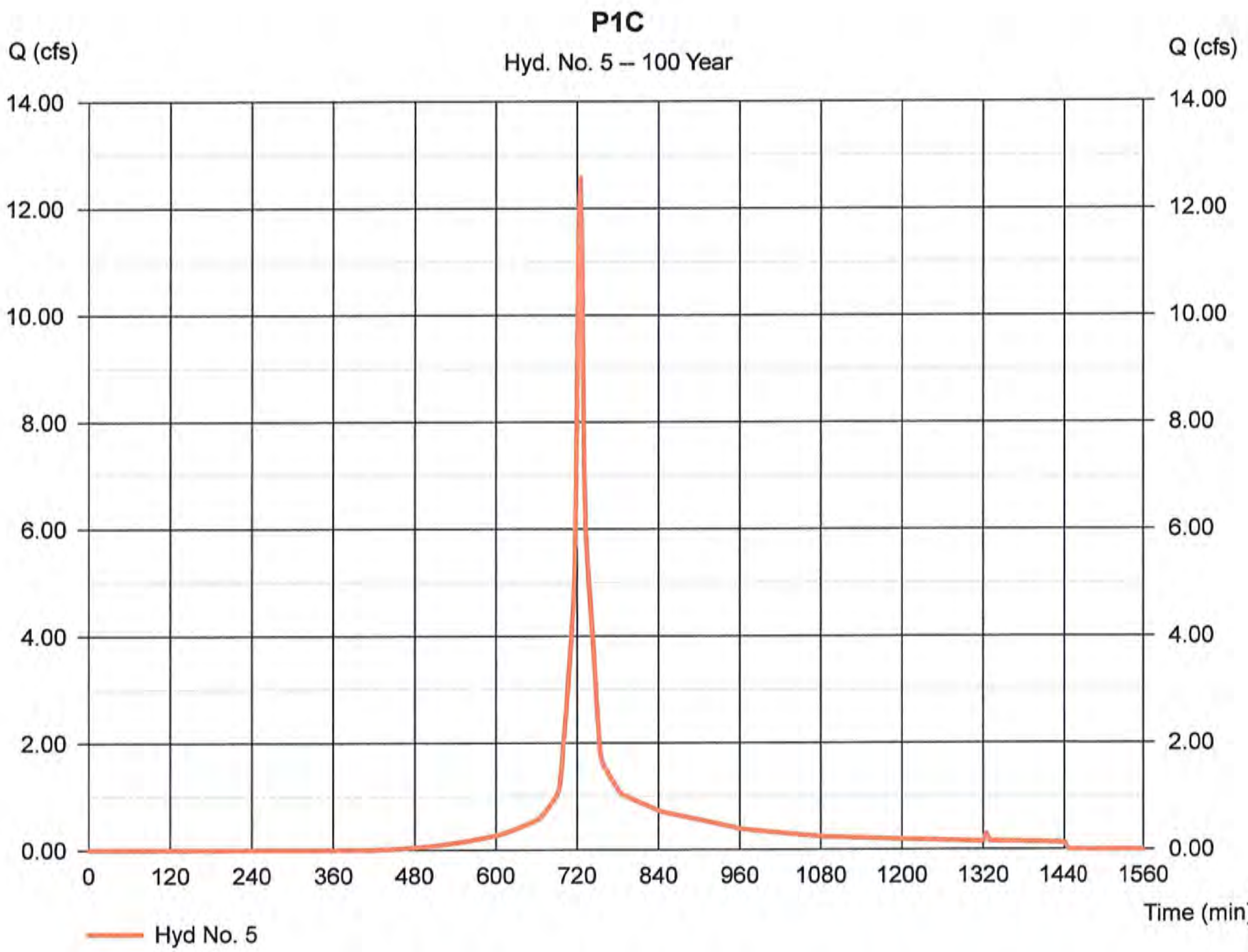
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 5

P1C

Hydrograph type	= SCS Runoff	Peak discharge	= 12.57 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 37,723 cuft
Drainage area	= 2.810 ac	Curve number	= 78.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

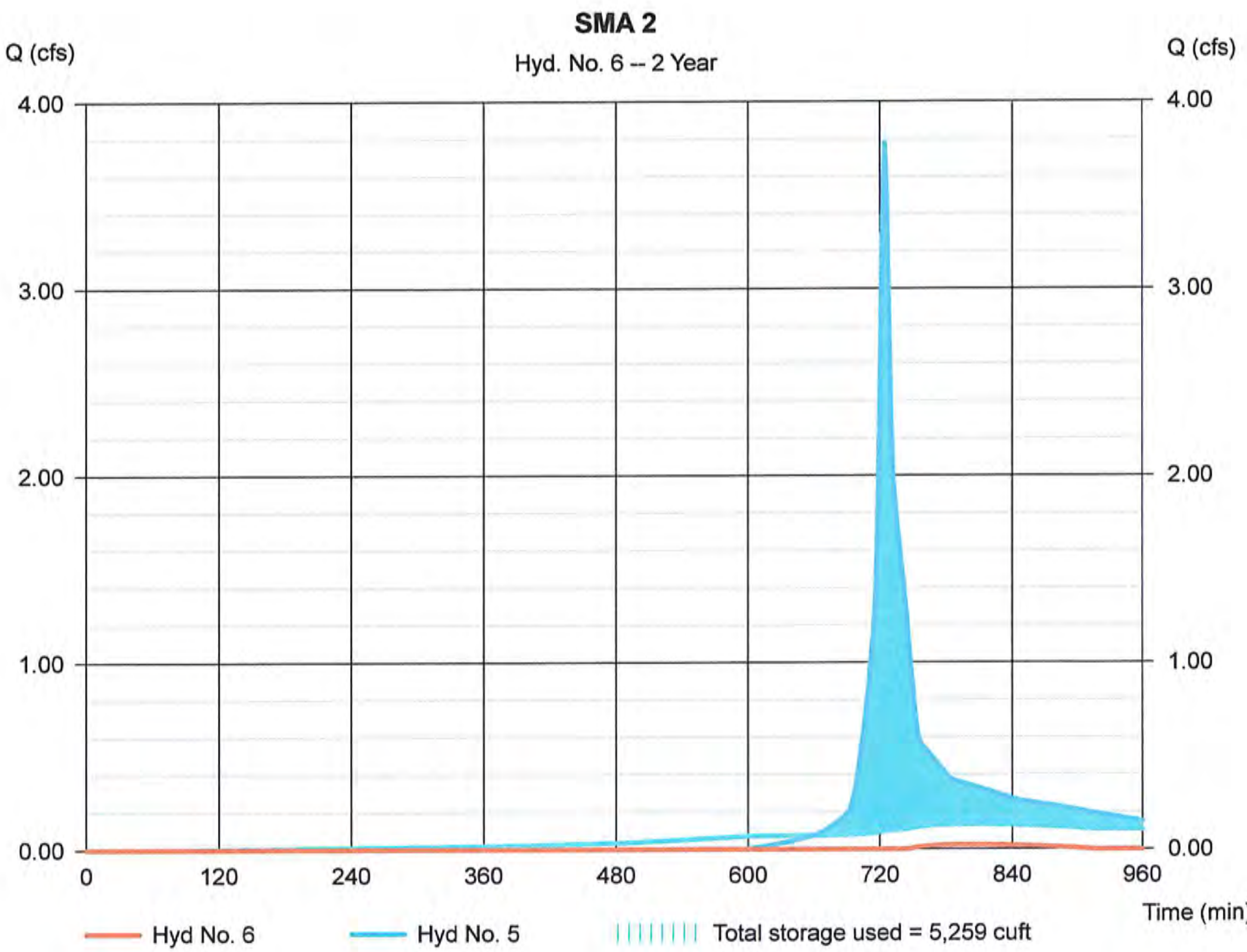
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 6

SMA 2

Hydrograph type	= Reservoir	Peak discharge	= 0.022 cfs
Storm frequency	= 2 yrs	Time to peak	= 802 min
Time interval	= 2 min	Hyd. volume	= 158 cuft
Inflow hyd. No.	= 5 - P1C	Max. Elevation	= 314.28 ft
Reservoir name	= SMA 2	Max. Storage	= 5,259 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

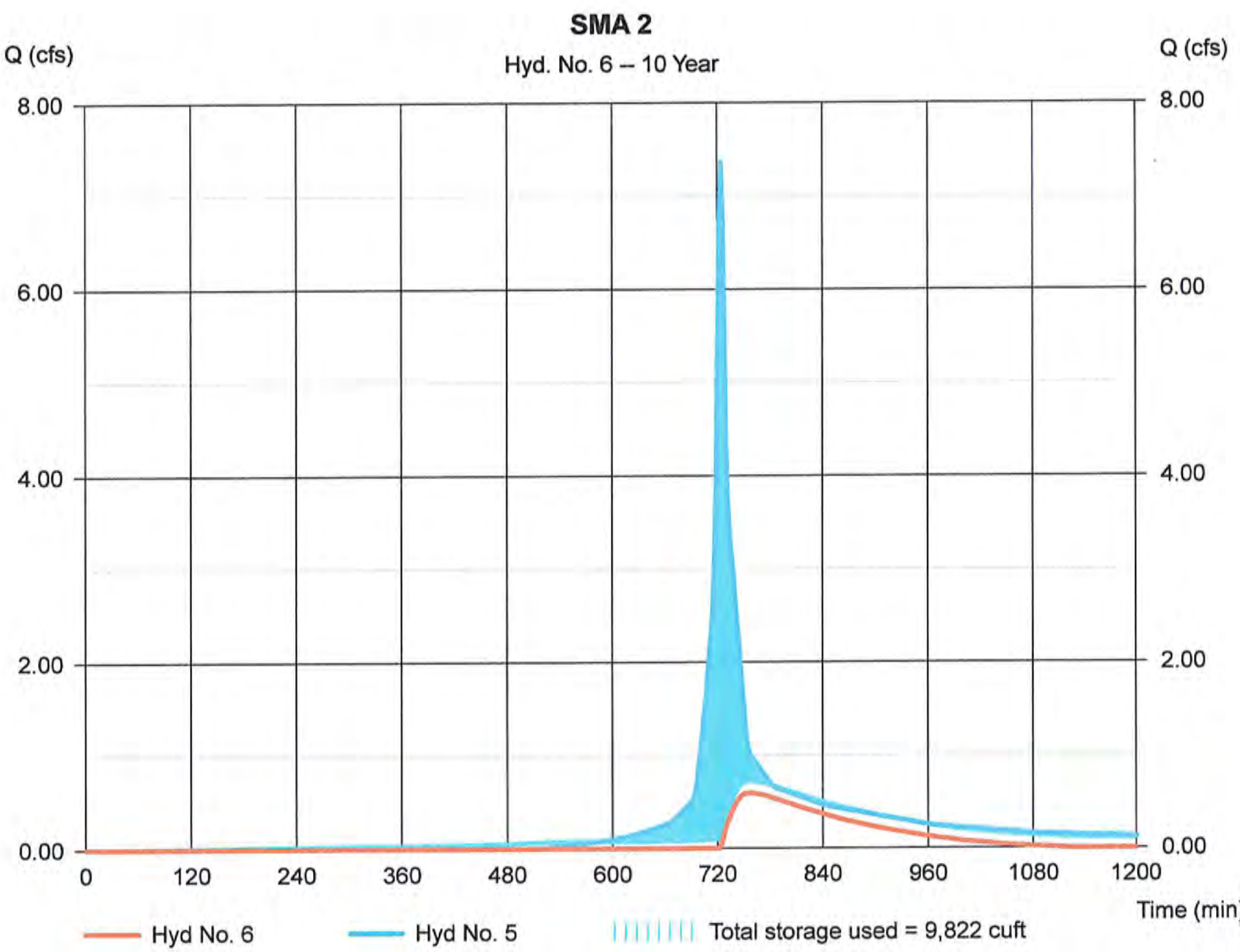
Thursday, Jun 22, 2017

Hyd. No. 6

SMA 2

Hydrograph type	= Reservoir
Storm frequency	= 10 yrs
Time interval	= 2 min
Inflow hyd. No.	= 5 - P1C
Reservoir name	= SMA 2
Peak discharge	= 0.594 cfs
Time to peak	= 756 min
Hyd. volume	= 5,460 cuft
Max. Elevation	= 315.00 ft
Max. Storage	= 9,822 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

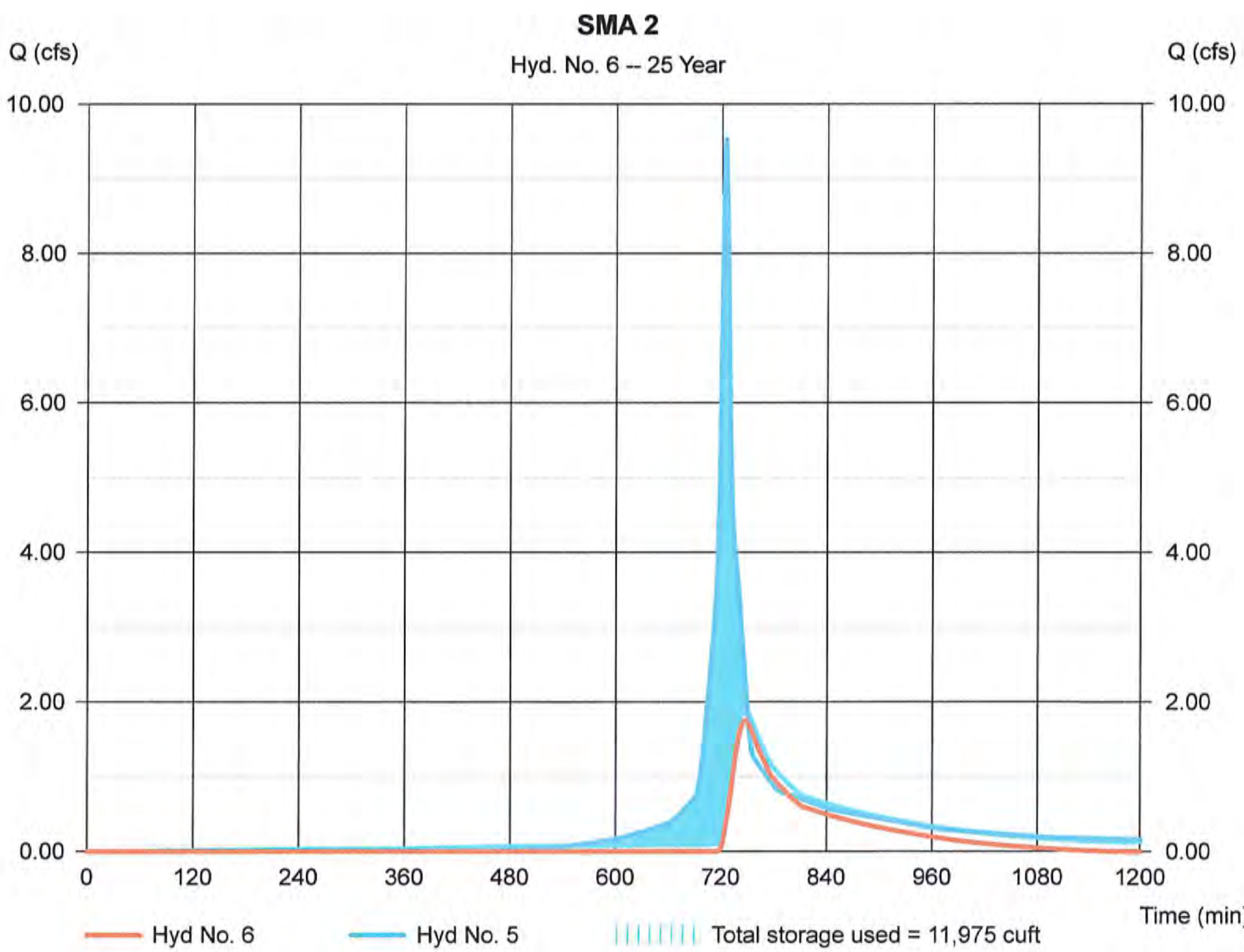
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 6

SMA 2

Hydrograph type	= Reservoir	Peak discharge	= 1.750 cfs
Storm frequency	= 25 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 10,030 cuft
Inflow hyd. No.	= 5 - P1C	Max. Elevation	= 315.21 ft
Reservoir name	= SMA 2	Max. Storage	= 11,975 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



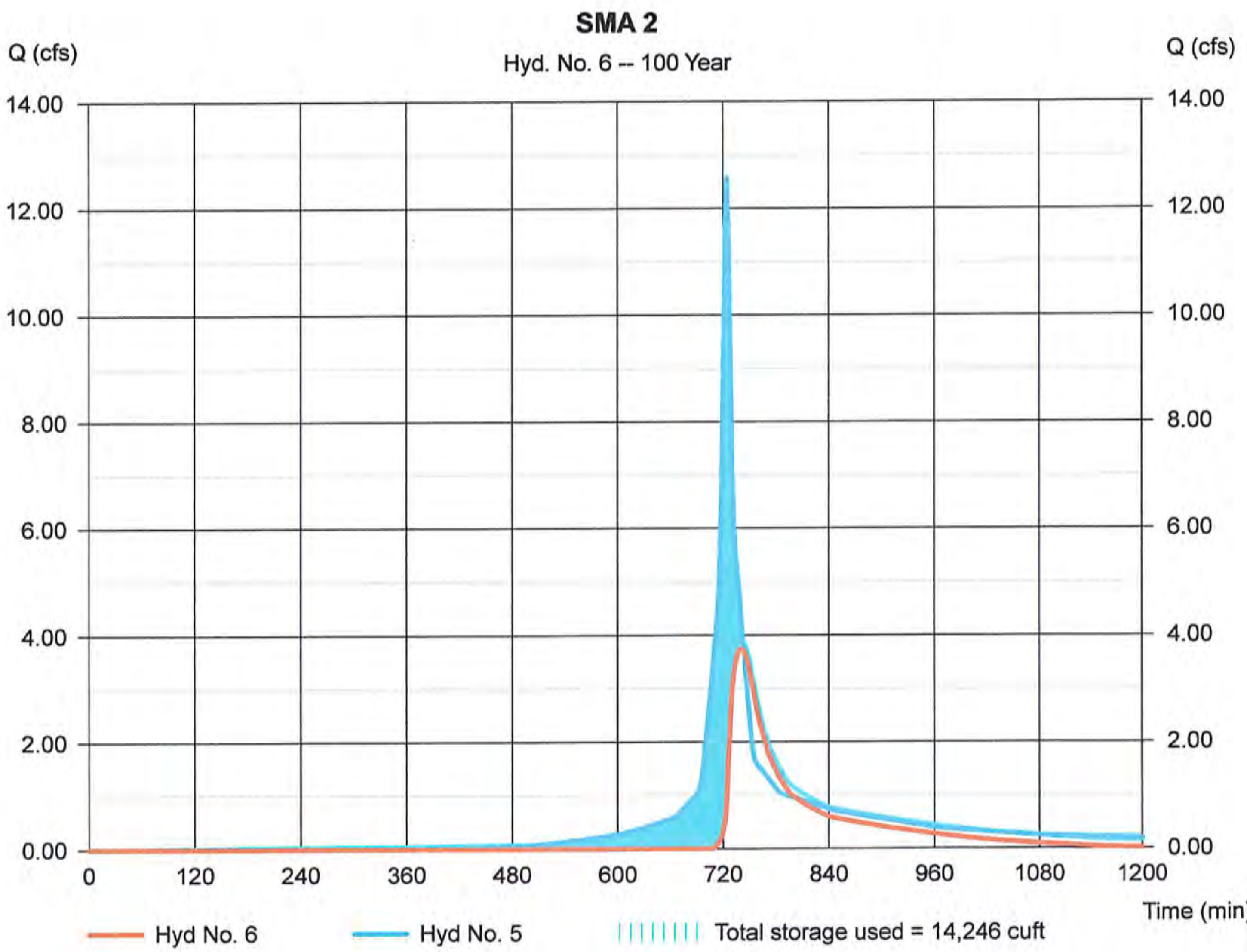
Hydrograph Report

Hyd. No. 6

SMA 2

Hydrograph type	= Reservoir	Peak discharge	= 3.748 cfs
Storm frequency	= 100 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 17,115 cuft
Inflow hyd. No.	= 5 - P1C	Max. Elevation	= 315.42 ft
Reservoir name	= SMA 2	Max. Storage	= 14,246 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Pond No. 17 - SMA 2

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 313.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	313.00	2,287	0	0
1.00	314.00	4,746	3,442	3,442
2.00	315.00	8,187	6,388	9,830
3.00	316.00	12,883	10,446	20,276
4.00	317.00	14,586	13,724	34,000

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 313.00	0.00	0.00	0.00
Length (ft)	= 33.00	0.00	0.00	0.00
Slope (%)	= 9.00	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

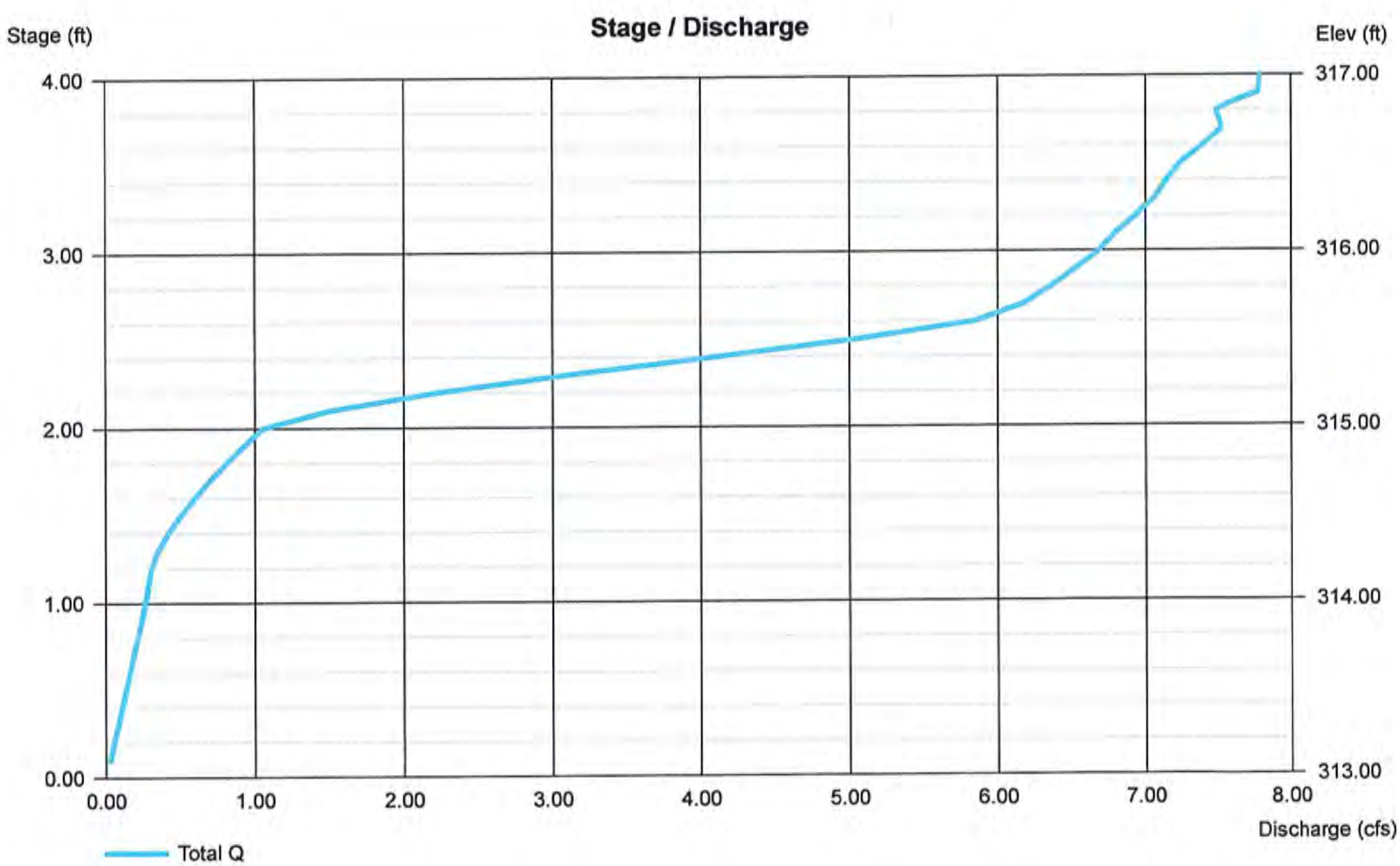
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	0.25	3.75	0.00
Crest El. (ft)	= 315.50	314.20	315.00	0.00
Weir Coeff.	= 3.33	3.33	2.60	3.33
Weir Type	= Riser	Rect	Broad	---
Multi-Stage	= Yes	Yes	Yes	No

Exfil.(in/hr) = 2.410 (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).



Worksheet 2: Runoff curve number and runoff **SM-2069**

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked RJH Date 6/22/2017

Circle one: Present [Developed] Subcatchment P-1B

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			0.72	70.40
B	Woods- Good Condition	55			3.23	177.86
B	Open Space-Good Condition	61			1.07	65.47
A	Open Space-Good Condition	39			1.30	50.81
A	Woods- Good Condition	30			0.41	12.30
C	Open Space-Good Condition	74			1.47	108.71
C	Woods- Good Condition	70			0.90	62.79
C	Open Space-Fair Condition	79			0.18	14.55
				404605		
				Totals =	9.29	562.89

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{562.89}{9.29} =$ 60.60 ; Use CN = 60.6

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr	2	10	100
Rainfall, P (24-hour)	in	3.1	4.5	6.4
Runoff, Q (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.39	1.06	2.24
Runoff, Q	cf	13156	35583	75586

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/2016

Location: Boxborough, MA Checked ______ Date ______

Circle one: Present **Developed** SubcatchmentP P-1B

Circle one: **Tc** Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			WOODS			
2. Mannings roughness coeff., n (table 3-1)			0.6			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.06			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.19			0.19

Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			UNPAVED			
8. Flow Length, L		ft	66			
9. Watercourse slope, s		ft/ft	0.11			
10. Average Velocity, V (figure 3-1)		ft/s	5.35			
11. Tt = L / 3600V	Compute Tt	hr	0.00			0.00

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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.19
min 11.4

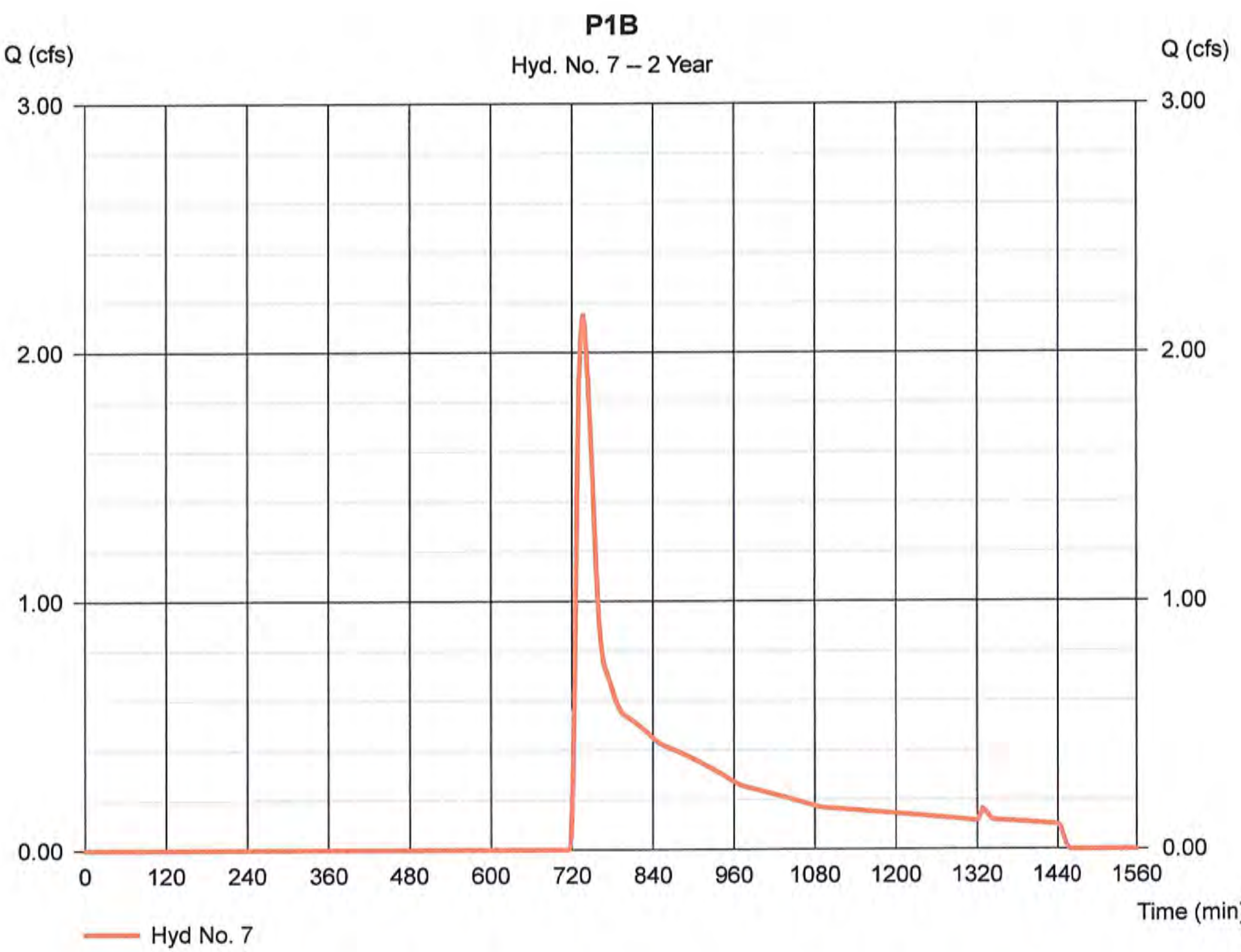
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 7

P1B

Hydrograph type	= SCS Runoff	Peak discharge	= 2.150 cfs
Storm frequency	= 2 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 13,568 cuft
Drainage area	= 9.290 ac	Curve number	= 60.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 11.40 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



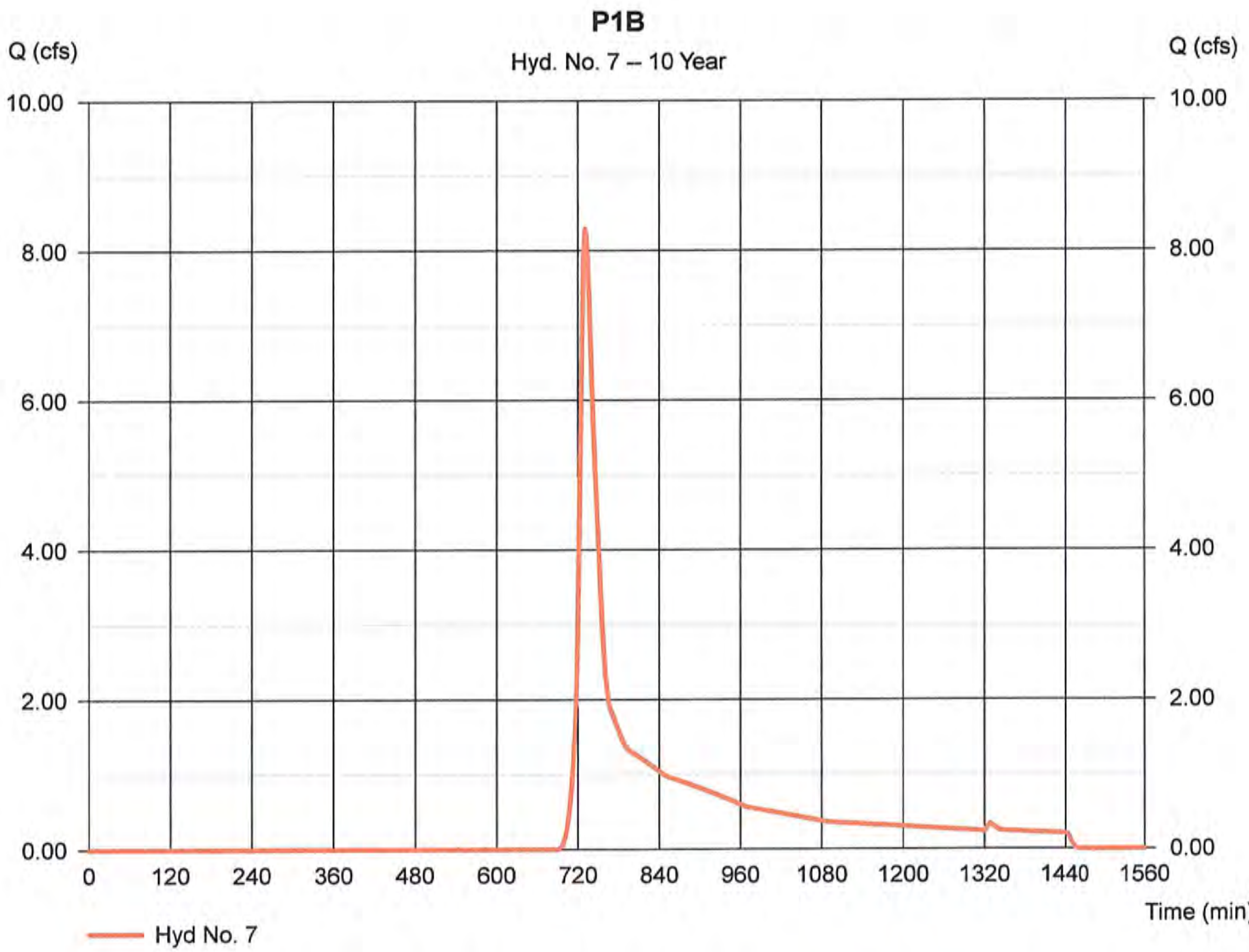
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 7

P1B

Hydrograph type	= SCS Runoff	Peak discharge	= 8.292 cfs
Storm frequency	= 10 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 36,700 cuft
Drainage area	= 9.290 ac	Curve number	= 60.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 11.40 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



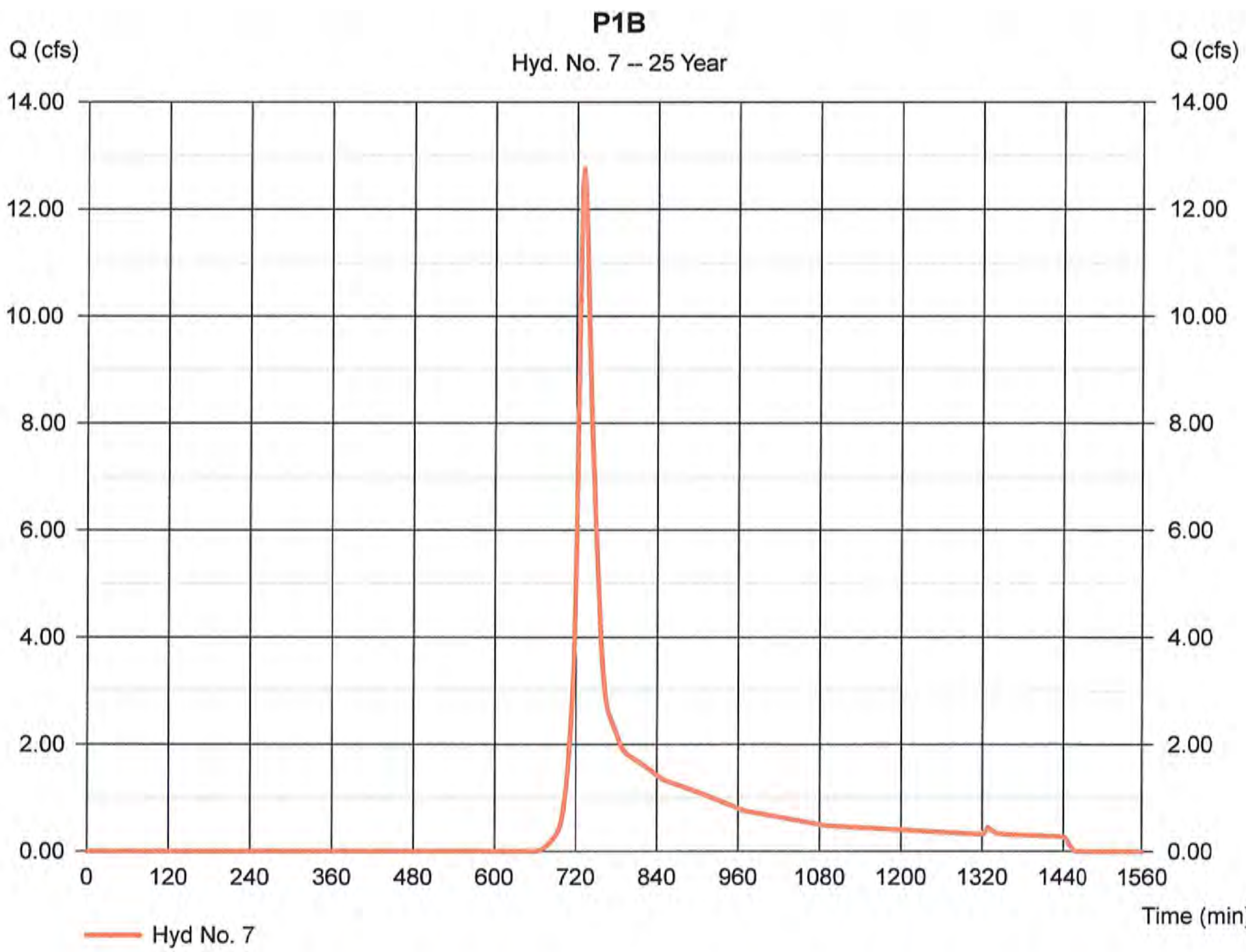
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 7

P1B

Hydrograph type	= SCS Runoff	Peak discharge	= 12.75 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 52,977 cuft
Drainage area	= 9.290 ac	Curve number	= 60.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 11.40 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



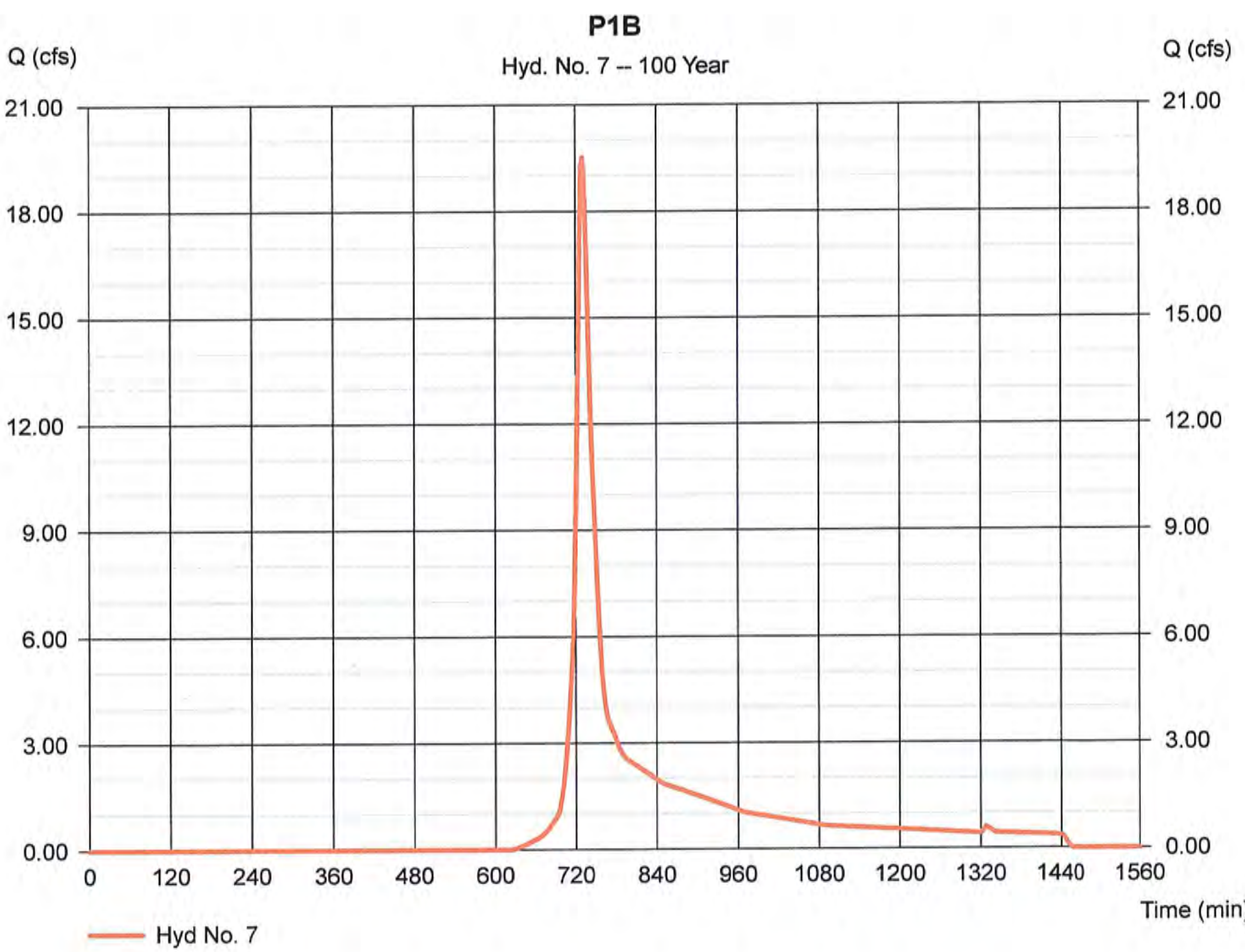
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 7

P1B

Hydrograph type	= SCS Runoff	Peak discharge	= 19.53 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 77,958 cuft
Drainage area	= 9.290 ac	Curve number	= 60.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 11.40 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked RJH Date 6/22/2017

Circle one: Present Developed Subcatchment P-1D

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			1.16	113.68
B	Woods- Good Condition	55			0.00	0.00
B	Open Space-Good Condition	61			1.77	107.76
				127478 Totals =	2.93	221.43

1/ Use only one CN source per line.

CN (weighted) = total product / total area = 221.43 / 2.93 = 75.67 ; Use CN = 75.7

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 (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	1.06	2.10	3.69
Runoff, Q	cf	11303	22341	39236

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

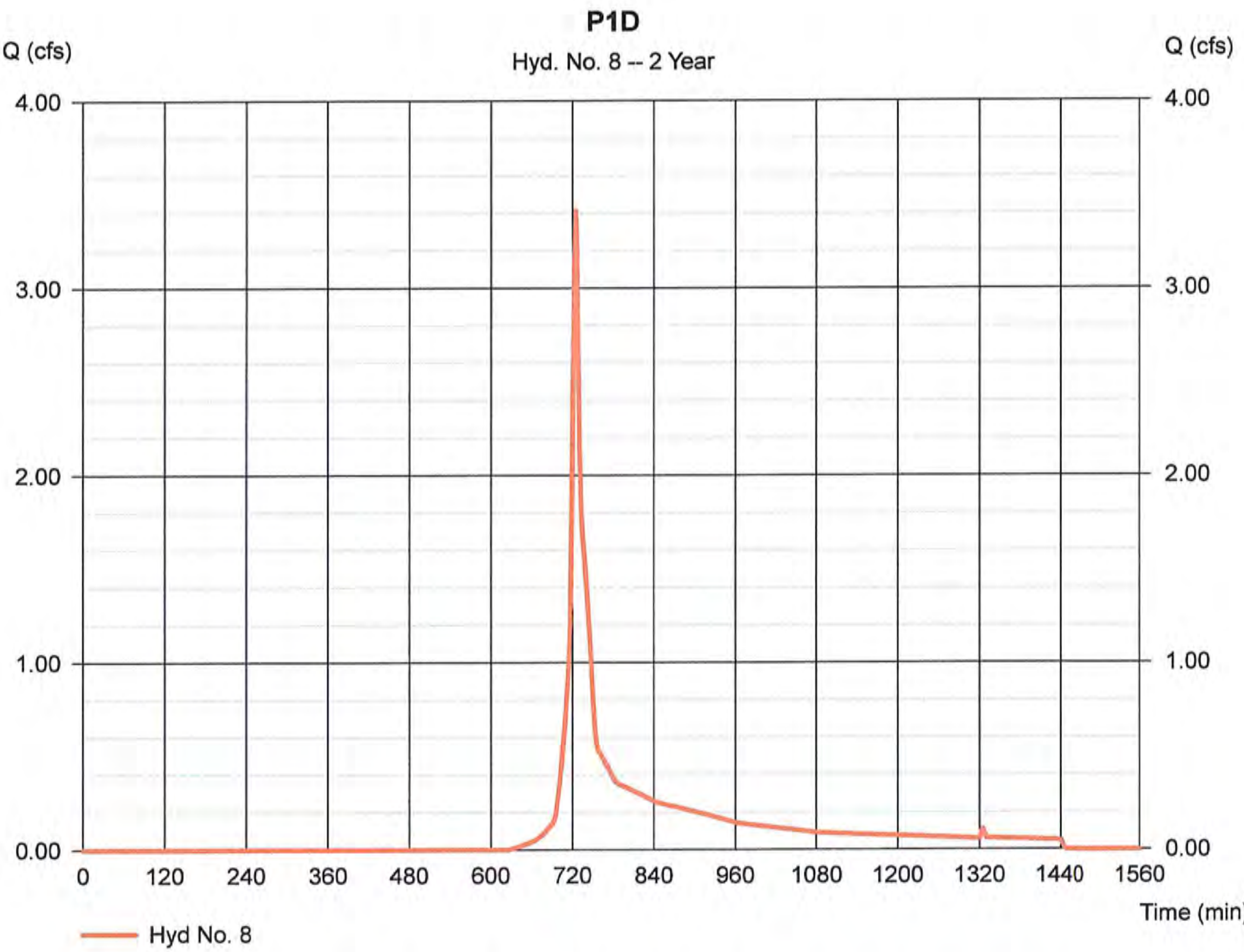
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 8

P1D

Hydrograph type	= SCS Runoff	Peak discharge	= 3.414 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 10,629 cuft
Drainage area	= 2.930 ac	Curve number	= 75.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



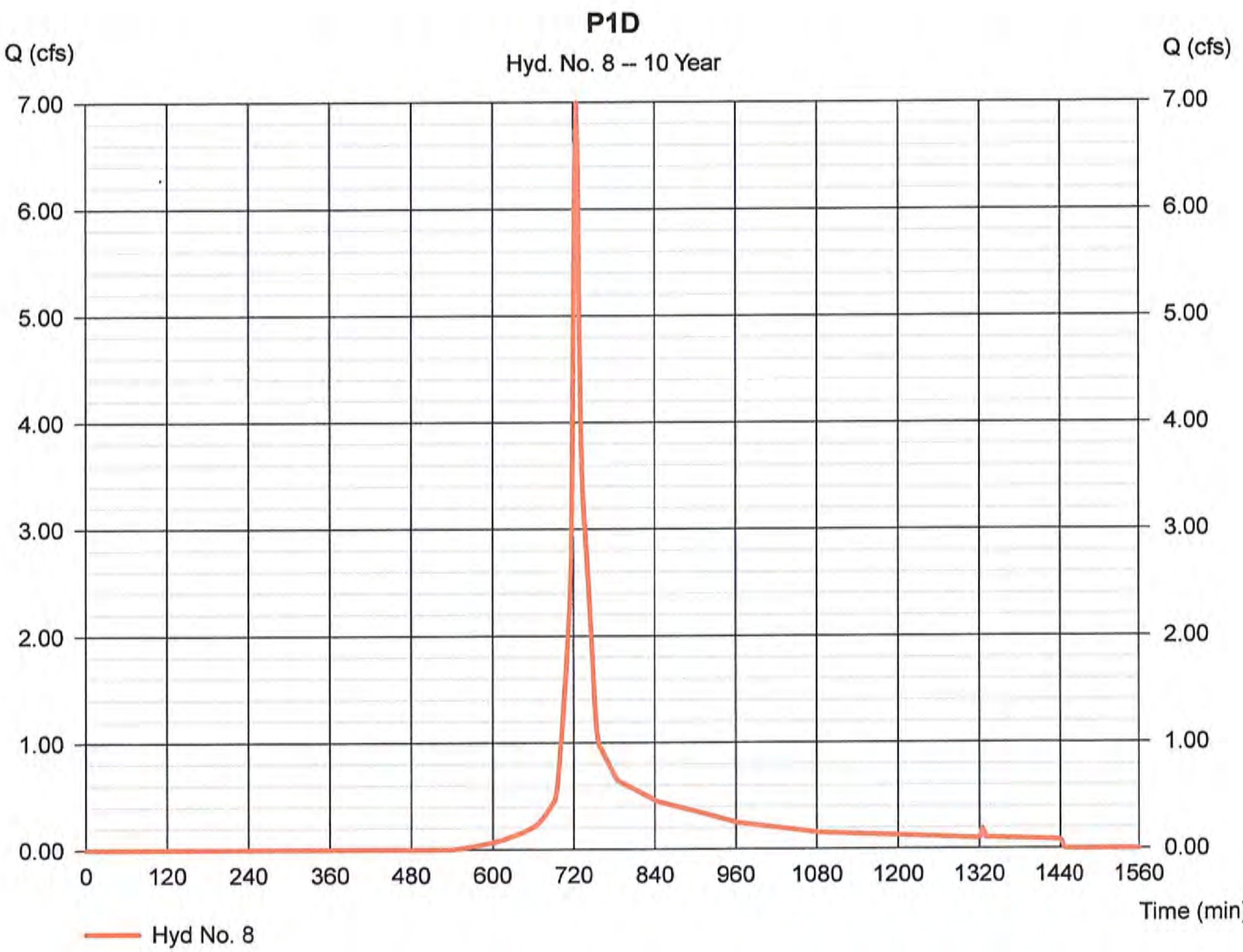
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 8

P1D

Hydrograph type	= SCS Runoff	Peak discharge	= 6.996 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 20,998 cuft
Drainage area	= 2.930 ac	Curve number	= 75.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

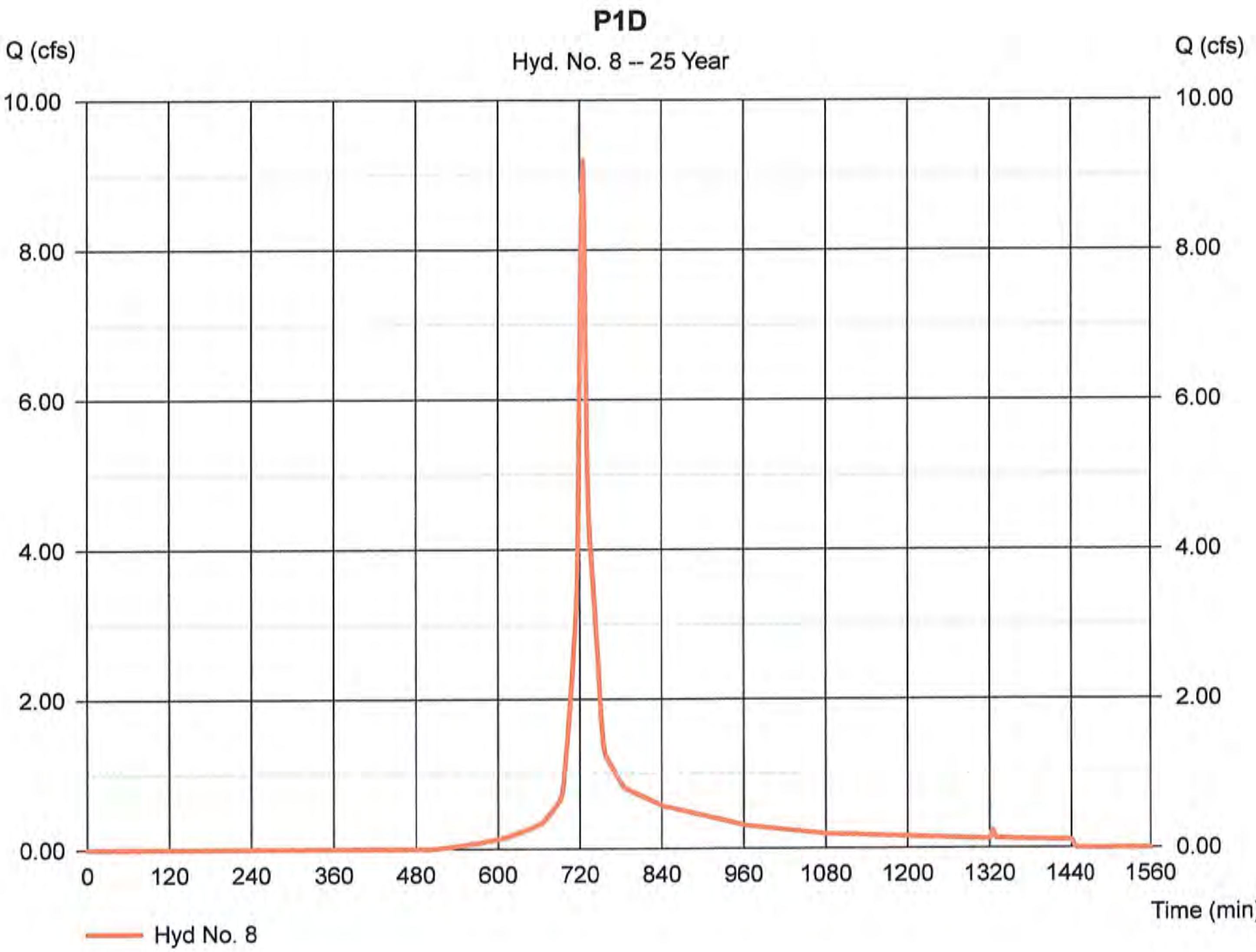
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 8

P1D

Hydrograph type	= SCS Runoff	Peak discharge	= 9.199 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 27,496 cuft
Drainage area	= 2.930 ac	Curve number	= 75.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



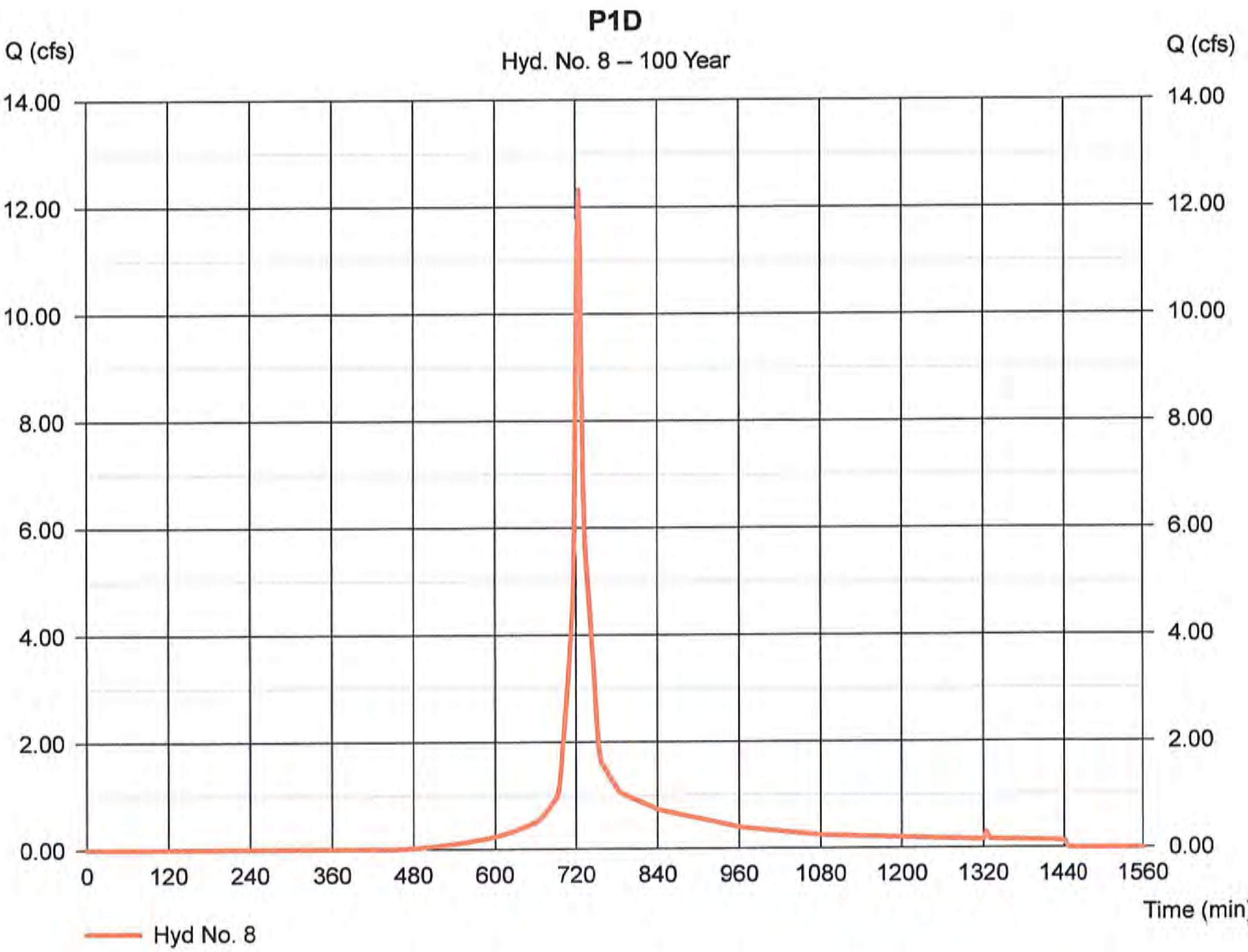
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 8

P1D

Hydrograph type	= SCS Runoff	Peak discharge	= 12.32 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 36,863 cuft
Drainage area	= 2.930 ac	Curve number	= 75.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

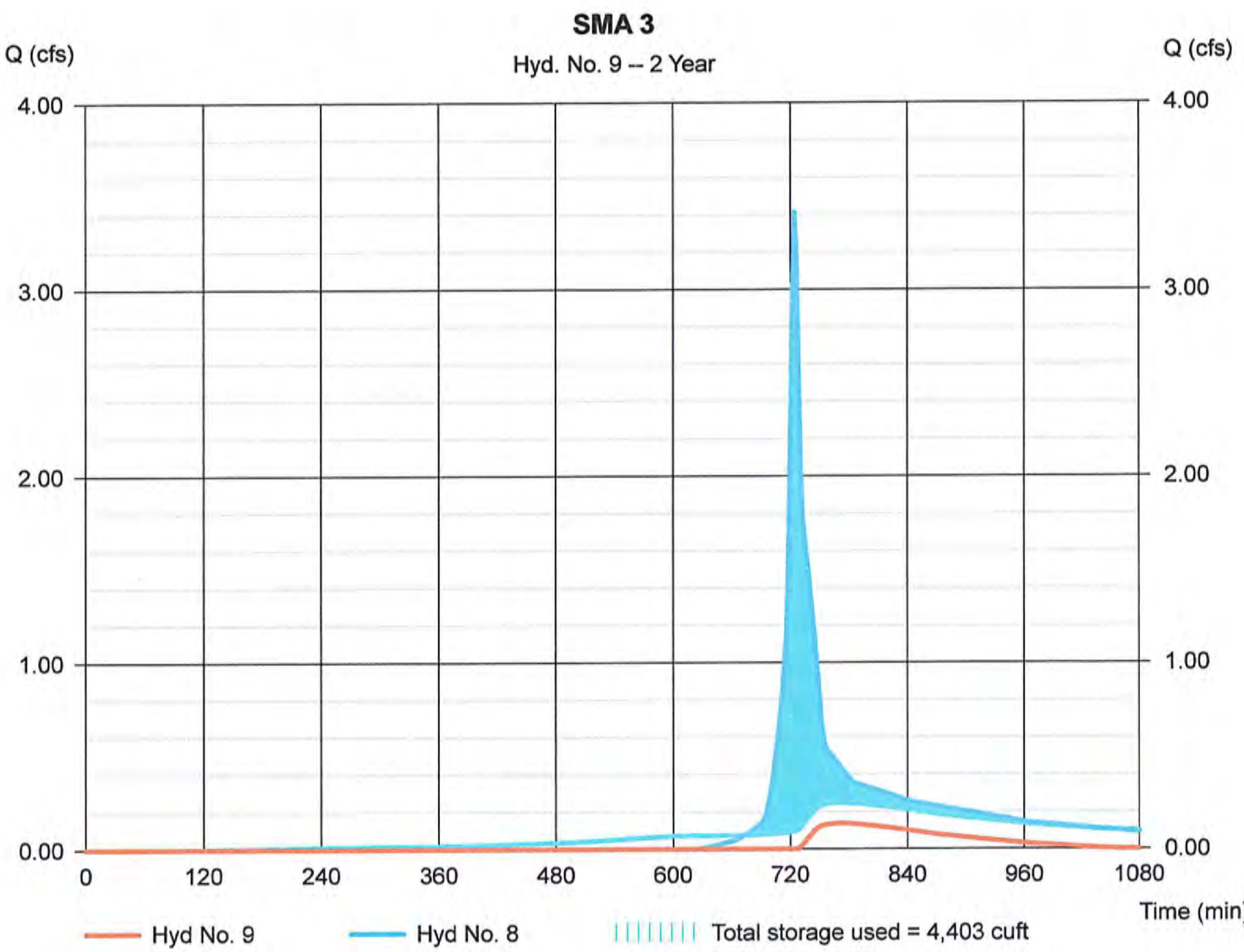
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 9

SMA 3

Hydrograph type	= Reservoir	Peak discharge	= 0.138 cfs
Storm frequency	= 2 yrs	Time to peak	= 774 min
Time interval	= 2 min	Hyd. volume	= 1,301 cuft
Inflow hyd. No.	= 8 - P1D	Max. Elevation	= 308.80 ft
Reservoir name	= SMA 3	Max. Storage	= 4,403 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

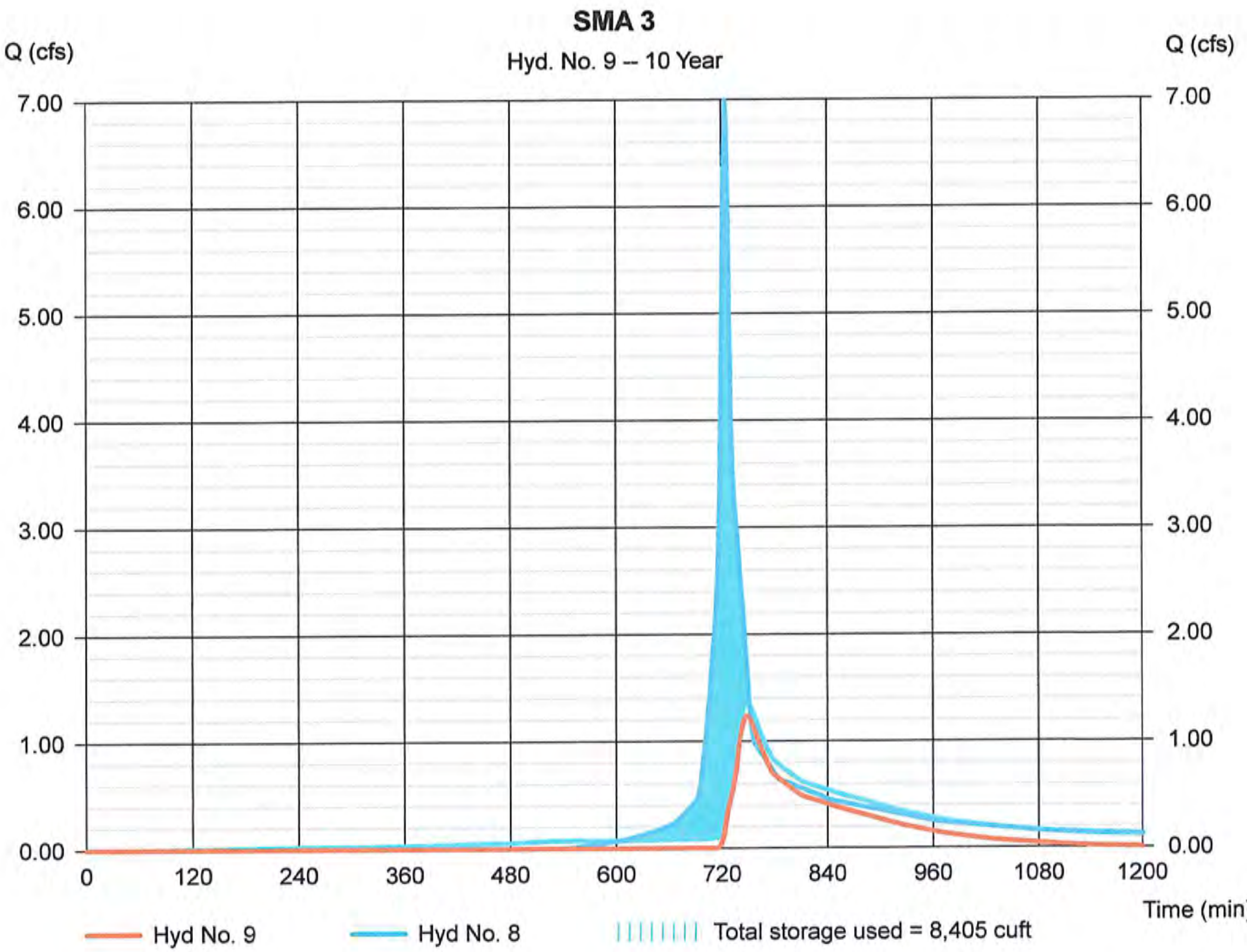
Thursday, Jun 22, 2017

Hyd. No. 9

SMA 3

Hydrograph type	= Reservoir	Peak discharge	= 1.233 cfs
Storm frequency	= 10 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 7,611 cuft
Inflow hyd. No.	= 8 - P1D	Max. Elevation	= 309.39 ft
Reservoir name	= SMA 3	Max. Storage	= 8,405 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

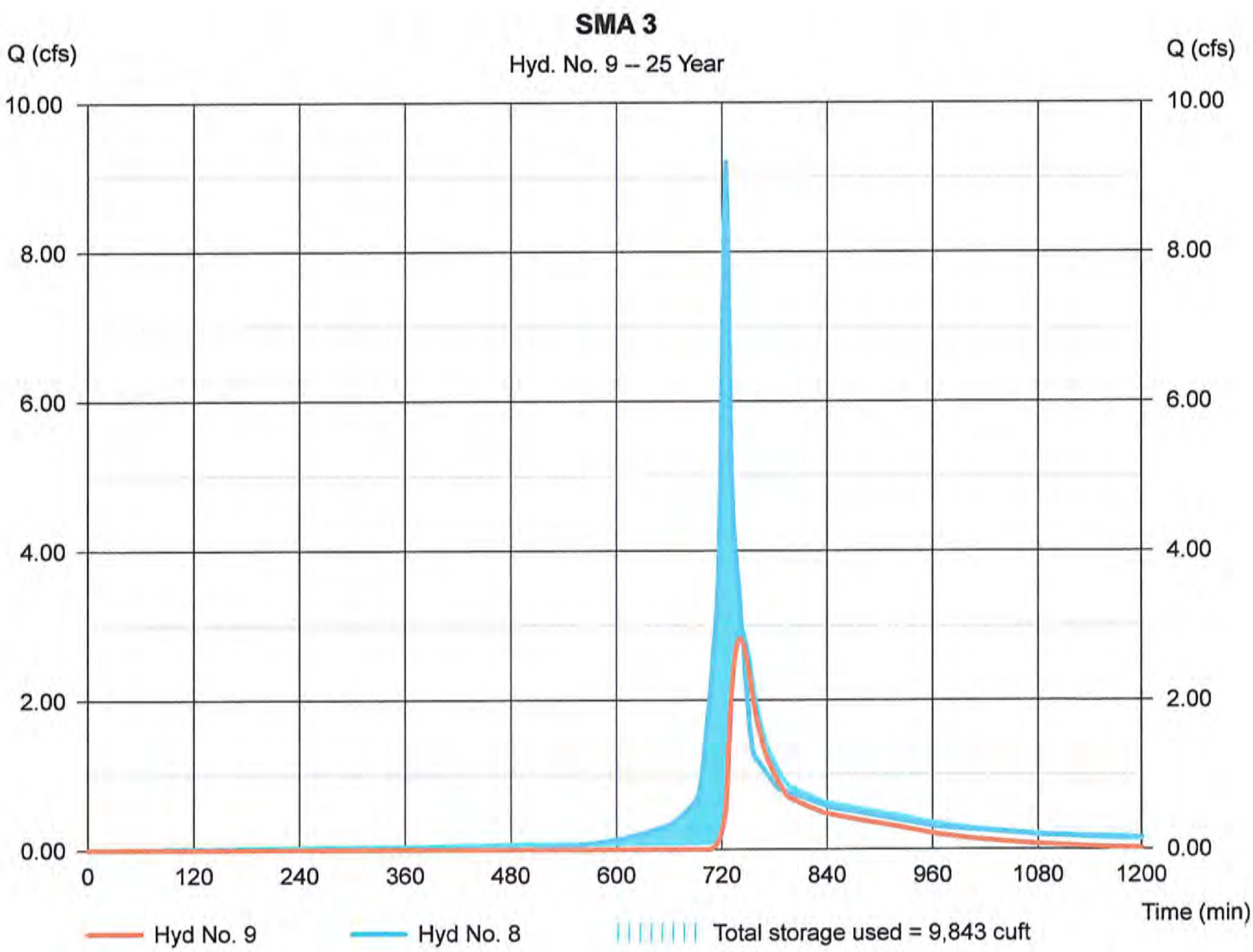
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 9

SMA 3

Hydrograph type	= Reservoir	Peak discharge	= 2.814 cfs
Storm frequency	= 25 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 12,668 cuft
Inflow hyd. No.	= 8 - P1D	Max. Elevation	= 309.59 ft
Reservoir name	= SMA 3	Max. Storage	= 9,843 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

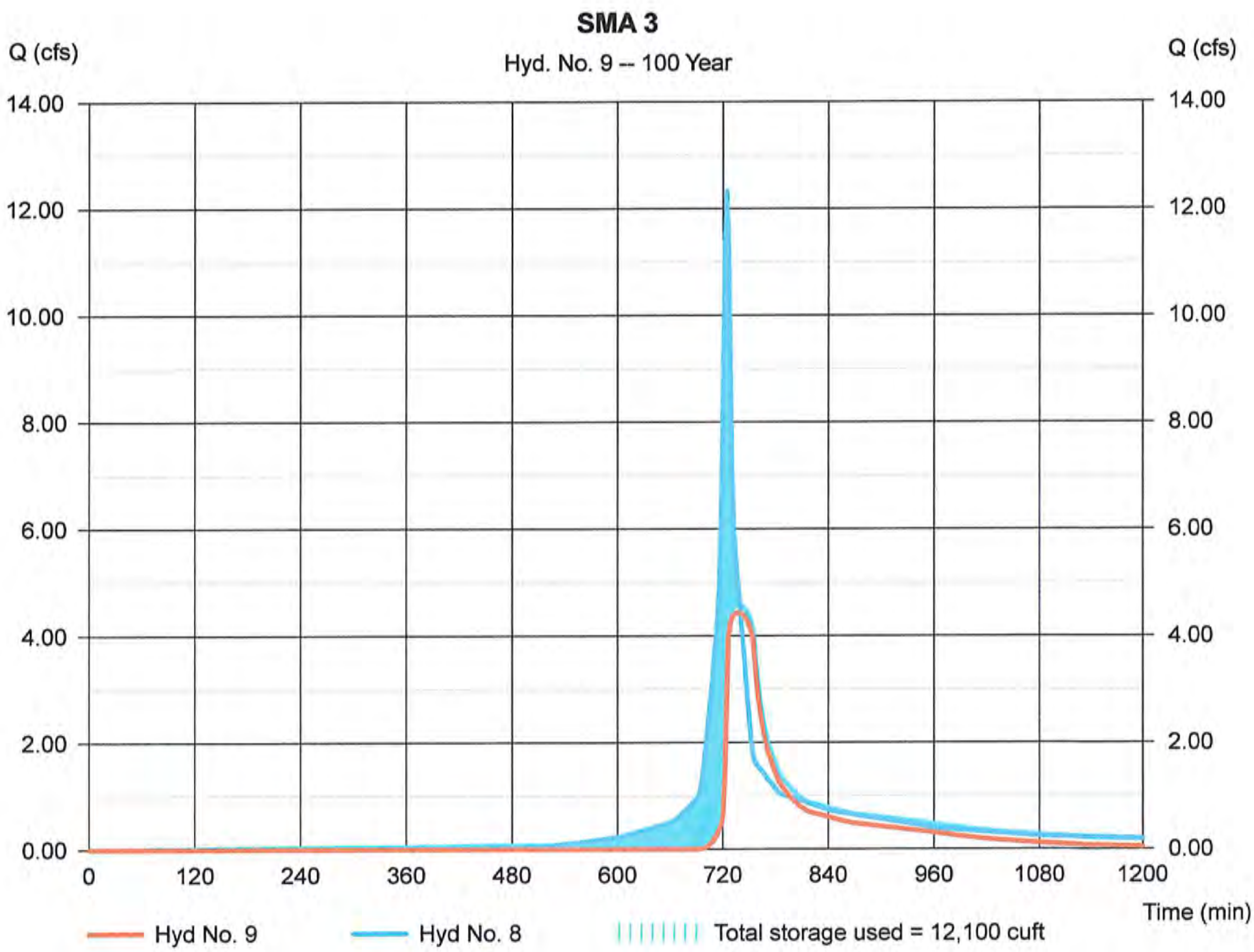
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 9

SMA 3

Hydrograph type	= Reservoir	Peak discharge	= 4.429 cfs
Storm frequency	= 100 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 20,290 cuft
Inflow hyd. No.	= 8 - P1D	Max. Elevation	= 309.90 ft
Reservoir name	= SMA 3	Max. Storage	= 12,100 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Pond No. 12 - SMA 3

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 308.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	308.00	4,580	0	0
1.00	309.00	6,466	5,495	5,495
2.00	310.00	8,356	7,390	12,886
3.00	311.00	9,950	9,141	22,026
4.00	312.00	11,553	10,740	32,766

Culvert / Orifice Structures

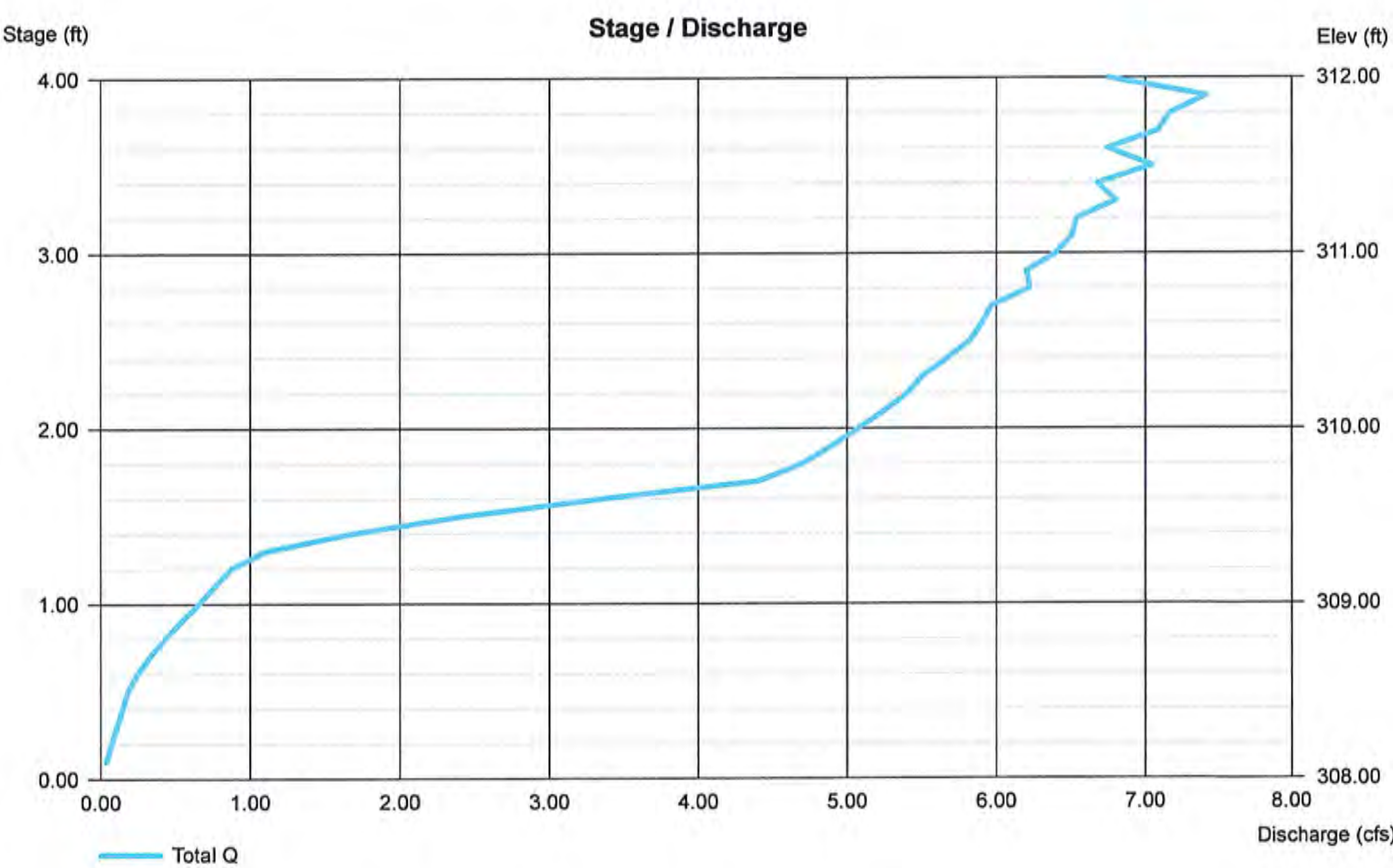
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 308.00	0.00	0.00	0.00
Length (ft)	= 32.00	0.00	0.00	0.00
Slope (%)	= 6.30	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	0.25	3.75	0.00
Crest El. (ft)	= 309.58	308.50	309.25	0.00
Weir Coeff.	= 3.33	3.33	2.60	3.33
Weir Type	= Riser	Rect	Broad	---
Multi-Stage	= Yes	Yes	Yes	No

Exfil.(in/hr) = 2.410 (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).



Worksheet 2: Runoff curve number and runoff **SM-2069**

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked RJH Date 6/22/2017

Circle one: Present Developed Subcatchment P-1E

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			2.42	237.40
B	Woods- Good Condition	55			3.81	209.34
B	Open Space-Good Condition	61			4.78	291.40
B	Brush - Good Condition	48			0.16	7.68
A	Open Space-Good Condition	39			0.16	6.08
				493171 Totals =	11.32	751.90

1/ Use only one CN source per line.

CN (weighted) = total product / total area = 751.90 / 11.32 = 66.41 ; Use CN = 66.4

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency..	yr	2	10	100
Rainfall, P (24-hour)........................	in	3.1	4.5	6.4
Runoff, Q.. (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.61	1.42	2.78
Runoff, Q..	cf	25087	58526	114239

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/2016

Location: Boxborough, MA Checked ________ Date ________

Circle one: Present **Developed** SubcatchmentPP-1E

Circle one: **Tc** Tt through subarea

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

Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			UNPAVED			
8. Flow Length, L		ft	246			
9. Watercourse slope, s		ft/ft	0.075			
10. Average Velocity, V (figure 3-1)		ft/s	4.42			
11. Tt = L / 3600V	Compute Tt	hr	0.02			0.02

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

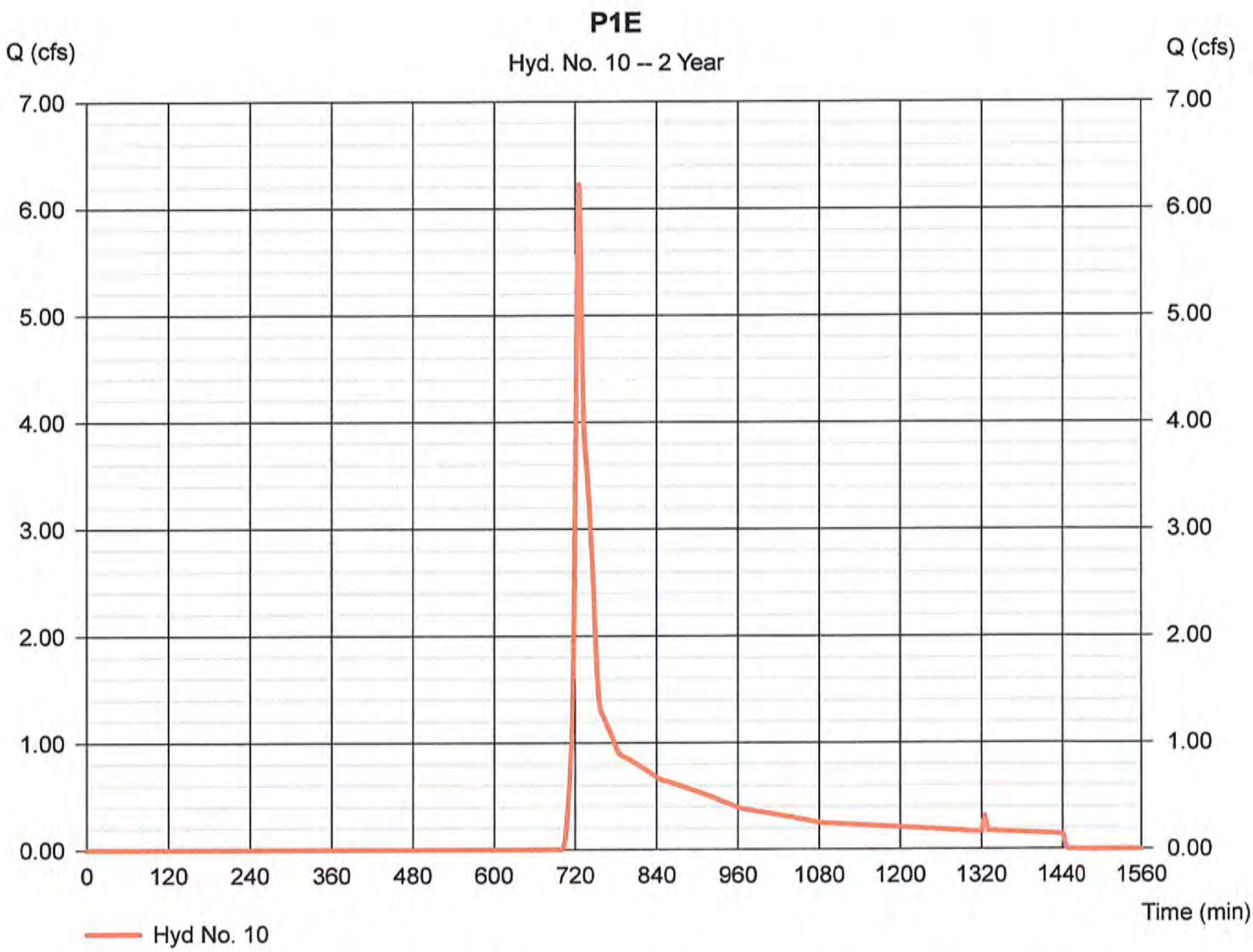
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.10
min 6.0

Hydrograph Report

Hyd. No. 10

P1E

Hydrograph type	= SCS Runoff	Peak discharge	= 6.227 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 23,494 cuft
Drainage area	= 11.320 ac	Curve number	= 66.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

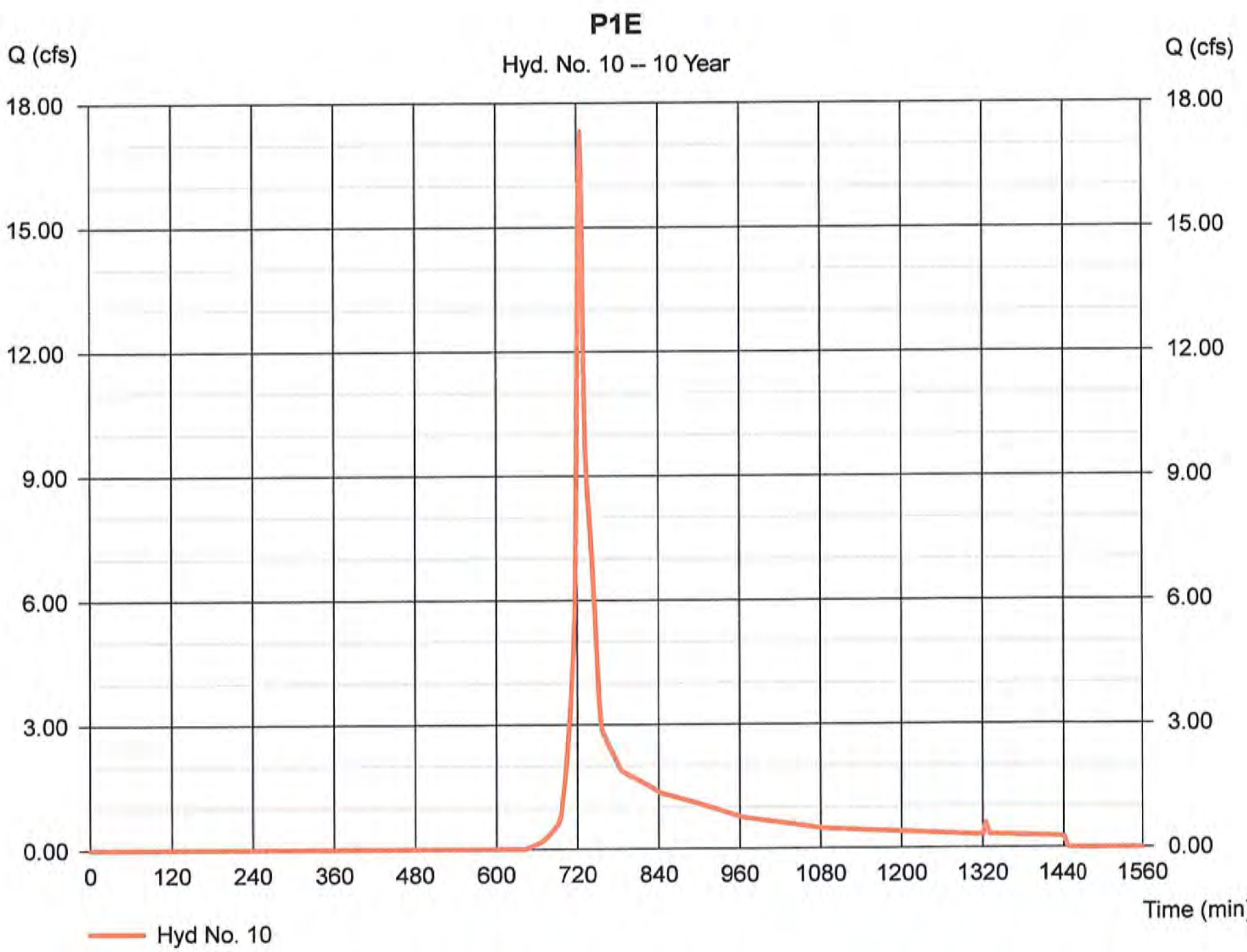
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 10

P1E

Hydrograph type	= SCS Runoff	Peak discharge	= 17.32 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 54,827 cuft
Drainage area	= 11.320 ac	Curve number	= 66.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



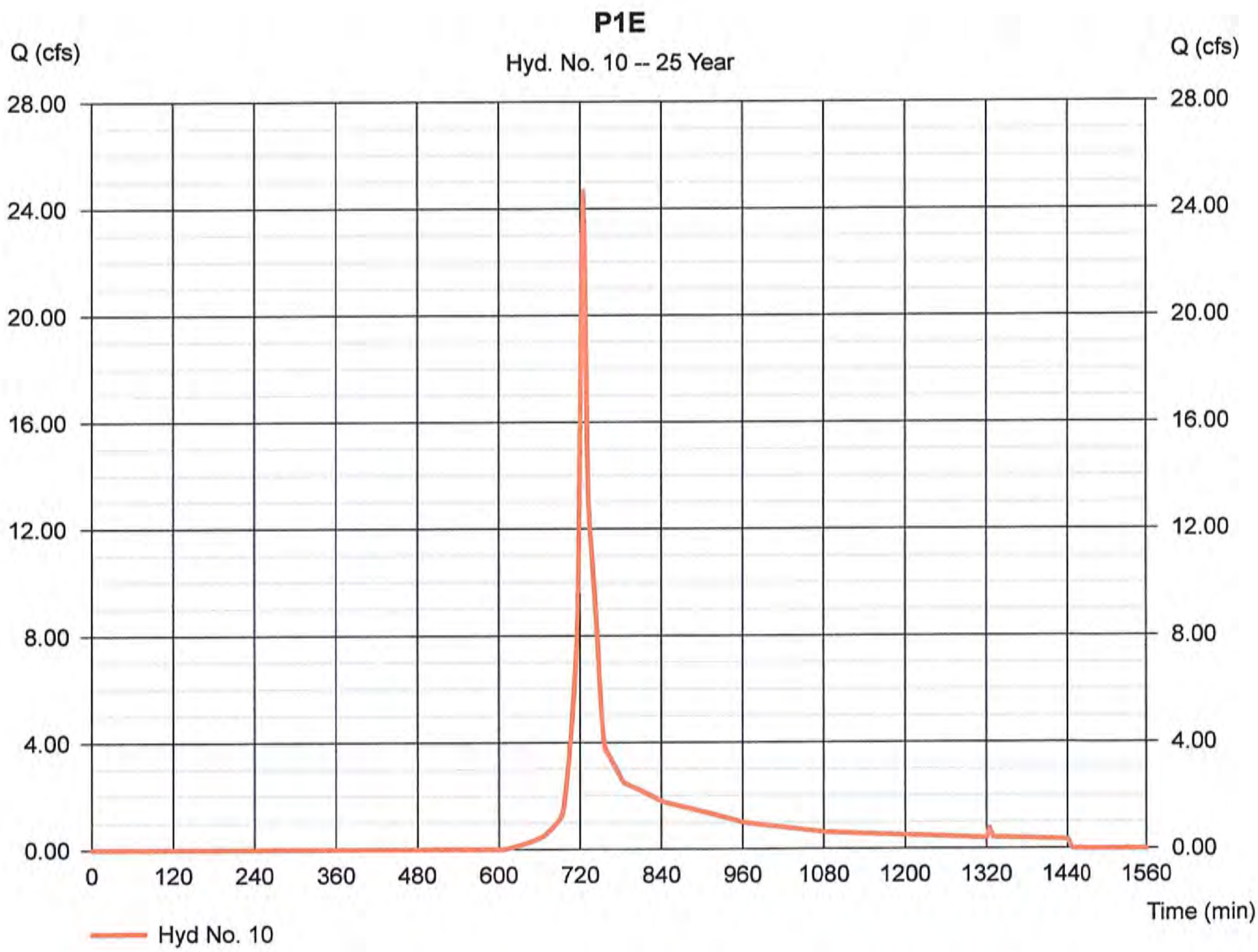
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 10

P1E

Hydrograph type	= SCS Runoff	Peak discharge	= 24.65 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 75,770 cuft
Drainage area	= 11.320 ac	Curve number	= 66.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



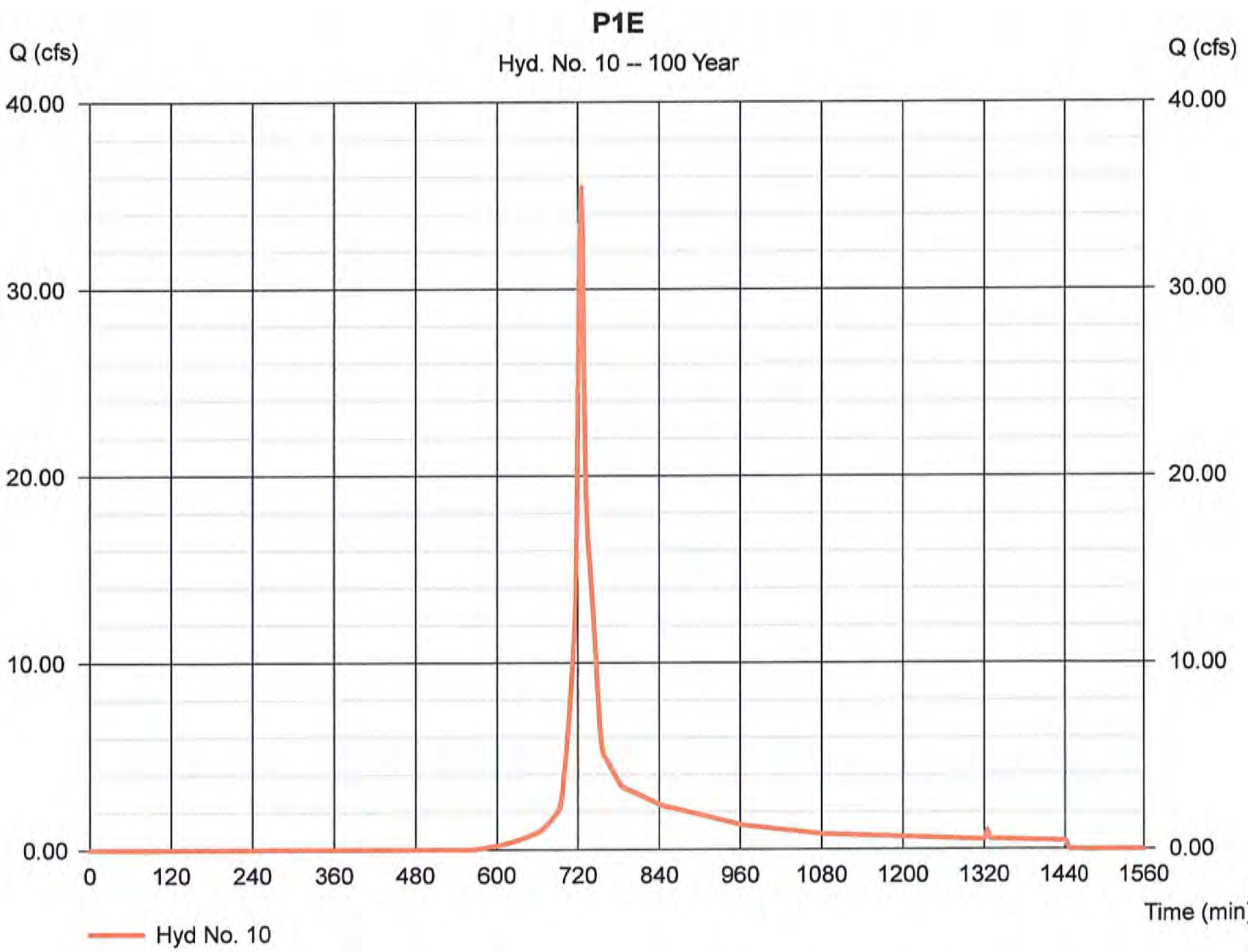
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 10

P1E

Hydrograph type	= SCS Runoff	Peak discharge	= 35.47 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 107,036 cuft
Drainage area	= 11.320 ac	Curve number	= 66.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

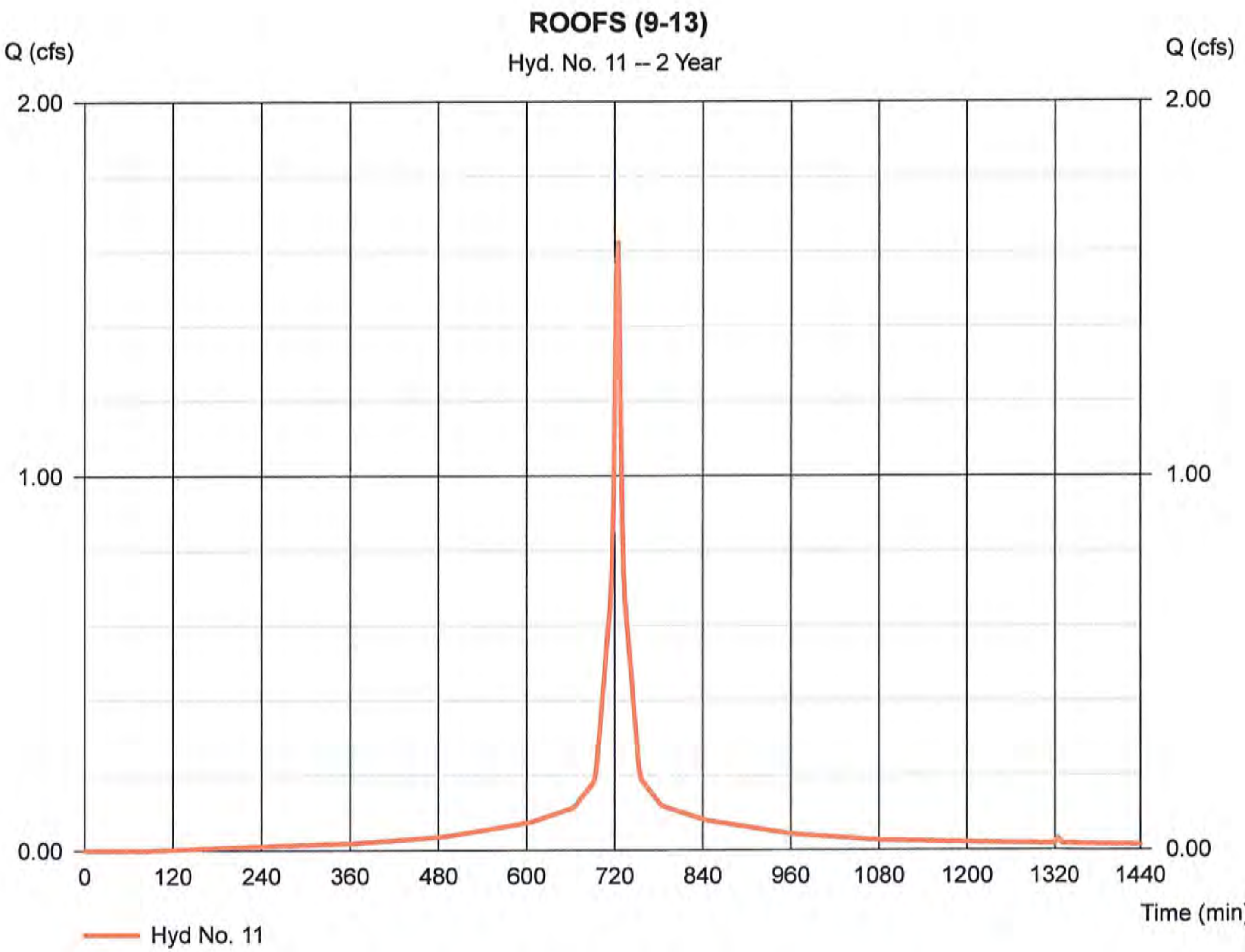


Hydrograph Report

Hyd. No. 11

ROOFS (9-13)

Hydrograph type	= SCS Runoff	Peak discharge	= 1.624 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 5,465 cuft
Drainage area	= 0.560 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



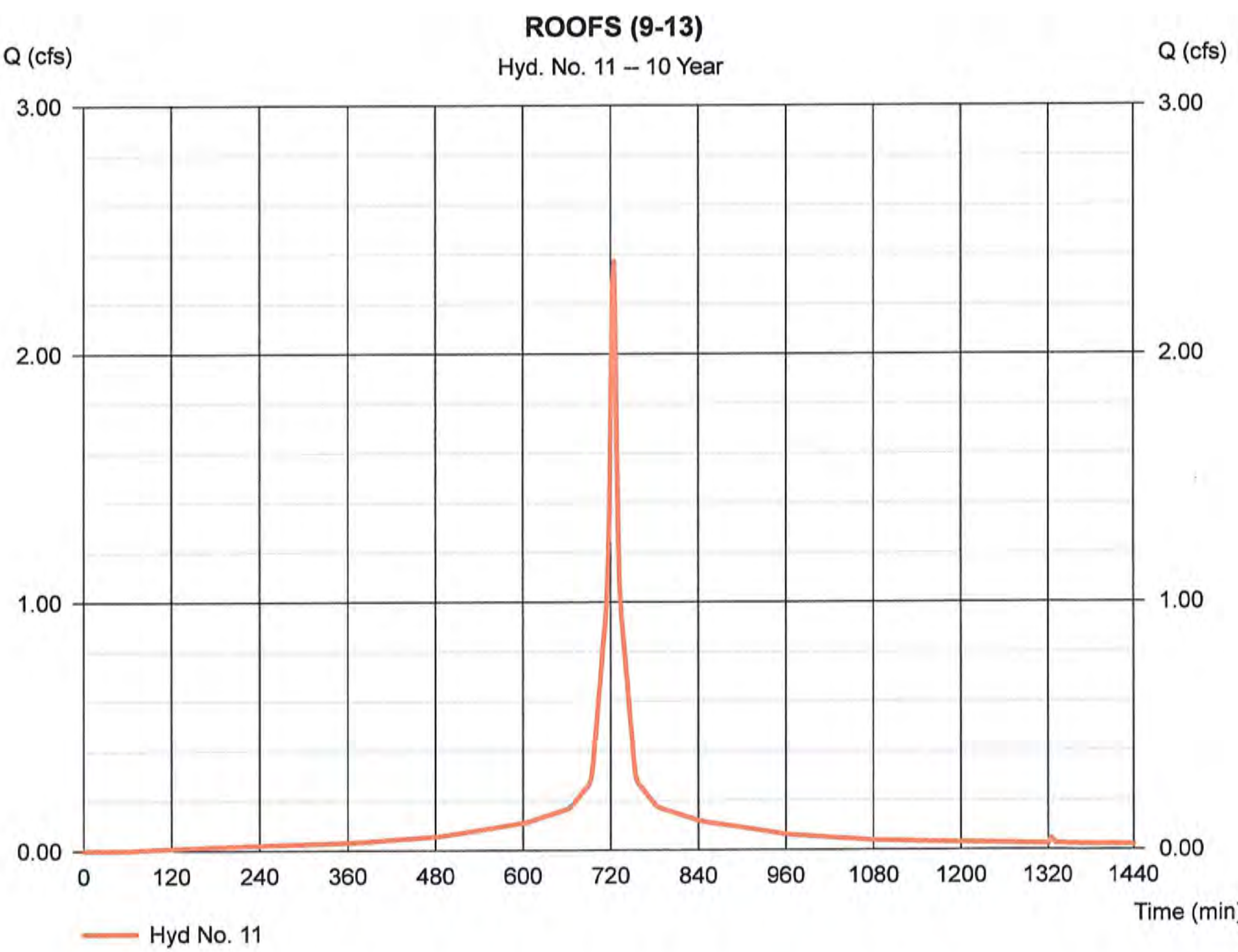
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 11

ROOFS (9-13)

Hydrograph type	= SCS Runoff	Peak discharge	= 2.373 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 8,126 cuft
Drainage area	= 0.560 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

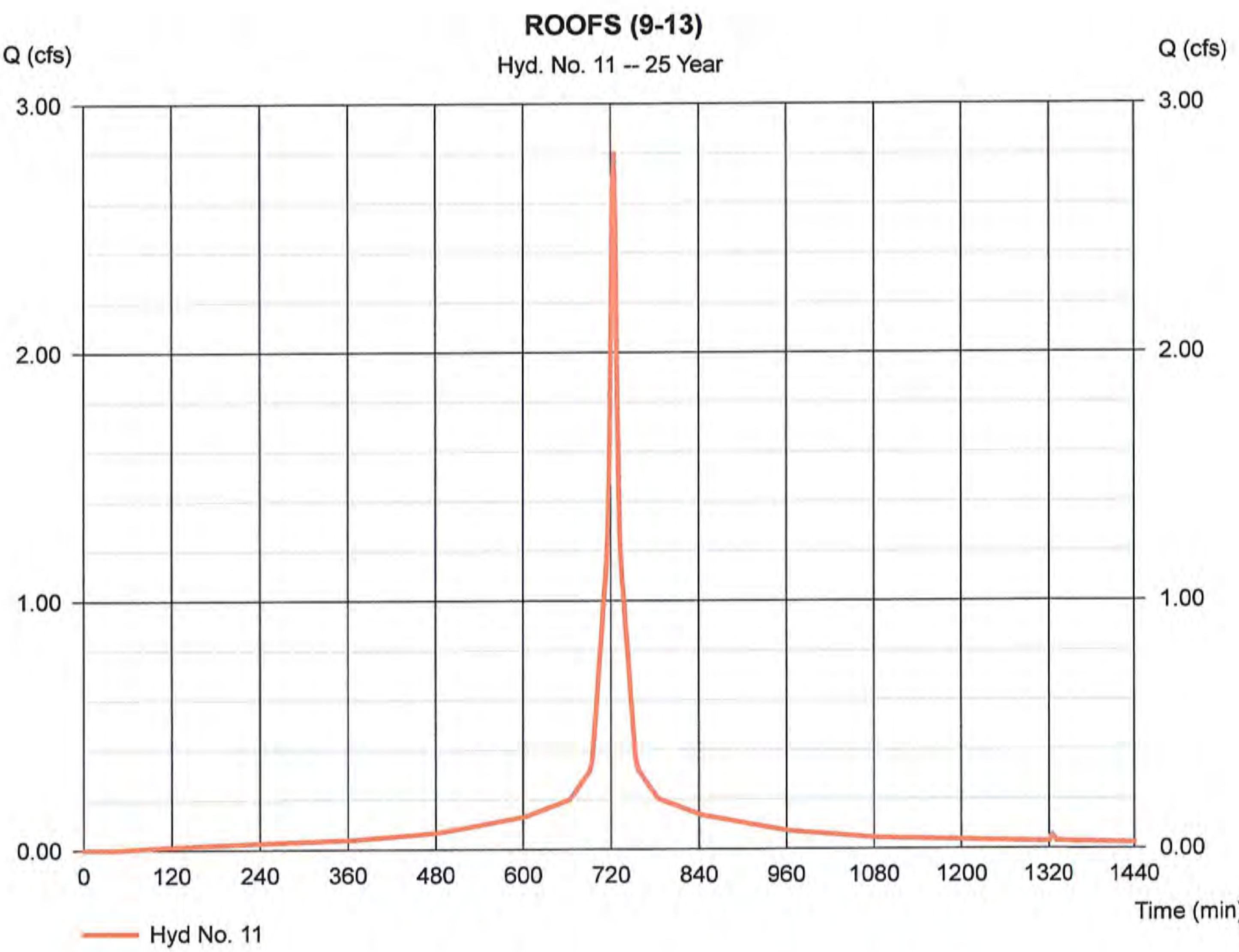
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 11

ROOFS (9-13)

Hydrograph type	= SCS Runoff	Peak discharge	= 2.801 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 9,648 cuft
Drainage area	= 0.560 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



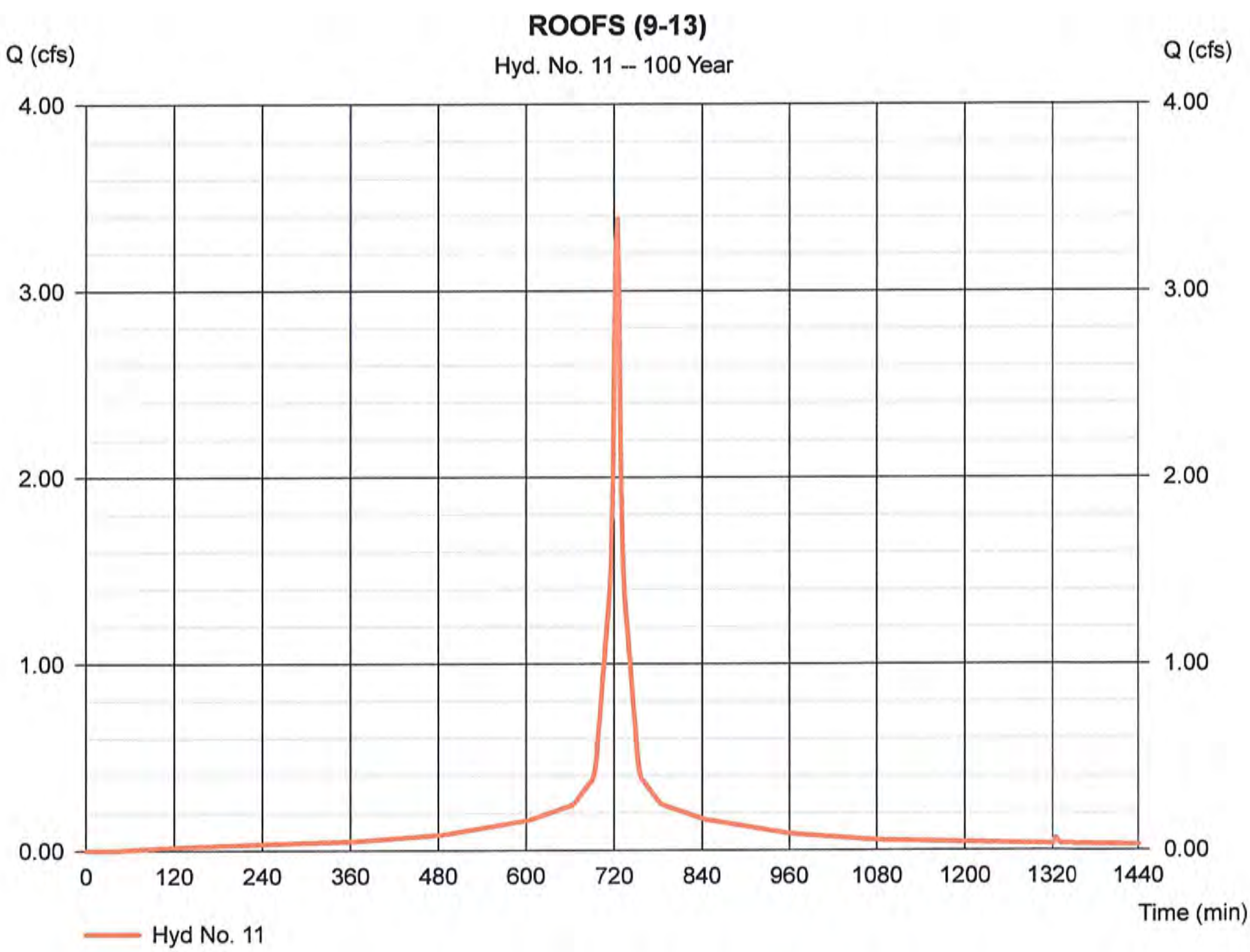
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 11

ROOFS (9-13)

Hydrograph type	= SCS Runoff	Peak discharge	= 3.387 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 11,742 cuft
Drainage area	= 0.560 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



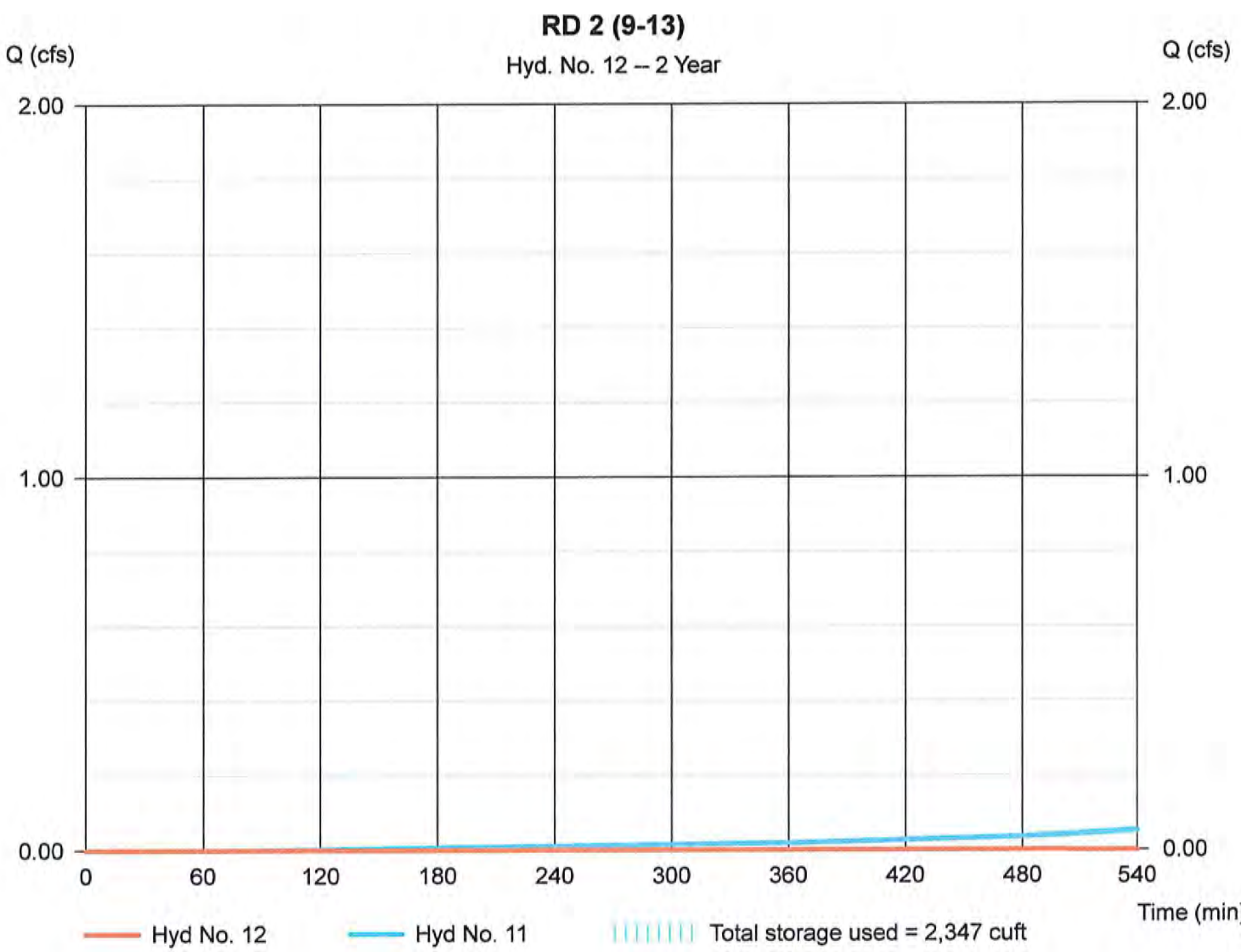
Hydrograph Report

Hyd. No. 12

RD 2 (9-13)

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 480 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 11 - ROOFS (9-13)	Max. Elevation	= 2.56 ft
Reservoir name	= RD 2	Max. Storage	= 2,347 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

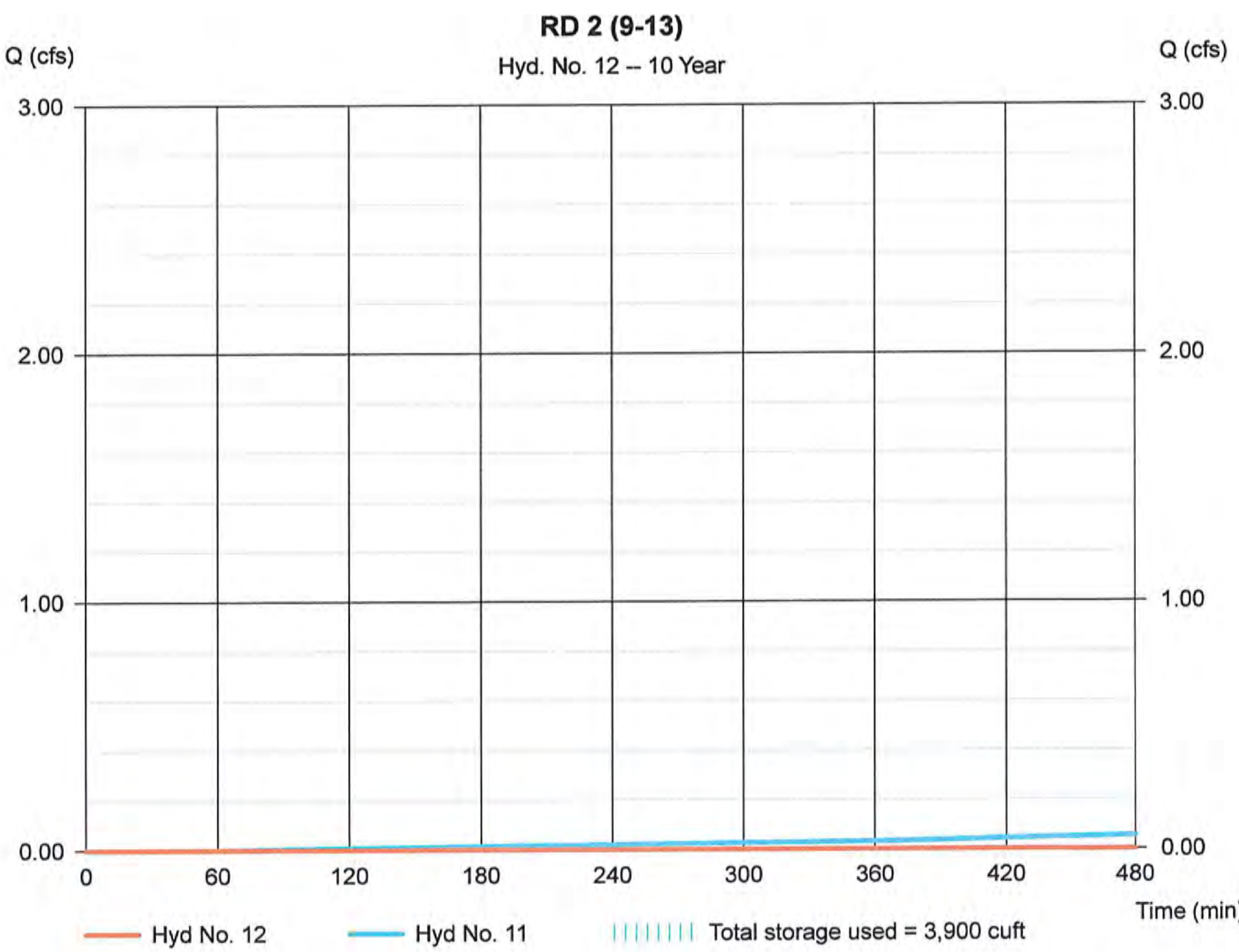
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 12

RD 2 (9-13)

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= 394 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 11 - ROOFS (9-13)	Max. Elevation	= 3.95 ft
Reservoir name	= RD 2	Max. Storage	= 3,900 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



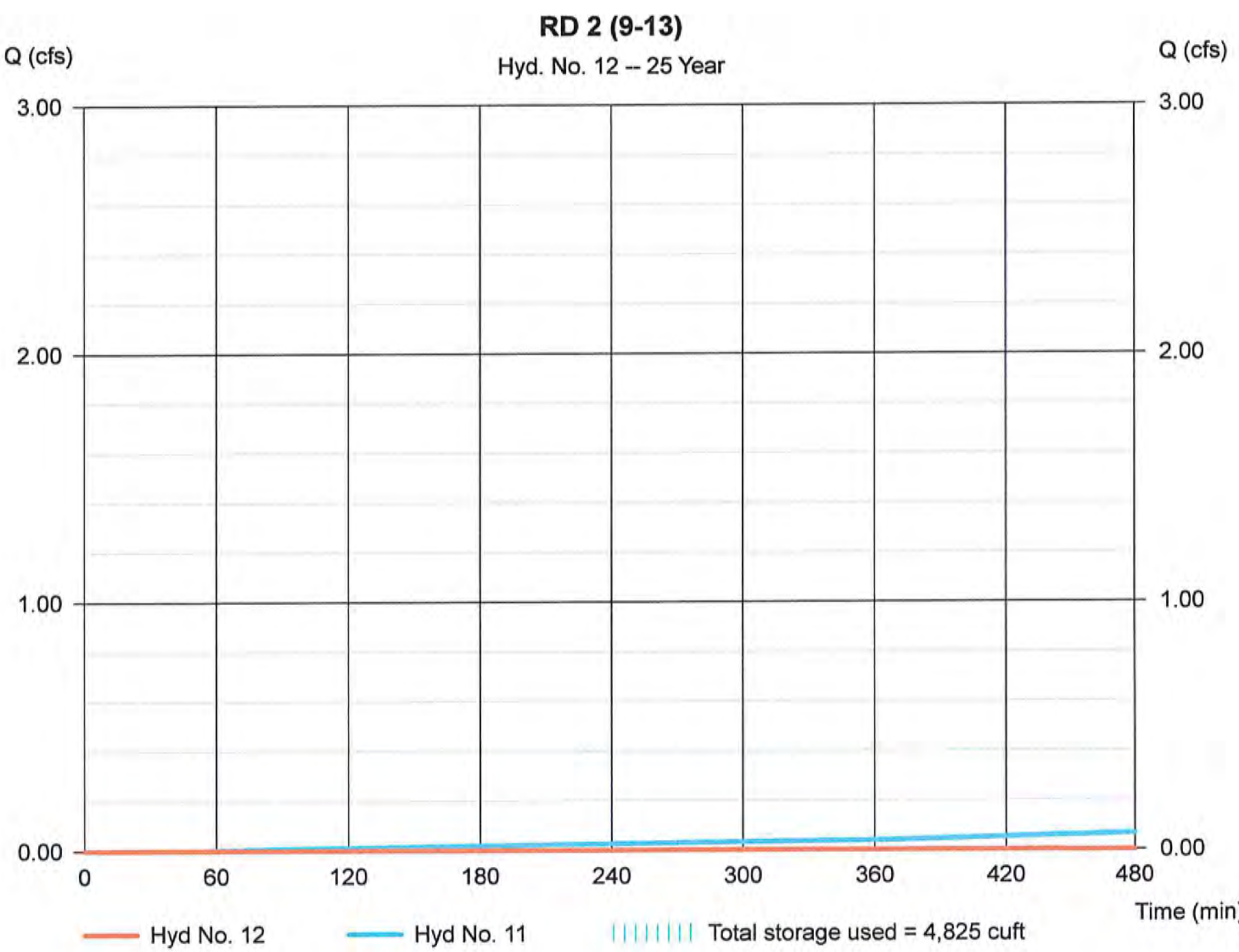
Hydrograph Report

Hyd. No. 12

RD 2 (9-13)

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 25 yrs	Time to peak	= 422 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 11 - ROOFS (9-13)	Max. Elevation	= 4.86 ft
Reservoir name	= RD 2	Max. Storage	= 4,825 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

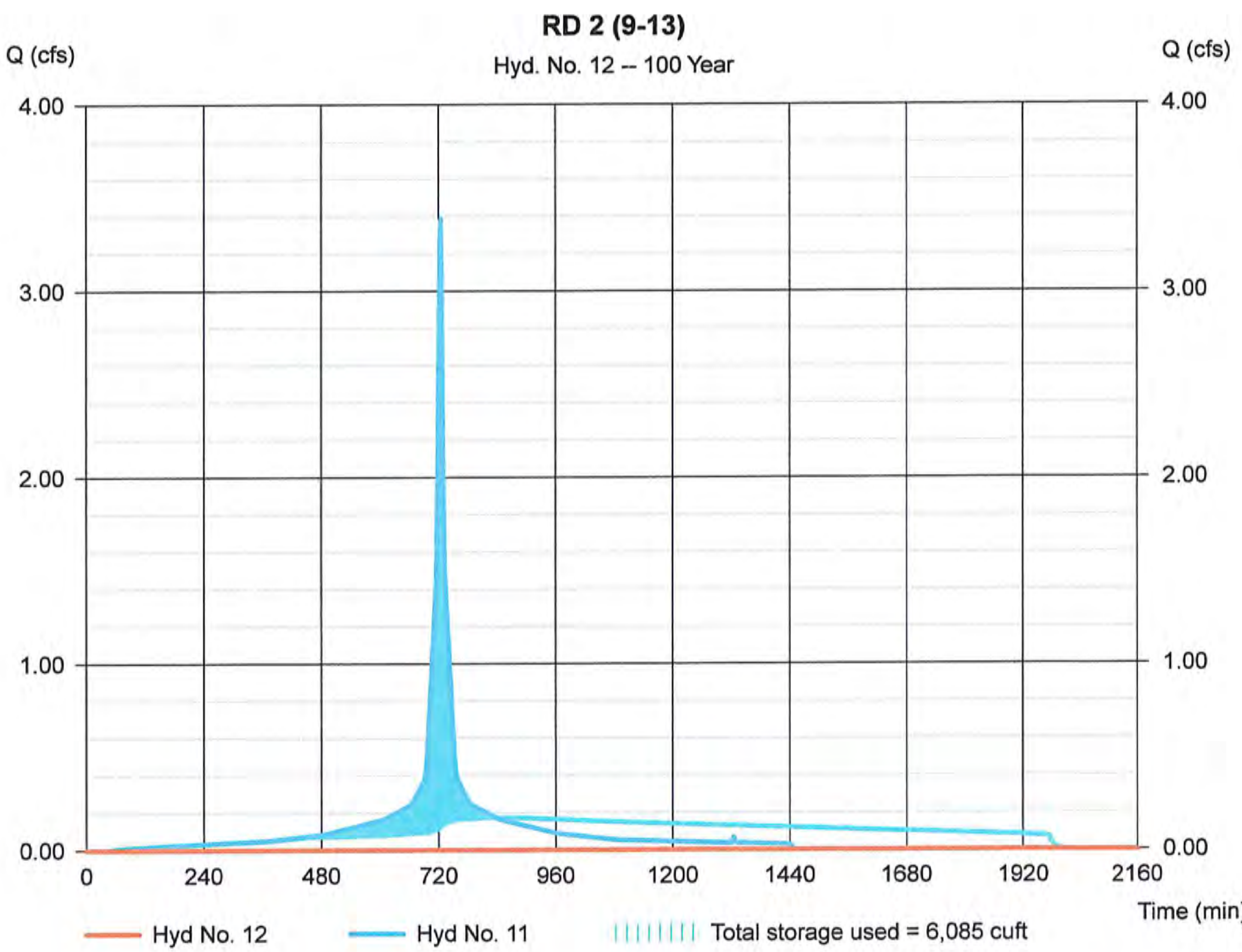
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 12

RD 2 (9-13)

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 316 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 11 - ROOFS (9-13)	Max. Elevation	= 6.69 ft
Reservoir name	= RD 2	Max. Storage	= 6,085 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Pond No. 9 - RD 2

Pond Data

UG Chambers - Invert elev. = 1.00 ft, Rise x Span = 5.00 x 8.33 ft, Barrel Len = 34.64 ft, No. Barrels = 4, Slope = 0.00%, Headers = No
Encasement - Invert elev. = 0.00 ft, Width = 9.08 ft, Height = 7.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	0.00	n/a	0	0
0.70	0.70	n/a	352	352
1.40	1.40	n/a	629	981
2.10	2.10	n/a	831	1,813
2.80	2.80	n/a	816	2,629
3.50	3.50	n/a	790	3,418
4.20	4.20	n/a	750	4,168
4.90	4.90	n/a	693	4,861
5.60	5.60	n/a	605	5,466
6.30	6.30	n/a	425	5,891
7.00	7.00	n/a	352	6,244

Culvert / Orifice Structures

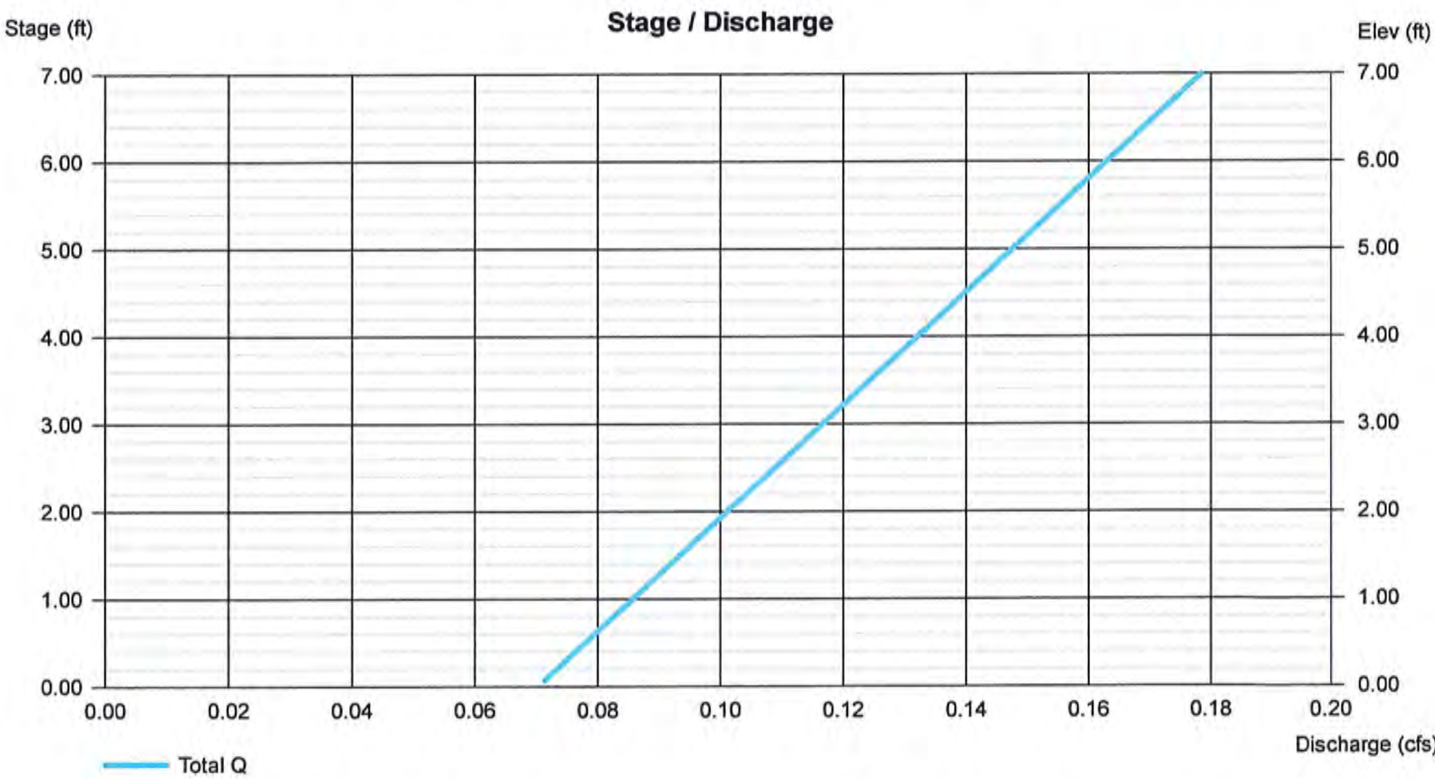
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	6.00	0.00	0.00
Span (in)	= 12.00	6.00	0.00	0.00
No. Barrels	= 1	4	0	0
Invert El. (ft)	= 321.00	323.76	0.00	0.00
Length (ft)	= 24.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	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) = 2.410 (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).



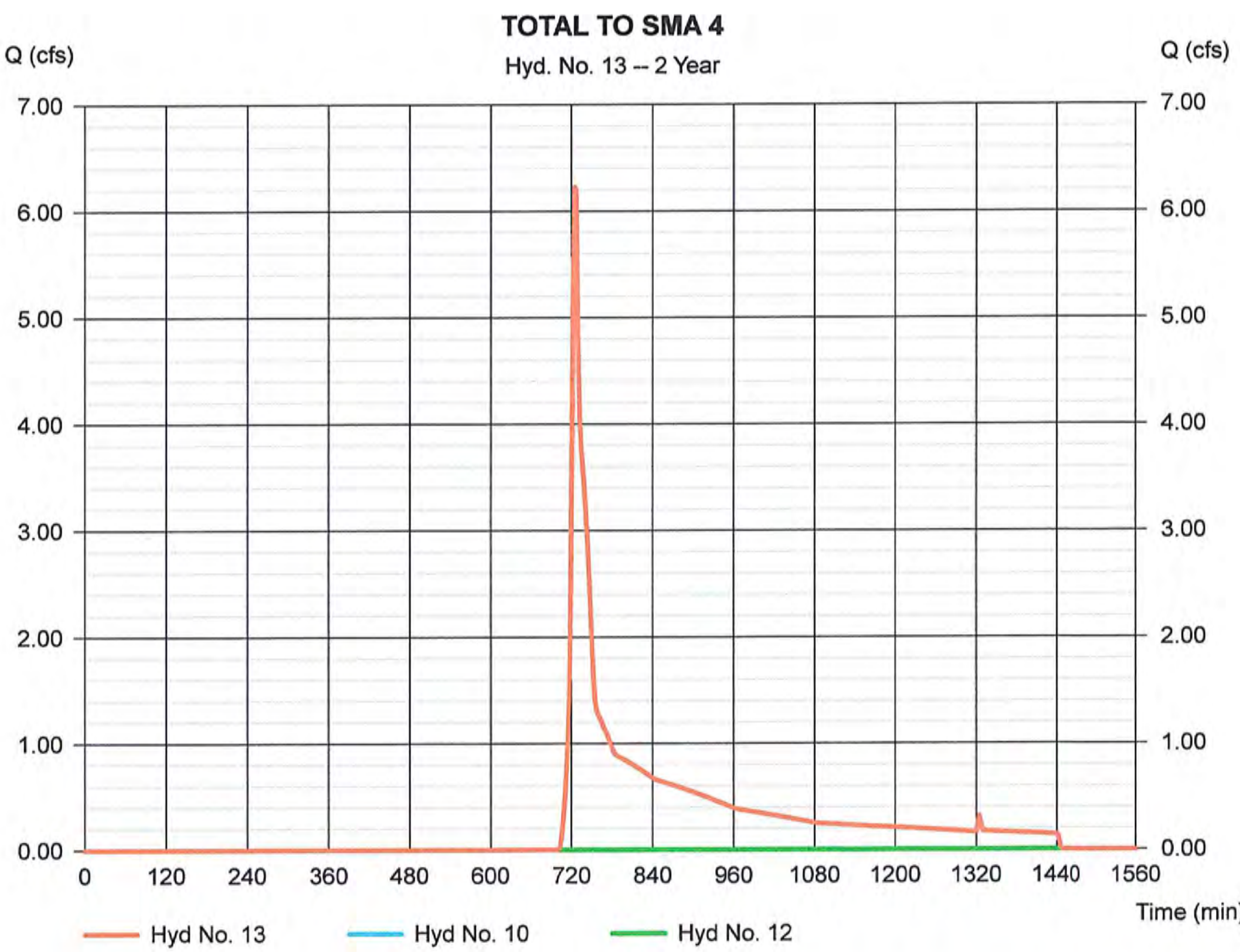
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 13

TOTAL TO SMA 4

Hydrograph type	= Combine	Peak discharge	= 6.227 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 23,494 cuft
Inflow hyds.	= 10, 12	Contrib. drain. area	= 11.320 ac



Hydrograph Report

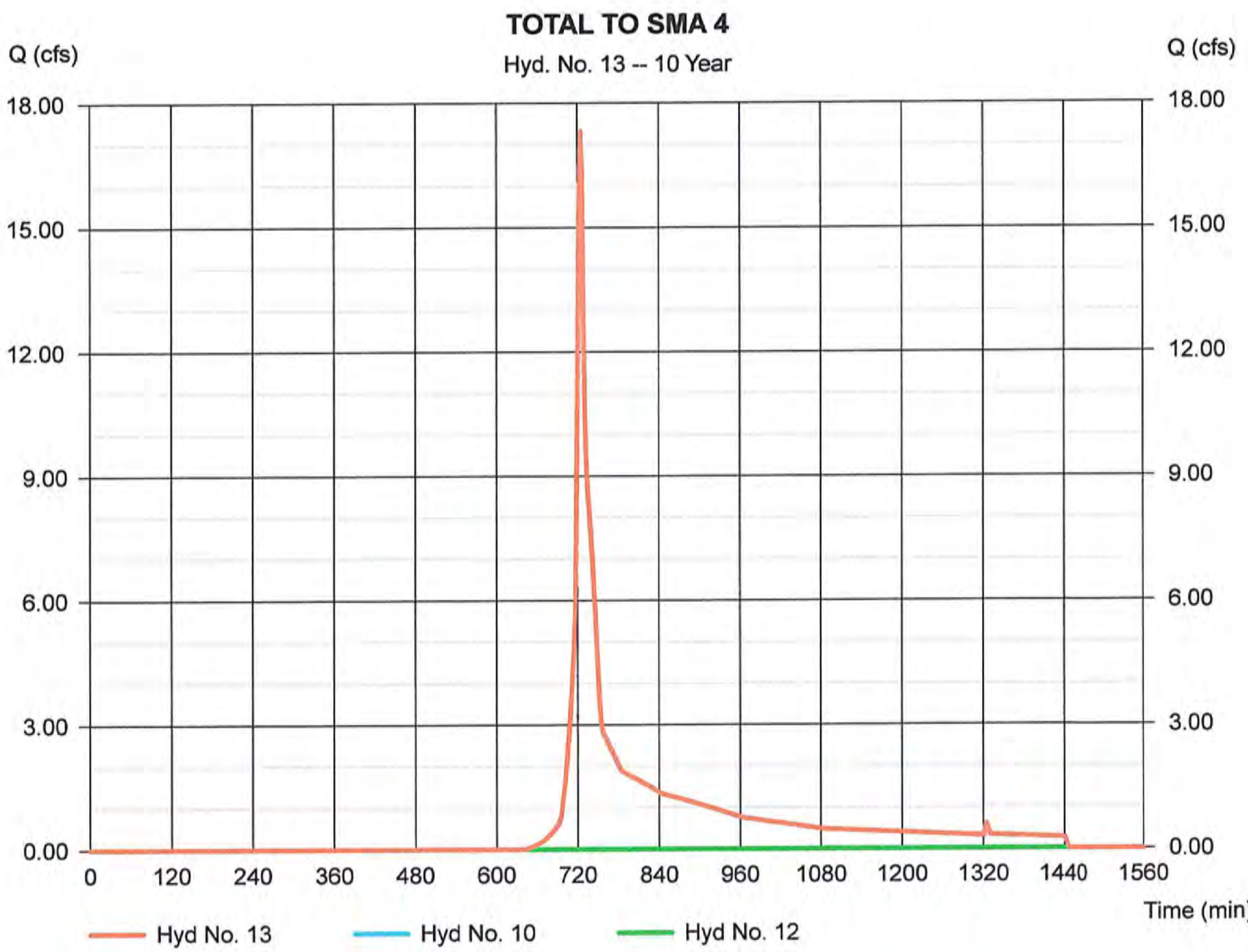
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 13

TOTAL TO SMA 4

Hydrograph type	= Combine	Peak discharge	= 17.32 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 54,827 cuft
Inflow hyds.	= 10, 12	Contrib. drain. area	= 11.320 ac



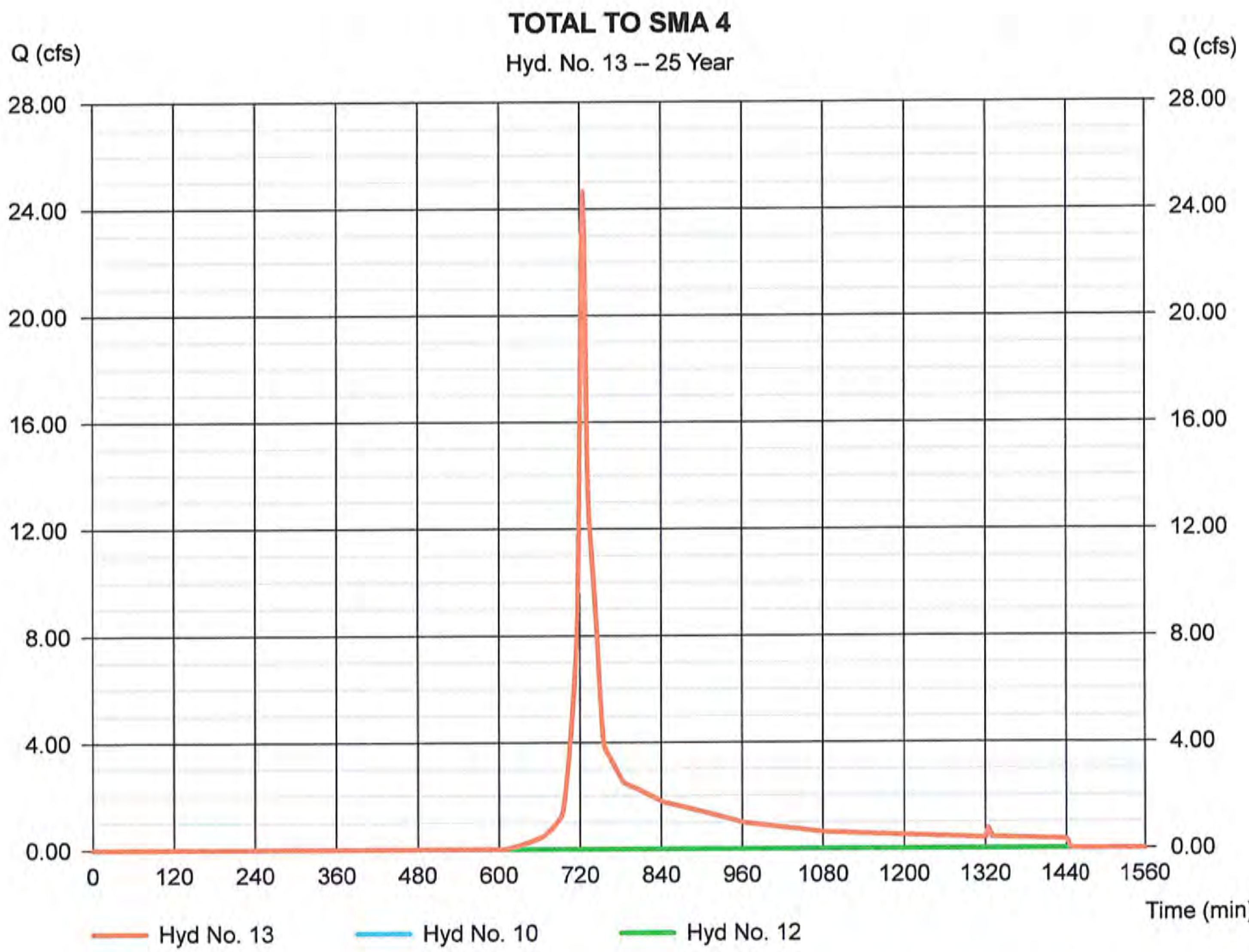
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 13

TOTAL TO SMA 4

Hydrograph type	= Combine	Peak discharge	= 24.65 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 75,770 cuft
Inflow hyds.	= 10, 12	Contrib. drain. area	= 11.320 ac



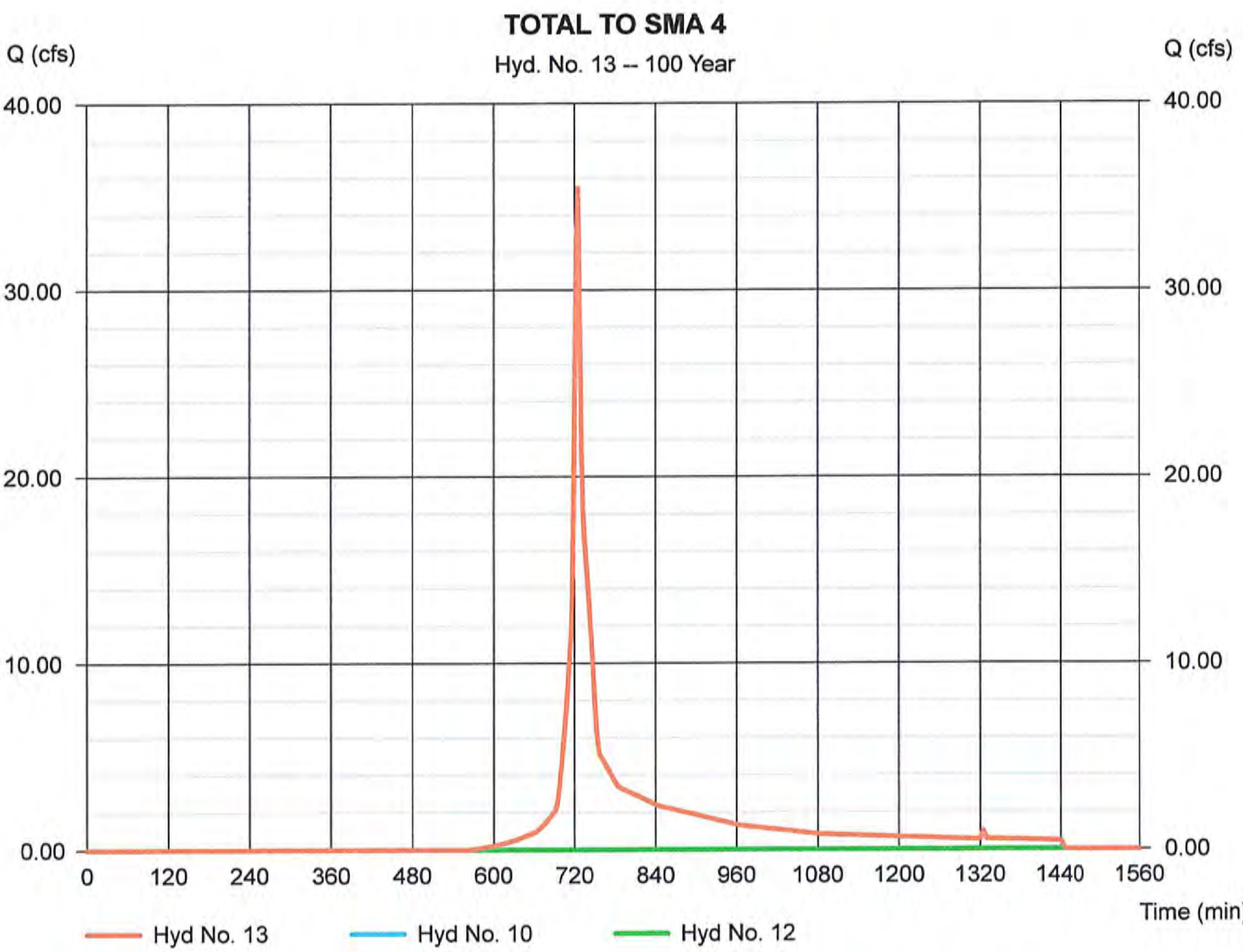
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 13

TOTAL TO SMA 4

Hydrograph type	= Combine	Peak discharge	= 35.47 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 107,036 cuft
Inflow hyds.	= 10, 12	Contrib. drain. area	= 11.320 ac



Hydrograph Report

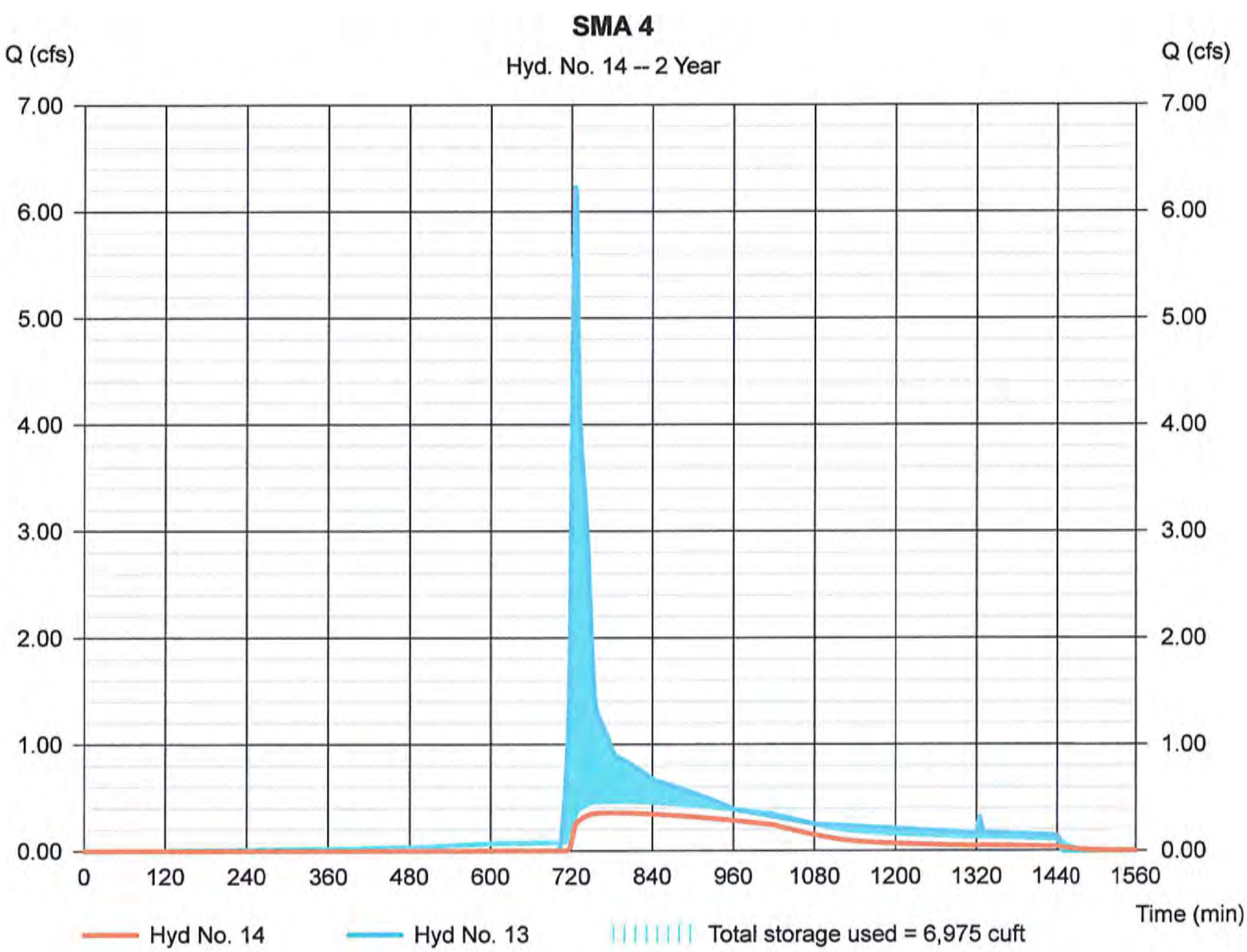
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 14

SMA 4

Hydrograph type	= Reservoir	Peak discharge	= 0.356 cfs
Storm frequency	= 2 yrs	Time to peak	= 778 min
Time interval	= 2 min	Hyd. volume	= 7,902 cuft
Inflow hyd. No.	= 13 - TOTAL TO SMA 4	Max. Elevation	= 314.39 ft
Reservoir name	= SMA 4	Max. Storage	= 6,975 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

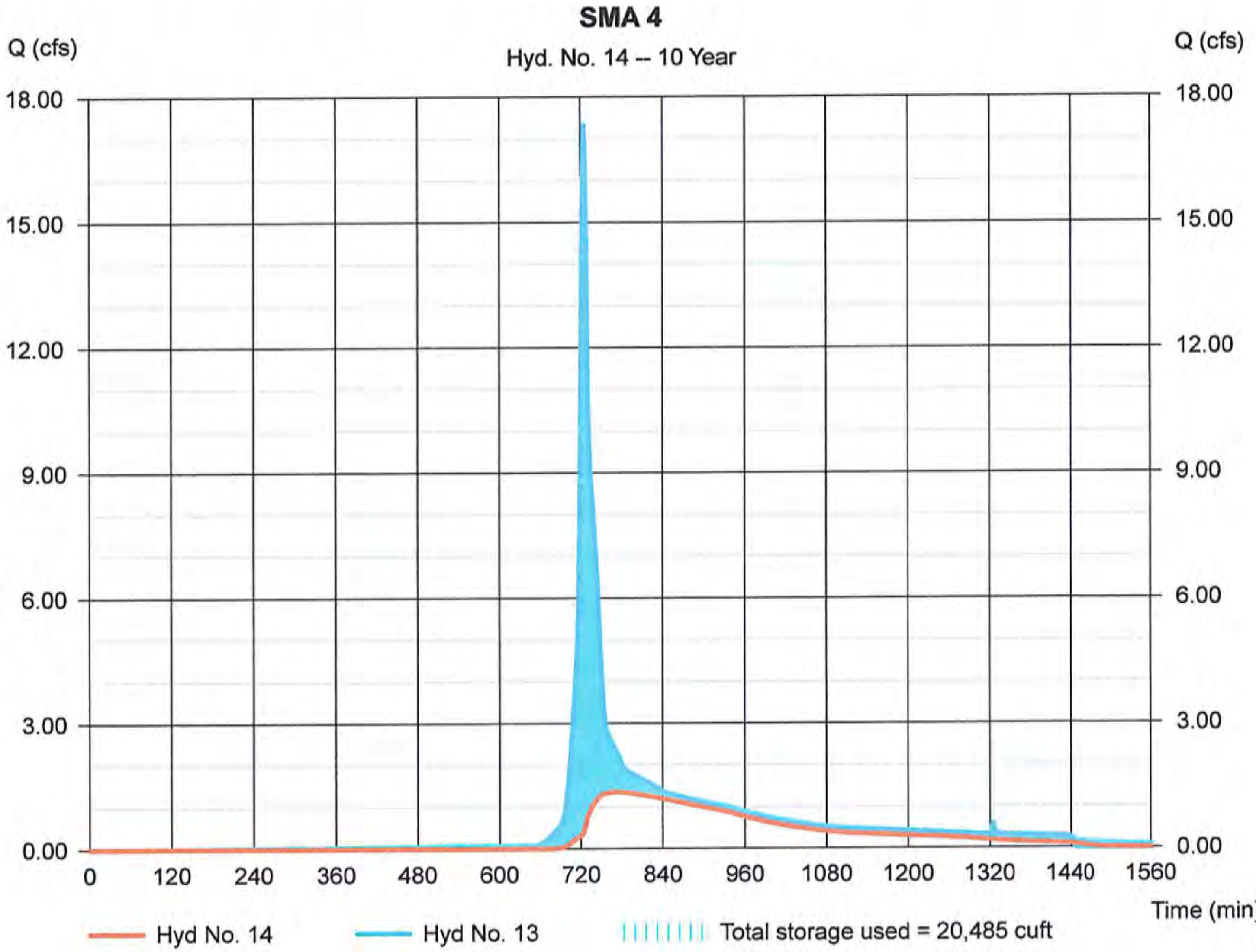
Thursday, Jun 22, 2017

Hyd. No. 14

SMA 4

Hydrograph type	= Reservoir	Peak discharge	= 1.353 cfs
Storm frequency	= 10 yrs	Time to peak	= 772 min
Time interval	= 2 min	Hyd. volume	= 25,716 cuft
Inflow hyd. No.	= 13 - TOTAL TO SMA 4	Max. Elevation	= 315.38 ft
Reservoir name	= SMA 4	Max. Storage	= 20,485 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

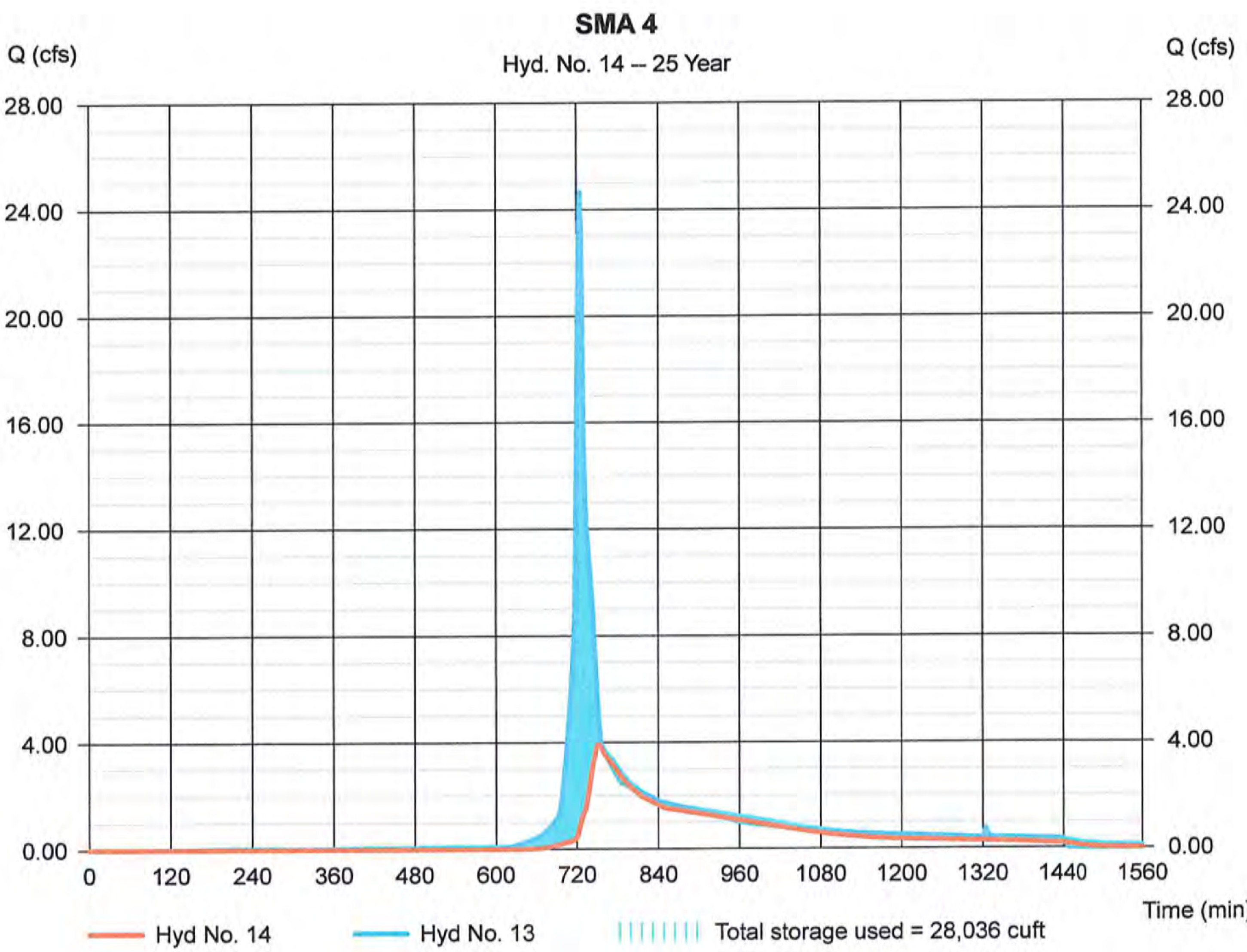
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 14

SMA 4

Hydrograph type	= Reservoir	Peak discharge	= 3.941 cfs
Storm frequency	= 25 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 41,518 cuft
Inflow hyd. No.	= 13 - TOTAL TO SMA 4	Max. Elevation	= 315.83 ft
Reservoir name	= SMA 4	Max. Storage	= 28,036 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



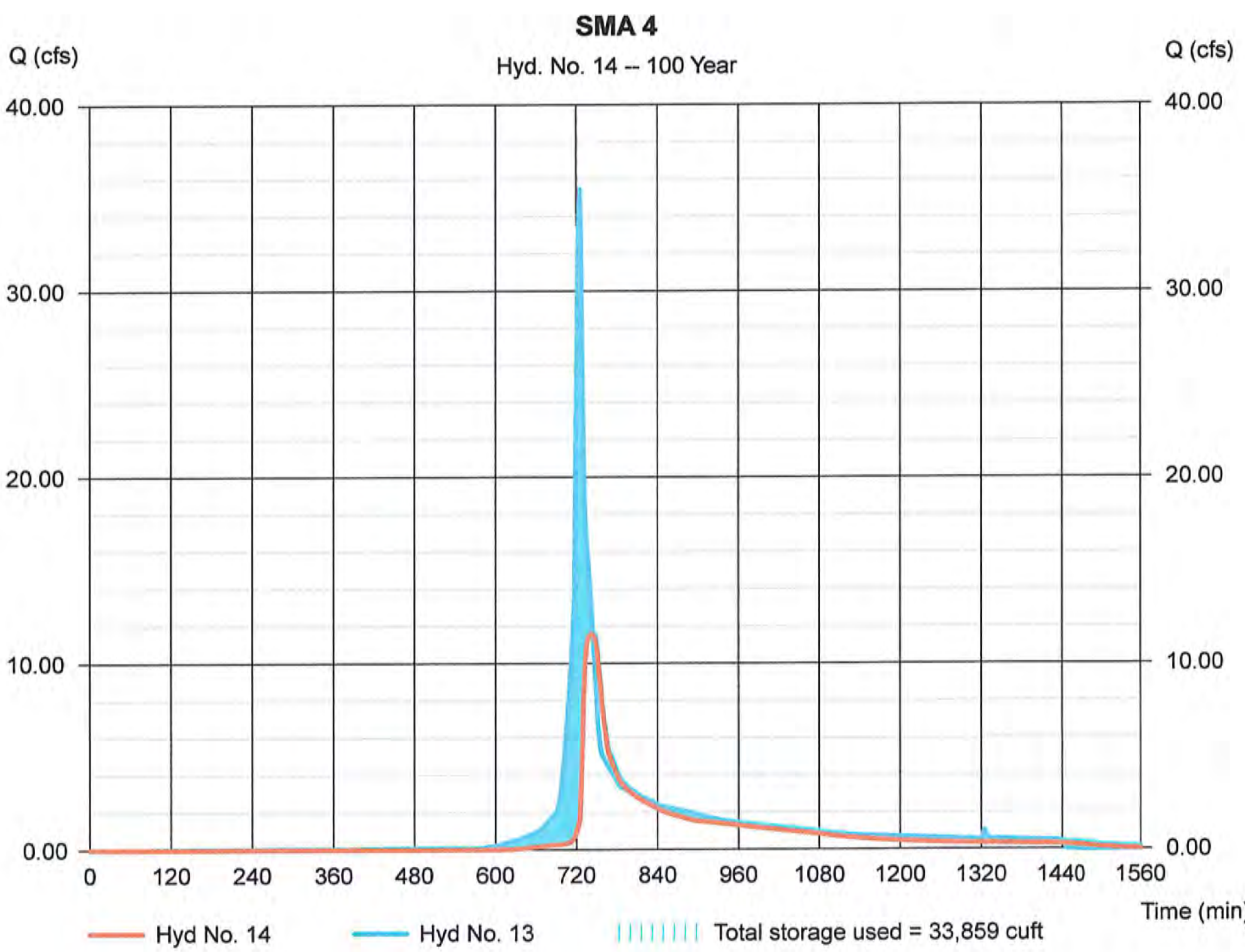
Hydrograph Report

Hyd. No. 14

SMA 4

Hydrograph type	= Reservoir	Peak discharge	= 11.57 cfs
Storm frequency	= 100 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 67,773 cuft
Inflow hyd. No.	= 13 - TOTAL TO SMA 4	Max. Elevation	= 316.14 ft
Reservoir name	= SMA 4	Max. Storage	= 33,859 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Pond No. 14 - SMA 4

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 313.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	313.50	2,034	0	0
0.50	314.00	8,577	2,464	2,464
1.50	315.00	15,058	11,665	14,130
2.50	316.00	18,756	16,872	31,001
3.50	317.00	21,855	20,284	51,285

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	4.00	0.00	0.00
Span (in)	= 18.00	4.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 313.00	313.50	0.00	0.00
Length (ft)	= 50.00	0.00	0.00	0.00
Slope (%)	= 0.50	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	Yes	No	No

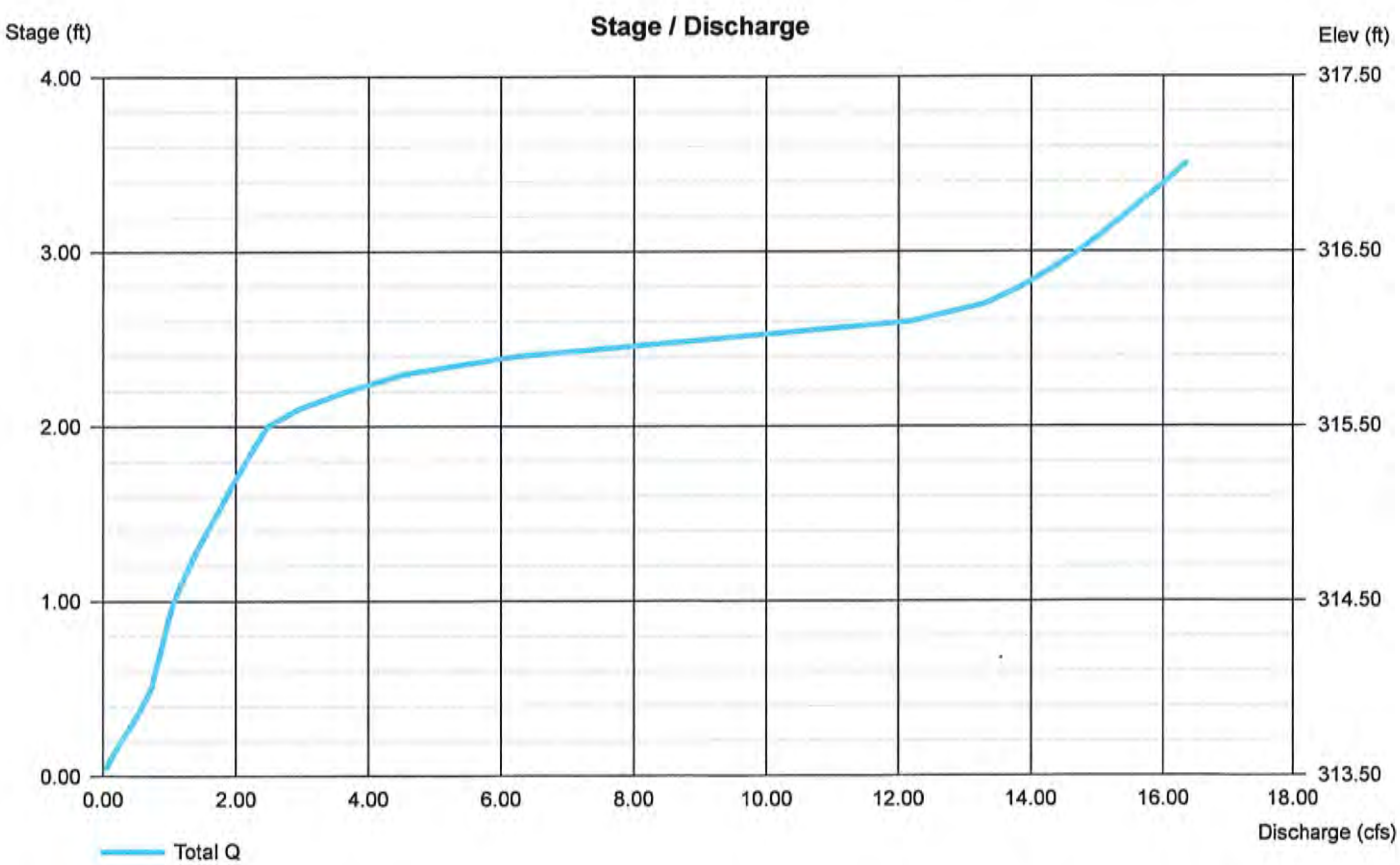
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	0.25	3.75	0.00
Crest El. (ft)	= 315.83	314.40	315.50	0.00
Weir Coeff.	= 3.33	3.33	2.60	3.33
Weir Type	= Riser	Rect	Broad	---
Multi-Stage	= Yes	Yes	Yes	No

Exfil.(in/hr) = 2.410 (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).



Worksheet 2: Runoff curve number and runoff **SM-2069**

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked RJH Date 6/22/2017

Circle one: Present Developed Subcatchment P-1G

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			1.48	144.92
B	Woods- Good Condition	55			0.24	12.98
B	Open Space-Good Condition	61			2.00	121.77
A	Open Space-Good Condition	39			0.65	25.27
				189880.00 Totals =	4.36	304.95

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{304.95}{4.36} =$ 69.96 ; Use CN = 70.0

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	0.77	1.67	3.12
Runoff, Q..	cf	12160	26436	49396

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/2016

Location: Boxborough, MA Checked ______ Date ______

Circle one: Present **Developed** SubcatchmentPP-1G

Circle one: **Tc** Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			GRASS			
2. Mannings roughness coeff., n (table 3-1)			0.24			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.05			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.10			0.10

Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			UNPAVED			
8. Flow Length, L		ft	273			
9. Watercourse slope, s		ft/ft	0.04			
10. Average Velocity, V (figure 3-1)		ft/s	3.23			
11. Tt = L / 3600V	Compute Tt	hr	0.02			0.02

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

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

min 7.2

Hydrograph Report

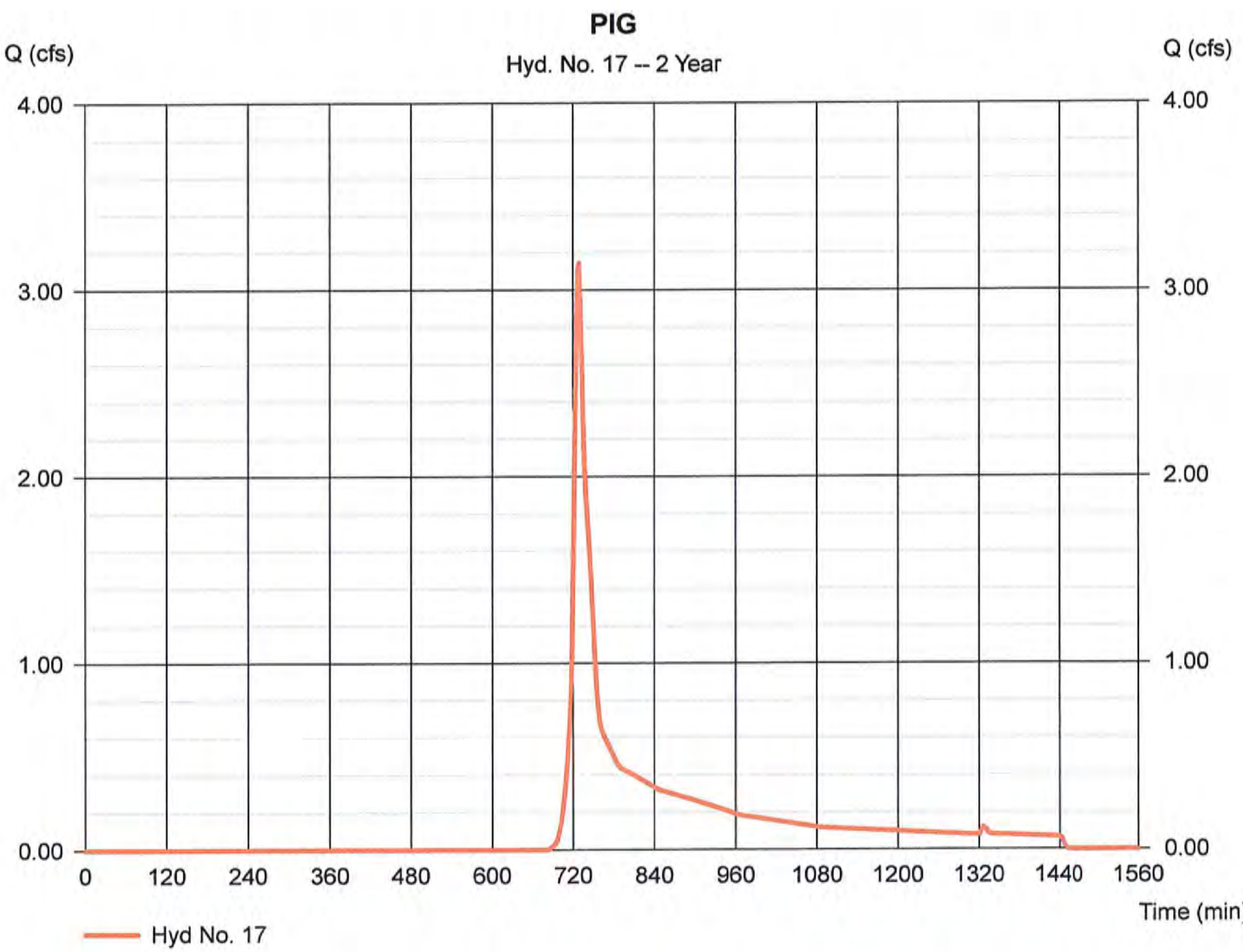
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 17

PIG

Hydrograph type	= SCS Runoff	Peak discharge	= 3.145 cfs
Storm frequency	= 2 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 12,195 cuft
Drainage area	= 4.360 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.20 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



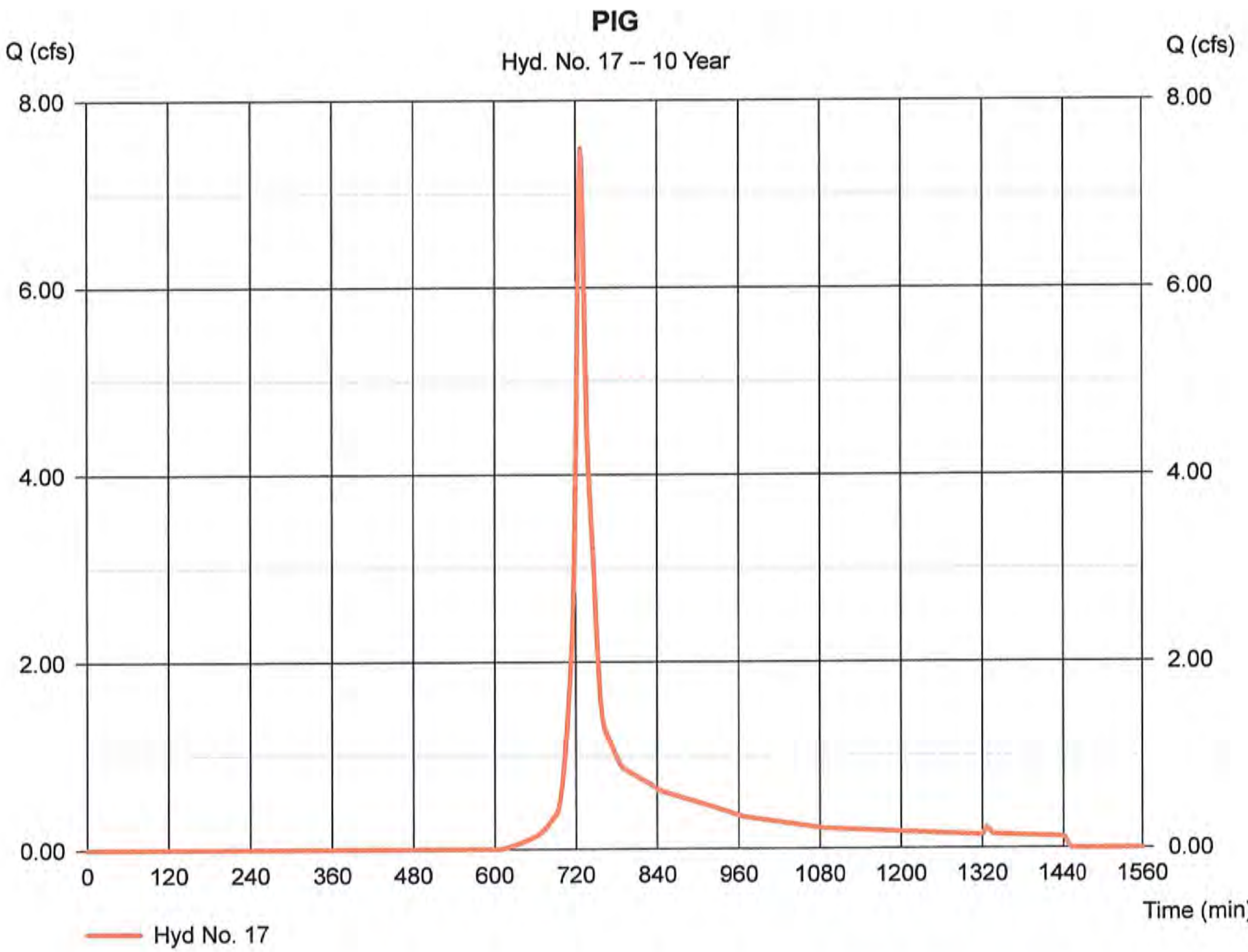
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 17

PIG

Hydrograph type	= SCS Runoff	Peak discharge	= 7.488 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 26,490 cuft
Drainage area	= 4.360 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.20 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

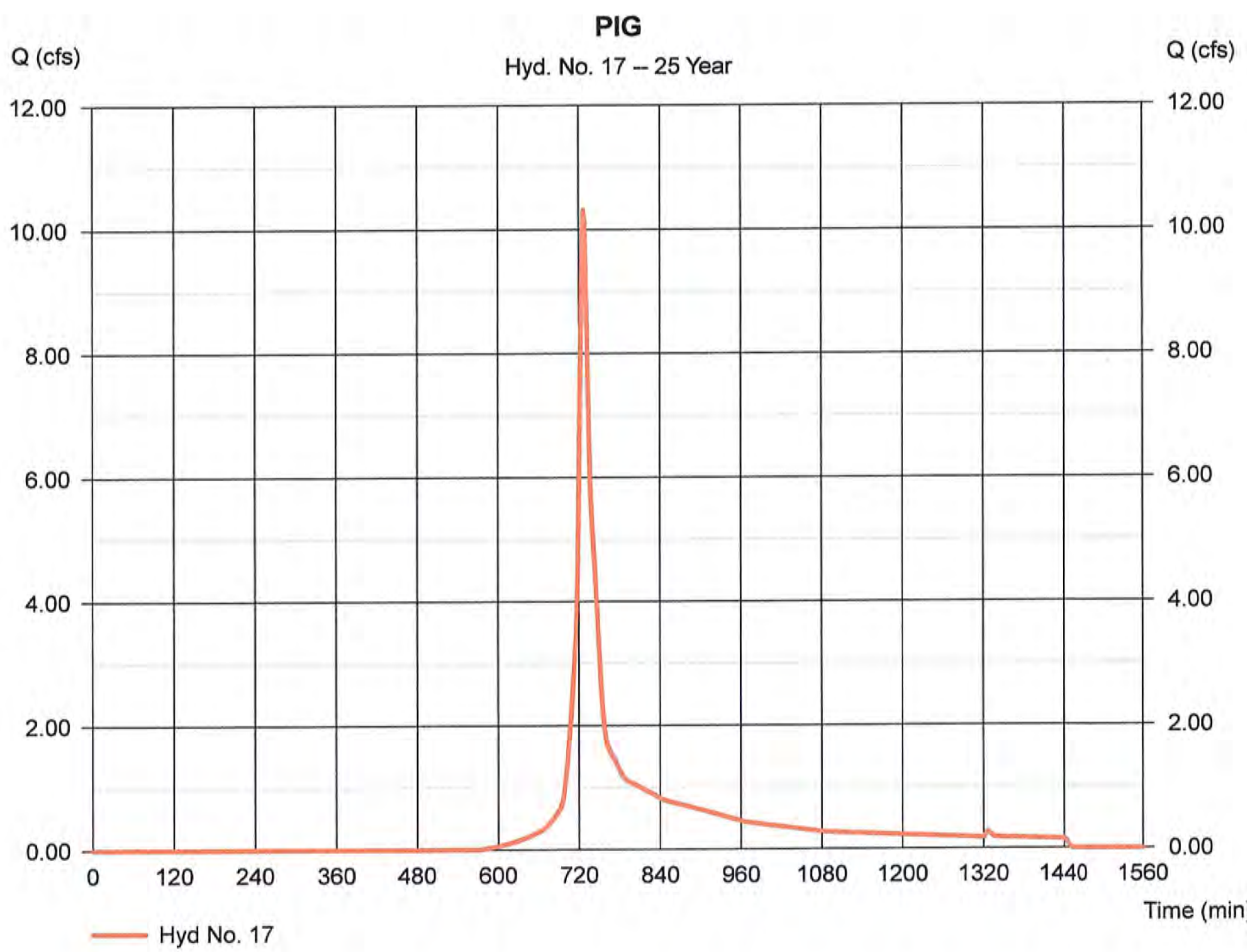
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 17

PIG

Hydrograph type	= SCS Runoff	Peak discharge	= 10.32 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 35,791 cuft
Drainage area	= 4.360 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.20 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

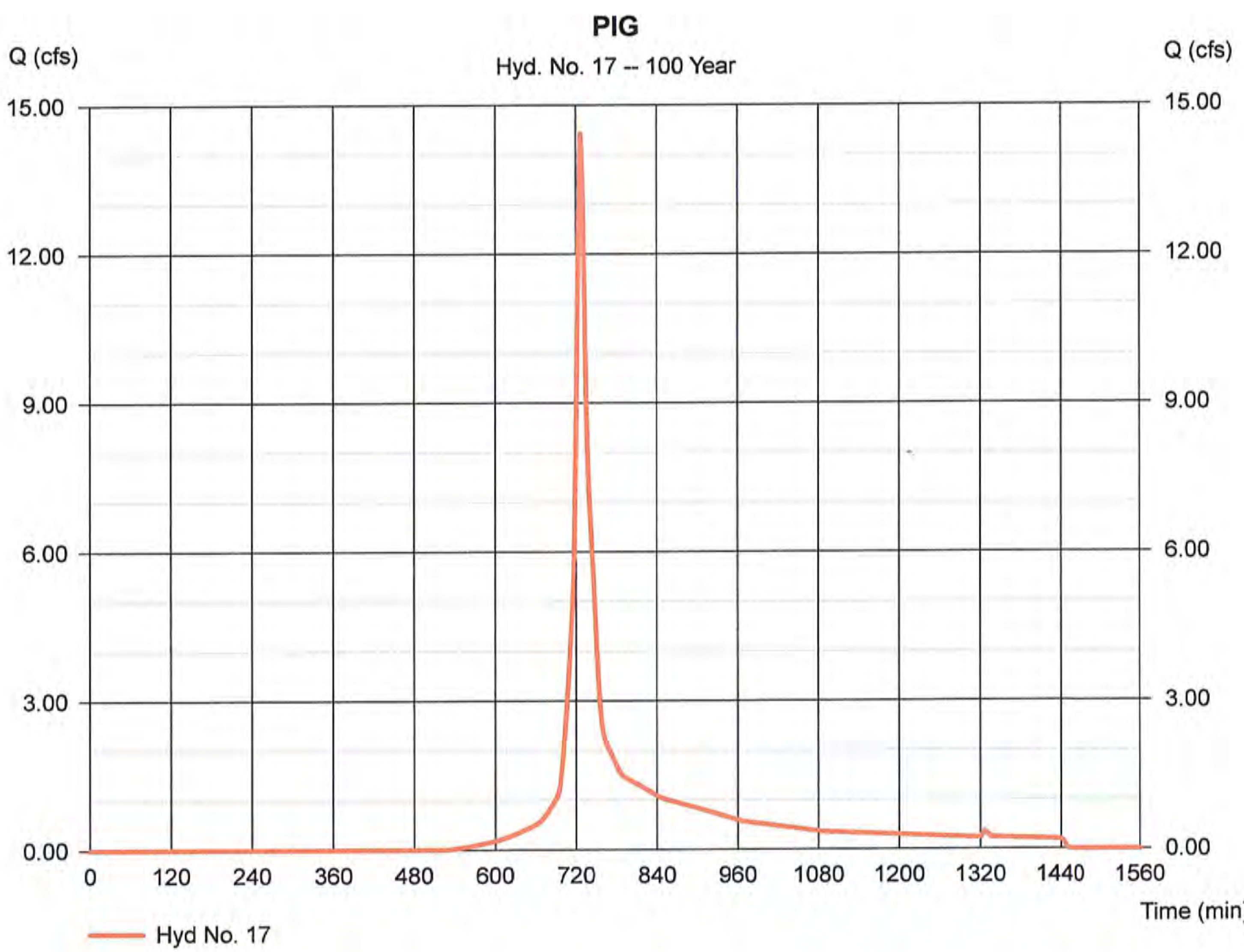
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 17

PIG

Hydrograph type	= SCS Runoff	Peak discharge	= 14.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 49,473 cuft
Drainage area	= 4.360 ac	Curve number	= 70
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 7.20 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

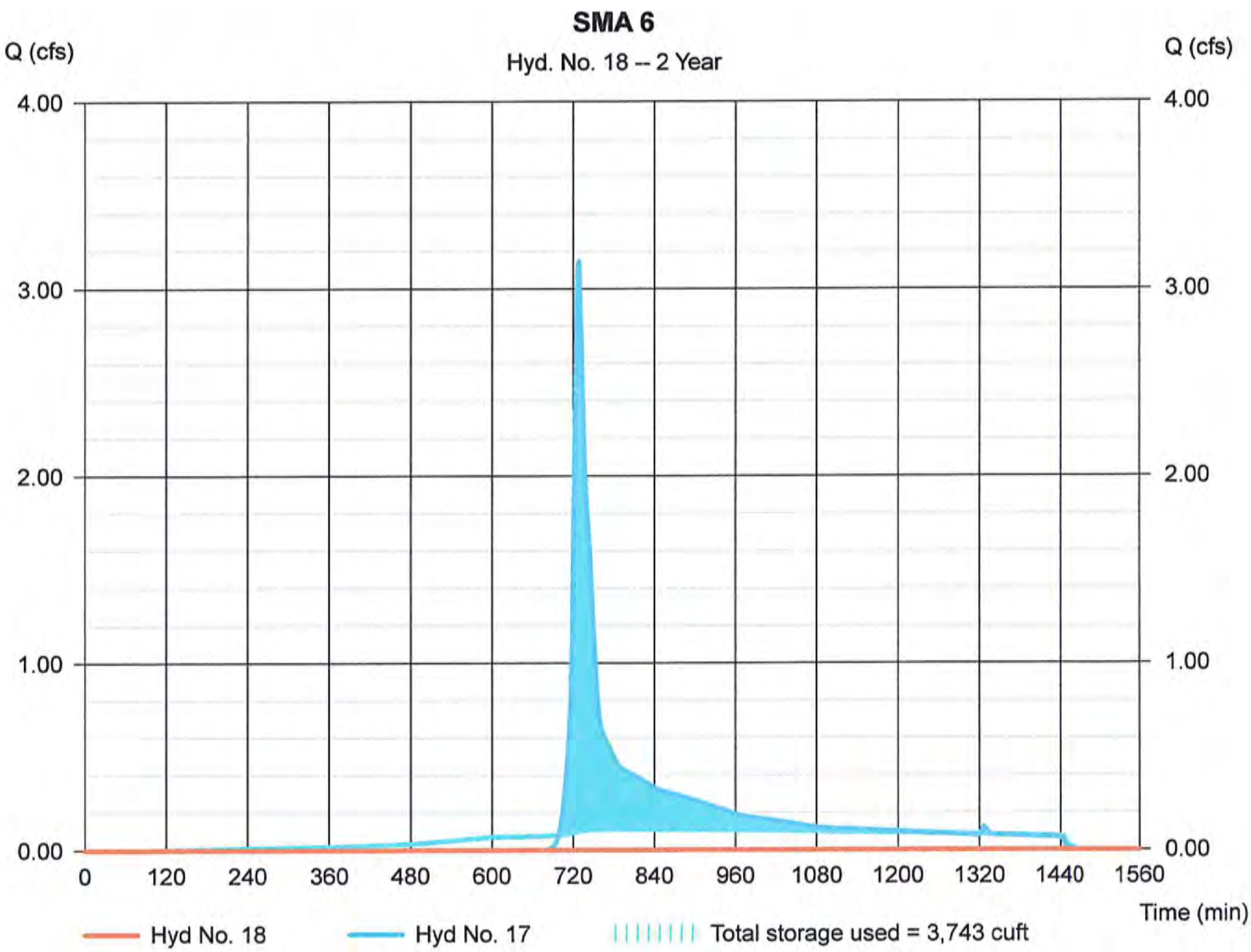
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 18

SMA 6

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 17 - PIG	Max. Elevation	= 319.39 ft
Reservoir name	= SMA 6	Max. Storage	= 3,743 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

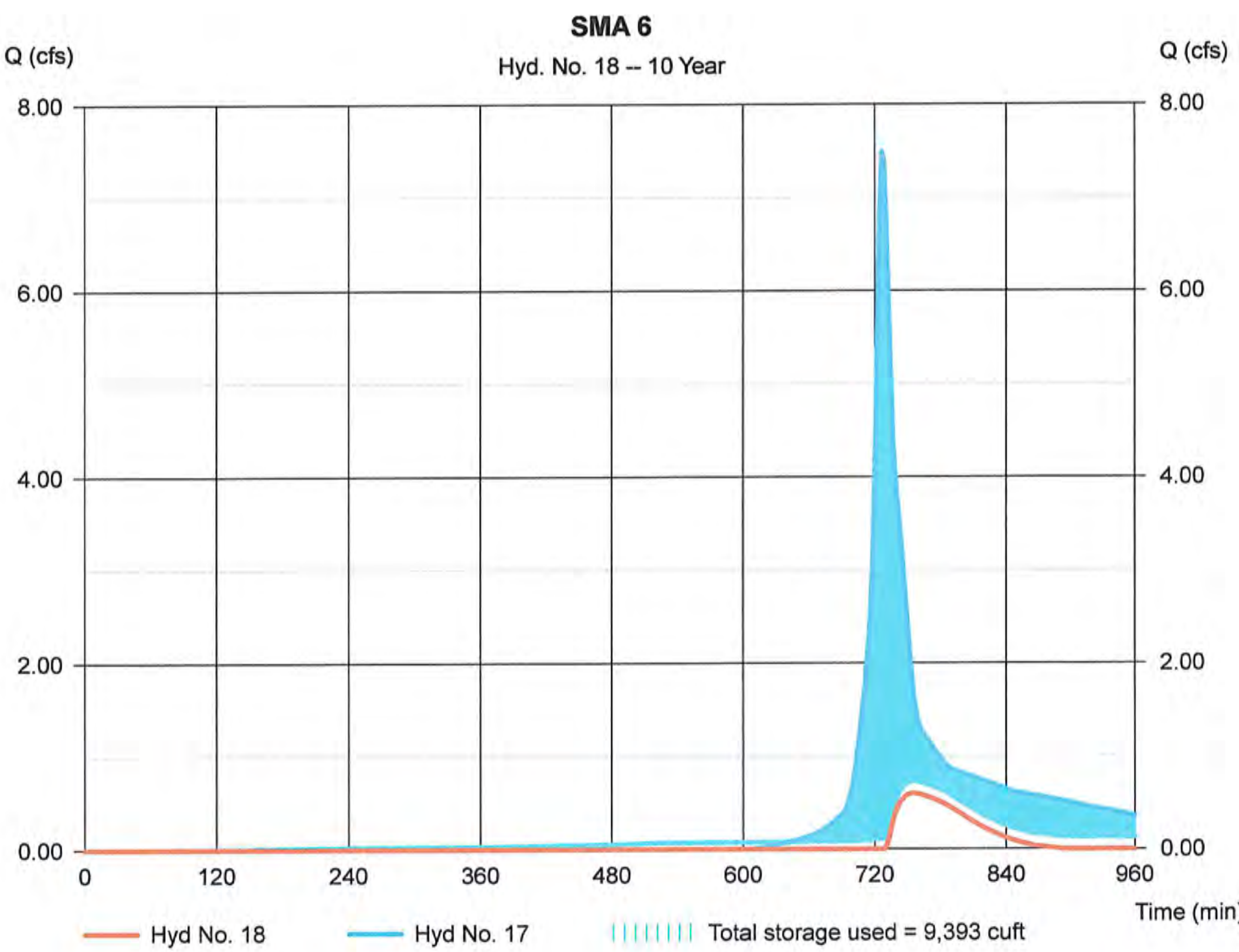
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 18

SMA 6

Hydrograph type	= Reservoir	Peak discharge	= 0.600 cfs
Storm frequency	= 10 yrs	Time to peak	= 754 min
Time interval	= 2 min	Hyd. volume	= 2,705 cuft
Inflow hyd. No.	= 17 - PIG	Max. Elevation	= 320.66 ft
Reservoir name	= SMA 6	Max. Storage	= 9,393 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

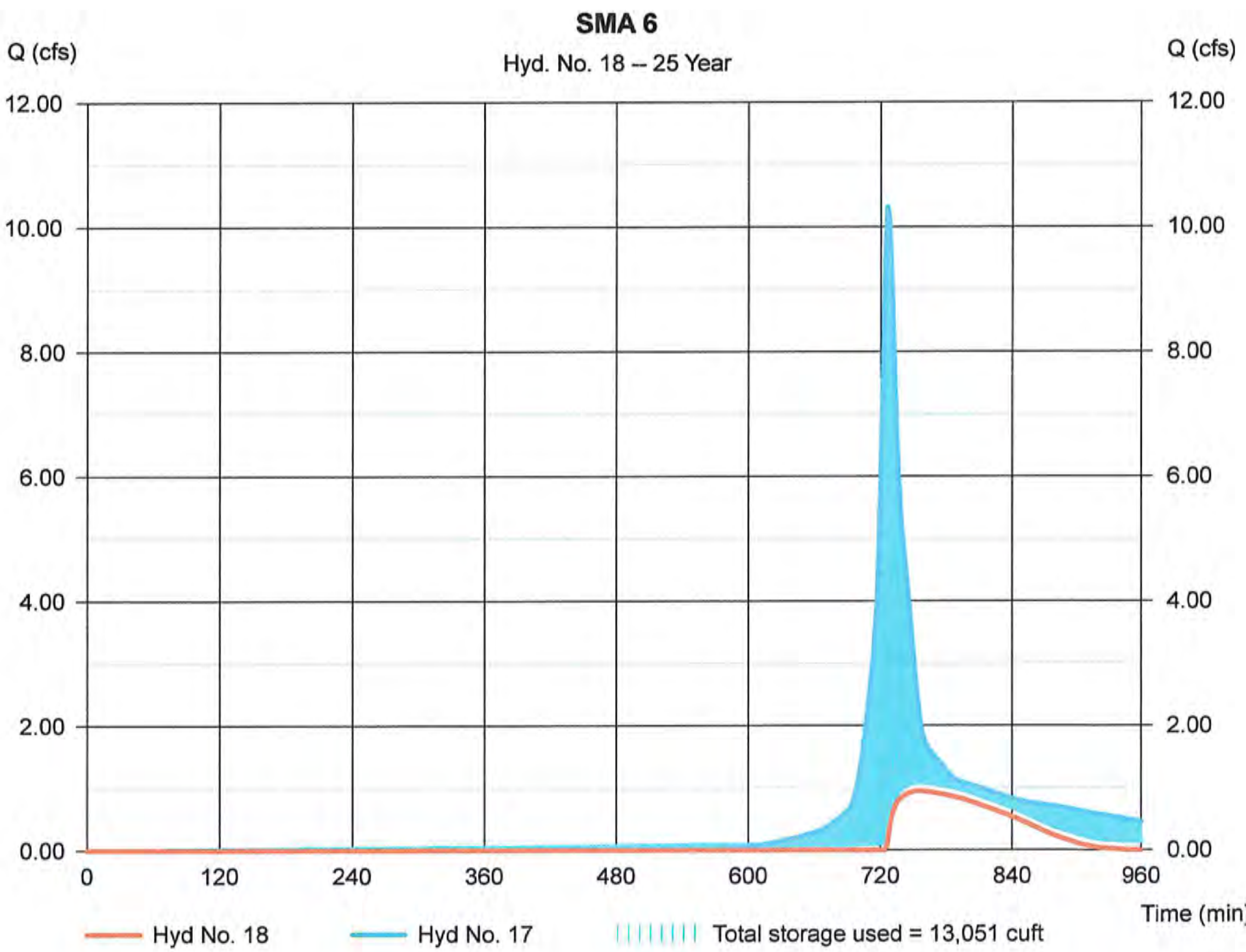
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 18

SMA 6

Hydrograph type	= Reservoir	Peak discharge	= 0.948 cfs
Storm frequency	= 25 yrs	Time to peak	= 754 min
Time interval	= 2 min	Hyd. volume	= 6,580 cuft
Inflow hyd. No.	= 17 - PIG	Max. Elevation	= 321.26 ft
Reservoir name	= SMA 6	Max. Storage	= 13,051 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

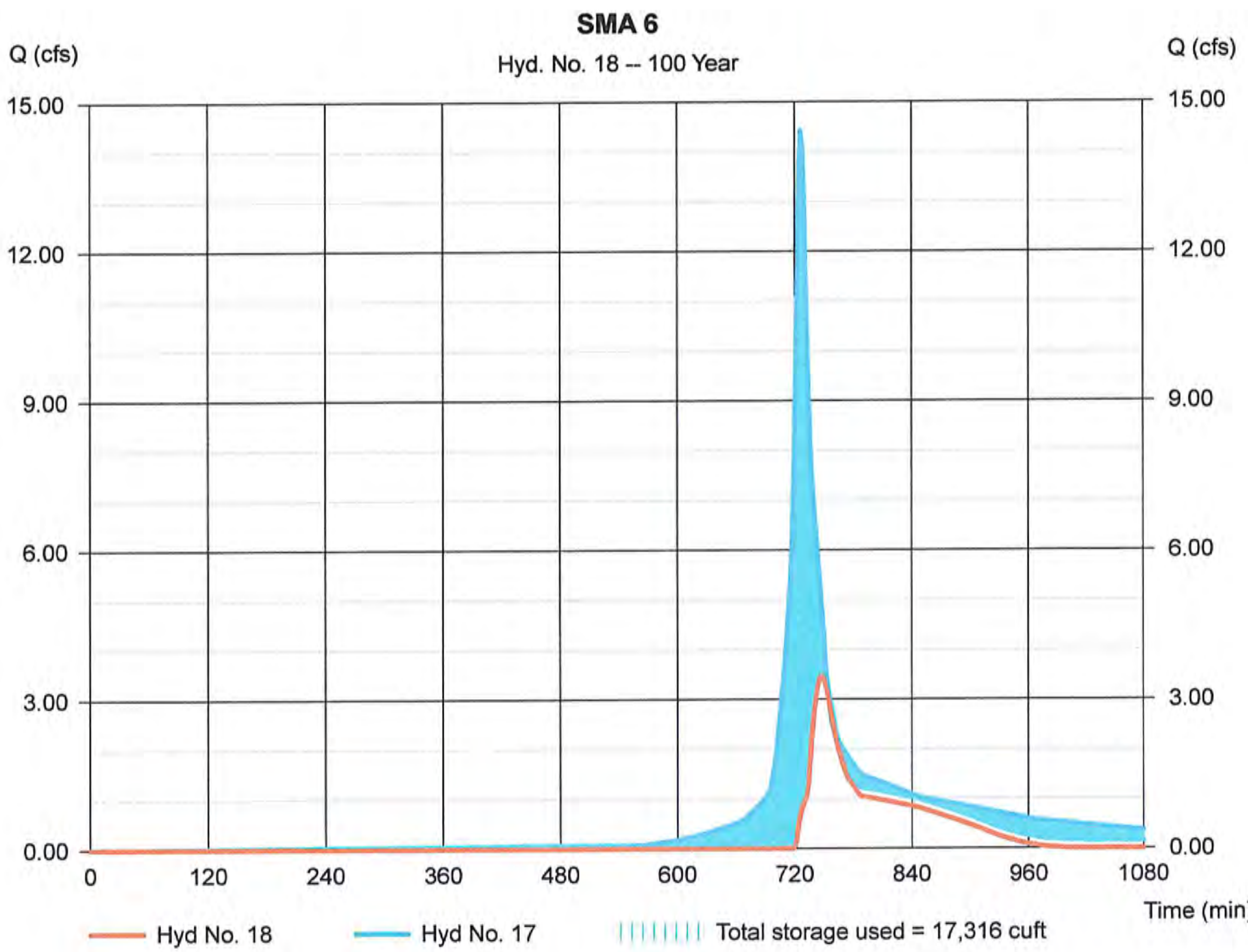
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 18

SMA 6

Hydrograph type	= Reservoir	Peak discharge	= 3.451 cfs
Storm frequency	= 100 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 14,089 cuft
Inflow hyd. No.	= 17 - PIG	Max. Elevation	= 321.86 ft
Reservoir name	= SMA 6	Max. Storage	= 17,316 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Pond No. 24 - SMA 6

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 318.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	318.00	2,004	0	0
1.00	319.00	2,762	2,373	2,373
2.00	320.00	4,340	3,521	5,894
3.00	321.00	6,415	5,343	11,237
4.00	322.00	7,764	7,078	18,315

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	6.00	0.00	0.00
Span (in)	= 12.00	6.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 318.00	320.00	0.00	0.00
Length (ft)	= 75.00	0.00	0.00	0.00
Slope (%)	= 0.50	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	Yes	No	No

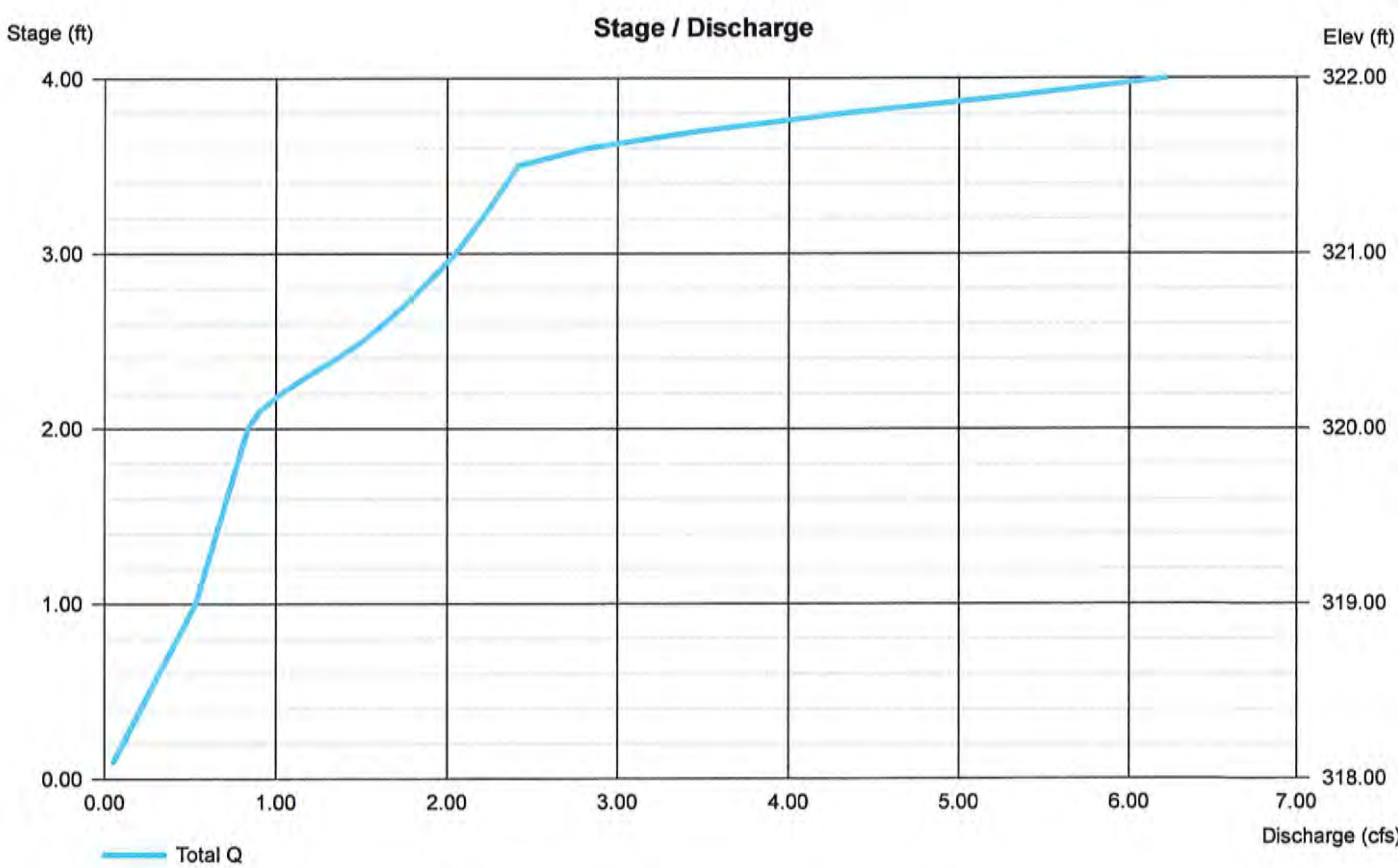
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	4.00	0.00	0.00
Crest El. (ft)	= 322.00	321.50	0.00	0.00
Weir Coeff.	= 3.33	2.60	3.33	3.33
Weir Type	= Riser	Broad	---	---
Multi-Stage	= Yes	Yes	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).



Worksheet 2: Runoff curve number and runoff SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked RJH Date 6/22/2017

Circle one: Present Developed Subcatchment P-1H

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			2.25	220.41
B	Woods- Good Condition	55			0.00	0.00
B	Open Space-Good Condition	61			1.60	97.71
A	Open Space-Good Condition	39			0.10	3.96
				172162.00 Totals =	3.95	322.07

1/ Use only one CN source per line.

CN (weighted) = total product / total area = 322.07 / 3.95 = 81.49 ; Use CN = 81.5

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	1.42	2.59	4.30
Runoff, Q	cf	20424	37173	61723

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

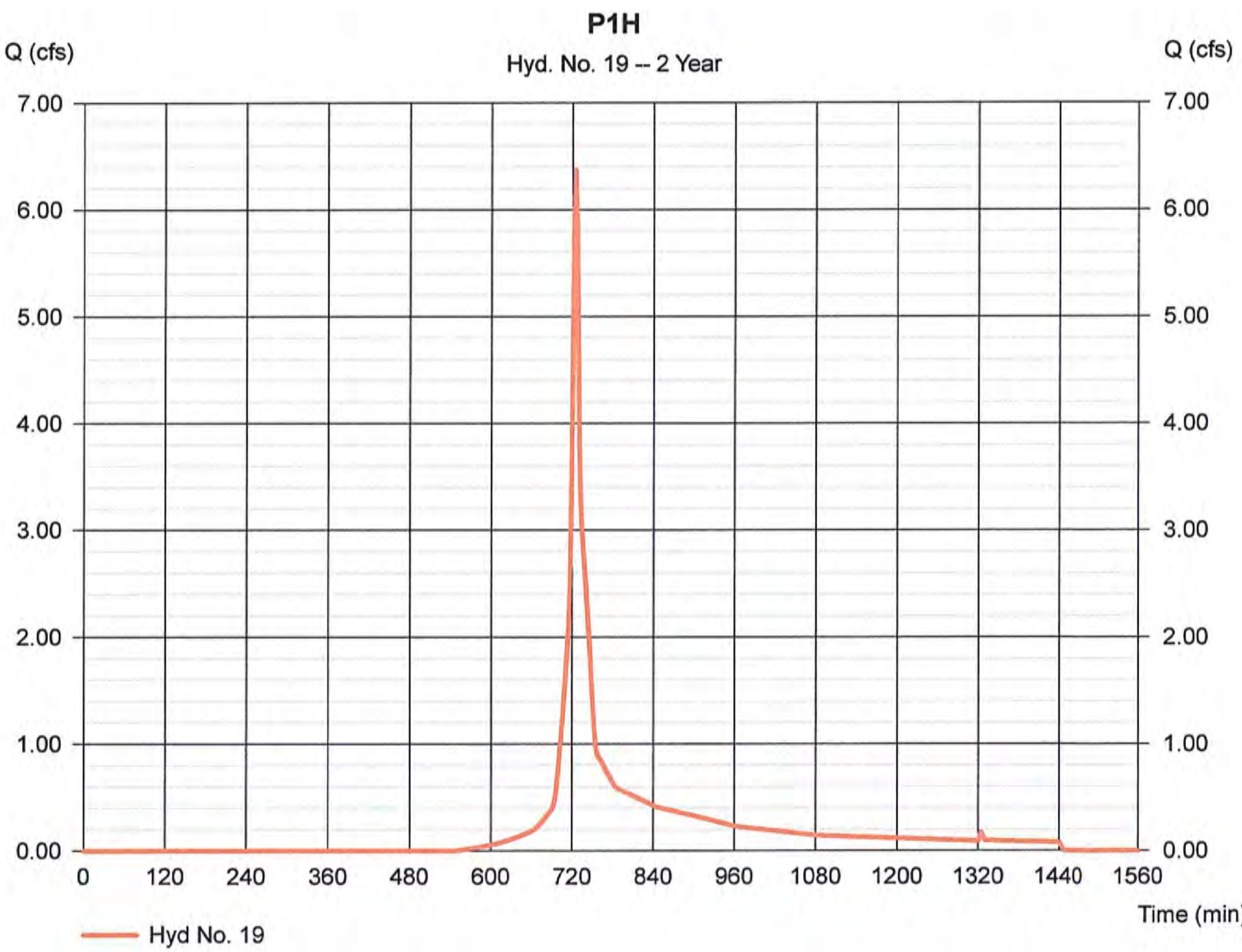
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 19

P1H

Hydrograph type	= SCS Runoff	Peak discharge	= 6.372 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 19,145 cuft
Drainage area	= 3.950 ac	Curve number	= 81.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

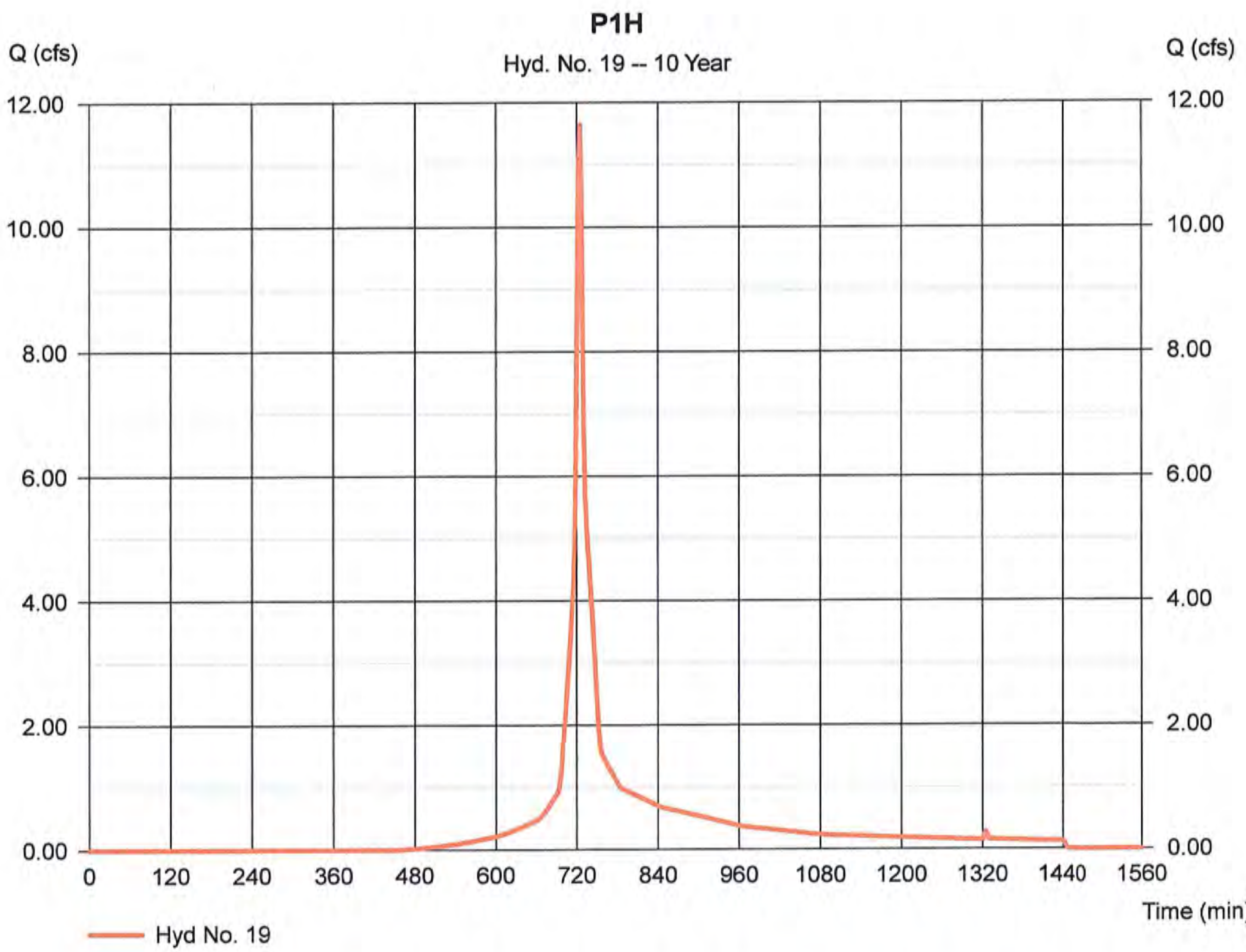


Hydrograph Report

Hyd. No. 19

P1H

Hydrograph type	= SCS Runoff	Peak discharge	= 11.65 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 34,841 cuft
Drainage area	= 3.950 ac	Curve number	= 81.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



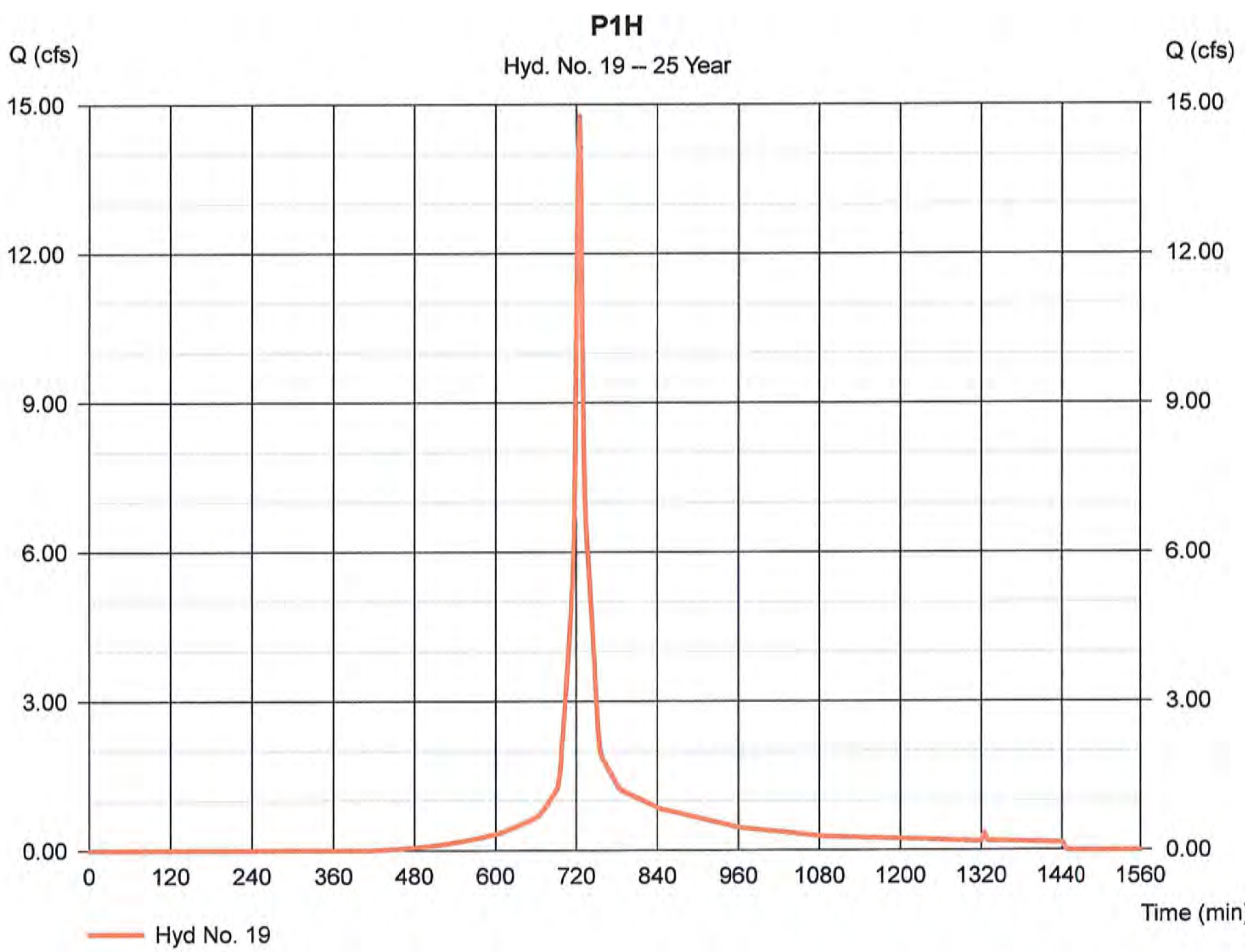
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 19

P1H

Hydrograph type	= SCS Runoff	Peak discharge	= 14.77 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 44,362 cuft
Drainage area	= 3.950 ac	Curve number	= 81.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

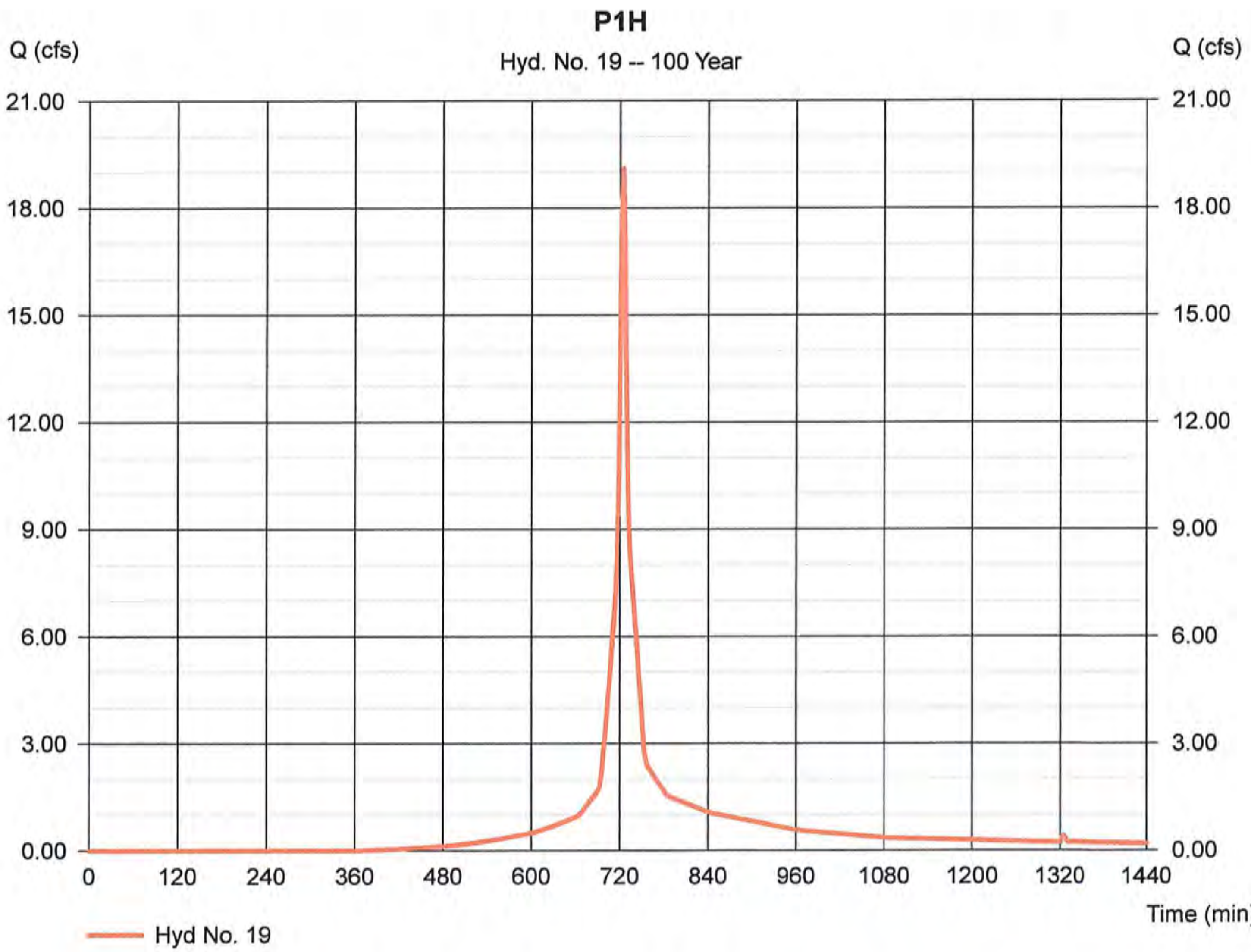


Hydrograph Report

Hyd. No. 19

P1H

Hydrograph type	= SCS Runoff	Peak discharge	= 19.11 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 57,845 cuft
Drainage area	= 3.950 ac	Curve number	= 81.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Pond No. 5 - SMA 7

Pond Data

UG Chambers - Invert elev. = 311.00 ft, Rise x Span = 5.00 x 8.33 ft, Barrel Len = 101.13 ft, No. Barrels = 6, Slope = 0.00%, Headers = No
Encasement - Invert elev. = 310.00 ft, Width = 9.08 ft, Height = 7.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	310.00	n/a	0	0
0.70	310.70	n/a	1,543	1,543
1.40	311.40	n/a	2,755	4,298
2.10	312.10	n/a	3,640	7,938
2.80	312.80	n/a	3,573	11,512
3.50	313.50	n/a	3,458	14,969
4.20	314.20	n/a	3,284	18,254
4.90	314.90	n/a	3,033	21,287
5.60	315.60	n/a	2,649	23,936
6.30	316.30	n/a	1,863	25,799
7.00	317.00	n/a	1,543	27,342

Culvert / Orifice Structures

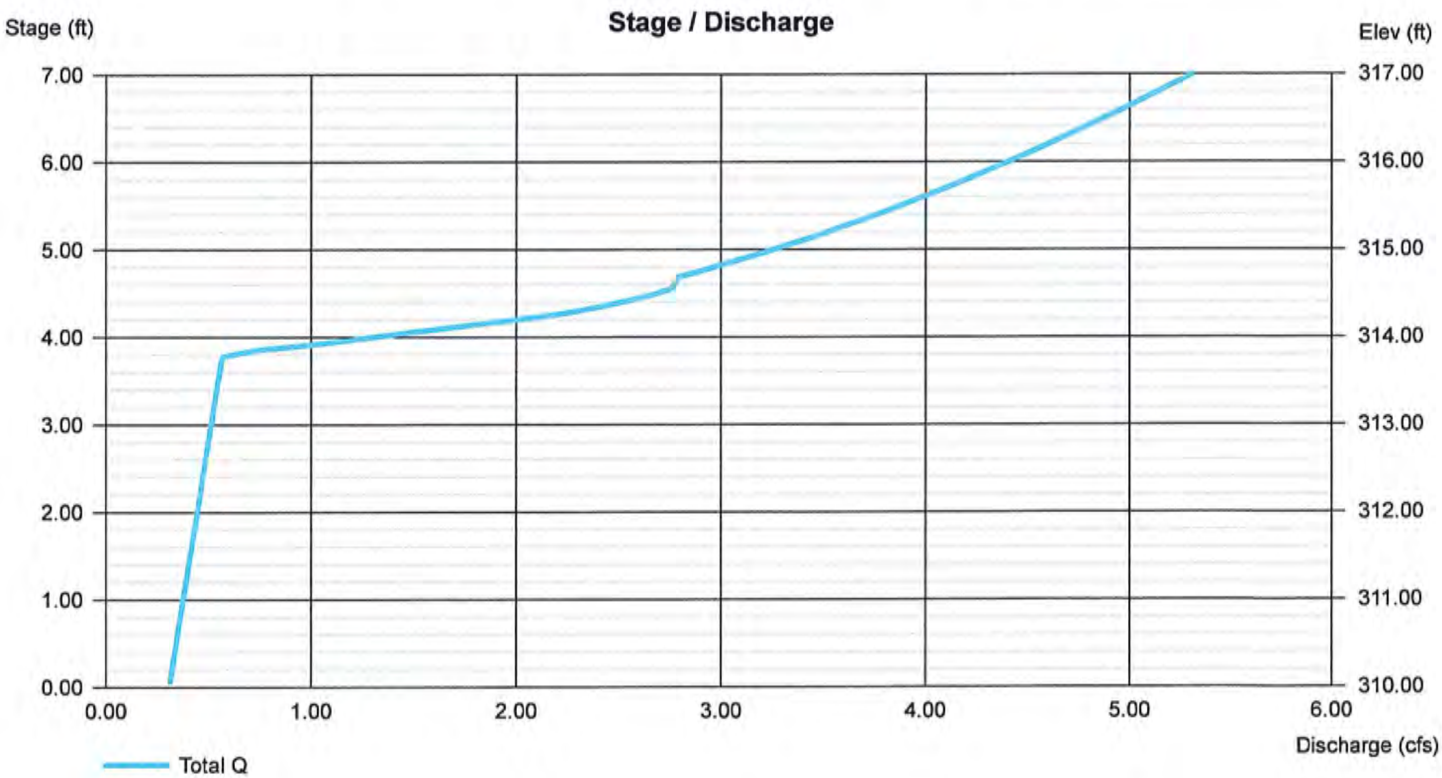
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	6.00	0.00	0.00
Span (in)	= 12.00	6.00	0.00	0.00
No. Barrels	= 1	6	0	0
Invert El. (ft)	= 313.50	313.76	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	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) = 2.410 (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

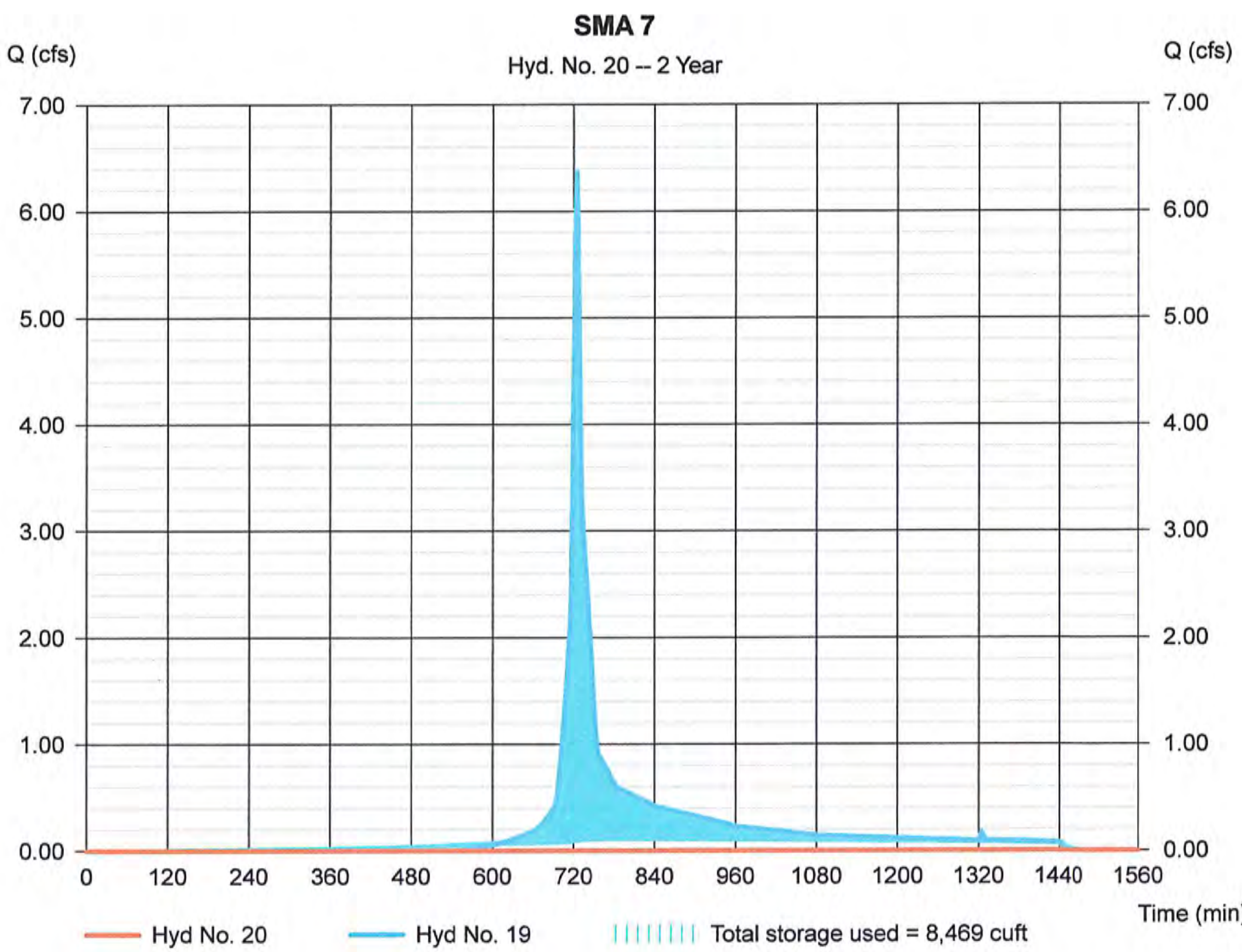
Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 20

SMA 7

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 644 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 19 - P1H	Max. Elevation	= 312.20 ft
Reservoir name	= SMA 7	Max. Storage	= 8,469 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

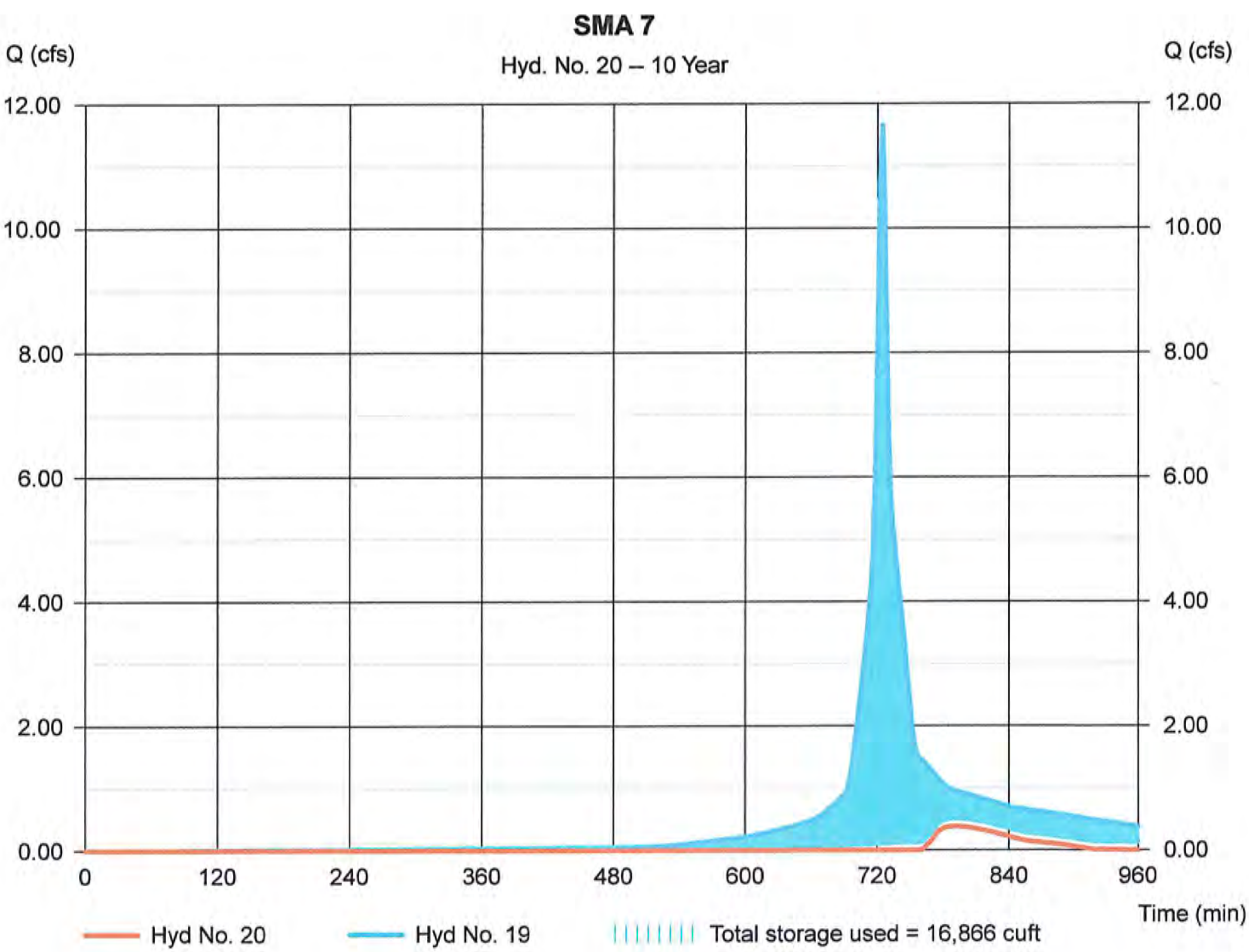
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 20

SMA 7

Hydrograph type	= Reservoir	Peak discharge	= 0.382 cfs
Storm frequency	= 10 yrs	Time to peak	= 792 min
Time interval	= 2 min	Hyd. volume	= 1,919 cuft
Inflow hyd. No.	= 19 - P1H	Max. Elevation	= 313.90 ft
Reservoir name	= SMA 7	Max. Storage	= 16,866 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

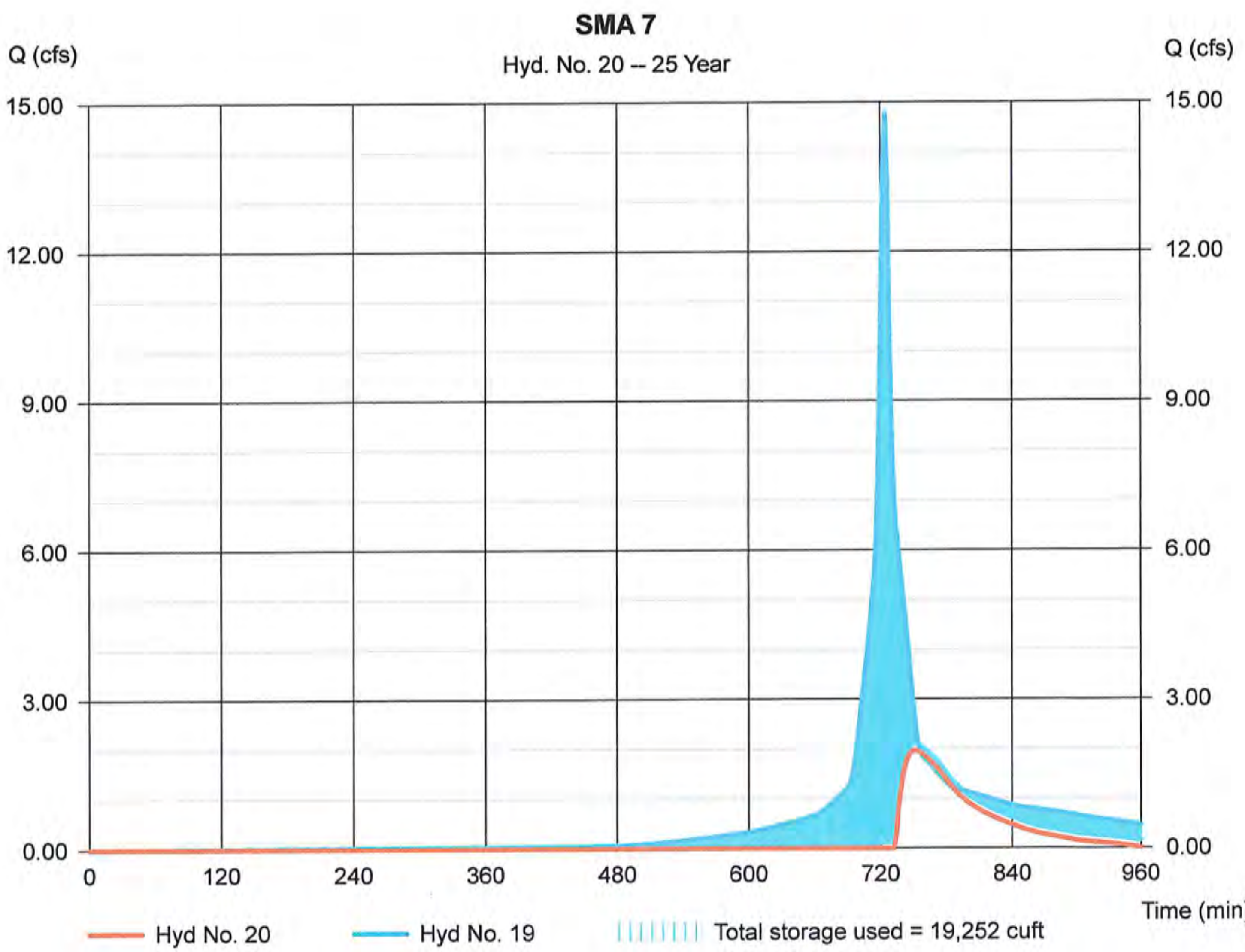
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 20

SMA 7

Hydrograph type	= Reservoir	Peak discharge	= 1.967 cfs
Storm frequency	= 25 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 8,826 cuft
Inflow hyd. No.	= 19 - P1H	Max. Elevation	= 314.43 ft
Reservoir name	= SMA 7	Max. Storage	= 19,252 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

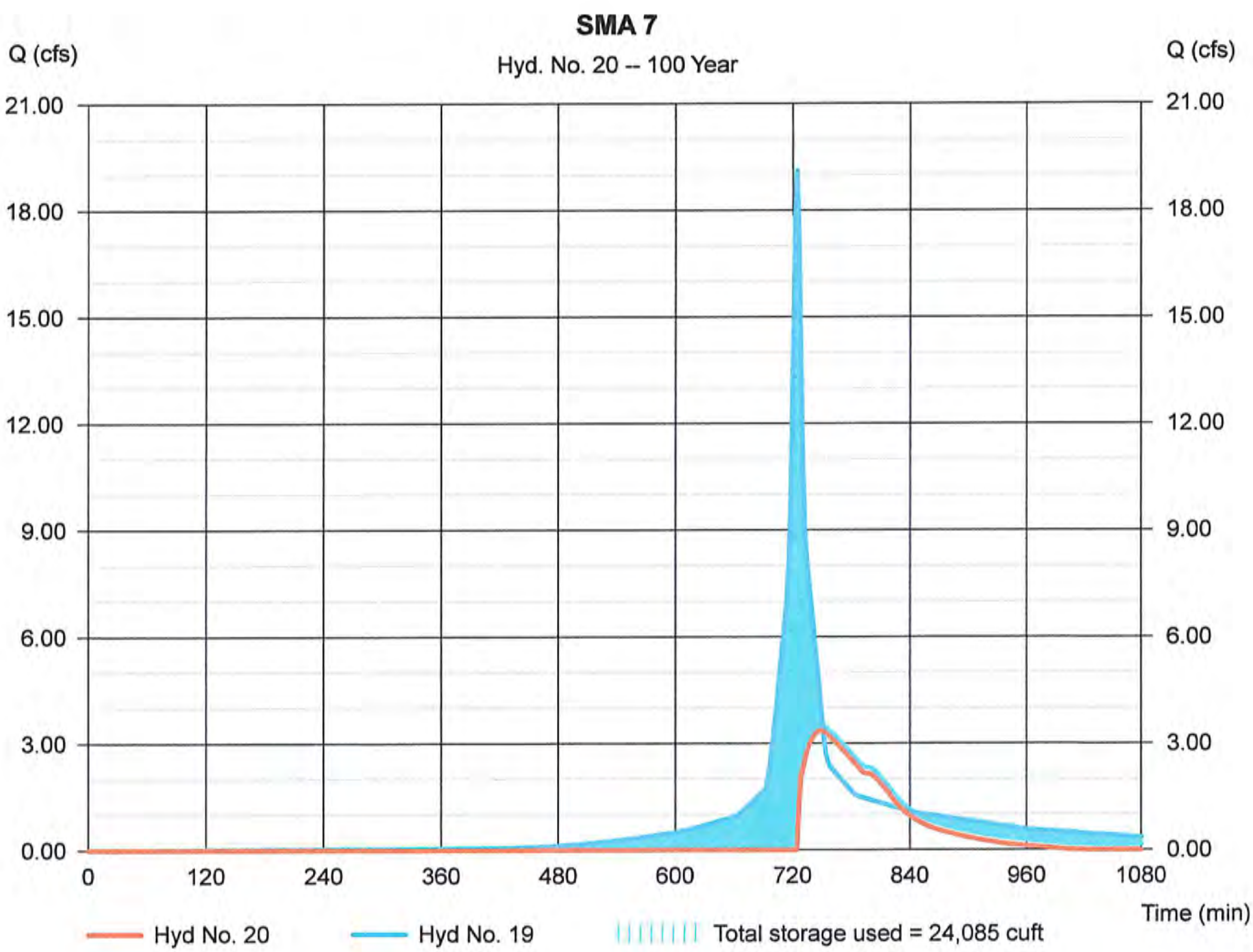
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 20

SMA 7

Hydrograph type	= Reservoir	Peak discharge	= 3.358 cfs
Storm frequency	= 100 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 19,048 cuft
Inflow hyd. No.	= 19 - P1H	Max. Elevation	= 315.66 ft
Reservoir name	= SMA 7	Max. Storage	= 24,085 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Worksheet 2: Runoff curve number and runoff **SM-2069**

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked RJH Date 6/22/2017

Circle one: Present Developed Subcatchment P-1I

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
-	Impervious	98			1.45	141.96
B	Woods- Good Condition	55			0.00	0.00
B	Open Space-Good Condition	61			2.14	130.48
A	Open Space-Good Condition	39			0.56	21.75
				180571.00 Totals =	4.15	294.19

1/ Use only one CN source per line.

CN (weighted) = total product / total area = 294.19 / 4.15 = 70.97 ; Use CN = 71.0

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	0.82	1.74	3.22
Runoff, Q..	cf	12295	26245	48471

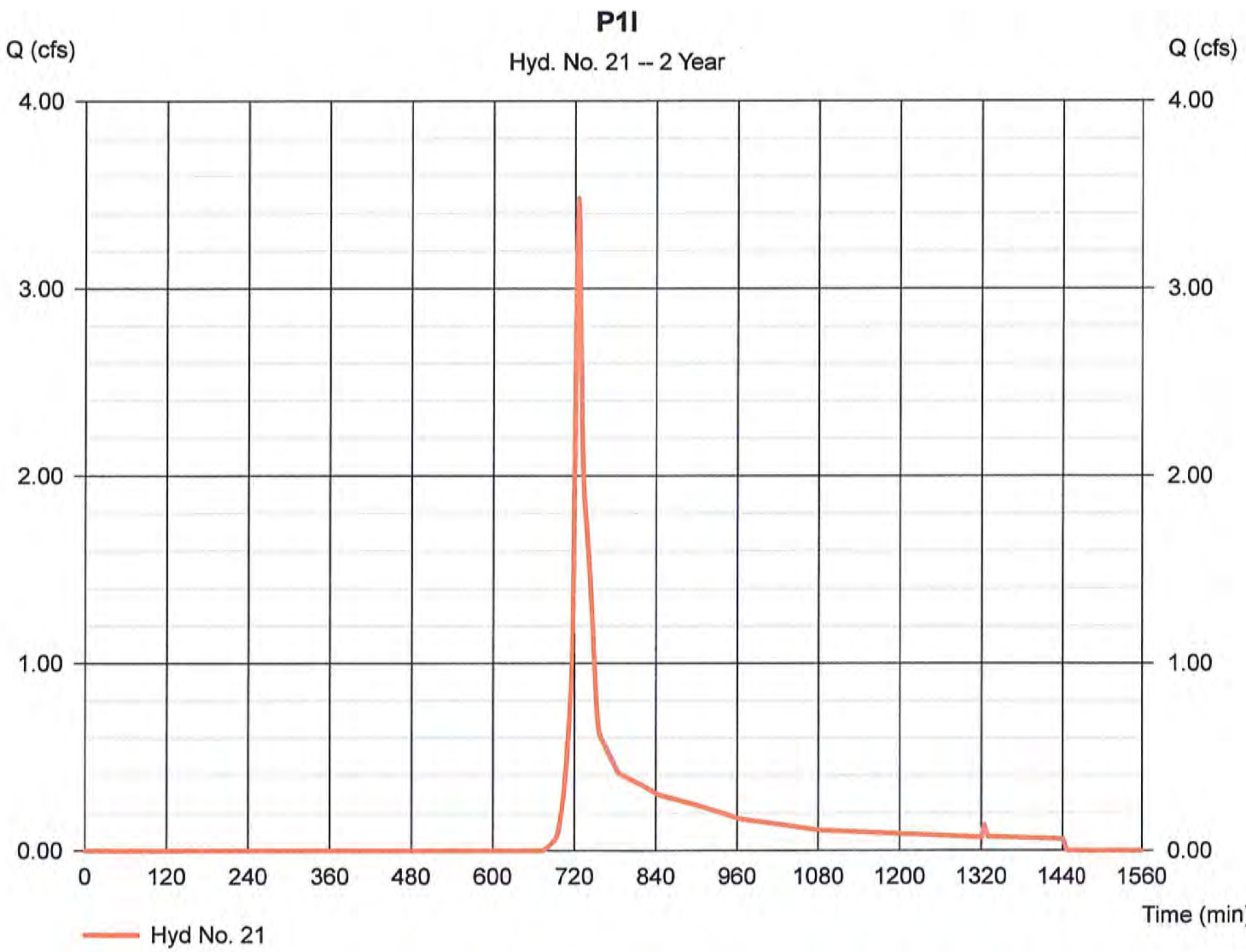
D-2 (210-VI-TR-55, Second Ed., June 1986)

Hydrograph Report

Hyd. No. 21

P1I

Hydrograph type	= SCS Runoff	Peak discharge	= 3.481 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 11,561 cuft
Drainage area	= 4.150 ac	Curve number	= 71
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



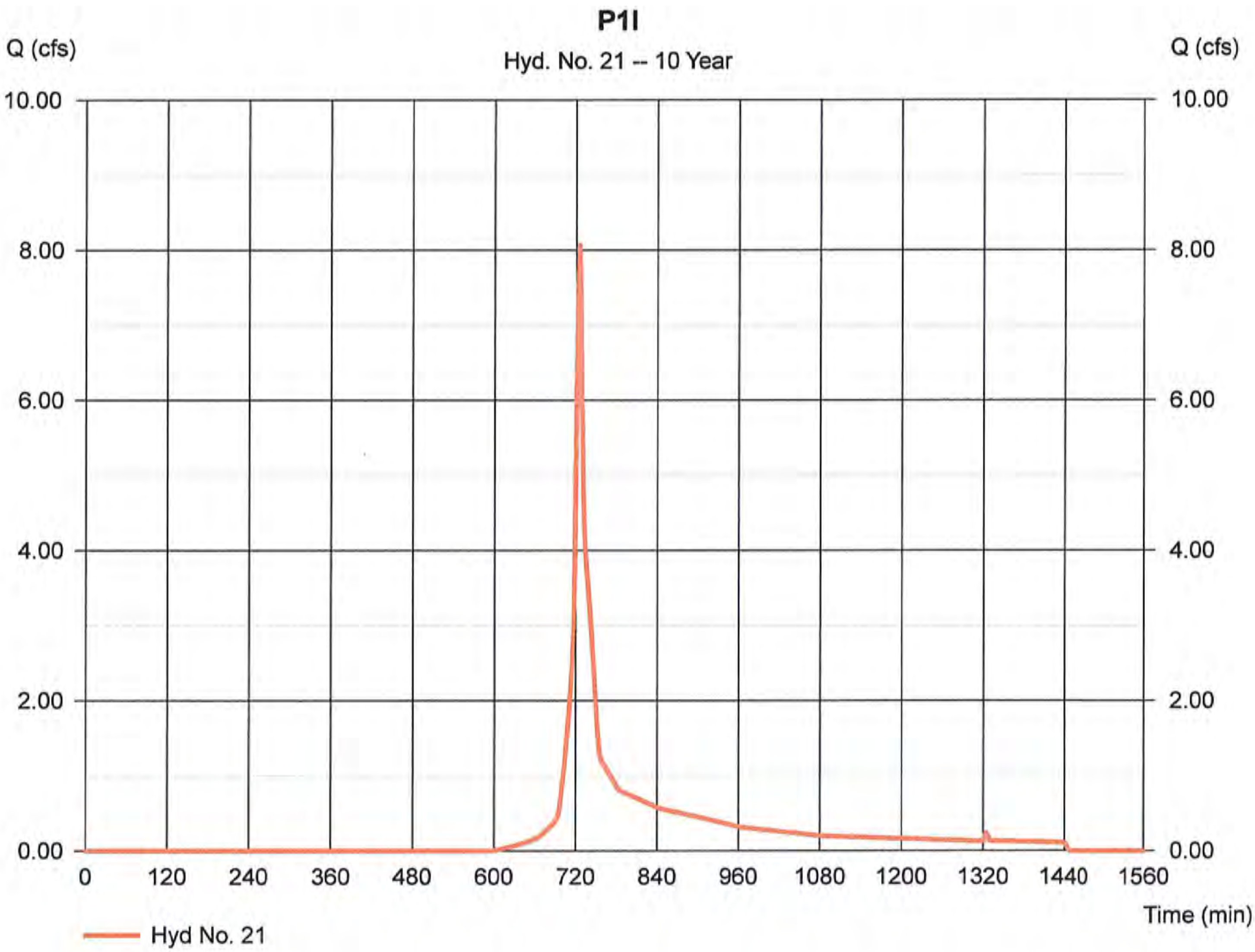
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 21

P1I

Hydrograph type	= SCS Runoff	Peak discharge	= 8.073 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 24,664 cuft
Drainage area	= 4.150 ac	Curve number	= 71
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

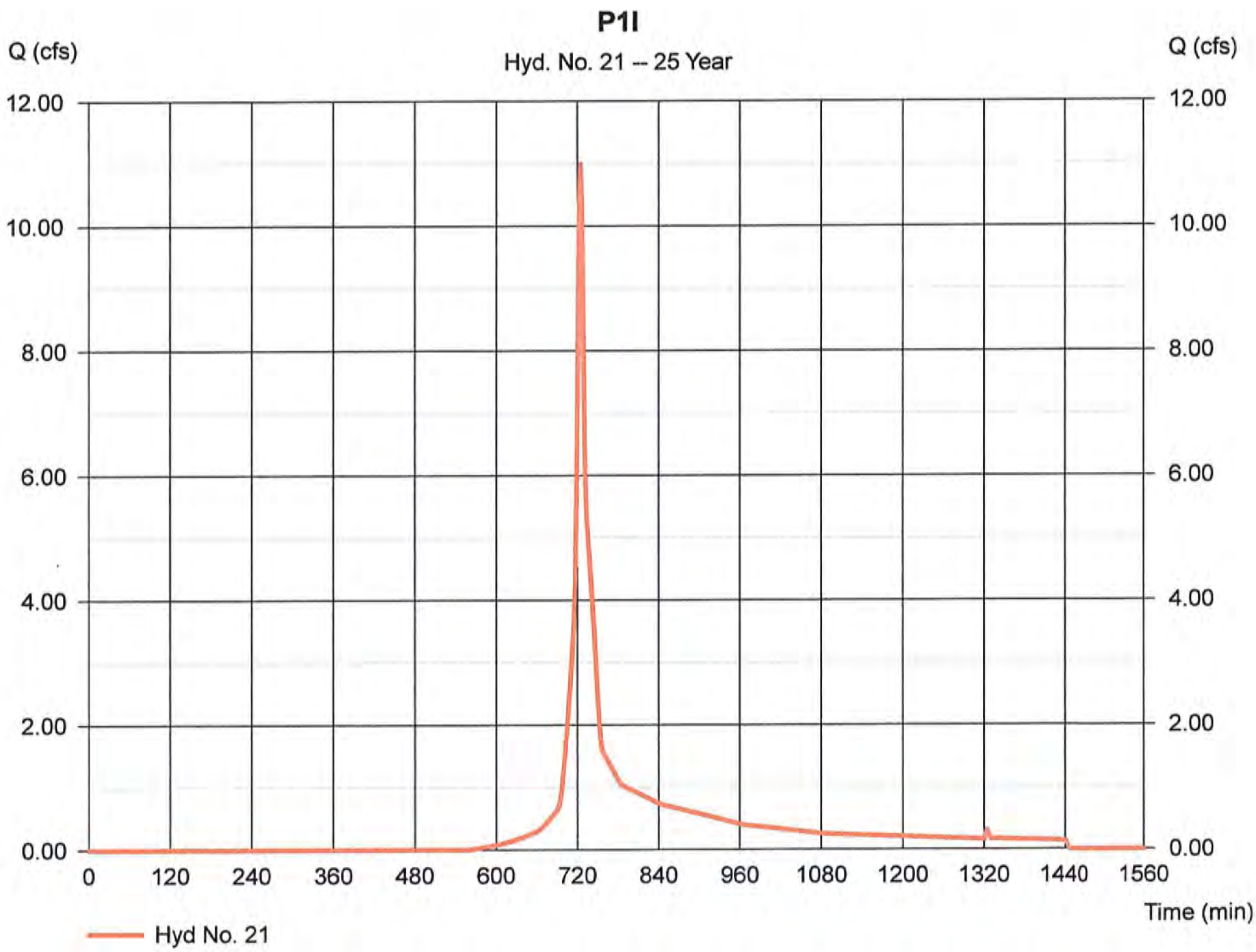
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 21

P1I

Hydrograph type	= SCS Runoff	Peak discharge	= 11.00 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 33,130 cuft
Drainage area	= 4.150 ac	Curve number	= 71
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



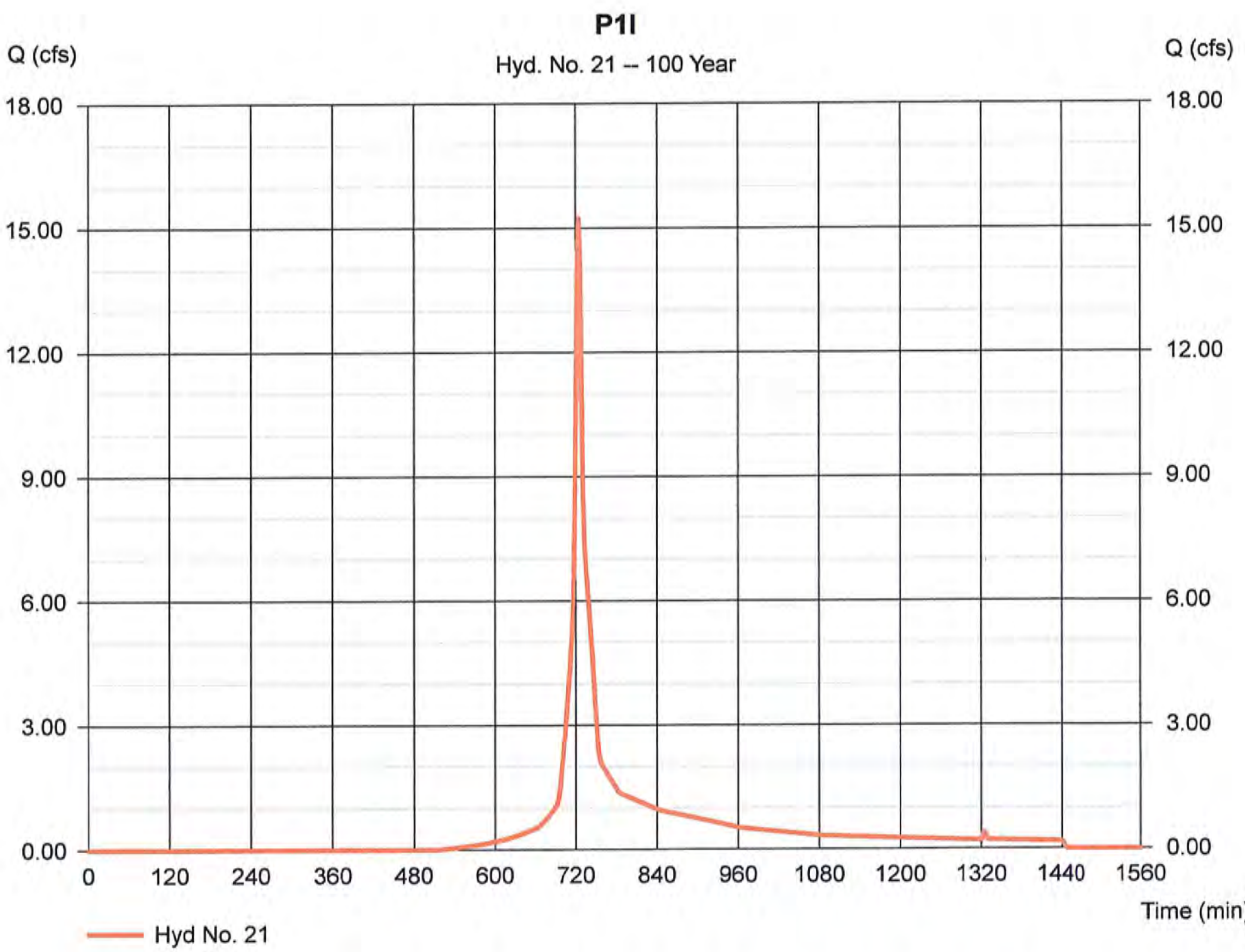
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 21

P1I

Hydrograph type	= SCS Runoff	Peak discharge	= 15.22 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 45,536 cuft
Drainage area	= 4.150 ac	Curve number	= 71
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

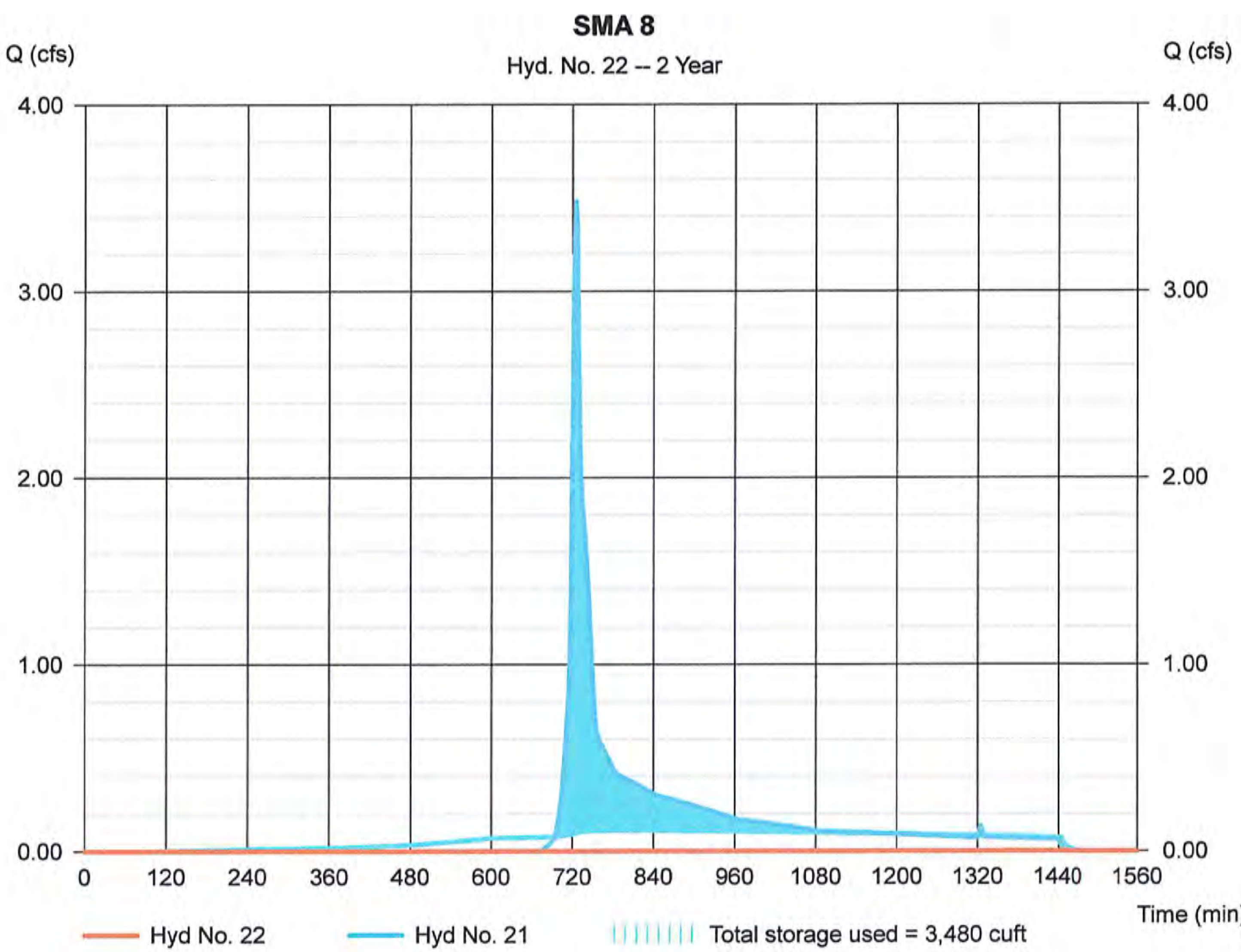
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 22

SMA 8

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 21 - P1I	Max. Elevation	= 312.59 ft
Reservoir name	= SMA 8	Max. Storage	= 3,480 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

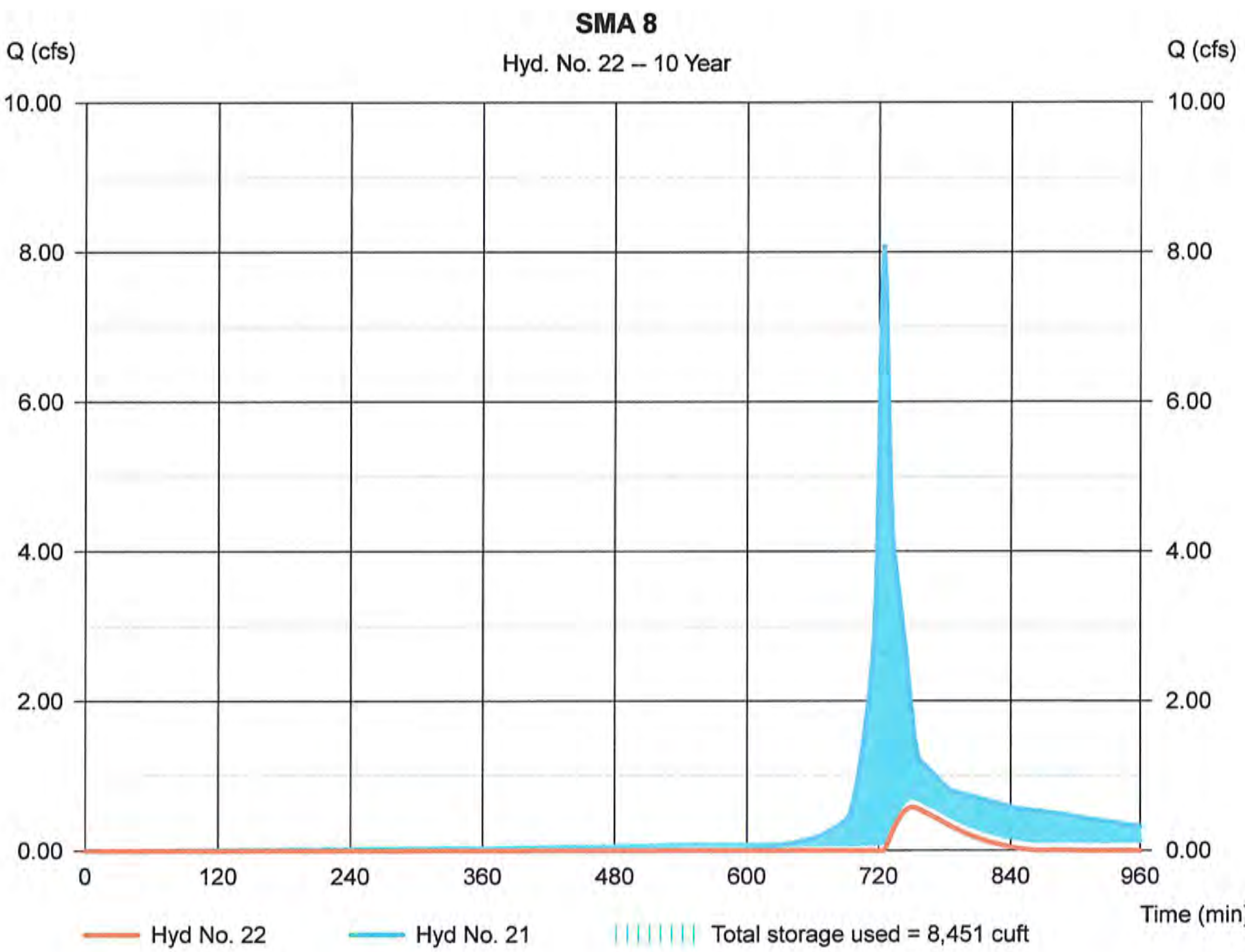
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 22

SMA 8

Hydrograph type	= Reservoir	Peak discharge	= 0.579 cfs
Storm frequency	= 10 yrs	Time to peak	= 750 min
Time interval	= 2 min	Hyd. volume	= 2,102 cuft
Inflow hyd. No.	= 21 - P1I	Max. Elevation	= 313.59 ft
Reservoir name	= SMA 8	Max. Storage	= 8,451 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

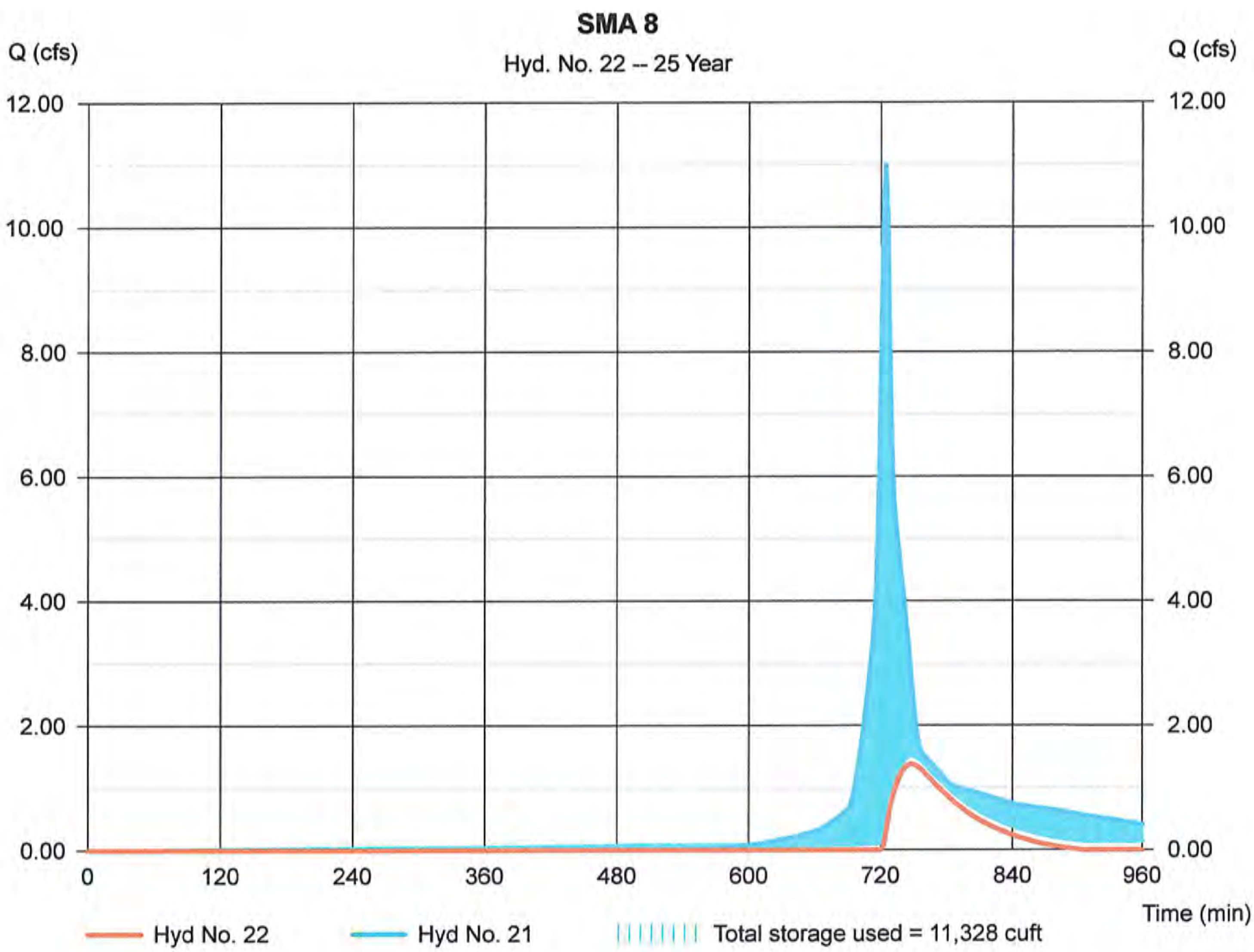
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 22

SMA 8

Hydrograph type	= Reservoir	Peak discharge	= 1.379 cfs
Storm frequency	= 25 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 5,896 cuft
Inflow hyd. No.	= 21 - P1I	Max. Elevation	= 314.06 ft
Reservoir name	= SMA 8	Max. Storage	= 11,328 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

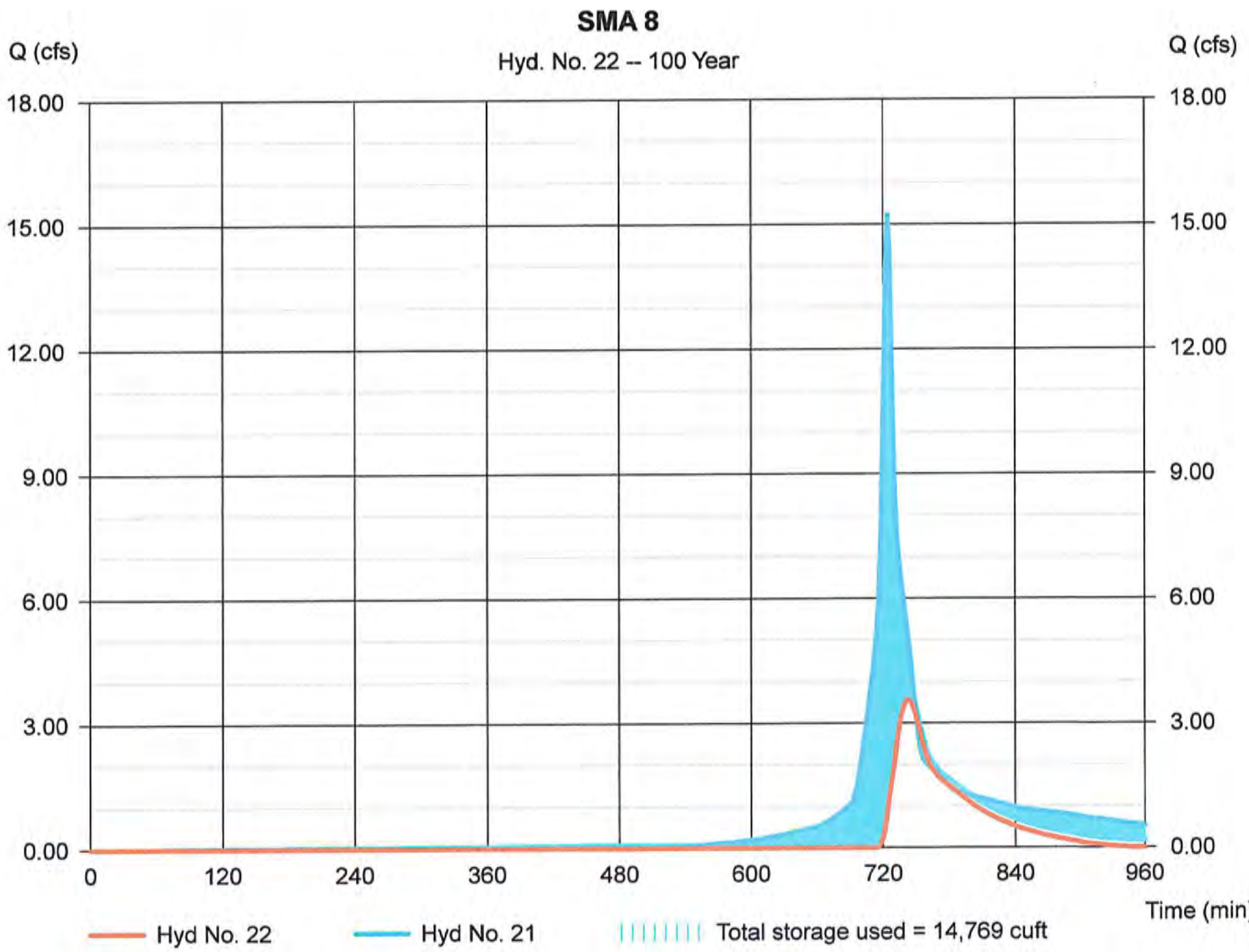
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 22

SMA 8

Hydrograph type	= Reservoir	Peak discharge	= 3.552 cfs
Storm frequency	= 100 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 12,762 cuft
Inflow hyd. No.	= 21 - P1I	Max. Elevation	= 314.51 ft
Reservoir name	= SMA 8	Max. Storage	= 14,769 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Pond No. 25 - SMA 8

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 311.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	311.00	1,042	0	0
1.00	312.00	1,938	1,467	1,467
2.00	313.00	5,216	3,444	4,911
3.00	314.00	6,750	5,966	10,877
4.00	315.00	8,706	7,707	18,583

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 310.00	0.00	0.00	0.00
Length (ft)	= 25.00	0.00	0.00	0.00
Slope (%)	= 3.00	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

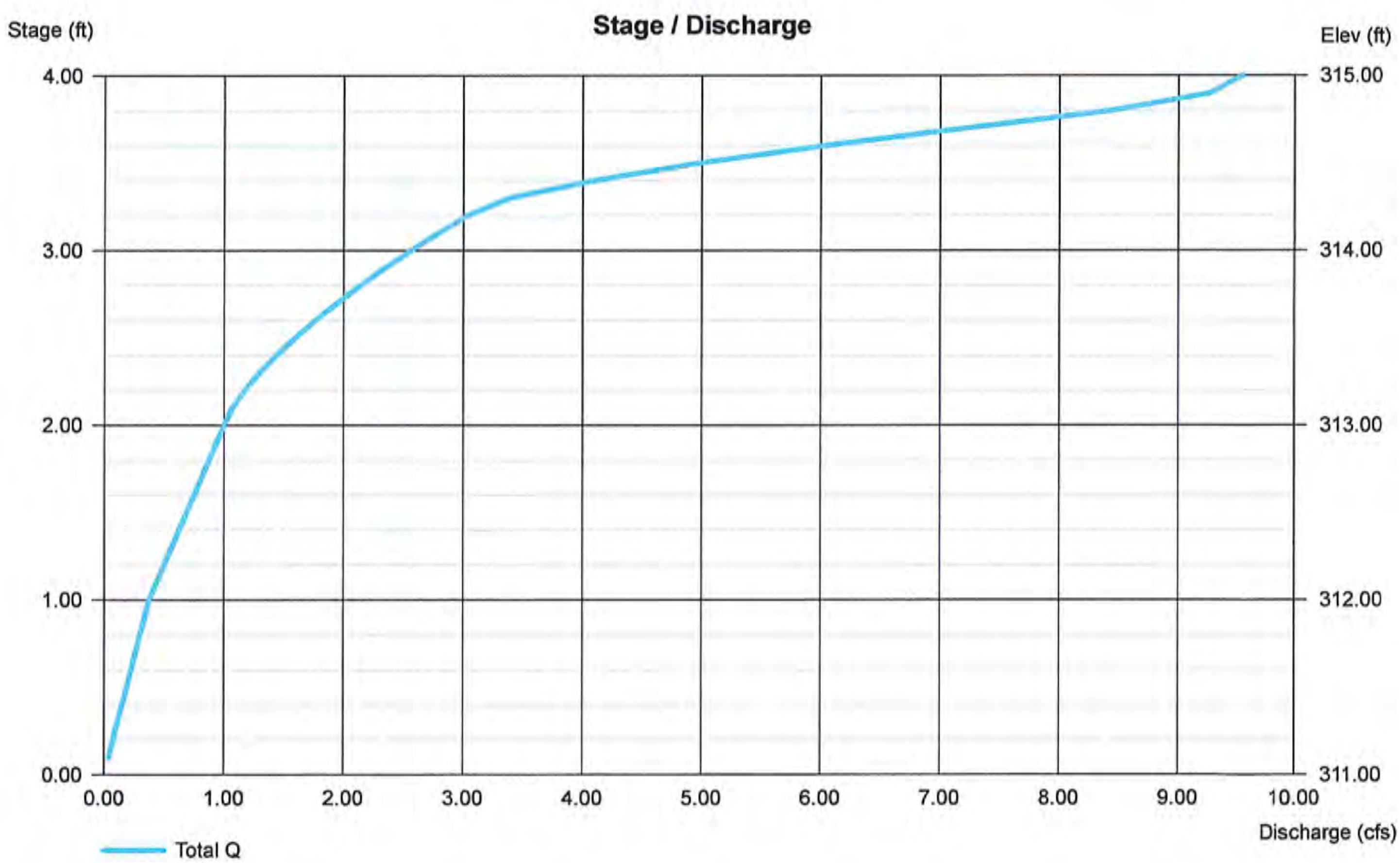
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	0.38	3.62	0.00
Crest El. (ft)	= 314.75	313.00	314.25	0.00
Weir Coeff.	= 3.33	3.33	2.60	3.33
Weir Type	= Riser	Rect	Broad	---
Multi-Stage	= Yes	Yes	Yes	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).



Worksheet 2: Runoff curve number and runoff **SM-2069**

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked ______ Date ______

Circle one: Present Developed Subcatchment P-3

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/			Area	Product of CN x Area
		Table 2-2	Fig. 2-3	Fig. 2-4	Acres	
B	Woods- Good Condition	55			0.73	40.05
B	Open- Good Condition	61			0.05	3.29
	Impervious	98			0.09	8.72
B	Brush-Good Condition	48			0.37	17.62
1/ Use only one CN source per line.				53929 Totals =	1.24	69.67

CN (weighted) = total product / total area = 69.67 / 1.24 = 56.28 ; Use CN = 56.3

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency..	yr	2	10	100
Rainfall, P (24-hour).........................	in	3.1	4.5	6.4
Runoff, Q... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.26	0.81	1.86
Runoff, Q...	cf	1153	3640	8366

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/2016

Location: Boxborough, MA Checked ______ Date ______

Circle one: Present **Developed** SubcatchmentP P-3

Circle one: **Tc** Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			GRASS			
2. Mannings roughness coeff., n (table 3-1)			0.6			
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	0.046			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.21			0.21

Shallow concentrated Flow		Segment ID	B-C	C-D		
7. Surface Description (paved or unpaved)			UNPAVED	PAVED		
8. Flow Length, L		ft	99	145		
9. Watercourse slope, s		ft/ft	0.098	0.055		
10. Average Velocity, V (figure 3-1)		ft/s	5.05	4.77		
11. Tt = L / 3600V	Compute Tt	hr	0.01	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				0.00

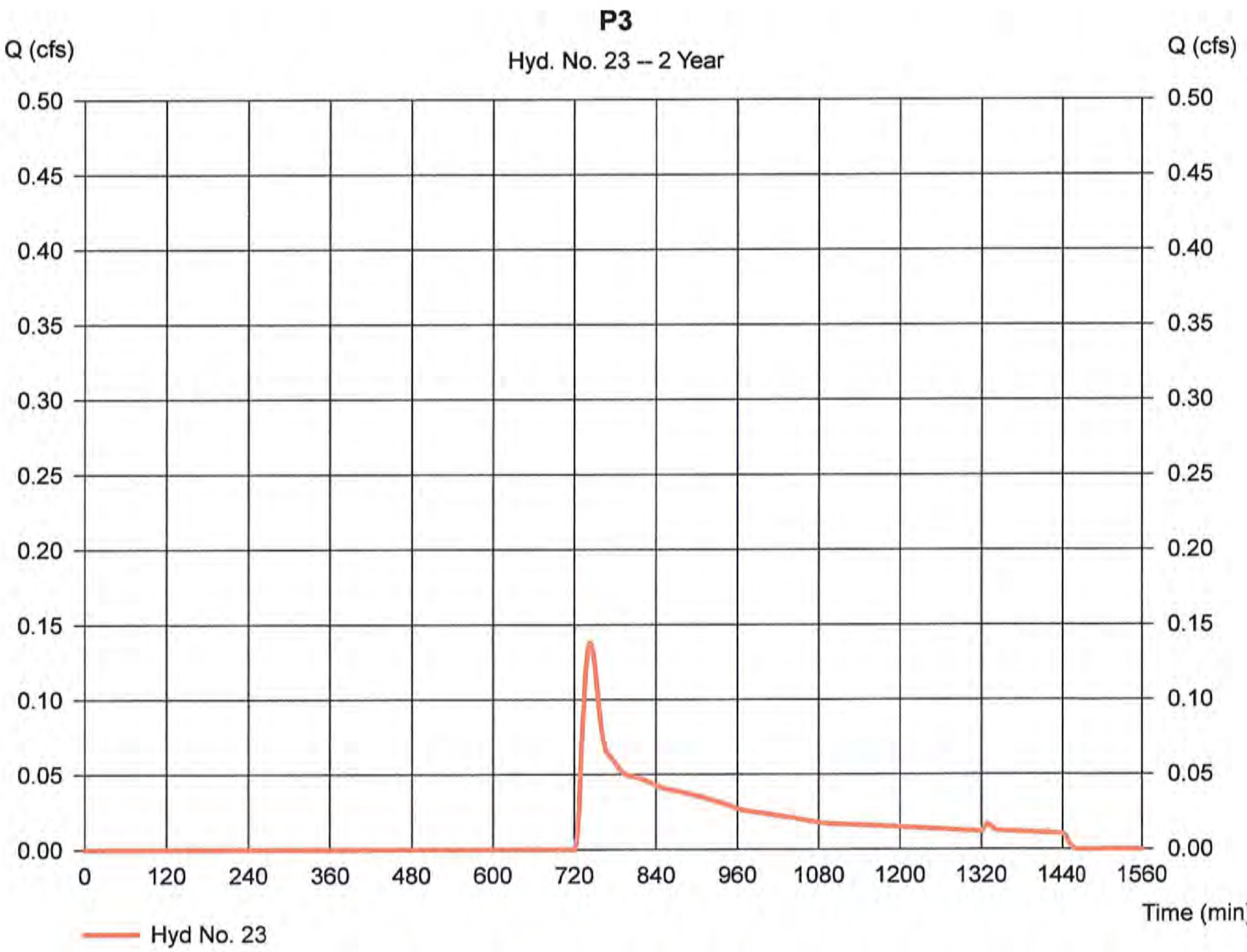
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.22 min 13.3

Hydrograph Report

Hyd. No. 23

P3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.138 cfs
Storm frequency	= 2 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 1,194 cuft
Drainage area	= 1.240 ac	Curve number	= 56.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 13.30 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

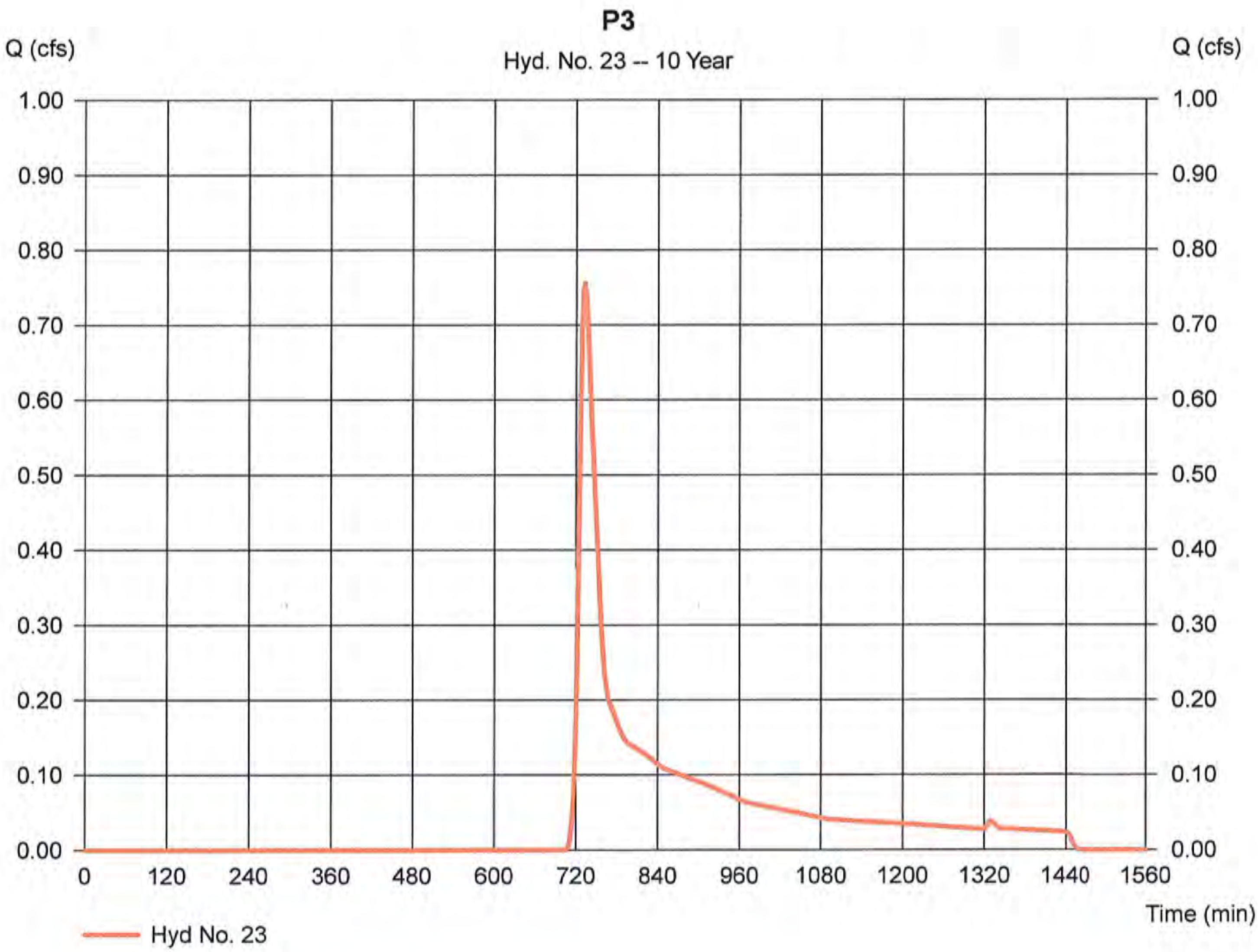
Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Jun 22, 2017

Hyd. No. 23

P3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.756 cfs
Storm frequency	= 10 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 3,766 cuft
Drainage area	= 1.240 ac	Curve number	= 56.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 13.30 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



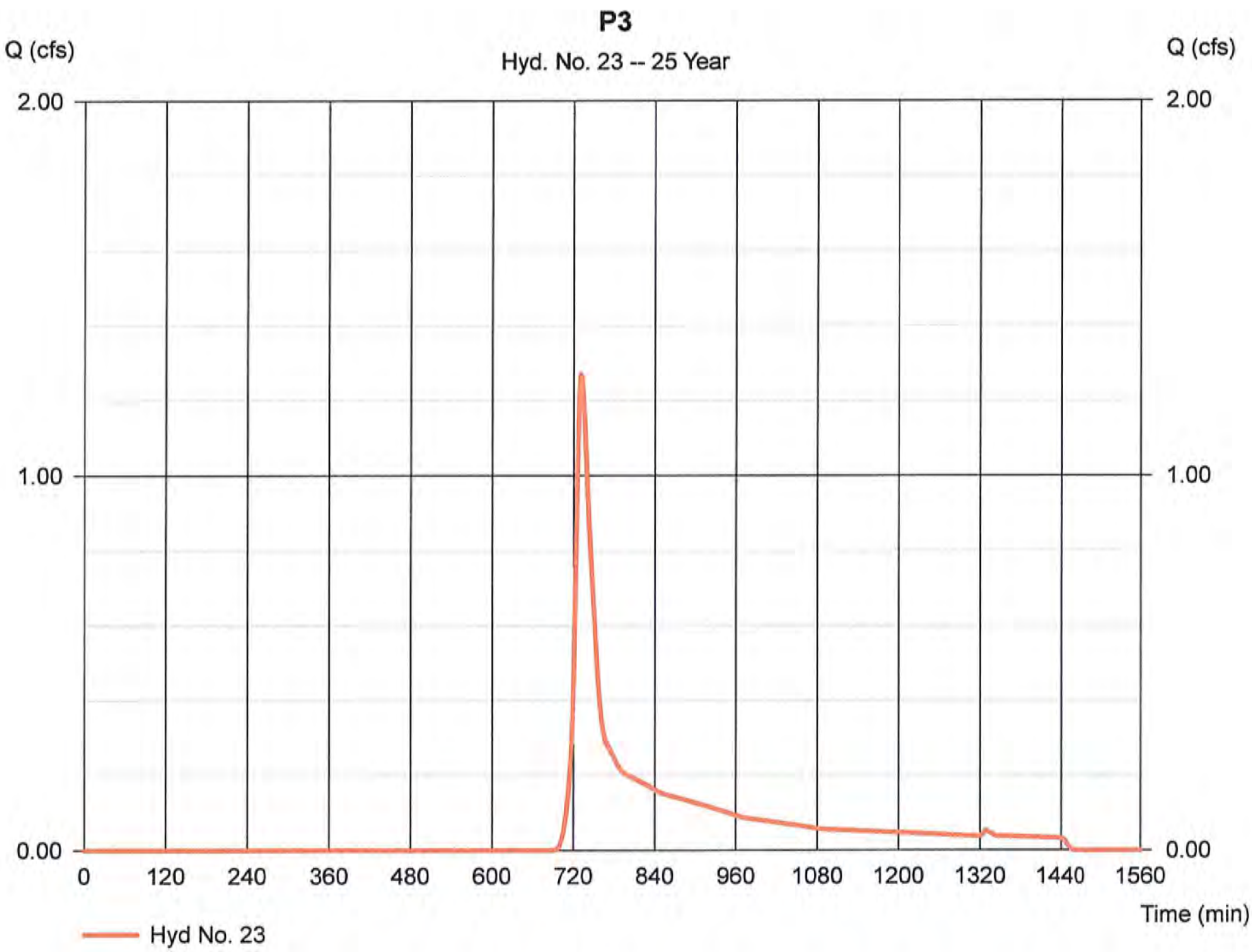
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 23

P3

Hydrograph type	= SCS Runoff	Peak discharge	= 1.271 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 5,664 cuft
Drainage area	= 1.240 ac	Curve number	= 56.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 13.30 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



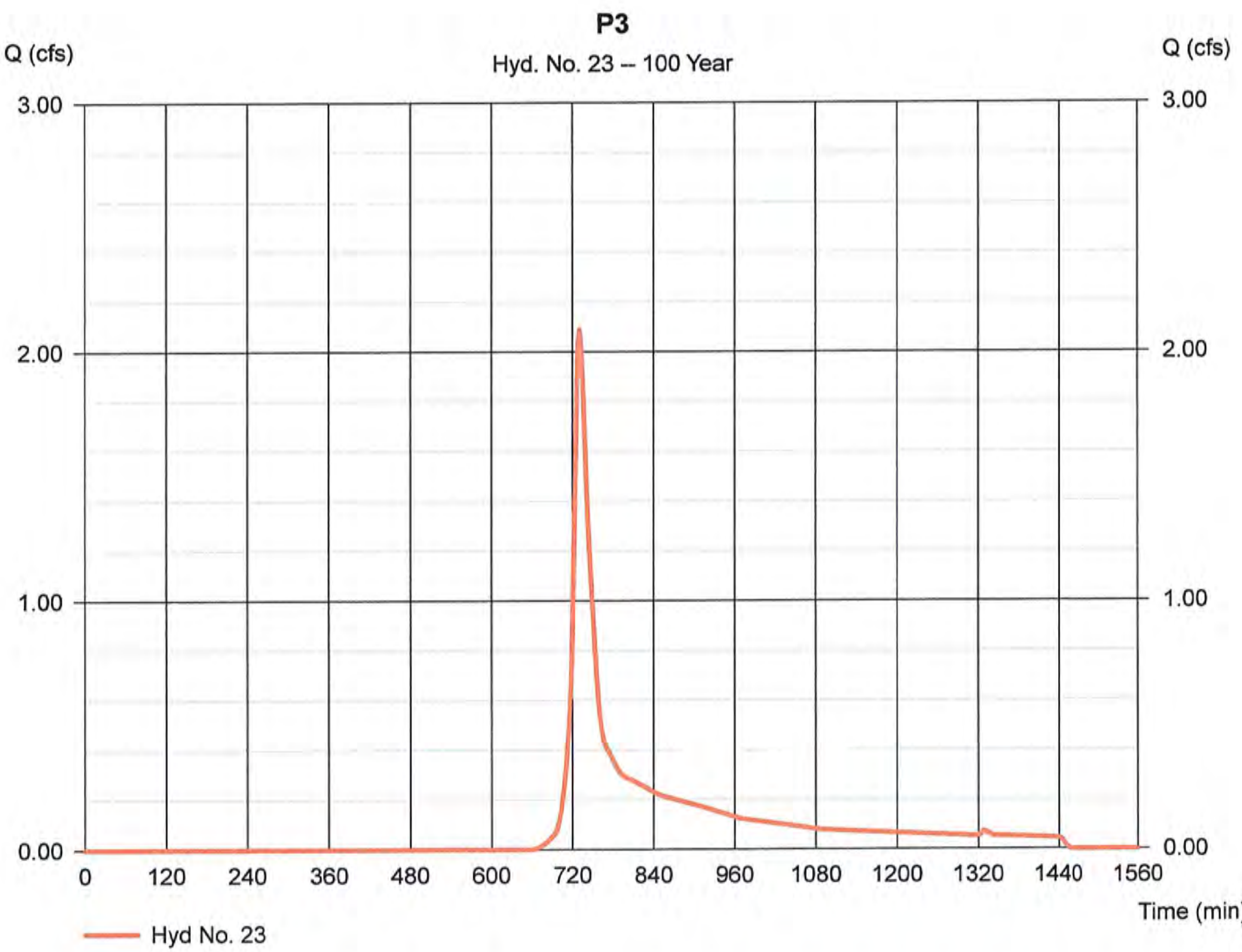
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 23

P3

Hydrograph type	= SCS Runoff	Peak discharge	= 2.089 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 8,651 cuft
Drainage area	= 1.240 ac	Curve number	= 56.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 13.30 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked ______ Date ______

Circle one: Present [Developed] Subcatchment P-4

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
B	Woods- Good Condition	55			0.19	10.50
B	Open- Good Condition	61			0.57	34.83
B	Impervious Roof	98			0.00	0.00
				33184.00 Totals =	0.76	45.32

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{45.32}{0.76}$ = 59.50 ; Use CN = 59.5

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	0.35	0.99	2.14
Runoff, Q......................................	cf	978	2739	5926

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-2069

Project: 700-800 Mass Ave By JTM Date 11/18/2016

Location: Boxborough, MA Checked ______ Date ______

Circle one: Present **Developed** SubcatchmentP P-4

Circle one: **Tc** Tt through subarea

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			WOODS			
2. Mannings roughness coeff., n (table 3-1)			0.6			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.1			
5. Land Slope, s		ft/ft	0.02			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.29			0.29

Shallow concentrated Flow		Segment ID	B-C			
7. Surface Description (paved or unpaved)			UNPAVED			
8. Flow Length, L		ft	26			
9. Watercourse slope, s		ft/ft	0.32			
10. Average Velocity, V (figure 3-1)		ft/s	9.13			
11. Tt = L / 3600V	Compute Tt	hr	0.00			0.00

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

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.29
min 17.4

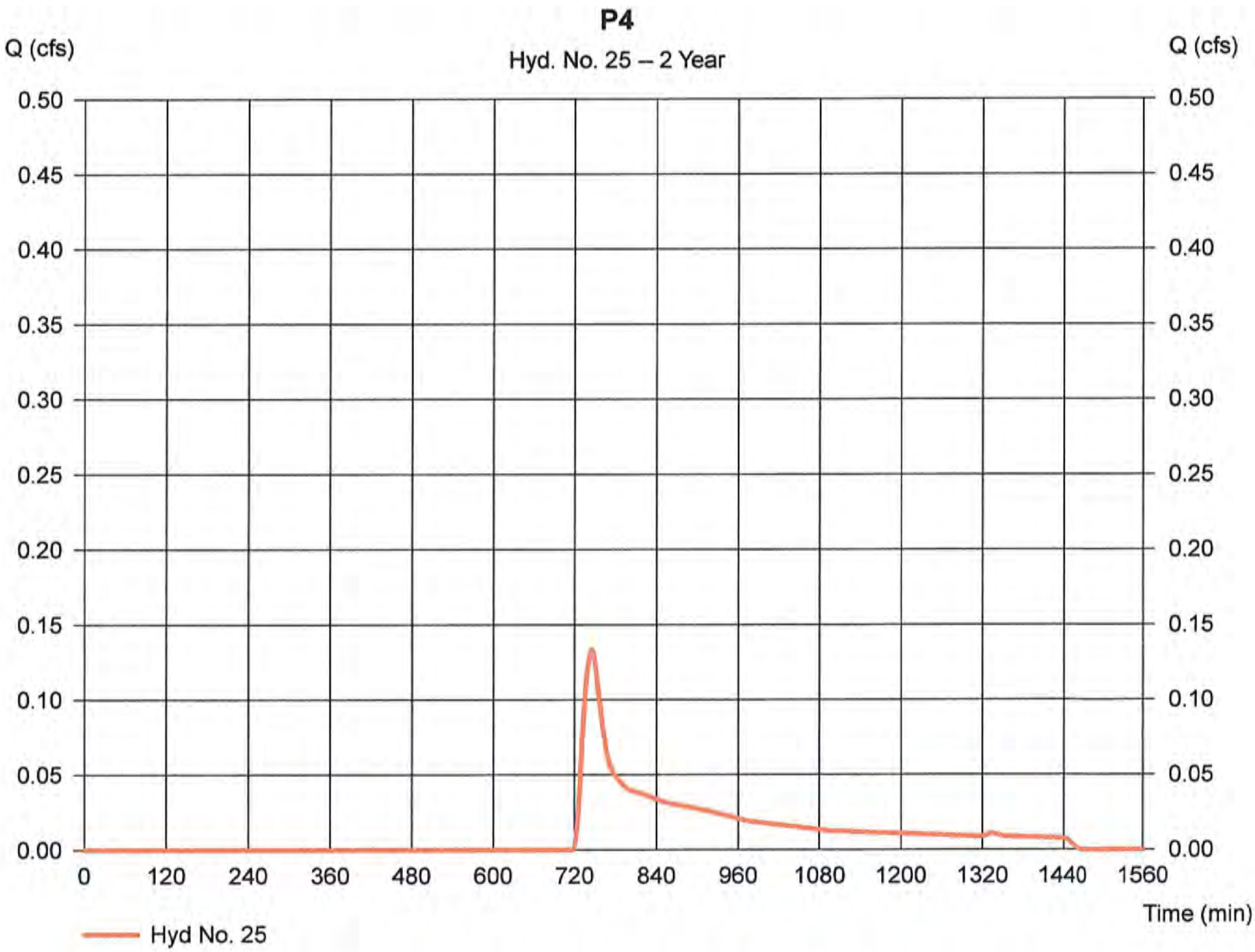
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 25

P4

Hydrograph type	= SCS Runoff	Peak discharge	= 0.133 cfs
Storm frequency	= 2 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 976 cuft
Drainage area	= 0.760 ac	Curve number	= 59.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.40 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

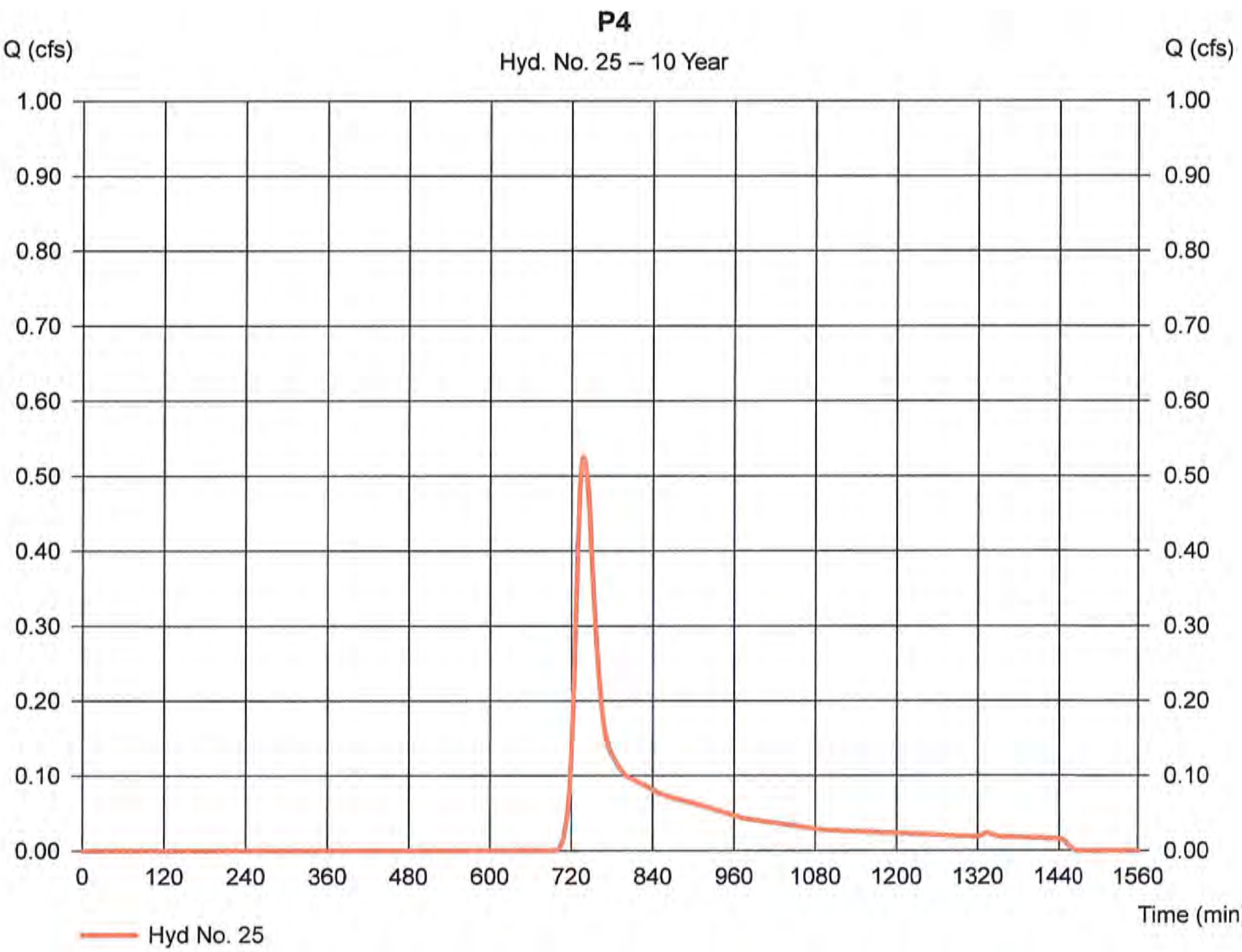


Hydrograph Report

Hyd. No. 25

P4

Hydrograph type	= SCS Runoff	Peak discharge	= 0.525 cfs
Storm frequency	= 10 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 2,733 cuft
Drainage area	= 0.760 ac	Curve number	= 59.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.40 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



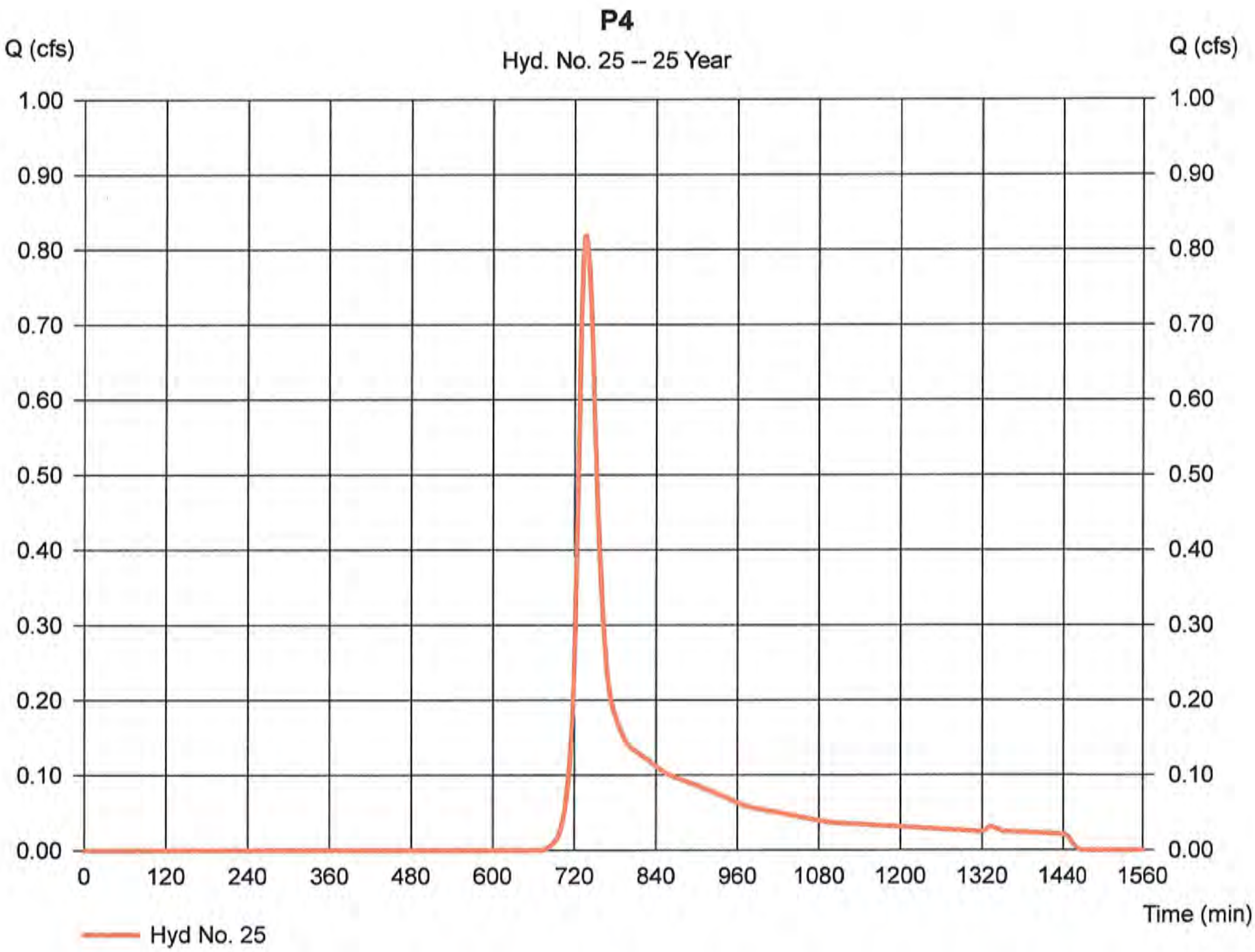
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 25

P4

Hydrograph type	= SCS Runoff	Peak discharge	= 0.819 cfs
Storm frequency	= 25 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 3,983 cuft
Drainage area	= 0.760 ac	Curve number	= 59.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.40 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



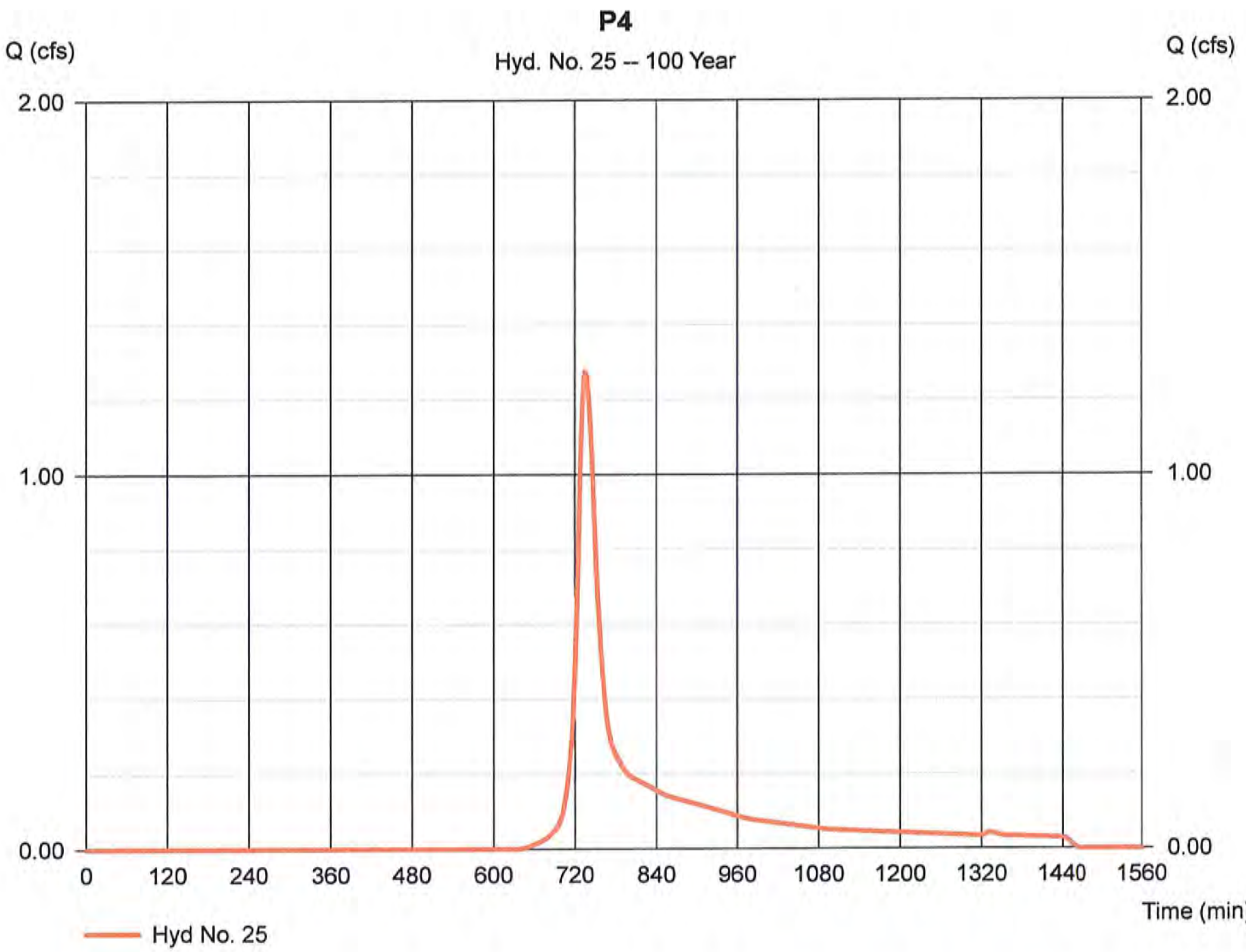
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 25

P4

Hydrograph type	= SCS Runoff	Peak discharge	= 1.275 cfs
Storm frequency	= 100 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 5,913 cuft
Drainage area	= 0.760 ac	Curve number	= 59.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 17.40 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff **SM-2069**

Project: 700-800 Mass Ave By JTM Date 11/18/16

Location: Boxborough, MA Checked RJH Date 6/22/2017

Circle one: Present Developed Subcatchment P-5

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
B	Woods- Good Condition	55			0.08	4.56
B	Open- Good Condition	61			0.03	1.64
				4787.00 Totals =	0.11	6.21

1/ Use only one CN source per line.

CN (weighted) = total product / total area = 6.21 / 0.11 = 56.47 ; Use CN = 56.5

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	0.26	0.82	1.88
Runoff, Q	cf	105	327	749

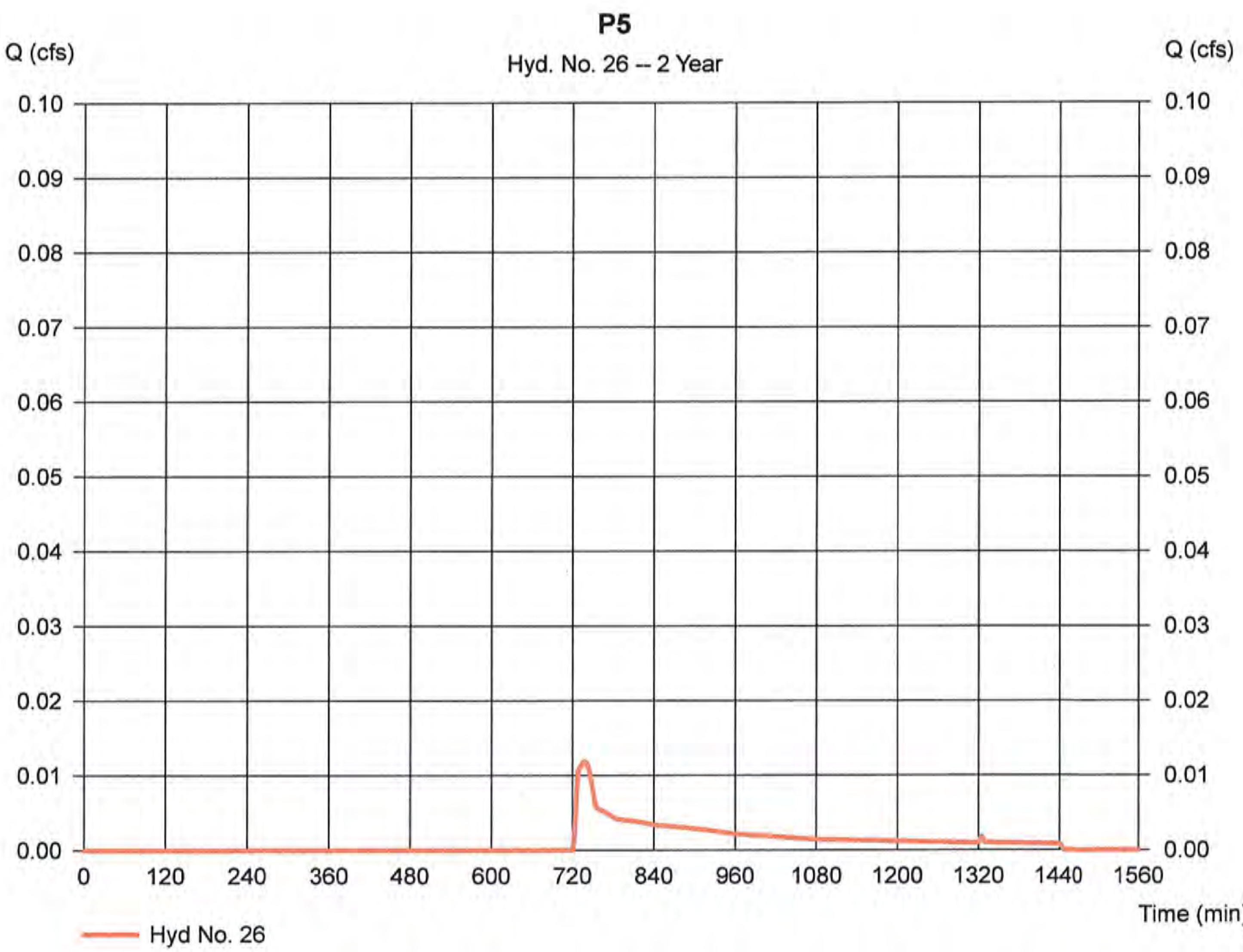
 (210-VI-TR-55, Second Ed., June 1986)

Hydrograph Report

Hyd. No. 26

P5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.012 cfs
Storm frequency	= 2 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 98 cuft
Drainage area	= 0.110 ac	Curve number	= 56.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



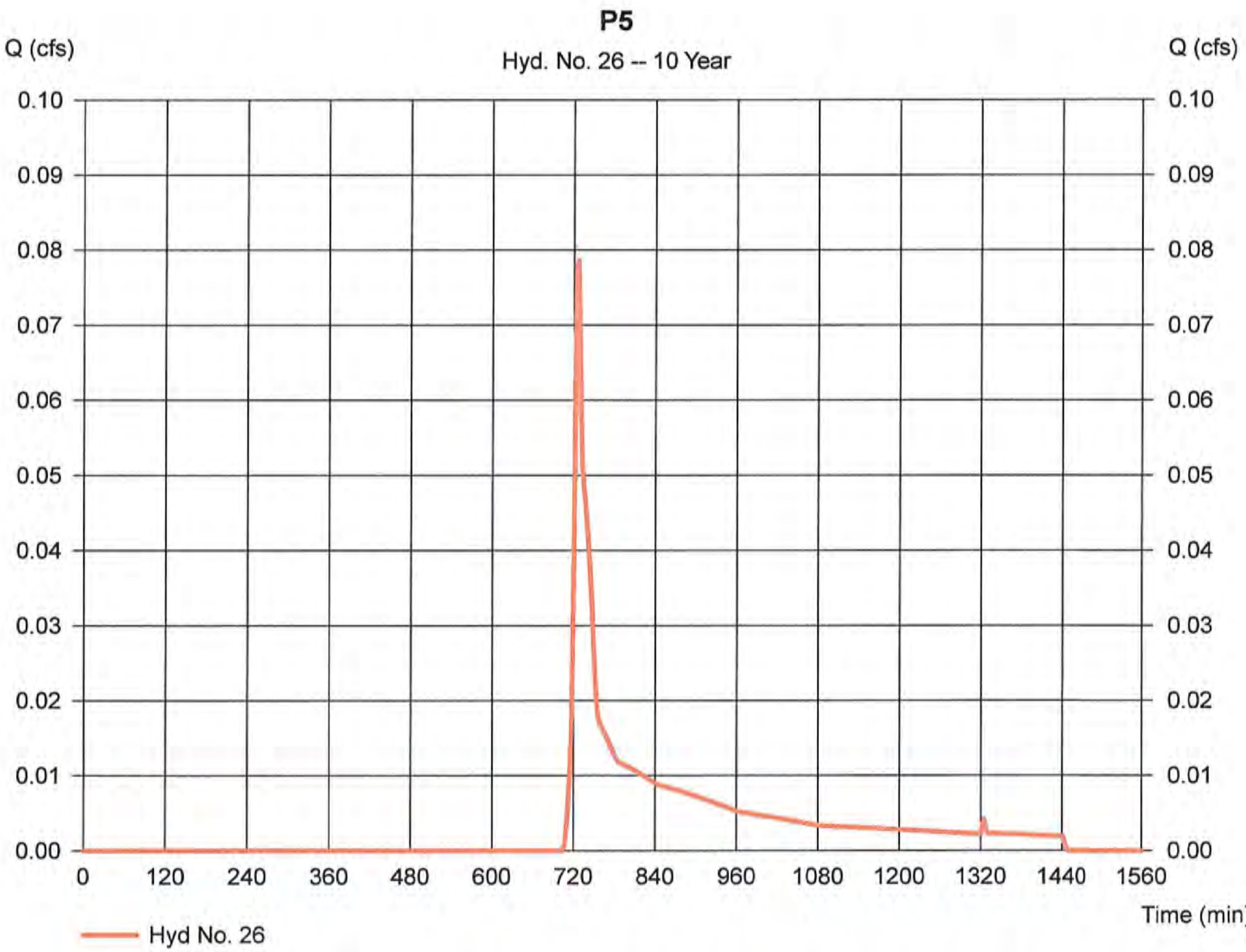
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 26

P5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.079 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 308 cuft
Drainage area	= 0.110 ac	Curve number	= 56.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



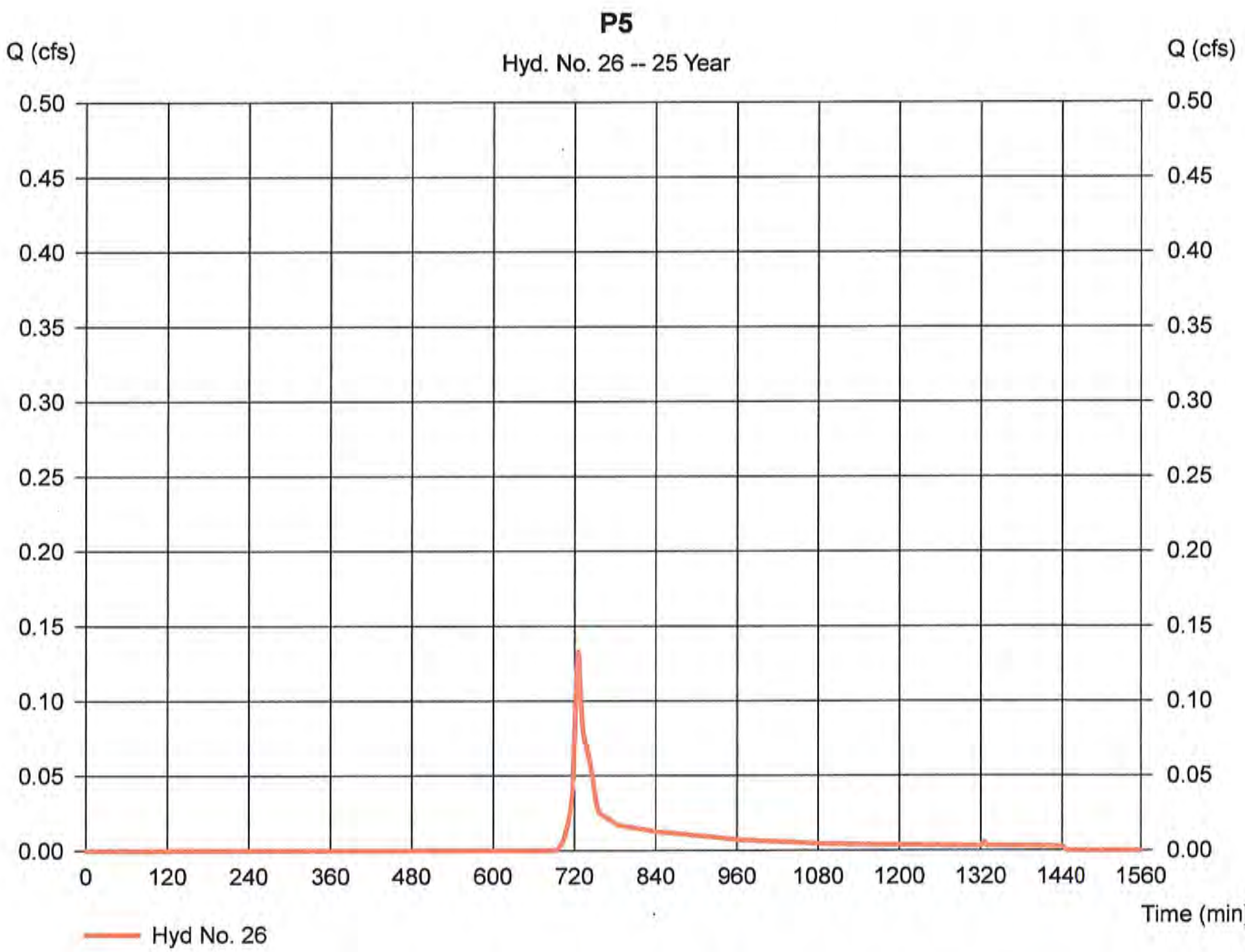
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 26

P5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.133 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 462 cuft
Drainage area	= 0.110 ac	Curve number	= 56.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



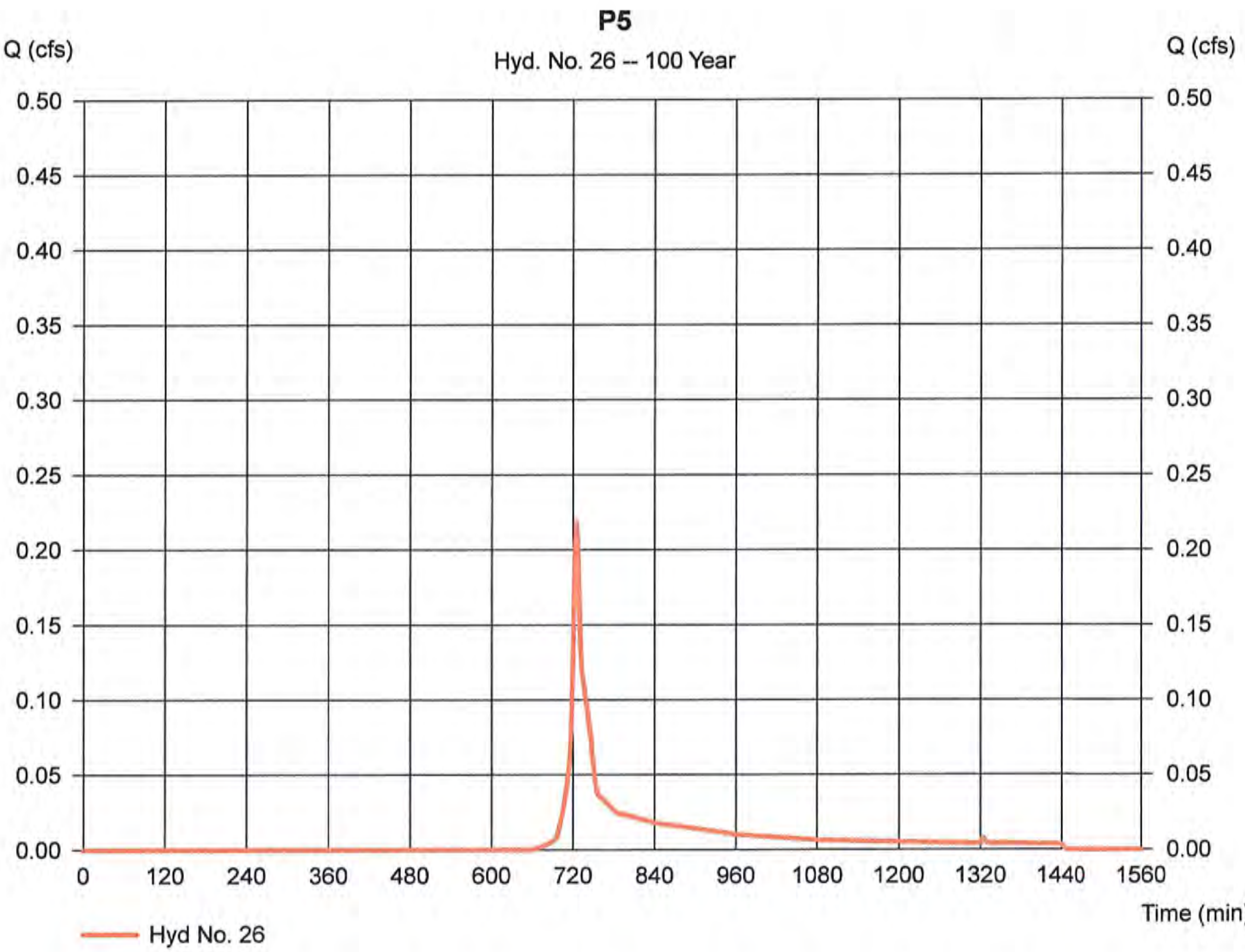
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 26

P5

Hydrograph type	= SCS Runoff	Peak discharge	= 0.219 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 704 cuft
Drainage area	= 0.110 ac	Curve number	= 56.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



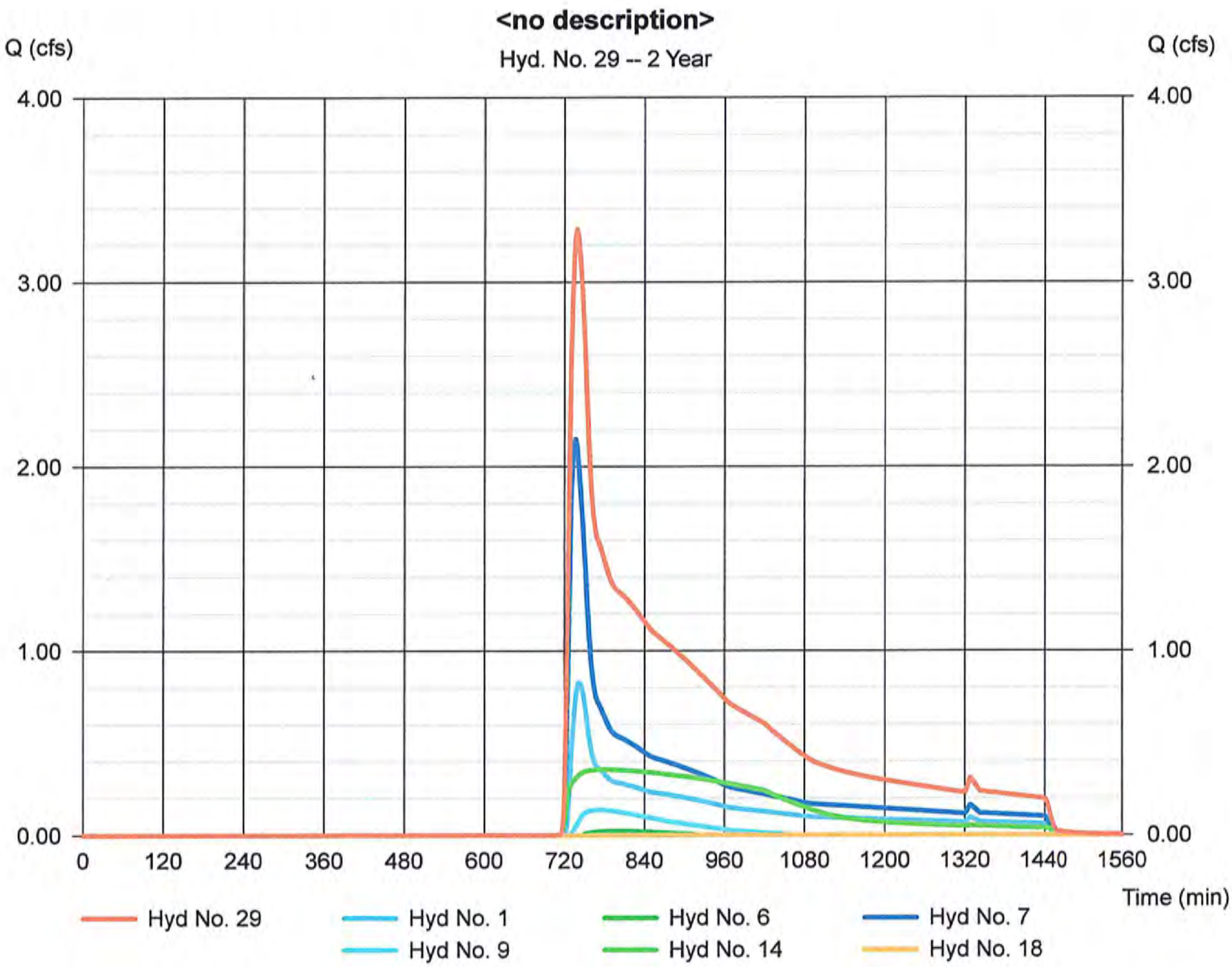
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 29

<no description>

Hydrograph type	= Combine	Peak discharge	= 3.286 cfs
Storm frequency	= 2 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 29,814 cuft
Inflow hyds.	= 1, 6, 7, 9, 14, 18	Contrib. drain. area	= 16.070 ac

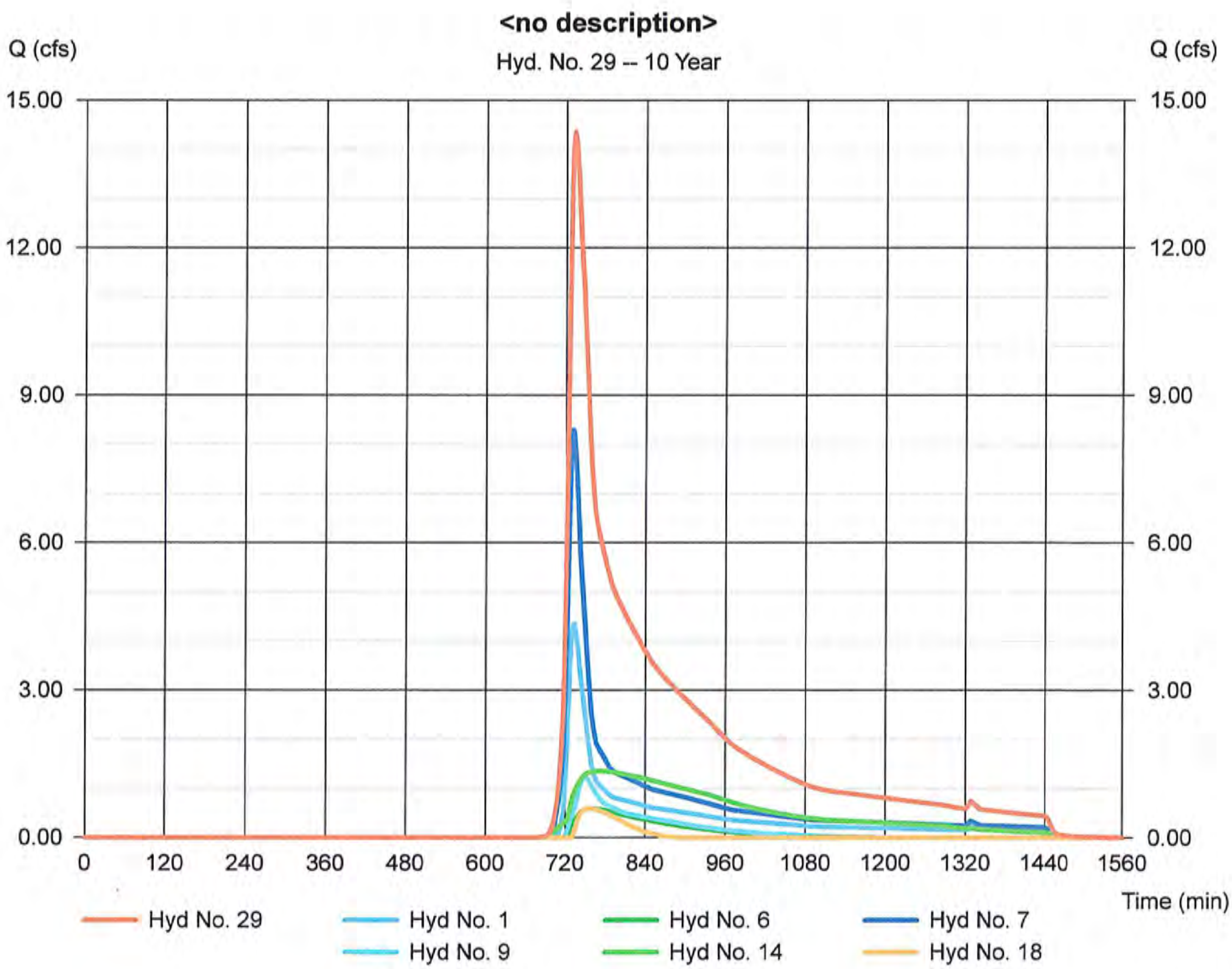


Hydrograph Report

Hyd. No. 29

<no description>

Hydrograph type	= Combine	Peak discharge	= 14.37 cfs
Storm frequency	= 10 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 99,469 cuft
Inflow hyds.	= 1, 6, 7, 9, 14, 18	Contrib. drain. area	= 16.070 ac



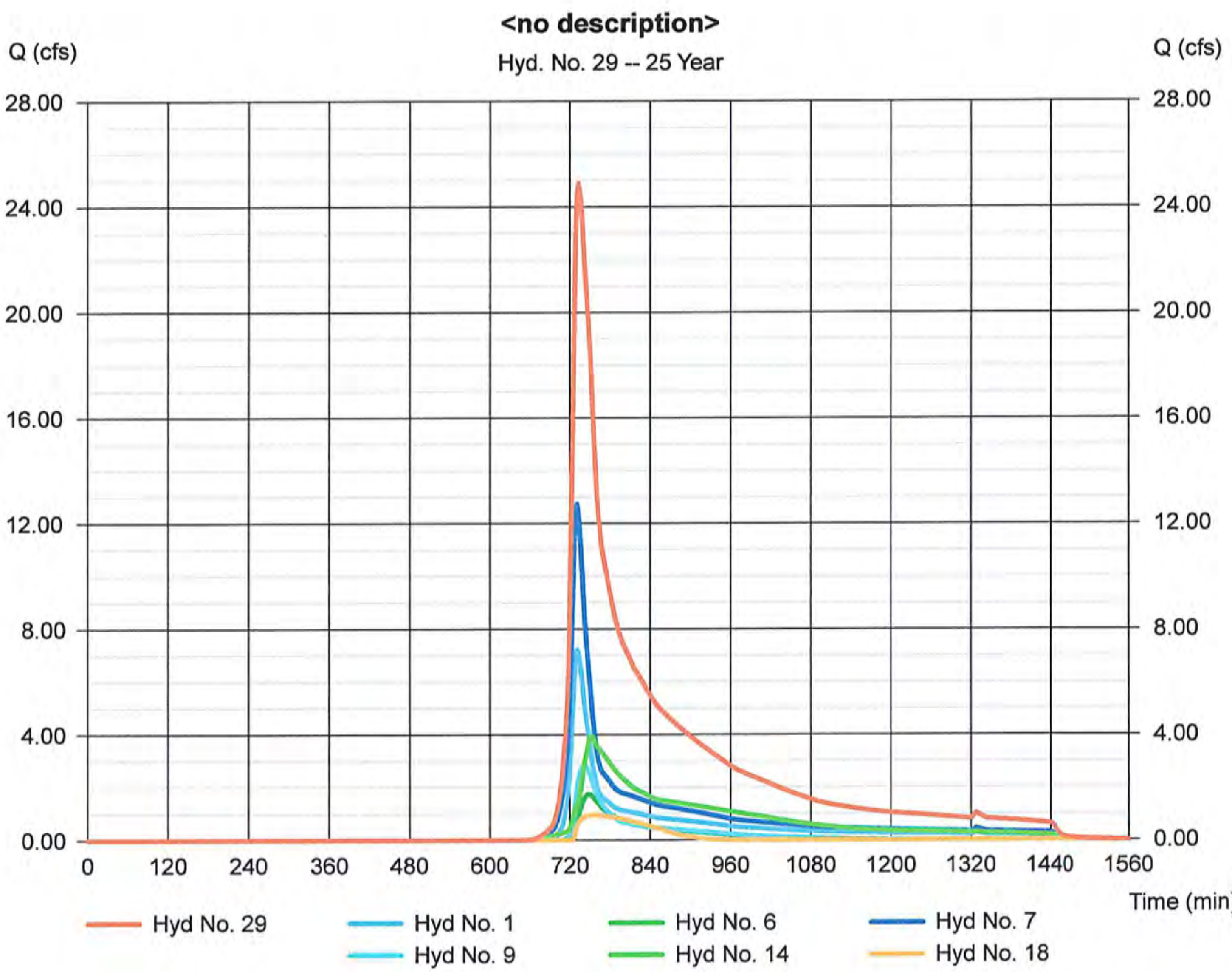
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 29

<no description>

Hydrograph type	= Combine	Peak discharge	= 24.89 cfs
Storm frequency	= 25 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 155,608 cuft
Inflow hyds.	= 1, 6, 7, 9, 14, 18	Contrib. drain. area	= 16.070 ac



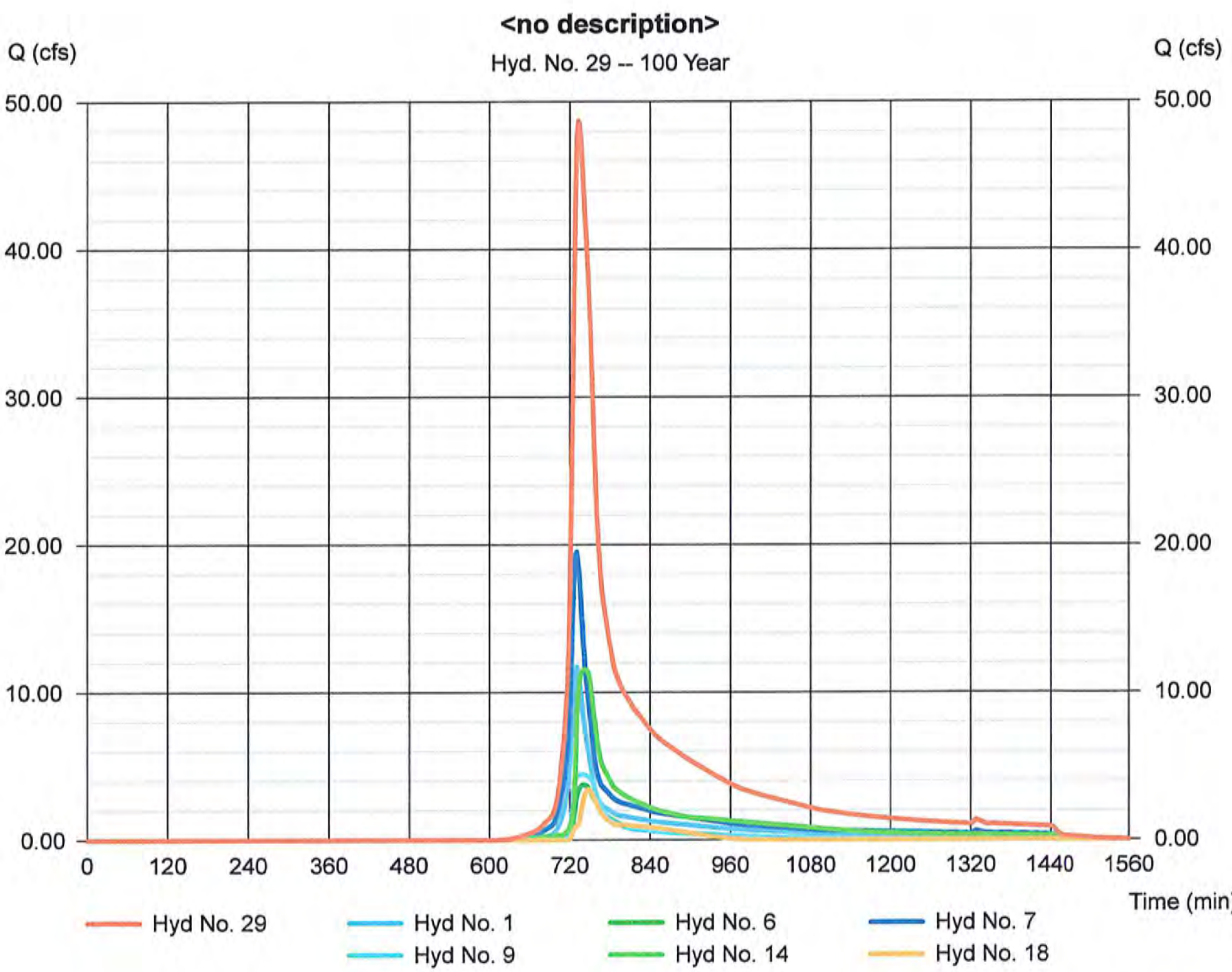
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 29

<no description>

Hydrograph type	= Combine
Storm frequency	= 100 yrs
Time interval	= 2 min
Inflow hyds.	= 1, 6, 7, 9, 14, 18
Peak discharge	= 48.73 cfs
Time to peak	= 732 min
Hyd. volume	= 245,616 cuft
Contrib. drain. area	= 16.070 ac



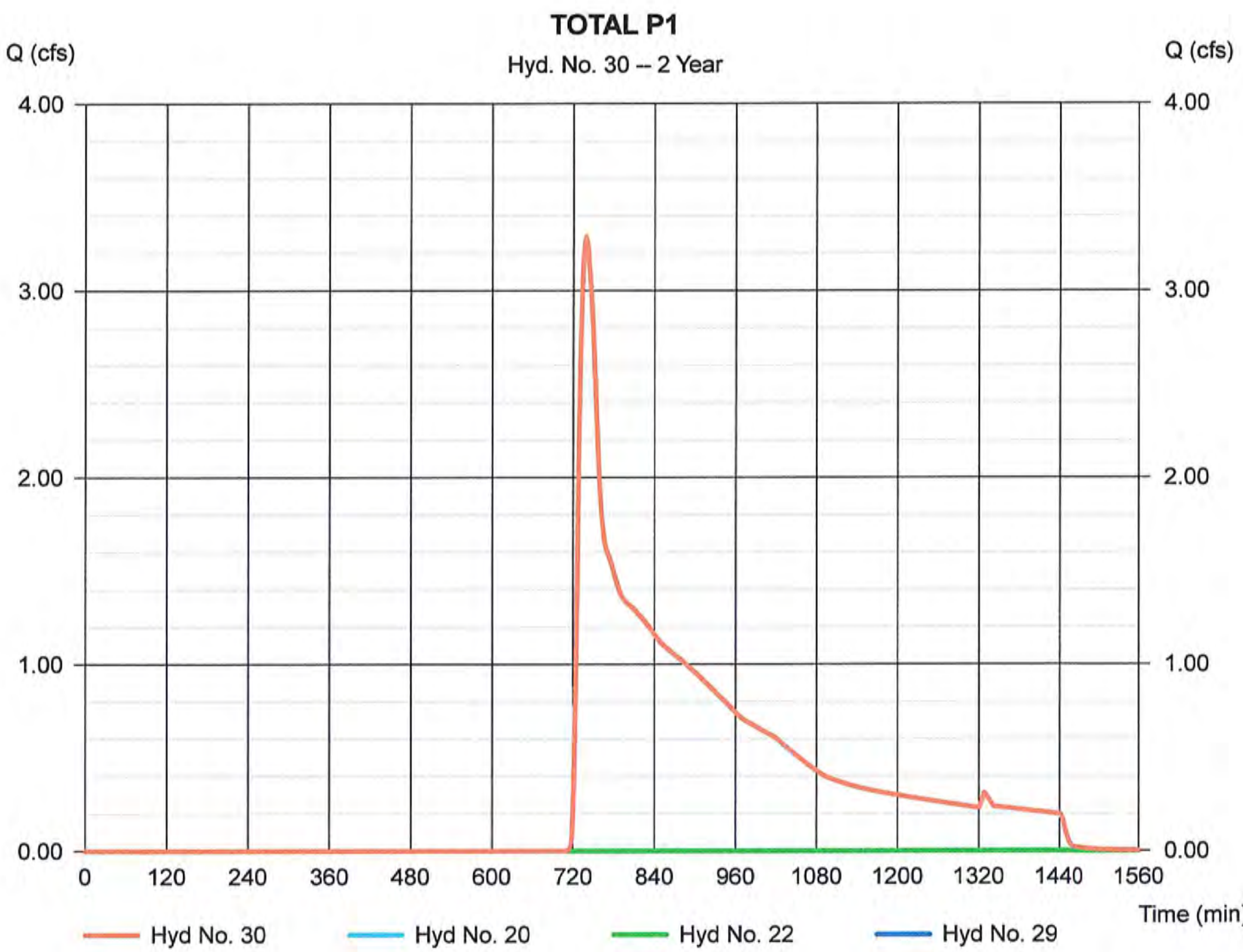
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 30

TOTAL P1

Hydrograph type	= Combine	Peak discharge	= 3.286 cfs
Storm frequency	= 2 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 29,814 cuft
Inflow hyds.	= 20, 22, 29	Contrib. drain. area	= 0.000 ac



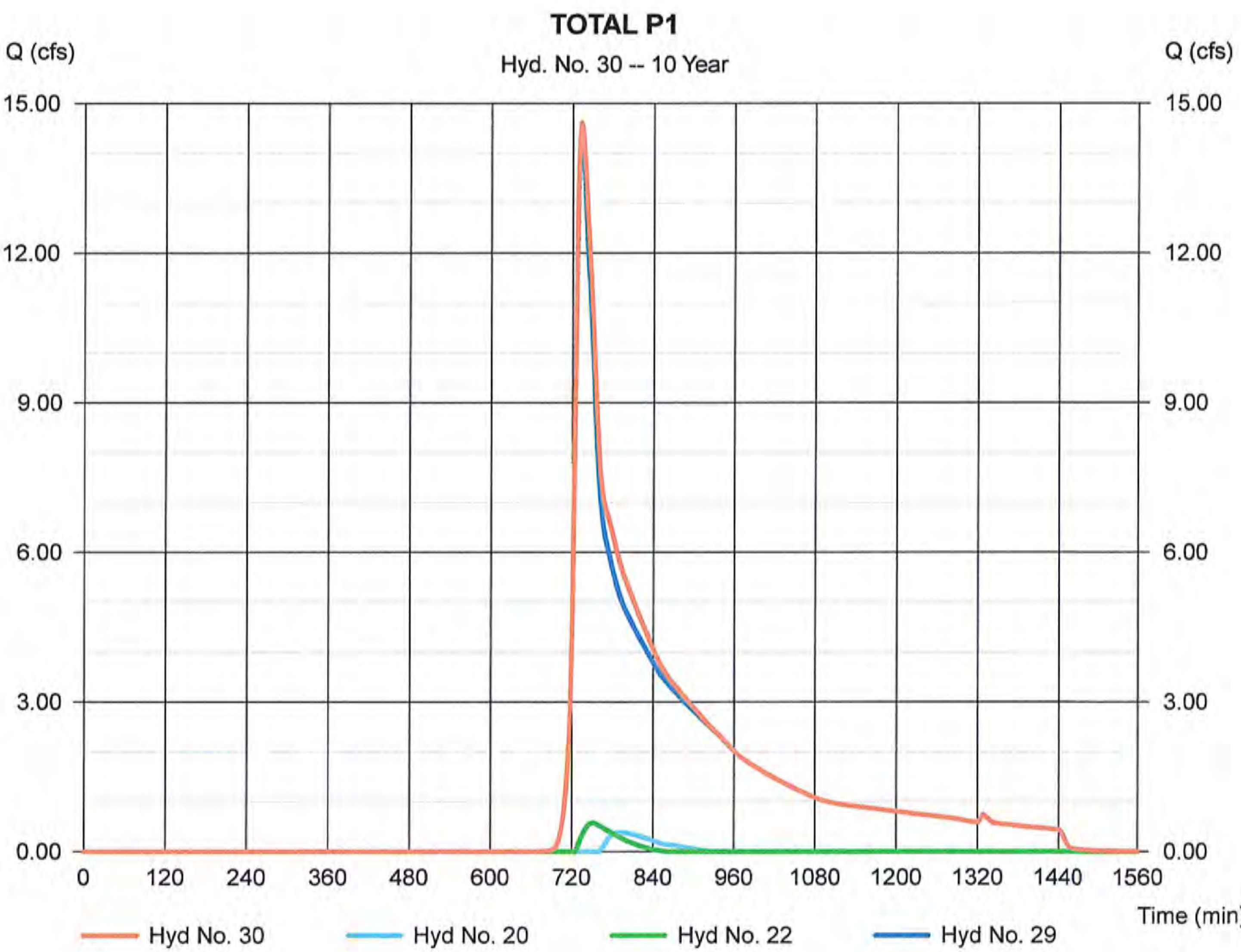
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 30

TOTAL P1

Hydrograph type	= Combine	Peak discharge	= 14.62 cfs
Storm frequency	= 10 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 103,491 cuft
Inflow hyds.	= 20, 22, 29	Contrib. drain. area	= 0.000 ac



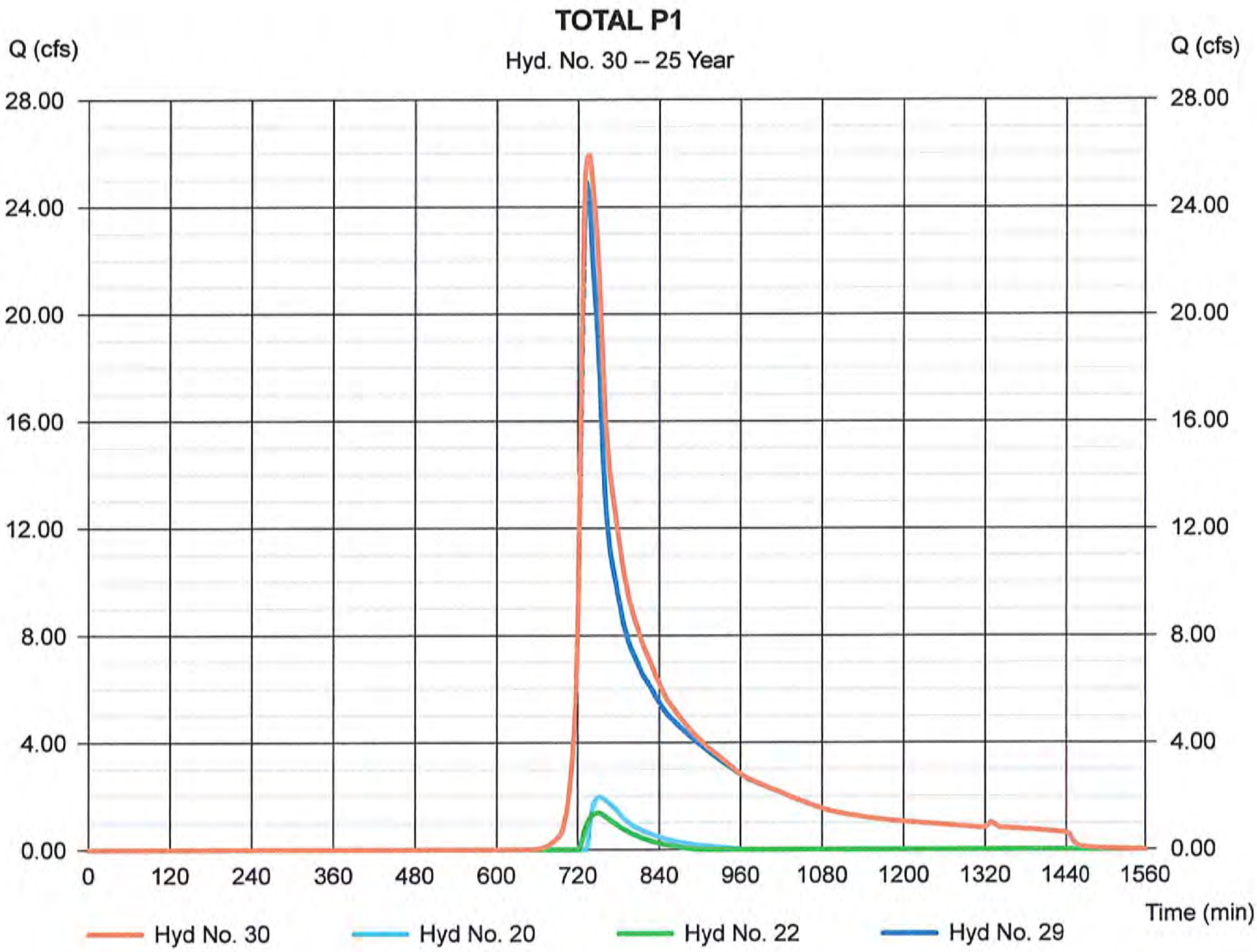
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 30

TOTAL P1

Hydrograph type	= Combine	Peak discharge	= 25.93 cfs
Storm frequency	= 25 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 170,330 cuft
Inflow hyds.	= 20, 22, 29	Contrib. drain. area	= 0.000 ac



Hydrograph Report

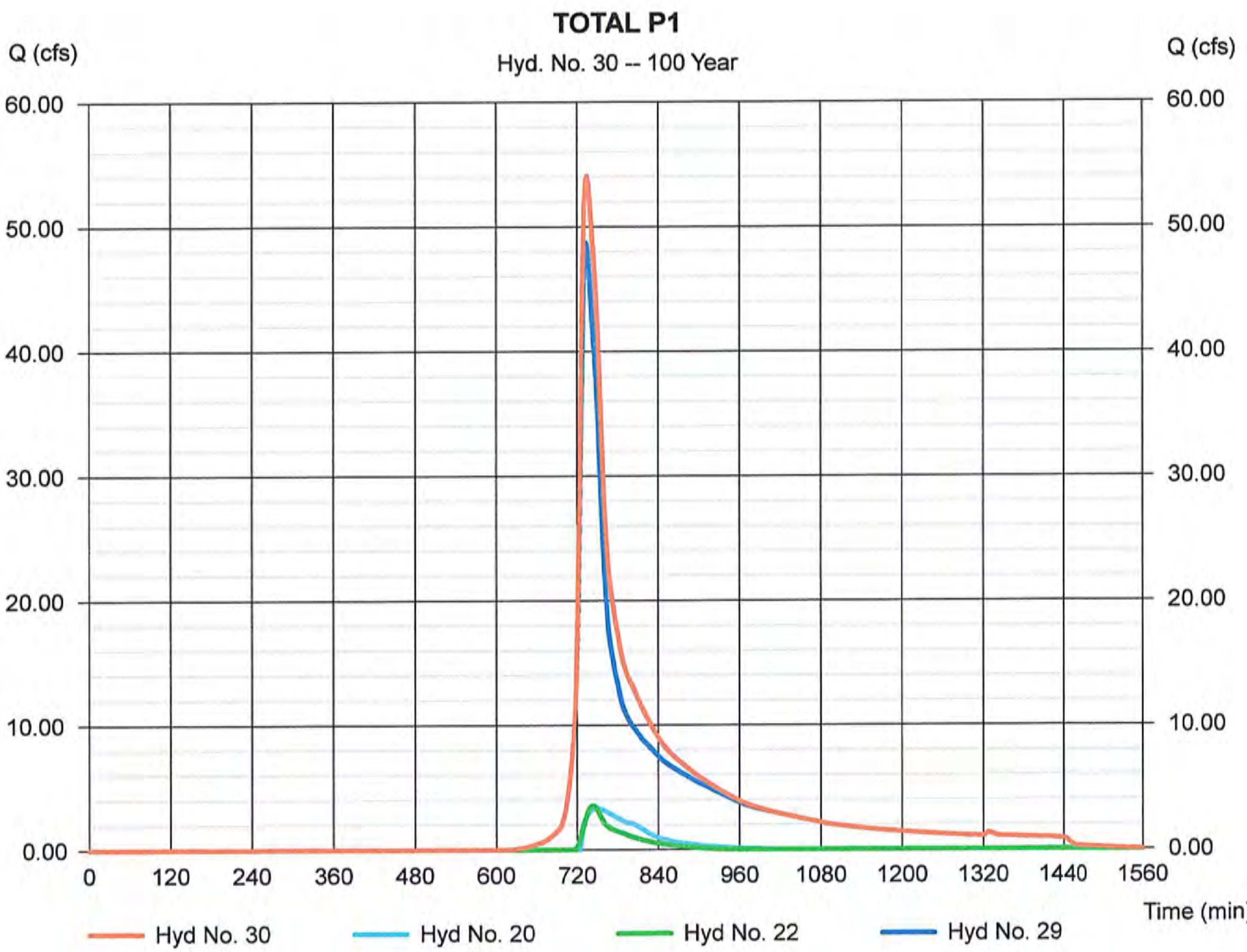
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 30

TOTAL P1

Hydrograph type	= Combine
Storm frequency	= 100 yrs
Time interval	= 2 min
Inflow hyds.	= 20, 22, 29

Peak discharge	= 54.10 cfs
Time to peak	= 734 min
Hyd. volume	= 277,427 cuft
Contrib. drain. area	= 0.000 ac



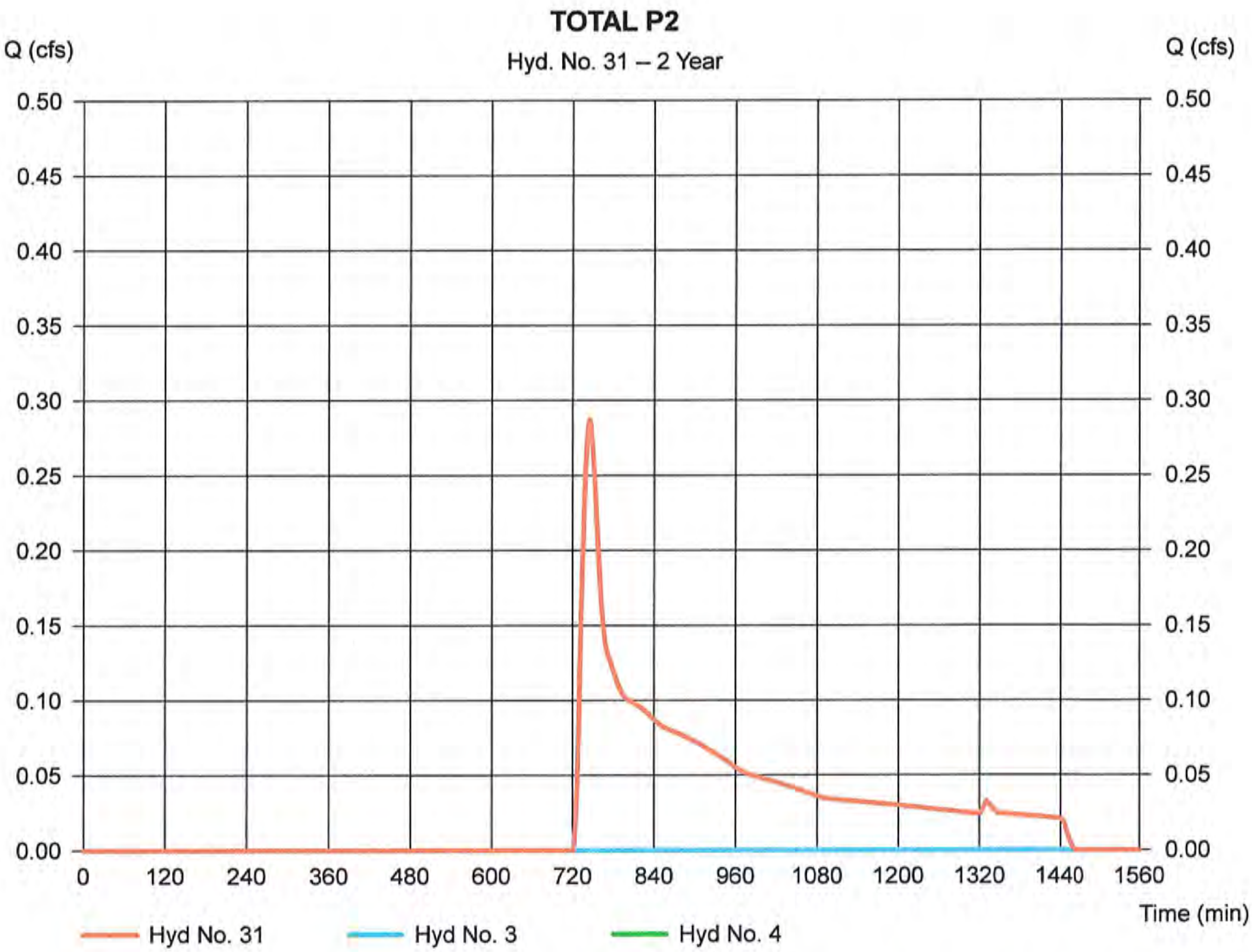
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 31

TOTAL P2

Hydrograph type	= Combine	Peak discharge	= 0.287 cfs
Storm frequency	= 2 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 2,429 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 2.530 ac



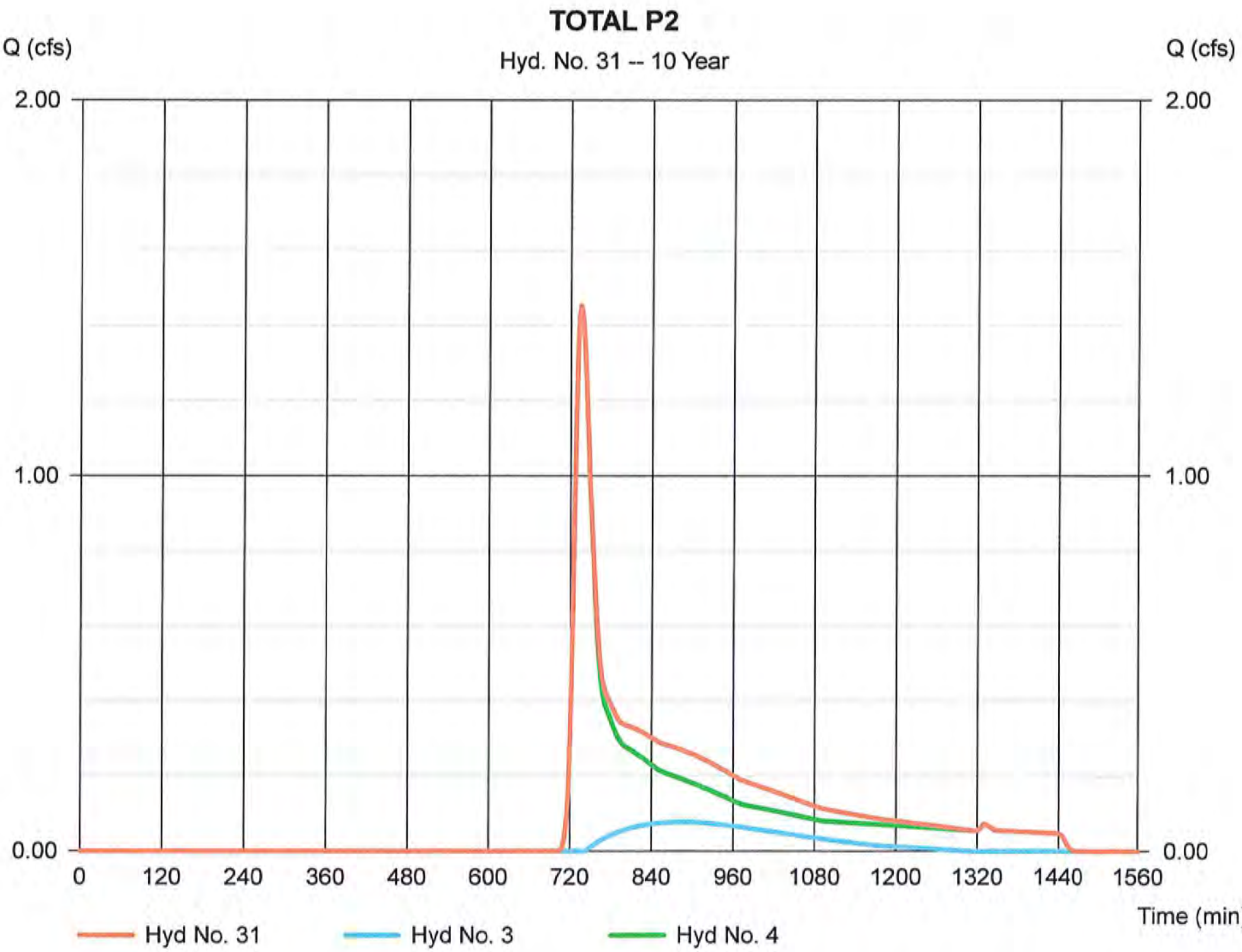
Hydrograph Report

Hyd. No. 31

TOTAL P2

Hydrograph type	= Combine
Storm frequency	= 10 yrs
Time interval	= 2 min
Inflow hyds.	= 3, 4

Peak discharge	= 1.453 cfs
Time to peak	= 734 min
Hyd. volume	= 8,892 cuft
Contrib. drain. area	= 2.530 ac



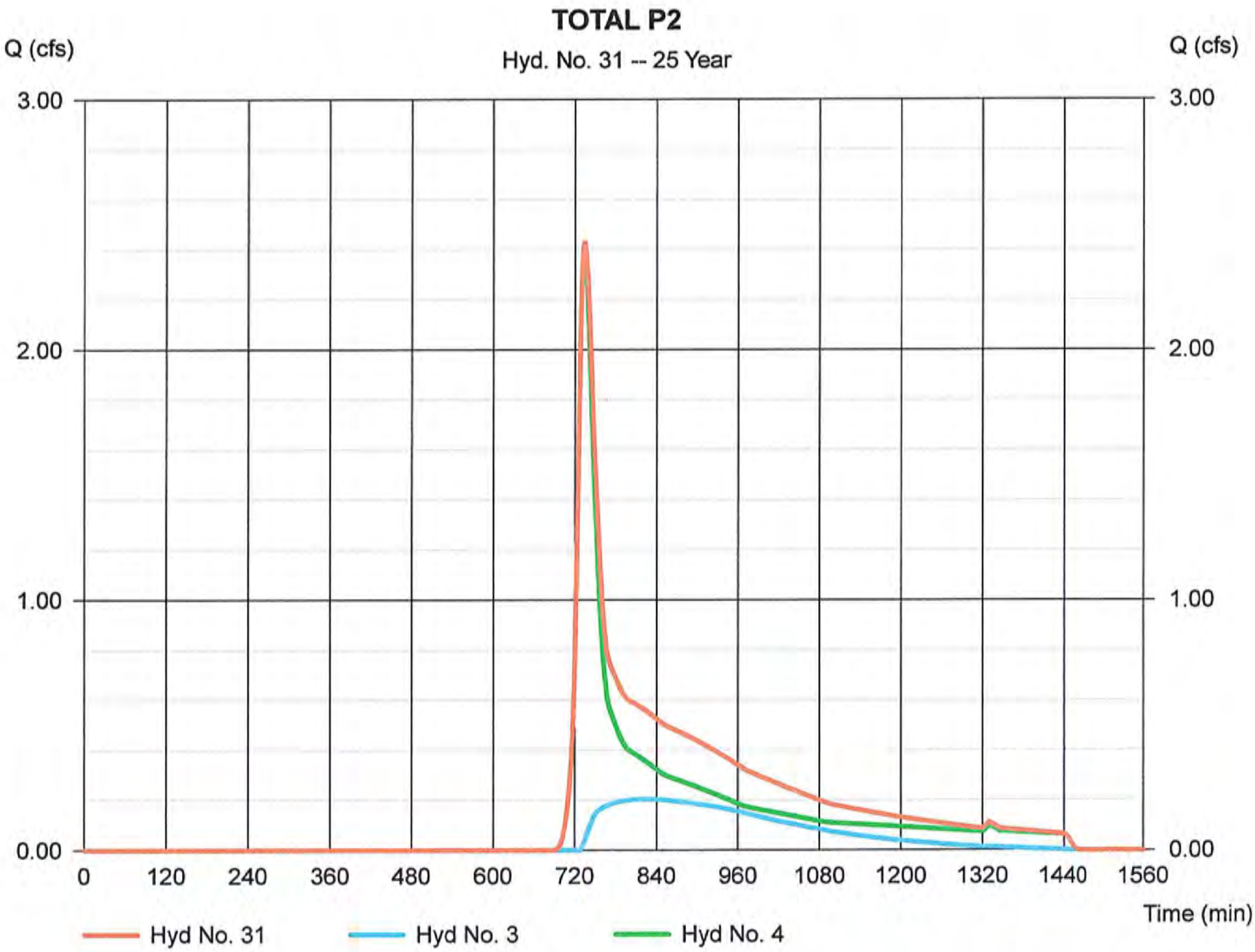
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 31

TOTAL P2

Hydrograph type	= Combine	Peak discharge	= 2.429 cfs
Storm frequency	= 25 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 15,168 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 2.530 ac



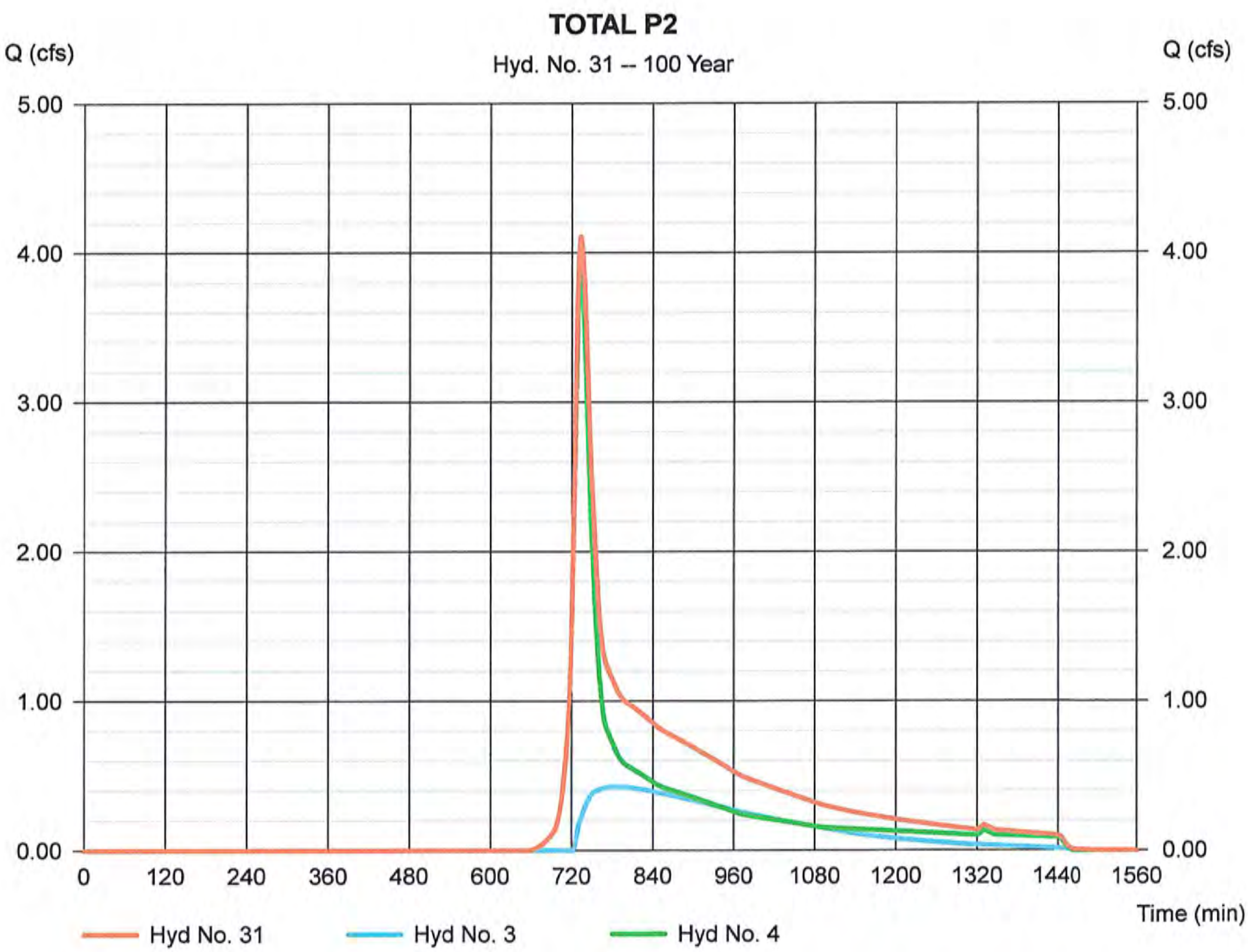
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 31

TOTAL P2

Hydrograph type	= Combine	Peak discharge	= 4.109 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 25,069 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 2.530 ac



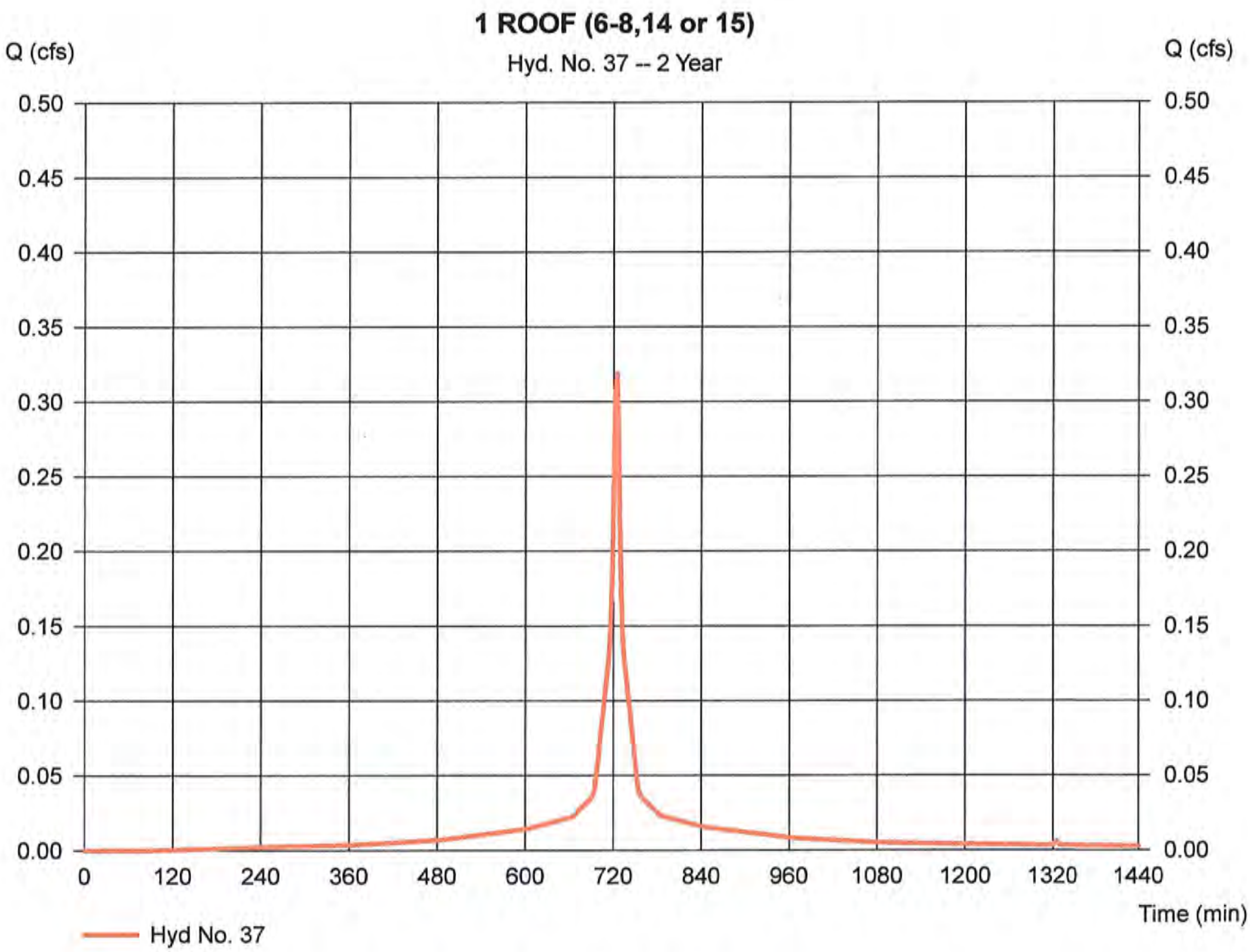
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 | Thursday, Jun 22, 2017

Hyd. No. 37

1 ROOF (6-8,14 or 15)

Hydrograph type	= SCS Runoff	Peak discharge	= 0.319 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,074 cuft
Drainage area	= 0.110 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



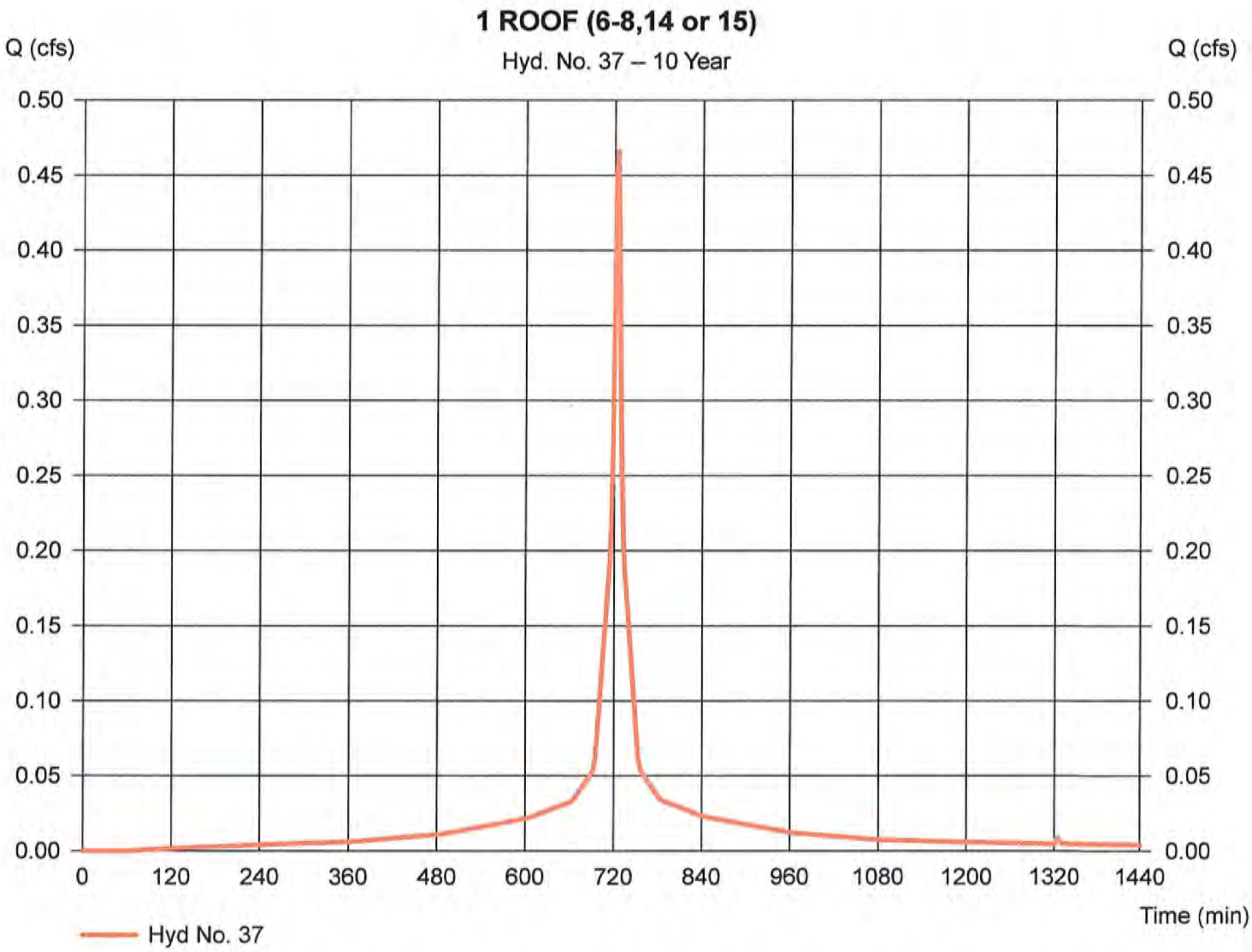
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 37

1 ROOF (6-8,14 or 15)

Hydrograph type	= SCS Runoff	Peak discharge	= 0.466 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,596 cuft
Drainage area	= 0.110 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

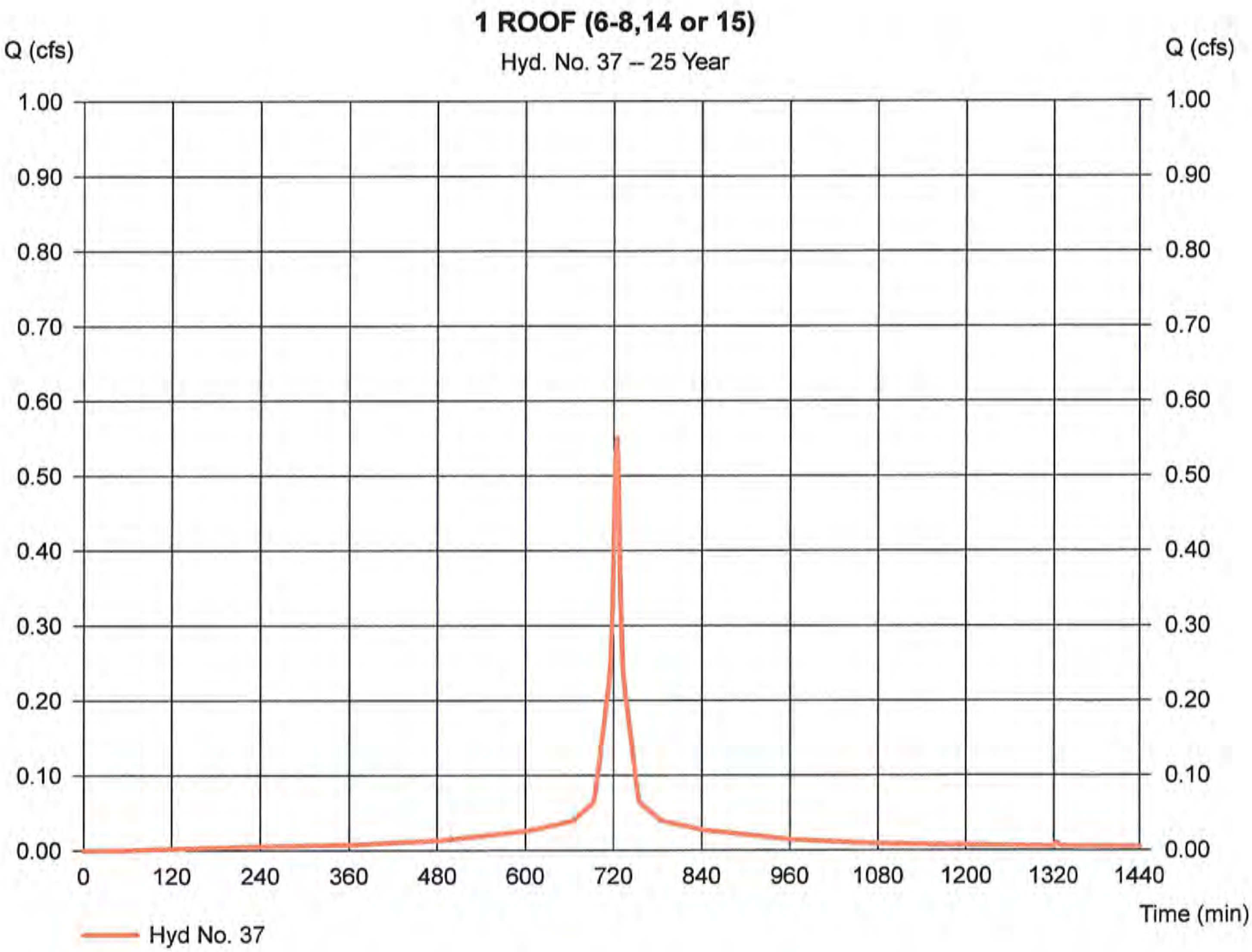


Hydrograph Report

Hyd. No. 37

1 ROOF (6-8,14 or 15)

Hydrograph type	= SCS Runoff	Peak discharge	= 0.550 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,895 cuft
Drainage area	= 0.110 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.30 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

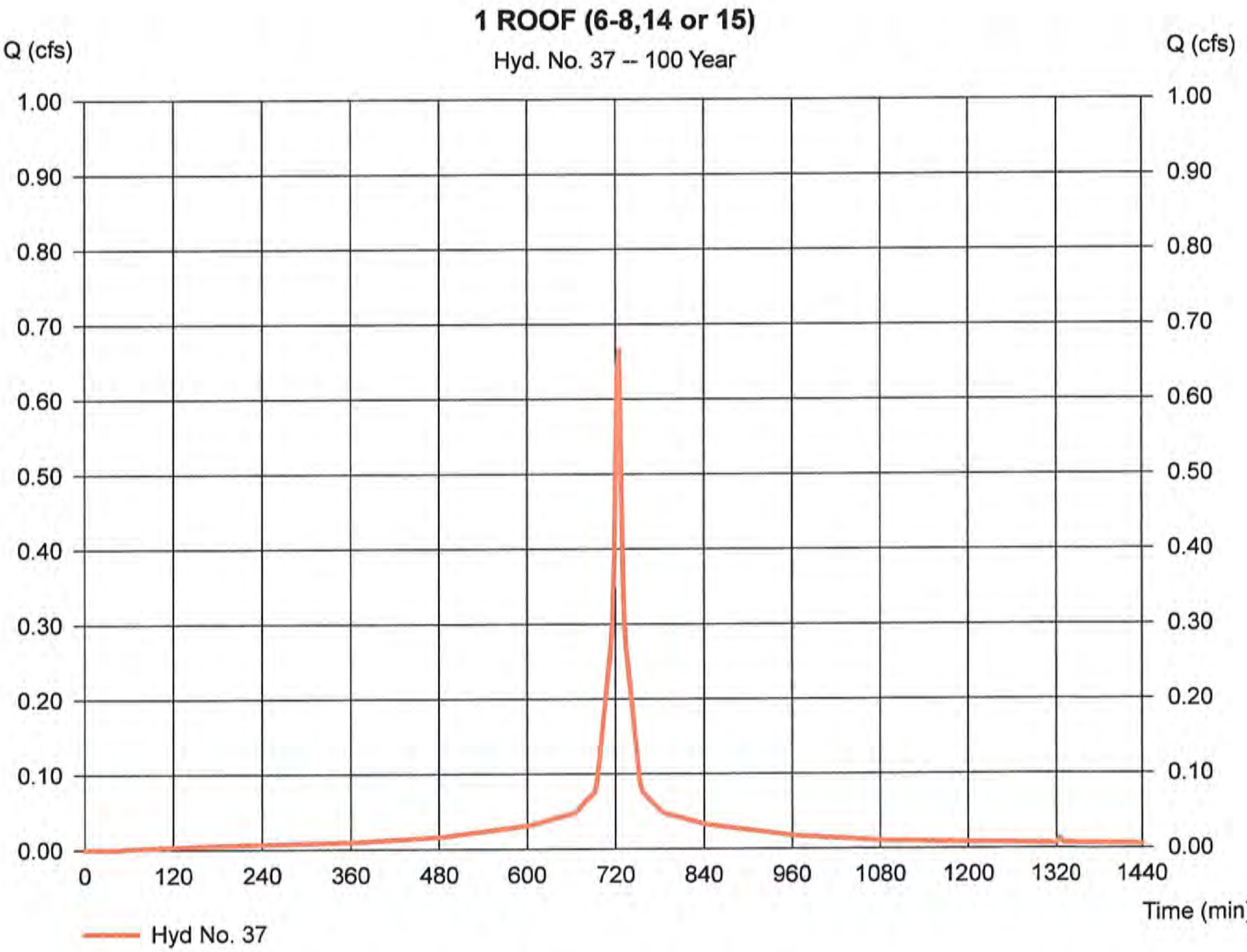


Hydrograph Report

Hyd. No. 37

1 ROOF (6-8,14 or 15)

Hydrograph type	= SCS Runoff	Peak discharge	= 0.665 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 2,307 cuft
Drainage area	= 0.110 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

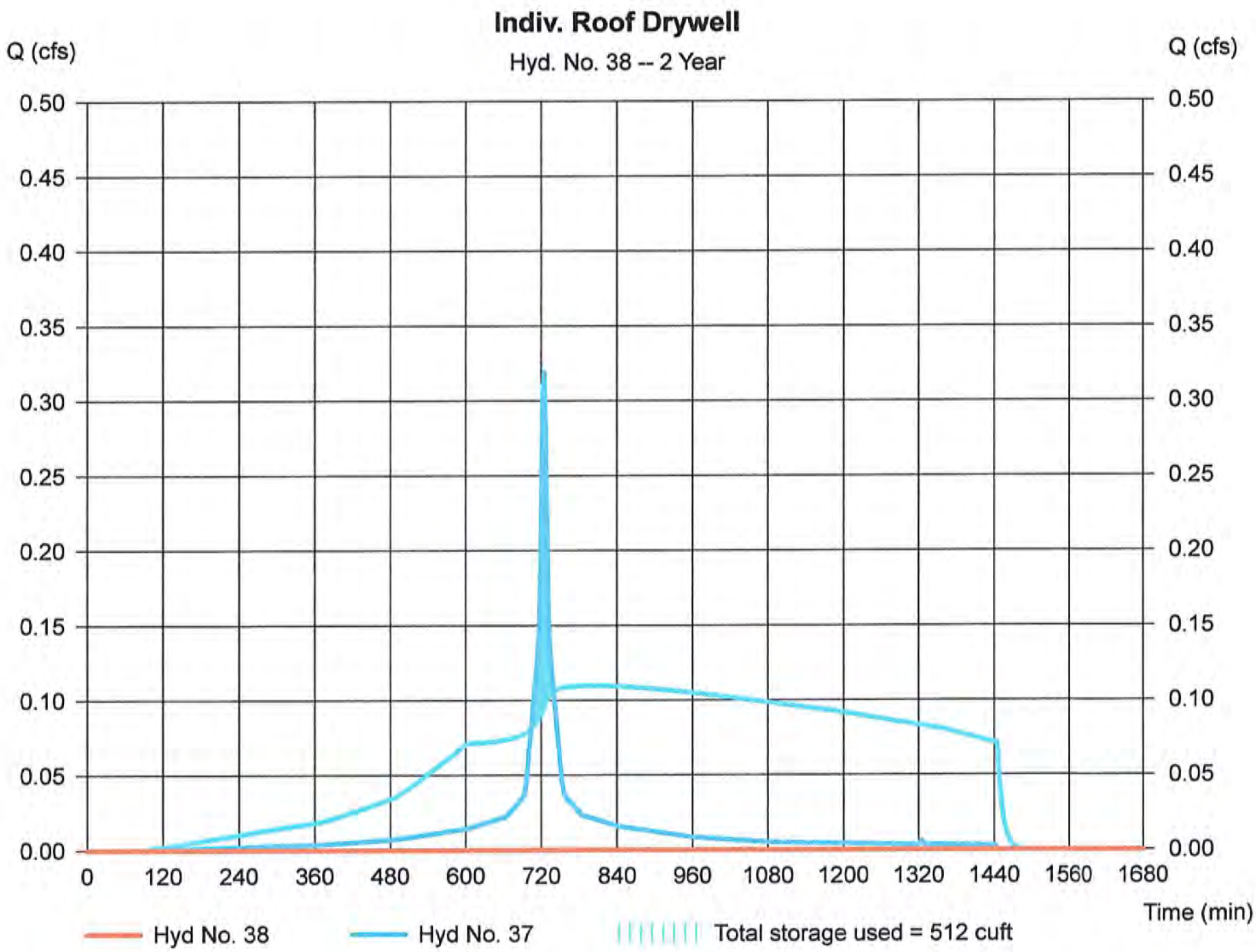
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 38

Indiv. Roof Drywell

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 1268 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 37 - 1 ROOF (6-8,14 or 15)	Max. Elevation	= 2.43 ft
Reservoir name	= INDIV. RD	Max. Storage	= 512 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

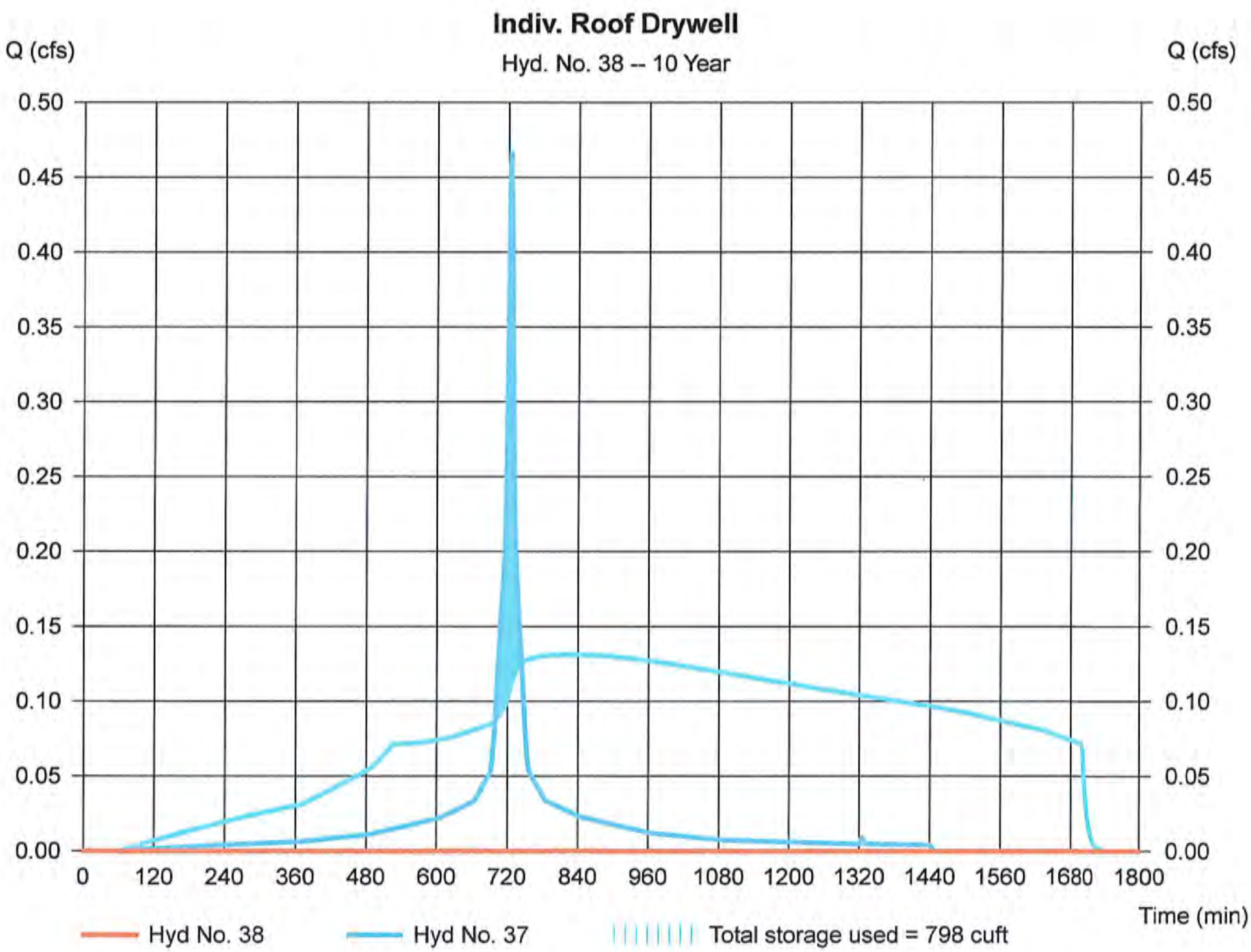
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 38

Indiv. Roof Drywell

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= 496 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 37 - 1 ROOF (6-8,14 or 15)	Max. Elevation	= 3.79 ft
Reservoir name	= INDIV. RD	Max. Storage	= 798 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

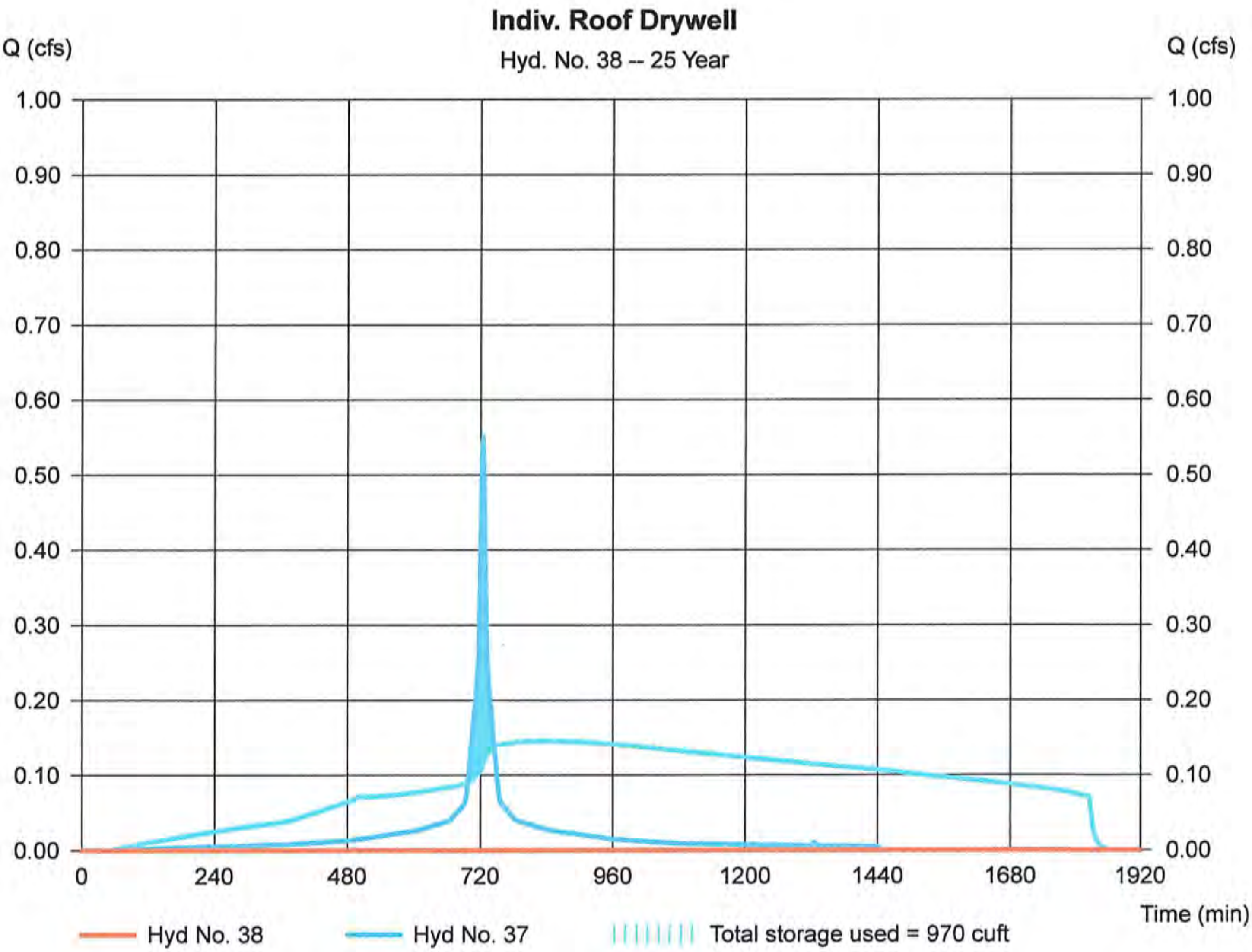
Hydraflow Hydrographs by Intelisolve v9.2 — Thursday, Jun 22, 2017

Hyd. No. 38

Indiv. Roof Drywell

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 25 yrs	Time to peak	= 580 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 37 - 1 ROOF (6-8,14 or 15)	Max. Elevation	= 4.61 ft
Reservoir name	= INDIV. RD	Max. Storage	= 970 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

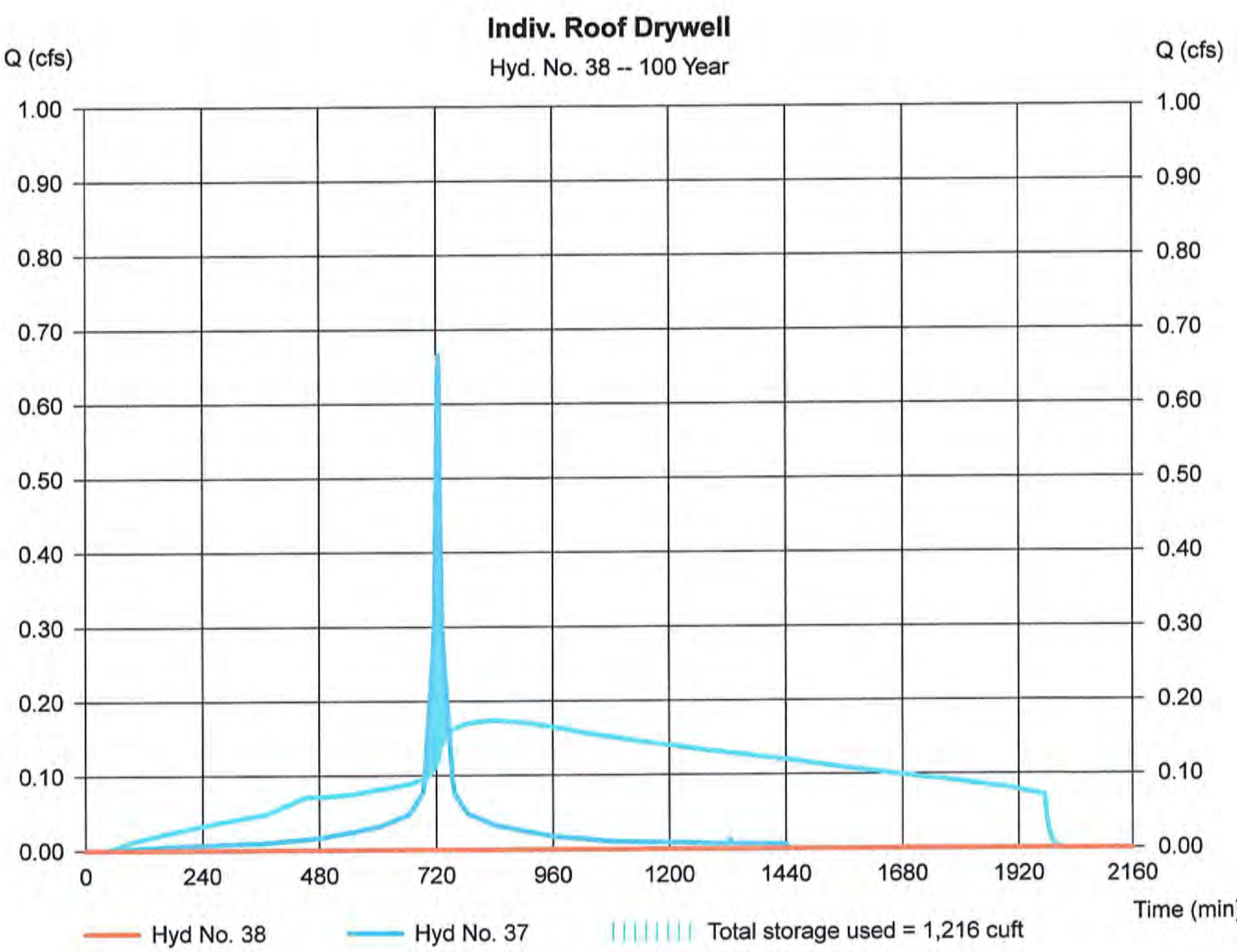
Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Hyd. No. 38

Indiv. Roof Drywell

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 1756 min
Time interval	= 2 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 37 - 1 ROOF (6-8,14 or 15)	Max. Elevation	= 5.78 ft
Reservoir name	= INDIV. RD	Max. Storage	= 1,216 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 Thursday, Jun 22, 2017

Pond No. 19 - INDIV. RD

Pond Data

UG Chambers - Invert elev. = 1.00 ft, Rise x Span = 5.00 x 8.33 ft, Barrel Len = 30.31 ft, No. Barrels = 1, Slope = 0.00%, Headers = No
Encasement - Invert elev. = 0.00 ft, Width = 10.33 ft, Height = 70.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	0.00	n/a	0	0
7.00	7.00	n/a	1,472	1,472
14.00	14.00	n/a	877	2,349
21.00	21.00	n/a	877	3,226
28.00	28.00	n/a	877	4,102
35.00	35.00	n/a	877	4,979
42.00	42.00	n/a	877	5,856
49.00	49.00	n/a	877	6,733
56.00	56.00	n/a	877	7,610
63.00	63.00	n/a	877	8,487
70.00	70.00	n/a	877	9,364

Culvert / Orifice Structures

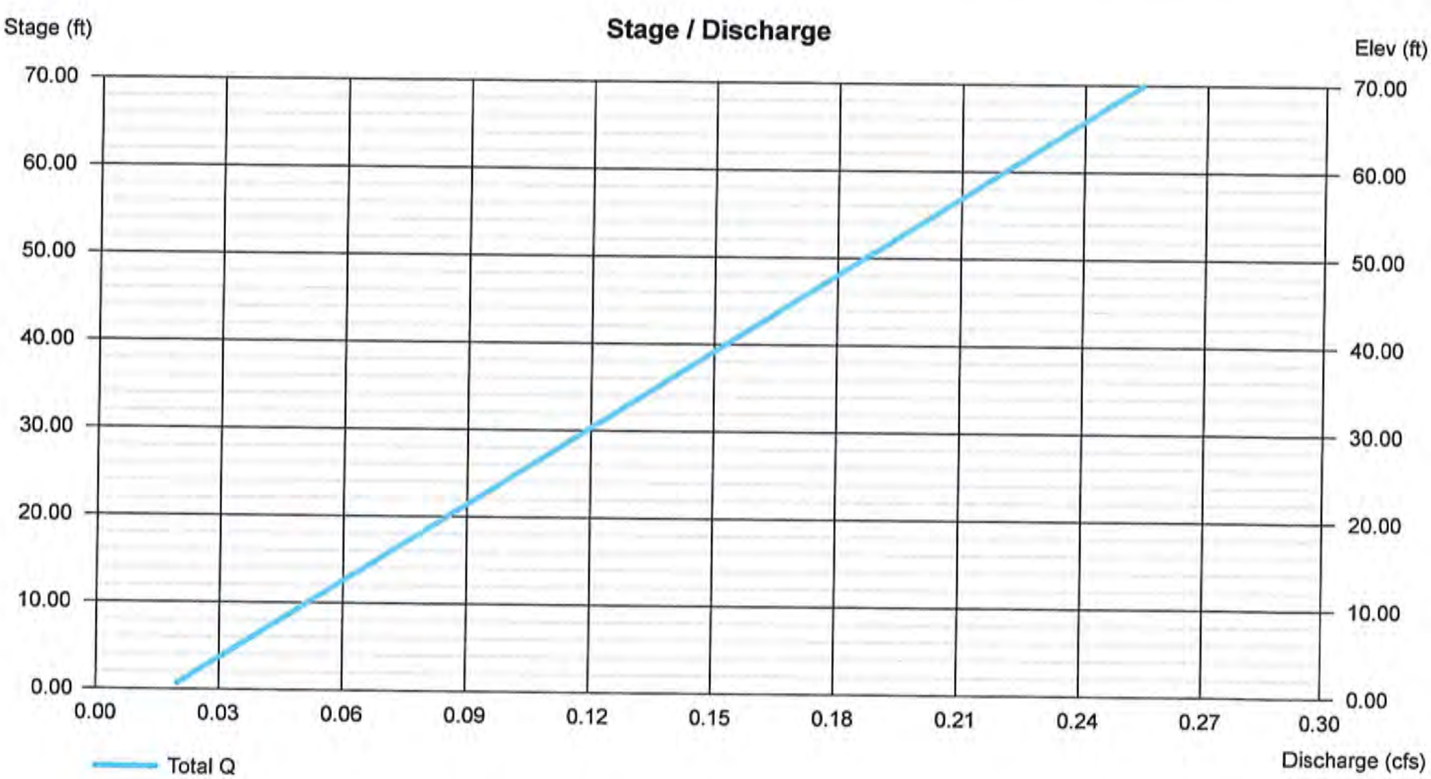
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

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) = 2.410 (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).



Water Quality Volume Calculations

Water Quality Volume Calculations

Job: SM-2069

Calculated by: JTM RJH
Date: 12/22/2016 Rev. 06/23/2017

Subcatchment CB1 AND 2 (SMA 1)
Soils:
Hydrologic Group: B
Required Water Quality Volume
1 inches of runoff x impervious area

Impervious area: 0.23000459 acres
10,019 s.f.

Sediment Forebay P3 B

Elev. (FT)	Change Elev. (FT)	Area (SF)	Inc. Volume (CF)	
323	0	397		
324	1	653	525	
325	1	932	792.5	
			0	**1,318**

Required Water Quality Volume

V= 10,019 s.f. x $\frac{1}{12}$ = **835 c.f.**

Volume Provided 1,318 c.f.

1,318	**c.f. >**	**835**	**c.f. O.K.**

Subcatchment CB 3 (SMA 1)
Soils:
Hydrologic Group: B
Required Water Quality Volume
1 inches of runoff x impervious area

Impervious area: 0.16000918 acres
6,970 s.f.

Sediment Forebay P3 B

Elev. (FT)	Change Elev. (FT)	Area (SF)	Inc. Volume (CF)	
322	0	460		
323	1	632	546	
324	1	632	632	
			0	**1,178**

Required Water Quality Volume

V= 6,970 s.f. x $\frac{1}{12}$ = **581 c.f.**

Volume Provided 1,178 c.f.

1,178	**c.f. >**	**581**	**c.f. O.K.**

Subcatchment Road A 1900 to 2450 (SMA 2)
Soils:
Hydrologic Group: B
Required Water Quality Volume
1 inches of runoff x impervious area

Impervious area: 0.9181359 acres
39,994 s.f.

Sediment Forebay P3A

Elev. (FT)	Change Elev. (FT)	Area (SF)	Inc. Volume (CF)	
314	0	314		
315	1	686	500	
316	1	1186	936	
317	1	1815	1500.5	2,937
317.5	0.5	2000	953.75	**3,390**

Required Water Quality Volume

V= 39,994 s.f. x $\frac{1}{12}$ = **3,333 c.f.**

Volume Provided 3,390 c.f.

3,390	**c.f. >**	**3,333**	**c.f. O.K.**

Subcatchment Road A 1450 to 1900 (SMA 2)
Soils:
Hydrologic Group: B
Required Water Quality Volume
1 inches of runoff x impervious area

Impervious area: 0.36000918 acres
15,682 s.f.

Sediment Forebay P3A					
Elev. (FT)	Change Elev. (FT)		Area (SF)	Inc. Volume (CF)	
310		0	267		
311		1	1336	801.5	
312		1	2789	2062.5	
313		1	3857	3323	**6,187**

Required Water Quality Volume

V= 15,682 s.f. x $\frac{1}{12}$ = **1,307 c.f.**

Volume Provided 6,187 c.f.

6,187	**c.f. >**	**1,307**	**c.f. O.K.**

Subcatchment P1D (SMA 3)
Soils:
Hydrologic Group: B
Required Water Quality Volume
1 inches of runoff x impervious area

Impervious area: 1.15996327 acres
50,528 s.f.

Sediment Forebay P1C					
Elev. (FT)	Change Elev. (FT)		Area (SF)	Inc. Volume (CF)	
312		0	1462		
313		1	2129	1795.5	
314		1	2862	2495.5	
				0	**4,291**

Required Water Quality Volume

V= 50,528 s.f. x $\frac{1}{12}$ = **4,211 c.f.**

Volume Provided 4,291 c.f.

4,291	**c.f. >**	**4,211**	**c.f. O.K.**

Subcatchment P1E (SMA 4)
Soils:
Hydrologic Group: B
Required Water Quality Volume
0.5 inches of runoff x impervious area

Impervious area: 2.42247475 acres
105,523 s.f.

Sediment Forebay P1D					
Elev. (FT)	Change Elev. (FT)		Area (SF)	Inc. Volume (CF)	
318		0	2187		
319		1	2637	2412	
320		1	3114	2875.5	5287.5

Required Water Quality Volume

V= 105,523 s.f. x $\frac{0.5}{12}$ = **4,397 c.f.**

Volume Provided 0 c.f.

5,288	**c.f. >**	**4,397**	**c.f. O.K.**

Subcatchment P1H (SMA 7)
Soils:
Hydrologic Group: B
Required Water Quality Volume
0.5 inches of runoff x impervious area

Impervious area: 2.24908173 acres
97,970 s.f.

Sediment Forebay P1D					
Elev. (FT)	Change Elev. (FT)		Area (SF)	Inc. Volume (CF)	
318		0	1600		
319		1	2111	1855.5	
320		1	2667	2389	4244.5
321		1	3293	2980	5369

Required Water Quality Volume

V= 97,970 s.f. x $\frac{0.5}{12}$ = **4,082 c.f.**

Volume Provided 5,369 c.f.

5,369	**c.f. >**	**4,082**	**c.f. O.K.**

Project: 700-800 Mass Ave
Location: Boxborough, MA
Prepared For: Stamski & McNary, Inc.

CONTECH
ENGINEERED SOLUTIONS

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

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

Given:

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)
DMH-25	0.50	0.0007813	6.0	0.100	1.00

Procedure:

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

Structure Name	qu (csm/in.)
DMH-25	774.00

1. Compute Q Rate using the following equation:

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

where:

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

Structure Name	Q_1 (cfs)
DMH-25	0.60

Groundwater Recharge Calculations

Recharge Volume Calculations

Job: SM-2069

Calculated by: RJH
Date: 6/23/17

SMA 1

Soils: Charlton Hollis Rock Outcrop
Hydrologic Group: B
Required Recharge Volume
0.35 inches of runoff x impervious area

Impervious area: 0.68 acres
29,577 s.f.

Required Recharge Volume (Rv)

$$Rv = 29{,}577 \text{ s.f.} \times \frac{0.35}{12} = \mathbf{863 \text{ c.f.}}$$

Simple Dynamic Method

A=Rv / (D+KT)
Rv=A(D+kT)

D (depth of infiltration facility):	1 ft
K (saturated hydraulic conductivity):	1.02 inches/hour
	0.085 feet/hour
T (time):	2 hours
A=	3,841 s.f.
Volume of Chambers=	397
Rv=	4,494 c.f. > 863 c.f.

72 Hour Drawdown

Rv/(K x Bottom Area)= 2.26 Hours

2.26 < 72 hours O.K.

Recharge Volume Calculations

Job: SM-2069

Calculated by: RJH
Date: 6/23/17

SMA 2

Soils: Charlton Hollis Rock Outcrop

Hydrologic Group: B

Required Recharge Volume

0.35 inches of runoff x impervious area

Impervious area: 1.28 acres
55,676 s.f.

Required Recharge Volume (Rv)

$$Rv = 53{,}724 \text{ s.f.} \times \frac{0.35}{12} = \mathbf{1{,}567 \text{ c.f.}}$$

Simple Dynamic Method

A=Rv / (D+KT)

Rv=A(D+kT)

D (depth of infiltration facility):	1.2 ft		
K (saturated hydraulic conductivity):	2.41 inches/hour		
	0.2008333 feet/hour		
T (time):	2 hours		
A=	4,746 s.f.		
Volume of Chambers=	397		
Rv=	7,602 c.f.	>	1,567 c.f.

72 Hour Drawdown

Rv/(K x Bottom Area)= 1.03 Hours

1.03 < 72 hours O.K.

Recharge Volume Calculations

Job: SM-2069

Calculated by: RJH
Date: 6/23/17

SMA 3

Soils: Charlton Hollis Rock Outcrop
Hydrologic Group: B
Required Recharge Volume
0.35 inches of runoff x impervious area

Impervious area: 1.16 acres
50,528 s.f.

Required Recharge Volume (Rv)

Rv = 50,528 s.f. x $\frac{0.35}{12}$ = **1,474 c.f.**

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

D (depth of infiltration facility):	0.5 ft	
K (saturated hydraulic conductivity):	2.41 inches/hour	
	0.2008333 feet/hour	
T (time):	2 hours	
A=	4,580 s.f.	
Rv=	4,130 c.f.	> 1,474 c.f.

72 Hour Drawdown
Rv/(K x Bottom Area)= 1.78 Hours
1.78 < 72 hours O.K.

Recharge Volume Calculations

Job: SM-2069

Calculated by:
Date:

SMA 4

Soils:	Charlton Hollis Rock Outcrop	
Hydrologic Group:	A AND B	

Required Recharge Volume

0.35 inches of runoff x impervious area
0.6 inches of runoff x impervious area

Impervious area:	1.99 acres	*B Soil*
	86,562 s.f.	
Impervious area:	0.44 acres	*A Soil*
	18,961 s.f.	

Required Recharge Volume (Rv)

$$Rv = 86{,}562 \text{ s.f.} \times \frac{0.35}{12} = \mathbf{2{,}525 \text{ c.f.}}$$

$$Rv = 18{,}961 \text{ s.f.} \times \frac{0.6}{12} = \mathbf{948 \text{ c.f.}}$$

Simple Dynamic Method

A=Rv / (D+KT)
Rv=A(D+kT)

D (depth of infiltration facility):	0.5 ft		
K (saturated hydraulic conductivity):	2.41 inches/hour		
	0.2008333 feet/hour		
T (time):	2 hours		
A=	5,305 s.f.		
Rv=	4,783 c.f.	>	3,473

72 Hour Drawdown

Rv/(K x Bottom Area)= 2.63 Hours

2.63 < 72 hours O.K.

Recharge Volume Calculations

Job: SM-2069

Calculated by: RJH
Date: 6/23/17

RD

Soils: Charlton Hollis Rock Outcrop
Hydrologic Group: B
Required Recharge Volume
0.35 inches of runoff x impervious area

Impervious area: 0.11 acres
4,851 s.f.

Required Recharge Volume (Rv)

$$Rv = 4{,}851 \text{ s.f.} \times \frac{0.35}{12} = \mathbf{141\ c.f.}$$

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

D (depth of infiltration facility):	1	ft
K (saturated hydraulic conductivity):	2.41	inches/hour
	0.2008333	feet/hour
T (time):	2	hours
A=	1,651	s.f.
Voids=	0.40	
Volume of Chambers=	3,834	
Rv=	5,158	c.f. > 141 c.f.

72 Hour Drawdown
Rv/(K x Bottom Area)= 0.18 Hours
0.18 < 72 hours O.K.

Recharge Volume Calculations

Job: SM-2069

Calculated by: RJH
Date: 6/23/17

RD 2

Soils: Charlton Hollis Rock Outcrop
Hydrologic Group: B
Required Recharge Volume
0.35 inches of runoff x impervious area

Impervious area: 0.56 acres
24,255 s.f.

Required Recharge Volume (Rv)

$$Rv = 24{,}255 \text{ s.f.} \times \frac{0.35}{12} = \mathbf{707} \textbf{ c.f.}$$

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

D (depth of infiltration facility):	1	ft
K (saturated hydraulic conductivity):	2.41	inches/hour
	0.2008333	feet/hour
T (time):	2	hours
A=	1,569	s.f.
Voids=	0.40	
Volume of Chambers=	3,408	
Rv=	4,666	c.f. > 707 c.f.

72 Hour Drawdown
Rv/(K x Bottom Area)= 1.03 Hours
1.03 < 72 hours O.K.

Recharge Volume Calculations

Job: SM-2069

Calculated by: RJH
Date: 6/23/17

SMA 6

Soils: Charlton Hollis Rock Outcrop

Hydrologic Group: B

Required Recharge Volume

0.6 inches of runoff x impervious area

Impervious area: 1.48 acres
64,417 s.f.

Required Recharge Volume (Rv)

$$Rv = 64{,}417 \text{ s.f.} \times \frac{0.6}{12} = \mathbf{3{,}221 \text{ c.f.}}$$

Simple Dynamic Method

A=Rv / (D+KT)

Rv=A(D+kT)

D (depth of infiltration facility):	2 ft	
K (saturated hydraulic conductivity):	2.41 inches/hour	
	0.2008333 feet/hour	
T (time):	2 hours	
A=	2,004 s.f.	
Volume of Chambers=	18,531	
Rv=	23,344 c.f.	> 3,221 c.f.

72 Hour Drawdown

Rv/(K x Bottom Area)= 0.87 Hours

0.87 < 72 hours O.K.

Recharge Volume Calculations

Job: SM-2069

Calculated by: RJH
Date: 6/23/17

SMA 7

Soils: Charlton Hollis Rock Outcrop

Hydrologic Group: B

Required Recharge Volume

0.35 inches of runoff x impervious area

Impervious area: 2.25 acres
97,970 s.f.

Required Recharge Volume (Rv)

$$Rv = 97{,}970 \text{ s.f.} \times \frac{0.35}{12} = \mathbf{2{,}857 \text{ c.f.}}$$

Simple Dynamic Method

A=Rv / (D+KT)

Rv=A(D+kT)

D (depth of infiltration facility):	1	ft
K (saturated hydraulic conductivity):	2.41	inches/hour
	0.2008333	feet/hour
T (time):	2	hours
A=	7,036	s.f.
Voids=	0.40	
Volume of Chambers=	13,426	
Rv=	19,067	c.f. > 2,857 c.f.

72 Hour Drawdown

Rv/(K x Bottom Area)= 1.06 Hours

1.06 < 72 hours O.K.

Recharge Volume Calculations

Job: SM-2069

Calculated by: RJH
Date: 6/23/17

SMA 8

Soils: Charlton Hollis Rock Outcrop
Hydrologic Group: B
Required Recharge Volume
0.35 inches of runoff x impervious area

Impervious area: 1.45 acres
63,099 s.f.

Required Recharge Volume (Rv)

$$Rv = 63{,}099 \text{ s.f.} \times \frac{0.35}{12} = \mathbf{1{,}840 \text{ c.f.}}$$

Simple Dynamic Method

A=Rv / (D+KT)
Rv=A(D+kT)

D (depth of infiltration facility):	2 ft	
K (saturated hydraulic conductivity):	2.41 inches/hour	
	0.2008333 feet/hour	
T (time):	2 hours	
A=	1,042 s.f.	
Rv=	2,503 c.f.	> 1,840 c.f.

72 Hour Drawdown

Rv/(K x Bottom Area)= 3.66 Hours

3.66 < 72 hours O.K.

Inlet Grate Capacity Calculations

Inlet Grate Capacity Calculations

Job: SM-2069 | Calculated by: JTM
Project: 700-800 Mass Ave | Date: 12/22/2016

LeBARON FOUNDRY, INC. LF246 inlet grate pass area A = 225 sq. in.
1.56 sq. ft.

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

C = orifice coefficient
C = 0.6 square edges
A = inlet area
A = 1.56 sq. ft.
g = gravitational constant
g = 32.2 ft/sec^2
h = head on inlet
h = 0.33 ft. (low points)
0.17 ft. (on slope)
f = clogging factor
f = 0.66

Single Grate
Q (MAX)= 2.85 cfs (LP) low points LF246
Q (MAX)= 2.04 cfs (OS) on slope LF246
Double Grate
Q (MAX)= 5.70 cfs (LP) low points LF246
Q (MAX)= 4.09 cfs (OS) on slope LF246

	TRIBUTARY AREA (AC)	TIME OF CONC.	100 YR INTENSITY	C	Q=CiA Q100	POSITION	Q (MAX)	single grate	double grate
CB1	0.10	10	7.6	0.9	0.68	LP	2.85	yes	
CB2	0.16	10	7.6	0.77	0.94	LP	2.85	yes	
CB3	0.23	10	7.6	0.69	1.21	LP	2.85	yes	
CB4	0.15	10	7.6	0.76	0.87	OS	2.04	yes	
CB4A	0.26	10	7.6	0.68	1.34	LP	2.85	yes	
CB5	0.11	10	7.6	0.77	0.64	OS	2.04	yes	
CB6	0.29	10	7.6	0.51	1.12	OS	2.04	yes	
CB7	0.16	10	7.6	0.77	0.94	OS	2.04	yes	
CB8	0.44	10	7.6	0.44	1.47	LP	2.85	yes	
CB9	0.25	10	7.6	0.79	1.50	LP	2.85	yes	
CB10	0.15	10	7.6	0.76	0.87	OS	2.04	yes	
CB11	0.12	10	7.6	0.78	0.71	OS	2.04	yes	
CB12	0.28	10	7.6	0.6	1.28	OS	2.04	yes	
CB13	0.28	10	7.6	0.68	1.45	OS	2.04	yes	

CB14	0.31	10	7.6	0.72	1.70	OS	4.09		yes
CB15	0.46	10	7.6	0.69	2.41	OS	4.09		yes
CB16	0.3	10	7.6	0.78	1.78	LP	2.85	yes	
CB17	0.43	10	7.6	0.72	2.35	LP	2.85	yes	
CB18	0.27	10	7.6	0.67	1.37	OS	2.04	yes	
CB19	0.2	10	7.6	0.76	1.16	OS	2.04	yes	
CB20	0.17	10	7.6	0.86	1.11	OS	2.04	yes	
CB21	0.12	10	7.6	0.73	0.67	OS	2.04	yes	
CB22	0.31	10	7.6	0.7	1.65	OS	2.04	yes	
CB23	0.13	10	7.6	0.79	0.78	OS	2.04	yes	
CB24	0.77	10	7.6	0.72	4.21	LP	5.7		yes
CB25	0.31	10	7.6	0.61	1.44	OS	2.04	yes	
CB26	0.22	10	7.6	0.61	1.02	OS	2.04	yes	
CB27	0.31	10	7.6	0.67	1.58	OS	2.04	yes	
CB28	0.14	10	7.6	0.75	0.80	OS	2.04	yes	

TSS Removal Calculations

INSTRUCTIONS:
1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: Pretreatment SMA-1

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Catch Basin W/ Hood	25%	1.00	0.25	0.75
Sediment Forebay	25%	0.75	0.19	0.56

Total TSS Removal = 44%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 2069
Prepared By: JTM
Date: 11/14/16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:
1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

TSS Removal Calculation Worksheet

Location: Pretreatment SMA-2

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Catch Basin W/ Hood	25%	1.00	0.25	0.75
Sediment Forebay	25%	0.75	0.19	0.56

Total TSS Removal = 44%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 2069
Prepared By: JTM
Date: 11/14/16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: Pretreatment SMA-3

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Catch Basin W/ Hood	25%	1.00	0.25	0.75
Sediment Forebay	25%	0.75	0.19	0.56

Total TSS Removal = 44%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 2069
Prepared By: JTM
Date: 11/14/16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Non-automated: Mar. 4, 2008

INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

TSS Removal Calculation Worksheet

Location: SMA-1

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Catch Basin W/ Hood	25%	1.00	0.25	0.75
Infiltration Basin W/ Sed. Forebay	80%	0.75	0.60	0.15

Total TSS Removal = 85%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 2069
Prepared By: JTM
Date: 11/14/16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

TSS Removal Calculation Worksheet

Location: SMA-2

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Catch Basin W/ Hood	25%	1.00	0.25	0.75
Infiltration Basin W/ Sed. Forebay	80%	0.75	0.60	0.15

Total TSS Removal = 85%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 2069
Prepared By: JTM
Date: 11/14/16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

TSS Removal Calculation Worksheet

Location: SMA-3

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Catch Basin W/ Hood	25%	1.00	0.25	0.75
Infiltration Basin W/ Sed. Forebay	80%	0.75	0.60	0.15

Total TSS Removal = 85%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 2069
Prepared By: JTM
Date: 11/14/16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

TSS Removal Calculation Worksheet

Location: SMA-4

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Catch Basin W/ Hood	25%	1.00	0.25	0.75
Infiltration Basin W/ Sed. Forebay	80%	0.75	0.60	0.15

Total TSS Removal = 85%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 2069
Prepared By: JTM
Date: 11/14/16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

TSS Removal Calculation Worksheet

Location: SMA-7

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Catch Basin W/ Hood	25%	1.00	0.25	0.75
Subsurface Basin W/ Sed. Forebay	80%	0.75	0.60	0.15

Total TSS Removal = 85%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 2069
Prepared By: JTM
Date: 11/14/16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

VortSentry® HS Estimated Net Annual TSS Reduction

CONTECH
ENGINEERED SOLUTIONS

700-800 MASS AVE
BOXBOROUGH, MA
Model VSHS48
System DMH-25

Design Ratio[1] = $\frac{0.5 \text{ acres} \times 0.9}{63 \text{ ft3}}$ **= 0.007**

Rainfall Intensity "/hr	Flow Rate cfs	Operating Rate[2] cfs/ft^3	% Total Rainfall Depth[3]	Rmvl. Effcy[4] (%)	Rel. Effcy (%)
0.02	0.01	0.00014	10.2%	98.0%	10.0%
0.04	0.02	0.00029	9.6%	98.0%	9.5%
0.06	0.03	0.00043	9.4%	98.0%	9.3%
0.08	0.04	0.00057	7.7%	98.0%	7.6%
0.10	0.05	0.00072	8.6%	98.0%	8.4%
0.12	0.05	0.00086	6.3%	98.0%	6.2%
0.14	0.06	0.00100	4.7%	98.0%	4.6%
0.16	0.07	0.00115	4.6%	98.0%	4.5%
0.18	0.08	0.00129	3.5%	98.0%	3.5%
0.20	0.09	0.00143	4.3%	98.0%	4.3%
0.25	0.11	0.00179	8.0%	98.0%	7.8%
0.30	0.14	0.00215	5.6%	98.0%	5.5%
0.35	0.16	0.00251	4.4%	98.0%	4.3%
0.40	0.18	0.00286	2.5%	98.0%	2.5%
0.45	0.20	0.00322	2.5%	98.0%	2.5%
0.50	0.23	0.00358	1.4%	98.0%	1.4%
0.75	0.34	0.00537	5.0%	98.0%	4.9%
1.00	0.45	0.00716	1.0%	97.9%	1.0%
1.50	0.68	0.01074	0.0%	93.0%	0.0%
2.00	0.90	0.01432	0.0%	89.0%	0.0%
3.00	1.35	0.02149	0.5%	73.0%	0.4%
					97.9%
				% rain falling at >3"/hr =	0.0%
				Removal Efficiency Adjustment[4] =	6.5%
				Predicted Net Annual Load Removal Efficiency =	**91.4%**

1 - Design Ratio = (Total Drainage Area x Runoff Coefficient) / VortSentry HS Treatment Volume
= The Total Drainage Area and Runoff Coefficient are specified by the site engineer.

2 - Operating Rate (cfs/ft^3) = Rainfall Intensity ("/hr) x Design Ratio

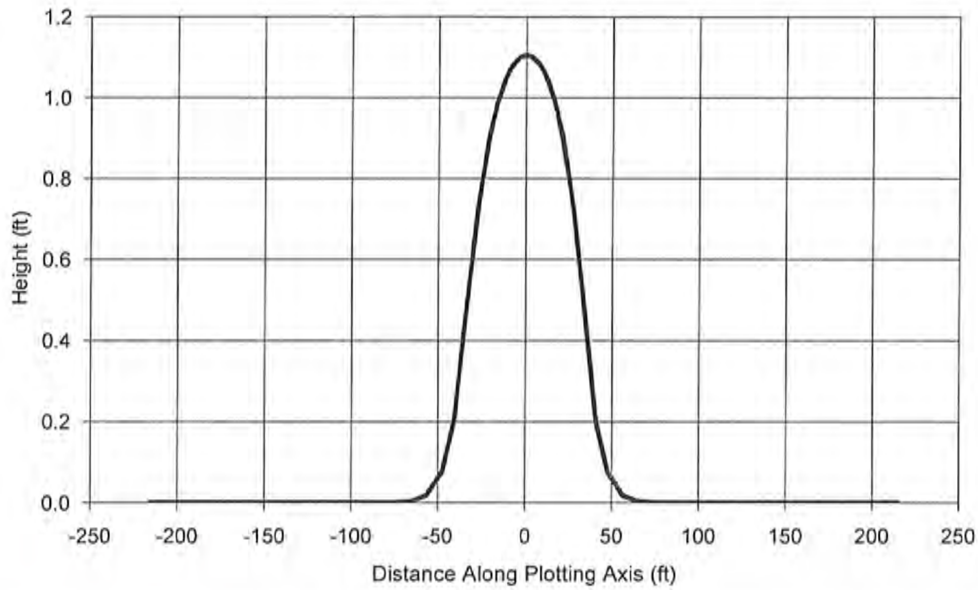
3 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA

4 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Calculated by:	CJA	Date:	11/29/16	Checked by:		Date:	

Groundwater Mounding Calculations

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 1

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:26:30 PM

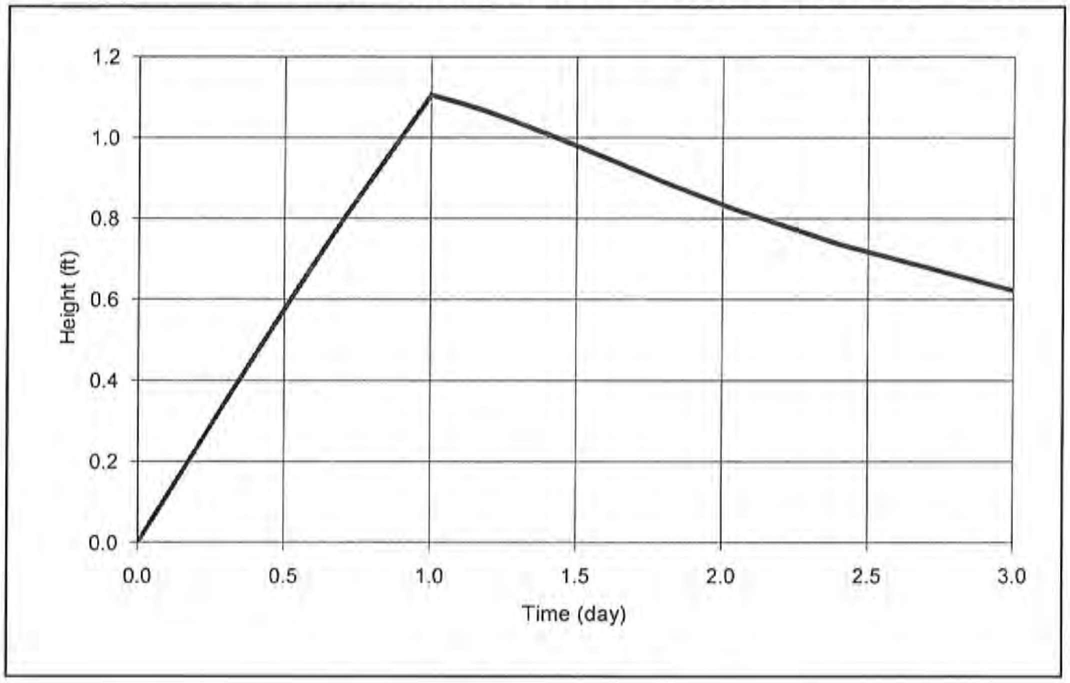
INPUT PARAMETERS

Application rate: 0.29 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.25
Hydraulic conductivity: 3 ft/day
Initial saturated thickness: 10 ft
Length of application area: 56.33 ft
Width of application area: 52 ft
Constant head boundary used at: 215 ft
Plotting axis from Y-Axis: 45 degrees
Edge of recharge area:
positive X: 26 ft
positive Y: 26 ft
Total volume applied: 849.4564 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-152	-152	-215	0
-127.9	-127.9	-181	0
-103.7	-103.7	-147	0
-79.5	-79.5	-112	0
-60.5	-60.5	-86	0
-45.8	-45.8	-65	0
-33.7	-33.7	-48	0.08
-23.5	-23.5	-33	0.5
-14.7	-14.7	-21	0.91
-8.8	-8.8	-12	1.04
-4.8	-4.8	-7	1.09
0	0	0	1.1
4.8	4.8	7	1.09
8.8	8.8	12	1.04
14.7	14.7	21	0.91
23.5	23.5	33	0.5
33.7	33.7	48	0.08
45.8	45.8	65	0
60.5	60.5	86	0
79.5	79.5	112	0
103.7	103.7	147	0
127.9	127.9	181	0
152	152	215	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 1

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:27:23 PM

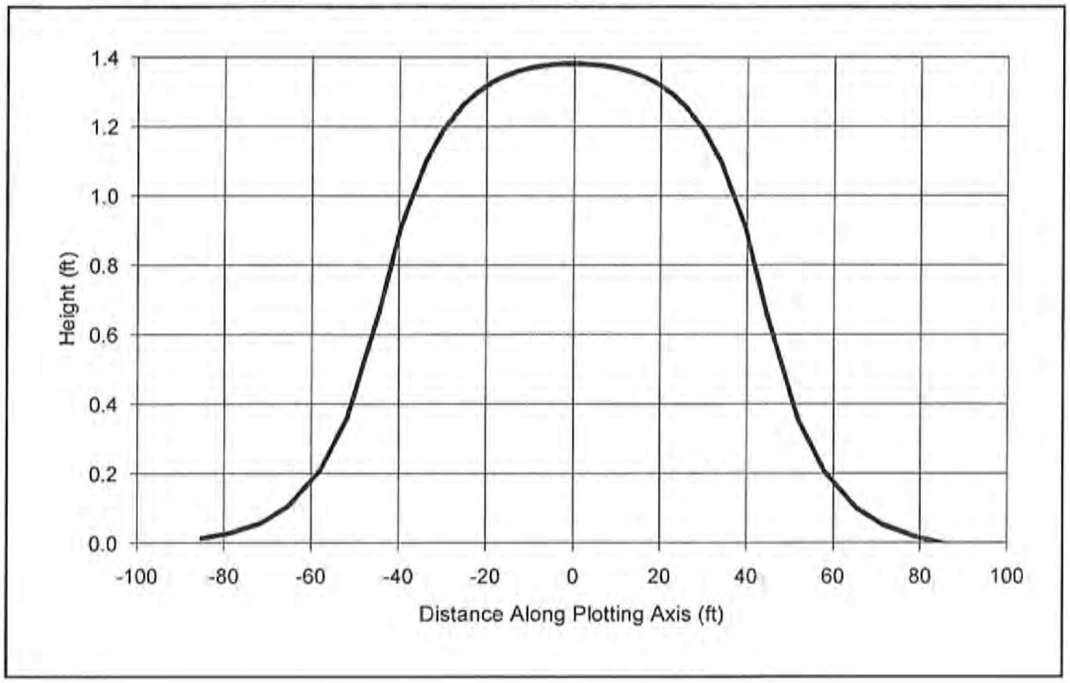
INPUT PARAMETERS

Application rate: 0.29 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.25
Hydraulic conductivity: 3 ft/day
Initial saturated thickness: 10 ft
Length of application area: 56.33 ft
Width of application area: 52 ft
Constant head boundary used at: 215 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 849.4564 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.02
0	0.05
0.1	0.11
0.2	0.18
0.2	0.26
0.3	0.35
0.4	0.46
0.5	0.6
0.7	0.8
1	1.1
1	1.1
1.1	1.09
1.2	1.06
1.3	1.03
1.4	1
1.6	0.95
1.8	0.89
2	0.82
2.4	0.74
3	0.62

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 2

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:33:45 PM

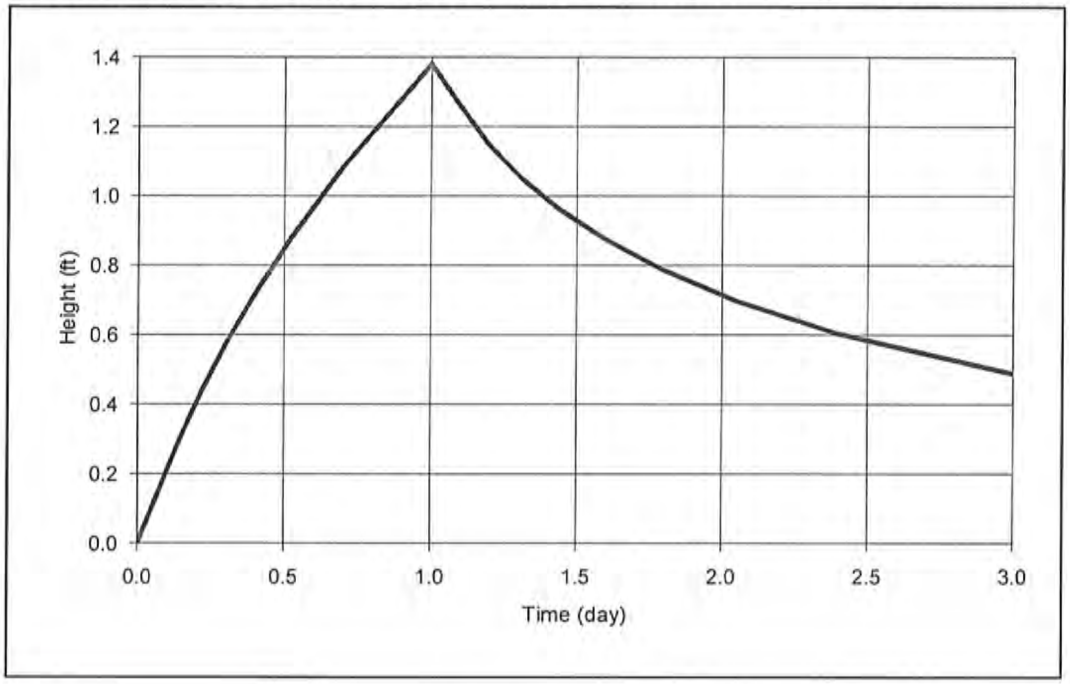
INPUT PARAMETERS

Application rate: 0.66 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.31
Hydraulic conductivity: 8 ft/day
Initial saturated thickness: 10 ft
Length of application area: 87.67 ft
Width of application area: 27 ft
Constant head boundary used at: 85 ft
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 43.8 ft
Total volume applied: 1562.279 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-85	-85	0.01
0	-71.5	-71	0.06
0	-58	-58	0.21
0	-44.4	-44	0.67
0	-33.8	-34	1.1
0	-25.6	-26	1.26
0	-18.9	-19	1.33
0	-13.2	-13	1.36
0	-8.2	-8	1.37
0	-4.9	-5	1.38
0	-2.7	-3	1.38
0	0	0	1.38
0	2.7	3	1.38
0	4.9	5	1.38
0	8.2	8	1.37
0	13.2	13	1.36
0	18.9	19	1.33
0	25.6	26	1.26
0	33.8	34	1.1
0	44.4	44	0.66
0	58	58	0.2
0	71.5	71	0.05
0	85	85	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 2

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:33:53 PM

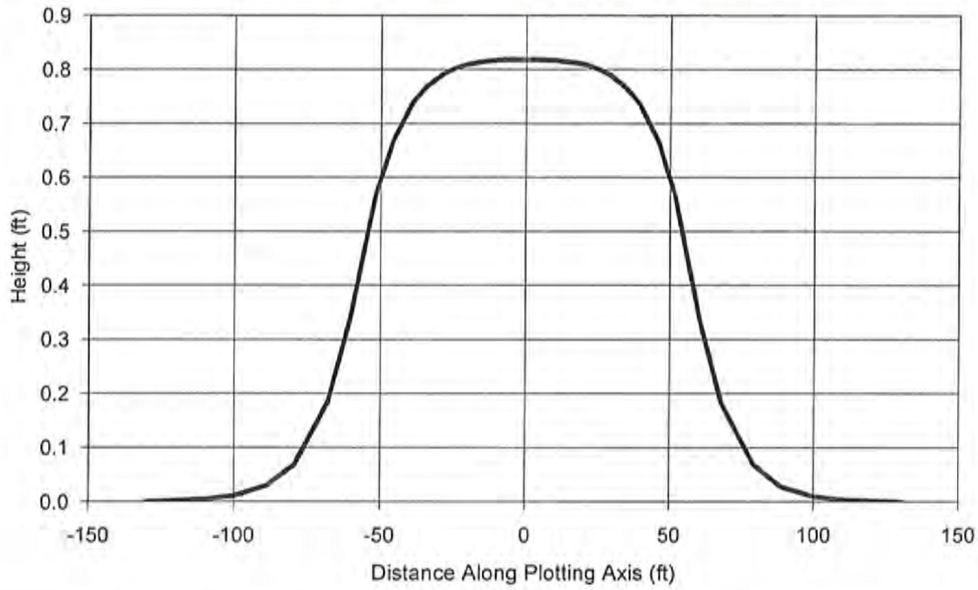
INPUT PARAMETERS

Application rate: 0.66 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.31
Hydraulic conductivity: 8 ft/day
Initial saturated thickness: 10 ft
Length of application area: 87.67 ft
Width of application area: 27 ft
Constant head boundary used at: 85 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 1562.279 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.03
0	0.1
0.1	0.2
0.2	0.32
0.2	0.44
0.3	0.57
0.4	0.72
0.5	0.88
0.7	1.08
1	1.38
1	1.35
1.1	1.27
1.2	1.15
1.3	1.05
1.4	0.96
1.6	0.87
1.8	0.79
2	0.7
2.4	0.6
3	0.49

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 3

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:28:26 PM

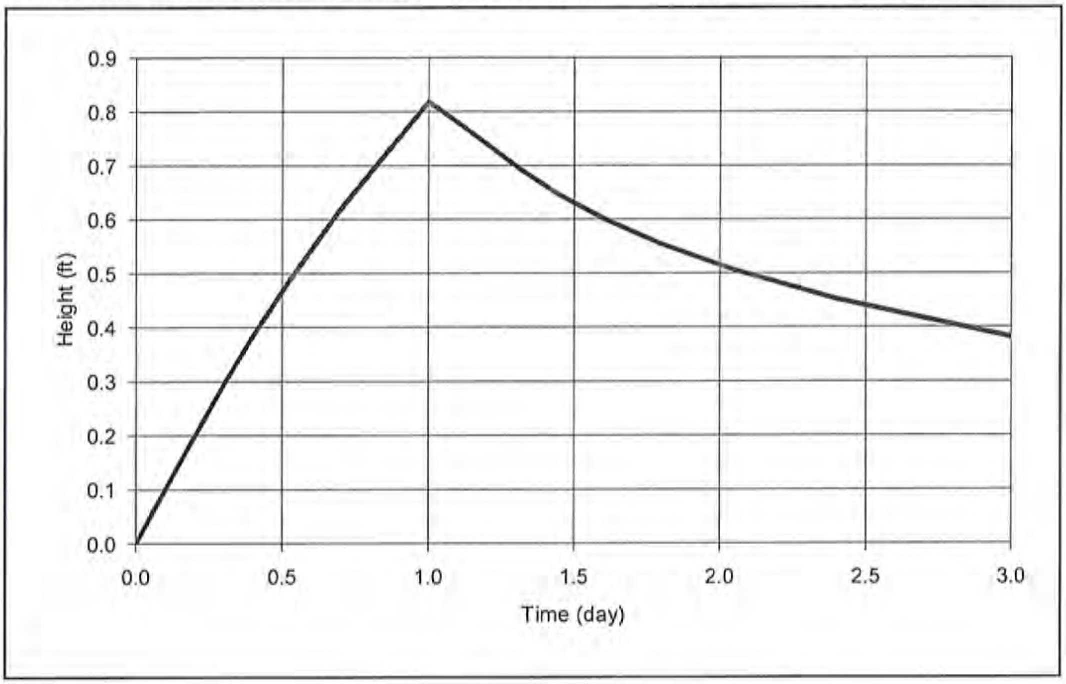
INPUT PARAMETERS

Application rate: 0.31 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.31
Hydraulic conductivity: 8 ft/day
Initial saturated thickness: 10 ft
Length of application area: 115.45 ft
Width of application area: 40.33 ft
Constant head boundary used at: 130 ft
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 57.7 ft
Total volume applied: 1443.391 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-130	-130	0
0	-109.3	-109	0
0	-88.6	-89	0.03
0	-68	-68	0.18
0	-51.7	-52	0.57
0	-39.1	-39	0.74
0	-28.8	-29	0.79
0	-20.1	-20	0.81
0	-12.6	-13	0.82
0	-7.5	-8	0.82
0	-4.1	-4	0.82
0	0	0	0.82
0	4.1	4	0.82
0	7.5	8	0.82
0	12.6	13	0.82
0	20.1	20	0.81
0	28.8	29	0.79
0	39.1	39	0.74
0	51.7	52	0.57
0	68	68	0.18
0	88.6	89	0.03
0	109.3	109	0
0	130	130	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 3

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:28:33 PM

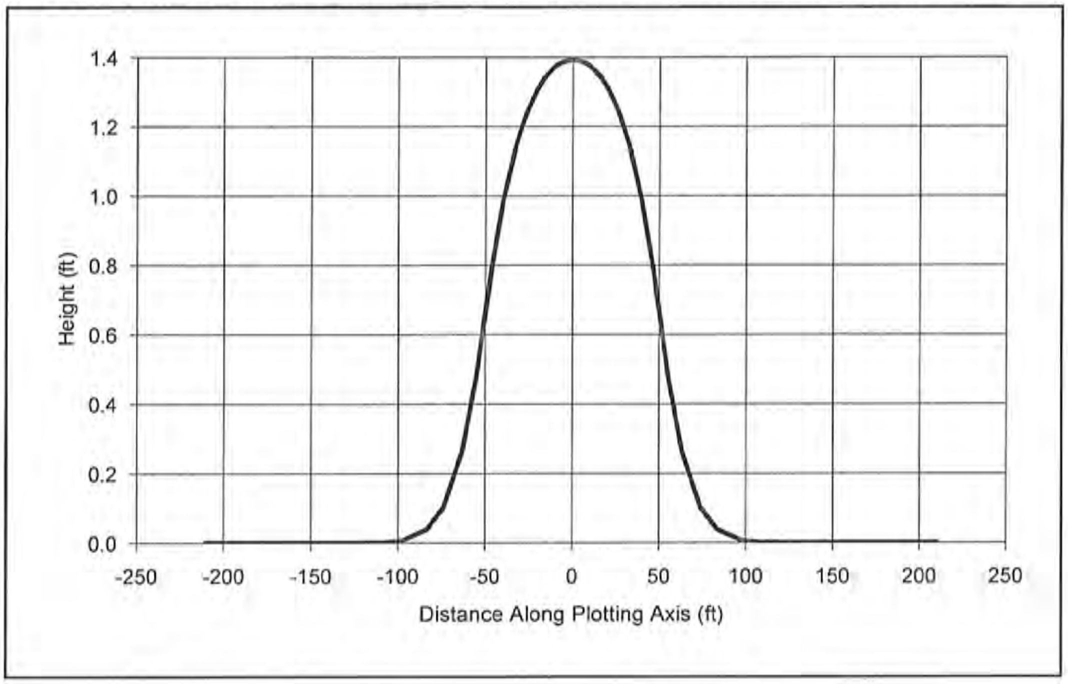
INPUT PARAMETERS

Application rate: 0.31 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.31
Hydraulic conductivity: 8 ft/day
Initial saturated thickness: 10 ft
Length of application area: 115.45 ft
Width of application area: 40.33 ft
Constant head boundary used at: 130 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 1443.391 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.01
0	0.04
0.1	0.1
0.2	0.15
0.2	0.22
0.3	0.29
0.4	0.38
0.5	0.49
0.7	0.62
1	0.82
1	0.81
1.1	0.78
1.2	0.74
1.3	0.7
1.4	0.65
1.6	0.6
1.8	0.56
2	0.51
2.4	0.45
3	0.38

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 4

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:28:58 PM

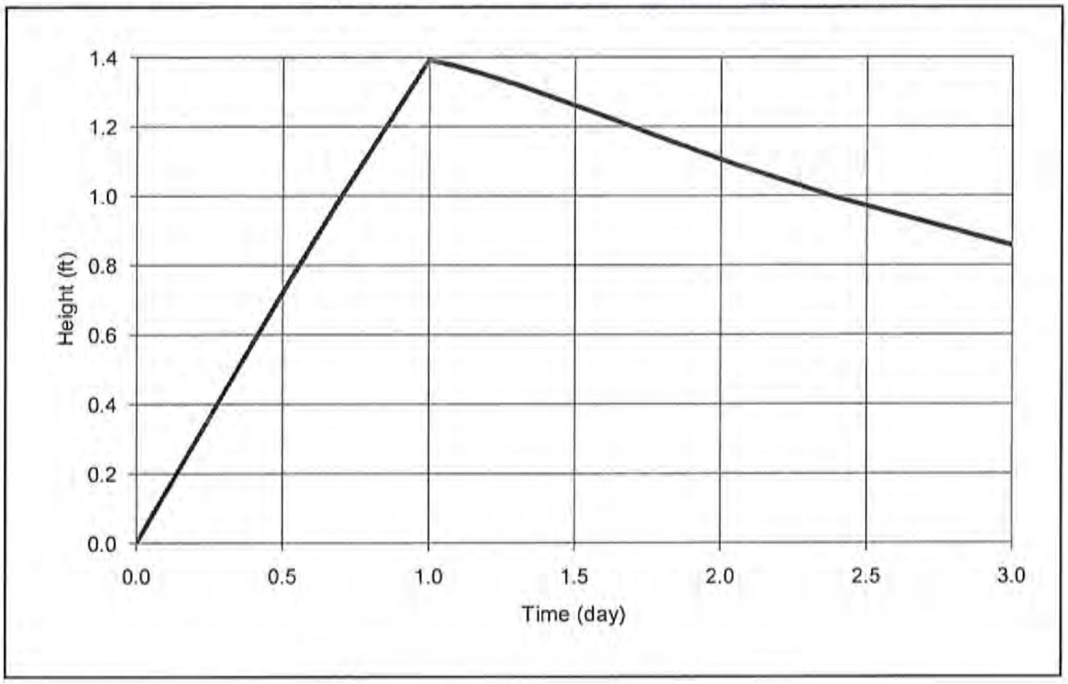
INPUT PARAMETERS

Application rate: 0.45 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.31
Hydraulic conductivity: 8 ft/day
Initial saturated thickness: 10 ft
Length of application area: 106 ft
Width of application area: 72 ft
Constant head boundary used at: 210 ft
Plotting axis from Y-Axis: 45 degrees
Edge of recharge area:
positive X: 36 ft
positive Y: 36 ft
Total volume applied: 3434.4 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-148.5	-148.5	-210	0
-124.9	-124.9	-177	0
-101.3	-101.3	-143	0
-77.6	-77.6	-110	0
-59.1	-59.1	-84	0.04
-44.7	-44.7	-63	0.26
-32.9	-32.9	-47	0.79
-23	-23	-33	1.15
-14.4	-14.4	-20	1.31
-8.6	-8.6	-12	1.36
-4.7	-4.7	-7	1.38
0	0	0	1.39
4.7	4.7	7	1.38
8.6	8.6	12	1.36
14.4	14.4	20	1.31
23	23	33	1.15
32.9	32.9	47	0.79
44.7	44.7	63	0.26
59.1	59.1	84	0.04
77.6	77.6	110	0
101.3	101.3	143	0
124.9	124.9	177	0
148.5	148.5	210	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 4

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:29:09 PM

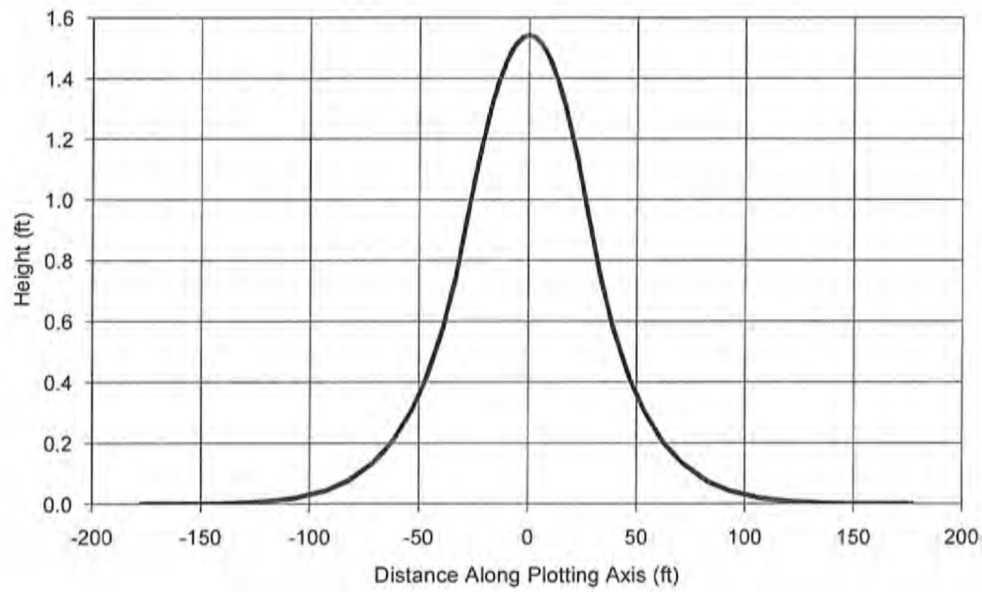
INPUT PARAMETERS

Application rate: 0.45 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.31
Hydraulic conductivity: 8 ft/day
Initial saturated thickness: 10 ft
Length of application area: 106 ft
Width of application area: 72 ft
Constant head boundary used at: 210 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 3434.4 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.02
0	0.07
0.1	0.14
0.2	0.22
0.2	0.32
0.3	0.44
0.4	0.58
0.5	0.75
0.7	1
1	1.39
1	1.39
1.1	1.37
1.2	1.35
1.3	1.32
1.4	1.28
1.6	1.23
1.8	1.17
2	1.09
2.4	0.99
3	0.86

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 6

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:37:51 PM

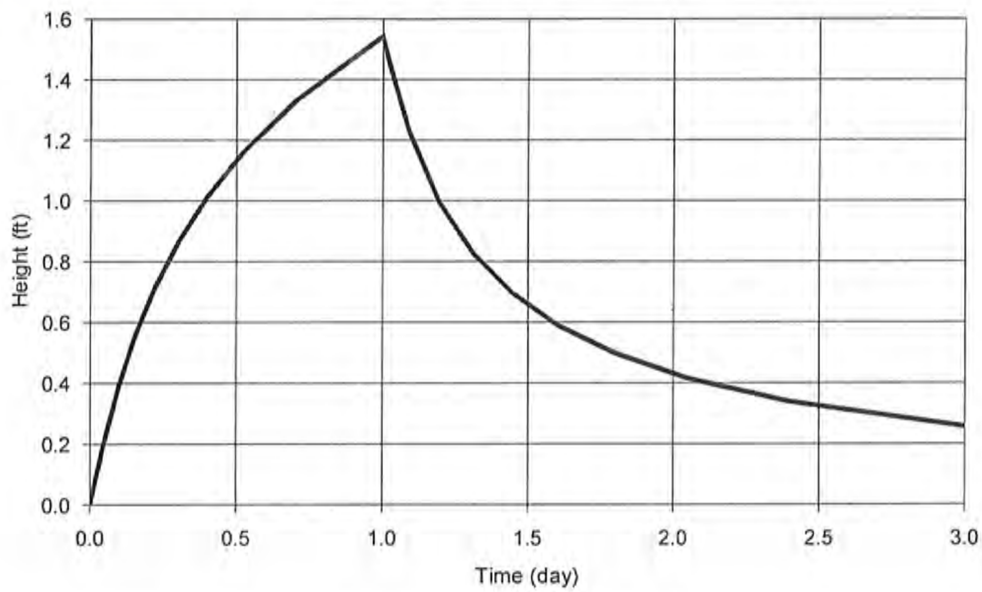
INPUT PARAMETERS

Application rate: 1.52 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 53 ft
Width of application area: 40 ft
Constant head boundary used at: 177 ft
Plotting axis from Y-Axis: 45 degrees
Edge of recharge area:
positive X: 20 ft
positive Y: 20 ft
Total volume applied: 3222.4 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-125.2	-125.2	-177	0
-105.3	-105.3	-149	0
-85.3	-85.3	-121	0.01
-65.4	-65.4	-93	0.04
-49.8	-49.8	-70	0.14
-37.7	-37.7	-53	0.31
-27.8	-27.8	-39	0.57
-19.4	-19.4	-27	0.96
-12.1	-12.1	-17	1.3
-7.3	-7.3	-10	1.45
-3.9	-3.9	-6	1.52
0	0	0	1.54
3.9	3.9	6	1.52
7.3	7.3	10	1.45
12.1	12.1	17	1.3
19.4	19.4	27	0.96
27.8	27.8	39	0.57
37.7	37.7	53	0.31
49.8	49.8	70	0.14
65.4	65.4	93	0.04
85.3	85.3	121	0.01
105.3	105.3	149	0
125.2	125.2	177	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 6

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:38:18 PM

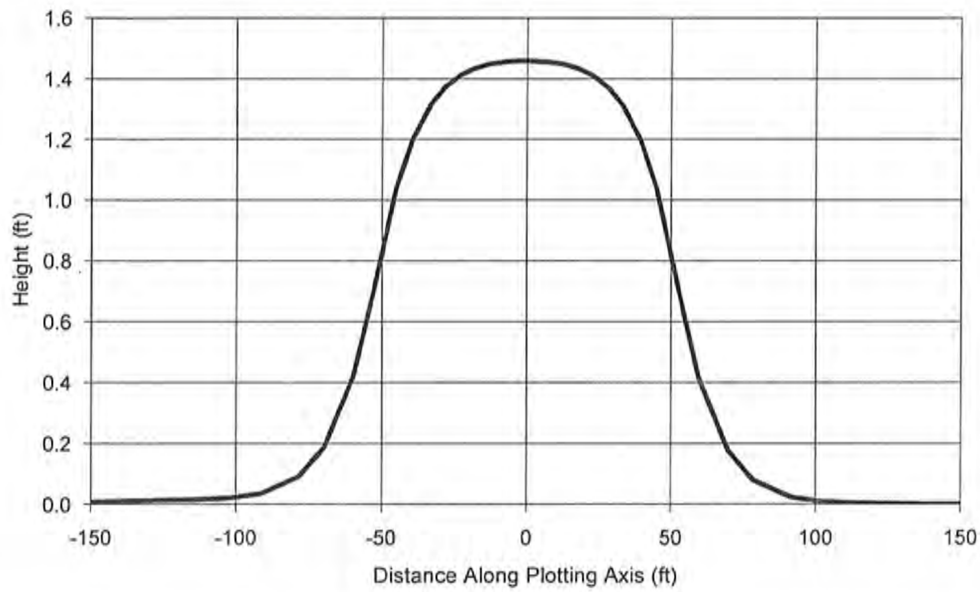
INPUT PARAMETERS

Application rate: 1.52 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 53 ft
Width of application area: 40 ft
Constant head boundary used at: 177 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 3222.4 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.06
0	0.2
0.1	0.39
0.2	0.56
0.2	0.72
0.3	0.86
0.4	1.01
0.5	1.16
0.7	1.33
1	1.54
1	1.44
1.1	1.23
1.2	1
1.3	0.83
1.4	0.7
1.6	0.59
1.8	0.5
2	0.42
2.4	0.34
3	0.26

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 7

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:30:44 PM

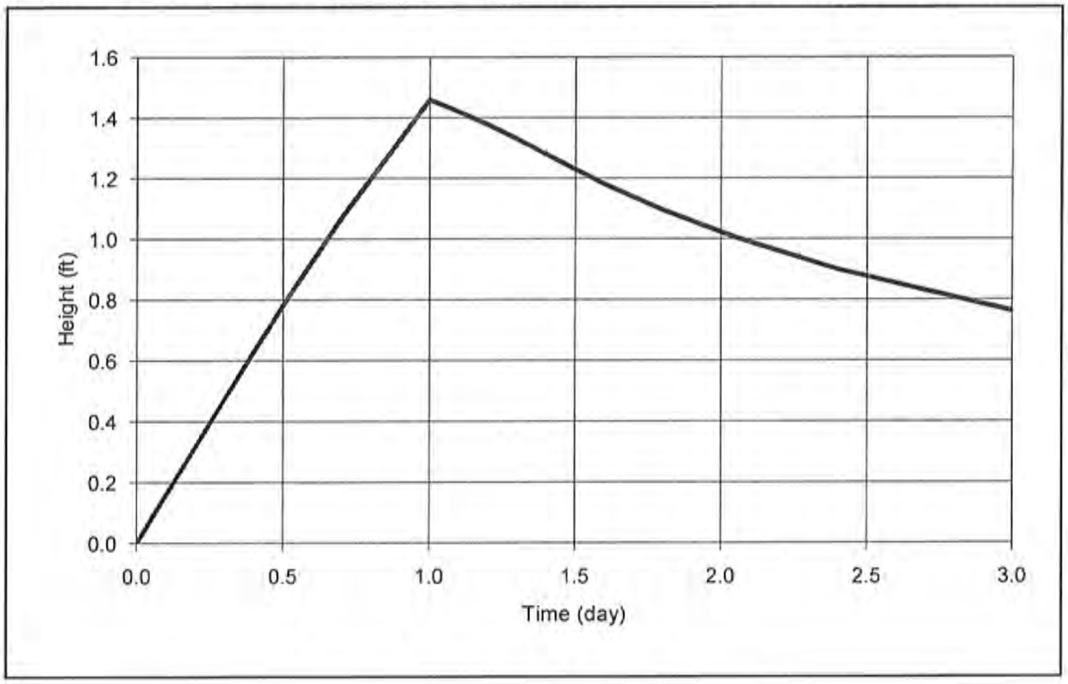
INPUT PARAMETERS

Application rate: 0.49 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.31
Hydraulic conductivity: 8 ft/day
Initial saturated thickness: 10 ft
Length of application area: 104 ft
Width of application area: 56 ft
Constant head boundary used at: 150 ft
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 52 ft
Total volume applied: 2853.76 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-150	-150	0.01
0	-126.2	-126	0.01
0	-102.3	-102	0.02
0	-78.4	-78	0.09
0	-59.7	-60	0.42
0	-45.2	-45	1.04
0	-33.3	-33	1.32
0	-23.2	-23	1.41
0	-14.5	-15	1.44
0	-8.7	-9	1.46
0	-4.7	-5	1.46
0	0	0	1.46
0	4.7	5	1.46
0	8.7	9	1.45
0	14.5	15	1.44
0	23.2	23	1.41
0	33.3	33	1.31
0	45.2	45	1.03
0	59.7	60	0.41
0	78.4	78	0.08
0	102.3	102	0.01
0	126.2	126	0
0	150	150	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 7

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:30:51 PM

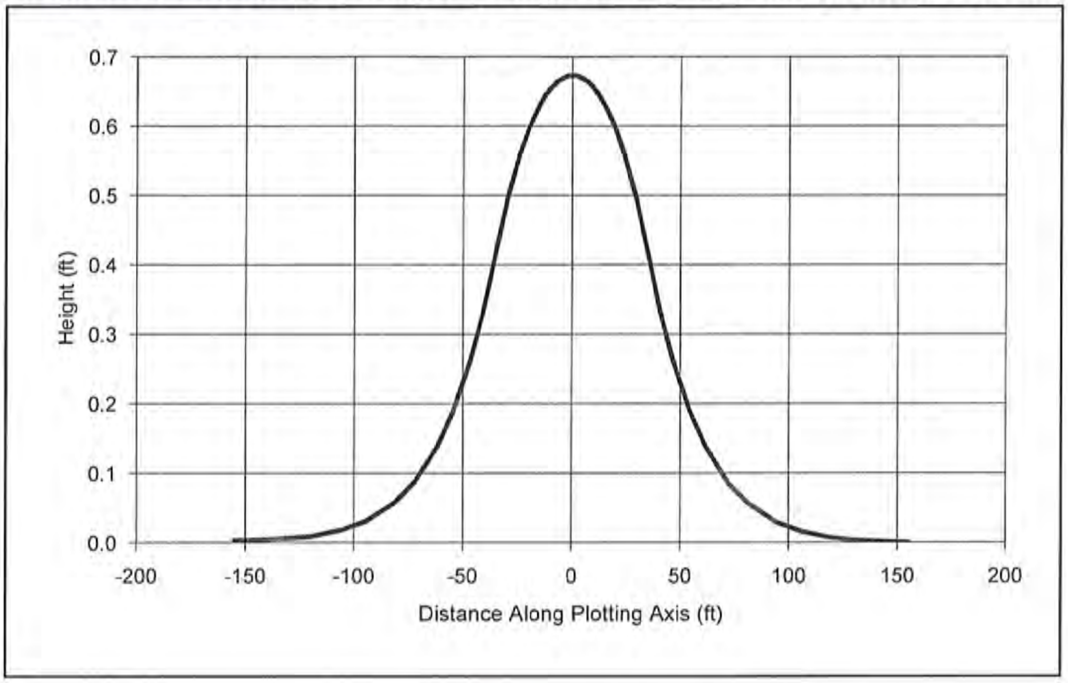
INPUT PARAMETERS

Application rate: 0.49 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.31
Hydraulic conductivity: 8 ft/day
Initial saturated thickness: 10 ft
Length of application area: 104 ft
Width of application area: 56 ft
Constant head boundary used at: 150 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 2853.76 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.02
0	0.07
0.1	0.15
0.2	0.24
0.2	0.35
0.3	0.47
0.4	0.63
0.5	0.82
0.7	1.07
1	1.46
1	1.45
1.1	1.42
1.2	1.38
1.3	1.32
1.4	1.26
1.6	1.18
1.8	1.1
2	1.01
2.4	0.9
3	0.76

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 8

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:36:49 PM

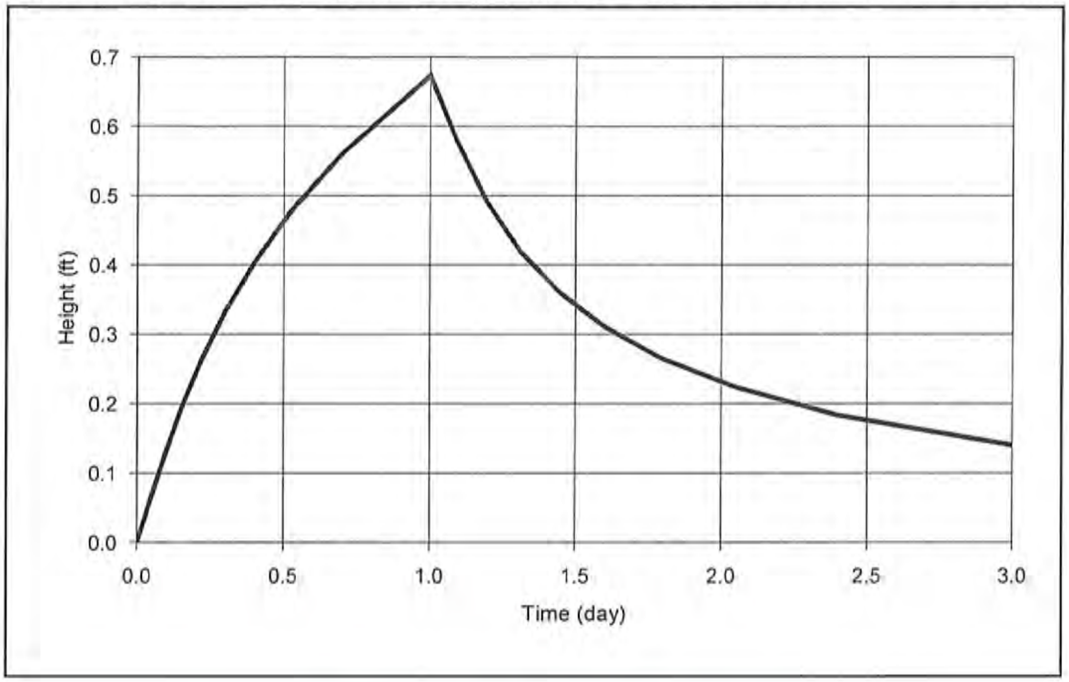
INPUT PARAMETERS

Application rate: 0.47 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 70 ft
Width of application area: 55 ft
Constant head boundary used at: 155 ft
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 35 ft
Total volume applied: 1809.5 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-155	-155	0
0	-130.4	-130	0.01
0	-105.7	-106	0.02
0	-81	-81	0.06
0	-61.7	-62	0.14
0	-46.7	-47	0.26
0	-34.4	-34	0.43
0	-24	-24	0.56
0	-15	-15	0.63
0	-9	-9	0.66
0	-4.9	-5	0.67
0	0	0	0.67
0	4.9	5	0.67
0	9	9	0.66
0	15	15	0.63
0	24	24	0.56
0	34.4	34	0.43
0	46.7	47	0.26
0	61.7	62	0.14
0	81	81	0.06
0	105.7	106	0.02
0	130.4	130	0
0	155	155	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: Stamski and McNary, Inc.

PROJECT: SMA 8

ANALYST: Richard Harrington

DATE: 6/23/2017 TIME: 2:36:57 PM

INPUT PARAMETERS

Application rate: 0.47 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 70 ft
Width of application area: 55 ft
Constant head boundary used at: 155 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 1809.5 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.02
0	0.06
0.1	0.13
0.2	0.2
0.2	0.26
0.3	0.33
0.4	0.4
0.5	0.48
0.7	0.56
1	0.67
1	0.65
1.1	0.58
1.2	0.49
1.3	0.42
1.4	0.36
1.6	0.31
1.8	0.26
2	0.22
2.4	0.18
3	0.14

STAMSKI AND McNARY, INC.
1000 MAIN STREET
ACTON, MASSACHUSETTS 01720
TEL (978) 263-8585
FAX (978) 263-9883

JOB 2069 700-800 MASS AVE
SHEET NO. ____ OF ____
CALCULATED BY JTM DATE 11/28/16
CHECKED BY RJH DATE 6/23/17
SCALE ____

GROUNDWATER MOUNDING

APPLICATION RATE

SMA 1

REQUIRED RECHARGE VOLUME = 863
BOTTOM AREA = 56.33 × 52 = 2929

$$\text{APPLICATION RATE} = \frac{RRV}{\text{BOT. AREA}} = \frac{863}{2929} = 0.29$$

SMA 2

REQUIRED RECHARGE VOLUME = 1567
BOTTOM AREA = 87.67 × 27 = 2367

$$\text{APPLICATION RATE} = \frac{RRV}{\text{BOT. AREA}} = \frac{1567}{2367} = 0.66$$

SMA 3

REQUIRED RECHARGE VOLUME = 1474
BOTTOM AREA = 115.45 × 40.33 = 4656

$$\text{APPLICATION RATE} = \frac{RRV}{\text{BOT. AREA}} = \frac{1474}{4656} = 0.31$$

SMA 4

REQUIRED RECHARGE VOLUME = 3437
BOTTOM AREA = 106 × 72 = 7632

$$\text{APPLICATION RATE} = \frac{RRV}{\text{BOT. AREA}} = \frac{3437}{7632} = 0.45$$

SMA 5 removed

STAMSKI AND McNARY, INC.
1000 MAIN STREET
ACTON, MASSACHUSETTS 01720
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FAX (978) 263-9883

JOB 2069 700-800 MASS AVE
SHEET NO. ____ OF ____
CALCULATED BY JTM DATE 11/28/16
CHECKED BY RJH DATE 6/23/17
SCALE ____

GROUNDWATER MOUNDING

APPLICATION RATE

SMA 6

REQUIRED RECHARGE VOLUME = 3221
BOTTOM AREA = 53 × 40 = 2120

APPLICATION RATE = $\frac{RRV}{BOT.\ AREA} = \frac{3221}{2120} = 1.52$

SMA 7

REQUIRED RECHARGE VOLUME = 2857
BOTTOM AREA = 104 × 56 = 5824

APPLICATION RATE = $\frac{RRV}{BOT.\ AREA} = \frac{2857}{5824} = 0.49$

SMA 8

REQUIRED RECHARGE VOLUME = 1840
BOTTOM AREA = 70 × 55 = 3850

APPLICATION RATE = $\frac{RRV}{BOT.\ AREA} = \frac{1840}{3850} = 0.47$

RD 1 - REMOVED

REQUIRED RECHARGE VOLUME =
BOTTOM AREA =

APPLICATION RATE =

RD 2

REQUIRED RECHARGE VOLUME = 707
BOTTOM AREA = 41 × 37 = 1517

APPLICATION RATE = $\frac{RRV}{BOT.\ AREA} = \frac{707}{1517} = 0.47$

TABLE 2-1 HYDROLOGIC SOIL PROPERTIES CLASSIFIED BY SOIL TEXTURE*

Texture Class	Effective Water Capacity (C_w) porosity	Minimum Infiltration Rate (f) in/hr	Hydrologic Soil Grouping
Sand	0.35	8.27	A
Loamy Sand	0.31	2.41	A
Sandy Loam	0.25	1.02	B
Loam	0.19	.52	B
Silt Loam	0.17	.27	C
Sandy Clay Loam	0.14	.17	C
Clay Loam	0.14	.09	D
Silty Clay Loam	0.11	.06	D
Sandy Clay	0.09	.05	D
Silty Clay	0.09	.04	D
Clay	0.08	.02	D

* Source: Rawls, Brakensiek and Saxton, 1982

SPECIFIC YIELD VALUES (%)

Coarse gravel	0.23
Medium gravel	0.24
Fine gravel	0.25
Coarse sand	0.27
Medium sand	0.28
Fine sand	0.23
Silt	0.08
Clay	0.03

HYDRAULIC CONDUCTIVITY VALUES (FT/DAY)

MATERIAL	AVERAGE	RANGE
Fine gravel	1476	1181 - 3280
Medium gravel	886	689 - 1181
Coarse gravel	492	328 – 689
Coarse sand	148	65 - 328
Medium sand	39	16 - 65
Fine sand	8	3 - 16
Silt	0.3	0.03 – 3
Clay	0.0007	<0.03
S & G mix	172	16 – 328
S & G glacial till		<100
Glacial till		<10

*Mass DEP Groundwater Mounding for Systems Larger than 2,000 GPD Presentation

DESIGN STORM: 100 YEAR
DATE: 12/22/2016
DONE BY: JTM
FILE: 2069 RATIONAL METHOD.wb3

STORM SEWER DESIGN

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

PROJECT: SM-2069
LOCATION Boxborough, MA

FROM	TO	LENGTH (FT)	TRIBUTARY AREA INCR. (ACRES)	TRIBUTARY AREA TOTAL (ACRES)	TIME OF FLOW TO UPPER END (MIN)	TIME OF FLOW TIME IN SECTION (MIN)	RUNOFF COEFF. "C"	RAINFALL INTENSITY (IN/HR)	"Q" TOTAL RUNOFF (CFS)	SLOPE of PIPE (FT/FT)	DIAM (IN)	MANN. "n"	CAPACITY FULL (CFS)	VELOCITY FULL (FPS)	DESIGN FLOW VELOCITY (FPS)	DESIGN FLOW VELOCITY HEAD (FT)	DESIGN FLOW DEPTH OF FLOW (FT)	DESIGN FLOW TOTAL ENERGY HEAD (FT)	MANHOLE INVERT DROP (FT)	FALL IN PIPE (FT)	DRAIN INV. ELEVATION UPPER END	DRAIN INV. ELEVATION LOWER END
CB-1	DMH-1	9		0.10	10	0.04	0.90	7.6	0.68	0.012	12	0.012	4.26	5.43	3.97	0.24	0.27	0.51		0.11	324.34	324.23
CB-2	DMH-1	19		0.16	10	0.10	0.77	7.6	0.93	0.006	12	0.012	2.93	3.73	3.30	0.17	0.39	0.55		0.11	324.34	324.23
DMH-1	Forebay	27		0.26	10	0.07	0.82	7.6	1.62	0.023	12	0.012	5.88	7.50	6.36	0.63	0.36	0.98		0.63	324.13	323.50
CB-3	Forebay +	12		0.23	10	0.04	0.69	7.6	1.20	0.017	12	0.012	4.97	6.34	5.18	0.42	0.33	0.75		0.20	323.20	323.00
CB-4	DMH-2	15		0.15	10	0.07	0.76	7.6	0.87	0.009	12	0.012	3.72	4.74	3.84	0.23	0.33	0.55		0.14	322.58	322.44
CB-4A	DMH-2	106		0.26	10	0.38	0.68	7.6	1.35	0.011	12	0.012	4.03	5.13	4.60	0.33	0.40	0.72		1.16	323.60	322.44
CB-5	DMH-2	13		0.11	10	0.06	0.77	7.6	0.65	0.011	12	0.012	4.00	5.09	3.73	0.22	0.27	0.49		0.14	322.58	322.44
DMH-2	DMH-3	182		0.52	10	0.46	0.73	7.6	2.87	0.017	12	0.012	5.04	6.41	6.62	0.68	0.54	1.22		3.11	320.21	317.10
DMH-3	Flared End	61		0.52	10	0.16	0.73	7.6	2.87	0.016	12	0.012	4.93	6.28	6.51	0.66	0.55	1.20		1.00	317.00	316.00
CB-6	DMH-4	10		0.29	10	0.04	0.51	7.6	1.13	0.013	12	0.012	4.39	5.60	4.68	0.34	0.35	0.69		0.13	316.58	316.45
CB-7	DMH-4	18		0.16	10	0.08	0.77	7.6	0.93	0.007	12	0.012	3.27	4.17	3.59	0.20	0.37	0.57		0.13	316.58	316.45
DMH-4	Flared End	51		0.45	10	0.11	0.60	7.6	2.07	0.036	12	0.012	7.28	9.27	7.99	0.99	0.37	1.36		1.82	316.35	314.53
CB-8	DMH-5	10		0.44	10	0.04	0.44	7.6	1.47	0.010	12	0.012	3.85	4.91	4.56	0.32	0.43	0.75		0.10	312.85	312.75
CB-9	DMH-5	20		0.25	10	0.09	0.79	7.6	1.50	0.005	12	0.012	2.72	3.47	3.54	0.19	0.53	0.72		0.10	312.85	312.75
DMH-5	Flared End	63		0.69	10	0.19	0.57	7.6	2.96	0.010	12	0.012	3.91	4.98	5.48	0.47	0.65	1.12		0.65	312.65	312.00
CB-10	DMH-6	13		0.15	10	0.06	0.76	7.6	0.87	0.008	12	0.012	3.38	4.30	3.60	0.20	0.35	0.55		0.10	317.59	317.49
CB-11	DMH-6	19		0.12	10	0.11	0.78	7.6	0.71	0.005	12	0.012	2.79	3.56	2.95	0.14	0.34	0.48		0.10	317.59	317.49
DMH-6	DMH-7	41		0.27	10	0.19	0.77	7.6	1.58	0.005	12	0.012	2.76	3.51	3.62	0.20	0.54	0.74		0.21	313.31	313.10
CB-12	DMH-9	13		0.28	10	0.05	0.60	7.6	1.28	0.012	12	0.012	4.27	5.44	4.73	0.35	0.37	0.72		0.16	322.38	322.22
CB-13	DMH-9	19		0.28	10	0.07	0.68	7.6	1.44	0.008	12	0.012	3.54	4.50	4.25	0.28	0.44	0.72		0.16	322.38	322.22
DMH-9	DMH-8	54		0.56	10	0.22	0.64	7.6	2.71	0.005	15	0.012	4.94	4.03	4.11	0.26	0.66	0.92		0.27	321.34	321.07
DMH-8	DMH-7	101		0.56	10	0.41	0.64	7.6	2.71	0.005	15	0.012	4.97	4.05	4.13	0.26	0.66	0.92		0.51	313.61	313.10
DMH-7	Forebay	41		0.83	10	0.11	0.68	7.6	4.29	0.012	15	0.012	7.72	6.29	6.44	0.64	0.66	1.31		0.50	313.00	312.50
DMH-7	INF	65		0.83	10	0.13	0.68	7.6	4.29	0.023	15	0.012	10.62	8.66	8.17	1.04	0.55	1.59		1.50	312.00	310.50
CB-14	DMH-10	23		0.31	10	0.08	0.72	7.6	1.69	0.010	12	0.012	3.77	4.80	4.65	0.34	0.47	0.80		0.22	323.47	323.25
CB-15	DMH-10	12		0.46	10	0.03	0.69	7.6	2.40	0.018	12	0.012	5.22	6.64	6.50	0.66	0.48	1.13		0.22	323.47	323.25
CB-16	DMH-11	19		0.30	10	0.08	0.78	7.6	1.79	0.005	12	0.012	2.79	3.56	3.77	0.22	0.58	0.80		0.10	321.58	321.48
CB-17	DMH-11	5		0.43	10	0.01	0.72	7.6	2.36	0.020	12	0.012	5.45	6.94	6.66	0.69	0.46	1.14		0.10	321.58	321.48
DMH-11	DMH-10	135		1.20	10	0.35	0.73	7.6	6.67	0.010	15	0.012	6.99	5.70	6.49	0.65	0.98	1.63		1.35	320.60	319.25
DMH-10	Flared End	63		1.97	10	0.15	0.72	7.6	10.76	0.010	18	0.012	11.10	6.28	7.16	0.80	1.19	1.98		0.60	319.00	318.40
DI 1	DMH-9A	12		0.82	10	0.05	0.20	7.6	1.25	0.008	12	0.012	3.52	4.48	4.09	0.26	0.41	0.67		0.10	324.80	324.70
DMH-9A	DMH 9B	55		0.82	10	0.27	0.20	7.6	1.25	0.005	12	0.012	2.75	3.50	3.41	0.18	0.47	0.65		0.28	324.60	324.32
DMH 9B	Forebay	48		0.82	10	0.16	0.20	7.6	1.25	0.015	12	0.012	4.65	5.93	5.00	0.39	0.35	0.74		0.70	320.70	320.00
DI 2	Flared End	78		5.79	10	0.25	0.16	7.6	7.11	0.005	18	0.012	8.14	4.61	5.19	0.42	1.08	1.50		0.40	317.45	317.05
CB-18	DMH-13	14		0.27	10	0.04	0.67	7.6	1.37	0.024	12	0.012	6.00	7.65	6.15	0.59	0.32	0.91		0.34	330.58	330.24
CB-19	DMH-13	20		0.20	10	0.06	0.76	7.6	1.16	0.017	12	0.012	5.02	6.40	5.19	0.42	0.33	0.74		0.34	330.58	330.24
DMH-13	DMH-12	113		0.47	10	0.36	0.71	7.6	2.52	0.010	12	0.012	3.85	4.91	5.22	0.42	0.59	1.01		1.13	323.91	322.78
DMH-12	DMH-11	183		1.2	10	0.47	0.73	7.6	6.67	0.010	15	0.012	6.99	5.70	6.49	0.65	0.98	1.63		1.83	322.53	320.70
DI 3	Flared End	83		1.57	10	0.33	0.21	7.6	2.45	0.005	15	0.012	5.15	4.20	4.14	0.27	0.61	0.87		0.45	337.45	337.00
DI 4	Flared End	92		0.25	10	0.62	0.20	7.6	0.38	0.005	12	0.012	2.78	3.54	2.46	0.09	0.25	0.34		0.48	336.48	336.00
CB-20	DMH-14	21		0.17	10	0.08	0.86	7.6	1.11	0.010	12	0.012	3.85	4.91	4.23	0.28	0.37	0.64		0.21	344.76	344.55
CB-21	DMH-14	10		0.12	10	0.04	0.73	7.6	0.66	0.021	12	0.012	5.58	7.11	4.75	0.35	0.23	0.58		0.21	344.76	344.55
DMH-14	DMH-15	71		0.29	10	0.18	0.80	7.6	1.77	0.025	12	0.012	6.10	7.77	6.70	0.70	0.37	1.06		1.78	341.88	340.10
DMH-15	DMH-16	79		0.29	10	0.21	0.80	7.6	1.77	0.022	12	0.012	5.70	7.26	6.38	0.63	0.38	1.01		1.73	340.00	338.27
DMH-16	DMH-17	137		0.29	10	0.29	0.80	7.6	1.77	0.040	12	0.012	7.71	9.82	7.97	0.99	0.33	1.31		5.49	337.25	331.76
CB-22	DMH-17	13		0.31	10	0.04	0.70	7.6	1.64	0.017	12	0.012	5.01	6.38	5.69	0.50	0.39	0.89		0.22	331.98	331.76
CB-23	DMH-17	9		0.13	10	0.03	0.79	7.6	0.78	0.024	12	0.012	6.02	7.67	5.25	0.43	0.24	0.67		0.22	331.98	331.76
DMH-17	DMH-17A	190		0.73	10	0.32	0.76	7.6	4.20	0.039	12	0.012	7.65	9.75	9.94	1.54	0.53	2.06		7.50	330.00	322.50
DMH-17A	DMH-18	80		0.73	10	0.15	0.76	7.6	4.20	0.029	15	0.012	11.98	9.77	8.87	1.22	0.51	1.73		2.35	322.25	319.90
CB-27	DMH-22	23		0.31	10	0.05	0.67	7.6	1.59	0.031	12	0.012	6.82	8.68	7.04	0.77	0.33	1.09		0.72	339.52	338.80
CB-28	DMH-22	14		0.14	10	0.03	0.75	7.6	0.80	0.051	12	0.012	8.74	11.13	6.84	0.73	0.20	0.93		0.72	339.52	338.80
DMH-22	DMH-21	154		0.45	10	0.29	0.70	7.6	2.39	0.041	12	0.012	7.83	9.98	8.71	1.18	0.38	1.55		6.37	338.00	331.63
DMH-21	DMH-20	86		0.45	10	0.17	0.70	7.6	2.39	0.040	12	0.012	7.66	9.76	8.58	1.14	0.38	1.52		3.40	331.00	327.60
CB-25	DMH-20	20		0.31	10	0.05	0.61	7.6	1.43	0.033	12	0.012	7.05	8.98	7.03	0.77	0.31	1.07		0.67	328.27	327.60
CB-26	DMH-20	17		0.22	10	0.04	0.61	7.6	1.03	0.039	12	0.012	7.65	9.74	6.75	0.71	0.25	0.95		0.67	328.27	327.60
DMH-20	DMH-19A	62		0.98	10	0.10	0.65	7.6	4.84	0.038	12	0.012	7.53	9.59	10.17	1.61	0.58	2.19		2.37	327.00	324.63
DI 8	DMH-19A	149		1.06	10	0.45	0.20	7.6	1.61	0.016	12	0.012	4.82	6.14	5.50	0.47	0.40	0.87		2.33	323.75	321.42
DMH-19A	DMH-19	43		2.04	10	0.07	0.42	7.6	6.45	0.031	15	0.012	12.25	9.98	10.10	1.59	0.64	2.23		1.32	321.32	320.00
DMH-19	DMH-18	130		2.04	10	0.22	0.42	7.6	6.45	0.030	15	0.012	12.03	9.81	9.96	1.54	0.65	2.19		3.85	323.75	319.90
CB-24	DMH-18	27		0.77	10	0.10	0.72	7.6	4.20	0.006	15	0.012	5.21	4.25	4.72	0.35	0.85	1.20		0.15	319.96	319.81
DMH-18	DMH-18A	44		3.54	10	0.07	0.55	7.6	14.85	0.020	18	0.012	16.27	9.21	10.43	1.69	1.13	2.82		0.90	319.65	318.75
DMH-18A	INF	20		3.54	10	0.03	0.55	7.6	14.85	0.020	18	0.012	16.08	9.11	10.33	1.66	1.13	2.79		0.40	318.65	318.25
DI 5	DMH-23	221		0.86	10	0.54	0.20	7.6	1.31	0.033	12	0.012	6.98	8.89	6.77	0.71	0.29	1.00		7.25	329.00	321.75
DI 6	DMH-23	8		1.21	10	0.02	0.20	7.6	1.84	0.031	12	0.012	6.81	8.68	7.37	0.84	0.36	1.20		0.25	321.25	321.00
DMH-23	DMH 24	113		2.07	10	0.29	0.20	7.6	3.15	0.015	15	0.012	8.57	6.99	6.42	0.64	0.52	1.16		1.70	315.40	313.70
DMH 24	Flared End	40		2.07	10	0.10	0.20	7.6	3.15	0.015	15	0.012	8.56	6.98	6.41	0.64	0.52	1.16		0.60	313.60	313.00
DI 7	Flared End	84		0.66	10	0.34	0.20	7.6	1.00	0.010	15	0.012	7.03	5.73	4.06	0.26	0.32	0.58		0.85	309.00	308.15

CB - CATCH BASIN
DI - DROP INLET
DMH- DRAIN MANHOLE
INF - INFILTRATION AREA

DESIGN STORM: 25 YEAR (Pipe Velocity)
DATE: 12/22/2016
DONE BY: JTM
FILE: 2069 RATIONAL METHOD.wb3

STORM SEWER DESIGN

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

PROJECT: SM-2069
LOCATION Boxborough, MA

			TRIBUTARY AREA		TIME OF FLOW										DESIGN FLOW						DRAIN INV. ELEVATION	
FROM	TO	LENGTH (FT)	INCR. (ACRES)	TOTAL (ACRES)	TO UPPER END (MIN)	TIME IN SECTION (MIN)	RUNOFF COEFF. "C"	RAINFALL INTENSITY (IN/HR)	"Q" TOTAL RUNOFF (CFS)	SLOPE of PIPE (FT/FT)	DIAM (IN)	MANN. "n"	CAPACITY FULL (CFS)	VELOCITY FULL (FPS)	VELOCITY (FPS)	VELOCITY HEAD (FT)	DEPTH OF FLOW (FT)	TOTAL ENERGY HEAD (FT)	MANHOLE INVERT DROP (FT)	FALL IN PIPE (FT)	UPPER END	LOWER END
CB-1	DMH-1	9		0.10	10	0.04	0.90	5.7	0.51	0.012	12	0.012	4.26	5.43	3.62	0.20	0.23	0.43		0.11	324.34	324.23
CB-2	DMH-1	19		0.16	10	0.10	0.77	5.7	0.70	0.006	12	0.012	2.93	3.73	3.05	0.14	0.33	0.47		0.11	324.34	324.23
DMH-1	Forebay	27		0.26	10	0.08	0.82	5.7	1.21	0.023	12	0.012	5.88	7.50	5.87	0.53	0.31	0.84		0.63	324.13	323.50
CB-3	Forebay +	12		0.23	10	0.04	0.69	5.7	0.90	0.017	12	0.012	4.97	6.34	4.78	0.35	0.29	0.64		0.20	323.20	323.00
CB-4	DMH-2	15		0.15	10	0.07	0.76	5.7	0.65	0.009	12	0.012	3.72	4.74	3.54	0.19	0.28	0.47		0.14	322.58	322.44
CB-4A	DMH-2	106		0.26	10	0.41	0.68	5.7	1.01	0.011	12	0.012	4.03	5.13	4.26	0.28	0.34	0.62		1.16	323.60	322.44
CB-5	DMH-2	13		0.11	10	0.06	0.77	5.7	0.48	0.011	12	0.012	4.00	5.09	3.44	0.18	0.24	0.42		0.14	322.58	322.44
DMH-2	DMH-3	182		0.52	10	0.49	0.73	5.7	2.15	0.017	12	0.012	5.04	6.41	6.15	0.59	0.46	1.04		3.11	320.21	317.10
DMH-3	Flared End	61		0.52	10	0.17	0.73	5.7	2.15	0.016	12	0.012	4.93	6.28	6.06	0.57	0.46	1.03		1.00	317.00	316.00
CB-6	DMH-4	10		0.29	10	0.04	0.51	5.7	0.85	0.013	12	0.012	4.39	5.60	4.30	0.29	0.30	0.58		0.13	316.58	316.45
CB-7	DMH-4	18		0.16	10	0.09	0.77	5.7	0.70	0.007	12	0.012	3.27	4.17	3.29	0.17	0.31	0.48		0.13	316.58	316.45
DMH-4	Flared End	51		0.45	10	0.12	0.60	5.7	1.55	0.036	12	0.012	7.28	9.27	7.32	0.83	0.31	1.14		1.82	316.35	314.53
CB-8	DMH-5	10		0.44	10	0.04	0.44	5.7	1.10	0.010	12	0.012	3.85	4.91	4.23	0.28	0.37	0.64		0.10	312.85	312.75
CB-9	DMH-5	20		0.25	10	0.10	0.79	5.7	1.12	0.005	12	0.012	2.72	3.47	3.29	0.17	0.45	0.61		0.10	312.85	312.75
DMH-5	Flared End	63		0.69	10	0.20	0.57	5.7	2.22	0.010	12	0.012	3.91	4.98	5.14	0.41	0.54	0.95		0.65	312.65	312.00
CB-10	DMH-6	13		0.15	10	0.07	0.76	5.7	0.65	0.008	12	0.012	3.38	4.30	3.31	0.17	0.30	0.47		0.10	317.59	317.49
CB-11	DMH-6	19		0.12	10	0.12	0.78	5.7	0.54	0.005	12	0.012	2.79	3.56	2.74	0.12	0.30	0.41		0.10	317.59	317.49
DMH-6	DMH-7	41		0.27	10	0.20	0.77	5.7	1.19	0.005	12	0.012	2.76	3.51	3.37	0.18	0.46	0.63		0.21	313.31	313.10
CB-12	DMH-9	13		0.28	10	0.05	0.60	5.7	0.96	0.012	12	0.012	4.27	5.44	4.38	0.30	0.32	0.62		0.16	322.38	322.22
CB-13	DMH-9	19		0.28	10	0.08	0.68	5.7	1.08	0.008	12	0.012	3.54	4.50	3.93	0.24	0.38	0.61		0.16	322.38	322.22
DMH-9	DMH-8	54		0.56	10	0.24	0.64	5.7	2.03	0.005	15	0.012	4.94	4.03	3.82	0.23	0.56	0.78		0.27	321.34	321.07
DMH-8	DMH-7	101		0.56	10	0.44	0.64	5.7	2.03	0.005	15	0.012	4.97	4.05	3.84	0.23	0.56	0.79		0.51	313.61	313.10
DMH-7	Forebay	41		0.83	10	0.11	0.68	5.7	3.22	0.012	15	0.012	7.72	6.29	6.00	0.56	0.56	1.12		0.50	313.00	312.50
DMH-7	INF	65		0.83	10	0.14	0.68	5.7	3.22	0.023	15	0.012	10.62	8.66	7.56	0.89	0.47	1.36		1.50	312.00	310.50
CB-14	DMH-10	23		0.31	10	0.09	0.72	5.7	1.27	0.010	12	0.012	3.77	4.80	4.33	0.29	0.40	0.69		0.22	323.47	323.25
CB-15	DMH-10	12		0.46	10	0.03	0.69	5.7	1.80	0.018	12	0.012	5.22	6.64	6.03	0.57	0.41	0.97		0.22	323.47	323.25
CB-16	DMH-11	19		0.30	10	0.09	0.78	5.7	1.34	0.005	12	0.012	2.79	3.56	3.51	0.19	0.49	0.68		0.10	321.58	321.48
CB-17	DMH-11	5		0.43	10	0.01	0.72	5.7	1.77	0.020	12	0.012	5.45	6.94	6.18	0.59	0.39	0.98		0.10	321.58	321.48
DMH-11	DMH-10	135		1.20	10	0.36	0.73	5.7	5.00	0.010	15	0.012	6.99	5.70	6.19	0.60	0.78	1.38		1.35	320.60	319.25
DMH-10	Flared End	63		1.97	10	0.15	0.72	5.7	8.07	0.010	18	0.012	11.10	6.28	6.84	0.73	0.95	1.67		0.60	319.00	318.40
DI 1	DMH-9A	12		0.82	10	0.05	0.20	5.7	0.93	0.008	12	0.012	3.52	4.48	3.78	0.22	0.35	0.57		0.10	324.80	324.70
DMH-9A	DMH 9B	55		0.82	10	0.29	0.20	5.7	0.93	0.005	12	0.012	2.75	3.50	3.16	0.15	0.40	0.55		0.28	324.60	324.32
DMH 9B	Forebay	48		0.82	10	0.17	0.20	5.7	0.93	0.015	12	0.012	4.65	5.93	4.60	0.33	0.30	0.63		0.70	320.70	320.00
DI 2	Flared End	78		5.79	10	0.27	0.16	5.7	5.33	0.005	18	0.012	8.14	4.61	4.90	0.37	0.88	1.25		0.40	317.45	317.05
CB-18	DMH-13	14		0.27	10	0.04	0.67	5.7	1.03	0.024	12	0.012	6.00	7.65	5.66	0.50	0.28	0.77		0.34	330.58	330.24
CB-19	DMH-13	20		0.20	10	0.07	0.76	5.7	0.87	0.017	12	0.012	5.02	6.40	4.78	0.35	0.28	0.63		0.34	330.58	330.24
DMH-13	DMH-12	113		0.47	10	0.39	0.71	5.7	1.89	0.010	12	0.012	3.85	4.91	4.86	0.37	0.49	0.86		1.13	323.91	322.78
DMH-12	DMH-11	183		1.2	10	0.49	0.73	5.7	5.00	0.010	15	0.012	6.99	5.70	6.19	0.60	0.78	1.38		1.83	322.53	320.70
DI 3	Flared End	83		1.57	10	0.36	0.21	5.7	1.84	0.005	15	0.012	5.15	4.20	3.83	0.23	0.51	0.74		0.45	337.45	337.00
DI 4	Flared End	92		0.25	10	0.67	0.20	5.7	0.29	0.005	12	0.012	2.78	3.54	2.28	0.08	0.22	0.30		0.48	336.48	336.00
CB-20	DMH-14	21		0.17	10	0.09	0.86	5.7	0.83	0.010	12	0.012	3.85	4.91	3.91	0.24	0.32	0.55		0.21	344.76	344.55
CB-21	DMH-14	10		0.12	10	0.04	0.73	5.7	0.50	0.021	12	0.012	5.58	7.11	4.37	0.30	0.20	0.50		0.21	344.76	344.55
DMH-14	DMH-15	71		0.29	10	0.19	0.80	5.7	1.33	0.025	12	0.012	6.10	7.77	6.19	0.60	0.32	0.91		1.78	341.88	340.10
DMH-15	DMH-16	79		0.29	10	0.22	0.80	5.7	1.33	0.022	12	0.012	5.70	7.26	5.89	0.54	0.33	0.86		1.73	340.00	338.27
DMH-16	DMH-17	137		0.29	10	0.31	0.80	5.7	1.33	0.040	12	0.012	7.71	9.82	7.34	0.84	0.28	1.12		5.49	337.25	331.76
CB-22	DMH-17	13		0.31	10	0.04	0.70	5.7	1.23	0.017	12	0.012	5.01	6.38	5.26	0.43	0.34	0.76		0.22	331.98	331.76
CB-23	DMH-17	9		0.13	10	0.03	0.79	5.7	0.59	0.024	12	0.012	6.02	7.67	4.86	0.37	0.21	0.58		0.22	331.98	331.76
DMH-17	DMH-17A	190		0.73	10	0.34	0.76	5.7	3.15	0.039	12	0.012	7.65	9.75	9.25	1.33	0.45	1.77		7.50	330.00	322.50
DMH-17A	DMH-18	80		0.73	10	0.16	0.76	5.7	3.15	0.029	15	0.012	11.98	9.77	8.18	1.04	0.43	1.47		2.35	322.25	319.90
CB-27	DMH-22	23		0.31	10	0.06	0.67	5.7	1.19	0.031	12	0.012	6.82	8.68	6.49	0.65	0.28	0.93		0.72	339.52	338.80
CB-28	DMH-22	14		0.14	10	0.04	0.75	5.7	0.60	0.051	12	0.012	8.74	11.13	6.32	0.62	0.18	0.80		0.72	339.52	338.80
DMH-22	DMH-21	154		0.45	10	0.32	0.70	5.7	1.79	0.041	12	0.012	7.83	9.98	8.09	1.02	0.33	1.34		6.37	338.00	331.63
DMH-21	DMH-20	86		0.45	10	0.18	0.70	5.7	1.79	0.040	12	0.012	7.66	9.76	7.91	0.97	0.33	1.30		3.40	331.00	327.60
CB-25	DMH-20	20		0.31	10	0.05	0.61	5.7	1.07	0.033	12	0.012	7.05	8.98	6.44	0.64	0.26	0.90		0.67	328.27	327.60
CB-26	DMH-20	17		0.22	10	0.05	0.61	5.7	0.77	0.039	12	0.012	7.65	9.74	6.17	0.59	0.21	0.80		0.67	328.27	327.60
DMH-20	DMH-19A	62		0.98	10	0.11	0.65	5.7	3.63	0.038	12	0.012	7.53	9.59	9.47	1.39	0.49	1.88		2.37	327.00	324.63
DI 8	DMH-19A	149		1.06	10	0.49	0.20	5.7	1.21	0.016	12	0.012	4.82	6.14	5.09	0.40	0.34	0.74		2.33	323.75	321.42
DMH-19A	DMH-19	43		2.04	10	0.08	0.42	5.7	4.84	0.031	15	0.012	12.25	9.98	9.38	1.36	0.54	1.91		1.32	321.32	320.00
DMH-19	DMH-18	130		2.04	10	0.23	0.42	5.7	4.84	0.030	15	0.012	12.03	9.81	9.26	1.33	0.55	1.88		3.85	323.75	319.90
CB-24	DMH-18	27		0.77	10	0.10	0.72	5.7	3.15	0.006	15	0.012	5.21	4.25	4.44	0.31	0.70	1.01		0.15	319.96	319.81
DMH-18	DMH-18A	44		3.54	10	0.07	0.55	5.7	11.14	0.020	18	0.012	16.27	9.21	9.90	1.52	0.91	2.43		0.90	319.65	318.75
DMH-18A	INF	20		3.54	10	0.03	0.55	5.7	11.14	0.020	18	0.012	16.08	9.11	9.82	1.50	0.92	2.41		0.40	318.65	318.25
DI 5	DMH-23	221		0.86	10	0.59	0.20	5.7	0.98	0.033	12	0.012	6.98	8.89	6.23	0.60	0.25	0.85		7.25	329.00	321.75
DI 6	DMH-23	8		1.21	10	0.02	0.20	5.7	1.38	0.031	12	0.012	6.81	8.68	6.79	0.72	0.31	1.02		0.25	321.25	321.00
DMH-23	DMH 24	113		2.07	10	0.32	0.20	5.7	2.36	0.015	15	0.012	8.57	6.99	5.93	0.55	0.44	0.99		1.70	315.40	313.70
DMH 24	Flared End	40		2.07	10	0.11	0.20	5.7	2.36	0.015	15	0.012	8.56	6.98	5.93	0.55	0.44	0.99		0.60	313.60	313.00
DI 7	Flared End	84		0.66	10	0.38	0.20	5.7	0.75	0.010	15	0.012	7.03	5.73	3.73	0.22	0.28	0.49		0.85	309.00	308.15

CB - CATCH BASIN
DI - DROP INLET
DMH- DRAIN MANHOLE
INF - INFILTRATION AREA

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

A = area (ac)

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

CB-1

Surface Cover	A (ac)	C	Product A x C
impervious	0.10	0.9	0.09
lands/grass	0.00	0.2	0
woods	0	0.15	0
sum =	0.10	sum =	0.09

C = $\boxed{0.90}$ = total product / total area

CB-2

Surface Cover	A (ac)	C	Product A x C
impervious	0.13	0.9	0.117
lands/grass	0.03	0.2	0.006
woods	0	0.15	0
sum =	0.16	sum =	0.123

C = $\boxed{0.77}$ = total product / total area

DMH-1

Surface Cover	A (ac)	C	Product A x C
CB 1	0.10	0.90	0.09
CB-2	0.16	0.77	0.123
sum =	0.26	sum =	0.213

C = $\boxed{0.82}$ = total product / total area

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

A = area (ac)

CB-3

Surface Cover	A (ac)	C	Product A x C
impervious	0.16	0.9	0.144
lands/grass	0.07	0.2	0.014
woods	0	0.15	0
sum =	0.23	sum =	0.158

C = **0.69** = total product / total area

Closed Drainage System SM-2069

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

A = area (ac)

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

CB-4

Surface Cover	A (ac)	C	Product A x C
impervious	0.12	0.9	0.108
lands/grass	0.03	0.2	0.006
woods	0	0.15	0
sum =	0.15	sum =	0.114

C = $\boxed{0.76}$ = total product / total area

CB-4A

Surface Cover	A (ac)	C	Product A x C
impervious	0.18	0.9	0.162
lands/grass	0.08	0.2	0.016
woods	0	0.15	0
sum =	0.26	sum =	0.178

C = $\boxed{0.68}$ = total product / total area

CB-5

Surface Cover	A (ac)	C	Product A x C
impervious	0.09	0.9	0.081
lands/grass	0.02	0.2	0.004
woods	0	0.15	0
sum =	0.11	sum =	0.085

C = $\boxed{0.77}$ = total product / total area

DMH-2

Surface Cover	A (ac)	C	Product A x C
CB-4	0.15	0.76	0.114
CB-4A	0.26	0.68	0.178
CB-5	0.11	0.77	0.085
sum =	0.52	sum =	0.377

C = $\boxed{0.73}$ = total product / total area

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

A = area (ac)

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

CB-6

Surface Cover	A (ac)	C	Product A x C
impervious	0.13	0.9	0.117
lands/grass	0.16	0.2	0.032
woods	0	0.15	0
sum =	0.29	sum =	0.149

C = **0.51** = total product / total area

CB-7

Surface Cover	A (ac)	C	Product A x C
impervious	0.13	0.9	0.117
lands/grass	0.03	0.2	0.006
woods	0	0.15	0
sum =	0.16	sum =	0.123

C = **0.77** = total product / total area

DMH-4

Surface Cover	A (ac)	C	Product A x C
CB-6	0.29	0.51	0.149
CB-7	0.16	0.77	0.123
sum =	0.45	sum =	0.272

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

Closed Drainage System SM-2069

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

A = area (ac)

C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

CB-8

Surface Cover	A (ac)	C	Product A x C
impervious	0.15	0.9	0.135
lands/grass	0.29	0.2	0.058
woods	0	0.15	0
sum =	0.44	sum =	0.193

C = **0.44** = total product / total area

CB-9

Surface Cover	A (ac)	C	Product A x C
impervious	0.21	0.9	0.189
lands/grass	0.04	0.2	0.008
woods	0	0.15	0
sum =	0.25	sum =	0.197

C = **0.79** = total product / total area

DMH-5

Surface Cover	A (ac)	C	Product A x C
CB-8	0.44	0.44	0.193
CB-9	0.25	0.79	0.197
sum =	0.69	sum =	0.39

C = **0.57** = total product / total area

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

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

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

CB-10

Surface Cover	A (ac)	C	Product A x C
impervious	0.12	0.9	0.108
lands/grass	0.03	0.2	0.006
woods	0	0.15	0
sum =	0.15	sum =	0.114

C = **0.76** = total product / total area

CB-11

Surface Cover	A (ac)	C	Product A x C
impervious	0.10	0.9	0.09
lands/grass	0.02	0.2	0.004
woods	0	0.15	0
sum =	0.12	sum =	0.094

C = **0.78** = total product / total area

DMH-6

Surface Cover	A (ac)	C	Product A x C
CB-10	0.15	0.76	0.114
CB-11	0.12	0.78	0.094
sum =	0.27	sum =	0.208

C = **0.77** = total product / total area

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,
C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

A = area (ac)

CB-12

Surface Cover	A (ac)	C	Product A x C
impervious	0.16	0.9	0.144
lands/grass	0.12	0.2	0.024
woods	0	0.15	0
sum =	0.28	sum =	0.168

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

CB-13

Surface Cover	A (ac)	C	Product A x C
impervious	0.19	0.9	0.171
lands/grass	0.09	0.2	0.018
woods	0	0.15	0
sum =	0.28	sum =	0.189

C = **0.68** = total product / total area

DMH-9

Surface Cover	A (ac)	C	Product A x C
CB-12	0.28	0.60	0.168
CB-13	0.28	0.68	0.189
sum =	0.56	sum =	0.357

C = **0.64** = total product / total area

DMH-7

Surface Cover	A (ac)	C	Product A x C
DMH-6	0.27	0.77	0.208
DMH-8	0.56	0.64	0.357
sum =	0.83	sum =	0.565

C = **0.68** = total product / total area

Project:	700-800 Mass Ave	By JTM	Date 10/17/2016
Location:	Boxborough, MA	Checked	Date

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

A = area (ac)

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

DI 4

Surface Cover	A (ac)	C	Product A x C
impervious	0.00	0.9	0
lands/grass	0.25	0.2	0.05
woods	0	0.15	0
sum =	0.25	sum =	0.05

C = $\boxed{0.20}$ = total product / total area

Closed Drainage System SM-2069

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

A = area (ac)

DI 3

Surface Cover	A (ac)	C	Product A x C
impervious	0.03	0.9	0.027
lands/grass	1.30	0.2	0.26
woods	0.24	0.15	0.036
sum =	1.57	sum =	0.323

C = **0.21** = total product / total area

Closed Drainage System SM-2069

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

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

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

DI 2

Surface Cover	A (ac)	C	Product A x C
impervious	0.00	0.9	0
lands/grass	1.33	0.2	0.266
woods	4.46	0.15	0.669
sum =	5.79	sum =	0.935

C = $\boxed{0.16}$ = total product / total area

Closed Drainage System SM-2069

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,
C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

A = area (ac)

CB-16

Surface Cover	A (ac)	C	Product A x C
impervious	0.25	0.9	0.225
lands/grass	0.05	0.2	0.01
woods	0	0.15	0
sum =	0.30	sum =	0.235

C = **0.78** = total product / total area

CB-17

Surface Cover	A (ac)	C	Product A x C
impervious	0.32	0.9	0.288
lands/grass	0.11	0.2	0.022
woods	0	0.15	0
sum =	0.43	sum =	0.31

C = **0.72** = total product / total area

DMH-11

Surface Cover	A (ac)	C	Product A x C
CB-16	0.30	0.78	0.235
DMH-12	0.47	0.71	0.332
CB-17	0.43	0.72	0.310
sum =	1.2	sum =	0.877

C = **0.73** = total product / total area

Closed Drainage System

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,
C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

A = area (ac)

CB-18

Surface Cover	A (ac)	C	Product A x C
impervious	0.18	0.9	0.162
lands/grass	0.09	0.2	0.018
woods	0	0.15	0
sum =	0.27	sum =	0.18

C = **0.67** = total product / total area

CB-19

Surface Cover	A (ac)	C	Product A x C
impervious	0.16	0.9	0.144
lands/grass	0.04	0.2	0.008
woods	0	0.15	0
sum =	0.20	sum =	0.152

C = **0.76** = total product / total area

DMH-13

Surface Cover	A (ac)	C	Product A x C
CB-18	0.27	0.67	0.18
CB-19	0.20	0.76	0.152
sum =	0.47	sum =	0.332

C = **0.71** = total product / total area

Project:	700-800 Mass Ave	By	JTM	Date 10/17/2016
Location:	Boxborough, MA	Checked		Date

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,
C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

A = area (ac)

DI 1

Surface Cover	A (ac)	C	Product A x C
impervious	0.00	0.9	0
lands/grass	0.82	0.2	0.164
woods	0	0.15	0
sum =	0.82	sum =	0.164

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

DMH-9A

Surface Cover	A (ac)	C	Product A x C
DI 1	0.82	0.20	0.164
sum =	0.82	sum =	0.164

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

Project: 700-800 Mass Ave By JTM Date 10/17/2016

Location: Boxborough, MA Checked ______ Date ______

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

A = area (ac)

CB-14

Surface Cover	A (ac)	C	Product A x C
impervious	0.23	0.9	0.207
lands/grass	0.08	0.2	0.016
woods	0	0.15	0
sum =	0.31	sum =	0.223

C = **0.72** = total product / total area

CB-15

Surface Cover	A (ac)	C	Product A x C
impervious	0.32	0.9	0.288
lands/grass	0.14	0.2	0.028
woods	0	0.15	0
sum =	0.46	sum =	0.316

C = **0.69** = total product / total area

DMH-10

Surface Cover	A (ac)	C	Product A x C
DMH-11	1.2	0.73	0.877
CB-14	0.31	0.72	0.223
CB-15	0.46	0.69	0.316
sum =	1.97	sum =	1.416

C = **0.72** = total product / total area

Closed Drainage System SM-2069

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

A = area (ac)

C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

CB-20

Surface Cover	A (ac)	C	Product A x C
impervious	0.16	0.9	0.144
lands/grass	0.01	0.2	0.002
woods	0	0.15	0
sum =	0.17	sum =	0.146

C = $\boxed{0.86}$ = total product / total area

CB-21

Surface Cover	A (ac)	C	Product A x C
impervious	0.09	0.9	0.081
lands/grass	0.03	0.2	0.006
woods	0	0.15	0
sum =	0.12	sum =	0.087

C = $\boxed{0.73}$ = total product / total area

DMH-14

Surface Cover	A (ac)	C	Product A x C
CB-20	0.17	0.86	0.146
CB-21	0.12	0.73	0.087
sum =	0.29	sum =	0.233

C = $\boxed{0.80}$ = total product / total area

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,
C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

A = area (ac)

CB-22

Surface Cover	A (ac)	C	Product A x C
impervious	0.22	0.9	0.198
lands/grass	0.09	0.2	0.018
woods	0	0.15	0
sum =	0.31	sum =	0.216

C = **0.70** = total product / total area

CB-23

Surface Cover	A (ac)	C	Product A x C
impervious	0.11	0.9	0.099
lands/grass	0.02	0.2	0.004
woods	0	0.15	0
sum =	0.13	sum =	0.103

C = **0.79** = total product / total area

DMH-17

Surface Cover	A (ac)	C	Product A x C
CB-22	0.31	0.70	0.216
DMH-16	0.29	0.80	0.233
CB-23	0.13	0.79	0.103
sum =	0.73	sum =	0.552

C = **0.76** = total product / total area

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

A = area (ac)

CB-24

Surface Cover	A (ac)	C	Product A x C
impervious	0.57	0.9	0.513
lands/grass	0.20	0.2	0.04
woods	0	0.15	0
sum =	0.77	sum =	0.553

C = **0.72** = total product / total area

DMH-18

Surface Cover	A (ac)	C	Product A x C
CB-24	0.77	0.72	0.553
DMH-19	2.04	0.42	0.849
DMH-17	0.73	0.76	0.552
sum =	3.54	sum =	1.954

C = **0.55** = total product / total area

Project:	700-800 Mass Ave	By	JTM	Date 10/17/2016
Location:	Boxborough, MA	Checked		Date

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,
C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

A = area (ac)

CB-27

Surface Cover	A (ac)	C	Product A x C
impervious	0.21	0.9	0.189
lands/grass	0.10	0.2	0.02
woods	0	0.15	0
sum =	0.31	sum =	0.209

C = **0.67** = total product / total area

CB-28

Surface Cover	A (ac)	C	Product A x C
impervious	0.11	0.9	0.099
lands/grass	0.03	0.2	0.006
woods	0	0.15	0
sum =	0.14	sum =	0.105

C = **0.75** = total product / total area

DMH-22

Surface Cover	A (ac)	C	Product A x C
CB-27	0.31	0.67	0.209
CB-28	0.14	0.75	0.105
sum =	0.45	sum =	0.314

C = **0.70** = total product / total area

Closed Drainage System SM-2069

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

A = area (ac)

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

DI 8

Surface Cover	A (ac)	C	Product A x C
impervious	0.00	0.9	0
lands/grass	1.06	0.2	0.212
woods	0	0.15	0
sum =	1.06	sum =	0.212

C = $\boxed{0.20}$ = total product / total area

DMH-19A

Surface Cover	A (ac)	C	Product A x C
DI 8	1.06	0.20	0.212
DMH-20	0.98	0.65	0.637
sum =	2.04	sum =	0.849

C = $\boxed{0.42}$ = total product / total area

Closed Drainage System SM-2069

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,
C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

A = area (ac)

CB-25

Surface Cover	A (ac)	C	Product A x C
impervious	0.18	0.9	0.162
lands/grass	0.13	0.2	0.026
woods	0	0.15	0
sum =	0.31	sum =	0.188

C = **0.61** = total product / total area

CB-26

Surface Cover	A (ac)	C	Product A x C
impervious	0.13	0.9	0.117
lands/grass	0.09	0.2	0.018
woods	0	0.15	0
sum =	0.22	sum =	0.135

C = **0.61** = total product / total area

DMH-20

Surface Cover	A (ac)	C	Product A x C
CB-25	0.31	0.61	0.188
DMH-21	0.45	0.70	0.314
CB-26	0.22	0.61	0.135
sum =	0.98	sum =	0.637

C = **0.65** = total product / total area

Closed Drainage System SM-2069

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

A = area (ac)

DI 5

Surface Cover	A (ac)	C	Product A x C
impervious	0.00	0.9	0
lands/grass	0.86	0.2	0.172
woods	0	0.15	0
sum =	0.86	sum =	0.172

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

DI 6

Surface Cover	A (ac)	C	Product A x C
impervious	0.00	0.9	0
lands/grass	1.21	0.2	0.242
woods	0	0.15	0
sum =	1.21	sum =	0.242

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

DMH-23

Surface Cover	A (ac)	C	Product A x C
DI 5	0.86	0.20	0.172
DI 6	1.21	0.20	0.242
sum =	2.07	sum =	0.414

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

Project:	700-800 Mass Ave	By	JTM	Date	10/17/2016
Location:	Boxborough, MA	Checked		Date	

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,
C = 0.90 impervious
C = 0.20 landscaped / grass
C = 0.15 woods

A = area (ac)

DI 7

Surface Cover	A (ac)	C	Product A x C
impervious	0.00	0.9	0
lands/grass	0.66	0.2	0.132
woods	0	0.15	0
sum =	0.66	sum =	0.132

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

No. SM-2069

Date: 4-28-97

Commonwealth of Massachusetts
BOXBOROUGH, Massachusetts

Soil Suitability Assessment for On-site Sewage Disposal

Performed By: RICHARD J. HARRINGTON - STAMSKI & McNARY, INC. Date: 4-28-97
Witnessed By: JUDITH GIORGIO - NASHOBA B.O.H.

Location Address or Lot # ASSESSOR'S MAP 6 PARCEL 130, 127.1 MAP 10 PARCEL STOW ROAD, MASS AVE	Owner's Name, Address, and Telephone # AUTHENTIC HOMES 98 CHARTER ROAD ACTON, MA 01720 263-8628
New Construction ☒ Repair ☐	

Office Review

Published Soil Survey Available: No ☐ Yes ☒

Year Published ...... Publication Scale ...... Soil Map Unit
Drainage Class A Soil Limitations RAPID PERMEABILITY

Surficial Geologic Report Available: No ☒ Yes ☐

Year Published Publication Scale
Geologic Material (Map Unit)
Landform

Flood Insurance Rate Map:

Above 500 year flood boundary No ☐ Yes ☒

Within 500 year flood boundary No ☒ Yes ☐

Within 100 year flood boundary No ☒ Yes ☐

Wetland Area:

National Wetland Inventory Map (map unit) WETLANDS FLAGGED ON SITE

Wetlands Conservancy Program Map (map unit)

Current Water Resource Conditions (USGS): Month

Range: Above Normal ☐ Normal ☒ Below Normal ☐

Other References Reviewed: ______

Location Address or Lot No. PARCEL 127.1 STOW RD
BOXBORO

On-site Review

Deep Hole Number SM-6 Date: 4-28-97 Time: 10:35 Weather RAIN 40°

Location (identify on site plan)

Land Use WOODS Slope (%) Surface Stones —

Vegetation TREES

Landform TERRACE

Position on landscape (sketch on the back)

Distances from:

Open Water Body — feet Drainage way — feet

Possible Wet Area 120+ feet Property Line — feet

Drinking Water Well 1200 feet Other —

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0'-0" - 0'-6"	A	SANDY LOAM	10YR 3/3	—	MASSIVE FRIABLE
0'-6" - 1'-6"	B	LOAMY SAND	2.5Y 5/6	—	MASSIVE FRIABLE
1'-6" - 4'-0"	C_1	COARSE SAND	2.5Y 6/4	—	GRANULAR FRIABLE 5% BOULDERS
4'-0" - 6'-6"	C_2	LOAMY SAND	2.5Y 6/3	—	MASSIVE FRIABLE

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) ICE CONTACT OUTWASH

Depth to Bedrock: 6'-6" POSSIBLE BOULDERS OR REFUSAL

Depth to Groundwater: Standing Water in the Hole: —

Weeping from Pit Face: —

Estimated Seasonal High Ground Water: 6'-6"

Location Address or Lot No. PARCEL 127.1 STOW RD
BOXBORO

On-site Review

Deep Hole Number SM-7 Date: 4-28-97 Time: 10:55 Weather RAIN 40°

Location (identify on site plan)
Land Use WOODS Slope (%) 5 Surface Stones —
Vegetation PINE
Landform
Position on landscape (sketch on the back)

Distances from:

Open Water Body — feet
Possible Wet Area 150± feet
Drinking Water Well >200 feet
Drainage way — feet
Property Line 100± feet
Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0'-0" – 0'-6"	A	SANDY LOAM	10YR 3/3	—	MASSIVE FRIABLE
0'-6" – 1'-6"	B	LOAMY SAND	2.5Y 5/6	—	MASSIVE FRIABLE
1'-6" – 8'-0"	C_1	MEDIUM SAND	2.5Y 6/3	—	MASSIVE VERY FRIABLE
8'-0" – 10'-0"	C_2	FINE SAND	2.5Y 6/2	>5% 8'-0" GREYS	MASSIVE FRIABLE

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) PROGLACIAL OUTWASH
Depth to Bedrock: —
Depth to Groundwater: Standing Water in the Hole: —
Weeping from Pit Face: —
Estimated Seasonal High Ground Water: 8'-0"

Location Address or Lot No. PARCEL 127.1 STOW RD
BOXBORO

On-site Review

Deep Hole Number SM-8 Date: 4-28-97 Time: 11:00 Weather RAIN 40°
Location (identify on site plan)
Land Use WOODS Slope (%) Surface Stones —
Vegetation PINE
Landform
Position on landscape (sketch on the back)
Distances from:
Open Water Body — feet
Possible Wet Area >150' feet
Drinking Water Well — feet
Drainage way — feet
Property Line 100' feet
Other —

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0'-0"- 0'-8"	A	SANDY LOAM	10YR 3/3	—	MASSIVE FRIABLE
0'-8"- 1'-6"	B	LOAMY SAND	2.5Y 5/6	—	MASSIVE FRIABLE
1'-6"- 6'-0"	C_1	COARSE SAND	2.5Y 6/4	—	GRANULAR FRIABLE
6'-0"- 10'-0"	C_2	LOAMY SAND	2.5Y 6/2	8'-0" 75% GREYS	MASSIVE FRIABLE

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) ICE CONTACT OUTWASH
Depth to Bedrock: —
Depth to Groundwater: Standing Water in the Hole: —
Weeping from Pit Face: —
Estimated Seasonal High Ground Water: 8'-0"

Location Address or Lot No. PARCEL 127.1 STOW RD
BOXBORO

On-site Review

Deep Hole Number SM-9 Date: 4-28-97 Time: 11:15 Weather RAIN 40°

Location (identify on site plan)

Land Use WOODS Slope (%) 5 Surface Stones —

Vegetation PINE

Landform

Position on landscape (sketch on the back)

Distances from:

Open Water Body — feet

Possible Wet Area ?150 feet

Drinking Water Well — feet

Drainage way feet

Property Line 50± feet

Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0'-0" - 0'-6"	A	SANDY LOAM	10YR 3/3	—	MASSIVE FRIABLE
0'-6" - 1'-6"	B	LOAMY SAND	2.5Y 5/6	—	MASSIVE FRIABLE
1'-6" - 7'-0"	C_1	LOAMY SAND	2.5Y 6/4	—	MEDIUM MASSIVE FRIABLE 5% BOULDERS
7'-0" - 9'-0"	C2	FINE LOAMY SAND	2.5Y 6/2	75% 7'-0" GREYS	FINE MASSIVE FIRM

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) ICE CONTACT OUTWASH

Depth to Bedrock: BOULDERS 9'-0"

Depth to Groundwater: Standing Water in the Hole: —

Weeping from Pit Face: —

Estimated Seasonal High Ground Water: 7'-0"

Location Address or Lot No. PARCEL 127.1 STOW RD
BOXBORO

On-site Review

Deep Hole Number SM-10 Date: 4-28-97 Time: 11:30 Weather RAIN 40°
Location (identify on site plan)
Land Use WOODS Slope (%) 2 Surface Stones —
Vegetation PINE
Landform OUTWASH PLAIN
Position on landscape (sketch on the back)
Distances from:
Open Water Body — feet Drainage Way — feet
Possible Wet Area 7150 feet Property Line — feet
Drinking Water Well — feet Other —

DEEP OBSERVATION HOLE LOG*

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0'-0" – 0'-6"	A	SANDY LOAM	10YR 3/3	—	MASSIVE FRIABLE
0'-6" – 1'-0"	B	LOAMY SAND	10YR 5/6	—	MASSIVE FRIABLE
1'-0" – 10'-0"	C	COARSE SAND	2.5Y 6/4	—	GRANULAR LOOSE

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) PROGLACIAL OUTWASH Depth to Bedrock: —
Depth to Groundwater: Standing Water in the Hole: — Weeping from Pit Face: —
Estimated Seasonal High Ground Water: 10'-0"

Location Address or Lot No. PARCEL 127.1 STOW RD
BOXBORO

On-site Review

Deep Hole Number SM-11 Date: 4-28-97 Time: 11:40 Weather RAIN 40°
Location (identify on site plan)
Land Use WOODS Slope (%) 2 Surface Stones —
Vegetation PINE
Landform OUTWASH PLAIN
Position on landscape (sketch on the back)
Distances from:

Open Water Body — feet
Possible Wet Area >150± feet
Drinking Water Well — feet
Drainage way — feet
Property Line — feet
Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0'-0" - 0'-6"	A	SANDY LOAM	10YR 3/3	—	MASSIVE FRIABLE
0'-6" - 1'-0"	B	LOAMY SAND	10YR 5/6	—	MASSIVE FRIABLE
1'-0" - 11'-0"	C	COARSE SAND	2.5Y 6/4	—	GRANULAR LOOSE

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) PROGLACIAL OUTWASH
Depth to Bedrock: —
Depth to Groundwater: Standing Water in the Hole: —
Weeping from Pit Face: —
Estimated Seasonal High Ground Water: 11'-0"

MAP 6 PARCELS 130, 127.1
Location Address or Lot No. MAP 10 · PARCEL
BOXBORO

Determination for Seasonal High Water Table

Method Used:

- [x] Depth observed standing in observation hole .... inches
- [ ] Depth weeping from side of observation hole .... inches
- [x] Depth to soil mottles .... inches
- [ ] Ground water adjustment .... feet

Index Well Number .... Reading Date .... Index well level ....

Adjustment factor .... Adjusted ground water level ....

Depth of Naturally Occurring Pervious Material

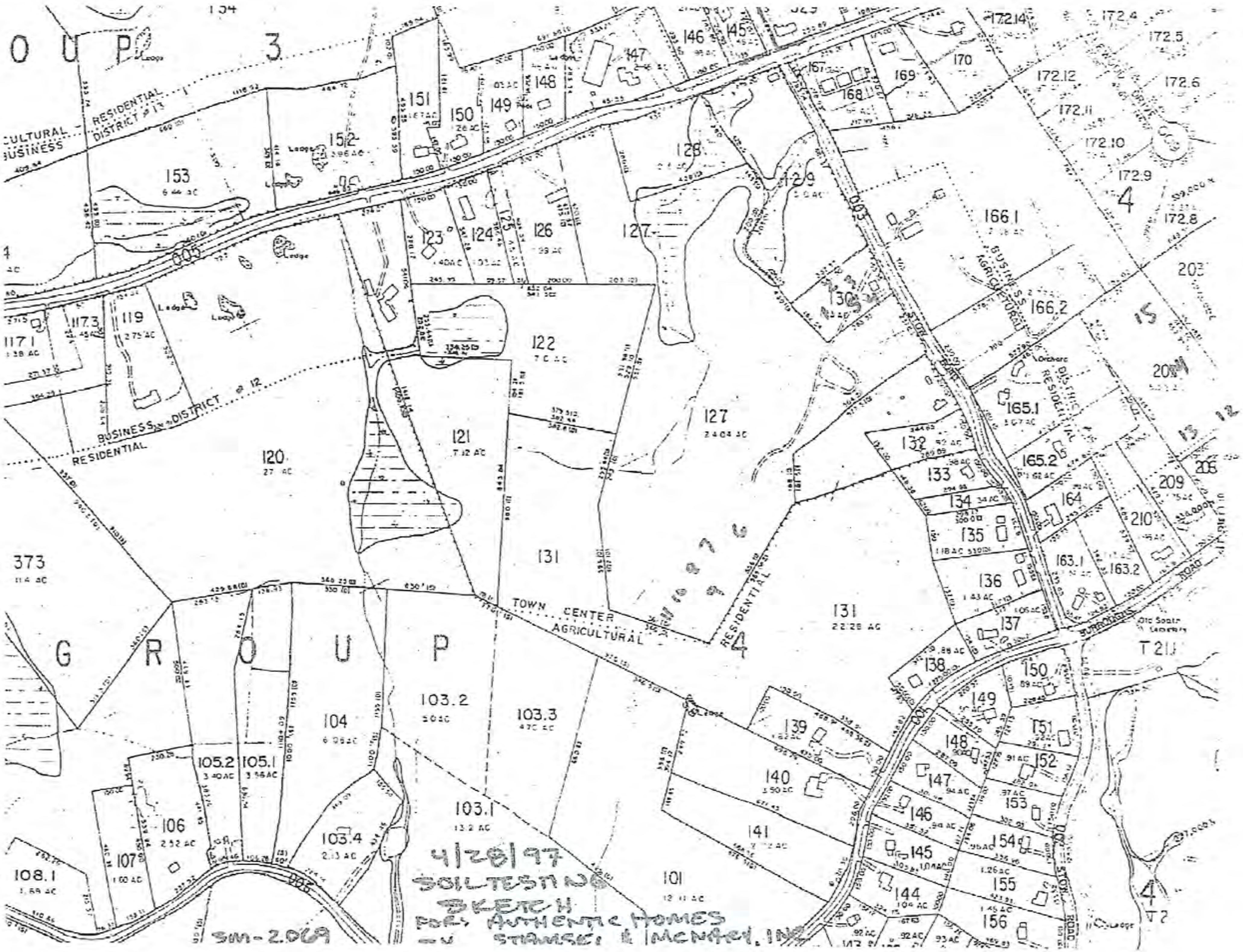
Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system? yes

If not, what is the depth of naturally occurring pervious material? ________

Certification

I certify that on 10-25-94 (date) I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature [signature] Date 4-28-97



GROUP 3
GROUP 4
RESIDENTIAL DISTRICT # 13
CULTURAL BUSINESS
BUSINESS DISTRICT # 12
RESIDENTIAL
TOWN CENTER AGRICULTURAL
BUSINESS AGRICULTURAL
DISTRICT RESIDENTIAL
RESIDENTIAL
STOW ROAD
Orchard
Ledge
4/28/97
SOILTESTING SKETCH
FOR: AUTHENTIC HOMES
BY: STAMSKI & McNARY, INC.
SM-2069

SEWT 10" DUH / DEPT

FORM 11 - SOIL EVALUATOR FORM
Page 1 of 3

No. SM 2069

Date: 8/13/98

Commonwealth of Massachusetts
Boxborough, Massachusetts
Soil Suitability Assessment for On-site Sewage Disposal

Performed By: George Dimakarakos / STAMSKI & McNARY INC Date: 8/13/98
Witnessed By: MATT MORAN N.A.B.H. BERNIE ... N.A.B.H
MARGO WEBBER D.E.P.

Location Address or Lot # PARCEL 127.1 PARCEL 130 STOW ROAD	Owner's Name, Address, and Telephone # AUTHENTIC HOMES INC 93 CHARTER ROAD ACTON, MA 01720 263-9628

New Construction ☐ Repair ☐

Office Review

Published Soil Survey Available: No ☐ Yes ☒
Year Published ______ Publication Scale ______ Soil Map Unit ______
Drainage Class ______ Soil Limitations ______
Surficial Geologic Report Available: No ☒ Yes ☐
Year Published ______ Publication Scale ______
Geologic Material (Map Unit) ______
Landform ______
Flood Insurance Rate Map:
Above 500 year flood boundary No ☐ Yes ☒
Within 500 year flood boundary No ☒ Yes ☐
Within 100 year flood boundary No ☒ Yes ☐
Wetland Area:
National Wetland Inventory Map (map unit) Upland
Wetlands Conservancy Program Map (map unit) ______

Current Water Resource Conditions (USGS): Month April, 1998
Range: Above Normal ☐ Normal ☒ Below Normal ☐
Other References Reviewed: ______

DEP APPROVED FORM - 12/1/95

Location Address or Lot No. PARCEL 127.1, STOW ROAD

On-site Review

Deep Hole Number 16 Date: 4/29/98 Time: 8:30 Weather SUNNY 50's
Location (identify on site plan)
Land Use WOODS Slope (%) 2 Surface Stones
Vegetation WOODS
Landform TERRACE
Position on landscape (sketch on the back) ON SLOPE
Distances from:
Open Water Body feet Drainage way feet
Possible Wet Area feet Property Line feet
Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 - 6"	A	SANDY LOAM	10YR3/3	–	MASSIVE, FRIABLE
6" - 18"	B	LOAMY SAND	10YR5/6	–	MASSIVE, VERY FRIABLE
18" - 144"	C	FINE SAND	2.5Y5/4	RUST BAND @56"	SINGLE GRAIN VERY FRIABLE FINE

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) PROGLACIAL OUTWASH DepthtoBedrock: —
Depth to Groundwater: Standing Water in the Hole: 144" Weeping from Pit Face: 132"
Estimated Seasonal High Ground Water: 7.37' (SEE ATTACHED CALCS)

Location Address or Lot No. PARCEL 127.1 STOW RD

On-site Review

Deep Hole Number 17 Date: 4/29/98 Time: 8:45 Weather SUNNY 50's
Location (identify on site plan)
Land Use WOODS Slope (%) 2 Surface Stones
Vegetation WOODS
Landform TERRACE
Position on landscape (sketch on the back) BOTTOM SLOPE
Distances from:
Open Water Body feet Drainage way feet
Possible Wet Area feet Property Line feet
Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 - 20"	A_1	SANDY LOAM	10YR3/3	—	MASSIVE, FRIABLE
20"-27"	A_2	SANDY LOAM	7.5YR3/4	—	MASSIVE, FRIABLE
27"-36"	B	SANDY LOAM	10YR4/4	—	MASSIVE, FRIABLE
36"-132"	C_1	FINE SAND	2.5Y5/4		VERY FRIABLE SINGLE GRAIN
132"-180"	C_2	LOAMY SAND	2.5Y4/3	RUST BAND @66"	MASSIVE, FRIABLE GRAVELLY 10% STONES GLEYED BELOW 132"

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) PROGLACIAL OUTWASH Depth to Bedrock: —
Depth to Groundwater: Standing Water in the Hole: BOTTOM Weeping from Pit Face: 132"
Estimated Seasonal High Ground Water: 7.37' (SEE ATTACHED CALC'S)

Location Address or Lot No. PARCEL 127.1 , STOW ROAD

On-site Review

Deep Hole Number 18 Date: 4/29/98 Time: 9:15 Weather SUNNY 50's

Location (identify on site plan)

Land Use WOODS Slope (%) 3-5 Surface Stones

Vegetation WOODS

Landform TERRACE

Position on landscape (sketch on the back) ON SLOPE

Distances from:

Open Water Body feet Drainage way feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 - 8"	A	SANDY LOAM	10YR3/3	-	MASSIVE, FRIABLE
8" - 18"	B	LOAMY SAND	10YR5/6	-	MASSIVE, VERY FRIABLE
18" - 216"	C	MEDIUM SAND	2.5Y5/4	HIGH & LOW CHROMA BANDS @ 84"	SINGLE GRAIN VERY FRIABLE

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) PROGLACIAL OUTWASH Depth to Bedrock:

Depth to Groundwater: Standing Water in the Hole: BOTTOM Weeping from Pit Face: 168"

Estimated Seasonal High Ground Water: 10.37' (SEE ATTACHED CALC'S)

Location Address or Lot No. PARCEL 127.1 STOW ROAD

On-site Review

Deep Hole Number 19 Date: 9/29/98 Time: 9:30 Weather SUNNY 60

Location (identify on site plan)

Land Use WOODS Slope (%) 5 Surface Stones

Vegetation WOODS

Landform TERRACE ON SLOPE

Position on landscape (sketch on the back)

Distances from:

Open Water Body feet Drainage way feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 - 6"	A	SANDY LOAM	10YR3/2	—	MASSIVE, FRIABLE
6" - 18"	B	LOAMY SAND	10YR 4/6	—	MASSIVE, VERY FRIABLE
18" - 216"	C	MEDIUM COARSE SAND	10YR4/6	FAINT MOTTLES @ 132"	LOOSE, SINGLE GRAIN GRAVELLY COBBLY

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) ICE CONTACT OUTWASH Depth to Bedrock: —

Depth to Groundwater: Standing Water in the Hole: 198 Weeping from Pit Face: 198"

Estimated Seasonal High Ground Water: 12.87' (SEE ATTACHED CALC'S)

Location Address or Lot No. PARCEL 127.1, STOW ROAD

On-site Review

Deep Hole Number 20 Date: 4/29/98 Time: 9:45 Weather SUNNY 60'S

Location (identify on site plan)

Land Use WOODS Slope (%) 3-5 Surface Stones

Vegetation WOODS

Landform TERRACE

Position on landscape (sketch on the back) ON SLOPE

Distances from:

Open Water Body feet Drainage way feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 - 6"	A	SANDY LOAM	10YR3/3	—	MASSIVE, FRIABLE
6"-18"	B	LOAMY SAND	10YR5/6	—	MASSIVE, VERY FRIABLE
18"-192"	C	FINE-MEDIUM SAND	2.5Y5/4	HIGH-LOW CHROMA @72"	VERY FRIABLE SINGLE GRAIN 15% GRAVEL (SANDY LOAM LENSE @ ± 3-4', APPROX 10' LONG)

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) ICE CONTACT OUTWASH Depth to Bedrock:

Depth to Groundwater: Standing Water in the Hole: BOTTOM Weeping from Pit Face: 180"

Estimated Seasonal High Ground Water: 11.37' (SEE ATTACHED CALC'S)

DEP APPROVED FORM - 12/07/95

Location Address or Lot No. PARCEL 130 , SNOW RD

On-site Review

Deep Hole Number 21 Date: 4/29/98 Time: 11:00 Weather 60's SUNNY

Location (identify on site plan)

Land Use YARD Slope (%) 3-5 Surface Stones

Vegetation GRASS/BRUSH

Landform

Position on landscape (sketch on the back) ON SLOPE

Distances from:

Open Water Body feet Drainage way feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-8"	A	SANDY LOAM	10YR3/3	—	MASSIVE, FRIABLE
8"-18"	B	LOAMY SAND	10YR5/6	—	MASSIVE, VERY FRIABLE
18"-174"	C	LOAMY SAND	2.5Y5/3	COMMON 7.5YR5/8 2.5Y6/2 @ 36"	MASSIVE, FRIABLE 15% GRAVEL 5% COBBLES

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) ABLATION TILL DepthtoBedrock: —

Depth to Groundwater: Standing Water in the Hole: 138" Weeping from Pit Face: 120"

Estimated Seasonal High Ground Water: 36"

Location Address or Lot No. PARCEL 130 , STOW RD

On-site Review

Deep Hole Number 22 Date: 4/21/98 Time: 11:20 Weather SUNY 60's

Location (identify on site plan)

Land Use YARD Slope (%) 3-5 Surface Stones

Vegetation BRUSH

Landform

Position on landscape (sketch on the back) ON SLOPE

Distances from:

Open Water Body feet Drainage way feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 - 8"	A	SANDY LOAM	10YR3/3		MASSIVE, FRIABLE
8"-24"	B	LOAMY SAND	10YR5/6		MASSIVE, FRIABLE
24"- 182"	C	LOAMY SAND	2.5Y5/4	COMMON 7.5YR5/8 + 2.5Y6/2 @48"	MASSIVE, FRIABLE MOIST 15% GRAVEL 10% STONES

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) ABLATION DepthtoBedrock:

Depth to Groundwater: Standing Water in the Hole: 13' Weeping from Pit Face: 12'6"

48"

Estimated Seasonal High Ground Water:

Location Address or Lot No. PARCEL 130, STOW RD

On-site Review

Deep Hole Number 23 Date: 4/29/98 Time: 11:50 Weather 60'S SUNNY

Location (identify on site plan)

Land Use YARD Slope (%) 5-8 Surface Stones

Vegetation BRUSH

Landform

Position on landscape (sketch on the back) ON SLOPE

Distances from:

Open Water Body feet Drainage way feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-8"	A	SANDY LOAM	10YR 3/3		MASSIVE, FRIABLE
8"-24"	B	LOAMY SAND	10YR 5/6	COMMON 7.5YR 5/8	MASSIVE, FRIABLE
24"-144"	C	LOAMY SAND	2.5Y5/4	2.5Y6/2 @ 66"	MASSIVE, FRIABLE 10% BOULDERS 15% GRAVEL 10% STONES

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) ABLATION TILL Depth to Bedrock:

Depth to Groundwater: Standing Water in the Hole: BOTTOM Weeping from Pit Face: 132"

Estimated Seasonal High Ground Water: 66"

Location Address or Lot No. PARCEL 13, STOW ROAD

On-site Review

Deep Hole Number 24 Date: 4/29/98 Time: 12:15 Weather SUNNY 60's

Location (identify on site plan)

Land Use YARD Slope (%) 3-5 Surface Stones

Vegetation BRUSH

Landform

Position on landscape (sketch on the back) ON SLOPE

Distances from:

Open Water Body feet Drainage way feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-18"	FILL				
18"-36"	C_1	FINE SAND	2.5Y5/6		VERY FRIABLE SINGLE GRAIN
36"-150"	C_2	LOAMY SAND	2.5Y4/3	COMMON 7.5YR5/8 2.5Y6/2 @ 36"	FIRM IN PLACE 10% GRAVEL

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) ABLATION TILL Depth to Bedrock: —

Depth to Groundwater: Standing Water in the Hole: 138" Weeping from Pit Face: 126"

Estimated Seasonal High Ground Water: 36"

Location Address or Lot No. PARCEL 170, STOW ROAD

On-site Review

Deep Hole Number 25 Date: 4/29/98 Time: 12:25 Weather SUNNY 60's

Location (identify on site plan)

Land Use YARD Slope (%) 3-5 Surface Stones

Vegetation BRUSH

Landform

Position on landscape (sketch on the back) ON SLOPE

Distances from:

Open Water Body feet Drainage way feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-12"	A	SANDY LOAM	10YR3/2	—	MASSIVE, FRIABLE
12"-24"	B	LOAMY SAND	10YR5/6	—	MASSIVE, VERY FRIABLE
24"-144"	C	LOAMY SAND	2.5Y5/4	COMMON 7.5YR5/8 7.5Y6/2 @ 36"	MASSIVE, FRIABLE 10% GRAVEL 10% STONES

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) ABLATION TILL DepthtoBedrock:

Depth to Groundwater: Standing Water in the Hole: 162" Weeping from Pit Face: 162"

Estimated Seasonal High Ground Water: 36"

Location Address or Lot No. PARCEL 130 STOW ROAD

On-site Review

Deep Hole Number 2S Date: 4/29/98 Time: 12:35 Weather SUNNY 60's

Location (identify on site plan)

Land Use YARD Slope (%) 3-5 Surface Stones

Vegetation BRUSH

Landform

Position on landscape (sketch on the back) ON SLOPE

Distances from:

Open Water Body feet Drainage way feet

Possible Wet Area feet Property Line feet

Drinking Water Well feet Other

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-12"	A	SANDY LOAM	10YR3/3	–	MASSIVE, FRIABLE.
12"-24"	B	LOAMY SAND	10YR5/6	–	MASSIVE, FRIABLE
24"-144"	C	LOAMY SAND	2.5Y5/3	COMMON 7.5YR5/8 7.5Y6/2 @ 36"	MASSIVE FRIABLE 10% GRAVEL COBBLY

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) ABLATION TILL Depth to Bedrock:

Depth to Groundwater: Standing Water in the Hole: 132" Weeping from Pit Face: 84"

Estimated Seasonal High Ground Water: 36"

Location Address or Lot No. PARCEL 127.1 STOW ROAD

COMMONWEALTH OF MASSACHUSETTS

BOXBORO" , Massachusetts

Percolation Test*

Date: 8/13/98		Time: 9:48
Observation Hole #	16	17
Depth of Perc	50"	44"
Start Pre-soak	9:48	9:54
End Pre-soak	10:03	10:09
Time at 12"	10:03	
Time at 9"	10:05	
Time at 6"	10:08	
Time (9"-6")	3	UNABLE TO SATURATE
Rate Min./Inch	2	<2

* Minimum of 1 percolation test must be performed in both the primary area AND reserve area.

Site Passed ☒ Site Failed ☐

Performed By: George Dimakarakos / STAMSKI & McNARY, INC

Witnessed By: MATT MORAN - NABH

Comments: MARGO WEBBER - DEP

Location Address or Lot No. PARCEL 127.1, STOW ROAD

COMMONWEALTH OF MASSACHUSETTS

BOXBORO, Massachusetts

Percolation Test*

Date: 8/13/98	Time: 10:12	
Observation Hole #	18	19
Depth of Perc	45	40"
Start Pre-soak	10:12	10:18
End Pre-soak	10:27	
Time at 12"	10:27	
Time at 9"	10:34	
Time at 6"	10:41	
Time (9"-6")	7	UNABLE TO SAT.
Rate Min./Inch	3	<2

* Minimum of 1 percolation test must be performed in both the primary area AND reserve area.

Site Passed ☒ Site Failed ☐

Performed By: George Dimakarakos / STAMSKI & MCNARY, INC.

Witnessed By: MATT MORAN - NASH.

Comments: MARGO - WEBBER - DEP

Location Address or Lot No. PARCEL 130

COMMONWEALTH OF MASSACHUSETTS

BOXBORO, Massachusetts

Percolation Test*

Date: 8/13/98	Time: 1110	
Observation Hole #	22	23
Depth of Perc	53"	48"
Start Pre-soak	11:10	11:38
End Pre-soak	11:25	11:53
Time at 12"	11:25	11:53
Time at 9"	11:45	12:05
Time at 6"	12:22	12:25
Time (9"-6")	27	20
Rate Min./Inch	13	7

* Minimum of 1 percolation test must be performed in both the primary area AND reserve area.

Site Passed ☒ Site Failed ☐

Performed By: George Dimakarakos / STAMSKI + MCNARY, INC

Witnessed By: MATT MORAN - NABHA

Comments:

Location Address or Lot No. Parcel 127.1, PARCEL 130
STOW ROAD

Determination for Seasonal High Water Table

Method Used:

- ☐ Depth observed standing in observation hole .... inches
- ☐ Depth weeping from side of observation hole ...... inches
- ☒ Depth to soil mottles ...... inches
- TP's 16-20 ☒ Ground water adjustment 3.63 feet

Index Well Number .... Reading Date .... Index well level ....

Adjustment factor .... Adjusted ground water level ....

Depth of Naturally Occurring Pervious Material

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

If not, what is the depth of naturally occurring pervious material? __________

Certification

I certify that on 7/26/95 (date) I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature George Dimakarakos Date 9/13/98

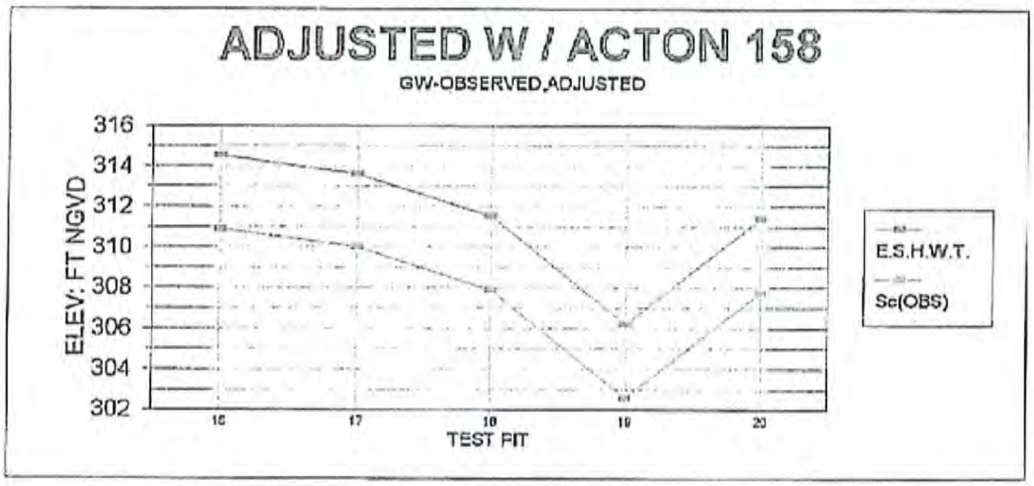
STAMSKI & McNARY INC.

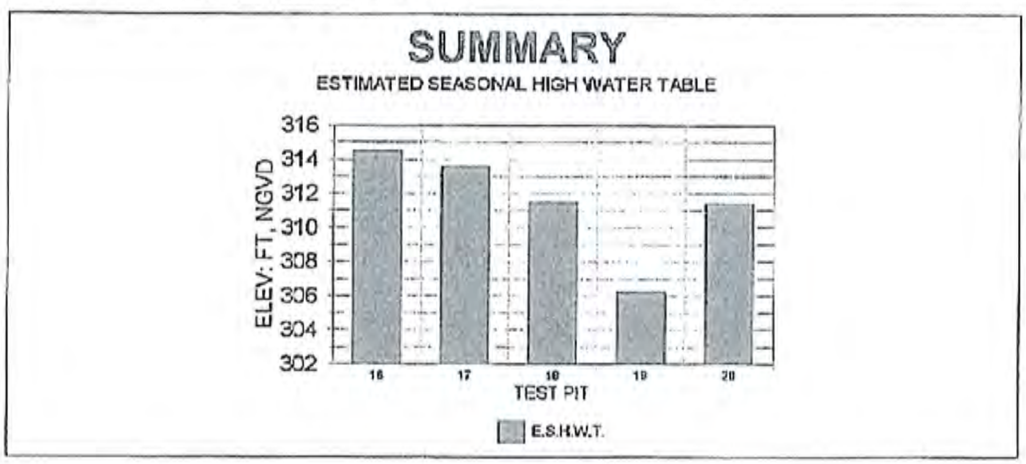
CALCULATED BY: GD

PROJECT: SM-2069

REFERENCE WELL: ACTON 158
FRIMPTER CALCULATIONS:
Sc=MEASURED DEPTH TO GW @ SITE
14.98 =OwMAX=MAX GW ELEV IN WELL
17.34 =Owc=MEASURED GW IN WELL
8.3 =Sr=RANGE OF WATER LEVEL
5.4 =Owr=RECORDED UPPER LIMIT OF WELL
Sh=SEASONAL HIGH AT SITE
Sc-Sr/Owr(Owc-OwMAX)=Sh

TEST PIT #	GROUND ELEV.	Sc FT	Sc(OBS) ELEV	Sh FT	FRIMPTER ADJUSTED ELEV.	E.S.H.W.T. N.G.V.D.
16	321.90	11.00	310.90	7.37	314.53	314.53
17	321.00	11.00	310.00	7.37	313.63	313.63
18	321.90	14.00	307.90	10.37	311.53	311.53
19	319.10	16.50	302.60	12.87	306.23	306.23
20	322.80	15.00	307.80	11.37	311.43	311.43



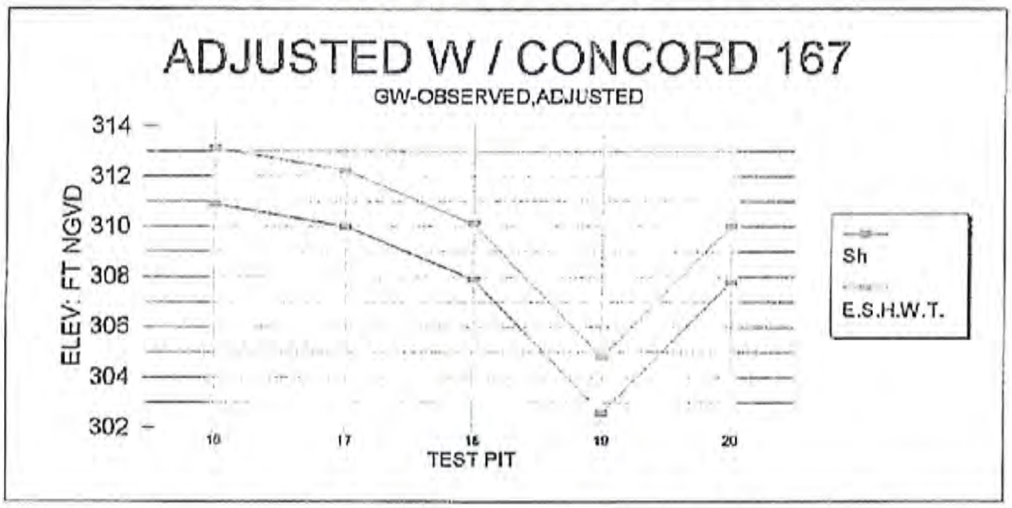


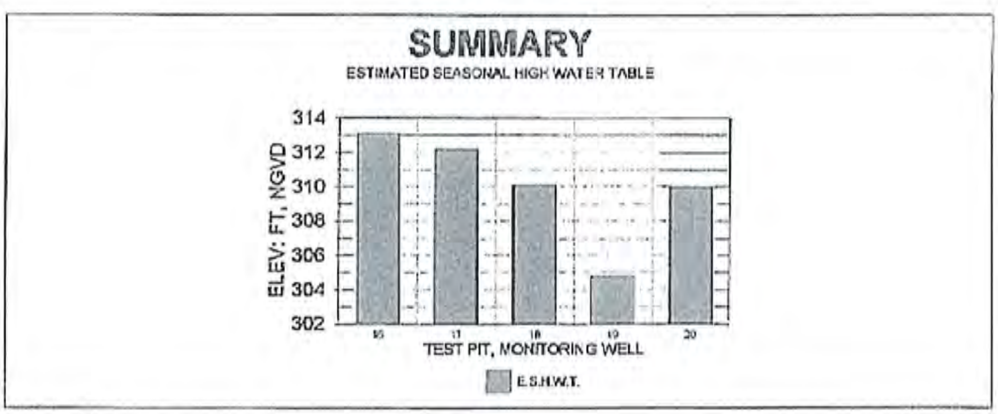
CALCULATED BY: GD

PROJECT: SM-2069

REFERENCE WELL:CONCORD 167
FRIMPTER CALCULATIONS:
Sc=MEASURED DEPTH TO GW @ SITE
4.47 =OwMAX=MAX GW ELEV IN WELL
5.73 =Owc=MEASURED GW IN WELL
8.3 =Sr=RANGE OF WATER LEVEL
4.72 =Owr=RECORDED UPPER LIMIT OF WELL
Sh=SEASONAL HIGH AT SITE
Sc-Sr/Owr(Owc-OwMAX)=Sh

TEST PIT #	GROUND ELEV.	Sc FT	Sc(OBS) ELEV	Sh FT	FRIMPTER ADJUSTED ELEV.	E.S.H.W.T. N.G.V.D.
16	321.90	11.00	310.90	8.78	313.12	**313.12**
17	321.00	11.00	310.00	8.78	312.22	**312.22**
18	321.90	14.00	307.90	11.78	310.12	**310.12**
19	319.10	16.50	302.60	14.28	304.82	**304.82**
20	322.80	15.00	307.80	12.78	310.02	**310.02**





USE ACTON 158

SUMMARY OF GROUND-WATER LEVELS APRIL 1998 PROVISIONAL

WELL	TOPO	LITHO	START YEAR OF RECORD	NET CHANGE IN MONTH (FEET)	NET CHANGE IN ONE YEAR (FEET)	DEPARTURE FROM MONTHLY MEDIAN (FEET)	WATER LEVEL BELOW LAND-SURFACE DATUM (FEET)	DAY
MASSACHUSETTS								
ACTON 158	T	S	1965	+ 0.16	- 1.57	+ 0.47	17.34	22
ANDOVER 462	V	S	1968	- 0.35	- 0.90	- 0.69	14.77	22
ATTLEBORO 83	V	S	1964	- 0.26	- 0.03	+ 0.19	3.27	28
BARNSTABLE 230	F	S	1957	+ 0.03	+ 0.01	+ 1.93	20.74 >	28
BARNSTABLE 247	F	S	1962	+ 0.47	- 0.31	+ 2.78	20.83 >	28
BECKET 12	T	S	1986	+ 0.15	+ 0.09	+ 0.35	3.12	21
BILLERICA 363	H	S	1962	- 1.66	- 0.35	- 4.25	8.50 <	22
BLANDFORD 9	V	S	1986	- 1.15	- 0.62	- 0.92	3.18 <	21
BOURNE 198	F	S	1962	- 0.05	+ 0.85	+ 2.40	29.78 >	28
BOYLSTON 87	V	T	1995	- 2.12	- 1.37	-----	5.92	29
BREWSTER 21	F	S	1962	+ 0.45	+ 0.38	+ 1.71	7.80	22
BREWSTER 22	F	S	1962	+ 0.62	+ 0.47	+ 2.22	28.15 >	22
CHATHAM 138	F	S	1962	+ 0.58	+ 0.34	+ 2.17	21.10	28
CHELMSFORD 384	T	S	1987	- 0.47	- 0.57	+ 0.46	14.81	22
CHESHIRE 2	H	T	1951	- 0.02	+ 0.26	+ 0.08	1.85	21
CHICOPEE 95	T	S	1984	+ 0.53	+ 0.04	+ 0.76	20.37	20
COLRAIN 8	V	S	1965	- 0.86	- 0.92	- 0.34	16.93	21
CONCORD 165	T	S	1965	+ 0.66	- 1.07	+ 1.80	39.74.	22
CONCORD 167	T	S	1965	- 0.86	- 0.55	+ 0.35	5.73	22
CUMMINGTON 13	V	S	1986	- 0.17	- 0.31	- 0.48	3.86	20
DEDHAM 231	S	T	1965	- 0.28	+ 2.09	+ 0.99	3.83	27
DEERFIELD 44	V	S	1965	- 0.06	- 0.10	+ 0.21	2.40	21
DOVER 10	T	S	1965	- 0.35	+ 0.59	+ 0.10	31.52	27
DUXBURY 79	V	S	1965	- 0.35	+ 0.31	+ 0.55	7.40	27
DUXBURY 80	V	R	1965	- 0.36	+ 0.21	+ 0.61	20.92	27
EAST BRIDGEWATER 30	H	T	1958	- 0.39	+ 1.76	+ 1.57	3.46	27
EDGARTOWN 52	V	S	1976	+ 0.79	- 0.33	+ 4.37	13.68 >	28
FOXBOROUGH 3	T	S	1965	- 0.44	- 0.19	+ 0.61	17.26	28
FREETOWN 23	T	S	1964	+ 0.19	- 0.45	+ 1.03	11.84	27
GEORGETOWN 168	V	S	1965	- 1.10	- 0.95	- 0.29	4.23	22
GRANBY 68	V	S	1954	- 0.33	- 0.03	+ 0.18	6.15	20
GRANVILLE 5	T	S	1965	+ 0.61	- 0.81	+ 0.65	31.57	21
GRANVILLE 6	S	S	1965	+ 0.15	- 0.11	+ 0.07	3.30	21
GREAT BARRINGTON 2	V	T	1951	- 0.46	+ 0.05	- 1.12	8.88	20
HALIFAX 97	V	R	1977	-----	-----	-----	-----	
HANSON 76	V	S	1964	- 0.15	+ 0.67	+ 0.15	4.13	27
HARDWICK 1	T	S	1965	- 2.40	- 1.94	- 0.22	12.55	24
HARDWICK 31	T	S	1984	- 3.17	- 0.06	+ 0.19	10.64	20
HAVERHILL 23	T	S	1960	- 0.91	- 0.80	+ 0.59	9.36	22
HAWLEY 8	S	T	1986	+ 0.13	- 0.16	+ 0.59	2.79	20
HOLDEN 169	F	T	1995	- 0.46	- 0.39	-----	1.05	29
LAKEVILLE 14	T	S	1964	- 0.57	- 0.29	+ 3.11	10.07	23
LEXINGTON 104	V	S	1965	- 0.37	- 0.08	+ 0.57	1.73	22
MASHPEE 29	F	S	1976	+ 0.03	+ 0.17	+ 1.75	6.26	28
MIDDLEBOROUGH 82	V	T	1965	- 1.42	- 0.59	+ 1.17	4.17	23
MONTGOMERY 19	S	S	1986	+ 0.03	+ 0.08	+ 0.20	3.50	21
NANTUCKET 228	F	S	1976	+ 0.82	+ 0.72	+ 3.08	21.21 >	24
NEW BEDFORD 116	V	S	1964	- 0.09	+ 0.19	+ 0.27	3.59	27
NEWBURY 27	V	T	1965	- 1.05	- 1.38	+ 0.93	4.37	22

SUMMARY OF GROUND-WATER LEVELS APRIL 1998 PROVISIONAL

The following well characteristics are provided for each of 142 wells in the MA-RI

Table 1.--General well information and water-level statistics for wells in the Massachusetts-Rhode Island Observation-Well Network.

[Water levels are in feet below land-surface elevation; * indicates insufficient length of record for use in estimating water levels]

MASSACHUSETTS WELLS

ACTON (ACW) 158
Start year of record - 1965
Land-surface elevation 153 ft, well depth 33.8 ft
Lithology - SAND
Topographic setting - TERRACE
Remarks - none
Period of record - HIGH (OWmax) 14.98 LOW 21.86 (OWr) 5.40

ANDOVER (AJW) 462
Start year of record - 1968
Land-surface elevation 110 ft, well depth 32.5 ft
Lithology - SAND
Topographic setting - TERRACE
Remarks - Water level affected by nearby construction starting about January 1993
Period of record - HIGH (OWmax) 11.72 LOW 22.56 (OWr) 8.57

ATTLEBORO (ATW) 83
Start year of record - 1964
Land-surface elevation 145 ft, well depth 21.0 ft
Lithology - SAND
Topographic setting - VALLEY
Remarks - none
Period of record - HIGH (OWmax) 1.98 LOW 5.23 (OWr) 2.72

BARNSTABLE (A1W) 230
Start year of record - 1957
Land-surface elevation 43.23 ft, well depth 35.8 ft
Lithology - SAND
Topographic setting - FLAT
Remarks - none
Period of record - HIGH (OWmax) 20.51 LOW 26.59 (OWr) 4.84

BARNSTABLE (A1W) 247
Start year of record - 1962
Land-surface elevation 44.52 ft, well depth 52.0 ft
Lithology - SAND
Topographic setting - FLAT
Remarks - none
Period of record - HIGH (OWmax) 20.52 LOW 28.64 (OWr) 4.80
BECKET (A3W) 12
Start year of record - 1986
Land-surface elevation 1285 ft, well depth 35.0 ft
Lithology - SAND
Topographic setting - TERRACE
Remarks - none
Period of record - HIGH (OWmax) 2.36 LOW 4.62 (OWr) 2.06

BILLERICA (BCW) 363
Start year of record - 1962
Land-surface elevation 166 ft, well depth 15.0 ft
Lithology - SAND
Topographic setting - HILLTOP
Remarks - none
Period of record - HIGH (OWmax) 0.73 LOW 15.00 (dry) (OWr) 10.88

CHELMSFORD (CHW) 384
Start year of record - 1987
Land-surface elevation 125 ft, well depth 42.0 ft
Lithology - SAND
Topographic setting - TERRACE
Remarks - none
Period of record - HIGH (OWmax) 14.24 LOW 17.31 (OWr) 2.62

CHESHIRE (CJW) 2
Start year of record - 1951
Land-surface elevation 1210 ft, well depth 22.0 ft
Lithology - TILL
Topographic setting - HILLTOP
Remarks - Water level may be affected by nearby pumping during summer period
Period of record - HIGH (OWmax) 0.09 LOW 19.83 (OWr) 17.14

CHICOPEE (CMW) 95
Start year of record - 1984
Land-surface elevation 200 ft, well depth 34.0 ft
Lithology - SAND
Topographic setting - TERRACE
Remarks - none
Period of record - HIGH (OWmax) 19.40 LOW 23.62 (OWr) 3.31

COLRAIN (CSW) 8
Start year of record - 1965
Land-surface elevation 460 ft, well depth 32.0 ft
Lithology - SAND
Topographic setting - VALLEY
Remarks - Water level affected by North River
Period of record - HIGH (OWmax) 14.62 LOW 23.48 (OWr) 7.74

CONCORD (CTW) 165
Start year of record - 1965
Land-surface elevation 201.12 ft, well depth 67.0 ft
Lithology - SAND
Topographic setting - TERRACE
Remarks - none
Period of record - HIGH (OWmax) 35.50 LOW 47.10 (OWr) 4.67

CONCORD (CTW) 167
Start year of record - 1965
Land-surface elevation 135 ft, well depth 24.0 ft
Lithology - SAND
Topographic setting - TERRACE
Remarks - none
Period of record - HIGH (OWmax) 4.47 LOW 10.59 (OWr) 4.72

CUMMINGTON (CYW) 13
Start year of record - 1986
Land-surface elevation 988 ft, well depth 39.0 ft
Lithology - SAND
Topographic setting - VALLEY
Remarks - none
Period of record - HIGH (OWmax) 2.10 LOW 6.52 (OWr) 4.42

DEDHAM (DDW) 231
Start year of record - 1965
Land-surface elevation 65 ft, well depth 22.0 ft
Lithology - TILL
Topographic setting - HILLSIDE
Remarks - none
Period of record - HIGH (OWmax) 2.45 LOW 14.96 (OWr) 10.87

LETTER OF
TRANSMITTAL

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Civil & Structural Engineering * Land Surveying * Land Planning

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257 Ayer Road, Harvard, MA 01451
978.772.1590
FAX 978.772.1591

To: John Lyons
571 Burroughs Road
Boxborough, MA 01719

Date: December 8, 2004
Job No: Boxborough Library
Subject: Soil Test Results

We Are Sending You: X Attached | Via | hand | FEDEX

Under separate cover | | mail | AM | PM

The Following Items:

COPIES	DATE	NO.	DESCRIPTION	SCALE
1			Soil test results	
1			Sketch plan	

Disposition:

For approval	For bids due
X For your use	Approved as noted
For review and comment	Returned after loan to us
Please contact me if questions	Returned as requested
I will contact you	As requested

Remarks:

John,

Call if you need anything further.

Rgards,
Cal

No. 00.229

Date: 11/28/00

Commonwealth of Massachusetts
BOXBOROUGH, Massachusetts
Soil Suitability Assessment for On-site Sewage Disposal

Performed By: Barry Berzinis, GPR, INC. Date: 11/27/00
Witnessed By: unwitnessed

Location Address or Lot No. 800 Mass Ave. Boxborough, MA	Owner's Name: John - Lyons
	Address:
New Construction ☒ Repair ☐	Telephone No.:

Office Review

Published Soil Survey Available: No ☐ Yes ☒

Year Published 1989 Publication Scale 1:25,000 Soil Map Unit 7B/Charlton-Hollis-Rock Outcrop Complex

Drainage Class Excessively drained Soil Limitations Slope and depth to bedrock

Surficial Geologic Report Available: No ☐ Yes ☒

Year Published 1948 Publication Scale 1:31,680

Geologic Material (Map Unit) Qgm

Landform Ground moraine

Flood Insurance Rate Map: 250184 003C

Above 500 year flood boundary No ☐ Yes ☒

Within 500 year flood boundary No ☒ Yes ☐

Within 100 year flood boundary No ☒ Yes ☐

Wetland Area:

National Wetland Inventory Map (map unit) NO

Wetlands Conservancy Program Map (map unit) NO

Current Water Resource Conditions (USGS): Month October

Range: Above Normal ☐ Normal ☒ Below Normal ☐

Other References Reviewed: National Heritage Atlas 2000-01 Edition

Location Address or Lot No. 800 Mass Ave. Boxborough, MA

On-site Review

Deep Hole Number: 1100-01 Date: 11-27-00 Time:7:30 AM Weather: 40's, Cloudy

Location (identify on site plan) See sketch

Land Use Residential Wooded Slope(%) 5 Surface Stones Many

Vegetation Oak, Maple & White pine

Landform Ground moraine

Position on landscape (sketch on the back) Top of Knoll

Distances from:

Open Water Body >200 feet Drainage way >200 feet

Possible Wet Area >200 feet Property Line >100 feet

Drinking Water Well >200 feet Other

DEEP OBSERVATION HOLE LOG

1100-01

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-5	A	fsl	10YR3/4	--	m, mfvr, cl
5-16	Bw1	fsl	10YR 4/6	--	m, mfvr, dw
16-26	Bw2	fsl	10YR 5/6	--	m ,mvfr, gw
26-68	C1	ls	2.5Y 5/3-5/4	@35" 5-10%fm 10YR 6/8f&m 2.5Y 6/1-6/2	lsbk-ipl, mfr, gw
68-104	C2	ls-s pockets s&fs	2.5Y 5/3-6/3	15%fm&c 2.5Y 6/8 5%f&m 10YR 6/8 10% f&m 2.5Y 6/1-6/2	m-1sbk, mvfr

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ablation Till Depth to Bedrock: >104"

Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None

Estimated Seasonal High Ground Water: 35"

Location Address or Lot No. 800 Mass Ave. Boxborough, MA

On-site Review

Deep Hole Number: 1100-02 Date: 11-27-00 Time: 8:00 AM Weather: 40's, Cloudy

Location (identify on site plan) See sketch

Land Use Residential Wooded Slope(%) 4 Surface Stones Many

Vegetation Oak, Maple & White pine

Landform Ground moraine

Position on landscape (sketch on the back) Top of Knoll

Distances from:

Open Water Body >200 feet   Drainage way >200 feet

Possible Wet Area >150 feet   Property Line >100 feet

Drinking Water Well >200 feet   Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-4	A	fsl	10YR 3/4	--	m,mvfr, ci
4-16	Bw1	fsl	10YR 4/6	--	m, mvfr, dw
16-32	Bw2	fsl	10Y 5/6	--	m,mvfr,gw
32 - 60	C1	ls	2.5Y5/3-5/4	@36" 5 - 10 f&m 10YR 6/8 10% f&m 2.5 Y 6/2	lsbk mfr, gw
60 - 106	C2	ls-s	2.5Y 5/3-4/3	10% fmc 2.5Y 6/8 5% f&m 10YR 6/8 10% f&m 2.5Y 6/2	m-lsbk, mvfr

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ablation Till   Depth to Bedrock: >106"

Depth to Groundwater: Standing Water in the Hole: None   Weeping from Pit Face: None

Estimated Seasonal High Ground Water: 36"

Location Address or Lot No. 800 Mass Ave. Boxborough, MA

On-site Review

Deep Hole Number: 1100-03 Date: 11-27-00 Time:8:30Am Weather: 40's, Cloudy

Location (identify on site plan) See sketch

Land Use Residential Wooded Slope(%) 7 Surface Stones Many

Vegetation Oak, Maple & White pine

Landform Ground moraine

Position on landscape (sketch on the back) Mild Slope

Distances from:

Open Water Body >200 feet Drainage way >200 feet

Possible Wet Area >150 feet Property Line >150 feet

Drinking Water Well >200 feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-4	A	fsl	10YR 3/4	--	m,mvfr,ci
40-30	Bw1	fsl	10YR 4/6	--	m,mvfr,dw
30-36	Bw2	fsl	10YR 5/6	--	m,mvfr,gw
				@36"	
36-84	C	ls	2.5Y 5/3-5/4		lsbk, mfr, Ang/Subang C & S

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ablation Till Depth to Bedrock: >84"

Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None

Estimated Seasonal High Ground Water: 36"

Location Address or Lot No. 800 Mass Ave. Boxborough, MA

On-site Review

Deep Hole Number: 1100-04 Date: 11-27-00 Time:9:00AM Weather: 40's, Cloudy

Location (identify on site plan) See sketch

Land Use Residential Wooded Slope(%) 4 Surface Stones Many

Vegetation Oak, Maple & White pine

Landform Ground moraine

Position on landscape (sketch on the back) Mild Slope

Distances from:

Open Water Body >200 feet Drainage way >200 feet

Possible Wet Area >200 feet Property Line >200 feet

Drinking Water Well >200 feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 - 4	A	fsl	10YR 3/4	--	m,mvfr
40 - 30	Bw	fsl	10YR4/6-5/6	--	m,mvfr
30 - 53	C	ls	2.5YR 5/3-5/4	ND	lsbk, mfr, Ang C & S

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ablation Till Depth to Bedrock: possible @ 53", nested boulders

Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None

Estimated Seasonal High Ground Water: Not determined

Location Address or Lot No. 800 Mass Ave. Boxborough, MA

On-site Review

Deep Hole Number: 1100-05 Date: 11-27-00 Time:9:30AM Weather: 40's, Cloudy

Location (identify on site plan) See sketch

Land Use Residential Wooded Slope(%) 4 Surface Stones Many

Vegetation Oak, Maple & White pine

Landform Ground moraine

Position on landscape (sketch on the back) Mild Slope

Distances from:

Open Water Body >200 feet Drainage way >200 feet

Possible Wet Area >200 feet Property Line >200 feet

Drinking Water Well >200 feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 - 3	A	fsl	10YR 3/4	--	m,mvfr
3 - 34	Bw	fsl	10YR4/6-5/6	--	m,mvfr
				@34"	
34 - 86	C	ls w/pockets s& fs	25Y 5/3 - 5/4		m-lsbk, mfr, mvfr, mostly angular c & s

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ablation Till Depth to Bedrock: >86"

Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None

Estimated Seasonal High Ground Water: 34"

Location Address or Lot No. 800 Mass Ave. Boxborough, MA

On-site Review

Deep Hole Number: 1100-06 Date: 11-27-00 Time:10AM Weather: 40's, Cloudy

Location (identify on site plan) See sketch

Land Use Residential Wooded Slope(%) 6 Surface Stones Many

Vegetation Oak, Maple & White pine

Landform Ground moraine

Position on landscape (sketch on the back) Top of Knoll

Distances from:

Open Water Body >200 feet Drainage way >200 feet

Possible Wet Area >200 feet Property Line >200 feet

Drinking Water Well >200 feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 - 4	A	fsl	10YR 3/4	--	
4 - 30	Bw	fsl	10YR4/5-5/6	--	
				@30"	
30 - 69	C	ls-s	2.5YR 5/3-6/3		
					mostly angular c & s

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ablation Till Depth to Bedrock: >69"

Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None

Estimated Seasonal High Ground Water: 34"

Location Address or Lot No. 800 Mass Ave. Boxborough, MA

On-site Review

Deep Hole Number: 1100-07 Date: 11-27-00 Time:10:30AM Weather: 40's, Cloudy

Location (identify on site plan) See sketch

Land Use Residential Wooded Slope(%) 4 Surface Stones Many

Vegetation Oak, Maple & White pine

Landform Ground moraine

Position on landscape (sketch on the back) Top of Knoll

Distances from:

Open Water Body >200 feet Drainage way >150 feet

Possible Wet Area >200 feet Property Line >150 feet

Drinking Water Well >200 feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 - 3	A	fsl	10YR3/4	--	m,mvfr
3 - 26	Bw	fsl	10YR5/6	--	m,mvfr
				@34"	
26-86	C	ls w/pockets s	2.5YR 5/3-5/4		m-lsbk, mfr

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Ablation Till Depth to Bedrock: >86

Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None

Estimated Seasonal High Ground Water: 34"

Location Address or Lot No. 800 Mass Ave. Boxborough, MA

On-site Review

Deep Hole Number: 1100-08 Date: 11-27-00 Time: 11:00AM Weather: 40's, Cloudy

Location (identify on site plan) See sketch

Land Use Residential Wooded Slope(%) 5 Surface Stones Many

Vegetation Oak, Maple & White pine

Landform Ground moraine

Position on landscape (sketch on the back) Top of Knoll

Distances from:

Open Water Body >200 feet Drainage way >200 feet

Possible Wet Area >200 feet Property Line >200 feet

Drinking Water Well >200 feet Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0 - 3	A	fsl	10YR 3/4	--	m, mvfr
3 - 30	Bw	fsl	10YR5/6	--	m, mvf
30 - 78	C	ls	2.5YR 5/3	N/D	>60% coarse angular fragment

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

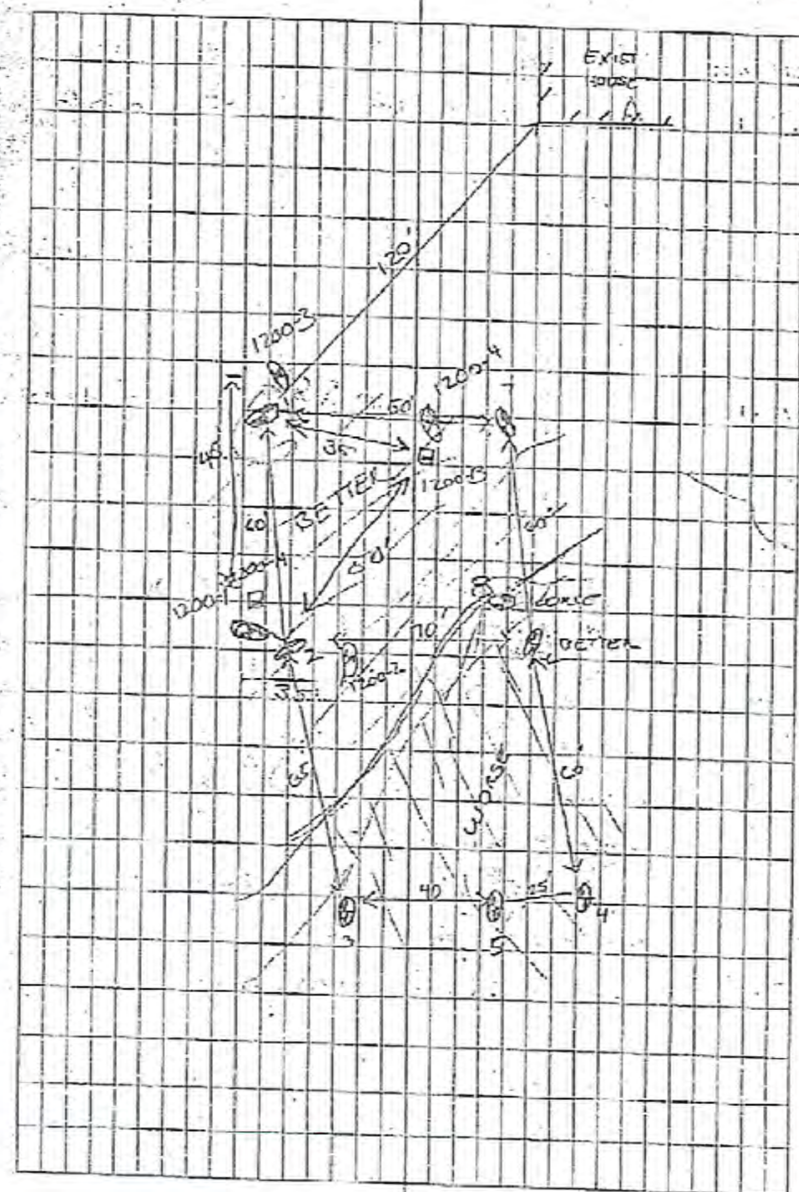
Parent Material (geologic) Ablation Till Depth to Bedrock: >78"

Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None

Estimated Seasonal High Ground Water: Not Determined

U1100-U7					
0-3	A	fsl	10YR 3/4	-	m, mvfr
3-26	Bw	fsl	10YR 3/6	-	m, mvfr
26-86	C	ls w/packed s	2.5Y 5/3 5/4	@ 34"	m-sbk, vfr
	NO SWO	NO REF			
U1100-8					
0-3	A	fsl	10YR 3/4	-	m, mvf
3-30	Bw	fsl	10YR 5/6	-	m, mvf
30-78	C	ls	2.5Y 5/3	14 lo	
					>60% COARSE ANGULAR FRAGMENTS
			/		
	MANY	NESTED	ANGULAR	BOULDERS	

E10/69



12-12-00
CLOUDY
50's-30's

BOXBOROUGH LIBRARY
MASS AVE
BOXBOROUGH, MA

JOB# 00-227

EXCAV: TOWN BOXBOROUGH (SCOTT)
NASH: BRIDGETTE BRADLEY
CPR: BB, BDL

TH/DEPTH	HORIZON	TEXTURE	COLOR	RMF	OTHER
1200-1					
0-4	A	fsl	10YR 3/4	-	m, mvfr, cl
4-18	Bw1	fsl	10YR 4/6	-	m, mvfr, dw
18-32	Bw2	fsl	10YR 5/6	-	m, mvfr, gw
32-65	C1	LS	2.5Y 5/3-5/4	@ 36" 5-10% f2m 10YR 5/8 10% f2m 2.5Y 6/2	1 sbk, mfr, gw
65-110	C2	LS-S	2.5Y 5/6-4/3	10% fmc 7.5Y 6/8 5% f2n 10YR 4/8 10% f2m 2.5Y 6/2	m-1sbk, mvfr

NO GWO   ESHGW@ 36"   NO REF

E10/13

1200-2					
0-5	A	fsl	10YR 3/4	-	m, mvfr, cl
5-20	Bw1	fsl	10YR 4/6	-	m, mvfr, cw
20-33	Bw2	fsl	10YR 5/6	-	m, mvfr, gw
33-89	C1	LS	2.5Y 5/6-5/4	@ 35" 5-10% f2n 10YR 5/8 5-10% f2m 2.5Y 6/2	1sbk, mfr, gw MANY C, S & B
89-114	C2	LS-S	2.5Y 5/6-4/3	10% fmc 2.5Y 4/8 5% f 10YR 5/8 10% f2m 2.5Y 7/1-6/2	m-1sbk, mvfr

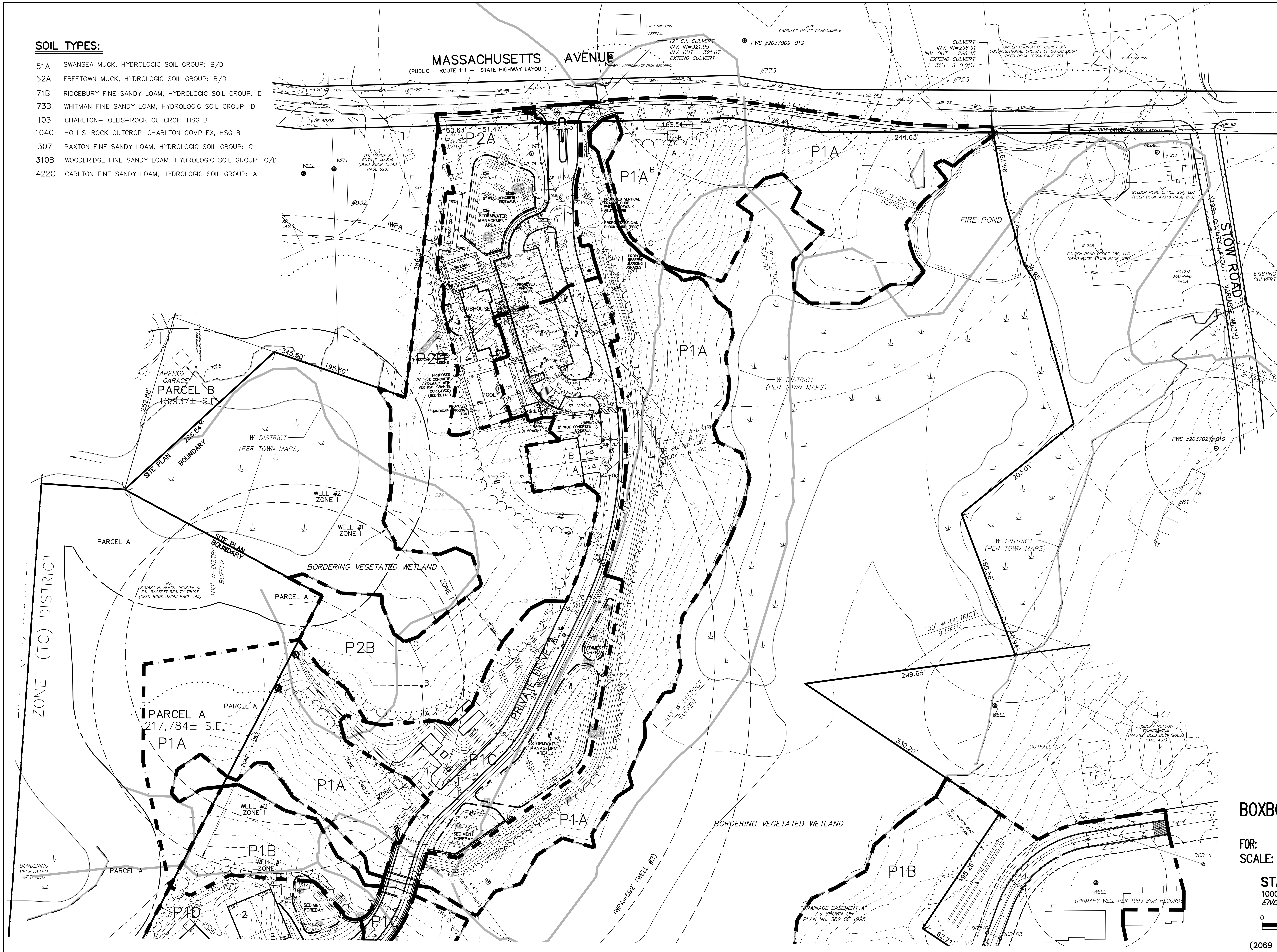
NO GWO   ESHGW @ 35"   NO REF

SOIL TYPES:

51A	SWANSEA MUCK, HYDROLOGIC SOIL GROUP: B/D
52A	FREETOWN MUCK, HYDROLOGIC SOIL GROUP: B/D
71B	RIDGEBURY FINE SANDY LOAM, HYDROLOGIC SOIL GROUP: D
73B	WHITMAN FINE SANDY LOAM, HYDROLOGIC SOIL GROUP: D
103	CHARLTON-HOLLIS-ROCK OUTCROP, HSG B
104C	HOLLIS-ROCK OUTCROP-CHARLTON COMPLEX, HSG B
307	PAXTON FINE SANDY LOAM, HYDROLOGIC SOIL GROUP: C
310B	WOODBRIDGE FINE SANDY LOAM, HYDROLOGIC SOIL GROUP: C/D
422C	CARLTON FINE SANDY LOAM, HYDROLOGIC SOIL GROUP: A

LEGEND:

SUBCATCHMENT BORDER
SOIL DIVIDE
A B C TIME OF CONCENTRATION
E1 SUBCATCHMENT



POST-DEVELOPMENT
DRAINAGE MAP
IN
BOXBOROUGH, MASSACHUSETTS
(MIDDLESEX COUNTY)

FOR: BOXBOROUGH TOWN CENTER, LLC
SCALE: 1"=60' DECEMBER 22, 2016
REV: JUNE 22, 2017

STAMSKI AND MCNARY, INC.
1000 MAIN STREET ACTON, MASSACHUSETTS
ENGINEERING - PLANNING - SURVEYING

0 30 60 120 180 240 FT

(2069 SITE-8.dwg) SHEET 1 OF 2 SM-2069

LEGEND:

SUBCATCHMENT BORDER

SOIL DIVIDE

A B C TIME OF CONCENTRATION

E1 SUBCATCHMENT

SOIL TYPES:

51A	SWANSEA MUCK, HYDROLOGIC SOIL GROUP: B/D
52A	FREETOWN MUCK, HYDROLOGIC SOIL GROUP: B/D
71B	RIDGEBURY FINE SANDY LOAM, HYDROLOGIC SOIL GROUP: D
73B	WHITMAN FINE SANDY LOAM, HYDROLOGIC SOIL GROUP: D
103	CHARLTON–HOLLIS–ROCK OUTCROP, HYDROLOGIC SOIL GROUP: B
104C	HOLLIS–ROCK OUTCROP–CHARLTON COMPLEX, HYDROLOGIC SOIL GROUP: B
307	PAXTON FINE SANDY LOAM, HYDROLOGIC SOIL GROUP: C
310B	WOODBRIDGE FINE SANDY LOAM, HYDROLOGIC SOIL GROUP: C/D
422C	CARLTON FINE SANDY LOAM, HYDROLOGIC SOIL GROUP: A

POST–DEVELOPMENT
DRAINAGE MAP
IN

BOXBOROUGH, MASSACHUSETTS

(MIDDLESEX COUNTY)

FOR: BOXBOROUGH TOWN CENTER, LLC

SCALE: 1"=60' DECEMBER 22, 2016

REV: JUNE 22, 2017

STAMSKI AND MCNARY, INC.

1000 MAIN STREET ACTON, MASSACHUSETTS

ENGINEERING – PLANNING – SURVEYING

0 30 60 120 180 240 FT

(2069 SITE–8.dwg) SHEET 2 OF 2 SM–2069