

Stamski And McNary, Inc.

Engineering - Planning – Surveying

1000 Main Street; Acton, MA 01720 (978) 263-8585

www.stamskiandmcnary.com

Stormwater Management Report

For

The Residences at Constitution Drive
Acton, MA

June 13, 2013

Applicant:

Lexington Holding, LLC
6 Open Space Drive
Sandwich, MA 02563

SM-4993

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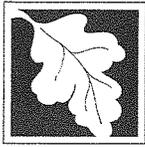
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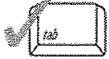
Checklist for Stormwater Report



Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

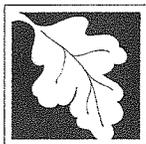
In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans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

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

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

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

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



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

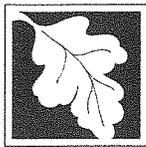
Registered Professional Engineer Block and Signature

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

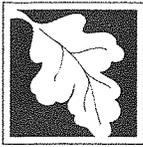
Checklist (continued)

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): _____

Standard 1: No New Untreated Discharges

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



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

Standard 3: Recharge

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

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



Checklist for Stormwater Report

Checklist (continued)

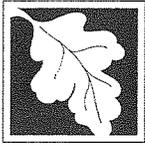
Standard 3: Recharge (continued)

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

Standard 4: Water Quality

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

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



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

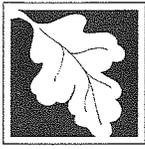
- The BMP is sized (and calculations provided) based on:
 - The ½" or 1" Water Quality Volume or
 - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the 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 for Stormwater Report

Checklist (continued)

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

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

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

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

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



Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 9: Operation and Maintenance Plan

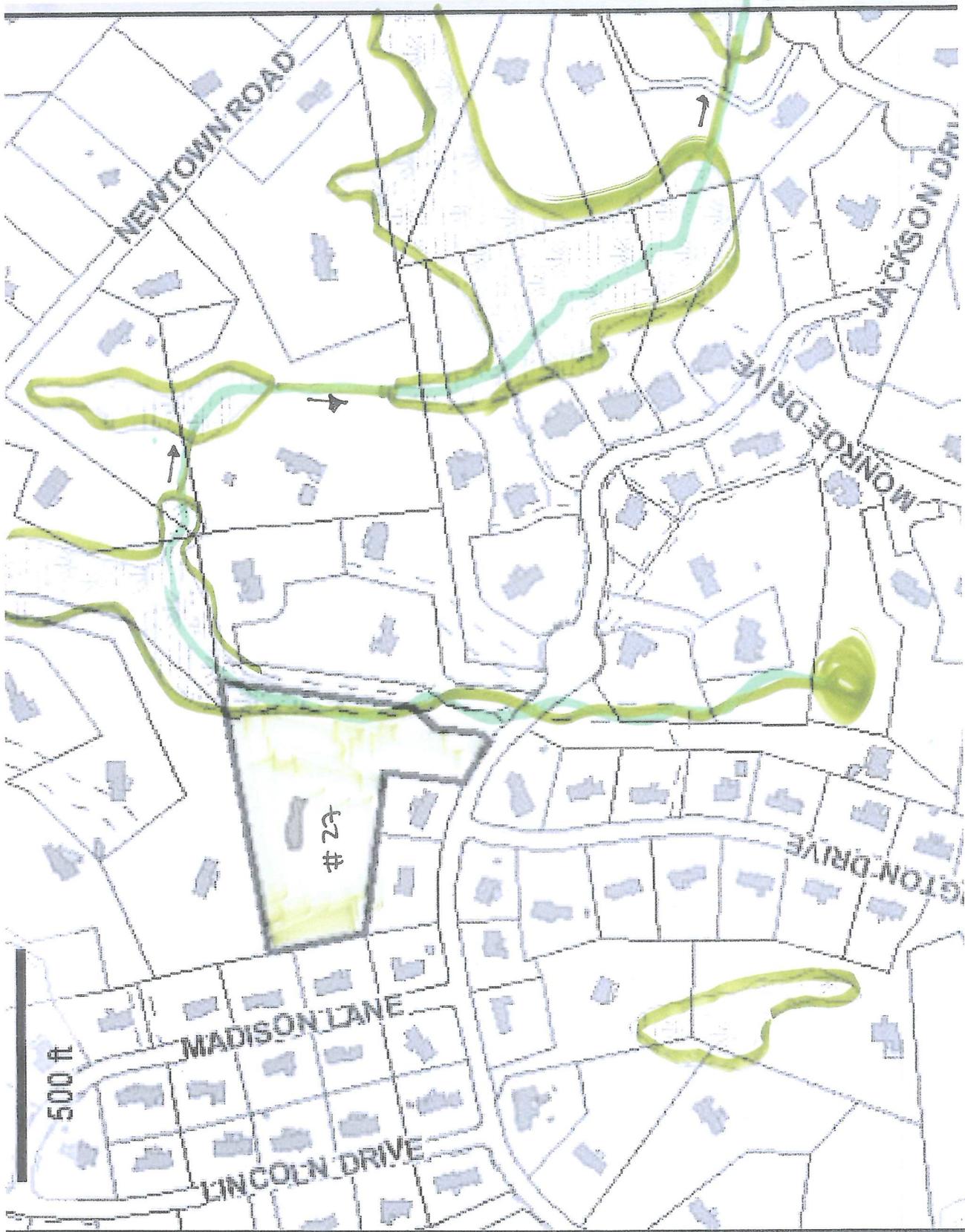
- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - Name of the stormwater management system owners;
 - Party responsible for operation and maintenance;
 - Schedule for implementation of routine and non-routine maintenance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

Standard 10: Prohibition of Illicit Discharges

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

Narrative

500 SCALE
LOCUS MAP
1" = 500'
SUM 4 89



500 SCALE - LOCUS MAP (SHOWS DWELLINGS)

Stormwater Management

The proposed project is to develop a five lot residential compound subdivision from an existing residential parcel. An existing single family dwelling will be relocated on site and four new single family dwellings will be constructed with all five lots being served by the same private way. As part of the Definitive Subdivision application for the residential compound, this Report has been prepared which analyzes the proposed stormwater management system designed for the site and demonstrates its control of peak rate of runoff from pre to post-development conditions.

Pre-Development

The site is approximately 4.0 acres that has previously been developed. Existing structures onsite include a single family dwelling and an attached garage. A paved drive runs from Jackson Drive up to the garage. Vegetated wetlands border an intermittent stream which runs along the Eastern property line. This stream conveys runoff from this site and the neighborhood into Conant Brook off-site. The existing runoff from the site is sent in two directions. The runoff from the majority of the site including the existing dwelling, driveway, and two abutting lots is sent directly to the BVW. The remaining runoff is sent towards the Western property line towards Madison Lane. Runoff from the site flowing to the BVW has been analyzed as Subcatchment E1. The runoff flowing offsite towards Madison Lane has been analyzed as Subcatchment E2.

Post-Development

A stormwater management system that controls the peak rate of runoff has been designed for the proposed project in accordance with local subdivision rules and regulations. The existing house will be relocated and four additional new single family dwellings will be constructed. The existing paved drive will be removed and replaced with a new private paved drive that will serve all five lots. For the post development runoff, the site has been broken into fourteen subcatchments. Subcatchment P1 consists of the uncontrolled runoff from below the proposed way which drains to the edge of the BVW. This subcatchment is comprised of primarily existing conditions to remain undisturbed along the eastern side of the site along with the runoff collected by CB-1 and the sheet flow from the rear lots of Lot 4 and Lot 5. Subcatchment P2 allows for uncontrolled runoff to be sent off the Western lot line towards Madison Lane. P2 is a small area of open grass and woods on the western side of the property on Lot 2 and Lot 3. Subcatchment P3 includes the up-gradient overland flow onto the site from the abutter's lots (#29 & #31 Jackson Drive) and the area to the west of the proposed drive on Lot 1. Runoff from Subcatchment P3 is collected by Stormwater Management Area 1 in order to control the peak rate, with an outlet control structure provided to the level spreader. Subcatchment P4 includes the runoff from the Cul-de-Sac area including portions of the individual driveways and front yards of Lot 3, Lot 4 and Lot 5. The runoff will be collected by two catch basins (CB-3 & CB-4) and conveyed to Stormwater Management Area 2 where the runoff will be treated and stored for recharge. Subcatchment P5 includes runoff from the

front of Lots 2 and 3. The runoff will be collected by two drop inlet catch basins and will be directed into the level spreader. Subcatchments 6 thru 10 are the runoff area from each individual roof. The roof runoff for each lot is sent into its own drywell to be stored and recharged within each lot in a decentralized manner throughout the site.

Subcatchments 11 and 12 are comprised of the runoff from the driveway turnouts from Lot 2 and 3 respectively. The runoff will be collected by a stone infiltration trench located along each driveway edge. Subcatchments 13 and 14 consist of runoff from the back yard area of Lots 2 and 3 respectively. Runoff from Subcatchments 13 and 14 will be collected by a stone infiltration trench on each lot. Runoff from the 14 Post-Development Subcatchments have a reduced peak flow rate and peak volume from Pre-Development conditions.

Compliance with MA DEP Stormwater Management Standards

Compliance with the Stormwater Management Standards is as follows:

Standard 1: No Untreated Discharges

Currently there is 2,586 square feet of untreated runoff going directly to the BVW over vegetated areas within the 100’ buffer zone. There is also 95 square feet of untreated runoff going directly to the BVW over vegetated areas within 50’ of the BVW. The proposed drive reduces the direct runoff from 2,586 square feet to 530 square feet of runoff within the 100’ buffer zone and reducing the runoff going directly to the BVW within 50’ from 95 square feet to 0. Drywell units, an infiltration basin with a sediment forebay, a level spreader, and road drywell will treat impervious runoff before it reaches the wetlands. Roof runoff will be treated by individual drywells located on each lot. This will be an improvement over existing conditions which has no treatment for the paved driveway or roof runoff.

Standard 2: Peak Rate Attenuation

The Post-Development peak discharge rates must not be increased from pre-development rates for the 2-year, 10-year, 25-year, and 100-year storm events. Also, offsite flood impact from the 100-year storm must not be increased. With a combination of infiltration and detention, the peak runoff rate and volume have been decreased. The peak runoff rates have been summarized in the following tables.

Discharge Summary Tables

Subcatchment E1 to P1, SMA1, SMA 2, P5 (Direct to BVW): Peak Rate

| 2-year Storm | | 10-year Storm | | 100-year Storm | |
|--------------|------------|---------------|------------|----------------|------------|
| Pre (cfs) | Post (cfs) | Pre (cfs) | Post (cfs) | Pre (cfs) | Post (cfs) |
| 1.504 | 1.288 | 4.565 | 3.306 | 9.735 | 9.160 |

Subcatchment E2 and P2 (Off western lot line towards Madison Lane): Peak Rate

| 2-year Storm | 10-year Storm | 100-year Storm |
|--------------|---------------|----------------|
|--------------|---------------|----------------|

| Pre (cfs) | Post (cfs) | Pre (cfs) | Post (cfs) | Pre (cfs) | Post (cfs) |
|-----------|------------|-----------|------------|-----------|------------|
| 0.022 | 0.017 | 0.138 | 0.095 | 0.405 | 0.249 |

Standard 3: Stormwater Recharge

The basin and road drywell have been sized to infiltrate the required recharge volume as specified in the Massachusetts Stormwater Handbook. The “Simple Dynamic” method was used with a Rawls Rate of 1.02 in/hr in sizing the required storage volume to infiltrate the recharging runoff. Calculations were performed to insure drawdown within 72 hours to provide storage for the next storm event. Mounding calculations were performed to insure the required recharge volume will not form a mound that breaks out above the ground surface. Detailed calculations showing compliance with Standard 3 have been attached to this report.

Standard 4: Water Quality

The required water quality volume for this project is 0.5” of runoff over the impervious area since the infiltration rate is less than 2.4 inches per hour. This volume will be treated to meet the 80% TSS removal requirement of Standard 4. For this development, the combination of an infiltration basin, a water quality swale, and a road drywell will treat the impervious runoff area. Calculations showing treatment levels are attached.

Standard 5: Land Uses with Higher Potential Pollutant Loads

The site is will not contain “land uses with higher potential pollutant loads.”

Standard 6: Critical Areas

The site does not discharge runoff to critical areas.

Standard 7: Redevelopment

The proposed project is new development.

Standard 8: Construction Period Controls

The erosion and sedimentation control measures will be followed in accordance with the Erosion and Sedimentation Control Plan, Sheet 7 of 7, and will be consistent with the requirements of the NPDES Construction General Permit. The project will require coverage under the NPDES Construction General Permit.

Standard 9: Operation and Maintenance Plan

An Operation and Maintenance Plan is included in this report.

Standard 10: Illicit Discharges to Drainage System

An Illicit Discharge Compliance will be provided prior to the discharge of stormwater runoff to the post-construction stormwater BMP’s.

Design Basis

1. The United States Department of Agriculture Natural Resource Conservation Service (N.R.C.S.) TR55 methodology was used to determine offsite rates of runoff.
2. The twenty-four hour rainfall, taken from N.R.C.S. publications, is 6.4 inches for the 100-year storm, 4.5 inches for the 10-year storm, and 3.1 inches for the 2-year storm event.
3. The hydrologic calculations were performed using the computer program: "Hydraflow Hydrographs 2007" by Intelisolve.
4. The soil types of the site were taken from the N.R.C.S. Soil Survey Map for Concord.
5. Soil conditions and estimated seasonal high groundwater table were based on on-site soil evaluations.

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 | 1.504 | 2 | 732 | 7,761 | --- | ---- | ----- | E1-Direct to BVW |
| 2 | SCS Runoff | 0.022 | 2 | 744 | 216 | --- | ---- | ----- | E2-To West lot line |
| 11 | SCS Runoff | 0.902 | 2 | 730 | 4,069 | --- | ---- | ----- | P1-Direct to BVW |
| 12 | SCS Runoff | 0.017 | 2 | 736 | 135 | --- | ---- | ----- | P2-To west lot line |
| 13 | SCS Runoff | 0.455 | 2 | 732 | 2,191 | --- | ---- | ----- | P3-To SMA-1 |
| 14 | Reservoir | 0.243 | 2 | 746 | 1,776 | 13 | 101.00 | 311 | SMA-1 |
| 15 | SCS Runoff | 0.624 | 2 | 726 | 2,247 | --- | ---- | ----- | P4-Cul-de-sac |
| 16 | Reservoir | 0.000 | 2 | 804 | 0 | 15 | 1.86 | 1,191 | SMA-2 |
| 17 | SCS Runoff | 0.241 | 2 | 728 | 1,066 | --- | ---- | ----- | P5-Lot 2 and 3 front yard areas |
| 18 | SCS Runoff | 0.125 | 2 | 724 | 420 | --- | ---- | ----- | P6-Lot 1 roof |
| 19 | Reservoir | 0.000 | 2 | 624 | 0 | 18 | 0.98 | 170 | Lot 1 roof drywell RD1 |
| 20 | SCS Runoff | 0.159 | 2 | 724 | 537 | --- | ---- | ----- | P7-Lot 2 roof |
| 21 | Reservoir | 0.000 | 2 | 580 | 0 | 20 | 1.27 | 238 | Lot 2 roof drywell RD2 |
| 22 | SCS Runoff | 0.159 | 2 | 724 | 537 | --- | ---- | ----- | P8-Lot 3 roof |
| 23 | Reservoir | 0.000 | 2 | 580 | 0 | 22 | 1.27 | 238 | Lot 3 roof drywell RD3 |
| 24 | SCS Runoff | 0.159 | 2 | 724 | 537 | --- | ---- | ----- | P9-Lot 4 roof |
| 25 | Reservoir | 0.000 | 2 | 580 | 0 | 24 | 1.27 | 238 | Lot 4 roof drywell RD4 |
| 26 | SCS Runoff | 0.061 | 2 | 724 | 205 | --- | ---- | ----- | P10-Lot 5 roof |
| 27 | Reservoir | 0.000 | 2 | 514 | 0 | 26 | 0.95 | 82.4 | Lot 5 roof drywell RD5 |
| 29 | Combine | 1.288 | 2 | 732 | 6,910 | 11, 14, 16, 17, | ---- | ----- | Total to BVW |
| 4993 runoff.gpw | | | | | Return Period: 2 Year | | | Monday, Feb 25, 2013 | |

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 | 4.565 | 2 | 730 | 18,999 | --- | ---- | ---- | E1-Direct to BVW | |
| 2 | SCS Runoff | 0.138 | 2 | 732 | 723 | --- | ---- | ---- | E2-To West lot line | |
| 11 | SCS Runoff | 2.281 | 2 | 730 | 9,129 | --- | ---- | ---- | P1-Direct to BVW | |
| 12 | SCS Runoff | 0.095 | 2 | 728 | 409 | --- | ---- | ---- | P2-To west lot line | |
| 13 | SCS Runoff | 1.262 | 2 | 730 | 5,147 | --- | ---- | ---- | P3-To SMA-1 | |
| 14 | Reservoir | 0.647 | 2 | 744 | 4,438 | 13 | 101.35 | 1,023 | SMA-1 | |
| 15 | SCS Runoff | 1.295 | 2 | 726 | 4,459 | --- | ---- | ---- | P4-Cul-de-sac | |
| 16 | Reservoir | 0.609 | 2 | 738 | 1,467 | 15 | 2.38 | 1,538 | SMA-2 | |
| 17 | SCS Runoff | 0.689 | 2 | 728 | 2,548 | --- | ---- | ---- | P5-Lot 2 and 3 front yard areas | |
| 18 | SCS Runoff | 0.182 | 2 | 724 | 624 | --- | ---- | ---- | P6-Lot 1 roof | |
| 19 | Reservoir | 0.000 | 2 | 550 | 0 | 18 | 1.48 | 287 | Lot 1 roof drywell RD1 | |
| 20 | SCS Runoff | 0.233 | 2 | 724 | 798 | --- | ---- | ---- | P7-Lot 2 roof | |
| 21 | Reservoir | 0.000 | 2 | 520 | 0 | 20 | 1.99 | 398 | Lot 2 roof drywell RD2 | |
| 22 | SCS Runoff | 0.233 | 2 | 724 | 798 | --- | ---- | ---- | P8-Lot 3 roof | |
| 23 | Reservoir | 0.000 | 2 | 520 | 0 | 22 | 1.99 | 398 | Lot 3 roof drywell RD3 | |
| 24 | SCS Runoff | 0.233 | 2 | 724 | 798 | --- | ---- | ---- | P9-Lot 4 roof | |
| 25 | Reservoir | 0.000 | 2 | 520 | 0 | 24 | 1.99 | 398 | Lot 4 roof drywell RD4 | |
| 26 | SCS Runoff | 0.089 | 2 | 724 | 305 | --- | ---- | ---- | P10-Lot 5 roof | |
| 27 | Reservoir | 0.000 | 2 | 446 | 0 | 26 | 1.44 | 139 | Lot 5 roof drywell RD5 | |
| 29 | Combine | 3.306 | 2 | 738 | 17,582 | 11, 14, 16, 17, | ---- | ---- | Total to BVW | |
| 4993 runoff.gpw | | | | | Return Period: 10 Year | | | Monday, Feb 25, 2013 | | |

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|-----------------|--------------------------|-----------------|---------------------|--------------------|------------------------|-----------------|------------------------|-------------------------|---------------------------------|
| 1 | SCS Runoff | 6.640 | 2 | 730 | 26,642 | --- | ----- | ----- | E1-Direct to BVW |
| 2 | SCS Runoff | 0.240 | 2 | 730 | 1,103 | --- | ----- | ----- | E2-To West lot line |
| 11 | SCS Runoff | 3.177 | 2 | 730 | 12,463 | --- | ----- | ----- | P1-Direct to BVW |
| 12 | SCS Runoff | 0.156 | 2 | 728 | 608 | --- | ----- | ----- | P2-To west lot line |
| 13 | SCS Runoff | 1.797 | 2 | 730 | 7,128 | --- | ----- | ----- | P3-To SMA-1 |
| 14 | Reservoir | 1.067 | 2 | 742 | 6,282 | 13 | 101.51 | 1,361 | SMA-1 |
| 15 | SCS Runoff | 1.710 | 2 | 726 | 5,848 | --- | ----- | ----- | P4-Cul-de-sac |
| 16 | Reservoir | 1.427 | 2 | 730 | 2,663 | 15 | 2.48 | 1,599 | SMA-2 |
| 17 | SCS Runoff | 0.995 | 2 | 726 | 3,548 | --- | ----- | ----- | P5-Lot 2 and 3 front yard areas |
| 18 | SCS Runoff | 0.215 | 2 | 724 | 741 | --- | ----- | ----- | P6-Lot 1 roof |
| 19 | Reservoir | 0.000 | 2 | 528 | 0 | 18 | 1.80 | 358 | Lot 1 roof drywell RD1 |
| 20 | SCS Runoff | 0.275 | 2 | 724 | 948 | --- | ----- | ----- | P7-Lot 2 roof |
| 21 | Reservoir | 0.000 | 2 | 480 | 0 | 20 | 2.46 | 493 | Lot 2 roof drywell RD2 |
| 22 | SCS Runoff | 0.275 | 2 | 724 | 948 | --- | ----- | ----- | P8-Lot 3 roof |
| 23 | Reservoir | 0.000 | 2 | 480 | 0 | 22 | 2.46 | 493 | Lot 3 roof drywell RD3 |
| 24 | SCS Runoff | 0.275 | 2 | 724 | 948 | --- | ----- | ----- | P9-Lot 4 roof |
| 25 | Reservoir | 0.000 | 2 | 480 | 0 | 24 | 2.46 | 493 | Lot 4 roof drywell RD4 |
| 26 | SCS Runoff | 0.105 | 2 | 724 | 362 | --- | ----- | ----- | P10-Lot 5 roof |
| 27 | Reservoir | 0.000 | 2 | 522 | 0 | 26 | 1.75 | 174 | Lot 5 roof drywell RD5 |
| 29 | Combine | 6.144 | 2 | 730 | 24,956 | 11, 14, 16, 17, | ----- | ----- | Total to BVW |
| 4993 runoff.gpw | | | | | Return Period: 25 Year | | | Monday, Feb 25, 2013 | |

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 | 9.735 | 2 | 730 | 38,160 | --- | ---- | ----- | E1-Direct to BVW | |
| 2 | SCS Runoff | 0.405 | 2 | 730 | 1,706 | --- | ---- | ----- | E2-To West lot line | |
| 11 | SCS Runoff | 4.491 | 2 | 728 | 17,400 | --- | ---- | ----- | P1-Direct to BVW | |
| 12 | SCS Runoff | 0.249 | 2 | 728 | 920 | --- | ---- | ----- | P2-To west lot line | |
| 13 | SCS Runoff | 2.589 | 2 | 730 | 10,089 | --- | ---- | ----- | P3-To SMA-1 | |
| 14 | Reservoir | 1.570 | 2 | 740 | 9,061 | 13 | 101.77 | 1,895 | SMA-1 | |
| 15 | SCS Runoff | 2.299 | 2 | 726 | 7,852 | --- | ---- | ----- | P4-Cul-de-sac | |
| 16 | Reservoir | 2.223 | 2 | 728 | 4,480 | 15 | 2.56 | 1,644 | SMA-2 | |
| 17 | SCS Runoff | 1.451 | 2 | 726 | 5,048 | --- | ---- | ----- | P5-Lot 2 and 3 front yard areas | |
| 18 | SCS Runoff | 0.260 | 2 | 724 | 902 | --- | ---- | ----- | P6-Lot 1 roof | |
| 19 | Reservoir | 0.000 | 2 | 494 | 0 | 18 | 2.29 | 460 | Lot 1 roof drywell RD1 | |
| 20 | SCS Runoff | 0.333 | 2 | 724 | 1,153 | --- | ---- | ----- | P7-Lot 2 roof | |
| 21 | Reservoir | 0.000 | 2 | 430 | 0 | 20 | 3.35 | 625 | Lot 2 roof drywell RD2 | |
| 22 | SCS Runoff | 0.333 | 2 | 724 | 1,153 | --- | ---- | ----- | P8-Lot 3 roof | |
| 23 | Reservoir | 0.000 | 2 | 430 | 0 | 22 | 3.35 | 625 | Lot 3 roof drywell RD3 | |
| 24 | SCS Runoff | 0.333 | 2 | 724 | 1,153 | --- | ---- | ----- | P9-Lot 4 roof | |
| 25 | Reservoir | 0.000 | 2 | 430 | 0 | 24 | 3.35 | 625 | Lot 4 roof drywell RD4 | |
| 26 | SCS Runoff | 0.127 | 2 | 724 | 440 | --- | ---- | ----- | P10-Lot 5 roof | |
| 27 | Reservoir | 0.000 | 2 | 498 | 0 | 26 | 2.22 | 223 | Lot 5 roof drywell RD5 | |
| 29 | Combine | 9.160 | 2 | 728 | 35,988 | 11, 14, 16, 17, | ---- | ----- | Total to BVW | |
| 4993 runoff.gpw | | | | | Return Period: 100 Year | | | Monday, Feb 25, 2013 | | |

Worksheet 2: Runoff curve number and runoff

SM-4993

Project: 27 Jackson Drive By JTM Date 1/18/13

Location: Acton, MA Checked RJA Date 2/20/13

Existing E1

1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio) | CN 1/ | | | Area Acres | Product of CN x Area |
|--|---|-----------|----------|----------|---------------|----------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| Narragansett 416B B | Woods(good Condition) | 55 | | | 1.81 | 99.55 |
| Narragansett 416B B | Open(Good Condition) | 61 | | | 0.73 | 44.53 |
| Whitman 73B D | Open(Good Condition) | 80 | | | 0.17 | 13.60 |
| | Impervious | 98 | | | 0.22 | 21.56 |
| Whitman 73B D | Woods(Good Condition) | 77 | | | 0.45 | 34.65 |
| Narragansett 416B B | Abutting 1/2 Acre Residential # 29 and #31 | 70 | | | 0.57 | 39.90 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Totals = | | | | | 3.95 | 253.79 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{253.79}{3.95} = 64.25$; Use CN = 64.3

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..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | 0.52 | 1.28 | 2.58 |
| Runoff, Q..... cf D-2 | 7498 | 18378 | 36938 |

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

Project: 27 Jackson Drive

By JTM

Date 1/18/2013

Location: Acton, MA

Checked RJM

Date 2/20/13

Circle one:

| |
|---------|
| Present |
| Tc |

 Developed Tt

Subcatchment E1

Circle one:

| |
|----|
| Tc |
|----|

 through subarea

Sheet flow (Applicable to Tc only)

1. Surface Description (table 3-1)

2. Mannings roughness coeff., n (table 3-1)

3. Flow length, L (total L <= 300 ft)

4. Two-yr 24-hr rainfall, P2

5. Land Slope, s

6. $Tt = 0.007 (nL)^{0.8} / (P2^{0.5} s^{0.4})$

| | | | | |
|------------|-------|---------------|--|------|
| Segment ID | A-B | | | |
| | Woods | | | |
| | 0.4 | | | |
| | 50 | ft | | |
| | 3.1 | in | | |
| | 0.04 | ft/ft | | |
| | 0.16 | Compute Tt hr | | 0.16 |

Shallow concentrated Flow

7. Surface Description (paved or unpaved)

8. Flow Length, L

9. Watercourse slope, s

10. Average Velocity, V (figure 3-1)

11. $Tt = L / 3600V$

| | | | | |
|------------|---------|---------------|--|------|
| Segment ID | B-C | | | |
| | unpaved | | | |
| | 458 | ft | | |
| | 0.04 | ft/ft | | |
| | 3.23 | ft/s | | |
| | 0.04 | Compute Tt hr | | 0.04 |

Channel flow

12. Cross sectional flow area, a

13. Wetted perimeter, pw

14. Hydraulic radius, $r=a/wp$

15. Channel Slope, s

16. Manning's roughness coeff., n

17. $V = 1.49 r^{2/3} s^{1/2} / n$

18. Flow length, L

19. $Tt = L / 3600V$

| | | | | |
|------------|--|--|--|---|
| Segment ID | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | 0 |

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

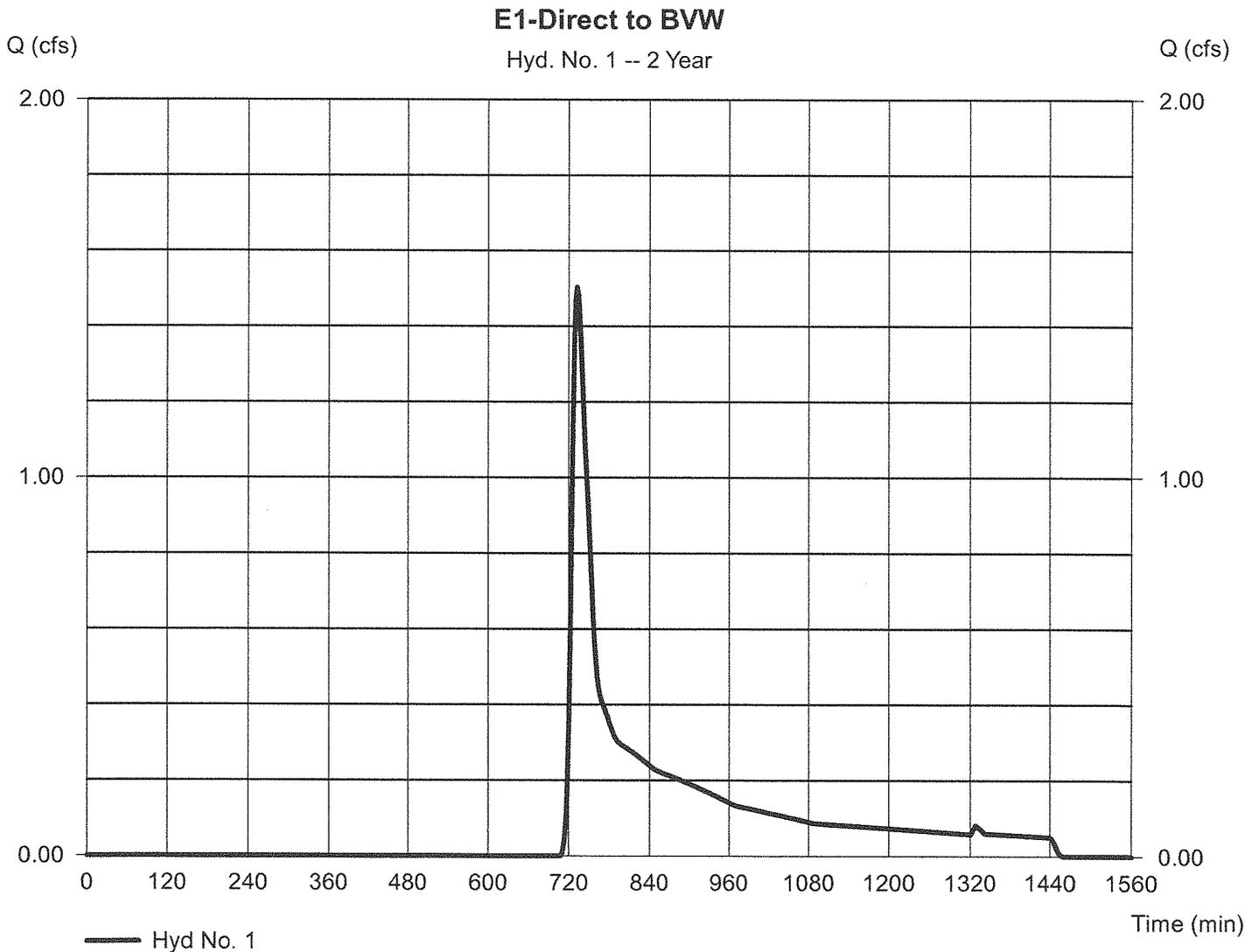
Wednesday, Feb 20, 2013

Hyd. No. 1

E1-Direct to BVW

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 3.950 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 1.504 cfs
Time to peak = 732 min
Hyd. volume = 7,761 cuft
Curve number = 64.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 11.90 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

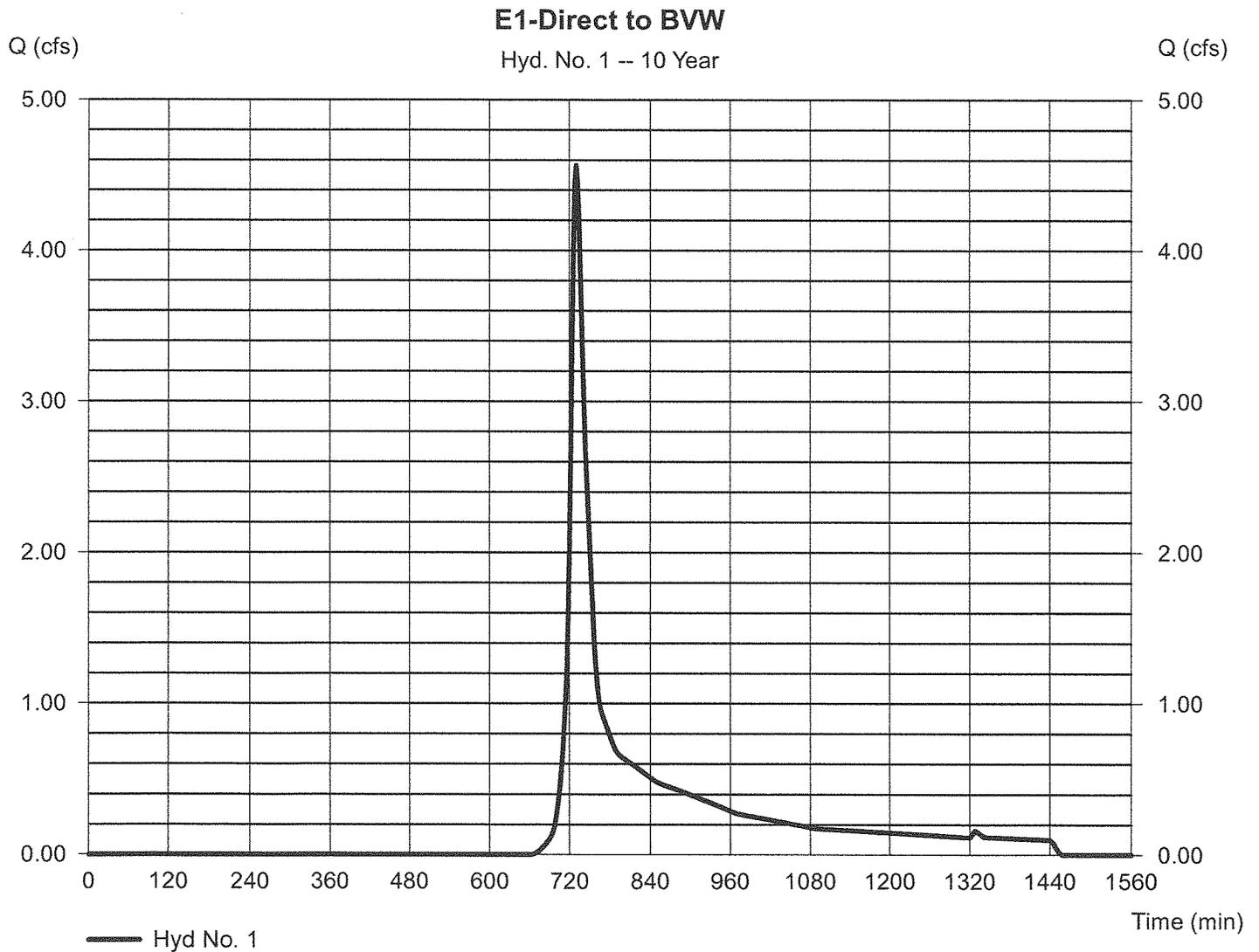
Wednesday, Feb 20, 2013

Hyd. No. 1

E1-Direct to BVW

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 3.950 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 4.565 cfs
Time to peak = 730 min
Hyd. volume = 18,999 cuft
Curve number = 64.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 11.90 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

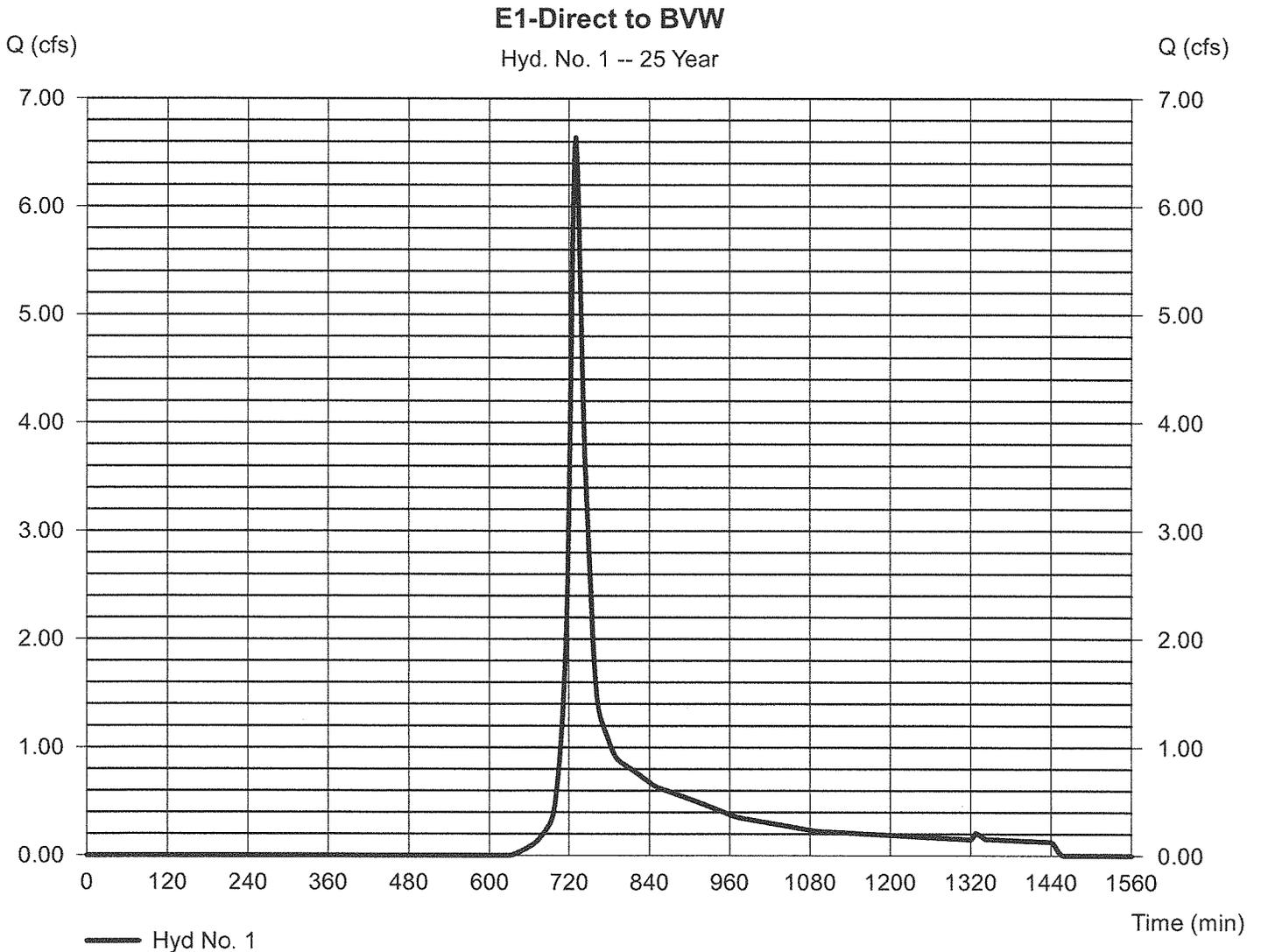
Wednesday, Feb 20, 2013

Hyd. No. 1

E1-Direct to BVW

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 3.950 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 6.640 cfs
Time to peak = 730 min
Hyd. volume = 26,642 cuft
Curve number = 64.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 11.90 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

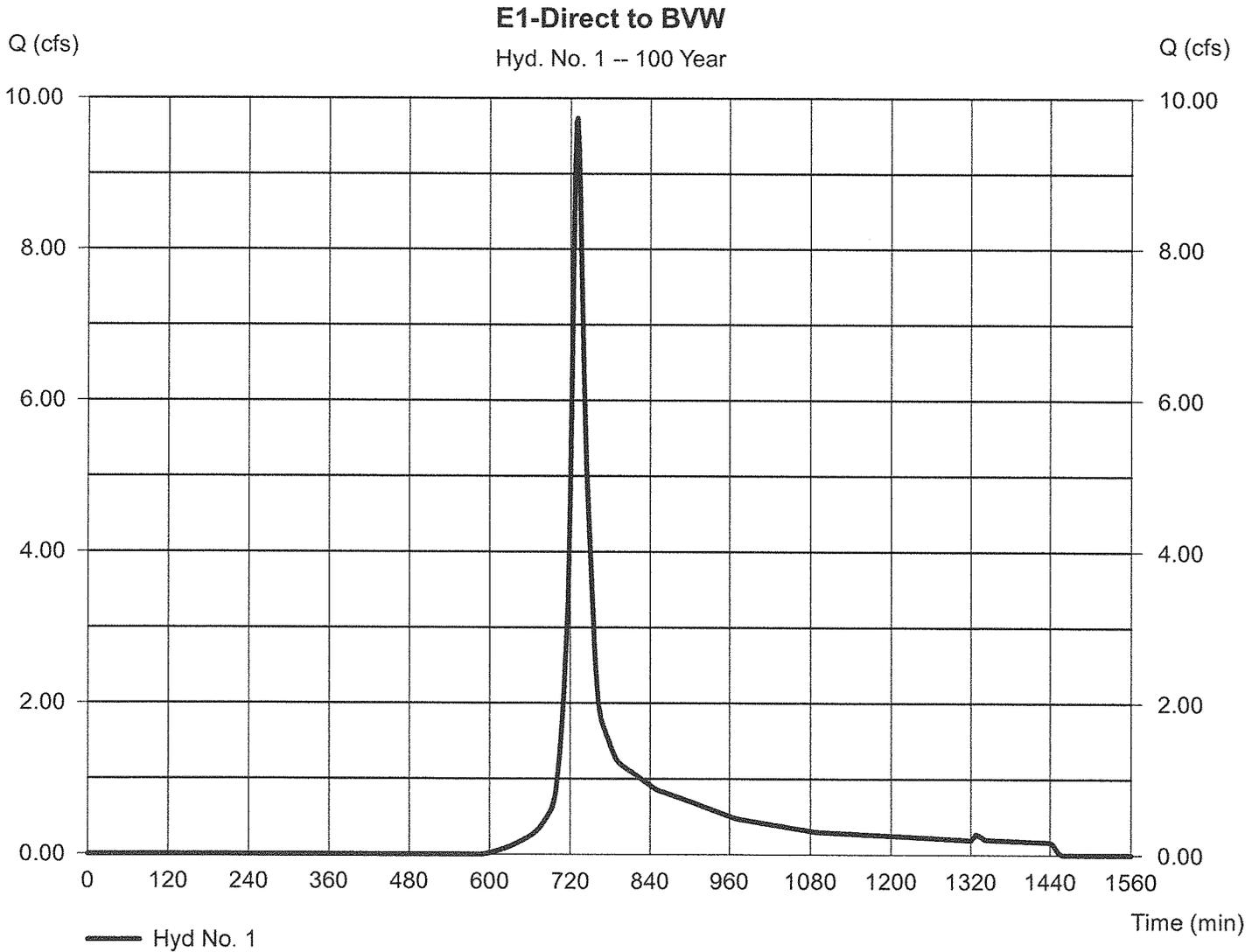
Wednesday, Feb 20, 2013

Hyd. No. 1

E1-Direct to BVW

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 3.950 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 9.735 cfs
Time to peak = 730 min
Hyd. volume = 38,160 cuft
Curve number = 64.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 11.90 min
Distribution = Type III
Shape factor = 484



Worksheet 2: Runoff curve number and runoff

SM-4993

Project: 27 Jackson Drive By JTM Date 1/18/13
 Location: Acton, MA Checked RST Date 2/25/13
 Circle one: Existing Developed E2

1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio) | CN 1/ | | | Area Acres | Product of CN x Area |
|--|---|-----------|----------|----------|---------------|----------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| Narragansett 416B B | Wooded | 55 | | | 0.26 | 14.30 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Totals = | | | | | 0.26 | 14.30 |

1/ Use only one CN source per line.

$$\text{CN (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{14.30}{0.26} = 55.00 ; \text{ Use CN} = \boxed{55.0}$$

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..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | 0.22 | 0.74 | 1.75 |

Runoff, Q..... cf

| | | |
|-----|-----|------|
| 210 | 701 | 1654 |
|-----|-----|------|

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

Project: 27 Jackson Drive

By JTM

Date 1/18/2013

Location: Acton, MA

Checked RSH

Date 2/20/13

Circle one:

| |
|---------|
| Present |
| Tc |

 Developed Tt through subarea

E2

Sheet flow (Applicable to Tc only)

1. Surface Description (table 3-1)
2. Mannings roughness coeff., n (table 3-1)
3. Flow length, L (total L <= 300 ft)
4. Two-yr 24-hr rainfall, P2
5. Land Slope, s
6. $Tt = 0.007 (nL)^{0.8} / (P2^{0.5} s^{0.4})$

| | | | |
|---------------|-------|--|------|
| Segment ID | A-B | | |
| | Woods | | |
| | 0.4 | | |
| ft | 50 | | |
| in | 3.1 | | |
| ft/ft | 0.03 | | |
| Compute Tt hr | 0.18 | | 0.18 |

Shallow concentrated Flow

7. Surface Description (paved or unpaved)
8. Flow Length, L
9. Watercourse slope, s
10. Average Velocity, V (figure 3-1)
11. $Tt = L / 3600V$

| | | | |
|---------------|-------|--|------|
| Segment ID | B-C | | |
| | Woods | | |
| ft | 21 | | |
| ft/ft | 0.08 | | |
| ft/s | 4.56 | | |
| Compute Tt hr | 0.00 | | 0.00 |

Channel flow

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

| | | | |
|------------|--|--|---|
| Segment ID | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | 0 |

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.18
min 10.7

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

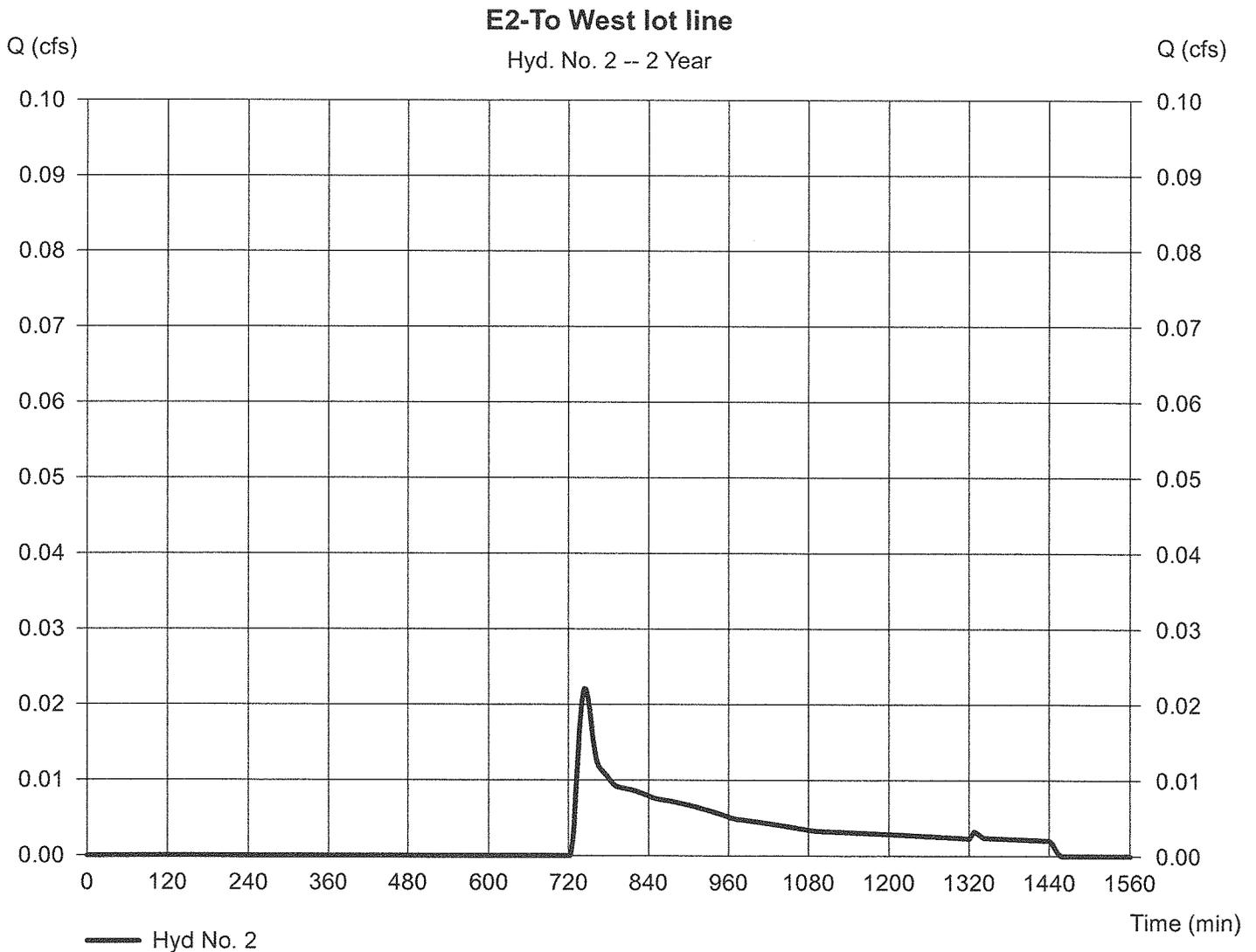
Wednesday, Feb 20, 2013

Hyd. No. 2

E2-To West lot line

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.260 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.022 cfs
Time to peak = 744 min
Hyd. volume = 216 cuft
Curve number = 55
Hydraulic length = 0 ft
Time of conc. (Tc) = 10.70 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

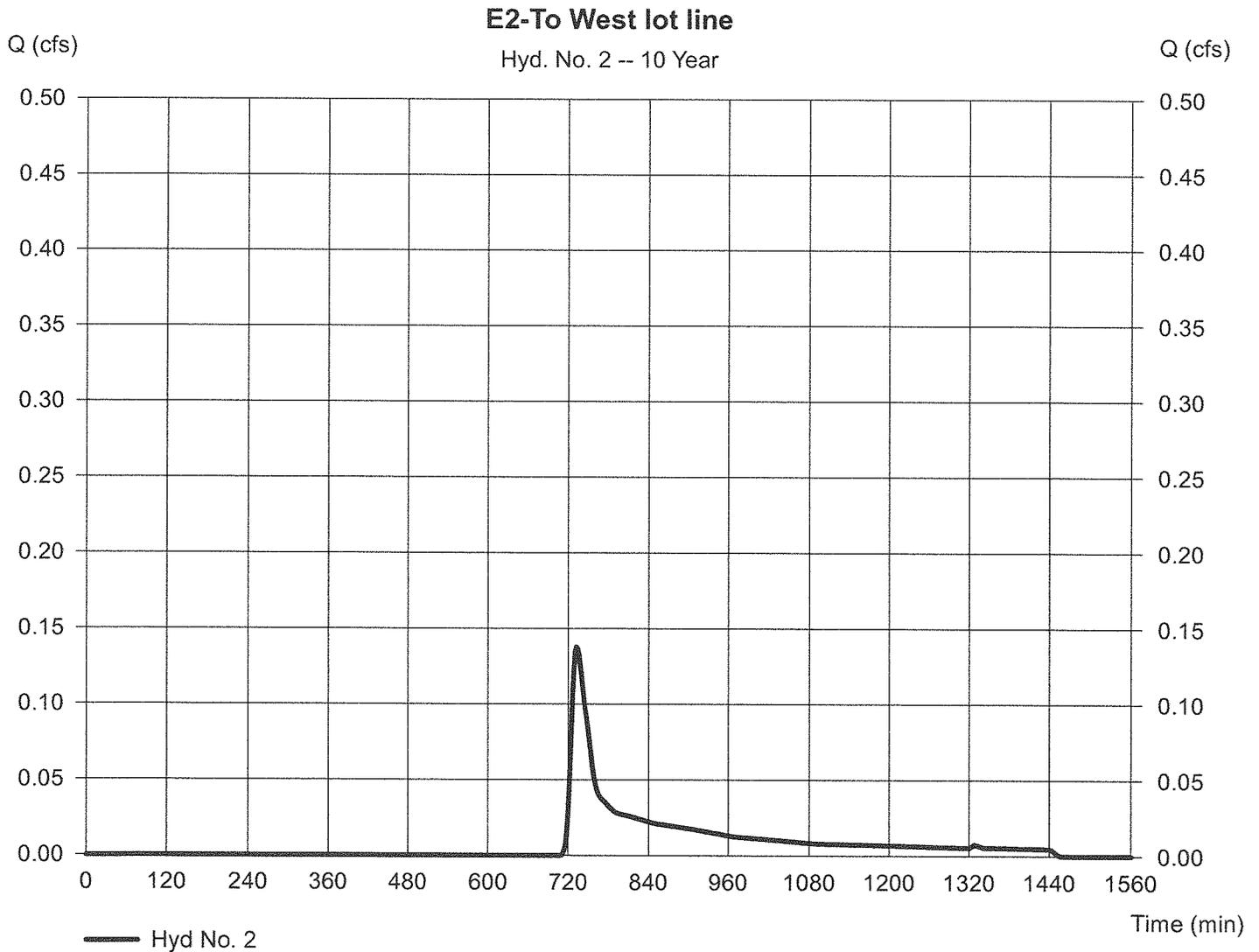
Wednesday, Feb 20, 2013

Hyd. No. 2

E2-To West lot line

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.260 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.138 cfs
Time to peak = 732 min
Hyd. volume = 723 cuft
Curve number = 55
Hydraulic length = 0 ft
Time of conc. (Tc) = 10.70 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

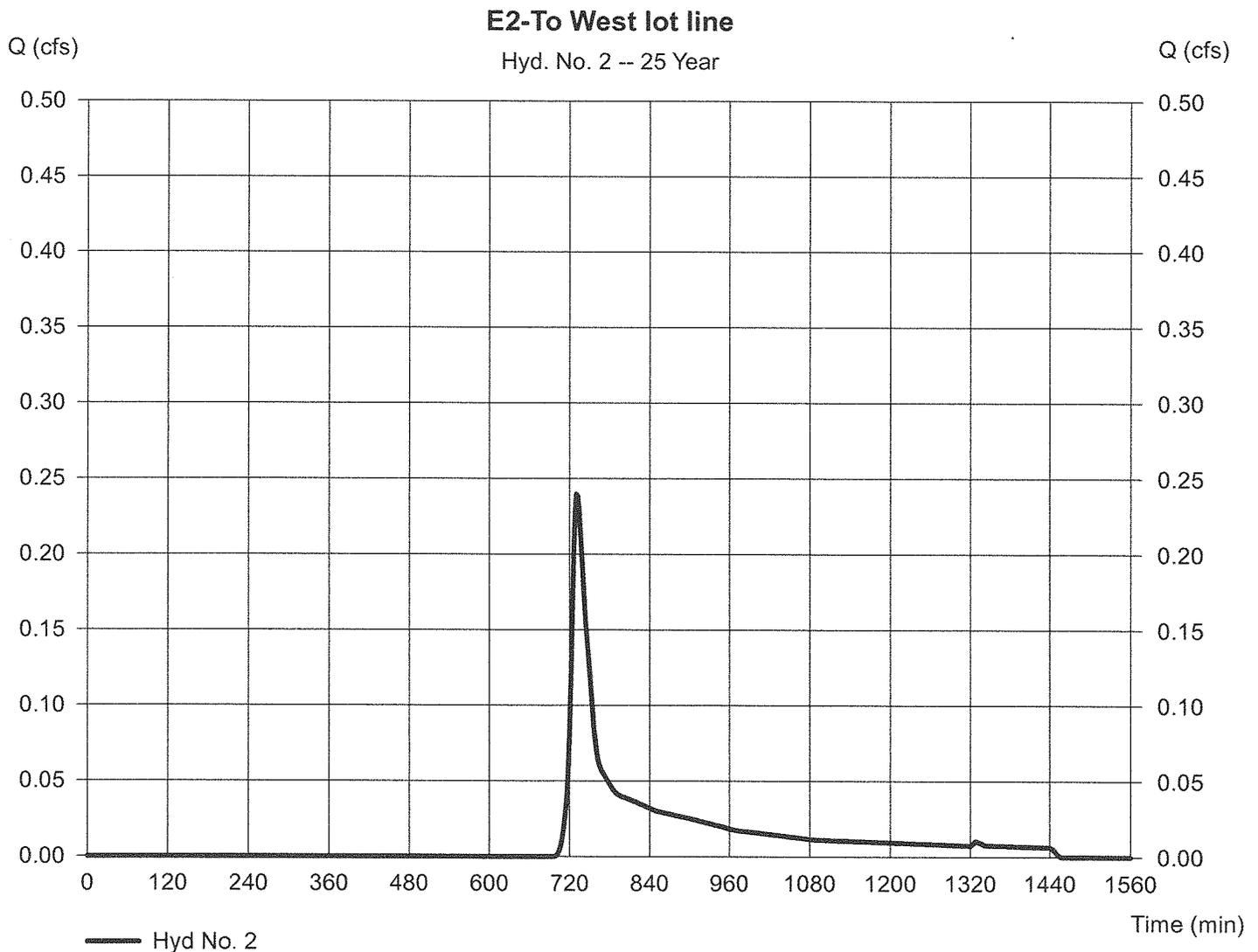
Wednesday, Feb 20, 2013

Hyd. No. 2

E2-To West lot line

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 0.260 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 0.240 cfs
Time to peak = 730 min
Hyd. volume = 1,103 cuft
Curve number = 55
Hydraulic length = 0 ft
Time of conc. (Tc) = 10.70 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

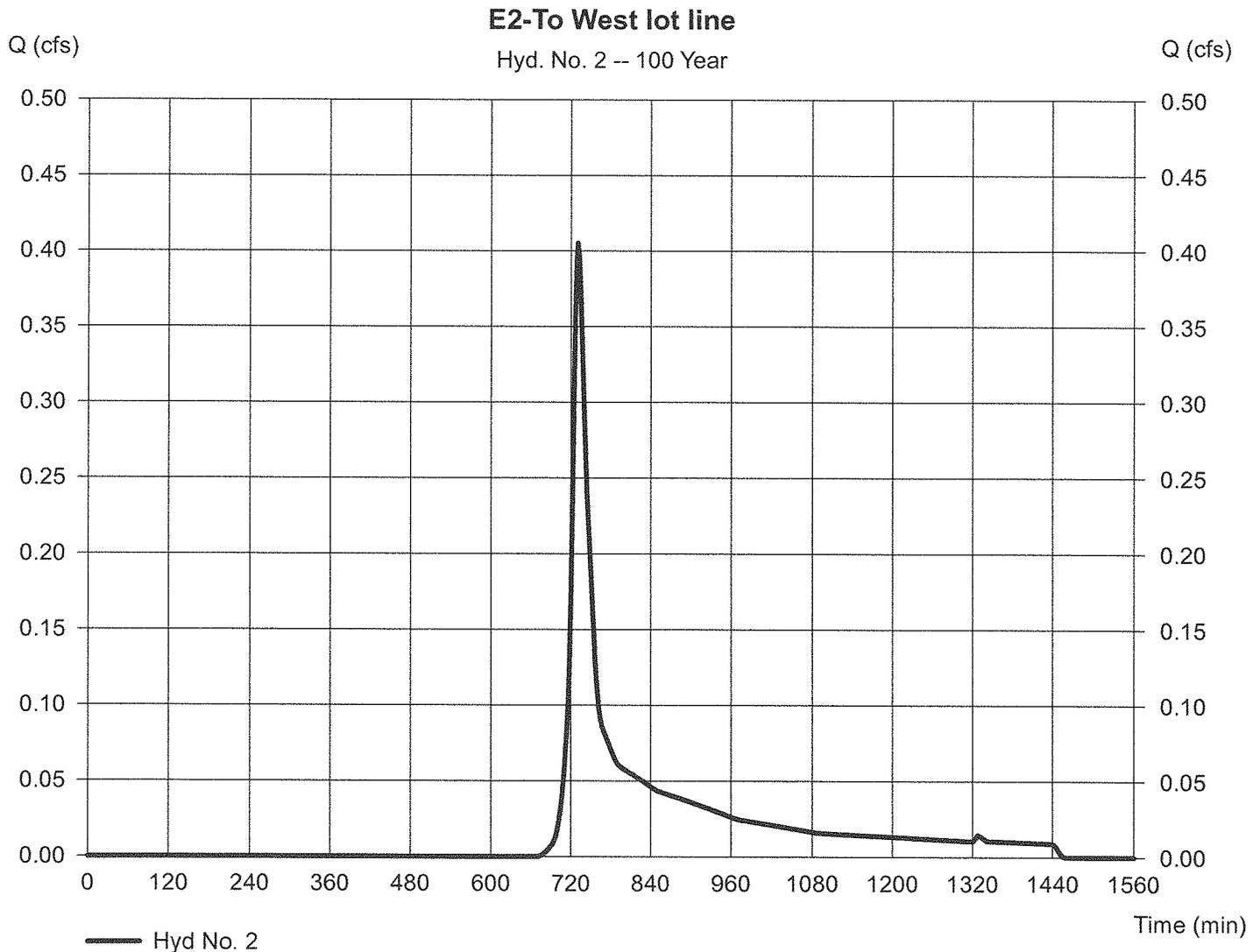
Wednesday, Feb 20, 2013

Hyd. No. 2

E2-To West lot line

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.260 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 0.405 cfs
Time to peak = 730 min
Hyd. volume = 1,706 cuft
Curve number = 55
Hydraulic length = 0 ft
Time of conc. (Tc) = 10.70 min
Distribution = Type III
Shape factor = 484



Post-Development Hydrology

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|----------|--------------------------|-----------------|---------------------|--------------------|--------------------|-----------------|------------------------|-------------------------|---------------------------------|
| 1 | SCS Runoff | 1.504 | 2 | 732 | 7,761 | --- | ---- | ---- | E1-Direct to BVW |
| 2 | SCS Runoff | 0.022 | 2 | 744 | 216 | --- | ---- | ---- | E2-To West lot line |
| 11 | SCS Runoff | 0.902 | 2 | 730 | 4,069 | --- | ---- | ---- | P1-Direct to BVW |
| 12 | SCS Runoff | 0.017 | 2 | 736 | 135 | --- | ---- | ---- | P2-To west lot line |
| 13 | SCS Runoff | 0.455 | 2 | 732 | 2,191 | --- | ---- | ---- | P3-To SMA-1 |
| 14 | Reservoir | 0.243 | 2 | 746 | 1,776 | 13 | 101.00 | 311 | SMA-1 |
| 15 | SCS Runoff | 0.624 | 2 | 726 | 2,247 | --- | ---- | ---- | P4-Cul-de-sac |
| 16 | Reservoir | 0.000 | 2 | 804 | 0 | 15 | 1.86 | 1,191 | SMA-2 |
| 17 | SCS Runoff | 0.241 | 2 | 728 | 1,066 | --- | ---- | ---- | P5-Lot 2 and 3 front yard areas |
| 18 | SCS Runoff | 0.125 | 2 | 724 | 420 | --- | ---- | ---- | P6-Lot 1 roof |
| 19 | Reservoir | 0.000 | 2 | 624 | 0 | 18 | 0.98 | 170 | Lot 1 roof drywell RD1 |
| 20 | SCS Runoff | 0.159 | 2 | 724 | 537 | --- | ---- | ---- | P7-Lot 2 roof |
| 21 | Reservoir | 0.000 | 2 | 580 | 0 | 20 | 1.27 | 238 | Lot 2 roof drywell RD2 |
| 22 | SCS Runoff | 0.159 | 2 | 724 | 537 | --- | ---- | ---- | P8-Lot 3 roof |
| 23 | Reservoir | 0.000 | 2 | 580 | 0 | 22 | 1.27 | 238 | Lot 3 roof drywell RD3 |
| 24 | SCS Runoff | 0.159 | 2 | 724 | 537 | --- | ---- | ---- | P9-Lot 4 roof |
| 25 | Reservoir | 0.000 | 2 | 580 | 0 | 24 | 1.27 | 238 | Lot 4 roof drywell RD4 |
| 26 | SCS Runoff | 0.061 | 2 | 724 | 205 | --- | ---- | ---- | P10-Lot 5 roof |
| 27 | Reservoir | 0.000 | 2 | 514 | 0 | 26 | 0.95 | 82.4 | Lot 5 roof drywell RD5 |
| 29 | Combine | 1.288 | 2 | 732 | 6,910 | 11, 14, 16, 17, | ---- | ---- | Total to BVW |

4993 runoff.gpw

Return Period: 2 Year

Monday, Feb 25, 2013

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 | 4.565 | 2 | 730 | 18,999 | ---- | ----- | ----- | E1-Direct to BVW | |
| 2 | SCS Runoff | 0.138 | 2 | 732 | 723 | ---- | ----- | ----- | E2-To West lot line | |
| 11 | SCS Runoff | 2.281 | 2 | 730 | 9,129 | ---- | ----- | ----- | P1-Direct to BVW | |
| 12 | SCS Runoff | 0.095 | 2 | 728 | 409 | ---- | ----- | ----- | P2-To west lot line | |
| 13 | SCS Runoff | 1.262 | 2 | 730 | 5,147 | ---- | ----- | ----- | P3-To SMA-1 | |
| 14 | Reservoir | 0.647 | 2 | 744 | 4,438 | 13 | 101.35 | 1,023 | SMA-1 | |
| 15 | SCS Runoff | 1.295 | 2 | 726 | 4,459 | ---- | ----- | ----- | P4-Cul-de-sac | |
| 16 | Reservoir | 0.609 | 2 | 738 | 1,467 | 15 | 2.38 | 1,538 | SMA-2 | |
| 17 | SCS Runoff | 0.689 | 2 | 728 | 2,548 | ---- | ----- | ----- | P5-Lot 2 and 3 front yard areas | |
| 18 | SCS Runoff | 0.182 | 2 | 724 | 624 | ---- | ----- | ----- | P6-Lot 1 roof | |
| 19 | Reservoir | 0.000 | 2 | 550 | 0 | 18 | 1.48 | 287 | Lot 1 roof drywell RD1 | |
| 20 | SCS Runoff | 0.233 | 2 | 724 | 798 | ---- | ----- | ----- | P7-Lot 2 roof | |
| 21 | Reservoir | 0.000 | 2 | 520 | 0 | 20 | 1.99 | 398 | Lot 2 roof drywell RD2 | |
| 22 | SCS Runoff | 0.233 | 2 | 724 | 798 | ---- | ----- | ----- | P8-Lot 3 roof | |
| 23 | Reservoir | 0.000 | 2 | 520 | 0 | 22 | 1.99 | 398 | Lot 3 roof drywell RD3 | |
| 24 | SCS Runoff | 0.233 | 2 | 724 | 798 | ---- | ----- | ----- | P9-Lot 4 roof | |
| 25 | Reservoir | 0.000 | 2 | 520 | 0 | 24 | 1.99 | 398 | Lot 4 roof drywell RD4 | |
| 26 | SCS Runoff | 0.089 | 2 | 724 | 305 | ---- | ----- | ----- | P10-Lot 5 roof | |
| 27 | Reservoir | 0.000 | 2 | 446 | 0 | 26 | 1.44 | 139 | Lot 5 roof drywell RD5 | |
| 29 | Combine | 3.306 | 2 | 738 | 17,582 | 11, 14, 16, 17, | ----- | ----- | Total to BVW | |
| 4993 runoff.gpw | | | | | Return Period: 10 Year | | | Monday, Feb 25, 2013 | | |

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|----------|--------------------------|-----------------|---------------------|--------------------|--------------------|-----------------|------------------------|-------------------------|---------------------------------|
| 1 | SCS Runoff | 6.640 | 2 | 730 | 26,642 | --- | ---- | ----- | E1-Direct to BVW |
| 2 | SCS Runoff | 0.240 | 2 | 730 | 1,103 | --- | ---- | ----- | E2-To West lot line |
| 11 | SCS Runoff | 3.177 | 2 | 730 | 12,463 | --- | ---- | ----- | P1-Direct to BVW |
| 12 | SCS Runoff | 0.156 | 2 | 728 | 608 | --- | ---- | ----- | P2-To west lot line |
| 13 | SCS Runoff | 1.797 | 2 | 730 | 7,128 | --- | ---- | ----- | P3-To SMA-1 |
| 14 | Reservoir | 1.067 | 2 | 742 | 6,282 | 13 | 101.51 | 1,361 | SMA-1 |
| 15 | SCS Runoff | 1.710 | 2 | 726 | 5,848 | --- | ---- | ----- | P4-Cul-de-sac |
| 16 | Reservoir | 1.427 | 2 | 730 | 2,663 | 15 | 2.48 | 1,599 | SMA-2 |
| 17 | SCS Runoff | 0.995 | 2 | 726 | 3,548 | --- | ---- | ----- | P5-Lot 2 and 3 front yard areas |
| 18 | SCS Runoff | 0.215 | 2 | 724 | 741 | --- | ---- | ----- | P6-Lot 1 roof |
| 19 | Reservoir | 0.000 | 2 | 528 | 0 | 18 | 1.80 | 358 | Lot 1 roof drywell RD1 |
| 20 | SCS Runoff | 0.275 | 2 | 724 | 948 | --- | ---- | ----- | P7-Lot 2 roof |
| 21 | Reservoir | 0.000 | 2 | 480 | 0 | 20 | 2.46 | 493 | Lot 2 roof drywell RD2 |
| 22 | SCS Runoff | 0.275 | 2 | 724 | 948 | --- | ---- | ----- | P8-Lot 3 roof |
| 23 | Reservoir | 0.000 | 2 | 480 | 0 | 22 | 2.46 | 493 | Lot 3 roof drywell RD3 |
| 24 | SCS Runoff | 0.275 | 2 | 724 | 948 | --- | ---- | ----- | P9-Lot 4 roof |
| 25 | Reservoir | 0.000 | 2 | 480 | 0 | 24 | 2.46 | 493 | Lot 4 roof drywell RD4 |
| 26 | SCS Runoff | 0.105 | 2 | 724 | 362 | --- | ---- | ----- | P10-Lot 5 roof |
| 27 | Reservoir | 0.000 | 2 | 522 | 0 | 26 | 1.75 | 174 | Lot 5 roof drywell RD5 |
| 29 | Combine | 6.144 | 2 | 730 | 24,956 | 11, 14, 16, 17, | ---- | ----- | Total to BVW |

4993 runoff.gpw

Return Period: 25 Year

Monday, Feb 25, 2013

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 | 9.735 | 2 | 730 | 38,160 | --- | ----- | ----- | E1-Direct to BVW | |
| 2 | SCS Runoff | 0.405 | 2 | 730 | 1,706 | --- | ----- | ----- | E2-To West lot line | |
| 11 | SCS Runoff | 4.491 | 2 | 728 | 17,400 | --- | ----- | ----- | P1-Direct to BVW | |
| 12 | SCS Runoff | 0.249 | 2 | 728 | 920 | --- | ----- | ----- | P2-To west lot line | |
| 13 | SCS Runoff | 2.589 | 2 | 730 | 10,089 | --- | ----- | ----- | P3-To SMA-1 | |
| 14 | Reservoir | 1.570 | 2 | 740 | 9,061 | 13 | 101.77 | 1,895 | SMA-1 | |
| 15 | SCS Runoff | 2.299 | 2 | 726 | 7,852 | --- | ----- | ----- | P4-Cul-de-sac | |
| 16 | Reservoir | 2.223 | 2 | 728 | 4,480 | 15 | 2.56 | 1,644 | SMA-2 | |
| 17 | SCS Runoff | 1.451 | 2 | 726 | 5,048 | --- | ----- | ----- | P5-Lot 2 and 3 front yard areas | |
| 18 | SCS Runoff | 0.260 | 2 | 724 | 902 | --- | ----- | ----- | P6-Lot 1 roof | |
| 19 | Reservoir | 0.000 | 2 | 494 | 0 | 18 | 2.29 | 460 | Lot 1 roof drywell RD1 | |
| 20 | SCS Runoff | 0.333 | 2 | 724 | 1,153 | --- | ----- | ----- | P7-Lot 2 roof | |
| 21 | Reservoir | 0.000 | 2 | 430 | 0 | 20 | 3.35 | 625 | Lot 2 roof drywell RD2 | |
| 22 | SCS Runoff | 0.333 | 2 | 724 | 1,153 | --- | ----- | ----- | P8-Lot 3 roof | |
| 23 | Reservoir | 0.000 | 2 | 430 | 0 | 22 | 3.35 | 625 | Lot 3 roof drywell RD3 | |
| 24 | SCS Runoff | 0.333 | 2 | 724 | 1,153 | --- | ----- | ----- | P9-Lot 4 roof | |
| 25 | Reservoir | 0.000 | 2 | 430 | 0 | 24 | 3.35 | 625 | Lot 4 roof drywell RD4 | |
| 26 | SCS Runoff | 0.127 | 2 | 724 | 440 | --- | ----- | ----- | P10-Lot 5 roof | |
| 27 | Reservoir | 0.000 | 2 | 498 | 0 | 26 | 2.22 | 223 | Lot 5 roof drywell RD5 | |
| 29 | Combine | 9.160 | 2 | 728 | 35,988 | 11, 14, 16, 17, | ----- | ----- | Total to BVW | |
| 4993 runoff.gpw | | | | | Return Period: 100 Year | | | Monday, Feb 25, 2013 | | |

Worksheet 2: Runoff curve number and runoff

SM-4993

Project: 27 Jackson Drive By JTM Date 2/6/13
 Location: Acton, MA Checked _____ Date _____
 Circle one: Present **Developed** P1 _____

1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio) | CN 1/ | | | Area Acres | Product of CN x Area |
|--|---|-----------|----------|----------|---------------|----------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| Narragansett 416B B | Woods(good Condition) | 55 | | | 0.27 | 14.85 |
| Narragansett 416B B | Open(Good Condition) | 61 | | | 0.54 | 32.94 |
| Whitman 73B D | Open(Good Condition) | 80 | | | 0.21 | 17.04 |
| | Impervious | 98 | | | 0.08 | 7.84 |
| Whitman 73B D | Woods(Good Condition) | 77 | | | 0.41 | 31.88 |
| Narragansett B | Brush(Good Condition) | 48 | | | 0.05 | 2.40 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Totals = | | | | | 1.57 | 106.95 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{106.95}{1.57} = 68.25$; Use CN = **68.3**

2. Runoff

Frequency..... yr
 Rainfall, P (24-hour)..... in
 Runoff, Q..... in
 (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)
 Runoff, Q..... cf
 D-2

| Storm #1 | Storm #2 | Storm #3 |
|----------|----------|----------|
| 2 | 10 | 100 |
| 3.1 | 4.5 | 6.4 |
| 0.69 | 1.55 | 2.96 |

3925 8816 16813
 (210-VI-TR-55, Second Ed., June 1986)

Project: 27 Jackson Drive

By JTM

Date 2/6/2013

Location: Acton, MA

Checked _____

Date _____

Circle one: Present Developed

Circle one: Tc Tt

through subarea

P1

Sheet flow (Applicable to Tc only)

1. Surface Description (table 3-1)

2. Mannings roughness coeff., n (table 3-1)

3. Flow length, L (total L <= 300 ft)

4. Two-yr 24-hr rainfall, P2

5. Land Slope, s

6. $Tt = 0.007 (nL)^{0.8} / (P2^{0.5} s^{0.4})$

Compute Tt hr

| | | | | |
|------------|-------|--|--|--|
| Segment ID | A-B | | | |
| | Woods | | | |
| | 0.4 | | | |
| | 50 | | | |
| | 3.1 | | | |
| | 0.04 | | | |
| | 0.16 | | | |

0.16

Shallow concentrated Flow

7. Surface Description (paved or unpaved)

8. Flow Length, L

9. Watercourse slope, s

10. Average Velocity, V (figure 3-1)

11. $Tt = L / 3600V$

Compute Tt hr

| | | | | |
|------------|---------|--|--|--|
| Segment ID | B-C | | | |
| | unpaved | | | |
| | 381 | | | |
| | 0.058 | | | |
| | 3.89 | | | |
| | 0.03 | | | |

0.03

Channel flow

12. Cross sectional flow area, a

13. Wetted perimeter, pw

14. Hydraulic radius, $r=a/wp$

15. Channel Slope, s

16. Manning's roughness coeff., n

17. $V = 1.49 r^{2/3} s^{1/2} / n$

18. Flow length, L

19. $Tt = L / 3600V$

Compute r

Compute V

Compute Tt hr

| | | | | |
|------------|--|--|--|--|
| Segment ID | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

0

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

hr
min

0.19
11.1

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

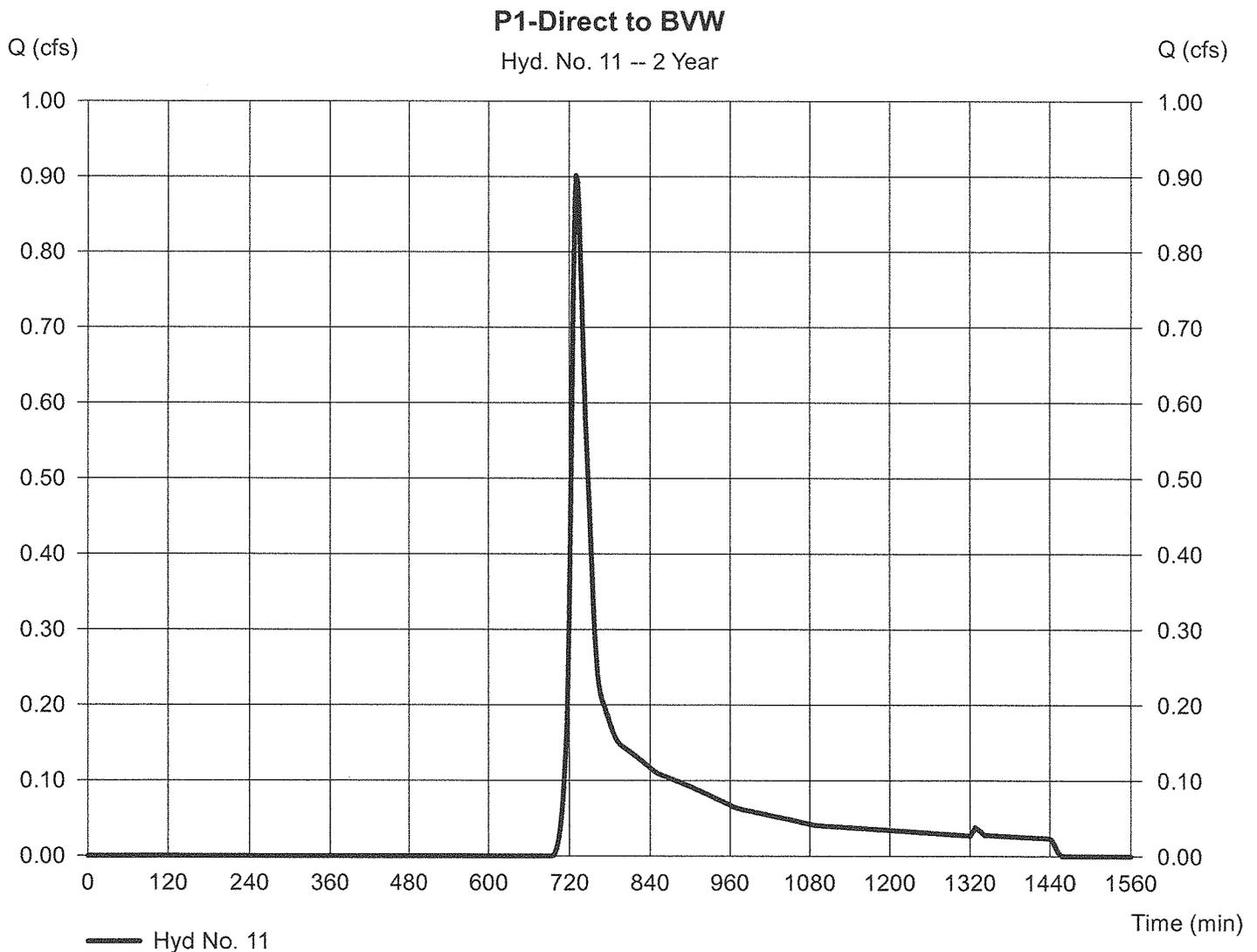
Wednesday, Feb 20, 2013

Hyd. No. 11

P1-Direct to BVW

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 1.570 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.902 cfs
Time to peak = 730 min
Hyd. volume = 4,069 cuft
Curve number = 68.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 11.10 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

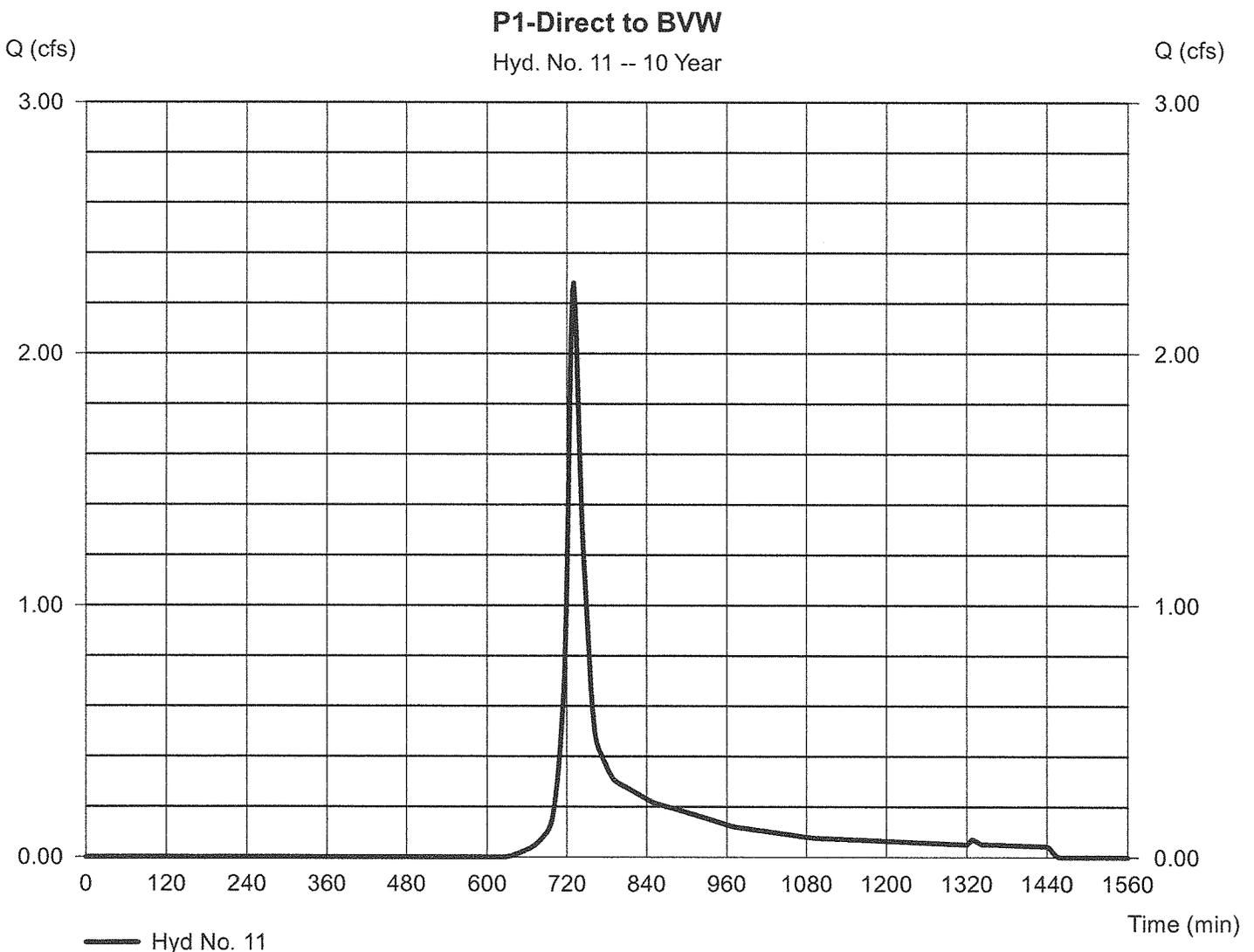
Wednesday, Feb 20, 2013

Hyd. No. 11

P1-Direct to BVW

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 1.570 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 2.281 cfs
Time to peak = 730 min
Hyd. volume = 9,129 cuft
Curve number = 68.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 11.10 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

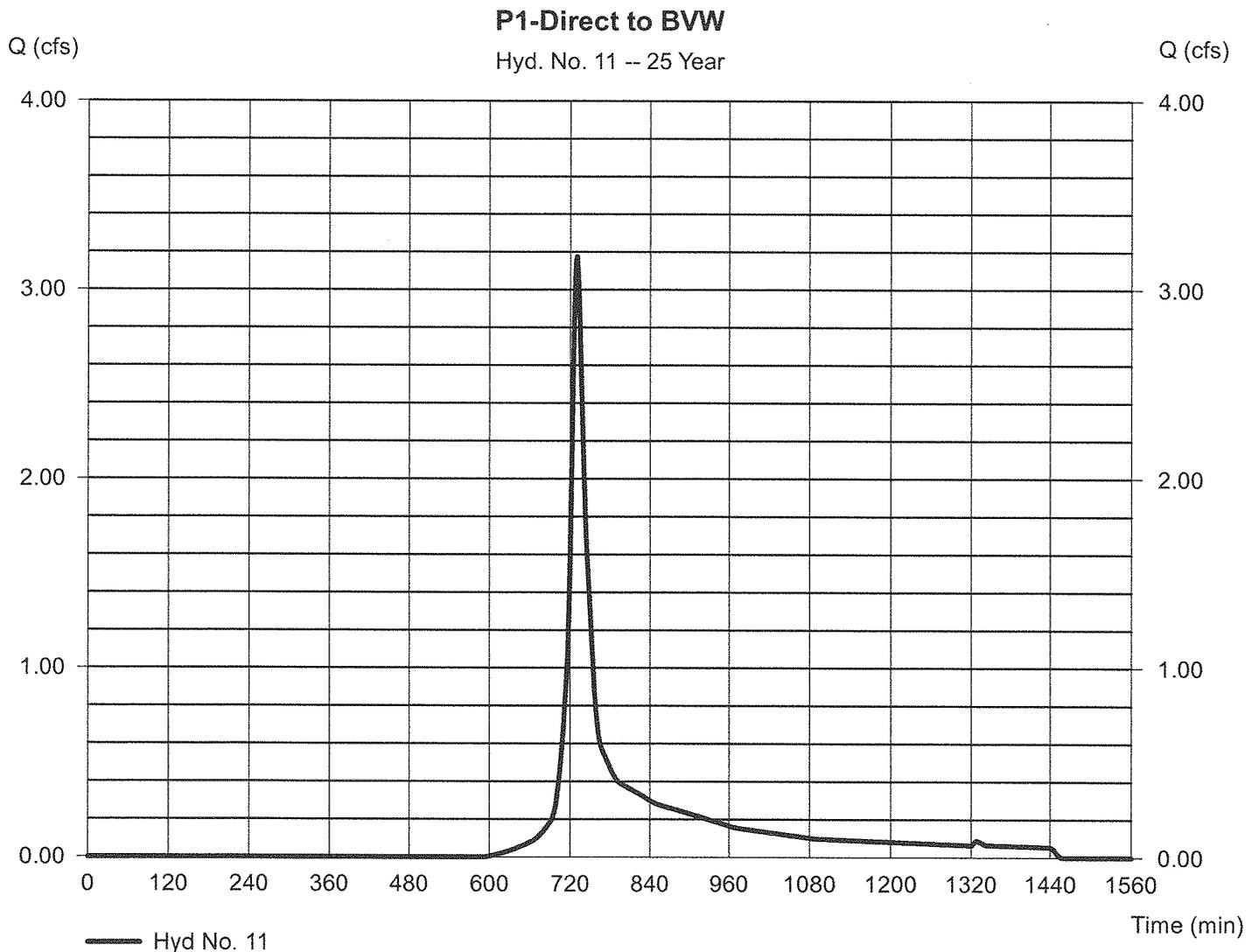
Wednesday, Feb 20, 2013

Hyd. No. 11

P1-Direct to BVW

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 1.570 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 3.177 cfs
Time to peak = 730 min
Hyd. volume = 12,463 cuft
Curve number = 68.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 11.10 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

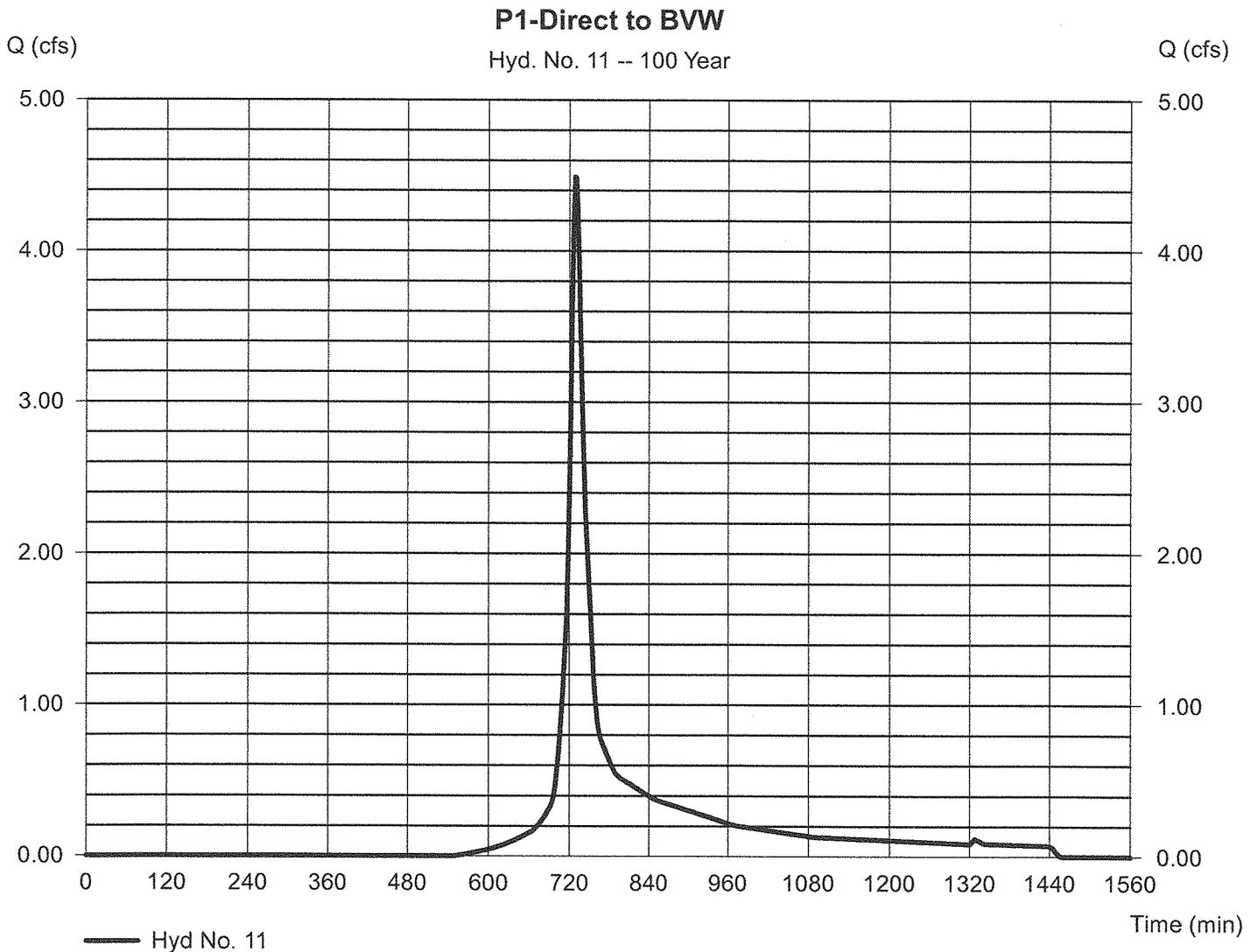
Wednesday, Feb 20, 2013

Hyd. No. 11

P1-Direct to BVW

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 1.570 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 4.491 cfs
Time to peak = 728 min
Hyd. volume = 17,400 cuft
Curve number = 68.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 11.10 min
Distribution = Type III
Shape factor = 484



Worksheet 2: Runoff curve number and runoff

SM-4993

Project: 27 Jackson Drive By JTM Date 2/6/13
 Location: Acton, MA Checked _____ Date _____
 Circle one: Present **Developed** P2 _____

1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio) | CN 1/ | | | Area Acres | Product of CN x Area |
|--|---|-----------|----------|----------|-------------------|----------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| Narragansett 416B B | Open(Good Condition) | 61 | | | 0.05 | 3.05 |
| Narragansett 416B B | Wooded(Good Condition) | 55 | | | 0.08 | 4.40 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Totals = | | | | | 0.13 | 7.45 |

1/ Use only one CN source per line.

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{7.45}{0.13} = 57.31 ; \text{ Use CN} = 57.3$$

2. Runoff

Frequency..... yr

Rainfall, P (24-hour)..... in

Runoff, Q..... in
 (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)

Runoff, Q..... cf

| Storm #1 | Storm #2 | Storm #3 |
|----------|----------|----------|
| 2 | 10 | 100 |
| 3.1 | 4.5 | 6.4 |
| 0.29 | 0.87 | 1.95 |

| | | |
|-----|-----|-----|
| 135 | 409 | 920 |
|-----|-----|-----|

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

Project: 27 Jackson Drive

By JTM

Date 2/6/2013

Location: Acton, MA

Checked _____

Date _____

Circle one:

| | |
|---------|-----------|
| Present | Developed |
|---------|-----------|

P2

Circle one:

| | |
|----|----|
| Tc | Tt |
|----|----|

 through subarea _____

Sheet flow (Applicable to Tc only)

1. Surface Description (table 3-1)
2. Mannings roughness coeff., n (table 3-1)
3. Flow length, L (total L <= 300 ft)
4. Two-yr 24-hr rainfall, P2
5. Land Slope, s
6. $Tt = 0.007 (nL)^{0.8} / (P2^{0.5} s^{0.4})$

Compute Tt hr

| | | | |
|------------|------|--|--|
| Segment ID | A-B | | |
| | OPEN | | |
| | 0.24 | | |
| ft | 50 | | |
| in | 3.1 | | |
| ft/ft | 0.03 | | |
| | 0.12 | | |

0.12

Shallow concentrated Flow

7. Surface Description (paved or unpaved)
8. Flow Length, L
9. Watercourse slope, s
10. Average Velocity, V (figure 3-1)
11. $Tt = L / 3600V$

Compute Tt hr

| | | | |
|------------|---------|--|--|
| Segment ID | B-C | | |
| | unpaved | | |
| ft | 26 | | |
| ft/ft | 0.06 | | |
| ft/s | 3.95 | | |
| | 0.00 | | |

0.00

Channel flow

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

Compute r

Compute V

Compute Tt hr

| | | | |
|------------|--|--|--|
| Segment ID | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

0

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

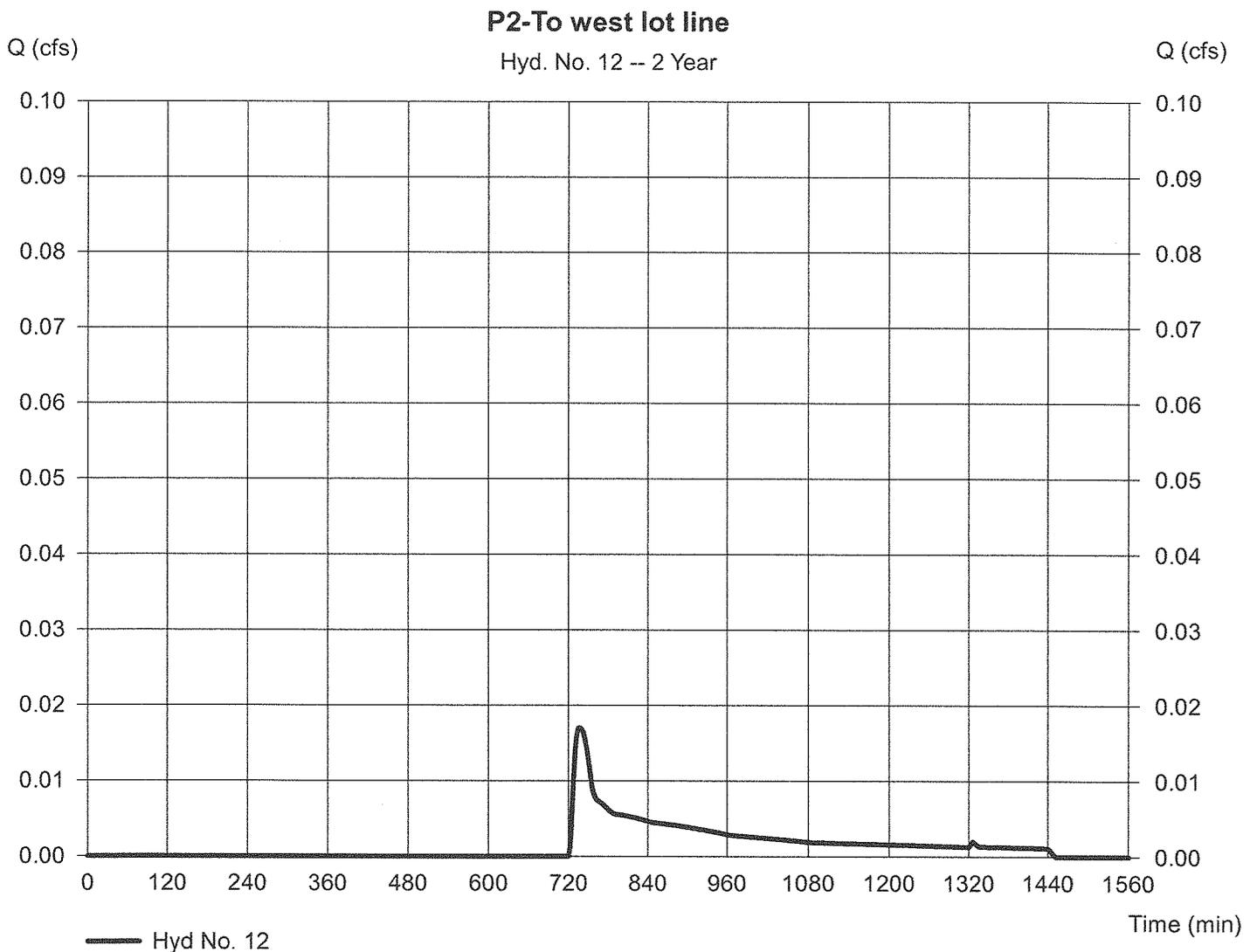
Wednesday, Feb 20, 2013

Hyd. No. 12

P2-To west lot line

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.130 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.017 cfs
Time to peak = 736 min
Hyd. volume = 135 cuft
Curve number = 57.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 7.20 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

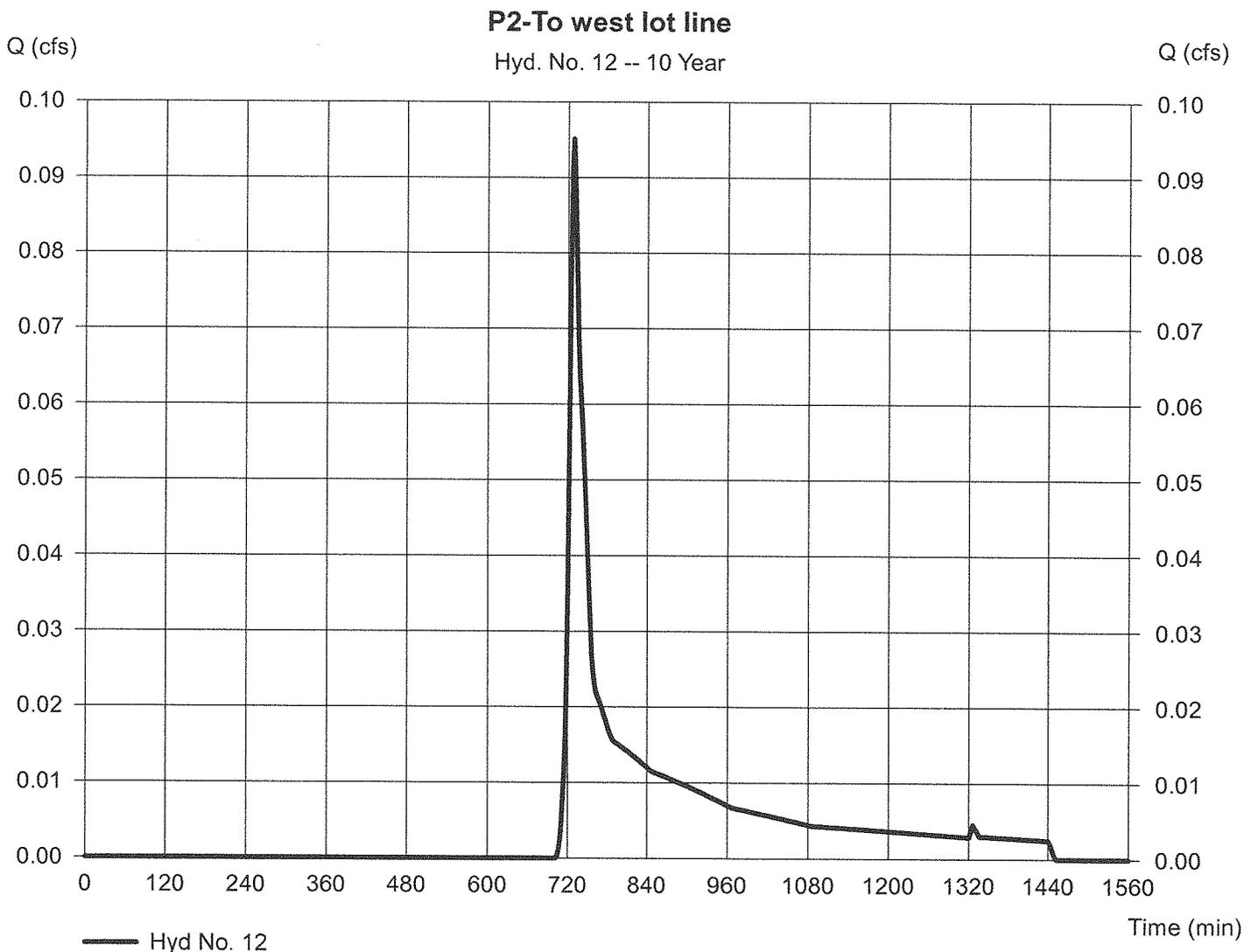
Wednesday, Feb 20, 2013

Hyd. No. 12

P2-To west lot line

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.130 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.095 cfs
Time to peak = 728 min
Hyd. volume = 409 cuft
Curve number = 57.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 7.20 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

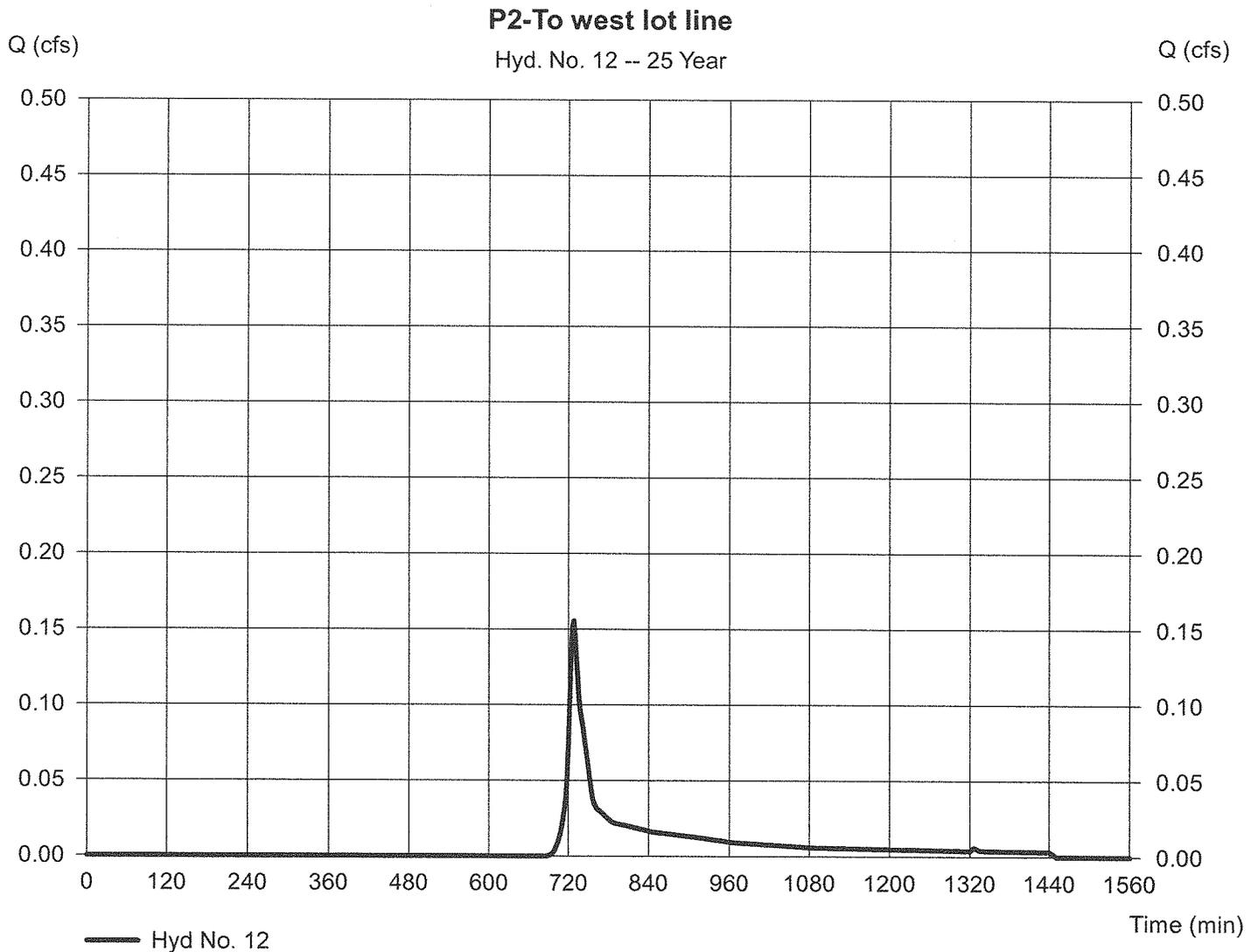
Wednesday, Feb 20, 2013

Hyd. No. 12

P2-To west lot line

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 0.130 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 0.156 cfs
Time to peak = 728 min
Hyd. volume = 608 cuft
Curve number = 57.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 7.20 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

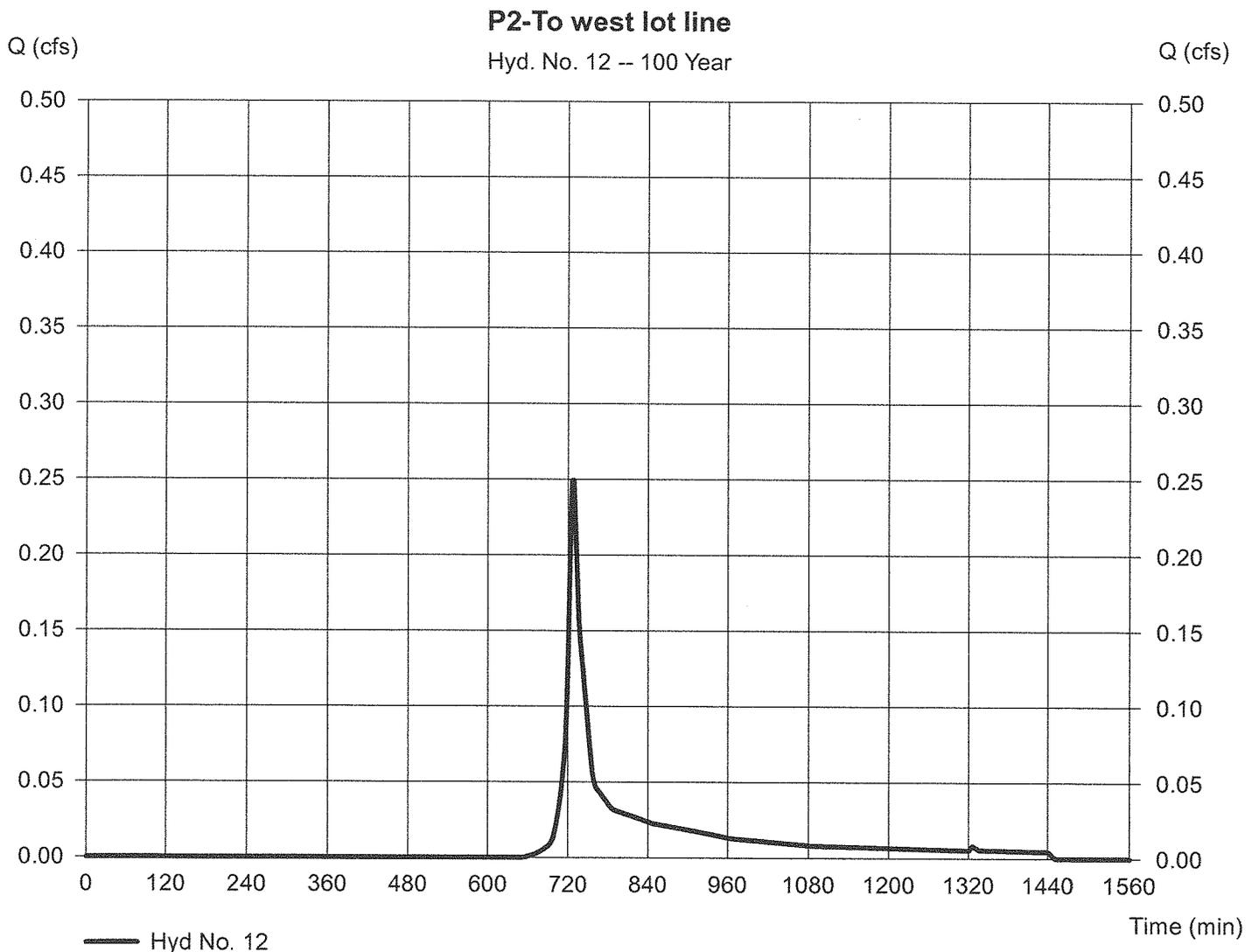
Wednesday, Feb 20, 2013

Hyd. No. 12

P2-To west lot line

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.130 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 0.249 cfs
Time to peak = 728 min
Hyd. volume = 920 cuft
Curve number = 57.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 7.20 min
Distribution = Type III
Shape factor = 484



Project: 27 Jackson Drive

By JTM

Date 2/6/2013

Location: Acton, MA

Checked _____

Date _____

Circle one:

| | |
|---------|-----------|
| Present | Developed |
| Tc | Tt |

through subarea P3

Sheet flow (Applicable to Tc only)

1. Surface Description (table 3-1)

2. Mannings roughness coeff., n (table 3-1)

3. Flow length, L (total L <= 300 ft)

4. Two-yr 24-hr rainfall, P2

5. Land Slope, s

6. $Tt = 0.007 (nL)^{0.8} / (P2^{0.5} s^{0.4})$

Compute Tt hr

| | | | | |
|------------|-------|--|--|------|
| Segment ID | A-B | | | |
| | Woods | | | |
| | 0.4 | | | |
| | 50 | | | |
| | 3.1 | | | |
| | 0.04 | | | |
| | 0.16 | | | 0.16 |

Shallow concentrated Flow

7. Surface Description (paved or unpaved)

8. Flow Length, L

9. Watercourse slope, s

10. Average Velocity, V (figure 3-1)

11. $Tt = L / 3600V$

Compute Tt hr

| | | | | |
|------------|---------|--|--|------|
| Segment ID | B-C | | | |
| | unpaved | | | |
| | 452 | | | |
| | 0.033 | | | |
| | 2.93 | | | |
| | 0.04 | | | 0.04 |

Channel flow

12. Cross sectional flow area, a

13. Wetted perimeter, pw

14. Hydraulic radius, $r=a/wp$

15. Channel Slope, s

16. Manning's roughness coeff., n

17. $V = 1.49 r^{2/3} s^{1/2} / n$

18. Flow length, L

19. $Tt = L / 3600V$

Compute r

Compute V

Compute Tt hr

| | | | | |
|------------|--|--|--|---|
| Segment ID | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | 0 |

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

hr 0.20
min 12.1

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

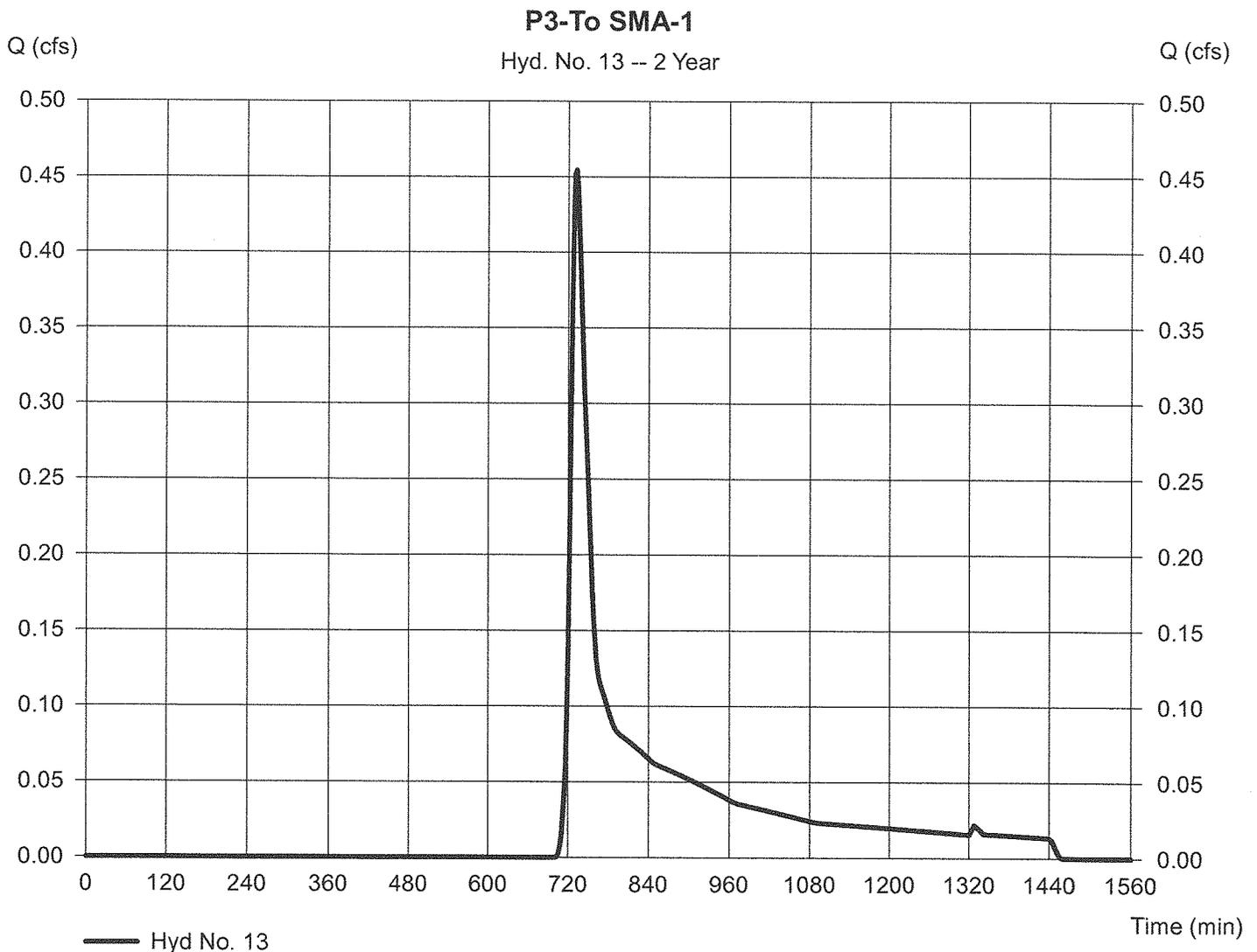
Wednesday, Feb 20, 2013

Hyd. No. 13

P3-To SMA-1

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.980 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.455 cfs
Time to peak = 732 min
Hyd. volume = 2,191 cuft
Curve number = 66.1
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.10 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

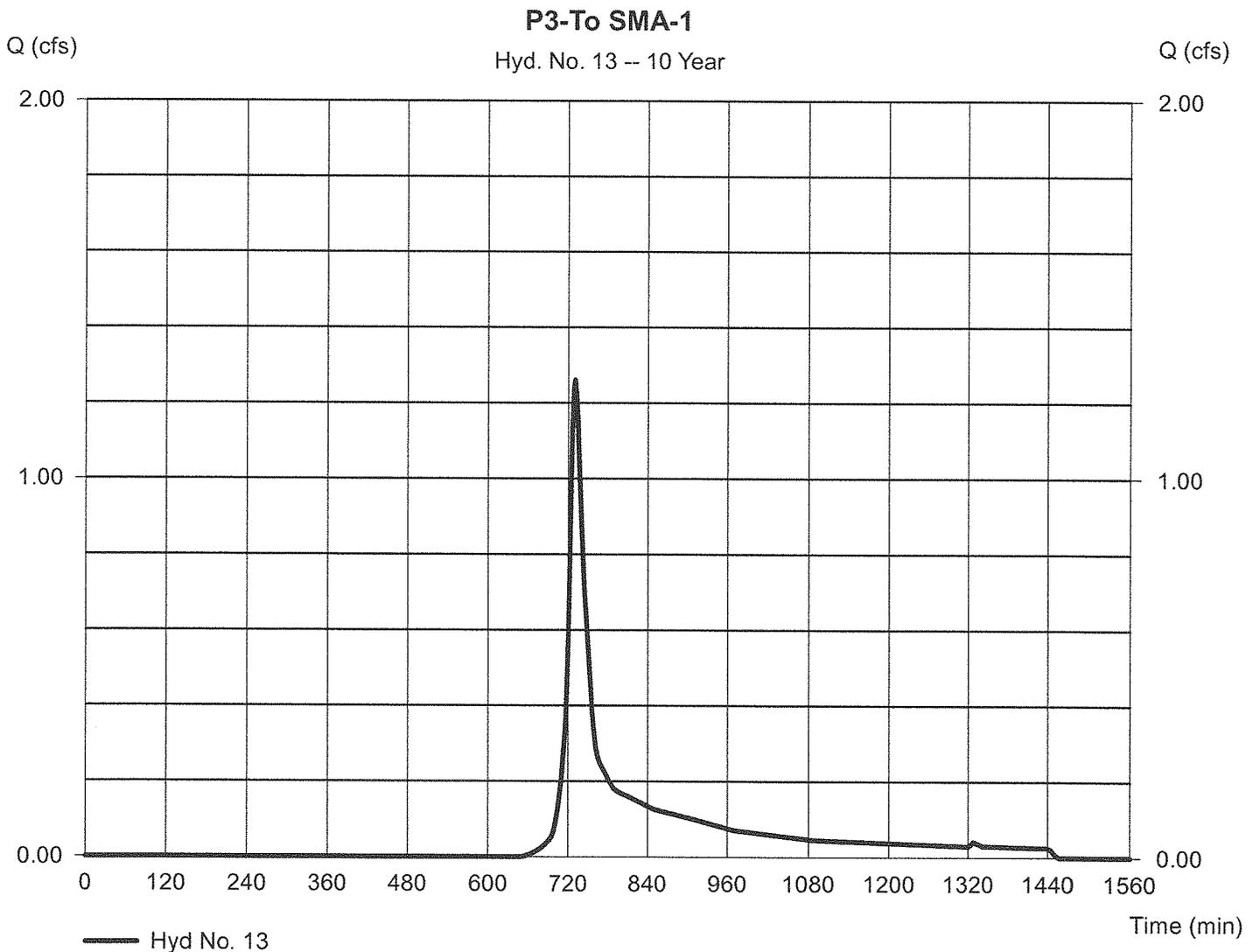
Wednesday, Feb 20, 2013

Hyd. No. 13

P3-To SMA-1

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.980 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 1.262 cfs
Time to peak = 730 min
Hyd. volume = 5,147 cuft
Curve number = 66.1
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.10 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

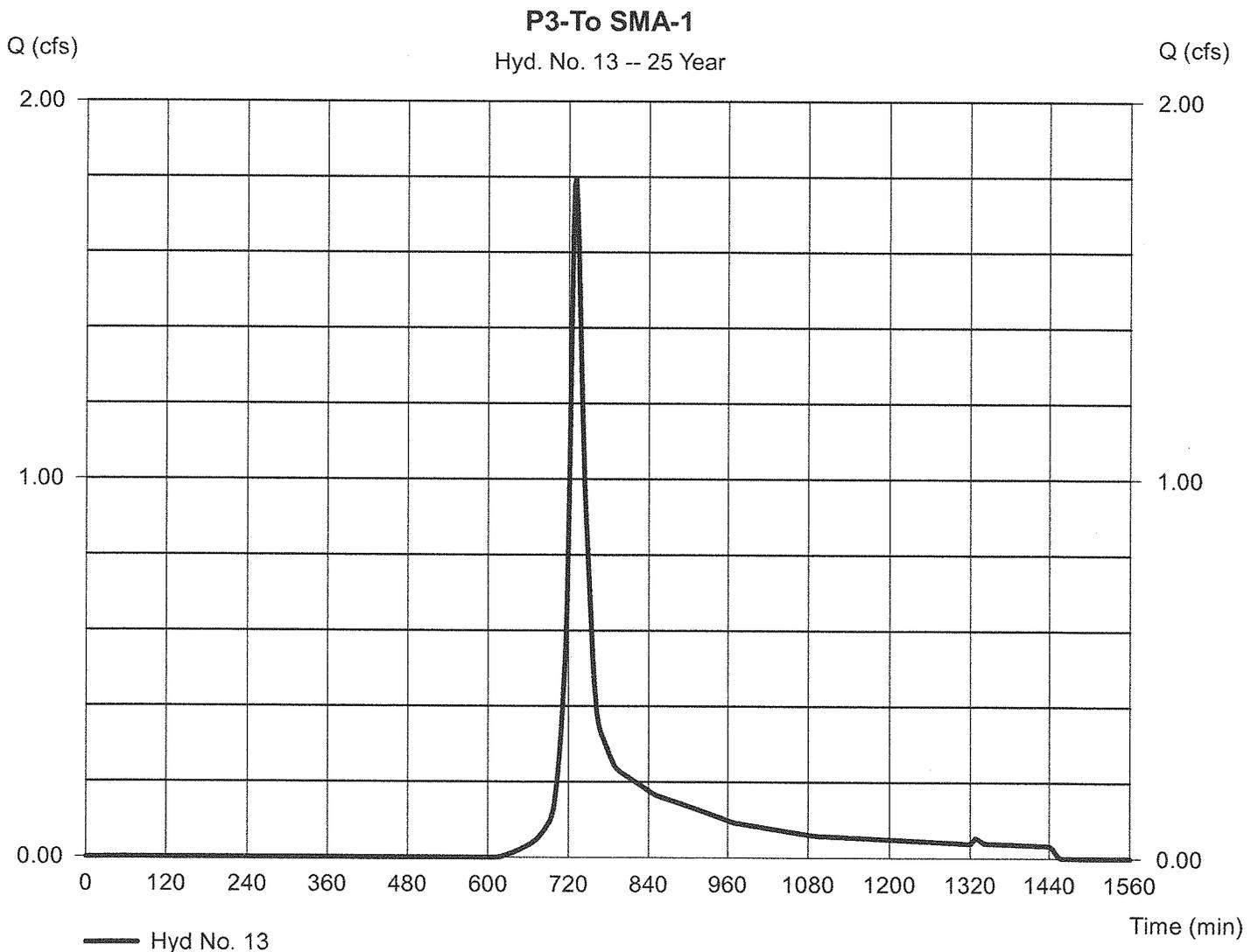
Wednesday, Feb 20, 2013

Hyd. No. 13

P3-To SMA-1

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 0.980 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 1.797 cfs
Time to peak = 730 min
Hyd. volume = 7,128 cuft
Curve number = 66.1
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.10 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

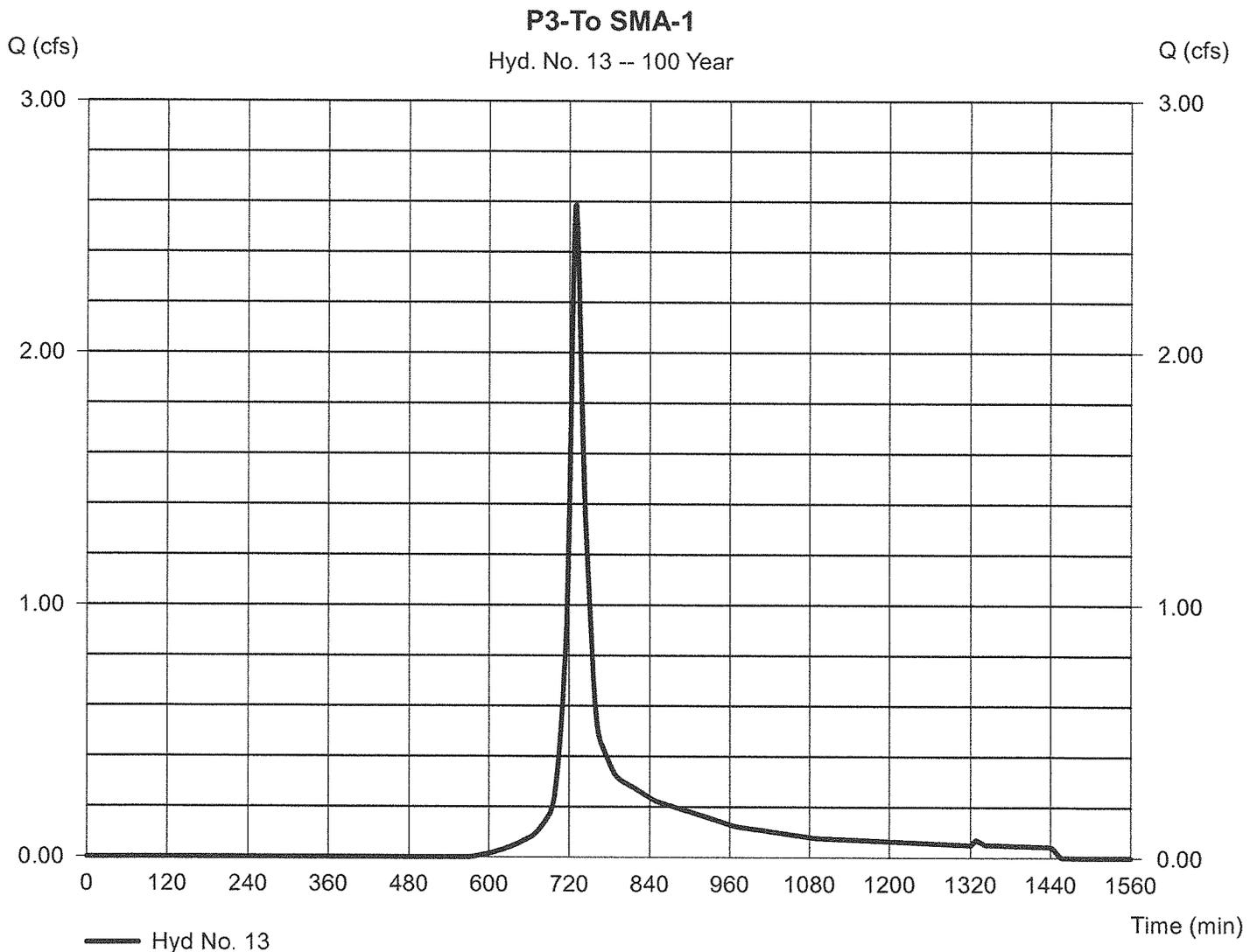
Wednesday, Feb 20, 2013

Hyd. No. 13

P3-To SMA-1

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.980 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 2.589 cfs
Time to peak = 730 min
Hyd. volume = 10,089 cuft
Curve number = 66.1
Hydraulic length = 0 ft
Time of conc. (Tc) = 12.10 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Monday, Feb 25, 2013

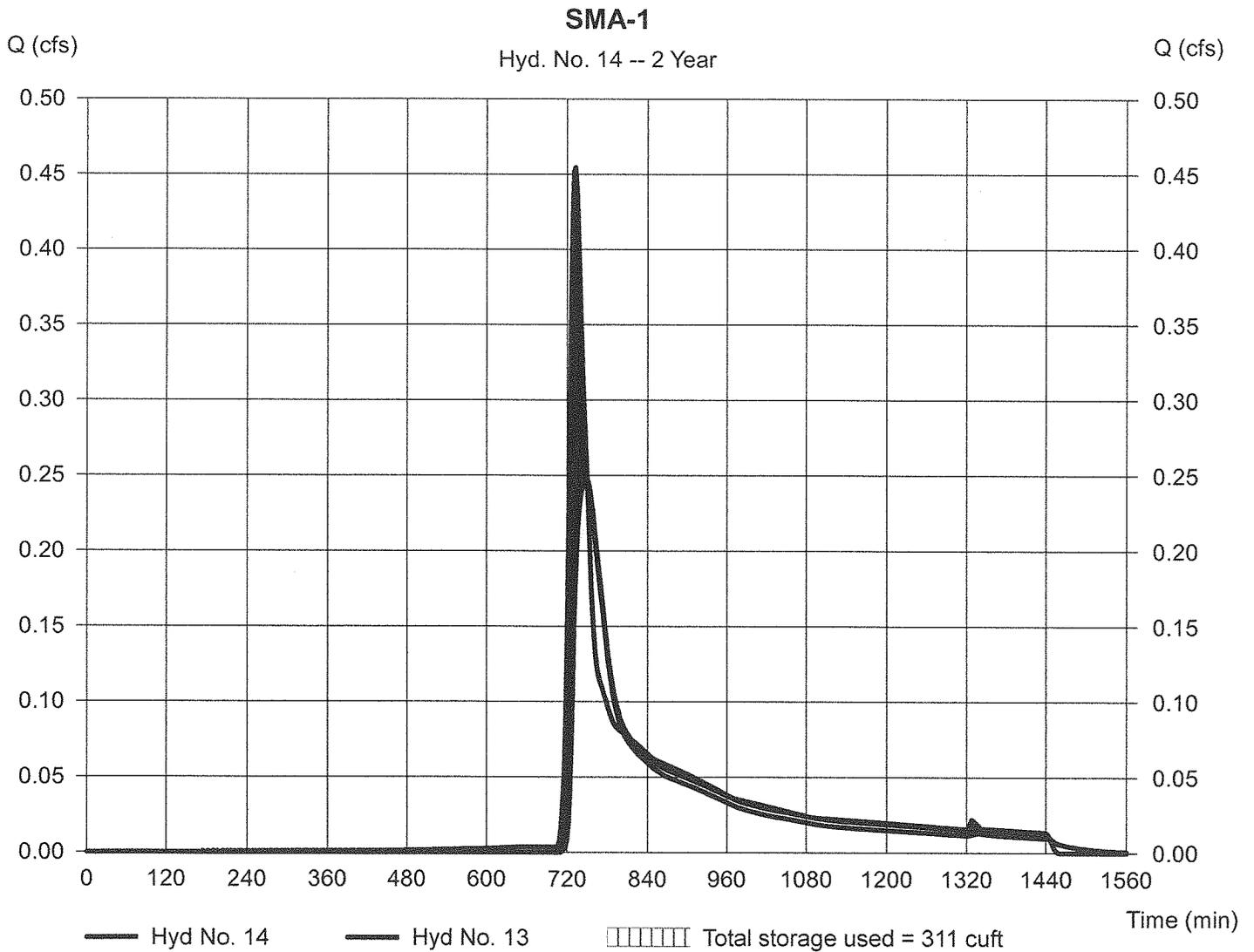
Hyd. No. 14

SMA-1

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 2 min
Inflow hyd. No. = 13 - P3-To SMA-1
Reservoir name = SMA-1

Peak discharge = 0.243 cfs
Time to peak = 746 min
Hyd. volume = 1,776 cuft
Max. Elevation = 101.00 ft
Max. Storage = 311 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Monday, Feb 25, 2013

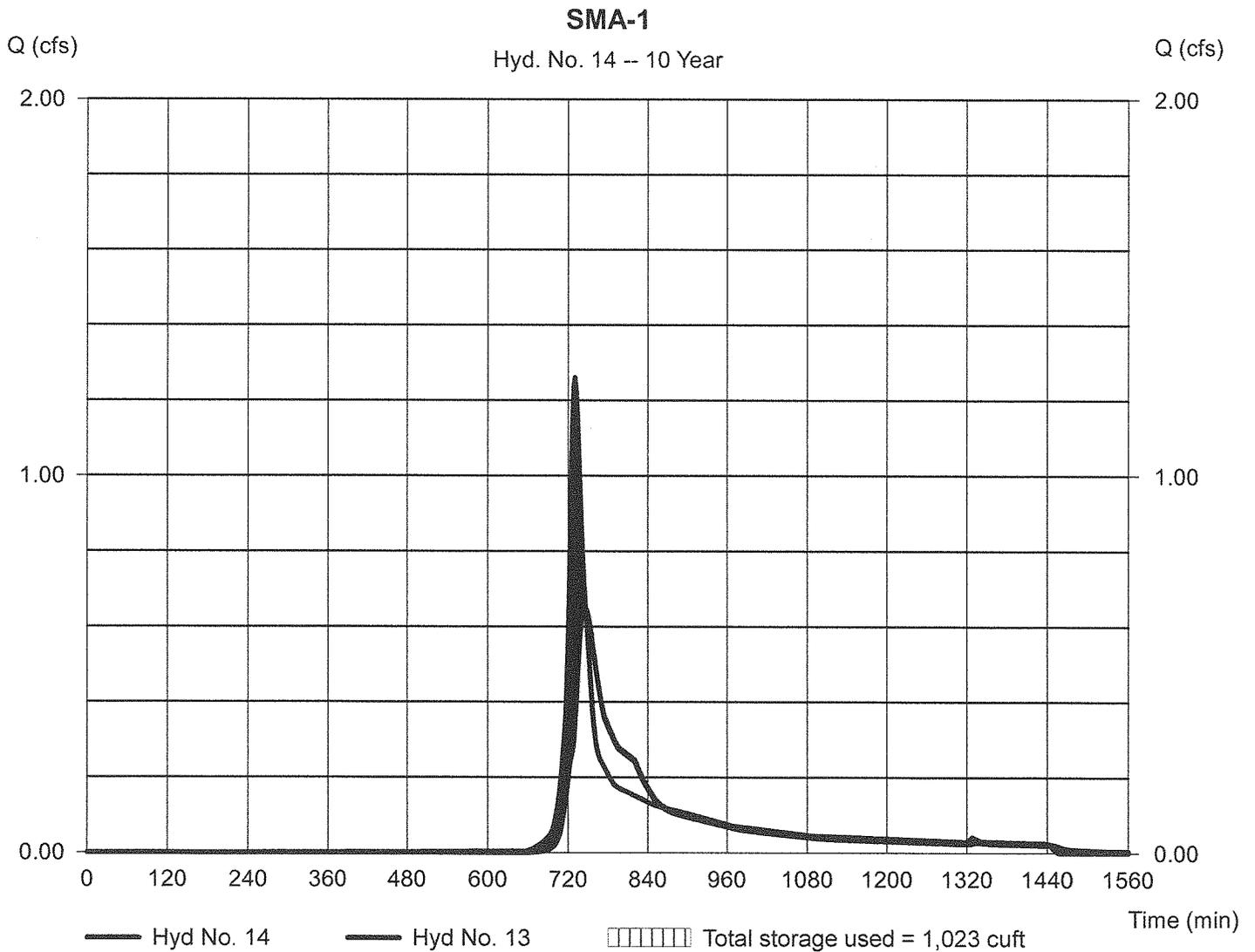
Hyd. No. 14

SMA-1

Hydrograph type = Reservoir
Storm frequency = 10 yrs
Time interval = 2 min
Inflow hyd. No. = 13 - P3-To SMA-1
Reservoir name = SMA-1

Peak discharge = 0.647 cfs
Time to peak = 744 min
Hyd. volume = 4,438 cuft
Max. Elevation = 101.35 ft
Max. Storage = 1,023 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Monday, Feb 25, 2013

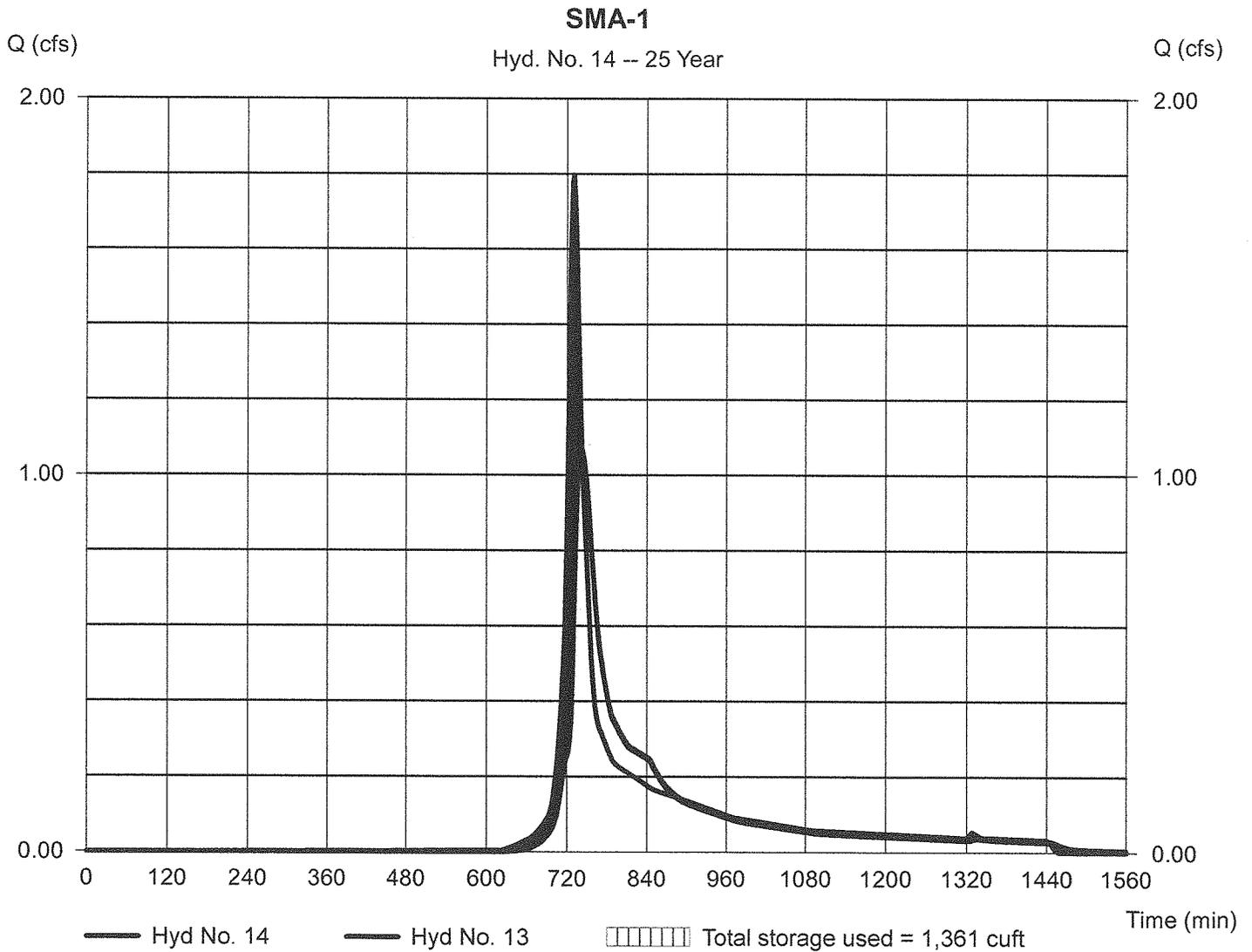
Hyd. No. 14

SMA-1

Hydrograph type = Reservoir
Storm frequency = 25 yrs
Time interval = 2 min
Inflow hyd. No. = 13 - P3-To SMA-1
Reservoir name = SMA-1

Peak discharge = 1.067 cfs
Time to peak = 742 min
Hyd. volume = 6,282 cuft
Max. Elevation = 101.51 ft
Max. Storage = 1,361 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Monday, Feb 25, 2013

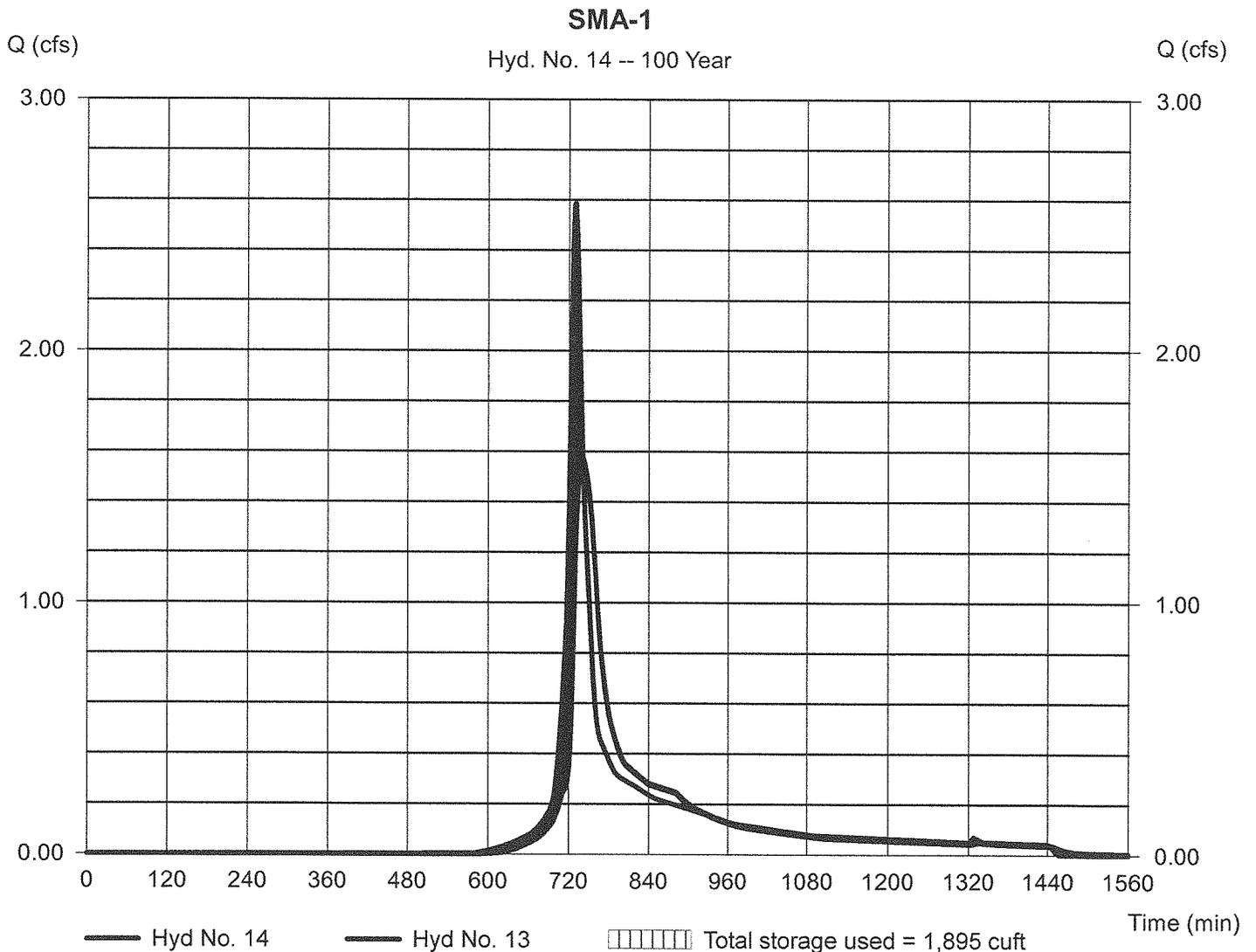
Hyd. No. 14

SMA-1

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 2 min
Inflow hyd. No. = 13 - P3-To SMA-1
Reservoir name = SMA-1

Peak discharge = 1,570 cfs
Time to peak = 740 min
Hyd. volume = 9,061 cuft
Max. Elevation = 101.77 ft
Max. Storage = 1,895 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Worksheet 2: Runoff curve number and runoff

SM-4993

Project: 27 Jackson Drive By JTM Date 2/6/13
 Location: Acton, MA Checked _____ Date _____
 Circle one: Present Developed P4

1. Runoff curve number (CN)

| Soil name and hydrologic group | Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio) | CN 1/ | | | Area Acres | Product of CN x Area |
|---|---|-----------|----------|----------|---------------|-------------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| (appendix A) Narragansett 416B B | Open(Good Condition) | 61 | | | 0.36 | 21.96 |
| Narragansett 416B B | Impervious | 98 | | | 0.23 | 22.54 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Totals = | | | | | 0.59 | 44.50 |

1/ Use only one CN source per line.

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{44.50}{0.59} = 75.42 ; \text{ Use CN} = \boxed{75.4}$$

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..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | 1.05 | 2.08 | 3.67 |

Runoff, Q..... cf

| | | |
|------|------|------|
| 2250 | 4463 | 7857 |
|------|------|------|

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

Project: 27 Jackson Drive

By JTM

Date 2/6/2013

Location: Acton, MA

Checked _____

Date _____

Circle one: Present Developed

P4

Circle one: Tc Tt through subarea _____

Sheet flow (Applicable to Tc only)

1. Surface Description (table 3-1)

2. Mannings roughness coeff., n (table 3-1)

3. Flow length, L (total L <= 300 ft)

4. Two-yr 24-hr rainfall, P2

5. Land Slope, s

6. $Tt = 0.007 (nL)^{0.8} / (P2^{0.5} s^{0.4})$

Compute Tt hr

| | | | | |
|------------|-------|--|--|------|
| Segment ID | A-B | | | |
| | Open | | | |
| | 0.24 | | | |
| | 50 | | | |
| | 3.1 | | | |
| | 0.047 | | | |
| | 0.10 | | | 0.10 |

Shallow concentrated Flow

7. Surface Description (paved or unpaved)

8. Flow Length, L

9. Watercourse slope, s

10. Average Velocity, V (figure 3-1)

11. $Tt = L / 3600V$

Compute Tt hr

| | | | | |
|------------|---------|-------|--|------|
| Segment ID | B-C | C-D | | |
| | unpaved | PAVED | | |
| | 102 | 53 | | |
| | 0.049 | 0.047 | | |
| | 3.57 | 4.41 | | |
| | 0.01 | 0.00 | | 0.01 |

Channel flow

12. Cross sectional flow area, a

13. Wetted perimeter, pw

14. Hydraulic radius, $r=a/wp$

15. Channel Slope, s

16. Manning's roughness coeff., n

17. $V = 1.49 r^{2/3} s^{1/2} / n$

18. Flow length, L

19. $Tt = L / 3600V$

Compute r

Compute V

Compute Tt hr

| | | | | |
|------------|--|--|--|---|
| Segment ID | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | 0 |

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

hr
min

0.11
6.6

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

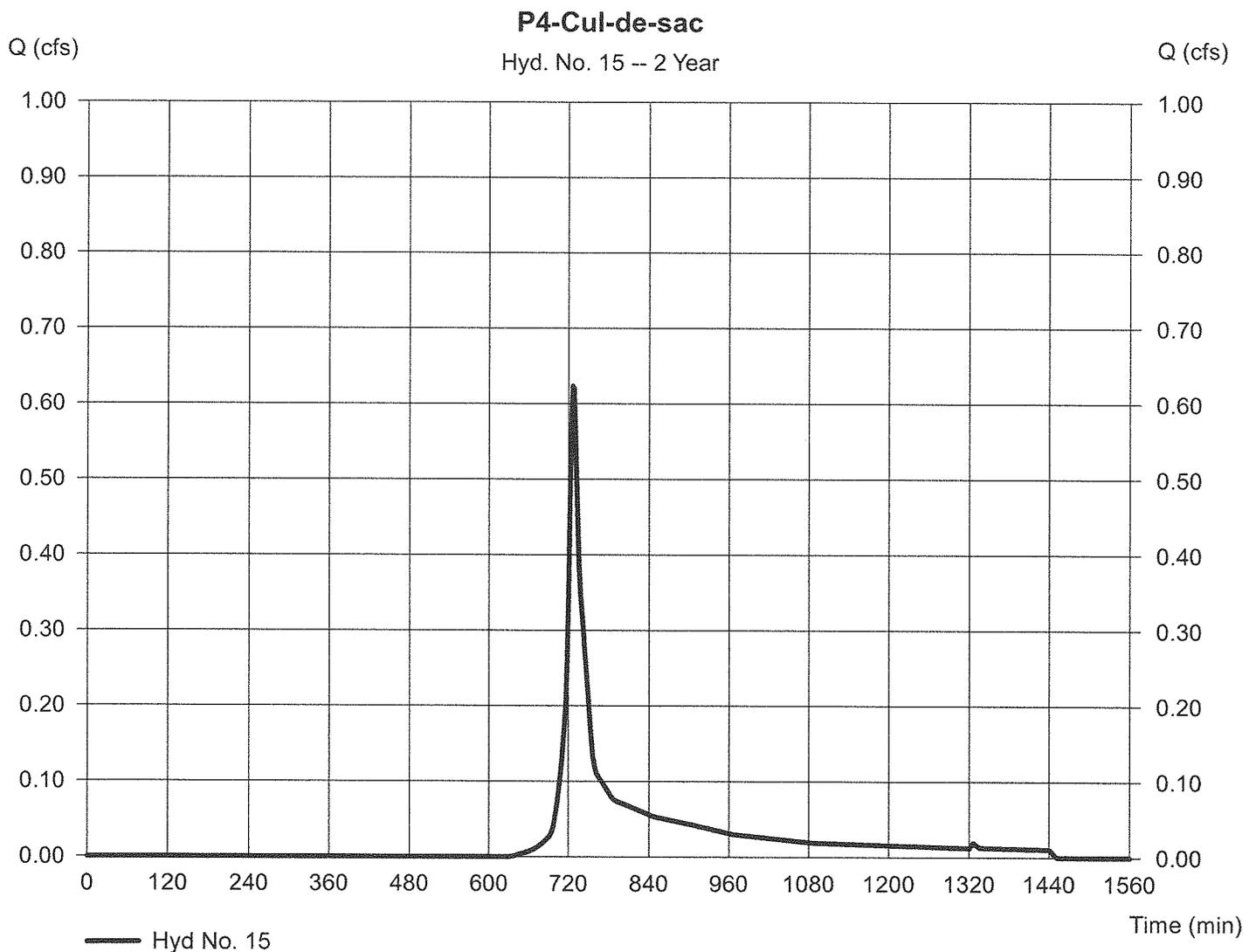
Wednesday, Feb 20, 2013

Hyd. No. 15

P4-Cul-de-sac

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.590 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.624 cfs
Time to peak = 726 min
Hyd. volume = 2,247 cuft
Curve number = 75.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.60 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

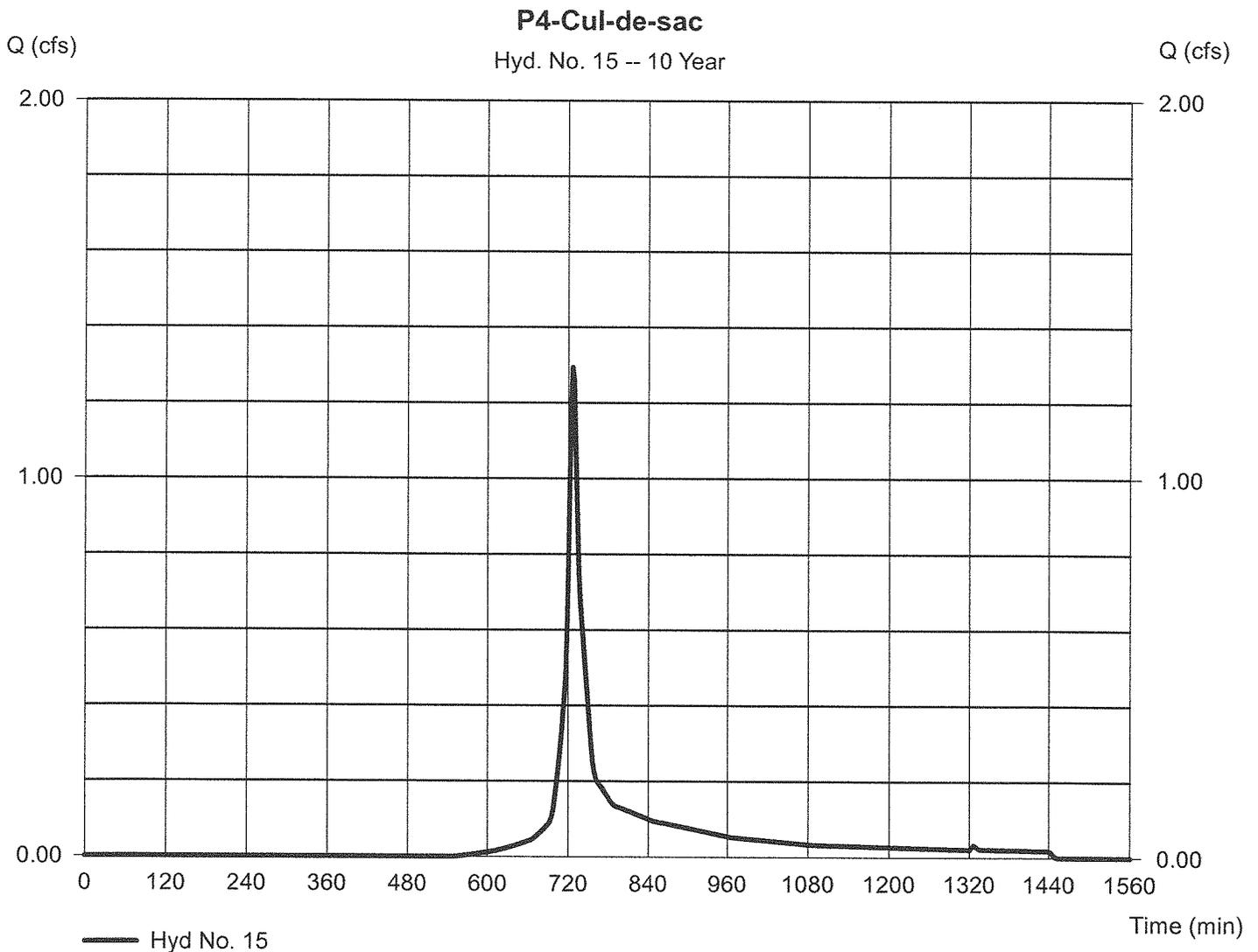
Wednesday, Feb 20, 2013

Hyd. No. 15

P4-Cul-de-sac

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.590 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 1.295 cfs
Time to peak = 726 min
Hyd. volume = 4,459 cuft
Curve number = 75.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.60 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

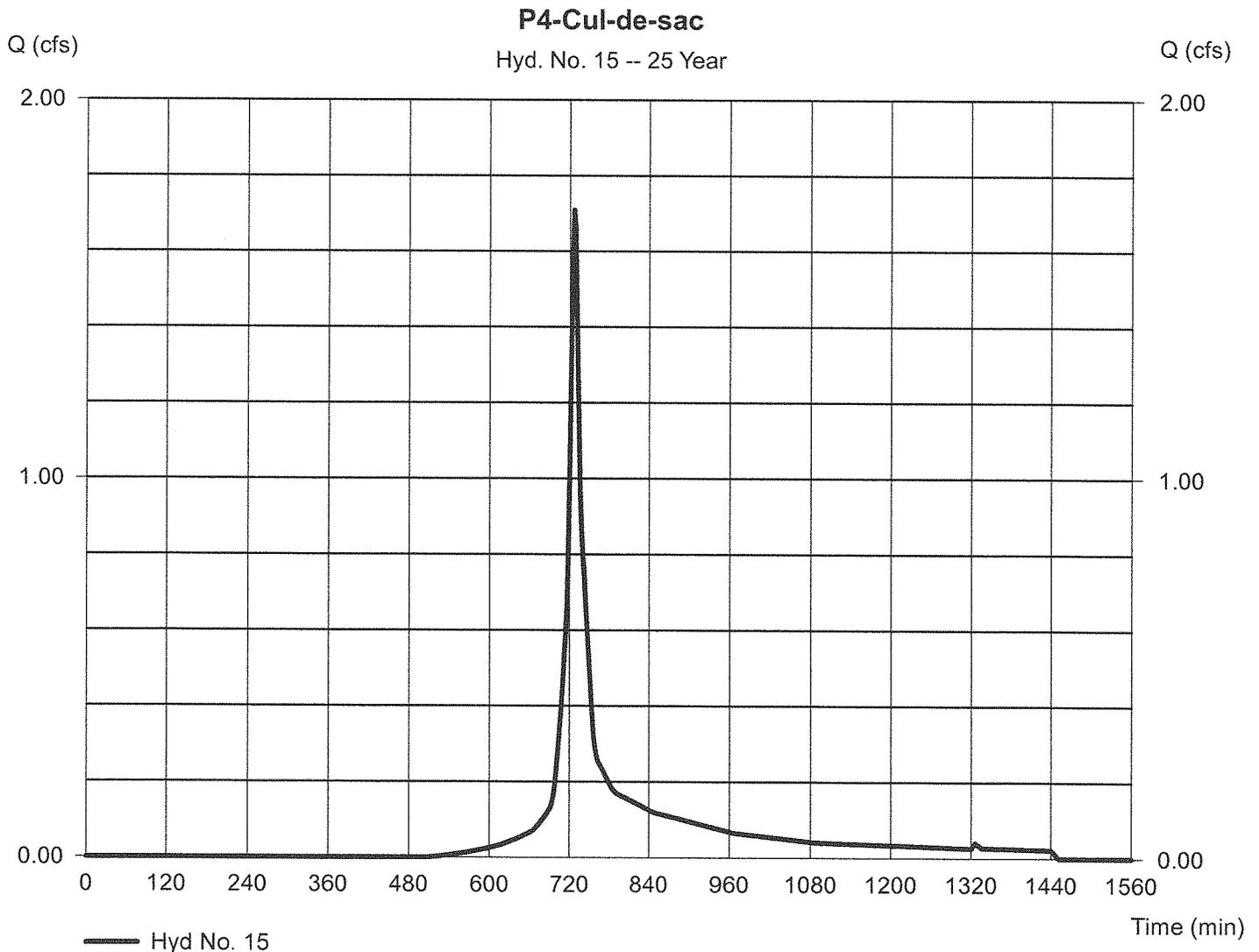
Wednesday, Feb 20, 2013

Hyd. No. 15

P4-Cul-de-sac

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 0.590 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 1.710 cfs
Time to peak = 726 min
Hyd. volume = 5,848 cuft
Curve number = 75.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.60 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

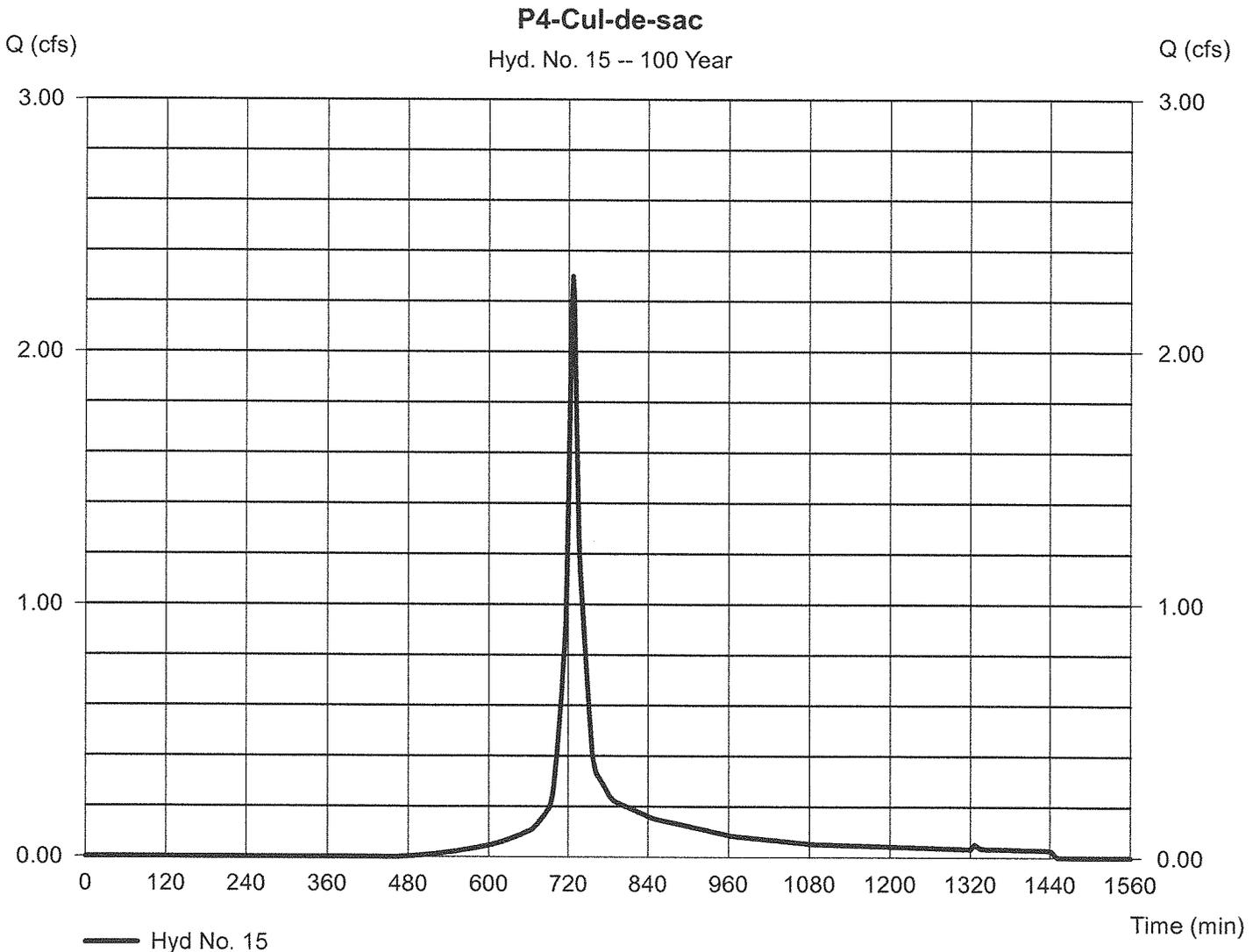
Wednesday, Feb 20, 2013

Hyd. No. 15

P4-Cul-de-sac

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.590 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 2.299 cfs
Time to peak = 726 min
Hyd. volume = 7,852 cuft
Curve number = 75.4
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.60 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

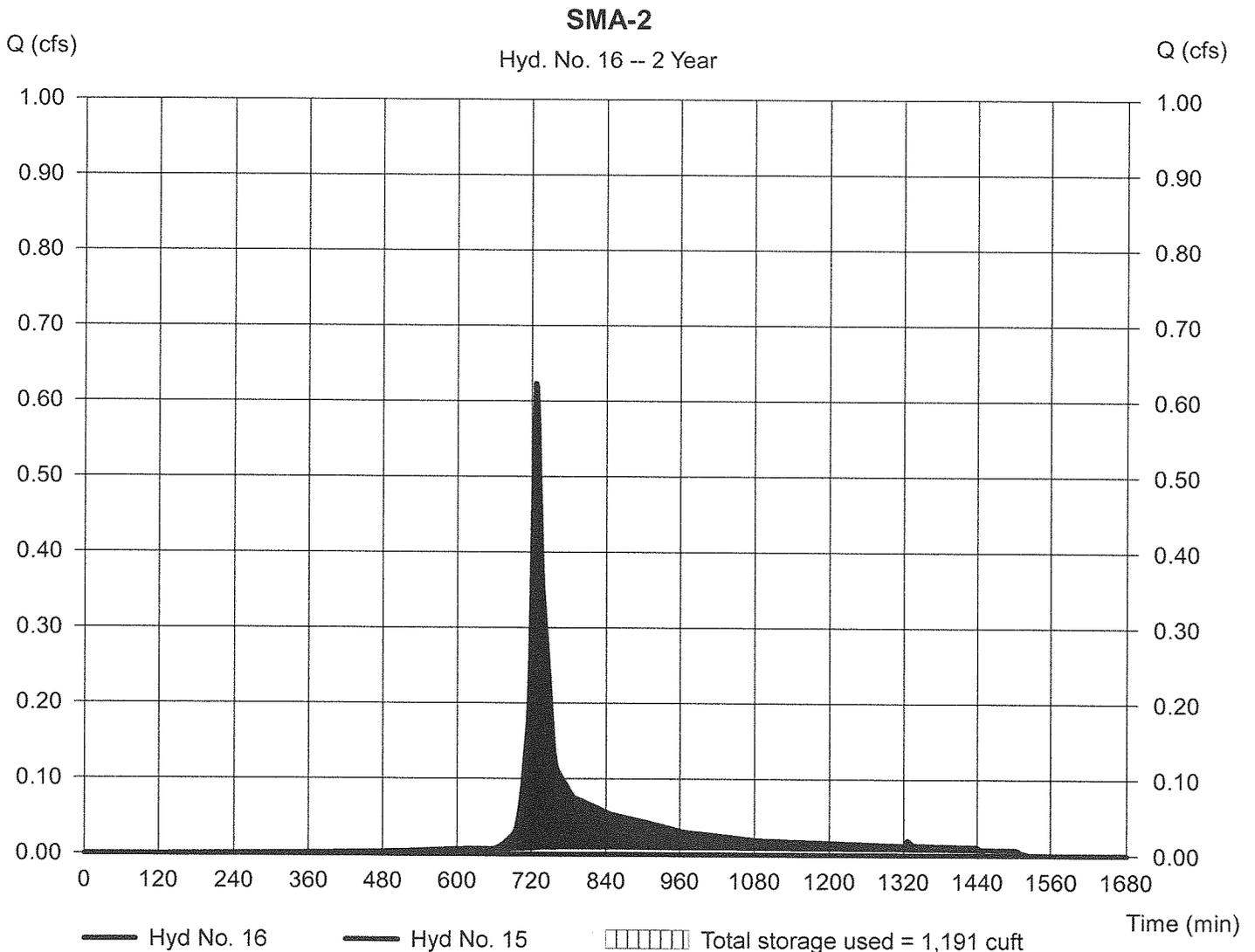
Hyd. No. 16

SMA-2

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 2 min
Inflow hyd. No. = 15 - P4-Cul-de-sac
Reservoir name = SMA-2

Peak discharge = 0.000 cfs
Time to peak = 804 min
Hyd. volume = 0 cuft
Max. Elevation = 1.86 ft
Max. Storage = 1,191 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

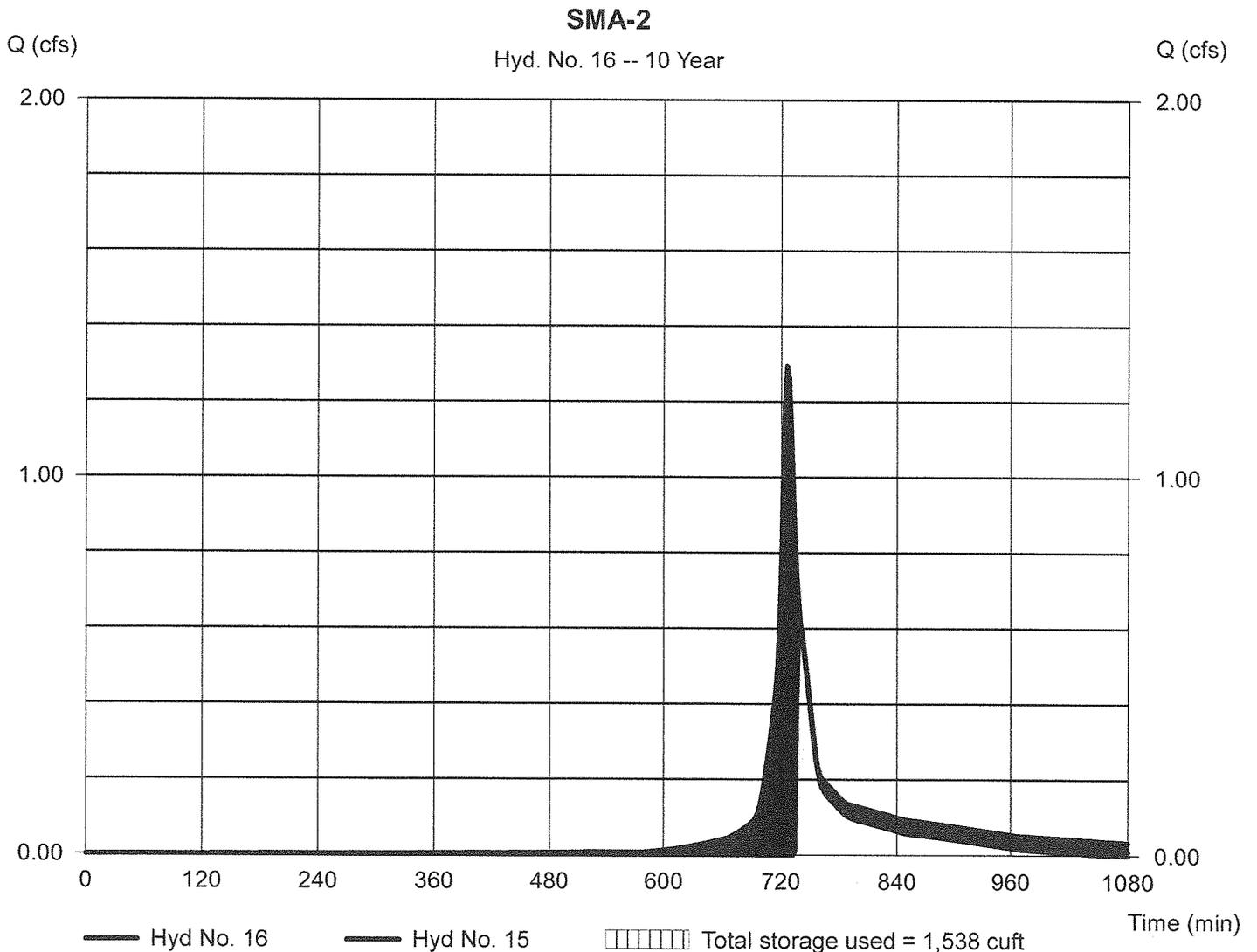
Hyd. No. 16

SMA-2

Hydrograph type = Reservoir
Storm frequency = 10 yrs
Time interval = 2 min
Inflow hyd. No. = 15 - P4-Cul-de-sac
Reservoir name = SMA-2

Peak discharge = 0.609 cfs
Time to peak = 738 min
Hyd. volume = 1,467 cuft
Max. Elevation = 2.38 ft
Max. Storage = 1,538 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

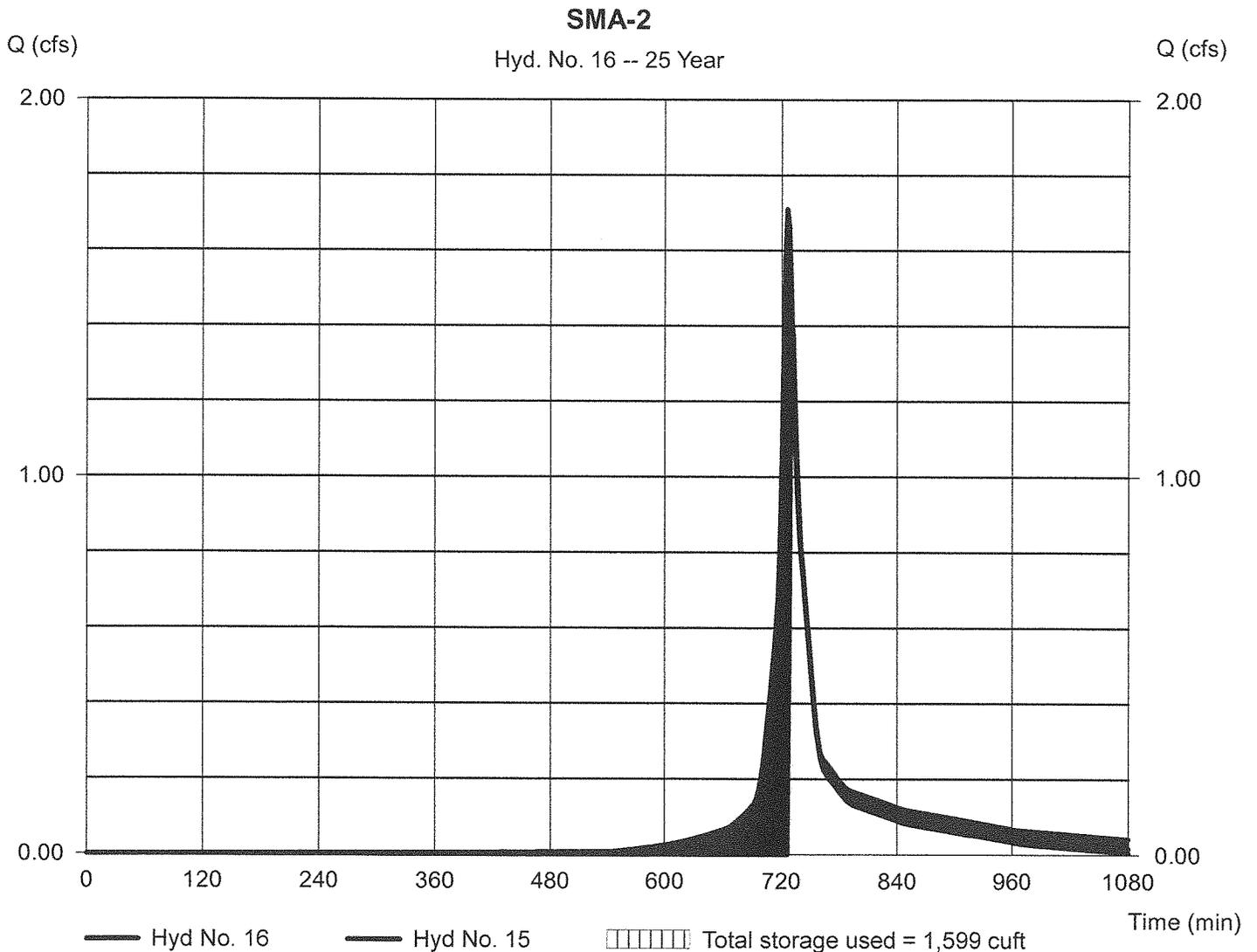
Hyd. No. 16

SMA-2

Hydrograph type = Reservoir
Storm frequency = 25 yrs
Time interval = 2 min
Inflow hyd. No. = 15 - P4-Cul-de-sac
Reservoir name = SMA-2

Peak discharge = 1.427 cfs
Time to peak = 730 min
Hyd. volume = 2,663 cuft
Max. Elevation = 2.48 ft
Max. Storage = 1,599 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

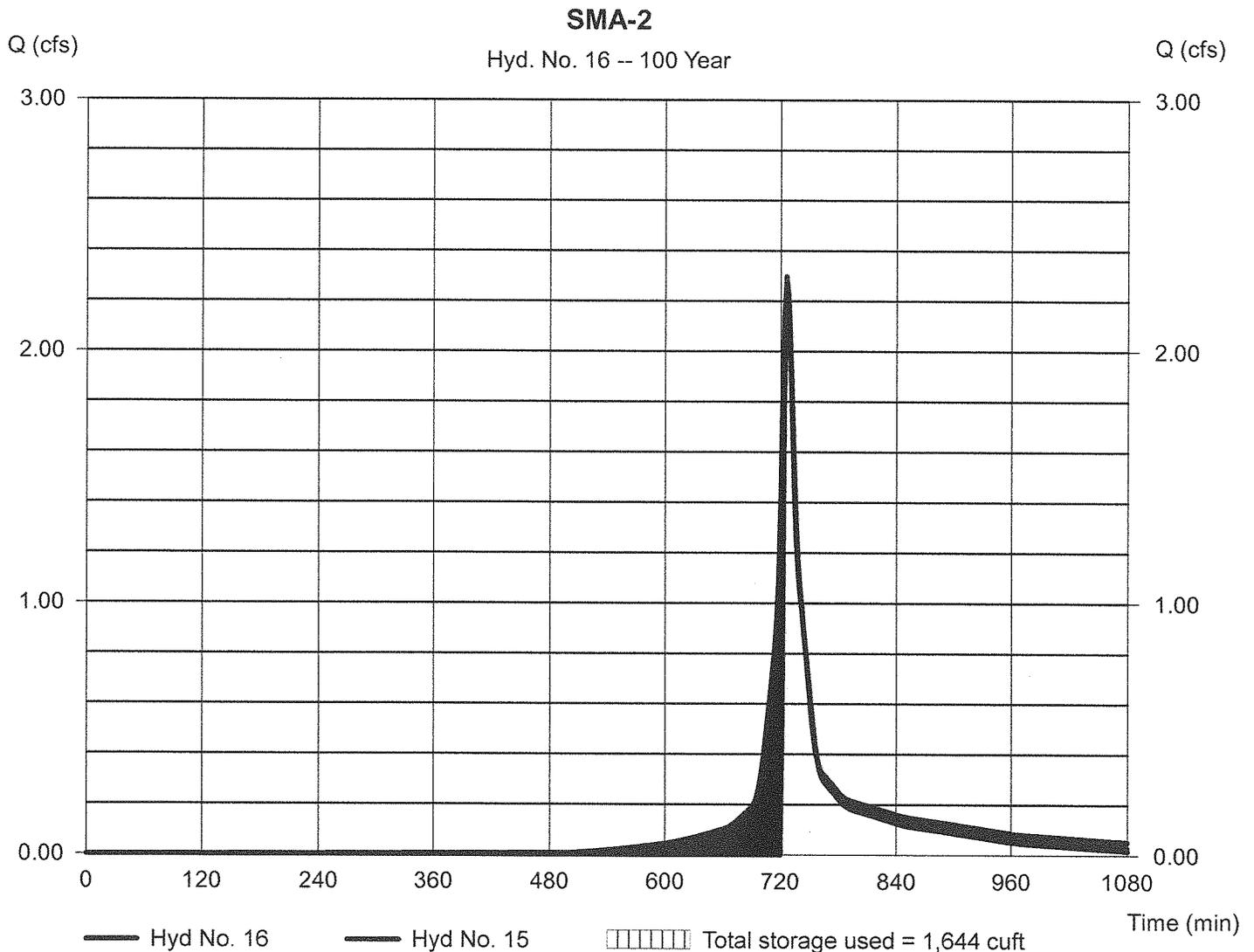
Hyd. No. 16

SMA-2

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 2 min
Inflow hyd. No. = 15 - P4-Cul-de-sac
Reservoir name = SMA-2

Peak discharge = 2.223 cfs
Time to peak = 728 min
Hyd. volume = 4,480 cuft
Max. Elevation = 2.56 ft
Max. Storage = 1,644 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Worksheet 2: Runoff curve number and runoff

SM-4993

Project: 27 Jackson Drive By JTM Date 2/6/13
 Location: Acton, MA Checked _____ Date _____
 Circle one: Present Developed _____ P5 _____

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 Acres | Product of CN x Area |
|--|---|-----------|----------|----------|---------------|-------------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| | Impervious | 98 | | | 0.08 | 5.88 |
| Narragansett 416B B | Open(Good Condition) | 61 | | | 0.46 | 28.06 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Totals = | | | | | 0.52 | 33.94 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{33.94}{0.52} = 65.27$; Use CN = 65.3

2. Runoff

| | Storm #1 | Storm #2 | Storm #3 |
|---|----------|----------|----------|
| Frequency..... yr | 2 | 10 | 100 |
| Rainfall, P (24-hour)..... in | 3.1 | 4.3 | 6.4 |
| Runoff, Q..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | 0.56 | 1.35 | 2.67 |

Runoff, Q..... cf 1063 2545 5043
 (210-VI-TR-55, Second Ed., June 1986)

Project: 27 Jackson Drive

By JTM

Date 2/6/2013

Location: Acton, MA

Checked _____

Date _____

Circle one:

| | |
|---------|-----------|
| Present | Developed |
| Tc | Tt |

 through subarea

P5

Sheet flow (Applicable to Tc only)

1. Surface Description (table 3-1)

2. Mannings roughness coeff., n (table 3-1)

3. Flow length, L (total L <= 300 ft)

4. Two-yr 24-hr rainfall, P2

5. Land Slope, s

6. $Tt = 0.007 (nL)^{0.8} / (P2^{0.5} s^{0.4})$

Compute Tt hr

| | | | | |
|------------|------|--|--|------|
| Segment ID | A-B | | | |
| | Open | | | |
| | 0.24 | | | |
| | 50 | | | |
| | 3.1 | | | |
| | 0.02 | | | |
| | 0.14 | | | 0.14 |

Shallow concentrated Flow

7. Surface Description (paved or unpaved)

8. Flow Length, L

9. Watercourse slope, s

10. Average Velocity, V (figure 3-1)

11. $Tt = L / 3600V$

Compute Tt hr

| | | | | |
|------------|---------|--|--|------|
| Segment ID | B-C | | | |
| | unpaved | | | |
| | 92 | | | |
| | 0.07 | | | |
| | 4.27 | | | |
| | 0.01 | | | 0.01 |

Channel flow

12. Cross sectional flow area, a

13. Wetted perimeter, pw

14. Hydraulic radius, $r=a/wp$

15. Channel Slope, s

16. Manning's roughness coeff., n

17. $V = 1.49 r^{2/3} s^{1/2} / n$

18. Flow length, L

19. $Tt = L / 3600V$

Compute r

Compute V

Compute Tt hr

| | | | | |
|------------|--|--|--|---|
| Segment ID | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | 0 |

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

hr 0.14
min 8.7

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

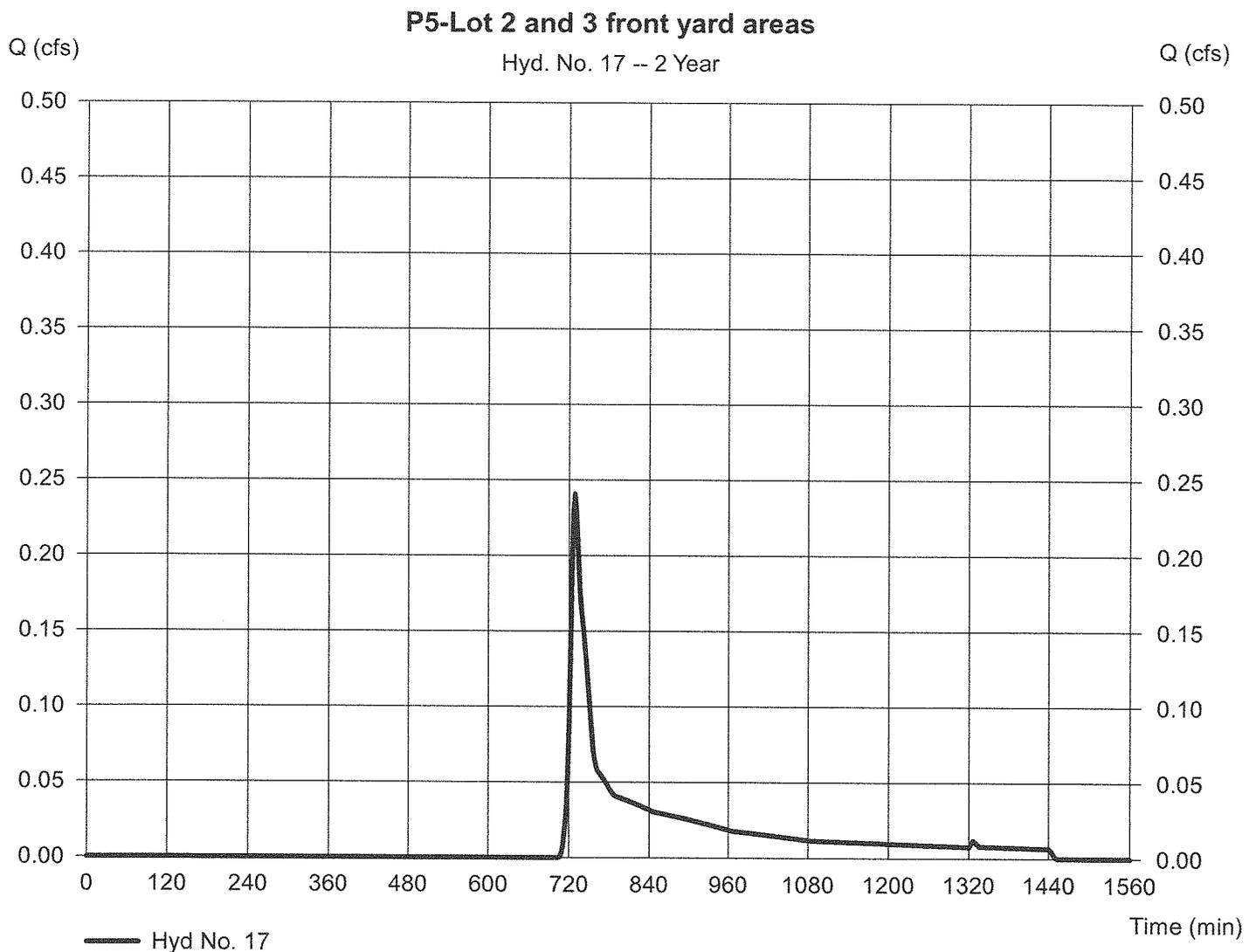
Wednesday, Feb 20, 2013

Hyd. No. 17

P5-Lot 2 and 3 front yard areas

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.520 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.241 cfs
Time to peak = 728 min
Hyd. volume = 1,066 cuft
Curve number = 65.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.70 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

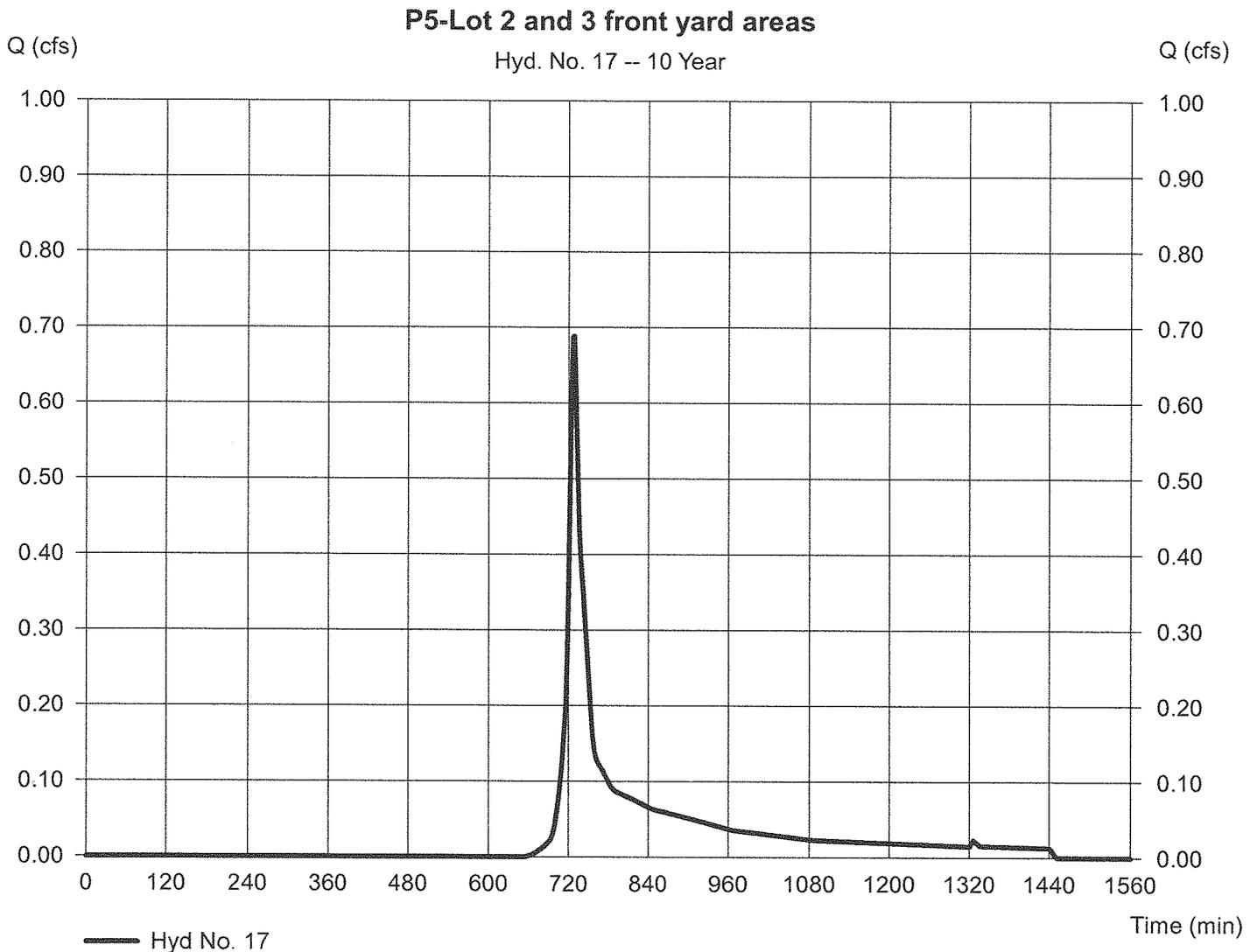
Wednesday, Feb 20, 2013

Hyd. No. 17

P5-Lot 2 and 3 front yard areas

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.520 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.689 cfs
Time to peak = 728 min
Hyd. volume = 2,548 cuft
Curve number = 65.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.70 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

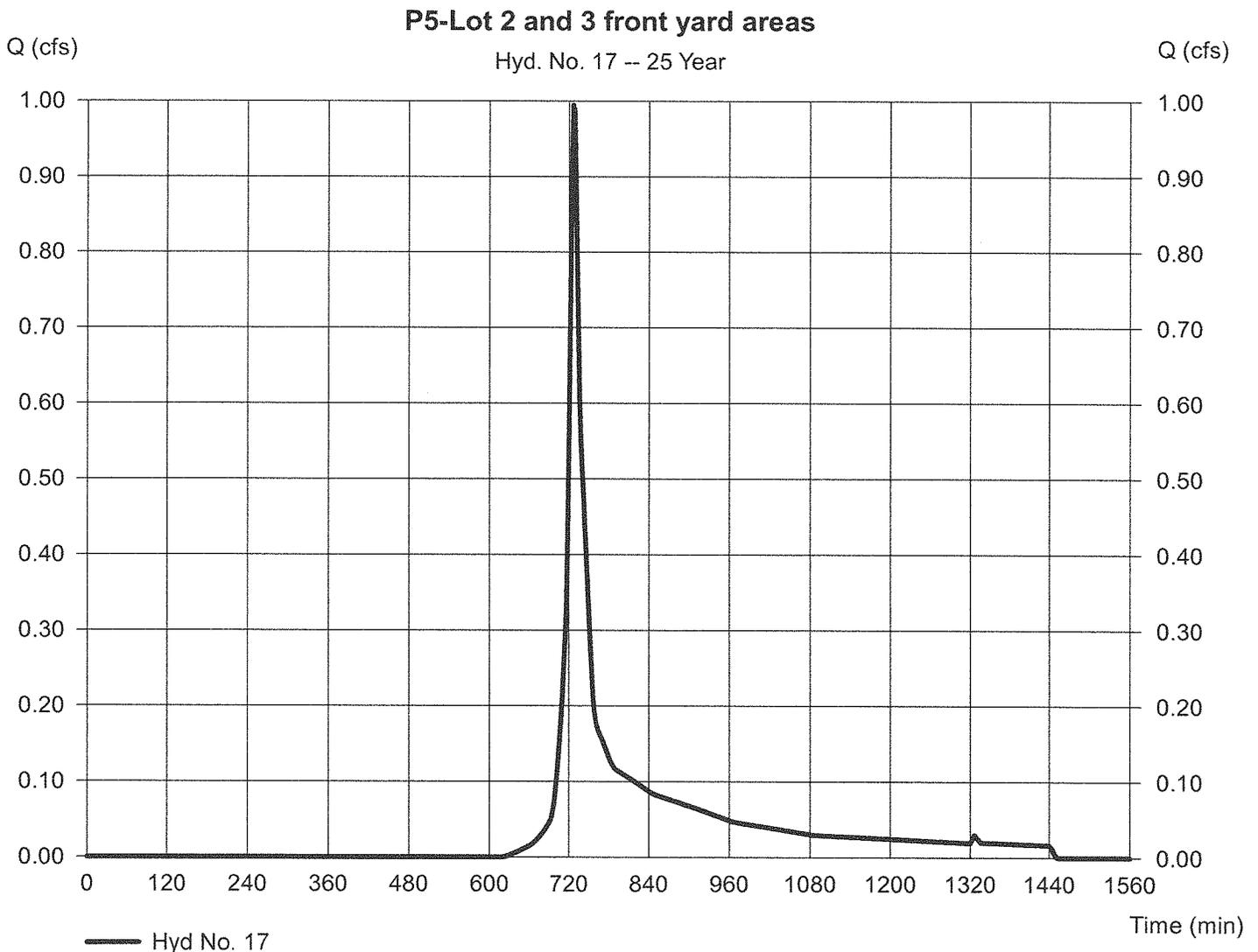
Wednesday, Feb 20, 2013

Hyd. No. 17

P5-Lot 2 and 3 front yard areas

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 0.520 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 0.995 cfs
Time to peak = 726 min
Hyd. volume = 3,548 cuft
Curve number = 65.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.70 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

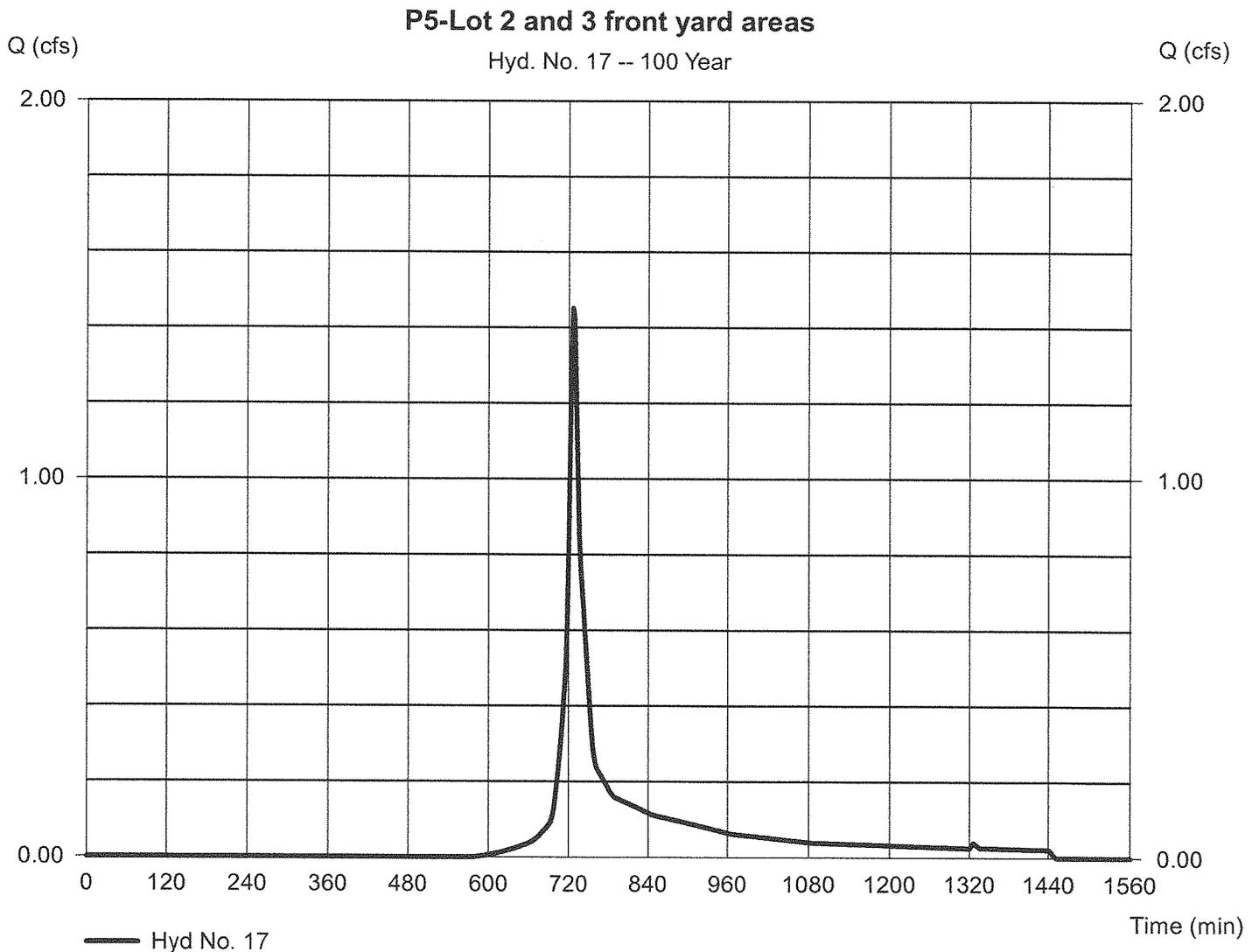
Wednesday, Feb 20, 2013

Hyd. No. 17

P5-Lot 2 and 3 front yard areas

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.520 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 1.451 cfs
Time to peak = 726 min
Hyd. volume = 5,048 cuft
Curve number = 65.3
Hydraulic length = 0 ft
Time of conc. (Tc) = 8.70 min
Distribution = Type III
Shape factor = 484



Worksheet 2: Runoff curve number and runoff

SM-4993

Project: 27 Jackson Drive By JTM Date 2/6/13
 Location: Acton, MA Checked _____ Date _____
 Circle one: Present **Developed** _____ P6 _____

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 Acres | Product of CN x Area |
|--|---|-----------|----------|----------|---------------|----------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| | Impervious | 98 | | | 0.04 | 4.21 |
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| | | | | | | |
| Totals = | | | | | 0.04 | 4.21 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{4.21}{0.04} = 98.00$; Use CN = **98.0**

2. Runoff

| | Storm #1 | Storm #2 | Storm #3 |
|--|----------|----------|----------|
| Frequency..... yr | 2 | 10 | 100 |
| Rainfall, P (24-hour)..... in | 3.1 | 4.5 | 6.4 |
| Runoff, Q..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | 2.87 | 4.26 | 6.16 |
| Runoff, Q..... cf D-2 | 448 | 666 | 962 |

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

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

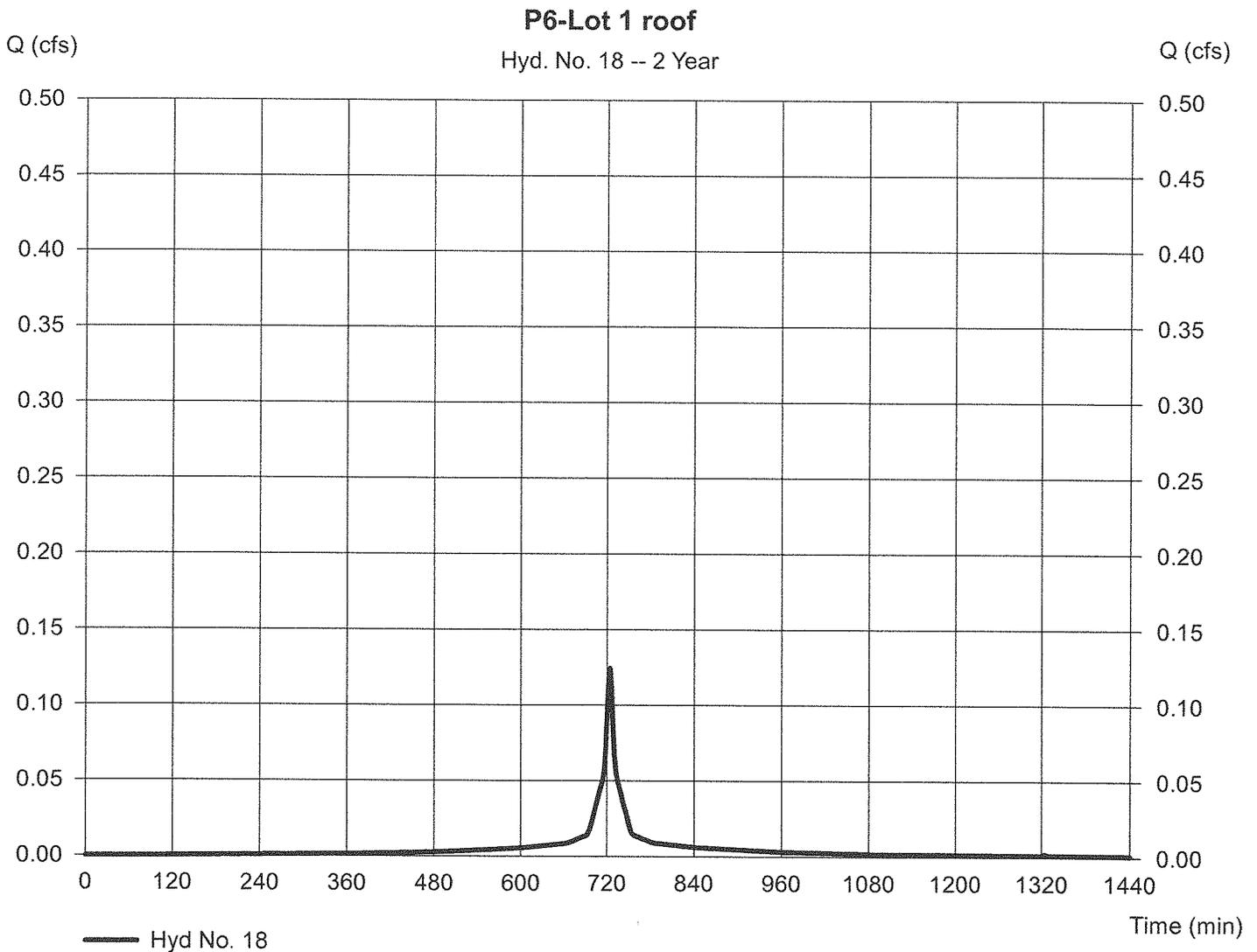
Wednesday, Feb 20, 2013

Hyd. No. 18

P6-Lot 1 roof

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.043 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.125 cfs
Time to peak = 724 min
Hyd. volume = 420 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

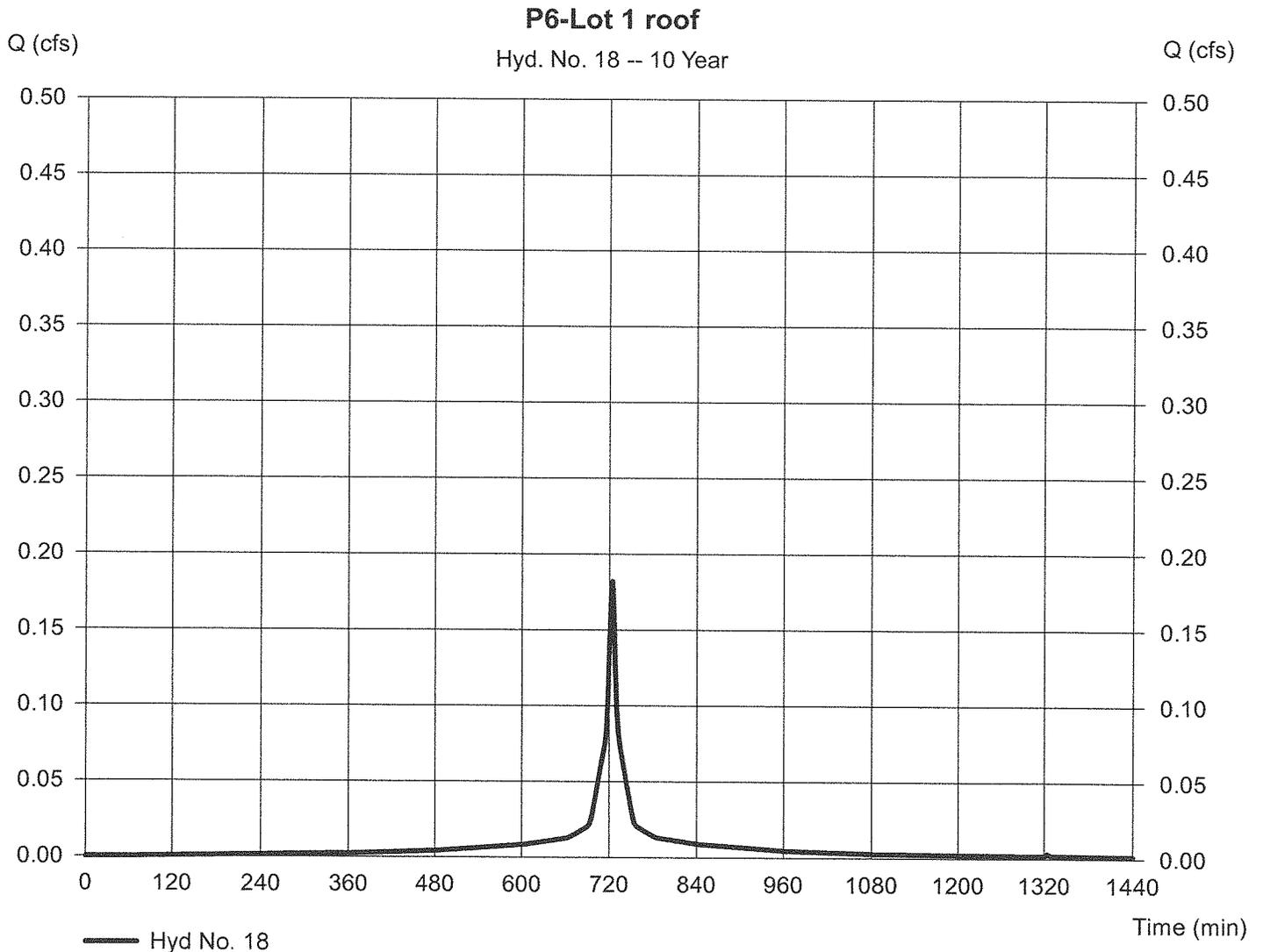
Wednesday, Feb 20, 2013

Hyd. No. 18

P6-Lot 1 roof

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.043 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.182 cfs
Time to peak = 724 min
Hyd. volume = 624 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

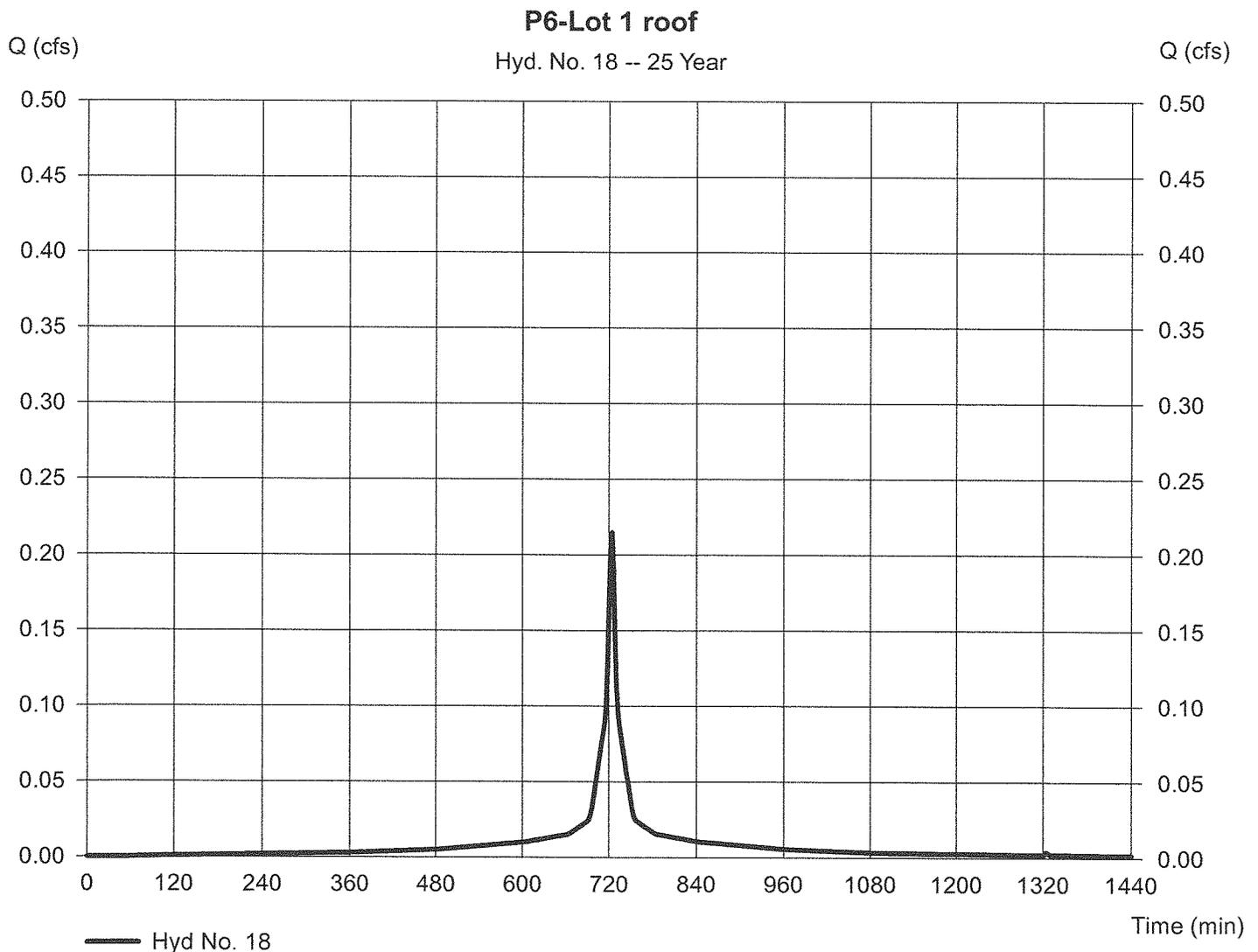
Wednesday, Feb 20, 2013

Hyd. No. 18

P6-Lot 1 roof

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 0.043 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 0.215 cfs
Time to peak = 724 min
Hyd. volume = 741 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

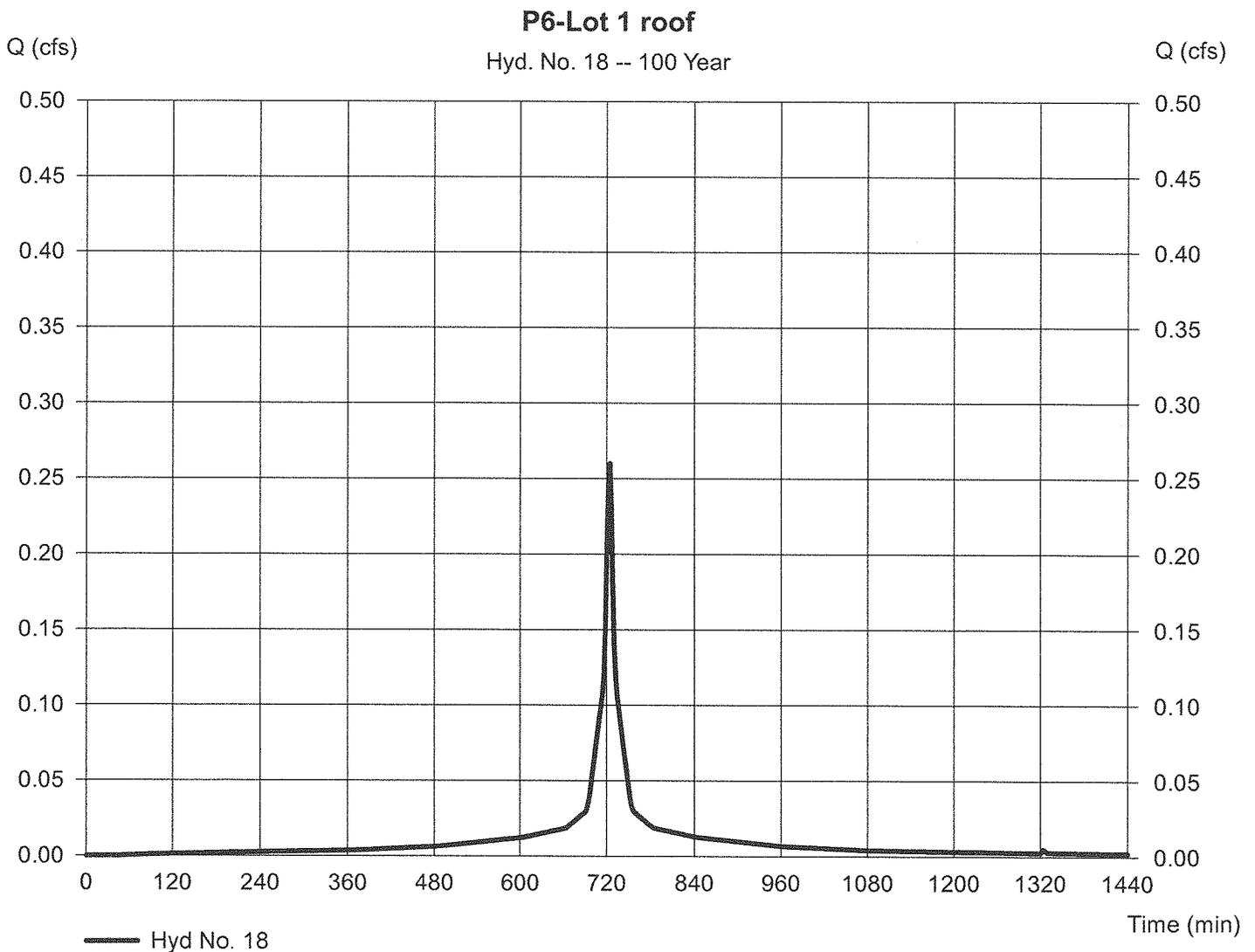
Wednesday, Feb 20, 2013

Hyd. No. 18

P6-Lot 1 roof

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.043 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 0.260 cfs
Time to peak = 724 min
Hyd. volume = 902 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

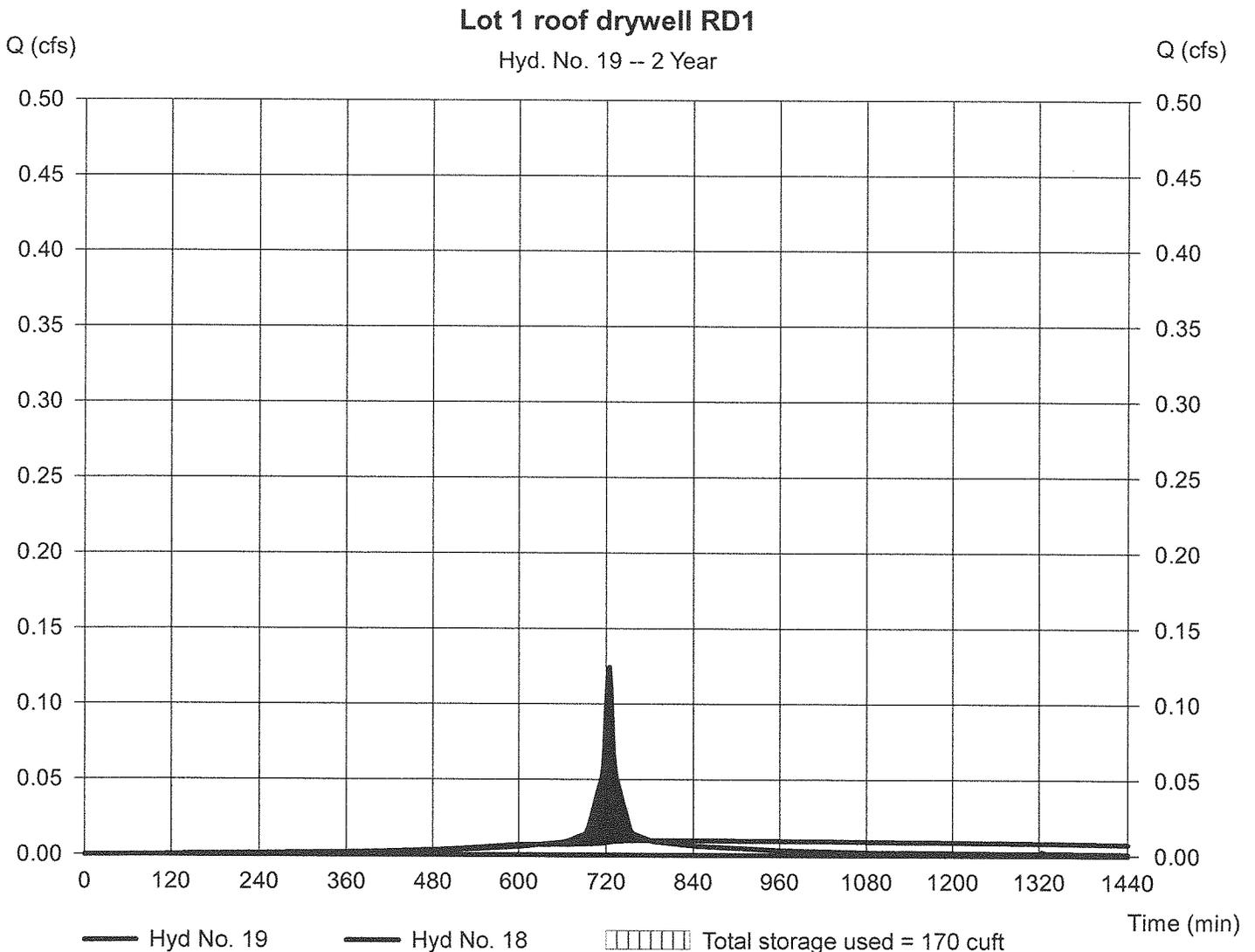
Wednesday, Feb 20, 2013

Hyd. No. 19

Lot 1 roof drywell RD1

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 624 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 18 - P6-Lot 1 roof | Max. Elevation | = 0.98 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 170 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

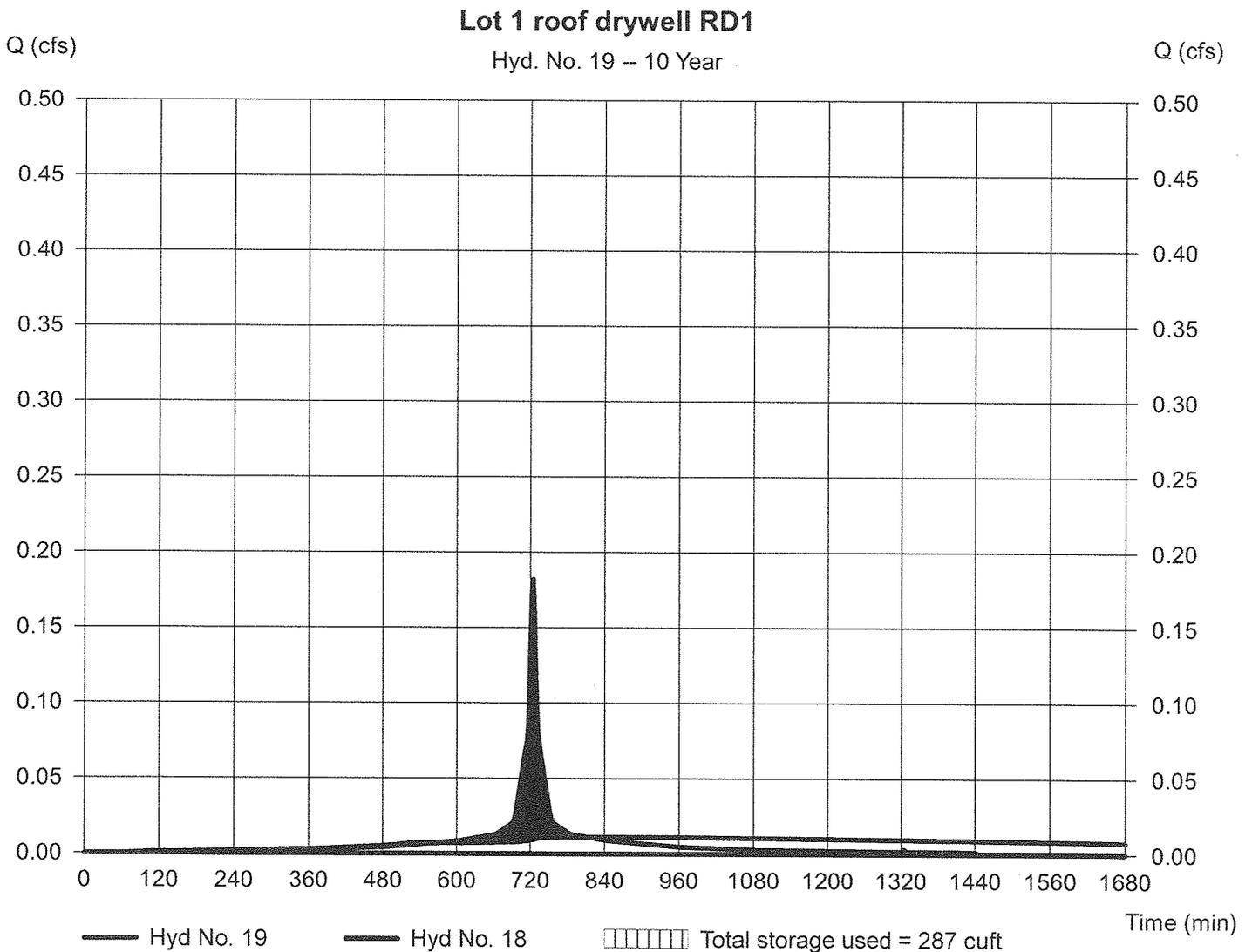
Wednesday, Feb 20, 2013

Hyd. No. 19

Lot 1 roof drywell RD1

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 550 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 18 - P6-Lot 1 roof | Max. Elevation | = 1.48 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 287 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

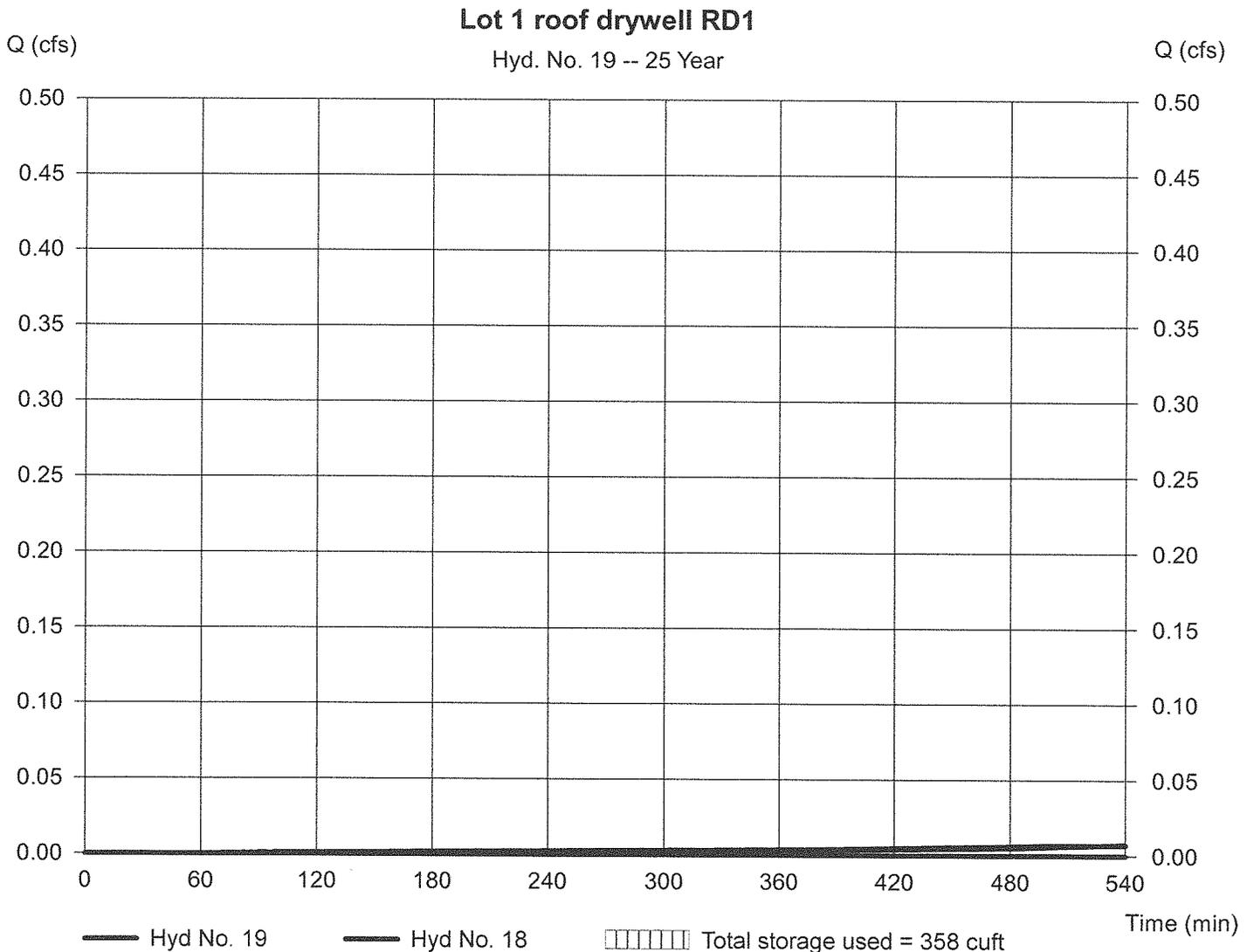
Wednesday, Feb 20, 2013

Hyd. No. 19

Lot 1 roof drywell RD1

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 25 yrs | Time to peak | = 528 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 18 - P6-Lot 1 roof | Max. Elevation | = 1.80 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 358 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

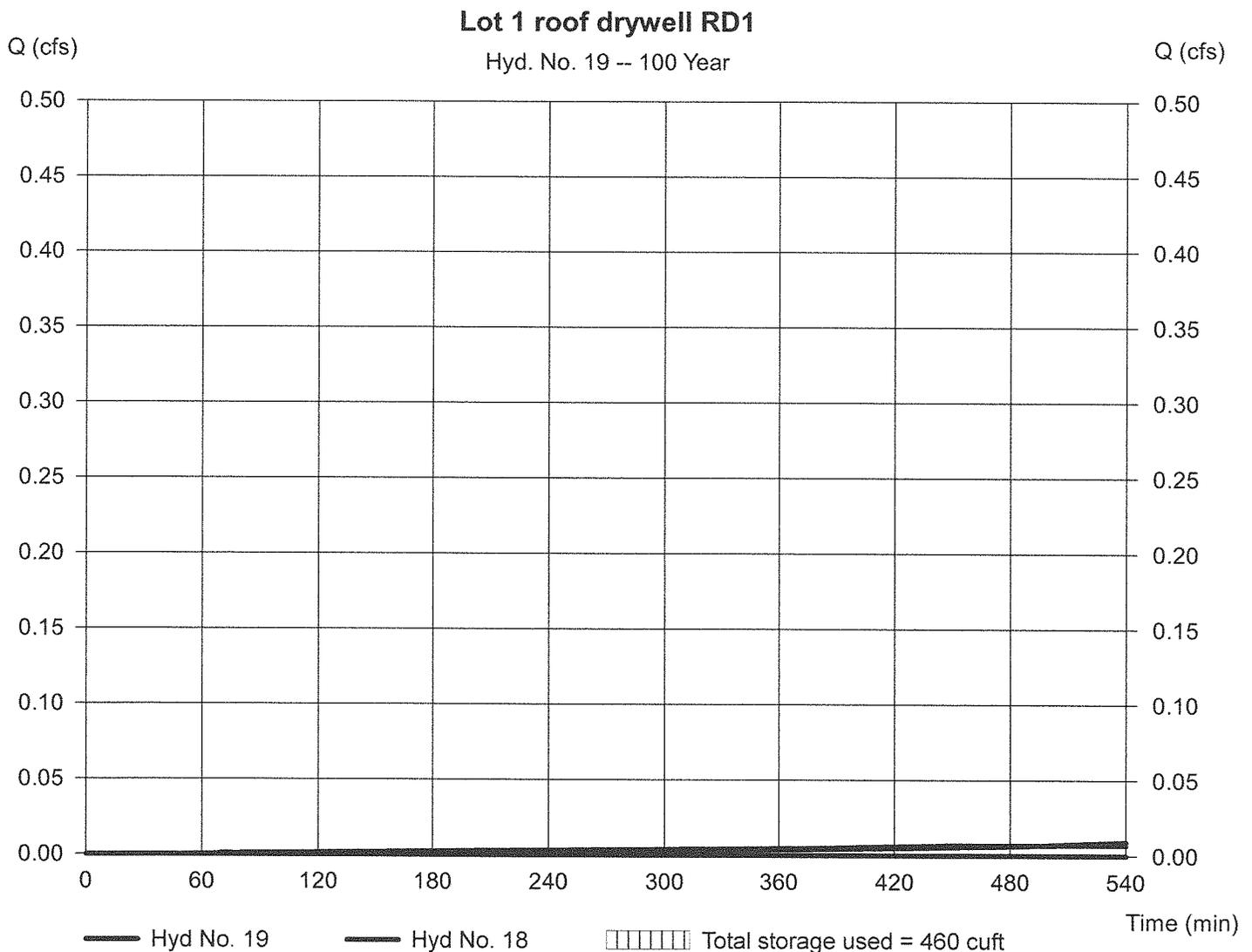
Wednesday, Feb 20, 2013

Hyd. No. 19

Lot 1 roof drywell RD1

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 494 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 18 - P6-Lot 1 roof | Max. Elevation | = 2.29 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 460 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Worksheet 2: Runoff curve number and runoff

SM-4993

Project: 27 Jackson Drive By JTM Date 2/6/13
 Location: Acton, MA Checked _____ Date _____
 Circle one: Present **Developed** P7

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 Acres | Product of CN x Area |
|--|---|-----------|----------|----------|---------------|-------------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| | Impervious | 98 | | | 0.06 | 5.39 |
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| | | | | | | |
| Totals = | | | | | 0.06 | 5.39 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{5.39}{0.06} = 98.00$; Use CN = **98.0**

2. Runoff

| | Storm #1 | Storm #2 | Storm #3 |
|---|----------|----------|----------|
| Frequency..... yr | 2 | 10 | 100 |
| Rainfall, P (24-hour)..... in | 3.1 | 4.6 | 6.4 |
| Runoff, Q..... in (Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.) | 2.87 | 4.26 | 6.16 |

Runoff, Q..... cf **573 851 1230**
 D-2 (210-VI-TR-55, Second Ed., June 1986)

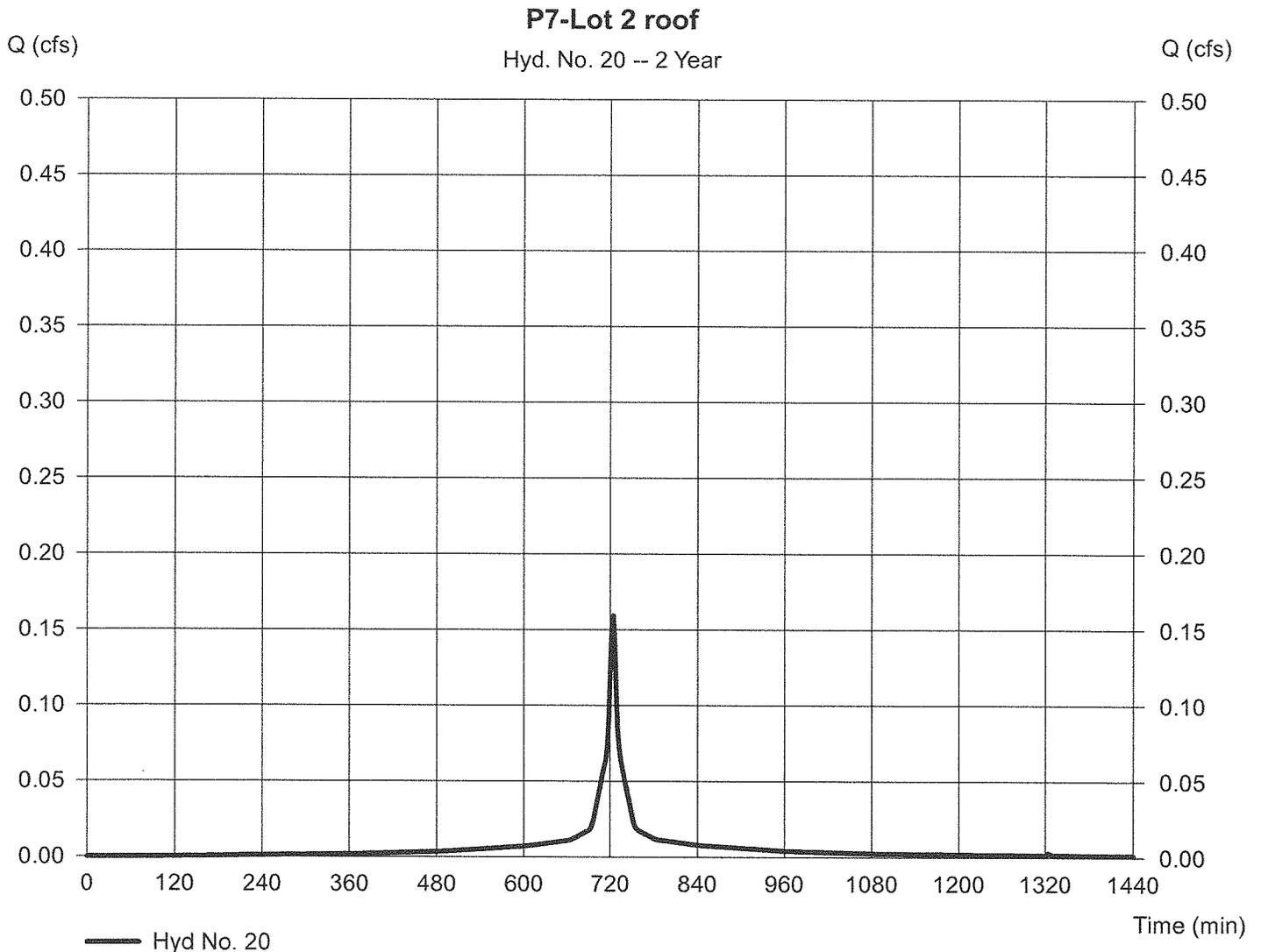
Hydrograph Report

Hyd. No. 20

P7-Lot 2 roof

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.159 cfs
Time to peak = 724 min
Hyd. volume = 537 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

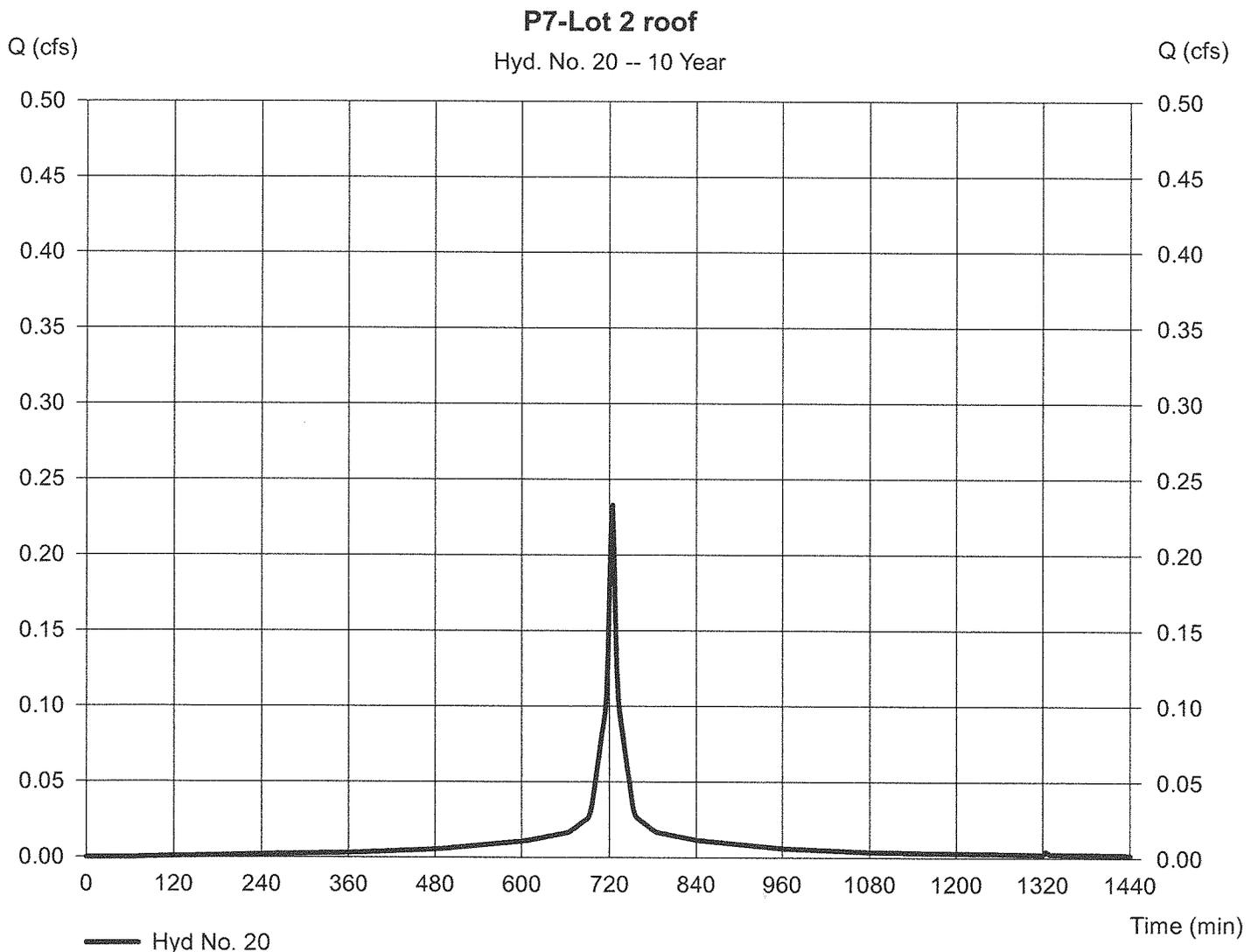
Wednesday, Feb 20, 2013

Hyd. No. 20

P7-Lot 2 roof

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.233 cfs
Time to peak = 724 min
Hyd. volume = 798 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

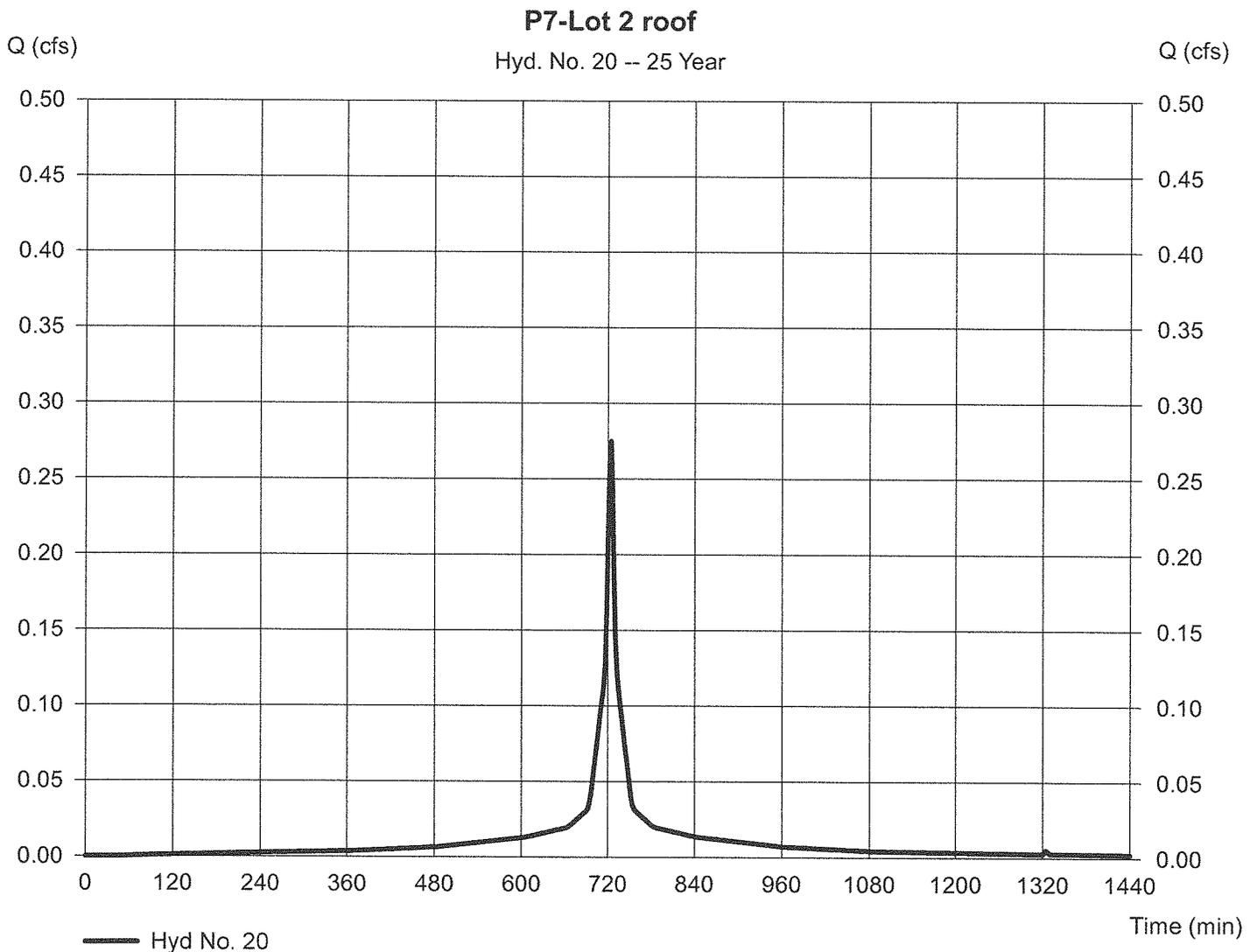
Wednesday, Feb 20, 2013

Hyd. No. 20

P7-Lot 2 roof

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 0.275 cfs
Time to peak = 724 min
Hyd. volume = 948 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

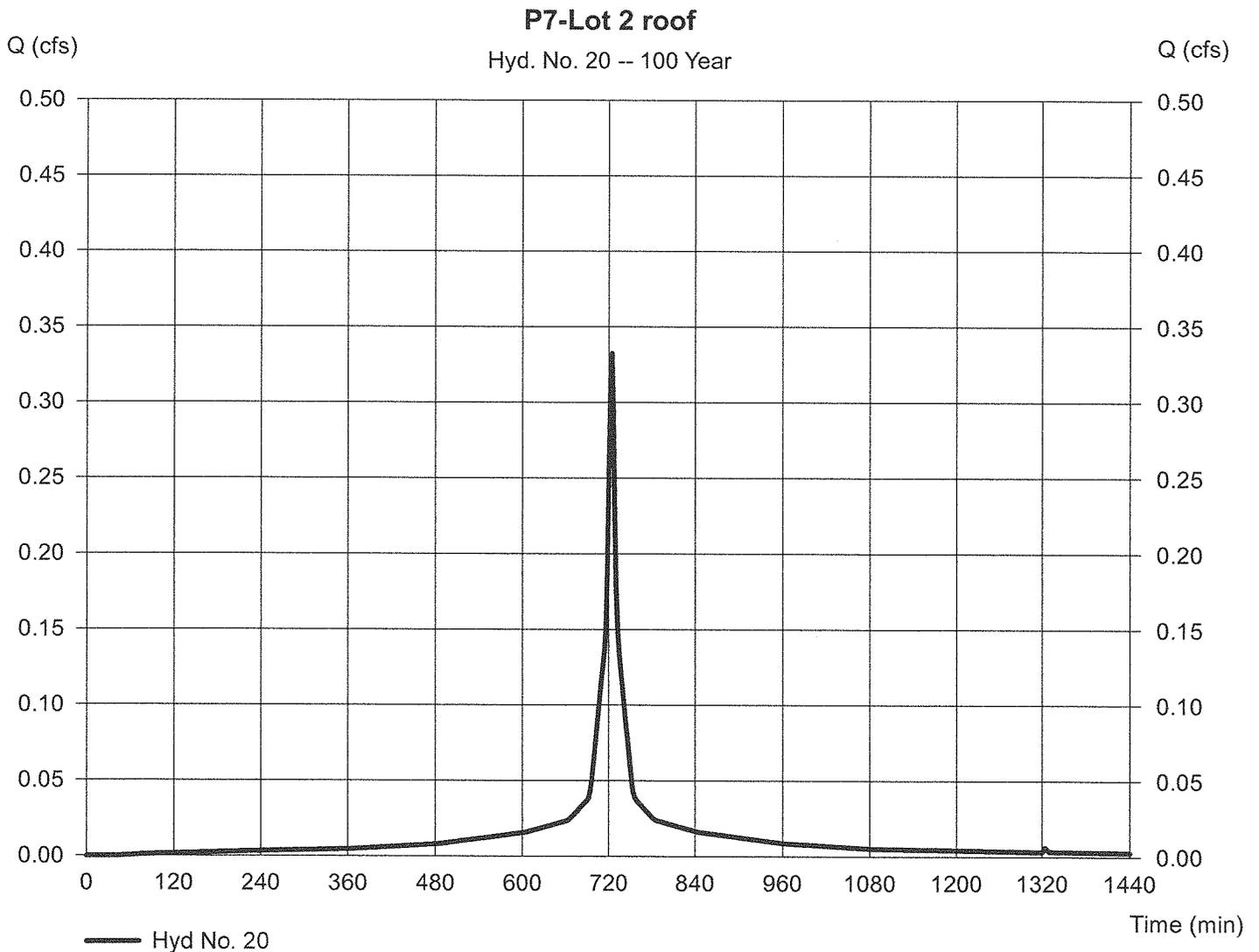
Wednesday, Feb 20, 2013

Hyd. No. 20

P7-Lot 2 roof

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 0.333 cfs
Time to peak = 724 min
Hyd. volume = 1,153 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

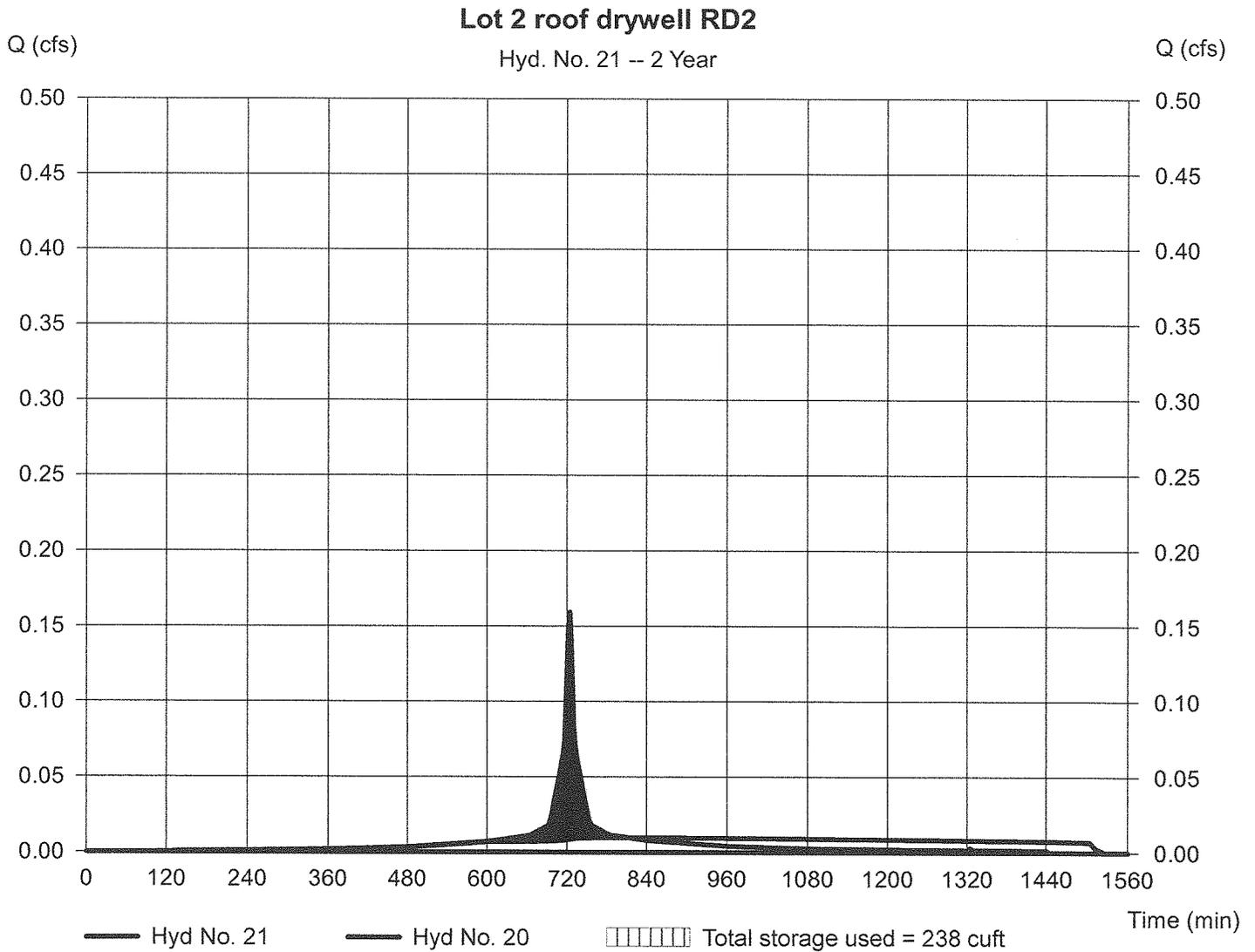
Hyd. No. 21

Lot 2 roof drywell RD2

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 2 min
Inflow hyd. No. = 20 - P7-Lot 2 roof
Reservoir name = Lots 1,2,3,4 drywells Rd 1,2,3,4

Peak discharge = 0.000 cfs
Time to peak = 580 min
Hyd. volume = 0 cuft
Max. Elevation = 1.27 ft
Max. Storage = 238 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

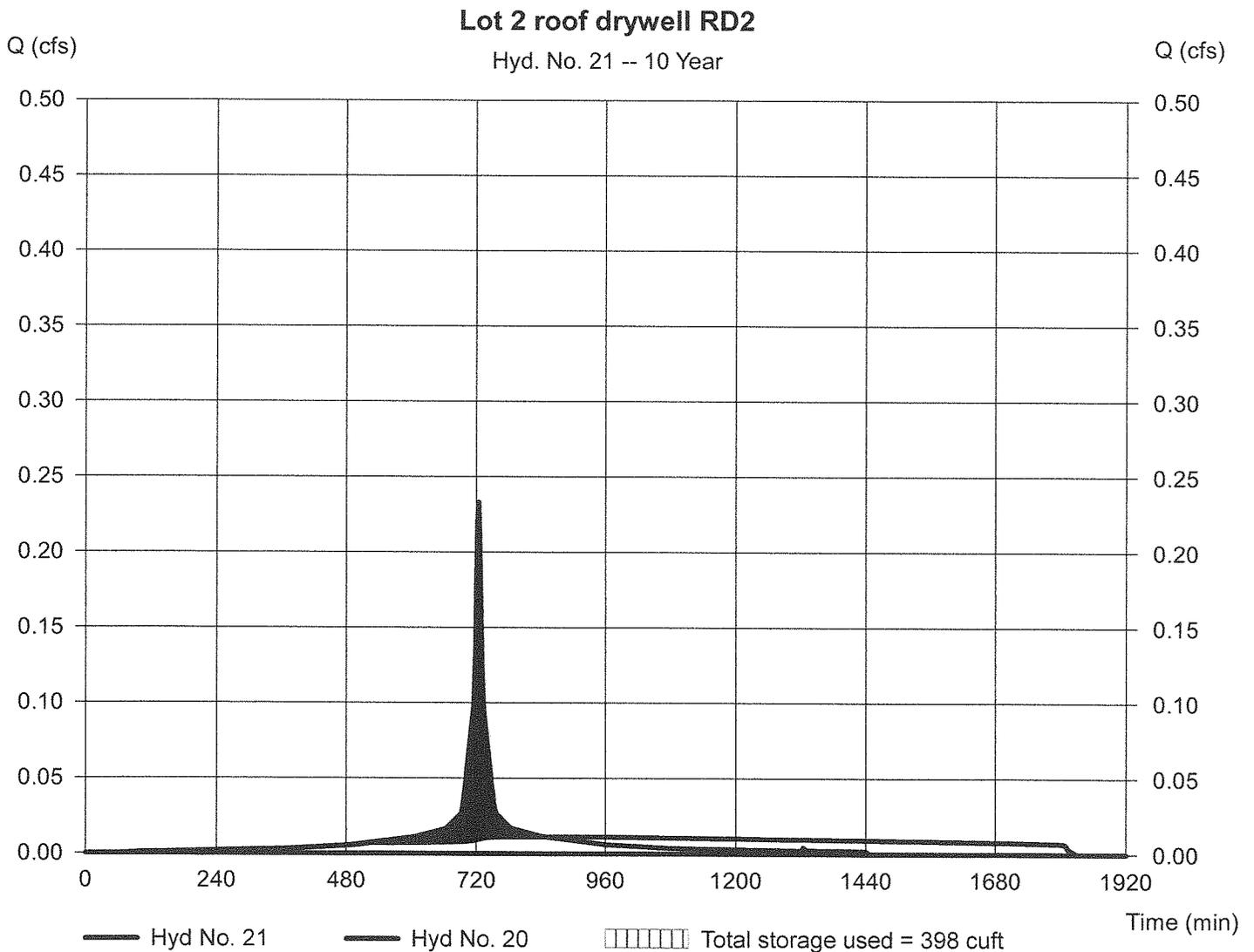
Wednesday, Feb 20, 2013

Hyd. No. 21

Lot 2 roof drywell RD2

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 520 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 20 - P7-Lot 2 roof | Max. Elevation | = 1.99 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 398 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

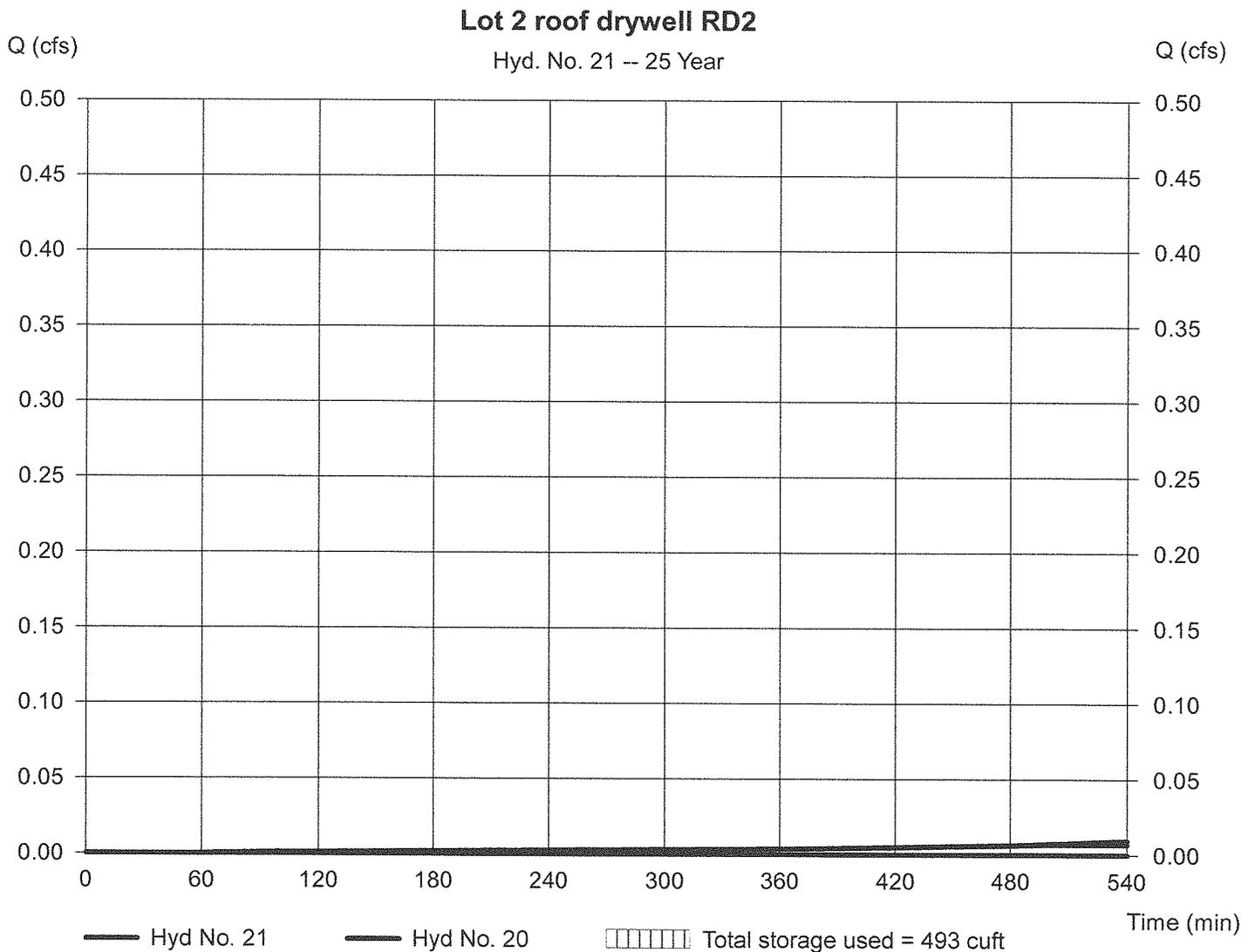
Wednesday, Feb 20, 2013

Hyd. No. 21

Lot 2 roof drywell RD2

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 25 yrs | Time to peak | = 480 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 20 - P7-Lot 2 roof | Max. Elevation | = 2.46 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 493 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

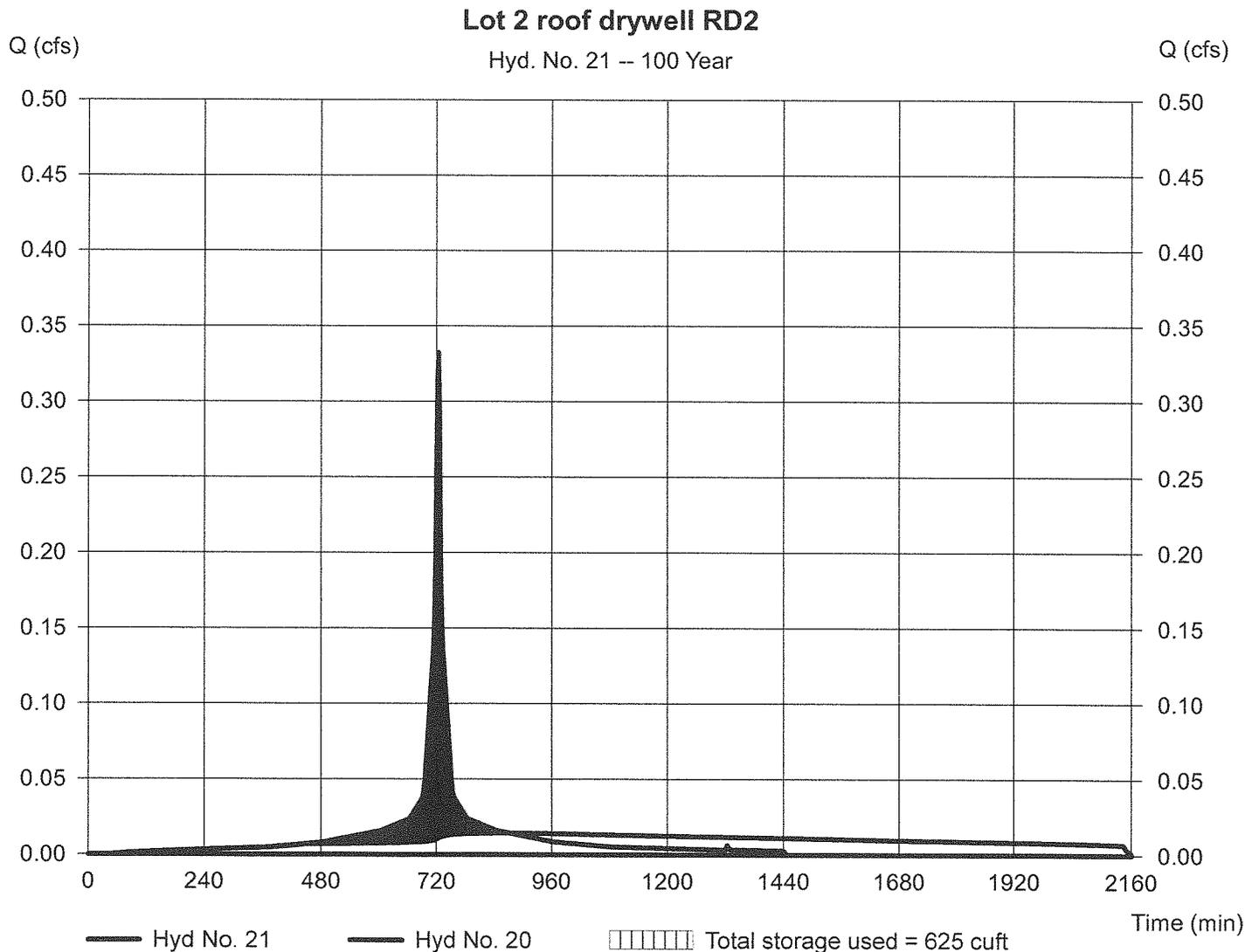
Wednesday, Feb 20, 2013

Hyd. No. 21

Lot 2 roof drywell RD2

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 430 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 20 - P7-Lot 2 roof | Max. Elevation | = 3.35 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 625 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Worksheet 2: Runoff curve number and runoff

SM-4993

Project: 27 Jackson Drive By JTM Date 2/6/13
 Location: Acton, MA Checked _____ Date _____
 Circle one: Present **Developed** _____ P8 _____

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 Acres | Product of CN x Area |
|--|---|-----------|----------|----------|---------------|----------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| | Impervious | 98 | | | 0.06 | 5.39 |
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| | | | | | | |
| Totals = | | | | | 0.06 | 5.39 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{5.39}{0.06} = 98.00$; Use CN = **98.0**

2. Runoff

| | Storm #1 | Storm #2 | Storm #3 |
|-------------------------------|----------|----------|----------|
| Frequency..... yr | 2 | 10 | 100 |
| Rainfall, P (24-hour)..... in | 3.1 | 4.5 | 6.4 |
| Runoff, Q..... in | 2.87 | 4.26 | 6.16 |

| | | | |
|-------------------|-----|-----|------|
| Runoff, Q..... cf | 573 | 851 | 1230 |
|-------------------|-----|-----|------|

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

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

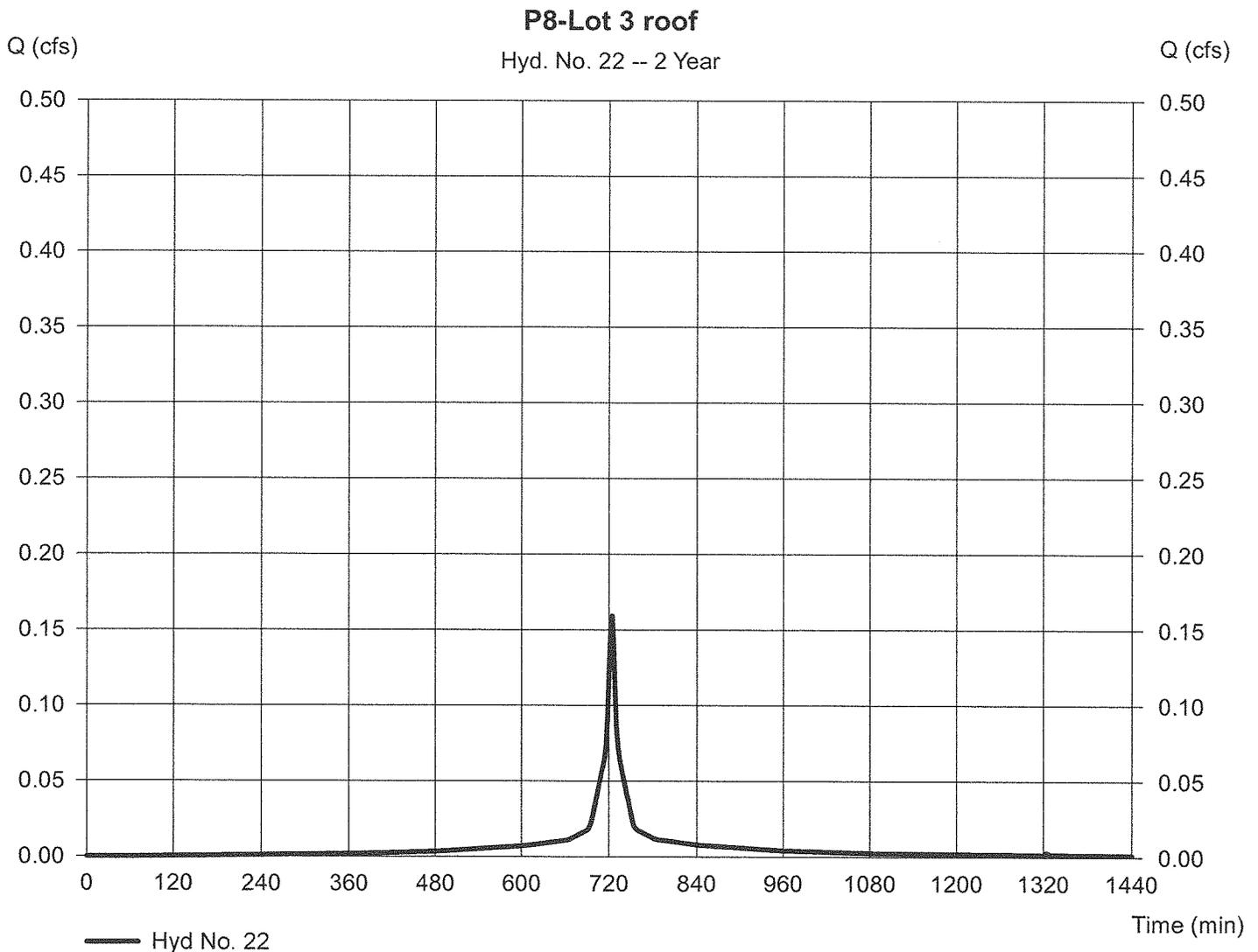
Wednesday, Feb 20, 2013

Hyd. No. 22

P8-Lot 3 roof

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.159 cfs
Time to peak = 724 min
Hyd. volume = 537 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

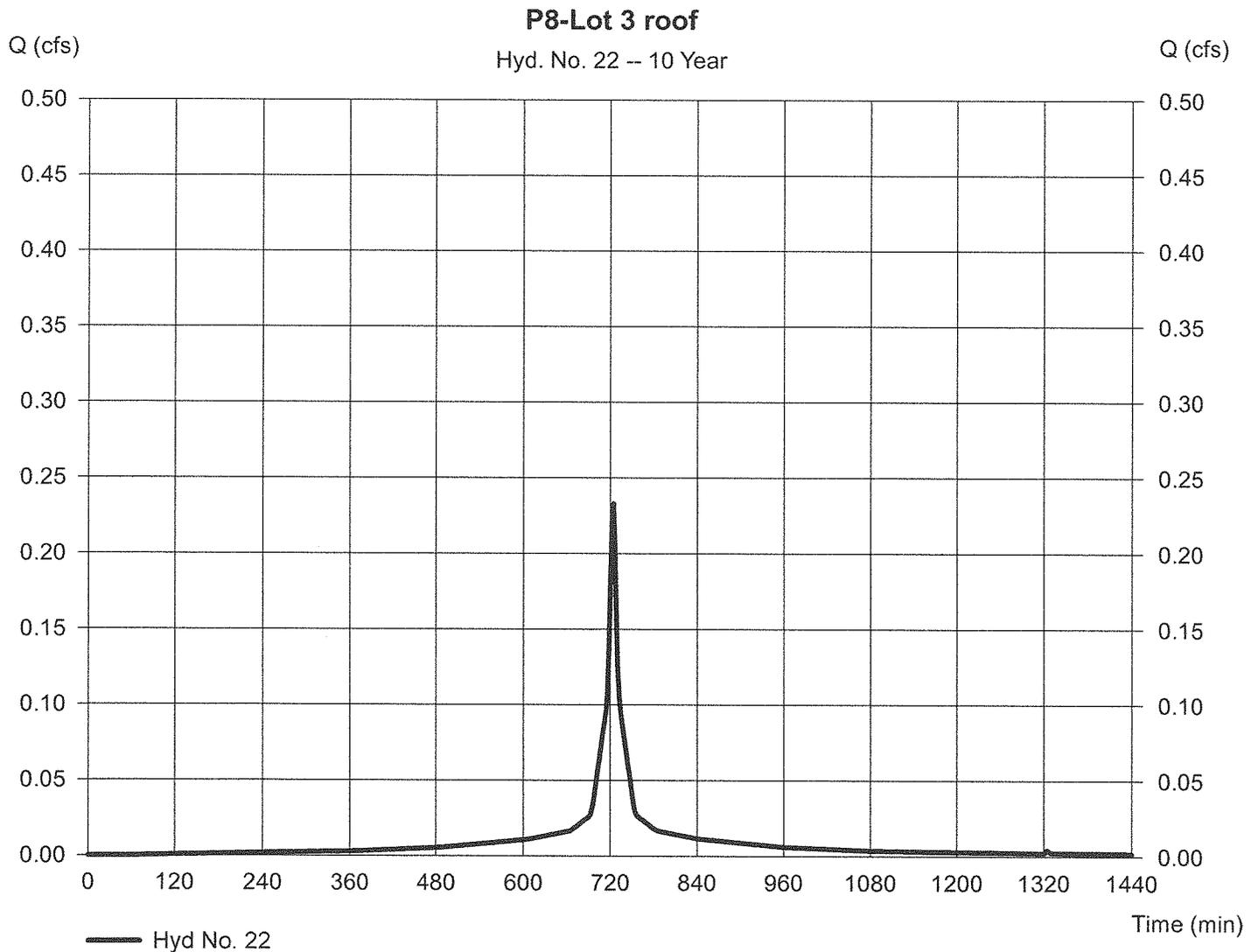
Wednesday, Feb 20, 2013

Hyd. No. 22

P8-Lot 3 roof

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.233 cfs
Time to peak = 724 min
Hyd. volume = 798 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

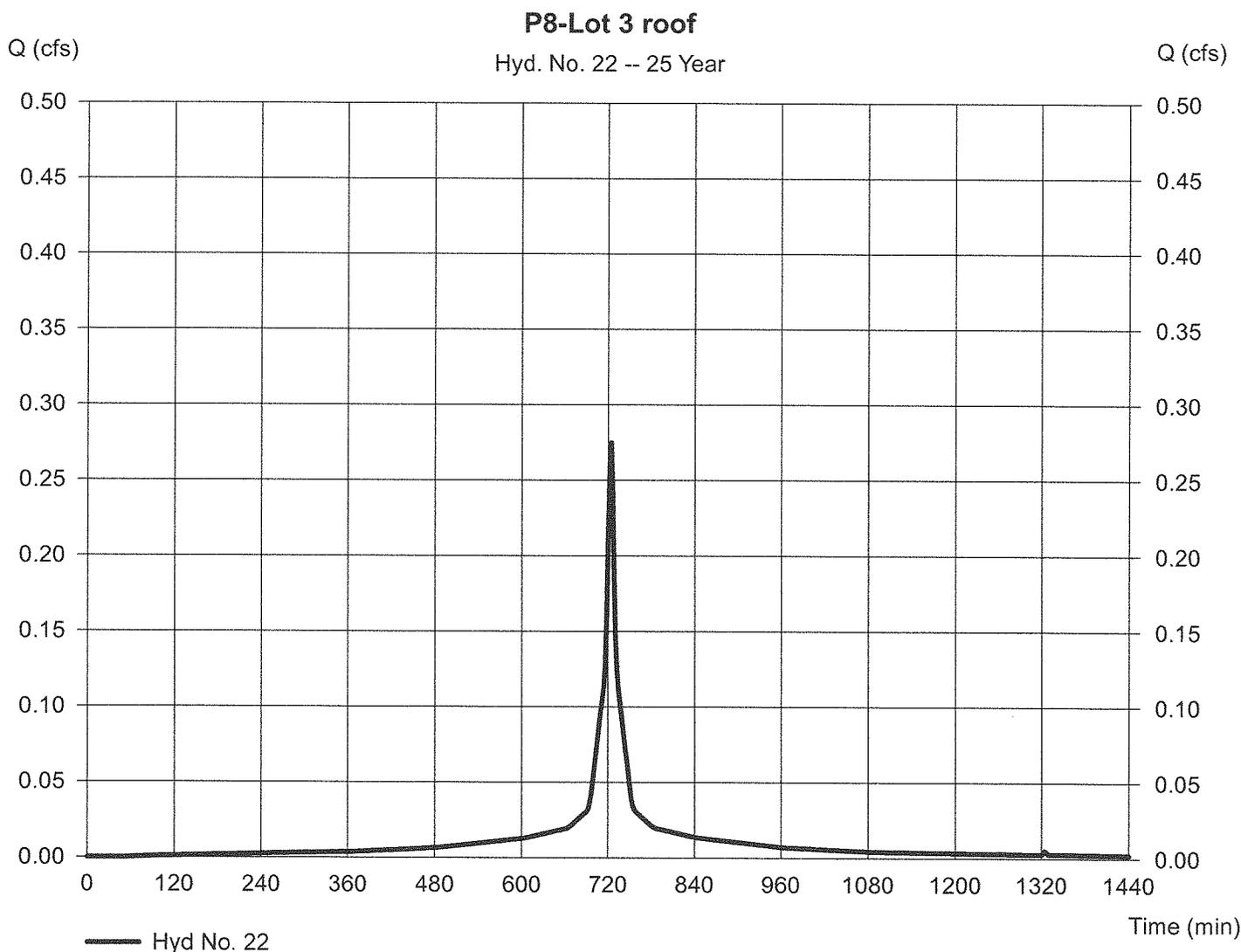
Wednesday, Feb 20, 2013

Hyd. No. 22

P8-Lot 3 roof

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 0.275 cfs
Time to peak = 724 min
Hyd. volume = 948 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

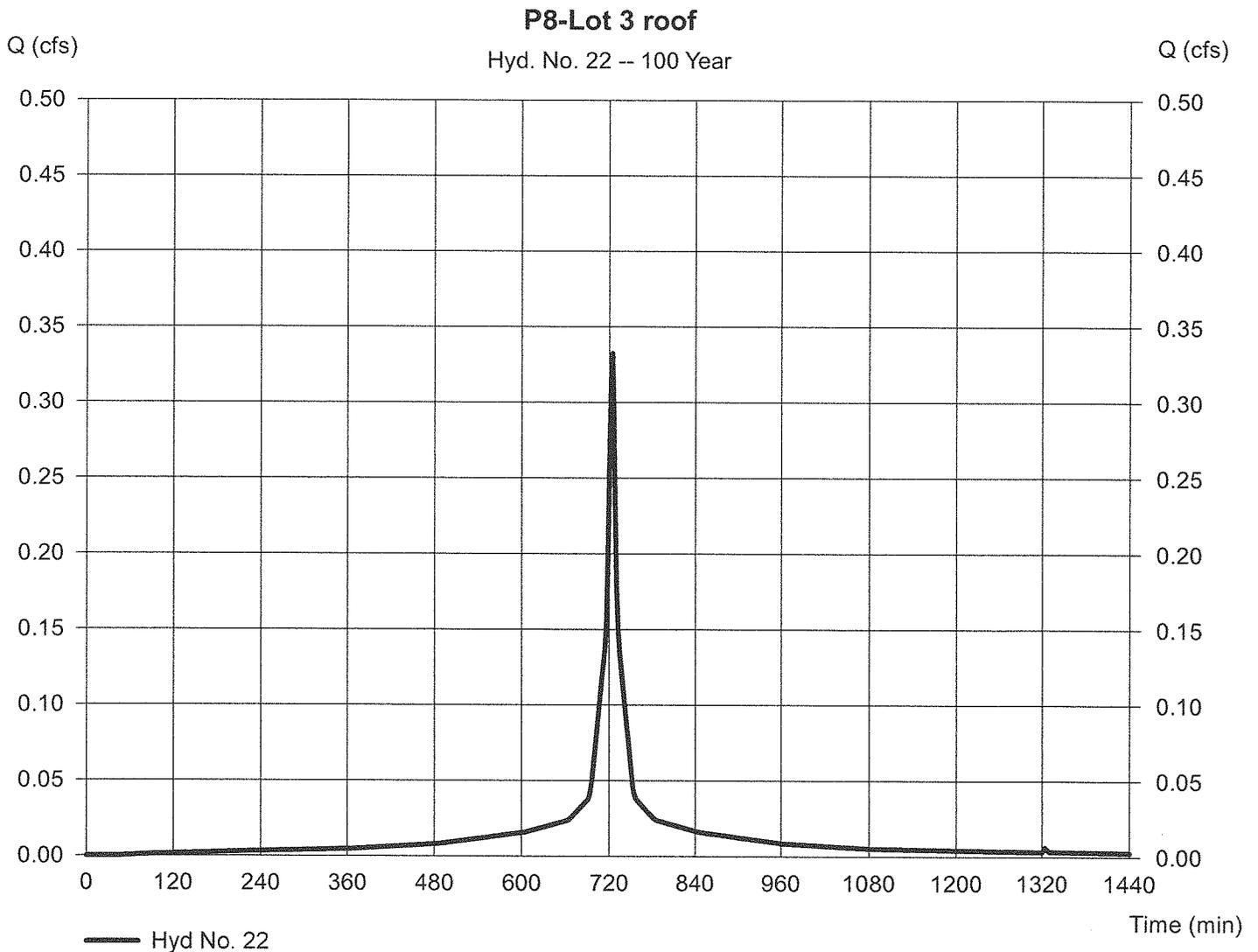
Wednesday, Feb 20, 2013

Hyd. No. 22

P8-Lot 3 roof

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 0.333 cfs
Time to peak = 724 min
Hyd. volume = 1,153 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

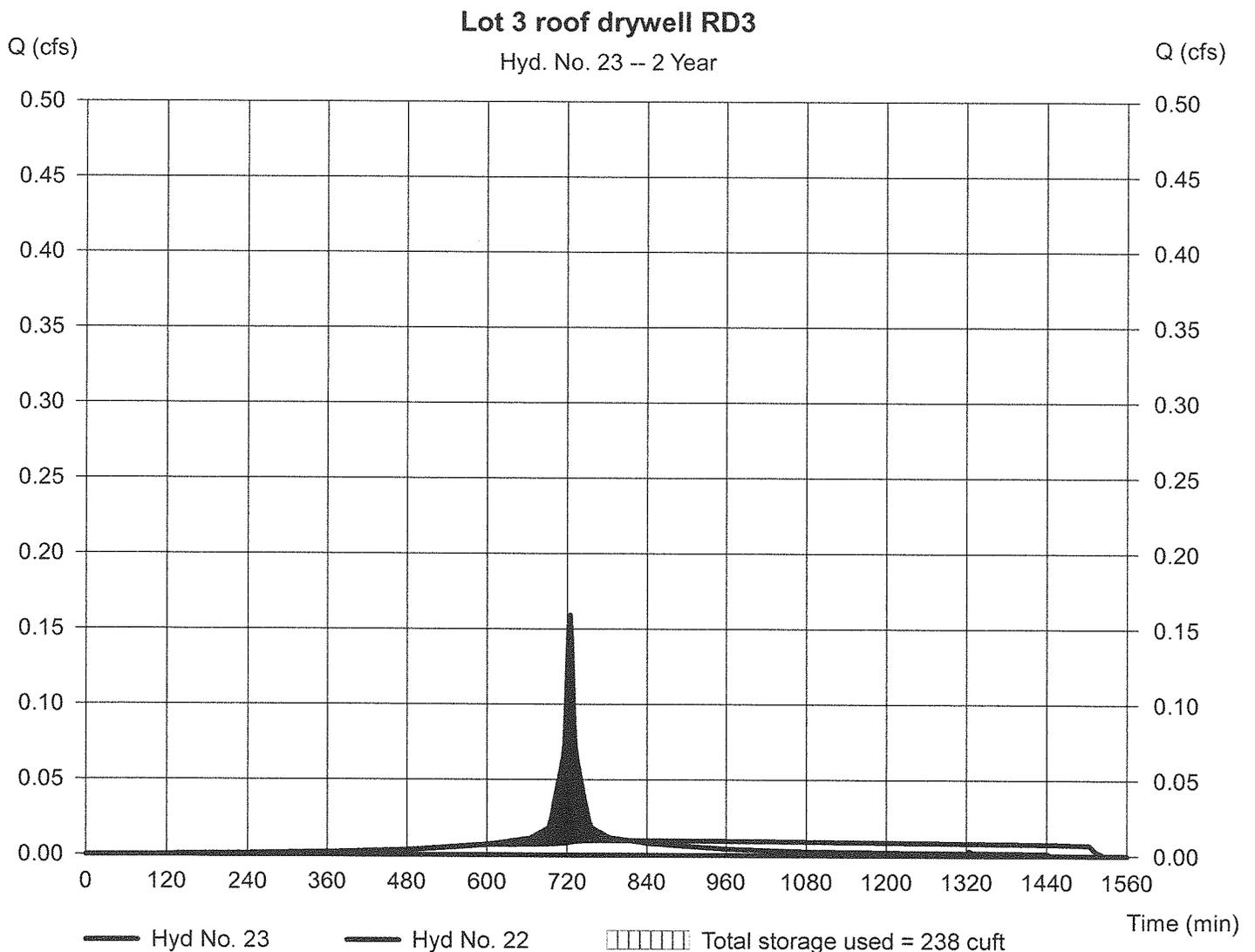
Hyd. No. 23

Lot 3 roof drywell RD3

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 2 min
Inflow hyd. No. = 22 - P8-Lot 3 roof
Reservoir name = Lots 1,2,3,4 drywells Rd 1,2,3,4

Peak discharge = 0.000 cfs
Time to peak = 580 min
Hyd. volume = 0 cuft
Max. Elevation = 1.27 ft
Max. Storage = 238 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

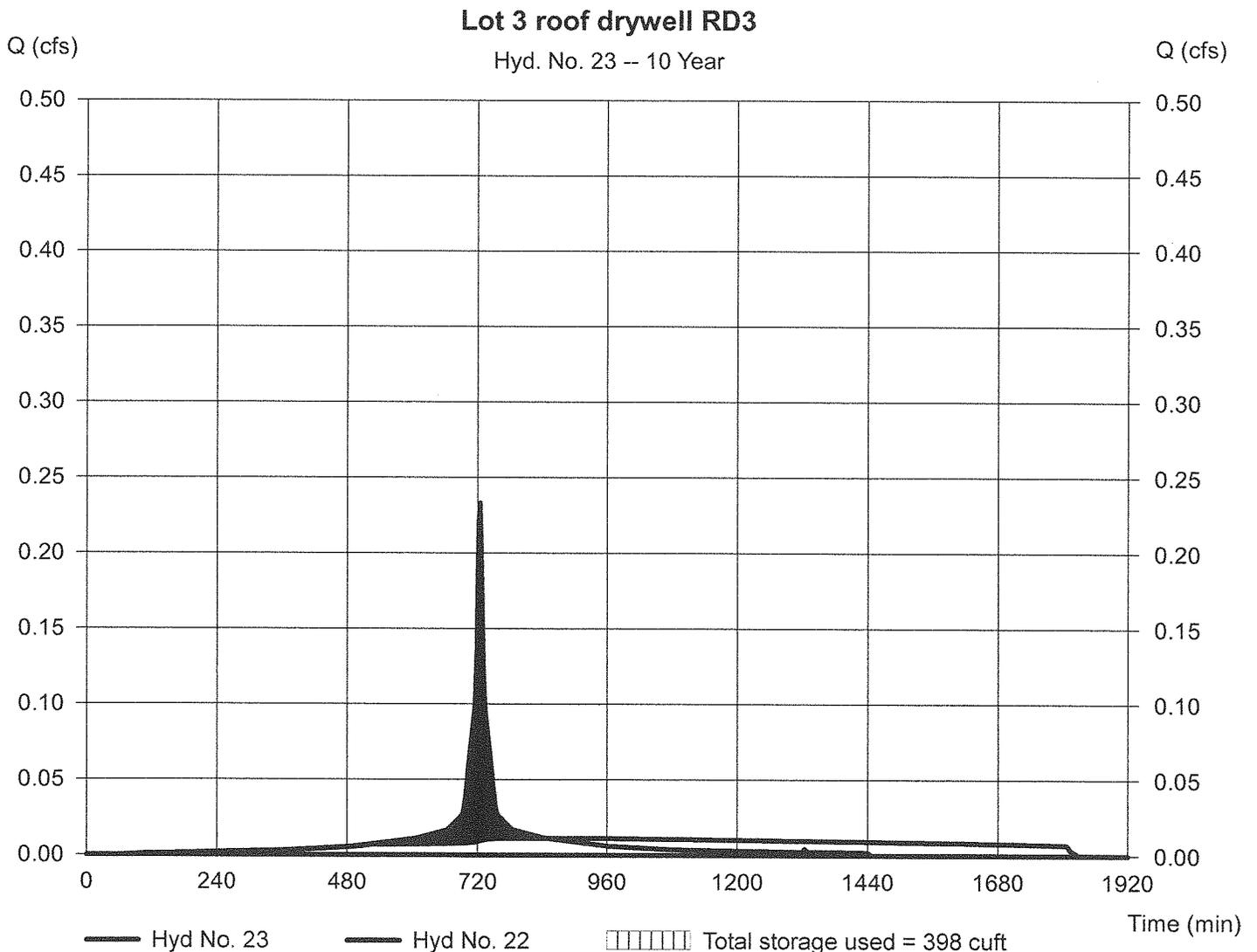
Wednesday, Feb 20, 2013

Hyd. No. 23

Lot 3 roof drywell RD3

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 520 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 22 - P8-Lot 3 roof | Max. Elevation | = 1.99 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 398 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

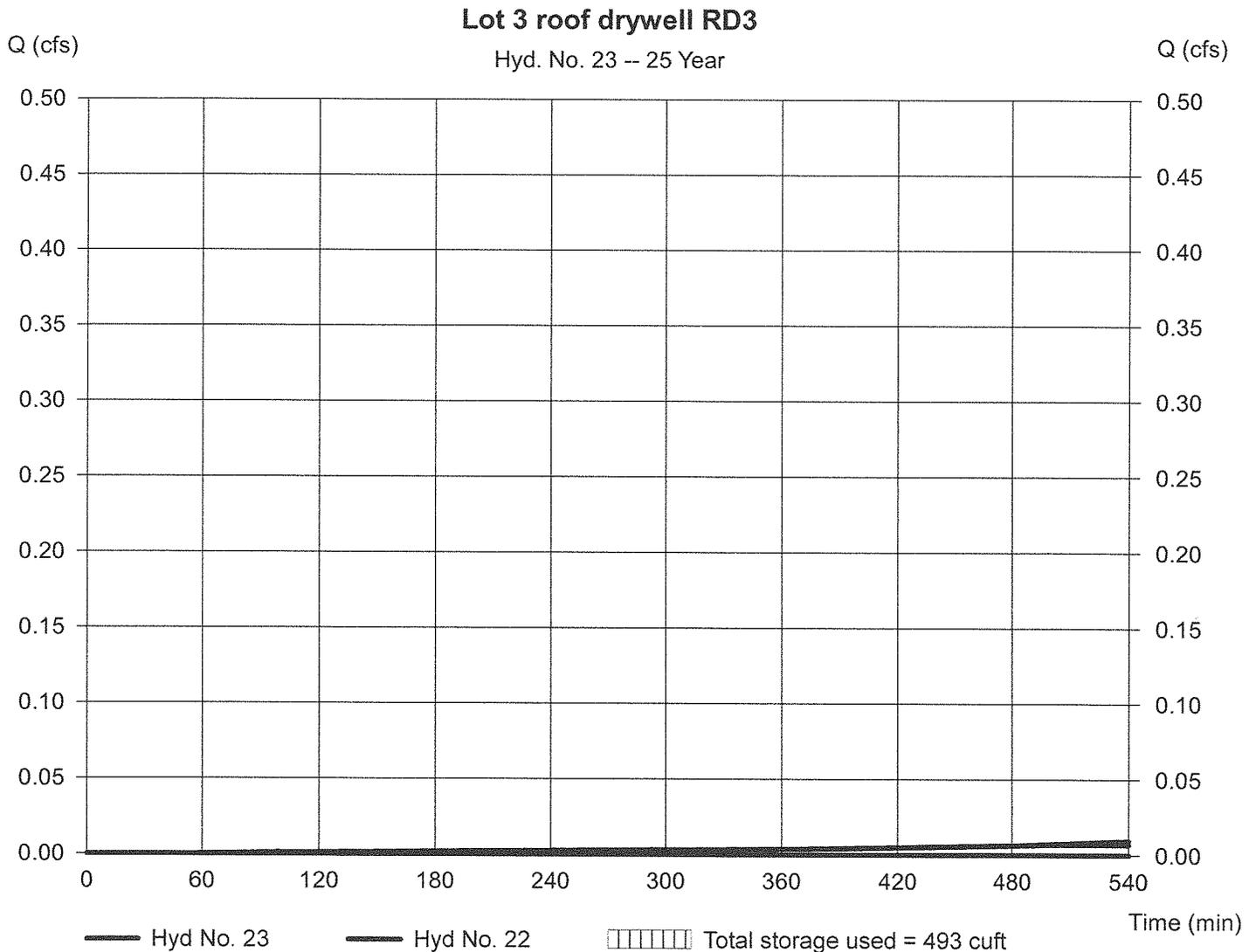
Wednesday, Feb 20, 2013

Hyd. No. 23

Lot 3 roof drywell RD3

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 25 yrs | Time to peak | = 480 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 22 - P8-Lot 3 roof | Max. Elevation | = 2.46 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 493 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

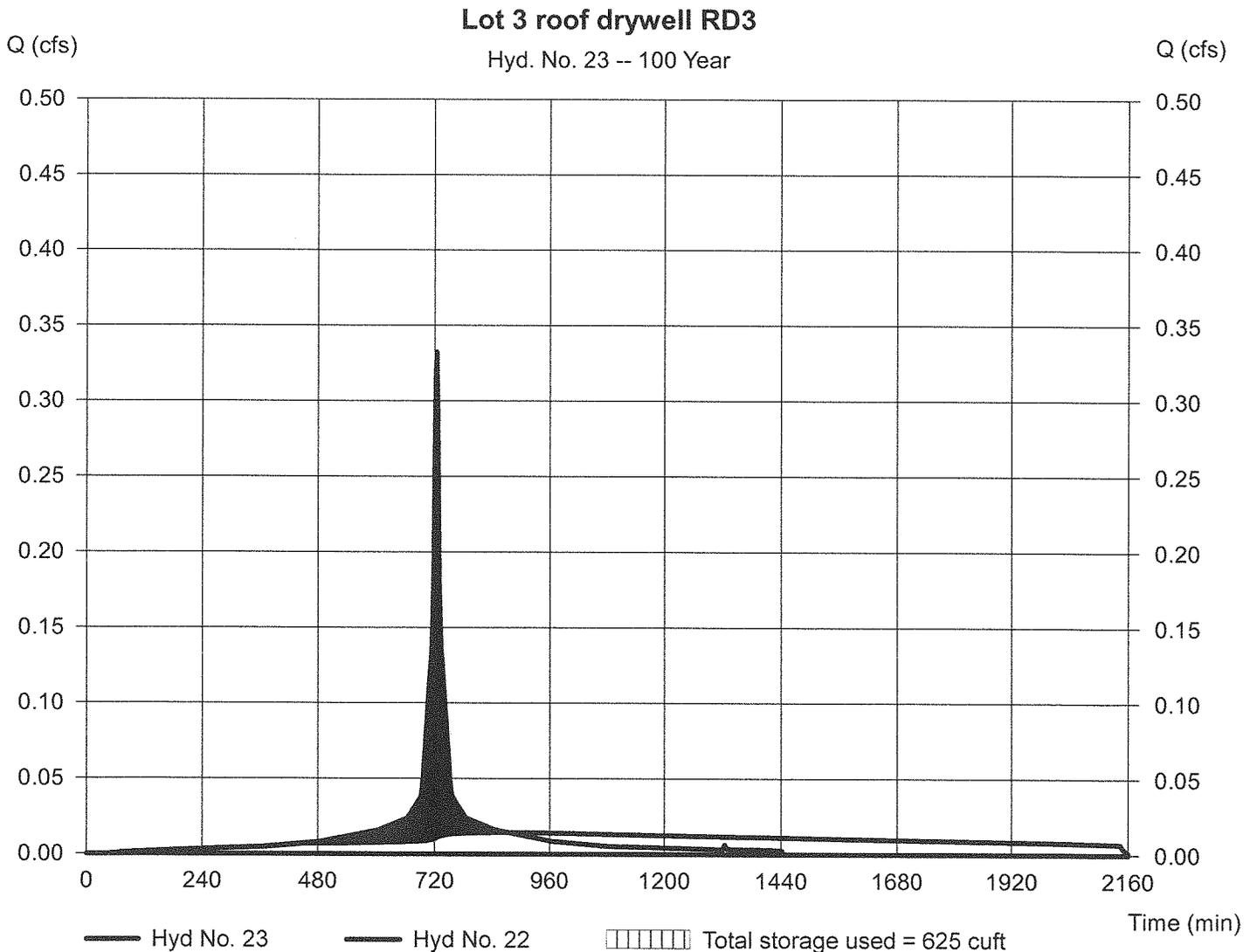
Wednesday, Feb 20, 2013

Hyd. No. 23

Lot 3 roof drywell RD3

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 430 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 22 - P8-Lot 3 roof | Max. Elevation | = 3.35 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 625 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Worksheet 2: Runoff curve number and runoff

SM-4993

Project: 27 Jackson Drive By JTM Date 2/6/13
 Location: Acton, MA Checked _____ Date _____
 Circle one: Present **Developed** _____ P9 _____

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 Acres | Product of CN x Area |
|--|---|-----------|----------|----------|---------------|----------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| | Impervious | 98 | | | 0.06 | 5.39 |
| | | | | | | |
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| | | | | | | |
| | | | | | | |
| | | | | | | |
| Totals = | | | | | 0.06 | 5.39 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{5.39}{0.06}$ = 98.00 ; Use CN =

2. Runoff

| | Storm #1 | Storm #2 | Storm #3 |
|-------------------------------|----------|----------|----------|
| Frequency..... yr | 2 | 10 | 100 |
| Rainfall, P (24-hour)..... in | 3.1 | 4.5 | 6.4 |
| Runoff, Q..... in | 2.87 | 4.26 | 6.16 |

| | | | |
|-------------------|-----|-----|------|
| Runoff, Q..... cf | 573 | 851 | 1230 |
|-------------------|-----|-----|------|

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

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

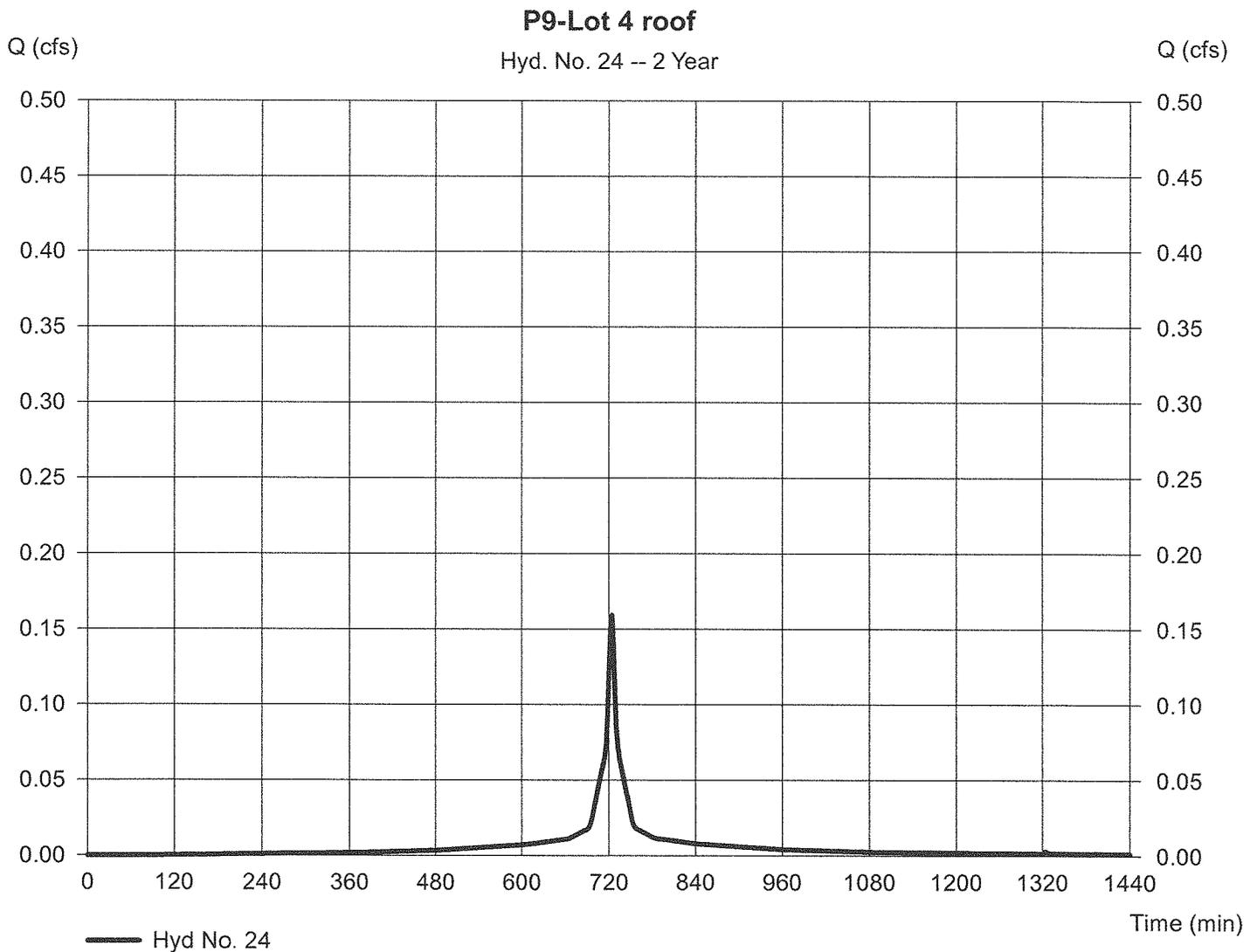
Wednesday, Feb 20, 2013

Hyd. No. 24

P9-Lot 4 roof

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.159 cfs
Time to peak = 724 min
Hyd. volume = 537 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

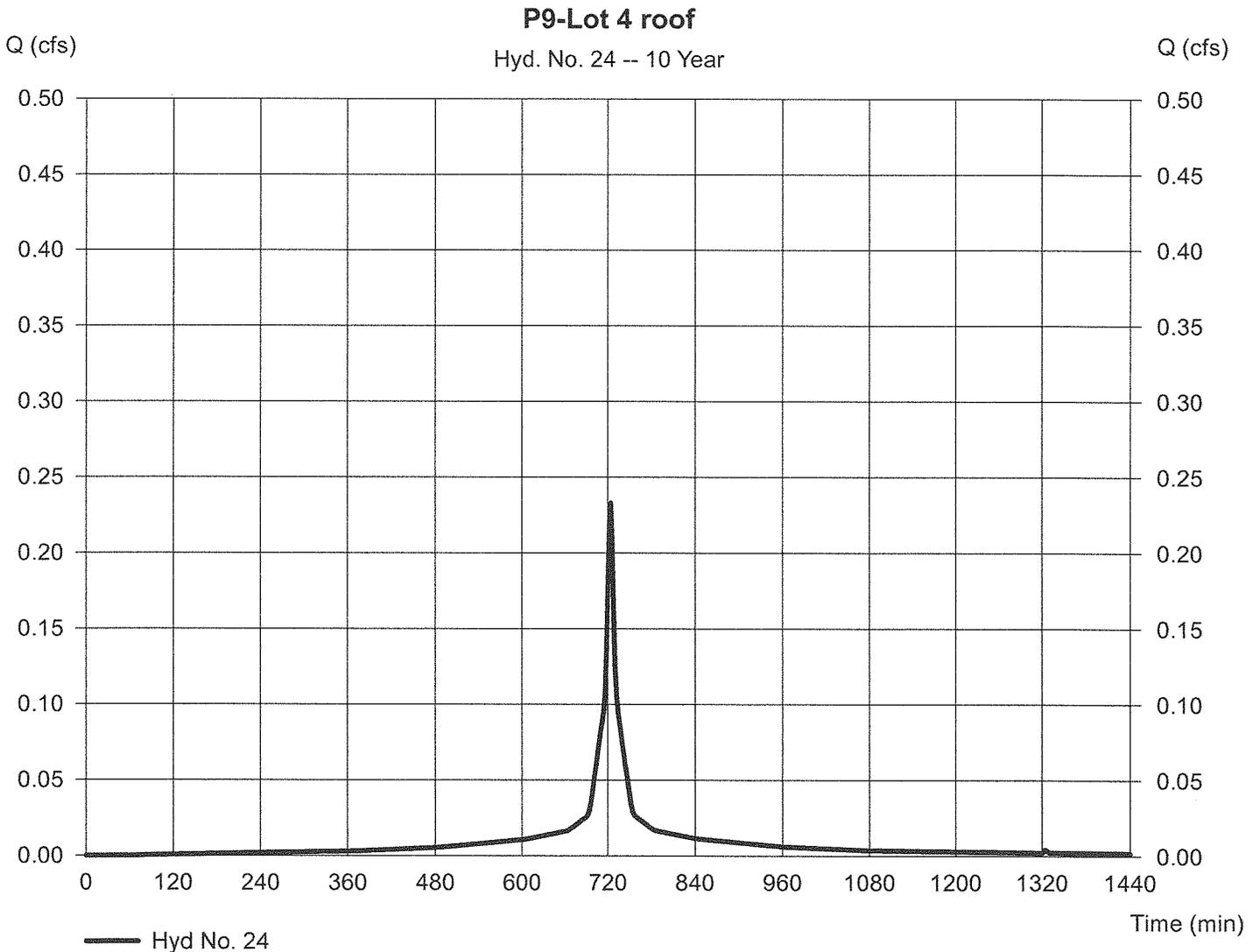
Wednesday, Feb 20, 2013

Hyd. No. 24

P9-Lot 4 roof

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.233 cfs
Time to peak = 724 min
Hyd. volume = 798 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

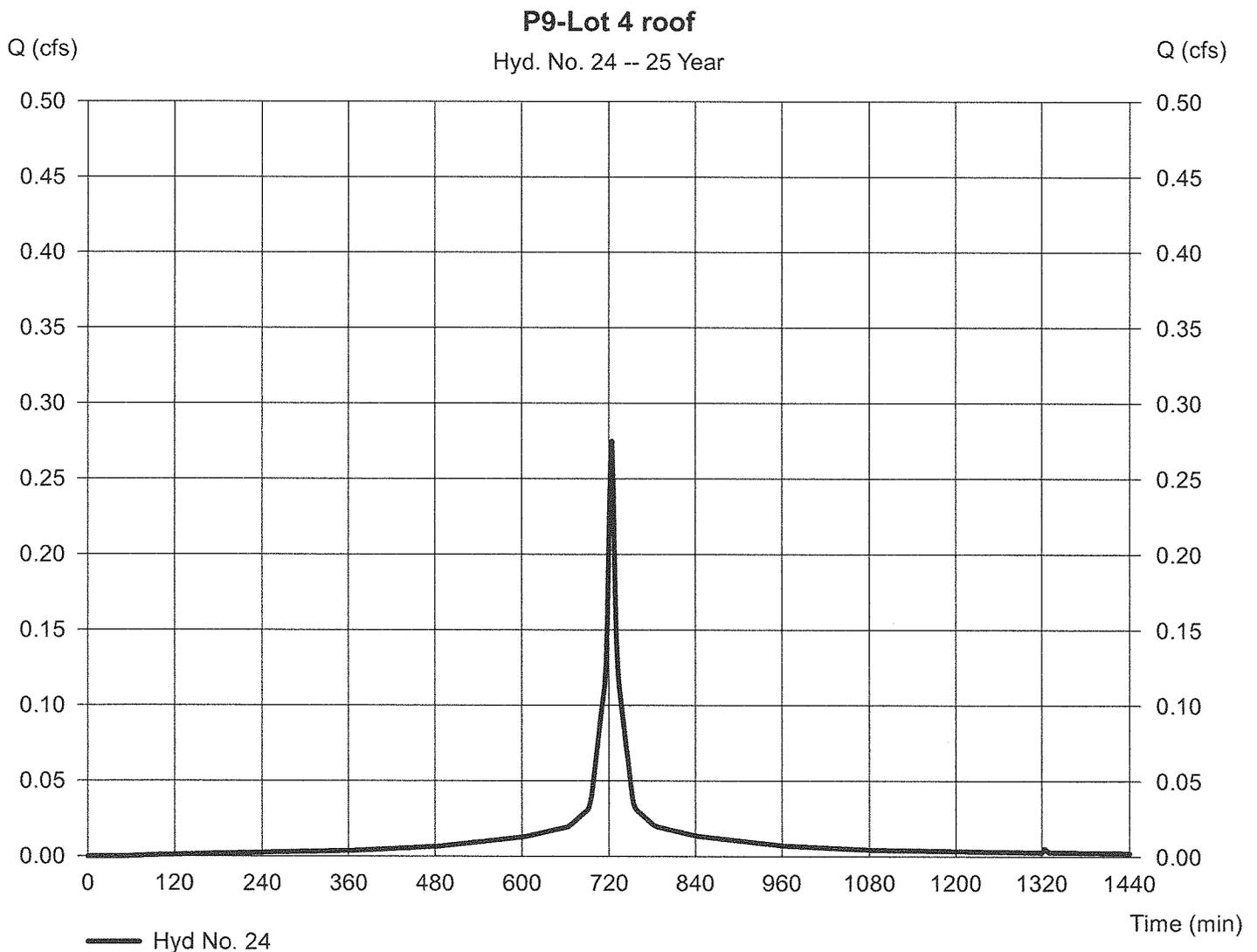
Wednesday, Feb 20, 2013

Hyd. No. 24

P9-Lot 4 roof

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 0.275 cfs
Time to peak = 724 min
Hyd. volume = 948 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

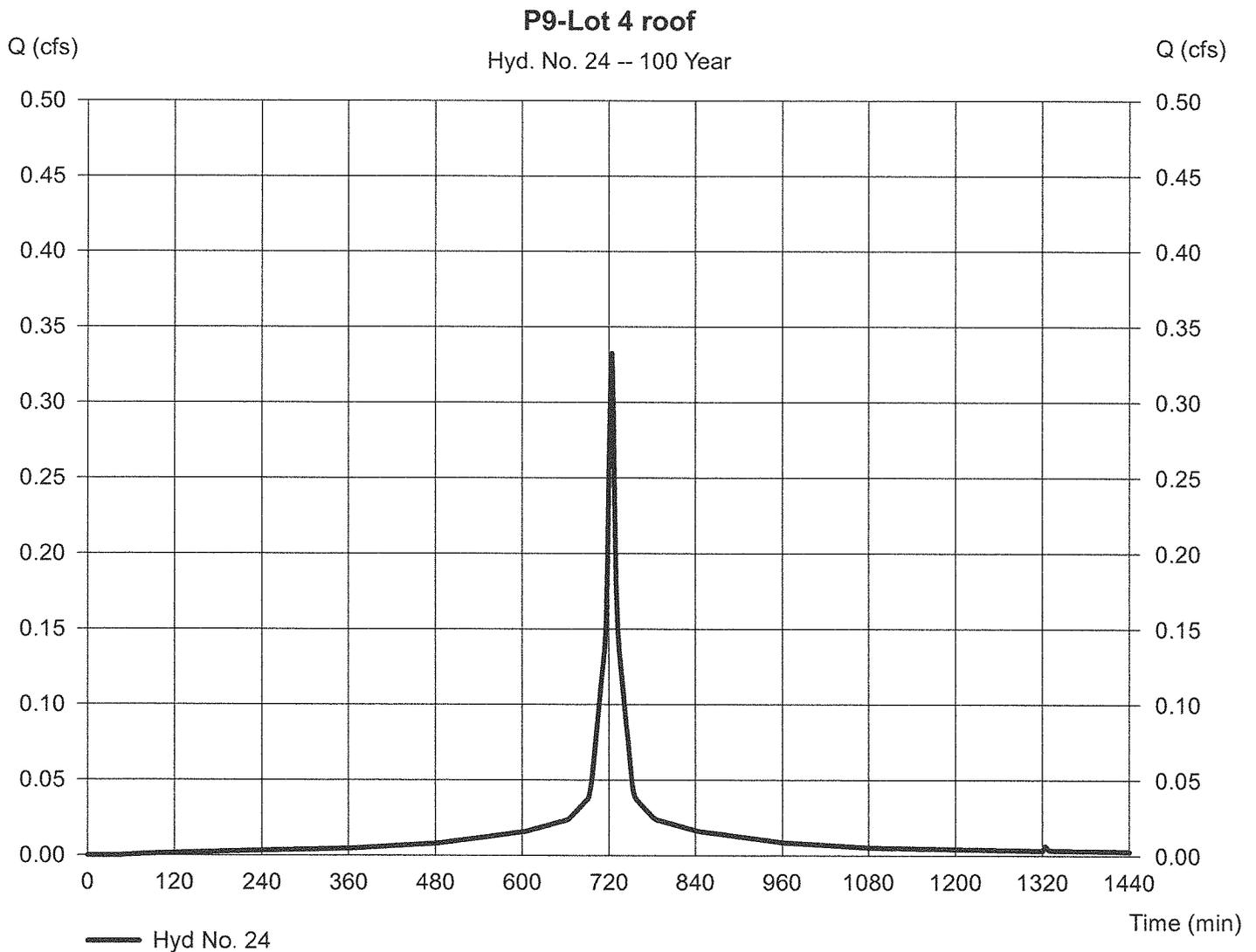
Wednesday, Feb 20, 2013

Hyd. No. 24

P9-Lot 4 roof

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.055 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 0.333 cfs
Time to peak = 724 min
Hyd. volume = 1,153 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

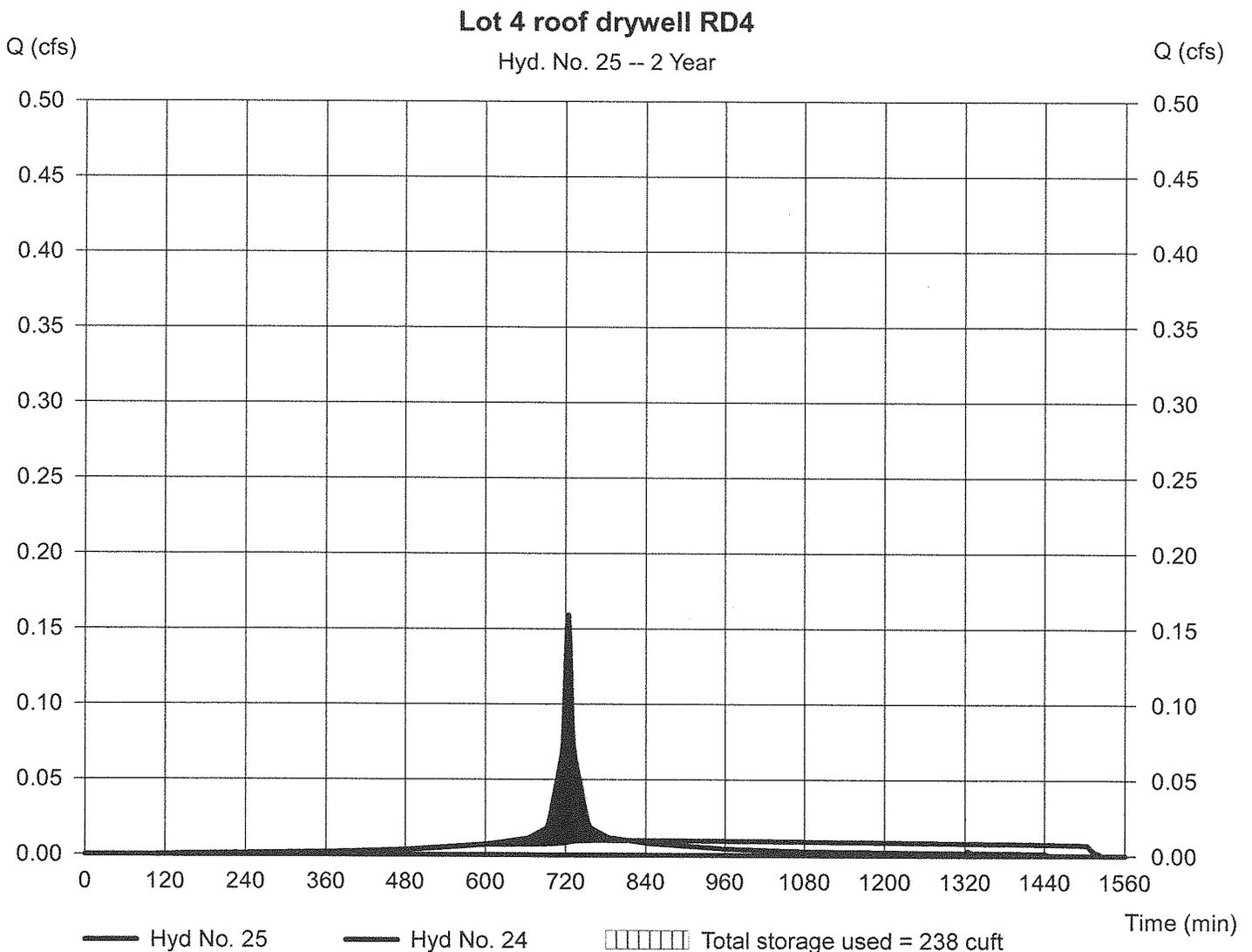
Hyd. No. 25

Lot 4 roof drywell RD4

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 2 min
Inflow hyd. No. = 24 - P9-Lot 4 roof
Reservoir name = Lots 1,2,3,4 drywells Rd 1,2,3,4

Peak discharge = 0.000 cfs
Time to peak = 580 min
Hyd. volume = 0 cuft
Max. Elevation = 1.27 ft
Max. Storage = 238 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

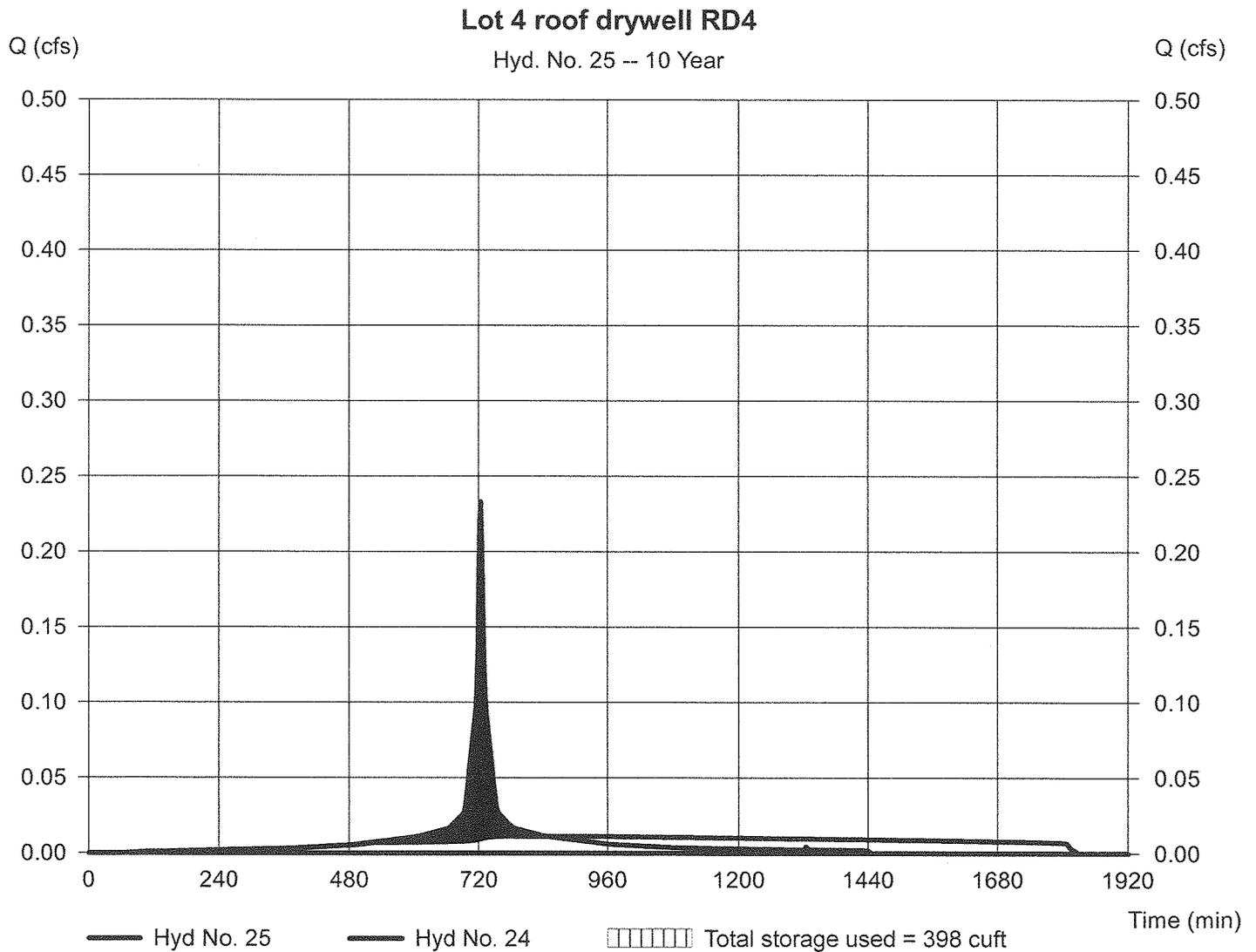
Hyd. No. 25

Lot 4 roof drywell RD4

Hydrograph type = Reservoir
Storm frequency = 10 yrs
Time interval = 2 min
Inflow hyd. No. = 24 - P9-Lot 4 roof
Reservoir name = Lots 1,2,3,4 drywells Rd 1,2,3,4

Peak discharge = 0.000 cfs
Time to peak = 520 min
Hyd. volume = 0 cuft
Max. Elevation = 1.99 ft
Max. Storage = 398 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

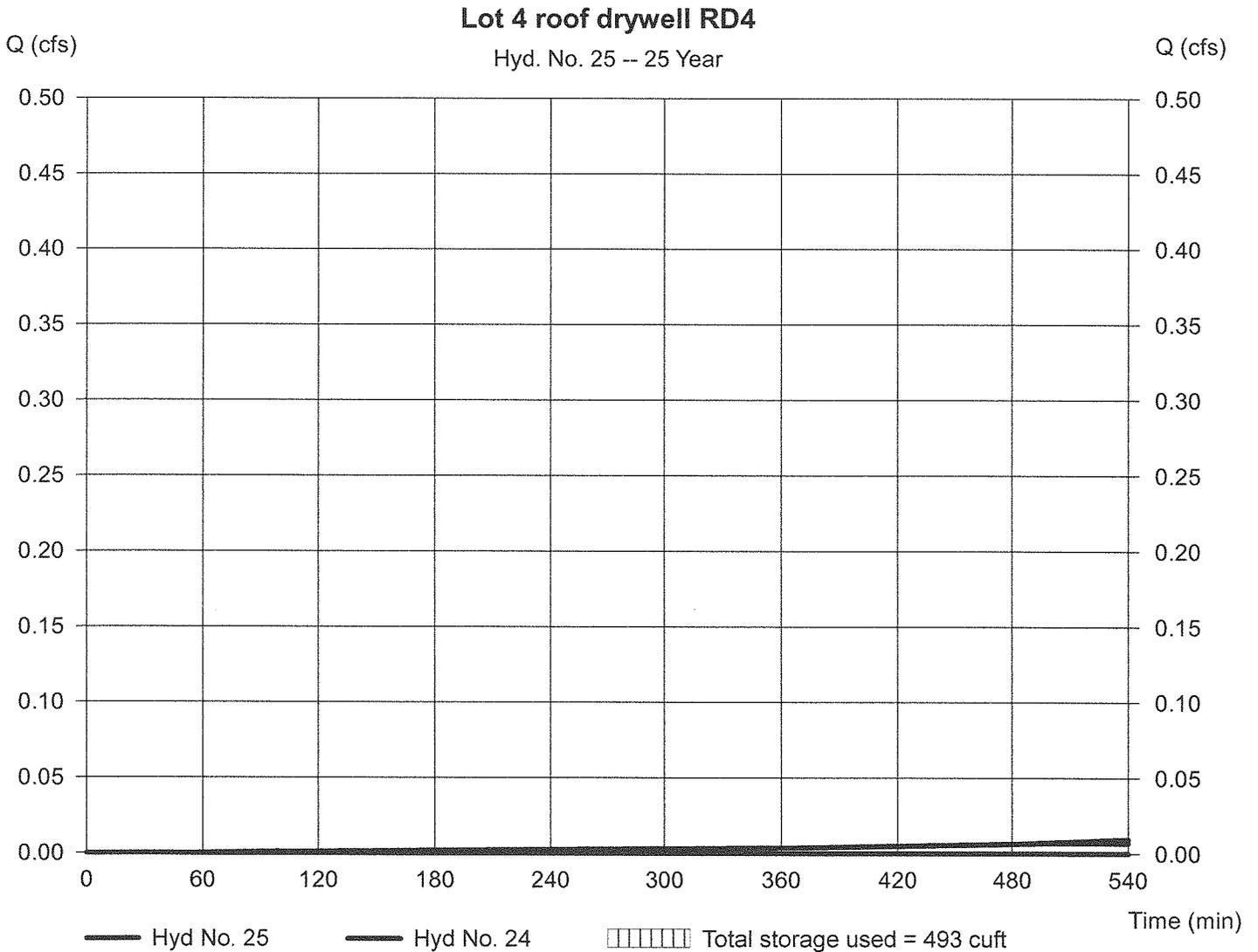
Wednesday, Feb 20, 2013

Hyd. No. 25

Lot 4 roof drywell RD4

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 25 yrs | Time to peak | = 480 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 24 - P9-Lot 4 roof | Max. Elevation | = 2.46 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 493 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

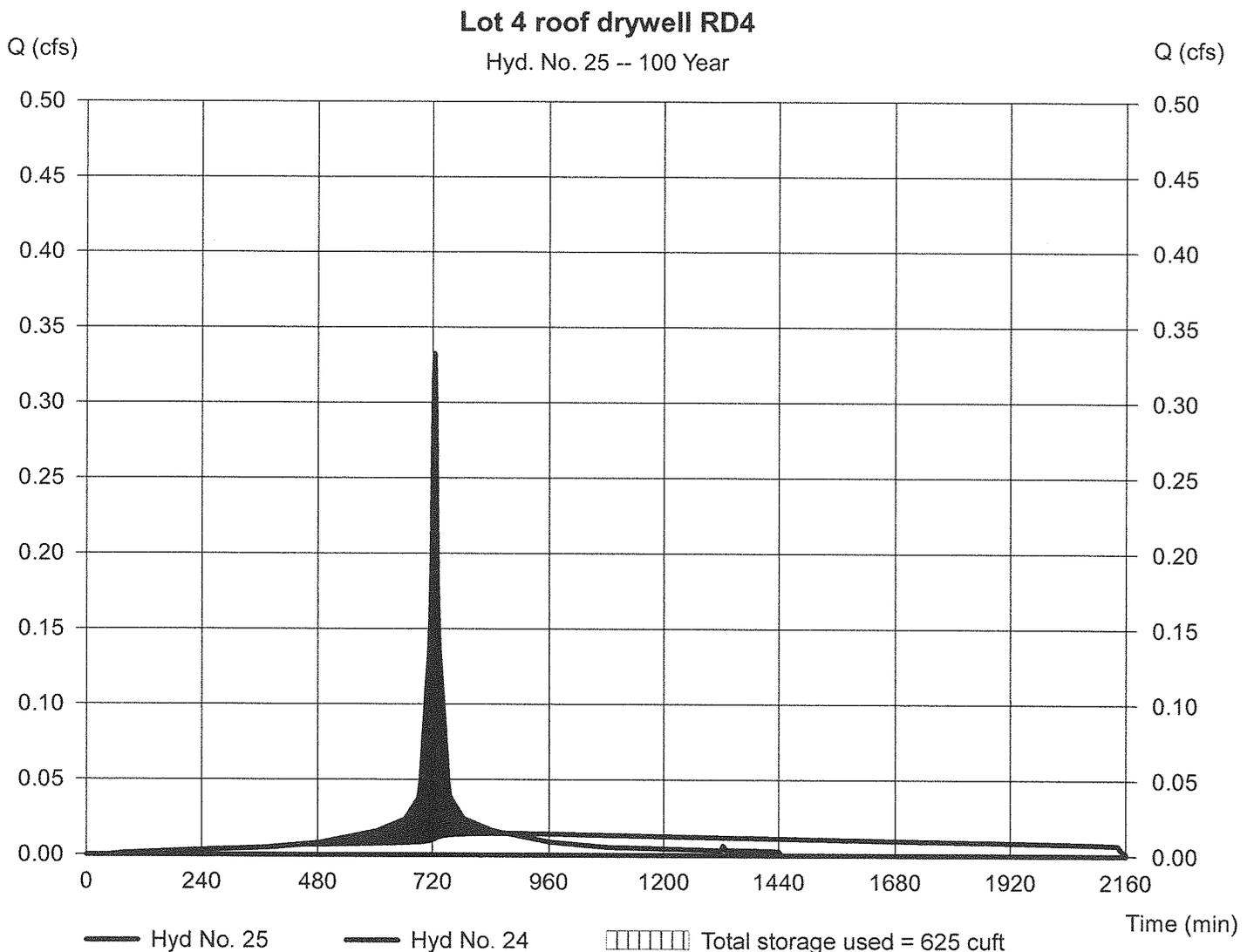
Wednesday, Feb 20, 2013

Hyd. No. 25

Lot 4 roof drywell RD4

| | | | |
|-----------------|------------------------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 430 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 24 - P9-Lot 4 roof | Max. Elevation | = 3.35 ft |
| Reservoir name | = Lots 1,2,3,4 drywells Rd 1,2,3,4 | Max. Storage | = 625 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Worksheet 2: Runoff curve number and runoff

SM-4993

Project: 27 Jackson Drive By JTM Date 2/6/13

Location: Acton, MA Checked _____ Date _____

Circle one: Present **Developed** P10 _____

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 Acres | Product of CN x Area |
|--|---|-----------|----------|----------|---------------|-------------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| | Impervious | 98 | | | 0.02 | 2.06 |
| | | | | | | |
| | | | | | | |
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| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Totals = | | | | | 0.02 | 2.06 |

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{2.06}{0.02} = 98.00$; Use CN = **98.0**

2. Runoff

Frequency..... yr
 Rainfall, P (24-hour)..... in
 Runoff, Q..... in
 (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)
 Runoff, Q..... cf
 D-2

| Storm #1 | Storm #2 | Storm #3 |
|----------|----------|----------|
| 2 | 10 | 100 |
| 3.1 | 4.6 | 6.4 |
| 2.87 | 4.26 | 6.16 |

| | | |
|-----|-----|-----|
| 219 | 325 | 470 |
|-----|-----|-----|

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

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

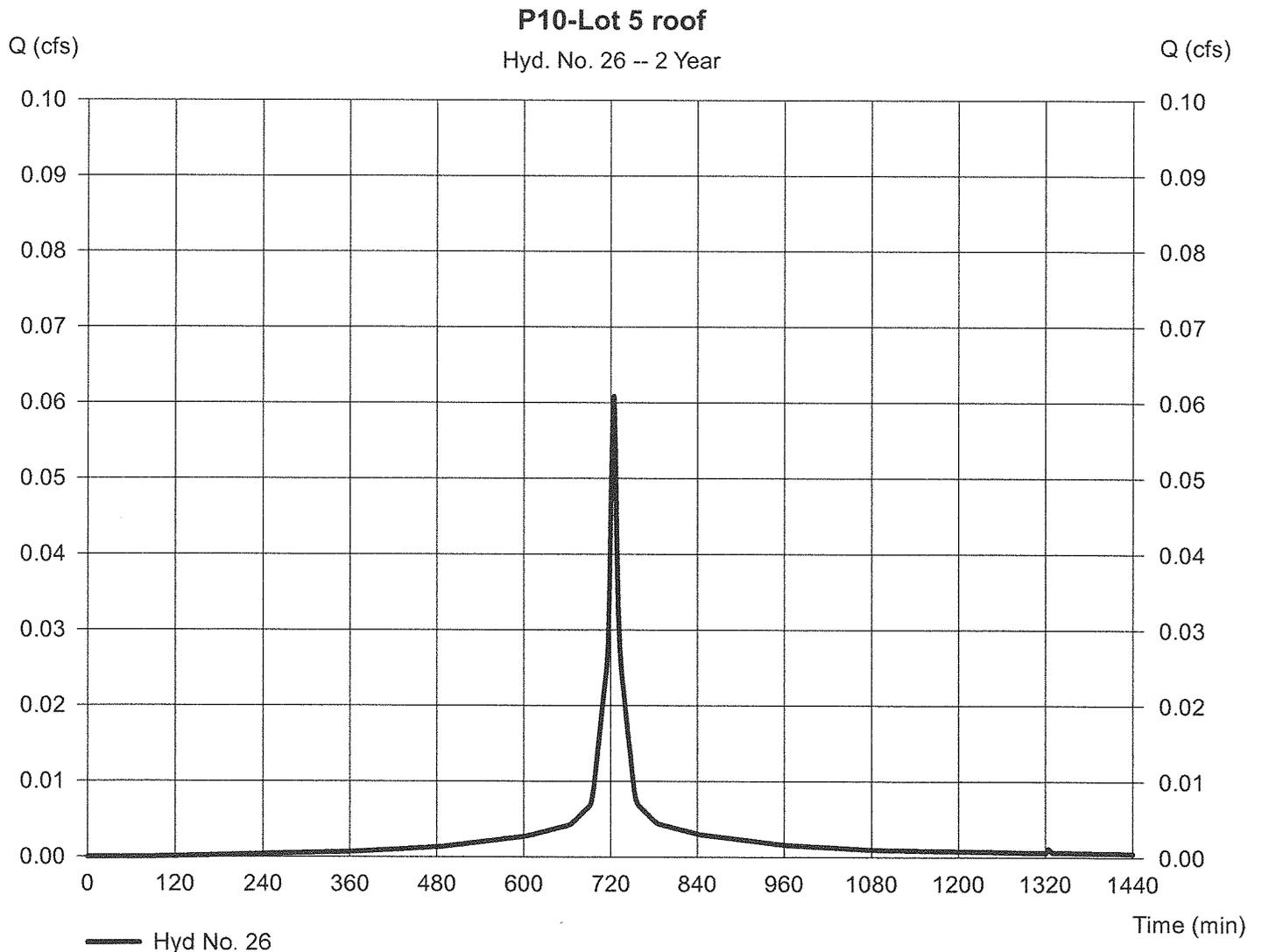
Wednesday, Feb 20, 2013

Hyd. No. 26

P10-Lot 5 roof

Hydrograph type = SCS Runoff
Storm frequency = 2 yrs
Time interval = 2 min
Drainage area = 0.021 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 3.10 in
Storm duration = 24 hrs

Peak discharge = 0.061 cfs
Time to peak = 724 min
Hyd. volume = 205 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

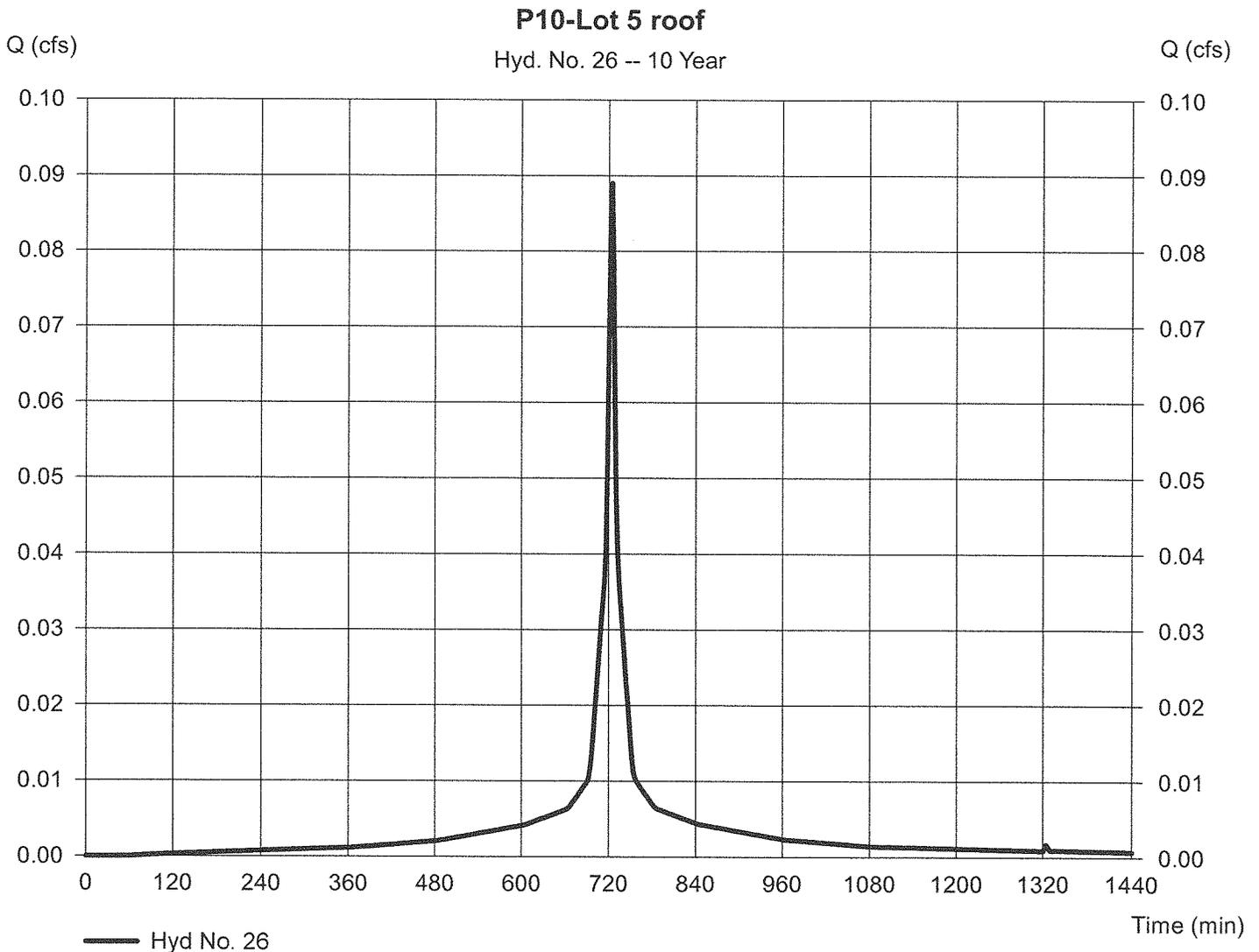
Wednesday, Feb 20, 2013

Hyd. No. 26

P10-Lot 5 roof

Hydrograph type = SCS Runoff
Storm frequency = 10 yrs
Time interval = 2 min
Drainage area = 0.021 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 4.50 in
Storm duration = 24 hrs

Peak discharge = 0.089 cfs
Time to peak = 724 min
Hyd. volume = 305 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

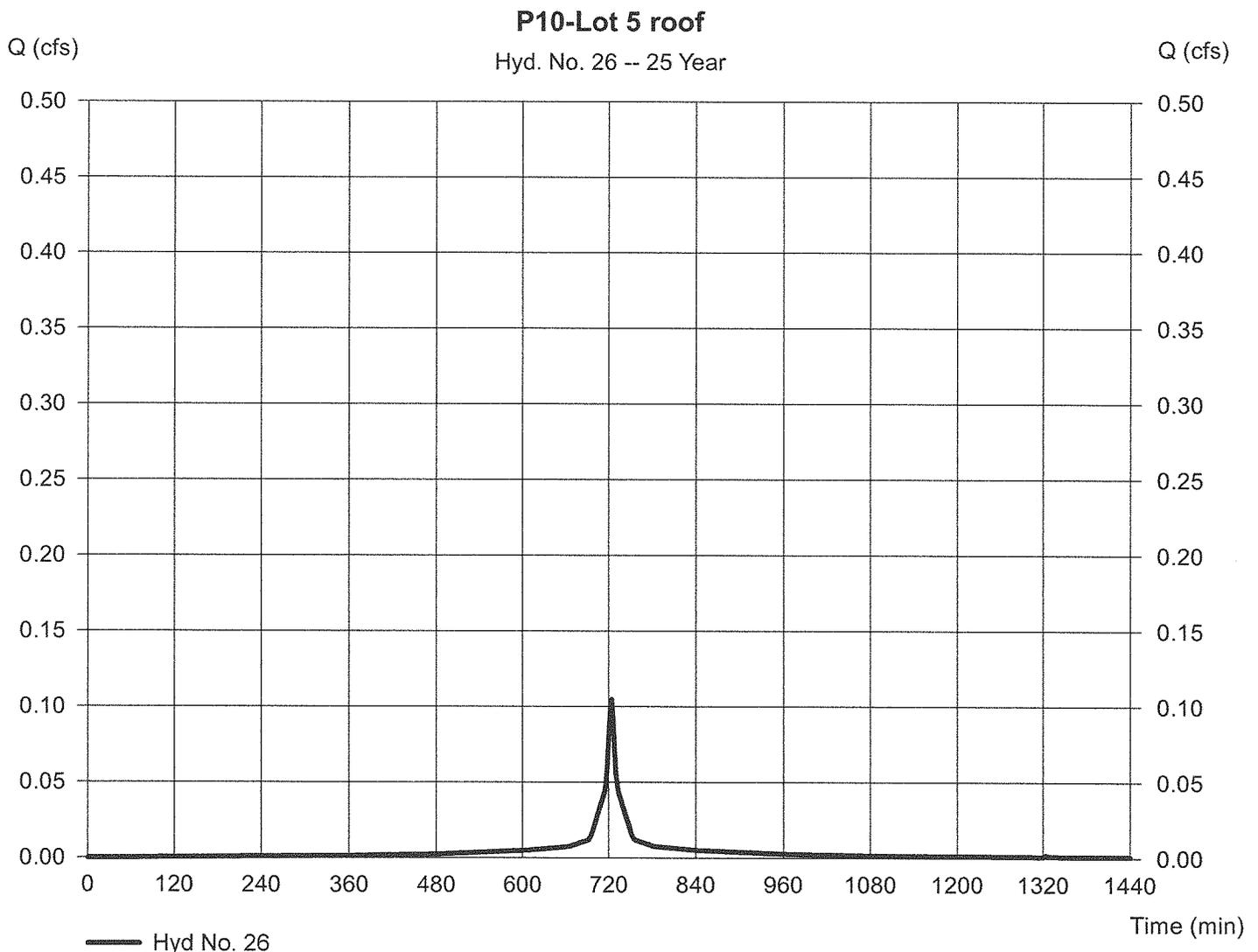
Wednesday, Feb 20, 2013

Hyd. No. 26

P10-Lot 5 roof

Hydrograph type = SCS Runoff
Storm frequency = 25 yrs
Time interval = 2 min
Drainage area = 0.021 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 5.30 in
Storm duration = 24 hrs

Peak discharge = 0.105 cfs
Time to peak = 724 min
Hyd. volume = 362 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

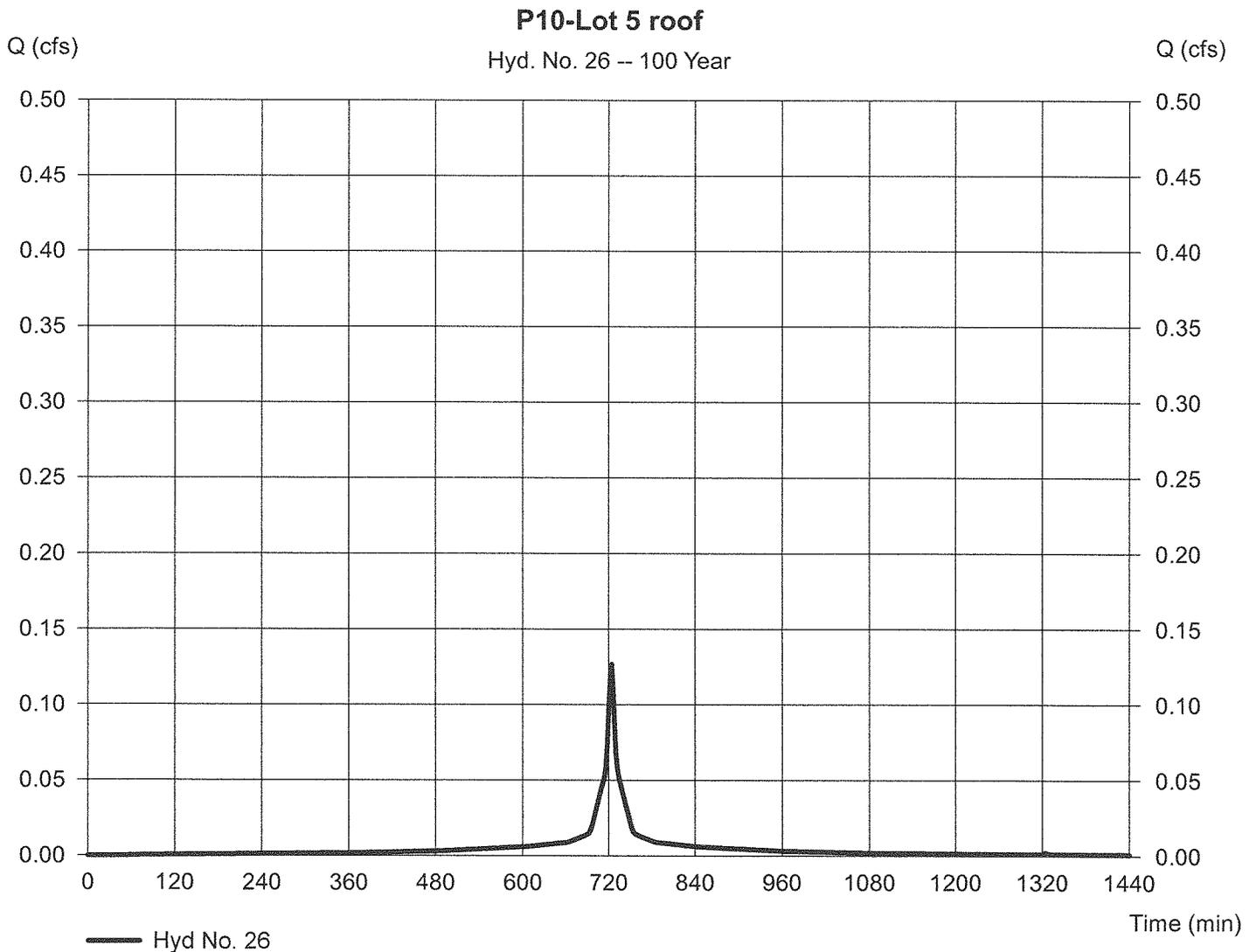
Wednesday, Feb 20, 2013

Hyd. No. 26

P10-Lot 5 roof

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Time interval = 2 min
Drainage area = 0.021 ac
Basin Slope = 0.0 %
Tc method = USER
Total precip. = 6.40 in
Storm duration = 24 hrs

Peak discharge = 0.127 cfs
Time to peak = 724 min
Hyd. volume = 440 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 6.00 min
Distribution = Type III
Shape factor = 484



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

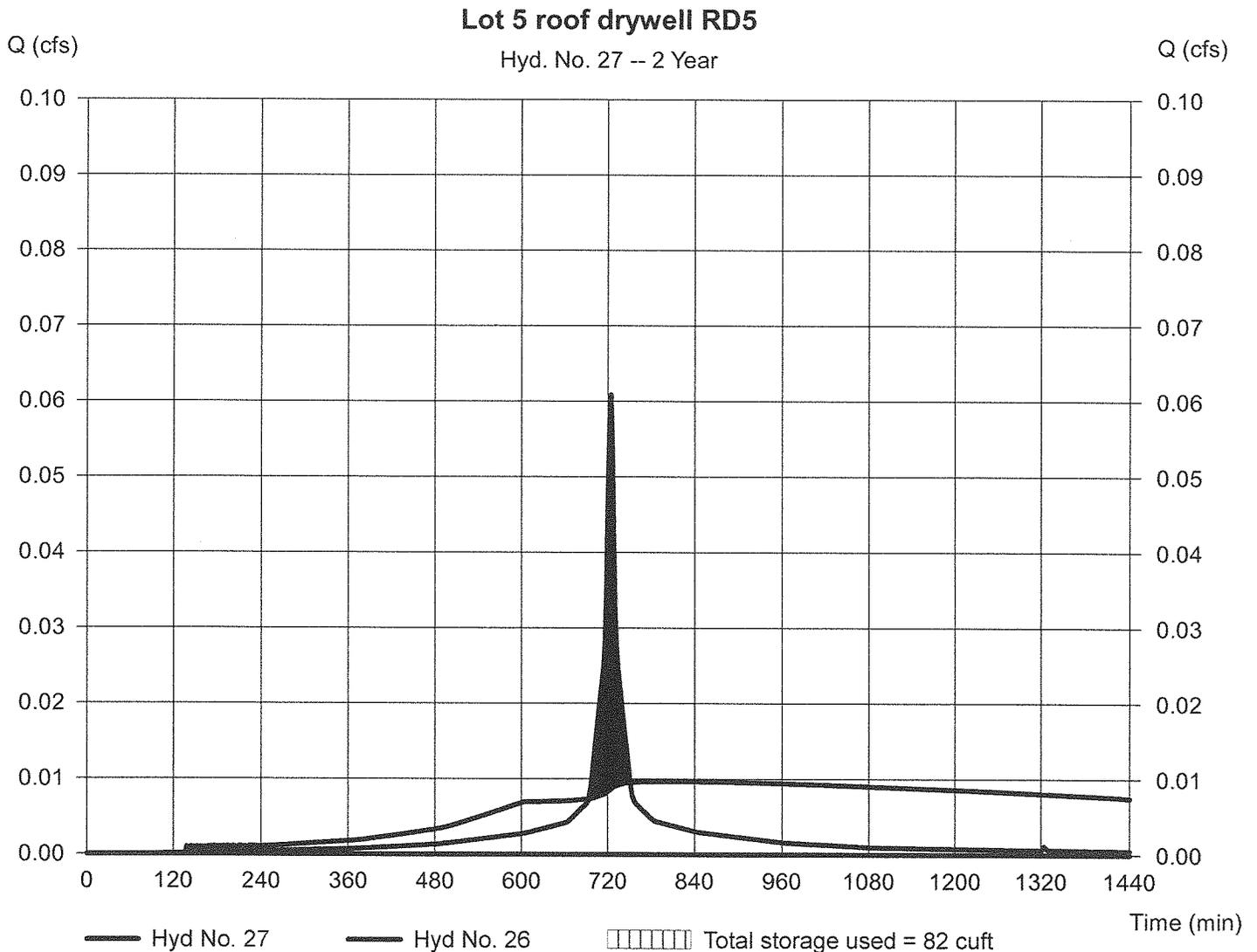
Wednesday, Feb 20, 2013

Hyd. No. 27

Lot 5 roof drywell RD5

| | | | |
|-----------------|-----------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 514 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 26 - P10-Lot 5 roof | Max. Elevation | = 0.95 ft |
| Reservoir name | = Lot 5 Drywell RD5 | Max. Storage | = 82 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

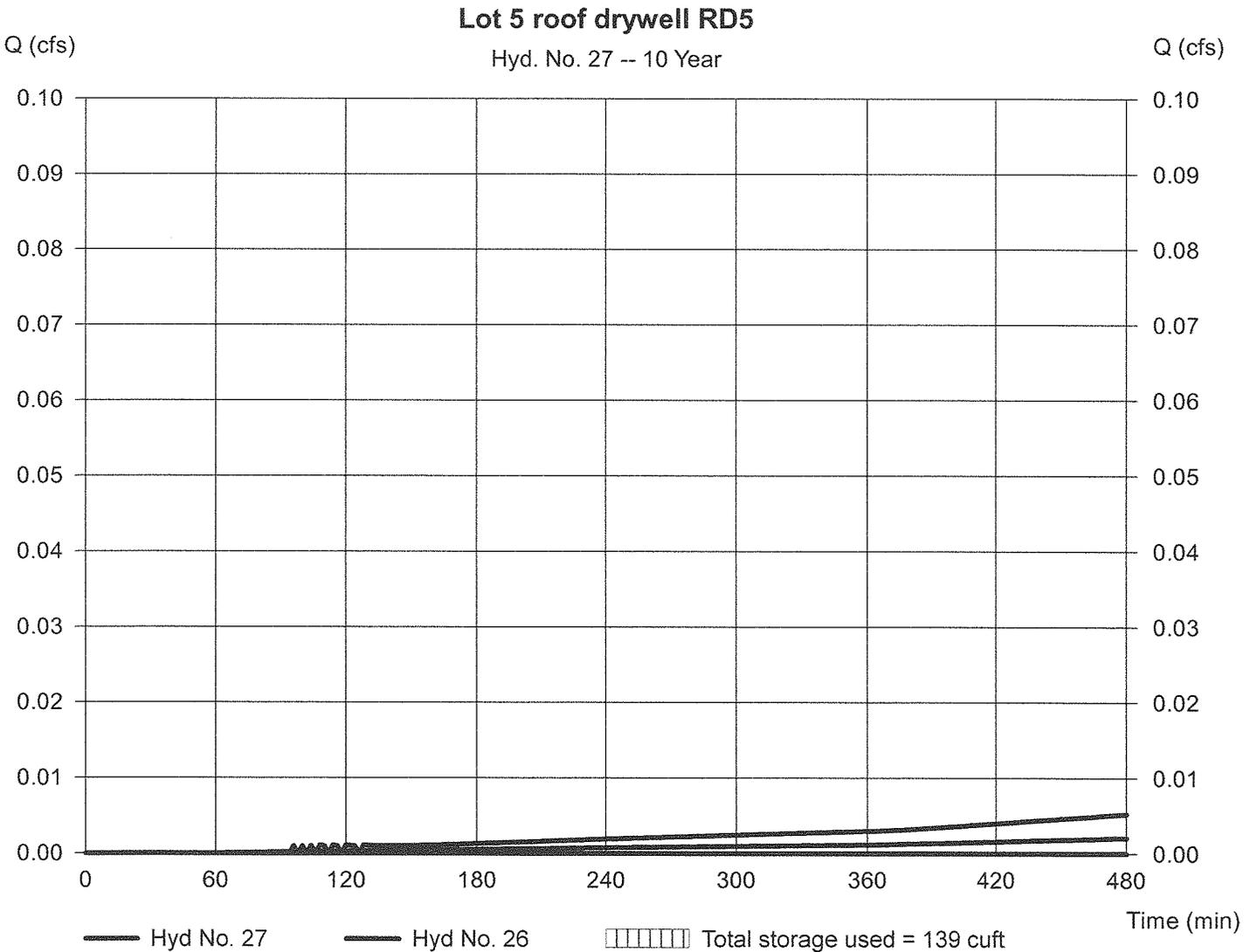
Hyd. No. 27

Lot 5 roof drywell RD5

Hydrograph type = Reservoir
Storm frequency = 10 yrs
Time interval = 2 min
Inflow hyd. No. = 26 - P10-Lot 5 roof
Reservoir name = Lot 5 Drywell RD5

Peak discharge = 0.000 cfs
Time to peak = 446 min
Hyd. volume = 0 cuft
Max. Elevation = 1.44 ft
Max. Storage = 139 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

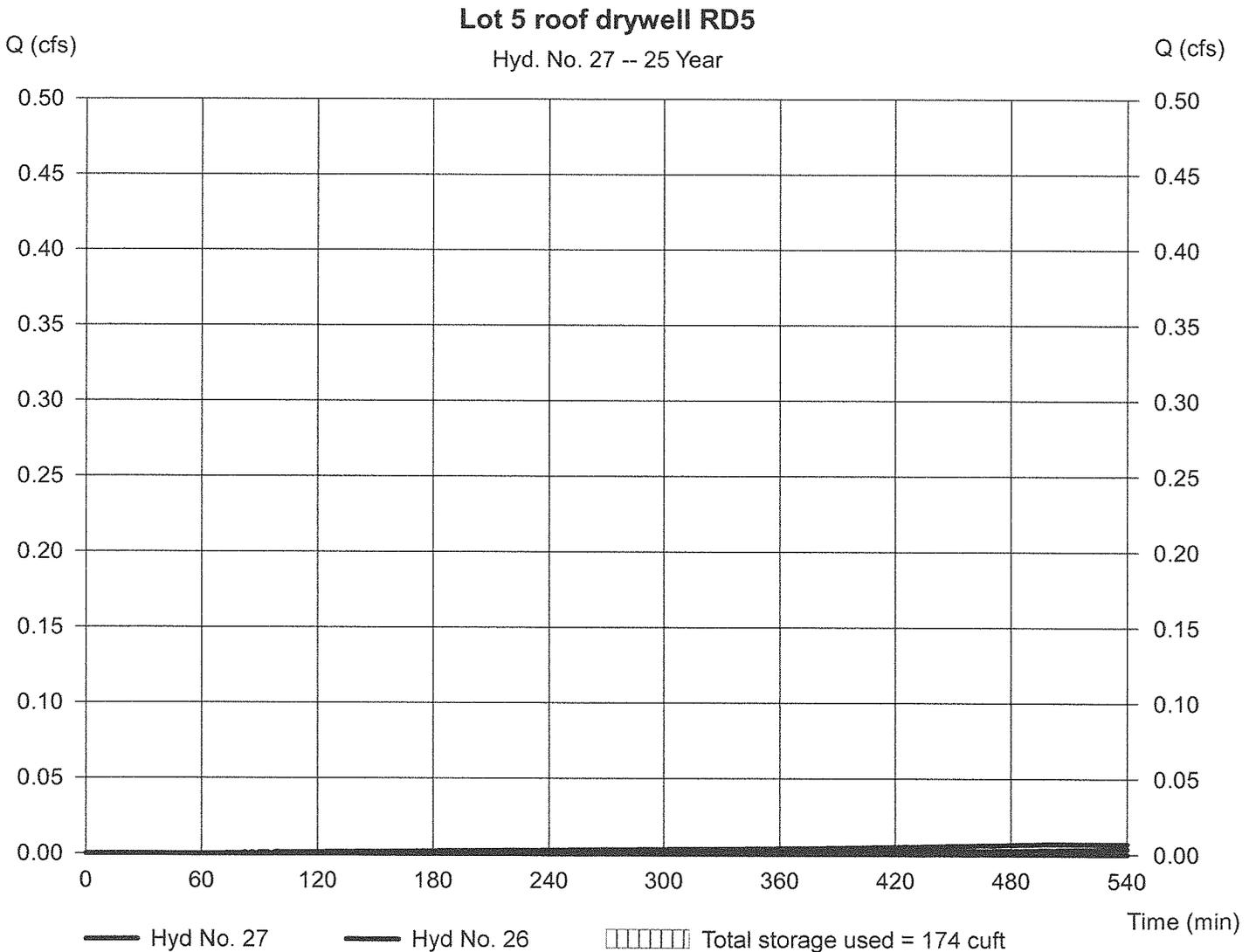
Wednesday, Feb 20, 2013

Hyd. No. 27

Lot 5 roof drywell RD5

| | | | |
|-----------------|-----------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 25 yrs | Time to peak | = 522 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 26 - P10-Lot 5 roof | Max. Elevation | = 1.75 ft |
| Reservoir name | = Lot 5 Drywell RD5 | Max. Storage | = 174 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

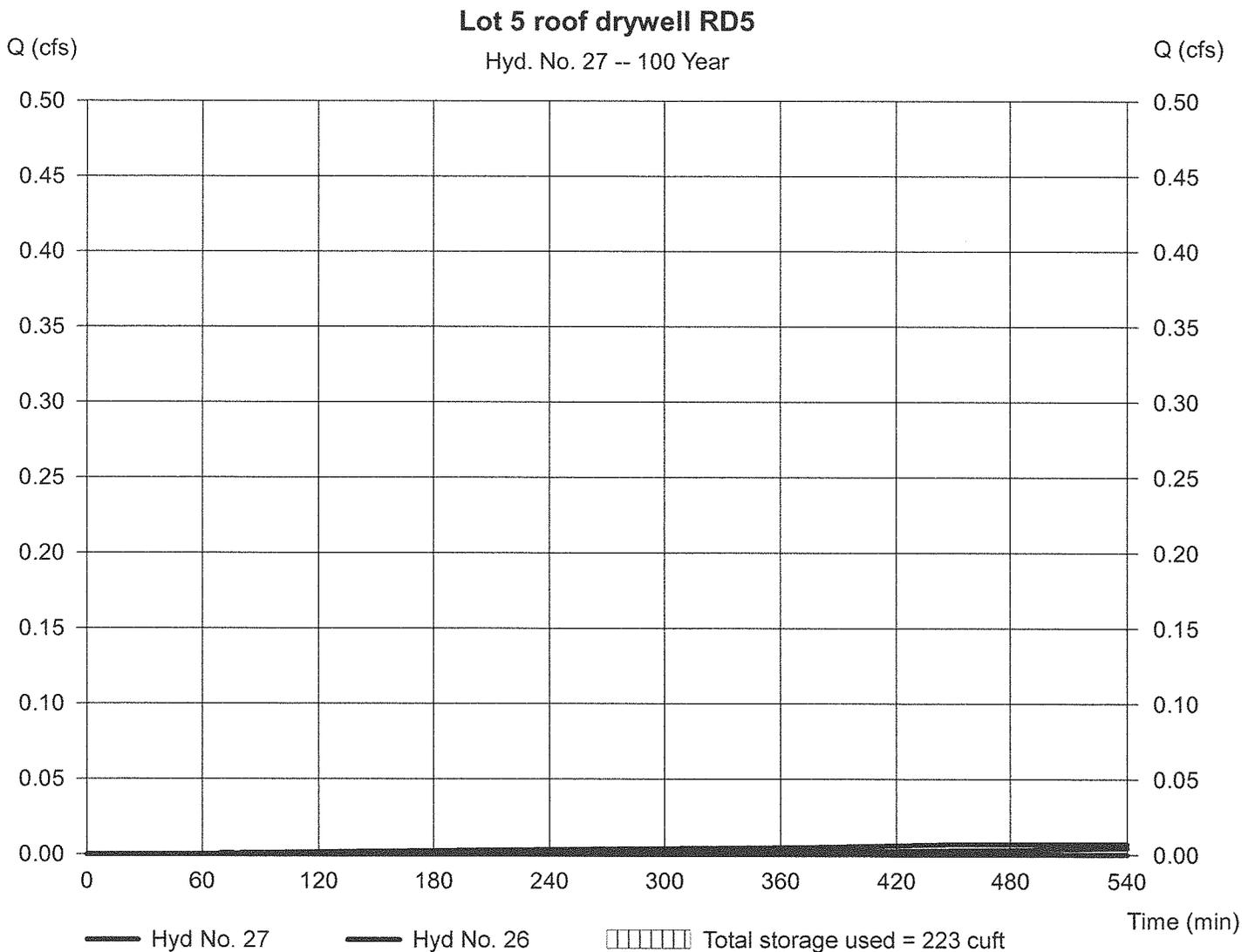
Wednesday, Feb 20, 2013

Hyd. No. 27

Lot 5 roof drywell RD5

| | | | |
|-----------------|-----------------------|----------------|-------------|
| Hydrograph type | = Reservoir | Peak discharge | = 0.000 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 498 min |
| Time interval | = 2 min | Hyd. volume | = 0 cuft |
| Inflow hyd. No. | = 26 - P10-Lot 5 roof | Max. Elevation | = 2.22 ft |
| Reservoir name | = Lot 5 Drywell RD5 | Max. Storage | = 223 cuft |

Storage Indication method used. Exfiltration extracted from Outflow.



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

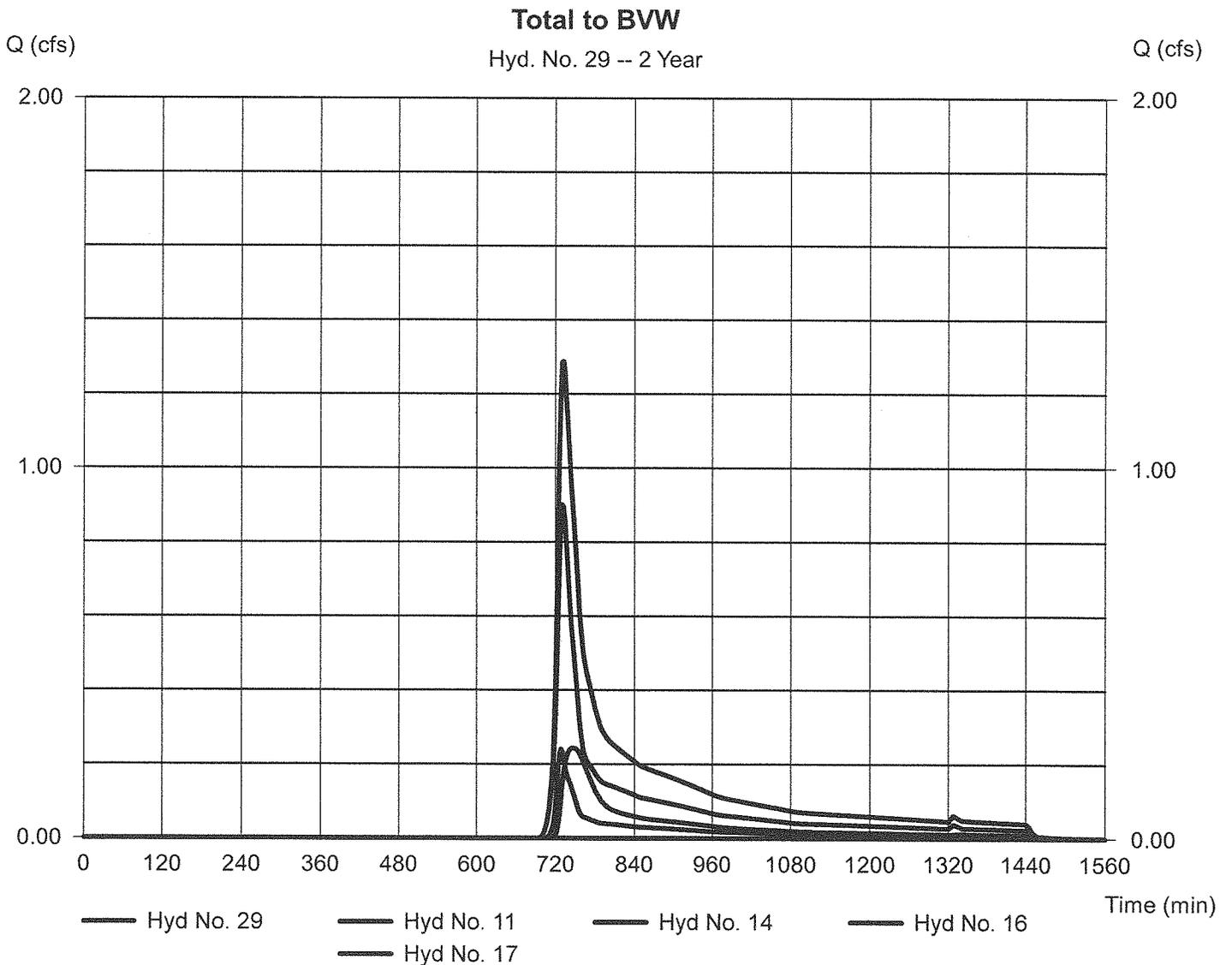
Wednesday, Feb 20, 2013

Hyd. No. 29

Total to BVW

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 2 min
Inflow hyds. = 11, 14, 16, 17

Peak discharge = 1.288 cfs
Time to peak = 732 min
Hyd. volume = 6,910 cuft
Contrib. drain. area = 2.090 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

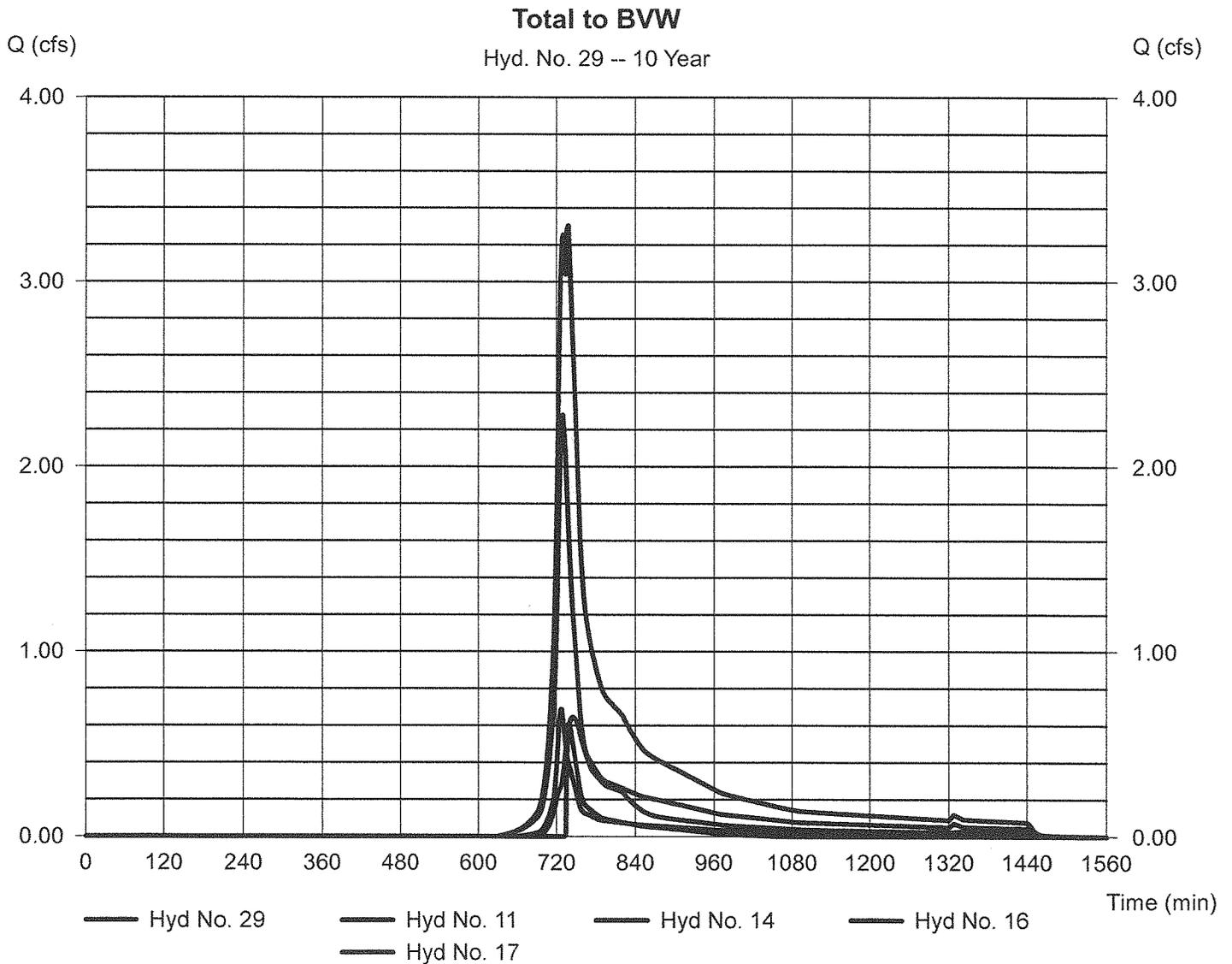
Wednesday, Feb 20, 2013

Hyd. No. 29

Total to BVW

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 2 min
Inflow hyds. = 11, 14, 16, 17

Peak discharge = 3.306 cfs
Time to peak = 738 min
Hyd. volume = 17,582 cuft
Contrib. drain. area = 2.090 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

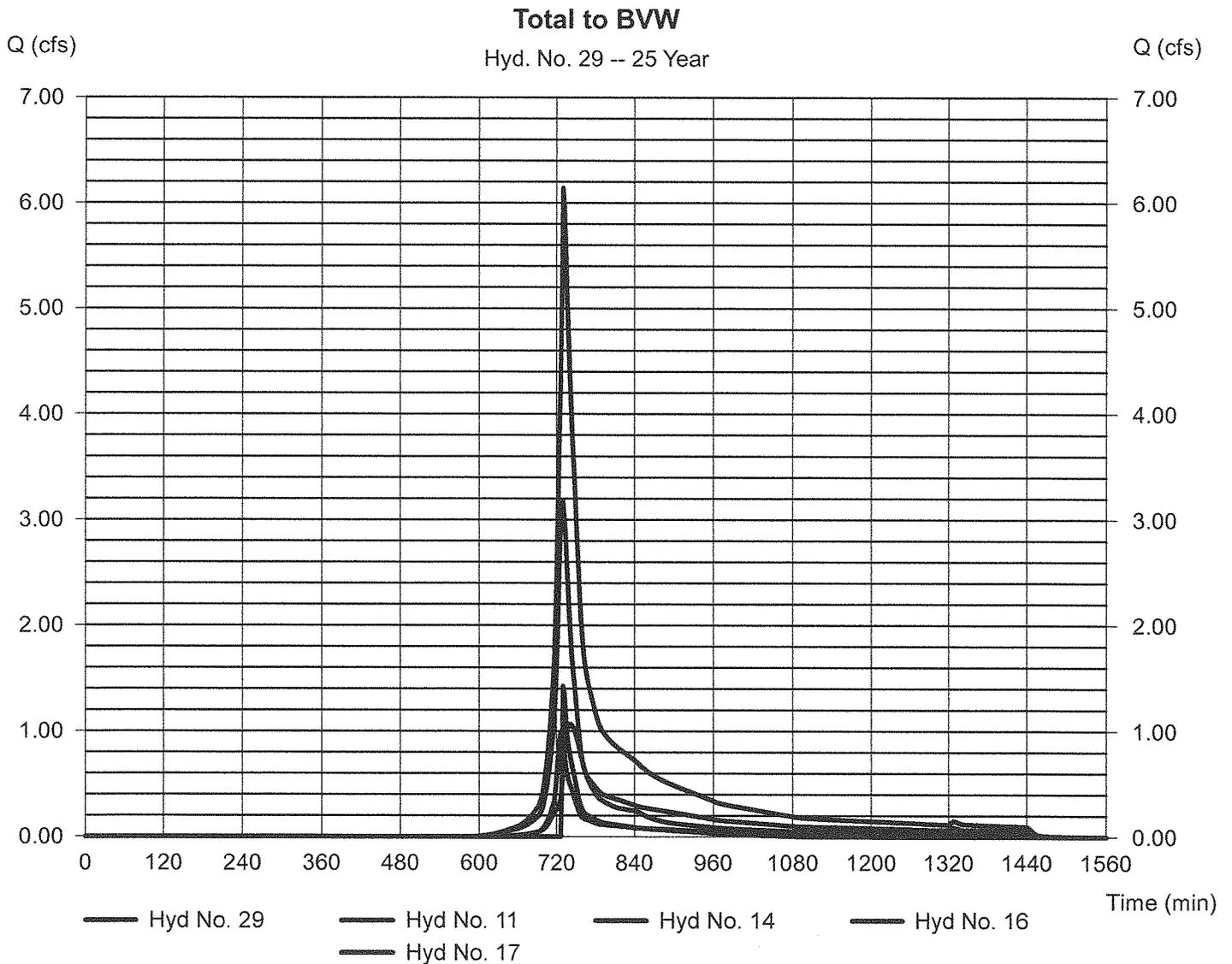
Wednesday, Feb 20, 2013

Hyd. No. 29

Total to BVW

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 2 min
Inflow hyds. = 11, 14, 16, 17

Peak discharge = 6.144 cfs
Time to peak = 730 min
Hyd. volume = 24,956 cuft
Contrib. drain. area = 2.090 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

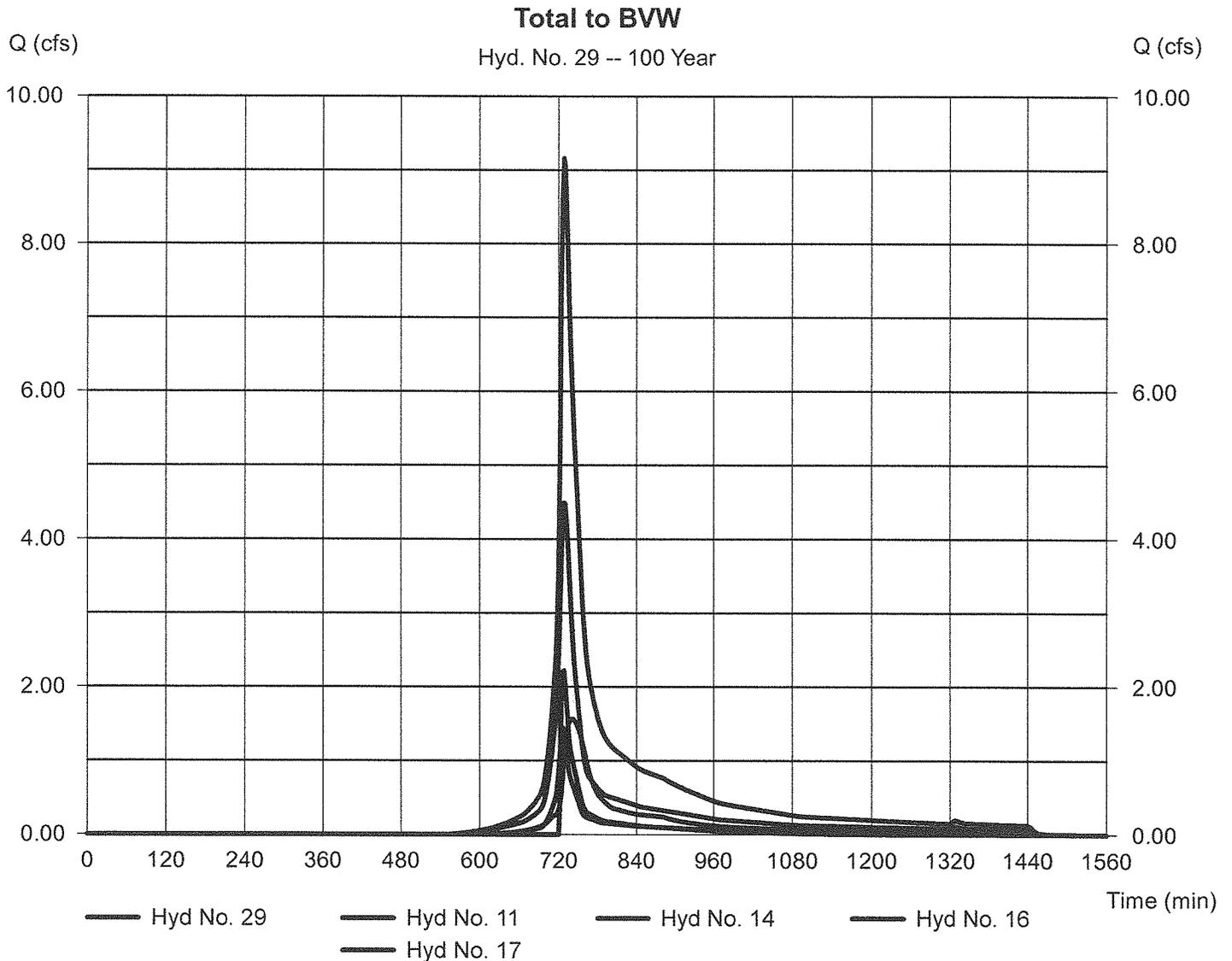
Wednesday, Feb 20, 2013

Hyd. No. 29

Total to BVW

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 2 min
Inflow hyds. = 11, 14, 16, 17

Peak discharge = 9.160 cfs
Time to peak = 728 min
Hyd. volume = 35,988 cuft
Contrib. drain. area = 2.090 ac



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2

Monday, Feb 25, 2013

Pond No. 1 - SMA-1

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Beginning Elevation = 100.50 ft

Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|------------|----------------|---------------------|----------------------|----------------------|
| 0.00 | 100.50 | 30 | 0 | 0 |
| 0.50 | 101.00 | 1,584 | 305 | 305 |
| 1.50 | 102.00 | 2,602 | 2,072 | 2,377 |
| 2.50 | 103.00 | 4,280 | 3,406 | 5,783 |

Culvert / Orifice Structures

| | [A] | [B] | [C] | [PrfRsr] |
|-----------------|----------|--------|--------|----------|
| Rise (in) | = 12.00 | 4.00 | 6.00 | 0.00 |
| Span (in) | = 12.00 | 4.00 | 6.00 | 0.00 |
| No. Barrels | = 1 | 1 | 2 | 0 |
| Invert El. (ft) | = 100.40 | 100.75 | 101.10 | 0.00 |
| Length (ft) | = 97.00 | 1.00 | 1.00 | 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 | Yes | No |

Weir Structures

| | [A] | [B] | [C] | [D] |
|----------------|----------------------|------|------|------|
| Crest Len (ft) | = 4.00 | 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 | = 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).

Stage / Storage / Discharge Table

| Stage ft | Storage cuft | Elevation ft | Civ A cfs | Civ B cfs | Civ C cfs | PrfRsr cfs | Wr A cfs | Wr B cfs | Wr C cfs | Wr D cfs | Exfil cfs | User cfs | Total cfs |
|----------|--------------|--------------|-----------|-----------|-----------|------------|----------|----------|----------|----------|-----------|----------|-----------|
| 0.00 | 0 | 100.50 | 0.00 | 0.00 | 0.00 | --- | 0.00 | --- | --- | --- | 0.000 | --- | 0.000 |
| 0.50 | 305 | 101.00 | 0.25 ic | 0.24 ic | 0.00 | --- | 0.00 | --- | --- | --- | 0.037 | --- | 0.280 |
| 1.50 | 2,377 | 102.00 | 1.92 ic | 0.38 ic | 1.52 ic | --- | 0.00 | --- | --- | --- | 0.061 | --- | 1.970 |
| 2.50 | 5,783 | 103.00 | 2.62 oc | 0.48 ic | 2.15 ic | --- | 0.00 | --- | --- | --- | 0.101 | --- | 2.724 |

Pond Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

Pond No. 3 - SMA-2

Pond Data

UG Chambers - Invert elev. = 0.50 ft, Rise x Span = 2.50 x 4.25 ft, Barrel Len = 37.60 ft, No. Barrels = 4, Slope = 0.00%, Headers = No
 Encasement - Invert elev. = 0.00 ft, Width = 6.25 ft, Height = 3.50 ft, Voids = 40.00%

Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|------------|----------------|---------------------|----------------------|----------------------|
| 0.00 | 0.00 | n/a | 0 | 0 |
| 0.35 | 0.35 | n/a | 132 | 132 |
| 0.70 | 0.70 | n/a | 208 | 340 |
| 1.05 | 1.05 | n/a | 264 | 604 |
| 1.40 | 1.40 | n/a | 260 | 864 |
| 1.75 | 1.75 | n/a | 253 | 1,117 |
| 2.10 | 2.10 | n/a | 242 | 1,359 |
| 2.45 | 2.45 | n/a | 226 | 1,584 |
| 2.80 | 2.80 | n/a | 202 | 1,786 |
| 3.15 | 3.15 | n/a | 152 | 1,938 |
| 3.50 | 3.50 | n/a | 132 | 2,069 |

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 | 1 | 0 | 0 |
| Invert El. (ft) | = 0.50 | 0.00 | 0.00 | 0.00 |
| Length (ft) | = 40.00 | 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) | = 4.00 | 0.00 | 0.00 | 0.00 |
| Crest El. (ft) | = 2.25 | 0.00 | 0.00 | 0.00 |
| Weir Coeff. | = 3.33 | 3.33 | 3.33 | 3.33 |
| Weir Type | = Riser | --- | --- | --- |
| Multi-Stage | = Yes | No | No | No |
| Exfil.(in/hr) | = 1.020 (by Wet area) | | | |
| TW Elev. (ft) | = 0.00 | | | |

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

Stage / Storage / Discharge Table

| Stage ft | Storage cuft | Elevation ft | Clv A cfs | Clv B cfs | Clv C cfs | PrfRsr cfs | Wr A cfs | Wr B cfs | Wr C cfs | Wr D cfs | Exfil cfs | User cfs | Total cfs |
|----------|--------------|--------------|-----------|-----------|-----------|------------|----------|----------|----------|----------|-----------|----------|-----------|
| 0.00 | 0 | 0.00 | 0.00 | --- | --- | --- | 0.00 | --- | --- | --- | 0.000 | --- | 0.000 |
| 0.35 | 132 | 0.35 | 0.00 | --- | --- | --- | 0.00 | --- | --- | --- | 0.025 | --- | 0.025 |
| 0.70 | 340 | 0.70 | 0.00 | --- | --- | --- | 0.00 | --- | --- | --- | 0.027 | --- | 0.027 |
| 1.05 | 604 | 1.05 | 0.00 | --- | --- | --- | 0.00 | --- | --- | --- | 0.030 | --- | 0.030 |
| 1.40 | 864 | 1.40 | 0.00 | --- | --- | --- | 0.00 | --- | --- | --- | 0.032 | --- | 0.032 |
| 1.75 | 1,117 | 1.75 | 0.00 | --- | --- | --- | 0.00 | --- | --- | --- | 0.035 | --- | 0.035 |
| 2.10 | 1,359 | 2.10 | 0.00 | --- | --- | --- | 0.00 | --- | --- | --- | 0.037 | --- | 0.037 |
| 2.45 | 1,584 | 2.45 | 1.20 oc | --- | --- | --- | 1.19 | --- | --- | --- | 0.040 | --- | 1.231 |
| 2.80 | 1,786 | 2.80 | 4.30 oc | --- | --- | --- | 4.30 s | --- | --- | --- | 0.042 | --- | 4.342 |
| 3.15 | 1,938 | 3.15 | 5.07 oc | --- | --- | --- | 5.07 s | --- | --- | --- | 0.045 | --- | 5.115 |
| 3.50 | 2,069 | 3.50 | 5.60 oc | --- | --- | --- | 5.60 s | --- | --- | --- | 0.047 | --- | 5.643 |

Pond Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

Pond No. 2 - Lots 1,2,3,4 drywells Rd 1,2,3,4

Pond Data

UG Chambers - Invert elev. = 0.50 ft, Rise x Span = 2.50 x 4.25 ft, Barrel Len = 23.35 ft, No. Barrels = 2, Slope = 0.00%, Headers = No
 Encasement - Invert elev. = 0.00 ft, Width = 6.25 ft, Height = 3.50 ft, Voids = 40.00%

Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|------------|----------------|---------------------|----------------------|----------------------|
| 0.00 | 0.00 | n/a | 0 | 0 |
| 0.35 | 0.35 | n/a | 41 | 41 |
| 0.70 | 0.70 | n/a | 65 | 106 |
| 1.05 | 1.05 | n/a | 82 | 188 |
| 1.40 | 1.40 | n/a | 81 | 268 |
| 1.75 | 1.75 | n/a | 78 | 347 |
| 2.10 | 2.10 | n/a | 75 | 422 |
| 2.45 | 2.45 | n/a | 70 | 492 |
| 2.80 | 2.80 | n/a | 63 | 555 |
| 3.15 | 3.15 | n/a | 47 | 602 |
| 3.50 | 3.50 | n/a | 41 | 643 |

Culvert / Orifice Structures

Weir Structures

| | [A] | [B] | [C] | [PrfRsr] | | [A] | [B] | [C] | [D] |
|-----------------|--------|------|------|----------|----------------|-----------------------|------|------|------|
| Rise (in) | = 0.00 | 0.00 | 0.00 | 0.00 | Crest Len (ft) | = 0.00 | 0.00 | 0.00 | 0.00 |
| Span (in) | = 0.00 | 0.00 | 0.00 | 0.00 | Crest El. (ft) | = 0.00 | 0.00 | 0.00 | 0.00 |
| No. Barrels | = 0 | 0 | 0 | 0 | Weir Coeff. | = 3.33 | 3.33 | 3.33 | 3.33 |
| Invert El. (ft) | = 0.00 | 0.00 | 0.00 | 0.00 | Weir Type | = --- | --- | --- | --- |
| Length (ft) | = 0.00 | 0.00 | 0.00 | 0.00 | Multi-Stage | = No | No | No | No |
| 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 | Exfil.(in/hr) | = 1.020 (by Wet area) | | | |
| Multi-Stage | = n/a | No | No | No | 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).

Stage / Storage / Discharge Table

| Stage ft | Storage cuft | Elevation ft | Clv A cfs | Clv B cfs | Clv C cfs | PrfRsr cfs | Wr A cfs | Wr B cfs | Wr C cfs | Wr D cfs | Exfil cfs | User cfs | Total cfs |
|----------|--------------|--------------|-----------|-----------|-----------|------------|----------|----------|----------|----------|-----------|----------|-----------|
| 0.00 | 0 | 0.00 | --- | --- | --- | --- | --- | --- | --- | --- | 0.000 | --- | 0.000 |
| 0.35 | 41 | 0.35 | --- | --- | --- | --- | --- | --- | --- | --- | 0.008 | --- | 0.008 |
| 0.70 | 106 | 0.70 | --- | --- | --- | --- | --- | --- | --- | --- | 0.008 | --- | 0.008 |
| 1.05 | 188 | 1.05 | --- | --- | --- | --- | --- | --- | --- | --- | 0.009 | --- | 0.009 |
| 1.40 | 268 | 1.40 | --- | --- | --- | --- | --- | --- | --- | --- | 0.010 | --- | 0.010 |
| 1.75 | 347 | 1.75 | --- | --- | --- | --- | --- | --- | --- | --- | 0.011 | --- | 0.011 |
| 2.10 | 422 | 2.10 | --- | --- | --- | --- | --- | --- | --- | --- | 0.012 | --- | 0.012 |
| 2.45 | 492 | 2.45 | --- | --- | --- | --- | --- | --- | --- | --- | 0.012 | --- | 0.012 |
| 2.80 | 555 | 2.80 | --- | --- | --- | --- | --- | --- | --- | --- | 0.013 | --- | 0.013 |
| 3.15 | 602 | 3.15 | --- | --- | --- | --- | --- | --- | --- | --- | 0.014 | --- | 0.014 |
| 3.50 | 643 | 3.50 | --- | --- | --- | --- | --- | --- | --- | --- | 0.015 | --- | 0.015 |

Pond Report

Hydraflow Hydrographs by Intelisolve v9.2

Wednesday, Feb 20, 2013

Pond No. 11 - Lot 5 Drywell RD5

Pond Data

UG Chambers - Invert elev. = 0.50 ft, Rise x Span = 2.50 x 4.25 ft, Barrel Len = 23.36 ft, No. Barrels = 1, Slope = 0.00%, Headers = No
 Encasement - Invert elev. = 0.00 ft, Width = 6.25 ft, Height = 3.50 ft, Voids = 40.00%

Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|------------|----------------|---------------------|----------------------|----------------------|
| 0.00 | 0.00 | n/a | 0 | 0 |
| 0.35 | 0.35 | n/a | 20 | 20 |
| 0.70 | 0.70 | n/a | 32 | 53 |
| 1.05 | 1.05 | n/a | 41 | 94 |
| 1.40 | 1.40 | n/a | 40 | 134 |
| 1.75 | 1.75 | n/a | 39 | 173 |
| 2.10 | 2.10 | n/a | 38 | 211 |
| 2.45 | 2.45 | n/a | 35 | 246 |
| 2.80 | 2.80 | n/a | 31 | 277 |
| 3.15 | 3.15 | n/a | 24 | 301 |
| 3.50 | 3.50 | n/a | 20 | 321 |

Culvert / Orifice Structures

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

Weir Structures

| | [A] | [B] | [C] | [D] |
|----------------|-----------------------|------|------|------|
| Crest Len (ft) | = 0.00 | 0.00 | 0.00 | 0.00 |
| Crest El. (ft) | = 0.00 | 0.00 | 0.00 | 0.00 |
| Weir Coeff. | = 3.33 | 3.33 | 3.33 | 3.33 |
| Weir Type | = --- | --- | --- | --- |
| Multi-Stage | = No | No | No | No |
| Exfil.(in/hr) | = 1.020 (by Wet area) | | | |
| TW Elev. (ft) | = 0.00 | | | |

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

Stage / Storage / Discharge Table

| Stage ft | Storage cuft | Elevation ft | Civ A cfs | Civ B cfs | Civ C cfs | PrfRsr cfs | Wr A cfs | Wr B cfs | Wr C cfs | Wr D cfs | Exfil cfs | User cfs | Total cfs |
|----------|--------------|--------------|-----------|-----------|-----------|------------|----------|----------|----------|----------|-----------|----------|-----------|
| 0.00 | 0 | 0.00 | --- | --- | --- | --- | --- | --- | --- | --- | 0.000 | --- | 0.000 |
| 0.35 | 20 | 0.35 | --- | --- | --- | --- | --- | --- | --- | --- | 0.004 | --- | 0.004 |
| 0.70 | 53 | 0.70 | --- | --- | --- | --- | --- | --- | --- | --- | 0.004 | --- | 0.004 |
| 1.05 | 94 | 1.05 | --- | --- | --- | --- | --- | --- | --- | --- | 0.005 | --- | 0.005 |
| 1.40 | 134 | 1.40 | --- | --- | --- | --- | --- | --- | --- | --- | 0.005 | --- | 0.005 |
| 1.75 | 173 | 1.75 | --- | --- | --- | --- | --- | --- | --- | --- | 0.005 | --- | 0.005 |
| 2.10 | 211 | 2.10 | --- | --- | --- | --- | --- | --- | --- | --- | 0.006 | --- | 0.006 |
| 2.45 | 246 | 2.45 | --- | --- | --- | --- | --- | --- | --- | --- | 0.006 | --- | 0.006 |
| 2.80 | 277 | 2.80 | --- | --- | --- | --- | --- | --- | --- | --- | 0.007 | --- | 0.007 |
| 3.15 | 301 | 3.15 | --- | --- | --- | --- | --- | --- | --- | --- | 0.007 | --- | 0.007 |
| 3.50 | 321 | 3.50 | --- | --- | --- | --- | --- | --- | --- | --- | 0.007 | --- | 0.007 |

Infiltration Trench Calculation

Project: 27 Jackson Drive by: JTM Date: 2/4/2013

Location: Acton, MA checked: Date:

P11-Lot 2 Turnout

Area of Driveway: 835 S.F. 0.02 AC
 Direct runoff 100 yr Storm Event: 6.26 inches From Figure 2.1 210 VI-TR55
 based on 6.4 inches of rainfall

Turnout runoff volume to be infiltrated

$$835 \text{ S.F.} \times 6.26 \text{ IN} = 436 \text{ FT}^3$$

Infiltration trench sizing

Length: 34 ft
 Width: 2 ft
 Depth: 2 ft
 40% voids with gravel

Volume provided: $L' \times W' \times D' \times 40\%$

$$34 \times 2 \times 2 \times 40\% = 54 \text{ FT}^3$$

Infiltration

(Total area +Infiltration) (1.02 in/hr (Rawls # for Loam)) x 24 hours*(1ft/12in)

$$68 + 136 * 1.02 * 24 = 416 \text{ ft}^3 \text{ per 24 hours}$$

$$54 \text{ FT}^3 + 416 \text{ FT}^3 = 471 \text{ FT}^3$$

| |
|--|
| 471 FT ³ > 436 FT ³ O.K. |
|--|

Infiltration Trench Calculation

Project: 27 Jackson Drive by: JTM Date: 2/4/2013

Location: Acton, MA checked: Date:

P12- ot 3 Turnout

Area of Driveway: 920 S.F. 0.02 AC
 Direct runoff 100 yr Storm Event: 6.26 inches From Figure 2.1 210 VI-TR55
 based on 6.4 inches of rainfall

Turnout runoff volume to be infiltrated

$$920 \text{ S.F.} \times 6.26 \text{ IN} = 480 \text{ FT}^3$$

Infiltration trench sizing

Length: 35 ft
 Width: 3 ft
 Depth: 2 ft

40% voids with gravel

Volume provided: L' x W' x D' X 40%

$$35 \times 3 \times 2 \times 40\% = 84 \text{ FT}^3$$

Infiltration

(Total area +Infiltration) (1.02 in/hr (Rawls # for Loam)) x 24 hours*(1ft/12in)

$$105 + 140 * 1.02 * 24 = 500 \text{ ft}^3 \text{ per 24 hours}$$

$$84 \text{ FT}^3 + 500 \text{ FT}^3 = 584 \text{ FT}^3$$

| | | | | | |
|-----|-----------------|---|-----|-----------------|------|
| 584 | FT ³ | > | 480 | FT ³ | O.K. |
|-----|-----------------|---|-----|-----------------|------|

Infiltration Trench Calculation

Project: 27 Jackson Drive by: JTM Date: 2/4/2013

Location: Acton, MA checked: Date:

P13-Lot 2 Rear lawn area

Area of Driveway: 3058 S.F. 0.07 AC
 Direct runoff 100 yr Storm Event: 2.23 inches From Table 2.1 210 VI-TR55
 based on 6.4 inches of rainfall

Lawn runoff volume to be infiltrated

$$3058 \text{ S.F.} \times 2.23 \text{ IN} = 568 \text{ FT}^3$$

Infiltration trench sizing

Length: 40 ft
 Width: 3 ft
 Depth: 2 ft

40% voids with gravel

Volume provided: L' x W' x D' X 40%

$$40 \times 3 \times 2 \times 40\% = 96 \text{ FT}^3$$

Infiltration

(Total area +Infiltration) (1.02 in/hr (Rawls # for Loam)) x 24 hours*(1ft/12in)
 120 + 160 * 1.02*24 = 571 ft³ per 24 hours

$$96 \text{ FT}^3 + 571 \text{ FT}^3 = 667 \text{ FT}^3$$

| |
|--|
| 667 FT ³ > 568 FT ³ O.K. |
|--|

Infiltration Trench Calculation

Project: 27 Jackson Drive by: JTM Date: 2/4/2013

Location: Acton, MA checked: Date:

P14-Lot 3 Rear lawn area

Area of Driveway: 3191 S.F. 0.07 AC
 Direct runoff 100 yr Storm Event: 2.23 inches From Table 2.1 210 VI-TR55
 based on 6.4 inches of rainfall

Lawn runoff volume to be infiltrated

$$3191 \text{ S.F.} \times 2.23 \text{ IN} = 593 \text{ FT}^3$$

Infiltration trench sizing

Length: 40 ft
 Width: 3 ft
 Depth: 2 ft

40% voids with gravel

Volume provided: $L' \times W' \times D' \times 40\%$

$$40 \times 3 \times 2 \times 40\% = 96 \text{ FT}^3$$

Infiltration

(Total area +Infiltration) (1.02 in/hr (Rawls # for Loam)) x 24 hours*(1ft/12in)

$$120 + 160 * 1.02 * 24 = 571 \text{ ft}^3 \text{ per 24 hours}$$

$$96 \text{ FT}^3 + 571 \text{ FT}^3 = 667 \text{ FT}^3$$

| |
|--|
| 667 FT ³ > 593 FT ³ O.K. |
|--|

Water Quality Volume Calculations

STAMSKI AND McNARY, INC.

1000 Main Street
ACTON, MASSACHUSETTS 01720
TEL (978) 263-8585
FAX (978) 263-9883

JOB 4993
SHEET NO. _____ OF _____
CALCULATED BY _____ DATE _____
CHECKED BY _____ DATE _____
SCALE _____

SMA-2

Water quality volume

0.5 inch of runoff

Road Area = 5836 S.F.

$$\text{Volume} = 5836 \times \frac{.5}{12} = 243.17 \text{ ft}^3$$

Provided

Isolated Row - 1 Row 5 Chambers

$$5 \times 74.9 \text{ ft}^3 = 374.5 \text{ ft}^3 > 243.17 \text{ ft}^3 \quad / \text{ OK.}$$

SMA-1

Water quality volume

0.5 inch of runoff

Road area = 2158 S.F.

$$\text{Volume} = 2158 \times \frac{.5}{12} = 89.92 \text{ ft}^3$$

Provided

| | | | |
|--------|--------|------|-----|
| Center | 100.75 | Area | 338 |
| | 100.5 | | 144 |

$$\text{Volume} = \frac{338(6.25) + 144}{2} = 114.25 \text{ ft}^3 > 89.92 \text{ ft}^3 \quad / \text{ C.K.}$$

CB-1

Water quality volume

0.5 inch of runoff

Road area = 3108

$$\text{Volume} = 3108 \times \frac{.5}{12} = 129.5 \text{ ft}^3$$

Provided

| | | | |
|--------|------|------|-------|
| Center | 98 | Area | 296.5 |
| | 97.5 | | 122.5 |

$$\text{Volume} = \frac{296.5(6.25) + 122.5}{2} = 135.4 \text{ ft}^3$$

STAMSKI AND McNARY, INC.

1000 Main Street
ACTON, MASSACHUSETTS 01720
TEL (978) 263-8585
FAX (978) 263-9883

JOB 4993

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

Sediment Porebay Sizing

SMA-2

0.1 Inches of runoff

Road Area = 5836 S.F.

$$\text{Volume} = 5836 \times \frac{0.1}{12} = 48.63 \text{ ft}^3$$

SMA-1

0.1 Inches of runoff

Road Area = 2158 S.F.

$$\text{Volume} = 2158 \times \frac{0.1}{12} = 17.98 \text{ ft}^3$$

CB-1

0.1 Inches of runoff

Road Area = 3108 S.F.

$$\text{Volume} = 3108 \times \frac{0.1}{12} = 25.9 \text{ ft}^3$$

Groundwater Recharge Calculations

STAMSKI AND McNARY, INC.

1000 Main Street
 ACTON, MASSACHUSETTS 01720
 TEL (978) 263-8585
 FAX (978) 263-9883

JOB 4993

SHEET NO. _____ OF _____

CALCULATED BY JTM DATE _____

CHECKED BY _____ DATE _____

SCALE _____

SMA-1

Required Recharge Volume

$$R_v = F \times \text{Imp Area} \quad F = .35 \text{ inch}$$

Road Area = 2158 S.F.

$$R_v = \frac{.35}{12} \times 2158 = 62.94 \text{ ft}^3$$

- Storage Volume (Simple Dynamic)

$$A = R_v \cdot (D + \frac{1}{2}T)$$

$$R_v = 62.94$$

$$D = 3$$

$$K = 1.02$$

$$T = 3$$

$$A = \frac{62.94}{1 + \frac{1.02 \cdot 3}{12}} = 370.3 \text{ SF}$$

$$V = A \times D$$

$$V = 370.3 \times 1 = 370.3 \text{ ft}^3$$

- 72 hour Drawdown

$$T = \frac{R_v}{K (\text{Bul. Area})}$$

$$= \frac{62.94}{.02 \cdot (144)} = 5.2 \text{ hours} < 72 \text{ hours}$$

STAMSKI AND McNARY, INC.

1000 Main Street
ACTON, MASSACHUSETTS 01720

TEL (978) 263-8585

FAX (978) 263-9883

JOB _____

SHEET NO. _____ OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____

Required Recharge Volume

SMA-2

$R_v = F \times \text{Imp Area}$ $F = .35 \text{ Inch}$

Road area = 59836

$$R_v = \frac{.35}{12} \times 59836 = 170.22 \text{ ft}^3$$

- Storage Volume (Simple Dynamic)

$$A = R_v \div (D + K/T)$$

$$R_v = 170.22$$

$$D = 3.5$$

$$K = 1.02$$

$$T = 2$$

$$\frac{170.22}{3.5 + \frac{1.02}{2}} = 46.38 \text{ S.F.}$$

$$V = A \times D$$

$$V = 46.38 \times 3.5 = 162.33 \text{ ft}^3$$

- 72 Hour Drawdown

$$T = \frac{R_v}{K (\text{Bot. Area})}$$

$$T = \frac{170.22}{\frac{1.02}{12} (170.22)} = 1.67 \text{ hours} < 72 \text{ hours} \quad / \quad \text{C.K.}$$

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 value within Row
5. Total TSS Removal = Sum All Values in Column D

Location: **CB-1 Within Subcatchment P-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 |
| WATER QUALITY SWALE* | 80% | 0.80 | 0.60 | 0.15 |
| *SIZED TO CONTROL WATER QUAL. VOL. | | | | |
| | | | | |
| | | | | |

Total TSS Removal =

85%

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

Project: 4993
 Prepared By: JTM
 Date: 2/21/2013

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

TSS Removal

Calculation Worksheet

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

Location:

| A | B | C | D | E |
|--|-------------------------------|--------------------|----------------------|----------------------|
| BMP ¹ | TSS Removal Rate ¹ | Starting TSS Load* | Amount Removed (B*C) | Remaining Load (C-D) |
| DEEP SUMP CATCH BASIN W/ HOOD | 25% | 1.00 | 0.25 | 0.75 |
| INFILTRATION BASIN W/ SEDIMENT FOREBAY | 80% | 0.75 | 0.60 | 0.15 |
| | | | | |
| | | | | |
| | | | | |

Total TSS Removal =

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

Project:
 Prepared By:
 Date:

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

TSS Removal Calculation Worksheet

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 value within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

Location:

| A | B | C | D | E |
|-------------------------------|-------------------------------|--------------------|----------------------|----------------------|
| BMP ¹ | TSS Removal Rate ¹ | Starting TSS Load* | Amount Removed (B*C) | Remaining Load (C-D) |
| DEEP SUMP CATCH BASIN W/ HOOD | 25% | 1.00 | 0.25 | 0.75 |
| SUBSURFACE STRUCTURE | 80% | 0.75 | 0.60 | 0.15 |
| | | | | |
| | | | | |
| | | | | |

Total TSS Removal =

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

Project:
 Prepared By:
 Date:

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

TSS Removal Calculation Worksheet

Groundwater Mounding Calculations

STAMSKI AND McNARY, INC.

1000 Main Street
ACTON, MASSACHUSETTS 01720
TEL (978) 263-8585
FAX (978) 263-9883

JOB 27 JACKSON DRIVE

SHEET NO. _____ OF _____

CALCULATED BY POSTA DATE 3/6/13

CHECKED BY _____ DATE _____

SCALE _____

GROUNDWATER MONITORING CALCULATIONS

SMA-2

REQUIREMENT: MONITORING VOLUME IS AVAILABLE AFTER 3 DAYS FOR NEXT STORM EVENT.

VOLUME SUBJECT TO MONITORING ANALYSIS:

AVAILABLE STORAGE WITHIN SMA-2 = 2,069 CF.

VOLUME UTILIZED DURING ^{100% PEAK} STORM EVENT = 1,644 CF

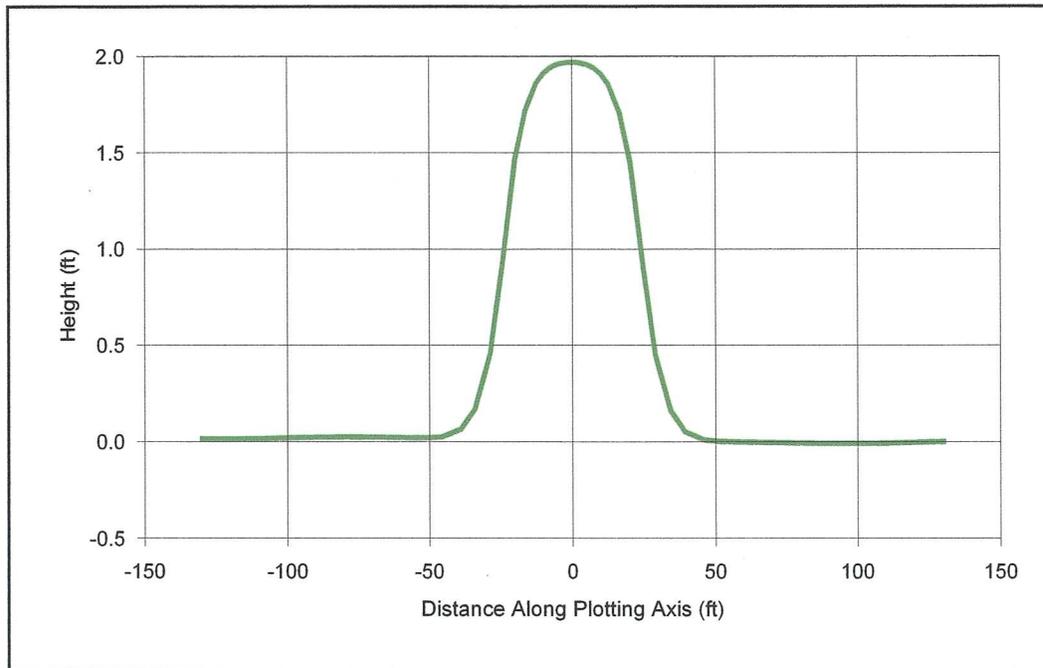
VOLUME AVAILABLE FOR NEXT STORM EVENT = 425 CF

1644 CF - 425 = 1,219 CF = VOLUME TO BE ANALYZED

APPLYMENT RATE = $\frac{1,219 \text{ CF}}{48' \times 41'} = 0.6 \text{ CF/SF/DAY}$

SEE HANTUSH METHOD - FOR GROUNDWATER ANALYSIS

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



COMPANY: Stamski and McNary, Inc.

PROJECT: SM-4993 SMA-2 Cul-de-sac Runoff

ANALYST: RJH

DATE: 3/6/2013 TIME: 1:08:10 PM

INPUT PARAMETERS

Application rate: 0.6 c.ft/day/sq. ft

Duration of application: 1 days

Fillable porosity: 0.3

Hydraulic conductivity: 2.04 ft/day

Initial saturated thickness: 8 ft

Length of application area: 48 ft

Width of application area: 41 ft

Constant head boundary used at: 130 ft

Plotting axis from Y-Axis: 355 degrees

Edge of recharge area:

positive X: -20.5 ft

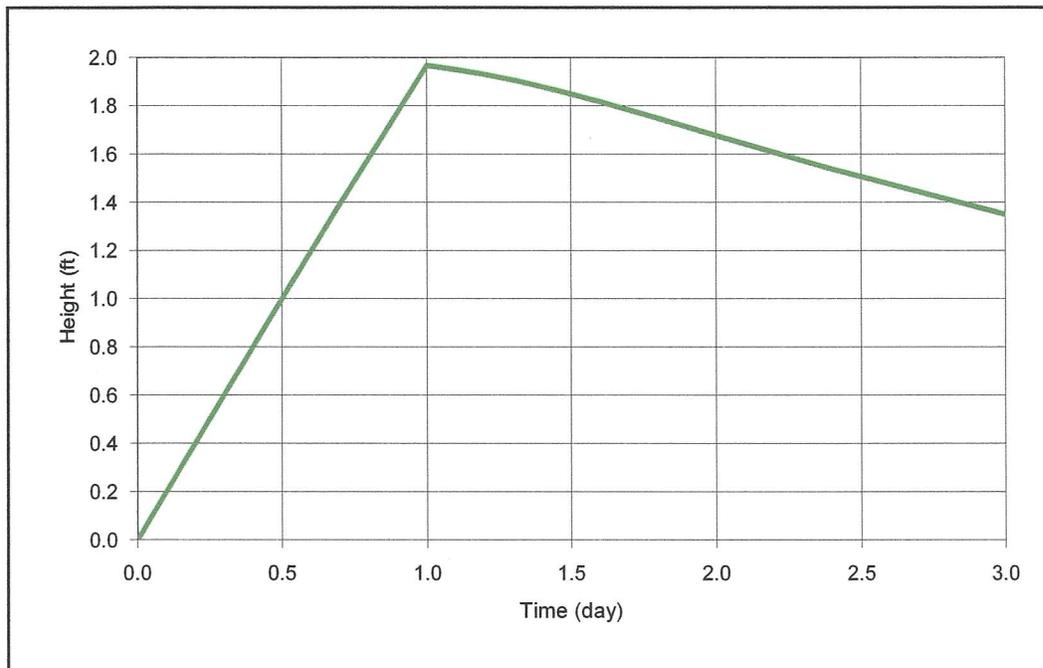
positive Y: 234.3 ft

Total volume applied: 1180.8 c.ft

MODEL RESULTS

| X (ft) | Y (ft) | Plot Axis (ft) | Mound Height (ft) |
|-----------|-----------|----------------------|-------------------------|
| 11.3 | -129.5 | -130 | 0.01 |
| 9.5 | -108.9 | -109 | 0.01 |
| 7.7 | -88.3 | -89 | 0.02 |
| 5.9 | -67.7 | -68 | 0.02 |
| 4.5 | -51.5 | -52 | 0.02 |
| 3.4 | -39 | -39 | 0.06 |
| 2.5 | -28.7 | -29 | 0.46 |
| 1.8 | -20.1 | -20 | 1.46 |
| 1.1 | -12.5 | -13 | 1.86 |
| 0.7 | -7.5 | -8 | 1.94 |
| 0.4 | -4.1 | -4 | 1.96 |
| 0 | 0 | 0 | 1.97 |
| -0.4 | 4.1 | 4 | 1.96 |
| -0.7 | 7.5 | 8 | 1.94 |
| -1.1 | 12.5 | 13 | 1.86 |
| -1.8 | 20.1 | 20 | 1.46 |
| -2.5 | 28.7 | 29 | 0.45 |
| -3.4 | 39 | 39 | 0.05 |
| -4.5 | 51.5 | 52 | 0 |
| -5.9 | 67.7 | 68 | 0 |
| -7.7 | 88.3 | 89 | -0.01 |
| -9.5 | 108.9 | 109 | -0.01 |
| -11.3 | 129.5 | 130 | 0 |

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



COMPANY: Stamski and McNary, Inc.

PROJECT: SM-4993 SMA-2 Cul-de-sac Runoff

ANALYST: RJH

DATE: 3/6/2013 TIME: 1:08:32 PM

INPUT PARAMETERS

Application rate: 0.6 c.ft/day/sq. ft
 Duration of application: 1 day
 Total simulation time: 3 day
 Fillable porosity: 0.3
 Hydraulic conductivity: 2.04 ft/day
 Initial saturated thickness: 8 ft
 Length of application area: 48 ft
 Width of application area: 41 ft
 Constant head boundary used at: 130 ft
 Groundwater mounding @
 X coordinate: 1 ft
 Y coordinate: 1 ft
 Total volume applied: 1180.8 cft

MODEL RESULTS

| Time (day) | Mound Height (ft) |
|------------|-------------------|
| 0 | 0 |
| 0 | 0.03 |
| 0 | 0.09 |
| 0.1 | 0.19 |
| 0.2 | 0.31 |
| 0.2 | 0.44 |
| 0.3 | 0.6 |
| 0.4 | 0.8 |
| 0.5 | 1.04 |
| 0.7 | 1.39 |
| 1 | 1.96 |
| 1 | 1.96 |
| 1.1 | 1.95 |
| 1.2 | 1.93 |
| 1.3 | 1.9 |
| 1.4 | 1.86 |
| 1.6 | 1.82 |
| 1.8 | 1.75 |
| 2 | 1.66 |
| 2.4 | 1.54 |
| 3 | 1.35 |

Pipe Sizing Calculations

DESIGN STORM: 100 YEAR
 DATE: 2/13/2013
 DONE BY: JTM
 FILE: 4993 RATIONAL METHOD.wb3

STORM SEWER DESIGN
 (ADS N-12) $n=0.010$
 (ADS N-12) $n=0.012$
 (ADS N-12) $n=0.013$
 (Cast Iron) $n=0.011$

PROJECT: SM-4993
 LOCATION: Acton, MA

4"-10"
 12"-36"
 42"-60"

| FROM | TO | LENGTH (FT) | TRIBUTARY AREA | | TIME OF FLOW | | RUNOFF COEFF. "C" | RAINFALL INTENSITY (IN/HR) | "Q" TOTAL RUNOFF (CFS) | SLOPE OF PIPE (FT/FT) | DIAM (IN) | MANN. "n" | CAPACITY FULL (CFS) | VELOCITY FULL (FPS) | VELOCITY (FPS) | VELOCITY HEAD (FT) | DEPTH OF FLOW (FT) | TOTAL ENERGY HEAD (FT) | MANHOLE INVERT DROP (FT) | FALL IN PIPE (FT) | DRAIN INV. ELEVATION | | GROUND SURFACE | |
|-------|------------|-------------|----------------|---------------|-----------------|--------------------|-------------------|----------------------------|------------------------|-----------------------|-----------|-----------|---------------------|---------------------|----------------|--------------------|--------------------|------------------------|--------------------------|-------------------|----------------------|-----------|----------------|-----------|
| | | | INCR. (ACRES) | TOTAL (ACRES) | UPPER END (MIN) | TO UPPER END (MIN) | | | | | | | | | | | | | | | UPPER END | LOWER END | UPPER END | LOWER END |
| CB-1 | Flared end | 23 | 0.05 | 0.05 | 10 | 0.13 | 0.90 | 7.6 | 0.34 | 0.010 | 12 | 0.012 | 3.85 | 4.91 | 3.02 | 0.14 | 0.20 | 0.34 | 0.23 | 98.73 | 98 | 101.23 | 98 | 101.23 |
| CB2 | SMH-1 | 31 | 0.05 | 0.05 | 10 | 0.19 | 0.90 | 7.6 | 0.34 | 0.007 | 12 | 0.012 | 3.32 | 4.23 | 2.71 | 0.11 | 0.22 | 0.33 | 0.23 | 101.23 | 101 | 104.25 | 101.5 | 104.25 |
| CB3 | DMH-1 | 18 | 0.48 | 0.48 | 10 | 0.03 | 0.43 | 7.6 | 1.58 | 0.104 | 12 | 0.012 | 12.42 | 15.82 | 10.82 | 1.82 | 0.24 | 2.06 | 1.87 | 106.37 | 104.5 | 110.87 | 110.39 | 110.39 |
| CB4 | DMH-1 | 68 | 0.11 | 0.11 | 10 | 0.17 | 0.65 | 7.6 | 0.54 | 0.067 | 12 | 0.012 | 10.00 | 12.74 | 6.71 | 0.70 | 0.16 | 0.85 | 4.58 | 109.08 | 104.5 | 113.58 | 110.39 | 110.39 |
| DMH-1 | Overflow | 26 | 0.59 | 0.59 | 10 | 0.11 | 0.35 | 7.6 | 1.57 | 0.006 | 12 | 0.012 | 2.93 | 3.79 | 3.79 | 0.22 | 0.52 | 0.74 | 0.15 | 106.8 | 106.65 | 110.39 | 106.65 | 106.65 |
| D1-1 | DMH-2 | 55 | 0.26 | 0.26 | 10 | 0.35 | 0.25 | 7.6 | 0.50 | 0.005 | 12 | 0.012 | 2.75 | 3.50 | 2.64 | 0.11 | 0.29 | 0.39 | 0.38 | 108.75 | 108.47 | 110.9 | 116 | 116 |
| D1-2 | DMH-2 | 76 | 0.26 | 0.26 | 10 | 0.23 | 0.59 | 7.6 | 1.16 | 0.020 | 12 | 0.012 | 5.47 | 6.96 | 5.50 | 0.47 | 0.31 | 0.78 | 1.53 | 110 | 108.47 | 113 | 116 | 116 |
| DMH2 | Flared End | 134 | 0.52 | 0.52 | 10 | 0.60 | 0.42 | 7.6 | 1.68 | 0.005 | 12 | 0.012 | 2.78 | 3.55 | 3.70 | 0.21 | 0.56 | 0.77 | 0.70 | 108.45 | 107.75 | 116 | 107 | 107 |

Closed Drainage System

SM-4993

1 of 5

Project: Jackson Drive

By JTM Date 2/13/2013

Location: Acton, MA

Checked _____ Date _____

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

A = area (ac)

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

CB-1

| Surface Cover | A (ac) | C | Product A x C |
|------------------|-----------------------------|------|------------------|
| impervious | 0.05 | 0.9 | 0.045 |
| lands/grass | | 0.2 | 0 |
| woods | <u> </u> | 0.15 | <u>0</u> |
| sum = | 0.05 | | sum = 0.045 |

C = 0.90 = total product / total area

Closed Drainage System

SM-4993

2 of 5

Project: Jackson Drive

By JTM Date 2/13/2013

Location: Acton, MA

Checked _____ Date _____

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

A = area (ac)

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

CB2

| Surface Cover | A (ac) | C | Product A x C |
|---------------|--------|-------|---------------|
| Impervious | 0.16 | 0.9 | 0.144 |
| Grass | 0.32 | 0.2 | 0.064 |
| | | | <u>0.000</u> |
| sum = | 0.48 | sum = | 0.208 |

C = 0.43 = total product / total area

CB2

| Surface Cover | A (ac) | C | Product A x C |
|---------------|--------|-------|---------------|
| Impervious | 0.07 | 0.9 | 0.063 |
| Grass | 0.04 | 0.2 | 0.008 |
| | | | <u>0.000</u> |
| sum = | 0.11 | sum = | 0.071 |

C = 0.65 = total product / total area

DMH-1

| Surface | A | C | Product |
|---------|---|---|---------|
|---------|---|---|---------|

| Cover | (ac) | | A x C |
|-------|-------|-------|--------|
| CB2 | 0.48 | 0.43 | 0.2064 |
| CB5 | 0.11 | 0.65 | 0.000 |
| | <hr/> | | <hr/> |
| sum = | 0.59 | sum = | 0.2064 |

$C = \boxed{0.35} = \text{total product} / \text{total area}$

Closed Drainage System

SM-4993

3 of 5

Project: Jackson Drive By JTM Date 2/13/2013
 Location: Acton, MA Checked _____ Date _____

Rational Method

Q = peak flow rate, (cfs)

i = rainfall intensity inches/hour

C = runoff coefficient,

A = area (ac)

C = 0.90 impervious

C = 0.20 landscaped / grass

C = 0.15 woods

CB-3

| Surface Cover | A (ac) | C | Product A x C |
|---------------|--------------|-------|---------------|
| impervious | 0.02 | 0.9 | 0.018 |
| lands/grass | 0.24 | 0.2 | 0.048 |
| woods | <u>0.000</u> | 0.15 | <u>0.000</u> |
| sum = | 0.26 | sum = | 0.066 |

C = 0.25 = total product / total area

CB-4

| Surface Cover | A (ac) | C | Product A x C |
|---------------|--------------|-------|---------------|
| impervious | 0.15 | 0.9 | 0.135 |
| lands/grass | 0.12 | 0.2 | 0.024 |
| woods | <u>0.000</u> | 0.15 | <u>0.000</u> |
| sum = | 0.27 | sum = | 0.159 |

C = 0.59 = total product / total area

DMH-2

| Surface | A | C | Product |
|---------|---|---|---------|
|---------|---|---|---------|

| Cover | (ac) | | A x C |
|---|-------|-------|-------|
| CB-2 | 0.26 | 0.25 | 0.066 |
| CB-3 | 0.27 | 0.59 | 0.159 |
| | <hr/> | | <hr/> |
| sum = | 0.53 | sum = | 0.225 |
| C = 0.42 = total product / total area | | | |

Inlet Grate Capacity Calculations

Job: SM-4993

Calculated by: JTM
Date: 2/22/2013

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

$$Q = (C * A * \text{SQRT}(2 * g * h)) * f$$

C = orifice coefficient

C = 0.6 square edges

A = inlet area

A = 1.51 sq. ft.

g = gravitational constant

g = 32.2 ft/sec²

h = head on inlet

h = 0.33 ft. (low points)

0.17 ft. (on slope)

f = clogging factor

f = 0.66

Single Grate

Q (MAX)= 2.75 cfs (LP) low points LF248

Q (MAX)= 1.97 cfs (OS) on slope LF248

Double Grate

Q (MAX)= 5.50 cfs low points LF248

Q (MAX)= 3.95 cfs on slope LF248

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

| | TRIBUTARY | TIME OF | 10 YR | | Q=CiA | | | single | double |
|-----|-----------|---------|-----------|------|-------|----------|---------|--------|--------|
| | AREA (AC) | CONC. | INTENSITY | C | Q10 | POSITION | Q (MAX) | grate | grate |
| CB1 | 0.05 | 10 | 7.6 | 0.9 | 0.34 | LP | 2.75 | yes | |
| CB2 | 0.05 | 10 | 7.6 | 0.9 | 0.34 | OS | 1.97 | yes | |
| CB3 | 0.48 | 10 | 7.6 | 0.43 | 1.58 | OS | 1.97 | yes | |
| CB4 | 0.11 | 10 | 7.6 | 0.65 | 0.54 | OS | 1.97 | yes | |

Water Balance Calculations

Water Balance Calculations

SM-4993

Project: 27 Jackson Drive

By: JTM

Date: 3/4/2013

Location: Acton MA

Checked: RJH

Date: 3/4/2013

Pre-Development Recharge

CN= 62.7
From Figure 1, infiltration= 18.2 in/year
Drainage Area= 158,558 s.f.

Recharge= 158,558 x 18.2 /12 in/ft 240,480 c.f./year

Post-Development Recharge

CN= 69.8
From Figure 1, infiltration= 17.4 in/year
Drainage area= 158,558 s.f.

Recharge= 158,558 x 17.4 /12 in/ft 229,910 c.f./year

Post-Development Drywell Infiltration

CN= 98
From Figure 1, runoff= 30.6 in/year (directed to drywells)
Roof Area = 10,454 s.f.
* Recharge= 10,454 x 30.6 /12 in/ft 26,658 c.f./year

Post-Development Vs. Pre-Development
256,567 > 240,480
c.f./year c.f./year

*Additional recharge provided by SMA-1 and SMA-2 but not included in infiltration calcs

Total CN

PRE

| Subcatchm | Area | CN | Sum |
|-----------|------|------|--------|
| 1 | 3.38 | 63.3 | 213.95 |
| 2 | 0.26 | 55 | 14.30 |
| 3 | 0 | 0 | 0.00 |
| 4 | 0 | 0 | 0.00 |
| 5 | 0 | 0 | 0.00 |

Post

| | Area | CN | Sum |
|-----|------|------|--------|
| P1 | 1.57 | 68.3 | 107.23 |
| P2 | 0.13 | 57.3 | 7.45 |
| P3 | 0.41 | 60.7 | 24.89 |
| P4 | 0.59 | 75.4 | 44.49 |
| P5 | 0.52 | 65.3 | 33.96 |
| P6 | 0.04 | 98 | 3.92 |
| P7 | 0.06 | 98 | 5.88 |
| P8 | 0.06 | 98 | 5.88 |
| P9 | 0.06 | 98 | 5.88 |
| P10 | 0.02 | 98 | 1.96 |
| P11 | 0.02 | 98 | 1.96 |
| P12 | 0.02 | 98 | 1.96 |
| P13 | 0.07 | 61 | 4.27 |
| P14 | 0.07 | 61 | 4.27 |

| | | | |
|-------|---------|------|--------|
| Total | 3.64 | | 228.25 |
| | Average | 62.7 | |

| | | | |
|-------|---------|------|--------|
| Total | 3.64 | | 253.99 |
| | Average | 69.8 | |

STAMSKI AND McNARY, INC.

80 Harris Street
 ACTON, MASSACHUSETTS 01720
 (508) 263-8585

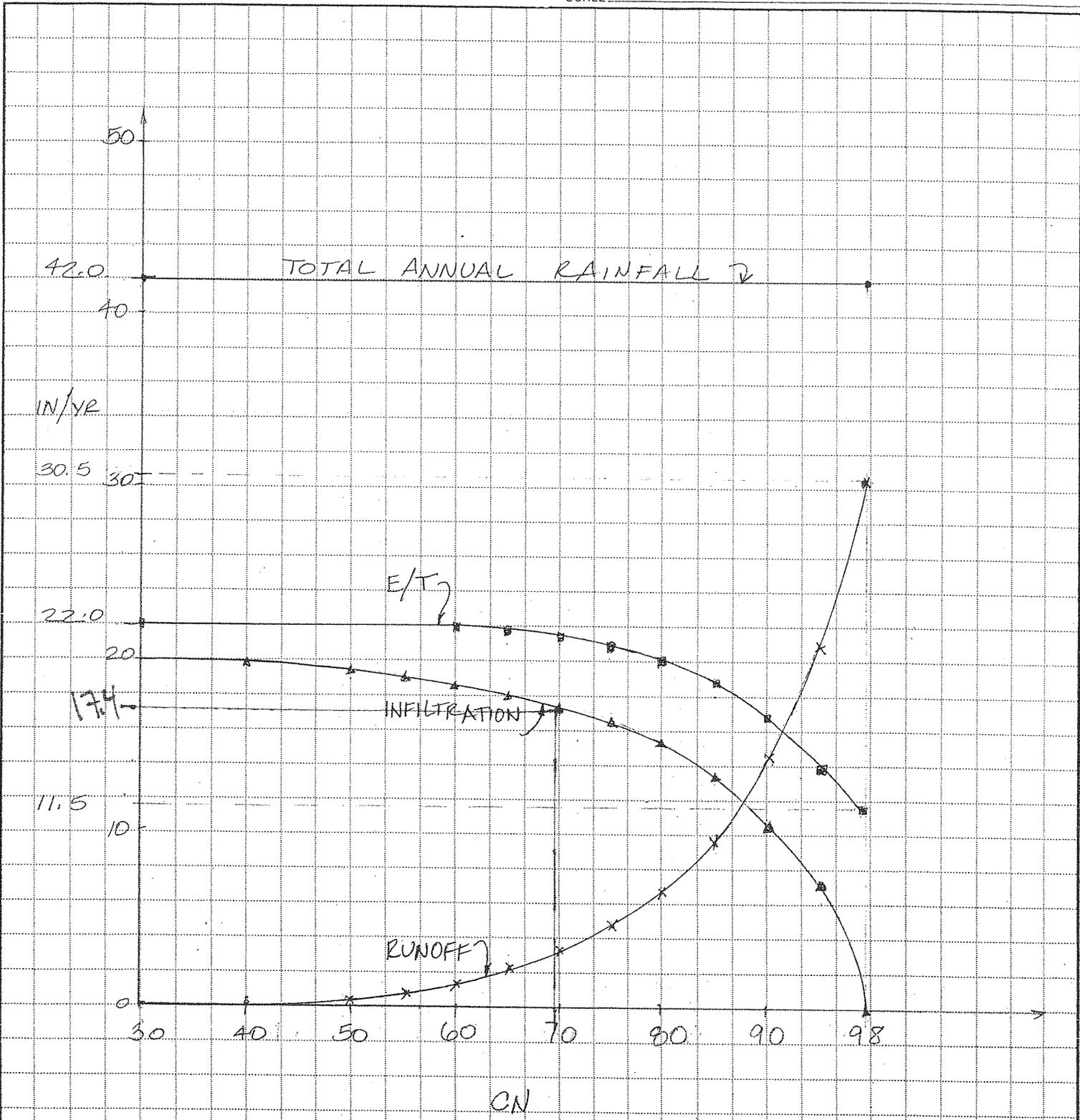
JOB 47 JACKSON DRIVE

SHEET NO. 76 OF _____

CALCULATED BY _____ DATE _____

CHECKED BY _____ DATE _____

SCALE _____



NOTE: GRAPH COMPILED FROM DATA PUBLISHED BY NOAA (1984-1988)
 (SEE REPORT FROM STAMSKI & McNARY, INC. SUBMITTED W/ TOWN OF ACTON ENG. DEPT.)

Drainage Maps