Stormwater Management Report

For

429 Great Road

Acton, MA

April 22, 2016

Applicant:

Country Properties, LLC
6 Proctor Street
Acton, MA 01720

SM-5369

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Engineering - Planning – Surveying
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Narrative

STORMWATER MANAGEMENT

The site is located at 429 Great Road in Acton, Massachusetts and is approximately 1.16 acres in size and has been previously developed. There is an existing building with a paved parking lot, and a detached barn located on the site. The Natural Resource Conservation Service (N.R.C.S.) soil survey report for Middlesex County and associated soil map for Acton indicates that soils located on the site are Merrimac-Urban Land Complex and Charlton-Urban land-Hollis Complex. Merrimac-Urban Land Complex and Charlton-Urban land-Hollis Complex. are in Hydrologic Group A.

Pre-Development

The site is comprised of one subcatchment. Subcatchment E1 contains the existing building, barn, and the paved parking lot. This subcatchment ultimately drains to the Wetland off-site to the east. The subcatchment can be seen on the attached drainage maps.

Post-Development

The fully developed site will consist of the proposed building, paved driveway, and a walkway. The post-development site has been divided into four subcatchments. Subcatchment P1A contains the lawn and landscaped areas surrounding the building and driveway. The subcatchment drains to the Wetland located off-site to the east. Subcatchment P1B contains a portion of the lawn and driveway. The runoff is collected through three catchbasins, directed into a manhole containing a Contech CDS 2015-4 unit, and infiltrated through a subsurface infiltration area. Subcatchment P1C contains a portion of the landscaped area around the building and a portion of the driveway. The runoff is collected through a catchbasin, directed into a manhole containing a Vortsentry HS36 unit, and infiltrated through a subsurface infiltration area. Subcatchment P1D contains the remaining portion of the driveway. The runoff is directed away from the building towards an 8" stone diaphragm, 3' filter strip and into an infiltration trench. All roof runoff from the building will be collected and infiltrated in a roof drywell.

This project would qualify as a "Redevelopment Project" as defined by the Stormwater Management Standards but all standards have been met. The following describes the drainage system and the project's compliance with the Stormwater Management Standards.

The proposed impervious surface within the Great Road right of way has been decreased by approximately 130 s.f. Therefore, the proposed runoff within the right of way has not been analyzed.

Standard #1 Untreated direct discharge of Stormwater:

The untreated Stormwater standard states that there will be no untreated stormwater point source discharge to resource areas. Point source runoff from all areas with impervious cover drains to either the Subsurface Infiltration Areas, Infiltration Trench or roof drywell. All Stormwater Management Areas retain and recharge the runoff. No discharge is proposed from any of the proposed Stormwater BMPs.

Standard #2 Post-Development Peak Discharge:

The Stormwater Management Policy requires that peak discharge rates for the 2-year and 10-year storm events not be increased from pre-development conditions. Furthermore, the 100-year storm event will not increase flooding impacts offsite.

Attenuation of peak discharge rates will be accomplished by using infiltration.

The following table summarizes the peak runoff rates to the overland flow discharge points.

Discharge Summary Table

Total Runoff

2-year Storm		10-year Storm		100-year Storm	
Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)	Pre (cfs)	Post (cfs)
0.009	0.000	0.179	0.007	0.877	0.118

Detailed Calculations are attached.

Standard #3 Recharge to Groundwater:

This standard prescribes the stormwater volume that must be recharged to groundwater based on the existing site soil conditions. The Natural Resources Conservation Service (N.R.C.S.) Middlesex Soil Survey map indicates that the site contains soils in hydrologic group A. The stormwater management Policy requires 0.6 inches of runoff over the total impervious area to be recharged in areas with the respective soil groups. Furthermore the town's regulations require that the annual water budget is balanced to preserve groundwater supply. Detailed "Water Balance Calculations" showing compliance with this standard are attached.

Standard #4 TSS Removal:

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

Standard #5 Higher Potential Pollutant Loads:

The site is not considered to have a "Higher Potential Pollutant Load" as defined in the Stormwater Management Policy.

Standard #6 Protection of Critical Areas:

The site does not discharge runoff to critical areas.

Standard #7 Redevelopment Projects:

The proposed project qualifies as redevelopment but meets all the requirements for new development.

Standard #8 Erosion/Sediment Control:

Erosion and sediment controls are incorporated into the project design to prevent erosion, control sediment movement, and stabilize exposed and disturbed soils during construction. Temporary erosion and sedimentation controls during construction include minimizing areas of exposed soil, directing and controlling runoff, and rapidly stabilizing exposed areas. Soils left exposed for extended periods will be mulched and seeded for temporary vegetative cover. Following construction, exposed areas will be permanently vegetated with appropriate ground cover. Erosion and sedimentation control measures will be maintained throughout all phases of construction. Inspections will be made regularly and after rainfalls exceeding 0.5 inches in a 24-hour period during construction. The contractor will be required to inspect erosion and sedimentation control measures at the end of each workday, when precipitation is forecasted, and after each rainfall. All measures will be inspected prior to each weekend. The contractor will replace and repair any malfunctioning or damaged control measures including vegetative stabilization.

Long term erosion and sedimentation control will be realized using the Best Management Practices described previously. Areas where soils have been disturbed will be loamed and vegetated with lawn, trees, and shrubs.

Standard #9 Operation and Maintenance Plan:

An Operation and Maintenance plan has been prepared and is shown on the plan set.

Standard #10 Illicit Discharges to Drainage System:

No known illicit discharges exist and none are proposed.

Design Basis

1. The rational method (Q=CIA) was used as a basis for sizing pipes. Runoff Coefficients: C=0.15 for woods, 0.20 for grass/landscaped areas, 0.76 for gravel, and 0.90 for impervious surfaces.
2. The 100-year storm was used for sizing pipes. Rainfall intensity values were taken from the U.S. Weather Bureau Technical Paper 40.
3. The United States Department of Agriculture Natural Resource Conservation Service (N.R.C.S.) TR55 methodology was used to determine offsite rates of runoff.
4. The twenty-four hour rainfall, taken from N.R.C.S. publications, is 6.4 inches for the 100-year storm, 4.5 inches for the 10-year storm, and 3.1 inches for the 2-year storm event.
5. The hydrologic calculations were performed using the computer program: "Hydraflow Hydrographs 2007" by Intelisolve.
6. The soil types of the site were taken from the N.R.C.S. Soil Survey Map from nesoil.com.
7. Soil conditions and estimated seasonal high groundwater table were based on on-site soil evaluations.
8. The Hantoush Method was used for Mounding analysis.

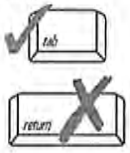
Checklist for Stormwater Report

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

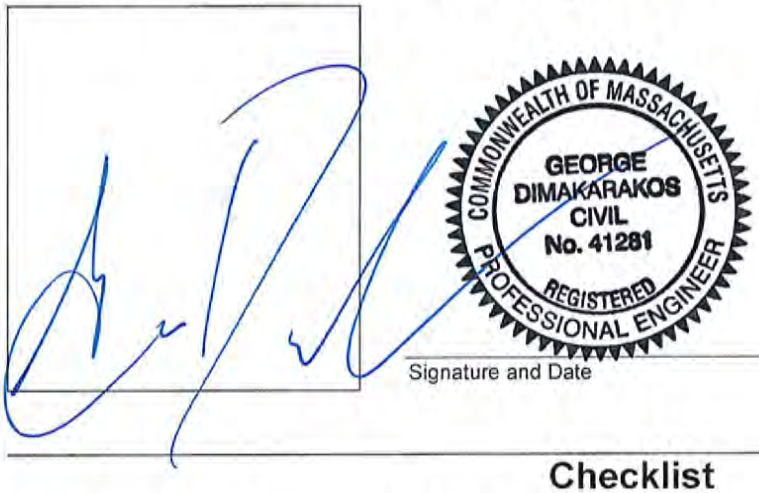
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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

Checklist 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.

Pre-Development Hydrology

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	0.009	2	904	252	----	------	------	E1

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	0.179	2	744	1,573	----	------	------	E1

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	0.877	2	734	4,683	----	------	------	E1

Worksheet 2: Runoff curve number and runoff SM-5369

Project: 429 Great Rd By JTM Date 4/13/16

Location: Acton, MA Checked _____ Date _____

Circle one: [Present] Developed E1

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
A	Woods	30			0.31	9.23
A	Open	39			0.66	25.74
	Impervious	98			0.21	20.45
Totals =					1.18	55.43

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{55.43}{1.18} = 47.11$; Use CN = 47.1

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.1	4.5	6.4
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.06	0.38	1.12
Runoff, Q.....	cf	258	1610	4793

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

Project: 429 Great Rd By JTM Date 4/13/2016

Location: Acton, MA Checked _____ Date _____

Circle one: Present / Developed E1

Circle one: Tc / Tt through subarea _____

		Segment ID					
Sheet flow (Applicable to Tc only)			A-B	B-C			
1. Surface Description (table 3-1)			Woods	Grass			
2. Mannings roughness coeff., n (table 3-1)			0.4	0.24			
3. Flow length, L (total L <= 300 ft)		ft	42	8			
4. Two-yr 24-hr rainfall, P2		in	3.1	3.1			
5. Land Slope, s		ft/ft	0.0333	0.013			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.15	0.04			0.19
Shallow concentrated Flow		Segment ID	C-D	D-E	E-F	F-G	G-H
7. Surface Description (paved or unpaved)			unpaved	paved	unpaved	paved	unpaved
8. Flow Length, L		ft	185	25	86	20	182
9. Watercourse slope, s		ft/ft	0.02	0.02	0.02	0.013	0.015
10. Average Velocity, V (figure 3-1)		ft/s	2.28	2.87	2.28	2.32	1.98
11. Tt = L / 3600V	Compute Tt	hr	0.02	0.00	0.01	0.00	0.03	0.06
Channel flow		Segment ID					
12. Cross sectional flow area, a		sf					
13. Wetted perimeter, pw		ft					
14. Hydraulic radius, r=a/wp	Compute r	ft					
15. Channel Slope, s		ft/ft					
16. Manning's roughness coeff., n							
17. V = 1.49 r^2/3 s^1/2 / n	Compute V	ft/s					
18. Flow length, L		ft					
19. Tt = L / 3600V	Compute Tt	hr					0

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.25 min 15.0

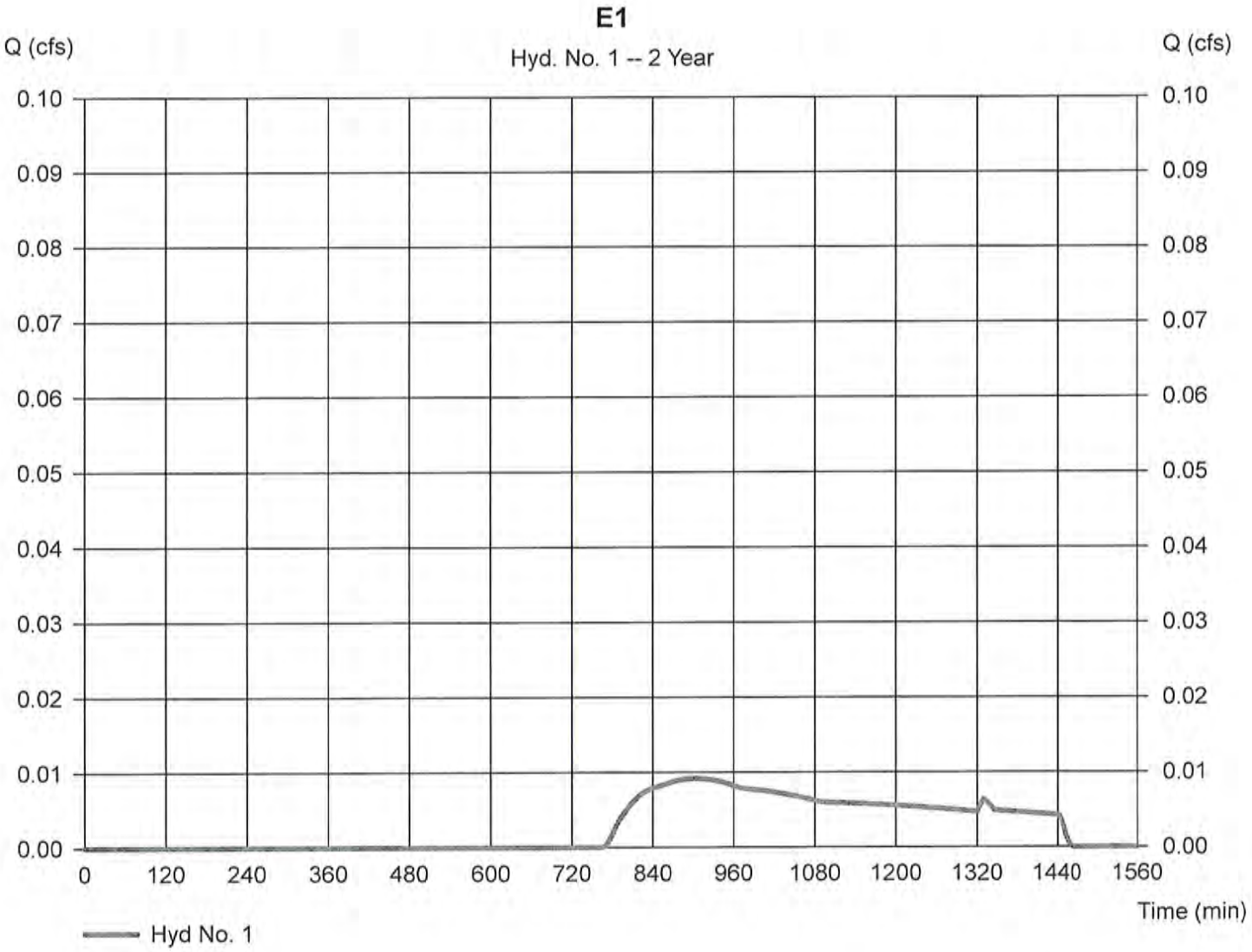
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 1

E1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.009 cfs
Storm frequency	= 2 yrs	Time to peak	= 904 min
Time interval	= 2 min	Hyd. volume	= 252 cuft
Drainage area	= 1.180 ac	Curve number	= 47.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 15.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



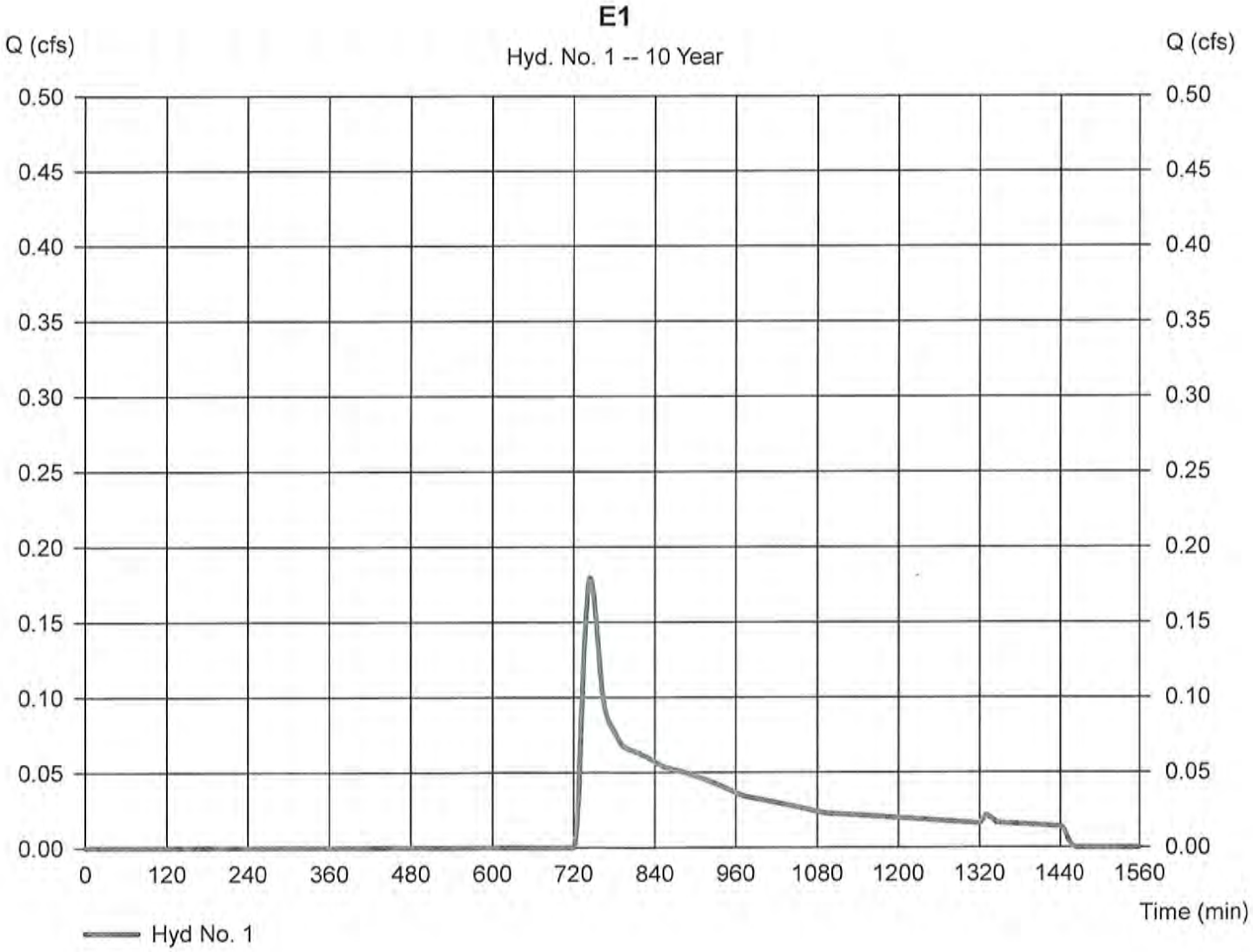
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 1

E1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.179 cfs
Storm frequency	= 10 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 1,573 cuft
Drainage area	= 1.180 ac	Curve number	= 47.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 15.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



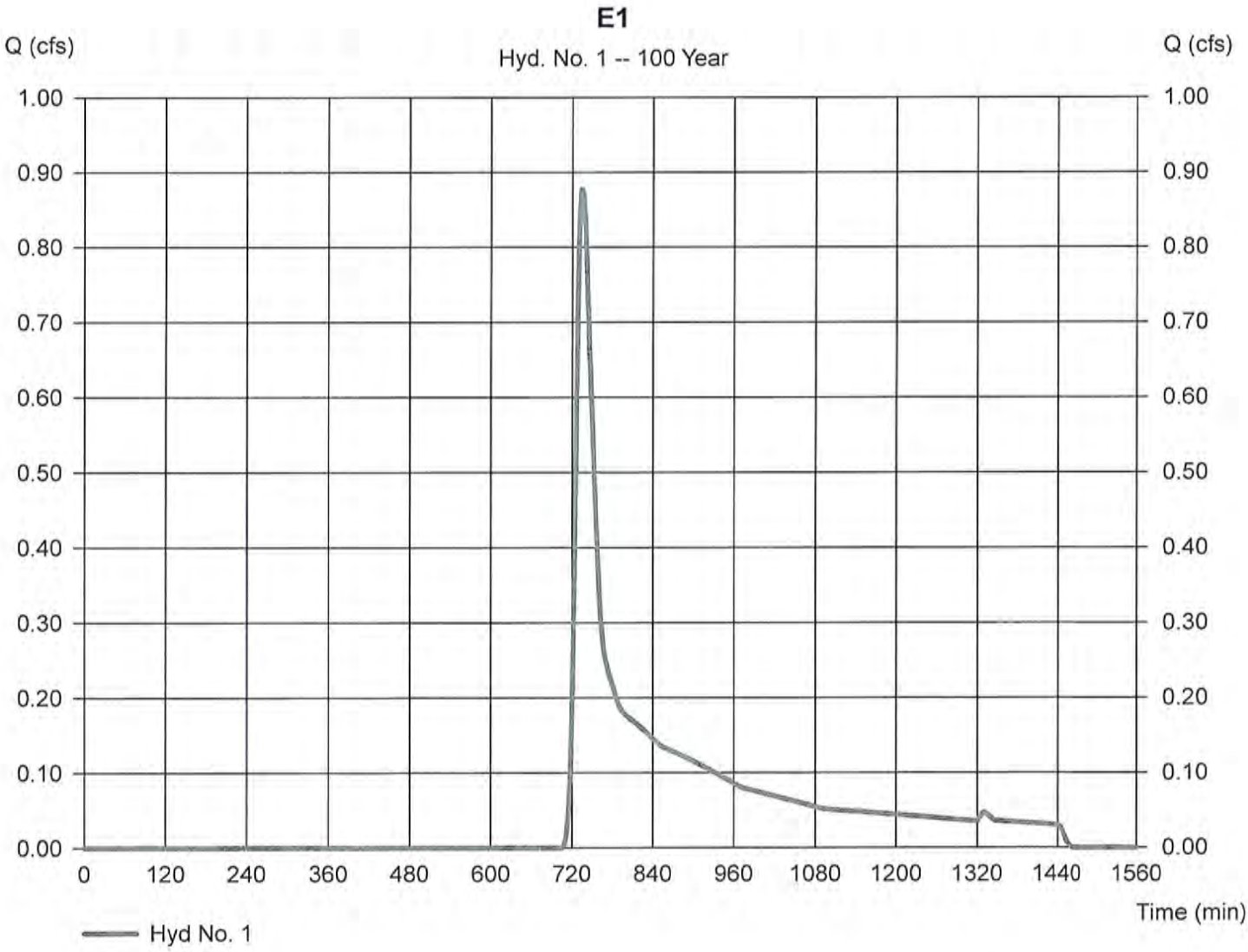
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 1

E1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.877 cfs
Storm frequency	= 100 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 4,683 cuft
Drainage area	= 1.180 ac	Curve number	= 47.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 15.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	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	0.000	2	n/a	0	----	------	------	P1A
2	SCS Runoff	0.357	2	724	1,084	----	------	------	P1B
3	Reservoir	0.166	2	734	1,084	2	200.90	113	Infiltration Area 1
4	SCS Runoff	0.290	2	724	976	----	------	------	P1C
5	Reservoir	0.102	2	738	976	4	198.69	142	Infiltration Area 2
6	SCS Runoff	0.696	2	724	2,342	----	------	------	Roof
7	Reservoir	0.239	2	738	2,342	6	201.98	356	Roof Drywell

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	0.007	2	886	182	----	------	------	P1A
2	SCS Runoff	0.681	2	724	2,036	----	------	------	P1B
3	Reservoir	0.205	2	744	2,036	2	201.42	400	Infiltration Area 1
4	SCS Runoff	0.424	2	724	1,451	----	------	------	P1C
5	Reservoir	0.120	2	742	1,451	4	199.11	280	Infiltration Area 2
6	SCS Runoff	1.017	2	724	3,483	----	------	------	Roof
7	Reservoir	0.281	2	742	3,483	6	202.43	690	Roof Drywell

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	SCS Runoff	0.118	2	738	977	----	------	------	P1A
2	SCS Runoff	1.148	2	724	3,454	----	------	------	P1B
3	Reservoir	0.281	2	746	3,454	2	202.41	892	Infiltration Area 1
4	SCS Runoff	0.605	2	724	2,097	----	------	------	P1C
5	Reservoir	0.150	2	744	2,097	4	199.86	476	Infiltration Area 2
6	SCS Runoff	1.452	2	724	5,032	----	------	------	Roof
7	Reservoir	0.363	2	744	5,032	6	203.29	1,160	Roof Drywell

Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Friday, Apr 22, 2016

Pond No. 1 - Infiltration Area 1

Pond Data

UG Chambers - Invert elev. = 201.00 ft, Rise x Span = 1.33 x 2.83 ft, Barrel Len = 28.48 ft, No. Barrels = 7, Slope = 0.00%, Headers = No
Encasement - Invert elev. = 200.50 ft, Width = 3.54 ft, Height = 2.33 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	200.50	n/a	0	0
0.23	200.73	n/a	66	66
0.47	200.97	n/a	66	132
0.70	201.20	n/a	133	264
0.93	201.43	n/a	142	407
1.17	201.67	n/a	138	544
1.40	201.90	n/a	129	674
1.63	202.13	n/a	116	790
1.86	202.36	n/a	90	880
2.10	202.60	n/a	66	946
2.33	202.83	n/a	66	1,012

Culvert / Orifice Structures

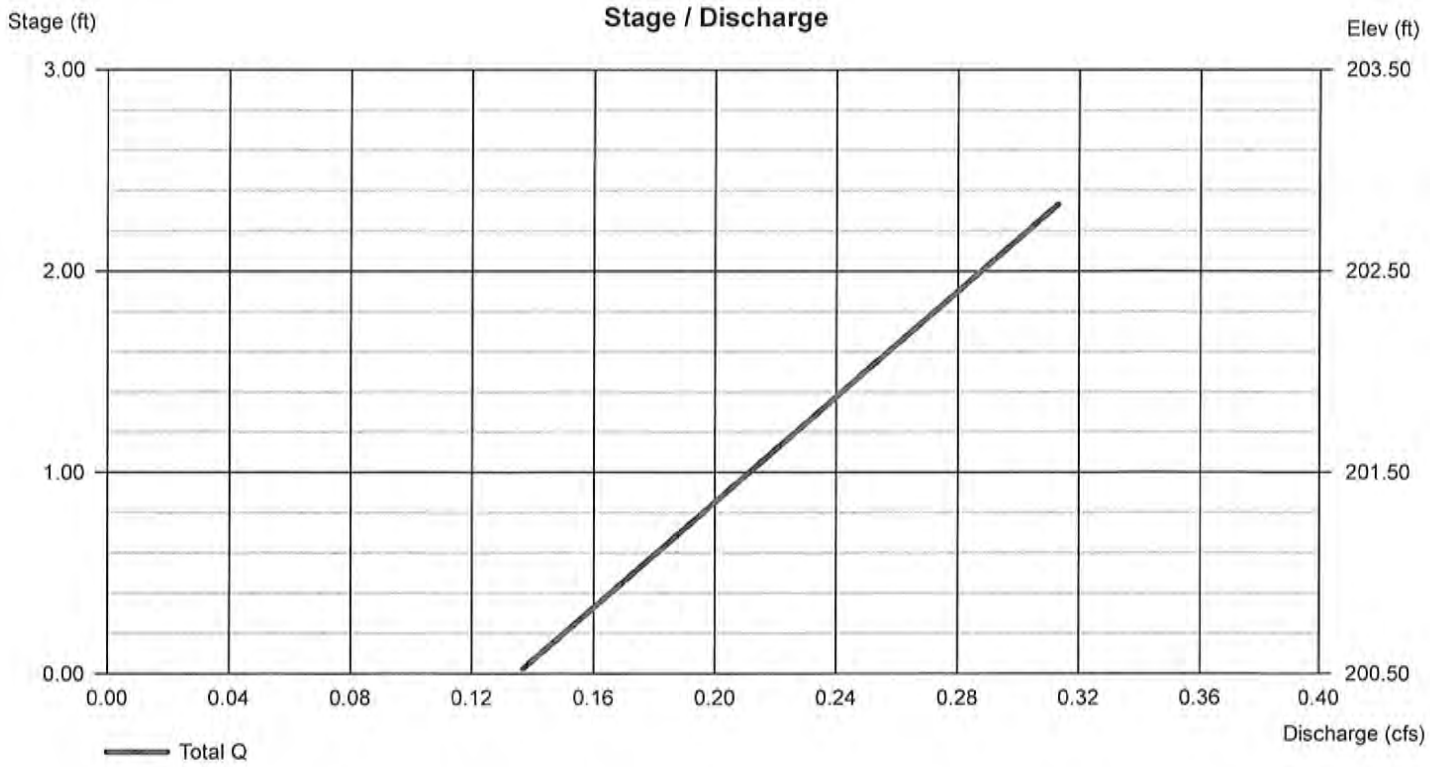
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 8.270 (by Wet area)
TW Elev. (ft) = 0.00

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



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Pond No. 2 - Infiltration Area 2

Pond Data

UG Chambers - Invert elev. = 198.50 ft, Rise x Span = 1.33 x 2.83 ft, Barrel Len = 21.36 ft, No. Barrels = 5, Slope = 0.00%, Headers = No
Encasement - Invert elev. = 198.00 ft, Width = 3.63 ft, Height = 2.33 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	198.00	n/a	0	0
0.23	198.23	n/a	36	36
0.47	198.47	n/a	36	72
0.70	198.70	n/a	72	144
0.93	198.93	n/a	77	222
1.17	199.17	n/a	75	296
1.40	199.40	n/a	70	366
1.63	199.63	n/a	63	430
1.86	199.86	n/a	49	479
2.10	200.10	n/a	36	515
2.33	200.33	n/a	36	551

Culvert / Orifice Structures

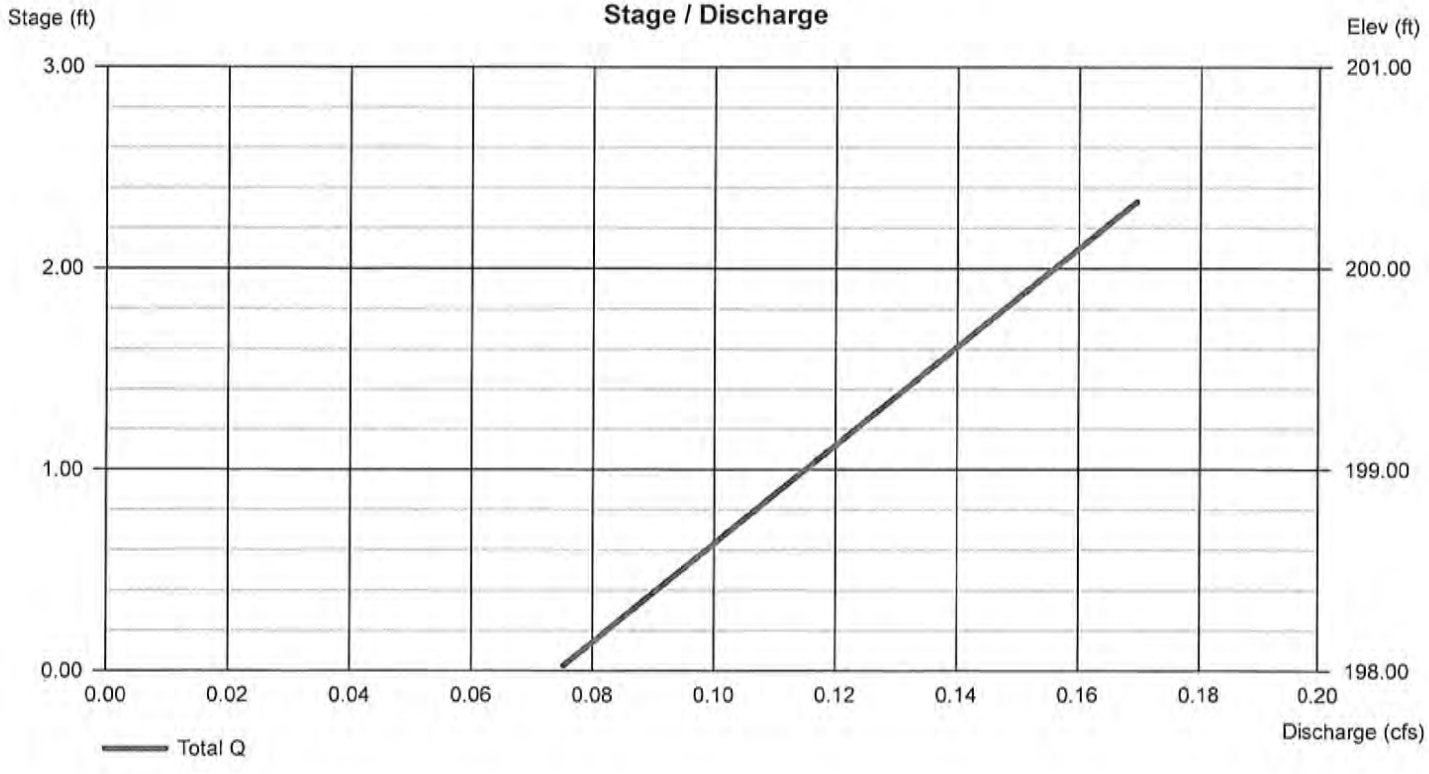
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 8.270 (by Wet area)
TW Elev. (ft) = 0.00

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



Pond Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Pond No. 4 - Roof Drywell

Pond Data

UG Chambers - Invert elev. = 201.75 ft, Rise x Span = 1.33 x 2.83 ft, Barrel Len = 35.60 ft, No. Barrels = 7, Slope = 0.00%, Headers = No
Encasement - Invert elev. = 201.25 ft, Width = 3.54 ft, Height = 2.33 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	201.25	n/a	0	0
0.23	201.48	n/a	82	82
0.47	201.72	n/a	82	164
0.70	201.95	n/a	166	331
0.93	202.18	n/a	178	509
1.17	202.42	n/a	172	680
1.40	202.65	n/a	162	842
1.63	202.88	n/a	146	988
1.86	203.11	n/a	112	1,100
2.10	203.35	n/a	82	1,182
2.33	203.58	n/a	82	1,264

Culvert / Orifice Structures

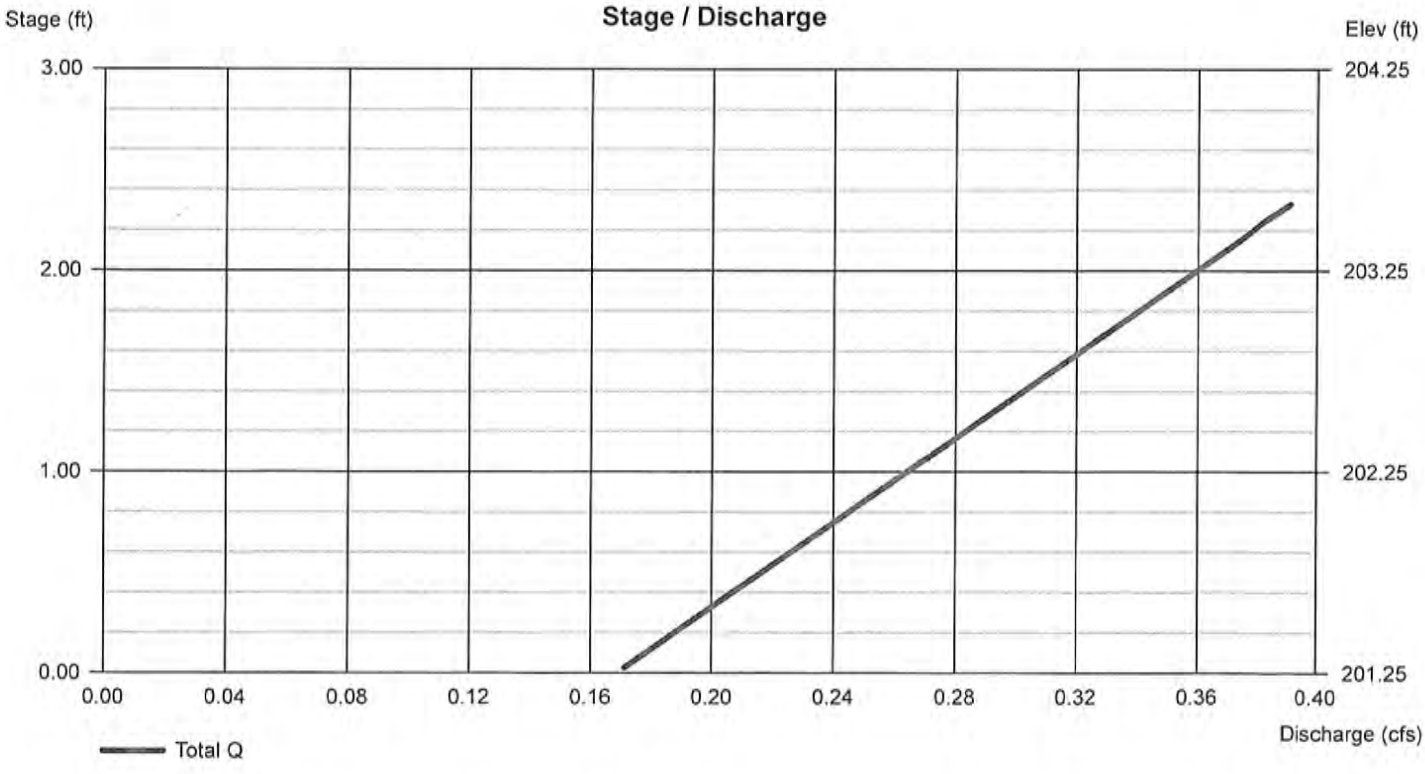
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 8.270 (by Wet area)
TW Elev. (ft) = 0.00

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



Worksheet 2: Runoff curve number and runoff SM-5369

Project: 429 Great Rd By JTM Date 4/14/16

Location: Acton, MA Checked _____ Date _____

Circle one: Present [Developed] P1A

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
A	Woods	30			0.02	0.70
A	Open	39			0.51	19.80
	Impervious	98			0.00	0.00
Totals =					0.53	20.50

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{20.50}{0.53} = 38.61$; Use CN = [38.6]

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.1	4.5	6.4
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.00	0.10	0.54
Runoff, Q.....	cf	1	195	1045

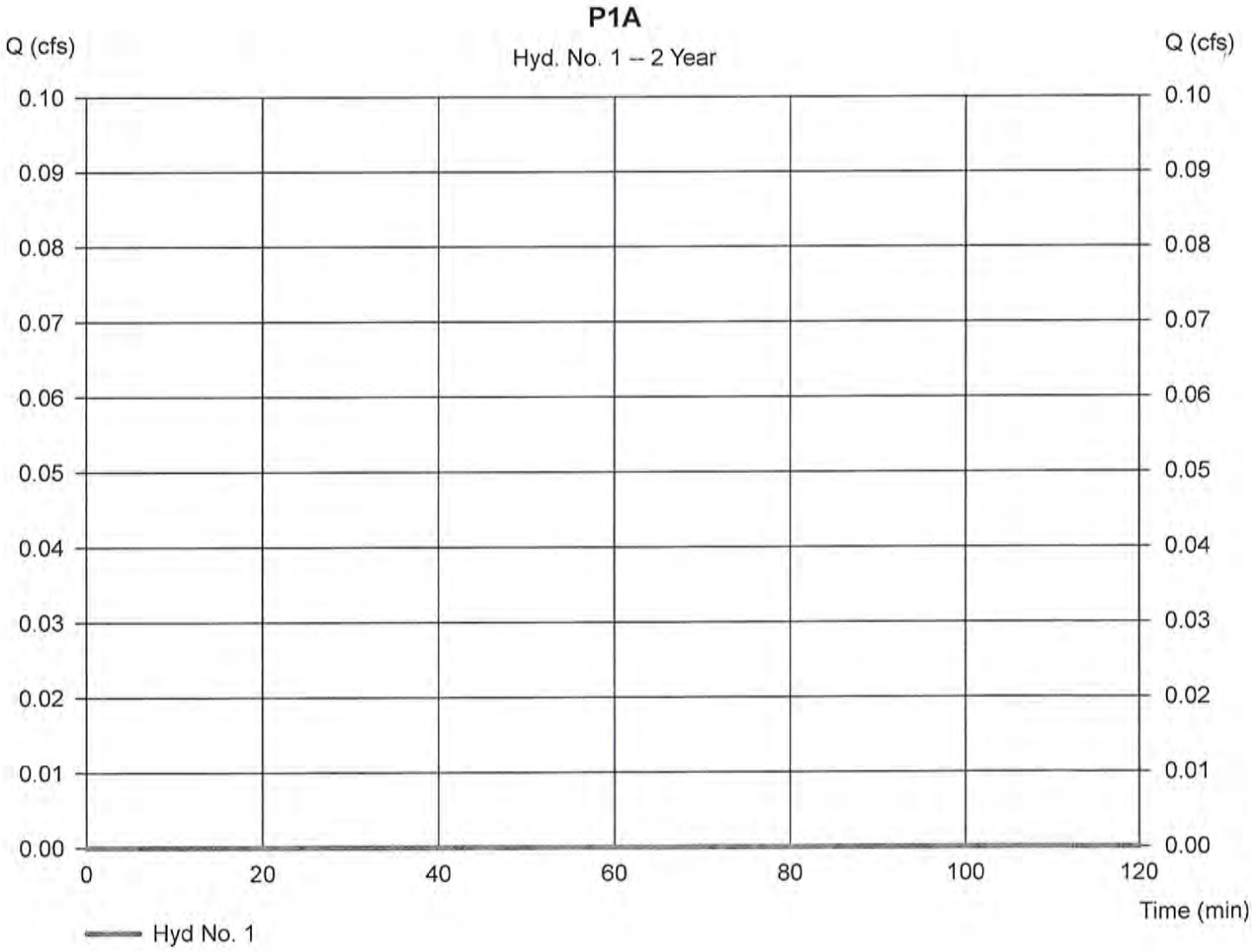
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 1

P1A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Drainage area	= 0.530 ac	Curve number	= 38.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



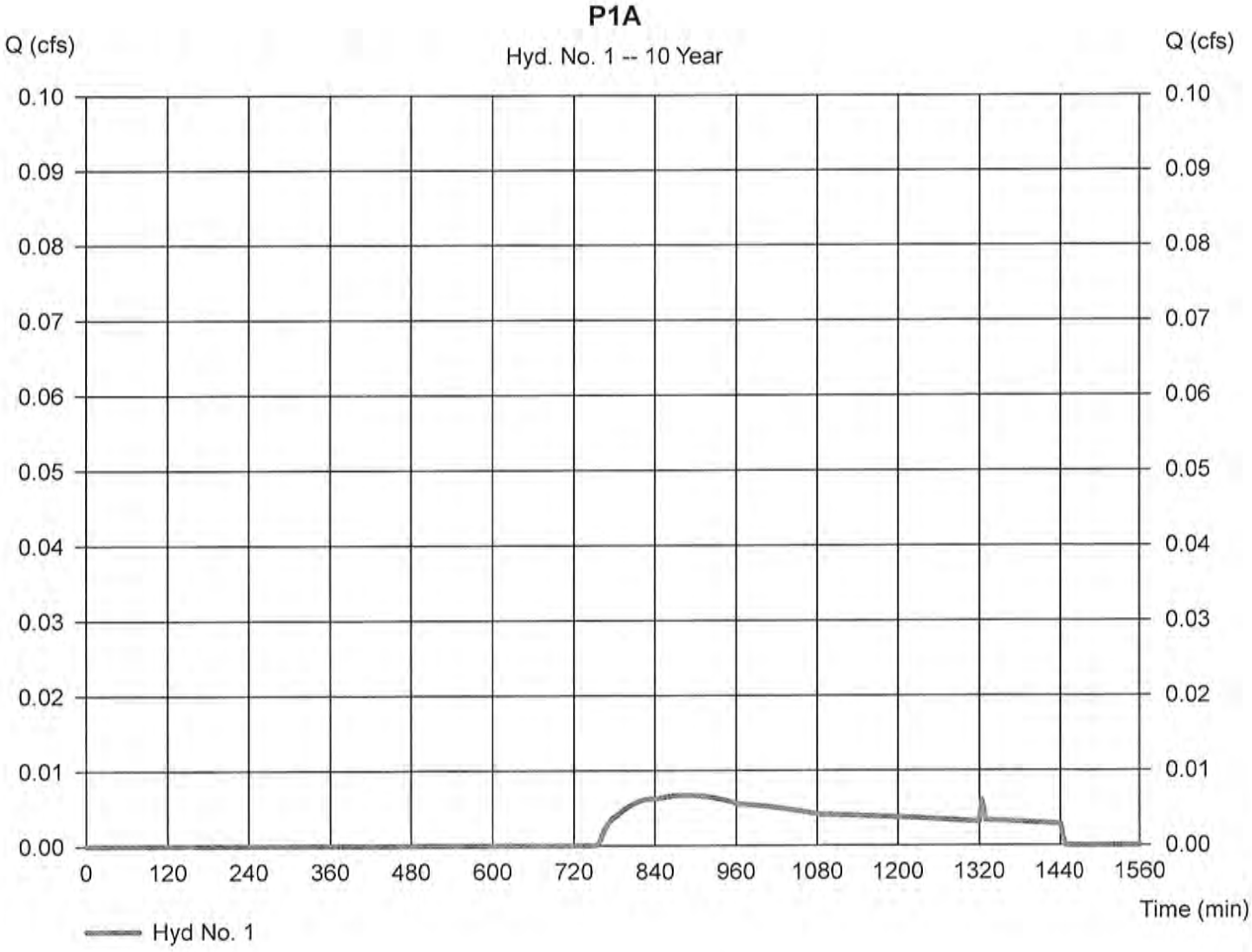
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 1

P1A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.007 cfs
Storm frequency	= 10 yrs	Time to peak	= 886 min
Time interval	= 2 min	Hyd. volume	= 182 cuft
Drainage area	= 0.530 ac	Curve number	= 38.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



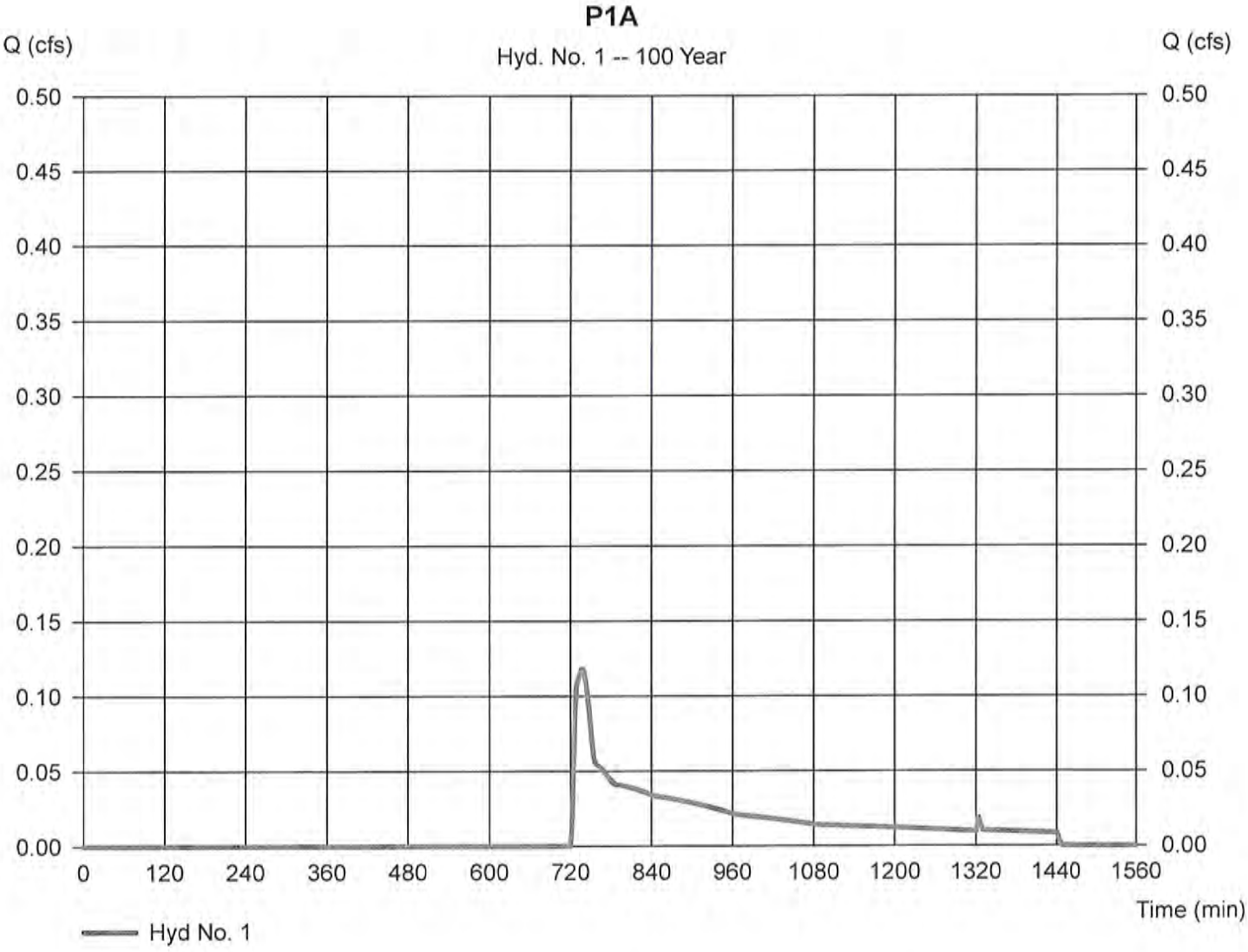
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 1

P1A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.118 cfs
Storm frequency	= 100 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 977 cuft
Drainage area	= 0.530 ac	Curve number	= 38.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Worksheet 2: Runoff curve number and runoff SM-5369

Project: 429 Great Rd By JTM Date 4/14/16

Location: Acton, MA Checked _____ Date _____

Circle one: Present [Developed] P1B

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
A	Woods	30			0.00	0.00
A	Open	39			0.08	3.14
	Impervious	98			0.17	16.86
Totals =					0.25	20.01

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{20.01}{0.25} = 79.19$; Use CN = 79.2

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.1	4.5	6.4
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	1.27	2.39	4.06
Runoff, Q.....	cf	1168	2194	3722

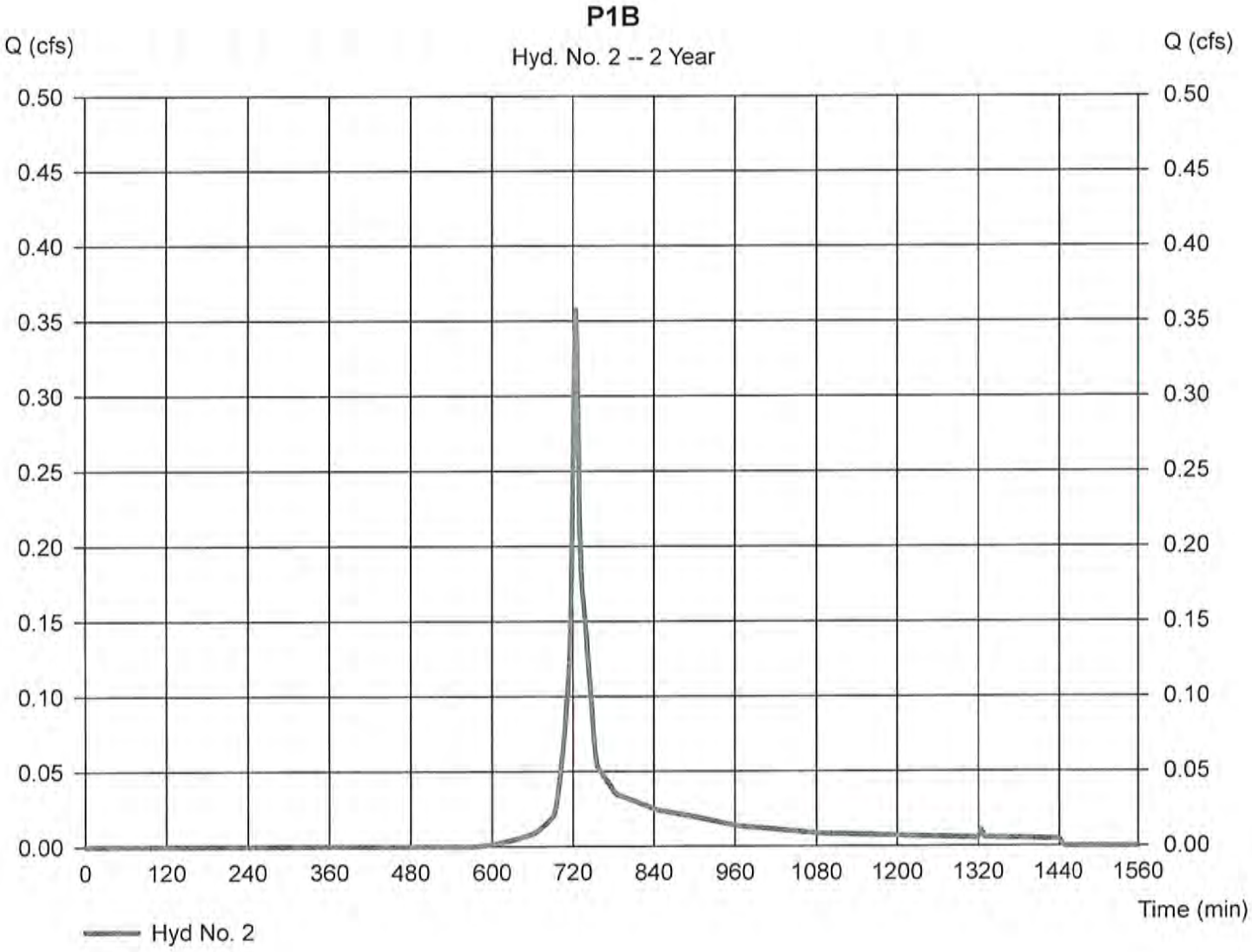
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 2

P1B

Hydrograph type	= SCS Runoff	Peak discharge	= 0.357 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,084 cuft
Drainage area	= 0.250 ac	Curve number	= 79.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



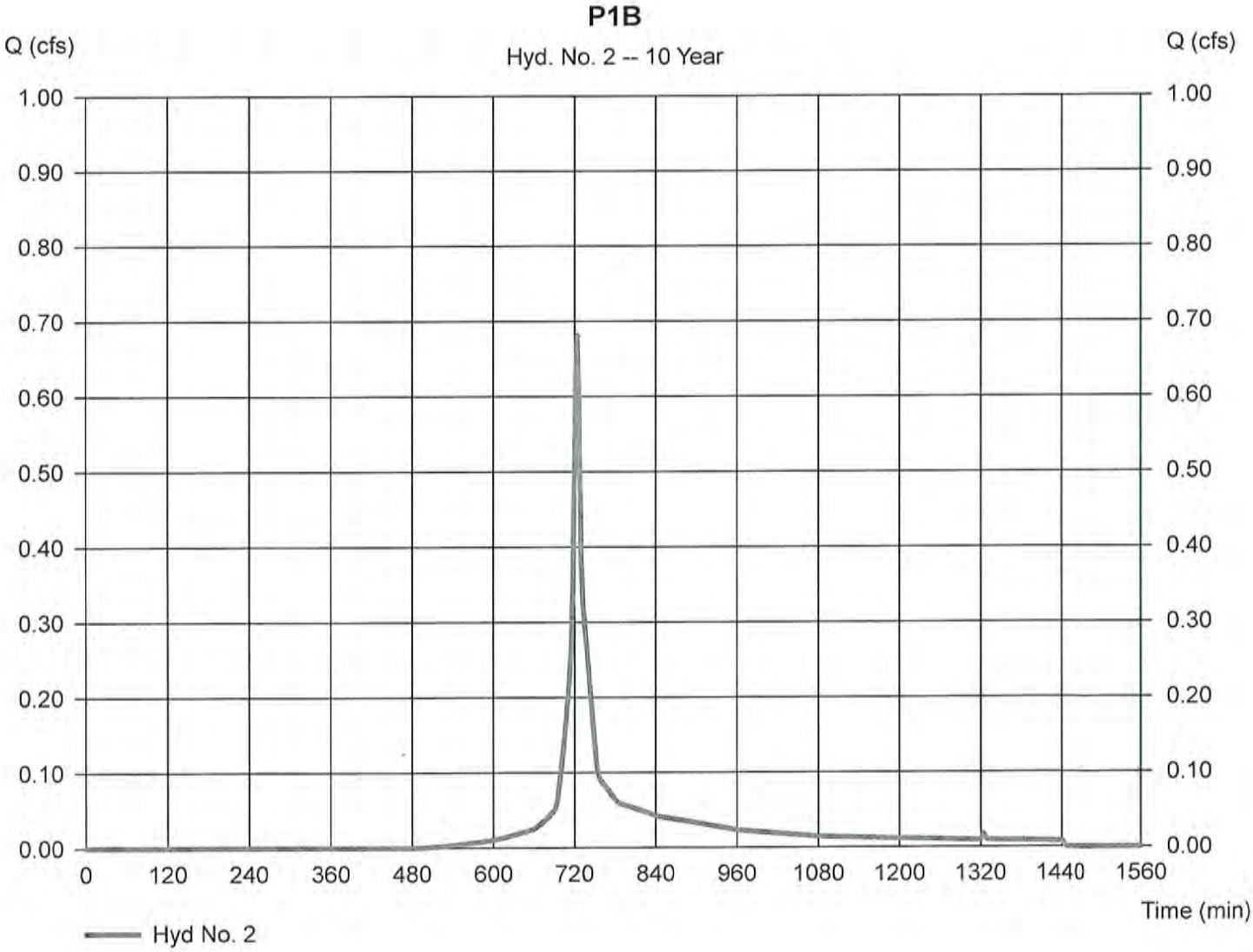
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 2

P1B

Hydrograph type	= SCS Runoff	Peak discharge	= 0.681 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 2,036 cuft
Drainage area	= 0.250 ac	Curve number	= 79.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



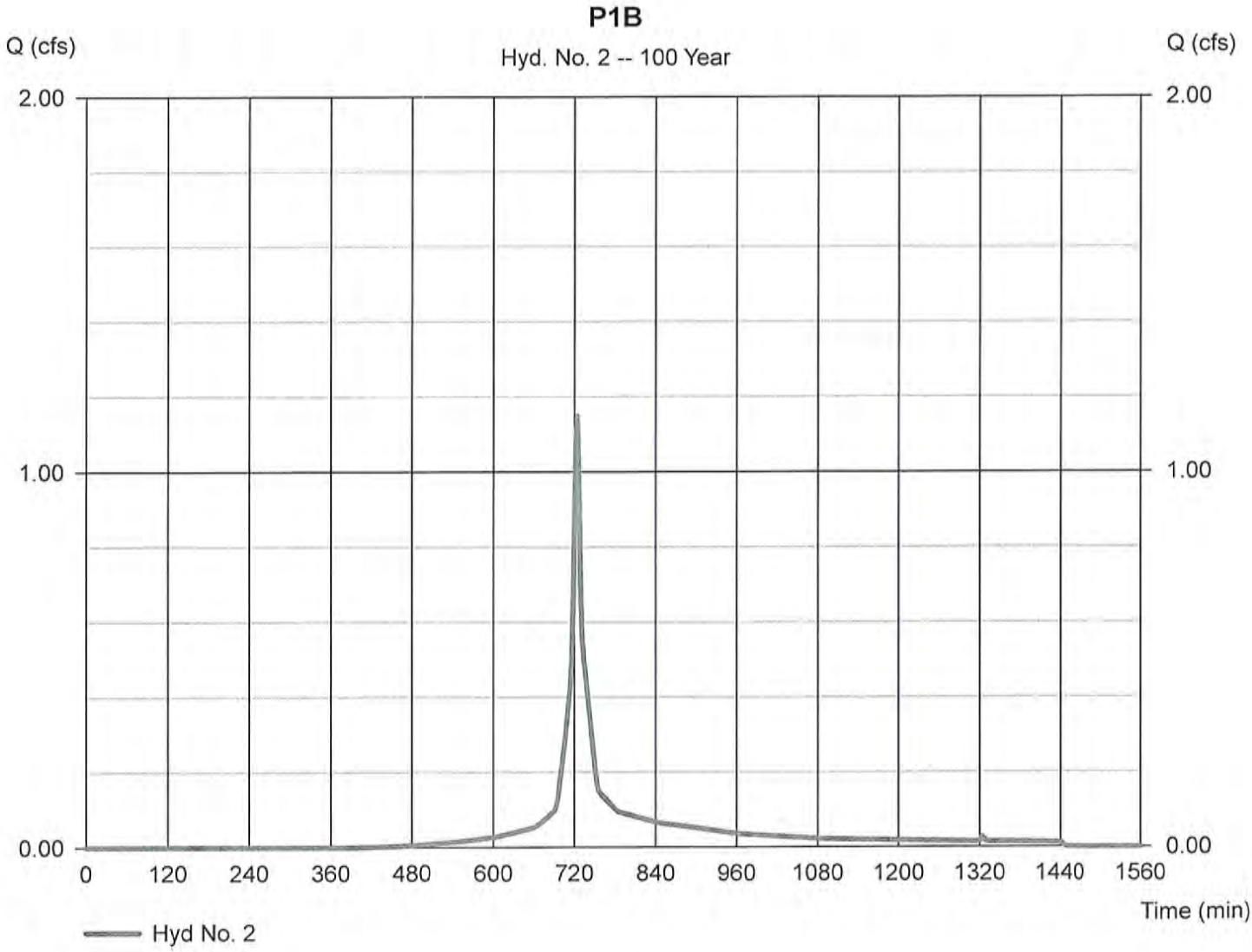
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 2

P1B

Hydrograph type	= SCS Runoff	Peak discharge	= 1.148 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 3,454 cuft
Drainage area	= 0.250 ac	Curve number	= 79.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

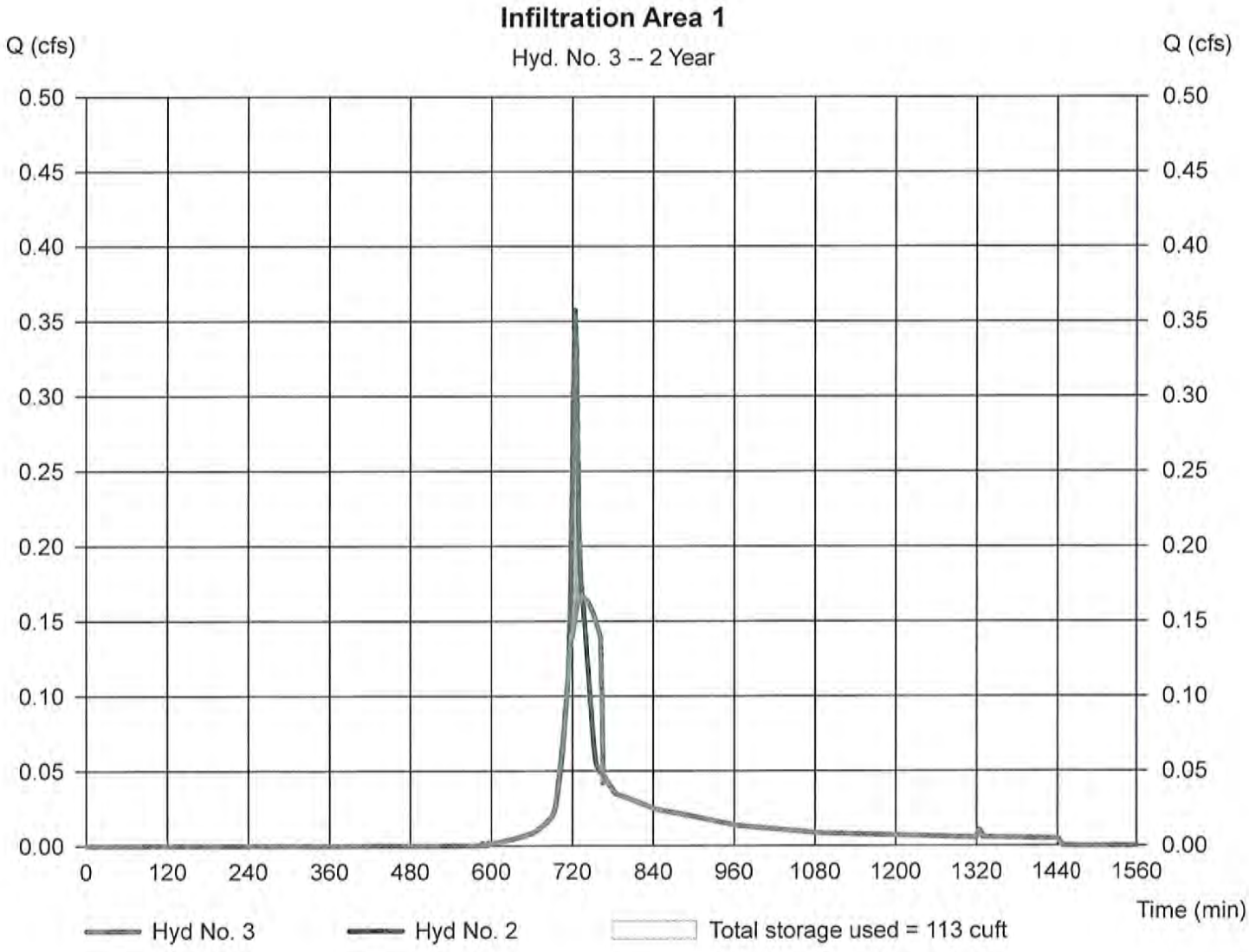
Hydraflow Hydrographs by Intelisolve v9.2 — Friday, Apr 22, 2016

Hyd. No. 3

Infiltration Area 1

Hydrograph type	= Reservoir	Peak discharge	= 0.166 cfs
Storm frequency	= 2 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 1,084 cuft
Inflow hyd. No.	= 2 - P1B	Max. Elevation	= 200.90 ft
Reservoir name	= Infiltration Area 1	Max. Storage	= 113 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

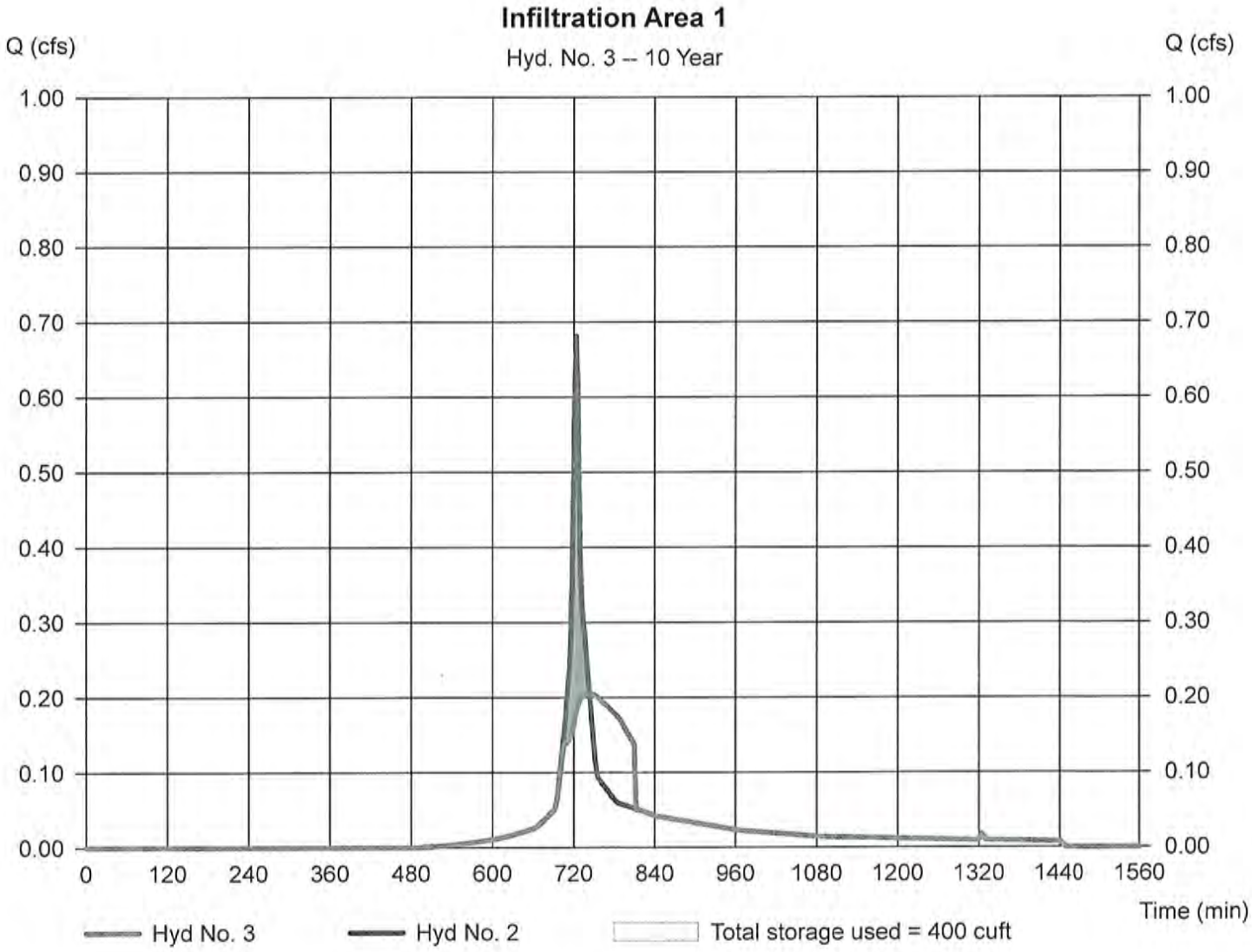
Hydraflow Hydrographs by Intelisolve v9.2 — Friday, Apr 22, 2016

Hyd. No. 3

Infiltration Area 1

Hydrograph type	= Reservoir	Peak discharge	= 0.205 cfs
Storm frequency	= 10 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 2,036 cuft
Inflow hyd. No.	= 2 - P1B	Max. Elevation	= 201.42 ft
Reservoir name	= Infiltration Area 1	Max. Storage	= 400 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

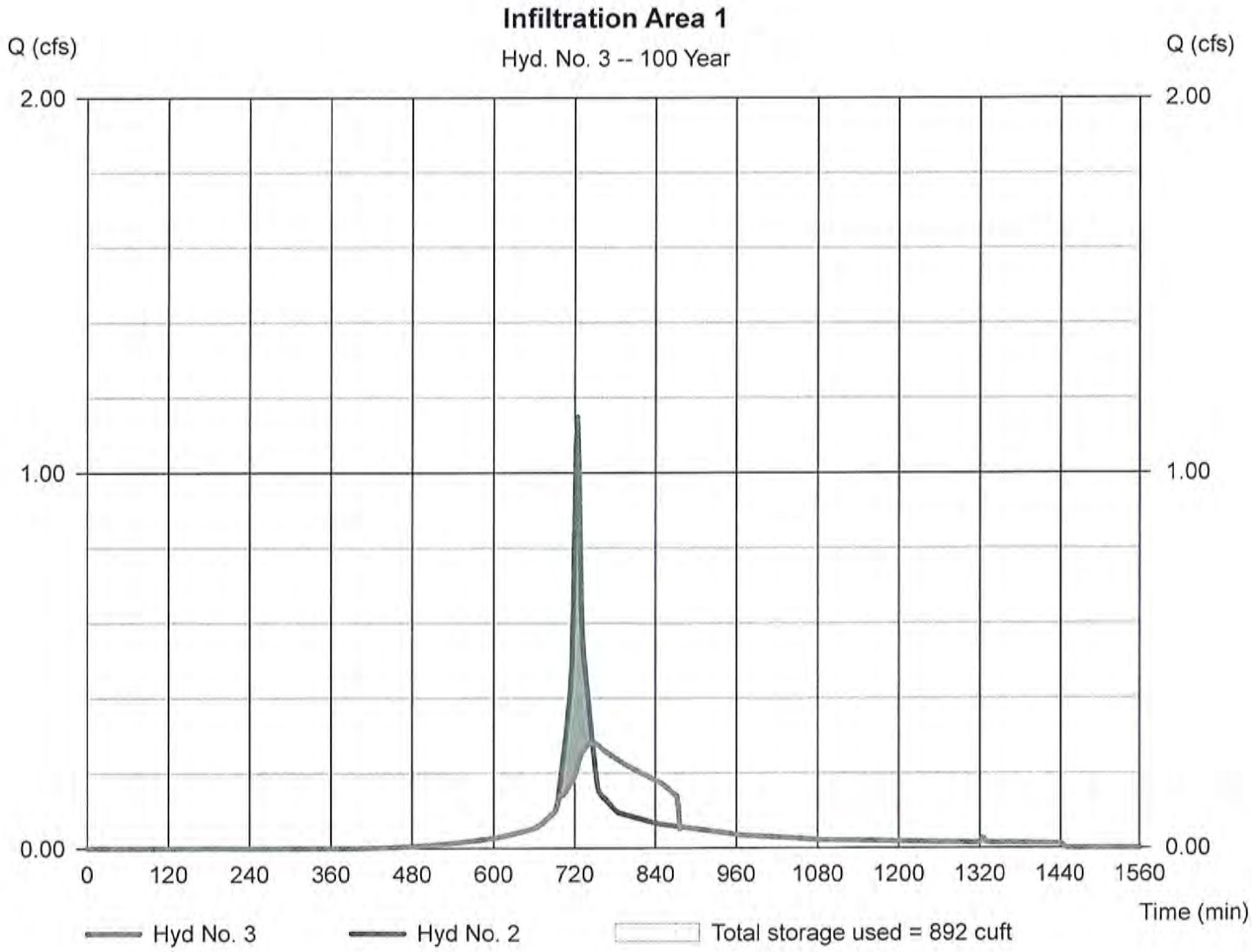
Hydraflow Hydrographs by Intelisolve v9.2 — Friday, Apr 22, 2016

Hyd. No. 3

Infiltration Area 1

Hydrograph type	= Reservoir	Peak discharge	= 0.281 cfs
Storm frequency	= 100 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 3,454 cuft
Inflow hyd. No.	= 2 - P1B	Max. Elevation	= 202.41 ft
Reservoir name	= Infiltration Area 1	Max. Storage	= 892 cuft

Storage Indication method used. Outflow includes exfiltration.



Worksheet 2: Runoff curve number and runoff SM-5369

Project: 429 Great Rd By JTM Date 4/14/16

Location: Acton, MA Checked _____ Date _____

Circle one: Present [Developed] P1C

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
A	Woods	30			0.00	0.00
A	Open	39			0.00	0.13
	Impervious	98			0.10	9.87
				Totals =	0.10	10.00

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{10.00}{0.10} = 96.16$; Use CN = 96.2

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency	yr	2	10	100
Rainfall, P (24-hour)	in	3.1	4.5	6.4
Runoff, Q (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	2.67	4.05	5.94
Runoff, Q	cf	1007	1530	2244

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

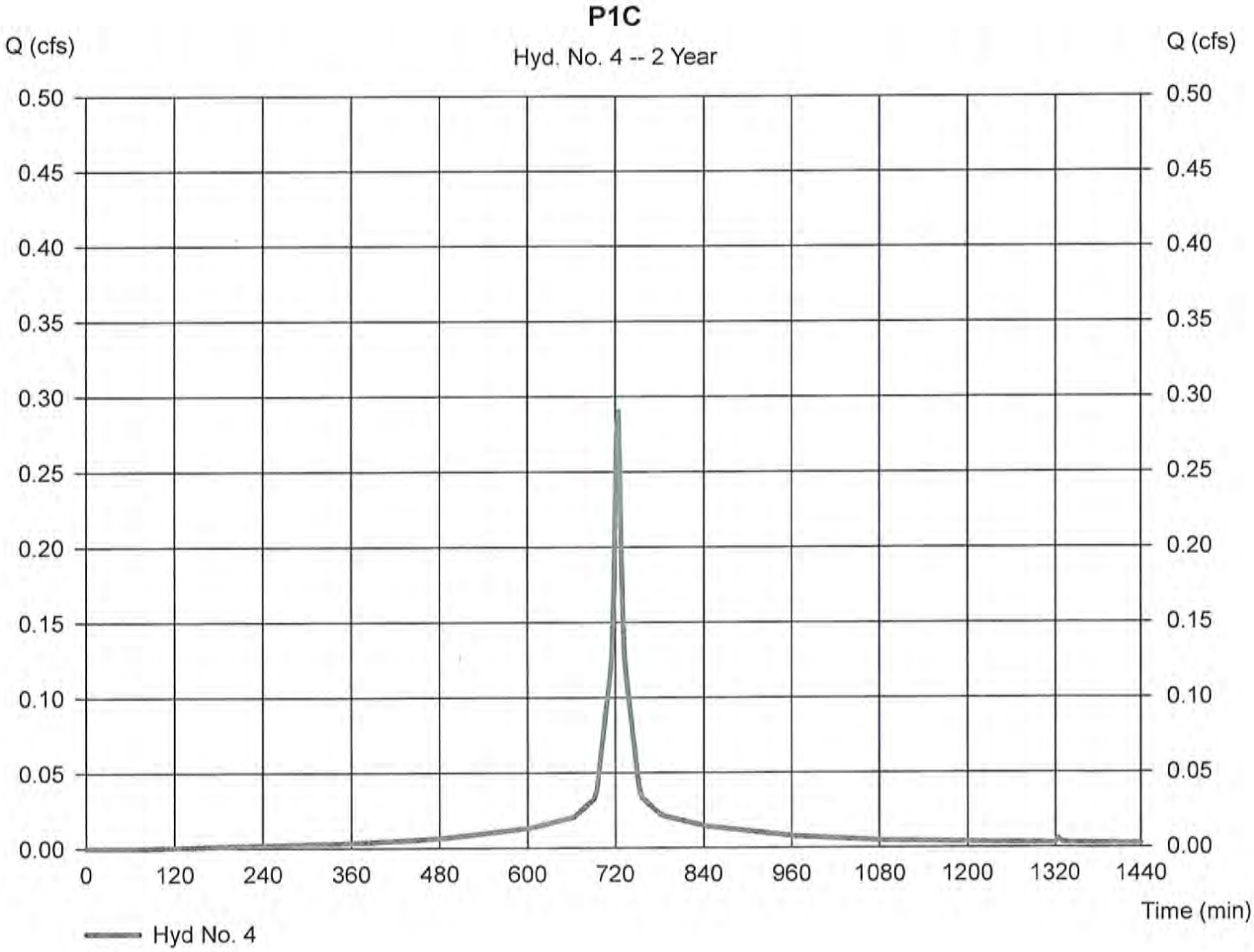
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 4

P1C

Hydrograph type	= SCS Runoff	Peak discharge	= 0.290 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 976 cuft
Drainage area	= 0.100 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



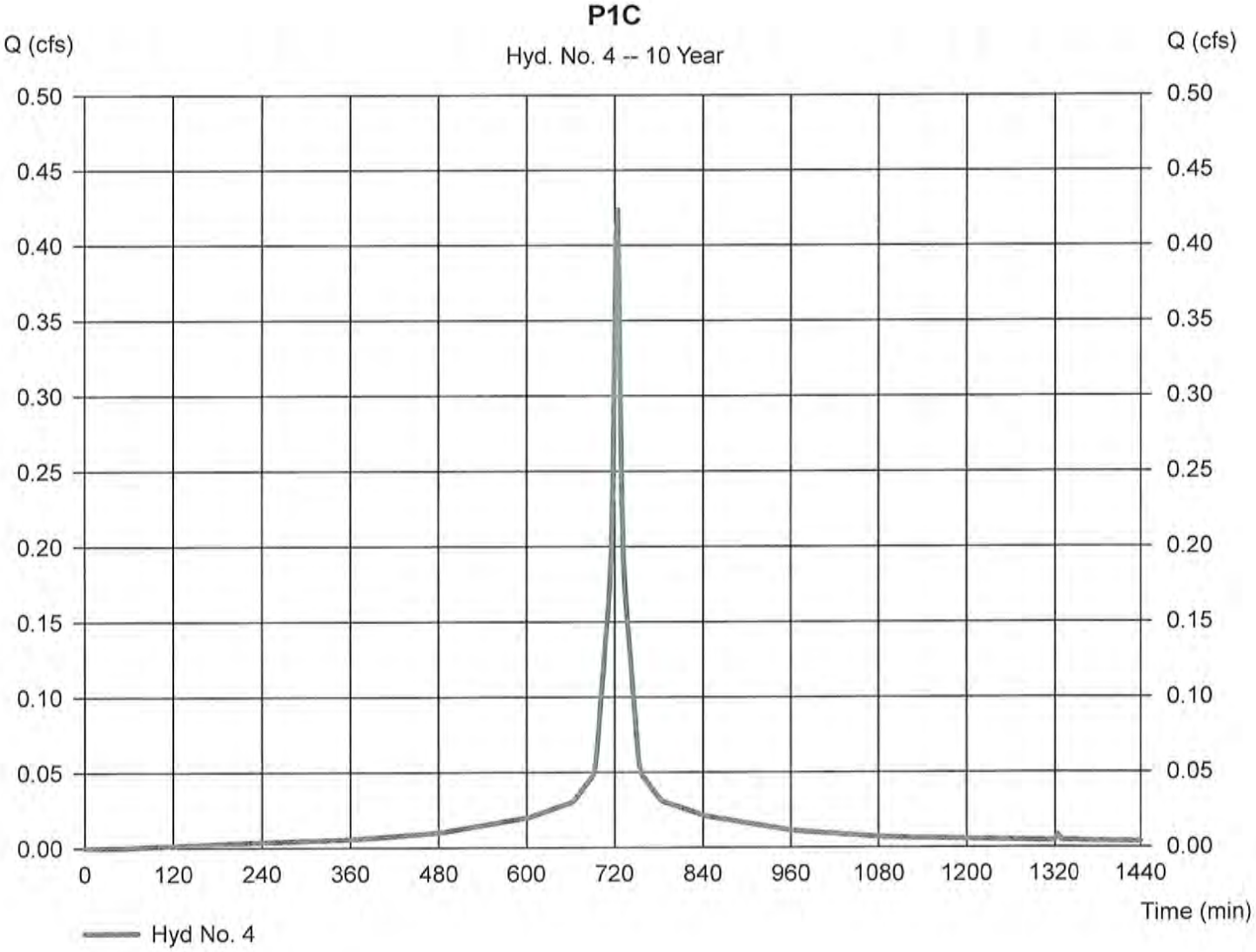
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 4

P1C

Hydrograph type	= SCS Runoff	Peak discharge	= 0.424 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,451 cuft
Drainage area	= 0.100 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



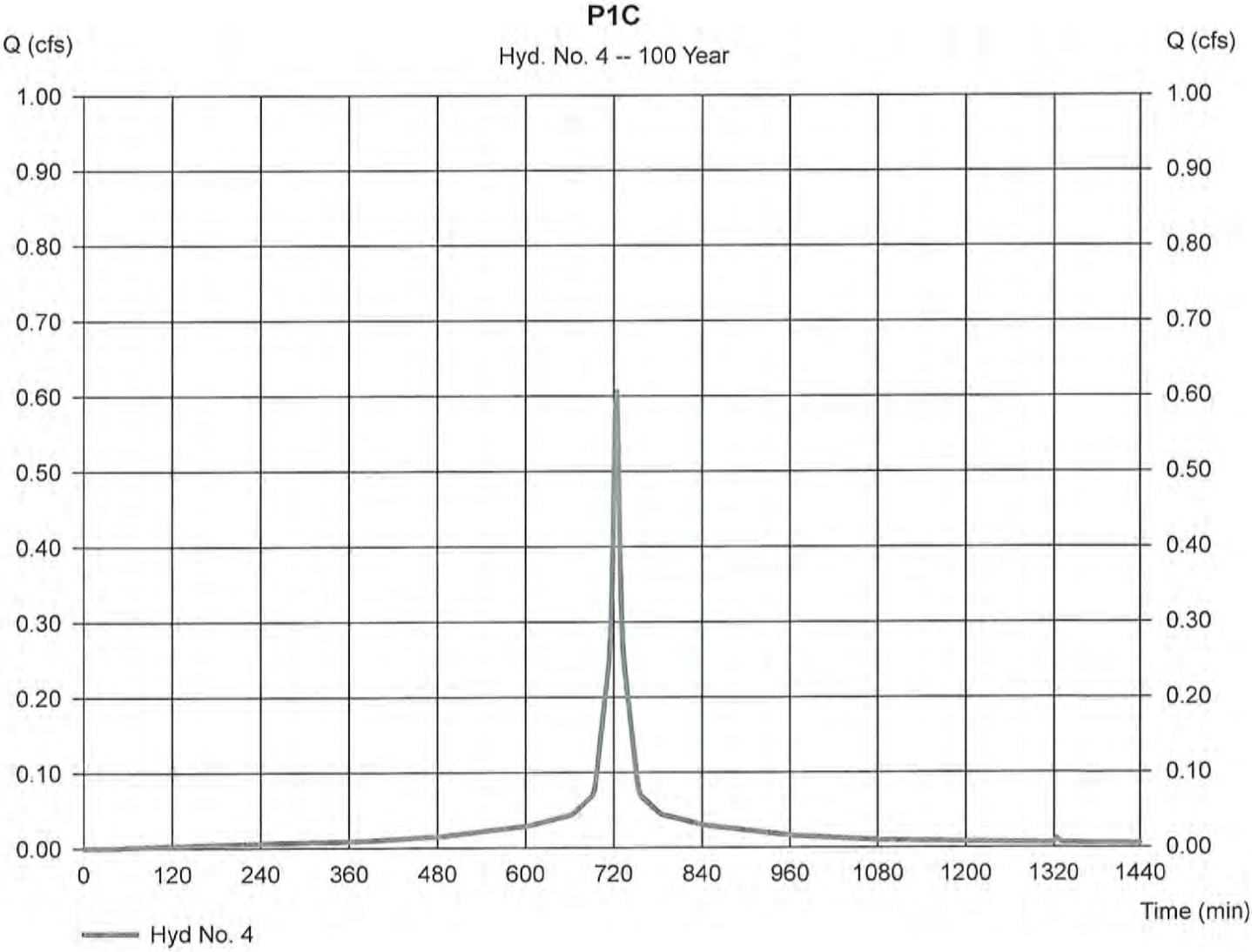
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 4

P1C

Hydrograph type	= SCS Runoff	Peak discharge	= 0.605 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 2,097 cuft
Drainage area	= 0.100 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

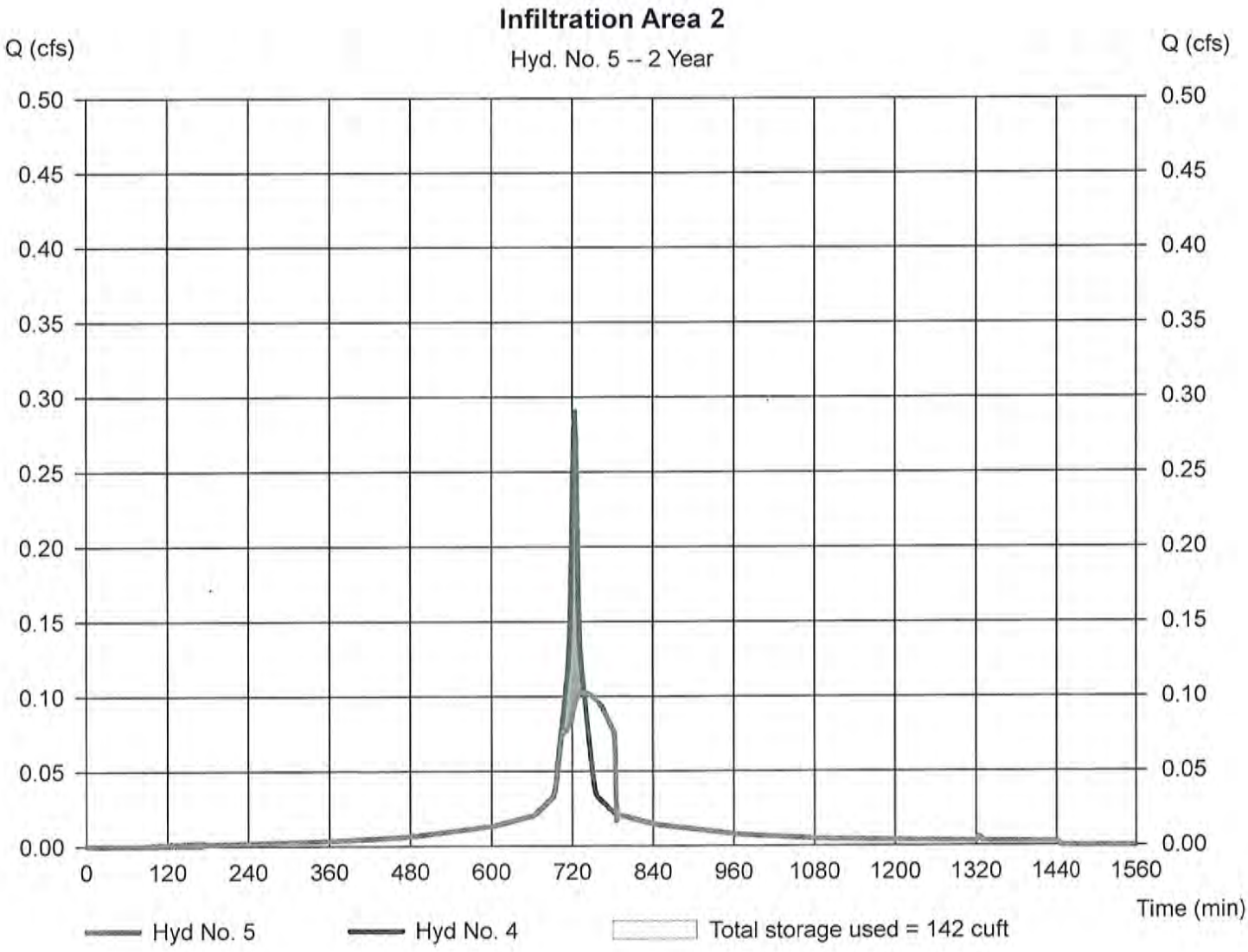
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 5

Infiltration Area 2

Hydrograph type	= Reservoir	Peak discharge	= 0.102 cfs
Storm frequency	= 2 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 976 cuft
Inflow hyd. No.	= 4 - P1C	Max. Elevation	= 198.69 ft
Reservoir name	= Infiltration Area 2	Max. Storage	= 142 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

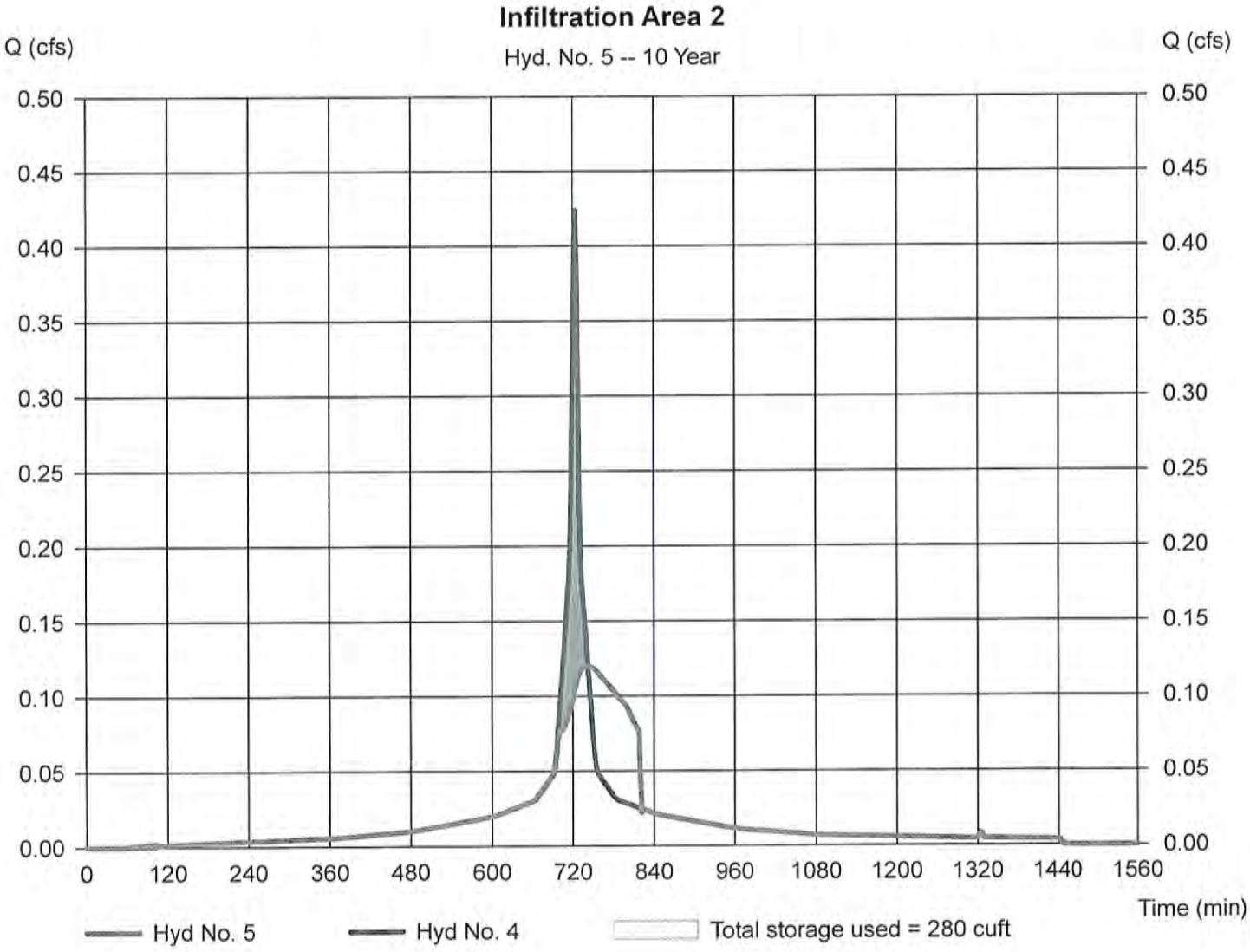
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 5

Infiltration Area 2

Hydrograph type	= Reservoir	Peak discharge	= 0.120 cfs
Storm frequency	= 10 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 1,451 cuft
Inflow hyd. No.	= 4 - P1C	Max. Elevation	= 199.11 ft
Reservoir name	= Infiltration Area 2	Max. Storage	= 280 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

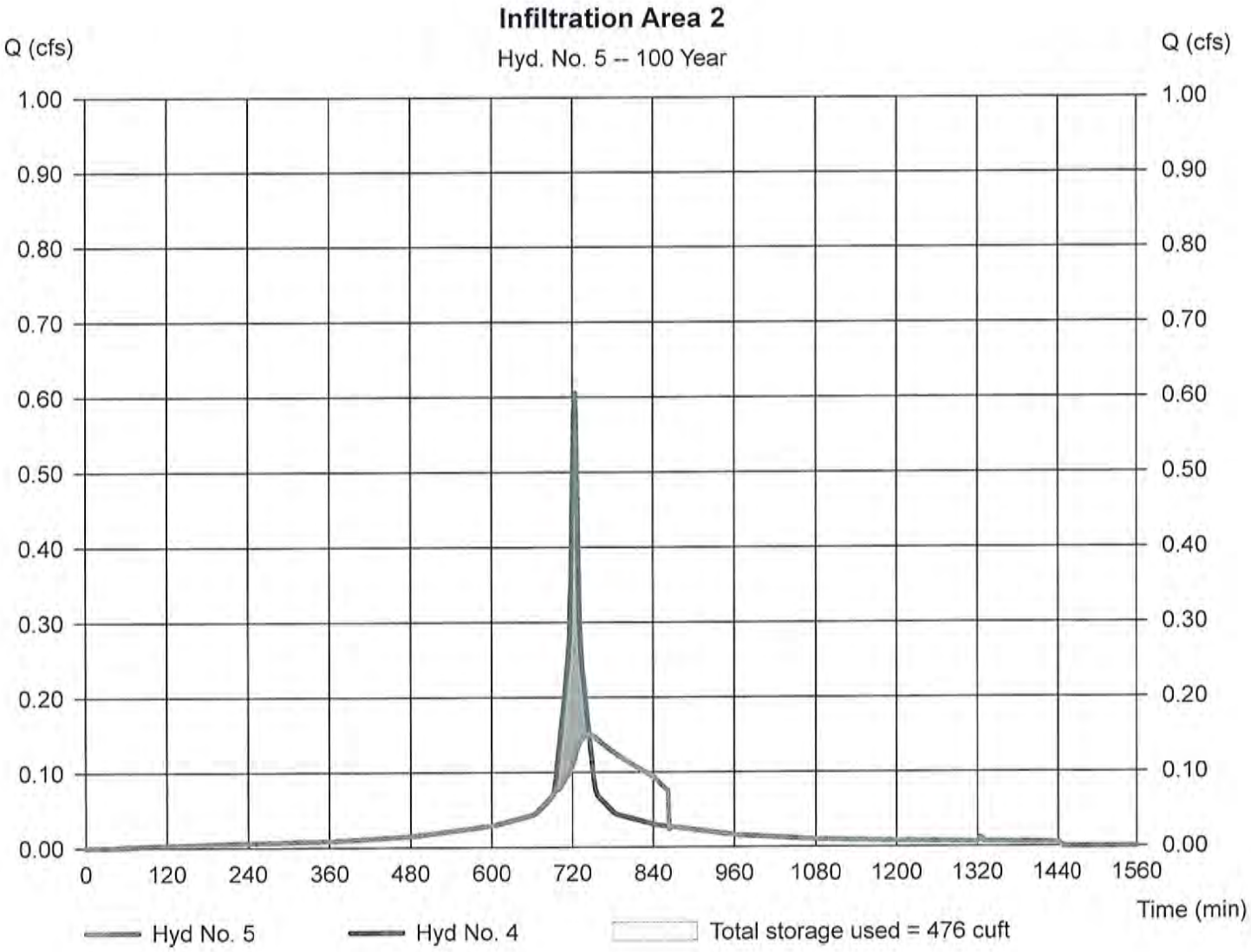
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 5

Infiltration Area 2

Hydrograph type	= Reservoir	Peak discharge	= 0.150 cfs
Storm frequency	= 100 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 2,097 cuft
Inflow hyd. No.	= 4 - P1C	Max. Elevation	= 199.86 ft
Reservoir name	= Infiltration Area 2	Max. Storage	= 476 cuft

Storage Indication method used. Outflow includes exfiltration.



Worksheet 2: Runoff curve number and runoff SM-5369

Project: 429 Great Rd By JTM Date 4/14/16

Location: Acton, MA Checked _____ Date _____

Circle one: Present [Developed] P1D

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
A	Woods	30			0.00	0.00
A	Open	39			0.00	0.00
	Impervious	98			0.04	3.75
Totals =					0.04	3.75

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{3.75}{0.04} = 98.00$; 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..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	2.87	4.26	6.16
Runoff, Q.....	cf	398	592	856

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

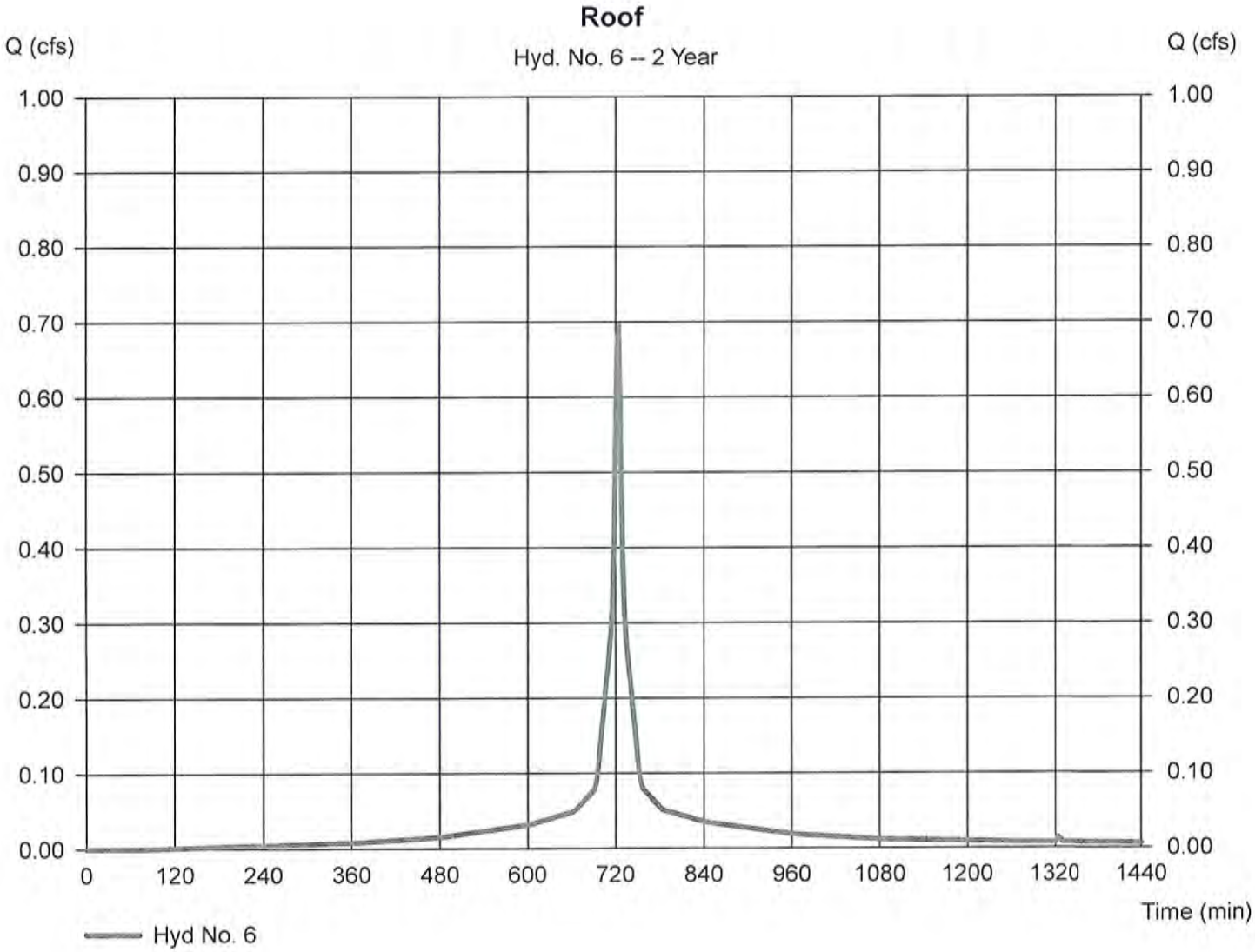
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 6

Roof

Hydrograph type	= SCS Runoff	Peak discharge	= 0.696 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 2,342 cuft
Drainage area	= 0.240 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 3.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



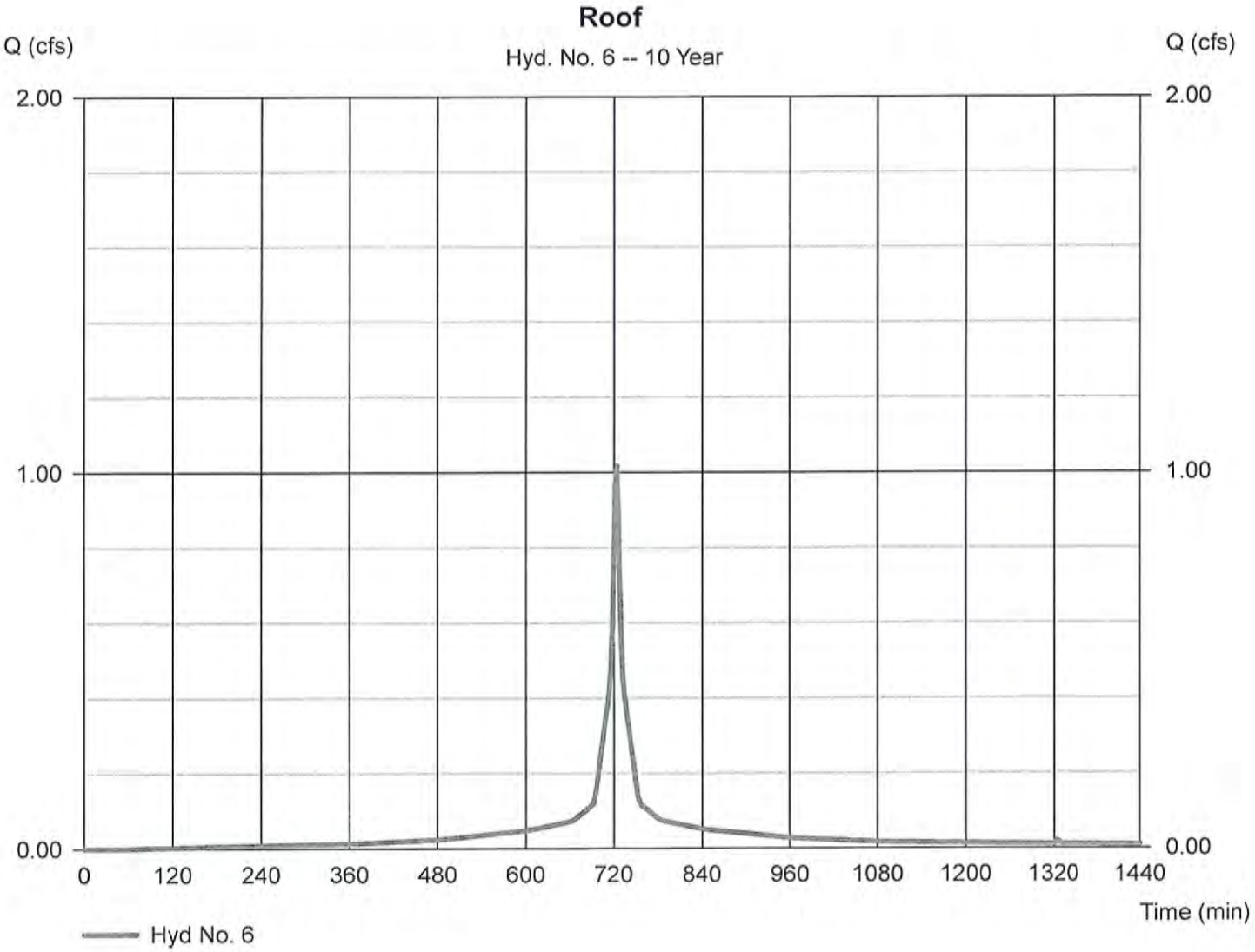
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 6

Roof

Hydrograph type	= SCS Runoff	Peak discharge	= 1.017 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 3,483 cuft
Drainage area	= 0.240 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 4.50 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



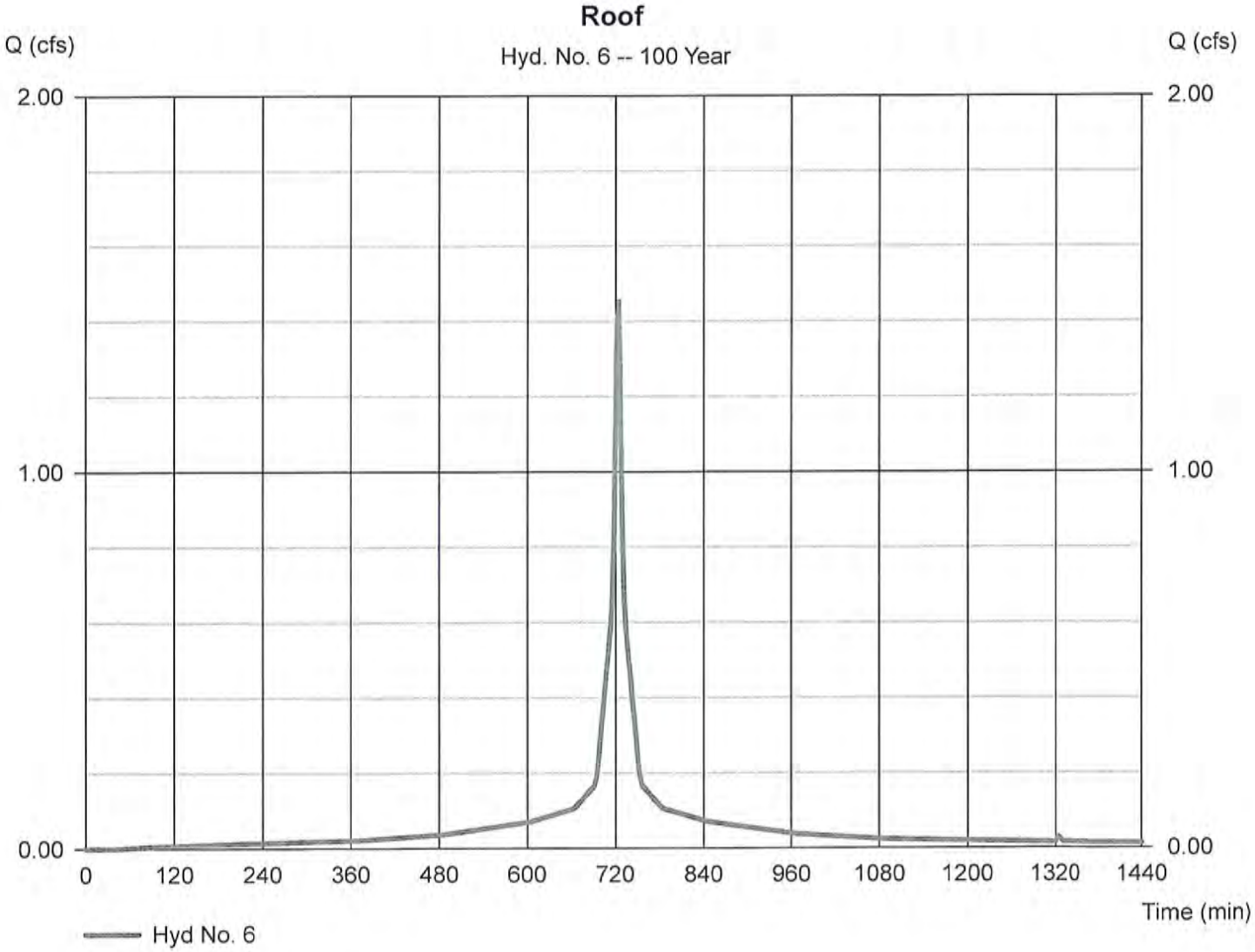
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 6

Roof

Hydrograph type	= SCS Runoff	Peak discharge	= 1.452 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 5,032 cuft
Drainage area	= 0.240 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 6.00 min
Total precip.	= 6.40 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

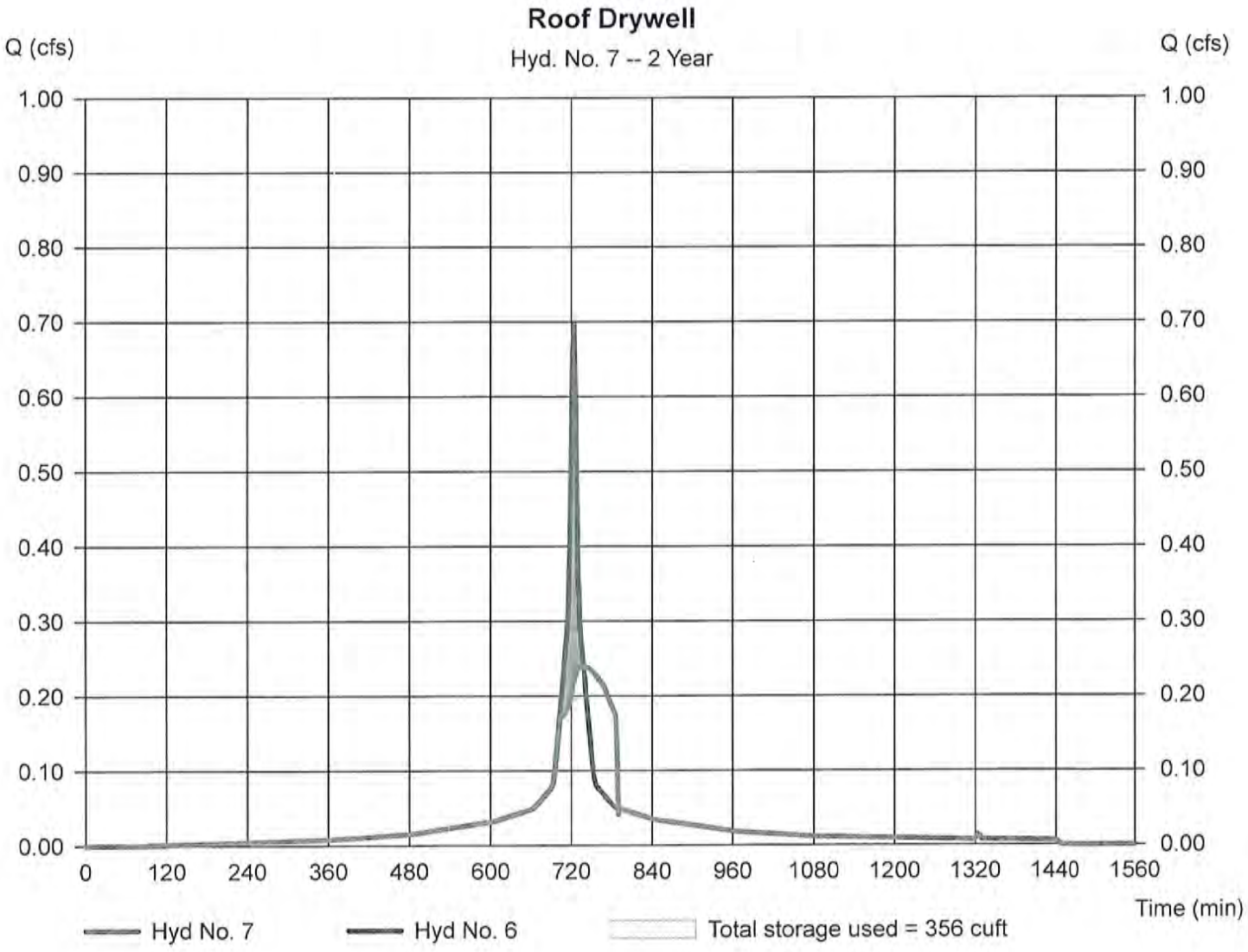
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 7

Roof Drywell

Hydrograph type	= Reservoir	Peak discharge	= 0.239 cfs
Storm frequency	= 2 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 2,342 cuft
Inflow hyd. No.	= 6 - Roof	Max. Elevation	= 201.98 ft
Reservoir name	= Roof Drywell	Max. Storage	= 356 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

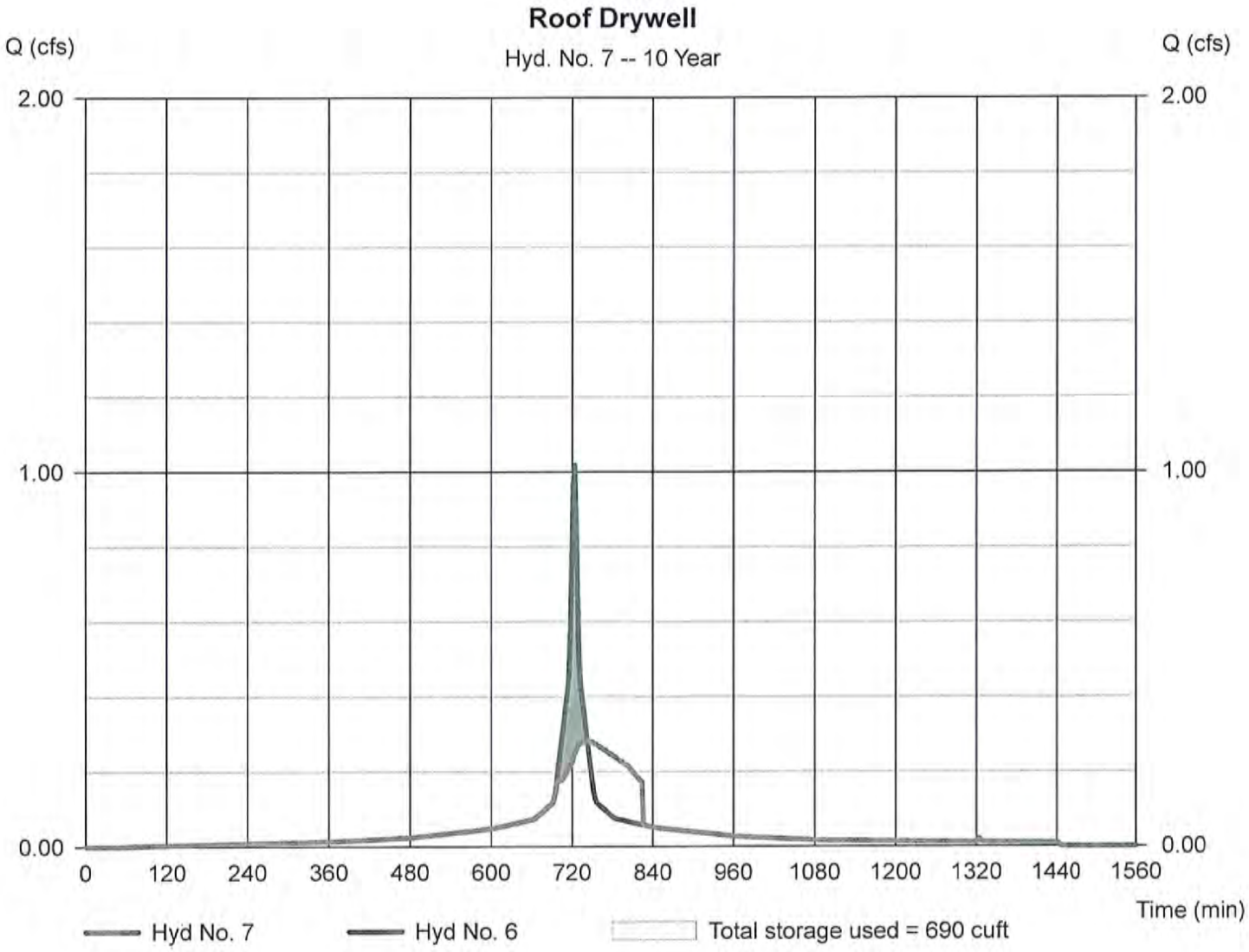
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 7

Roof Drywell

Hydrograph type	= Reservoir	Peak discharge	= 0.281 cfs
Storm frequency	= 10 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 3,483 cuft
Inflow hyd. No.	= 6 - Roof	Max. Elevation	= 202.43 ft
Reservoir name	= Roof Drywell	Max. Storage	= 690 cuft

Storage Indication method used. Outflow includes exfiltration.



Hydrograph Report

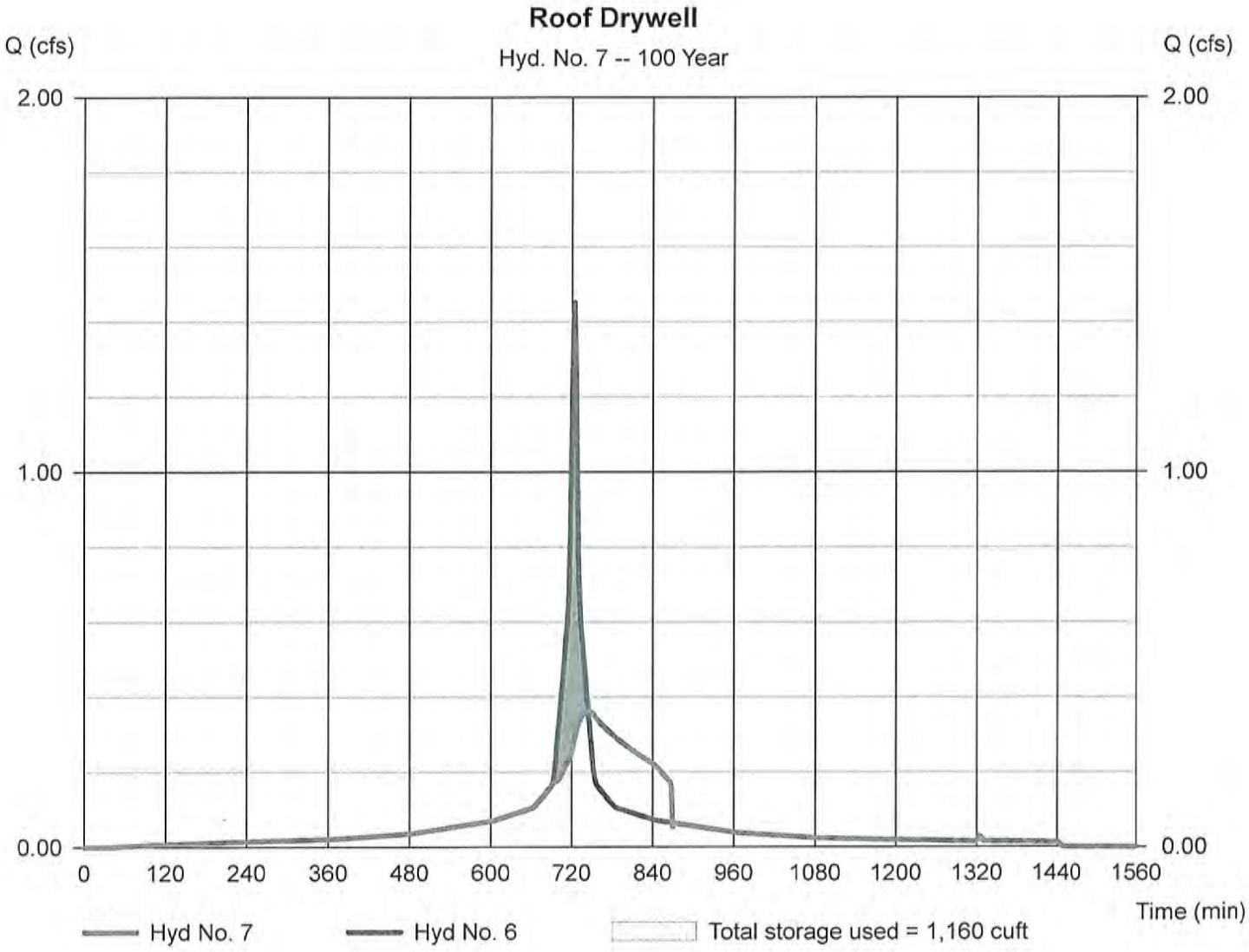
Hydraflow Hydrographs by Intelisolve v9.2 — Wednesday, Apr 20, 2016

Hyd. No. 7

Roof Drywell

Hydrograph type	= Reservoir	Peak discharge	= 0.363 cfs
Storm frequency	= 100 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 5,032 cuft
Inflow hyd. No.	= 6 - Roof	Max. Elevation	= 203.29 ft
Reservoir name	= Roof Drywell	Max. Storage	= 1,160 cuft

Storage Indication method used. Outflow includes exfiltration.



Water Quality Volume Calculations

Project: 429 Great Road
Location: Acton, MA
Prepared For: James Melvin - Stamski & McNary, Inc.

CONTECH ENGINEERED SOLUTIONS

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

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

Given:

Structure Name	Impv. (acres)	A ($miles^2$)	t_c (min)	t_c (hr)	WQV (in)
DMH4	0.17	0.0002689	6.0	0.100	1.00
DMH5	0.10	0.0001574	6.0	0.100	1.00

Procedure:

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

Structure Name	qu (csm/in.)
DMH4	774.00
DMH5	774.00

1. Compute Q Rate using the following equation:

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

where:

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

Structure Name	Q_1 (cfs)
DMH4	0.21
DMH5	0.12

Water Quality Volume Calculations

Job: SM-5369

Calculated by: JTM
Date: 4/19/2016

Subcatchment P1D

Soils: Merrimac-Urban Land Complaex
Hydrologic Group: A
Required Water Quality Volume
1 inches of runoff x impervious area

Impervious area: 0.04 acres
1,667 s.f.

Required Water Quality Volume

$$V = 1{,}667 \text{ s.f.} \times \frac{1}{12} = \mathbf{139} \text{ c.f.}$$

Volume Provided 172 c.f.

172	**c.f. >**	**139**	**c.f. O.K.**

Groundwater Recharge Calculations

Recharge Volume Calculations

Job: SM-5369

Calculated by: JTM
Date: 4/19/2016

P1B

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

Impervious area: 0.17 acres
7,496 s.f.

Required Recharge Volume (Rv)

$$Rv = 7{,}496 \text{ s.f.} \times \frac{0.6}{12} = \mathbf{375 \text{ c.f.}}$$

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

D (depth of infiltration facility):	0.5	ft
K (saturated hydraulic conductivity):	8.27	inches/hour
	0.6891667	feet/hour
T (time):	2	hours
A=	735	s.f.
Voids=	0.40	
Volume of Chambers=	397	
Rv=	1,557	c.f. > 375 c.f.

72 Hour Drawdown
Rv/(K x Bottom Area)= 0.35 Hours
0.35 < 72 hours O.K.

P1C

Soils: Merrimac-Urban land complex

Hydrologic Group: A

Required Recharge Volume

0.6 inches of runoff x impervious area

Impervious area: 0.10 acres

4,388 s.f.

Required Recharge Volume (Rv)

$$Rv = 4{,}388 \text{ s.f.} \times \frac{0.6}{12} = \mathbf{219\ c.f.}$$

Simple Dynamic Method

A=Rv / (D+KT)

Rv=A(D+kT)

D (depth of infiltration facility):	0.5	ft
K (saturated hydraulic conductivity):	8.27	inches/hour
	0.6891667	feet/hour
T (time):	2	hours
A=	424	s.f.
Voids=	0.40	
Volume of Chambers=	220	
Rv=	889	c.f. > 219 c.f.

72 Hour Drawdown

Rv/(K x Bottom Area)= 0.36 Hours

0.36 < 72 hours O.K.

P1D

Soils: Merrimac-Urban land complex

Hydrologic Group: A

Required Recharge Volume

0.6 inches of runoff x impervious area

Impervious area: 0.04 acres

1,667 s.f.

Required Recharge Volume (Rv)

$$Rv = 1{,}667 \text{ s.f.} \times \frac{0.6}{12} = \mathbf{83\ c.f.}$$

Simple Dynamic Method

A=Rv / (D+KT)

Rv=A(D+kT)

D (depth of infiltration facility): 1 ft

K (saturated hydraulic conductivity): 8.27 inches/hour

0.6891667 feet/hour

T (time): 2 hours

A= 360 s.f.

Voids= 0.40

Rv= 640 c.f. > 83 c.f.

72 Hour Drawdown

Rv/(K x Bottom Area)= 0.19 Hours

0.19 < 72 hours O.K.

Roof Drywell

Soils: Merrimac-Urban land complex

Hydrologic Group: A

Required Recharge Volume

0.6 inches of runoff x impervious area

Impervious area: 0.24 acres

10,510 s.f.

Required Recharge Volume (Rv)

$$Rv = 10{,}510 \text{ s.f.} \times \frac{0.6}{12} = \mathbf{526\ c.f.}$$

Simple Dynamic Method

A=Rv / (D+KT)

Rv=A(D+kT)

D (depth of infiltration facility):	0.5	ft
K (saturated hydraulic conductivity):	8.27	inches/hour
	0.6891667	feet/hour
T (time):	2	hours
A=	933	s.f.
Voids=	0.40	
Volume of Chambers=	514	
Rv=	1,987	c.f. > 526 c.f.

72 Hour Drawdown

Rv/(K x Bottom Area)= 0.38 Hours

0.38 < 72 hours O.K.

Inlet Grate Capacity Calculations

Inlet Grate Capacity Calculations

Job: SM-5369
Project: 429 Great Road

Calculated by: JTM
Date: 4/19/2016

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

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

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

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

	TRIBUTARY AREA (AC)	TIME OF CONC.	100 YR INTENSITY	C	Q=CiA Q100	POSITION	Q (MAX)	single grate	double grate
CB1	0.17	10	7.6	0.57	0.74	OS	2.04	yes	
CB2	0.08	10	7.6	0.9	0.55	OS	2.04	yes	
CB3	0.12	10	7.6	0.78	0.71	LP	2.85	yes	

Infiltration Trench Sizing Calculations

Infiltration Trench Calculation

Project: 429 Great Rd by: JTM Date: 4/13/2016

Location: Acton, MA checked: Date:

P11-Lot 2 Turnout

Area of Driveway:	1667	S.F.	0.04 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

1667 S.F. x 6.26 IN = 870 FT^3

Infiltration trench sizing

Length:	72 ft
Width:	5 ft
Depth:	1 ft

40% voids with gravel

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

72 x 5 x 1 x 40 % = 144 FT^3

Infiltration

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

360 + 144 * 8.27*24 = 8336 ft^3 per 24 hours

144 FT^3 + 8336 FT^3 = 8480 FT^3

8480	FT^3 >	870	FT^3 O.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 within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

Location: Pretreatment for Subsurface Inf. Area 1

TSS Removal Calculation Worksheet

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
CDS 2015-4	89.2%	0.75	0.67	0.08

Total TSS Removal = 92%

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

Project: 5369
Prepared By: JTM
Date: 4/19/16

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

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

Mass. Dept. of Environmental Protection

INSTRUCTIONS:

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

Non-automated: Mar. 4, 2008

Location: Pretreatment for Subsurface Inf. Area 2

TSS Removal Calculation Worksheet

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
Vortsentry HS36	91.5%	0.75	0.69	0.06

Total TSS Removal = 94%

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

Project: 5369
Prepared By: JTM
Date: 4/19/16

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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: Pretreatment Infiltration Trench

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Grass and gravel filter strip	25%	1.00	0.25	0.75
Stone and filter fabric layer	25%	0.75	0.19	0.56

Total TSS Removal = 44%

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

Project: 5369

Prepared By: JTM

Date: 4/19/16

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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: Subsirface Infiltration Area 1

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
CDS 2015-4	89.2%	**1.00**	0.89	0.11
Stormtech subsurface Structure	80%	0.11	0.09	0.02

Total TSS Removal = 98%

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

Project: 5369
Prepared By: JTM
Date: 4/19/16

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

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

Non-automated: Mar. 4, 2008

Location: Subsirface Infiltration Area 2

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Vortsentry HS36	91.5%	1.00	0.92	0.08
Stormtech subsurface Structure	80%	0.08	0.06	0.02

Total TSS Removal = 98%

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

Project: 5369
Prepared By: JTM
Date: 4/19/16

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

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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: Infiltration Trench

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Infiltration Trench with pretreament	80%	1.00	0..8	0.20

Total TSS Removal = 80%

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

Project: 5369

Prepared By: JTM

Date: 4/19/16

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

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

CONTECH ENGINEERED SOLUTIONS

429 GREAT ROAD
ACTON, MA
for SYSTEM: DMH4

Area	0.17	acres	CDS Model	
Weighted C	0.90		2015-4	
Tc	6	minutes	CDS Treatment Capacity	
			1.4	cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Removal Efficiency (%)	Incremental Removal (%)
0.02	10.2%	10.2%	0.00	0.00	97.1	9.9
0.04	9.6%	19.8%	0.01	0.01	96.9	9.4
0.06	9.4%	29.3%	0.01	0.01	96.8	9.1
0.08	7.7%	37.0%	0.01	0.01	96.6	7.5
0.10	8.6%	45.6%	0.02	0.02	96.5	8.3
0.12	6.3%	51.9%	0.02	0.02	96.3	6.1
0.14	4.7%	56.5%	0.02	0.02	96.2	4.5
0.16	4.6%	61.2%	0.02	0.02	96.0	4.5
0.18	3.5%	64.7%	0.03	0.03	95.9	3.4
0.20	4.3%	69.1%	0.03	0.03	95.7	4.2
0.25	8.0%	77.1%	0.04	0.04	95.4	7.6
0.30	5.6%	82.7%	0.05	0.05	95.0	5.3
0.35	4.4%	87.0%	0.05	0.05	94.6	4.1
0.40	2.5%	89.5%	0.06	0.06	94.2	2.4
0.45	2.5%	92.1%	0.07	0.07	93.9	2.4
0.50	1.4%	93.5%	0.08	0.08	93.5	1.3
0.75	5.0%	98.5%	0.11	0.11	91.6	4.6
1.00	1.0%	99.5%	0.15	0.15	89.8	0.9
1.50	0.0%	99.5%	0.23	0.23	86.1	0.0
2.00	0.0%	99.5%	0.31	0.31	82.3	0.0
3.00	0.5%	100.0%	0.46	0.46	74.9	0.4
						95.7
					Removal Efficiency Adjustment[2] =	6.5%
					Predicted % Annual Rainfall Treated =	93.5%
					Predicted Net Annual Load Removal Efficiency =	**89.2%**

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

VortSentry® HS Estimated Net Annual TSS Reduction

CONTECH ENGINEERED SOLUTIONS

429 GREAT ROAD
ACTON, MA
Model VSHS36
System DMH5

Design Ratio[1] = $\frac{0.1 \text{ acres} \times 0.9}{27 \text{ ft3}}$ **= 0.003**

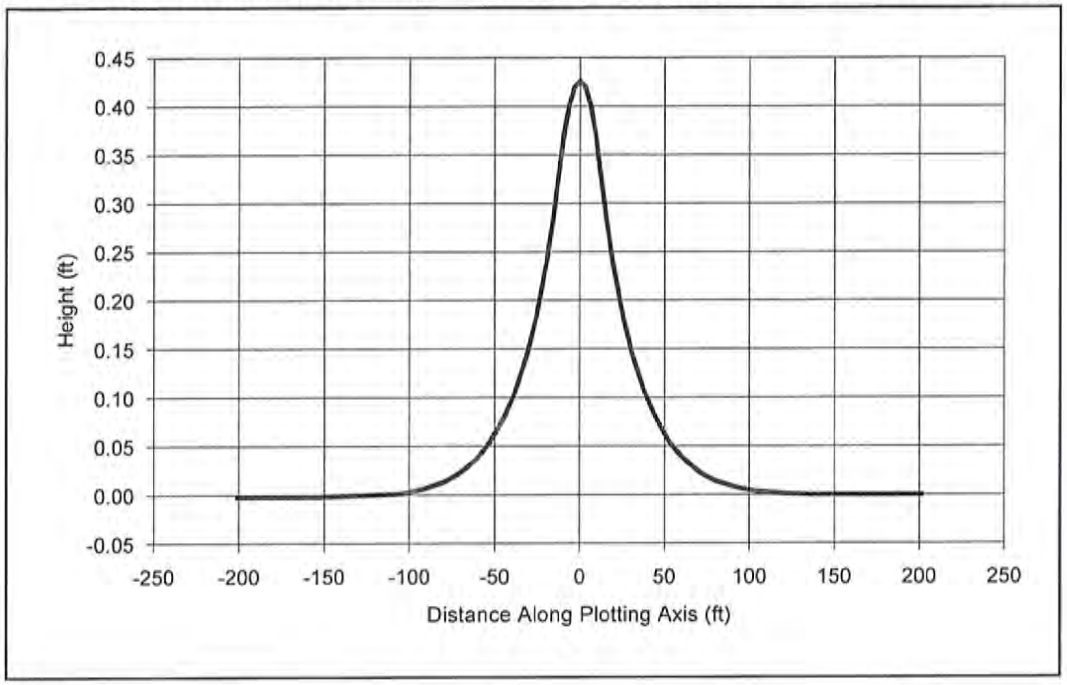
Rainfall Intensity "/hr	Flow Rate cfs	Operating Rate[2] cfs/ft³	% Total Rainfall Depth[3]	Rmvl. Effcy[4] (%)	Rel. Effcy (%)
0.02	0.00	0.00007	10.2%	98.0%	10.0%
0.04	0.00	0.00014	9.6%	98.0%	9.5%
0.06	0.01	0.00020	9.4%	98.0%	9.3%
0.08	0.01	0.00027	7.7%	98.0%	7.6%
0.10	0.01	0.00034	8.6%	98.0%	8.4%
0.12	0.01	0.00041	6.3%	98.0%	6.2%
0.14	0.01	0.00048	4.7%	98.0%	4.6%
0.16	0.01	0.00054	4.6%	98.0%	4.5%
0.18	0.02	0.00061	3.5%	98.0%	3.5%
0.20	0.02	0.00068	4.3%	98.0%	4.3%
0.25	0.02	0.00085	8.0%	98.0%	7.8%
0.30	0.03	0.00102	5.6%	98.0%	5.5%
0.35	0.03	0.00119	4.4%	98.0%	4.3%
0.40	0.04	0.00136	2.5%	98.0%	2.5%
0.45	0.04	0.00153	2.5%	98.0%	2.5%
0.50	0.05	0.00170	1.4%	98.0%	1.4%
0.75	0.07	0.00255	5.0%	98.0%	4.9%
1.00	0.09	0.00340	1.0%	98.0%	1.0%
1.50	0.14	0.00509	0.0%	98.0%	0.0%
2.00	0.18	0.00679	0.0%	98.0%	0.0%
3.00	0.27	0.01019	0.5%	95.7%	0.5%
					98.0%
				% rain falling at >3"/hr =	0.0%
				Removal Efficiency Adjustment[4] =	6.5%
				Predicted Net Annual Load Removal Efficiency =	**91.5%**

1 - Design Ratio = (Total Drainage Area x Runoff Coefficient) / VortSentry HS Treatment Volume
= The Total Drainage Area and Runoff Coefficient are specified by the site engineer.
2 - Operating Rate (cfs/ft³) = Rainfall Intensity ("/hr) x Design Ratio
3 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
4 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Calculated by: CJA	Date: 04/20/16	Checked by:	Date:

Groundwater Mounding Calculations

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



COMPANY: Stamski and McNary, Inc.

PROJECT: 5369 Inf Area 1

ANALYST: James Melvin

DATE: 4/21/2016 TIME: 9:48:03 AM

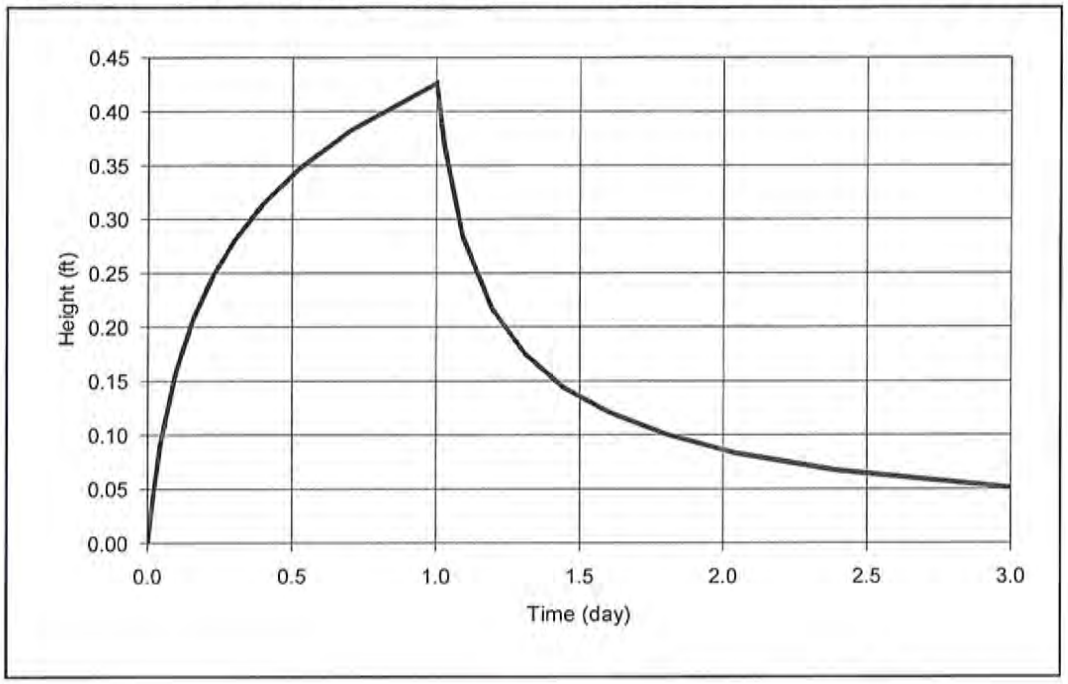
INPUT PARAMETERS

Application rate: 0.85 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 23.36 ft
Width of application area: 31.47 ft
Constant head boundary used at: 201 ft
Plotting axis from Y-Axis: 0 degrees
Edge of recharge area:
positive X: 0 ft
positive Y: 11.7 ft
Total volume applied: 624.8683 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
0	-201	-201	0
0	-169	-169	0
0	-137.1	-137	0
0	-105.1	-105	0
0	-80	-80	0.01
0	-60.5	-61	0.04
0	-44.6	-45	0.08
0	-31.1	-31	0.14
0	-19.5	-19	0.24
0	-11.7	-12	0.34
0	-6.3	-6	0.4
0	0	0	0.43
0	6.3	6	0.4
0	11.7	12	0.34
0	19.5	19	0.24
0	31.1	31	0.14
0	44.6	45	0.08
0	60.5	61	0.04
0	80	80	0.01
0	105.1	105	0
0	137.1	137	0
0	169	169	0
0	201	201	0

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



COMPANY: Stamski and McNary, Inc.

PROJECT: 5369 Inf Area 1

ANALYST: James Melvin

DATE: 4/21/2016 TIME: 9:48:15 AM

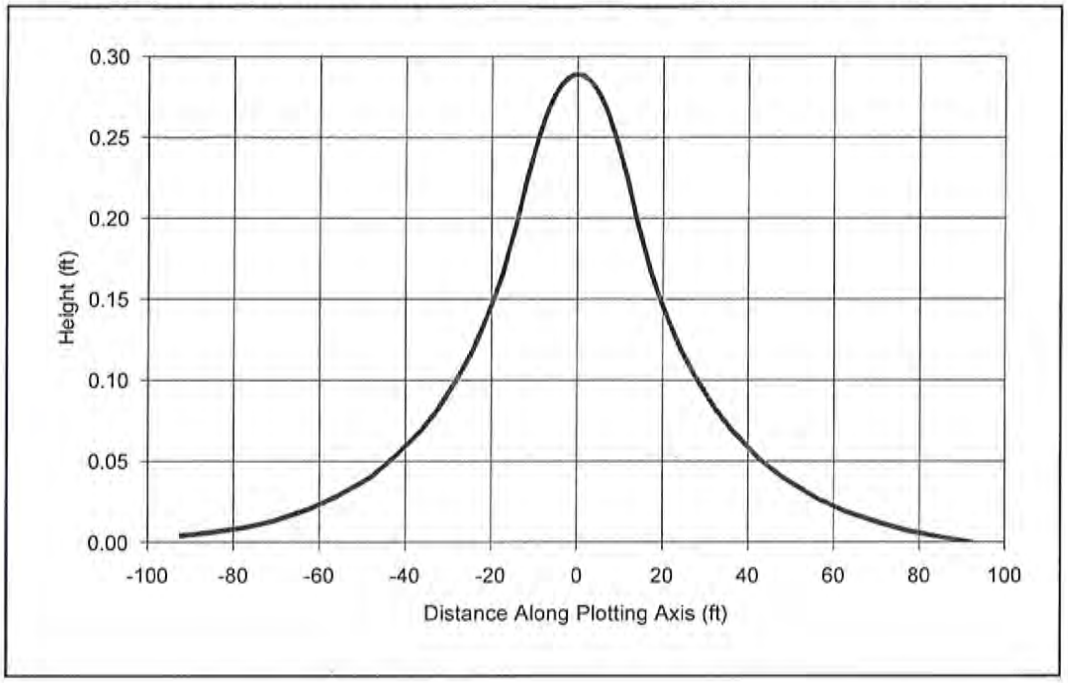
INPUT PARAMETERS

Application rate: 0.85 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 23.36 ft
Width of application area: 31.47 ft
Constant head boundary used at: 201 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 624.8683 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.03
0	0.09
0.1	0.16
0.2	0.21
0.2	0.25
0.3	0.28
0.4	0.31
0.5	0.35
0.7	0.38
1	0.43
1	0.37
1.1	0.28
1.2	0.22
1.3	0.18
1.4	0.14
1.6	0.12
1.8	0.1
2	0.08
2.4	0.07
3	0.05

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



COMPANY: Stamski and McNary, Inc.

PROJECT: 5369 Inf Area 2

ANALYST: James Melvin

DATE: 4/21/2016 TIME: 9:54:17 AM

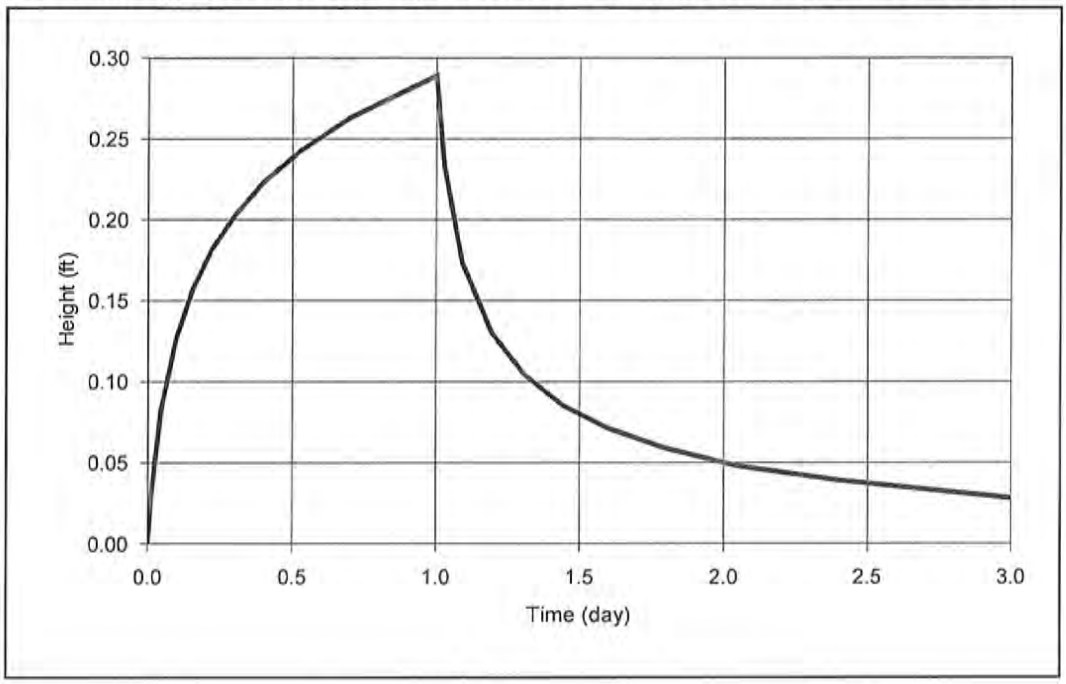
INPUT PARAMETERS

Application rate: 0.86 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 23.36 ft
Width of application area: 18.16 ft
Constant head boundary used at: 92 ft
Plotting axis from Y-Axis: 30 degrees
Edge of recharge area:
positive X: 6.7 ft
positive Y: 11.7 ft
Total volume applied: 364.8271 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-46	-79.7	-92	0
-38.7	-67	-77	0.01
-31.4	-54.3	-63	0.02
-24.1	-41.7	-48	0.04
-18.3	-31.7	-37	0.07
-13.8	-24	-28	0.1
-10.2	-17.7	-20	0.14
-7.1	-12.3	-14	0.2
-4.5	-7.7	-9	0.25
-2.7	-4.6	-5	0.28
-1.4	-2.5	-3	0.28
0	0	0	0.29
1.4	2.5	3	0.28
2.7	4.6	5	0.28
4.5	7.7	9	0.25
7.1	12.3	14	0.2
10.2	17.7	20	0.14
13.8	24	28	0.1
18.3	31.7	37	0.07
24.1	41.7	48	0.04
31.4	54.3	63	0.02
38.7	67	77	0.01
46	79.7	92	0

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



COMPANY: Stamski and McNary, Inc.

PROJECT: 5369 Inf Area 2

ANALYST: James Melvin

DATE: 4/21/2016 TIME: 9:54:26 AM

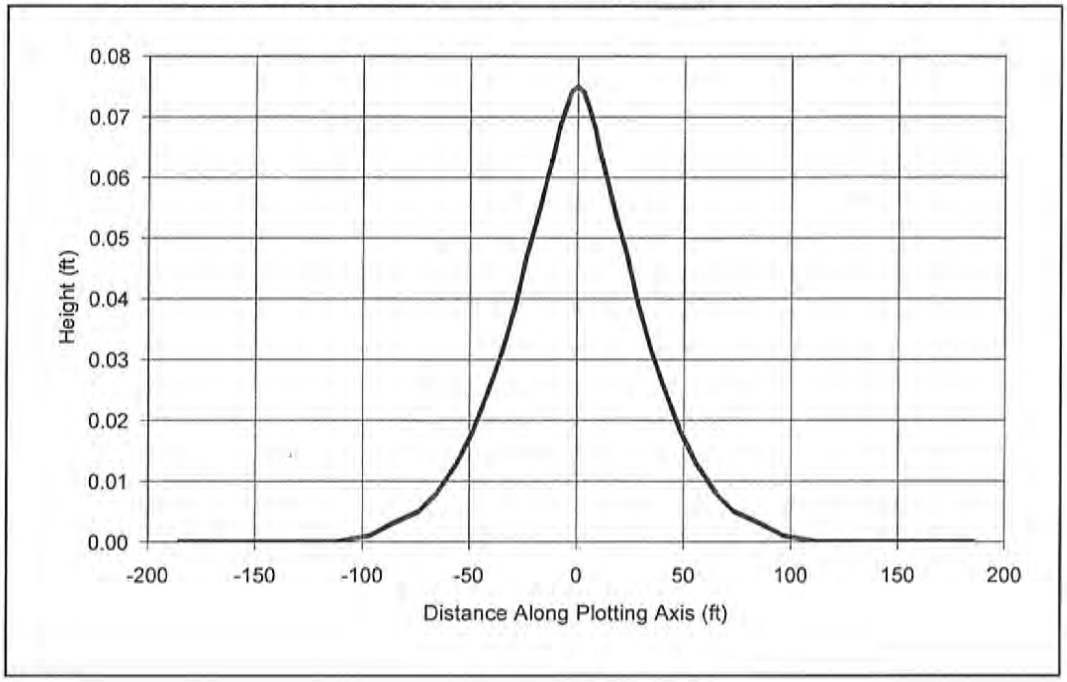
INPUT PARAMETERS

Application rate: 0.86 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 23.36 ft
Width of application area: 18.16 ft
Constant head boundary used at: 92 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 364.8271 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.03
0	0.08
0.1	0.13
0.2	0.16
0.2	0.18
0.3	0.2
0.4	0.22
0.5	0.24
0.7	0.26
1	0.29
1	0.24
1.1	0.17
1.2	0.13
1.3	0.1
1.4	0.08
1.6	0.07
1.8	0.06
2	0.05
2.4	0.04
3	0.03

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



COMPANY: Stamski and McNary, Inc.

PROJECT: 5369 Inf Trench

ANALYST: James Melvin

DATE: 4/21/2016 TIME: 9:59:23 AM

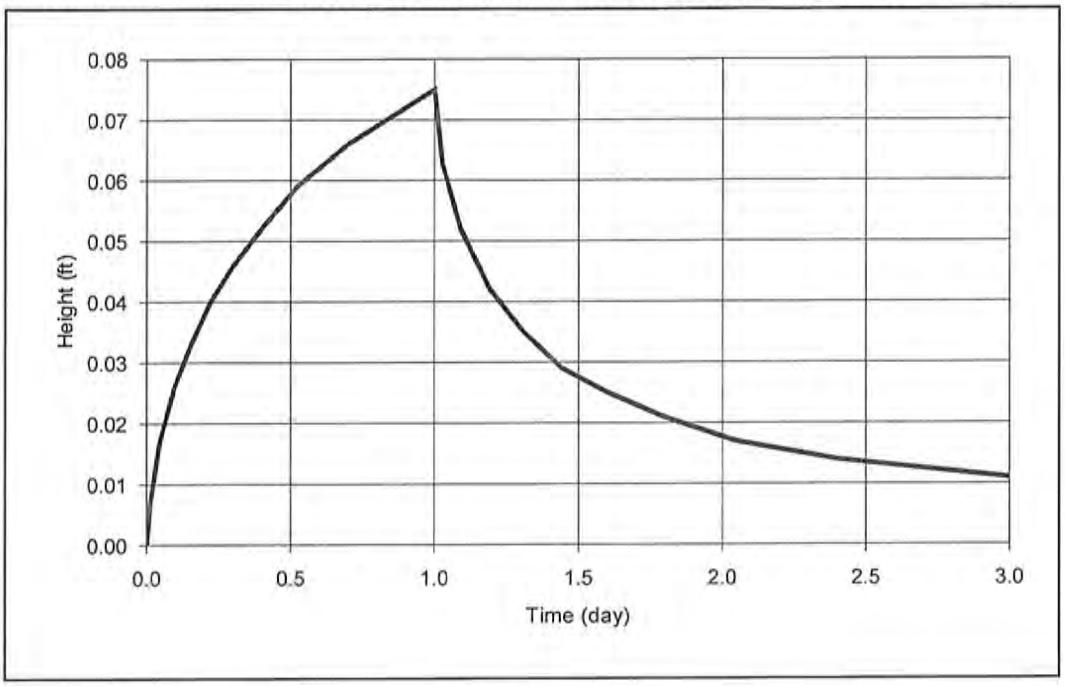
INPUT PARAMETERS

Application rate: 0.39 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 72 ft
Width of application area: 5 ft
Constant head boundary used at: 185 ft
Plotting axis from Y-Axis: 30 degrees
Edge of recharge area:
positive X: 2.5 ft
positive Y: 4.3 ft
Total volume applied: 140.4 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-92.5	-160.2	-185	0
-77.8	-134.7	-156	0
-63.1	-109.3	-126	0
-48.4	-83.8	-97	0
-36.8	-63.7	-74	0
-27.8	-48.2	-56	0.01
-20.5	-35.5	-41	0.02
-14.3	-24.8	-29	0.04
-9	-15.5	-18	0.05
-5.4	-9.3	-11	0.06
-2.9	-5	-6	0.07
0	0	0	0.08
2.9	5	6	0.07
5.4	9.3	11	0.06
9	15.5	18	0.05
14.3	24.8	29	0.04
20.5	35.5	41	0.02
27.8	48.2	56	0.01
36.8	63.7	74	0
48.4	83.8	97	0
63.1	109.3	126	0
77.8	134.7	156	0
92.5	160.2	185	0

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



COMPANY: Stamski and McNary, Inc.

PROJECT: 5369 Inf Trench

ANALYST: James Melvin

DATE: 4/21/2016 TIME: 9:59:35 AM

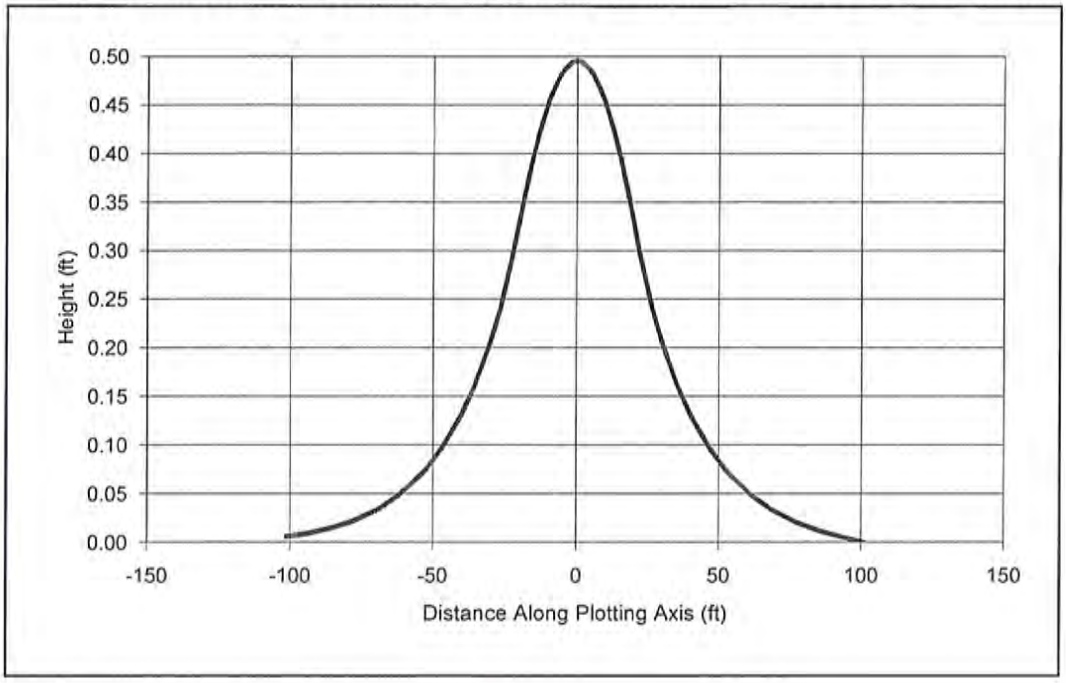
INPUT PARAMETERS

Application rate: 0.39 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 72 ft
Width of application area: 5 ft
Constant head boundary used at: 185 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 140.4 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.01
0	0.02
0.1	0.03
0.2	0.03
0.2	0.04
0.3	0.05
0.4	0.05
0.5	0.06
0.7	0.07
1	0.08
1	0.06
1.1	0.05
1.2	0.04
1.3	0.04
1.4	0.03
1.6	0.02
1.8	0.02
2	0.02
2.4	0.01
3	0.01

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



COMPANY: Stamski and McNary, Inc.

PROJECT: 5369 Roof Drywell

ANALYST: James Melvin

DATE: 4/21/2016 TIME: 10:04:28 AM

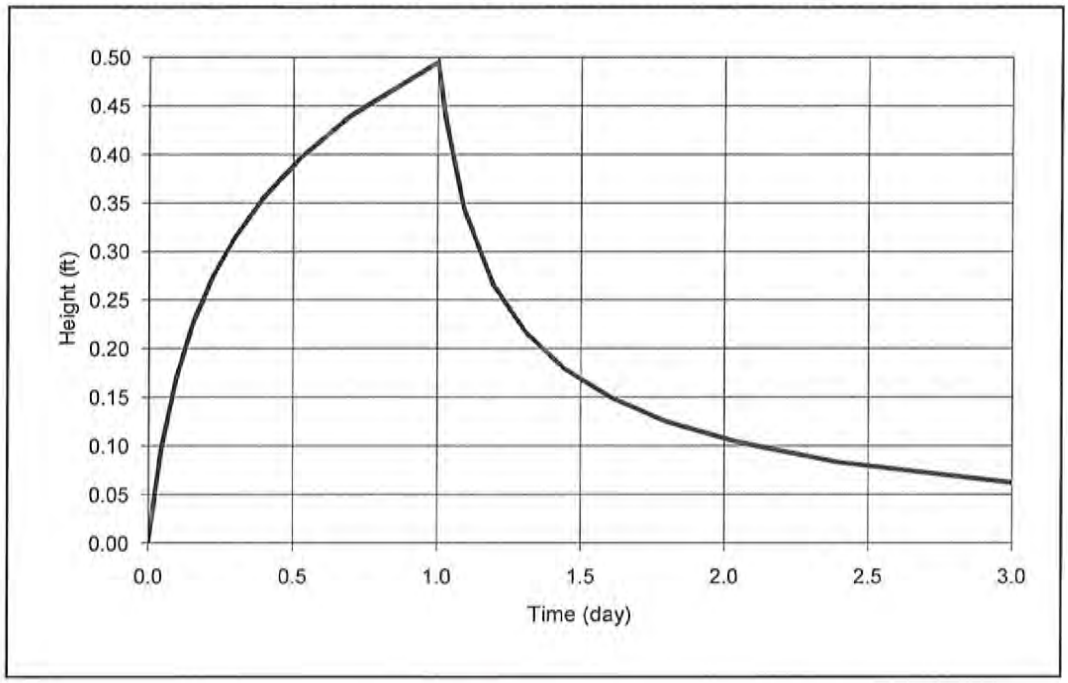
INPUT PARAMETERS

Application rate: 0.84 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 37.6 ft
Width of application area: 24.81 ft
Constant head boundary used at: 101 ft
Plotting axis from Y-Axis: 30 degrees
Edge of recharge area:
positive X: 10.9 ft
positive Y: 18.8 ft
Total volume applied: 783.599 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-50.5	-87.5	-101	0.01
-42.5	-73.6	-85	0.02
-34.4	-59.6	-69	0.03
-26.4	-45.7	-53	0.07
-20.1	-34.8	-40	0.13
-15.2	-26.3	-30	0.2
-11.2	-19.4	-22	0.29
-7.8	-13.5	-16	0.39
-4.9	-8.5	-10	0.45
-2.9	-5.1	-6	0.48
-1.6	-2.8	-3	0.49
0	0	0	0.5
1.6	2.8	3	0.49
2.9	5.1	6	0.48
4.9	8.5	10	0.45
7.8	13.5	16	0.39
11.2	19.4	22	0.29
15.2	26.3	30	0.2
20.1	34.8	40	0.13
26.4	45.7	53	0.07
34.4	59.6	69	0.03
42.5	73.6	85	0.01
50.5	87.5	101	0

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



COMPANY: Stamski and McNary, Inc.

PROJECT: 5369 Roof Drywell

ANALYST: James Melvin

DATE: 4/21/2016 TIME: 10:04:33 AM

INPUT PARAMETERS

Application rate: 0.84 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 3 day
Fillable porosity: 0.35
Hydraulic conductivity: 39 ft/day
Initial saturated thickness: 10 ft
Length of application area: 37.6 ft
Width of application area: 24.81 ft
Constant head boundary used at: 101 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 783.5991 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.03
0	0.1
0.1	0.17
0.2	0.23
0.2	0.27
0.3	0.32
0.4	0.36
0.5	0.4
0.7	0.44
1	0.5
1	0.44
1.1	0.34
1.2	0.27
1.3	0.22
1.4	0.18
1.6	0.15
1.8	0.12
2	0.1
2.4	0.08
3	0.06

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

JOB 5369 429 GREAT Rd
SHEET NO. _____ OF _____
CALCULATED BY JTM DATE 4/19/16
CHECKED BY _____ DATE _____
SCALE _____

RATE OF APPLICATION

INF AREA 1

WATER QUALITY VOLUME
$7496 \times \frac{1}{12} = 625$ C.F.

APPLICATION RATE $= \frac{625 \text{ C.F.}}{23.36 \times 31.47} = \frac{625}{735} = 0.85$

INF AREA 2

WATER QUALITY VOLUME
$4388 \times \frac{1}{12} = 366$

APPLICATION RATE $= \frac{366}{23.36 \times 18.16} = \frac{366}{424} = 0.86$

INF TRENCH

WATER QUALITY VOLUME
$1667 \times \frac{1}{12} = 139$ C.F.

APPLICATION RATE $= \frac{139}{72 \times 5} = \frac{139}{360} = 0.39$

ROOF DRYWELL

WATER QUALITY VOLUME
$10563 \times \frac{1}{12} = 880$ C.F.

APPLICATION RATE $= \frac{880}{37.6 \times 24.81} = \frac{880}{1046} = 0.84$

Storm Sewer Design

DESIGN STORM: 100 YEAR
DATE: 4/19/2016
DONE BY: JTM
FILE: 5369 RATIONAL METHOD.wb3

STORM SEWER DESIGN

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

PROJECT: SM-5369
LOCATION: Acton, MA

FROM	TO	LENGTH (FT)	TRIBUTARY AREA		TIME OF FLOW		RUNOFF COEFF. "C"	RAINFALL INTENSITY (IN/HR)	"Q" TOTAL RUNOFF (CFS)	SLOPE of PIPE (FT/FT)	DIAM (IN)	MANN. "n"	CAPACITY FULL (CFS)	VELOCITY FULL (FPS)	DESIGN FLOW					FALL IN PIPE (FT)	DRAIN INV. ELEVATION		GROUND SURFACE	
			INCR. (ACRES)	TOTAL (ACRES)	TO UPPER END (MIN)	TIME IN SECTION (MIN)									VELOCITY (FPS)	VELOCITY HEAD (FT)	DEPTH OF FLOW (FT)	TOTAL ENERGY HEAD (FT)	MANHOLE INVERT DROP (FT)		UPPER END	LOWER END	UPPER END	LOWER END
CB-1	DMH-1	46		0.17	10	0.26	0.57	7.6	0.74	0.005	12	0.012	2.72	3.47	2.95	0.13	0.36	0.49		0.23	202.30	202.07	206.80	205.00
DMH-1	DMH-2	54		0.17	10	0.31	0.57	7.6	0.74	0.005	12	0.012	2.72	3.47	2.95	0.13	0.36	0.49		0.27	201.97	201.70	205.00	207.33
DMH-2	DMH-3	64		0.17	10	0.36	0.57	7.6	0.74	0.005	12	0.012	2.72	3.47	2.95	0.13	0.36	0.49		0.32	201.60	201.28	207.33	208.20
CB-2	DMH-3	7		0.08	10	0.03	0.90	7.6	0.55	0.014	12	0.012	4.60	5.87	3.92	0.24	0.23	0.47		0.10	201.38	201.28	207.00	206.33
DMH-3	INF	4		0.25	10	0.01	0.68	7.6	1.28	0.050	12	0.012	8.61	10.97	7.87	0.96	0.26	1.22		0.20	201.28	201.08	206.33	203.83
CB-3	DMH-4	17		0.12	10	0.10	0.78	7.6	0.71	0.005	12	0.012	2.80	3.57	2.96	0.14	0.34	0.48		0.09	198.87	198.78	201.75	202.20
DMH-4	INF	4		0.12	10	0.01	0.78	7.6	0.71	0.050	12	0.012	8.61	10.97	6.55	0.67	0.19	0.86		0.20	198.78	198.58	202.20	201.33

CB-1
DMH-1
DMH-2
CB-2
DMH-3
CB-3
DMH-4

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

Project: 429 Great Road By JTM Date 4/19/2016

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	0.09	0.9	0.081
lands/grass	0.08	0.2	0.016
woods	0	0.15	0
sum =	0.17	sum =	0.097

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

DMH-2

Surface Cover	A (ac)	C	Product A x C
CB 1	0.17	0.57	0.097
			0.000
sum =	0.17	sum =	0.097

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

Project: 429 Great Road By JTM Date 4/19/2016

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-2

Surface Cover	A (ac)	C	Product A x C
impervious	0.08	0.9	0.072
lands/grass	0.00	0.2	0
woods	0.00	0.15	0
sum =	0.08	sum =	0.072

C = **0.90** = total product / total area

DMH-3

Surface Cover	A (ac)	C	Product A x C
CB-2	0.08	0.90	0.072
DMH-2	0.17	0.57	0.097
sum =	0.25	sum =	0.169

C = **0.68** = total product / total area

Project: 429 Great Road By JTM Date 4/19/2016

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	0.10	0.9	0.09
lands/grass	0.02	0.2	0.004
woods	0	0.15	0
sum =	0.12	sum =	0.094

C = **0.78** = total product / total area

DMH-4

Surface Cover	A (ac)	C	Product A x C
CB-3	0.12	0.78	0.094
sum =	0.12	sum =	0.094

C = **0.78** = total product / total area

Soil Evaluation

Commonwealth of Massachusetts
City/Town of

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

A. Facility Information

COUNTRY PROPERTIES, LLC
Owner Name

429 GREAT ROAD
Street Address

Map/Lot #

ACTON
City

MA
State

01720
Zip Code

B. Site Information

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

2. Soil Survey Available? ☑ Yes ☐ No If yes: NRCS (Source) 626B, 631C (Soil Map Unit)

Soil Name: MERRIMAC URBAN LAND COMPLEX; CHARLTON URBAN LAND HOLLIS COMPLEX

Soil Limitations:

Geologic/Parent Material: SAND AND GRAVEL GLACIOFLUVIAL DEPOSITS

Landform: OUTWASH TERRACE, OUTWASH PLAIN

3. Surficial Geological Report Available? ☑ Yes ☐ No If yes: OLIVER (Year Published/Source) ____ (Publication Scale) TILL or BEDROCK (Map Unit)

4. Flood Rate Insurance Map

Above the 500-year flood boundary? ☑ Yes ☐ No Within the 100-year flood boundary? ☐ Yes ☑ No

If Yes, continue to #5.

5. Within a velocity zone? ☐ Yes ☑ No

6. Within a Mapped Wetland Area? ☐ Yes ☑ No MassGIS Wetland Data Layer: — (Wetland Type)

7. Current Water Resource Conditions (USGS): 2/16 (Month/Year) Range: ☐ Above Normal ☐ Normal ☑ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of

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

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

Deep Observation Hole Number: 1 | 2/23/16 (Date) | 9:00 A.M. (Time) | Sunny (Weather)

1. Location

Ground Elevation at Surface of Hole: _____ feet | Latitude/Longitude: /

Description of Location: LAWN

2. Land Use: LAWN (e.g., woodland, agricultural field, vacant lot, etc.) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | Slope (%)

Vegetation: LAWN | Landform | Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body: – feet | Drainage Way: – feet | Wetlands: >100' feet

Property Line: >10' feet | Drinking Water Well: – feet | Other: feet

4. Parent Material: SAND AND GRAVEL GLACIOFLUVIAL | Unsuitable Materials Present: ☐ Yes ☑ No

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

5. Groundwater Observed: ☑ Yes ☐ No | If yes: 62" Depth Weeping from Pit | 95" Depth Standing Water in Hole

Estimated Depth to High Groundwater: 60" inches | _____ elevation

Deep Observation Hole Number: 1

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
14	A	10YR 3/2	–	–	–	SL	–	–	M	F	–
14	B	10YR 4/6	–	–	–	LS	–	–	M	F	–
65	C_1	2.5Y 5/3	60"	High/Low	–	COARSE SAND	20	5	S.G.	Loose	–
120	C_2	2.5Y 5/3	–	–	–	MED SAND	20	5	S.G.	Loose	–

Additional Notes:

Commonwealth of Massachusetts
City/Town of

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

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

Deep Observation Hole Number: 2 | 2/23/16 (Date) | 9:00 A.M (Time) | SUNNY (Weather)

1. Location

Ground Elevation at Surface of Hole: _____ feet | Latitude/Longitude: /

Description of Location: LAWN

2. Land Use: LAWN (e.g., woodland, agricultural field, vacant lot, etc.) | Surface Stones (e.g., cobbles, stones, boulders, etc.) | Slope (%)

Vegetation: LAWN | Landform | Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body: – feet | Drainage Way: – feet | Wetlands: >100 feet

Property Line: >10' feet | Drinking Water Well: _____ feet | Other: _____ feet

4. Parent Material: SAND AND GRAVEL GLACIOFLUVIAL | Unsuitable Materials Present: ☐ Yes ☑ No

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

5. Groundwater Observed: ☑ Yes ☐ No | If yes: 62" Depth Weeping from Pit | 60" Depth Standing Water in Hole

Estimated Depth to High Groundwater: 60" inches | _____ elevation

Deep Observation Hole Number: 2

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
14	A	10YR 3/2	–	–	–	SL	–	–	M	F	–
19	B	10YR 4/6	–	–	–	LS	–	–	M	F	–
65	C_1	2.5Y 5/3	60	High/low	–	COARSE SAND	20	5	S.G.	LOOSE	–
114	C_2	2.5Y 5/3	–	–	–	MED. SAND	20	5	S.G.	LOOSE	–

Additional Notes:

Commonwealth of Massachusetts
City/Town of

Percolation Test

Form 12

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

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

A. Site Information

COUNTRY PROPERTIES, LLC
Owner Name

429 GREAT ROAD
Street Address or Lot #

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

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	Date	Time	Date	Time
	2/23/16	9:30 AM		
Observation Hole #	P7-A			
Depth of Perc	48"			
Start Pre-Soak				
End Pre-Soak	24 GALLONS			
Time at 12"	UNABLE TO			
Time at 9"	SATURATE			
Time at 6"				
Time (9"-6")				
Rate (Min./Inch)				
	Test Passed: ☑ Test Failed: ☐		Test Passed: ☐ Test Failed: ☐	

JAMES MELVAN - STAMSITI AND McNARY, INC
Test Performed By:

EVAN CARLONI - ACTON BOH
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of

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

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole # _____	Obs. Hole # _____
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☐ Depth weeping from side of observation hole	_____ inches	_____ inches
☑ Depth to soil redoximorphic features (mottles)	SEE SOIL LOGS inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole # _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

Obs. Hole # _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

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

   ☑ Yes ☐ No

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

   c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

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

[signature]	2/23/16
Signature of Soil Evaluator	Date
JAMES MELVIN SE 13716	7/1/18
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License
EVAN CARLONI - ACTON	ACTON
Name of Board of Health Witness	Board of Health

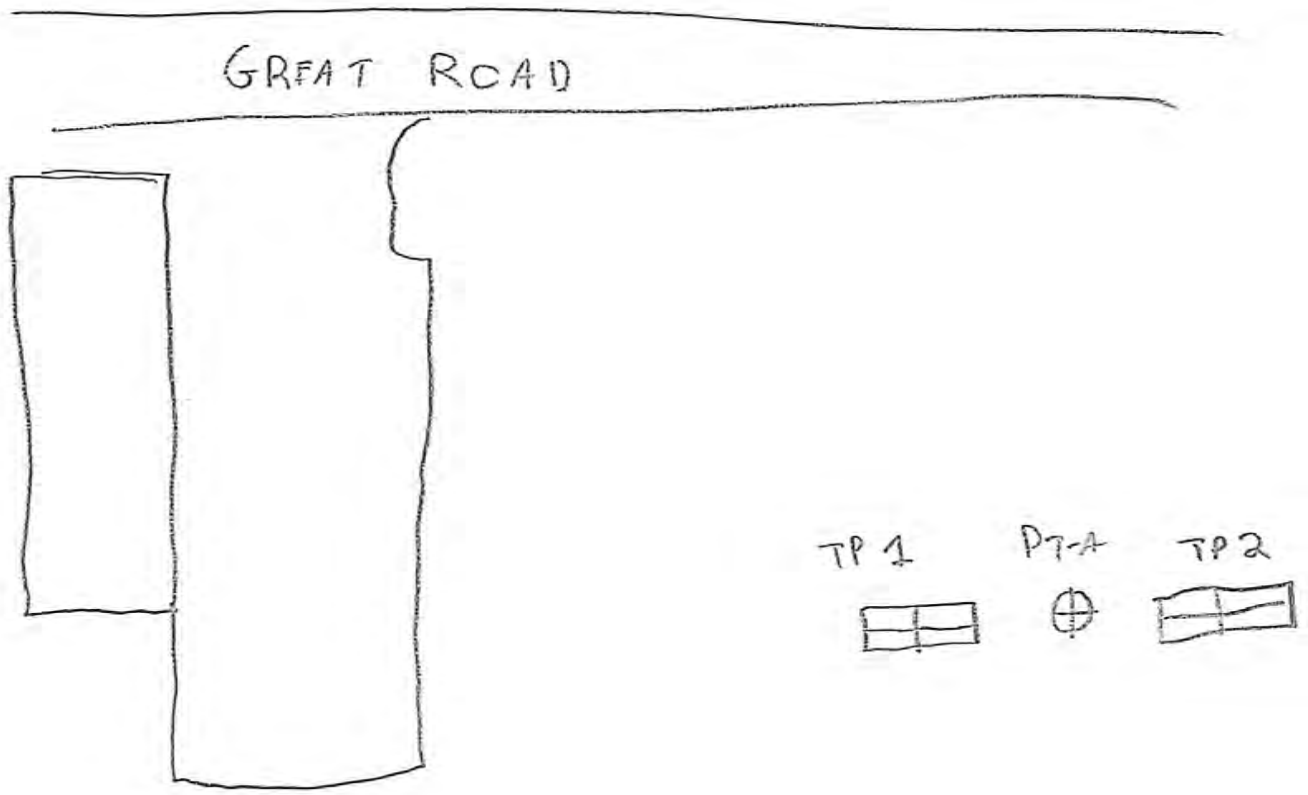
Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Commonwealth of Massachusetts
City/Town of

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

Field Diagrams

Use this sheet for field diagrams:



Commonwealth of Massachusetts
City/Town of

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

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

Deep Observation Hole Number: D-1 | 2/23/16 (Date) | 10:00 AM (Time) | SUNNY (Weather)

1. Location

   Ground Elevation at Surface of Hole: _____ feet Latitude/Longitude: /

   Description of Location: LAWN

2. Land Use: LAWN (e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)

   Vegetation: LAWN Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from:

Open Water Body	– feet	Drainage Way	– feet	Wetlands	710' feet
Property Line	710' feet	Drinking Water Well	– feet	Other	– feet

4. Parent Material: _____ Unsuitable Materials Present: ☐ Yes ☐ No

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

5. Groundwater Observed: ☑ Yes ☐ No If yes: 41" Depth Weeping from Pit; 57" Depth Standing Water in Hole

   Estimated Depth to High Groundwater: 36" inches elevation

   Deep Observation Hole Number: D-1

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
14	A	10YR 3/2				SL			M	F	
22	B	10YR 5/4				SL			M	F	
62	C	2.5Y 5/3	36	F/G/10Y		COARSE SAND	10	–	S.G.	LOOSE	

Additional Notes:

Commonwealth of Massachusetts
City/Town of

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

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

Deep Observation Hole Number: D-2 | 2/23/16 (Date) | 10:00 AM (Time) | SUNNY (Weather)

1. Location

Ground Elevation at Surface of Hole: _____ feet | Latitude/Longitude: /

Description of Location: LAWN

2. Land Use: LAWN (e.g., woodland, agricultural field, vacant lot, etc.) | Surface Stones (e.g., cobbles, stones, boulders, etc.) | Slope (%)

Vegetation: LAWN | Landform | Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body: - feet | Drainage Way: - feet | Wetlands: >100' feet

Property Line: >10' feet | Drinking Water Well: - feet | Other: - feet

4. Parent Material: _____ Unsuitable Materials Present: ☐ Yes ☐ No

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

5. Groundwater Observed: ☑ Yes ☐ No If yes: 59 Depth Weeping from Pit | 83 Depth Standing Water in Hole

Estimated Depth to High Groundwater: 48" inches | _____ elevation

Deep Observation Hole Number: D-2

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
22	A	10YR 3/2				SL	-	-	M	F	-
40	B	10YR 5/4				SL	-	-	M	F	-
93	C	25Y 5/3	48	HIGH/10Y		COARSE SAND	10	-	S.G.	LOOSE	-

Additional Notes:

Operation and Maintenance Manual

Schedule for Inspection and Maintenance:

Contech Proprietary BMP: (DMH-4 and 5)
Inspection and maintenance of the unit can be performed form the surface, without entry into the unit. Perform maintenance a minimum of twice per year. The unit should be cleaned once the sediment has reached a depth of 75% of the sump in the chamber.

Perform frequent inspections during the first year of installation to accurately establish the maintenance schedule.

Remove oil and sediment through the manhole cover with the use of a vacuum truck.

Disposal from the unit is similar to that of any other best management practice (BMP). Consult local guidelines or your Contech area marketing manager prior to disposing the separator contents.

Deep Sump and Hooded Catch Basins: (CB 1-3)
During construction, catch basin grates shall be wrapped with filter fabric. Catch basins shall be cleaned upon the completion of construction. After construction, the deep sumps for all catch basins and drain manholes shall be inspected four times a year and cleaned four times a year. Sediment removed shall be disposed of in accordance with applicable local, state, and federal guidelines and regulations. The depth of the sediment in a basin shall not exceed a depth of 18 inches as determined by probing with a stick. If the stick hits the bottom within 30 inches of the water level, more than 18 inches of sediment has accumulated and must be removed. Licensed persons should remove and dispose of the contents of the sump in accordance with applicable regulations.

Drain Manholes: (DMH 1, 2, and 3)
The drain manholes shall be inspected four times a year. Any cause of or potential for clogging shall be addressed.

Subsurface Structures:
Inspect the chambers after every major storm for the first few months to ensure proper stabilization and function. Thereafter, inspect and clean at least twice per year. Any debris that may clog the system shall be removed. Water levels should be recorded over several days to check the drywell drainage. If chambers cannot be cleaned they may have to be re-installed.

Infiltration Trench
The Infiltration trench shall be inspected annually. The filter fabric shall be inspected for excessive sediment build up. If appreciable amounts of sediment are observed the top layer of stone shall be moved aside and the filter fabric cleaned or replaced. The top layer of stone shall then be washed and placed over the filter fabric.

Emergency Contacts:
In the event of a hazardous materials spill on the site the following parties shall be contacted:
Fire Department: ph: 978-264-9645

Records:
The responsible parties shall maintain an inspection log of all elements of the storm water management plan. The responsible parties shall maintain a maintenance log documenting the inspection and maintenance of the drainage structures under his control. A copy of the erosion control and storm water maintenance plan and inspection logs shall be kept onsite at all times.

Responsibility Party:
The current Owner shall be responsible for all inspection and maintenance of the items.

Name: _____

Signature: _____

Date: _____

429 Great Road

Operation and Maintenance Inspection Log

Year: _____

Catch Basins	**Four times per year**
Subsurface Drainage Structu	**Once per year**
Contech Units	**Two times per year**
Infiltration Trenches	**Two time per year**

Contech Units (DMH 4 and 5)

Previous Inspection Date: _____
Inspection Date: _____
Inspector Name: _____
Comments:

Action Required:

Catch Basins: CB1-3 **CB** _____

Previous Inspection Date: _____
Inspection Date: _____
Inspector Name: _____
Sediment Depth: _____ (Remove if depth greater than 18")
Comments:

Action Required:

Subsurface Drainage Structure

Previous Inspection Date: _____
Inspection Date: _____
Inspector Name: _____
Comments:

Action Required:

Infiltration Trench:

Previous Inspection Date: _____

Inspection Date: _____

Inspector Name: _____

Comments:

Action Required: