Stamski And McNary, Inc.
Engineering - Planning – Surveying
1000 Main Street; Acton, MA 01720 (978) 263-8585
www.stamskiandmcnary.com

Stormwater Management Report

For

246 Old Road to Nine Acre Corner

Map 11E, Parcel 3079
Concord, MA

March 18, 2020

Owner : Concord Country Club
246 Old Road to Nine Acre Corner
Concord, MA 01742

SM-4621B File: 4621B StormwaterReportCover.doc

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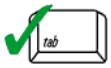
Checklist for Stormwater Report

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.

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

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.

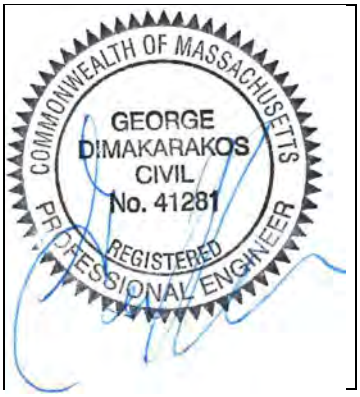
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the 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 3/19/2020

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): Infiltration Basin

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.

Narrative

STORMWATER MANAGEMENT

The proposed project is for the construction of an Irrigation Pond to serve the Concord Country Club located at 246 Old Road to Nine Acre Corner. The proposed irrigation pond will provide a water reservoir to help meet the demand of the existing irrigation system. The clearing necessary for the construction of the irrigation pond has already occurred prior to the preparation of this report.

Pre-Development

The subject property is an approximately 198.7 acre parcel that is used as a Country Club containing a golf course, tennis courts, and other typical amenities for the land use. The topography of the parcel is variable due to the substantial area occupied, however the topography of the proposed work area is more consistent with the land sloping generally from west to east. The project site consists of one pre-development subcatchment.

Subcatchment E-1 contains the entire work area and the portion of the golf course that drains towards it. The subcatchment generally drains from a high point to the east of the work area to the Bordering Vegetated Wetland located to the west. The pre-development vegetative coverage within this subcatchment consisted primarily wooded area, as well as grass cover, gravel cart paths, and a manicured wooded area.

Post-Development

The proposed project is for the construction of an irrigation pond to provide a storage reservoir for the existing irrigation system. The irrigation water will be sourced from a series of groundwater wells located on the property, as it is under existing conditions. Although the irrigation pond will serve as an impoundment to store pumped groundwater and will not rely on surface runoff to fill it, some surface runoff will inevitably enter the pond. The pond will be fitted with controls and monitored so that overflow of the pond is not anticipated, however for the purpose of this analysis our office has assumed that the pond is full up to the overflow in order to account for the most extreme scenario. The proposed Subcatchments are shown on the attached drainage map.

Subcatchment P-1 contains the irrigation pond and the upgradient area that will drain to it. The vegetative cover of this subcatchment will be primarily grass, manicured wooded area, and meadow area. Gravel cart paths are also located within this subcatchment. The pond has been treated as impervious as the plastic liner will prevent any groundwater recharge from the pond. The pond overflow will be diverted to an infiltration basin located at the toe-slope of the embankment. The infiltration basin has been designed to infiltrate the 2, 10, and 25-year storm events, and will attenuate peak flows for the 100-year storm event.

Subcatchment P-1A contains the portion of the site that will drain directly into the infiltration basin. The vegetative cover within this subcatchment will be primarily grass and meadow area. The infiltration basin has been designed to infiltrate the 2, 10, and 25-year storm events, and will attenuate peak flows for the 100-year storm event.

Subcatchment P-1B contains the remainder of the pre-development subcatchment. Runoff from this subcatchment will flow uncontrolled towards the Bordering Vegetative Wetland.

For this analysis, the infiltration basin outflow and Subcatchment P-1B have been combined to demonstrate that the proposed stormwater management system will result in a net reduction in peak flows

and total volume leaving the work area when compared to the pre-development subcatchment, Subcatchment E-1.

Compliance with MA DEP Stormwater Management Standards

Compliance with the Stormwater Management Standards is as follows:

Standard #1 No Untreated Discharges:

No new untreated discharges are proposed. Any additional runoff will be treated and/or infiltrated.

Standard #2 Peak Rate Attenuation:

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

Discharge Summary Tables

Pre-Development vs. Post-Development Total

	2-year Storm		10-year Storm		25-year Storm		100-year Storm	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Peak Flow (cfs)	0.000	0.000	0.040	0.005	0.193	0.033	1.735	1.470
Total Volume (cf)	0.000	0	895	55.6	5,236	948	17,785	13,173

Standard #3 Stormwater Recharge:

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 soil in Hydrologic Group A. The Stormwater Management Policy requires 0.60 inches of runoff over the total impervious area to be recharged in areas with Hydrologic Group A soils. Detailed "Recharge Volume Calculations" showing compliance with this standard are attached.

Standard #4 Water Quality:

According to the guidelines provided in the Stormwater Management Standards 80% Total Suspended Solids (TSS) removal is required for the total increase in impervious area associated with the project. This standard requires 1.0 inches of water over the impervious area in areas of rapid infiltration. The use of an infiltration basin will be utilized to achieve the required treatment levels. The infiltration basin has been selected due to the TMDL of the Assabet River associated with Phosphorous.

Standard #5 Land Uses with Higher Potential Pollutant Loads:

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

Standard #6 Critical Areas:

The site is within a Zone II. The infiltration basin has been selected in accordance with Table CA 3 of the Massachusetts Stormwater Handbook.

Standard #7 Redevelopment:

This project is not for redevelopment. This standard would require that the Stormwater Management Standards be met to the extent practicable. The project has been designed to meet all of the standards.

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 included in this report as well as shown on the plan set.

Standard #10 Illicit Discharges to Drainage System:

No known illicit discharges exist nor are any proposed.

Design Basis

1. The United States Department of Agriculture Natural Resource Conservation Service (N.R.C.S.) TR55 methodology was used to determine offsite rates of runoff.
2. The twenty-four hour rainfall, taken from the NOAA Atlas, is 7.90 inches for the 100-year storm, 6.16 inches for the 25-year storm, 5.02 inches for the 10-year storm, and 3.21 inches for the 2-year storm event.
3. The hydrologic calculations were performed using the computer program: “Hydrology Studio” by Hydrology Studio.
4. The soil types of the site were taken from the N.R.C.S. Soil Survey Map for Middlesex County.
5. Soil conditions and estimated seasonal high groundwater table were based on on-site soil evaluations.
6. The Natural Resources Conservation Service (N.R.C.S.) soil survey indicated the presences of Windsor loamy sand. This soil group rates as Hydrologic Group A.

SUMMARY TABLE **SM-4621B**

Project: 246 Old Road to Nine Acre Corner By PFK Rev Date 3/18/20

Location: Concord, MA Checked Date

EX	AREA	CN	TIME OF CONCENTRATION
E-1	8.88	32	12.5

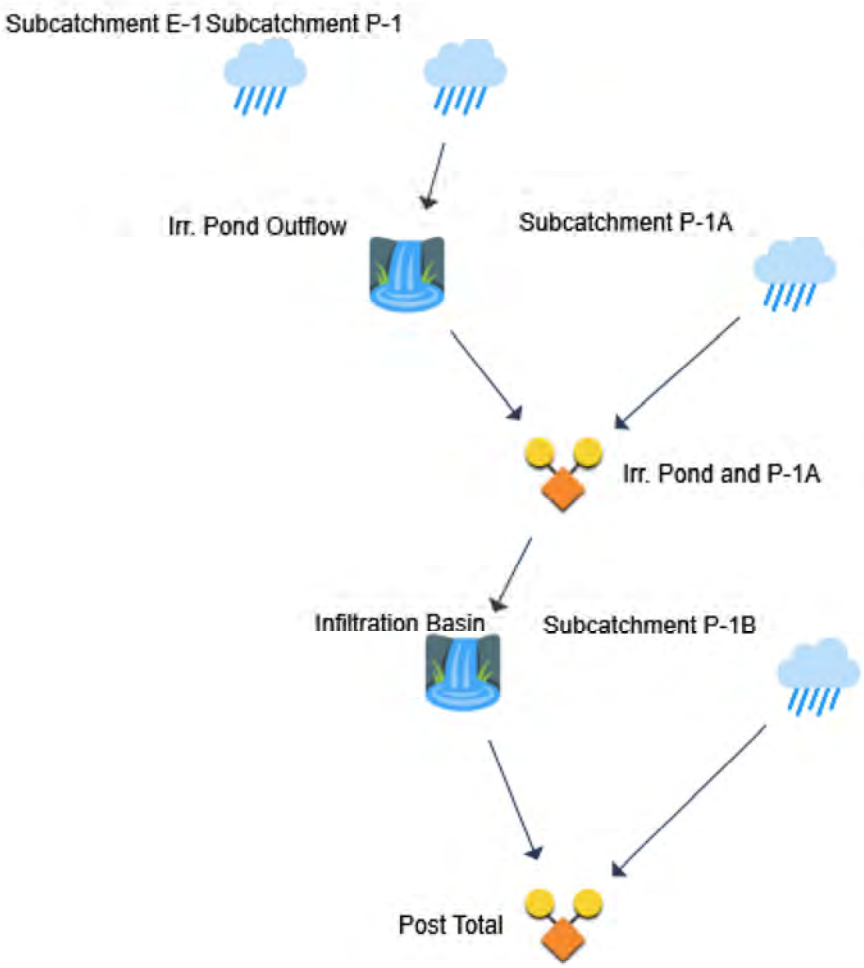
PROP	AREA	CN	TIME OF CONCENTRATION
P-1	5.46	53	10.5
P-1A	0.60	34	6.0
P-1B	2.82	30	12.2
SUM	**8.88**		

Basin Model

Hydrology Studio v 3.0.0.14

Project Name:

03-18-2020



Pre-Development Hydrology

Hydrograph 2-yr Summary

Project Name:

03-19-2020

Hydrology Studio v 3.0.0.14

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Subcatchment E-1	0.000	0.00	0.000	----		
3	NRCS Runoff	Subcatchment P-1	0.369	12.43	4,089	----		
4	Pond Route	Irr. Pond Outflow	0.112	15.70	4,079	3	148.02	1,132
5	NRCS Runoff	Subcatchment P-1A	0.000	0.00	0.000	----		
6	Junction	Irr. Pond and P-1A	0.112	15.70	4,079	4, 5		
7	Pond Route	Infiltration Basin	0.000	0.00	0.000	6	136.02	61.3
9	NRCS Runoff	Subcatchment P-1B	0.000	0.00	0.000	----		
10	Junction	Post Total	0.000	0.00	0.000	7, 9		

Hydrograph 10-yr Summary

Project Name:

03-19-2020

Hydrology Studio v 3.0.0.14

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Subcatchment E-1	0.040	22.13	895	----		
3	NRCS Runoff	Subcatchment P-1	3.493	12.20	17,781	----		
4	Pond Route	Irr. Pond Outflow	0.586	13.80	17,771	3	148.09	5,928
5	NRCS Runoff	Subcatchment P-1A	0.005	22.07	129	----		
6	Junction	Irr. Pond and P-1A	0.588	13.87	17,899	4, 5		
7	Pond Route	Infiltration Basin	0.000	0.00	-0.002	6	136.08	322
9	NRCS Runoff	Subcatchment P-1B	0.005	22.13	55.6	----		
10	Junction	Post Total	0.005	22.13	55.6	7, 9		

Hydrograph 25-yr Summary

Project Name:

03-19-2020

Hydrology Studio v 3.0.0.14

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Subcatchment E-1	0.193	14.73	5,236	----		
3	NRCS Runoff	Subcatchment P-1	6.716	12.17	29,670	----		
4	Pond Route	Irr. Pond Outflow	1.302	12.97	29,660	3	148.16	10,126
5	NRCS Runoff	Subcatchment P-1A	0.024	12.47	488	----		
6	Junction	Irr. Pond and P-1A	1.322	12.97	30,149	4, 5		
7	Pond Route	Infiltration Basin	0.000	14.10	-0.001	6	137.17	4,606
9	NRCS Runoff	Subcatchment P-1B	0.033	15.33	948	----		
10	Junction	Post Total	0.033	15.33	948	7, 9		

Hydrograph 100-yr Summary

Project Name:

03-19-2020

Hydrology Studio v 3.0.0.14

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Subcatchment E-1	1.735	12.43	17,785	----		
3	NRCS Runoff	Subcatchment P-1	12.59	12.17	51,162	----		
4	Pond Route	Irr. Pond Outflow	3.023	12.67	51,152	3	148.28	18,058
5	NRCS Runoff	Subcatchment P-1A	0.173	12.27	1,406	----		
6	Junction	Irr. Pond and P-1A	3.101	12.67	52,558	4, 5		
7	Pond Route	Infiltration Basin	1.379	13.83	9,506	6	138.41	10,144
9	NRCS Runoff	Subcatchment P-1B	0.287	12.50	4,153	----		
10	Junction	Post Total	1.542	13.83	13,658	7, 9		

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment E-1

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.000 cfs
Storm Frequency	= 2-yr	Time to Peak	= 0.00 hrs
Time Interval	= 2 min	Runoff Volume	= 0.000 cuft
Drainage Area	= 8.88 ac	Curve Number	= 32
Tc Method	= User	Time of Conc. (Tc)	= 12.5 min
Total Rainfall	= 3.21 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484

Qp = 0.00 cfs

Worksheet 2: Runoff curve number and runoff **SM-4621B**

Project: 246 Old Road to Nine Acre Corner By PFK Date 3/11/20

Location: Concord, MA Checked _____ Date _____

Circle one: [Pre-Dev] Developed Subcatchment E-1

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	Wooded - Good Condition	30			6.35	190.53
A	Open Space - Lawn	39			1.53	59.53
	Impervious	98			0.00	0.00
A	Gravel - Cartpath	76			0.04	2.93
A	Woods/grass combination	32			0.97	30.96
1/ Use only one CN source per line.					Totals =	8.88 283.95

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{283.95}{8.88}$ = 31.96 ; Use CN = 32

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.21	5.02	7.9
Runoff, Q.....	in	0.05	0.03	0.53

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-4621B

Project: 246 Old Road to Nine Acre Corner By PFK Date 3/18/2020

Location: Concord, MA Checked _____ Date _____

Circle one: Pre-Dev / Developed
Circle one: Tc / Tt through subarea

Subcatchment E-1

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			Woods			
2. Mannings roughness coeff., n (table 3-1)			0.4			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.21			
5. Land Slope, s		ft/ft	0.05			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.14			0.14
Shallow concentrated Flow		Segment ID	B-C	C-D		
7. Surface Description (paved or unpaved)			UNPAVED	UNPAVED	UNPAVED	
8. Flow Length, L		ft	422	120	410	
9. Watercourse slope, s		ft/ft	0.05	0.2	0.06	
10. Average Velocity, V (figure 3-1)		ft/s	3.61	7.22	3.95	
11. Tt = L / 3600V	Compute Tt	hr	0.03	0.00	0.03	0.07
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 0.21
min 12.5

Hydrograph Report

Project Name:

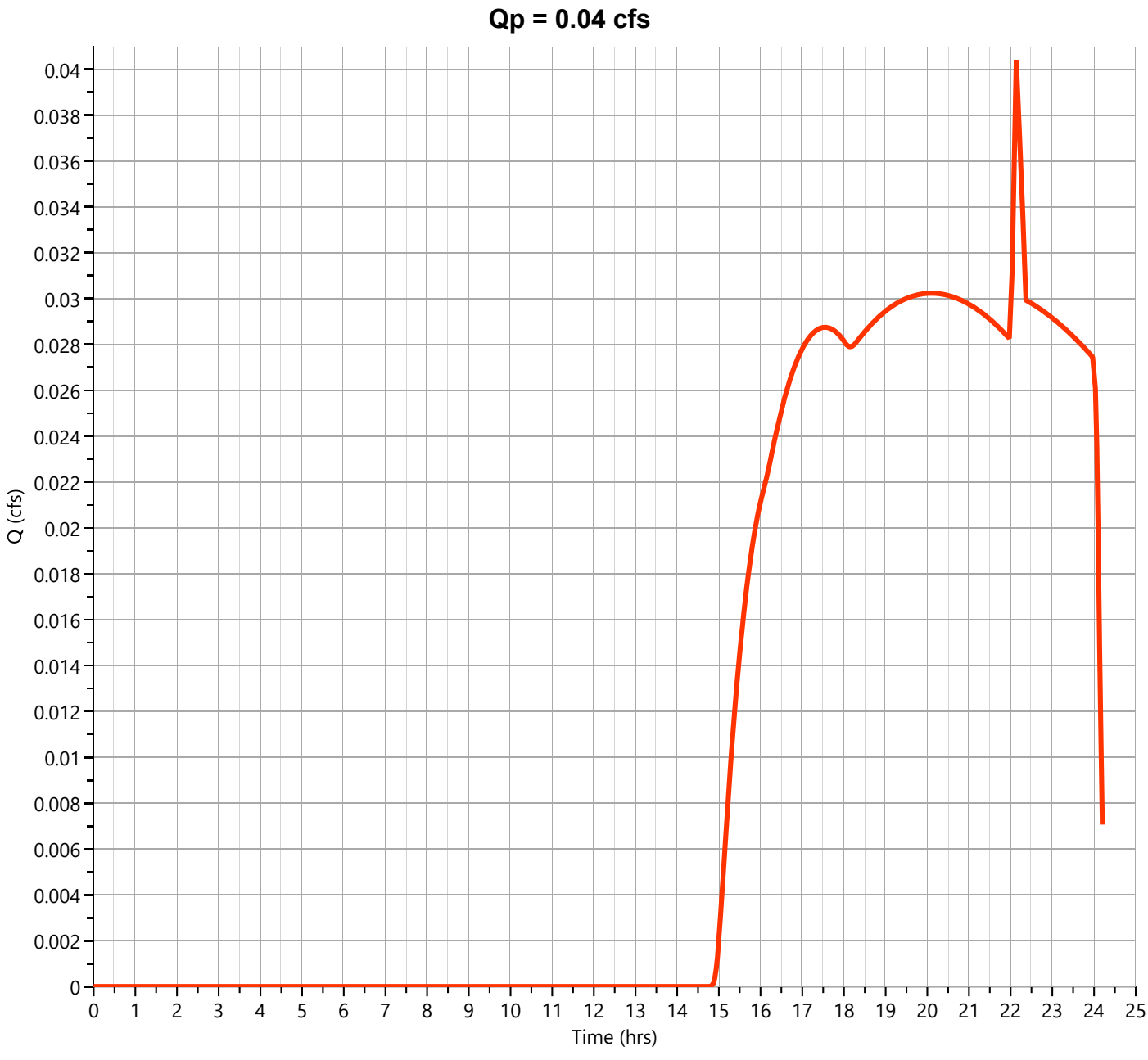
Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment E-1

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.040 cfs
Storm Frequency	= 10-yr	Time to Peak	= 22.13 hrs
Time Interval	= 2 min	Runoff Volume	= 895 cuft
Drainage Area	= 8.88 ac	Curve Number	= 32
Tc Method	= User	Time of Conc. (Tc)	= 12.5 min
Total Rainfall	= 5.02 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

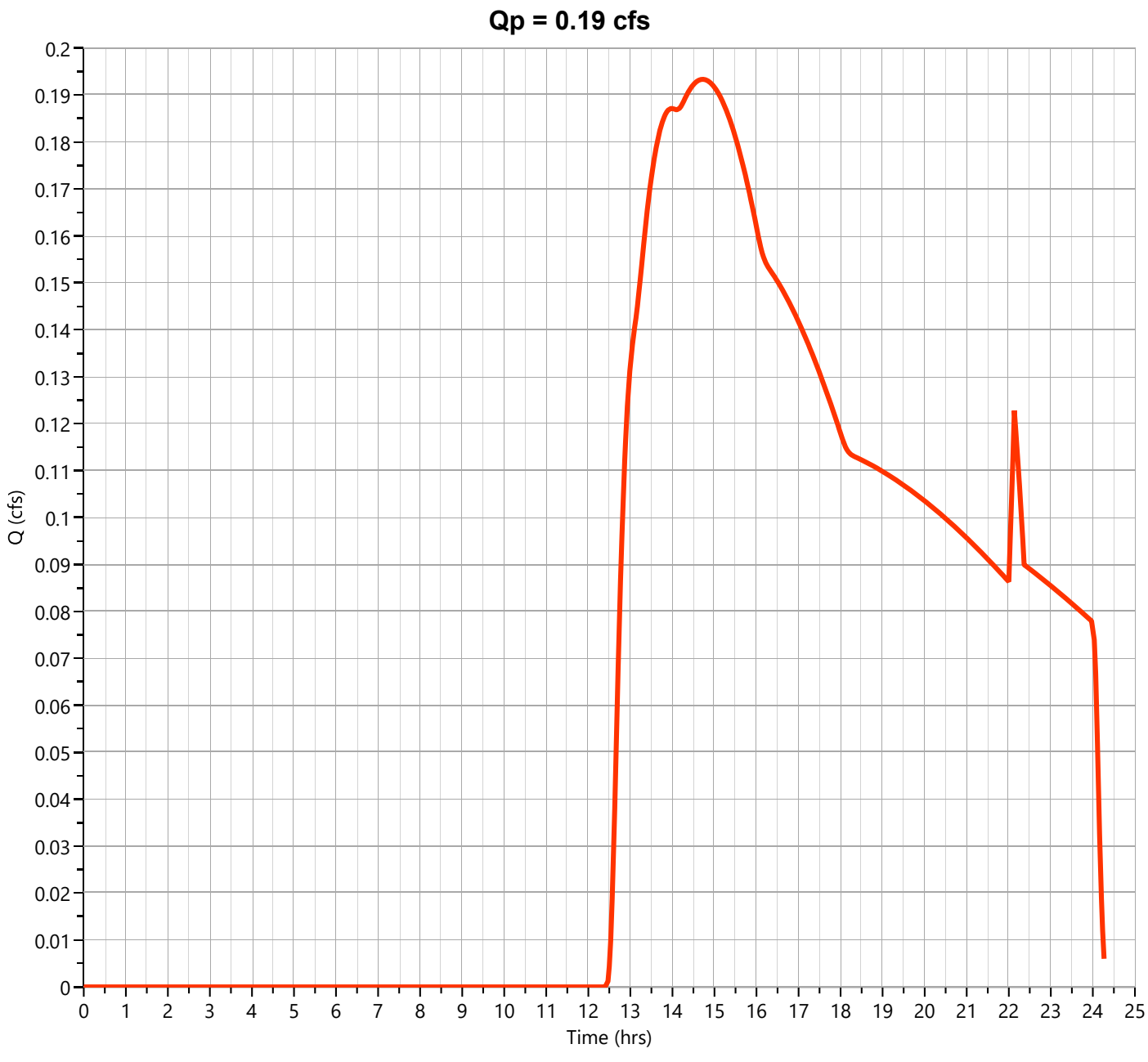
Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment E-1

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.193 cfs
Storm Frequency	= 25-yr	Time to Peak	= 14.73 hrs
Time Interval	= 2 min	Runoff Volume	= 5,236 cuft
Drainage Area	= 8.88 ac	Curve Number	= 32
Tc Method	= User	Time of Conc. (Tc)	= 12.5 min
Total Rainfall	= 6.16 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

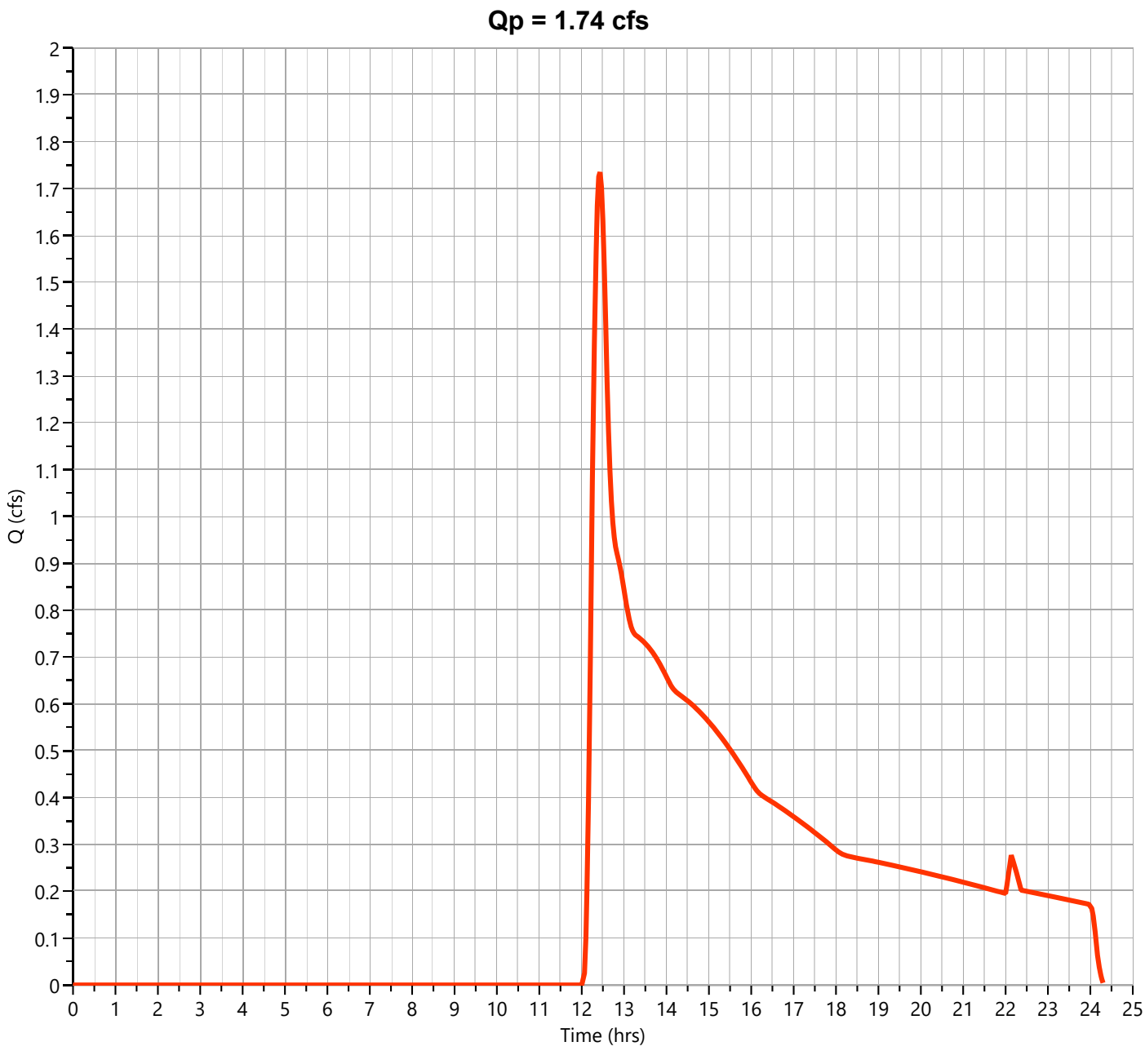
Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment E-1

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 1.735 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.43 hrs
Time Interval	= 2 min	Runoff Volume	= 17,785 cuft
Drainage Area	= 8.88 ac	Curve Number	= 32
Tc Method	= User	Time of Conc. (Tc)	= 12.5 min
Total Rainfall	= 7.90 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Post-Development Hydrology

Worksheet 2: Runoff curve number and runoff **SM-4621B**

Project: 246 Old Road to Nine Acre Corner By PFK Date 3/11/20

Location: Concord, MA Checked _____ Date _____

Circle one: Pre-Dev **Developed** Subcatchment P-1

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	Wooded - Good Condition	30			1.57	47.18
A	Open Space - Lawn	39			1.22	47.77
	Impervious	98			1.65	161.90
A	Gravel - Cartpath	76			0.04	2.93
A	Woods/grass combination	32			0.97	30.96
1/ Use only one CN source per line.					Totals =	5.46	290.74

CN (weighted) = $\frac{\text{total product}}{\text{total area}} = \frac{290.74}{5.46} = 53.29$; Use CN = **53**

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency.....	yr	2	10	100
Rainfall, P (24-hour).....	in	3.21	5.02	7.9
Runoff, Q..... (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)	in	0.21	0.89	2.53

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-4621B

Project: 246 Old Road to Nine Acre Corner By PFK Date 3/18/2020

Location: Concord, MA Checked _____ Date _____

Circle one: Pre-Dev | Developed
Circle one: Tc | Tt through subarea

Subcatchment P-1

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			Woods			
2. Mannings roughness coeff., n (table 3-1)			0.4			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.21			
5. Land Slope, s		ft/ft	0.05			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.14			0.14

Shallow concentrated Flow		Segment ID	B-C	C-D		
7. Surface Description (paved or unpaved)			UNPAVED	UNPAVED		
8. Flow Length, L		ft	388	96		
9. Watercourse slope, s		ft/ft	0.05	0.33		
10. Average Velocity, V (figure 3-1)		ft/s	3.61	9.27		
11. Tt = L / 3600V	Compute Tt	hr	0.03	0.00		

Channel flow		Segment ID				
12. Cross sectional flow area, a		sf				
13. Wetted perimeter, pw		ft				
14. Hydraulic radius, r=a/wp	Compute r	ft				
15. Channel Slope, s		ft/ft				
16. Manning's roughness coeff., n						
17. V = 1.49 r^2/3 s^1/2 / n	Compute V	ft/s				
18. Flow length, L		ft				
19. Tt = L / 3600V	Compute Tt	hr				0

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19) hr 0.18
min 10.5

Hydrograph Report

Project Name:

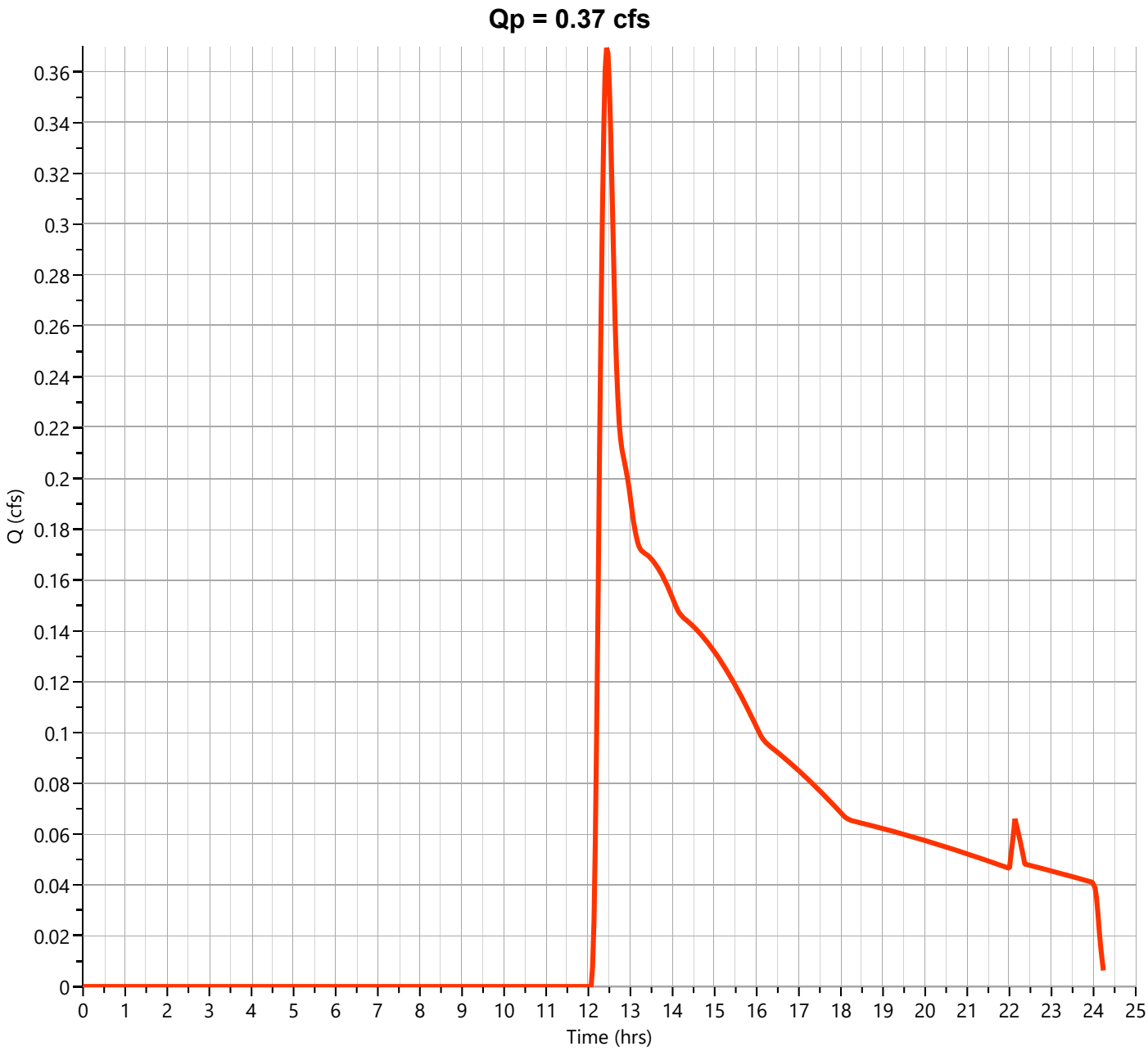
Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment P-1

Hyd. No. 3

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.369 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.43 hrs
Time Interval	= 2 min	Runoff Volume	= 4,089 cuft
Drainage Area	= 5.46 ac	Curve Number	= 53
Tc Method	= User	Time of Conc. (Tc)	= 10.5 min
Total Rainfall	= 3.21 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

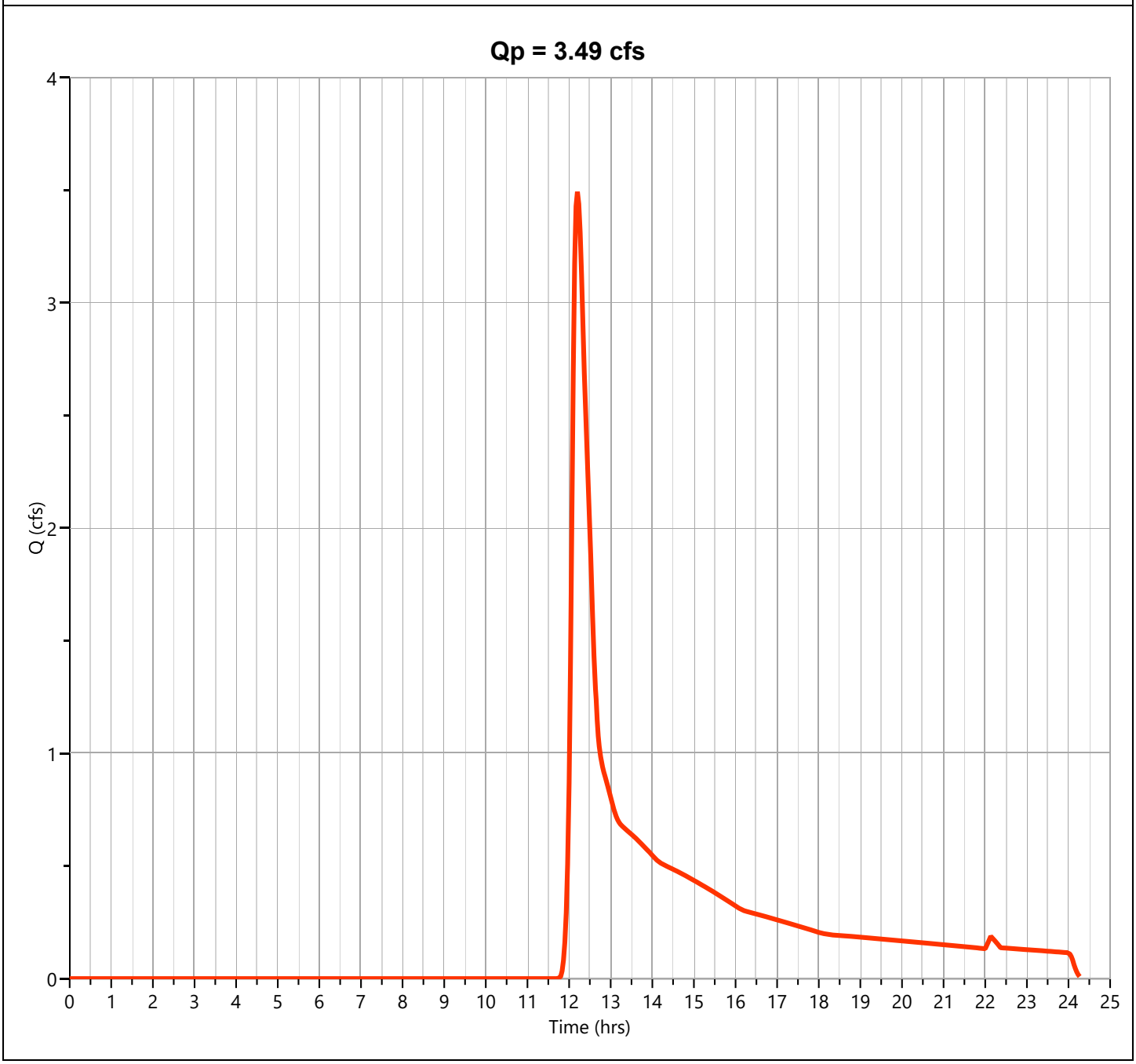
Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment P-1

Hyd. No. 3

Hydrograph Type	= NRCS Runoff	Peak Flow	= 3.493 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.20 hrs
Time Interval	= 2 min	Runoff Volume	= 17,781 cuft
Drainage Area	= 5.46 ac	Curve Number	= 53
Tc Method	= User	Time of Conc. (Tc)	= 10.5 min
Total Rainfall	= 5.02 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

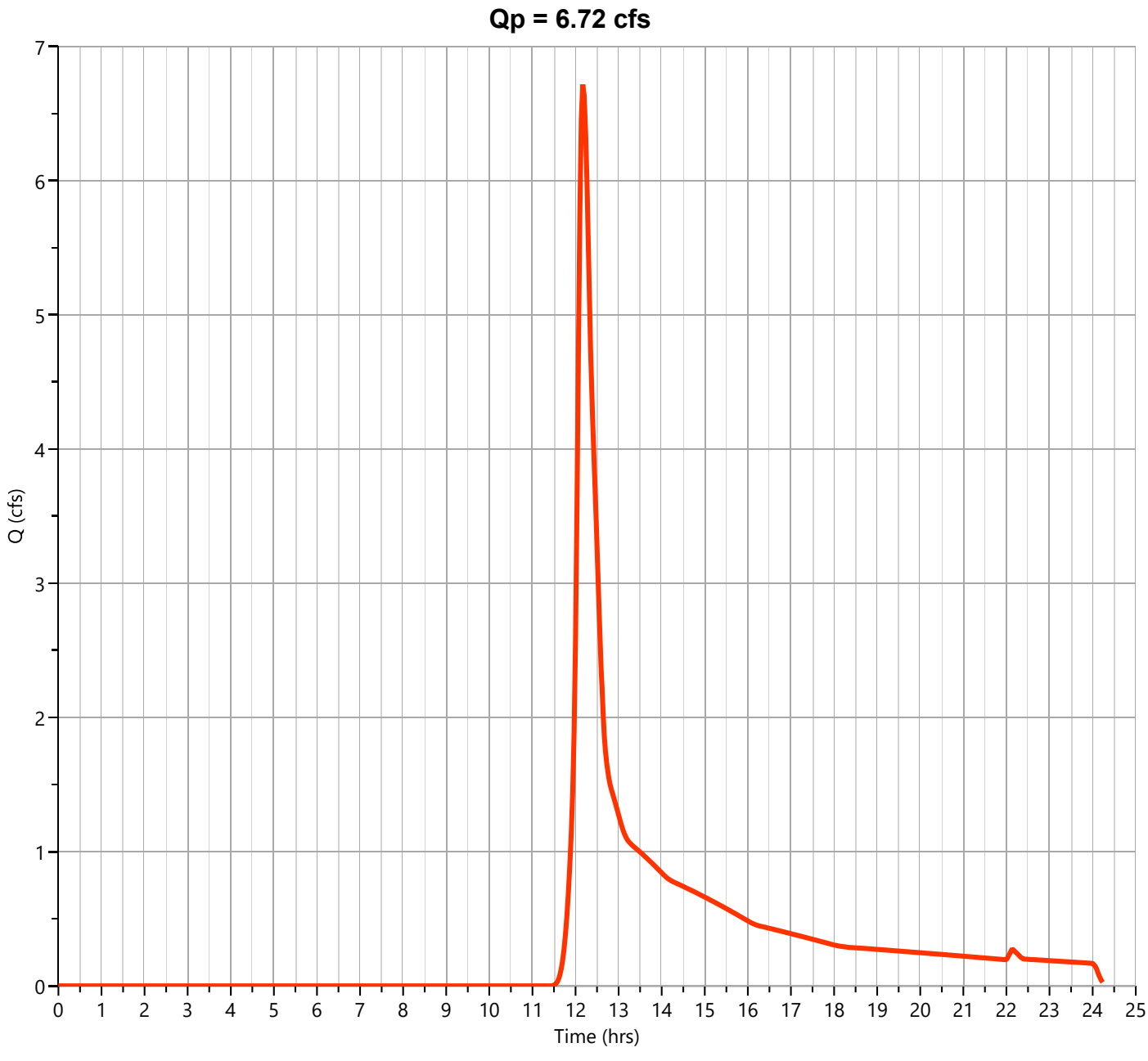
Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment P-1

Hyd. No. 3

Hydrograph Type	= NRCS Runoff	Peak Flow	= 6.716 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.17 hrs
Time Interval	= 2 min	Runoff Volume	= 29,670 cuft
Drainage Area	= 5.46 ac	Curve Number	= 53
Tc Method	= User	Time of Conc. (Tc)	= 10.5 min
Total Rainfall	= 6.16 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

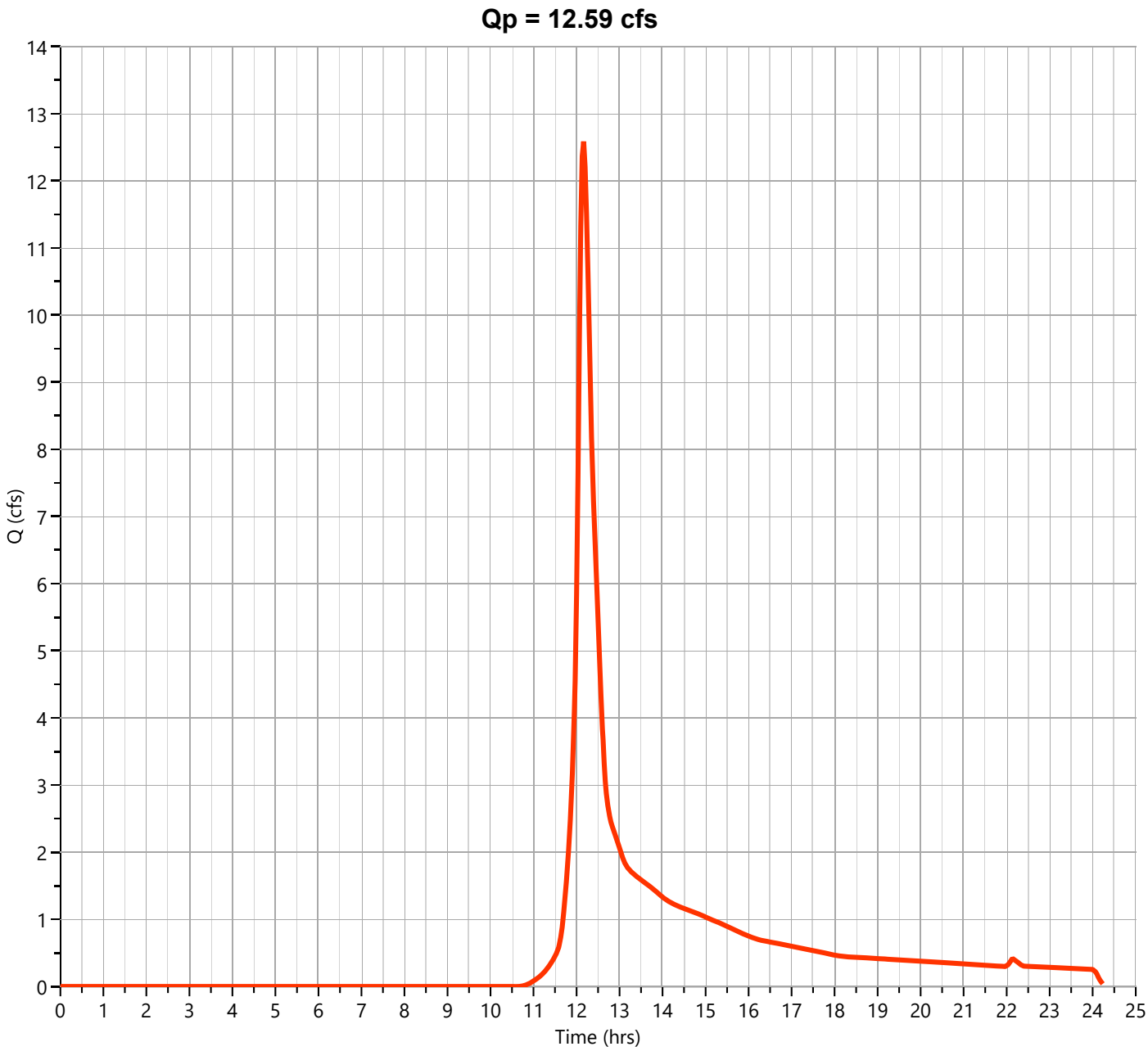
Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment P-1

Hyd. No. 3

Hydrograph Type	= NRCS Runoff	Peak Flow	= 12.59 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.17 hrs
Time Interval	= 2 min	Runoff Volume	= 51,162 cuft
Drainage Area	= 5.46 ac	Curve Number	= 53
Tc Method	= User	Time of Conc. (Tc)	= 10.5 min
Total Rainfall	= 7.90 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

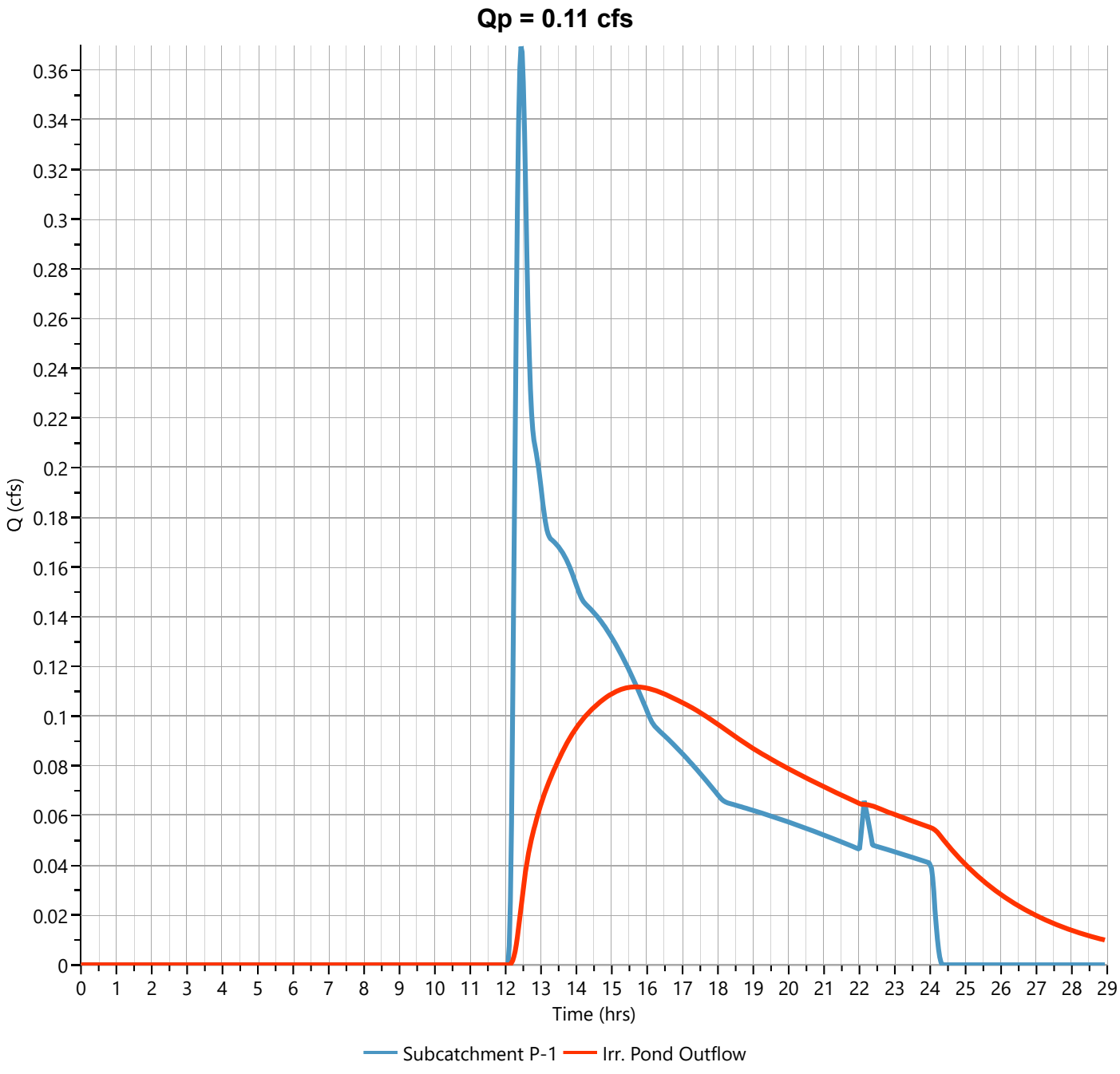
Irr. Pond Outflow

Hyd. No. 4

Hydrograph Type	= Pond Route	Peak Flow	= 0.112 cfs
Storm Frequency	= 2-yr	Time to Peak	= 15.70 hrs
Time Interval	= 2 min	Hydrograph Volume	= 4,079 cuft
Inflow Hydrograph	= 3 - Subcatchment P-1	Max. Elevation	= 148.02 ft
Pond Name	= Full Irrigation Pond	Max. Storage	= 1,132 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 2.76 hrs



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

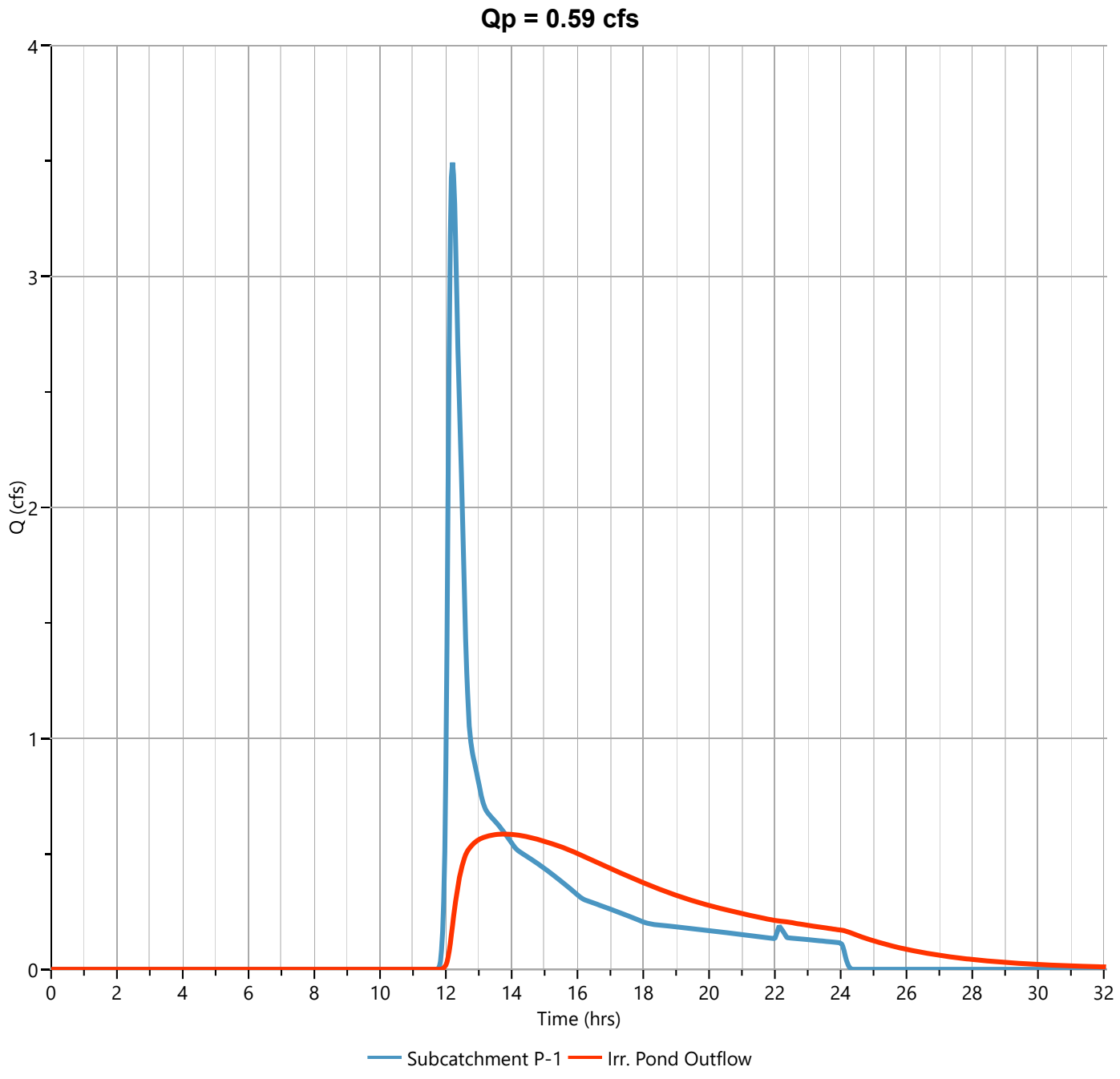
Irr. Pond Outflow

Hyd. No. 4

Hydrograph Type	= Pond Route	Peak Flow	= 0.586 cfs
Storm Frequency	= 10-yr	Time to Peak	= 13.80 hrs
Time Interval	= 2 min	Hydrograph Volume	= 17,771 cuft
Inflow Hydrograph	= 3 - Subcatchment P-1	Max. Elevation	= 148.09 ft
Pond Name	= Full Irrigation Pond	Max. Storage	= 5,928 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 2.75 hrs



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

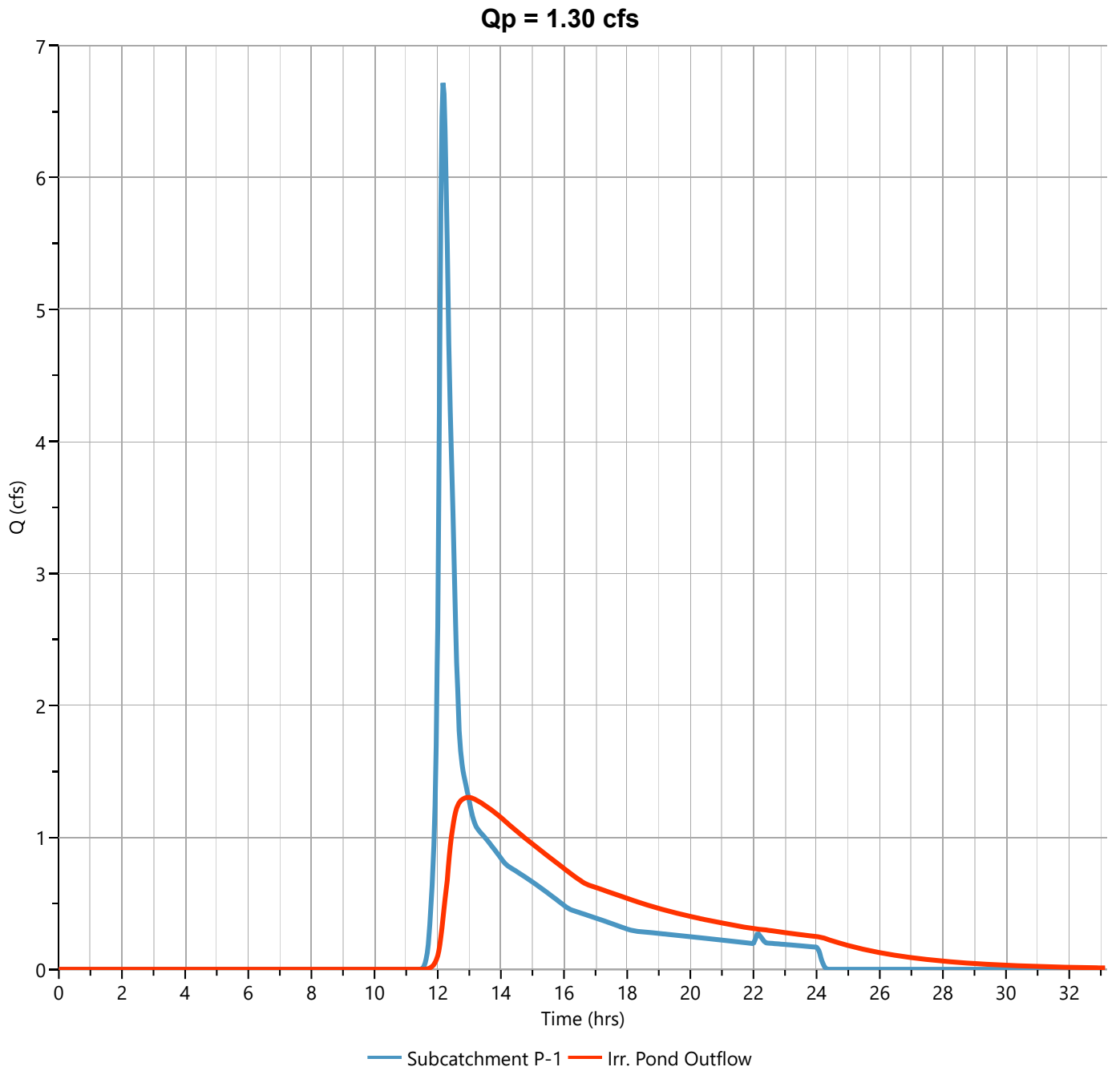
Irr. Pond Outflow

Hyd. No. 4

Hydrograph Type	= Pond Route	Peak Flow	= 1.302 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.97 hrs
Time Interval	= 2 min	Hydrograph Volume	= 29,660 cuft
Inflow Hydrograph	= 3 - Subcatchment P-1	Max. Elevation	= 148.16 ft
Pond Name	= Full Irrigation Pond	Max. Storage	= 10,126 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 2.49 hrs



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

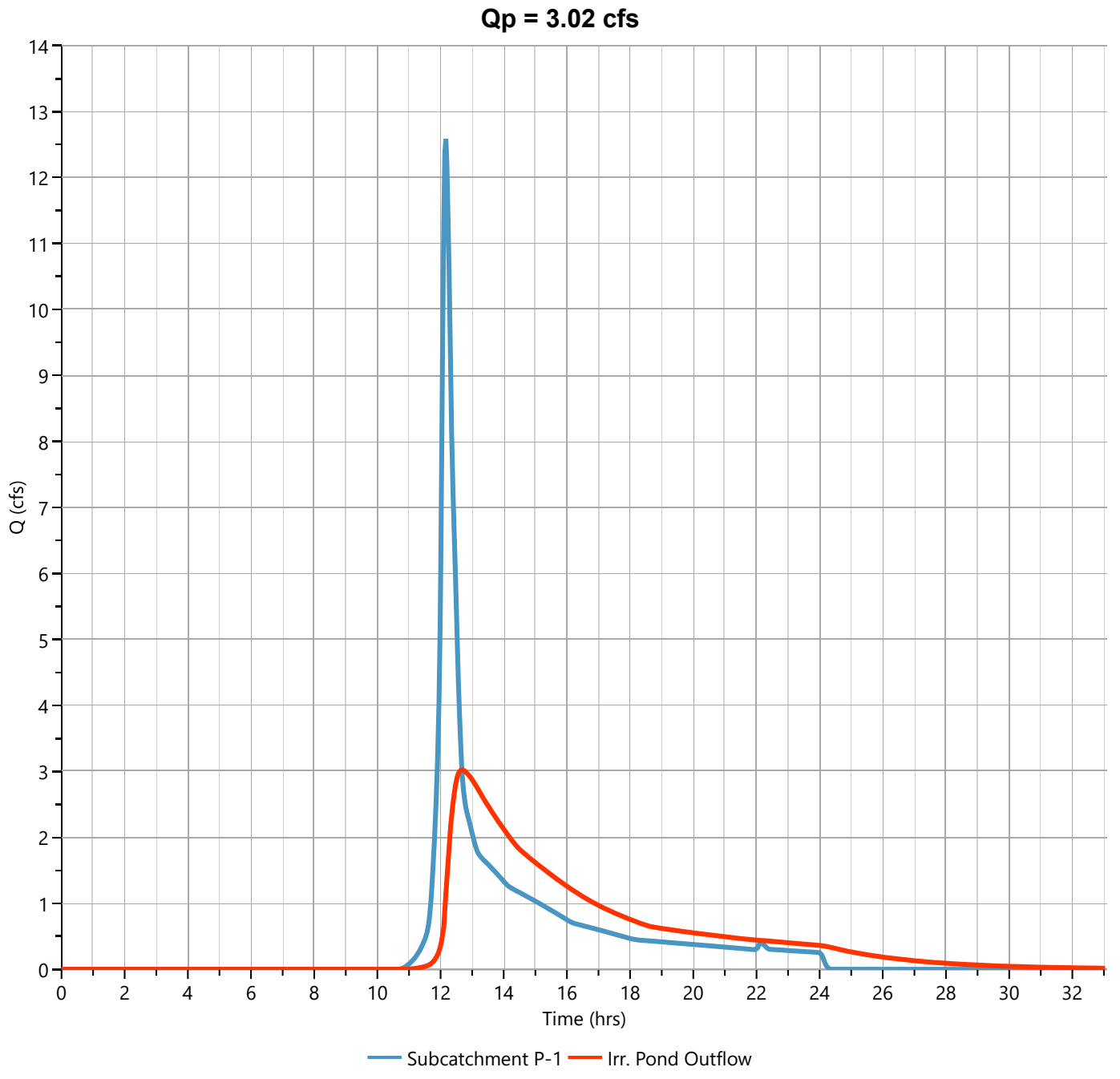
Irr. Pond Outflow

Hyd. No. 4

Hydrograph Type	= Pond Route	Peak Flow	= 3.023 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.67 hrs
Time Interval	= 2 min	Hydrograph Volume	= 51,152 cuft
Inflow Hydrograph	= 3 - Subcatchment P-1	Max. Elevation	= 148.28 ft
Pond Name	= Full Irrigation Pond	Max. Storage	= 18,058 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 2.11 hrs



Pond Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

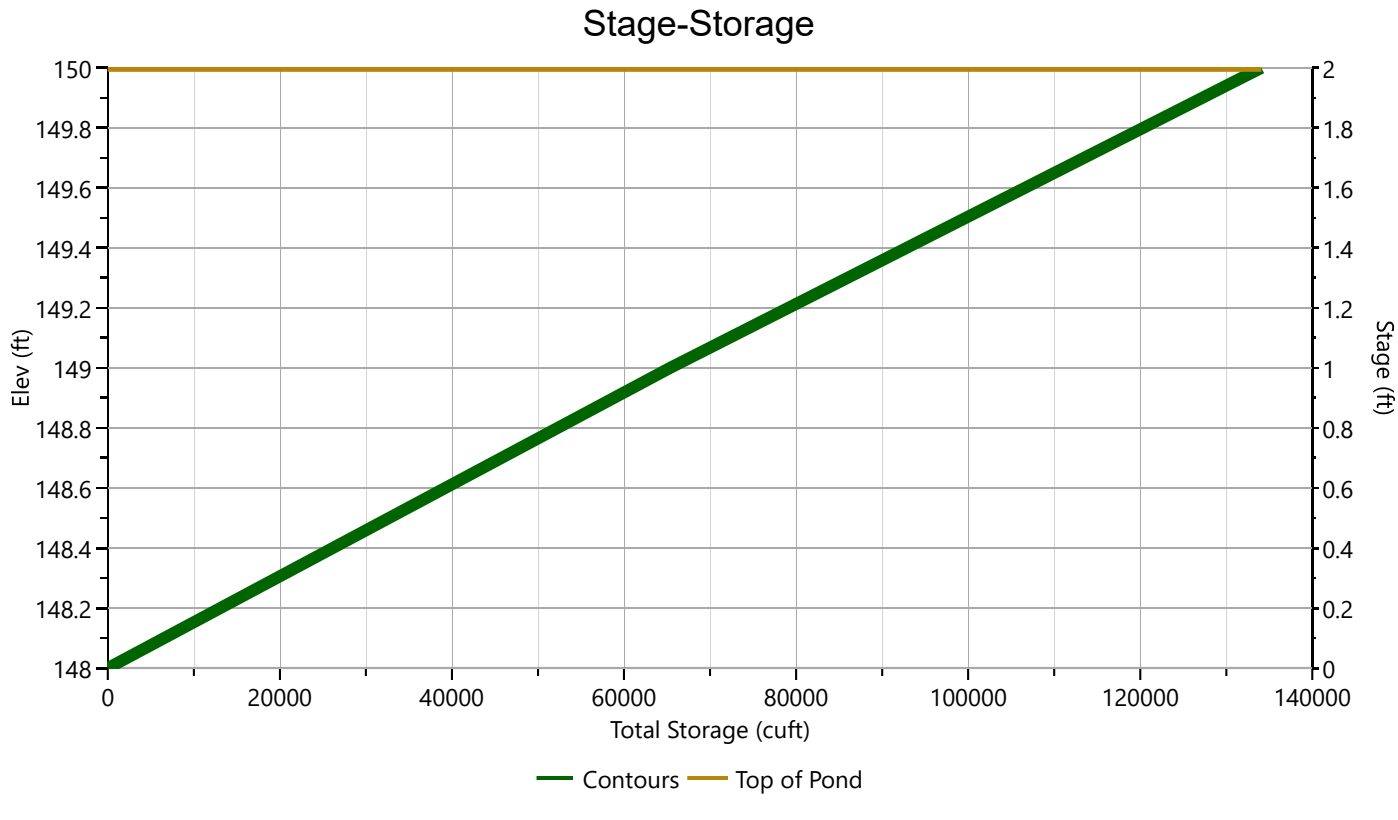
Full Irrigation Pond

Stage-Storage

User Defined Contours	
Description	**Input**
Bottom Elevation, ft	148.00
Voids (%)	100.00
Volume Calc	None

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour Area (sqft)	Incr. Storage (cuft)	Total Storage (cuft)
0.00	148.00	63,628	0.000	0.000
1.00	149.00	67,025	65,327	65,327
2.00	150.00	70,480	68,753	134,079



Pond Report

Project Name:

Hydrology Studio v 3.0.0.14

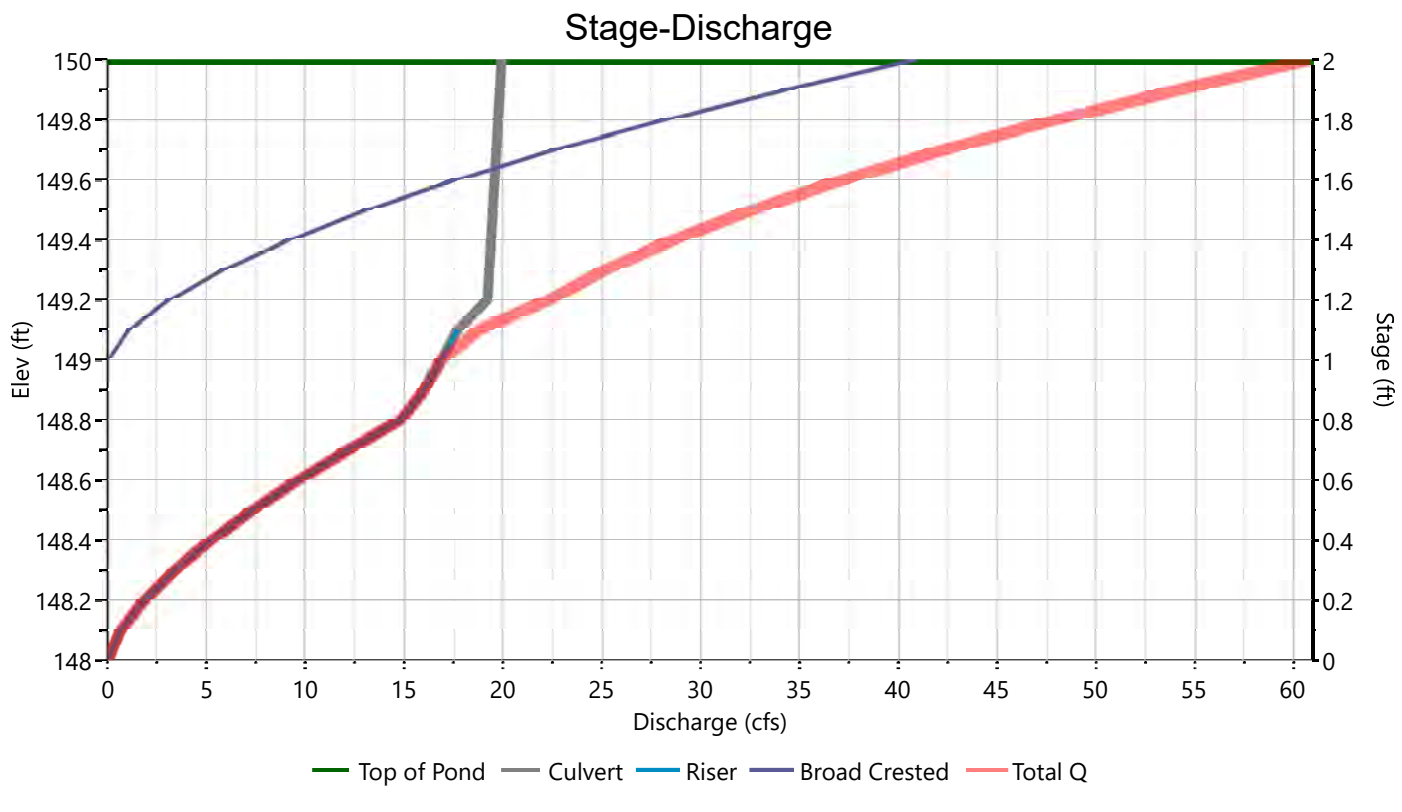
03-19-2020

Full Irrigation Pond

Stage-Discharge

Culvert / Orifices	Culvert	Orifices			Orifice Plate	
		1	2	3		
Rise, in	15				Orifice Dia, in	
Span, in	15				No. Orifices	
No. Barrels	1				Invert Elevation, ft	
Invert Elevation, ft	138.00				Height, ft	
Orifice Coefficient, Co	0.60				Orifice Coefficient, Co	
Length, ft	53					
Barrel Slope, %	3.8					
N-Value, n	0.012					
Weirs	**Riser***	**Weirs**			**Ancillary**	
		1	2	3		
Shape / Type	Circular	Broad Crested			Exfiltration, in/hr	
Crest Elevation, ft	148	149				
Crest Length, ft	6.28	10				
Angle, deg		18.4 (3:1)				
Weir Coefficient, Cw	3.3	3.3				

**Routes through Culvert.*



Pond Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

Full Irrigation Pond

Stage-Storage-Discharge Summary

Stage (ft)	Elev. (ft)	Storage (cuft)	Culvert (cfs)	Orifices, cfs			Riser (cfs)	Weirs, cfs			Pf Riser (cfs)	Exfil (cfs)	User (cfs)	Total (cfs)
				1	2	3		1	2	3				
0.00	148.00	0.000	0.000				0.000	0.000						0.000
1.00	149.00	65,327	16.87 ic				16.87 ic	0.000						16.87
2.00	150.00	134,079	19.93 ic				0.000	40.92						60.85

Suffix key: ic = inlet control, oc = outlet control, s = submerged weir

Pond Report

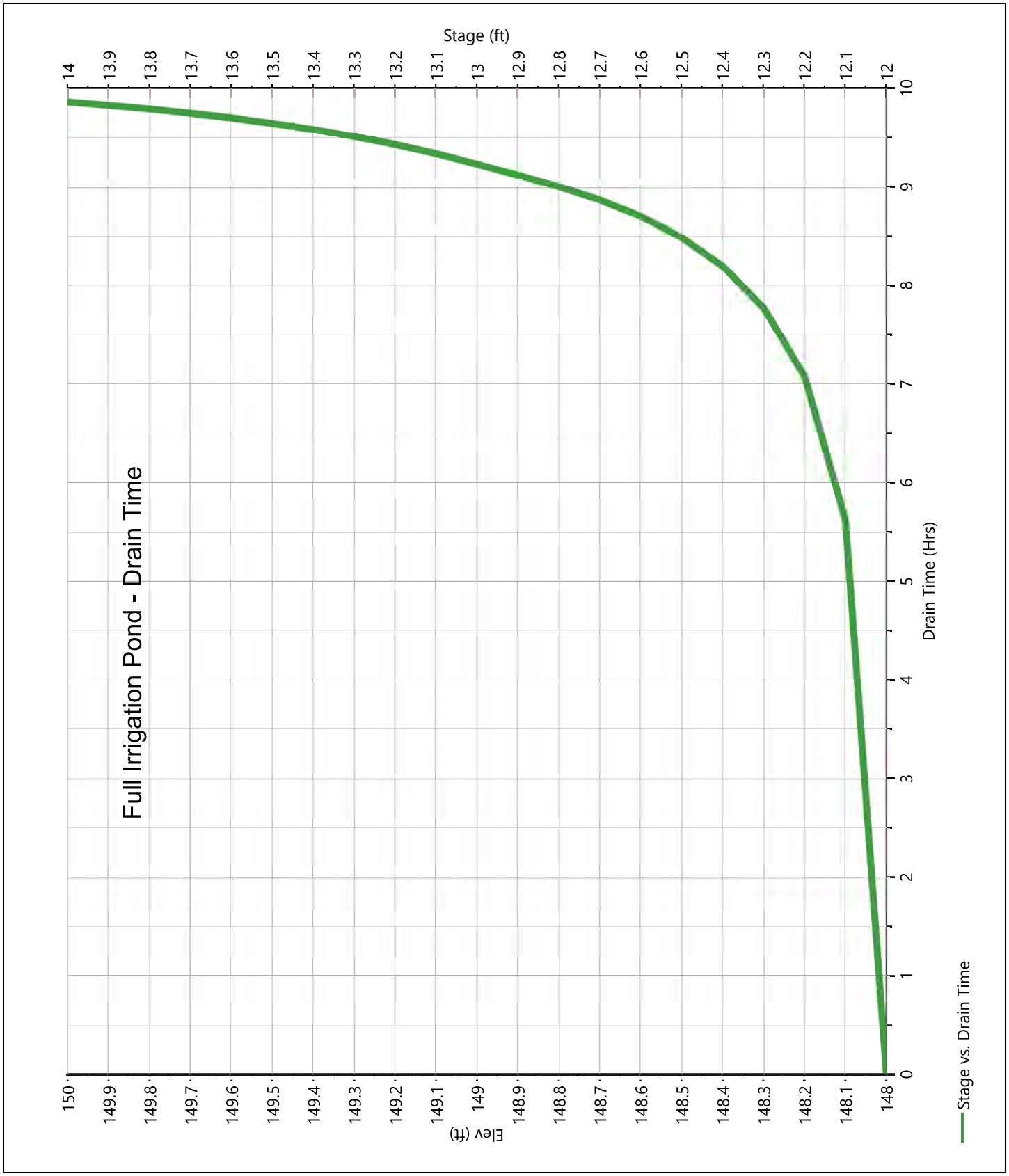
Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

Full Irrigation Pond

Pond Drawdown



Worksheet 2: Runoff curve number and runoff **SM-4621B**

Project: 246 Old Road to Nine Acre Corner By PFK Date 3/11/20

Location: Concord, MA Checked ______ Date ______

Circle one: Pre-Dev **[Developed]** Subcatchment P-1A

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/			Area	Product of CN x Area
		Table 2-2	Fig. 2-3	Fig. 2-4	Acres	
A	Wooded - Good Condition	30			0.31	9.38
A	Open Space - Lawn	39			0.29	11.26
	Impervious	98			0.00	0.00
A	Gravel - Cartpath	76			0.00	0.00
A	Woods/grass combination	32			0.00	0.00
				Totals =	0.60	20.64

1/ Use only one CN source per line.

CN (weighted) = $\frac{\text{total product}}{\text{total area}}$ = $\frac{20.64}{0.60}$ = 34.32 ; Use CN = 34

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency......................................	yr	2	10	100
Rainfall, P (24-hour).......................	in	3.21	5.02	7.9
Runoff, Q..	in	0.02	0.07	0.71

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

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

Subcatchment P-1A

Hyd. No. 5

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.000 cfs
Storm Frequency	= 2-yr	Time to Peak	= 0.00 hrs
Time Interval	= 2 min	Runoff Volume	= 0.000 cuft
Drainage Area	= 0.6 ac	Curve Number	= 34
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 3.21 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484

Qp = 0.00 cfs

Hydrograph Report

Project Name:

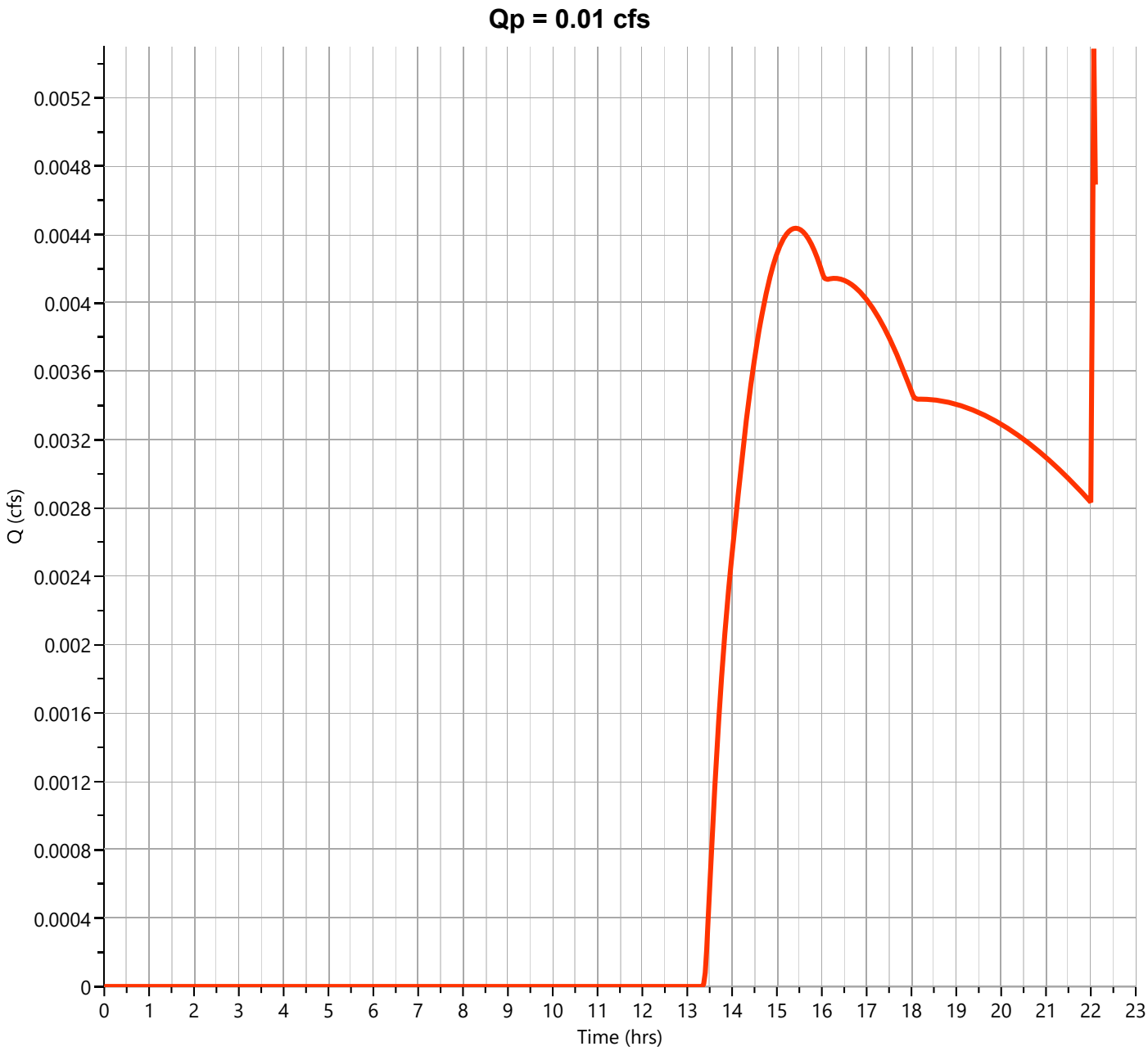
Hydrology Studio v 3.0.0.14

03-19-2020

Subcatchment P-1A

Hyd. No. 5

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.005 cfs
Storm Frequency	= 10-yr	Time to Peak	= 22.07 hrs
Time Interval	= 2 min	Runoff Volume	= 129 cuft
Drainage Area	= 0.6 ac	Curve Number	= 34
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 5.02 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

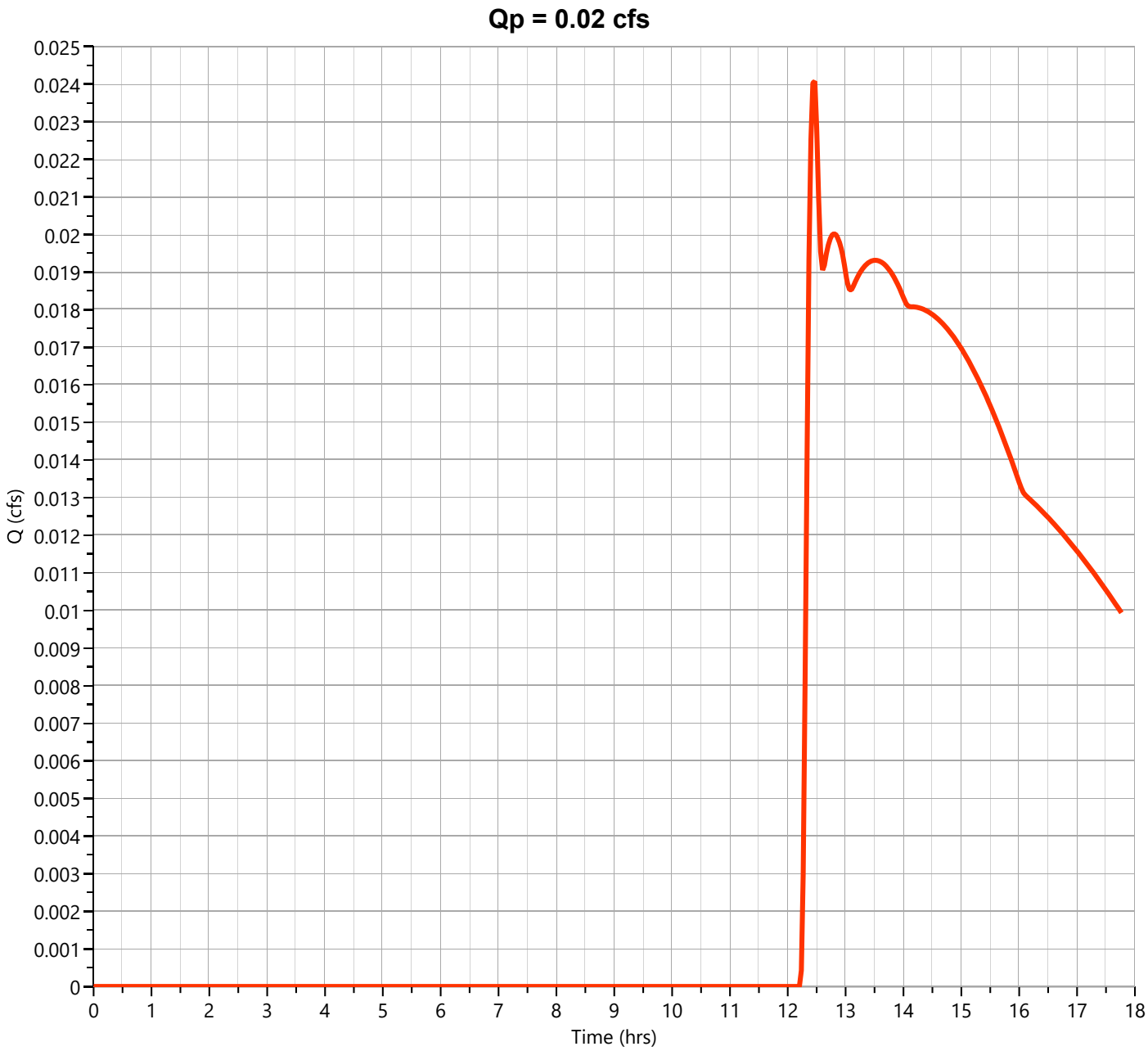
Hydrology Studio v 3.0.0.14

03-19-2020

Subcatchment P-1A

Hyd. No. 5

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.024 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.47 hrs
Time Interval	= 2 min	Runoff Volume	= 488 cuft
Drainage Area	= 0.6 ac	Curve Number	= 34
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 6.16 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

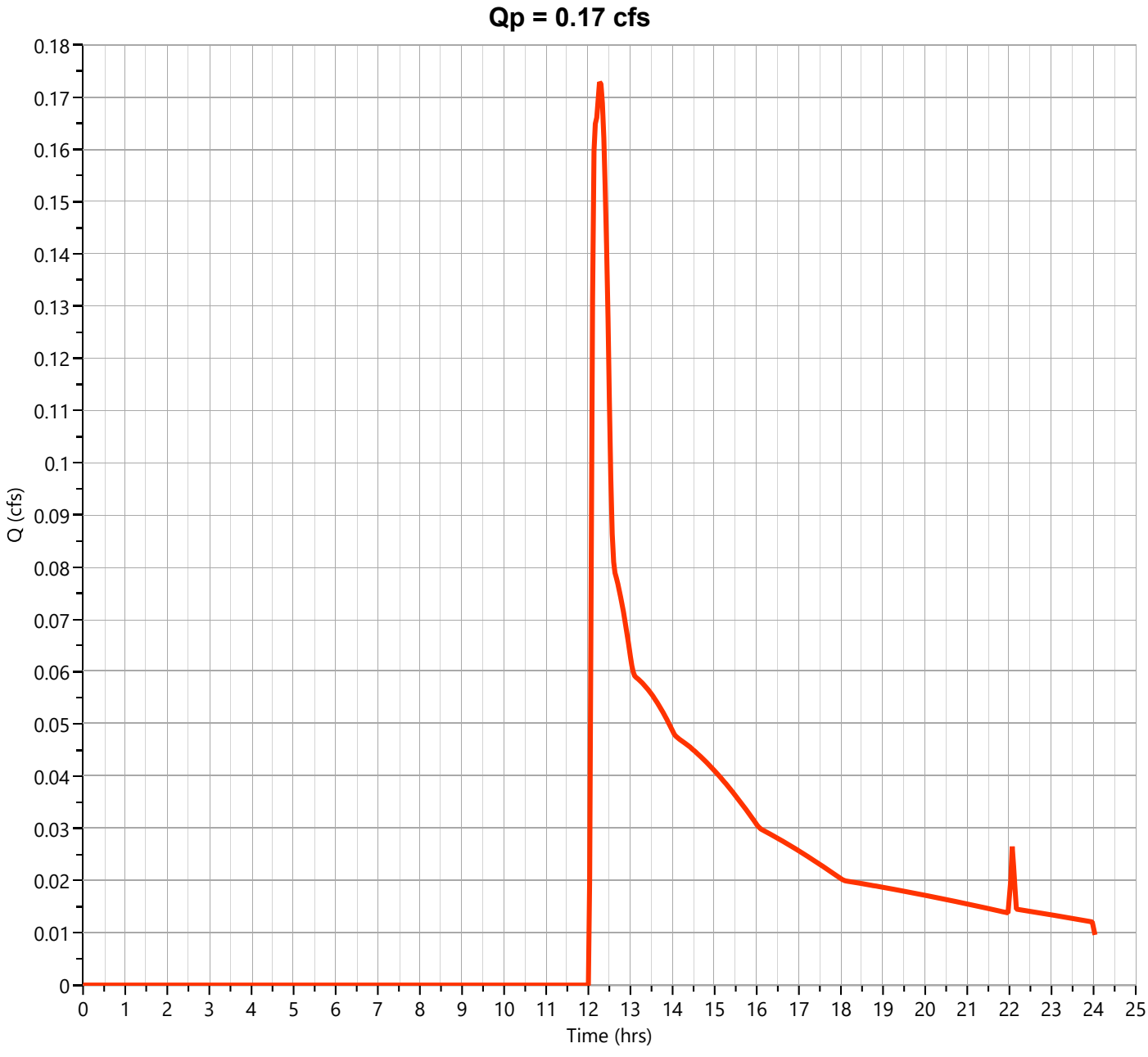
Hydrology Studio v 3.0.0.14

03-19-2020

Subcatchment P-1A

Hyd. No. 5

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.173 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.27 hrs
Time Interval	= 2 min	Runoff Volume	= 1,406 cuft
Drainage Area	= 0.6 ac	Curve Number	= 34
Tc Method	= User	Time of Conc. (Tc)	= 6.0 min
Total Rainfall	= 7.90 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

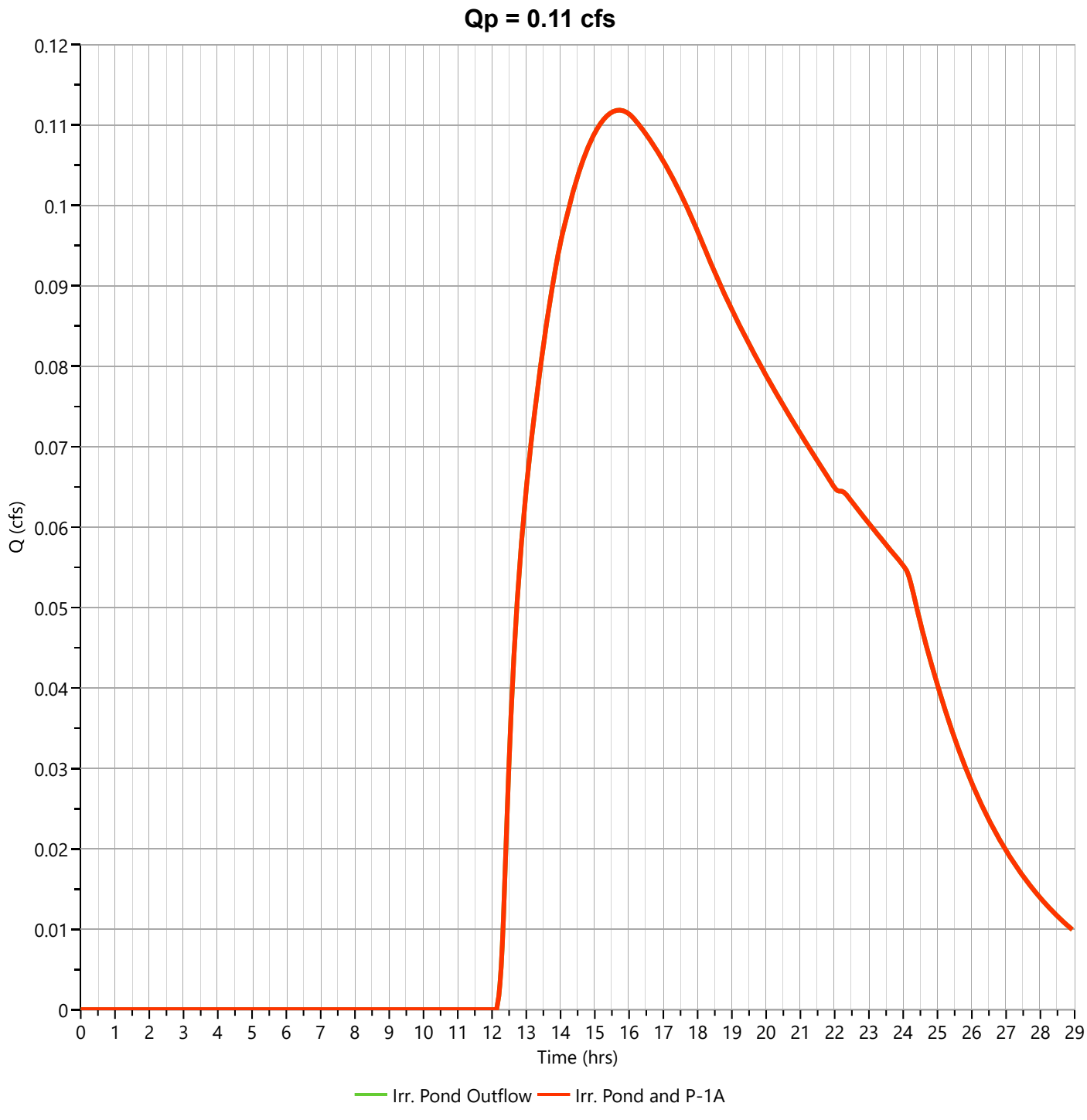
Hydrology Studio v 3.0.0.14

03-19-2020

Irr. Pond and P-1A

Hyd. No. 6

Hydrograph Type	= Junction	Peak Flow	= 0.112 cfs
Storm Frequency	= 2-yr	Time to Peak	= 15.70 hrs
Time Interval	= 2 min	Hydrograph Volume	= 4,079 cuft
Inflow Hydrographs	= 4, 5	Total Contrib. Area	= 0.6 ac



Hydrograph Report

Project Name:

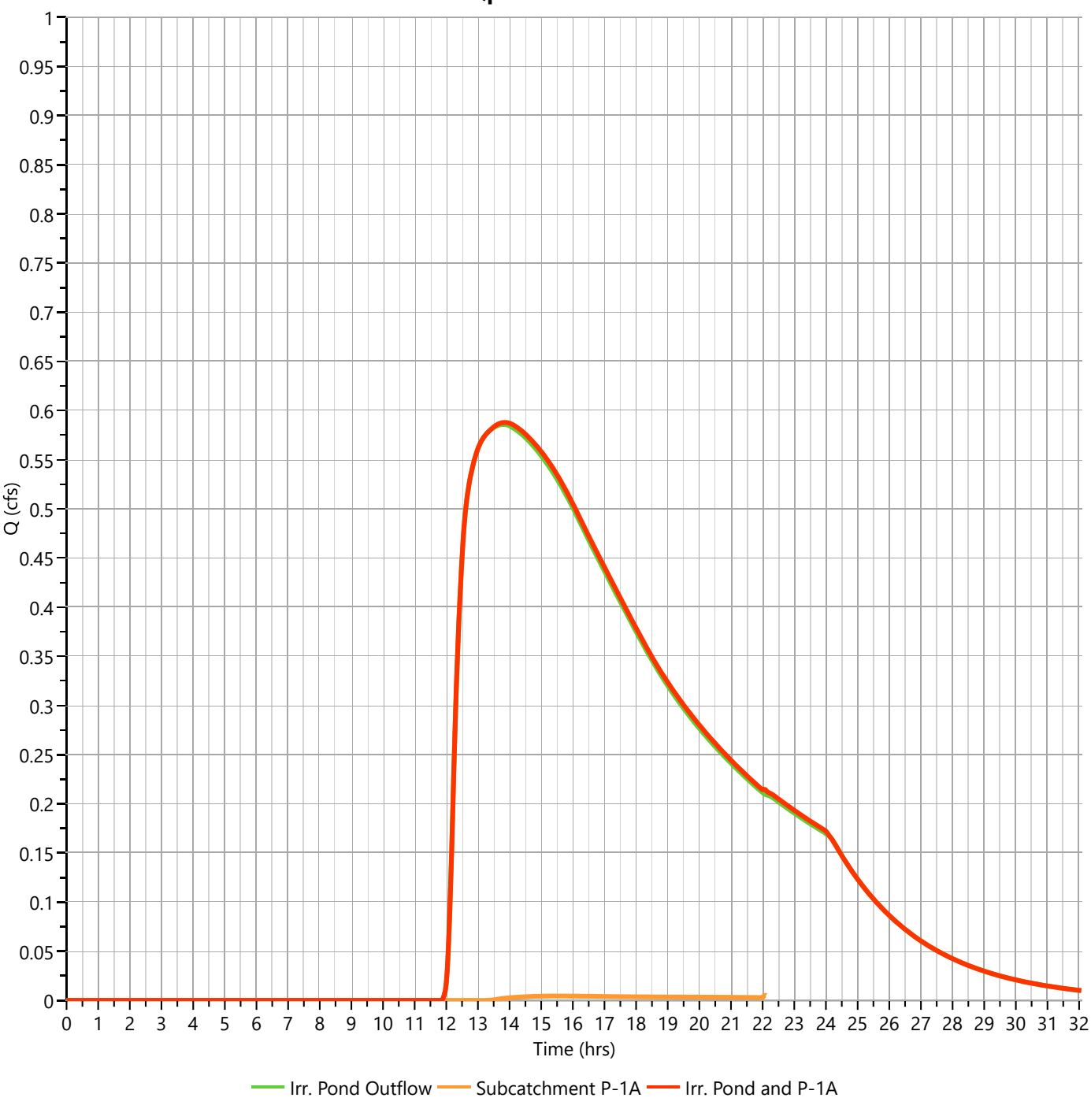
Hydrology Studio v 3.0.0.14

03-19-2020

Irr. Pond and P-1A

Hyd. No. 6

Hydrograph Type	= Junction	Peak Flow	= 0.588 cfs
Storm Frequency	= 10-yr	Time to Peak	= 13.87 hrs
Time Interval	= 2 min	Hydrograph Volume	= 17,899 cuft
Inflow Hydrographs	= 4, 5	Total Contrib. Area	= 0.6 ac



Hydrograph Report

Project Name:

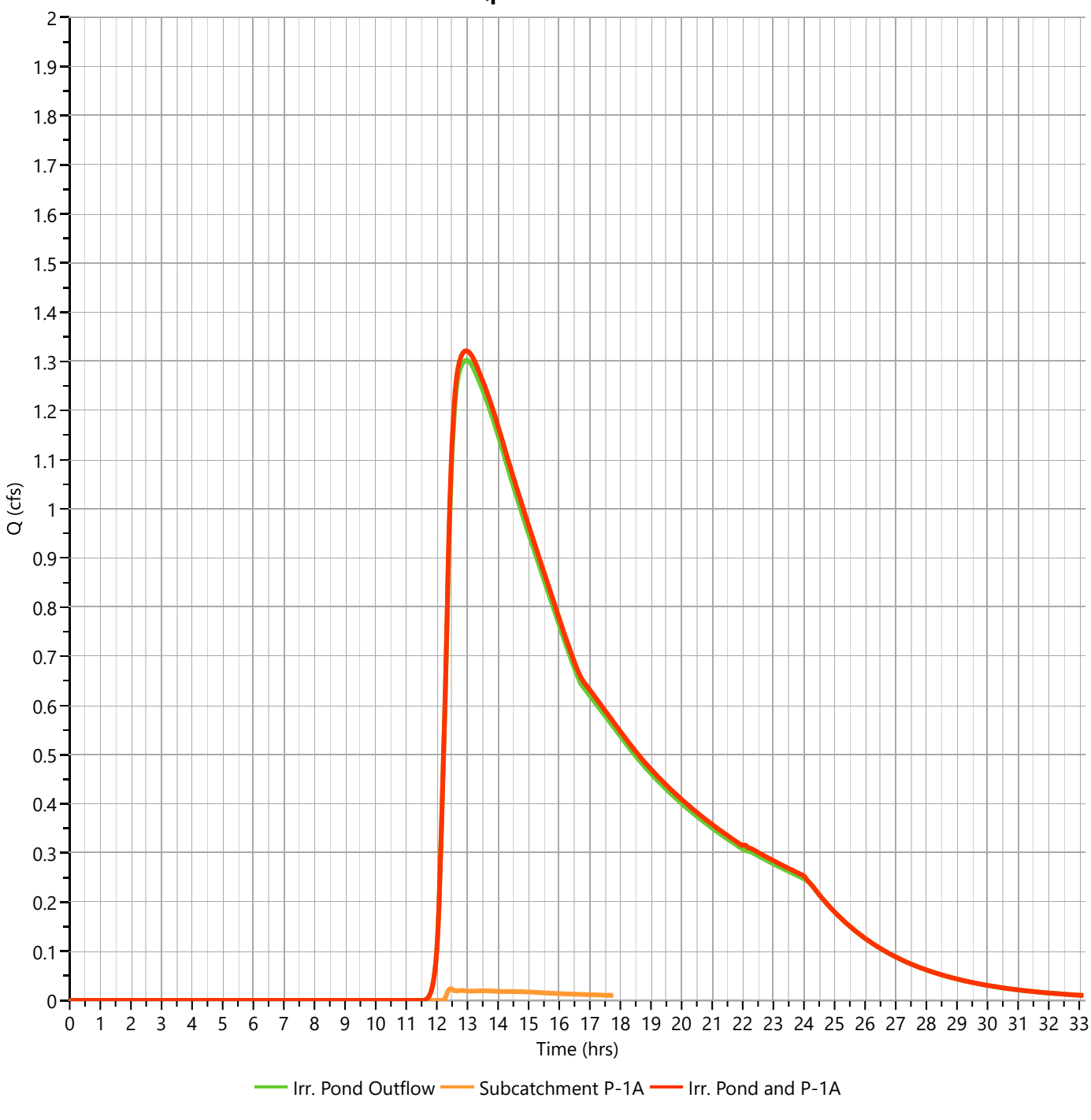
Hydrology Studio v 3.0.0.14

03-19-2020

Irr. Pond and P-1A

Hyd. No. 6

Hydrograph Type	= Junction	Peak Flow	= 1.322 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.97 hrs
Time Interval	= 2 min	Hydrograph Volume	= 30,149 cuft
Inflow Hydrographs	= 4, 5	Total Contrib. Area	= 0.6 ac



Hydrograph Report

Project Name:

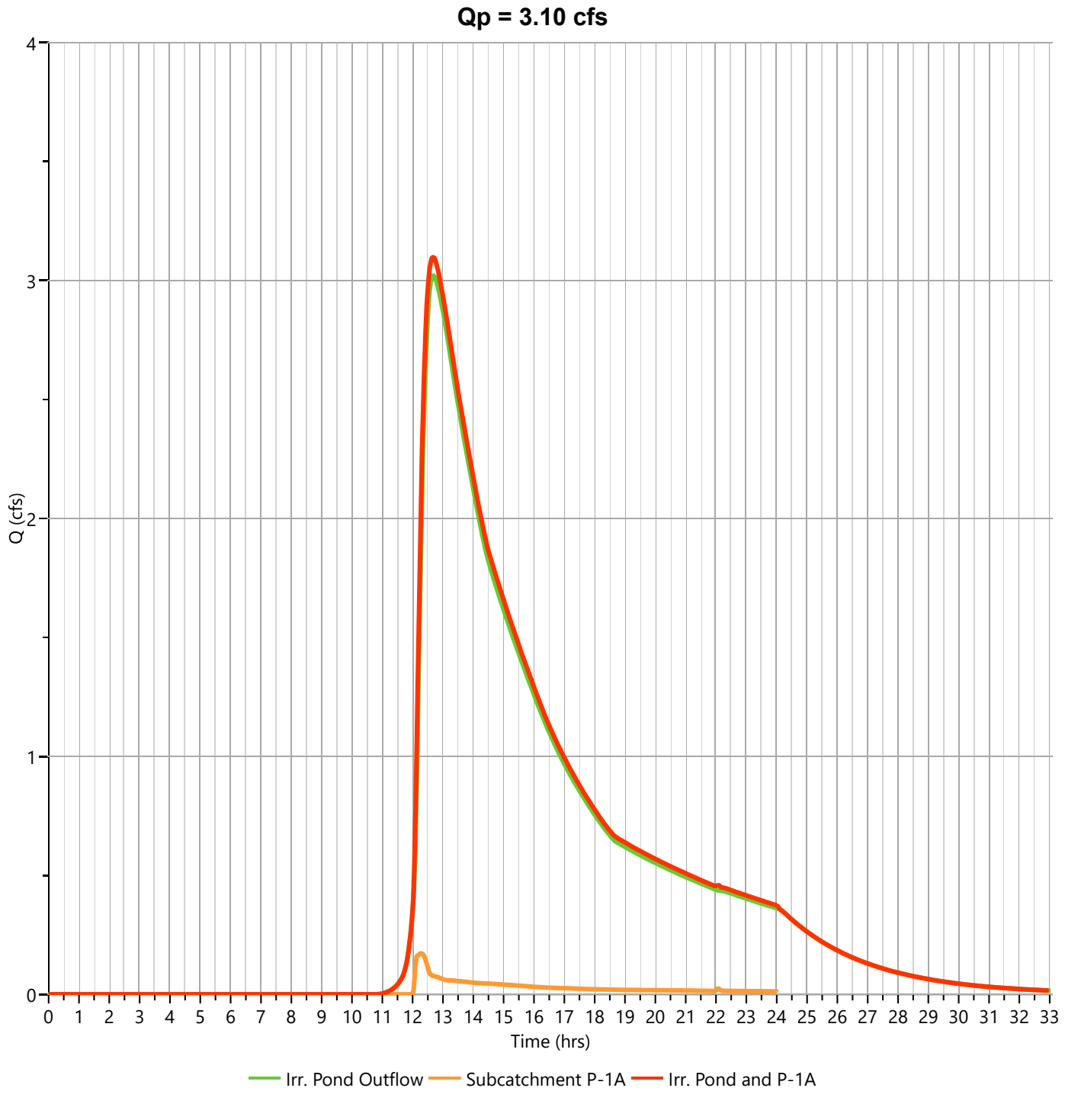
Hydrology Studio v 3.0.0.14

03-19-2020

Irr. Pond and P-1A

Hyd. No. 6

Hydrograph Type	= Junction	Peak Flow	= 3.101 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.67 hrs
Time Interval	= 2 min	Hydrograph Volume	= 52,558 cuft
Inflow Hydrographs	= 4, 5	Total Contrib. Area	= 0.6 ac



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

Infiltration Basin

Hyd. No. 7

Hydrograph Type	= Pond Route	Peak Flow	= 0.000 cfs
Storm Frequency	= 2-yr	Time to Peak	= 0.00 hrs
Time Interval	= 2 min	Hydrograph Volume	= 0.000 cuft
Inflow Hydrograph	= 6 - Irr. Pond and P-1A	Max. Elevation	= 136.02 ft
Pond Name	= Infiltration Basin	Max. Storage	= 61.3 cuft

Pond Routing by Storage Indication Method

Qp = 0.00 cfs

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

Infiltration Basin

Hyd. No. 7

Hydrograph Type	= Pond Route	Peak Flow	= 0.000 cfs
Storm Frequency	= 10-yr	Time to Peak	= 0.00 hrs
Time Interval	= 2 min	Hydrograph Volume	= -0.002 cuft
Inflow Hydrograph	= 6 - Irr. Pond and P-1A	Max. Elevation	= 136.08 ft
Pond Name	= Infiltration Basin	Max. Storage	= 322 cuft

Pond Routing by Storage Indication Method

Qp = 0.00 cfs

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

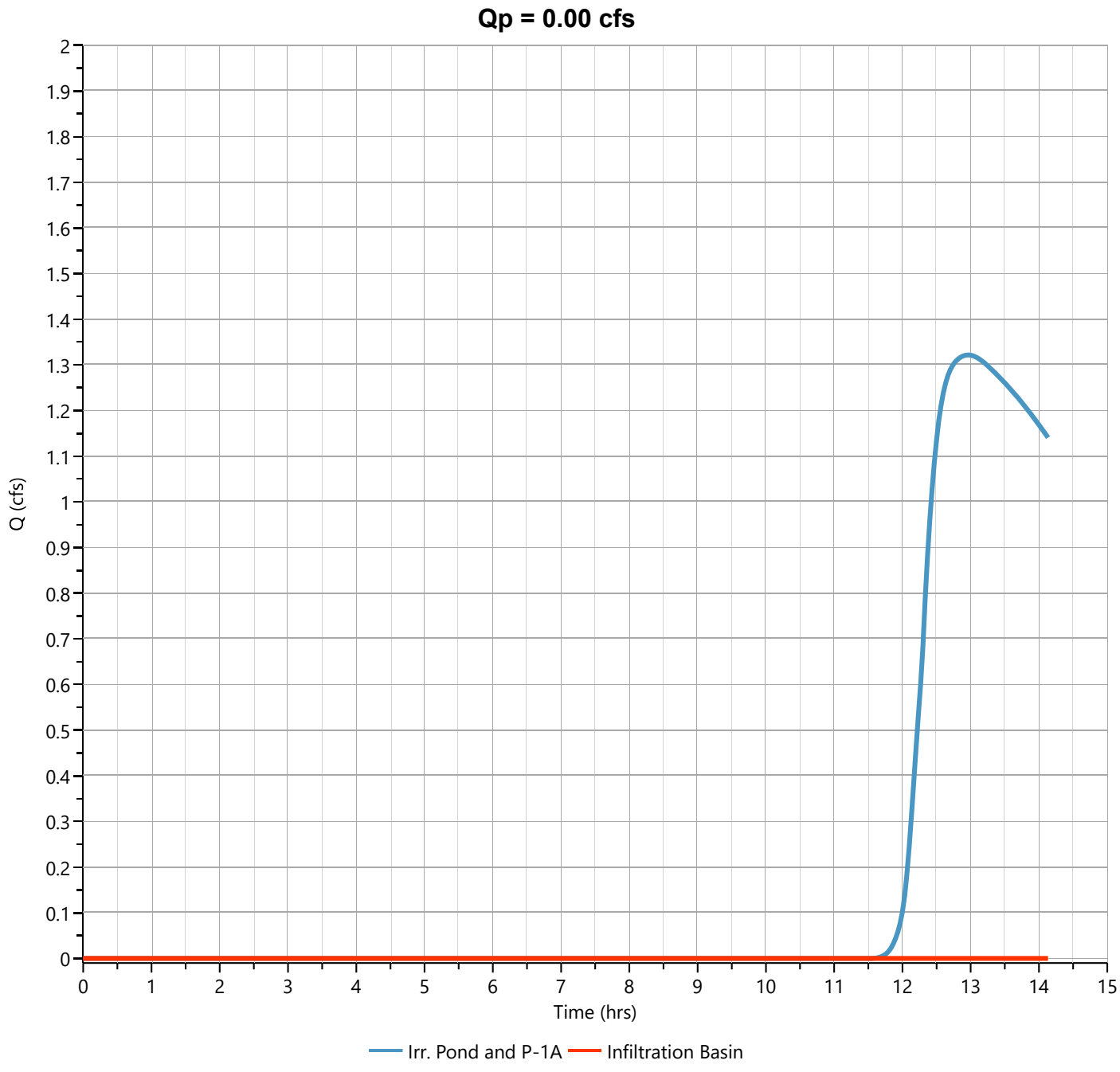
03-19-2020

Infiltration Basin

Hyd. No. 7

Hydrograph Type	= Pond Route	Peak Flow	= 0.000 cfs
Storm Frequency	= 25-yr	Time to Peak	= 14.10 hrs
Time Interval	= 2 min	Hydrograph Volume	= -0.001 cuft
Inflow Hydrograph	= 6 - Irr. Pond and P-1A	Max. Elevation	= 137.17 ft
Pond Name	= Infiltration Basin	Max. Storage	= 4,606 cuft

Pond Routing by Storage Indication Method



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

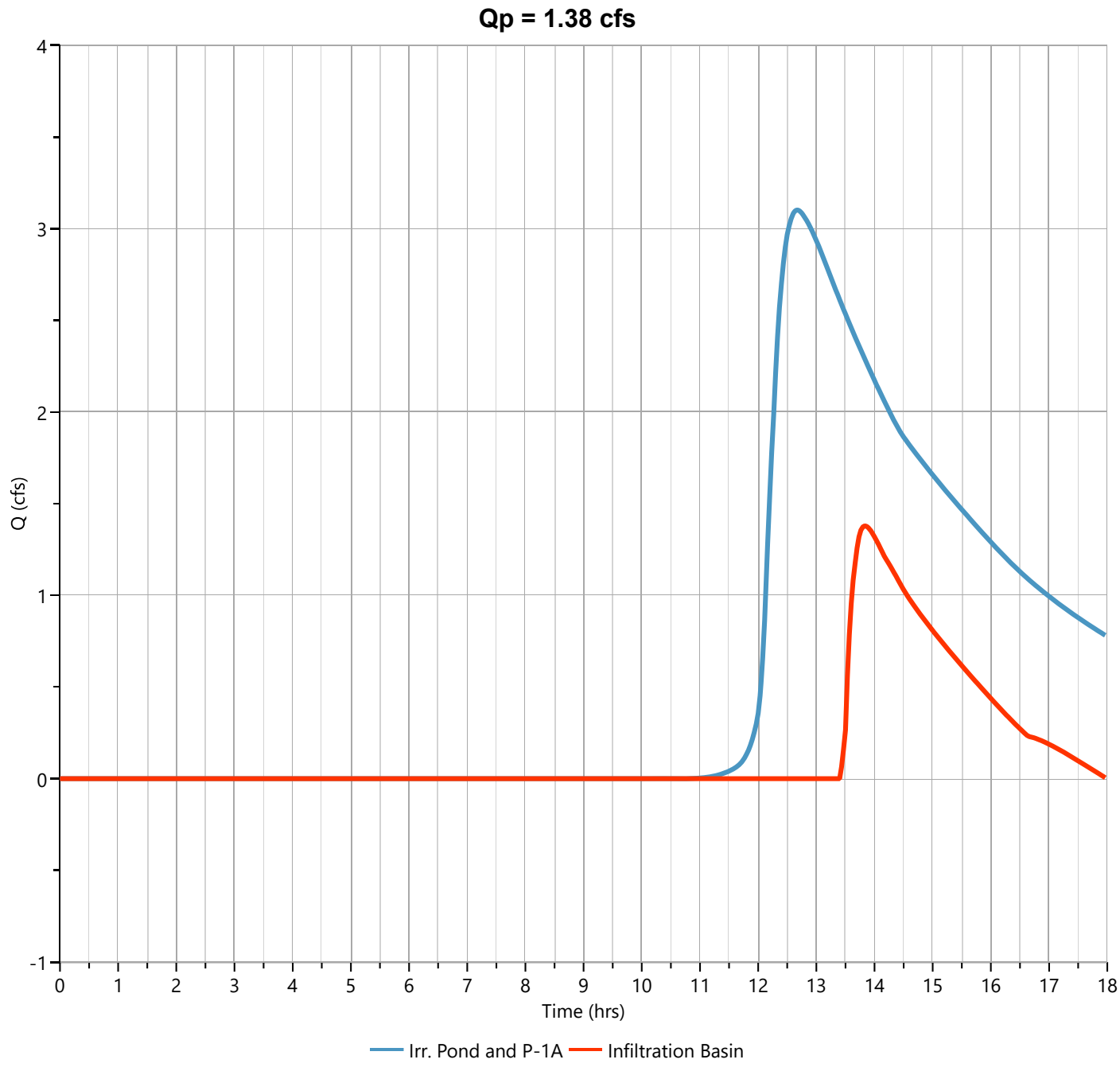
03-19-2020

Infiltration Basin

Hyd. No. 7

Hydrograph Type	= Pond Route	Peak Flow	= 1.379 cfs
Storm Frequency	= 100-yr	Time to Peak	= 13.83 hrs
Time Interval	= 2 min	Hydrograph Volume	= 9,506 cuft
Inflow Hydrograph	= 6 - Irr. Pond and P-1A	Max. Elevation	= 138.41 ft
Pond Name	= Infiltration Basin	Max. Storage	= 10,144 cuft

Pond Routing by Storage Indication Method



Pond Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

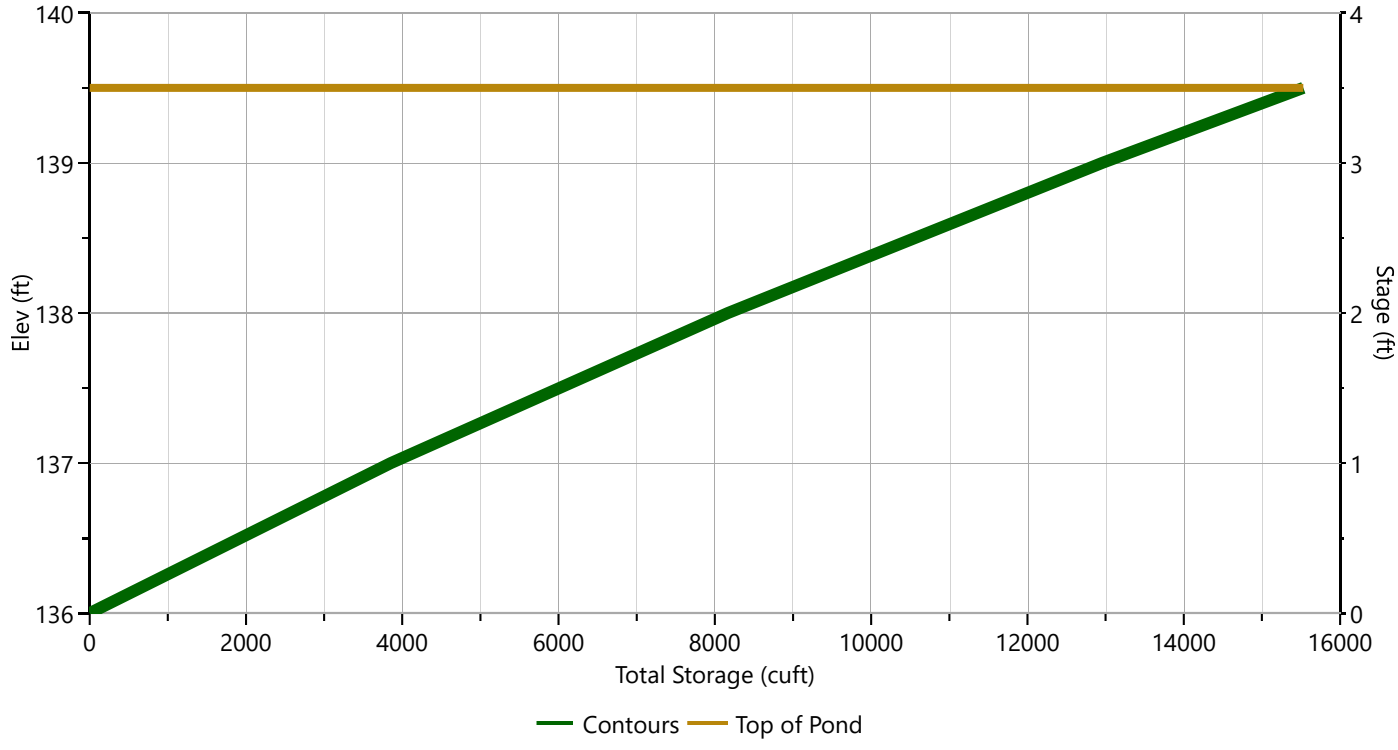
Infiltration Basin

Stage-Storage

User Defined Contours	
Description	**Input**
Bottom Elevation, ft	136.00
Voids (%)	100.00
Volume Calc	Ave End Area

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour Area (sqft)	Incr. Storage (cuft)	Total Storage (cuft)
0.00	136.00	3,627	0.000	0.000
1.00	137.00	4,081	3,854	3,854
2.00	138.00	4,548	4,315	8,169
3.00	139.00	5,027	4,788	12,956
3.50	139.50	5,272	2,575	15,531



Pond Report

Project Name:

Hydrology Studio v 3.0.0.14

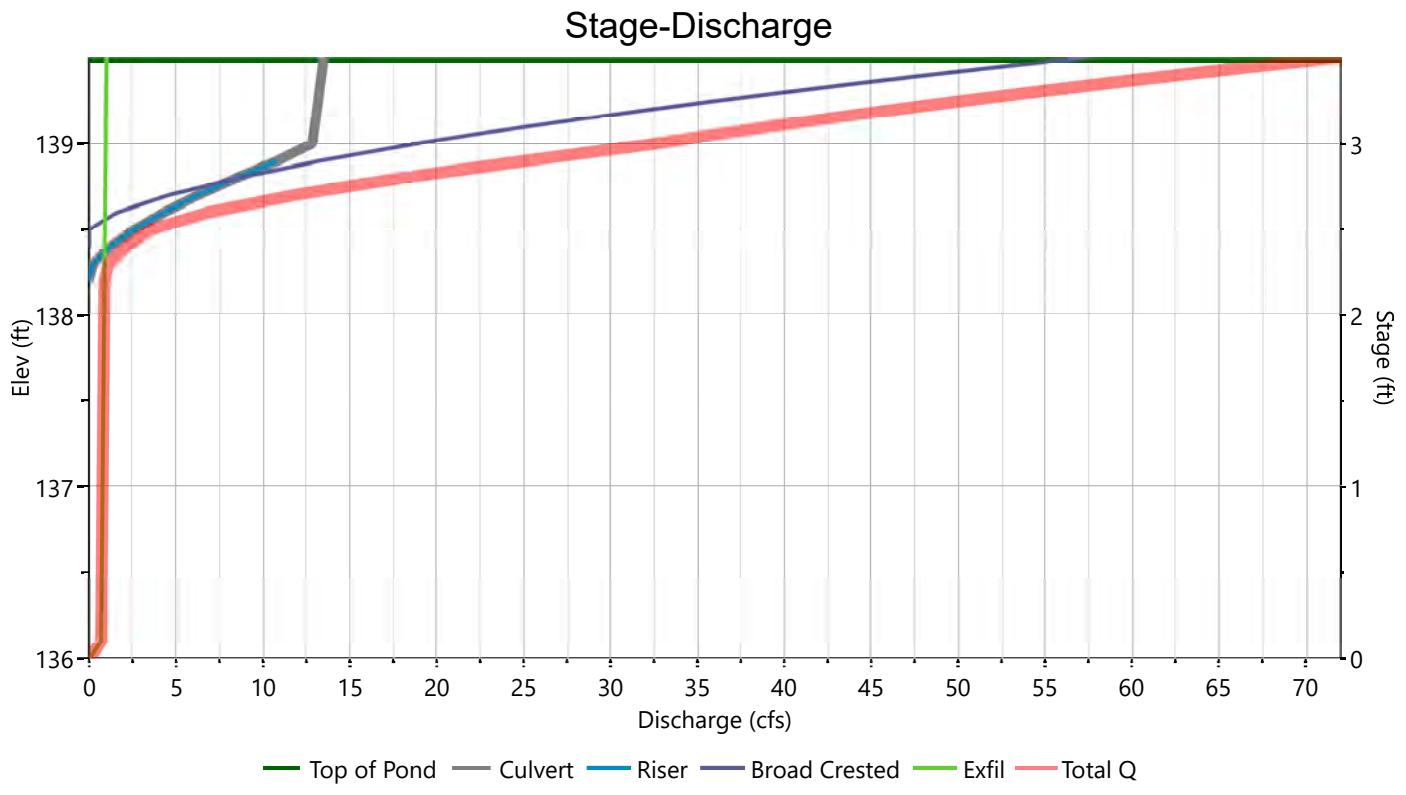
03-19-2020

Infiltration Basin

Stage-Discharge

Culvert / Orifices	Culvert	Orifices			Orifice Plate	
		1	2	3		
Rise, in	15				Orifice Dia, in	
Span, in	15				No. Orifices	
No. Barrels	1				Invert Elevation, ft	
Invert Elevation, ft	133.65				Height, ft	
Orifice Coefficient, Co	0.60				Orifice Coefficient, Co	
Length, ft	19					
Barrel Slope, %	2.1					
N-Value, n	0.012					
Weirs	**Riser***	**Weirs**			**Ancillary**	
		1	2	3		
Shape / Type	Circular	Broad Crested			Exfiltration, in/hr	8.27**
Crest Elevation, ft	138.25	138.5				
Crest Length, ft	6.28	15				
Angle, deg		18.4 (3:1)				
Weir Coefficient, Cw	3.3	3.3				

*Routes through Culvert. **Exfiltration extracted from outflow hydrograph. Rate applied to contours.



Pond Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

Infiltration Basin

Stage-Storage-Discharge Summary

Stage (ft)	Elev. (ft)	Storage (cuft)	Culvert (cfs)	Orifices, cfs			Riser (cfs)	Weirs, cfs			Pf Riser (cfs)	Exfil (cfs)	User (cfs)	Total (cfs)
				1	2	3		1	2	3				
0.00	136.00	0.000	0.000				0.000	0.000				0.000		0.000
1.00	137.00	3,854	0.000 ic				0.000	0.000				0.781		0.781
2.00	138.00	8,169	0.000 ic				0.000	0.000				0.871		0.871
3.00	139.00	12,956	12.84 ic				0.000	18.90				0.962		32.71
3.50	139.50	15,531	13.50 ic				0.000	57.42				1.009		71.93

Suffix key: ic = inlet control, oc = outlet control, s = submerged weir

Pond Report

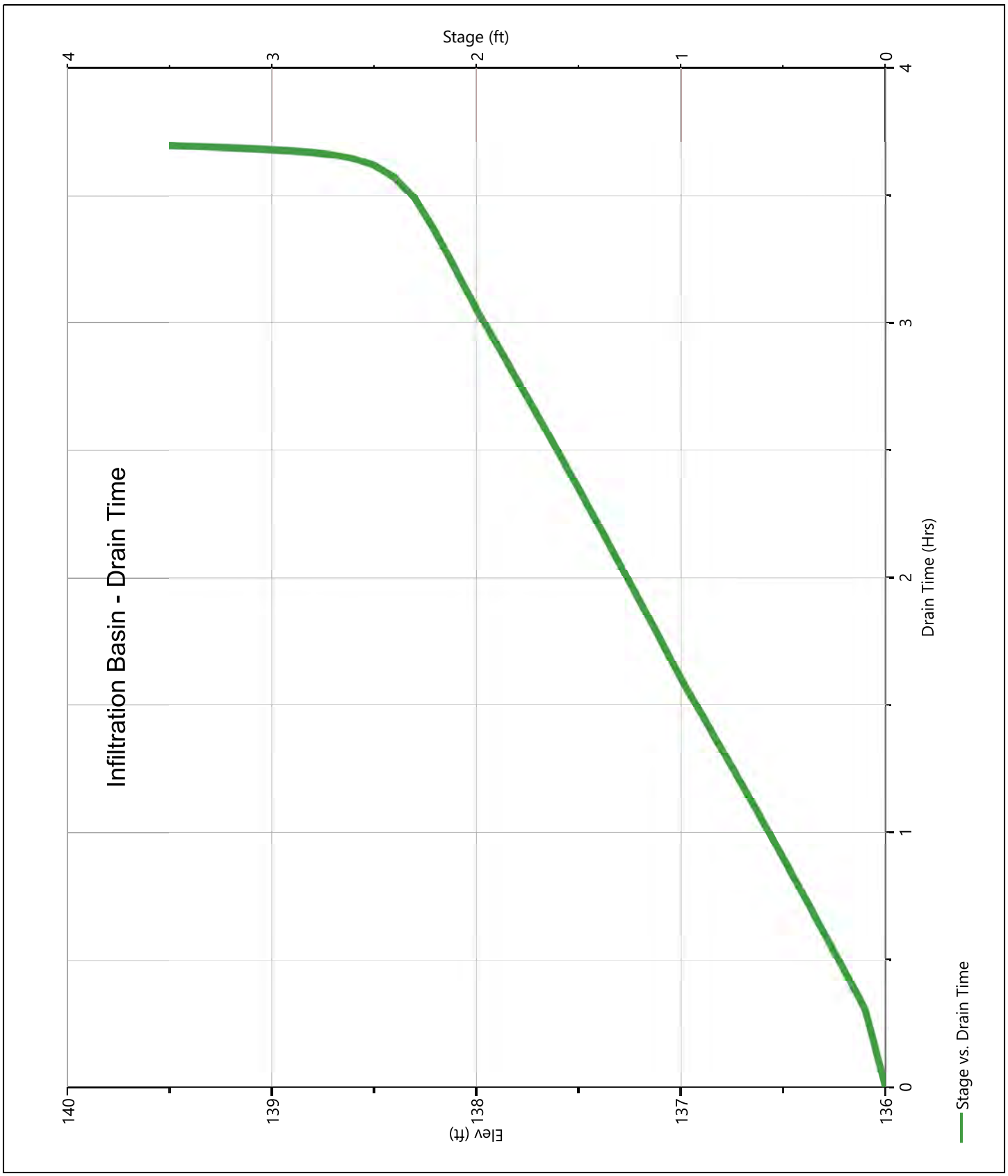
Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

Infiltration Basin

Pond Drawdown



Worksheet 2: Runoff curve number and runoff **SM-4621B**

Project: 246 Old Road to Nine Acre Corner By PFK Date 3/18/20

Location: Concord, MA Checked ______ Date ______

Circle one: Pre-Dev **Developed** Subcatchment P-1B

1. Runoff curve number (CN)

Soil name and hydrologic group (appendix A)	Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio)	CN 1/ Table 2-2	CN 1/ Fig. 2-3	CN 1/ Fig. 2-4	Area Acres	Product of CN x Area
A	Wooded - Good Condition	30			2.82	84.48
A	Open Space - Lawn	39			0.00	0.00
	Impervious	98			0.00	0.00
A	Gravel - Cartpath	76			0.00	0.00
A	Woods/grass combination	32			0.00	0.00
				Totals =	2.82	84.48

1/ Use only one CN source per line.

CN (weighted) = total product / total area = 84.48 / 2.82 = 30.00 ; Use CN = 30

2. Runoff

		Storm #1	Storm #2	Storm #3
Frequency......................................	yr	2	10	100
Rainfall, P (24-hour).......................	in	3.21	5.02	7.9
Runoff, Q..	in	0.10	0.01	0.39

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

Worksheet 3: Time of Concentration (Tc) or travel time (Tt) SM-4621B

Project: 246 Old Road to Nine Acre Corner By PFK Date 3/18/2020

Location: Concord, MA Checked _____ Date _____

Circle one: Pre-Dev | Developed
Circle one: Tc | Tt through subarea Subcatchment P-1B

Sheet flow (Applicable to Tc only)		Segment ID	A-B			
1. Surface Description (table 3-1)			Woods			
2. Mannings roughness coeff., n (table 3-1)			0.8			
3. Flow length, L (total L <= 300 ft)		ft	50			
4. Two-yr 24-hr rainfall, P2		in	3.21			
5. Land Slope, s		ft/ft	0.125			
6. Tt = 0.007 (nL)^0.8 / (P2^0.5 s^0.4)	Compute Tt	hr	0.17			0.17

Shallow concentrated Flow		Segment ID	B-C	C-D		
7. Surface Description (paved or unpaved)			UNPAVED	UNPAVED		
8. Flow Length, L		ft	94	244		
9. Watercourse slope, s		ft/ft	0.12	0.025		
10. Average Velocity, V (figure 3-1)		ft/s	5.59	2.55		
11. Tt = L / 3600V	Compute Tt	hr	0.00	0.03		

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 0.20
min 12.2

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment P-1B

Hyd. No. 9

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.000 cfs
Storm Frequency	= 2-yr	Time to Peak	= 0.00 hrs
Time Interval	= 2 min	Runoff Volume	= 0.000 cuft
Drainage Area	= 2.82 ac	Curve Number	= 30
Tc Method	= User	Time of Conc. (Tc)	= 12.2 min
Total Rainfall	= 3.21 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484

Qp = 0.00 cfs

Hydrograph Report

Project Name:

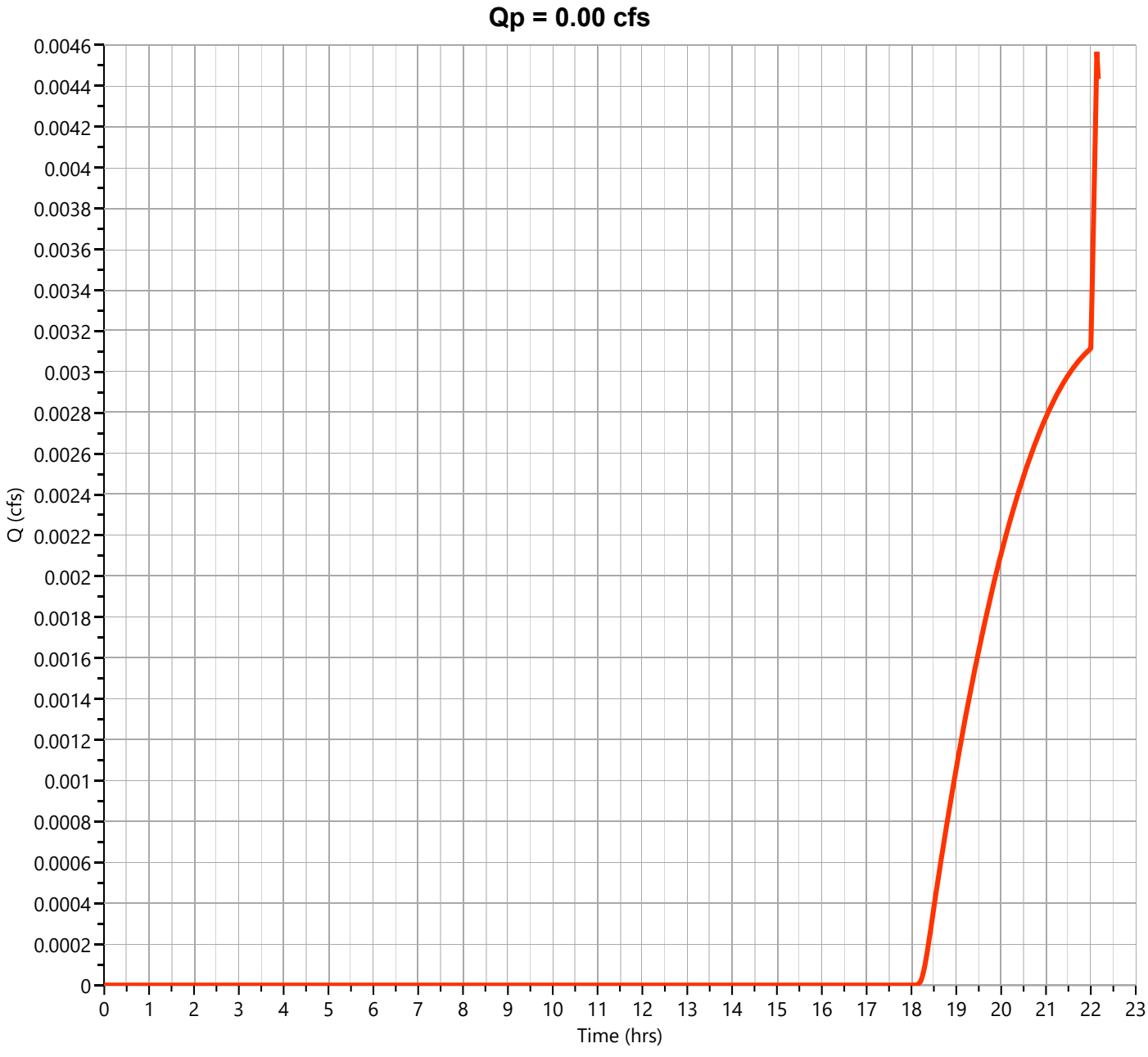
Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment P-1B

Hyd. No. 9

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.005 cfs
Storm Frequency	= 10-yr	Time to Peak	= 22.13 hrs
Time Interval	= 2 min	Runoff Volume	= 55.6 cuft
Drainage Area	= 2.82 ac	Curve Number	= 30
Tc Method	= User	Time of Conc. (Tc)	= 12.2 min
Total Rainfall	= 5.02 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

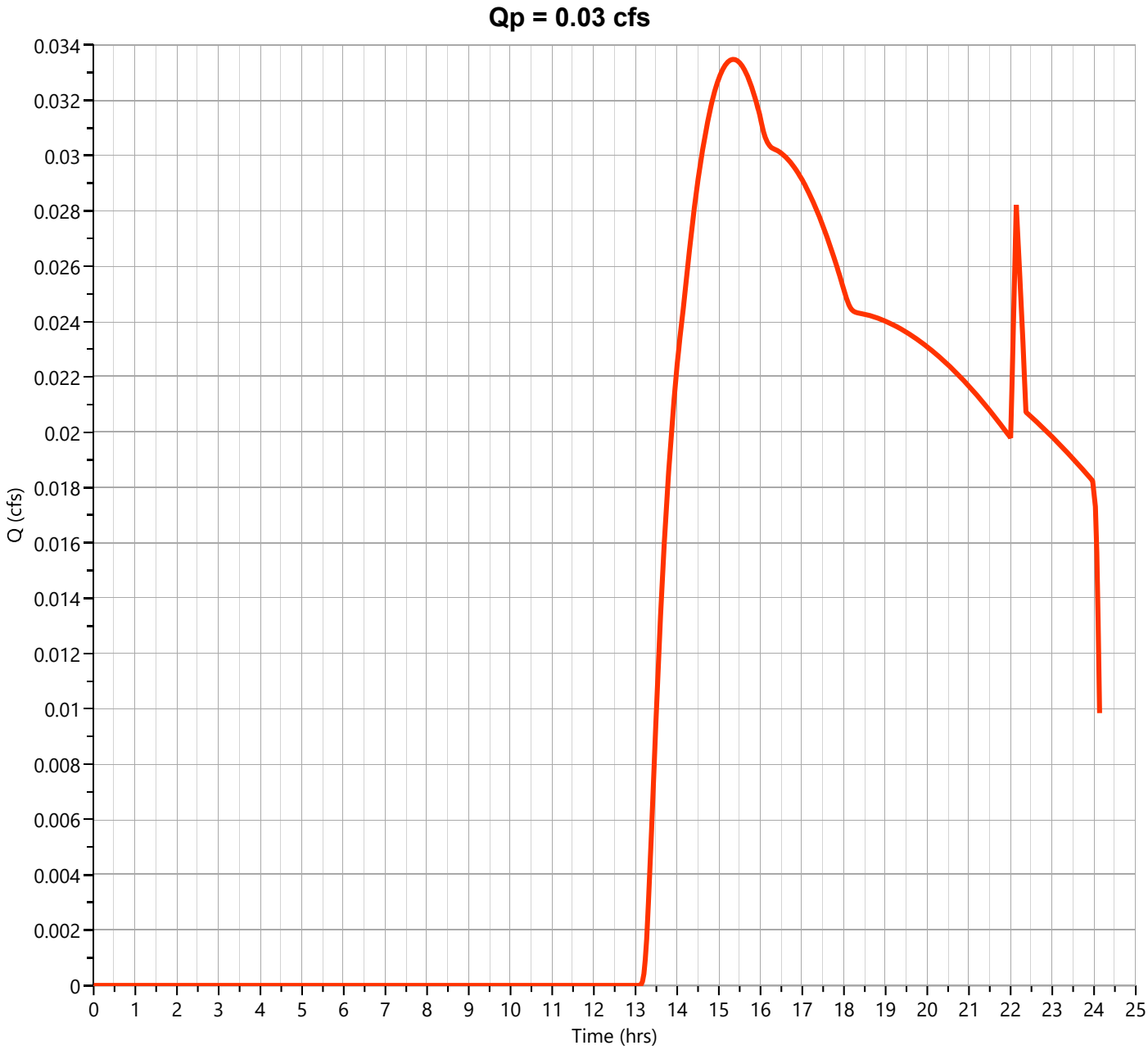
Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment P-1B

Hyd. No. 9

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.033 cfs
Storm Frequency	= 25-yr	Time to Peak	= 15.33 hrs
Time Interval	= 2 min	Runoff Volume	= 948 cuft
Drainage Area	= 2.82 ac	Curve Number	= 30
Tc Method	= User	Time of Conc. (Tc)	= 12.2 min
Total Rainfall	= 6.16 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

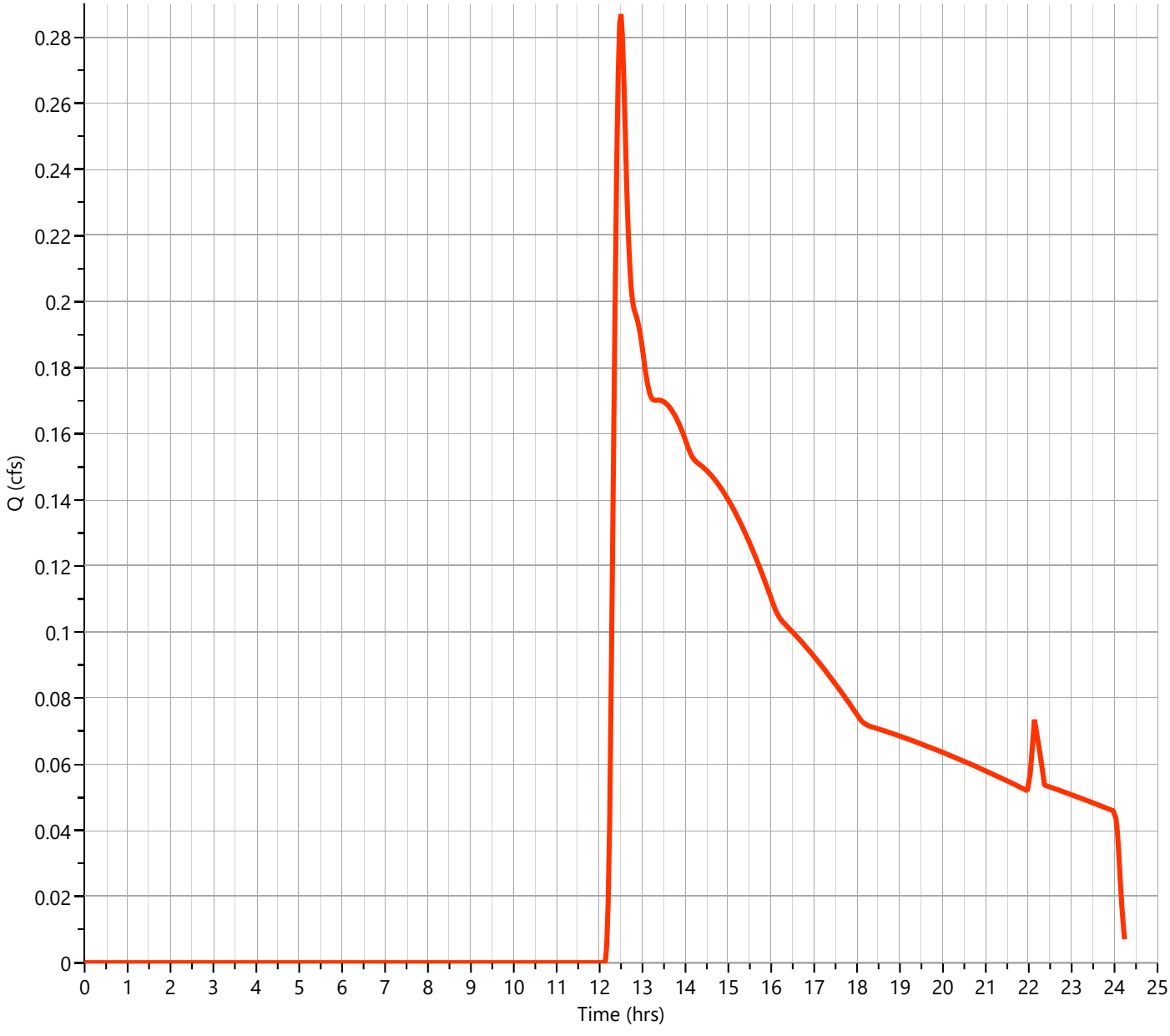
Hydrology Studio v 3.0.0.14

03-18-2020

Subcatchment P-1B

Hyd. No. 9

Hydrograph Type	= NRCS Runoff	Peak Flow	= 0.287 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.50 hrs
Time Interval	= 2 min	Runoff Volume	= 4,153 cuft
Drainage Area	= 2.82 ac	Curve Number	= 30
Tc Method	= User	Time of Conc. (Tc)	= 12.2 min
Total Rainfall	= 7.90 in	Design Storm	= Type III
Storm Duration	= 24 hrs	Shape Factor	= 484



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.14

03-19-2020

Post Total

Hyd. No. 10

Hydrograph Type	= Junction	Peak Flow	= 0.000 cfs
Storm Frequency	= 2-yr	Time to Peak	= 0.00 hrs
Time Interval	= 2 min	Hydrograph Volume	= 0.000 cuft
Inflow Hydrographs	= 7, 9	Total Contrib. Area	= 2.82 ac

Qp = 0.00 cfs

Hydrograph Report

Project Name:

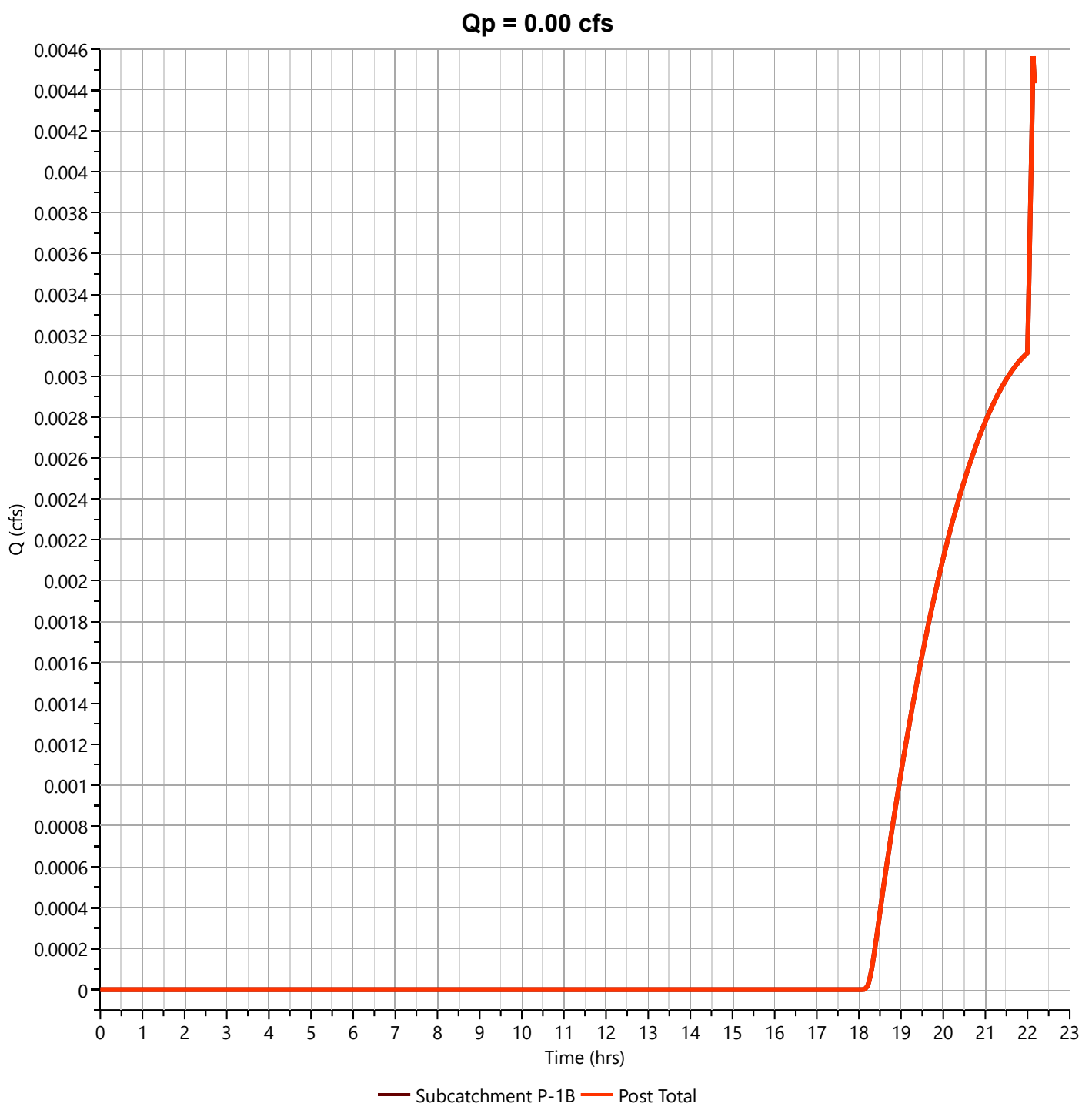
Hydrology Studio v 3.0.0.14

03-19-2020

Post Total

Hyd. No. 10

Hydrograph Type	= Junction	Peak Flow	= 0.005 cfs
Storm Frequency	= 10-yr	Time to Peak	= 22.13 hrs
Time Interval	= 2 min	Hydrograph Volume	= 55.6 cuft
Inflow Hydrographs	= 7, 9	Total Contrib. Area	= 2.82 ac



Hydrograph Report

Project Name:

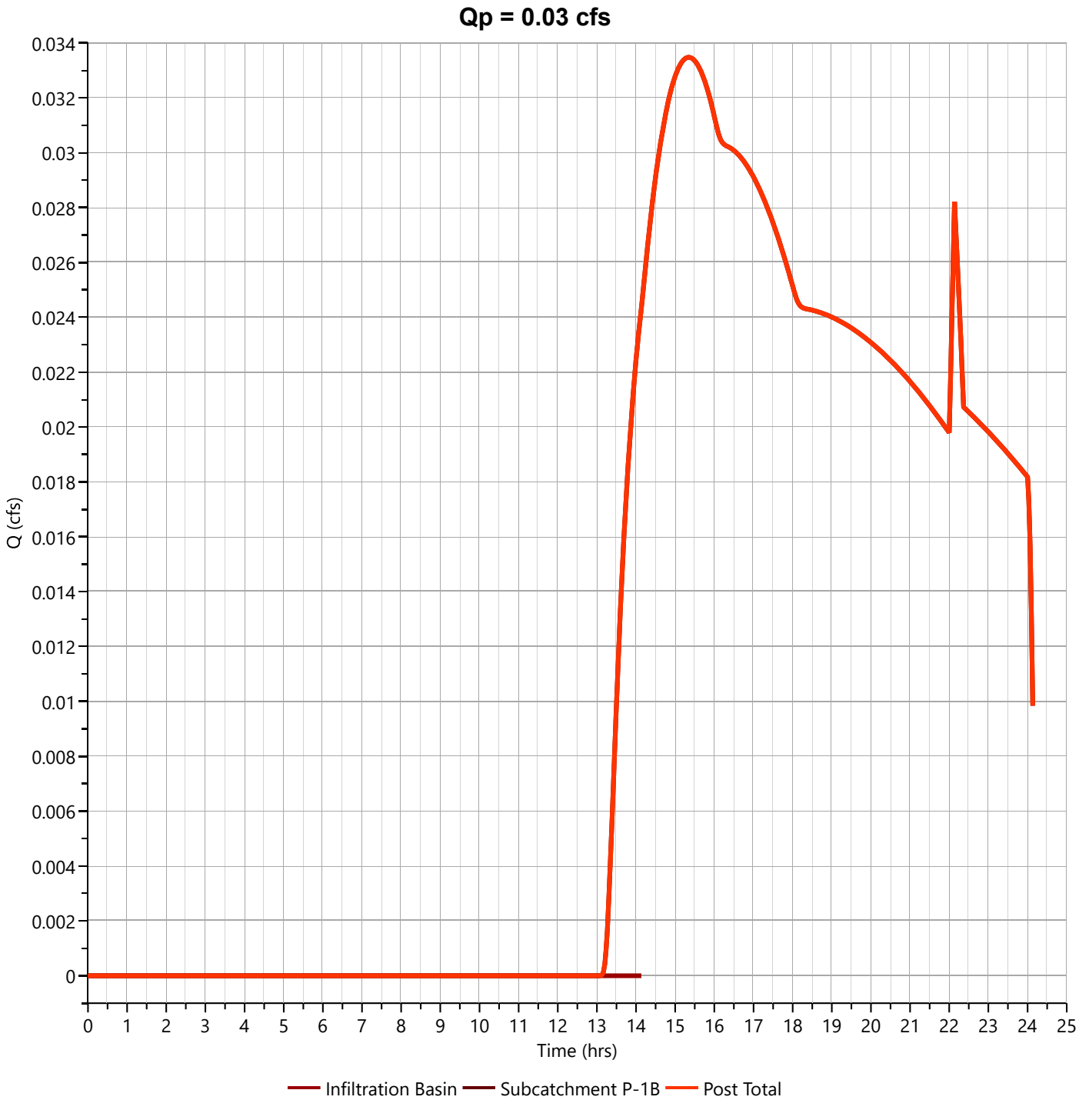
Hydrology Studio v 3.0.0.14

03-19-2020

Post Total

Hyd. No. 10

Hydrograph Type	= Junction	Peak Flow	= 0.033 cfs
Storm Frequency	= 25-yr	Time to Peak	= 15.33 hrs
Time Interval	= 2 min	Hydrograph Volume	= 948 cuft
Inflow Hydrographs	= 7, 9	Total Contrib. Area	= 2.82 ac



Hydrograph Report

Project Name:

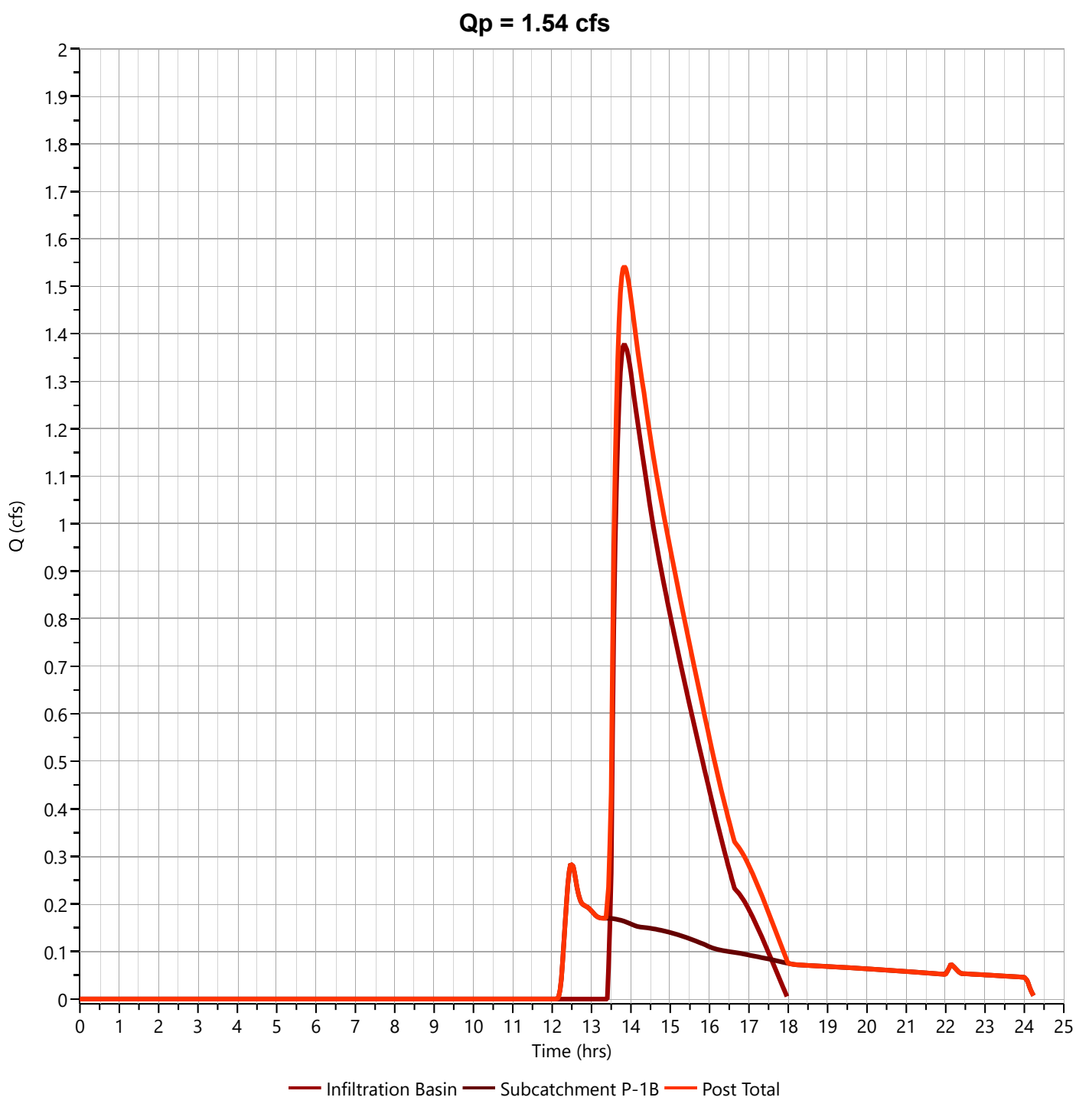
Hydrology Studio v 3.0.0.14

03-19-2020

Post Total

Hyd. No. 10

Hydrograph Type	= Junction	Peak Flow	= 1.542 cfs
Storm Frequency	= 100-yr	Time to Peak	= 13.83 hrs
Time Interval	= 2 min	Hydrograph Volume	= 13,658 cuft
Inflow Hydrographs	= 7, 9	Total Contrib. Area	= 2.82 ac



Water Quality Volume Calculations

Water Quality Volume Calculations

Job: SM-4621B

Calculated by: PFK
Date: 3/18/2020

Infiltration Basin
Soils:
Hydrologic Group: A
Required First Flush Volume
1 inch of runoff x impervious area

Impervious area: 1.65 acres
71,964 s.f.

Required Water Quality Volume

V= 71,964 s.f. x $\frac{1}{12}$ = **5,997 c.f.**

Volume Provided 9,365 c.f. Below Outlet

9,365 c.f. > 5,997 c.f. O.K.

Groundwater Recharge Calculations

Recharge Volume Calculations

Job: SM-4621B

Calculated by: PFK
Date: 3/18/2020

Infiltration Basin-1
Soils:
Hydrologic A
Required Recharge Volume
0.6 inches of runoff x impervious area

Impervious 1.65 acres
71,964 s.f.

Required Recharge Volume (Rv)

Rv = 71,964 s.f. x $\frac{0.6}{12}$ = **3,598 c.f.**

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

D (depth of infiltration facility):	2.25	ft			
K (saturated hydraulic conductivity):	8.27	inches/hour			
	0.69	feet/hour			
T (time):	2	hours			
A=	3,627	s.f.			
Voids=	1.00				
Rv=	13,160	c.f.	>	3,598	c.f.
Basin Volume:	9,365	c.f.			

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

Soil Evaluations

Commonwealth of Massachusetts
City/Town of

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

A. Facility Information

CONCORD COUNTRY CLUB
Owner Name

246 OLD ROAD TO NINE ACRE CORNER
Street Address

11E, 3079
Map/Lot #

CONCORD
City

MA
State

01742
Zip Code

B. Site Information

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

2. Soil Survey Available? ☒ Yes ☐ No If yes: WEB SOIL SURVEY (Source) 255 C (Soil Map Unit)

WINDSOR LOAMY SAND
Soil Name

Soil Limitations

SANDY GLACIOFLUVIAL DEPOSITS
Soil Parent material

Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: OLIVER (Year Published/Source) SAND & GRAVEL, FINE GRAINED DEPOSIT (Map Unit)

Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: Wetland Type

7. Current Water Resource Conditions (USGS): 1/29/2020 (Month/Day/ 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: TP-20-1 (Hole #) 1/30/2020 (Date) 8:45AM (Time) 30° clear (Weather) _____ (Latitude) _____ (Longitude:)

1. Land Use: GOLF COURSE (e.g., woodland, agricultural field, vacant lot, etc.) — NONE, SITE HAS BEEN CLEARED (Vegetation) — NONE (Surface Stones (e.g., cobbles, stones, boulders, etc.)) — 0-10 (Slope (%))

Description of Location: SW CORNER OF PROPERTY

2. Soil Parent Material: SG — Landform: _____ — Position on Landscape (SU, SH, BS, FS, TS): BS

3. Distances from: Open Water Body ≥100 feet; Drainage Way >50 feet; Wetlands ≥100 feet; Property Line ≥10 feet; Drinking Water Well _____ feet; Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
16"	B_w	FINE SAND	10YR 5/6	—	—	—	—	—	SG	L	
102"	C	FINE SAND	10YR 5/3	46	high/low	2	—	—	SG	L	

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: TP-20-2 (Hole #) 1/30/2020 (Date) 9:00 (Time) _____ (Weather) _____ (Latitude) _____ Longitude:

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

Description of Location: _____

2. Soil Parent Material: _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (In)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
16	Bw	SAND	10YR 5/6	—	—	—	—	—	SG	L	
52	C1	SAND	10YR 6/4	—	—	—	—	—	SG	L	
108	C2	FINE SAND	10YR 5/3	58	HIGH/low	2	—	—	SG	L	

Additional Notes: _____

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)	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date SEE LOGS

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

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

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material SEE LOGS

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 (exclude A and O Horizons)? 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.

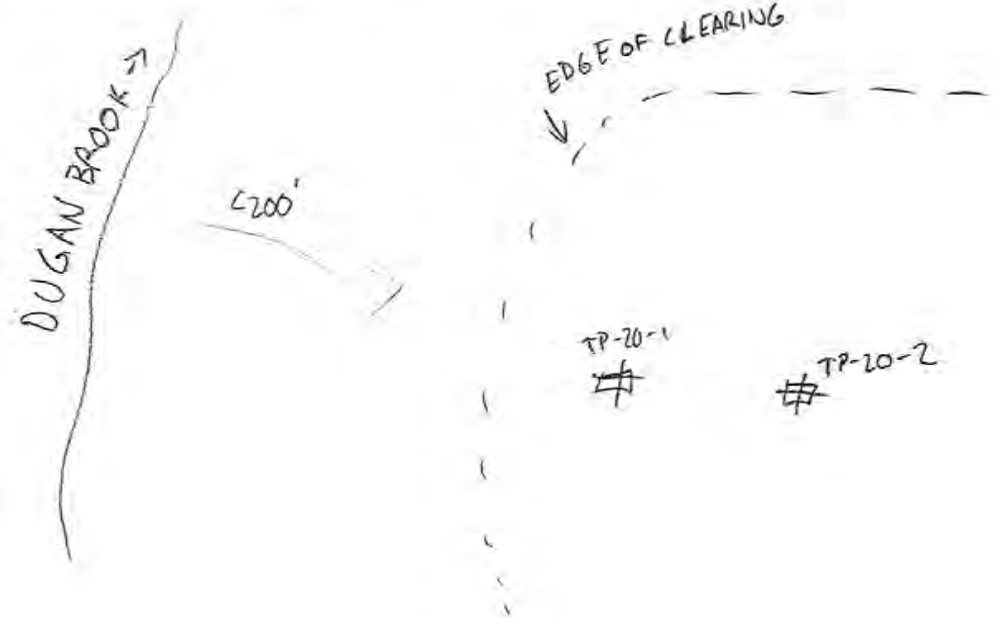
Signature of Soil Evaluator — Date: 1/30/2020

PAUL KIRCHNER, SE 14237 — Typed or Printed Name of Soil Evaluator / License # — Expiration Date of License: 7/1/2021

Name of Approving Authority Witness — Approving Authority

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.

Field Diagrams: Use this area for field diagrams:



Commonwealth of Massachusetts
City/Town of

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

A. Facility Information

Concord Country Club
Owner Name

Street Address

Map/Lot #

Concord
City

MA
State

01742
Zip Code

B. Site Information

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

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 255C (Soil Map Unit)

Windsor Loamy Sand
Soil Name

N/A
Soil Limitations

Loose sandy glaciofluvial deposits
Soil Parent material

Landform

3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: — (Year Published/Source) — (Map Unit)

—
Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer:

Wetland Type

7. Current Water Resource Conditions (USGS): 3/5/2020 (Month/Day/ 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: 320-1 (Hole #) 3/5/20 (Date) _____ (Time) _____ (Weather) _____ (Latitude) _____ Longitude:

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

   Description of Location: _____

2. Soil Parent Material: Outwash _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
   Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: — Depth Weeping from Pit — Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0–22+	C	fine sand	2.5Y 5/4	196"	10YR 4/6	3%	—	—	M	F	

Additional Notes: Top & Sub already stripped

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: 320-2 (Hole #) 3/5/20 (Date) _____ (Time) _____ (Weather) _____ (Latitude) _____ Longitude:

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

   Description of Location: _____

2. Soil Parent Material: Outwash _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
   Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: — Depth Weeping from Pit — Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-312	C	fine sand	2.5Y 5/4	—	—	—	—	—	M	F	

Additional Notes: Top & subsoil already stripped

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: 320-3 (Hole #) 3/5/20 (Date) _____ (Time) _____ (Weather) _____ (Latitude) _____ Longitude:

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

Description of Location: _____

2. Soil Parent Material: Outwash _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: — Depth Weeping from Pit — Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-20	B_w	LS	10YR 4/6	—	—	—	—	—	M	F	
20-72	C_1	fine sand	2.5Y 5/4	—	—	—	—	—	M	F	
72-192	C_2	fine-medium sand	2.5Y 5/4	—	—	—	—	—			

Additional Notes: Topsoil already stripped

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: 320-4 (Hole #) 3/5/20 (Date) _____ (Time) _____ (Weather) _____ (Latitude) _____ (Longitude:)

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

Description of Location: _____

2. Soil Parent Material: Outwash _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: ~ Depth Weeping from Pit ~ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-48	C_1	med. sand	2.5 Y 5/4	-	-	-	-	-	SG	Loose	
48-180	C_2	fine-med. sand	2.5 Y 5/4	-	-	-	-	-	M	F	
180-312	C_3	med. sand	2.5 Y 5/4	-	-	-	-	-	SG	Loose	

Additional Notes:
Top & subsoil already stripped

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: 320-5 (Hole #) 3/5/20 (Date) _____ (Time) _____ (Weather) _____ (Latitude) _____ (Longitude)

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

   Description of Location: _____

2. Soil Parent Material: Outwash _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
   Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: — Depth Weeping from Pit — Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	Bw	SL	10YR 4/6	—	—	—	—	—	M	F	
12-296	C	Med. Sand	2.5Y 5/4	—	—	—	—	—	SG	Loose	

Additional Notes:
Topsoil already stripped

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: 320-6 (Hole #) 3/5/20 (Date) _____ (Time) _____ (Weather) _____ (Latitude) _____ (Longitude:)

1. Land Use _____ (e.g., woodland, agricultural field, vacant lot, etc.) _____ Vegetation _____ Surface Stones (e.g., cobbles, stones, boulders, etc.) _____ Slope (%)

Description of Location: _____

2. Soil Parent Material: Outwash _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: — Depth Weeping from Pit — Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-60	C_1	Med. Sand	2.5Y 5/4	—	—	—	—	—	SG	Loose	
60-228	C_2	Fine Sand	2.5Y 5/4						m	F	

Additional Notes:
Top & subsoil already stripped

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.

Daniel Carr
Signature of Soil Evaluator

3/5/2026
Date

Daniel Carr / SE 13201
Typed or Printed Name of Soil Evaluator / License #

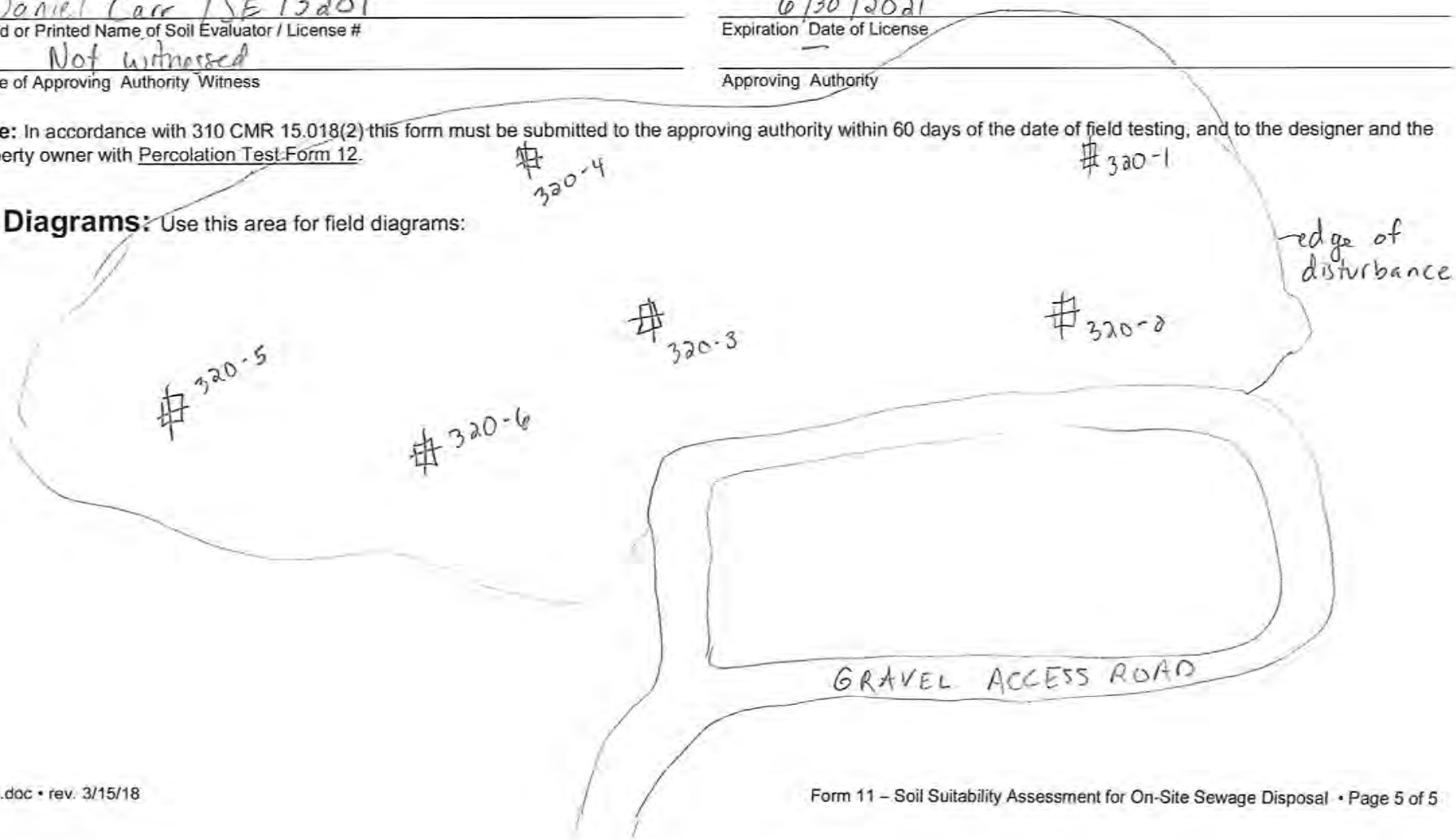
6/30/2021
Expiration Date of License

Not witnessed
Name of Approving Authority Witness

Approving Authority

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.

Field Diagrams: Use this area for field diagrams:



Drainage Maps

Stormwater Operation and Maintenance Manual

Stamski And McNary, Inc.
Engineering - Planning – Surveying
1000 Main Street; Acton, MA 01720 (978) 263-8585
www.stamskiandmcnary.com

Stormwater Operation and Maintenance Manual

For

Concord Country Club

Irrigation Pond
246 Old Road to Nine Acre Corner
Concord, MA 01742

March 18, 2020

Responsible Party:

Applicant:	Concord Country Club 246 Old Road to Nine Acre Corner Concord, MA 01742

Table of Contents

Schedule for Inspection and Maintenance:

Infiltration Basin:
Preventative maintenance should be performed at least twice a year, and ideally sediment should be removed from the sediment forebay after every major storm event. Sediment shall be disposed of in accordance with applicable local, state, and federal guidelines and regulations.

Once online, the basin shall be inspected after every major storm event (1" in 24 hours), for the first 3 months. Thereafter, the basin should be inspected at least twice per year. Important items to check for include: differential settlement, cracking, erosion, leakage, or tree growth on the embankments, condition of riprap, sediment accumulation and the health of the turf.
At least twice a year, the buffer area and side slopes of the basin should be mowed. Grass clippings and accumulated organic matter should be removed to prevent the formation of an impervious organic mat. Trash and debris should also be removed at this time. Scarify bottom area and add additional sand if necessary.

Sediment should be removed from the basin as necessary. Removal procedures should not take place until the floor of the basin is thoroughly dry. Pretreatment devises associated with basins should be inspected and cleaned at least twice a year and ideally every other month.

Overflow Trench:
The 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 washed before being replaced over the perforated pipe.

Emergency Contacts:
In the event of a hazardous materials spill on the site the following parties shall be contacted:
Fire Department: ph: 978-318-3488

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

Responsible Party:
The Country Club shall be responsible for the inspection and maintenance of the infiltration basin.

Budget: The estimated annual operation and maintenance budget is $500.

Illicit Discharges: THERE WILL BE NO ILLICIT DISCHARGES ON SITE.

Name: _____

Signature: _____

Date: _____

Concord Country Club Irrigation Pond

Operation and Maintenance Inspection Log

Year: _____

Inspection Items:	**Frequency:**
Infiltration Basin	**Monthly**

Infiltration Basin 1:

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

_____

Erosion in Basin: _____
Outlet Structure: _____
Comments:

Action Required: