STORMWATER MANAGEMENT REPORT
05/17/19

HANOVER CROSSING
1775 WASHINGTON STREET
HANOVER, MA

HANOVER
CROSSING

PREPARED FOR:

PREP PROPERTY GROUP
5905 E.GALBRAITH ROAD, SUITE 1000
CINCINNATI, OH 45236

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Date: 2019.05.28 12:56:36 -04'00'

PREPARED BY:

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TABLE OF CONTENTS

INTRODUCTION

The purpose of this report is to analyze the pre-development and post-development drainage conditions for the proposed project and to demonstrate that the project will have no negative impacts on the surrounding properties and resource areas. An extensive Stormwater management system has been designed for the site. This system will fully comply with the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards. The design incorporates many best management practices recommended by the Massachusetts Stormwater Management Handbook

EXISTING SITE

The property is The Hanover Mall ("Mall") located at 1,775 Washington St. (Route 53) in Hanover, MA. The Mall consisting of approximately 833,000 s.f. of commercial retail space and approximately 3,509 parking spaces. A portion of the property lies within the Town of Norwell. The total property consists of approximately 106.4 acres. The property is bounded by Washington Street to the west, Route 3 to the north, South St. to the east, and Mill St. to the south. Third Herring Brook ("Brook") traverses across the property dividing the property between Hanover and Norwell. A number of resource areas are located on the property including isolated and bordering vegetated wetlands, bordering land subject to flooding, and riverfront. The site is mostly developed with the exception of areas adjacent to wetlands areas and areas adjacent to and east of the Brook.

Currently runoff from the site is collected through a series of catch basins and routed through the drainage pipe network before discharging through #8 pipes to the wetlands system adjacent to the Brook.

Runoff from the parking lot of Dick's Sporting Goods (DSG) is collected and treated by 2 bioretention swales. This parking lot, DSG's roof drainage, Macy's Furniture and its parking lot are routed through the stormwater management basin located to the east of Hanover Mall Dr.

Runoff from retail building of Office Max and Sleepy's are also collected through a series of catch basins before discharging to the wetlands system located to the southwest adjacent to the intersection of Washington and Mill St. This wetlands system does not have an outlet.

The wetlands system located to the south of DSG drains through a 12 inch rcp culvert pipe beneath Hanover Mall Dr. to a small wetlands system before draining to the larger wetlands system adjacent to the Brook. Runoff from the woodlands and wetlands located to the east of the Brook drains to the Brook. See Existing Drainage Exhibits #1 & #2 in Attachment A.

PROPOSED SITE

The proposed project entails the removal of the majority of the existing enclosed Mall and the construction of a new outdoor mixed use lifestyle center consisting of approximately 506,000 sf of retail, an approximately 92,500 sf grocery store and a 297 unit apartment complex with total parking of approximately 3,700+/- spaces.

A stormwater management system has been designed to comply with MassDEP Stormwater Management Standards. The Stormwater management system will incorporate many best management practices (BMPs), and an operations and maintenance program designed to treat, recharge, and reduce peak stormwater runoff rates generated from the proposed development.

See Proposed Conditions Drainage Exhibits #1 & #2 in Attachment B.

MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION STORMWATER MANAGEMENT STANDARDS

The following is a discussion of the MassDEP Stormwater Management Standards.

STANDARD 1: NO NEW UNTREATED DISCHARGES

The proposed project has been designed for no new untreated discharges from the site.

STANDARD 2: PEAK RATE ATTENUATION

Existing and developed sites were modeled using Hydraflow Hydrographs Extension for Autodesk Civil 3D 2019. This computer software uses the TR55/TR20 tabular method of computing peak flows, hydrograph addition, and pond routing. The curve numbers were determined using soil survey maps. See soil survey map in Attachment D. A conservative estimate of time of concentration of 6 minutes was used for the hydrographs within the development areas.

As can be seen from the runoff summary chart, the peak flows from the design storms on the site will be reduced as a result of this project. Peak flow mitigation will be provided within the multiple subsurface recharge systems and the infiltration basin.

The entire TR55 analysis is included in Attachment A (existing conditions) and B (proposed conditions) of this report.

STANDARD 3: RECHARGE

The development area is located within urban land according to the NRCS soil map. Urban land does not have an associated hydrologic soil group. The adjacent

soils to the south are hydrologic group B soils. Recharge volume has been calculated based on group B soils. Based on MassDEP guidelines for recharge, the required recharge volume for hydrologic group B soils is 0.35".

The dedicated recharge volume has been provided in the infiltration basin and subsurface recharge systems and far exceeds the volume required. See Required Dedicated Recharge Volume Calculation in Attachment C for recharge calculations.

STANDARD 4: STORMWATER QUALITY

Stormwater runoff from the site will be enhanced by means of a number of BMPs, which have been designed to comply with the MassDEP Stormwater Management Standards. See BMP Location Map in Attachment C. The following BMPs will be incorporated:

- Pavement sweeping and maintenance program
- Deep sump catch basins with water quality elbows
- Oil grit separators
- Proprietary separators
- Subsurface infiltration chamber systems
- Infiltration basin
- Exfiltrating bioretention areas

The Total Suspended Solids (TSS) removal is expected to be greater than 80%. See TSS Removal Calculation Worksheets in Attachment C.

STANDARD 5: Land Uses with Higher Potential Pollutant Loads (LUHPPL's)

The proposed project is considered a land use with higher potential pollutant loads for high-intensity use parking lots. Treatment has been provided for 1 inch of water quality volume in the equivalent flow rate from the proprietary separators. BMPs have been chosen from the list of approved BMPs for use on LUPHPLs.

The proposed use is not an industrial use and is not subject to the US EPA's NPDES Multi-Sector General Permit.

STANDARD 6: CRITICAL AREAS

Third Herring Brook has recently been designated as a Coldwater Fishery Resource associated with an unnamed tributary (SARIS 9456540). Coldwater Fisheries are an outstanding resource waters (ORW). BMPs chosen are within the list of approved BMPs for Coldwater Fisheries. Roofs of proposed buildings will be painted white to reduce temperature of stormwater runoff.

The southern portion of the property is located within the Town of Hanover's Aquifer Protection District. The entire property is not located within the Zone II Groundwater Protection Area, surface water protection area, or an area of critical environmental concern.

STANDARD 7: REDEVELOPMENT

The proposed project is a redevelopment project and has been designed to comply with the DEP Stormwater Management Standards to the maximum extent practicable.

STANDARD 8: CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION CONTROL

A construction period pollution prevention plan is included in the Demolition Plans provided within the Site Development Plans for Hanover Crossing Commercial by Kelly Engineering Group, Inc. The project is subject to a NPDES General Construction Permit and a Stormwater Pollution Prevention Plan (SWPPP) will be prepared and submitted to the EPA once a site contractor is established.

STANDARD 9: OPERATIONS AND MAINTENANCE PLAN

The Stormwater Management System Operation and Maintenance Plan and Long Term Pollution Prevention Plan, Operations and Maintenance Log, and BMP Location Map are provided in Attachment C.

STANDARD 10: ILLICIT DISCHARGES

An Illicit Discharge Statement is attached and can be found in the Table of Contents. The Long Term Pollution Prevention Plan address illicit discharges and can be found in Attachment C.

HYDROLOGY AND HYDRAULICS:

To minimize the disturbance to the resource areas and its buffers, the existing pipe outlets will be maintained. The on-site drainage systems have been designed to reduce the flows into the majority of the existing pipes.

CONCLUSION

An extensive stormwater management system has been designed for the project. The stormwater management system has been designed to comply with MassDEP Stormwater Management Standards and will incorporate a number of BMPs that will ensure that the runoff will be treated prior and peak runoff rates will be reduced prior to leaving the site.

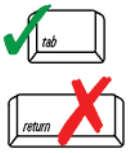
The construction of the stormwater management system will ensure that stormwater runoff from this site will be greatly improved and that there will be no adverse impacts on surrounding properties or resource areas.

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.

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[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.

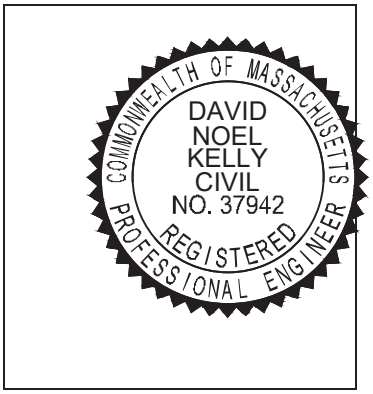
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



Digitally signed by David Noel Kelly P.E.
DN: cn=David Noel Kelly P.E., o=Kelly Engineering GRoup, Inc., ou, email=dkelly@kellyemgoineeringgroup.com, c=US
Date: 2019.05.28 12:57:05 -04'00'

Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic 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.

ILLICIT DISCHARGE STATEMENT

This statement has been prepared to comply with Stormwater Management Standard #10 as referenced in the Massachusetts Stormwater Handbook, Volume One, Chapter One, Page 25. This handbook has been issued by the Massachusetts Department of Environmental Protection for compliance with revised Regulations for Wetlands 310 CMR 10.00.

As detailed in the Site Development Plans accompanying this application this project will not involve any illicit discharge to the stormwater management system. Furthermore, to the best of my knowledge there are no illicit discharges to the stormwater management system of the existing site.

Owner and Responsible Party for Operating and Managing the site:

Prep Hanover Real Estate LLC
1790 Bonanza Dr.
Suite 201
Park City, UT 84060
c/o
Hanover Crossing
1775 Washington Street
Hanover, MA 02339
781-826-7386

Brandon Li For Ed Callahan 5/17/19

Ed Callahan – General Manager Date

RUNOFF SUMMARY

Peak Runoff Chart

Storm	Existing	Proposed	Difference
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.36	201.85	195.1	-6.75
10,5.08	339.07	335.12	-3.95
25,6.15	426	423.58	-2.42
50,6.97	493.19	489.17	-4.02
100,7.80	562.06	555.78	-6.28

Runoff Volume Chart

Storm	Existing	Proposed	Difference
(yr, inches)	(cf)	(cf)	(cf)
2,3.36	777,762	757,660	-20,102
10,5.08	1,345,506	1,329,167	-16,339
25,6.15	1,712,629	1,698,010	-14,619
50,6.97	1,998,429	1,984,815	-13,614
100,7.80	2,290,621	2,277,782	-12,839

Note:

1. Peak runoff rates do not account for exfiltration rates of the subsurface infiltration systems within the Hanover Crossing Commercial development.

2. Proposed Runoff Volume does not include 30,000+/- cu.ft. of dedicated recharge volume in roof infiltration systems and exfiltrating bioretention areas.

KELLY ENGINEERING GROUP, INC.
Zero Campanelli Drive-Braintree-MA 02184 Phone 781 843 4333

Attachment A
Existing Conditions

LEGEND

- DRAINAGE AREA WATERSHED
- TIME OF CONCENTRATION
- CONTOUR MAJOR
- CONTOUR MINOR

PIPE 1
PIPE 2
PIPE 5
PIPE 6

AREA 11
AREA 12
AREA 13
AREA 14
AREA 15 BASIN
AREA 16
AREA 17 TO BASIN
AREA 18

AREA PIPE 1
AREA PIPE 2
AREA PIPE 3
AREA PIPE 4
AREA PIPE 5
AREA PIPE 6
AREA PIPE 7
AREA PIPE 8

335' SHALLOW CONCENTRATED FLOW
125' SHALLOW CONCENTRATED FLOW
50' SHEET FLOW
625' SHALLOW CONCENTRATED FLOW
790' SHALLOW CONCENTRATED FLOW
24' SHALLOW CONCENTRATED FLOW
40' SHALLOW CONCENTRATED FLOW
TIME OF CONCENTRATION (TYP.)

HANOVER MALL DRIVE
WASHINGTON STREET
MILL STREET (PUBLIC WAY)
ROOF DRAIN
ROOF DRAINS
SD

HANOVER CROSSING
1775 WASHINGTON ST.
HANOVER, MA

SCALE: 1"= 200'

DATE: 05/17/19

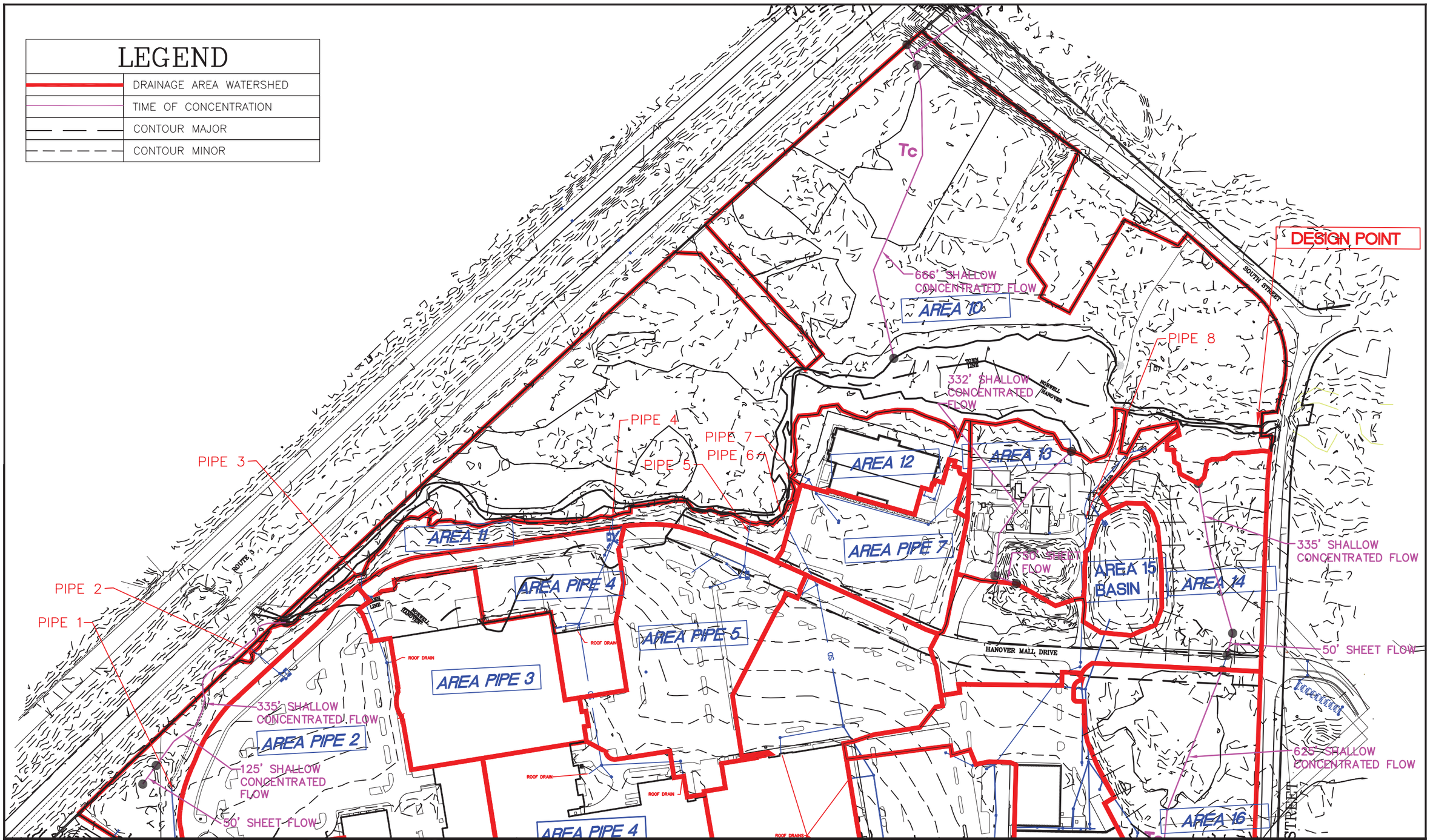
2016-075-EXDR00

EXISTING DRAINAGE EXHIBIT #1

KELLY ENGINEERING GROUP, INC.
CIVIL ENGINEERING CONSULTANTS
0 CAMPANELLI DRIVE · BRAINTREE MA · 02184
PHONE: 781 843 4333 FAX: 781 843 0028

LEGEND

———	DRAINAGE AREA WATERSHED
———	TIME OF CONCENTRATION
— — —	CONTOUR MAJOR
- - - - -	CONTOUR MINOR



HANOVER CROSSING
1775 WASHINGTON ST.
HANOVER, MA

SCALE: 1"= 200'

DATE: 05/17/19

2016-075-EXDR00

EXISTING DRAINAGE EXHIBIT #2

KELLY ENGINEERING GROUP, INC.
CIVIL ENGINEERING CONSULTANTS
0 CAMPANELLI DRIVE · BRAINTREE MA · 02184
PHONE: 781 843 4333 FAX: 781 843 0028

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area Pipe 1**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	118762	7244482
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	501042	4.9E+07
Roof		98	165478	1.6E+07
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	785282.00	7.3E+07
		Acres =	18.0275941	

CN or C (weighted) = total product/total area = **92.4**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area Pipe 2**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	22386	1365546
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	198785	1.9E+07
Roof		98	66337	6501026
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	287508.00	2.7E+07
		Acres =	6.60027548	

CN or C (weighted) = total product/total area = **95.1**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area Pipe 3**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	385	23485
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	107282	1.1E+07
Roof		98	28201	2763698
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	135868.00	1.3E+07
		Acres =	3.11910009	

CN or C (weighted) = total product/total area = **97.9**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area Pipe 4**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	13072	797392
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	77243	7569814
Roof		98	115873	1.1E+07
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	206188.00	2E+07
		Acres =	4.73342516	

CN or C (weighted) = total product/total area = **95.7**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area Pipe 5**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	19692	1201212
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	144704	1.4E+07
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	164396.00	1.5E+07
		Acres =	3.77401286	

CN or C (weighted) = total product/total area = **93.6**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area Pipe 6**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	22140	1350540
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	271960	2.7E+07
Roof		98	221688	2.2E+07
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	515788.00	5E+07
		Acres =	11.8408632	

CN or C (weighted) = total product/total area = **96.4**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area Pipe 7**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	21101	1287161
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	67640	6628720
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	88741.00	7915881
		Acres =	2.03721304	

CN or C (weighted) = total product/total area = **89.2**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area Pipe 8**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	24687	1505907
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	169454	1.7E+07
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	194141.00	1.8E+07
		Acres =	4.4568641	

CN or C (weighted) = total product/total area = **93.3**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area Pipe 9**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	21371	1303631
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	95535	9362430
Roof		98	44326	4343948
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	161232.00	1.5E+07
		Acres =	3.70137741	

CN or C (weighted) = total product/total area = **93.1**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area 10**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	0	0
Woods	Hydrologic Group D; Good Condition	77	512933	3.9E+07
Impervious		98	0	0
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	447180	3.4E+07
		Totals =	960113.00	7.4E+07
		Acres =	22.0411616	

CN or C (weighted) = total product/total area = **77.0**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area 11**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	0	0
Woods	Hydrologic Group D; Good Condition	77	115019	8856463
Impervious		98	0	0
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	115019.00	8856463
		Acres =	2.64047291	

CN or C (weighted) = total product/total area = **77.0**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area 12**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	16218	989298
Woods	Hydrologic Group D; Good Condition	77	17238	1327326
Impervious		98	2284	223832
Roof		98	29952	2935296
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	65692.00	5475752
		Acres =	1.50808081	

CN or C (weighted) = total product/total area = **83.4**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area 13**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	41386	2524546
Woods	Hydrologic Group D; Good Condition	77	30965	2384305
Impervious		98	1000	98000
Roof		98	3141	307818
Wetlands	Hydrologic Group D; Good Condition	77	0	0
Gravel	Hydrologic Group B	85	28540	2425900
		Totals =	105032.00	7740569
		Acres =	2.41120294	

CN or C (weighted) = total product/total area = **73.7**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area 14**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group A; Good Condition	39	17695	690105
Grass	Hydrologic Group B; Good Condition	61	55484	3384524
Woods	Hydrologic Group B; Good Condition	55	73760	4056800
Impervious		98	26930	2639140
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	1782	137214
Gravel	Hydrologic Group B	85	17209	1462765
		Totals =	192860.00	1.2E+07
		Acres =	4.42745638	

CN or C (weighted) = total product/total area = **64.1**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area 15**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	41590	2536990
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	0	0
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	41590.00	2536990
		Acres =	0.95477502	

CN or C (weighted) = total product/total area = **61.0**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area 16**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	27305	1665605
Woods	Hydrologic Group B; Good Condition	77	111544	8588888
Impervious		98	7493	734314
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	53153	4092781
		Totals =	199495.00	1.5E+07
		Acres =	4.57977502	

CN or C (weighted) = total product/total area = **75.6**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area 17**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	17298	1055178
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	161483	1.6E+07
Roof		98	63519	6224862
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	242300.00	2.3E+07
		Acres =	5.56244261	

CN or C (weighted) = total product/total area = **95.4**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Existing Conditions - Area 18**

Circle One: **Pre** or Post

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	0	0
Woods	Hydrologic Group D; Good Condition	77	50897	3919069
Impervious		98	0	0
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	122469	9430113
		Totals =	173366.00	1.3E+07
		Acres =	3.97993572	

CN or C (weighted) = total product/total area = **77.0**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Hydraflow Table of Contents

Existing.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 05 / 13 / 2019

Hydraflow Table of Contents

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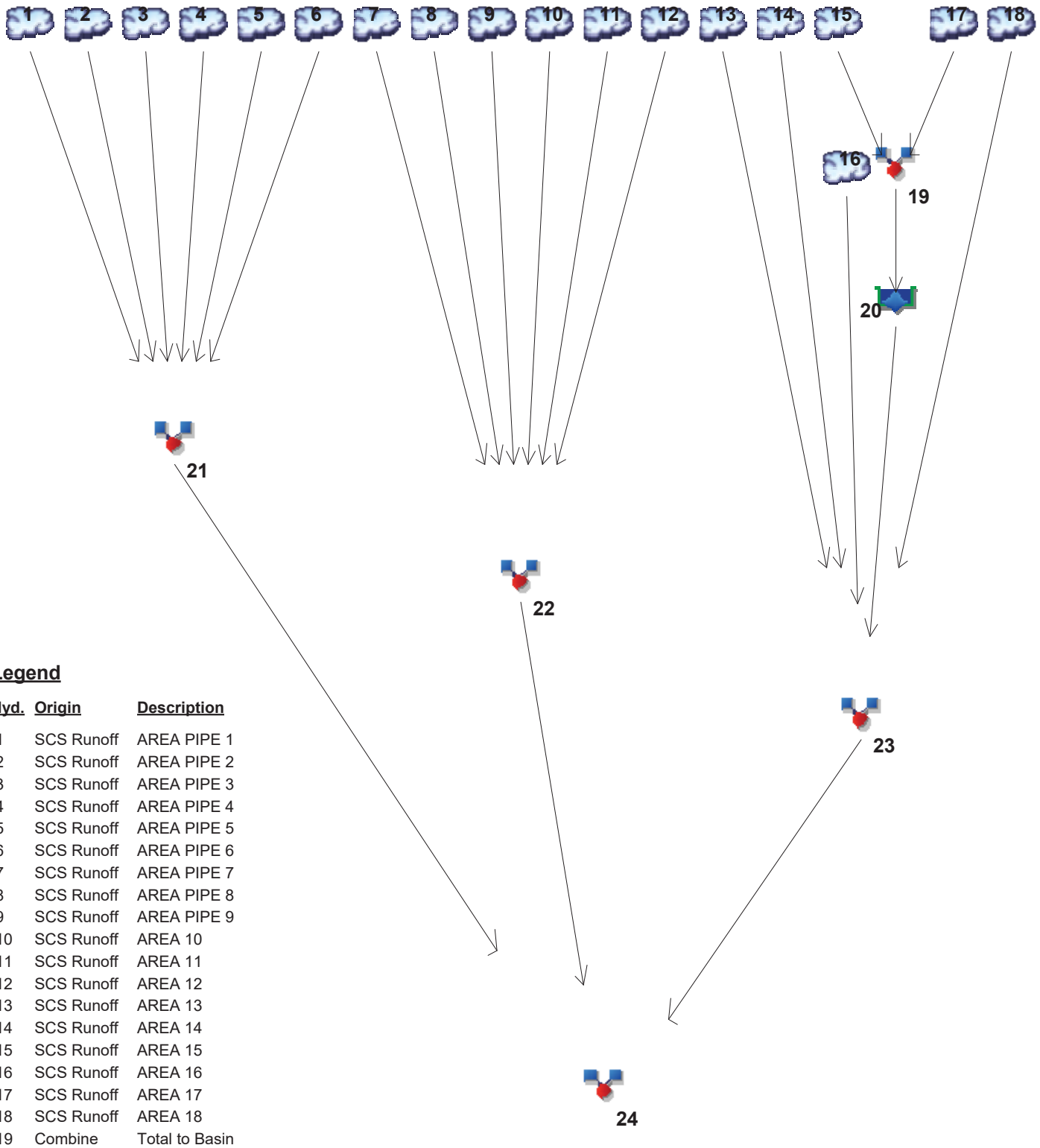
Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Legend

Hyd.	Origin	Description
1	SCS Runoff	AREA PIPE 1
2	SCS Runoff	AREA PIPE 2
3	SCS Runoff	AREA PIPE 3
4	SCS Runoff	AREA PIPE 4
5	SCS Runoff	AREA PIPE 5
6	SCS Runoff	AREA PIPE 6
7	SCS Runoff	AREA PIPE 7
8	SCS Runoff	AREA PIPE 8
9	SCS Runoff	AREA PIPE 9
10	SCS Runoff	AREA 10
11	SCS Runoff	AREA 11
12	SCS Runoff	AREA 12
13	SCS Runoff	AREA 13
14	SCS Runoff	AREA 14
15	SCS Runoff	AREA 15
16	SCS Runoff	AREA 16
17	SCS Runoff	AREA 17
18	SCS Runoff	AREA 18
19	Combine	Total to Basin
20	Reservoir	Route thru Basin
21	Combine	Total 1 - 6
22	Combine	Total 7 - 12
23	Combine	Total 13 - 18
24	Combine	Total Site Runoff

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	50.41	-------	-------	81.18	100.11	114.53	129.08	AREA PIPE 1
2	SCS Runoff	------	-------	19.77	-------	-------	30.84	37.66	42.87	48.13	AREA PIPE 2
3	SCS Runoff	------	-------	9.810	-------	-------	14.94	18.12	20.55	23.02	AREA PIPE 3
4	SCS Runoff	------	-------	14.35	-------	-------	22.25	27.12	30.84	34.61	AREA PIPE 4
5	SCS Runoff	------	-------	10.89	-------	-------	17.28	21.21	24.21	27.24	AREA PIPE 5
6	SCS Runoff	------	-------	36.40	-------	-------	56.07	68.22	77.51	86.90	AREA PIPE 6
7	SCS Runoff	------	-------	5.154	-------	-------	8.669	10.84	12.50	14.17	AREA PIPE 7
8	SCS Runoff	------	-------	12.78	-------	-------	20.36	25.02	28.57	32.15	AREA PIPE 8
9	SCS Runoff	------	-------	10.55	-------	-------	16.84	20.71	23.66	26.63	AREA PIPE 9
10	SCS Runoff	------	-------	23.53	-------	-------	48.71	65.32	78.37	91.75	AREA 10
11	SCS Runoff	------	-------	2.978	-------	-------	6.165	8.288	9.945	11.64	AREA 11
12	SCS Runoff	------	-------	3.046	-------	-------	5.602	7.220	8.462	9.717	AREA 12
13	SCS Runoff	------	-------	2.954	-------	-------	6.569	9.006	10.92	12.89	AREA 13
14	SCS Runoff	------	-------	2.189	-------	-------	6.716	10.02	12.71	15.56	AREA 14
15	SCS Runoff	------	-------	0.379	-------	-------	1.403	2.186	2.832	3.518	AREA 15
16	SCS Runoff	------	-------	4.784	-------	-------	10.18	13.82	16.67	19.59	AREA 16
17	SCS Runoff	------	-------	16.76	-------	-------	26.07	31.81	36.19	40.62	AREA 17
18	SCS Runoff	------	-------	4.023	-------	-------	8.358	11.22	13.45	15.74	AREA 18
19	Combine	15, 17,	-------	17.12	-------	-------	27.47	33.99	39.02	44.13	Total to Basin
20	Reservoir	19	-------	2.943	-------	-------	4.980	7.522	9.782	12.34	Route thru Basin
21	Combine	1, 2, 3, 4, 5, 6,	-------	141.63	-------	-------	222.55	272.45	310.53	348.97	Total 1 - 6
22	Combine	7, 8, 9, 10, 11, 12,	-------	48.35	-------	-------	89.18	115.78	136.43	157.47	Total 7 - 12
23	Combine	13, 14, 16, 18, 20,	-------	14.95	-------	-------	32.30	44.83	55.53	66.93	Total 13 - 18
24	Combine	21, 22, 23	-------	201.85	-------	-------	339.07	426.00	493.19	562.06	Total Site Runoff

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	50.41	2	724	155,934	------	------	------	AREA PIPE 1
2	SCS Runoff	19.77	2	724	63,161	------	------	------	AREA PIPE 2
3	SCS Runoff	9.810	2	724	33,081	------	------	------	AREA PIPE 3
4	SCS Runoff	14.35	2	724	46,280	------	------	------	AREA PIPE 4
5	SCS Runoff	10.89	2	724	34,116	------	------	------	AREA PIPE 5
6	SCS Runoff	36.40	2	724	118,864	------	------	------	AREA PIPE 6
7	SCS Runoff	5.154	2	724	15,591	------	------	------	AREA PIPE 7
8	SCS Runoff	12.78	2	724	39,908	------	------	------	AREA PIPE 8
9	SCS Runoff	10.55	2	724	32,859	------	------	------	AREA PIPE 9
10	SCS Runoff	23.53	2	734	106,198	------	------	------	AREA 10
11	SCS Runoff	2.978	2	732	12,403	------	------	------	AREA 11
12	SCS Runoff	3.046	2	724	9,103	------	------	------	AREA 12
13	SCS Runoff	2.954	2	724	9,242	------	------	------	AREA 13
14	SCS Runoff	2.189	2	732	10,611	------	------	------	AREA 14
15	SCS Runoff	0.379	2	726	1,652	------	------	------	AREA 15
16	SCS Runoff	4.784	2	732	20,101	------	------	------	AREA 16
17	SCS Runoff	16.76	2	724	53,802	------	------	------	AREA 17
18	SCS Runoff	4.023	2	736	19,520	------	------	------	AREA 18
19	Combine	17.12	2	724	55,454	15, 17,	------	------	Total to Basin
20	Reservoir	2.943	2	750	50,793	19	86.25	28,519	Route thru Basin
21	Combine	141.63	2	724	451,435	1, 2, 3, 4, 5, 6,	------	------	Total 1 - 6
22	Combine	48.35	2	724	216,061	7, 8, 9, 10, 11, 12,	------	------	Total 7 - 12
23	Combine	14.95	2	732	110,266	13, 14, 16, 18, 20,	------	------	Total 13 - 18
24	Combine	201.85	2	724	777,762	21, 22, 23	------	------	Total Site Runoff

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	81.18	2	724	258,373	------	------	------	AREA PIPE 1
2	SCS Runoff	30.84	2	724	101,298	------	------	------	AREA PIPE 2
3	SCS Runoff	14.94	2	724	51,298	------	------	------	AREA PIPE 3
4	SCS Runoff	22.25	2	724	73,690	------	------	------	AREA PIPE 4
5	SCS Runoff	17.28	2	724	55,714	------	------	------	AREA PIPE 5
6	SCS Runoff	56.07	2	724	187,676	------	------	------	AREA PIPE 6
7	SCS Runoff	8.669	2	724	26,863	------	------	------	AREA PIPE 7
8	SCS Runoff	20.36	2	724	65,409	------	------	------	AREA PIPE 8
9	SCS Runoff	16.84	2	724	53,986	------	------	------	AREA PIPE 9
10	SCS Runoff	48.71	2	734	215,219	------	------	------	AREA 10
11	SCS Runoff	6.165	2	730	25,135	------	------	------	AREA 11
12	SCS Runoff	5.602	2	724	16,882	------	------	------	AREA 12
13	SCS Runoff	6.569	2	724	19,705	------	------	------	AREA 13
14	SCS Runoff	6.716	2	730	27,199	------	------	------	AREA 14
15	SCS Runoff	1.403	2	724	4,582	------	------	------	AREA 15
16	SCS Runoff	10.18	2	730	41,603	------	------	------	AREA 16
17	SCS Runoff	26.07	2	724	85,977	------	------	------	AREA 17
18	SCS Runoff	8.358	2	736	39,558	------	------	------	AREA 18
19	Combine	27.47	2	724	90,560	15, 17,	------	------	Total to Basin
20	Reservoir	4.980	2	750	85,898	19	86.98	43,833	Route thru Basin
21	Combine	222.55	2	724	728,050	1, 2, 3, 4, 5, 6,	------	------	Total 1 - 6
22	Combine	89.18	2	726	403,493	7, 8, 9, 10, 11, 12,	------	------	Total 7 - 12
23	Combine	32.30	2	730	213,964	13, 14, 16, 18, 20,	------	------	Total 13 - 18
24	Combine	339.07	2	724	1,345,506	21, 22, 23	------	------	Total Site Runoff

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	100.11	2	724	322,890	------	------	------	AREA PIPE 1
2	SCS Runoff	37.66	2	724	125,154	------	------	------	AREA PIPE 2
3	SCS Runoff	18.12	2	724	62,643	------	------	------	AREA PIPE 3
4	SCS Runoff	27.12	2	724	90,815	------	------	------	AREA PIPE 4
5	SCS Runoff	21.21	2	724	69,272	------	------	------	AREA PIPE 5
6	SCS Runoff	68.22	2	724	230,617	------	------	------	AREA PIPE 6
7	SCS Runoff	10.84	2	724	34,039	------	------	------	AREA PIPE 7
8	SCS Runoff	25.02	2	724	81,429	------	------	------	AREA PIPE 8
9	SCS Runoff	20.71	2	724	67,265	------	------	------	AREA PIPE 9
10	SCS Runoff	65.32	2	734	288,850	------	------	------	AREA 10
11	SCS Runoff	8.288	2	730	33,734	------	------	------	AREA 11
12	SCS Runoff	7.220	2	724	21,959	------	------	------	AREA 12
13	SCS Runoff	9.006	2	724	26,917	------	------	------	AREA 13
14	SCS Runoff	10.02	2	730	39,467	------	------	------	AREA 14
15	SCS Runoff	2.186	2	724	6,810	------	------	------	AREA 15
16	SCS Runoff	13.82	2	730	56,247	------	------	------	AREA 16
17	SCS Runoff	31.81	2	724	106,091	------	------	------	AREA 17
18	SCS Runoff	11.22	2	736	53,092	------	------	------	AREA 18
19	Combine	33.99	2	724	112,902	15, 17,	------	------	Total to Basin
20	Reservoir	7.522	2	748	108,240	19	87.36	51,803	Route thru Basin
21	Combine	272.45	2	724	901,391	1, 2, 3, 4, 5, 6,	------	------	Total 1 - 6
22	Combine	115.78	2	726	527,276	7, 8, 9, 10, 11, 12,	------	------	Total 7 - 12
23	Combine	44.83	2	730	283,963	13, 14, 16, 18, 20,	------	------	Total 13 - 18
24	Combine	426.00	2	724	1,712,629	21, 22, 23	------	------	Total Site Runoff

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	114.53	2	724	372,548	------	------	------	AREA PIPE 1
2	SCS Runoff	42.87	2	724	143,471	------	------	------	AREA PIPE 2
3	SCS Runoff	20.55	2	724	71,341	------	------	------	AREA PIPE 3
4	SCS Runoff	30.84	2	724	103,959	------	------	------	AREA PIPE 4
5	SCS Runoff	24.21	2	724	79,695	------	------	------	AREA PIPE 5
6	SCS Runoff	77.51	2	724	263,559	------	------	------	AREA PIPE 6
7	SCS Runoff	12.50	2	724	39,584	------	------	------	AREA PIPE 7
8	SCS Runoff	28.57	2	724	93,748	------	------	------	AREA PIPE 8
9	SCS Runoff	23.66	2	724	77,479	------	------	------	AREA PIPE 9
10	SCS Runoff	78.37	2	732	347,131	------	------	------	AREA 10
11	SCS Runoff	9.945	2	730	40,541	------	------	------	AREA 11
12	SCS Runoff	8.462	2	724	25,921	------	------	------	AREA 12
13	SCS Runoff	10.92	2	724	32,674	------	------	------	AREA 13
14	SCS Runoff	12.71	2	730	49,561	------	------	------	AREA 14
15	SCS Runoff	2.832	2	724	8,665	------	------	------	AREA 15
16	SCS Runoff	16.67	2	730	67,879	------	------	------	AREA 16
17	SCS Runoff	36.19	2	724	121,532	------	------	------	AREA 17
18	SCS Runoff	13.45	2	736	63,805	------	------	------	AREA 18
19	Combine	39.02	2	724	130,197	15, 17,	------	------	Total to Basin
20	Reservoir	9.782	2	746	125,536	19	87.62	57,220	Route thru Basin
21	Combine	310.53	2	724	1,034,572	1, 2, 3, 4, 5, 6,	------	------	Total 1 - 6
22	Combine	136.43	2	726	624,404	7, 8, 9, 10, 11, 12,	------	------	Total 7 - 12
23	Combine	55.53	2	730	339,455	13, 14, 16, 18, 20,	------	------	Total 13 - 18
24	Combine	493.19	2	724	1,998,429	21, 22, 23	------	------	Total Site Runoff

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	129.08	2	724	422,941	------	------	------	AREA PIPE 1
2	SCS Runoff	48.13	2	724	162,032	------	------	------	AREA PIPE 2
3	SCS Runoff	23.02	2	724	80,147	------	------	------	AREA PIPE 3
4	SCS Runoff	34.61	2	724	117,274	------	------	------	AREA PIPE 4
5	SCS Runoff	27.24	2	724	90,264	------	------	------	AREA PIPE 5
6	SCS Runoff	86.90	2	724	296,923	------	------	------	AREA PIPE 6
7	SCS Runoff	14.17	2	724	45,225	------	------	------	AREA PIPE 7
8	SCS Runoff	32.15	2	724	106,243	------	------	------	AREA PIPE 8
9	SCS Runoff	26.63	2	724	87,840	------	------	------	AREA PIPE 9
10	SCS Runoff	91.75	2	732	407,323	------	------	------	AREA 10
11	SCS Runoff	11.64	2	730	47,570	------	------	------	AREA 11
12	SCS Runoff	9.717	2	724	29,976	------	------	------	AREA 12
13	SCS Runoff	12.89	2	724	38,653	------	------	------	AREA 13
14	SCS Runoff	15.56	2	728	60,255	------	------	------	AREA 14
15	SCS Runoff	3.518	2	724	10,646	------	------	------	AREA 15
16	SCS Runoff	19.59	2	730	79,920	------	------	------	AREA 16
17	SCS Runoff	40.62	2	724	137,176	------	------	------	AREA 17
18	SCS Runoff	15.74	2	736	74,868	------	------	------	AREA 18
19	Combine	44.13	2	724	147,822	15, 17,	------	------	Total to Basin
20	Reservoir	12.34	2	744	143,161	19	87.86	62,335	Route thru Basin
21	Combine	348.97	2	724	1,169,580	1, 2, 3, 4, 5, 6,	------	------	Total 1 - 6
22	Combine	157.47	2	726	724,176	7, 8, 9, 10, 11, 12,	------	------	Total 7 - 12
23	Combine	66.93	2	730	396,857	13, 14, 16, 18, 20,	------	------	Total 13 - 18
24	Combine	562.06	2	724	2,290,621	21, 22, 23	------	------	Total Site Runoff

Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	17.4950	4.2000	0.6438	--------
3	0.0000	0.0000	0.0000	--------
5	40.8144	10.8000	0.7755	--------
10	45.6810	10.9000	0.7723	--------
25	106.0698	18.5000	0.9101	--------
50	44.6078	10.9000	0.6858	--------
100	47.7883	11.3000	0.6734	--------

File name: Boston IDF curve.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	4.19	3.17	2.61	2.25	1.99	1.80	1.65	1.53	1.42	1.34	1.26	1.20
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	4.80	3.88	3.28	2.86	2.55	2.30	2.10	1.94	1.80	1.69	1.59	1.50
10	5.39	4.37	3.70	3.23	2.88	2.60	2.38	2.20	2.04	1.91	1.80	1.70
25	5.99	5.03	4.34	3.82	3.42	3.10	2.84	2.61	2.43	2.26	2.12	2.00
50	6.69	5.55	4.79	4.24	3.83	3.50	3.23	3.01	2.82	2.66	2.52	2.40
100	7.29	6.09	5.29	4.70	4.25	3.90	3.61	3.37	3.17	2.99	2.84	2.70

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

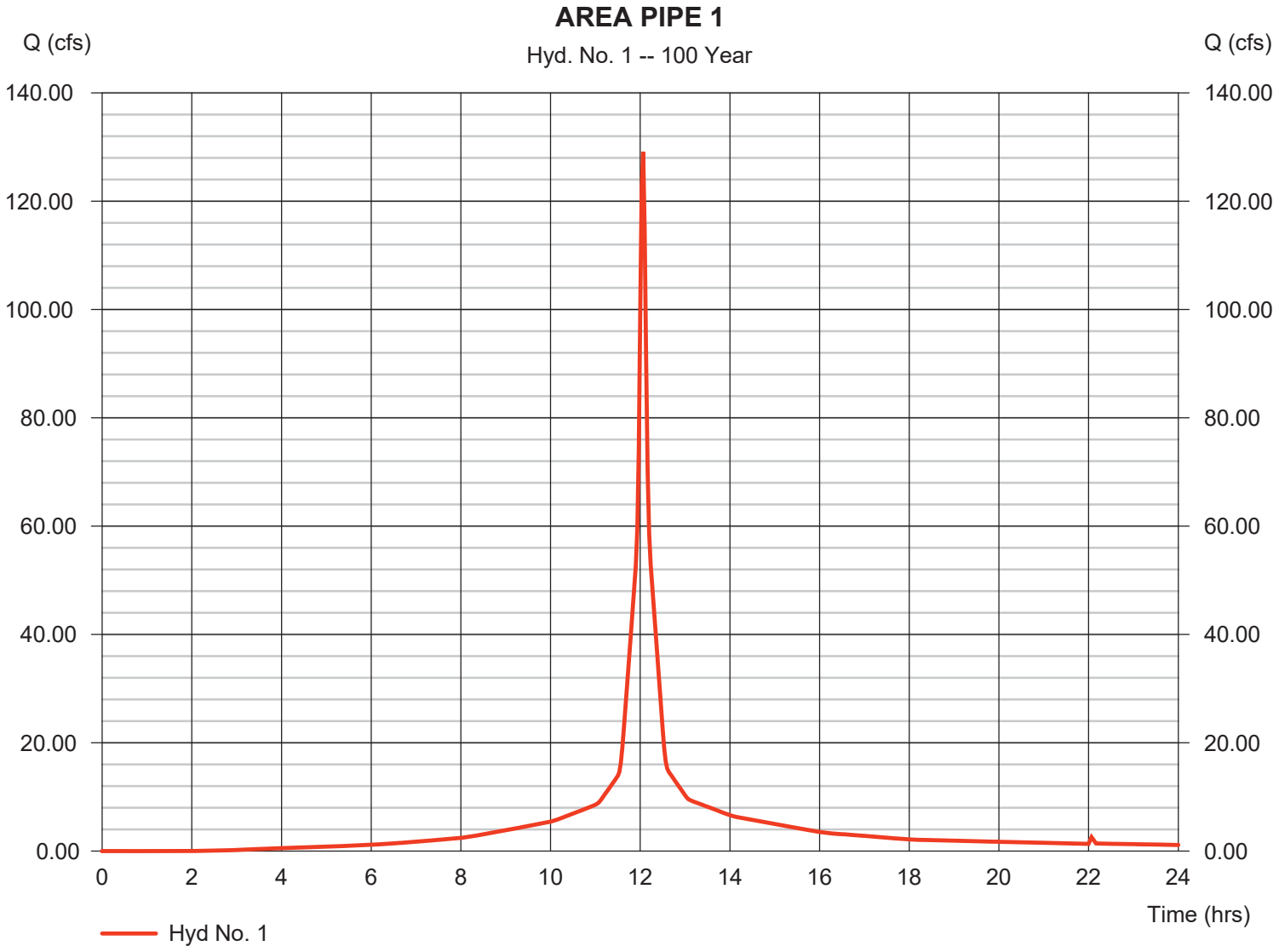
Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	3.36	0.00	0.00	5.08	6.15	6.97	7.80
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hydrograph Report

Hyd. No. 1

AREA PIPE 1

Hydrograph type	= SCS Runoff	Peak discharge	= 129.08 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 422,941 cuft
Drainage area	= 18.030 ac	Curve number	= 92.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

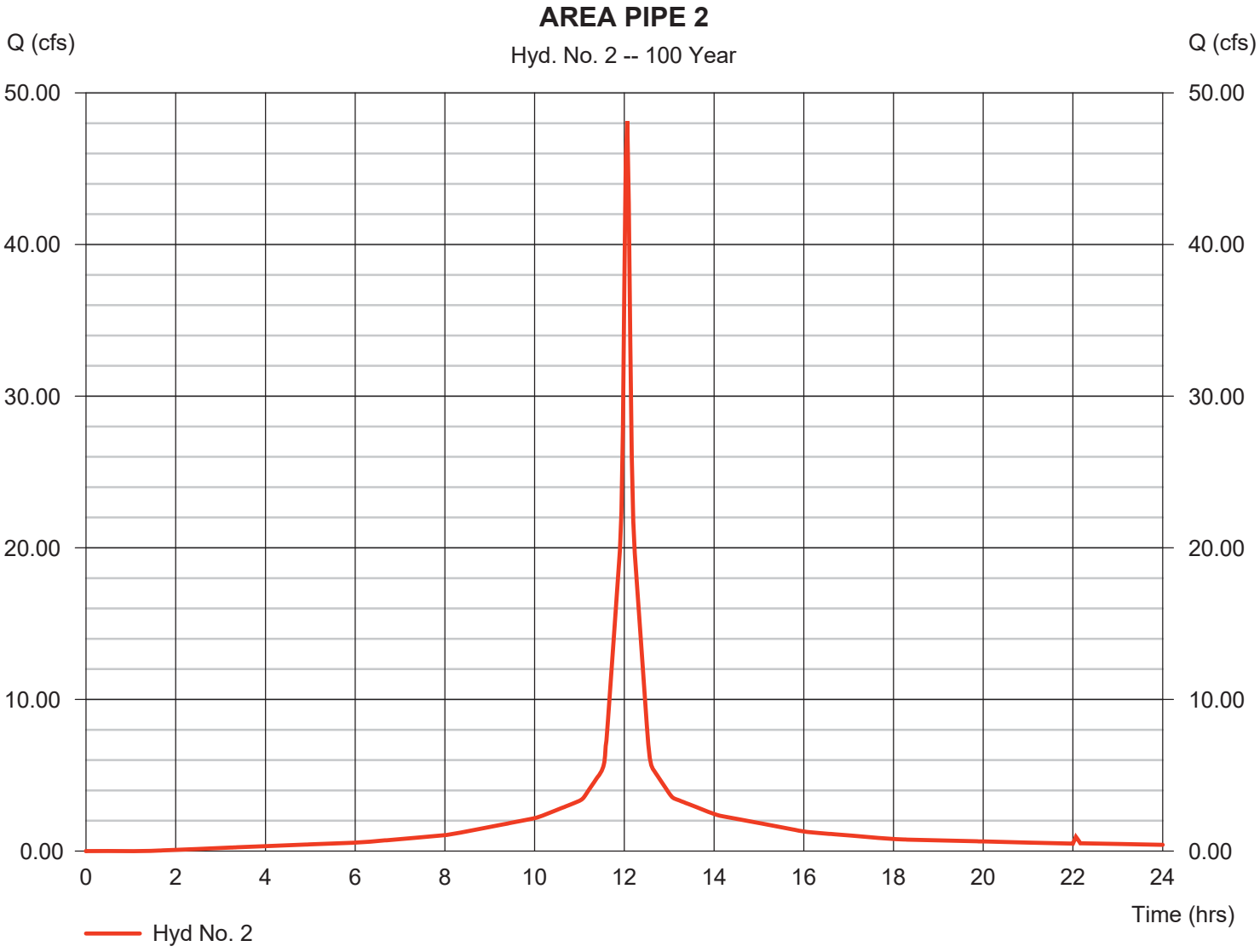


Hydrograph Report

Hyd. No. 2

AREA PIPE 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	48.13 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	162,032 cuft
Drainage area	=	6.600 ac	Curve number	=	95.1
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

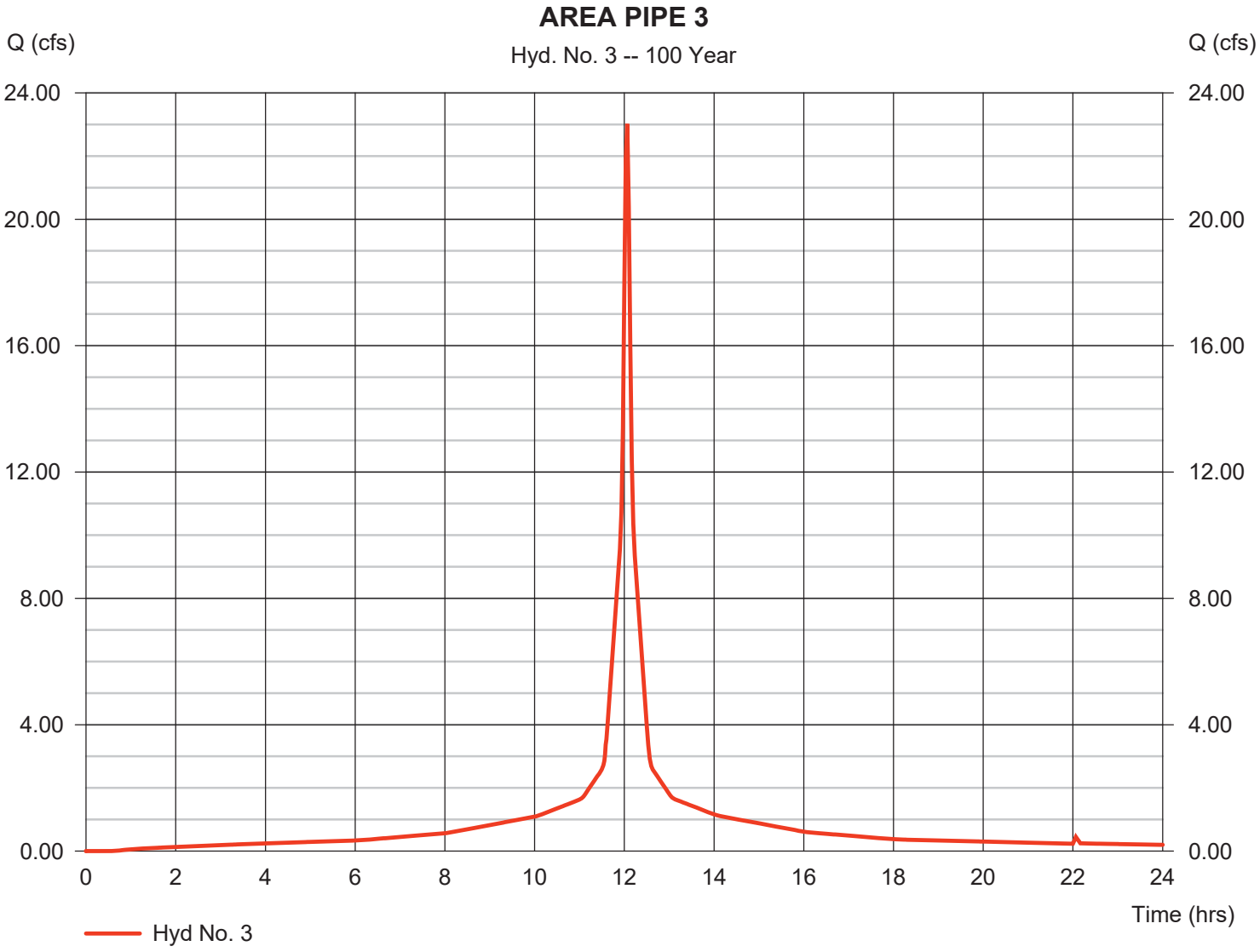


Hydrograph Report

Hyd. No. 3

AREA PIPE 3

Hydrograph type	=	SCS Runoff	Peak discharge	=	23.02 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	80,147 cuft
Drainage area	=	3.120 ac	Curve number	=	97.9
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

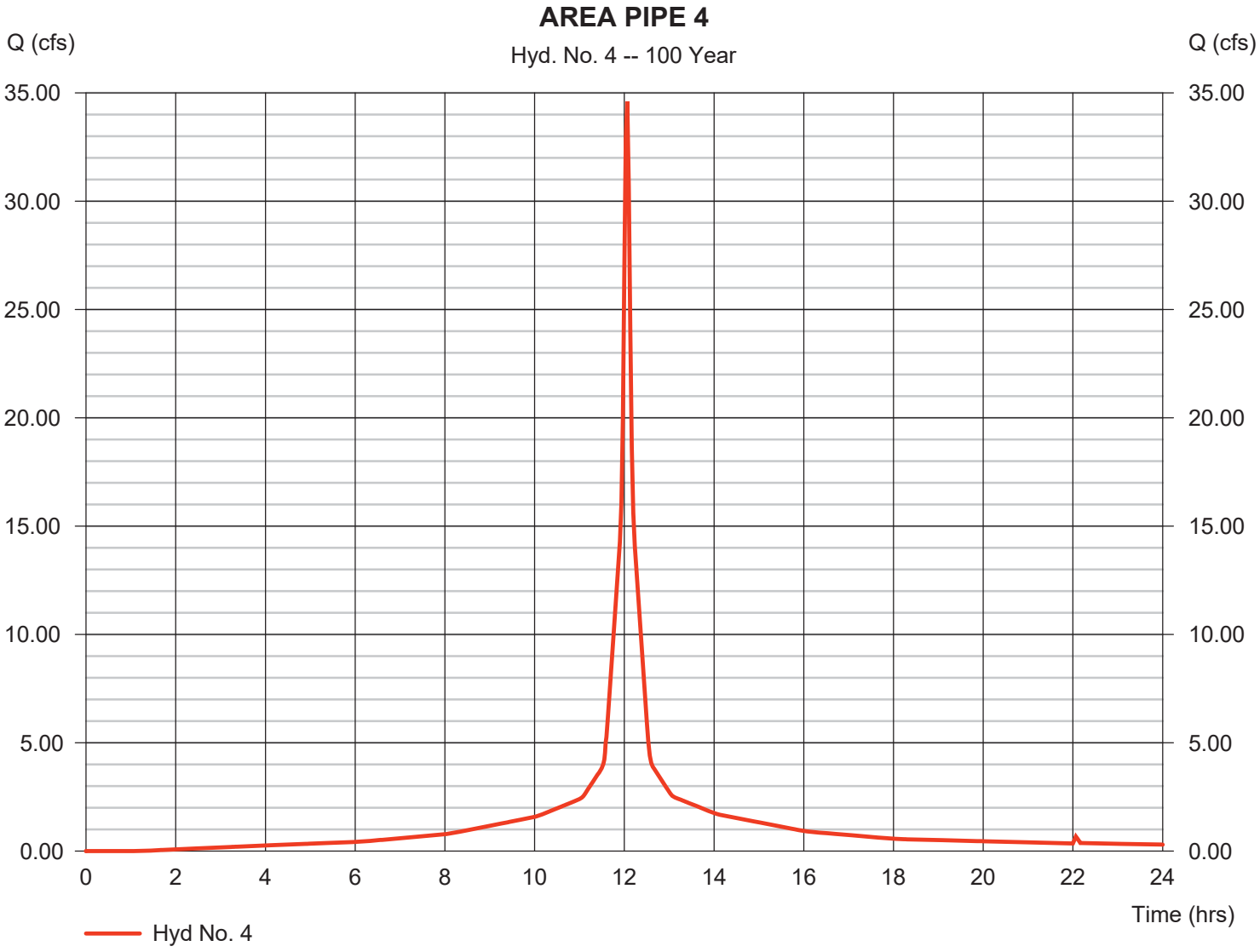


Hydrograph Report

Hyd. No. 4

AREA PIPE 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	34.61 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	117,274 cuft
Drainage area	=	4.730 ac	Curve number	=	95.7
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

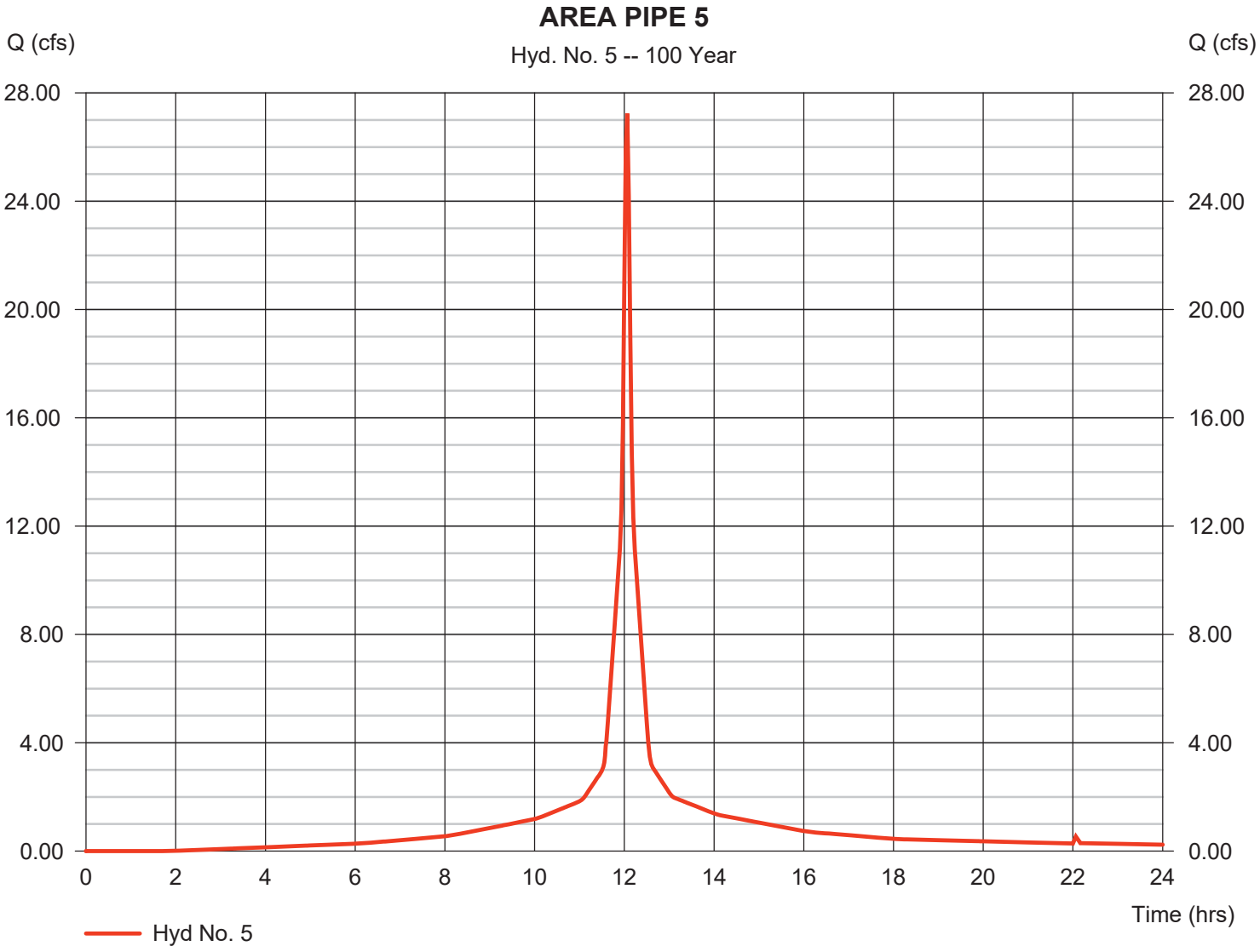


Hydrograph Report

Hyd. No. 5

AREA PIPE 5

Hydrograph type	= SCS Runoff	Peak discharge	= 27.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 90,264 cuft
Drainage area	= 3.770 ac	Curve number	= 93.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

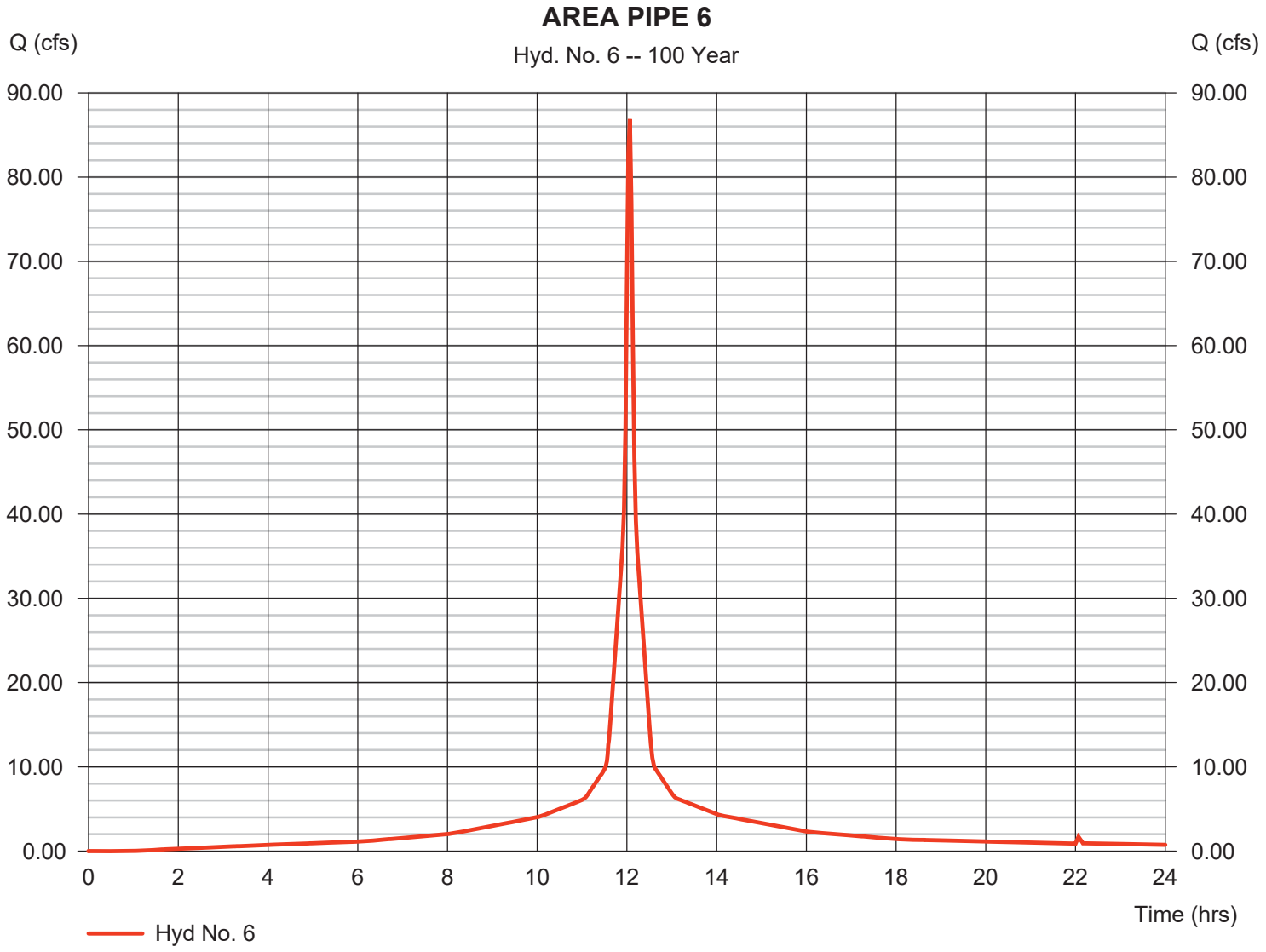


Hydrograph Report

Hyd. No. 6

AREA PIPE 6

Hydrograph type	=	SCS Runoff	Peak discharge	=	86.90 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	296,923 cuft
Drainage area	=	11.840 ac	Curve number	=	96.4
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

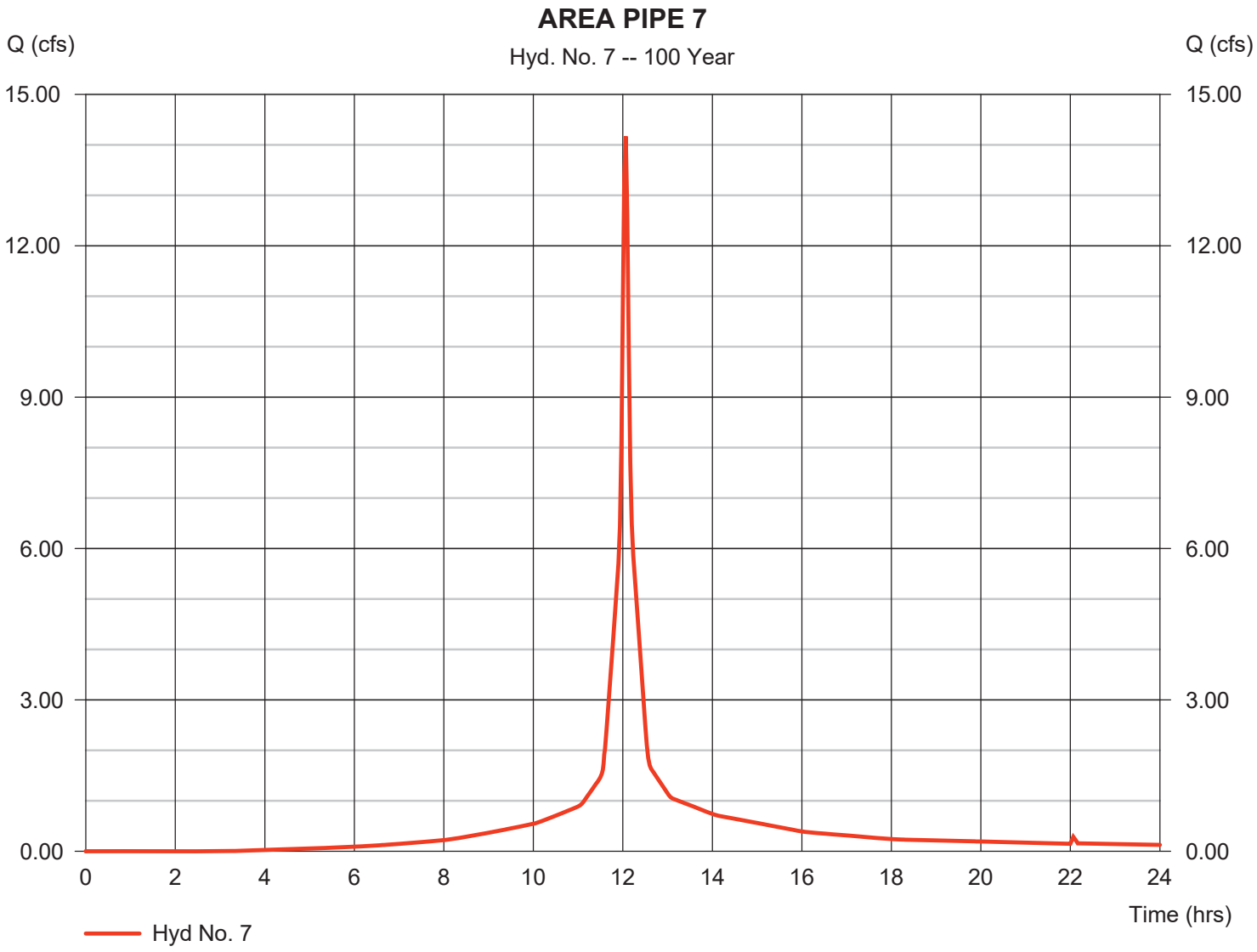


Hydrograph Report

Hyd. No. 7

AREA PIPE 7

Hydrograph type	=	SCS Runoff	Peak discharge	=	14.17 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	45,225 cuft
Drainage area	=	2.040 ac	Curve number	=	89.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

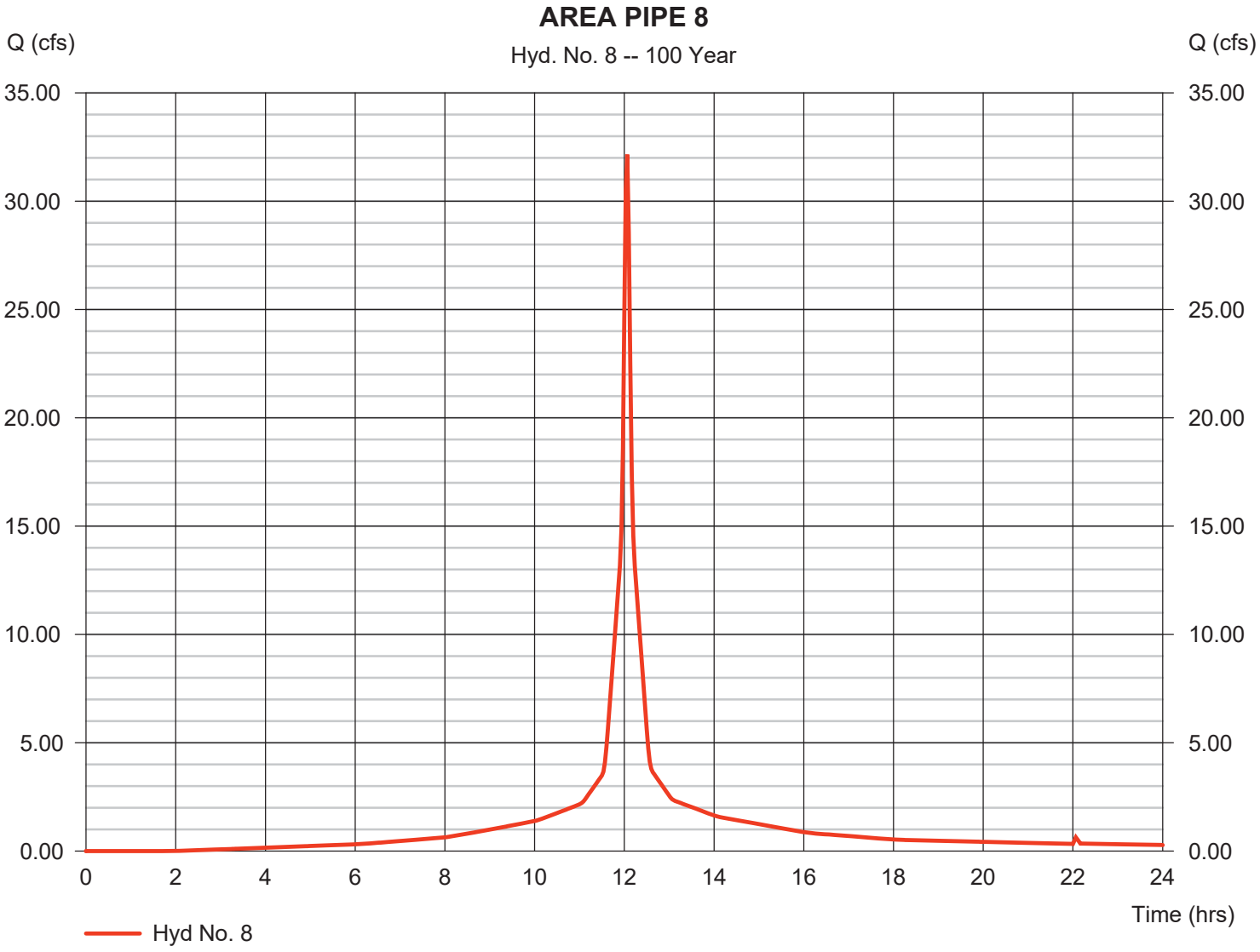


Hydrograph Report

Hyd. No. 8

AREA PIPE 8

Hydrograph type	=	SCS Runoff	Peak discharge	=	32.15 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	106,243 cuft
Drainage area	=	4.460 ac	Curve number	=	93.3
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

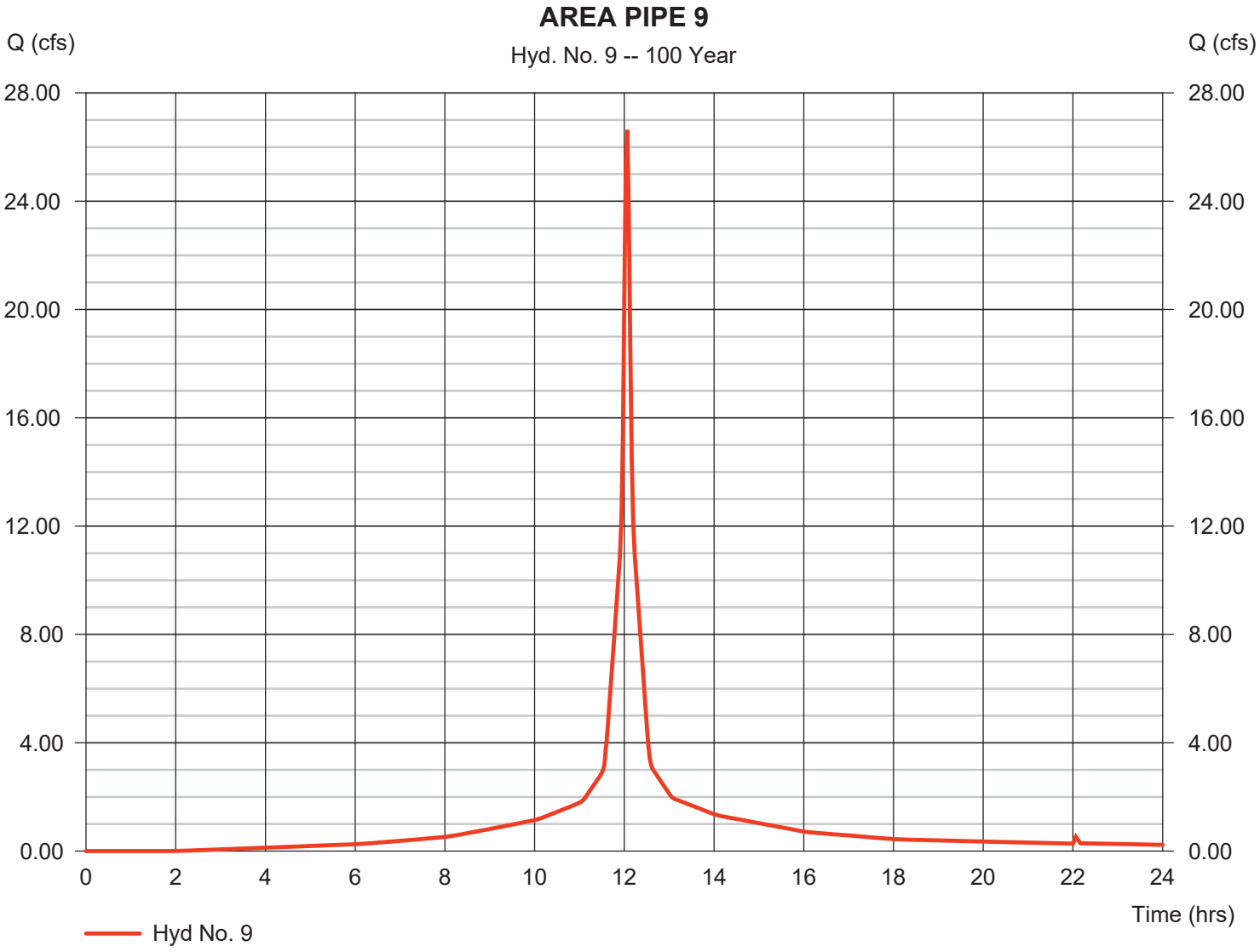


Hydrograph Report

Hyd. No. 9

AREA PIPE 9

Hydrograph type	= SCS Runoff	Peak discharge	= 26.63 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 87,840 cuft
Drainage area	= 3.700 ac	Curve number	= 93.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

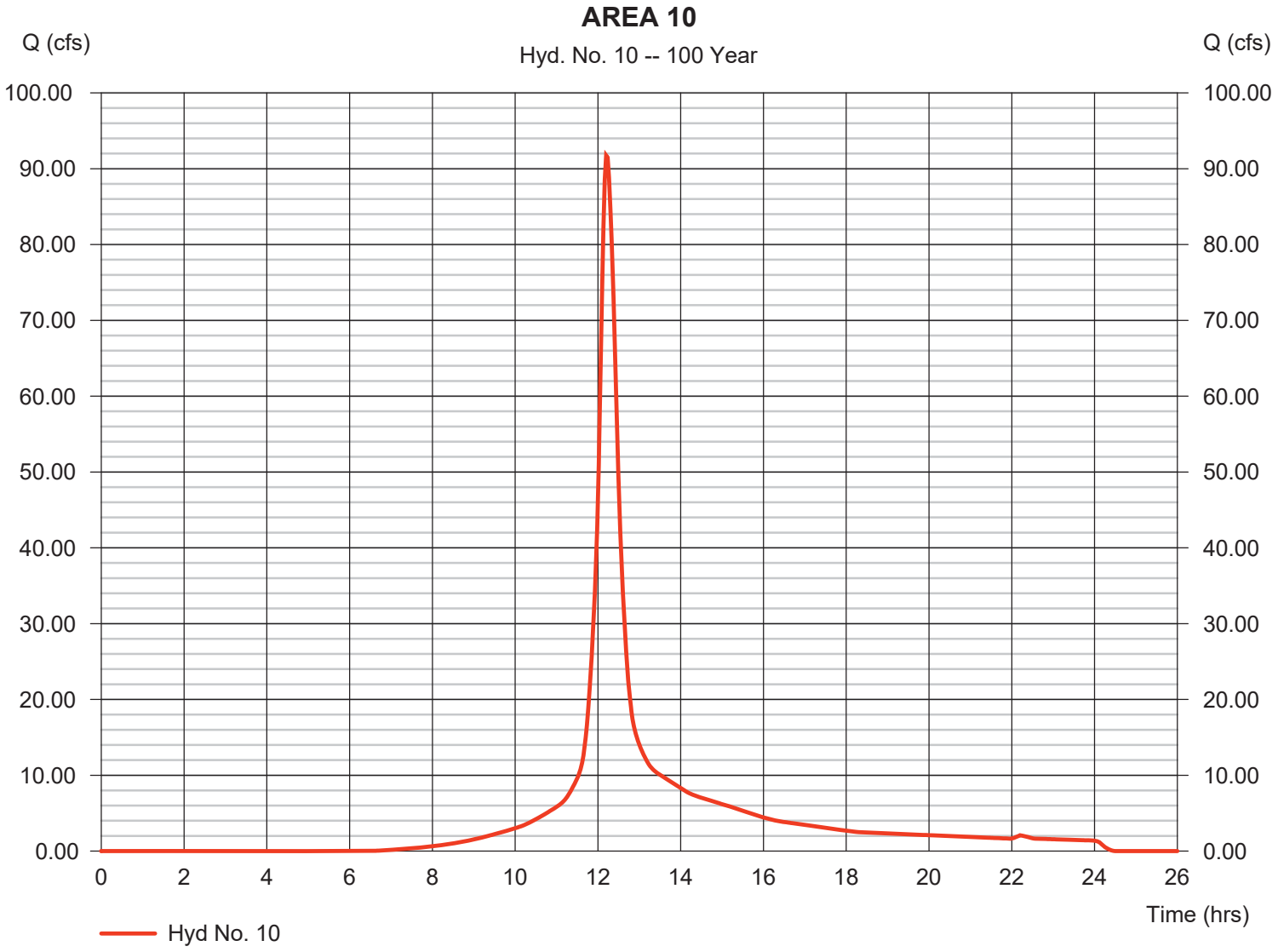


Hydrograph Report

Hyd. No. 10

AREA 10

Hydrograph type	= SCS Runoff	Peak discharge	= 91.75 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.20 hrs
Time interval	= 2 min	Hyd. volume	= 407,323 cuft
Drainage area	= 22.040 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.90 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 10

AREA 10

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.36		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 12.04**	**+**	**0.00**	**+**	**0.00**	**=**	**12.04**
Shallow Concentrated Flow							
Flow length (ft)	= 666.00		0.00		0.00		
Watercourse slope (%)	= 1.40		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.91		0.00		0.00		
Travel Time (min)	**= 5.81**	**+**	**0.00**	**+**	**0.00**	**=**	**5.81**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

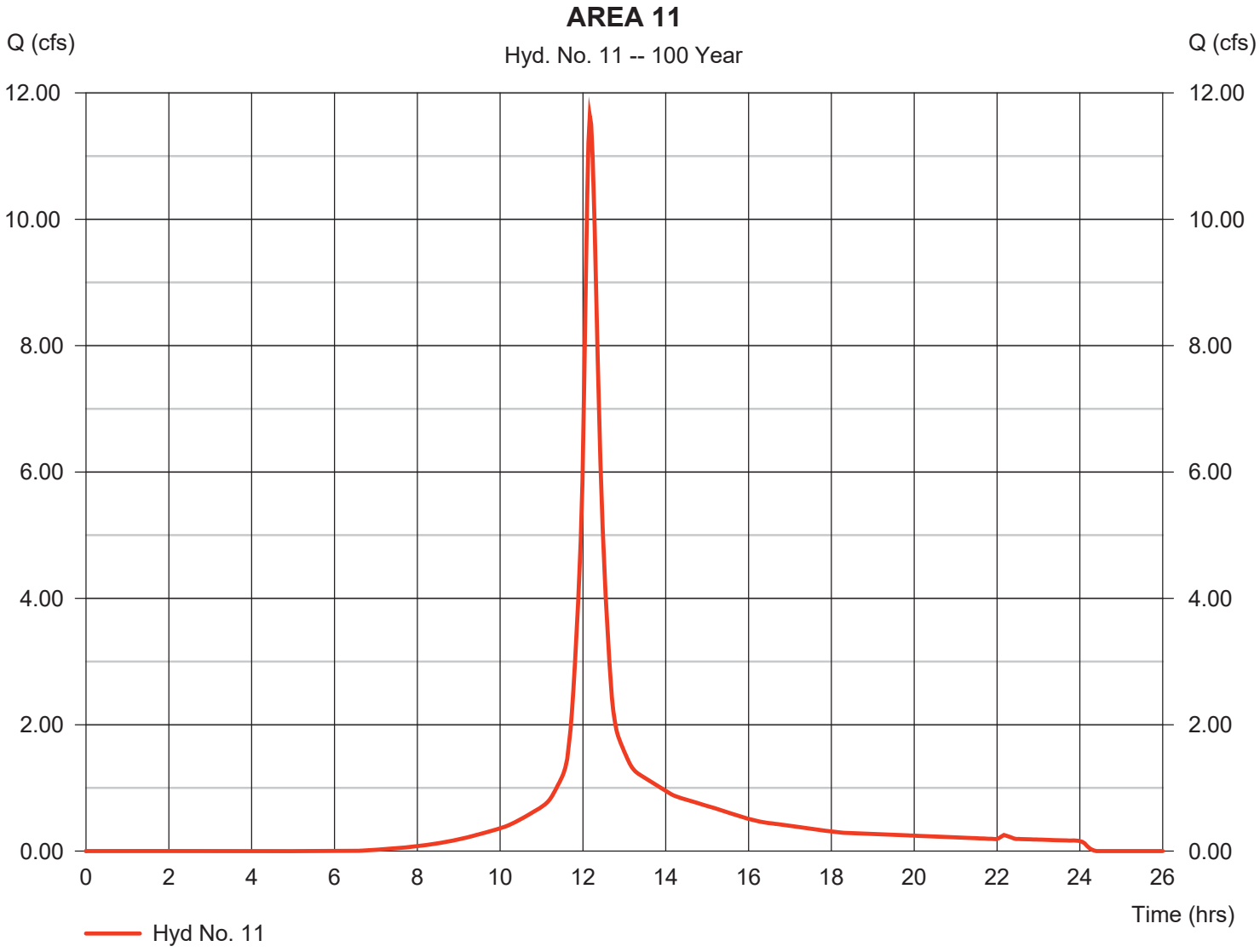
Total Travel Time, Tc ..... 17.90 min

Hydrograph Report

Hyd. No. 11

AREA 11

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.64 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	47,570 cuft
Drainage area	=	2.640 ac	Curve number	=	77
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 11

AREA 11

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.36		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 12.04**	**+**	**0.00**	**+**	**0.00**	**=**	**12.04**
Shallow Concentrated Flow							
Flow length (ft)	= 125.00		335.00		0.00		
Watercourse slope (%)	= 4.00		1.10		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=3.23		1.69		0.00		
Travel Time (min)	**= 0.65**	**+**	**3.30**	**+**	**0.00**	**=**	**3.95**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

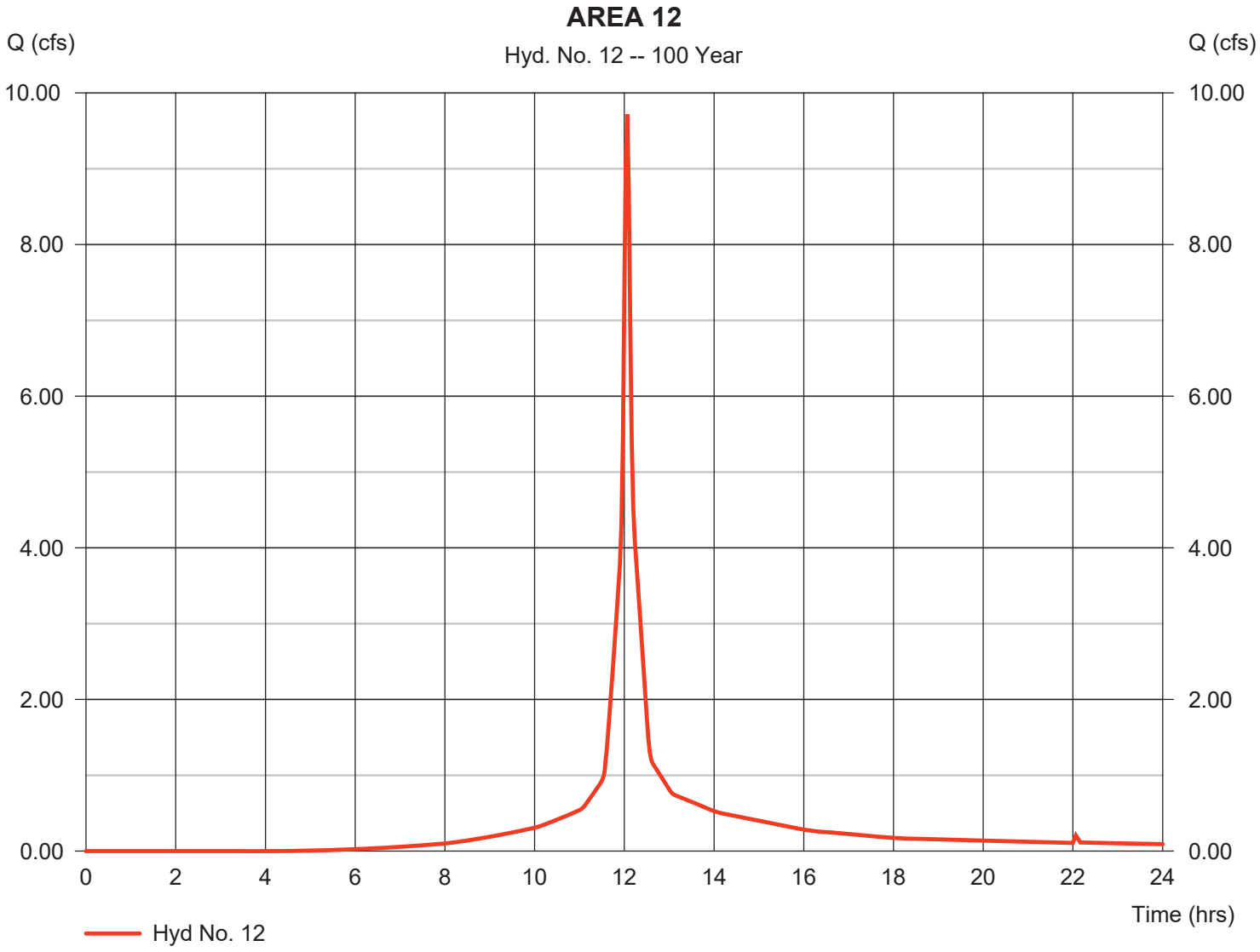
Total Travel Time, Tc ..... 16.00 min

Hydrograph Report

Hyd. No. 12

AREA 12

Hydrograph type	= SCS Runoff	Peak discharge	= 9.717 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 29,976 cuft
Drainage area	= 1.510 ac	Curve number	= 83.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

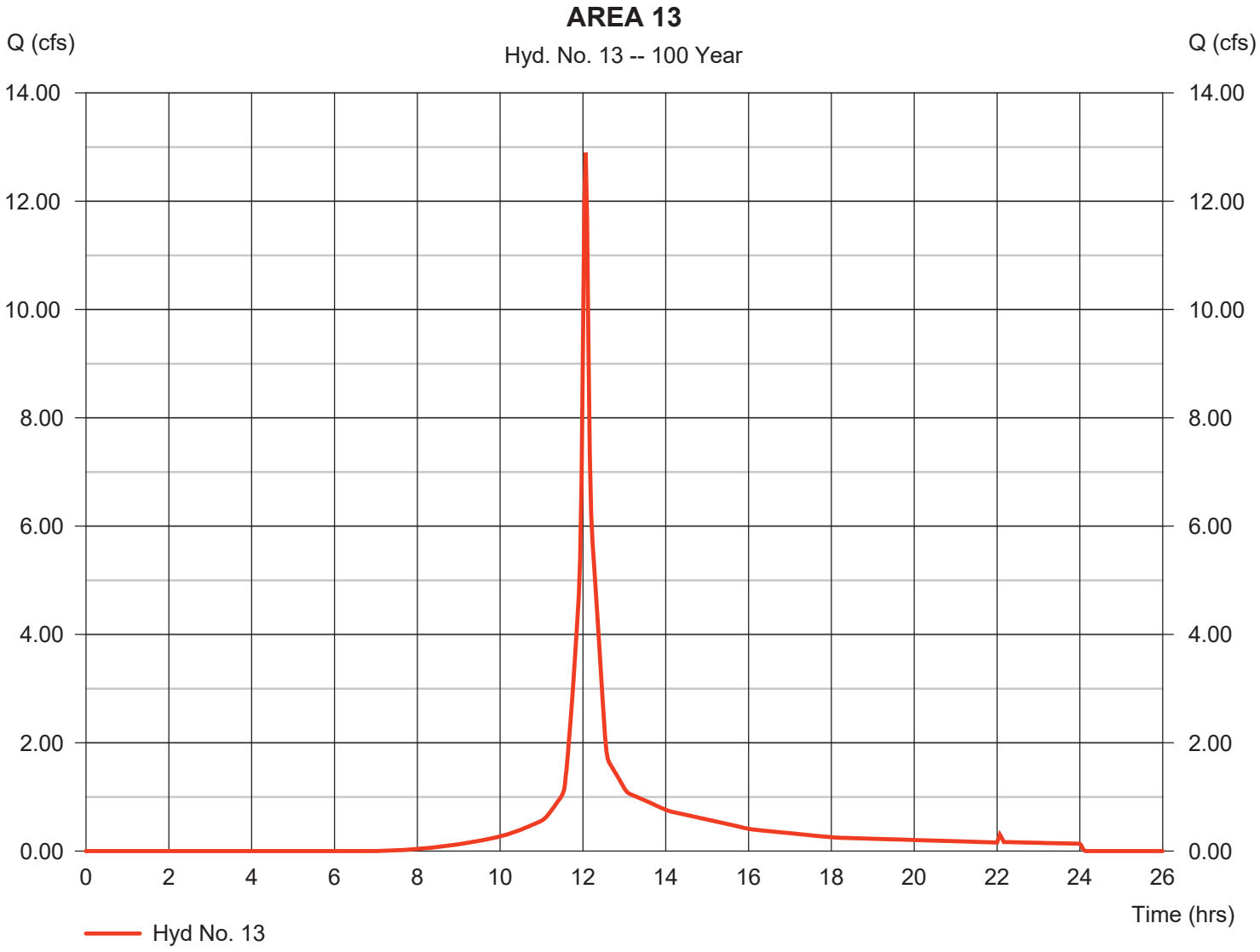


Hydrograph Report

Hyd. No. 13

AREA 13

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.89 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	38,653 cuft
Drainage area	=	2.410 ac	Curve number	=	73.7
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.10 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 13

AREA 13

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.36		0.00		0.00		
Land slope (%)	= 25.00		0.00		0.00		
Travel Time (min)	**= 4.38**	**+**	**0.00**	**+**	**0.00**	**=**	**4.38**
Shallow Concentrated Flow							
Flow length (ft)	= 332.00		0.00		0.00		
Watercourse slope (%)	= 4.20		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.31		0.00		0.00		
Travel Time (min)	**= 1.67**	**+**	**0.00**	**+**	**0.00**	**=**	**1.67**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

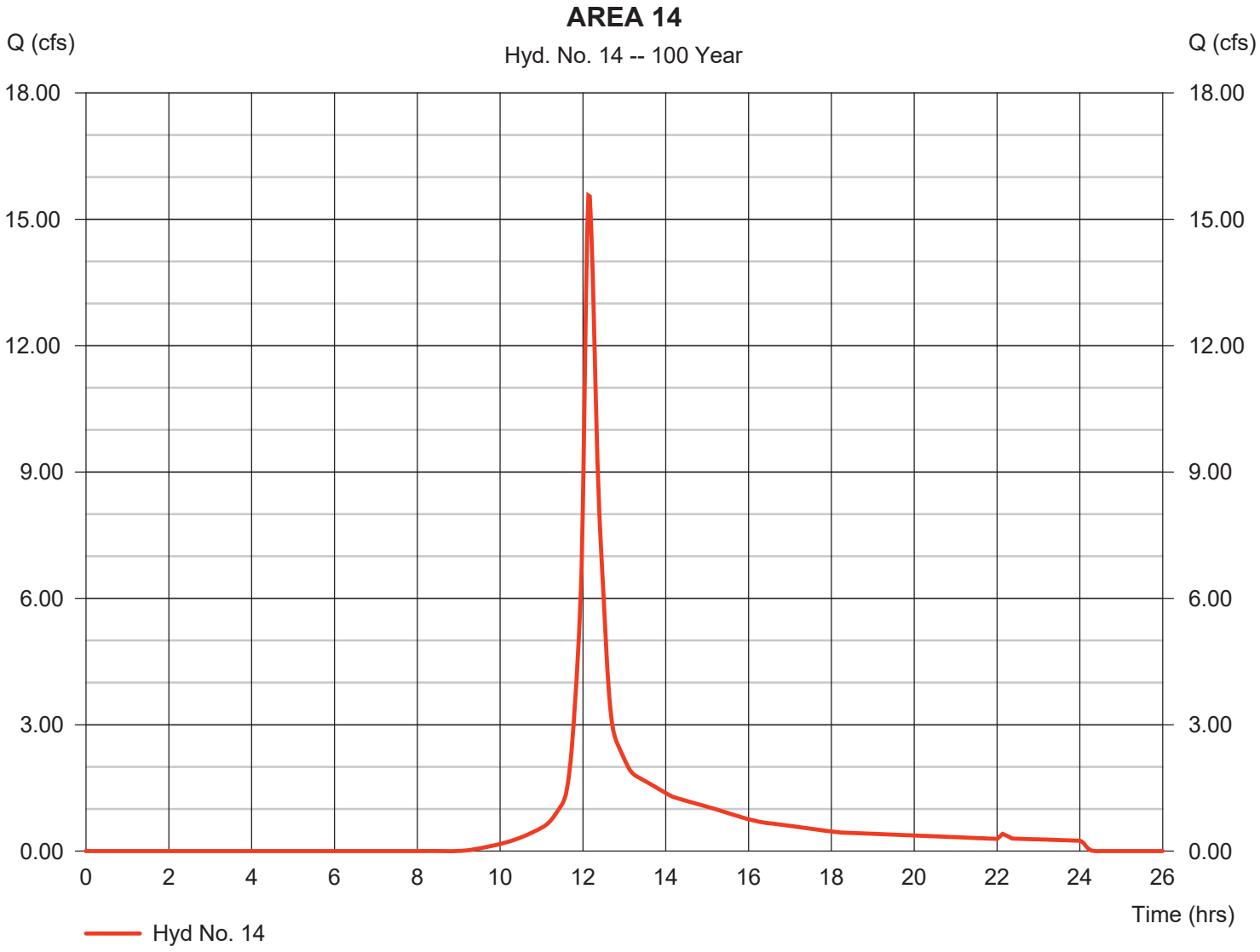
Total Travel Time, Tc ..... 6.10 min

Hydrograph Report

Hyd. No. 14

AREA 14

Hydrograph type	=	SCS Runoff	Peak discharge	=	15.56 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	60,255 cuft
Drainage area	=	4.430 ac	Curve number	=	64.1
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	12.60 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 14

AREA 14

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.36		0.00		0.00		
Land slope (%)	= 2.80		0.00		0.00		
Travel Time (min)	**= 10.52**	**+**	**0.00**	**+**	**0.00**	**=**	**10.52**
Shallow Concentrated Flow							
Flow length (ft)	= 335.00		0.00		0.00		
Watercourse slope (%)	= 2.80		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.70		0.00		0.00		
Travel Time (min)	**= 2.07**	**+**	**0.00**	**+**	**0.00**	**=**	**2.07**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

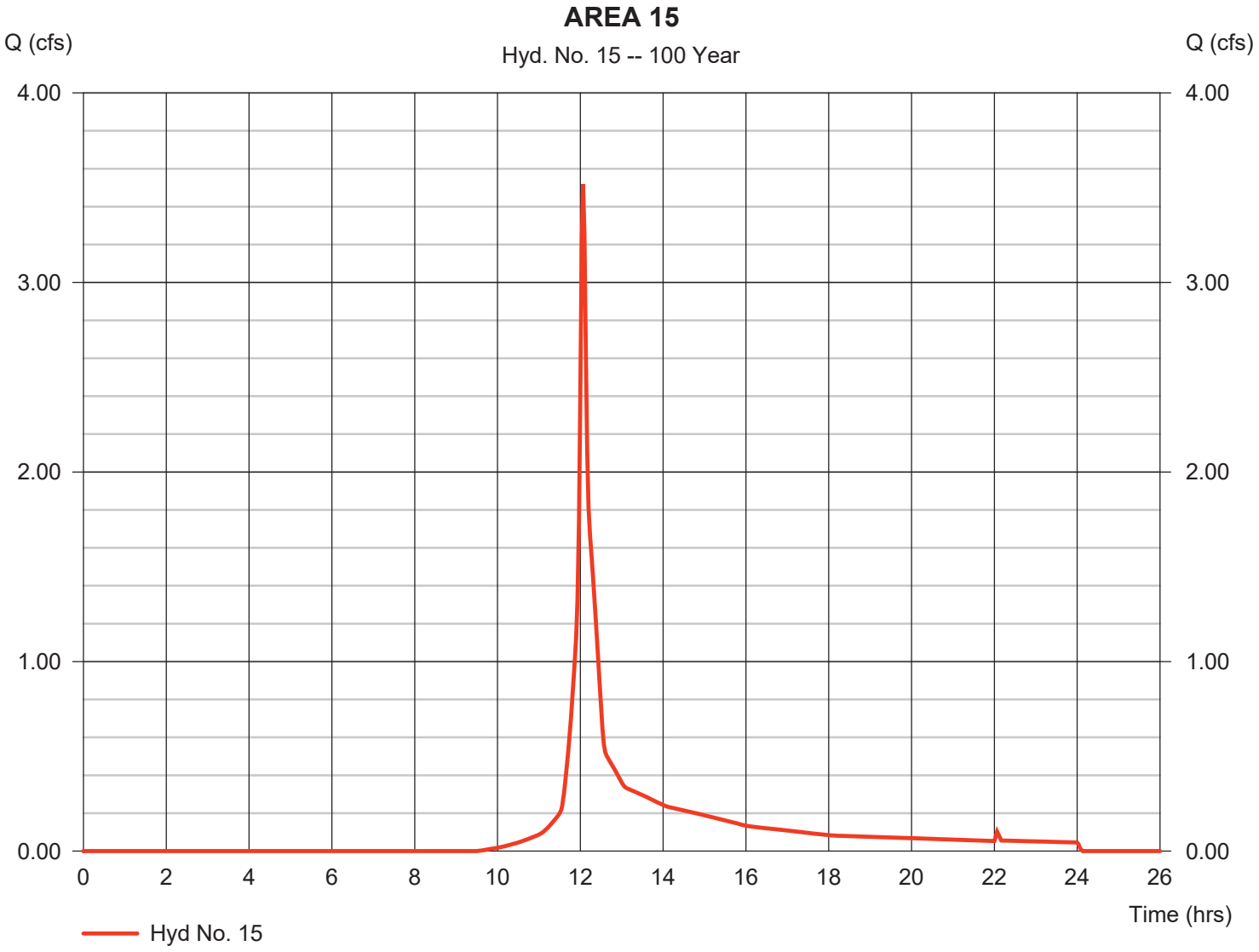
Total Travel Time, Tc ..... 12.60 min

Hydrograph Report

Hyd. No. 15

AREA 15

Hydrograph type	= SCS Runoff	Peak discharge	= 3.518 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 10,646 cuft
Drainage area	= 0.950 ac	Curve number	= 61
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

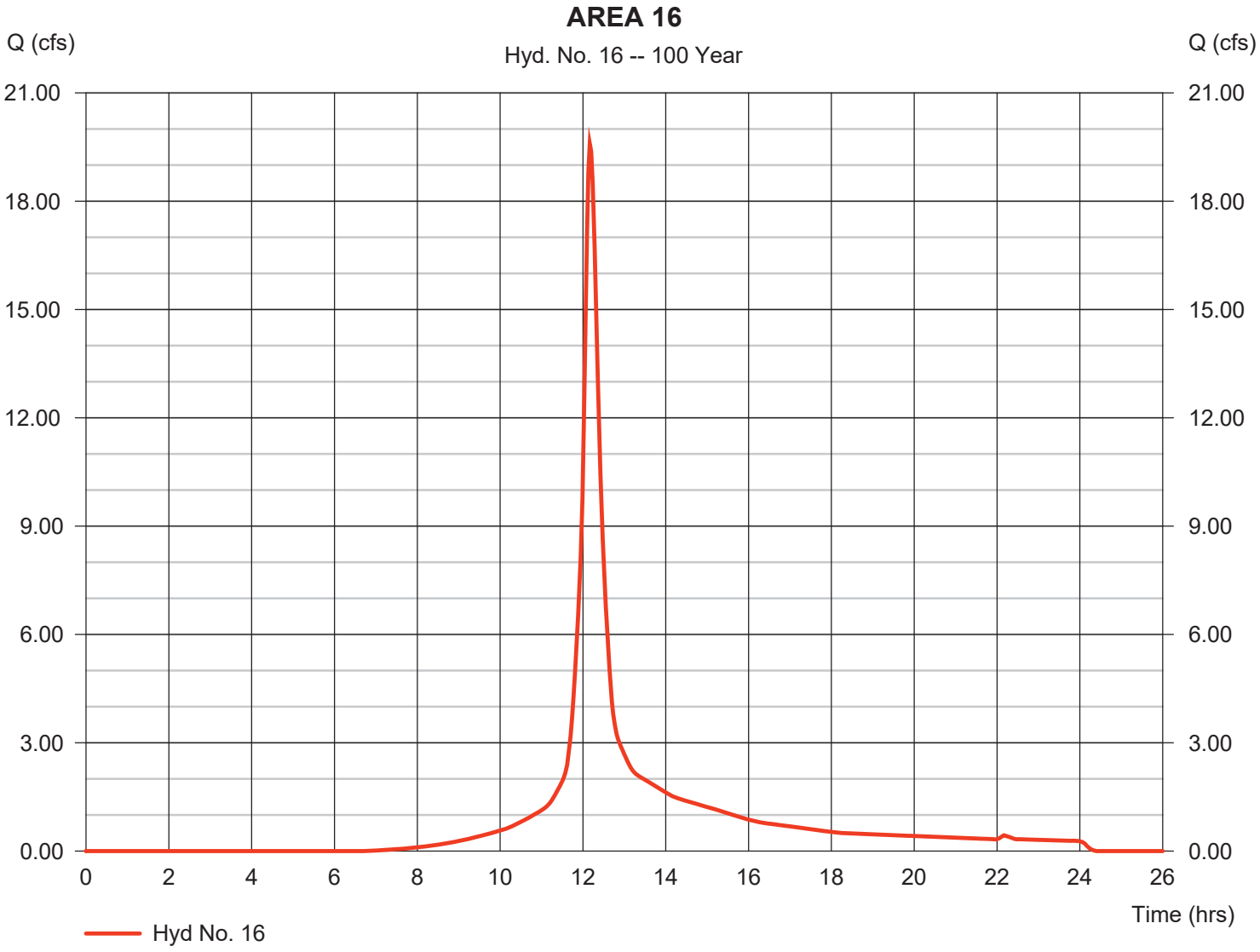


Hydrograph Report

Hyd. No. 16

AREA 16

Hydrograph type	=	SCS Runoff	Peak discharge	=	19.59 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	79,920 cuft
Drainage area	=	4.580 ac	Curve number	=	75.6
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.60 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 16

AREA 16

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.36		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 12.04**	**+**	**0.00**	**+**	**0.00**	**=**	**12.04**
Shallow Concentrated Flow							
Flow length (ft)	= 625.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 4.57**	**+**	**0.00**	**+**	**0.00**	**=**	**4.57**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

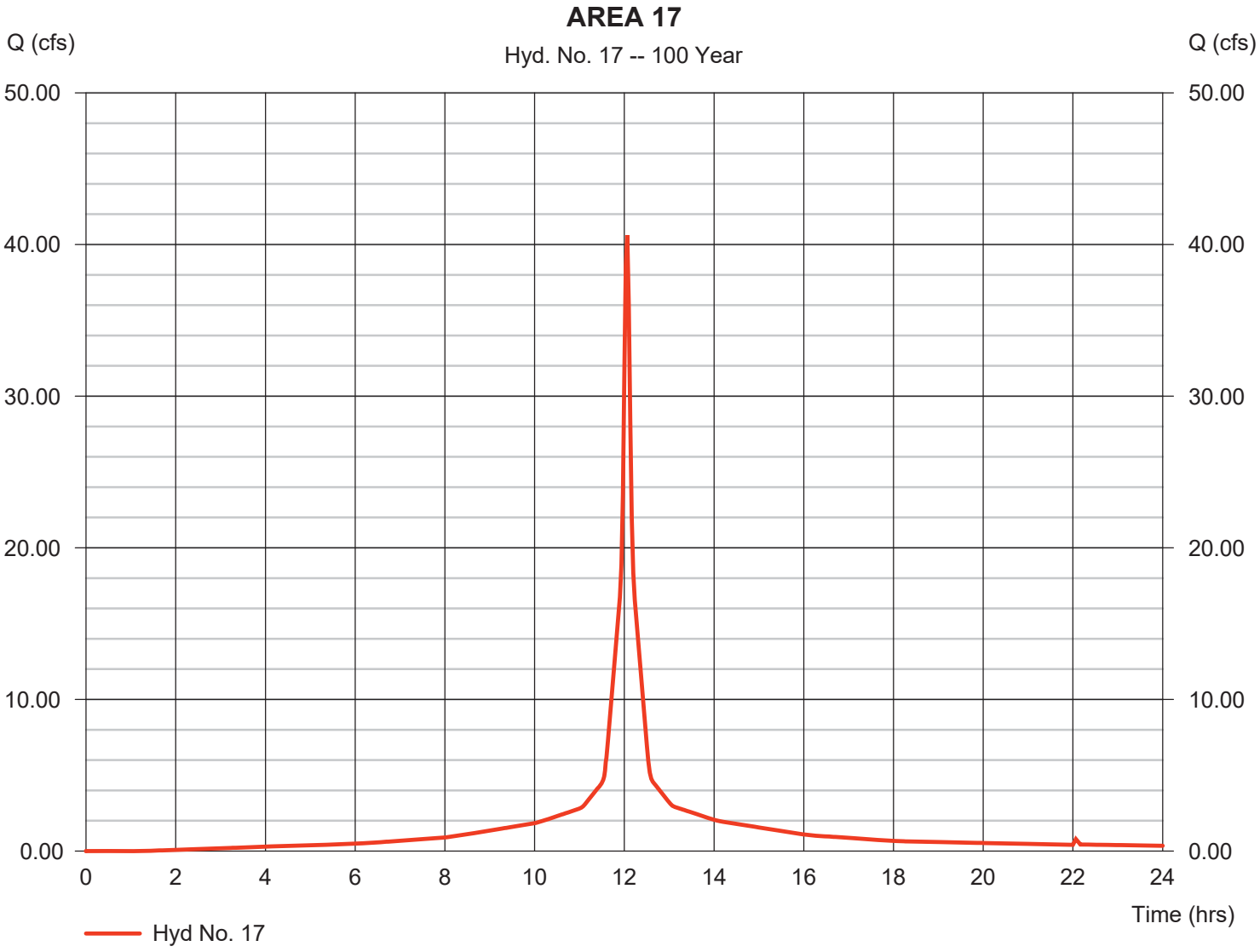
Total Travel Time, Tc ..... 16.60 min

Hydrograph Report

Hyd. No. 17

AREA 17

Hydrograph type	=	SCS Runoff	Peak discharge	=	40.62 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	137,176 cuft
Drainage area	=	5.560 ac	Curve number	=	95.4
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

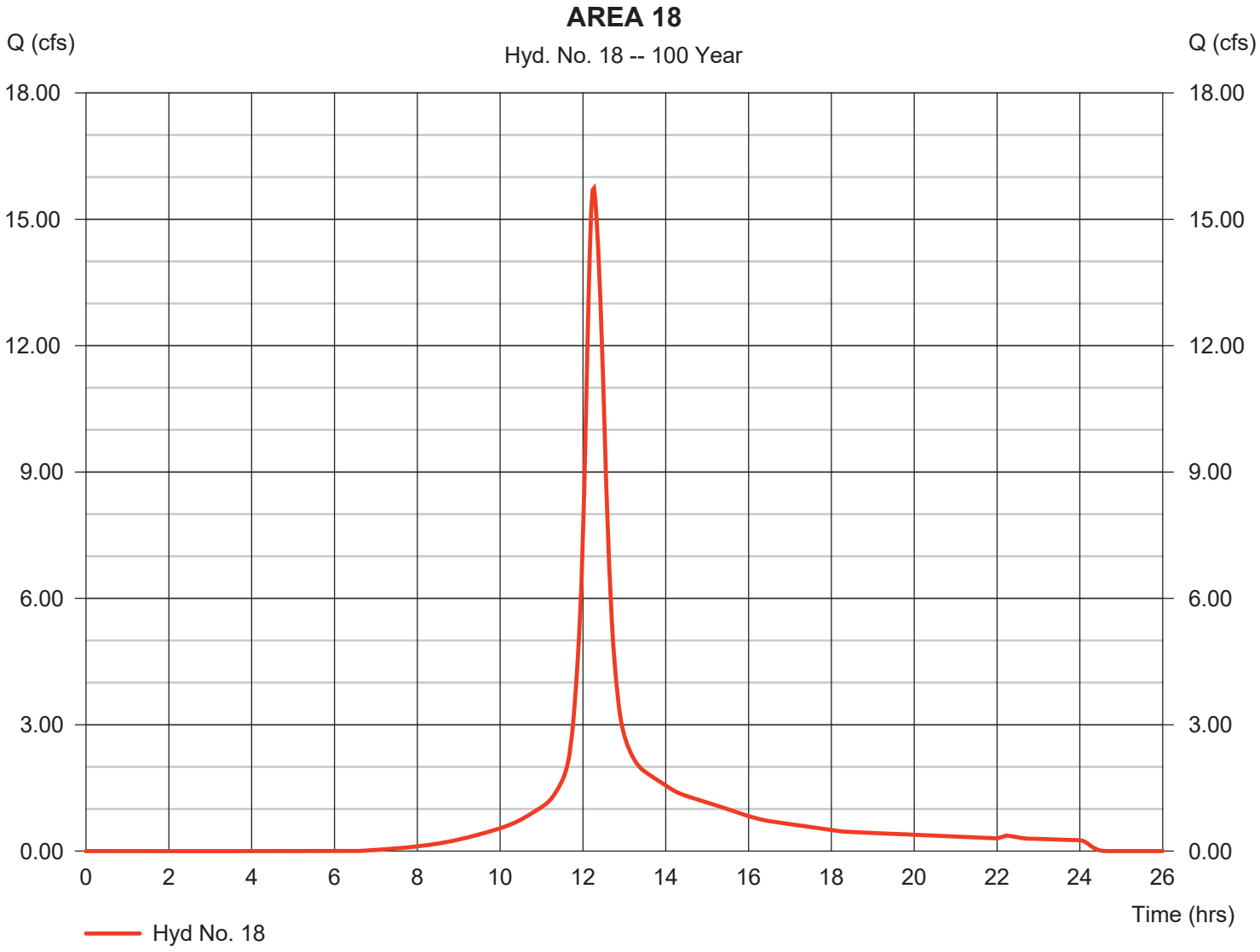


Hydrograph Report

Hyd. No. 18

AREA 18

Hydrograph type	= SCS Runoff	Peak discharge	= 15.74 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 74,868 cuft
Drainage area	= 3.980 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.50 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 18

AREA 18

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.36		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 12.04**	**+**	**0.00**	**+**	**0.00**	**=**	**12.04**
Shallow Concentrated Flow							
Flow length (ft)	= 40.00		24.00		790.00		
Watercourse slope (%)	= 2.00		25.00		1.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=2.28		8.07		1.61		
Travel Time (min)	**= 0.29**	**+**	**0.05**	**+**	**8.16**	**=**	**8.50**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

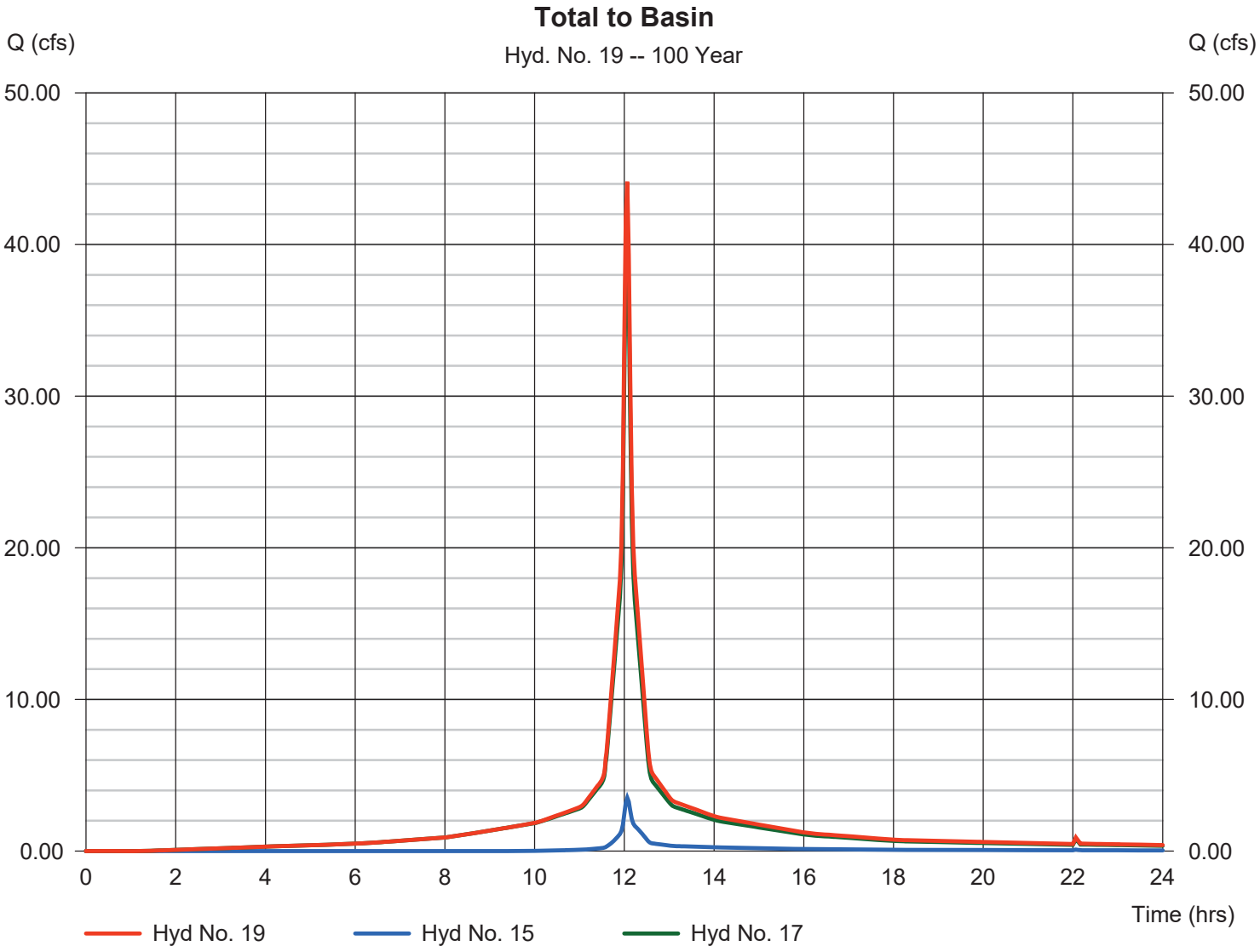
Total Travel Time, Tc ..... 20.50 min

Hydrograph Report

Hyd. No. 19

Total to Basin

Hydrograph type	= Combine	Peak discharge	= 44.13 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 147,822 cuft
Inflow hyds.	= 15, 17	Contrib. drain. area	= 6.510 ac



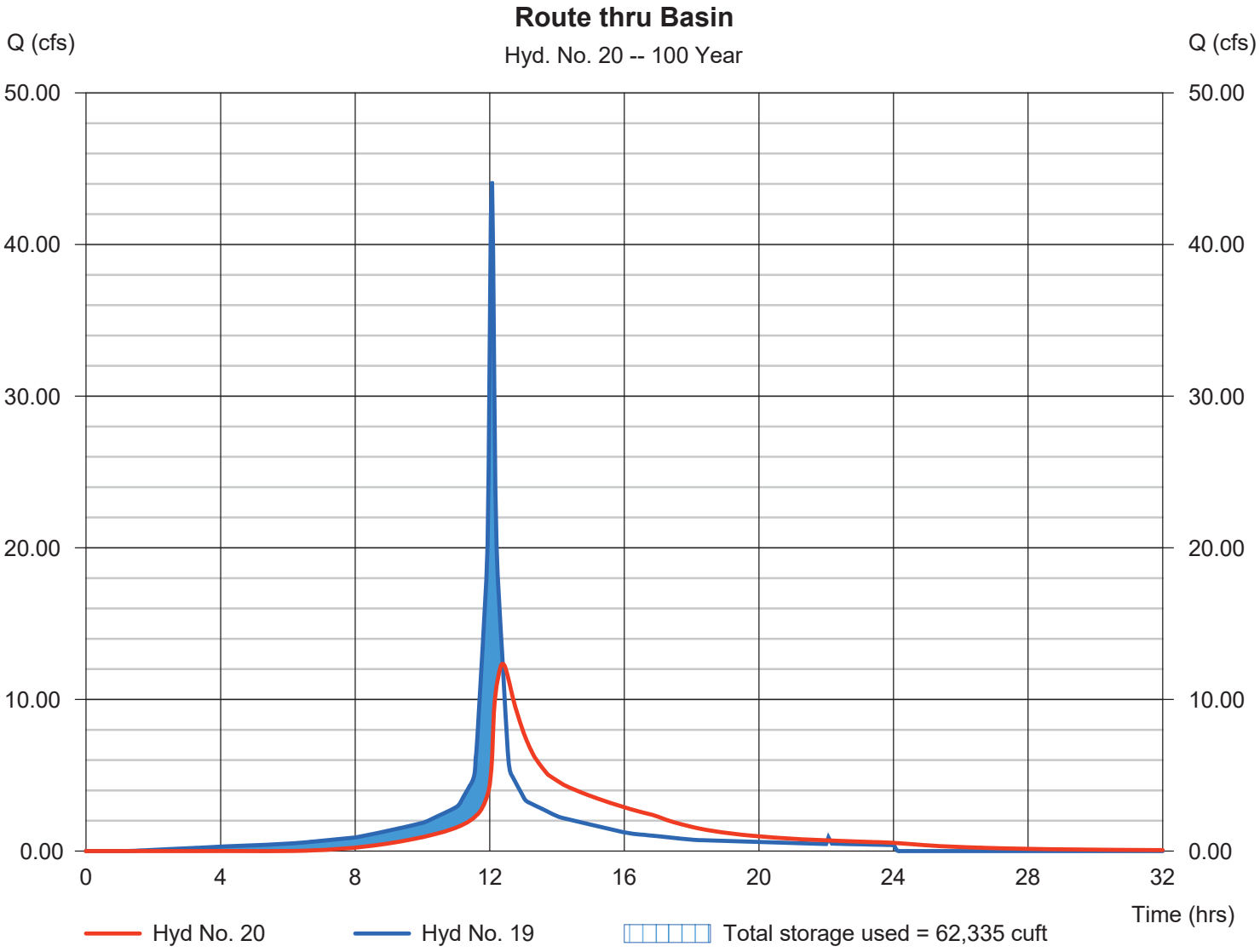
Hydrograph Report

Hyd. No. 20

Route thru Basin

Hydrograph type	=	Reservoir	Peak discharge	=	12.34 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.40 hrs
Time interval	=	2 min	Hyd. volume	=	143,161 cuft
Inflow hyd. No.	=	19 - Total to Basin	Max. Elevation	=	87.86 ft
Reservoir name	=	Existing pond	Max. Storage	=	62,335 cuft

Storage Indication method used.



Pond Report

Pond No. 2 - Existing pond

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 84.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	84.00	6,721	0	0
2.00	86.00	17,295	23,196	23,196
4.00	88.00	24,980	42,036	65,232
6.00	90.00	31,839	56,675	121,907
6.20	90.20	32,740	6,457	128,364

Culvert / Orifice Structures

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

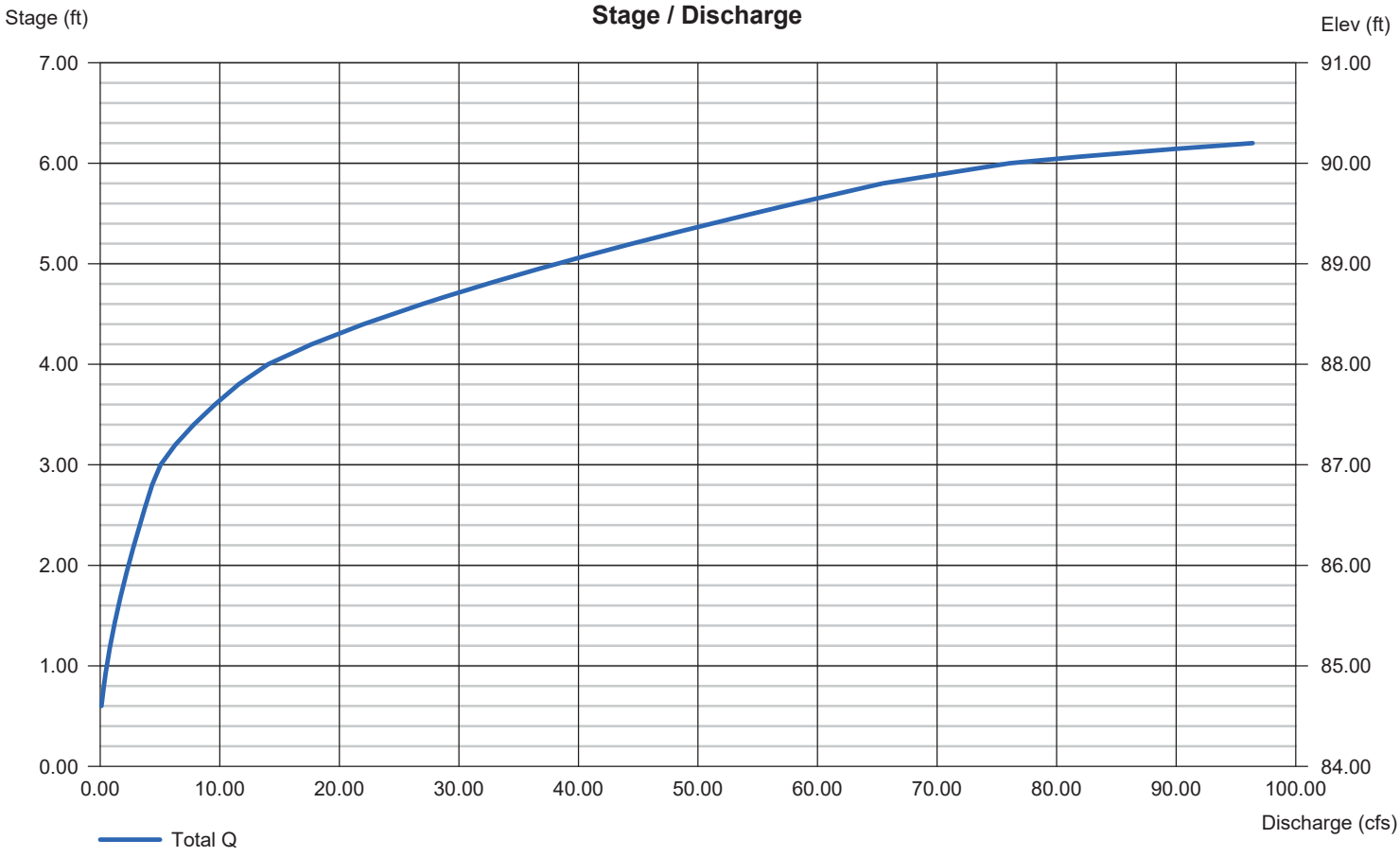
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.35	1.50	3.00	28.00
Crest El. (ft)	= 84.40	86.90	87.90	89.90
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	Rect	Rect	Rect
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

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

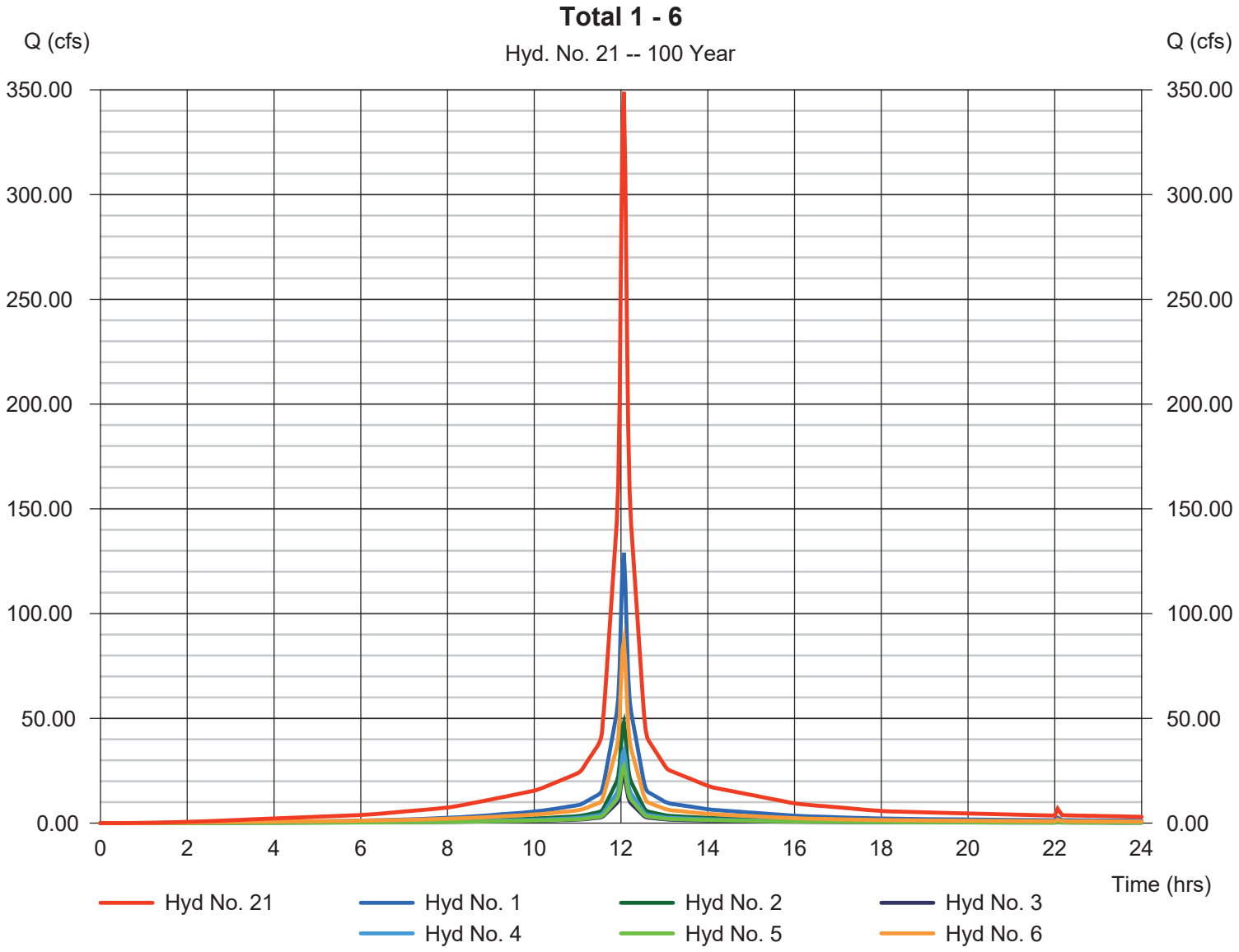


Hydrograph Report

Hyd. No. 21

Total 1 - 6

Hydrograph type	= Combine	Peak discharge	= 348.97 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 1,169,580 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 6	Contrib. drain. area	= 48.090 ac

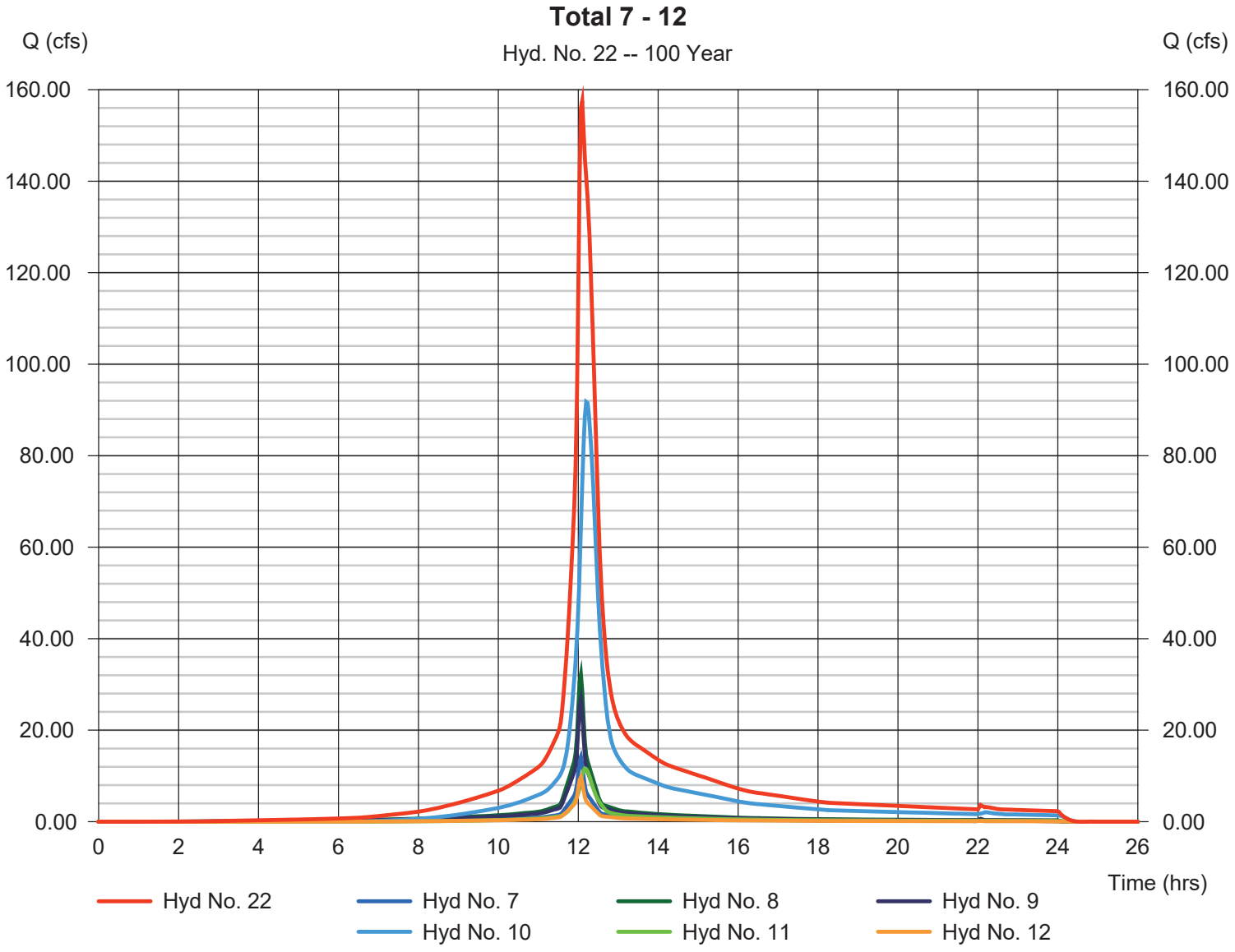


Hydrograph Report

Hyd. No. 22

Total 7 - 12

Hydrograph type	= Combine	Peak discharge	= 157.47 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 724,176 cuft
Inflow hyds.	= 7, 8, 9, 10, 11, 12	Contrib. drain. area	= 36.390 ac

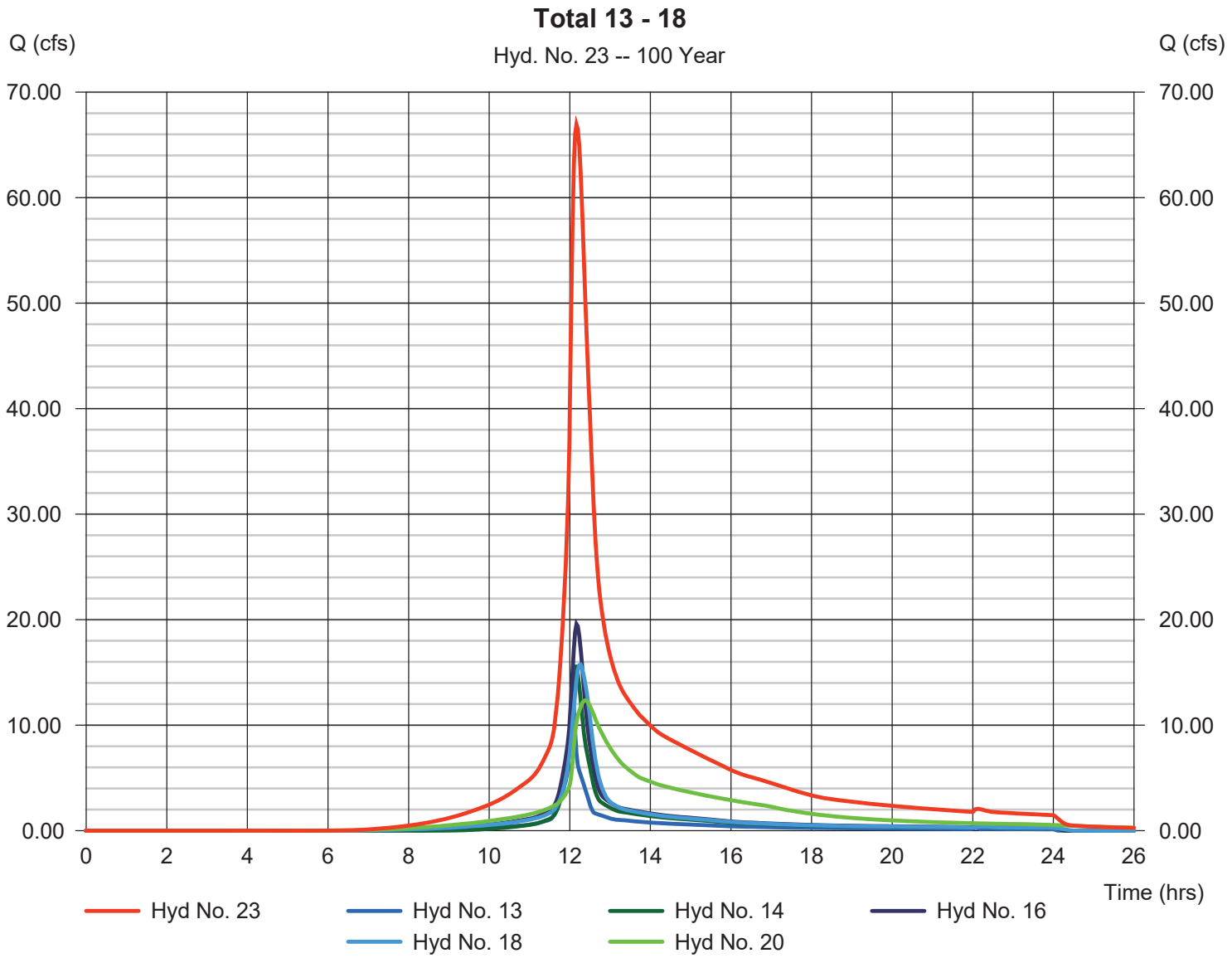


Hydrograph Report

Hyd. No. 23

Total 13 - 18

Hydrograph type	= Combine	Peak discharge	= 66.93 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 396,857 cuft
Inflow hyds.	= 13, 14, 16, 18, 20	Contrib. drain. area	= 15.400 ac

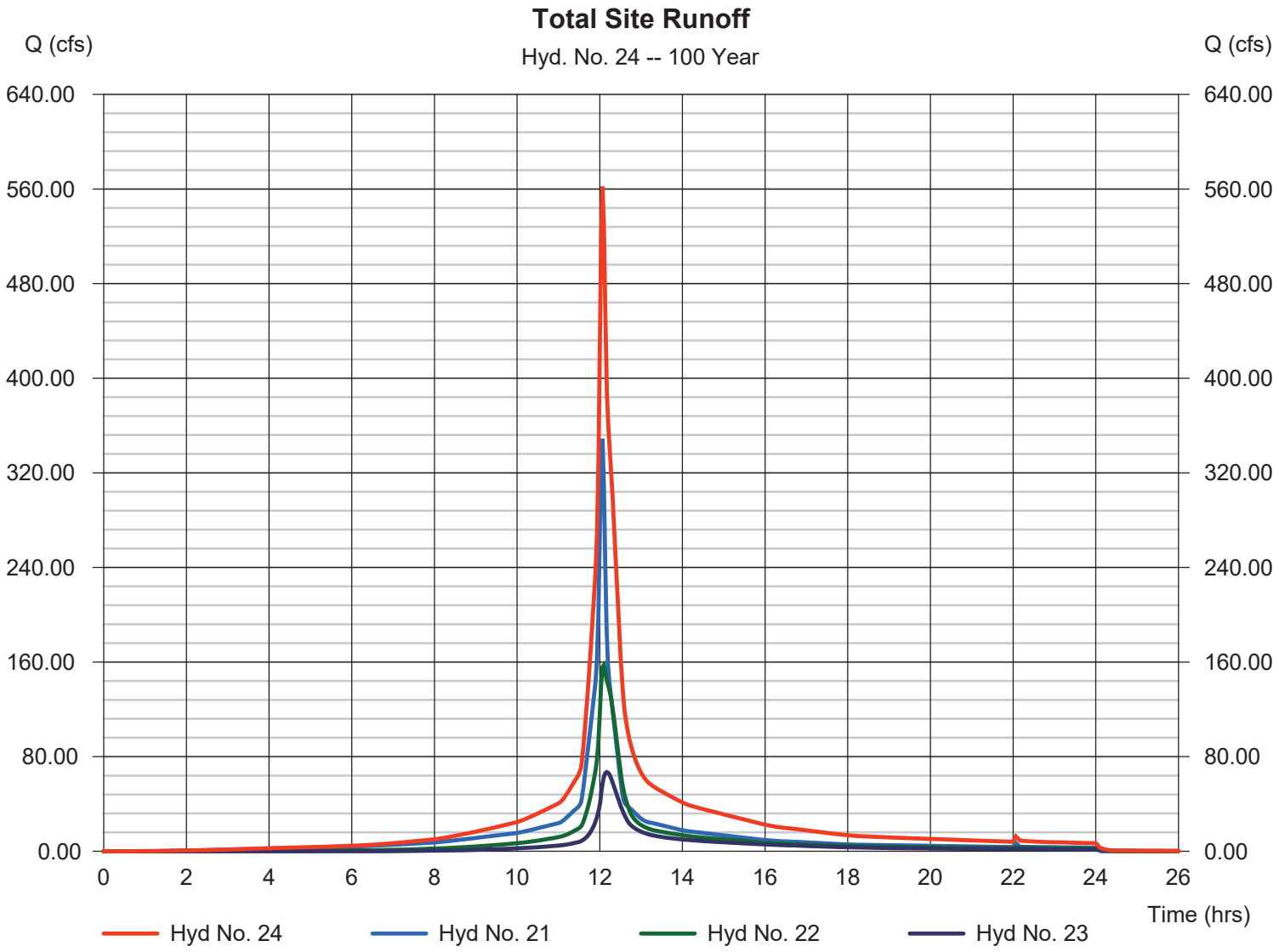


Hydrograph Report

Hyd. No. 24

Total Site Runoff

Hydrograph type	= Combine	Peak discharge	= 562.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 2,290,621 cuft
Inflow hyds.	= 21, 22, 23	Contrib. drain. area	= 0.000 ac



KELLY ENGINEERING GROUP, INC.
Zero Campanelli Drive-Braintree-MA 02184 Phone 781 843 4333

Attachment B
Proposed Conditions

LEGEND

DRAINAGE AREA WATERSHED

TIME OF CONCENTRATION

PIPE 1
PIPE 2
PIPE 5
PIPE 6
PIPE 15
PIPE 9

AREA 11
AREA R1
AREA R2
AREA R3
AREA R4
AREA R5
AREA R6
AREA 14B
AREA 14A
AREA PIPE 4
AREA PIPE 5
AREA PIPE 3
AREA PIPE 2
AREA PIPE 6
AREA PIPE 1
AREA PIPE 9
AREA TO SUBSURFACE SYSTEM/ PIPE 8
AREA 17B TO PIPE 8
AREA 17A TO BASIN
AREA 16
AREA 18

335' SHALLOW CONCENTRATED FLOW
125' SHALLOW CONCENTRATED FLOW
50' SHEET FLOW
390' SHALLOW CONCENTRATED FLOW
50' SHEET FLOW
790' SHALLOW CONCENTRATED FLOW
24' SHALLOW CONCENTRATED FLOW
40' SHALLOW CONCENTRATED FLOW
50' SHEET FLOW

SUBSURFACE INFILTRATION CHAMBER SYSTEMS (TYP.)
SUBSURFACE ROOF INFILTRATION CHAMBER SYSTEMS (TYP.)
INFILTRATION BASIN

Tc
TIME OF CONCENTRATION (T)

SIGN POST

MILL STREET
WASHINGTON STREET

HANOVER CROSSING
1775 WASHINGTON ST.
HANOVER, MA

SCALE: 1"= 200'

DATE: 05/17/19

2016-075-PRDR00

PROPOSED DRAINAGE EXHIBIT #1

KELLY ENGINEERING GROUP, INC.
CIVIL ENGINEERING CONSULTANTS
0 CAMPANELLI DRIVE · BRAINTREE MA · 02184
PHONE: 781 843 4333 FAX: 781 843 0028

LEGEND

	DRAINAGE AREA WATERSHED
	TIME OF CONCENTRATION

ROUTE 3

50' SHEET FLOW

Tc

666' SHALLOW CONCENTRATED FLOW

AREA 10

PIPE 8

PIPE 12

AREA 12

PIPE 14

PIPE 13

DESIGN POINT

AREA PIPE 7

PIPE 4

PIPE 7

PIPE 6

PIPE 5

AREA 13

AREA R4

AREA 14B

PIPE 15

PIPE 3

AREA 11

AREA R1

AREA R2

PIPE 2

PIPE 1

AREA R3

AREA R5

AREA R6

MILL STREET

AREA PIPE 4

AREA PIPE 5

AREA 14A

335' SHALLOW CONCENTRATED FLOW

125' SHALLOW CONCENTRATED FLOW

AREA PIPE 3

SUBSURFACE INFILTRATION CHAMBER SYSTEMS (TYP.)

390' SHALLOW CONCENTRATED FLOW

50' SHEET FLOW

AREA TO SUBSURFACE

AREA 16

HANOVER CROSSING
1775 WASHINGTON ST.
HANOVER, MA

SCALE: 1"= 200'

DATE: 05/17/19

2016-075-PRDR00

PROPOSED DRAINAGE EXHIBIT #2

KELLY ENGINEERING GROUP, INC.
CIVIL ENGINEERING CONSULTANTS
0 CAMPANELLI DRIVE · BRAINTREE MA · 02184
PHONE: 781 843 4333 FAX: 781 843 0028

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area Pipe 1**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	157903	9632083
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	548189	5.4E+07
Roof		98	68357	6698986
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	774449.00	7E+07
		Acres =	17.7789027	

CN or C (weighted) = total product/total area = **90.5**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area Pipe 2**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	22469	1370609
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	132726	1.3E+07
Roof		98	91795	8995910
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	246990.00	2.3E+07
		Acres =	5.67011019	

CN or C (weighted) = total product/total area = **94.6**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area Pipe 3**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	9257	564677
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	101024	9900352
Roof		98	74084	7260232
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	184365.00	1.8E+07
		Acres =	4.23243802	

CN or C (weighted) = total product/total area = **96.1**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area Pipe 4**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	12619	769759
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	67996	6663608
Roof		98	78610	7703780
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	159225.00	1.5E+07
		Acres =	3.65530303	

CN or C (weighted) = total product/total area = **95.1**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area Pipe 5**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	47278	2883958
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	215937	2.1E+07
Roof		98	18507	1813686
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	281722.00	2.6E+07
		Acres =	6.4674472	

CN or C (weighted) = total product/total area = **91.8**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area Pipe 6**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	26926	1642486
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	203908	2E+07
Roof		98	163231	1.6E+07
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	394065.00	3.8E+07
		Acres =	9.0464876	

CN or C (weighted) = total product/total area = **95.5**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area R1**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	11695	713395
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	25970	2545060
Roof		98	10861	1064378
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	48526.00	4322833
		Acres =	1.11400367	

CN or C (weighted) = total product/total area = **89.1**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area Pipe 7**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	4294	261934
Woods	Hydrologic Group D; Good Condition	77	7232	556864
Impervious		98	0	0
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	11526.00	818798
		Acres =	0.26460055	

CN or C (weighted) = total product/total area = **71.0**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area to Subsurface System / Pipe 8**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	22787	1390007
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	185984	1.8E+07
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	208771.00	2E+07
		Acres =	4.79272268	

CN or C (weighted) = total product/total area = **94.0**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area Pipe 9**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	21371	1303631
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	95535	9362430
Roof		98	44326	4343948
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	161232.00	1.5E+07
		Acres =	3.70137741	

CN or C (weighted) = total product/total area = **93.1**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area 10**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	0	0
Woods	Hydrologic Group D; Good Condition	77	512933	3.9E+07
Impervious		98	0	0
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	447180	3.4E+07
		Totals =	960113.00	7.4E+07
		Acres =	22.0411616	

CN or C (weighted) = total product/total area = **77.0**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area 11**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	0	0
Woods	Hydrologic Group D; Good Condition	77	115019	8856463
Impervious		98	0	0
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	115019.00	8856463
		Acres =	2.64047291	

CN or C (weighted) = total product/total area = **77.0**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area R2**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	37428	2283108
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	24089	2360722
Roof		98	16278	1595244
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	77795.00	6239074
		Acres =	1.78592746	

CN or C (weighted) = total product/total area = **80.2**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area R3**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	9043	551623
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	17994	1763412
Roof		98	15030	1472940
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	42067.00	3787975
		Acres =	0.96572544	

CN or C (weighted) = total product/total area = **90.0**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area 12**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	0	0
Woods	Hydrologic Group D; Good Condition	77	9752	750904
Impervious		98	0	0
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	9752.00	750904
		Acres =	0.22387511	

CN or C (weighted) = total product/total area = **77.0**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area R4**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	13273	809653
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	29872	2927456
Roof		98	10413	1020474
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	53558.00	4757583
		Acres =	1.2295225	

CN or C (weighted) = total product/total area = **88.8**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area R5**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	11813	720593
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	23774	2329852
Roof		98	9892	969416
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	45479.00	4019861
		Acres =	1.04405418	

CN or C (weighted) = total product/total area = **88.4**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area 13**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	17609	1074149
Woods	Hydrologic Group D; Good Condition	77	21383	1646491
Impervious		98	0	0
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	38992.00	2720640
		Acres =	0.89513315	

CN or C (weighted) = total product/total area = **69.8**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area R6**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	19142	1167662
Woods	Hydrologic Group B; Good Condition	55	0	0
Impervious		98	33631	3295838
Roof		98	23738	2326324
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	76511.00	6789824
		Acres =	1.75645087	

CN or C (weighted) = total product/total area = **88.7**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area 14A**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	18017	1099037
Woods	Hydrologic Group B; Good Condition	55	0	0
Impervious		98	19723	1932854
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	37740.00	3031891
		Acres =	0.86639118	

CN or C (weighted) = total product/total area = **80.3**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area 14B**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group A; Good Condition	39	14754	575406
Grass	Hydrologic Group B; Good Condition	61	13376	815936
Woods	Hydrologic Group D; Good Condition	77	38523	2966271
Impervious		98	0	0
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	66653.00	4357613
		Acres =	1.53014233	

CN or C (weighted) = total product/total area = **65.4**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area 16**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	9172	559492
Woods	Hydrologic Group B; Good Condition	77	104051	8011927
Impervious		98	4845	474810
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	53153	4092781
		Totals =	171221.00	1.3E+07
		Acres =	3.9306933	

CN or C (weighted) = total product/total area = **76.7**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area 17A**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	37435	2283535
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	91060	8923880
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	128495.00	1.1E+07
		Acres =	2.9498393	

CN or C (weighted) = total product/total area = **87.2**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area 17B**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	9492	579012
Woods	Hydrologic Group D; Good Condition	77	0	0
Impervious		98	93980	9210040
Roof		98	63519	6224862
Wetlands	Hydrologic Group D; Good Condition	77	0	0
		Totals =	166991.00	1.6E+07
		Acres =	3.83358586	

CN or C (weighted) = total product/total area = **95.9**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Runoff Curve Number and Runoff

Name: Hanover Crossing **By:** bgl **Date:** 04/30/19
Location : 1775 Washington Street Hanover MA
Description: **Proposed Conditions - Area 18**

Circle One: Pre **or Post**

Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	**CN**	s.f.	Product of CN x Area
Grass	Hydrologic Group B; Good Condition	61	0	0
Woods	Hydrologic Group D; Good Condition	77	50897	3919069
Impervious		98	0	0
Roof		98	0	0
Wetlands	Hydrologic Group D; Good Condition	77	122469	9430113
		Totals =	173366.00	1.3E+07
		Acres =	3.97993572	

CN or C (weighted) = total product/total area = **77.0**

Reference: *Urban Hydrology for Small Watersheds*
Technical Release 55, Soil Conservation Service
U.S. Department of Agriculture, June 1986

Hydraflow Table of Contents

Proposed.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Monday, 05 / 13 / 2019

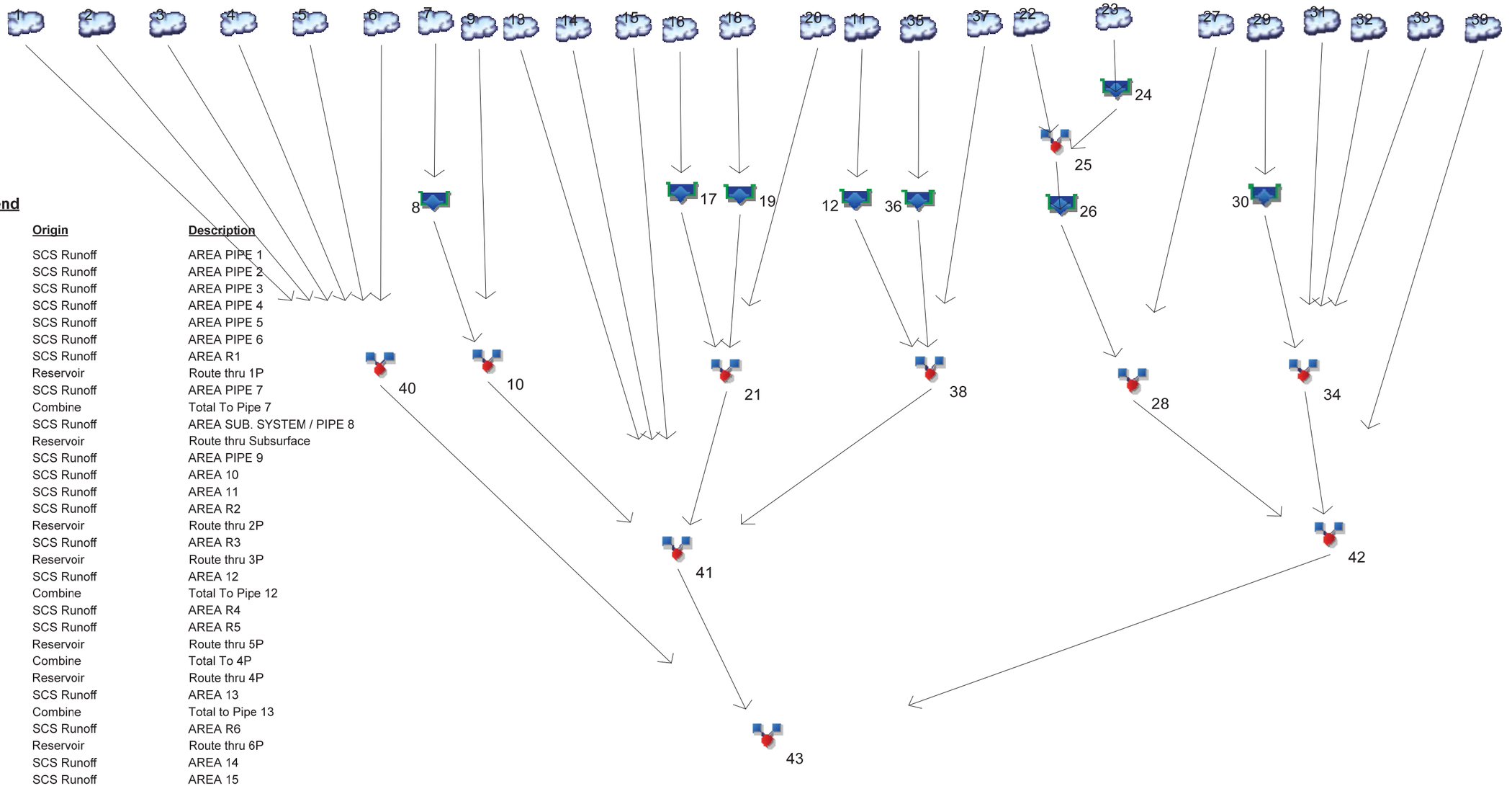
Hydraflow Table of Contents

Proposed.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Monday, 05 / 13 / 2019

100 - Year

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	AREA PIPE 1
2	SCS Runoff	AREA PIPE 2
3	SCS Runoff	AREA PIPE 3
4	SCS Runoff	AREA PIPE 4
5	SCS Runoff	AREA PIPE 5
6	SCS Runoff	AREA PIPE 6
7	SCS Runoff	AREA R1
8	Reservoir	Route thru 1P
9	SCS Runoff	AREA PIPE 7
10	Combine	Total To Pipe 7
11	SCS Runoff	AREA SUB. SYSTEM / PIPE 8
12	Reservoir	Route thru Subsurface
13	SCS Runoff	AREA PIPE 9
14	SCS Runoff	AREA 10
15	SCS Runoff	AREA 11
16	SCS Runoff	AREA R2
17	Reservoir	Route thru 2P
18	SCS Runoff	AREA R3
19	Reservoir	Route thru 3P
20	SCS Runoff	AREA 12
21	Combine	Total To Pipe 12
22	SCS Runoff	AREA R4
23	SCS Runoff	AREA R5
24	Reservoir	Route thru 5P
25	Combine	Total To 4P
26	Reservoir	Route thru 4P
27	SCS Runoff	AREA 13
28	Combine	Total to Pipe 13
29	SCS Runoff	AREA R6
30	Reservoir	Route thru 6P
31	SCS Runoff	AREA 14
32	SCS Runoff	AREA 15
33	SCS Runoff	AREA 16
34	Combine	Total Area 14
35	SCS Runoff	AREA 17A
36	Reservoir	Route thru Basin
37	SCS Runoff	AREA 17B
38	Combine	Total 8, 17A, & 17B to Pipe 8
39	SCS Runoff	AREA 18
40	Combine	Total 1 - 6
41	Combine	Total 7 - 12
42	Combine	Total 13 - 18
43	Combine	Total Site Runoff

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	-------	46.91	-------	-------	77.48	96.32	110.67	125.14	AREA PIPE 1
2	SCS Runoff	------	-------	16.79	-------	-------	26.34	32.22	36.70	41.23	AREA PIPE 2
3	SCS Runoff	------	-------	12.93	-------	-------	19.97	24.32	27.65	31.01	AREA PIPE 3
4	SCS Runoff	------	-------	10.96	-------	-------	17.10	20.89	23.78	26.69	AREA PIPE 4
5	SCS Runoff	------	-------	17.77	-------	-------	28.85	35.66	40.85	46.09	AREA PIPE 5
6	SCS Runoff	------	-------	28.45	-------	-------	44.39	54.21	61.71	69.28	AREA PIPE 6
7	SCS Runoff	------	-------	2.795	-------	-------	4.707	5.890	6.792	7.700	AREA R1
8	Reservoir	7	-------	2.072	-------	-------	3.283	3.953	4.495	5.001	Route thru 1P
9	SCS Runoff	------	-------	0.267	-------	-------	0.637	0.892	1.095	1.304	AREA PIPE 7
10	Combine	8, 9	-------	2.284	-------	-------	3.777	4.614	5.321	5.998	Total To Pipe 7
11	SCS Runoff	------	-------	14.16	-------	-------	22.35	27.40	31.25	35.13	AREA SUB. SYSTEM / PIPE 8
12	Reservoir	11	-------	5.798	-------	-------	10.22	12.23	14.00	15.78	Route thru Subsurface
13	SCS Runoff	------	-------	10.55	-------	-------	16.84	20.71	23.66	26.63	AREA PIPE 9
14	SCS Runoff	------	-------	23.53	-------	-------	48.71	65.32	78.37	91.75	AREA 10
15	SCS Runoff	------	-------	2.978	-------	-------	6.165	8.288	9.945	11.64	AREA 11
16	SCS Runoff	------	-------	3.121	-------	-------	6.067	7.967	9.435	10.92	AREA R2
17	Reservoir	16	-------	1.762	-------	-------	5.564	6.124	6.716	8.164	Route thru 2P
18	SCS Runoff	------	-------	2.518	-------	-------	4.187	5.217	6.002	6.793	AREA R3
19	Reservoir	18	-------	1.491	-------	-------	2.599	3.127	3.501	3.863	Route thru 3P
20	SCS Runoff	------	-------	0.326	-------	-------	0.674	0.903	1.082	1.264	AREA 12
21	Combine	17, 19, 20	-------	3.451	-------	-------	8.665	9.891	10.97	12.89	Total To Pipe 12
22	SCS Runoff	------	-------	4.480	-------	-------	7.533	9.420	10.86	12.31	AREA R4
23	SCS Runoff	------	-------	3.738	-------	-------	6.319	7.917	9.135	10.36	AREA R5
24	Reservoir	23	-------	2.331	-------	-------	3.746	4.526	5.178	5.855	Route thru 5P
25	Combine	22, 24	-------	6.493	-------	-------	10.78	13.28	15.18	17.16	Total To 4P
26	Reservoir	25	-------	5.686	-------	-------	9.771	11.84	13.58	15.38	Route thru 4P
27	SCS Runoff	------	-------	0.844	-------	-------	2.086	2.950	3.639	4.352	AREA 13
28	Combine	26, 27	-------	6.220	-------	-------	11.21	13.92	16.17	18.51	Total to Pipe 13
29	SCS Runoff	------	-------	3.519	-------	-------	6.495	8.380	9.827	11.29	AREA R6
30	Reservoir	29	-------	2.049	-------	-------	4.460	5.561	6.369	7.258	Route thru 6P
31	SCS Runoff	------	-------	2.149	-------	-------	3.902	5.007	5.853	6.708	AREA 14
32	SCS Runoff	------	-------	0.992	-------	-------	2.902	4.279	5.395	6.564	AREA 15
33	SCS Runoff	------	-------	4.362	-------	-------	9.083	12.24	14.70	17.21	AREA 16
34	Combine	30, 31, 32, 33	-------	8.468	-------	-------	18.35	24.44	29.19	34.08	Total Area 14

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
35	SCS Runoff	------	-------	6.935	-------	-------	12.01	15.17	17.58	20.01	AREA 17A
36	Reservoir	35	-------	0.578	-------	-------	2.737	3.664	4.243	4.734	Route thru Basin
37	SCS Runoff	------	-------	9.732	-------	-------	14.98	18.22	20.70	23.20	AREA 17B
38	Combine	12, 36, 37	-------	13.85	-------	-------	24.09	30.90	35.25	39.51	Total 8, 17A, & 17B to Pipe 8
39	SCS Runoff	------	-------	4.023	-------	-------	8.358	11.22	13.45	15.74	AREA 18
40	Combine	1, 2, 3, 4, 5, 6,	-------	133.83	-------	-------	214.12	263.62	301.37	339.44	Total 1 - 6
41	Combine	10, 13, 14, 15, 21, 38,	-------	48.12	-------	-------	94.65	122.58	143.91	166.32	Total 7 - 12
42	Combine	28, 34, 39,	-------	15.77	-------	-------	32.69	43.44	51.96	60.31	Total 13 - 18
43	Combine	40, 41, 42	-------	195.10	-------	-------	335.12	423.58	489.17	555.78	Total Site Runoff

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	46.91	2	724	142,962	------	------	------	AREA PIPE 1
2	SCS Runoff	16.79	2	724	53,264	------	------	------	AREA PIPE 2
3	SCS Runoff	12.93	2	724	42,001	------	------	------	AREA PIPE 3
4	SCS Runoff	10.96	2	724	35,026	------	------	------	AREA PIPE 4
5	SCS Runoff	17.77	2	724	54,692	------	------	------	AREA PIPE 5
6	SCS Runoff	28.45	2	724	90,914	------	------	------	AREA PIPE 6
7	SCS Runoff	2.795	2	724	8,450	------	------	------	AREA R1
8	Reservoir	2.072	2	728	8,051	7	85.31	1,629	Route thru 1P
9	SCS Runoff	0.267	2	724	863	------	------	------	AREA PIPE 7
10	Combine	2.284	2	728	8,914	8, 9	------	------	Total To Pipe 7
11	SCS Runoff	14.16	2	724	44,552	------	------	------	AREA SUB. SYSTEM / PIPE 8
12	Reservoir	5.798	2	734	41,585	11	94.61	16,806	Route thru Subsurface
13	SCS Runoff	10.55	2	724	32,859	------	------	------	AREA PIPE 9
14	SCS Runoff	23.53	2	734	106,198	------	------	------	AREA 10
15	SCS Runoff	2.978	2	732	12,403	------	------	------	AREA 11
16	SCS Runoff	3.121	2	724	9,380	------	------	------	AREA R2
17	Reservoir	1.762	2	730	8,716	16	85.02	2,434	Route thru 2P
18	SCS Runoff	2.518	2	724	7,649	------	------	------	AREA R3
19	Reservoir	1.491	2	730	7,028	18	85.33	2,244	Route thru 3P
20	SCS Runoff	0.326	2	724	994	------	------	------	AREA 12
21	Combine	3.451	2	730	16,738	17, 19, 20	------	------	Total To Pipe 12
22	SCS Runoff	4.480	2	716	9,253	------	------	------	AREA R4
23	SCS Runoff	3.738	2	716	7,701	------	------	------	AREA R5
24	Reservoir	2.331	2	722	7,168	23	85.57	2,436	Route thru 5P
25	Combine	6.493	2	718	16,421	22, 24	------	------	Total To 4P
26	Reservoir	5.686	2	720	15,979	25	85.60	2,386	Route thru 4P
27	SCS Runoff	0.844	2	724	2,779	------	------	------	AREA 13
28	Combine	6.220	2	720	18,758	26, 27	------	------	Total to Pipe 13
29	SCS Runoff	3.519	2	724	10,520	------	------	------	AREA R6
30	Reservoir	2.049	2	730	9,419	29	85.21	3,030	Route thru 6P
31	SCS Runoff	2.149	2	724	6,424	------	------	------	AREA 14
32	SCS Runoff	0.992	2	724	3,634	------	------	------	AREA 15
33	SCS Runoff	4.362	2	732	18,199	------	------	------	AREA 16
34	Combine	8.468	2	728	37,675	30, 31, 32, 33	------	------	Total Area 14

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	SCS Runoff	6.935	2	724	20,819	------	------	------	AREA 17A
36	Reservoir	0.578	2	784	12,314	35	93.38	12,118	Route thru Basin
37	SCS Runoff	9.732	2	724	31,840	------	------	------	AREA 17B
38	Combine	13.85	2	724	85,740	12, 36, 37	------	------	Total 8, 17A, & 17B to Pipe 8
39	SCS Runoff	4.023	2	736	19,520	------	------	------	AREA 18
40	Combine	133.83	2	724	418,857	1, 2, 3, 4, 5, 6,	------	------	Total 1 - 6
41	Combine	48.12	2	726	262,851	10, 13, 14, 15, 21, 38,	------	------	Total 7 - 12
42	Combine	15.77	2	726	75,952	28, 34, 39,	------	------	Total 13 - 18
43	Combine	195.10	2	724	757,660	40, 41, 42	------	------	Total Site Runoff

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	77.48	2	724	242,422	------	------	------	AREA PIPE 1
2	SCS Runoff	26.34	2	724	85,940	------	------	------	AREA PIPE 2
3	SCS Runoff	19.97	2	724	66,556	------	------	------	AREA PIPE 3
4	SCS Runoff	17.10	2	724	56,175	------	------	------	AREA PIPE 4
5	SCS Runoff	28.85	2	724	91,283	------	------	------	AREA PIPE 5
6	SCS Runoff	44.39	2	724	145,808	------	------	------	AREA PIPE 6
7	SCS Runoff	4.707	2	724	14,577	------	------	------	AREA R1
8	Reservoir	3.283	2	728	14,178	7	85.76	2,293	Route thru 1P
9	SCS Runoff	0.637	2	724	1,926	------	------	------	AREA PIPE 7
10	Combine	3.777	2	726	16,105	8, 9	------	------	Total To Pipe 7
11	SCS Runoff	22.35	2	724	72,407	------	------	------	AREA SUB. SYSTEM / PIPE 8
12	Reservoir	10.22	2	732	69,440	11	95.14	22,896	Route thru Subsurface
13	SCS Runoff	16.84	2	724	53,986	------	------	------	AREA PIPE 9
14	SCS Runoff	48.71	2	734	215,219	------	------	------	AREA 10
15	SCS Runoff	6.165	2	730	25,135	------	------	------	AREA 11
16	SCS Runoff	6.067	2	724	18,161	------	------	------	AREA R2
17	Reservoir	5.564	2	726	17,497	16	85.88	3,384	Route thru 2P
18	SCS Runoff	4.187	2	724	13,051	------	------	------	AREA R3
19	Reservoir	2.599	2	730	12,429	18	85.66	3,015	Route thru 3P
20	SCS Runoff	0.674	2	724	2,014	------	------	------	AREA 12
21	Combine	8.665	2	726	31,941	17, 19, 20	------	------	Total To Pipe 12
22	SCS Runoff	7.533	2	716	16,022	------	------	------	AREA R4
23	SCS Runoff	6.319	2	716	13,400	------	------	------	AREA R5
24	Reservoir	3.746	2	722	12,868	23	86.19	3,624	Route thru 5P
25	Combine	10.78	2	718	28,890	22, 24	------	------	Total To 4P
26	Reservoir	9.771	2	720	28,448	25	86.09	3,166	Route thru 4P
27	SCS Runoff	2.086	2	724	6,334	------	------	------	AREA 13
28	Combine	11.21	2	720	34,782	26, 27	------	------	Total to Pipe 13
29	SCS Runoff	6.495	2	724	19,561	------	------	------	AREA R6
30	Reservoir	4.460	2	728	18,460	29	85.69	4,253	Route thru 6P
31	SCS Runoff	3.902	2	724	11,789	------	------	------	AREA 14
32	SCS Runoff	2.902	2	724	9,044	------	------	------	AREA 15
33	SCS Runoff	9.083	2	730	37,046	------	------	------	AREA 16
34	Combine	18.35	2	726	76,338	30, 31, 32, 33	------	------	Total Area 14

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	SCS Runoff	12.01	2	724	36,774	------	------	------	AREA 17A
36	Reservoir	2.737	2	748	28,270	35	94.03	18,331	Route thru Basin
37	SCS Runoff	14.98	2	724	50,213	------	------	------	AREA 17B
38	Combine	24.09	2	724	147,922	12, 36, 37	------	------	Total 8, 17A, & 17B to Pipe 8
39	SCS Runoff	8.358	2	736	39,558	------	------	------	AREA 18
40	Combine	214.12	2	724	688,184	1, 2, 3, 4, 5, 6,	------	------	Total 1 - 6
41	Combine	94.65	2	728	490,306	10, 13, 14, 15, 21, 38,	------	------	Total 7 - 12
42	Combine	32.69	2	726	150,679	28, 34, 39,	------	------	Total 13 - 18
43	Combine	335.12	2	724	1,329,167	40, 41, 42	------	------	Total Site Runoff

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	96.32	2	724	305,441	------	------	------	AREA PIPE 1
2	SCS Runoff	32.22	2	724	106,403	------	------	------	AREA PIPE 2
3	SCS Runoff	24.32	2	724	81,886	------	------	------	AREA PIPE 3
4	SCS Runoff	20.89	2	724	69,404	------	------	------	AREA PIPE 4
5	SCS Runoff	35.66	2	724	114,370	------	------	------	AREA PIPE 5
6	SCS Runoff	54.21	2	724	180,146	------	------	------	AREA PIPE 6
7	SCS Runoff	5.890	2	724	18,479	------	------	------	AREA R1
8	Reservoir	3.953	2	728	18,080	7	86.10	2,762	Route thru 1P
9	SCS Runoff	0.892	2	724	2,672	------	------	------	AREA PIPE 7
10	Combine	4.614	2	728	20,752	8, 9	------	------	Total To Pipe 7
11	SCS Runoff	27.40	2	724	89,874	------	------	------	AREA SUB. SYSTEM / PIPE 8
12	Reservoir	12.23	2	732	86,907	11	95.49	26,609	Route thru Subsurface
13	SCS Runoff	20.71	2	724	67,265	------	------	------	AREA PIPE 9
14	SCS Runoff	65.32	2	734	288,850	------	------	------	AREA 10
15	SCS Runoff	8.288	2	730	33,734	------	------	------	AREA 11
16	SCS Runoff	7.967	2	724	23,986	------	------	------	AREA R2
17	Reservoir	6.124	2	728	23,322	16	86.08	3,858	Route thru 2P
18	SCS Runoff	5.217	2	724	16,479	------	------	------	AREA R3
19	Reservoir	3.127	2	730	15,858	18	85.87	3,526	Route thru 3P
20	SCS Runoff	0.903	2	724	2,703	------	------	------	AREA 12
21	Combine	9.891	2	728	41,883	17, 19, 20	------	------	Total To Pipe 12
22	SCS Runoff	9.420	2	716	20,338	------	------	------	AREA R4
23	SCS Runoff	7.917	2	716	17,040	------	------	------	AREA R5
24	Reservoir	4.526	2	722	16,507	23	86.64	4,413	Route thru 5P
25	Combine	13.28	2	718	36,845	22, 24	------	------	Total To 4P
26	Reservoir	11.84	2	720	36,403	25	86.44	3,682	Route thru 4P
27	SCS Runoff	2.950	2	724	8,850	------	------	------	AREA 13
28	Combine	13.92	2	720	45,253	26, 27	------	------	Total to Pipe 13
29	SCS Runoff	8.380	2	724	25,467	------	------	------	AREA R6
30	Reservoir	5.561	2	728	24,366	29	86.02	5,011	Route thru 6P
31	SCS Runoff	5.007	2	724	15,277	------	------	------	AREA 14
32	SCS Runoff	4.279	2	724	13,003	------	------	------	AREA 15
33	SCS Runoff	12.24	2	730	49,797	------	------	------	AREA 16
34	Combine	24.44	2	726	102,443	30, 31, 32, 33	------	------	Total Area 14

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	SCS Runoff	15.17	2	724	47,011	------	------	------	AREA 17A
36	Reservoir	3.664	2	746	38,507	35	94.44	22,785	Route thru Basin
37	SCS Runoff	18.22	2	724	61,676	------	------	------	AREA 17B
38	Combine	30.90	2	724	187,089	12, 36, 37	------	------	Total 8, 17A, & 17B to Pipe 8
39	SCS Runoff	11.22	2	736	53,092	------	------	------	AREA 18
40	Combine	263.62	2	724	857,650	1, 2, 3, 4, 5, 6,	------	------	Total 1 - 6
41	Combine	122.58	2	728	639,574	10, 13, 14, 15, 21, 38,	------	------	Total 7 - 12
42	Combine	43.44	2	726	200,788	28, 34, 39,	------	------	Total 13 - 18
43	Combine	423.58	2	724	1,698,010	40, 41, 42	------	------	Total Site Runoff

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	110.67	2	724	354,056	------	------	------	AREA PIPE 1
2	SCS Runoff	36.70	2	724	122,120	------	------	------	AREA PIPE 2
3	SCS Runoff	27.65	2	724	93,649	------	------	------	AREA PIPE 3
4	SCS Runoff	23.78	2	724	79,561	------	------	------	AREA PIPE 4
5	SCS Runoff	40.85	2	724	132,152	------	------	------	AREA PIPE 5
6	SCS Runoff	61.71	2	724	206,511	------	------	------	AREA PIPE 6
7	SCS Runoff	6.792	2	724	21,495	------	------	------	AREA R1
8	Reservoir	4.495	2	728	21,096	7	86.43	3,125	Route thru 1P
9	SCS Runoff	1.095	2	724	3,272	------	------	------	AREA PIPE 7
10	Combine	5.321	2	726	24,368	8, 9	------	------	Total To Pipe 7
11	SCS Runoff	31.25	2	724	103,298	------	------	------	AREA SUB. SYSTEM / PIPE 8
12	Reservoir	14.00	2	732	100,330	11	95.84	29,383	Route thru Subsurface
13	SCS Runoff	23.66	2	724	77,479	------	------	------	AREA PIPE 9
14	SCS Runoff	78.37	2	732	347,131	------	------	------	AREA 10
15	SCS Runoff	9.945	2	730	40,541	------	------	------	AREA 11
16	SCS Runoff	9.435	2	724	28,562	------	------	------	AREA R2
17	Reservoir	6.716	2	728	27,898	16	86.29	4,408	Route thru 2P
18	SCS Runoff	6.002	2	724	19,125	------	------	------	AREA R3
19	Reservoir	3.501	2	730	18,504	18	86.04	3,933	Route thru 3P
20	SCS Runoff	1.082	2	724	3,248	------	------	------	AREA 12
21	Combine	10.97	2	728	49,651	17, 19, 20	------	------	Total To Pipe 12
22	SCS Runoff	10.86	2	716	23,675	------	------	------	AREA R4
23	SCS Runoff	9.135	2	716	19,855	------	------	------	AREA R5
24	Reservoir	5.178	2	722	19,323	23	87.10	5,021	Route thru 5P
25	Combine	15.18	2	718	42,997	22, 24	------	------	Total To 4P
26	Reservoir	13.58	2	720	42,555	25	86.77	4,073	Route thru 4P
27	SCS Runoff	3.639	2	724	10,881	------	------	------	AREA 13
28	Combine	16.17	2	720	53,437	26, 27	------	------	Total to Pipe 13
29	SCS Runoff	9.827	2	724	30,078	------	------	------	AREA R6
30	Reservoir	6.369	2	728	28,977	29	86.30	5,613	Route thru 6P
31	SCS Runoff	5.853	2	724	17,995	------	------	------	AREA 14
32	SCS Runoff	5.395	2	724	16,245	------	------	------	AREA 15
33	SCS Runoff	14.70	2	730	59,898	------	------	------	AREA 16
34	Combine	29.19	2	726	123,115	30, 31, 32, 33	------	------	Total Area 14

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	SCS Runoff	17.58	2	724	54,946	------	------	------	AREA 17A
36	Reservoir	4.243	2	746	46,441	35	94.76	26,221	Route thru Basin
37	SCS Runoff	20.70	2	724	70,469	------	------	------	AREA 17B
38	Combine	35.25	2	724	217,241	12, 36, 37	------	------	Total 8, 17A, & 17B to Pipe 8
39	SCS Runoff	13.45	2	736	63,805	------	------	------	AREA 18
40	Combine	301.37	2	724	988,050	1, 2, 3, 4, 5, 6,	------	------	Total 1 - 6
41	Combine	143.91	2	728	756,411	10, 13, 14, 15, 21, 38,	------	------	Total 7 - 12
42	Combine	51.96	2	726	240,356	28, 34, 39,	------	------	Total 13 - 18
43	Combine	489.17	2	724	1,984,815	40, 41, 42	------	------	Total Site Runoff

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	125.14	2	724	403,457	------	------	------	AREA PIPE 1
2	SCS Runoff	41.23	2	724	138,051	------	------	------	AREA PIPE 2
3	SCS Runoff	31.01	2	724	105,564	------	------	------	AREA PIPE 3
4	SCS Runoff	26.69	2	724	89,854	------	------	------	AREA PIPE 4
5	SCS Runoff	46.09	2	724	150,204	------	------	------	AREA PIPE 5
6	SCS Runoff	69.28	2	724	233,227	------	------	------	AREA PIPE 6
7	SCS Runoff	7.700	2	724	24,563	------	------	------	AREA R1
8	Reservoir	5.001	2	728	24,164	7	86.77	3,507	Route thru 1P
9	SCS Runoff	1.304	2	724	3,898	------	------	------	AREA PIPE 7
10	Combine	5.998	2	726	28,062	8, 9	------	------	Total To Pipe 7
11	SCS Runoff	35.13	2	724	116,907	------	------	------	AREA SUB. SYSTEM / PIPE 8
12	Reservoir	15.78	2	732	113,940	11	96.23	32,156	Route thru Subsurface
13	SCS Runoff	26.63	2	724	87,840	------	------	------	AREA PIPE 9
14	SCS Runoff	91.75	2	732	407,323	------	------	------	AREA 10
15	SCS Runoff	11.64	2	730	47,570	------	------	------	AREA 11
16	SCS Runoff	10.92	2	724	33,266	------	------	------	AREA R2
17	Reservoir	8.164	2	728	32,602	16	86.99	4,846	Route thru 2P
18	SCS Runoff	6.793	2	724	21,816	------	------	------	AREA R3
19	Reservoir	3.863	2	730	21,195	18	86.23	4,357	Route thru 3P
20	SCS Runoff	1.264	2	724	3,812	------	------	------	AREA 12
21	Combine	12.89	2	728	57,608	17, 19, 20	------	------	Total To Pipe 12
22	SCS Runoff	12.31	2	716	27,070	------	------	------	AREA R4
23	SCS Runoff	10.36	2	716	22,722	------	------	------	AREA R5
24	Reservoir	5.855	2	722	22,189	23	87.63	5,634	Route thru 5P
25	Combine	17.16	2	718	49,259	22, 24	------	------	Total To 4P
26	Reservoir	15.38	2	720	48,817	25	87.16	4,477	Route thru 4P
27	SCS Runoff	4.352	2	724	13,007	------	------	------	AREA 13
28	Combine	18.51	2	720	61,824	26, 27	------	------	Total to Pipe 13
29	SCS Runoff	11.29	2	724	34,799	------	------	------	AREA R6
30	Reservoir	7.258	2	728	33,697	29	86.67	6,228	Route thru 6P
31	SCS Runoff	6.708	2	724	20,775	------	------	------	AREA 14
32	SCS Runoff	6.564	2	724	19,669	------	------	------	AREA 15
33	SCS Runoff	17.21	2	730	70,335	------	------	------	AREA 16
34	Combine	34.08	2	726	144,475	30, 31, 32, 33	------	------	Total Area 14

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	SCS Runoff	20.01	2	724	63,033	------	------	------	AREA 17A
36	Reservoir	4.734	2	746	54,528	35	95.07	29,616	Route thru Basin
37	SCS Runoff	23.20	2	724	79,375	------	------	------	AREA 17B
38	Combine	39.51	2	724	247,843	12, 36, 37	------	------	Total 8, 17A, & 17B to Pipe 8
39	SCS Runoff	15.74	2	736	74,868	------	------	------	AREA 18
40	Combine	339.44	2	724	1,120,356	1, 2, 3, 4, 5, 6,	------	------	Total 1 - 6
41	Combine	166.32	2	728	876,245	10, 13, 14, 15, 21, 38,	------	------	Total 7 - 12
42	Combine	60.31	2	726	281,167	28, 34, 39,	------	------	Total 13 - 18
43	Combine	555.78	2	724	2,277,782	40, 41, 42	------	------	Total Site Runoff

Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	17.4950	4.2000	0.6438	--------
3	0.0000	0.0000	0.0000	--------
5	40.8144	10.8000	0.7755	--------
10	45.6810	10.9000	0.7723	--------
25	106.0698	18.5000	0.9101	--------
50	44.6078	10.9000	0.6858	--------
100	47.7883	11.3000	0.6734	--------

File name: Boston IDF curve.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	4.19	3.17	2.61	2.25	1.99	1.80	1.65	1.53	1.42	1.34	1.26	1.20
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	4.80	3.88	3.28	2.86	2.55	2.30	2.10	1.94	1.80	1.69	1.59	1.50
10	5.39	4.37	3.70	3.23	2.88	2.60	2.38	2.20	2.04	1.91	1.80	1.70
25	5.99	5.03	4.34	3.82	3.42	3.10	2.84	2.61	2.43	2.26	2.12	2.00
50	6.69	5.55	4.79	4.24	3.83	3.50	3.23	3.01	2.82	2.66	2.52	2.40
100	7.29	6.09	5.29	4.70	4.25	3.90	3.61	3.37	3.17	2.99	2.84	2.70

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

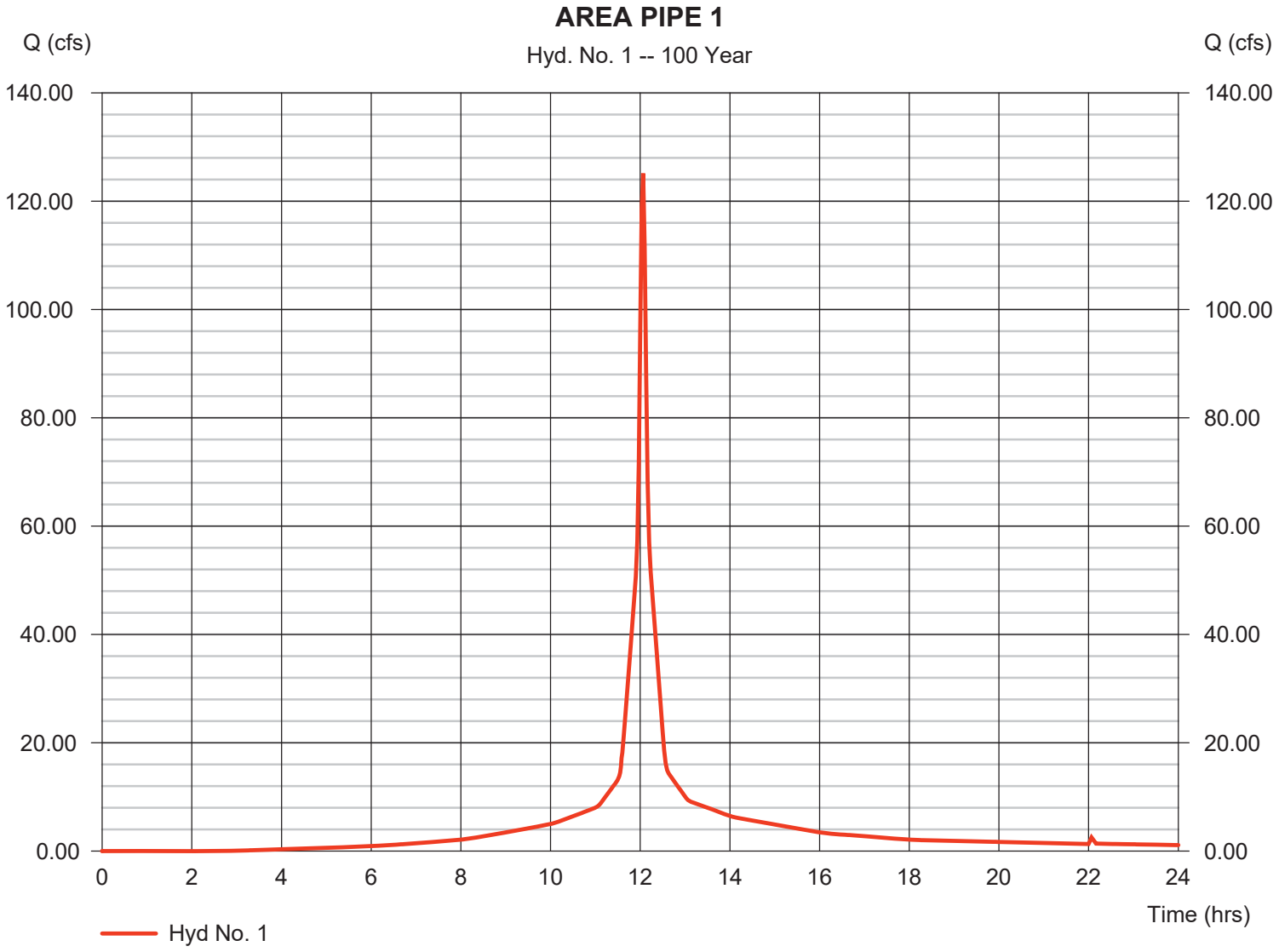
Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	3.36	0.00	0.00	5.08	6.15	6.97	7.80
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hydrograph Report

Hyd. No. 1

AREA PIPE 1

Hydrograph type	= SCS Runoff	Peak discharge	= 125.14 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 403,457 cuft
Drainage area	= 17.780 ac	Curve number	= 90.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

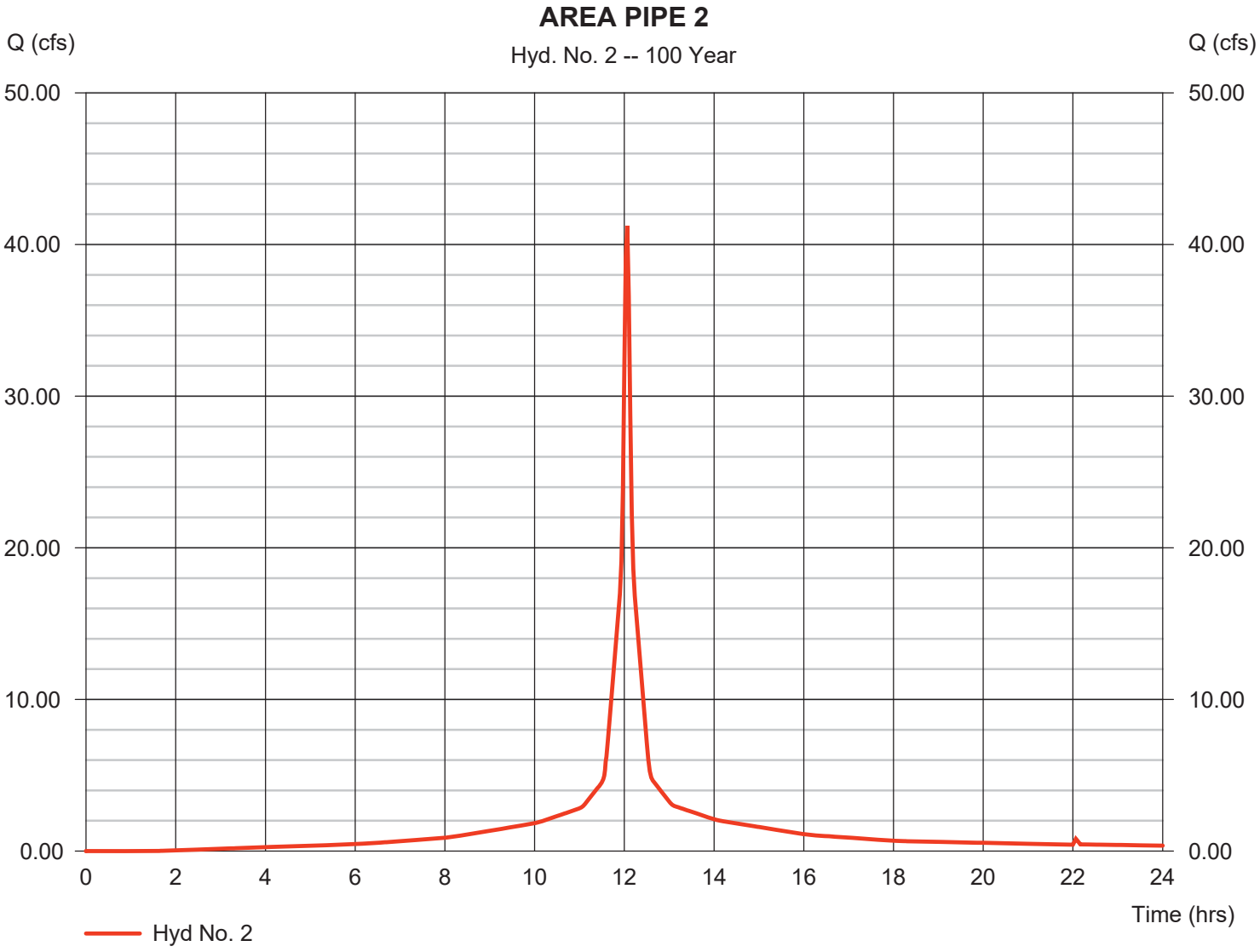


Hydrograph Report

Hyd. No. 2

AREA PIPE 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	41.23 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	138,051 cuft
Drainage area	=	5.670 ac	Curve number	=	94.6
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

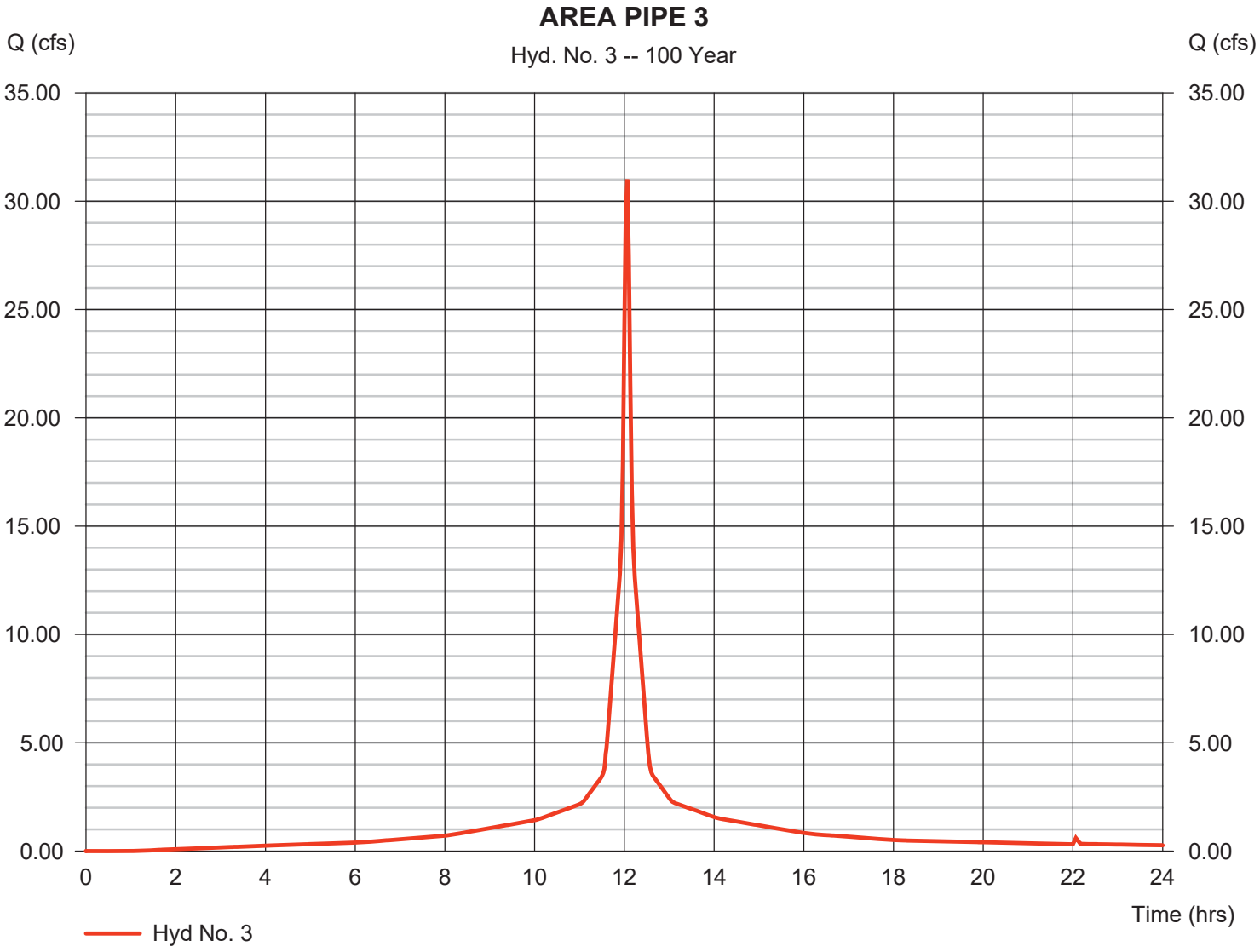


Hydrograph Report

Hyd. No. 3

AREA PIPE 3

Hydrograph type	= SCS Runoff	Peak discharge	= 31.01 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 105,564 cuft
Drainage area	= 4.230 ac	Curve number	= 96.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

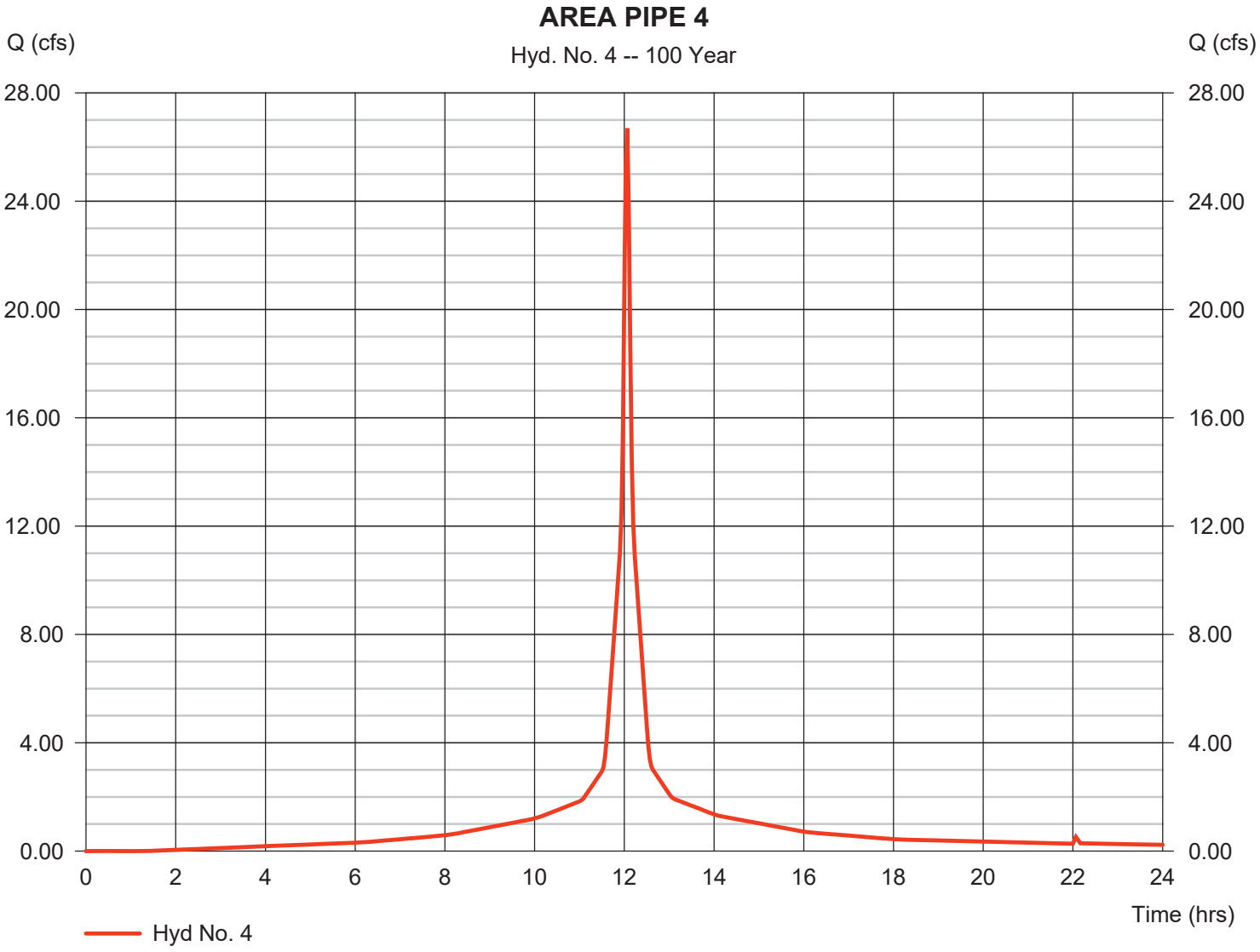


Hydrograph Report

Hyd. No. 4

AREA PIPE 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	26.69 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	89,854 cuft
Drainage area	=	3.660 ac	Curve number	=	95.1
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

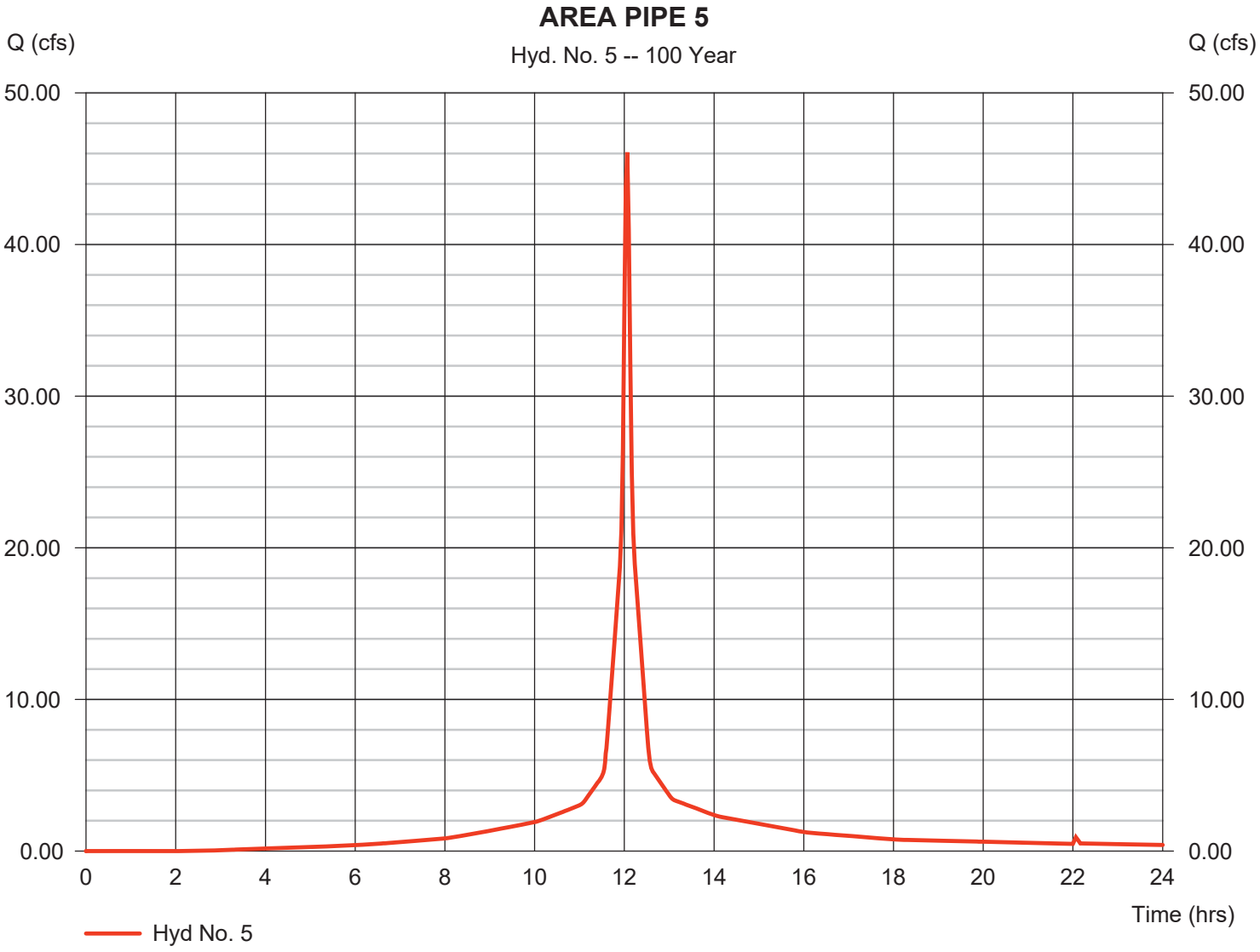


Hydrograph Report

Hyd. No. 5

AREA PIPE 5

Hydrograph type	=	SCS Runoff	Peak discharge	=	46.09 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	150,204 cuft
Drainage area	=	6.470 ac	Curve number	=	91.8
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

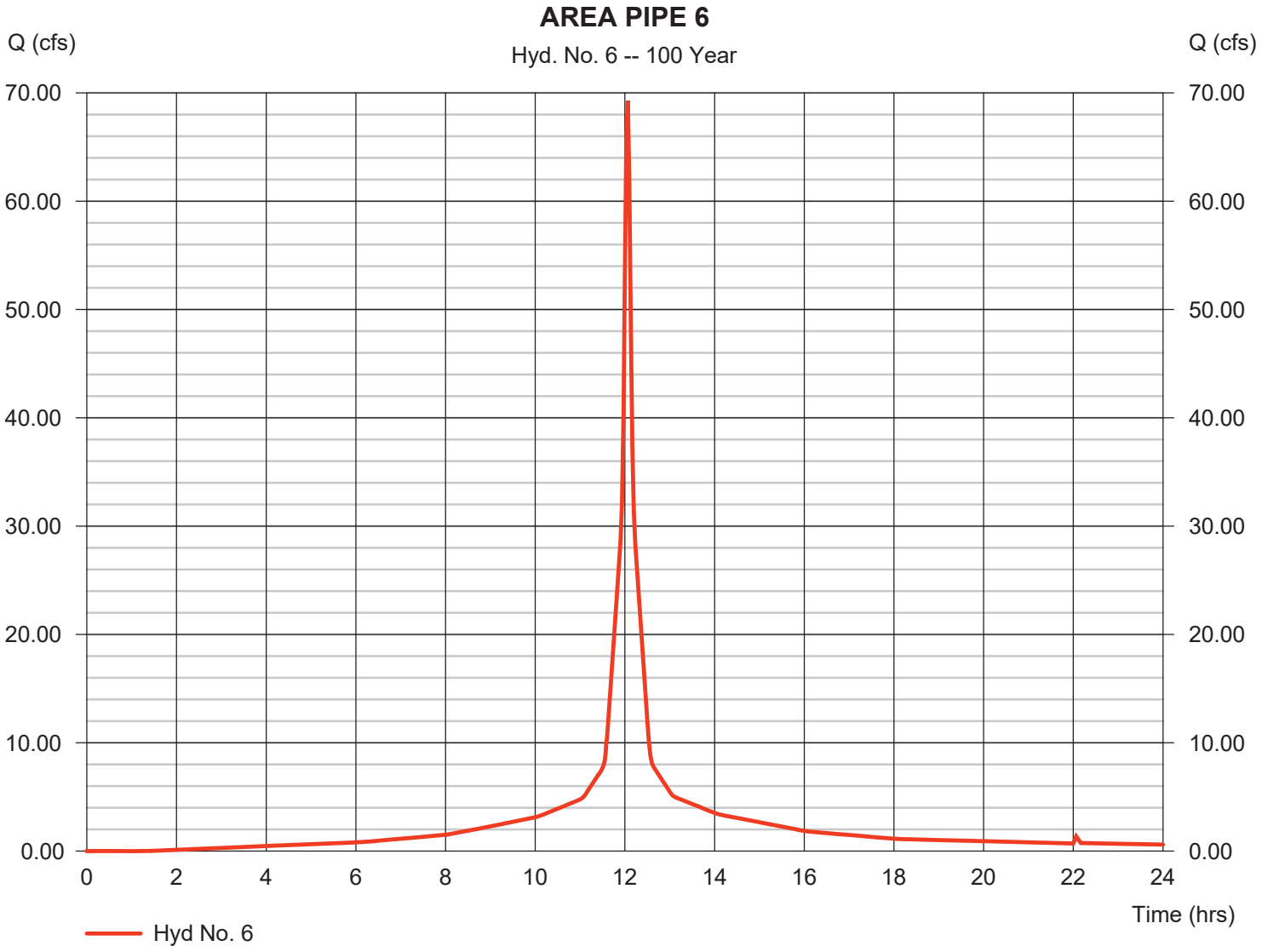


Hydrograph Report

Hyd. No. 6

AREA PIPE 6

Hydrograph type	=	SCS Runoff	Peak discharge	=	69.28 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	233,227 cuft
Drainage area	=	9.500 ac	Curve number	=	95.1
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

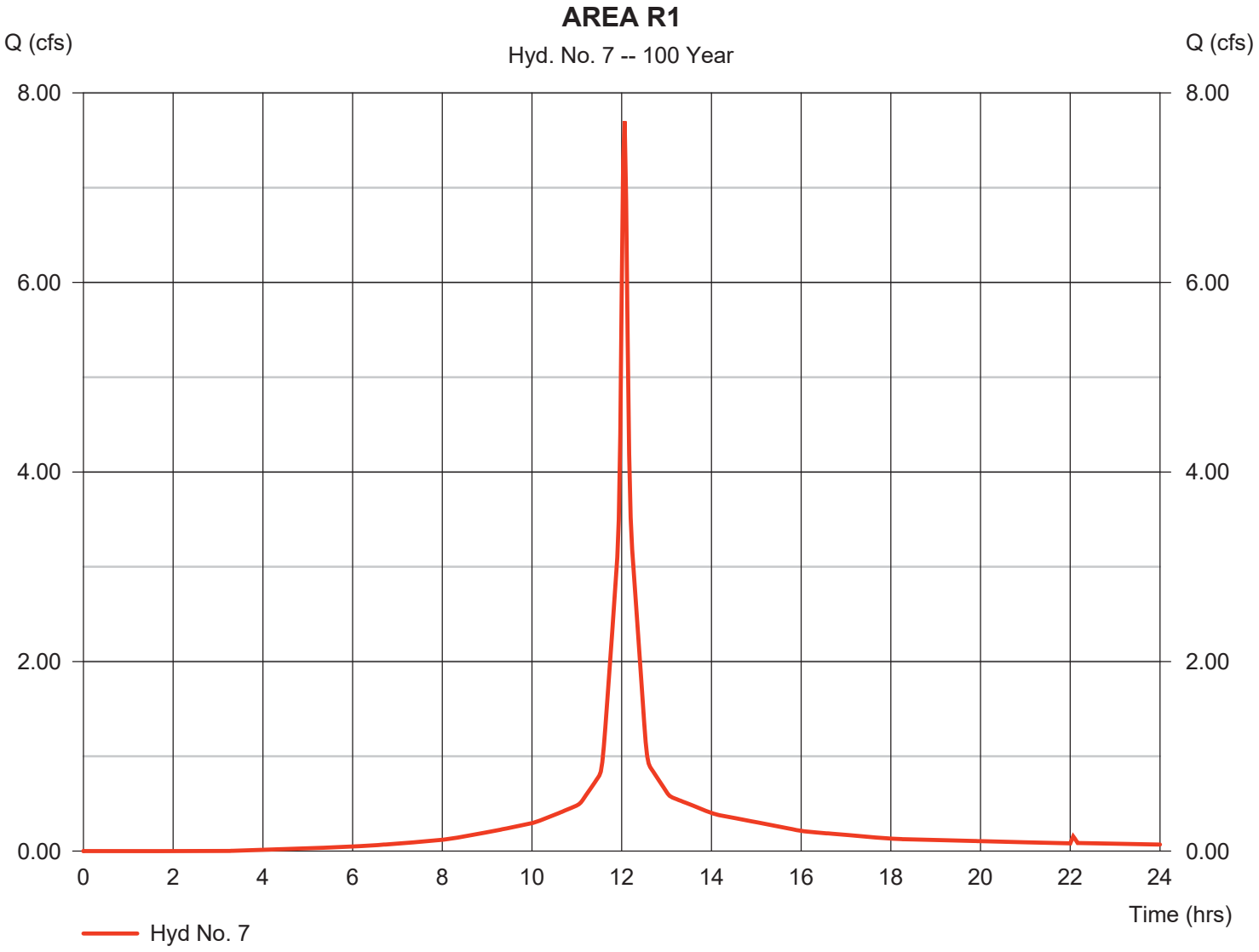


Hydrograph Report

Hyd. No. 7

AREA R1

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.700 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	24,563 cuft
Drainage area	=	1.110 ac	Curve number	=	89.1
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



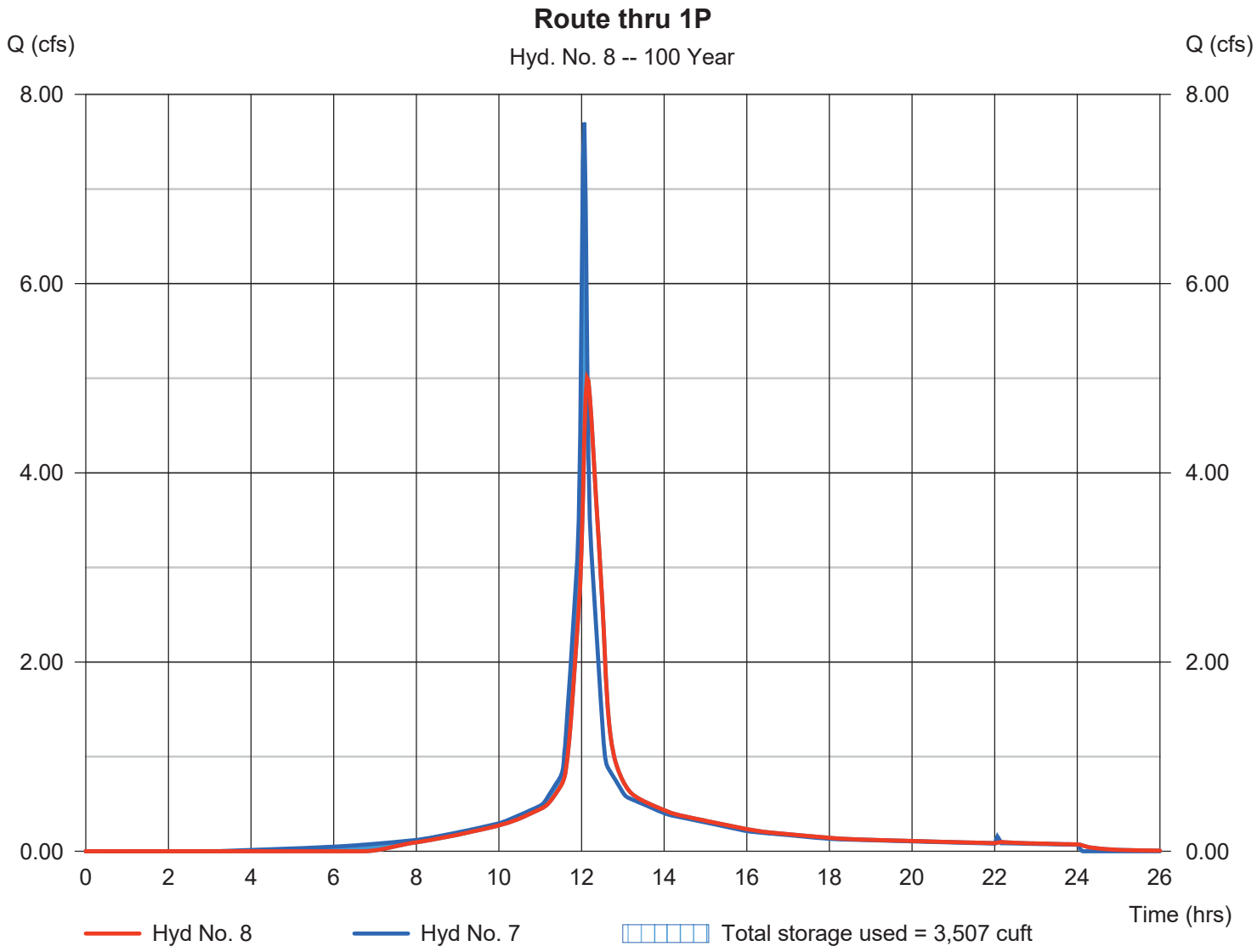
Hydrograph Report

Hyd. No. 8

Route thru 1P

Hydrograph type	= Reservoir	Peak discharge	= 5.001 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 24,164 cuft
Inflow hyd. No.	= 7 - AREA R1	Max. Elevation	= 86.77 ft
Reservoir name	= 1P	Max. Storage	= 3,507 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 3 - 1P

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	84.00	n/a	0	0
0.50	84.50	n/a	392	392
1.00	85.00	n/a	784	1,176
2.00	86.00	n/a	1,481	2,657
3.00	87.00	n/a	1,133	3,790
3.50	87.50	n/a	392	4,182

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 84.50	0.00	0.00	0.00
Length (ft)	= 30.00	0.00	0.00	0.00
Slope (%)	= 1.70	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

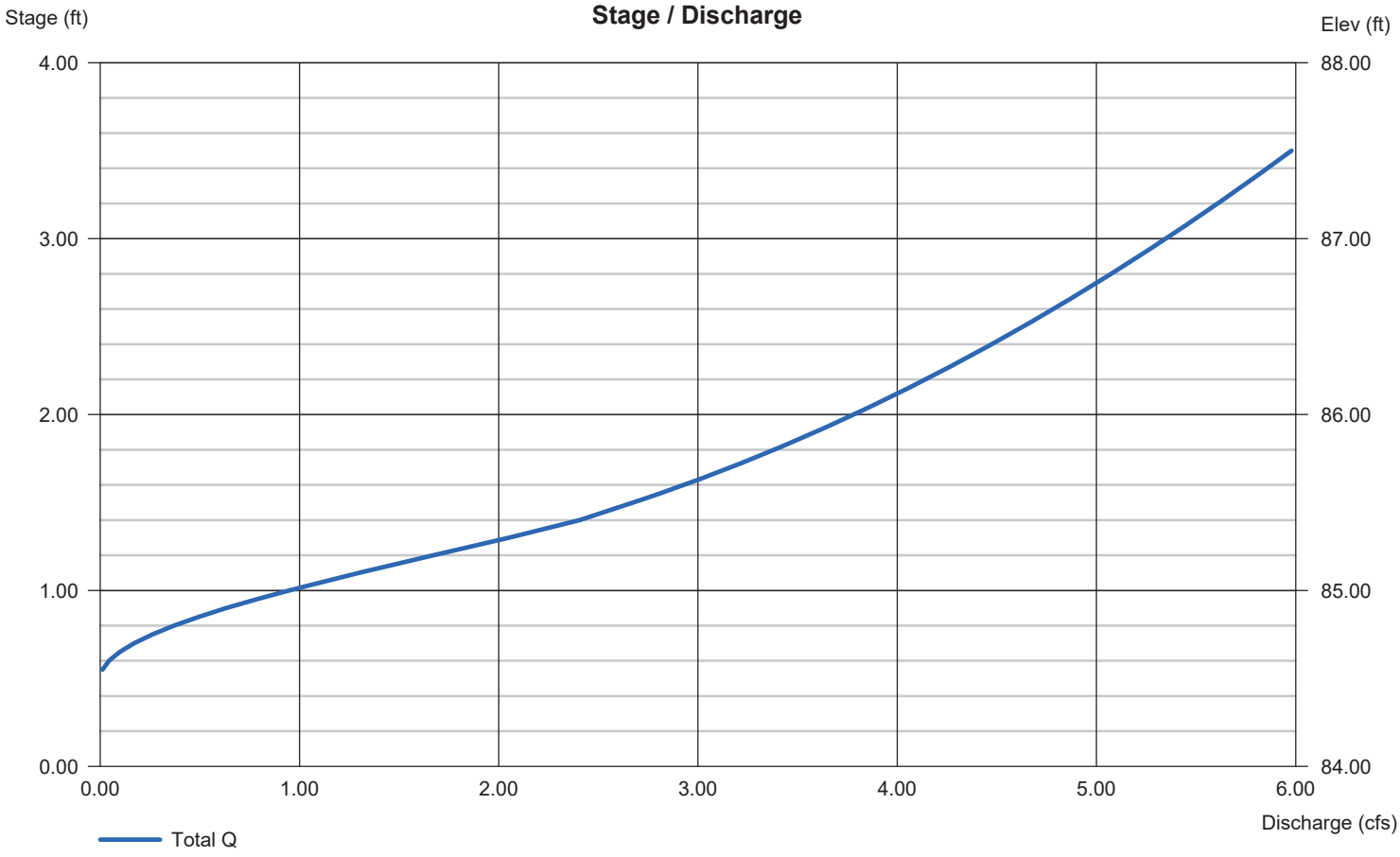
Weir Structures

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

Exfil.(in/hr) = 1.020 (by Wet area)

TW Elev. (ft) = 0.00

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

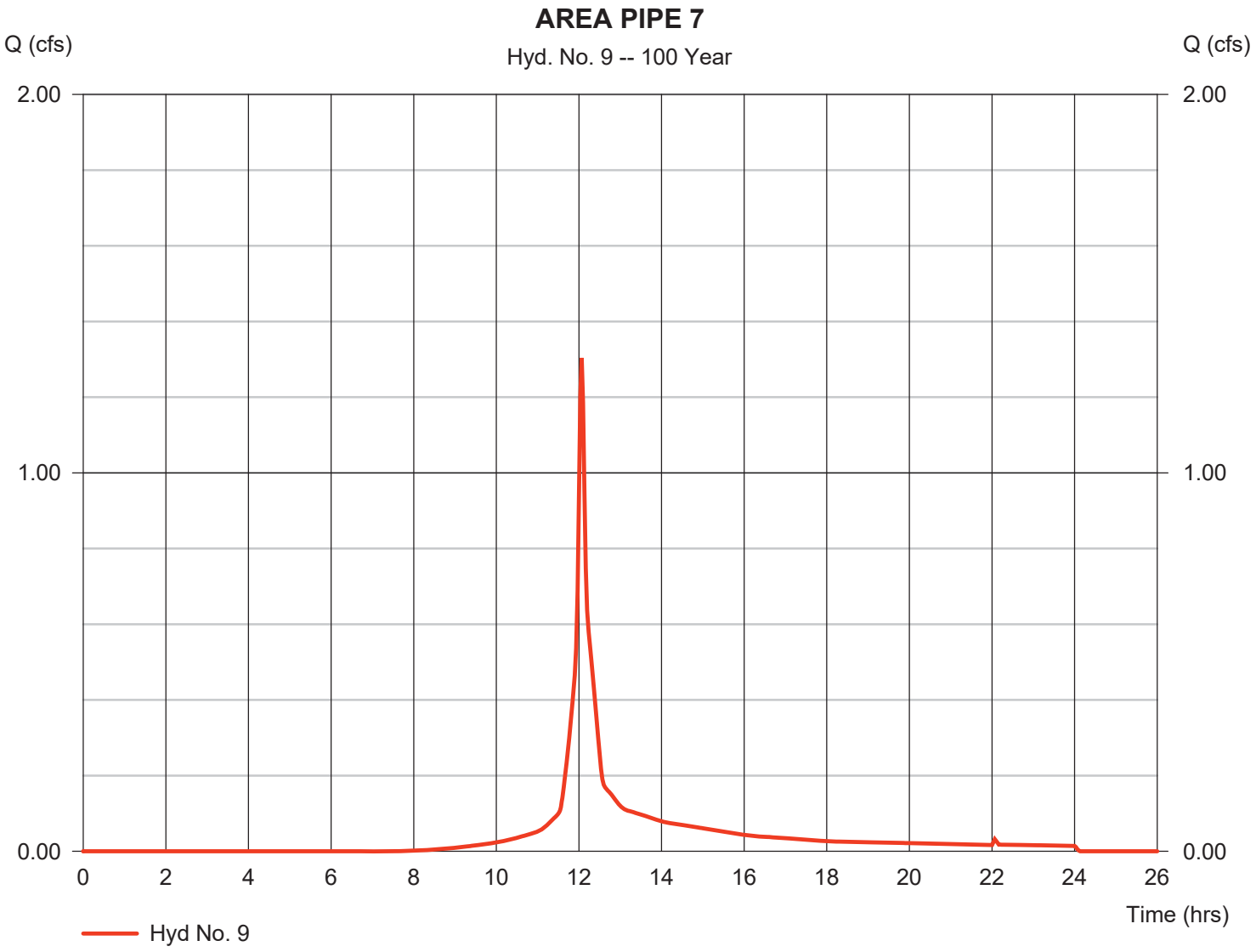


Hydrograph Report

Hyd. No. 9

AREA PIPE 7

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.304 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	3,898 cuft
Drainage area	=	0.260 ac	Curve number	=	71
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

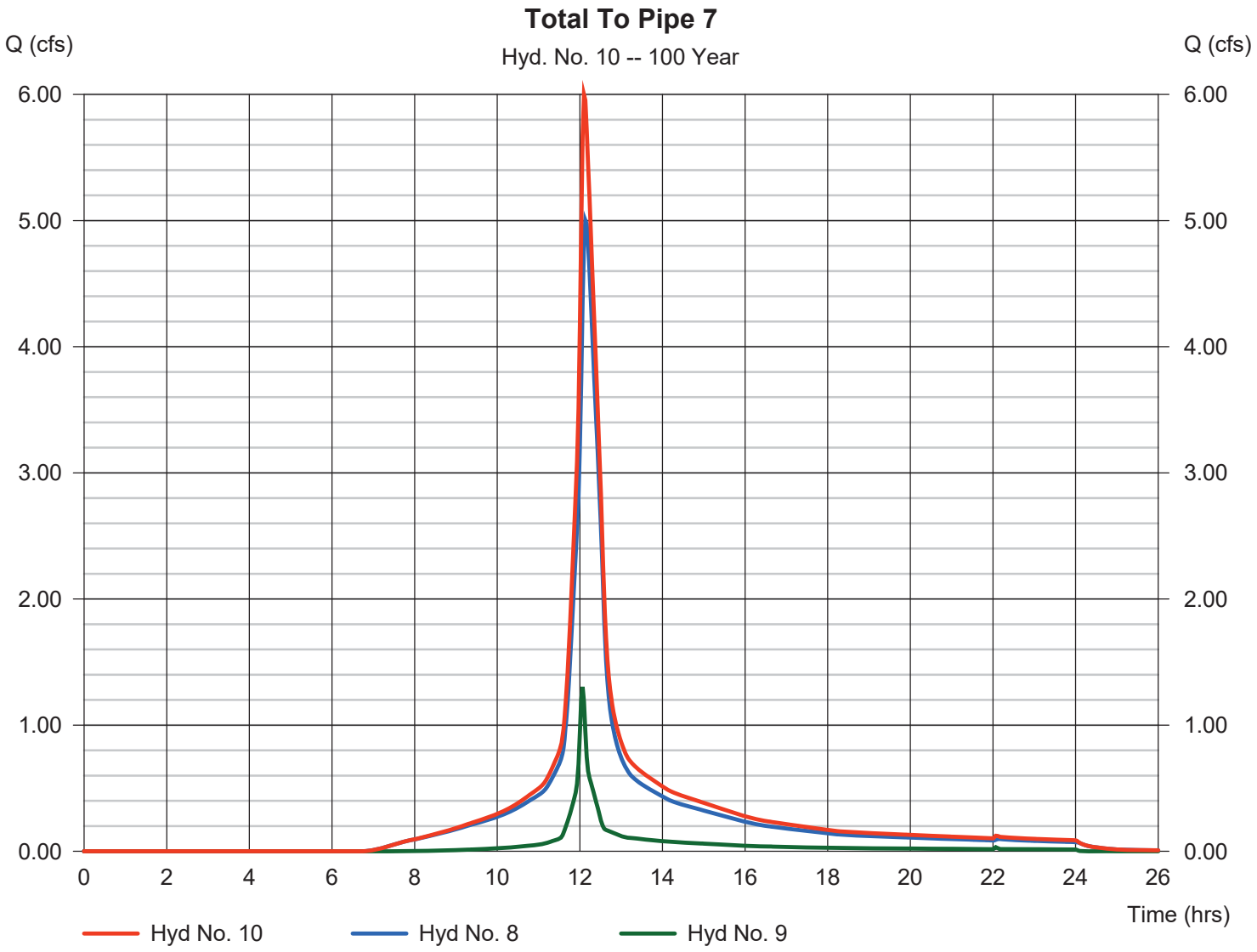


Hydrograph Report

Hyd. No. 10

Total To Pipe 7

Hydrograph type	= Combine	Peak discharge	= 5.998 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 28,062 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.260 ac

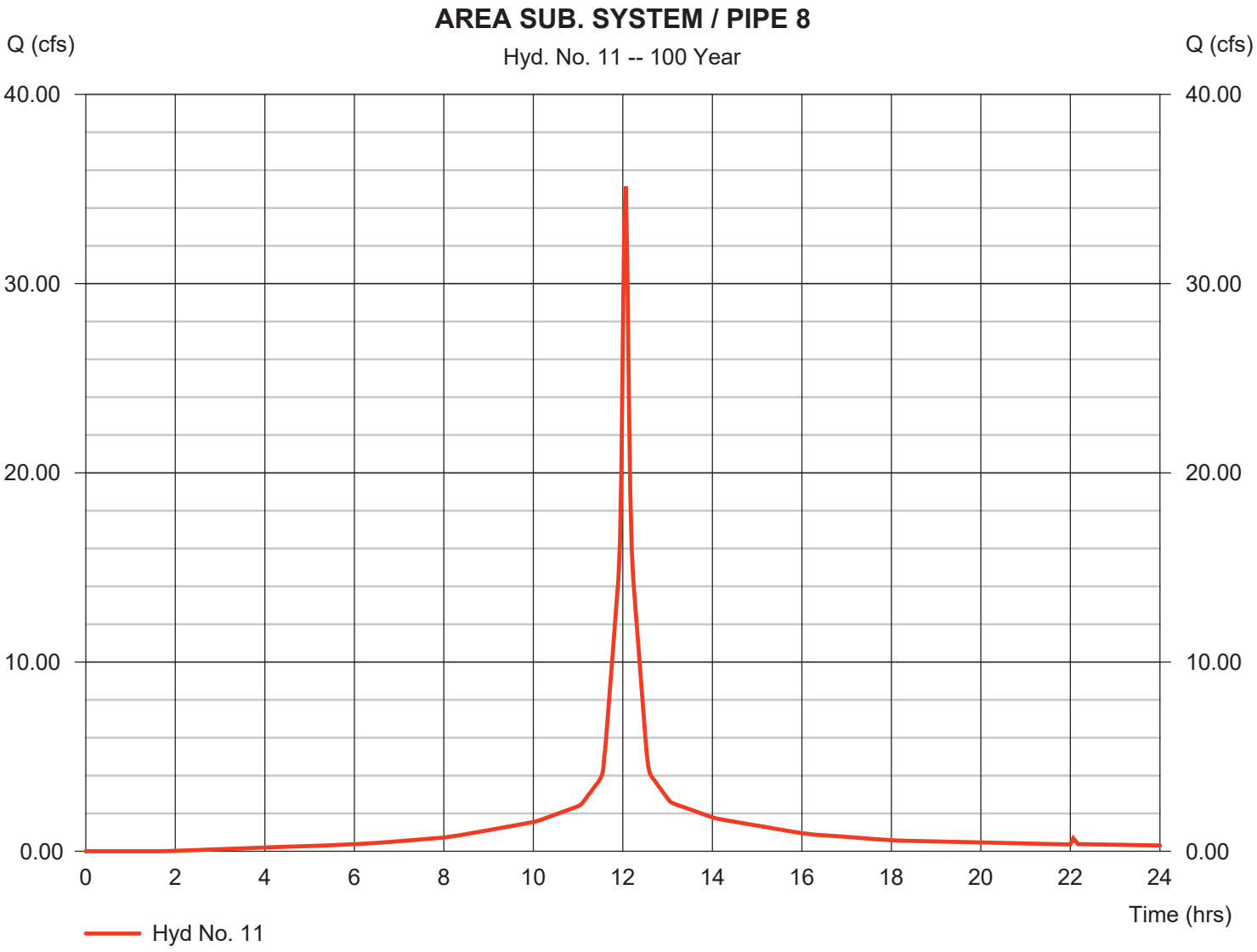


Hydrograph Report

Hyd. No. 11

AREA SUB. SYSTEM / PIPE 8

Hydrograph type	= SCS Runoff	Peak discharge	= 35.13 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 116,907 cuft
Drainage area	= 4.850 ac	Curve number	= 94
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



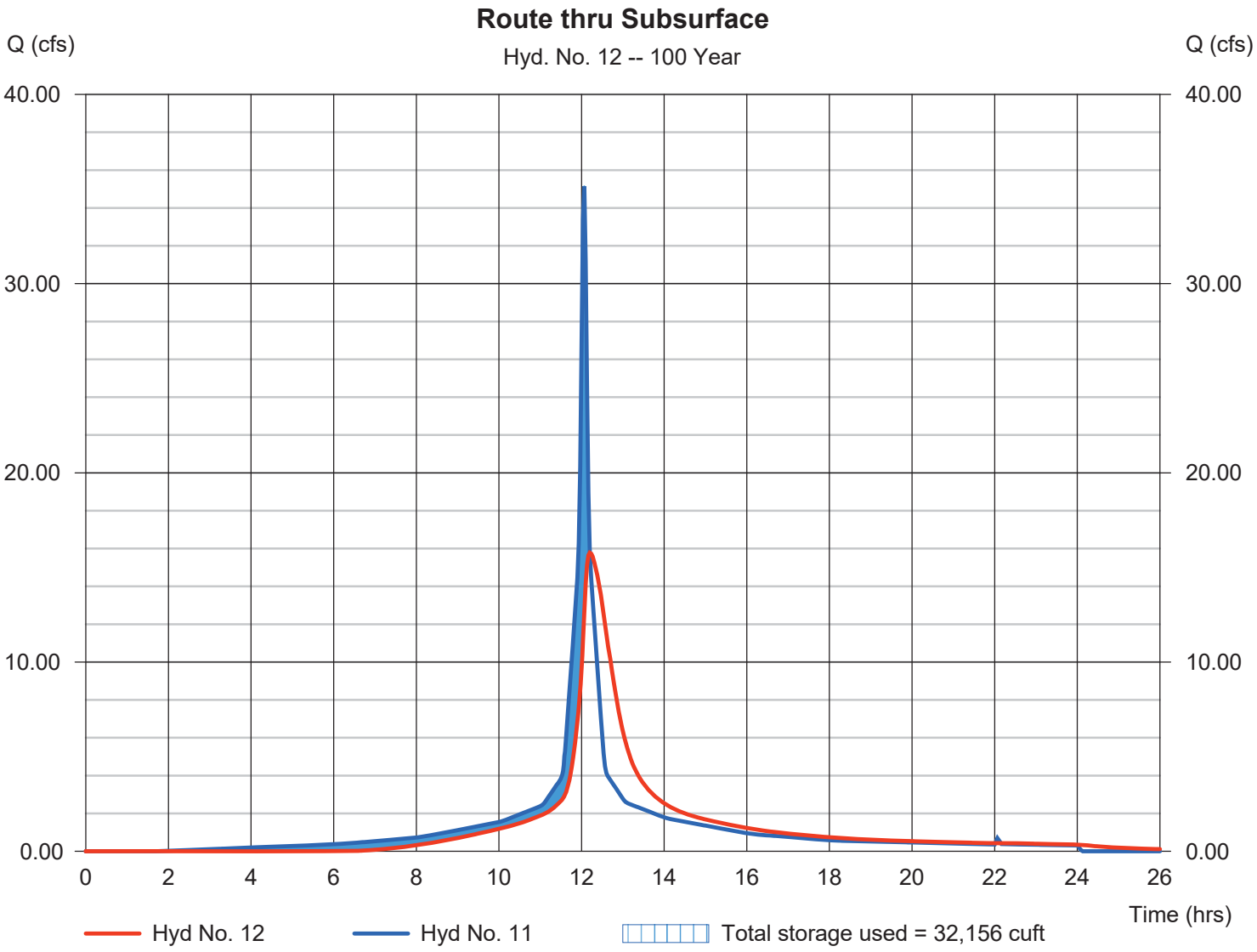
Hydrograph Report

Hyd. No. 12

Route thru Subsurface

Hydrograph type	=	Reservoir	Peak discharge	=	15.78 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	113,940 cuft
Inflow hyd. No.	=	11 - AREA SUB. SYSTEM / PIPE 3	Max. Elevation	=	96.23 ft
Reservoir name	=	Subsurface Infiltration Chamber System	Max. Storage	=	32,156 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Subsurface Infiltration Chamber System

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	93.00	n/a	0	0
0.50	93.50	n/a	2,925	2,925
1.00	94.00	n/a	6,365	9,290
1.50	94.50	n/a	6,180	15,470
2.00	95.00	n/a	5,932	21,402
2.50	95.50	n/a	5,303	26,705
3.00	96.00	n/a	3,983	30,688
3.50	96.50	n/a	3,169	33,857

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 21.00	0.00	0.00	0.00
Span (in)	= 21.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 93.50	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

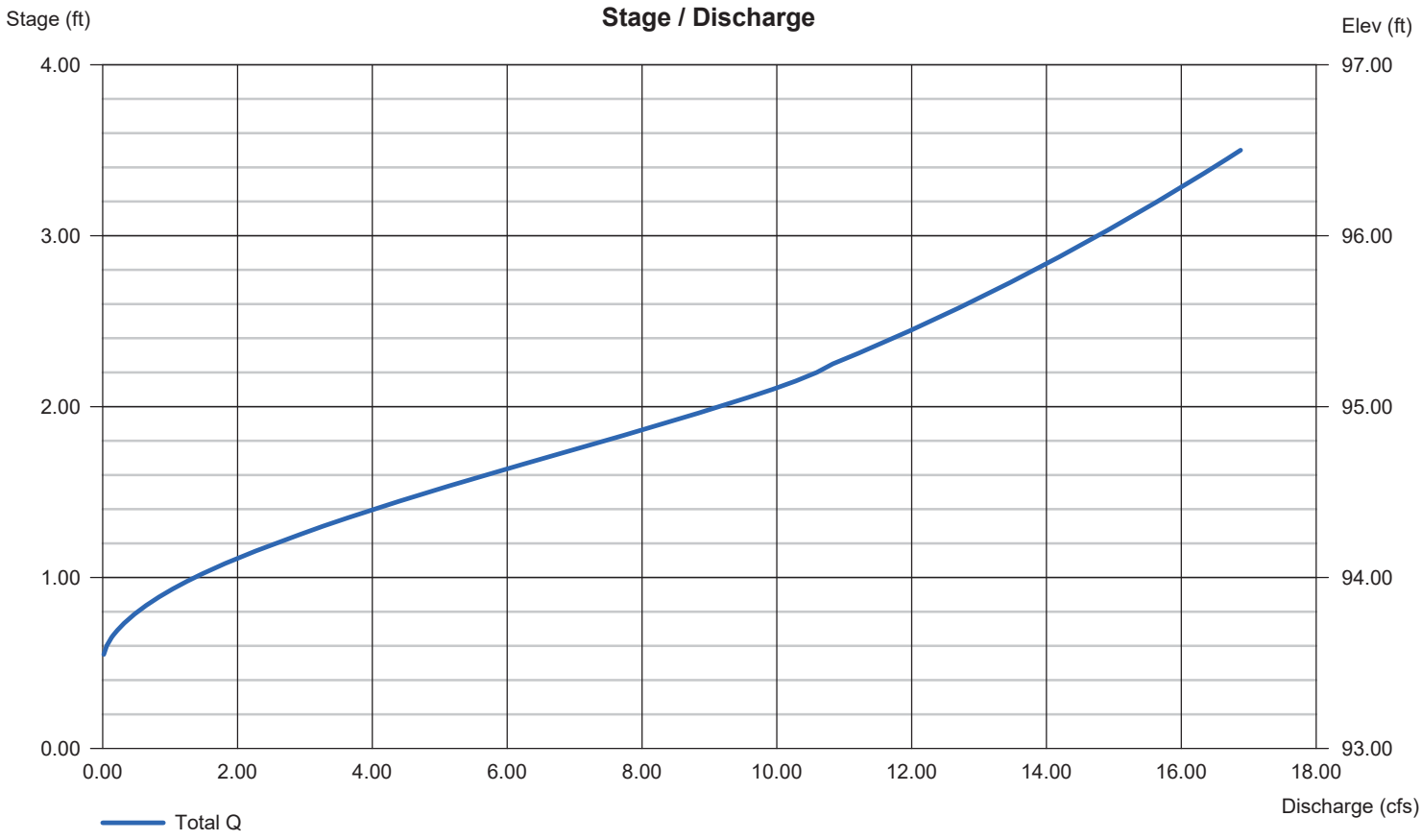
Weir Structures

	[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) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

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

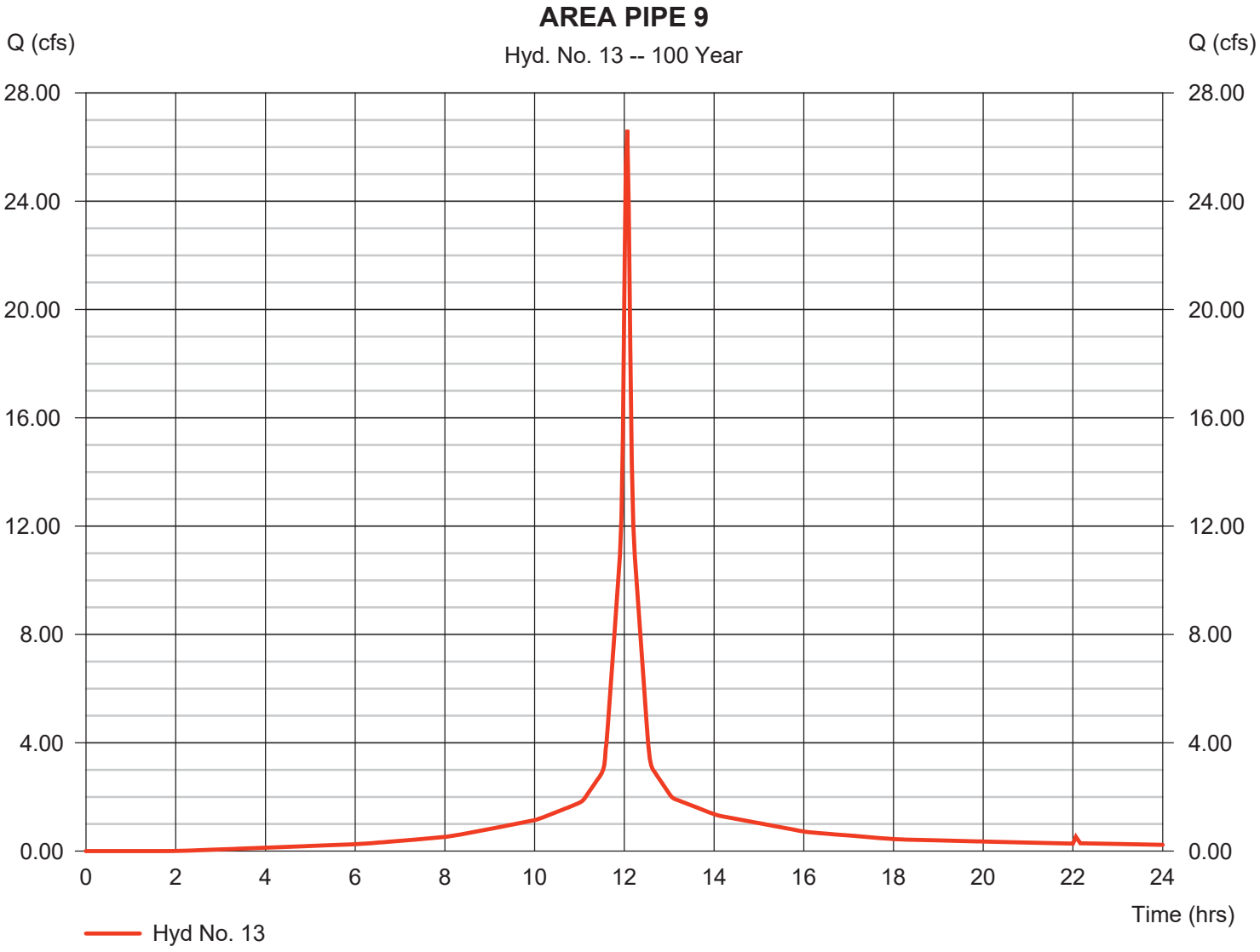


Hydrograph Report

Hyd. No. 13

AREA PIPE 9

Hydrograph type	= SCS Runoff	Peak discharge	= 26.63 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 87,840 cuft
Drainage area	= 3.700 ac	Curve number	= 93.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

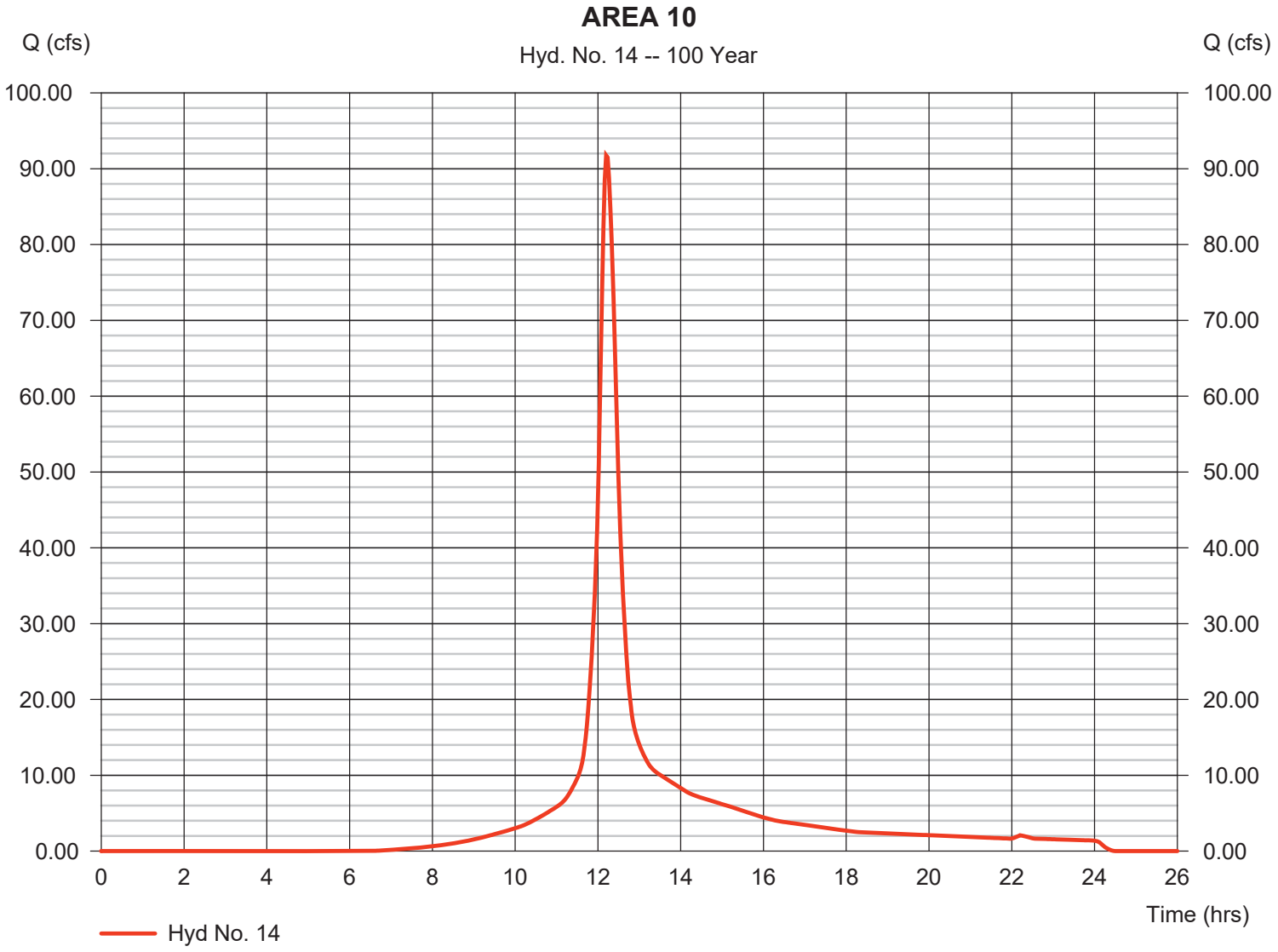


Hydrograph Report

Hyd. No. 14

AREA 10

Hydrograph type	=	SCS Runoff	Peak discharge	=	91.75 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	407,323 cuft
Drainage area	=	22.040 ac	Curve number	=	77
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	17.90 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 14

AREA 10

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.36		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 12.04**	**+**	**0.00**	**+**	**0.00**	**=**	**12.04**
Shallow Concentrated Flow							
Flow length (ft)	= 666.00		0.00		0.00		
Watercourse slope (%)	= 1.40		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.91		0.00		0.00		
Travel Time (min)	**= 5.81**	**+**	**0.00**	**+**	**0.00**	**=**	**5.81**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

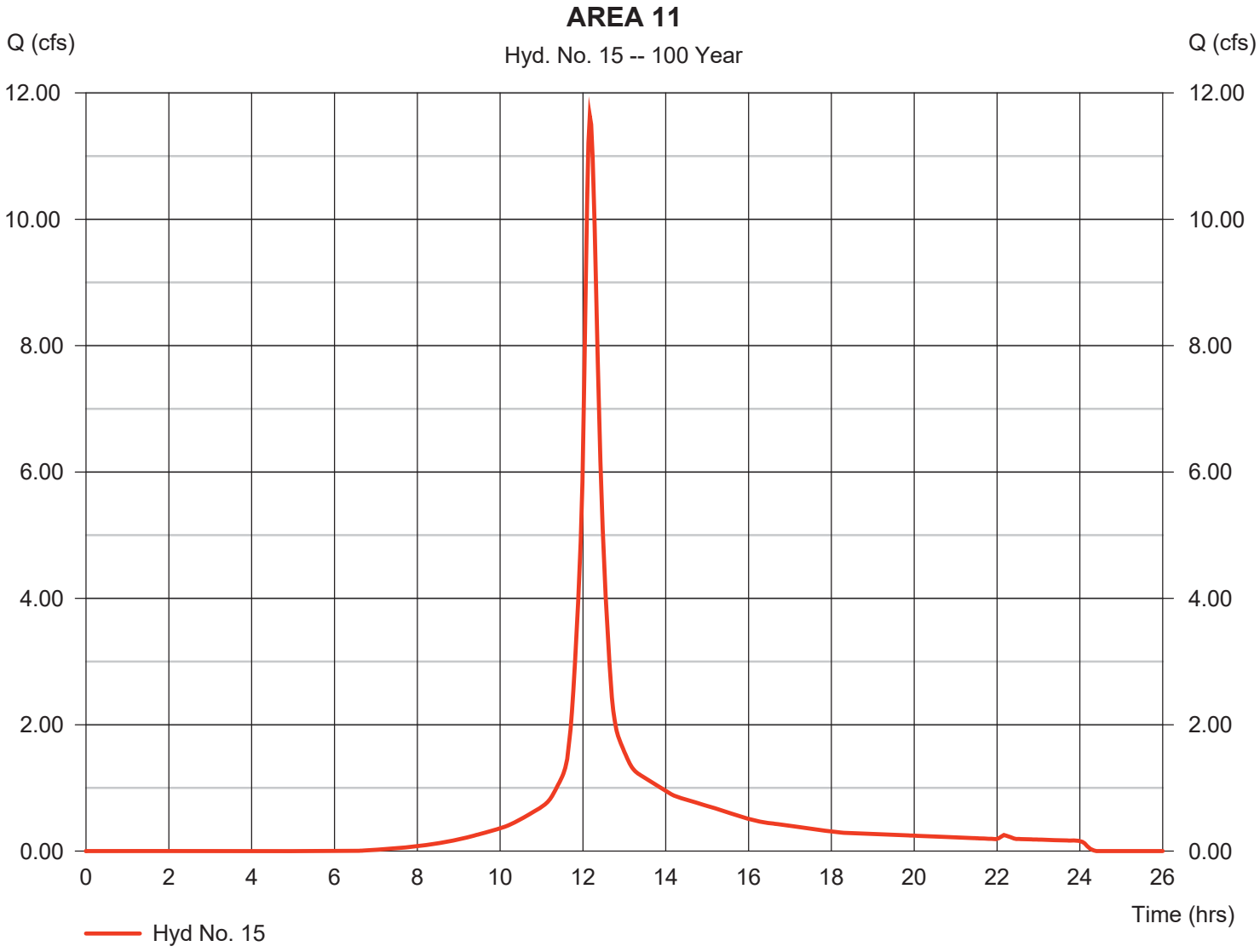
Total Travel Time, Tc ..... 17.90 min

Hydrograph Report

Hyd. No. 15

AREA 11

Hydrograph type	= SCS Runoff	Peak discharge	= 11.64 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 47,570 cuft
Drainage area	= 2.640 ac	Curve number	= 77
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 16.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



TR55 Tc Worksheet

Hyd. No. 15

AREA 11

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.36		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 12.04**	**+**	**0.00**	**+**	**0.00**	**=**	**12.04**
Shallow Concentrated Flow							
Flow length (ft)	= 125.00		335.00		0.00		
Watercourse slope (%)	= 4.00		1.10		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=3.23		1.69		0.00		
Travel Time (min)	**= 0.65**	**+**	**3.30**	**+**	**0.00**	**=**	**3.95**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

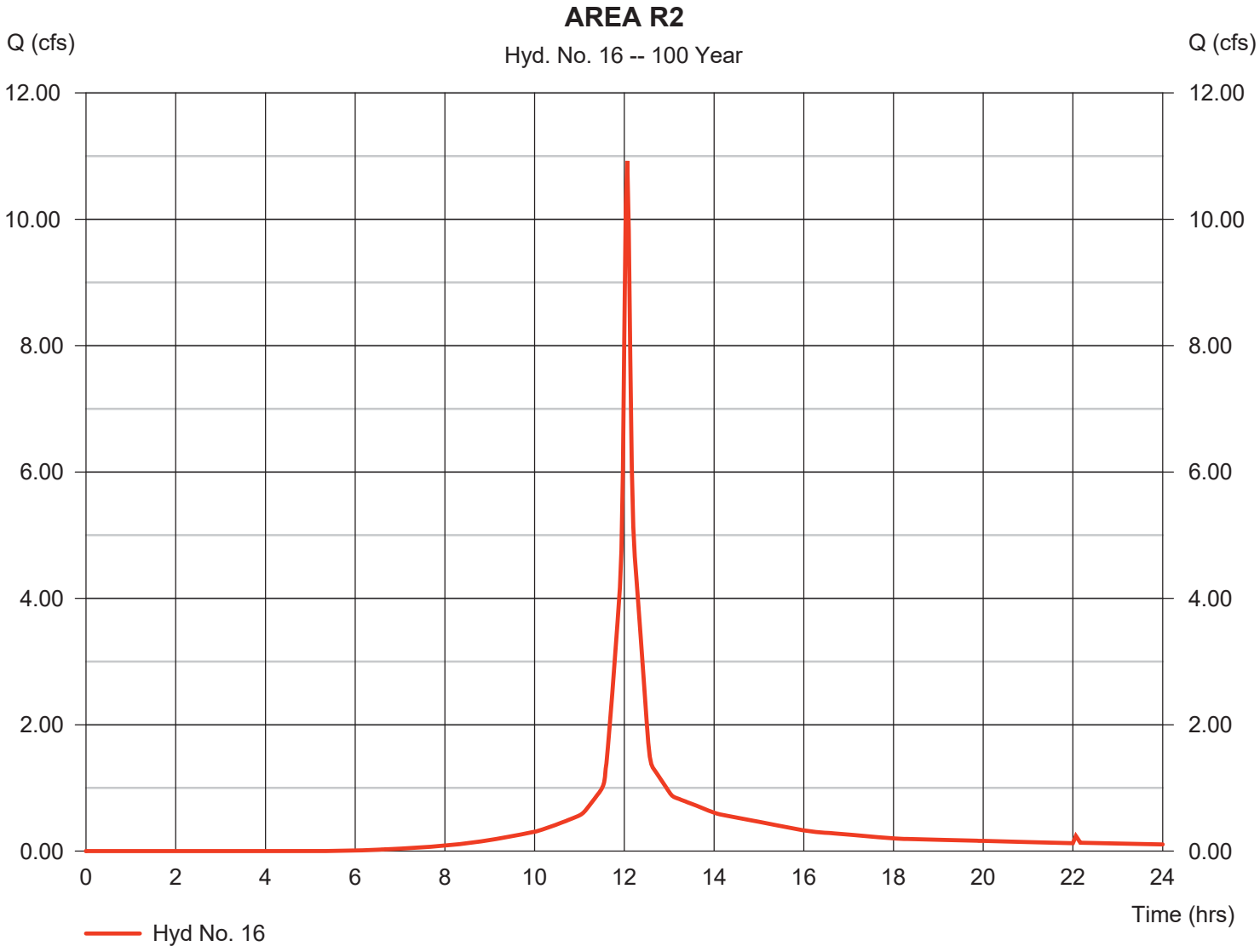
Total Travel Time, Tc ..... 16.00 min

Hydrograph Report

Hyd. No. 16

AREA R2

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.92 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	33,266 cuft
Drainage area	=	1.790 ac	Curve number	=	80.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



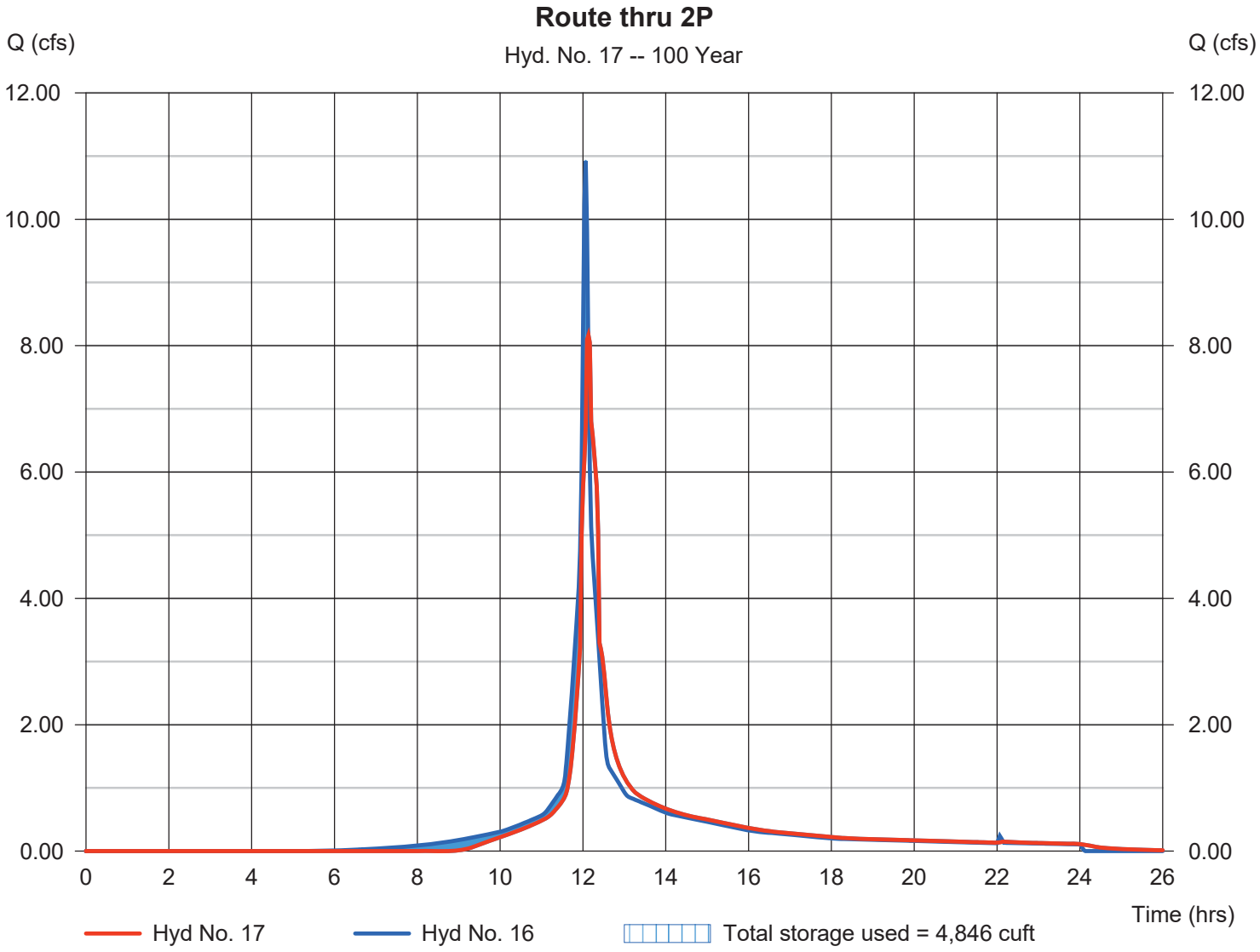
Hydrograph Report

Hyd. No. 17

Route thru 2P

Hydrograph type	= Reservoir	Peak discharge	= 8.164 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 32,602 cuft
Inflow hyd. No.	= 16 - AREA R2	Max. Elevation	= 86.99 ft
Reservoir name	= 2P	Max. Storage	= 4,846 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 4 - 2P

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	83.87	n/a	0	0
0.50	84.37	n/a	653	653
1.00	84.87	n/a	1,394	2,047
1.50	85.87	n/a	1,307	3,354
2.00	86.87	n/a	1,263	4,617
2.50	86.37	n/a	1,089	5,706
3.00	86.87	n/a	828	6,534
3.50	87.37	n/a	653	7,187

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	0.00	0.00	0.00
Span (in)	= 15.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 84.37	0.00	0.00	0.00
Length (ft)	= 93.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

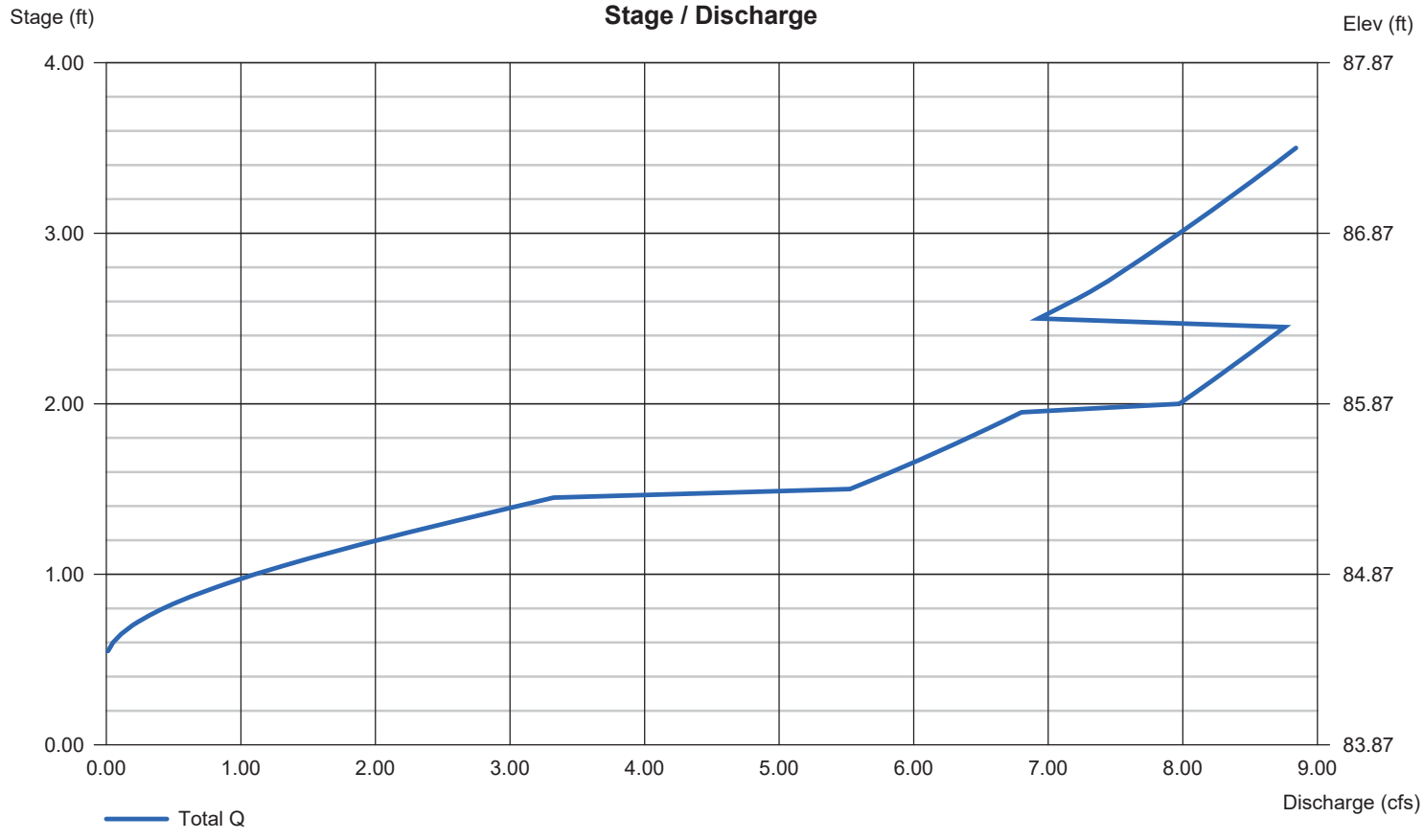
Weir Structures

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

Exfil.(in/hr) = 1.020 (by Wet area)

TW Elev. (ft) = 0.00

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

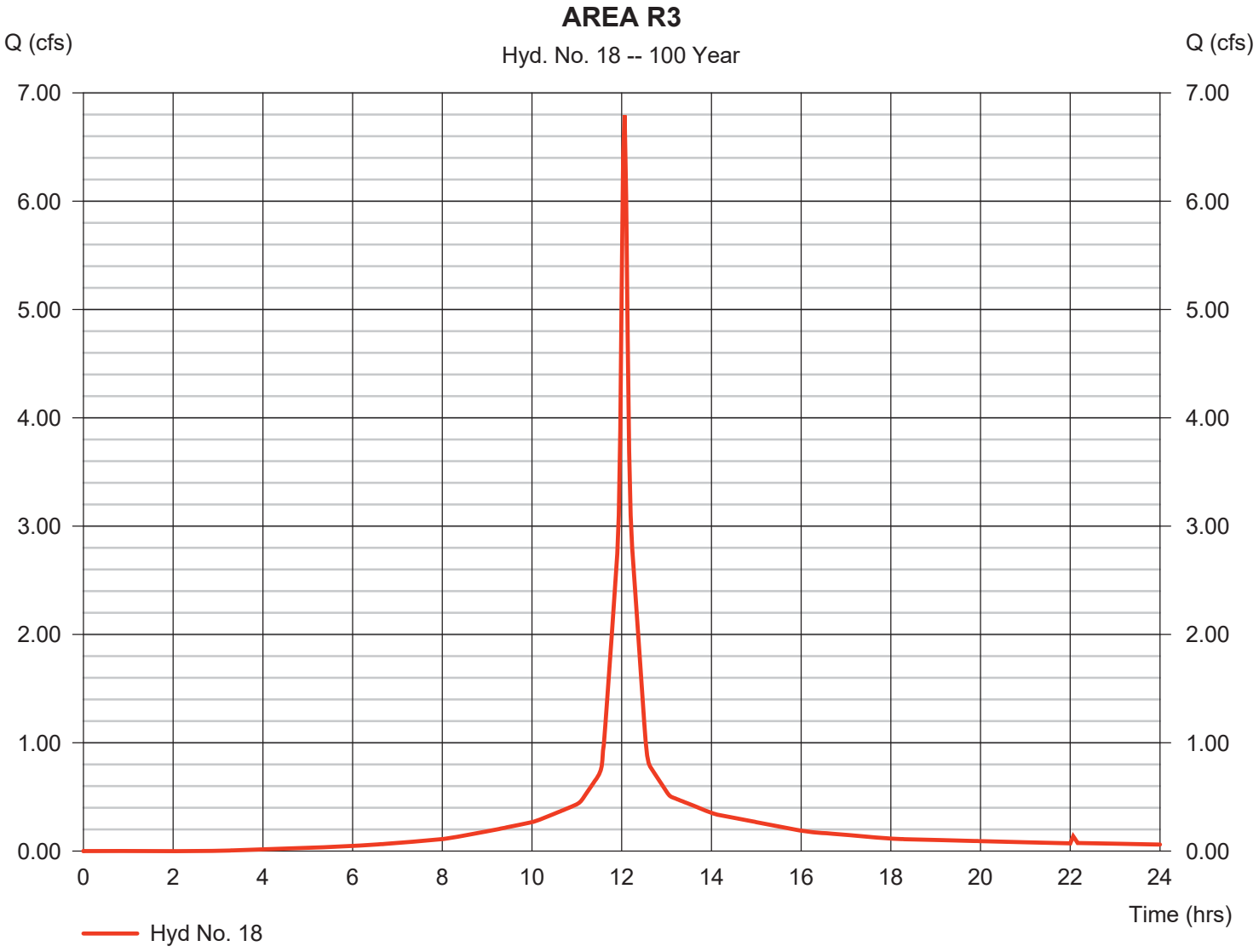


Hydrograph Report

Hyd. No. 18

AREA R3

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.793 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	21,816 cuft
Drainage area	=	0.970 ac	Curve number	=	90
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



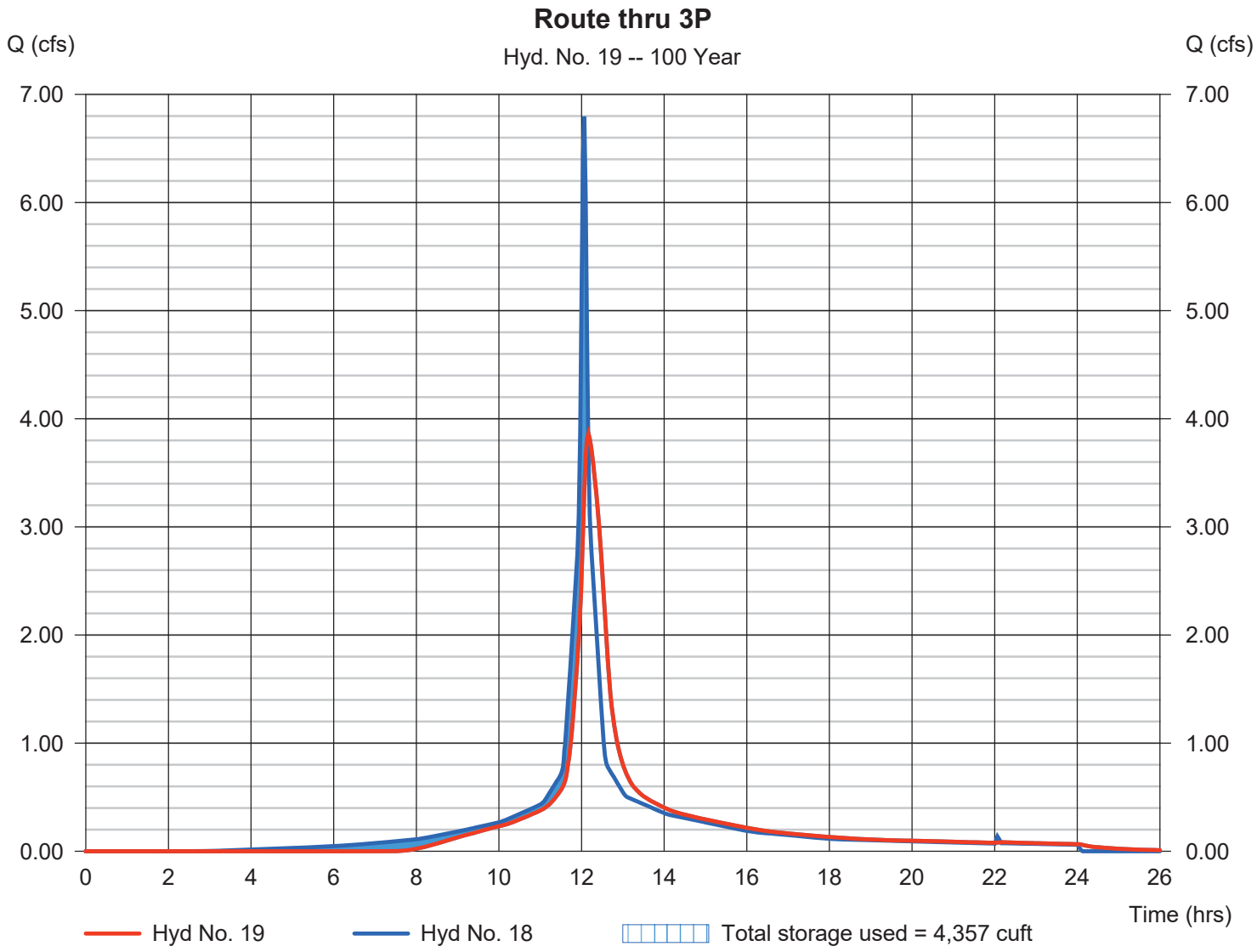
Hydrograph Report

Hyd. No. 19

Route thru 3P

Hydrograph type	= Reservoir	Peak discharge	= 3.863 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.17 hrs
Time interval	= 2 min	Hyd. volume	= 21,195 cuft
Inflow hyd. No.	= 18 - AREA R3	Max. Elevation	= 86.23 ft
Reservoir name	= 3P	Max. Storage	= 4,357 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 5 - 3P

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	84.18	n/a	0	0
0.50	84.68	n/a	610	610
1.00	85.18	n/a	1,263	1,873
1.50	85.68	n/a	1,220	3,093
2.00	86.18	n/a	1,176	4,269
2.50	86.68	n/a	1,002	5,271
3.00	87.18	n/a	740	6,011
3.50	87.68	n/a	654	6,665

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 84.68	0.00	0.00	0.00
Length (ft)	= 62.00	0.00	0.00	0.00
Slope (%)	= 1.30	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

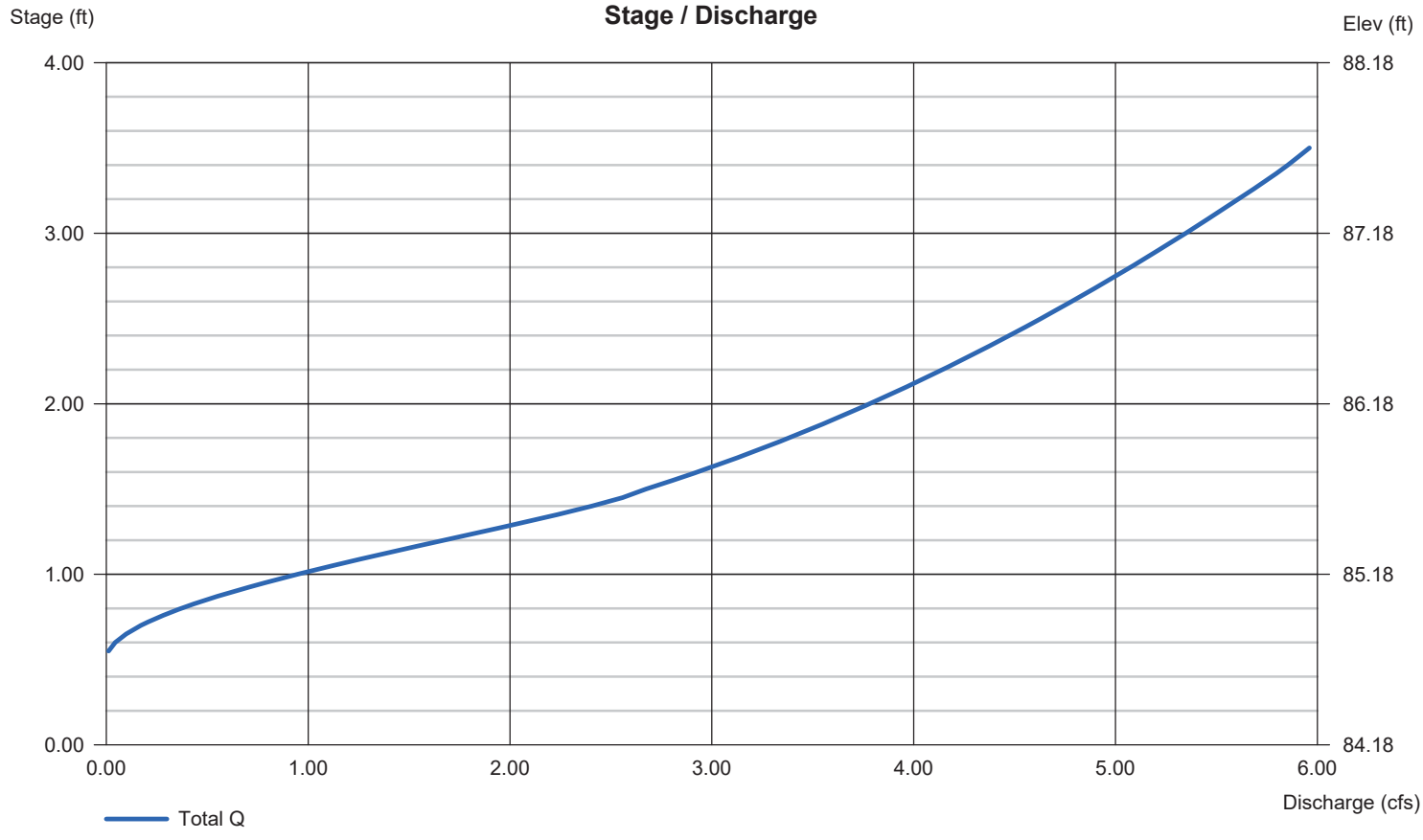
Weir Structures

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

Exfil.(in/hr) = 1.020 (by Wet area)

TW Elev. (ft) = 0.00

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

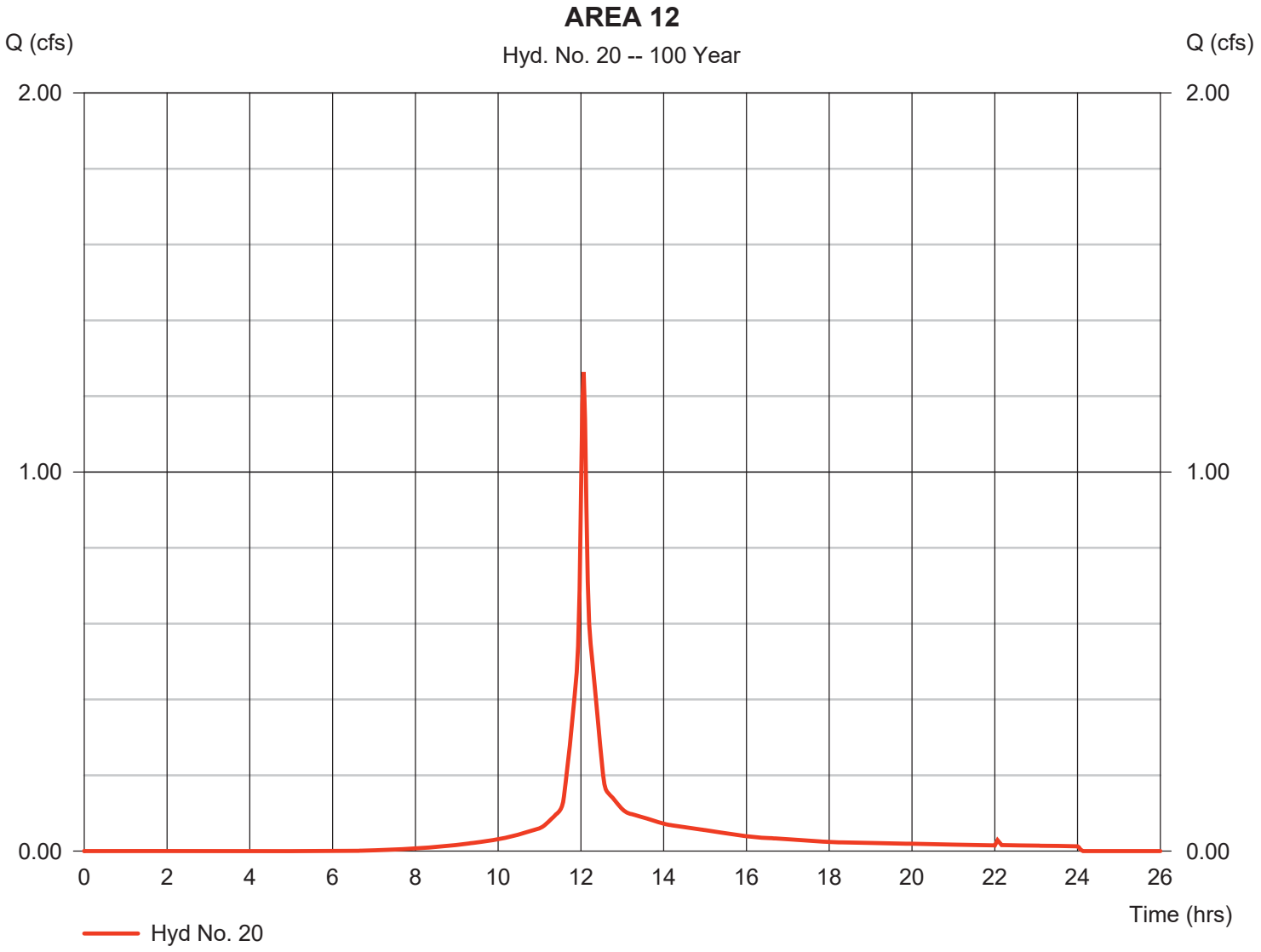


Hydrograph Report

Hyd. No. 20

AREA 12

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.264 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	3,812 cuft
Drainage area	=	0.220 ac	Curve number	=	77
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

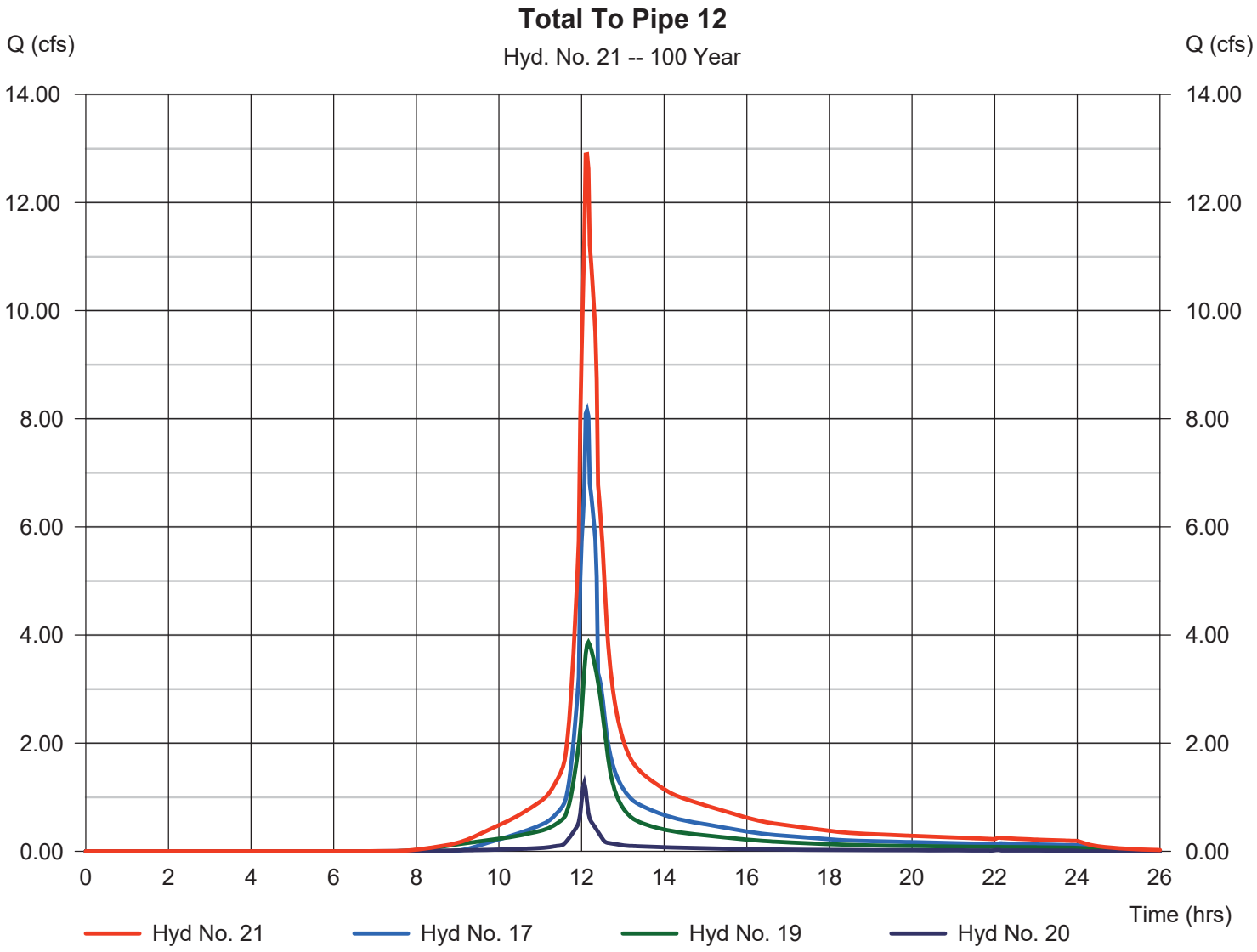


Hydrograph Report

Hyd. No. 21

Total To Pipe 12

Hydrograph type	=	Combine	Peak discharge	=	12.89 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	57,608 cuft
Inflow hyds.	=	17, 19, 20	Contrib. drain. area	=	0.220 ac

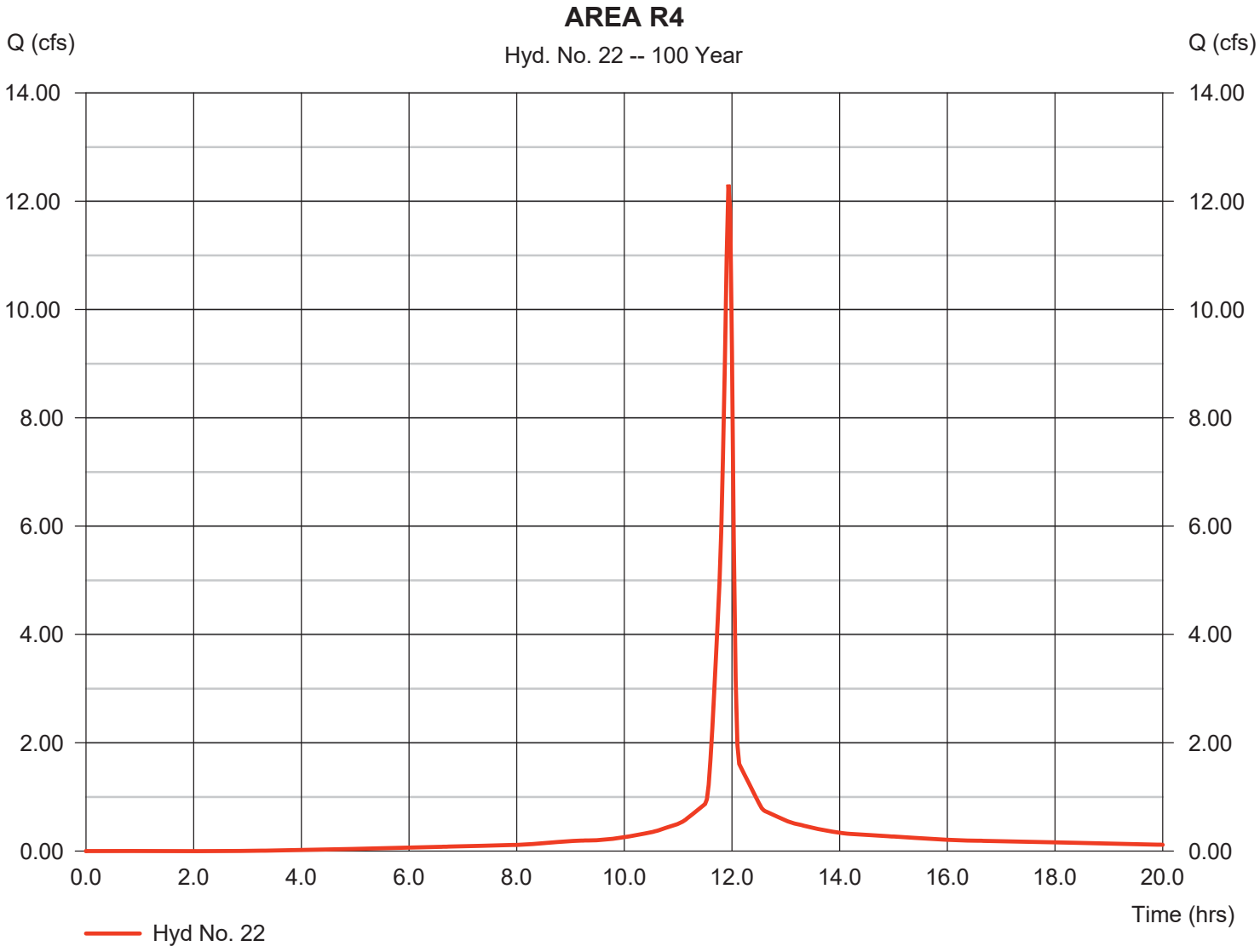


Hydrograph Report

Hyd. No. 22

AREA R4

Hydrograph type	=	SCS Runoff	Peak discharge	=	12.31 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	27,070 cuft
Drainage area	=	1.230 ac	Curve number	=	88.8
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

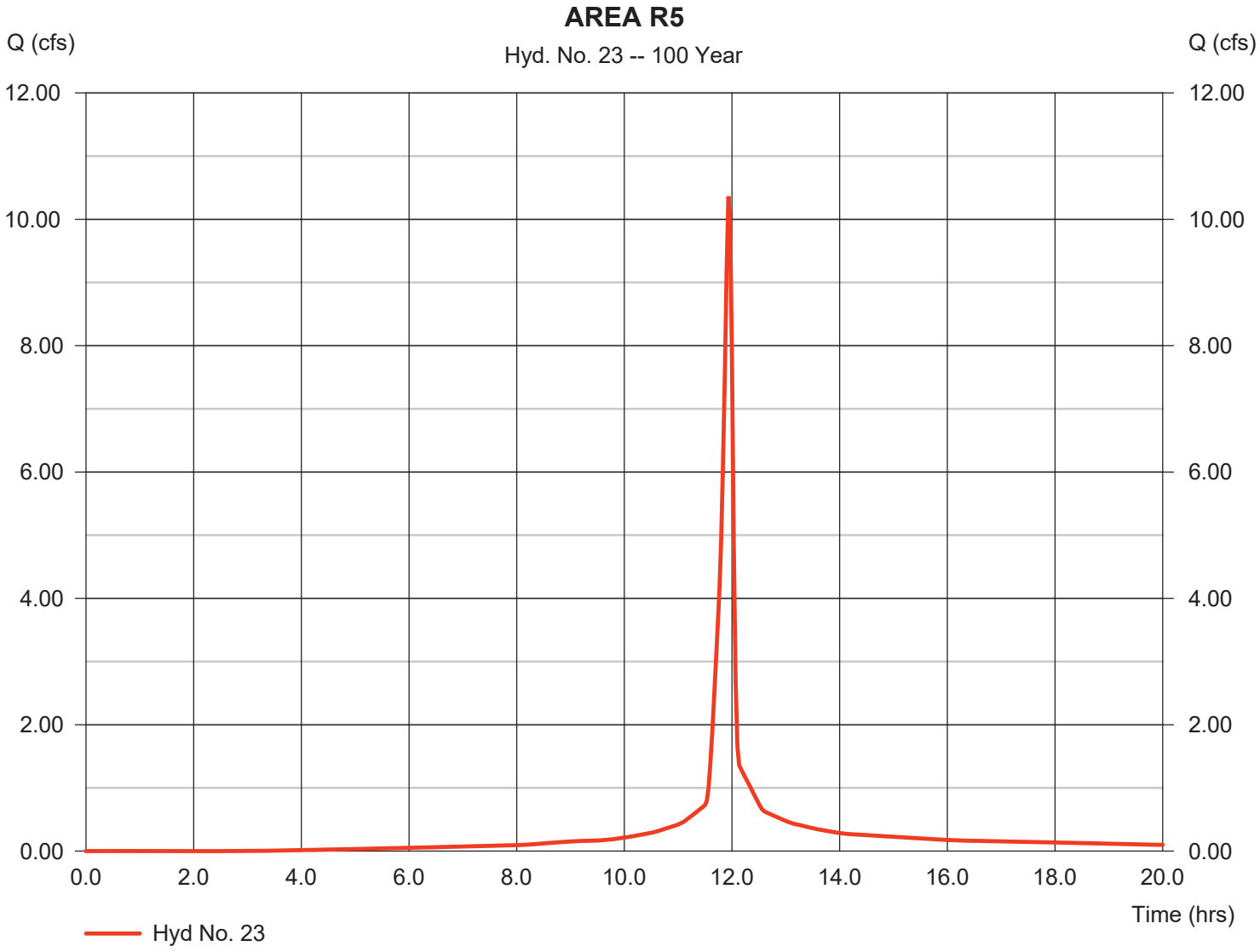


Hydrograph Report

Hyd. No. 23

AREA R5

Hydrograph type	=	SCS Runoff	Peak discharge	=	10.36 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	22,722 cuft
Drainage area	=	1.040 ac	Curve number	=	88.4
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



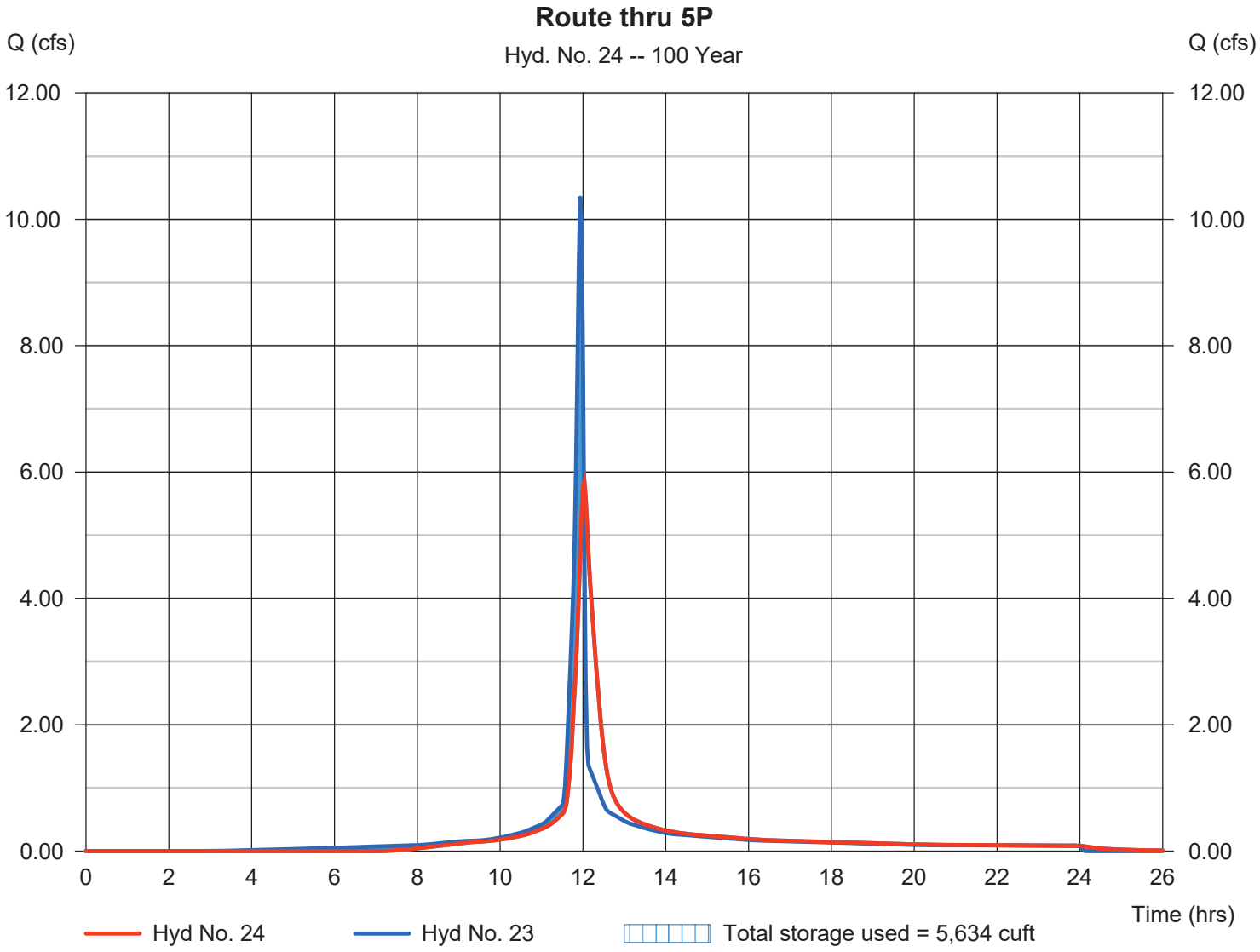
Hydrograph Report

Hyd. No. 24

Route thru 5P

Hydrograph type	= Reservoir	Peak discharge	= 5.855 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 22,189 cuft
Inflow hyd. No.	= 23 - AREA R5	Max. Elevation	= 87.63 ft
Reservoir name	= 5P	Max. Storage	= 5,634 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 7 - 5P

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	84.18	n/a	0	0
0.50	84.68	n/a	523	523
1.00	85.18	n/a	1,089	1,612
1.50	85.68	n/a	1,089	2,701
2.00	86.18	n/a	958	3,659
2.50	86.68	n/a	871	4,530
3.00	87.18	n/a	654	5,184
3.50	87.68	n/a	566	5,750

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 84.68	0.00	0.00	0.00
Length (ft)	= 41.00	0.00	0.00	0.00
Slope (%)	= 1.50	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

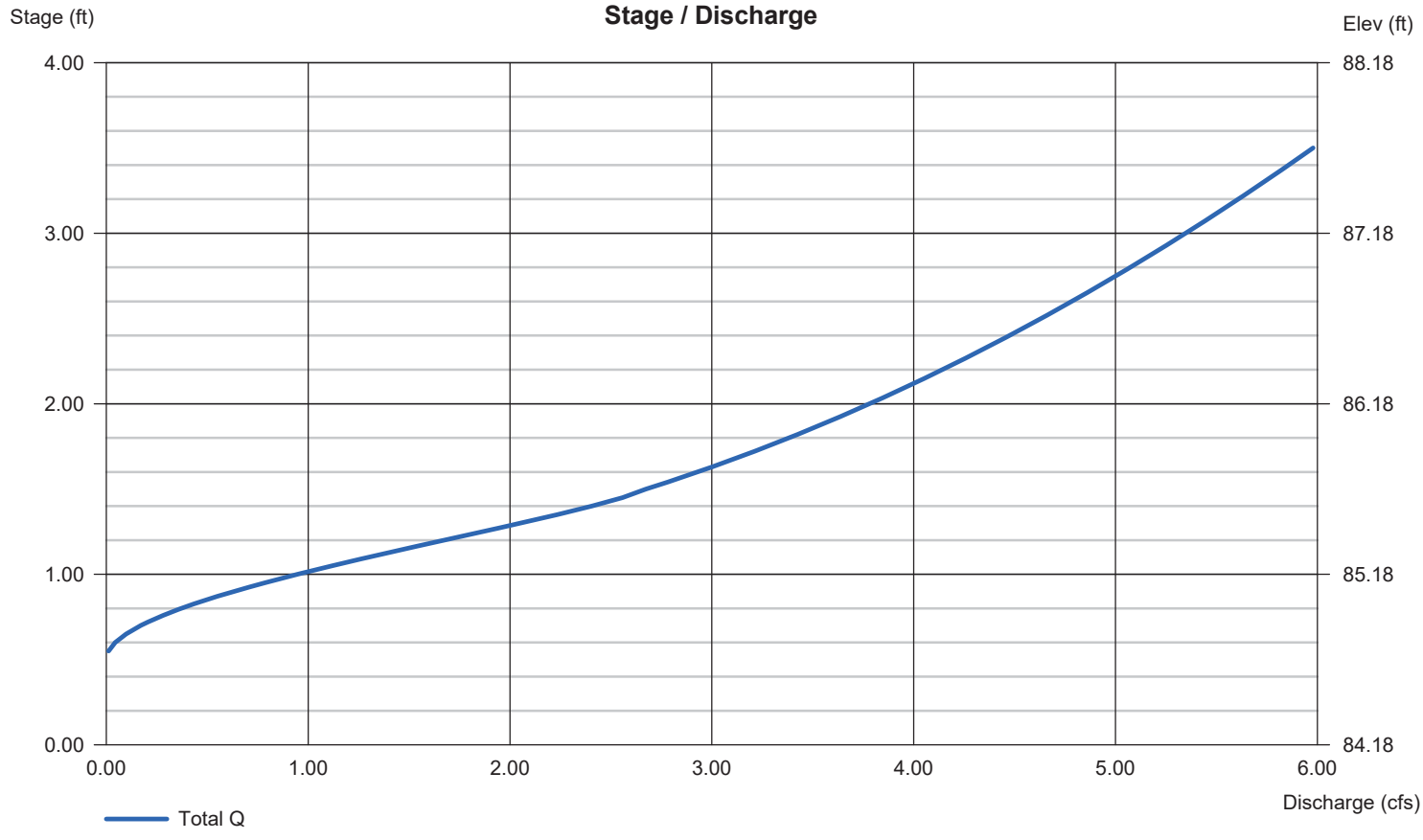
Weir Structures

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

Exfil.(in/hr) = 1.020 (by Wet area)

TW Elev. (ft) = 0.00

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

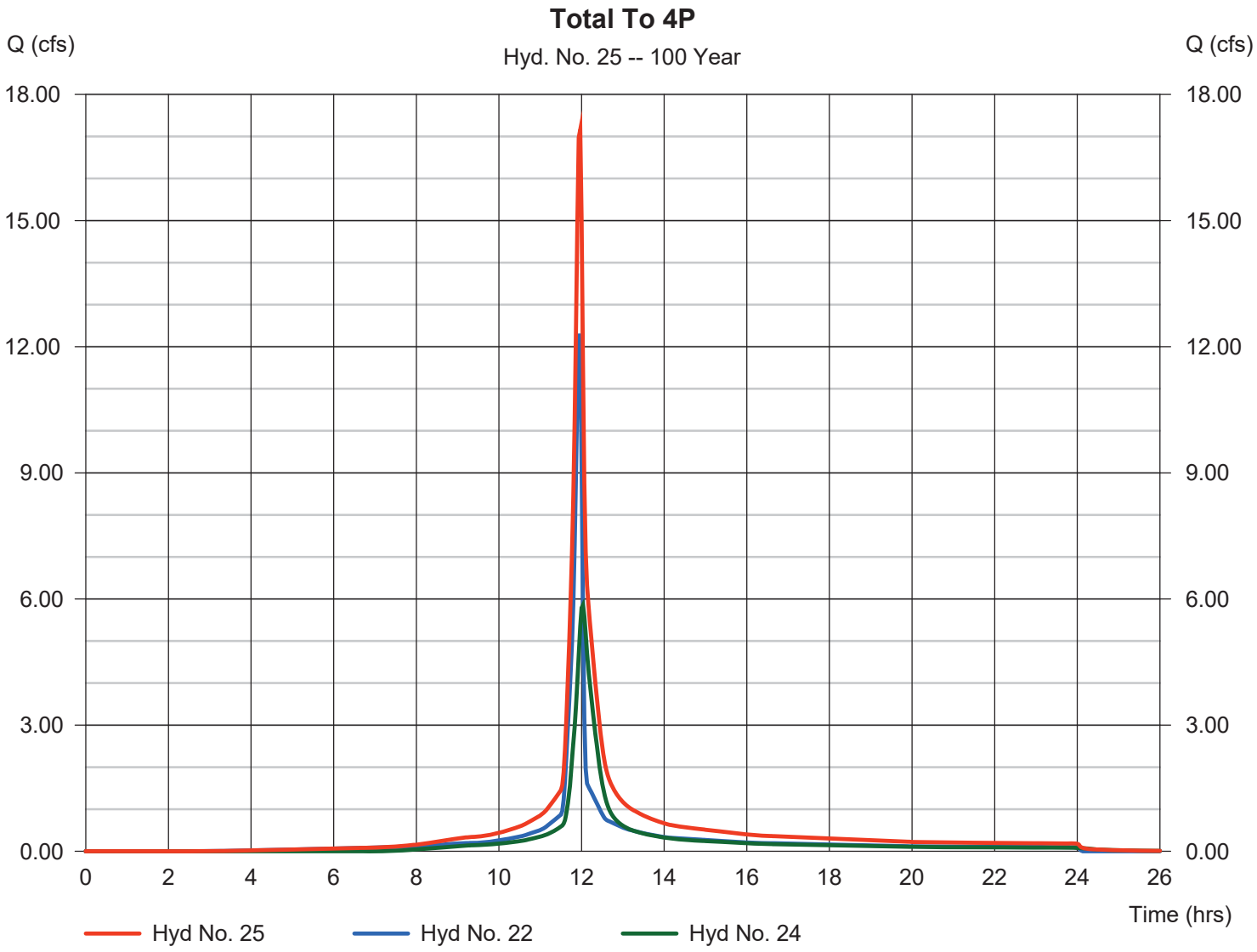


Hydrograph Report

Hyd. No. 25

Total To 4P

Hydrograph type	= Combine	Peak discharge	= 17.16 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 49,259 cuft
Inflow hyds.	= 22, 24	Contrib. drain. area	= 1.230 ac



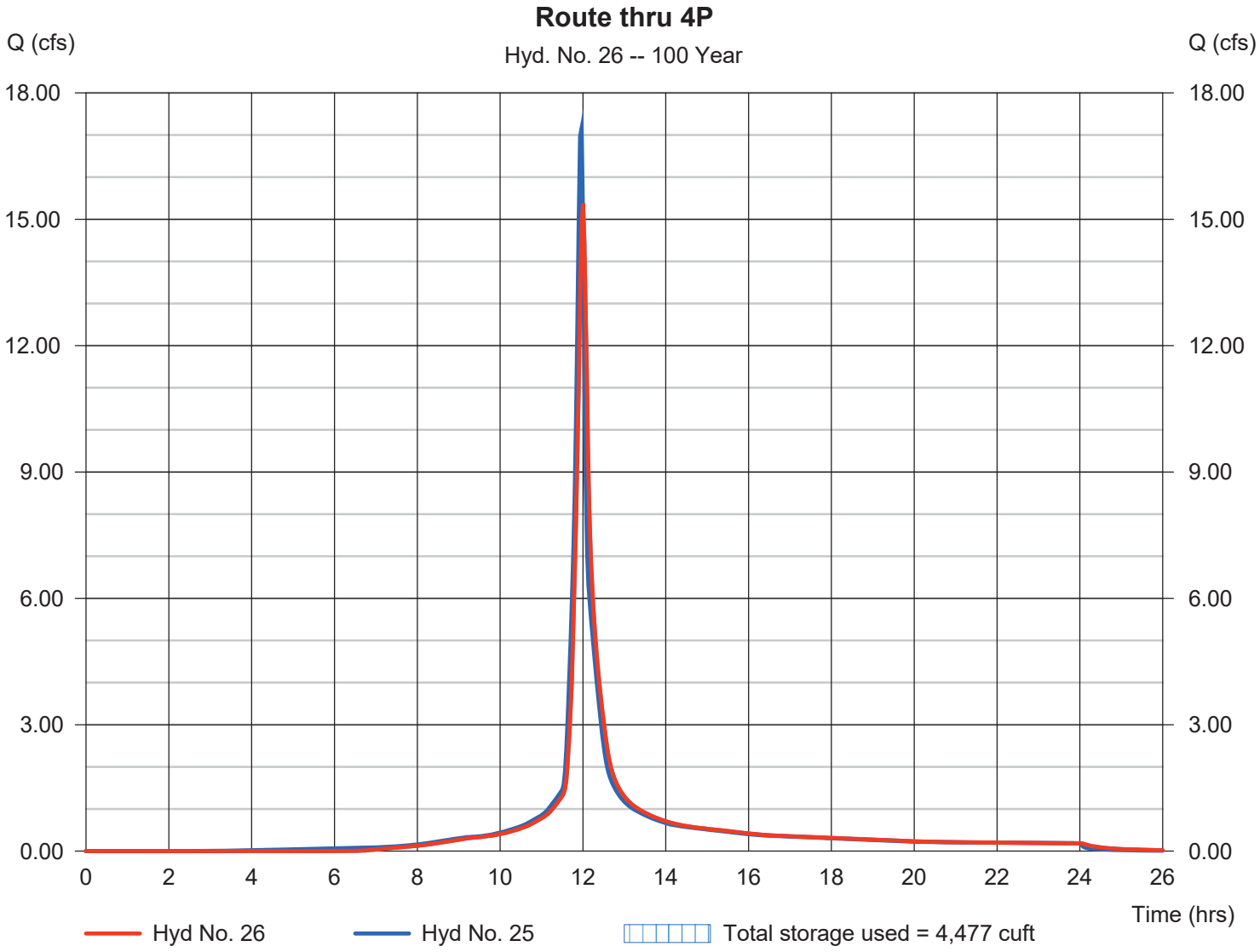
Hydrograph Report

Hyd. No. 26

Route thru 4P

Hydrograph type	= Reservoir	Peak discharge	= 15.38 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 48,817 cuft
Inflow hyd. No.	= 25 - Total To 4P	Max. Elevation	= 87.16 ft
Reservoir name	= 4P	Max. Storage	= 4,477 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 6 - 4P

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	84.00	n/a	0	0
0.50	84.50	n/a	436	436
1.00	85.00	n/a	914	1,350
1.50	85.50	n/a	871	2,221
2.00	86.00	n/a	828	3,049
2.50	86.50	n/a	741	3,790
3.00	87.00	n/a	566	4,356
3.50	87.50	n/a	436	4,792

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 21.00	0.00	0.00	0.00
Span (in)	= 21.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 84.50	0.00	0.00	0.00
Length (ft)	= 73.40	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

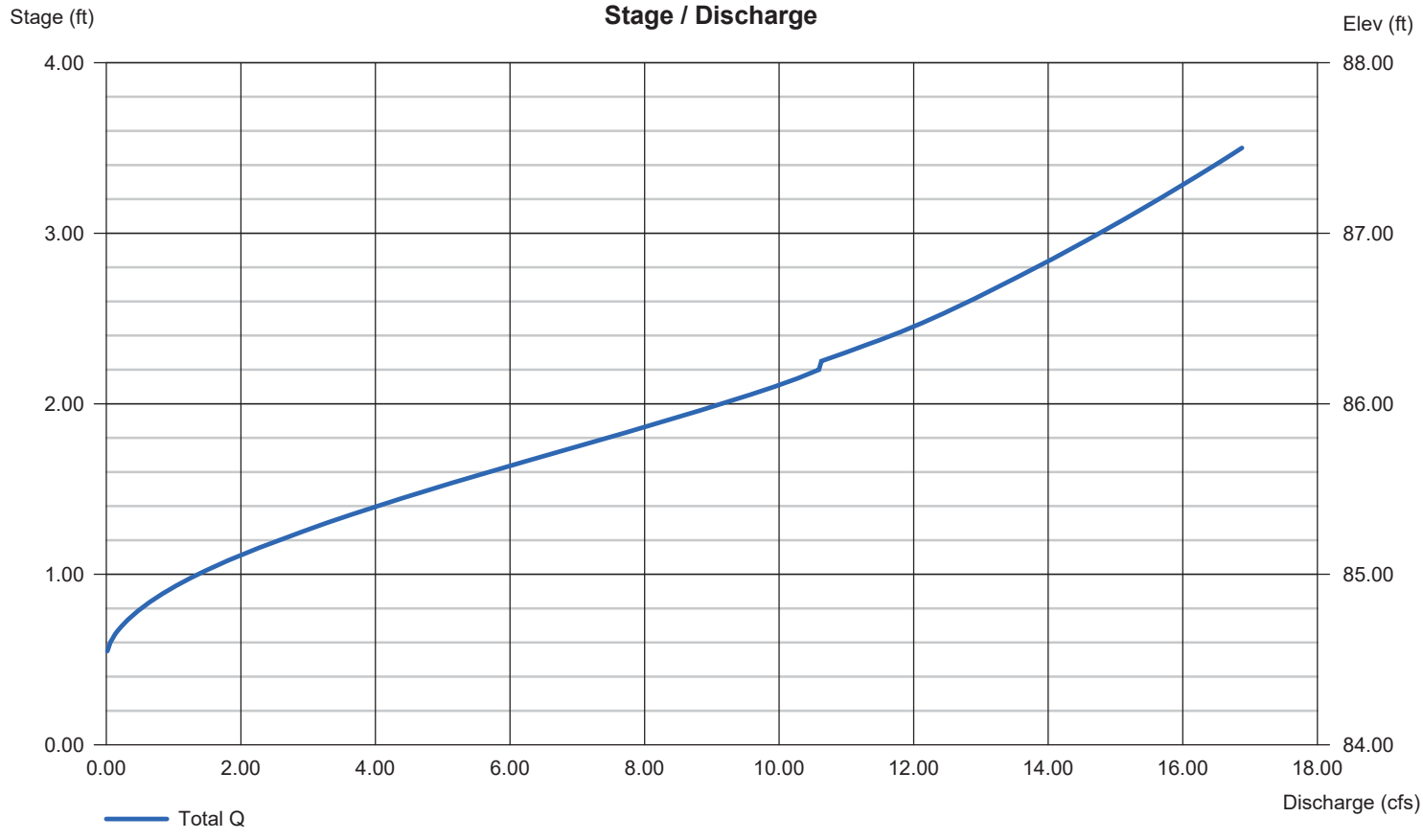
Weir Structures

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

Exfil.(in/hr) = 1.020 (by Wet area)

TW Elev. (ft) = 0.00

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

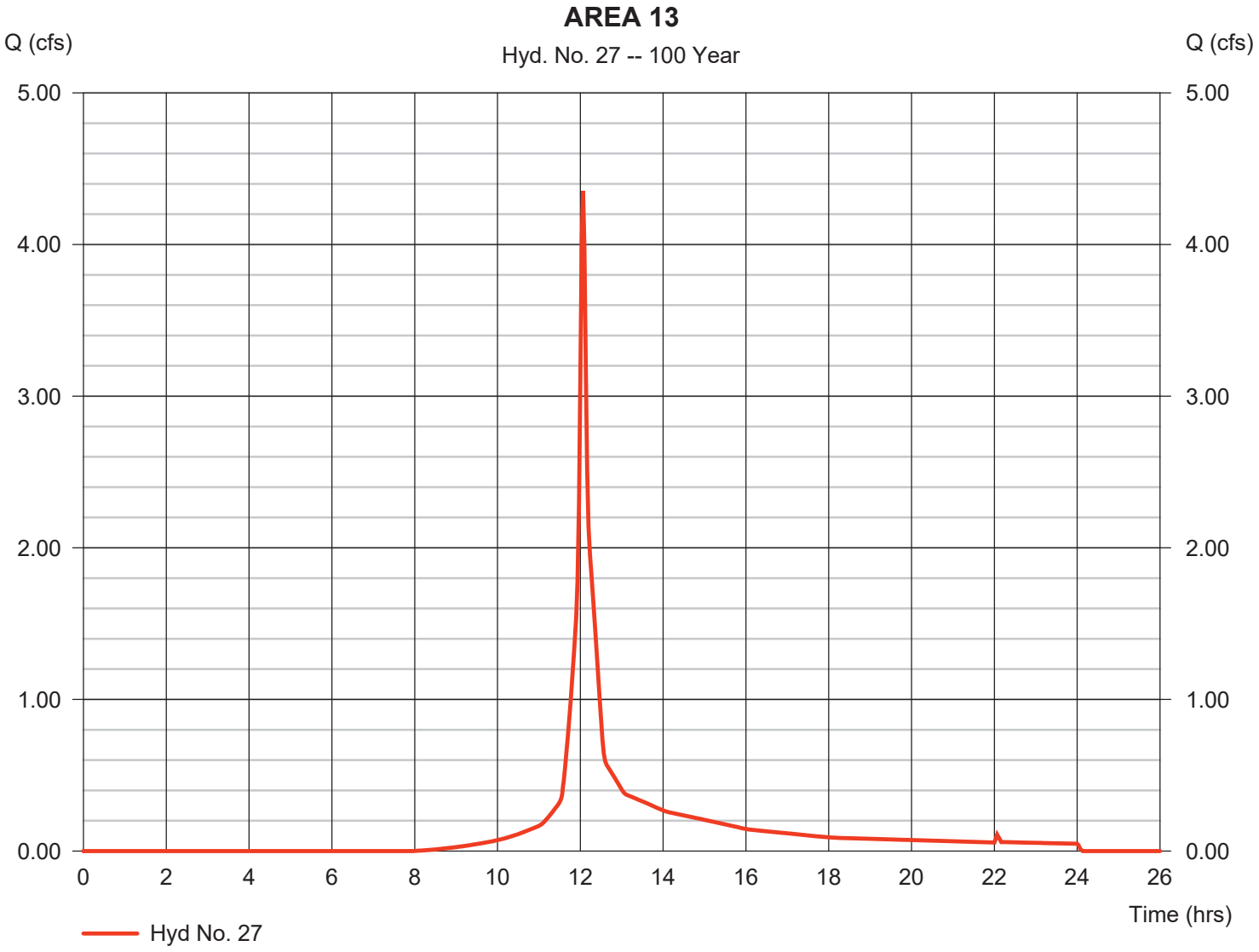


Hydrograph Report

Hyd. No. 27

AREA 13

Hydrograph type	= SCS Runoff	Peak discharge	= 4.352 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 13,007 cuft
Drainage area	= 0.895 ac	Curve number	= 69.8
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

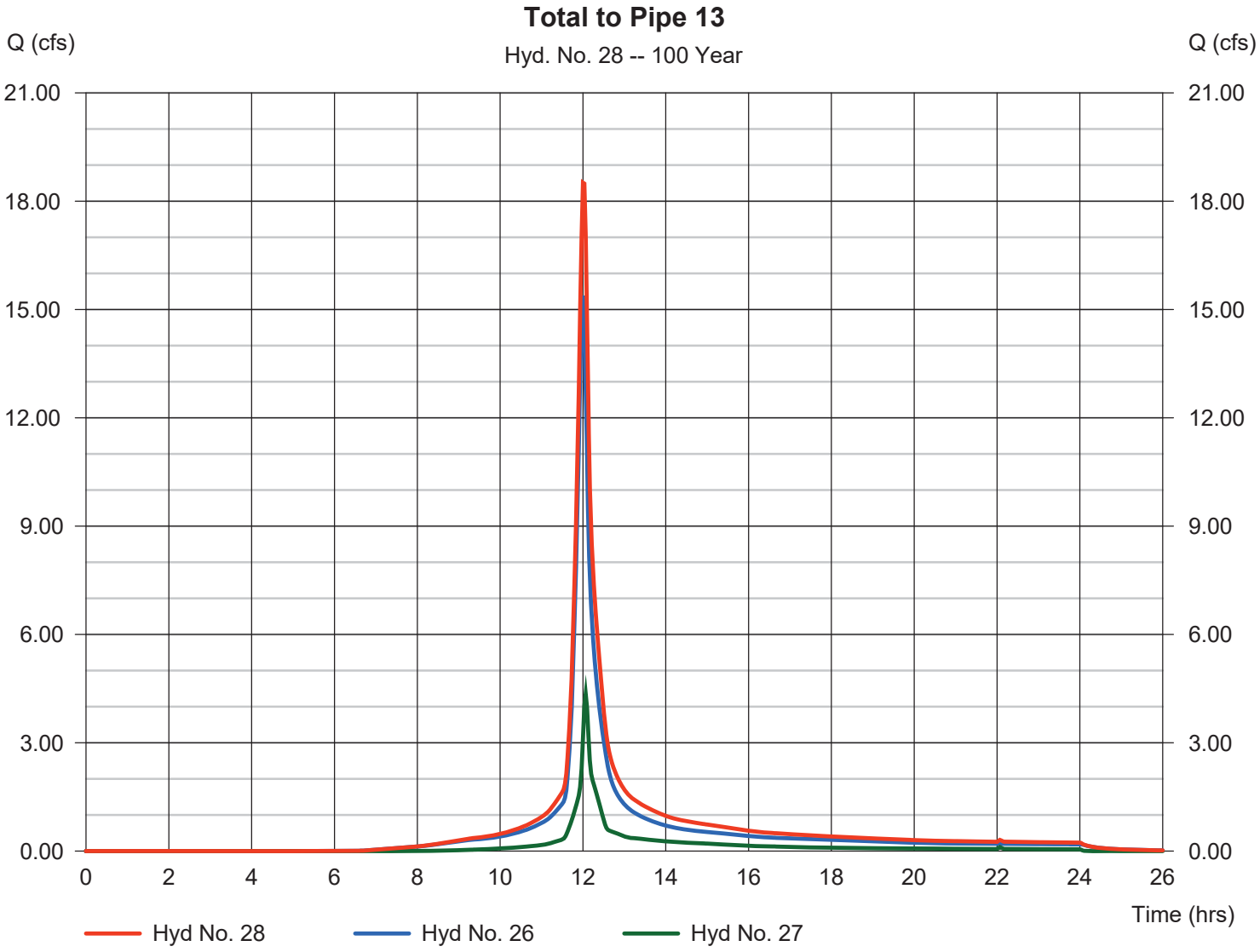


Hydrograph Report

Hyd. No. 28

Total to Pipe 13

Hydrograph type	= Combine	Peak discharge	= 18.51 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 61,824 cuft
Inflow hyds.	= 26, 27	Contrib. drain. area	= 0.895 ac

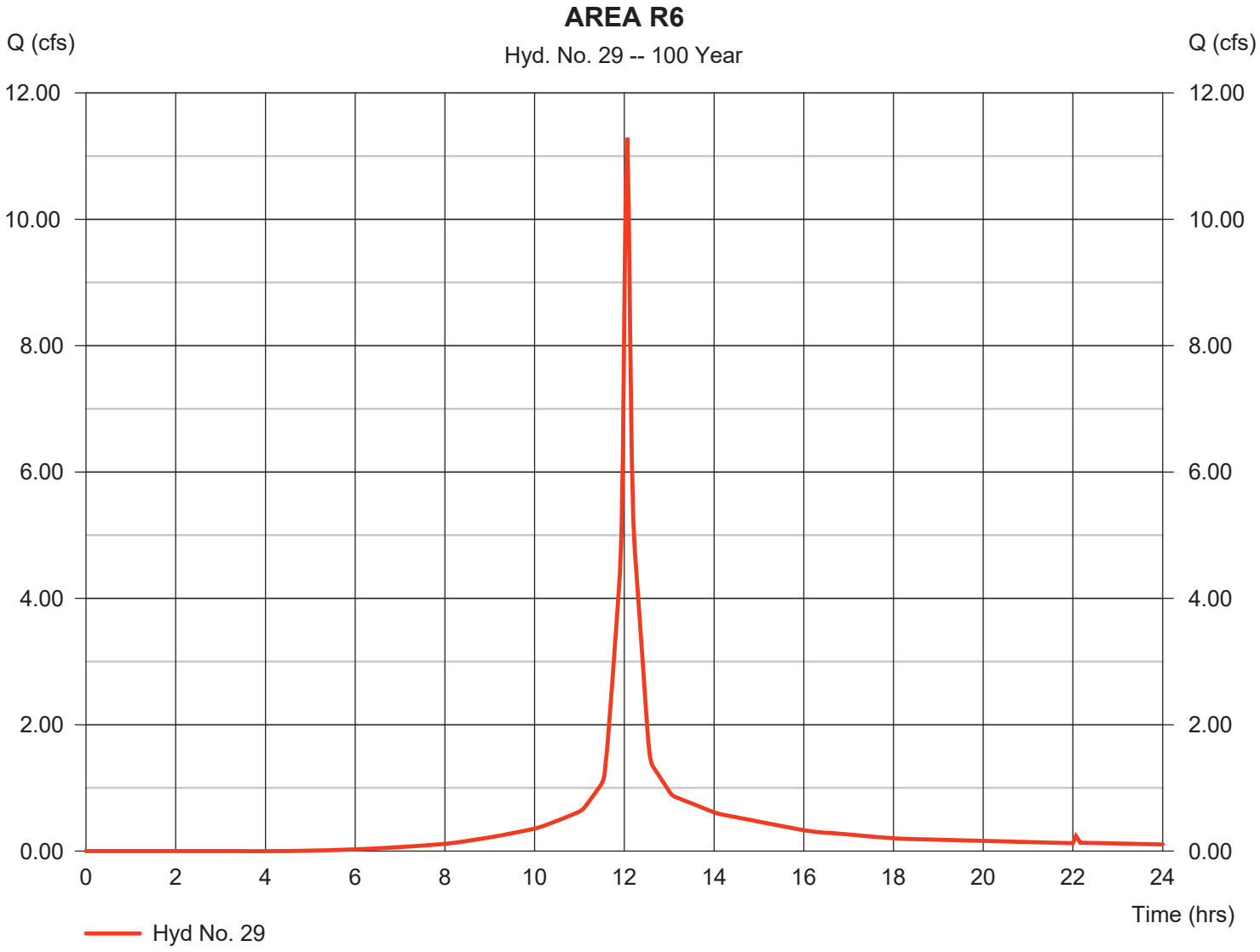


Hydrograph Report

Hyd. No. 29

AREA R6

Hydrograph type	=	SCS Runoff	Peak discharge	=	11.29 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	34,799 cuft
Drainage area	=	1.760 ac	Curve number	=	83.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



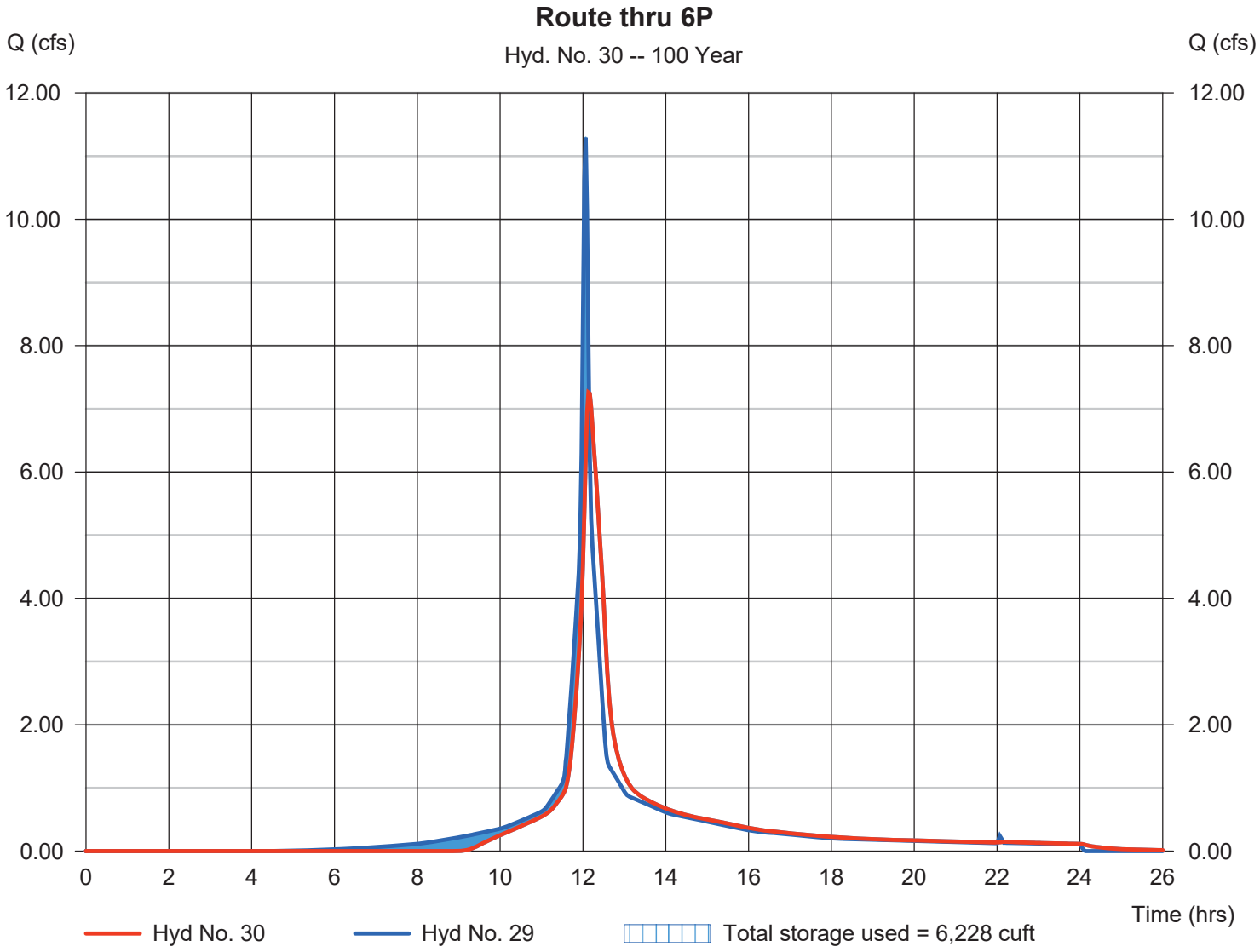
Hydrograph Report

Hyd. No. 30

Route thru 6P

Hydrograph type	= Reservoir	Peak discharge	= 7.258 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 33,697 cuft
Inflow hyd. No.	= 29 - AREA R6	Max. Elevation	= 86.67 ft
Reservoir name	= 6P	Max. Storage	= 6,228 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 8 - 6P

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	83.83	n/a	0	0
0.50	84.33	n/a	653	653
1.00	84.83	n/a	1,394	2,047
1.50	85.33	n/a	1,307	3,354
2.00	85.83	n/a	1,263	4,617
2.50	86.33	n/a	1,089	5,706
3.00	86.83	n/a	828	6,534
3.50	87.33	n/a	653	7,187

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	0.00	0.00	0.00
Span (in)	= 15.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 84.50	0.00	0.00	0.00
Length (ft)	= 122.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

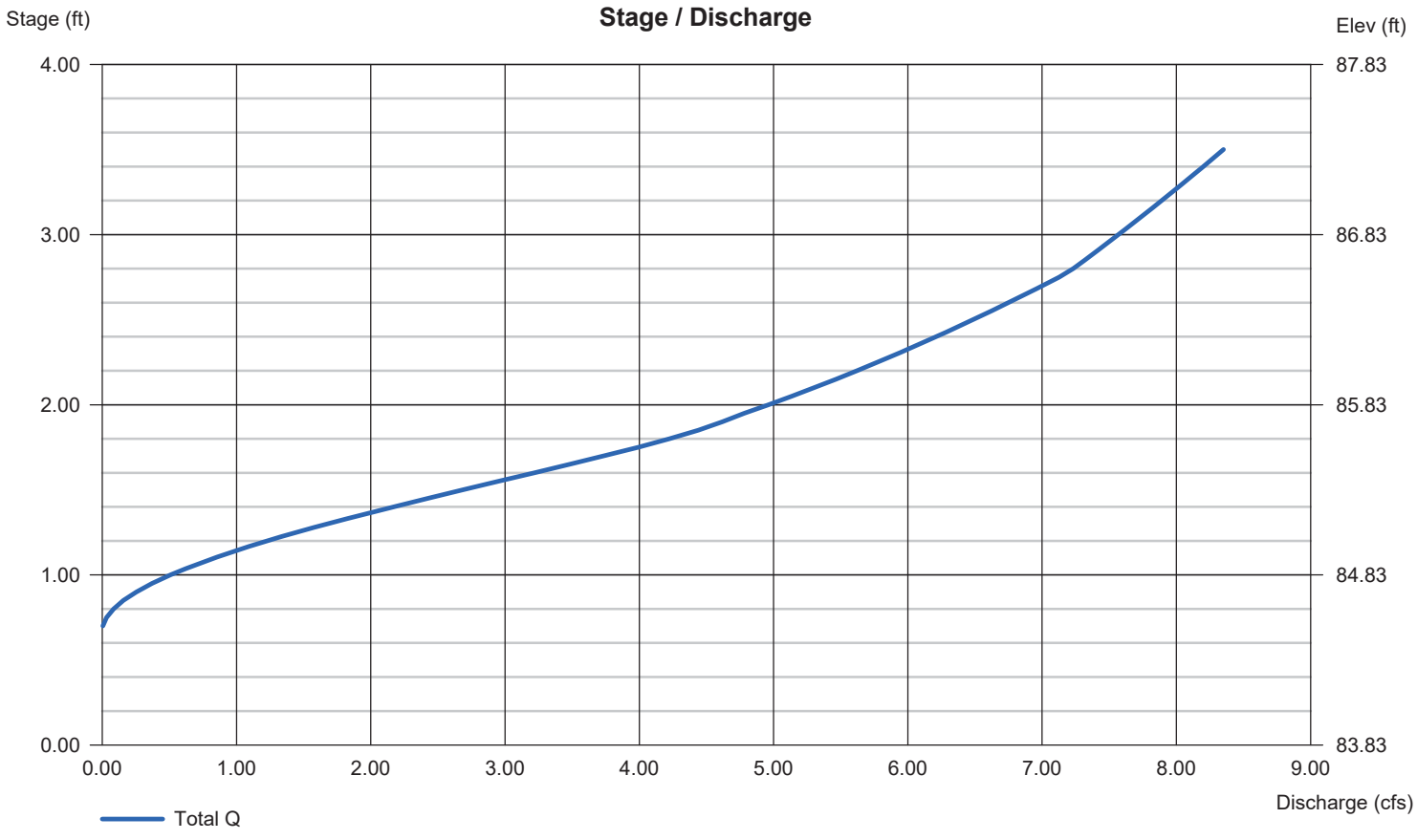
Weir Structures

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

Exfil.(in/hr) = 1.020 (by Wet area)

TW Elev. (ft) = 0.00

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

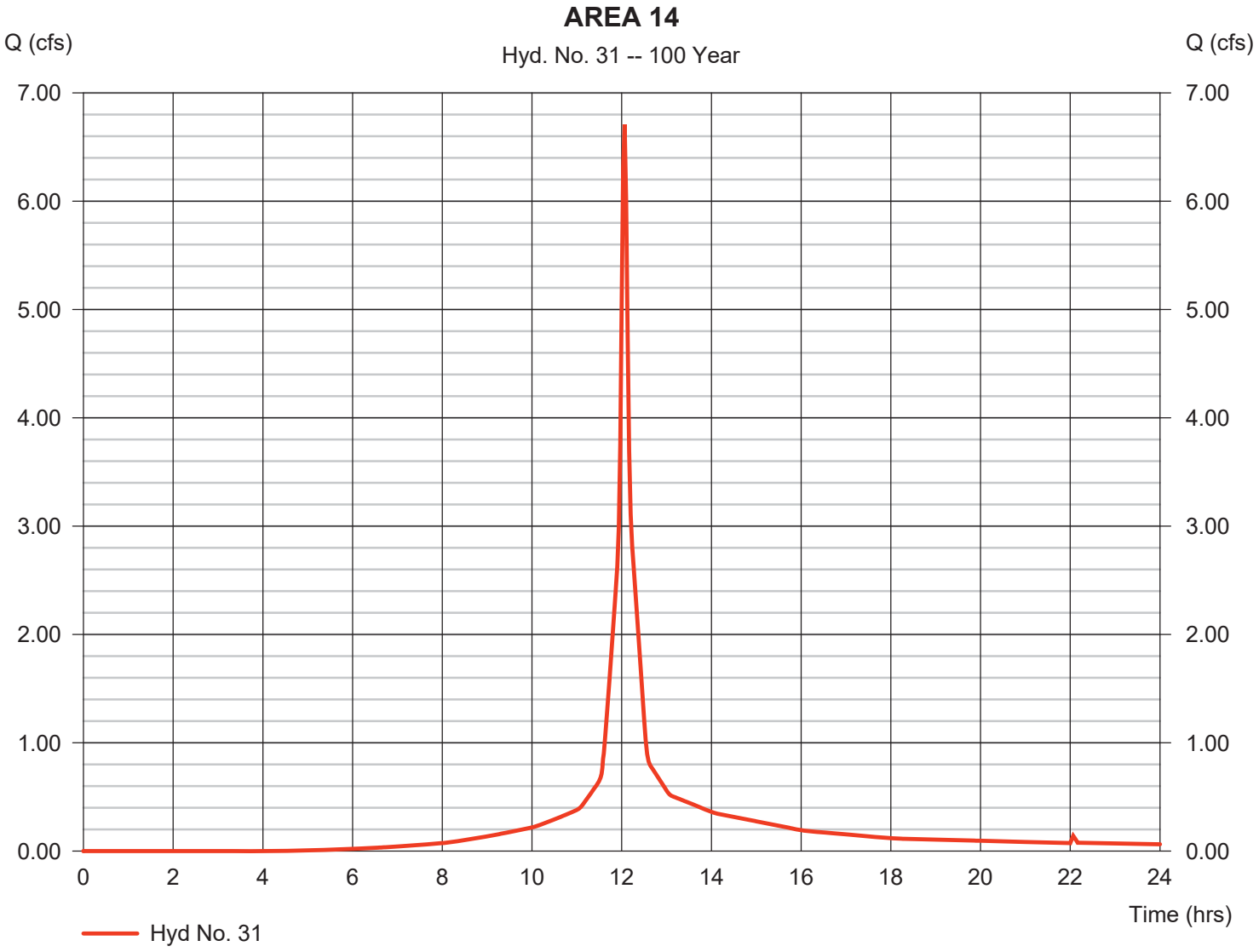


Hydrograph Report

Hyd. No. 31

AREA 14

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.708 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	20,775 cuft
Drainage area	=	1.030 ac	Curve number	=	84.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

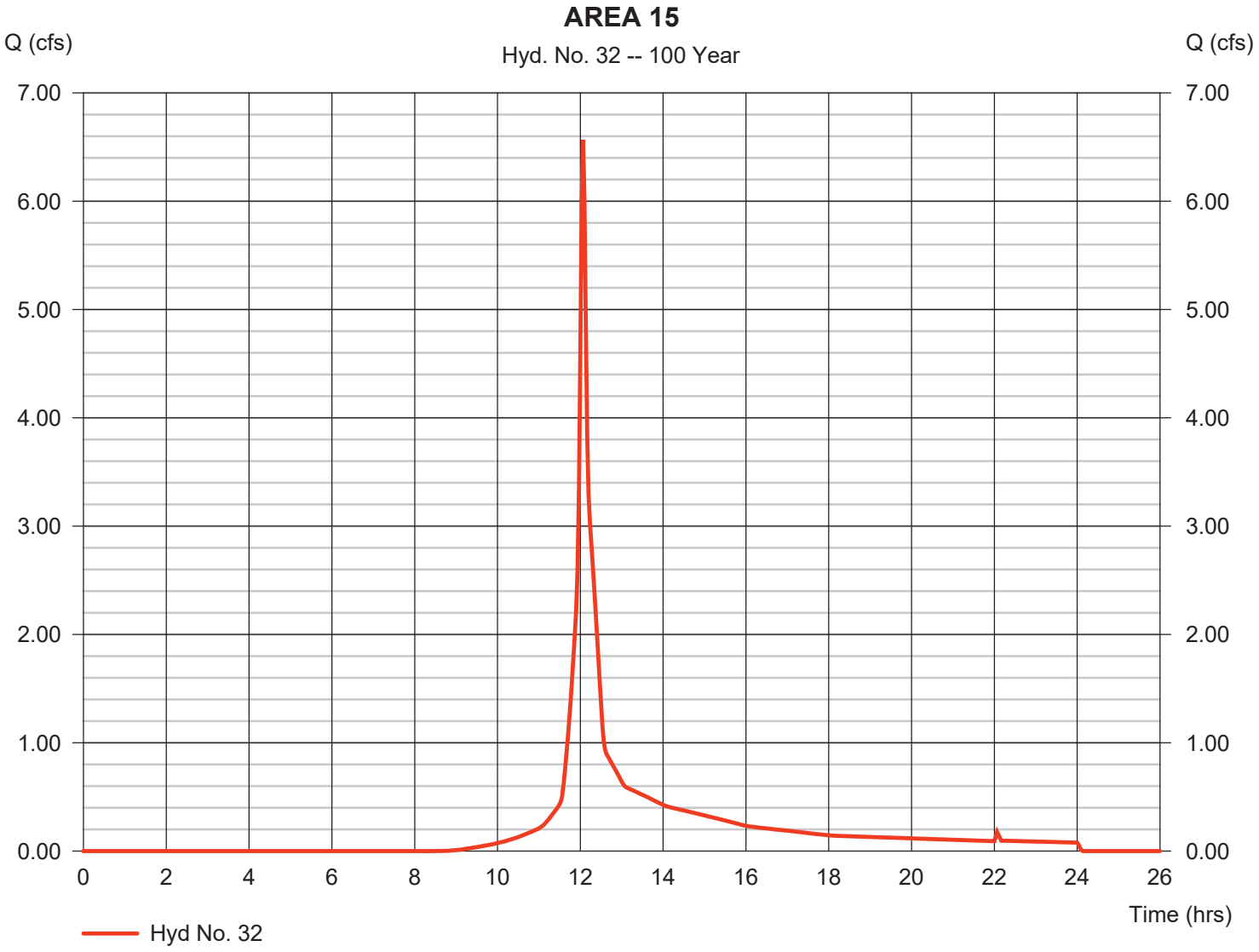


Hydrograph Report

Hyd. No. 32

AREA 15

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.564 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	19,669 cuft
Drainage area	=	1.530 ac	Curve number	=	65.4
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

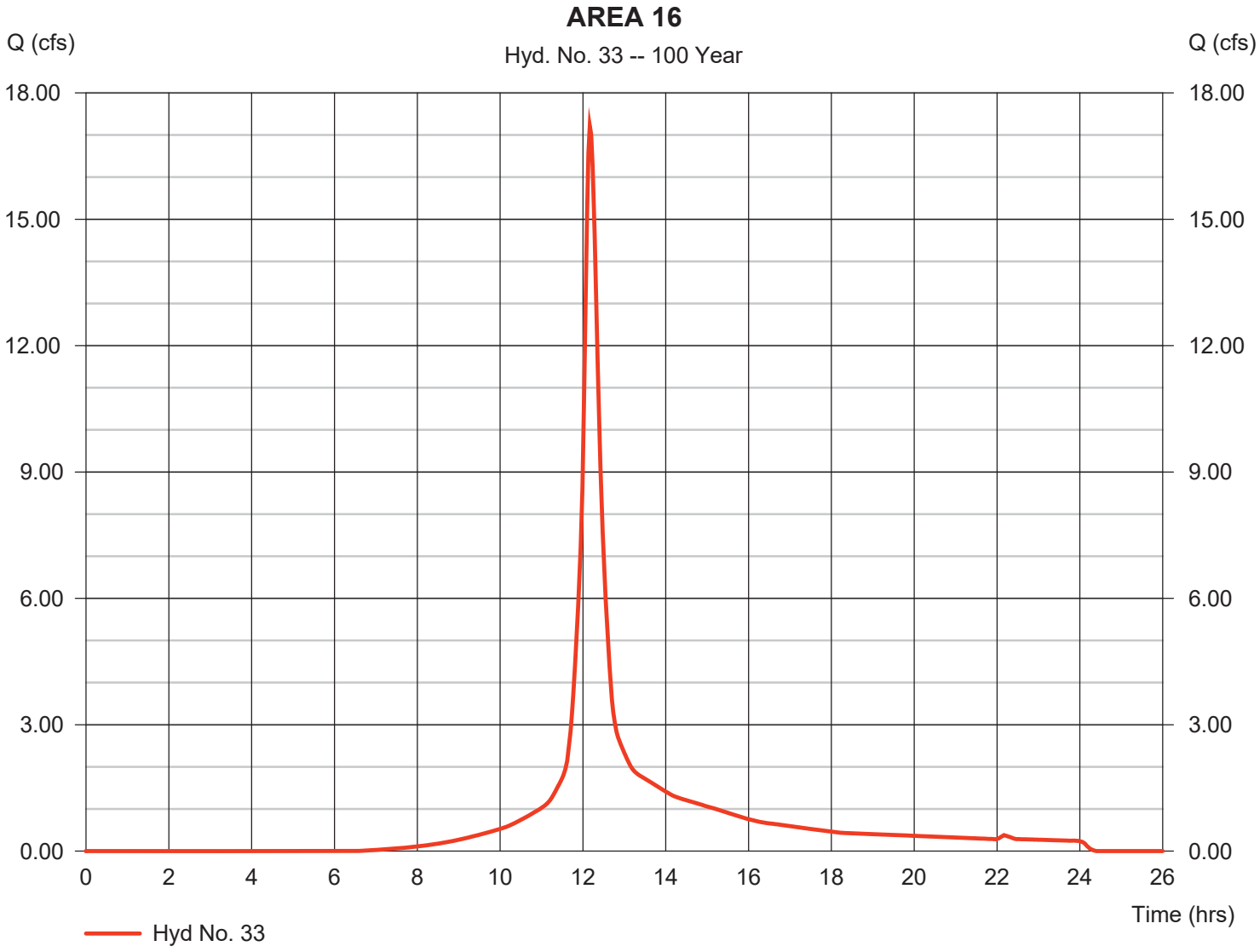


Hydrograph Report

Hyd. No. 33

AREA 16

Hydrograph type	=	SCS Runoff	Peak discharge	=	17.21 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	70,335 cuft
Drainage area	=	3.930 ac	Curve number	=	76.7
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	14.90 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 33

AREA 16

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.36		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 12.04**	**+**	**0.00**	**+**	**0.00**	**=**	**12.04**
Shallow Concentrated Flow							
Flow length (ft)	= 390.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 2.85**	**+**	**0.00**	**+**	**0.00**	**=**	**2.85**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

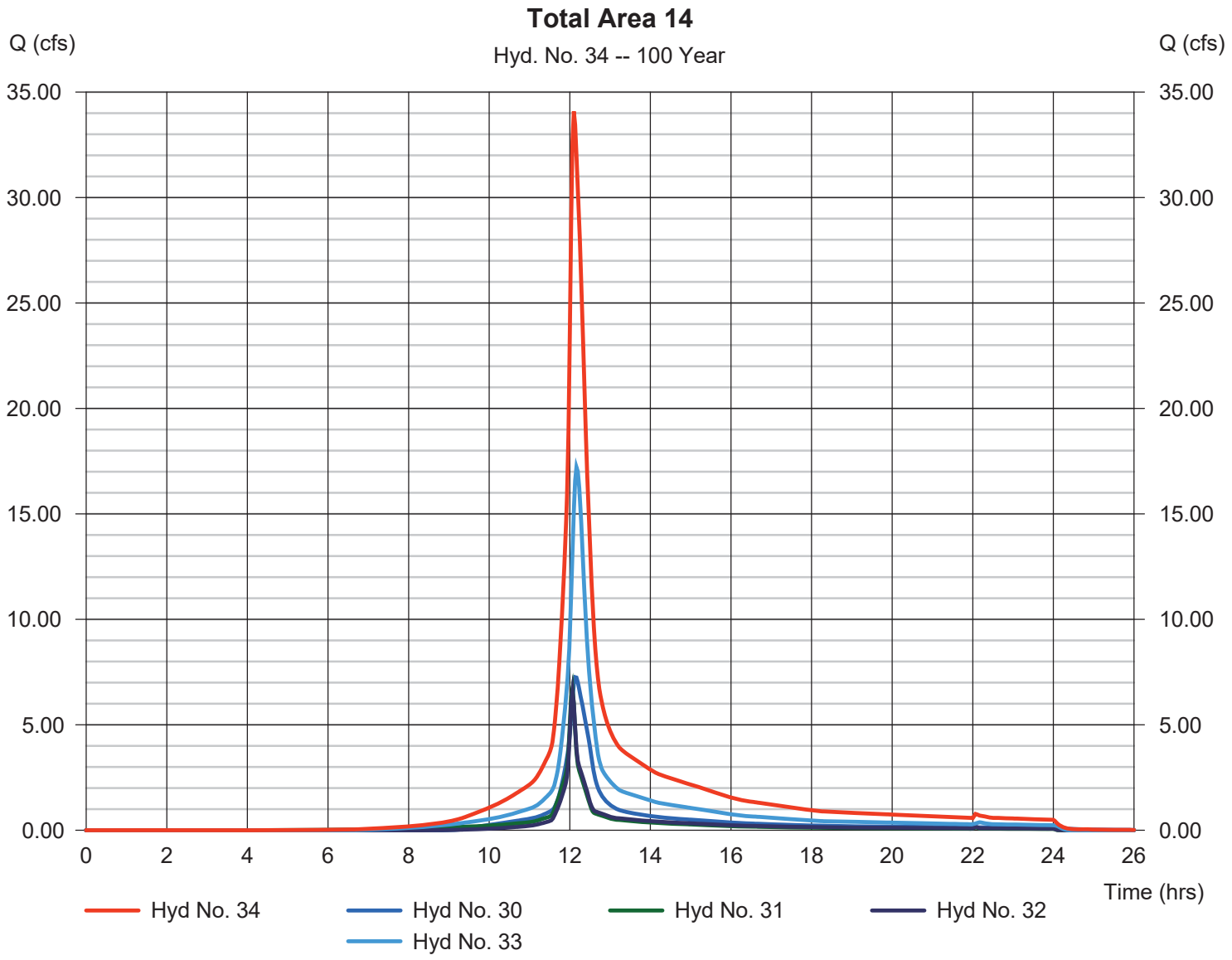
Total Travel Time, Tc ..... 14.90 min

Hydrograph Report

Hyd. No. 34

Total Area 14

Hydrograph type	= Combine	Peak discharge	= 34.08 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 144,475 cuft
Inflow hyds.	= 30, 31, 32, 33	Contrib. drain. area	= 6.490 ac

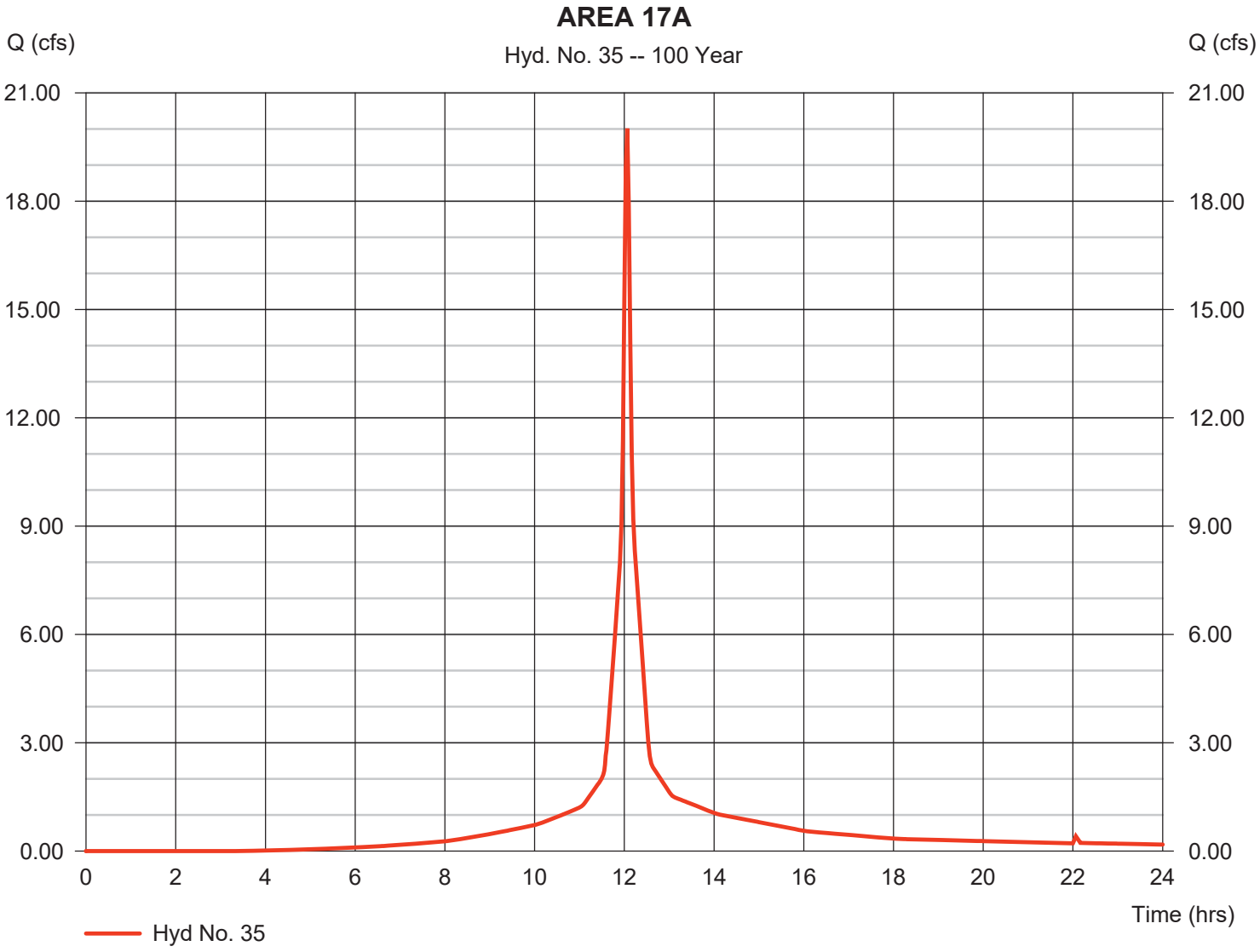


Hydrograph Report

Hyd. No. 35

AREA 17A

Hydrograph type	=	SCS Runoff	Peak discharge	=	20.01 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	63,033 cuft
Drainage area	=	2.950 ac	Curve number	=	87.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



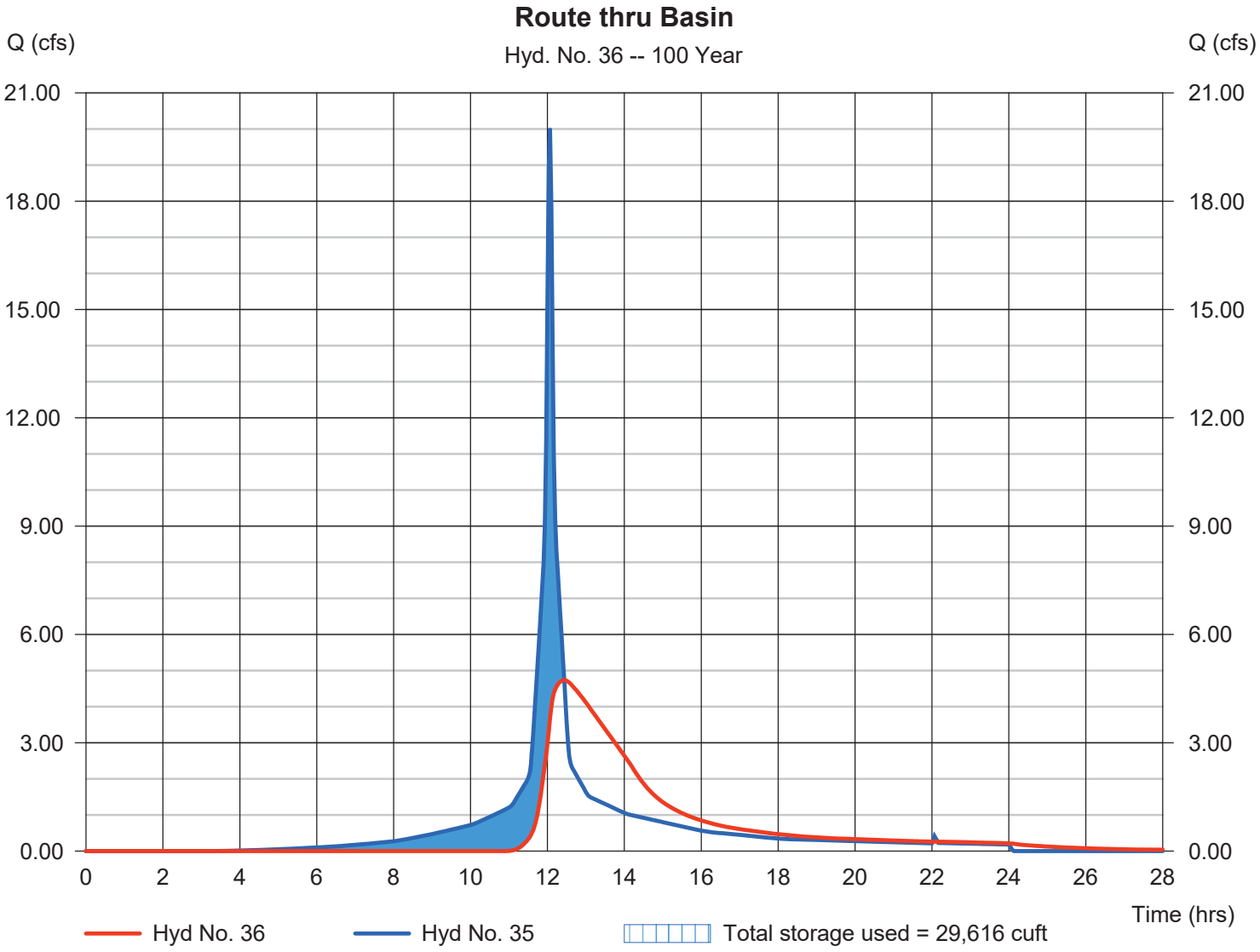
Hydrograph Report

Hyd. No. 36

Route thru Basin

Hydrograph type	=	Reservoir	Peak discharge	=	4.734 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.43 hrs
Time interval	=	2 min	Hyd. volume	=	54,528 cuft
Inflow hyd. No.	=	35 - AREA 17A	Max. Elevation	=	95.07 ft
Reservoir name	=	Infiltration Basin	Max. Storage	=	29,616 cuft

Storage Indication method used.



Pond Report

Pond No. 2 - Infiltration Basin

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 92.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	92.00	7,947	0	0
1.00	93.00	9,018	8,483	8,483
2.00	94.00	10,146	9,582	18,065
3.00	95.00	11,330	10,738	28,803
4.00	96.00	12,570	11,950	40,753

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 93.00	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

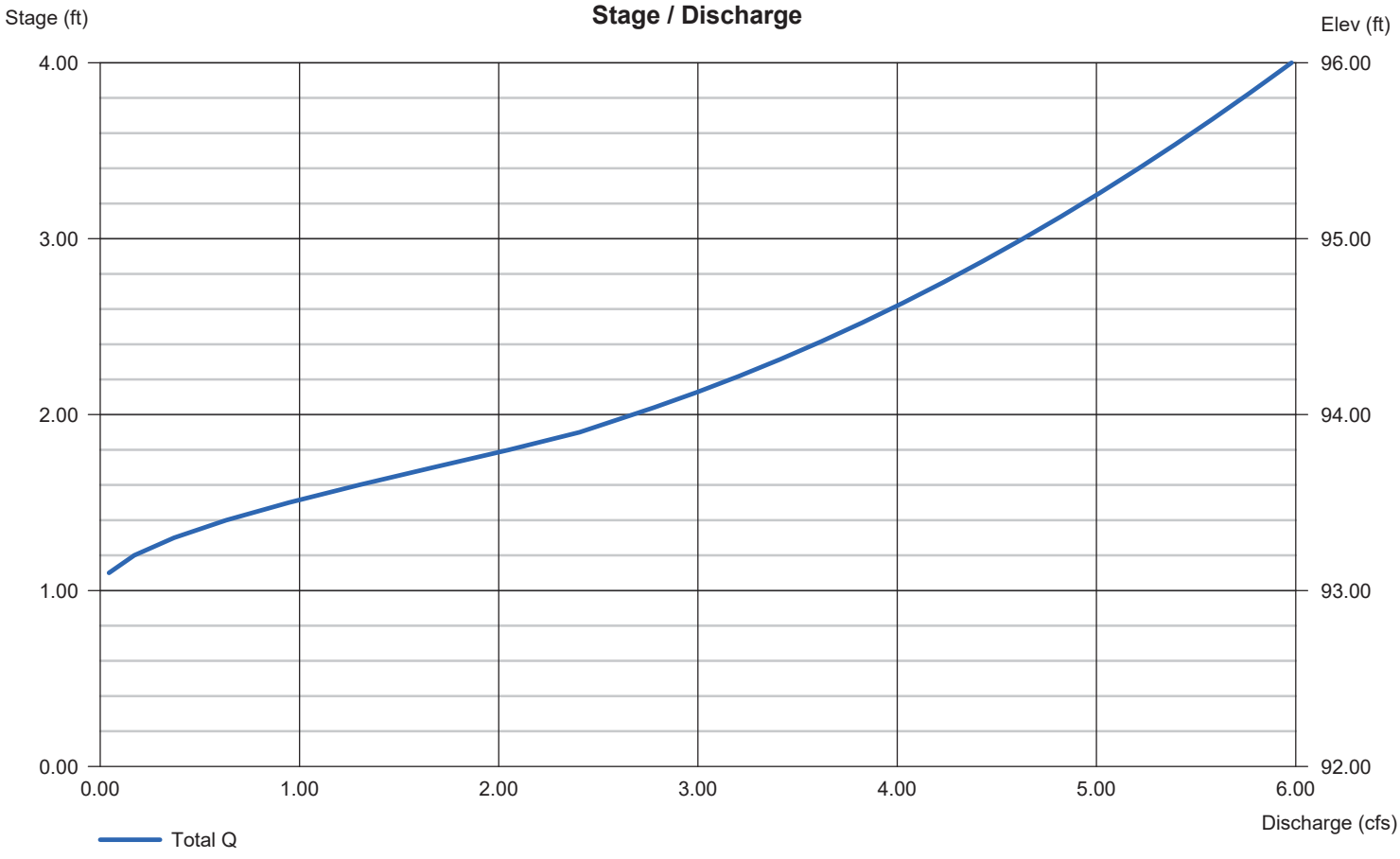
Weir Structures

	[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) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

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

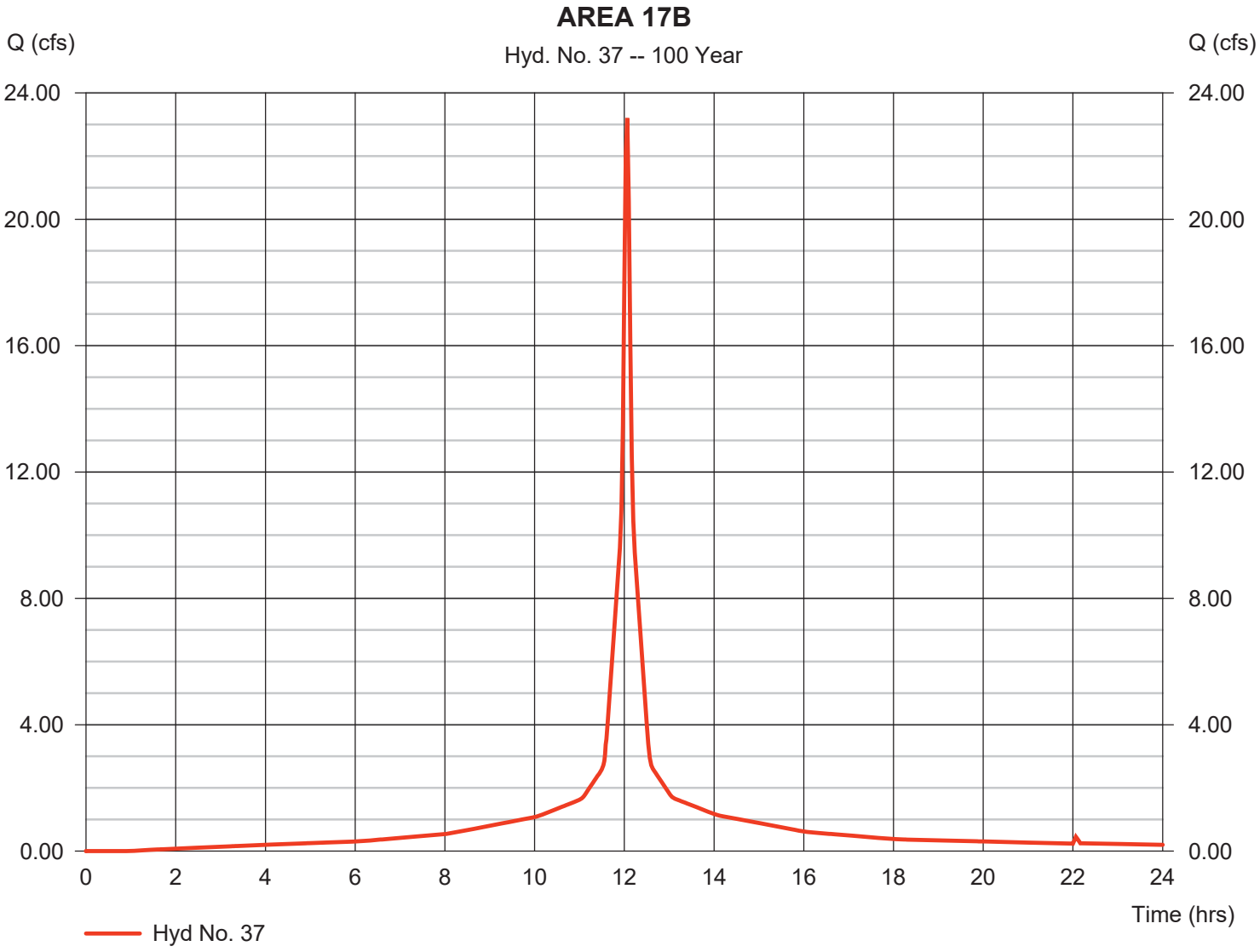


Hydrograph Report

Hyd. No. 37

AREA 17B

Hydrograph type	= SCS Runoff	Peak discharge	= 23.20 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 79,375 cuft
Drainage area	= 3.160 ac	Curve number	= 96.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

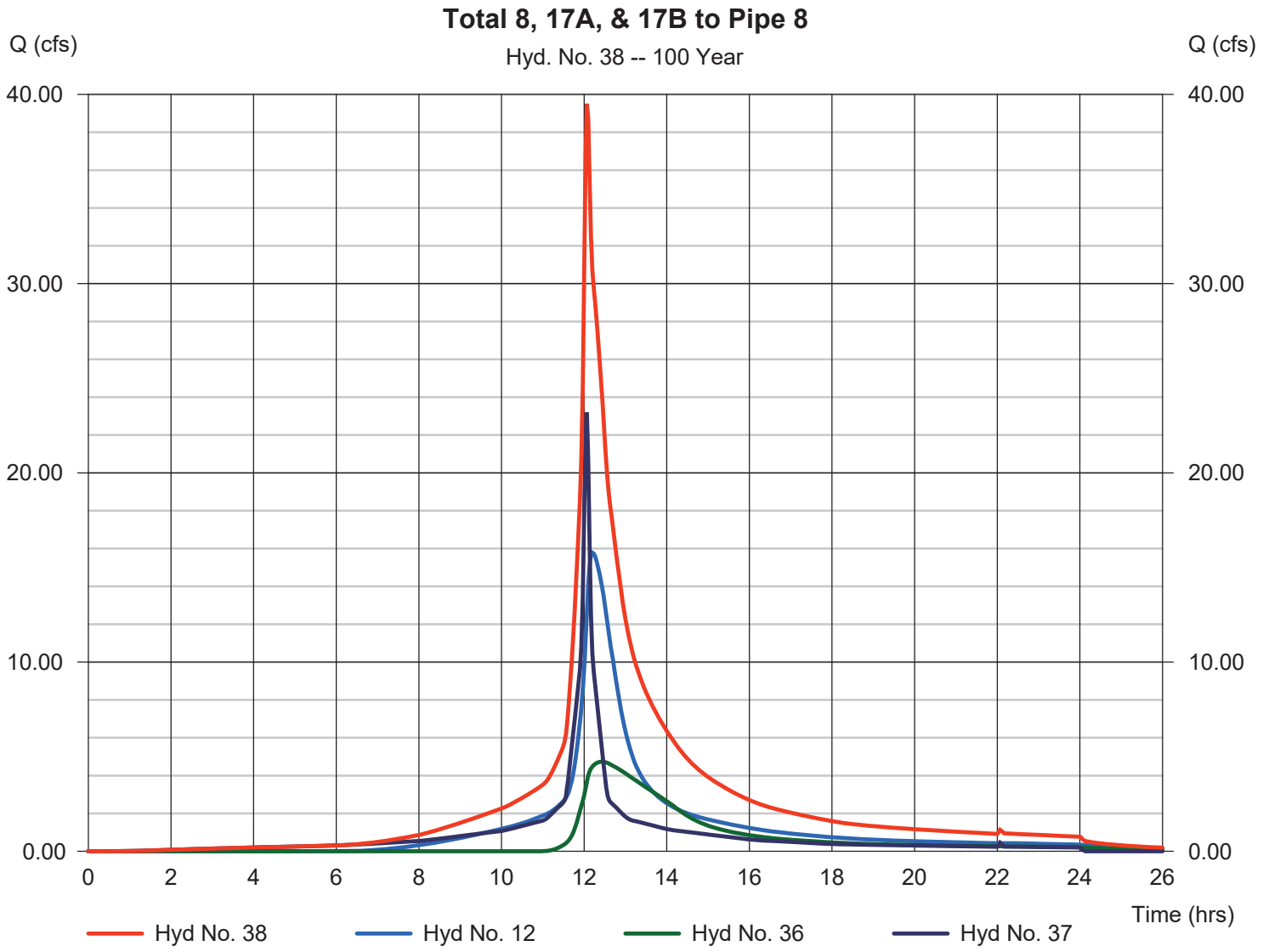


Hydrograph Report

Hyd. No. 38

Total 8, 17A, & 17B to Pipe 8

Hydrograph type	= Combine	Peak discharge	= 39.51 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 247,843 cuft
Inflow hyds.	= 12, 36, 37	Contrib. drain. area	= 3.160 ac

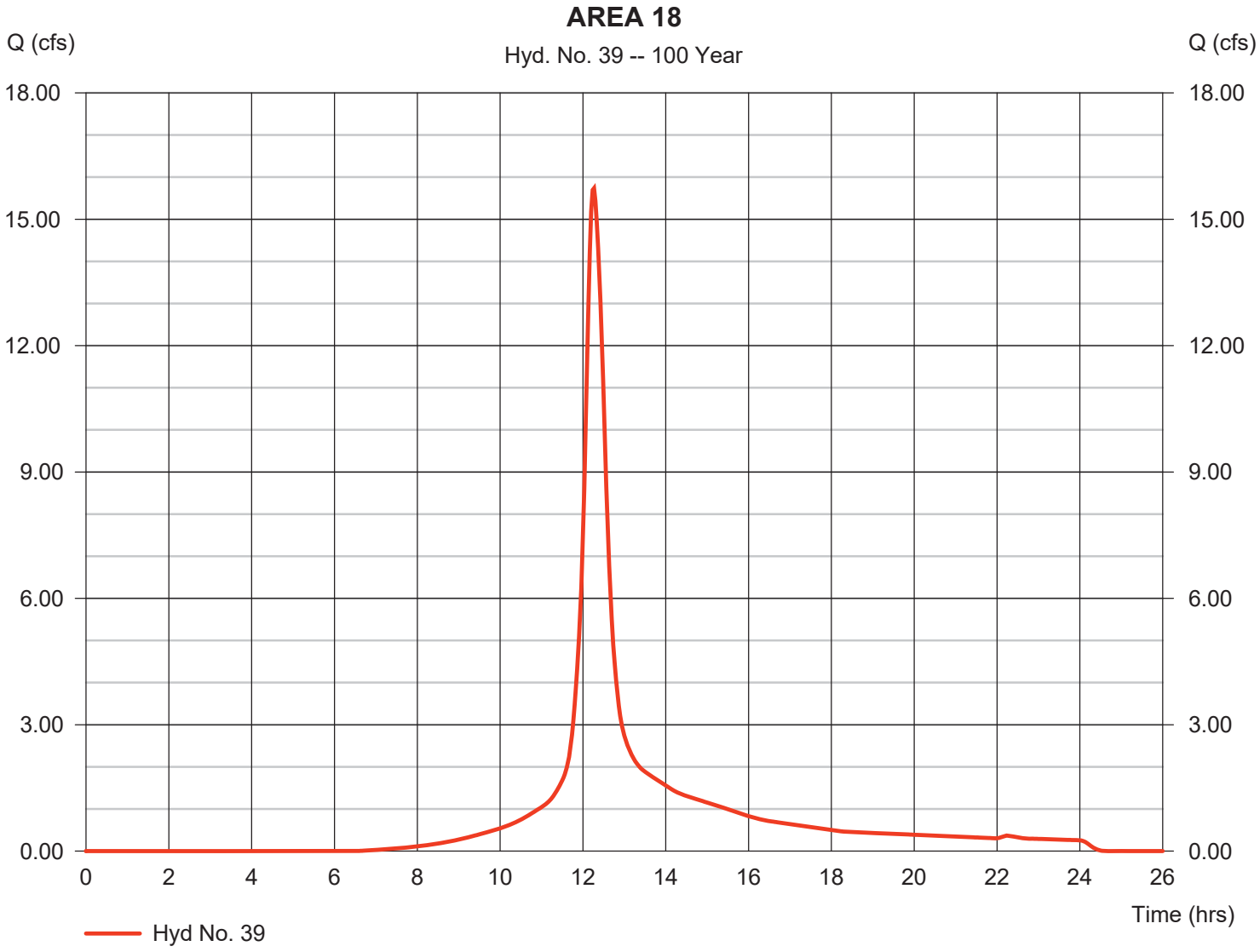


Hydrograph Report

Hyd. No. 39

AREA 18

Hydrograph type	=	SCS Runoff	Peak discharge	=	15.74 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.27 hrs
Time interval	=	2 min	Hyd. volume	=	74,868 cuft
Drainage area	=	3.980 ac	Curve number	=	77
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.50 min
Total precip.	=	7.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 39

AREA 18

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.36		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 12.04**	**+**	**0.00**	**+**	**0.00**	**=**	**12.04**
Shallow Concentrated Flow							
Flow length (ft)	= 40.00		24.00		790.00		
Watercourse slope (%)	= 2.00		25.00		1.00		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=2.28		8.07		1.61		
Travel Time (min)	**= 0.29**	**+**	**0.05**	**+**	**8.16**	**=**	**8.50**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

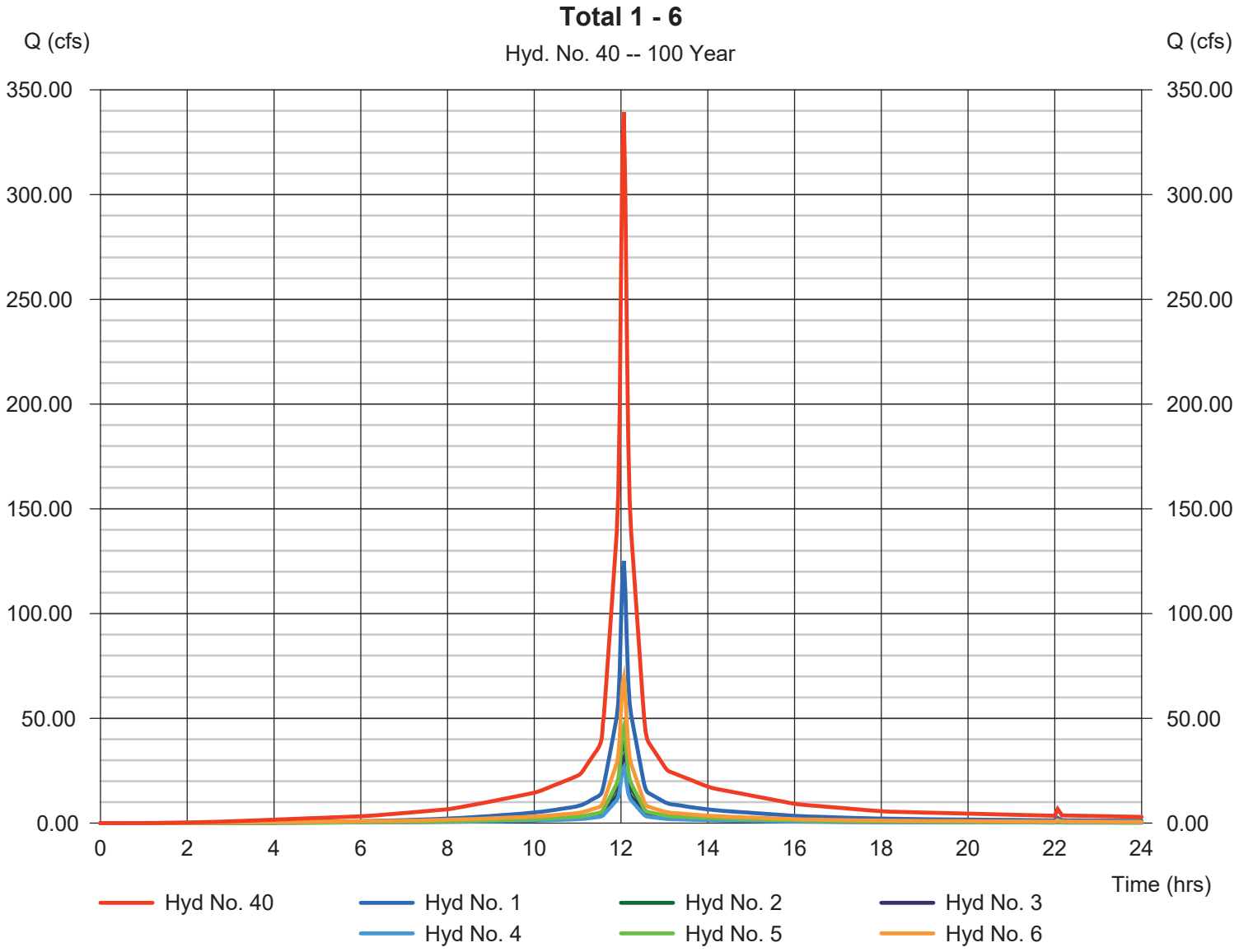
Total Travel Time, Tc ..... 20.50 min

Hydrograph Report

Hyd. No. 40

Total 1 - 6

Hydrograph type	= Combine	Peak discharge	= 339.44 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 1,120,356 cuft
Inflow hyds.	= 1, 2, 3, 4, 5, 6	Contrib. drain. area	= 47.310 ac

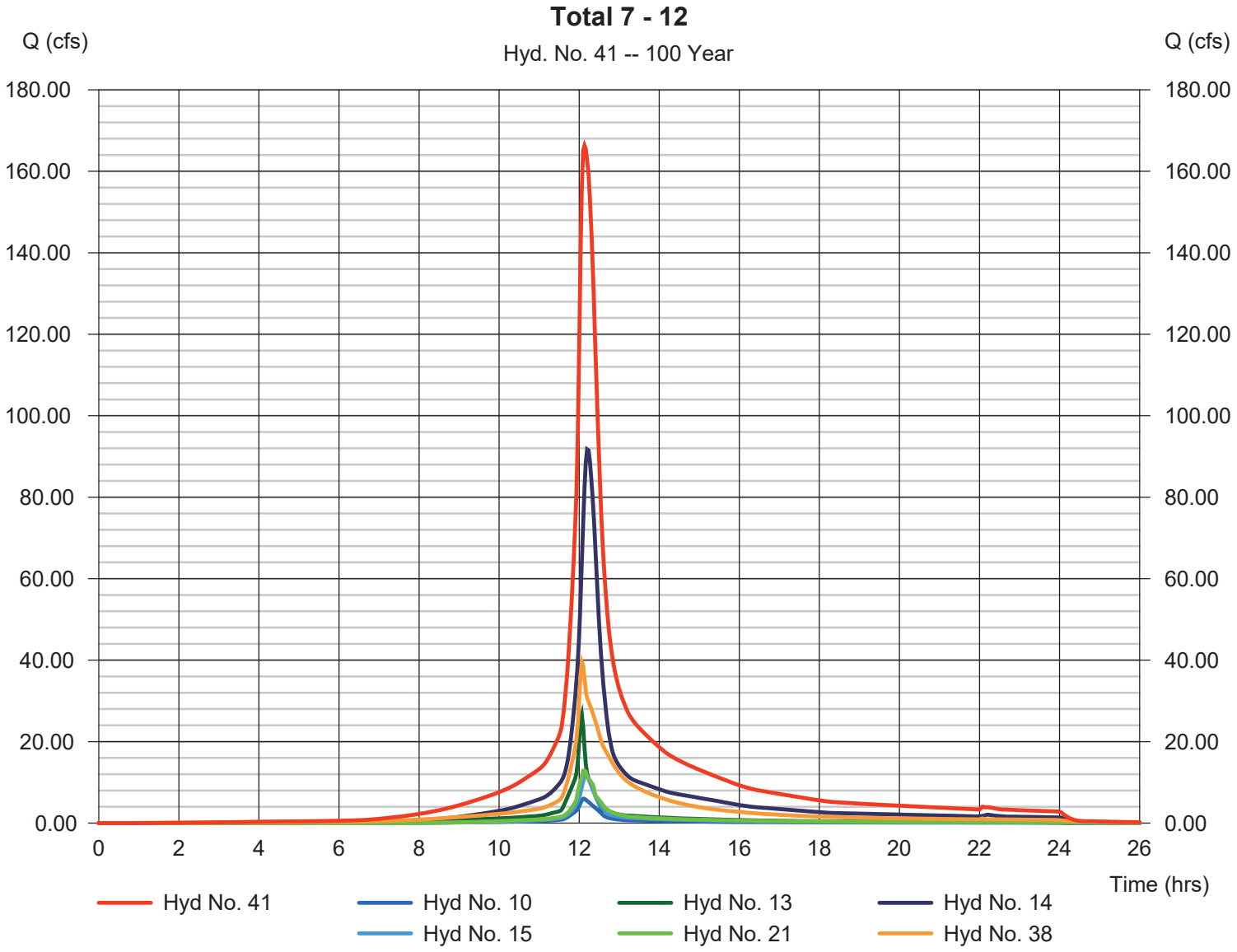


Hydrograph Report

Hyd. No. 41

Total 7 - 12

Hydrograph type	=	Combine	Peak discharge	=	166.32 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.13 hrs
Time interval	=	2 min	Hyd. volume	=	876,245 cuft
Inflow hyds.	=	10, 13, 14, 15, 21, 38	Contrib. drain. area	=	28.380 ac

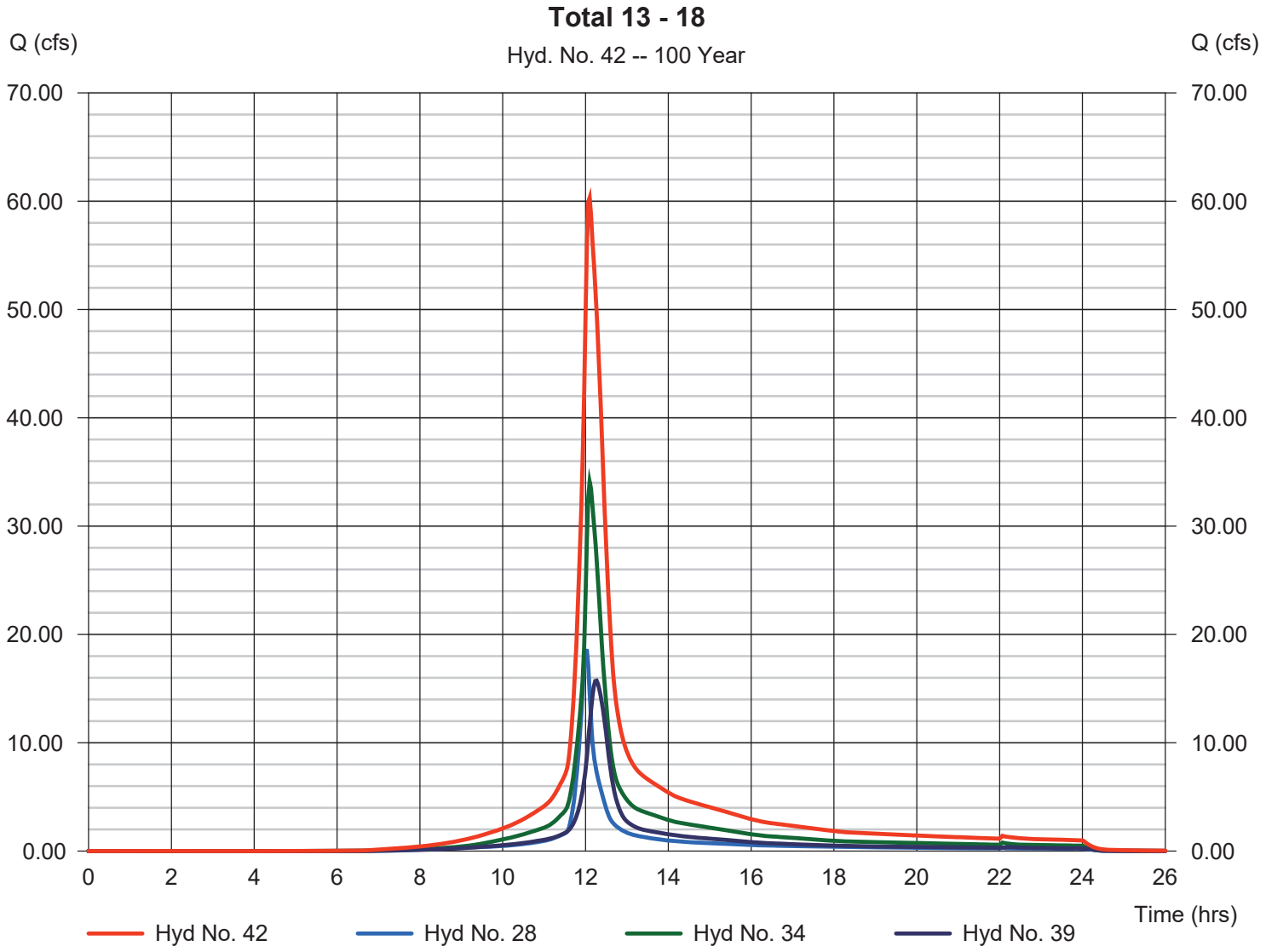


Hydrograph Report

Hyd. No. 42

Total 13 - 18

Hydrograph type	= Combine	Peak discharge	= 60.31 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.10 hrs
Time interval	= 2 min	Hyd. volume	= 281,167 cuft
Inflow hyds.	= 28, 34, 39	Contrib. drain. area	= 3.980 ac

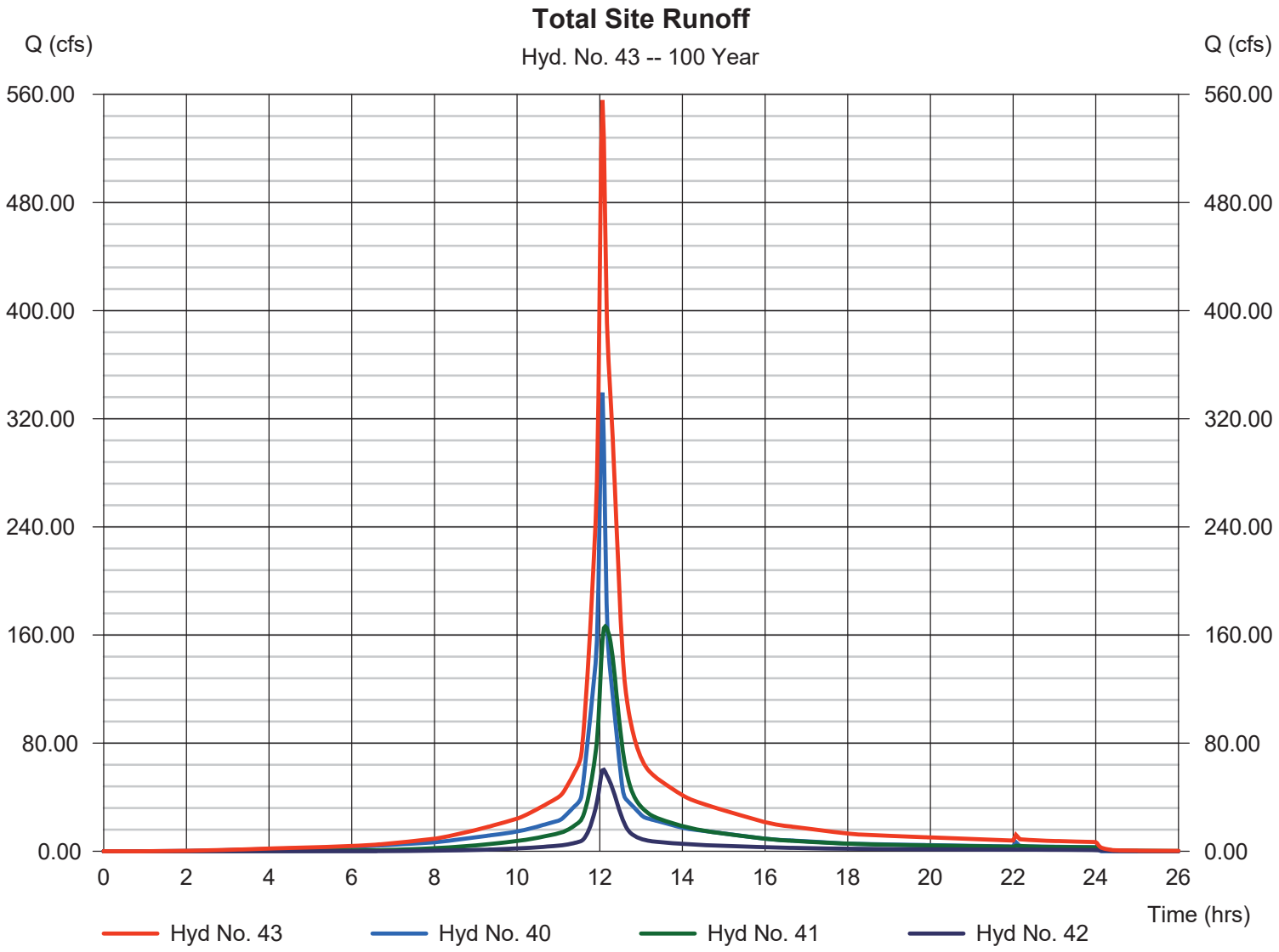


Hydrograph Report

Hyd. No. 43

Total Site Runoff

Hydrograph type	= Combine	Peak discharge	= 555.78 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 2,277,782 cuft
Inflow hyds.	= 40, 41, 42	Contrib. drain. area	= 0.000 ac



KELLY ENGINEERING GROUP, INC.
Zero Campanelli Drive-Braintree-MA 02184 Phone 781 843 4333

Attachment C
Best Management Practices

Required Dedicated Recharge Volume Calculation

Hanover Crossing – Commercial

Existing impervious area = 56.14 acres
Proposed impervious area = 54.26 acres
Increase in impervious area = -1.88 acres (-81,857+/- s.f.) Net decrease in impervious area

Required recharge volume = 0 s.f. * 0.35" /12 (Hydrologic Group B soils) = **0 cu.ft.**

Provided recharge volume = **40,000+/- cu.ft**. (see Provided Recharge Volume Table)

Hanover Crossing – Residential

(See Residential Recharge Calculations)

Provided Recharge Volume & Drain Down Time Table
Hanover Crossing

Notes:
Recharge volume is based on soil texture from NRCS soil survey. Soils within the development area are hydrologic group B soils.
0.35 inch of recharge volume is required over the increase in impervious area.
The proposed development will decrease impervious area by approximately 2 acres within the commercial development.
Recharge volume is not required within the commercial development.
An infiltration rate of 1.02 in/hr is used for hydrologic group B Sandy Loamy soils for calculating drain down times.

Building	Area	1 inch Roof Rech. Vol.	Provided Rech. Vol.	Bottom Area	Recharge Rate	Drain Down Time
	(s.f.)	(cu.ft.)	(cu.ft.)	(s.f.)	(cu.ft./hr)	(hr)
Building 1	21,234	1,770	1,869	840	71	24
Building 2	29,037	2,420	2,454	1,094	93	24
Building 3	46,654	3,888	4,113	1,823	155	24
Grocer	79,332	6,611	7,058	3,096	263	24
Building 4	36,095	3,008	3,135	1,388	118	24
Theater	42,508	3,542	3,624	1,601	136	24
Building 5	36,095	3,008	3,135	1,388	118	24
Building 6	18,592	1,549	1,615	728	62	24
Building 7	32,957	2,746	2,786	1,239	105	24
Subsurface Infiltration System			2,925	14,623	1,243	2
Infiltration Basin			8,483	7,947	675	13
Total		37,238	**41,197**			

Hanover Crossing - Residential
Hanover, MA

Recharge Calculations

Required Recharge Volume[1]

Rv = F x impervious area

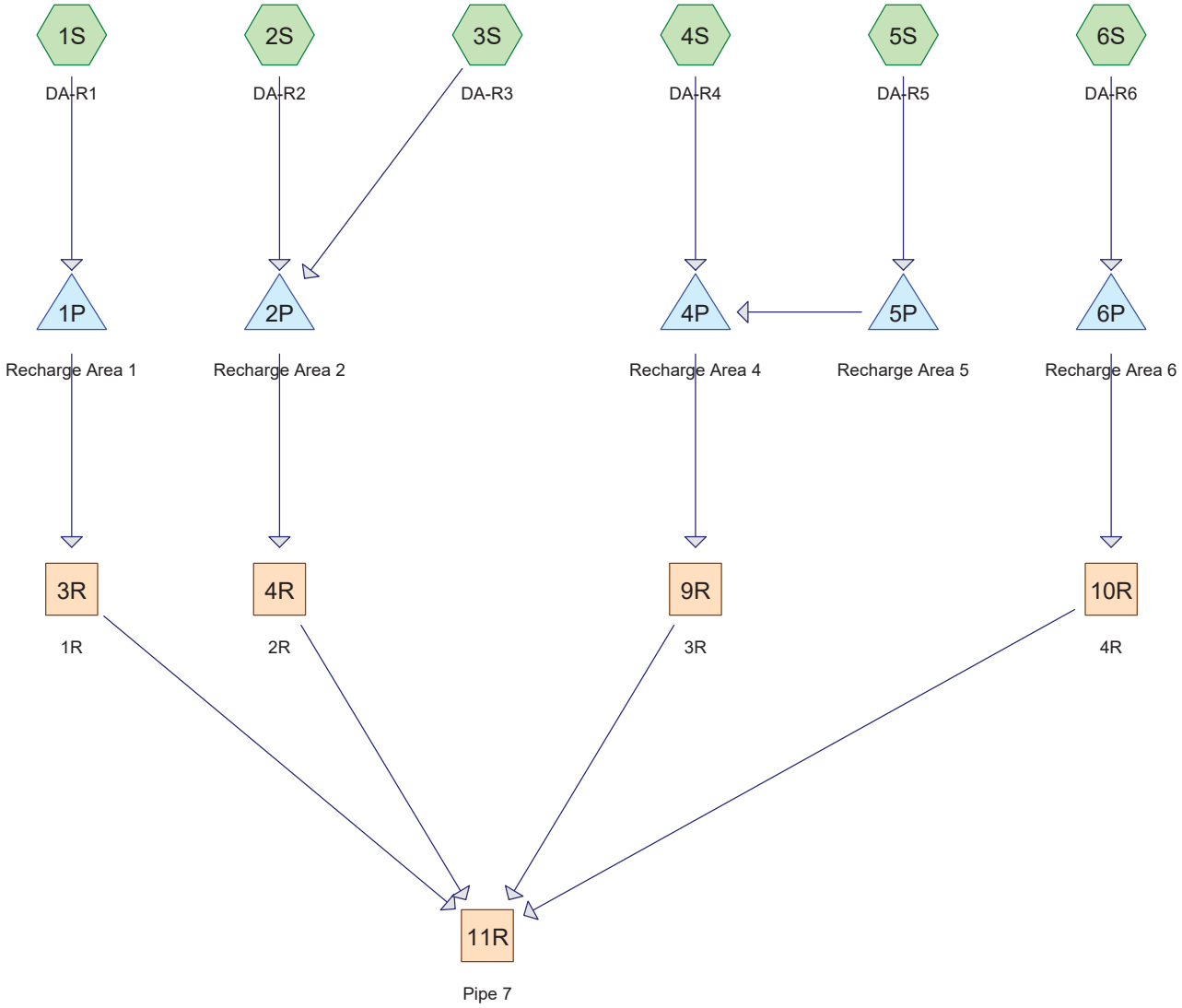
Where: Rv = required recharge volume (acre-feet)
F = target depth factor associated with each hydrologic soil group (inches)
Impervious Area = New pavement and rooftop area on site (acres)

NRCS Hydrologic Soil Type	Approx. Soil Texture	Target Depth Factor (inches)	Impervious Area (acre)	Rv (acre-feet)	Rv (cf)
A	sand	0.60	0.00	0.000	0
B	loam	0.35	3.05	0.089	3,875
C	silty loam	0.25	0.00	0.000	0
D	clay	0.10	0.00	0.000	0
			Total =	**0.089**	**3,875**

Provided Recharge Volume[2]

Infiltration Basin	Simple/Dynamic Recharge Volume (acre-feet)	Simple/Dymanic Recharge Volume (cf)
R.A. 1	0.017	741
R.A. 2	0.023	1002
R.A. 4	0.019	828
R.A. 5	0.014	610
R.A. 6	0.026	1133
Total =	**0.099**	**4312**

Notes:
1.) Refer to Massachusetts Stormwater Handbook Volume 3, Chapter 1, page 15 dated February 2008.
2.) Provided recharge volume is based on the Static Method, refer to Massachusetts Stormwater Handbook Volume 3, Chapter 1, page 18 dated February 2008.



Subcat Reach Pond Link

Routing Diagram for Proposed Watershed Infiltration Simple Dynamic
Prepared by Tetra Tech Inc, Printed 5/13/2019

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.760	98	(3S)
2.350	61	>75% Grass cover, Good, HSG B (1S, 2S, 3S, 4S, 5S, 6S)
3.160	98	Pavement (1S, 2S, 4S, 5S, 6S)
1.630	98	Roof (1S, 2S, 4S, 5S, 6S)
7.900	**87**	**TOTAL AREA**

Summary for Subcatchment 1S: DA-R1

Runoff = 0.40 cfs @ 12.10 hrs, Volume= 0.017 af, Depth> 0.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs
Type III 24-hr Recharge Rainfall=1.07"

	Area (ac)	CN	Description
*	0.600	98	Pavement
*	0.250	98	Roof
	0.270	61	>75% Grass cover, Good, HSG B
	1.120	89	Weighted Average
	0.270		24.11% Pervious Area
	0.850		75.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry,**

Summary for Subcatchment 2S: DA-R2

Runoff = 0.09 cfs @ 12.32 hrs, Volume= 0.006 af, Depth> 0.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs
Type III 24-hr Recharge Rainfall=1.07"

	Area (ac)	CN	Description
*	0.550	98	Pavement
*	0.370	98	Roof
	0.860	61	>75% Grass cover, Good, HSG B
	1.780	80	Weighted Average
	0.860		48.31% Pervious Area
	0.920		51.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	50	0.0300	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.36"
4.3	420	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.3	32	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.2	61	0.0100	4.91	3.86	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
9.5	563	Total			

Summary for Subcatchment 3S: DA-R3

Runoff = 0.40 cfs @ 12.09 hrs, Volume= 0.017 af, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs
Type III 24-hr Recharge Rainfall=1.07"

	Area (ac)	CN	Description
*	0.410	98	
*	0.350	98	
	0.210	61	>75% Grass cover, Good, HSG B
	0.970	90	Weighted Average
	0.210		21.65% Pervious Area
	0.760		78.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	33	0.0300	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.36"
0.3	17	0.0200	0.99		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.36"
0.2	27	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	133	0.0100	4.91	3.86	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
4.3	210	Total, Increased to minimum Tc = 6.0 min			

Summary for Subcatchment 4S: DA-R4

Runoff = 0.40 cfs @ 12.13 hrs, Volume= 0.019 af, Depth> 0.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs
Type III 24-hr Recharge Rainfall=1.07"

	Area (ac)	CN	Description
*	0.690	98	Pavement
*	0.240	98	Roof
	0.300	61	>75% Grass cover, Good, HSG B
	1.230	89	Weighted Average
	0.300		24.39% Pervious Area
	0.930		75.61% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.36"
0.3	27	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.0	127	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.1	24	0.0100	4.91	3.86	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012
8.6	228	Total			

Summary for Subcatchment 5S: DA-R5

Runoff = 0.30 cfs @ 12.14 hrs, Volume= 0.014 af, Depth> 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs
Type III 24-hr Recharge Rainfall=1.07"

	Area (ac)	CN	Description
*	0.550	98	Pavement
*	0.230	98	Roof
	0.270	61	>75% Grass cover, Good, HSG B
	1.050	88	Weighted Average
	0.270		25.71% Pervious Area
	0.780		74.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	32	0.0300	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.36"
0.3	18	0.0200	1.00		**Sheet Flow, Paved** Smooth surfaces n= 0.011 P2= 3.36"
0.3	58	0.0200	2.87		**Shallow Concentrated Flow, Paved** Paved Kv= 20.3 fps
5.0	147	0.0100	0.49	0.39	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.120
8.9	255	Total			

Summary for Subcatchment 6S: DA-R6

Runoff = 0.47 cfs @ 12.23 hrs, Volume= 0.026 af, Depth> 0.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs
Type III 24-hr Recharge Rainfall=1.07"

	Area (ac)	CN	Description
*	0.770	98	Pavement
*	0.540	98	Roof
	0.440	61	>75% Grass cover, Good, HSG B
	1.750	89	Weighted Average
	0.440		25.14% Pervious Area
	1.310		74.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.36"
0.3	27	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.5	58	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
7.1	210	0.0100	0.49	0.39	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.120
15.1	345	Total			

Summary for Reach 3R: 1R

Inflow Area = 1.120 ac, 75.89% Impervious, Inflow Depth > 0.00" for Recharge event
Inflow = 0.00 cfs @ 13.02 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 13.03 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.6 min

Routing by Sim-Route method, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs

Summary for Reach 4R: 2R

Inflow Area = 2.750 ac, 61.09% Impervious, Inflow Depth = 0.00" for Recharge event
Inflow = 0.00 cfs @ 11.50 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 11.50 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Sim-Route method, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs

Summary for Reach 9R: 3R

Inflow Area = 2.280 ac, 75.00% Impervious, Inflow Depth = 0.00" for Recharge event
Inflow = 0.00 cfs @ 11.50 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 11.50 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Sim-Route method, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs

Summary for Reach 10R: 4R

Inflow Area = 1.750 ac, 74.86% Impervious, Inflow Depth = 0.00" for Recharge event
Inflow = 0.00 cfs @ 11.50 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 11.50 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Sim-Route method, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs

Summary for Reach 11R: Pipe 7

Inflow Area = 7.900 ac, 70.25% Impervious, Inflow Depth > 0.00" for Recharge event
Inflow = 0.00 cfs @ 13.03 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 13.04 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.6 min

Routing by Sim-Route method, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs

Summary for Pond 1P: Recharge Area 1

Inflow Area = 1.120 ac, 75.89% Impervious, Inflow Depth > 0.18" for Recharge event
Inflow = 0.40 cfs @ 12.10 hrs, Volume= 0.017 af
Outflow = 0.05 cfs @ 13.02 hrs, Volume= 0.007 af, Atten= 87%, Lag= 55.1 min
Discarded = 0.05 cfs @ 11.80 hrs, Volume= 0.007 af
Primary = 0.00 cfs @ 13.02 hrs, Volume= 0.000 af

Routing by Sim-Route method, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs
Peak Elev= 85.53' @ 13.02 hrs Surf.Area= 0.045 ac Storage= 0.010 af

Plug-Flow detention time= 35.3 min calculated for 0.007 af (43% of inflow)
Center-of-Mass det. time= 14.9 min (755.8 - 740.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	85.00'	0.041 af	**20.50'W x 96.18'L x 3.50'H Field A** 0.158 af Overall - 0.055 af Embedded = 0.104 af x 40.0% Voids
#2A	85.50'	0.055 af	**ADS_StormTech SC-740 +Cap** x 52 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 52 Chambers in 4 Rows
		0.096 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	85.50'	**12.0" Round Culvert** L= 30.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 85.50' / 85.00' S= 0.0167 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Discarded	85.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.05 cfs @ 11.80 hrs HW=85.01' (Free Discharge)
2=Exfiltration (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.00 cfs @ 13.02 hrs HW=85.53' TW=0.00' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.00 cfs @ 0.59 fps)

Summary for Pond 2P: Recharge Area 2

Inflow Area = 2.750 ac, 61.09% Impervious, Inflow Depth > 0.10" for Recharge event
Inflow = 0.43 cfs @ 12.11 hrs, Volume= 0.023 af
Outflow = 0.11 cfs @ 11.96 hrs, Volume= 0.016 af, Atten= 74%, Lag= 0.0 min
Discarded = 0.11 cfs @ 11.96 hrs, Volume= 0.016 af
Primary = 0.00 cfs @ 11.50 hrs, Volume= 0.000 af

Routing by Sim-Route method, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs
Peak Elev= 84.21' @ 12.66 hrs Surf.Area= 0.108 ac Storage= 0.009 af

Plug-Flow detention time= 27.5 min calculated for 0.016 af (70% of inflow)
Center-of-Mass det. time= 13.6 min (758.0 - 744.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	84.00'	0.097 af	**49.00'W x 96.18'L x 3.50'H Field A** 0.379 af Overall - 0.137 af Embedded = 0.242 af x 40.0% Voids
#2A	84.50'	0.137 af	**ADS_StormTech SC-740 +Cap** x 130 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 130 Chambers in 10 Rows
		0.234 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	84.50'	**18.0" Round Culvert** L= 93.1' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 84.50' / 83.53' S= 0.0104 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf
#2	Discarded	84.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.11 cfs @ 11.96 hrs HW=84.01' (Free Discharge)
2=Exfiltration (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.00 cfs @ 11.50 hrs HW=84.00' TW=0.00' (Dynamic Tailwater)
1=Culvert (Controls 0.00 cfs)

Summary for Pond 4P: Recharge Area 4

Inflow Area = 2.280 ac, 75.00% Impervious, Inflow Depth > 0.10" for Recharge event
Inflow = 0.40 cfs @ 12.13 hrs, Volume= 0.019 af
Outflow = 0.05 cfs @ 11.84 hrs, Volume= 0.008 af, Atten= 87%, Lag= 0.0 min
Discarded = 0.05 cfs @ 11.84 hrs, Volume= 0.008 af
Primary = 0.00 cfs @ 11.50 hrs, Volume= 0.000 af

Routing by Sim-Route method, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs
Peak Elev= 84.49' @ 13.11 hrs Surf.Area= 0.052 ac Storage= 0.011 af

Plug-Flow detention time= 33.2 min calculated for 0.008 af (42% of inflow)
Center-of-Mass det. time= 13.0 min (755.7 - 742.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.97'	0.047 af	**30.00'W x 74.82'L x 3.50'H Field A** 0.180 af Overall - 0.063 af Embedded = 0.117 af x 40.0% Voids
#2A	84.47'	0.063 af	**ADS_StormTech SC-740 +Cap** x 60 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 60 Chambers in 6 Rows
		0.110 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	84.50'	**18.0" Round Culvert** L= 73.4' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 84.50' / 83.70' S= 0.0109 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf
#2	Discarded	83.97'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.05 cfs @ 11.84 hrs HW=83.98' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.00 cfs @ 11.50 hrs HW=83.97' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 5P: Recharge Area 5

Inflow Area = 1.050 ac, 74.29% Impervious, Inflow Depth > 0.16" for Recharge event
Inflow = 0.30 cfs @ 12.14 hrs, Volume= 0.014 af
Outflow = 0.06 cfs @ 11.96 hrs, Volume= 0.009 af, Atten= 79%, Lag= 0.0 min
Discarded = 0.06 cfs @ 11.96 hrs, Volume= 0.009 af
Primary = 0.00 cfs @ 11.50 hrs, Volume= 0.000 af

Routing by Sim-Route method, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs
Peak Elev= 84.44' @ 12.69 hrs Surf.Area= 0.061 ac Storage= 0.006 af

Plug-Flow detention time= 29.8 min calculated for 0.009 af (63% of inflow)
Center-of-Mass det. time= 14.9 min (758.9 - 744.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	84.18'	0.056 af	**39.50'W x 67.70'L x 3.50'H Field A** 0.215 af Overall - 0.076 af Embedded = 0.139 af x 40.0% Voids
#2A	84.68'	0.076 af	**ADS_StormTech SC-740 +Cap** x 72 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 72 Chambers in 8 Rows
		0.132 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	84.91'	**12.0" Round Culvert** L= 41.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 84.91' / 84.50' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf
#2	Discarded	84.18'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.06 cfs @ 11.96 hrs HW=84.19' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 11.50 hrs HW=84.18' TW=83.97' (Dynamic Tailwater)
↑—**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 6P: Recharge Area 6

Inflow Area = 1.750 ac, 74.86% Impervious, Inflow Depth > 0.18" for Recharge event
Inflow = 0.47 cfs @ 12.23 hrs, Volume= 0.026 af
Outflow = 0.08 cfs @ 11.93 hrs, Volume= 0.011 af, Atten= 83%, Lag= 0.0 min
Discarded = 0.08 cfs @ 11.93 hrs, Volume= 0.011 af
Primary = 0.00 cfs @ 11.50 hrs, Volume= 0.000 af

Routing by Sim-Route method, Time Span= 11.50-13.50 hrs, dt= 0.01 hrs
Peak Elev= 84.33' @ 13.17 hrs Surf.Area= 0.077 ac Storage= 0.015 af

Plug-Flow detention time= 30.6 min calculated for 0.011 af (43% of inflow)
Center-of-Mass det. time= 10.7 min (757.8 - 747.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.83'	0.069 af	**34.75'W x 96.18'L x 3.50'H Field A** 0.269 af Overall - 0.096 af Embedded = 0.173 af x 40.0% Voids
#2A	84.33'	0.096 af	**ADS_StormTech SC-740 +Cap** x 91 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 91 Chambers in 7 Rows
		0.165 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	84.50'	**15.0" Round Culvert** L= 122.2' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 84.50' / 83.22' S= 0.0105 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf
#2	Discarded	83.83'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.08 cfs @ 11.93 hrs HW=83.84' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 11.50 hrs HW=83.83' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Controls 0.00 cfs)

Hanover Crossing - Residential
Hanover, MA

Drawdown Calculations

Drawdown Time[1]

$$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ Area)}$$

Where: $Time_{drawdown}$ = time it takes the basin to drain completely (hours)
Rv = storage volume (cubic feet)
K = saturated hydraulic conductivity[2] (inch/hour)
Bottom Area = bottom area of recharge structure (square feet)

Infiltration Basin	Rv (cf)	K (in/hr)	Bottom Area (sf)	Drawdown Time (hr)
R.A. 1	741	1.02	1,972	4.4
R.A. 2	1,002	1.02	4713	2.5
R.A. 4	828	1.02	2244	4.3
R.A. 5	610	1.02	2674	2.7
R.A. 6	1,133	1.02	3343	4.0

Notes:
1.) Refer to Massachusetts Stormwater Handbook Volume 3, Chapter 1, page 25 dated February 2008.
2.) Refer to Massachusetts Stormwater Handbook Volume 3, Chapter 1, page 22 dated February 2008 (Rawls Rates Table).
3.) Refer to HydroCAD® report.

INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Proprietary Separator- 1775 Washington St. Hanover

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 5%	**0.05**	**1.00**	**0.05**	**0.95**
Deep Sump and Hooded Catch Basin	**0.25**	**0.95**	**0.24**	**0.71**
Proprietary Treatment Practice	0.80	**0.71**	0.57	0.14

Total TSS Removal = 86%

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

Project: HANOVER CROSSING

Prepared By: **Kelly Engineering Group,Inc.**

Date: **5/17/2019**

*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:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Proprietary Separator- 1775 Washington St. Hanover

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 5%	0.05	1.00	0.05	0.95
Deep Sump and Hooded Catch Basin	0.25	0.95	0.24	0.71
Proprietary Treatment Practice	0.00	0.71	0.00	0.71
Subsurface Infiltration Structure	0.80	0.71	0.57	0.14
	0.00	0.14	0.00	0.14

Total TSS Removal = 86%

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

Project: HANOVER CROSSING

Prepared By: Kelly Engineering Group,Inc.

Date: 5/17/2019

*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:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Infiltration Basin - 1775 Washington St. Hanover, MA

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 5%	0.05	1.00	0.05	0.95
Deep Sump and Hooded Catch Basin	0.25	0.95	0.24	0.71
Bioretention Area	0.90	0.71	0.64	0.07
Infiltration Basin	0.80	0.07	0.06	0.01
	0.00	0.01	0.00	0.01

Total TSS Removal = 99%

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

Project: HANOVER CROSSING

Prepared By: Kelly Engineering Group,Inc.

Date: 5/17/2019

*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 SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

HANOVER CROSSING
HANOVER, MA

Area	12.96 ac	Unit Site Designation	WQU 1
Weighted C	0.9	Rainfall Station #	69
t_c	20 min		
CDS Model	4040-8	CDS Treatment Capacity	12.4 cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.23	0.23	10.2
0.04	9.6%	19.8%	0.47	0.47	9.6
0.06	9.4%	29.3%	0.70	0.70	9.3
0.08	7.7%	37.0%	0.93	0.93	7.6
0.10	8.6%	45.6%	1.17	1.17	8.3
0.12	6.3%	51.9%	1.40	1.40	6.0
0.14	4.7%	56.5%	1.63	1.63	4.4
0.16	4.6%	61.2%	1.87	1.87	4.4
0.18	3.5%	64.7%	2.10	2.10	3.3
0.20	4.3%	69.1%	2.33	2.33	4.0
0.25	8.0%	77.1%	2.92	2.92	7.2
0.30	5.6%	82.7%	3.50	3.50	4.9
0.35	4.4%	87.0%	4.08	4.08	3.7
0.40	2.5%	89.5%	4.67	4.67	2.1
0.45	2.5%	92.1%	5.25	5.25	2.0
0.50	1.4%	93.5%	5.83	5.83	1.1
0.75	5.0%	98.5%	8.75	8.75	3.4
1.00	1.0%	99.5%	11.66	11.66	0.6
1.50	0.0%	99.5%	17.50	12.40	0.0
2.00	0.0%	99.5%	23.33	12.40	0.0
3.00	0.5%	100.0%	34.99	12.40	0.1
					92.1
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.2%
				Predicted Net Annual Load Removal Efficiency =	**85.6%**

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.

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

HANOVER CROSSING
HANOVER, MA

Area	3.05 ac	Unit Site Designation	WQU 2
Weighted C	0.9	Rainfall Station #	69
t_c	15 min		
CDS Model	2025-5	CDS Treatment Capacity	**3.2 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.05	0.05	10.2
0.04	9.6%	19.8%	0.11	0.11	9.6
0.06	9.4%	29.3%	0.16	0.16	9.3
0.08	7.7%	37.0%	0.22	0.22	7.6
0.10	8.6%	45.6%	0.27	0.27	8.3
0.12	6.3%	51.9%	0.33	0.33	6.1
0.14	4.7%	56.5%	0.38	0.38	4.5
0.16	4.6%	61.2%	0.44	0.44	4.4
0.18	3.5%	64.7%	0.49	0.49	3.3
0.20	4.3%	69.1%	0.55	0.55	4.1
0.25	8.0%	77.1%	0.69	0.69	7.3
0.30	5.6%	82.7%	0.82	0.82	5.0
0.35	4.4%	87.0%	0.96	0.96	3.8
0.40	2.5%	89.5%	1.10	1.10	2.2
0.45	2.5%	92.1%	1.23	1.23	2.1
0.50	1.4%	93.5%	1.37	1.37	1.1
0.75	5.0%	98.5%	2.06	2.06	3.6
1.00	1.0%	99.5%	2.74	2.74	0.6
1.50	0.0%	99.5%	4.11	3.20	0.0
2.00	0.0%	99.5%	5.48	3.20	0.0
3.00	0.5%	100.0%	8.23	3.20	0.1
					93.1
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.2%
				Predicted Net Annual Load Removal Efficiency =	**86.7%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

HANOVER CROSSING
HANOVER, MA

Area	2.32 ac	Unit Site Designation	WQU 3
Weighted C	0.9	Rainfall Station #	69
t_c	10 min		
CDS Model	2025-5	CDS Treatment Capacity	**3.2 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.04	0.04	10.2
0.04	9.6%	19.8%	0.08	0.08	9.6
0.06	9.4%	29.3%	0.13	0.13	9.4
0.08	7.7%	37.0%	0.17	0.17	7.7
0.10	8.6%	45.6%	0.21	0.21	8.4
0.12	6.3%	51.9%	0.25	0.25	6.1
0.14	4.7%	56.5%	0.29	0.29	4.5
0.16	4.6%	61.2%	0.33	0.33	4.5
0.18	3.5%	64.7%	0.38	0.38	3.4
0.20	4.3%	69.1%	0.42	0.42	4.1
0.25	8.0%	77.1%	0.52	0.52	7.5
0.30	5.6%	82.7%	0.63	0.63	5.1
0.35	4.4%	87.0%	0.73	0.73	4.0
0.40	2.5%	89.5%	0.83	0.83	2.3
0.45	2.5%	92.1%	0.94	0.94	2.2
0.50	1.4%	93.5%	1.04	1.04	1.2
0.75	5.0%	98.5%	1.57	1.57	3.9
1.00	1.0%	99.5%	2.09	2.09	0.7
1.50	0.0%	99.5%	3.13	3.13	0.0
2.00	0.0%	99.5%	4.17	3.20	0.0
3.00	0.5%	100.0%	6.26	3.20	0.1
					95.0
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**88.5%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

HANOVER CROSSING
HANOVER, MA

Area	1.56 ac	Unit Site Designation	WQU 4
Weighted C	0.9	Rainfall Station #	69
t_c	10 min		
CDS Model	2020-5	CDS Treatment Capacity	**2.2 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.03	0.03	10.2
0.04	9.6%	19.8%	0.06	0.06	9.6
0.06	9.4%	29.3%	0.08	0.08	9.4
0.08	7.7%	37.0%	0.11	0.11	7.7
0.10	8.6%	45.6%	0.14	0.14	8.4
0.12	6.3%	51.9%	0.17	0.17	6.2
0.14	4.7%	56.5%	0.20	0.20	4.5
0.16	4.6%	61.2%	0.22	0.22	4.5
0.18	3.5%	64.7%	0.25	0.25	3.4
0.20	4.3%	69.1%	0.28	0.28	4.1
0.25	8.0%	77.1%	0.35	0.35	7.5
0.30	5.6%	82.7%	0.42	0.42	5.2
0.35	4.4%	87.0%	0.49	0.49	4.0
0.40	2.5%	89.5%	0.56	0.56	2.3
0.45	2.5%	92.1%	0.63	0.63	2.2
0.50	1.4%	93.5%	0.70	0.70	1.2
0.75	5.0%	98.5%	1.05	1.05	4.0
1.00	1.0%	99.5%	1.40	1.40	0.7
1.50	0.0%	99.5%	2.11	2.11	0.0
2.00	0.0%	99.5%	2.81	2.20	0.0
3.00	0.5%	100.0%	4.21	2.20	0.1
					95.1
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**88.7%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

HANOVER CROSSING
HANOVER, MA

Area	4.96 ac	Unit Site Designation	WQU 5
Weighted C	0.9	Rainfall Station #	69
t_c	15 min		
CDS Model	3025-6	CDS Treatment Capacity	**5.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.09	0.09	10.2
0.04	9.6%	19.8%	0.18	0.18	9.6
0.06	9.4%	29.3%	0.27	0.27	9.3
0.08	7.7%	37.0%	0.36	0.36	7.6
0.10	8.6%	45.6%	0.45	0.45	8.3
0.12	6.3%	51.9%	0.54	0.54	6.0
0.14	4.7%	56.5%	0.62	0.62	4.4
0.16	4.6%	61.2%	0.71	0.71	4.4
0.18	3.5%	64.7%	0.80	0.80	3.3
0.20	4.3%	69.1%	0.89	0.89	4.0
0.25	8.0%	77.1%	1.12	1.12	7.2
0.30	5.6%	82.7%	1.34	1.34	4.9
0.35	4.4%	87.0%	1.56	1.56	3.8
0.40	2.5%	89.5%	1.78	1.78	2.1
0.45	2.5%	92.1%	2.01	2.01	2.1
0.50	1.4%	93.5%	2.23	2.23	1.1
0.75	5.0%	98.5%	3.35	3.35	3.4
1.00	1.0%	99.5%	4.46	4.46	0.6
1.50	0.0%	99.5%	6.69	5.00	0.0
2.00	0.0%	99.5%	8.92	5.00	0.0
3.00	0.5%	100.0%	13.38	5.00	0.1
					92.5
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.2%
				Predicted Net Annual Load Removal Efficiency =	**86.0%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

HANOVER CROSSING
HANOVER, MA

Area	8.01 ac	Unit Site Designation	WQU 6
Weighted C	0.9	Rainfall Station #	69
t_c	20 min		
CDS Model	3035-6	CDS Treatment Capacity	7.6 cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.14	0.14	10.2
0.04	9.6%	19.8%	0.29	0.29	9.6
0.06	9.4%	29.3%	0.43	0.43	9.3
0.08	7.7%	37.0%	0.58	0.58	7.6
0.10	8.6%	45.6%	0.72	0.72	8.3
0.12	6.3%	51.9%	0.87	0.87	6.0
0.14	4.7%	56.5%	1.01	1.01	4.4
0.16	4.6%	61.2%	1.15	1.15	4.4
0.18	3.5%	64.7%	1.30	1.30	3.3
0.20	4.3%	69.1%	1.44	1.44	4.0
0.25	8.0%	77.1%	1.80	1.80	7.2
0.30	5.6%	82.7%	2.16	2.16	4.9
0.35	4.4%	87.0%	2.52	2.52	3.7
0.40	2.5%	89.5%	2.88	2.88	2.1
0.45	2.5%	92.1%	3.24	3.24	2.0
0.50	1.4%	93.5%	3.60	3.60	1.1
0.75	5.0%	98.5%	5.41	5.41	3.4
1.00	1.0%	99.5%	7.21	7.21	0.6
1.50	0.0%	99.5%	10.81	7.60	0.0
2.00	0.0%	99.5%	14.42	7.60	0.0
3.00	0.5%	100.0%	21.63	7.60	0.1
					92.3
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.2%
				Predicted Net Annual Load Removal Efficiency =	**85.9%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

HANOVER CROSSING
HANOVER, MA

Area	0.56 ac	Unit Site Designation	WQU 7
Weighted C	0.9	Rainfall Station #	69
t_c	5 min		
CDS Model	1515-3	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	10.2
0.04	9.6%	19.8%	0.02	0.02	9.6
0.06	9.4%	29.3%	0.03	0.03	9.4
0.08	7.7%	37.0%	0.04	0.04	7.7
0.10	8.6%	45.6%	0.05	0.05	8.5
0.12	6.3%	51.9%	0.06	0.06	6.2
0.14	4.7%	56.5%	0.07	0.07	4.6
0.16	4.6%	61.2%	0.08	0.08	4.5
0.18	3.5%	64.7%	0.09	0.09	3.4
0.20	4.3%	69.1%	0.10	0.10	4.2
0.25	8.0%	77.1%	0.13	0.13	7.6
0.30	5.6%	82.7%	0.15	0.15	5.3
0.35	4.4%	87.0%	0.18	0.18	4.1
0.40	2.5%	89.5%	0.20	0.20	2.3
0.45	2.5%	92.1%	0.23	0.23	2.3
0.50	1.4%	93.5%	0.25	0.25	1.2
0.75	5.0%	98.5%	0.38	0.38	4.2
1.00	1.0%	99.5%	0.50	0.50	0.8
1.50	0.0%	99.5%	0.75	0.75	0.0
2.00	0.0%	99.5%	1.00	1.00	0.0
3.00	0.5%	100.0%	1.50	1.00	0.2
					96.4
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.4%
				Predicted Net Annual Load Removal Efficiency =	**89.9%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

HANOVER CROSSING
HANOVER, MA

Area	3.56 ac	Unit Site Designation	WQU 8
Weighted C	0.9	Rainfall Station #	69
t_c	15 min		
CDS Model	3020-6	CDS Treatment Capacity	**3.9 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.06	0.06	10.2
0.04	9.6%	19.8%	0.13	0.13	9.6
0.06	9.4%	29.3%	0.19	0.19	9.4
0.08	7.7%	37.0%	0.26	0.26	7.6
0.10	8.6%	45.6%	0.32	0.32	8.4
0.12	6.3%	51.9%	0.38	0.38	6.1
0.14	4.7%	56.5%	0.45	0.45	4.5
0.16	4.6%	61.2%	0.51	0.51	4.4
0.18	3.5%	64.7%	0.58	0.58	3.3
0.20	4.3%	69.1%	0.64	0.64	4.1
0.25	8.0%	77.1%	0.80	0.80	7.3
0.30	5.6%	82.7%	0.96	0.96	5.0
0.35	4.4%	87.0%	1.12	1.12	3.8
0.40	2.5%	89.5%	1.28	1.28	2.2
0.45	2.5%	92.1%	1.44	1.44	2.1
0.50	1.4%	93.5%	1.60	1.60	1.1
0.75	5.0%	98.5%	2.40	2.40	3.7
1.00	1.0%	99.5%	3.20	3.20	0.6
1.50	0.0%	99.5%	4.81	3.90	0.0
2.00	0.0%	99.5%	6.41	3.90	0.0
3.00	0.5%	100.0%	9.61	3.90	0.1
					93.7
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**87.2%**

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.

CONTECH® ENGINEERED SOLUTIONS

VORTSENTRY® HS ESTIMATED NET ANNUAL TSS REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

HANOVER CROSSING
HANOVER, MA

Area	0.45 ac	Unit Site Deignation	WQI 9
Weighted C	0.9	Rainfall Station #	69
t_c	6 min	Design Ratio[1]	0.0150
VSHS Model	HS36	VSHS Treatment Capacity	0.55 cfs

Rainfall Intensity[1] (in/hr)	Flow Rate (cfs)	Operating Rate[2] cfs/ft[3]	% Total Rainfall	Rel. Effcy (%)
0.02	0.01	0.00031	10.2%	10.0%
0.04	0.02	0.00061	9.6%	9.5%
0.06	0.02	0.00092	9.4%	9.3%
0.08	0.03	0.00122	7.7%	7.6%
0.10	0.04	0.00153	8.6%	8.4%
0.12	0.05	0.00183	6.3%	6.2%
0.14	0.06	0.00214	4.7%	4.6%
0.16	0.06	0.00244	4.6%	4.5%
0.18	0.07	0.00275	3.5%	3.5%
0.20	0.08	0.00306	4.3%	4.3%
0.25	0.10	0.00382	8.0%	7.8%
0.30	0.12	0.00458	5.6%	5.5%
0.35	0.14	0.00535	4.4%	4.3%
0.40	0.16	0.00611	2.5%	2.5%
0.45	0.18	0.00688	2.5%	2.5%
0.50	0.20	0.00764	1.4%	1.4%
0.75	0.30	0.01146	5.0%	4.7%
1.00	0.41	0.01528	1.0%	0.9%
1.50	0.61	0.02292	0.0%	0.0%
2.00	0.81	0.03056	0.0%	0.0%
3.00	1.22	0.04584	0.2%	0.0%
				97.2%
			% rain falling at >3"/hr =	0.3%
			Removal Efficiency Adjustment[4] =	6.5%
			Predicted Net Annual Load Removal Efficiency =	**90.7%**

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

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

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

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

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

HANOVER CROSSING
HANOVER, MA

Area	4.32 ac	Unit Site Designation	WQU 10
Weighted C	0.9	Rainfall Station #	69
t_c	10 min		
CDS Model	3025-6	CDS Treatment Capacity	**5.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.08	0.08	10.2
0.04	9.6%	19.8%	0.16	0.16	9.6
0.06	9.4%	29.3%	0.23	0.23	9.4
0.08	7.7%	37.0%	0.31	0.31	7.6
0.10	8.6%	45.6%	0.39	0.39	8.4
0.12	6.3%	51.9%	0.47	0.47	6.1
0.14	4.7%	56.5%	0.54	0.54	4.5
0.16	4.6%	61.2%	0.62	0.62	4.4
0.18	3.5%	64.7%	0.70	0.70	3.3
0.20	4.3%	69.1%	0.78	0.78	4.1
0.25	8.0%	77.1%	0.97	0.97	7.3
0.30	5.6%	82.7%	1.17	1.17	5.0
0.35	4.4%	87.0%	1.36	1.36	3.8
0.40	2.5%	89.5%	1.56	1.56	2.2
0.45	2.5%	92.1%	1.75	1.75	2.1
0.50	1.4%	93.5%	1.94	1.94	1.1
0.75	5.0%	98.5%	2.92	2.92	3.7
1.00	1.0%	99.5%	3.89	3.89	0.6
1.50	0.0%	99.5%	5.83	5.00	0.0
2.00	0.0%	99.5%	7.78	5.00	0.0
3.00	0.5%	100.0%	11.66	5.00	0.1
					93.6
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**87.1%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

HANOVER CROSSING
HANOVER, MA

Area	3.21 ac	Unit Site Designation	WQU 11
Weighted C	0.9	Rainfall Station #	69
t_c	10 min		
CDS Model	3020-6	CDS Treatment Capacity	**3.9 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.06	0.06	10.2
0.04	9.6%	19.8%	0.12	0.12	9.6
0.06	9.4%	29.3%	0.17	0.17	9.4
0.08	7.7%	37.0%	0.23	0.23	7.6
0.10	8.6%	45.6%	0.29	0.29	8.4
0.12	6.3%	51.9%	0.35	0.35	6.1
0.14	4.7%	56.5%	0.40	0.40	4.5
0.16	4.6%	61.2%	0.46	0.46	4.5
0.18	3.5%	64.7%	0.52	0.52	3.4
0.20	4.3%	69.1%	0.58	0.58	4.1
0.25	8.0%	77.1%	0.72	0.72	7.4
0.30	5.6%	82.7%	0.87	0.87	5.1
0.35	4.4%	87.0%	1.01	1.01	3.9
0.40	2.5%	89.5%	1.16	1.16	2.2
0.45	2.5%	92.1%	1.30	1.30	2.2
0.50	1.4%	93.5%	1.44	1.44	1.2
0.75	5.0%	98.5%	2.17	2.17	3.8
1.00	1.0%	99.5%	2.89	2.89	0.7
1.50	0.0%	99.5%	4.33	3.90	0.0
2.00	0.0%	99.5%	5.78	3.90	0.0
3.00	0.5%	100.0%	8.67	3.90	0.1
					94.4
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**87.9%**

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.

Project:	**Hanover Crossing**
Location:	**Hanover, MA**
Prepared For:	**Kelly Engineering**

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" of runoff from the contributing impervious surface.

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

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).

Compute Q Rate using the following equation:

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

where:

Q = flow rate associated with first 1" 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" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
WQU 1	12.96	0.0202500	20.0	0.333	1.00	572.00	11.58
WQU 2	3.05	0.0047609	15.0	0.250	1.00	628.00	2.99
WQU 3	2.32	0.0036234	10.0	0.167	1.00	700.00	2.54
WQU 4	1.56	0.0024375	10.0	0.167	1.00	700.00	1.71
WQU 5	4.96	0.0077453	15.0	0.250	1.00	628.00	4.86
WQU 6	8.01	0.0125156	20.0	0.333	1.00	572.00	7.16
WQU 7	0.56	0.0008698	5.0	0.083	1.00	795.00	0.69

Project:	**Hanover Crossing**
Location:	**Hanover, MA**
Prepared For:	**Kelly Engineering**

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" of runoff from the contributing impervious surface.

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

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).

Compute Q Rate using the following equation:

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

where:

Q = flow rate associated with first 1" 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" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
WQU 8	3.56	0.0055625	15.0	0.250	1.00	628.00	3.49
WQI 9	0.45	0.0007031	6.0	0.100	1.00	774.00	0.54
WQU 10	4.32	0.0067500	10.0	0.167	1.00	700.00	4.73
WQU 11	3.21	0.0050156	10.0	0.167	1.00	700.00	3.51

Hanover Crossing - Residential
Hanover, MA

MaDEP Standard Method to Convert Required Water Quality Volume to a Discharge Rate

Water Quality Unit	Areas (acres)			% Impervious	Impervious Area (mi^2)	WQV (inches)	CN	Tc		qu (csm/in)	Q (cfs)	Stormceptor Model	Design Capacity (cfs)
	Impervious (A)	Pervious	Total					(min)	(hrs)				
STC-1	0.47	0.23	0.70	67.1%	0.0007	1.0	98	5.0	0.083	795	0.58	STC-900	0.89
STC-2	0.14	0.05	0.19	73.7%	0.0002	1.0	98	5.0	0.083	796	0.17	STC-450i	0.40
STC-3	0.44	0.77	1.21	36.4%	0.0007	1.0	98	5.0	0.083	797	0.55	STC-900	0.89
STC-4	0.55	0.16	0.71	77.5%	0.0009	1.0	98	5.0	0.083	798	0.69	STC-900	0.89
STC-6	0.55	0.27	0.82	67.1%	0.0009	1.0	98	5.0	0.083	800	0.69	STC-900	0.89
STC-7	0.69	0.30	0.99	69.7%	0.0011	1.0	98	5.0	0.083	801	0.86	STC-900	0.89
STC-8	0.31	0.26	0.57	54.4%	0.0005	1.0	98	5.0	0.083	802	0.39	STC-450	0.40
STC-9	0.38	0.26	0.64	59.4%	0.0006	1.0	98	5.0	0.083	803	0.48	STC-900	0.89

Water Quality Flow (WQF) = Q = (qu) (A) (WQV)

Where: qu = the unit peak discharge (in csm/in)
A = impervious surface drainage area (in square miles)
WQV = water quality volume (in inches)

Notes:
1. Refer to MaDEP Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices, dated September 10, 2013.

Brief Stormceptor Sizing Report - STC-1

Project Information & Location			
Project Name	Hanover Crossing Residential	**Project Number**	18296
City	Hanover	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/26/2019
Designer Information		**EOR Information (optional)**	
Name	Nate Cheal	**Name**	
Company	Tetra Tech	**Company**	
Phone #	508-786-2331	**Phone #**	
Email	nate.cheal@tetratech.com	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	STC-1
Target TSS Removal (%)	75
TSS Removal (%) Provided	84
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	84
STC 900	90
STC 1200	90
STC 1800	90
STC 2400	93
STC 3600	93
STC 4800	95
STC 6000	95
STC 7200	96
STC 11000	97
STC 13000	97
STC 16000	98
StormceptorMAX	Custom

DMH 101

Sizing Details

Drainage Area	
Total Area (acres)	0.7
Imperviousness %	67.1

Rainfall	
Station Name	BLUE HILL
State/Province	Massachusetts
Station ID #	0736
Years of Records	58
Latitude	42°12'44"N
Longitude	71°6'53"W

Water Quality Objective	
TSS Removal (%)	75.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.58

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Brief Stormceptor Sizing Report - STC-2

Project Information & Location			
Project Name	Hanover Crossing Residential	**Project Number**	18296
City	Hanover	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/26/2019
Designer Information		**EOR Information (optional)**	
Name	Nate Cheal	**Name**	
Company	Tetra Tech	**Company**	
Phone #	508-786-2331	**Phone #**	
Email	nate.cheal@tetratech.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	STC-2
Target TSS Removal (%)	75
TSS Removal (%) Provided	92
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	92
STC 900	95
STC 1200	96
STC 1800	96
STC 2400	97
STC 3600	97
STC 4800	98
STC 6000	98
STC 7200	98
STC 11000	99
STC 13000	99
STC 16000	99
StormceptorMAX	Custom

CB 103

Sizing Details

Drainage Area	
Total Area (acres)	0.19
Imperviousness %	73.7

Rainfall	
Station Name	BLUE HILL
State/Province	Massachusetts
Station ID #	0736
Years of Records	58
Latitude	42°12'44"N
Longitude	71°6'53"W

Water Quality Objective	
TSS Removal (%)	75.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.17

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Brief Stormceptor Sizing Report - STC-3

Project Information & Location			
Project Name	Hanover Crossing Residential	**Project Number**	18296
City	Hanover	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/26/2019
Designer Information		**EOR Information (optional)**	
Name	Nate Cheal	**Name**	
Company	Tetra Tech	**Company**	
Phone #	508-786-2331	**Phone #**	
Email	nate.cheal@tetratech.com	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	STC-3
Target TSS Removal (%)	75
TSS Removal (%) Provided	85
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	85
STC 900	90
STC 1200	90
STC 1800	91
STC 2400	93
STC 3600	93
STC 4800	95
STC 6000	95
STC 7200	96
STC 11000	97
STC 13000	97
STC 16000	98
StormceptorMAX	Custom

DMH 205A

Stormceptor®

Rinker MATERIALS™

Sizing Details

Drainage Area

Total Area (acres)	1.21
Imperviousness %	36.4

Rainfall

Station Name	BLUE HILL
State/Province	Massachusetts
Station ID #	0736
Years of Records	58
Latitude	42°12'44"N
Longitude	71°6'53"W

Water Quality Objective

TSS Removal (%)	75.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.55

Up Stream Storage

Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion

Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution

Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Brief Stormceptor Sizing Report - STC-4

Project Information & Location			
Project Name	Hanover Crossing Residential	**Project Number**	18487
City	Hanover	**State/ Province**	Massachusetts
Country	United States of America	**Date**	5/13/2019
Designer Information		**EOR Information (optional)**	
Name	Nate Cheal	**Name**	
Company	Tetra Tech	**Company**	
Phone #	508-786-2331	**Phone #**	
Email	nate.cheal@tetratech.com	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	STC-4
Target TSS Removal (%)	75
TSS Removal (%) Provided	84
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	84
STC 900	89
STC 1200	90
STC 1800	90
STC 2400	92
STC 3600	92
STC 4800	94
STC 6000	94
STC 7200	95
STC 11000	97
STC 13000	97
STC 16000	98
StormceptorMAX	Custom

DMH 201

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Rinker MATERIALS™

Sizing Details

Drainage Area

Total Area (acres)	0.71
Imperviousness %	77.5

Rainfall

Station Name	BLUE HILL
State/Province	Massachusetts
Station ID #	0736
Years of Records	58
Latitude	42°12'44"N
Longitude	71°6'53"W

Water Quality Objective

TSS Removal (%)	75.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.69

Up Stream Storage

Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion

Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution

Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Brief Stormceptor Sizing Report - STC-6

Project Information & Location			
Project Name	Hanover Crossing Residential	**Project Number**	18296
City	Hanover	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/26/2019
Designer Information		**EOR Information (optional)**	
Name	Nate Cheal	**Name**	
Company	Tetra Tech	**Company**	
Phone #	508-786-2331	**Phone #**	
Email	nate.cheal@tetratech.com	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	STC-6
Target TSS Removal (%)	75
TSS Removal (%) Provided	83
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	83
STC 900	89
STC 1200	89
STC 1800	89
STC 2400	92
STC 3600	92
STC 4800	94
STC 6000	94
STC 7200	95
STC 11000	97
STC 13000	97
STC 16000	98
StormceptorMAX	Custom

DMH 501

Sizing Details

Drainage Area	
Total Area (acres)	0.82
Imperviousness %	67.1

Rainfall	
Station Name	BLUE HILL
State/Province	Massachusetts
Station ID #	0736
Years of Records	58
Latitude	42°12'44"N
Longitude	71°6'53"W

Water Quality Objective	
TSS Removal (%)	75.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.69

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Brief Stormceptor Sizing Report - STC-7

Project Information & Location			
Project Name	Hanover Crossing Residential	**Project Number**	18296
City	Hanover	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/26/2019
Designer Information		**EOR Information (optional)**	
Name	Nate Cheal	**Name**	
Company	Tetra Tech	**Company**	
Phone #	508-786-2331	**Phone #**	
Email	nate.cheal@tetratech.com	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	STC-7
Target TSS Removal (%)	75
TSS Removal (%) Provided	81
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	81
STC 900	88
STC 1200	88
STC 1800	88
STC 2400	91
STC 3600	91
STC 4800	93
STC 6000	93
STC 7200	95
STC 11000	96
STC 13000	96
STC 16000	97
StormceptorMAX	Custom

DMH 405

Sizing Details

Drainage Area	
Total Area (acres)	0.99
Imperviousness %	69.7

Rainfall	
Station Name	BLUE HILL
State/Province	Massachusetts
Station ID #	0736
Years of Records	58
Latitude	42°12'44"N
Longitude	71°6'53"W

Water Quality Objective	
TSS Removal (%)	75.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.86

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Brief Stormceptor Sizing Report - STC-8

Project Information & Location			
Project Name	Hanover Crossing Residential	**Project Number**	18296
City	Hanover	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/26/2019
Designer Information		**EOR Information (optional)**	
Name	Nate Cheal	**Name**	
Company	Tetra Tech	**Company**	
Phone #	508-786-2331	**Phone #**	
Email	nate.cheal@tetratech.com	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	STC-8
Target TSS Removal (%)	75
TSS Removal (%) Provided	87
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	87
STC 900	92
STC 1200	92
STC 1800	93
STC 2400	94
STC 3600	95
STC 4800	96
STC 6000	96
STC 7200	97
STC 11000	98
STC 13000	98
STC 16000	98
StormceptorMAX	Custom

DMH 607

Sizing Details

Drainage Area	
Total Area (acres)	0.57
Imperviousness %	54.4

Rainfall	
Station Name	BLUE HILL
State/Province	Massachusetts
Station ID #	0736
Years of Records	58
Latitude	42°12'44"N
Longitude	71°6'53"W

Water Quality Objective	
TSS Removal (%)	75.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.39

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
- For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

Brief Stormceptor Sizing Report - STC-9

Project Information & Location			
Project Name	Hanover Crossing Residential	**Project Number**	18296
City	Hanover	**State/ Province**	Massachusetts
Country	United States of America	**Date**	4/26/2019
Designer Information		**EOR Information (optional)**	
Name	Nate Cheal	**Name**	
Company	Tetra Tech	**Company**	
Phone #	508-786-2331	**Phone #**	
Email	nate.cheal@tetratech.com	**Email**	

Stormwater Treatment Recommendation
The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	STC-9
Target TSS Removal (%)	75
TSS Removal (%) Provided	86
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	86
STC 900	91
STC 1200	91
STC 1800	91
STC 2400	94
STC 3600	94
STC 4800	95
STC 6000	96
STC 7200	96
STC 11000	98
STC 13000	98
STC 16000	98
StormceptorMAX	Custom

DMH 601

Sizing Details

Drainage Area	
Total Area (acres)	0.64
Imperviousness %	59.4

Rainfall	
Station Name	BLUE HILL
State/Province	Massachusetts
Station ID #	0736
Years of Records	58
Latitude	42°12'44"N
Longitude	71°6'53"W

Water Quality Objective	
TSS Removal (%)	75.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.48

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

HANOVER CROSSING
1775 WASHINGTON STREET HANOVER, MA

STORMWATER MANAGEMENT SYSTEM OPERATION AND MAINTENANCE PLAN & LONG-TERM POLLUTION PREVENTION PLAN

05/17/19

Prepared by:

KELLY ENGINEERING GROUP, INC.
Zero Campanelli Drive
Braintree, Massachusetts 02184

OWNER AND RESPONSIBLE PARTY:
PREP Hanover Real Estate LLC
1790 Bonanza Drive, Suite 201
Park City, UT 84060

c/o
Hanover Crossing
1775 Washington St.
Hanover, MA

Note: If ownership of this property changes then the new owner becomes the responsible party. The Owner may assign responsibility to a tenant on the property.

Introduction

Considerable time, effort and cost has been spent in the design and construction of the stormwater management system for this development. The stormwater management system consists of a number of Best Management Practices (BMP's). These BMP's combine to ensure that storm runoff from the site will not damage the sensitive environmental resources surrounding the site. In order to ensure that these BMP's operate as designed it is very important that the procedures in this operation and maintenance plan be followed. Most of these operation procedures require observation and measurement; however, at certain times more extensive maintenance measures may be needed. The following is an itemization of each of these BMP's and their maintenance needs.

The party responsible for maintenance should contract with a maintenance organization capable of performing the more extensive measures such as pumping of catch basin sumps, etc.

BMP No. 1 – Paved Road Surface/Parking Lot Area:

- Regularly pick up and remove litter from the parking lot area, landscaped islands and perimeter landscaped areas and water quality areas.

- The paved area is to be swept a minimum of two times per year, at least once during April and again during September with a high efficiency vacuum sweeper or a regenerative air sweeper. If a mechanical sweeper is used, the paved area is to be swept a minimum of once a month.

BMP No. 2 - Deep Sump Catch Basins:

- Basins are to be inspected 4 times per year.
  1. Verify that tees are secure and free-flowing.
  2. Measure depth of sediment below water line.

- Basins are to be cleaned whenever sediment and hydrocarbons are observed. Basins are to be cleaned a minimum of twice per year. One of these cleanings shall occur before April 15th of each year and one shall occur before September 15th of each year. Basins may be cleaned either using a clamshell or a vacuum pump.

- All liquid shall be pumped from the sump of each basin at least once per year.

- All sediments and hydrocarbons should be properly handled and disposed of, in accordance with local, state and federal guidelines and regulations.

Note: See catch basin detail for explanation of terms.

BMP No. 3 – Proprietary Separators:

Contech VSHS:

- Twice a year inspect the Units to ensure that it is operating correctly and to measure the sediment depth.

- When the sediment depth is within 6" of the dry weather water surface elevation, the Unit should be cleaned. This determination can be made by taking 2 measurements with a stadia rod or similar measuring device; one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. The Unit should be cleaned out if the difference between the two measurements is six inches or less.

- Cleanout of the Units shall occur during dry weather, with a vacuum truck or a "clamshell" grab. Sediment is evacuated through the manhole over the grit chamber. See VortSentry Manual for required servicing and maintenance.

Contech CDS:

- Twice a year inspect the Units to ensure that it is operating correctly and to measure the sediment depth using a "dip stick". The floatables should be removed and the sump cleaned when the sump is above 85% full. At least once a year, the unit should be pumped down and the screen carefully inspected for damage and to ensure that it is properly fastened. Ideally, the screen should be power washed for the inspection.

Stormceptors:

- Twice a year inspect the Units to ensure that it is operating correctly and to measure the sediment depth using a "dip stick" and the oil depth.

- Whenever the oil is observed, the entire liquid volume shall be pumped from the units. Oil is pumped through the 6" inspection/clean out pipe.

- For Stormceptor 450i, when the sediment depth is 8" or more the sediment shall be completely pumped from the stormceptor units. Sediment is pumped through the 24" opening.

- Sediment shall be pumped through the 24" opening when sediment depth indicates required maintenance. See Stormceptor Technical Manual for sediment depth requiring servicing.

If any problems are encountered, contact the manufacturer.

BMP No. 4 - Subsurface Recharge Systems:

- The inlet pipe and observation basin shall be inspected 4 times a year. Any accumulated debris shall be removed.

- Inspect recharge facilities following a rainfall event greater than 2.5 inches in a 24 hour period.

- If standing water is observed for more than 48 hours following a storm event, immediately retain a qualified professional to assess whether infiltration function has been lost and develop recommended corrective actions.

BMP No. 5 – Infiltration Basin

- **Infiltration Basin**
  Inspect recharge pond once per year and following a rainfall event greater than 2.5 inches in a 24 hour period. Remove sediment annually. If standing water is observed for more than 48 hours following a storm event, immediately retain a qualified professional to assess whether infiltration function has been lost and develop recommended corrective actions.

- On a regular basis, as required by growing conditions, those portions of the side slopes that are planted with grass shall be mowed and otherwise maintained in such a manner as to maintain a dense cover of grass. Any area of erosion or other conditions of slope instability shall be corrected at the time they occur.

- **Inlet and outlet structures.**
  On a regular basis, the inlet pipe and outlet structure shall be checked for debris and removed as necessary to ensure unobstructed flow of water through the water quality pond. Impoundment embankments and outlet structures should be inspected at least once annually by a qualified

professional for structural integrity and for any conditions which could adversely affect their function.

- **Flared end section and rip rap**.
  Level spreader should be inspected at least once annually for any conditions which could adversely affect their function.

BMP No. 6 –Exfiltrating Bioretention Areas

- Trees and shrubs shall be inspected and repaired twice per year (spring and fall) to evaluate their health and remove any dead or severely diseased vegetation. Diseased vegetation should be treated as necessary using preventative and low-toxic measure to the extent possible.

- Apply an alkaline product such as limestone one to two times per year to counteract soil acidity resulting from acidic precipitation and runoff. Before applying limestone, determine the pH of the soil to determine quantity of limestone needed.

- Inspect bioretention cells regularly for sediment build-up, structural damage, and standing water.

- Inspect soil and repair eroded areas monthly. Remove litter and debris monthly.

- Upon failure, excavate bioretention area, scarify bottom and sides, replace soil, and replant.

- Shovel snow and ice from catch basins within bioretention areas. Allow for drainage to flow. Do not pile snow onto bioretention areas. Keep curb openings clear of snow and ice for positive flow of runoff. Do not store salt nor de-icing chemicals nor dispose of snow containing salt or de-icing chemicals.

Snow Removal:

- There shall be no plowing or stock piling of snow within all resource areas without the prior written permission from state or local approving authority.
- Deicing agents shall include calcium chloride and magnesium chloride or approved by the Town of Hanover Department of Public Works. Road salts such as sodium chloride shall not be used as a deicing agent.
- De-icing materials shall be stored in the interior of buildings, on impervious pads and covered to protect from wind and precipitation. There shall be no exterior storage of deicing chemicals.

Storage and Use of Chemicals:

- No pesticides, herbicides, nor insecticides shall be stored nor used within all resource areas and any area subject to the jurisdiction of local and state regulations without the prior written permission from state or local approving authority.
- Chemical storage on site shall be limited. Any chemicals that must be stored shall be stored in a secure area in accordance with Local and State regulations.

Hazardous Waste:

- Containment – In the event of a discharge or spill of oil or another hazardous material, outlets to stormwater management ponds shall be plugged so that hazardous material do not enter resource areas.
- Reporting **-** In the event of a discharge or spill of oil or another hazardous material, responsible facility personnel, oil spill and/or hazardous material removal organizations, federal, state, and local regulatory agencies, the Town of Hanover Department of Public Works, and the EPA National Response Center

1-800-424-8802 shall be rapidly notified.

- Hazardous Waste – All hazardous waste materials will be disposed of in the manner specified by local, state and/or federal regulations and by the manufacturer of such products.
- There shall be no illicit discharges to the stormwater management system.

Material and Waste Storage, Handling and Management:

- All waste materials will be collected and stored in a securely lidded metal dumpster from a solid waste management company licensed to do business by the state and the town. The dumpster will comply with all local and state solid waste management regulations.

Training for Long Term Pollution Prevention Plan:

- All staff or personnel involved and responsible for implementing the Stormwater Management System Operations and Maintenance Plan and the Long-Term Pollution Prevention Plan shall be properly trained as required under the DEP Stormwater Management Regulations. Training shall be documented with records kept with other stormwater maintenance records.

Pet Waste Management:

- Pooper-scooper laws for pets shall be followed.
- Never dump pet waste into storm drains, catch basins, or the drainage system.
- Pet waste shall be scooped up and disposed of properly in the garbage.

Lawn and Garden activities:

- There shall be no exterior storage of fertilizers, pesticides, herbicides, or insecticides. No pesticides, herbicides, nor insecticides shall be stored nor used within any resource areas its buffers, and any area subject to the jurisdiction of local and state regulations without the prior written permission from state or local approving authority.
- Fertilizers and pesticides shall be applied properly, sparingly, and outside any resource areas and its buffers.

To reduce the impact of fertilizers, consider the following tips;

- Don't fertilize before a rain storm.
- Consider using organic fertilizers. They release nutrients more slowly.
- Test soils before applying fertilizers. Some soils may not need fertilizers. A standard soil test costs $9.00. (Call the UMass Extension Soil Testing Lab at 413-545-2311 or download a soil test order form at http://www.umass.edu/plsoils/soiltest/.)

Hanover Crossing

PROJECT LOCATION: 1775 Washington Street Hanover, MA

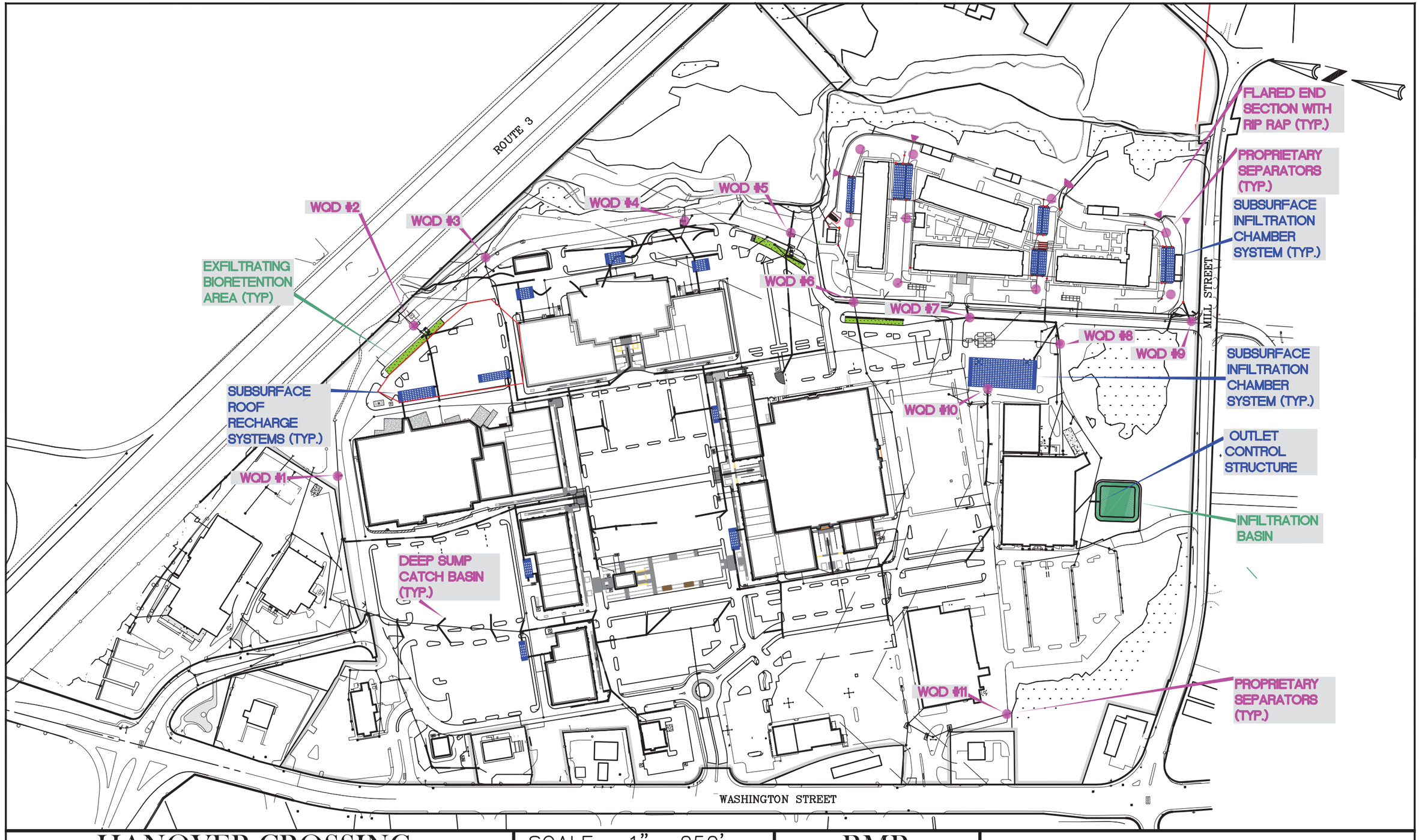
STORMWATER MANAGEMENT BEST MANAGEMENT PRACTICES - INSPECTION SCHEDULE AND EVALUATION CHECKLIST

Best Management Practice	Inspection Frequency (1)	Date	Inspector	Minimum Maintenance and Key Items to Check (1)	Cleaning/Repair Needed yes__ no__ (list items)	Date of Cleaning /Repair	Performed By
Street Sweeping	2x per year			Vacuum sweeper			
Deep Sump Catch Basins with Water Quality Elbows	4x per year			Remove sediment 1x per year or if >6”			
Infiltration Basin	Annually			Inspect inlets, vegetation, spillways, overflow discharge pipes, drain time less than 3 days			
Proprietary Separators	4x per year			Per Manufacturer Requirements			
Subsurface Infiltration Chamber Systems	4x per year			Inspect after 2.5” rain in 24 hours, drain time less than 3 days			
Exfiltrating Bioretention Areas	Monthly			Remove sediment. Inspect soils and vegetation.			

(1) Refer to the Operation and Maintenance Plan for recommendations regarding frequency of inspections and maintenance of specific BMP's.

recommendations regarding frequency for inspection and maintenance of specific BMPs.

Stormwater Control Manager/Environmental Monitor: **Stamp/Signature**



HANOVER CROSSING
1775 WASHINGTON ST.
HANOVER, MA

SCALE: 1"= 250'

DATE: 05/17/19

2016-075-BMP00

BMP LOCATION MAP

KELLY ENGINEERING GROUP
civil engineering consultants
0 Campanelli Drive, Braintree, MA 02184
Phone: 781-843-4333 www.kellyengineeringgroup.com

KELLY ENGINEERING GROUP, INC.
Zero Campanelli Drive-Braintree-MA 02184 Phone 781 843 4333

Attachment D
Miscellaneous

NOAA Atlas 14, Volume 10, Version 2
Location name: Hanover, Massachusetts, USA*
Latitude: 42.1474°, Longitude: -70.8452°
Elevation: 119.04 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.300** (0.237-0.377)	**0.372** (0.293-0.468)	**0.490** (0.385-0.618)	**0.588** (0.459-0.745)	**0.722** (0.547-0.962)	**0.826** (0.613-1.13)	**0.930** (0.672-1.32)	**1.08** (0.729-1.55)	**1.27** (0.827-1.89)	**1.42** (0.902-2.15)
10-min	**0.425** (0.336-0.534)	**0.527** (0.416-0.662)	**0.694** (0.545-0.875)	**0.833** (0.650-1.06)	**1.02** (0.774-1.36)	**1.17** (0.869-1.60)	**1.32** (0.952-1.87)	**1.53** (1.03-2.19)	**1.80** (1.17-2.68)	**2.01** (1.28-3.05)
15-min	**0.500** (0.395-0.628)	**0.621** (0.489-0.779)	**0.817** (0.641-1.03)	**0.980** (0.765-1.24)	**1.20** (0.911-1.60)	**1.38** (1.02-1.88)	**1.55** (1.12-2.20)	**1.80** (1.22-2.58)	**2.12** (1.38-3.16)	**2.36** (1.50-3.59)
30-min	**0.698** (0.550-0.875)	**0.865** (0.682-1.09)	**1.14** (0.895-1.44)	**1.37** (1.07-1.73)	**1.68** (1.27-2.24)	**1.92** (1.43-2.62)	**2.16** (1.56-3.08)	**2.51** (1.70-3.61)	**2.96** (1.93-4.42)	**3.31** (2.10-5.03)
60-min	**0.895** (0.706-1.12)	**1.11** (0.875-1.39)	**1.46** (1.15-1.84)	**1.75** (1.37-2.22)	**2.16** (1.63-2.87)	**2.47** (1.83-3.36)	**2.78** (2.01-3.95)	**3.22** (2.18-4.63)	**3.81** (2.48-5.67)	**4.25** (2.70-6.46)
2-hr	**1.15** (0.910-1.43)	**1.44** (1.14-1.80)	**1.92** (1.52-2.41)	**2.32** (1.83-2.92)	**2.87** (2.19-3.80)	**3.30** (2.47-4.47)	**3.72** (2.72-5.27)	**4.35** (2.97-6.20)	**5.19** (3.40-7.65)	**5.82** (3.72-8.74)
3-hr	**1.33** (1.06-1.65)	**1.68** (1.33-2.08)	**2.24** (1.78-2.79)	**2.70** (2.13-3.39)	**3.34** (2.56-4.41)	**3.84** (2.88-5.18)	**4.33** (3.18-6.09)	**5.07** (3.46-7.18)	**6.04** (3.97-8.84)	**6.78** (4.35-10.1)
6-hr	**1.75** (1.41-2.16)	**2.17** (1.74-2.68)	**2.85** (2.28-3.53)	**3.42** (2.72-4.25)	**4.20** (3.23-5.48)	**4.80** (3.63-6.40)	**5.40** (3.98-7.50)	**6.27** (4.32-8.79)	**7.42** (4.91-10.7)	**8.30** (5.36-12.2)
12-hr	**2.29** (1.85-2.80)	**2.77** (2.24-3.39)	**3.56** (2.86-4.37)	**4.21** (3.37-5.20)	**5.11** (3.96-6.59)	**5.80** (4.40-7.64)	**6.49** (4.79-8.88)	**7.44** (5.16-10.3)	**8.69** (5.79-12.4)	**9.63** (6.27-14.0)
24-hr	**2.79** (2.27-3.39)	**3.36** (2.73-4.09)	**4.30** (3.48-5.24)	**5.08** (4.09-6.22)	**6.15** (4.79-7.86)	**6.97** (5.33-9.10)	**7.80** (5.79-10.5)	**8.91** (6.22-12.2)	**10.4** (6.97-14.7)	**11.5** (7.53-16.6)
2-day	**3.16** (2.59-3.81)	**3.87** (3.17-4.67)	**5.03** (4.10-6.09)	**5.99** (4.86-7.29)	**7.32** (5.75-9.29)	**8.34** (6.42-10.8)	**9.36** (7.02-12.6)	**10.8** (7.58-14.6)	**12.7** (8.57-17.8)	**14.1** (9.31-20.1)
3-day	**3.46** (2.84-4.15)	**4.22** (3.47-5.07)	**5.47** (4.47-6.59)	**6.50** (5.29-7.88)	**7.93** (6.25-10.0)	**9.03** (6.98-11.6)	**10.1** (7.62-13.5)	**11.7** (8.23-15.7)	**13.7** (9.30-19.1)	**15.3** (10.1-21.6)
4-day	**3.73** (3.08-4.47)	**4.52** (3.73-5.42)	**5.81** (4.77-6.98)	**6.88** (5.61-8.31)	**8.35** (6.60-10.5)	**9.48** (7.35-12.2)	**10.6** (8.01-14.1)	**12.2** (8.63-16.4)	**14.3** (9.72-19.8)	**15.9** (10.5-22.3)
7-day	**4.50** (3.73-5.35)	**5.32** (4.41-6.34)	**6.66** (5.50-7.96)	**7.78** (6.38-9.34)	**9.31** (7.40-11.6)	**10.5** (8.17-13.3)	**11.7** (8.83-15.3)	**13.3** (9.45-17.6)	**15.4** (10.5-21.0)	**16.9** (11.3-23.6)
10-day	**5.21** (4.33-6.17)	**6.05** (5.03-7.19)	**7.44** (6.17-8.86)	**8.59** (7.08-10.3)	**10.2** (8.11-12.6)	**11.4** (8.89-14.4)	**12.6** (9.54-16.4)	**14.2** (10.1-18.7)	**16.2** (11.1-22.1)	**17.8** (11.9-24.6)
20-day	**7.27** (6.09-8.55)	**8.20** (6.87-9.66)	**9.72** (8.11-11.5)	**11.0** (9.11-13.0)	**12.7** (10.2-15.6)	**14.1** (11.0-17.5)	**15.4** (11.7-19.6)	**16.9** (12.2-22.0)	**18.8** (13.0-25.3)	**20.3** (13.7-27.7)
30-day	**8.97** (7.55-10.5)	**9.97** (8.38-11.7)	**11.6** (9.72-13.7)	**13.0** (10.8-15.3)	**14.8** (11.9-18.0)	**16.3** (12.8-20.0)	**17.7** (13.4-22.3)	**19.1** (13.9-24.8)	**21.0** (14.6-27.9)	**22.4** (15.2-30.3)
45-day	**11.1** (9.39-13.0)	**12.2** (10.3-14.2)	**13.9** (11.7-16.3)	**15.4** (12.9-18.1)	**17.4** (14.0-21.0)	**19.0** (14.9-23.1)	**20.5** (15.5-25.6)	**21.8** (15.9-28.1)	**23.6** (16.5-31.2)	**25.0** (17.0-33.6)
60-day	**12.9** (10.9-15.0)	**14.0** (11.9-16.4)	**15.9** (13.4-18.6)	**17.4** (14.6-20.4)	**19.6** (15.8-23.5)	**21.2** (16.7-25.7)	**22.8** (17.3-28.3)	**24.1** (17.6-30.9)	**25.8** (18.1-34.0)	**27.1** (18.5-36.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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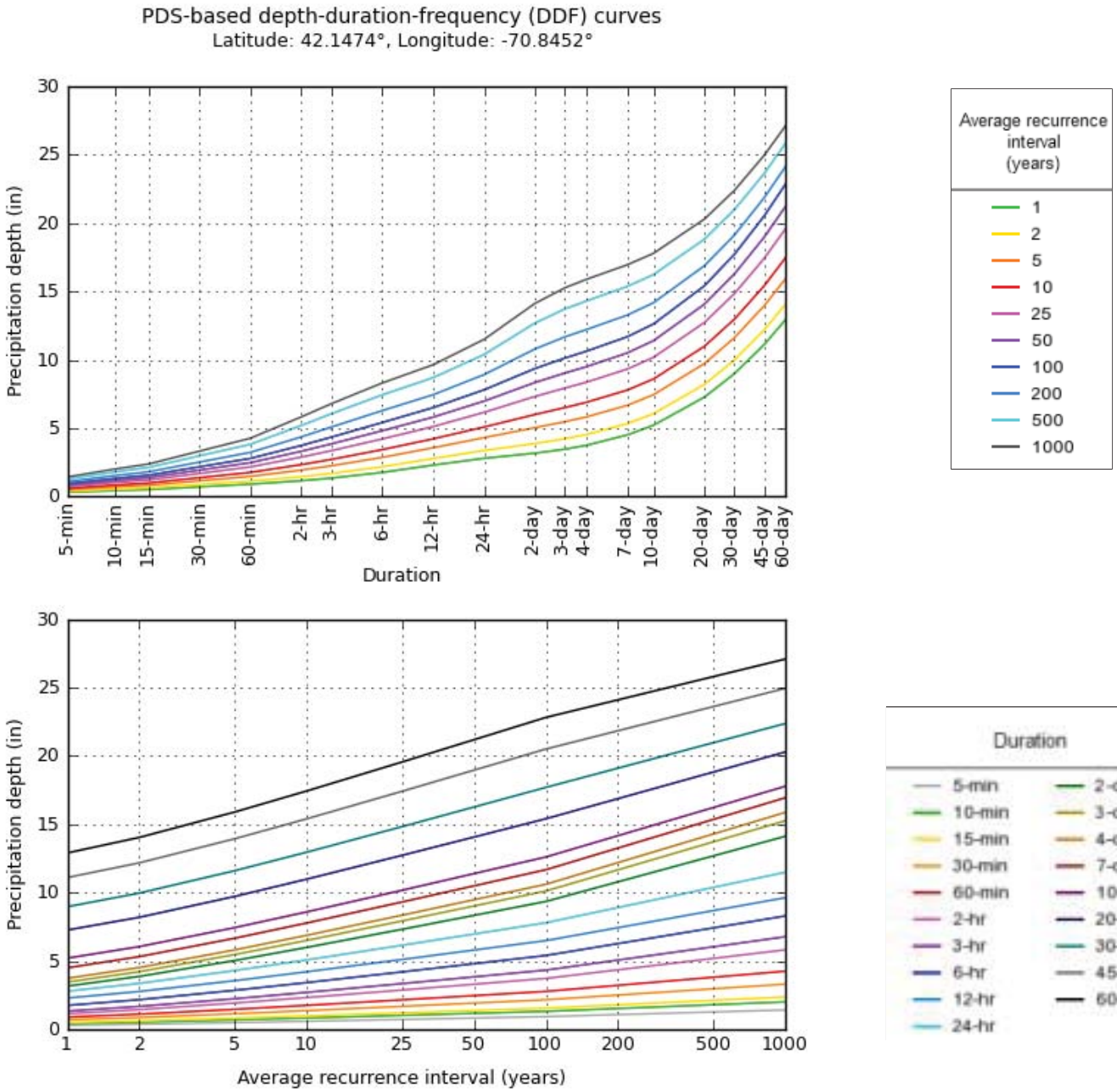
PF graphical



NOAA Atlas 14, Volume 10, Version 2

Created (GMT): Fri Apr 5 15:20:29 2019

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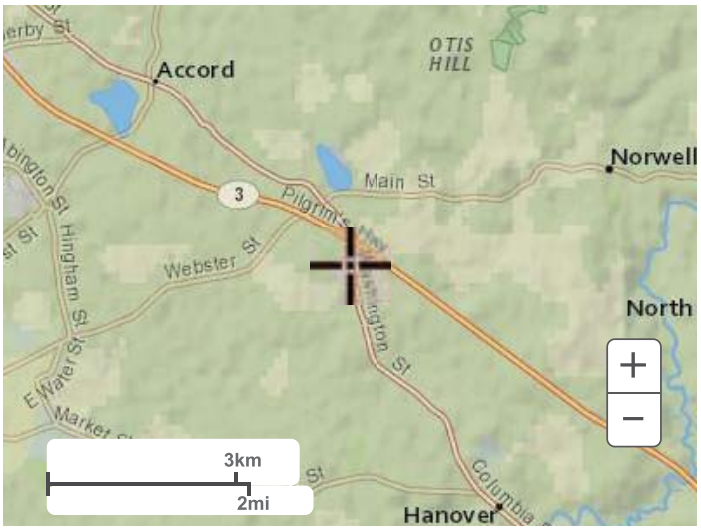
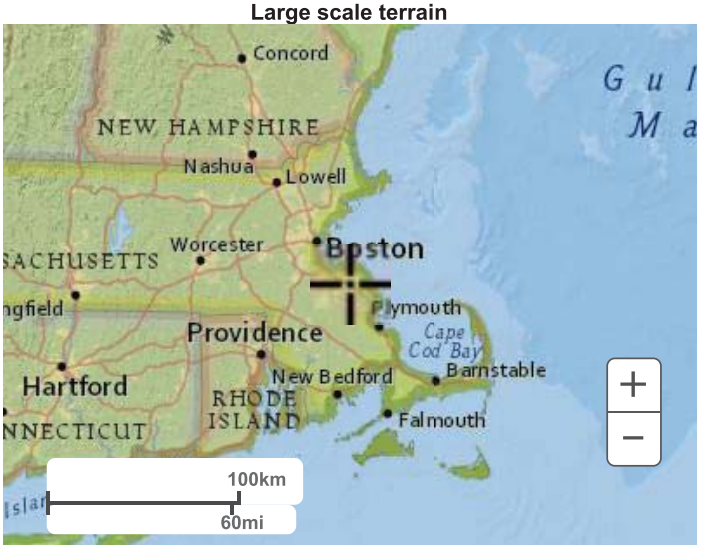
Maps & aerials

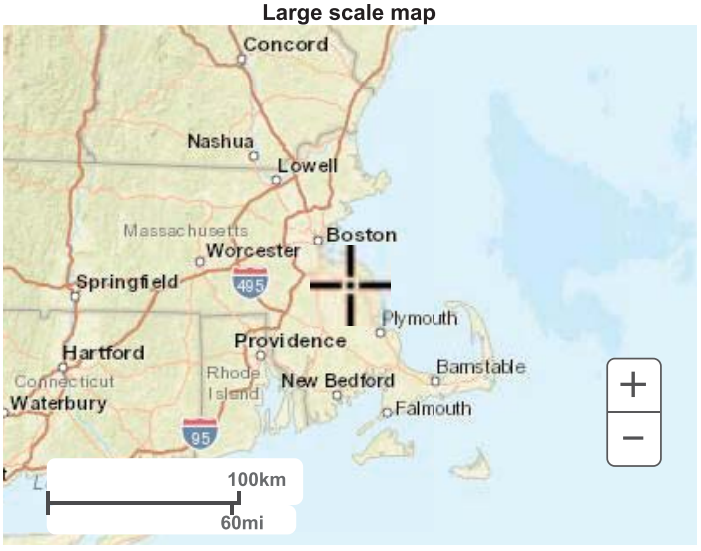
Small scale terrain



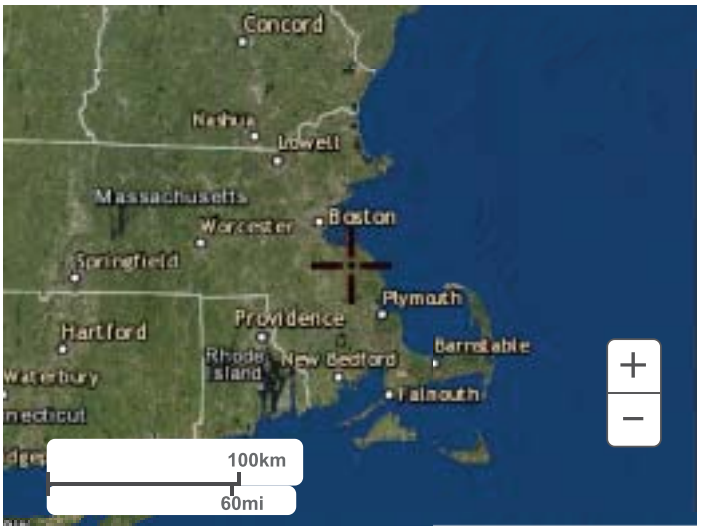
Large scale terrain



Large scale map



Large scale aerial



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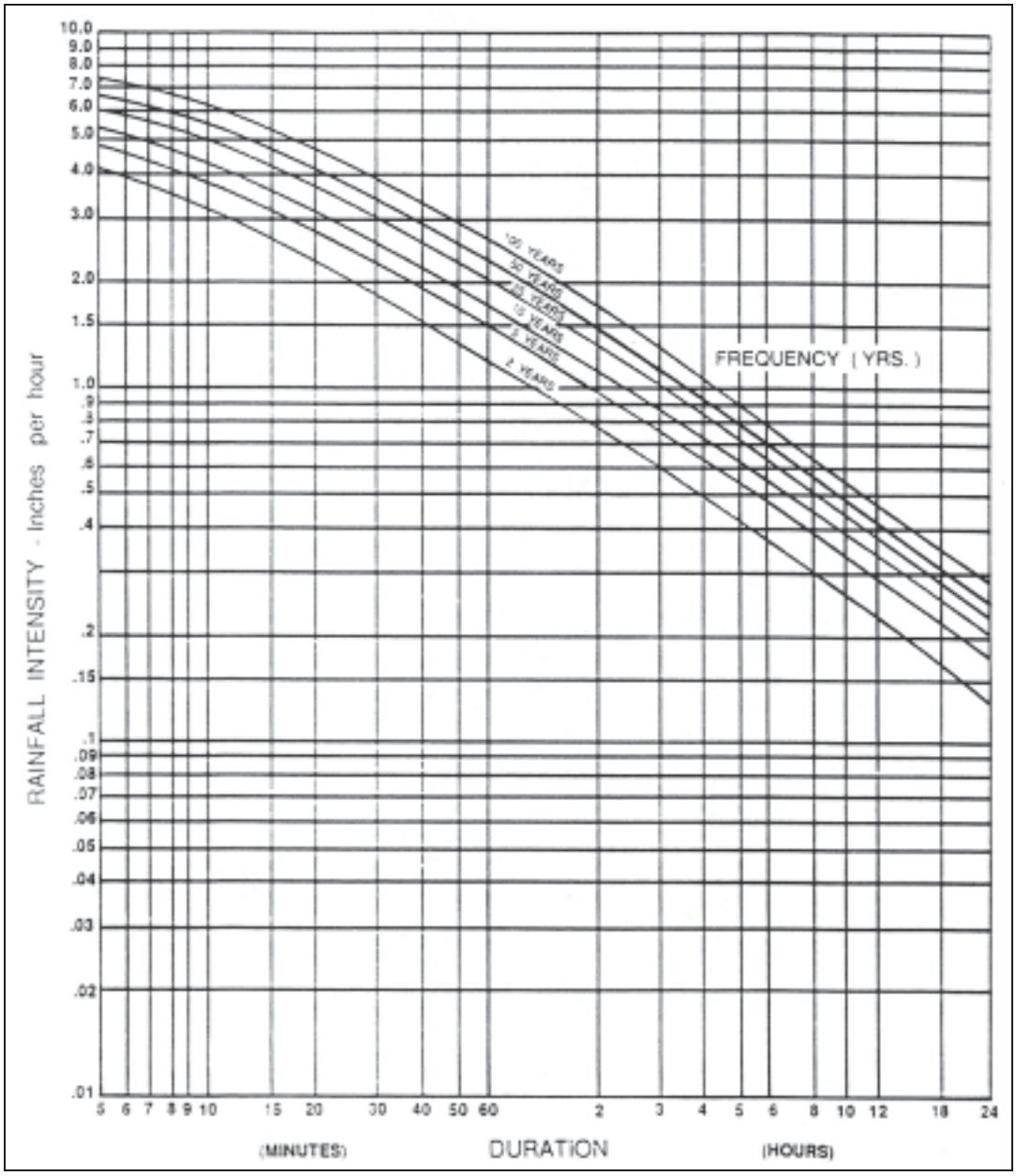

Intensity – Duration – Frequency
Curve for Boston, MA

Attention must be given to ensure consistency in units. In particular, the Target Depth Factors must be converted to feet.

NRCS HYDROLOGIC SOIL TYPE	APPROX. SOIL TEXTURE	TARGET DEPTH FACTOR (F)
A	sand	**0.6-inch**
B	loam	**0.35-inch**
C	silty loam	**0.25-inch**
D	clay	**0.1-inch**

Table 2.3.2: Recharge Target Depth by Hydrologic Soil Group

When a site contains multiple Hydrologic Soil Groups, determine the *Required Recharge Volume* for each impervious area by Hydrologic Soil Group and then add the volumes together.

Example: Assume a ten (10) acre site. 5.0 acres are proposed to be developed for a retail use. A section of the entrance roadway is to be bridged over a stream that is classified as land under water. As such, the bridging is subject to the Wetlands Protection Act Regulations, and the Stormwater Management Standards apply to stormwater runoff from all proposed roads, parking areas, and rooftops. Of the 5.0 acres proposed to be developed, 2 acres of impervious surfaces are proposed atop Hydrologic Soil Group (HSG) "A" soils, 1 acre of impervious surfaces atop HSG "B" soil, 1.5 acres of impervious surfaces atop HSG "C" soil, and 0.5 acres are proposed to be landscaped area. The remaining 5.0 acres, located on HSG "A" soil, are proposed to remain forested. Determine the *Required Recharge Volume*.

Solution: The *Required Recharge Volume* is determined only for the impervious surfaces. The 5.0-acre forested area and the 0.5-acre landscaped area are not impervious areas. Although converted from forest, landscaped area is pervious area for purposes of Standard 3. Use *Equation (1)* to determine the *Required Recharge Volume* for each Hydrologic Soil Group covered by impervious area. Add together the *Required Recharge Volumes* determined for each HSG.

Rv = F x impervious area

$Rv = [(F_{HSG\ "A"})\ (Area_1)] + [(F_{HSG\ "B"})\ (Area_2)] + [(F_{HSG\ "C"})(Area_3)] + [(F_{HSG\ "D"})(Area_4)]$ ***Equation (2)***

Rv = [(0.6-in/12)(2 acres)] + [(0.35-in/12)(1 acre)] + [(0.25-in/12)(1.5 acres)] + [(0.1-in/12)(0 acres)]

Rv = 0.1605 acre-feet

Rv = 0.1605 acre-feet x 43560 square feet/acre-feet = 6,991 cubic feet or *258.9 cubic yards*

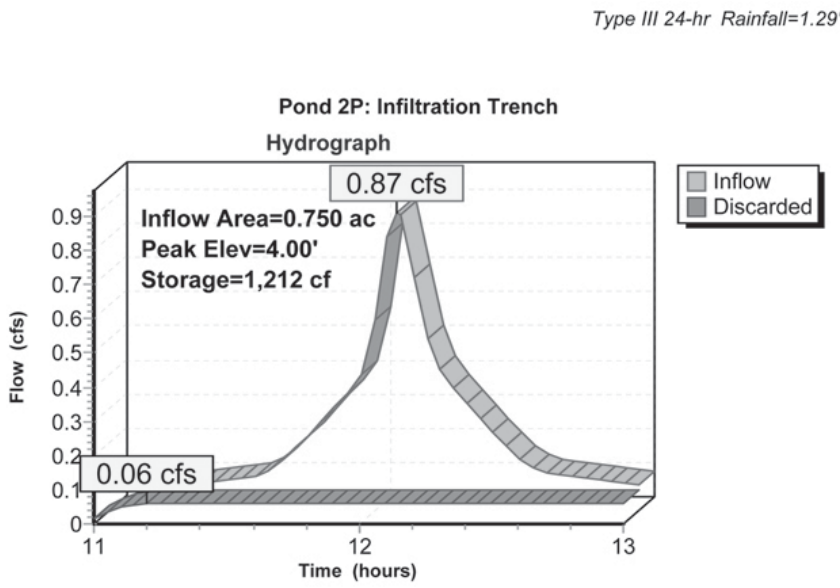

Table 2.3.3. 1982 Rawls Rates[18]

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

[18] Rawls, Brakensiek and Saxton, 1982

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MASTEP Technology Review

Technology Name: CDS (Continuous Deflective Separator) - Contech Stormwater Solutions, Inc.

Studies Reviewed:

- NJCAT Technology Verification High Efficiency Continuous Deflective Separators CDS Technologies Inc. January 2010.
- Independent Review of CDS 2015 Product Evaluation, FB Environmental Associates, 2009.
- NJCAT Technology Verification Addendum Report High Efficiency Continuous Deflective Separators CDS Technologies Inc. December 2004
- Continuous Deflection Separation (CDS) Unit For Sediment Control In Brevard County, Florida January, 2000

Date: 5/13/2011
Reviewer: Jerry Schoen

Rating: 2

Brief rationale for rating: MASTEP rating is based primarily on NJCAT 2010 field study and FB Environmental 2009 laboratory study. Both studies generally followed TARP field or NJDEP-recommended laboratory test protocols, with some exceptions. The 2010 field study sampled storms totaling 37% of average annual rainfall (50% is required), and experienced excessively large influent particles. This is discussed further below and in the MASTEP study description. In the FB lab study, no evidence of a Quality Assurance Project Plan, little discussion of quality control, higher than recommended particle size distribution, limited range of influent sediment concentration, sediments analyzed by SSC method but not TSS.

The Florida field study monitored 5 storm events and encountered sampling/equipment problems in four of them. The NJCAT lab study was conducted on a unit that was specially modified for testing in New Jersey, and is now being sold in NJ and NY.

Other Comments:

FB Environmental Associates study:

- OK-110 sediment mix used. This is recommended by Maine DEP, but produces sediments somewhat larger than those recommended by New Jersey DEP.
- Sediment analysis conducted with whole sample; essentially SSC method. SSC is generally regarded as more accurate than TSS method, but comparisons with other studies or products that use TSS data are problematic.
- Full range of flows were tested.
- Only one target sediment concentration was tested; average influent SSC was 313 mg/l, slightly outside of recommended 100-300 mg/l range.
- Scour test was performed; system produced no scour at flows up to 137% of capacity.

NJCAT 2010 Study

- Mean influent particle size was 500-600 microns, well above the TARP criteria of < 100 microns. To address this problem, the testing agency separated samples into

filtered subsamples of several size ranges (> 2000 microns, < 2000, < 500 and < 50). Removal efficiencies were calculated for each of these ranges, with results ranging from 64% (for <50 micron particles) to 99% (for > 2000 microns).

- TSS and SSC efficiencies were calculated by Event Mean Concentration and by Sum Of Loads methods.
- Study was well document. Other than issues of particle size and % annual rainfall, study closely followed TARP guidelines.

NJCAT 2004 Study

- Expectations of sediment removal performance comparable to this study should be confined to units that contain the sediment weir and a 2400 micron screen.
- The study did not include a scour test.
- A particularly fine sediment mix (Sil-Col-Sil 106, pre-washed to remove all particles > 100 microns), which makes sediment removal more difficult. Higher removal efficiencies may be obtained if sediment particle size range is larger.
- A narrow range of influent sediment (164 – 203 mg/l, average 184), was tested but this is within the NJDEP-recommended 100-300 mg/l range.
- TSS analysis appears to have been performed by a non- standardized method.
- No discussion of quality control.

Brevard County FL study

- This study was performed before release of the TARP Tier II Protocols and does not conform to them.
- The study states that "testing under higher flow conditions would be desirable."
- TSS, BOD, COD, pH, total phosphorus, and turbidity were monitored.

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MASTEP Technology Review

Technology Name: VortSentry HS

Studies Reviewed: VortSentry® HS Performance Testing With OK-110.Tetreault, Heather

Removal Characteristics of the VortSentry® Model HS48 using the F-55 Test Standard. Contech Stormwater Solutions Product Evaluation.

Date: January 29, 2009

Reviewers: Sarah Titus, Jerry Schoen

Rating: 2

Brief rationale for rating:

These comments are based primarily on the Tetreault study, which is the stronger of the two. The Tetreault study is a lab test conducted by the manufacturer at their facility. Generally sound procedures were followed. Sediment mix tested is slightly larger than recommended by NJDEP, with no fines. No QAPP or quality control data.

TARP Requirements Not Met*:

- Not a third party study
- No documentation of a Quality Assurance Project Plan, no QC data

Other Comments

- TSS removal efficiency, calculated according to the NJDEP weighted formula, was 69.6%.
- Particle Size Distribution does not match the 55% sand, 40% silt, 5% clay mix recommended by NJDEP. OK-110 was used. This tested to a D50 of 105 microns, with no particles < 50 microns. Field conditions are variable with regard to solids characteristics, and comparison of this experiment to field-derived data will be accordingly affected.
- A full range of flows (25% - 125%) was tested.
- Scour test was performed. Some scour was observed at flows exceeding capacity (effluent concentrations ranged from 21 – 41 mf/l for washout conditions).
- Influent TSS concentrations of 92-359 mg/l closely matched the recommended 100-300 mgl/l.

* Criteria also based on NJDEP laboratory testing guidelines.

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MASTEP Technology Review

Technology Name: Stormceptor

Studies Reviewed: Final NJCAT Technology Verification Stormceptor STC900 September 2004, Coventry University Study, 1996; Technology Assessment, University of Massachusetts, 1997.

Date: November 23, 2007

Reviewer: Jerry Schoen

Rating: 2

Brief rationale for rating: This rating is primarily based on the 2005 NJCAT Technology Verification study. In general, this was a well-conducted test, which in large part followed NJDEP test guidelines for laboratory studies. MASTEP considers NJDEP laboratory test guidelines to be essentially the equivalent of TARP field protocols. Issues of concern: the study measured suspended sediment concentration (SSC) rather than total suspended solids (TSS). Although SSC is considered by many scientists to be the preferred method, it is at odds with Massachusetts stormwater regulations, which are based on TSS treatment. Comparing SSC and TSS results is considered an inexact science. The test was conducted with higher influent sediment concentrations than is preferred, but results were fairly consistent across all ranges studied. The particle size distribution also appears to be higher than the target test range. There are additional field studies that in general support the results obtained in this laboratory studies. These studies do not satisfy TARP protocols, but they do not contradict results obtained in the NJCAT study.

TARP Requirements Not Met*:

- Measurements in TSS.
- Influent sediment concentration is 100 – 300 mg/l: actual was 153-460.
- No documentation of a Quality Assurance Project Plan
- Third party studies are preferred. This was conducted by Stormceptor personnel, with sample analyses conducted by an external laboratory.

* Criteria also based on NJDEP laboratory testing guidelines.

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MASTEP Technology Review

Technology Name: Stormceptor 450i.

Studies Reviewed: Multi-Phase Physical Model Testing of a Stormceptor STC450i

Date: March 14, 2009

Reviewers: Jerry Schoen

Rating: 2

Brief rationale for rating:

This laboratory study is generally well conducted and documented. No documentation of a quality assurance project, plan but quality control data was reported. Sediment analysis was done by the SSC method, but not the TSS method. Although SSC is considered by many scientists to be the preferred method, it is at odds with Massachusetts stormwater regulations, which are based on TSS treatment. Comparing SSC and TSS results is considered an inexact science.

TARP Requirements Not Met*:

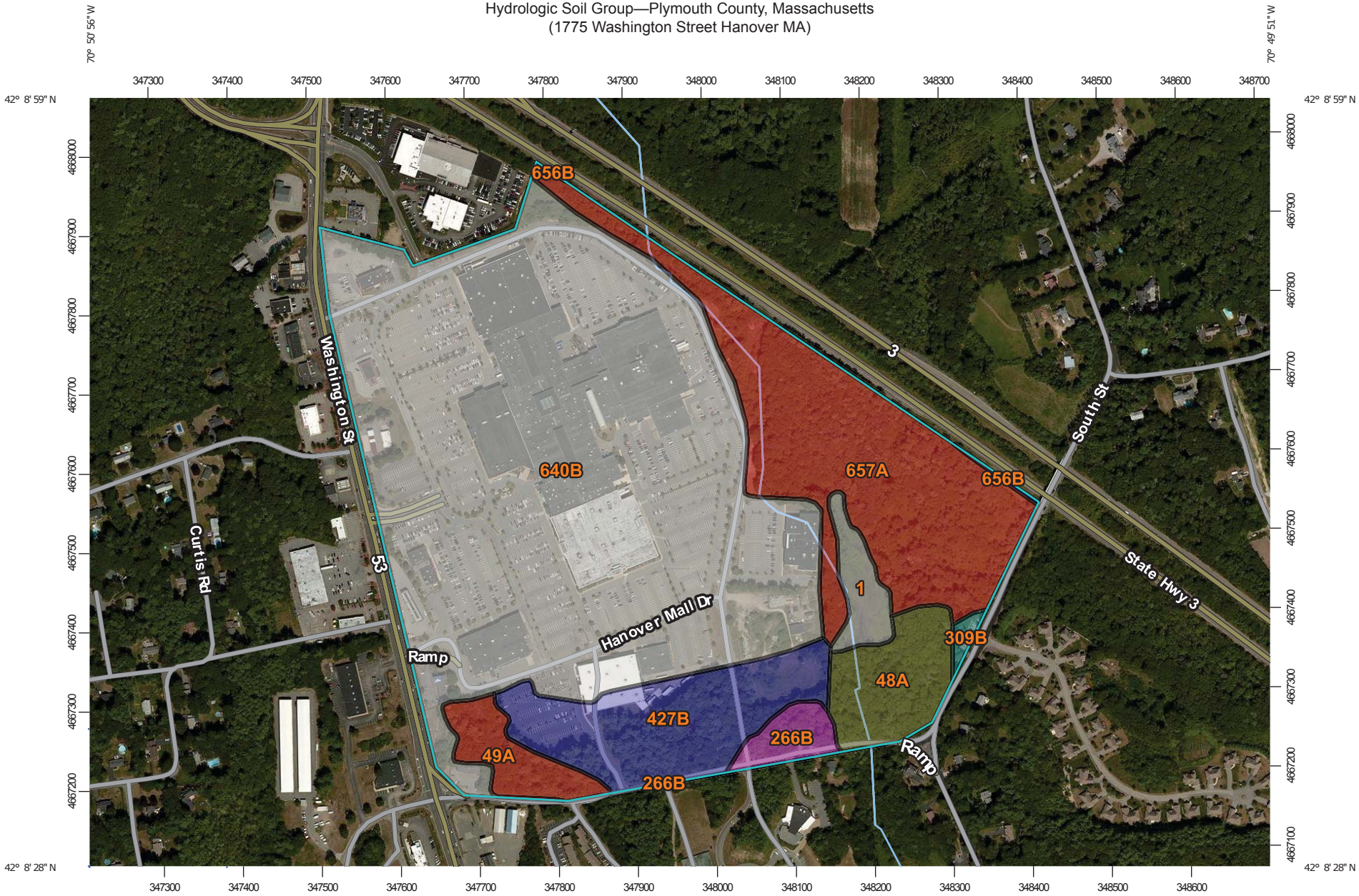
- No documentation of a Quality Assurance Project Plan
- TSS analysis was not performed.

Other Comments

- SSC removal efficiency, calculated according to the NJDEP weighted formula, was 59.5 – 63.6%.
- SSC removal evaluated using event mean concentration and modified mass balance method, the latter considered to be a particularly accurate method of evaluating sediment removal in a laboratory setting.
- Particle Size Distribution (with d50 of 67 microns) closely matched the 55% sand, 40% silt, 5% clay mix recommended by NJDEP.
- A full range of flows (2% - 125%) was tested.
- Scour test was performed at 500% of design flow. This is more rigorous than the 125% recommended for scour tests. Effluent concentrations for the scour tests ranged from 5.9 – 6.1mg/l, not considered a significant level of scour.

* Laboratory testing was based on the NJDEP TARP laboratory testing guidelines.

Hydrologic Soil Group—Plymouth County, Massachusetts
(1775 Washington Street Hanover MA)



Map Scale: 1:6,830 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 11, Sep 7, 2018

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 26, 2014—Sep 4, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		2.1	1.8%
48A	Brockton sandy loam, 0 to 3 percent slopes, extremely stony	C/D	5.2	4.5%
49A	Norwell mucky fine sandy loam, 0 to 3 percent slopes, extremely stony	D	3.0	2.6%
266B	Warwick fine sandy loam, 3 to 8 percent slopes	A	1.8	1.6%
309B	Moshup loam, 3 to 8 percent slopes, very stony	C	0.4	0.3%
427B	Newfields fine sandy loam, 3 to 8 percent slopes, extremely stony	B	10.4	9.0%
640B	Urban land, till substratum, 0 to 8 percent slopes		71.3	61.7%
656B	Udorthents - Urban land complex, 0 to 8 percent slopes	B	0.1	0.1%
657A	Aquepts, 0 to 3 percent slopes	D	21.2	18.4%
Totals for Area of Interest			**115.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

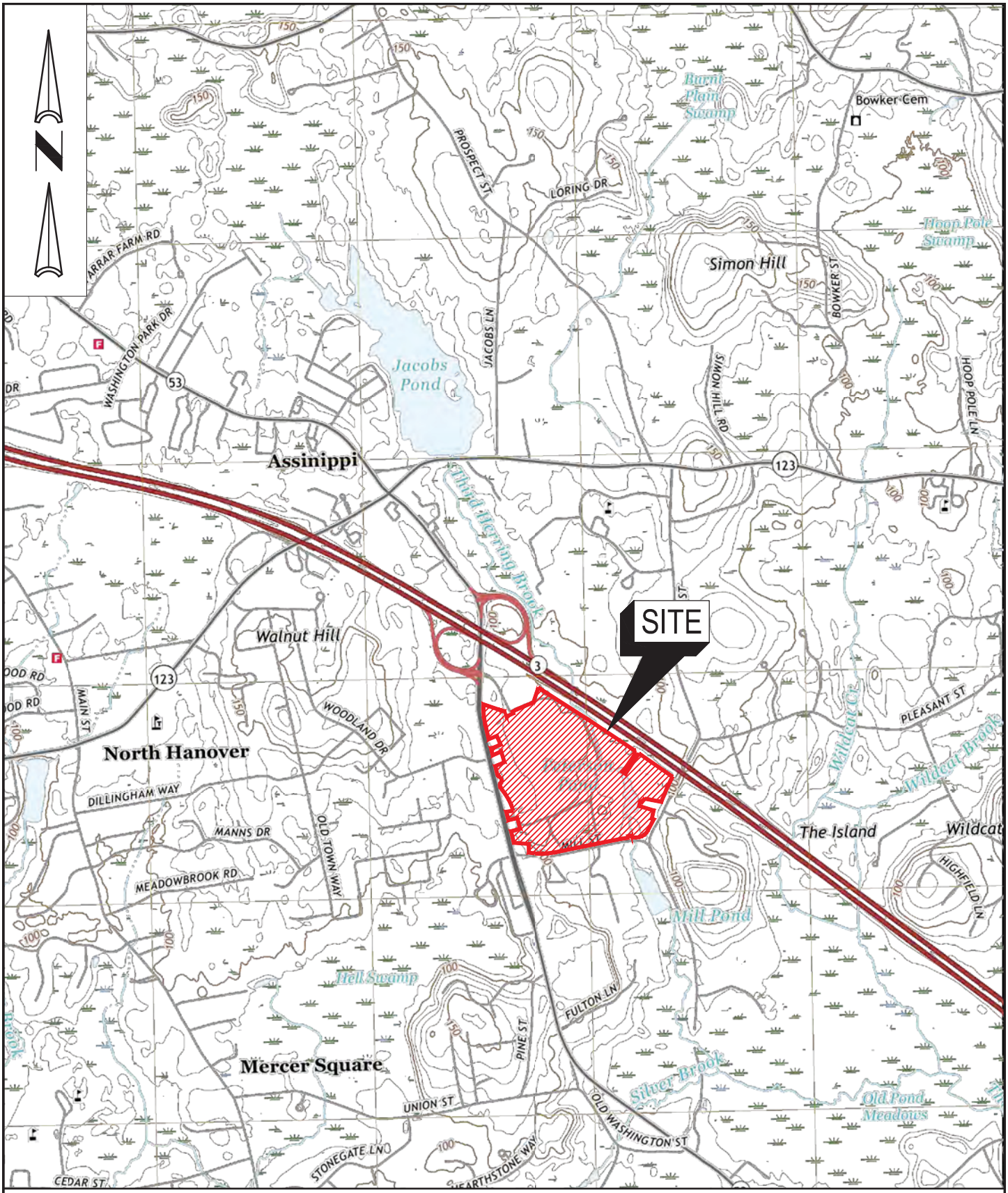
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



SCALE; 1"= 2083'±

DATE 05/15/19

1775 WASHINGTON ST. HANOVER, MA

LOCATION PLAN

SOURCE: USGS

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2016-075-USGS