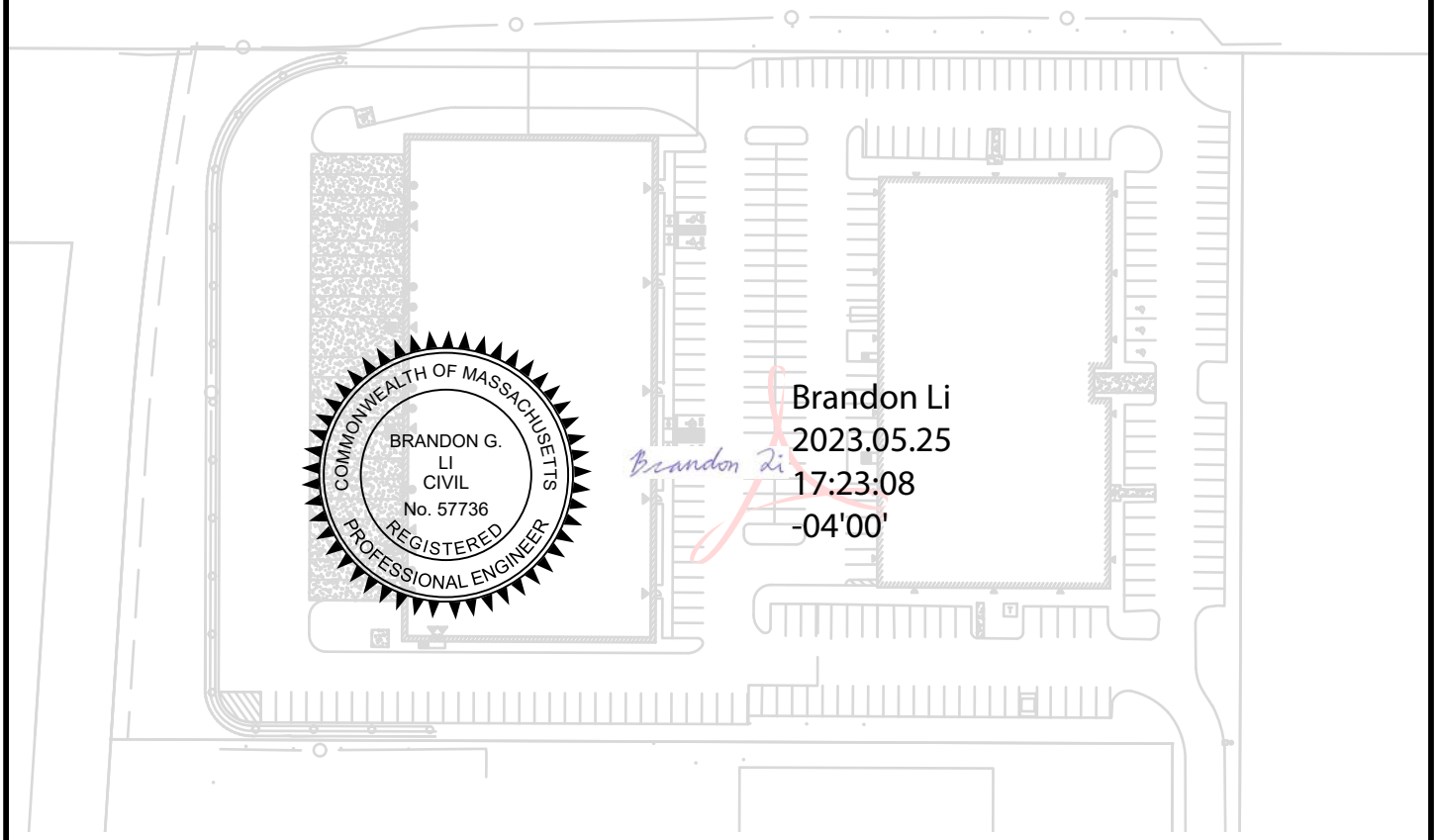
STORMWATER MANAGEMENT REPORT

05/24/2023

33 RIVERSIDE DRIVE
PEMBROKE,MA



COMMONWEALTH OF MASSACHUSETTS
BRANDON G. LI
CIVIL
No. 57736
REGISTERED PROFESSIONAL ENGINEER

Brandon Li
2023.05.25
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PREPARED FOR:

RADER PROPERTIES, INC
80 WASHINGTON STREET, J-40
NORWELL, MA 02061

KELLY ENGINEERING GROUP
civil engineering consultants
0 Campanelli Drive, Braintree, MA 02184
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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. The design incorporates many best management practices recommended by the Massachusetts Stormwater Management Handbook.

EXISTING SITE

The site is located at 33 Riverside Drive in Pembroke MA. The site is currently occupied by an existing 2 story office building with 172 parking spaces, a septic system, stormwater management, utilities, and other amenities. The remainder of the site is undeveloped woodlands.

Currently runoff from the easterly development portion of the site drains towards the catch basin inlets and routed to existing leaching pit manholes. The westerly portion of the site drains to the north and to Water Street. See Existing Drainage Exhibit in **Attachment A.**

PROPOSED SITE

The proposed project consists of a 45,000 s.f. flex industrial/warehouse building with 14 loading docks, 98 new parking spaces, stormwater management system, utilities, and other site amenities. The proposed project will result in approximately 2.6 acres of new impervious area.

A stormwater management system has been designed to comply with Massachusetts Department of Environmental Protection's stormwater management

standards and the Town of Pembroke Planning Board Rules and Regulations Governing the Issuance of Site Plan Approval Section 5.3 Drainage. The Stormwater management system will incorporate many Best Management Practices (BMPs), which will include a proprietary water quality units subsurface recharge chambers, and an operations and maintenance program designed to treat, recharge, and detain runoff generated from the proposed development of the site. See Proposed Conditions Drainage Exhibit in **Attachment B**.

STORMWATER MANAGEMENT STANDARDS

The following is a discussion of the Massachusetts Stormwater Management Standards

STANDARD 1: NO NEW UNTREATED DISCHARGES

The proposed project has been designed for no new untreated discharges from the site. The proposed pavement areas will be treated by a proprietary water quality device.

STANDARD 2: PEAK RATE ATTENUATION

Existing and proposed conditions were modeled using Hydraflow Hydrographs Extension for AutoCAD Civil 3D by Autodesk, Inc. v2022. This computer software uses the TR55/TR20 tabular method of computing peak flows, hydrograph addition, and pond routing. The curve numbers for the existing and proposed conditions analysis are based on hydrologic group A soils. Soil survey maps show soils onsite are Carver-Urban Land with a soils rating of hydrologic group A. See soil survey map in **Attachment D**. For the purposes of the proposed conditions analysis, a conservative estimate of time of concentration of 6 minutes is used.

As can be seen from the summary chart below, the peak flows from the design storm on the site will be reduced as a result of this project. Peak flow mitigation will be

provided within the subsurface recharge systems. The recharge chambers were used to attenuate peak flows. An infiltration rate of 8.27 in/hr. is used based hydrologic group A sands. See Infiltration Rates in **Attachment E**.

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

STANDARD 3: RECHARGE

Based on DEP guidelines for recharge, the required recharge volume for hydrologic group A soils is 0.6". The total increase in impervious area on the proposed site is approximately 2.6 acres. The dedicated recharge volume has been provided in the subsurface recharge system. See **Attachment C** for recharge calculations.

STANDARD 4: STORMWATER QUALITY

Stormwater runoff from the site will be enhanced by means of a number of Best Management Practices (BMP's), which have been designed to comply with the DEP Stormwater Management Guidelines. In order to achieve a Total Suspended Solids (TSS) removal rate of 80%, the following BMP's will be incorporated:

- Pavement sweeping and maintenance program
- Deep sump hooded catch basins
- Proprietary water quality devices
- Subsurface recharge chambers

The total TSS removal is expected to be greater than 80%. See TSS Removal in **Attachment C**.

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

The proposed project is not considered a land use with higher potential pollutant loads. The proposed use is not subject to a NPDES Multi-Sector General Permit.

STANDARD 6: CRITICAL AREAS

The site is not in an active public water supply, surface water protection area, nor groundwater protection area, and is not in an area of critical environmental concern.

STANDARD 7: REDEVELOPMENT

A portion of the proposed project will occur within previously developed areas.

STANDARD 8: CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION CONTROL

Construction pollution prevention and erosion controls are provided in the Site Development Plans.

STANDARD 9: OPERATIONS AND MAINTENANCE PLAN

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

STANDARD 10: ILLICIT DISCHARGES

An Illicit Discharge Statement is attached and can be found it the Table of Contents.

CONCLUSION

An extensive stormwater management system has been designed for the project. The stormwater management system has been designed to comply with current (DEP) standards and will incorporate a number of Best Management Practices ("BMP's") that will ensure that the runoff will be treated, recharged and detained on site.

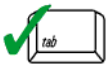
The construction of the stormwater management system will ensure that stormwater runoff from this site will be of high quality and that there will be no adverse impacts on surrounding properties.

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

Brandon Li
2023.05.25
17:25:05 -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:

RADER PROPERTIES, INC
80 Washington Street, J-40
Norwell, MA 02061

Brandon Li

for Jim Rader

05/24/23

Date

RUNOFF SUMMARY

Peak Runoff Chart

DESIGN POINT 1

Storm	Existing	Proposed	Difference
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.38	1.089	1.089	0
10,5.04	1.945	1.945	0
25,6.08	2.488	2.488	0
50,6.85	2.891	2.891	0
100,7.68	3.324	3.324	0

Peak Runoff Chart

DESIGN POINT 2

Storm	Existing	Proposed	Difference
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.38	6.148	6.148	0
10,5.04	10.69	10.69	0
25,6.08	13.560	13.560	0
50,6.85	15.67	15.67	0
100,7.68	17.95	17.95	0

Peak Runoff Chart

DESIGN POINT 3

Storm	Existing	Proposed	Difference
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.38	0.008	0	-0.008
10,5.04	0.231	0.005	-0.226
25,6.08	0.788	0.046	-0.742
50,6.85	1.515	0.590	-0.925
100,7.68	2.6	1.665	-0.935

Peak Runoff Chart

DESIGN POINT 4

Storm	Existing	Proposed	Difference
(yr, inches)	(cfs)	(cfs)	(cfs)
2,3.38	0.005	0	-0.005
10,5.04	0.126	0.005	-0.121
25,6.08	0.484	0.110	-0.374
50,6.85	1.010	0.594	-0.416
100,7.68	1.9	1.206	-0.694

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

Attachment A
Existing Conditions

ROUTE 3
COMMONWEALTH OF MASSACHUSETTS
(PUBLIC - 300' WIDE LIMITED ACCESS HIGHWAY)

107' SHALLOW CONCENTRATED FLOW @ 18.7%

361' SHALLOW CONCENTRATED FLOW @ 0.4%

TIME OF CONCENTRATION

DRAINAGE AREA 1

DRAINAGE AREA 3

DRAINAGE AREA 4

DRAINAGE AREA 5

DRAINAGE AREA 2

EXISTING BUILDING

50' SHEET FLOW @ 1.5%

35' SHALLOW CONCENTRATED FLOW @ 1.9%

26.6' SHALLOW CONCENTRATED FLOW @ 4.8%

50' SHEET FLOW @ 2.4%

127' SHALLOW CONCENTRATED FLOW @ 8.7%

276' SHALLOW CONCENTRATED FLOW @ 2.1%

TIME OF CONCENTRATION

WATER STREET
(PUBLIC - 45' WIDE COUNTY LAYOUT - DECREE NO. 2141)

N/F
R.K. LHC, LLC
& C/O RK CENTERS

N/F
RIVERSIDE STORAGE REALTY TRUST
& SENNETT ROBERT TR.

RADER PROPERTIES, INC. 33 RIVERSIDE DRIVE PEMBROKE, MA	SCALE: 1"= 60' DATE: 05/24/2023 2023-026-EXDR00	EXISTING DRAINAGE EXHIBIT	KELLY ENGINEERING GROUP civil engineering consultants 0 Campanelli Drive, Braintree, MA 02184 Phone: 781-843-4333 www.kellyengineeringgroup.com

Runoff Curve Number and Runoff

Name: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: **Existing Conditions** AREA 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
Building		98	0.00	0
Pavement		98	12327.38	1208083
Grass	Hydrologic Group A: Good Condition	39	2512.58	97990.6
Woods	Hydrologic Group A: Good Condition	30	1097.55	32926.5
		Totals =	15937.51	1339000
		Acres =	0.5215153	

CN or C (weighted) = total product/total area = **84.0**

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: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: **Existing Conditions** AREA 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
Building		98	33268.18	3260281
Pavement		98	34750.70	3405568
Grass	Hydrologic Group A: Good Condition	39	5542.24	216147
Woods	Hydrologic Group A: Good Condition	30	10385.95	311578
		Totals =	83947.06	7193576
		Acres =	2.7469589	

CN or C (weighted) = total product/total area = **85.7**

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: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: **Existing Conditions** AREA 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
Building		98		0
Pavement		98	13317.31	1305097
Grass	Hydrologic Group A: Good Condition	39	11077.01	432004
Woods	Hydrologic Group A: Good Condition	30	71358.84	2140765
		Totals =	95753.17	3877865
		Acres =	3.1332843	

CN or C (weighted) = total product/total area = **40.5**

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: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: **Existing Conditions** AREA 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
Building		98		0
Pavement		98	9040.81	885999
Grass	Hydrologic Group A: Good Condition	39	8156.23	318093
Woods	Hydrologic Group A: Good Condition	30	53961.13	1618834
		Totals =	71158.16	2822926
		Acres =	2.3284739	

CN or C (weighted) = total product/total area = **39.7**

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: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: **Existing Conditions** AREA 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
Building		98		0
Pavement		98		0
Grass	Hydrologic Group A: Good Condition	39	1304.52	50876.2
Woods	Hydrologic Group A: Good Condition	30	3763.30	112899
		Totals =	5067.82	163775
		Acres =	0.1658318	

CN or C (weighted) = total product/total area = **32.3**

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

Watershed Model Schematic

Legend

Hyd.	Origin	Description
1	SCS Runoff	AREA 1
2	SCS Runoff	AREA 2
3	SCS Runoff	AREA 3
4	SCS Runoff	AREA 4
5	SCS Runoff	AREA 5

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	------	-------	1.089	-------	-------	1.945	2.488	2.891	3.324	AREA 1
2	SCS Runoff	------	-------	6.148	-------	-------	10.69	13.56	15.67	17.95	AREA 2
3	SCS Runoff	------	-------	0.008	-------	-------	0.231	0.788	1.515	2.600	AREA 3
4	SCS Runoff	------	-------	0.005	-------	-------	0.125	0.481	1.001	1.866	AREA 4
5	SCS Runoff	------	-------	0.000	-------	-------	0.001	0.003	0.010	0.028	AREA 5

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.089	2	724	3,255	------	------	------	AREA 1
2	SCS Runoff	6.148	2	724	18,399	------	------	------	AREA 2
3	SCS Runoff	0.008	2	1326	147	------	------	------	AREA 3
4	SCS Runoff	0.005	2	1324	60	------	------	------	AREA 4
5	SCS Runoff	0.000	2	n/a	0	------	------	------	AREA 5

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.945	2	724	5,869	------	------	------	AREA 1
2	SCS Runoff	10.69	2	724	32,480	------	------	------	AREA 2
3	SCS Runoff	0.231	2	746	2,992	------	------	------	AREA 3
4	SCS Runoff	0.125	2	744	1,848	------	------	------	AREA 4
5	SCS Runoff	0.001	2	1324	19	------	------	------	AREA 5

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	2.488	2	724	7,581	------	------	------	AREA 1
2	SCS Runoff	13.56	2	724	41,629	------	------	------	AREA 2
3	SCS Runoff	0.788	2	736	6,287	------	------	------	AREA 3
4	SCS Runoff	0.481	2	738	4,023	------	------	------	AREA 4
5	SCS Runoff	0.003	2	878	88	------	------	------	AREA 5

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	2.891	2	724	8,869	------	------	------	AREA 1
2	SCS Runoff	15.67	2	724	48,497	------	------	------	AREA 2
3	SCS Runoff	1.515	2	730	9,354	------	------	------	AREA 3
4	SCS Runoff	1.001	2	726	6,059	------	------	------	AREA 4
5	SCS Runoff	0.010	2	746	169	------	------	------	AREA 5

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	3.324	2	724	10,273	------	------	------	AREA 1
2	SCS Runoff	17.95	2	724	55,963	------	------	------	AREA 2
3	SCS Runoff	2.600	2	730	13,159	------	------	------	AREA 3
4	SCS Runoff	1.866	2	726	8,610	------	------	------	AREA 4
5	SCS Runoff	0.028	2	740	281	------	------	------	AREA 5

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

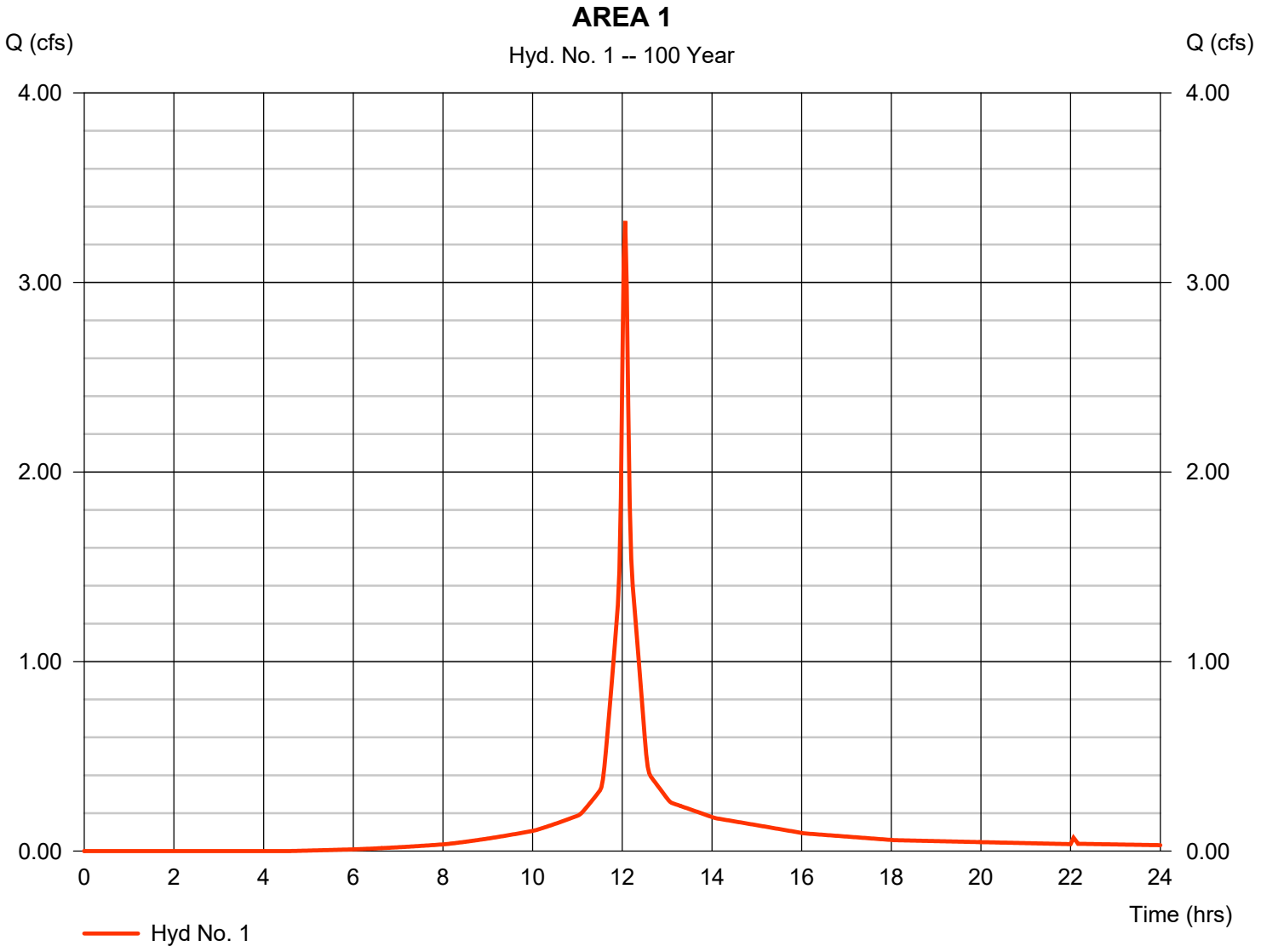
Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	3.38	0.00	0.00	5.04	6.08	6.85	7.68
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.324 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	10,273 cuft
Drainage area	=	0.522 ac	Curve number	=	84
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.68 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

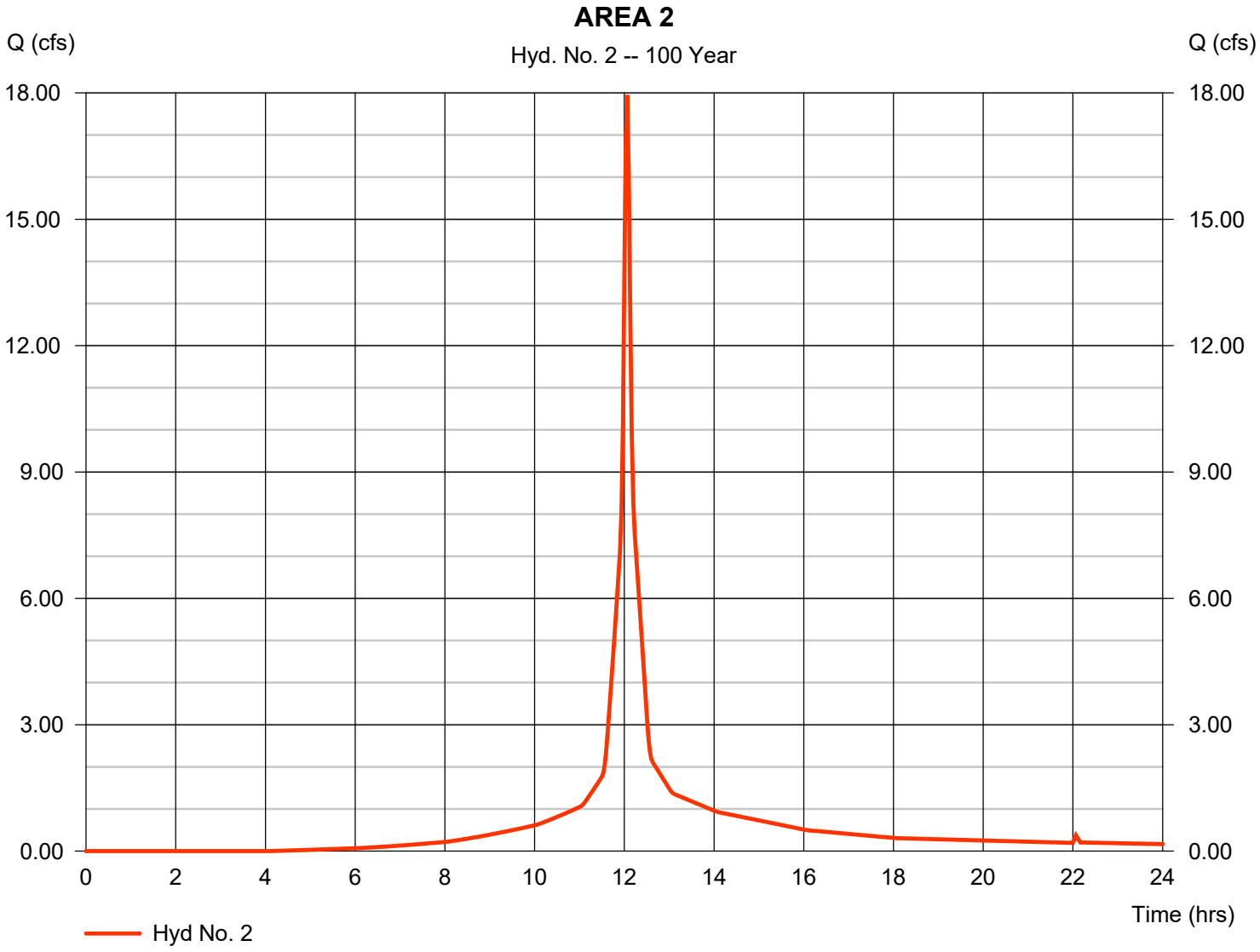


Hydrograph Report

Hyd. No. 2

AREA 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	17.95 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	55,963 cuft
Drainage area	=	2.747 ac	Curve number	=	85.7
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.68 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

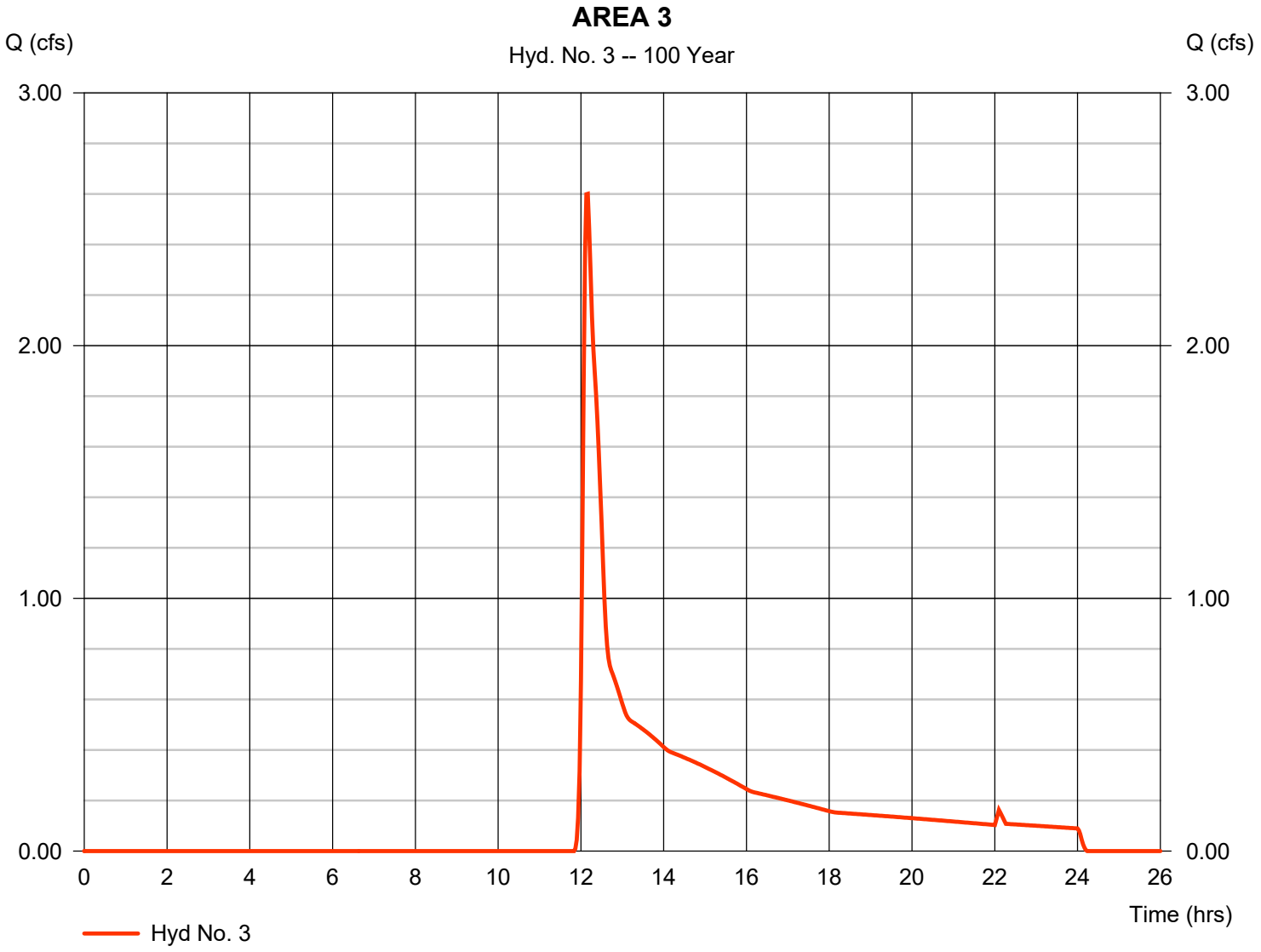


Hydrograph Report

Hyd. No. 3

AREA 3

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.600 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.17 hrs
Time interval	=	2 min	Hyd. volume	=	13,159 cuft
Drainage area	=	3.133 ac	Curve number	=	40.5
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	7.40 min
Total precip.	=	7.68 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

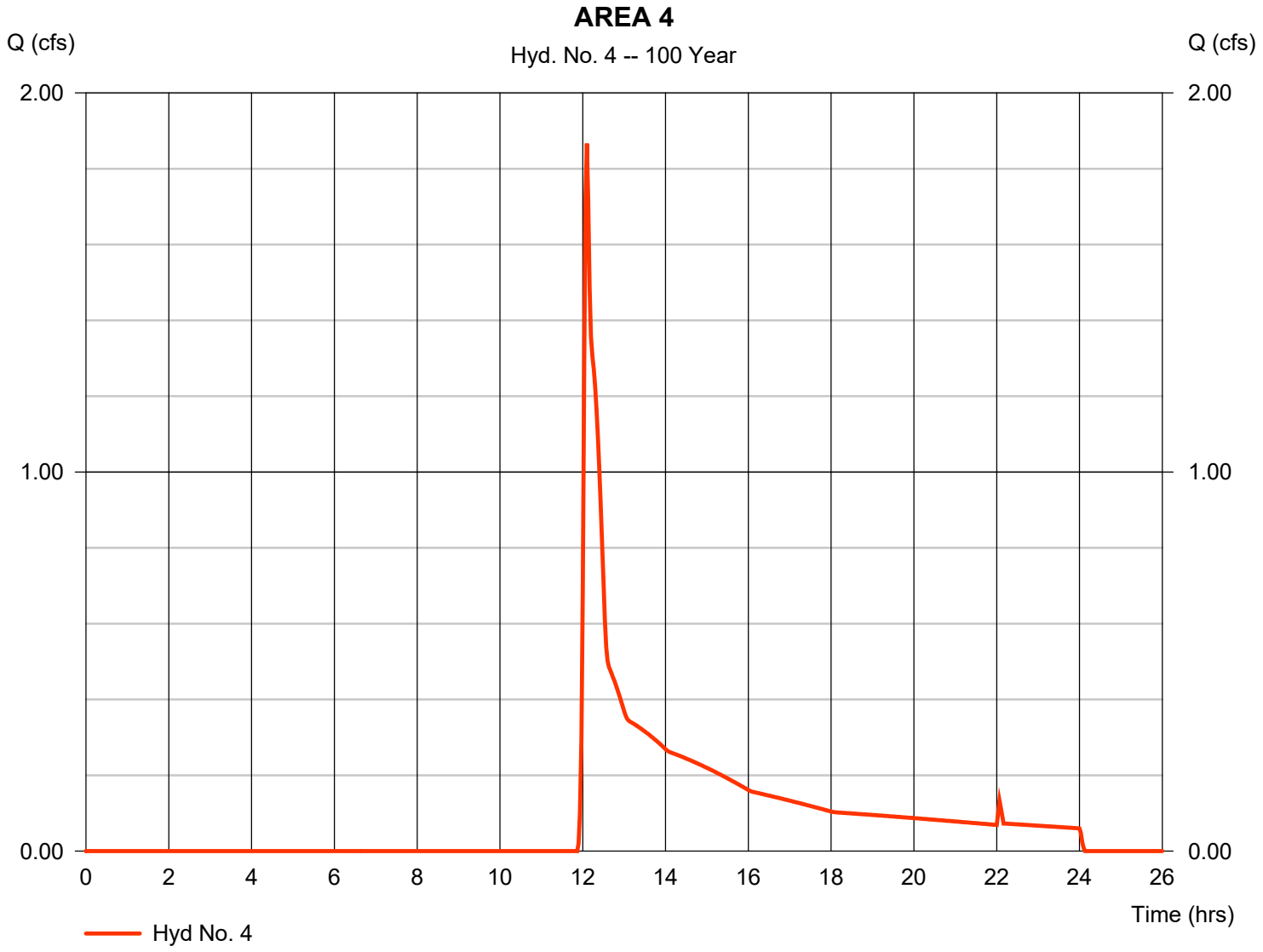


Hydrograph Report

Hyd. No. 4

AREA 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.866 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.10 hrs
Time interval	=	2 min	Hyd. volume	=	8,610 cuft
Drainage area	=	2.328 ac	Curve number	=	39.7
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	3.40 min
Total precip.	=	7.68 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

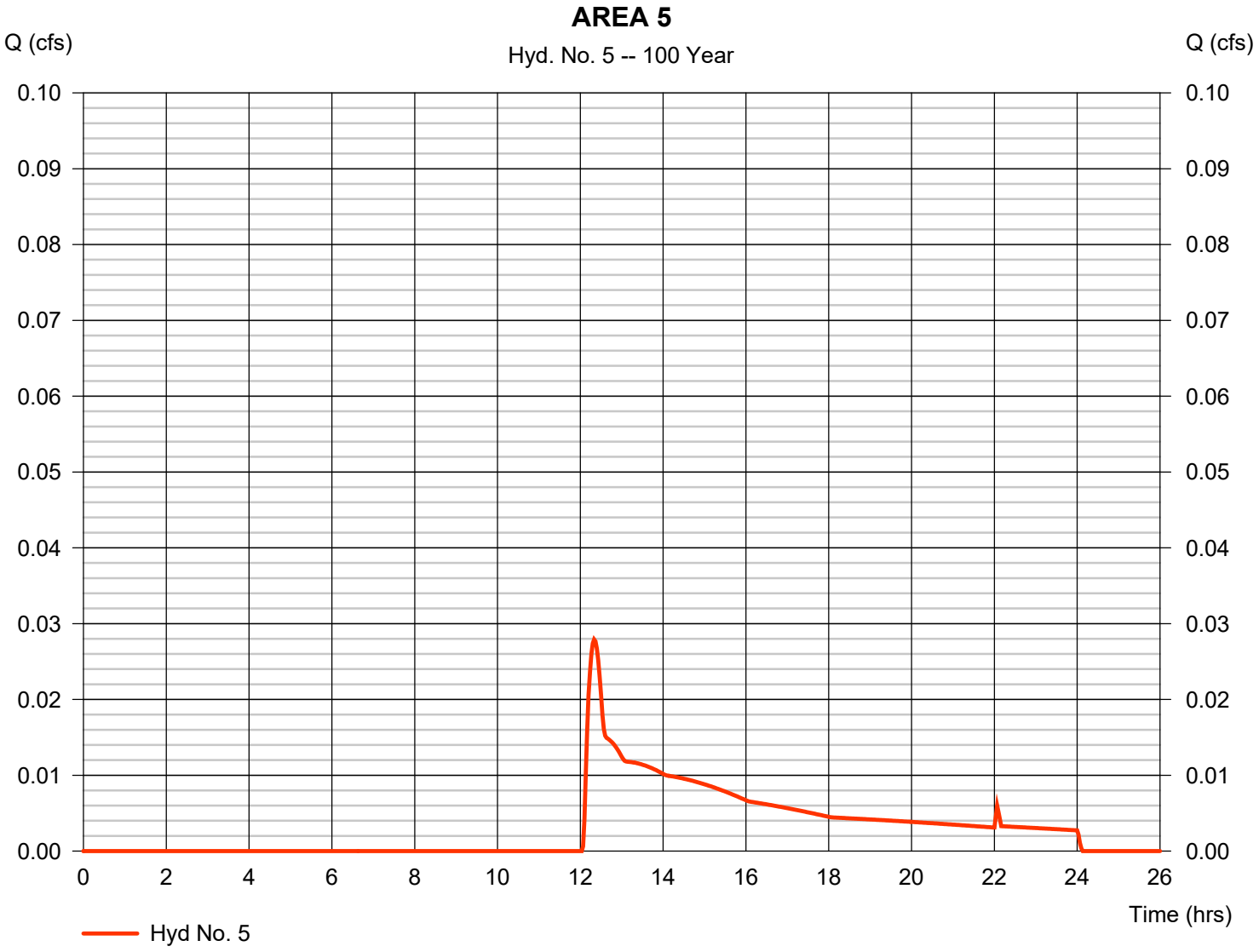


Hydrograph Report

Hyd. No. 5

AREA 5

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.028 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.33 hrs
Time interval	=	2 min	Hyd. volume	=	281 cuft
Drainage area	=	0.166 ac	Curve number	=	32.3
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.68 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



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

Attachment B
Proposed Conditions

ROUTE 3
COMMONWEALTH OF MASSACHUSETTS
(PUBLIC - 300' WIDE LIMITED ACCESS HIGHWAY)

DP#3

DP#1

RECHARGE SYSTEM 3

WATER STREET
(PUBLIC - 45' WIDE COUNTY LAYOUT - DECREE NO. 114)

DRAINAGE AREA 3B

RECHARGE SYSTEM 1B

DRAINAGE AREA 1A

DRAINAGE AREA 3A

DRAINAGE AREA 1B

DRAINAGE AREA 2A

DRAINAGE AREA 2B

RECHARGE SYSTEM 2B

DRAINAGE AREA 4B

DRAINAGE AREA 4A

DRAINAGE AREA 4B

DP#4

DP#2

RECHARGE SYSTEM 4

RD

SD

T

RADER PROPERTIES, INC. 33 RIVERSIDE DRIVE PEMBROKE, MA	SCALE: 1"= 60' DATE: 05-24-2023 2023-026-PRDR00	PROPOSED DRAINAGE EXHIBIT	KELLY ENGINEERING GROUP civil engineering consultants 0 Campanelli Drive, Braintree, MA 02184 Phone: 781-843-4333 www.kellyengineeringgroup.com

Runoff Curve Number and Runoff

Name: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: PROPOSED CONDITIONS AREA 1A

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
Building		98	0.00	0
Pavement		98	12327.38	1208083
Grass	Hydrologic Group A: Good Condition	39	2512.58	97990.6
Woods	Hydrologic Group A: Good Condition	30	1097.55	32926.5
		Totals =	15937.51	1339000
		Acres =	0.52151526	

CN or C (weighted) = total product/total area = **84.0**

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: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: PROPOSED CONDITIONS AREA 1B

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
Building		98	0.00	0
Pavement		98	17550.00	1719900
Grass	Hydrologic Group A: Good Condition	39	1421.00	55419
Woods	Hydrologic Group A: Good Condition	30	0.00	0
		Totals =	18971.00	1775319
		Acres =	0.6207788	

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: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: PROPOSED CONDITIONS AREA 2A

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
Building		98	33268.18	3260281
Pavement		98	34750.70	3405568
Grass	Hydrologic Group A: Good Condition	39	5542.24	216147
Woods	Hydrologic Group A: Good Condition	30	10385.95	311579
		Totals =	83947.07	7193576
		Acres =	2.74695894	

CN or C (weighted) = total product/total area = **85.7**

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: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: PROPOSED CONDITIONS AREA 2B

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
Building		98	0.00	0
Pavement		98	22979.00	2251942
Grass	Hydrologic Group A: Good Condition	39	1852.41	72244
Woods	Hydrologic Group A: Good Condition	30	0.00	0
		Totals =	24831.41	2324186
		Acres =	0.81254614	

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: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: **PROPOSED CONDITIONS** AREA 3A

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
Building		98	33812.20	3313595
Pavement		98	30439.13	2983035
Grass	Hydrologic Group A: Good Condition	39	8415.84	328218
Woods	Hydrologic Group A: Good Condition	30	0.00	0
		Totals =	72667.17	6624848
		Acres =	2.37785231	

CN or C (weighted) = total product/total area = **91.2**

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: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: **PROPOSED CONDITIONS** AREA 4A

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
Building		98	11185.24	1096154
Pavement		98	18510.12	1813992
Grass	Hydrologic Group A: Good Condition	39	4233.17	165093
Woods	Hydrologic Group A: Good Condition	36	0.00	0
		Totals =	33928.53	3075239
		Acres =	1.11022672	

CN or C (weighted) = total product/total area = **90.6**

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: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: PROPOSED CONDITIONS AREA 3B

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
Building		98		0
Pavement		98		0
Grass	Hydrologic Group A: Good Condition	39		0
Woods	Hydrologic Group A: Good Condition	36	11051.30	397847
		Totals =	11051.30	397847
		Acres =	0.36162642	

CN or C (weighted) = total product/total area = **36.0**

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: RADER PROPERTIES, INC **By:** AJV **Date:** 05/16/23
Location : 33 RIVERSIDE DRIVE, PEMBOROKE, MA
Description: **PROPOSED CONDITIONS** AREA 4B

Circle One: Pre or **Post**

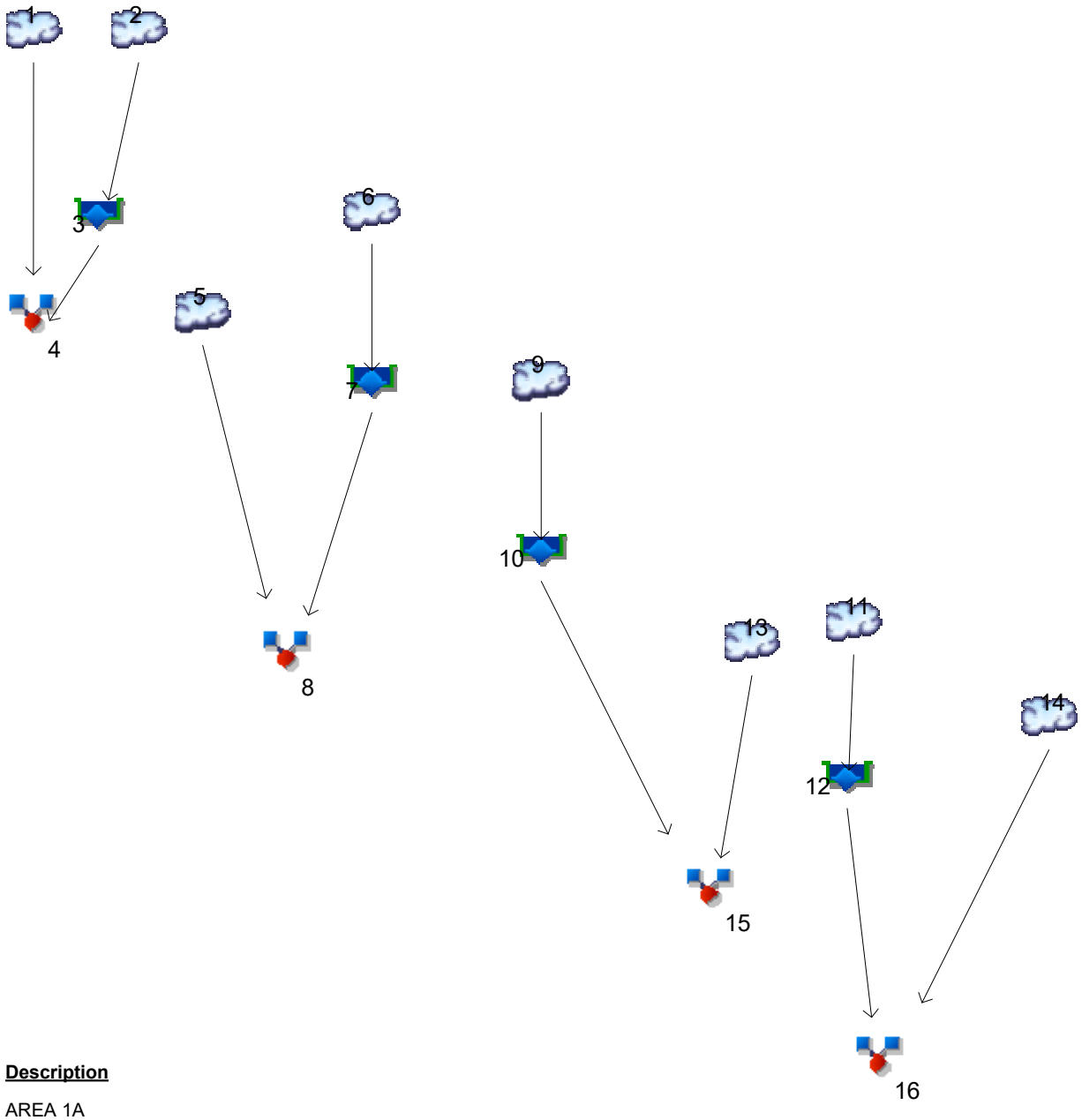
Runoff Curve Number (CN):

Surface Description	Soil Name; hydrologic group; hydrologic condition	CN	s.f.	Product of CN x Area
Building		98		0
Pavement		98		0
Grass	Hydrologic Group A: Good Condition	39		0
Woods	Hydrologic Group A: Good Condition	36	10371.56	373376
		Totals =	10371.56	373376
		Acres =	0.33938357	

CN or C (weighted) = total product/total area = **36.0**

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

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	AREA 1A
2	SCS Runoff	AREA 1B
3	Reservoir	reacharge 1B
4	Combine	DESIGN POINT 1
5	SCS Runoff	AREA 2A
6	SCS Runoff	Area 2B
7	Reservoir	rech 2b
8	Combine	DESIGN POINT 2
9	SCS Runoff	AREA 3A
10	Reservoir	Recharge 3
11	SCS Runoff	AREA 4A
12	Reservoir	Reacharge 4
13	SCS Runoff	AREA 3B
14	SCS Runoff	AREA 4B
15	Combine	DESIGN POINT 3
16	Combine	DESIGN POINT 4

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	------	-------	1.089	-------	-------	1.945	2.488	2.891	3.324	AREA 1A
2	SCS Runoff	------	-------	1.806	-------	-------	2.821	3.451	3.915	4.413	AREA 1B
3	Reservoir	2	-------	0.000	-------	-------	0.000	0.000	0.000	0.000	reacharge 1B
4	Combine	1, 3	-------	1.089	-------	-------	1.945	2.488	2.891	3.324	DESIGN POINT 1
5	SCS Runoff	------	-------	6.148	-------	-------	10.69	13.56	15.67	17.95	AREA 2A
6	SCS Runoff	------	-------	2.364	-------	-------	3.693	4.517	5.124	5.776	Area 2B
7	Reservoir	6	-------	0.000	-------	-------	0.000	0.000	0.000	0.000	rech 2b
8	Combine	5, 7	-------	6.148	-------	-------	10.69	13.56	15.67	17.95	DESIGN POINT 2
9	SCS Runoff	------	-------	6.462	-------	-------	10.40	12.84	14.64	16.57	AREA 3A
10	Reservoir	9	-------	0.000	-------	-------	0.000	0.019	0.533	1.557	Recharge 3
11	SCS Runoff	------	-------	2.961	-------	-------	4.803	5.946	6.788	7.691	AREA 4A
12	Reservoir	11	-------	0.000	-------	-------	0.000	0.085	0.533	1.098	Reacharge 4
13	SCS Runoff	------	-------	0.000	-------	-------	0.005	0.030	0.071	0.140	AREA 3B
14	SCS Runoff	------	-------	0.000	-------	-------	0.005	0.028	0.066	0.131	AREA 4B
15	Combine	10, 13,	-------	0.000	-------	-------	0.005	0.046	0.590	1.665	DESIGN POINT 3
16	Combine	12, 14,	-------	0.000	-------	-------	0.005	0.110	0.594	1.206	DESIGN POINT 4

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.089	2	724	3,255	------	------	------	AREA 1A
2	SCS Runoff	1.806	2	724	5,659	------	------	------	AREA 1B
3	Reservoir	0.000	2	n/a	0	2	41.85	1,085	reacharge 1B
4	Combine	1.089	2	724	3,255	1, 3	------	------	DESIGN POINT 1
5	SCS Runoff	6.148	2	724	18,399	------	------	------	AREA 2A
6	SCS Runoff	2.364	2	724	7,407	------	------	------	Area 2B
7	Reservoir	0.000	2	692	0	6	41.78	1,347	rech 2b
8	Combine	6.148	2	724	18,399	5, 7	------	------	DESIGN POINT 2
9	SCS Runoff	6.462	2	724	19,796	------	------	------	AREA 3A
10	Reservoir	0.000	2	702	0	9	37.79	3,708	Recharge 3
11	SCS Runoff	2.961	2	724	9,032	------	------	------	AREA 4A
12	Reservoir	0.000	2	n/a	0	11	37.02	1,738	Reacharge 4
13	SCS Runoff	0.000	2	n/a	0	------	------	------	AREA 3B
14	SCS Runoff	0.000	2	n/a	0	------	------	------	AREA 4B
15	Combine	0.000	2	702	0	10, 13,	------	------	DESIGN POINT 3
16	Combine	0.000	2	n/a	0	12, 14,	------	------	DESIGN POINT 4

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.945	2	724	5,869	------	------	------	AREA 1A
2	SCS Runoff	2.821	2	724	9,091	------	------	------	AREA 1B
3	Reservoir	0.000	2	n/a	0	2	42.47	2,276	reacharge 1B
4	Combine	1.945	2	724	5,869	1, 3	------	------	DESIGN POINT 1
5	SCS Runoff	10.69	2	724	32,480	------	------	------	AREA 2A
6	SCS Runoff	3.693	2	724	11,899	------	------	------	Area 2B
7	Reservoir	0.000	2	656	0	6	42.36	2,880	rech 2b
8	Combine	10.69	2	724	32,480	5, 7	------	------	DESIGN POINT 2
9	SCS Runoff	10.40	2	724	32,711	------	------	------	AREA 3A
10	Reservoir	0.000	2	696	0	9	38.43	8,266	Recharge 3
11	SCS Runoff	4.803	2	724	15,031	------	------	------	AREA 4A
12	Reservoir	0.000	2	n/a	0	11	37.70	3,885	Reacharge 4
13	SCS Runoff	0.005	2	886	141	------	------	------	AREA 3B
14	SCS Runoff	0.005	2	886	132	------	------	------	AREA 4B
15	Combine	0.005	2	886	141	10, 13,	------	------	DESIGN POINT 3
16	Combine	0.005	2	886	132	12, 14,	------	------	DESIGN POINT 4

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	2.488	2	724	7,581	------	------	------	AREA 1A
2	SCS Runoff	3.451	2	724	11,260	------	------	------	AREA 1B
3	Reservoir	0.000	2	n/a	0	2	42.90	3,052	reacharge 1B
4	Combine	2.488	2	724	7,581	1, 3	------	------	DESIGN POINT 1
5	SCS Runoff	13.56	2	724	41,629	------	------	------	AREA 2A
6	SCS Runoff	4.517	2	724	14,738	------	------	------	Area 2B
7	Reservoir	0.000	2	686	0	6	42.75	3,891	rech 2b
8	Combine	13.56	2	724	41,629	5, 7	------	------	DESIGN POINT 2
9	SCS Runoff	12.84	2	724	40,930	------	------	------	AREA 3A
10	Reservoir	0.019	2	748	12	9	38.87	11,261	Recharge 3
11	SCS Runoff	5.946	2	724	18,856	------	------	------	AREA 4A
12	Reservoir	0.085	2	748	77	11	38.15	5,258	Reacharge 4
13	SCS Runoff	0.030	2	744	386	------	------	------	AREA 3B
14	SCS Runoff	0.028	2	744	363	------	------	------	AREA 4B
15	Combine	0.046	2	748	398	10, 13,	------	------	DESIGN POINT 3
16	Combine	0.110	2	748	440	12, 14,	------	------	DESIGN POINT 4

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	2.891	2	724	8,869	------	------	------	AREA 1A
2	SCS Runoff	3.915	2	724	12,871	------	------	------	AREA 1B
3	Reservoir	0.000	2	n/a	0	2	43.23	3,637	reacharge 1B
4	Combine	2.891	2	724	8,869	1, 3	------	------	DESIGN POINT 1
5	SCS Runoff	15.67	2	724	48,497	------	------	------	AREA 2A
6	SCS Runoff	5.124	2	724	16,847	------	------	------	Area 2B
7	Reservoir	0.000	2	614	0	6	43.05	4,647	rech 2b
8	Combine	15.67	2	724	48,497	5, 7	------	------	DESIGN POINT 2
9	SCS Runoff	14.64	2	724	47,050	------	------	------	AREA 3A
10	Reservoir	0.533	2	748	727	9	39.15	13,194	Recharge 3
11	SCS Runoff	6.788	2	724	21,706	------	------	------	AREA 4A
12	Reservoir	0.533	2	744	769	11	38.39	5,974	Reacharge 4
13	SCS Runoff	0.071	2	738	633	------	------	------	AREA 3B
14	SCS Runoff	0.066	2	738	594	------	------	------	AREA 4B
15	Combine	0.590	2	746	1,360	10, 13,	------	------	DESIGN POINT 3
16	Combine	0.594	2	744	1,363	12, 14,	------	------	DESIGN POINT 4

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

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	3.324	2	724	10,273	------	------	------	AREA 1A
2	SCS Runoff	4.413	2	724	14,611	------	------	------	AREA 1B
3	Reservoir	0.000	2	n/a	0	2	43.61	4,281	reacharge 1B
4	Combine	3.324	2	724	10,273	1, 3	------	------	DESIGN POINT 1
5	SCS Runoff	17.95	2	724	55,963	------	------	------	AREA 2A
6	SCS Runoff	5.776	2	724	19,125	------	------	------	Area 2B
7	Reservoir	0.000	2	940	0	6	43.39	5,481	rech 2b
8	Combine	17.95	2	724	55,963	5, 7	------	------	DESIGN POINT 2
9	SCS Runoff	16.57	2	724	53,669	------	------	------	AREA 3A
10	Reservoir	1.557	2	744	2,624	9	39.40	14,761	Recharge 3
11	SCS Runoff	7.691	2	724	24,791	------	------	------	AREA 4A
12	Reservoir	1.098	2	742	1,858	11	38.60	6,574	Reacharge 4
13	SCS Runoff	0.140	2	728	956	------	------	------	AREA 3B
14	SCS Runoff	0.131	2	728	897	------	------	------	AREA 4B
15	Combine	1.665	2	744	3,580	10, 13,	------	------	DESIGN POINT 3
16	Combine	1.206	2	742	2,755	12, 14,	------	------	DESIGN POINT 4

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

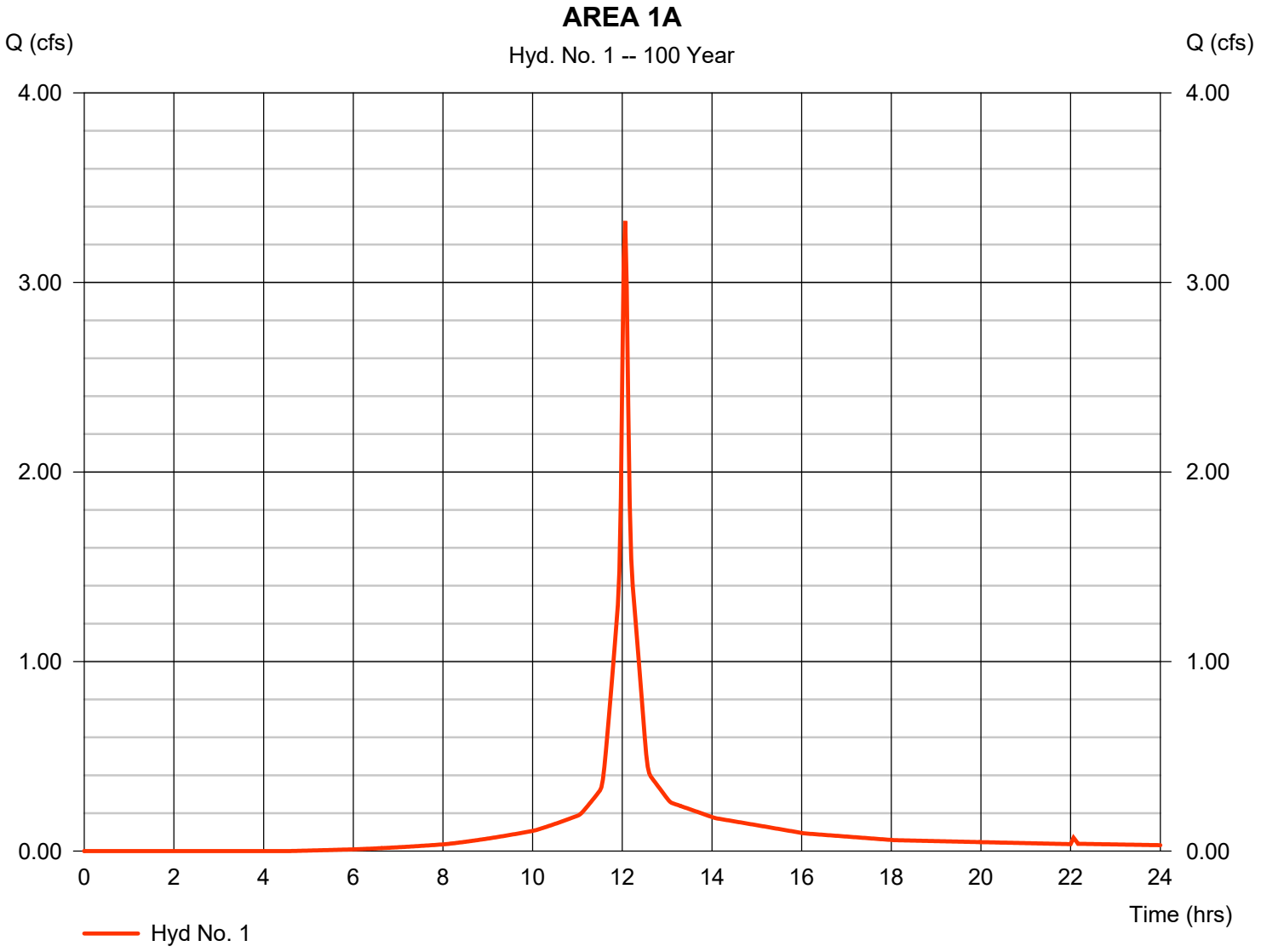
Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	3.38	0.00	0.00	5.04	6.08	6.85	7.68
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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 1A

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.324 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	10,273 cuft
Drainage area	=	0.522 ac	Curve number	=	84
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.68 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

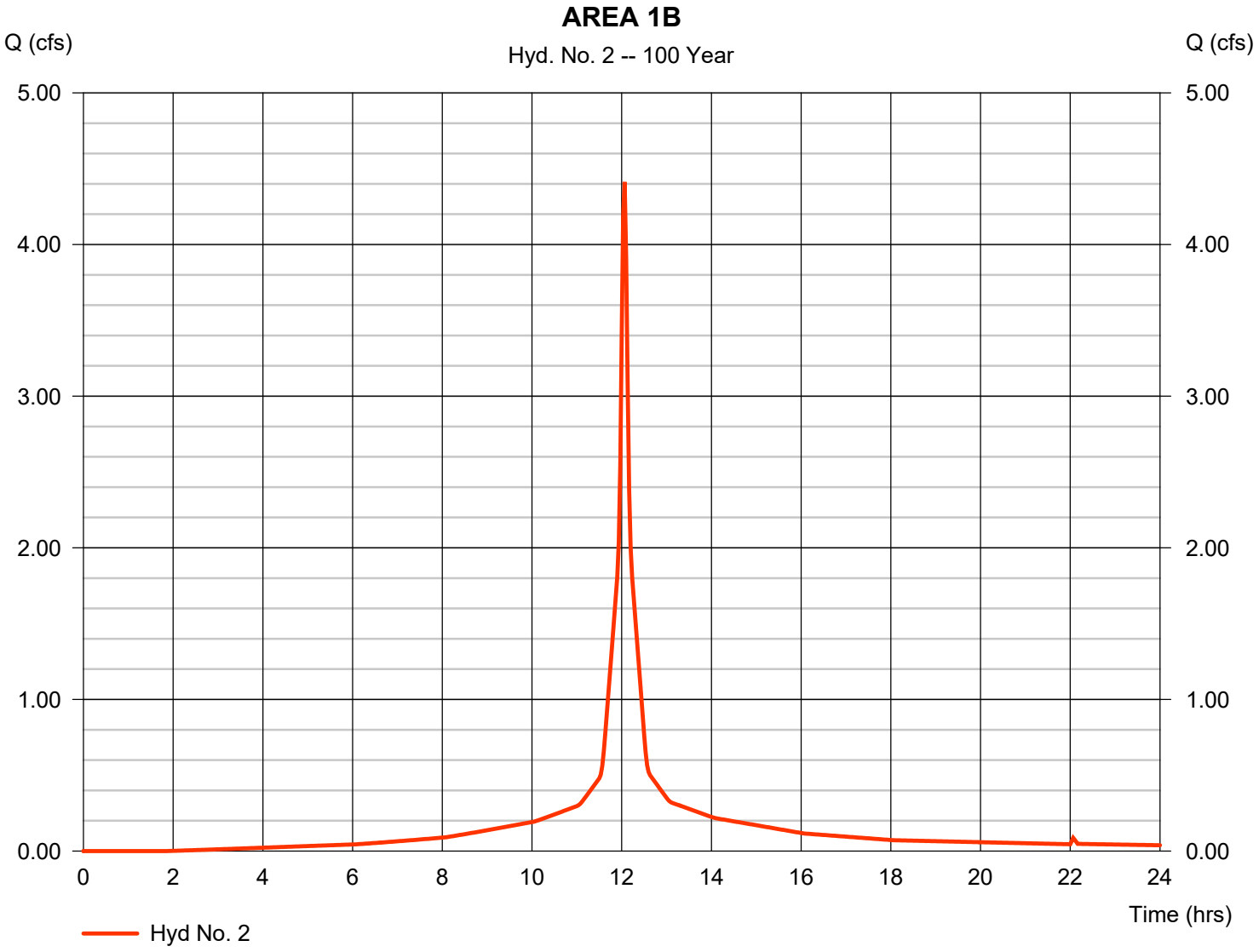


Hydrograph Report

Hyd. No. 2

AREA 1B

Hydrograph type	= SCS Runoff	Peak discharge	= 4.413 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.07 hrs
Time interval	= 2 min	Hyd. volume	= 14,611 cuft
Drainage area	= 0.621 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.	= 7.68 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484



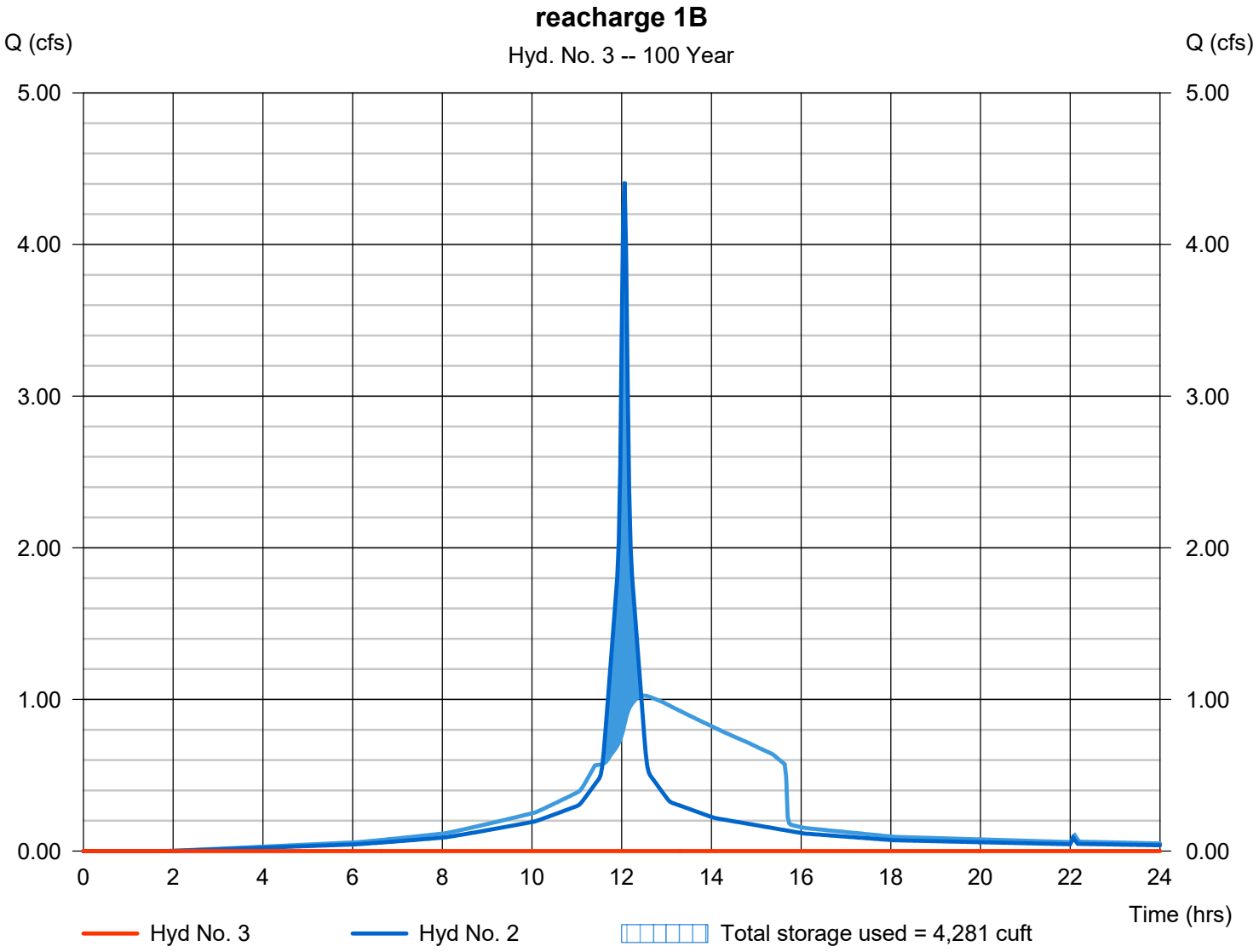
Hydrograph Report

Hyd. No. 3

reacharge 1B

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	100 yrs	Time to peak	=	n/a
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	2 - AREA 1B	Max. Elevation	=	43.61 ft
Reservoir name	=	SYS 1	Max. Storage	=	4,281 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond No. 1 - SYS 1

Pond Data

UG Chambers -Invert elev. = 41.50 ft, Rise x Span = 3.00 x 5.00 ft, Barrel Len = 52.00 ft, No. Barrels = 7, Slope = 0.00%, Headers = No
Encasement -Invert elev. = 41.00 ft, Width = 5.75 ft, Height = 4.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	41.00	n/a	0	0
0.40	41.40	n/a	335	335
0.80	41.80	n/a	662	997
1.20	42.20	n/a	765	1,762
1.60	42.60	n/a	751	2,514
2.00	43.00	n/a	728	3,242
2.40	43.40	n/a	694	3,936
2.80	43.80	n/a	646	4,582
3.20	44.20	n/a	574	5,157
3.60	44.60	n/a	431	5,588
4.00	45.00	n/a	335	5,923

Culvert / Orifice Structures

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

Weir Structures

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

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

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	41.00	---	---	---	---	---	---	---	---	0.000	---	0.000
0.04	33	41.04	---	---	---	---	---	---	---	---	0.406	---	0.406
0.08	67	41.08	---	---	---	---	---	---	---	---	0.412	---	0.412
0.12	100	41.12	---	---	---	---	---	---	---	---	0.417	---	0.417
0.16	134	41.16	---	---	---	---	---	---	---	---	0.423	---	0.423
0.20	167	41.20	---	---	---	---	---	---	---	---	0.429	---	0.429
0.24	201	41.24	---	---	---	---	---	---	---	---	0.434	---	0.434
0.28	234	41.28	---	---	---	---	---	---	---	---	0.440	---	0.440
0.32	268	41.32	---	---	---	---	---	---	---	---	0.445	---	0.445
0.36	301	41.36	---	---	---	---	---	---	---	---	0.451	---	0.451
0.40	335	41.40	---	---	---	---	---	---	---	---	0.456	---	0.456
0.44	401	41.44	---	---	---	---	---	---	---	---	0.462	---	0.462
0.48	467	41.48	---	---	---	---	---	---	---	---	0.468	---	0.468
0.52	534	41.52	---	---	---	---	---	---	---	---	0.473	---	0.473
0.56	600	41.56	---	---	---	---	---	---	---	---	0.479	---	0.479
0.60	666	41.60	---	---	---	---	---	---	---	---	0.484	---	0.484
0.64	732	41.64	---	---	---	---	---	---	---	---	0.490	---	0.490
0.68	798	41.68	---	---	---	---	---	---	---	---	0.495	---	0.495
0.72	865	41.72	---	---	---	---	---	---	---	---	0.501	---	0.501
0.76	931	41.76	---	---	---	---	---	---	---	---	0.507	---	0.507
0.80	997	41.80	---	---	---	---	---	---	---	---	0.512	---	0.512
0.84	1,074	41.84	---	---	---	---	---	---	---	---	0.518	---	0.518
0.88	1,150	41.88	---	---	---	---	---	---	---	---	0.523	---	0.523
0.92	1,227	41.92	---	---	---	---	---	---	---	---	0.529	---	0.529
0.96	1,303	41.96	---	---	---	---	---	---	---	---	0.534	---	0.534
1.00	1,380	42.00	---	---	---	---	---	---	---	---	0.540	---	0.540
1.04	1,456	42.04	---	---	---	---	---	---	---	---	0.546	---	0.546
1.08	1,533	42.08	---	---	---	---	---	---	---	---	0.551	---	0.551
1.12	1,609	42.12	---	---	---	---	---	---	---	---	0.557	---	0.557
1.16	1,686	42.16	---	---	---	---	---	---	---	---	0.562	---	0.562
1.20	1,762	42.20	---	---	---	---	---	---	---	---	0.568	---	0.568
1.24	1,838	42.24	---	---	---	---	---	---	---	---	0.573	---	0.573

Continues on next page...

SYS 1

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.28	1,913	42.28	---	---	---	---	---	---	---	---	0.579	---	0.579
1.32	1,988	42.32	---	---	---	---	---	---	---	---	0.585	---	0.585
1.36	2,063	42.36	---	---	---	---	---	---	---	---	0.590	---	0.590
1.40	2,138	42.40	---	---	---	---	---	---	---	---	0.596	---	0.596
1.44	2,213	42.44	---	---	---	---	---	---	---	---	0.601	---	0.601
1.48	2,288	42.48	---	---	---	---	---	---	---	---	0.607	---	0.607
1.52	2,363	42.52	---	---	---	---	---	---	---	---	0.613	---	0.613
1.56	2,439	42.56	---	---	---	---	---	---	---	---	0.618	---	0.618
1.60	2,514	42.60	---	---	---	---	---	---	---	---	0.624	---	0.624
1.64	2,587	42.64	---	---	---	---	---	---	---	---	0.629	---	0.629
1.68	2,659	42.68	---	---	---	---	---	---	---	---	0.635	---	0.635
1.72	2,732	42.72	---	---	---	---	---	---	---	---	0.640	---	0.640
1.76	2,805	42.76	---	---	---	---	---	---	---	---	0.646	---	0.646
1.80	2,878	42.80	---	---	---	---	---	---	---	---	0.652	---	0.652
1.84	2,951	42.84	---	---	---	---	---	---	---	---	0.657	---	0.657
1.88	3,024	42.88	---	---	---	---	---	---	---	---	0.663	---	0.663
1.92	3,096	42.92	---	---	---	---	---	---	---	---	0.668	---	0.668
1.96	3,169	42.96	---	---	---	---	---	---	---	---	0.674	---	0.674
2.00	3,242	43.00	---	---	---	---	---	---	---	---	0.679	---	0.679
2.04	3,311	43.04	---	---	---	---	---	---	---	---	0.685	---	0.685
2.08	3,381	43.08	---	---	---	---	---	---	---	---	0.691	---	0.691
2.12	3,450	43.12	---	---	---	---	---	---	---	---	0.696	---	0.696
2.16	3,520	43.16	---	---	---	---	---	---	---	---	0.702	---	0.702
2.20	3,589	43.20	---	---	---	---	---	---	---	---	0.707	---	0.707
2.24	3,659	43.24	---	---	---	---	---	---	---	---	0.713	---	0.713
2.28	3,728	43.28	---	---	---	---	---	---	---	---	0.718	---	0.718
2.32	3,797	43.32	---	---	---	---	---	---	---	---	0.724	---	0.724
2.36	3,867	43.36	---	---	---	---	---	---	---	---	0.730	---	0.730
2.40	3,936	43.40	---	---	---	---	---	---	---	---	0.735	---	0.735
2.44	4,001	43.44	---	---	---	---	---	---	---	---	0.741	---	0.741
2.48	4,066	43.48	---	---	---	---	---	---	---	---	0.746	---	0.746
2.52	4,130	43.52	---	---	---	---	---	---	---	---	0.752	---	0.752
2.56	4,195	43.56	---	---	---	---	---	---	---	---	0.757	---	0.757
2.60	4,259	43.60	---	---	---	---	---	---	---	---	0.763	---	0.763
2.64	4,324	43.64	---	---	---	---	---	---	---	---	0.769	---	0.769
2.68	4,389	43.68	---	---	---	---	---	---	---	---	0.774	---	0.774
2.72	4,453	43.72	---	---	---	---	---	---	---	---	0.780	---	0.780
2.76	4,518	43.76	---	---	---	---	---	---	---	---	0.785	---	0.785
2.80	4,582	43.80	---	---	---	---	---	---	---	---	0.791	---	0.791
2.84	4,640	43.84	---	---	---	---	---	---	---	---	0.796	---	0.796
2.88	4,697	43.88	---	---	---	---	---	---	---	---	0.802	---	0.802
2.92	4,755	43.92	---	---	---	---	---	---	---	---	0.808	---	0.808
2.96	4,812	43.96	---	---	---	---	---	---	---	---	0.813	---	0.813
3.00	4,870	44.00	---	---	---	---	---	---	---	---	0.819	---	0.819
3.04	4,927	44.04	---	---	---	---	---	---	---	---	0.824	---	0.824
3.08	4,985	44.08	---	---	---	---	---	---	---	---	0.830	---	0.830
3.12	5,042	44.12	---	---	---	---	---	---	---	---	0.835	---	0.835
3.16	5,099	44.16	---	---	---	---	---	---	---	---	0.841	---	0.841
3.20	5,157	44.20	---	---	---	---	---	---	---	---	0.847	---	0.847
3.24	5,200	44.24	---	---	---	---	---	---	---	---	0.852	---	0.852
3.28	5,243	44.28	---	---	---	---	---	---	---	---	0.858	---	0.858
3.32	5,286	44.32	---	---	---	---	---	---	---	---	0.863	---	0.863
3.36	5,329	44.36	---	---	---	---	---	---	---	---	0.869	---	0.869
3.40	5,372	44.40	---	---	---	---	---	---	---	---	0.875	---	0.875
3.44	5,416	44.44	---	---	---	---	---	---	---	---	0.880	---	0.880
3.48	5,459	44.48	---	---	---	---	---	---	---	---	0.886	---	0.886
3.52	5,502	44.52	---	---	---	---	---	---	---	---	0.891	---	0.891
3.56	5,545	44.56	---	---	---	---	---	---	---	---	0.897	---	0.897
3.60	5,588	44.60	---	---	---	---	---	---	---	---	0.902	---	0.902
3.64	5,621	44.64	---	---	---	---	---	---	---	---	0.908	---	0.908
3.68	5,655	44.68	---	---	---	---	---	---	---	---	0.914	---	0.914
3.72	5,688	44.72	---	---	---	---	---	---	---	---	0.919	---	0.919
3.76	5,722	44.76	---	---	---	---	---	---	---	---	0.925	---	0.925
3.80	5,755	44.80	---	---	---	---	---	---	---	---	0.930	---	0.930
3.84	5,789	44.84	---	---	---	---	---	---	---	---	0.936	---	0.936
3.88	5,822	44.88	---	---	---	---	---	---	---	---	0.941	---	0.941
3.92	5,856	44.92	---	---	---	---	---	---	---	---	0.947	---	0.947
3.96	5,889	44.96	---	---	---	---	---	---	---	---	0.953	---	0.953
4.00	5,923	45.00	---	---	---	---	---	---	---	---	0.958	---	0.958

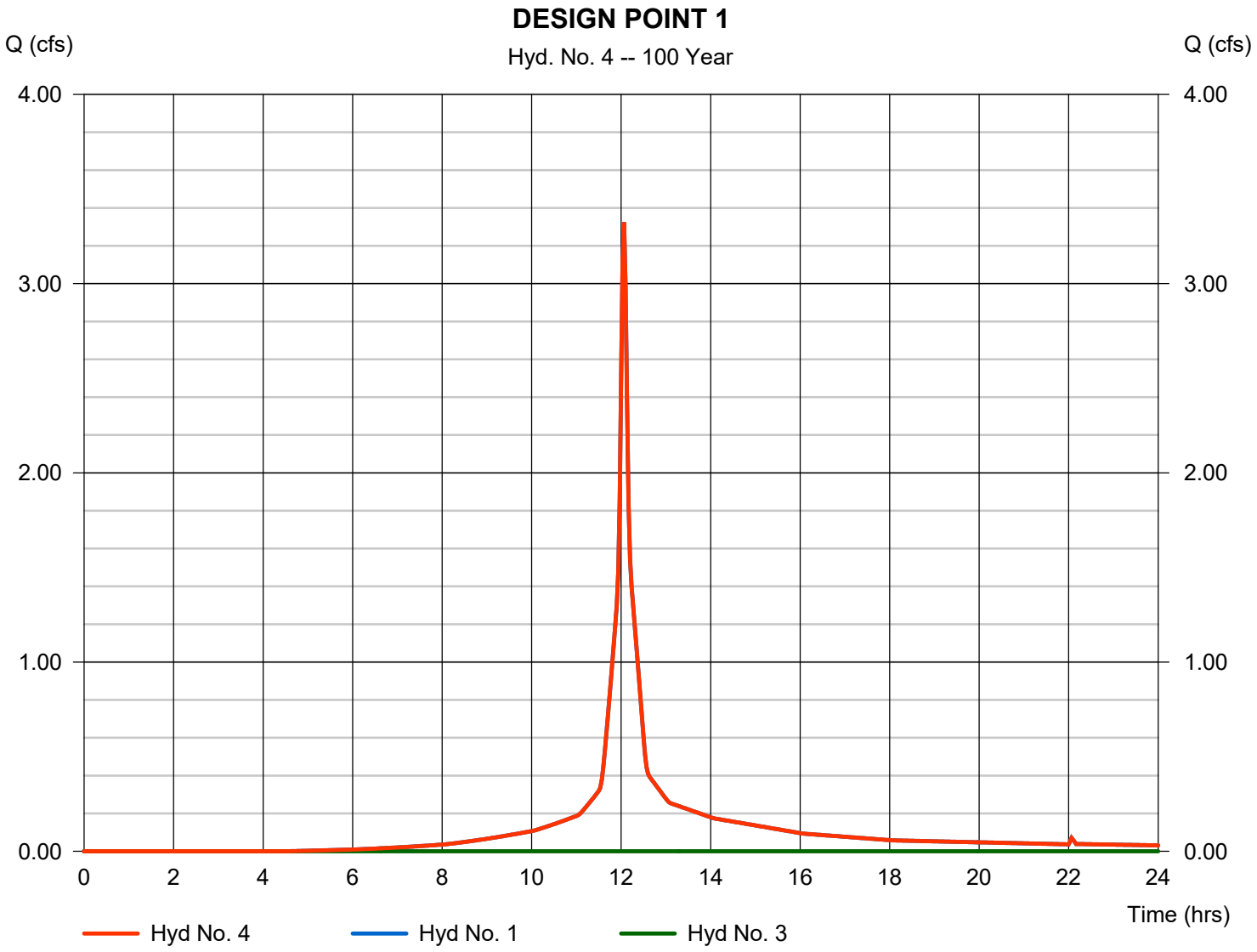
...End

Hydrograph Report

Hyd. No. 4

DESIGN POINT 1

Hydrograph type	=	Combine	Peak discharge	=	3.324 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	10,273 cuft
Inflow hyds.	=	1, 3	Contrib. drain. area	=	0.522 ac

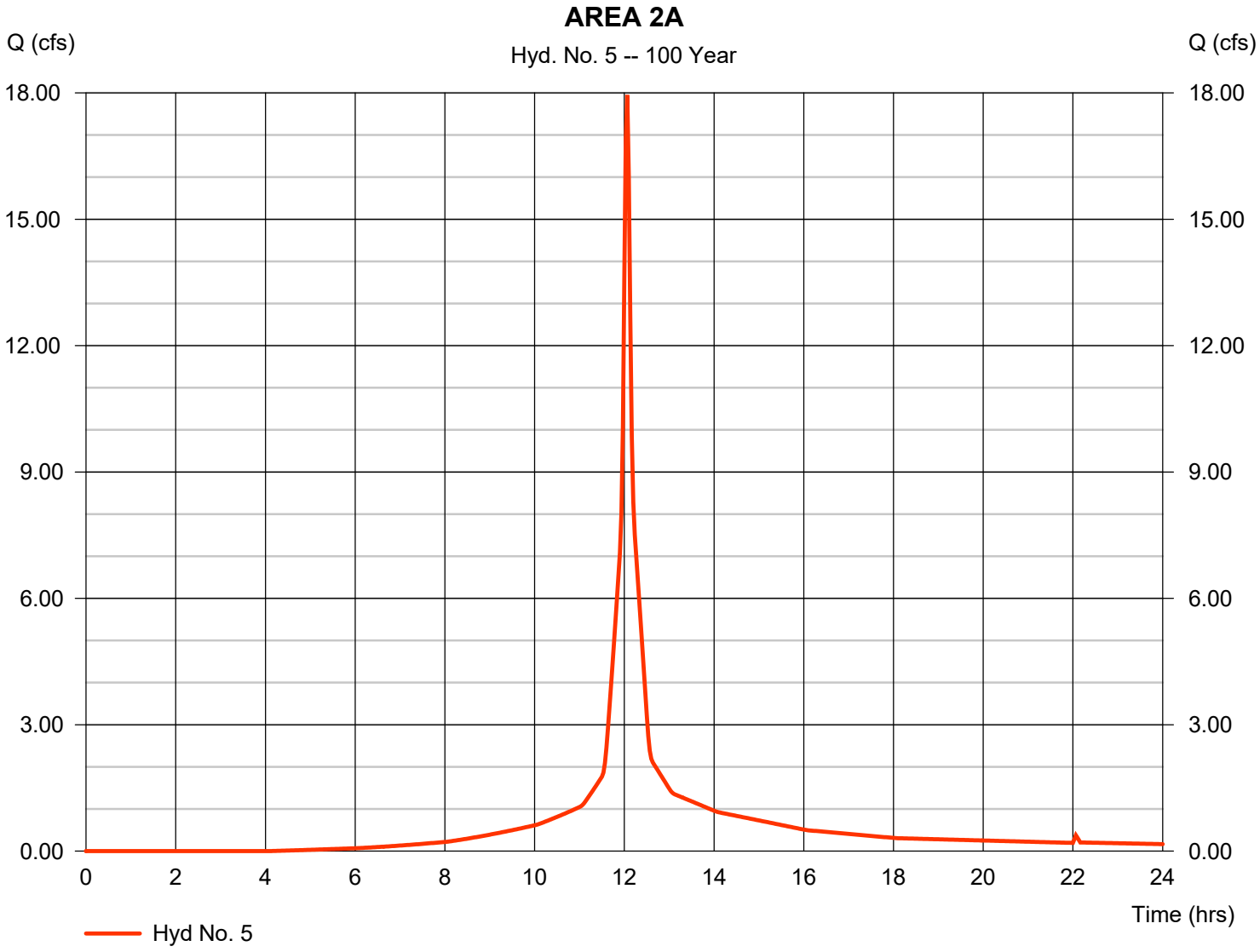


Hydrograph Report

Hyd. No. 5

AREA 2A

Hydrograph type	=	SCS Runoff	Peak discharge	=	17.95 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	55,963 cuft
Drainage area	=	2.747 ac	Curve number	=	85.7
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.68 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

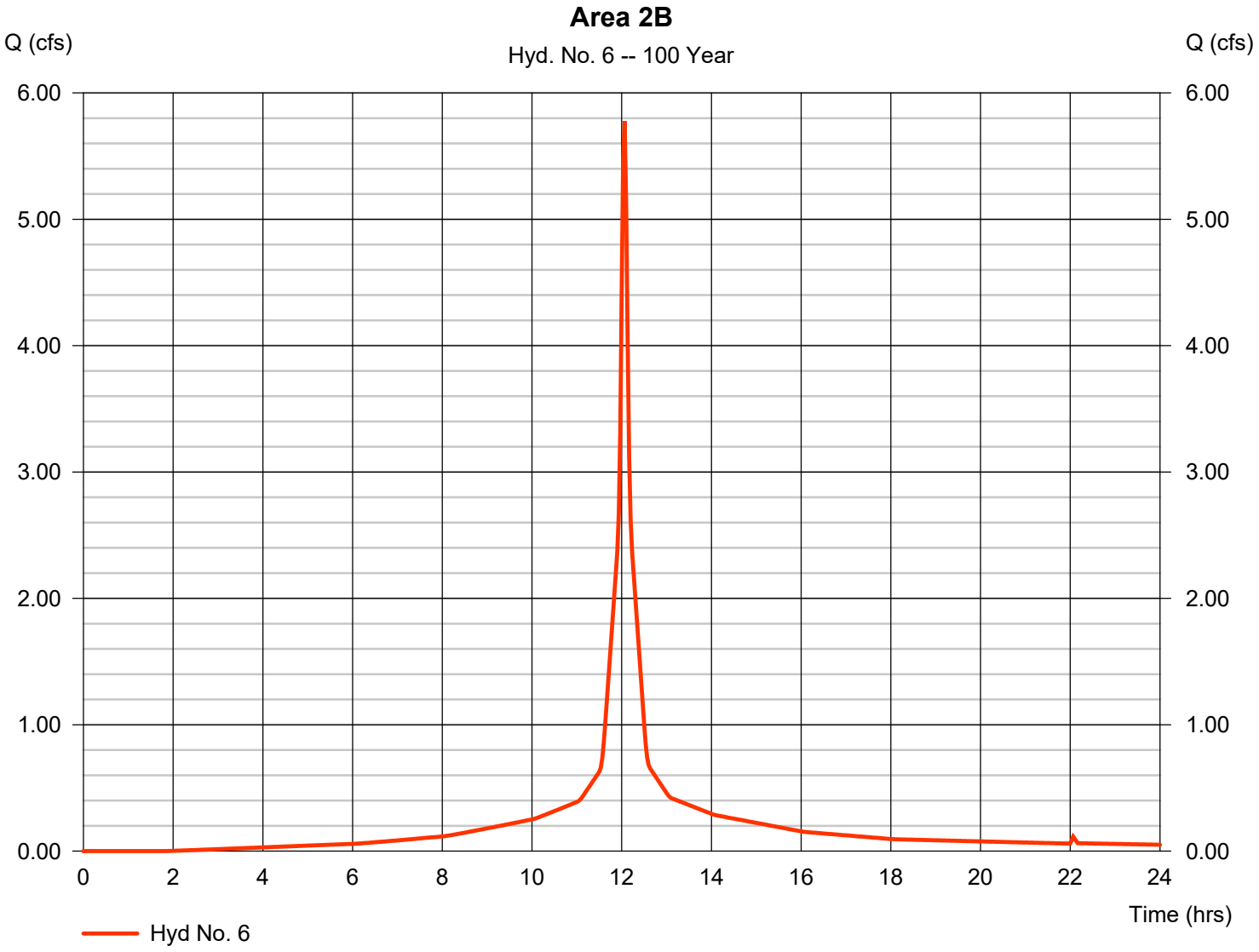


Hydrograph Report

Hyd. No. 6

Area 2B

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.776 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	19,125 cuft
Drainage area	=	0.813 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.	=	7.68 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



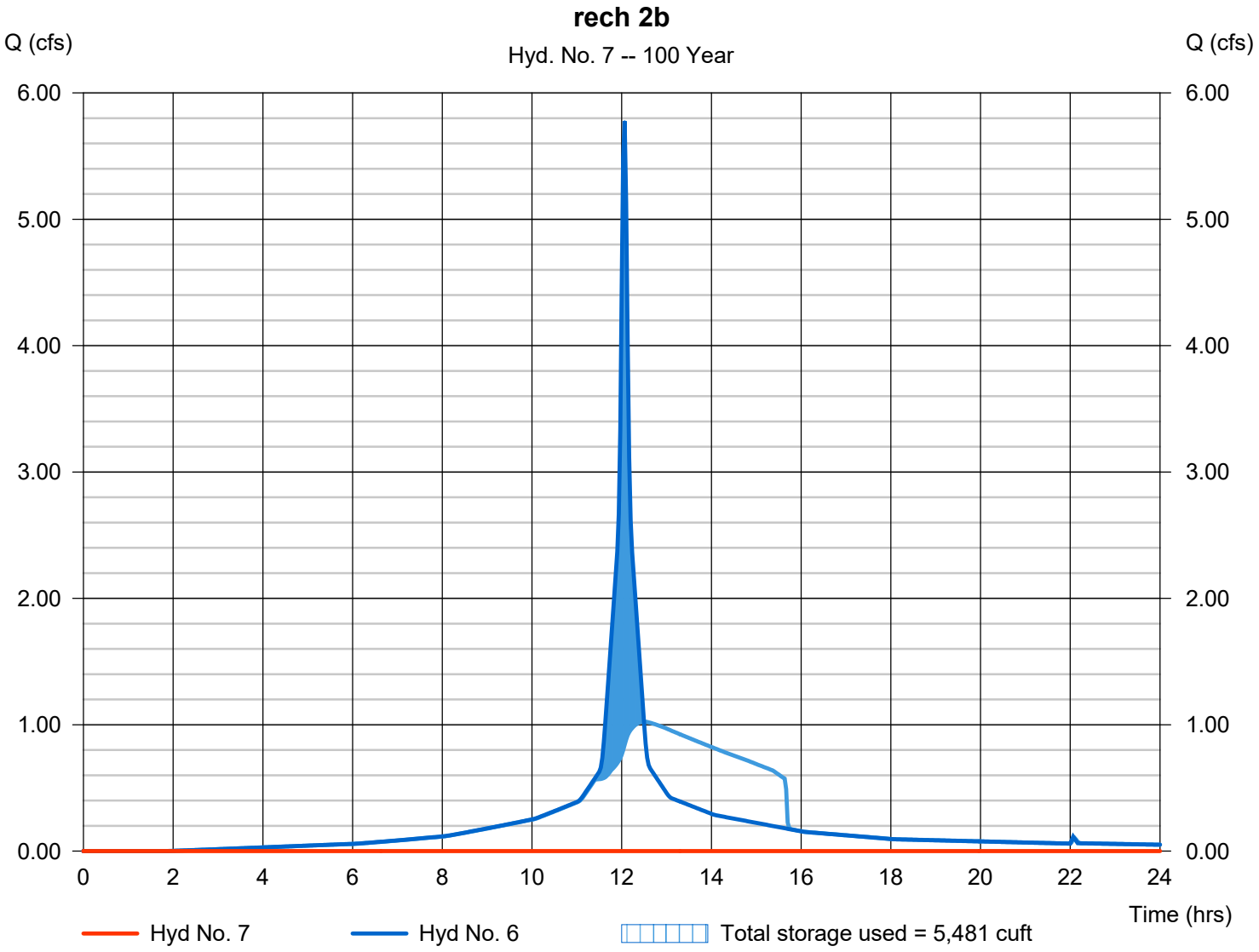
Hydrograph Report

Hyd. No. 7

rech 2b

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	100 yrs	Time to peak	=	15.67 hrs
Time interval	=	2 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	6 - Area 2B	Max. Elevation	=	43.39 ft
Reservoir name	=	SYS 2	Max. Storage	=	5,481 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond No. 2 - SYS 2

Pond Data

UG Chambers -Invert elev. = 41.50 ft, Rise x Span = 3.00 x 5.00 ft, Barrel Len = 101.65 ft, No. Barrels = 5, Slope = 0.00%, Headers = No
Encasement -Invert elev. = 41.00 ft, Width = 5.75 ft, Height = 4.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	41.00	n/a	0	0
0.40	41.40	n/a	468	468
0.80	41.80	n/a	924	1,392
1.20	42.20	n/a	1,069	2,461
1.60	42.60	n/a	1,049	3,510
2.00	43.00	n/a	1,017	4,527
2.40	43.40	n/a	969	5,496
2.80	43.80	n/a	902	6,398
3.20	44.20	n/a	802	7,200
3.60	44.60	n/a	602	7,802
4.00	45.00	n/a	468	8,270

Culvert / Orifice Structures

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

Weir Structures

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

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

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	41.00	---	---	---	---	---	---	---	---	0.000	---	0.000
0.04	47	41.04	---	---	---	---	---	---	---	---	0.567	---	0.567
0.08	94	41.08	---	---	---	---	---	---	---	---	0.575	---	0.575
0.12	140	41.12	---	---	---	---	---	---	---	---	0.583	---	0.583
0.16	187	41.16	---	---	---	---	---	---	---	---	0.591	---	0.591
0.20	234	41.20	---	---	---	---	---	---	---	---	0.598	---	0.598
0.24	281	41.24	---	---	---	---	---	---	---	---	0.606	---	0.606
0.28	327	41.28	---	---	---	---	---	---	---	---	0.614	---	0.614
0.32	374	41.32	---	---	---	---	---	---	---	---	0.622	---	0.622
0.36	421	41.36	---	---	---	---	---	---	---	---	0.630	---	0.630
0.40	468	41.40	---	---	---	---	---	---	---	---	0.637	---	0.637
0.44	560	41.44	---	---	---	---	---	---	---	---	0.645	---	0.645
0.48	653	41.48	---	---	---	---	---	---	---	---	0.653	---	0.653
0.52	745	41.52	---	---	---	---	---	---	---	---	0.661	---	0.661
0.56	837	41.56	---	---	---	---	---	---	---	---	0.668	---	0.668
0.60	930	41.60	---	---	---	---	---	---	---	---	0.676	---	0.676
0.64	1,022	41.64	---	---	---	---	---	---	---	---	0.684	---	0.684
0.68	1,115	41.68	---	---	---	---	---	---	---	---	0.692	---	0.692
0.72	1,207	41.72	---	---	---	---	---	---	---	---	0.700	---	0.700
0.76	1,300	41.76	---	---	---	---	---	---	---	---	0.707	---	0.707
0.80	1,392	41.80	---	---	---	---	---	---	---	---	0.715	---	0.715
0.84	1,499	41.84	---	---	---	---	---	---	---	---	0.723	---	0.723
0.88	1,606	41.88	---	---	---	---	---	---	---	---	0.731	---	0.731
0.92	1,713	41.92	---	---	---	---	---	---	---	---	0.738	---	0.738
0.96	1,820	41.96	---	---	---	---	---	---	---	---	0.746	---	0.746
1.00	1,926	42.00	---	---	---	---	---	---	---	---	0.754	---	0.754
1.04	2,033	42.04	---	---	---	---	---	---	---	---	0.762	---	0.762
1.08	2,140	42.08	---	---	---	---	---	---	---	---	0.770	---	0.770
1.12	2,247	42.12	---	---	---	---	---	---	---	---	0.777	---	0.777
1.16	2,354	42.16	---	---	---	---	---	---	---	---	0.785	---	0.785
1.20	2,461	42.20	---	---	---	---	---	---	---	---	0.793	---	0.793
1.24	2,566	42.24	---	---	---	---	---	---	---	---	0.801	---	0.801

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SYS 2

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.28	2,671	42.28	---	---	---	---	---	---	---	---	0.809	---	0.809
1.32	2,776	42.32	---	---	---	---	---	---	---	---	0.816	---	0.816
1.36	2,880	42.36	---	---	---	---	---	---	---	---	0.824	---	0.824
1.40	2,985	42.40	---	---	---	---	---	---	---	---	0.832	---	0.832
1.44	3,090	42.44	---	---	---	---	---	---	---	---	0.840	---	0.840
1.48	3,195	42.48	---	---	---	---	---	---	---	---	0.847	---	0.847
1.52	3,300	42.52	---	---	---	---	---	---	---	---	0.855	---	0.855
1.56	3,405	42.56	---	---	---	---	---	---	---	---	0.863	---	0.863
1.60	3,510	42.60	---	---	---	---	---	---	---	---	0.871	---	0.871
1.64	3,612	42.64	---	---	---	---	---	---	---	---	0.879	---	0.879
1.68	3,713	42.68	---	---	---	---	---	---	---	---	0.886	---	0.886
1.72	3,815	42.72	---	---	---	---	---	---	---	---	0.894	---	0.894
1.76	3,917	42.76	---	---	---	---	---	---	---	---	0.902	---	0.902
1.80	4,018	42.80	---	---	---	---	---	---	---	---	0.910	---	0.910
1.84	4,120	42.84	---	---	---	---	---	---	---	---	0.918	---	0.918
1.88	4,222	42.88	---	---	---	---	---	---	---	---	0.925	---	0.925
1.92	4,323	42.92	---	---	---	---	---	---	---	---	0.933	---	0.933
1.96	4,425	42.96	---	---	---	---	---	---	---	---	0.941	---	0.941
2.00	4,527	43.00	---	---	---	---	---	---	---	---	0.949	---	0.949
2.04	4,624	43.04	---	---	---	---	---	---	---	---	0.956	---	0.956
2.08	4,721	43.08	---	---	---	---	---	---	---	---	0.964	---	0.964
2.12	4,818	43.12	---	---	---	---	---	---	---	---	0.972	---	0.972
2.16	4,915	43.16	---	---	---	---	---	---	---	---	0.980	---	0.980
2.20	5,011	43.20	---	---	---	---	---	---	---	---	0.988	---	0.988
2.24	5,108	43.24	---	---	---	---	---	---	---	---	0.995	---	0.995
2.28	5,205	43.28	---	---	---	---	---	---	---	---	1.003	---	1.003
2.32	5,302	43.32	---	---	---	---	---	---	---	---	1.011	---	1.011
2.36	5,399	43.36	---	---	---	---	---	---	---	---	1.019	---	1.019
2.40	5,496	43.40	---	---	---	---	---	---	---	---	1.026	---	1.026
2.44	5,586	43.44	---	---	---	---	---	---	---	---	1.034	---	1.034
2.48	5,677	43.48	---	---	---	---	---	---	---	---	1.042	---	1.042
2.52	5,767	43.52	---	---	---	---	---	---	---	---	1.050	---	1.050
2.56	5,857	43.56	---	---	---	---	---	---	---	---	1.058	---	1.058
2.60	5,947	43.60	---	---	---	---	---	---	---	---	1.065	---	1.065
2.64	6,037	43.64	---	---	---	---	---	---	---	---	1.073	---	1.073
2.68	6,128	43.68	---	---	---	---	---	---	---	---	1.081	---	1.081
2.72	6,218	43.72	---	---	---	---	---	---	---	---	1.089	---	1.089
2.76	6,308	43.76	---	---	---	---	---	---	---	---	1.097	---	1.097
2.80	6,398	43.80	---	---	---	---	---	---	---	---	1.104	---	1.104
2.84	6,479	43.84	---	---	---	---	---	---	---	---	1.112	---	1.112
2.88	6,559	43.88	---	---	---	---	---	---	---	---	1.120	---	1.120
2.92	6,639	43.92	---	---	---	---	---	---	---	---	1.128	---	1.128
2.96	6,719	43.96	---	---	---	---	---	---	---	---	1.135	---	1.135
3.00	6,799	44.00	---	---	---	---	---	---	---	---	1.143	---	1.143
3.04	6,880	44.04	---	---	---	---	---	---	---	---	1.151	---	1.151
3.08	6,960	44.08	---	---	---	---	---	---	---	---	1.159	---	1.159
3.12	7,040	44.12	---	---	---	---	---	---	---	---	1.167	---	1.167
3.16	7,120	44.16	---	---	---	---	---	---	---	---	1.174	---	1.174
3.20	7,200	44.20	---	---	---	---	---	---	---	---	1.182	---	1.182
3.24	7,261	44.24	---	---	---	---	---	---	---	---	1.190	---	1.190
3.28	7,321	44.28	---	---	---	---	---	---	---	---	1.198	---	1.198
3.32	7,381	44.32	---	---	---	---	---	---	---	---	1.206	---	1.206
3.36	7,441	44.36	---	---	---	---	---	---	---	---	1.213	---	1.213
3.40	7,501	44.40	---	---	---	---	---	---	---	---	1.221	---	1.221
3.44	7,562	44.44	---	---	---	---	---	---	---	---	1.229	---	1.229
3.48	7,622	44.48	---	---	---	---	---	---	---	---	1.237	---	1.237
3.52	7,682	44.52	---	---	---	---	---	---	---	---	1.244	---	1.244
3.56	7,742	44.56	---	---	---	---	---	---	---	---	1.252	---	1.252
3.60	7,802	44.60	---	---	---	---	---	---	---	---	1.260	---	1.260
3.64	7,849	44.64	---	---	---	---	---	---	---	---	1.268	---	1.268
3.68	7,896	44.68	---	---	---	---	---	---	---	---	1.276	---	1.276
3.72	7,943	44.72	---	---	---	---	---	---	---	---	1.283	---	1.283
3.76	7,990	44.76	---	---	---	---	---	---	---	---	1.291	---	1.291
3.80	8,036	44.80	---	---	---	---	---	---	---	---	1.299	---	1.299
3.84	8,083	44.84	---	---	---	---	---	---	---	---	1.307	---	1.307
3.88	8,130	44.88	---	---	---	---	---	---	---	---	1.314	---	1.314
3.92	8,177	44.92	---	---	---	---	---	---	---	---	1.322	---	1.322
3.96	8,223	44.96	---	---	---	---	---	---	---	---	1.330	---	1.330
4.00	8,270	45.00	---	---	---	---	---	---	---	---	1.338	---	1.338

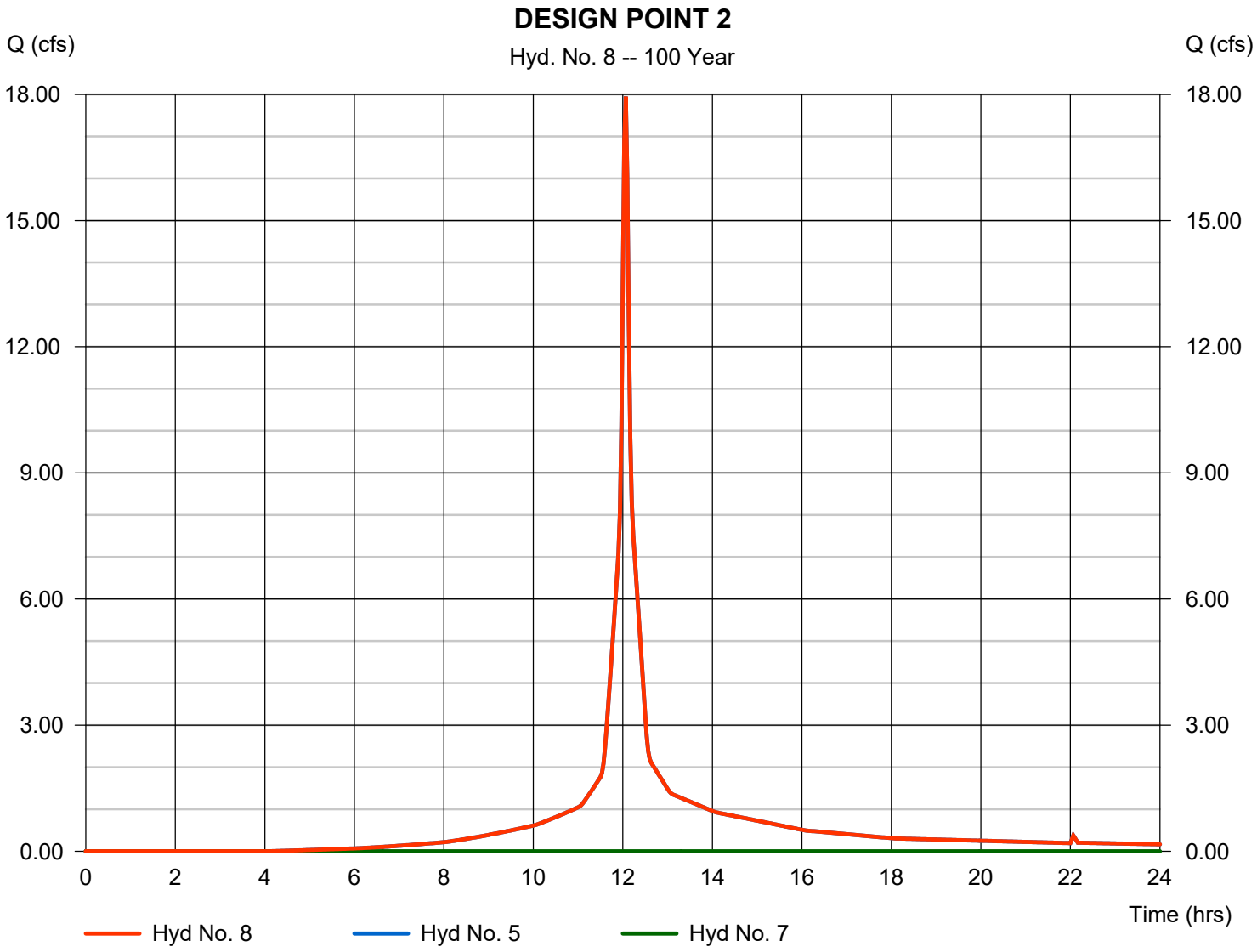
...End

Hydrograph Report

Hyd. No. 8

DESIGN POINT 2

Hydrograph type	=	Combine	Peak discharge	=	17.95 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	55,963 cuft
Inflow hyds.	=	5, 7	Contrib. drain. area	=	2.747 ac

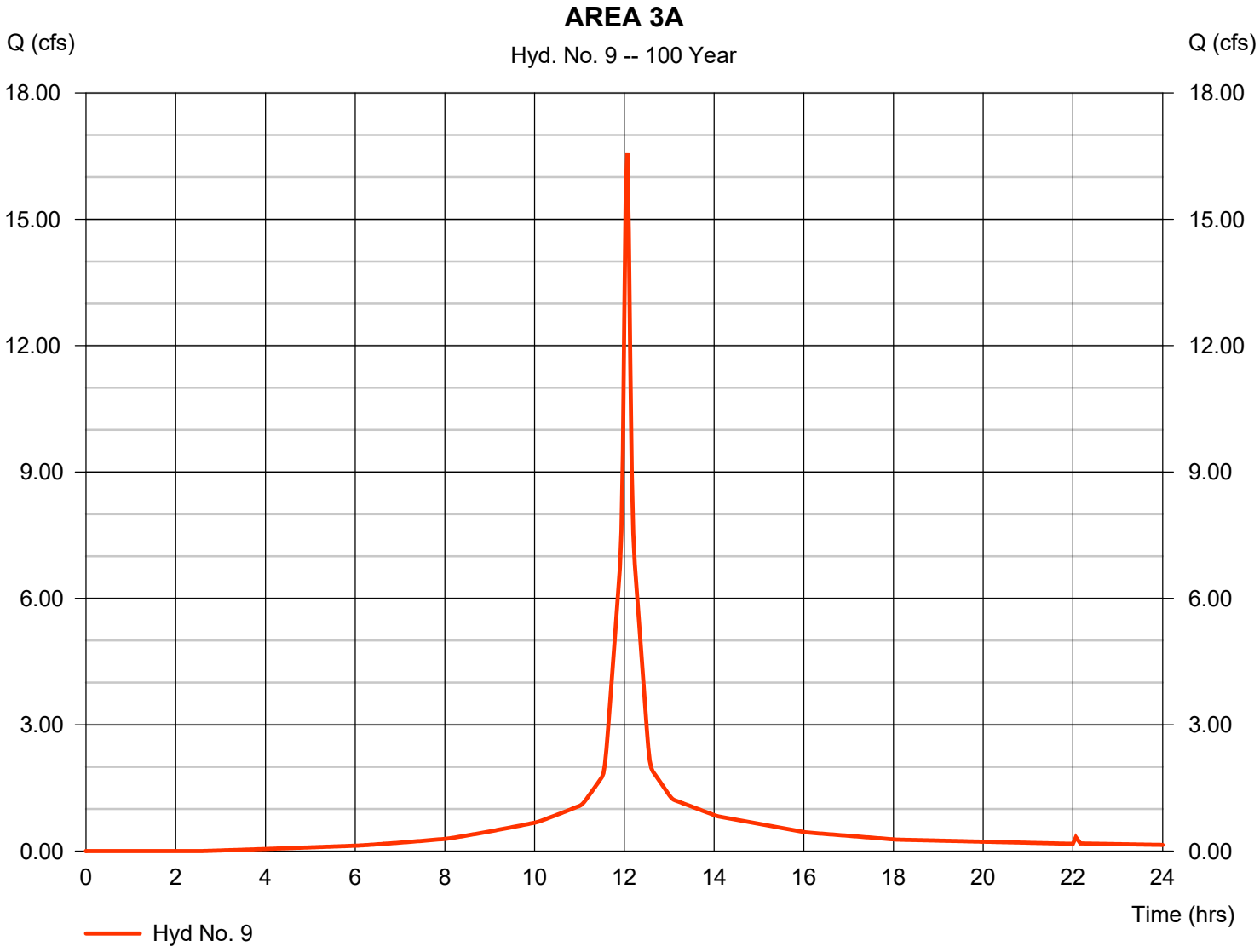


Hydrograph Report

Hyd. No. 9

AREA 3A

Hydrograph type	=	SCS Runoff	Peak discharge	=	16.57 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	53,669 cuft
Drainage area	=	2.378 ac	Curve number	=	91.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.68 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



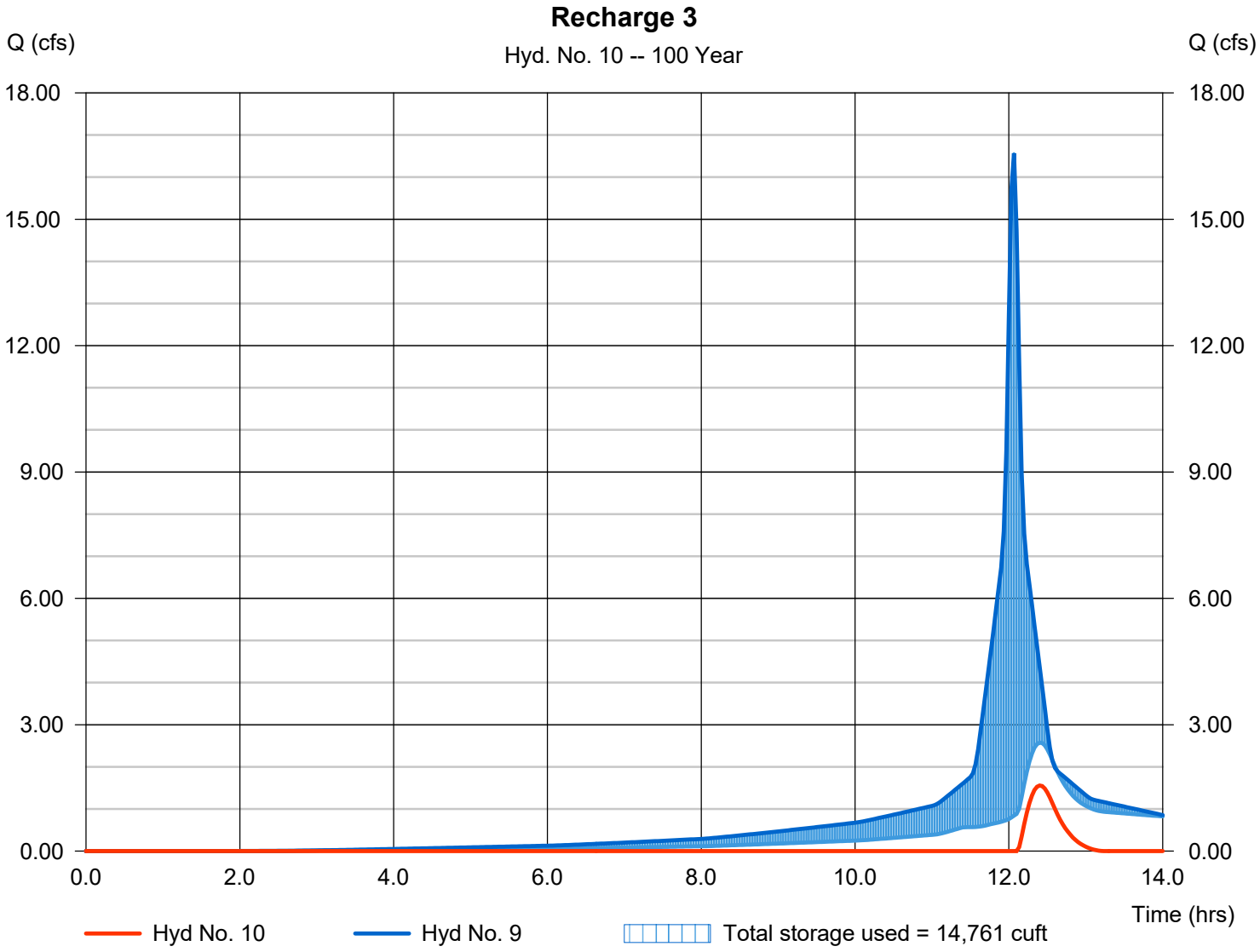
Hydrograph Report

Hyd. No. 10

Recharge 3

Hydrograph type	=	Reservoir	Peak discharge	=	1.557 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.40 hrs
Time interval	=	2 min	Hyd. volume	=	2,624 cuft
Inflow hyd. No.	=	9 - AREA 3A	Max. Elevation	=	39.40 ft
Reservoir name	=	SYS 3	Max. Storage	=	14,761 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond No. 3 - SYS 3

Pond Data

UG Chambers -Invert elev. = 37.50 ft, Rise x Span = 3.00 x 5.00 ft, Barrel Len = 171.00 ft, No. Barrels = 8, Slope = 0.00%, Headers = No
Encasement -Invert elev. = 37.00 ft, Width = 5.75 ft, Height = 4.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	37.00	n/a	0	0
0.40	37.40	n/a	1,259	1,259
0.80	37.80	n/a	2,488	3,747
1.20	38.20	n/a	2,877	6,624
1.60	38.60	n/a	2,824	9,447
2.00	39.00	n/a	2,737	12,184
2.40	39.40	n/a	2,609	14,794
2.80	39.80	n/a	2,428	17,222
3.20	40.20	n/a	2,159	19,381
3.60	40.60	n/a	1,620	21,001
4.00	41.00	n/a	1,259	22,260

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 10.00	8.00	0.00	0.00
Span (in)	= 10.00	8.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 38.80	39.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

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

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	37.00	0.00	0.00	---	---	---	---	---	---	0.000	---	0.000
0.04	126	37.04	0.00	0.00	---	---	---	---	---	---	1.527	---	1.527
0.08	252	37.08	0.00	0.00	---	---	---	---	---	---	1.548	---	1.548
0.12	378	37.12	0.00	0.00	---	---	---	---	---	---	1.569	---	1.569
0.16	504	37.16	0.00	0.00	---	---	---	---	---	---	1.590	---	1.590
0.20	629	37.20	0.00	0.00	---	---	---	---	---	---	1.611	---	1.611
0.24	755	37.24	0.00	0.00	---	---	---	---	---	---	1.632	---	1.632
0.28	881	37.28	0.00	0.00	---	---	---	---	---	---	1.652	---	1.652
0.32	1,007	37.32	0.00	0.00	---	---	---	---	---	---	1.673	---	1.673
0.36	1,133	37.36	0.00	0.00	---	---	---	---	---	---	1.694	---	1.694
0.40	1,259	37.40	0.00	0.00	---	---	---	---	---	---	1.715	---	1.715
0.44	1,508	37.44	0.00	0.00	---	---	---	---	---	---	1.736	---	1.736
0.48	1,756	37.48	0.00	0.00	---	---	---	---	---	---	1.757	---	1.757
0.52	2,005	37.52	0.00	0.00	---	---	---	---	---	---	1.778	---	1.778
0.56	2,254	37.56	0.00	0.00	---	---	---	---	---	---	1.799	---	1.799
0.60	2,503	37.60	0.00	0.00	---	---	---	---	---	---	1.820	---	1.820
0.64	2,752	37.64	0.00	0.00	---	---	---	---	---	---	1.841	---	1.841
0.68	3,001	37.68	0.00	0.00	---	---	---	---	---	---	1.862	---	1.862
0.72	3,249	37.72	0.00	0.00	---	---	---	---	---	---	1.883	---	1.883
0.76	3,498	37.76	0.00	0.00	---	---	---	---	---	---	1.904	---	1.904
0.80	3,747	37.80	0.00	0.00	---	---	---	---	---	---	1.925	---	1.925
0.84	4,035	37.84	0.00	0.00	---	---	---	---	---	---	1.946	---	1.946
0.88	4,322	37.88	0.00	0.00	---	---	---	---	---	---	1.967	---	1.967
0.92	4,610	37.92	0.00	0.00	---	---	---	---	---	---	1.988	---	1.988
0.96	4,898	37.96	0.00	0.00	---	---	---	---	---	---	2.009	---	2.009
1.00	5,185	38.00	0.00	0.00	---	---	---	---	---	---	2.030	---	2.030
1.04	5,473	38.04	0.00	0.00	---	---	---	---	---	---	2.051	---	2.051
1.08	5,761	38.08	0.00	0.00	---	---	---	---	---	---	2.071	---	2.071
1.12	6,048	38.12	0.00	0.00	---	---	---	---	---	---	2.092	---	2.092
1.16	6,336	38.16	0.00	0.00	---	---	---	---	---	---	2.113	---	2.113
1.20	6,624	38.20	0.00	0.00	---	---	---	---	---	---	2.134	---	2.134
1.24	6,906	38.24	0.00	0.00	---	---	---	---	---	---	2.155	---	2.155

Continues on next page...

SYS 3

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.28	7,188	38.28	0.00	0.00	---	---	---	---	---	---	2.176	---	2.176
1.32	7,471	38.32	0.00	0.00	---	---	---	---	---	---	2.197	---	2.197
1.36	7,753	38.36	0.00	0.00	---	---	---	---	---	---	2.218	---	2.218
1.40	8,035	38.40	0.00	0.00	---	---	---	---	---	---	2.239	---	2.239
1.44	8,318	38.44	0.00	0.00	---	---	---	---	---	---	2.260	---	2.260
1.48	8,600	38.48	0.00	0.00	---	---	---	---	---	---	2.281	---	2.281
1.52	8,882	38.52	0.00	0.00	---	---	---	---	---	---	2.302	---	2.302
1.56	9,165	38.56	0.00	0.00	---	---	---	---	---	---	2.323	---	2.323
1.60	9,447	38.60	0.00	0.00	---	---	---	---	---	---	2.344	---	2.344
1.64	9,721	38.64	0.00	0.00	---	---	---	---	---	---	2.365	---	2.365
1.68	9,995	38.68	0.00	0.00	---	---	---	---	---	---	2.386	---	2.386
1.72	10,268	38.72	0.00	0.00	---	---	---	---	---	---	2.407	---	2.407
1.76	10,542	38.76	0.00	0.00	---	---	---	---	---	---	2.428	---	2.428
1.80	10,816	38.80	0.00 ic	0.00	---	---	---	---	---	---	2.449	---	2.449
1.84	11,089	38.84	0.01 ic	0.00	---	---	---	---	---	---	2.470	---	2.476
1.88	11,363	38.88	0.03 ic	0.00	---	---	---	---	---	---	2.490	---	2.516
1.92	11,637	38.92	0.06 ic	0.00	---	---	---	---	---	---	2.511	---	2.569
1.96	11,910	38.96	0.10 ic	0.00	---	---	---	---	---	---	2.532	---	2.632
2.00	12,184	39.00	0.15 ic	0.00	---	---	---	---	---	---	2.553	---	2.707
2.04	12,445	39.04	0.22 ic	0.01 ic	---	---	---	---	---	---	2.574	---	2.798
2.08	12,706	39.08	0.29 ic	0.02 ic	---	---	---	---	---	---	2.595	---	2.909
2.12	12,967	39.12	0.37 ic	0.05 ic	---	---	---	---	---	---	2.616	---	3.038
2.16	13,228	39.16	0.46 ic	0.09 ic	---	---	---	---	---	---	2.637	---	3.187
2.20	13,489	39.20	0.56 ic	0.13 ic	---	---	---	---	---	---	2.658	---	3.351
2.24	13,750	39.24	0.66 ic	0.19 ic	---	---	---	---	---	---	2.679	---	3.528
2.28	14,011	39.28	0.77 ic	0.25 ic	---	---	---	---	---	---	2.700	---	3.719
2.32	14,272	39.32	0.88 ic	0.32 ic	---	---	---	---	---	---	2.721	---	3.920
2.36	14,533	39.36	0.99 ic	0.39 ic	---	---	---	---	---	---	2.742	---	4.128
2.40	14,794	39.40	1.11 ic	0.47 ic	---	---	---	---	---	---	2.763	---	4.344
2.44	15,036	39.44	1.23 ic	0.55 ic	---	---	---	---	---	---	2.784	---	4.561
2.48	15,279	39.48	1.34 ic	0.64 ic	---	---	---	---	---	---	2.805	---	4.778
2.52	15,522	39.52	1.45 ic	0.72 ic	---	---	---	---	---	---	2.826	---	4.991
2.56	15,765	39.56	1.55 ic	0.80 ic	---	---	---	---	---	---	2.847	---	5.194
2.60	16,008	39.60	1.64 ic	0.87 ic	---	---	---	---	---	---	2.868	---	5.379
2.64	16,250	39.64	1.71 ic	0.94 ic	---	---	---	---	---	---	2.889	---	5.535
2.68	16,493	39.68	1.79 ic	0.99 ic	---	---	---	---	---	---	2.910	---	5.686
2.72	16,736	39.72	1.86 ic	1.05 ic	---	---	---	---	---	---	2.930	---	5.838
2.76	16,979	39.76	1.94 ic	1.10 ic	---	---	---	---	---	---	2.951	---	5.985
2.80	17,222	39.80	2.01 ic	1.15 ic	---	---	---	---	---	---	2.972	---	6.126
2.84	17,438	39.84	2.07 ic	1.20 ic	---	---	---	---	---	---	2.993	---	6.263
2.88	17,653	39.88	2.14 ic	1.24 ic	---	---	---	---	---	---	3.014	---	6.395
2.92	17,869	39.92	2.20 ic	1.29 ic	---	---	---	---	---	---	3.035	---	6.525
2.96	18,085	39.96	2.26 ic	1.33 ic	---	---	---	---	---	---	3.056	---	6.650
3.00	18,301	40.00	2.32 ic	1.37 ic	---	---	---	---	---	---	3.077	---	6.773
3.04	18,517	40.04	2.38 ic	1.41 ic	---	---	---	---	---	---	3.098	---	6.893
3.08	18,733	40.08	2.44 ic	1.45 ic	---	---	---	---	---	---	3.119	---	7.011
3.12	18,949	40.12	2.50 ic	1.49 ic	---	---	---	---	---	---	3.140	---	7.126
3.16	19,165	40.16	2.55 ic	1.53 ic	---	---	---	---	---	---	3.161	---	7.239
3.20	19,381	40.20	2.60 ic	1.56 ic	---	---	---	---	---	---	3.182	---	7.350
3.24	19,543	40.24	2.66 ic	1.60 ic	---	---	---	---	---	---	3.203	---	7.459
3.28	19,705	40.28	2.71 ic	1.64 ic	---	---	---	---	---	---	3.224	---	7.567
3.32	19,867	40.32	2.76 ic	1.67 ic	---	---	---	---	---	---	3.245	---	7.672
3.36	20,029	40.36	2.81 ic	1.70 ic	---	---	---	---	---	---	3.266	---	7.776
3.40	20,191	40.40	2.86 ic	1.74 ic	---	---	---	---	---	---	3.287	---	7.879
3.44	20,353	40.44	2.90 ic	1.77 ic	---	---	---	---	---	---	3.308	---	7.980
3.48	20,515	40.48	2.95 ic	1.80 ic	---	---	---	---	---	---	3.329	---	8.079
3.52	20,677	40.52	3.00 ic	1.83 ic	---	---	---	---	---	---	3.349	---	8.178
3.56	20,839	40.56	3.04 ic	1.86 ic	---	---	---	---	---	---	3.370	---	8.275
3.60	21,001	40.60	3.09 ic	1.89 ic	---	---	---	---	---	---	3.391	---	8.371
3.64	21,127	40.64	3.13 ic	1.92 ic	---	---	---	---	---	---	3.412	---	8.466
3.68	21,253	40.68	3.18 ic	1.95 ic	---	---	---	---	---	---	3.433	---	8.560
3.72	21,379	40.72	3.22 ic	1.98 ic	---	---	---	---	---	---	3.454	---	8.653
3.76	21,505	40.76	3.26 ic	2.01 ic	---	---	---	---	---	---	3.475	---	8.745
3.80	21,630	40.80	3.30 ic	2.04 ic	---	---	---	---	---	---	3.496	---	8.835
3.84	21,756	40.84	3.35 ic	2.06 ic	---	---	---	---	---	---	3.517	---	8.925
3.88	21,882	40.88	3.39 ic	2.09 ic	---	---	---	---	---	---	3.538	---	9.015
3.92	22,008	40.92	3.43 ic	2.12 ic	---	---	---	---	---	---	3.559	---	9.103
3.96	22,134	40.96	3.47 ic	2.14 ic	---	---	---	---	---	---	3.580	---	9.190
4.00	22,260	41.00	3.51 ic	2.17 ic	---	---	---	---	---	---	3.601	---	9.277

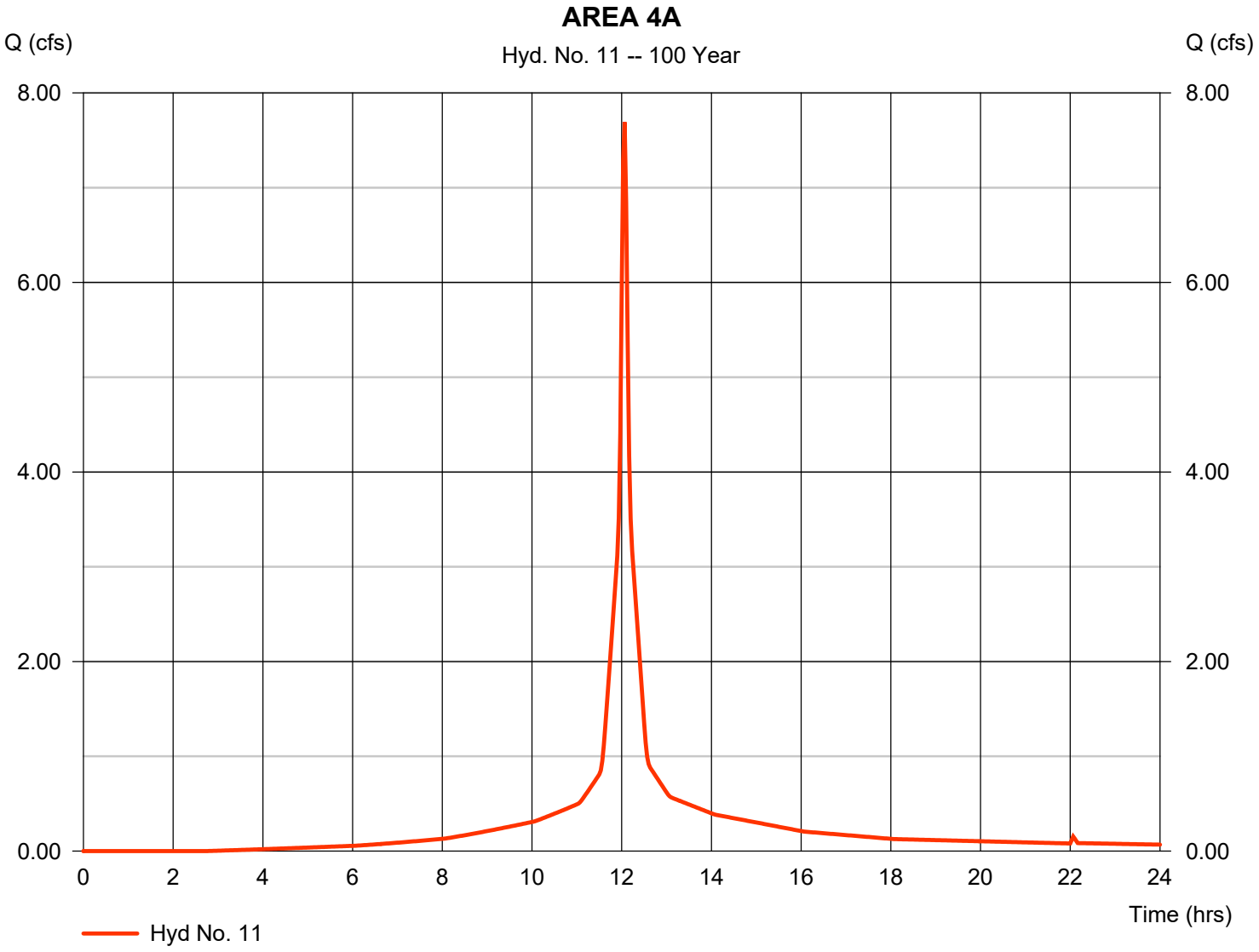
...End

Hydrograph Report

Hyd. No. 11

AREA 4A

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.691 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	24,791 cuft
Drainage area	=	1.110 ac	Curve number	=	90.6
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	7.68 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484



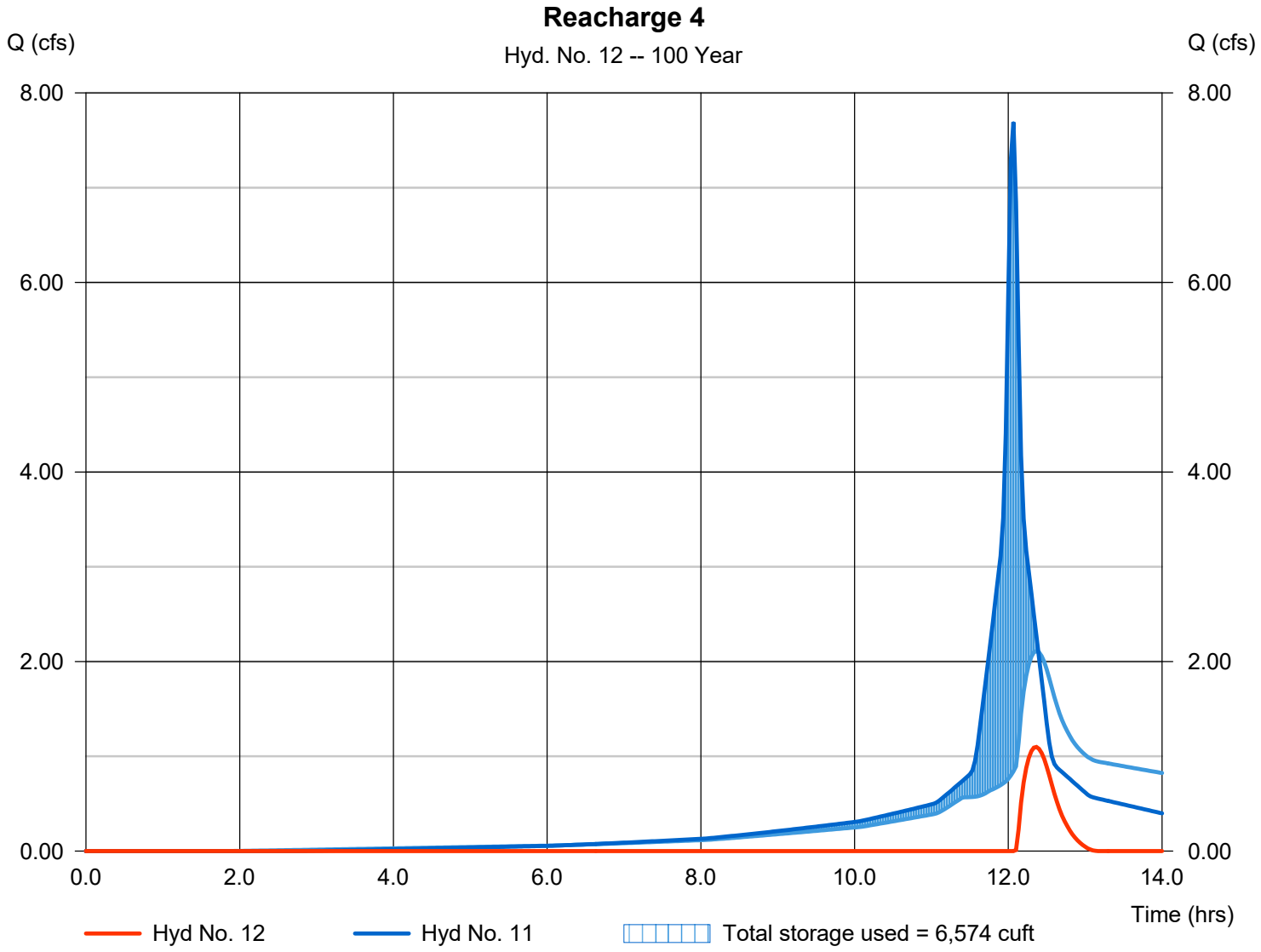
Hydrograph Report

Hyd. No. 12

Reacharge 4

Hydrograph type	=	Reservoir	Peak discharge	=	1.098 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.37 hrs
Time interval	=	2 min	Hyd. volume	=	1,858 cuft
Inflow hyd. No.	=	11 - AREA 4A	Max. Elevation	=	38.60 ft
Reservoir name	=	SYS 4	Max. Storage	=	6,574 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond No. 4 - SYS 4

Pond Data

UG Chambers -Invert elev. = 36.70 ft, Rise x Span = 3.00 x 5.00 ft, Barrel Len = 87.00 ft, No. Barrels = 7, Slope = 0.00%, Headers = No
Encasement -Invert elev. = 36.20 ft, Width = 5.75 ft, Height = 4.00 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	36.20	n/a	0	0
0.40	36.60	n/a	560	560
0.80	37.00	n/a	1,108	1,668
1.20	37.40	n/a	1,281	2,949
1.60	37.80	n/a	1,257	4,206
2.00	38.20	n/a	1,218	5,424
2.40	38.60	n/a	1,162	6,586
2.80	39.00	n/a	1,081	7,667
3.20	39.40	n/a	961	8,628
3.60	39.80	n/a	721	9,349
4.00	40.20	n/a	560	9,910

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 10.00	0.00	0.00	0.00
Span (in)	= 10.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 38.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

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

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	36.20	0.00	---	---	---	---	---	---	---	0.000	---	0.000
0.04	56	36.24	0.00	---	---	---	---	---	---	---	0.680	---	0.680
0.08	112	36.28	0.00	---	---	---	---	---	---	---	0.689	---	0.689
0.12	168	36.32	0.00	---	---	---	---	---	---	---	0.698	---	0.698
0.16	224	36.36	0.00	---	---	---	---	---	---	---	0.708	---	0.708
0.20	280	36.40	0.00	---	---	---	---	---	---	---	0.717	---	0.717
0.24	336	36.44	0.00	---	---	---	---	---	---	---	0.726	---	0.726
0.28	392	36.48	0.00	---	---	---	---	---	---	---	0.736	---	0.736
0.32	448	36.52	0.00	---	---	---	---	---	---	---	0.745	---	0.745
0.36	504	36.56	0.00	---	---	---	---	---	---	---	0.754	---	0.754
0.40	560	36.60	0.00	---	---	---	---	---	---	---	0.764	---	0.764
0.44	671	36.64	0.00	---	---	---	---	---	---	---	0.773	---	0.773
0.48	782	36.68	0.00	---	---	---	---	---	---	---	0.782	---	0.782
0.52	893	36.72	0.00	---	---	---	---	---	---	---	0.792	---	0.792
0.56	1,003	36.76	0.00	---	---	---	---	---	---	---	0.801	---	0.801
0.60	1,114	36.80	0.00	---	---	---	---	---	---	---	0.810	---	0.810
0.64	1,225	36.84	0.00	---	---	---	---	---	---	---	0.820	---	0.820
0.68	1,336	36.88	0.00	---	---	---	---	---	---	---	0.829	---	0.829
0.72	1,447	36.92	0.00	---	---	---	---	---	---	---	0.838	---	0.838
0.76	1,557	36.96	0.00	---	---	---	---	---	---	---	0.848	---	0.848
0.80	1,668	37.00	0.00	---	---	---	---	---	---	---	0.857	---	0.857
0.84	1,796	37.04	0.00	---	---	---	---	---	---	---	0.866	---	0.866
0.88	1,924	37.08	0.00	---	---	---	---	---	---	---	0.876	---	0.876
0.92	2,052	37.12	0.00	---	---	---	---	---	---	---	0.885	---	0.885
0.96	2,180	37.16	0.00	---	---	---	---	---	---	---	0.894	---	0.894
1.00	2,308	37.20	0.00	---	---	---	---	---	---	---	0.904	---	0.904
1.04	2,436	37.24	0.00	---	---	---	---	---	---	---	0.913	---	0.913
1.08	2,564	37.28	0.00	---	---	---	---	---	---	---	0.922	---	0.922
1.12	2,693	37.32	0.00	---	---	---	---	---	---	---	0.932	---	0.932
1.16	2,821	37.36	0.00	---	---	---	---	---	---	---	0.941	---	0.941
1.20	2,949	37.40	0.00	---	---	---	---	---	---	---	0.950	---	0.950
1.24	3,074	37.44	0.00	---	---	---	---	---	---	---	0.959	---	0.959

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SYS 4

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.28	3,200	37.48	0.00	---	---	---	---	---	---	---	0.969	---	0.969
1.32	3,326	37.52	0.00	---	---	---	---	---	---	---	0.978	---	0.978
1.36	3,451	37.56	0.00	---	---	---	---	---	---	---	0.987	---	0.987
1.40	3,577	37.60	0.00	---	---	---	---	---	---	---	0.997	---	0.997
1.44	3,703	37.64	0.00	---	---	---	---	---	---	---	1.006	---	1.006
1.48	3,829	37.68	0.00	---	---	---	---	---	---	---	1.015	---	1.015
1.52	3,954	37.72	0.00	---	---	---	---	---	---	---	1.025	---	1.025
1.56	4,080	37.76	0.00	---	---	---	---	---	---	---	1.034	---	1.034
1.60	4,206	37.80	0.00	---	---	---	---	---	---	---	1.043	---	1.043
1.64	4,328	37.84	0.00	---	---	---	---	---	---	---	1.053	---	1.053
1.68	4,449	37.88	0.00	---	---	---	---	---	---	---	1.062	---	1.062
1.72	4,571	37.92	0.00	---	---	---	---	---	---	---	1.071	---	1.071
1.76	4,693	37.96	0.00	---	---	---	---	---	---	---	1.081	---	1.081
1.80	4,815	38.00	0.00 ic	---	---	---	---	---	---	---	1.090	---	1.090
1.84	4,937	38.04	0.01 ic	---	---	---	---	---	---	---	1.099	---	1.106
1.88	5,059	38.08	0.03 ic	---	---	---	---	---	---	---	1.109	---	1.135
1.92	5,180	38.12	0.06 ic	---	---	---	---	---	---	---	1.118	---	1.175
1.96	5,302	38.16	0.10 ic	---	---	---	---	---	---	---	1.127	---	1.227
2.00	5,424	38.20	0.15 ic	---	---	---	---	---	---	---	1.137	---	1.290
2.04	5,540	38.24	0.22 ic	---	---	---	---	---	---	---	1.146	---	1.363
2.08	5,656	38.28	0.29 ic	---	---	---	---	---	---	---	1.155	---	1.446
2.12	5,773	38.32	0.37 ic	---	---	---	---	---	---	---	1.165	---	1.536
2.16	5,889	38.36	0.46 ic	---	---	---	---	---	---	---	1.174	---	1.636
2.20	6,005	38.40	0.56 ic	---	---	---	---	---	---	---	1.183	---	1.741
2.24	6,121	38.44	0.66 ic	---	---	---	---	---	---	---	1.193	---	1.853
2.28	6,237	38.48	0.77 ic	---	---	---	---	---	---	---	1.202	---	1.970
2.32	6,353	38.52	0.88 ic	---	---	---	---	---	---	---	1.211	---	2.091
2.36	6,470	38.56	0.99 ic	---	---	---	---	---	---	---	1.221	---	2.214
2.40	6,586	38.60	1.11 ic	---	---	---	---	---	---	---	1.230	---	2.340
2.44	6,694	38.64	1.23 ic	---	---	---	---	---	---	---	1.239	---	2.464
2.48	6,802	38.68	1.34 ic	---	---	---	---	---	---	---	1.249	---	2.587
2.52	6,910	38.72	1.45 ic	---	---	---	---	---	---	---	1.258	---	2.706
2.56	7,018	38.76	1.55 ic	---	---	---	---	---	---	---	1.267	---	2.817
2.60	7,126	38.80	1.64 ic	---	---	---	---	---	---	---	1.277	---	2.915
2.64	7,234	38.84	1.71 ic	---	---	---	---	---	---	---	1.286	---	2.994
2.68	7,342	38.88	1.79 ic	---	---	---	---	---	---	---	1.295	---	3.083
2.72	7,450	38.92	1.86 ic	---	---	---	---	---	---	---	1.305	---	3.168
2.76	7,559	38.96	1.94 ic	---	---	---	---	---	---	---	1.314	---	3.249
2.80	7,667	39.00	2.01 ic	---	---	---	---	---	---	---	1.323	---	3.329
2.84	7,763	39.04	2.07 ic	---	---	---	---	---	---	---	1.333	---	3.406
2.88	7,859	39.08	2.14 ic	---	---	---	---	---	---	---	1.342	---	3.480
2.92	7,955	39.12	2.20 ic	---	---	---	---	---	---	---	1.351	---	3.553
2.96	8,051	39.16	2.26 ic	---	---	---	---	---	---	---	1.361	---	3.624
3.00	8,147	39.20	2.32 ic	---	---	---	---	---	---	---	1.370	---	3.694
3.04	8,243	39.24	2.38 ic	---	---	---	---	---	---	---	1.379	---	3.762
3.08	8,339	39.28	2.44 ic	---	---	---	---	---	---	---	1.389	---	3.828
3.12	8,436	39.32	2.50 ic	---	---	---	---	---	---	---	1.398	---	3.894
3.16	8,532	39.36	2.55 ic	---	---	---	---	---	---	---	1.407	---	3.958
3.20	8,628	39.40	2.60 ic	---	---	---	---	---	---	---	1.416	---	4.020
3.24	8,700	39.44	2.66 ic	---	---	---	---	---	---	---	1.426	---	4.082
3.28	8,772	39.48	2.71 ic	---	---	---	---	---	---	---	1.435	---	4.143
3.32	8,844	39.52	2.76 ic	---	---	---	---	---	---	---	1.444	---	4.203
3.36	8,916	39.56	2.81 ic	---	---	---	---	---	---	---	1.454	---	4.262
3.40	8,988	39.60	2.86 ic	---	---	---	---	---	---	---	1.463	---	4.320
3.44	9,061	39.64	2.90 ic	---	---	---	---	---	---	---	1.472	---	4.377
3.48	9,133	39.68	2.95 ic	---	---	---	---	---	---	---	1.482	---	4.433
3.52	9,205	39.72	3.00 ic	---	---	---	---	---	---	---	1.491	---	4.489
3.56	9,277	39.76	3.04 ic	---	---	---	---	---	---	---	1.500	---	4.544
3.60	9,349	39.80	3.09 ic	---	---	---	---	---	---	---	1.510	---	4.598
3.64	9,405	39.84	3.13 ic	---	---	---	---	---	---	---	1.519	---	4.652
3.68	9,461	39.88	3.18 ic	---	---	---	---	---	---	---	1.528	---	4.705
3.72	9,517	39.92	3.22 ic	---	---	---	---	---	---	---	1.538	---	4.757
3.76	9,573	39.96	3.26 ic	---	---	---	---	---	---	---	1.547	---	4.809
3.80	9,629	40.00	3.30 ic	---	---	---	---	---	---	---	1.556	---	4.860
3.84	9,685	40.04	3.35 ic	---	---	---	---	---	---	---	1.566	---	4.911
3.88	9,741	40.08	3.39 ic	---	---	---	---	---	---	---	1.575	---	4.962
3.92	9,797	40.12	3.43 ic	---	---	---	---	---	---	---	1.584	---	5.011
3.96	9,854	40.16	3.47 ic	---	---	---	---	---	---	---	1.594	---	5.061
4.00	9,910	40.20	3.51 ic	---	---	---	---	---	---	---	1.603	---	5.110

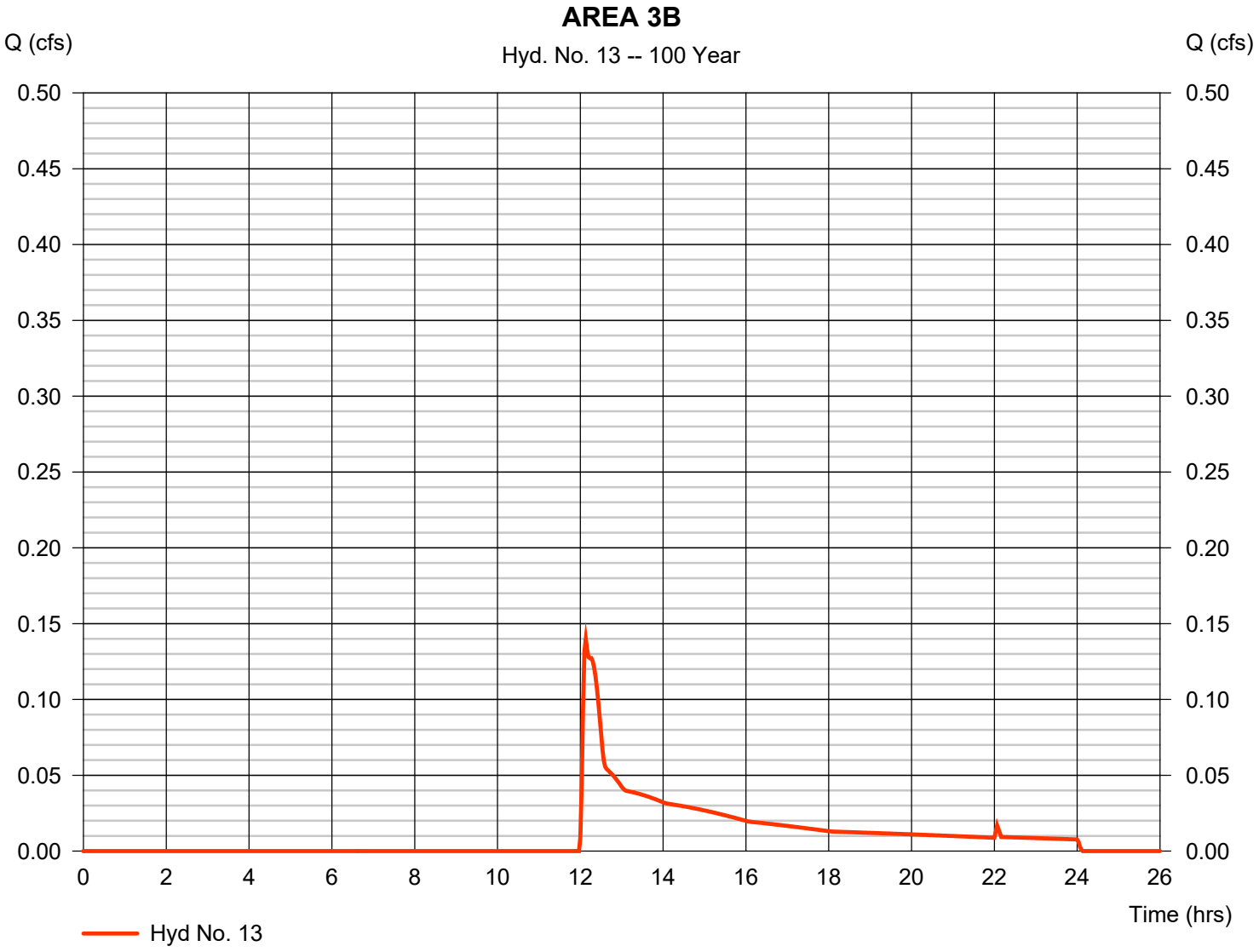
...End

Hydrograph Report

Hyd. No. 13

AREA 3B

Hydrograph type	= SCS Runoff	Peak discharge	= 0.140 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 956 cuft
Drainage area	= 0.362 ac	Curve number	= 36
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.68 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

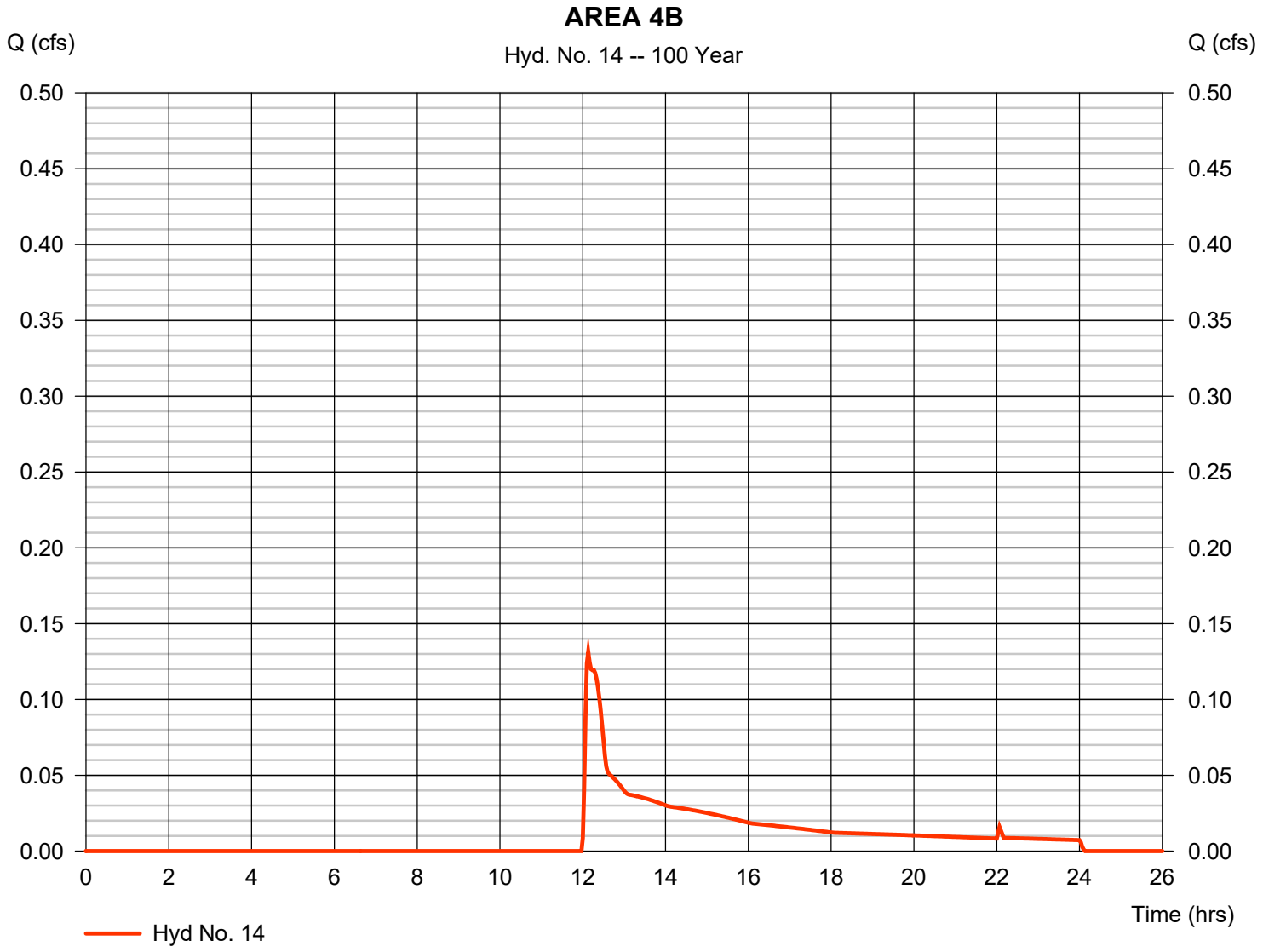


Hydrograph Report

Hyd. No. 14

AREA 4B

Hydrograph type	= SCS Runoff	Peak discharge	= 0.131 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.13 hrs
Time interval	= 2 min	Hyd. volume	= 897 cuft
Drainage area	= 0.339 ac	Curve number	= 36
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 7.68 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

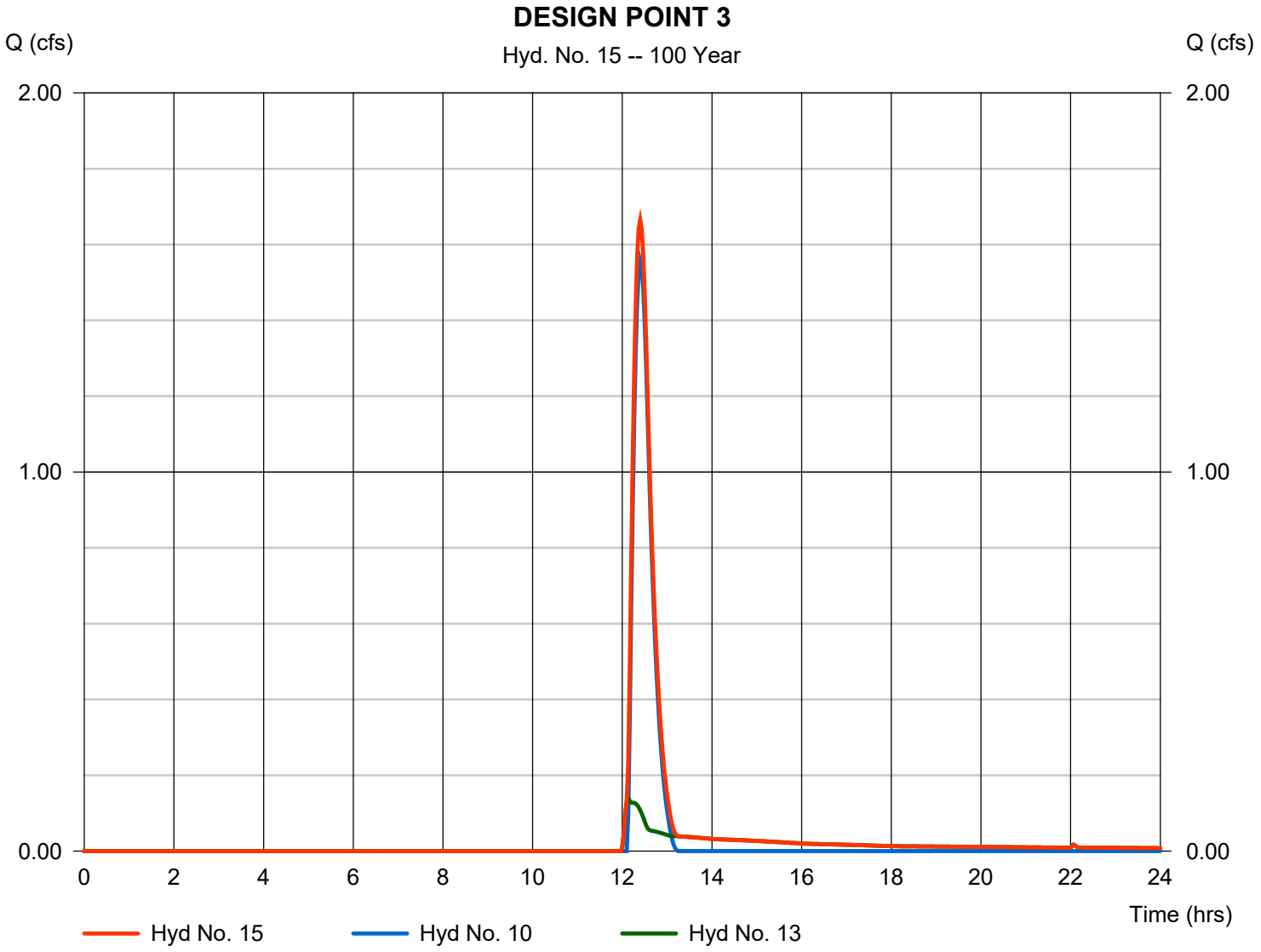


Hydrograph Report

Hyd. No. 15

DESIGN POINT 3

Hydrograph type	=	Combine	Peak discharge	=	1.665 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.40 hrs
Time interval	=	2 min	Hyd. volume	=	3,580 cuft
Inflow hyds.	=	10, 13	Contrib. drain. area	=	0.362 ac

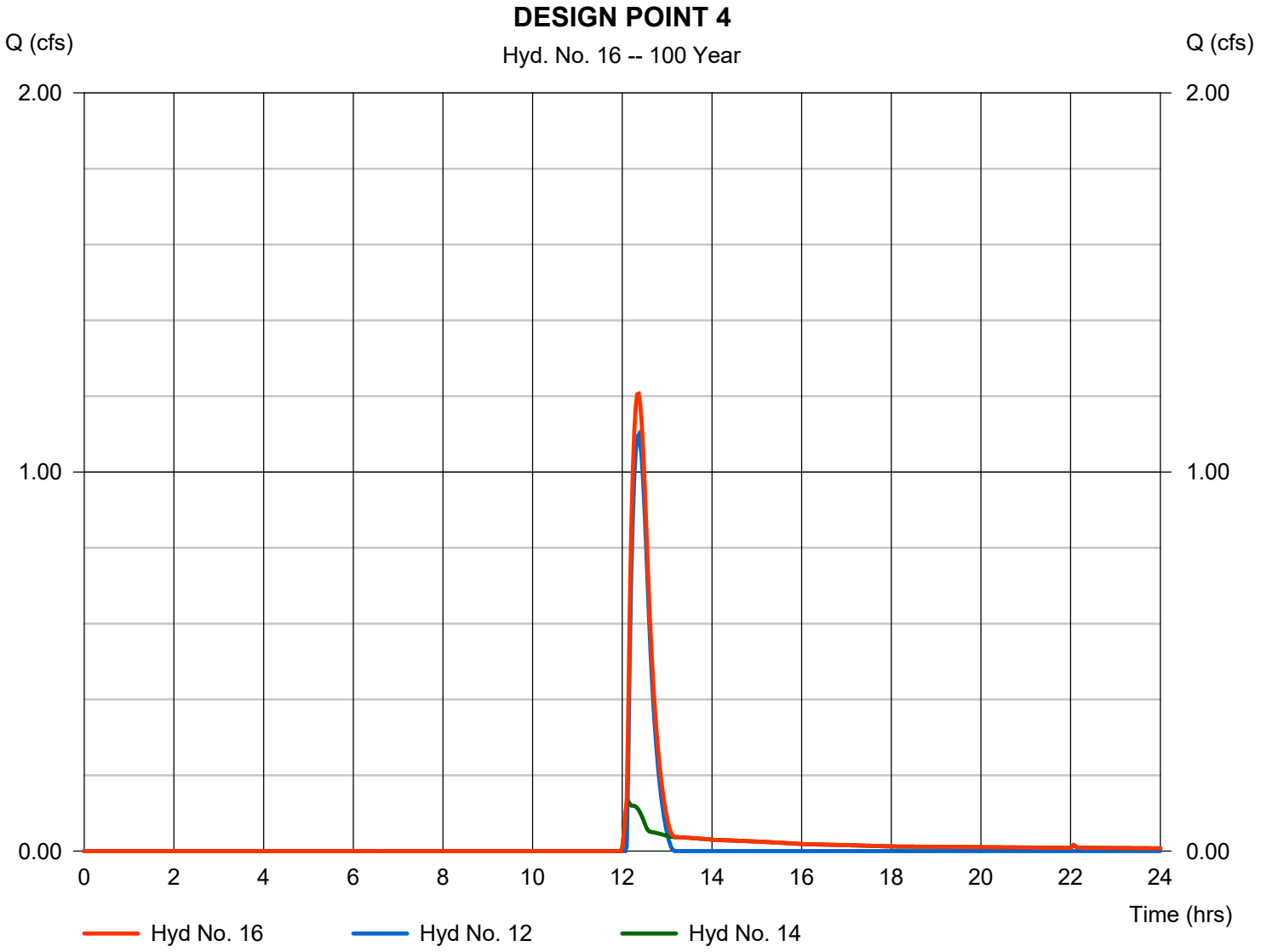


Hydrograph Report

Hyd. No. 16

DESIGN POINT 4

Hydrograph type	=	Combine	Peak discharge	=	1.206 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.37 hrs
Time interval	=	2 min	Hyd. volume	=	2,755 cuft
Inflow hyds.	=	12, 14	Contrib. drain. area	=	0.339 ac



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

Attachment C
Best Management Practices

Recharge System Calculations

Required Dedicated Recharge Volume = 112,390 s.f. *0.6"/12 (Hydrologic Group A soils)
= **5,620 cu.ft.**

Recharge System 1
Dedicated Recharge Volume = 4,281+/- cu.ft. @ elevation 43.61'

Recharge System 2
Dedicated Recharge Volume = 5,481+/- cu.ft. @ elevation 43.39'

Recharge System 3
Dedicated Recharge Volume = 10,816+/- cu.ft. @ elevation 38.8

Recharge System 4
Dedicated Recharge Volume = 4,815+/- cu.ft. @ elevation 38.0'

Total Provided Recharge Volume = **25,393+/- cu.ft**.

72 HR Drain Down Time

Draw down analysis is based on soil texture from NRCS soil survey.
The soils are Sands (8.27 in/hr).

Recharge System 1
Bottom Contact Area = 2319.02 s.f.
Recharge Rate = 2319.02 s.f. * 8.27 in/hr *1/12 = 1598.19 cu.ft/ hr
Drain Time for recharge volume = 4,281 cu.ft / 1598.19 cu.ft/hr = **2.7 hours**

Recharge System 2
Bottom Contact Area = 3217.80 s.f.
Recharge Rate = 3217.80 s.f. * 8.27 in/hr *1/12 = 2217.60 cu.ft/ hr
Drain Time for recharge volume = 5,481 cu.ft / 2217.60 cu.ft/hr = **2.5 hours**

Recharge System 3
Bottom Contact Area = 8709.59 s.f.
Recharge Rate = 8709.59 s.f. * 8.27 in/hr *1/12 = 6002.36 cu.ft/ hr
Drain Time for recharge volume = 10816 cu.ft / 6002.36 cu.ft/hr = **1.8 hours**

Recharge System 4
Bottom Contact Area = 3842.07 s.f.
Recharge Rate = 3842.07 s.f. * 8.27 in/hr *1/12 = 2647.83 cu.ft/ hr
Drain Time for recharge volume = 4815 cu.ft / 2647.83 cu.ft/hr = **1.8 hours**

CULTEC Stormwater Design Calculator

Date:	May 25, 2023

Project Number:	2023-026

Project Information:

RADER PROPERTIES, INC
33 RIVERSIDE DRIVE
PEMBOKE
MA
SYSTEM 1

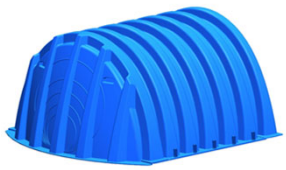
Calculations Performed By:

KELLY ENGINEERING GROUP
0 CAMPANELLI DRIVE
BRAINTREE MA
02184
USA
781-843-4333
KELLYENGINEERINGGROUP.COM

RECHARGER 360HD

Recharger 360HD Chamber Specifications

Height	**36.0**	inches
Width	**60.0**	inches
Length	**4.17**	feet
Installed Length	**3.67**	feet
Bare Chamber Volume	**36.69**	cu. feet
Installed Chamber Volume	**55.78**	cu. feet



Breakdown of Storage Provided by Recharger 360HD Stormwater System

Within Chambers	**3,686.14**	cu. feet
Within Feed Connectors	**4.11**	cu. feet
Within Stone	**2,234.33**	cu. feet
Total Storage Provided	**5,924.6**	**cu. feet**
Total Storage Required	5700.00	cu. feet

Materials List

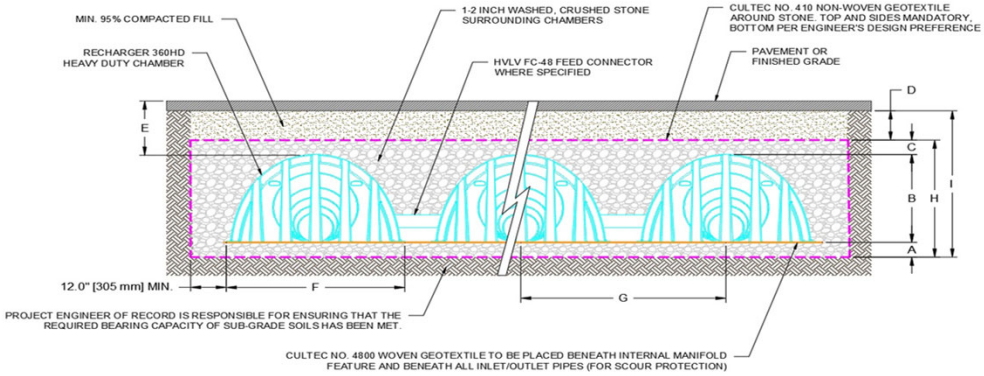
Recharger 360HD			
Total Number of Chambers Required	**98**	**pieces**	
Separator Row Chambers	**14**	pieces	Separator Row Qty Included in Total
Chamber Units	**98**	pieces	
End Caps	**14**	pieces	
HVLV FC-48 Feed Connectors	**6**	pieces	*Based on 1 Internal Manifold*
CULTEC No. 410 Non-Woven Geotextile	**752**	sq. yards	
CULTEC No. 4800 Woven Geotextile	**99**	feet	
Stone	**207**	cu. yards	

Bed Detail

Bed Layout Information

Number of Rows Wide	**7**	pieces
Number of Chambers Long	**14**	pieces
Chamber Row Width	**39.50**	feet
Chamber Row Length	**53.88**	feet
Bed Width	**41.50**	feet
Bed Length	**55.88**	feet
Bed Area Required	**2319.02**	sq. feet
Length of Separator Row	**53.88**	feet

Bed detail for reference only. Not project specific. Not to scale.



Conceptual graphic only. Not job specific.

Cross Section Table Reference

A	Depth of Stone Base	**6.0**	inches
B	Chamber Height	**36.0**	inches
C	Depth of Stone Above Units	**6.0**	inches
D	Depth of 95% Compacted Fill	**12.0**	inches
E	Max. Depth Allowed Above the Chamber	**12.00**	feet
F	Chamber Width	**60.0**	inches
G	Center to Center Spacing	**5.75**	feet
H	Effective Depth	**4.00**	feet
I	Bed Depth	**5.00**	feet

CULTEC Stormwater Design Calculator

Date:	May 25, 2023

Project Number:	2023-026

Project Information:

RADER PROPERTIES, INC
33 RIVERSIDE DRIVE
PEMBOKE
MA
SYSTEM 2

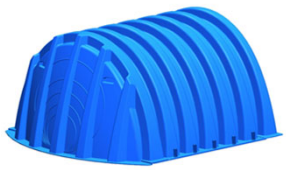
Calculations Performed By:

KELLY ENGINEERING GROUP
0 CAMPANELLI DRIVE
BRAINTREE MA
02184
USA
781-843-4333
KELLYENGINEERINGGROUP.COM

RECHARGER 360HD

Recharger 360HD Chamber Specifications

Height	**36.0**	inches
Width	**60.0**	inches
Length	**4.17**	feet
Installed Length	**3.67**	feet
Bare Chamber Volume	**36.69**	cu. feet
Installed Chamber Volume	**55.78**	cu. feet



Breakdown of Storage Provided by Recharger 360HD Stormwater System

Within Chambers	**5,201.32**	cu. feet
Within Feed Connectors	**5.48**	cu. feet
Within Stone	**3,065.76**	cu. feet
Total Storage Provided	**8,272.6**	**cu. feet**
Total Storage Required	7985.00	cu. feet

Materials List

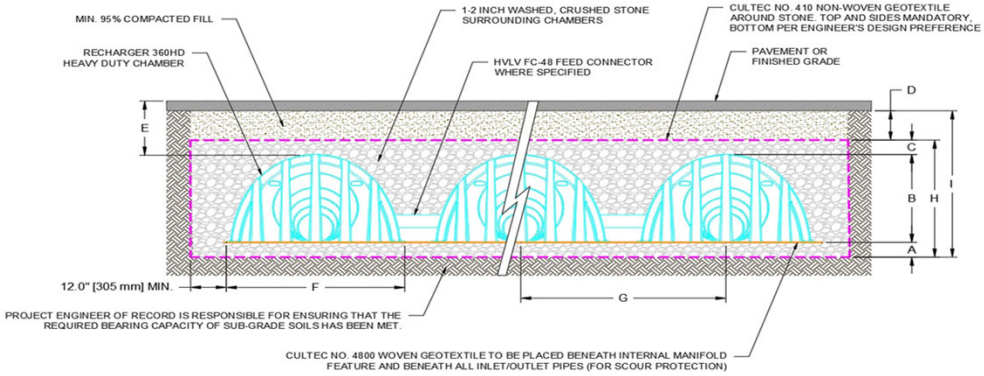
Recharger 360HD			
Total Number of Chambers Required	**140**	**pieces**	
Separator Row Chambers	**28**	pieces	Separator Row Qty Included in Total
Chamber Units	**140**	pieces	
End Caps	**10**	pieces	
HVLV FC-48 Feed Connectors	**8**	pieces	*Based on 2 Internal Manifolds*
CULTEC No. 410 Non-Woven Geotextile	**1046**	sq. yards	
CULTEC No. 4800 Woven Geotextile	**171**	feet	
Stone	**284**	cu. yards	

Bed Detail

Bed Layout Information

Number of Rows Wide	**5**	pieces
Number of Chambers Long	**28**	pieces
Chamber Row Width	**28.00**	feet
Chamber Row Length	**105.26**	feet
Bed Width	**30.00**	feet
Bed Length	**107.26**	feet
Bed Area Required	**3217.80**	sq. feet
Length of Separator Row	**105.26**	feet

Bed detail for reference only. Not project specific. Not to scale.



Conceptual graphic only. Not job specific.

Cross Section Table Reference

A	Depth of Stone Base	**6.0**	inches
B	Chamber Height	**36.0**	inches
C	Depth of Stone Above Units	**6.0**	inches
D	Depth of 95% Compacted Fill	**12.0**	inches
E	Max. Depth Allowed Above the Chamber	**12.00**	feet
F	Chamber Width	**60.0**	inches
G	Center to Center Spacing	**5.75**	feet
H	Effective Depth	**4.00**	feet
I	Bed Depth	**5.00**	feet

CULTEC Stormwater Design Calculator

Date:	May 25, 2023

Project Number:	2023-026

Project Information:

RADER PROPERTIES, INC
33 RIVERSIDE DRIVE
PEMBOKE
MA
SYSTEM 3

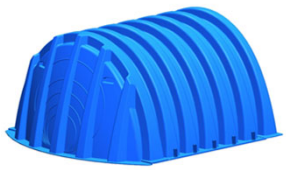
Calculations Performed By:

KELLY ENGINEERING GROUP
0 CAMPANELLI DRIVE
BRAINTREE MA
02184
USA
781-843-4333
KELLYENGINEERINGGROUP.COM

RECHARGER 360HD

Recharger 360HD Chamber Specifications

Height	**36.0**	inches
Width	**60.0**	inches
Length	**4.17**	feet
Installed Length	**3.67**	feet
Bare Chamber Volume	**36.69**	cu. feet
Installed Chamber Volume	**55.78**	cu. feet



Breakdown of Storage Provided by Recharger 360HD Stormwater System

Within Chambers	**14,486.16**	cu. feet
Within Feed Connectors	**9.59**	cu. feet
Within Stone	**8,137.05**	cu. feet
Total Storage Provided	**22,632.8**	**cu. feet**
Total Storage Required	22200.00	cu. feet

Materials List

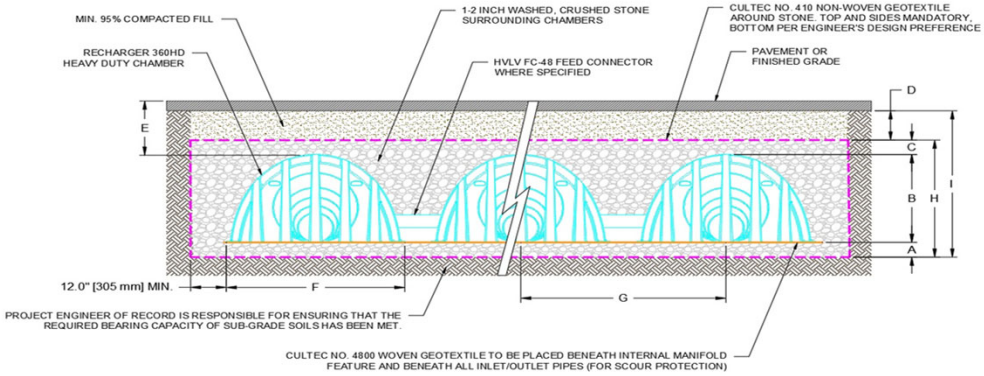
Recharger 360HD			
Total Number of Chambers Required	**392**	**pieces**	
Separator Row Chambers	**49**	pieces	Separator Row Qty Included in Total
Chamber Units	**392**	pieces	
End Caps	**16**	pieces	
HVLV FC-48 Feed Connectors	**14**	pieces	*Based on 2 Internal Manifolds*
CULTEC No. 410 Non-Woven Geotextile	**2677**	sq. yards	
CULTEC No. 4800 Woven Geotextile	**287**	feet	
Stone	**753**	cu. yards	

Bed Detail

Bed Layout Information

Number of Rows Wide	**8**	pieces
Number of Chambers Long	**49**	pieces
Chamber Row Width	**45.25**	feet
Chamber Row Length	**182.33**	feet
Bed Width	**47.25**	feet
Bed Length	**184.33**	feet
Bed Area Required	**8709.59**	sq. feet
Length of Separator Row	**182.33**	feet

Bed detail for reference only. Not project specific. Not to scale.



Conceptual graphic only. Not job specific.

Cross Section Table Reference

A	Depth of Stone Base	**6.0**	inches
B	Chamber Height	**36.0**	inches
C	Depth of Stone Above Units	**6.0**	inches
D	Depth of 95% Compacted Fill	**12.0**	inches
E	Max. Depth Allowed Above the Chamber	**12.00**	feet
F	Chamber Width	**60.0**	inches
G	Center to Center Spacing	**5.75**	feet
H	Effective Depth	**4.00**	feet
I	Bed Depth	**5.00**	feet

CULTEC Stormwater Design Calculator

Date:	May 25, 2023

Project Number:	2023-026

Project Information:

RADER PROPERTIES, INC
33 RIVERSIDE DRIVE
PEMBOKE
MA
SYSTEM 4

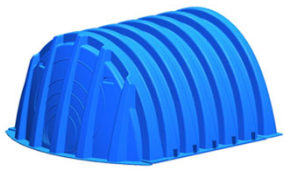
Calculations Performed By:

KELLY ENGINEERING GROUP
0 CAMPANELLI DRIVE
BRAINTREE MA
02184
USA
781-843-4333
KELLYENGINEERINGGROUP.COM

RECHARGER 360HD

Recharger 360HD Chamber Specifications

Height	**36.0**	inches
Width	**60.0**	inches
Length	**4.17**	feet
Installed Length	**3.67**	feet
Bare Chamber Volume	**36.69**	cu. feet
Installed Chamber Volume	**55.78**	cu. feet



Breakdown of Storage Provided by Recharger 360HD Stormwater System

Within Chambers	**6,254.50**	cu. feet
Within Feed Connectors	**8.22**	cu. feet
Within Stone	**3,642.23**	cu. feet
Total Storage Provided	**9,904.9**	**cu. feet**
Total Storage Required	9800.00	cu. feet

Materials List

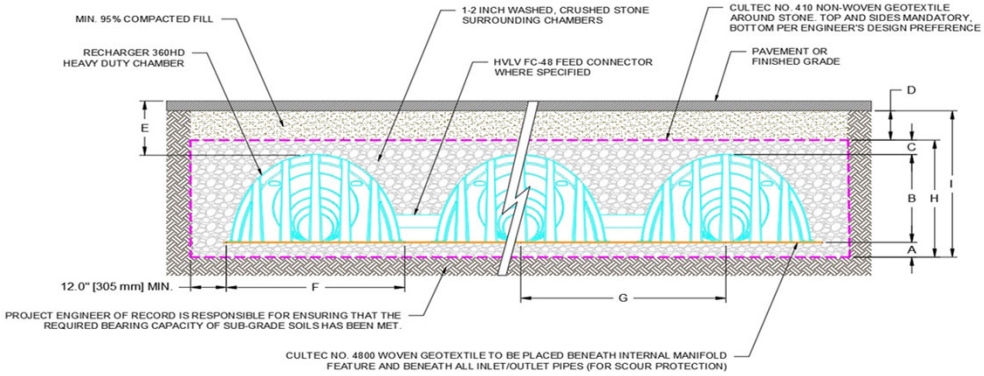
Recharger 360HD			
Total Number of Chambers Required	**168**	**pieces**	
Separator Row Chambers	**24**	pieces	Separator Row Qty Included in Total
Chamber Units	**168**	pieces	
End Caps	**14**	pieces	
HVLV FC-48 Feed Connectors	**12**	pieces	*Based on 2 Internal Manifolds*
CULTEC No. 410 Non-Woven Geotextile	**1216**	sq. yards	
CULTEC No. 4800 Woven Geotextile	**179**	feet	
Stone	**337**	cu. yards	

Bed Detail

Bed Layout Information

Number of Rows Wide	**7**	pieces
Number of Chambers Long	**24**	pieces
Chamber Row Width	**39.50**	feet
Chamber Row Length	**90.58**	feet
Bed Width	**41.50**	feet
Bed Length	**92.58**	feet
Bed Area Required	**3842.07**	sq. feet
Length of Separator Row	**90.58**	feet

Bed detail for reference only. Not project specific. Not to scale.



Conceptual graphic only. Not job specific.

Cross Section Table Reference

A	Depth of Stone Base	**6.0**	inches
B	Chamber Height	**36.0**	inches
C	Depth of Stone Above Units	**6.0**	inches
D	Depth of 95% Compacted Fill	**12.0**	inches
E	Max. Depth Allowed Above the Chamber	**12.00**	feet
F	Chamber Width	**60.0**	inches
G	Center to Center Spacing	**5.75**	feet
H	Effective Depth	**4.00**	feet
I	Bed Depth	**5.00**	feet

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: 33 Riverside Drive, Pembroke, 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**
Proprietary Treatment Practice	**0.50**	**0.95**	**0.47**	**0.48**
Subsurface Infiltration Structure	**0.80**	**0.48**	**0.38**	**0.10**

Total TSS Removal = **80%**

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

Project: 2023-026

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

Date: **5/24/2023**

*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

Project: 33 Riverside Drive
Location: Pembroke,
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)
WQI 1	0.14	0.0002188	5.0	0.083	1.00	795.00	0.17
WQI 2	0.48	0.0007500	5.0	0.083	1.00	795.00	0.60
WQI 3	0.34	0.0005313	5.0	0.083	1.00	795.00	0.42
WQI 4	0.45	0.0007031	5.0	0.083	1.00	795.00	0.56
WQI 5	0.60	0.0009375	5.0	0.083	1.00	795.00	0.75

The WQf sizing calculation selects the minimum size CDS/Cascade/StormCeptor model capable of operating at the computed WQf peak flowrate prior to bypassing. It assumes free discharge of the WQf through the unit and ignores the routing effect of any upstream storm drain piping. As with all hydrodynamic separators, there will be some impact to the Hydraulic Gradient of the corresponding drainage system, and evaluation of this impact should be considered in the design.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

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

33 RIVERSIDE DRIVE
PEMBROKE,

Area	**0.14 ac**	Unit Site Designation	**WQI 1**
Weighted C	**0.9**	Rainfall Station #	**68**
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	9.3%	9.3%	0.00	0.00	9.3
0.04	9.5%	18.8%	0.01	0.01	9.5
0.06	8.7%	27.5%	0.01	0.01	8.7
0.08	10.1%	37.6%	0.01	0.01	10.1
0.10	7.2%	44.8%	0.01	0.01	7.2
0.12	6.0%	50.8%	0.02	0.02	6.0
0.14	6.3%	57.1%	0.02	0.02	6.3
0.16	5.6%	62.7%	0.02	0.02	5.6
0.18	4.7%	67.4%	0.02	0.02	4.7
0.20	3.6%	71.0%	0.03	0.03	3.6
0.25	8.2%	79.1%	0.03	0.03	8.2
0.50	14.9%	94.0%	0.06	0.06	14.7
0.75	3.2%	97.3%	0.09	0.09	3.1
1.00	1.2%	98.5%	0.13	0.13	1.2
1.50	0.7%	99.2%	0.19	0.19	0.7
2.00	0.8%	100.0%	0.25	0.25	0.7
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					99.5
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**93.0%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk 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

33 RIVERSIDE DRIVE
PEMBROKE,

Area	**0.48 ac**	Unit Site Designation	**WQI 2**
Weighted C	**0.9**	Rainfall Station #	**68**
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	9.3%	9.3%	0.01	0.01	9.3
0.04	9.5%	18.8%	0.02	0.02	9.5
0.06	8.7%	27.5%	0.03	0.03	8.7
0.08	10.1%	37.6%	0.03	0.03	10.1
0.10	7.2%	44.8%	0.04	0.04	7.1
0.12	6.0%	50.8%	0.05	0.05	5.9
0.14	6.3%	57.1%	0.06	0.06	6.2
0.16	5.6%	62.7%	0.07	0.07	5.5
0.18	4.7%	67.4%	0.08	0.08	4.6
0.20	3.6%	71.0%	0.09	0.09	3.5
0.25	8.2%	79.1%	0.11	0.11	7.9
0.50	14.9%	94.0%	0.22	0.22	13.6
0.75	3.2%	97.3%	0.32	0.32	2.8
1.00	1.2%	98.5%	0.43	0.43	1.0
1.50	0.7%	99.2%	0.65	0.65	0.5
2.00	0.8%	100.0%	0.86	0.86	0.5
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					96.6
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**90.2%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk 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

33 RIVERSIDE DRIVE
PEMBROKE,

Area	**0.34 ac**	Unit Site Designation	**WQI 3**
Weighted C	**0.9**	Rainfall Station #	**68**
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	9.3%	9.3%	0.01	0.01	9.3
0.04	9.5%	18.8%	0.01	0.01	9.5
0.06	8.7%	27.5%	0.02	0.02	8.7
0.08	10.1%	37.6%	0.02	0.02	10.1
0.10	7.2%	44.8%	0.03	0.03	7.2
0.12	6.0%	50.8%	0.04	0.04	6.0
0.14	6.3%	57.1%	0.04	0.04	6.3
0.16	5.6%	62.7%	0.05	0.05	5.5
0.18	4.7%	67.4%	0.06	0.06	4.6
0.20	3.6%	71.0%	0.06	0.06	3.6
0.25	8.2%	79.1%	0.08	0.08	8.0
0.50	14.9%	94.0%	0.15	0.15	14.0
0.75	3.2%	97.3%	0.23	0.23	2.9
1.00	1.2%	98.5%	0.31	0.31	1.1
1.50	0.7%	99.2%	0.46	0.46	0.6
2.00	0.8%	100.0%	0.61	0.61	0.6
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					97.9
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**91.4%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk 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

33 RIVERSIDE DRIVE
PEMBROKE,

Area	**0.45 ac**	Unit Site Designation	**WQI 4**
Weighted C	**0.9**	Rainfall Station #	**68**
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	9.3%	9.3%	0.01	0.01	9.3
0.04	9.5%	18.8%	0.02	0.02	9.5
0.06	8.7%	27.5%	0.02	0.02	8.7
0.08	10.1%	37.6%	0.03	0.03	10.1
0.10	7.2%	44.8%	0.04	0.04	7.1
0.12	6.0%	50.8%	0.05	0.05	6.0
0.14	6.3%	57.1%	0.06	0.06	6.2
0.16	5.6%	62.7%	0.06	0.06	5.5
0.18	4.7%	67.4%	0.07	0.07	4.6
0.20	3.6%	71.0%	0.08	0.08	3.5
0.25	8.2%	79.1%	0.10	0.10	7.9
0.50	14.9%	94.0%	0.20	0.20	13.7
0.75	3.2%	97.3%	0.30	0.30	2.8
1.00	1.2%	98.5%	0.41	0.41	1.0
1.50	0.7%	99.2%	0.61	0.61	0.5
2.00	0.8%	100.0%	0.81	0.81	0.5
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					96.9
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**90.4%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk 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

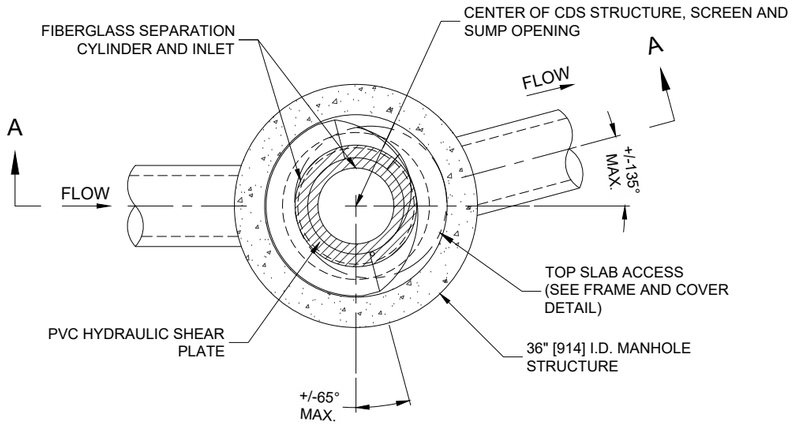
CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

33 RIVERSIDE DRIVE
PEMBROKE,

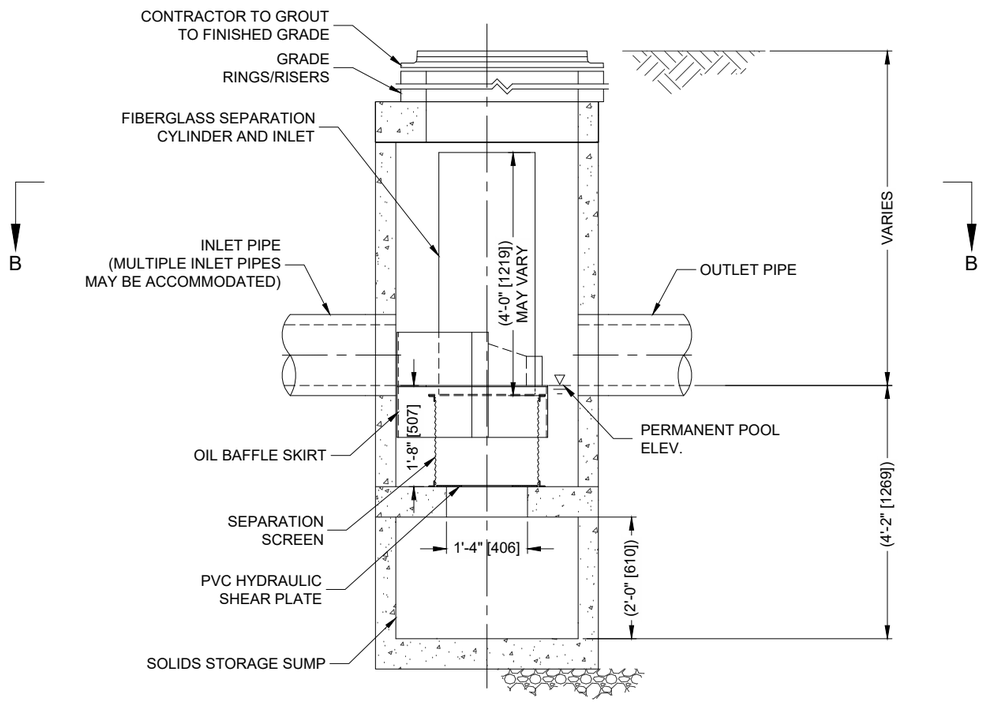
Area	**0.60 ac**	Unit Site Designation	**WQI 5**
Weighted C	**0.9**	Rainfall Station #	**68**
t_c	**5 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.01	0.01	9.3
0.04	9.5%	18.8%	0.02	0.02	9.5
0.06	8.7%	27.5%	0.03	0.03	8.7
0.08	10.1%	37.6%	0.04	0.04	10.0
0.10	7.2%	44.8%	0.05	0.05	7.1
0.12	6.0%	50.8%	0.06	0.06	5.9
0.14	6.3%	57.1%	0.08	0.08	6.2
0.16	5.6%	62.7%	0.09	0.09	5.4
0.18	4.7%	67.4%	0.10	0.10	4.5
0.20	3.6%	71.0%	0.11	0.11	3.5
0.25	8.2%	79.1%	0.14	0.14	7.7
0.50	14.9%	94.0%	0.27	0.27	13.2
0.75	3.2%	97.3%	0.41	0.41	2.6
1.00	1.2%	98.5%	0.54	0.54	0.9
1.50	0.7%	99.2%	0.81	0.81	0.5
2.00	0.8%	100.0%	1.08	1.00	0.4
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					95.5
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**89.0%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.



PLAN VIEW B-B
N.T.S.

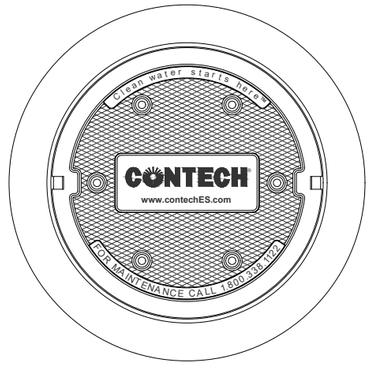


ELEVATION A-A
N.T.S.

CDS1515-3-C DESIGN NOTES

CDS1515-3-C RATED TREATMENT CAPACITY IS 1.0 CFS, OR PER LOCAL REGULATIONS.

THE STANDARD CDS1515-3-C CONFIGURATION IS SHOWN.



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO..
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH ENGINEERED SOLUTIONS LLC
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS1515-3-C
ONLINE CDS
STANDARD DETAIL

RADER PROPERTIES, INC

33 Riverside Drive, Pembroke, MA

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

5/24/2023

Prepared by:

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

OWNER AND RESPONSIBLE PARTY:
RADER PROPERTIES, INC
80 Washington Street, J-40
Norwell, MA 02061

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 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.

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 – Flared end section and rip rap

- **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.

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.
- Road salts and de-icing materials shall be stored on impervious pads and covered to protect from wind and precipitation.
- No de-icing materials 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.
- No de-icing materials shall be stored within Zone I, Zone II, Zone A, and 200 feet from a river or estuary.

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.

Spill prevention response and containment:

- Containment – In the event of a discharge or spill of oil or another hazardous material, , the following procedures are to be followed to mitigate or prevent the release of hazardous waste;
  1. Secure the Area
  2. Halt / shut down the operation
  3. Keep unauthorized people away from the release area by using physical barriers (ie. caution tape)
  4. Determine the source material involved
  5. Refer to the 2020 Emergency Response Guidebook for properties of the material including any

potential evacuation distances.

6. Utilize appropriate chemical protective clothing
7. Attempt to locate the source of the release and the extent of the contamination
8. Undertake initial response actions to halt the release of oil or other material and contain its spread using absorbent materials, physical barriers, containment pail, etc.
9. Look for storm drains, manhole covers and other vertical access points and dike off or dam to prevent material from entering these areas. Outlets to stormwater management ponds shall be plugged so that hazardous material do not enter resource areas.
10. Take those actions to protect public health, safety and the environment that can be taken without compromising your safety or the safety of others.
11. Initiate notification procedures. Notifications to local, State and Federal agencies (including National Emergency Response Center when applicable)

- Local Police / Fire – 911
- Municipal Department of Public Works
- Applicable State authority: MASS DEP 1-888-304-1133
- Environmental Contractor: Clean Harbors 1-800-645-8265
- National Emergency Response Center (if release exceeds US DOT "reportable quantity" amount): 1-800-424-8802
- CHEMTREC: 1-800-424-9300
- AIG PIER 1-877-743-7669
- Once the emergency response crew arrives at the scene, the following actions will be taken:
- Material that has been released to impervious surface (ie. concrete or pavement) will be absorbed using a suitable absorbent such as Speedi Dry or diatomaceous earth. This material will then be containerized and sent to a fully licensed waste management facility for disposal.
- Material that has reached any pervious surface such as soil will result in the remediation of the affected area to the extent that all contamination is removed. All material collected as a result of remediation will be containerized and sent for disposal at a fully licensed waste management facility. In addition, analytics will be conducted when necessary to determine if all contamination has been removed.
- Prior to leaving any site, appropriate backfill will be used to replace any ground cover removed during the clean-up process.
- Any damaged container involved in an accident will be placed into a suitable salvage drum and shipped to a fully licensed waste management facility for disposal.

- The first priority of any emergency response is life and health. If you do not have adequate information or personal protective equipment, do not approach the release.

Hazardous Waste:

- 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.

Vehicle Washing:

- Use soap sparingly. Use a hose nozzle with a trigger to save water.
- Pour buck of soapy water into sink / sewer system, instead of in the drainage system.
- Wash vehicle on grassy area, so the ground can filter the water.
- Take vehicle to a commercial car wash.
- Vehicle washing shall not be permitted 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.

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/.)

Illicit Discharges:

Illicit discharges that are not allowed to the stormwater management system include;

- wastewater discharges
- discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease

Allowable Non-Stormwater Discharges;

- firefighting,
- water line flushing,
- landscape irrigation,
- uncontaminated groundwater,
- potable water sources,
- foundation drains,
- air conditioning condensation,
- footing drains, individual resident car washing,
- flows from riparian habitats and wetlands,
- dechlorinated water from swimming pools
- water used for street washing and water used to clean residential buildings without detergents.

Marcus Partners

PROJECT LOCATION: 33 Riverside Drive, Pembroke, MA

STORMWATER ANAGEMENT BEST MANAGEMENT PRACTICES - INSPECTION SCHEDULE AND EVALUATION CHECKLIST

Best Management Practice	Inspection Frequency (1)	Date I	Inspector	Minimum Maintenance and Key Items to Check (1)	Cleaning/Repair Needed yes__ no__ (list items)	Date of Cleaning /Repair	Perform ed By
Street Sweeping	2x per year			Vacuum sweeper			
Deep Sump and Hooded Catch Basins	4x per year			Remove sediment 1x per year or if >6”			
Outlet Control Structure & Level spreader	2x per year first year, annually thereafter			Inspect inlets and outlets			
Recharge Chambers	4x per year			Inspect after 2.5” rain in 24 hours, drain time less than 3 days			
CDS water Quality device	4x per year			Per manufacturer Requirements			

(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**

ROUTE 3
COMMONWEALTH OF MASSACHUSETTS

FLARED END SECTION

WQD#1

RECHARGE SYSTEM 1B

WQD#4

RECHARGE SYSTEM 3

RD

RD

WQD#2

RD

RECHARGE SYSTEM 4

RECHARGE SYSTEM 2B

WQD#5

LEVEL SPREADER

WQD#6

TO RIVERSIDE DRIVE

WQD#3

SD

GS

D

T

RADER PROPERTIES, INC.
33 RIVERSIDE DRIVE
PEMBROKE, MA

SCALE: 1"= 60'

5/24/2023

2023-026-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
Pipe Sizing

Rational Method Calculations

33 Riverside Drive Pembroke, MA

i = Rainfall Intensity 6.5 in/hr (25 year storm) @ a time of concentration of 5 minutes

C = 0.4 (green Area)

C = 0.9 (Impervious Area)

Area	Pavement (s.f.)	Roof (s.f.)	Sidewalk (s.f.)	Total Impervious (s.f.)	Green (s.f.)	Total Area (s.f.)
WQD #1	6096	0	0	6096	10098	16194
WQD #2	21124	0	0	21124	0	21124
WQD #3	14743	0	0	14743	7977	22720
WQD #4	19755	0	0	19755	1357	21112
WQD #5	26027	0	0	26027	0	26027
ROOF	0	9000	0	9000	0	9000

Area	Impervious (acres)	Green (acres)	C (Imp.)	Intensity (in/hr)	C(Green)	Total Area (acres)	Q = CiA (cfs)
WQD #1	0.1399	0.232	0.9	6.5	0.4	0.3718	1.421
WQD #2	0.4849	0.000	0.9	6.5	0.4	0.4849	2.837
WQD #3	0.3385	0.183	0.9	6.5	0.4	0.5216	2.456
WQD #4	0.4535	0.031	0.9	6.5	0.4	0.4847	2.734
WQD #5	0.5975	0.000	0.9	6.5	0.4	0.5975	3.495
ROOF	0.2066	0.000	0.9	6.5	0.4	0.2066	1.209

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 25 2023

WQD#1

Circular

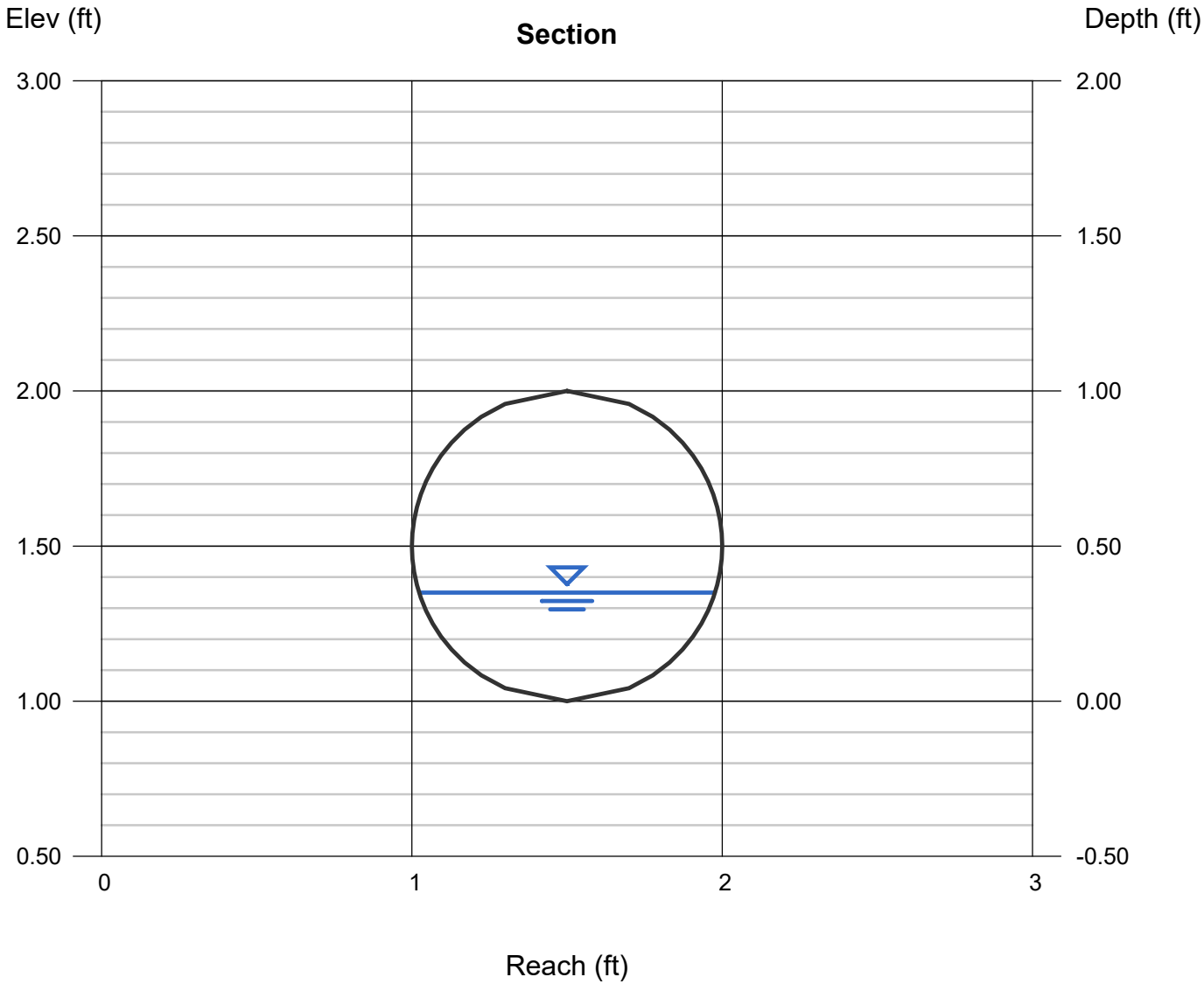
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1.00
Slope (%)	= 2.10
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.42

Highlighted

Depth (ft)	= 0.35
Q (cfs)	= 1.420
Area (sqft)	= 0.25
Velocity (ft/s)	= 5.75
Wetted Perim (ft)	= 1.27
Crit Depth, Yc (ft)	= 0.51
Top Width (ft)	= 0.96
EGL (ft)	= 0.86



Channel Report

WQD#2

Circular

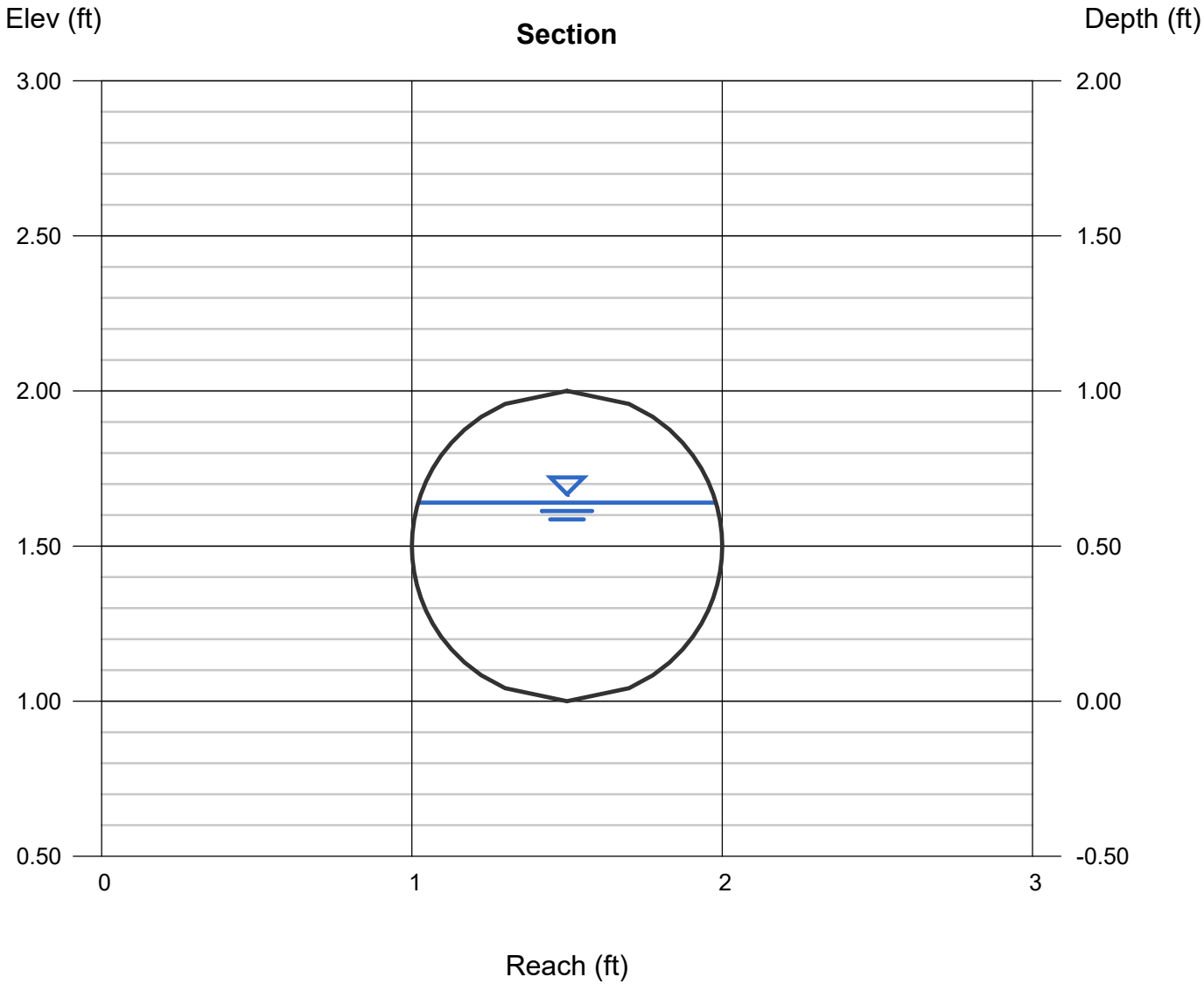
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1.00
Slope (%)	= 1.00
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.84

Highlighted

Depth (ft)	= 0.64
Q (cfs)	= 2.840
Area (sqft)	= 0.53
Velocity (ft/s)	= 5.35
Wetted Perim (ft)	= 1.85
Crit Depth, Yc (ft)	= 0.73
Top Width (ft)	= 0.96
EGL (ft)	= 1.08



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 25 2023

WQD#3

Circular

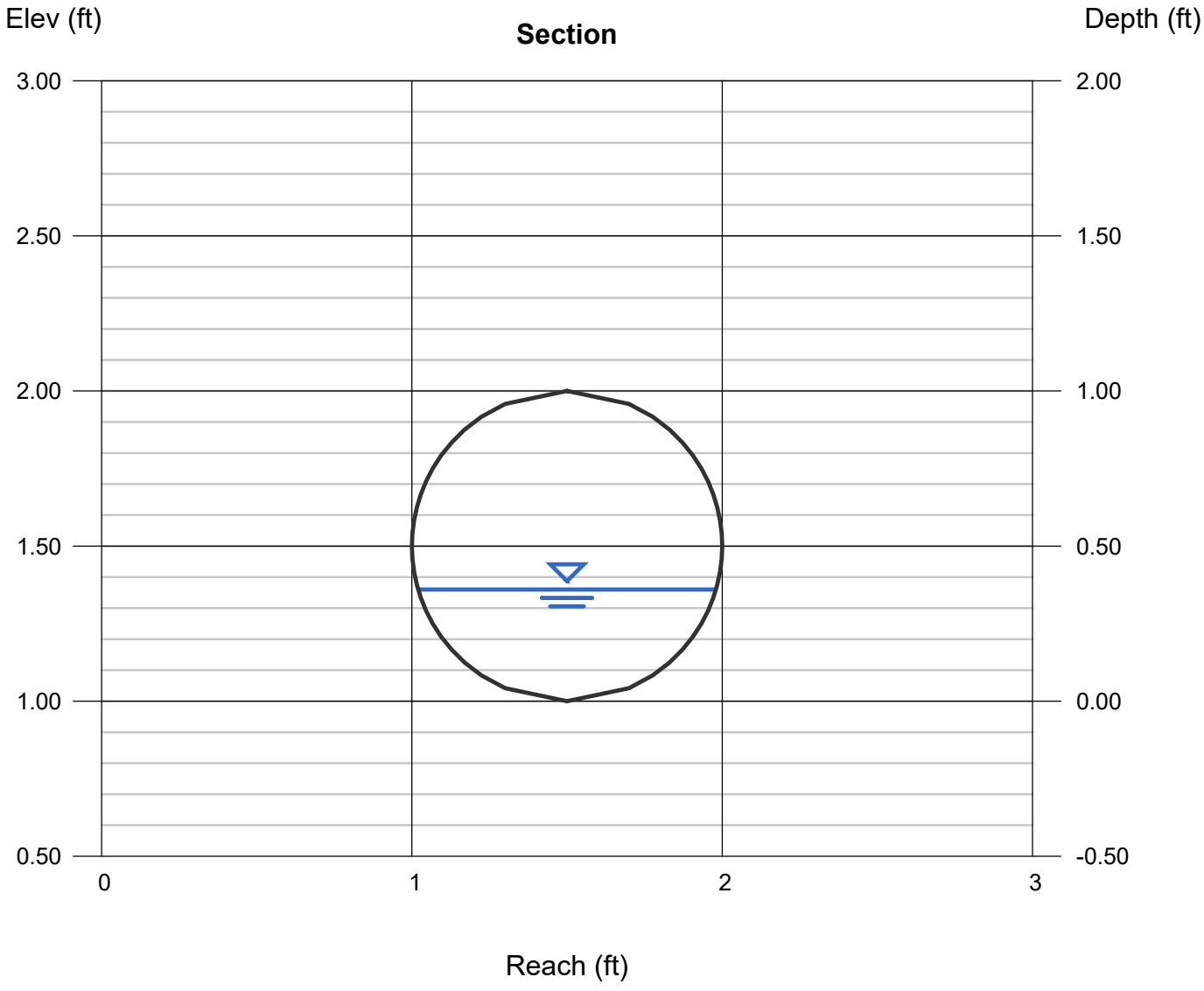
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1.00
Slope (%)	= 5.30
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.46

Highlighted

Depth (ft)	= 0.36
Q (cfs)	= 2.456
Area (sqft)	= 0.26
Velocity (ft/s)	= 9.60
Wetted Perim (ft)	= 1.29
Crit Depth, Yc (ft)	= 0.68
Top Width (ft)	= 0.96
EGL (ft)	= 1.79



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 25 2023

WQD#4

Circular

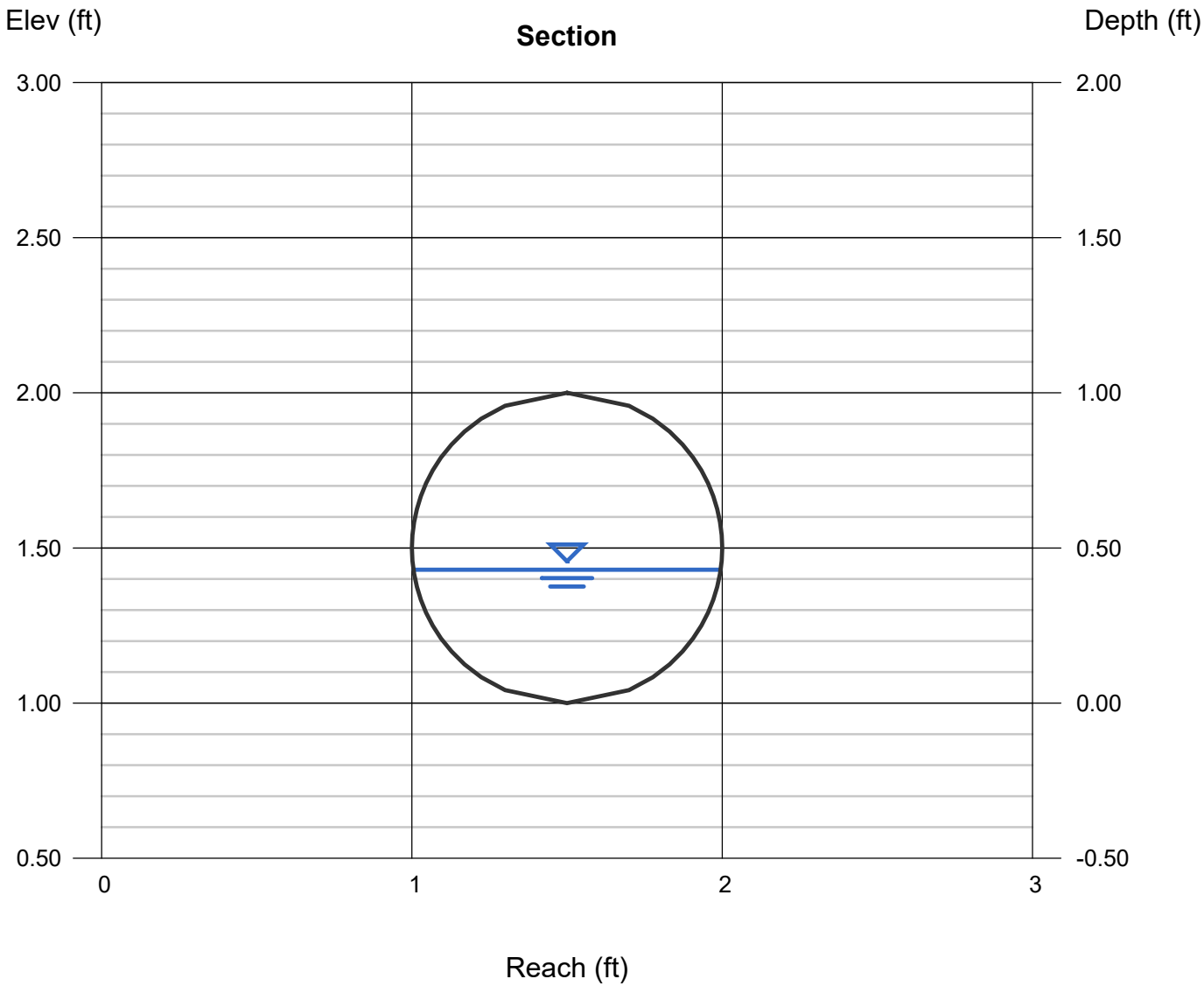
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1.00
Slope (%)	= 3.40
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.73

Highlighted

Depth (ft)	= 0.43
Q (cfs)	= 2.734
Area (sqft)	= 0.33
Velocity (ft/s)	= 8.41
Wetted Perim (ft)	= 1.43
Crit Depth, Yc (ft)	= 0.71
Top Width (ft)	= 0.99
EGL (ft)	= 1.53



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 25 2023

WQD#5

Circular

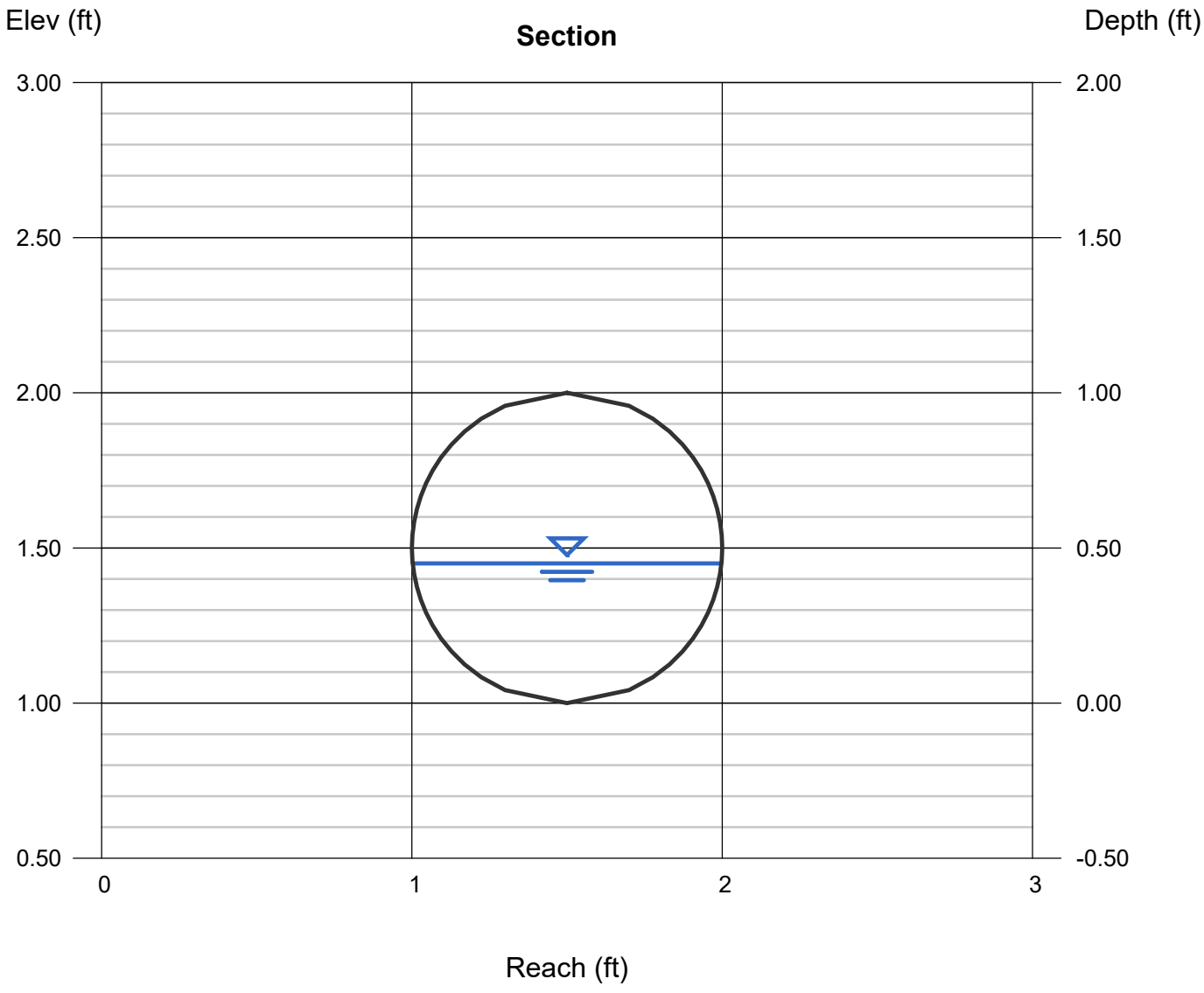
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1.00
Slope (%)	= 5.00
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 3.50

Highlighted

Depth (ft)	= 0.45
Q (cfs)	= 3.495
Area (sqft)	= 0.34
Velocity (ft/s)	= 10.13
Wetted Perim (ft)	= 1.47
Crit Depth, Yc (ft)	= 0.80
Top Width (ft)	= 1.00
EGL (ft)	= 2.05



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, May 25 2023

ROOF

Circular

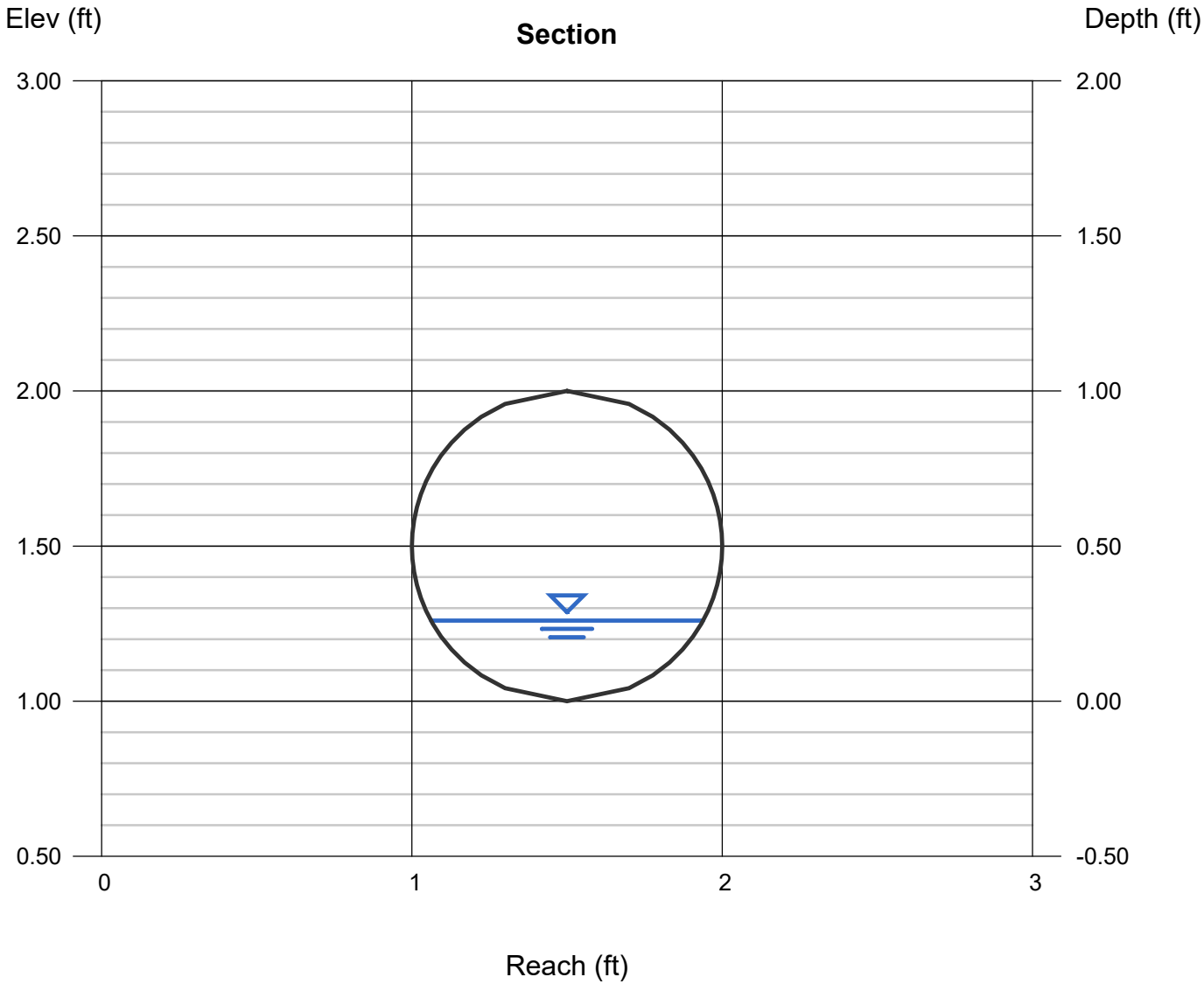
Diameter (ft)	= 1.00
Invert Elev (ft)	= 1.00
Slope (%)	= 5.00
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.21

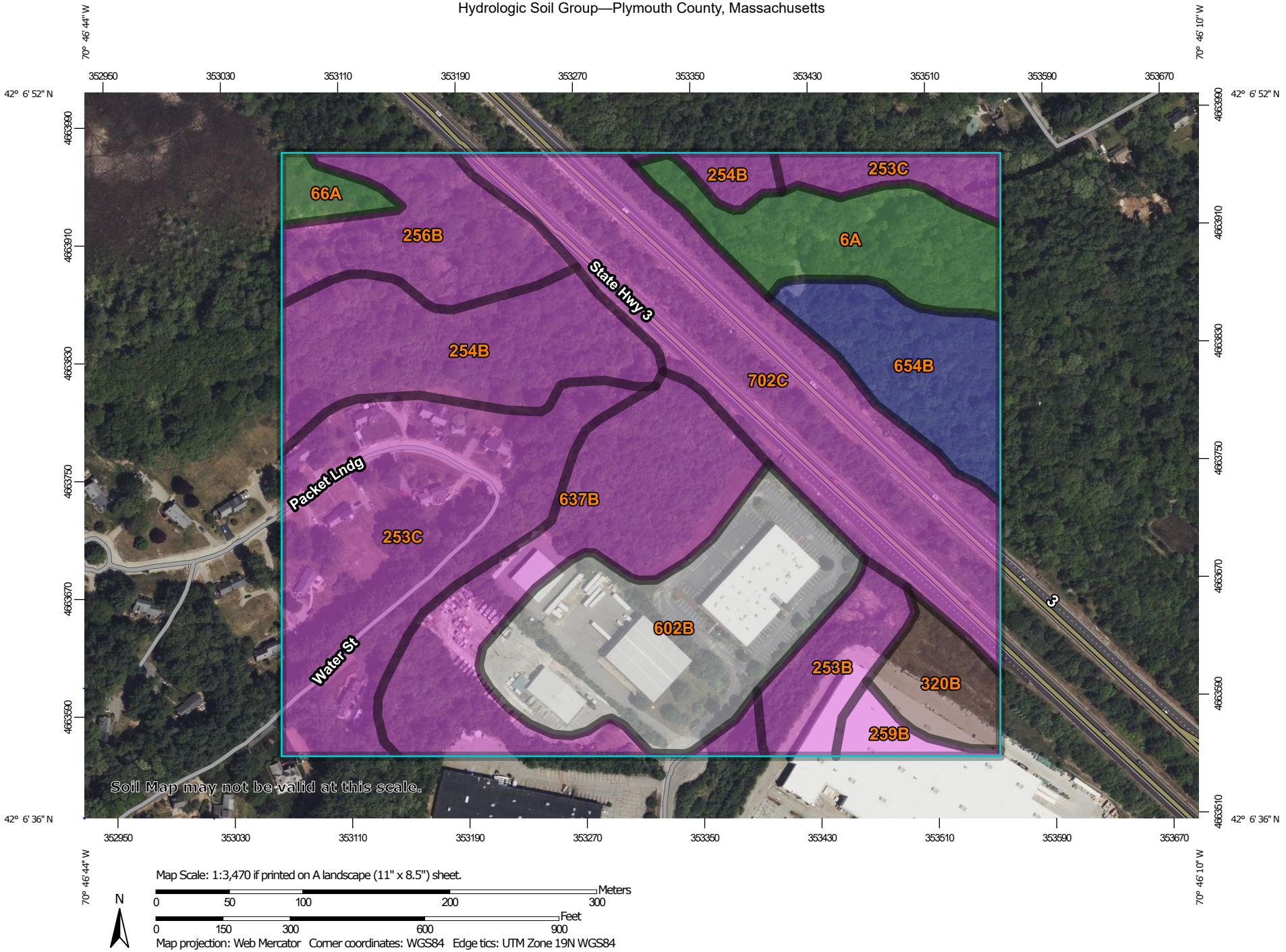
Highlighted

Depth (ft)	= 0.26
Q (cfs)	= 1.209
Area (sqft)	= 0.16
Velocity (ft/s)	= 7.37
Wetted Perim (ft)	= 1.07
Crit Depth, Yc (ft)	= 0.47
Top Width (ft)	= 0.88
EGL (ft)	= 1.10



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

Attachment E
Supporting Documentation



Map Scale: 1:3,470 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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 15, Sep 9, 2022

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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
6A	Scarboro muck, coastal lowland, 0 to 3 percent slopes	A/D	3.4	6.8%
66A	Ipswich - Pawcatuck - Matunuck complex, 0 to 2 percent slopes, very frequently flooded	A/D	0.6	1.2%
253B	Hinckley loamy sand, 3 to 8 percent slopes	A	1.8	3.6%
253C	Hinckley loamy sand, 8 to 15 percent slopes	A	9.1	18.2%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	5.1	10.3%
256B	Deerfield loamy fine sand, 3 to 8 percent slopes	A	3.2	6.5%
259B	Carver loamy coarse sand, 3 to 8 percent slopes	A	0.6	1.1%
320B	Birchwood sand, 3 to 8 percent slopes	B/D	1.4	2.9%
602B	Urban land, 0 to 8 percent slopes		6.6	13.3%
637B	Carver - Urban land complex, 0 to 8 percent slopes	A	6.3	12.7%
654B	Udorthents, loamy, 0 to 8 percent slopes	B	2.9	5.8%
702C	Udipsamments, 8 to 15 percent slopes	A	8.7	17.5%
Totals for Area of Interest			**49.8**	**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

Plymouth County, Massachusetts

637B—Carver - Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9y58
Elevation: 0 to 390 feet
Mean annual precipitation: 41 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Carver and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carver

Setting

Landform: Moraines, pitted outwash plains, outwash plains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Sandy glaciofluvial deposits

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
Oe - 2 to 3 inches: moderately decomposed plant material
A - 3 to 7 inches: coarse sand
E - 7 to 10 inches: coarse sand
Bw1 - 10 to 15 inches: coarse sand
Bw2 - 15 to 28 inches: coarse sand
BC - 28 to 32 inches: coarse sand
C - 32 to 67 inches: coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F149BY005MA - Dry Outwash
Hydric soil rating: No

Minor Components

Udipsamments

Percent of map unit: 10 percent
Landform: Dikes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Linear
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Kames, terraces, outwash plains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Data Source Information

Soil Survey Area: Plymouth County, Massachusetts
Survey Area Data: Version 15, Sep 9, 2022

NOAA Atlas 14, Volume 10, Version 3
Location name: Pembroke, Massachusetts, USA*
Latitude: 42.1114°, Longitude: -70.7734°
Elevation: m/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	**0.299** (0.238-0.373)	**0.371** (0.295-0.463)	**0.488** (0.387-0.610)	**0.585** (0.461-0.736)	**0.719** (0.548-0.947)	**0.818** (0.612-1.10)	**0.925** (0.673-1.30)	**1.05** (0.717-1.49)	**1.25** (0.815-1.82)	**1.41** (0.901-2.10)
10-min	**0.424** (0.338-0.528)	**0.526** (0.418-0.655)	**0.692** (0.549-0.866)	**0.829** (0.653-1.04)	**1.02** (0.777-1.34)	**1.16** (0.867-1.56)	**1.31** (0.954-1.84)	**1.49** (1.02-2.11)	**1.77** (1.15-2.58)	**2.00** (1.28-2.98)
15-min	**0.499** (0.397-0.621)	**0.618** (0.492-0.771)	**0.813** (0.645-1.02)	**0.975** (0.768-1.23)	**1.20** (0.914-1.58)	**1.36** (1.02-1.84)	**1.54** (1.12-2.16)	**1.75** (1.20-2.49)	**2.08** (1.36-3.04)	**2.35** (1.50-3.51)
30-min	**0.700** (0.557-0.872)	**0.867** (0.690-1.08)	**1.14** (0.904-1.43)	**1.37** (1.08-1.72)	**1.68** (1.28-2.22)	**1.91** (1.43-2.58)	**2.16** (1.58-3.04)	**2.47** (1.68-3.49)	**2.92** (1.91-4.27)	**3.31** (2.11-4.93)
60-min	**0.901** (0.717-1.12)	**1.12** (0.888-1.39)	**1.47** (1.17-1.84)	**1.76** (1.39-2.22)	**2.17** (1.65-2.85)	**2.46** (1.84-3.32)	**2.79** (2.03-3.91)	**3.17** (2.16-4.50)	**3.76** (2.46-5.51)	**4.26** (2.72-6.36)
2-hr	**1.16** (0.932-1.44)	**1.46** (1.17-1.80)	**1.94** (1.55-2.41)	**2.34** (1.86-2.92)	**2.89** (2.23-3.79)	**3.30** (2.49-4.42)	**3.74** (2.75-5.22)	**4.28** (2.94-6.01)	**5.12** (3.37-7.41)	**5.83** (3.76-8.60)
3-hr	**1.36** (1.09-1.67)	**1.70** (1.37-2.09)	**2.26** (1.81-2.79)	**2.72** (2.17-3.38)	**3.36** (2.60-4.38)	**3.83** (2.91-5.11)	**4.35** (3.22-6.03)	**4.97** (3.43-6.94)	**5.94** (3.94-8.55)	**6.78** (4.39-9.93)
6-hr	**1.78** (1.45-2.18)	**2.19** (1.78-2.68)	**2.87** (2.32-3.52)	**3.43** (2.76-4.23)	**4.20** (3.27-5.42)	**4.78** (3.65-6.29)	**5.40** (4.02-7.39)	**6.14** (4.28-8.47)	**7.28** (4.87-10.4)	**8.25** (5.39-11.9)
12-hr	**2.32** (1.90-2.81)	**2.79** (2.28-3.39)	**3.56** (2.90-4.34)	**4.20** (3.40-5.14)	**5.08** (3.98-6.48)	**5.74** (4.41-7.46)	**6.44** (4.81-8.67)	**7.25** (5.10-9.89)	**8.46** (5.72-11.9)	**9.47** (6.25-13.5)
24-hr	**2.82** (2.33-3.40)	**3.38** (2.78-4.07)	**4.29** (3.51-5.18)	**5.04** (4.11-6.12)	**6.08** (4.80-7.67)	**6.85** (5.30-8.81)	**7.68** (5.77-10.2)	**8.62** (6.12-11.6)	**10.00** (6.82-13.9)	**11.1** (7.42-15.7)
2-day	**3.21** (2.67-3.84)	**3.89** (3.23-4.66)	**5.01** (4.14-6.01)	**5.93** (4.87-7.15)	**7.21** (5.74-9.03)	**8.16** (6.37-10.4)	**9.17** (6.96-12.1)	**10.3** (7.40-13.8)	**12.1** (8.31-16.6)	**13.5** (9.09-18.9)
3-day	**3.51** (2.93-4.18)	**4.24** (3.53-5.05)	**5.44** (4.51-6.50)	**6.43** (5.31-7.72)	**7.80** (6.24-9.72)	**8.82** (6.92-11.2)	**9.90** (7.56-13.0)	**11.2** (8.03-14.8)	**13.0** (9.01-17.7)	**14.6** (9.85-20.2)
4-day	**3.79** (3.17-4.50)	**4.55** (3.80-5.40)	**5.78** (4.81-6.88)	**6.81** (5.63-8.14)	**8.21** (6.59-10.2)	**9.27** (7.29-11.7)	**10.4** (7.95-13.5)	**11.7** (8.44-15.4)	**13.6** (9.42-18.4)	**15.1** (10.3-20.8)
7-day	**4.55** (3.83-5.36)	**5.34** (4.49-6.30)	**6.63** (5.56-7.84)	**7.70** (6.42-9.15)	**9.17** (7.40-11.3)	**10.3** (8.13-12.9)	**11.4** (8.79-14.7)	**12.7** (9.29-16.7)	**14.6** (10.2-19.6)	**16.1** (11.0-22.0)
10-day	**5.25** (4.44-6.17)	**6.07** (5.12-7.13)	**7.40** (6.23-8.72)	**8.51** (7.12-10.1)	**10.0** (8.13-12.3)	**11.2** (8.88-13.9)	**12.4** (9.53-15.8)	**13.7** (10.0-17.8)	**15.5** (10.9-20.7)	**17.0** (11.7-23.1)
20-day	**7.31** (6.23-8.52)	**8.22** (6.99-9.58)	**9.70** (8.22-11.3)	**10.9** (9.22-12.8)	**12.6** (10.3-15.2)	**13.9** (11.1-17.0)	**15.2** (11.8-19.1)	**16.6** (12.3-21.3)	**18.4** (13.1-24.2)	**19.7** (13.7-26.4)
30-day	**9.02** (7.72-10.5)	**10.00** (8.55-11.6)	**11.6** (9.88-13.5)	**12.9** (11.0-15.1)	**14.8** (12.1-17.7)	**16.2** (13.0-19.6)	**17.6** (13.6-21.8)	**18.9** (14.1-24.1)	**20.7** (14.8-27.1)	**22.0** (15.4-29.2)
45-day	**11.2** (9.60-12.9)	**12.2** (10.5-14.1)	**14.0** (12.0-16.2)	**15.4** (13.1-17.9)	**17.4** (14.3-20.7)	**19.0** (15.2-22.8)	**20.5** (15.9-25.1)	**21.8** (16.4-27.6)	**23.5** (17.0-30.6)	**24.7** (17.4-32.6)
60-day	**13.0** (11.2-14.9)	**14.1** (12.2-16.3)	**16.0** (13.7-18.4)	**17.5** (14.9-20.3)	**19.6** (16.2-23.2)	**21.3** (17.1-25.4)	**22.8** (17.7-27.8)	**24.2** (18.2-30.5)	**25.9** (18.8-33.4)	**27.0** (19.1-35.4)

[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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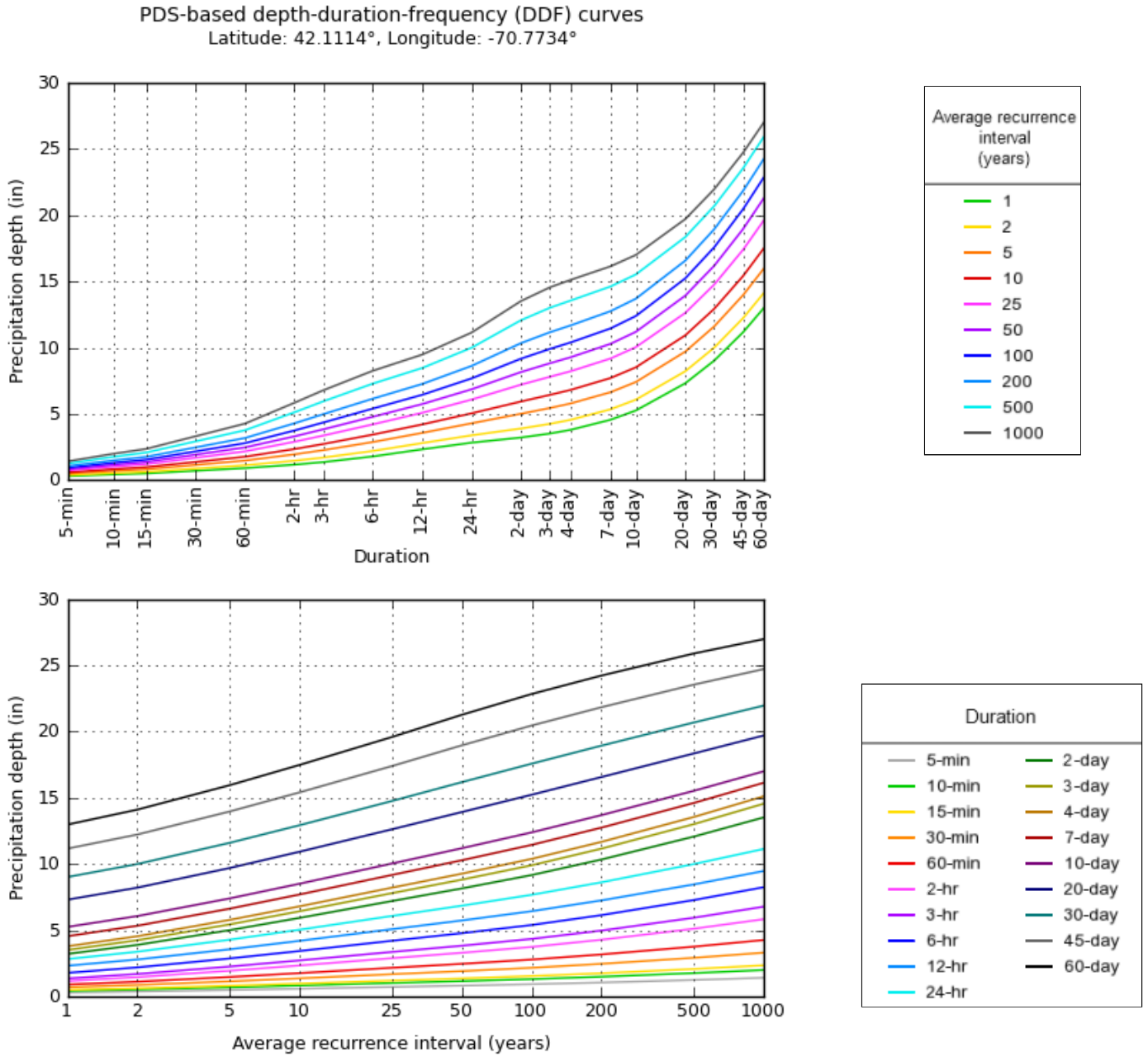
PF graphical



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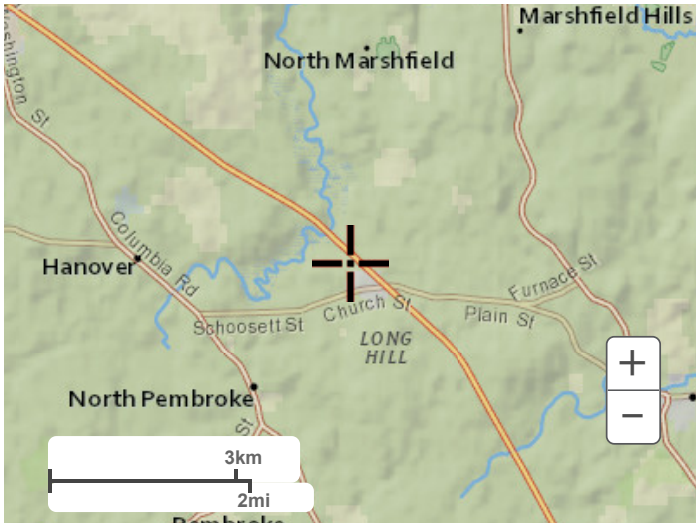
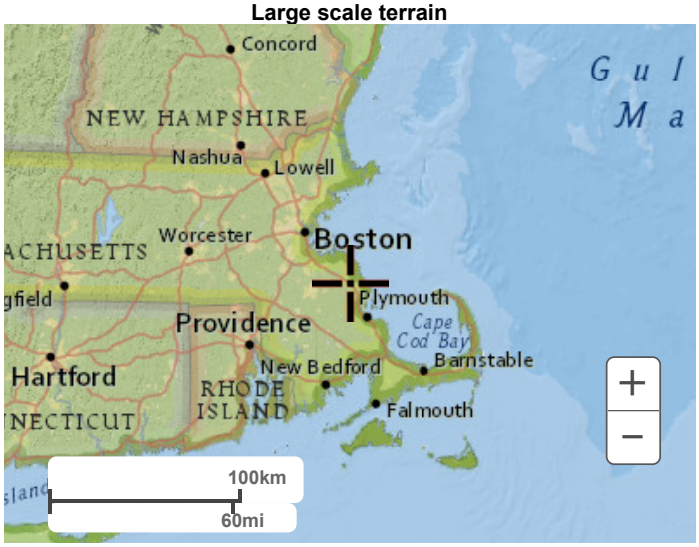
Maps & aerials

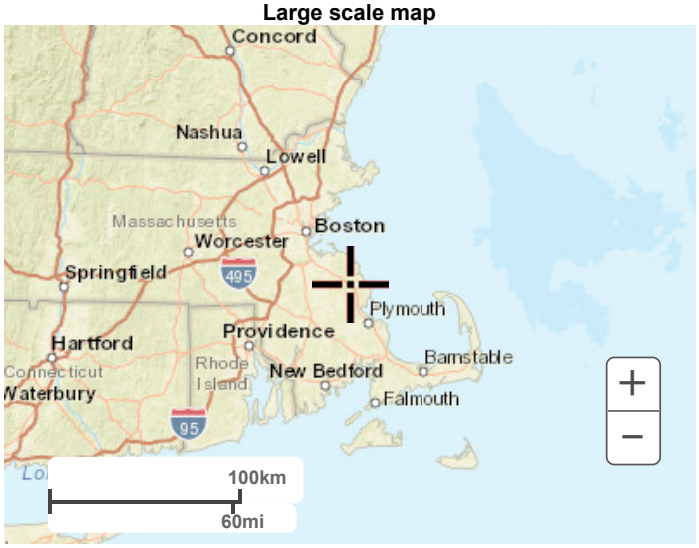
Small scale terrain



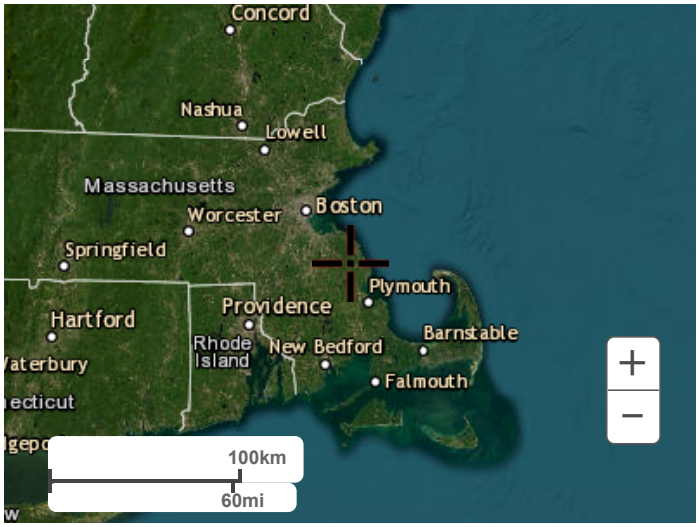
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

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*

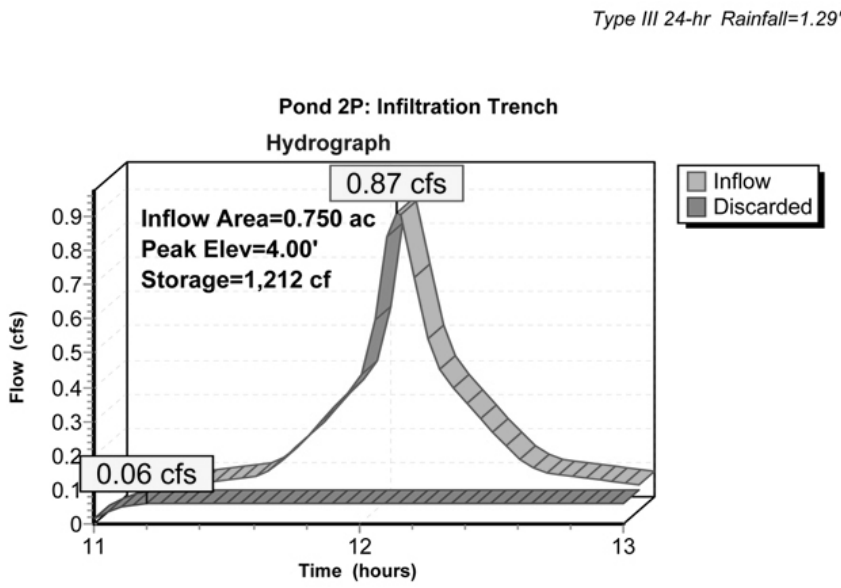

Table 2.3.3. 1982 Rawls Rates[18]

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